User Manual for the West Virginia Wetland Rapid Assessment Method (WVWRAM)

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Water Quality Standards and Assessment Section
Division of Water and Wastewater Management
WV Department of Environmental Protection

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Contents

1.0 INTRODUCTION

1.1 Purpose

The West Virginia Wetland Rapid Assessment Method (WVWRAM) is a standardized protocol for rapidly assessing the functions, services, values, and condition of wetlands. The West Virginia Department of Environmental Protection (WVDEP) has developed this method in coordination with the West Virginia Division of Natural Resources (WVDNR), with funding from the U.S. Environmental Protection Agency's Wetland Program Development program. This document describes the user protocols of a two-part wetland assessment method, which consists of a rapid field assessment and GIS assessment. Details of the data analysis and methods, including the formulas behind the user interface, are described in the separate WVWRAM Reference Manual. The GIS and field assessments are combined to produce a regulatory score that is part of the input for Clean Water Act permitting, including impact assessment and compensatory mitigation. The wetland condition score supports probabilistic wetland monitoring activities at WVDEP. The WVDNR land acquisition score supports decision-making regarding state lands. WVWRAM provides a science-based method to support conservation, restoration, enhancement, and protection of wetlands in West Virginia.

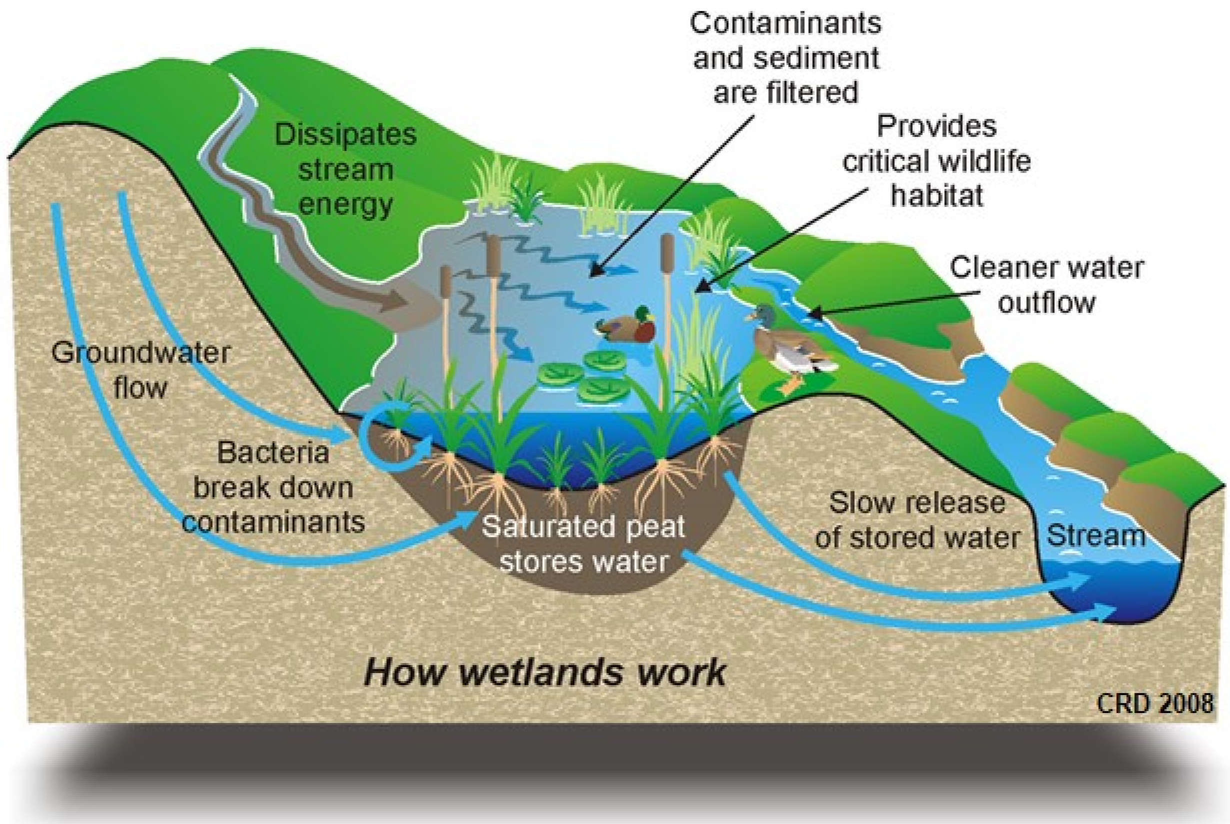
WVWRAM is applicable to wetlands of any type anywhere in West Virginia. After the field assessment is completed and the GIS assessment is run, metrics are generated which answer the following questions:

- How effective is the wetland in improving water quality downstream, including sediment retention, nutrient processing, and pollutant removal?
- How effective is the wetland in slowing and storing flood waters and providing base flow to streams?
- How effective is the wetland in providing wildlife habitat and maintaining biodiversity and ecological integrity?
- What is the current quality or condition of the wetland?

The field portion of WVWRAM is designed to be completed in 1-4 hours by a 2-person team. At least one person on the assessment team must have the skill level of a wetland delineator, i.e., the ability to identify dominant wetland plants, describe hydric soils, understand hydrology, recognize stressors, and perform general field survey work. Assessors are strongly encouraged to attend WVDEP-approved training prior to implementation of the rapid assessment protocol. The GIS portion of the assessment requires a basic knowledge of ArcGIS mapping and shapefile creation. Data entry and final scoring is done in an MS-Access database.

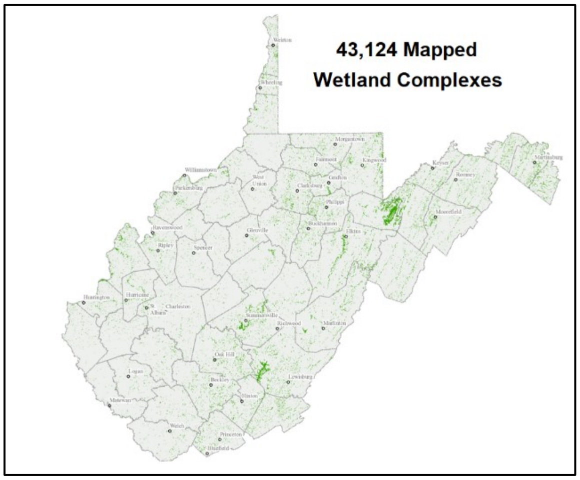
1.2 Background

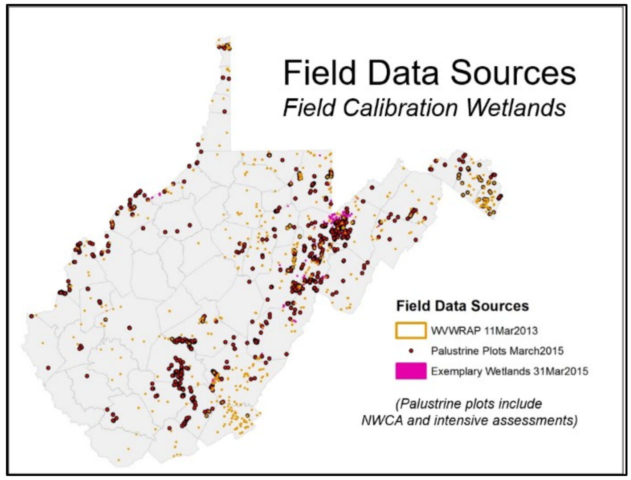
West Virginia and federal goals for "no net loss" of wetlands refer not only to acreage but also to the beneficial functions and services that wetlands provide in terms of filtering water, reducing sedimentation and flood flows, providing wildlife habitat, and maintaining ecological integrity. The primary drivers for developing WVWRAM were the need to (a) quantify functions and values of wetlands for regulatory programs and (b) provide information to state agencies and to the public to assist in avoidance of impacts and promote conservation of wetlands (Federal Register 2008, West Virginia Code 2012, WVDEP 2014).



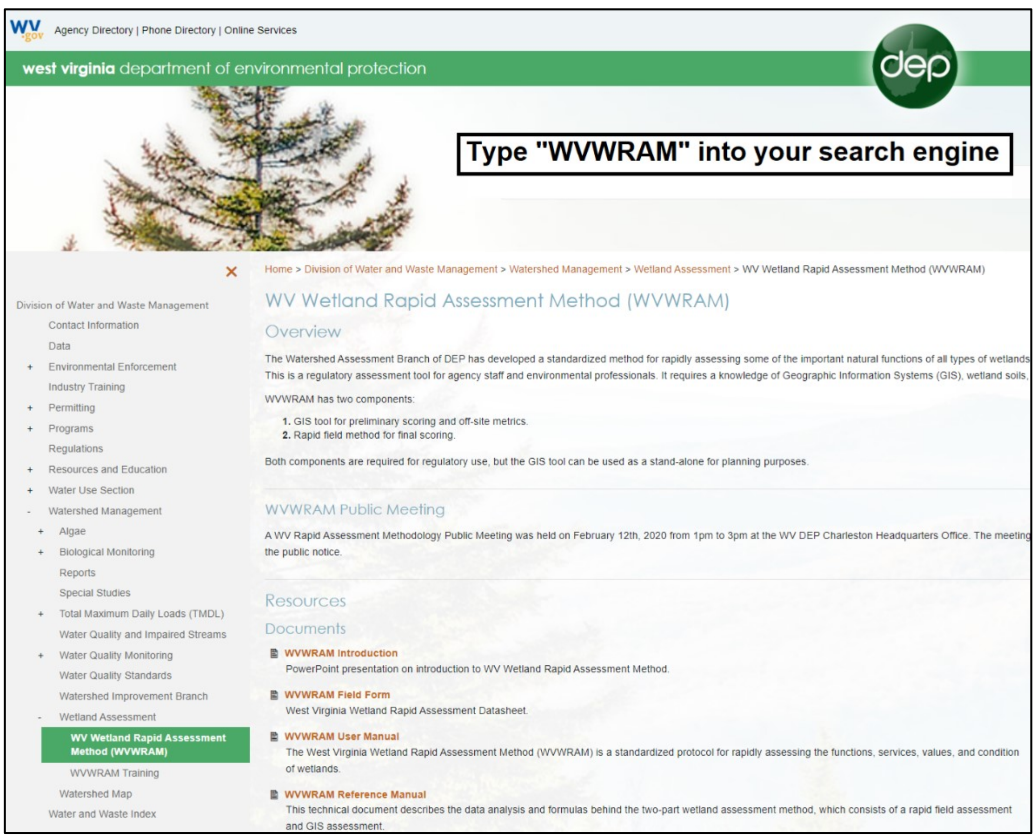
The functional assessment metrics that make up WVWRAM are based on validated approaches currently in use by other states and organizations, in particular those of Washington (Hruby 2012), Oregon (Adamus et al. 2010), California (CWMW 2013), Ohio (Mack 2001), Minnesota (Bourdaghs 2014), Wisconsin (Miller et al. 2017), and NatureServe (FaberLangendoen et al. 2016). Washington, Oregon, California, Ohio, and NatureServe have performed specific validation and repeatability testing on their wetland functional assessments. The involvement of literally hundreds of wetland scientists in the testing processes, and the similarity of the final metrics, gives us confidence that the approaches are robust. The groundwork done for 605 wetland sites by West Virginia University (Veselka and Anderson 2011), and the 1667 wetland plots of the West Virginia Natural Heritage Program (WVDNR 2016) provided important data for adapting these validated functional assessment methods to the West Virginia context.

The GIS component of WVWRAM was developed based on data for 43,124 wetland complexes mapped in the state. The field component of WVWRAM was developed based on 2,273 wetlands with existing field data and 70 sites that were directly surveyed during method development. These sites are shown on the maps below.





Additional information and updates to WVWRAM are available on the WVDEP website: type "WVWRAM" into your search engine.



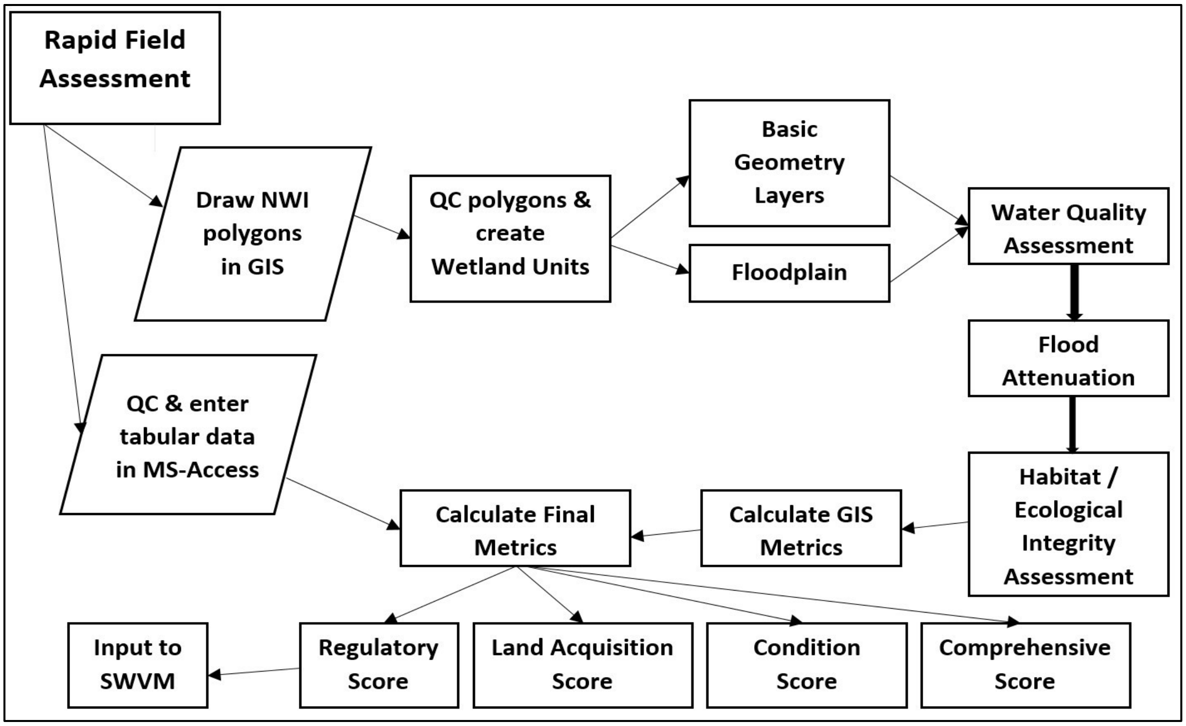
1.3 Limitations

WVWRAM, including both GIS and rapid field assessment of wetland functions, is not intended to answer all questions about wetlands. The following are important limitations:

- WVWRAM does not change any current procedures for determining wetland jurisdictional status or delineating wetland boundaries.
- WVWRAM does not assess all possible functions, values, and services that a wetland might support, but rather focuses on water quality, flood attenuation, and habitat/ecological integrity.
- WVWRAM is not intended to address the important question, “Is a wetland mitigation project in a geomorphically appropriate location?” That is, is the project sited in a location where key processes can be expected to adaptively sustain the wetland and wetland functions?
- WVWRAM is an additional tool for monitoring mitigation banks or other wetland restoration projects but does not replace more detailed performance criteria or standards required for credit release. WVWRAM scores may not be sufficiently sensitive to detect, in the short term, mild changes in some functions. Quantifying smaller changes will often require more intensive measurement protocols.
- The numeric estimates WVWRAM provides of wetland functions are not actual direct measures of those attributes. Rather, they are estimates of those attributes arrived at by using standardized scoring models that systematically combine well-accepted indicators that have been validated by other states or through peer-reviewed research. WVWRAM does not assess the viability of a particular site for restoration, although it may be used in conjunction with WVDEP’s restorable wetlands model to determine promising and potentially high-functioning restoration sites.

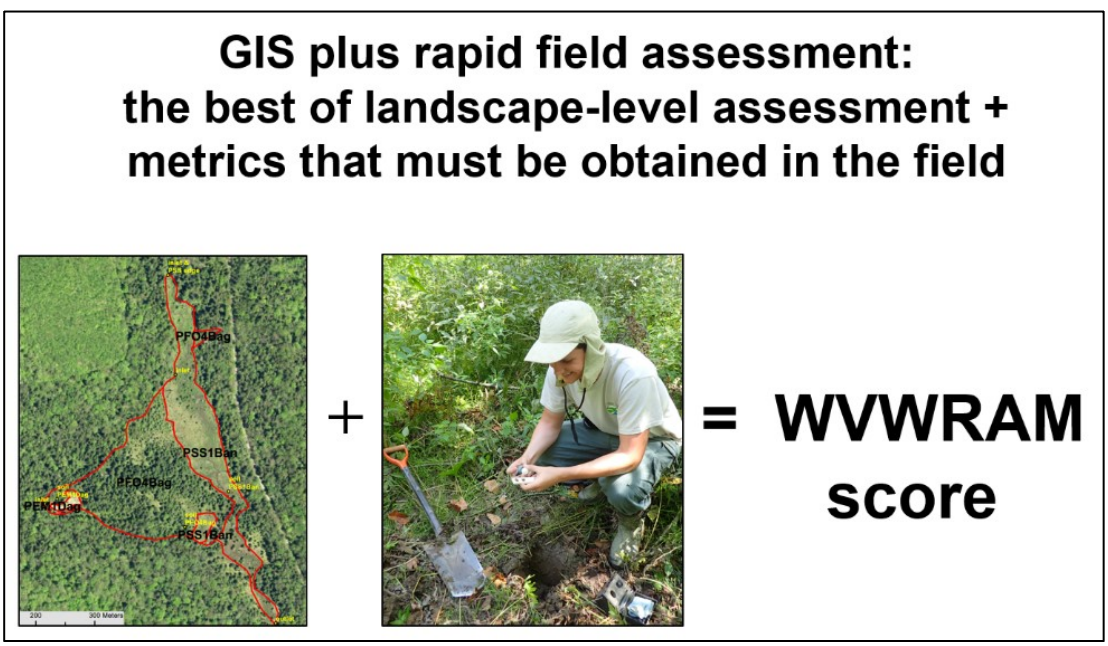
1.4 Flow chart of field and GIS components of WVWRAM

The field and GIS components of WVWRAM are designed to complement one another to produce a robust set of metrics that consider watershed- and landscape-level processes in addition to on-the-ground processes within the wetland itself. It is possible to run desktop scenarios using only the GIS portion of the assessment, for example to evaluate potential mitigation sites or land acquisitions. Both field and GIS components are required for regulatory or monitoring purposes. The specific metrics used for each scoring purpose and the formulas used to calculate scores are described in the companion document “Reference Manual for the West Virginia Wetland Rapid Assessment Method”.



1.5 Overview of metrics and weights

Specific measurements and observations are recorded during field assessment. The field assessment complements and improves the GIS assessment score, with the two assessment levels supporting a final score that blends the best of landscape-level assessment with metrics that must be obtained in the field.



The rationale and strategy for calculating each metric, including source data and submetrics as applicable, are described in the companion document "Reference Manual for the West Virginia Wetland Rapid Assessment Method".

The GIS portion draws on 62 statewide GIS datasets to calculate a preliminary score for the wetland.

The final WVWRAM score requires a field assessment, which is done by technicians with the skill level of a wetland delineator, and typically takes 1-4 hours to complete.

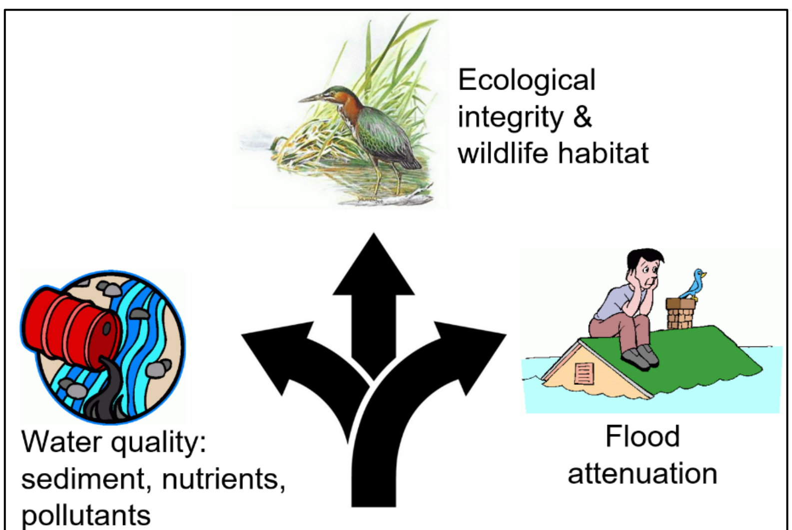
62 statewide GIS datasets

- Biodiversity
- Ecosystems
- Elevation
- Geology
- Hydrology
- Imagery
- Infrastructure
- Jurisdiction
- Landcover
- Landform
- Soils
- Stressors

Field assessment

- Level of effort: 2 technicians x 1-4 hours
- Skill level required: wetland delineator plus 2-day WVWRAM training

The many possible functions of a wetland are combined into three composite functions that are particularly important in West Virginia: (a) water quality, including sediment retention, nutrient transformation, and pollutant removal, (b) flood attenuation, including slowing and storing flood water and stream baseflow augmentation, and (c) ecological integrity and wildlife habitat.



3 composite functions

The field metrics are combined with the preliminary GIS score to calculate the final WVWRAM score. Sixty-five metrics are used for the regulatory score. Note that the "Value to Society" metrics are not included in the regulatory score. "Value to Society" metrics are, however, included in the comprehensive functional score, since they are important for land acquisition and other conservation decisions.

65 metrics in 6 categories (regulatory)

	Intrinsic Potential	Landscape Opportunity	Value to Society
Water Quality	vegetation, soil, hydrology	50 m buffer, contributing watershed	public use, planning
Flood Attenuation	vegetation, soil, hydrology	50 m buffer, contributing watershed	economic risk
Habitat/ Ecological Integrity	vegetation, soil, hydrology	perimeter, 300 m / 1 km buffer, contrib. watershed	investment, public use, access

Framework for GIS and Field Metrics

Water Quality (25 points) (floodplain/non-floodplain wetlands)

Intrinsic potential to provide function	16/16 points max
1. Headwater location	1/1
2. Vegetation	10/5
3. Surface depressions	5/0
4. Surface water outflow	0/4
5. Organic soil	0/3
6. Seasonal ponding, slope, wetland/upland interface	0/3
Landscape opportunity	5/4 points max
1. Discharges to the wetland	
2. Land use disturbance within buffer	
3. Land use disturbance in contributing watershed	
4. Roads and railroads	
5. Impaired waters, algal blooms, powerboat use	
Value to society (not included in regulatory score)	4/4 points max
1. Wetland discharges to impaired waters	
2. Water quality issues present in 12-digit HUC watershed	
3. Watershed or water quality plan exists	
4. Public use of water quality (water supply, fisheries, recreation)	

Flood Attenuation (25 points) (floodplain/non-floodplain wetlands)

Intrinsic potential to provide function	17/14 points max
1. Headwater location	1/1
2. Median percent slope	2/2
3. Vegetation	9/5
4. Runoff and Storage	5/4
5. Surface Water Outflow	0/2
Landscape opportunity	4/2 points max
1. Overland flow delivered to wetland	2/2
2. Connectivity to historic floodplain	2/0
Value to society (not included in regulatory score)	4/4 points max
1. Location in FEMA floodway	
2. Economically valuable flood risk areas nearby	

Habitat and Ecological Integrity (50 points + special concern adjustment 1-100 pts*)

Intrinsic potential to provide function	30 points max
1. Vegetation (structure and floristic quality)	15
2. Hydrology (intact regime, floodplain connectivity)	9
3. Soils and structural patches	6
Landscape opportunity	13 points max
1. Buffer and landscape integrity	7
2. Landscape-level hydrologic connectivity	3
3. Landscape-level ecological connectivity	3
Value to society (not included in regulatory score)	7 points max
1. Societal investment	3
2. Public use and access	4
Wetlands of Special Conservation Concern, including Exemplary Wetlands	
1. Documented rare species or high-quality natural communities	1-100 points

**Note that 100% of open water wetlands and > 98% of vegetated wetlands score < 100. Exemplary Wetlands with total scores > 100 comprise less than 2% of vegetated wetlands.*

1.6 Regulatory use

WVWRAM scores are intended to inform compensatory mitigation requirements pertaining to the Clean Water Act, as detailed in the Federal Register (2008).

1.6.1 What to Submit

Applicants should submit the following materials below for permit review.

For each site assessed:

- WVWRAM Final Score Report.
- Completed WVWRAM Field Datasheet.
- Assessment Area map showing the wetland with wetland type(s) attributed (e.g. PEM1Btn), as it was submitted to the WVWRAM GIS Tool.
- Buffer Area map, annotated to show areas that break the 50m and 300m-contiguous buffer.
- Site photos showing inlet, outlet, soil(s), wetland type(s), and stressors.

In addition, if representative sampling is performed, submittal materials include:

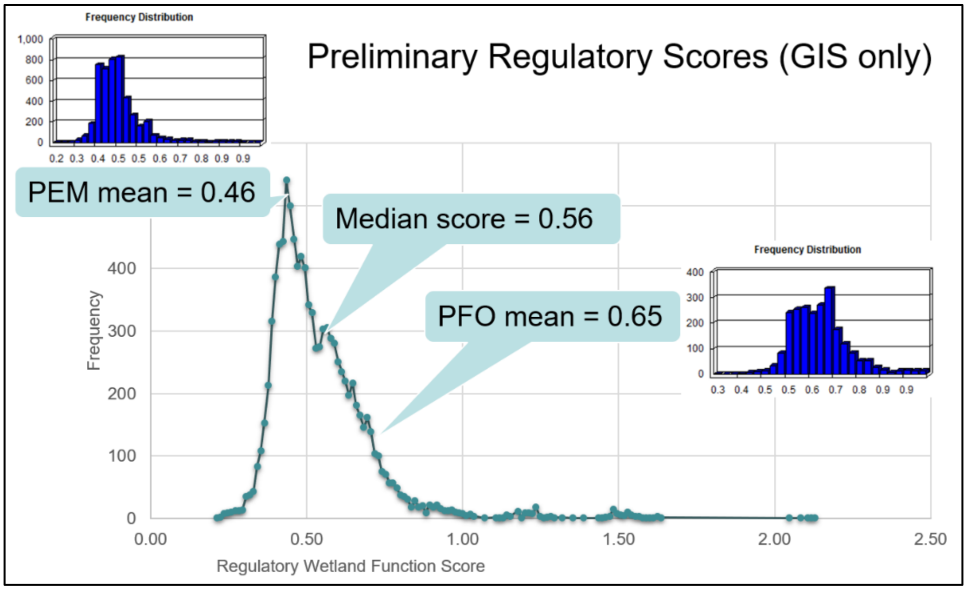
- Overall site map showing all wetlands in the sample.
- Spreadsheet indicating site name, acreage, preliminary GIS score, sampling groups based on preliminary GIS score, WVWRAM score, and which sites were field-sampled.

1.6.2 Regulatory score

The regulatory score is based on metrics that assess the chemical, physical, and biological integrity of jurisdictional wetlands in West Virginia. The regulatory score does not include WVWRAM's "Value to Society" metrics, which are assessed for other purposes such as conservation land acquisition. The non-regulatory metrics are in the light gray panel on the first page of the field form. All other sections of the field form are required for regulatory assessments.

The regulatory score is an input to the Stream and Wetland Valuation Metric (SWVM) spreadsheet, which is used in West Virginia to calculate mitigation debits and credits for wetlands. WVWRAM scores do not include the calculations for additional factors in the SWVM including temporal loss-construction, temporal loss-maturity, and long-term protection.

The regulatory score is based on a 0-1 index for 98% of wetlands in the state. Exemplary wetlands of special conservation concern (2% of wetlands) have scores above 1.0.



Emergent wetlands (PEM), on average, score lower than forested wetlands (PFO), but the scores range depending on the individual functions of a particular wetland site, as shown in the histograms above.

1.6.3 Representative sampling of complex sites

When a single regulated site includes many similar small wetlands, representative sampling may be conducted under certain conditions. All wetlands must be delineated and run through the WVWRAM GIS Tool. Any wetland greater than one acre in size must be individually field-sampled. Wetlands that are smaller than one acre may be grouped into categories based on their preliminary GIS scores, with group breaks at each 0.1 score interval, as follows:

Representative Sampling Group Categories based on WVWRAM Preliminary GIS Score

0 to 0.1	> 0.4 to 0.5	> 0.8 to 0.9
> 0.1 to 0.2	> 0.5 to 0.6	> 0.9 to 1.0
> 0.2 to 0.3	> 0.6 to 0.7	> 1.0 (Exemplary Wetlands – sample all)
> 0.3 to 0.4	> 0.7 to 0.8	

In each sampling group, at least 10% of the wetlands must be field-sampled, beginning with the largest wetland. For example, if there are nine wetlands smaller than one acre with GIS scores from >0.3 to 0.4, the largest one is field-sampled, and its score is applied to the other wetlands in the group. If there are 12 in a group, the largest two wetlands are field-sampled, and the average of their scores is applied to the other wetlands in the sampling group.

1.6.4 Year-round assessment

WVWRAM is designed to produce robust, repeatable results during the growing season.

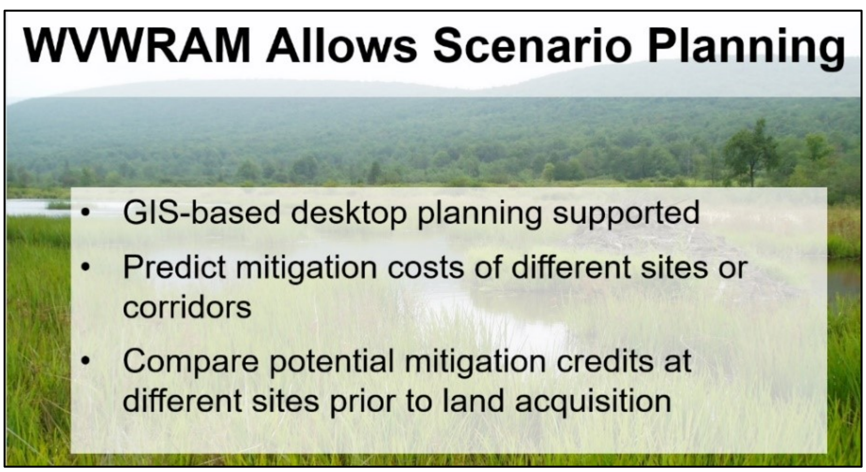
Assessors are strongly encouraged to perform the assessment during the index period of May 1 - October 31 for most of West Virginia, or June 1 - September 30 for elevations above 3000 feet. If the assessment is performed outside the growing season, then a vegetation adjustment reflecting unknown but potentially high-quality vegetation will be made to the SWVM for impacts to wetlands.

Permittees may avoid the vegetation adjustment by providing an update to the WVWRAM field form during the next growing season and prior to final approval of their mitigation obligations.

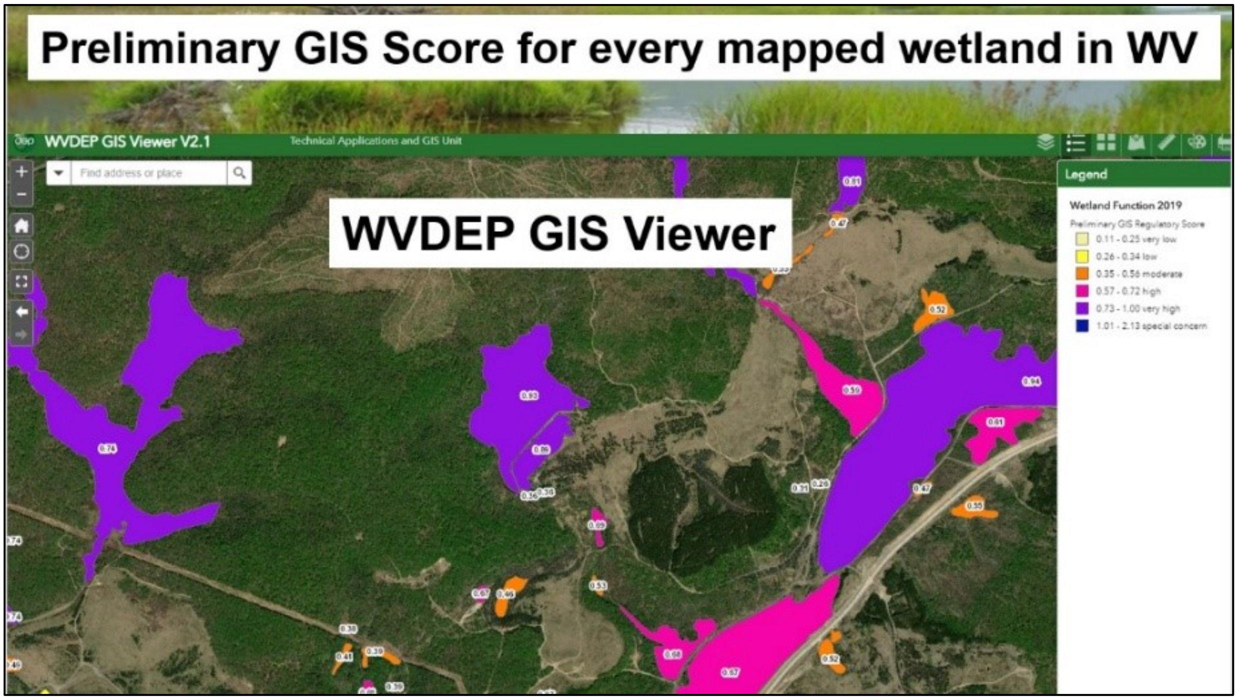
For WVWRAM assessments done outside the index period, surveyors must fill out most of the field form including soils, woody vegetation structure, presence of tall emergent marsh, vegetation fringing open water, and all stressors. The only part of the field form that is not filled out during out-of-season assessments is the rapid floristic quality (vegetation species and cover, pages 5&6 of the field form).

1.6.5 Scenario planning

The WVWRAM GIS Tool, used in combination with the SWVM, allows for scenario planning to minimize impacts to high-functioning wetlands and to predict mitigation credits.



Preliminary GIS scores of all mapped wetlands in West Virginia are posted on the DEP Data Viewer (https://tagis.dep.wv.gov/wvdep_gis_viewer/). Click the "Layer List" icon in the upper right corner and select the "Wetland Function" layer. Note that the preliminary GIS score is generally within about 30% of the final regulatory score.



1.6.5.1 User data privacy

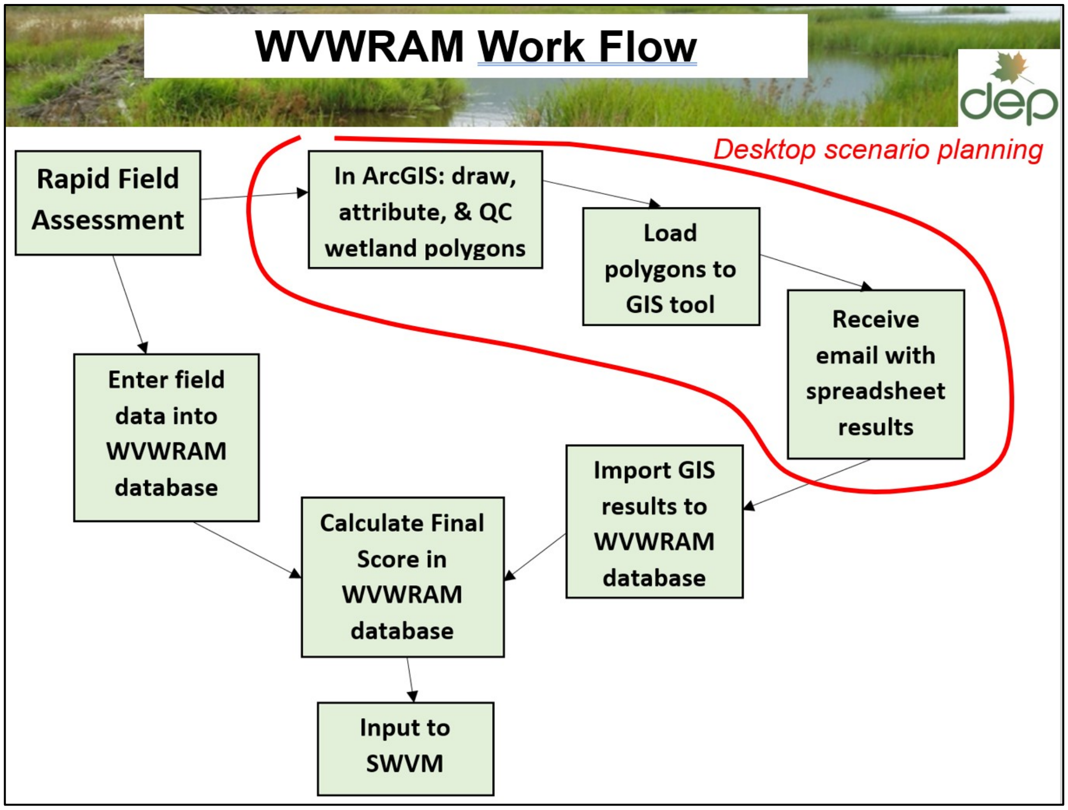
Submitting data to the WVWRAM GIS Tool for scenario planning or site assessment does not compromise the privacy of user data. While the statewide GIS scores from the National Wetland Inventory mapped wetlands are publicly available on the WVDEP GIS Viewer, individual user input and output data in the WVWRAM GIS Tool is private and is neither seen nor stored by any agency. The WVWRAM GIS Tool runs on the WVU GIS Tech Center server. GIS results are deleted after they are sent to the user and are not FOIA-able.

1.6.5.2 Planning to minimize impacts

The WVDEP GIS Viewer "Wetland Function" layer may be used for early planning and avoidance of impacts to high-functioning wetlands. However, this layer does not include all wetlands in West Virginia. As project planning progresses, eventually all potentially impacted wetlands will need to be individually delineated.

For more detailed planning after potentially impacted wetlands have been delineated, the WVWRAM GIS Tool may be used as a stand-alone for desktop scenario planning. Each wetland must have an NWI code, but complete codes with all modifiers are not required for preliminary GIS assessment. For example, wetlands may be labeled PEM rather than PEM1Ban, although codes with more modifiers will give a more accurate preliminary score.

Wetlands in an entire project area may be attributed with NWI codes and zipped into a single shapefile, which is submitted to the WVWRAM GIS Tool to obtain Preliminary Regulatory Impact Scores for each mapped wetland.

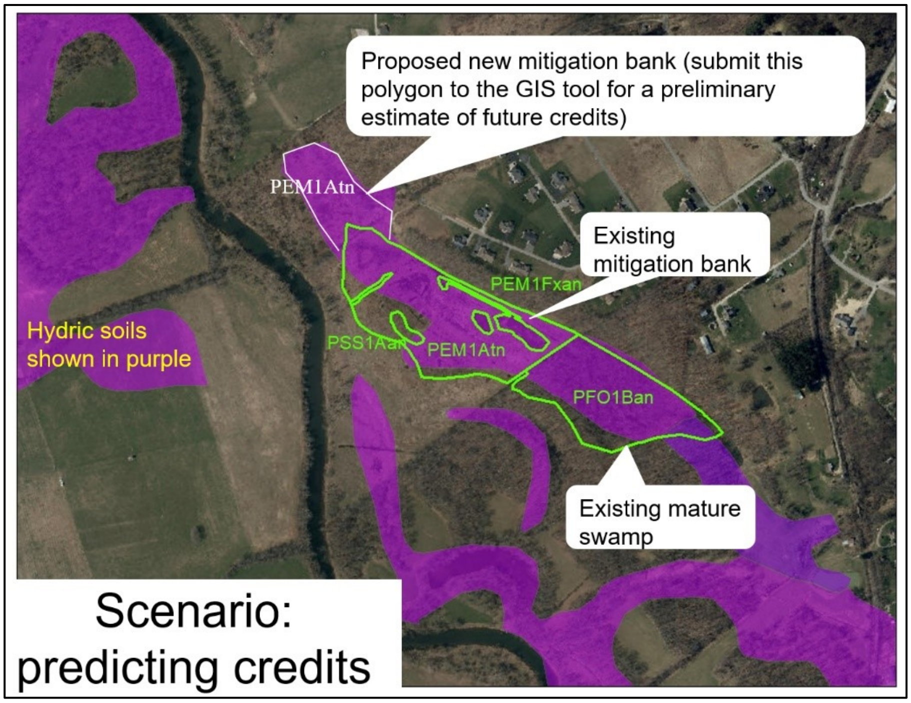


1.6.5.2 Planning for wetland restoration

Mitigation banks, in-lieu fees restoration sites, and permittee-responsible restoration sites can benefit from advance planning to choose favorable settings for land acquisition and to maximum WVWRAM scores based on successful restoration actions.

For initial site evaluation, and to compare different settings in terms of WVWRAM metrics that are determined by the landscape, create an attributed shapefile of the potential restoration site. Each wetland polygon must have an NWI code, but complete codes with all modifiers are not required for preliminary GIS assessment. For example, wetlands may be labeled PEM rather than PEM1Ban, although codes with more modifiers will give a more accurate preliminary score. Multiple wetlands may be included in the shapefile. Zip the shapefile and submit it to the WVWRAM GIS Tool for preliminary regulatory restoration scores.

To further refine predicted WVWRAM scores, for example when planning a mitigation bank, the field datasheet can be filled out, entered into the WVWRAM database, and linked to GIS results. Then individual metrics can be adjusted to reflect proposed restoration design scenarios. For efficient scenario planning for mitigation banks, the following steps are recommended.



- Decide on your possible site configurations, i.e., where the different wetland types will be located at maturity. Make an attributed shapefile for each configuration and load it to the WVWRAM GIS Tool. Multiple wetlands can be included in a single shapefile, but overlapping configurations cannot, since the WVWRAM GIS Tool will dissolve adjacent polygons into a connected Wetland Unit for scoring. Submit each overlapping configuration as a separate zipped shapefile.
- Decide on your restoration actions. Fill out the database for your first restoration action scenario.
- Import the GIS results for that scenario. Click "Calculate Score".
- Now that your first scenario is loaded and scored, you can experiment with different actions as long as they are tied to the same GIS results (same wetland type mapping). For example, change the stressor checklist if stressors are removed, or add microtopography or structural patches. Click "Calculate Score" each time you want to see the impact of a particular restoration action.
- After trying your possible restoration action scenarios for the first site configuration/map, you can make a duplicate of the datasheet to for your next site configuration/map. Revise the data as desired. Be careful with the soils and vegetation tabs – if the NWI types change then the data on soils/veg must be deleted and re-entered. Import the GIS results for your second site configuration/map. Click "Calculate Score". Then experiment with different actions and click "Calculate Score" when you wish to see the impact of those actions on the score.
- Steps to estimate the trajectory of restoration progress from baseline to post-construction, 5 years, 10 years, and maturity. Consider which restoration actions will show results

immediately (like removing stressors) and which will take time (like vegetation growth). Make maps of how the site will likely look at the different time intervals. For example, it may start as a PEM, but by year 10 it may be a PSS, and by maturity the trees you've planted will make a PFO. Submit your mapping scenarios to the GIS Tool. Amend your datasheets to reflect the actions, link to GIS results and "Calculate Score".

1.6.6 Linear projects

Linear projects are likely to impact portions of a large number of wetlands. Scenario planning (discussed above) along the proposed linear project route and alternative routes is strongly recommended to minimize impacts to high-functioning wetlands. Representative sampling, also discussed above, allows many similar sites to be efficiently assessed.

Impacts to portions of wetlands are discussed later in this manual under "Field Measurement Protocols/Assessment area". When part of a wetland is impacted, its score depends on the score of the entire wetland that contains it. Often it will not be possible to access the non-impacted portion of the wetland, and in this case the wetland must be mapped from air photos. See the section in this manual under "Field Measurement Protocols/Wetland mapping" for more details.

1.6.7 Cumulative impacts

Cumulative impacts may be quantified by summing the pre-impact regulatory scores across a watershed and comparing them to the sum of the post-impact regulatory scores for the same watershed.

1.6.8 Special note on restoration site assessment and scoring

The WVWRAM Regulatory Restoration Score is an input to the SWVM for determining mitigation credit. WVWRAM use at restoration sites such as mitigation banks, in-lieu fee sites, and permittee-responsible mitigation sites differs from WVWRAM use at impact sites in two ways. First, the Assessment Area is treated differently, and second, the GIS-based Site Biodiversity Rank is not applied to restoration sites.

The Project Area, not the Wetland Unit, is the primary Assessment Area for restoration monitoring. While this entails some loss in repeatability, it is the only way to provide the change detection over time needed for restoration monitoring. However, if there is a direct hydrologic connection between the mitigation wetland and existing wetlands, then the hydrology metrics (floodplain, dominant water source, outlet, connection to stream continuum, hydrology stressors) should be filled out for the entire Wetland Unit. If the Project Area is part of a larger Wetland Unit, i.e., if connected wetlands exist, then a baseline WVWRAM and final release WVWRAM should be conducted on connected wetlands to ensure they have not been drained, flooded, invaded, or otherwise degraded by the restoration project.

The GIS-derived Site Biodiversity Rank is not applied to restoration scores, in other words, pre-existing biodiversity elements are not counted toward the restoration score. In the unusual scenario where rare biodiversity elements move in naturally (without assistance), and if they are documented and accepted into the WVDNR Natural Heritage database, they may be counted toward the WVWRAM Regulatory Restoration Score via the field-based Site Biodiversity Rank.

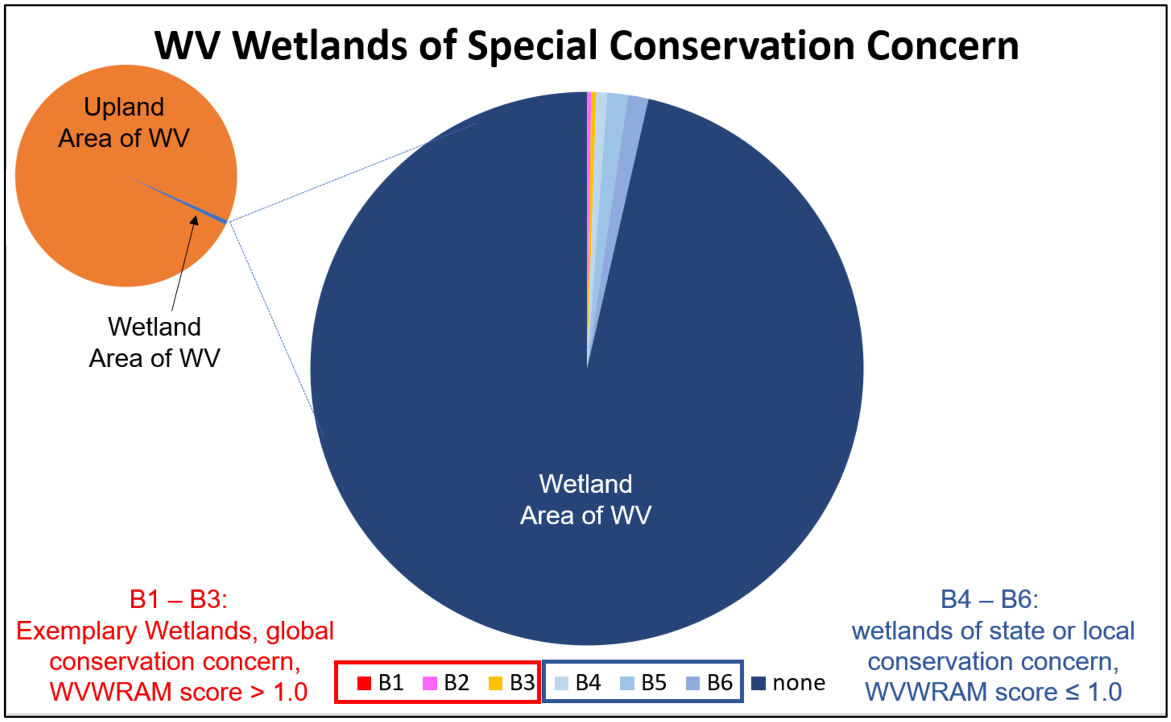
1.6.9 Exemplary Wetlands

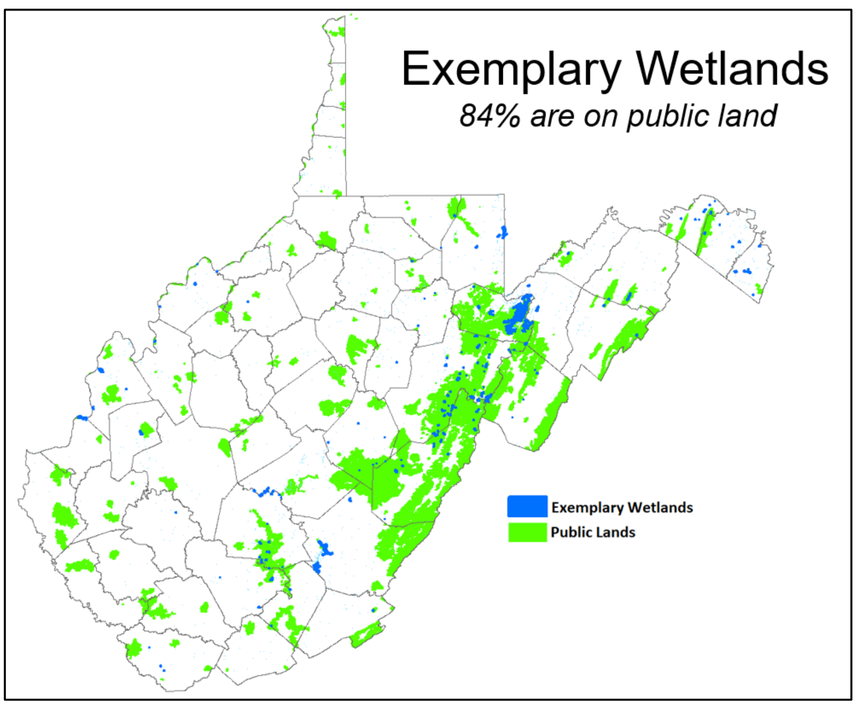
Exemplary Wetlands are defined as wetlands that support globally rare, threatened, or endangered species or exceptionally high-quality natural communities, as documented in the WVDNR Natural Heritage Database (WVDNR 2020). Exemplary Wetlands have a Site Biodiversity Rank of B1, B2, or B3 following criteria developed by WVDNR in cooperation with the national NatureServe network (WVDNR 2014). These criteria have been in use since 2012 by the West Virginia Outdoor Heritage Conservation Fund established by the West Virginia Legislature (West Virginia Legislature 1985, WVOHCF 2019). Site Biodiversity Ranks for West Virginia wetlands may be summarized as:

Site Biodiversity Rank	Significance	Associated Threat Level	Number of WV Wetlands	Exemplary Wetlands
B1	Outstanding global biodiversity significance	Globally critically imperiled	6	yes
B2	High global biodiversity significance	Globally imperiled	100	yes
B3	Global biodiversity significance	Globally vulnerable	129	yes
B4	Outstanding state biodiversity significance	Globally stable but critically imperiled at the state level	270	no
B5	State biodiversity significance	Globally stable but imperiled at the state level	518	no
B6	Local biodiversity significance	Globally stable but vulnerable at the state level	519	no
none	General habitat value	Presumed stable	41,582	no

It is difficult or impossible to replace the functions lost when Exemplary Wetlands are impacted since they contain highly specialized habitats and rare species. Exemplary Wetlands make up less than 2% of vegetated wetlands, and less than 0.5% of all wetlands in West Virginia. Exemplary

Wetlands are concentrated in the Allegheny Mountains and eastern panhandle regions of West Virginia, with a smaller number occurring along the Ohio River or elsewhere. Eighty-four percent of Exemplary Wetlands are located on public land.





1.7 Measurement quality objectives for field activities

Measurement Quality Objectives are acceptance criteria for the data quality indicators of precision, accuracy (or bias), representativeness, comparability, and completeness.

REPRESENTATIVENESS is the expression of the degree to which data reflect a characteristic of an environmental condition or a population. WVWRAM addresses representativeness by basing score ranges on preliminary GIS assessment of every mapped wetland in the state, including more than 40,000 wetland complexes. Note that current mapping is based largely on imagery and methods from the 1980's and thus includes only about two-thirds of the state's wetlands. Within each sampled wetland, representativeness is addressed by locating vegetation and soil sampling areas within each mapped National Wetlands Inventory (NWI) polygon.

COMPARABILITY expresses the confidence with which one data set can be compared to another. WVWRAM combines preliminary GIS assessment with rapid field assessment, allowing comparison of the two methods at each site. Each metric is assessed in GIS, and then improved during rapid field assessment. Since the metrics are drawn from established methods in use by other states or by NatureServe, the common metrics should allow some comparison with wetland data collected elsewhere in the USA.

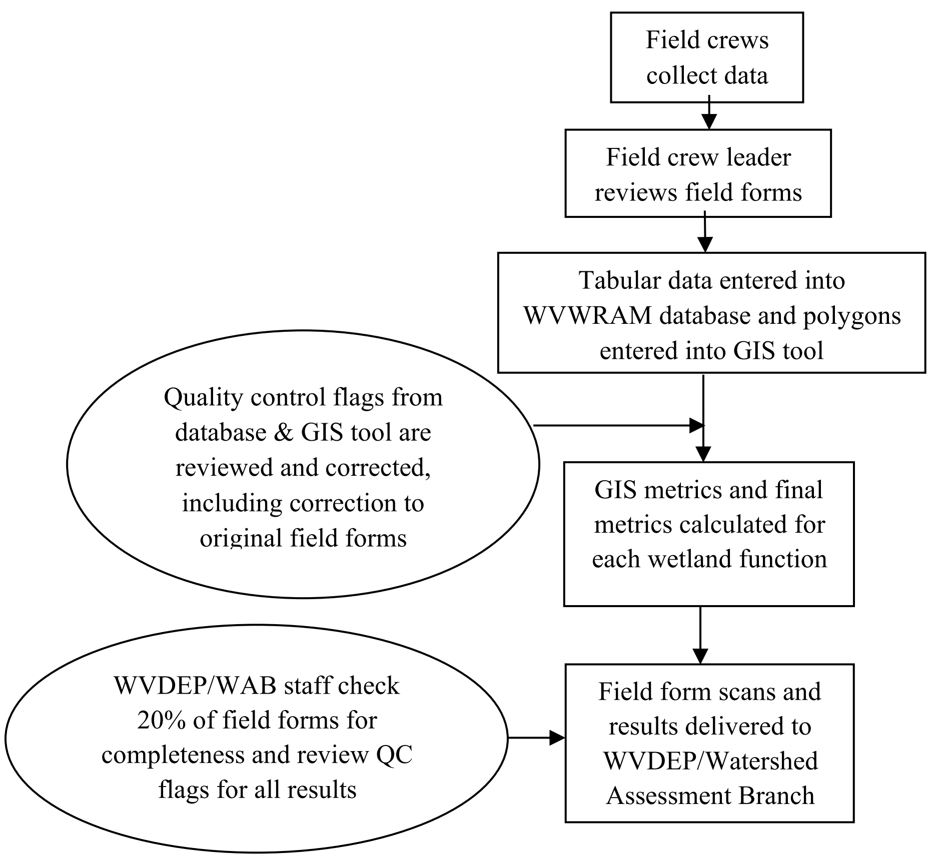
COMPLETENESS is expressed as the percentage of usable data actually obtained compared to the amount that was expected. Field-testing of the protocol was designed to maximize the amount of useful data that is obtained. The protocol has been revised multiple times to meet this goal. It is critically important that all data fields on the field form are completed carefully by field personnel.

PRECISION defines the agreement between or among independent measurements of the same parameter at the same location. Precision as applied to field-based observations is sometimes referred to as reproducibility or repeatability. Repeatability was built into WVWRAM by selecting an approach that has already been refined through repeatability studies in multiple states. In particular, the definition of the assessment area and the metrics chosen are based on the results of repeatability studies. Six of the seventy sites sampled during field-testing in 2017-2018 were replicates, i.e., they were sampled separately by different crews, and while this sample size is too small for significant comparison, the resulting scores matched with a reassuring r^2 (correlation coefficient) value of 0.99. Preliminary GIS scores were compared to final scores after rapid field assessment, with the results strongly positively correlated and r^2 value of 0.51. Comparison of field scores with GIS scores highlight the GIS metrics that are most in need of field verification. WVWRAM emphasizes collection of field data to support and improve the preliminary GIS score, with particular emphasis on the metrics that have large discrepancies between field and GIS.

ACCURACY is the degree of agreement of a measurement with the known or true value. Accuracy will be addressed through audits of field crews by the Senior Wetland Scientist or other experts, with an emphasis on correct adherence to NWI mapping standards, identification of soil characteristics, and identification of plant species. In some cases, unidentified plant specimens may be taken to local herbaria for consultation with experts. The results of audits of field crews will be shared with the crews in an effort to continually improve accuracy as the method is implemented.

1.8 Data management and review

Data management includes skilled/trained field personnel, good field data collection practices, review of field data forms, data entry into the database, and review of the final electronic records. At each step of the process, checks of the data are performed to ensure that high quality and accurate data are transmitted to the next level of the process. If during any step of the process, errors are found in >5% of the sites or appear to follow a systematic pattern, more extensive checks of the data will be employed.



Data management process. *Squares depict step processes and ovals depict quality assurance checks.*

Each field metric contributes directly to the final WVWRAM functional assessment score. Field-delineated spatial data (mapped wetland polygons according to the National Wetlands Inventory standard) are input to the GIS tool of WVWRAM. Field form data are input to the WVWRAM MS-Access wetland database. After the data are entered and checked, then the GIS results are imported to the WVWRAM database and merged with field tabular data to result in final metrics and scores.

All field data, including field form scans, photographs, GPS files, and WVWRAM database results will be transferred from the field teams to the WVDEP Watershed Assessment Branch for review and archival.

The companion document "Reference Manual for the West Virginia Wetland Rapid Assessment Method" contains additional details regarding data analysis, tracking, and archival.

2.0 FIELD PREPARATION

2.1 Field Team

WVWRAM is designed to be completed in 1-4 hours by 2 field personnel with the skill level of wetland delineators. Field teams will be led by a team leader with experience in field assessment of wetlands including wetland plant identification, wetland soils, hydrology, and field surveying.

Prior to assessing a wetland site, the field Team Leader will ensure that each field crew has the necessary experience, skill, and field equipment and that the equipment is in good working condition. If deviations from the standard protocol are found or incorrect use of procedures is observed, the Team Leader will discuss and correct the problems with the field crew immediately.

2.2 Recommended Training

Assessors including agency personnel and consultants are strongly encouraged to attend WVDEP-led or WVDEP-approved training prior to implementation of the rapid assessment protocol. Subjects covered during training include:

- Overview of the WVWRAM, including the regulatory context
- Key botanical, soil, and hydrology characteristics of WV wetlands
- Field mapping and assigning National Wetlands Inventory attributes
- Identification of wetland stressors
- Distinguishing organic soil and mucky modified mineral from mineral soil
- Proper completion of data forms
- Equipment decontamination
- Quality assurance skills for maintaining precision, accuracy, and comparability in data collection
- Data entry and calculation of final wetland function scores

2.3 Field Equipment

The equipment and supplies used for field data collection are listed in the table below.

Field Supplies and Equipment

SAMPLING ACTIVITY	SUPPLIES & EQUIPMENT
Decontamination	Pump sprayer (1 or 2-gallon) for water rinse
Decontamination	Mister or small sprayer (about a quart) for 10% bleach solution
Decontamination	Stiff brush
Decontamination	Bleach
General	Air photo packet (wetland boundary, 50m (164 ft) buffer, 300m (984 ft) buffer, attributed NWI polygons, soil overlay)
General	Clipboard, Pencils, Markers
General	Field forms on Rite-in-Rain paper
General	WVWRAM User Manual, Field reference sheets (NWI codes, water regime definitions, soil definitions and keys), laminated or on Rite-in-Rain
General	GPS unit with target points loaded
General	Digital camera (may be on GPS or phone); note that date/time stamp on photos is recommended
General	Measuring tape, minimum 20 meters (66 feet) length
General	First aid kit, sunscreen, insect repellant, water bottle, hat, lunch, appropriate footware (e.g., knee/hip boots, waders), cell phone (at least one per team for safety)
Soils	Munsell color chart
Soils	Shovel and/or soil auger
Soils	Soil pH kit (Lovibond Soil pH Test Kit)
Vegetation	Aquatic bed sampler (mini grappling hook attached to throwing rope)
Vegetation	dbh tape, or Biltmore scale on clipboard
Vegetation	Flora references; Flora of Virginia AND FloraQuest (for WV filter) mobile apps, plus DEP's Guide to Common Wetland Plants are highly recommended
Vegetation	Hand lens
Vegetation	Plant press and pressing supplies: collection bags, labels, soil knife, newspaper, blotting paper, cardboard spacers, waxed paper (aquatics)

2.4 Equipment Decontamination

All equipment and clothing that comes into contact with potentially contaminated soil or water will be decontaminated between wetland sites, to avoid spreading rana virus, chytrid fungus, snake fungal disease, or invasive plant species between wetlands. Potentially contaminated soil includes all wet soils in West Virginia. Disposable equipment intended for one-time use will not be decontaminated, but will be packaged for appropriate disposal.

The soil auger, soil knife, shovel, measuring tape, aquatic bed sampler, and all footwear must always be decontaminated between sites, along with any other items that contact wetland soils and water.

Decontaminate prior to leaving for the field if possible. If you must decontaminate at the field site, set up the decontamination area at least 30 meters (100 ft) from the wetland edge. There are four required steps to decontamination.

1. Brush off all soil, seeds, and vegetative matter.

2. Rinse clean with water. Use stiff brush as needed. Don't forget boot treads. A pump sprayer (2-gallon capacity or sized according to crew needs) makes it easy to rinse when away from piped water.

3. Spray with 10% bleach solution (1 part bleach to 9 parts water) and allow to soak for 5 minutes. Don't forget the bottom of your boots. The bleach solution must be used or replaced each week as it loses its effectiveness over time, unlike concentrated bleach which does not get "denatured" quickly. A small sprayer such as a plant mister or hairspray sprayer works well.

4. Rinse with water. Bleach should not be introduced into the wetland.

2.5 Field Crew Leader checklist

2.5.1 Prior to field season

- Prepare field sampling schedule and distribute to field staff.
- Contact landowners for permission to access sites.
- Acquire necessary permits for collection of plant species (WVDNR) and sampling permission (state lands, federal lands, conservation or private lands).
- Make photocopies of field forms on Rite-in-Rain paper.
- Print and laminate copies of the reference sheets (if laminator is not available, at least print them on sturdy Rite-in-Rain paper.
- Print and bind copies of the User Manual.
- Gather field equipment and have it ready to go, clean, with batteries charged.
- Practice loading points or imagery for a wetland site onto the GPS unit (Garmin subscription to Birds-eye imagery may be helpful)
- Order sunblock and insect repellent. Check supply of Rite-in-Rain notebooks and check first aid kit.
- Sign out vehicles as needed.

2.5.2 Prior to each field assessment

- Confirm site access, including driving, parking, and hiking access routes.
- Communicate meeting time and directions to sampling team.
- Prepare and print (or load to mobile device) air photos with wetland boundary, 50m (164 ft) buffer, 300m (984 ft) buffer, attributed NWI polygons, and soil overlay. These maps will be corrected in the field. Note that prior office mapping of NWI polygons using GIS will greatly speed field assessment. Office mapping should be done at a scale of 1:3000 or finer, after consulting multiple sets of imagery including USFWS Wetlands Mapper and Google Earth historic imagery. Leaf-off imagery and color infrared, including the 1996 color infrared for WV, and the 2003 SAMB imagery, are helpful resources. Elevation models and hydric soils are also key references for office mapping of NWI polygons.
- Confirm that blank field forms, reference sheets, user manual, and air photos are in clipboard.
- Check that GPS is charged and loaded with target point(s) and imagery if available.
- Confirm that all equipment is decontaminated, operational, and packed in vehicle.
- Review important characteristics of site such as land use history or habitat features.

2.5.3 At the field site

- Assign field tasks to crew and review safety and decontamination protocols.
- If land managers or local residents are present, request information about land use history.
- Conduct assessment.
- Check all field forms for completeness before leaving the site.

3.0 FIELD MEASUREMENT PROTOCOLS

Field data are collected at each sampling site by a 2-person team with experience in wetland assessment, wetland plants, soils, and hydrology. The field crew follows the methodology detailed in this WVWRAM User Manual, including use of the WVWRAM field forms.

All data and samples will be evaluated on-site, with no off-site or laboratory measurements, with the exception of unidentified plants. Unidentified plants may be collected, labeled, pressed, and dried for further study.

The Team Leader will be responsible for making sure that all field forms are completed and accurate. Team members will provide the Team Leader with completed field forms before leaving a site. The Team Leader will check each field form for completeness (i.e., all fields requiring information are completed) before leaving the site. When the Team Leader finds that data are missing or data have been incorrectly entered onto the field form, field team members will be notified of specific problems before leaving the site and, if necessary, sites will be sampled again to obtain missing data or data that were not completed correctly.

The following guidelines must be used when completing any of the field forms associated with West Virginia's Wetland Functional Assessment:

- Print in pencil; do not use cursive writing style.
- Make sure that writing is legible and dark.
- Fill in all areas of the header and boxes on field forms.
- Use scientific names for all vegetation.
- If you look for a metric to sample and there are none present, write "none".
- If you cannot collect the data for some reason, write in "not collected" and an explanation.
- Do not leave any sections of the field form blank.
- If you include measurements in any notes or comments, then specify units of measure (e.g. meters, feet).

Efficient workflow varies with the size of the wetland and whether the wetland delineation is done in tandem with (immediately prior to) the WVWRAM assessment by the same survey team.

<u>When the wetland delineation is done in tandem with the WVWRAM assessment</u>, it is most efficient to:

- During the delineation, carefully observe the vegetation, structural patches, microtopography, hydrology, water sources, outlet, buffer, and stressors along the perimeter and within the wetland. Map wetland type boundaries (e.g. PEM1B, PFO1A). Take photos as needed of inlets, outlet, wetland type, or stressors.
- Fill out the identifiers on the WVWRAM field form and evaluate the 50-meter and 300-meter buffer, comparing air photos to observed current land use.
- Revisit the interior of the wetland while carefully observing the vegetation, structural patches, microtopography, hydrology, water sources, outlet, buffer, and stressors.
- Sample the soils and vegetation in each mapped wetland type.
- Fill out the field form, ending with the stressors page.

For <u>small wetlands (< 0.5 acre) when the assessment is done separately from the delineation,</u> it is most efficient to:

- Fill out the identifiers on the field form and evaluate the 50-meter and 300-meter buffer, comparing air photos to observed current land use.
- Walk the entire wetland while carefully observing the vegetation, structural patches, microtopography, hydrology, water sources, outlet, buffer, and stressors.
- Sample the soils and vegetation in each wetland type and map the wetland types.
- Fill out the field form, ending with the stressors page.

For <u>larger wetlands (> 0.5 acre) when the assessment is done separately from the delineation</u>, the most efficient workflow is slightly different. In this case, it is best to:

- Fill out the identifiers on the field form and evaluate the 50-meter and 300-meter buffer, comparing air photos to observed current land use.
- Walk the perimeter of wetland while carefully observing the vegetation, structural patches, microtopography, hydrology, water sources, outlet, buffer, and stressors. Take photos of wetland types, inlets, outlet, key features, or stressors. Record GPS points as needed.
- Duck into the middle of the wetland when a new wetland type (different NWI code) is spotted, to sample the soils and vegetation, assign an NWI code for mapping, take photos, and record GPS points for mapping. Don't forget to check your air photos to spot any new wetland types that may not be visible from the perimeter.
- Once you are half-way around the perimeter, stop and fill out as much as you can of the field form. This run-through will also remind you to look for certain features like structural patches and pay attention to depressions, microtopography, stressors, and other features.
- Complete the perimeter walk and continue to sample any new wetland types you encounter. Ensure you have observed all of the wetland types by checking the air photo.
- As you near the end of the walk, review the field form and update or amend the form as necessary, ending with the stressors page.

3.1 Identifiers

Begin the field assessment by filling out the identifiers for the site. Assign a Site Name and SiteEventCode that are meaningful and unique within the stand-along version of the WVWRAM database you are using (WVDEP staff should also refer to section 4.4.1.2). Examples are:

Site Name: Laurel Fork Site 3 baseline; SiteEventCode: LF3b-2023

Site Name: Pipeline Crossing 14; SiteEventCode: PC14

Avoid using punctuation other than hyphen (-) and underline (_) in the Site Name and SiteEventCode. Add the Site Name and Survey Date to all field forms. In case of sheets being separated on windy days or during transfer to the office, this information is key to the integrity of the data. We recommend stapling the field forms together for each site, but the Site Name and Survey Date must still be recorded on each sheet.

Add the crew leader name and the name(s) of any field crew members. Note the date and start time of the assessment. Check to be sure all gear has been decontaminated prior to entering the site.

Write down driving, and if needed walking, directions to the site. If your text does not fit in the small box on page 1 of the field form, continue on the overflow page at the back of the field form. Add any notes or observations related to wetland condition or function, including land use history, site conditions, wildlife observed, discussions with landowner or other on-site or off-site personnel. Include any deviations from protocol in this section. Use the overflow sheet if your notes do not fit on page 1.

Note the make and model of your GPS unit, and confirm that it is set to the NAD83 datum. Note the coordinates using decimal degrees. Coordinates can be recorded anywhere within the AA boundary. The purpose of the coordinates is to provide a quality control link between the tabular data and GIS polygons.

Data collected for identifiers:

Identifiers — **West Virginia Wetland Rapid Assessment Datasheet** — Page 1 of 9 total pages
WVWRAM Field Form 02/12/2019

Site name Queens Mitigation Wetland Date 9·7·2018 SiteEventCode MC-123_W113
Crew leader name Elizabeth Byers Field crew name(s) Jack Hopkins
Time (24 hr) Start 9:45 End 13:30
■ gear decontaminated prior to entering site
■ all datasheets checked by crew leader at end of sampling
Directions to site:
From Parsons, WV, follow FR41 south along the Shavers Fork for 7 miles. Wetland is on the right (North of road) just past the first horseshoe bend in the river. Walk down brushy slope to wetland.
Notes on land use history, site conditions, wildlife observed, discussions with landowner or other on-site personnel, or deviations from protocol:
Historically ditched, grazed, and farmed. Restoration around 2012 included ditch plugging, depression excavations, microtopography (drunken bulldozer), ground water dams, and planting. Tom Biebighauser design. Site is on upper, seldom-flooded floodplain of Shavers Fork including toeslope wetland below road. No channelized flow observed.
GPS make/model Garmin Oregon 650t GPS datum: ■ NAD83 ☐ other ______
Coordinates (decimal degrees): 39.02160, -79.71093
■ Photos of inlet, outlet, NWI types, soils, stressors, and any other key features

3.1.1 Photographs

Several photographs are required as you proceed through the assessment. Take photographs of:

- water sources or inlets,
- wetland outlet
- each NWI wetland type
- soil pits, and
- any other key features or stressors you observe.

West Virginia Wetland Rapid Assessment Datasheet - Photo Log — Page 9 of 9 total pages

Site name Queens Mitigation **Date** 9·7·2018
Camera type/camera number Olympus Stylus 600 **Photographer** Jack Hopkins

Take photos of inlet(s), outlet, each NWI wetland type, and any other key features.
Notes: Dispersed groundwater flow (no observable water source or outlet)

Disk Photo # *(field)*	Photo Description (use key words)	Photo ID *(DEP office)*	Disk Photo # *(field)*	Photo Description (use key words)	Photo ID *(DEP office)*
1	PSS1Btn				
2	PSS1Btn - soil				
3	PUB3Hb				
4	PUB3Hb - beaver dam				

Record the required photos on the photo log of the field form, including the site name, date, camera type/number, photographer, photo #, and brief description. WVDEP staff may add a photo identification code afterward. A "timestamp" app or camera function is helpful in keeping track of photos.An efficient way to label field photo files when you download them in the office is to rename all photos from a particular site to *SiteName_Date_Photographer_Autonumber*. For example, all the photo files from one site could be named *"BlisterSwamp_20180725_EByers (1).jpg"*. Then, photos showing key features can have a descriptor added, such as the NWI wetland type attribute. This method of file naming is quick and allows easy searching of large photograph collections. Here is an example of photo file naming:

PSS1Dbag_soil_FisherSpringRun_20180907_EByers (4)
PSS1Dbag_FisherSpringRun_20180907_EByers (6)
PSS1Dbag_soil6_FisherSpringRun_20180907_EByers (12)
black Oa substrate_FisherSpringRun_20180907_EByers (14)

Reduce subjectivity in your photographic record by:

- Using the same camera, when possible, with the same field of view (e.g., 28 or 35 mm wide angle).
- Take photographs of wetland types while facing along geographic coordinate directions (north-south, east-west), preferably from the center of the wetland type.
- Set your camera to provide a date and time stamp on each image.
- Use a tape measure with large numbers for taking soil profile photographs, such as a Keson collapsible survey rod.

3.2 Page one: Assessment area and purpose

3.2.1 Assessment area

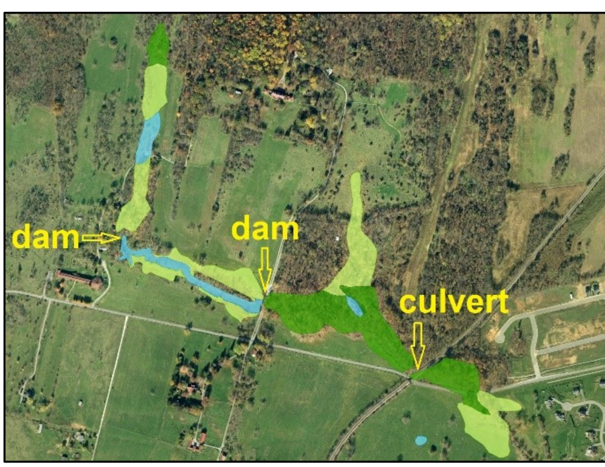
The Assessment Area (AA) is delimited based on breaks in hydrology. The AA normally encompasses the entire wetland unit, which is defined as the hydrologically connected areas of the wetland. AA's are separated by upland habitat or by hydrologic breaks. An AA cannot cross upland habitat, although small inclusions of upland habitat are permitted if they do not impact the hydrology of the wetland.

Examples of hydrologic breaks include stream riffles, sudden changes in elevation, dams, culverts, constriction of the wetland outlet, or any abrupt change in the water regime (CWMW 2013, Hruby 2012, Adamus et al. 2010, Collins et al. 2005). If a wetland is bisected by a stream wider than 3 meters (10 feet), then wetlands on opposite banks may be assessed as separate AA's. Lakes and larger streams also form AA boundaries.

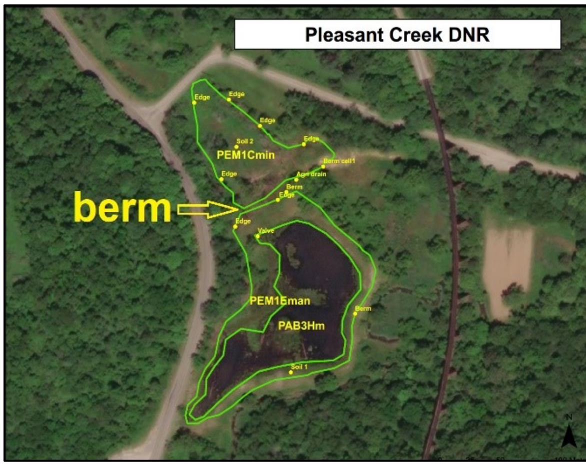
Example of wetland constriction as a hydrologic break between two AA's (Shaw Run, Jefferson County).


Example of a lake as a hydrologic break (Sleepy Creek, Berkeley County).

Example of four AA's separated by two dams and a culvert (N. Fork Bullskin Run, Jefferson County).



Example of berm as hydrologic break between two AA's (Pleasant Creek, Barbour & Taylor Counties).



Examples of stream wider than 3 m (10 ft) and culvert as hydrologic breaks between AAs.

If a wetland is too large to sample in a half-day, e.g., greater than 25 acres in size, then it may be broken into smaller AA's as follows (Hruby 2012, Collins et al. 2005):

1. Identify the hydrologic upper and lower boundaries of the wetland.
2. Divide the wetland into approximate halves, halfway between the upper and lower boundaries. If it is still > 25 acres, repeat this process.
3. Alternatively, if there are tributary stream channels within the wetland, assessors may divide the wetland along the approximate watershed divides between the tributary streams (for small streams), or along the streams themselves (for larger streams).

If the Wetland Unit is broken into smaller AA units, then a single AA unit would be assessed in the half-day period.

Boundaries of the Assessment Area *should not be based solely* on property lines, fence lines, mapped soil series, vegetation associations, elevation zones, land use, or land use designations. Hydrologic breaks are the key determinant of Assessment Area boundaries.

For wetlands entering the regulatory process, it will not be uncommon for the Project Area to be smaller than the Wetland Unit. ***Note that when the Project Area is smaller than the Wetland Unit, the entire Wetland Unit should be field-assessed*** whenever possible. When it is not possible to obtain permission to access the entire Wetland Unit, an effort should be made to estimate metrics for the non-accessible part of the wetland by observing vegetation, hydrology, and stressors from a distance, i.e., observing from the road, looking over a fence, or by using aerial photos. The entire Wetland Unit must be mapped for use in the GIS part of the assessment, using air photos. The delineated project area should also be mapped. Note that repeatability of wetland assessment scores is significantly reduced when the entire Wetland Unit is not assessed. See section 1.6.8 *Special note on restoration site assessment* for exceptions to assessing the entire Wetland Unit.

Example:

Assessment Area *Check one (p.25)*
■ AA is the entire Wetland Unit (most sites).
❑ AA is a portion of the very large WU (> 25 acres)
❑ AA is only the Project Area, smaller than the WU - see manual for exceptions when project area survey is acceptable
Comment ______________________________

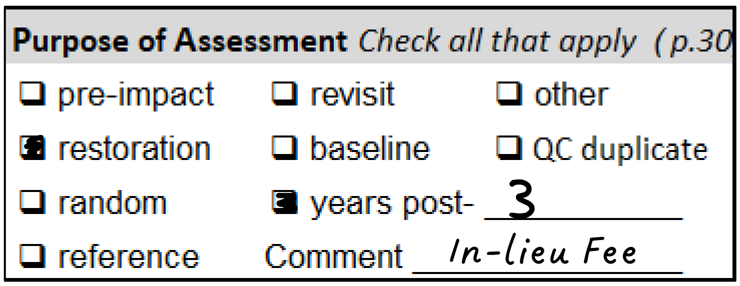
Once the AA is established, the entire area will be walked and all physical and biological features will be noted. Some of the metrics may require a second walk-through in order to confirm or modify initial observations.

3.2.2 Purpose of assessment

The purpose of the assessment should be noted to assist with data archival and analysis. One assessment may serve more than one purpose, so check all boxes that apply. **Pre-impact** assessments are typically conducted to determine mitigation debits at wetlands that will be damaged or destroyed. **Restoration** sites should be additionally described as either **baseline** or **years post-construction**, in which case the number of years should be written after the prompt "years post-" and **revisit** indicated. **Random** sites are probabilistic monitoring sites selected by state or federal agencies to contribute to our knowledge of wetland condition, status, and trends statewide. Random sites may be either baseline or revisits, and if they are revisits then the number of years since the baseline should be noted in "years post-" and **revisit** indicated.

National Wetland Condition Assessment sites should be marked as "random", with "NWCA" in the comment field, and either "baseline" or "years post-" indicated and **revisit** indicated. **Reference** sites are known high-quality wetlands with intact buffers and few to no stressors. **QC duplicate** assessments of sites are those that have already been sampled by a different field team on the same day/week as part of quality control. **Other** sites include opportunistic sites, sites used for training, or any other sites that do not fit into the existing categories. When "other" is checked, then a comment should be included explaining why the site was assessed.

Example:


Purpose of Assessment *Check all that apply (p.30*

❑ pre-impact ❑ revisit ❑ other

■ restoration ❑ baseline ❑ QC duplicate

❑ random ■ years post- 3

❑ reference Comment In-lieu Fee

3.3 Page one: Wetland mapping

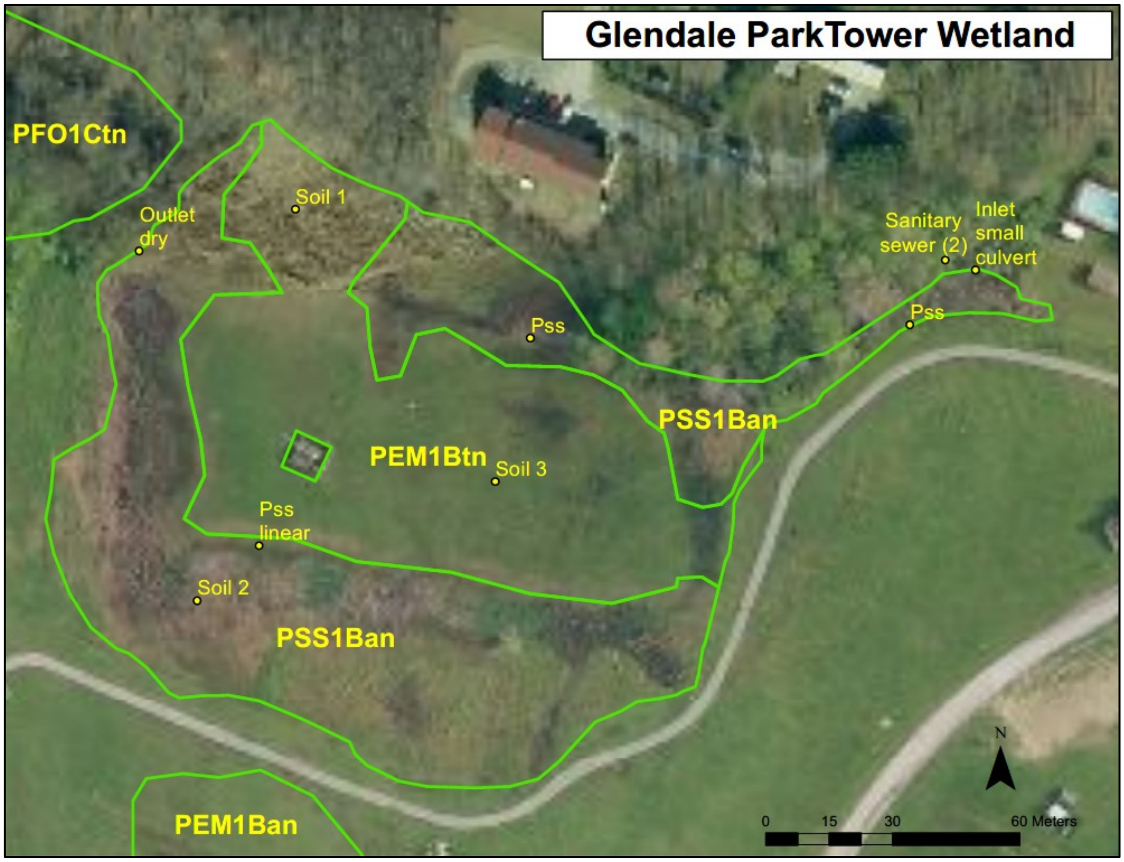
Some wetland sites will be delineated prior to rapid field assessment, particularly those in the regulatory process. For sites that do not have a delineation, or where the project area covers only part of the Wetland Unit, the boundary of the Wetland Unit must be mapped. In addition, for all sites, the wetland types within each Wetland Unit must be mapped.

3.3.1 GPS points and tracks

A Global Positioning System (GPS) or other mapping system is used in the field, along with aerial imagery, to map the boundaries of the AA (if not already delineated), and to map the boundaries between NWI wetland types such as forested or emergent wetlands within the AA. Specify the datum used with GPS units to ensure that GPS data can be imported into the GIS part of the assessment. The NAD83 datum is most compatible with the WVWRAM GIS Tool.

Good workflow includes taking frequent GPS points and giving them simple labels. Common labels might be "PSS-PEM bndry" for the boundary between a scrub-shrub and emergent wetland, or "soil" for a soil pit. GPS tracks are also helpful, as are mobile mapping programs and/or mapping phone apps. Drawing directly on the aerial imagery, either hard copy or on a tablet or phone, is very useful. The goal is to gather enough information to draw the boundaries of wetland types and note special features such as inlets, outlet, soil samples, and stressors.

Forested wetland polygons must have enough width to provide forest functions, typically at least 10 meters (33 feet). A single row of trees around a pond does not constitute a forested wetland.



Wetland Unit with scrub-shrub and emergent wetland types mapped in green lines, yellow NWI codes, and key features labeled.

Wetland Unit with forested and emergent wetland types mapped in green, with yellow NWI codes. The white band represents the project area, which directly impacts 0.2 acre (shown in red) of the 1-acre AA (the Wetland Unit). In this case, a wetland delineation was available for the red project area, and the rest of the wetland was field-mapped with GPS.

3.3.2 Mapping from air photos

When it is not possible to obtain permission to access part of a Wetland Unit, an effort should be made to assess the non-accessible part of the wetland by observing vegetation, hydrology, and stressors from a distance, i.e., across a fence. The entire Wetland Unit must still be mapped for use in the GIS part of the assessment, using air photos.

Mapping from air photos is easy for many emergent wetlands, which show up well on many types of air photos. Forested and scrub-shrub wetlands, and wetlands on the drier end of the hydrology gradient, can be more difficult and may require elevation maps and soil maps. Before you map, you may save some effort by checking the currently mapped wetland inventory for the state in case your wetland is already mapped or partly mapped. The current inventory dates mostly to 1980's and includes about two-thirds of the wetlands in the state, but many wetlands are poorly mapped or not mapped at all. It may be viewed on the USFWS Wetlands Mapper or a slightly updated version may be viewed on the DEP website at: http://tagis.dep.wv.gov/wvwetlands/.

Consulting multiple sources of imagery is important in assessing hydrologic regime. Permanently flooded wetlands will show as wet in all imagery, whereas seasonal saturation or inundation will show as dry on some image dates and wet on others. Depending on the sun angle when the imagery was taken, some images show clear shadows for trees, allowing forest and scrub-shrub to be distinguished. Recommended datasets include:

- WV DEP GIS Viewer: basemaps, layers https://tagis.dep.wv.gov/wvdep_gis_viewer/
- WV DEP map services http://tagis.dep.wv.gov/home/MapServices
- WV Flood Tool: FEMA flood models, basemaps, reference layers https://www.mapwv.gov/flood/map/
- Google Earth App: current and historical imagery
- USFWS wetland mapper https://www.fws.gov/wetlands/data/mapper.html
- WV GIS Technical Center GIS Data/Services http://mapwv.gov/gis_services.html
  - WV Best Leaves Off (2018-2022)
  - Elevation rasters and hillshade
- SoilWeb: hydric soils, soil profiles https://casoilresource.lawr.ucdavis.edu/gmap/
- Watershed Resources Registry West Virginia https://watershedresourcesregistry.org/map/?config=stateConfigs/westvirginia.json
- USGS Historic Topographic Map Explorer https://livingatlas.arcgis.com/topoexplorer/index.html

3.3.3 NWI codes

NWI code(s) are assigned to each wetland type within the AA. These codes are included as WVWRAM reference sheets (NWI 2015) and must be carried in the field. Laminating the reference sheets or printing them on Rite-in-Rain paper is strongly recommended.

If the AA contains more than one wetland type, and the different wetland types cover at least 0.1 acre each, then, a separate polygon for each NWI wetland type must be drawn. For example, if a site has 0.5 acre of forested wetland and 0.1 acre of emergent wetland, it would contain two NWI wetland types. If the entire AA is less than 0.2 acre then it should only contain one NWI wetland type. For example, if a site has 0.1 acre of forested wetland and 0.05 acre of emergent wetland, then the entire site is mapped as forested wetland. The result will look like the National Wetlands Inventory mapping, as shown in the examples above.

NWI attributes for system, class, subclass and modifiers are required. Vegetation class and water regime modifiers are particularly important for functional assessment. Use the WVWRAM reference sheets and the detailed NWI definitions in this manual to ensure you have the correct code. The easiest workflow for assigning NWI wetland code is to first assign the System, which is typically P (Palustrine). Then assign the class (vegetation type). Common classes include FO (forested), SS (scrubshrub), EM (emergent), or AB (aquatic bed). Examine the vegetation to determine the subclass. Common subclasses are persistent, broad-leaved deciduous, or needle-leaved evergreen.

Excerpt from reference sheet showing the most commonly-used NWI system, class, and subclass:

System	P - Palustrine							
Class	RB – Rock Bottom	UB – Unconsolidated Bottom	AB – Aquatic Bed	US – Unconsolidated Shore	ML – Moss-Lichen	EM – Emergent	SS – Scrub-Shrub	FO – Forested
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	1 Moss 2 Lichen	1 Persistent 2 Nonpersistent 5 *Phragmites australis*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen

Occasionally vegetated lakeshores or vegetated riverine systems may be encountered, and the following NWI attributes may be used with subclasses and modifiers as needed: vegetated lacustrine littoral (L2AB…, L2US5…, L2em…) or vegetated riverine (R2AB…, R3AB…, R2US5…, R3US5…, R2EM…, R3EM…, R4SB7…).

After assigning the first 4 characters of the NWI wetland code, the soil should be sampled before assigning the NWI modifiers. NWI modifiers must be assigned for all sites. For water regime, use the nontidal column. Water regime is assigned after observing the vegetation and hydrology and sampling the soil. The soil contains important information, including organic matter, chroma and redoximorphic features, to help determine the frequency of saturation or inundation. Special modifiers must be added if they are present, beginning with the top category "b" (beaver) on the special modifiers list. List <u>only the topmost</u> applicable special modifier for each NWI wetland type. If no special modifiers apply to the site, leave this field blank.

Excerpt from reference sheet showing NWI modifiers, with WV modifiers circled:

MODIFIERS

In order to more adequately describe the wetland and deepwater habitats, one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy.

Water Regime			Special Modifiers	Water Chemistry		Soil
Nontidal	**Saltwater Tidal**	**Freshwater Tidal**		**Halinity/Salinity**	**pH Modifiers for Fresh Water**	
A Temporarily Flooded	L Subtidal	S Temporarily Flooded- Fresh Tidal	b Beaver	1 Hyperhaline / Hypersaline	a Acid	g Organic
B Seasonally Saturated	M Irregularly Exposed	Q Regularly Flooded-Fresh Tidal	d Partly Drained/Ditched	2 Euhaline / Eusaline	t Circumneutral	n Mineral
C Seasonally Flooded	N Regularly Flooded	R Seasonally Flooded-Fresh Tidal	f Farmed	3 Mixohaline / Mixosaline (Brackish)	i Alkaline	
D Continuously Saturated	P Irregularly Flooded	T Semipermanently Flooded-Fresh Tidal	m Managed	4 Polyhaline		
E Seasonally Flooded / Saturated		V Permanently Flooded-Fresh Tidal	h Diked/Impounded	5 Mesohaline		
F Semipermanently Flooded			r Artificial Substrate	6 Oligohaline		
G Intermittently Exposed			s Spoil	0 Fresh		
H Permanently Flooded			x Excavated			
J Intermittently Flooded						
K Artificially Flooded						

Water chemistry modifiers are added based on the "pH Modifiers for Fresh Water", using the field-sampled pH of the soil, with pH < 5.5 = "a" (acid), pH 5.5 – 7.4 = "t" (circumneutral), and pH > 7.4 = "i" (alkaline). In rare cases, salinity modifiers may be used. West Virginia does not use Halinity modifiers.

Soil modifiers "g" (organic) or "n" (mineral) are added after determining whether a histosol is present in the NWI wetland type. If organic material is present, but it does not meet the requirement for a histosol, then the soil is considered mineral. Note that the soils portion of the field form includes tips on assigning NWI Modifiers for pH and soil.

3.4 Page one: Special conservation concern

Certain wetlands are recognized as being of special conservation concern for their outstanding biodiversity value or threatened status (Adamus et al. 2010, Berglund and McEldowney 2008, and Mack 2001). Wetlands of Special Conservation Concern in West Virginia are identified by their calculated Site Biodiversity Rank, which is based on the quality and abundance of rare species populations and high-quality natural communities (WVDNR 2014, Faber-Langendoen et al 2009, Tomaino et al 2008, CONHP 2005, TNC 1991).

Surveying for rare species is not part of the rapid assessment protocol; however, if survey data have already been documented by the state, then they will be included in the GIS assessment. Certain types of wetlands are known to be rare or of particularly high conservation concern in the state. Detailed surveys are not necessary to recognize these wetlands; therefore, noting these wetland types is a required part of the rapid field assessment. These include old growth swamp, large bogs or fens, large patches of mature forested swamp, and Ridge & Valley summit sinkhole wetlands. Many of these have already been mapped by the state (WVDEP 2016). Definitions of these wetland types are:

Old Growth Swamp: Must meet all criteria for "Mature Forested Swamp" below, plus the wetland must be a remnant old-growth patch, with its older canopy trees >130 years old, i.e., stand dates to before the logging boom in WV 1880-1915. Site Biodiversity Rank = B3 minimum.

Large Bog or Fen: Wetland > 0.5 hectare (1.2 acres) in size with seasonally or permanently saturated organic soils covering at least 0.1 hectare (0.25 acre) or 10% of the wetland. Vegetation is herbaceous and generally characterized by extensive cover of mosses and sedges. Rainfall and groundwater are important water sources. This category includes both acidic bogs and fens, typically found in the mountain counties, and calcareous fens, found on marl deposits in the eastern panhandle. Site Biodiversity Rank = B4 minimum.

Mature Forested Swamp: Wetland > 0.5 hectare (1.2 acres) in size in which mean diameter of canopy trees (dbh of FACW and FAC species only) exceeds 30 cm (12 inches), and/or the average age of trees exceeds 80 years, and/or there are >5 trees/acre with diameter >50 cm (20 inches). The canopy must be dominated by one or more of the following trees: oak, ash, maple (red or silver), elm, sweetgum, birch, spruce, hemlock, fir, larch, pitch pine, or blackgum. Site Biodiversity Rank = B5 minimum.

Summit Sinkhole Wetland: Sandstone-over-karst acidic sinkhole wetlands on the summits of the Ridge & Valley (Pendleton, Hardy, Hampshire, Morgan, Berkeley Counties only). No size requirement. Site Biodiversity Rank = B5 minimum.

On the field form, check the first box that applies. For example, if "old-growth swamp" is checked, do not check any of the lower boxes. Write in the B-rank corresponding to the top-most box checked. Most sites will be ranked "none".

Example:

Special Conservation Concern *Check one(p32)*

__B5__ B-rank from topmost box in list below. Read definitions in manual!

- ☐ old-growth swamp (B3)
- ☐ large bog or fen (B4)
- ■ mature forested swamp (B5)
- ☐ summit sinkhole (Ridge&Valley only)(B5)
- ☐ no known special concern (none)

Comment __Pin oak swamp__

3.5 Page one: Perimeter and natural buffer

Buffers are vegetated areas adjacent to wetlands that can reduce impacts to these resources from adjacent land uses or disturbances through physical, chemical, and biological processes. Buffers also provide some of the terrestrial habitats necessary for wetland-dependent species that require both aquatic and terrestrial habitats. Buffer extent and condition is important for all wetland functions (Hruby 2103, McElfish et al. 2008). Metrics in this group are quantitative.

Prior to the field visit, buffers should be generated via GIS at 50m (164 ft) and 300m (984 ft) from the office-mapped AA boundary. If the office-mapped AA boundary is corrected in the field, then the GIS buffers must also be corrected in the field. The 50m buffer and 300m buffer maps must be printed on the air photo for use in the rapid field assessment.

Natural perimeter and buffers are defined in the "Buffers" table below.

Buffers: guidelines for identifying natural wetland buffers
(adapted from Collins et al. 2006, Faber-langendoen et al. 2016, Hruby 2012, Miller et al. 2001, Taylor and Knight 2003)

Natural buffer	Excluded from natural buffer
Natural upland habitats, open water, vegetated levees, old fields, naturally vegetated rights-of-way, hayfields, low-intensity hiking trails (used up to a few times a week but not daily), 2- or 3-strand fences that don't interfere with wildlife movement.	Industrial areas, residential developments, parking lots, agricultural cropland, grazed pastures, regularly mowed areas, orchards, commercial tree plantations, heavy timbering (>50% of mature trees) within last 5 years, roads (paved, gravel, dirt), railroads, bike trails, horse trails, intensively (daily) used hiking trails, bridges, hardened channels, culverts, fences that interfere with wildlife movement, areas accessible to dogs or other pets that can stress wildlife, highly compacted or disturbed soils (often found on reclaimed mine lands), large amounts of trash, intense human visitation or recreational impacts.

3.5.1 Natural perimeter

The ability of a buffer to protect a wetland increases with buffer extent along the wetland perimeter. For some kinds of stress, such as predation by feral pets or disruption of plant communities by cattle, small breaks in buffers may be adequate to nullify the benefits of an existing buffer. However, for most stressors, small breaks in buffers caused by such features as trails and small, unpaved roadways probably do not significantly disrupt the buffer functions (CWMW 2013, Faber-Langendoen et al. 2016).

On air photo, draw in the portion of the perimeter adjacent to undisturbed land. The AA perimeter must be walked in field to verify its condition. To qualify as part of the undisturbed perimeter, the undisturbed land segments must be at least 10 meters (33 feet) wide and extend along the perimeter of the wetland for at least 10 meters (33 feet). Open water is considered buffer. In the field as you are walking the perimeter, observe any disturbances in the immediate natural buffer (within view of the perimeter). Many disturbances may already be excluded from the natural buffer as sketched on the air photo. Within the natural buffer, note the following, which are not always discernible on an air photo: highly compacted or disturbed soils, large amounts of trash, intense human visitation or recreational impacts. If any of these are noted, exclude these portions from the buffer perimeter. See the "Buffers" table above for additional guidelines regarding what to include or exclude from natural buffer. Estimate the percent of natural perimeter and check the box for the appropriate category.

Example:

PERIMETER AND NATURAL BUFFER		
Natural perimeter *Check one*		
■ 100%	❑ 75-99%	❑ < 75%

3.5.2 50m buffer for water quality

Buffers reduce the inputs of non-point source contaminants, help to control erosion and runoff, and generally protect the wetland from human activities (Hruby 2013, McElfish et al. 2008). Farming, grazing, golf courses, residential areas, commercial land uses, urban areas, and developed areas in general, are major sources of pollutants (Sheldon et al. 2005). Tilled fields are a source of nutrients, pesticides, and sediment. Pastures are a source of nutrients and pathogenic bacteria, and clearcut areas are a source of sediment (Sheldon et al. 2005). A well-vegetated buffer of 50 meters (164 ft) will only remove 60-80% of some pollutants from surface runoff into a wetland. Consequently, polluting land uses within the 50 meter (164 feet) buffer are likely to be significant sources of pollution to the wetland (CWMW 2013, Hruby 2012, Faber-Landendoen et al. 2016, Miller et al 2017, WI GIS-RAM 2016, and Mack 2001).

On the air photo containing the 50m buffer line, sketch the parts of the 50m buffer that are currently in natural buffer land uses, using the same criteria as used in the "Buffers" table at the beginning of this section EXCEPT for certain fences that may interfere with wildlife movement, but do not impact water quality. From the sketch, estimate the undisturbed percentage of the buffer and check the box for the appropriate category.

Example:

50m (164') natural buffer for water quality *Check one*
❑ > 90%
■ 75-90%
❑ 50-75%
❑ < 50%

3.5.3 Contiguous 300m natural buffer for wildlife

A wider buffer has a greater capacity to serve as habitat for wetland edge-dependent species and species that require both wetlands and uplands to complete their life cycle (Adamus et al. 2010, CWMW 2013, Faber-Landendoen et al. 2016, and Berglund and McEldowney 2008). The habitat must touch the wetland and be accessible to wildlife species. Core habitat for many wildlife species, particularly birds and amphibians, extends to between 300-1000 meters (984-3280 ft) from the wetland edge. Plant biodiversity is correlated with natural buffer extents of 60-300 meters (196-984 ft) from the wetland edge (Hruby 2013, Wilson and Dorcas 2003, Sheldon et al 2005, Ervin 2009, Rooney et al. 2012, Houlahan et al. 2006, Rittenhouse and Semlitsch 2007, McElfish et al. 2008, Eigenbrod et al. 2008).

On air photo containing the 300 meter (984 feet) buffer line, sketch in the contiguous undisturbed land within a 300 meter (984 feet) buffer. To qualify as undisturbed buffer, the undisturbed land 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. Disturbances such as roads break the buffer, such that natural vegetation on the other side of a road does not count as buffer for this metric. Open water is considered natural buffer. See the "Buffers" table at the beginning of this section for additional guidelines regarding what to include or exclude from natural buffer. Estimate the percent cover and check the box for the appropriate category.

Example:

Contiguous 300m (984') natural wildlife buffer *Check one*		
❑ > 90%	■ 60-90%	❑ < 60%

3.6 Page one: Non-regulatory additional information

Wetlands are considered more valuable in terms of their functions when those functions are directly used or recognized by society. Indicators of high value to society include public ownership, less restrictive access policies, physical infrastructure such as parking or boardwalks, visibility from roads and trails, prior investment of funds for conservation or enhancement, inclusion in watershed planning, or a history of scientific monitoring (Adamus et al. 2010, Veselka and Anderson 2011). Metrics in this group are qualitative.

3.6.1 Ownership and public access

Ownership may be public or private. Some privately-owned wetlands, such as Cranesville Swamp, have permanent unrestricted access to the public. Other privately-owned wetlands may have public access on certain days, for certain events, or by prior arrangement with the landowner, e.g., school groups may arrange to visit Winfield Swamp on the Kanawha River.

Example:

Ownership/Access *Check one*

- ■ public, or private with permanent unrestricted access
- ❑ private, with seasonal, partial, or case-by-case access
- ❑ private, without public access

Comment *Monongahela National Forest*

3.6.2 Public or private investment

Prior investment of funds for preservation or restoration are one way that society places value on a wetland or wetland functions. Typical forms of investment are conservation easements and restoration sites. Examples of "other" types of investment that may be observed in the field include tree planting, invasive plant removal, fencing out of livestock, or culvert replacement.

Example:

Investment *Check one*

- ❑ compensatory mitigation site
- ❑ conservation easement
- ■ other conservation investment
- ❑ no known conservation investment

Comment *CRP site: cattle fenced out 2016*

3.6.3 Planning or scientific use

Watershed groups and government entities may include wetlands in their management plans for land and water resources. The plan must specifically include wetlands, either in terms of water quality and flood control benefits or in terms of habitat for native species. Sustained scientific use requires that plants, animals, or water in the wetland have been monitored for more than two years, unrelated to any regulatory requirements, and data are available to the public.

Example:

Planning or scientific use *Check all that apply*
■ water quality plan includes wetland
❑ habitat plan includes wetland
■ monitored > 2yrs, non-regulatory, data available to public
❑ no known planning or sustained scientific use
Comment Watershed Group has plan & 5 yrs data

3.6.4 Recreational infrastructure

Recreation infrastructure may include roads, trails, boardwalks, maintained parking, an informational kiosk or brochure, or boat access. Maintained roads must be within 30 meters (98 feet) of the wetland with views of the wetland, and maintained trails must be within 10 meters (33 feet) of the wetland.

Example:

Recreation Infrastructure *Check all that apply*
■ maintained parking
■ boardwalk
■ informational kiosk or brochure
❑ maintained road w/i 30m (100') with view
■ maintained trail
❑ boat access
❑ no infrastructure
Comment Parking for 10 vehicles

3.6.5 Other public use

Other public use includes:

- Wetland Viewshed: wetland is visible from public roads, public parking lots, public buildings, or public paved paths that adjoin or are within 100 meters (328 feet) of wetland.
- Evidence of regular non-consumptive use: birdwatching, walking, hiking, photography.
- Evidence of regular, potentially sustainable consumptive use: hunting, wild food gathering (blueberries, cranberries), collection of non-timber forest products.

Example:

Other Public Use *Check all that apply*
■ wetland visible from public area <100m (328')
■ evidence of non-consumptive use
❑ evidence of consumptive use
❑ no evidence of public use
Comment *Known birding hotspot*

3.7 Page one: Topography and structure

Metrics in this group are quantitative, and some of them are based on field-mapping.

3.7.1 Surface depressions

Surface depressions in a wetland that receives overland or overbank flow can trap sediments during a flood event (Hruby 2012, Adamus et al. 2010, Brinson 1993). Depressions in floodplain wetlands will tend to accumulate sediment and the pollutants associated with sediment (phosphorus and some toxins). Depressions reduce flood water velocities (Fennessey et al. 2004) while wetland vegetation takes up and stores phosphorus from nutrient-laden water (Reddy et al 1999). Wetlands where a larger part of the total area has depressions are relatively better at removing pollutants associated with sediments than those that have no such depressions. Nitrite removal is aided by upland/wetland contact (Adamus et al. 2010).

Estimate the percentage of the wetland that has depressions. Count only depressions that hold water for at least a week after a flood recedes. Look for deposition of fine or mucky sediments in the bottom of the depression. Some examples of features that are considered depressions include beaver ponds, swales, and the hollow portion of hummock-hollow microtopography. For ponds or impounded wetlands consider only the amount of water that can be retained after a heavy rain. Many impoundments are already full, with a spillway or water control device that passes water freely downstream. However, if the outlet is highly constricted then the impoundment may significantly delay water after a heavy rain. Check the box for the appropriate category.

Example:

Depressions *Check one*			
❑ none	❑ trace-10%	■ 10-33%	❑ >33%

3.7.2 Microtopographic complexity

Microtopography, or topographic variability on the scale of individual plants, describes soil surface variation within an elevation range from about 1 cm (0.4 in) to as much as 1 meter (3.3 feet) (Moser et al 2007). It encompasses both vertical relief and surface roughness, and for this assessment should include the soil surface and objects embedded in the soil such as boulders or spreading tree roots (but not tree trunks or standing vegetation).

Microtopographic complexity serves to slow and hold water during a flood event (Tweedy and Evans 2001, Mack 2001, Adamus et al. 2010, MI DNRE 2010). Surface roughness of floodplains is described in detail, with example photographs, in "Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Floodplains (Acremont and Schneider 1989). Microtopographic features create small-scale vertical relief that is important for chemical reactions, which tend to occur at the upland-wetland interface (Hruby 2012). Small-scale features such as hummocks, tussocks, and mounds provide wildlife habitat for amphibians, birds, and specialized plants (WVDNR 2015b).

Estimate the percentage of the wetland with complex microtopography, including animal burrows, mounds, hummocks, tussocks, exposed tree roots, boulders, debris deposits, upturned tree root wads, stumps, pit and mound structure, islands, natural levees, dry channels, pits, and wide soil cracks. Above-ground vegetation is considered elsewhere; do not include here. However, the exposed root mass or soil buildup around a tussock graminoid or multi-stemmed shrub is included in this metric. Coarse woody debris is recorded in the Structural Patches metric, but the portion of coarse woody debris that is in direct contact with the ground is included here.

Check the box for the appropriate category. In wetlands that lack a dense movement-inhibiting shrub layer, this metric can often be quickly estimated by considering the need to pay attention to balance while walking through the wetland. At < 3% microtopographic complexity, most surveyors can walk freely without looking at the ground. At 3-40% most surveyors must pay attention to their footing but can still move unhindered through the wetland. Above 40% most surveyors will need to slow down, pick their footing with care, and pay attention to balance.

Example:

Microtopographic complexity *Check one*		
❑ < 3%	■ 3-40%	❑ > 40%

3.7.3 Karst topography

Karst areas have a uniquely sensitive underground ecology and provide calcium-rich water to above-ground ecosystems. Karst systems lack natural filtering capacity and are vulnerable to pollution wherever they occur in the state (Gutiérrez et al. 2014). Wetlands in karst areas may buffer streams and caves that are particularly vulnerable to nutrient pollution. Water inputs to wetlands from limestone, dolomite, or marl deposits and contain elevated levels of calcium or magnesium. A rich and diverse flora and fauna are characteristic of calcareous wetlands (WVDNR 2015b). We have multiple ways to identify wetlands in karst areas (mapped geology, mapped soils, soil pH). The visual evidence of karst topography (springs, sinking streams, sinkholes, caves, and/or limestone/dolomite outcrops is one more way to capture this, particularly where soils or geology are not well mapped or pH is in the middle range, as sometimes occurs in WV. Perhaps because other states have more abundant calcareous substrates than West Virginia, the karst metric is not commonly used in rapid assessment by other states. It is, however, of clear importance in our state, as presented in the WV State Wildlife Action Plan (WVDNR 2015b). Check the appropriate boxes regarding observed evidence of karst topography.

Example:

Karst topography *Check all that apply*
■ limestone spring
❑ sinkhole
❑ sinking stream (not on mined land)
❑ isolated closed depression over limestone
■ limestone/dol outcrop
❑ cave adjacent
❑ no evidence of karst

3.7.4 Structural patch richness

Structural patch richness is a count of the number of different types of features that may provide habitat for plant or animal species. This metric is different from microtopographic complexity in that it addresses the number of different patch types. Structural patch richness is related to key wetland services including short- or long-term surface water storage, dissipation of energy, cycling of nutrients, retention of particulates, and maintenance of plant and animal communities (CWMW 2013, Mack 2001, Adamus et al 2010, Hruby 2012).

Each patch must cover at least 3 square meters (32 square feet). Smaller patches can be aggregated to reach the required area. Definitions of structural patches are given below.

> ***Open water patch***. For the structural patch checklist, an open water patch is defined as a patch of surface water open to the sky that is more than 1 square meter (11 square feet) in diameter but less than 0.1 acre (the size at which it would be mapped as a separate NWI wetland type). The water must be either unvegetated or with openings in the vegetation large enough for a flying bat to drink, at least 2.1 m (7 ft) long and 0.3 m (1 ft) wide. Even small patches of open water provide important drinking water sources for bats and other species. Patches must aggregate to at least 3 square meters (32 square feet) in area.
>
> ***Oxbows, secondary channels, swales.*** Cutoff channels or oxbows are inactive or less active parts of old channels that have been bypassed by the continued meandering of the current fluvial channel. These channels have bed and banks, but do not convey surface flow during normal flow levels. They often pond surface water or upwelling ground water, and provide important habitat and refugia for many species. Secondary channels may be dry for part of the year but carry water during flood flows. Swales are broad, elongated, vegetated, shallow depressions that can sometimes help to convey flood flows

to and from vegetated marsh plains or floodplains; however they lack obvious banks, regularly spaced deeps and shallows, or other characteristics of channels. Swales can entrap water after flood flows recede. They can act as localized recharge zones and they can sometimes receive emergent groundwater.

***Pools inaccessible to fish*.** For this protocol, a pool is defined as a shallow topographic basin more than 1 meter (3.3 feet) in diameter. Patches must aggregate to at least 3 square meters (32 square feet) in area. Pools should be inaccessible to fish for optimum amphibian breeding. Pools generally lack vegetation but exist within a well-vegetated wetland. Pools fill with water at least seasonally. They commonly serve as foraging sites for birds and as breeding sites for amphibians.

Springs or upwelling groundwater. Springs are areas where ground water intersects the land surface and emerges. Springs typically occur at breaks in slope (e.g. at the base of a slope) or along the banks of a fluvial channel, but they may also occur anywhere across the wetland surface where upwelling occurs.

Non-vegetated flats (mudflats, sandflats). A flat is a non-vegetated area of silt, clay, or sand adjacent to seasonal or perennial open water and is a potential resting and feeding area for birds or other species. In West Virginia, this habitat is especially important for spotted sandpipers and migrating shorebirds.

Animal mounds or burrows. Burrowing crayfish and some vertebrates make mounds or holes as part of their foraging, denning, predation, or other behaviors. The resulting soil disturbance helps to redistribute soil nutrients and influences plant species composition and abundance. To be considered a patch type there should be evidence that a population of burrowing animals has occupied the wetland. Mounds and burrows must, in aggregate, make up the required patch size of at least 3 square meters (32 square feet) in area.

Beaver dams or lodges. Beavers create dams or lodges across fluvial channels using sticks, logs, mud, and stones. The dams provide protection for the beavers and ready access to food. Dams also cause a backwater pond upstream of the dam, causing deposition of sediment and allowing infiltration of water.

Abundant deciduous leaf litter. Abundant deciduous tree and shrub leaf litter for foraging is a key habitat requirement for certain birds in WV, especially Swainson's Warbler and Rusty Blackbird. Leaf litter also provides habitat for salamanders and invertebrates (Fox et al. 2010, Bailey 2017). Leaf litter must be abundant, i.e., covering much of the ground surface, and with more than one leaf layer in thickness.

Plant hummocks or tussocks. Hummocks are mounds created by plants (often multi-stemmed shrubs or mosses), created by the collection of sediment and organic material around wetland plants, or created by freeze-thaw processes (typically seen in WV only at elevations above 3600 feet). Irregular or elongated hummocks can also be formed by surface roots of trees in a wetland. Hummocks are typically less than 1m high. Tussocks are grasses that grow in clumps, tufts, or bunches, rather than forming a sod or lawn. There is an extra checkbox for ***abundant*** **hummocks and tussocks (>25% cover of wetland).** Check both of the "hummocks or tussocks" boxes if these features cover more than 25% of the wetland.

Coarse woody debris*.** Coarse woody debris (CWD) is any dead woody fragment greater than 10 centimeters (4 inches) diameter and 91 centimeters (3 feet) long. CWD must be lying horizontally on the ground or be angled up from the ground at 45 degrees or less. There is an extra checkbox for ***abundant CWD **(>3% cover of wetland).** Check both of the "coarse woody debris" boxes if these features cover more than 3% of the wetland. Coarse woody debris provides important services and is an indicator of dynamic ecology. Bryophyte and fungal diversity are closely related to CWD availability (Kumar et al. 2016). It provides basking habitat for turtles, which use wood perches preferentially over rock substrates. CWD can be a source of food for invertebrates, and it increases overall topographic heterogeneity. It can be a refuge to hide from predators in a low-relief landscape.

Standing snags. Any standing, dead woody vegetation that is at least 137 centimeters (4.5 feet) tall with at least 7.6 centimeters (3 inches) diameter at breast height (dbh) is considered a snag. There is an extra checkbox for ***abundant*** **standing snags if there are 3 or more snags per acre with dbh > 25 centimeters (10 inches).** Check both of the "standing snags" boxes if these features cover meet the abundance criteria. If standing snags are leaning close to the ground, they can be separated from coarse woody debris by the angle of repose: more than 45 degrees is a snag, and an angle less than or equal to 45 degrees is considered coarse woody debris (USDA-FS 2016). Tall, woody vegetation, such as trees and tall shrubs, can take many years to fall to the ground after dying. These standing snags provide habitat for many species of birds and small mammals. Standing snags are of most value if they have exfoliating bark, crevices, cavities, or cracks. During summer, northern long-eared bats roost singly or in colonies in cavities, underneath bark, crevices, or hollows of both live and dead trees and snags, typically ≥ 7.6 centimeters (3 inches) dbh (USFWS 2014).

Upturned tree root wads (tip-up mounds) and pits. Windthrow contributes to natural tree fall in wetlands, especially where water tables are high and root systems are shallow. When the root system of a tree is upended, it creates a mound of earth and roots and an adjacent pit, which provides important microsites with varying moisture conditions, exposed mineral soil and decaying matter. These habitats benefit plant species (McAlister et al 2000) and provide habitat for fungi, invertebrates, amphibians, small mammals, and birds.

Check the appropriate boxes for any structural patches that are observed

Example:

Structural Patch Type. ≥ 3 m^2 (32 ft^2) patch unless otherwise specified. *Check all that apply*
■ Open water
❑ Oxbows, secondary channels, swales
❑ Pools inaccessible to fish
❑ Springs or upwelling groundwater
❑ Non-vegetated flats (mudflats, sandflats)
■ Animal mounds or burrows
❑ Beaver dams or lodges
❑ Abundant deciduous leaf litter
❑ Plant hummocks or tussocks
❑ Plant hummocks or tussocks > 25% cover of wetland (abundant)
■ Coarse woody debris at least 10 cm (4") diameter and 91 cm (36") long
❑ Coarse woody debris, abundant: > 3% cover of wetland
■ Standing snags at least 7.6 cm (3") diameter and 137 cm (4.5') tall
❑ Standing snags, abundant: ≥ 3/acre with dbh > 25 cm (10")
❑ Upturned tree root wads (tip-up mounds) and pits
Comment crayfish burrows, bark-on snags

3.8 Page two: Vegetation structure

Metrics in this group are both qualitative and quantitative.

3.8.1 Vegetation structure

Vegetation structure includes both the vertical structure, i.e., the number of strata present, and the horizontal interspersion of vegetation types. Structural components are drawn from the NWI attribute, which is based on vegetation classes classified by Cowardin et al. (1979). These are supplemented by field observations of strata (canopy, understory trees, shrub, herb, and bryophyte strata) and several size ranges within the emergent class of vegetation to address important bird habitats. Complex vegetation structure optimizes potential breeding areas, escape, cover, food production, and native species richness (CWMW 2013, Hruby et al. 2000, Hruby 2012, and Faber-Langendoen et al. 2016). It also provides surface roughness, which reduces flow velocities and increases the contact time between water and vegetation to support biogeochemical cycling functions and water quality services (USEPA 2002, Järvelä 2003).

For forested wetland areas, check the strata that have at least 5% cover of the forested wetland or occupy at least 0.1 acre.

Example:

VEGETATION STRUCTURE *(p.47)*

Skip if no PFO present. Forest structure. *Check all that apply*

Stratum covers ≥ 5% of PFOs or occupies ≥ 0.1 acre:

■ Canopy ❑ Understory ■ Shrub ■ Herb ❑ Moss

For forested wetlands, are all native canopy tree species with > 10% cover present in the sapling (shrub) strata? Do not count 1st year seedlings that have not yet survived a year of deer browse.

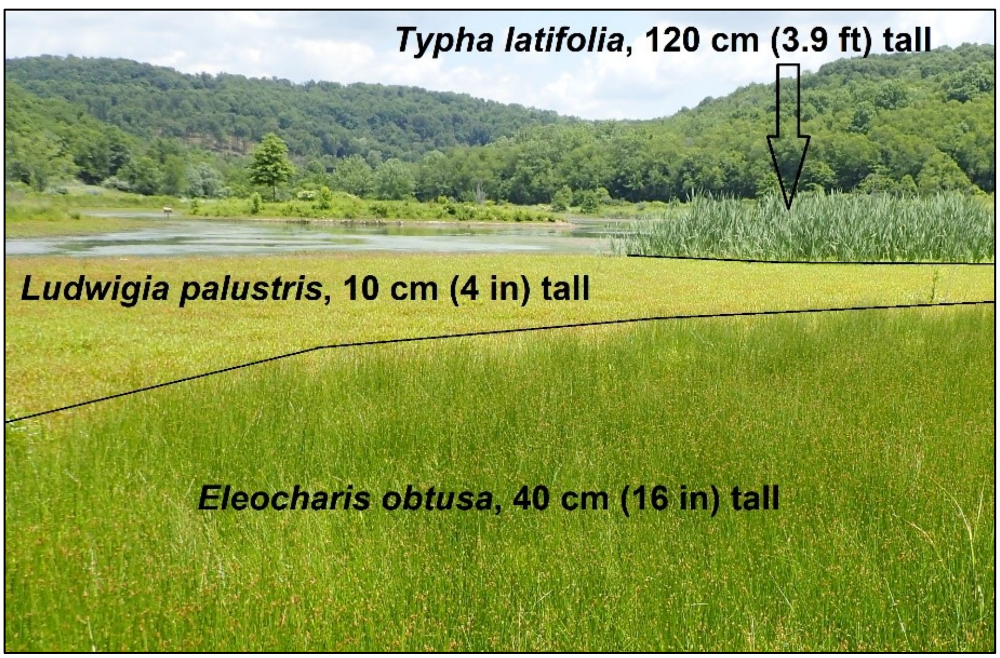
Example:

Skip if no PFO present. Forest regeneration. *Check one*

All native tree canopy species with >10% cover are present in the sapling layer.

■ Yes ❑ No

For emergent wetland areas, check the herbaceous height strata for stands of at least 0.1 acre. These should be clearly differentiated height classes. In the photograph below (Pleasant Creek, Barbour County), separate stands with three different height classes cover more than 0.1 acre each within the emergent wetland. If, however, all three species were mixed together, there would only be one height class (> 100 cm or 3.3 ft) represented by the tallest species in the mixed group, which would be cattail.



Example:

Skip if no PEM present. PEM canopy height(s). *Check all that apply*
Height stratum covers ≥ 5% of PEMs or occupies ≥ 0.1 acre:
■ < 30 cm (1 ft) ■ 30-100 cm (1-3.3 ft) ■ > 100 cm (3.3 ft)

Note whether tall graminoid marsh is one of the herbaceous strata. Tall marsh must have standing water at least seasonally, and must be dominated by cattails, bluejoint grass, or any species in the Cyperaceae family, including sedges, bulrushes, or spikerushes.

Example:

Tall (>100 cm) graminoid marsh *Check one*
Tall marsh with at least seasonal standing water and cattails, sedges, bluejoint grass, or bulrushes occupies ≥ 0.1 acre.
■ Yes ❑ No

3.8.2 Vegetated shorelines

Vegetation fringing the banks of open water, including lakes, reservoirs, ponds or streams, provides vertical structure to filter out pollutants or absorb them, enhancing sediment retention and stabilization, phosphorus retention, and nitrate removal (Adamus et al. 2010, Hruby 2012). Wetlands in which the average width of shoreline vegetation is large are more likely to retain sediment and toxic compounds than where shoreline vegetation is narrow (Adamus et al. 1991). Aquatic bed species that die back every year play a role in improving water quality. These plants take up nutrients in the spring and summer that would otherwise be available to stimulate algal blooms in the water body (Reynolds and Davies 2001). In addition, aquatic bed species change the chemistry of the lake/pond bottom to facilitate the binding of phosphorus (Moore et al. 1994). Vegetated shorelines provide physical protection from erosion, including shoreline anchoring and the dissipation of erosive forces (Adamus and others. 1991). Fringing wetlands that have extensive, persistent (especially woody) plants provide protection from overbank flows or waves associated with large storms (Adamus and others 1991). Deeply rooted shoreline vegetation is resistant to change and recovers quickly, improving the structural integrity of the shoreline and protecting against erosion (NY DEC 2010).

Observe the boundaries of the AA where it touches open water, including lakes, reservoirs, through-flowing perennial streams or ponds with an area of at least 0.1 acre. Is there a band of wetland vegetation at least 10 meters (33 ft) wide along at least 90% of the wetland-water boundary? Include aquatic vegetation growing in the water along the shoreline. For perennial streams, the shoreward edge of wetland vegetation must extend at least slightly below bankfull height to be considered as fringing.

Example:

Vegetation fringing open water *Check one (p.44)*
At least 90% of open water (lake, pond ≥ 0.1 acre, perennial stream)
boundaries are fringed by band of wetland vegetation ≥ 10 m (33 ft) wide.
■ Yes ❑ No ("no" includes sites not adjacent to open water)

3.8.3 Mowed or grazed vegetation

Persistent, ungrazed vegetation improves water quality by acting as a filter to trap sediment, nutrients, and pollutants. When vegetation is grazed or mowed to heights below 15 cm (6 inches), this function is reduced (Sheldon et al. 2005, Adamus et al. 1991, Adamus et al. 2010, Hruby 2012).

On the air photo, outline the portions of the AA covered by grazed pastures and vegetation that is regularly mowed to < 15 cm (6 in) height. Hayfields that are mowed a few times a year are not considered to be intensively mowed, since the vegetation exceeds 15 cm (6 in) height for much of the growing season. Estimate the percent cover and mark the appropriate box.

Example:

Mowed or grazed wetland			
Mowed < 15 cm (6") tall or livestock-grazed areas			
■ none	❑ trace - 33%	❑ 33-67%	❑ > 67%

3.9 Page two: Hydrology

Metrics in this group are both qualitative and quantitative.

3.9.1 Floodplain

Whether or not the wetland lies within an active floodplain has a profound impact on its ability to filter water and reduce overland or overbank flows (Brinson 1993, Brinson et al 1995). "Floodplain" and "Non-floodplain" wetlands are therefore assessed using different variables. For example, surface depressions are important in holding floodwaters in a wetland, and woody vegetation physically slows flood flows and associated debris. Non-floodplain wetlands, with slower-moving and often subsurface groundwater flows, have water quality functions that are more dependent on the presence of organic soils or the irregularity of the upland-wetland edge.

Observe the wetland, the water sources to the wetland, and the nearest stream. Does it appear that the wetland receives overland or overbank flow during a 100-year flood or more frequently? Are there major, active beaver influences in the wetland that result in water storage and overland or overbank flow during storms? Consider the primary and secondary indicators of hydrology as described in the 1987 wetland delineation manual and regional supplement (Environmental

Laboratory 1987, COE 2012), such as drainage patterns, drift lines, sediment deposition, watermarks, FEMA maps, and local soil survey hydrology data in making the determination.

Additional clues are often present in the soil profile. Wetlands in an active floodplain may be "problem soils" without clear hydric indicators if soils are deposited or eroded frequently. Some active, braided forested floodplains will contain leaves buried in layers with sediment in multiple sequences, although these may be less common when higher and lower gradient areas are near each other. These organic matter layers may meet "O" horizon (organic soil material) criteria as degrading material and could contain stratified layers or thin muck. Slackwater areas within the floodplain may accumulate organic matter within the soil and less commonly they may accumulate organic soil materials. Non-floodplain wetlands in disturbed or actively managed (agricultural) areas commonly do not accumulate organic soil materials. In forested or undisturbed non-floodplain settings, wetlands may accumulate organic soil material and generally have well-developed hydric indicators. In any of these situations, organic matter may enrich the mineral soil imparting a darker color and resulting in dark or black mineral "A", a mucky modified mineral horizon, or an "O" horizon.

At least 10% of the AA must be in an active floodplain or under beaver influence for it to be considered a floodplain wetland for the purposes of this protocol. All other wetlands are considered non-floodplain wetlands in WVWRAM. If it is not clear which category to mark, proceed to the "Connection to River Continuum" section and then return to this section after evaluating the position of the wetland relative to the active floodplain.

Example:

HYDROLOGY
Check one
■ Floodplain Wetland Unit (≥10% of wetland receives overland flow in 100-yr flood or more frequently, or major beaver influence in headwater wetlands)
❑ Non-floodplain Wetland Unit (may have stream associated with it but overland flow or beavers impact <10% of wetland)

3.9.2 Largest water source

Surface water sources and outlets are a basic input to the functional attributes (Tiner 2003, Tiner 2011) of a wetland, in particular Tiner's Wetland Landscape Position and Water Flow Path. These are used to determine headwater position and hydrologic connectivity. Tiner (2011) defines lotic headwater wetlands as "wetlands along first- and second-order perennial streams in hilly terrain including all intermittent streams above these perennial streams". Headwater wetlands are upstream of all aquatic habitats and provide important protection to these ecosystems, including sediment retention and stabilization, phosphorus retention, and nitrate removal and retention (USEPA 2015, Adamus et al. 2010, Hruby 2012, Savage and Baker 2007). Wetlands found in the headwaters of streams often do not generally store significant surface water; however, they can help to reduce peak flows by slowing and desynchronizing the initial peak flows from a storm (Brassard et al. 2000, Hruby 2012). In the words of Michael Davis, Deputy Assistant of the Army, to the U.S. Senate: "The most recent data and scientific literature indicate that isolated and headwater wetlands often play an ecological role that is as important as other types of wetlands in protecting water quality, reducing flood flows, and providing habitat for many species of fish and wildlife" (Davis 1997). The American Fisheries Society has documented the important role of headwater wetlands in providing ecological functions not only within headwater regions, but also in downstream rivers and lakes. Fishery functions of headwater wetlands include providing habitat for endemic and threatened fish species as well as supporting economically important fisheries, and providing native or threatened fish species with critical refuge habitat from invasive aquatic species (Colvin et al. 2019). The overall biodiversity of river networks is tied to the integrity of headwater streams and wetlands, which offer refuge to animal and plant species from temperature and flow extremes, competitors, predators, and introduced species. Headwaters also serve as a source of colonizing species, provide spawning sites and rearing areas, are a rich source of food, and provide migration corridors between watersheds (Meyer at al 2007).

Observe the largest surface water source or inlet to the AA and note its flow type. Permanently-flowing channels typically have a channel bed, banks, and ordinary high-water marks. Intermittent streams carry water only part of the year; they flow only when they receive water from rainfall runoff or wet weather springs (e.g., return flow of groundwater), or from some surface source such as melting snow. Ephemeral streams flow only in direct response to precipitation; they receive little or no water from springs, melting snow, or other sources; their channels are at all times above the water table; and the channel may be as indistinct as a vegetated swale or vegetation lying down in the direction of flow out of the wetland (USGS 2016).

After you have determined the flow type of the largest inlet, observe whether it is a 1st, 2nd, or 3+ order stream. Sometimes it will be necessary to check a topographic map to determine this.

Note whether the inlet is natural or altered/constructed. Altered or constructed inlets include culverts, ditches, weirs, or pipes.

Example:

Largest water source *Check one; note stream order if perm. flowing*

■ relatively permanently flowing and→ ■ 1st or 2nd ❑ 3+ order
❑ intermittent or ephemeral
❑ underground spring
❑ no visible inlet (dispersed groundwater and precipation only)
❑ bidirectional (no stream; water level follows lake level or river flood stage)

If largest water source is a surface stream: *Check one*

❑ natural ■ altered or constructed

Comment culvert

3.9.3 Largest outlet

Pollutants that are in the form of particulates (e.g., sediment, or phosphorus that is bound to sediment) will be retained in a wetland with no outlet. An outlet that flows only seasonally is usually better at trapping particulates than one that is flowing all the time because there is no chance for a downstream release of particulates for most of the year (Adamus et al. 1991). Outlet restrictions such as culverts or dams impact the hydrologic connectivity of the wetland (Hruby 2012, Adamus et al. 2010, Faber-Langendoen et al. 2016).

Observe the largest outlet from the AA and note its flow type. Permanently-flowing channels typically have a channel bed, banks, and ordinary high-water marks. Permanently flowing but highly constricted channels are typically small or heavily incised, narrow channels anchored in steep slopes; there may be rapids or evidence of erosion on the downgradient side of a highly constricted outlet, and there may be high water marks along the constricted area several feet above the normal water level. Intermittent streams carry water only part of the year; they flow only when they receive water from rainfall runoff or wet weather springs (e.g., return flow of groundwater), or from some surface source such as melting snow. Ephemeral streams flow only in direct response to precipitation; they receive little or no water from springs, melting snow, or other sources; their channels are at all times above the water table; and the channel may be as indistinct as a vegetated swale or vegetation lying down in the direction of flow out of the wetland (USGS 2016).

Note whether the outlet is natural or altered/constructed. Altered or constructed outlets include culverts, ditches, weirs, pipes, or spillways.

Example:

Largest outlet is... *Check one* *(p.47)*

❑ relatively permanently flowing

■ relatively permanently flowing but highly constricted

❑ intermittent or ephemeral

❑ no surface outlet (groundwater only)

If largest outlet is a surface stream: *Check one if applicable*

❑ natural ■ altered or constructed

Comment *undersized culvert*

3.9.4 Connection to the river continuum

Wetlands connected to the river continuum provide heightened water quality, flood attenuation, habitat, and ecological integrity functions to their watersheds (Vannote et al 1980, CWMW 2013, Faber-Langendoen et al. 2016, Berglund and McEldowney 2008, Miller et al 2017, Mack 2001, Brinson 1993). Wetlands are more likely to receive flood waters and the accompanying rich exchange of organisms and nutrients if they are well-connected to their historic floodplain (Junk et al 1989, Acreman and Holden 2013). The degree of stream channel entrenchment or incisement are important indicators of connection to the river continuum (Rosgen 1996, Montgomery and MacDonald 2002).

Floodplain wetlands that are strongly connected to streams have a high capacity to receive overbank flow and intercept floodwaters (Miller et al 2017). For riverine wetlands, hydrologic connectivity is assessed based on evidence of overbank flow between the stream and the wetland (USACE 2012), and observations of barriers to river flooding such as human-created levees and dikes, or impairments caused by rivershore rip-rap (Collins et al. 2006).

For "Overbank flooding and connection to the river continuum," mark the boxes for all features that are observed within the wetland. For the last criteria, the flood-prone width must be estimated. This section may be skipped if there is no stream nearby nor potentially connected. Some indicators of overbank flooding match hydrology indicators in the Corps wetland delineation manual (USACE 2012), including water marks, sediment deposits, drift deposits, moss trim lines, and drainage patterns.

Example:

Overbank flooding and connection to river continuum *Check all that are observed <u>within the wetland</u>. Skip if no stream nearby/potentially connected.*
❑ active beaver dam
❑ flood deposits (sediment deposits, debris, drift deposits, flood wrack)
❑ vegetation flattened and aligned along flow lines
❑ tree trunks with flood lines (water marks, silt coatings, staining, moss or lichen trim lines) or flood impact scars
❑ absence of leaf litter under deciduous trees as a result of flooding (not livestock impacts)
■ braided stream channels, backwater sloughs, backchannels, or other flood drainage patterns present
■ flood-prone area (inundated at 2 x maximum bankfull depth) overlaps at least 10% of wetland

For "Disconnection from the river continuum," mark the boxes for all features that are observed at the nearest stream. For the last two criteria, the entrenchment ratio and flood-prone width must be estimated. This section may be skipped if there is no stream nearby nor potentially connected.

Example:

Disconnection from river continuum *Check all that are observed at the <u>stream that controls the floodplain</u>. Skip if no stream potentially connected.*	
❑ physical barriers between wetland & stream (roads, railbeds, hardened levees)	*(pp.48-51)*
❑ artificial drainage of floodplain between wetland and stream (ditches, drains, grading of land to improve drainage)	
■ stream channel hardened (riprap, gabions, concrete)	
■ stream channel straightened and/or moved to toeslope (meanders eliminated)	
■ dam upstream significantly reduces flooding	
❑ land subsidence or significant streamflow reduction (sinking stream) in mined areas NOT on karst	
❑ stream channel banks are steep, eroding, have abundant bank slides or slumps, have < 50% cover of roots, or are unvegetated	
❑ stream is entrenched or moderately entrenched (Rosgen ER < 2.2 or Rosgen types A, F, G, B). Entrenchment is calculated as the flood-prone width divided by the bankfull width. Flood-prone width is measured at the elevation equal to twice the maximum bankfull depth. Maximum bankfull depth is the height of bankfull flow above the thalweg.	
❑ stream is incised; bank height ratio (BHR) > 1.5. Bank height ratio is calculated as the height of lowest bank divided by maximum bankful depth.	
❑ flood prone area (inundated at 2 x maximum bankfull depth) does not extend to more than 10% of wetland	

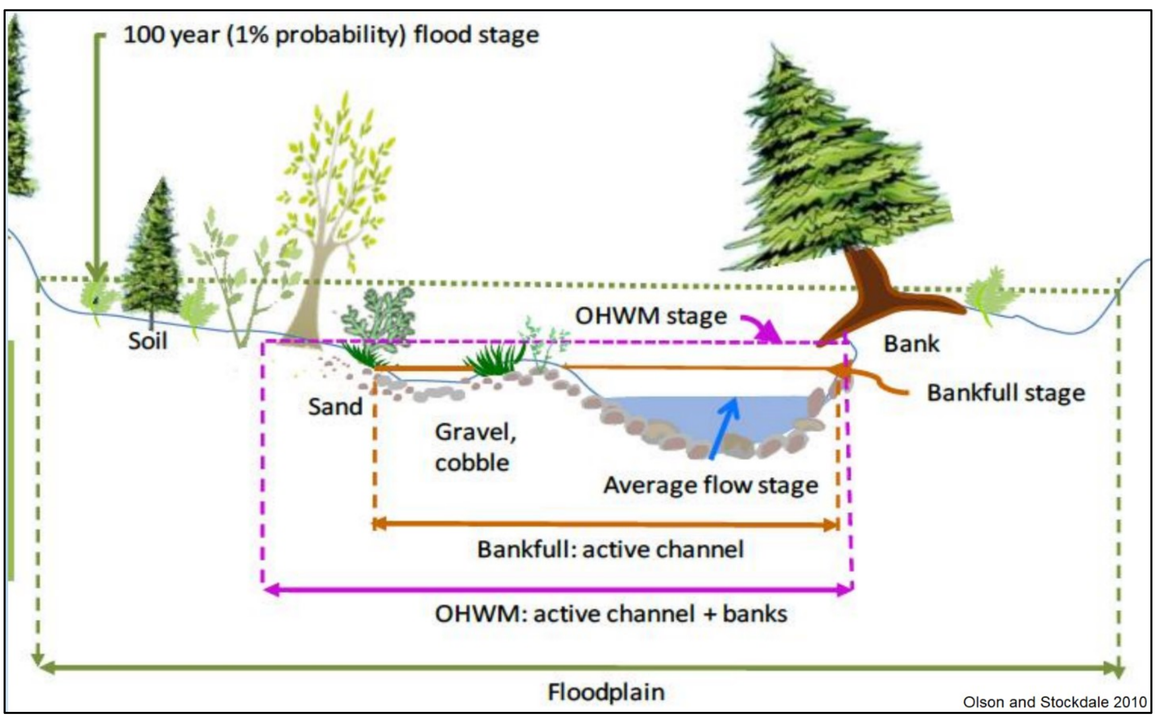
The degree of stream channel entrenchment is an important indicator of connection to the river continuum (Rosgen 1996, Montgomery and MacDonald 2002). Entrenchment is calculated as the flood-prone width divided by the bankfull width. The flood-prone width is measured at the elevation equal to twice the maximum bankfull depth. Maximum bankfull depth is the height of bankfull flow above the thalweg. Note that for entrenched streams, or streams with legacy sediments, bankfull elevation is often within the channel. Bankfull should be measured on a straight reach of the stream. It often coincides with the first slope break (the first gentle area of slope on the channel bank).

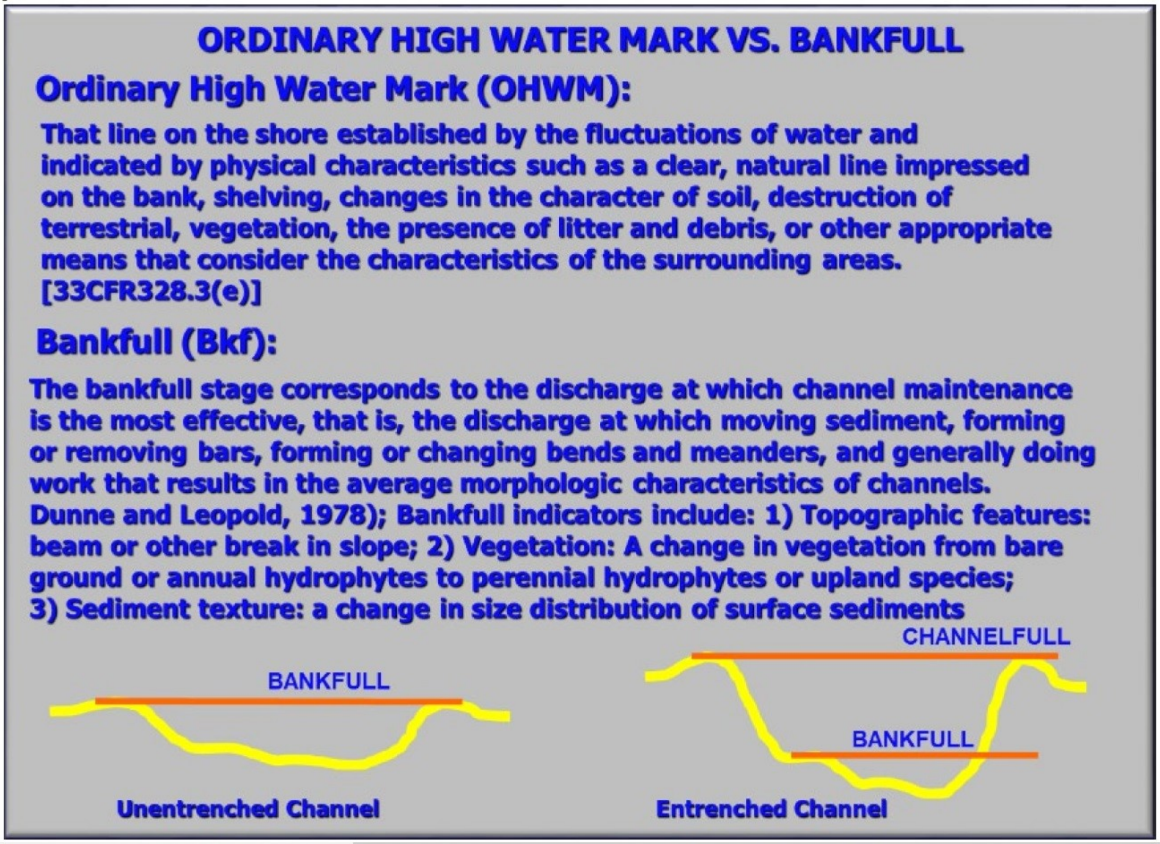
Example:

Worksheet for entrenchment, incisement, and flood-prone area measurements *(pp.54-56)*	
See user manual for diagrams and definitions. Any units may be used as long as they are consistent.	
maximum bankfull depth: 0.4 m	20 m / 3.0 m = 3.3 m (not entrenched)
2 x maximum bankfull depth: 0.8 m	flood-prone width / bankfull width = entrenchment ratio (ER)
bankfull width: 3.0 m	
flood-prone width (inundated at 2 x max bankfull depth): 20.0 m	
lowest bank height: 1.0 m	1.0 m / 0.8 m = 1.3 m (not incised)
	lowest bank height / maximum bankfull depth = bank height ratio (BHR)

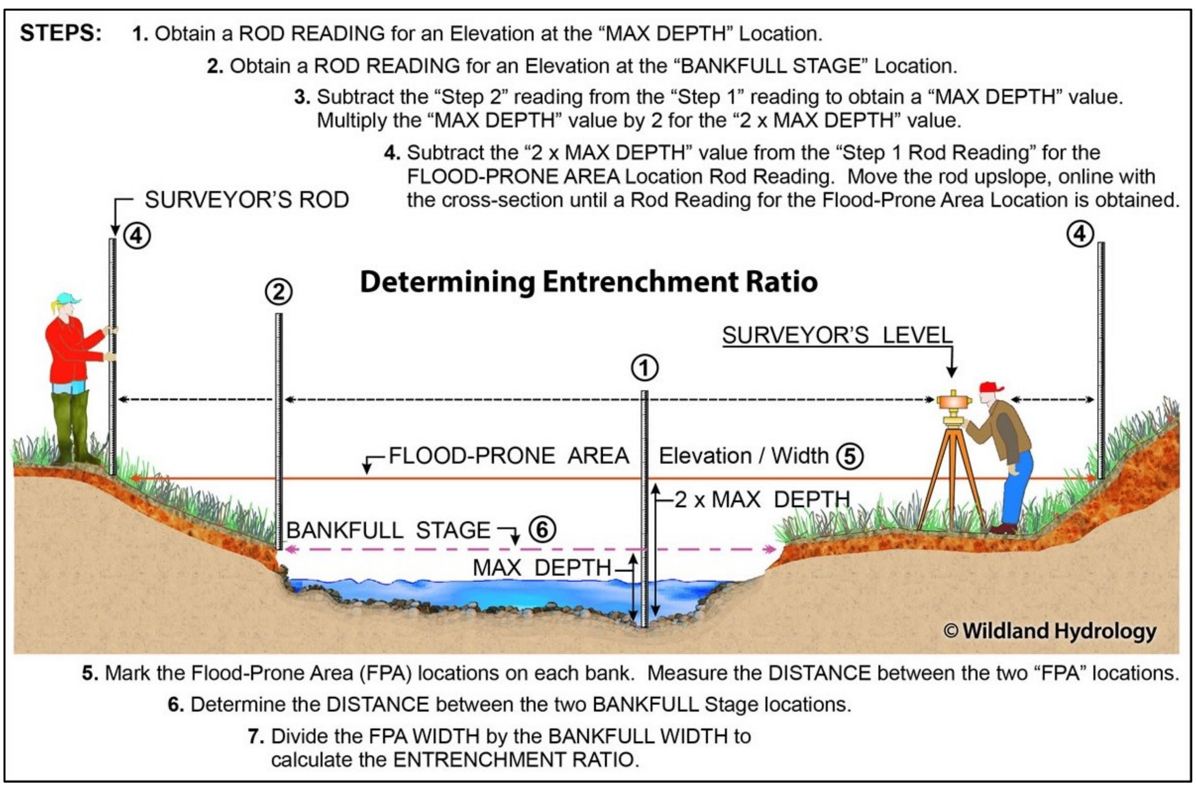
Entrenchment and incisement are measured using a measuring tape, pole, and clinometer/laser. Measurements of bankfull depth and width must be accurate within 10%, for example +/- 10 cm (4 in) for 1 meter (3.3 feet) bankfull depth, or +/- 1 meter (3.3 feet) for 10 meter (33 ft) channel width (Heitke et al. 2008).

Tips on identifying bankfull are given in the diagrams below.





Entrenchment is measured using the method in Rosgen (1996), shown in the diagram below.



3.10 Page three: Stressors

Stressors are highly useful in determining deviations from natural processes (CWMW 2013, Hruby 2012, Adamus et al. 2010, Faber-Langendoen et al. 2016, Mack 2001, and Veselka and Anderson 2011). Stressors may be grouped into hydrology, water quality, vegetation, and soils categories.

3.10.1 Hydrology stressors

Mark the circles for any stressors that are present, then review the total hydrologic disturbances and rank severity of impact by checking the appropriate box below.

Example:

Hydrology Stressors. *Check all that apply, then review total disturbance below. (p.57)*

- ○ Ditch
- ○ Tile or drain
- ○ Weir, spillway, standing pipe or water control structure
- ○ Impoundment impacting hydrology (excluding beaver dams)
- ○ Berm
- ● Road or impervious surface (paved and/or not at grade)
- ○ RR track
- ○ Undersized or perched culvert
- ○ Pump, spring box, water well
- ○ Filling/excavating/grading the land surface
- ○ Dredging of aquatic bed
- ○ Point source discharge
- ● Stormwater input
- ○ Agricultural runoff
- ○ Invasive vegetation concentrated along watercourses, with at least twice as much invasive cover as areas away from watercourses
- ○ Adjacent stream channel/riparian zone aggrading, with fresh splays of sediment, partially buried culverts, or bar formation
- ● More than 25% of the upland-wetland edge is abrupt and straight, not a gradual and complex transition zone > 3 meters (10 ft) wide
- ○ Wetland is in a floodplain but is disconnected or partially disconnected from the river continuum.
- ○ Other_______________________________

Review the total hydrologic disturbances above and rank severity of impact by checking one box below.

- ❑ Intact: Hydrologic regime is characterized by natural patterns, with no major hydrologic stressors present.
- ■ Mild on-going disturbance and/or past disturbance but now essentially recovered. For example, small ditches or diversions; berms or roads at/near grade; or minor flow additions.
- ❑ Moderate on-going disturbance and/or in the process of recovering from more severe disturbance in the past. For example, dams upstream or downstream moderately affect hydroperiod; ditches or diversions < 1 m (3.3 ft) deep; two lane roads; culverts adequate for base stream flow but not flood flow; or moderate flow additions. Outlets may be moderately constricted, but flow is still possible.
- ❑ Severe on-going disturbance. For example, dams upstream or downstream moderately to substantially affect hydroperiod; a 4-lane highway; diversions upstream or > 1 m (3.3 ft) deep that withdraw a significant portion of flow; large amounts of fill or excavation; significant artificial groundwater pumping; or heavy flow additions. Outlets may be substantially constricted, blocking most flow.
- ❑ Hydrology is entirely artificial; no natural inflows. E.g., a water treatment wetland constructed below the outflow from a wastewater treatment plant.

3.10.2 Water quality stressors

Mark the boxes for any water quality stressors that are present. You may optionally circle the stressors seen.

Example:

Water Quality Stressors. *Check all that apply.*

❑ No water quality stressors observed.

■ Discharges to the wetland: stormwater discharges, livestock or agricultural runoff, straight pipes, drainage ditches, industrial discharges, oil slicks, sediment plumes, algal mats, odors, adjacent spoil piles, leaking silt fences, road salt, ROW herbicide, or erosion on the upland edges.

❑ Contiguous water body has algal bloom, power boat use, or other observable impairment.

❑ Other ______________________________________

3.10.3 Vegetation removal or alteration

Mark the box that best describes vegetation stresses in the wetland.

- Minimal or no stress. Minimal or no signs of anthropogenic vegetation removal or alteration OR impacts occurred in the past (typically > 80 years ago) and the wetland appears to have recovered to near-natural conditions. Most West Virginia wetlands are forested in the absence of vegetation stress. Within our minimally disturbed forested wetlands, there are often areas kept open naturally by beaver along small streams. Minimal or no stress typically refers to mature forested wetlands with vertical structure including shrubs and herbaceous cover, undisturbed peatland vegetation, and beaver systems composed of small ponds, emergent, and shrub areas.
- Moderate. Vegetation removal or alteration is on-going and has a moderate impact in terms of either severity or extent OR impacts occurred in the past and the wetland is still in the process of recovering. The most common category of vegetation stress is moderate. This category includes successional swamps and many open wetlands. Successional swamps are dominated by early-successional tree species such as black willow (*Salix nigra*) or box elder (*Acer negundo*), by young trees of any species, by trees with no shrub or herb layer, or by shrub species. Many shrub swamps and emergent swamps in West Virginia are recovering from past disturbances. Whenever the vegetation is NOT mature forested swamp, surveyors must consider the land use history, hydrology and beaver presence in determining whether vegetation is kept open by natural processes or whether it is recovering from past disturbance. The presence of man-made berms, impoundments, stream channelization, or drainage structures are indicators that vegetation has likely been stressed in the past.
- Severe. More than half of wetland is impacted by regular mowing, clearing, grazing, timbering, farming, dredging of aquatic bed, herbicide/pesticide/fertilizer application, burning, excessive herbivory (livestock, deer, grass carp in aquatic beds) or other form of on-going vegetation removal or alteration. Surveyors are encouraged to add a comment describing the particular stress.

  Example:

Vegetation Removal or Alteration. *Check one box that best describes the wetland.*

❑ Minimal or no signs of anthropogenic vegetation removal or alteration OR impacts occurred in the past (typically > 80 years ago) and the wetland appears to have recovered to near-natural conditions. Examples: mature forested swamps, undisturbed beaver systems, undisturbed peatlands.

■ Moderate. Vegetation removal or alteration is on-going and has a moderate impact in terms of either severity or extent OR impacts occurred in the past and the wetland is still in the process of recovering. Examples: successional swamps (black willow, box elder), young/unstructured swamps, many shrub/emergent.

❑ Severe. More than half of wetland is impacted by regular mowing, clearing, grazing, timbering, farming, dredging of aquatic bed, herbicide/pesticide/fertilizer application, burning, excessive herbivory or other form of on-going vegetation removal or alteration. Comment______________________

3.10.4 Soil stressors

Mark the circles for any stressors that are present, then review the total soil disturbances and rank severity of impact by checking the appropriate box below. Examples for severity of impact are described below.

- Intact: no anthropogenic disturbance.
- Small to moderate stress to soil profile. On-going stressors affect < 10% of wetland OR impacts occurred in the past and the soil profile has largely recovered. Depth of disturbance typically < 10 cm (4"); ponding/channeling of water in disturbed areas has little or no impact on overall site hydrology. Examples: vehicle tracks cross < 10% of wetland without impacting hydrology, light seasonal grazing, walking trails traverse wetland, fill or grading occurs in < 10% of wetland and does not impact hydrology.
- Substantial stress to soil profile with extensive and long-lasting impacts; depth of disturbance > 10 cm (4"), may cause significant ponding or channeling of water that alters hydrology and vegetation. Examples: strip mines, heavily grazed areas, row crops, filled or graded landscapes, and areas with heavy vehicle use.

Example:

Soil Stressors. *Check all that apply, then review total disturbance below.*

● Livestock (trampling, pugging, compaction, or heavy grazing that leads to erosion)
● Machinery (plowing, filling, grading, dredging, compaction)
❍ ATV or vehicles (ruts, compaction, other disturbance)
❍ Removal of soil (mining, excavation)
❍ Replacement of soil with waste or fill (mining spoil, landfill)
❍ Other trampling or soil compaction
❍ Other erosion, sedimentation, or stressor. Comment ______________________________

Review the total soil disturbances above and rank severity of impact by checking one box below.

❑ Intact: no anthropogenic disturbance.
■ Small to moderate stress to soil profile. On-going stressors affect < 10% of wetland OR impacts occurred in the past and the soil profile has largely recovered. Depth of disturbance typically < 10 cm (4"); ponding/channeling of water in disturbed areas has little or no impact on overall site hydrology.
❑ Substantial stress to soil profile with extensive and long-lasting impacts; depth of disturbance > 10 cm (4"), may cause significant ponding or channeling of water that alters hydrology and vegetation.

3.11 Page four: Soils

At the top of the Soils field form, the NWI wetland type code must be filled out. Examination of the wetland soil is essential to correctly determine the water regime, pH, and soil modifiers to the NWI wetland code. Refer to the NWI Code Reference Sheets while filling out this page.

Assign the NWI System, Class, and Subclass based on observed vegetation (e.g., PEM1). Then sample the soil and assign the Water Regime (PEM1**B**), pH (PEM1B**a**), and soil organic/mineral (Pem1Ba**n**) modifiers. Add Special Modifers (PEM1B**b**an) if present.

At least one soil sample must be located in each non-permanently ponded vegetation type of the AA. In addition, at least one soil sample must be observed and recorded for every 10 acres of wetland sampled. Count the number of NWI wetland types in the AA that are NOT permanently ponded. Place a soil sampling location near the center of each of these wetland types. If a particular NWI type is larger than 10 acres, then add soil samples until there is at least one sample for every 10 acres. Mark the location of the soil samples on the air photo. Each soil sampling location will be excavated to at least 40 cm (16 in) depth and if deep organic material is encountered, up to 80 cm (32 in) depth. Measurements include determination of (a) pH reading at 10 cm (4 in) depth (b) presence of at least 2 cm (0.8 in) organic material in the upper 0-8 cm (0-3 in) of the soil profile, (c) total depth of surficial organic material, and (d) deep organic soils at up to 80 cm (32 in) depth. Soil sampling may be done using either a soil pit or an auger hole. All soil holes should be backfilled before leaving the site. Additional soils pages may be needed for wetlands with more than 4 NWI types.

Example:

WV Wetland Rapid Assessment Datasheet - Soils Page 4

Site name *Queens mitigation* Date *Sept 7, 2018*

NWI Wetland Types *Refer to NWI code sheets. List all NWI codes present in assessment area; minimum 1 soil sample per each NWI code; minimum 1 soil sample per each 10 acres; NWI codes may be sampled more than once.*
Assign System, Class, and Subclass of the NWI code based on vegetation (ex. PEM1). Then sample soil and assign Water Regime, pH, and Soil organic/mineral modifiers. Add Special modifiers if present (ex. PEM1Abtn). *(p.33,59,91, Reference Sheets)*

NWI Wetland Type Code (refer to NWI Codes diagram): NWI System & Class	Sub-class	Wat. reg.	Spe-cial	pH	Soil	Sampled	Not sampled (permanently ponded)	Soil notes — Optional notes on soil profile or soil features.
Examp. *PEM*	*1*	*B*	*d*	*t*	*n*	■	❑	*Example 0-5cm sapric, 5-15cm mucky mod min, 15-30+cm silt loam 25% redox conc*
1. *PSS*	*1*	*B*		*t*	*n*	■	❑	*0-12 cm 7-5YR 4/2; 12-20cm redox conc 5%*
2. *PUB*	*3*	*H*	*b*			❑	■	*beaver pond, silt/muck bottom*

3.11.1 NWI water regime

Water regime is assigned after observing the vegetation and hydrology and sampling the soil. The soil contains important information, including organic matter, chroma and redoximorphic features, to help determine the frequency of saturation or inundation.

In West Virginia, all non-tidal water regime modifiers are used. West Virginia does not use saltwater tidal or freshwater tidal water regime modifiers. Read the definitions carefully and use all available information (vegetation, soils, hydrology) to select the water regime that best fits the site. The most common water regimes in West Virginia are temporarily flooded (the driest wetlands) and seasonally saturated, although all types of non-tidal water regimes occur.

Temporarily Flooded (A) 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 the most of the season.

Seasonally Saturated (B). 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.

Seasonally Flooded (C). 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.

Continuously Saturated (D) 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.

Seasonally Flooded-Saturated (E) 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.

Semipermanently Flooded (F). 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.

Intermittently Exposed (G) Water covers the substrate throughout the year except in years of extreme drought.

Permanently Flooded (H) Water covers the substrate throughout the year in all years.

Intermittently Flooded (J) 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 Water Regime may change as soil moisture conditions change. Some areas exhibiting this Water Regime do not fall within our definition of wetland because they do not have hydric soils or support hydrophytes. This Water Regime is generally limited to the arid West.

Artificially Flooded (K) 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 Water 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 pasturelands supplied by diversion ditches or artesian wells, are included under this Modifier. The Artificially Flooded Water Regime Modifier should not be used in the Riverine system or for impoundments or excavated wetlands unless both water inputs and outputs are controlled to achieve a specific depth and duration of flooding.

3.11.2 Special modifiers

Special modifiers must be added if they are present, beginning with the top category “b” (beaver) on the special modifiers list. Choose the first one (if any) from the list that applies. Do not list more than one special modifier.

Beaver (b). These wetlands have been created or modified by beaver (Castor canadensis). Dam building by beaver may increase the size of existing wetlands or create small impoundments that are easily identified on aerial imagery. Such flooding frequently creates Dead Forested or Dead Scrub-Shrub Wetland initially, followed in a few years by Aquatic Bed and Emergent Wetland.

Partly Drained/Ditched (d). A partly drained wetland has been altered hydrologically, but soil moisture is still sufficient to support hydrophytes. Drained areas that can no longer support hydrophytes are not considered wetland. This Modifier is also used to identify wetlands containing, or connected to, ditches. The Partly Drained/Ditched Modifier can be applied even if the ditches are too small to delineate. The Excavated Modifier should be used to identify ditches that are large enough to delineate as separate features; however, the Partly Drained/Ditched Modifier also should be applied to the wetland area affected by the ditching.

Farmed (f). Farmed wetlands occur where the soil surface has been mechanically or physically altered for production of crops, but where hydrophytes would become reestablished if the farming were discontinued. Farmed wetlands should be classified as Palustrine-Farmed. Cultivated cranberry bogs may be classified Palustrine-Farmed or Palustrine Scrub-Shrub Wetland-Farmed.

Managed (m). This modifier is used to identify wetlands where water inputs are controlled to achieve a specific water regime or habitat type, usually for waterfowl management. Water control structures in combination with dikes and impoundments are common; however, this modifier should not be used in conjunction with the Artificially Flooded regime nor used to describe reservoirs nor for use in the Riverine system.

Excavated (x). This Modifier is used to identify wetland basins or channels that were excavated by humans.

Diked/Impounded (h). These wetlands have been created or modified by a man-made barrier or dam that obstructs the inflow or outflow of water.

Artificial Substrate (r). This Modifier describes concrete-lined drainage ways, as well as Rock Bottom, Unconsolidated Bottom, Rocky Shore and Unconsolidated Shore where the substrate material has been emplaced by humans. Jetties and breakwaters are examples of Artificial Rocky Shores.

Spoil (s).The Spoil Modifier is used to describe wetlands where deposition of spoil material forms the primary substrate type. By definition, spoil is material that has been excavated and emplaced by humans. Ancillary data may be needed to identify spoil in areas such as reclaimed strip mines that have become vegetated.

3.11.3 Soil pH

Soil pH is a key element in classifying the NWI wetland type. Soil pH has a strong impact on the plant and animal life that lives in a wetland. It also has a strong impact on the ability of the wetland to filter and absorb certain nutrients and pollutants. Soil pH is a clue to identifying wetlands impacted by acid or alkaline mine drainage. Soil pH is measured at 10 centimeters (4 inches) depth in order to maximize the correlation with the plant root zone and to provide compatibility with existing pH measurements from 1,667 palustrine wetlands in West Virginia.

pH thresholds for the NWI water chemistry modifier are as follows:

> ***Acid*** (a): pH <5.5
> ***Circumneutral*** (t): pH range 5.5-7.4
> ***Alkaline*** (i): pH >7.4

Record the pH value of soil at 10 cm (4 in) below the surface at each sampling location.

Example:

Soil pH	*pH value of soil at 10 cm (4") below the surface (p.63)*				
Soil sampling site #					*Add pH modifier to NWI code at top of page:*
Ex.	1	2	3	4	*pH < 5.5 = acid (a)*
5.7	6.3	___	6.8	___	*pH 5.5-7.4 = circumneutral (t)*
					pH > 7.4 = alkaline (i)

3.11.4 Organic material near surface

Organic material near the soil surface is a good indicator that a wetland can remove a wide range of nutrients and pollutants from surface and ground water. Denitrification is high in all soils with anaerobic conditions. Occurrence of redoximorphic features and/or accumulation of organic matter in the soil surface horizon is usually indicative of anaerobic conditions caused by saturated soil conditions. Soils mapped by NRCS are the best published source of information on organic soils; however, many of the smaller wetland soil areas in West Virginia have not been mapped by NRCS. Small areas of hydric soils, e.g. hydric soil inclusions, are often recognized in the soil survey as minor components of mapped soils. Therefore, field assessment of critical soil properties is required. The top 8 cm (3 in) of the soil profile is where the soil is likely to have maximum alternating wet and dry contact with nutrients or pollutants, and where many of the chemical and biological reactions occur (Hruby 2012). Soils must be outside the area of permanent ponding.

Organic soils can be recognized by their light weight (low bulk density) and the presence of partly decomposed plant material. Textures that qualify as having adequate organic content for this metric include peat, mucky peat, muck, and mucky modified mineral soil. NRCS Soil Survey data that show organic horizons (Oa, Oe, Oi) are good indicators that organic material may be present at the site.

Refer to the WVWRAM reference sheet "Field Test for Determining Organic Matter". Use the tests for moist soil color, air-dry soil color, rubbed fiber content, soil strength, and gritty feel. Informal tips on identifying organic material also include dark color (chroma 2 or less on Munsell chart), although fibrous organic material (Oi or Oe horizon) may not be dark-colored. Organic material tends to stain your hands and does not wash off as easily as mineral soil. After 3 rubs, organic material generally still feels greasy, oily, or "snotty".

Remove the litter layer, which consists of recent dead plant material that lies on the surface of the soil. Litter is undecomposed or partly decomposed but still readily identifiable as leaves, stems, small twigs, or other plant material. Litter is typically less than one year old.

Dig a small hole and collect a sample from the top 8 centimeters (3 inches) below the surface. Determine whether at least 2 cm (0.8 in) depth of organic material is present.

Example:

3.11.6 Total depth of surficial organic material

This metric is required for condition and restoration monitoring, but it is <u>not required for impact assessment</u>. Record the total depth of organic and/or mucky modified mineral soil. Be sure to mark the units of measurement (cm or inches). Choose the soil sample with the deepest organic material and add a brief description of it. Is it peat (fibric), mucky peat (hemic), muck (sapric) or mucky modified mineral soil, and what is the depth of each type?

Example:

ORGANIC MATERIAL

2 cm (0.8") Organic Material Near Surface *Remove duff layer. Collect sample from top 8 cm (3") of soil profile. Refer to <u>Organic Soils</u> reference sheet.*
Peat, mucky peat, muck, or mucky modified mineral soil in top 8 cm (3") below the soil surface. *(p.63 & Reference Sheet)*

Soil sampling site #

1	2	3	4	
■	■	□	□	Present: at least 2 cm (0.8") thick organic layer or mucky modified mineral layer
□	□	■	□	Not present

3.11.5 Deep organic soil

Deep organic soils provide important habitat to specialist plants and animals, including bog and fen species (WVDNR 2015b). Peatlands are the most vulnerable of all freshwater habitats for threatened dragonfly and damselfly species in the northeastern USA (White et al. 2014). Wetlands with deep organic soils store more carbon per hectare than any other terrestrial ecosystem type (Amthor et al. 1998). Peatlands are considered Wetlands of Special Conservation Concern in West Virginia. The larger peatlands have been mapped and are included in the

Exemplary Wetlands database (WVDEP 2019). Some smaller peatlands have not been mapped and therefore field assessment must include a metric for deep organic soil. Ohio (Mack 2001) also considers peatlands as wetlands of special conservation concern.

At each soil sampling location, determine whether histosols or histic epipedons are present. Excavate each soil hole to a depth of 40 cm (16 in). If peat, muck, or mucky peat begins within this depth, continue excavation to a depth of 80 cm (32 in) to determine if a histosol is present. Histosols and histic epipedons are defined as follows (NRCS 2014, NRCS 2018):

Histosol (Field Indicator of Hydric Soil = A1). Peat, mucky peat, or muck soil with at least 12-18% organic matter by weight and ≥ 40 cm (16 in) thick within the upper 80 cm (32 in) of soil profile; note that the 40 cm (16 in) of organic matter is cumulative and can occur anywhere in the top 80 cm (32 in), even in stratified layering; alternatively, organic soil material of any thickness resting on rock or on fragmental material having interstices filled with organic materials.

Histic epipedon (Field Indicator of Hydric Soil = A2). Peat, mucky peat, or muck soil with at least 12-18% organic matter by weight and greater than or equal to 20 cm (8 in) thick, but < 40 cm (16 in) thick, as a surface horizon. Aquic conditions or artificial drainage is required.

Soil modifiers "g" (organic) or "n" (mineral) are added after determining whether a histosol is present in the NWI wetland type. If organic material is present, but it does not meet the requirement for a histosol, then the soil is considered mineral.

Organic soil (g). In general "a soil is classified as an organic soil (Histosols) if more than half of the upper 80 cm (32 inches) of the soil is organic or if organic soil material of any thickness rests on rock or on fragmental material having interstices filled with organic matter." Organic soil material is soil material that contains at least 12-18 percent organic carbon by weight, the required amount depending on the clay content in the mineral fraction (Soil Survey Staff 1999).

Mineral soil (n). Soil composed of predominantly mineral rather than organic materials, i.e., it does not meet the criteria above for organic soil.

Example:

Deep Organic Soil. *Excavate each soil hole to either 40 cm (16") depth of organic soil, or 80 cm (32") total soil depth, whichever comes first.*
Histosol : Peat, mucky peat, or muck soil with at least 12-18% organic matter by weight and >= 40 cm (16") deep within the upper 80 cm (32") of soil profile.
Histic epipedon : Peat, mucky peat, or muck soil with at least 12-18% organic matter by weight and >= 20 cm (8") thick, but < 40 cm (16") thick, as a surface horizon. Aquic conditions or artificial drainage is required. Note that mucky modified mineral soil is NOT included in this section. (p.64)

Soil sampling site #					Add Soil modifier to NWI code at top of page:
1	2	3	4		*organic (g)*
☐	☐	☐	☐	Histosol present; NWI soil modifier = organic (g)	*mineral (n)*
☐	☐	☐	☐	Histic epipedon present, but no histosol; NWI soil modifier = mineral (n)	
■	☐	☐	■	Neither histosol nor histic epipedon present; NWI soil modifier = mineral (n)	

3.12 Pages five & six: Rapid floristic quality assessment

Metrics in this group are both qualitative and quantitative.

Floristic quality assessment (FQA) evaluates the ecological condition and integrity of natural habitats based on the plant species that grow in them. Each species is characterized by a Coefficient of Conservatism (CoC) based on its tolerance of disturbance and its fidelity to intact natural habitats (Swink and Wilhelm 1994, Wilhelm and Masters 1999). CoC values have been assigned to all species in the West Virginia flora (Rentch and Anderson 2006, WVDNR 2015a). The assemblages of plant species present in a wetland reflects the potential number of niches available for invertebrates, birds, and mammals (Bourdaghs 2014, Hruby et al. 2000, Knops et al. 1999). Plant biodiversity affects fundamental ecosystem processes such as nutrient dynamics, autotrophic production, susceptibility to invasive species and fungal disease, richness and structure of insect communities, and the overall integrity and functioning of ecosystems (Knops et al. 1999, Fennessy et al. 1998). Excessive nutrients, particularly total P and NO_3-NO_2-N, have been significantly correlated with lower floristic quality (Fennessy et al. 1998).

Floristic quality assessment in its original design requires a high degree of botanical skill and effort, and has not generally been included in rapid field assessment methodologies. However, new studies in Minnesota, Pennsylvania, and Oklahoma indicate that FQA can be successfully adapted to the constraints of rapid field assessment (Spyreas 2016, Bourdaghs 2014, Chamberlain and Brooks 2016). A significant limitation of the Rapid FQA method is that is does not account for species richness. Therefore, only the "cover-weighted mean CoC" (wmC) value, which does not depend on species richness, is measured. Bourdaghs (2014) and Spyreas (2016) have correlated wmC with wetland condition independent of wetland size.

Recording only the small number of dominant species greatly decreases the botanical knowledge and time investment required to conduct floristic quality assessment. The level of botanical skill required to perform Rapid FQA using the dominant species approach is the same as that required for wetland delineation.

The Rapid FQA species checklist is organized by growth form/strata that follow the USFWS (Dahl et al. 2015) definitions:

- Tree Stratum – Woody plants which at maturity are usually 6 meters (20 feet) or more in height and generally have a single trunk, unbranched for 1 meter (3.3 feet) or more above the ground, and a more or less definite crown.
- Shrub Stratum – Woody plants that, at maturity, are usually less than 6 meters (20 feet) tall and generally exhibit several erect, spreading, or prostrate stems.
- Vine Stratum – all vines
- Herb Stratum – Plants with no persistent woody tissue (stems and branches) above ground. Most species die back at the end of the growing season. The herb stratum is further divided into ferns, forbs, and graminoids on the WVWRAM datasheet.

- Aquatic Stratum – true aquatic plants that are submergent or have floating leaves
- Non-vascular Stratum – mosses, liverworts, and fungi

3.12.1 Highly invasive wetland species

Invasive species are non-native species that can spread into natural ecosystems, and displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes (CWMW 2013, Hruby 2012, Adamus et al. 2010, Faber-Langendoen et al. 2016, Miller et al 2017, Mack 2001). Invasive species may disrupt ecosystem processes and cause major alterations in plant community composition and structure. They establish readily in natural systems and spread rapidly. Their ecological impacts 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 (Dukes and Mooney 1999, Faber-Langendoen et al 2016).

WVDNR maintains rankings of invasive plant species for West Virginia (WVDNR 2009). Rapid FQA includes the negative impacts of invasive plant species by applying negative CoC values of -1, -3, and -5 to occasionally, moderately, and highly invasive species, respectively (DeBerry et al. 2015).

Highly invasive wetland plants are recorded on same field form as other species during the Rapid FQA.

Highly invasive wetland plants of West Virginia

Top three

Phalaris arundinacea (Reed Canarygrass) FACW
Lythrum salicaria (Purple Loosestrife) FACW
Phragmites australis (Common Reed) FACW

…and the rest of the dirty dozen

Arthraxon hispidus (Small Carpetgrass) FAC
Iris pseudacorus (Yellow Iris) OBL
Lonicera japonica (Japanese Honeysuckle) FAC
Microstegium vimineum (Japanese Stiltgrass) FAC
Myriophyllum aquaticum, M. spicatum (Parrotfeather, Eurasian water-milfoil) OBL
Polygonum cuspidatum/Fallopia japonica (Japanese Knotweed) FAC
Polygonum perfoliatum (Asiatic Tearthumb, Mile-a-minute) FAC
Rosa multiflora (Multiflora Rose) FAC
Typha x glauca, T. latifolia, T. angustifolia (Cattail) OBL

Source: WVDNR 2009

3.12.2 Rapid FQA preparation

The Rapid FQA must be performed May 1-October 31 (June 1-September 30 for elevations above 3000 feet). If performed outside this period, then maximum points are assigned for sites to be impacted, and minimum points are assigned to restoration sites.

The level of botanical skill required to perform Rapid FQA is similar to that required for wetland delineation. Dominant species, defined as species with 10% or higher cover in a wetland type, must be correctly identified to species. The summed cover values of identified species in each vegetated wetland type must equal least 80%. The exception is wetland types with less than 100% vegetation cover, such as many aquatic bed communities. In this case, the summed cover values of correctly identified species must sum to at least 80% of the total cover. For example, if a shallow pond is 50% open water and 50% aquatic vegetation, then the correctly identified vegetation cover must equal at least 40% (80% of 50%).

Percent cover is measured as absolute percent cover, not relative cover, for Rapid FQA, as it is in wetland delineation (COE 2012).

Aquatic vegetation can be effectively sampled with a mini-grappling hook or garden hand cultivator attached to a rope, with several tosses into the water to obtain a representative sample.

The Rapid FQA is carried out through a progressive meander sampling approach. Sampling consists of walking through each NWI wetland type in the AA and recording the dominant plant species that are present. Larger, more diverse, or more complex sites will take longer to sample than smaller, simpler, or less diverse sites. The meander sampling approach provides flexibility to meet the challenge of sampling AA's of varying size and complexity. Following the meander, absolute percent cover is estimated for the species observed in each wetland type present.

Highly invasive species must be recorded if they are present, even if they are not dominant in the wetland type. Species that are neither highly invasive in wetlands nor dominant do not need to be recorded, although they may be optionally included.

Unknown species may be keyed out in the field or collected for later study. Standard flora references that surveyors should refer to are:

1. Common Wetland Plants of West Virginia (Faulkner & Byers 2019). Illustrated guide to the 100 most common wetland plants in WV and their look-alikes. Available free on DEP website.
2. Flora of Virginia (Weakley et al 2015 & High Country Apps). This is the best single reference for West Virginia, including most West Virginia species. It is available in book form and as a user-friendly Android/iOS app. The book is technical with a few line drawings. The app is beginner-friendly with graphical and text keys. abundant photos, and technical descriptions.
3. Flora of the Southeastern and Mid-Atlantic States (Weakley 2021 & High Country Apps). Available as an electronic book (free pdf download) or iOS/Android "FloraQuest: Northern Tier" app. Includes the entire flora of WV. The app can be filtered by state,

with outstanding technical & graphical keys, abundant photos, and range maps, but no technical descriptions.

4. Flora of West Virginia (Strausbaugh and Core 1978). Outdated and incomplete but a good secondary reference, with West Virginia habitats and line drawings of most species.
5. Aquatic and Wetland Plants of Northeastern North America Vols I-II. (Crow and Hellquist 2000 & 2006). Easy-to-use keys and detailed line drawings. Does not include all WV wetland species.
6. Flora of North America (FNA 1993+). Excellent but not all families have been completed. Volumes 22-25 (grasses, sedges, rushes) are particularly helpful.
7. In areas with Internet connections, or for office use, the "GoBotany" website has excellent, well-illustrated keys covering many, but not all, West Virginia species.
8. Other sources to discover the family or genus (but not the species) include: Newcomb's Wildflower Guide, the iNaturalist, Seek, or PlantNet app or website which offer image-recognition and community identification of species.

3.12.3 Rapid FQA in the field

Fill out the site name and date on the Rapid FQA field form.

Write in the NWI wetland type codes. Check to ensure that they match the codes on the Soils field form.

Note that NWI communities with the same attribute code are lumped together into a single discontinuous assessment target for Rapid FQA. For example, if you have two stands of forested conifer swamp on opposite margins of the wetland, and both have an NWI code of PFO4Ban, then the stands are treated as one wetland type, and assessed as a single unit. Each field form has room for three NWI wetland type types that are recorded in numbered spaces. Additional field forms must be used when there are more than three wetland types.

To determine whether the dominant species have been identified, sum the cover values of identified vascular plant species across all strata within each wetland type. Stop when all dominant vascular plant species (≥ 10% total cover across all strata) AND highly invasive (bolded) plants have been identified AND the sum of species cover is ≥ 80%.

Estimate the percent area of each NWI wetland type within the AA – this figure may be calculated more precisely from GIS after returning to the office. The total area should sum to 100% of the AA.

Most vegetated wetland types have at least 100% vegetated cover, and with overlapping strata the cover is often greater than 100%. However, aquatic beds or mudflats may have large areas of unvegetated water or soil. For NWI wetland types with total vegetative cover of < 100%, the required minimum sum of species is ≥ 80% of the total cover. In the example below, the aquatic bed community (PAB4Hx) has only 70% total vegetative cover (the rest is open water). Eighty percent of 70% = 56%, so the required minimum identified cover is 56% for this aquatic bed.

Example:

NWI Wetland Type Code NWI codes must match codes on Soils sheet	**Dominant species identified**	**% of AA** field estimate or GIS	Total veg cover if < 100%	Sum of identified cover
1. PSS1Btn	■	74		137
2. PAB4Hx	■	11	70	60
3. PEM1Ctn	■	15		88

Begin the meander in a representative area (i.e., the most typical or predominant) of wetland type #1.

Species are listed alphabetically on the form by scientific name for each plant group. There are three spaces in front of each name that correspond to the NWI wetland type codes recorded at the top of the field form.

Record the presence of plant species by circling the space in front of a species name that corresponds with the wetland type number in which the species is observed. The same species can occur in multiple wetland types in a single AA. Make the circle large enough to later record the percent cover once the meander survey in that wetland type is complete. For example, if wetland type #1 recorded in an AA is PSS1Btn, and *Rosa multiflora* is observed while sampling in this wetland type, then the leftmost space in front of *Rosa multiflora* would be circled.

When the wetland type has been thoroughly observed via the meander survey, and all potentially dominant species have been circled, then estimate the cover values for the circled species. Cover estimates are ocular. Cover estimates are necessarily imprecise in a "plotless" meander survey, but nevertheless care should be taken to give realistic estimates that correctly identify the dominant species. Use absolute cover, not relative cover, for all species. Typical cover values are 0.1, 1, 3, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100 percent. The goal is to correctly identify dominant species with 10% cover or more.

Blank lines are included on the checklist for "write-in" species. Required "write-in" species include identified dominant species that are not on the checklist and unknown species collected for further study (include collection number on field form). Other species may be optionally added, for example, species that are not on the checklist but are observed at the beginning of the survey, before their dominance status is known.

Example:

Species Checklist. Circle space when species has at least 10% cover in wetland type. At the end of each wetland type meander, record cover within circles. Highly invasive wetland species are ***underlined*** and must be recorded even if they have < 10% cover. Write in any dominant species not listed. Use absolute cover, not relative cover. Typical cover values are 0.1, 1, 3, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100 percent.											
Aquatic Plants (true aquatic plants that are submergent or have floating leaves)											
NWI wetland type #				NWI wetland type #				NWI wetland type #			
1	2	3		1	2	3		1	2	3	
			Brasenia schreberi				*Lemna valdiviana*				*Potamogeton crispus*
			Callitriche heterophylla		1		***Myriophyllum aquaticum***		60		*Potamogeton sp.(not P. crispus)*
			Ceratophyllum demersum				***Myriophyllum spicatum***				*Wolffia brasiliensis*
			Hydrilla verticillata				*Nuphar lutea ssp. advena*		10		Unk submerged (c)
	10	10	*Lemna minor*				*Nymphaea odorata*				

Example:

Graminoids (grasses, sedges, rushes)											
			Acorus calamus				*Danthonia compressa*				*Juncus tenuis*
			Agrostis gigantea				*Dichanthelium clandestinum*	40	10	10	*Leersia oryzoides*
			Agrostis hyemalis				*Dichanthelium dichotomum*				*Leersia virginica*
			Andropogon gerardii				*ssp. microcarpon*	1		3	***Microstegium vimineum***
			Anthoxanthum odoratum				*Dulichium arundinaceum*				***Phalaris arundinacea***
5			***Arthraxon hispidus***				*Echinochloa crus-galli*				***Phragmites australis***
			Calamagrostis canadensis				*Eleocharis obtusa*				*Phleum pratense*

The meander path should move from wetland type to wetland type so that **approximately equal amounts of time are spent in all parts of the AA**.

The Rapid FQA ends when all dominant species and at least 80% cover have been correctly identified to species **for each wetland type** in the AA. Add the sum of cover for all species in each NWI type to the top right of page 5, to ensure that you have enough cover identified.

3.13 Collecting and handling unknown plant specimens

Field surveyors will identify common dominant plants in the wetland to species. Unknown dominant species, or ones that are particularly difficult to identify, such as some grasses or species in the genus Carex, may need additional study or verification by an expert taxonomist.

Vouchers will be collected for any dominant species that cannot be identified with certainty in the field. These specimens will be further examined and identified to species back at the office, if necessary, with the aid of microscopy and/or additional reference materials; alternatively, the specimen will be taken to a local herbarium or an experienced botanist with comprehensive knowledge of the local flora for identification.

3.13.1 Collecting plant specimens

Try to collect representative (typical) specimens that are mature, healthy, and have key structures needed for identification (e.g., leaves, stems, flowers and/or fruits, roots, rhizomes). For each species to be collected, collect enough plant material for species identification and to fill a standard herbarium sheet (29 x 42 cm, 11 x 16 in) when pressed. Additional guidelines adapted from USEPA (2016) include:

- If the plant is small enough, collect the entire plant (or several plants) including the roots.
- If the plant is too large to fit in the plant press, collect 1) sufficient leaves and stems to illustrate leaf shape and size, opposite or alternate branching, and buds, 2) some of the root or rhizome, and 3) the inflorescence (flowering stem) with open flowers. In the case of trees, shrubs, or vines, material should be selected to illustrate the overall characteristics of the plant and the range of variation in flowers, leaves, and other structures.
- For grasses and grass-like plants, include roots or rhizomes. Whenever possible, include mature fruit, which are often critical for identification; e.g., perigynia for *Carex* (sedge) species, grains for grasses, capsules for *Juncus* species, etc.
- If the species has separate male plants and female plants (e.g., *Salix* sp. (willows)) or male and female flowers on the same plant, collect specimens from both sexes whenever possible. Indicate whether male and female parts are from the same individual or separate individuals.
- If the species is immature or senescent, collect a sample that illustrates as many key diagnostic parts of the plant as possible.

For each species collected, place enough fresh plant material for a complete specimen into a plastic bag (e.g., 2-gallon zipper-lock or larger bag, if necessary). Using a permanent marker, write the NWI wetland type attribute (e.g., PEM1Abtn) on the outside of the bag. Bagging plants individually can help keep plant parts together and prevent mixing different species. However, if it is easier, multiple species can be placed into larger bags. If more than one specimen is included in a single bag, be sure they can be easily distinguished from one another and related to their NWI wetland type. For example, tag individual species by bundling plant material by the stems with masking tape, a strip of flagging, or wire and labeling with the NWI wetland type and collection number. Keep specimen collection bags out of the sun and cool during the sampling day. If a cooler with ice is available, place bags in the cooler until pressed.

3.13.2 Pressing plant specimens

Press plant specimens as soon as possible, usually at the end of the sampling day. Assign a collection number and fill out label data. Blank voucher labels are included with the field form. Guidelines for pressing plant specimens are adapted from USEPA (2016).

Plant specimens should be pressed and dried in a standard plant press (30 x 45 cm, 12 x 18 inches) composed of a breathable wooden frame, corrugated cardboard ventilators, blotters, folded newsprint, and a set of adjustable straps. The wooden frame and straps bind the press. Newsprint specimen folders, each containing plant material, are sandwiched between two moisture-absorbing blotters. The "blotter-newsprint sandwiches" are placed between corrugated cardboards. The corrugations of the cardboard should run parallel to the shorter dimension (30 cm or 12 in) of the press for best air circulation. Bulky specimens may require extra blotters and cardboard. Plant pressing is done as follows:

- To begin pressing a specimen, place a cardboard on the bottom wooden frame of the press, then add a blotter.
- Lay a newsprint folder on top of the blotter. Place the filled-in voucher label inside the newsprint, or write the label data directly on the outside of the newsprint.
- Clean as much dirt as possible off the plant material before placing it in the newsprint folder. It is often helpful to flick dirt from the roots with your thumb and index finger. Some muddy roots may need to be immersed in water to remove dirt. Try to not immerse other parts of the plant.
- Place the plant material inside the sheet of folded newsprint so that it lies entirely within the dimensions of the plant press.
- Carefully arrange the plant material to display diagnostic features.
    - Lay the specimen flat and avoid overlapping plant parts.
    - Spread leaves, flowers, and fruits so they can be easily observed from different perspectives.
    - Show upper and lower surfaces of leaves and flowers.
    - If possible, arrange material so some flowers have the blossom open, and some flowers and fruits appear in longitudinal and transverse views.
    - Multiples of smaller plants of the same species should be pressed together on one sheet.
    - For large specimens, bend stems sharply into a V or N shape so they fit within the press frame. Avoid curving or twisting stems.
    - Thick stems, large fruits, or bulbs may be trimmed to reduce bulk by cutting them in half lengthwise.
- Examples of small, loose plant parts (i.e., seeds, *Carex* perigynia) should be placed in a small paper packet or envelope inside of the newspaper.
- Once the plant material is arranged, fold the newsprint closed.
- Add another blotter, then a cardboard on top of the newsprint folder.
- To begin pressing the next specimen, place a blotter over the top cardboard in the stack. Repeat steps until the press is full or all specimens are included.
- Use two adjustable straps to tighten and firmly compress the plant press and its contents.

3.13.3 Drying plant specimens

Pressed plant specimens should be thoroughly dried before removing them from the presses. Guidelines for drying plant specimens are adapted from USEPA (2016).

- To encourage drying, keep full presses in a warm, dry, well-ventilated location in the vehicle during the day and in a well-ventilated warm location at the lodging location at night.

- As the specimens dry they will lose volume, so periodically tighten the straps on the press to maintain pressure on the specimens and minimize shrinkage and wrinkling.
- Rapid and thorough drying is enhanced by low humidity and ample airflow around and through the presses. The best preservation of color and morphology is obtained with rapid drying over low heat. Also, dry air circulating through the press may kill many insects and insect eggs, potentially protecting the specimens from damage.
- The easiest way to achieve these conditions is by using an electric plant dryer that provides steady bottom heat (95°F to 113°F), where plants usually dry in 12 to 48 hours. Plant dryers are typically constructed as a simple box with a heat source (often light bulbs) and a fan for air circulation, on which plant presses can be placed to accelerate drying.

3.13.4 Labeling of plant vouchers

All unknown plant vouchers collected for identification will be labeled clearly in the field and for tracking in the office/herbarium. This information may be written directly on the newsprint used for pressing, or it may be written on a sample label and included INSIDE the newsprint. At a minimum, the sample labels will contain the following information: site name, collector, date of collection, collection number, NWI polygon code, and percent cover. Every voucher will be assigned a unique sample number. The sample number will be the short name of the collector plus a sequential number. For example, EByers-1873 would be the sample number for Elizabeth Byers' 1873rd collection. For those botanists who keep a regular collection book, the sample number will be the same as their collection book number.

Example:

West Virginia Wetland Rapid Assessment Datasheet - Plant Voucher

Site name Montrose DOH **Date** June 23, 2017

NWI code PEM1Ftn **Percent cover within the NWI code area** 40

Collector E Byers **Collection #** 1993

Species name or pseudonym Unknown Polygonum

Additional notes (optional): mat-forming, vegetative, rhizomatous

4.0 DATA ENTRY AND SCORING

WVWRAM scoring involves several steps including checking the field data, creating a shapefile of the wetland site and uploading it to the WVWRAM GIS tool, entering the field forms into the

WVWRAM database, importing the GIS results to the database, and running the final scoring modules within the database.

4.1 Post-assessment office checklist

Prior to entering data, review the checklist below to ensure all the materials you need for scoring are at hand.

- Correct NWI polygon mapping as needed. Create attributed shapefile and check for any data validation errors.
- Upload NWI-attributed shapefile to the WVWRAM GIS tool.
- Confirm identification of any unidentified plant species.
- Optionally (recommended), rename all digital photos with site name, date, photographer, and optional notes. e.g.,
    - ElklickRun_20180625_EByers_snags
    - BuffaloSwamp_20170730_CAshworth_Stachys_tenuifolia
- Enter completed and checked field forms into WVWRAM MS-Access database.
- Check accuracy of data entry.
- Load GIS results to WVWRAM database.
- Calculate final score and view/print final score.

4.2 WVDEP office checklist

- Check completeness and accuracy of submitted field forms, GIS polygons, annotated field maps, and digital photos, WVWRAM database records, and final scores. Archive all materials.
- Add records to WVWRAM database. Update GIS data in working copy of NWI_WV to include improved field mapping and function scores.
- As needed, provide final results to users or stakeholders, or input regulatory score into SWVM.

4.3 Create and upload shapefile to GIS tool

After completing the field portion of the assessment, there are several office tasks that must be done. One of these is creating a GIS shapefile of the field mapping, if you have not already done this using a mobile mapping app in the field. Field-delineated spatial data (mapped wetland polygons according to the National Wetlands Inventory standard) are input to the GIS tool of WVWRAM.

4.3.1 Create NWI-compliant shapefile

Create a polygon shapefile of the wetland from the recorded GPS points, GPS tracks, and annotated field maps. It is best to do this the same day or shortly after the field assessment, while the site is still fresh in the minds of mappers. If you have a separate GIS office preparing the shapefile, then be sure to provide a detailed field map or annotated air photo for them to follow, in addition to providing GPS points/tracks.

Each of the NWI wetland types on the field forms will have at one or more polygons representing it. Workflow tips to create an error-free shapefile include:

- First map the outline of the wetland, i.e., the upland-wetland boundary.
- Ensure that the shapefile has an OBJECTID field with a unique ID for each polygon.
- Create fields for SiteName [short text], SurveyDate [Date], and Attribute [short text].
- Add the SiteName and SurveyDate information for the wetland.
- Cut the wetland into polygons so that each NWI wetland type that is listed on the field form is represented.
- It is fine to have more than one polygon with the same NWI wetland type, for example there could be a PFO4Ban on both the eastern and western margins of an otherwise open wetland. However, polygons with the same NWI wetland type (all characters exactly the same) may not touch. If they touch, they must be merged into a single polygon.
- If you need to add additional connected polygons to the wetland, use "auto-complete polygon" to avoid drawing over a boundary and creating slivers or gaps.
- Add the NWI wetland type in the Attribute field for each polygon. Note that the NWI wetland type is screened to exclude non-target wetland types such as unvegetated lacustrine and riverine polygons. NWI wetland types that are accepted by the WVWRAM GIS tool include all palustrine (P…), vegetated lacustrine littoral (L2AB…, L2US5…, L2em…) and vegetated riverine (R2AB…, R3AB…, R2US5…, R3US5…, R2EM…, R3EM…, R4SB7…).

4.3.2 Check shapefile prior to upload

Check the completeness and accuracy of each NWI polygon in the shapefile. Wetland attribute codes (e.g., PEM1Btn) should be complete and conform to the NWI standard. Codes may be checked on the NWI website (https://fwsprimary.wim.usgs.gov/decoders/wetlands.aspx). Polygons must not overlap, must not contain unintended slivers or gaps, and should comply with the NWI mapping standard. If a user is performing multiple assessments, the data verification steps can be streamlined by using the NWI Wetlands Data Verification Toolset (https://www.fws.gov/wetlands/data/verification-tools.html). This toolset identifies six common errors:

- Incorrect wetland codes not allowed by NWI
- Adjacent wetlands with the same wetland code
- Sliver wetlands less than 0.01 acre

- Sliver uplands less than 0.01 acre
- Lake and pond size errors (NWI lakes are > 20 acres, ponds are 20 acres or less)
- Overlapping wetland polygons

Note that the OBJECTID must be unique for each record.

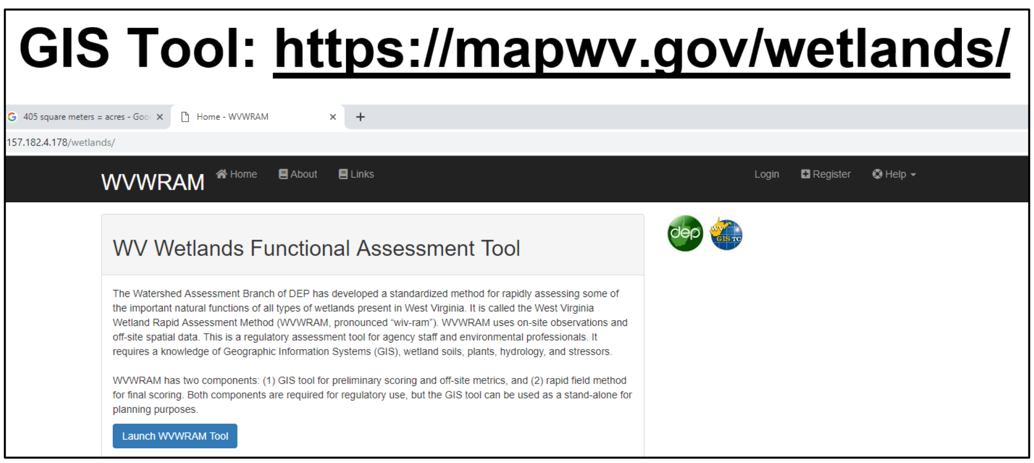
The schema for the attribute file must contain the fields: **OBJECTID [ObjectID], SiteName [short text], SurveyDate [Date], and Attribute [short text]**. For example, in the table below, "GlendaleParkTower" contains three polygons, two that are scrub-shrub and one that is an emergent wetland. The other two AA's in the table contain one polygon each.

WVWRAM2018

OBJECTID *	SHAPE *	SiteName	SurveyDate	Attribute	SHAPE_Length	SHAPE_Area
2	Polygon	GlendaleParkTower	7/3/2018	PSS1Ban	592.348171	7897.978274
4	Polygon	GlendaleParkTower	7/3/2018	PEM1Btn	554.045869	7435.069645
12	Polygon	KerensDOH2	7/5/2018	PFO1Btn	1290.226585	7585.509313
13	Polygon	KerensDOH1	7/5/2018	PFO1Btn	167.224558	1865.442714
17	Polygon	GlendaleParkTower	7/3/2018	PSS1Ban	436.917495	2745.775857

4.3.3 Run the WVWRAM GIS Tool

Once the input NWI polygons pass the data verification tests, proceed with running the GIS assessment tool. The tool runs through an internet portal maintained by the WV GIS Tech Center at https://mapwv.gov/wetlands/.



Typical datasets with several wetlands take 2-3 hours to run. The GIS results are output to an Excel spreadsheet that is emailed to the user and serves as a stand-alone preliminary scoring for planning purposes. For final scoring, GIS results must be imported to the WVWRAM MS-Access database and merged with tabular field data.

4.3.4 Interpret and communicate preliminary GIS scores

In some cases, users will run GIS-only assessments to use in scenario planning. This can assist with mitigation bank siting, land acquisition decisions, and other applications. The preliminary

GIS scores will give an indication of the likely range of final scores to be expected at various sites. The preliminary GIS score alone is not sufficient for regulatory purposes; these sites require both the GIS scoring and a rapid field assessment.

4.4 Enter the field form data

4.4.1 Check field forms prior to input

Check completeness and accuracy of submitted field forms.

4.4.1.1 User Assignment of Site Event Code

Users outside WVDEP may assign a Site Event Code of their own choosing. The Site Event Code must be unique for each AA and each assessment event within the dataset.

4.4.1.2 WVDEP Assignment of Site Event Code

WVDEP users must assign a Site Event Code as per the state protocol. WVDEP's Site Event Code is based on the WVDEP Stream Code plus a sequential number for the wetland and for the sampling event.

For wetlands that have been mapped in the National Wetlands Inventory (NWI), the geographic portion of the Site Event Code can be found on the WVDEP server in the WetlandCode feature class.

For wetland assessments that are not mapped in the NWI, or where the NWI mapping cannot be easily matched to the new mapping, the nearest stream segment must be identified. On the WVDEP server, use the attribute FINALCODE from NHD_StreamMerge shapefile to obtain a code for the nearest stream segment. Then add "_W…" and a sequential number. To determine the correct sequential number, consult the existing values for WU_WetlCode in addition to the SiteCode in the WVWRAM database. The first available (unused) sequential number should be used. Finally, re-visits or replicate assessments need a suffix of "_R…" followed by the first unused sequential number. Follow the workflow below:

(a) Wetland is mapped in NWI

- Open M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WetlandUnits.gdb\WU_WetlCode
- Find the polygon from WU_WetlCode that overlaps the new wetland assessment mapping
- Site Event Code = WetlCode (add re-visit code if applicable).
- Examples: MC-123-DI_W1 or OL-10_W3

(b) Wetland is not mapped in NWI

- Open M:\wr\WTRSHD_BRANCH\NHD_24K_STREAM_LINES\NHD_StreamMerge_20180202_inWV.shp
- Find the stream segment nearest to the wetland
- Site Event Code = FINALCODE (of closest stream segment) + "_W" + (first available sequential number) + re-visit code if applicable.

- Note that the first available sequential number for the wetland should be determined after looking at the highest existing number for wetlands associated with the stream segment in both the WU_WetlCode file and the WVWRAM MS-Access database.
- Examples: PL-44-D_W20 or OUS_W30

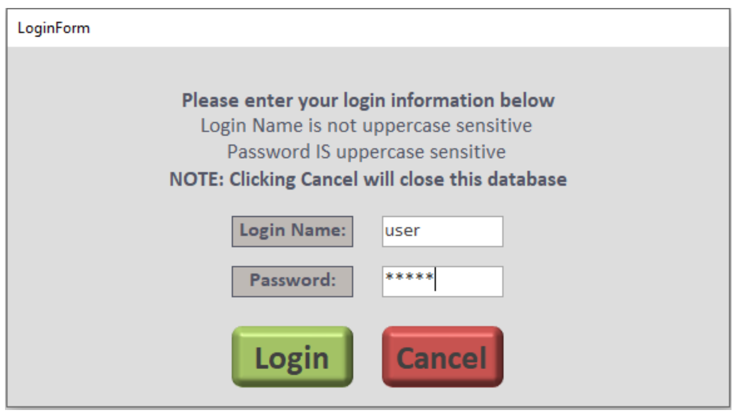
(c) Re-visits or replicate assessments
- Add "_R"+ sequential number.
- Examples: MC-123-CH_W1_R1 or OMN_W9_R2

4.4.2 Enter data

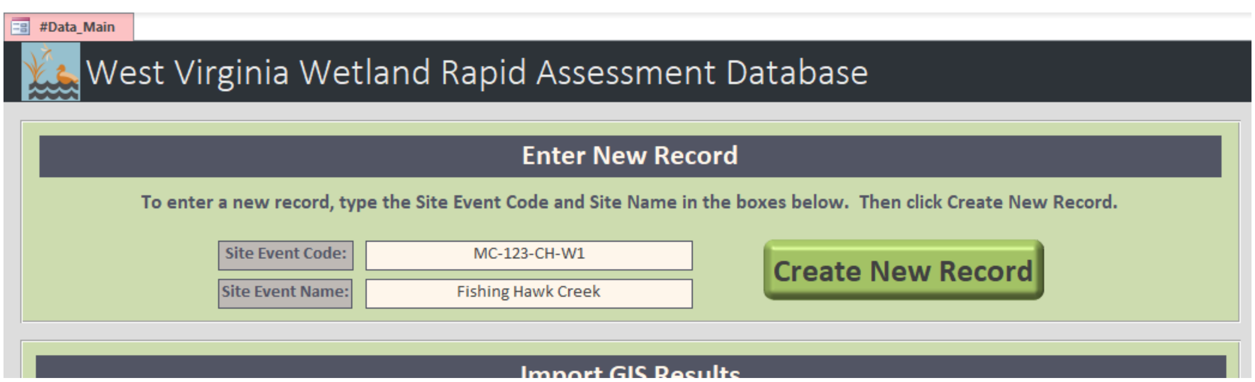
Enter completed, checked field forms into the WVWRAM MS-Access database. If the database has not been installed on your device yet, refer to the WVWRAM Reference Manual for installation instructions. Log into the WVWRAM database as a "user":

Login Name: user

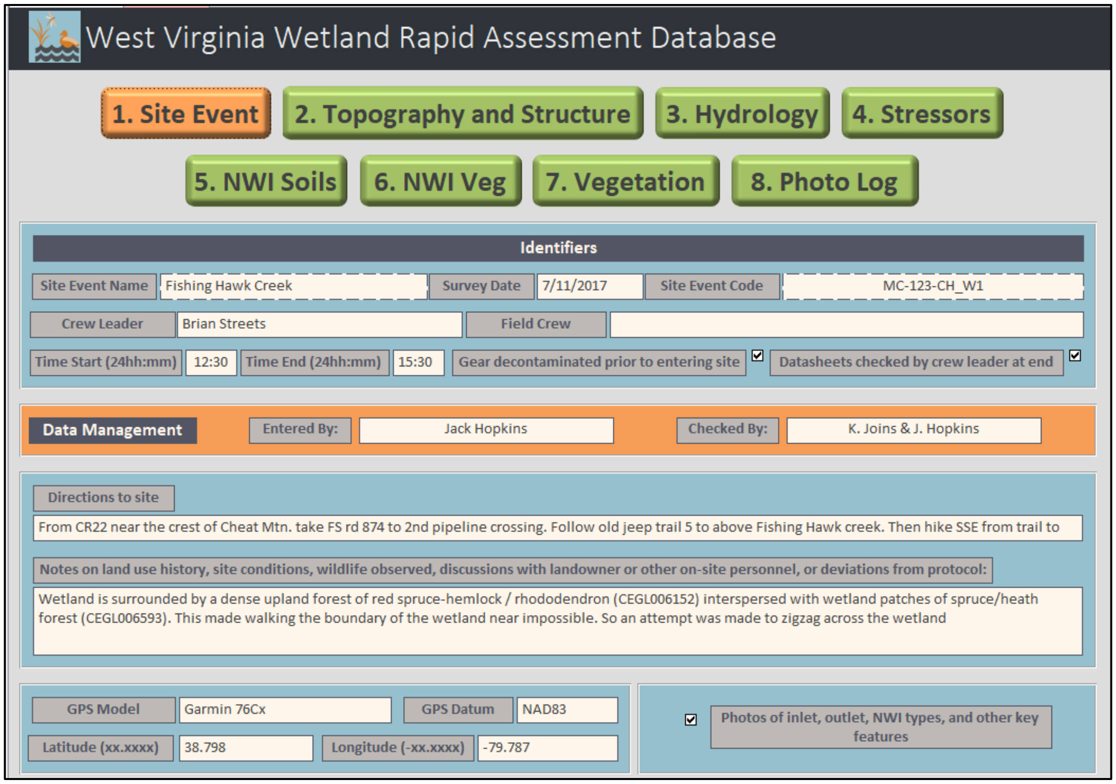
Password: user1



The "user" login grants full access to enter and edit data from the field forms, to import GIS results from the Excel spreadsheet, and to calculate the final score. Enter your site event code and site event name and click "Create New Record".



Enter data from the field forms, moving sequentially through the tabs. It is fine to move backward through the tabs to check or correct data that have already been entered, but do not skip forward over any tabs. In particular, the **vegetation tabs use data from earlier tabs and will cause the database to crash if they are not filled out in the correct order**.



4.4.3 Check data entry

Check accuracy of data entry. This is normally done by comparing the MS-Access report output to the original field form. The person completing the check will initial the database record. Data entry and checking will be done by different individuals.

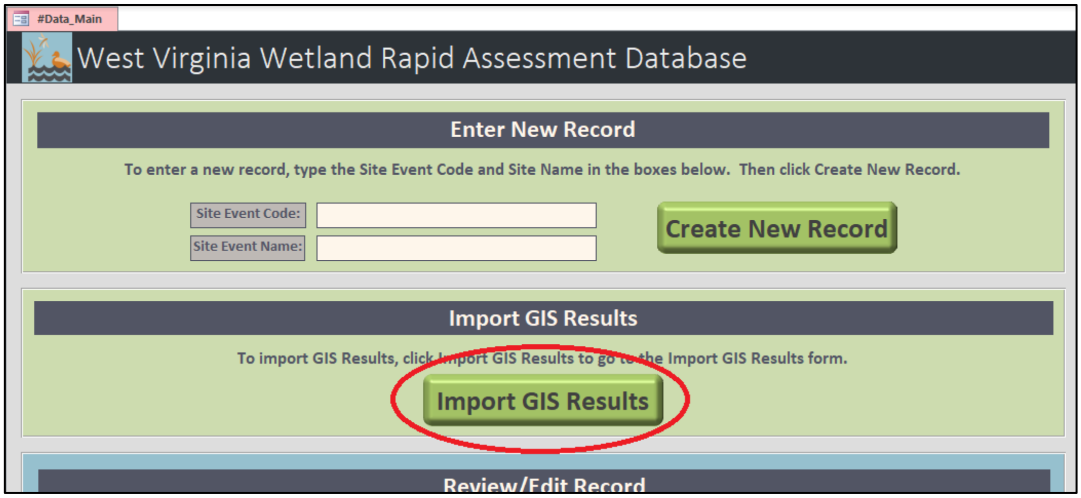
4.5 Calculate final scores

The final WVWRAM score is calculated after merging the GIS and field form data. The spreadsheet generated by the WVWRAM GIS Tool must be imported into the WVWRAM database. Then, the scoring module is run within the database to roll up the metrics into a final score. It is important to check the final scores for unexpected results, which may indicate data errors, prior to using or sharing.

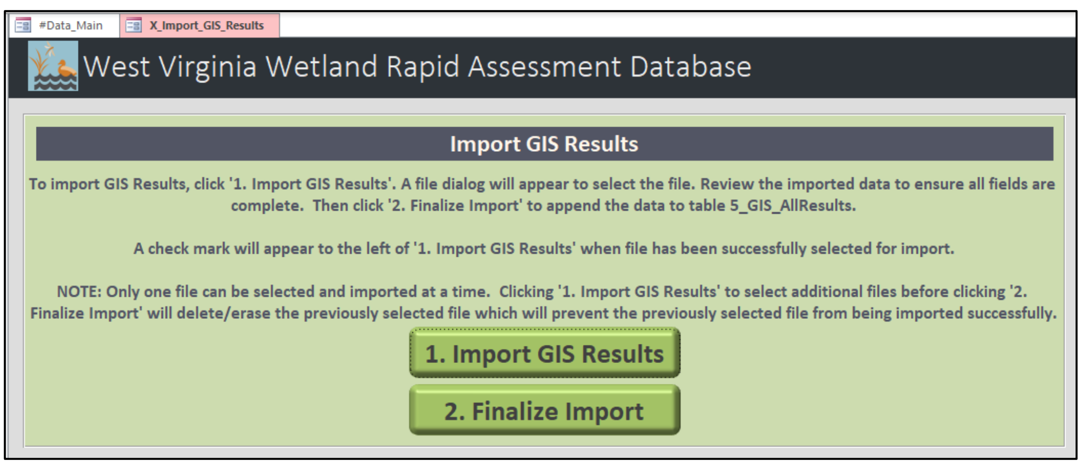
GIS results are imported into the WVWRAM MS-Access database after field data have been entered, or at least after the Site and Site Event table have been populated.

4.5.1 Import GIS results spreadsheet

Open WVWRAM MS-Access database. Confirm that a New Record has already been created for the site or sites (e.g., field form has been at least partially entered). Exactly one row of GIS results can be imported for each field form. If you have mapped and run multiple polygons, be sure that all the sites exist in the WVWRAM database before importing the spreadsheet.

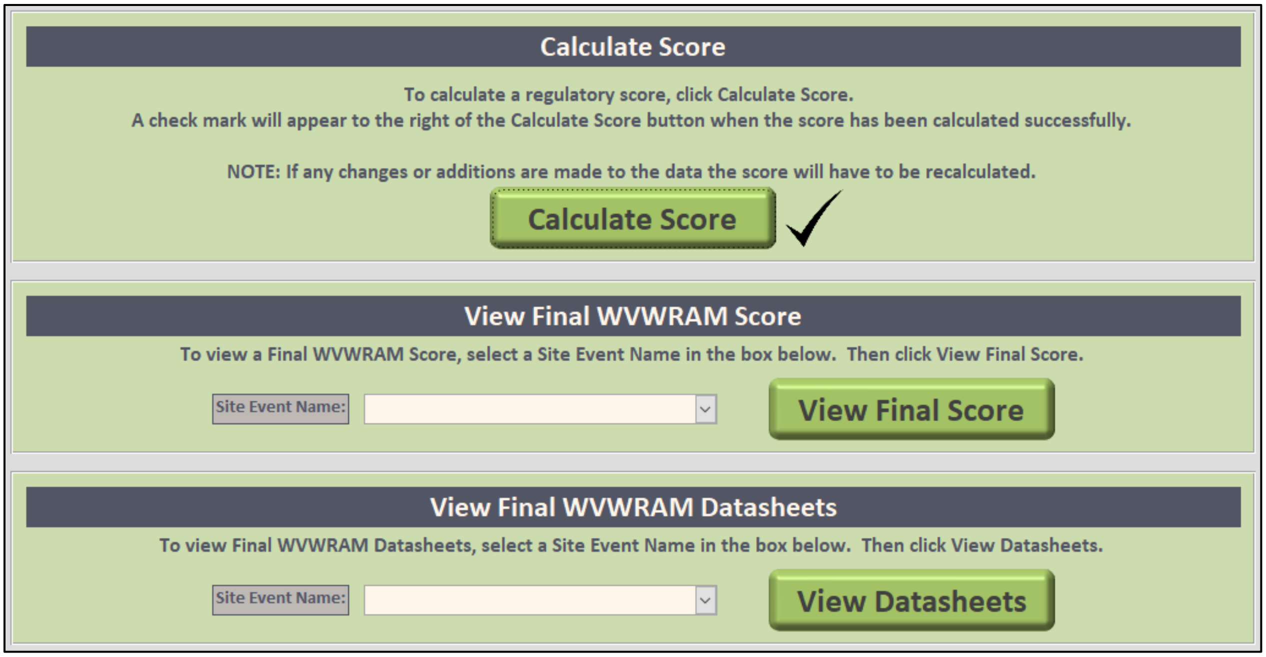


On the main form of the database, click on **"Import GIS Results". Read and follow the directions in the database carefully!**



4.5.2 Calculate Final Score and View Reports

The final step to calculate WVWRAM score is to merge GIS and field data. This is done within the WVWRAM MS-Access database. On the main menu, select "Calculate Score". A check mark will appear to the right of the "Calculate Score" button when the score has been calculated successfully.



Once the final score has been calculated, users may view the final score report or the field datasheet by selecting a Site Event Name and the appropriate button.

4.5.3 Input regulatory score to SWVM

If the WVWRAM site is part of a Clean Water Act mitigation process, enter the regulatory score into “Part III: Wetlands” on the Stream and Wetland Valuation Metric (SWVM) spreadsheet.

4.5.4 WVDEP data entry and review

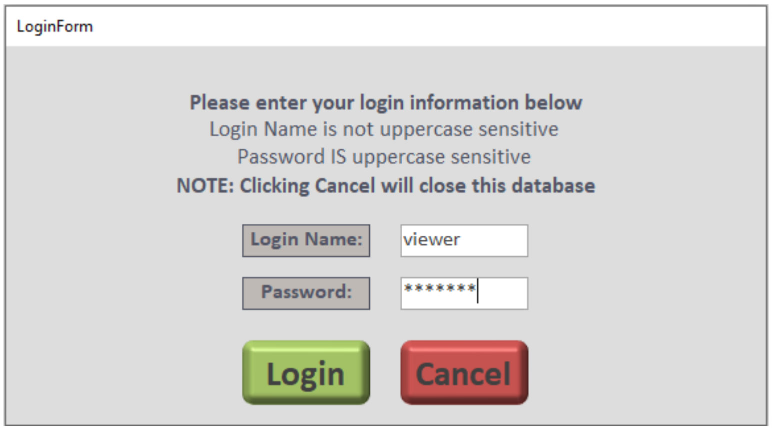
For WVDEP statewide probabilistic sampling sites, all field data including field form scans, photographs, map or GIS files, and WVWRAM database results will be archived in the Wetlands folder on the DEP server. WAB staff will review all data for accuracy and completeness. Quality control flags generated by the WVWRAM database or GIS tool will be reviewed for all sites. More thorough review of field forms and results, including comparison of air photos with mapping and data fields, will be performed for 5% of sites and as requested for unusual or problematic sites.

4.6 View-only mode

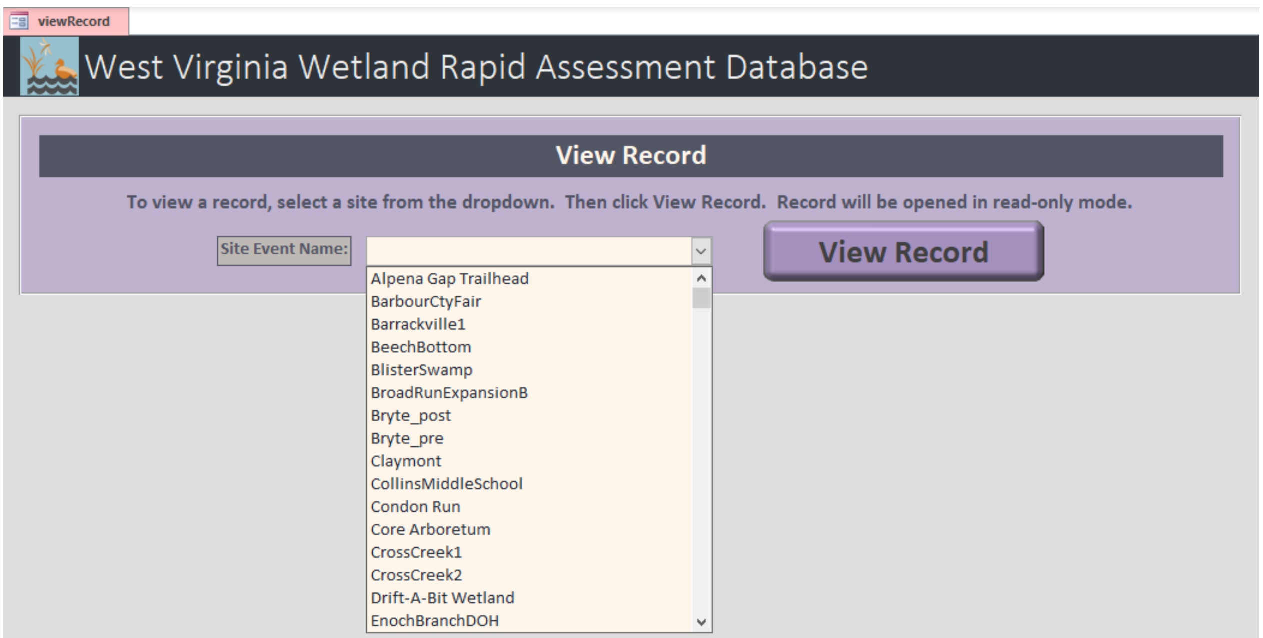
Regulators and reviewers may wish to review scores directly within the WVWRAM database rather than on a report output from the database. In order to avoid inadvertently changing data, reviewers should log into the database as a “viewer”:

Login Name: viewer

Password: viewer1



The "viewer" login will bring up a curtailed menu that allows only viewing of the data. No data fields can be changed.



If a user is logged in as "user" instead of "viewer", they may still select the "View Record" button if they wish to view particular records without risk of changing data inadvertently.

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6.0 APPENDICES

6.1 Acronym list

AA	Assessment Area
CoC	Coefficient of Conservatism
COE	U.S. Army Corps of Engineers
CONHP	Colorado Natural Heritage Program
CWMW	California Wetlands Monitoring Workgroup
DQO	Data Quality Objective
FGDC	Federal Geographic Data Committee
FNA	Flora of North America project
FQA	Floristic Quality Assessment
GIS	Geographic Information System
GIS-RAM	Geographic Information System – Rapid Assessment Method
GPS	Geographic Positioning System
HGM	Hydrogeomorphic Wetland Classification System
MI DNRE	Michigan Department of Natural Resources and Environment
MQO	Measurement Quality Objective
mwC	Mean abundance-weighted Coefficient of Conservatism
NAD83	North American Datum 1983
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
Ohio EPA	Ohio Environmental Protection Agency
QAPP	Quality Assurance Project Plan
SWVM	Stream and Wetland Valuation Metric
TNC	The Nature Conservancy
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WAB	Watershed Assessment Branch
WVDEP	West Virginia Department of Environmental Protection
WVDNR	West Virginia Division of Natural Resources
WVOHCF	West Virginia Outdoor Heritage Conservation Fund
WVWRAM	West Virginia Wetland Rapid Assessment Method

6.2 NWI systems and classes

NWI attribute codes that are used in West Virginia Wetland Rapid Assessment Method fall within the Riverine, Lacustrine, and Palustrine Systems as defined by Cowardin et al. (1979). They include:

Riverine System

R2AB… Lower perennial aquatic bed, any subclass, any modifiers.
R2US5… Lower perennial unconsolidated shore, vegetated, any modifiers.
R2EM… Lower perennial emergent nonpersistent, any subclass, any modifiers.
R3AB… Upper perennial aquatic bed, any subclass, any modifiers.
R3US5… Upper perennial unconsolidated shore, vegetated, any modifiers.
R3EM… Upper perennial emergent, any subclass, any modifiers.
R4SB7… Intermittent streambed, vegetated, any modifiers.

Lacustrine System, Littoral Subsystem

L2AB… Littoral aquatic bed, any subclass, any modifiers.
L2US5… Littoral unconsolidated shore, vegetated, any modifiers.
L2EM… Littoral emergent, any subclass, any modifiers.

Palustrine System

P… All palustrine classes and subclasses, plus any modifiers.

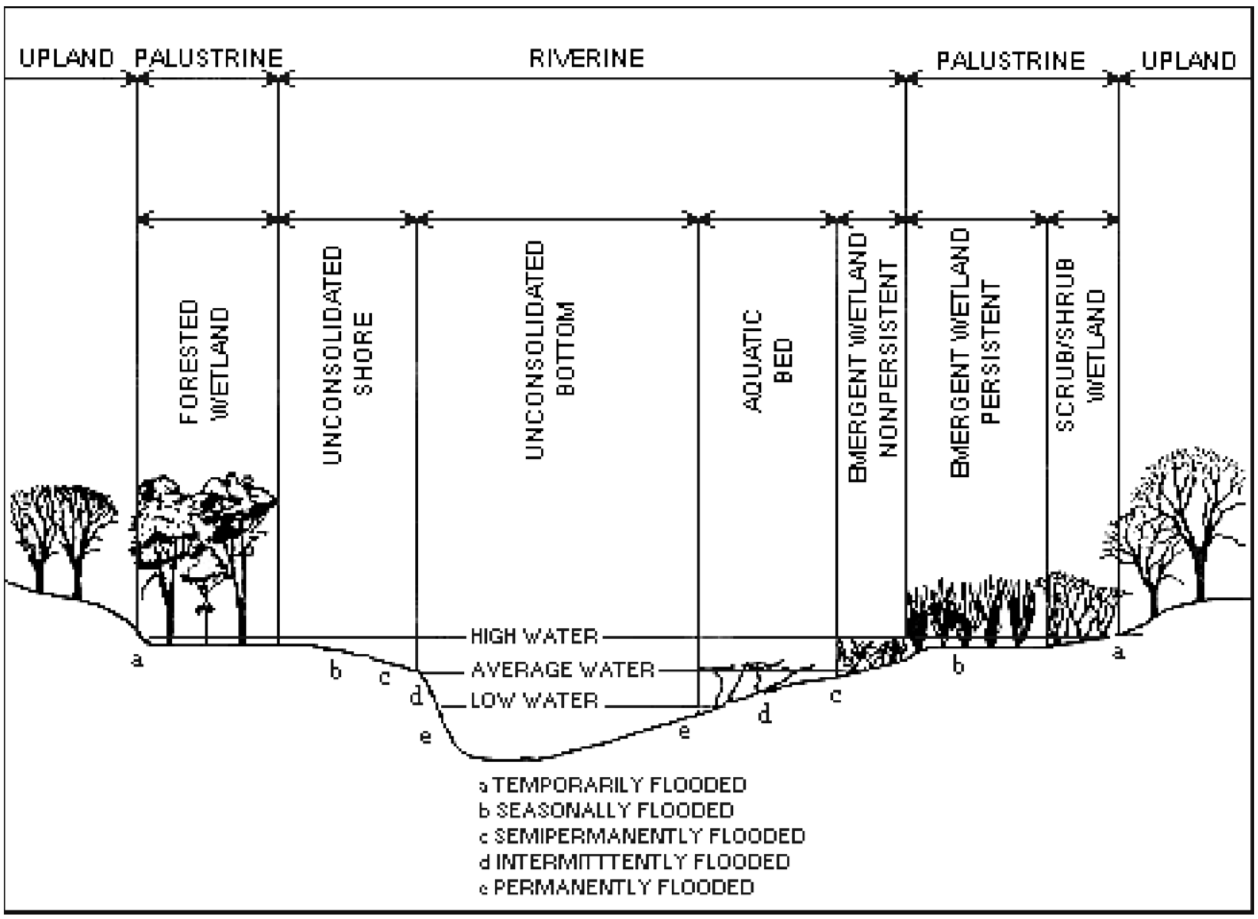
6.2.1 NWI systems and subsystems

Riverine System. The Riverine System includes all wetlands and deepwater habitats contained within a channel, with the exception of wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. A channel is an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water. Springs discharging into a channel are considered part of the Riverine System. Water is usually, but not always, flowing in the Riverine System. Upland islands or Palustrine wetlands may occur in the channel, but they are not included in the Riverine System.

Lower Perennial (R2). This Subsystem is characterized by a low gradient. Some water flows all year, except during years of extreme drought. The substrate consists mainly of sand and mud. Oxygen deficits may sometimes occur. The fauna is composed mostly of species that reach their maximum abundance in still water, and true planktonic organisms are common. The gradient is lower than that of the Upper Perennial Subsystem and the floodplain is well developed.

Upper Perennial (R3). This Subsystem is characterized by a high gradient. Some water flows all year, except during years of extreme drought. The substrate consists of rock, cobbles, or gravel with occasional patches of sand. The natural dissolved oxygen concentration is normally near saturation. The fauna is characteristic of running water, and there are few or no planktonic forms. The gradient is high compared with that of the Lower Perennial Subsystem, and there is very little floodplain development.

Intermittent (R4). This Subsystem includes channels that contain flowing water only part of the year. When the water is not flowing, it may remain in isolated pools or surface water may be absent.

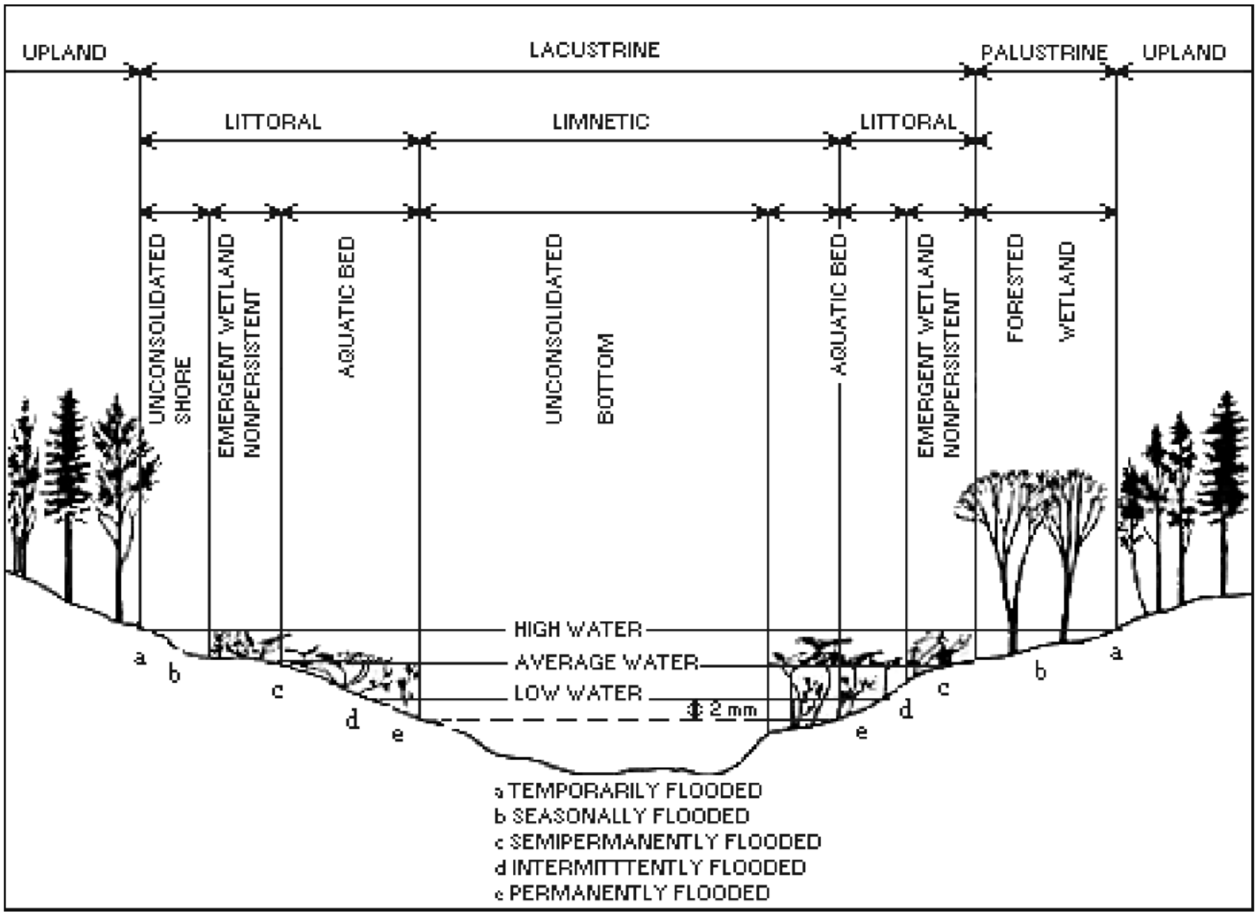


Examples of habitats in the Riverine and Palustrine Systems (Cowardin et al 1979).

Lacustrine System. The Lacustrine System includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with 30 percent or greater areal coverage; and (3) total area of at least 8 hectares (20 acres). Similar wetlands and deepwater habitats totaling less than 8 hectares (20 acres) are also included in the Lacustrine System if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin equals or exceeds 2.5 meters (8.2

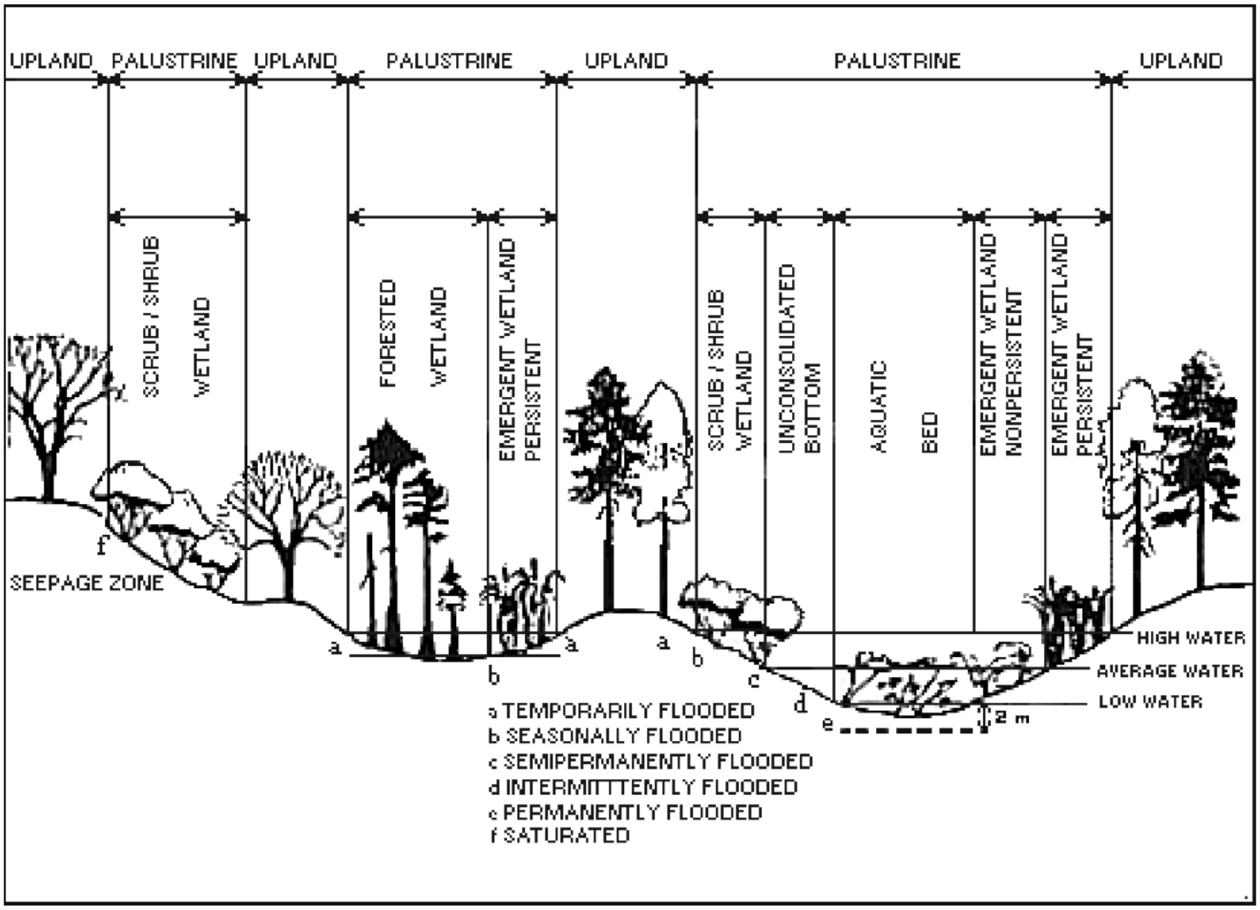
feet) at low water. Islands of Palustrine wetlands may lie within the boundaries of the Lacustrine System.

Littoral (L2). This subsystem includes all wetland habitats in the Lacustrine System. It extends from the shoreward boundary of the System to a depth of 2.5 meters (8.2 feet) below low water, or to the maximum extent of nonpersistent emergent plants if these grow at depths greater than 2.5 meters (8.2 feet).



Examples of habitats in the Lacustrine and Palustrine Systems (Cowardin et al 1979)

Palustrine System (P). The Palustrine System includes all wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. It also includes wetlands lacking such vegetation, but with all of the following characteristics: (1) area less than 8 hectares (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2.5 meters (8.2 feet) at low water. The Palustrine System was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, or fen. It also includes the small, shallow, permanent, or intermittent water bodies often called ponds. Palustrine wetlands may be situated shoreward of lakes or river channels; on river floodplains; in isolated catchments; or on slopes. They may also occur as islands in lakes or rivers. The erosive forces of wind and water are of minor importance except during severe floods.



Examples of habitats in the Palustrine System (Cowardin et al 1979)

6.2.2 NWI classes and subclasses

Rock Bottom (RB). The Class Rock Bottom includes all wetlands with substrates having an aerial cover of stones, boulders, or bedrock 75 percent or greater and vegetative cover of less than 30 percent. Rock Bottoms are usually high-energy habitats with well-aerated waters. Animals that live on the rocky surface are generally firmly attached by hooking or sucking devices, although they may occasionally move about over the substrate. Some may be permanently attached by cement. A few animals hide in rocky crevices and under rocks, some move rapidly enough to avoid being swept away, and others burrow into the finer substrates between boulders. Plants are also firmly attached (e.g., by holdfasts), and in the Riverine System both plants and animals are commonly streamlined or flattened in response to high water velocities.

Bedrock (RB1). Bottoms in which bedrock covers 75 percent or more of the surface.

Rubble (RB2). Bottoms with less than 75 percent areal cover of bedrock, but stones and boulders alone, or in combination with bedrock, cover 75 percent or more of the surface.

Unconsolidated Bottom (UB). The Class Unconsolidated Bottom includes all wetlands with at least 25 percent cover of particles smaller than stones and a vegetative cover less than 30 percent. Water regimes are restricted to permanently flooded, intermittently exposed, and semipermanently flooded. Unconsolidated Bottoms are characterized by the lack of large stable surfaces for plant and animal attachment. In the Riverine System, the substrate type is largely determined by current velocity, and plants and animals exhibit a high degree of morphologic and behavioral adaptation to flowing water. In the Lacustrine and Palustrine Systems, there is usually a high correlation, within a given water body, between the nature of the substrate and the number of species and individuals.

Cobble-Gravel (UB1). The unconsolidated particles smaller than stones are predominantly cobbles and gravel, although finer sediments may be intermixed.

Sand (UB2). The unconsolidated particles smaller than stones are predominantly sand, although finer or coarser sediments may be intermixed.

Mud (UB3). The unconsolidated particles smaller than stones are predominantly silt and clay, although coarser sediments or organic material may be intermixed. Organisms living in mud must be able to adapt to low oxygen concentrations.

Organic (UB4). The unconsolidated material smaller than stones is predominantly organic; there is no minimum depth requirement. The organic material is dead plant tissue in varying stages of decomposition. The number of species is limited and faunal productivity is very low.

Aquatic Bed (AB). The Class "Aquatic Bed" includes wetlands where plants that grow principally on or below the surface of the water are the uppermost life form layer with at least 30 percent areal coverage. Plants include submerged or floating-leaved rooted vascular plants, freefloating vascular plants, submergent mosses, and algae. They are best developed in relatively permanent water or under conditions of repeated flooding. The plants are attached to the substrate, and float freely on, or beneath, the water surface.

Algal (AB1). In these Aquatic Beds, algae have the greatest areal coverage. The stoneworts *Chara, Nitella,* and *Tolypella* are examples of algae that look much like vascular plants and may grow in similar situations. Other algae bearing less resemblance to vascular plants are also common. Mats of filamentous algae may cover the bottom in dense blankets, and may rise to the surface under certain conditions, or may become stranded on Unconsolidated or Rocky Shores.

Aquatic Moss (AB2). In this Subclass, aquatic mosses have the greatest areal coverage. Aquatic mosses are far less common than algae or vascular plants. Aquatic Moss Beds occur primarily in the Riverine System and in Permanently Flooded and Intermittently Exposed parts of some Lacustrine systems. The most important genera such as *Fissidens, Drepanocladus,* and *Fontinalis*. *Fontinalis* may grow to depths as great as 120 meters

(394 feet). For simplicity, aquatic liverworts of the genus *Marsupella* are included in this Subclass.

Rooted Vascular (AB3). In this Subclass, rooted vascular plants have the greatest areal coverage. In the Riverine, Lacustrine, and Palustrine Systems, rooted vascular submergent plants occur at all depths within the photic zone. They often occur in sheltered areas where there is little water movement. However, they also occur in the flowing water of the Riverine System, where they may be streamlined or flattened in response to high water velocities. Typical genera include pondweeds (*Potamogeton*), horned pondweed (*Zannichellia palustris*), eelgrass (*Valisneria americana*), and waterweed (*Elodea*). The riverweed (*Podostemum ceratophyllum*) is included in this Class despite its lack of truly recognizable roots.

Some rooted vascular aquatic plants have floating leaves. Typical dominants include water lilies (*Nymphaea, Nuphar*), floating-leaf pondweed (*Potamogeton natans*), and water shield (*Brasenia schreberi*). Plants such as yellow water lily (*Nuphar lutea*) and water smartweed (*Polygonum amphibium*), which may stand erect above the water surface or substrate, may be considered either emergents or rooted vascular aquatic plants, depending on the life form adopted at a particular site.

Floating Vascular (AB4). In this Subclass, vascular plants that float freely on or below the water surface have the greatest areal coverage. Floating Vascular Beds occur in the Lacustrine, Palustrine, and Riverine Systems. Dominant plants that float on the surface include the duckweeds (*Lemna, Spirodela*) and mosquito ferns (*Azolla*). These plants are found primarily in protected portions of slow-flowing rivers and in the Lacustrine and Palustrine Systems. They are easily moved about by wind or water currents. Dominant types for beds floating below the surface include bladderworts (*Utricularia*), coontails (*Ceratophyllum*), and watermeal (*Wolffia*).

Streambed (SB). The Class Streambed includes all wetlands contained within the Intermittent Subsystem of the Riverine System. Streambeds vary greatly in substrate and form depending on the gradient of the channel, the velocity of the water, and the sediment load. The substrate material frequently changes abruptly between riffles and pools, and complex patterns of bars may form on the convex side of single channels or be included as islands within the bed of braided streams. In mountainous areas the entire channel may be cut through bedrock. In most cases streambeds are not vegetated because of the scouring effect of moving water, but, like Unconsolidated Shores, they may be colonized by “pioneer” annuals or perennials during periods of low flow or they may have perennial emergents and shrubs that are too scattered to qualify the area for classification as Emergent Wetland or Scrub-Shrub Wetland.

Vegetated (SB7). These Streambeds are exposed long enough to be colonized by pioneer plants that, unlike Emergent Wetland plants or Scrub-Shrub Wetland plants, are usually killed by rising water levels. Many of the pioneer species are weedy mesophytes or xerophytes. At least 30 percent cover of pioneer plants is required. Common panic grass (Panicum capillare) is a typical species in the Riverine System.

Unconsolidated Shore (US). The Class Unconsolidated Shore includes wetland habitats having three characteristics: (1) unconsolidated substrates with less than 75 percent areal cover of stones, boulders, or bedrock; (2) less than 30 percent areal cover of vegetation other than pioneering plants; and (3) any of the following water regimes: irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, intermittently flooded, saturated, or artificially flooded. Note that intermittent channels of the Riverine System are classified as Streambed.

Unconsolidated Shores are characterized by substrates lacking vegetation except for pioneer plants that become established during brief periods when growing conditions are favorable. Erosion and deposition by waves and currents produce a number of landforms such as beaches, bars, and flats, all of which are included in this Class. Unconsolidated Shores are commonly found adjacent to Unconsolidated Bottoms in all Systems; in the Palustrine and Lacustrine Systems, the Class may occupy the entire basin. As in Unconsolidated Bottoms, the particle size of the substrate and the water regime are the important factors determining the types of plant and animal communities present. Different substrates usually support characteristic invertebrate fauna. Faunal distribution is controlled by waves, currents, interstitial moisture, water quality, and grain size.

Cobble-Gravel (US1). The unconsolidated particles smaller than stones are predominantly cobbles and gravel. Shell fragments, sand, and silt often fill the spaces between the larger particles. Stones and boulders may be found scattered on some Cobble-Gravel Shores. In areas of strong wave and current action these shores take the form of beaches or bars, but occasionally they form extensive flats.

Sand (US2). The unconsolidated particles smaller than stones are predominantly sand, although finer or coarser sediments may be intermixed. Sand may be either calcareous or terrigenous in origin. Sand shores are a prominent feature of the Riverine, and Lacustrine Systems where the substrate material is exposed to the sorting and washing action of waves.

Mud (US3). The unconsolidated particles smaller than stones are predominantly silt and clay, although coarser sediments or organic material may be intermixed. Anaerobic conditions often exist below the surface. Mud Shores have a higher organic content than Cobble-Gravel or Sand Shores. They are typically found in areas of minor wave action. They tend to have little slope and are frequently called flats. Mud Shores support diverse populations of tube-dwelling and burrowing invertebrates that include worms, clams, and crustaceans. They are commonly colonized by algae and diatoms that may form a crust or mat. Mud Shores may also result from removal of vegetation by man, animals, or fire, or from the discharge of thermal waters or pollutants.

Organic (US4). The unconsolidated material smaller than stones is predominantly organic; there is no minimum depth requirement. The organic material is dead plant tissue in varying stages of decomposition.

Vegetated (US5). Some Unconsolidated Shores are exposed for a sufficient period to be colonized by pioneer plants that, unlike Emergent Wetland plants or Scrub-Shrub Wetland plants, are usually killed by rising water levels. Many of the pioneer species are weedy mesophytes or xerophytes. At least 30 percent cover of pioneer plants is required. Examples of dominant types are rough cocklebur (*Xanthium strumarium*) and large barnyard grass (*Echinochloa crusgalli*).

Moss-Lichen Wetland (ML). The Moss-Lichen Wetland Class includes areas where mosses or lichens cover at least 30 percent of substrates other than rock and where emergents, shrubs, or trees alone or in combination cover less than 30 percent. Mosses and lichens are important components of the flora in many wetlands, but these plants usually form a ground cover under a dominant layer of trees, shrubs, or emergents. In some instances, higher plants are uncommon and mosses or lichens dominate the flora. Moss-Lichen Wetlands are rare in West Virginia.

Moss (ML1). The areal coverage of mosses, typically peatmoss (*Sphagnum*), exceeds that of lichens.

Lichen (ML2). The areal coverage of lichens, typically reindeer lichen (*Cladina, Cladonia*) exceeds that of mosses.

Emergent Wetland (EM). In this Class, emergent plants—i.e., erect, rooted, herbaceous hydrophytes, excluding mosses and lichens—are the tallest life form with at least 30% areal coverage. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants. Emergent Wetlands are known by many names, including marsh, wet meadow, fen, and slough. Areas that are dominated by pioneer plants, which become established during periods of low water, are not Emergent Wetlands and should be classified as Vegetated Unconsolidated Shores or Vegetated Streambeds.

Persistent (EM1). The areal coverage of persistent emergents exceeds that of nonpersistent emergents. Persistent emergents are emergent hydrophytes whose stems and leaves are evident all year above the surface of the water or above the soil surface if water is absent. Persistent Emergent Wetlands occur only in the Palustrine System. Palustrine Persistent Emergent Wetlands contain a vast array of grasslike plants such as cattails (*Typha*), bulrushes (*Scirpus*), sedges (*Carex*); and true grasses such as manna grasses (*Glyceria*). There is also a variety of broad-leaved persistent emergents such as purple loosestrife (*Lythrum salicaria*) and some species of smartweeds (*Polygonum*).

Nonpersistent (EM2). The areal coverage of nonpersistent emergents exceeds that of persistent emergents. Nonpersistent emergents are emergent hydrophytes whose stems and leaves are evident above the water surface, or above the soil surface if surface water is absent, only during the growing season or shortly thereafter. During the dormant season, there is no obvious sign of emergent vegetation. Nonpersistent Emergent Wetlands occur in all nontidal Systems. Nonpersistent emergents also include species such as green arrow arum (*Peltandra virginica*), pickerelweed (*Pontederia cordata*), and arrowheads (*Sagittaria*). Movement of ice in Riverine or Lacustrine Systems can remove all traces of emergent vegetation during the winter. Where this occurs, the area should be classified as Nonpersistent Emergent Wetland.

Phragmites (EM5). Wetlands in this subclass are dominated by common reed (*Phragmites australis*).

Scrub-Shrub Wetland (SS). In Scrub-Shrub Wetlands, woody plants less than 6 meters (20 feet) tall are the dominant life form—i.e., the tallest life form with at least 30 percent areal coverage. The "shrub" life form actually includes true shrubs, young specimens of tree species that have not yet reached 6 meters (20 feet) in height, and woody plants (including tree species) that are stunted because of adverse environmental conditions. Scrub-Shrub Wetlands may represent a successional stage leading to Forested Wetland, or they may be relatively stable communities. They occur only in the Palustrine System. Scrub-Shrub Wetlands are known by many names, such as shrub swamp, shrub carr, bog, or fen. For practical reasons we have also included stands of young trees less than 6 meters (20 feet) tall.

Broad-leaved Deciduous (SS1). In this Subclass, broad-leaved deciduous species have the greatest areal coverage within the shrub layer. In the Palustrine System, typical species are alders (*Alnus*), willows (*Salix*), buttonbush (*Cephalanthus occidentalis*), and meadowsweet (*Spiraea alba*).

Needle-leaved Deciduous (SS2). In this Subclass, needle-leaved deciduous species have the greatest areal coverage within the shrub layer. Young stands of Larch (*Larix laricina*) saplings at Cranesville Swamp are an example.

Broad-leaved Evergreen (SS3). In this Subclass, broad-leaved evergreen species have the greatest areal coverage within the shrub layer. In the Palustrine System, the broadleaved evergreen species are typically found on organic soils. Characteristic broad-leaved evergreen species in West Virginia include great laurel (*Rhododendron maximum*) and mountain laurel (*Kalmia latifolia*).

Needle-leaved Evergreen (SS4). In this Subclass, needle-leaved evergreen species have the greatest areal coverage within the shrub layer. Examples of dominant types include young or stunted red spruce (*Picea rubens*) and pitch pine (*Pinus rigida*).

Dead (SS5). This Subclass includes stands of dead woody plants less than 6 meters (20 feet) tall, regardless of their density, with less than 30 percent cover of living vegetation. If living vegetation equals or exceeds 30 percent in such stands, the Class and Subclass are based on the dominant life form of the living plants. Dead Scrub-Shrub Wetlands are usually produced by a prolonged rise in the water level resulting from impoundment by beavers or humans. Such wetlands may also result from fire, insect infestation, air pollution, or herbicides.

Deciduous (SS6). A wetland plant community where deciduous shrubs or woody vegetation less than 6 meters (20 feet) tall represents the dominant spatial coverage.

Evergreen (SS7). A wetland plant community where evergreen shrubs or woody vegetation less than 6 meters (20 feet) tall represents the dominant spatial coverage.

Forested Wetland (FO). In Forested Wetlands, trees are the dominant life form—i.e., the tallest life form with at least 30 percent areal coverage. Trees are defined as woody plants at least 6 meters (20 feet) in height. Forested Wetlands occur only in the Palustrine System in West Virginia and normally possess an overstory of trees, an understory of young trees or shrubs, and an herbaceous layer.

Broad-leaved Deciduous (FO1). In this Subclass, broad-leaved deciduous species have the greatest areal coverage in the tree layer. Common dominant species include red maple (*Acer rubrum*), American elm (*Ulmus americana*), ash (*Fraxinus pennsylvanica and F. nigra*), black gum (*Nyssa sylvatica*), pin oak (*Quercus palustris*), and swamp white oak (*Quercus bicolor*). Wetlands in this Subclass generally occur on mineral soils or highly decomposed organic soils (muck).

Needle-leaved Deciduous (FO2). In this Subclass, needle-leaved deciduous species have the greatest areal coverage in the tree layer. This subclass includes larch (*Larix laricina*) swamps.

Broad-Leaved Evergreen (FO3). In this Subclass, broad-leaved evergreen species have the greatest areal coverage in the tree layer. This subclass is not known to be present in West Virginia.

Needle-leaved Evergreen (FO4). In this Subclass, needle-leaved evergreen species have the greatest areal coverage in the tree layer. Red spruce, growing on nutrient-poor organic soils, represents a major dominant of this subclass in West Virginia.

Dead (FO5). This Subclass includes stands of dead woody plants 6 meters (20 feet) in height or taller, regardless of their density, with less than 30 percent cover of living vegetation. If living vegetation equals or exceeds 30 percent in such stands, the Class and Subclass are based on the dominant life form of the living plants. Dead Forested Wetlands, like Dead ScrubShrub Wetlands, are most common in, or around the edges of, man-made impoundments and beaver ponds. The same factors that produce Dead Scrub-Shrub Wetlands produce Dead Forested Wetlands.

Deciduous (FO6). A wetland plant community where deciduous tree species 6 meters (20 feet) tall or taller represent the dominant spatial coverage.

Evergreen (FO7). A wetland plant community where evergreen tree species 6 meters (20 feet) tall or taller represent the dominant spatial coverage.

6.2.3 Tips on distinguishing NWI classes and subclasses

If living vegetation (except pioneer species) covers 30 percent or more of the substrate, then Classes are distinguished on the basis of the life form of the plants that constitute the uppermost layer of vegetation and that possess an aerial coverage 30 percent or greater. For example, an area with 30 percent cover of trees and 60% cover of shrubs is classified as Forested Wetland; an area with 20 percent areal coverage of trees over the same (60 percent) shrub layer is classified as Scrub-Shrub Wetland. When trees or shrubs alone cover less than 30 percent of an area but in combination cover 30 percent or more, the wetland is classified as Scrub-Shrub Wetland. When trees and shrubs cover less than 30 percent of the area but the total cover of vegetation (except pioneer species) is 30 percent or greater, the wetland is assigned to the appropriate Class for the predominant life form below the shrub layer.

When the height of two or more plant life forms in an area is equal, and each covers 30 percent or more of the area, the Class is based on the life form that has the greater cover. If the cover of the life forms is equal, then the Class is based on the life form that is more persistent. If the life forms are equally persistent, then the Class is based on the life form that would normally be considered to be more advanced from a successional standpoint (e.g., tree > shrub > emergent plant > moss or lichen).

When an area is covered more or less uniformly by dead trees or dead shrubs—regardless of their abundance—and living vegetation covers less than 30 percent of that area, the site would be placed in either the Dead Forested Wetland Subclass or the Dead Scrub-Shrub Wetland Subclass, depending on whether dead trees or dead shrubs predominate. However, if living vegetation covers 30 percent or more of a stand of dead trees or shrubs, then the dominant life form, Class, and Subclass would be based on the living vegetation, using the rules outlined above.

If living vegetation covers less than 30 percent of the substrate, the physiography and composition of the substrate are the principal characteristics used to distinguish Classes. Substrate particle sizes include boulders, stones, cobbles, gravel, sand, silt, and alone or in combination, along with the term 'bedrock,' as Subclasses for nonvegetated wetlands.

The nature of the substrate reflects regional and local variations in geology and the influence of wind, waves, and currents on erosion and deposition of substrate materials. Bottoms, Shores, and Streambeds are separated based on duration of inundation. In the Riverine, Lacustrine, and Palustrine Systems, Bottoms are submerged all or most of the time, whereas Streambeds and Shores are exposed much of the time.

6.3 Glossary

Absolute cover: In vegetation sampling, the percentage of the ground surface that is covered by the aerial portions (leaves and stems) of a plant species when viewed from above. Due to overlapping plant canopies, the sum of absolute cover values for all species in a wetland type or stratum may exceed 100 percent. In contrast, "relative cover" is the absolute cover of a species divided by the total coverage of all species in that stratum, expressed as a percent. Absolute cover, NOT relative cover, must be used to calculate rapid floristic quality in WVWRAM.

Acid: Term applied to water or soil with a pH less than 5.5.

Aeration: The exchange of air in soils with air from the atmosphere

Alkaline: Term applied to water or soil with a pH greater than 7.4.

Assessment Area (AA): The AA is nearly always the hydrologically connected area of a wetland. AA's are separated by upland habitat or by hydrologic breaks. Examples of hydrologic breaks include stream riffles, sudden changes in elevation, dams, perched culverts, different water levels on either side of a road, constrictions to flow, any abrupt change in the water regime, streams more than 3 m (10 ft) wide, or lakes. In rare occasions, the AA will be smaller than the wetland, for example in wetlands larger than 25 acres, or for time-series monitoring of restoration sites. See also Wetland Unit definition.

Bankfull: Bankfull stage corresponds to the discharge at which stream channel maintenance is the most effective, that is, the discharge at which moving sediment, forming or removing bars, forming a changing bends and meanders, and generally doing work that results in the average morphologic characteristics of channels (Dunne and Leopold 1978). Bankfull indicators include: 1) Topographic features: berm or other break in slope; 2) Vegetation: A change in vegetation from bare ground or annual hydrophytes to perennial hydrophytes or upland species; 3) Sediment texture: a change in size distribution of surface sediments.

Bar: An elongated landform formed by waves, currents, or deposition of unconsolidated sediments such as sand, gravel, stones, cobbles, or rubble and with water on two sides.

Beach: A sloping landform on the shore of larger water bodies, generated by waves, currents, or deposition of sediments and extending from the water to a distinct break in landform or substrate type.

Brackish: Marine and Estuarine waters with Mixohaline salinity. The term should not be applied to inland waters.

Boulder: Rock fragments larger than 60.4 cm (24 inches) in diameter.

Broad-leaved deciduous: Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that are shed during the cold or dry season.

Broad-leaved evergreen: Woody angiosperms (trees or shrubs) with relatively wide, flat leaves that generally remain green and are usually persistent for a year or more.

Calcareous: Formed of calcium carbonate or magnesium carbonate by biological deposition or inorganic precipitation. Calcareous sands are usually formed of a mixture of fragments of mollusk shell, echinoderm spines and skeletal material, coral, foraminifera, and algal platelets.

Channel: An open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water.

Circumneutral: Term applied to water with a pH of 5.5 to 7.4.

Cobbles: Rock fragments 7.6 cm (3 inches) to 25.4 cm (10 inches) in diameter.

Deciduous stand: A plant community where deciduous trees or shrubs represent the dominant spatial coverage of woody vegetation.

Dominant: The species making up the majority of spatial cover.

Dormant season: The non-growing portion of the year for vegetation.

Effectively drained: A condition where ground or surface water has been removed by artificial means to the point that an area no longer meets the definition of wetland.

Emergent hydrophytes: Erect, rooted, herbaceous angiosperms that may be temporarily to permanently flooded at the base but do not tolerate prolonged inundation of the entire plant.

Emergent mosses: Mosses occurring in wetlands, but generally not covered by water.

Entrenchment ratio: The entrenchment ratio is the ratio of the width of the flood prone area of a stream to its bankfull width (Rosgen, 1994). The greater the ratio, the more entrenched a stream is within its banks. An entrenched stream lacks access to a broad floodplain, usually due to chronic incision (termed stream degradation). Severely entrenched streams have abandoned their former floodplains. In such streams, the associated riparian flora and fauna are negatively impacted, stream velocity tends to increase, adjacent groundwater levels are reduced, and erosion of the bed and banks is more likely.

Ephemeral stream: Ephemeral streams flow only in direct response to precipitation; they receive little or no water from springs, melting snow, or other sources; their channels are at all times above the water table; and the channel may be as indistinct as a vegetated swale or vegetation lying down in the direction of flow out of the wetland. Ephemeral streams have less flow than intermittent streams and are typically shallow. Ephemeral streams are normally dry for most of the year.

Eusaline: Inland water with excessive or supersaturated with inland salts.

Evergreen stand: A plant community where evergreen trees or shrubs represent the dominant spatial coverage of woody vegetation.

Exemplary Wetlands: Exemplary Wetlands are defined as wetlands that support globally rare, threatened, or endangered species or exceptionally high-quality natural communities, as documented in the WVDEP Exemplary Wetlands Database (WVDEP 2019) and the WVDNR Natural Heritage Database (WVDNR 2020). Exemplary Wetlands have a Site Biodiversity Rank of B1, B2, or B3 following criteria developed by WVDNR in cooperation with the national NatureServe network (WVDNR 2014). These criteria have also been in use since 2012 by the

West Virginia Outdoor Heritage Conservation Fund established by the West Virginia Legislature (West Virginia Legislature 1985, WVOHCF 2019). Site Biodiversity Ranks for West Virginia wetlands may be summarized as:

Site Biodiversity Rank	Significance	Associated Threat Level	Number of WV Wetlands	Exemplary Wetlands
B1	Outstanding global biodiversity significance	Globally critically imperiled	6	yes
B2	High global biodiversity significance	Globally imperiled	100	yes
B3	Global biodiversity significance	Globally vulnerable	129	yes
B4	Outstanding state biodiversity significance	Globally stable but critically imperiled at the state level	270	no
B5	State biodiversity significance	Globally stable but imperiled at the state level	518	no
B6	Local biodiversity significance	Globally stable but vulnerable at the state level	519	no
none	General habitat value	Presumed stable	41,582	no

Fibric material: Fibric material is slightly decomposed organic material. Most often the original source of the organic matter (e.g., red maple) can be identified. Fibric material has a rubbed fiber content of 40 percent or more (by volume). Soil horizons composed of fibric material are designated Oi. See also definition of *Peat*.

Flat: Flats are unconsolidated sediments found along lakes, rivers, estuarine or marine near shore areas that may be irregularly shaped or elongate and continuous with the shore.

Floating plant: A non-anchored plant that floats freely in the water or on the surface.

Floating-leaved plant: A rooted, herbaceous hydrophyte with some leaves floating on the water surface; e.g., white water lily, floating-leaved pondweed. Plants such as yellow water lily sometimes have leaves raised above the surface are considered floating-leaved plants or emergents, depending on their growth habit at a particular site.

Floodplain: The area of low-lying ground adjacent to a river, formed mainly of river sediments and subject to flooding.

Flood prone area: The area adjacent to the stream that is innundated or saturated when the elevation of the water is at twice the maximum depth at bankfull stage (Rosgen 2002). The flood prone contour is estimated as twice the maximum bankfull depth, which is estimated as the average height of the bankfull contour above the thalweg. Thalweg and bankfull contours are determined at straight reaches within the assessment area (several determinations can be made and averaged, depending on the size of the assessment area). When the flood prone contour is above the bank top, the width of the flood prone area can be too great to measure in the field. In such cases, the lateral extent of flood prone area can be estimated on an orthophoto or topographic map.

Freshwater: Term applied to water with salinity less than 0.5 parts per thousand dissolved salts.

Gravel: A mixture composed primarily of rock fragments 2 mm (0.08 inch) to 7.6 cm (3 inches) in diameter.

Ground Water: Water filling all the unblocked pores of an underlying material below the water table.

Growing season: The frost-free period or growing portion of the year. Growing season dates are determined through onsite observations of the following indicators of biological activity in a given year: (1) above-ground growth and development of vascular plants and/or (2) soil temperature. If onsite data gathering is not practical, growing season dates may be approximated by using WETS tables available from the NRCS National Water and Climate Center to determine the median dates of 28 ºF (−2.2 ºC) air temperatures in spring and fall based on long-term records gathered at the nearest appropriate National Weather Service meteorological station (Summers et al. 2017).

Haline: Term used to indicate presence of ocean salt.

Hemic material: Hemic material is partially decomposed (intermediate decomposition) organic material. It often has the look and feel of mature compost. Hemic material has a rubbed fiber content of 17 to 40 percent (by volume). Soil horizons composed of hemic material are designated Oe. See also definition of *Mucky peat*.

Herbaceous: Vegetation modifier for plants with no persistent woody tissue (stems and branches) above ground. Most species die back at the end of the growing season.


Profile of a Histosol

Histic epipedon: A surface horizon of peat, mucky peat, or muck soil with at least 12-18% organic matter by weight and ≥ 20 cm (8 in) thick, but < 40 cm (16 in) thick. Aquic conditions or artificial drainage is required.

Histosol: Peat, mucky peat, or muck soil with at least 12-18% organic matter by weight and ≥ 40 cm (16 in) thick within the upper 80 cm (32 in) of soil profile; note that the 40 cm (16 in) of organic matter is cumulative and can occur anywhere in the top 80 cm (32 in), even in stratified layering; alternatively, organic soil material of any thickness resting on rock or on fragmental material having interstices filled with organic materials.

Histosols formed in thick accumulations of organic matter from decaying plant material. The organic-dominated layers are typically at least 40 cm thick and commonly much thicker. They have a minimum of 12 to 18% organic carbon, by weight (depending on clay content), and most have significantly more than this. Histosols do not exhibit the kinds of horizons common to mineral soils but rather have layers, or tiers, that vary in color, botanical origin of the organic material, amount of mixed-in mineral soil material, degree of decomposition, and other properties. Histosols generally have significantly lower bulk density and higher nutrient- and water-holding capacities than most mineral soils (NRCS 2015). Histosol suborders that pertain to WVWRAM are characterized by decomposition of organic material under wet conditions (but not permanently submerged) and include Fibrists (peat), Saprists (muck), and Hemists (mucky peat).

Hummock: A low mound, ridge, or microtopographic high. In wet areas, plants growing on hummocks may avoid some of the hydrologic stress of inundation or shallow water tables.

Hydric soil: Soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part.

Hydrophyte, **hydrophytic**: Any plant growing in water or on a substrate that is at least periodically deficient in oxygen because of excessive water content.

Intermittent stream: Intermittent streams have flowing water periods during the wet season (winter-spring) but are normally dry during hot summer months. Intermittent streams do not have continuous flowing water year-round and are not "relatively permanent waters." Intermittent streams carry water only part of the year; they flow only when they receive water from rainfall, runoff, or springs, or from some surface source such as melting snow.

Invasive species: Non-native species that (1) are not native to, yet can spread into, natural ecosystems, and that also (2) displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes. WVDNR maintains the list of invasive plant species for West Virginia (WVDNR 2009).

Litter: Layer of recent dead plant material that lies on the surface of the soil. Litter is undecomposed or partly decomposed but still readily identifiable as leaves, stems, small twigs, or other plant material. Typically litter is less than one year old. Undecomposed litter is plant material that has not begun to decompose and has no observable evidence of decomposition. This most often occurs in woodland areas as a surface layer of loose, fluffy leaves and/or needles that can be easily brushed aside with one’s hand or blown from one area to another by a strong wind. Undecomposed litter is not considered part of the soil. When present, depth measurements for a profile description start below the undecomposed litter and at the top of the organic material that has observable evidence of decomposition, i.e., fibric, hemic, or sapric. The thickness of the litter layer may be recorded as centimeters (inches) to zero, e.g., +5 cm (+3 in) to 0.

Marl: An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal proportions, formed primarily under freshwater lacustrine conditions (USDA 2010).

Mesophyte, **mesophytic**: Any plant growing where moisture and aeration conditions lie between extremes. (Plants typically found in habitats with average moisture conditions, not usually dry or wet.)

Mesosaline: Term to characterize waters with salinity of 5 to 18 ppt land-derived salts.

Mineral soil: Soil composed of predominantly mineral rather than organic materials. Organic soil material may be present, but not enough to meet the criteria for a histosol.

Mixosaline: Term to characterize waters with salinity of 0.5 to 30 ppt land-derived salts.

Mud: Wet soft earth composed predominantly of clay and silt--fine mineral sediments less than 0.074 mm (0.0029 in) in diameter.

Muck: Dark, finely divided, well decomposed organic soil material. Muck, or sapric soil material, is the most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material. See also definition of *Sapric material.*

Mucky modified mineral soil: Mucky mineral soil is a mineral soil material that has an unusually high amount of sapric organic matter. Mucky modified mineral soil material that has 0 percent clay has between 5 and 12 percent organic carbon. Mucky modified mineral soil material that has 60 percent clay has between 12 and 18 percent organic carbon. Soils with an intermediate amount of clay have intermediate amounts of organic carbon. Where the organic component is peat (fibric material) or mucky peat (hemic material), mucky mineral soil material does not occur.

Mucky peat: Also called "hemic soil material", mucky peat is organic soil material intermediate in degree of decomposition between the less decomposed fibric material (peat) and the more decomposed sapric material (muck). See also definition of *Hemic material*.

Needle-leaved deciduous: Woody gymnosperms (trees or shrubs) with needle-shaped or scale-like leaves that are shed during the cold or dry season.

Needle-leaved evergreen: Woody gymnosperms with green, needle-shaped, or scale-like leaves that are retained by plants throughout the year.

Nonpersistent emergents: Emergent hydrophytes whose leaves and stems break down at the end of the growing season so that most aboveground portions of the plants are easily transported by currents, waves, or ice. The breakdown may result from normal decay or the physical force of strong waves or ice. At certain seasons of the year there are no visible traces of the plants above the surface of the water.

Oligosaline: Term to characterize water with salinity of 0.5 to 5.0 ppt land-derived salts.

Open water: Any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of flowing or standing water is either non-emergent, sparse, or absent. Examples of open waters include rivers, streams, lakes, and ponds.

Open water patch: For the structural patch checklist on page one of the datasheet, an open water patch is defined as a patch of surface water open to the sky that is more than 1 square meter (11 square feet) in diameter but less than 0.1 acre (the size at which it would be mapped as a separate NWI wetland type). Even small patches of open water provide important drinking water sources for bats and other species. Patches must aggregate to at least 3 square meters (32 square feet) in area.

Ordinary high water mark: The term ordinary high water mark means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas (33 CFR 328.3e).

Organic matter: Soil organic matter is any material produced originally by living organisms (plant or animal) that is returned to the soil and goes through the decomposition process. At any given time, it consists of a range of materials from the intact original tissues of plants and animals to substantially decomposed tissues.

Organic soil: In wetlands, a soil that contains enough organic soil material to meet the criteria for a histosol. See definition of *Histosol*.

Organic soil material: Soil composed of predominantly organic rather than mineral material. The organic material is made up of plant and animal residue in the soil in various stages of decomposition. Organic soil material associated with wetland soils and, excluding live roots, has 18 percent or more organic carbon with 60 percent or more clay or 12 percent or more organic carbon with 0 percent clay. Soils with an intermediate amount of clay have an intermediate amount of organic carbon.

Peat: Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. Peat, or fibric soil material, is the least decomposed of all organic soil material. Peat contains a large amount of well-preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material. See also definition of *Fibric material*.

Perennial stream: see Relatively permanently-flowing stream.

Permanently-flowing stream: see Relatively permanently-flowing stream.

Persistent emergent: Emergent hydrophytes that normally remain standing at least until the beginning of the next growing season.

pH value: PH is a numerical designation of acidity or alkalinity in water or soil.

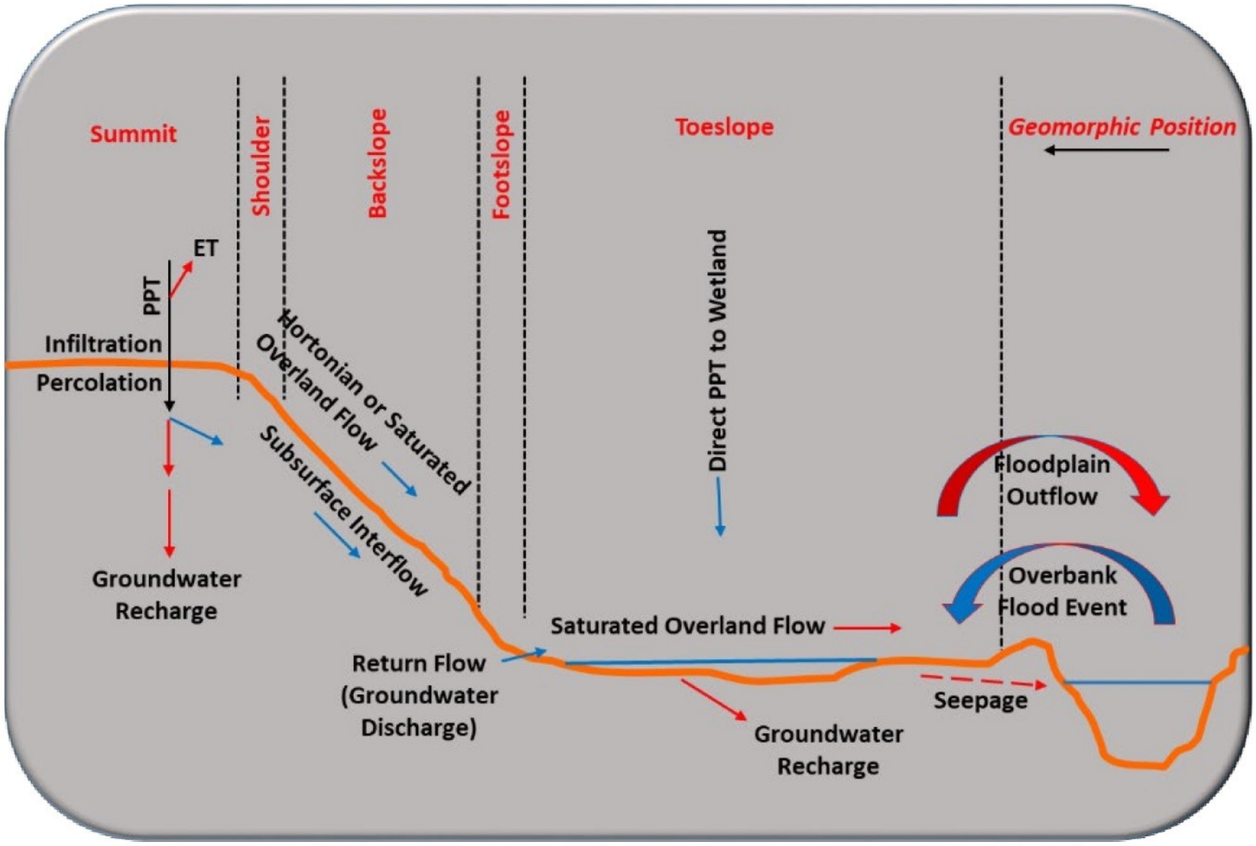
Pioneer plants: Herbaceous annual and seedling perennial plants that colonize areas as a first stage in secondary succession.

Photic zone: The extent (depth) that sunlight penetrates a water column.

Polysaline: Term to characterize water with salinity of 18 to 30 ppt due to land-derived salts.

Relatively permanently-flowing stream: Perennial stream with continuous flow in parts of its stream bed throughout the year during years of normal rainfall. The stream channel typically has a channel bed, banks, and ordinary high-water marks.

Return flow: Groundwater discharge at the base of a slope (see diagram).



Saline: General term for waters containing various dissolved salts. Restricted to description of inland waters where the ratios of the salts often vary; the term haline is applied to estuarine and marine waters where the salts are roughly in the same proportion as found in undiluted seawater.

Salinity: Salinity is the total amount of dissolved salt in grams in one kilogram of seawater, usually reported in parts per thousand.

Sand: Composed predominantly of coarse-grained mineral sediments with diameters larger than 0.074 mm (0.0029 in) and smaller than 2 mm (0.079 in).

Sapric material: Sapric material is highly decomposed organic material. It most often has a black or a very dark reddish black color with a massive or solid appearance. Sapric material has rubbed fiber content of less than 17 percent (by volume). Soil horizons composed of sapric material are designated Oa. See also definition of *Muck.*

Shrub: A woody plant that, at maturity, is usually less than 6 meters (20 feet) tall and generally exhibits several erect, spreading, or prostrate stems.

Rubble: Rock fragments larger than 25 cm (10 inches) but less than 60 cm (24 inches).

Submergent plant: A vascular or nonvascular hydrophyte, either rooted or non-rooted, which lies entirely beneath the water surface, except for flowering parts in some species; e.g., wild celery or the stoneworts.

Terrigenous: Derived from or originating on the land (usually referring to sediments) as opposed to material or sediments produced in the ocean (marine) or because of biologic activity (biogenous).

Thalweg: A line connecting the lowest points along the length of a riverbed. It can be quite sinuous and wander within the channel. It is sometimes referred to as the “low flow channel”.

Tree: A woody plant which at maturity is usually 6 meters (20 feet) or more in height and generally has a single trunk, unbranched for 1 meter (3.3 feet) or more above the ground, and a more or less definite crown.

Tussock: A plant growth form, generally in grasses or sedges, in which plants grow in tufts or clumps bound together by roots and elevated above the substrate.

Understory trees: Young trees or lower-stature trees that grow below the forest canopy, but above the shrub layer.

Water table: The upper surface of a zone of saturation.

Wetland Unit: The hydrologically connected area of a wetland. Wetland Units are separated by upland habitat or by hydrologic breaks. Examples of hydrologic breaks include stream riffles, sudden changes in elevation, dams, perched culverts, different water levels on either side of a road, constrictions to flow, any abrupt change in the water regime, streams greater than 3 m (10 ft) wide, and lakes. In most cases, the Wetland Unit is equivalent to the Assessment Area.

Woody plant: A seed plant (gymnosperm or angiosperm) that develops persistent, hard, fibrous tissues and includes species of trees and shrubs.

6.4 Field reference sheets and field forms

Field reference sheets and field forms are included on the following pages.

NWI Wetlands and Deepwater Map Code Diagram

System: M - Marine

Subsystem: 1 - Subtidal

- Class: RB – Rock Bottom
  - Subclass: 1 Bedrock; 2 Rubble
- Class: UB – Unconsolidated Bottom
  - Subclass: 1 Cobble-Gravel; 2 Sand; 3 Mud
- Class: AB – Aquatic Bed
  - Subclass: 1 Algal; 3 Rooted Vascular
- Class: RF – Reef
  - Subclass: 1 Coral; 3 Worm

Subsystem: 2 - Intertidal

- Class: AB – Aquatic Bed
  - Subclass: 1 Algal; 3 Rooted Vascular
- Class: RF – Reef
  - Subclass: 1 Coral; 3 Worm
- Class: RS – Rocky Shore
  - Subclass: 1 Bedrock; 2 Rubble
- Class: US – Unconsolidated Shore
  - Subclass: 1 Cobble-Gravel; 2 Sand; 3 Mud; 4 Organic

System: E - Estuarine

Subsystem: 1 - Subtidal

- Class: RB – Rock Bottom
  - Subclass: 1 Bedrock; 2 Rubble
- Class: UB – Unconsolidated Bottom
  - Subclass: 1 Cobble-Gravel; 2 Sand; 3 Mud; 4 Organic
- Class: AB – Aquatic Bed
  - Subclass: 1 Algal; 3 Rooted Vascular; 4 Floating Vascular
- Class: RF – Reef
  - Subclass: 2 Mollusk; 3 Worm

Subsystem: 2 - Intertidal

- Class: AB – Aquatic Bed
  - Subclass: 1 Algal; 3 Rooted Vascular; 4 Floating Vascular
- Class: RF – Reef
  - Subclass: 2 Mollusk; 3 Worm
- Class: SB – Streambed
  - Subclass: 1 Bedrock; 2 Rubble; 3 Cobble-Gravel; 4 Sand; 5 Mud; 6 Organic
- Class: RS – Rocky Shore
  - Subclass: 1 Bedrock; 2 Rubble
- Class: US – Unconsolidated Shore
  - Subclass: 1 Cobble-Gravel; 2 Sand; 3 Mud; 4 Organic
- Class: EM – Emergent
  - Subclass: 1 Persistent; 2 Non-persistent; 5 *Phragmites australis*
- Class: SS – Scrub-Shrub
  - Subclass: 1 Broad-Leaved Deciduous; 2 Needle-Leaved Deciduous; 3 Broad-Leaved Evergreen; 4 Needle-Leaved Evergreen; 5 Dead; 6 Deciduous; 7 Evergreen
- Class: FO – Forested
  - Subclass: 1 Broad-Leaved Deciduous; 2 Needle-Leaved Deciduous; 3 Broad-Leaved Evergreen; 4 Needle-Leaved Evergreen; 5 Dead; 6 Deciduous; 7 Evergreen

System: R - Riverine

Subsystem: 1 - Tidal; 2 – Lower Perennial; 3 – Upper Perennial; 4* - Intermittent

- Class: RB** – Rock Bottom
  - Subclass: 1 Bedrock; 2 Rubble
- Class: UB – Unconsolidated Bottom
  - Subclass: 1 Cobble-Gravel; 2 Sand; 3 Mud; 4 Organic
- Class: AB – Aquatic Bed
  - Subclass: 1 Algal; 2 Aquatic Moss; 3 Rooted Vascular; 4 Floating Vascular
- Class: SB***– Streambed
  - Subclass: 1 Bedrock; 2 Rubble; 3 Cobble-Gravel; 4 Sand; 5 Mud; 6 Organic; 7 Vegetated
- Class: RS – Rocky Shore
  - Subclass: 1 Bedrock; 2 Rubble
- Class: US – Unconsolidated Shore
  - Subclass: 1 Cobble-Gravel; 2 Sand; 3 Mud; 4 Organic; 5 Vegetated
- Class: EM – Emergent
  - Subclass: 2 Nonpersistent

* **Intermittent** is limited to the **Streambed** Class;
** **Rock Bottom** is not permitted for the **Lower Perennial** Subsystem;
*** **Streambed** is limited to **Tidal** and **Intermittent** Subsystems

Classification of Wetlands and Deepwater Habitats of the United States, Cowardin *et al.* 1979

August, 2015

NWI Wetlands and Deepwater Map Code Diagram

System: L - Lacustrine

Subsystem: 1 - Limnetic

Class	RB – Rock Bottom	UB – Unconsolidated Bottom	AB – Aquatic Bed
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular

Subsystem: 2 - Littoral

Class	RB – Rock Bottom	UB – Unconsolidated Bottom	AB – Aquatic Bed	RS – Rocky Shore	US – Unconsolidated Shore	EM – Emergent
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent

System: P - Palustrine

Class	RB – Rock Bottom	UB – Unconsolidated Bottom	AB – Aquatic Bed	US – Unconsolidated Shore	ML – Moss-Lichen	EM – Emergent	SS – Scrub-Shrub	FO – Forested
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	1 Moss 2 Lichen	1 Persistent 2 Nonpersistent 5 *Phragmites australis*	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen

MODIFIERS

In order to more adequately describe the wetland and deepwater habitats, one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy.

Water Regime			Special Modifiers	Water Chemistry		Soil
Nontidal	**Saltwater Tidal**	**Freshwater Tidal**		**Halinity/Salinity**	**pH Modifiers for Fresh Water**	
A Temporarily Flooded	L Subtidal	S Temporarily Flooded- Fresh Tidal	b Beaver	1 Hyperhaline / Hypersaline	a Acid	g Organic
B Seasonally Saturated	M Irregularly Exposed	Q Regularly Flooded-Fresh Tidal	d Partly Drained/Ditched	2 Euhaline / Eusaline	t Circumneutral	n Mineral
C Seasonally Flooded	N Regularly Flooded	R Seasonally Flooded-Fresh Tidal	f Farmed	3 Mixohaline / Mixosaline (Brackish)	i Alkaline	
D Continuously Saturated	P Irregularly Flooded	T Semipermanently Flooded-Fresh Tidal	m Managed	4 Polyhaline		
E Seasonally Flooded / Saturated		V Permanently Flooded-Fresh Tidal	h Diked/Impounded	5 Mesohaline		
			r Artificial Substrate	6 Oligohaline		
F Semipermanently Flooded			s Spoil	0 Fresh		
G Intermittently Exposed			x Excavated			
H Permanently Flooded						
J Intermittently Flooded						
K Artificially Flooded						

NWI Water Regime Restriction Table

Class/Subclass	Code	Marine Subtidal M1	Marine Intertidal M2	Estuarine Subtidal E1	Estuarine Intertidal E2	Riverine Tidal R1	Riverine Lower Perennial R2	Riverine Upper Perennial R3	Riverine Intermittent R4	Lacustrine Limnetic L1	Lacustrine Littoral L2	Palustrine P
ROCK BOTTOM	RB	L		L		T V		F G H		V G H K	T V F G H K	F G H K
Bedrock	RB1	L		L		T V		F G H		V G H K	T V F G H K	F G H K
Rubble	RB2	L		L		T V		F G H		V G H K	T V F G H K	F G H K
UNCONSOLIDATED BOTTOM	UB	L		L		T V	F G H	F G H		V G H K	T V F G H K	T V F G H K
Cobble-Gravel	UB1	L		L		T V	F G H	F G H		V G H K	T V F G H K	T V F G H K
Sand	UB2	L		L		T V	F G H	F G H		V G H K	T V F G H K	T V F G H K
Mud	UB3	L		L		T V	F G H	F G H		V G H K	T V F G H K	T V F G H K
Organic	UB4			L		T V	F G H			V G H K	T V F G H K	T V F G H K
AQUATIC BED	AB	L	M N	L	M N	Q T V	C F G H	C F G H		V G H K	Q T V C F G H K	R T V C F G H K
Algal	AB1	L	M N	L	M N	T V	F G H	F G H		V G H K	T V F G H K	T V F G H K
Aquatic Moss	AB2					T V	F G H	F G H		V G H K	T V F G H K	T V F G H K
Rooted Vascular	AB3	L	M	L	M	Q T V	C F G H	C F G H		V G H K	Q T V C F G H K	R T V C F G H K
Floating Vascular	AB4			L	M N	Q T V	C F G H	C F G H		V G H K	Q T V C F G H K	R T V C F G H K
REEF	RF	L	M N	L	M N							
Coral	RF1	L	M N									
Mollusk	RF2			L	M N							
Worm	RF3	L	M N	L	M N							
STREAMBED	SB				M N P	Q			A C J			
Bedrock	SB1				M N P	Q			A C J			
Rubble	SB2				M N P	Q			A C J			
Cobble-Gravel	SB3				M N P	Q			A C J			
Sand	SB4				M N P	Q			A C J			
Mud	SB5				M N P	Q			A C J			
Organic	SB6				M N P	Q			C			
Vegetated	SB7								A C J			
ROCKY SHORE	RS		M N P		M N P	Q	A C	A C			Q A C J K	
Bedrock	RS1		M N P		M N P	Q	A C	A C			Q A C J K	
Rubble	RS2		M N P		M N P	Q	A C	A C			Q A C J K	
UNCONSOLIDATED SHORE	US		M N P		M N P	Q	A C E J	A C E J			Q A C E J K	R S A C E J K
Cobble-Gravel	US1		M N P		M N P	Q	A C J	A C J			Q A C J K	R S A C J K
Sand	US2		M N P		M N P	Q	A C J	A C J			Q A C J K	R S A C J K
Mud	US3		M N P		M N P	Q	A C J	A C J			Q A C J K	R S A C J K
Organic	US4		M N P		M N P	Q	E	E			Q E	E
Vegetated	US5						A C J	A C J			Q A C J K	A C J K

Saltwater Tidal = **BROWN** Water Regimes; Freshwater Tidal = **BLUE** Water Regimes; Nontidal = **RED** Water Regimes.

Class/Subclass	Code	Marine Subtidal M1	Marine Intertidal M2	Estuarine Subtidal E1	Estuarine Intertidal E2	Riverine Tidal R1	Riverine Lower Perennial R2	Riverine Upper Perennial R3	Riverine Intermittent R4	Lacustrine Limnetic L1	Lacustrine Littoral L2	Palustrine P
MOSS-LICHEN	ML											B C D E
Moss	ML1											B C D E
Lichen	ML2											B C D E
EMERGENT												
Persistent	EM1				N P							R S T A B C D E F J K
Non persistent	EM2				N P	Q T V	F G H				Q T V F G H K	T V F G H K
Phragmites australis	EM5				P							R S T A B C D E F K
SCRUB-SHRUB												
Broad-Leaved Deciduous	SS1				P							R S T A B C D E F J K
Needle-Leaved Deciduous	SS2				P							R S T A B C D E F J K
Broad-Leaved Evergreen	SS3				N P							R S A B C D E K
Needle-Leaved Evergreen	SS4				P							R S A B C D E K
Dead	SS5				M N P							T V F G H K
Deciduous	SS6				P							R S T A B C D E F J K
Evergreen	SS7				N P							R S A B C D E K
FORESTED												
Broad-Leaved Deciduous	FO1				P							R S T A B C D E F K
Needle-Leaved Deciduous	FO2				P							R S T A B C D E F K
Broad-Leaved Evergreen	FO3				N P							R S A B C D E K
Needle-Leaved Evergreen	FO4				P							R S A B C D E K
Dead	FO5				M N P							T V F G H K
Deciduous	FO6				P							R S T A B C D E F K
Evergreen	FO7				N P							R S A B C D E K

Saltwater Tidal = **BROWN** Water Regimes; Freshwater Tidal = **BLUE** Water Regimes; Nontidal = **RED** Water Regimes.

NWI Water Regime Nontidal Modifiers

Temporarily Flooded (A) 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 the most of the season.

Seasonally Saturated (B). 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.

Seasonally Flooded (C). 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.

Continuously Saturated (D) 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.

Seasonally Flooded-Saturated (E) 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.

Semipermanently Flooded (F). 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.

Intermittently Exposed (G) Water covers the substrate throughout the year except in years of extreme drought.

Permanently Flooded (H) Water covers the substrate throughout the year in all years.

Intermittently Flooded (J) 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 Water Regime may change as soil moisture conditions change. Some areas exhibiting this Water Regime do not fall within our definition of wetland because they do not have hydric soils or support hydrophytes. This Water Regime is generally limited to the arid West.

Artificially Flooded (K) 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 Water 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 pasturelands supplied by diversion ditches or artesian wells, are included under this Modifier. The Artificially Flooded Water Regime Modifier should not be used in the Riverine system or for impoundments or excavated wetlands unless both water inputs and outputs are controlled to achieve a specific depth and duration of flooding.

Determining Soil Texture by the "Feel Method"

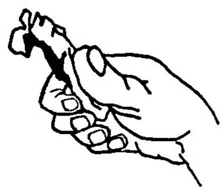
Texture Classification
C = Coarse
MC = Moderately Coarse
M = Medium
F = Fine

Start

Place approximately one tablespoon of soil in palm. Add water a drop at a time and knead the soil to break down all aggregates. Soil is at the proper consistency when plastic and mobile, like moist putty.

Does soil remain in a ball when squeezed?
- NO → Is the soil to dry?
  - YES → Place approximately one tablespoon of soil in palm…
  - NO → Is the soil too wet?
    - YES → Add dry soil to soak up water. → Place approximately one tablespoon of soil in palm…
    - NO 0 -10% ** → SAND C*
- YES ↓

Place ball of soil between thumb and forefinger, gently pushing the soil with the thumb, working it upward into a ribbon. Form a ribbon of uniform thickness and width. Allow the ribbon to emerge and extend over the forefinger, breaking from its own weight.



Does the soil form a ribbon?
- NO 0 -15% ** → LOAMY SAND C *
- YES ↓

Does the soil make a weak ribbon less than 1" long before breaking?
- NO → Does the soil make a medium ribbon 1" to 2" long before breaking?
  - NO → Does the soil make a strong ribbon 2" or longer before breaking?

Weak ribbon — YES: Excessively wet a small pinch of soil in palm of hand and rub with forefinger.
- Does the soil feel very gritty? YES 0-20% → Sandy Loam MC
- NO → Does the soil feel very smooth? YES 0-27% → Silt or Silt/ Loam M
- NO → Neither grittiness nor smoothness predominates. YES 7-27% → Loam M

Medium ribbon — YES: Excessively wet a small pinch of soil in palm of hand and rub with forefinger.
- Does the soil feel very gritty? YES 20-35% → Sandy Clay Loam MC
- NO → Does the soil feel very smooth? YES 27-40% → Silty Clay Loam F
- NO → Neither grittiness nor smoothness predominates YES 27-40% → Clay Loam F

Strong ribbon — YES: Excessively wet a small pinch of soil in palm of hand and rub with forefinger.
- Does the soil feel very gritty? YES 35-55% → Sandy Clay MC
- NO → Does the soil feel very smooth? YES 40-60% → Silty Clay F
- NO → Neither grittiness nor smoothness predominates YES 40-100% → Clay F

* Sand Particle size should be estimated (very fine, fine, medium, coarse) for these textures. Individual grains of very fine sand are not visible without magnification and there is a gritty feeling to a very small sample ground between the teeth. Some fine sand particles may be just visible. Medium sand particles are easily visible. Examples of sand size descriptions where one size is predominant are; very fine sand, fine sandy loam, loamy coarse sand.

** Cay percentage range.

Modified from: Thien, Steven J., Kansas state University, 1979 Jour. Agronomy education.

Field Test for Determining the Kind of Organic Matter

Being able to estimate the amount and describe the kind of organic matter in the soil are essential skills needed by a wetland scientist when making a hydric soil determination. The organic matter content in a soil is expressed as either organic carbon or organic matter (by dry weight). The correction factor for converting organic carbon to organic matter is approximately 1.7.

Soil material is divided into 3 categories depending upon the organic matter content within the soil: organic soil material, mineral soil material, and mucky mineral soil. **Organic soil material** associated with wetland soils and, excluding live roots, has 18 percent or more organic carbon with 60 percent or more clay or 12 percent or more organic carbon with 0 percent clay. Soils with an intermediate amount of clay have an intermediate amount of organic carbon. **Mineral soil material** has a higher mineral content and less organic matter than organic soil material. Mucky mineral soil is a mineral soil material that has an unusually high amount of sapric organic matter. Mucky modified mineral soil material that has 0 percent clay has between 5 and 12 percent organic carbon. Mucky modified mineral soil material that has 60 percent clay has between 12 and 18 percent organic carbon. Soils with an intermediate amount of clay have intermediate amounts of organic carbon. Where the organic component is peat (fibric material) or mucky peat (hemic material), mucky mineral soil material does not occur.

Depending on the degree of decomposition, soil organic matter is classified into four categories: undecomposed litter, fibric, hemic, or sapric material. The **Rubbed fiber content** is used when determining the degree of decomposition of soil organic matter. The rubbed fiber content is estimated in the field by first taking a moist sample (about the size of a marshmallow) and removing the live roots. Live roots do not count as soil organic matter and are not considered when determining the fiber content. The sample is then rubbed in the palm of one's hand using the thumb of the other for about 10 times using firm pressure. The rubbing shreds and breaks up any decomposed organic matter that is still intact. After rubbing, the sample is compressed into a round mass and then pulled apart into two halves. The percent fiber content is estimated by examining the broken face using a hand lens (10 power or more). If there is a question between unrubbed and rubbed fiber content, rubbed content is used.

Undecomposed litter is plant material that has not begun to decompose and has no observable evidence of decomposition. This most often occurs in woodland areas as a surface layer of loose, fluffy leaves and/or needles that can be easily brushed aside with one's hand or blown from one area to another by a strong wind. Undecomposed litter is not considered part of the soil. When present, depth measurements for a profile description start below the undecomposed litter and at the top of the organic material that has observable evidence of decomposition (i.e., fibric, hemic, or sapric). The thickness of the litter layer may be recorded as inches to zero (e.g., +3 inches to 0).
Fibric material is slightly decomposed organic material. Most often the original source of the organic matter (e.g., red maple) can be identified. Fibric material has a rubbed fiber content of 40 percent or more (by volume). Soil horizons composed of fibric material are designated Oi.
Hemic material is partially decomposed (intermediate decomposition) organic material. It often has the look and feel of mature compost. Hemic material has a rubbed fiber content of 17 to 40 percent (by volume). Soil horizons composed of hemic material are designated Oe.
Sapric material is highly decomposed organic material. It most often has a black or a very dark reddish black color with a massive or solid appearance. Sapric material has rubbed fiber content of less than 17 percent (by volume). Soil horizons composed of sapric material are designated Oa.

Peat, Mucky Peat, and Muck

Peat, mucky peat, and muck are terms used to describe fibric, hemic, and sapric materials associated with wetness. Key factors to consider when making this determination are landscape position and presence of indicators of wetland hydrology. These terms should only be considered in areas where there is a high probability of soil saturation, flooding, and/or ponding. Soils with organic horizons comprised of peat, mucky peat, and muck are most often found within depressions, swales, at the base of long slopes (footslope and toeslope), or in low areas adjacent to water bodies. Organic surface horizons (Oi, Oe, and/or Oa horizons) associated with Histosols, histic epipedons, and soils that are gleyed in the upper part of the subsoil are almost always peat, mucky peat, and/or muck. These areas most often have indicators of wetland hydrology (e.g., water-stained leaves, sediment deposits, etc.). There are some situations where the surface organic layers of a hydric soil are comprised of fibric, hemic, and/or sapric material. These typically occur in transitional areas.

Field Tips:
1. Another form of the strength test is to clean the face of a test pit and probe the soil. A finger or trowel will easily penetrate an organic horizon but there is strong resistence when probing a mineral horizon.
2. Never assume that a thick black surface layer is the same soil texture throughout. In many situations, a black surface layer of well decomposed organic matter (Oa horizon) is underlain by a black mineral soil (A horizon). Always check to confirm whether there is a dark mineral horizon (A horizon) directly underlying the surface organic layers (O horizon).
3. Before trying to estimate the kind (sands, silt, and/or clay) or amount of mineral soil in an organic rich surface layer, first determine the soil texture of the mineral horizon (E, B, or C) that directly underlies the organic rich layer. Assuming the mineral component of the soil is similar throughout the upper part of the soil, this makes for a good comparison (gritty feel and/or strength) when estimating the mineral content in an organic rich layer.
4. Laboratory analysis conducted at the University of Rhode Island by Dr. Mark Stolt confirms that the highest amount of organic carbon (OC) one might expect in soil organic matter is about 50 percent, and in most situations it is 40 percent. When estimating the OC in fibric material (Oi horizon), it is most often less than 40 percent. For hemic material (Oe horizon) the maximum OC content is typically 30 percent, and the maximum for sapric material (Oa horizon) is about 25 percent.

For additional guidance on describing, documenting and estimating the amount and kind of organic material in a soil refer to the following documents:
- U.S. Army Corps of Engineers, Regional Supplement to the Corp of Engineers Wetland Delineation Manual: Northcentral and Northeast Region
- Field Indicators for Identifying Hydric Soils in New England, Version 3, April 2004
- National Soil Survey Center, U.S. Department of Agriculture, Field Book for Describing and Sampling Soils, Version 3.0

USE OF THIS CHART: Depending on the site, determining the organic matter content of a soil can be difficult often with significant differences between experienced professionals. No field test alone is reliable enough to conclude with a high degree of confidence that a particular sample has a specified percentage of organic carbon/organic matter. The confidence level increases as additional tests are applied and results compared.

Compiled by Peter C. Fletcher Draft December 8, 2011

FIELD TEST	ORGANIC SOIL MATERIAL (OSM)	MUCKY MINERAL SOIL (MMS)	MINERAL SOIL MATERIAL (MSM)
1. **Soil Color Moist:** Organic matter is a strong coloring agent in the soil and as little as 3 to 5% can turn a mineral soil black. Dark and very dark colors confirm the presence of organic matter in soil. Soil color alone is not a definitive test for OSM or MMS.	Fibric and hemic material, typically have colors with values of 4 or less and chromas of 3 or less. Sapric material has very dark soil colors with values and chromas of 2 or less. Organic soils formed in tidal marshes often have higher values and chromas.	Has a very dark soil color most often with values and chromas of 2 or less.	Has a broad spectrum of soil colors including black. Soils that have colors with values of 3 or higher and chromas of 2 or more are most often MSM.
2. **Air-Dry Soil Color:** For this test smear a very moist soil sample onto a sheet of white paper and let dry.	The dry soil retains nearly all of its dark color.	The dry soil retains some of its dark color, typically with values of 4 or less and chromas of 2 or less.	The dry soil turns a light color with values of 4 or higher and any chroma, or values and chromas of 3 or higher.
3. **Rubbed Fiber Content:** The percentage of visible fibers observed with a hand lens after rubbing in one's palm approximately 10 times. Live roots do not count as soil organic matter and should be removed before conducting this test.	Fibric material has a rubbed fiber content of 40% or more by volume. Hemic material has rubbed fiber content of 17 to 40%. For Sapric material it is less than 17%. *Reliable test for fibric and hemic material when used in combination with Test 6.*	Typically lacks fibers or has low fiber content.	Most often lacks fibers or has a very low fiber content.
4. **Soil Strength:** For this test, remove a clod (undisturbed piece) of soil, about the size of a lemon, from the side of the pit. The sample should be very moist but not saturated. If dripping wet, wrap the sample in a paper towel to remove excess water. When conducting this test, the soil sample should be squeezed but not repeatedly worked within one's hand.	When squeezed firmly, soil material oozes out freely from between one's fingers. *Reliable test for sapric material when used in combination with Tests 1 and 5.* 	When squeezed firmly, soil material has a slight to moderate tendency to ooze between one's fingers. *Reliable test when used in combination with Tests 1, 2, and 5.*	When squeezed firmly, soil material forms a solid mass and no soil material oozes from between one's fingers. *Reliable test when used in combination with Tests 2, 5 and/or 6.*
5. **Gritty Feel:** For this test rub a saturated sample in one's palm using moderate thumb pressure. This test is unreliable if the mineral fraction of the soil is predominantly very fine sand, silt and/or clay size particles.	After 5 rubs retains its greasy, slippery feel with no grittiness.	Initially has a creamy, smooth feel that after 3 to 5 rubs has an underlying gritty feel. *Reliable test when the mineral soil is a sand, loamy sand, sandy loam or loam.*	Has a gritty feel after 1 or 2 rubs. This test only works well when there are sand size particles present. *Reliable test when the mineral soil is a sand, loamy sand, sandy loam or loam.*
6. **Air-dry Weight:** For this test form a moist sample of soil into a mass about the size of a lime and let dry for 1-2 days.	Soil sample becomes significantly lighter in weight and retains most of its original color. If sapric, the mass often shrinks in size.	May lose a noticeable amount of its original weight and retains some of its dark color. When held up to the light, one can often see a shiny reflection off the mineral soil particles.	Retains a significant amount of its original weight and turns considerably lighter in color.
7. **Squeezed Liquid:** For this test, place a saturated sample of soil about the size of a lemon in one's palm and squeeze using firm pressure. The extruded liquid and particulates are then examined. If there is a difference in results (fibric, hemic, or sapric) between this method and the rubbed fiber content, the rubbed fiber content is used. This method was originally developed by L.von Post and is described in more detail in ASTM Standard D 5715-00		The liquid extruded from fibric material is typically clear to brown with no organic solids. The liquid extruded from hemic material is dark and often turbid with as much as 1/3 of the sample squeezed out. For sapric material the liquid is very turbid or it is thick and pasty with most of the sample squeezed out. The test is not used for mineral soils or mucky mineral soils.	

West Virginia Wetland Rapid Assessment Datasheet

WVWRAM Field Form 4/3/2024

Identifiers *(refer to page 25 of WVWRAM User Manual)*

Site name ____ Date_____________ SiteEventCode

Crew leader name ______________________________ Field crew name(s) ____

Time (24 hr) Start ____________ End ____________

❑ gear decontaminated prior to entering site *(p.21)*

Directions to site:

❑ all datasheets checked by crew leader at end of sampling

Notes on land use history, site conditions, wildlife observed, discussions with landowner or other on-site personnel, or deviations from protocol:

GPS make/model ______________________________ GPS datum: ❑ NAD83 ❑ other _______

Coordinates (decimal degrees): ____

❑ Photos of inlet, outlet, NWI types, soils, stressors, and any other key features *(p.26)*

Assessment Area *Check one (p.27)*

- ❑ AA is the entire Wetland Unit (most sites).
- ❑ AA is a portion of the very large WU (> 25 acres)
- ❑ AA is only the Project Area, smaller than the WU - see manual for exceptions when project area survey is acceptable

Comment ____________________________

Mapping *All boxes should be checked at completion (p.31)*

- ❑ current land use compared to air photo for 50m (164 ft) and 300m (984 ft) buffer
- ❑ NWI wetland types GPS'ed and/or drawn on air photo
- ❑ perimeter walked; inlet, outlet, or other features GPS'ed and/or drawn on air photo
- ❑ soil sample locations GPS'ed and/or drawn on air photo

Purpose of Assessment *Check all that apply (p.30)*

- ❑ pre-impact
- ❑ revisit
- ❑ other
- ❑ restoration
- ❑ baseline
- ❑ QC duplicate
- ❑ random
- ❑ years post- ___________
- ❑ reference

Comment ________________

Special Conservation Concern *Check one(p35)*

________ B-rank from topmost box in list below. Read definitions in manual!

- ❑ old-growth swamp (B3)
- ❑ large bog or fen (B4)
- ❑ mature forested swamp (B5)
- ❑ summit sinkhole (Ridge&Valley only)(B5)
- ❑ no known special concern (none)

Comment ________________

PERIMETER AND NATURAL BUFFER *(p.37)*

Natural perimeter *Check one (p.37)*

❑ 100% ❑ 75-99% ❑ < 75%

50m (164') natural buffer for water quality *Check one (p.38)*

- ❑ > 90%
- ❑ 75-90%
- ❑ 50-75%
- ❑ < 50%

Contiguous 300m (984') natural wildlife buffer *Check one (p.39)*

❑ > 90% ❑ 60-90% ❑ < 60%

NON-REGULATORY ADDITIONAL INFORMATION *For land acquisition and full functional scores (p.39)*

Ownership/Access *Check one (p.40)*

- ❑ public, or private with permanent unrestricted access
- ❑ private, with seasonal, partial, or case-by-case access
- ❑ private, without public access

Comment ____________________________

Investment *Check one (p.40)*

- ❑ compensatory mitigation site
- ❑ conservation easement
- ❑ other conservation investment
- ❑ no known conservation investment

Comment ____________________________

Recreation Infrastructure *Check all that apply (p.41)*

- ❑ maintained parking
- ❑ boardwalk
- ❑ informational kiosk or brochure
- ❑ maintained road w/i 30m (100') with view
- ❑ maintained trail
- ❑ boat access
- ❑ no infrastructure

Comment ____________________________

Planning or scientific use *Check all that apply (p.41)*

- ❑ water quality plan includes wetland
- ❑ habitat plan includes wetland
- ❑ monitored > 2yrs, non-regulatory, data available to public
- ❑ no known planning or sustained scientific use

Comment ____________________________

Other Public Use *Check all that apply (p.41)*

- ❑ wetland visible from public area <100m (328')
- ❑ evidence of non-consumptive use
- ❑ evidence of consumptive use
- ❑ no evidence of public use

Comment ________________________

TOPOGRAPHY AND STRUCTURE *(p.41)*

Depressions *Check one (p.42)*

❑ none ❑ trace-10% ❑ 10-33% ❑ >33%

Microtopographic complexity *Check one (p.42)*

❑ < 3% ❑ 3-40% ❑ > 40%

Karst topography *Check all that apply (p.43)*

- ❑ limestone spring
- ❑ sinkhole
- ❑ sinking stream (not on mined land)
- ❑ isolated closed depression over limestone
- ❑ limestone/dol outcrop
- ❑ cave adjacent
- ❑ no evidence of karst

Structural Patch Type. ≥ 3 m^2 (32 ft^2) patch unless otherwise specified. *Check all that apply (p.44)*

- ❑ Open water
- ❑ Oxbows, secondary channels, swales
- ❑ Pools inaccessible to fish
- ❑ Springs or upwelling groundwater
- ❑ Non-vegetated flats (mudflats, sandflats)
- ❑ Animal mounds or burrows
- ❑ Beaver dams or lodges
- ❑ Abundant deciduous leaf litter
- ❑ Plant hummocks or tussocks
- ❑ Plant hummocks or tussocks > 25% cover of wetland (abundant)
- ❑ Coarse woody debris at least 10 cm (4") diameter and 91 cm (36") long
- ❑ Coarse woody debris, abundant: > 3% cover of wetland
- ❑ Standing snags at least 7.6 cm (3") diameter and 137 cm (4.5') tall
- ❑ Standing snags, abundant: ≥ 3/acre with dbh > 25 cm (10")
- ❑ Upturned tree root wads (tip-up mounds) and pits

Comment ____

West Virginia Wetland Rapid Assessment Datasheet: Veg Structure and Hydrology

Site name ____ Date _________________________

VEGETATION STRUCTURE *(p.47)*

Skip if no PFO present. Forest structure. *Check all that apply (p.47)*

Stratum covers ≥ 5% of PFOs or occupies ≥ 0.1 acre:

❑ Canopy ❑ Understory ❑ Shrub ❑ Herb ❑ Moss

Skip if no PEM present. PEM canopy height(s). *Check all that apply (p.48)*

Height stratum covers ≥ 5% of PEMs or occupies ≥ 0.1 acre:

❑ < 30 cm (1 ft) ❑ 30-100 cm (1-3.3 ft) ❑ > 100 cm (3.3 ft)

Skip if no PFO present. Forest regeneration. *Check one (p.47)*

All native tree canopy species with >10% cover are present in the sapling layer.

❑ Yes ❑ No

Tall (>100 cm) graminoid marsh *Check one (p.48)*

Tall marsh with at least seasonal standing water and cattails, sedges, bluejoint grass, or bulrushes occupies ≥ 0.1 acre.

❑ Yes ❑ No

Vegetation fringing open water *Check one (p.49)*

At least 90% of open water (lake, pond ≥ 0.1 acre, perennial stream) boundaries are fringed by band of wetland vegetation ≥ 10 m (33 ft) wide.

❑ Yes ❑ No ("no" includes sites not adjacent to open water)

Mowed or grazed wetland *Check one (p.50)*

Mowed < 15 cm (6") tall or livestock-grazed areas

❑ none ❑ trace - 33% ❑ 33-67% ❑ > 67%

HYDROLOGY *(p.50)*

Check one (p.50)

❑ Floodplain Wetland Unit (≥10% of wetland receives overland flow in 100-yr flood or more frequently, or major beaver influence in headwater wetlands)

❑ Non-floodplain Wetland Unit (may have stream associated with it but overland flow or beavers impact <10% of wetland)

Largest water source *Check one; note stream order if perm. flowing (p.51)*

❑ relatively permanently flowing and→ ❑ 1st or 2nd ❑ 3+ order

❑ intermittent or ephemeral

❑ underground spring

❑ no visible inlet (dispersed groundwater and precipitation only)

❑ bidirectional (no stream; water level follows lake level or river flood stage)

If largest water source is a surface stream: *Check one if applicable*

❑ natural ❑ altered or constructed

Comment ________________________________

Largest outlet is… *Check one (p.53)*

❑ relatively permanently flowing

❑ relatively permanently flowing but highly constricted

❑ intermittent or ephemeral

❑ no surface outlet (groundwater only)

If largest outlet is a surface stream: *Check one if applicable*

❑ natural ❑ altered or constructed

Comment ________________________________

Overbank flooding and connection to river continuum *Check all that are observed within the wetland. Skip if no stream nearby/potentially connected. (pp.53-56)*

❑ active beaver dam

❑ flood deposits (sediment deposits, debris, drift deposits, flood wrack)

❑ vegetation flattened and aligned along flow lines

❑ tree trunks with flood lines (water marks, silt coatings, staining, moss or lichen trim lines) or flood impact scars

❑ absence of leaf litter under deciduous trees as a result of flooding (not livestock impacts)

❑ braided stream channels, backwater sloughs, backchannels, or other flood drainage patterns present

❑ flood-prone area (inundated at 2 x maximum bankfull depth) overlaps at least 10% of wetland

Disconnection from river continuum *Check all that are observed at the stream that controls the floodplain. Skip if no stream potentially connected. (pp.53-56)*

❑ physical barriers between wetland & stream (roads, railbeds, hardened levees)

❑ artificial drainage of floodplain between wetland and stream (ditches, drains, grading of land to improve drainage)

❑ stream channel hardened (riprap, gabions, concrete)

❑ stream channel straightened and/or moved to toeslope (meanders eliminated)

❑ dam upstream significantly reduces flooding

❑ land subsidence or significant streamflow reduction (sinking stream) in mined areas NOT on karst

❑ stream channel banks are steep, eroding, have abundant bank slides or slumps, have < 50% cover of roots, or are unvegetated

❑ stream is entrenched or moderately entrenched (Rosgen ER < 2.2 or Rosgen types A, F, G, B). Entrenchment is calculated as the flood-prone width divided by the bankfull width. Flood-prone width is measured at the elevation equal to twice the maximum bankfull depth. Maximum bankfull depth is the height of bankfull flow above the thalweg.

❑ stream is incised; bank height ratio (BHR) > 1.5. Bank height ratio is calculated as the height of lowest bank divided by maximum bankful depth.

❑ flood prone area (inundated at 2 x maximum bankfull depth) does not extend to more than 10% of wetland

Worksheet for entrenchment, incisement, and flood-prone area measurements *(pp.54-56)*

See user manual for diagrams and definitions. Any units may be used as long as they are consistent.

maximum bankfull depth: __________________

2 x maximum bankfull depth: _______________

bankfull width: ____________________________

flood-prone width (inundated at 2 x max bankfull depth): ______________

lowest bank height: ______________________

______________ / ____________ = _______________

flood-prone width / bankfull width = entrenchment ratio (ER)

_______________ / ____________________ = ___________________

lowest bank height / maximum bankfull depth = bank height ratio (BHR)

West Virginia Wetland Rapid Assessment Datasheet: Stressors

Site name ____ Date _________________________

Hydrology Stressors. *Check all that apply, then review total disturbance below. (p.57)*

- ❍ Ditch
- ❍ Tile or drain
- ❍ Weir, spillway, standing pipe or water control structure
- ❍ Impoundment impacting hydrology (excluding beaver dams)
- ❍ Berm
- ❍ Road or impervious surface (paved and/or not at grade)
- ❍ RR track
- ❍ Undersized or perched culvert
- ❍ Pump, spring box, water well
- ❍ Filling/excavating/grading the land surface
- ❍ Dredging of aquatic bed
- ❍ Point source discharge
- ❍ Stormwater input
- ❍ Agricultural runoff
- ❍ Invasive vegetation concentrated along watercourses, with at least twice as much invasive cover as areas away from watercourses
- ❍ Adjacent stream channel/riparian zone aggrading, with fresh splays of sediment, partially buried culverts, or bar formation
- ❍ More than 25% of the upland-wetland edge is abrupt and straight, not a gradual and complex transition zone > 3 meters (10 ft) wide
- ❍ Wetland is in a floodplain but is disconnected or partially disconnected from the river continuum.
- ❍ Other____

Review the total hydrologic disturbances above and rank severity of impact by checking one box below.

- ❑ Intact: Hydrologic regime is characterized by natural patterns, with no major hydrologic stressors present.
- ❑ Mild on-going disturbance and/or past disturbance but now essentially recovered. For example, small ditches or diversions; berms or roads at/near grade; or minor flow additions.
- ❑ Moderate on-going disturbance and/or in the process of recovering from more severe disturbance in the past. For example, dams upstream or downstream moderately affect hydroperiod; ditches or diversions < 1 m (3.3 ft) deep; two lane roads; culverts adequate for base stream flow but not flood flow; or moderate flow additions. Outlets may be moderately constricted, but flow is still possible.
- ❑ Severe on-going disturbance. For example, dams upstream or downstream moderately to substantially affect hydroperiod; a 4-lane highway; diversions upstream or > 1 m (3.3 ft) deep that withdraw a significant portion of flow; large amounts of fill or excavation; significant artificial groundwater pumping; or heavy flow additions. Outlets may be substantially constricted, blocking most flow.
- ❑ Hydrology is entirely artificial; no natural inflows. E.g., a water treatment wetland constructed below the outflow from a wastewater treatment plant.

Water Quality Stressors. *Check all that apply. (p.57)*

- ❑ No water quality stressors observed.
- ❑ Discharges to the wetland: stormwater discharges, livestock or agricultural runoff, straight pipes, drainage ditches, industrial discharges, oil slicks, sediment plumes, algal mats, odors, adjacent spoil piles, leaking silt fences, road salt, ROW herbicide, or erosion on the upland edges.
- ❑ Contiguous water body has algal bloom, power boat use, or other observable impairment.
- ❑ Other ____

Vegetation Removal or Alteration. *Check one box that best describes the wetland. (p.58)*

- ❑ Minimal or no signs of anthropogenic vegetation removal or alteration OR impacts occurred in the past (typically > 80 years ago) and the wetland appears to have recovered to near-natural conditions. Examples: mature forested swamps, undisturbed beaver systems, undisturbed peatlands.
- ❑ Moderate. Vegetation removal or alteration is on-going and has moderate impact in terms of either severity or extent OR impacts occurred in the past and wetland is still in the process of recovering. Examples: successional swamps (black willow, box elder), young/unstructured swamps, many shrub/emergent.
- ❑ Severe. More than half of wetland is impacted by regular mowing, clearing, grazing, timbering, farming, dredging of aquatic bed, herbicide/pesticide/fertilizer application, burning, excessive herbivory or other form of on-going vegetation removal or alteration. Comment________________________

Soil Stressors. *Check all that apply, then review total disturbance below. (p.59)*

- ❍ Livestock (trampling, pugging, compaction, or heavy grazing that leads to erosion)
- ❍ Machinery (plowing, filling, grading, dredging, compaction)
- ❍ ATV or vehicles (ruts, compaction, other disturbance)
- ❍ Removal of soil (mining, excavation)
- ❍ Replacement of soil with waste or fill (mining spoil, landfill)
- ❍ Other trampling or soil compaction
- ❍ Other erosion, sedimentation, or stressor. Comment ____

Review the total soil disturbances above and rank severity of impact by checking one box below.

- ❑ Intact: no anthropogenic disturbance.
- ❑ Small to moderate stress to soil profile. On-going stressors affect < 10% of wetland OR impacts occurred in the past and the soil profile has largely recovered. Depth of disturbance typically < 10 cm (4"); ponding/channeling of water in disturbed areas has little or no impact on overall site hydrology.
- ❑ Substantial stress to soil profile with extensive and long-lasting impacts; depth of disturbance > 10 cm (4"), may cause significant ponding or channeling of water that alters hydrology and vegetation.

WV Wetland Rapid Assessment Datasheet - Soils

Site name ______________________________ Date ______________

NWI Wetland Types *Refer to NWI code sheets. List all NWI codes present in assessment area; minimum 1 soil sample per each NWI code; minimum 1 soil sample per each 10 acres; NWI codes may be sampled more than once.*
Assign System, Class, and Subclass of the NWI code based on vegetation (ex. PEM1). Then sample soil and assign Water Regime, pH, and Soil organic/mineral modifiers. Add Special modifiers if present (ex. PEM1Abtn). *(p.33,59,91, Reference Sheets)*

NWI Wetland Type Code (refer to NWI Codes diagram) NWI System & Class	Sub-class	Wat. reg.	Spe-cial	pH	Soil	Sampled	Not sampled (permanently ponded)	Soil notes *Optional notes on soil profile or soil features.*
Examp. PEM	1	B	d	t	n	■	❑	***Example*** *0-5cm sapric, 5-15cm mucky mod min, 15-30+cm silt loam 25% redox conc*
1.						❑	❑	
2.						❑	❑	
3.						❑	❑	
4.						❑	❑	

NWI Water Regime *Refer to NWI code diagram, NWI Water Regime Non-tidal Modifiers, and NWI Water Regime Restriction reference sheets. (p.60)*

Add Water Regime modifier to NWI code at top of page:

		seasonally flooded-saturated (E)	*permanently flooded (H)*
temporarily flooded (A)	*seasonally flooded (C)*	*semipermanently flooded (F)*	*intermittently flooded (J)*
seasonally saturated (B)	*continuously saturated (D)*	*intermittently exposed (G)*	*artificially flooded (K)*

Special Modifiers *Only if applicable. Refer to NWI Code diagram and definitions. (p.62)*

If applicable, add Special modifier to NWI code at top of page. Add only the first applicable modifier, in this order: b, d, f, m, h, r, s, x
beaver (b), partly ditched/drained (d), farmed (f), managed (m), diked/impounded (h), artificial substrate (r), spoil (s), excavated (x)

Soil pH *pH value of soil at 10 cm (4") below the surface (p.63)*

Soil sampling site #

Ex.	1	2	3	4
5.7	_____	_____	_____	_____

Add pH modifier to NWI code at top of page:
pH < 5.5 = acid (a)
pH 5.5-7.4 = circumneutral (t)
pH > 7.4 = alkaline (i)

ORGANIC MATERIAL

2 cm (0.8") Organic Material Near Surface *Remove duff layer. Collect sample from top 8 cm (3") of soil profile. Refer to Organic Soils reference sheet.*
Peat, mucky peat, muck, or mucky modified mineral soil in top 8 cm (3") below the soil surface. *(p.63 & Reference Sheet)*

Soil sampling site #

1	2	3	4	
❑	❑	❑	❑	Present: at least 2 cm (0.8") thick organic layer or mucky modified mineral layer
❑	❑	❑	❑	Not present

Total Depth of Surficial Organic Material *(not required for impact assessment; required for condition & restoration monitoring) (p.64 & Reference Sheet)*

Soil sampling site #

Ex.	1	2	3	4	
					cm
15	_____	_____	_____	_____	inches

Description of Organic Material: peat/fibric, mucky peat/hemic, muck/sapric, or mucky modified mineral soil. *Ex. 0-5cm sapric, 5-15cm mucky mod min*

Deep Organic Soil. *Excavate each soil hole to either 40 cm (16") depth of organic soil, or 80 cm (32") total soil depth, whichever comes first.*
Histosol : Peat, mucky peat, or muck soil with at least 12-18% organic matter by weight and >= 40 cm (16") deep within the upper 80 cm (32") of soil profile.
Histic epipedon : Peat, mucky peat, or muck soil with at least 12-18% organic matter by weight and >= 20 cm (8") thick, but < 40 cm (16") thick, as a surface horizon. Aquic conditions or artificial drainage is required. Note that mucky modified mineral soil is NOT included in this section. (p.64)

Soil sampling site #

1	2	3	4	
❑	❑	❑	❑	Histosol present; NWI soil modifier = organic (g)
❑	❑	❑	❑	Histic epipedon present, but no histosol; NWI soil modifier = mineral (n)
❑	❑	❑	❑	Neither histosol nor histic epipedon present; NWI soil modifier = mineral (n)

Add Soil modifier to NWI code at top of page:
organic (g)
mineral (n)

West Virginia Wetland Rapid FQA Datasheet

(refer to WVWRAM User Manual pages 66-74)

WVWRAM Field Form

Site name ____ Date ______________________

NWI Wetland Type Code (p.69) *NWI codes must match codes on Soils sheet*	**Dominant species identified**	**% of AA** *field estimate or GIS (p.69)*	*Total veg cover if < 100%*	*Sum of identified cover*
1. ______________________	❑			
2. ______________________	❑			
3. ______________________	❑			

Dominant species identification (p.69)**.** Sum cover values of identified vascular plant species across all strata within each wetland type. Stop when all dominant vascular plant species (≥ 10% total cover across all strata) AND highly invasive (bolded) plants have been identified AND the sum of species cover is ≥ 80%. For NWI wetland types with total vegetative cover of < 100% (e.g., aquatic bed, mudflats), the sum of species must be ≥ 80% of the total vegetative cover. Example: PAB has total cover of 40%. 80% of 40% = 32% is the required sum of species cover.

Species Checklist. Circle space when species has at least 10% cover in wetland type. At the end of each wetland type meander, record cover within circles. Highly invasive wetland species are ***underlined*** and must be recorded even if they have < 10% cover. Write in any dominant species not listed. Use absolute cover, not relative cover. Typical cover values are 0.1, 1, 3, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100 percent.

Aquatic Plants (true aquatic plants that are submergent or have floating leaves)

NWI wetland type #

1	2	3	Species	1	2	3	Species	1	2	3	Species
___	___	___	*Brasenia schreberi*	___	___	___	*Lemna minor*	___	___	___	*Potamogeton sp.(not P. crispus)*
___	___	___	*Callitriche heterophylla*	___	___	___	***Myriophyllum aquaticum***	___	___	___	*Utricularia gibba*
___	___	___	*Ceratophyllum demersum*	___	___	___	*Nuphar lutea ssp. advena*	___	___	___	*Wolffia brasiliensis*
___	___	___	*Elodea canadensis*	___	___	___	*Nymphaea odorata*	___	___	___	____________________
___	___	___	***Hydrilla verticillata***	___	___	___	*Potamogeton crispus*	___	___	___	____________________

Trees (woody plants that typically mature to a maximum height > 6 m)

NWI wetland type #

1	2	3	Species	1	2	3	Species	1	2	3	Species
___	___	___	*Abies balsamea*	___	___	___	*Crataegus sp.*	___	___	___	*Prunus serotina*
___	___	___	*Acer negundo*	___	___	___	*Fagus grandifolia*	___	___	___	*Quercus alba*
___	___	___	*Acer rubrum*	___	___	___	*Fraxinus americana*	___	___	___	*Quercus bicolor*
___	___	___	*Acer saccharinum*	___	___	___	*Fraxinus pennsylvanica*	___	___	___	*Quercus palustris*
___	___	___	*Acer saccharum*	___	___	___	*Juglans nigra*	___	___	___	*Quercus rubra*
___	___	___	*Aesculus flava*	___	___	___	*Liquidambar styraciflua*	___	___	___	*Robinia pseudoacacia*
___	___	___	*Betula alleghaniensis*	___	___	___	*Liriodendron tulipifera*	___	___	___	*Salix alba*
___	___	___	*Betula lenta*	___	___	___	*Nyssa sylvatica*	___	___	___	*Salix nigra*
___	___	___	*Betula nigra*	___	___	___	*Picea rubens*	___	___	___	*Tsuga canadensis*
___	___	___	*Carpinus caroliniana ssp. virg.*	___	___	___	*Pinus rigida*	___	___	___	*Ulmus americana*
___	___	___	*Carya cordiformis*	___	___	___	*Platanus occidentalis*	___	___	___	*Ulmus rubra*
___	___	___	*Carya ovata*	___	___	___	*Populus tremuloides*	___	___	___	____________________

Shrubs (woody plants with that typically mature to a maximum height < 6 m, often multi-stemmed)

NWI wetland type #

1	2	3	Species	1	2	3	Species	1	2	3	Species
___	___	___	*Alnus incana ssp. rugosa*	___	___	___	*Kalmia latifolia*	___	___	___	*Spiraea tomentosa*
___	___	___	*Alnus serrulata*	___	___	___	*Ligustrum vulgare*	___	___	___	*Vaccinium angustifolia*
___	___	___	*Aronia melanocarpa*	___	___	___	*Lindera benzoin*	___	___	___	*Spiraea tomentosa*
___	___	___	*Asimina triloba*	___	___	___	*Lonicera morrowii*	___	___	___	*Vaccinium angustifolia*
___	___	___	*Berberis thunbergii*	___	___	___	*Physocarpus opulifolius*	___	___	___	*Vaccinium myrtilloides*
___	___	___	*Cephalanthus occidentalis*	___	___	___	*Rhododendron maximum*	___	___	___	*Vaccinium oxycoccos*
___	___	___	*Cornus amomum*	___	___	___	***Rosa multiflora***	___	___	___	*Viburnum dentatum*
___	___	___	*Elaeagnus umbellata*	___	___	___	*Rosa palustris*	___	___	___	*Viburnum nudum var. cassinoides*
___	___	___	*Gaylussacia baccata*	___	___	___	*Rubus pensilvanicus*	___	___	___	*Viburnum recognitum*
___	___	___	*Hypericum densiflorum*	___	___	___	*Salix sericea*	___	___	___	____________________
___	___	___	*Ilex mucronata*	___	___	___	*Sambucus nigra ssp. canadensis*	___	___	___	____________________
___	___	___	*Ilex verticillata*	___	___	___	*Spiraea alba*	___	___	___	____________________

Woody Vines

1	2	3	Species	1	2	3	Species	1	2	3	Species
___	___	___	*Apios americana*	___	___	___	***Lonicera japonica***	___	___	___	*Toxicodendron radicans*
___	___	___	*Clematis virginiana*	___	___	___	*Rubus hispidus*	___	___	___	____________________

Site Name: ______________________________ **Date:** ______________

Ferns

NWI wetland type # 1 2 3		NWI wetland type # 1 2 3		NWI wetland type # 1 2 3	
___ ___ ___	*Dennstaedtia punctilobula*	___ ___ ___	*Osmunda cinnamomea*	___ ___ ___	*Pteridium aquilinum*
___ ___ ___	*Onoclea sensibilis*	___ ___ ___	*Osmunda regalis var. spectabilis*	___ ___ ___	*Thelypteris noveboracensis*

Forbs (broad-leaved herbs, excluding true aquatics which are in the first section of the checklist)

___ ___ ___	*Acorus calamus*	___ ___ ___	***Iris pseudacorus***	___ ___ ___	*Ranunculus hispidus var. nitidus*
___ ___ ___	*Agrimonia parviflora*	___ ___ ___	*Justicia americana*	___ ___ ___	*Ranunculus repens*
___ ___ ___	*Alisma subcordatum*	___ ___ ___	*Laportea canadensis*	___ ___ ___	*Sagittaria latifolia*
___ ___ ___	*Apocynum cannabinum*	___ ___ ___	*Lespedeza cuneata*	___ ___ ___	*Saururus cernuus*
___ ___ ___	*Asclepias incarnata*	___ ___ ___	*Ludwigia palustris*	___ ___ ___	*Solidago altissima*
___ ___ ___	*Bidens frondosa*	___ ___ ___	*Ludwigia peploides*	___ ___ ___	*Solidago canadensis*
___ ___ ___	*Bidens tripartita*	___ ___ ___	*Lycopus uniflorus*	___ ___ ___	*Solidago gigantea*
___ ___ ___	*Boehmeria cylindrica*	___ ___ ___	*Lysimachia nummularia*	___ ___ ___	*Solidago rugosa*
___ ___ ___	*Caltha palustris*	___ ___ ___	***Lythrum salicaria***	___ ___ ___	*Solidago uliginosa*
___ ___ ___	*Chelone glabra*	___ ___ ___	*Mimulus ringens*	___ ___ ___	*Sorghum halapense*
___ ___ ___	*Cicuta maculata*	___ ___ ___	*Murdannia keisak*	___ ___ ___	*Symphyotrichum lanceolatum*
___ ___ ___	*Diodia virginiana*	___ ___ ___	*Myosotis scorpioides*	___ ___ ___	*Symphyotrichum lateriflorum*
___ ___ ___	*Dipsacus fullonum*	___ ___ ___	*Nasturtium officinale*	___ ___ ___	*Symphyotrichum prenanthoides*
___ ___ ___	*Doellingeria umbellata*	___ ___ ___	*Packera aurea*	___ ___ ___	*Symphyotrichum puniceum*
___ ___ ___	*Epilobium coloratum*	___ ___ ___	*Pilea pumila*	___ ___ ___	*Symplocarpus foetidus*
___ ___ ___	*Eupatorium perfoliatum*	___ ___ ___	*Polygonum amphibium*	___ ___ ___	*Trifolium pratense*
___ ___ ___	*Euthamia graminifolia*	___ ___ ___	*Polygonum caespitosum longisetur*	___ ___ ___	*Verbena hastata*
___ ___ ___	*Galium aparine*	___ ___ ___	***Polygonum cuspidatum***	___ ___ ___	*Verbesina alternifolia*
___ ___ ___	*Galium tinctorium*	___ ___ ___	*Polygonum hydropiperoides*	___ ___ ___	*Vernonia noveboracensis*
___ ___ ___	*Glechoma hederacea*	___ ___ ___	*Polygonum pensylvanicum*	___ ___ ___	*Viola cucullata*
___ ___ ___	*Helenium autumnale*	___ ___ ___	***Polygonum perfoliatum***	___ ___ ___	*Xanthium strumarium*
___ ___ ___	*Hibiscus moscheutos*	___ ___ ___	*Polygonum punctatum*	___ ___ ___	______________
___ ___ ___	*Hypericum mutilum*	___ ___ ___	*Polygonum sagittatum*	___ ___ ___	______________
___ ___ ___	*Impatiens capensis*	___ ___ ___	*Ranunculus acris*	___ ___ ___	______________

Graminoids (grasses, sedges, rushes)

___ ___ ___	*Agrostis gigantea*	___ ___ ___	*Carex stricta*	___ ___ ___	*Juncus effusus*
___ ___ ___	*Agrostis perennans*	___ ___ ___	*Carex torta*	___ ___ ___	*Juncus tenuis*
___ ___ ___	*Agrostis stolonifera*	___ ___ ___	*Carex tribuloides*	___ ___ ___	*Leersia oryzoides*
___ ___ ___	*Andropogon gerardii*	___ ___ ___	*Carex trisperma*	___ ___ ___	*Leersia virginica*
___ ___ ___	*Anthoxanthum odoratum*	___ ___ ___	*Carex utriculata*	___ ___ ___	***Microstegium vimineum***
___ ___ ___	***Arthraxon hispidus***	___ ___ ___	*Carex vulpinoidea*	___ ___ ___	*Panicum dichotomiflorum*
___ ___ ___	*Calamagrostis canadensis*	___ ___ ___	*Cinna arundinacea*	___ ___ ___	***Phalaris arundinacea***
___ ___ ___	*Carex aquatilis*	___ ___ ___	*Cinna latifolia*	___ ___ ___	***Phragmites australis***
___ ___ ___	*Carex atlantica*	___ ___ ___	*Danthonia compressa*	___ ___ ___	*Poa compressa /pratensis/trivialis*
___ ___ ___	*Carex canescens*	___ ___ ___	*Dichanthelium clandestinum*	___ ___ ___	*Poa palustris*
___ ___ ___	*Carex crinita*	___ ___ ___	*Dichanthelium dichotomum microcarpor*	___ ___ ___	*Rhynchospora alba*
___ ___ ___	*Carex debilis*	___ ___ ___	*Dulichium arundinaceum*	___ ___ ___	*Schoenoplectus pungens*
___ ___ ___	*Carex echinata*	___ ___ ___	*Echinochloa crus-galli*	___ ___ ___	*Schoenoplectus tabernaemontani*
___ ___ ___	*Carex folliculata*	___ ___ ___	*Eleocharis obtusa*	___ ___ ___	*Scirpus atrovirens*
___ ___ ___	*Carex frankii*	___ ___ ___	*Eleocharis palustris*	___ ___ ___	*Scirpus cyperinus*
___ ___ ___	*Carex grayii*	___ ___ ___	*Eleocharis tenuis*	___ ___ ___	*Scirpus polyphyllus*
___ ___ ___	*Carex gynandra*	___ ___ ___	*Eriophorum virginicum*	___ ___ ___	*Setaria faberi*
___ ___ ___	*Carex intumescens*	___ ___ ___	*Glyceria laxa*	___ ___ ___	*Setaria parviflora*
___ ___ ___	*Carex lupulina*	___ ___ ___	*Glyceria melicaria*	___ ___ ___	*Sparganium americanum /eurycarpum*
___ ___ ___	*Carex lurida*	___ ___ ___	*Glyceria septentrionalis*	___ ___ ___	*Sparganium chlorocarpum*
___ ___ ___	*Carex prasina*	___ ___ ___	*Glyceria striata*	___ ___ ___	***Typha latifolia, Typha sp.***
___ ___ ___	*Carex scoparia*	___ ___ ___	*Holcus lanatus*	___ ___ ___	______________
___ ___ ___	*Carex squarrosa*	___ ___ ___	*Juncus acuminatus*	___ ___ ___	______________
___ ___ ___	*Carex stipata*	___ ___ ___	*Juncus brevicaudatus /subcaudatus*	___ ___ ___	______________

Non-vascular Plants *(DO NOT INCLUDE non-vascular species in the dominant species calculations)*

___ ___ ___	*Sphagnum spp.*	___ ___ ___	*Filamentous Algae*	___ ___ ___	______________
___ ___ ___	*Total mosses & liverworts*	___ ___ ___	*Chara algae*	___ ___ ___	______________

West Virginia Wetland Rapid FQA Datasheet (extra pages for sites with > 3 wetland types)

Page ____

(refer to WVWRAM User Manual pages 66-74)

WVWRAM Field Form

Site name ____ Date ______________________

NWI Wetland Type Code *(p.69)* *NWI codes must match codes on Soils sheet*	**Dominant species identified**	**% of AA** *field estimate or GIS (p.69)*	*Total veg cover if < 100%*	*Sum of identified cover*
#__.____________________	❑			
#__.____________________	❑			
#__.____________________	❑			

Dominant species identification (p.71)**.** Sum cover values of identified vascular plant species across all strata within each wetland type. Stop when all dominant vascular plant species (≥ 10% total cover across all strata) and highly invasive (bolded) plants have been identified AND the sum of species cover is ≥ 80%. For NWI wetland types with total vegetative cover of < 100% (e.g., aquatic bed, mudflats), the sum of species must be ≥ 80% of the total vegetative cover. Example: PAB has total cover of 40%. 80% of 40% = 32% is the required sum of species cover.

Species Checklist. Circle space when species has at least 10% cover in wetland type. At the end of each wetland type meander, record cover within circles. Highly invasive wetland species are ***underlined*** and must be recorded even if they have < 10% cover. Write in any dominant species not listed. Use absolute cover, not relative cover. Typical cover values are 0.1, 1, 3, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100 percent.

Aquatic Plants (true aquatic plants that are submergent or have floating leaves)

NWI wetland type #		NWI wetland type #		NWI wetland type #	
#__ #__ #__		#__ #__ #__		#__ #__ #__	
___ ___ ___	*Brasenia schreberi*	___ ___ ___	*Lemna minor*	___ ___ ___	*Potamogeton sp.(not P. crispus)*
___ ___ ___	*Callitriche heterophylla*	___ ___ ___	***Myriophyllum aquaticum***	___ ___ ___	*Utricularia gibba*
___ ___ ___	*Ceratophyllum demersum*	___ ___ ___	*Nuphar lutea ssp. advena*	___ ___ ___	*Wolffia brasiliensis*
___ ___ ___	*Elodea canadensis*	___ ___ ___	*Nymphaea odorata*	___ ___ ___	____________
___ ___ ___	***Hydrilla verticillata***	___ ___ ___	*Potamogeton crispus*	___ ___ ___	____________

Trees (woody plants that typically mature to a maximum height > 6 m)

NWI wetland type #		NWI wetland type #		NWI wetland type #	
#__ #__ #__		#__ #__ #__		#__ #__ #__	
___ ___ ___	*Abies balsamea*	___ ___ ___	*Crataegus sp.*	___ ___ ___	*Prunus serotina*
___ ___ ___	*Acer negundo*	___ ___ ___	*Fagus grandifolia*	___ ___ ___	*Quercus alba*
___ ___ ___	*Acer rubrum*	___ ___ ___	*Fraxinus americana*	___ ___ ___	*Quercus bicolor*
___ ___ ___	*Acer saccharinum*	___ ___ ___	*Fraxinus pennsylvanica*	___ ___ ___	*Quercus palustris*
___ ___ ___	*Acer saccharum*	___ ___ ___	*Juglans nigra*	___ ___ ___	*Quercus rubra*
___ ___ ___	*Aesculus flava*	___ ___ ___	*Liquidambar styraciflua*	___ ___ ___	*Robinia pseudoacacia*
___ ___ ___	*Betula alleghaniensis*	___ ___ ___	*Liriodendron tulipifera*	___ ___ ___	*Salix alba*
___ ___ ___	*Betula lenta*	___ ___ ___	*Nyssa sylvatica*	___ ___ ___	*Salix nigra*
___ ___ ___	*Betula nigra*	___ ___ ___	*Picea rubens*	___ ___ ___	*Tsuga canadensis*
___ ___ ___	*Carpinus caroliniana ssp. virg.*	___ ___ ___	*Pinus rigida*	___ ___ ___	*Ulmus americana*
___ ___ ___	*Carya cordiformis*	___ ___ ___	*Platanus occidentalis*	___ ___ ___	*Ulmus rubra*
___ ___ ___	*Carya ovata*	___ ___ ___	*Populus tremuloides*	___ ___ ___	____________

Shrubs (woody plants with that typically mature to a maximum height < 6 m, often multi-stemmed)

NWI wetland type #		NWI wetland type #		NWI wetland type #	
#__ #__ #__		#__ #__ #__		#__ #__ #__	
___ ___ ___	*Alnus incana ssp. rugosa*	___ ___ ___	*Kalmia latifolia*	___ ___ ___	*Spiraea tomentosa*
___ ___ ___	*Alnus serrulata*	___ ___ ___	*Ligustrum vulgare*	___ ___ ___	*Vaccinium angustifolia*
___ ___ ___	*Aronia melanocarpa*	___ ___ ___	*Lindera benzoin*	___ ___ ___	*Spiraea tomentosa*
___ ___ ___	*Asimina triloba*	___ ___ ___	*Lonicera morrowii*	___ ___ ___	*Vaccinium angustifolia*
___ ___ ___	*Berberis thunbergii*	___ ___ ___	*Physocarpus opulifolius*	___ ___ ___	*Vaccinium myrtilloides*
___ ___ ___	*Cephalanthus occidentalis*	___ ___ ___	*Rhododendron maximum*	___ ___ ___	*Vaccinium oxycoccos*
___ ___ ___	*Cornus amomum*	___ ___ ___	***Rosa multiflora***	___ ___ ___	*Viburnum dentatum*
___ ___ ___	*Elaeagnus umbellata*	___ ___ ___	*Rosa palustris*	___ ___ ___	*Viburnum nudum var. cassinoides*
___ ___ ___	*Gaylussacia baccata*	___ ___ ___	*Rubus pensilvanicus*	___ ___ ___	*Viburnum recognitum*
___ ___ ___	*Hypericum densiflorum*	___ ___ ___	*Salix sericea*	___ ___ ___	____________
___ ___ ___	*Ilex mucronata*	___ ___ ___	*Sambucus nigra ssp. canadensis*	___ ___ ___	____________
___ ___ ___	*Ilex verticillata*	___ ___ ___	*Spiraea alba*	___ ___ ___	____________

Woody Vines

___ ___ ___	*Apios americana*	___ ___ ___	***Lonicera japonica***	___ ___ ___	*Toxicodendron radicans*
___ ___ ___	*Clematis virginiana*	___ ___ ___	*Rubus hispidus*	___ ___ ___	____________

Page ____

Site Name: ________________________________ **Date:** ____________________

Ferns

NWI wetland type #		NWI wetland type #		NWI wetland type #	
#__ #__ #__		#__ #__ #__		#__ #__ #__	
___ ___ ___	*Dennstaedtia punctilobula*	___ ___ ___	*Osmunda cinnamomea*	___ ___ ___	*Pteridium aquilinum*
___ ___ ___	*Onoclea sensibilis*	___ ___ ___	*Osmunda regalis var. spectabilis*	___ ___ ___	*Thelypteris noveboracensis*

Forbs (broad-leaved herbs, excluding true aquatics which are in the first section of the checklist)

___ ___ ___	*Acorus calamus*	___ ___ ___	***Iris pseudacorus***	___ ___ ___	*Ranunculus hispidus var. nitidus*
___ ___ ___	*Agrimonia parviflora*	___ ___ ___	*Justicia americana*	___ ___ ___	*Ranunculus repens*
___ ___ ___	*Alisma subcordatum*	___ ___ ___	*Laportea canadensis*	___ ___ ___	*Sagittaria latifolia*
___ ___ ___	*Apocynum cannabinum*	___ ___ ___	*Lespedeza cuneata*	___ ___ ___	*Saururus cernuus*
___ ___ ___	*Asclepias incarnata*	___ ___ ___	*Ludwigia palustris*	___ ___ ___	*Solidago altissima*
___ ___ ___	*Bidens frondosa*	___ ___ ___	*Ludwigia peploides*	___ ___ ___	*Solidago canadensis*
___ ___ ___	*Bidens tripartita*	___ ___ ___	*Lycopus uniflorus*	___ ___ ___	*Solidago gigantea*
___ ___ ___	*Boehmeria cylindrica*	___ ___ ___	*Lysimachia nummularia*	___ ___ ___	*Solidago rugosa*
___ ___ ___	*Caltha palustris*	___ ___ ___	***Lythrum salicaria***	___ ___ ___	*Solidago uliginosa*
___ ___ ___	*Chelone glabra*	___ ___ ___	*Mimulus ringens*	___ ___ ___	*Sorghum halapense*
___ ___ ___	*Cicuta maculata*	___ ___ ___	*Murdannia keisak*	___ ___ ___	*Symphyotrichum lanceolatum*
___ ___ ___	*Diodia virginiana*	___ ___ ___	*Myosotis scorpioides*	___ ___ ___	*Symphyotrichum lateriflorum*
___ ___ ___	*Dipsacus fullonum*	___ ___ ___	*Nasturtium officinale*	___ ___ ___	*Symphyotrichum prenanthoides*
___ ___ ___	*Doellingeria umbellata*	___ ___ ___	*Packera aurea*	___ ___ ___	*Symphyotrichum puniceum*
___ ___ ___	*Epilobium coloratum*	___ ___ ___	*Pilea pumila*	___ ___ ___	*Symplocarpus foetidus*
___ ___ ___	*Eupatorium perfoliatum*	___ ___ ___	*Polygonum amphibium*	___ ___ ___	*Trifolium pratense*
___ ___ ___	*Euthamia graminifolia*	___ ___ ___	*Polygonum caespitosum longisetur*	___ ___ ___	*Verbena hastata*
___ ___ ___	*Galium aparine*	___ ___ ___	***Polygonum cuspidatum***	___ ___ ___	*Verbesina alternifolia*
___ ___ ___	*Galium tinctorium*	___ ___ ___	*Polygonum hydropiperoides*	___ ___ ___	*Vernonia noveboracensis*
___ ___ ___	*Glechoma hederacea*	___ ___ ___	*Polygonum pensylvanicum*	___ ___ ___	*Viola cucullata*
___ ___ ___	*Helenium autumnale*	___ ___ ___	***Polygonum perfoliatum***	___ ___ ___	*Xanthium strumarium*
___ ___ ___	*Hibiscus moscheutos*	___ ___ ___	*Polygonum punctatum*	___ ___ ___	____________________
___ ___ ___	*Hypericum mutilum*	___ ___ ___	*Polygonum sagittatum*	___ ___ ___	____________________
___ ___ ___	*Impatiens capensis*	___ ___ ___	*Ranunculus acris*	___ ___ ___	____________________

Graminoids (grasses, sedges, rushes)

___ ___ ___	*Agrostis gigantea*	___ ___ ___	*Carex stricta*	___ ___ ___	*Juncus effusus*
___ ___ ___	*Agrostis perennans*	___ ___ ___	*Carex torta*	___ ___ ___	*Juncus tenuis*
___ ___ ___	*Agrostis stolonifera*	___ ___ ___	*Carex tribuloides*	___ ___ ___	*Leersia oryzoides*
___ ___ ___	*Andropogon gerardii*	___ ___ ___	*Carex trisperma*	___ ___ ___	*Leersia virginica*
___ ___ ___	*Anthoxanthum odoratum*	___ ___ ___	*Carex utriculata*	___ ___ ___	***Microstegium vimineum***
___ ___ ___	***Arthraxon hispidus***	___ ___ ___	*Carex vulpinoidea*	___ ___ ___	*Panicum dichotomiflorum*
___ ___ ___	*Calamagrostis canadensis*	___ ___ ___	*Cinna arundinacea*	___ ___ ___	***Phalaris arundinacea***
___ ___ ___	*Carex aquatilis*	___ ___ ___	*Cinna latifolia*	___ ___ ___	***Phragmites australis***
___ ___ ___	*Carex atlantica*	___ ___ ___	*Danthonia compressa*	___ ___ ___	*Poa compressa /pratensis/trivialis*
___ ___ ___	*Carex canescens*	___ ___ ___	*Dichanthelium clandestinum*	___ ___ ___	*Poa palustris*
___ ___ ___	*Carex crinita*	___ ___ ___	*Dichanthelium dichotomum microcarpor*	___ ___ ___	*Rhynchospora alba*
___ ___ ___	*Carex debilis*	___ ___ ___	*Dulichium arundinaceum*	___ ___ ___	*Schoenoplectus pungens*
___ ___ ___	*Carex echinata*	___ ___ ___	*Echinochloa crus-galli*	___ ___ ___	*Schoenoplectus tabernaemontani*
___ ___ ___	*Carex folliculata*	___ ___ ___	*Eleocharis obtusa*	___ ___ ___	*Scirpus atrovirens*
___ ___ ___	*Carex frankii*	___ ___ ___	*Eleocharis palustris*	___ ___ ___	*Scirpus cyperinus*
___ ___ ___	*Carex grayii*	___ ___ ___	*Eleocharis tenuis*	___ ___ ___	*Scirpus polyphyllus*
___ ___ ___	*Carex gynandra*	___ ___ ___	*Eriophorum virginicum*	___ ___ ___	*Setaria faberi*
___ ___ ___	*Carex intumescens*	___ ___ ___	*Glyceria laxa*	___ ___ ___	*Setaria parviflora*
___ ___ ___	*Carex lupulina*	___ ___ ___	*Glyceria melicaria*	___ ___ ___	*Sparganium americanum /eurycarpum*
___ ___ ___	*Carex lurida*	___ ___ ___	*Glyceria septentrionalis*	___ ___ ___	*Sparganium chlorocarpum*
___ ___ ___	*Carex prasina*	___ ___ ___	*Glyceria striata*	___ ___ ___	***Typha latifolia, Typha sp.***
___ ___ ___	*Carex scoparia*	___ ___ ___	*Holcus lanatus*	___ ___ ___	____________________
___ ___ ___	*Carex squarrosa*	___ ___ ___	*Juncus acuminatus*	___ ___ ___	____________________
___ ___ ___	*Carex stipata*	___ ___ ___	*Juncus brevicaudatus /subcaudatus*	___ ___ ___	____________________

Non-vascular Plants *(DO NOT INCLUDE non-vascular species in the dominant species calculations)*

___ ___ ___	*Sphagnum spp.*	___ ___ ___	*Filamentous Algae*	___ ___ ___	____________________
___ ___ ___	*Total mosses & liverworts*	___ ___ ___	*Chara algae*	___ ___ ___	____________________

West Virginia Wetland Rapid Assessment Datasheet - Photo Log *(p.26 of WVWRAM User Manual)* Page ____

Site name ____ **Date**__________________

Camera type/camera number__________________________________ **Photographer**__________________

Take photos of inlet(s), outlet, each NWI wetland type, soils, stressors and any other key features.

Notes:

Photo # *(field)*	Photo Description (use key words)	Photo ID *(DEP office)*	Photo # *(field)*	Photo Description (use key words)	Photo ID *(DEP office)*

West Virginia Wetland Rapid Assessment Datasheet - overflow notes

Page ____

Site name ____ **Date**____________________

Directions to site:

Notes on land use history, site conditions, wildlife observed, discussions with landowner or other on-site personnel, or deviations from protocol:

Other overflow notes (include datasheet heading):

WV Wetland Rapid Assessment Datasheet - Soils (extra page for sites with >4 soil samples)

Site name ______________________________ Date ______________________

NWI Wetland Types *Refer to NWI code sheets. List all NWI codes present in assessment area; minimum 1 soil sample per each NWI code; minimum 1 soil sample per each 10 acres; NWI codes may be sampled more than once.*
Assign System, Class, and Subclass of the NWI code based on vegetation (ex. PEM1). Then sample soil and assign Water Regime, pH, and Soil organic/mineral modifiers. Add Special modifiers if present (ex. PEM1Abtn). *(p.33,59,91, Reference Sheets)*

NWI Wetland Type Code (refer to NWI Codes diagram): NWI System & Class	Sub-class	Wat. reg.	Spe-cial	pH	Soil	Sampled	Not sampled (permanently ponded)	Soil notes *Optional notes on soil profile or soil features.*
Examp. PEM	1	B	d	t	n	■	❑	***Example*** *0-5cm sapric, 5-15cm mucky mod min, 15-30+cm silt loam 25% redox conc*
__.						❑	❑	
__.						❑	❑	
__.						❑	❑	
__.						❑	❑	

NWI Water Regime *Refer to NWI code diagram, NWI Water Regime Non-tidal Modifiers, and NWI Water Regime Restriction reference sheets. (p.60)*

Add Water Regime modifier to NWI code at top of page:

		seasonally flooded-saturated (E)	*permanently flooded (H)*
temporarily flooded (A)	*seasonally flooded (C)*	*semipermanently flooded (F)*	*intermittently flooded (J)*
seasonally saturated (B)	*continuously saturated (D)*	*intermittently exposed (G)*	*artificially flooded (K)*

Special Modifiers *Only if applicable. Refer to NWI Code diagram and definitions. (p.62)*

If applicable, add Special modifier to NWI code at top of page. Add only the first applicable modifier, in this order: b, d, f, m, h, r, s, x

beaver (b), partly ditched/drained (d), farmed (f), managed (m), diked/impounded (h), artificial substrate (r), spoil (s), excavated (x)

Soil pH *pH value of soil at 10 cm (4") below the surface (p.63)*

Soil sampling site #

Ex. __ __ __ __

5.7 _____ _____ _____ _____

Add pH modifier to NWI code at top of page:
pH < 5.5 = acid (a)
pH 5.5-7.4 = circumneutral (t)
pH > 7.4 = alkaline (i)

ORGANIC MATERIAL

2 cm (0.8") Organic Material Near Surface *Remove duff layer. Collect sample from top 8 cm (3") of soil profile. Refer to Organic Soils reference sheet.*
Peat, mucky peat, muck, or mucky modified mineral soil in top 8 cm (3") below the soil surface. *(p.63 & Reference Sheet)*

Soil sampling site #

__ __ __ __

❑ ❑ ❑ ❑ Present: at least 2 cm (0.8") thick organic layer or mucky modified mineral layer

❑ ❑ ❑ ❑ Not present

Total Depth of Surficial Organic Material *(not required for impact assessment; required for condition & restoration monitoring) (p.64 & Reference Sheet)*

Soil sampling site #

Ex. __ __ __ __ cm

15 _____ _____ _____ _____ inches

Description of Organic Material: peat/fibric, mucky peat/hemic, muck/sapric, or mucky modified mineral soil. *Ex. 0-5cm sapric, 5-15cm mucky mod min*

Deep Organic Soil. *Excavate each soil hole to either 40 cm (16") depth of organic soil, or 80 cm (32") total soil depth, whichever comes first.*
Histosol : Peat, mucky peat, or muck soil with at least 12-18% organic matter by weight and >= 40 cm (16") deep within the upper 80 cm (32") of soil profile.
Histic epipedon : Peat, mucky peat, or muck soil with at least 12-18% organic matter by weight and >= 20 cm (8") thick, but < 40 cm (16") thick, as a surface horizon. Aquic conditions or artificial drainage is required. Note that mucky modified mineral soil is NOT included in this section. (p.64)

Soil sampling site #

__ __ __ __

❑ ❑ ❑ ❑ Histosol present; NWI soil modifier = organic (g)

❑ ❑ ❑ ❑ Histic epipedon present, but no histosol; NWI soil modifier = mineral (n)

❑ ❑ ❑ ❑ Neither histosol nor histic epipedon present; NWI soil modifier = mineral (n)

Add Soil modifier to NWI code at top of page:
organic (g)
mineral (n)

West Virginia Wetland Rapid Assessment Datasheet - Plant Voucher *(p.74 of WVWRAM User Manual)*

Site name ____ **Date**__________________

NWI code____________________ **Percent cover within the NWI code area**______________________

Collector______________________________ **Collection #**______________________

Species name or pseudonym ____

Additional notes (optional):

West Virginia Wetland Rapid Assessment Datasheet - Plant Voucher

Site name ____ **Date**__________________

NWI code____________________ **Percent cover within the NWI code area**______________________

Collector______________________________ **Collection #**______________________

Species name or pseudonym ____

Additional notes (optional):

West Virginia Wetland Rapid Assessment Datasheet - Plant Voucher

Site name ____ **Date**__________________

NWI code____________________ **Percent cover within the NWI code area**______________________

Collector______________________________ **Collection #**______________________

Species name or pseudonym ____

Additional notes (optional):