Proposed Classification for Biological Assessment of Florida Inland Freshwater Wetlands

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by

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Table of Contents

List of Tables……..……..... iii

Wetland Classification – Background.……..... 1

Florida Natural Areas Inventory…….... 3

Soil Conservation Service…….. 3

Florida Land-use, Cover and Forms Classification System……. 5

Florida Fish and Wildlife Conservation Commission……..... 6

U.S. Fish and Wildlife Service – National Wetlands Inventory…….…..... 7

Other Classification Systems…….…..... 11
Ecosystems of Florida (Myer and Ewel 1990)…….…... 11
The Nature Conservancy……. 11
Lake County Water Authority/Seminole County……..…. 11

Hydrogeomorphic Wetland Classification……..…. 12

Classification Crosswalks……..... 14

Proposed Wetland Classification Approach for Biological Assessment…….…..... 15

Literature Cited……..... 32

List of Tables

Table 1. General characteristics for 3 broad categories of inland freshwater wetlands in Florida…….…….. 2

Table 2 FNAI inland freshwater wetland communities and synonymy….. 4

Table 3. SCS inland freshwater wetland communities……..... 5

Table 4. FLUCCS inland freshwater wetland codes and nomenclature……..... 6

Table 5. FWC inland freshwater wetland habitats and percent statewide areas…….….. 7

Table 6. NWI hierarchy of selected inland freshwater wetland types represented in Florida……. 8

Table 7. Water regime modifiers describing NWI wetland and deepwater habitats…….…….…..... 9

Table 8. Percent Statewide area for NWI inland freshwater wetland systems…….…….. 10

Table 9. HGM (hydrogeomorphology) determinants of wetland function.…. 13

Table 10. HGM Peninsular Florida Depression wetland class comparison… 14

Table 11. Classification cross-reference of FNAI inland freshwater wetland communities……... 16

Table 12. Classification cross-reference of SCS inland freshwater wetland communities……..…. 17

Table 13. Classification cross-reference of FLUCCS inland freshwater wetland classes……..…… 18

Table 14. Classification cross-reference of FWC inland freshwater wetland habitats……...…….....19

Table 15. Classification cross-reference of NWI inland freshwater wetland systems……..….. 20

Table 16. Classification crosswalk summaries (total and average number of repeat references)……..…..... 21

Table 17. FNAI crosswalk summary……..... 23

Table 18. SCS crosswalk summary……. 24

Table 19. FLUCCS crosswalk summary……..….. 25

Table 20. FWC crosswalk summary……..…..... 26

Table 21. NWI crosswalk summary……..… 27

Table 22. Proposed classification for biological assessment of Florida inland freshwater wetlands……..…….…..... 28

Table 23. Classification cross-reference of proposed wetland bioassessment classes in Florida…….….. 30

Wetland Classification

Successful biological monitoring depends on judicious classification: selection of too few classes may overlook important characteristics; too many may unnecessarily complicate development of biocriteria (Karr and Chu 1999). Classifications are used to describe and organize ecosystems and land cover into distinct categories useful to land managers, planners and scientists, according to specific agency goals. The goal of classification for biological assessment is to group ecosystems with similar biological attributes and biological response to human disturbance. Because biological assessments measure ecosystem health relative to reference conditions, classification must distinguish local environments and address regional variability.

Geography, landscape position, geomorphology, hydropattern, climate, physical/chemical variables, and biogeographic processes determine the structure and function of local ecosystems. Aspects of these driving forces are incorporated in most hierarchical classification systems, while others are based on plant community structure and species composition. Regardless of the number or resolution of classes, at all levels of classification there is overlap because of common species distributions and intergrading physical environmental conditions.

Several classification schemes have been developed to describe Florida's inland freshwater wetlands (Wharton et al. 1977, Cowardin et al 1979, FDOT 1979/1985, SCS 1981, Ewel and Kushlan 1990, FDNR 1988, FNAI 1990, Brinson 1993, Trott et al 1997, TNC 1997). Descriptions of each are given below, followed by crosswalk comparisons between classifications. Although there is considerable overlap between key characteristics and wetland classes, each classification is goal specific. A common approach orders Florida’s inland freshwater wetlands into three broad groups (Table 1): wetlands associated with flowing water; wetlands adjacent to ponds and lakes; and depressional or stillwater wetlands. General descriptions, review of plant community associations, and cross-reference of State classifications provide foundations for the development of wetland bioassessment classes.

Here a proposed classification for biological assessment of Florida inland freshwater wetlands is described. It is a tiered approach using broad landscape categories (River, Depression, Lake, Strand, Seepage and Flatland) subdivided into forested and non-forested classes. Proposed wetland ecoregions partition the State and further specify wetland classes. Modifiers (hydropattern, water source, and soil type) lend additional resolution. Classification approaches to Florida wetlands are described, and five prominent systems are cross-referenced to generate a framework for common nomenclature and to utilize the best components of existing systems. The proposed classification uses aspects of HGM and FNAI classification structure. Twelve proposed classes are then compared with other descriptions for inland freshwater wetlands to provide cross-reference with other classifications used in Florida. Classification crosswalks are provided in an HTML format for additional utility.

Table 1. Comparisons, general characteristics and plant community associations compared for 3 broad categories of inland freshwater wetlands: a) flowing water, b) lake fringe and c) basin, depression wetland types (adapted from Erwin, Doherty, Brown, Best 1997).

General Type	Abstracted from Ecosystems of Florida	FNAI / FDNR	FLUCFCS	Other Synonyms	General Characteristics
Flowing water wetlands	River (stream) swamps; blackwater floodplain forest	Bottomland forest, floodplain forest, blackwater stream, seepage stream, strand, slough	615 stream and lake swamps; 616 inland ponds and sloughs; 617 mixed wetland hardwoods; 630 wetland forested mixed	Swamp forest, swamp hardwoods, bottomland hardwoods, backwater swamps	Forested wetlands within stream or river floodplains generally consist of a wide variety of tree species including cypress, blackgum, ash, elm, some oaks, sugar berry, maple, cabbage palm, sweet gum, hickories.
Lake fringe wetlands	Lake fringe swamps	River floodplain lake, swamp lake	615 stream and lake swamps	Lake fringe swamp, lake fringe forest	Forested wetlands on fringe of lakes; species include cypress, blackgum, ash, elm, some oaks, sugar berry, maple, cabbage palm, sweet gum, hickories; wet tolerant species such as cypress, blackgum and ash found in deeper zone; transitional species commonly landward of the land/water interface.
	Lake fringe marshes	Flatwood/prairie/marsh	any 640-series freshwater wetlands, especially 641 freshwater marshes and 644 emergent aquatic vegetation	Lake marsh, lake fringe marsh, lake littoral zone	Herbaceous emergent vegetation within littoral zone of lake (rushes, bulrushes, beak rushes, fuirena, pickerel weed) , or fringing lake border within high water levels (maidencane, blue maidencane, sedges, composites.
Stillwater, basin or depression wetlands	Cypress ponds/cypress strands, cypress/gum swamps	Cypress dome or basin swamp, gum swamp, cypress/gum slough, swale or strand	621 cypress; 613 gum swamps; 624 cypress-pine-cabbage palm	Cypress swamp, cypress gum swamp, cypress-gum-bay swamp	Cypress and gum swamps are very similar in characteristics and species composition with a shift in dominant species driven primarily by slight differences in fire frequency and hydropattern. Dominant species include cypress, blackgum, loblolly bay, dahoon holly, sweet magnolias and maple.
	Bay swamps	Baygall	611 bay swamps	Seepage swamps, bayheads, sandhill bog	Bay swamps are generally dominated by loblolly bay and sweet magnolia and maple with some red bay mixed with maple, with cypress and blackgum in deeper portions.
	Mixed hardwood swamps	Bottomland forest	617 mixed wetland hardwoods; 630 wetland forested mixed	Swamp forest, wetland hardwood hammocks, freshwater swamp forest	Forested wetlands composed of a large variety of hardwoods with varying degrees of tolerance to hydric conditions. Common species include red maple, oaks, bays, cypress, black gum, sweet gum, ash, hickory and pines.
	Flatwoods/depression marshes	Wet flatwoods, wet prairie, depression marsh	Any 640 series freshwater wetlands, especially 641 freshwater marshes; 643 wet prairie; 644 emergent aquatic vegetation	Hydric flatwood marshes, pine savannahs, marshes, herbaceous wetlands, freshwater marshes	Several common types of depression marshes exist. Although most have a mixture of herbs and grasses, a few species generally dominate (maidencane, pickerel weed, arrowhead, arrowroot, needlerush, bullrush, sawgrass and cattail).

Florida Natural Areas Inventory - Guide to the Natural Communities of Florida

Eighty-one natural communities in Florida are described and classified as Terrestrial, Palustrine, Lacustrine, Riverine, Subterranean, or Marine/Estuarine. Natural communities are defined as distinct and reoccurring assemblages of populations of plants, animals, fungi and microorganisms naturally associated with each other and their physical environment. This classification/inventory is unique in that it describes pristine natural communities without human intervention, providing information on reference condition. For each Natural Community Type brief descriptions of characteristic flora and fauna, physical setting, soil types, hydropattern, fire frequency, associated communities, and development impact are given. Synonyms and comparisons with other vegetation classifications are also reported.

Inland freshwater wetlands are generally classified within the Palustrine Group (Table 2), although 2 Lacustrine types (third level) may be interpreted as wetland (Flatwoods/Prairie/Marsh Lake and River Floodplain/Swamp Lake). FNAI defines palustrine natural communities as freshwater wetlands dominated by plants adapted to anaerobic substrate conditions imposed by substrate saturation or inundation during at least 10% of the growing season. Nineteen wetland types in 4 categories (Wet Flatlands, Seepage Wetlands, Floodplain Wetlands, Basin Wetlands) are classified within the Palustrine Group.

Soil Conservation Service, U.S. Department of Agriculture

Twenty-six vegetative communities are identified from soil series and field studies. Aquatic communities are not included. Ecological communities are described as mature (late successional) and pristine ecosystems. Community specific information includes: 1) Occurrence, 2) Description (typical soil, vegetation, wildlife), 3) Land-use Interpretation (utility as natural land, rangeland, woodland, urban), and 4) Endangered and Threatened Flora and Fauna. Distribution maps identify locations for each community type within Florida.

The report also correlates ecological communities with soil series. Matrices identifying plant species occurrence within climatic zones (North, Central, South, and South Tropical) indicate the species status for each of the 26 ecological community types as either Characterizing (typical or indicative) or Occurring (present). Introduced species are noted. Plant species include: 129 grasses; 41 grass-like sedges and rushes; 127 trees; 470 herbaceous species; 89 vines; and 242 shrubs. From this database, plant species occurrence can be cross-referenced with soils series, climatic zones and ecological community types. Eleven SCS ecological communities are classified as wetland (Table 3).

Table 2. Florida Natural Areas Inventory inland freshwater wetland communities and synonymy (FNAI 1990).

Palustrine

Wet Flatlands

- **Hydric Hammock** (synonyms: wetland hardwood hammock, wet hammock)
- **Marl Prairie** (synonyms: scrub cypress, marl flat, dwarf cypress savanna, sedge flat, spikerush marsh)
- **Wet Flatwoods** (synonyms: low flatwoods, moist pine barren, hydric flatwoods, pond-pine flatwoods, pocosin, cabbage palm/pine savanna/flatwoods)
- **Wet Prairie** (synonyms: sand marsh, savanna, coastal savanna, coastal prairie, pitcher plant prairie)

Seepage Wetlands

- **Baygall** (synonyms: seepage swamp, bayhead, bay swamp)
- **Seepage Slope** (synonyms: herb bog, pitcher plant bog, grass-sedge bog, shrub bog, seep)

Floodplain Wetlands

- **Bottomland Forest** (synonyms: bottomland hardwoods, river/stream bottom, lowland hardwood forest, mesic hammock)
- **Floodplain Forest** (synonyms: bottomland hardwoods, seasonally flooded basins/flats, oak-gum-cypress, river terrace)
- **Floodplain Marsh** (synonyms: river marsh)
- **Floodplain Swamp** (synonyms: river swamp, bottomland hardwoods, seasonally flooded basins/flats, oak-gum-cypress, cypress-tupelo, slough, oxbow, backwater swamp)
- **Freshwater Tidal Swamp** (synonyms: tidewater swamp, rivermouth swamp, sweetbay swamp, tupelo-redbay)
- **Slough**
- **Strand Swamp** (synonyms: cypress strand)
- **Swale** (synonyms: slough, river of grass, glades)

Basin Wetlands

- **Basin Marsh** (synonyms: prairie, freshwater marsh)
- **Basin Swamp** (synonyms: gum swamp, bay, bayhead, swamp)
- **Bog** (synonyms: bog swamp, pocosins, evergreen shrub bogs, wet scrub/shrub, peat islands)
- **Depression Marsh** (synonyms: isolated wetland, flatwoods pond, St. John's wort pond, pineland depression, ephemeral pond, seasonal marsh)
- **Dome Swamp** (synonyms: isolated wetland, cypress dome/pond, gum pond, bayhead, cypress gall)

Lacustrine

- **Flatwoods / Prairie / Marsh Lake** (synonyms: flatwoods pond, ephemeral pond, grass pond, St. John's wort pond, pineland depression, swale, prairie pond)
- **River Floodplain Lake and Swamp Lake** (synonyms: cypress pond, gum pond, backwater pond, blackwater pond)

Table 3. Soil Conservation Service (1981) classification of inland freshwater wetland communities.

10 - Cutthroat Seeps
12 - Wetland Hardwood Hammocks
16 - Scrub Cypress
17 - Cypress Swamp
20 - Bottomland Hardwoods
21 - Swamp Hardwoods
22 - Shrub Bogs - Bay Swamps
23 - Pitcher Plant Bogs
24 – Sawgrass Marsh
25 - Freshwater Marsh
26 - Slough

1 Flatwood categories (6-South, 7-North, and 8-Cabbage Palm) may also include wetland communities dependent upon soil type, elevation, proximity to water table, or wetland definition.

Florida Department of Transportation - Florida Land-use, Cover and Forms Classification System

FLUCCS was developed in 1976 (and modified in 1985) by the Thematic Mapping Section of FDOT to provide a uniform and flexible classification system for use by State agencies. Its model was the US Geological Survey classification system (USGS Circular 671). Classes reflect information obtainable from aerial photographic interpretation and satellite multispectral image analysis. There are 4 hierarchical levels, based on photography scale and image resolution (Level 1 scale 1:500,000 or greater; Level IV scale 1:24,000 or less).

Wetlands (Level I - code 600) are considered areas where the water table is at, near or above the land surface for a significant portion of most years supporting aquatic or hydrophytic vegetation. Twenty-two inland freshwater wetland communities (Level III) are presently described within 5 classes (Level II): 610 Wetland Hardwood Forests; 620 Wetland Coniferous Forest; 630 Wetland Forest Mixed (Scrub); 640 Vegetated Non-Forested Wetlands; and 650 Intermittent Ponds (Table 4). Level IV classifications are indicated for freshwater marshes (641) if 66% or more of the community is comprised of a single species (sawgrass, cattail, spike rush, maidencane, dog fennel/low marsh grasses, arrowroot, giant cutgrass, shrub/vine). Brief community descriptions provide typical plant species and limited density estimates – information used in interpretation and analysis of aerial photography and multi-spectral imaging. Information on wetland geomorphology, hydroperiod, soils, or landscape associations is not included.

Table 4. Florida Land-use, Cover and Forms classification of inland freshwater wetlands (FDOT 1976/1985).

610 - Wetland Hardwood Forests
611 - Bay Swamps
613 - Gum Swamps
614 - Titi Swamps
615 - Stream and Lake Swamps (Bottomland)
616 - Inland Ponds and Sloughs
617 - Mixed Wetland Hardwoods
618 - Willow and Elderberry
619 - Exotic Wetland Hardwood
620 - Wetland Coniferous Forests
621 - Cypress
622 - Pond Pine
623 - Atlantic White Cedar
624 - Cypress - Pine - Cabbage Palm
625 - Hydric Pine Flatwoods
626 - Hydric Pine Savanna
627 - Slash Pine Swamp Forest
630 - Wetland Forested Mixed
631 - Wetland Scrub
640 - Vegetated Non-Forested Wetlands
641 - Freshwater Marshes
643 - Wet Prairies
644 -Emergent Aquatic Vegetation
645 - Submergent Aquatic Vegetation
646 - Treeless Hydric Savanna
653 - Intermittent Ponds

Florida Fish and Wildlife Conservation Commission – Florida Land Cover

Formerly the Florida Game and Freshwater Fish Commission, FWC developed a classification for a Statewide land-cover map developed from Landsat Thematic Mapper data (Kautz et al 1993). Twenty-two land-cover types were identified and mapped for Florida (35% vegetated uplands, 24% wetlands, 42% disturbed). Inland freshwater wetland habitats were classed into 6 land-cover types: Freshwater Marsh/Wet Prairie, Cypress Swamp, Hardwood Swamp, Bay Swamp, Shrub Swamp, and Bottomland Hardwood Swamp (Table 5). Freshwater Marsh and Wet Prairie, occurring mostly in South Florida, were the most abundant wetland vegetation type (38% of wetlands, 7% State land area). Bay Swamp was difficult to distinguish from Hardwood Swamp. Some “natural” community/land-cover types may be interpreted as disturbed land-cover types and vice-versa. Cox et al (1994) provide brief wetland plant community descriptions and tabulations of area cover for wetland types by county.

Table 5. Florida Fish and Wildlife Conservation Commission habitat-community classifications and percent areas for Florida inland freshwater wetland types.

habitat code	wetand habitat / community type	% wetland area	% State area
11	Freshwater marsh and wet prairie	38.17	6.88
12	Cypress swamp	22.57	4.07
13	Hardwood swamp	26.63	4.80
14	Bay swamp	2.22	0.40
15	Shrub swamp	9.01	1.62
17	Bottomland hardwoods	1.40	0.25
	% totals	100.00	18.03

U.S. Fish and Wildlife Service – National Wetlands Inventory

This classification for wetland and deepwater habitats of the United States (Cowardin et al 1979) defines wetlands by plants (hydrophytes), soils (hydric soils) and frequency of flooding. It is hierarchical (Table 6), with the highest level, System, defining general hydro-geomorphic or chemical factors (wetland systems include Riverine, Lacustrine, Palustrine). Subsystems define landscape position (Riverine has 3 – Lower/Upper Perennial and Intermittent; Lacustrine has 2 – Limnetic and Littoral; Palustrine has no subsystem). Within Subsystems, Classes identify substrate, flooding regime (hydropattern), or vegetation form. Florida wetland NWI classes are: Aquatic Bed (dominated by submergent and floating vegetation); Emergent (dominated by emergent herbaceous angiosperms), Scrub-Shrub (dominated by shrubs and small trees); and Forested (tree dominated). Subclass partitions are based on vegetation life form (rooted/floating vascular plants; persistent/non-persistent plants; deciduous/evergreen; needle-leaved/broad-leaved). Only Palustrine Forested classes in Florida have subclasses. The lowest level classification category, subordinate to Subclass, is the Dominance type, defined by dominant plant species and determined by percent area cover.

Palustrine systems include all nontidal wetlands (salinity below 0.5 ppt) dominated by trees, shrubs, or persistent emergents or nonvegetated systems less than 8 ha or a low water depth not exceeding 2m. Representative of the majority wetland types, the Palustrine system includes wetlands situated shoreward of lakes and river channels, on floodplains, in isolated catchments, or on slopes. Wetlands classified within Riverine and Lacustrine systems only include open water classes of Aquatic Bed and Emergent non-persistent vegetation.

Several modifiers are used to more fully describe wetlands and deepwater habitats: Water Regime, Water Chemistry, Soil, and Human Actions. The water regime modifiers have specific utility for wetland characterization, describing the depth, duration and frequency in

Table 6. USFWS National Wetlands Inventory (Cowardin et al 1979) hierarchy of selected inland freshwater wetland types represented in Florida (System, Subsystem, Class, Subclass, Dominance Type).

R – Riverine
w/in channel habitats;
Bounded by uplands or wetlands dominated by trees, shrubs or persistent emergents vegetation.
2 – Lower Perennial
AB – Aquatic Bed
EM – Emergent Marsh (non-persistent)
3 – Upper Perennial
AB – Aquatic Bed

L – Lacustrine
Bounded by upland or wetlands dominated by trees, shrubs or persistent emergent vegetation. (wetland vegetation < 30% coverage)
1 – Limetic -- > 2 m depth at low water
2 – Littoral -- < 2 m depth at low water; all wetlands in Lacustrine System
AB – Aquatic Bed
EM – Emergent Marsh (non-persistent)

P – Palustrine
Non-tidal wetlands dominated by trees, shrubs, persistent emergent vegetation.
AB – Aquatic Bed
EM – Emergent Marsh
SS – Scrub Shrub
FO – Forested
1 – Broad-Leaved Deciduous
2 – Needle-Leaved Deciduous
3 – Broad-Leaved Evergreen
4 – Needle-Leaved Evergreen
6 – *Deciduous*
7 – *Evergreen*

inundation (i.e., hydropattern or hydroperiod). Seven hydroperiods are defined (Table 7), ordered generally from less to more water: Intermittently Flooded, Temporarily Flooded, Saturated, Seasonally Flooded, Semipermanently Flooded, Intermittently Exposed, Permanently Flooded.

The National Wetlands Inventory geographic information database using this classification is available for Florida. Maps were prepared from high altitude aerial photographs and digitally transformed. Wetlands were identified based on vegetation, visible hydrology and geographic location. NWI maps reflect the specific year and season of the photography, as well as interpreter skills and technology limits, affecting the accuracy of wetland locations, boundaries and classifications.

Table 7. National Wetland Inventory water regime modifiers used in classification and mapping of Florida wetland and deepwater habitats (i.e., hydroperiod) (Cowardin et al 1979).

A **Temporarily Flooded** – surface water present for brief periods during growing season, but water table usually lies well below soil surface.

B **Saturated** – substrate saturated at or near surface during growing season, but surface water is seldom present.

C **Seasonally Flooded** – surface water present for extended periods, especially early in growing season, often absent near end; water table often near, at, or above surface.

D - Seasonally Flooded / Well Drained
E - Seasonally Flooded / Saturated

F **Semipermanently Flooded** – surface water persists throughout growing season in most years; water table very near, at, or above surface.

G **Intermittently Exposed** – surface water present throughout year, except in drought years.

H **Permanently Flooded** – surface water always present; vegetation is obligate, hydrophytic.

J **Intermittently Flooded** – exposed substrates with surface water periodically present; do not necessarily have hydric/wetland soils.

K **Artificially Flooded** – amount and duration of surface water controlled by human constructions.

Combined water regime modifiers:
W Intermittently Flooded / Temporary
Y Saturated / Semipermanent / Seasonal
Z Intermittently Exposed / Permanent

NWI identifies 17 classes of inland freshwater wetlands in Florida covering 23% of the landscape (Table 8) (10 Palustrine, 4 Riverine, and 3 Lacustrine). Within Palustrine systems, Forest subsystems in total account for 53% of State wetlands, followed by the Emergent class (34%) and Scrub-Shrub class (11%). Riverine and Lacustrine wetland classes account for less than 3% of State wetland area, but were included here to enable cross-reference with other classification descriptions of Emergent and Aquatic-Bed vegetation associations. Distributional variation of NWI classes within the 4 proposed wetland regions of Florida is discussed later in the context of bioassessment classes.

Table 8. U.S. Fish and Wildlife Service National Wetlands Inventory (NWI) classifications (Cowardin et al 1979) and percent areas for Florida inland freshwater wetlands.

NWI code	Wetland class description	% wetland area	% state area
R 2 AB	Riverine, Lower Perennial, Aquatic Bed	0.07	0.01
R 2 EM	Riverine, Lower Perennial, Emergent, non-persistent	0.00	0.00
R 3 AB	Riverine, Upper Perennial, Aquatic Bed	0.00	0.00
R 4 SB	Riverine, Intermittent, Streambed	0.00	0.00
L 1 AB	Lacustrine, Limnetic, Aquatic Bed	0.04	0.01
L 2 AB	Lacustrine, Littoral, Aquatic Bed	1.28	0.29
L 2 EM	Lacustrine, Littoral, Emergent, non-persistent	0.03	0.01
P AB 3	Palustrine, Aquatic Bed, Rooted Vascular	0.60	0.14
P AB 4	Palustrine, Aquatic Bed, Floating Vascular	0.15	0.03
P EM	Palustrine, Emergent	34.17	7.71
P SS	Palustrine, Scrub Shrub	11.18	2.52
P FO 1	Palustrine, Forested, Broad-Leaved Deciduous	5.74	1.30
P FO 2	Palustrine, Forested, Needle-Leaved Deciduous	8.58	1.94
P FO 3	Palustrine, Forested, Broad-Leaved Evergreen	4.92	1.11
P FO 4	Palustrine, Forested, Needle-Leaved Evergreen	10.78	2.43
P FO 6	Palustrine, Forested, Deciduous (mixed)	0.01	0.00
P FO 7	Palustrine, Forested, Evergreen (mixed)	22.44	5.06
		100.00	
% NWI inland freshwater wetlands			22.55
% upland area			63.00
% other (estuarine) wetlands and deepwater habitats			14.44
state total area			100.00

Other Classification Systems

Ecosystems of Florida (Myer and Ewel 1990)
Thirteen inland freshwater forested wetland types (Swamps) are described by Ewel (1990): River Swamps (Whitewater Floodplain Forest, Blackwater Floodplain Forest, and Spring Run Swamp); and Stillwater Swamps (Bay Swamp, Cypress Pond, Cypress Savanna, Cypress Strand, Gum Pond, Hydric Hammock, Lake Fringe Swamp, Melaleuca Swamp, Mixed Hardwood Swamp, and Shrub Bog). Environmental variables determining structure and function of swamps are described (hydroperiod, fire frequency, organic matter accumulation, and water source). Common woody plants, productivity and nutrient estimates, wildlife occurrence and changes/impacts are inventoried or described for each swamp type. A comparison is given with NWI classes and modifiers (water regime, pH, and soil). An inverse relationship between hydroperiod and plant species richness is proposed, with River Swamps and Hydric Hammocks having greater number of species than Bay Swamps or Cypress/Gum Ponds for example. Swamp productivity is shown to generally increase as groundwater and surface flow become more important water sources than direct rainfall.

Inland freshwater herbaceous wetlands (Marshes) are classified by Kushlan (1990) according to general physiognomy or by characteristic plants. Marsh distribution is explained using local and regional topography, rainfall, evapotranspiration, and geology. Five major Marsh Systems are described for Florida, from higher to lower elevation: Highland, Flatwoods, Kissimmee, St. Johns and Everglades. Six Marsh Associations are described using dominant plant species, hydroperiod, fire frequency and organic matter accumulation: Water Lily, Submersed, Cattail, Flag, Saw Grass, and Wet Prairie. Predominant marsh plant associations are identified within major marsh systems (regions).

The Nature Conservancy
An alliance-level classification of vegetation of the Southeastern United States includes multiple hierarchical levels: Division (vegetated, non-vegetated); Order (dominant vegetation form – trees, shrubs, herbaceous-vascular, non-vascular); Class (cover, density estimates – canopy, crown, height class); Subclass (dominant life form - evergreen, deciduous, perennial, annual, mixed); Group (lifezone - temperate, subtropical, tropical); Subgroup (use history – natural, planted, cultivated); and Formation (hydropattern, drought/temperature tolerance, vegetation habit). Alliances are defined using dominant plant species or vegetation associations. Descriptors include successional sere and soil type. An estimated 256 vegetation alliances are identified for Florida.

Lake County Water Authority/Seminole County
A simple dichotomous key for wetland classification using easily identifiable characteristics applied to summer and winter seasons results in 4 forested wetlands (Cypress Swamp, Hydric Hammock, Bayhead, Hardwood Swamp) and 3 herbaceous wetlands (Deep Marsh, Shallow Marsh, Wet Prairie). Typical flora and fauna are described by LCWA. Quantitative information on water quality (P/N removal),

evapotranspiration, hydroperiod, high/low water levels, recharge potential, peat depth, wildlife utilization and gross primary productivity is given in Brown et al (1983).

Hydrogeomorphic Wetland Classification - U.S. Army Corps of Engineers

Developed through the Waterways Experiment Station, the hydrogeomorphic classification approach for wetlands emphasizes external and independent controls that maintain ecosystem functions (Brinson 1993). Thus maintenance of wetland functions is inferred from provision of local hydrogeomorphic controls. Function refers to processes that are necessary for the self-maintenance of an ecosystem. Because biological integrity addresses both community structure (species composition) and ecosystem processes (function), several wetland classification developed for biological assessments have been based on the HGM functional approach.

Three determinants are used to define wetland class:

1) geomorphology (topographic position and landscape association);
2) water source (precipitation, surface water, groundwater); and
3) hydrodynamics (direction and strength of flow).

First order HGM classes are discriminated by geomorphic settings (Riverine, Depressional, Lake Fringe, Slope, and Flats), and further categorized by dominant hydrologic aspects. Synonyms and descriptions from other classifications are compared with HGM regional classes (Table 9). Regional subclasses can be identified to discriminate classes based on climatic, geographic and other external functions. HGM classification, however, is not designed to discriminate vegetative associations and species compositions. Thus, at the subclass level community descriptions can be employed from other classification systems and based on field inventories to further subdivide wetland types.

Development of ecoregions is necessary for consideration of biogeographic aspects such as species distributions. HGM models for Florida, developed by The U.S. Army Corps of Engineers Waterways Experiment Station, divide Florida into 2 regions: Panhandle and Peninsula. Each regional class is subdivided into Herbaceous and Forested subclasses. As an example, the HGM Peninsular-Florida-Depression wetland class is compared with other classifications (Table 10).

The coarse resolution of HGM functional classes does not distinguish all wetland ecosystem types within a region, and all HGM classes are not necessarily represented within regions or States. Five geomorphic settings may not be distinct, or it may not be possible to identify dominant hydrologic characteristics. In Florida, the HGM class Flats is not readily discriminated from Depression or Slope classes, and several water sources may exist for a wetland type. The classification is designed as a generic approach that defines broad functional classes according to independent physical conditions that determine wetland attributes. As such, the HGM approach provides a uniform and scientific organizing framework for wetland classification.

Table 9. Geomorphic landscape position, water source and directional flow for HGM classes (adapted from Brinson 1993 and Trott et al 1997), with examples of wetlands named from other Florida classification systems (FLUCCS, GFC, FNAI).

Geomorphology	Water Source (dominant)	Hydrodynamics (dominant)	Plant Community Type: Forested	Herbaceous
Riverine marsh	Channel, overbank	Horizontal unidirectional	Bottomland hardwood	Maidencane
Depressional	Groundwater, surface	Vertical, bidirectional	Cypress/Gum	Basin marsh
Lake fringe	lacustrine, overbank	Horizontal, bidirectional	Mixed hardwood	Emergent marsh
Slope	Groundwater	Horizontal, unidirectional	Baygall	Seepage bogs
Organic flats	Precipitation	Vertical	Hydric savanna	Sawgrass marsh
Mineral flats	Precipitation	Vertical	Wet flatwoods	Wet, marl prairies

Table 10. Comparison of wetland classification nomenclature with HGM Peninsular-Florida-Depression wetland class (adapted from Trott et al. 1997).

Classification System	Code - Wetland (Community) Types
Herbaceous-Depression	
FNAI	Depression Marsh
	Basin Marsh
SCS	25 – Freshwater Marsh
FLUCCS	641 – Freshwater Marshes
	644 – Emergent Aquatic Vegetation
FWC	11 – Freshwater Marsh and Wet Prairie
NWI	PEM – Palustrine-Emergent Wetland
Forest-Depression	
FNAI	Dome Swamp
	Basin Swamp
	Bog
SCS	17 – Cypress Swamp
	22 – Shrub Bogs, Bay Swamps
FLUCCS	616 – Inland Ponds and Sloughs
	621 – Cypress
	613 – Gum Swamps
FWC	12 – Cypress Swamp
	13 – Hardwood Swamp
	15 – Shrub Swamp
NWI	PFO – Palustrine-Forested Wetland

Classification Crosswalks

State and Federal wetland classifications are cross-referenced, comparing wetland types and descriptions between systems. An effort was made to be inclusive rather than restrictive in the comparisons. Therefore, wetland types from different classification approaches with similar keying characters were linked as well as wetland types that had possible associations based on broad and general descriptions or limited information. Wetland nomenclature was 'best fit' to corresponding wetlands named in other classifications. Two outcomes came of this: a single class or community type often fit more than one wetland description in another system; and some cross-references although weak were more similar than dissimilar. In addition, some ecosystem types only marginally met generalized wetland criteria but were included to provide cross-reference to like ecosystems identified in other classifications as wetland (partial characterizations included descriptions of hydrophytes, hydric soils, hydroperiods, and landscape position).

It follows that the resolution of cross-references made here is coarse with varying degrees of reliability. Crosswalks are designed to: 1) facilitate comparisons between goal specific classification approaches; 2) identify common nomenclature; 3) relate wetland typology to State databases; 4) utilize organizational and descriptive strengths of existing methods; and 5) provide a framework for wetland regionalization and classifications necessary for biological assessments. Inland freshwater wetlands from 5 Florida classifications are compared:

FNAI (1990) Guide to the Natural Communities of Florida (Table 11);
SCS (1981) 26 Ecological Communities of Florida (Table 12)
FDOT (1976/1985) Florida Land-use, Cover and Forms Classification (Table 13)
FWC Florida Landcover (Kautz et al 1993) (Table 14)
USFWS National Wetlands Inventory (Cowardin et al 1979) (Table 15).

An HTML formatted database links classification nomenclature. This allows users to quickly identify wetland synonyms and provides cross-reference for common approaches and the proposed wetland bioassessment classification.

Because each classification approach was designed within specific agency goals, no cross-references are uniform. General trends are evident (Table 16). Total number of possible cross-references increased (from 80 to 160) as the number of classes increased within a classification system (from 7 to 22). Mean number of cross-references per wetland type decreased with increasing number of classes (between 2 and 3 references per class). Tables 17-21 identify frequency and numbers of cross-references for each classification. Wetlands with high numbers of cross-references include: FWC-Freshwater Marsh and Wet Prairie, Bottomland Hardwood, Pinelands; SCS-Bottomland Hardwood, Swamp Hardwood, Freshwater Marsh; NWI-Emergent, Scrub Shrub, Broad-leaved Deciduous, Needle-leaved Deciduous, Forested-mixed (19); FNAI-Floodplain Forest, Dome Swamp; and FLUCCS-Cypress, Freshwater Marsh, Wet Prairie, Emergent Aquatic Vegetation. This indicates agreement on wetland description between classifications and/or generality in nomenclature.

Proposed Wetland Classification Approach for Biological Assessment

Appropriate consideration of the factors necessary to create homogenous sets for comparing biological condition requires the identification of wetland classes within ecological regions. A tiered and aggregated wetland classification system is presented here that is referenced to preliminary wetland ecoregions and cross-referenced to other classifications used in Florida. The proposed system is a product of several complementary efforts: a literature review on classification methods; cross-referencing of Florida wetland classifications; field trials and visits to typical wetland communities; and consultation with FDEP personnel associated with past efforts and current applications.

Table 11. Florida Natural Areas Inventory inland freshwater wetland communities and classification cross-reference.

FNAI	SCS	FLUCCS	FWC	NWI
Palustrine				
Wet Flatlands				
Hydric Hammock	21-Swamp Hardwood	617	13	PFO6
Marl Prairie	16-Scrub Cypress	621, 641, 643	11	PEM, PFO2
Wet Flatwoods	6-7-N/S Florida Flatwoods		3	PFO4, PFO7
Wet Prairie	25-Freshwater Marsh, 23-Pitcher Plant Bog	310, 643	11	PEM
Seepage Wetlands				
Baygall	22-Shrub Bog/Bay Swamp	611, 614	14	PFO3, PFO7
Seepage Slope	23-Pitcher Plant Bog, 12-Wetland Hardwood Hammock	310, 614, 643	11, 15	PEM, PSS
Floodplain Wetlands				
Bottomland Forest	20-Bottomland Hardwood	615, 617, 623, 630	17	PFO1
Floodplain Forest	20-Bottomland Hardwood, 21-Swamp Hardwood	615, 617, 618, 619, 630	17	PFO1, PFO2
Floodplain Marsh	25-Freshwater Marsh	641, 643, 644	11	PEM, R2EM, L2EM, R4SB
Floodplain Swamp	20-Bottomland Hardwood, 17-Cypress Swamp	613, 615, 621	17	PFO1, PFO2
Freshwater Tidal Swamp	20-Bottomland Hardwood	613, 615, 621, 623, 624	12	PFO6, PFO7
Slough	26-Slough	621	12	PFO2, PFO6
Strand Swamp	16-Scrub Cypress, 17-Cypress Swamp	621, 618, 619	12	PFO2
Swale	24-Sawgrass Marsh	641, 643	11	PEM
Basin Wetlands				
Basin Marsh	25-Freshwater Marsh	641, 643, 644	11	PEM, PAB
Basin Swamp	17-Cypress Swamp, 12-Wetland Hardwood Hammock	613, 616, 617, 621	13, 14	PFO6
Bog	22-Shrub Bog/Bay Swamp	310, 614, 618, 619, 630	15	PSS
Depression Marsh	25-Freshwater Marsh	641, 644, 653	11	PEM, PAB
Dome Swamp	17-Cypress Swamp, 12-Wetland Hardwood Hammock	613, 616, 621	12, 13, 14	PFO2, PFO3, PFO6
Lacustrine				
Flatwoods/Prairie/Marsh Lake	25-Freshwater Marsh	641, 643, 644	11	L2EM, PEM
River Floodplain Lake/Swamp Lake	20-Bottomland Hardwood	615, 645	11, 17	R2AB, R3AB, L1AB, L2AB

Table 12. Soil Conservation Service inland freshwater wetland communities and classification cross-reference.

SCS	FNAI	FLUCCS	FWC	NWI
8 Cabbage Palm Flatwoods		624-Cypress-Pine-Cabbage Palm		
10 Cutthroat Seep			3	PEM, PSS
12 Wetland Hardwood Hammock	Seepage Slope, Basin Swamp, Dome Swamp	617-Mixed Wetland Hardwood, 613-Gum Swamp	13	PFO1,PFO6
16 Scrub Cypress	Strand Swamp, Marl Prairie	621-Cypress	12	PFO2
17 Cypress Swamp	Dome Swamp, Floodplain Swamp, Strand Swamp, Basin Swamp	621-Cypress	12	PFO2, PFO6
20 Bottomland Hardwood	Bottomland Forest, Floodplain Forest, Floodplain Swamp, Freshwater Tidal Swamp, River Floodplain Lake/Swamp Lake	615-Stream/Lake Swamp, 622-Pond Pine, 623-Atlantic White Cedar	17	PFO1, PFO6
21 Swamp Hardwood	Hydric Hammock, Flooplain Forest	613-Gum Swamp, 618-Willow/Elderberry, 619-Exotic Wetland Hardwood, 623-Atlantic White Cedar, 624-Cypress-Pine-Cabbage Palm	13, 17	PFO1, PFO6
22 Shrub Bog, Bay Swamp	Baygall, Bog	611-Bay Swamp, 614-Titi Swamp, 618-Willow/Elderberry, 619-Exotic Wetland Hardwood	14, 15	PFO3, PFO7
23 Pitcher Plant Bog	Seepage Slope, Wet Prairie	643-Wet Prairie	11	PEM, PSS
24 Sawgrass Marsh	Swale	641-Freshwater Marsh, 644-Emergent Aquatic Vegetation	11	PEM
25 Freshwater Marsh	Basin Marsh, Depression Marsh, Floodplain Marsh, Wet Prairie, Flatwoods/Prairie/Marsh Lake	641-Freshwater Marsh, 643-Wet Prairie, 644-Emergent Aquatic Vegetation, 645-Submergent Aquatic Vegetation, 653-Intermittent Ponds	11	PEM, R2AB, R2EM, R3AB, R4SB, L1AB, L2AB, L2EM, PAB3, PAB4, PSS
26 Slough	Slough	616-Inland Ponds and Sloughs, 653-Intermittent Ponds, 646-Treeless Hydric Savanna	11, 15	PEM
6,7 N, S Florida Flatwoods	Wet Flatwoods	625-Hydric Pine Flatwoods, 622-Pond Pine, 626-Hydric Pine Savanna, 646-Treeless Hydric Savanna, 627- Slash Pine Swamp Forest	3	PFO4, PFO7

Table 13. Florida Land-use, Cover and Forms inland freshwater wetland classes and classification cross-reference.

FLUCCS	FNAI	SCS	FWC	NWI
610 - *Wetland Hardwood Forests*				
611 - Bay Swamps	Baygall	22-Shrub Bog/Bay Swamp	14	PFO3, PFO6
613 - Gum Swamps	Basin Swamp, Dome Swamp, Floodplain Swamp, Freshwater Tidal Swamp, River Floodplain/Swamp	21-Swamp Hardwood, 12-Wetland Hardwood Hammock	13	PFO1, PFO6
614 - Titi Swamps	Seepage Slope, Bog, Baygall	22-Shrub Bog/Bay Swamp	15	PFO1, PFO6
615 - Stream and Lake Swamps (Bottomland)	Bottomland Forest, Floodplain Forest, Floodplain Swamp, Freshwater Tidal Swamp, River Floodplain Lake/Swamp Lake	20-Bottomland Hardwood	17	
616 - Inland Ponds and Sloughs	Basin Swamp, Dome Swamp	26-Slough	13	PSS, PFO1, PFO6
617 - Mixed Wetland Hardwoods	Hydric Hammock, Bottomland Forest, Floodplain Forest, Basin Swamp	12-Wetland Hardwood Hammock	13	PFO1, PFO6
618 - Willow and Elderberry	Bog, Slough, Floodplain Forest	22-Shrub Bog/Bay Swamp, 21-Swamp Hardwood	15	PSS, PFO1, PFO6
619 - Exotic Wetland Hardwood	Bog, Slough, Floodplain Forest	22-Shrub Bog/Bay Swamp, 21-Swamp Hardwood	15	PSS, PFO6
620 - *Wetland Coniferous Forests*				
621 - Cypress	Dome Swamp, Basin Swamp, Strand Swamp, Floodplain Swamp, Marl Prairie	16-Scrub Cypress, 17-Cypress Swamp	12	PFO2, PFO6
622 - Pond Pine	Wet Flatwoods	6-7-N/S Florida Flatwoods, 20-Bottomland Hardwood	3	PFO4, PFO7
623 - Atlantic White Cedar	Bottomland Forest, Freshwater Tidal Swamp	20-Bottomland Hardwood, 21-Swamp Hardwood	17	PFO4, PFO7
624 - Cypress - Pine - Cabbage Palm	Wet Flatwoods, Freshwater Tidal Swamp	8-Cabbage Palm Flatwoods, 21-Swamp Hardwood	17	PFO6, PFO7
625 - Hydric Pine Flatwoods	Wet Flatwoods	6-7-N/S Florida Flatwoods	3	PFO4
626 - Hydric Pine Savanna	Wet Flatwoods	7-S Florida Flatwoods	3	PFO4
627 - Slash Pine Swamp Forest	Wet Flatwoods	6-7-N/S Florida Flatwoods	3	PFO4
630 - *Wetland Forested Mixed*				
631 - Wetland Scrub	Bog, Wet Flatwoods, Bottomland Forest, Floodplain Forest, Flatwoods/Prairie/Marsh Lake	22-Shrub Bog/Bay Swamp	15	PSS
640 - *Vegetated Non-Forested Wetlands*				
641 - Freshwater Marshes	Basin Marsh, Depression Marsh, Swale, Marl Prairie, Flatwoods/Prairie/Marsh Lake	25-Freshwater Marsh, 24-Sawgrass Marsh	11	PEM, R2EM, R4SB, L2EM
643 - Wet Prairies	Wet Prairie, Marl Prairie, Seepage Slope, Swale, Basin Marsh, Flatwwoods/Prairie/Marsh Lake	23-Pitcher Plant Bog, 25-Freshwater Marsh	11	PEM, R2EM, R4SB, L2EM
644 - Emergent Aquatic Vegetation	Basin Marsh, Depression Marsh, Floodplain Marsh, Flatwoods/Prairie/Marsh Lake	25-Freshwater Marsh, 24-Sawgrass Marsh	11	R2AB, R3AB, L1AB, L2AB, PAB3, PAB4
645 - Submerged Aquatic Vegetation	River Floodplain Lake/Swamp Lake	25-Freshwater Marsh	11	R2AB, R3AB, L1AB, L2AB, PAB3
646 - Treeless Hydric Savanna	Wet Flatwoods	26-Slough	3, 11	PFO4
653 - Intermittent Ponds	Depression Marsh	25-Freshwater Marsh, 26-Slough	11	PEM1, PUB4

Table 14. Florida Fish and Wildlife Conservation Service inland freshwater wetland habitats and classification cross-reference.

FWC	FNAI	SCS	FLUCCS	NWI
11 Freshwater Marsh and Wet Prairie	Basin Marsh, Depression Marsh, Wet Prairie, Floodplain Marsh, Swale, Marl Prairie, Seepage Slope, Flatwoods/Prairie/Marsh Lake, River Floodplain Lake/Swamp Lake	25-Freshwater Marsh, 24-Sawgrass Marsh, 26-Slough, 23-Pitcher Plant Bog	641, 643, 644, 645, 646, 653	L1AB, L2AB, L2EM, R1AB, R1EM, R2AB, R2EM, R3AB, R4SB, PAB, PEM
12 Cypress Swamp	Dome Swamp, Slough, Strand Swamp, Freshwater Tidal Swamp	16-Scrub Cypress, 17-Cypress Swamp	621	PFO2
13 Hardwood Swamp	Basin Swamp, Bottomland Forest, Hydric Hammock	12-Wetland Hardwood Hammock, 21-Swamp Hardwood	613, 616, 617	PFO6
14 Bay Swamp	Baygall	22-Shrub Bog/Bay Swamp	611	PFO3, PFO7
15 Shrub Swamp	Bog, Seepage Slope (Titi Bog),	22-Shrub Bog/Bay Swamp, 26-Slough	614, 618, 619, 631	PSS
17 Bottomland Hardwood	Bottomland Forest, Floodplain Forest, Floodplain Swamp, River Floodplain Lake/Swamp Lake	20-Bottomland Hardwood, 21-Swamp Hardwood	615, 623, 624	PFO1
3 Pinelands	Wet Flatwoods	6-7-N/S Florida Flatwoods, 10-Cutthroat Seeps	622, 625, 626, 627, 646	PFO4, PFO7

Table 15. USFWS National Wetland Inventory inland freshwater wetland systems and classification cross-reference.

NWI	FNAI	SCS	FLUCCS	FWC
R2AB Riverine, Lower Perennial, Aquatic Bed		25-Freshwater Marsh	644, 645	11
R2EM Riverine, Lower Perennial, Emergent, non-persistent	Floodplain Marsh	25-Freshwater Marsh	641, 643	11
R3AB Riverine, Upper Perennial, Aquatic Bed	River Floodplain Lake/Swamp Lake	25-Freshwater Marsh	644, 645	11
R4SB Riverine, Intermittent, Streambed	Floodplain Marsh	25-Freshwater Marsh	641, 643	11
L1AB Lacustrine, Limnetic, Aquatic Bed	River Floodplain Lake/Swamp Lake	25-Freshwater Marsh	644, 645	11
L2AB Lacustrine, Littoral, Aquatic Bed	River Floodplain Lake/Swamp Lake	25-Freshwater Marsh	644, 645	11
L2EM Lacustrine, Littoral, Emergent, non-persistent	Floodplain Marsh, Flatwoods/Prairie/Marsh Lake	25-Freshwater Marsh	641, 643	11
PAB3 Palustrine, Aquatic Bed, Rooted Vascular	Depression Marsh, Basin Marsh	25-Freshwater Marsh	644, 645	11
PAB4 Palustrine, Aquatic Bed, Floating Vascular	Depression Marsh	25-Freshwater Marsh	644	11
PEM Palustrine, Emergent	Depression Marsh, Basin Marsh, Floodplain Marsh, Wet Prairie, Marl Prairie, Seepage Slope, Swale, Flatwoods/Prairie/Marsh Lake	25-Freshwater Marsh, 24-Sawgrass Marsh, 23-Pitcher Plant Bog	641, 643, 653	11
PSS Palustrine, Scrub Shrub	Bog, Seepage Slope	25-Freshwater Marsh, 23-Pitcher Plant Bog, 10-Cutthroat Seep	614, 616, 618, 619, 631	15
PFO1 Palustrine, Forested, Broad-Leaved Deciduous	Bottomland Forest, Floodplain Forest, Floodplain Swamp	12-Wetland Hardwood Hammock, 21-Swamp Hardwood, 20-Bottomland Hardwood	613, 614, 615, 616, 617	17
PFO2 Palustrine, Forested, Needle-Leaved Deciduous	Dome Swamp, Strand Swamp, Basin Swamp, Floodplain Forest, Floodplain Swamp, Slough, Marl Prairie	16-Cypress Scrub, 17-Cypress Swamp	621	12
PFO3 Palustrine, Forested, Broad-Leaved Evergreen	Baygall, Dome Swamp	22-Shrub Bog/Bay Swamp	611	14
PFO4 Palustrine, Forested, Needle-Leaved Evergreen	Wet Flatwoods	6-7-N/S Florida Flatwoods	622, 623, 625, 626, 627, 646	3
PFO6 Palustrine, Forested, Deciduous (mixed)	Hydric Hammock, Slough, Basin Swamp, Dome Swamp, Freshwater Tidal Swamp	12-Wetland Hardwood Hammock, 21-Swamp Hardwood, 20-Bottomland Hardwood, 17-Cypress Swamp	611, 613, 614, 615, 616, 617, 619, 621, 624	13
PFO7 Palustrine, Forested, Evergreen (mixed)	Wet Flatwoods, Baygall, Freshwater Tidal Swamp	6-7-N/S Florida Flatwoods, 22-Shrub Bog/Bay Swamp	622, 623, 624	14

Table 16 Classification crosswalk summaries: (tot) number of cross-references per wetland class; (avg) mean number of cross-references per classification for each wetland class.

FWC	tot	avg	SCS	tot	avg	NWI	tot	avg
11 Freshwater Marsh and Wet Prairie	30	7.5	10-Cutthroat Seep	5	1.3	R2AB Riverine, Lower Perennial, Aquatic Bed	4	1.0
12 Cypress Swamp	8	2.0	12-Wetland Hardwood Hammock	8	2.0	R2EM Riverine, Lower Perennial, Emergent, non-persistent	5	1.3
13 Hardwood Swamp	9	2.3	16-Scrub Cypress	5	1.3	R3AB Riverine, Upper Perennial, Aquatic Bed	5	1.3
14 Bay Swamp	5	1.3	17-Cypress Swamp	7	1.8	R4SB Riverine, Intermittent, Streambed	5	1.3
15 Shrub Swamp	9	2.3	20-Bottomland Hardwood	10	2.5	L1AB Lacustrine, Limnetic, Aquatic Bed	5	1.3
17 Bottomland Hardwood	10	2.5	21-Swamp Hardwood	10	2.5	L2AB Lacustrine, Littoral, Aquatic Bed	5	1.3
3 Pinelands	10	2.5	22-Shrub Bog, Bay Swamp	9	2.3	L2EM Lacustrine, Littoral, Emergent, non-persistent	6	1.5
			23-Pitcher Plant Bog	6	1.5	PAB3 Palustrine, Aquatic Bed, Rooted Vascular	6	1.5
number of wetland types:		**7**	24-Sawgrass Marsh	5	1.3	PAB4 Palustrine, Aquatic Bed, Floating Vascular	4	1.0
tot. no.of cross-references:		**81**	25-Freshwater Marsh	22	5.5	PEM Palustrine, Emergent	15	3.8
mean no. cross-references per type:		**2.9**	26-Slough	7	1.8	PSS Palustrine, Scrub Shrub	11	2.8
			6-7-N, S Florida Flatwoods	4	1.0	PFO1 Palustrine, Forested, Broad-Leaved Deciduous	12	3.0
						PFO2 Palustrine, Forested, Needle-Leaved Deciduous	11	2.8
			number of wetland types:		**12**	PFO3 Palustrine, Forested, Broad-Leaved Evergreen	5	1.3
			tot. no.of cross-references:		**98**	PFO4 Palustrine, Forested, Needle-Leaved Evergreen	9	2.3
			mean no. cross-references per type:		**2.0**	PFO6 Palustrine, Forested, *Deciduous* (mixed)	19	4.8
						PFO7 Palustrine, Forested, *Evergreen* (mixed)	9	2.3
						number of wetland types:		**17**
						tot. no.of cross-references:		**136**
						mean no. cross-references per type:		**2.0**

Table 16. – continued. Classification crosswalk summaries: (tot) number of cross-references per wetland class; (avg) mean number of cross-references per classification for each wetland class.

FNAI	tot	avg	FLUCCS	tot	avg
Hydric Hammock	4	1.0	611 - Bay Swamps	5	1.3
Marl Prairie	6	1.5	613 - Gum Swamps	10	2.5
Wet Flatwoods	5	1.3	614 - Titi Swamps	7	1.8
Wet Prairie	6	1.5	615 - Stream and Lake Swamps	7	1.8
Baygall	6	1.5	616 - Inland Ponds and Sloughs	7	1.8
Seepage Slope	9	2.3	617 - Mixed Wetland Hardwoods	8	2.0
Bottomland Forest	7	1.8	618 - Willow and Elderberry	8	2.0
Floodplain Forest	10	2.5	619 - Exotic Wetland Hardwood	8	2.0
Floodplain Marsh	9	2.3	621 - Cypress	11	2.8
Floodplain Swamp	8	2.0	622 - Pond Pine	6	1.5
Freshwater Tidal Swamp	9	2.3	623 - Atlantic White Cedar	7	1.8
Slough	5	1.3	624 - Cypress - Pine - Cabbage Palm	7	1.8
Strand Swamp	7	1.8	625 - Hydric Pine Flatwoods	4	1.0
Swale	5	1.3	626 - Hydric Pine Savanna	4	1.0
Basin Marsh	9	2.3	627 - Slash Pine Swamp Forest	4	1.0
Basin Swamp	9	2.3	631 - Wetland Scrub	9	2.3
Bog	8	2.0	641 - Freshwater Marshes	12	3.0
Depression Marsh	7	1.8	643 - Wet Prairies	11	2.8
Dome Swamp	11	2.8	644 - Emergent Aquatic Vegetation	13	3.3
Flatwoods/Prairie/Marsh Lake	7	1.8	645 - Submergent Aquatic Vegetation	8	2.0
River Floodplain Lake/Swamp Lake	9	2.3	646 - Treeless Hydric Savanna	5	1.3
			653 - Intermittent Ponds	6	1.5
number of wetland types:		**21**			
tot. no.of cross-references:		**156**	number of wetland types:		**22**
mean no. cross-references per type:		**1.9**	tot. no.of cross-references:		**167**
			mean no. cross-references per type:		**1.9**

Table 17. Florida Natural Areas Inventory crosswalk summary.

FNAI	no. cross-references per wetland class: SCS	FLUCCS	FWC	NWI
Hydric Hammock	1	1	1	1
Marl Prairie	1	3	1	2
Wet Flatwoods	1		1	2
Wet Prairie	2	2	1	1
Baygall	1	2	1	2
Seepage Slope	2	3	2	2
Bottomland Forest	1	4	1	1
Floodplain Forest	2	5	1	2
Floodplain Marsh	1	3	1	4
Floodplain Swamp	2	3	1	2
Freshwater Tidal Swamp	1	5	1	2
Slough	1	1	1	2
Strand Swamp	2	3	1	1
Swale	1	2	1	1
Basin Marsh	1	3	1	2
Basin Swamp	2	4	2	1
Bog	1	5	1	1
Depression Marsh	1	3	1	2
Dome Swamp	2	3	3	3
Flatwoods/Prairie/Marsh Lake	1	3	1	2
River Floodplain Lake/Swamp Lake	1	2	2	4

no. times class is cross-referenced:	no. classes cross-referenced:			
1	3	5	1	9
2	4	5	2	2
3	1	3	1	2
4	2	3	2	
5	1	1		2
> 5		3		1

Table 18. Soil Conservation Service crosswalk summary.

SCS	no. cross-references per wetland class: FNAI	FLUCCS	FWC	NWI
10-Cutthroat Seep	1		1	2
12-Wetland Hardwood Hammock	3	2	1	2
16-Scrub Cypress	2	1	1	1
17-Cypress Swamp	4	1	1	1
20-Bottomland Hardwood	5	3	1	1
21-Swamp Hardwood	2	5	2	1
22-Shrub Bog, Bay Swamp	2	4	2	1
23-Pitcher Plant Bog	2	1	1	2
24-Sawgrass Marsh	1	2	1	1
25-Freshwater Marsh	5	5	1	11
26-Slough	1	3	2	1
6-7-N, S Florida Flatwoods	1	8	1	2

no. times class is cross-referenced:	no. classes cross-referenced:			
1	14	14		9
2	7	9	5	3
3				1
4			1	1
5				1

Table 19. Florida Land-use, Cover and Forms crosswalk summary.

FLUCCS	no. cross-references per wetland class: FNAI	SCS	FWC	NWI
611 - Bay Swamps	1	1	1	2
613 - Gum Swamps	5	2	1	2
614 - Titi Swamps	3	1	1	2
615 - Stream and Lake Swamps	5	1	1	
616 - Inland Ponds and Sloughs	2	1	1	3
617 - Mixed Wetland Hardwoods	4	1	1	2
618 - Willow and Elderberry	2	2	1	3
619 - Exotic Wetland Hardwood	3	2	1	2
621 - Cypress	6	2	1	2
622 - Pond Pine	1	2	1	2
623 - Atlantic White Cedar	2	2	1	2
624 - Cypress - Pine - Cabbage Palm	2	2	1	2
625 - Hydric Pine Flatwoods	1	1	1	1
626 - Hydric Pine Savanna	1	1	1	1
627 - Slash Pine Swamp Forest	1	1	1	1
631 - Wetland Scrub	6	1	1	1
641 - Freshwater Marshes	5	2	1	4
643 - Wet Prairies	5	2	1	4
644 - Emergent Aquatic Vegetation	4	2	1	6
645 - Submergent Aquatic Vegetation	1	1	1	5
646 - Treeless Hydric Savanna	1	1	2	1
653 - Intermittent Ponds	1	2	1	2

no. times class is cross-referenced:	no. classes cross-referenced:			
1	5	2	2	2
2	4	3		5
3	6	1	2	2
4	5	1	1	1
5		3	1	1
> 5			1	1

Table 20. Florida Fish and Wildlife Conservation crosswalk summary.

FWC	no. cross-references per wetland class: FNAI	SCS	FLUCCS	NWI
11-Freshwater Marsh and Wet Prairie	9	4	6	11
12-Cypress Swamp	4	2	1	1
13-Hardwood Swamp	3	2	3	1
14-Bay Swamp	1	1	1	2
15-Shrub Swamp	2	2	4	1
17-Bottomland Hardwood	4	2	3	1
3-Pinelands	1	2	5	2

no. times class is cross-referenced:	no. classes cross-referenced:			
1	18	9	20	17
2	3	2	1	1

Table 21. National Wetlands Inventory crosswalk summary.

SCS	no. cross-references per wetland class: FNAI	SCS	FLUCCS	FWC
R2AB Riverine, Lower Perennial, Aquatic Bed		1		1
R2EM Riverine, Lower Perennial, Emergent, non-persistent	1	1	2	1
R3AB Riverine, Upper Perennial, Aquatic Bed	1	1	2	1
R4SB Riverine, Intermittent, Streambed	1	1	2	1
L1AB Lacustrine, Limnetic, Aquatic Bed	1	1	2	1
L2AB Lacustrine, Littoral, Aquatic Bed	1	1	2	1
L2EM Lacustrine, Littoral, Emergent, non-persistent	2	1	2	1
PAB3 Palustrine, Aquatic Bed, Rooted Vascular	2	1	2	1
PAB4 Palustrine, Aquatic Bed, Floating Vascular	1	1	1	1
PEM Palustrine, Emergent	8	3	3	1
PSS Palustrine, Scrub Shrub	2	3	5	1
PFO1 Palustrine, Forested, Broad-Leaved Deciduous	3	3	5	1
PFO2 Palustrine, Forested, Needle-Leaved Deciduous	7	2	1	1
PFO3 Palustrine, Forested, Broad-Leaved Evergreen	2	1	1	1
PFO4 Palustrine, Forested, Needle-Leaved Evergreen	1	1	6	1
PFO6 Palustrine, Forested, *Deciduous* (mixed)	5	4	9	1
PFO7 Palustrine, Forested, *Evergreen* (mixed)	3	2	3	1

no. times class is cross-referenced:	no. classes cross-referenced:			
1	6	4	7	7
2	11	6	8	
3	2		3	
4			2	
5			1	
> 5	1	1	1	1

The proposed classification for wetland bioassessments builds on commonalities between and key elements from prominent classifications (namely HGM, FNAI, and NWI). It is organized by landscape geomorphology (River, Depression, Lake, Slope, Flats) and dominant vegetative form (Forested, Herbaceous, Shrub) (Table 22). Additional resolution is provided through (subclass) descriptors: Hydroperiod (depth, duration and frequency of inundation); Primary Water Source (rainfall, surface or ground-water); and Soil Type (organic or mineral).

Limited information on descriptors restricts their application. For example, very little is known about the hydropattern of isolated basin or depression wetlands. Referencing hydroperiod modifiers from NWI wetlands database may provide description. Inferences about hydrology can also be based on vegetative associations described in the literature and learned from the field. Both FNAI and SCS include plant community characteristics and descriptions of wetland hydroperiod. Vegetation associations further classify wetlands, either by cross-reference with other classifications or through use of inventories and descriptions provided by research (scientific and technical literature) and monitoring (State agency programs).

Table 22. Proposed classification for biological assessment of Florida inland freshwater wetlands.

1.	wetland is primarily forest	2
	wetland is primarily herbaceous	3
	wetland is shrub dominated	**Shrub-scrub**
2	wetland is within stream channel or floodplain	**River Swamp**
	wetland is an isolated depression	**Depression Swamp**
	wetland is along a lake edge (permanent water >2 meters deep)	**Lake Swamp**
	wetland located on sloped topography	**Strand / Seepage Swamp**
	wetland associated with flat landscape; water source primarily precipitation	**Flatland Swamp**
3	wetland is within a stream channel or floodplain	**River Marsh**
	wetland is an isolated depression	**Depression marsh**
	wetland is along a lake edge (permanent water >2 meters deep)	**Lake marsh**
	wetland located on sloped topography with groundwater source	**Seepage Marsh**
	wetland associated with flat landscape; water source primarily precipitation	**Wet Prairie**

Descriptors:

Hydroperiod: Depth, duration, and frequency of inundation
Primary water source: rainfall, surface water, groundwater
Soil type: organic, mineral
Plant community association

Finally, wetland classes are partitioned into proposed wetland ecoregions (Panhandle, North, Central, South). Inventorying NWI wetland classes within 4 proposed wetland ecoregions reveals distributional variation across Florida. Distribution maps are presented in the wetland Regions report – here trends are discussed in the context of wetland classes proposed for biological assessments. Twenty-two percent of the Panhandle Region is wetland; 35% of the South Florida Region is wetland; wetlands in the North and Central Regions cover 16% of the landscape. Generally, there is a trend of declining forested wetlands and increasing non-forested wetlands latitudinally from the Panhandle to South Florida.

Deciduous-Forest wetlands are most abundant within the Panhandle Region (51%) followed by Needle-leaved-Evergreen-Forests (32%). Emergent wetlands account for less than 4% of the wetlands in the region. In the North Region, the Deciduous-Forest class is again the most common wetland (62%) but Emergent wetland area proportionally increased (13%). Evergreen-Forest classes (Broad and Needle-leaved together) account for 16% of wetlands in the region. In the Central Region, Emergent and Deciduous-Forest classes are equally represented, each about 40% of area wetlands. Evergreen-Forest wetlands decreased to about 10% of the region's wetlands. Shrub-Scrub classes in the Panhandle, North and Central Regions represent 7-9% of regional wetlands. In the South Florida Region, Emergent wetlands are prominent landscape features (61% of wetlands and 22% of landscape). Forested wetlands are less common (Deciduous and Evergreen-Forest classes account for 16% and 5% of area wetlands, respectively). Shrub-Scrub wetlands are more common in South Florida (17% of wetlands in the region).

Based on regional differences in distribution and abundance of wetlands across Florida, modifiers and plant community descriptions should be used to generate greater resolution for prominent wetland classes in a landscape. In the Panhandle Region, water source and hydroperiod are likely to discriminate River Swamps into Bottomland and Floodplain Forests. In the South Region, modifiers are likely to discriminate Marshes into Seepage, Prairie or Emergent wetlands. Additional description to Palustrine Emergent Marshes may result from a partitioning of typical or mean annual flooding or water depth (e.g., Shallow and Deep-water).

The 12 proposed wetland classes are compared with 5 classification networks to identify synonyms, generate descriptions and provide cross-reference (Table 23). Common nomenclature from the classification crosswalks includes: Bottomland, Floodplain, Dome, Basin, Wet Flatwoods, Strand, Slough, Seep, Marsh, Prairie and Bog. Dominant plant community associations commonly included in classifications are: cypress (needle-leaved deciduous), bay (broad-leaved evergreen), hardwood (mixed deciduous), and sawgrass.

For forested wetlands, River Swamp had the greatest number of cross-references (21) and Seepage Swamp had the least (7). For Non-forested wetlands, River Marsh had the greatest number of cross-references (13); Wet Prairie and Seepage Bog each had 9. Groundwater influenced wetlands are unique enough communities to warrant specific consideration in all classifications. In general there is less conflict (greater certainty) among similar categories of Non-forested wetlands than for Forested wetlands (average number of cross-references 11 and 15, respectively). Generally NWI and FLUCCS classifications generated the greatest number of cross-references for proposed classes due both to generality of nomenclature

Table 23. Classification cross-reference of proposed classes for biological assessment of inland freshwater wetlands in Florida.

Forested wetlands:

River Swamp

FNAI: Bottomland Forest, Floodplain Forest, Floodplain Swamp, Freshwater Tidal Swamp, River Floodplain Swamp

FLUCCS: 613-Gum Swamp, 615-Stream and Lake Swamp (Bottomland), 617-Mixed Wetland Hardwood, 621-Cypress, 623-Atlantic White Cedar, 624-Cypress-Pine-Cabbage Palm

FWC: 12-Cypress, 13-Hardwood Swamp, 17-Bottomland Hardwood

NWI: PFO1-Palustrine Forested Broad-leaved Deciduous, PFO2-Palustrine Forested Needle-leaved Deciduous, PFO6-Palustrine Forested Deciduous mixed, PFO7-Palustrine Forested Evergreen mixed

SCS: 17-Cypress Swamp, 20-Bottomland Hardwood, 21-Swamp Hardwood

Depression Swamp

FNAI: Basin Swamp, Bog, Dome Swamp, Baygall

FLUCCS: 611-Bay Swamp, 613-Gum Swamp, 617-Mixed Wetland Hardwood, 621-Cypress

FWC: 12-Cypress, 13-Hardwood Swamp, 14-Bay Swamp

NWI: PFO2-Palustrine Forested Needle-leaved Deciduous, PFO3-Palustrine Forested Broad-leaved Evergreen, PFO6-Palustrine Forested Deciduous mixed

SCS: 17-Cypress Swamp, 22-Shrub Bog/Bay Swamp

Lake Swamp

FNAI: Swamp Lake, Basin Swamp, Bottomland Forest

FLUCCS: 613-Gum Swamp, 615-Lake Swamp (Bottomland), Mixed Wetland Hardwood, 621-Cypress, 624-Cypress-Pine-Cabbage Palm

FWC: 12-Cypress Swamp, 13-Hardwood Swamp, 17-Bottomland Hardwood

NWI: PFO2-Palustrine Forested Needle-leaved Deciduous, PFO6-Palustrine Forested Deciduous mixed

SCS: 17-Cypress Swamp, 21-Swamp Hardwoods

Strand Swamp

FNAI: Strand Swamp

FLUCCS: 614-Titi Swamp, 617-Mixed Wetland Hardwood, 618-Willow and Elderberry, 619-Exotic Wetland Hardwood, 621-Cypress, 631-Wetland Scrub

FWC: 12-Cypress Swamp, 13-Hardwood Swamp, 15-Shrub Swamp

NWI: PFO2-Palustrine Forested Needle-leaved Deciduous, PFO6-Palustrine Forested Deciduous mixed

SCS: 12-Wetland Hardwood Hammock, 16-Scrub Cypress, 17-Cypress Swamp

Seepage Swamp

FNAI: Baygall

FLUCCS: 611-Bay Swamp

FWC: 14-Bay Swamp

NWI: PFO3-Palustrine Forested Broad-leaved Evergreen, PFO7-Palustrine Forested Evergreen mixed

SCS: 10-Cutthroat Seep, 22-Shrub Bog/Bay Swamp

Flatland Swamp

FNAI: Hydric Hammock, Wet Flatwoods

FLUCCS: 614-Titi Swamp, 616-Inland Ponds and Sloughs, 618-Willow and Elderberry, 619-Exotic Wetland Hardwood, 622-Pond Pine, 624-Cypress-Pine-Cabbage Palm, 625-Hydric Pine Flatwoods, 626-Hydric Pine Savanna, 627-Slash Pine Swamp Forest

FWC: 13-Hardwood Swamp, 3-Pinelands

NWI: PFO4-Palustrine Forested Needle-leaved Evergreen, PFO7-Palustrine Forested Evergreen mixed

SCS: 6/7-Flatwoods

Table 23 – continued. Cross-reference of wetland types with proposed bioassessment classification.

Non-forested wetlands:

River Marsh
- FNAI: Floodplain Marsh
- FLUCCS: 641-Freshwater Marsh, 644-Emergent Aquatic Vegetation
- FWC: 11-Freshwater Marsh and Wet Prairie
- NWI: R2AB-Riverine Lower Perennial Aquatic Bed, R2EM-Riverine Lower Perennial Emergent Non-persistent, R3AB-Riverine Upper Perennial Aquatic Bed, R4SB-Riverine Intermittent Streambed, PAB3-Palustrine Aquatic Bed Rooted Vascular, PAB4-Palustrine Aquatic Bed Floating Vascular, PEM-Palustrine Emergent
- SCS: 25-Freshwater Marsh

Depression Marsh
- FNAI: Basin Marsh, Bog, Depression Marsh
- FLUCCS: 641-Freshwater Marsh, 644-Emergent Aquatic Vegetation, 653-Intermittent Pond
- FWC: 11-Freshwater Marsh and Wet Prairie
- NWI: PAB3-Palustrine Aquatic Bed Rooted Vascular, PAB4-Palustrine Aquatic Bed Floating Vascular, PEM-Palustrine Emergent
- SCS: 25-Freshwater Marsh, 24-Sawgrass Marsh

Lake Marsh
- FNAI: Flatwoods/Prairie/Marsh Lake, Basin Marsh
- FLUCCS: 641-Freshwater Marsh, 644-Emergent Aquatic Vegetation, 645-Submergent Aquatic Vegetation
- FWC: 11-Freshwater Marsh and Wet Prairie
- NWI: L1AB-Lacustrine Limnetic Aquatic Bed, L2AB-Lacustrine Littoral Aquatic Bed, L2EM-Lacustrine Littoral Emergent non-persistent, PAB3- Palustrine Aquatic Bed Rooted Vascular, PAB4- Palustrine Aquatic Bed Floating Vascular, PEM-Palustrine Emergent
- SCS: 25-Freshwater Marsh

Seepage Bog
- FNAI: Swale, Slough, Seepage Slope
- FLUCCS: 641-Freshwater Marsh, 643-Wet Prairie
- FWC: 11-Freshwater Marsh and Wet Prairie
- NWI: PEM-Palustrine Emergent
- SCS: 10-Cutthroat Seep, 23-Pitcher Plant Bog

Wetland Prairie
- FNAI: Wet Prairie, Marl Prairie
- FLUCCS: 643-Wet Prairie, 646-Treeles Hydric Savanna
- FWC: 11-Freshwater Marsh and Wet Prairie
- NWI: PEM-Palustrine Emergent
- SCS: 25-Freshwater Marsh, 26-Slough, 24-Sawgrass Marsh

Shrub Scrub
- FNAI: Seepage Slope, Bog, Slough
- FLUCCS: 631-Wetland Scrub, 614-Titi Swamp, 616-Inland Pond and Slough, 618-Willow and Elderberry, 619-Exotic Wetland Hardwood
- FWC: 15-Shrub Swamp
- NWI: PSS-Palustrine Scrub Shrub
- SCS: Shrub Bog/Bay Swamp

(NWI) and to different organizing foundations (FLUCCS). Approaches utilizing a combination of factors (hydrology, geomorphology and biology) result in descriptive and more consistent classifications than those developed for technological application.

FNAI provides the most comprehensive descriptions for its communities, using species lists and typical hydroperiods (and other information) to classify biologically distinct wetlands organized by landscape position. SCS also provides ecosystem attributes but does not include hydrology or geomorphology as keying characters, resulting in less distinct community types. FLUCCS is not organized by landscape features, rather by dominant vegetation readily identifiable through remote sensing, resulting in nomenclature that is not descriptive for biological assessment. The NWI system first divides wetlands by landscape features followed by dominant vegetative form, but classification, while hierarchical, often lacks resolution for assessing biological condition and the nomenclature is not conducive to localities. FWC habitats were chosen based on imaging criteria and with only 7 wetland habitats is too aggregated for biological description.

The wetland classification approach proposed here is a preliminary effort to group similar wetlands together for purposes of detecting biological condition. Considerations have been made to keep the system simple and user-friendly, but robust enough to generate a consistent wetland typology. Field studies are needed to test differences between 12 wetland classes in 4 regions across the State. Proposed classes and regions should be peer reviewed by agency personnel involved in past efforts and current programs.

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