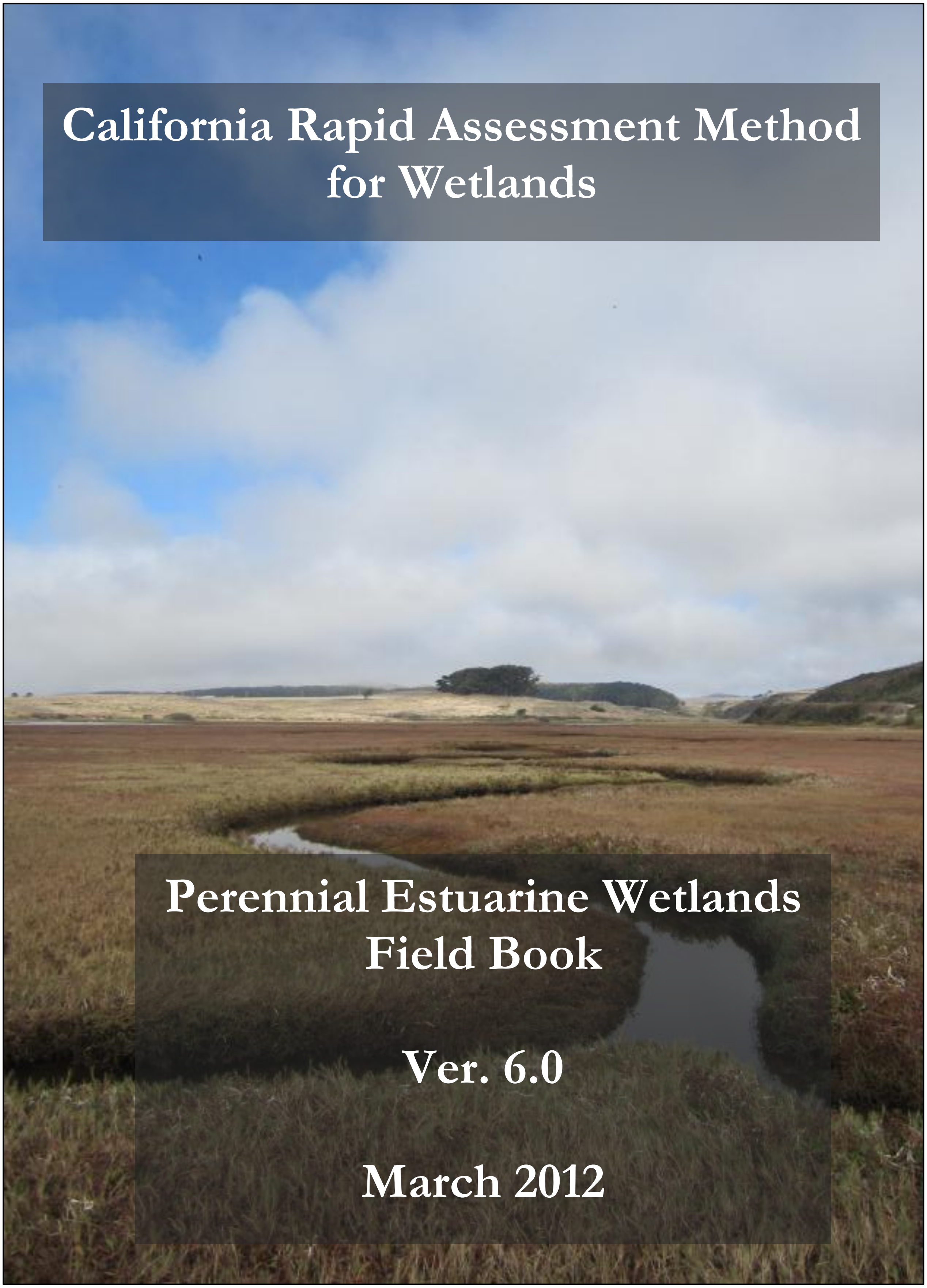
California Rapid Assessment Method for Wetlands



Perennial Estuarine Wetlands Field Book

Ver. 6.0

March 2012

Basic Information Sheet: Perennial Estuarine Wetlands

CRAM Site ID:				
Project Site ID:				
Assessment Area Name:				
Project Name:	**Date (m/d/y)**			
Assessment Team Members for This AA				

Center of AA:

Latitude: **Longitude:**

Wetland Sub-type:

□ Perennial Saline □ Perennial Non-saline

AA Category:

□ Restoration □ Mitigation □ Impacted □ Ambient □ Reference □ Training

□ Other:

What best describes the tidal stage over the course of the time spent in the field?
Note: It is recommended that the assessment be conducted during low tide.

□ high tide □ low tide

Photo Identification Numbers and Description:

	Photo ID No.	Description	Latitude	Longitude	Datum
1		North			
2		South			
3		East			
4		West			
5					
6					
7					
8					
9					
10					

Site Location Description:

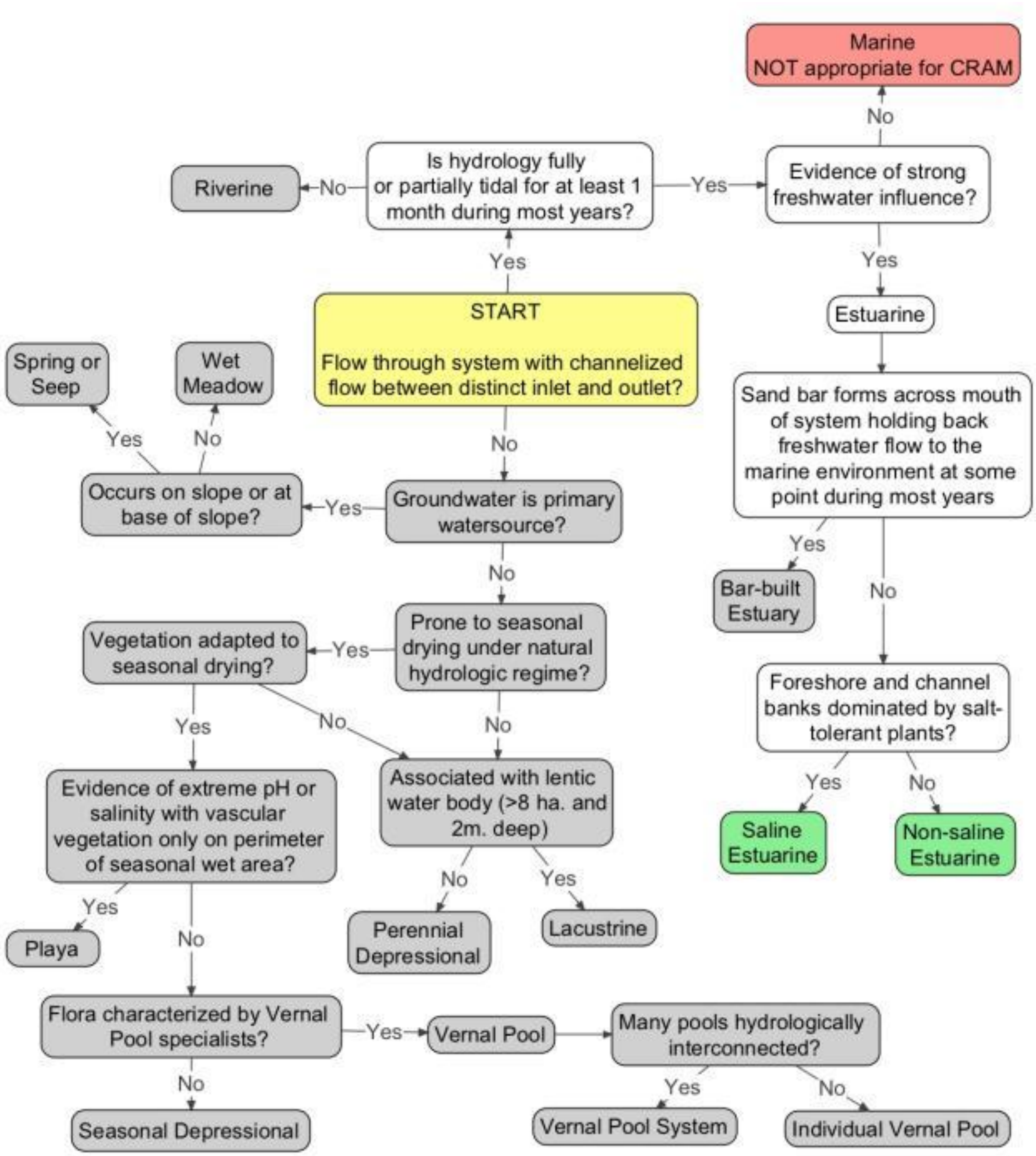
Comments:

Scoring Sheet: Perennial Estuarine Wetlands

AA Name:					**(m/d/y)**			
Attribute 1: Buffer and Landscape Context					**Comments**			
(D) Aquatic Area Connectivity Score			Alpha.	Numeric				
Buffer (based on sub-metrics A-C)								
(A submetric) Score for Buffer: Percent of AA with Buffer	Alpha.	Numeric						
(B submetric) Score for Buffer: Average Buffer Width								
(C submetric) Score for Buffer: Buffer Condition								
Raw Attribute Score = $D+[C \times (A \times B)^{1/2}]^{1/2}$ (use numerical value to nearest whole integer)					**Final Attribute Score = (Raw Score/24) x 100**			
Attribute 2: Hydrology Attribute								
Water Source			Alpha.	Numeric				
Hydroperiod								
Hydrologic Connectivity								
Raw Attribute Score = sum of numeric scores					**Final Attribute Score = (Raw Score/36) x 100**			
Attribute 3: Physical Structure Attribute								
Structural Patch Richness			Alpha.	Numeric				
Topographic Complexity								
Raw Attribute Score = sum of numeric scores					**Final Attribute Score = (Raw Score/24) x 100**			
Attribute 4: Biotic Structure Attribute								
Plant Community Composition (based on sub-metrics A-C)								
Plant Community submetric A: Number of plant layers	Alpha.	Numeric						
Plant Community submetric B: Number of Co-dominant species								
Plant Community submetric C: Percent Invasion								
Plant Community Composition (*average of submetrics A-C rounded to nearest whole integer*)								
Horizontal Interspersion								
Vertical Biotic Structure								
Raw Attribute Score = sum of numeric scores					**Final Attribute Score = (Raw Score/36) x 100**			
Overall AA Score (average of four final Attribute Scores)								

Identify Wetland Type

Figure 1: Flowchart to determine wetland type and sub-type.



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 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.

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 (*Sarcocornia* 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.

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 (*Schoenoplectus species),* and willows (*Salix* spp.).

Establish the Assessment Area (AA)

The boundary of an estuarine wetland AA should be determined during low tide. The AA should not extend above the backshore, as indicated by wrack lines, transitions from intertidal to upland vegetation, etc., and it should not extend more than 10 m across a non-vegetated tidal flat that adjoins the foreshore. The AA should not extend across any tidal channel that is wider than 30 m or that cannot be safely crossed at low tide. The boundary of the AA can extend along the midline of such channels but not across them. The AA can incorporate any smaller channels that can be safely crossed on the ground. The AA will therefore include all of the intertidal marsh plain and associated features, such as pannes and natural levees, plus all of the tidal channels that can be crossed, plus the exposed banks and beds of channels that border the AA (Figure 2).

Figure 2: Example of an estuarine wetland and a characeristic Assessment Area.

Table 1: Examples of features that *should* be used to delineate AA boundaries

- diversion ditches
- end-of-pipe large discharges
- grade control or water height-control structures
- major channel confluences
- open water areas more than 30 m wide on average or broader than the wetland
- transitions between wetland types, such as riverine to estuarine at the inward extent of the estuarine wetland
- foreshores, backshores and uplands at least 5 m wide
- weirs, culverts, dams, levees, and other flow control structures

Table 2: Examples of features that *should not* be used to delineate 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, unless access is not allowed
- spatial changes in land cover or land use along the wetland border
- state and federal jurisdictional boundaries

Table 3: Recommended maximum and minimum AA sizes

Wetland Type	Recommended AA Size
Perennial Saline	Recommended size and shape for estuarine wetlands is a 1 ha circle (radius about 55 m), but the shape can be non-circular if necessary to fit the wetland and to meet hydrogeomorphic criteria. The recommended minimum size is 0.1 ha (about 30 m x 30 m).
Perennial Non-saline	

Special Note:

**Wetlands smaller than the recommended AA sizes can be assessed in their entirety.*

Attribute 1: Buffer and Landscape Context

Metric 1: Aquatic Area Abundance

Definition: The Assessment Area's Aquatic Area Abundance within a landscape is assessed in terms of its spatial association with other areas of aquatic resources, such as other wetlands, lakes, streams, etc. Wetlands close to each other have a greater potential to interact ecologically and hydrologically, and such interactions are generally beneficial.

For estuarine wetlands, on digital or hardcopy site imagery, draw a straight line extending 500 m from the AA boundary in each of the four cardinal compass directions from the center point. Along each transect line, estimate the percentage of the segment that passes through wetland or an aquatic feature of any kind, including open water. Use the worksheet below to record these estimates.

Special Note:

**Aquatic features are scored for this metric as they would be identified in CRAM AAs. For example, all of a Riverine wetland would be identified as an aquatic feature, including the associated floodplain and riparian area. Vernal pool systems that occur in a landscape are scored so as to include the surrounding upland area as part of the aquatic feature (as described in the CRAM Manual and the Vernal Pool field books).*

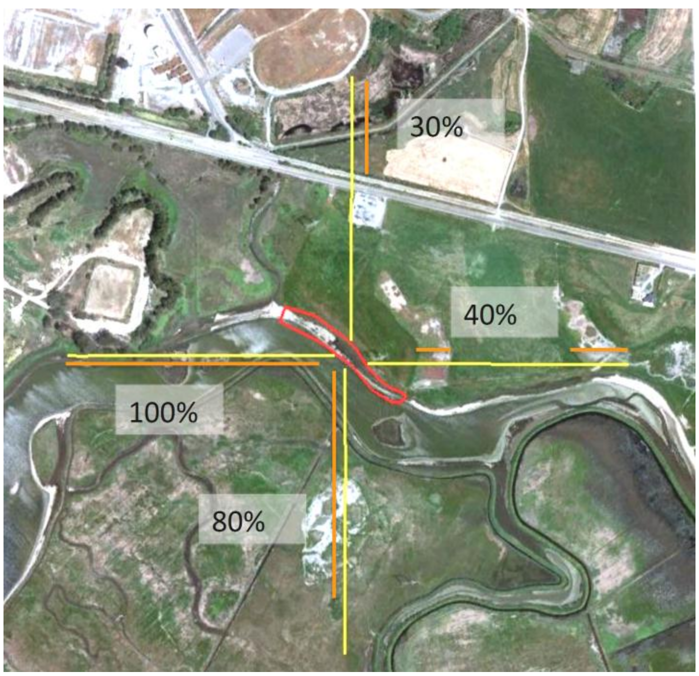


Figure 3: Diagram illustrating the method to assess the Aquatic Area Abundance of estuarine wetlands. This example shows that an average of 62.5% of the 500 m transects cross an aquatic feature of any kind. Here the orange bars next to the yellow transect lines indicate portions of the line that pass through wetland or aquatic habitat. Note that this AA is positioned along a fringing estuarine mash between open water and uplands. As a result, the AA is in a more linear shape.

Worksheet for Aquatic Area Abundance Metric for Estuarine Wetlands

Percentage of Transect Lines that Contains an Aquatic Feature of Any Kind	
Segment Direction	Percentage of Transect Length That is an Aquatic Feature
North	
South	
East	
West	
Average Percentage of Transect Length that is an Aquatic Feature	

Table 4: Rating for Aquatic Area Abundance for Estuarine wetlands.

Rating	Alternative States
A	An average of 76 – 100 % of the transects pass through an aquatic feature of any kind.
B	An average of 51 – 75 % of the transects pass through an aquatic feature of any kind.
C	An average of 26 – 50 % of the transects pass through an aquatic feature of any kind.
D	An average of 0 – 25 % of the transects pass through an aquatic feature of any kind.

Metric 2: Buffer

Definition: The buffer is the area adjoining the AA that is in a natural or semi-natural state and currently not dedicated to anthropogenic uses that would severely detract from its ability to entrap contaminants, discourage forays into the AA by people and non-native predators, or otherwise protect the AA from stress and disturbance.

To be considered as buffer, a suitable land cover type must be at least 5 m wide and extend along the perimeter of the AA for at least 5 m. The maximum width of the buffer is 250 m. At distances beyond 250 m from the AA, the buffer becomes part of the landscape context of the AA.

Special Note:

**Any area of open water at least 30 m wide that is adjoining the AA, such as a lake, large river, or large slough, is not considered in the assessment of the buffer. Such open water is considered to be neutral, and is neither part of the wetland nor part of the buffer. There are three reasons for excluding large areas of open water (i.e., more than 30 m wide) from Assessment Areas and their buffers.*

1) *Assessments of buffer extent and buffer width are inflated by including open water as a part of the buffer.*
2) *While there may be positive correlations between wetland stressors and the quality of open water, quantifying water quality generally requires laboratory analyses beyond the scope of rapid assessment.*
3) *Open water can be a direct source of stress (i.e., water pollution, waves, boat wakes) or an indirect source of stress (i.e., promotes human visitation, encourages intensive use by livestock looking for water, provides dispersal for non-native plant species), or it can be a source of benefits to a wetland (e.g., nutrients, propagules of native plant species, water that is essential to maintain wetland hydroperiod, etc.).*

**However, any area of open water that is within 250 m of the AA but is not adjoining the AA is considered part of the buffer.*

Submetric A: Percent of AA with Buffer

Definition: This submetric is based on the relationship between the extent of buffer and the functions they provide to aquatic areas. Areas with more buffer typically provide more habitat values, better water quality and other valuable functions. This submetric is scored by visually estimating from aerial imagery (with field verification) the percent of the AA perimeter that is surrounded by at least 5 meters of buffer land cover (Figure 4).

In the example below (Figure 4), most of the area around the AA (the cross-hatched area) consists of non-buffer land cover types. The AA adjoins a major roadway, parking lot, and other developments that are non-buffer land cover types. There is a nearby wetland, but it is separated from the AA by a major roadway and is not considered buffer. The open water area is neutral and not considered in assessing the percentage of the AA perimeter that has buffer. In this example, the only areas that would be considered buffer are the two brown areas labeled “Upland Buffer”.

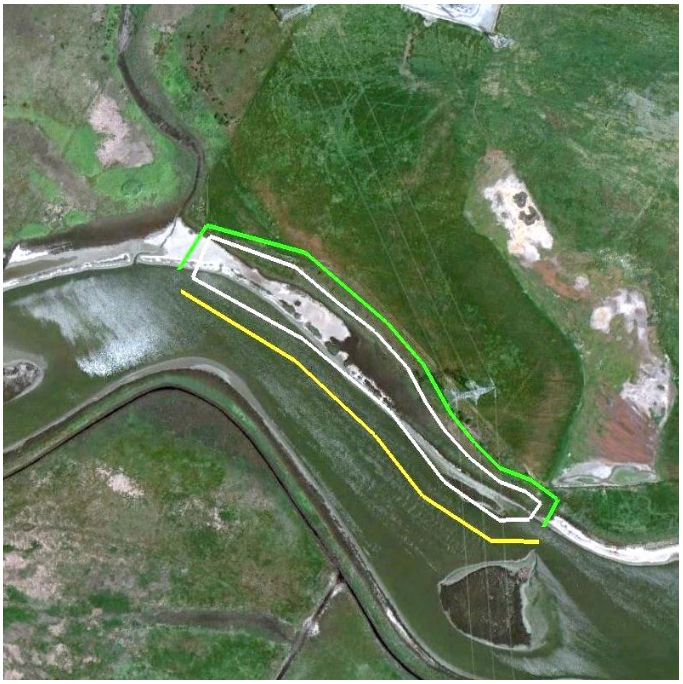


Figure 4: Diagram of approach to estimate Percent of AA with Buffer for Estuarine AAs. The white line is the edge of the AA, the green line indicates where there is at least 5 meters of buffer adjacent to the AA. The yellow line indicates where there is open water greater than 30 meters wide directly adjacent to the AA. This portion of the AA perimeter is not considered in the estimate of the percent of the AA with buffer. In this example 100% of the AA has buffer.

Table 5: Guidelines for identifying wetland buffers and breaks in buffers.

Examples of Land Covers Included in Buffers	**Examples of Land Covers Excluded from Buffers** Notes: buffers do not cross these land covers; areas of open water adjacent to the AA are not included in the assessment of the AA or its buffer.
• at-grade bike and foot trails, or trails (with light traffic) • horse trails • natural upland habitats • nature or wildland parks • range land and pastures • railroads (with infrequent use: 2 trains per day or less) • roads not hazardous to wildlife, such as seldom used rural roads, forestry roads or private roads • swales and ditches • vegetated levees	• commercial developments • fences that interfere with the movements of wildlife (i.e. food safety fences that prevent the movement of deer, rabbits and frogs) • intensive agriculture (row crops, orchards and vineyards) • golf courses • paved roads (two lanes or larger) • lawns • active railroads (more than 2 trains per day) • parking lots • horse paddocks, feedlots, turkey ranches, etc. • residential areas • sound walls • sports fields • urbanized parks with active recreation • pedestrian/bike trails (with heavy traffic)

Percent of AA with Buffer Worksheet.
In the space provided below make a quick sketch of the AA, or perform the assessment directly on the aerial imagery; indicate where buffer is present, estimate the percentage of the AA perimeter providing buffer functions, and record the estimate amount in the space provided.

Percent of AA with Buffer: ________ **%**

Table 6: Rating for Percent of AA with Buffer.

Rating	Alternative States (not including open-water areas)
A	Buffer is 75 - 100% of AA perimeter.
B	Buffer is 50 – 74% of AA perimeter.
C	Buffer is 25 – 49% of AA perimeter.
D	Buffer is 0 – 24% of AA perimeter.

Submetric B: Average Buffer Width

Definition: The average width of the buffer adjoining the AA is estimated by averaging the lengths of eight straight lines drawn at regular intervals around the AA from its perimeter outward to the nearest non-buffer land cover or 250 m, which ever is first encountered. It is assumed that the functions of the buffer do not increase significantly beyond an average width of about 250 m. The maximum buffer width is therefore 250 m. The minimum buffer width is 5 m, and the minimum length of buffer along the perimeter of the AA is also 5 m. Any area that is less than 5 m wide and 5 m long is too small to be a buffer. See Table 5 above for more guidance regarding the identification of AA buffers.

Table 7: Steps to estimate Buffer Width for Estuarine wetlands

Step 1	Identify areas in which open water is directly adjacent to the AA, with no vegetated wetland or upland area in between. **These areas are excluded from buffer calculations.**
Step 2	From the previous sub-metric, identify the areas that have buffer adjacent to the AA.
Step 3	For the area that has been identified as having buffer, draw eight straight lines 250 m in length perpendicular to the AA at regularly spaced intervals starting at the AA boundary (see Figure 5 below).
Step 4	Estimate the buffer width of each of the lines as they extend away from the AA. Record these lengths on the worksheet below.
Step 5	Calculate the average buffer width. Record this width on the worksheet below.

Figure 5: Diagram of approach to estimate Average Buffer Width for Estuarine AAs. The white line is the edge of the AA. Continuing with the example from above, eight lines were drawn evenly distributed where buffer is present around the AA. All lines in this example are 250 meters long except for the one that intercepts a power sub-station north of the AA. Note that no lines were drawn out into the open water directly adjacent to the AA.

Worksheet for calculating average buffer width of AA

Line	**Buffer Width (m)**
A	
B	
C	
D	
E	
F	
G	
H	
Average Buffer Width	

Table 8: Rating for average buffer width.

Rating	**Alternative States**
A	Average buffer width is 190 – 250 m.
B	Average buffer width 130 – 189 m.
C	Average buffer width is 65 – 129 m.
D	Average buffer width is 0 – 64 m.

Submetric C: Buffer Condition

Definition: The condition of a buffer is assessed according to the extent and quality of its vegetation cover, the overall condition of its substrate, and the amount of human visitation. Buffer conditions are assessed only for the portion of the wetland border that has **already been identified as buffer** (i.e., as in Figure 5). Thus, evidence of direct impacts (parking lots, buildings, etc.) by people are excluded from this metric, because these features are not included as buffer land covers; instead these impacts are included in the Stressor Checklist. If there is no buffer, assign a score of D.

Figure 6: Diagram of approach to assess Buffer Condition for Estuarine AAs. The white line is the edge of the AA. Continuing with the example from above, this submetric assesses the condition of the buffer only where it was found to be present in the two previous steps (the shaded area with green edge shown).

Table 9: Rating for Buffer Condition.

Rating	Alternative States
A	Buffer for AA is dominated by native vegetation, has undisturbed soils, and is apparently subject to little or no human visitation.
B	Buffer for AA is characterized by an intermediate mix of native and non-native vegetation (25-75%), but mostly undisturbed soils and is apparently subject to little or low impact human visitation.
	OR
	Buffer for AA is dominated by native vegetation, but shows some soil disturbance and is apparently subject to little or low impact human visitation.
C	Buffer for AA is characterized by substantial (>75%) amounts of non-native vegetation AND there is at least a moderate degree of soil disturbance/compaction, and/or there is evidence of at least moderate intensity of human visitation.
D	Buffer for AA is characterized by barren ground and/or highly compacted or otherwise disturbed soils, and/or there is evidence of very intense human visitation.

Attribute 2: Hydrology

Metric 1: Water Source

Definition: Water sources directly affect the extent, duration, and frequency of the hydrological dynamics within an Assessment Area. Water sources include direct and indirect inputs of water into the AA as well as any diversions of water from the AA. Diversions are considered a water source because they affect the ability of the AA to function as a source of water for other habitats while also directly affecting the hydrology of the AA.

A water source is direct if it supplies water mainly to the AA, rather than to areas through which the water must flow to reach the AA. Natural, direct sources include rainfall, ground water discharge, and flooding of the AA due to naturally high riverine flows. Examples of unnatural, direct sources include stormdrains that empty directly into the AA or into an immediately adjacent area. Indirect sources that should not be considered in this metric include large regional dams that have ubiquitous effects on broad geographic areas of which the AA is a small part. For example, the salinity regimes of estuarine wetlands in San Francisco Bay are affected by dams in the Sierra Nevada, but these effects are not direct. But some of the same wetlands are directly affected by nearby discharges from sewage treatment facilities. Engineered hydrological controls, such as weirs, tide gates, flashboards, grade control structures, check dams, etc., can serve to demarcate the boundary of an AA, but they are not considered water sources. However, the effects of urbanization on hydrological dynamics in the immediate watershed containing the AA ("hydromodification") *are* considered in this metric; because hydromodification both increases the volume and intensity of runoff during and immediately after rainy season storm events and reduces infiltration that supports base flow discharges during the drier seasons later in the year.

Natural sources of water for estuarine wetlands include by definition a combination of marine (i.e., tidal) and riverine (i.e., fluvial) sources. This metric is focused on the non-tidal water sources that account for the conditions during the growing season, regardless of the time of year when these sources exist. To assess water source, the plant species composition of the wetland should be compared to what is expected, in terms of the position of the wetland along the salinity gradient of the estuary, as adjusted for the overall wetness of the water year. In general, altered sources are indicated by vegetation that is either more tolerant of saline conditions or less tolerant than would be expected. If the plant community is unexpectedly salt-tolerant, then an unnatural decrease in freshwater supply is indicated. Conversely, if the community is less salt-tolerant than expected, than an unnatural increase in freshwater is indicated.

To score this metric use site aerial imagery and any other information collected about the region or watershed surrounding the AA to assess the water sources within an area 2 km upstream of the AA (Figure 7).

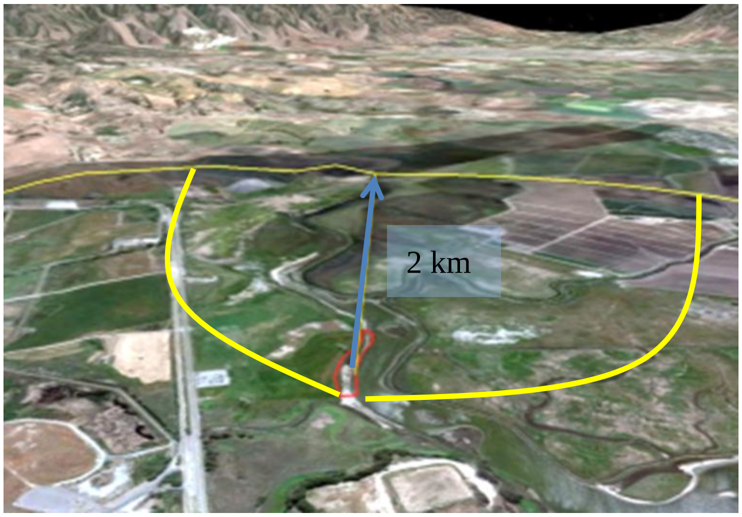


Figure 7: Diagram of approach to assess water sources affecting a CRAM AA showing an oblique view of the watershed. After identifying the portion of the aerial imagery that constitutes the area of the watershed directly contributing to the AA, assess the condition of the freshwater sources in a 2 km region (represented by yellow line) upstream of the AA (represented with red box).

Table 10: Rating for Water Source.

Rating	Alternative States
A	Freshwater sources that affect the dry season condition of the AA, such as its flow characteristics, hydroperiod, or salinity regime, are precipitation, groundwater, and/or natural runoff, or natural flow from an adjacent freshwater body, or the AA naturally lacks water in the dry season. There is **no indication** that dry season conditions are substantially controlled by artificial water sources.
B	Freshwater sources that affect the dry season condition of the AA are mostly natural, but also obviously include occasional or small effects of modified hydrology. Indications of such anthropogenic inputs include developed land or irrigated agricultural land that comprises **less than 20%** of the immediate drainage basin within about 2 km upstream of the AA, or that is characterized by the presence of a few small stormdrains or scattered homes with septic systems. No large point sources or dams control the overall hydrology of the AA.
C	Freshwater sources that affect the dry season conditions of the AA are primarily urban runoff, direct irrigation, pumped water, artificially impounded water, water remaining after diversions, regulated releases of water through a dam, or other artificial hydrology. Indications of substantial artificial hydrology include developed or irrigated agricultural land that comprises **more than 20%** of the immediate drainage basin within about 2 km upstream of the AA, or the presence of major point source discharges that obviously control the hydrology of the AA. OR Freshwater sources that affect the dry season conditions of the AA are **substantially controlled** by known diversions of water or other withdrawals directly from the AA, its encompassing wetland, or from its drainage basin.
D	Natural, freshwater sources that affect the dry season conditions of the AA have **been eliminated** based on the following indicators: impoundment of all possible wet season inflows, diversion of all dry-season inflow, predominance of xeric vegetation, etc.

Metric 2: Hydroperiod

Definition: Hydroperiod is the characteristic frequency and duration of inundation or saturation of a wetland during a typical year. The natural hydroperiod for estuarine wetlands is governed by the tides, and includes predictable variations in inundation regimes over days, weeks, months, and seasons. The volume of water that flows into and from an estuarine wetland due to the changing stage of the tide is termed the "tidal prism."

The tidal prism consists of inputs from both tidal (i.e., marine or estuarine) and non-tidal (e.g., fluvial or upland) sources. The timing, duration, and frequency of inundation of the wetland by these waters are collectively referred to the tidal hydroperiod.

Under natural conditions, increases in tidal prism (e.g., because of sea level rise) tend to cause increases in inorganic sedimentation, which raises the elevation of the wetland substrate and thus reduces its hydroperiod. If the sediment supply is adequate, estuarine marshes tend to build upward in quasi-equilibrium with sea level rise.

A change in the hydroperiod of an estuarine wetland (i.e., a change in the tidal prism) can be inferred from changes in channel morphology, drainage network density, and the relative abundance of plants indicative of either high or low marsh. A preponderance of shrink-swell cracks or dried pannes on the wetland plain is indicative of decreased hydroperiod. In addition, inadequate tidal flushing may be indicated by algal blooms or by encroachment of freshwater vegetation. Dikes, levees, ponds, or ditches are indicators of an altered hydroperiod resulting from management for flood control, salt production, waterfowl hunting, mosquito control, etc. Table 12 provides narratives for rating Hydroperiod for perennial estuarine wetlands.

Table 11: Field Indicators of Altered Hydroperiod.

Direct Engineering Evidence	Indirect Ecological Evidence
Reduced Extent and Duration of Inundation or Saturation	
• Upstream spring boxes • Impoundments • Pumps, diversions, ditching that move water ***out of*** the wetland	• Evidence of aquatic wildlife mortality • Encroachment of terrestrial vegetation • Stress or mortality of hydrophytes • Compressed or reduced plant zonation
Increased Extent and Duration of Inundation or Saturation	
• Berms • Dikes • Pumps, diversions, ditching that move water ***into*** the wetland	• Late-season vitality of annual vegetation • Recently drowned riparian vegetation • Extensive fine-grain deposits

Table 12: Rating of Hydroperiod for Perennial Estuarine wetlands.

Rating	Alternative States
A	AA is subject to the full tidal prism, with two daily tidal minima and maxima, with minimal evidence of human-caused alterations to tidal hydrology.
B	AA is subject to reduced, or muted, tidal prism as a consequence of human action, although two daily minima and maxima are observed.
C	AA is subject to muted tidal prism as a consequence of human action, with tidal fluctuations evident only in relation to extreme daily highs or spring tides.
D	AA is subject to muted tidal prism as a consequence of human action, plus there is inadequate drainage, such that the marsh plain tends to remain flooded during low tide.

Metric 3: Hydrologic Connectivity

Definition: Hydrologic Connectivity describes the ability of water to flow into or out of the wetland, or to accommodate rising flood waters without dramatic changes in water level, which can result in stress to wetland plants and animals.

This metric is scored by assessing the degree to which the lateral movement of rising tides or flood waters are restricted by unnatural features such as levees, dikes, sea walls, or road grades in the AA, **its encompassing wetland** and the associated upland transition zone. In smaller estuarine systems the entire wetland will be assessed; however, in larger systems this metric should be assessed only for the part of the wetland within about 500 meters of the AA.

For estuarine wetlands, this metric should be scored by considering anthropogenic restrictions on the tidal or fluvial hydrology. **The percentage of restriction should be calculated only in consideration of those features (levees, dikes, seawalls, transportation infrastructure, or other fills) that restrict flood tides.**

Indicate on your aerial imagery where restrictions to the lateral movement of flood waters exist.

Table 13: Rating of Hydrologic Connectivity for Estuarine wetlands

Rating	Alternative States
A	Rising water in the wetland that contains the AA has unrestricted access to adjacent areas, without levees, dikes or other obstructions to the lateral movement of flood waters.
B	There are unnatural features such as levees, dikes or road grades that limit the amount of adjacent transition zone or the lateral movement of flood waters, relative to what is expected for the setting. But, the limitations exist for **less than 50%** of the boundary of wetland that contains the AA. Restrictions may be intermittent along margins of the wetland, or they may occur only along one bank or shore of the wetland.
C	The amount of adjacent transition zone or the lateral movement of flood waters is limited, relative to what is expected for the setting, by unnatural features, such as levees, dikes or road grades, for **50-90%** of the wetland that contains the AA.
D	The amount of adjacent transition zone or the lateral movement of flood waters is limited, relative to what is expected for the setting, by unnatural features, such as levees, dikes or road grades, for **more than 90%** of the wetland that contains the AA.

Attribute 3: Physical Structure

Metric 1: Structural Patch Richness

Definition: Patch richness is the number of different obvious types of physical surfaces or features that may provide habitat for aquatic, wetland, or riparian species. This metric is different from topographic complexity in that it addresses the number of different patch types, whereas topographic complexity evaluates the spatial arrangement and interspersion of the types.

Special Note:

**Physical patches can be natural or unnatural.*

Patch Type Definitions:

Abundant wrack or organic debris in channel or on floodplain. Wrack is an accumulation of natural or unnatural floating debris across the wetland plain, along the edges of channels or along the high water line of a wetland. Organic debris includes loose vegetation and twigs not yet deposited by hydrologic processes. This patch type does not include standing dead vegetation.

Animal mounds and burrows. Many vertebrates and invertebrates make mounds or holes as a consequence of their foraging, denning, predation, or other behaviors. The resulting soil disturbance helps to redistributes soil nutrients and influences plant species composition and abundance. To be considered a patch type there should be evidence that a population of burrowing animals has occupied the Assessment Area. A single burrow or mound does not constitute a patch.

Bank slumps or undercut banks in channels or along shorelines. A bank slump is a portion of an estuarine bank that has broken free from the rest of the bank but has not eroded away. Undercuts are areas along the bank or shoreline of a wetland that have been excavated by waves or flowing water. These areas can provide habitat for fishes and invertebrates.

Debris jams. A debris jam is an accumulation of drift wood and other flotage across a channel that partially or completely obstructs surface water flow.

Filamentous macroalgae and algal mats. Macroalgae occurs on benthic sediments and on the water surface of all types of wetlands. Macroalgae are important primary producers, representing the base of the food web in some wetlands. Algal mats can provide abundant habitat for macro-invertebrates, amphibians, and small fishes.

Non-vegetated flats (sandflats, mudflats, gravel flats, etc.). A flat is a non-vegetated area of silt, clay, sand, shell hash, gravel, or cobble at least 10 m wide and at least 30 m long that adjoins the wetland foreshore and is a potential resting and feeding area for fishes, shorebirds, wading birds, and other waterbirds. Flats can be similar to large bars (see definitions of point bars and in-channel bars below), except that they lack the convex profile of bars and their compositional material is not as obviously sorted by size or texture.

Pannes or pools on floodplain. A panne is a shallow topographic basin lacking vegetation but existing on a well-vegetated wetland plain. Pannes fill with water at least seasonally due to overland flow. They commonly serve as foraging sites for waterbirds and as breeding sites for amphibians.

Plant hummocks or sediment mounds. Hummocks are mounds created by plants along the banks and floodplains of tidal systems created by the collection of sediment and biotic material around wetland plants. Hummocks are typically less than 1m high. Sediment mounds are similar to hummocks but lack plant cover. They are depositional features formed from repeated flood flows depositing sediment on the floodplain.

Point bars and in-channel bars. Bars are sedimentary features within intertidal channels. They are patches of transient bedload sediment that form along the inside of meander bends or in the middle of straight channel reaches. They sometimes support vegetation. They are convex in profile and their surface material varies in size from small on top to larger along their lower margins. They can consist of any mixture of silt, sand, gravel, cobble, and boulders.

Pools or depressions in channels. Pools are areas along tidal channels that are much deeper than the average depths of their channels and that tend to retain water longer than other areas of the channel during periods of low or no surface flow.

Secondary channels on floodplains or along shorelines. Channels confine estuarine flow. A channel consists of a bed and its opposing banks, plus its floodplain. Estuarine wetlands can have a primary channel, and one or more secondary channels of varying sizes that convey tidal flows.

Shellfish beds (living). Oysters, clams and mussels are common bivalves that create beds on the banks and bottoms of wetland systems. Shellfish beds influence the condition of their environment by affecting flow velocities, providing substrates for plant and animal life, and playing particularly important roles in the uptake and cycling of nutrients and other water-borne materials.

Soil cracks. Repeated wetting and drying of fine grain soil that typifies some wetlands can cause the soil to crack and form deep fissures that increase the mobility of heavy metals, promote oxidation and subsidence, while also providing habitat for amphibians and macroinvertebrates. Cracks must be a minimum of 1 inch deep to qualify.

Standing snags. Tall, woody vegetation, such as trees and tall shrubs, can take many years to fall to the ground after dying. These standing "snags" provide habitat for many species of birds and small mammals. Any standing, dead woody vegetation within the AA that is at least 3 m tall is considered a snag.

Submerged vegetation. Submerged vegetation consists of aquatic macrophytes such as *Zostera marina* (eelgrass) 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. Submerged vegetation can strongly influence nutrient cycling while providing food and shelter for fish and other organisms.

Structural Patch Type Worksheet for Estuarine Wetlands

Circle each type of patch that is observed in the AA and enter the total number of observed patches in the worksheet below.

STRUCTURAL PATCH TYPE (circle for presence)	**Estuarine**
Minimum Patch Size	**3 m^2**
Abundant wrackline or organic debris in channel, on floodplain, or across depressional wetland plain	**1**
Animal mounds and burrows	**1**
Bank slumps or undercut banks in channels or along shoreline	**1**
Debris jams	**1**
Filamentous macroalgae or algal mats	**1**
Non-vegetated flats or bare ground (sandflats, mudflats, gravel flats, etc.)	**1**
Pannes or pools on floodplain	**1**
Plant hummocks and/or sediment mounds	**1**
Point bars and in-channel bars	**1**
Pools or depressions in channels (wet or dry channels)	**1**
Secondary channels on floodplains or along shorelines	**1**
Shellfish beds (living)	**1**
Soil cracks	**1**
Standing snags (at least 3 m tall)	**1**
Submerged vegetation	**1**
Total Possible	**15**
No. Observed Patch Types (enter here and use in Table 14 below)	

Table 14: Rating of Structural Patch Richness.

Rating	No. of Patch Types
A	≥ 9
B	6 – 8
C	3 – 5
D	≤ 2

Metric 2: Topographic Complexity

Definition: Topographic complexity refers to the micro- and macro-topographic relief and variety of elevations within a wetland due to physical features and elevation gradients. Table 15 indicates the range of topographic features that occur in riverine wetlands.

Table 15: Typical indicators of Macro- and Micro-topographic Complexity

Wetland Type	Examples of Topographic Features
Estuarine	channels large and small, ditches, islands, bars, pannes, potholes, natural and unnatural levees or dikes, shellfish beds, hummocks, bank slumps, first-order tidal channels, soil cracks, partially buried debris, plant hummocks, burrows, animal tracks

Worksheet for AA Topographic Complexity

At two locations in the AA, make a sketch of the profile from the AA boundary to AA boundary. Try to capture the major channels, slopes and intervening micro-topographic relief. Based on these sketches and the profiles in Figure 8, choose a description in Table 16 that best describes the overall topographic complexity of the AA.

North to South
East to West

Figure 8: Scale-independent schematic profiles of Topographic Complexity.
Each profile A-D represents a characteristic portion of a cross-section through an AA.

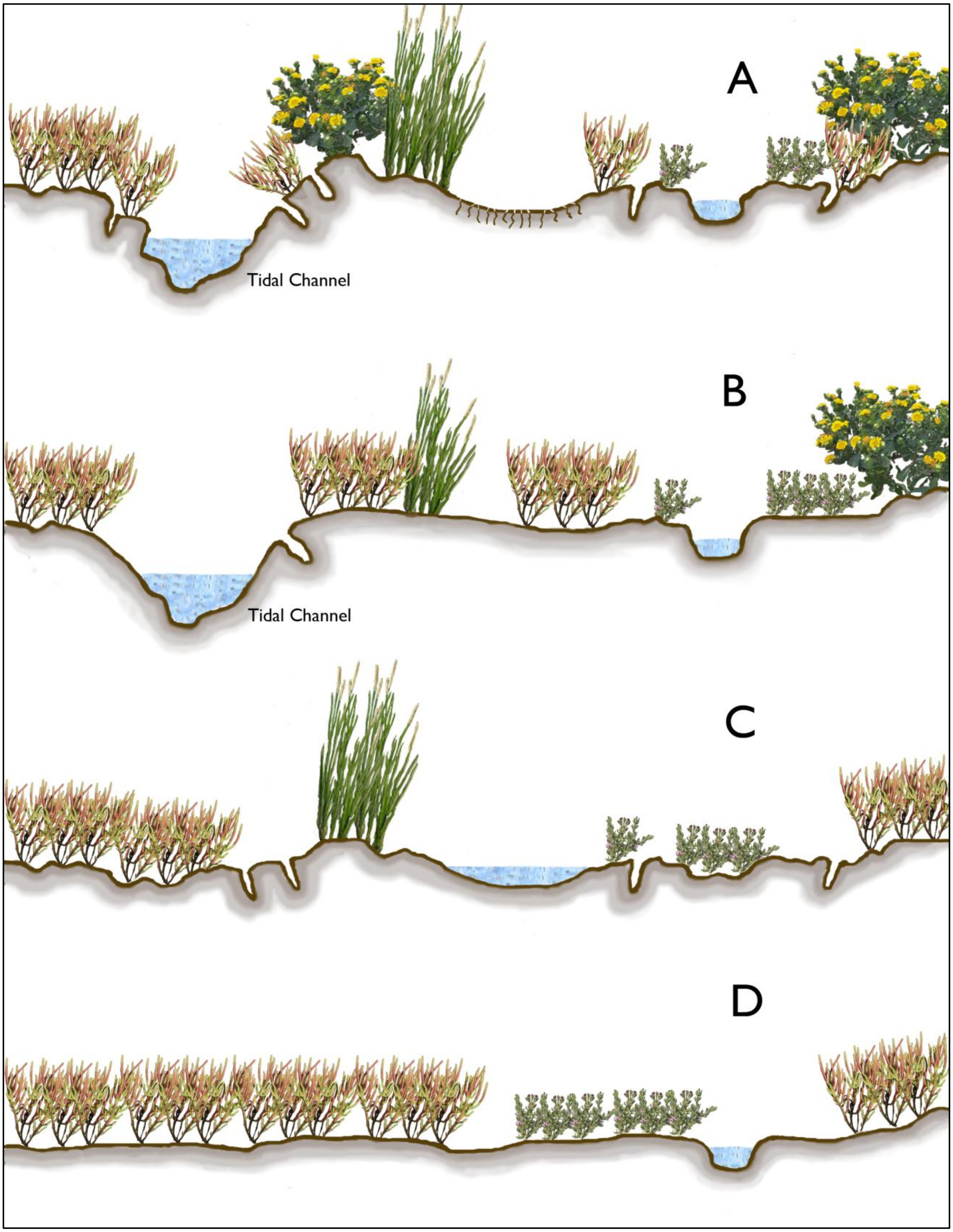


Table 16: Rating of Topographic Complexity for Estuarine Wetlands.

Rating	Alternative States (based on diagrams in Figure 8 above)
A	The vegetated plain of the AA in cross-section has well-formed tidal channels that are well-drained during ebb tide and a variety of micro-topographic features created by plants, animal tracks, cracks, partially buried debris, retrogressing channels (filling-in with sediment and plants), natural and unnatural levees along channels, potholes and pannes that together comprise a complex array of ups and downs resembling diagram A in Figure 8.
B	The vegetated plain of the AA has channels and a variety of micro-topographic features as described above for "A" but they are less abundant and/or they comprise less variability in elevation overall, as illustrated in diagram B of Figure 8.
C	The vegetated plain of the AA has a variety of micro-topographic features as described above for "A" but lacks well-formed tidal channels that are well-drained during ebb tide. If channels exist, they mostly do not drain well or are filling-in with sediment. The plain overall resembles diagram C of Figure 8.
D	The vegetated plain of the AA has little or no micro-topographic relief and few or no well-formed channels. The plain resembles diagram D of Figure 8.

Attribute 4: Biotic Structure

Metric 1: Plant Community Metric

Definition: The Plant Community Metric is composed of three submetrics: Number of Plant Layers, Number of Co-dominant Plant Species, and Percent Invasion. A thorough reconnaissance of an AA is required to assess its condition using these submetrics. The assessment for each submetric is guided by a set of Plant Community Worksheets. The Plant Community metric is calculated based on these worksheets.

A "plant" is defined as an individual of any vacular macrophyte species of tree, shrub, herb/forb, or fern, whether submerged, floating, emergent, prostrate, decumbent, or erect, including non-native (exotic) plant species. Mosses and algae are not included among the species identified in the CRAM Manual's Appendix. For the purposes of CRAM, a plant "layer" is a stratum of vegetation indicated by a discreet canopy at a specified height that comprises at least 5% of the area of the AA where the layer is expected.

Non-native species owe their occurrence in California to the actions of people since shortly before Euroamerican contact. Many non-native species are now *naturalized* in California, and may be widespread in occurrence. "Invasive" species are non-native species that "(1) are not native to, yet can spread into, wildland ecosystems, and that also (2) displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes" (CalIPC 2012). CRAM uses the California Invasive Plant Council (CalIPC) list to determine the invasive status of plants, with augmentation by regional experts.

Submetric A: Number of Plant Layers Present

To be counted in CRAM, a layer must cover at least 5% of *the portion of the AA that is suitable for the layer*. This would be the littoral zone of estuarine wetlands for the one aquatic layer, called "floating." The "short," "medium," and "tall" layers might be found throughout the non-aquatic areas of each wetland class, except in areas of exposed bedrock, mudflat, beaches, active point bars, etc. The "very tall" layer is usually expected to occur along the backshore.

It is essential that the layers be identified by the actual plant heights (i.e., the approximate maximum heights) of plant species in the AA, regardless of the growth potential of the species. For example, a young gumplant less than 0.3 m tall would belong to the "short" layer, even though in the future the same individual gumplant might belong to the "medium or tall" layer. Some species might belong to multiple plant layers. For example, areas of pickleweed of all different heights might collectively represent two non-aquatic layers in an estuarine AA.

It should be noted that widespread species may occupy different layers in different parts of California, and the identification of dominant species must be based on an identification of the actual species present in the AA.

Layer definitions:

Floating Layer. This layer includes rooted aquatic macrophytes such as *Ruppia cirrhosa* (ditchgrass), *Ranunculus aquatilis* (water buttercup), and *Potamogeton foliosus* (leafy pondweed) that create floating or buoyant canopies at or near the water surface that shade the water column. This layer also includes non-rooted aquatic plants such as *Lemna* spp. (duckweed) and *Eichhornia crassipes* (water hyacinth) that form floating canopies.

Short Vegetation. This layer has a maximum height of 30 cm. It includes small emergent vegetation and plants. It can include young forms of species that grow taller as well. Vegetation that is naturally short in its mature stage includes *Distichlis spicata* (saltgrass), *Jaumea carnosa*, and *Frankenia salina*.

Medium Vegetation. This layer never exceeds 75 cm in height. It commonly includes emergent vegetation such *Sarcocornia virginica* (pickleweed), *Atriplex* spp. (saltbush), rushes (*Juncus* spp.), and *Rumex crispus* (curly dock).

Tall Vegetation. This layer never exceeds 1.5 m in height. It usually includes the tallest emergent vegetation and the larger shrubs. Examples include *Rubus ursinus* (California blackberry), *Spartina foliosa* (cordgrass)

Very Tall Vegetation. This layer is reserved for plants that are taller than 1.5 m. Examples include *Typha latifolia* (broad-leaved cattail), *Schoenoplectus californicus* (bulrush) and *Baccharis piluaris* (coyote brush).

Special Note:

**Standing (upright) dead or senescent vegetation from the previous growing season can be used in addition to live vegetation to assess the number of plant layers present. However, the lengths of prostrate stems or shoots are disregarded. In other words, fallen vegetation should not be "held up" to determine the plant layer to which it belongs. The number of plant layers must be determined based on the way the vegetation presents itself in the field.*

**If the AA supports less that 5% plant cover and/or no plant layers are present (e.g. some concrete channels), automatically assign a score of "D" to the plant community metric*

Figure 9: Flow Chart to Determine Plant Dominance

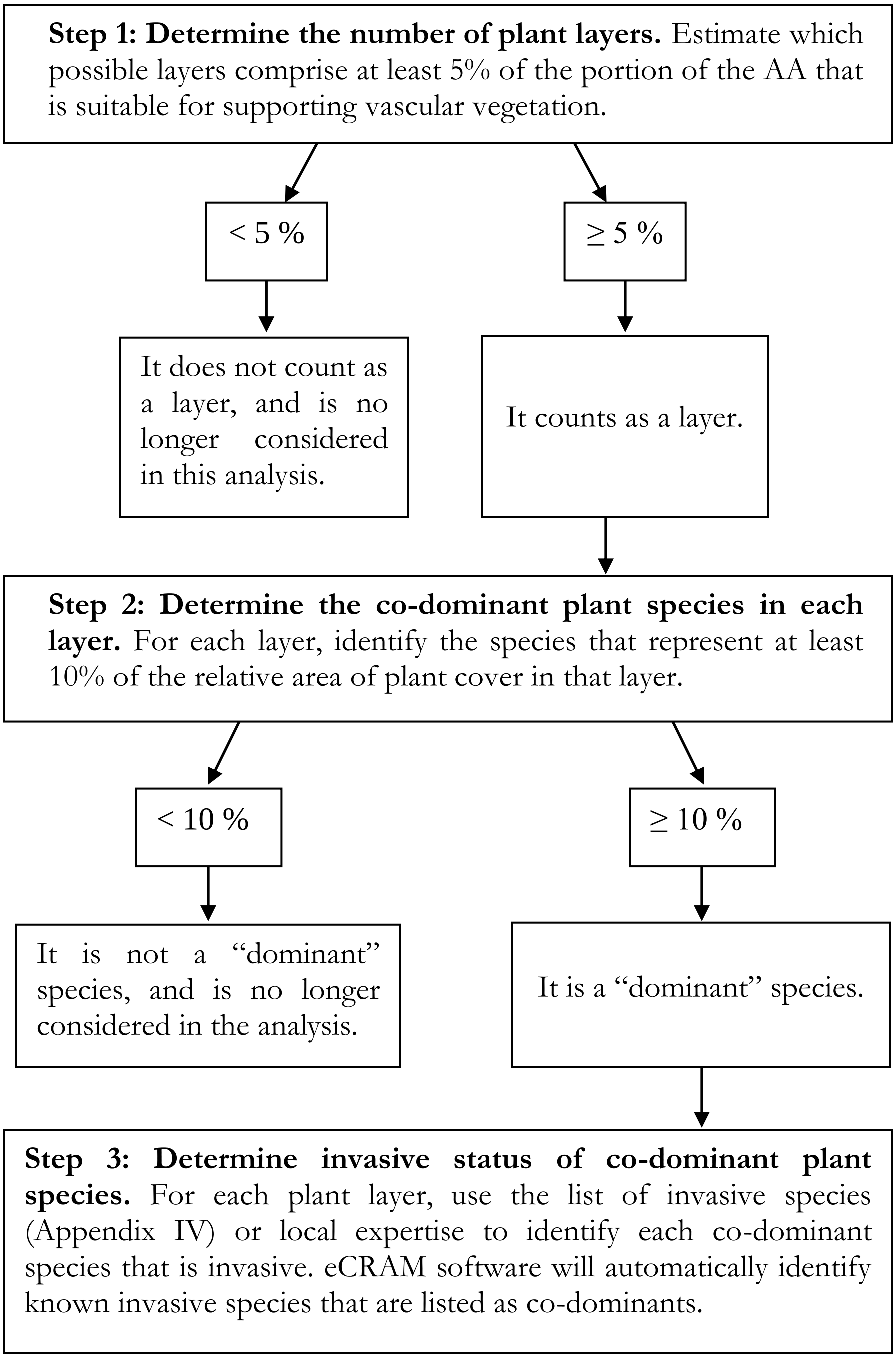


Table 17: Summary of plant layer heights for Estuarine wetlands

Wetland Type	Plant Layers				
	Aquatic	Semi-aquatic and Riparian			
	Floating	Short	Medium	Tall	Very Tall
Perennial Saline Estuarine	On Water Surface	<0.3 m	0.3 – 0.75 m	0.75 – 1.5 m	>1.5 m

Submetric B: Number of Co-dominant Species

For each plant layer in the AA, every species represented by living vegetation that comprises at least 10% relative cover within the layer is considered to be dominant in that layer, and should be recorded in the appropriate part of the Plant Community Metric Worksheet. Only living vegetation in growth position is considered in this metric. Dead or senescent vegetation is disregarded. When identifying the total number of dominant species in an AA, count each species only once; do not count a species multiple times if it is found in more than one layer.

Submetric C: Percent Invasion

The number of invasive co-dominant species for all plant layers combined is assessed as a percentage of the total number of co-dominants, based on the results of the Number of Co-dominant Species sub-metric. The invasive status for California wetland and riparian plant species is based on the Cal-IPC list. However, the best professional judgment of local experts may be used in addition to the Cal-IPC list to determine whether or not a co-dominant species is invasive in a very localized context.

Plant Community Metric Worksheet: Co-dominant species richness
(A dominant species represents ≥10% *relative* cover)

Special Note:

** Combine the counts of co-dominant species from all layers to identify the total species count. Each plant species is only counted once when calculating the Number of Co-dominant Species and Percent Invasion submetric scores, regardless of the numbers of layers in which it occurs.*

Floating or Canopy-forming	Invasive?	Short (<0.3 m)	Invasive?
Medium (0.3 – 0.75 m)	**Invasive?**	**Tall (0.75 – 1.5 m)**	**Invasive?**
Very Tall (>1.5 m)	**Invasive?**		
		Total number of co-dominant species for all layers combined (enter here and use in Table 18)	
		Percent Invasion (enter here and use in Table 18)	

Table 18: Ratings for submetrics of Plant Community Metric.

Rating	Number of Plant Layers Present	Number of Co-dominant Species	Percent Invasion
Perennial Saline Wetlands			
A	4 – 5	≥ 5	0 – 15%
B	2 – 3	4	16 – 30%
C	1	2 – 3	31 – 45%
D	0	0 – 1	46 – 100%
Perennial Non-Saline			
A	4 – 5	≥ 7	0 – 20%
B	3	5 – 6	21 – 35%
C	1 – 2	3 – 4	36 – 60%
D	0	0 – 2	61 – 100%

Metric 2: Horizontal Interspersion

Definition: Horizontal interspersion refers to the variety and interspersion of plant "zones." Plant zones are obvious multi-species associations (in some cases zones may be plant monocultures; for instance pickleweed) that remain relatively constant in makeup throughout the AA and which are arrayed along gradients of elevation, moisture, or other environmental factors that seem to affect the plant community organization in a two-dimensional plan view. Examples may include "marsh channel edge" composed of cordgrass and pickleweed, or "levee" composed of gumplant and frankenia. In all cases, the plant "zones" are defined by a relatively unvarying combination of physiognomy and species composition. Think of each plant zone as extending from the top of the tallest plants down through all of the vegetation to ground level. A zone may include groups of species of multiple heights, and this metric is not based on the layers established in the Plant Community Submetric A.

Saltmarsh plant communities are seldom completely uniform over large expanses. The dynamics of salt marsh plant associations can be subtle and lead to variations in the abundances of common species within different areas of an AA. The differences in relative dominance among plant species across an AA may reflect ecological differences supporting an identification of different "plant zones." For example, a salt marsh plant zone that is dominated by *Sarcocornia pacifica* with some included *Jaumea carnosa* and *Distichlis spicata* may be ecologically differentiable from a similar zone dominated by *Distichlis*. The possible ecological significance of micro-scale variation in plant dominance should be considered carefully in scoring this metric.

Interspersion is essentially a measure of the number of distinct zones and the amount of edge between them. It is important to base the assessment of this metric on a combination of aerial image interpretation and field reconnaissance. The user should focus on the major zones that are visible in plan view (birds eye view) at a height from which the whole AA fills the view. An "A" condition means BOTH more zones AND a greater degree of interspersion, and the departure from the "A" condition is proportional to BOTH the reduction in the numbers of zones AND their interspersion.

Horizontal Interspersion Complexity Worksheet.

Use the spaces below to make a quick sketch of the AA in plan view, outlining the major plant zones (this should take no longer than 10 minutes). Assign the zones names and record them on the right. Based on the sketch, choose a single profile from Figure 10 that best represents the AA overall.

	Assigned zones: **1)** **2)** **3)** **4)** **5)** **6)**

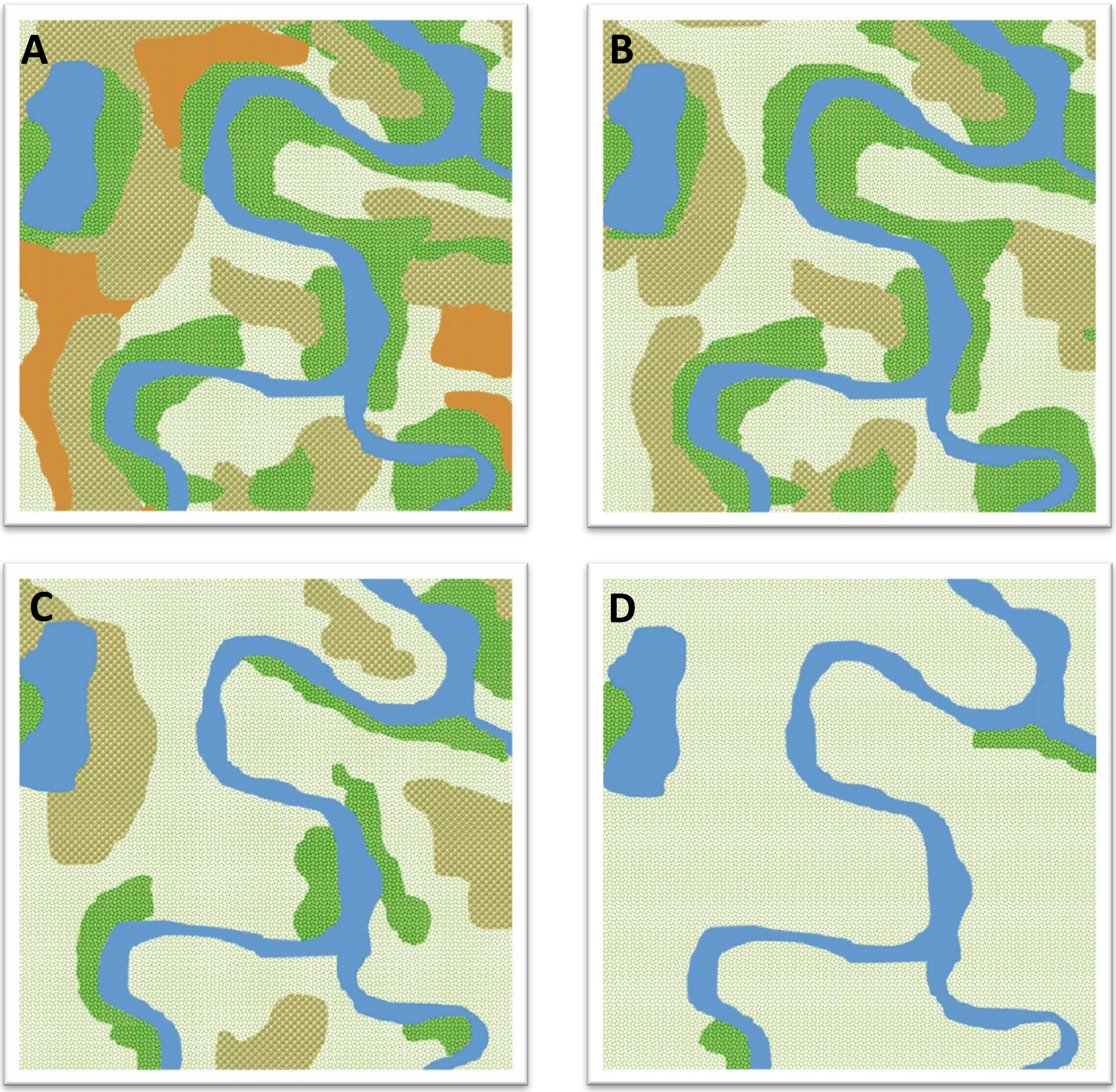


Figure 10: Schematic diagrams of varying degrees of interspersion of plant zones and patches for Perennial Saline Estuaries. In these diagrams, each plant zone or patch type has a unique color and comprises at least 5% of the AA.

Table 19: Rating of Horizontal Interspersion for Estuarine wetlands

Rating	Alternative States
A	AA has a high degree of plan-view interspersion.
B	AA has a moderate degree of plan-view interspersion.
C	AA has a low degree of plan-view interspersion.
D	AA has minimal plan-view interspersion.

Metric 3: Vertical Biotic Structure

Definition: The vertical component of biotic structure consists of the interspersion and complexity of plant layers. For estuarine wetlands this metric is assessed as the amount of living vegetation, entrained litter, or detritus across the marsh plain and the amount of space beneath it.

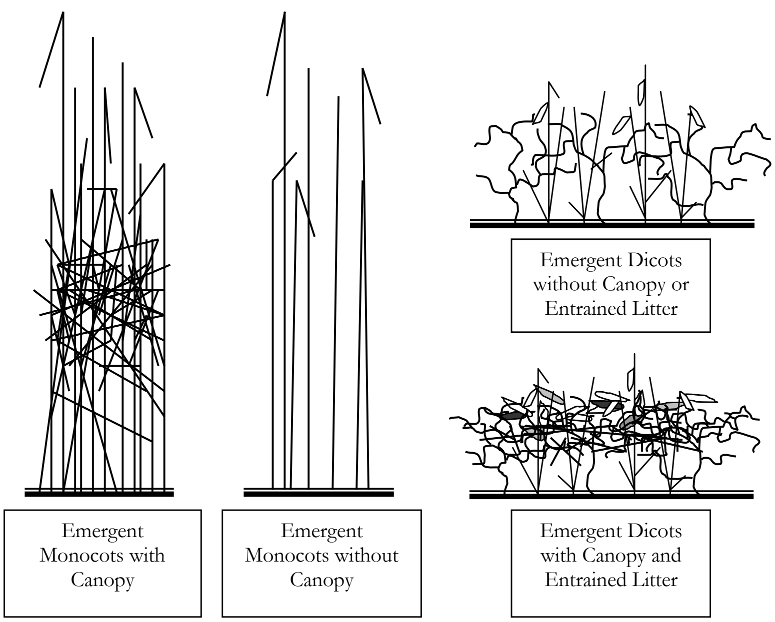


Figure 11: Schematic diagrams of plant canopies and entrained litter used to assess Vertical Biotic Structure in Estuarine wetlands

Table 20: Rating of Vertical Biotic Structure for Estuarine wetlands

Rating	Alternative States
A	**Most** of the vegetated plain of the AA **has** a dense canopy of living vegetation, entrained litter or detritus forming a "ceiling" of cover 10-20 cm of above the wetland surface that shades the surface and can provide abundant cover for wildlife.
B	**Less than half** of the vegetated plain of the AA **has** a dense canopy of vegetation, entrained litter or detritus as described in "A" above; OR **More than half** of the vegetated plain **has** a dense canopy of living vegetation, entrained litter or detritus, but the ceiling it forms is **much less** than 10-20 cm above the ground surface.
C	**Less than half** of the vegetated plain of the AA **has** a dense canopy of living vegetation or entrained litter or detritus **AND** the ceiling it forms is **much less** than 10-20 cm above the ground surface.
D	**Most** of the AA **lacks** a dense canopy of living vegetation, entrained litter or detritus.

Guidelines to Complete the Stressor Checklists

Definition: A stressor, as defined for the purposes of the CRAM, is an anthropogenic perturbation within a wetland or its environmental setting that is likely to negatively impact the condition and function of the CRAM Assessment Area (AA). A disturbance is a natural phenomenon that affects the AA.

There are four underlying assumptions of the Stressor Checklist: (1) deviation from the best achievable condition can be explained by a single stressor or multiple stressors acting on the wetland; (2) increasing the number of stressors acting on the wetland causes a decline in its condition (there is no assumption as to whether this decline is additive (linear), multiplicative, or is best represented by some other non-linear mode); (3) increasing either the intensity or the proximity of the stressor results in a greater decline in condition; and (4) continuous or chronic stress increases the decline in condition.

The process to identify stressors is the same for all wetland types. For each CRAM attribute, a variety of possible stressors are listed. Their presence and likelihood of significantly affecting the AA are recorded in the Stressor Checklist Worksheet. For the Hydrology, Physical Structure, and Biotic Structure attributes, the focus is on stressors operating within the AA or within 50 m of the AA. For the Buffer and Landscape Context attribute, the focus is on stressors operating within 500 m of the AA. More distant stressors that have obvious, direct, controlling influences on the AA can also be noted.

Table 21: Wetland disturbances and conversions.

<table>
<tr><td>Has a major disturbance occurred at this wetland?</td><td>Yes</td><td colspan="2">No</td><td colspan="2"></td><td></td></tr>
<tr><td>If yes, was it a flood, fire, landslide, or other?</td><td>flood</td><td colspan="2">fire</td><td colspan="2">landslide</td><td>other</td></tr>
<tr><td>If yes, then how severe is the disturbance?</td><td colspan="2">likely to affect site next 5 or more years</td><td colspan="2">likely to affect site next 3-5 years</td><td colspan="2">likely to affect site next 1-2 years</td></tr>
<tr><td rowspan="4">Has this wetland been converted from another type? If yes, then what was the previous type?</td><td colspan="2">depressional</td><td colspan="2">vernal pool</td><td colspan="2">vernal pool system</td></tr>
<tr><td colspan="2">non-confined riverine</td><td colspan="2">confined riverine</td><td colspan="2">seasonal estuarine</td></tr>
<tr><td colspan="2">perennial saline estuarine</td><td colspan="2">perennial non-saline estuarine</td><td colspan="2">wet meadow</td></tr>
<tr><td colspan="2">lacustrine</td><td colspan="2">seep or spring</td><td colspan="2">playa</td></tr>
</table>

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Point Source (PS) discharges (POTW, other non-stormwater discharge)		
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)		
Flow diversions or unnatural inflows		
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)		
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology		
Comments		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Filling or dumping of sediment or soils **(N/A for restoration areas)**		
Grading/ compaction **(N/A for restoration areas)**		
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed		
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)		
Heavy metal impaired (PS or Non-PS pollution)		
Pesticides or trace organics impaired (PS or Non-PS pollution)		
Bacteria and pathogens impaired (PS or Non-PS pollution)		
Trash or refuse		
Comments		

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer		
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present	Significant negative effect on AA
Urban residential		
Industrial/commercial		
Military training/Air traffic		
Dams (or other major flow regulation or disruption)		
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)		
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)		
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

CRAM Score Guidelines

Table 22: 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: $\left(\text{Buffer Condition} \times \left(\text{\% AA with Buffer} \times \text{Average Buffer Width} \right)^{½} \right)^{½} + \text{Landscape Connectivity}$ • 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, and then calculate the average Topographic Complexity score for all six replicates.
Step 3: Calculate final Attribute Score	For each Attribute, divide its Raw Attribute 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.