WETLANDS OF CALIFORNIA, PART II: CLASSIFICATION AND DESCRIPTION OF WETLANDS OF THE CENTRAL AND SOUTHERN CALIFORNIA COAST AND COASTAL WATERSHEDS

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ABSTRACT

The modified Cowardin et al. (1979) classification described herein provides a methodology to identify all wetlands along the central and southern California coast and in the adjacent coastal watersheds from the Carmel River in Monterey County, to the Tijuana River in San Diego County. Use of classification tables in association with concepts of ecosystem context, site scale, and classification goals is intended to result in the development of a code (wetland type number) and wetland name that include information on the: (1) system, subsystem, class and subclass; (2) water regime and water chemistry; (3) hydrogeomorphic unit; and (4) substrate, dominance, or characteristic type of the wetland in question. A wetland data-page format also is proposed that provides a method for organizing information on the site location, characteristic species, ecosystem functions, socio-economic values, impacts, and conservation efforts for reference examples of the various wetland types.

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Seventeen years ago Cowardin et al. (1979) presented a nationwide framework that continues today as the single best method for classifying wetlands on the national scale. Regionalization of this effort has begun in the American West because many important features of western wetlands were not covered with sufficient detail in previous efforts to identify the richness of wetland types. Specifically, in 1991, the United States Environmental Protection Agency (EPA), Region IX, funded a study to produce a classification, inventory, and description of wetland types along the coast and in coastal watersheds of the Southern Coastal, Transverse, and Peninsular Ranges in central and southern California. This region extends for approximately 400 miles, or about one-half the length of the state, from the Carmel River (ca. 36°30′N lat.) in Monterey County, south to the Tijuana River (ca. 32°30′N lat.) in San Diego County.

The investment by EPA was based upon an earlier compilation of wetland information (Ferren 1989) that was gathered in California for more than ten years and organized according to a modified version of the U.S. Fish and Wildlife Service (FWS) wetland classification (Cowardin et al. 1979). This ten-year effort was initiated because, at the time, no existing vegetation or habitat classification scheme (e.g., Munz 1959; Cheatham and Haller 1975; Holland 1986) adequately documented the great richness of wetland types in California, or attempted to incorporate the special environmental attributes that occur in the region as a result of the Mediterranean and arid climates. Ferren (1989, p. 3) ". . . found it necessary for communication purposes to categorize wetlands into some hierarchical system that would delineate the types of wetlands according to physical and biological criteria". The Cowardin et al. (1979) system is such a hierarchical classification, ". . . progressing from system to subsystems, at the general levels, to classes, subclasses, and dominance types. . . . Modifiers for water regime, water chemistry, and soils are applied to classes, subclasses, and dominance types".

Concern for the absence of thorough documentation of California wetlands, however, is replaced by alarm when one considers the extensive losses of wetlands (see Part I, Ferren et al. 1996a) that have occurred in the coastal watersheds without previous documentation of the habitat richness, ecosystem functions, and socio-economic values of these wetlands. Extensive agricultural development, rapid urbanization, flood control practices, and the continuing extraction of physical resources (such as petrochemicals, gravel, and water) are among the main contributors to these losses and to the degradation of many of the remaining wetlands (e.g., California Department of Parks and Recreation 1988; Dahl 1990; Leidy 1990; National Audubon Society 1992). Furthermore, changes proposed to the jurisdictional limits of wetlands as recognized by federal regulatory agencies would result in the elimination of federal jurisdiction

over many types of wetlands in western North America, and would exacerbate the potential threat of additional losses in California. Thus, this study was motivated by an urgent need for a mechanism to articulate the scope of the wetland heritage of California, particularly central and southern California, so that conservation efforts can accurately protect these resources.

Study region. California is a state of many contrasts and contradictions. Within its borders are the highest mountain (4420 m [14,495 ft]) in the lower 48 states, Mt. Whitney, and the lowest point on the continent, 85 m (276 ft) below sea level at Death Valley. The Modoc Plateau in northeastern California is a region of relatively low population density; southwestern California is one of the most densely populations regions in the world. With regard to its biotic reputation, California harbors one of the richest floras in the world (Raven and Axelrod 1978) but supports a freshwater fish fauna that is notably depauperate (Moyle 1976). Both flora (Stebbins and Major 1965; Fiedler 1995) and fauna (Moyle 1976) are renown for their high endemism.

The study region for the proposed classification includes the coastal boundary at Point Conception, Santa Barbara County, between northern and southern California biogeographic provinces, which contributes to the many contrasts that affect wetlands. These contrasts include differences between and among: (1) northern cool and moist and southern warm and dry Mediterranean climates; (2) Mediterranean and arid climates; (3) cold, high elevations and mild, low elevations; (4) interior and coastal locations; (5) oceanic and terrestrial processes; (6) intermittent and perennial water bodies; (7) widespread and narrowly-restricted habitats and organisms; (8) coarse-scale physiographic areas and fine-scale habitat sites; (9) historic and current land use practices; (10) natural and artificial landforms; (11) pristine and degraded habitats; and (12) wilderness and urbanized regions. Additional natural elements that contribute to the region's remarkable wetland diversity include the great variation in water chemistry (e.g., fresh, salt, alkali, sulfur, petroleum) and natural processes (e.g., aeolian, fluvial, glacial, arid, volcanic, and structural). Refer to Part I of this treatise (Ferren et al. 1996a) for additional aspects of the environmental setting of the region.

Thus it is with this frame of reference—diversity, anomaly, and contrast—that the study region and its wetland resources are presented. As representative of California as a whole, the central and southern coast and coastal watersheds illustrate the complexity of the state's physical and biological diversity that contribute to the formation of the rich wetland heritage of the state.

Wetlands definition. Wetlands in California and elsewhere vary widely in topographic setting, hydrology, chemistry, substrate, veg-

etation physiognomy, and persistence. Before we proceed with the examination of the Mediterranean-climate wetlands of California, acceptance and consistent application of a wetland definition is essential. We endorse for use in California the definition proposed by Cowardin et al. (1979). At the state level, the Fish and Game Commission, Department of Fish and Game, and the Coastal Commission also accept this definition and the associated technique for the classification of wetlands (Gibbons 1992). At the regional level, the County of Santa Barbara and the City of San Diego are examples of governments that also accept this definition.

Cowardin et al. (1979) have provided some helpful insights concerning the definition of wetlands. They suggest that the term **wetlands** ". . . has grown out of a need to understand and describe the characteristics and values of all types of land, and to wisely and effectively manage wetland ecosystems. There is no single, correct, indisputable, ecologically sound definition for wetlands because of the diversity of wetlands and because the demarcation between dry and wet environments occurs along a continuum. . ..The primary objective of this classification is to impose boundaries on natural systems for the purposes of inventory, evaluation, and management" (Cowardin et al. 1979:3). Their definition follows:

> *Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For the purpose of this classification, wetlands must have one or more of the following attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; (3) the substrate is nonsoil and is saturated or covered with shallow water at some time during the growing season of each year (Cowardin et al. 1979, p. 3).*

This definition is broad enough to include the special nature of wetlands in the California Chaparral and Estuarine Provinces, and the Colorado Plateau and Desert Provinces in California (Bailey 1978; Cowardin et al. 1979). The National Research Council (1995), however, has offered a new definition that refines some aspects of the Cowardin et al. definition. In addition to the definition of wetlands, the following definition for **deepwater habitat** has been offered by the U.S. Fish and Wildlife Service in Cowardin et al. (1979, p. 3):

> *[Deepwater habitats are] permanently flooded lands lying below the deepwater boundary of wetlands. Deepwater habitats include environments where surface water is permanent and often deep, so that water, rather than air, is the principal me-*

dium within which the dominant organisms live. . . . As in wetlands, the dominant plants are hydrophytes: however, the substrates are considered nonsoil because the water is too deep to support emergent vegetation. . . .

Use of these definitions in association with the modified hierarchical classification of wetlands and deepwater habitats requires some additional explanation. The FWS classification is hierarchical and progresses from systems and subsystems to classes, subclasses, dominance types, and habitat modifiers (Cowardin et al. 1979). Systems and subsystems (Table 1) are delineated according to major physical attributes such as tidal flushing, ocean-derived salts, and the energy of flowing water or waves. Classes and subclasses describe the type of substrate and habitat or the physiognomy of the vegetation or faunal assemblage. Wetland classes are divided into physical types (i.e., rock bottom, unconsolidated bottom, streambed, rocky shore, and unconsolidated shore) and biotic types (i.e., aquatic bed, reef, moss-lichen wetland, emergent wetland, scrub-shrub wetland, and forested wetland).

Preliminary Questions for Classification

To provide a basis for the classification proposed herein, a series of questions can be raised and answered that will assist the classifier in collecting information that will be necessary for the development of a wetland name and numerical code. Answers to these questions provide some of the basic information needed to identify a particular wetland and to relate it to other wetlands. Below, we provide discussion for each question.

1. What are the goals of the project or task? Why is there a need to classify and describe wetlands? A clear statement and understanding of goals of a project or task will help determine the scope, scale, and detail that a wetland classification must include. If the goal of a project is to map and classify only vegetation, then some form of vegetation nomenclature and classification will be necessary. Such a project might generally ignore all of the nonvegetated wetland habitats. However, if the goal of a project is to identify hydrogeomorphic units and relate them to physical processes, then a more detailed analysis and nomenclature is necessary. Our modified Cowardin et al. approach provides the flexibility to consider various levels of detail to meet the goals of a wide variety of projects and tasks.

2. What is the ecosystem context of the wetland under construction? It is essential for most projects that include classification to determine the context in which occur the particular elements that

are to be classified. For the purposes of wetland classification it is important to identify the system of wetlands (and any associated deepwater habitats) to which a wetland belongs (e.g., Marine, Estuarine, Riverine, Lacustrine, Palustrine) or with which a wetland is associated (e.g., a Palustrine Forested Wetland on a channel bar within the Riverine System). In addition, it may also be important to identify the broader ecosystem context within which smaller wetlands occur (e.g., vernal pools occurring within grassland or chaparral), to assess the various ecosystem functions the wetland may provide.

3. At what scale will the classification be applied? Will the scale include, for example, an entire river channel or only a bar and/or back-bar channel within the main channel? The scale of a site under consideration and the detail of the classification are important factors to communicate so that it is clear what has been identified or mapped, and what the wetland relationship is to the ecosystem context as well as the goals of a project. Scale is often a perplexing issue that can result in confusion over what is being classified. Using our modified Cowardin et al. approach regarding spatial scale, it is possible to identify both the coarser-scale hydrogeomorphic or ecosystem context (e.g., type of natural lacustrine environment such as a Montane-Alkali-Lake) and the finer-scale hydrogeomorphic unit (e.g., an intermittently-flooded, unconsolidated shore), as well as the wetland associated with the latter (e.g., Emergent Nonpersistent Wetland). In general, the finer the scale, the less variable the site and easier it is to classify and name the wetland. For example, a riparian corridor may be mapped as forested wetland at a coarser-scale and yet perhaps contain four different types of forested wetland at a finer-scale, each characterized by a different water regime, hydrogeomorphic unit, dominance type, and ecosystem function. There is a degree of fineness, however, that no longer reflects a wetland type, but reflects instead, the individual organisms or substrate types of a larger-scale wetland type. It is the best professional judgement of the classifier that is generally the source of this decision, and thus the more field experience one has, the more accurate the decision becomes to split or lump hydrogeomorphic units or sites.

Temporal scale is another issue that can cause confusion, particularly in the Mediterranean climatic portions of the study region. Many wetlands types are flooded during part of the year and desiccated during another (e.g., vernal pools, vernal ponds, vernal lakes, and margins of streams and rivers), or are only intermittently flooded (e.g., playa lakes and some streams). Because a site may be characterized by different flooding regimes and dominance types during different times of the year, a single wetland site could be classified

differently depending upon the time of year, which year, project purpose, or the person doing the classifying. Such also is the case for sites that receive periodic disturbance (e.g., streambeds, floodplains, and deltas), whereby one site characterized by wetlands from a particular system, class, or subclass could be converted to wetlands of another system, class, or subclass. Such conversion is often a natural and characteristic process for the study region; thus temporal scale, like spatial scale, is important in classification and adds to the diversity and complexity of wetland types.

The modified Cowardin et al. approach provides flexibility to describe a specific wetland within the goals of a particular project. This flexibility may result in confusion or even differences of application to the same or similar sites. We believe, however, that it is more useful and a better reflection of the field experience to incorporate a series of choices than to limit scale and miss opportunities to identify particular types of wetlands. This belief has guided the development of our classification hierarchy.

4. If the context and scale have been decided, what are the class(es) and subclass(es) of wetlands that characterize the site? Is the site in question dominated by abiotic and/or biotic wetland classes? Although, in general, a particular wetland is characterized by one class and subclass, in various cases, sites of larger scale will have several attributes or mixtures of attributes at the class or subclass levels. Thus, it is important to determine the dominant characteristic of the chosen scale. In general, the finer the scale of the ecosystem or site context, the more homogeneous the wetland habitat will be. For example, a dune swale wetland is a type of hydrogeomorphic unit that, if sufficiently large and flooded seasonally, may support examples of wetland types from palustrine aquatic bed, emergent, scrub-shrub, and forested wetland classes.

In other examples, wetland sites (e.g., river channels, lake shores, and marine beaches) can be characterized by episodes of natural or artificial disturbance, and may support a mosaic of components from different abiotic classes (e.g., unconsolidated shore) and biotic classes (e.g., emergent, scrub-shrub, and forested wetlands). It is important, therefore to have some metric by which to assess dominance, and to attribute a site or portions of a site to one or more classes and subclasses of wetland (e.g., cobble-gravel, emergent-persistent, broadleaved-deciduous). Some sites, wetland types, or ecosystem contexts are problematic for other reasons (e.g., how should one classify tenajas from the Santa Rosa Plateau?) or appear to be "hybrids" (e.g., the Tijuana Estuary has characteristics of river-mouth and bay types of estuaries). Thus classification of the associated wetlands, including attribution of class and subclass, and a choice of scale or type of ecosystem context, also can be difficult to decide.

However, by having *a predetermined goal and some sense of appropriate scale* and detail of classification needed, one can reduce the number of problems encountered in the classification process.

5. What are the various hydrogeomorphic and geochemical attributes of the wetland, such as water regimes, chemistry regimes, and hydrogeomorphic units? Are more than one combination of attributes identifiable at the site? Although the system, subsystem, class, and subclass descriptors provide the context and structure to a wetland, it is the combination of hydrology, chemistry, and geomorphology that provide the distinguishing features among many wetland types. Differentiation among wetland types often is dependent upon knowledge of ecosystem processes reflected in the hydrogeomorphology and geochemistry of the ecosystem or wetland site. Differentiation of water regimes (e.g., intertidal, permanently flooded, seasonally flooded, and saturated) and chemistry regimes (e.g., alkaline, hyperhaline, and euryhaline) can be important in distinguishing among related (e.g., proximally or structurally) but functionally different wetlands. Although identification of physical attributes may require some expertise, many clues (e.g., salt crusts, rack from flooding, dried algal mats, mottled soil, etc.) can be found in the field that reveal physical characteristics of wetlands.

6. What are the dominant substrate(s) or organism(s) of the wetland that contribute to the character of the site? Descriptive terminology for wetlands often includes types of substrate (e.g., unconsolidated bottom, mud) and type of organism(s) (e.g., algae, mosses, vascular plants) or particular organisms (e.g., *Salicornia virginica* [Pickleweed]) that dominate or characterize the site or wetland. Some knowledge of substrates and organisms is essential for classification, and the level of detail in classification will depend on the specificity of the identifications. However, our modified Cowardin et al. approach allows for both generality (e.g., Class Forested Wetland) and specificity (e.g., Subclass Broadleaved Deciduous, Dominance Type *Alnus rhombifolia* [White Alder]). Animals as well as plants can be important components in the classification process, as exemplified by estuarine intertidal mud flats (Class Unconsolidated Bottom, Subclass Mud) that are dominated by horn snails (*Cerithidea californica*).

7. What are the observed or inferred ecosystem functions and socio-economic values of the wetland and/or the ecosystem context within which the wetland occurs? One important goal in the classification of wetlands is to differentiate wetland types that perform different ecosystem functions (e.g., hydrology) or groupings of functions (e.g., food chain support, habitat, and hydrology/water-quality). Some wetlands that are visually similar in hydrogeomor-

phology and dominance type may in fact perform significantly different ecosystem functions. This difference may be a reflection of the ecosystem context, disturbance history, or regional location, but nonetheless can be an important factor in the classification process. For example, wetland riparian forests occur throughout the region along rivers and streams and on margins of ponds and lakes of coastal watersheds, but some of those associated with hydrogeomorphic units that can occur in proximity (e.g., floodplains, banks, and bars) and are dominated by the same combination of tree species (e.g., alders, willows, and cottonwoods) may support different groupings of riparian-dependent migratory or resident bird species. The presence of various rare and endangered species (e.g., Least Bell's Vireo, *Vireo bellii pusillus*; Yellow-breasted Chat, *Icteria virens*; Willow Fly Catcher, *Empidomox traillii*; and Western Yellow-billed Cuckoo, *Coccyzus americanus occidentalis*) apparently reflects the importance of site characteristics that are not present in most of the riparian forests extant in the region. In this example, habitat function for riparian bird species is an important wetland feature to consider in the classification process, which can result in the differentiation of some forested wetlands from others, particularly if those sites also are nesting habitat for rare and endangered birds.

Socio-economic values are an important attribute that many wetlands have, but the value to humans (e.g., nonconsumptive types such as recreation) generally does not directly affect the classification process. However, indirectly, human land-use practices can greatly affect wetlands by transforming them from one class (e.g., Forested Wetland) to another (e.g., Emergent Wetland) as a result of deforestation, flood control, and other activities. Thus, some knowledge of ecosystem functions and socio-economic values is important for understanding the interface between wetland classification and the assessment of ecosystem functions and socio-economic values, both at site-specific and ecosystem levels. Although we do not include coding or nomenclature for ecosystem functions or socio-economic values directly in our modified Cowardin et al. approach, such information can be included with the description of wetland types (e.g., Table 10), and can be used in the rationale for separating types that otherwise are similar in classification but significantly different in ecosystem function (see Mertes et al. 1995).

A Modified Cowardin et al. Approach

Our starting point for this study was a draft classification prepared by Ferren (1989), which was a previous compilation of information on Santa Barbara regional wetlands, organized into an expanded hierarchical version of Cowardin et al. (1979). Our original goal was to locate and visit examples of all types of wetlands we would

be able to classify for the study region. From a combination of team field experience, references, assistance from others, and reconnaissance trips we compiled the information from which we developed the classification and determined the types. The scope of our project changed during the course of the three year effort, however, because we realized that the nearly limitless variation of habitats and dominance types would make it difficult for us to complete an inventory of wetland types. Thus we narrowed our focus to include: (1) the development of a methodology to identify and classify wetlands in the study region according to a modified Cowardin et al. approach; and (2) a presentation of an illustrated catalogue of examples organized according to this hierarchical classification.

Field methods. Field work was conducted from Fall 1991 to Summer 1994, and focused on: (1) visits to known sites of interest; (2) reconnaissance trips into poorly explored regions; and (3) generalized transects from the intertidal marine shoreline to the crest of the coastal watershed divides, extending from the Carmel River Watershed at the northern limit of the study region to the Tijuana River Watershed at the southern limit of the region. We designed a data sheet onto which we recorded information regarding the physical attributes (e.g., ecosystem context, hydrogeomorphology, and geochemistry) and biological attributes (e.g., vegetation physiognomy and dominant or characteristic species) from "reference site" wetlands. Obtaining answers to the questions raised above was an important part of this process. Botanical vouchers of taxa unknown to us or important records for sites or habitats were prepared and deposited at UCSB as part of the inventory of dominant and characteristic species. Photographs were taken of virtually all sites, and, along with field notes, were arranged partially for access by trip, county, and system of classification. A literature and other resource review, and interviews with regional and local specialists, contributed to the information base we have compiled. Early versions of the new classification methodology were tested by various users, and modifications were made over the course of three years.

Classification methods. To achieve the goal to classify the wetlands of the region, we developed a numerical, hierarchical presentation of the modified Cowardin et al. (1979) approach to provide a method to organize the wetland types. Our nomenclature for the wetlands is generally derived from the orderly presentation of names for the various categories of wetland information provided in the wetland type number. To describe the rich variation in wetlands of the study region, we added several categories of information to the hierarchy by Cowardin et al. that aid in the characterization of California wetlands. Perhaps the most important categories are the site-specific "geomorphic" types we designate as **hydrogeomorphic**

TABLE 1. GENERAL DESCRIPTION OF THE SYSTEMS AND SUBSYSTEMS OF WETLANDS AND DEEPWATER HABITATS (ADAPTED FROM COWARDIN ET AL. 1979).

- **Marine System** (Fig. 3a): The open ocean overlying the continental shelf and the adjacent coastline. Water regimes are determined by oceanic tides and salinities from NaCl (halite) exceed 30 ppt (parts per thousand). Subsystems include intertidal wetlands and subtidal deepwater habitats. See Lafferty et al. (1995).
- **Estuarine System** (Fig. 3b): Coastal embayments that have at least occasional access to the ocean, and thus water with ocean-derived salts entering with the tides, and in which the ocean water is at least occasionally diluted by freshwater runoff from the adjacent land. Subsystems include intertidal wetlands and subtidal deepwater habitats. See Ferren et al. (1995c).
- **Riverine System** (Fig. 3c): Wetlands and deepwater habitats within a channel that are influenced strongly by the energy of flowing water. The Riverine System excludes (1) stands of persistent vegetation such as trees, shrubs, and some forms of emergent vegetation; and (2) channels with ocean-derived salts in excess of 0.5 ppt (i.e., estuarine channels). Subsystems include tidal; upper, mid, and lower perennial; and upper, mid, and lower intermittent categories. See Leidy et al. (1995).
- **Lacustrine System** (Fig. 3d): Wetlands and deepwater habitats located in large, at least intermittently-flooded depressions, or dammed canyons, river valleys, or montane valleys. Shoreline features and vegetation are influenced by the energy of waves and lack stands of trees, shrubs, persistent emergents, and mosses and lichens that exceed 30% cover. Total area generally exceeds 8 hectares (20 acres); in smaller examples the limnetic subsystem is not present. Subsystems include littoral (wetland) and limnetic (deepwater habitat) types. See Fiedler et al. (1995).
- **Palustrine System** (Fig. 3e): The nontidal wetlands dominated by trees, shrubs, persistent or nonpersistent emergents, mosses or lichens, and such wetlands in tidal areas where salinity from ocean-derived salts is below 0.5 ppt. Also included are wetlands that lack vegetation but: (1) are less than 8 hectares; (2) lack wave-formed shorelines; (3) have water depths less than 2 meters (6.6 feet) at low water; and (4) have salinity due to ocean derived salts less than 0.5 ppt. Thus palustrine wetlands lack the physical and biological attributes of the other four systems but often are in proximity to examples of those systems. The Palustrine System lacks subsystems, and thus all palustrine types are classified directly into classes and subclasses. See Ferren et al. (1995b).

units (e.g., land forms such as flats, slopes, pools, channels, beds), many of which are defined in a glossary provided herein (Appendix I). Use of hydrogeomorphic units results in the ability to differentiate wetlands of similar hydrology, chemistry, or dominance type that occur in different topographic landforms and that may have different ecosystem functions and socio-economic values.

For the purposes of the classification and partial inventory of California wetlands, we also have provided keys to the level of wetland subclasses and a catalogue of selected types for each system (see Part III, Ferren et al. 1996b). Hierarchical information for each of the types or group of types has been organized in tabular form, and additional information (e.g., description, functions and values, characteristic species, examples, impacts, and literature) is catego-

TABLE 2. SYSTEMS, SUBSYSTEMS, CLASSES, AND SUBCLASSES OF WETLANDS AND DEEPWATER HABITATS. Nomenclature adopted or modified form Cowardin et al. (1979). Asterisk (*) indicates new subsystem, class, or subclass added to Cowardin et al. (1979). For this classification, the user would choose one from each of the system, subsystem, class, and subclass categories. Because of potential temporal changes or issues of scale, a particular site may be classified in more than one way. However, for each purpose, a single wetland numerical code and name would be developed. See key to systems, subsystems, and classes in Part III (Ferren et al. 1996b).

I. THE SYSTEMS AND SUBSYSTEMS

10.000 System Marine
- 11.000 Subsystem Intertidal (Wetlands)
- 12.000 Subsystem Subtidal (Deepwater Habitats)

20.000 System Estuarine
- 21.000 Subsystem Intertidal (Wetlands)
- 22.000 Subsystem Subtidal (Deepwater Habitats)

30.000 System Riverine
- 31.000 Subsystem Tidal (Wetlands)
- 32.000 Subsystem Upper Intermittent (Wetlands)*
- 33.000 Subsystem Mid Intermittent (Wetlands)*
- 34.000 Subsystem Lower Intermittent (Wetlands)*
- 35.000 Subsystem Upper Perennial (Wetlands)*
- 36.000 Subsystem Mid Perennial (Wetlands)*
- 37.000 Subsystem Lower Perennial (Wetlands)*
- 38.000 Subsystem Limnetic (Deepwater Habitats)

40.000 System Lacustrine
- 41.000 Subsystem Littoral (Wetlands)
- 42.000 Subsystem Limnetic (Deepwater Habitats)

50.000 System Palustrine
- 50.000 There are no subsystems; all habitats are wetlands.

II. THE WETLAND CLASSES AND SUBCLASSES

00.100 Abiotic Classes and Subclasses

00.110 Class Rock Bottom
- 00.111 Subclass Bedrock
- 00.112 Subclass Rubble/Boulder

00.120 Class Unconsolidated Bottom
- 00.121 Subclass Cobble-Gravel
- 00.122 Subclass Sand
- 00.123 Subclass Mud
- 00.124 Subclass Organic
- 00.125 Subclass Vegetated

00.130 Class Riverbed or Streambed
- 00.131 Subclass Bedrock
- 00.132 Subclass Rubble/Boulder
- 00.133 Subclass Cobble-Gravel
- 00.134 Subclass Sand
- 00.135 Subclass Mud
- 00.136 Subclass Organic
- 00.137 Subclass Vegetated Streambeds

00.140 Class Rocky Shore
- 00.141 Subclass Bedrock
- 00.142 Subclass Rubble/Boulder

TABLE 2. CONTINUED

00.150 Class Unconsolidated Shore
- 00.151 Subclass Cobble-Gravel
- 00.152 Subclass Sand
- 00.153 Subclass Mud
- 00.154 Subclass Organic
- 00.155 Subclass Vegetated

00.200 Biotic Classes and Subclasses

00.210 Class Aquatic Bed
- 00.211 Subclass Attached Algal*
- 00.212 Subclass Floating Algal*
- 00.213 Subclass Aquatic Moss
- 00.214 Subclass Rooted Vascular
- 00.215 Subclass Floating Vascular

00.220 Class Reef
- 00.221 Subclass Coral
- 00.222 Subclass Mollusc
- 00.223 Subclass Worm

00.230 Class Moss-Lichen Wetland
- 00.231 Subclass Moss
- 00.232 Subclass Lichen

00.240 Class Emergent Wetland
- 00.241 Subclass Persistent
- 00.242 Subclass Nonpersistent

00.250 Class Scrub-Shrub Wetland
- 00.251 Subclass Broadleaved Deciduous
- 00.252 Subclass Needleleaved Deciduous
- 00.253 Subclass Broadleaved Evergreen
- 00.254 Subclass Needleleaved Evergreen
- 00.255 Subclass Mixed Deciduous*
- 00.256 Subclass Mixed Evergreen*
- 00.257 Subclass Mixed Deciduous and Evergreen*
- 00.258 Subclass Dead

00.260 Class Woodland and Forested Wetland
- 00.261 Subclass Broadleaved Deciduous
- 00.262 Subclass Needleleaved Deciduous
- 00.263 Subclass Broadleaved Evergreen
- 00.264 Subclass Needleleaved Evergreen
- 00.265 Subclass Mixed Deciduous*
- 00.266 Subclass Mixed Evergreen*
- 00.267 Subclass Mixed Deciduous and Evergreen*
- 00.268 Subclass Dead

rized and presented on a sample "wetland data page" (Table 10) for a selected wetland type.

There are six approaches to the classification technique:

(1) use of modified Cowardin hierarchy tables for choice of wetland system, subsystem, class, and subclass and corresponding numerical code (Tables 1, 2);
(2) use of water regime tables for choice of appropriate wetland

TABLE 3. WATER REGIMES: WETLANDS AND DEEPWATER HABITATS. Nomenclature adopted or modified from Cowardin et al. (1979). Asterisk (*) indicates new water regime added to Cowardin et al. 1979. This table provides a numerical, hierarchical listing of water regimes that are ranked by tidal water-regimes and nontidal water-regimes and from which a type would be selected for a wetland classification. All water regime terms are defined in the accompanying Glossary (Appendix I).

(10.0)	**Tidal Water-Regimes**
	(11.0) Subtidal Regime
	(12.0) Irregularly-Exposed Regime
	(13.0) Regularly-Flooded Regime
	(14.0) Irregularly-Flooded Regime
	(15.0) Seasonally-Exposed Regime*
	(16.0) Seasonally-Flooded Regime*
(20.0)	**Nontidal Water-Regimes**
	(21.0) Permanently-Flooded Regime
	(22.0) Intermittently-Exposed Regime
	(23.0) Semipermanently-Flooded Regime
	(24.0) Seasonally-Flooded Regime
	(25.0) Permanently-Saturated Regime
	(26.0) Seasonally-Saturated Regime*
	(27.0) Temporarily-Flooded Regime
	(28.0) Intermittently-Flooded Regime
	(29.0) Phreatophytic Regime*

hydrology descriptor and corresponding numerical code (Table 3);

(3) use of water/soil chemistry tables for choice of appropriate wetland chemistry descriptor and corresponding numerical code (Table 4);

(4) use of hydrogeomorphic tables for choice of appropriate hydrogeomorphic unit and corresponding numerical code (Table 5 and Tables 6 and 7 in Appendix II);

(5) use of dominance/substrate tables for choice of appropriate substrate or biotic dominance (or characteristic) type(s) and corresponding numerical code (Tables 8, 9 in Appendix II); and

TABLE 4. WATER/SOIL CHEMISTRY: WETLANDS AND DEEPWATER HABITATS. This table provides a numerical listing of nine alternatives for water/soil chemistry and from which a type would be selected for a wetland classification. All water/soil chemistry terms are defined in the accompanying Glossary (Appendix I).

(00.**1**.000)	Fresh Water (Circumneutral)
(00.**2**.000)	Fresh Water (Acidic)
(00.**3**.000)	Fresh Water (Alkaline)
(00.**4**.000)	Saline, Haline (Eusaline, Euhaline)
(00.**5**.000)	Brackish (Mixosaline, Mixohaline)
(00.**6**.000)	Eurysaline, Euryhaline
(00.**7**.000)	Hypersaline, Hyperhaline
(00.**8**.000)	Sulfur-Affected
(00.**9**.000)	Petroleum-Affected

TABLE 5. HYDROGEOMORPHIC UNITS: MARINE, ESTUARINE, RIVERINE, LACUSTRINE, AND PALUSTRINE WETLANDS. This table provides an overview of the high-order categories (hundred-level series) of hydrogeomorphic (HGM) units for all wetland systems of the central and southern California coast and coastal watersheds. Specific HGM units for the combined marine and estuarine systems and the combined riverine, lacustrine, and palustrine systems are presented in Tables 6 and 7, respectively, in Appendix II.

(00.0.**100**.0000)	Water Bodies (Hydrogeomorphic Context)
(00.0.**200**.0000)	Channels, Fissures, Drainages, Inverts, Falls
(00.0.**300**.0000)	Shores, Beaches, Banks, Benches, Margins
(00.0.**400**.0000)	Beds, Bottoms, Bars, Reefs
(00.0.**500**.0000)	Flats, Plains, Deltas, Washes, Floodplains, Terraces
(00.0.**600**.0000)	Headlands, Bluffs, Slopes, Fans
(00.0.**700**.0000)	Seeps, Springs
(00.0.**800**.0000)	Pools, Ponds, Lakes, Meadows, Marshes, Swales
(00.0.**900**.0000)	Artificial Structures

(6) creation of a wetland data page (Table 10) for each example that includes: (a) wetland name and numerical code; (b) the above information, nos. 1–5, in a hierarchical format; (b) list of characteristic and associated species; (d) an estimate of the wetland's ecosystem functions and socio-economic values; (e) a discussion of the impacts and conservation efforts; and (f) a list of references or available sources of additional information.

We wish to emphasize that each of the classification components can be used individually to achieve a specific goal or answer a particular question. Again, they are designed to be combined to provide a methodology for the classification of wetlands and the compilation of a catalogue of the types. The hierarchical nature of the numerical code, classification tables, and catalogue allow the approach to be open ended. This results in the ability in most cases for a user to add new elements to the classification in virtually all levels of the hierarchy. Thus, in the tradition of the Cowardin et al. approach, we have designed a classification scheme that can be tailored to the needs of the user, the complexity of the site, and the level of information available at the time the classification is applied. In other words, the classification can be "lumped-up" for less detail, a generalization of the wetland ecosystem or habitat, or for the classification of coarse-scale sites (e.g., channels or estuaries). In contrast, the classification also can be "split-down" for more detail (e.g., substrate particle size) or for the classification of fine-scale sites (e.g., channel-bars or estuarine flats).

We have modified the Cowardin et al. (1979) approach to the classification of wetlands, however, in a number of significant ways:

(1) elements have been added to the original classification such

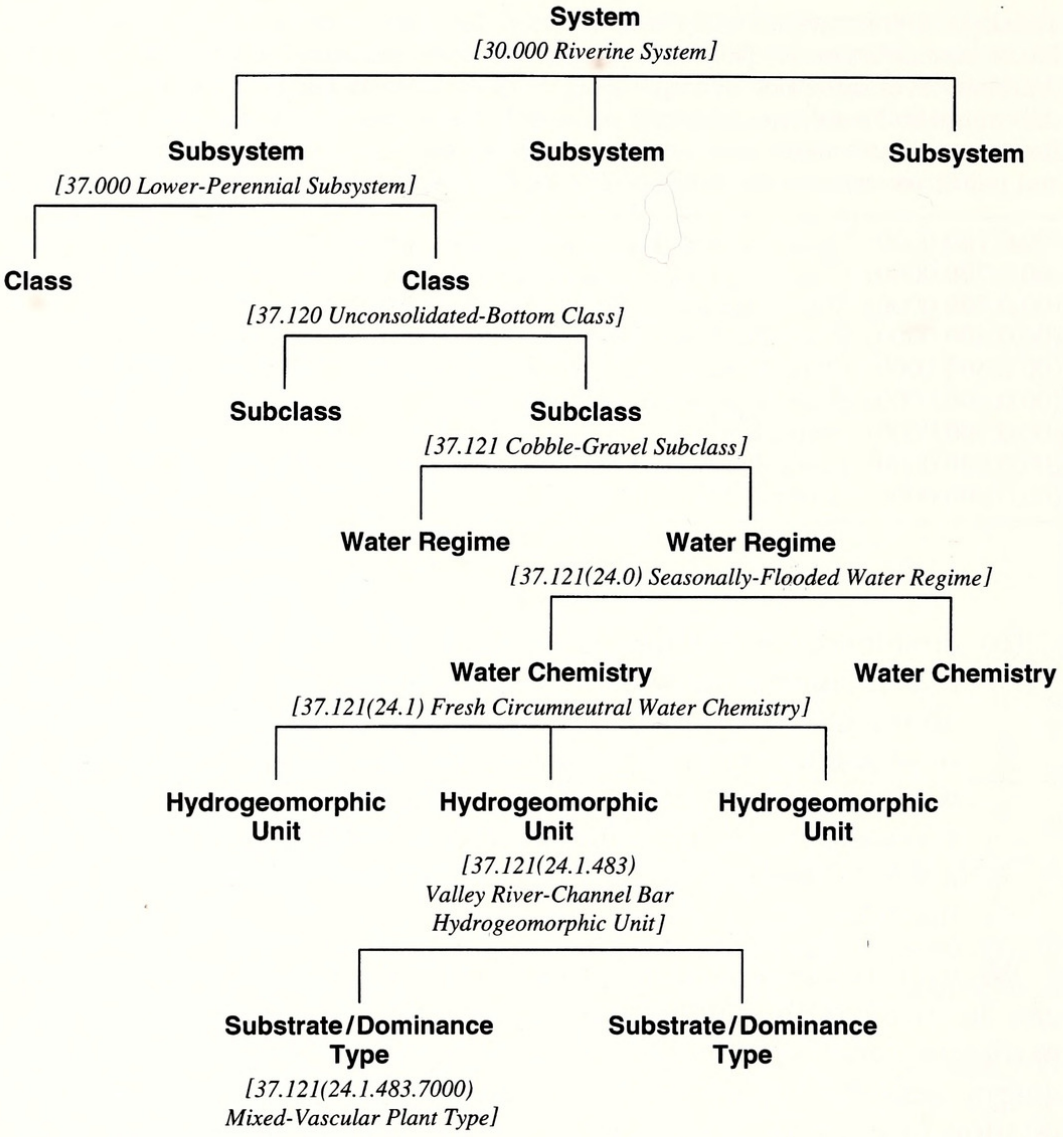

FIG. 1. Diagram of the Wetland Classification Hierarchy. Selected elements of the sample hierarchy are in bold face and examples are in small italic. The example provided demonstrates a riverine wetland with the corresponding numerical and written elements taken from the classification tables. The wetland example is identified as follows: No. 37.121 (24.1.483.7000) = Riverine Lower-Perennial Unconsolidated-Bottom (Cobble-Gravel) Seasonally-Flooded Valley River-Channel Bar Wetland. The dominance type (Mixed-Vascular Plant Type) could be added to the subclass designation (Cobble-Gravel), but this addition perhaps would be most meaningful if the wetland classification was identified as Class Vegetated, Subclass Nonpersistent. Nonetheless, the pioneering, nonpersistent vegetation on river bars could be included in this name as (Cobble-Gravel/Mixed-Vascular-Plant).

as new subsystems to the Riverine System and new subclasses to various classes;

(2) a numerical code has been applied to the modified classification;

(3) the original classification has been expanded to include the

Cowardin et al. modifiers and other modifiers for water regimes and soil/water chemistry;

(4) a classification of hydrogeomorphic units (tidally-influenced and nontidally-influenced) created for this hierarchy has been added to the numerical code; and

(5) a classification of substrate, dominance, and/or characteristic types has been created and added to the code.

The result is a hierarchical classification with multiple descriptors (elements) and descriptor states (specific examples) that includes a code generally composed of a 15 digit number, with decimal points and parentheses separating various descriptors identifying a particular type of wetland. A comma can be used to separate a series of descriptor states if more than one is used for a descriptor (see example below). An explanation of the code follows and an example is diagrammed in Figure 1:

"00.000(00.0.000.0000)"[1]

"00" = the system and subsystem descriptor (Table 2)
00."000" = the class and subclass descriptor (Table 2)
00.000.("00") = the water regime descriptor (Table 3)
00.000.(00."0") = the water chemistry descriptor (Table 4)
00.000.(00.0."000") = the hydrogeomorphic descriptor (Table 5 and Tables 6 and 7 in Appendix II)
00.000.(00.0.000."0000") = the substrate, dominance, and/or characteristic type descriptor (Tables 8, 9 in Appendix II)

The hydrogeomorphic descriptor (.000) includes the category level (e.g., .100), the series level (e.g., .110), and the units level (e.g., 111). Substrate/dominance/characteristic types (.0000) include hierarchies for substrates, biotic kingdoms, families, genera, species, physiognomy, and persistence.

Example Wetland Code Number: **41.125(28.3.442.1800, 5241, 5554, 5559)**

"**41**" = System: **Lacustrine** (40); Subsystem: **Littoral** (41)
41."**125**" = Class: **Unconsolidated Bottom** (120); Subclass: **Vegetated** (125)
41.125("**28**") = Water Regime: **Intermittently-Flooded** (28)
41.125(28."**3**") = Water Chemistry: **Alkali** (3)
41.125(28.3."**442**") = Hydrogeomorphic Unit: **Montane-Lake-Bed** (442)
41.125(28.3.432."**1800, 5241, 5554, 5559**") = Substrate and Dominance Types: **Mud** (1800), ***Heliotropium*** (5241), ***Chenopodium*** (5554), and ***Suaeda*** (5559)

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[1] Zeros = empty descriptor states.

TABLE 10. EXAMPLE OF LACUSTRINE WETLAND DATA PAGE.

LACUSTRINE WETLAND No.: 41.125(28.3.442.1800,5241,5554,5559), Fig. 2a and 2b.

NAME: LACUSTRINE-LITTORAL UNCONSOLIDATED-BOTTOM-VEGETATED (MUD, *HELIOTROPIUM, CHENOPODIUM, SUAEDA*) INTERMITTENTLY-FLOODED ALKALI MONTANE-LAKE-BED WETLAND

CLASSIFICATION:

System: Lacustrine
Subsystem: Lacustrine littoral
Class: Unconsolidated Bottom
Subclass: Vegetated
Water Regime: Intermittently Flooded
Water Chemistry: Alkaline
HGM Unit: Montane lake-bed
Substrate/Dominance Type: Mud
Substrate/Dominance Type: *Heliotropium*
Substrate/Dominance Type: *Chenopodium*
Substrate/Dominance Type: *Suaeda*

DESCRIPTION: The unconsolidated bottom of the only natural alkali montane lake in the study region, when flooded, is represented by the subclass aquatic bed, with characteristic species that include *Zannichellia palustris, Ruppia cirrhosa, Potomogeton* spp. and others. When desiccated, as shown here, the montane lake-bed becomes vegetated with annual species.

SPECIES: Characteristic: *Suaeda calceoliformis, Chenopodium macrospermum, Heliotropium curassavicum.* Associated: *Atriplex rosea, Bassia hyssopifolia.*

ECOSYSTEM FUNCTIONS: Baldwin Lake serves as foraging and nesting habitat for several raptors, including the bald eagle.

REFERENCE EXAMPLE: Baldwin Lake, San Bernardino Mountains, San Bernardino Co.

IIMPACTS: Proposed is a plan to raise the lake level to enhance endangered species habitat for the bald eagle and the shay meadows stickleback. Groundwater in the Big Bear Basin is being overdrafted for competing domestic and municipal uses as well as recreational and downstream commitments.

CONSERVATION EFFORTS: Lands north of Baldwin Lake have been purchased by The Nature Conservancy (TNC), and are to be designated as the "North Baldwin Lake and Holcomb Valley Special Interest Area" within the San Bernardino Forest.

LITERATURE: U.S. Forest Service 1988; Stevenson 1990.

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FIG. 2A,B. Lacustrine-Littoral Unconsolidated-Bottom-Vegetated (Mud, *Heliotropium, Chenopodium, Suaeda*) Intermittently-Flooded Alkali Montane-Lake-Bed Wetland. San Bernardino Co., San Bernardino Mountains, Baldwin Lake. Plants dominant or characteristic of the intermittently-flooded alkali lake-bed include *Atriplex rosea, Bassia hyssopifolia, Chenopodium macrospermum, Heliotropium curassavicum,* and *Suaeda calceoliformis.* Wetland Type No.: 41.125(28.3.442.1800,5241,5554,5559).


2A
2B

Nomenclature for this wetland includes the name of the descriptor states in hierarchical order as presented in the wetland number code, except for types of substrates and dominance or characteristic species that help describe the wetland, which are placed in parentheses following the subclass names. The above example reads as follows:

Lacustrine-Littoral Unconsolidated-Bottom-Vegetated (Mud, *Heliotropium, Chenopodium, Suaeda*) Alkali Montane-Lake-Bed Wetland

This example is a type of lacustrine wetland at Baldwin Lake in the San Bernardino Mountains (Fig. 2a, b). If a user of the classification does not have information for each of the descriptors, then an abbreviated version of the classification can be employed. For example, if the lake water chemistry was unknown and the lake-bed either was: (A) not colonized by nonpersistent plants; or (B) the names of them were unknown; or (C) the user wanted only to describe the wetland class and its corresponding water regime and hydrogeomorphic unit, the classifications and nomenclature alternatives would be as follows:

Example A: **41.123(28.0.442.1800)**
Lacustrine-Littoral Unconsolidated-Bottom (Mud) Intermittently-Flooded Montane-Lake-Bed Wetland

Example B: **41.125(28.0.442.1800,7200)**
Lacustrine-Littoral Unconsolidated-Bottom (Mud, Mixed-Nonpersistent Vascular-Plants) Intermittently-Flooded Montane-Lake-Bed Wetland

Example C: **41.120(28.0.442.0000)**
Lacustrine-Littoral Unconsolidated-Bottom Intermittently-Flooded Montane-Lake-Bed Wetland

The wetland classification methodology presented herein is designed to accommodate differences among classification goals, scope, and degree of detail, depending on the immediate project needs or background of the classifier. We hope the flexibility to "lump up" or "split down" in the classification will meet the needs of many users; however, we also recognize that this "fluidity" may be less suited for those who prefer fewer choices and more rigid application. We do not intend this classification to be exhaustive. We realize that the vastness of the study region and complexity of the environment limit our ability to include descriptor states for all types at this time, particularly at the rank of dominance type. Thus, we suggest this treatment be considered open-ended, as Cowardin et al. (1979) was intended to be open-ended and expandable. Additional field work and research will reveal more examples below the level of subclass, including additional hydrogeomorphic units.

Conclusions

Successful conservation of California's wetland heritage will depend on the compilation of details that enable us to identify the multitude of wetland types still found in the state. Although we may never know much about the approximately 90% of the wetland resources that have been lost, there are opportunities to conserve the richness that remain. Extensive inventory of all wetland types and documentation of their ecosystem functions are vital. Unique and vulnerable examples in particular need to be identified and protected. Furthermore, a framework with which to demonstrate wetland characteristics and relationships is needed that is sufficiently detailed to achieve the identification of the integrity and salient features of an enormous range of wetland types. We believe our classification methodology provides a regional example of such a framework.

With the great quantity of new information on wetlands being published at a national scale, and with the many alternatives to identification and classification of wetland types and their functions, we express hope that enough coordination will take place to establish standards by which at least regional priorities for wetland study and conservation can be initiated. We suggest several key opportunities that users of this classification could seize:

1. Field test this methodology and identify potential gaps in its flexibility to provide suggestions for its improvement.
2. Conduct inventories and mapping of wetlands throughout the study region in a coordinated effort to identify and conserve the diversity of wetlands and wetland resources and functions in central and southern California coastal watersheds.
3. Classify wetlands at disturbed sites and restored sites to monitor the change of particular wetlands from one type and set of functions to another type and set of functions, as a demonstration of the need for flexibility when interpreting wetlands in a Mediterranean climate.
4. Develop workshops on wetland classification, mapping, and functional assessment to broaden the participation and understanding of wetland inventory, conservation, and restoration.
5. Expand this methodology to other ecoregions in California to produce an integrated, statewide classification that can be used to identify the wetland richness at a broader scale.
6. Develop a computerized database version of the numerical, hierarchical classification of wetlands so that the potentially vast amount of information obtained through inventory and classification can be manipulated for research, conservation, and managerial purposes.

We encourage others to continue our regionalization effort, and

FIG. 3. 3A. Marine Wetland System: Ventura Co., Ventura River Delta. Marine-Intertidal Unconsolidated-Shore (Cobble-Gravel) Regularly-Flooded Delta-Shore Wetland; and Marine-Intertidal Aquatic-Bed Algal (Mixed-Protista) and Rooted-Vascular-Plant (*Phyllospadix*) Regularly-Flooded and Irregularly-Exposed Delta-Shore Wetlands.

3B. Estuarine Wetland System: Santa Barbara Co., Carpinteria Salt Marsh. Estuarine-Intertidal Unconsolidated-Shore (Mud) Regularly-Flooded Tidal-Marsh-Channel Wetland; and Emergent-Persistent (*Salicornia*) Irregularly-Flooded Middle-Salt-Marsh Wetland.

3C. Riverine Wetland System: Monterey Co., Big Sur River. Riverine Lower-Perennial Unconsolidated-Bottom (Cobble-Gravel) Permanently-Flooded River-Bed Wetland; and Palustrine-Forested Needleleaved-Evergreen (*Sequoia*) Temporarily-Flooded River-Bank and Broadleaved-Deciduous (*Alnus*) Seasonally-Flooded River-Bank Wetlands.

3D. Lacustrine Wetland System: San Diego Co., Cuyamacha Lake. Lacustrine-Littoral Unconsolidated-Shore (Mixed-Coarse and Mixed-Fines) Intermittently-Flooded Montane-Lake-Shore Wetland; and Emergent-Nonpersistent (*Polygonum*) Intermittently-Flooded Montane-Lake Wetland.

3E. Palustrine Wetland System: Santa Barbara Co., Foothills of the San Rafael Mountains. Palustrine Emergent-Persistent (*Eleocharis*) Seasonally-Flooded Vernal-Marsh Wetland; and Palustrine Unconsolidated-Bottom (Mud) Seasonally-Flooded Vernal-Pond Wetland.

we offer this methodology as a test to categorize the wetlands by a modified Cowardin et al. (1979) approach. An additional emphasis on hydrogeomorphic information will help differentiate wetlands based upon detailed physical as well as biological attributes. In the end, conservation of California's remaining wetlands may lie in our ability to discern the details of their form and function.

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APPENDIX 1: GLOSSARY

Below is a listing of terms cited in this treatise, and their definitions. Sources of the definitions are listed below. Terms without a citation were defined by the authors.

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Glossary

algal. Subclass in the Cowardin et al. wetland classification referring to algal communities found in the aquatic bed subclass (Cowardin et al. 1979).

alkaline (alkali). Pertaining to habitats or substances having a pH greater than 7; basic (Lincoln et al. 1982).

alluvial. Having stream deposits and sediments formed by the action of running water (California Coastal Commission 1987).

alluvial fans. A low, outspread, relatively flat to gently sloping mass of loose rock material, shaped like an open fan or a segment of a cone, deposited by a stream

(esp. in a semiarid region) at the place where it issues from a narrow mountain valley upon a plain or broad valley, or where a tributary stream is near or at its junction with the main stream, or wherever a constriction in a valley abruptly ceases or the gradient of the stream suddenly decreases; it is steepest near the mouth of the valley where its apex points upstream, and it slopes gently and convexly outward with gradually decreasing gradient (Bates and Jackson 1980).

aquatic. Growing or living in or frequenting water; taking place in or on water (Warner and Hendrix 1984).

aquatic bed. Class in the Cowardin et al. wetland classification referring to wetland and deepwater habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years (Cowardin et al. 1979).

aquatic moss. Subclass in the Cowardin et al. wetland classification referring to mosses, and presumably other bryophytes, that are found in the aquatic bed subclass (Cowardin et al. 1979).

artificially flooded. Water regime in the Cowardin et al. wetland classification in which the amount and duration of flooding is controlled by means of pumps or siphons in combination with dikes or dams (Cowardin et al. 1979).

backbar channel. A channel formed behind a bar connected to the main channel but usually at a higher bed elevation than the main channel. Backbar channels may or may not contain flowing or standing water.

backshore. The zone of a typical beach profile above mean high water; also used for the zone covered only in exceptionally severe storms (Lincoln et al. 1982).

backwater pools. A pool type formed by an eddy along channel margins downstream from obstructions such as bars, rootwads, or boulders, or resulting from back-flooding upstream from an obstructional blockage. Backwater pools are sometimes separated from the channel by and or gravel bars (American Fisheries Society 1985).

bank. The portion of the channel cross section that restricts lateral movement of water at normal levels. The bank often has a gradient steeper than 45° and exhibits a distinct break in slope from the stream bottom. An obvious change in substrate may be a reliable delineation of the bank (American Fisheries Society 1985).

bar. An elongated landform generated by waves and currents, usually running parallel to the shore, composed predominantly of unconsolidated sand, gravel, stones, cobbles, or rubble and with water on two sides (Cowardin et al. 1979).

bay. A wide, curving indentation, recess, or arm of a sea or lake into the land or between two capes or headlands, larger than a cove, and usually smaller than, but of the same general character as, a gulf (Bates and Jackson 1984).

beach. A sloping landform on the shore of larger water bodies, generated by waves and currents and extending from the water to a distinct break in landform or substrate type (e.g., a foredune, cliff, or bank) (Cowardin et al. 1979).

bed. The substrate plane, bounded by banks, over which the water column at some point in time resides (American Fisheries Society 1985).

bedrock. Subclass in Cowardin et al. referring to classes in which the bedrock covers 70% or more of the surface (Cowardin et al. 1979).

bench. A long, narrow, relatively level terrace or platform breaking the continuity of a slope. The term sometimes denotes a form cut in solid rock, as distinguished from one in unconsolidated material (Bates and Jackson 1984).

berm. a levee, shelf, ledge or bench along a stream bank that may extend laterally into the channel to partially obstruct the flow, or parallel to the flow to contain the flow within its stream banks. Berms may be natural or artificial (American Fisheries Society 1985).

bluff. A high bank or bold headland, presenting a precipitous front; a steep cliff (Bates and Jackson 1984).

bottom. The floor upon which any body of water rests (Bates and Jackson 1984).

bottomland. A lowland, usually highly fertile, along a stream; an alluvial plain (Bates and Jackson 1984).

brackish. Marine and estuarine waters with mixohaline salinity. The term should not be applied to inland waters (Cowardin et al. 1979).

breakwater. An offshore structure (such as a wall or jetty) that, by breaking the force of the waves, protects a harbor, anchorage, beach, or shore area (Bates and Jackson 1984).

broad-leaved deciduous. Subclass in the Cowardin wetland classification referring to wetlands in which the predominant trees or shrubs are angiosperms that lose their leaves once a year.

broad-leaved evergreen. Subclass in the Cowardin wetland classification referring to wetlands in which the predominant trees or shrubs are angiosperms that retain their leaves for longer than one year, and that always have some canopy.

canyon. A stream-cut chasm or gorge, the sides of which are composed of cliffs or a series of cliffs rising from its bed. Canyons are characteristic of arid or semiarid regions where downcutting by streams greatly exceeds weathering (Bates and Jackson 1984).

cascades. A habitat type characterized by swift current, exposed rocks and boulders, high gradient and considerable turbulence and surface agitation, and consisting of a stepped series of drops (American Fisheries Society 1985).

channel. An open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water (Langbein and Iseri 1960).

channel bank. The sloping land bordering a channel. The bank has steeper slope than the bottom of the channel and is usually steeper than the land surrounding the channel (Cowardin et al. 1979).

circumneutral. Term applied to water with a pH of 5.5 to 7.4 (Cowardin et al. 1979).

cliff. Any high, very steep to perpendicular or overhanging face of rock (Bates and Jackson 1984).

cobble-gravel. Subclass in the Cowardin et al. wetland classification referring to unconsolidated particles smaller than stones, sometimes intermixed with finer sediments (Cowardin et al. 1979).

community. An association of living organisms having mutual relationships among themselves and their environment and thus functioning, at least to some degree, as an ecological unit (Warner and Hendrix 1984).

coral. Subclass in the Cowardin et al. wetland classification referring to widely distributed, well-adapted, highly diverse and productive ecosystems characteristic of shallow waters in warm seas (Cowardin et al. 1979).

cove. A small narrow sheltered bay, inlet, creek, or recess in a coast, often inside a larger embayment; it usually affords anchorage to small craft (Bates and Jackson 1984).

culvert. Any covered structure, not classified as a bridge, that constitutes a transverse drain, waterway, or other opening under a road, railroad, canal, or similar structure (Bates and Jackson 1980); any covered structure that acts as a drain (Bates and Jackson, 1984).

dam. An artificial barrier or wall constructed across a watercourse or valley for one or more of the following purposes: creating a pond or lake for the storage of water; diverting water from a watercourse into a conduit or channel; creating a hydraulic head that can be used to generate power; improving river navigability; controlling floods; or retention of debris. It may be constructed of wood, earth materials, rocks, or solid masonry (Bates and Jackson 1980).

dead. Subclass in the scrub-shrub wetland and forested wetland classes of the Cowardin et al. wetland classification in which forested wetlands are dominated by dead woody vegetation (Cowardin et al. 1979).

deepwater habitat. Permanently flooded land below the deepwater boundary of wetland (Cowardin et al. 1979).

delta. A fan-shaped alluvial deposit at the mouth of a river (California Coastal Commission 1987).

dike. A tabular body of igneous rock that cuts across the structure of adjacent rocks or cuts massive rocks. A massive wall or embankment built around a low-lying area to prevent flooding (Bates and Jackson 1984).

ditch. A long, narrow excavation artificially dug in the ground; especially an open and usually unpaved waterway, channel, or trench for conveying water for drainage or irrigation, and usually smaller than a canal. Some ditches may be natural watercourses (Bates and Jackson 1980).

dominant. An organism or other abiotic component exerting considerable influence upon a community by its size, abundance, or coverage; the highest ranking individual in a dominance hierarchy (Lincoln et al. 1982).

drainage. (1) An artificial water course, such as a ditch or trench; (2) a natural watercourse modified to increase its flow (Stein 1973).

dune pond ("lake"). A lake occupying a basin formed as a result of the blocking of the mouth of a stream by sand dunes migrating along the shore (Bates and Jackson 1980).

dune swale. A low place among sand dunes, typically moister and often having distinctive vegetation differing from the surrounding sand environment.

ecosystem. A community of organisms and their physical environment interacting as an ecological unit; the entire biological and physical content of a biotype; biosystem; holocoem (Lincoln et al. 1982).

ecosystem context. Environmental setting of habitats comprising an ecosystem.

ecosystem functions. Processes that are necessary for the self-maintenance of an ecosystem such as primary production, nutrient cycling, decomposition, etc. The term is used primarily as a distinction from values (L. C. Lee & Associates, Inc. 1994).

emergent. Having part of a plant aerial and the rest submersed; with parts extending out of the water (Little and Jones 1980).

emergent hydrophytes. Erect, rooted, herbaceous angiosperms (flowering plants) that may be temporarily to permanently flooded at the base but do not tolerate prolonged inundation of the entire plant (e.g., bulrushes, saltmarsh cordgrass) (Cowardin et al. 1979).

emergent wetland. Class in the Cowardin et al. wetland classification characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens, and which is present for most of the growing season (Cowardin et al. 1979).

ensaline (euhaline). Salinity approximating seawater (33‰).

falls. A waterfall or other precipitous descent of water (Bates and Jackson 1980).

fault sag ponds. A small, enclosed depression along an active or recent fault. It is caused by differential movement between slices and blocks within the fault zone or by warping and tilting associated with differential displacement along the fault, and it forms the site of a sag pond (Bates and Jackson 1980).

flat. A level landform composed of unconsolidated sediments—usually mud or sand. Flats may be irregularly shaped or elongate and contiguous with the shore, whereas bars are generally elongate, parallel to the shore, and separated from the shore by water (Cowardin et al. 1979).

floating vascular. Subclass in the Cowardin et al. wetland classification referring to a large array of vascular plants floating above a substrate and that are found in the aquatic bed subclass (Cowardin et al. 1979).

floodplain. The deposit of alluvium that covers a valley flat, which is the fundamental land form produced by lateral erosion of meandering streams and rivers (Thornbury 1969).

forested wetland. Class in the Cowardin et al. wetland classification referring to woody vegetation that is 5 m (15 ft) tall or taller found in all water regimes (Cowardin et al. 1979).

fresh water. Water having a salinity of less than 0.5 ppt, or, alternatively, less than 2 ppt (Lincoln et al. 1982).

freshwater marsh. An circumneutral ecosystem of more or less continuously waterlogged soil dominated by emersed herbaceous plants, but without a surface accumulation of peat.

fringe marsh. A saturated, poorly drained area, intermittently or permanently water covered, close to and along the edge of a land mass.

geomorphic. Referring to the shape of a land surface (L. C. Lee & Associates, Inc. 1994).

habitat. The ecological and/or physical place determined and bounded by the needs and the presence of a specific plant or animal population, which contains a particular combination of environmental conditions sufficient for that population's survival (Warner and Hendrix 1984).

haline. Term used to indicate dominance of ocean salt (Cowardin et al. 1979).

haline marshes. A saturated, poorly drained area, intermittently or permanently water covered, having aquatic and grasslike vegetation, influenced predominately by ocean salts.

halophyte. A plant living in saline conditions; a plant tolerating or thriving in an alkaline soil rich in sodium and calcium salts; a seashore plant (Lincoln et al. 1982).

headland. A point of land, usually high and with a sheer drop, extending out into a body of water, especially the sea; a promontory (California Coastal Commission 1987).

herbaceous. A plant having the characteristics of an herb; having the texture and color of a foliage leaf (Little and Jones 1980).

hogback ridge. Any ridge with a sharp summit and steep slopes of nearly equal inclination on both flanks, and resembling in outline the back of a hog (Bates and Jackson 1984).

hydric soil. Soil that is wet long enough to periodically produce anaerobic conditions, thereby influencing the growth of plants (Cowardin et al. 1979).

hydrogeomorphic unit. A land form characterized by a specific origin, geomorphic setting, water source, and hydrodynamic.

hydrophyte. Any plant growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content (plants typically found in wet habitats) (Cowardin et al. 1979).

hyperhaline. Term used to characterize waters with salinity greater than 40 ppt (parts per thousand) due to ocean-derived salts (Cowardin et al. 1979).

hypersaline. Term used to characterize waters with salinity greater than 40 ppt due to land-derived salts (Cowardin et al. 1979).

intermittently exposed. Water regime in the Cowardin et al. wetland classification in which surface water is present throughout the year except in years of extreme drought (Cowardin et al. 1979).

intermittently flooded. Water regime in the Cowardin et al. wetland classification in which the substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity (Cowardin et al. 1979).

intertidal zone. The shore zone between the highest and lowest tides; eulittoral zone; littoral; tidal zone (Lincoln et al. 1982).

irregularly exposed. Water regime in the Cowardin et al. wetland classification in which the land surface is exposed by tides less often than daily (Cowardin et al. 1979).

irregularly flooded. Water regime in the Cowardin et al. wetland classification in which tidal water alternately floods and exposes the land surface less often than daily (Cowardin et al. 1979).

islet. A small or minor island (Bates and Jackson 1984).

lacustrine. Pertaining to, produced by, or inhabiting a lake or lakes (Bates and Jackson 1984).

lagoon. A shallow body of water separated from a larger bay or from the open ocean by a land form such as a sand spit or reef (California Coastal Commission 1987).

lake. Any inland body of standing water, larger and deeper than a pond [usually greater than 20 acres]. The term includes an expanded part of a river, a reservoir behind a dam, and a lake basin formerly or intermittently covered by water (Bates and Jackson 1984).

levee. An artificial embankment along a watercourse or an arm of the sea, to protect land from flooding (Bates and Jackson 1984).

lichen. Subclass in the Cowardin class moss-lichen wetland in which areas with reindeer moss (*Cladonia rangiferina*) is dominant (Cowardin et al. 1979).

littoral. Inhabiting bottom of sea or lake near shore, roughly within a depth to which light and wave action reach. For sea, usually taken as between high tide mark and 200 meters (i.e., approximately to limit of continental shelf). For lakes, approximately down to 10 meters (Abercrombie et al. 1983).

macroalgae. A large, macroscopic algae, typically referring to kelps.

macroinvertebrate. A large, macroscopic animal species without a spinal column, typically referring to large insects.

macrophyte. A large, macroscopic plant, used especially of aquatic forms such as kelp (Lincoln et al. 1982).

main channel pool. A pool formed by mid-channel scour that encompasses greater than sixty percent of the wetted channel (California Department of Fish and Game 1991).

marine. Of, or belonging to, or caused by the sea (Bates and Jackson 1984).

marsh. A saturated, poorly drained area, intermittently or permanently water covered; having aquatic and grasslike vegetation, especially without the formation of peat (Bates and Jackson 1984).

mesohaline. Term used to characterize waters with salinity of 5 to 18 ppt due to ocean-derived salts (Cowardin et al. 1979).

mesosaline. Term used to characterize waters with salinity of 5 to 18 ppt due to land-derived salts (Cowardin et al. 1979).

mixohaline. Term used to characterize water with salinity of 0.5 ppt to 30 ppt due to ocean-derived salts (Cowardin et al. 1979).

mixosaline. Term used to characterize water with salinity of 0.5 to 30 ppt due to land-derived salts (Cowardin et al. 1979).

mollusk. Subclass in the Cowardin et al. wetland classification referring to reef systems formed by members of the invertebrate phylum Mollusca (Cowardin et al. 1979).

montane. Of, pertaining to, or inhabiting cool upland slopes below the timber line, characterized by the dominance of evergreen trees (Bates and Jackson 1980).

montane alkali lakes. Lakes with a water pH greater than 7 found in cool; upland habitats below the timber line.

montane freshwater lakes. Circumneutral lakes found in cool, upland habitats below the timber line.

moss. Subclass in the Cowardin class moss-lichen wetland in which areas with mosses, typically peats, are dominant (Cowardin et al. 1979).

moss-lichen wetland. Class in the Cowardin et al. wetland classification that includes areas where mosses or lichens cover substrates other than rock and where emergents, shrubs, or trees make up less than 30% of the areal cover. The only water regime is saturated (Cowardin et al. 1979).

mud. Wet soft earth composed predominantly of clay and silt-fine mineral sediments. Also refers to a subclass within the Cowardin et al. wetland classification system (Cowardin et al. 1979).

needle-leaved deciduous. Subclass in the Cowardin et al. wetland classification referring to wetlands where trees or shrubs are predominantly conifers that shed their leaves once a year.

needle-leaved evergreen. Subclass in the Cowardin et al. wetland classification re-

ferring to wetlands where trees or shrubs are predominantly conifers that retain their leaves for longer than one year.

nonpersistent. Subclass in the Cowardin et al. wetland classification referring to wetlands dominated by plants which fall to the surface of the substrate or below the surface of the water at the end of the growing season, so that, at certain seasons of the year, there is no obvious sign of emergent vegetation (Cowardin et al. 1979).

nonpersistent emergent. Emergent hydrophytes whose leaves and stems breakdown at the end of the growing season so that most above-ground portions of the plants are easily transported by currents, waves, or ice. The breakdown may result from normal decay or the physical force of strong waves or ice. At certain seasons of the year there are no visible traces of the plants above the surface of the water (Cowardin et al. 1979).

organic. Subclass in Cowardin et al. wetland classification referring to unconsolidated material smaller than stones that is predominantly organic in origin (Cowardin et al. 1979).

palustrine. Pertaining to wet or marshy habitats (Lincoln et al. 1982).

permanently flooded. Water regime in the Cowardin et al. wetland classification in which water covers the land surface throughout the year in all years (Cowardin et al. 1979).

persistent. Subclass in the Cowardin et al. wetland classification referring to wetland dominated by species that normally remain standing at least until the beginning of the next growing season, found only in the estuarine and palustrine systems (Cowardin et al. 1979).

persistent emergent. Emergent hydrophytes that normally remain standing at least until the beginning of the next growing season (e.g., bulrushes and cattails) (Cowardin et al. 1979).

petroleum-affected. Influenced by an oily, thick, flammable substance that is usually formed from a mixture of various hydrocarbons.

phreatophyte. A perennial plant which is very deeply rooted, deriving its water from a more or less permanent, subsurface water supply; it is thus not dependent upon annual rainfall for survival (Little and Jones 1980).

phytoplankton. The photosynthesizing organisms residing in the plankton (Levinton 1982).

plain. Any flat area, large or small, at a low elevation; specifically an extensive region of comparatively smooth and level or gently undulating land, having few or no prominent surface irregularities but sometimes having a considerable slope, and usually at a low elevation with reference to surrounding areas. A plain may be either forested or bare of trees, and may be formed by deposition or by erosion (Bates and Jackson 1980).

playa lake. A shallow, intermittent lake in an arid region, occupying a playa in the wet season but drying up in the summer; an ephemeral lake that upon evaporation leaves or forms a playa (Bates and Jackson 1984).

polyhaline. Term used to characterize water with salinity of 18 to 30 ppt due to ocean-derived salts (Cowardin et al. 1979).

polysaline. Term used to characterize water with salinity of 18 to 30 ppt due to land-derived salts (Cowardin et al. 1979).

pond. A natural body of standing fresh water occupying a small surface depression, usually smaller than a lake and larger than a pool (Bates and Jackson 1980).

pool. Channel or floodplain habitats containing water with no, or reduced current velocities; a small depression containing water at least seasonally or intermittantly.

rapids. A part of a stream where the current is moving with a greater swiftness than usual and where the water surface is broken by obstructions but without a sufficient break in slope to form a waterfall, as where the water descends over a series of small steps. It commonly results from a sudden steepening of the stream

gradient, from the presence of a restricted channel, or from the unequal resistance of the successive rocks traversed by the stream (Bates and Jackson 1980).

reference wetland. A wetland within a relatively homogeneous biogeographic region that is representative of a specific hydrogeomorphic wetland type (L. C. Lee & Associates, Inc. 1994).

reef. A class in the Cowardin et al. wetland classification referring to ridge-like or mound-like structures formed by the colonization and growth of sedentary invertebrates (Cowardin et al. 1979).

regularly flooded. Water regime in the Cowardin et al. wetland classification in which tidal waters alternately flood and expose the land surface at least once daily (Cowardin et al. 1979).

reservoir. A pond or lake, natural or artificial, from which water may be withdrawn for irrigation or water supply (Bates and Jackson 1984).

revetment. A structure built along the coast to prevent erosion and other damage by wave action; similar to a sea wall (California Coastal Commission 1987).

riffle. A shallow rapids where the water flows swiftly over partially or completely submerged obstructions to produce surface agitation, but standing waves are absent (American Fisheries Society 1985).

riparian. Pertaining to the banks and other adjacent terrestrial (as opposed to aquatic) environs of freshwater bodies, watercourses, estuaries, and surface-emergent aquifers (springs, seeps, oases), whose transported fresh waters provide soil moisture sufficiently in excess of that otherwise available through local precipitation to potentially support the growth of mesic vegetation (Warner and Hendrix 1984).

river. A natural or human-modified watercourse that contains water for at least part of the year.

river banks. The portion of the channel cross section that restricts lateral movement of water at normal discharges. Banks often have a gradient steep than 45° and exhibit a distinct break in slope from the stream bed (American Fisheries Society 1985).

river channels. Natural or artificial open conduits which continuously or periodically contain moving water, or which forms a connection between two bodies of water (Langbein and Iseri 1960).

rock bottom. Class in the Cowardin et al. wetland classification referring to all wetlands and deepwater habitats with substrates having an areal cover of stones, boulders, or bedrock 75% or greater and vegetative cover of less than 30%.

rocky shore. Class in the Cowardin et al. wetland classification referring to all wetland environments characterized by bedrock, stones, or boulders which singly or in combination have an areal cover of 70% or more and an areal coverage by vegetation of less than 30% (Cowardin et al. 1979).

rooted vascular. Subclass in the Cowardin et al. wetland classification referring to a large array of vascular plants rooted in a substrate and that are found in the aquatic bed subclass (Cowardin et al. 1979).

rubble. Subclass in Cowardin et al. wetland classification referring to classes with less than 70% areal cover of bedrock, but stones and boulders alone, or in combination with bedrock, cover 70% or more of the surface (Cowardin et al. 1979).

runs. An area of swiftly flowing water, without surface agitation or waves, which approximates uniform flow and in which the slope of the water surface is roughly parallel to the overall gradient of the stream reach (American Fisheries Society 1985).

sag pond. A small body of water occupying an enclosed depression or sag formed where active or recent fault movement has impounded drainage; specifically one of many ponds and small lakes along the San Andreas Fault in California (Bates and Jackson 1984).

saline. General term for waters containing various dissolved salts. Use of saline can be restricted to inland waters where the ratios of the salts often vary; the term

haline can be applied to coastal waters where the salts are roughly in the same proportion as found in diluted sea water (Cowardin et al. 1979).

saline marsh. A saturated, poorly drained area, intermittently or permanently water covered, having aquatic and grasslike vegetation whose water chemistry contains various dissolved salts.

salinity. The total amount of solid material in grams contained in 1 kilogram of water when all the carbonate has been converted to oxide, the bromine and iodine replaced by chlorine, and all the organic matter completely oxidized (Cowardin et al. 1979).

sand. Subclass in the Cowardin et al. wetland classification referring to unconsolidated particles smaller than stones, sometimes intermixed with finer sediments (Cowardin et al. 1979).

saturated. Water regime in the Cowardin et al. wetland classification in the substrate is saturated to the surface for extended periods during the growing season, but surface water is seldom present (Cowardin et al. 1979).

scour pools. A pool formed by flow directed either laterally or obliquely against a partial channel obstruction or bank (California Department of Fish and Game 1991).

scrub-shrub wetland. Class in the Cowardin et al. wetland classification referring to areas dominated by woody vegetation less than 5 m (15 feet) tall.

seasonally flooded. Water regime in the Cowardin et al. wetland classification in which surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years (Cowardin et al. 1979).

seasonally flooded (estuarine). Water regime in estuaries with seasonally-closed mouths and seasonally-flooded habitats.

sea stack. A small, steep-sided rocky projection above sea level near a cliffed shore (California Coastal Commission 1987).

sediment. Fine-grain material and organic material in suspension, in transit, or deposited by air, water, or ice on the earth's surface (California Coastal Commission 1987).

seep. An area of minor groundwater outflow onto the land surface or into a stream channel or other waterbody. Flows are usually too small to be a spring (American Fisheries Society 1985).

semipermanently flooded. Water regime in the Cowardin et al. wetland classification in which surface water persists throughout the growing season in most years (Cowardin et al. 1979).

shore. The narrow strip of land immediately bordering any body of water, especially a sea or a large lake (Bates and Jackson 1984).

slope. The inclined surface of any part of the Earth's surface; also, a broad part of a continent descending toward an ocean (Bates and Jackson 1980).

socioeconomic values (ecosystem). Society's perceptions of the worth of an ecosystem, typically stemming from whether the system provides a form of pleasure or recreation, such as fishing, boating, etc.

spring. A place where ground water flows naturally from a rock or the soil into the land surface or into a body of surface water. Its occurrence depends on the nature and relationship of rocks, especially permeable and impermeable strata, on the position of the water table, and on the topography (Bates and Jackson 1980).

- **cold spring.** A spring whose water has a temperature appreciably below the mean annual atmospheric temperature in the area (Bates and Jackson 1980).
- **hot spring.** A thermal spring whose temperature is above that of the human body (Bates and Jackson 1980).

stream. Any body of running water that moves under gravity to progressively lower levels, in a relatively narrow but clearly defined channel on the surface of the ground, in a subterranean cavern, or beneath or in a glacier (Bates and Jackson 1980).

stream bed. Class in the Cowardin et al. wetland classification referring to wetlands contained within the intermittent subsystem of the riverine system and all channels of the estuarine system or of the tidal subsystem of the riverine system (Cowardin et al. 1979).

stream channel. The bed where a natural stream of water runs or may run; the long narrow depression shaped by the concentrated flow of a stream and covered continuously or periodically by water (Bates and Jackson 1980).

submersed. Under water, submerged (Little and Jones 1980).

subtidal. Water regime in the Cowardin et al. wetland classification in which the substrate is permanently flooded with tidal water (Cowardin et al. 1979).

sulfur-affected. Influenced by the non-metallic element sulfur.

swamp. Wet, spongy ground, saturated or intermittently inundated by standing water, typically dominated by woody plants but without an accumulation of surface peat (Lincoln et al. 1982).

temporarily flooded. Water regime in the Cowardin et al. wetland classification in which surface water is present for brief periods especially early in the growing season, but the water table usually lies well below the soil surface for most of the year (Cowardin et al. 1979).

tenaja. Pools in seasonal streams that may support a flora similar to vernal pools upon desiccation.

terrace. A relatively level bench or steplike surface breaking the continuity of a slope. The term is applied to both the lower or front slope (the riser) and the flat surface (the tread) (Bates and Jackson 1984).

tidal. Water regime in the Cowardin et al. wetland classification are largely determined by oceanic tides (Cowardin et al. 1979).

tide. The periodic rise and fall of the ocean water masses and atmosphere, produced by gravitational effects of the moon and sun on the Earth (Lincoln et al. 1982).

tide cycle. The duration of a given tidal sequence, as for example a lunar month or a tidal day (Lincoln et al. 1982).

tide gate. A gate through which water flows when the tide is in one direction and which closes automatically when the tide is in the opposite direction (Stein 1973).

tideland. The coastal area of land that is regularly covered and uncovered by the rise and fall of a normal daily tide (Lincoln et al. 1982).

tide pool. Habitat in the rocky intertidal zone that retains some water at low tide (California Coastal Commission 1987).

tidal flat. An extensive flat tract of land alternatively covered and uncovered by the tide, and comprising mostly unconsolidated mud and sand; tide flat (Lincoln et al. 1982).

tidal marsh. A low elevation marshy coastal area formed of mud and the root mat of halophytic plants, regularly inundated during high tide (Lincoln et al. 1982).

unconsolidated bottom. Class in Cowardin et al. wetland classification referring to all wetland and deepwater habitats with at least 25% cover of particles smaller than stones, and a vegetative cover less than 30% (Cowardin et al. 1979).

unconsolidated shore. Class in Cowardin et al. wetland classification referring to all wetland habitats having three characteristics: (1) unconsolidated substrates with less than 75% areal cover of stones, boulders, or bedrock; (2) less than 30% areal cover of vegetation other than pioneering plants; and (3) any of the following water regimes: irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, intermittently flooded, saturated, or artificially flooded (Cowardin et al. 1979).

upland. The ground above a floodplain; that zone sufficiently above and/or away from transported waters as to be dependent upon local precipitation for its water supplies (Warner and Hendrix 1984).

vegetated. Subclass in the Cowardin et al. wetland classification referring to nontidal

areas exposed for a sufficient period to be colonized by herbaceous annuals or seedling herbaceous perennials (pioneer plants) (Cowardin et al. 1979).

vegetated streambed. Subclass in the class streambed in the Cowardin et al. wetland classification referring to streambeds exposed long enough to be colonized by herbaceous annuals or seedling herbaceous perennials (pioneer plants) (Cowardin et al. 1979).

vernal pond. A body of water usually smaller than a true lake and larger than a pool (i.e., vernal pool), that fills with seasonal rain and usually desiccates sometime before the next rain season. All vernal ponds are wetlands.

vernal pool. Wetlands that occur in shallow basins that are generally underlain by an impervious subsoil layer (e.g., a "clay pan" or "hard pan") or bedrock outcrop, which produces a seasonally perched water table. Zedler (1987) defines the habitat as follows: "a vernal pool is a natural habitat of the Mediterranean climate region of the Pacific Coast [of North America] covered by shallow water for extended periods during the cool season but completely dry for most of the warm season drought." He has identified four important phases of the habitat cycle: wetting phase; aquatic phase; drying phase; and drought phase.

wash. A watercourse associated with an alluvial fan, stream, or river channel. Washes are often associated with arid environments and are characterized by large, high energy discharges with high bed-material load transport. Washes are often intermittent and their beds sparsely vegetated.

watershed. A geographical region which drains into a particular body of water (Little and Jones 1980).

water table. The upper surface of a zone of saturation. No water table exists where that surface is formed by an impermeable body (Cowardin et al. 1979).

wave cut platform. A gently sloping surface produced by wave erosion, extending far into the sea or lake from the base of the wave cut cliff (Bates and Jackson, 1984).

wetlands. Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For the purposes of this classification wetlands must have one or more or the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year (Cowardin et al. 1979).

worm. Subclass in the Cowardin et al. wetland classification referring to large colonies of Sabellariid worms living in individual tubes constructed from cemented sand grains. Worm reefs are generally confined to tropical waters (Cowardin et al. 1979).

APPENDIX II: TABLES 6–9

TABLE 6. HYDROGEOMORPHIC UNITS: MARINE AND ESTUARINE SYSTEMS. This table provides a numerical, hierarchical listing of the various hydrogeomorphic (HGM) units determined by the authors to be characteristic of wetlands in the study region and that are flooded by tidal water containing ocean-derived salts. Various HGM units in this table are specific to either marine or estuarine wetlands.

("00") = Water Regime
(00."0") = Water Chemistry
(00.0."000") = Hydrogeomorphic Unit
(00.0.000."0000") = Substrate/Dominance/Characteristic Types

(00.0.100.0000) Water Bodies (Hydrogeomorphic Context)

- (00.0.110.0000) Oceans
- (00.0.120.0000) Exposed Bays
  - (00.0.120) Large Exposed Bays
  - (00.0.121) Small Exposed Bays
- (00.0.130.0000) Estuaries
  - (00.0.131) Bay-Estuaries
  - (00.0.132) Lagoonal Estuaries
  - (00.0.133) River-Mouth Estuaries
  - (00.0.134) Canyon-Mouth Estuaries
  - (00.0.135) Structural-Basin Estuaries
  - (00.0.136) Dune-Stream Estuaries
  - (00.0.137) Agricultural Drainage Mouths
  - (00.0.138) Urban Drainage Mouths
- (00.0.140.0000) Coves
  - (00.0.141) Coves
- (00.0.150.0000) Lagoons
  - (00.0.151) Lagoons
- (00.0.160.0000) Harbors/Ports
  - (00.0.161) Large Harbors/Ports
  - (00.0.162) Small Harbors/Ports
- (00.0.170.0000) Tidal Ponds
  - (00.0.171) Tidal Dune-Swale Ponds
  - (00.0.172) Tidal Marsh Ponds
- (00.0.180.0000) Tide Pools
  - (00.0.181) Large Tide Pools
  - (00.0.182) Small Tide Pools

(00.0.200.0000) Channels, Fissures, Caves

- (00.0.210.0000) Surge Channels
  - (00.0.211) Large (Wide/Long) Surge Channels
  - (00.0.212) Small (Narrow/Short) Surge Channels
- (00.0.220.0000) Estuarine Channels
  - (00.0.221) Deep (Subtidal) Natural Estuarine Channels
  - (00.0.222) Shallow (Intertidal) Natural Estuarine Channels
  - (00.0.223) Deep (Subtidal) Artificial Estuarine Channels
  - (00.0.224) Shallow (Intertidal) Artificial Estuarine Channels
- (00.0.230.0000) Tidal-River Channels
  - (00.0.231) Deep (Subtidal) Main-Stem River Channels
  - (00.0.232) Shallow (Intertidal) Main-Stem River Channels
  - (00.0.233) Deep (Subtidal) Distributary River Channels
  - (00.0.234) Shallow (Intertidal) Distributary River Channels
- (00.0.240.0000) Tidal-Stream Channels
  - (00.0.241) Deep (Subtidal) Canyon-Stream Channels
  - (00.0.242) Shallow (Intertidal) Canyon-Stream Channels
  - (00.0.243) Deep (Subtidal) Dune-Stream Channels
  - (00.0.244) Shallow (Intertidal) Dune-Stream Channels
- (00.0.250.0000) Tidal-Marsh Channels
  - (00.0.251) Deep (Subtidal), Large, Tidal-Marsh Channels
  - (00.0.252) Shallow (Intertidal), Large, Tidal-Marsh Channels
  - (00.0.253) Deep (Subtidal), Intermediate, Tidal-Marsh Channels
  - (00.0.254) Shallow (Intertidal), Intermediate, Tidal-Marsh Channels
  - (00.0.255) Deep (Subtidal), Small, Tidal-Marsh Channels
  - (00.0.256) Shallow (Intertidal), Small, Tidal-Marsh Channels

TABLE 6. CONTINUED

(00.0.260.0000) Fissures
(00.0.261) Large (Wide/Long) Fissures
(00.0.262) Small (Narrow/Short) Fissures
(00.0.270.0000) Sea Caves
(00.0.271) Large Sea-Caves
(00.0.272) Small Sea-Caves
(00.0.280.0000) Culverts
(00.0.281) Large (Wide/Long) Culverts
(00.0.282) Small (Narrow/Short) Culverts
(00.0.290.0000) Tidal Ditches
(00.0.291) Deep (Subtidal), Large Tidal-Ditches
(00.0.292) Shallow (Intertidal), Large Tidal-Ditches
(00.0.293) Deep (Subtidal), Intermediate Tidal-Ditches
(00.0.294) Shallow (Intertidal), Intermediate Tidal-Ditches
(00.0.295) Deep (Subtidal), Small Tidal-Ditches
(00.0.296) Shallow (Intertidal), Small Tidal-Ditches

(00.0.300.0000) Shores, Beaches, Banks, Benches

(00.0.310.0000) Shores
(00.0.311) Ocean Shores
(00.0.312) Exposed Bay Shores
(00.0.313) Estuary Shores
(00.0.314) Cove Shores
(00.0.315) Lagoon Shores
(00.0.316) Harbor Shores
(00.0.320.0000) Beaches
(00.0.321) Ocean Beaches
(00.0.322) Exposed Bay Beaches
(00.0.323) Estuary Beaches
(00.0.324) Cove Beaches
(00.0.325) Lagoon Beaches
(00.0.326) Harbor Beaches
(00.0.330.0000) Banks
(00.0.331) Estuary Banks
(00.0.340.0000) Benches
(00.0.341) Ocean Benches
(00.0.342) Exposed Bay Benches
(00.0.343) Estuary Benches
(00.0.345) Lagoon Benches
(00.0.346) Harbor Benches
(00.0.350.0000) Terraces
(00.0.351) Estuary Terraces
(00.0.360.0000) Ledges/Ridges
(00.0.361) Ledges
(00.0.362) Hogback Ridges

(00.0.400.0000) Bottoms, Beds, Bars, Reefs, Sea Stacks, Islets

(00.0.410.0000) Beds/Bottoms/Floors
(00.0.411) Deep (Subtidal) Beds/Bottoms/Floors
(00.0.412) Shallow (Intertidal) Beds/Bottoms/Floors
(00.0.420.0000) Bars
(00.0.421) Deep (Subtidal) Bars
(00.0.422) Shallow (Intertidal) Bars
(00.0.430.0000) Reefs
(00.0.431) Large Reefs
(00.0.432) Small Reefs
(00.0.440.0000) Sea Stacks
(00.0.441) Large Sea-Stacks
(00.0.442) Small Sea-Stacks
(00.0.450.0000) Islets
(00.0.451) Large Islets
(00.0.452) Small Islets

TABLE 6. CONTINUED

(00.0.500.0000) Flats, Deltas

(00.0.510.0000) Flats
- (00.0.511) Mineral (Mud, Sand) Flats
- (00.0.512) Precipitate (Salt) Flats, Pannes
- (00.0.513) Vegetated-Algal Flats
- (00.0.514) Vegetated-Plant Flats

(00.0.520.0000) Deltas
- (00.0.521) Deltas

(00.0.600.0000) Headlands, Bluffs, Slopes

(00.0.610.0000) Headlands
- (00.0.611) Large Headlands
- (00.0.612) Small Headlands

(00.0.620.0000) Cliffs/Bluffs
- (00.0.621) Cliffs/Bluffs

(00.0.630.0000) Slopes
- (00.0.631) Ocean Slopes
- (00.0.632) Exposed Bay Slopes
- (00.0.633) Estuary Slopes
- (00.0.634) Cove Slopes
- (00.0.635) Lagoon Slopes
- (00.0.636) Harbor Slopes

(00.0.700.0000) Seeps, Springs

(00.0.710.0000) Seeps
- (00.0.711) Seeps

(00.0.720.0000) Springs
- (00.0.721) Springs

(00.0.800.0000) Marshes

(00.0.810.0000) Salt Marshes
- (00.0.811) Low-Intertidal Salt Marshes
- (00.0.812) Middle-Intertidal Salt Marshes
- (00.0.813) High-Intertidal Salt Marshes

(00.0.820.0000) Brackish Marshes
- (00.0.821) Low-Intertidal Brackish Marshes
- (00.0.822) Middle-Intertidal Brackish Marshes
- (00.0.823) High-Intertidal Brackish Marshes

(00.0.830.0000) Fringe Marshes
- (00.0.831) Low-Intertidal Fringe Marshes
- (00.0.832) Middle-Intertidal Fringe Marshes
- (00.0.833) High-Intertidal Fringe Marshes

(00.0.840.0000) Diked Marshes
- (00.0.841) Low-Intertidal Diked Marshes
- (00.0.842) Middle-Intertidal Diked Marshes
- (00.0.843) High-Intertidal Diked Marshes

(00.0.900.0000) Artificial Structures

(00.0.910.0000) Stationary Artificial Structures
- (00.0.911) Jetties/Breakwaters
- (00.0.912) Sea Wall/Revetment
- (00.0.913) Dams/Levees
- (00.0.914) Earthen Berms/Dikes
- (00.0.915) Dredge Spoils
- (00.0.916) Pilings/Piers
- (00.0.917) Oil Platforms
- (00.0.918) Boat Ramps
- (00.0.919) Wreckage

(00.0.920.0000) Floating Artificial Structures
- (00.0.921) Hulls
- (00.0.922) Docks
- (00.0.923) Buoys
- (00.0.924) Logs

TABLE 7. HYDROGEOMORPHIC UNITS: RIVERINE, LACUSTRINE, AND PALUSTRINE SYSTEMS. This table provides a numerical, hierarchical listing of the various hydrogeomorphic (HGM) units determined by the authors to be characteristic of wetlands in the study region and that are not flooded by tidal water containing ocean-derived salts. Various HGM units in this table are specific to the riverine, lacustrine, or palustrine systems.

("00") = Water Regime (00.0."000") = Hydrogeomorphic Unit
(00."0") = Water Chemistry (00.0.000."0000") = Substrate/Dominance/Characteristic Types

(00.0.100.0000) Water Bodies (Hydrogeomorphic Context)

(00.0.110.0000) Pools
- (00.0.111) Vernal Pools
- (00.0.112) Tenajas
- (00.0.113) Main Channel Pools
- (00.0.114) Scour Pools
- (00.0.115) Backwater Pools

(00.0.120.0000) Riffles
- (00.0.121) Riffles
- (00.0.122) Rapids
- (00.0.123) Cascades
- (00.0.124) Runs
- (00.0.125) Falls

(00.0.130.0000) Springs
- (00.0.131) Cold Springs
- (00.0.132) Hot Springs

(00.0.140.0000) Palustrine Ponds, Lakes, Reservoirs
- (00.0.141) Dune Ponds ("Lakes")
- (00.0.142) Coastal Ponds
- (00.0.143) Fault Sag Ponds
- (00.0.144) Glacial Ponds ("Lakes")
- (00.0.145) Vernal Ponds
- (00.0.146) Palustrine Vernal Lakes
- (00.0.147) Agricultural Ponds, Reservoirs
- (00.0.148) Recreational Ponds, Reservoirs
- (00.0.149) Diked Estuarine Basins

(00.0.150.0000) Lacustrine Lakes, Reservoirs
- (00.0.151) Montane Freshwater Lakes
- (00.0.152) Montane Alkali Lakes
- (00.0.153) Playa Lakes
- (00.0.154) Montane Reservoirs
- (00.0.155) River-Valley Reservoirs
- (00.0.156) Canyon Reservoirs
- (00.0.157) Caldera Lakes

(00.0.160.0000) Streams
- (00.0.161) Montane Streams
- (00.0.162) Foothill/Terrace Streams
- (00.0.163) Valley Streams
- (00.0.164) Coastal-Plain Streams
- (00.0.165) Canyon Streams

(00.0.170.0000) Rivers
- (00.0.171) Montane Rivers
- (00.0.172) Foothill Rivers
- (00.0.173) Valley Rivers
- (00.0.174) Coastal-Plain Rivers
- (00.0.175) Canyon Rivers

(00.0.180.0000) Drainages
- (00.0.181) Montane Drainages
- (00.0.182) Coastal Canyon Drainages

(00.0.200.0000) Channels, Drainages, Inverts, Falls

(00.0.210.0000) Stream Channels
- (00.0.211) Montane Stream Channels
- (00.0.212) Foothill/Terrace Stream Channels
- (00.0.213) Valley Stream Channels
- (00.0.214) Coastal Plain Stream Channels

TABLE 7. CONTINUED

(00.0.215) Distributary Channels
(00.0.220.0000) River Channels
(00.0.221) Montane River Channels
(00.0.222) Foothill River Channels
(00.0.223) Valley River Channels
(00.0.224) Coastal Plain River Channels
(00.0.225) Distributary Channels
(00.0.226) Canyon River Channels
(00.0.230.0000) Backbar Channels
(00.0.231) Stream Backbar Channels
(00.0.232) River Backbar Channels
(00.0.240.0000) Drainage Channels
(00.0.241) Vernal Drainage Channels
(00.0.242) Montane Drainage Channels
(00.0.250.0000) Inverts
(00.0.251) Montane Drainage Inverts
(00.0.260.0000) Falls
(00.0.261) Montane Stream Falls
(00.0.262) Foothill Stream Falls
(00.0.263) Montane River Falls
(00.0.264) Foothill River Falls
(00.0.270.0000) Lacustrine Channels
(00.0.280.0000) Artificial Ditches

(00.0.300.0000) Shores, Beaches, Banks, Margins

(00.0.310.0000) Palustrine Pond Shores
(00.0.311) Dune Pond Shores
(00.0.312) Coastal Pond Shores
(00.0.313) Fault Sag Pond Shores
(00.0.314) Glacial Pond ("Lake") Shores
(00.0.315) Vernal Pond Shores
(00.0.316) Agricultural Pond Shores
(00.0.317) Recreational Pond Shores
(00.0.320.0000) Palustrine Lake/Reservoir Shores
(00.0.321) Vernal Palustrine-Lake Shores
(00.0.322) Agricultural Palustrine-Lake Shores
(00.0.323) Recreational Palustrine-Lake Shores
(00.0.330.0000) Lacustrine Lake/Reservoir Shores
(00.0.331) Montane Freshwater Lacustrine-Lake Shores
(00.0.332) Montane Alkali Lacustrine-Lake Shores
(00.0.333) Playa Lake Shores
(00.0.334) Montane Reservoir Shores
(00.0.335) River-Valley Reservoir Shores
(00.0.336) Canyon Reservoir Shores
(00.0.337) Caldera Lake Shores
(00.0.340.0000) Stream Shores
(00.0.341) Montane Stream-Shores
(00.0.342) Foothill/Terrace Stream-Shores
(00.0.343) Valley Stream-Shores
(00.0.344) Coastal-Plain Stream-Shores
(00.0.345) Canyon Stream-Shores
(00.0.350.0000) River Shores
(00.0.351) Montane River-Shores
(00.0.352) Foothill River-Shores
(00.0.353) Valley River-Shores
(00.0.354) Coastal-Plain River-Shores
(00.0.355) Canyon River-Shores
(00.0.360.0000) Beaches
(00.0.361) River Beaches
(00.0.362) Lake Beaches
(00.0.370.0000) Stream Banks
(00.0.371) Montane Stream-Banks
(00.0.372) Foothill/Terrace Stream-Banks
(00.0.373) Valley Stream-Banks

TABLE 7. CONTINUED

(00.0.374) Coastal-Plain Stream-Banks
(00.0.375) Canyon Stream-Banks
(00.0.380.0000) River Banks
(00.0.381) Montane River-Banks
(00.0.382) Foothill River-Banks
(00.0.383) Valley River-Banks
(00.0.384) Coastal-Plain River-Banks
(00.0.385) Canyon River Banks
(00.0.390.0000) Margins
(00.0.391) Stream Margins
(00.0.392) River Margins
(00.0.393) Estuary Margins
(00.0.394) Pool Margins
(00.0.395) Pond Margins
(00.0.396) Swale Margins
(00.0.397) Lake Margins
(00.0.398) Seep, Spring Margins
(00.0.399) Meadow, Marsh Margins

(00.0.400.0000) Beds, Bottoms, Bars

(00.0.410.0000) Pool Beds/Bottoms
(00.0.411) Vernal Pool Beds/Bottoms
(00.0.412) Tenaja Beds/Bottoms
(00.0.413) Main-Channel Pool Bottoms
(00.0.414) Scour Pool Bottoms
(00.0.415) Backwater Pool Bottoms
(00.0.420.0000) Palustrine Pond Beds/Bottoms
(00.0.421) Dune Pond ("Lake") Beds/Bottoms
(00.0.422) Coastal Pond Beds/Bottoms
(00.0.423) Fault Sag Pond Beds/Bottoms
(00.0.424) Glacial Pond ("Lake") Beds/Bottoms
(00.0.425) Vernal Pond Beds/Bottoms
(00.0.426) Agricultural Pond/Reservoir Beds/Bottoms
(00.0.427) Recreational Pond/Reservoir Beds/Bottoms
(00.0.430.0000) Palustrine Lake Beds/Bottoms
(00.0.431) Palustrine Vernal Lake Beds/Bottoms
(00.0.432) Palustrine Perennial Lake Beds/Bottoms
(00.0.433) Palustrine Agricultural Lake Beds/Bottoms
(00.0.434) Palustrine Recreational Lake/Reservoir Beds/Bottoms
(00.0.440.0000) Lacustrine Lake/Reservoir Beds/Bottoms
(00.0.441) Montane Freshwater Lake Beds/Bottoms
(00.0.442) Montane Alkali Lake Beds/Bottoms
(00.0.443) Playa Lake Beds/Bottoms
(00.0.444) Montane Reservoir Beds/Bottoms
(00.0.445) River-Valley Reservoir Beds/Bottoms
(00.0.446) Canyon Reservoir Beds/Bottoms
(00.0.447) Caldera Lake Beds/Bottoms
(00.0.450.0000) Stream Beds/Bottoms
(00.0.451) Montane Streambeds
(00.0.452) Foothill/Terrace Streambeds
(00.0.453) Valley Streambeds
(00.0.454) Coastal Plain Streambeds
(00.0.455) Canyon Streambeds
(00.0.460.0000) River Beds/Bottoms
(00.0.461) Montane Riverbeds
(00.0.462) Foothill Riverbeds
(00.0.463) Valley Riverbeds
(00.0.464) Coastal-Plain Riverbeds
(00.0.465) Canyon Riverbeds
(00.0.470.0000) Stream-Channel Bars
(00.0.471) Montane Stream-Channel Bars
(00.0.472) Foothill/Terrace Stream-Channel Bars
(00.0.473) Valley Stream-Channel Bars
(00.0.474) Coastal-Plain Stream-Channel Bars

TABLE 7. CONTINUED

(00.0.475) Canyon Stream-Channel Bars
(00.0.480.0000) River-Channel Bars
(00.0.481) Montane River-Channel Bars
(00.0.482) Foothill River-Channel Bars
(00.0.483) Valley River-Channel Bars
(00.0.484) Coastal-Plain River-Channel Bars
(00.0.485) Canyon River-Channel Bars
(00.0.490.0000) Lake Bars

(00.0.500.0000) Flats, Plains, Washes, Bottomlands, Terraces

(00.0.510.0000) Flats
(00.0.511) Vernal Flats
(00.0.520.0000) Plains
(00.0.521) Coastal Plains
(00.0.522) Montane-Valley Vernal Plains
(00.0.523) Alkali Vernal Plains
(00.0.524) Haline Vernal Plains
(00.0.530.0000) Deltas
(00.0.531) Stream Deltas
(00.0.532) River Deltas
(00.0.533) Coastal Deltas
(00.0.534) Lake Deltas
(00.0.540.0000) Washes
(00.0.541) Stream Washes
(00.0.542) River Washes
(00.0.543) Alluvial Washes
(00.0.550.0000) Floodplains, Bottomlands
(00.0.551) Stream Floodplains, Bottomlands
(00.0.552) River Floodplains, Bottomlands
(00.0.553) Canyon Floodplains, Bottomlands
(00.0.554) Montane Floodplains, Bottomlands
(00.0.560.0000) Terraces
(00.0.561) River Terraces
(00.0.562) Stream Terraces
(00.0.563) Valley Terraces
(00.0.564) Coastal Terraces

(00.0.600.0000) Headlands, Bluffs, Slopes

(00.0.610.0000) Headlands
(00.0.620.0000) Cliffs/Bluffs
(00.0.621) Coastal Cliffs/Bluffs
(00.0.622) Canyon Cliffs/Bluffs
(00.0.630.0000) Slopes
(00.0.631) Coastal Plain Slopes
(00.0.632) Canyon Slopes
(00.0.633) Foothill Slopes
(00.0.634) Montane Slopes
(00.0.640.0000) Alluvial Fans
(00.0.641) Montane Alluvial Fans
(00.0.642) Foothill Alluvial Fans
(00.0.643) Valley Alluvial Fans

(00.0.700.0000) Seeps, Springs

(00.0.710.0000) Seeps
(00.0.711) Drainage Head Seeps
(00.0.712) Bluff and Slope Seeps
(00.0.713) Canyon Seeps
(00.0.714) Stream Bank/Bed Seeps
(00.0.715) River Bank/Bed Seeps
(00.0.716) Montane Seeps
(00.0.717) Foothill Seeps
(00.0.718) Valley and Plain Seeps
(00.0.719) Lake Seeps
(00.0.720.0000) Springs
(00.0.721) Drainage-Head Springs

TABLE 7. CONTINUED

(00.0.722) Bluff and Slope Springs
(00.0.723) Canyon Springs
(00.0.724) Stream Bank/Bed Springs
(00.0.725) River Bank/Bed Springs
(00.0.726) Montane Springs
(00.0.727) Foothill Springs
(00.0.728) Valley and Plain Springs
(00.0.729) Lake Springs
(00.0.730.0000) Hot Springs
(00.0.740.0000) Artificial Seeps
(00.0.750.0000) Artificial Springs

(00.0.800.0000) Palustrine Basins/Depressions: Pools, Ponds, Lakes, Meadows, Marshes, Swales

(00.0.810.0000) Vernal Pools
(00.0.811) Coastal-Terrace Vernal Pools
(00.0.812) Mesa Vernal Pools
(00.0.813) River-Terrace Vernal Pools
(00.0.814) Coastal-Valley/Plain Vernal Pools
(00.0.815) Foothill-Valley Vernal Pools
(00.0.816) Montane-Plateau Vernal Pools
(00.0.820.0000) Palustrine Ponds, Lakes
(00.0.821) Coastal-Dune Ponds ("Lakes")
(00.0.822) Coastal-Canyon Ponds
(00.0.823) Fault-Sag Ponds
(00.0.824) Glacial Ponds ("Lakes")
(00.0.825) Vernal Ponds
(00.0.826) Palustrine Vernal Lakes
(00.0.827) Agricultural Ponds
(00.0.828) Recreational Ponds
(0.0.830.0000) Meadows
(00.0.831) Montane Vernal Meadows
(00.0.832) Montane Perennial Meadows
(00.0.840.0000) Marshes
(00.0.841) Vernal Freshwater Marshes
(00.0.842) Perennial Freshwater Marshes
(00.0.843) Saline Marshes
(00.0.844) Haline Marshes
(00.0.845) Stream-Channel Marshes
(00.0.846) River-Channel Marshes
(00.0.847) Lake-Shore Marshes
(00.0.848) Diked Estuarine Marshes
(00.0.850.0000) Swales
(00.0.851) Montane Drainages Swales
(00.0.852) Coastal Terrace Drainage Swales
(00.0.853) Dune/Beach Swales
(00.0.854) Vernal Drainage Swales
(00.0.855) Artificial Drainage Swales

(00.0.900.0000) Artificial Structures

(00.0.910.0000) Stationary Artificial Structures
(00.0.911) Jetties/Breakwaters
(00.0.912) Bank Revetments
(00.0.913) Dams/Levees
(00.0.914) Earthen Berms/Dikes
(00.0.915) Dredge spoils
(00.0.916) Pilings/Piers
(00.0.917) Platforms
(00.0.918) Boat Ramps
(00.0.919) Wreckage
(00.0.920.0000) Floating Artificial Structures
(00.0.921) Hulls
(00.0.922) Docks
(00.0.923) Buoys
(00.0.924) Logs

TABLE 8. SUBSTRATE/DOMINANCE/CHARACTERISTIC TYPES: MARINE AND ESTUARINE SYSTEMS. This table provides a numerical, hierarchical listing of major substrate categories and dominant or characteristic species of marine and estuarine wetlands (i.e., tidal-flooding with water containing ocean-derived salts). This table serves as a source of information when compiling a wetland numerical code and name. Most categories or types are either open-ended or contain open numbers for additions.

("00") = Water Regime (00.0."000") = Hydrogeomorphic Unit
(00."0") = Water Chemistry (00.0.000."0000") = Substrate/Dominance/Characteristic Types

SUBSTRATE/DOMINANCE/CHARACTER TYPES (Categories)

(00.0.000.1000) Non-Organic and Non-Living Organic Dominance Types

(00.0.000.1100) Open Water Types
(00.0.000.1200) Bedrock Types
(00.0.000.1300) Boulder Types
(00.0.000.1400) Cobble Types
(00.0.000.1500) Mixed-Coarse Types
(00.0.000.1600) Sand Types
(00.0.000.1700) Mixed-Fine Types
(00.0.000.1800) Mud Types
(00.0.000.1900) Organic Types

(00.0.000.2000) Algal (Protista-Monera) Dominance Types

(00.0.000.2100) Diatom Types
(00.0.000.2110) Estuarine Diatoms
(00.0.000.2111) *Himphora* sp.
(00.0.000.2112) *Nitachia longissima*
(00.0.000.2113) *Pleurosigma estuarii*
(00.0.000.2200) Green Algal Types
(00.0.000.2210) Bladder Types
(00.0.000.2220) Branching Foliose Types
(00.0.000.2221) *Codium*
(00.0.000.2230) Non-branching Foliose Types
(00.0.000.2231) *Ulva*
(00.0.000.2240) Turf Types
(00.0.000.2241) *Bryopsis*
(00.0.000.2242) *Cladophora*
(00.0.000.2250) Encrusting Types
(00.0.000.2260) Filamentous Types
(00.0.000.2261) *Chaetomorpha*
(00.0.000.2262) *Enteromorpha*
(00.0.000.2263) *Ulothrix*
(00.0.000.2300) Brown Algal Types
(00.0.000.2310) Bladder Types
(00.0.000.2311) *Cystoseira*
(00.0.000.2312) *Egregia*
(00.0.000.2313) *Halidrys*
(00.0.000.2314) *Sargassum*
(00.0.000.2320) Branching Foliose Types
(00.0.000.2321) *Desmarestia*
(00.0.000.2322) *Eisenia*
(00.0.000.2323) *Fucus*
(00.0.000.2324) *Hesperophycus*
(00.0.000.2325) *Pelvetia*
(00.0.000.2326) *Postelsia*
(00.0.000.2327) *Zonaria*
(00.0.000.2330) Non-branching Foliose Types
(00.0.000.2331) *Alaria*
(00.0.000.2332) *Colpomenia*

TABLE 8. CONTINUED

(00.0.000.2333) *Dictyota*
(00.0.000.2334) *Laminaria*
(00.0.000.2335) *Pterogophora*
(00.0.000.2340) Turf Types
(00.0.000.2341) *Pelvetiopsis*
(00.0.000.2350) Encrusting Types
(00.0.000.2351) *Ralfsia*
(00.0.000.2360) Filamentous Types
(00.0.000.2361) *Giffordia*
(00.0.000.2362) *Scytosiphon*
(00.0.000.2400) Red Algal Types
(00.0.000.2410) Bladder Types
(00.0.000.2420) Branching Foliose Types
(00.0.000.2421) *Botryoglossum*
(00.0.000.2422) *Gastroclonium*
(00.0.000.2423) *Gelidium*
(00.0.000.2424) *Gigartina*
(00.0.000.2425) *Gracilaria*
(00.0.000.2426) *Prionites*
(00.0.000.2427) *Rhodoglossum*
(00.0.000.2428) *Rhodomela*
(00.0.000.2430) Non-branching Foliose Types
(00.0.000.2431) *Halosaccion*
(00.0.000.2432) *Iridaea*
(00.0.000.2433) *Nemalion*
(00.0.000.2434) *Porphyra*
(00.0.000.2440) Turf Types
(00.0.000.2441) *Endocladia*
(00.0.000.2450) Encrusting Types
(00.0.000.2451) *Pseudolithophyllum*
(00.0.000.2460) Filamentous Types
(00.0.000.2461) *Bangia*
(00.0.000.2462) *Polysiphonia*
(00.0.000.2463) *Rhodochorton*
(00.0.000.2470) Erect Coralline Types
(00.0.000.2471) *Bossiella*
(00.0.000.2472) *Corallina*
(00.0.000.2500) Mixed Protista Type
(00.0.000.2600) Blue-Green Algal Type

(00.0.000.3000) Moss-Lichen, Fungal Types

(00.0.000.3100) Moss Types
(00.0.000.3200) Liverwort Types
(00.0.000.3300) Mixed-Bryophyte Types
(00.0.000.3400) Lichen Types
(00.0.000.3500) Moss-Lichen Types
(00.0.000.3600) Fungal Types

(00.0.000.4000) Pteriodophyte Dominance Types

(00.0.000.4100) Quillwort Dominance Types
(00.0.000.4200) Horsetail Dominance Types
(00.0.000.4300) Fern Dominance Types
(00.0.000.4310) Aquatic Bed Types
(00.0.000.4311) *Azolla filiculoides*

(00.0.000.5000) Dicot Vascular-Plant Dominance Types

(00.0.000.5100) Aquatic-Bed Types
(00.0.000.5200) Persistent Emergent Types (Asteraceae)
(00.0.000.5210) *Jaumea*
(00.0.000.5211) *Jaumea carnosa*
(00.0.000.5220) *Euthamia*
(00.0.000.5221) *Euthamia occidentalis*
(00.0.000.5300) Persistent Emergent Types (Chenopodiaceae)
(00.0.000.5310) *Arthrocnemum*
(00.0.000.5311) *Arthrocnemum subterminale*

TABLE 8. CONTINUED

(00.0.000.5320) *Atriplex*
(00.0.000.5321) *Atriplex watsonii*
(00.0.000.5330) *Salicornia*
(00.0.000.5331) *Salicornia virginica*
(00.0.000.5340) *Suaeda*
(00.0.000.5341) *Suaeda esteroa*
(00.0.000.5400) Persistent Emergent Types (Other)
(00.0.000.5410) Batidaceae
(00.0.000.5411) *Batis maritima*
(00.0.000.5420) Convolvulaceae
(00.0.000.5421) *Cressa truxillensis*
(00.0.000.5430) Cuscutaceae
(00.0.000.5431) *Cuscuta salina*
(00.0.000.5440) Frankeniaceae
(00.0.000.5441) *Frankenia salina*
(00.0.000.5450) Plumbaginaceae
(00.0.000.5451) *Limonium californicum*
(00.0.000.5500) Nonpersistent Emergent Types
(00.0.000.5510) Asteraceae
(00.0.000.5511) *Cotula coronopifolia*
(00.0.000.5512) *Lasthenia glabrata*
(00.0.000.5520) Brassicaceae
(00.0.000.5521) *Hutchinsia procumbens*
(00.0.000.5530) Caryophyllaceae
(00.0.000.5531) *Spergularia marina*
(00.0.000.5540) Chenopodiaceae
(00.0.000.5541) *Atriplex triangularis*
(00.0.000.5542) *Chenopodium macrospermum*
(00.0.000.5543) *Salicornia europaea*
(00.0.000.5544) *Suaeda calceoliformis*
(00.0.000.5550) Scrophulariaceae
(00.0.000.5551) *Cordylanthus maritimus*
(00.0.000.5600) Scrub-Shrub Types
(00.0.000.5610) Aizoaceae
(00.0.000.5611) *Carpobrotus edulis*
(00.0.000.5612) *Malephora crocea*
(00.0.000.5620) Asteraceae
(00.0.000.5621) *Baccharis douglasii*
(00.0.000.5622) *Baccharis pilularis*
(00.0.000.5623) *Baccharis salicifolia*
(00.0.000.5624) *Isocoma menziesii*
(00.0.000.5630) Chenopodiaceae
(00.0.000.5631) *Atriplex lentiformis*
(00.0.000.5632) *Suaeda californica*
(00.0.000.5633) *Suaeda taxifolia*
(00.0.000.5640) Salicaceae
(00.0.000.5641) *Salix exigua*
(00.0.000.5642) *Salix lasiolepis*
(00.0.000.5700) Woodland Types
(00.0.000.5800) Forest Types

(00.0.000.6000) Monocot Vascular-Plant Dominance Types

(00.0.000.6100) Aquatic-Bed Types
(00.0.000.6110) Lemnaceae
(00.0.000.6111) *Lemna gibba*
(00.0.000.6112) *Lemna minor*
(00.0.000.6113) *Lemna minuscula*
(00.0.000.6120) Potamogetonaceae
(00.0.000.6121) *Potamogeton pectinatus*
(00.0.000.6122) *Ruppia cirrhosa*
(00.0.000.6123) *Ruppia maritima*
(00.0.000.6130) Zannichelliaceae
(00.0.000.6131) *Zannichellia americana*
(00.0.000.6140) Zosteraceae

TABLE 8. CONTINUED

(00.0.000.6141) *Phyllospadix scouleri*
(00.0.000.6142) *Phyllospadix torreyi*
(00.0.000.6143) *Zostera marina*
(00.0.000.6200) Persistent Emergent Types (Cyperaceae—Sedges)
(00.0.000.6210) *Carex*
(00.0.000.6220) *Eleocharis*
(00.0.000.6221) *Eleocharis macrostachya*
(00.0.000.6230) *Scirpus*
(00.0.000.6231) *Scirpus americanus*
(00.0.000.6232) *Scirpus californicus*
(00.0.000.6233) *Scirpus maritimus*
(00.0.000.6234) *Scirpus pungens*
(00.0.000.6235) *Scirpus robustus*
(00.0.000.6300) Persistent Emergent Types (Juncaceae—Rushes)
(00.0.000.6310) *Juncus*
(00.0.000.6311) *Juncus acutus*
(00.0.000.6312) *Juncus balticus*
(00.0.000.6400) Persistent Emergent Types (Poaceae—Grasses)
(00.0.000.6410) *Distichlis*
(00.0.000.6411) *Distichlis spiata*
(00.0.000.6420) *Leymus*
(00.0.000.6421) *Leymus triticoides*
(00.0.000.6430) *Monanthochloe*
(00.0.000.6431) *Monanthochloe littoralis*
(00.0.000.6440) *Spartina*
(00.0.000.6441) *Spartina foliosa*
(00.0.000.6500) Persistent Emergent Types (Other)
(00.0.000.6510) Juncaginaceae
(00.0.000.6511) *Triglochin concinna*
(00.0.000.6520) Typhaceae
(00.0.000.6521) *Typha domingensis*
(00.0.000.6600) Nonpersistent Emergent Types
(00.0.000.6610) Juncaceae
(00.0.000.6611) *Juncus bufonius*

(00.0.000.7000) Mixed-Vascular Types

(00.0.000.8000) Animal Dominance Types

(00.0.000.8100) Sponge Types
(00.0.000.8110) Encrusting Types
(00.0.000.8111) *Halichondria*
(00.0.000.8112) *Haliclona*
(00.0.000.8113) *Hymenamphiastra*
(00.0.000.8114) *Leucetta*
(00.0.000.8115) *Leucosolenia*
(00.0.000.8116) *Ophlitaspongia*
(00.0.000.8120) Erect Types
(00.0.000.8121) *Microciona*
(00.0.000.8200) Coelenterate Types
(00.0.000.8210) Hydroid Types
(00.0.000.8211) *Aglaophenia*
(00.0.000.8212) *Anthopleura*
(00.0.000.8213) *Corynactis*
(00.0.000.8214) *Epiactis*
(00.0.000.8215) *Obelia*
(00.0.000.8216) *Tubularia*
(00.0.000.8300) Mollusc Types
(00.0.000.8310) Gastropod Types
(00.0.000.8311) *Cerithidea*
(00.0.000.8312) *Haliotis*
(00.0.000.8313) *Littorina*
(00.0.000.8314) *Surpulorbis*
(00.0.000.8315) *Tegula*

TABLE 8. CONTINUED

(00.0.000.8320) Oyster Types
(00.0.000.8321) *Crassostrea*
(00.0.000.8322) *Ostrea*
(00.0.000.8330) Mussel Types
(00.0.000.8331) *Mytilus*
(00.0.000.8340) Clam Types
(00.0.000.8341) *Donax*
(00.0.000.8342) *Macoma*
(00.0.000.8343) *Mya*
(00.0.000.8344) *Penitella*
(00.0.000.8345) *Protothaca*
(00.0.000.8346) *Tagelus*
(00.0.000.8400) Annelid Types
(00.0.000.8410) Burrow Dwelling Polychaete Types
(00.0.000.8411) *Euzonus*
(00.0.000.8420) Tube Building Polychaete types
(00.0.000.8421) *Phragmatopoma*
(00.0.000.8422) *Polydora*
(00.0.000.8423) *Spirorbis*
(00.0.000.8424) *Surpula*
(00.0.000.8500) Crustacean Types
(00.0.000.8510) Amphipod Types
(00.0.000.8511) *Megalorchestia*
(00.0.000.8520) Barnacle Types
(00.0.000.8521) *Cthamalus*
(00.0.000.8522) *Balanus*
(00.0.000.8523) *Lepas*
(00.0.000.8524) *Pollicipes*
(00.0.000.8525) *Semibalanus*
(00.0.000.8526) *Tetraclita*
(00.0.000.8530) Crab Types
(00.0.000.8531) *Emerita*
(00.0.000.8532) *Hemigrapsus*
(00.0.000.8533) *Pachygrapsus*
(00.0.000.8534) *Pagurus*
(00.0.000.8535) *Uca*
(00.0.000.8600) Insect Types
(00.0.000.8610) Midge Types
(00.0.000.8620) Mosquito Types
(00.0.000.8630) Blackfly Types
(00.0.000.8640) Staphylinid beetles
(00.0.000.8700) Echinoderm Types
(00.0.000.8710) Sand Dollar Types
(00.0.000.8711) *Dendraster*
(00.0.000.8720) Sea Urchin Types
(00.0.000.8721) *Strongylocentrotus*
(00.0.000.8800) Other Invertebrate Types
(00.0.000.8810) Bryozoan Types
(00.0.000.8811) *Bugula*
(00.0.000.8812) *Thalamoporella*
(00.0.000.8820) Tunicate Types
(00.0.000.8821) *Botyrloides*
(00.0.000.8822) *Ciona*
(00.0.000.8823) *Diplosoma*
(00.0.000.8824) *Styela*
(00.0.000.8900) Vertebrate Types
(00.0.000.8910) Fish Types
(00.0.000.8920) Bird Types
(00.0.000.8230) Mammal Types
(00.0.000.8931) *Phoca*
(00.0.000.8932) *Zalophus*

TABLE 9. SUBSTRATE/DOMINANCE/CHARACTERISTIC TYPES: RIVERINE, LACUSTRINE, AND PALUSTRINE SYSTEMS. This table provides a numerical, hierarchical listing of major substrate categories and dominant or characteristic species of riverine, lacustrine, and palustrine wetlands (i.e., wetlands not flooded with tidal water containing ocean-derived salts). This table serves as a source of information when compiling a wetland numerical code. Most categories or types are either open-ended or contain open numbers for additions.

("00") = Water Regime
(00."0") = Water Chemistry
(00.0."000") = Hydrogeomorphic Unit
(00.0.000."0000") = Substrate/Dominance/Characteristic Types

SUBSTRATE/DOMINANCE/CHARACTERISTIC TYPES (Categories)

(00.0.000.1000) Non-Organismic Dominance Types

(00.0.000.1100) Open Water Types
(00.0.000.1200) Bedrock Types
(00.0.000.1300) Boulder Types
(00.0.000.1400) Cobble Types
(00.0.000.1500) Mixed-Course Types
(00.0.000.1600) Sand Types
(00.0.000.1700) Mixed-Fine Types
(00.0.000.1800) Mud Types
(00.0.000.1900) Organic Types

(00.0.000.2000) Algal (Protista-Monera) Dominance/Characteristic Types

(00.0.000.2100) Diatom Types
(00.0.000.2200) Green Algal Types
(00.0.000.2210) Bladder Types
(00.0.000.2220) Branching Foliose Types
(00.0.000.2221) *Chara*
(00.0.000.2222) *Nitella*
(00.0.000.2230) Non-branching Foliose Types
(00.0.000.2240) Turf Types
(00.0.000.2250) Encrusting Types
(00.0.000.2260) Filamentous Types
(00.0.000.2261) *Enteromorpha*
(00.0.000.2300) Brown Algal Types
(00.0.000.2400) Red Algal Types
(00.0.000.2500) Mixed-Protista Types
(00.0.000.2600) Blue-Green Algal Types

(00.0.000.3000) Moss-Lichen, Fungi Dominance/Characteristic Types

(00.0.000.3100) Moss Types
(00.0.000.3200) Liverwort Types
(00.0.000.3300) Mixed Bryophyte Types
(00.0.000.3400) Lichen Types
(00.0.000.3500) Moss-Lichen Types
(00.0.000.3600) Fungi Types

(00.0.000.4000) Pteridophyte Dominance/Characteristic Types

(00.0.000.4100) Quillwort Types
(00.0.000.4110) *Isoetes*
(00.0.000.4111) *Isoetes howellii*
(00.0.000.4200) Horsetail Types
(00.0.000.4210) *Equisetum*
(00.0.000.4211) *Equisetum hyemale*
(00.0.000.4212) *Equisetum laevigatum*
(00.0.000.4213) *Equisetum telmateia*

TABLE 9. CONTINUED

(00.0.000.4300) Fern Types
(00.0.000.4310) Aquatic Bed Types
(00.0.000.4311) *Azolla filiculoides*
(00.0.000.4320) Emergent Types
(00.0.000.4321) *Adiantum capillus-veneris*
(00.0.000.4322) *Athyrium filix-femina*
(00.0.000.4323) *Marsilea vestita*
(00.0.000.4324) *Pilularia americana*
(00.0.000.4325) *Polystichum munitum*
(00.0.000.4326) *Pteridium aquilinum*
(00.0.000.4327) *Thelypteris puberula*
(00.0.000.4328) *Woodwardia fimbriata*

(00.0.000.5000) Dicot/Conifer Vascular-Plant Dominance/Characteristic Types

(00.0.000.5100) Aquatic-Bed types
(00.0.000.5110) Callitrichaceae
(00.0.000.5111) *Callitriche heterophylla*
(00.0.000.5112) *Callitriche marginata*
(00.0.000.5120) Ceratophyllaceae
(00.0.000.5121) *Ceratophyllum demersum*
(00.0.000.5130) Elatinaceae
(00.0.000.5131) *Elatine californica*
(00.0.000.5132) *Elatine rubella*
(00.0.000.5140) Haloragaceae
(00.0.000.5141) *Myriophyllum aquaticum*
(00.0.000.5142) *Myriophyllum sibericum*
(00.0.000.5150) Hippuridaceae
(00.0.000.5151) *Hippuris vulgaris*
(00.0.000.5160) Ranunculaceae
(00.0.000.5161) *Ranunculus aquatilus*
(00.0.000.5200) Persistent Emergent Types (A–K Families)
(00.0.000.5210) Aizoaceae
(00.0.000.5211) *Tetragonia tetragonioides*
(00.0.000.5220) Apiaceae (A–H)
(00.0.000.5221) *Apium graveolens*
(00.0.000.5222) *Berula erecta*
(00.0.000.5223) *Cicuta douglasii*
(00.0.000.5224) *Eryngium vaseyi*
(00.0.000.5225) *Foeniculum vulgare*
(00.0.000.5226) *Hydrocotyle ranunculoides*
(00.0.000.5230) Apiaceae (I–Z)
(00.0.000.5231) *Oenanthe sarmentosa*
(00.0.000.5232) *Perideridia* spp.
(00.0.000.5233) *Sphenosciadium capitellatum*
(00.0.000.5240) Apocynaceae, Asclepiadaceae
(00.0.000.5241) *Apocynum cannabinum*
(00.0.000.5242) *Asclepias fascicularis*
(00.0.000.5250) Asteraceae (A–L)
(00.0.000.5251) *Artemisia douglasiana*
(00.0.000.5252) *Artemisia ludoviciana*
(00.0.000.5253) *Aster chilensis*
(00.0.000.5254) *Conyza canadensis*
(00.0.000.5255) *Euthamia occidentalis*
(00.0.000.5256) *Gutierrezia sarothrae*
(00.0.000.5257) *Helenium bolanderi*
(00.0.000.5258) *Helenium puberulum*
(00.0.000.5259) *Jaumea carnosa*
(00.0.000.5260) Asteraceae (M–Z)
(00.0.000.5261) *Solidago californica*
(00.0.000.5262) *Solidago confinis*
(00.0.000.5263) *Solidago spathulata*
(00.0.000.5270) Chenopodiaceae, Datiscaceae
(00.0.000.5271) *Arthrocnemum subterminale*
(00.0.000.5272) *Salicornia virginica*
(00.0.000.5273) *Datisca glomerata*

TABLE 9. CONTINUED

(00.0.000.5280) Fabaceae
(00.0.000.5281) *Amorpha fruticosa*
(00.0.000.5282) *Hoita macrostachya*
(00.0.000.5283) *Hoita orbiculata*
(00.0.000.5284) *Lupinus* sp.
(00.0.000.5285) *Melilotus alba*
(00.0.000.5290) Frankeniaceae
(00.0.000.5291) *Frankenia salina*
(00.0.00.5300) Persistent Emergent Types (L–P Families)
(00.0.000.5310) Hyperacaceae
(00.0.000.5311) *Hypericum anagalliodes*
(00.0.000.5320) Lamiaceae
(00.0.000.5321) *Mentha arvensis*
(00.0.000.5322) *Stachys ajugoides*
(00.0.000.5323) *Stachys albens*
(00.0.000.5324) *Stachys bullata*
(00.0.000.5325) *Stachys chamissonis*
(00.0.000.5326) *Stachys pycnantha*
(00.0.000.5330) Lythraceae, Nyphaeaceae
(00.0.000.5331) *Lythrum californicum*
(00.0.000.5332) *Lythrum hyssopifolia*
(00.0.000.5333) *Nuphar luteum* ssp. *polysepalum*
(00.0.000.5334) *Nymphaea odorata*
(00.0.000.5340) Onagraceae
(00.0.000.5341) *Epilobium ciliatum*
(00.0.000.5342) *Ludwigia hexapetala*
(00.0.000.5343) *Oenothera elata* ssp. *hookeri*
(00.0.000.5350) Polygonaceae
(00.0.000.5351) *Polygonum* sp.
(00.0.000.5352) *Polygonum* sp.
(00.0.000.5353) *Polygonum hydropiperoides*
(00.0.000.5354) *Polygonum lapathifolium*
(00.0.000.5355) *Polygonum punctatum*
(00.0.000.5356) *Rumex conglomeratus*
(00.0.000.5357) *Rumex crispus*
(00.0.000.5358) *Rumex occidentalis*
(00.0.000.5359) *Rumex salicifolius*
(00.0.000.5400) Persistent Emergent Types (R–U Families)
(00.0.000.5410) Ranunculaceae
(00.0.000.5411) *Delphinium glaucum*
(00.0.000.5420) Rosaceae
(00.0.000.5421) *Ivesia argyrocoma*
(00.0.000.5422) *Potentilla anserina*
(00.0.000.5430) Saururaceae
(00.0.000.5431) *Anemopsis californica*
(00.0.000.5440) Saxifragaceae
(00.0.000.5441) *Boykinia rotundifolia*
(00.0.000.5450) Scrophulariaceae, Solanaceae
(00.0.000.5451) *Scrophularia* spp.
(00.0.000.5452) *Datura wrightii*
(00.0.000.5453) *Nicotiana quadrivalis*
(00.0.000.5454) *Petunia parviflora*
(00.0.000.5460) Urticaceae
(00.0.000.5461) *Urtica dioica*
(00.0.000.5470) Verbenaceae
(00.0.000.5471) *Phyla nodiflora*
(00.0.000.5472) *Verbena bracteata*
(00.0.000.5473) *Verbena lasiostachys*
(00.0.000.5500) Nonpersistent Emergent Types
(00.0.000.5510) Aizoaceae, Amaranthaceae, Apiaceae
(00.0.000.5511) *Glinus lotoides*
(00.0.000.5512) *Amaranthus* spp.
(00.0.000.5513) *Berula erecta*
(00.0.000.5514) *Eryngium aristulatum*
(00.0.000.5515) *Hydrocotyle ranunculoides*
(00.0.000.5516) *Oenanthe armentosa*

TABLE 9. CONTINUED

(00.0.000.5520) Asteraceae (A–G)
(00.0.000.5521) *Anthemis cotula*
(00.0.000.5522) *Artemisia biennis*
(00.0.000.5523) *Artemisia douglasiana*
(00.0.000.5524) *Conyza coulteri*
(00.0.000.5525) *Cotula coronopifolia*
(00.0.000.5526) *Eclipta alba*
(00.0.000.5527) *Gnaphalium luteo-album*
(00.0.000.5528) *Gnaphalium palustre*
(00.0.000.5530) Asteraceae (H–X)
(00.0.000.5531) *Helenium puberulum*
(00.0.000.5532) *Lasthenia californica*
(00.0.000.5533) *Lasthenia glabrata* ssp. *coulteri*
(00.0.000.5534) *Psilocarphus brevissimus*
(00.0.000.5535) *Xanthium strumarium*
(00.0.000.5540) Boraginaceae, Brassicaceae, Campanulaceae
(00.0.000.5241) *Heliotropium curassavicum*
(00.0.000.5542) *Plagiobothrys undulatus*
(00.0.000.5543) *Plagiobothrys trachycarpus*
(00.0.000.5544) *Rorripa curvisiliqua*
(00.0.000.5545) *Rorripa nasturtium-aquaticum*
(00.0.000.5546) *Rorripa palustris*
(00.0.000.5547) *Downingia cuspidata*
(00.0.000.5548) *Lobelia dunnii* var. *serrata*
(00.0.000.5550) Chenopodiaceae
(00.0.000.5551) *Atriplex rosea*
(00.0.000.5552) *Atriplex triangularis*
(00.0.000.5553) *Chenopodium berlandieri*
(00.0.000.5554) *Chenopodium macrospermum*
(00.0.000.5555) *Chenopodium rubrum*
(00.0.000.5556) *Kochia scoparia*
(00.0.000.5557) *Monolepis nuttalliana*
(00.0.000.5558) *Salicornia europea*
(00.0.000.5559) *Suaeda calceoliformis*
(00.0.000.5560) Lamiaceae, Lythraceae
(00.0.000.5561) *Mentha arvensis*
(00.0.000.5562) *Mentha piperiodes*
(00.0.000.5563) *Pogogyne abramsii*
(00.0.000.5564) *Pogogyne douglassii*
(00.0.000.5565) *Stachys albens*
(00.0.000.5566) *Ammannia coccinea*
(00.0.000.5567) *Lythrum hyssopifolia*
(00.0.000.5570) Onagraceae, Malvaceae, Polygonaceae
(00.0.000.5571) *Ludwigia peploides* ssp. *peploides*
(00.0.000.5572) *Ludwigia hexapetala*
(00.0.000.5573) *Epilobium ciliatum*
(00.0.000.5574) *Oenothera elata* ssp. *hookeri*
(00.0.000.5575) *Malvella leprosa*
(00.0.000.5576) *Sidalcea* spp.
(00.0.000.5580) Polygonaceae, Ranunculaceae
(00.0.000.5581) *Polygonum emersum* var. *emersum*
(00.0.000.5582) *P. emersum* var. *stipulaceum*
(00.0.000.5583) *Polygonum lapathifolium*
(00.0.000.5584) *Polygonum punctatum*
(00.0.000.5585) *Polygonum* sp.
(00.0.000.5586) *Rumex maritimus*
(00.0.000.5587) *Myosurus* spp.
(00.0.000.5588) *Ranunculus* spp.
(00.0.000.5590) Scrophulariaceae
(00.0.000.5591) *Castilleja minor*
(00.0.000.5592) *Limosella aquatica*
(00.0.000.5593) *Lindernia dubia*
(00.0.000.5594) *Mimulus cardinalis*
(00.0.000.5595) *Mimulus guttatus*
(00.0.000.5596) *Mimulus* spp.
(00.0.000.5597) *Veronica americana*

TABLE 9. CONTINUED

(00.0.000.5598) *Veronica anagallis-aquatica*
(00.0.000.5599) *Veronica peregrina*
(00.0.000.5600) Scrub-Shrub Types (A–M Families)
(00.0.000.5610) Aizoaceae, Anacardiaceae
(00.0.000.5611) *Carpobrotus edulis*
(00.0.000.5612) *Malephora crocea*
(00.0.000.5613) *Malosma laurina*
(00.0.000.5614) *Toxicodendron diversilobum*
(00.0.000.5620) Asteraceae
(00.0.000.5621) *Baccharis douglasii*
(00.0.000.5622) *Baccharis pilularis*
(00.0.000.5623) *Baccharis salicifolia*
(00.0.000.5624) *Brickellia californica*
(00.0.000.5625) *Isocoma menziesii*
(00.0.000.5626) *Lepidospartum squamatum*
(00.0.000.5627) *Pluchea sericea*
(00.0.000.5628) *Chrysothamnus nauseous*
(00.0.000.5630) Caprifoliaceae
(00.0.000.5631) *Lonicera involucrata*
(00.0.000.5632) *Sambucus mexicana*
(00.0.000.5633) *Symphoricarpos mollis*
(00.0.000.5640) Chenopodiaceae
(00.0.000.5641) *Atriplex canescens*
(00.0.000.5642) *Atriplex lentiformis*
(00.0.000.5643) *Suaeda moquinii*
(00.0.000.5644) *Suaeda taxifolia*
(00.0.000.5650) Cornaceae
(00.0.000.5651) *Cornus sericea* ssp. *occidentalis*
(00.0.000.5660) Grossulariaceae
(00.0.000.5661) *Ribes divaricatum*
(00.0.000.5670) Lamiaceae
(00.0.000.5671) *Salvia mellifera*
(00.0.000.5680) Malvaceae
(00.0.000.5681) *Malacothamnus fasciculatus*
(00.0.000.5690) Myriacaceae, Oleaceae
(00.0.000.5691) *Myrica californica*
(00.0.000.5692) *Forestiera pubescens*
(00.0.000.5700) Scrub-Shrub Types (N–Z Families)
(00.0.000.5710) Platanaceae
(00.0.000.5711) *Platanus racemosa*
(00.0.000.5720) Polygonaceae
(00.0.000.5721) *Eriogonum fasciculatum*
(00.0.000.5722) Ranunculaceae
(00.0.000.5723) *Clematis ligusticifolia*
(00.0.000.5730) (P–R Families)
(00.0.000.5740) Rhamnaceae
(00.0.000.5741) *Ceanothus oliganthus*
(00.0.000.5742) *Ceanothus spinosus*
(00.0.000.5743) *Rhamnus californica*
(00.0.000.5750) Rosaceae
(00.0.000.5751) *Prunus* spp.
(00.0.000.5752) *Rosa californica*
(00.0.000.5753) *Rosa gymnocarpa*
(00.0.000.5754) *Rosa woodsii*
(00.0.000.5755) *Rubus ursinus*
(00.0.000.5756) *Rubus* spp.
(00.0.000.5757) *Heteromeles arbutifolia*
(00.0.000.5760) Salicaceae
(00.0.000.5761) *Populus balsamifera*
(00.0.000.5762) *Salix breweri*
(00.0.000.5763) *Salix exigua*
(00.0.000.5764) *Salix geyeriana*
(00.0.000.5765) *Salix laevigata*
(00.0.000.5766) *Salix lasiolepis*

TABLE 9. CONTINUED

(00.0.000.5767) *Salix lemmonii*
(00.0.000.5768) *Salix lutea*
(00.0.000.5769) *Salix scouleriana*
(00.0.000.5770) Solanaceae
(00.0.000.5771) *Nicotiana glauca*
(00.0.000.5780) Tamaricaceae
(00.0.000.5781) *Tamarix ramosissima*
(00.0.000.5790) Vitaceae
(00.0.000.5791) *Vitus girdiana*

(00.0.00.5800) Woodland Tree Types
(00.0.000.5810) Fagaceae
(00.0.000.5811) *Quercus agrifolia* var. *agrifolia*
(00.0.000.5812) *Quercus agrifolia* var. *oxydenia*
(00.0.000.5813) *Quercus lobata*
(00.0.000.5814) *Quercus wislizenii*
(00.0.000.5820) Platanaceae
(00.0.000.5821) *Platanus racemosa*
(00.0.000.5830) Salicaceae
(00.0.000.5831) *P. balsamifera* ssp. *trichocarpa*
(00.0.000.5832) *Populus fremontii* ssp. *fremontii*
(00.0.000.5833) *Salix laevigata*
(00.0.000.5834) *Salix lasiolepis*
(00.0.000.5835) *Salix lucida* ssp. *lasiandra*

(00.0.000.5900) Forest Tree Types
(00.0.000.5910) Aceraceae
(00.0.000.5911) *Acer negundo*
(00.0.000.5912) *Acer macrophyllum*
(00.0.000.5920) Betulaceae; Cupressaceae (Conifers)
(00.0.000.5921) *Alnus rhombifolia*
(00.0.000.5922) *Calocedrus decurrens*
(00.0.000.5930) Fagaceae
(00.0.000.5931) *Lithocarpus densiflorus*
(00.0.000.5932) *Quercus agrifolia* var. *agrifolia*
(00.0.000.5933) *Quercus agrifolia* var. *oxydenia*
(00.0.000.5934) *Quercus kelloggii*
(00.0.000.5935) *Quercus lobata*
(00.0.000.5936) *Quercus wislizenii*
(00.0.000.5940) Juglandaceae
(00.0.000.5941) *Juglans californica* var. *californica*
(00.0.000.5942) *Juglans californica* var. *hindsii*
(00.0.000.5950) Lauraceae, Myricaceae, Oleaceae
(00.0.000.5951) *Umbellularia californica*
(00.0.000.5952) *Myrica californica*
(00.0.000.5953) *Fraxinus velutina*
(00.0.000.5960) Pinaceae (Conifers)
(00.0.000.5961) *Abies concolor*
(00.0.000.5962) *Pinus contorta* ssp. *murrayana*
(00.0.000.5963) *Pinus jeffreyi*
(00.0.000.5970) Platanaceae
(00.0.000.5971) *Platanus racemosa*
(00.0.000.5980) Salicaceae
(00.0.000.5981) *Populus balsamifera* ssp. *trichoarpa*
(00.0.000.5982) *Populus fremontii* ssp. *fremontii*
(00.0.000.5983) *Populus tremuloides*
(00.0.000.5984) *Salix goodingii*
(00.0.000.5985) *Salix laevigata*
(00.0.000.5986) *Salix lasiolepis*
(00.0.000.5987) *Salix lucida* ssp. *lasiandra*
(00.0.000.5990) Taxodiaceae (Conifers)
(00.0.000.5991) *Sequoia sempervirens*

(00.0.000.6000) Monocot Vascular-Plant Dominance/Characteristic Types

(00.0.000.6100) Aquatic-Bed types
(00.0.000.6110) Alismataceae

TABLE 9. CONTINUED

(00.0.000.6111) *Alisma plantago-aquatica*
(00.0.000.6112) *Echinodorus berteroi*
(00.0.000.6120) Cyperaceae
(00.0.000.6121) *Eleocharis parvula*
(00.0.000.6130) Hydrocharitaceae
(00.0.000.6131) *Egeria densa*
(00.0.000.6132) *Elodea canadensis*
(00.0.000.6133) *Elodea nuttallii*
(00.0.000.6134) *Najas guadalupensis*
(00.0.000.6135) *Najas marina*
(00.0.000.6140) Lemnaceae
(00.0.000.6141) *Lemna gibba*
(00.0.000.6142) *Lemna minor*
(00.0.000.6143) *Lemna minuscula*
(00.0.000.6144) *Lemna trisulca*
(00.0.000.6145) *Spirodela polyrrhiza*
(00.0.000.6146) *Spirodela punctata*
(00.0.000.6147) *Wolffia* spp.
(00.0.000.6148) *Wolffiella* spp.
(00.0.000.6150) Potamogetonaceae
(00.0.000.6151) *Potamogeton foliosa*
(00.0.000.6152) *Potamogeton pectinatus*
(00.0.000.6153) *Potamogeton*
(00.0.000.6154) *Ruppia cirrhosa*
(00.0.000.6155) *Ruppia maritima*
(00.0.000.6160) Zannichelliaceae
(00.0.000.6161) *Zannichellia palustris*
(00.0.000.6200) Persistent Emergent Types (Cyperaceae—Sedges)
(00.0.000.6210) *Carex* (a–m)
(00.0.000.6211) *Carex alma*
(00.0.000.6212) *Carex barbarae*
(00.0.000.6213) *Carex multicaulis*
(00.0.000.6220) *Carex* (o–z)
(00.0.000.6221) *Carex obnupta*
(00.0.000.6222) *Carex praegracilis*
(00.0.000.6223) *Carex nutkatensis*
(00.0.000.6224) *Carex senta*
(00.0.000.6230) *Cyperus*
(00.0.000.6231) *Cyperus*
(00.0.000.6232) *Cyperus eragrostis*
(00.0.000.6233) *Cyperus involucratus*
(00.0.000.6234) *Cyperus strigosus*
(00.0.000.6240) *Eleocharis*
(00.0.000.6241) *Eleocharis acicularis*
(00.0.000.6242) *Eleocharis macrostachya*
(00.0.000.6243) *Eleocharis montevidensis*
(00.0.000.6244) *Eleocharis parishii*
(00.0.000.6250) *Scirpus*
(00.0.000.6251) *Scirpus acutus*
(00.0.000.6252) *Scirpus americanus*
(00.0.000.6253) *Scirpus californicus*
(00.0.000.6254) *Scirpus maritimus*
(00.0.000.6255) *Scirpus microcarpus*
(00.0.000.6256) *Scirpus pungens*
(00.0.000.6257) *Scirpus robustus*
(00.0.000.6300) Persistent Emergent Types (Juncaceae—Rushes)
(00.0.000.6310) *Juncus* (a–n)
(00.0.000.6311) *Juncus acutus*
(00.0.000.6312) *Juncus balticus*
(00.0.000.6313) *Juncus dubius*
(00.0.000.6314) *Juncus effusus*
(00.0.000.6315) *Juncus falcatus*
(00.0.000.6316) *Juncus macrophyllus*

TABLE 9. CONTINUED

(00.0.000.6317) *Juncus mexicanus*
(00.0.000.6318) *Juncus lesueurii*
(00.0.000.6319) *Juncus longistylis*
(00.0.000.6320) *Juncus* (o–z)
(00.0.000.6321) *Juncus occidentalis*
(00.0.000.6322) *Juncus oxymeris*
(00.0.000.6323) *Juncus patens*
(00.0.000.6324) *Juncus phaeocephalis*
(00.0.000.6325) *Juncus rugulosus*
(00.0.000.6326) *Juncus tenuis*
(00.0.000.6327) *Juncus xiphioides*
(00.0.000.6400) Persistent Emergent Types (Poaceae A–E Grasses)
(00.0.000.6410) *Agrostis*
(00.0.000.6411) *Agrostis idahoensis*
(00.0.000.6412) *Agrostis scabra*
(00.0.000.6413) *Agrostis stolonifera*
(00.0.000.6414) *Agrostis viridis*
(00.0.000.6420) *Andropogon*
(00.0.000.6421) *Andropogon virginica*
(00.0.000.6430) *Arundo*
(00.0.000.6431) *Arundo donax*
(00.0.000.6440) *Cortaderia* spp.
(00.0.000.6450) *Cynodon*
(00.0.000.6451) *Cynodon dactylon*
(00.0.000.6460) *Danthonia*
(00.0.000.6461) *D. californica* var. *americana*
(00.0.000.6462) *D. californica* var. *californica*
(00.0.000.6470) *Deschampsia*
(00.0.000.6471) *D. caespitosa* ssp. *caespitosa*
(00.0.000.6480) *Distichlis*
(00.0.000.6481) *Distichlis spicata*
(00.0.000.6500) Persistent Emergent Types (Poaceae F–O Grasses)
(00.0.000.6510) *Echinochloa*
(00.0.000.6511) *Echinochloa crus-galli*
(00.0.000.6520) *Elymus*
(00.0.000.6521) *Elymus glaucus*
(00.0.000.6522) *E. trachycaulus* ssp. *trachycaulus*
(00.0.000.6530) *Festuca*
(00.0.000.6531) *Festuca arundinaceae*
(00.0.000.6532) *Festuca rubra*
(00.0.000.6540) *Glyceria*
(00.0.000.6541) *Glyceria elata*
(00.0.000.6550) *Holcus*
(00.0.000.6560) *Hordeum*
(00.0.000.6561) *Hordeum brachyantherum* ssp. *brachyantherum*
(00.0.000.6562) *Hordeum brachyantherum* ssp. *californicum*
(00.0.000.6563) *Hordeum jubatum*
(00.0.000.6570) *Leptochloa*
(00.0.000.6571) *Leptochloa uninerva*
(00.0.000.6580) *Leymus*
(00.0.000.6581) *Leymus condensatus*
(00.0.000.6582) *Leymus triticoides*
(00.0.000.6590) *Muhlenbergia*
(00.0.000.6591) *Muhlenbergia andina*
(00.0.000.6592) *Muhlenbergia asperifolia*
(00.0.000.6593) *Muhlenbergia filiformis*
(00.0.000.6594) *Muhlenbergia rigens*
(00.0.000.6600) Persistent Emergent Types (Poaceae P–Z Grasses)
(00.0.000.6610) *Paspalum*
(00.0.000.6611) *Paspalum dilitatum*
(00.0.000.6612) *Paspalum distichum*
(00.0.000.6620) *Pennisetum*

TABLE 9. CONTINUED

(00.0.000.6621) *Pennisetum clandestinum*
(00.0.000.6630) *Phalaris*
(00.0.000.6631) *Phalaris aquatica*
(00.0.000.6640) *Piptatherum*
(00.0.000.6641) *Piptatherum miliaceum*
(00.0.000.6650) *Poa*
(00.0.000.6651) *Poa pratensis*
(00.0.000.6700) Persistent Emergent Types (Other Families)
(00.0.000.6710) Liliaceae
(00.0.000.6711) *Smilacina racemosa*
(00.0.000.6712) *Veratrum californicum*
(00.0.000.6720) Sparganiaceae
(00.0.000.6721) *Sparganium eurycarpum*
(00.0.000.6730) Typhaceae
(00.0.000.6731) *Typha angustifolia*
(00.0.000.6732) *Typha domingensis*
(00.0.000.6733) *Typha latifolia*
(00.0.000.6800) Nonpersistent Emergent Types (Poaceae)
(00.0.000.6810) *Hordeum*
(00.0.000.6811) *Hordeum depressum*
(00.0.000.6812) *Hordeum marinum*
(00.0.000.6820) *Lolium*
(00.0.000.6821) *Lolium multiflorum*
(00.0.000.6830) *Orcuttia*
(00.0.000.6831) *Orcuttia californica*
(00.0.000.6840) *Paspalum*
(00.0.000.6841) *Paspalum distichum*
(00.0.000.6850) *Polypogon*
(00.0.000.6851) *Polypogon monspeliensis*
(00.0.000.6860) *Vulpia*
(00.0.000.6900) Nonpersistent Emergent Types (Other Families)
(00.0.000.6910) Alismataceae
(00.0.000.6911) *Alisma plantago-aquatica*
(00.0.000.6912) *Echinodorus berteroi*
(00.0.000.6920) Cyperaceae
(00.0.000.6921) *Cyperus erythrorhizos*
(00.0.000.6922) *Cyperus odoratus*
(00.0.000.6923) *Cyperus squarrosus*
(00.0.000.6924) *Cyperus* sp.
(00.0.000.6925) *Eleocharis bella*
(00.0.000.6926) *Eleocharis maerostachya*
(00.0.000.6930) Juncaceae
(00.0.000.6931) *Juncus bufonius*
(00.0.000.6932) *Juncus xiphioides*
(00.0.000.6940) Juncaginaceae
(00.0.000.6941) *Lilaea scilloides*
(00.0.000.6950) Liliaceae
(00.0.000.6960) Orchidaceae
(00.0.000.6961) *Epipactis gigantea*

(00.0.000.7000) Mixed-Vascular Plant Dominance/Characteristic Types

(00.0.000.8000) Animal Dominance/Characteristic Types

(00.0.000.8100) Sponge Types
(00.0.000.8200) Coleneterate Types
(00.0.000.8300) Mollusc Types
(00.0.000.8400) Annelid Types
(00.0.000.8500) Crustacean Types
(00.0.000.8600) Insect Types
(00.0.000.8700) Echinoderm Types
(00.0.000.8800) Other Invertebrate Types
(00.0.000.8900) Vertebrate Types