U.S. Fish and Wildlife Service

Dichotomous Keys and Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path, and Waterbody Type: Version 3.0

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Cover: Maryland freshwater tidal marsh; Classification = Lotic River Tidal Fringe Microtidal.

Dichotomous Keys and Mapping Codes for Wetland Landscape Position, Landform, Water Flow Path, and Waterbody Type Descriptors: Version 3.0

Ralph W. Tiner
Regional Wetland Coordinator

U.S. Fish and Wildlife Service
National Wetlands Inventory Project
Northeast Region
300 Westgate Center Drive
Hadley, MA 01035

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Note: The findings and conclusions in this report are those of the author and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

Table of Contents

	Page
Section 1. Introduction	**1**
Need for New Descriptors	1
Background on Development of Keys	2
Use of the Keys	3
Uses of Enhanced Digital Database	4
Changes from Version 2.0	4
Future Considerations	9
Organization of this Report	10
Section 2. Wetland Keys	**11**
Key A-1. Key to Landscape Position	14
Key B-1. Key to Inland Landforms	19
Key C-1. Key to Coastal Landforms	23
Key D-1. Key to Water Flow Paths	26
Section 3. Waterbody Keys	**29**
Key A-2: Key to Major Waterbody Type	30
Key B-2. Key to Waterbody Landscape Position for Lakes and Ponds	31
Key C-2: Key to River/Stream Flow Duration and Other Modifiers Key	32
Key D-2: Key to Lakes	33
Key E-2: Key to Oceans and Marine Embayments	34
Key F-2: Key to Estuaries	35
Key G-2: Key to Water Flow Paths	36
Key H-2: Key to Estuarine Hydrologic Circulation Types	38
Section 4. Coding System for LLWW Descriptors	**39**
Coding for Wetlands	39
Landscape Position Codes	39
Landform Codes	41
Water Flow Path Codes	44
Codes for Other Modifiers	45
Coding for Waterbodies	47
Landscape Position Codes for Lakes and Ponds	47
Waterbody Type Codes	47
Water Flow Path Codes	53
Estuarine Hydrologic Circulation Type Codes	54
Codes for Other Modifiers	54
Section 5. Application of the Descriptors	**55**
Section 6. Acknowledgments	**56**
Section 7. References	**57**
Section 8. Glossary	**60**

Appendices:

A: Examples of LLWW Types: Tidal and Nontidal Wetlands

B: Simplified Keys for Landscape Position, Landform, and Water Flow Path

West Virginia sedge meadow (foreground) and alder swamp (middle);
Classification = Terrene Headwater Basin Outflow.

New York floodplain forested wetland; Classification = Lotic River Floodplain Throughflow.

Section 1. Introduction

A wide variety of wetlands have formed across the United States. To describe this diversity and to inventory wetland resources, government agencies and scientists have devised various wetland classification systems (Tiner 1999). Features used to classify wetlands include vegetation, hydrology, water chemistry, origin of water, soil types, landscape position, landform (geomorphology), wetland origin, wetland size, and ecosystem form/energy sources.

The U.S. Fish and Wildlife Service's wetland and deepwater habitat classification (Cowardin et al. 1979) is the national standard for wetland classification in the United States. This classification system emphasizes vegetation, substrate, hydrology, water chemistry, and certain impacts (e.g., partly drained, excavated, impounded, and farmed). These properties are important for describing wetlands and separating them into groups for inventory and mapping purposes and for natural resource management. They do not, however, include some abiotic properties important for evaluating wetland functions (Brinson 1993). Moreover, the classification of deepwater habitats is limited mainly to general aquatic ecosystem (marine, estuarine, lacustrine, and riverine) and bottom substrate type, with a few subsystems noted for riverine deepwater habitats. The Service's classification system would benefit from the application of additional descriptors that more fully encompass the range of characteristics associated with wetlands and deepwater habitats.

In the early 1990s, Mark Brinson created a hydrogeomorphic (HGM) classification system to serve as a foundation for wetland evaluation (Brinson 1993). He described the HGM system as "a generic approach to classification and not a specific one to be used in practice" (Brinson 1993, p. 2). This system emphasized the location of a wetland in a watershed (its geomorphic setting), its sources of water, and its hydrodynamics. The system was designed for evaluating similar wetlands in a given geographic area and for developing a set of quantifiable characteristics for "reference wetlands" rather than for inventorying wetland resources (Smith et al. 1995). A series of geographically focused models or "function profiles" for various wetland types in some regions have been created or are in development for use in functional assessment (e.g., Brinson et al. 1995, Ainslie et al. 1999, Smith and Klimas 2002; for a more complete listing of HGM reports see http://el.erdc.usace.army.mil/wetlands/hgmhp.html).

Need for New Descriptors

As of May 2014 the Service's National Wetlands Inventory (NWI) Program has produced digital wetland data for all of the coterminous United States (48 states), Hawaii, and 35 percent of Alaska (Bergeson 2013). Although these data represent a wealth of information about U.S. wetlands, they lack hydrogeomorphic and other characteristics needed to perform assessments of wetland functions over broad geographic areas. Using geographic information system (GIS) technology and geospatial databases, it is now possible to predict wetland functions for watersheds - a major natural resource planning unit. Watershed managers and municipal planners could make better use of NWI data if additional descriptors (e.g., hydrogeomorphic-

type attributes) were added to the current NWI database (Honachefsky 1999). Watershed-based preliminary assessments of wetland functions could be performed. This new information would also permit more detailed characterizations of wetlands for reports and for developing scientific studies and lists of potential reference wetland sites. The Wetlands Subcommittee of the Federal Geographic Data Committee (FGDC) in drafting wetland mapping standards recommended use of these indicators (FGDC Wetlands Subcommittee 2009). They recognized the value of adding these attributes to the existing NWI data thereby making the database a more powerful analytical tool.

Background on Development of Keys

Since the Cowardin et al. wetland classification system (1979) is the national standard and forms the basis of the most extensive wetland database for the country, it would be desirable to develop additional modifiers to enhance the current data. This would greatly increase the value of NWI digital data for natural resource planning, management, and conservation. Unfortunately, Brinson's "A Hydrogeomorphic Classification of Wetlands" (1993) was not designed for use with the Service's wetland classification. He used some terms from the Cowardin et al. system but defined them differently (e.g., Lacustrine and Riverine). Consequently, a set of hydrogeomorphic-type descriptors was needed that would be more compatible with the Cowardin et al. system. Such descriptors would bridge the gap between these two systems, so that NWI data could be used to produce preliminary assessments of wetland functions based on characteristics identified in the NWI digital database. In addition, more descriptive information on deepwater habitats would also be beneficial. For example, identification of the extent of dammed rivers and streams in the United States is a valuable statistic, yet according to the Service's classification dammed rivers are classified as Lacustrine deepwater habitats with no provision for separating dammed rivers from dammed lacustrine waters. Differentiation of estuaries by various properties would also be useful for national or regional inventories.

Recognizing the need to better describe wetlands from the abiotic standpoint in the spirit of the HGM approach, the Service developed a set of dichotomous keys for use with NWI data (Tiner 1997b). The keys bridge the gap between the Service's wetland classification and the HGM system by providing descriptors for landscape position, landform, water flow path and waterbody type (LLWW descriptors) important for producing better characterizations of wetlands and deepwater habitats. The LLWW descriptors for wetlands can be easily correlated with the HGM types to make use of HGM profiles when they become available. The LLWW attributes were designed chiefly as descriptors for the Service's existing classification system (Cowardin et al. 1979) and to be applied to NWI digital data, but they can be used independently to describe a wetland or deepwater habitat. Consequently, there is some overlap with Cowardin et al. since some users may wish to use these descriptors without reference to the Cowardin et al. type (i.e., Marine and Estuarine landscape positions).

The first set of dichotomous keys was created to improve descriptions of wetlands in the northeastern United States (Tiner 1995a, b). They were initially used to enhance NWI data for predicting functions of potential wetland restoration sites in Massachusetts (Tiner 1995a, 1997a). Later, the keys were modified for use in predicting wetland functions for watersheds nationwide

(Tiner 1997b, 2000, 2003a, and 2011). A set of keys for waterbodies was added to improve the Service's ability to characterize wetland and aquatic resources for watersheds.

The keys are periodically updated based on application in various physiographic regions. Since 2011, numerous applications of the descriptors have been performed by the NWI and by others. To date LLWW descriptors have been applied to wetland data in 27 states: Alaska, California, Colorado, *Connecticut*, *Delaware*, Georgia, Maine, Maryland, *Massachusetts*, *Michigan*, *Minnesota*, Mississippi, Missouri, Montana, New Hampshire, *New Jersey*, New Mexico, New York, *Oregon*, Pennsylvania, *Rhode Island*, South Carolina, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming. (Note: The states listed in *italics* indicate where statewide applications have been completed or are being performed or planned depending on funding; for more details, see powerpoint presentation posted online at: http://www.fws.gov/northeast/ecologicalservices/pdf/wetlands/NWIPlus_Presentation_ASWM_Nov2013.pdf). The Center for Watershed Protection has included LLWW descriptors as a key element of its Wetlands-at-Risk Protection Tool (http://www.wetlandprotection.org/identify-priority-wetlands/assess-wetland-functions-desktop/34/24-preliminary-assessment-of-wetland-function.html) which is used a guide for protecting wetlands in watersheds and at the local level. A consulting firm has used the LLWW descriptors to classify wetlands for performing a functional assessment of wetlands in an area planned for surface mining in Nova Scotia (Stantec Consulting Ltd. 2011).

Use of the Keys

Two sets of dichotomous keys (composed of pairs of contrasting statements) are provided - one for wetlands and one for waterbodies. Vegetated wetlands (e.g., marshes, swamps, bogs, flatwoods, and wet meadows) and periodically exposed nonvegetated wetlands (e.g., mudflats, beaches, and other exposed shorelines) should be classified using the wetland keys, while the waterbody keys should be used for permanent deep open water habitats (subtidal or $\geq$8.2 feet deep for nontidal waters). Some sites may qualify as both wetlands and waterbodies. A good example is a pond. Shallow ponds less than 20 acres in size meet the Service's definition of wetland, but they are also waterbodies. Such areas can be classified as both wetland and waterbody, if desirable. Ponds should be first classified to a landscape position and then to a particular pond type using the waterbody keys. Another example would be permanently flooded aquatic beds in the shallow water zone of a lake. They are classified using the wetland descriptors, yet they also clearly represent a section of the lake (waterbody). This approach has worked well in producing watershed-based wetland characterizations and preliminary assessments of wetland functions. When applying the attributes to existing NWI data, the NWI polygons may actually encompass more than one landscape type. This situation is frequently encountered in headwater locations where streamside wetlands and neighboring groundwater-driven wetlands have been classified as the same NWI type (e.g., PFO1E or PFO1C). Since splitting the polygon into two different sections is not usually done, the LLWW descriptors added should apply to the conditions reflective of the majority of the wetland polygon. Ideally the wetland area should be separated into two polygons reflecting different characteristics. There may likely be a difference in water regimes (e.g., a flooded regime for the overflow wetland and a seasonally saturated one for the wetland slightly upslope).

Uses of Enhanced Digital Database

When the LLWW classifications are added to the standard NWI database, a NWI+ database is created. The combination of NWI and LLWW classifications (the NWI+ database) may be used to: (1) produce a more complete description of wetland and deepwater habitat characteristics for watersheds, (2) predict the likely functions of individual wetlands, and (3) estimate the capacity of an entire suite of wetlands to perform certain functions in a watershed or other geographic area of interest. To date such work has been done for three states – Connecticut, Delaware, and Rhode Island (Tiner et al. 2011, 2013, and 2014a) and several watersheds including Maine's Casco Bay watershed, Maryland's Nanticoke River and Coastal Bays watersheds, the Delaware portion of the Nanticoke River, Pennsylvania's Lake Erie watershed, and numerous small watersheds in New York (see Tiner et al. 1999, 2000, 2001, 2014b; Machung and Forgione 2002; Tiner 2002; see sample reports on the NWI+ website: http://www.aswm.org/wetland-science/wetlands-one-stop-mapping/5044-nwi-reports for application of the LLWW descriptors). These characterizations are based on our current knowledge of wetland functions for specific types (Tiner 2003b) and may be refined in the future, as needed, based on the applicable HGM profiles and other information. The new terms can also be used to describe wetlands for reports of various kinds including wetland permit reviews, wetland trend reports, and other reports requiring more comprehensive descriptions of individual wetlands.

The LLWW classification is not without its limitations. One study evaluated the use of LLWW classification in upstate New York for identifying differences in surface water quality as an indicator of hydrologic function (Azzolina et al. 2007). The researchers did not find any differences in surface water chemistry between terrene, lotic stream-headwater and lotic stream wetlands. This is not surprising since: (1) the classification is not designed to address surface water chemistry, (2) the classification relies on existing maps and aerial imagery to identify additional features that are needed to predict eleven wetland functions, and (3) the study area is a "predominantly unspoiled setting" with similar characteristics (i.e., New York City's water supply watersheds). The LLWW classification does not address soil-water chemistry but relies on the Cowardin et al. (1979) classification to identify water chemistry differences among wetlands. However, if one wants to predict differences in surface water chemistry it would be useful to consider the soluble mineralogical composition of the underlying geology as well as land use locally and upstream. This would be part of a "condition assessment" and that is beyond the intent of LLWW. Also classification errors do occur as they do with any detailed inventory based on remote sensing and geographic information system (GIS) analysis and such errors will often have an effect on predicted functions.

Changes from Version 2.0

Application of the descriptors to wetlands in many regions of the country has identified the value of adding a few other features to further enhance wetland characterization. To aid previous users of the system, the significant changes are summarized in following paragraphs.

Inland Wetland versus Deepwater Habitat

The update of the Cowardin et al. system by the Federal Geographic Data Committee now defines the boundary between inland wetlands and deepwater habitats at 8.2 feet or 2.5 meters (FGDC Wetlands Subcommittee 2013): wetlands <8.2 feet and deepwater habitats ≥8.2 feet. This necessitated a slight change in the keys to include more shallow water habitat as wetland. The previous breakpoint was a 6.6 feet or 2 meters (Cowardin et al. 1979). For estuarine and marine wetlands the boundary between wetland and deepwater habitat remains unchanged – at the extreme spring low water mark.

Adding Landscape Position to Ponds and Lakes

Since ponds are considered wetlands by Cowardin et al. (1979) and they are included in the landscape-level assessment of wetland functions, designating their landscape position would be worthwhile. Although this can be generally interpreted from their water flow path (e.g., vertical flow and outflow = terrene; throughflow = lotic), there are exceptions (e.g., throughflow caused by ditching). Applying landscape position for ponds was recommended in Version 2.0, but from now on landscape position should be applied to all ponds. Assigning landscape position to lakes would describe the landscape context for these large waterbodies (e.g., within estuarine wetlands and those in paludified peatland landscapes) and highlight some other differences among lakes. One benefit of this change could be to help track increases in open water (ponds) within salt marshes due to rising sea-level as well as to separate these waters from other estuarine waters. Also generalized lotic ("*LO*") can be used if one does not want to separate rivers from streams.

Peatland Landform

To emphasize the development of wetlands that arise from peat formations, the "*Peatland*" landform has been added. This descriptor will be applied to bogs and fens as identification of intertidal peatlands may be more difficult since zones within tidal salt marshes may be comprised of peat, muck, mucky peat, or mineral soils. Numerous types of bogs and fens can be further described as necessary. *Patterned Peatland* may be used to identify peatlands where a complex of strings (ridges) and flarks (depresssions) is evident. *Bog* may be used to describe an essentially ombrotrophic peatland (precipitation-dependent and not receiving significant contributions of water from groundwater). Bog types may include: *Kettle Bog* (early stage of raised bog with bog occurring along an open water kettle), *Plateau Bog* (middle stage of raised bog with bog covering entire depression but topography is generally flat, not significantly domed-shaped), *Raised Bog* (bog topography is domed-shaped completely filling the original depression), *Blanket Bog* (bog formed on slope and extending over rolling terrain), and *Pocosin* (southern bog typical of coastal North and South Carolina). *Fen* can be used to describe a peatland that receives significant groundwater. Fens may be further described by water chemistry: *Poor Fen* (boglike vegetation but known to receive groundwater; pH acidic <5.5), *Rich Fen* (in limestone regions, receiving nutrient-rich waters from groundwater; pH alkaline >7.4), and *Circumneutral Fen* (pH is 5.5-7.4). Fens can also be classified as slope types: *Hillslope* (side of a hill), *Stream Valley Slope* (in a stream valley, typically a narrow valley in the mountains), and *Toe-of-Slope* (at bottom of a hill or slope).

Slope Wetlands

Since montane regions have many wetlands on slopes, more subtypes have been listed to allow for more complete descriptions. Slope wetlands located at the bottom of a hill can be classified as *Toe-of-Slope* wetlands; those forming from a point discharge can be identified as *Seep* wetlands, broader ones forming along and across a hillside as *Hillslope*, and those along a stream in a stream valley in mountains as *Stream Valley Slope* wetlands. If the latter are subject to frequent stream overflow, they would, however, be classified in the Lotic landscape position and if not, they would be classified as Terrene Outflow Discharge to Stream types.

Throughflow Wetlands

The emphasis on throughflow is now placed on surface water connections for this water flow path. Wetlands where throughflow is achieved by groundwater connections can be categorized by a combination of vertical flow and throughflow with the addition of a groundwater-connection descriptor (*Vertical flow-throughflow, groundwater-connected*) – see discussion for "geographically isolated wetlands" below. Further breakdowns are possible to separate perennial, intermittent, and artificial throughflow (see codes). Same is true for outflow.

Inflow Artificial

This water flow path (*Inflow Artificial*) was added to describe the flow of water in wetlands formed in impoundments where water is pumped in for containment and then drawdown occurs naturally. Such wetlands can be found in diked areas for deposition of dredged material or to hold contaminated water, for example.

Vertical Flow

Since the term "isolated" when applied to wetlands does not adequately address the predominant flow of water, it has been replaced by "*Vertical Flow*" (VR) because the water in such wetlands moves up and down in response to water inputs and outputs. Although all wetlands experience vertical water movements, the hydrodynamics of wetlands lacking inlets and outlets is characterized by such fluctuations (Brinson 1993). See additional discussion in next three subsections.

Geographically Isolated Wetlands

Geographically isolated wetlands have been defined as wetlands completely surrounded by upland and lacking a surface water inlet or outlet (Tiner 2003c, d; "topographically isolated" depressional wetlands of Brinson 1993, p. 20). The water flow path for these wetlands can be described as "*Vertical Flow*" as discussed above. Such wetlands may experience infrequent outflow, throughflow, or inflow of surface water during extremely wet periods which may link them hydrologically to other wetlands and waters at times. In many places, geographically isolated wetlands may be connected to other wetlands and waters by groundwater. A good example is found in the Prairie Pothole Region of the Upper Midwest (e.g., Iowa, Minnesota, and the Dakotas) where geographically isolated wetlands are connected by groundwater and that

outflow, throughflow, or inflow is determined largely by topographic position on the landscape. For these wetlands where groundwater connections are documented or can be readily interpreted, the following terms can be used with the addition of a groundwater-connected modifier ("gc"): *Vertical flow-throughflow/groundwater-connected*, *Vertical flow-outflow/groundwater-connected*, and *Vertical flow-inflow/groundwater connected*. For isolated wetlands on sandy soils near large lakes where groundwater levels are strongly influenced by lake levels, water flow path should be classified as *Bidirectional-nontidal/groundwater lake-influenced* (i.e., "BIgl"). Note that *bidirectional-nontidal* should not be used with ponds, unless the hydrology is strongly influenced by lake levels or the pond is imbedded within a vegetated lentic wetland with a bidirectional-nontidal flow path.

Isolated Complexes of Wetlands

Where a group of interconnected wetlands in a locale do not appear to have an outlet or inlet to a river, stream, or other wetlands connected to such waters, they may be considered an "isolated complex." Their water flow path can be simply classified as "*Vertical Flow Complex*." If there is a need to describe connections among these wetlands, combine "Vertical Flow" with other water flow paths to designate the type of connection. Where naturally connected by a stream, for example, classify as *Vertical flow-throughflow*, *Vertical flow-outflow*, and *Vertical flow-inflow*, or where connected by ditches, classify as *Vertical flow-artificial throughflow*, *Vertical flow-artificial outflow*, and *Vertical flow-artificial inflow*. Of course, these wetlands may be also linked to other waters via underground sources (see discussion of geographically isolated wetlands above).

Wetlands in Karst Regions

Karst regions are well-recognized for their disappearing streams or sinkhole ponds whose water goes downward into the underground karst drainage system for variable distances before coming to the surface as a new stream, spring or seep, for example. For associated wetlands at these locations, the water flow path is classified as *Vertical flow-throughflow* with the descriptor for "*subsurface flow karst*" ("sk") added to the term. Wetlands upstream should be designated with the normal water flow path (e.g., Throughflow or Outflow).

Terrene Wetlands

There are many wetlands on the 100-year floodplain that are not flooded frequently enough by overflow to be classified as Lotic and these wetlands have been defined as Terrene. Since Terrene wetlands include other types as well, it would be useful to identify the major types. With this version, Terrene wetlands can now be separated into three general types: Terrene Headwater (TE1; those that are the source of a stream or river), Terrene Riparian (TE2; those on the 100-year floodplain but not frequently overflowed by river or stream), and Terrene Non-riparian (TE3; including but not necessarily limited to geographically isolated wetlands). The riparian types include peatlands and other wetlands along rivers and streams that occur on the 100-year floodplain and whose primary source of water is either groundwater or surface water (i.e., precipitation) and are not flooded frequently by river or stream overflow.

Tidal Range Descriptors for Tidal Wetlands

Because tidal hydrology is already addressed by landscape position (e.g., estuarine, marine, or lotic tidal) adding bidirectional-tidal as water flow path did not provide any new information. An important feature of their hydrology is, however, the tidal range. While Version 2.0 listed three ranges (*Microtidal*, *Mesotidal*, and *Macrotidal*), application of these descriptors for projects did not often include these important variables. For Version 3.0, the bidirectional-tidal (BT) water flow path has been replaced by tidal ranges which can be obtained for specific locations from NOAA's tide table charts (http://tidesandcurrents.noaa.gov/tide_predictions.html). Also, the three ranges have been expanded to five ranges to highlight wetlands/estuaries with very small tidal ranges ("*Nanotidal*" –1.0 ft/ 0.3m or less = "NA") and others experiencing huge tides ("*Megatidal*" – 26.2 ft/8 m or more = "MG"; Woodroffe 2002). The former addresses the tidal range in coastal ponds and some large bays subject to wind tides (e.g., Barnegat Bay, NJ and Pamlico and Albermarle Sounds, NC), while the latter brings attention to estuaries with the world's highest tides (e.g., Bay of Fundy).

Lotic Water Permanence

For the Lotic landscape position, the gradients used in the previous versions of this classification have been replaced by a set of descriptors that address "*Flow Duration*" descriptors. These descriptors focus on water permanence or the effect of dams on rivers and streams which is very important for evaluating functions. The descriptors are: *Tidal*, *Dammed*, *Perennial*, *Intermittent*, *Ephemeral*, and *Unknown*. Also add "lake" as a subtype of Perennial for the Lotic River landscape position to address "river lakes" – semi-enclosed waterbodies directly connected to the river (e.g., many examples along the Mississippi River, especially the upper part).

Lake and Lentic Wetland Subtypes

To facilitate use of pond codes to better describe lakes and consistency, the coding of lakes was revised to match those of ponds except for the ones specific to lakes. Codes for the latter were changed to letters at the end of the alphabet since the pond codes begin with "a".

Other Modifications

Several other changes were made including the following:

(1) added another type of bar-built estuary – *coastal pond/lagoon-artificially open* to identify those estuaries that are kept open by breachways or dredged canals;
(2) deleted the coastal pond and lagoon modifier for fringe coastal landforms ("FRcp" and "FRlg") since the estuarine landscape position already addresses these characteristics as subtypes of *bar-built estuary;*
(3) for Terrene wetlands added a descriptor for landscape position to indicate that a montane wetland is located in an alpine valley ("*av*");
(4) for Terrene wetlands that contain a large lake where the lake has little influence on the wetland, the modifier "*lk*" can be added to indicate that the wetland contains a lake (i.e., the lake

is imbedded in the wetland);
(5) added two modifiers for Slope wetlands to provide more detail if desired to identify toe slope wetlands and discharge slopes (seeps);
(6) added *arroyo* as a subtype of river and stream to address dry streambeds subject to intermittent or ephemeral flows;
(7) added modifiers for nonvegetated fringe wetlands to describe *beach* and *bar*;
(8) changed the definition of *active floodplain* to represent areas that are frequently flooded (i.e., 50% chance of flooding every year; flooded every other year on average), while the floodplain landform still includes the so-called 100-year floodplain (i.e., the broad alluvial plain that is flooded at least once every 100 years on average);
(9) added *dredged material disposal area* to pond subtypes;
(10) deleted two subtypes of island wetlands: ebb delta and flood delta – they now can be classified using the modifier "*eb*" or "*fd*", respectively;
(11) added *river lake* and *oxbow lake* as specific types of floodplain lakes and deleted the types that were based on the surrounding land (e.g. *floodplain – forest matrix* and *floodplain – herb matrix*);
(12) added silvicultural management ("*sm*") and agriculture ("*ag*") to highlight those activities in wetlands as previous versions included modifiers for grazing ("*gz*"), wildlife management ("*wm*"), and cranberry bog ("*cr*" for commercial bogs).

Future Considerations

To date, the classification has worked well in a wide variety of landscapes in the lower 48 states. Many of the changes in this version are the result of applications beyond the eastern part of the country. Clearly application in other regions will help improve and refine the system. In particular there is need for further evaluation of the classification's utility in tropical regions and boreal and arctic regions, especially in paludified landscapes where the landscape is dominated by wetland (see image below). The complexity of such landscapes is challenging. In 2015, the LLWW descriptors will be applied to an updated mapping project for Kodiak National Wildlife Refuge which should be particularly challenging due to its size (1.9 million acres), its varied topography and wilderness qualities. Statewide applications for New Mexico and Minnesota may also uncover other issues that may need further clarification.

Peatlands north of Upper Red Lake, Minnesota (former Glacial Lake Agassiz) - a region dominated by wetland; area shown covers roughly 800 square miles. (U.S. Geological Survey)

Organization of this Report

The report is organized into eight sections: (1) Introduction, (2) Wetland Keys, (3) Waterbody Keys, (4) Coding System for LLWW Descriptors, (5) Application of the Descriptors, (6) Acknowledgments, (7) References, and (8) Glossary, plus Appendices.

Texas flatwood; Classification = Terrene Headwater Flat Outflow.

California vernal pool; Classification = Terrene Non-riparian Basin Vertical Flow.
(J. Gillrich photo)

Section 2. Wetland Keys

Three keys are provided to identify wetland landscape position and landform for individual wetlands: Key A for classifying the former and Keys B and C for the latter (for inland wetlands and coastal wetlands, respectively). A fourth key - Key D - addresses the flow of water associated with wetlands. Table 1 lists some of the more commonly used LLWW descriptors. It gives readers a good idea of what the various combinations may be. (Note: Ponds and lakes should be identified in one of several landscape positions to aid in recognizing the abundance of open water within vegetated wetland complexes; this is particularly important in estuarine areas where rising sea-level will likely produce more ponds within salt marshes, for example.)

The keys and terminology are intentionally comprehensive to be able to use the system for site-specific classification. However, large-scale applications for landscape-level or watershed-level characterizations and assessments utilize only the basic terms. For example, for landscape position: *Marine*, *Estuarine*, *Lotic River*, *Lotic Stream*, *Lentic*, and *Terrene*; for landform: *Peatland*, *Slope*, *Basin*, *Floodplain*, *Flat*, *Fringe*, and *Island*; for water flow path: *Inflow*, *Outflow*, *Throughflow*, *Vertical Flow*, *Bidirectional-nontidal*, and various tidal ranges; and a few select modifiers, especially *headwater*, *estuarine-discharge*, and those addressing tidal restrictions. Many descriptors are used for ponds to highlight their differences and others are used to separate perennial from intermittent watercourses and natural from altered waterbodies. Numerous examples of landscape-level applications can be found online: examples of the "maps" can be seen via the NWI+ web mapper: http://nwiplus.cmi.vt.edu/nwiplusmapper/ while online NWI+ reports present the methods and results: http://www.aswm.org/wetland-science/wetlands-one-stop-mapping/5044-nwi-reports. Although these early products demonstrate the basic application of the classification, they do not incorporate any of the latest modifications of the system.

Users should first identify the landscape position associated with the subject wetland following Key A-1. Afterwards, using Key B-1 for inland wetlands and Key C-1 for salt and brackish tidal wetlands, users will determine the associated landform. The landform keys include provisions for identifying specific regional wetland types such as Carolina bays, pocosins, flatwoods, cypress domes, prairie potholes, playas, woodland vernal pools, West Coast vernal pools, interdunal swales, and salt flats. Key D-1 addresses water flow path descriptors. Various other modifiers may also be applied to better describe wetlands, such as headwater areas; these are included in the four main keys.

Besides the descriptors provided in the keys, there are numerous other attributes that can be used to describe the condition of wetlands. Some examples are other descriptors that address resource condition could be ones that emphasize human modification, (e.g., natural vs. altered, with further subdivisions of the latter descriptor possible), the condition of wetland buffers, or levels of pollution (e.g., pristine, low pollution, moderate pollution, and high pollution). Addressing wetland condition, however, was beyond the main goal of describing wetlands from a hydrogeomorphic standpoint.

Table 1. List of landscape position, landform, and some of the more commonly used water flow path, and waterbody type descriptors (LLWW descriptors). Note that more detailed categorization of landforms, water flow path, and pond types are possible through the use of the keys, but they have not been shown here. *Note that lakes and ponds are now assigned as a "landform" so that their landscape position can be identified.*

Landscape	Landform	Water Flow Path	Waterbody Type
Marine	Fringe	Macrotidal	Open Ocean
	Island	Mesotidal	Reef-protected Waters
		Microtidal	Atoll Lagoon
			Fjord
			Semi-protected Oceanic Bay
Estuarine	Fringe	Macrotidal	Fjord
	Basin	Mesotidal	Island Protected Rocky Headland Bay
	Basin (tidally restricted)	Microtidal	Rocky Headland Bay
	Island	Nanotidal	Tectonic Estuary
	Island (delta)		River-dominated Estuary
	Lake		Bar-built Estuary
	Pond		Bar-built Estuary (Coastal Pond)
			Bar-built Estuary (Hypersaline Lagoon)
			Island-protected Estuary
			Shoreline Bay Estuary
Lotic	Floodplain	Throughflow	River (Flow Durations: Tidal, Dammed, Perennial, Ephemeral, and Intermittent)
	Basin	Throughflow-intermittent	Stream (Flow Durations: Tidal, Dammed, Perennial, Ephemeral, and Intermittent)
	Flat	Throughflow-entrenched	
	Fringe	Bidirectional-nontidal	
	Island	Microtidal	
	Pond	Mesotidal	
	Lake		

Lentic	Fringe Basin Flat Island Peatland Pond	Bidirectional-nontidal Throughflow Nanotidal	Natural Lake (Main Body, Open Embayment, Semi-enclosed Embayment, Barrier Beach Lagoon) Dammed River Valley Lake (Reservoir) Dammed River Valley Lake (Hydropower) Dammed River Valley Lake (Other) Other Dammed Lake (Former Natural Lake) Other Dammed Lake (Artificial)
Terrene	Fringe (pond) Basin Basin (former floodplain) Flat Flat (former floodplain) Slope Floodplain Peatland Lake Pond	Outflow Outflow-intermittent Inflow Throughflow Throughflow-intermittent Throughflow-entrenched Vertical Flow Paludified Outflow-artificial Throughflow-artificial	Pond (Natural, Dammed/Impounded, Excavated, Beaver, Other Artificial; many other types)

Key A-1: Key to Landscape Position

This key allows characterization of wetlands based on their location in or along a waterbody, in a drainageway, or in relative isolation ("geographically isolated" - surrounded by upland). *Attention: Lakes and ponds should also be classified by landscape position.* See Figure 1 for schematic of landscape positions.

1. Wetland (including pond and shallow lake and associated wetland) is either: (a) completely surrounded by upland (non-hydric soils or filled lands that are now upland development) or (b) a freshwater marsh or swamp surrounded by upland and tidal salt/brackish wetland and subject to tidal inundation only during severe storms……..**Terrene Non-riparian**
Go to Key B-1 for inland landform

Note: If wetland is a freshwater wetland directly behind an estuarine wetland (e.g., salt marsh) apply "ed" (estuarine discharge) to the wetland classification.

1. Wetland is not in those locations…….…….....2

2. Wetland is located in or along an estuary, gulf, or ocean and frequently flooded by salt or brackish water…….....3

2. Wetland (including pond or shallow lake) is not frequently inundated by salt or brackish tides.....4

3. Wetland is located in or along an ocean or gulf.....**Marine**
Go to Key C-1 for coastal landform

3. Wetland is located in an estuary.....**Estuarine**
Go to Key E-2 for Estuary Type, then to Key C-1 for coastal landform

Note: An estuary is represented by salt and brackish tidal waters and contiguous wetlands where marine waters are mixed with fresh water from rivers, streams, and/or upland runoff; *tidal freshwater wetlands are not considered part of the estuary for this classification* (following Cowardin et al. 1979). If an area was formerly connected to an estuary but now is completely cut-off from tidal flow, it is should be classified as one of the other landscape positions depending on current site characteristics. Such areas may be designated with a modifier to identify them as "former estuarine wetland." Lands overflowed infrequently by tides such as overwash areas on barrier islands are considered Terrene, while those frequently flooded and colonized by salt/brackish marsh plants (halophytes) are classified as Estuarine. Tidal freshwater wetlands (e.g., mapped as PEMR, PFO1R, and PSS1S by the NWI) contiguous to salt/brackish/oligohaline tidal marshes are classified as Lotic if a stream or river extends completely through it, or Terrene if lacking a stream or if stream does not flow completely the wetland. Freshwater wetland islands (e.g., PFO_R or PSS_R by NWI) imbedded within estuarine wetlands and freshwater wetlands on levees along rivers in the upper estuary (oligohaline zone) should also be classified as Estuarine given their location in the estuary. The latter situation should be a minor occurrence, while the former may be a misclassification by the NWI as the area may actually be an upland island.

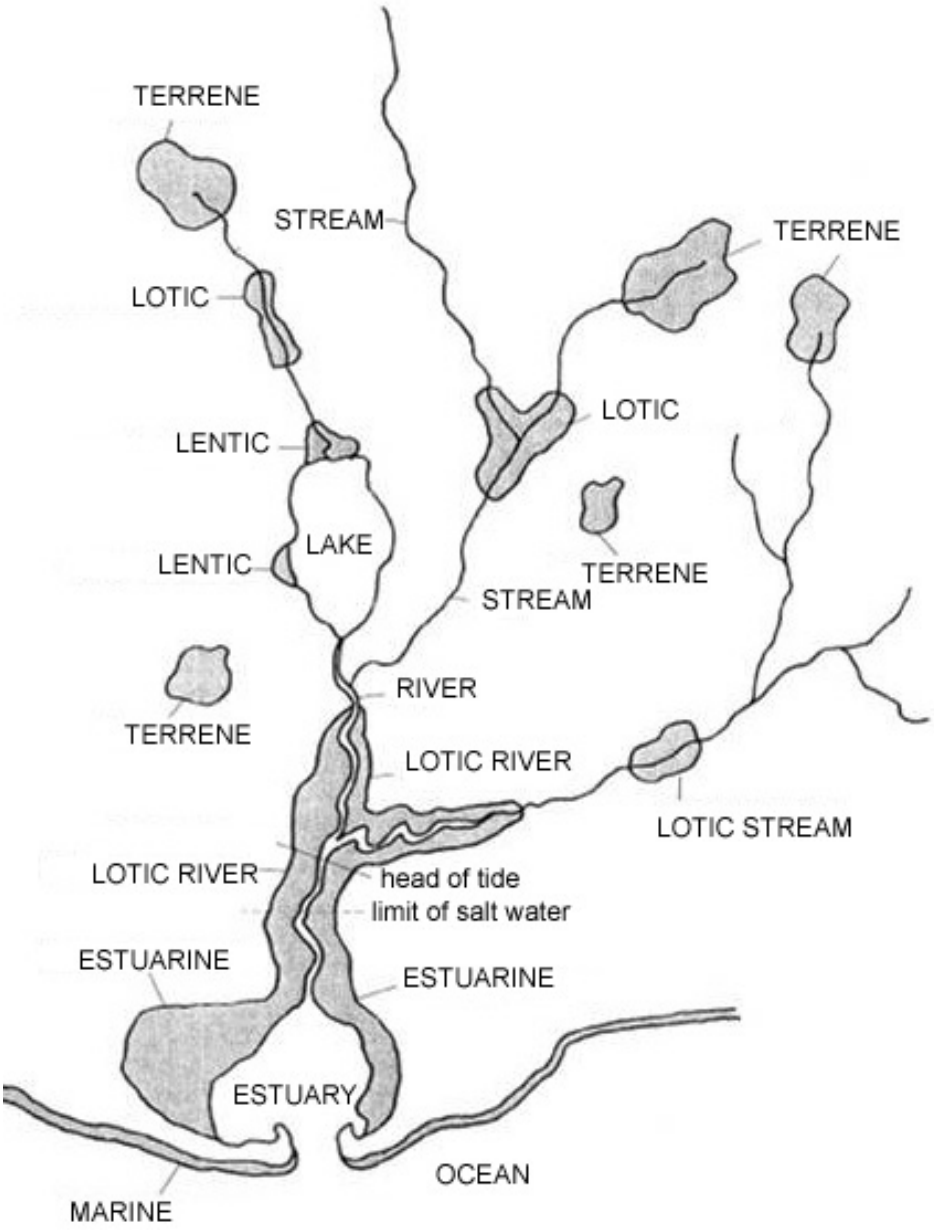


Figure 1. General landscape positions for wetlands, with a few waterbodies shown (ocean, estuary, lake, river, and stream).

4. Wetland is located in or along a lake or reservoir (permanent waterbody where standing water is typically much deeper than 8.2 feet at low water but including large shallow lakes ≥20 acres), including streamside wetlands in a lake basin (the depression containing the lake), and wetlands behind barrier islands and beaches with open access to a lake (e.g., Great Lakes).....**Lentic**

Go to Key D-2 for Lake Type

Then *Go to Key B-1 for inland landform*

Note: Lentic wetlands consist of all wetlands in a lake basin (i.e., the depression forming the lake), including lakeside wetlands intersected by streams emptying into the lake and ponds enclosed by Lentic wetlands. The upstream limit of lentic wetlands is defined by the upstream influence of the lake which is usually approximated by the limits of the basin within which the lake occurs. If the lake is imbedded in a wetland landscape as in arctic, subarctic, and boreal regions, or in the Mississippi delta, for example, the limits of the Lentic wetland should be those shoreline wetlands subject to periodic inundation during high lake levels and not the entire wetland landscape in which the lake is found. If desired, the "*lk*" modifier could be applied to the larger wetland to indicate that it contains at least one lake. Wetlands contiguous to the lake but at higher elevations and not in the lake basin should not be classified as Lentic; these wetlands should be treated as Terrene outflow types in most cases. This is especially common where lakes are artificially created by diking and/or excavation. "Throughflow" should be applied to lakeside wetlands along a stream that flow into the lake to emphasize the stream connection, while other Lentic wetlands are typically classified as "Bidirectional-nontidal" since water tables rise and fall with lake levels during the year. In addition to bidirectional classifications, the water flow path of Lentic wetlands should include the water flow path of the lake (e.g, "Bidirectional-nontidal/outflow"- for a wetland associated with an outflow lake). Tidally-influenced freshwater lakes are designated by the tidal range (e.g., "Microtidal"). Ponds may be included in the Lentic landscape position when imbedded within a Lentic vegetated wetland.

Exclusions: Large diked impoundments used for dredged material disposal are not considered artificial lakes as they do not contain permanent water. River lakes occur along some major rivers; these waterbodies are actually part of the river and associated wetlands are Lotic River types and not Lentic types.

Modifiers: Natural, Dammed River Valley, Other Dammed - see Key D-2 for subtypes of lakes that are more descriptive.

4. Wetland does not occur along a lake or reservoir….....5

5. Wetland is located in a river or stream (including in-stream ponds and shallow lakes), within its banks, or on its 100-year floodplain…….....6

Note: Included in this grouping are wetlands in sloughs that are along small streams or braided streams that may not be visible on mid-altitude aerial photography or on standard 1:24K topographic maps (apply "sl" slough descriptor).

Exclusion: Excluded are wetlands along flowing watercourses that are now impounded and where water flow is artificially controlled; they are either Lentic or Terrene.

5. Wetland is located along a river or stream but is above the 100-year flood level; its hydrology is maintained by groundwater seepage, runoff and/or precipitation……...**Terrene Non-riparian**
Go to Key B-1 for inland landform

Note: These terrene wetlands may occur: (1) on a slope or flat, or in a depression (including ponds, potholes, and playas) lacking a stream but may be contiguous to a river or stream, (2) on a historic floodplain (no longer part of the 100-year floodplain), and (3) in a landscape position crossed by a stream (e.g., an entrenched stream), but where the stream does not periodically inundate the entire wetland (e.g., broad coastal or glaciolacustrine flatwoods that are not Terrene Headwater types). These wetlands may include diked wetlands along rivers and streams that are no longer in the 100-year flood zone and that do not meet the definition of Lentic.

Modifiers: Should include Headwater modifier for wetlands that are contributing to a headwater stream; apply Stream Discharge if connected to a stream other than a headwater stream. If the wetland occurs in a high-elevation valley, a descriptor for Alpine valley can be added to the classification.

6. Wetland is the source of a river or stream; minor streams may flow into this wetland from adjacent hillsides…….……**Terrene Headwater**

Modifiers: If the wetland occurs in a high-elevation valley, a descriptor for Alpine Valley can be added.

6. Wetland is not the source of a stream.....7

7. Wetland is in a river or stream, within its banks, or on its active floodplain and at a minimum, subject to frequent overbank flooding (i.e., every other year on average)…….....8

7. Wetland occurs higher on the floodplain and is not subject to frequent overbank flooding ……
…….…**Terrene Riparian**

Note: These wetlands include peatlands along rivers and streams in northern latitudes as well as infrequently flooded riparian wetlands in arid and semi-arid regions and elsewhere.

8. Wetland is associated with a river (a broad channel mapped as a polygon or 2-lined watercourse on a 1:24,000 U.S. Geological Survey topographic map; generally wider than 25 feet)….....**Lotic River**
Go to Couplet "a" below
(*Also see note under first couplet #4 - Lentic re: streamside wetlands in lake basins*)

Modifier: If the wetland occurs in a high-elevation valley, a descriptor for Alpine Valley

can be added to the classification.

8. Wetland is associated with a stream (*linear or single-line watercourse on a 1:24,000 U.S. Geological Survey topographic map; generally 25 feet or less wide*) ….....**Lotic Stream**
Go to Couplet "a" below
(*Also see note under first couplet #4 - Lentic re: streamside wetlands in lake basins*)

Note: Artificial drainageways (i.e., ditches) are not considered part of the Lotic classification, whereas channelized streams are part of the Lotic landscape position.

Modifiers: Headwater (wetlands along first- and second-order perennial streams in hilly terrain and along first-order streams only on a coastal plain including all intermittent streams above these perennial streams) and Channelized (excavated stream course which now may be wider than 25 feet). If the wetland occurs in a high-elevation valley, a descriptor for Alpine Valley can be added to the classification. Arroyo can be used to designate dry streambeds in arid regions.

Flow Duration for Rivers and Streams

a. Water flow is under significant tidal influence (freshwater tidal wetlands).....**Tidal**
Go to Key B-1 for inland landform
a. Water flow is not under tidal influence (nontidal).....b

b. Water flow is perennial or intermittent but influenced by a dam.....**Dammed**
Go to Key B-1 for inland landform

Modifiers: Lock and Dammed, Run-of-River Dam, Beaver Dam, and Other Dam (see Waterbody Key B-2 for further information).

Note: The impounded section of a river created by a large dam is considered a man-made lake or reservoir (e.g., Hoover Dam and Lake Meade) and is treated as "Dammed River Valley Lake" in this classification. Smaller dams do not greatly alter the general linear nature of the watercourse and their impounded section is treated as "Dammed River."
b. Water flow is unrestricted.....c

c. Water flow is for brief periods during the year.....d
c. Water flow is perennial (year-round in most years).....**Perennial**
Go to Key B-1 for inland landform

Modifiers: Wetlands associated with "river lakes" can be identified by a subtype of Perennial (see codes). These are associated with large river systems, especially the Mississippi River.

d. Water flow is only for a few days associated with rainfall and snow melt...**Ephemeral**
Go to Key B-1 for inland landform

Modifier: Arroyo is a type of ephemeral wetland associated with arid regions.

d. Water flow lasts a couple of weeks or more but is not continuous through the year ….
…….....**Intermittent**
Go to Key B-1 for inland landform

Key B-1: Key to Inland Wetland Landforms

1. Wetland is formed by the accumulation of peat……...……..**Peatland**
Go to Key D-1 for water flow path

Note: Peat deposits should be thick enough to qualify as organic soil (>16 in. or 40 cm) or as a histic epipedon (8-16 in. or 20-40 cm comprised of fibric material) on top of muck. The focus of this category is to identify bogs or fens common at higher latitudes or at high elevations. *If peatland is along a river or stream and within the 100-year floodplain or is a floating mat, its linkage to the river can be identified by the Terrene Riparian landscape position.*

Modifiers: Patterned Peatland – complex of strings (ridges) and flarks (depresssions) evident. Bog (essentially ombrotrophic; not connected to groundwater, precipitation-dependent), bog types: Kettle Bog (early stage of raised bog with bog occurring along an open water kettle), Plateau Bog (middle stage of raised bog with bog covering entire depression but topography is generally flat, not significantly domed-shaped), Raised Bog (bog topography is domed-shaped completely filling the original depression), Blanket Bog (bog formed on slope and extending over rolling terrain), and Pocosin (southern bog typical of coastal North and South Carolina). Fen (receiving significant groundwater), fen types by water chemistry: Poor Fen (boglike vegetation but known to receive groundwater; pH acidic <5.5), Rich Fen (in limestone regions, receiving nutrient-rich waters from groundwater; pH alkaline >7.4), and Circumneutral Fen (pH is 5.5-7.4). Fens can also be classified as a Basin if formed in a depression or a Domed Fen where peat forms a mound from upwelling of groundwater, or as one of a few slope types: Hillslope (side of a hill), Stream Valley Slope (in a stream valley, typically a narrow valley in the mountains), and Toe-of-Slope (at bottom of a hill or slope).

1. Wetland substrate is not comprised of peat…….……2

2. Wetland occurs on a noticeable slope (e.g., greater than a 2 percent slope).....**Slope**
Go to Key D-1 for water flow path

Modifiers can be applied to Slope Wetlands to designate the type of inflow or outflow as Channelized Inflow or Outflow (intermittent or perennial, stream or river), Nonchannelized Inflow or Outflow (wetland lacking stream, but connected by observable surface seepage flow), or Nonchannelized-Subsurface Inflow or Outflow (suspected subsurface flow from or to a neighboring wetland upslope or downslope, respectively). Slope wetlands located at the bottom of a hill can be classified as Toe-of-Slope wetlands;

those forming from a point discharge can be identified as Seep wetlands; broader ones forming along the hillside as Hillslope; those along a stream in a stream valley in mountains as Stream Valley slope wetlands. If the latter are subject to frequent stream overflow, they would be in the Lotic landscape position and if not, they would be classified as Terrene Outflow Headwater or Discharge to Stream types, depending on the stream order.

Exclusions: Patterned fens occur on gentle slopes (about 2 percent or less) and can be recognized by a series of alternating depressions or hollows ("flarks" – pools usually dominated by herbaceous species) and linear ridges ("strings"- vegetated by dwarf shrubs and stunted trees) arranged perpendicular to the water flow; these areas are treated as Peatlands (see couplet 1 above). Also excluded from the Slope landform are beaches along large waterbodies and other nonvegetated wetlands (e.g., cobble-gravel bars along rivers); they are considered a type of Fringe wetland.

2. Wetland does not occur on a distinct slope.....3

3. Wetland is completely surrounded by water (and not from ditching)…….....**Island**
(Go to Key D-1 for water flow path)

Note: To be classified as Island, the wetland must be an island and not simply attached to or associated with an upland island. An island wetland formed in a delta at the mouth of a river or stream can be further classified as a Delta Island Wetland; other islands are associated with landscape positions (e.g., lotic river island wetland, lotic stream island wetland, lentic island wetland, or terrene island pond wetland). Vegetation class and subclass from Cowardin et al. 1979 should be applied to characterize the vegetation of wetland islands if not previously classified; vegetation is assumed to be rooted unless designated by a *modifier* - "Floating Mat" to indicate a floating island such as found in some lakes and large reservoirs.
Caution: Sections of marsh divided by ditching that are completely surrounded by water in the ditches are not considered Island for this classification.

3. Wetland does not form an island.....4

4. Wetland occurs within the banks of a river or stream or along the shores of a pond, lake, or island, or behind a barrier beach or island, and is either: (1) vegetated *and* typically permanently inundated, semipermanently flooded (including their tidal freshwater equivalents), regularly flooded (tidal), or permanently saturated due to this location; or (2) a nonvegetated bank or shore that is temporarily flooded or wetter .....**Fringe**
Go to Couplet "a" below for Types of Fringe Wetlands
Then *Go to Key D-1 for water flow path*

Attention: Vegetated fringe wetlands must border a permanent waterbody, but nonvegetated types may also occur along intermittent reaches of river systems. *Seasonally to temporarily flooded vegetated wetlands along rivers and streams (including tidal freshwater reaches, e.g., seasonally flooded-tidal) are classified*

as either Floodplain, Basin, or Flat landforms - see applicable categories.

a. Wetland forms along the shores of an *upland island* within a lake, pond, river, or stream.....b
a. Wetland does not form along the shores of an *upland island*.....d

b. Wetland forms behind a barrier island or beach spit along a lake.....Lentic Barrier Island Fringe Wetland or Lentic Barrier Beach Fringe Wetland
Modifier: Drowned River-mouth
b. Wetland forms along another type of island.....c

c. Wetland forms along an upland island in a river.....Lotic River Island Fringe Wetland
Note: Upland islands are usually are not mapped in streams due to mapping scale, but if mapped then = Lotic Stream Island Fringe Wetland or if in a pond formed in a stream then = Lotic Pond Island Fringe Wetland.
c. Wetland forms along an upland island in a lake or pond……..Lentic Island Fringe Wetland or Terrene Pond Island Fringe Wetland or if in a pond fomed in a stream then = Lotic Pond Island Fringe Wetland.

d. Wetland forms in or along a river or stream.....Lotic River Fringe Wetland or Lotic Stream Fringe Wetland
Modifiers: Bar and Beach (for nonvegetated areas)
d. Wetland forms in or along a pond or lake.....e

e. Wetland forms along a pond shore.....f
e. Wetland forms along a lake shore.....Lentic Fringe Wetland
Modifiers: Drowned River-mouth, Outlet, Inlet, Beach (nonvegetated)

f. Wetland occurs along an in-stream pond.....Lotic River or Stream Fringe Pond Wetland
f. Wetland occurs in another type of pond.....Terrene Fringe Pond Wetland

Note: Vegetation is assumed to be rooted unless designated by the floating mat modifier. For nonvegetated areas, the substrate should be described in the Cowardin et al. classification for the wetland.

4. Wetland does not exist along these shores, or if so, it is seasonally or temporarily flooded, seasonally saturated, or irregularly flooded.....5

5. Wetland occurs on a 100-year floodplain (alluvial processes in effect)……..**Floodplain***
(could specify the river system, if desirable). *Go to Key D-1 for water flow path*
Sub-landforms are listed below.

a. Wetland forms along the shores of a river island.....Floodplain Island Wetland
a. Wetland is not along an island.....b

b. Wetland forms in a depressional feature on a floodplain.....Floodplain Basin Wetland

or Floodplain Oxbow Wetland (a special type of depression)
b. Wetland forms on a broad nearly level terrace.....Floodplain Flat Wetland

*Note: Questionable floodplain areas may be verified by consulting soil surveys and locating the presence of alluvial soils, e.g., Fluvaquents or Fluvents, or soils with Fluvaquentic subgroups. While Lotic Floodplain wetlands will have a Throughflow water flow path; other types may be designated as Inflow, Outflow, or Vertical Flow if located on the floodplain terrace where they are not inundated every other year on average (Terrene Riparian types). Former floodplain wetlands restricted by levees or other features that restrict alluvial processes are classified as Basins or Flats and may be further designated as former floodplain.

Modifiers: Partly Drained; Confluence wetland - wetland at the intersection of two or more streams; River-mouth or stream-mouth wetland - wetland at point where a river and stream empties into lake; Meander scar wetland - the remnant of a former river meander.

5. Wetland does not occur on the 100-year floodplain.....6

6. Wetland exists in a distinct depression in various positions on the landscape (i.e., surrounded by upland, along smaller rivers and streams, along in-stream ponds, along lake shores, or on former floodplains)..... **Basin** or **Basin Former Floodplain** (including *Basin Oxbow Wetland Former Floodplain*) or **Basin Former Estuarine Fringe**. Can specify regional types: *Carolina Bay Basin Wetland* and *Pocosin Basin Wetland* (Atlantic Coastal Plain), *Cypress Dome Basin Wetland* (Florida), *Prairie Pothole Basin Wetland* (Upper Midwest), *"Salt Flat" Basin Wetland* (arid West), *Playa Basin Wetland* (Southwest), *West Coast Vernal Pool Basin Wetland* (California and Pacific Northwest), *Interdunal Basin Wetland* (sand dunes), *Woodland Vernal Pool Basin Wetland* (forests throughout the country), *Polygonal Basin Wetland* (Alaska), *Sinkhole Basin Wetland* (karst/limestone regions), or some type of *Island Basin Wetland* for basin wetlands on islands (e.g., sea islands of Georgia and South Carolina). Note: While ponds are a type of depressional wetland, they are treated as waterbodies and classified as Ponds.

Go to Key D-1 for water flow path

Modifiers may be applied to indicate artificially created basins due to beaver activity or human actions or artificially drained basins including: Beaver (beaver-created); wetlands created for various purposes or unintentionally formed due to human activities - may want to specify purpose like Aquaculture (e.g., fish and crayfish), Wildlife management (e.g., waterfowl impoundments), and Former floodplain, or to designate former salt marsh that is now nontidal (Former estuarine wetland). Other *modifiers* may be applied to designate the type of inflow or outflow as Channelized (intermittent or perennial, stream or river), Nonchannelized-wetland (contiguous wetland lacking stream), or Nonchannelized-subsurface flow (suspected subsurface flow to neighboring wetland), or to identify a headwater basin (Headwater) or a drainage divide wetland that discharges into two or more streams (Drainage divide), or to denote a spring-fed wetland (Spring-fed), a wetland bordering a pond (Pond basin wetland) and a wetland bordering an upland island in a pond (Pond island border). Consider additional modifiers such as Confluence

wetland - wetland at the intersection of two or more streams; River-mouth or Stream-mouth wetland - wetland at point where a river and a stream empties into a lake. For lentic basins associated with the Great Lakes, possibly identify Drowned River-mouth wetlands where mouth extends into the lake basin. Outlet or Inlet can be applied to identify the location of the basin wetland within the lake if desirable (e.g., larger lakes). Partly drained may be used for ditched/drained wetlands.

6. Wetland exists in a relatively level area.....**Flat** or specify *regional types* of flat wetlands, for example: **Salt Flat** (in the Great Basin) or flats that are fragments of once-larger former floodplains: **Flat Former Floodplain**.

Go to Key D-1 for water flow path

Note: If desirable, a *modifier* for drained flats can be applied (Partly drained). Other modifiers can be applied to designate the type of inflow or outflow as Channelized (intermittent or perennial, stream or river), Nonchannelized-wetland (contiguous wetland lacking stream), or Nonchannelized-subsurface flow (suspected subsurface flow to neighboring wetland). Consider additional modifiers such as Confluence wetland - wetland at the intersection of two or more streams; River-mouth or Stream-mouth wetland - wetland at point where a river and a stream empties into a lake.

Key C-1: Key to Coastal Landforms

1. Wetland is completely surrounded by water (not from ditching) in an inlet, river, or embayment.....**Island**

Go to Key D-1 for water flow path

a. Occurs in a delta at the mouth of a river.....Delta Island Wetland
(Could identify flood delta and ebb delta islands for tidal inlets if desirable.)
a. Occurs either in a river or an embayment …….....b

b. Occurs in a river.....River Island Wetland
b. Occurs in a coastal embayment.....c

c. Embayment is open…….. Open Bay Island Wetland

c. Embayment is sheltered or only periodically open to tidal influence…….d

d. Embayment is sheltered and naturally open to tides…….Sheltered Bay Island Wetland

d. Embayment under natural circumstances may be open or closed due to coastal processes; includes bays now permanently open via jetties and similar structures……...
…….……Coastal Pond Island Wetland

Note: The "island" landform should not be applied to sections of marshes fragmented by ditches. It is intended for islands surrounded by significant amounts of open water. It is realized that application of this landform may vary among users but for specific projects,

such usage should be consistent.

1. Wetland does not form such an island, but occurs behind barrier islands and beaches, or along the shores embayments, rivers, streams, and islands.....2

2. Wetland forms along the shore, contiguous with the estuarine or marine waterbody.....**Fringe**
Go to Key D-1 for water flow path

a. Occurs behind a barrier island or barrier beach spit.....Barrier Island Fringe Wetland or Barrier Spit Fringe Wetland [*Modifier* for overwash areas: Overwash]
a. Occurs elsewhere.....b

b. Occurs along a coastal embayment or along an island in a bay.....c
b. Occurs along a tidal river (including an island in the river), an oceanic island, or along a rocky coastline.....e

c. Embayment is open……. Open Bay Fringe Wetland or Open Bay Island Fringe Wetland (along island)
c. Embayment is sheltered or only periodically open to tidal influence…….d

d. Embayment is sheltered and naturally open to tides…….Sheltered Bay Fringe Wetland or Sheltered Bay Island Fringe Wetland (along island)
d. Embayment under natural circumstances may be open or closed due to coastal processes; includes bays now permanently open via jetties and similar structures……... …..…Coastal Pond Fringe Wetland or Coastal Pond Island Fringe Wetland (along island)

e. Occurs along a coastal river or along an island in a river.....River Fringe Wetland or River Island Fringe Wetland
e. Occurs elsewhere.....f

f. Occurs along an oceanic island.....Ocean Island Fringe Wetland
f. Occurs along the shores of exposed rocky mainland.....g

g. Occurs at toe of cliff……Toe-of-Bluff Fringe Wetland
g. Occurs elsewhere along rocky shore……Headland Fringe Wetland

2. Wetland is separated from main body of marsh by natural or artificial means; the former may be connected by a tidal stream extending through the upland or by washover channels (e.g., estuarine intertidal swales), whereas the latter occurs in an artificial impoundment or behind a road or railroad embankment where tidal flow is at least somewhat restricted.....**Basin**
Go to Key D-1 for water flow path

Modifiers may be applied to separate natural from created basins (managed fish and wildlife areas; aquaculture impoundments; salt hay diked lands; tidally restricted-road, and tidally restricted-railroad), and for other situations, as needed.

Note: For a tidal wetland to be considered a Basin wetland the hydrologic restriction

needs to be significant, such as a causeway crossing the entire marsh with only a culvert or bridge permitting access to tidal wetlands upstream. These sites may also be considered potential wetland restoration sites where hydrology can be restored to some degree based on site conditions and surrounding land use.

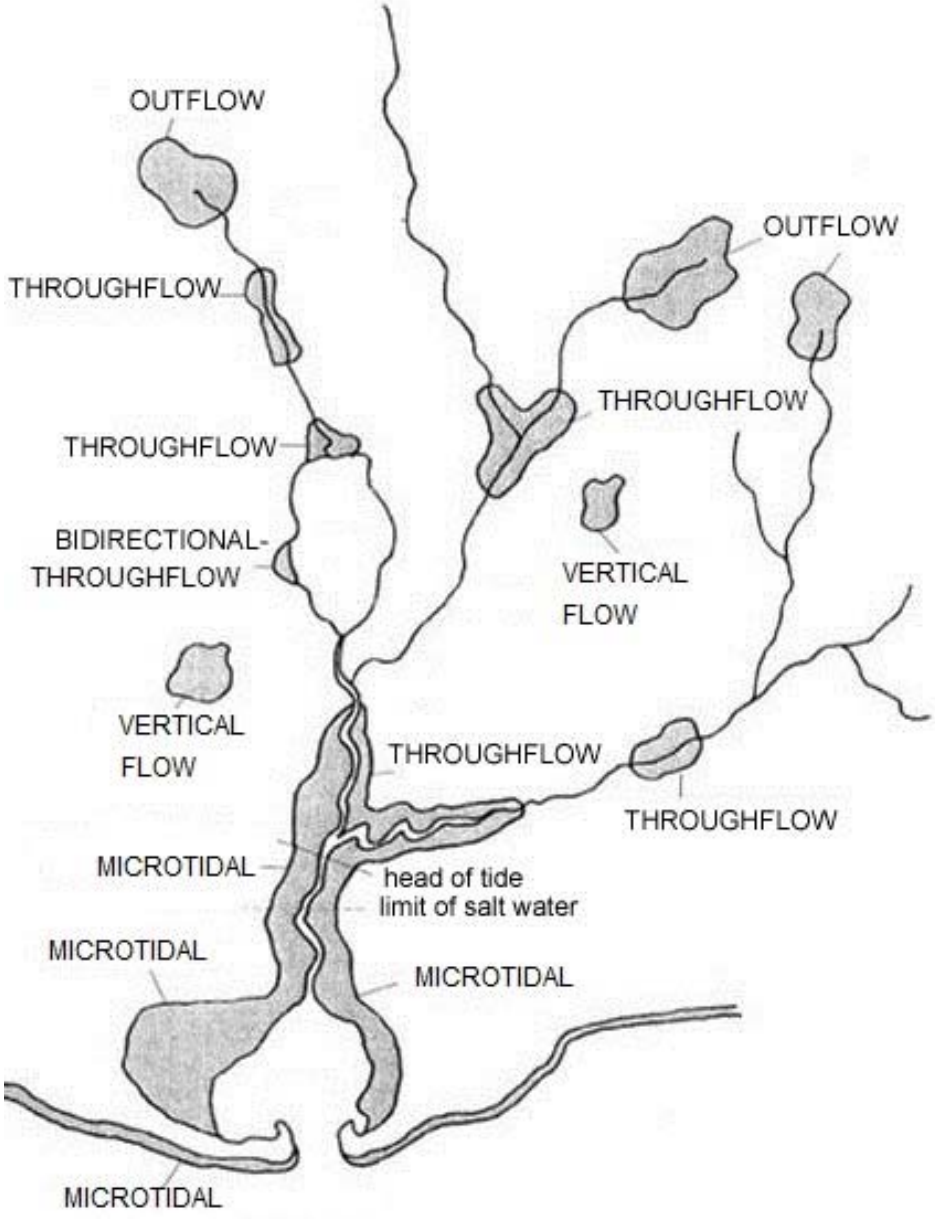


Figure 2. General depiction of some common water flow paths across the landscape. Note: Direction of flow for nontidal areas is from top of page downward. (See Figure 1 for labels of waterbody types)

Key D-1: Key to Water Flow Paths

For describing water flow path, an important distinction is made between surface and ground water connections. Surface water connections are more apparent and many can be recognized on aerial imagery, while groundwater linkages need to be established by research studies or onsite observations. Wetlands lacking apparent surface water connections have typically been viewed as "topographically isolated" or "geographically isolated" wetlands; their water flow path is described as vertical flow with options to include information on groundwater connections. Figure 2 provides a general depiction of major water flow paths across the landscape based on surface water connections.

1. Wetland is periodically flooded by tides (excluding infrequent storm tides)...**Bidirectional-tidal**
(apply tidal ranges below)

Megatidal: Equal to or greater than 26.2 ft (≥8 m)
Macrotidal: From 13.1 ft to less than 26.2 ft (4 m to <8 m)
Mesotidal: From 6.6 ft to less than 13.1 ft (2 m to <4 m)
Microtidal: Greater than 1.0 ft but less than 6.6 ft (>0.3 to <2.0 m)
Nanotidal: l.0 ft or less (≤0.3 m)

These descriptors should be applied to marine, estuarine, and tidal freshwater wetlands and associated waterbodies. If tidal flow is regulated by water control structures, water flow path should be designated as **Bidirectional-tidal Artificial**.

Modifier: Wind tides for areas with low tidal ranges (i.e., nanotidal) where the more prominent tides are wind-driven such as in North Carolina's Albemarle and Pamlico Sounds.

1. Wetland is not flooded by tides (except by infrequent storm tides).....2

2. Water levels fluctuate due to lake influences or by river flood stages (see note below), but water does not flow through this wetland.....**Bidirectional-nontidal, Bidirectional-nontidal/vertical flow, Bidirectional-nontidal/throughflow, Bidirectional-nontidal/outflow, Bidirectional-nontidal/inflow, and Bidirectional-nontidal Artificial.**

Note: Lentic wetlands with streams running through them are classified as Throughflow to emphasize this additional water source, while lentic wetlands located in coves or fringing the high ground would typically be classified as Bidirectional-nontidal. Further classification of the latter's water flow path is recommended to link the flow to the lake itself; the bidirectional-nontidal flow path should also include that of the lake. To accomplish that the following subcategories are established: **Bidirectional-nontidal/vertical flow** (for a geographically isolated lake), **Bidirectional-nontidal/throughflow**, **Bidirectional-nontidal/outflow**, and **Bidirectional-nontidal/inflow**. *Many floodplain wetlands are throughflow types, yet some are connected to the river through a single channel in which water rises and falls with changing river levels. The water flow path of the latter types is best classified as bidirectional-nontidal.* If flow is regulated by water-control structures, **Bidirectional-**

nontidal/artificial should be used. If the water level of a geographically isolated wetland is strongly influenced by lake-affected groundwater, its water flow path can be modified by *"groundwater lake-influenced" (*i.e., *Bidirectional-nontidal groundwater lake-influenced*); if this relationship is not known, however, the water flow path would be **Vertical Flow**. Various types of **Bidirectional-nontidal** water flow paths can also be applied to "ponds" that are completely imbedded within a vegetated lentic wetland.

2. Wetland is not subject to lake influences or if flooded by river high water, water flows through the wetland (overflow)...…….....3

3. Wetland is formed by paludification processes where in areas of low evapotranspiration and/or high rainfall, peat moss moves uphill creating wetlands on hillslopes (i.e., wetland develops upslope of the primary water source) and where directional flow cannot be readily determined …….....**Paludified**

Note: This water flow path is used for blanket peatland and where another water flow path of other peatlands cannot be readily determined.

3. Wetland is not formed by paludification processes or if so, directional flow can be readily determined…….…….....4

4. Wetland receives surface water from a stream, other waterbody or wetland (i.e., at a higher elevation) and surface water passes through the subject wetland to a stream, another wetland, or other waterbody at a lower elevation; a flow-through system..... **Throughflow**, **Throughflow-intermittent**, **Throughflow-entrenched**, or **Throughflow-artificial**

Modifiers: This water flow focuses on surface water connections. Groundwater-dominated throughflow wetlands such as found in the Prairie Pothole Region and Nebraska Sandhills are classified as having a combination of Vertical Flow and Throughflow with a modifier to indicate the link via groundwater (**Vertical flow-throughflow/groundwater-connected**) – see Couplet 5 below.

Note: **Throughflow-intermittent** is to be used with throughflow wetlands along intermittent streams; where there is seasonal throughflow via unchannelized flow, such as during snowmelt in mountainous regions, apply the "nonchannelized flow" ("nc") modifier. **Throughflow-entrenched** indicates that stream flow is through a wetland but the stream is deeply cut and does not overflow into the wetland (therefore the stream is, for practical purposes, separate from the wetland) - this water flow path is intended to be used with Terrene wetlands in this situation. **Throughflow-artificial** is used to designate wetlands where throughflow is human-caused - usually to indicate connection of Terrene wetlands to other Terrene wetlands and waters by ditches and not by streams either natural or channelized, or for diked/impounded wetlands along streams where hydrologic connectivity is regulated by water-control structures. In karst regions, the last wetland that surface water enters before going subterranean can also be considered to have **Throughflow** with an added modifier for Subsurface flow karst ("sk") since water flowing through the wetland to the underground network of water courses.

4. Surface water does not flow through this wetland to other wetlands or waters…….....5

5. Wetland has an inlet or an outlet for receiving or transporting surface water.....6

5. Wetland lacks such features (or such features are not apparent at the scale of mapping) and the water table primarily rises and falls within the wetland.....**Vertical Flow**

> Note: There is no observed or known surface or groundwater inflow from a stream, other waterbody, or wetland (i.e., no documented surface or ground water inflow from a wetland or other waterbody at a higher elevation) and no observed or known outflow of surface or ground water to other wetlands or waters; wetland receives water from three main sources: precipitation, groundwater discharge, and local runoff.
> Attention: *For practical purposes and general mapping applications, "**Vertical Flow**" is applied to a wetland with no obvious surface water connection to other wetlands and waters. If hydrologic data exist for a locale that document groundwater linkages, such wetlands can be identified as **Vertical flow-throughflow**, **Vertical flow-outflow**, or **Vertical flow-inflow** with a "groundwater-connected" modifier ("gc"). If an entire network of wetlands is not connected to a stream or river but linked to each other by surface water channels, the water flow path of all the wetlands in the group can be described as a "***Vertical flow complex***" to emphasize their interconnectivity by surface water. If desirable, such wetlands can be combined with other water flow paths to designate the direction of the internal flow where naturally connected: **Vertical flow complex-throughflow**, **Vertical flow complex-outflow**, and **Vertical flow complex-inflow**, or where connected by ditches: **Vertical flow complex-artificial throughflow**, **Vertical flow complex-artificial outflow**, and **Vertical flow complex-artificial inflow**.*

6. Wetland receives surface water inflow from a wetland or other waterbody at a higher elevation (or lower elevation if pumped in) and there is no observable or known significant discharge of surface water to a stream, wetland or waterbody at a lower elevation …….……..**Inflow** or **Inflow-artificial**

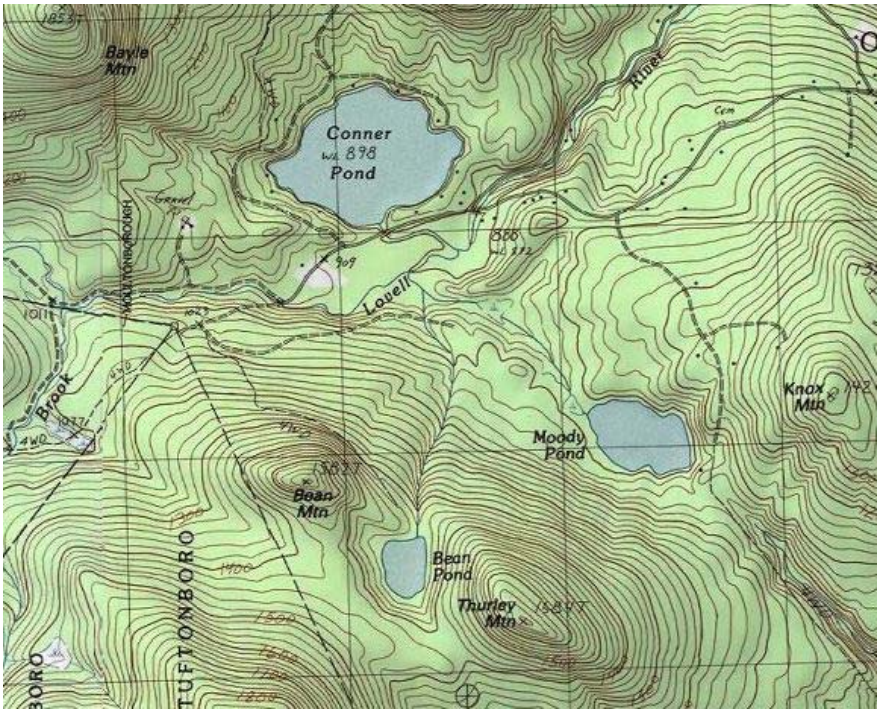
> *Attention: In karst regions, the last wetland that surface water enters before going subterranean can be considered to have a combined water flow path with an added modifier for Subsurface flow karst ("sk") – **Inflow-throughflow subsurface flow karst**.*

6. Wetland receives no surface water inflow from a wetland or permanent waterbody at a higher elevation (may receive flow from intermittent streams only or direct ground water discharge, e.g., during wet season in dry climates) and surface water is discharged from this wetland to a stream, wetland, or other waterbody at a lower elevation…..…..**Outflow, Outflow-intermittent, Outflow-perennial,** or **Outflow-artificial.**

> *Attention: Where outflow is solely through groundwater, the water flow path is considered **Vertical flow-outflow/groundwater-connected**.* If desirable, separate perennial outflow (**Outflow-perennial**) from intermitttent outflow (**Outflow-intermittent**) from outflow brought about by ditching (**Outflow-artificial**).

Section 3. Waterbody Keys

These keys are designed to expand the classification of waterbodies beyond the system and subsystem levels in the Service's wetland classification system (Cowardin et al. 1979). After classifying the waterbody according to Cowardin et al., users should then apply the waterbody type descriptors below. *All lakes and ponds should be assigned a landscape position (e.g., Lotic River, Lotic Stream, Estuarine, or Terrene; or Lentic for ponds imbedded within lakeside wetlands) to indicate their position in a watershed (e.g., LS_LK_,* 1 *ES_LK, TELK__ , TEPD_, or LEPD) – see Key B-2 below*. For Estuarine and Terrene landscapes, the lake or pond must be completely surrounded by wetland, typically vegetated wetland (e.g., marsh or swamp), but may be connected to another waterbody via a ditch or canal.



Examples of Terrene outflow lakes and ponds in mountains (Carroll County, New Hampshire)

Numerous other keys are given to further characterize waterbodies. Key A-2 helps describe the major waterbody type. Key B-2 addresses landscape Position for Lakes and Ponds. Key C-2 identifies different flow durations for rivers and streams. The third key, Key D-2, addresses lake types, while Keys E-2 and F-2 further define ocean and estuary types, respectively. Key G-2 describes water flow paths for waterbodies; it is virtually identical to the comparable key for wetlands.

Besides the keys provided and the modifiers listed in the code section, there are numerous other attributes that can be used to describe the condition of waterbodies. These are left to the user to determine. Some examples are other descriptors that address resource condition such as ones that emphasize human modification, (e.g., natural vs. altered, with further subdivisions of the latter descriptor possible), the condition of waterbody buffers (e.g., stream corridors), or levels of pollution (e.g., pristine, low pollution, moderate pollution, and high pollution).

Key A-2. Key to Major Waterbody Type

1. Waterbody is predominantly flowing water.....2
1. Waterbody is predominantly standing water.....7

Note: Fresh waterbodies may be tidal; if so, waterbody is classified as a Tidal Lake or Tidal Pond using criteria below to separate lakes from ponds.

2. Flow is unidirectional and waterbody is a river, stream, or similar channel.....3
2. Flow is tidal (bidirectional) at least seasonally; waterbody is an ocean, embayment, river, stream, or lake.....4

3. Waterbody is a polygonal feature (width = ~33 ft or 10 m or more) on a U.S. Geological Survey map or a National Wetlands Inventory Map (1:24,000/1:25,000).....**River**
3. Waterbody is a linear feature on such maps (less than 33 ft wide) or was originally a linear feature but is now a polygonal feature due to channelization (channelized stream)…….**Stream**
Go to River/Stream Flow Duration Key - Key C-2 - for other modifiers

Caution: For drier regions, mapped streams on DRG and/or NHD may actually be more of a drainageway; need to examine aerial photos/imagery to verify the existence of a defined channel.

4. Waterbody is freshwater.....5
4. Waterbody is salt or brackish.....6

5. Waterbody is a polygonal feature (width = ~33 ft or 10 m or more) on a U.S. Geological Survey map or a National Wetlands Inventory Map (1:24,000/1:25,000).....**River**
5. Waterbody is a linear feature on such maps (less than 33 ft wide) or was originally a linear feature but is now a polygonal feature due to channelization (channelized stream)…….**Stream**
Go to River/Stream Flow Duration Key - Key C-2 - for other modifiers

6. Part of a major ocean or its associated embayment; salinity is at or near sea strength (Marine system of Cowardin et al. 1979)….....**Ocean**
Go to Ocean Key - Key E-2
6. Part of an estuary where fresh water mixes with salt water to create a range of brackish to salt water conditions or a hyperhaline lagoon (Estuarine system of Cowardin et al. 1979).....**Estuary**
Go to Estuary Key - Key F-2

7. Waterbody is freshwater.....8
7. Waterbody is salt or brackish and tidal.....10

8. Waterbody is permanently flooded and deep (≥ 8.2 ft at low water), excluding small "kettle or bog ponds" (i.e., usually less than 5 acres in size and surrounded by bog vegetation).....**Lake**
Apply Landscape Position using Key B-2 then go to Lake Key - Key D-2

8. Waterbody is shallow (< 8.2 ft at low water) or a small "kettle or bog pond" (possibly with deeper water).....9

9. Waterbody is small (< 20 acres).....**Pond**
Apply Landscape Position using Key B-2

Separate natural from artificial ponds, then add other modifiers like the following. Some *examples* of modifiers for ponds: beaver, alligator, marsh, swamp, vernal, Prairie Pothole, Sandhill, sinkhole/karst, Grady, interdunal, farm-cropland, farm-livestock, golf, industrial, sewage/wastewater treatment, stormwater, aquaculture-catfish, aquaculture-shrimp, aquaculture-crayfish, cranberry, irrigation, aesthetic-business, acid-mine, arctic polygonal, kettle, bog, woodland, borrow pit, Carolina bay, tundra, coastal plain, tidal, and in-stream.

9. Waterbody is large (≥20 acres)..... **Lake**
Apply Landscape Position using Key B-2 then go to Lake Key - Key D-2

Note: According to the Federal Geographic Data Committee's 2013 wetland classification standard (FGDC-STD-004-2013 – a minor revision of Cowardin et al. 1979; http://www.fgdc.gov/standards/projects/FGDC-standards-projects/wetlands/nvcs-2013) a depth of 8.2 feet (2.5 m) at mean low water is the main separation point between wetland and deepwater habitat. Many permafrost lakes may be just slightly deeper, so for this classification they will be treated as shallow lakes and not deepwater habitat unless information to the contrary arises.

10. Part of a major ocean or its associated embayment (Marine system of Cowardin et al. 1979) .....**Ocean**
Go to Ocean Key - Key E-2

10. Part of an estuary where fresh water mixes with salt water or a hypersaline lagoon (Estuarine system of Cowardin et al. 1979).....**Estuary**
Go to Estuary Key - Key F-2

Key B-2. Key to Waterbody Landscape Position (for Lakes and Ponds only)

1. Lake or pond is contained within a vegetated wetland……...…2
1. Lake or pond is not part of a vegetated wetland complex……...…5

2. Waterbody is within an estuarine vegetated wetland……**Estuarine**
2. Waterbody is not within an estuarine wetland…….3

3. Waterbody is within a lentic vegetated wetland…….**Lentic**
3. Waterbody is not within a lentic vegetated wetland……4

4. Waterbody is within a terenne vegetated wetland…….……..**Terrene**
4. Waterbody is within a lotic vegetated wetland……..……**Lotic River or Lotic Stream**

5. Waterbody is the source of a river or stream or is geographically isolated……..…**Terrene**
5. Waterbody is located along a stream or river network…….. **Lotic River or Lotic Stream**

Note: This key is for assigning lakes and ponds a landscape position - Lotic River (e.g., floodplain pond), Lotic Stream (e.g., lake or pond created by damming a stream or in a streamside vegetated wetland subject to overbank flooding), Lentic (e.g., lake or pond within a lakeside vegetated wetland), Terrene (e.g., lake or pond surrounded by upland or that is the source of a stream), or Estuarine (e.g., lake or pond within a salt or brackish marsh). The lake or pond descriptor will be the "landform" descriptor to separate the waterbody from any fringing vegetated wetlands (e.g., ES_LK, LR_LK, LR_PD__, LS_PD__, and TEPD__). Lakes or ponds imbedded in lentic or estuarine vegetated wetlands should be attributed with that landscape position (i.e., LE_LK or LE_PD_ and ES_LK or ES_PD__). Wetlands associated with "isolated" ponds (TEPD_) are typically either Terrene basin wetlands, such as a cypress dome or cypress-gum pond where the entire pond is vegetated (TEBApd___), or Terrene pond fringe wetlands, such as semipermanently flooded wetlands along margins of a pond (TEFRpd__) unless the entire wetland is vegetated in which case they would be Terrene basin wetlands (TEBA__).

Key C-2. River/Stream Flow Duration and Other Modifiers

The flow duration is an important feature for rivers and streams and affects their value to fishes, aquatic life, and other wildlife. These characteristics may be identified by 1:24,000 U.S. Geological Survey topographic maps or high-intensity National Hydrographic Data (NHD) or from field observations.

1. Water flow is under tidal influence.....**Tidal Flow Duration**

Type of tidal river or stream: 1) natural river, 2) natural stream, 3) channelized river, 4) channelized stream, 5) canal (artificial polygonal lotic feature), 6) ditch (artificial linear lotic feature), 7) restored river segment (part of river where restoration was performed), and 8) restored stream segment (part of stream where restoration was performed).

1. Water flow is not under tidal influence (nontidal).....2

2. Water flow is dammed by man or beaver, yet still flowing downstream at least seasonally…….……..……..**Dammed Flow Duration**

Type of dammed river: 1) lock and dammed (canalized river, a series of locks and dams are present to aid navigation), 2) run-of-river dammed (low dam allowing flow during high water periods; often used for low-head hydropower generation), 3) beaver dammed, and 4) other dammed (unspecified, but not major western hydropower dam as such waterbodies are considered lakes, e.g., Lake Mead and Lake Powell).

2. Water flow is unrestricted.....3

3. Water flow is perennial (year-round) in all but the driest years; perennial rivers and streams…….**Perennial Flow Duration**
3. Water flow is not year-round…….....4

4. Water flow is occurs for prolonged periods (usually a couple weeks or more) and is generally seasonal in nature, lasting for varying periods during the growing season …….....**Intermittent Flow Duration**
4. Water flow is for brief periods tied to rainfall events (usually a few days) or may last longer during extremely wet years in arid regions.....**Ephemeral Flow Duration**

**Type of river or stream* - additional modifiers that may be applied as desired: 1) natural river-single thread (one channel), 2) natural river-multiple thread (braided) (multiple, wide, shallow channels), 3) natural river-multiple thread (anastomosed) (multiple, deep narrow channels), 4) natural stream-single thread, 5) channelized river (dredged/excavated), 6) channelized stream, 7) canal (artificial polygonal lotic feature), 8) ditch (artificial linear lotic feature), 9) restored river segment (part of river where restoration was performed), 10) restored stream segment (part of stream where restoration was performed), and 11) connecting channel (joins two lakes). Other possible descriptors: 1) for perennial rivers and streams - riffles (shallow, rippling water areas), pools (deeper, quiet water areas), and waterfalls (cascades), 2) for water depth of perennial rivers - deep rivers (≥8.2 ft at low water) from shallow rivers (<8.2 ft at low water), 3) nontidal river or stream segment emptying into an estuary, ocean, or lake (estuary-discharge, marine-discharge, or lake-discharge), 4) classification by stream order (1st, 2nd, 3rd, etc. for perennial segments), 5) channels patterns (straight, slight meandering, moderate meandering, and high meandering), 6) for streams with severely eroded streambanks to the point where the stream rarely overflows onto its former floodplain (incised), and 7) for intermittently flowing streambeds in arid regions – arroyos.

Key D-2. Key to Lakes.

The lake designation is for permanently flooded deep waters (≥8.2 feet). Some classification systems include shallow waterbodies or periodically exposed areas as "lakes." The Cowardin et al. system considers standing waterbodies larger than 20 acres to be part of the lacustrine system (regardless of water depth; shallow = wetlands; ≥8.2 feet = deepwater habitat), while smaller ones are typically part of the palustrine wetlands. For our purposes, "shallow lakes" and "seasonal or intermittent lakes" are considered some type of terrene or lotic wetland depending on the presence and location of a stream. Lentic wetlands are associated with permanently flooded standing waterbodies ≥ 8.2 feet at low water, but also include large shallow lakes greater than 20 acres in size.

1. Waterbody is not dammed or impounded.....**Natural Lake**

> *Modifiers*: While many lakes are situated in a basin surrounded by upland or nearly so, some lakes occur within a large wetland landscape. Examples of the latter include lakes in the arctic and subarctic, boreal region of northern Minnesota, the lower Mississippi delta, and Florida's Everglades. These lakes should be further classified as imbedded wetland lake (e.g., bog lake, floodplain lake, or polygonal wetland lake). The wetlands in the lake's waters can be classified as lentic but the expansive wetlands surrounding the lake should be assigned to the Lotic or Terrene landscape position. Main body, Open

embayment, Semi-enclosed embayment, Barrier beach lagoon, Seiche-influenced, River-fed and Stream-fed descriptors. Many specific types can be identified using modifiers similar to those used for ponds; other modifiers that could be created by the user should be added as descriptors at the end of the classification and could include crater, oxbow, glacial, and alkali, among others (see codes in Section 4 for common examples).

1. Waterbody is dammed, impounded, or excavated 2

2. Waterbody is dammed or impounded.....3
2. Waterbody is excavated.....4

3. Dammed river valley.....**Dammed River Valley Lake**

Modifiers: Reservoir, Hydropower, and Seiche-influenced; also River-fed and Stream-fed descriptors.

Note: When the dam inundates former floodplains and other low-lying areas, the waterbody is considered a Dammed River Valley Lake. If the dam crosses a higher gradient river and increase water depth in the channel without significant flooding of much neighboring "land," the waterbody is considered the dammed reach of a river.

3. Dammed natural lake or stream.....**Other Dammed Lake**

4. Deepwater excavated lake (e.g., quarry lake)…….…….……**Deep**.**Excavated Lake**

4. Shallow-water impoundment (e.g., large settling pond) – treat as wetland …..…….. …… **Shallow Excavated Lake**

Modifiers: Former natural lake, Artificial lake, River-fed and Stream-fed descriptors. Can apply various subcategories of impounded ponds to Shallow Excavated Lake.

Key E-2. Key to Oceans and Marine Embayments.

1. Waterbody is completely open, not protected by any feature.....**Open Ocean**
(Can further identify open bays if desirable, e.g., Gulf of Mexico.)
1. Waterbody is somewhat protected.....2

2. Associated with coral reef or island 3

2. Not associated with coral reef or island.....4

3. Open but protected by coral reef…….....**Reef-protected Waters**
3. Completely or nearly completely surrounded by a coral reef or coral islands.....**Atoll Lagoon**

4. Deep embayment was cut by glaciers and has an underwater sill at front end, restricting circulation; associated with rocky headlands.....**Fjord**
4. Other semi-protected embayment.....**Semi-protected Oceanic Bay**

Modifiers for all types above: Submerged vegetation (e.g., eelgrass or turtle-grass) or Floating rooted vegetation (e.g., macroalgae such as kelp beds).

Key F-2. Key to Estuaries.

The following types should encompass most of the estuaries located in the United States. There may be estuaries that do not fit within this classification. Such types should be brought to the attention of the author. *Recognize that some estuaries may include more than one type, especially bar-built estuary at the mouth of a coastal river and drowned river valley estuary further upstream.*

1. Estuary is surrounded by rocky headlands and shores.....2
1. Estuary is not surrounded by rocky headlands and shores.....4

2. Deep embayment cut by glaciers, with an underwater sill at front end, restricting circulation (e.g., Puget Sound).....**Fjord Estuary**
2. Not so, either open or semi-enclosed.....3

3. Protected by islands.....**Island Protected Rocky Headland Bay Estuary**
3. Not protected by islands.....**Rocky Headland Bay Estuary**

Modifiers: Open or Semi-enclosed

4. Estuary is tectonically formed (e.g., San Franciso Bay), including volcanic activity.....
.....**Tectonic Estuary**

Modifiers: Fault-formed and Volcanic-formed

4. Estuary is not tectonically formed …….....5

5. Estuary is river-dominated with a delta formed at the mouth of the river where it enters the sea (e.g., Mississippi River Delta).....**River-dominated Estuary**

Modifiers: See those under Drowned River Valley Estuary

5. Estuary is not river-dominated.....6

6. Estuary is a drowned river valley (e.g., Chesapeake Bay) or basin (e.g., Long Island Sound).....**Drowned River Valley Estuary or Drowned Basin**

Modifiers: Open Bay, River Channel, Semi-enclosed Bay, Bar-built Embayment, and Lake (large open waterbody surrounded by marsh with a relatively narrow channel connecting it with an estuarine embayment or the sea). Where bar-built features have formed at their mouths, use the "bar-built embayment" modifier for that area.

6. Estuary is not a drowned river valley.....7

7. Estuary formed behind and is protected by sandy barrier islands or barrier beaches (spits).....**Bar-built Estuary**

Modifiers: Coastal Pond (oligohaline to saline) and Hypersaline Lagoon (hypersaline)

7. Estuary is not behind sandy barrier islands or beaches.....8

8. Estuary is protected by reefs or other islands.....**Island Protected Estuary**
8. Estuary is an open or semi-enclosed embayment.....**Shoreline Bay Estuary**

Modifiers for all estuarine waterbodies: Inlet (includes any ebb- or flood- deltas that are completed submerged), Stabilized Inlet, Shoal (shallow water area), (Note: Submerged vascular plants such as eelgrass or turtle-grass, or submerged or floating-leaved macroalgae like kelp beds, should be identified using the Cowardin et al. system.) (Note: Long Island Sound is a drowned glacial lake basin; unique among estuaries.)

Key G-2. Key to Water Flow Paths

1. Water flow is tidally influenced and flooding is frequent (more than just storm tides) and not regulated by water-control structures……..**Bidirectional-tidal** (apply tidal ranges below)

Megatidal: Equal to or greater than 26.2 ft (≥8 m)
Macrotidal: From 13.1 ft to less than 26.2 ft (4 m to <8 m)
Mesotidal: From 6.6 ft to less than 13.1 ft (2 m to <4 m)
Microtidal: Greater than 1.0 ft but less than 6.6 ft (>0.3 to <2.0 m)
Nanotidal: l.0 ft or less (≤0.3 m)

These descriptors should be applied to estuarine and tidal freshwater waterbodies. If tidal flow is regulated by water control structures, water flow path should be designated as **Bidirectional-tidal Artificial**.

Modifier: Wind tides for areas with low tidal ranges (i.e., nanotidal) where the more prominent tides are wind-driven such as in North Carolina's Albemarle and Pamlico Sounds.

1. Water flow is not under the influence of the tides, or tidal flooding is infrequent (only by the highest storm tides) or regulated by water-control structures…….....2

2. Water flows out of the waterbody via a river, stream, or ditch, with little or no inflow (inflow could be from intermittent streams or ground water only) .....**Outflow**

Modifier: Human-caused for inflow via a ditch network. If interested, separate perennial outflow (**Outflow-perennial**) from intermitttent outflow (**Outflow-intermittent**) and artifical outflow via water-control structures and other means (**Outflow-artificial**).

2. Water flow is not so.....3

3. Water enters waterbody from river, stream, or ditch, flows through it, and continues to flow downstream..... **Throughflow, Throughflow-intermittent**, or **Throughflow-artificial**

Modifier: Human-caused for throughflow via a ditch network

Note: **Throughflow-intermittent** is applied to intermittent streams; **Throughflow-artificial** is used to indicate flow affected by ditches or regulated flows by water-control structures or other means.

3. Water flow is not throughflow.....4

4. Water flows in and/or out of the waterbody through water-control structures….....5

4. Water flow is not affected by water-control structures.....6

5. Water flow of adjacent waterbody is tidal and flow to waterbody is regulated by water-control structures……**Bidirectional-tidal Artificial**
5. Water flow of adjacent waterbody is not tidal and flow is regulated by water-control structures....…… ……..... **Bidirectional-nontidal Artificial**

6. Water flow enters via a river, stream, ditch, or is pumped in, but does not exit a pond, lake or reservoir, or impoundment; waterbody serves as a sink for water..... **Inflow or Inflow-artificial** (if pumped in)

Modifier: Human-caused for inflow via a ditch network.
Note: **Inflow-artificial** is used for wetlands that are present in active diked dredged material disposal impoundments or other impoundments designed to hold contaminated water, for example.

6. No apparent channelized inflow, sources of water include precipitation and local runoff, and possibly groundwater.....**Vertical Flow**

Attention: *For practical purposes and general mapping applications, "vertical flow" will be applied to a waterbody with no obvious surface water connection to other waters or noncontiguous wetlands. If hydrologic data exist for a locale that document groundwater linkages, such waters can be identified as either outflow. inflow, or throughflow with a*

*"groundwater-connected" modifier. If the whole network of waterbodies is not connected to a stream or river but linked to each other, the water flow path of all the waters in the group can be described as a "***Vertical flow complex***" to emphasize their interconnectivity. If desirable, such wetlands can be combined with other water flow paths to designate the direction of the internal flow where naturally connected:* ***Vertical flow-throughflow****,* ***Vertical flow-outflow****, and* ***Vertical flow-inflow****, or where connected by ditches:* ***Vertical flow-artificial throughflow****,* ***Vertical flow-artificial outflow****, and* ***Vertical flow-artificial inflow****.*

Key H-2. Key to Estuarine Hydrologic Circulation Types

1. Estuary is river-dominated with distinct salt wedge moving seasonally up and down the river; fresh water at surface with most saline waters at bottom; low energy system with silt and clay bottoms .....**Salt-wedge Estuary**
1. Estuary is not river-dominated 2

2. Estuarine water is well-mixed, no significant salinity stratification, salinity more or less the same from top to bottom of water column; high-energy system with sand bottom..... .....**Homogeneous Estuary**
2. Estuarine water is partially mixed, salinities different from top to bottom, but not strongly stratified; low energy system .....**Partially Mixed Estuary**

Section 4. Coding System for LLWW Descriptors

The following is the coding scheme for expanding classification of wetlands and waterbodies beyond typical NWI classifications. When enhancing NWI data, codes should be applied to all mapped wetlands and deepwater habitats (including linears). At a minimum, landscape position (including lotic), landform, and water flow path should be applied to wetlands, and waterbody type and water flow path to waterbodies.

Wetland and deepwater habitat data could be assigned to a specific estuary, lake system, watershed, or other geographic area of interest through use of geographic information system (GIS) technology by overlaying a template of that geographic area over the NWI+ data and clipping out the data for that area.

Coding for Wetlands

Wetlands are typically classified by landscape position, landform, and water flow path. Landforms are grouped according to Inland types and Coastal types with the latter referring to tidal wetlands associated with marine and estuarine waters. Use of other descriptors tends to be optional. They would be used for more detailed investigations and characterizations.

LANDSCAPE POSITION CODES

<u>Landscape Position</u>

ES	**Estuarine**
LE	**Lentic**
LR	**Lotic River***
LS	**Lotic Stream***
MA	**Marine**
TE1	**Terrene Headwater**
TE2	**Terrene Riparian**
TE3	**Terrene Non-riparian**

***LO** **Lotic** (if not separating rivers from streams)

<u>Estuary Type</u>

1	**Drowned river valley estuary**
a	open bay (fully exposed)
b	semi-enclosed bay
c	river channel
d	bar-built embayment
e	lake
2	**Bar-built estuary**
a	coastal pond-open

b	coastal pond-seasonally closed
c	coastal pond-intermittently open
d	hypersaline lagoon
e	coastal pond-artificially open (e.g., breachway)
3	**River-dominated estuary**
4	**Rocky headland bay estuary**
a	island protected
5	**Island protected estuary**
6	**Shoreline bay estuary**
a	open (fully exposed)
b	semi-enclosed
7	**Tectonic estuary**
a	fault-formed
b	volcanic-formed
8	**Fjord estuary**
9	**Drowned basin estuary**

<u>Lentic Type</u> (subtypes typically emphasize the surrounding landscape)

1	**Natural deep lake**
a	bog (lake in a bog)
b	woodland-wetland (lake in a forested or shrub wetland)
c	woodland-dryland (lake in an upland forest or shrub thicket)
d	emergent-wetland (lake in a marsh, wet meadow, or open fen)
d1	pothole (lake in a prairie pothole)
e	upland field (lake in an upland field or meadow)
f	playa
g	polygonal (unique lake formed in Arctic permafrost)
h	sinkhole-woodland (lake in upland forest in karst region)
i	sinkhole-field (lake in upland field in karst region)
j	Carolina bay
k	pocosin
l	cypress dome
m	vernal-woodland (vernal lake in a forest)
n	vernal-West Coast
o	interdunal (lake within sand dune)
p	grady
q	floodplain (lake on a floodplain)
q1	oxbow lake
q2	river lake
r	other
s	coastal lake (freshwater lake intermittently connected to ocean but not often enough to consider it estuarine)
t	coastal plain lake
v	main body

w		open embayment
x		semi-enclosed embayment
y		barrier beach lagoon
z		wetland landscape matrix (lake embedded in wetland)
2	**Dammed river/stream valley lake**	
a		reservoir
b		hydropower
c		flood control
d		other
3	**Other dammed lake**	
a		former natural
b		flood control basin
4	**Deep excavated lake** (e.g., quarry lake)	
5	**Shallow excavated lake** (e.g., settling basin; *use Pond codes for specific types of excavated lakes if desirable*)	
6	**Other artificial lake**	

<u>Lotic Flow Duration</u>

1	**Perennial**	
g		river lake
2	**Unknown**	
3	**Ephemeral**	
a		arroyo
4	**Intermittent**	
5	**Tidal**	
6	**Dammed**	
a		lock and dammed
b		run-of-river dam
c		beaver
d		other dammed
7	**Artificial** (ditch or channel)	

LANDFORM CODES

<u>Inland Landform</u>

SL	**Slope**	
SLpa		Slope, paludified
SLto		Slope, toe
SLdc		Slope, discharge
SLva		Slope, stream valley
PT	**Peatland**	
PTbg		Peatland, bog

PTbk	Peatland, kettle bog
PTbp	Peatland, plateau bog
PTbr	Peatland, raised bog
PTkb	Peatland, blanket bog
PTpn	Peatland, pocosin
PTpp	Peatland, patterned
PTfn	Peatland, fen
PTpf	Peatland, poor fen
PThf	Peatland, hillslope fen
PTtf	Peatland, toe-of-slope fen
PTbf	Peatland, basin fen
PTrf	Peatland, rich fen
PTcf	Peatland, circumneutral fen
PTdf	Peatland, domed fen
PTvf	Peatland, stream valley fen

IL Island*

ILde	Island, delta
ILrs	Island, reservoir
ILpd	Island, pond

FR Fringe*

FRil	Fringe, island*
FRbl	Fringe, barrier island
FRbb	Fringe, barrier beach
FRpd	Fringe, pond
FRdm	Fringe, drowned river mouth
FRot	Fringe, outlet
FRit	Fringe, inlet
FRsl	Fringe, slough (vegetated flowing watercourse lacking defined stream channel and bank)

FP Floodplain

FPba	Floodplain, basin
FPox	Floodplain, oxbow
FPfl	Floodplain, flat
FPil	Floodplain, island

BA Basin

BAcb	Basin, Carolina bay
BApo	Basin, pocosin
BAcd	Basin, cypress dome
BApp	Basin, prairie pothole
BApl	Basin, playa
BAwc	Basin, West Coast vernal pool
BAbb	Basin, barrier beach

BAid	Basin, interdunal
BAwv	Basin, woodland vernal
BApg	Basin, polygonal
BAsh	Basin, sinkhole
BApd	Basin, pond
BAgp	Basin, grady pond
BAsa	Basin, salt flat
BAaq	Basin, aquaculture (created)
BAcr	Basin, cranberry bog (created)
BAwm	Basin, wildlife management (created)
BAip	Basin, impoundment (created)
BAfe	Basin, former estuarine fringe
BAff	Basin, former floodplain
BAfo	Basin, former floodplain oxbow
BAdm	Basin, drowned river-mouth
BAot	Basin, outlet
BAit	Basin, inlet
BAsl	Basin, slough (vegetated flowing watercourse lacking defined channel)

FL Flat

FLsa	Flat, salt flat
FLfe	Flat, former estuarine fringe
FLff	Flat, former floodplain
FLsl	Flat, slough (vegetated flowing watercourse lacking defined stream channel)
FLva	Flat, stream valley

*Note: Inland slope wetlands and island wetlands associated with rivers, streams, and lakes are designated as such by the landscape position classification (e.g., Lotic River, Lotic Stream, or Lentic), therefore no additional terms are needed here to convey this association.

Coastal Landform

IL Island

ILdt	Island, delta
ILrv	Island, river
ILst	Island, stream
ILby	Island, open bay
ILsb	Island, sheltered bay
ILcp	Island, coastal pond

FR Fringe

FRal	Fringe, atoll lagoon
FRbl	Fringe, barrier island
FRbs	Fringe, barrier spit

FRby	Fringe, open bay
FRsb	Fringe, sheltered bay
FRbi	Fringe, open bay island
FRsi	Fringe, sheltered bay island
FRcp	Fringe, coastal pond
FRci	Fringe, coastal pond island
FRhl	Fringe, headland
FRoi	Fringe, oceanic island
FRlg	Fringe, lagoon
FRrv	Fringe, river
FRri	Fringe, river island
FRst	Fringe, stream
FRtb	Fringe, toe-of-bluff

BA Basin

BAaq	Basin, aquaculture (created)
BAid	Basin, interdunal (swale)
BAst	Basin, stream
BAsh	Basin, salt hay production (created)
BAtd	Basin, tidally restricted/road (not a management area)
BAtr	Basin, tidally restricted/railroad (not a management area)
BAwm	Basin, wildlife management (created)
BAip	Basin, impoundment (created)

WATER FLOW PATH CODES

PA **Paludified**
VR **Vertical flow**
VC **Vertical flow complex** (a complex of vertical flow wetlands connected via surface water or ground water linkages).
VCT ***Vertical flow complex-throughflow** (connected to other wetlands in an isolated complex)
VCO ***Vertical flow complex-outflow** (connected to other wetlands in an isolated complex)
VCI ***Vertical flow complex-inflow** (connected to other wetlands in an isolated complex)
VTA **Vertical flow complex-artificial throughflow** (connected by ditches to other wetlands in an isolated complex)
VOA **Vertical flow complex-artificial outflow** (connected by ditches to other wetlands in an isolated complex)
VIA **Vertical flow complex-artificial inflow** (connected by ditches to other wetlands in an isolated complex)
IN **Inflow**
IA **Inflow-artificial**
OU **Outflow**
OA **Outflow-artificial****

OP **Outflow-perennial**
OPA **Outflow-perennial-artificial**
OI **Outflow-intermittent**
OIA **Outflow-intermittent-artificial**
TH **Throughflow**
TA **Throughflow-artificial****
TN **Throughflow-entrenched**
TI **Throughflow-intermittent**
TP **Throughflow-perennial**
BI **Bidirectional-nontidal**
BIA **Bidirectional-nontidal artificial** (e.g., diked wetland along a lake)
BO **Bidirectional-nontidal/outflow** (lake)
TB **Bidirectional-nontidal/throughflow** (lake)
IB **Bidirectional-nontidal/isolated** (lake)
NB **Bidirectional-nontidal/inflow** (lake)
BT **Bidirectional-tidal**
BTA **Bidirectional-tidal artificial** (e.g., diked wetland)
NA **Nanotidal**
MI **Microtidal**
ME **Mesotidal**
MC **Macrotidal**
MG **Megatidal**

*Add "gc" to indicate connection is via groundwater (e.g., VOgd) if appropriate.
**To be used with wetlands connected to streams by ditches.

CODES FOR OTHER MODIFIERS (apply at the end of the code as desired)

aa abandoned agriculture (former farmed wetland now regenerating)
ae animal eat-out (barren patches due to animals, e.g., snow geese, nutria)
ag agricultural wetland (wetland used to produce crops)
av alpine valley (apply to mountainous terrain only)
bl barrier island (apply to nontidal wetlands on barrier islands)
bn barren
bv beaver-influenced wetland
ch channelized flow
cl coastal island (wetland on an island in an estuary or ocean excluding barrier islands)
cp coastal pond (e.g., barachois or salt pond)
cr cranberry bog (i.e., commercial operation)
da disposal area (typically dredged spoil)
dd drainage divide
dg partly drained-groundwater extraction
dr partly drained
ds discharge to stream (via seepage from Terrene saturated wetland)
eb ebb (apply to identify ebb delta island wetland in estuary)

ed	freshwater wetland discharging directly into an estuary (formerly “ef”)
fd	flood (apply to identify flood delta island wetland in estuary)
fe	former estuarine wetland
fg	fragmented
fm	floating mat
gc	groundwater-connected (apply to Vertical Flow only to indicate external flow)
gl	groundwater-influenced by lake levels
gz	grazed
hi	severely human-induced
hw	headwater
ir	irrigated (directly and currently influenced by irrigation infrastructure, current or historic)
lg	logged (subject to recent timber harvest)
li	lake island (wetland associated with a lake island)
lk	freshwater wetland that contains a lake but not significantly influenced by the lake (the lake is imbedded in a vegetated wetland matrix)
md	freshwater wetland discharging directly into marine waters
mk	muskrat-influenced wetland
nc	nonchannelized flow
ow	overwash
pi	pond island border
ri	river island (wetland associated with a river island)
rs	ridge-and-swale complex (wetland part of this type complex)
sd	surface water-dominated (apply to Water Flow Path only)
sf	spring-fed
sk	subsurface flow karst
sm	silviculture management (e.g., forest plantation)
ss	subsurface flow
td	tidally restricted/road
to	tidally restricted/other
tr	tidally restricted/railroad
wt	wind tides

Coding for Waterbodies

Besides Waterbody Type, waterbodies can be classified by landscape position (for lakes and ponds), water flow path (for lakes and ponds), estuary hydrologic type (for estuaries), and tidal range types (for estuaries and oceans).

LANDSCAPE POSITION CODES FOR LAKES AND PONDS

ES	**Estuarine**
LE	**Lentic**
LR	**Lotic River***
LS	**Lotic Stream***
TE1	**Terrene Headwater**
TE2	**Terrene Riparian**
TE3	**Terrene Non-riparian**

***LO** **Lotic** (if not separating rivers from streams)

WATERBODY TYPE CODES

RV **River**

- **1** **Perennial**
  - a connecting channel
  - b channelized
  - c waterfall
  - d riffle
  - e pool
  - f river lake (semi-enclosed waterbody connected to the river)
- **2** **Unknown**
  - a connecting channel
  - b channelized
  - c waterfall
  - d riffle
  - e pool
- **3** **Ephemeral**
  - a arroyo
- **4** **Intermittent**
  - a arroyo
- **5** **Tidal**
- **6** **Dammed**
  - a lock and dammed
  - b run-of-river dam
  - c beaver
  - d other dammed

ST **Stream**

- **1** **Perennial**
  - a connecting channel
  - b channelized
  - c waterfall
  - d riffle
  - e pool
- **2** **Unknown**
  - a connecting channel
  - b channelized
  - c waterfall
  - d riffle
  - e pool
- **3** **Ephemeral**
  - a arroyo
- **4** **Intermittent**
  - a arroyo
- **5** **Tidal**
- **6** **Dammed**
  - a lock and dammed
  - b run-of-river dam
  - c beaver
  - d other dammed
- **7** **Artificial** (ditch or channel)
  - a connecting channel
  - b ditch

LK **Lake**

- **1** **Natural lake**
  - a bog
  - b woodland-wetland (lake in a forested or shrub wetland)
  - c woodland-dryland (lake in an upland forest or shrub thicket)
  - d emergent-wetland (lake in a marsh, wet meadow, or open fen)
  - d1 pothole (lake in a prairie pothole)
  - e upland field (lake in an upland field or meadow)
  - f playa
  - g polygonal (unique lake formed in Arctic permafrost)
  - h sinkhole-woodland (lake in upland forest in karst region)
  - i sinkhole-field (lake in upland field in karst region)
  - j Carolina bay
  - k pocosin
  - l cypress dome
  - m vernal-woodland (vernal lake in a forest; may not exist)
  - n vernal-West Coast

o	interdunal (lake within sand dune)
p	grady
q	floodplain (lake on a floodplain)
q1	oxbow lake
q2	river lake
r	other
s	coastal lake (freshwater lake intermittently connected to ocean but not often enough to consider it estuarine)
t	coastal plain lake
v	main body (for huge lakes, like the Great Lakes or Great Salt Lake)
w	open embayment
x	semi-enclosed embayment
y	barrier beach lagoon
z	wetland landscape matrix (lake embedded in wetland)

Note: Can classify other types of natural lakes such as crater (volcanic origin), cirque (glacial origin), and kettle (glacial origin) simply by adding other modifiers as necessary.

2 **Dammed river valley lake**
- a reservoir
- b hydropower
- c other

3 **Other dammed lake**
- a former natural
- b artificial

4 **Deep excavated lake** (e.g., quarry lake)

5 **Shallow excavated lake** (e.g., settling basin; *use Pond codes for specific types if desirable*)

6 **Other artificial lake**

EY **Estuary**

1 **Drowned river valley estuary**
- a open bay (fully exposed)
- b semi-enclosed bay
- c river channel
- d bar-built embayment
- e lake

2 **Bar-built estuary**
- a coastal pond-open
- b coastal pond-seasonally closed
- c coastal pond-intermittently open
- d hypersaline lagoon
- e coastal pond-artificially open (e.g., breachway)

3 **River-dominated estuary**

4 **Rocky headland bay estuary**
a island protected
5 **Island protected estuary**
6 **Shoreline bay estuary**
a open (fully exposed)
b semi-enclosed
7 **Tectonic estuary**
a fault-formed
b volcanic-formed
8 **Fjord estuary**
9 **Drowned basin estuary**

Note: If desired, you can also designate river channel (rc), stream channel (sc),and inlet channel (ic) by modifiers. *Examples*: EY1rc = Drowned River Valley Estuary river channel; EY2ic= Bar-built estuary inlet channel. If not, simply classify all estuarine water as a single type, e.g., EY1 for Drowned River Valley or EY2 for Bar-built Estuary.

OB **Ocean**
1 **Open** (fully exposed)
2 **Semi-protected oceanic bay**
3 **Atoll lagoon**
4 **Other reef-protected waters**
5 **Fjord**

PD **Pond**
1 **Natural**
a bog
b woodland-wetland (pond in a forested or shrub wetland)
c woodland-dryland (pond in an upland forest or shrub thicket)
d emergent-wetland (pond in a marsh, wet meadow, or open fen)
d1 pothole (pond in a prairie pothole)
e upland field (pond in an upland field or meadow)
f playa
g polygonal (unique pond formed in Arctic permafrost)
h sinkhole-woodland (pond in upland forest in karst region)
i sinkhole-field (pond in upland field in karst region)
j Carolina bay
k pocosin
l cypress dome
m vernal-woodland (vernal pond in a forest)
n vernal-West Coast
o interdunal (pond within sand dune)
p grady
q floodplain (pond on a floodplain)
q1 floodplain – forest matrix

q2	floodplain – shrub matrix
q3	floodplain – herb matrix
q4	floodplain – mixed matrix
r	other
s	coastal pond (freshwater pond intermittently connected to ocean but not often enough to consider it estuarine)
t	coastal plain pond (Atlantic-Gulf coastal plain)
2	**Dammed/impounded**
a	agriculture
a1	cropland
a2	livestock (pond in pasture or rangeland for watering livestock)
a3	cranberry
a4	agricultural /forest (diked pond in a forested area that has some agricultural development; less than one-quarter of its perimeter borders an ag field)
a5	agricultural/shrubland (diked pond in a shrub area that has some agricultural development; less than one-quarter of its perimeter borders an ag field)
a6	agricultural/open field (diked pond in a field area that has some agricultural development; less than one-quarter of its perimeter borders an ag field)
b	aquaculture
b1	catfish
b2	crayfish
c	commercial
c1	commercial-stormwater
d	industrial
d1	industrial-stormwater
d2	industrial-wastewater
e	residential
e1	residential-stormwater
e2	residential/forest (diked pond in a forested area that has some residential development; less than one-quarter of its perimeter borders lawn or mowed field)
e3	residential/shrubland (diked pond in a shrub area that has some residential development; less than one-quarter of its perimeter borders lawn or mowed field)
e4	residential/field (diked pond in a field that has some residential development; less than one-quarter of its perimeter borders lawn or mowed field)
f	sewage treatment
g	golf
h	wildlife management
i	other recreational
j	mining
j1	sand/gravel

j2	coal
j3	mine reclamation
k	playa (altered)
o	other
p	natural upland (diked pond in a forest, shrubland, or open undeveloped land)
p1	upland forest (diked pond in an upland forest)
p2	upland shrub thicket (diked pond in an upland shrub thicket)
p3	upland field (diked pond in an upland field)
q	wetland (diked pond in a wetland)
q1	forested wetland (diked pond in a forested wetland)
q2	shrub swamp (diked pond in a shrub swamp)
q3	marsh (diked pond in a marsh)
q4	wet meadow (diked pond in wet meadow or fen)
q5	bog (diked pond in a bog)
r	dredged material disposal area (pond in diked disposal area)
3	**Excavated**
a	agriculture (excavated pond in an agricultural area; more than one-quarter of its perimeter borders an ag field including pasture; can further classify as a1-a6)
a1	cropland (pond in tilled field)
a2	livestock (pond in pasture or rangeland for watering livestock)
a3	cranberry (pond built for cranberry irrigation)
a4	agricultural /forest (excavated pond in a forested area that has some agricultural development; less than one-quarter of its perimeter borders an ag field)
a5	agricultural/shrubland (excavated pond in a shrub area that has some agricultural development; less than one-quarter of its perimeter borders an ag field)
a6	agricultural/open field (excavated pond in a field area that has some agricultural development; less than one-quarter of its perimeter borders an ag field)
b	aquaculture
b1	catfish
b2	crayfish
c	commercial
c1	commercial-stormwater
d	industrial
d1	industrial-stormwater
d2	industrial-wastewater
e	residential (excavated pond in a residential area of moderate to heavy density (more than one-quarter of its perimeter borders lawn or mowed field)
e1	residential-stormwater
e2	residential/forest (excavated pond in a forested area that has some residential development; less than one-quarter of its perimeter

	borders lawn or mowed field)
e3	residential/shrubland (excavated pond in a shrub area that has some residential development; less than one-quarter of its perimeter borders lawn or mowed field)
e4	residential/field (excavated pond in a field that has some residential development; less than one-quarter of its perimeter borders lawn or mowed field)
f	sewage treatment
g	golf
h	wildlife management
i	other recreational
j	mining
j1	sand/gravel
j2	coal
j3	mine reclamation
k	playa (altered)
o	other
p	natural upland (excavated pond in a forest, shrubland, or open undeveloped land)
p1	upland forest (excavated pond in an upland forest)
p2	upland shrub thicket (excavated pond in an upland shrub thicket)
p3	upland field (excavated pond in an upland field)
q	wetland (excavated pond in a wetland)
q1	forested wetland (excavated pond in a forested wetland)
q2	shrub swamp (excavated pond in a shrub swamp)
q3	marsh (excavated pond in a marsh)
q4	wet meadow (excavated pond in wet meadow or fen)
q5	bog (excavated pond in a bog)
r	dredged material disposal area (pond in diked disposal area)
4	**Beaver**
5	**Other artificial**

WATER FLOW PATH CODES

Note: For ponds and shallows of lakes use wetland water flow paths

AM	**Artificially manipulated**
IN	**Inflow**
IA	**Inflow-artificial***
OU	**Outflow**
OA	**Outflow-artificial***
OP	**Outflow-perennial**
OI	**Outflow-intermittent**
TH	**Throughflow**
TP	**Throughflow-perennial**
TA	**Throughflow-artificial***

TI **Throughflow-intermittent***
TN **Throughflow-entrenched**
BIA **Bidirectional-nontidal-artificial** (e.g., diked waterbody)
BTA **Bidirectional-tidal-artificial** (e.g., diked waterbody)
VR **Vertical flow** (lacking an apparent inlet and an outlet; geographically isolated)
NA **Nanotidal**
MI **Microtidal**
ME **Mesotidal**
MC **Macrotidal**
MG **Megatidal**

*Note: OA and TA are human-caused by ditches, while IA is applied to diked containment impoundments where water is pumped in; TI is to be used with throughflow ponds along intermittent streams. Ideally BT should not used for tidal waterbodies; use MI, ME, and MC instead; BTA is for tidal waters (impoundments) where tidal flow is regulated by water-control structures.

ESTUARINE HYDROLOGIC CIRCULATION CODES

SW **Salt-wedge/river-dominated type**
PM **Partially mixed type**
HO **Homogeneous/high energy type**

CODES FOR OTHER MODIFIERS (apply at end of code for given waterbody)

ch channelized or dredged
cw cold water (river or stream)
dv diverted
ef freshwater stream flowing directly into an estuary (formerly "ed")
ic incised channel (severely eroded; floodplain not as frequently flooded)
lv leveed
md freshwater stream flowing directly into marine waters
ox oxbow (lake)
wm wildlife management
ww warm water (river or stream)
wt wind tides

(Note: Can create others as needed to describe other features of importance.)

Section 5. Application of the Descriptors

As one can easily see, there are many descriptors to use to better characterize wetlands. The user may be challenged in terms of how to actually use them. While the full suite of descriptors are designed for site-specific characterizations, for inventory purposes a select group of the descriptors are used to describe the wetlands in large geographic areas and for using the NWI+ data for landscape-level functional assessments. Classifications for the latter purposes might be considered a Level One type classification (or bare bones approach). The following is a list of the most basic descriptors used for these efforts:

Landscape Position: Marine (MA), Estuarine (ES), Lentic (LE), Lotic River (LR), Lotic Stream (LS), and Terrene (TE)

Landform: Basin (BA), Flat (FL), Floodplain (FP), Fringe (FR), Island (IL), Peatland (PT), Pond (PD), Slope (SL), and Lake (LK)

Water Flow Path: Bidirectional-nontidal (BI), Bidirectional-tidal (BT), Inflow (IN), Outflow (OU), Throughflow (TH), and Vertical Flow (VR)

Other Descriptors: Headwater (hw), Estuarine discharge (ed), Tidally restricted (td, tr, and to), and more detailed descriptors for ponds

A simplified set of the dichotomous keys are provided as Appendix B to facilitate use of the descriptors for basic inventories. In our applications of the descriptors in the Northeast Region, we have typically done more than this, such as applying more detail for landscape position, water flow path, and lake classification. This can be seen by reviewing some of the NWI+ reports that are posted online at: http://www.aswm.org/wetland-science/wetlands-one-stop-mapping/5044-nwi-reports. Also it is highly recommended that future applications include designation of the three types of Terrene wetlands (i.e., Terrene Headwater, Terrene Riparian, and Terrene Non-riparian).

Section 5. Acknowledgments

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Section 7. Glossary

Alpine valley – in the western U.S., typically a high-elevation valley in the mountains, often at elevations above 10,000 feet in the Rockies

Arroyo -- a dry creek or stream bed in arid regions subject to ephemeral flows

Bar -- an elevated alluvial deposit forming the shore of a river, often gently sloping; may be composed of sand, gravel, or cobbles

Barrier Beach -- a coastal peninsular landform extending from the mainland into the ocean or large embayment or large lake (e.g., Great Lakes), typically providing protection to waters on the backside and allowing the establishment of salt marshes; similar to the barrier island, except connected to the mainland

Barrier Island -- a coastal insular landform, an island typically between the ocean (or possibly the Great Lakes) and the mainland; its presence usually promotes the formation of salt marshes on the backside

Basin -- a depressional (concave) landform; various types are further defined by the absence of a stream (isolated), by the presence of a stream and its position relative to a wetland (throughflow, outflow, inflow), or by its occurrence on a floodplain (floodplain basins include ox-bows and sloughs, for example)

Bay -- a coastal embayment of variable size and shape that is always opens to the sea through an inlet or other features

Beach – a wave-formed or alluvial-formed shoreline feature along an ocean, estuary, lake, or large river, often dominated by sand, but also comprised of coarser materials on rocky coasts

Carolina Bay -- a wetland formed in a semicircular or egg-shaped basin with a northwest to southeast orientation, found along the Atlantic Coastal Plain from southern New Jersey to Florida, and perhaps most common in Horry County, South Carolina

Channelization -- the act or result of excavating a stream or river channel to increase downstream flow of water or to increase depth for navigational purposes

Channelized -- water flow through a conspicuous drainageway, a stream or a river

Coastal Island -- an island in marine and estuarine areas

Coastal Pond -- pond and its associated wetlands that form behind a barrier beach and are subjected to varying tidal influence (intermittent to daily); the tidal connection for many coastal ponds has been stabilized by jetties; the ones that are only intermittently connected have low

salinities

Connecting Channel -- a river or stream that connects two adjacent lakes; lakes are typically close together considering their relative size; it is not any stream that occurs between two lakes in a drainage basin; perhaps the best examples are rivers connecting the Great Lakes, such as the St. Marys River connecting Lake Superior to Lake Huron, Detroit River connecting Lake St. Clair to Lake Erie, and the Niagara River connecting Lake Erie with Lake Ontario

Cypress Dome -- a wetland dominated by bald cypress growing in a basin that may be formed by the collapse of underlying limestone, forest canopy takes on a domed appearance with tallest trees in center and becoming progressively shorter as move toward margins of basin

Delta -- a typically lobed-shaped or fan-shaped landform formed by sedimentation processes at the mouth of a river carrying heavy sediment loads

Ditch -- a linear, often shallow, artificial channel created by excavation with intent to improve drainage of or to irrigate adjacent lands

Drained, Partly -- condition where a wetland has been ditched or tiled to lower the ground water table, but the area is still wet long enough and often enough to fall within the range of conditions associated with wetland hydrology

Entrenched -- condition where a stream cuts through a wetland and does not periodically overflow into the wetland; the affected wetland may be a terrene wetland cut by a stream or it could be a lotic wetland along an entrenched stream (the latter would usually have to be identified in the field)

Estuarine -- the landscape of estuaries (salt and brackish tidal waterbodies, such as bays and coastal rivers) including associated wetlands, typically occurring in sheltered or protected areas, not exposed to oceanic currents

Estuary -- a complex of saltwater and brackish wetlands and waterbodies subject to periodic inundation by tides; the mixing zone of freshwater and saltwater along the marine coasts; excludes the freshwater tidal reach of coastal rivers following Cowardin et al. (1979)

Flat -- a relatively level landform; may be a component of a floodplain

Flatwood -- forest of pines, hardwoods or mixed stands growing on interfluves on the Gulf-Atlantic Coastal Plain, typically with imperfectly drained soils; some flatwoods are wetlands, while others are dryland

Flooding, Frequent -- inundation every other year on average

Flooding, Infrequent -- inundation less than every other year on average

Flooding, Overbank -- inundation from rising water levels in rivers and streams when the water overflows the banks of these watercourses and cover the active floodplain

Floodplain -- a broad, generally flat landform occurring in a landscape shaped by fluvial or riverine processes; for purposes of this classification limited to the broad plain associated with large river systems subject to periodic flooding (e.g., once every 100 years or more often) and typically having alluvial soils; further subdivided into several subcategories: flat (broad, nearly level to gently sloping areas) and basin (depressional features such as oxbows and sloughs)

Floodplain, active -- floodplain that is frequently inundated, having more than a 50% chance of flooding in any year (i.e., 50 times in 100 years or about every other year on average)

Floodplain, historic -- floodplain that is no longer flooded by normal alluvial events due to human-alterations such as leveeing, diking, or altered river flow regimes or to natural processes such as changing river courses

Fringe -- a wetland occurring along a standing or flowing waterbody, i.e., a lake, pond, river, stream, estuary, or ocean, including tidal wetlands that are inundated frequently by tides, nontidal vegetated wetlands that are flooded for most of the growing season, and nonvegetated wetlands that form the banks of these waterbodies (such as cobble-gravel bars along river bends)

Ground Water -- water below ground, held in the soil or underground aquifers

Gulf – an arm of the sea; a large embayment of the ocean (e.g., Gulf of Mexico or Gulf of Maine)

Headland -- the seaward edge of the major continental land mass (North America), commonly called the mainland; not an island

High Gradient -- the fast-flowing segment of a drainage system, typically with no floodplain development; equivalent to the Upper Perennial and Intermittent Subsystems of the Riverine System in Cowardin et al. 1979

Inflow -- water enters; an inflow wetland is one that receives surface water from a stream or other waterbody or from significant surface or ground water from a wetland or waterbody at a higher elevation and has no significant discharge

Interdunal -- occurring between sand dunes, as in interdunal swale wetlands found in dunefields behind ocean and estuarine beaches and in sand plains like the Nebraska Sandhills

Island -- a landform completely surrounded by water and not a delta; some islands are entirely wetland, while others are uplands with or without a fringe wetland

Isolated -- lacking an apparent surface water connection to other wetlands and waterbodies; typically "geographically isolated" (surrounded by upland - nonhydric soils); may be connected to other wetlands and water via groundwater, but this is not known or has not been established

for the subject area; a collection of “isolated” wetlands may be connected via surface water but the group does not have a surface water outlet

Karst -- a limestone region characterized by sinkholes and underground caverns

Kettle -- a glacially formed depression typically created by a block of glacial ice left on the land by a retreating glacier; melting of the ice formed a kettle pond that may be quite deep, with bog vegetation frequently established along its perimeter

Lake -- an open waterbody greater than 20 acres in size that is completely surrounded by land or wetland and often having an inlet, outlet, or both

Lake, Floodplain – lake embedded in a floodplain, often with only a temporary connection to the river, either by overflow or an intermittently flooded channel; differs from river lake in that connection is more temporary, while the latter maintains its water connection through most of the year and appears to be part of the river

Lake, River – a semi-enclosed waterbody on floodplain that is directly connected to the river and clearly part of the river; these waters are often named waterbodies on the U.S.G.S. topographic maps

Lake Island -- an island in a lake

Lentic -- the landscape position associated with large, deep standing waterbodies (such as lakes and reservoirs) and contiguous wetlands formed in the lake basin (excludes seasonal and shallow lakes which are included in the *Terrene* landscape position)

Lotic -- the landscape position associated with flowing water systems (such as rivers, creeks, perennial streams, intermittent streams, and similar waterbodies) and contiguous wetlands

Marine -- the landscape position (or seascape) associated with the ocean's shoreline

Nonchannelized -- water exits through seepage, not through a river or stream channel or ditch

Outflow -- water exits naturally or through artificial means (e.g., ditches); an outflow wetland has water leaving via a stream, seepage, or ditch (artificial) to a wetland or waterbody at a lower elevation; it lacks an inflowing surface water source like an intermittent or perennial stream

Oxbow -- a former mainstem river bend now partly or completely cut off from mainstem

Paludified -- subjected to paludification, the process by which peat moss engulfs terrains of varying elevations due to an excess of water, typically associated with cold, humid climates of northern areas (boreal/arctic regions and fog-shrouded coasts)

Peatland – a wetland landform comprised of an organic deposit usually of peat formed under

conditions of nearly continuous saturation, typical of bogs and fens in higher latitudes and mountainous regions

Playa -- a type of basin wetland in the Southwest characterized by drastic fluctuations in water levels over the normal wet-dry cycle

Pocosin -- a shrub and/or forested wetland forming on organic soils in interstream divides (interfluves) on the Atlantic Coast Plain from Virginia to Florida, mostly in North Carolina

Pond -- a natural or human-made shallow open waterbody that may be subjected to periodic drawdowns and less than 20 acres in size

Prairie Pothole -- a glacially formed basin wetland found in the Upper Midwest especially in the Dakotas, western Minnesota, and Iowa

Reservoir -- a large, deep waterbody formed by a dike or dam created for a water supply for drinking water or agricultural purposes or for flood control, or similar purposes

River Island -- an island within a river

Salt Pond -- a coastal embayment of variable size and shape that is periodically and temporarily cut off from the sea by natural accretion processes; some may be kept permanently open by jetties and periodic maintenance dredging

Salt Flat -- a broad expanse of alkaline wetlands associated with arid regions, especially the Great Basin in the western United States

Sinkhole -- a depression formed by the collapse of underlying limestone deposits; may be wetland or nonwetland depending on drainage characteristics

Slope -- a non-peat wetland occurring on a slope; various types include those along a sloping stream (fringe), those formed at the toe of a slope, and those formed by point discharge of groundwater (seeps); sloping wetlands formed by paludification -- the process of bogging or swamping of uplands by peat moss in northern climes (humid and cold) are considered Peatland

Slough -- a vegetated wetland in a natural drainageway without a detectable stream on the aerial imagery where water flows through the system in a more or less unconfined manner; may have narrow, shallow channels or braided channels when observed on-the-ground; the term “slough” has various definitions in other contexts

Stream -- a natural drainageway that contains flowing water at least seasonally; different stream types: *perennial* where water flows continously in all years except drought or extremely dry years; <u>intermittent</u> where water flows only seasonally in most years; <u>channelized</u> where stream bed has been excavated or dredged

Stream, minor – for purposes of this classification, a linear stream at a scale of 1:24,000, often intermittent, that typically originates from a hillside seep and may connect to a large headwater wetland at the base of the hill

Subsurface Flow -- water leaves via ground water

Surface Water -- water occurring above the ground as in flooded or ponded conditions

Tectonic -- changes in the earth's surface caused by landslides, faulting, and volcanic activity

Terrene -- wetland surrounded or nearly so by uplands and lacking a channelized outlet stream, or if along a stream wetland is not overflowed by stream, thereby serves as a contributing water source for the stream; includes a variety of wetlands and natural and human-made ponds

Throughflow -- water entering and exiting, passing through; a throughflow wetland receives significant surface or ground water which passes through the wetland and is discharged to a stream, wetland or other waterbody at a lower elevation; throughflow may be perennial, intermittent, or associated with an entrenched stream

Tidal Flooding – water levels rise and fall in response to tides; frequent tidal flooding – inundation from tides occurs in most months and is not limited to extreme weather events (e.g., northeasters and hurricanes)

Vernal Pool -- a temporarily flooded basin; woodland vernal pools are found in humid temperature regions dominated by trees, these pools are surrounded by upland forests, are usually flooded from winter through mid-summer, and serve as critical breeding grounds for salamanders and woodland frogs; West Coast vernal pools occur in California, Oregon, and Washington on clayey soils, they are important habitats for many rare plants and animals.

APPENDICES

A: Examples of LLWW types: Tidal and Nontidal Wetlands

B. Simplified Keys for Landscape Position, Landform, and Water Flow Path

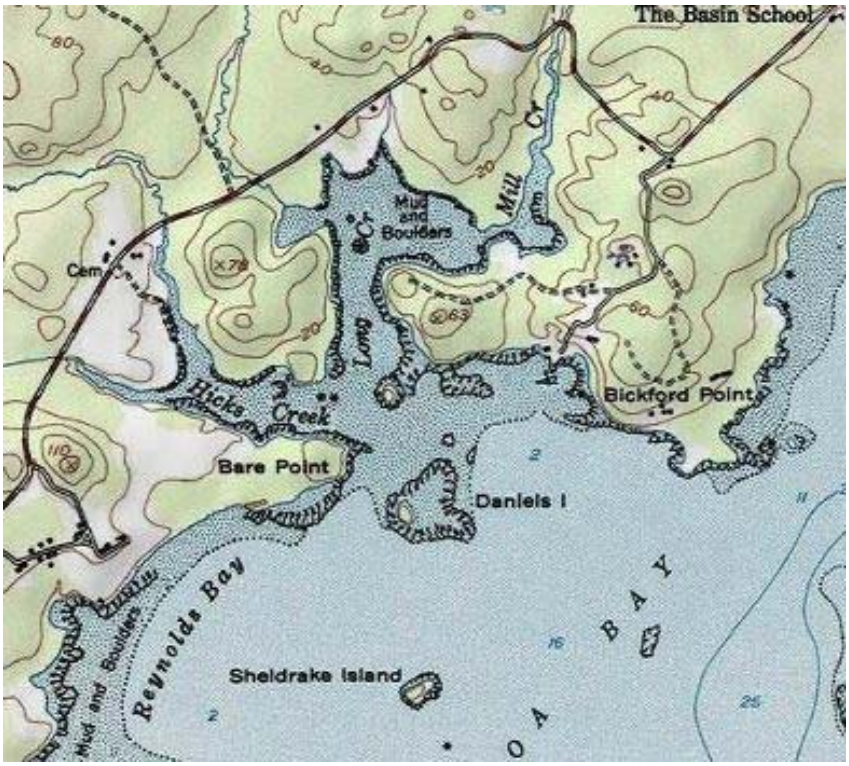
APPENDIX A:

Examples of LLWW types: Tidal and Nontidal Wetlands

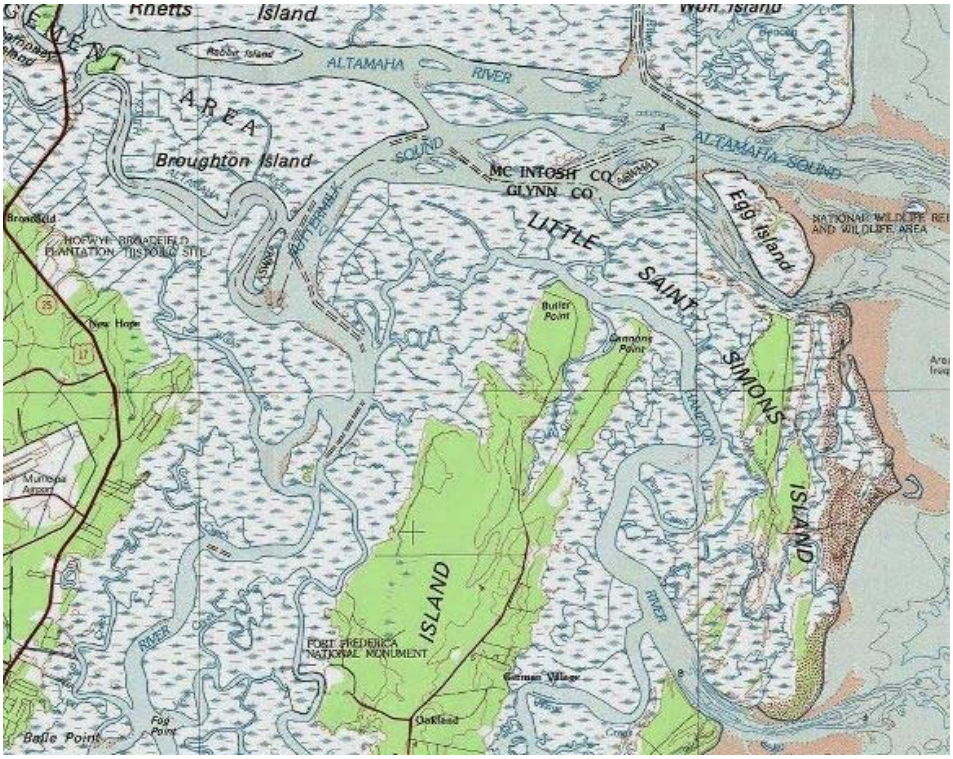
Data Sources: U.S. Geological Survey
Topographic Map and Aerial Photo

TIDAL WETLANDS

Gulf of Maine coastal wetlands (Wohoa Bay, Washington County, Maine). Classification for intertidal flats/rocky shores: *Marine or Estuarine Fringe Macrotidal*; salt marshes: *Estuarine Fringe Macrotidal*.

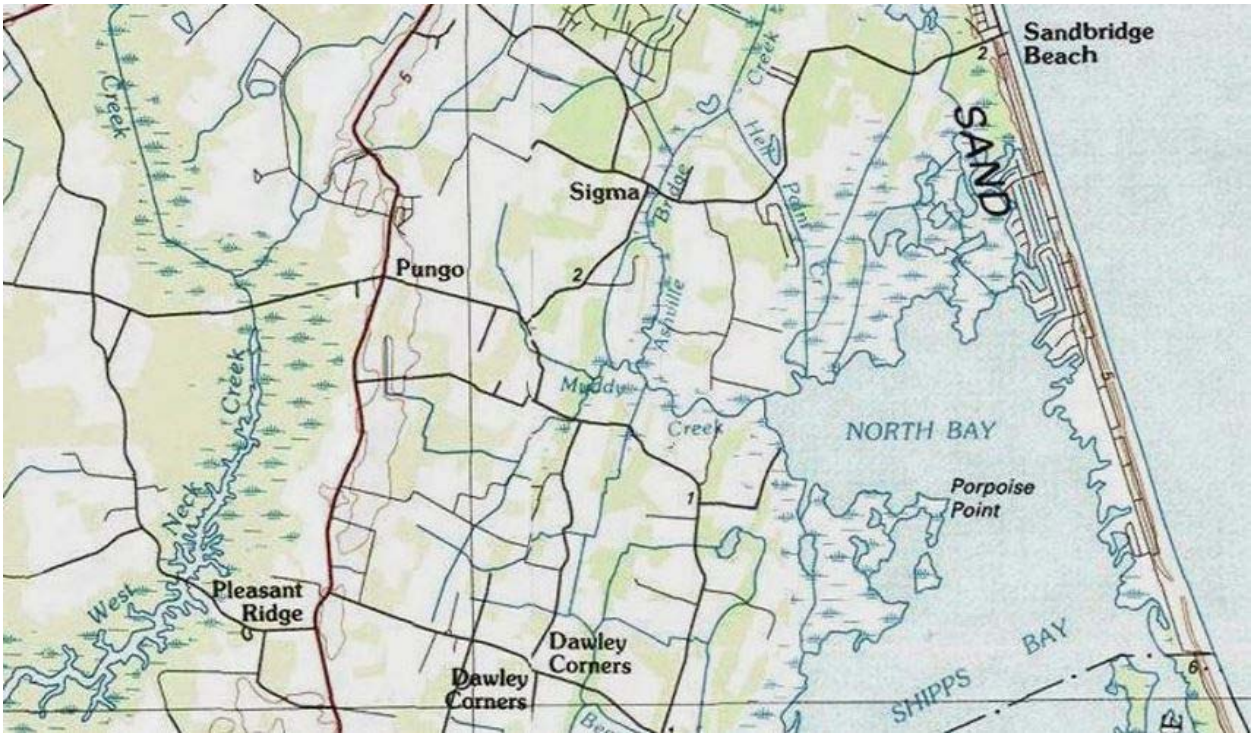


South Atlantic salt marshes (mouth of Altamaha River, Glynn and McIntosh Counties, Georgia). Classification of marshes and tidal flats: *Estuarine Fringe (barrier island) Mesotidal*; marsh island: *Estuarine Island Mesotidal*; ocean beach: *Marine Fringe Mesotidal.*



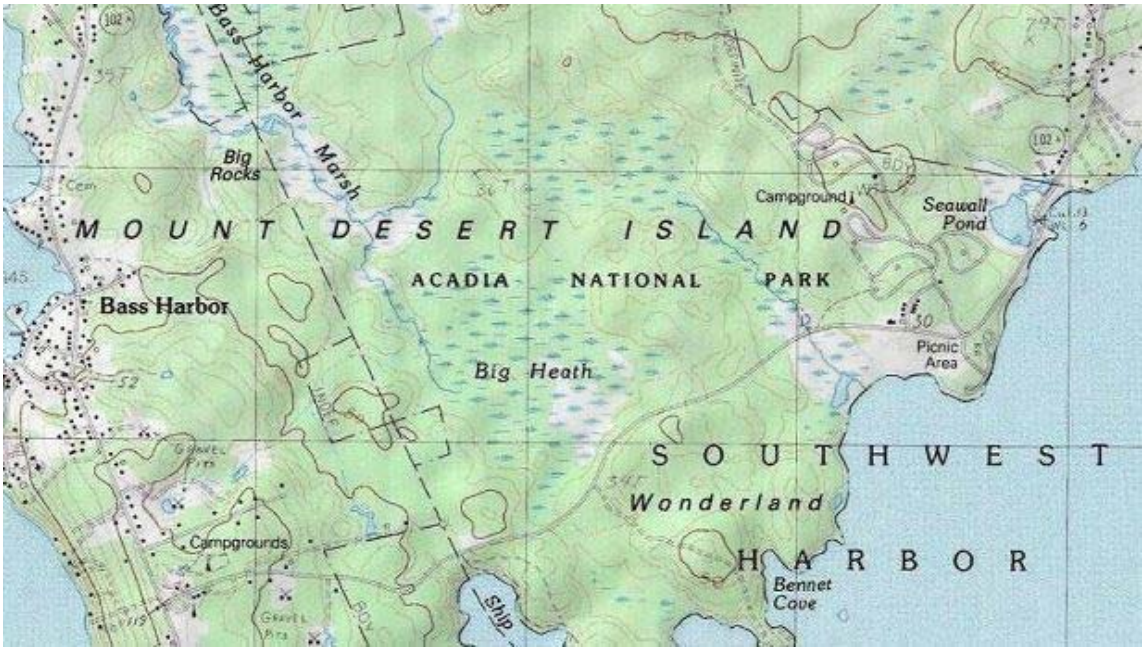
Florida tidal wetlands (Ten Thousands Islands region, Collier and Monroe Counties). Classification of mangroves, salt marshes, and tidal flats: *Estuarine Fringe Microtidal*; mangrove islands: *Estuarine Island Microtidal*.

Coastal Plain tidal wetlands (Back Bay, City of Virginia Beach, Virginia). Classification of tidal slightly brackish marshes along North Bay: *Estuarine Fringe Nanotidal, wind tides*; Classification of tidal swamps along West Neck Creek: *Lotic River Tidal Floodplain Nanotidal, wind tides*.

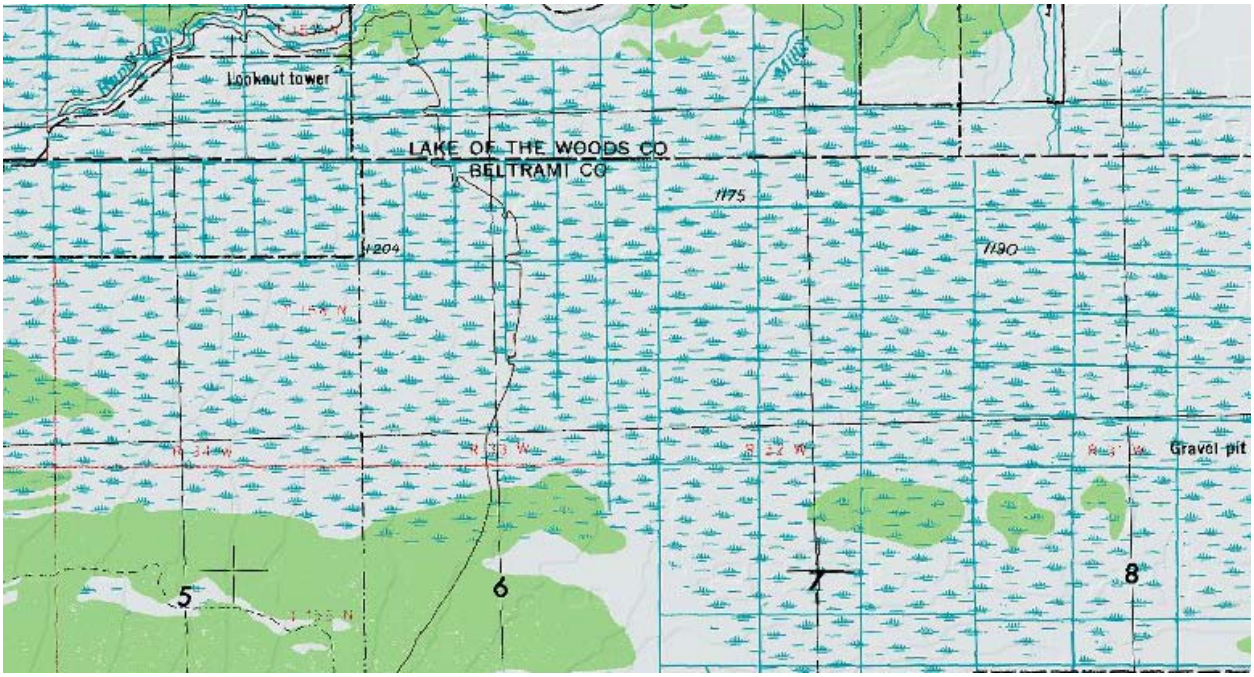


NONTIDAL WETLANDS

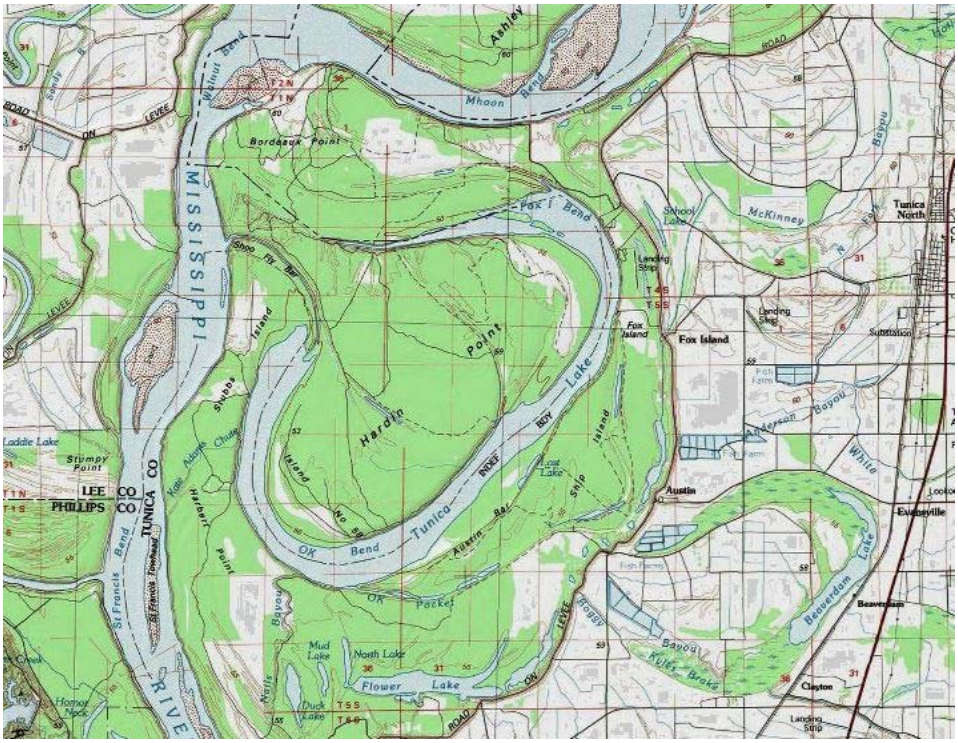
Northern shrub and forested bogs (Big Heath, Mount Desert Island, Hancock County, Maine). Classification of bog: *Terrene Headwater Peatland Outflow*.



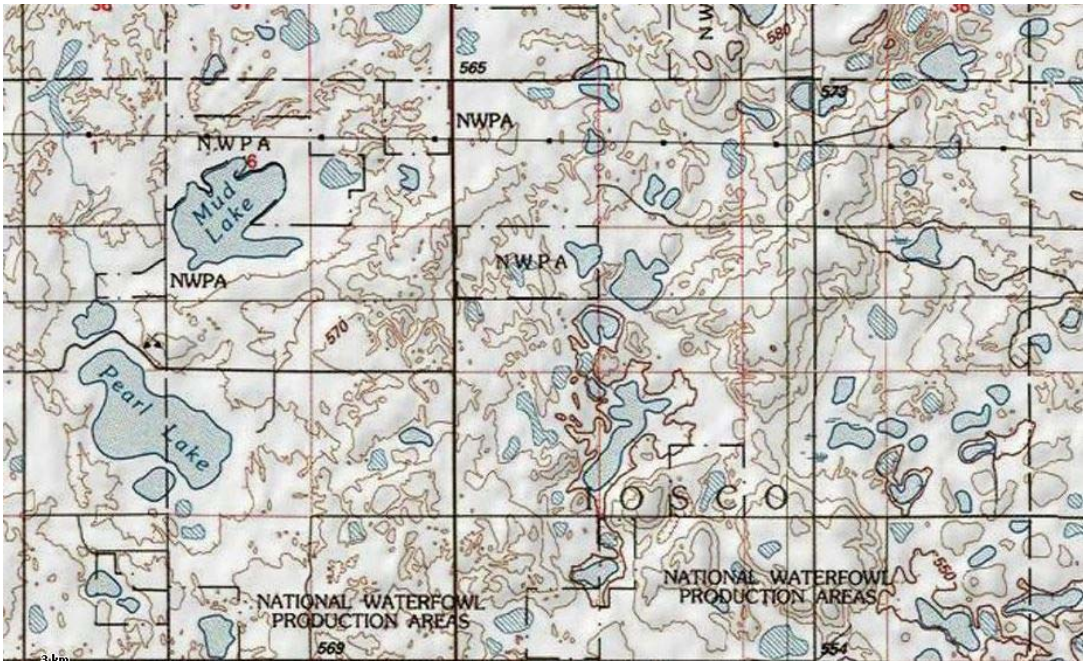
Peatland-dominated landscape (north of Upper Red Lake, Minnesota; area shown covers roughly 800 square miles). Classification of bogs and fens: *Terrene Headwater Peatland Outflow* (could separate bogs from fens; this is an example of the paludified landscape common to the boreal forest biome; the peatland is the part of the source of the Rapid River).



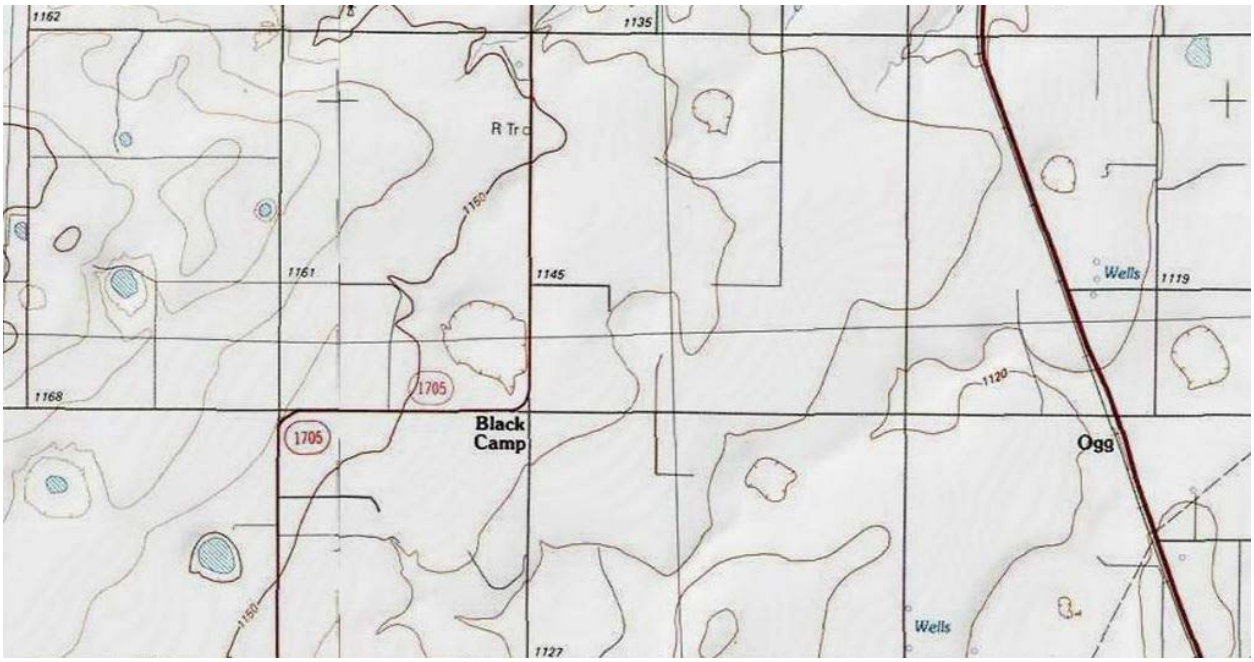
Floodplain wetlands (Mississippi River, Tunica County, Mississippi). Classification of temporarily flooded bottomland: *Lotic River Floodplain (flat) Throughflow*; river bars: *Lotic River Fringe Throughflow*; oxbow lake: *Lotic Natural Floodplain Lake (oxbow) Throughflow*.



Prairie Pothole marshes and lakes (Stutsman County, North Dakota). Classification of marshes: *Terrene Non-riparian Basin (prairie pothole) Vertical Flow* (*Vertical Flow/Outflow*; *Vertical Flow/ Throughflow*, or *Vertical Flow/Inflow* depending on ground water interactions, topographic position, and salinity); lakes: *Terrene Non-riparian Natural Lake (pothole)* – water flow path classification to be determined on a case-by-case basis by closer inspection of topographic data and aerial imagery.



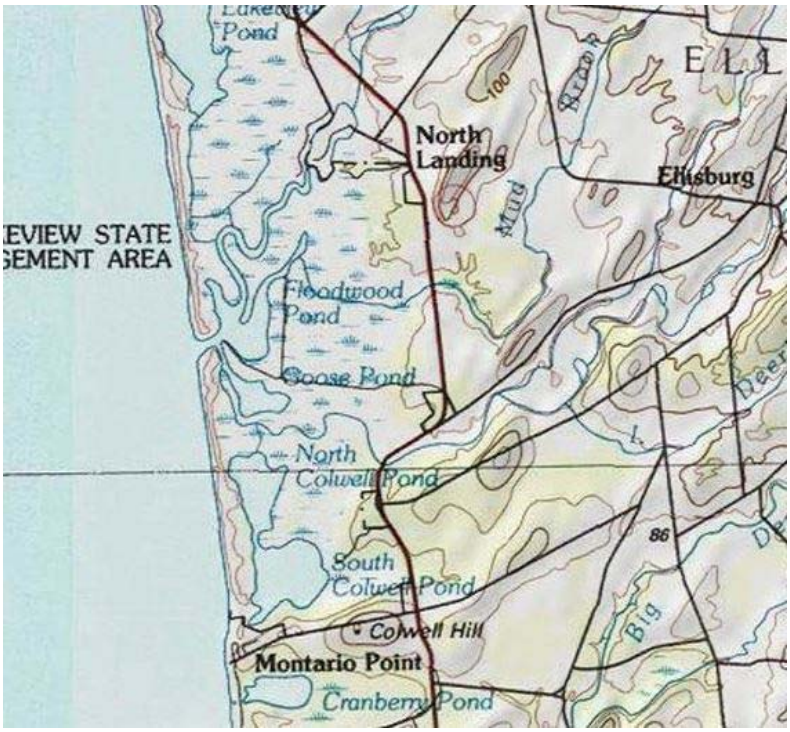
Southwest playa wetlands (Randall County, Texas). Classification: *Terrene Non-riparian Basin (playa) Vertical Flow*.



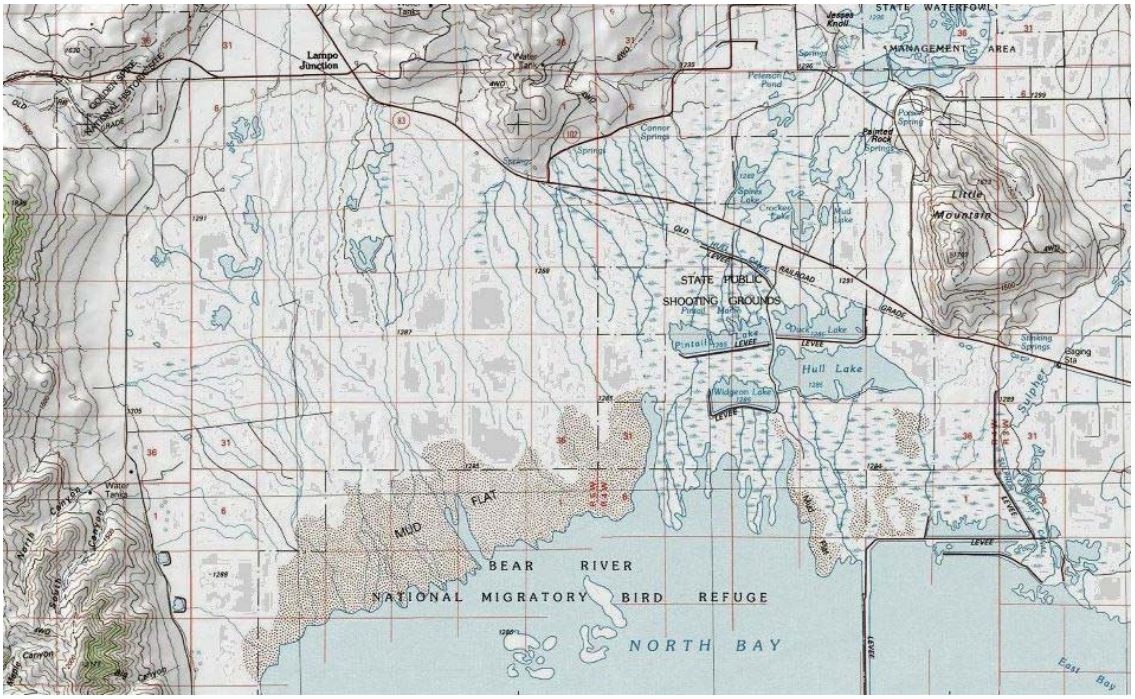
Lakeshore and streamside wetlands (Clear Lake, Lake County, California).

Classification of seasonally flooded marshes: *Lentic Basin Bidirectional-nontidal/throughflow*; lake: *Lotic Natural Lake Throughflow*; temporarily flooded streamside forested wetland along creek (lower edge): *Lotic Stream Flat Throughflow*.

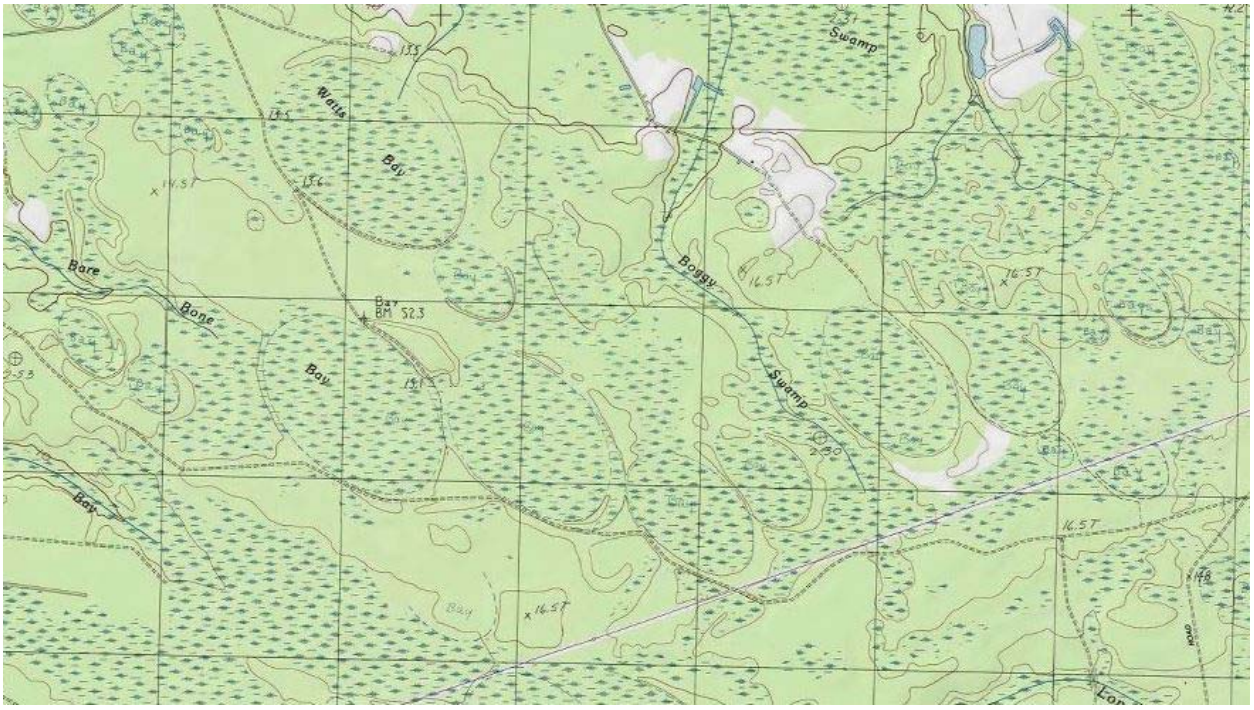
Great Lakes coastal wetlands (Lake Ontario, Jefferson County, New York). Classification for semipermanently flooded wetlands behind coastal barriers: *Lentic Fringe (barrier beach) Throughflow*; for seasonally flooded wetlands: *Lentic Basin (barrier beach) Throughflow* or *Bidirectional-nontidal*; for wetlands along feeder streams: *Lotic Stream Basin Throughflow* for seasonally flooded types or *Lotic Stream Flat Throughflow* for temporarily flooded types.



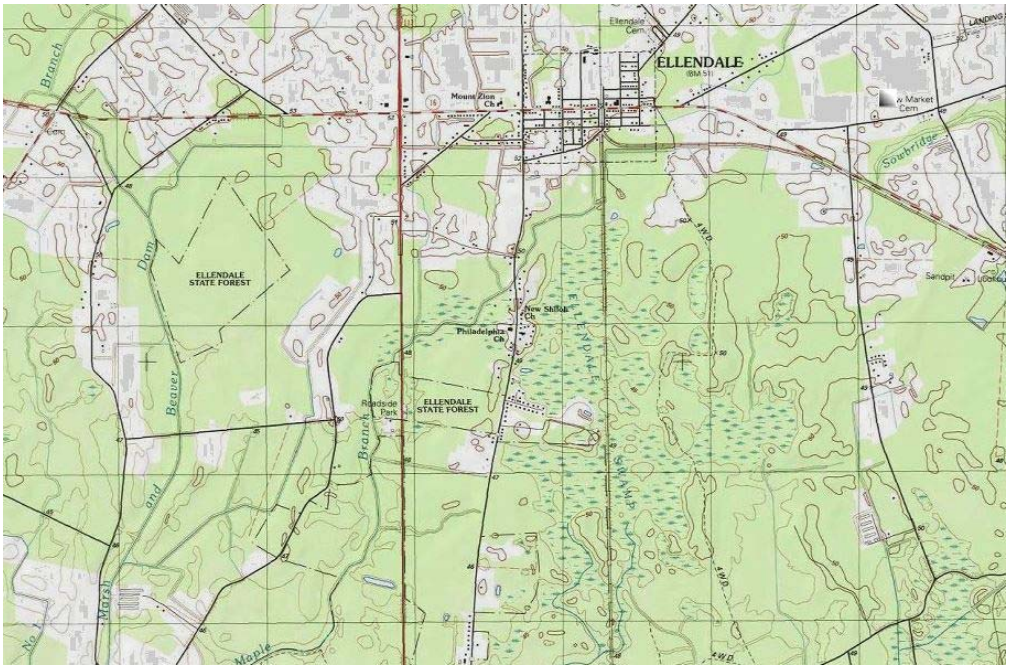
Great Salt Lake wetlands (Box Elder County, Utah). Classification of seasonally flooded nonvegetated and vegetated shores: *Lentic Basin (salt flat) Throughflow-intermittent*; temporarily flooded shores and marsh: *Lentic Flat (salt flat) Throughflow-intermittent*; the Great Salt Lake (the 4th largest terminal lake in the world): *Terrene Natural Lake Inflow*.

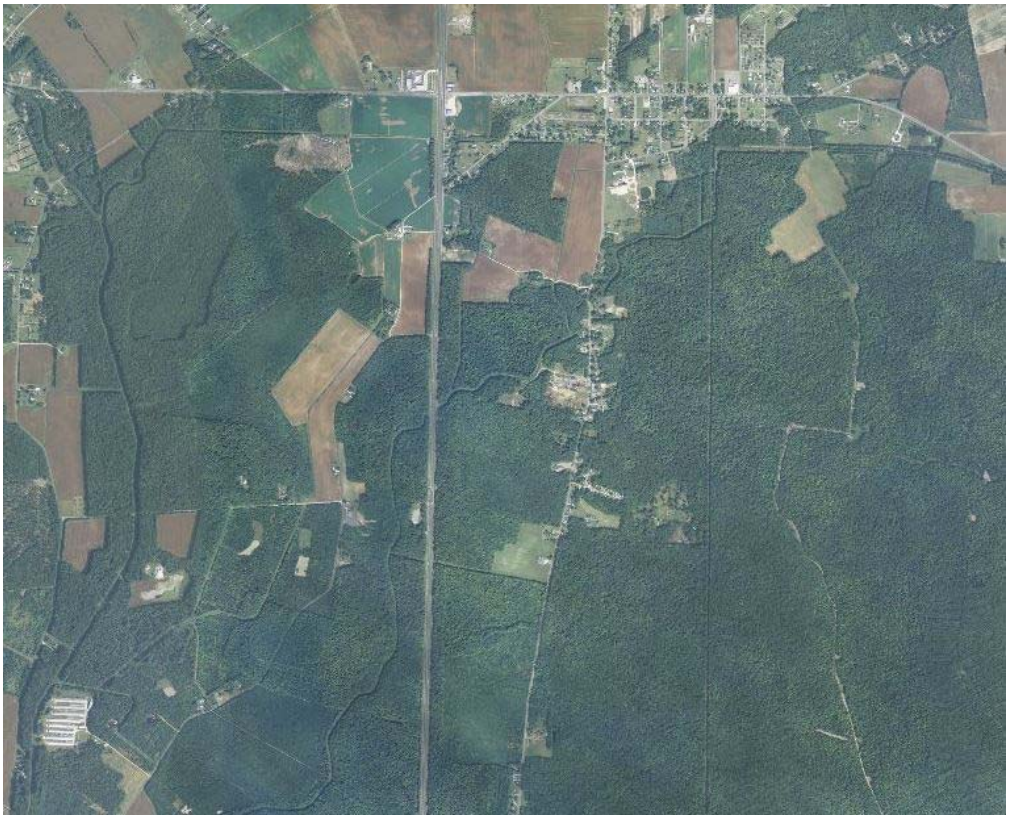


Carolina Bay wetlands (Horry County, South Carolina). Classification: *Terrene Headwater Basin (Carolina Bay) Outflow*.

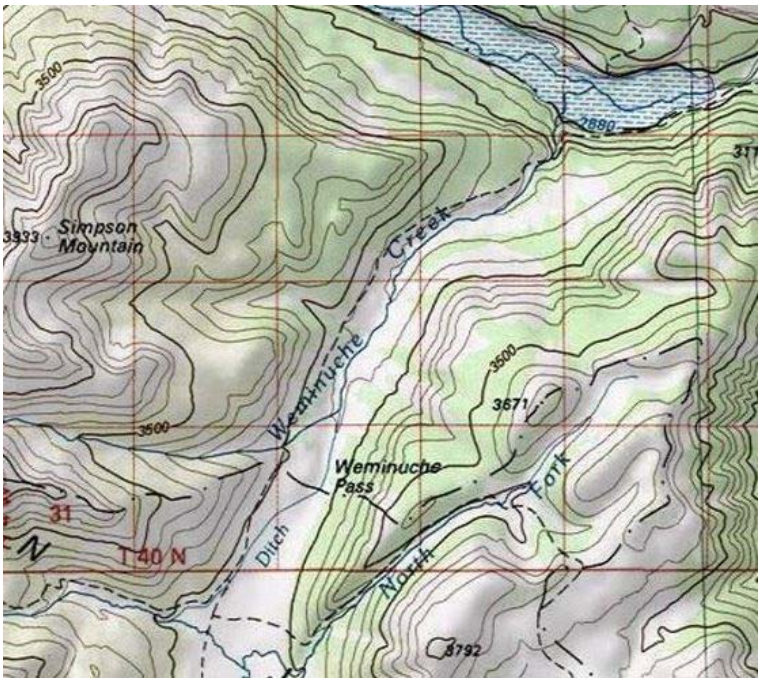


Coastal Plain flatwood and stream overflow wetlands (Sussex County, Delaware). Classification: in uppermost section of watershed: *Terrene Headwater Flat Outflow* and along stream, seasonally flooded forested wetland: *Lotic Stream Basin Throughflow, headwater*; temporarily flooded wetland: *Lotic Stream Flat Throughflow, headwater*.





Montane wetlands (Hinsdale County, Colorado). Classification of groundwater-discharge (saturated) wetland in narrow stream valley (bottom left): *Terrene Riparian Slope (stream valley) Outflow* (Note: Stream does not overflow this wetland so flow is from hillslope to wetland to stream); stream overflow wetland, seasonally flooded (broader area at bottom): *Lotic Stream Basin Throughflow, headwater*; waterbody (top): *Lotic Dammed River/Stream Valley Lake (reservoir) Throughflow*. (Note: The wetlands may qualify as *Peatland (fen)* landform depending on soil type.)



APPENDIX B:

Simplified Keys for Landscape Position, Landform, and Water Flow Path

(See codes for more descriptive pond types)

Landscape Position

1. Wetland borders a river, stream, lake, reservoir, estuary, or ocean	2
1. Wetland does not border these waters; it is completely surrounded by upland (dryland)	*Terrene Non-riparian*
2. Wetland lies along an ocean shore and is subject to frequent tidal flooding	*Marine*
2. Wetland does not lie along an ocean shore	3
3. Wetland lies in an estuary and is subject to frequent tidal flooding	*Estuarine*
3. Wetland does not lie in an estuary	4
4. Wetland forms the shore of a lake or reservoir or lies within its basin	*Lentic*
4. Wetland lies along a river or stream, or if along an estuary or estuarine wetland, it is a freshwater type that is only flooded by tides during severe storms	5
5. Wetland is the source of a river or stream; minor streams may flow into it from adjacent hillsides	*Terrene Headwater*
5. Wetland is not the source of a river or stream	6
6. Wetland is a freshwater type bordering an estuarine wetland and subject only to tidal flooding during severe storms	*Terrene Non-riparian*
6. Wetland occurs in or along a river or stream	7
7. Wetland is in a river or stream or on its active floodplain where it is frequently flooded by overflow	8
7. Wetland is along a river or stream but it is not frequently flooded by the river or stream	9
8. Wetland is on the active floodplain of a stream	*Lotic Stream*[1]
8. Wetland is on the active floodplain of a river	*Lotic River*
9. Wetland is on the 100-year floodplain	*Terrene Riparian*
9. Wetland is above the 100-year floodplain	*Terrene Non-riparian*

[1] The active floodplain is flooded every other year on average. Lotic wetlands are separated into Lotic River and Lotic Stream types based on watercourse width - approximately 25 feet (e.g., a polygon = Lotic River vs. linear = Lotic Stream at a scale of 1:24,000) and then are classified by flow durations: perennial, intermittent, ephemeral, and tidal.

Landform

1. Wetland is formed by the accumulation of peat (i.e., bog or fen)	*Peatland*
1. Wetland does not accumulate peat at the surface	2
2. Wetland occurs on a slope >2%	*Slope*
2. Wetland does not occur on a slope >2%	3
3. Wetland forms an island completely surrounded by water (excluding wetlands where extensive grid ditching might create this condition at a small scale)	*Island*
3. Wetland does not form on an island	4
4. Wetland occurs in the shallow water zone of a permanent nontidal waterbody[2], the intertidal zone of an estuary (regularly and irregularly flooded zones), or the regularly flooded (daily tidal inundation) zone of freshwater tidal wetlands	*Fringe*[3]
4. Wetland does not occur in these waters or intertidal zones	5
5. Wetland forms a nonvegetated bank or is within the banks of a river or stream	*Fringe*
5. Wetland is not a nonvegetated river or stream bank or within the banks	6
6. Wetland occurs on an alluvial plain	*Floodplain*[4]
6. Wetland does not occur on an alluvial plain	7
7. Wetland occurs on a nearly level landform	*Flat*
7. Wetland occurs in a distinct depression	*8*
8. Wetland is an shallow open water body less than 20 acres in size	*Pond*
8. Wetland is a vegetated wetland and not solely open water	*Basin*

[2] If the wetland is a shallow waterbody less than 20 acres in size it should be considered a *Pond*.
[3] Tidally restricted wetlands behind causeways, dikes, and similar structures are classified as Basins.
[4] Basin and Flat sub-landforms can be identified within this landform when desirable.

Water Flow Path[5]

1. Wetland is typically surrounded by upland (nonhydric soil); receives precipitation and runoff from adjacent areas with no apparent outflow	*Vertical Flow*[6]
1. Wetland is not geographically isolated but is connected to other wetlands or waters	2
2. Wetland is a sink receiving water from a river, stream, or other surface water source, lacking surface water outflow	*Inflow*
2. Wetland is not a sink; surface water flows through or out of the wetland	3
3. Wetland is subjected to frequent tidal flooding (consider applying tidal range descriptor)	*Bidirectional-Tidal*
3. Wetland is not tidally influenced or if flooded infrequently by storm tides, it is a freshwater wetland	4
4. Water flows out of the wetland, but does not flow into this wetland from another wetland or waterbody (except perhaps during severe storms)	*Outflow*[7]
4. Water flows in and out of the wetland	5
5. Water flows through the wetland, often coming from upstream or uphill sources	*Throughflow*[7]
5. Wetland is along a lake or reservoir and its water levels are subjected to the rise and fall of this waterbody; no stream flow through the wetland	*Bidirectional-Nontidal*

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[5] Surface water connections are emphasized because they are more readily identified than groundwater linkages. Note: The "Paludified" water flow path is not included in this simple key; paludified wetlands are common in northern climates where bogs are one of the most common wetland types in the region.

[6] Wetland is "geographically isolated"; hydrological relationship to other wetlands and watercourses may be more complex than can be determined by simple visual assessment of surface water conditions.

[7] If stream data are separated into intermittent and perennial flows, consider separating Outflow and Throughflow into perennial (OU and TH) and intermittent (OI and TI) water flow paths.