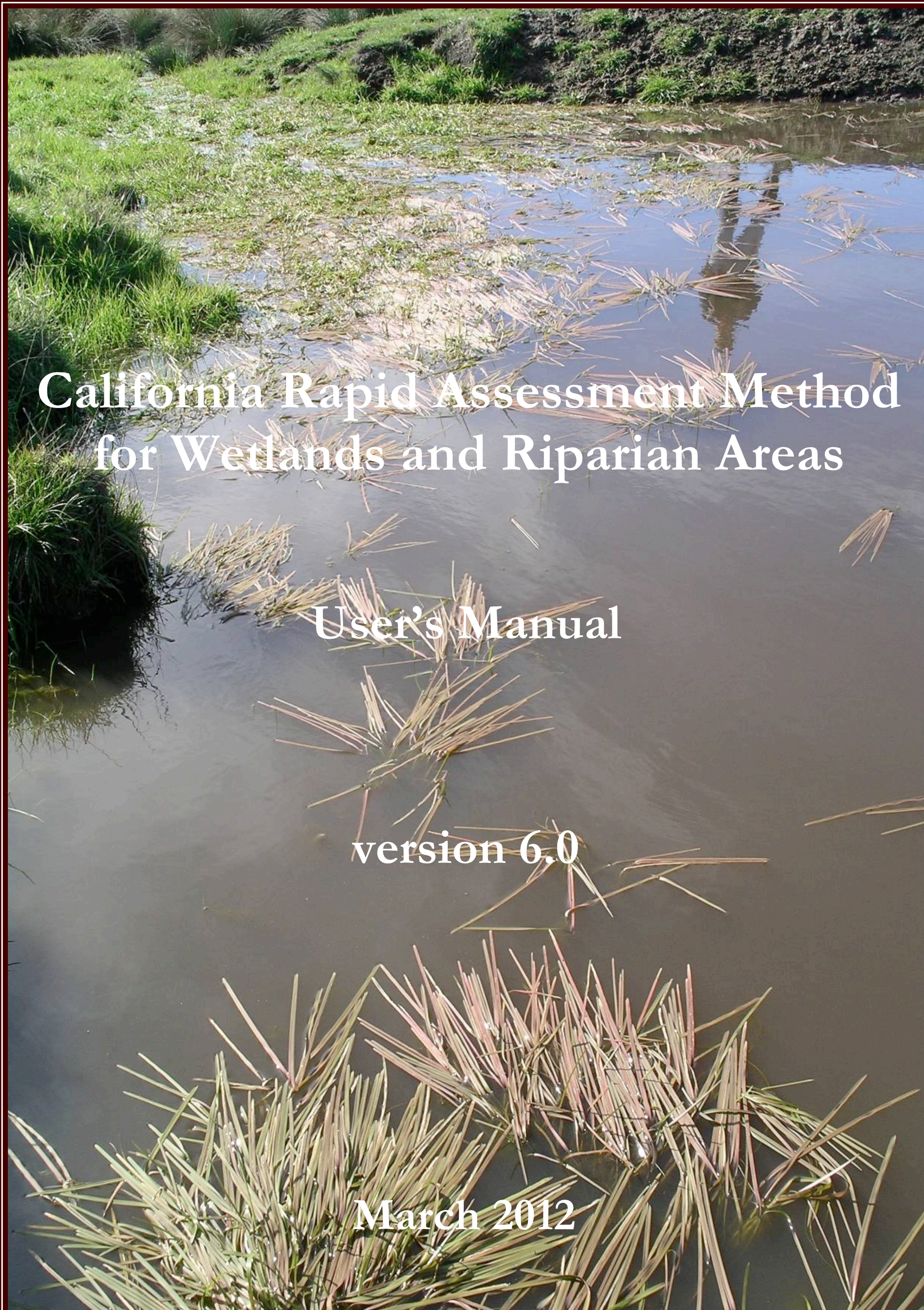


California Rapid Assessment Method for Wetlands and Riparian Areas

User's Manual

version 6.0

March 2012

This report should be cited as:

California Wetlands Monitoring Workgroup (CWMW). 2012. California Rapid Assessment Method (CRAM) for Wetlands and Riparian Areas, Version 6.0 pp. 95

Funding for initial CRAM development was provided to the San Francisco Estuary Institute, the Southern California Coastal Water Research Project, and the California Coastal Commission through USEPA contracts CD-96911101-0, CD-96911201-0, and CD-96911301-1, respectively. The contents of this document do not necessarily reflect the views and policies of the EPA nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Cover Photograph: Joshua N. Collins

California Rapid Assessment Method (CRAM) For Wetlands and Riparian Areas

User's Manual

Version 6.0
March 2012

A Product of the

Level 2 Committee

of the

California Wetlands Monitoring Workgroup

Edited by Kevin O'Connor
Central Coast Wetlands Group at Moss Landing Marine Labs

CALIFORNIA Wetland Monitoring Workgroup

L2 Committee of the California Wetlands Monitoring Workgroup	
Name	**Organization**
Marie Denn	National Park Service
Cara Clark	Central Coast Wetlands Group at Moss Landing Marine Labs
Ross Clark	Central Coast Wetlands Group at Moss Landing Marine Labs
Joshua Collins	San Francisco Estuary Institute
Cristina Grosso	San Francisco Estuary Institute
Cliff Harvey (Chair)	State Water Resources Control Board
Paul Jones	USEPA Region 9
Rebecca Loffler	Caltrans
Kevin Lunde	Bay Area Regional Water Quality Control Board
Kevin O'Connor	Central Coast Wetlands Group at Moss Landing Marine Labs
Sarah Pearce	San Francisco Estuary Institute
Chad Roberts	Consultant
Chris Solek	Southern California Coastal Water Research Project
Ayzik Solomesheh	Consultant
Eric Stein	Southern California Coastal Water Research Project
Dave Weixelman	U.S. Forest Service
Carol Witham	Consultant

Version History of CRAM Methodology

Version 6.0 released March 2012
Changes in this version:

- Removed text from Chapter 4: Guidelines for Scoring CRAM Metrics. This information is now maintained in individual field books.
- Removed some text from Chapter 3: Procedures for Using CRAM. This information is now maintained in individual field books.
- Removed Appendix VI. This information is now maintained in the Vernal Pools field books.
- Updated Appendix III with additional definitions
- Updated References section with additional citations
- Changed authorship, removed original Core and Regional Team information, added L2 Committee members
- Revised several figures and tables
- Replaced Seasonal Estuarine wetland sub-type with Bar-built estuarine wetland sub-type
- Revised wording through out the document to be consistent with recent developments in CRAM and wetland assessment in California.
- Fixed typos; updated heading and table of contents

Version 5.0.2 released 9/30/08
Changes in this version:

- Added section on version history of CRAM methodology and fixed typos
- Added paragraph in Section 2.3.1 to explain separation of assessments of condition and stress
- Added note to Section 3.2.2.2 that the depressional module was primarily based on perennial depressional wetlands and caution should be applied in the interpretation of scores in seasonal depressional wetlands
- Corrected text in various Sections to eliminate inconsistencies in terminology
- Updated figures in Chapter 3
- Revised the ratings for scoring Structural Patch Richness for Estuarine wetlands

Version 5.0.1 released 10/17/07
Changes in this version:

- Minor wording changes for clarification

Version 5.0.0 released 9/18/07
Changes in this version:

- Version numbering changed from 4.6 to 5.0—no other changes

Version 4.6 released 9/10/07
Changes in this version:

- Substantial changes in nearly all areas

- Changes to metrics included:
  - Wording changes for clarification
  - Added a second "B" rating for scoring Landscape Connectivity for Riverine wetlands
  - Revised the "C" and "D" ratings for scoring Number of Plant Layers Present for Slope and Confined Riverine wetlands

Versions 4.3 - 4.5

- Internal development versions

Version 4.2.3 released 11/1/06

Changes in this version:

- Reorganized volume 2 into three sections: Assessment Forms, Narratives, Tables & Figures; typos fixed

Version 4.2.2 released 8/17/06

Changes in this version:

- Added citation to title page and fixed typos

Version 4.2.1 released 8/10/06

Changes in this version:

- Vol 1, p. 15: Table 2.2, added new metric name Plant Community and bulleted its four component submetrics
- Vol 1, p. 36: Added language prescribing the calculation of mean submetric score in order to arrive at Plant Community metric value; in Table 3.8, changed expected maximum value of Biotic Structure attribute from 84 to 36 for Playas and Vernal Pools and 48 for all other wetland classes
- Vol 1, pp. 68-71: Changed "metric" to "submetric" for discussion of the four submetrics of the Plant Community metric
- Vol 2, pp.145-6: removed wrackline or organic debris in channel or on floodplain from worksheet 2 since this patch type is not expected in playas
- Vol 2, p. 55: Revised "D" narrative for number of plants layers present from "No layers are present" to "0-1 layer is present"
- Vol 2, pp. 133, 149, 166: Removed shading from scoring sheet for Interspersion and Zonation since this metric is assessed for vernal pools and playas
- Vol 2: Revised scoring forms to incorporate Plant Community metric

Version 4.2.0 released 8/4/06

Changes in this version:

- Split into two volumes: main manual and assessment forms
- Created separate volume for assessment forms - all supporting documents included with each class
- Updated entrenchment ratio and hydrologic connectivity metric bins
- Revised bins for percent co-dominant species that are non-native
- Added confined v. unconfined diagram
- Revised scoring to a 1-12 scale for all metrics

Version 4.1 released 7/11/06
Changes in this version:

- Separated estuarine class into two sub-classes: saline and non-saline

Version 4.0 released 5/25/06

Acknowledgments

The authors would like to credit the Washington State Wetland Rating System, the Ohio Rapid Assessment Method for Wetlands, and the Hydrogeomorphic (HGM) Functional Assessment Method for providing a foundation upon which to create the California Rapid Assessment Method for Wetlands (CRAM).

CRAM could not have been developed without the championship of Paul Jones (USEPA Region 9) and Richard Sumner (USEPA Office of Research and Development), technical guidance from Mary Kentula (USEPA Office of Research and Development), the inspirational successes of John Mack (Ohio EPA) and M. Siobhan Fennessy (Kenyon College), plus the abundant advice and review provided by the original CRAM Core Team and Regional Teams.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Large amounts of public funds and human resources are being invested in the protection, restoration, creation, and enhancement of wetlands in California. The State needs to be able to track the extent and condition of these habitats to evaluate the investments in them now and into the future. The community of wetland scientists, managers, and regulators needs to be able to answer the questions: where are the wetland areas and how are they doing? This need is clearly indicated by the California State Wetlands Conservation Policy.

A consortium of local, state and federal authorities has been developing new tools to increase the State's capacity to monitor its wetlands. The effort is guided by the three-level framework for surface water monitoring and assessment issued to the state by the USEPA (USEPA 2006). Level 1 consists of habitat inventories and landscape profiles based on the statewide wetland inventory as mandated by California Assembly Bill 2286, the California Aquatic Resources Inventory, the statewide riparian inventory as planned by the Riparian Habitat Joint Venture, and the California Wetlands Portal of the Regional Data Centers being developed by the State Water Resources Control Board and others as part of the California Environmental Data Exchange Network. Level 2 consists of rapid assessment of wetland condition in relation to the broadest suite possible of ecological and social services and beneficial uses. Level 3 consists of standardized protocols for intensive-quantitative assessment of selected services and to validate and explain Level 1 and Level 2 methods and results. All three levels are to be supported by data management systems that enable the State to compile local and regional Level 1-3 data into statewide summary reports. Level 1 and Level 2 methods are supported by open-source, web-based information systems (californiawetlands.net and cramwetlands.org) that are consistent with existing state and federal environmental databases. Level 3 protocols and results will be added to these information systems as they are developed.

This manual focuses on the California Rapid Assessment Method. CRAM is being developed as a cost-effective and scientifically defensible Level 2 method for monitoring the conditions of wetlands throughout California. The CRAM web site (www.cramwetlands.org) provides access to an electronic version of this manual, training materials, eCRAM and the CRAM database. CRAM results can be uploaded to the database, viewed, and retrieved via the CRAM web site using eCRAM. CRAM, eCRAM, and the supporting web sites are public and non-proprietary.

Initial CRAM development had focused on the wetlands of coastal watersheds from Mexico to Oregon. These watersheds in aggregate encompass almost as much variation in climate, geology, and land use as the State as a whole. A special effort was been made, however, to involve environmental scientists and managers who are familiar with inland arid montane environments that are not well represented in the coastal watersheds. Seasoned staff from natural resource management and regulatory agencies, NGO science institutions, the private sector, and academia worked together through four coastal Regional Teams and a statewide Core Team to provide the breadth and depth of technical and administrative experience necessary to help assure statewide applicability of CRAM. Since then the ongoing development process has moved inland to include the Central Valley, Inland Empire and Tahoe regions.

CRAM development has incorporated aspects of other approaches to habitat assessment used in California and elsewhere, including the Washington State Wetland Rating System (WADOE 1993), MRAM (Burglund 1999), and ORAM (Mack 2001). CRAM also draws on concepts from stream bio-assessment and wildlife assessment procedures of the California Department of Fish and Game, the different wetland compliance assessment methods of the San Francisco Bay Regional Water Quality Control Board and the Los Angeles Regional Water Quality Control Board, the Releve Method of the California Native Plant Society, and various HGM guidebooks that have been developed in California.

In essence, CRAM enables two or more trained practitioners working together in the field for one half day or less to assess the overall health of a wetland by choosing the best-fit set of narrative descriptions of observable conditions ranging from the worst commonly observed to the best achievable for the type of wetland being assessed. There are four alternative descriptions of condition for each metric of condition. Metrics are organized into four main attributes: (landscape context and buffer, hydrology, physical structure, and biotic structure) for each of six major types of wetlands recognized by CRAM (riverine wetlands, lacustrine wetlands, depressional wetlands, slope wetlands, playas, and estuarine wetlands). To the extent possible, CRAM has been standardized across all these wetland types, and the differences in metrics and narrative descriptions between wetland types have been minimized.

CRAM yields an overall score for each assessed area based on the component scores for the attributes and their metrics. The alternative narrative description for each metric has a fixed numerical value. An attribute score is calculated by combining (methods vary by attribute type) the values of the chosen narrative descriptions for the attribute's component metrics, and then converting the result into a percentage of the maximum possible score for the attribute. The overall score for an area is calculated by averaging the four final attribute scores . The maximum possible score represents the best condition that is likely to be achieved for the type of wetland being assessed. The overall score for a wetland therefore indicates how it is doing relative to the best achievable conditions for that wetland type in the state. Local conditions can be constrained by unavoidable land uses that should be considered when comparing wetlands from different land use settings.

CRAM also provides guidelines for identifying stressors that might account for low scores. Evident stressors are characterized as present or present and having a significant negative effect on an attribute score. The stressor checklist allows researchers and managers to explore possible relationships between condition and stress, and to identify actions to counter stressor effects.

CRAM is a cost-effective ambient monitoring and assessment tool that can be used to assess condition on a variety of scales, ranging from individual wetlands to watersheds and larger regions. Applications could include preliminary assessments to determine the need for more intensive analysis; supplementing information during the evaluation of wetland condition to aid in regulatory review under Section 401 and 404 of the Clean Water Act or other wetland regulations; and assisting in the assessment of restoration or mitigation projects by providing a rapid means of checking progress along a particular restoration trajectory. CRAM is not intended to replace any existing tools or approaches to monitoring or assessment, and will be used at the discretion of each individual agency to complement preferred approaches. Quality assurance and control practices have been developed to ensure that CRAM is appropriately applied in ambient and regulatory applications (California Wetland Monitoring Workgroup 2009).

CHAPTER 1: NEED, GOAL, STRATEGIC CONTEXT, INTENDED USES, AND GEOGRAPHIC SCOPE

1.0 Introduction

This document is the User's Manual for the California Rapid Assessment Method (CRAM) for Wetlands and Riparian Areas. Chapter 1 presents the rationale for CRAM, including why it's needed, its primary goal, its strategic context, intended uses, and the geographic scope of its applicability. Chapter 2 covers key terms, the conceptual framework for CRAM, and its development process. Chapter 3 describes the basic steps of the methodology.

1.1 Statement of Need

As this document is being released, large amounts of public and private funds are being invested in policies, programs, and projects to protect, restore, and manage wetlands in California. Most of these investments cannot be evaluated, however, because the ambient conditions of wetlands are not being monitored, the methods to monitor individual wetland areas are inconsistent, and there is little assurance of data quality. Furthermore, the results of monitoring are not readily available to analysts and decision makers. CRAM is a new approach that can provide consistent, scientifically defensible, affordable information about wetland conditions throughout California.

1.2 Justification for Rapid Assessment

The three most significant obstacles to developing adequate information about the conditions of California wetlands are (1) the lack of regional or statewide inventories of wetlands and related projects; (2) the high costs of conventional assessment methods; and (3) the lack of an information management system to support regional or statewide wetland assessments. The USEPA has developed a 3-tiered framework for comprehensive assessment and monitoring of surface waters that can guide efforts to overcome these obstacles (USEPA 2006).

> *Level 1*. Level 1 consists of map-based inventories and landscape profiles of wetlands and related habitats in a Geographic Information System (GIS). Inventories are essential for locating wetlands and for describing their geographic distribution and abundance. While there are various efforts to map wetlands on regional, county, and local levels, the California State Wetland Inventory as mandated by Assembly Bill 2286 is the primary wetland inventory for the State. The statewide inventory can be used to update the National Wetlands Inventory (NWI) of the USFWS and the National Hydrography Dataset (NHD) of the USGS, while also meeting many of the needs of regional wetland scientists, managers, and regulators. In addition to the inventory of wetlands, the State is supporting the development of web-based inventories of wetland projects (www.californiawetlands.net) that can be used to assess the cumulative effect of projects on the extent and overall ambient condition of wetlands. The State Wetland Inventory, Riparian Inventory, Wetlands Portal will aid wetland conservation planning by showing each wetland in the context of all others. They will also serve as sample frames for objective, probabilistic surveys of the ambient condition of wetlands and for assessing the effects of projects and other management actions on the ambient wetland condition at various scales ranging

from local watersheds to the State as a whole. Through the statewide Level 1 inventory and the Wetlands Portal, the State can overcome the obstacle of not having an adequate inventory of wetlands and related projects to track changes in their extent and condition.

Level 2. Level 2 methods assess the existing condition of a wetland relative to its broadest suite of suitable functions, services, and beneficial uses, such as flood control, groundwater recharge, pollution control, and wildlife support, based on the consensus of best professional judgment. In this regard, a level 2 assessment represents the overall functional capacity of a wetland. To be valid, rapid assessments must be strongly correlated to Level 3 measures of actual functions or services. Once validated, Level 2 assessments can be used where Level 3 data are lacking or too expensive to collect. Level 2 assessments can thus lessen the amount and kinds of data needed to monitor wetlands across large areas over long periods. CRAM is the most completely developed and tested Level 2 method for California at this time.

Level 3. Level 3 provides quantitative data about selected functions, services, or beneficial uses of wetlands. Such data are needed to develop indicators, to develop standard techniques of data collection and analysis, to explore mechanisms that account for observed conditions, to validate Level 1 and 2 methods, and to assess conditions when the results of Level 1 and Level 2 efforts are too general to meet the needs of wetland planners, managers, or regulators.

CRAM is based on a growing body of scientific literature and practical experience in the rapid assessment of environmental conditions. Several authors have reviewed methods of wetland assessment (Margules and Usher 1981, Westman 1985, Lonard and Clairain 1986, Jain *et al.* 1993, Stein and Ambrose 1998, Bartoldus 1999, Carletti *et al.* 2004, Fennessy *et al.* 2004). Most methods differ more in the details of data collection than in overall approach. In general, the most useful approaches focus on the visible, physical and/or biological structure of wetlands, and they rank or categorize wetlands along one or more stressor gradients (Stevenson and Hauer 2002). The indicators of condition are derived from intensive Level 3 studies that show relationships between the indicators, high-priority functions or ecological services of wetlands, and anthropogenic stress, such that the indicators can be used to assess the effects of management actions on wetland condition.

Existing methods have been used to assess wetlands at a variety of spatial scales, from habitat patches within local projects, to watersheds and regions of various sizes. Methods that are designed to assess large areas, such as the Synoptic Approach (Leibowitz *et al.* 1992), typically produce coarser and more general results than site-specific methods, such as the Hydrogeomorphic Method (HGM; Smith *et al.* 1995, Smith 2000) or the Index of Biotic Integrity (IBI; Karr 1981). Each scale of wetland assessment provides different information. Furthermore, assessments at different scales can be used for cross-validation, thereby increasing confidence in the approach being used. A comprehensive wetland monitoring program might include a variety of methods for assessing wetlands at different scales.

Existing methods also differ in the amount of effort and expertise they require. Methods such as the Wetland Rapid Assessment Procedure (WRAP; Miller and Gunsalus 1997) and the Descriptive Approach (USACOE 1995), are extremely rapid, whereas the Habitat Evaluation

Procedure (HEP; USFWS 1980), the New Jersey Watershed Method (Zampella *et al.* 1994), and the Bay Area Watersheds Science Approach (WSA version 3.0, Collins *et al.* 1998), are much more demanding of time and expertise.

None of the existing methods other than CRAM can be applied equally well to all kinds of wetlands in California. The HGM and the IBI are the most widely applied approaches in the U.S. While they are intended to be rapid, they require more time and resources than are usually available, and both have a somewhat limited range of applicability. For example, IBIs are developed separately for different ecological components of wetland ecosystems, such as vegetation and fish, and for different types of wetlands, such as wadeable streams and lakes. HGM guidebooks are similarly restricted to one type of habitat, such as vernal pools or riverine wetlands, and they are typically restricted to a narrowly defined bioregion. Some guidebooks are restricted to individual watersheds. Trial applications of rapid assessment methods developed for other states, including the Florida WRAP and the Ohio Rapid Assessment Method (ORAM; Mack 2001) in California coastal watersheds indicated that significant modifications of these methods would be required for their use in California, and lead to developing CRAM.

1.3 Goal and Intended Use

The overall goal of CRAM is to:

> *Provide rapid, scientifically defensible, standardized, cost-effective assessments of the status and trends in the condition of wetlands and the performance of related policies, programs and projects throughout California.*

CRAM is being developed as a rapid assessment tool to provide information about the condition of a wetland and the stressors that affect that wetland. CRAM is intended for cost-effective ambient monitoring and assessment that can be performed on different scales, ranging from an individual wetland, to a watershed or a larger region. It can be used to develop a picture of reference condition for a particular wetland type or to create a landscape-level profile of the conditions of different wetlands within a region of interest. This information can then be used in planning wetland protection and restoration activities. Additional applications could include:

- *preliminary* assessments to determine the need for more traditional intensive analysis or monitoring;
- providing *supplemental* information during the evaluation of wetland condition to aid in regulatory review under Section 401 and 404 of the Clean Water Act, the Coastal Zone Management Act, Section 1600 of the Fish and Game code, or local government wetland regulations; and
- *assisting* in the monitoring and assessment of restoration or mitigation projects by providing a rapid means of checking progress along restoration trajectories.

CRAM is *not* intended to replace any existing tools or approaches to monitoring or assessment, and will be used at the discretion of each individual agency to complement preferred approaches. Wetland impact analysis and compensatory mitigation planning and monitoring for larger wetland areas that exhibit more complex physical and biological functions will typically require more information than CRAM will be able to provide.

1.4 Related Rapid Assessment Efforts in California and Other States

Development of CRAM has incorporated concepts and methods from other wetland assessment programs in California and elsewhere, including the Washington State Wetland Rating System (WADOE 1993), MRAM (Burglund 1999), and ORAM (Mack 2001). CRAM also draws on concepts from stream bio-assessment and wildlife assessment procedures of the California Department of Fish and Game, the different wetland compliance assessment methods of the San Francisco Bay Regional Water Quality Control Board and the Los Angeles Regional Water Quality Control Board, the Releve Method of the California Native Plant Society, and various HGM guidebooks that are being used in California.

1.5 Geographic Scope

CRAM is intended for application to all kinds of wetlands throughout California. Although centered on coastal watersheds through much of the initial development process, it has now spread inland to the Central Valley, Inland Empire and Tahoe regions. CRAM development to date has involved scientists and managers from other regions to account for the variability in wetland type, form, and function that occurs with physiographic setting, latitude, altitude, and distance inland from the coast. Validation efforts have indicated that CRAM is broadly applicable throughout the range of conditions commonly encountered. However, since CRAM emphasizes the functional benefits of structural complexity, it may yield artificially low scores for wetlands that do not naturally appear to be structurally complex. CRAM should therefore be used with caution in such wetlands. This can include riverine wetlands in the headwater reaches of very arid watersheds, montane depressional wetlands above timberline, and vernal pools on exposed bedrock. Future refinements of CRAM will be used to adjust CRAM metrics as needed to remove any systematic bias against any particular kinds of wetlands or their settings[1].

1.6 Supporting Information Systems

Information management is an essential part of a successful program of environmental monitoring and assessment. CRAM is supported by a public web site (cramwetlands.org) that provides downloadable versions of this User's Manual, training materials, and access to an open-source database that allows registered CRAM practitioners to upload, view, and download CRAM results (eCRAM). The CRAM website and database are being developed in the context of a broad initiative in California to improve data and information sharing throughout the community of environmental scientists, managers, and the concerned public. The California Wetlands Monitoring Workgroup (CWMW) has developed the California Wetlands Portal (californiawetlands.net) as a mechanism to improve communication about the extent and condition of California's aquatic resources. Over time, the CRAM website will be integrated with the California Wetlands Portal website to provide a single point of entry for easy access to information about the State's wetlands and aquatic resources.[2]

---

[1] The riverine module of CRAM will be revised based on additional field work during FY 2012-14 to better accommodate assessment of arid headwater and other types of aridland streams.

[2] At this time, the CRAM database is only publicly accessible through the CRAM website (cramwetlands.org). In the future, the CRAM database may also be accessible via the information management system of the State's Surface Water Ambient Monitoring Program (SWAMP) through the coastal Regional Information Centers of the California Environmental Data Exchange Network (CEDEN).

1.7 Organization and Coordination to Develop CRAM

An organization was created to foster collaboration and coordination among the regional CRAM developers. USEPA awarded Wetland Program Development Grants through Section 104b(3) of the US Clean Water Act to the Southern California Coastal Water Research Project (SCCWRP), to a partnership of the Association of Bay Area Governments (ABAG) and the San Francisco Estuary Institute (SFEI), to a partnership of the Central Coast District of the California Coastal Commission (CCC) and the Moss Landing Marine Laboratories (MLML), and to the North Coast Region of the California Department of Fish and Game (CDFG) to develop and begin implementing Level 1-3 methods, with an emphasis on Level 2 (CRAM) and information management. The Principal Investigators (PIs) worked with sponsoring agencies to form a statewide Core Team and Regional Teams that have provided the breadth and depth of technical and administrative experience necessary to develop and begin implementing CRAM.

1.7.1 Core Team

The Core Team fostered collaboration and coordination among the regions to produce a rapid assessment method that is consistent for all kinds of wetlands throughout California. The Core Team consists of the PIs plus technical experts in government agencies, non-governmental organizations, and academia. Core Team members are listed in the acknowledgments at the front of this document. The Core Team set the direction for the PIs and the Regional Teams, reviewed their products, and promoted CRAM to potential user groups.

1.7.2 Regional Teams

The Regional Teams advised and reviewed the work of the PIs to ensure that CRAM addressed regional differences in wetland form, structure, and ecological service. The members of each Regional Team are listed in the acknowledgments at the front of this document. Members of the Regional Teams have assisted in the verification and validation of CRAM, and have provided feedback through the PIs to the Core Team about the utility of CRAM in the context of regional wetland regulation and management. Each Regional Team consisted of the PIs, local and regional wetland experts having experience with assessment methodologies, Core Team members who work within the region, and technical representatives from potential user groups.

1.7.3 Institutional Support

In 2010, the California Water Quality Monitoring Council (Kehoe 2006) directed the California Wetland Monitoring Workgroup (CWMW) to create a Level 2 Committee to coordinate the review, development and implementation of CRAM and other rapid assessment methods for all state agencies. CRAM is a core methodology of the Wetland and Riparian Assessment Program (WRAMP), a statewide strategy developed by the CWMW to coordinate ongoing wetland monitoring and assessment efforts that consists of standardized methods to monitor the distribution, abundance, and condition of wetlands and riparian areas throughout California. CRAM is also proposed as a key element of the State Water Board's emerging Wetland and Riparian Area Protection Policy (State Water Board Resolution No. 2008-0026) and is currently being tested by many other state and federal agencies for application to various regulatory and non-regulatory programs.

CHAPTER 2: KEY TERMS, CONCEPTS, ASSUMPTIONS, AND DEVELOPMENTAL PROCESS

2.0 Overview

CRAM uses standardized definitions for key terms, including "wetland," "disturbance," "stress," and "condition." CRAM is based on basic assumptions about functional relationships between condition and function or ecological service, and about the spatial relationships between stress and condition, as explained below.

2.1 Key Terms

Assessment Area (AA). An AA is the portion of a wetland that is the subject of a CRAM assessment. Multiple AAs might be needed to assess large wetlands. Rules for delineating an AA are presented in Section 3.5.

Stress. Stress is the consequence of anthropogenic events or actions that measurably affect conditions in the field. The key stressors tend to reduce the amount of wetlands, or they significantly decrease the quantity and/or quality of sediment supplies and/or water supplies upon which the wetlands depend. Gradients of stress result from spatial variations in the magnitude, intensity, or frequency of the stressors.

Disturbance. Disturbance is the consequence of natural phenomena, such as landslides, droughts, floods, wildfires, and endemic diseases that measurably affect conditions in the field.

Condition. The condition of a wetland is the state of its physical and biological structure and form relative to their best achievable states.

Buffer. For the purposes of CRAM, the buffer is the area outside the assessment area, including adjoining uplands and other wetland areas that can reduce the effects of stressors on the wetland's condition.

Landscape Context. The landscape context of a wetland consists of the lands, waters, and associated natural processes and human uses that directly affect the condition of the wetland or its buffer.

Ecological Services or Beneficial Uses. These are the benefits to society that are afforded by the conditions and functions of a wetland. Key ecological services for many types of wetlands in California include flood control, shoreline and stream bank protection, groundwater recharge, water filtration, conservation of cultural and aesthetic values, and support of endemic biological diversity.

Attribute. Attributes are categories of metrics used to assess condition of the wetland as well as its buffer and landscape context. There are four CRAM attributes: Buffer and Landscape Context, Hydrology, Physical Structure, and Biotic Structure.

Metric. A metric is a measurable component of an attribute. Each metric should be field-based (Fennessy *et al.* 2004), ecologically meaningful, and have a dose-dependent response to stress that can be distinguished from natural variation across a stressor gradient (Barbour *et al.* 1995).

Narrative Descriptions of Alternative States. For each type of wetland, the narrative descriptions of alternative states represent the full range of possible condition from the worst conditions that are commonly observed to the best achievable conditions, for each metric of each attribute in CRAM.

Indicators. These are visible clues or evidence about field conditions used to select the best-fit narrative description of alternative states for CRAM metrics.

Metric Score. The score for a CRAM metric is the numerical value associated with the narrative description of an alternative state that is chosen because it best-fits the condition observed at the time of the assessment.

Attribute Score. An attribute score is the percent of the maximum possible combination of the metric scores for the attribute.

CRAM Index Score or AA Score. A CRAM Indx score or AA score indicates the overall condition of an Assessment Area. It is calculated as the average of the four final attribute scores for the Assessment Area.

2.2 Conceptual Framework

CRAM was developed according to a set of underlying conceptual models and assumptions about the meaning and utility of rapid assessment, the best framework for managing wetlands, the driving forces that account for their condition, and the spatial relationships among the driving forces. These models and assumptions are explicitly stated in this section to help guide the interpretation of CRAM scores.

2.2.1 Management Framework

The management framework for CRAM is the Pressure-State-Response model (PSR) of adaptive management (Holling 1978, Bormann *et al.* 1994, Pinter *et al.* 1999). The PSR model states that human operations, such as agriculture, urbanization, recreation, and the commercial harvest of natural resources can be sources of stress or *pressure* affecting the condition or *state* of natural resources. The human *responses* to these changes include any organized behavior that aims to reduce, prevent or mitigate undesirable stresses or state changes. Natural resource protection depends on monitoring and assessment to understand the relationships between stress, state, and management responses. The managers' concerns guide the monitoring efforts, and the results of the monitoring should influence the managers' actions and concerns.

Assessment approaches vary in that they may evaluate any or all aspects of the pressure-state-response model. Pressure indicators describe the variables that directly cause (or may cause) wetland problems, such as discharges of fill or urban encroachment. State indicators evaluate the current condition of the wetland, such as plant diversity or concentration of a particular contaminant in the water. Response indicators demonstrate the efforts of managers to address the wetland problem, such as the implementation of best management practices. The approach used by CRAM is to focus on *condition* or *state*. A separate stressor checklist is then used to note which, if any, stressors appear to be exerting *pressure* affecting condition. It is assumed that managers with knowledge of pressures and states will exact more effective *responses*.

The PSR framework is a simple construct that can help organize the monitoring components of adaptive management. It can be elaborated to better represent complex systems involving interactions and nonlinear relations among stressors, states and management responses (e.g., Rissik *et al*. 2005) For the purposes of CRAM, the PSR model is simply used to clarify that CRAM is mainly intended to described state conditions of wetlands.

2.2.2 Rapid Assessment

CRAM embodies the basic assumption of most other rapid assessment methods that ecological conditions vary predictably along gradients of stress, and that the conditions can be evaluated based on a fixed set of observable indicators. CRAM metrics were built on this basic assumption according to the following three criteria common to most wetland rapid assessment methods (Fennessy *et al*. 2004):

1. *the method should assess existing conditions* (see Section 2.1 above), without regard for past, planned, or anticipated future conditions;
2. *the method should be truly rapid,* meaning that it requires two people no more than one half day of fieldwork plus one half day of subsequent data analysis to complete; and
3. *the method is a site assessment* based on field conditions and does not depend largely on inference from Level 1 data, existing reports, opinions of site managers, etc.

2.2.3 Forcing Functions, Stress, Buffer, and Condition

The condition of a wetland is determined by interactions among internal and external hydrologic, biologic (biotic), and physical (abiotic) processes (Brinson, 1993). CRAM is based on a series of assumptions about how these processes interact through space and over time. First, CRAM assumes that the condition of a wetland is mainly determined by the quantities and qualities of water and sediment (both mineral and organic) that are either processed on-site or that are exchanged between the site and its immediate surroundings. Second, the supplies of water and sediment are ultimately controlled by climate, geology, and land use. Third, geology and climate govern natural disturbance, whereas land use accounts for anthropogenic stress. Fourth, biota (especially vegetation) tend to mediate the effects of climate, geology, and land use on the quantity and quality of water and sediment (Figure 2.1). For example, vegetation can stabilize stream banks and hillsides, entrap sediment, filter pollutants, provide shade that lowers temperatures, reduce winds, etc. Fifth, stress usually originates outside the wetland, in the surrounding landscape or encompassing watershed. Sixth, buffers around the wetland can intercept and otherwise mediate stress (Figure 2.2).

2.2.4 Condition, Ecological Service, and CRAM Scores

Three major assumptions govern how wetlands are scored using CRAM. First, it is assumed that the societal value of a wetland (i.e., its ecological services) matters more than whatever intrinsic value it might have in the absence of people. This assumption does not preclude the fact that the support of biological diversity is a service to society. Second, it is assumed that the value depends more on the diversity of services than the level of any one service. Third, it is assumed that the diversity of services increases with structural complexity and size. CRAM therefore favors large, structurally complex examples of each type of wetland.

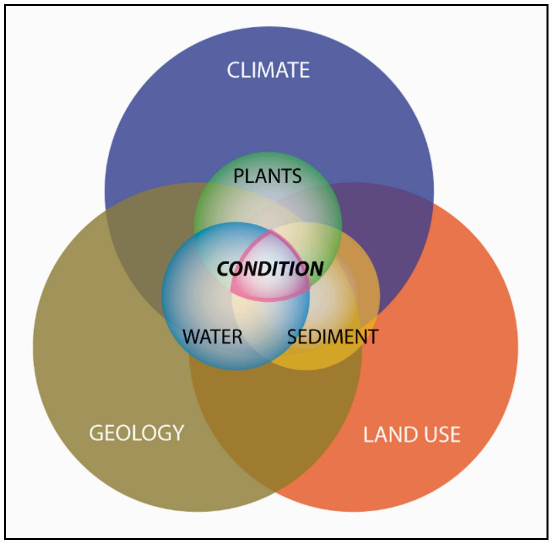


Figure 2.1: Spatial hierarchy of factors that control wetland conditions, which are ultimately controlled by climate, geology, and land use.

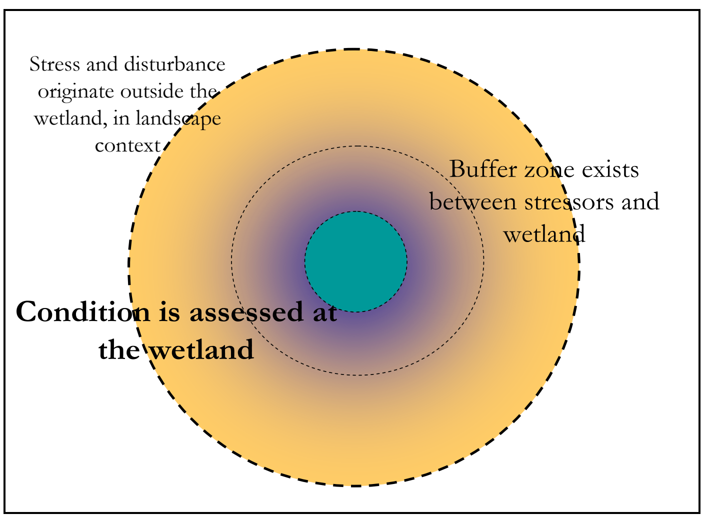


Figure 2.2: Spatial hierarchy of stressors, buffers, and wetland condition. Most stressors originate outside the wetland. The buffer exists between the wetland and the sources of stress, and serves to mediate the stress

2.3 Developmental Framework

The CRAM developmental process consisted of nine steps with distinct products organized into three phases: basic design, calibration, and validation (Table 2.1).

Table 2.1: Basic outline of CRAM development.

Core Team	Basic Design Phase	Develop conceptual models of wetland form and function
		Identify universal Attributes of wetland condition
		Nominate Metrics of the Attributes
		Nominate descriptions of alternative states for each Metric
Core and Regional Teams	Calibration Phase	Clarify and revise the Metrics and narrative descriptions of alternative states based on regional team input and inter- and intra-team comparisons
		Develop a checklist to identify stressors
		Test and select methods of scaling and weighting Attributes and Metrics
		Test and select formulas for calculating Attribute scores and AA scores
	Validation Phase	Validate Metrics and Attributes using Level 3 data
		Conduct independent peer review
		Provide outreach and training

2.3.1 Basic Design

This phase of CRAM development involved creating conceptual models of wetland form and function, defining key terms, developing the wetland typology, identifying the attributes, and formulating metrics that describe each attribute. The basic design work was done primarily through initial field-testing and feedback by Regional Teams and the Core Team. Version 2.0 of CRAM marked the completion of the basic design phase.

Each CRAM attribute is represented by a set of metrics (Table 2.2 below), and each metric is represented by a set of mutually exclusive narrative descriptions of alternative states. In aggregate, the alternative states of all the metrics for any type of wetland represent its full range of visible form and structure.

An effort was made to separate assessments of condition from assessments of stress. This was done to explore correlations between stress and condition. For example, CRAM AAs can be grouped according to their associated stressors, and the groups can be compared based on their CRAM scores. The separation has been difficult to achieve, however. For example, the Plant Community metric of the Biotic Structure attribute includes a sub-metric about the relative abundance of non-native plant species, although biological invasion is usually considered a significant stressor. Some autocorrelation can therefore be expected between stress and condition as assessed using the current version of CRAM

2.3.2 Verification

The verification phase was used to determine if the draft wetland classification scheme, the attributes, the metrics, and the narrative descriptions of alternative states were (1) clear and understandable; (2) comprehensive and appropriate; (3) sensitive to obvious variations in condition; (4) able to produce similar scores for areas subject to similar levels of the same kinds of stress; and (5) tended to foster repeatable results among different practitioners. The verification phase was also used to test and select methods of calculating, scaling, and weighting scores for metrics, attributes, and AAs.

Verification involved iterative adjustments to the classification system and the metrics during multiple field tests by each Regional Team. The amount of revision has declined steadily, but minor changes are expected to continue as the number of CRAM users and the amount of its use increases. For the CRAM version used in the Validation Phase, all the regional teams were able to meet the targeted within-team and between-team QAQC standards of 10% and 20%, respectively, for each metric.

Table 2.2: CRAM Attributes and Metrics.

Attributes		Metrics
Buffer and Landscape Context		Aquatic Area Abundance or Riparian Continuity
		Buffer:
		Percent of AA with Buffer
		Average Buffer Width
		Buffer Condition
Hydrology		Water Source
		Hydroperiod or Channel Stability
		Hydrologic Connectivity
Structure	Physical	Structural Patch Richness
		Topographic Complexity
	Biotic	Plant Community:
		Number of Plant Layers Present or Native Species Richness (vernal pools only)
		Number of Co-dominant Species
		Percent Invasion
		Horizontal Interspersion
		Vertical Biotic Structure

2.3.3 Validation

The purpose of the validation phase was to assess the overall performance of CRAM by regressing metric scores and attribute scores on Level 3 data representing expected relationships between condition and function or service (Table 2.3). The same models were used to guide alternative approaches for weighting and combining scores. CRAM performed best using the simplest combination rules without any weighting. The level of performance was adequate for the functions and services represented by the selected Level 3 data. The validation phase for estuarine wetlands and riverine/riparian systems was completed with CRAM version 4.0. The other types of wetlands will be validated as CRAM is implemented. A full report of the validation efforts to date is available at www.cramwetlands.org.

Table 2.3: Expected relationships among CRAM attributes, metrics, and key services.

	Buffer and Landscape Context	Hydrology			Physical Structure		Biotic Structure				
KEY SERVICES	Buffer and Landscape Connectivity Metrics	Water Source	Hydroperiod or Channel Stability	Hydrologic Connectivity	Structural Patch Richness	Topographic Complexity	Number of Plant Layers	Number of Co-dominant Species and Native Species Richness	Percent Invasion	Horizontal Interspersion and Zonation	Vertical Biotic Structure
Short- or long-term surface water storage	X		X	X	X	X				X	X
Subsurface water storage		X	X	X		X					
Moderation of groundwater flow or discharge	X	X									
Dissipation of energy					X	X	X			X	X
Cycling of nutrients	X		X	X	X	X	X	X	X		X
Removal of elements and compounds	X		X	X		X	X			X	
Retention of particulates			X	X	X	X	X	X		X	
Export of organic carbon			X	X			X		X	X	X
Maintenance of plant and animal communities	X		X	X	X	X	X	X	X	X	X

CHAPTER 3: PROCEDURES FOR USING CRAM

3.0 Summary

The general procedure for using CRAM consists of eight (8) steps (Table 3.1).

Table 3.1: Steps for using CRAM.

Step 1	Assemble background information about the management of the wetland.
Step 2	Classify the wetland using this the CRAM typology and this manual (see Section 3.2 and Figure 3.2).
Step 3	Verify the appropriate season and other timing aspects of the field assessment.
Step 4	Estimate the boundary of the AA in the office (subject to field verification).
Step 5	Conduct the office assessment of stressors and on-site conditions of the AA.
Step 6	Conduct the field assessment of stressors and on-site conditions of the AA.
Step 7	Complete CRAM assessment scores and QA/QC Procedures.
Step 8	Upload CRAM results into statewide information data management system.

3.1 Step 1: Assemble Background Information

CRAM assessments are aided by background information about the management objectives, history, known or expected stressors, and general ecological character of the wetland to be assessed. Background materials may include the following (Table 3.2).

Table 3.2: Example of background materials.

- USGS topographic quadrangles, National Wetlands Inventory (NWI), State Wetlands Inventory, road maps, and other maps of geology, soils, vegetation, land uses, etc.
- Air photos and other imagery, preferably geo-rectified with 1-3 m. pixel resolution.
- California Natural Diversity Database (CNDDB) search results.
- Relevant reports on geology, geotechnical conditions, hydrology, soils, environmental impacts, cultural history, land use, restoration and mitigation projects, management plans, etc., from water districts, flood control districts, open space districts, state and federal agencies, etc.

3.2 Step 2: Classify the Wetland according to the CRAM typology

Wetland classification requires the application of a standard wetland definition followed by the application of a standard wetland typology or classification system.

3.2.1 General Definitions of Wetlands and Riparian Areas

At this time, CRAM employs the following wetland definition provided by the National Wetland Inventory (NWI) of the US Fish and Wildlife Service (USFWS)[1].

> *"**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 of 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 not a soil and is saturated with water or covered by shallow water at some time during the growing season of each year" (Cowardin et al. 1979).*

CRAM is designed to assess vegetated wetlands, meaning wetlands that support at least 5% cover of vegetation during the peak growing season. Therefore, for the purposes of CRAM, a wetland is further defined as the vegetated portion of a discrete area of wetland habitat (as defined by NWI) that is large enough to contain one or more CRAM Assessment Areas (AAs). A wetland may be the same size as an AA or larger than multiple AAs, but it is never smaller than an AA (see AA delineation guidelines in Section 3.5 and AA size recommendations in Table 3.7 below). This modification of the NWI definition is necessary to convert a Level 1 wetland inventory based on the NWI definition into a sample frame for ambient surveys of wetland condition using CRAM. A sample frame is a list or map of every wetland or potential CRAM AA) within the population of wetlands to be surveyed (Särndal *et al.* 1992).

CRAM recognizes that all wetlands have some amount of adjacent riparian area, as defined by the NRC. CRAM employs the riparian definition provided by the US National Research Council (NRC):

> *"**Riparian Areas** are transitional between terrestrial and aquatic ecosystems and are distinguished by gradients in biophysical conditions, ecological processes and biota. They are areas through which surface and subsurface hydrology connect water bodies with their adjacent uplands. They include those portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems. Riparian areas are adjacent to perennial, intermittent, and ephemeral streams, lakes and estuarine-marine shorelines" (National Research Council 2001).*

Although the current version of CRAM can be used to assess all types of wetlands, riparian areas should considered part of the wetland (and included in a CRAM AA) only for riverine, depressional, and bar-built systems. At this time, the methodology for assessing the riparian area associated with lacustrine wetlands, vernal pools, playas, slope wetlands, and estuarine wetlands is still in development. For these wetland types, the riparian area is considered part of the wetland buffer, and not part of the wetland and not included in the CRAM AA.

---

[1] An alternative wetland definition for the State of California has been recommended by the Technical Advisory Team to the Policy Development Team for the California Wetland and Riparian Area Protection Policy (SFEI-ASC 2009).

The approximate boundaries of a wetland can be determined from the State Wetland Inventory, NWI, an existing Jurisdictional Delineation (JD), by using the State Inventory or NWI mapping methods, or by using the JD manual (USACE 1987). A JD is especially useful for determining the boundaries of a wetland when assessing impacted sites or mitigation sites as defined under Section 404 of the US Clean Water Act. When using the State Inventory, NWI, or the JD manual to identify a wetland, it is important to limit the wetland to the vegetated area, as described above.

If the wetland cannot be identified from an existing inventory or a JD, then its boundaries should be sketched on the base imagery for the CRAM assessment, using the general guidelines in Table 3.3 and Figure 3.1 below. A sketch map based on these guidelines cannot replace a JD, the State Wetland Inventory or NWI. Athough a JD is helpful in identifying the boundaries of a wetland where a CRAM assessment is to be conducted, it is NOT a prerequiste for conducting CRAM. CRAM can still be conducted on wetlands that do not have an associated JD.

Table 3.3: Guidelines to delineate a wetland for the purpose of CRAM.

Delineating Feature	Description of Features
Backshore	The backshore of a wetland is the boundary between the wetland and the adjoining upland, where the upland is at least 5m wide. The high-water contour of the wetland is a good proxy for its backshore boundary.
Foreshore	The foreshore of a wetland is the boundary between the vegetated wetland and any adjoining semi-aquatic, non-wetland area, such as an intertidal flat or a non-vegetated riverine channel bar, or a fully aquatic area such as the open water area of a lake or estuary that is at least 30m wide.
Adjoining Wetland	Any wetland that is mostly less than 5m distant from the wetland being assessed is an adjoining wetland.

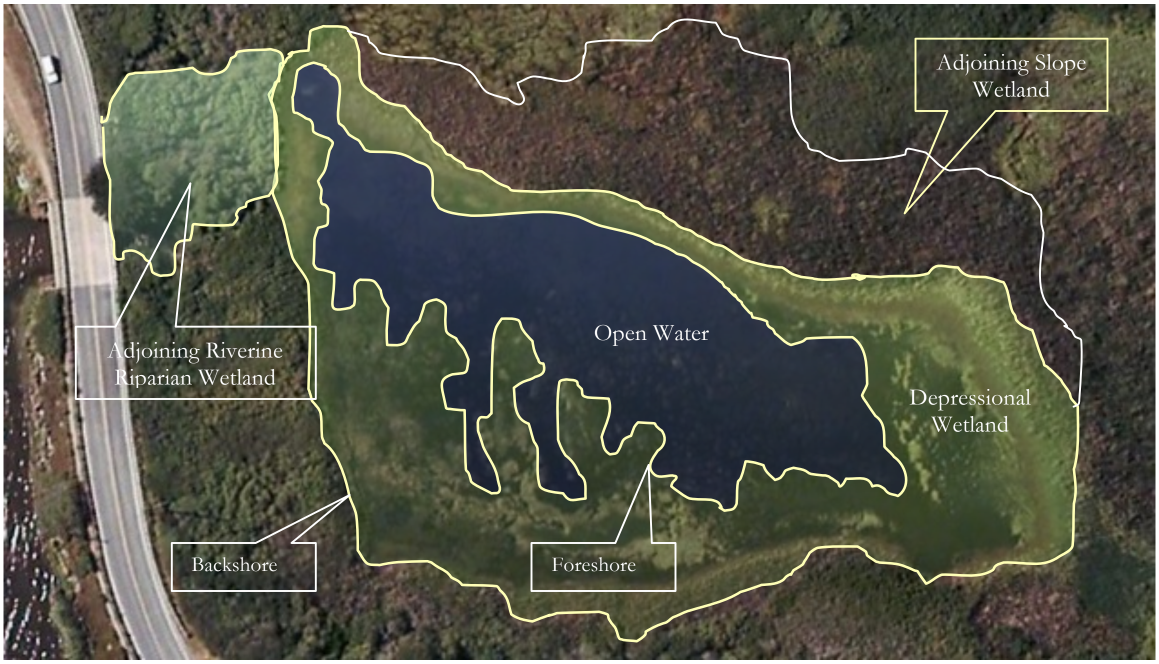


Figure 3.1: Using the backshores, foreshores, and the boundaries between wetland types to delineate a wetland.

3.2.2 Wetland Typology

In determining the appropriate wetland typology for CRAM, the Core Team considered the ecological typology used by NWI, the hydro-geomorphic (HGM) classification used by the USACE, and typologies used in state policy. The NWI typology emphasizes the habitat functions of wetlands. The HGM typology emphasizes wetland hydrology and landscape position. While the Core Team considered the need to be consistent with both of these typologies, it also considered the need to recognize the kinds of wetlands named in California wetland protection policies. The hierarchical CRAM typology reflects all of these considerations, but it favors the HGM classification system overall, with sub-types that reflect State policy.

The CRAM typology consists of six major wetland types, four of which have sub-types (Table 3.4 and Figure 3.2). Additional sub-types can be added in the future as needed.

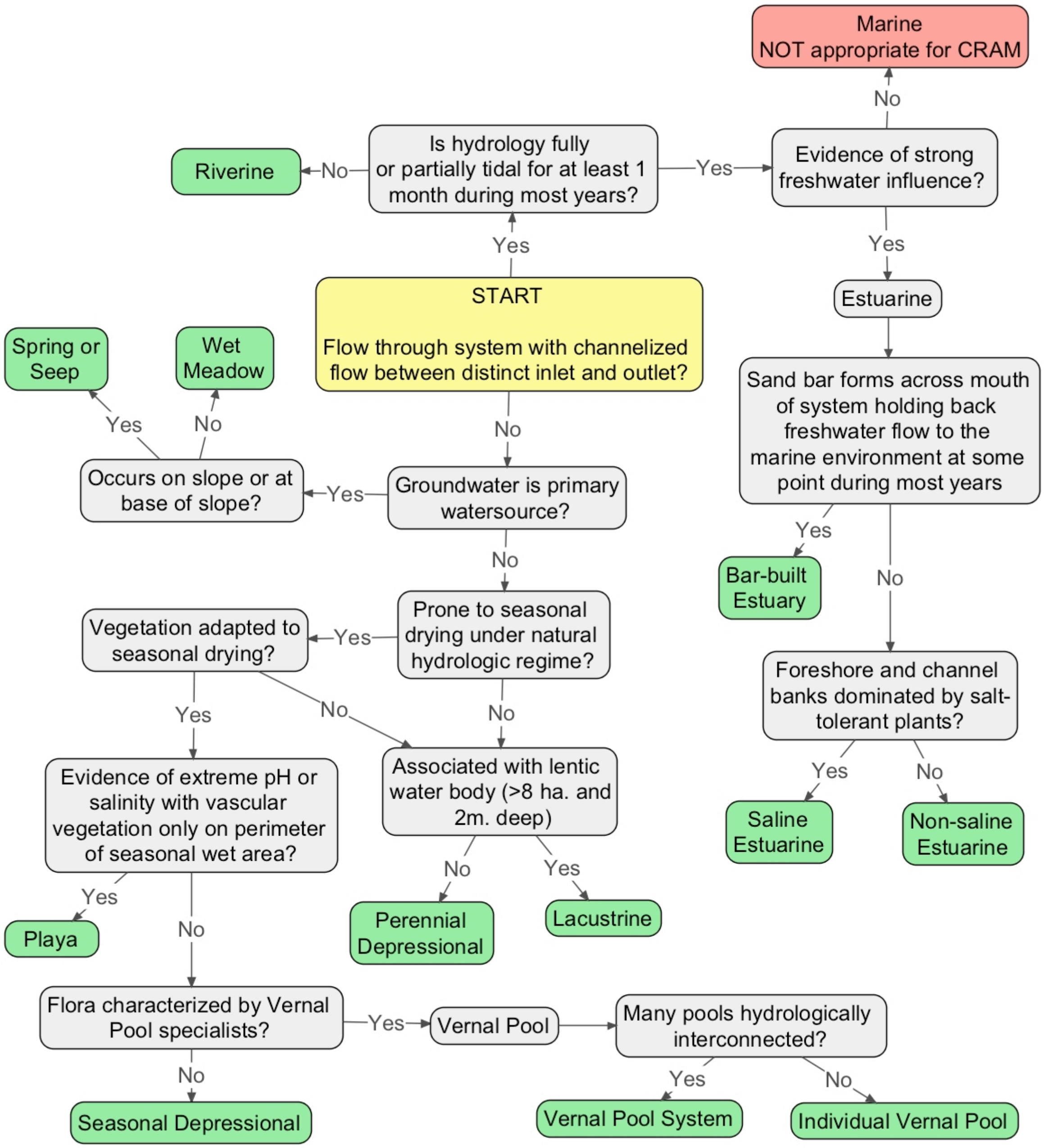
Table 3.4: The CRAM Wetland Typology.

CRAM Wetland Types	**CRAM Sub-types (these are recognized for some but not all metrics)**
Riverine Wetlands	Confined Riverine Wetlands
	Non-confined Riverine Wetlands
Depressional Wetlands	Individual Vernal Pools
	Vernal Pool Systems
	Depressional Wetlands
Playas	no sub-types
Estuarine Wetlands	Perennial Saline Estuarine Wetlands
	Perennial Non-saline Estuarine Wetlands
	Bar-Built Estuarine Wetlands
Lacustrine Wetlands	no sub-types
Slope Wetlands	Seeps and Springs
	Wet Meadows

Some wetlands will have undergone a conversion from one type to another due to either natural or anthropogenic events. For example, a channel avulsion may capture a depressional wetland and convert it to a riverine system, or construction of a dam may impound a stream and convert it to a lacustrine system. In any case, the wetland should be evaluated according to its current type and condition. Metric scores should be assigned using the ratings for the current state of the wetland, without regard for what the wetland might have been in the past, or what it might become in the future.

However, for converted wetlands, the historical type as well as the existing type should be noted. The stressor checklist enables the user to document if the wetland is currently being stressed by the conversion (i.e., if the process of conversion is continuing and a significant source of stress).

Figure 3.2: Flowchart to determine wetland type and sub-type.



3.2.2.1 Riverine (Including Closely Associated Riparian Areas)

A riverine wetland consists of the riverine channel and its active floodplain, plus any portions of the adjacent riparian areas that are likely to be strongly linked to the channel and immediate floodplain through bank stabilization and allochthonous organic material (productivity) inputs. An active floodplain is defined as the relatively level area that is periodically flooded, as evidenced by deposits of fine sediment, wrack lines, vertical zonation of plant communities, etc. The water level that corresponds to incipient flooding can vary depending on flow regulation and whether the channel is in equilibrium with water supplies and sediment supplies. Under equilibrium conditions, the usual high water contour that marks the inboard margin of the floodplain (i.e., the margin nearest the thalweg of the channel) corresponds to the height of bankfull flow, which has a recurrence interval of about 1.5 to 2.0 years under mesic climate conditions. The active floodplain can include broad areas of vegetated and non-vegetated bars and low benches among the distributaries of deltas and braided channel systems. The active floodplain does not include terraces that are geomorphologically disconnected from channel-forming processes, although riparian areas along terrace margins may be included as part of the floodplain. Vegetated wetlands can develop along the channel bottoms of intermittent and ephemeral streams during the dry season. Dry season assessment in these systems therefore includes the channel beds. However, the channel bed is excluded from the assessment when it contains non-wadeable flow. To help standardize the assessment of riverine wetlands, the assessments should be restricted to the dry season.

There may be a limit to the applicability of this module in low order (i.e., headwater) streams in very arid environments and in desert streams that tend not to support species-rich plant communities with complex horizontal and vertical structure. CRAM may be systematically biased against such naturally simple riverine systems. In addition, this module is not intended to apply to rivers with extremely broad floodplains, such as those which occur where large rivers occupy valleys with very low channel slopes, or near coastal embayments or the ocean, unless the extent of the floodplain included in the Assessment Area is limited to an area less than about two times bankfull width on each side of the channel.

Riverine wetlands are further classified as confined or non-confined, based on the ratio of valley width to channel width. Channels can also be entrenched, based on the ratio of flood-prone width to bankfull width (Figure 3.3 below).

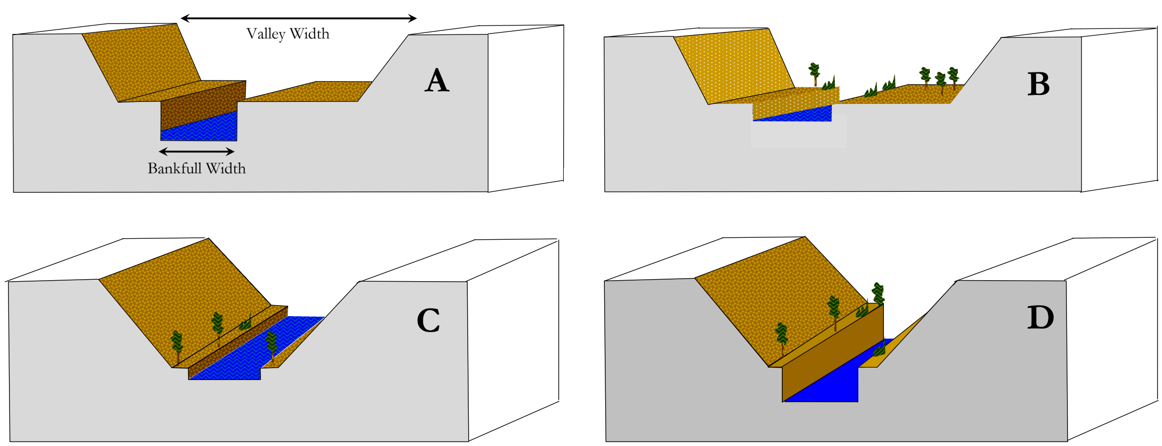


Figure 3.3: Illustrations of riverine confinement and entrenchment. (A) non-confined entrenched, (B) non-confined not entrenched, (C) confined not entrenched, and (D) confined entrenched riverine sub-types.

3.2.2.1.1 Non-confined Riverine Sub-type

In non-confined riverine systems, the width of the valley across which the system can migrate without encountering a hillside, terrace, or other feature that is likely to prevent further migration is at least twice the average bankfull width of the channel. Non-confined riverine systems typically occur on alluvial fans and plains, deltas in lakes, and along broad valleys.

3.2.2.1.2 Confined Riverine Sub-type

In confined riverine systems, the width of the valley across which the system can migrate without encountering a hillside, terrace, man-made levee, or urban development is less than twice the average bankfull width of the channel. A channel can also be considered confined by artificial levees and urban development if the average distance across the channel at bankfull is more than half the distance between the levees or more than half the width of the unurbanized lands that border the stream course. This assumes that the channel would not be allowed to migrate past the levees or into the urban development, or that levee breaches will be repaired.

3.2.2.2 Depressional Wetlands

Depressional wetlands occur in topographic lows (i.e., closed elevation contours) that allow the accumulation of surface water. These can occur as isolated basins with distinct boundaries, a complex of shallows and seasonally wet depressions created by the slight topographic relief with indistinct boundaries, and be natural or artificial in origin. The margins of distinct depressional wetlands are relatively easy to discern in aerial photos and in the field. Ponds on fault traces (e.g. sag ponds, snow melt ponds), valley bottoms (e.g. cutoff ox-bows on floodplains), and on broad saddles along ridge (e.g. kettle-holes in moraines) are examples of distinct, naturally occurring depressional wetlands. Stormwater treatment ponds, duck ponds, stock ponds, and water hazards on golf course are examples of artificially constructed depressional wetlands. Depressional wetlands differ from lacustrine wetlands (lakes) by lacking an adjacent area of open water at least 2 m deep and 8 ha total area. They differ from playas by lacking an adjacent area larger than the wetland of either alkaline or saline open water less than 2 m deep or non-vegetated, fine-grain sediments. Depressional wetlands are generally isolated from or hydrologically disconnected from surface water, and their hydrology is primarily determined by groundwater discharge, overland runoff, and precipitation.

Depressional wetland are typically comprised of three main parts: an area of open water, a non-vegetated area (**unvegetated flat)** that is exposed when the wetland is not full, and an area of emergent marsh vegetation that borders either the open water area or the non-vegetated area. The open water areas and non-vegetated areas have less than 5% absolute cover of vegetation. Some depressional wetlands lack the open water area and/or the non-vegetated area. CRAM recognizes that all wetlands have some amount of adjacent riparian area, as defined by the US National Research Council (NRC). For the purposes of CRAM, the riparian areas adjacent to depressional wetlands are considered part of the wetland.

Depressional wetlands can be perennial (perennially flooded) or ephemeral (seasonally or temporarily flooded), lacking surface ponding or saturated conditions during dry years. Perennial depressional wetlands have some amount of surface ponding for at least 9 months during most years (i.e. in greater than 5 out of 10 years.) Seasonally flooded depressional wetlands are defined as supporting surface ponding for between 4 and 9 months of the year, and temporarily flooded depressional wetlands possess surface water between 2 weeks and 4 months of the year.

Although depressional wetlands usually do not usually have outgoing surface drainage except during extreme flood events or heavy rainfall, they can have any combination of inlets and outlets or lack them completely. The predominant direction of flow is from the higher elevations toward the center of the depression. Potential water sources to depressional wetlands are direct precipitation, overland flow, streams, or groundwater/interflow from adjacent uplands. These systems may lose water through evapotranspiration, intermittent or perennial outlets, or recharge to groundwater. Vertical fluctuations in water levels can range from diurnal to seasonal.

A large variety of configurations exist for artificially constructed depressions. Basin-type depressions constructed within a stream or river channel (in-channel basins) essentially constitute a type conversion from a stream/river to a basin wetland. These can range from vegetated wetlands constructed within tributaries, such as low-flow headwaters, to sedimentation basins in stormwater channels designed to capture and retain sediment from runoff. In both extremes, these systems are designed to retain runoff over a period of time in order to promote sedimentation and detain flood flows. Offline basins are another type of artificially constructed basin depression that receives hydrologic inflow from stormwater, creeks or streams that have been built outside of the active channel or floodplain. Water is typically pumped into the wetland. This category may range from wetlands constructed from uplands that were never historically inundated, or wetlands constructed from wetland habitat with no hydrological connection to a stream or river.

Artificial depressions can also be associated with small tributary channels (typically first and second order streams) that receive hydrologic inputs through gravity flow of runoff from drainage networks. Offline channels refer to channelized systems that are created away from the historic channel or flood plan and receive hydrologic inflow from stormwater, creeks or streams by either gravity diversion or by mechanical pumping. The distinction made by this category is the recognition that the wetland may not be configured as a basin, but more like an open flowing channel, creek, or small streams with a distinct inflow and outflow.

3.2.2.2.1 Vernal Pool Wetlands

Vernal pools are ephemeral wetlands that form in shallow depressions underlain by bedrock or by an impervious, near-surface soil horizon. These depressions fill with rainwater and runoff during the winter and may remain inundated until spring or early summer, sometimes filling and emptying repeatedly during the wet season. Vernal pools undergo four distinct annual phases: (1) the wetting phase with the onset of the first rains; (2) the aquatic phase when the peak rainfall and inundation occurs; (3) the drying phase when many plants flower and produce seed and many animals disperse; and finally (4) the drought phase when the soil dries and cracks, and the plants succumb to extreme dry conditions. Vernal pools typically support a minimum of 30% cover of native plant species during the aquatic or drying phase. Vernal pools in disturbed areas or subjected to abnormal rainfall patterns might not meet this criterion due to invasion by non-native plants. If the wetland is mostly characteristic of a vernal pool but also has characteristics of other kinds of wetlands, such that its classification as a vernal pool is not completely certain, then it should be considered a vernal pool.

3.2.2.2.2 Vernal Pool Systems

Vernal pools often occur together and with vernal swales as vernal pool systems. These can have many pools of various sizes and shapes, varying floral and faunal composition, and various hydroperiods. Water can move between adjacent pools and swales through the thin soils above the underlying impervious substrate. The lack of surface flow between pools does not necessarily indicate that they are not hydrologically inter-connected.

3.2.2.2.3 Other Depressional Systems

Depressional wetlands other than vernal pools can be seasonal[1] or perennial, but their flora and fauna are mostly not characteristic of vernal pools, and they lack the impervious substrate that controls vernal pool hydrology. They differ from lacustrine wetlands by lacking an adjacent area of open water (at least 2 m deep and 8 ha total area). They differ from playas by lacking an adjacent area larger than the wetland of either alkaline or saline open water less than 2 m deep or non-vegetated, fine-grain sediments. Unlike slope wetlands (i.e., springs and seeps), depressional wetlands depend more on precipitation than groundwater as their water source.

3.2.2.3 Playa Wetlands

The central feature of a playa is a seasonal or perennial body of very sodic (i.e., strongly alkaline) or saline water less than 2m deep that is larger than the adjacent, fringing wetland. The benthic sediments of a playa are mostly very fine-grain clays and silts. The fringing wetlands are characterized by grasses and herbaceous plants tolerant of the soluble salts that accumulate along the margins of the playas (Gustavson *et al.* 1994, Rocchio 2006). Playas differ from vernal pools by having little or no vascular vegetation within the area that is seasonally saturated or inundated. Vernal pools are generally much smaller than playas. And, unlike vernal pools, playas are more dependent on runoff than direct precipitation. The condition of a playa can be strongly influenced by the condition of its watershed (Keate 2005). The shallowness of playas and their high salinity or alkalinity distinguishes them from lacustrine systems.

3.2.2.4 Estuarine Wetlands

An estuary consists of aquatic (i.e., sub-tidal) and semi-aquatic (i.e., intertidal) environments that are strongly influenced by mixtures of ocean water and upland runoff due to tidal processes operating through an ocean inlet. Estuaries are mostly enclosed by land. Their inlets may be natural or unnatural. Typical sources of freshwater include rivers, streams, lakes and reservoirs, point discharges (e.g., effluent from sewage treatment facilities), and storm drains.

An estuarine wetland consists of the vegetated marsh plain, its pannes, potholes, hummocks, and other habitat elements of the plain, as well as the natural levees, shell beds, submerged plant beds, and other habitat elements created or supported by tidal processes and associated with tidal channels that tend to dewater at low tide or that are less than 30m wide. Tidal channels that

[1] There may be a limit to the applicability of CRAM in seasonal depressional wetlands that tend not to support species-rich plant communities with complex horizontal and vertical structure. CRAM may be systematically biased against such naturally simple depressional systems. Therefore, while the current version of CRAM depressional module can be used in these systems, the results are being tracked carefully. The depressional wetlands CRAM module will be revised based on additional field work during FY 2012-03.

do not tend to dewater at low tide or that are wider than 30m are not considered to be part of the wetland and can serve to separate one estuarine wetland from another.

3.2.2.4.1 Perennial Saline Estuarine Wetland Sub-type

For the purposes of CRAM, saline estuarine wetlands are distinguished from non-saline estuarine wetlands by the obvious dominance of salt-tolerant species of emergent vascular vegetation, such as cordgrass (*Spartina* spp.), pickleweed (*Salicornia* spp.), and salt grass (*Distichlis* spp.) along the foreshore of the wetland and along the immediate banks of the larger tidal channels that tend to dewater at low tide.

3.2.2.4.2 Perennial Non-saline Estuarine Wetland Sub-type

In non-saline wetlands (i.e., brackish or freshwater estuarine wetlands), the plant community along the foreshore of the wetland and along the immediate banks of the larger tidal channels that tend to dewater at low tide is dominated by species that don't tolerate high salinities, such as cattails (*Typha* spp.), rushes (*Scirpus species),* and willows (*Salix* spp.).

3.2.2.4.3 Bar-Built Esturaine Sub-type

Bar-built estuaries are the reaches of coastal rivers and streams that are ecologically influenced by seasonal closures of their tidal inlets. The frequency and duration of inlet closure can be natural or managed. The tidal regime can be muted or not (i.e., the tidal range can be the same or less than that of the adjacent marine or estuarine system when the tidal inlet is open). The salinity regime of a bar-built estuary can be highly variable. It can be fresh throughout very wet years or hypersaline during extended droughts. Bar-built estuaries are often referred to as "lagoons;" geomorphologically this term refers to any coastal water feature behind a bay-mouth bar.

3.2.2.5 Lacustrine Wetlands

Lacustrine systems are lentic water bodies that usually exceed 8 hectares in total area during the dry season and that usually have a maximum dry season depth of at least 2m. They are deeper and larger than depressional wetlands or vernal pools or playas. Some lacustrine systems are separated from estuarine or marine systems by barrier beaches, dunes, or other natural or artificial barriers that are occasionally but irregularly breached. Some of these coastal lacustrine systems are locally referred to as lagoons. Here they are regarded as lacustrine systems because they resemble other lacustrine systems based on CRAM attributes and metrics.

3.2.2.6 Slope Wetlands

Slope wetlands form due to seasonal or perennial emergence of groundwater into the root zone or across the ground surface. Their hydroperiods are mainly controlled by unidirectional subsurface flow.

3.2.2.6.1 Seeps and Springs

These are slope wetlands that occur on hillsides or at the bases of dunes, hills, alluvial fans, etc. Springs are indicated by groundwater emerging and flowing across the ground surface or through indistinct or very small rivulets, runnels, and other features that are too small to be called a creek or riverine system. They often lack the features of riverine channels, such as a thalweg or floodplain. Seeps are similar to springs but lack a single-dominant origin of surface flow. Most of the flow is confined to the root zone and is not evident on the ground surface.

3.2.2.6.2 Wet Meadows

Wet meadows include bogs, fens, and alpine meadows where the hydrology is controlled mainly by fluctuations in ground water levels. They are associated with broad, gentle topographic gradients along which the near-surface ground water moves advectively, albeit slowly, in one dominant direction. If the hydroperiod of a wetland that looks like a wet meadow mainly depends on direct precipitation, then it is a depressional wetland (see Sections 3.2.2.2 and 3.2.2.3 above). Channels can lead into and from a wet meadow, but not all the way through it. If surface water moves through the wetland in a well-defined channel, then the wetland is riverine.

3.4 Step 4: Verify the Appropriate Assessment Window

The Assessment Window is the period of time each year when assessments of wetland condition based on CRAM should be conducted. One Assessment Window exists for all attributes and metrics of each wetland type, but different types of wetlands can have different Assessment Windows. For example, the window is not the same for vernal pools and estuarine wetlands.

In general, the CRAM Assessment Window falls within the *growing season for the characteristic plant community of the wetland type to be assessed*. For wetlands that are not subject to snowfall and that are non-tidal, the main growing season usually extends from March through September, although it may begin earlier at lower latitudes and altitudes. The growing season tends to start earlier and last longer in tidal wetlands than adjoining non-tidal wetlands due to the seasonal variations in tidal inundation. For wetlands subject to snowfall, the start of the growing season is retarded by the spring thaw, which at very high elevations may not happen until late May or early June, depending on the depth of the snow pack. For seasonal wetlands (e.g., vernal pools, playas, and some seeps), the growing season will generally be March through June, although it can be much shorter for vernal pools.

Since the timing of the growing season varies with altitude and latitude, the Assessment Window might vary within and between regions, and local or regional cues may be needed to determine when the window opens and closes each year. The best cues will be the early evidence of new growth of plants, and the subsequent senescence of the plants, for any given wetland types. For example, the assessment of seasonal depressional wetlands might begin after the start of the growing season (the window is opening) but before summertime desiccation of the wetland soils (the window is closing). Some experts can reconstruct conditions for the Assessment Window after it closes based on forensic botany and other field techniques. It should be clearly noted on the CRAM data sheets, however, if an assessment is being done outside the designated Assessment Window.

Note that the assessment of estuarine wetlands should occur at low tide, when most of the smaller intertidal channels of the wetland are dewatered and associated benthic indicators of conditions are visible.

Also note that riverine wetlands should not be assessed during high water, not only because some important indicators of channel condition might be concealed, but also because of the dangers presented by high flows. Riverine wetlands should be assessed late in the growing season, near the onset of base flow.

3.5 Step 5: Establish the Assessment Area (AA)

The Assessment Area (AA) is the portion of the Wetland that is assessed using CRAM. An AA might include a small wetland in its entirety. But, in most cases the wetland will be larger than the AA. Rules are therefore needed to delineate the AA.

Establishing a proper AA is a critical step in correctly performing a rapid assessment using CRAM. As explained below, the use of an incorrect AA can yield results that are not reproducible, and that are not likely to relate to stressors or management actions. The delineation of the boundary of an AA must adhere to the following guidelines.

It is assumed that different wetlands, even neighboring wetlands of the same type, can be managed differently, or for different purposes, and can be subject to different stressors. Therefore, each AA must not encompass or involve more than one wetland, as defined in the Level 1 inventory.

Since CRAM metrics vary between wetland types, each AA must only represent one type of wetland. Different types of wetlands can be contiguous with each other, or even nested one within the other, but each AA must only represent one wetland type.

The wetland AA must be classified using the typology provided in Section 3.2.2 and it must be assessed using the metrics designed for its wetland type. Misclassification of wetlands can lead to using the wrong CRAM module, which in turn will lead to spurious assessments.

Each of the additional considerations outlined below, if applied alone, could lead to defining a different AA for the same wetland. The delineation of an AA is therefore an optimization among these considerations. Experience has shown, however, that for the purpose of standardizing the AAs for any wetland type, the overriding considerations are hydro-geomorphic integrity and size.

3.5.1 Hydro-geomorphic Integrity

Wetland managers need to be able to distinguish between the effects of management actions and the natural variability within and among wetlands of any given type based on CRAM scores. In effect, the AA should help maximize the CRAM signal-to-noise ratio.

Each AA must therefore encompass most if not all of the natural spatial variability in the visible form and structure of its encompassing wetland, and the AA should also encompass most of the internal workings of the wetland that account for its homeostasis – its tendency to maintain a certain overall condition or return to it during or after significant stress or disturbance.

For an AA to have this desired level of integrity, it should be bounded by obvious physical changes in topography, hydrology, or infrastructure that significantly control the sources, volumes, rates, or general composition of sediment supplies or water supplies within the AA at the time of the field assessment. In essence, the boundaries of an AA should not extend beyond any features that represent or cause a major spatial change in water source or sediment source.

One way to visualize the AA is to identify the spatial scale at which the structure and form of the wetland seem to repeat themselves (i.e., the scale at which self-similarity becomes evident). This is assumed to be the scale at which the internal workings of the wetland yield the least variability in form and structure. For example, the s-shaped curve created by two consecutive river bends tends to have a wave length equal to 10x the average width of the river through the bends (Leopold 1994). Also, large estuarine wetlands tend to consist of a number of drainage networks of very similar length and drainage area for any given drainage order (Collins *et al.* 1987, Collins and Grossinger 2004). Shorelines can be characterized by alternating reaches of erosion and deposition that repeat themselves at certain spatial scales relating to wave fetch and shoreline geology (e.g., Philips 1986). Observing the patterns of self-similarity for a given wetland type can help identify the dimensions of the appropriate AA.

3.5.2 AA Size

For any given wetland type, larger AAs might tend to yield higher CRAM scores. This is because CRAM is especially sensitive to wetland structural complexity, and larger AAs can afford more opportunity to encounter variability in structure. For any given wetland type, having AAs of very different sizes can introduce variability into CRAM scores.

As stated above, one of the primary considerations for delineating an AA is its hydro-geomorphic integrity. The boundaries of the AA should be established based on clear breaks in surface hydrology, sediment supply, or geomorphology (see Tables 3.5 and 3.6 below). Experience has shown, however, that most of the AAs of each wetland type that are delineated according to indicators of hydro-geomorphic integrity fall within a narrow range of size, although their shapes are more variable. This suggests that size guidelines can be applied to the process of establishing an AA without necessarily violating the criterion for the hydro-geomorphic integrity of the AA.

Furthermore, in some cases the self-similar, self-organizing, integral area of a wetland is not clearly evident. For example, some wet meadows, brackish estuarine wetlands, large riverine systems, and fringing wetlands of playas and lacustrine systems lack obvious hydrological breaks or other features that clearly demarcate changes in water supplies or sediment supplies. In these cases, overall size may be the dominant criterion for delineating the AA.

The preferred AA size is generally greater for types of wetlands that tend to have broad, level planes than for wetlands fringing steep terrain. The size-frequency distribution of wetlands for each wetland type (a Level 1 analysis) was also considered when the recommendations for AA sizes were being developed.

Examples of features that should be used to delineate an AA, and other features that should not be used, are listed in Tables 3.5 and 3.6 below. The preferred and minimum AA sizes for each wetland type are presented below in Table 3.7.

To the degree possible, the delineation of an AA should first be based on the hydro-geomorphic considerations presented in Tables 3.5 and 3.6. But, if these considerations are not applicable, or if the resulting AA is more than about 25% larger than the preferred size presented in Table 3.7, then the AA delineation should rely only on the size guidelines. The number of AAs per wetland will depend on the purpose of the assessment, as outlined in Table 3.8.

In addition to the guidance below, there are special considerations for establishing a AA for each wetland type located in the field books of each CRAM module.

Table 3.5: Examples of features that should be used to delineate AA boundaries.

Flow-Through Wetlands	**Non Flow-Though Wetlands**	
Riverine, Estuarine and Slope Wetlands	**Lacustrine, Wet Meadows, Depressional, and Playa Wetlands**	**Vernal Pools and Vernal Pool Systems**
• diversion ditches • end-of-pipe large discharges • grade control or water height control structures • major changes in riverine entrenchment, confinement, degradation, aggradation, slope, or bed form • major channel confluences • water falls • open water areas more than 30 m wide on average or broader than the wetland • transitions between wetland types • foreshores, backshores and uplands at least 5 m wide • weirs, culverts, dams, levees, and other flow control structures	• above-grade roads and fills • berms and levees • jetties and wave deflectors • major point sources or outflows of water • open water areas more than 30 m wide on average or broader than the wetland • foreshores, backshores and uplands at least 5 m wide • weirs and other flow control structures	• above-grade roads and fills • major point sources of water inflows or outflows • weirs, berms, levees and other flow control structures

Table 3.6: Examples of features that should not be used to delineate any AAs.

- at-grade, unpaved, single-lane, infrequently used roadways or crossings
- bike paths and jogging trails at grade
- bare ground within what would otherwise be the AA boundary
- equestrian trails
- fences (unless designed to obstruct the movement of wildlife)
- property boundaries
- riffle (or rapid) – glide – pool transitions in a riverine wetland
- spatial changes in land cover or land use along the wetland border
- state and federal jurisdictional boundaries

Table 3.7: Preferred and minimum AA sizes for each wetland type.
Note: Wetlands smaller than the preferred AA sizes can be assessed in their entirety.

Wetland Type	Recommended AA Size
Slope	
Spring or Seep	Preferred size is 0.50 ha (about 75m x 75m, but shape can vary); there is no minimum size (least examples can be mapped as dots).
Wet Meadow	Preferred size is 2.0 ha (about 140m x 140m, but shape can vary); minimum size is 0.1 ha (about 30m x 30m).
Depressional	
Vernal Pool	There are no size limits (see Section 3.5.6 and Table 3.8).
Vernal Pool System	Preferred size is <10 ha (about 300m x 300m; shape can vary); there is no minimum size so long as there are between 3 and 6 pools. If the system has between 3 and 6 pools, assess all of them. If there are more than 6 pools, select 6 that represent the range in size of pools present on the site.
Other Depressional	Preferred size is 2.0 ha (about 140m x 140m, but shape can vary); Minimum size is 0.1 ha (about 30m x 30m).
Riverine	
Confined and Non-confined	Recommended length is 10x average bankfull channel width; maximum length is 200 m; minimum length is 100 m. AA should extend laterally (landward) from the bankfull contour to encompass all the vegetation (trees, shrubs vines, etc.) that probably provide woody debris, leaves, insects, etc. to the channel and its immediate floodplain; minimum width is 2 m.
Lacustrine	Preferred size is 2.0 ha (about 140m x 140m, but shape can vary); Minimum size is 0.5 ha (about 75m x 75m).
Playa	Preferred size is 2.0 ha (about 140m x 140m, but shape can vary); Minimum size is 0.5 ha (about 75m x 75m).

Estuarine	
Perennial Saline	Preferred size and shape for estuarine wetlands is a 1.0 ha circle (radius about 55m), but the shape can be non-circular if necessary to fit the wetland and to meet hydro-geomorphic and other criteria as outlined in Sections 3.5.1 through 3.5.3. The minimum size is 0.1 ha (about 30m x 30m).
Perennial Non-saline	
Seasonal	

3.5.3 Assessment Purpose

There are two primary purposes for using CRAM. It is used to assess the ambient condition of a population of wetlands or to assess the condition of an individual wetland or wetland project. The same guidelines for delineating AAs (see Tables 3.5 through 3.7 above) pertain to project assessments and ambient assessments using CRAM.

However, the number of AAs per wetland can vary between ambient surveys and individual wetland assessments. Multiple AAs might be required to assess the average condition of a wetland project that is many times larger than one AA, whereas just one AA would be required in the same wetland if it were only being assessed as part of an ambient survey (see Table 3.8).

Table 3.8: Guidelines for determining the number of AAs per wetland.

	Assessment Scenario
Single AA	If the size of the wetland is within the size limits given in Table 3.7, then the entire wetland constitutes the AA, regardless of the purpose of the assessment. Or If the wetland is one in a population of wetlands to be assessed as part of an ambient survey, then delineate one AA around each point randomly selected within the wetland as part of the sample draw from the ambient sample frame. For more information about ambient sampling design go to http://epa.gov/nheerl/arm/designing/design_intro.htm.
Multiple AAs	If the wetland is about twice as large as the preferred size AA from Table 3.7, and if the purpose is to assess the average condition of the wetland, then assess the second AA and report the results for both AAs. Or If the wetland is at least thrice as large as the preferred size AA from Table 3.7, and if the purpose is to assess the average condition of the wetland, then randomly select and assess three AAs from the array of all possible AAs for the wetland. If the overall score for the third AA differs from the average of the first two scores by more than 15%, then assess a randomly selected fourth AA; if its score differs from the average of the first three by more than 15%, then assess a randomly selected fifth AA. Repeat this procedure until the overall score for the latest AA is no more than 15% different than the average of all previous scores, or until the array of possible AAs is exhausted. For more detailed instructions on assessing multiple AAs per wetland, see Section 3.5.8 and Appendix I).
Reporting	The final boundaries of all the AAs of a wetland should be mapped using either the eCRAM software mapping tool or by drawing a heavy pencil line on a hardcopy of the site imagery. Hardcopy maps will need to be digitized using the online version of eCRAM as part of the process of entering CRAM results into the online CRAM database.

3.5.3 Special Considerations for Post-assessment Analysis

For CRAM scores to be comparable they must be standardized in terms of time (i.e., scores should represent comparable amounts of assessment effort during comparable years and times of year), and in terms of space (i.e., for any given wetland type, the scores should represent comparable amounts of wetlands, and these should have hydrological and ecological integrity; see Section 3.5.2 above).

For a variety of reasons, scores that do not meet these standards cannot be compared and cannot be combined into datasets. For example, assessments that take longer or that involve larger areas are likely to encounter more structural complexity and therefore yield higher scores.

The use of Assessment Windows (see Section 3.4 above), fixed assessment times (i.e., no assessment should take longer than one half day in the field), recommended AA sizes, and guidelines for assembling data of varying vintage will achieve more consistent assessment results.

To achieve the spatial standards, each AA for each wetland type should fall within a standard size range that is large enough to incorporate the natural processes of homeostasis that characterize the wetland (see discussion of AA integrity in Section 3.5.2), but small enough to meet the time constraints (see Table 3.7).

An additional spatial consideration for ambient surveys is that the probability of any wetland within a given area being selected for assessment increases with its size, and weighting CRAM scores for the inclusion probabilities of their associated AAs depends on having a standard AA size range for each wetland type. For more information about ambient sampling design go to http://epa.gov/nheerl/arm/designing/design_intro.htm.

Standardizing the shape of AAs (e.g., having all AAs be circles or squares of fixed size) may increase the ease with which they are delineated, but may also lead to a disregard of features such as water control structures that affect AA integrity. Standardizing the shapes of AAs is less important than standardizing their sizes.

3.5.4 Special Considerations for Assessing Projects

For the purposes of CRAM, a "project" includes any on-the-ground activity which results in a physical change in the area or condition of an aquatic resource[1]. Projects can be associated with a regulatory or funding decision. Such projects are often at least partly delimited by property lines or other administrative or legal boundaries. Wetland restoration projects, mitigation projects, mitigation banks, and wetlands that are targeted for development (i.e., impacted wetlands) are often delimited by property lines. However, for the purposes of CRAM, the definition of *project* is independent of any regulatory or administrative definition under the Clean Water Act, Porter Cologne, Section 1600 of the State's Fish and Game Code, Coastal Zone Management Act, CEQA, or NEPA.

Property lines, jurisdictional limits, and other administrative or legal boundaries should not automatically be used to delineate AAs, except for the assessment of a project, in which case the wetland and its AA(s) are confined to the project boundaries. A formal wetland Jurisdictional Delineations (JD) in good standing for a project can be used in the absence of any other wetland map to define the wetland and to help delimit the AA(s). If the project is much larger than one AA, then the process outlined in Appendix I should be used to assess multiple AAs.

The best achievable condition of a project might be unavoidably constrained by adjacent or nearby land uses. In these situations, the expected or target level of performance of a project might be adjusted for the land use constraints. In other words, although a project is assessed relative to the best achievable conditions for its wetland type throughout the State, what is expected or deemed acceptable for any particular project might reflect its land use setting. For example, stream restoration projects in urban landscapes need not be held to the same standards

---

[1] Projects can include the acquisition or placement of a wetland, riparian area, or other aquatic habitat in a conservation easement (or other permanent protection).

of high performance as projects in rural or non-developed landscapes. As CRAM scores accumulate throughout the State, their relationship to land use setting can be analyzed to guide local adjustments in project performance criteria that are based on CRAM.

3.6 Step 6: Conduct Initial Office Assessment of Condition Metrics and Stressors

For each CRAM assessment, there is initial office work to acquire the site imagery, plan logistics for the site visit, and to assemble information about the management of the site and its possible stressors. Preliminary scores can be developed for some metrics, based on existing documentation (e.g., aerial photography, reports, etc.), prior to conducting any fieldwork. Such preliminary scoring is not necessary, however, and any preliminary scores must be verified during the site visit. The initial office work is itemized in Table 3.10 below.

Table 3.10: CRAM metrics suitable for pre-site visit draft assessment.

<table>
<tr><th colspan="4">Background Information to Assemble Prior to the Site Visit</th></tr>
<tr><td colspan="4">• 1m-3m pixel resolution digital geo-rectified site imagery
• Site-specific and neighboring reports on hydrology, ecology, chemistry, etc.
• Access permission if needed
• Preliminary map of the Assessment Area
• Maps to the site, access points, and other logistical information</td></tr>
<tr><th colspan="4">Metrics/Submetrics Suitable for Preliminary Scoring Prior to Site Visit</th></tr>
<tr><th colspan="2">Attributes</th><td>Metrics/Submetrics</td><td>Suitable?</td></tr>
<tr><td colspan="2" rowspan="4">Buffer and Landscape Context</td><td>Landscape Connectivity</td><td>Yes</td></tr>
<tr><td>Percent of AA with Buffer</td><td>Yes</td></tr>
<tr><td>Average Buffer Width</td><td>Yes</td></tr>
<tr><td>Buffer Condition</td><td>No</td></tr>
<tr><td colspan="2" rowspan="3">Hydrology</td><td>Water Source</td><td>Yes</td></tr>
<tr><td>Hydroperiod or Channel Stability</td><td>No</td></tr>
<tr><td>Hydrologic Connectivity</td><td>Yes</td></tr>
<tr><td rowspan="8">Structure</td><td rowspan="2">Physical</td><td>Structural Patch Richness</td><td>No</td></tr>
<tr><td>Topographic Complexity</td><td>No</td></tr>
<tr><td rowspan="6">Biotic</td><td>Number of Plant Layers Present</td><td>No</td></tr>
<tr><td>Number of Co-dominant Species</td><td>No</td></tr>
<tr><td>Native Plant Species Richness</td><td>No</td></tr>
<tr><td>Percent Invasion</td><td>No</td></tr>
<tr><td>Horizontal Interspersion and Zonation</td><td>No</td></tr>
<tr><td>Vertical Biotic Structure</td><td>No</td></tr>
</table>

For air photos and other imagery, the minimum pixel resolution is 3m (i.e., each pixel in the digital image of a site should represent no more than about $9m^2$ of area). National Agriculture Imagery Program (NAIP; http://www.fsa.usda.gov) aerial imagery with a spatial resolution of 1m is available for the entire state (years 2005, 2009, and 2010) as either Digital Orthogonal

Quarterly Quadrangle (DOQQ) tiles or as compressed county mosaics (CCMs) from the Cal-Atlas website (atlas.ca.gov). Older, lower resolution (3m) imagery in DOQQ format is also available.

3.7 Step 7: Conduct Field Assessment of Condition Metrics and Stressors

After assembling the background information about the wetland to be assessed, the next step is to conduct an assessment of the wetland in the field. A complete description of CRAM metrics and the Stressor Checklist is provided in the individual field books for each CRAM module. Fieldwork for CRAM consists of finding and confirming the boundaries of the AA, and scoring the AA based on the condition metrics and stressor checklist. Any field-based modifications of the preliminary AA boundary must be recorded on the site imagery.

3.8 Step 8: Complete CRAM Scores and Basic QA/QC Procedures

3.8.1 Calculating CRAM Scores

Scores for CRAM are easily calculated. There is no weighting of any metrics or attributes. Weightings are not supported by theory or the validation exercises. Letter scores for each metric (A, B, C, D) are simply converted into whole integer scores (12, 9, 6, 3, respectively; see Step 1 in Table 3.11).

For the Hydrology and Physical Structure attributes, the attribute scores are simply calculated as the sum of the component metric scores (see Step 2 in Table 3.11).

For the Buffer and Landscape Context attribute, the submetric scores relating to buffer are combined into an overall buffer score that is added to the score for the Landscape Connectivity metric, using the formula in Step 2 in Table 3.11.

For the Biotic Structure attribute, the Plant Community metric consists of three submetrics (Number of Plant Layers Present; Number of Co-dominant Species; and Percent Invasion). Prior to calculating the Biotic Structure attribute score, the values for these submetrics must be averaged. Then the Biotic Structure attribute score can be calculated as described in Table 3.11.

Each raw attribute score is then converted into a percentage of the maximum possible score (see Step 3 in Table 3.11). This eliminates any weighting of one attribute relative to another due to their differences in numbers of component metrics and numbers of alternative states of the metrics.

An overall AA score is calculated by averaging the attribute scores. All scores are rounded to the nearest whole percentage value (see Step 4 in Table 3.11).

Different wetlands are likely to have different functions and ecological services due to differences in wetland form, structure, geomorphic setting, climatic regime, evolutionary stage, stressor regime, etc. It is therefore unlikely that the same CRAM score represents the same level of function or even the same set of functions for different wetlands. CRAM scores cannot be used to infer wetland function except in the context of correlations between CRAM scores and actual functional levels, as measured using Level 3 methods. Validation efforts to date indicate that CRAM scores are strongly correlated to a variety of wetland functions and services.

It is expected that the same scores for different wetlands of the same type probably represent the same overall condition and functional capacity. CRAM can therefore be used to track the progress of restoration efforts over time, to compare impacted sites to their in-kind mitigation sites, or to compare an individual wetland to the status and trends in ambient condition of its wetland type.

CRAM scores can also be used to compare the status and trends of different types of wetlands. This is because all wetlands are assessed relative to their best achievable condition. For example, separate ambient surveys of lacustrine and estuarine wetlands might reveal that one type is doing better than the other, relative to their particular overall best achievable conditions.

Table 3.11: Steps to calculate attribute scores and AA scores.

Step 1: Calculate Metric Score	For each Metric, convert the letter score into the corresponding numeric score: A=12, B=9, C=6 and D=3.
Step 2: Calculate Raw Attribute Score	For each Attribute, calculate the Raw Attribute Score as the sum of the numeric scores of the component Metrics, except in the following cases: • For Attribute 1 (Buffer and Landscape Context), the submetric scores relating to buffer are combined into an overall buffer score that is added to the score for the Landscape Connectivity metric, using the following formula: $\left(\text{Buffer Condition} \times \left(\text{\% AA with Buffer} \times \text{Average Buffer} \right)^{1/2} \right)^{1/2} + \text{Landscape Connectivity}$ • Prior to calculating the Biotic Structure Raw Attribute Score, average the three Plant Community sub-metrics. • For vernal pool systems, first calculate the average score for all three Plant Community sub-metrics for each replicate pool, then average these scores across all six replicate pools; calculate the average Topographic Complexity score for all six replicates.
Step 3: Calculate final Attribute Score	For each Attribute, divide its Raw Score by its maximum possible score, which is 24 for Buffer and Landscape Context, 36 for Hydrology, 24 for Physical Structure, and 36 for Biotic Structure.
Step 4: Calculate the AA Score	Calculate the AA score by averaging the final attribute scores. Round the average to the nearest whole integer.

There are many possible ways to graphically present CRAM scores. The choice should depend on the information to be conveyed and the intended audience. It will not usually be necessary to present metric scores except in the context of validation efforts and to explain attribute scores. The metric scores can be presented effectively, however, as a circular graph that depicts the contribution of each metric to the overall score (e.g., Figure 3.4A). Site-specific and ambient scores can be compared in bar charts (Figure 3.4B). The progress of a restoration or mitigation project can be shown as the change in average overall score relative to performance standards (Figure 3.4C). The ambient conditions of two different types of wetlands can be compared based on the frequency distributions of the overall scores (Figure 3.4D). The ambient condition of any given wetland type can be displayed as the cumulative frequency of overall scores (Figure 3.4E). The graphs pertaining to ambient condition or to any population of wetlands can be produced for a variety of spatial scales, from watersheds or regions to the State as a whole.

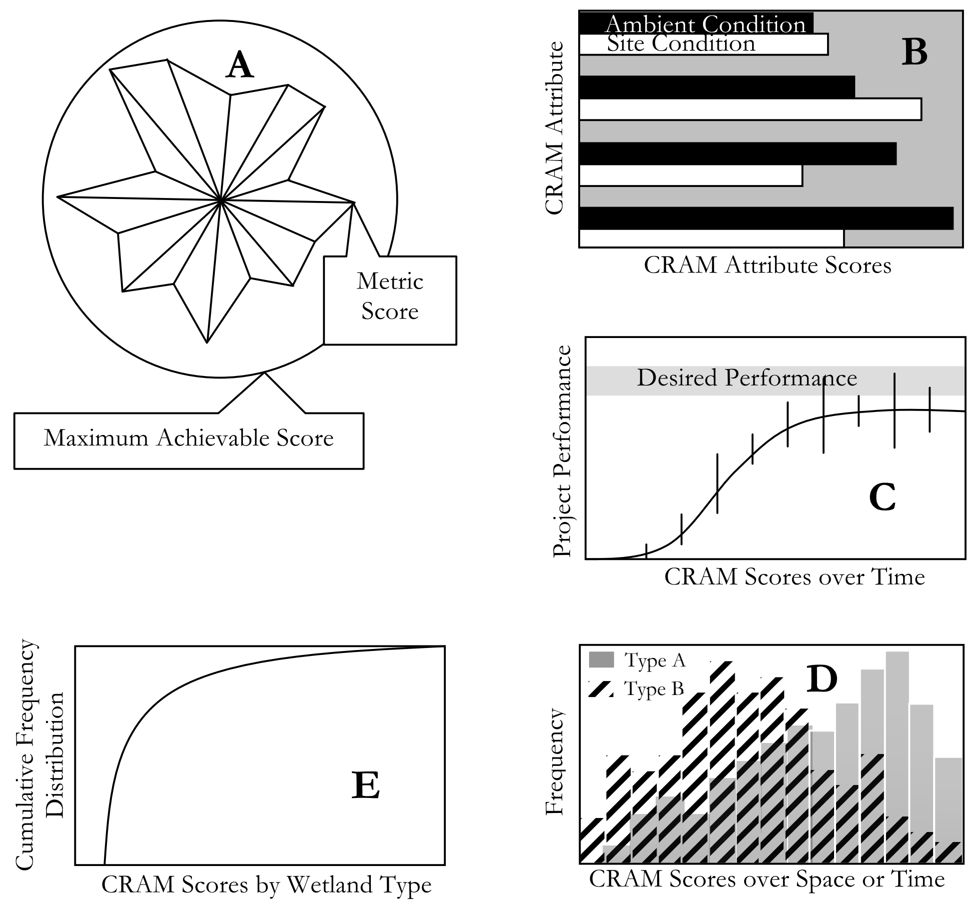


Figure 3.4: Example graphs for displaying CRAM results.

Figure shows (A) "spider plot" of metric scores for one or more AAs (multiple areas would be represented by average scores) (see Ambrose *et al.* 2006); (B) site-specific attribute scores compared to ambinet conditions or reference conditions; (C) changes in AA scores over time for a wetland an project; (D) comparison of two different populations of wetlands based on the frequency distribution of their AA scores; and (E) cummulative frequency distribution of scores for one population of wetlands.

3.8.2 Initial QA/QC Procedures for Data Collectors

Part of the value of CRAM is its ability to yield reproducible results for wetlands of similar condition, regardless of the data collector. Quality control procedures should be employed to assure that the data collectors or assessors are using the same approach and are obtaining information accurately when conducting CRAM assessments. For large wetland projects having numerous AAs and for ambient assessments involving multiple wetlands, it is recommended that at least 10% of the AAs be revisited by an independent CRAM assessment team and compared to the original assessments for the same AAs. The replicate scores should be within 10% of the original scores for each attribute.

In addition to taking on or more CRAM training courses, all CRAM practitioners are advised to carefully read and understand the most recent version of the CRAM User's Manual before they begin conducting assessments. The User's Manual and CRAM training materials are available at the CRAM web site (www.cramwetlands.org). Supporting materials include a photo-glossary with picture examples of many of the terms and wetland characteristics described or referenced in the User's Manual. These materials are intended to help users develop an understanding of the complete range of conditions for each metric, and arrive at consistent conclusions about wetland condition.

The initial quality control procedures for any assessment involve a basic review of the AA map and the summary scoring sheet. The recommended topics for the initial quality control are listed in Table 3.12 below.

Table 3.12: Recommended topics of initial QA/QC.

Recommended Topics of Initial QA/QC for CRAM Results
• *AA map quality:* hardcopy maps must be clear enough to be readily digitized. AA maps must be on geo-rectified imagery with minimum pixel resolution of 3 m (i.e., each pixel should represent no more than 9 m^2). • *Summary data sheet:* make sure all fields of information for site name, wetland type, date of assessment, personnel making the assessment, etc. are complete and legible. • *Summary score sheet*: make sure that every metric and attribute has a correct score, and that the overall site score is also correct. • *Summary stressor sheet:* make sure the stressor checklist has been completed.

3.8.3 Initial Quality Control Procedures for Data Managers

The main objective of data management is to assure that the data are accurately collected and verified for analysis and interpretation by CRAM practitioners and resource managers. Procedures described in this User's Manual are designed to help assure the accuracy and consistency of data collection and processing. Since metric scores are combined into more complex attribute and overall CRAM site scores, any errors in data collection can be compounded if quality control measures are not followed.

Data management involves maintaining various types of data and information, including hardcopy and electronic imaging and other background information for sites to be assessed using CRAM, as well as completed field data sheets. Routine backups of the computing systems and databases should be performed daily, along with measures to assure network and computer security. Backup files containing CRAM data should be stored in fireproof facilities. In addition, hardcopies of the data should be maintained and, if the data are only in electronic form, printouts of these data should be stored separately from the electronic versions.

These basic criteria for secure data management are currently met through administration of the CRAM web site and supporting database at the San Francisco Estuary Institute as a regional Information Center of the California Environmental Data Exchange Network (CEDEN). . The eCRAM software, the CRAM database, and its supporting web sites are open source. No aspect of CRAM programming is proprietary. The CRAM database incorporates numerous measures to assure accurate data entry and processing, including the following.

- Each database field that requires a value is checked for null or missing values.
- Standard codes are provided in look-up lists for populating the data table fields.
- The entry of duplicate records is prevented, based on a unique combination of fields that define the primary key.
- If one record set is related to another, it is checked for orphan records (parent records have child records and child records have parent records).
- Users are prompted to complete data fields as data are being uploaded into the database via the CRAM web site.
- Data entry and editing are password-protected; data authors can only access and edit their own data.
- All data are time-stamped and automatically assigned to a unique site code.
- Database users are automatically prompted to download new versions of CRAM if the version they have is outdated.

3.9 Step 9: Upload Assessment Data and Results

No CRAM assessment is complete until the results are uploaded into the CRAM database. The database is accessible at www.cramwetlands.org. Anyone who wants to enter data into the database must register on the CRAM website to obtain a database log-in name and password. Results for hardcopy versions of CRAM must be transcribed into the electronic version on the web site. The database is only accessible to registered users, and they can only access and edit their own data. All results can be viewed and downloaded by the public through interactive maps at the CRAM web site.

REFERENCES

Ambrose, R.F., J.C. Callaway, and S.F. Lee. 2006. An Evaluation of Compensatory Mitigation Projects Permitted Under Clean Water Act Section 401 by the California State Water Quality Control Board, 1991-1992. Prepared for California Environmental Protection Agency and California State Water Resources Control Board, Los Angeles, CA. 414 pp.

Barbour, M.T., J.B. Stribling, and J.R. Karr. 1995. Multimetric approach for establishing and measuring biological condition. In *Biological Assessment and Criteria, Tools for Water Resource Planning and Decision Making*, Eds. Wayne S. Davis and Thomas P. Simon, CRC Press, Inc.

Bartoldus, C.C., 1999. A comprehensive review of wetland assessment procedures: a guide for wetland practitioners. *Environmental Concern Inc*., St. Michaels, MD.

Bormann, B.T., P.G. Cunningham, M.H. Brooks, V.W. Manning, and M.W. Collopy. 1994. Adaptive Ecosystem Management in the Pacific Northwest. U.S. Department of Agriculture, *U.S. Forest Service General Technical Report PNW-GTR-341*. 22 pp.

Brinson, M.M. 1993. A Hydrogeomorphic Classification for Wetlands. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, USA. *Technical Report WRP-DE-4*.

Burglund, J. 1999. Montana Wetland Assessment Method. Montana Department of Transportation and Morrison-Maierle, Inc. Helena, MT.

California Wetlands Monitoring Workgroup 2009. Using CRAM (California Rapid Assessment Method) to Assess Wetland Projects as an Element of Regulatory and Management Programs. Technical Bulletin 46 p.

Cal-IPC. 2006. California Invasive Plant Inventory. Cal-IPC Publication 2006-02. California Invasive Plant Council: Berkeley, CA. Available: www.cal-ipc.org.

Carletti, A., G.A. De Leo, and I. Ferrari, 2004. A critical review of representative wetland rapid assessment methods in North America, Aquatic Conserv: Mar. Freshw. Ecosyst. 14: S103–S113.

Collins, J.N. San Francisco Estuary Institute. 1998. Bay Area Watersheds Science Approach. Version 3. The role of watershed science to support environmental planning and resource protection. Oakland, CA. 36 pp.

Collins, J.N. and R.M. Grossinger. 2004. Synthesis of scientific knowledge concerning estuarine landscapes and related habitats of the South Bay Ecosystem. Technical report of the South Bay Salt Pond Restoration Project. San Francisco Estuary Institute, Oakland, CA.

Collins, L.M., J.N. Collins, and L.B. Leopold. 1987. Geomorphic processes of an estuarine tidal marsh: preliminary results and hypotheses. In: International Geomorphology 1986 Part I. V. Gardner (ed.). John Wiley and Sons, LTD. Pp. 1049-1072.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish & Wildlife Service, Washington, D.C. 131 pp.

Fennessy, M.S, A.D. Jacobs, and M.E. Kentula. 2004. Review of Rapid Methods for Assessing Wetland Condition. EPA/620/R-04/009. National Health and Environmental Effects Research Laboratory, Office of Research and Development, Research Triangle Park, NC.

Gustavson, T.C, V.T. Holliday, and S.D. Hovorka1. 1994. Development of Playa Basins, Southern High Plains, Texas and New Mexico. pp. 5-14 in L. V. Urban and A. Wayne Wyatt, Co-Chairmen. *Proceedings of the Playa Basin Symposium*. Texas Tech University, Lubbock, TX, May 1994.

Holling, C.S. 1978. Adaptive Environmental Assessment and Management. John Wiley & Sons. New York, NY.

Jain, R.K., L.V. Urban, G.S. Stacey, and H.E. Balbach. 1993. Environmental Assessment. New York: McGraw Hill.

Karr, J.R. 1981. Assessment of Biotic Integrity Using Fish Communities. *Fisheries* 6:21-27.

Keate, N.S. 2005. Functional assessment of Great Salt Lake ecosystem slope and depressional wetlands. Utah Department of Natural Resources, Division of Wildlife Resources. Salt Lake City, UT.

Leibowitz, S.G., B. Abbruzzese, P.R. Adamus, L.E. Hughes, and J.T. Irish. 1992. A Synoptic Approach to Cumulative Impact Assessment: A Proposed Methodology. U.S. Environmental Protection Agency, Environmental Research Laboratory, Corvallis, Oregon. EPA/600/R-92/167.

Leopold, L.B. 1994. A view of the river. Harvard University Press.

Lonard, R.I. and E.J. Clairain, Jr. 1986. Identification of Methodologies for the Assessment of Wetland Functions and Values. in Kusler, J.A. and P. Riexinger (eds). *Proc. of the National Wetland Assessment Symposium*. pp. 66-72.

Mack, John J. 2001. Ohio Rapid Assessment Method for Wetlands, Manual for Using Version 5.0. Ohio EPA Technical Bulletin Wetland/2001-1-1. Ohio Environmental Protection Agency, Division of Surface Water, 401 Wetland Ecology Unit, Columbus, Ohio.

Margules, C. and M.B. Usher. 1981. Criteria Used in Assessing Wildlife Conservation Potential: A Review. *Biological Conservation* 21:79-109.

Miller, R.E., and B.E. Gunsalus. 1997. Wetland Rapid Assessment Procedure (WRAP) Technical Publication REG-001. South Florida Water Management District, Natural Resource Management Division, West Palm Beach, FL.

National Research Council. 2001. Compensating for Wetland Losses under the Clean Water Act. Washington, DC, National Academy of Sciences: 322.

Pinter, L., D.R. Cressman, and K. Zahedi. 1999. Capacity building for integrated environmental assessment and reporting: training manual. United Nations Environment Programme (UNEP), International Institute for Sustainable Development (IISD) and Ecologistics International Ltd.

Rissik, D., M. Cox, A. Moss, D. Rose, D. Scheltinga, L.T.H. Newham, A. Andrews, and S.C. Baker-Finch. 2005. VPSIRR (Vulnerability - Pressure - State - Impact - Risk and Response): An approach to determine the condition of estuaries and to assess where management responses are. In: A. Zerger and R.M. Argent. *MODSIM 2005 International Congress on Modeling and Simulation*, (170-176), Melbourne, Australia.

Rocchio, J. 2006. Intermountain playa ecological system ecological integrity assessment. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

San Francisco Estuary Institute Aquatic Science Center (SFEI-ASC). 2009. Technical Memorandum No. 2: Wetland Definition. Final. Produced by the Technical Advisory Team to the California Wetland and Riparian Area Protection Policy. 22 p.

Särndal, C.E., B. Swensson, and J. Wretman. 1992. Model assisted survey sampling. Springer-Verlag, New York.

Smith, D.R., A. Ammann, C. Bartoldus, and M.M. Brinson. 1995. An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices, Technical Report WRP-DE-9, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A307 121.

Smith, R.D. 2000. *Assessment of Riparian Ecosystem Integrity in the San Juan/San Mateo Watersheds, Orange County, California.* U.S. Army Engineer Research and Development Center, Waterways Experiment Station, Vicksburg, MS. Final Report to the U. S. Army Corps of Engineers, Los Angeles District.

Stein, E.D. and R.F. Ambrose. 1998. A Rapid Impact Assessment Method for Use in a Regulatory Context. *Wetlands*, Vol. 18(3).

Stevenson, R.J. and F.R. Hauer. 2002. Integrating Hydrogeomorphic and Index of Biotic Integrity approaches for environmental assessment of wetlands. *Journal of North American Benthological Society* 21(3): 502-513.

U.S. Army Corps of Engineers (USACOE). 1995. The highway methodology workbook supplement. Wetlands functions and values: A descriptive approach. U.S. Army Corps of Engineers, New England Division, NENEP-360-1-30a. 32 pp.

U.S. Environmental Protection Agency (USEPA). 2006. Application of elements of a state water monitoring and assessment program for wetlands. Wetlands Division, Office of Wetlands, Oceans and Watersheds, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Fish and Wildlife Service (USFWS). 1980. Habitat Evaluation Procedure (HEP) Manual, Washington, D.C.

Washington State Department of Ecology (WADOE). 1993. Washington State Wetlands Rating System– Technical Report 93-74. 61 pp.

Westman, W.E. 1985. Ecology, impact assessment, and environmental planning. John Wiley and Sons, New York.

Zampella, R.A., R.G. Lathrop, J.A. Bognar, L.J. Craig, and K.J. Laidig. 1994. A watershed-based wetland assessment method for the New Jersey Pinelands. Pinelands Commission, New Lisbon, NJ.

APPENDIX I: PROTOCOL FOR PROJECT ASSESSMENT BASED ON CRAM

Version 1.1

Introduction

There are generally two kinds of CRAM applications: assessments of ambient condition and assessments of project conditions. The approach is essentially the same in each case. The critical concepts common to both are Sample Universe and Sample Frame. The Sample Universe is the population of possible CRAM Assessment Areas (AAs) that is supposed to be assessed. The Sample Frame is a map of the Sample Universe. For more information about sample frames go to http://epa.gov/nheerl/arm/designing/design_intro.htm.

In the case of an ambient assessment, the Sample Universe consists of all the possible AAs of a single wetland type within a prescribed area that is larger than a project. For example, an ambient Sample Universe might encompass all of the possible AAs for lacustrine wetlands within a watershed, administrative region of an agency, congressional district, etc. In the case of a project assessment, the Sample Universe is all of the possible AAs for one kind of wetland within the boundaries of one project. The results are used to characterize the project.

Project Definition

For the purposes of CRAM, a "project" is any activity authorized under Section 404 of the US Clean Water Act, under the State's 401 Certification/WDR Programs, or under Section 1600 of the State's Fish and Game Code that directly changes the extent, type, or condition of at least 0.1 ha of non-riverine wetland, or at least 100m of riverine wetland length as defined in the CRAM Manual.

Project Assessment Steps

Step 1: Identify the Project Boundary

The project boundary is usually designated by the project sponsors and could include upland areas and other non-wetland areas (Figure 1). The project boundary has to be imported into a GIS as an overlay on 1-3m pixel resolution aerial imagery or a wetland inventory of comparable resolution and of recent vintage.

If a project is part of a larger wetland and is less that 80% of the recommended minimum size for a CRAM Assessment Area than conduct two assessments, one that is confined to project and one for the larger Assessment Area that includes the project.

Step 2: Identify the Sample Universe

Overlay the project boundary on the aerial imagery in the GIS and digitize the boundary of all non-riverine wetlands at least 0.1 ha in area and all riverine wetlands at least 100m long within the footprint of the project (Figure 1). All the wetlands of one type comprise a separate Sample Universe. There will be as many Sample Universes as there are wetland types within the project that meet the minimum polygon size requirements.

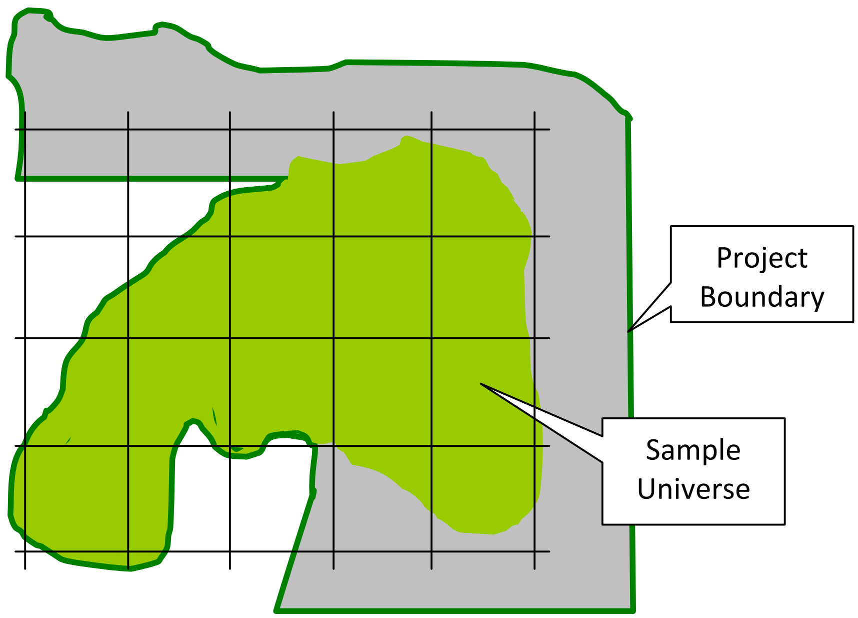


Figure 1: Diagrams of Project Boundary (dark green line) and Sample Universe (area shaded light green) showing a grid used to develop the Sample Frame of candidate AAs. A GIS can be used to generate the Sample Frame without using a grid.

Step 3: For each Sample Universe, Develop the Sample Frame (Figures 2-4)

The Sample Frame will be a map of all candidate AAs within the Sample Universe. See the following Table 3.7 from Chapter 3 of the CRAM Manual for a list of recommended AA sizes for each wetland type.

There are two ways to begin creating a Sample Frame. One way is to overlay the Sample Universe with a grid having a cell size just large enough to encompass one AA. Another way is to use a GIS to generate a map of the maximum number of non-overlapping AAs. At this stage of Sample Frame development, candidate AAs can overlap the edge of the Sample Universe, although they cannot overlap each other.

Any AAs that do not meet the criteria for an AA as presented in Chapter 3 of the CRAM Manual must be rejected. The following considerations are especially important.

- **a.** Each AA should not cross any obvious, major physical changes in topography, hydrology, or infrastructure that significantly control the sources, volumes, rates, or general composition of sediment supplies or water supplies within the AA at the time of the field assessment.
- **b.** Each AA can only include one wetland type. No AA can include any portion of more than one type of wetland, as defined by the CRAM Manual.
- **c.** Reject any candidate AA that is more than 50% outside the Sample Universe. The remaining AAs comprise the Sample Frame (Figure 3).

Table 3.7 (from Chapter 3 of the CRAM Manual): Preferred and minimum AA sizes for each wetland type. Note: wetlands smaller than the preferred AA sizes can be assessed in their entirety.

Wetland Type	Recommended AA Size
Slope	
Spring or Seep	Preferred size is 0.50 ha (about 75m x 75m, but shape can vary); there is no minimum size (least examples can be mapped as dots).
Wet Meadow	Preferred size is 2.0 ha (about 140m x 140m, but shape can vary); minimum size is 0.1 ha (about 30m x 30m).
Depressional	
Vernal Pool	There are no size limits
Vernal Pool System	Preferred size is <10 ha (about 300m x 300m; shape can vary); there is no minimum size so long as there are between 3 and 6 pools. If the system has between 3 and 6 pools, assess all of them. If there are more than 6 pools, select 6 that represent the range in size of pools present on the site.
Other Depressional	Preferred size is 2.0 ha (about 140m x 140m, but shape can vary); Minimum size is 0.1 ha (about 30m x 30m).
Riverine	
Confined and Non-confined	Recommended length is 10x average bankfull channel width; maximum length is 200 m; minimum length is 100 m. AA should extend laterally (landward) from the bankfull contour to encompass all the vegetation (trees, shrubs vines, etc.) that probably provide woody debris, leaves, insects, etc. to the channel and its immediate floodplain; minimum width is 2 m.
Lacustrine	Preferred size is 2.0 ha (about 140m x 140m, but shape can vary); Minimum size is 0.5 ha (about 75m x 75m).
Playa	Preferred size is 2.0 ha (about 140m x 140m, but shape can vary); Minimum size is 0.5 ha (about 75m x 75m).
Estuarine	
Perennial Saline	Preferred size and shape for estuarine wetlands is a 1.0 ha circle (radius about 55m), but the shape can be non-circular if necessary to fit the wetland and to meet hydro-geomorphic and other criteria as outlined in Sections 3.5.1 through 3.5.3. The minimum size is 0.1 ha (about 30m x 30m).
Perennial Non-saline	
Seasonal	

Step 4: Identify and assess any Sample Universe only large enough for one AA.

In these kinds of cases, the Sampler Universe and the AA are the same. After completing Step 4, go to Step 8.

Step 5: Identify any Sample Universe that is only large enough for two or three AAs, and assess all thee AAs that comprise the Sample Universe.

If at least 20% of any AA is outside the boundary of the Sample Universe, then, to the extent possible, re-shape the AA so that it fits entirely within the Sample Universe (Figure 4). After completing Step 5, go to Step 8.

Step 6: For each Sample Universe large enough for more than three AAs, assess the first two AAs randomly selected from the Sample Frame.

If at least 20% of a selected AA is outside the boundary of the Sample Universe, then re-shape the AA so that it fits entirely within the Sample Universe (Figure 4). Average the overall sites scores for these first two AAs. After completing Step 6, go to Step 7.

Step 7: For each Sample Universe identified in Step 6, complete the assessment.

Randomly select and assess a third AA. If the overall CRAM score for the third AA differs from the average score of the first two AAs by more than 15%, randomly select and assess a fourth AA. If the overall score for the fourth AA differs from the average score of the first three AAs by more than 15%, then randomly select and assess a fifth AA. If at least 20% of any AA is outside the boundary of the Sample Universe, then, to the extent possible, re-shape the AA so that it fits entirely within the Sample Universe (Figure 4). Continue this process until the overall score for the latest AA does not differ from the average score for all the previous AAs by more than 15%. After completing Step7, go to Step 8.

Step 8: Upload the CRAM results for each AA to the CRAM website.

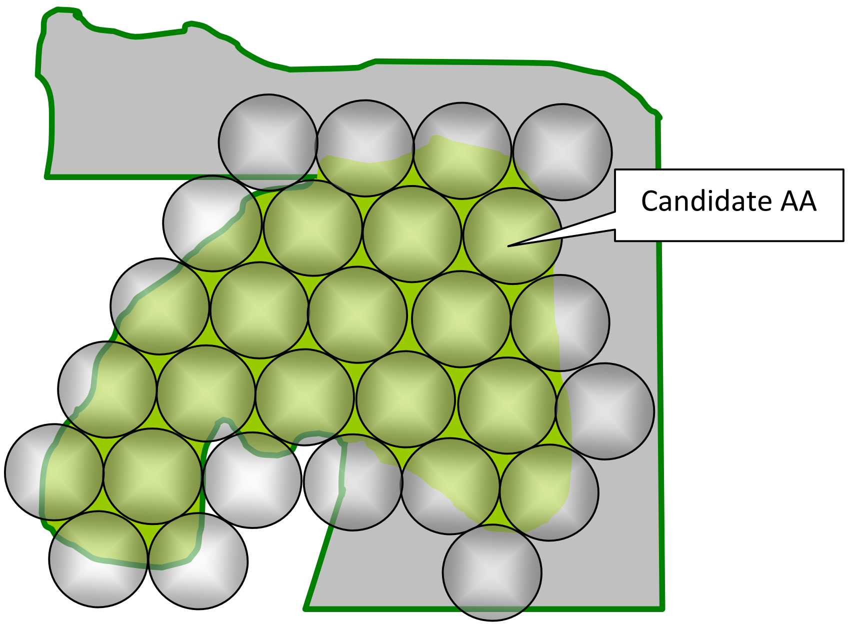


Figure 2: Map of the maximum number of candidate AAs generated in a GIS.

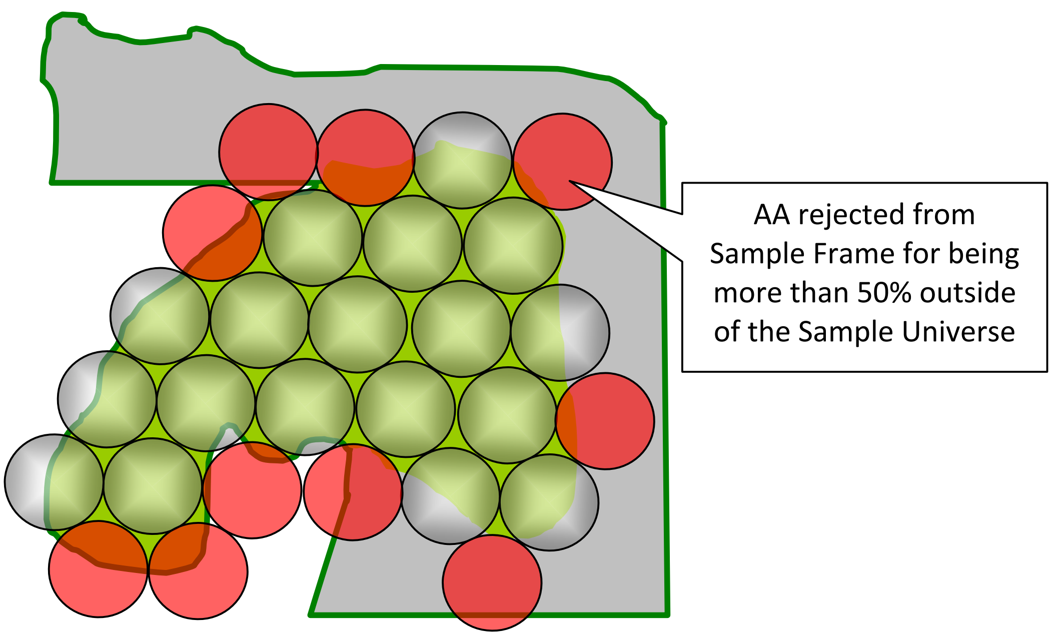


Figure 3: Map of the maximum number of candidate AAs showing AAs rejected for being more than 50% outside of the sample universe (red AAs.

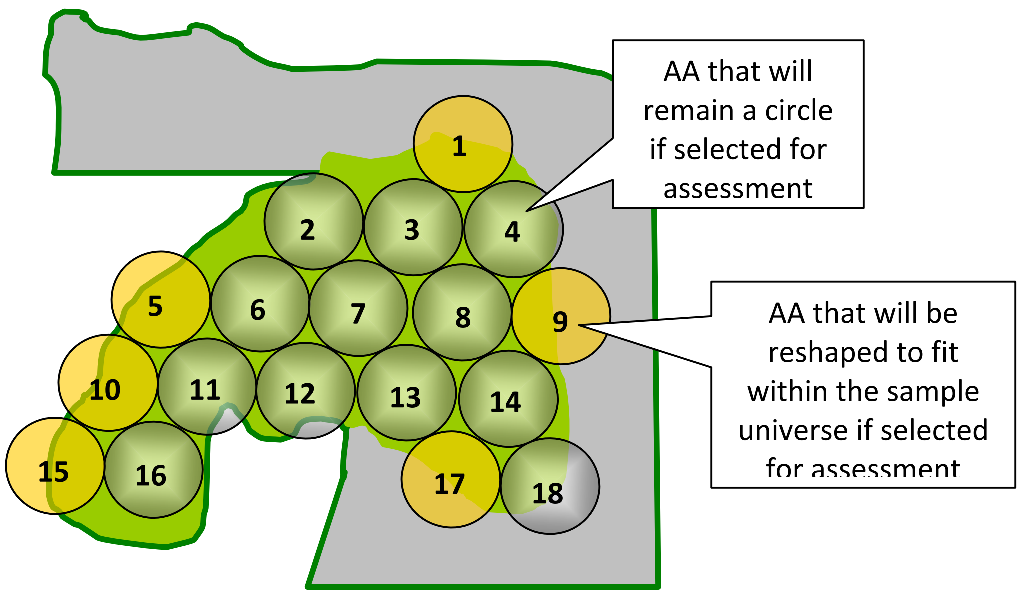
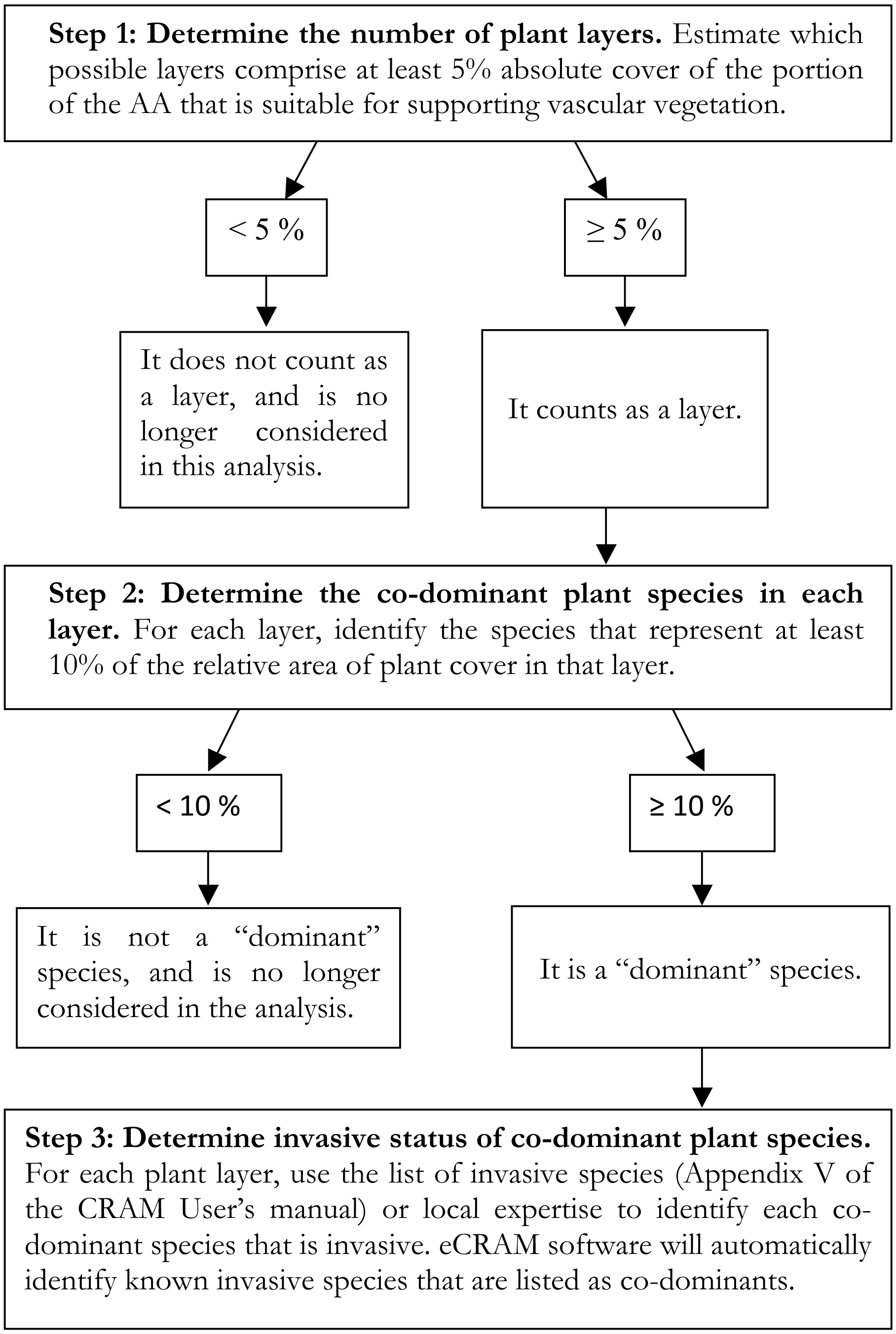


Figure 4: Sample Frame of final candidate AAs showing those entirely within the Sample universe (grey AAs) that do not have to be re-shaped if selected for assessment, and THOSE at 20% outside the sample universe (yellow AAs) that have to be reshaped if assessed. Each AA of the sample frame is numbered for random selection.

APPENDIX II: FLOW CHART TO DETERMINE PLANT DOMINANCE



APPENDIX III: GLOSSARY

aggradation – filling and raising of the level of the bed of a stream by deposition of sediment; the opposite of degradation

algal mat- macroalgae occurring on the water surface of a wetland.

allochthonous – external source of energy (carbon) for a stream (e.g., dead leaves, branches, and dead trees that fall into the river)

alluvial – refers to natural, channelized runoff from terrestrial terrain and the material borne or deposited by such runoff

anthropogenic – arising from human activity

aquatic area abundance- for the purposes of CRAM, a measure an aquatic area's spatial association with other areas of aquatic resources, such as other wetlands, lakes, streams, etc. For riverine systems, this metric is scored as the continuity of the riparian corridor over a prescribed distance upstream and downstream of the CRAM Assessment Area (AA).

arcuate- shaped or bent like an arc or bow (i.e. broadly curving)

assessment area – the portion of a wetland or riverine system that is the subject of the CRAM evaluation

assessment window – the period of time when assessments of wetland condition should be conducted. In general, it is during the growing season for the characteristic plant community of the wetland type to be assessed.

attribute – attributes constitute the obvious, universal aspects of wetland condition; CRAM recognizes a total of four attributes of condition within a wetland: (1) buffer and landscape context; (2) hydrology; (3) physical structure; and (4) biotic structure.

avulsion – sudden shift or movement of fluvial flow entirely or in part from one channel to another, less sinuous and steeper channel. Avulsions are typically formed during large storm events when high discharge erodes a new channel in the floodplain. Avulsions are more common in braided or aggrading stream channels.

backshore- the boundary between the wetland and the adjoining upland, where the upland is at least 5m wide. The high-water contour of the wetland is a good proxy for its backshore boundary.

bankfull – height of fluvial flow corresponding to the floodplain. This is the stage when water in the channel just begins to flow onto the floodplain.

bank slump- a portion of a bank that has broken free from the rest of the bank but has not eroded away

bar – a transient sedimentary feature within an intertidal and fluvial channel that is often exposed during low-water periods. Bars direct flows and form along the inside of a meander bend (point-bar) or in the middle of straight channel reach (in-channel bar). They are convex in profile and are comprised of alluvial or tidal deposits of sand, gravel, cobble, or other material. Their surface material varies in size from small on top to larger along their lower margins and they sometimes support vegetation.

barrier beach – a natural area of sand or gravel along a lacustrine, marine or estuarine shore that blocks the landward action of tides or waves

benthic – pertaining to the sea bed, river bed, or lake floor

berm- A flat strip of land, raised bank, or terrace bordering a wetland. Berms can be natural or artificial in origin.

borrow ditch-a ditch dug along a roadway to furnish fill and provide drainage

boulder- a size category of rock having a long axis greater than 25 cm

braided – a stream that forms an interlacing network of branching and recombining channels separated by floodplains, channel bars, or islands

buffer – for the purposes of CRAM, the area extending from the immediate edge of the AA that is in a natural, or semi-natural, state and protects the AA from stressors

catchment – synonymous with watershed. An area of land, bounded by a drainage divide, which drains to a fluvial channel or water body.

<u>**channel-**</u> a feature in tidal and fluvial systems consisting of a bed, its opposing banks, plus its floodplain, that confines and conveys surface water flow. The system of diverging and converging channels that characterize braided and anastomosing fluvial systems usually consist of one or more main (primary) channels plus secondary channels.

channel stability- a measure of the degree of channel aggradation (i.e. net accumulation of sediment on the channel bed causing it to rise over time) or degradation (i.e. net loss of sediment from the bed causing it to be lower over time).

coarse woody debris- a single piece of woody material, greater than 30 cm in diameter and greater than 3 m long

cobble-a size category of rock having a long axis from about 6 cm to about 25 cm

condition – condition is defined as the ability of a wetland to maintain its complexity and capacity for self-organization with respect to species composition, physio-chemical characteristics, and functional processes, relative to healthy wetlands of the same type. There are three primary aspects of condition: location, form, and structure.

confinement – the degree to which levee, terraces, or hillsides prevent the lateral migration of a fluvial channel

crenulated- having a margin that is very finely indented, notched, or with rounded (scalloped), projections, as in a crenulated foreshore of a wetland.

culvert- a drain or covered channel that crosses under a road, railway, etc.

debris jam – an accumulation of material, organic or inorganic, floating or submerged, that has been lodged into place by the action of a flowing water. Debris jams partially or completely obstruct surface water flow and sediment causing a change in the course of flow.

deciduous – plants (trees and shrubs) that shed all of their leaves annually, such that there is a time each year at which individuals of the species are essentially devoid of leaves

deposition – the settlement of materials out of moving water and onto the bed, banks, or floodplain of a wetland or riverine channel.

degradation – the long-term lowering of a fluvial channel due to erosion of its bed

detritus – deposition of newly dead or decaying organic matter

disturbance – the consequence of natural changes in forcing functions, or controlling factors, through space and over time; disturbance is natural, regardless of its frequency, persistence, or magnitude

drop structure- an artificial structure, typically small and built on streams with steep gradients, to pass water to a lower elevation while controlling the energy and velocity of the water as it passes over.

dryland farming-a system of growing crops in arid or semiarid regions without artificial irrigation, by reducing evaporation and by special methods of tillage.

duff – a spongy layer of decaying leaves, branches, and other organic materials along a wetland shore or in a riverine riparian area

ecological services – the services, or beneficial uses, for which a wetland can be managed; key ecological services for many types of wetland include flood control, groundwater recharge, water filtration, conservation of cultural values, aesthetics, and the support of special-status species.

emergent vegetation - plant species typically growing on saturated soils or on soils covered with water for most of the growing season; the leaves of emergent aquatic species are partly or entirely borne above the water surface; examples of such species include *Rorippa nasturtium-aquaticum* (watercress) and *Schoeneoplectus californicus* (tule, bulrush).

entrenchment – the inability of flows in a channel to exceed the channel banks (i.e. the vertical containment of stream); a measure of the degree to which fluvial flood flows are contained within channel banks without access to the effective valley. Entrenchment as a field measurement is calculated as the flood-prone width divided by the bankfull width.

effective valley width – the portion of a valley within which its fluvial channel is able to migrate without cutting into hill slopes, terraces, man-made levees, etc.

floodplain – the bench or broader flat area of a fluvial channel that corresponds to the height of the bankfull flow. It is a relatively flat depositional area that is periodically flooded, as evidenced by deposits of fine sediment, wrack lines, vertical zonation of plant communities, etc.

flood prone - land susceptible to inundation by extreme flood events. The height of the flood prone area approximately corresponds to twice bankfull height.

fluvial – of, relating to, or happening in, a river or stream

forb – a plant with a soft, rather than permanent, woody stem that is not a grass or grass-like

foreshore- the boundary between the vegetated wetland and any adjoining semi-aquatic, non-wetland area, such as an intertidal flat or a non-vegetated riverine channel bar, or a fully aquatic area such as the open water area of a lake or estuary that is at least 30m wide.

free-floating – plants that float at or just beneath the water surface without attachment to the substrate; free-floating aquatic species are transported freely by wind and water currents

function – for the purposes of Level 2 assessment, a function is something that a wetland stream or riparian area does. For example, groundwater recharge, flood-stage desynchronization, pollution filtration, wildlife support, and recreation are wetland functions. In this context, functions are identified separately from the processes that cause them to happen. In most cases, Level 3 tools are needed to assess the processes that account for functions.

herbaceous – a plant having stems that are not secondarily thickened and that die down annually

headcut- an erosional feature of some streams where an abrupt vertical drop in the stream bed occurs. The process of headcutting involves the initiation of channel incision at a nick point as the stream channel bed elevation adjusts to a natural or human induced disturbance. In flowing streams, head cuts resemble a small waterfall. A small plunge pool may be present at the base of the head cut due to the high energy of falling water. When not flowing, the head cut will resemble a very short cliff or bluff in the stream channel.

hummock – a mound composed of organic materials (typically less than 1m high) along the banks and floodplains of fluvial systems created by the collection of sediment and biotic material around wetland plants such as sedges.

hydrologic connectivity- a measure of the ability of water to flow into or out of the wetland, or to accommodate rising flood waters without persistent changes in water level that can result in stress to wetland plants and animals

hydroperiod- the characteristic frequency and duration of inundation or saturation of a wetland during a typical year

hyporheic – saturated zone under a river or stream, comprising substrate with the interstices filled with water

in-channel bar- a transient sedimentary feature within an intertidal or fluvial channel that forms in the middle of straight channel reach.

interfluve – the region of higher land between two fluvial channels or swales on a floodplain or in a braided channel system

interspersion-a measure of the number of distinct patches (as in plant zones) and the amount of edge between them.

invasive – species that have been introduced from other regions by the actions of people and that exhibit a tendency to significantly displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes.

litter- a layer of organic matter (partly decomposed leaves, twigs, etc) on the ground.

littoral zone – the nearshore area of a water body, where it is sufficiently shallow to allow light to penetrate to the bottom and reach rooted vegetation; corresponds with the limit of submerged aquatic vegetation

meander – the curves of a fluvial or tidal channel as viewed from above; a meander cutoff is a new, shorter channel across the narrow neck of a meander

metric – a measurable component of a CRAM attribute

muted- pertaining to an estuarine tidal regime in which the fluctuation of the water level is lower in amplitude than would be expected due to levees, culverts, tide gates, or other artificial devices which inhibit the exchange of water between the site and the tidal body. These obstructions reduce the range of tides but still allow frequent inundation and exposure.

natural levee – a low ridge landward of the active floodplain of a channel that forms by deposition during flood events.

nick point – an abrupt change of gradient in the profile of a stream or river, typically due to a change in the rate of erosion. This is the point where the stream is actively eroding the streambed to a new base level; nick points tend to migrate upstream. See definition for *headcut.*

nonpoint source discharge- any discharge to a wetland resulting from diffuse sources (e.g. land runoff, precipitation, atmospheric deposition, drainage, seepage, or hydrologic modification). Includes any type of discharge that does not meet the legal definition of "point source" (see definition below)

organic – pertaining to, or derived from, living organisms, or to compounds containing carbon as an essential component

panne – a shallow topographic basin that forms on a fluvial floodplain or tidal marsh plain. Pannes lack vegetation but exist on a well-vegetated wetland plain and fill with water at least seasonally due to overland flow.

patch – a spatially distinct structural element of a wetland system large enough to serve as habitat for wildlife, or to serve as an indicator of spatial variations in hydrological or edaphic (soil) conditions within a wetland

planar bed- a reach of a stream characterized by long, relatively straight channel of uniform depth

periphyton – benthic algae that grow attached to surfaces such as rocks or larger plants

point-bar- a transient sedimentary feature within an intertidal and fluvial channel that form along the inside of a meander bend

point-source discharge- any discernible confined and discrete conveyance (e.g. a pipe, ditch, channel, or conduit) from which pollutants are or may be discharged into a waterway. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.

pool (on floodplain)- a shallow topographic basin on a fluvial floodplain or tidal marsh plain that has been inundated by water.

pool (in channel)- a depression within a fluvial or tidal channel that is much deeper than the average depth of the channel. Pools tend to retain water longer than other areas of the channel during periods of low or no surface flow.

POTW-publicly-owned treatment work; a term used in the United States for a sewage treatment plant that is owned, and usually operated, by a local government agency. They are usually designed to treat domestic sewage and not industrial wastewater.

primary channel-a channel in fluvial and tidal systems that conveys the majority of the surface water flow

rating – for a CRAM metric, a rating represents its state relative to the full range of possible states, from worst possible state to best

reach – a length of stream, lacustrine shore, or estuarine shore that has generally consistent physical and biological characteristics

riffle or rapid – a submerged, topographical high area in a fluvial channel created by the accumulation of relatively coarse-grained sediment (gravel, cobble, or boulders) causing turbulent surface flow and indicated by standing waves

riparian – a transitional area between terrestrial and aquatic ecosystems, distinguished by gradients in biophysical conditions, ecological processes and biota; areas through which surface and subsurface hydrology connect water bodies with their adjacent uplands, including those portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems; riparian areas are adjacent to perennial, intermittent, and ephemeral streams, lakes and estuarine-marine shorelines (National Research Council 2001).

riprap- broken stones loosely deposited in water or on a soft bottom to provide a foundation and protect a riverbed or river banks from scour: used for revetments, embankments, breakwaters, etc.

run – a reach of straight, smooth, fast-moving fluvial flow between riffles; also called a glide

scour – concentrated erosive action of flowing water in streams that removes and carries away material from the bed and banks

secondary channel-a channel in fluvial and tidal systems that conveys flood flows, but not the majority of the flow

sediment – organic or inorganic material that has been transported and/or deposited by wind or water action. Sediment can be coarse (i.e., gravel or larger) or fine (i.e. clay, silt, sand). A fresh splay of sediment is one that has been deposited during the current or previous season's runoff event.

sediment mound- a depositional feature (typically less than 1m high) along the banks and floodplains of fluvial systems formed from repeated flood flows depositing sediment on the floodplain. Sediment mounds lack plant cover.

slough – a large tidal channel, or a large fluvial channel lacking an obvious terminal water body, can also refer to an abandoned fluvial channel within the effective valley

snag – a standing, dead tree or shrub at least 3 m (10 feet) tall

sorting-a measure of the spread of particle size in the substrate. Well-sorted particles are made up of similarly sized particles. Poorly sorted particles are made up of a wide variety of different particle sizes.

stress – the consequence of unnatural, anthropogenic changes in forcing functions or controlling factors; key stressors are anthropogenic actions that tend to modify the quantity and/or quality of physical or biological habitat, sediment supplies, and/or water supplies upon which the desired functions of the wetland depend

stressor – an agent that inflicts stress on a wetland

submerged or submergent vegetation - plant species that are adapted to spending their lifespan, from germination to fruiting, completely or nearly completely under water. Submerged vegetation consists of aquatic macrophytes such as *Elodea canadensis* (common elodea), *Ruppia cirrhosa* (ditchgrass), and *Zannichellia palustris* (horned pondweed) that are rooted in the sub-aqueous substrate but do not usually grow high enough in the overlying water column to intercept the water surface.

swale –broad, elongated, vegetated, shallow depressions that can sometimes help to convey flood flows to and from vegetated marsh plains or floodplains. However, they lack obvious banks, regularly spaced deeps and shallows, or other characteristics of channels. Swales can entrap water after flood flows recede. They can act as localized recharge zones and they can sometimes receive emergent groundwater.

thalweg – the line connecting the lowest or deepest points along the riverbed

thatch- a matted layer of partly decayed leaves, stems, etc. between growing vegetation and the soil.

tide gate- an opening through which water may flow freely when the tide sets in one direction, but which closes automatically and prevents the water from flowing in the other direction.

transportation corridor- a linear pathway for a particular mode of transportation (highway, road, rail, canal, etc.)

tributary- a type of secondary channel that originates in the wetland and only conveys flow between the wetland and the primary channel. Short tributaries that are entirely contained within the CRAM Assessment Area (AA) are regarded as secondary channels.

undercutting- the removal of material at the base of a streambank or shoreline of a wetland by the erosive action of flowing water

unnatural levee- an artificially raised embankment along a wetland that constrains water flows. Their primary purpose is to provide hurricane, storm, and flood protection relating to seasonal high water, storm surges, precipitation, and other weather events.

variegated- having variety in form. As viewed from above, a variegated shoreline resembles a meandering pathway. Variegated shorelines provide greater contact between water and land.

island- an area of land above the usual high water level and, at least at times, surrounded by water. Islands differ from hummocks and other mounds by being large enough to support trees or large shrubs.

vegetation management-the practice of manipulating vegetation within a prescribed management area. Includes prescribed burning, grazing, chemical applications, timber harvesting, and any other economically feasible methods of enhancing, retarding, or removing the above-ground parts of plants.

wetlands – 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; 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; and (3) the substrate is saturated with water or covered by shallow water at some time during the growing season of each year (Cowardin *et al.* 1979).

wier- a small overflow barrier used to alter the flow characteristics of a river or stream. Weirs are commonly used to prevent flooding, measure discharge, and to help render a river navigable.

wrack or wrackline – an accumulation of natural floating debris (kelp, plastic debris, wood, and similar material) left along the shore of a river, lake, tidal marsh, or other water body by high water levels

xeric – characterized by an extremely dry habitat

zonation – distribution of plants or animals arranged in zones or bands, caused by gradations of abiotic and/or biotic factors

APPENDIX IV: ACRONYM LIST

AA	Assessment Area
Cal-IPC	California Invasive Plant Council
CDF	California Department of Forestry and Fire Protection
CEDEN	California Environmental Data Exchange Network
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CRAM	California Rapid Assessment Method for Wetlands
DOQQ	Digital Orthogonal Quarterly Quadrangles
eCRAM	An electronic version of CRAM
GIS	Geographic Information System
HEP	Habitat Evaluation Procedure
HGM	Hydrogeomorphic Functional Assessment Method
IBI	Index of Biotic Integrity
JD	Jurisdictional Delineation
NAIP	National Agriculture Imagery Program
NGO	Non-governmental Organization
NHD	National Hydrography Dataset
NRC	National Research Council
NWI	National Wetlands Inventory
ORAM	Ohio Rapid Assessment Method
PI	Principal Investigator
POTW	Publically Owned Treatment Works
PSR	Pressure-State-Response Model
QA/QC	Quality Assurance/Quality Control
SWAMP	Surface Water Ambient Monitoring Program
USFWS	United States Fish and Wildlife Service
WRAP	Wetland Rapid Assessment Procedure

APPENDIX V: INVASIVE PLANT SPECIES LIST

[1]In general, code names consist of the first two letters of the genus and the first two letters of the species. For species in which this formula produces duplicate code names within the list, the final letter in the code is changed for one of the two species. In all such cases, the resulting code names of both species are presented in bold as a "flag" to warn the observer about the potential for an error of duplication. The invasive status is based upon species with a rating of high, moderate, and limited in the Cal-IPC Invasive Plant Inventory (Cal-IPC 2006). Indicator status is from the U.S. Fish and Wildlife Service's National List of Plant Species That Occur in Wetlands: California (Region 0), May 1988. FAC=Facultative, FACU=Facultative Upland, FACW=Facultative Wetland, NI=No Indicator, OBL=Obligate Wetland, UPL=Obligate Upland, na=Indicator status not available. A positive (+) or negative (-) sign is used with the Facultative Indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands). An asterisk (*) following a regional Indicator identifies tentative assignments based on limited information from which to determine the indicator status.

Appendix V-A: List of California Plant Species (alphabetized by plant species)

Appendix V-A: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Abies concolor	Abco	white fir	No	tree	Pinaceae	na
Acer circinatum	Acci	vine maple	No	shrub	Aceraceae	FAC
Acer macrophyllum	Acma	big-leaf maple	No	tree	Aceraceae	FAC
Acer negundo L.	Acne	box elder	No	tree	Aceraceae	FACW
Adiantum aleuticum	Adal	Five fingered fern	No	herb	Pteridaceae	na
Adiantum jordanii	Adjo	California maidenhair	No	herb	Pteridaceae	NI
Aesculus californica	Aeca	California buckeye	No	tree	Hippocastanaceae	na
Ageratina adenophora	Agad	sticky eupatorium	Yes	herb	Asteraceae	NI
Agrostis gigantea	Aggi	redtop	No	herb	Poaceae	NI
Agrostis stolonifera L.	Agst	creeping bentgrass	Yes	herb	Poaceae	FACW
Agrostis viridis	Agvi	water bentgrass	No	herb	Poaceae	OBL

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Ailanthus altissima (P. Mill.) Swingle	Aial	tree of heaven	Yes	tree	Simaroubaceae	FACU
Alisma plantago-aquatica	Alpl	water plantain	No	herb	Alismataceae	OBL
Allenrolfea occidentalis	Aloc	iodine bush	No	shrub	Chenopodiaceae	FACW+
Alnus incana	Alin	mountain alder	No	shrub	Betulaceae	NI
Alnus rhombifolia	Alrh	white alder	No	tree	Betulaceae	FACW
Alnus rubra	Alru	red alder	No	tree	Betulaceae	FACW
Alopecurus aequalis	Alae	shortawn foxtail	No	herb	Poaceae	OBL
Amaranthus albus	Amal	tumbleweed	No	herb	Amaranthaceae	FACU
Amaranthus californicus	Amca	California pigweed	No	herb	Amaranthaceae	FACW
Ambrosia artemisiifolia	Amat	common ragweed	No	herb	Asteraceae	FACU
Ambrosia chamissonis	Amch	beach-bur	No	shrub	Asteraceae	NI
Ambrosia psilostachya DC.	Amps	western ragweed	No	herb	Asteraceae	FAC
Ammannia coccinea Rottb.	Amco	tooth-cup	No	herb	Lythraceae	OBL
Ammophila arenaria	Amar	European beach grass	Yes	herb	Poaceae	FACU
Anagallis arvensis L.	Anar	scarlet pimpernel	No	herb	Primulaceae	FAC
Andropogon glomeratus (Walt.) B.S.P.	Angl	southwestern bushy bluestem	No	herb	Poaceae	FACW
Anemopsis californica (Nutt.)	Anca	yerba mansa	No	herb	Sauruaceae	OBL
Anthriscus caucalis	Ancc	bur chervil	No	herb	Apiaceae	na
Apium graveolens L.	Apgr	celery	No	herb	Apiaceae	FACW*
Apocynum cannabinum	Apca	indian hemp	No	shrub	Apocynaceae	FAC
Aquilegia formosa	Aqfo	columbine	No	herb	Ranunculaceae	OBL
Aralia californica A. Wats.	Arcl	California spikenard	No	herb	Araliaceae	FACW
Artemisia californica	Arca	California sagebrush	No	shrub	Asteraceae	NI
Artemisia douglasiana Bess.	Ardg	mugwort	No	shrub	Asteraceae	FACW
Artemisia ludoviciana	Arlu	silver wormwood	No	shrub	Asteraceae	FACU-
Artemisia tridentata	Artr	Great Basin sage	No	shrub	Asteraceae	na
Arundo donax L.	Ardo	giant reed	Yes	shrub	Poaceae	FAC+

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Aster subulatus Michx.	Assu	slender aster	No	herb	Asteraceae	FACW
Athyrium filix-femina	Atfi	common ladyfern	No	herb	Dryopteridaceae	FAC
Atriplex californica Moq.	Atca	California saltbush	No	shrub	Chenopodiaceae	FAC
Atriplex lentiformis ssp. lentiformis	Atle	Brewer's saltbush	No	shrub	Chenopodiaceae	FAC
Atriplex semibaccata	Atse	Australian saltbush	Yes	shrub	Chenopodiaceae	FAC
Atriplex triangularis	Attr	saltbush	No	herb	Chenopodiaceae	NI
Atriplex wattsonii	Atwa	Watson's saltbush	No	shrub	Chenopodiaceae	FACW+
Avena barbata	Avba	slender wild oat	Yes	herb	Poaceae	NI
Avena fatua	Avfa	wild oat	Yes	herb	Poaceae	NI
Avena sativa	Avsa	hay	No	herb	Poaceae	NI
Baccharis douglasii	Bado	marsh baccharis/Douglas' false-willow	No	shrub	Asteraceae	OBL
Baccharis emoryi Gray	Baem	Emory baccharis	No	shrub	Asteraceae	FACW
Baccharis pilularis	Bapi	coyote brush	No	shrub	Asteraceae	NI
Baccharis salicifolia	Basa	mule fat	No	shrub	Asteraceae	FACW
Baccharis sarothroides Gray	Basr	broom baccharis	No	shrub	Asteraceae	FAC
Bassia hyssopifolia	Bahy	bassia	Yes	herb	Chenopodiaceae	FAC
Batis maritima L.	Bama	saltwort, beachwort	No	shrub	Bataceae	OBL
Bergia texana (Hook.) Seub. ex Walp.	Bete	Texas bergia	No	herb	Elatinaceae	OBL
Berula erecta (Huds.) Coville	Beer	cutleaf water-parsnip	No	herb	Apiaceae	OBL
Beta vulgaris	Bevu	wild beet	No	herb	Chenopodiaceae	FACU
Bidens laevis (L.) B.S.P.	Bila	bur-marigold	No	herb	Asteraceae	OBL
Blennosperma nanum	Blna	common blennosperma	No	herb	Asteraceae	FACW
Boykinia occidentalis	Booc	coast boykinia	No	herb	Saxifragaceae	FACW
Brassica nigra	Brni	black mustard	Yes	herb	Brassicaceae	NI
Brickellia californica	Brca	California brickellbush	No	shrub	Scrophulariaceae	FACU
Bromus diandrus	Brdi	ripgut brome	Yes	herb	Poaceae	NI
Bromus madritensis	Brma	foxtail chess	Yes	herb	Poaceae	UPL

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Bromus mollis	Brmo	soft brome	No	herb	Poaceae	FACU-
Bromus tectorum	Brte	cheat grass	Yes	herb	Poaceae	NI
Callitriche heterophylla Pursh	Cahe	water starwort	No	herb	Callitrichaceae	OBL
Calocedrus decurrens	Cade	incense cedar	No	tree	Cupressaceae	na
Caltha palustris	Capa	marsh marigold	No	herb	Ranunculaceae	NI
Calystegia macrostegia	Cama	morning-glory	No	herb	Convovulaceae	NI
Calystegia sepium (L.) R. Br.	Case	hedge bindweed	No	herb	Convovulaceae	OBL
Camissonia chieranthifolia var. suffruticosa	Cach	beach evening primrose	No	shrub	Onagraceae	NI
Cardamine californica	Caca	milk maids, tooth wort	No	herb	Brassicaceae	UPL
Carduus pycnocephalus	Capy	Italian thistle	Yes	herb	Asteraceae	NI
Carex barbarae	Caba	Santa Barbara sedge	No	herb	Cyperaceae	FACW
Carex lenticularis	Cale	lakeshore sedge	No	herb	Cyperaceae	na
Carex lyngbyei	Caly	Lyngbyei's sedge	No	herb	Cyperaceae	OBL
Carex praegracilis W. Boott	Capr	clustered field sedge	No	herb	Cyperaceae	FACW-
Carex schottii	Casc	Schott's sedge	No	herb	Cyperaceae	OBL
Carex spissa Bailey	Casp	San Diego sedge	No	herb	Cyperaceae	FAC*
Carex Whitneyi	Cawh	sedge	No	herb	Cyperaceae	na
Carpobrotus edulis	Caed	iceplant	Yes	herb	Aizoaceae	NI
Casuarina equisetifolia	Caeq	river she-oak	No	tree	Casuarinaceae	na
Centaurea solstitialis	Ceso	yellow starthistle	Yes	herb	Asteraceae	NI
Centella asiatica	Ceas	Asiatic pennywort	No	herb	Apiaceae	NI
Cercocarpus betuloides	Cebe	mountain mahogany	No	shrub	Rosaceae	na
Chenopodium album	Chal	lamb's quarters	No	herb	Chenopodiaceae	FAC
Chenopodium ambrosioides	Cham	Mexican tea	No	herb	Chenopodiaceae	FAC
Chrysanthemum coronarium	Chco	garland chrysanthemum	Yes	herb	Asteraceae	na
Chrysothamnus nauseosus	Chna	rabbit brush	No	shrub	Asteraceae	na
Cicuta douglasii	Cido	western waterhemlock	No	herb	Apiaceae	OBL

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Cirsium arvense	Ciar	Canada thistle	Yes	herb	Asteraceae	FAC-
Cirsium vulgare (Savi) Ten.	Civu	bull thistle	Yes	herb	Asteraceae	FAC
Clematis ligusticifolia	Clli	virgin's bower	No	shrub	Ranunculaceae	FAC
Conium maculatum L.	Coma	poison hemlock	Yes	herb	Apiaceae	FAC
Conyza bonariensis	Cobo	horseweed	No	herb	Asteraceae	na
Conyza canadensis (L.) Cronq.	Coca	horseweed	No	herb	Asteraceae	FAC
Cordylanthus maritimus ssp. maritimus	Comr	salt marsh bird's beak	No	herb	Scrophulariaceae	OBL
Cordylanthus mollis ssp. mollis	Como	soft bird's beak	No	herb	Scrophulariaceae	OBL
Cornus sericea	Cosr	creek dogwood	No	shrub	Cornaceae	FACW
Cortaderia jubata	Coju	Andean pampas grass	Yes	herb	Poaceae	NI
Cortaderia selloana	Cose	pampas grass	Yes	herb	Poaceae	NI
Cotula coronopifolia L.	Coco	brass buttons	Yes	herb	Asteraceae	FACW+
Crassula aquatica (L.) Schoenl.	Craq	water pygmyweed	No	herb	Crassulaceae	OBL
Cressa truxillensis Kunth	Crtr	alkali weed	No	shrub	Convovulaceae	FACW
Crypsis schoenoides	Crsc	swamp pickle-grass	No	herb	Poaceae	OBL
Crypsis vaginiflora (Forsk.) Opiz	Crva	sharp-leaved Timothy	No	herb	Poaceae	OBL
Cuscuta salina	Cusa	witch's hair/dodder	No	herb	Cuscutaceae	NI
Cynara cardunculus	Cyca	artichocke thistle	Yes	herb	Asteraceae	NI
Cynodon dactylon	Cyda	Bermuda grass	Yes	herb	Poaceae	FACU
Cynosurus echinatus	Cyec	bristly dogstail grass	Yes	herb	Poaceae	na
Cyperus eragrostis Lam.	Cyer	umbrella sedge	No	herb	Cyperaceae	FACW
Cyperus esculentus	Cyes	nutsedge	No	herb	Cyperaceae	FACW
Cyperus involucratus	Cyin	nutsedge	No	herb	Cyperaceae	FACW+
Cyperus rotundus L.	Cyro	purple nutsedge	No	herb	Cyperaceae	FAC
Cyperus squarrosus L.	Cysq	awned flatsedge/bearded flatsedge	No	herb	Cyperaceae	OBL
Datisca glomerata (K. Presl) Baill.	Dagl	Durango root	No	herb	Datiscaceae	FACW
Delairea odorata/Senecio mikanoides	Deod	Cape (German) ivy	Yes	herb	Asteraceae	na

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Deschampsia cespitosa	Dece	tufted hairgrass	No	herb	Poaceae	FACW
Dichelostemma capitatum ssp. capitatum	Dica	blue dicks	No	herb	Liliaceae	FAC*
Distichlis spicata (L.) Greene	Disp	saltgrass	No	herb	Poaceae	FACW
Downingia cuspidata	Docu	toothed calicoflower	No	herb	Campanulaceae	OBL
Dryopteris arguta	Drar	wood fern	No	herb	Dryopteridaceae	NI
Echinochloa crus-galli (L.) Beauv.	Eccr	banyard grass	No	herb	Poaceae	FACW
Eclipta prostrata	Ecpr	eclipta	No	herb	Asteraceae	FAC+
Ehrharta erecta	Eher	veldt grass	Yes	herb	Poaceae	NI
Elatine brachysperma Gray	Elbr	shortseed waterwort	No	herb	Elatinaceae	OBL
Eleocharis acicularis	Elac	hairgrass	No	herb	Cyperaceae	OBL
Eleocharis geniculata	Elge	annual spikerush	No	herb	Cyperaceae	OBL
Eleocharis macrostachya	Elma	common spikerush	No	herb	Cyperaceae	NI
Eleocharis montevidensis	Elmo	sand spikerush	No	herb	Cyperaceae	FACW
Eleocharis parishii	Elpa	Parish's spikerush	No	herb	Cyperaceae	FACW
Eleocharis radicans	Elra	rooted spikerush	No	herb	Cyperaceae	OBL
Eleocharis rostellata	Elro	beaked spikerush	No	herb	Cyperaceae	OBL
Elymus elymoides	Elel	squirreltail	No	herb	Poaceae	FACU-
Emmenanthe penduliflora	Empe	whispering bells	No	herb	Hydrophyllaceae	NI
Encelia californica	Enca	bush sunflower	No	shrub	Asteraceae	NI
Epilobium (Zauschneria) canum	Epca	california fuchsia	No	herb	Onagraceae	na
Epilobium ciliatum Raf.	Epci	hairy willow-herb	No	herb	Onagraceae	FACW
Epilobium pygmaeum (Speg.)	Eppy	smooth willow-herb	No	herb	Onagraceae	OBL
Equisetum arvense	Eqar	common horsetail	No	herb	Equisetaceae	FAC
Equisetum laevigatum	Eqla	smooth scouring rush	No	herb	Equisetaceae	FACW
Equisetum telmateia Ehrh.	Eqte	giant horsetail	No	herb	Equisetaceae	OBL
Eriogonum fasciculatum	Erfa	California buckwheat	No	shrub	Polygonaceae	na
Eriophyllym confertifolium	Erco	golden yarrow	No	shrub	Asteraceae	NI

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Erodium botrys	Erbo	long-beaked filaree	No	herb	Geraniaceae	NI
Erodium cicutarium	Erci	red-stem filaree	Yes	herb	Geraniaceae	NI
Eryngium aristulatum var. parishii	Erar	San Diego-button celery	No	herb	Apiaceae	OBL
Eucalyptus globulus	Eugl	Tasmanian blue gum	Yes	tree	Mytaceae	NI
Euphorbia peplus	Eupe	petty spurge	No	herb	Euphorbiaceae	NI
Euphorbia terracina	Eute	Geraldton carnation weed	Yes	herb	Euphorbiaceae	na
Foeniculum vulgare P. Mill.	Fovu	sweet fennel	Yes	herb	Apiaceae	FACU-
Frankenia salina (Molina)	Frsa	alkali heath	No	herb	Frankeniaceae	FACW+
Fraxinus dipetala	Frdi	California ash	No	tree	Oleaceae	NI
Fraxinus latifolia	Frla	Oregon ash	No	tree	Oleaceae	FACW
Fraxinus velutina Torr.	Frve	velvet ash	No	tree	Oleaceae	FACW
Galium aparine	Gaap	goose grass	No	herb	Rubiaceae	FACU
Genista monspessulana	Gemo	French broom	Yes	shrub	Fabaceae	na
Glaux maritima	Glma	sea-milkwort	No	herb	Primulaceae	OBL
Gnaphalium californicum	Gncl	California everlasting	No	herb	Asteraceae	NI
Gnaphalium canescens ssp. beneolens	Gnca	fragrant everlasting	No	herb	Asteraceae	NI
Gnaphalium palustre Nutt.	Gnpa	lowland cudweed	No	herb	Asteraceae	FACW
Grindelia hirsutula var. hirsutula	Grhi	hairy gumweed	No	herb	Asteraceae	FACW
Grindelia stricta	Grst	marsh gum-plant	No	shrub	Asteraceae	OBL
Hedera helix	Hehe	English ivy	Yes	vine ("shrub")	Araliaceae	NI
Helianthus annuus L.	Hean	common sunflower	No	herb	Asteraceae	FAC-
Helianthus californicus DC.	Hecl	California sunflower	No	herb	Asteraceae	OBL
Heliotropium curassavicum L.	Hecu	alkali heliotrope	No	herb	Boraginaceae	OBL
Hemizonia paniculata Gray	Hepa	fascicled tarweed	No	herb	Asteraceae	FACU*
Hemizonia parryi var. australis	Hepr	southern tarplant	No	herb	Asteraceae	FAC
Heracleum lanatum	Hela	cow parsnip	No	herb	Apiaceae	FACU
Hesperevax caulescens	Heca	hogwallow starfish	No	herb	Asteraceae	OBL

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Hesperocnide tenella	Hete	western nettle	No	herb	Urticaceae	na
Heteromeles arbutifolia	Hear	toyon	No	shrub	Rosaceae	NI
Heterotheca grandiflora	Hegr	telegraph weed	No	herb	Asteraceae	NI
Hirschfeldia incana	Hiin	summer mustard	Yes	herb	Brassicaceae	UPL
Holcus lanatus	Hola	velvet grass	Yes	herb	Poaceae	FAC
Holodiscus discolor	Hodi	oceanspray	No	shrub	Rosaceae	na
Hordeum brachyantherum	Hobr	barley	No	herb	Poaceae	FACW
Hordeum geniculatum/H. marinum gussonianum	Hoge	Mediterrenean barley	Yes	herb	Poaceae	NI
Hordeum intercedens Nevski	Hoin	vernal barley	No	herb	Poaceae	FAC
Hordeum secalinum	Hose	meadow barley	No	herb	Poaceae	NI
Hydrilla verticillata (L. f.) Royle	Hyve	waterthyme	Yes	herb	Hydrocharitaceae	OBL
Hydrocotyle ranunculoides L. f.	Hyra	floating marsh pennywort	No	herb	Apiaceae	OBL
Hydrocotyle umbellata L.	Hyum	water-pennywort	No	herb	Apiaceae	OBL
Hydrocotyle verticillata Thunb.	Hyvr	whorled marsh pennywort	No	herb	Apiaceae	OBL
Iris pseudacorus	Irps	yellow water iris/yellow flag	Yes	herb	Iridaceae	OBL
Isocoma menziesii	Isme	coast goldenbush	No	shrub	Asteraceae	FAC+
Isoetes howellii Engelm.	Isho	Howell's quillwort	No	herb	Isoetaceae	OBL
Isoetes nuttallii A. Braun ex Engelm.	Isnu	Nuttall's quillwort	No	herb	Isoetaceae	OBL
Isomeris arborea	Isar	bladderpod	No	shrub	Capparaceae	NI
Jaumea carnosa (Less.) Gray	Jaca	marsh jaumea/salty Susan	No	herb	Asteraceae	OBL
Juglans californica	Juca	California black walnut	No	tree	Juglandaceae	FAC
Juncus acutus	Juac	southwestern spiny rush/sharp rush	No	herb	Juncaceae	FACW
Juncus balticus	Juba	Baltic rush	No	herb	Juncaceae	FACW+
Juncus bufonius L.	Jubu	toadrush	No	herb	Juncaceae	FACW+
Juncus effusus	Juef	common rush	No	herb	Juncaceae	FACW+
Juncus lesueurii	Jule	salt rush	No	herb	Juncaceae	FACW
Juncus longistylus	Julo	long-beaked rush	No	herb	Juncaceae	na

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Juncus mexicanus	Jume	Mexican rush	No	herb	Juncaceae	FACW
Juncus nevadensis	June	Sierra rush	No	herb	Juncaceae	FACW
Juncus occidentalis	Juoc	rush	No	herb	Juncaceae	NI
Juncus phaeocephalus	Juph	brown-headed creeping rush	No	herb	Juncaceae	FACW
Juncus rugulosus Engelm.	Juru	wrinkled rush	No	herb	Juncaceae	OBL
Juncus textilis	Jute	basket rush	No	herb	Juncaceae	OBL
Kyllinga brevifolia	Kybr	kyllinga	No	herb	Cyperaceae	FACW
Lactuca serriola L.	Lase	prickly lettuce	No	herb	Asteraceae	FAC
Larrea tridentata	Latr	creosote bush	No	shrub	Zygophyllaceae	na
Lasthenia glabrata Lindl.	Lagl	goldfields	No	herb	Asteraceae	FACW
Lathryus jepsonii var. jepsonii	Laje	tule pea	No	herb	Fabaceae	OBL
Lemna minor L.	Lemi	lesser duckweed	No	herb	Lemnaceae	OBL
Lemna minuta	Lemu	least duckweed	No	herb	Lemnaceae	OBL
Lepidium latifolium L.	Lelf	perennial pepperweed	Yes	herb	Brassicaceae	FACW
Lepidium latipes Hook.	Lela	dwarf pepper grass	No	herb	Brassicaceae	OBL
Lepidium nitidum	Leni	peppergrass	No	herb	Brassicaceae	FAC
Lepidospartum squamatum	Lesq	scalebroom	No	shrub	Asteraceae	NI
Leptochloa uninervia (J. Presl)	Leun	Mexican sprangletop	No	herb	Poaceae	FACW
Leymus condensatus	Leco	giant wild-rye	No	herb	Poaceae	FACU
Leymus triticoides	Letr	beardless wild-rye	No	herb	Poaceae	FAC+
Lilaeopsis masonii	Lima	Mason's lilaeopsis	No	herb	Apiaceae	OBL
Lilaeopsis occidentalis	Lioc	western grasswort	No	herb	Apiaceae	OBL
Limonium californicum	Lica	sea lavender/marsh rosemary	No	herb	Plumbaginaceae	OBL
Lithocarpus densiflorus	Lide	Tanbark oak	No	tree	Fagaceae	na
Lobularia maritima	Loma	sweet alyssum	Yes	herb	Brassicaceae	NI
Lolium multiflorum	Lomu	Italian ryegrass	Yes	herb	Poaceae	NI
Lolium perenne L.	Lope	perennial ryegrass	No	herb	Poaceae	FAC*

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Lonicera hispidula	Lohi	California honeysuckle	No	shrub	Caprifoliaceae	NI
Lonicera involucrata	Loin	twinberry honeysuckle	No	vine ("shrub")	Caprifoliaceae	FAC
Lotus argophyllus	Loar	silver lotus	No	herb	Fabaceae	NI
Lotus corniculatus	Loco	birdfoot trefoil	No	herb	Fabaceae	FAC
Lotus scoparius	Losc	deerweed	No	shrub	Fabaceae	NI
Ludwigia peploides (Kunth) Raven	Lupe	floating water primrose, false loosestrife	No	herb	Onagraceae	OBL
Lupinus arboreus	Luar	yellow bush lupine	No	shrub	Fabaceae	na
Lupinus chamissonis	Luch	silver dune lupine	No	shrub	Fabaceae	na
Lupinus lepidus	Lule	dwarf lupine	No	herb	Fabaceae	na
Lupinus polyphyllus	Lupo	bigleaf lupine	No	herb	Fabaceae	FACW
Lythrum californicum Torr. & Gray	Lyca	California loosestrife	No	herb	Lythraceae	OBL
Lythrum hyssopifolium	Lyhy	loosestrife	Yes	herb	Lythraceae	FACW
Malacothrix californica	Maca	malacothrix	No	herb	Asteraceae	na
Malacothrix torreyi	Mato	Torrey's desertdandelion	No	herb	Asteraceae	na
Malosma laurina	Mala	laurel sumac	No	shrub	Anacardiaceae	NI
Malvella leprosa (Ortega) Krapov.	Male	alkali mallow/whiteweed	No	herb	Malvaceae	FAC*
Marrubium vulgare L.	Mavu	horehound	Yes	herb	Lamiaceae	FACU
Marsilea vestita	Mave	hairy pepperwort	No	herb	Marsileaceae	OBL
Matricaria suaveolens	Masu	pineapple weed	No	herb	Asteraceae	NI
Medicago polymorpha L.	Mepo	California burclover	Yes	herb	Fabaceae	FACU-
Melilotus alba	Meal	white sweetclover	Yes	herb	Fabaceae	FACU
Melilotus indica	Mein	sourclover	Yes	herb	Fabaceae	FAC
Mentha piperita	Mepi	peppermint	No	herb	Lamiaceae	NI
Mentha pulegium	Mepu	pennyroyal	Yes	herb	Lamiaceae	OBL
Mentha spicata L.	Mesp	spearmint	No	herb	Lamiaceae	OBL
Mesembryanthemum crystallinum L.	Mecr	crystalline iceplant	Yes	herb	Aizoaceae	FAC
Mesembryanthemum nodiflorum	Meno	slender-leaved iceplant	Yes	herb	Aizoaceae	FAC

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Mimulus aurantiacus	Miau	bush monkeyflower	No	shrub	Scrophulariaceae	NI
Mimulus cardinalis Dougl. ex Benth.	Mica	scarlet monkeyflower	No	herb	Scrophulariaceae	OBL
Mimulus guttatus DC.	Migu	common monkeyflower	No	herb	Scrophulariaceae	FACW+
Mimulus moschatus	Mimo	musk monkeyflower	No	herb	Scrophulariaceae	OBL
Monanthochloe littoralis	Moli	wiregrass/shoregrass	No	herb	Poaceae	OBL
Muhlenbergia rigens (Benth.) A.S. Hitchc.	Muri	deergrass	No	herb	Poaceae	FACW
Myoporum laetum	Myla	mousehole tree	Yes	tree	Myoporaceae	NI
Myosotis symphytifolia	Mysy	forget-me-not	No	herb	Boraginaceae	NI
Myosurus minimus L.	Mymi	mouse tail	No	herb	Ranunculaceae	OBL
Myriophyllum aquaticum	Myaq	parrot's feather	Yes	herb	Haloragaceae	OBL
Najas marina	Nama	holly-leaved water-nymph	No	herb	Hydrocharitaceae	OBL
Nemacaulis denudata var. denudata	Nede	wooly-heads	No	herb	Polygonaceae	NI
Nicotiana glauca Graham	Nigl	tree tobacco	Yes	shrub	Solanaceae	FAC
Olea europaea	Oleu	olive	Yes	tree	Oleaceae	NI
Orizopsis mileaceum	Ormi	smilo grass	Yes	herb	Poaceae	NI
Osmorhiza brachypoda	Osbr	California sweetcicely	No	herb	Apiaceae	NI
Oxalis pes-caprae	Oxpe	Bermuda buttercup	Yes	herb	Oxalidaceae	NI
Parapholis incurva	Pain	sickle grass	No	herb	Poaceae	OBL
Paspalum distichum	Padi	knot grass	No	herb	Poaceae	OBL
Pennisetum clandestinum	Pecl	kikuyu grass	Yes	herb	Poaceae	FACU
Petasites frigidus (L.) Fries	Pefr	coltsfoot	No	herb	Asteraceae	NI
Phacelia distans	Phdi	phacelia	No	herb	Hydrophyllaceae	NI
Phalaris aquatica	Phaq	Harding grass	Yes	herb	Poaceae	FAC
Phalaris arundinacea	Phar	reed canary grass	No	herb	Poaceae	OBL
Phalaris lemmonii	Phle	Lemmon's canary grass	No	herb	Poaceae	FACW
Phoenix canariensis	Phca	Phoenix date palm	Yes	tree	Arecaceae	NI
Phragmites australis (Cav.) Trin. ex Steud.	Phau	common reed	No	herb	Poaceae	FACW

Appendix V-A: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Phyllospadix scouleri Hook.	Phsc	Scouler's surfgrass	No	herb	Zosteraceae	OBL
Phyllospadix torreyi S. Wats.	Phto	Torrey's surfgrass	No	herb	Zosteraceae	OBL
Picris echioides L.	Piec	bristly ox-tongue	Yes	herb	Asteraceae	FAC
Pilularia americana	Piam	American pillwort	No	herb	Marsileaceae	OBL
Pimpinella anisum	Pian	anise	No	herb	Umbelliferae	NI
Pinus jeffryi	Pije	Jeffrey pine	No	tree	Pinaceae	na
Pinus ponderosa	Pipo	ponderosa pine	No	tree	Pinaceae	FACU
Piptatherum miliaceum	Pimi	smilo grass	Yes	herb	Poaceae	NI
Plagiobothrys leptocladus	Plle	alkali plagiobothrys	No	herb	Boraginaceae	OBL
Plagiobothrys stipitatus	Plst	stipitate popcorn flower	No	herb	Boraginaceae	OBL
Plagiobothrys undulatus	Plun	coast popcorn-flower	No	herb	Boraginaceae	FACW
Plantago elongata Pursh	Plel	slender plantain	No	herb	Plantaginaceae	FACW*
Plantago erecta	Pler	dwarf plantain	No	herb	Plantaginaceae	na
Plantago lanceolata L.	Plla	English plantain	Yes	herb	Plantaginaceae	FAC-
Plantago major	Plma	common plantain	No	herb	Plantaginaceae	FAC
Plantago subnuda	Plsu	naked plantain	No	herb	Plantaginaceae	FACW
Platanus racemosa	Plra	western sycamore	No	tree	Platanaceae	FACW
Pluchea odorata	Plod	salt marsh fleabane	No	herb	Asteraceae	OBL
Pluchea sericea (Nutt.) Cav.	Plse	arrow weed	No	shrub	Asteraceae	FACW
Poa pratensis	Popr	Kentucky bluegrass	Yes	herb	Poaceae	FACU
Polygonum amphibium L.	Poam	water smartweed	No	herb	Polygonaceae	OBL
Polygonum arenastrum Jord. ex Boreau	Poar	common knotweed	No	herb	Polygonaceae	FAC
Polygonum lapathifolium L.	Pola	willow weed	No	herb	Polygonaceae	OBL
Polygonum punctatum	Popu	water smartweed	No	herb	Polygonaceae	OBL
Polypogon monspeliensis (L.) Desf.	Pomo	annual beard grass/rabbitfoot grass	Yes	herb	Poaceae	FACW+
Populus balsamifera	Poba	black cottonwood	No	tree	Salicaceae	FACW
Populus fremontii S. Wats.	Pofr	Fremont cottonwood	No	tree	Salicaceae	FAC+*

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Portulaca oleracea	Pool	common purslane	No	herb	Portulacaceae	FAC
Potamogeton foliosus Raf.	Pofo	leafy pondweed	No	herb	Potamogetonacea e	OBL
Potamogeton nodosus Poir.	Pono	long-leaved pondweed	No	herb	Potamogetonacea e	OBL
Potamogeton pectinatus	Pope	fennel-leaf pondweed	No	herb	Potamogetonacea e	OBL
Potentilla anserina	Poan	cinquefoil	No	herb	Rosaceae	NI
Prunus ilicifolia	Pril	holly-leaved cherry	No	tree	Rosaceae	na
Pseudotsuga menziesii	Psme	douglas fir	No	tree	Pinaceae	NI
Psilocarphus brevissimus Nutt.	Psbr	wooly marbles	No	herb	Asteraceae	OBL
Pteridium aquilinum	Ptaq	bracken fern	No	herb	Polypodiaceae	FACU
Puccinellia distans (Jacq.) Parl.	Pudi	European alkali grass	No	herb	Poaceae	OBL
Pulicaria paludosa Link	Pupa	Spanish sunflower	No	herb	Asteraceae	NI
Purshia tridentata	Putr	antelope bush	No	shrub	Rosaceae	na
Quercus agrifolia	Quag	coast live oak	No	tree	Fagaceae	NI
Quercus berberidifolia	Qube	scrub oak	No	shrub	Fagaceae	NI
Quercus durata	Qudu	leather oak	No	tree	Fagaceae	NI
Quercus garryana	Quga	Oregon oak	No	tree	Fagaceae	na
Quercus kelloggii	Quke	California black oak	No	tree	Fagaceae	na
Quercus lobata	Qulo	valley oak	No	tree	Fagaceae	FACU
Ranunculus aquatilis L.	Raaq	water buttercup	No	herb	Ranunculaceae	OBL
Raphanus sativus L.	Rasa	wild radish	Yes	herb	Brassicaceae	UPL
Retama monosperma	Remo	bridal broom	Yes	shrub	Fabaceae	NI
Rhamnus californica	Rhca	California coffeeberry	No	shrub	Rhamnaceae	NI
Rhododendron occidentalis	Rhoc	western azalea	No	shrub	Ericaceae	na
Rhus intergrifolia	Rhin	lemonadeberry	No	shrub	Anacardiaceae	na
Rhus ovata	Rhov	sugar bush	No	shrub	Anacardiaceae	NI

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Ribes divaricatum	Ridi	spreading gooseberry	No	shrub	Grossulariaceae	FACW
Ribes speciosum	Risp	fucshia-flowered gooseberry	No	shrub	Grossulariaceae	NI
Ribes visicosissimum	Rivi	sticky currant	No	shrub	Grossulariaceae	na
Ricinus communis L.	Rico	castor bean	Yes	herb	Euphorbiaceae	FACU
Robinia pseudoacacia	Rops	black locust	Yes	tree	Fabaceae	FACU-
Rorippa curvipes Greene	Rocu	bluntleaf yellow-cress	No	herb	Brassicaceae	OBL
Rorippa nasturtium-aquaticum	Rona	water cress	No	herb	Brassicaceae	OBL
Rorippa palustris (L.) Bess.	Ropa	marsh yellow-cress	No	herb	Brassicaceae	OBL
Rosa californica	Roca	California rose	No	shrub	Rosaceae	FAC
Rosa gymnocarpa	Rogy	wood rose	No	shrub	Rosaceae	NI
Rosa woodsii	Rowo	Wood's rose	No	shrub	Rosaceae	FAC-
Rubus discolor	Rudi	Himalaya blackberry	Yes	shrub	Rosaceae	FACW
Rubus parviflorus	Rupa	thimbleberry	No	shrub	Rosaceae	FAC+
Rubus rosaefolius	Ruro	Mauritius raspberry	No	shrub	Rosaceae	NI
Rubus ursinus	Ruur	California blackberry	No	herb	Rosaceae	FAC+
Rubus villosus	Ruvi	low-running blackberry	No	shrub	Rosaceae	NI
Rumex conglomeratus Murr.	Ruco	clustered dock	No	herb	Polygonaceae	FACW
Rumex crispus L.	Rucr	curly dock	Yes	herb	Polygonaceae	FACW-
Rumex maritimus L.	Rumr	golden dock	No	herb	Polygonaceae	FACW+
Ruppia maritima L.	Ruma	ditch-grass	No	herb	Potamogetonacea e	OBL
Salicornia bigelovii Torr.	Sabi	pickleweed	No	herb	Chenopodiaceae	OBL
Salicornia europea (S. rubra)	Saeu	slender glasswort	No	herb	Chenopodiaceae	OBL
Salicornia subterminalis	Sasu	Parish's glasswort	No	herb	Chenopodiaceae	OBL
Salicornia utahensis	Saut	Utah pickleweed	No	herb	Chenopodiaceae	NI
Salicornia virginica L.	Savi	common pickleweed	No	herb	Chenopodiaceae	OBL
Salix babylonica	Saba	weeping willow	No	tree	Chenopodiaceae	FACW-

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Salix exigua Nutt.	Saex	sandbar willow/narrow-leaved willow	No	shrub	Salicaceae	FACW
Salix gooddingii Ball	Sago	Goodding's black willow	No	tree	Salicaceae	FACW
Salix laevigata Bebb	Sala	red willow	No	tree	Salicaceae	FACW+
Salix lasiolepis Benth.	Sals	arroyo willow	No	shrub/tree	Salicaceae	FACW
Salix lemmonii	Sale	Lemmon's willow	No	shrub	Salicaceae	OBL
Salix lucida Muhl.	Salu	shining willow	No	shrub/tree	Salicaceae	FACW
Salix lutea Nutt.	Salt	yellow willow	No	shrub/tree	Salicaceae	OBL
Salix melanopsis	Samp	dusky willow	No	shrub	Salicaceae	FACW
Salix scouleriana	Sasc	Scouler willow	No	shrub	Salicaceae	FAC
Salix sitchensis	Sasi	Sitka willow	No	shrub/tree	Salicaceae	FACW+
Salsola soda L.	Saso	oppositeleaf Russian thistle	Yes	herb	Chenopodiaceae	FACW+
Salsola tragus	Satr	Russian thistle/tumbleweed	Yes	herb	Chenopodiaceae	NI
Salvia apiana	Saap	white sage	No	shrub	Lamiaceae	NI
Sambucus melanocarpa	Saml	black elderberry	No	shrub	Caprifoliaceae	FACU
Sambucus mexicana K. Presl ex DC.	Same	Mexican elderberry/blue elderberry	No	shrub	Caprifoliaceae	FACU
Saponaria officinalis	Saof	bouncing bet	Yes	herb	Caryophyllaceae	FACU
Schinus molle	Scmo	Peruvian pepper tree	Yes	tree	Anacardiaceae	NI
Schinus terebinthifolius Raddi	Scte	Brazilian pepper tree	Yes	tree	Anacardiaceae	NI
Scirpus acutus Muhl. ex Bigelow	Scac	common tule	No	herb	Cyperaceace	OBL
Scirpus americanus Pers.	Scam	three-square bulrush	No	herb	Cyperaceace	OBL
Scirpus californicus (C.A. Mey.) Steud.	Scca	California bulrush	No	herb	Cyperaceace	OBL
Scirpus cernuus Vahl	Scce	bulrush	No	herb	Cyperaceace	OBL
Scirpus maritimus L.	Scma	alkali bulrush	No	herb	Cyperaceace	OBL
Scirpus microcarpus	Scmi	bulrush	No	herb	Cyperaceace	OBL
Scirpus robustus Pursh	Scro	bulrush	No	herb	Cyperaceace	OBL
Senecio mikanoides/Delairea odorata	Semi	Cape (German) ivy	Yes	herb	Asteraceae	NI
Senecio triangularis	Setr	arrowleaf ragwort	No	herb	Asteraceae	OBL

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Senecio vulgaris	Sevu	common groundsel	No	herb	Asteraceae	NI*
Sequoia sempervirens	Sese	redwood	No	tree	Taxodiaceae	NI
Silybum marianum	Sima	milk thistle	Yes	herb	Asteraceae	NI
Sisymbrium irio	Siir	London rocket	Yes	herb	Brassicaceae	NI
Sisyrinchium bellum S. Wats.	Sibe	blue-eyed grass	No	herb	Iridaceae	FAC+
Solanum douglasii	Sodo	white-flowered nightshade	No	herb	Solanaceae	FAC
Solanum xantii	Soxa	nightshade	No	herb	Solanaceae	NI
Sonchus asper (L.) Hill	Soas	prickly sow-thistle	Yes	herb	Asteraceae	FAC
Sonchus oleraceous	Sool	common sow-thistle	No	herb	Asteraceae	NI*
Spartina alterniflora Loisel.	Spal	salt-water cordgrass	Yes	herb	Poaceae	OBL
Spartina densiflora Brongn.	Spde	dense-flowered cordgrass	Yes	herb	Poaceae	OBL
Spartina foliosa Trin.	Spfo	California cordgrass	No	herb	Poaceae	OBL
Spartina HYBRID	Sphy	cordgrass	No	herb	Poaceae	OBL
Spartina patens (Ait.) Muhl.	Sppa	salt-meadow cordgrass	Yes	herb	Poaceae	OBL
Spergularia bocconii	Spbo	Boccone's sandspurrey	No	herb	Carophyllaceae	FAC*
Spergularia macrotheca	Spmc	sand-spurrey	No	herb	Carophyllaceae	FAC+
Spergularia marina	Spma	saltmarsh sand-spurrey	No	herb	Carophyllaceae	OBL
Spergularia rubra	Spru	red sand-spurrey	No	herb	Carophyllaceae	FAC-
Spirodela punctata (G.F.W. Mey.)	Sppu	dotted duckmeat	No	herb	Lemnaceae	OBL
Sporobolus airoides	Spai	alkali sacaton	No	herb	Poaceae	FAC+
Stachys ajugoides Benth.	Staj	Ajuga hedgenettle	No	herb	Lamiaceae	OBL
Stachys albens Gray	Stal	rigid hedgenettle/marsh hedgenettle	No	herb	Lamiaceae	OBL
Stellaria media	Stme	common chickweed	No	herb	Caryophyllaceae	FACU
Suaeda calceoliformis	Sucl	horned sea-blite	No	herb	Chenopodiaceae	NI
Suaeda californica	Suca	sea-blite	No	shrub	Chenopodiaceae	FACW
Suaeda esteroa	Sues	estuary sea-blite	No	herb	Chenopodiaceae	FACW
Suaeda moquinii	Sumo	bush seepweed	No	shrub	Chenopodiaceae	na

Appendix V-A: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Suaeda taxifolia	Suta	woolly sea-blite	No	shrub	Chenopodiaceae	NI
Taeniatherum caput-medusae	Taca	medusa-head	Yes	herb	Poaceae	NI
Tamarix parviflora	Tapa	tamarisk	Yes	shrub/tree	Tamaricaceae	FAC
Tamarix ramosissima Ledeb.	Tara	saltceder	Yes	shrub/tree	Tamaricaceae	FAC
Taraxacum officinale	Taof	dandelion	No	herb	Asteraceae	FACU
Tetragonia tetragonioides	Tete	New Zealand spinach	No	herb	Aizoaceae	FACU*
Tolmiea menziesii	Tome	pig-a-back plant	No	herb	Saxifragaceae	OBL
Toxicodendron diversilobum	Todi	poison oak	No	shrub	Anacardiaceae	NI
Tribulus terrestris	Trte	puncturevine	No	herb	Zygophyllaceae	na
Trifolium repens L.	Trre	white clover	No	herb	Fabaceae	FAC
Triglochin concinna	Trco	arrow-grass	No	herb	Juncaginaceae	OBL
Triglochin maritima	Trma	seaside arrow-grass	No	herb	Juncaginaceae	OBL
Tropaeolum majus	Trmj	garden nasturtium	Yes	herb	Tropaeolaceae	na
Tsuga heterophylla	Tshe	hemlock	No	tree	Pinaceae	FACU
Typha angustifolia	Tyan	narrow-leaved cattail	No	herb	Typhaceae	OBL
Typha domingensis	Tydo	southern cattail	No	herb	Typhaceae	OBL
Typha latifolia	Tyla	common cattail/broad-leaved cattail	No	herb	Typhaceae	OBL
Umbellularia californica	Umca	California bay/California laurel	No	tree	Lauraceae	FAC
Urtica dioica L.	Urdi	stinging nettle	No	herb	Urticaceae	FACW
Veratrum californicum Dur.	Vecl	California corn lily	No	herb	Liliaceae	OBL
Verbascum thapsus	Veth	woolly mullein	Yes	herb	Scrophulariaceae	na
Verbena scabra Vahl	Vesc	sandpaper vervain	No	herb	Verbenaceae	OBL
Veronica americana Schwein	Veam	American speedwell/ brooklime	No	herb	Scrophulariaceae	OBL
Veronica anagallis-aquatica L.	Vean	water speedwell	No	herb	Scrophulariaceae	OBL
Veronica catenata.	Veca	chain speedwell	No	herb	Scrophulariaceae	OBL
Veronica peregrina L.	Vepe	hairy purslane/speedwell	No	herb	Scrophulariaceae	OBL
Vinca major	Vima	greater periwinkle	Yes	herb	Apocynaceae	NI

Appendix V-A: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Viola adunca	Viad	hookedspur violet	No	herb	Violaceae	FAC
Vitis californica	Vica	California wild grape	No	vine ("shrub")	Vitaceae	FACW
Vulpia myuros (L.) K.C. Gmel.	Vumy	foxtail fescue	Yes	herb	Poaceae	FACU*
Washingtonia filifera	Wafi	California fan palm	No	tree	Arecaceae	FACW
Wolffia columbiana Karst.	Woco	watermeal	No	herb	Lemnaceae	OBL
Woodwardia fimbriata	Wofi	giant chain fern	No	herb	Blechnaceae	FACW
Xanthium spinosum L.	Xasp	spiny cocklebur	No	herb	Asteraceae	FAC+
Xanthium strumarium L.	Xast	cocklebur	No	herb	Asteraceae	FAC+
Yucca whipplei	Yuwh	chaparral yucca	No	shrub	Liliaceae	na
Zannichellia palustris L.	Zapa	horned-pondweed	No	herb	Zannichelliaceae	OBL
Zostera marina L.	Zoma	common eelgrass	No	herb	Zosteraceae	OBL
Zostera pacifica L.	Zopa	seawrack/eelgrass	No	herb	Zosteraceae	OBL

Appendix V-B: List of California Plant Species (alphabetized by common name)

Appendix V-B: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Stachys ajugoides Benth.	Staj	Ajuga hedgenettle	No	herb	Lamiaceae	OBL
Scirpus maritimus L.	Scma	alkali bulrush	No	herb	Cyperaceace	OBL
Frankenia salina (Molina)	Frsa	alkali heath	No	herb	Frankeniaceae	FACW+
Heliotropium curassavicum L.	Hecu	alkali heliotrope	No	herb	Boraginaceae	OBL
Malvella leprosa (Ortega) Krapov.	Male	alkali mallow/whiteweed	No	herb	Malvaceae	FAC*
Plagiobothrys leptocladus	Plle	alkali plagiobothrys	No	herb	Boraginaceae	OBL
Sporobolus airoides	Spai	alkali sacaton	No	herb	Poaceae	FAC+
Cressa truxillensis Kunth	Crtr	alkali weed	No	shrub	Convovulaceae	FACW
Pilularia americana	Piam	American pillwort	No	herb	Marsileaceae	OBL
Veronica americana Schwein	Veam	American speedwell/ brooklime	No	herb	Scrophulariaceae	OBL
Cortaderia jubata	Coju	Andean pampas grass	Yes	herb	Poaceae	NI
Pimpinella anisum	Pian	anise	No	herb	Umbelliferae	NI
Polypogon monspeliensis (L.) Desf.	Pomo	annual beard grass/rabbitfoot grass	Yes	herb	Poaceae	FACW+
Eleocharis geniculata	Elge	annual spikerush	No	herb	Cyperaceae	OBL
Purshia tridentata	Putr	antelope bush	No	shrub	Rosaceae	na
Pluchea sericea (Nutt.) Cav.	Plse	arrow weed	No	shrub	Asteraceae	FACW
Triglochin concinna	Trco	arrow-grass	No	herb	Juncaginaceae	OBL
Senecio triangularis	Setr	arrowleaf ragwort	No	herb	Asteraceae	OBL
Salix lasiolepis Benth.	Sals	arroyo willow	No	shrub/tree	Salicaceae	FACW
Cynara cardunculus	Cyca	artichocke thistle	Yes	herb	Asteraceae	NI
Centella asiatica	Ceas	Asiatic pennywort	No	herb	Apiaceae	NI
Atriplex semibaccata	Atse	Australian saltbush	Yes	shrub	Chenopodiaceae	FAC
Cyperus squarrosus L.	Cysq	awned flatsedge/bearded flatsedge	No	herb	Cyperaceae	OBL
Juncus balticus	Juba	Baltic rush	No	herb	Juncaceae	FACW+

Appendix V-B: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Echinochloa crus-galli (L.) Beauv.	Eccr	banyard grass	No	herb	Poaceae	FACW
Hordeum brachyantherum	Hobr	barley	No	herb	Poaceae	FACW
Juncus textilis	Jute	basket rush	No	herb	Juncaceae	OBL
Bassia hyssopifolia	Bahy	bassia	Yes	herb	Chenopodiaceae	FAC
Camissonia chieranthifolia var. suffruticosa	Cach	beach evening primrose	No	shrub	Onagraceae	NI
Ambrosia chamissonis	Amch	beach-bur	No	shrub	Asteraceae	NI
Eleocharis rostellata	Elro	beaked spikerush	No	herb	Cyperaceae	OBL
Leymus triticoides	Letr	beardless wild-rye	No	herb	Poaceae	FAC+
Oxalis pes-caprae	Oxpe	Bermuda buttercup	Yes	herb	Oxalidaceae	NI
Cynodon dactylon	Cyda	Bermuda grass	Yes	herb	Poaceae	FACU
Lupinus polyphyllus	Lupo	bigleaf lupine	No	herb	Fabaceae	FACW
Acer macrophyllum	Acma	big-leaf maple	No	tree	Aceraceae	FAC
Lotus corniculatus	Loco	birdfoot trefoil	No	herb	Fabaceae	FAC
Populus balsamifera	Poba	black cottonwood	No	tree	Salicaceae	FACW
Sambucus melanocarpa	Saml	black elderberry	No	shrub	Caprifoliaceae	FACU
Robinia pseudoacacia	Rops	black locust	Yes	tree	Fabaceae	FACU-
Brassica nigra	Brni	black mustard	Yes	herb	Brassicaceae	NI
Isomeris arborea	Isar	bladderpod	No	shrub	Capparaceae	NI
Dichelostemma capitatum ssp. capitatum	Dica	blue dicks	No	herb	Liliaceae	FAC*
Sisyrinchium bellum S. Wats.	Sibe	blue-eyed grass	No	herb	Iridaceae	FAC+
Rorippa curvipes Greene	Rocu	bluntleaf yellow-cress	No	herb	Brassicaceae	OBL
Spergularia bocconii	Spbo	Boccone's sandspurrey	No	herb	Carophyllaceae	FAC*
Saponaria officinalis	Saof	bouncing bet	Yes	herb	Caryophyllaceae	FACU
Acer negundo L.	Acne	box elder	No	tree	Aceraceae	FACW
Pteridium aquilinum	Ptaq	bracken fern	No	herb	Polypodiaceae	FACU
Cotula coronopifolia L.	Coco	brass buttons	Yes	herb	Asteraceae	FACW+
Schinus terebinthifolius Raddi	Scte	Brazilian pepper tree	Yes	tree	Anacardiaceae	NI

Appendix V-B: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Atriplex lentiformis ssp. lentiformis	Atle	Brewer's saltbush	No	shrub	Chenopodiaceae	FAC
Retama monosperma	Remo	bridal broom	Yes	shrub	Fabaceae	NI
Cynosurus echinatus	Cyec	bristly dogstail grass	Yes	herb	Poaceae	na
Picris echioides L.	Piec	bristly ox-tongue	Yes	herb	Asteraceae	FAC
Baccharis sarothroides Gray	Basr	broom baccharis	No	shrub	Asteraceae	FAC
Juncus phaeocephalus	Juph	brown-headed creeping rush	No	herb	Juncaceae	FACW
Cirsium vulgare (Savi) Ten.	Civu	bull thistle	Yes	herb	Asteraceae	FAC
Scirpus cernuus Vahl	Scce	bulrush	No	herb	Cyperaceace	OBL
Scirpus microcarpus	Scmi	bulrush	No	herb	Cyperaceace	OBL
Scirpus robustus Pursh	Scro	bulrush	No	herb	Cyperaceace	OBL
Anthriscus caucalis	Ancc	bur chervil	No	herb	Apiaceae	na
Bidens laevis (L.) B.S.P.	Bila	bur-marigold	No	herb	Asteraceae	OBL
Mimulus aurantiacus	Miau	bush monkeyflower	No	shrub	Scrophulariaceae	NI
Suaeda moquinii	Sumo	bush seepweed	No	shrub	Chenopodiaceae	na
Encelia californica	Enca	bush sunflower	No	shrub	Asteraceae	NI
Fraxinus dipetala	Frdi	California ash	No	tree	Oleaceae	NI
Umbellularia californica	Umca	California bay/California laurel	No	tree	Lauraceae	FAC
Quercus kelloggii	Quke	California black oak	No	tree	Fagaceae	na
Juglans californica	Juca	California black walnut	No	tree	Juglandaceae	FAC
Rubus ursinus	Ruur	California blackberry	No	herb	Rosaceae	FAC+
Brickellia californica	Brca	California brickellbush	No	shrub	Scrophulariaceae	FACU
Aesculus californica	Aeca	California buckeye	No	tree	Hippocastanaceae	na
Eriogonum fasciculatum	Erfa	California buckwheat	No	shrub	Polygonaceae	na
Scirpus californicus (C.A. Mey.) Steud.	Scca	California bulrush	No	herb	Cyperaceace	OBL
Medicago polymorpha L.	Mepo	California burclover	Yes	herb	Fabaceae	FACU-
Rhamnus californica	Rhca	California coffeeberry	No	shrub	Rhamnaceae	NI
Spartina foliosa Trin.	Spfo	California cordgrass	No	herb	Poaceae	OBL

Appendix V-B: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Veratrum californicum Dur.	Vecl	California corn lily	No	herb	Liliaceae	OBL
Gnaphalium californicum	Gncl	California everlasting	No	herb	Asteraceae	NI
Washingtonia filifera	Wafi	California fan palm	No	tree	Arecaceae	FACW
Epilobium (Zauschneria) canum	Epca	california fuchsia	No	herb	Onagraceae	na
Lonicera hispidula	Lohi	California honeysuckle	No	shrub	Caprifoliaceae	NI
Lythrum californicum Torr. & Gray	Lyca	California loosestrife	No	herb	Lythraceae	OBL
Adiantum jordanii	Adjo	California maidenhair	No	herb	Pteridaceae	NI
Amaranthus californicus	Amca	California pigweed	No	herb	Amaranthaceae	FACW
Rosa californica	Roca	California rose	No	shrub	Rosaceae	FAC
Artemisia californica	Arca	California sagebrush	No	shrub	Asteraceae	NI
Atriplex californica Moq.	Atca	California saltbush	No	shrub	Chenopodiaceae	FAC
Aralia californica A. Wats.	Arcl	California spikenard	No	herb	Araliaceae	FACW
Helianthus californicus DC.	Hecl	California sunflower	No	herb	Asteraceae	OBL
Osmorhiza brachypoda	Osbr	California sweetcicely	No	herb	Apiaceae	NI
Vitis californica	Vica	California wild grape	No	vine ("shrub")	Vitaceae	FACW
Cirsium arvense	Ciar	Canada thistle	Yes	herb	Asteraceae	FAC-
Delairea odorata/Senecio mikanoides	Deod	Cape (German) ivy	Yes	herb	Asteraceae	na
Senecio mikanoides/Delairea odorata	Semi	Cape (German) ivy	Yes	herb	Asteraceae	NI
Ricinus communis L.	Rico	castor bean	Yes	herb	Euphorbiaceae	FACU
Apium graveolens L.	Apgr	celery	No	herb	Apiaceae	FACW*
Veronica catenata.	Veca	chain speedwell	No	herb	Scrophulariaceae	OBL
Yucca whipplei	Yuwh	chaparral yucca	No	shrub	Liliaceae	na
Bromus tectorum	Brte	cheat grass	Yes	herb	Poaceae	NI
Potentilla anserina	Poan	cinquefoil	No	herb	Rosaceae	NI
Rumex conglomeratus Murr.	Ruco	clustered dock	No	herb	Polygonaceae	FACW
Carex praegracilis W. Boott	Capr	clustered field sedge	No	herb	Cyperaceae	FACW-
Boykinia occidentalis	Booc	coast boykinia	No	herb	Saxifragaceae	FACW

Appendix V-B: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Isocoma menziesii	Isme	coast goldenbush	No	shrub	Asteraceae	FAC+
Quercus agrifolia	Quag	coast live oak	No	tree	Fagaceae	NI
Plagiobothrys undulatus	Plun	coast popcorn-flower	No	herb	Boraginaceae	FACW
Xanthium strumarium L.	Xast	cocklebur	No	herb	Asteraceae	FAC+
Petasites frigidus (L.) Fries	Pefr	coltsfoot	No	herb	Asteraceae	NI
Aquilegia formosa	Aqfo	columbine	No	herb	Ranunculaceae	OBL
Blennosperma nanum	Blna	common blennosperma	No	herb	Asteraceae	FACW
Typha latifolia	Tyla	common cattail/broad-leaved cattail	No	herb	Typhaceae	OBL
Stellaria media	Stme	common chickweed	No	herb	Caryophyllaceae	FACU
Zostera marina L.	Zoma	common eelgrass	No	herb	Zosteraceae	OBL
Senecio vulgaris	Sevu	common groundsel	No	herb	Asteraceae	NI*
Equisetum arvense	Eqar	common horsetail	No	herb	Equisetaceae	FAC
Polygonum arenastrum Jord. ex Boreau	Poar	common knotweed	No	herb	Polygonaceae	FAC
Athyrium filix-femina	Atfi	common ladyfern	No	herb	Dryopteridaceae	FAC
Mimulus guttatus DC.	Migu	common monkeyflower	No	herb	Scrophulariaceae	FACW+
Salicornia virginica L.	Savi	common pickleweed	No	herb	Chenopodiaceae	OBL
Plantago major	Plma	common plantain	No	herb	Plantaginaceae	FAC
Portulaca oleracea	Pool	common purslane	No	herb	Portulacaceae	FAC
Ambrosia artemisiifolia	Amat	common ragweed	No	herb	Asteraceae	FACU
Phragmites australis (Cav.) Trin. ex Steud.	Phau	common reed	No	herb	Poaceae	FACW
Juncus effusus	Juef	common rush	No	herb	Juncaceae	FACW+
Sonchus oleraceous	Sool	common sow-thistle	No	herb	Asteraceae	NI*
Eleocharis macrostachya	Elma	common spikerush	No	herb	Cyperaceae	NI
Helianthus annuus L.	Hean	common sunflower	No	herb	Asteraceae	FAC-
Scirpus acutus Muhl. ex Bigelow	Scac	common tule	No	herb	Cyperaceace	OBL
Spartina HYBRID	Sphy	cordgrass	No	herb	Poaceae	OBL
Heracleum lanatum	Hela	cow parsnip	No	herb	Apiaceae	FACU

Appendix V-B: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Baccharis pilularis	Bapi	coyote brush	No	shrub	Asteraceae	NI
Cornus sericea	Cosr	creek dogwood	No	shrub	Cornaceae	FACW
Agrostis stolonifera L.	Agst	creeping bentgrass	Yes	herb	Poaceae	FACW
Larrea tridentata	Latr	creosote bush	No	shrub	Zygophyllaceae	na
Mesembryanthemum crystallinum L.	Mecr	crystalline iceplant	Yes	herb	Aizoaceae	FAC
Rumex crispus L.	Rucr	curly dock	Yes	herb	Polygonaceae	FACW-
Berula erecta (Huds.) Coville	Beer	cutleaf water-parsnip	No	herb	Apiaceae	OBL
Taraxacum officinale	Taof	dandelion	No	herb	Asteraceae	FACU
Muhlenbergia rigens (Benth.) A.S. Hitchc.	Muri	deergrass	No	herb	Poaceae	FACW
Lotus scoparius	Losc	deerweed	No	shrub	Fabaceae	NI
Spartina densiflora Brongn.	Spde	dense-flowered cordgrass	Yes	herb	Poaceae	OBL
Ruppia maritima L.	Ruma	ditch-grass	No	herb	Potamogetonaceae	OBL
Spirodela punctata (G.F.W. Mey.)	Sppu	dotted duckmeat	No	herb	Lemnaceae	OBL
Pseudotsuga menziesii	Psme	douglas fir	No	tree	Pinaceae	NI
Datisca glomerata (K. Presl) Baill.	Dagl	Durango root	No	herb	Datiscaceae	FACW
Salix melanopsis	Samp	dusky willow	No	shrub	Salicaceae	FACW
Lupinus lepidus	Lule	dwarf lupine	No	herb	Fabaceae	na
Lepidium latipes Hook.	Lela	dwarf pepper grass	No	herb	Brassicaceae	OBL
Plantago erecta	Pler	dwarf plantain	No	herb	Plantaginaceae	na
Eclipta prostrata	Ecpr	eclipta	No	herb	Asteraceae	FAC+
Baccharis emoryi Gray	Baem	Emory baccharis	No	shrub	Asteraceae	FACW
Hedera helix	Hehe	English ivy	Yes	vine ("shrub")	Araliaceae	NI
Plantago lanceolata L.	Plla	English plantain	Yes	herb	Plantaginaceae	FAC-
Suaeda esteroa	Sues	estuary sea-blite	No	herb	Chenopodiaceae	FACW
Puccinellia distans (Jacq.) Parl.	Pudi	European alkali grass	No	herb	Poaceae	OBL
Ammophila arenaria	Amar	European beach grass	Yes	herb	Poaceae	FACU
Hemizonia paniculata Gray	Hepa	fascicled tarweed	No	herb	Asteraceae	FACU*

Appendix V-B: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Potamogeton pectinatus	Pope	fennel-leaf pondweed	No	herb	Potamogetonaceae	OBL
Adiantum aleuticum	Adal	Five fingered fern	No	herb	Pteridaceae	na
Hydrocotyle ranunculoides L. f.	Hyra	floating marsh pennywort	No	herb	Apiaceae	OBL
Ludwigia peploides (Kunth) Raven	Lupe	floating water primrose, false loosestrife	No	herb	Onagraceae	OBL
Myosotis symphytifolia	Mysy	forget-me-not	No	herb	Boraginaceae	NI
Bromus madritensis	Brma	foxtail chess	Yes	herb	Poaceae	UPL
Vulpia myuros (L.) K.C. Gmel.	Vumy	foxtail fescue	Yes	herb	Poaceae	FACU*
Gnaphalium canescens ssp. beneolens	Gnca	fragrant everlasting	No	herb	Asteraceae	NI
Populus fremontii S. Wats.	Pofr	Fremont cottonwood	No	tree	Salicaceae	FAC+*
Genista monspessulana	Gemo	French broom	Yes	shrub	Fabaceae	na
Ribes speciosum	Risp	fucshia-flowered gooseberry	No	shrub	Grossulariaceae	NI
Tropaeolum majus	Trmj	garden nasturtium	Yes	herb	Tropaeolaceae	na
Chrysanthemum coronarium	Chco	garland chrysanthemum	Yes	herb	Asteraceae	na
Euphorbia terracina	Eute	Geraldton carnation weed	Yes	herb	Euphorbiaceae	na
Woodwardia fimbriata	Wofi	giant chain fern	No	herb	Blechnaceae	FACW
Equisetum telmateia Ehrh.	Eqte	giant horsetail	No	herb	Equisetaceae	OBL
Arundo donax L.	Ardo	giant reed	Yes	shrub	Poaceae	FAC+
Leymus condensatus	Leco	giant wild-rye	No	herb	Poaceae	FACU
Rumex maritimus L.	Rumr	golden dock	No	herb	Polygonaceae	FACW+
Eriophyllym confertifolium	Erco	golden yarrow	No	shrub	Asteraceae	NI
Lasthenia glabrata Lindl.	Lagl	goldfields	No	herb	Asteraceae	FACW
Salix gooddingii Ball	Sago	Goodding's black willow	No	tree	Salicaceae	FACW
Galium aparine	Gaap	goose grass	No	herb	Rubiaceae	FACU
Artemisia tridentata	Artr	Great Basin sage	No	shrub	Asteraceae	na
Vinca major	Vima	greater periwinkle	Yes	herb	Apocynaceae	NI
Eleocharis acicularis	Elac	hairgrass	No	herb	Cyperaceae	OBL

Appendix V-B: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Grindelia hirsutula var. hirsutula	Grhi	hairy gumweed	No	herb	Asteraceae	FACW
Marsilea vestita	Mave	hairy pepperwort	No	herb	Marsileaceae	OBL
Veronica peregrina L.	Vepe	hairy purslane/speedwell	No	herb	Scrophulariaceae	OBL
Epilobium ciliatum Raf.	Epci	hairy willow-herb	No	herb	Onagraceae	FACW
Phalaris aquatica	Phaq	Harding grass	Yes	herb	Poaceae	FAC
Avena sativa	Avsa	hay	No	herb	Poaceae	NI
Calystegia sepium (L.) R. Br.	Case	hedge bindweed	No	herb	Convovulaceae	OBL
Tsuga heterophylla	Tshe	hemlock	No	tree	Pinaceae	FACU
Rubus discolor	Rudi	Himalaya blackberry	Yes	shrub	Rosaceae	FACW
Hesperevax caulescens	Heca	hogwallow starfish	No	herb	Asteraceae	OBL
Prunus ilicifolia	Pril	holly-leaved cherry	No	tree	Rosaceae	na
Najas marina	Nama	holly-leaved water-nymph	No	herb	Hydrocharitaceae	OBL
Viola adunca	Viad	hookedspur violet	No	herb	Violaceae	FAC
Marrubium vulgare L.	Mavu	horehound	Yes	herb	Lamiaceae	FACU
Suaeda calceoliformis	Sucl	horned sea-blite	No	herb	Chenopodiaceae	NI
Zannichellia palustris L.	Zapa	horned-pondweed	No	herb	Zannichelliaceae	OBL
Conyza bonariensis	Cobo	horseweed	No	herb	Asteraceae	na
Conyza canadensis (L.) Cronq.	Coca	horseweed	No	herb	Asteraceae	FAC
Isoetes howellii Engelm.	Isho	Howell's quillwort	No	herb	Isoetaceae	OBL
Carpobrotus edulis	Caed	iceplant	Yes	herb	Aizoaceae	NI
Calocedrus decurrens	Cade	incense cedar	No	tree	Cupressaceae	na
Apocynum cannabinum	Apca	indian hemp	No	shrub	Apocynaceae	FAC
Allenrolfea occidentalis	Aloc	iodine bush	No	shrub	Chenopodiaceae	FACW+
Lolium multiflorum	Lomu	Italian ryegrass	Yes	herb	Poaceae	NI
Carduus pycnocephalus	Capy	Italian thistle	Yes	herb	Asteraceae	NI
Pinus jeffryi	Pije	Jeffrey pine	No	tree	Pinaceae	na
Poa pratensis	Popr	Kentucky bluegrass	Yes	herb	Poaceae	FACU

Appendix V-B: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Pennisetum clandestinum	Pecl	kikuyu grass	Yes	herb	Poaceae	FACU
Paspalum distichum	Padi	knot grass	No	herb	Poaceae	OBL
Kyllinga brevifolia	Kybr	kyllinga	No	herb	Cyperaceae	FACW
Carex lenticularis	Cale	lakeshore sedge	No	herb	Cyperaceae	na
Chenopodium album	Chal	lamb's quarters	No	herb	Chenopodiaceae	FAC
Malosma laurina	Mala	laurel sumac	No	shrub	Anacardiaceae	NI
Potamogeton foliosus Raf.	Pofo	leafy pondweed	No	herb	Potamogetonaceae	OBL
Lemna minuta	Lemu	least duckweed	No	herb	Lemnaceae	OBL
Quercus durata	Qudu	leather oak	No	tree	Fagaceae	NI
Phalaris lemmonii	Phle	Lemmon's canary grass	No	herb	Poaceae	FACW
Salix lemmonii	Sale	Lemmon's willow	No	shrub	Salicaceae	OBL
Rhus intergrifolia	Rhin	lemonadeberry	No	shrub	Anacardiaceae	na
Lemna minor L.	Lemi	lesser duckweed	No	herb	Lemnaceae	OBL
Sisymbrium irio	Siir	London rocket	Yes	herb	Brassicaceae	NI
Erodium botrys	Erbo	long-beaked filaree	No	herb	Geraniaceae	NI
Juncus longistylus	Julo	long-beaked rush	No	herb	Juncaceae	na
Potamogeton nodosus Poir.	Pono	long-leaved pondweed	No	herb	Potamogetonaceae	OBL
Lythrum hyssopifolium	Lyhy	loosestrife	Yes	herb	Lythraceae	FACW
Gnaphalium palustre Nutt.	Gnpa	lowland cudweed	No	herb	Asteraceae	FACW
Rubus villosus	Ruvi	low-running blackberry	No	shrub	Rosaceae	NI
Carex lyngbyei	Caly	Lyngbyei's sedge	No	herb	Cyperaceae	OBL
Malacothrix californica	Maca	malacothrix	No	herb	Asteraceae	na
Baccharis douglasii	Bado	marsh baccharis/Douglas' false-willow	No	shrub	Asteraceae	OBL
Grindelia stricta	Grst	marsh gum-plant	No	shrub	Asteraceae	OBL
Jaumea carnosa (Less.) Gray	Jaca	marsh jaumea/salty Susan	No	herb	Asteraceae	OBL
Caltha palustris	Capa	marsh marigold	No	herb	Ranunculaceae	NI

Appendix V-B: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Rorippa palustris (L.) Bess.	Ropa	marsh yellow-cress	No	herb	Brassicaceae	OBL
Lilaeopsis masonii	Lima	Mason's lilaeopsis	No	herb	Apiaceae	OBL
Rubus rosaefolius	Ruro	Mauritius raspberry	No	shrub	Rosaceae	NI
Hordeum secalinum	Hose	meadow barley	No	herb	Poaceae	NI
Hordeum geniculatum/H. marinum gussonianum	Hoge	Mediterrenean barley	Yes	herb	Poaceae	NI
Taeniatherum caput-medusae	Taca	medusa-head	Yes	herb	Poaceae	NI
Sambucus mexicana K. Presl ex DC.	Same	Mexican elderberry/blue elderberry	No	shrub	Caprifoliaceae	FACU
Juncus mexicanus	Jume	Mexican rush	No	herb	Juncaceae	FACW
Leptochloa uninervia (J. Presl)	Leun	Mexican sprangletop	No	herb	Poaceae	FACW
Chenopodium ambrosioides	Cham	Mexican tea	No	herb	Chenopodiaceae	FAC
Cardamine californica	Caca	milk maids, tooth wort	No	herb	Brassicaceae	UPL
Silybum marianum	Sima	milk thistle	Yes	herb	Asteraceae	NI
Calystegia macrostegia	Cama	morning-glory	No	herb	Convovulaceae	NI
Alnus incana	Alin	mountain alder	No	shrub	Betulaceae	NI
Cercocarpus betuloides	Cebe	mountain mahogany	No	shrub	Rosaceae	na
Myosurus minimus L.	Mymi	mouse tail	No	herb	Ranunculaceae	OBL
Myoporum laetum	Myla	mousehole tree	Yes	tree	Myoporaceae	NI
Artemisia douglasiana Bess.	Ardg	mugwort	No	shrub	Asteraceae	FACW
Baccharis salicifolia	Basa	mule fat	No	shrub	Asteraceae	FACW
Mimulus moschatus	Mimo	musk monkeyflower	No	herb	Scrophulariaceae	OBL
Plantago subnuda	Plsu	naked plantain	No	herb	Plantaginaceae	FACW
Typha angustifolia	Tyan	narrow-leaved cattail	No	herb	Typhaceae	OBL
Tetragonia tetragonioides	Tete	New Zealand spinach	No	herb	Aizoaceae	FACU*
Solanum xantii	Soxa	nightshade	No	herb	Solanaceae	NI
Cyperus esculentus	Cyes	nutsedge	No	herb	Cyperaceae	FACW
Cyperus involucratus	Cyin	nutsedge	No	herb	Cyperaceae	FACW+
Isoetes nuttallii A. Braun ex Engelm.	Isnu	Nuttall's quillwort	No	herb	Isoetaceae	OBL

Appendix V-B: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Holodiscus discolor	Hodi	oceanspray	No	shrub	Rosaceae	na
Olea europaea	Oleu	olive	Yes	tree	Oleaceae	NI
Salsola soda L.	Saso	oppositeleaf Russian thistle	Yes	herb	Chenopodiaceae	FACW+
Fraxinus latifolia	Frla	Oregon ash	No	tree	Oleaceae	FACW
Quercus garryana	Quga	Oregon oak	No	tree	Fagaceae	na
Cortaderia selloana	Cose	pampas grass	Yes	herb	Poaceae	NI
Salicornia subterminalis	Sasu	Parish's glasswort	No	herb	Chenopodiaceae	OBL
Eleocharis parishii	Elpa	Parish's spikerush	No	herb	Cyperaceae	FACW
Myriophyllum aquaticum	Myaq	parrot's feather	Yes	herb	Haloragaceae	OBL
Mentha pulegium	Mepu	pennyroyal	Yes	herb	Lamiaceae	OBL
Lepidium nitidum	Leni	peppergrass	No	herb	Brassicaceae	FAC
Mentha piperita	Mepi	peppermint	No	herb	Lamiaceae	NI
Lepidium latifolium L.	Lelf	perennial pepperweed	Yes	herb	Brassicaceae	FACW
Lolium perenne L.	Lope	perennial ryegrass	No	herb	Poaceae	FAC*
Schinus molle	Scmo	Peruvian pepper tree	Yes	tree	Anacardiaceae	NI
Euphorbia peplus	Eupe	petty spurge	No	herb	Euphorbiaceae	NI
Phacelia distans	Phdi	phacelia	No	herb	Hydrophyllaceae	NI
Phoenix canariensis	Phca	Phoenix date palm	Yes	tree	Arecaceae	NI
Salicornia bigelovii Torr.	Sabi	pickleweed	No	herb	Chenopodiaceae	OBL
Tolmiea menziesii	Tome	pig-a-back plant	No	herb	Saxifragaceae	OBL
Matricaria suaveolens	Masu	pineapple weed	No	herb	Asteraceae	NI
Conium maculatum L.	Coma	poison hemlock	Yes	herb	Apiaceae	FAC
Toxicodendron diversilobum	Todi	poison oak	No	shrub	Anacardiaceae	NI
Pinus ponderosa	Pipo	ponderosa pine	No	tree	Pinaceae	FACU
Lactuca serriola L.	Lase	prickly lettuce	No	herb	Asteraceae	FAC
Sonchus asper (L.) Hill	Soas	prickly sow-thistle	Yes	herb	Asteraceae	FAC
Tribulus terrestris	Trte	puncturevine	No	herb	Zygophyllaceae	na

Appendix V-B: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Cyperus rotundus L.	Cyro	purple nutsedge	No	herb	Cyperaceae	FAC
Chrysothamnus nauseosus	Chna	rabbit brush	No	shrub	Asteraceae	na
Alnus rubra	Alru	red alder	No	tree	Betulaceae	FACW
Spergularia rubra	Spru	red sand-spurrey	No	herb	Carophyllaceae	FAC-
Salix laevigata Bebb	Sala	red willow	No	tree	Salicaceae	FACW+
Erodium cicutarium	Erci	red-stem filaree	Yes	herb	Geraniaceae	NI
Agrostis gigantea	Aggi	redtop	No	herb	Poaceae	NI
Sequoia sempervirens	Sese	redwood	No	tree	Taxodiaceae	NI
Phalaris arundinacea	Phar	reed canary grass	No	herb	Poaceae	OBL
Stachys albens Gray	Stal	rigid hedgenettle/marsh hedgenettle	No	herb	Lamiaceae	OBL
Bromus diandrus	Brdi	ripgut brome	Yes	herb	Poaceae	NI
Casuarina equisetifolia	Caeq	river she-oak	No	tree	Casuarinaceae	na
Eleocharis radicans	Elra	rooted spikerush	No	herb	Cyperaceae	OBL
Juncus occidentalis	Juoc	rush	No	herb	Juncaceae	NI
Salsola tragus	Satr	Russian thistle/tumbleweed	Yes	herb	Chenopodiaceae	NI
Cordylanthus maritimus ssp. maritimus	Comr	salt marsh bird's beak	No	herb	Scrophulariaceae	OBL
Pluchea odorata	Plod	salt marsh fleabane	No	herb	Asteraceae	OBL
Juncus lesueurii	Jule	salt rush	No	herb	Juncaceae	FACW
Atriplex triangularis	Attr	saltbush	No	herb	Chenopodiaceae	NI
Tamarix ramosissima Ledeb.	Tara	saltceder	Yes	shrub/tree	Tamaricaceae	FAC
Distichlis spicata (L.) Greene	Disp	saltgrass	No	herb	Poaceae	FACW
Spergularia marina	Spma	saltmarsh sand-spurrey	No	herb	Carophyllaceae	OBL
Spartina patens (Ait.) Muhl.	Sppa	salt-meadow cordgrass	Yes	herb	Poaceae	OBL
Spartina alterniflora Loisel.	Spal	salt-water cordgrass	Yes	herb	Poaceae	OBL
Batis maritima L.	Bama	saltwort, beachwort	No	shrub	Bataceae	OBL
Carex spissa Bailey	Casp	San Diego sedge	No	herb	Cyperaceae	FAC*

Appendix V-B: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Eryngium aristulatum var. parishii	Erar	San Diego-button celery	No	herb	Apiaceae	OBL
Eleocharis montevidensis	Elmo	sand spikerush	No	herb	Cyperaceae	FACW
Salix exigua Nutt.	Saex	sandbar willow/narrow-leaved willow	No	shrub	Salicaceae	FACW
Verbena scabra Vahl	Vesc	sandpaper vervain	No	herb	Verbenaceae	OBL
Spergularia macrotheca	Spmc	sand-spurrey	No	herb	Carophyllaceae	FAC+
Carex barbarae	Caba	Santa Barbara sedge	No	herb	Cyperaceae	FACW
Lepidospartum squamatum	Lesq	scalebroom	No	shrub	Asteraceae	NI
Mimulus cardinalis Dougl. ex Benth.	Mica	scarlet monkeyflower	No	herb	Scrophulariaceae	OBL
Anagallis arvensis L.	Anar	scarlet pimpernel	No	herb	Primulaceae	FAC
Carex schottii	Casc	Schott's sedge	No	herb	Cyperaceae	OBL
Salix scouleriana	Sasc	Scouler willow	No	shrub	Salicaceae	FAC
Phyllospadix scouleri Hook.	Phsc	Scouler's surfgrass	No	herb	Zosteraceae	OBL
Quercus berberidifolia	Qube	scrub oak	No	shrub	Fagaceae	NI
Limonium californicum	Lica	sea lavender/marsh rosemary	No	herb	Plumbaginaceae	OBL
Suaeda californica	Suca	sea-blite	No	shrub	Chenopodiaceae	FACW
Glaux maritima	Glma	sea-milkwort	No	herb	Primulaceae	OBL
Triglochin maritima	Trma	seaside arrow-grass	No	herb	Juncaginaceae	OBL
Zostera pacifica L.	Zopa	seawrack/eelgrass	No	herb	Zosteraceae	OBL
Carex Whitneyi	Cawh	sedge	No	herb	Cyperaceae	na
Crypsis vaginiflora (Forsk.) Opiz	Crva	sharp-leaved Timothy	No	herb	Poaceae	OBL
Salix lucida Muhl.	Salu	shining willow	No	shrub/tree	Salicaceae	FACW
Alopecurus aequalis	Alae	shortawn foxtail	No	herb	Poaceae	OBL
Elatine brachysperma Gray	Elbr	shortseed waterwort	No	herb	Elatinaceae	OBL
Parapholis incurva	Pain	sickle grass	No	herb	Poaceae	OBL
Juncus nevadensis	June	Sierra rush	No	herb	Juncaceae	FACW
Lupinus chamissonis	Luch	silver dune lupine	No	shrub	Fabaceae	na
Lotus argophyllus	Loar	silver lotus	No	herb	Fabaceae	NI

Appendix V-B: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Artemisia ludoviciana	Arlu	silver wormwood	No	shrub	Asteraceae	FACU-
Salix sitchensis	Sasi	Sitka willow	No	shrub/tree	Salicaceae	FACW+
Aster subulatus Michx.	Assu	slender aster	No	herb	Asteraceae	FACW
Salicornia europea (S. rubra)	Saeu	slender glasswort	No	herb	Chenopodiaceae	OBL
Plantago elongata Pursh	Plel	slender plantain	No	herb	Plantaginaceae	FACW*
Avena barbata	Avba	slender wild oat	Yes	herb	Poaceae	NI
Mesembryanthemum nodiflorum	Meno	slender-leaved iceplant	Yes	herb	Aizoaceae	FAC
Orizopsis mileaceum	Ormi	smilo grass	Yes	herb	Poaceae	NI
Piptatherum miliaceum	Pimi	smilo grass	Yes	herb	Poaceae	NI
Equisetum laevigatum	Eqla	smooth scouring rush	No	herb	Equisetaceae	FACW
Epilobium pygmaeum (Speg.)	Eppy	smooth willow-herb	No	herb	Onagraceae	OBL
Cordylanthus mollis ssp. mollis	Como	soft bird's beak	No	herb	Scrophulariaceae	OBL
Bromus mollis	Brmo	soft brome	No	herb	Poaceae	FACU-
Melilotus indica	Mein	sourclover	Yes	herb	Fabaceae	FAC
Typha domingensis	Tydo	southern cattail	No	herb	Typhaceae	OBL
Hemizonia parryi var. australis	Hepr	southern tarplant	No	herb	Asteraceae	FAC
Andropogon glomeratus (Walt.) B.S.P.	Angl	southwestern bushy bluestem	No	herb	Poaceae	FACW
Juncus acutus	Juac	southwestern spiny rush/sharp rush	No	herb	Juncaceae	FACW
Pulicaria paludosa Link	Pupa	Spanish sunflower	No	herb	Asteraceae	NI
Mentha spicata L.	Mesp	spearmint	No	herb	Lamiaceae	OBL
Xanthium spinosum L.	Xasp	spiny cocklebur	No	herb	Asteraceae	FAC+
Ribes divaricatum	Ridi	spreading gooseberry	No	shrub	Grossulariaceae	FACW
Elymus elymoides	Elel	squirreltail	No	herb	Poaceae	FACU-
Ribes visicosissimum	Rivi	sticky currant	No	shrub	Grossulariaceae	na
Ageratina adenophora	Agad	sticky eupatorium	Yes	herb	Asteraceae	NI
Urtica dioica L.	Urdi	stinging nettle	No	herb	Urticaceae	FACW
Plagiobothrys stipitatus	Plst	stipitate popcorn flower	No	herb	Boraginaceae	OBL

Appendix V-B: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Rhus ovata	Rhov	sugar bush	No	shrub	Anacardiaceae	NI
Hirschfeldia incana	Hiin	summer mustard	Yes	herb	Brassicaceae	UPL
Crypsis schoenoides	Crsc	swamp pickle-grass	No	herb	Poaceae	OBL
Lobularia maritima	Loma	sweet alyssum	Yes	herb	Brassicaceae	NI
Foeniculum vulgare P. Mill.	Fovu	sweet fennel	Yes	herb	Apiaceae	FACU-
Tamarix parviflora	Tapa	tamarisk	Yes	shrub/tree	Tamaricaceae	FAC
Lithocarpus densiflorus	Lide	Tanbark oak	No	tree	Fagaceae	na
Eucalyptus globulus	Eugl	Tasmanian blue gum	Yes	tree	Mytaceae	NI
Heterotheca grandiflora	Hegr	telegraph weed	No	herb	Asteraceae	NI
Bergia texana (Hook.) Seub. ex Walp.	Bete	Texas bergia	No	herb	Elatinaceae	OBL
Rubus parviflorus	Rupa	thimbleberry	No	shrub	Rosaceae	FAC+
Scirpus americanus Pers.	Scam	three-square bulrush	No	herb	Cyperaceace	OBL
Juncus bufonius L.	Jubu	toadrush	No	herb	Juncaceae	FACW+
Ammannia coccinea Rottb.	Amco	tooth-cup	No	herb	Lythraceae	OBL
Downingia cuspidata	Docu	toothed calicoflower	No	herb	Campanulaceae	OBL
Malacothrix torreyi	Mato	Torrey's desertdandelion	No	herb	Asteraceae	na
Phyllospadix torreyi S. Wats.	Phto	Torrey's surfgrass	No	herb	Zosteraceae	OBL
Heteromeles arbutifolia	Hear	toyon	No	shrub	Rosaceae	NI
Ailanthus altissima (P. Mill.) Swingle	Aial	tree of heaven	Yes	tree	Simaroubaceae	FACU
Nicotiana glauca Graham	Nigl	tree tobacco	Yes	shrub	Solanaceae	FAC
Deschampsia cespitosa	Dece	tufted hairgrass	No	herb	Poaceae	FACW
Lathrys jepsonii var. jepsonii	Laje	tule pea	No	herb	Fabaceae	OBL
Amaranthus albus	Amal	tumbleweed	No	herb	Amaranthaceae	FACU
Lonicera involucrata	Loin	twinberry honeysuckle	No	vine ("shrub")	Caprifoliaceae	FAC
Cyperus eragrostis Lam.	Cyer	umbrella sedge	No	herb	Cyperaceae	FACW
Salicornia utahensis	Saut	Utah pickleweed	No	herb	Chenopodiaceae	NI
Quercus lobata	Qulo	valley oak	No	tree	Fagaceae	FACU

Appendix V-B: List of California Plant Species (alphabetized by plant species)

Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Ehrharta erecta	Eher	veldt grass	Yes	herb	Poaceae	NI
Fraxinus velutina Torr.	Frve	velvet ash	No	tree	Oleaceae	FACW
Holcus lanatus	Hola	velvet grass	Yes	herb	Poaceae	FAC
Hordeum intercedens Nevski	Hoin	vernal barley	No	herb	Poaceae	FAC
Acer circinatum	Acci	vine maple	No	shrub	Aceraceae	FAC
Clematis ligusticifolia	Clli	virgin's bower	No	shrub	Ranunculaceae	FAC
Agrostis viridis	Agvi	water bentgrass	No	herb	Poaceae	OBL
Ranunculus aquatilis L.	Raaq	water buttercup	No	herb	Ranunculaceae	OBL
Rorippa nasturtium-aquaticum	Rona	water cress	No	herb	Brassicaceae	OBL
Alisma plantago-aquatica	Alpl	water plantain	No	herb	Alismataceae	OBL
Crassula aquatica (L.) Schoenl.	Craq	water pygmyweed	No	herb	Crassulaceae	OBL
Polygonum amphibium L.	Poam	water smartweed	No	herb	Polygonaceae	OBL
Polygonum punctatum	Popu	water smartweed	No	herb	Polygonaceae	OBL
Veronica anagallis-aquatica L.	Vean	water speedwell	No	herb	Scrophulariaceae	OBL
Callitriche heterophylla Pursh	Cahe	water starwort	No	herb	Callitrichaceae	OBL
Wolffia columbiana Karst.	Woco	watermeal	No	herb	Lemnaceae	OBL
Hydrocotyle umbellata L.	Hyum	water-pennywort	No	herb	Apiaceae	OBL
Hydrilla verticillata (L. f.) Royle	Hyve	waterthyme	Yes	herb	Hydrocharitaceae	OBL
Atriplex wattsonii	Atwa	Watson's saltbush	No	shrub	Chenopodiaceae	FACW+
Salix babylonica	Saba	weeping willow	No	tree	Chenopodiaceae	FACW-
Rhododendron occidentalis	Rhoc	western azalea	No	shrub	Ericaceae	na
Lilaeopsis occidentalis	Lioc	western grasswort	No	herb	Apiaceae	OBL
Hesperocnide tenella	Hete	western nettle	No	herb	Urticaceae	na
Ambrosia psilostachya DC.	Amps	western ragweed	No	herb	Asteraceae	FAC
Platanus racemosa	Plra	western sycamore	No	tree	Platanaceae	FACW
Cicuta douglasii	Cido	western waterhemlock	No	herb	Apiaceae	OBL
Emmenanthe penduliflora	Empe	whispering bells	No	herb	Hydrophyllaceae	NI

Appendix V-B: List of California Plant Species (alphabetized by plant species)						
Plant Species	Code[1]	Common Name	Invasive	Growth Habit	Family	Indicator status
Alnus rhombifolia	Alrh	white alder	No	tree	Betulaceae	FACW
Trifolium repens L.	Tre	white clover	No	herb	Fabaceae	FAC
Abies concolor	Abco	white fir	No	tree	Pinaceae	na
Salvia apiana	Saap	white sage	No	shrub	Lamiaceae	NI
Melilotus alba	Meal	white sweetclover	Yes	herb	Fabaceae	FACU
Solanum douglasii	Sodo	white-flowered nightshade	No	herb	Solanaceae	FAC
Hydrocotyle verticillata Thunb.	Hyvr	whorled marsh pennywort	No	herb	Apiaceae	OBL
Beta vulgaris	Bevu	wild beet	No	herb	Chenopodiaceae	FACU
Avena fatua	Avfa	wild oat	Yes	herb	Poaceae	NI
Raphanus sativus L.	Rasa	wild radish	Yes	herb	Brassicaceae	UPL
Polygonum lapathifolium L.	Pola	willow weed	No	herb	Polygonaceae	OBL
Monanthochloe littoralis	Moli	wiregrass/shoregrass	No	herb	Poaceae	OBL
Cuscuta salina	Cusa	witch's hair/dodder	No	herb	Cuscutaceae	NI
Dryopteris arguta	Drar	wood fern	No	herb	Dryopteridaceae	NI
Rosa gymnocarpa	Rogy	wood rose	No	shrub	Rosaceae	NI
Rosa woodsii	Rowo	Wood's rose	No	shrub	Rosaceae	FAC-
Verbascum thapsus	Veth	woolly mullein	Yes	herb	Scrophulariaceae	na
Suaeda taxifolia	Suta	woolly sea-blite	No	shrub	Chenopodiaceae	NI
Psilocarphus brevissimus Nutt.	Psbr	wooly marbles	No	herb	Asteraceae	OBL
Nemacaulis denudata var. denudata	Nede	wooly-heads	No	herb	Polygonaceae	NI
Juncus rugulosus Engelm.	Juru	wrinkled rush	No	herb	Juncaceae	OBL
Lupinus arboreus	Luar	yellow bush lupine	No	shrub	Fabaceae	na
Centaurea solstitialis	Ceso	yellow starthistle	Yes	herb	Asteraceae	NI
Iris pseudacorus	Irps	yellow water iris/yellow flag	Yes	herb	Iridaceae	OBL
Salix lutea Nutt.	Salt	yellow willow	No	shrub/tree	Salicaceae	OBL
Anemopsis californica (Nutt.)	Anca	yerba mansa	No	herb	Saururaceae	OBL