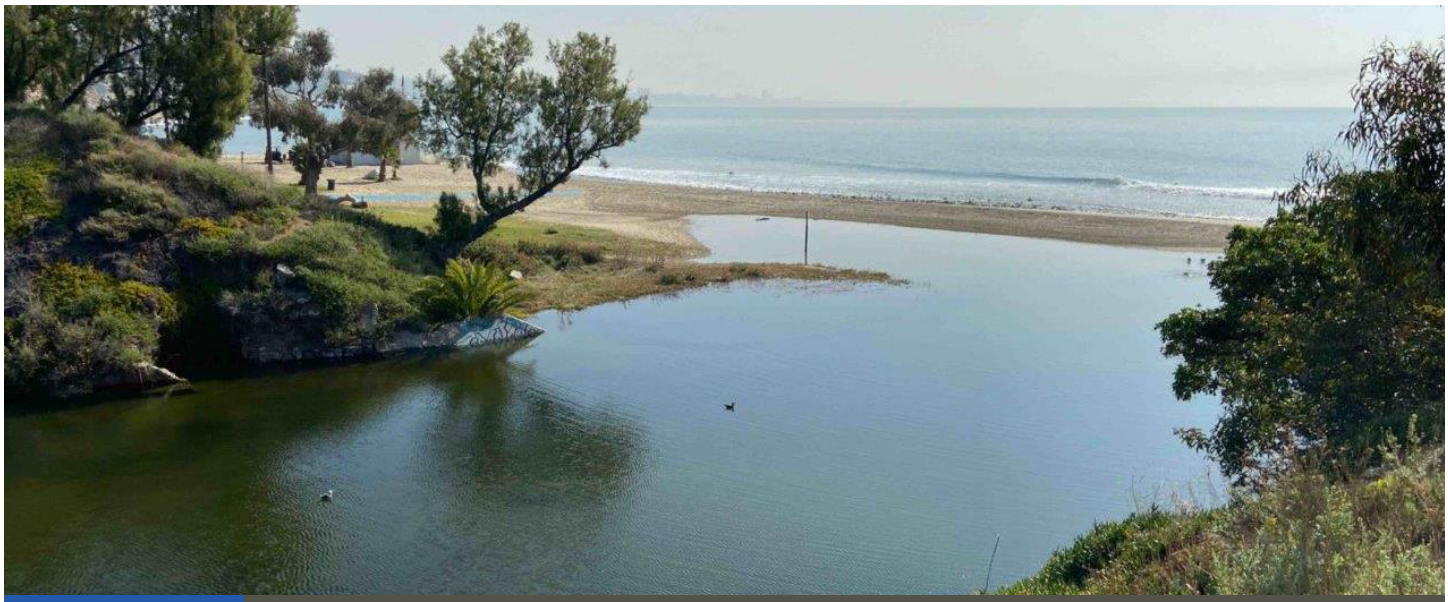

Standard Operating Procedures (7.1): California Rapid Assessment Method

March 2021

Prepared for the United States Environmental Protection Agency

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Standard Operating Procedures:
California Rapid Assessment Method (CRAM)

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Protocol Suitability Evaluation

A habitat suitability table containing appropriate coastal wetland habitat types (of those evaluated) to implement several California Rapid Assessment Method (CRAM) modules is displayed in Table 1. A comparative assessment of cost, effort, and data quality are shown in Table 2. A matrix of additional detailed categorical evaluations CRAM protocols can be found in Appendix 7.1A.

Table 1. Appropriate habitat types for CRAM survey protocols.

	Habitat Types					
Survey Protocol	**Tidal Channel**	**Mud/sand flat**	**Emergent salt marsh**	**Non-tidal salt marsh**	**Salt pan**	**'Degraded' / fill**
Estuarine CRAM	X (partial)	X (partial)	X			
Bar-Built CRAM	X (partial)	X (partial)	X	X		
Depressional CRAM				X		X
Slope CRAM				X		X
Playa CRAM					X	
Vernal Pool CRAM				X		X

Table 2. Categorical assessment of cost/effort and data quality for CRAM survey protocols.

	Evaluation Metric	CRAM Survey	Notes
Time / Effort	Office Preparation Time (per AA)	> 60 minutes	Identification of CRAM Assessment Area locations, background research, and Attributes 1 and 2 (using maps)
	Equipment Construction Time (one time)	Not Applicable	----
	Field Time (per AA)	> 120 minutes	One AA usually takes approximately three hours to complete
	Laboratory Time (per AA)	Not Applicable	----
	Post-Survey Processing / QAQC Time	10-30 minutes	Mainly data entry and raw score computation
	Minimum Repetition (site-dependent)	Few Repetitions	Depends on size of site, variability of Assessment Area scores and quantity of hydrologic sub-units
	Relative Cost (equipment and supplies)	< $15	----
Survey / Data Quality	Accuracy (at a survey area level)	Medium	----
	Precision (at a survey area level)	High	----
	Qualitative-Quantitative Score	Qualitative	----
	Subjectivity-Objectivity Score	Subjective	----

Resulting Data Types

The application of CRAM survey protocols will yield a quantitative final “Index” score between 25 and 100 for each individual Assessment Area (AA). Additionally, in each AA, scores will be recorded for a variety of metrics and attributes which can be analyzed independently or as part of the final score. Resulting data may be averaged for multiple AAs within the same hydrologic unit to provide a broad-scale condition score which may be compared to statewide quartiles as an assessment of regional or

project-level health. As CRAM scores are standardized, they may be compared across wetland types. For more details on CRAM assessment and analyses, refer to the CRAM Technical Bulletin (2019).

Objective

The following description of the summary and objectives of CRAM surveys are directly cited from the CRAM User Manual (CWMW 2012a):

> "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...
>
> A consortium of local, state and federal authorities has been developing new tools to increase the State's capacity to monitor its wetlands. Level 2 consists of rapid assessment of wetland condition in relation to the broadest suite possible of ecological and social services and beneficial uses. 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…
>
> 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. 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)."

More details on CRAM technical resources, manuals, SOPs, and documents can be found on the website: https://www.cramwetlands.org/documents.

Equipment

Equipment and supplies needed for this survey include:

1. GPS
2. Camera or camera app on a phone (e.g., "Solocator")
3. Range finder (preferable) or two 100 m transect tapes
4. CRAM Field Guide (required) and User Manual (optional)
5. Datasheets (Appendix 7.1B) and site maps with scale showing assessment area (an example can be found in Appendix 7.1C)

6. Meter stick to measure vegetation heights

Field Preparation

CRAM surveys for any of the wetland modules should only be conducted by trained practitioners who have received the corresponding CRAM training prior to any field work. For more information see www.cramwetlands.org. Batteries for all electronic devices should be checked and replaced as needed, and relevant data sheets should be printed and attached to the clipboards. Note that Assessment Areas (AA)'s should be defined *a priori* using mapping software (e.g., Google Earth, ArcGIS Pro, QGIS, etc.). Follow the User Manual requirements for defining an AA. Maps should be printed of each AA (Appendix 7.1C), including a scale bar, and attached to the datasheets. The final location of AAs can be adjusted in the field.

The following list describes the overarching steps for using CRAM (CWMW 2012a, pp 15):

Step 1. Assemble background information about the management of the wetland.
Step 2. Classify the wetland using CRAM typology.
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 (see below).
Step 7. Complete CRAM assessment scores and QA/QC Procedures.
Step 8. Upload CRAM results into statewide information data management system.

For details about each of the steps and what they entail, refer to the User Manual (CWMW 2012) or the corresponding Field Book (e.g., CWMW 2012b and CWMW 2012c).

Field Methods

Detailed field methods should follow protocols described in the User Manual (CWMW 2012) and the Field Book that corresponds with the type of wetland being surveyed for CRAM (e.g., CWMW 2012b, CWMW 2012c). Appendix 7.1B contains an example copy of the Estuarine CRAM datasheets, and Appendix 7.1C is an example of appropriate maps for one AA.

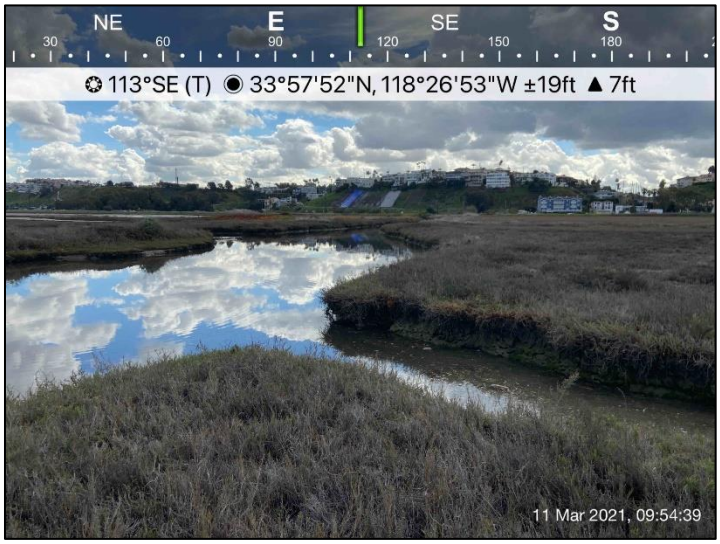

Figure 1. Example georeferenced photograph.

Helpful hint: In addition to the protocols in the field manual, marking the centroid of the AA with a PVC pipe will assist in finding the site again, and in permanently marking the location.

Additionally, geotagged and watermarked photographs using a phone application such as "Solocator" can help take georeferenced bearing photographs (Figure 1).

Laboratory Methods

Not applicable.

Data Entry and QAQC Procedures

Under no circumstances should anyone modify procedures to establish CRAM AAs, combine any aspects of two or more CRAM modules, or modify CRAM Attributes, Metrics, Metric descriptors, scoring tables, or procedures for calculating scores (CWMW 2019). Doing so will invalidate the CRAM assessment.

Data should be entered in the field using the appropriate data sheets (e.g., Appendix 7.1B). All required fields should be completed in full, and the data recorder should assign their name at the top of the document(s). Data should be transferred to the appropriate electronic database within three days, and the hard copies filed in labeled binders. It is also recommended to scan and store copies of raw data sheets electronically. Electronic copies of all data should be housed on an in-house dedicated server and backed up to a cloud-based or off-site server. Hard copies should be saved for five years. Electronic copies should be saved indefinitely.

Quality Assurance and Quality Control (QAQC) procedures should be conducted on all data. QAQC procedures should be conducted by the QA Officer and include a thorough review of all entries, double checking of all formulas or macros, and a confirmation that all data sheets and field notes are filed appropriately with electronic back-up copies available. QAQC should also verify that the entered data match the hard copies of the field data sheets. Any discrepancies should be corrected, and the initial data entry technician notified. QAQC'ed CRAM data should also be entered into the eCRAM public database through: www.cramwetlands.org. Only scores that are consistent with all QAQC requirements should be used to support regulatory and grant funding decisions; entry into eCRAM, for modules supported by eCRAM, is strongly encouraged (CWMW 2019).

Data Analyses

CRAM is intended for cost-effective ambient and project-specific 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. CRAM is intended to assess the overall condition of wetlands and streams (i.e., functional capacity); CRAM does not measure functions (CWMW 2019). In many cases, CRAM must be used in conjunction with Level 1 and 3 methods to provide the needed breadth and depth of assessment.

Additional CRAM applications could include (CWMW 2012a):

- *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;
- *Comparing* to ambient or reference systems; and
- *Assisting* in the monitoring and assessment of restoration or mitigation projects by providing a rapid means of checking progress along restoration trajectories.

Data can be evaluated by combining metric scores into an attribute score. The four attribute scores are averaged for an Index score for a given AA. Multiple AA Index scores can be averaged for a general condition assessment of that particular wetland habitat area. Care should be taken to use the data only as recommended by the User Manual (CWMW 2012a) and the Technical Bulletin (CWMW 2019) and not for purposes such as mitigation requirements. Refer to CWMW 2019 for appropriate confidence intervals.

Health and Safety Precautions

Not applicable.

References and Applicable Literature

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

California Wetlands Monitoring Workgroup (CWMW). 2012b. "Perennial Estuarine Wetlands Field Book." *California Rapid Assessment Method for Wetlands.* Version 6.0.

California Wetlands Monitoring Workgroup (CWMW). 2012c. "Depressional Wetlands Field Book." *California Rapid Assessment Method for Wetlands and Riparian Areas.* Version 6.0.

California Wetland Monitoring Workgroup (CWMW). 2019. Using the California Rapid Assessment Method (CRAM) for Project Assessment as an Element of Regulatory, Grant, and other Management Programs. Technical Bulletin – Version 2.0, 85 pp.

Fetscher, A.E., Collins, J., Grenier, L., Clark, R., Sutula, M. 2005. "Quality Assurance Project Plan for the Development of a Wetland Rapid Assessment Method in California: Phase II". *Prepared for the United States Environmental Protection Agency.*

Contact Information

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APPENDIX 7.1A

	Evaluation Metric	CRAM Survey	Notes
	Correlation to L2 CRAM	All Attributes	(same protocol)
Personnel Requirements	Specialty Equipment or Clothing Required	No Specialty Items	----
	Ease of Transport (amount or weight of supplies)	Some Items / Moderate	Only basic items are necessary (e.g., GPS, datasheet, clipboard)
	Ease of Implementation	Moderate	Depends on complexity of Assessment Area; usually approximately three hours per AA
	Expertise / Skill Level	Specific Training Required	Registration for CRAM trainings may be found at http://www.cramwetlands.org/training
	Number of Personnel	2 or more	Due to some subjectiveness of the survey methods, more scientific opinions will yield a higher degree of accuracy and reduce the subjectivity
	Training Requirements	CRAM certification training	Registration for CRAM trainings may be found at http://www.cramwetlands.org/training
	Seasonality of Survey Time	Spring and Fall	Varies based on the individual wetland module being applied.
	Suggested Frequency	Semi-annual	Dependent on the monitoring program objectives
Survey / Data Quality	Type of Output	Numerical	----
	Active or Passive Monitoring Style	Passive	----
	Specialty Computer Software Required	No	Mapping software (open source) is recommended for ease in mapping steps, though not required
	Availability of Online / External Resources	Many	Most materials may be found at http://www.cramwetlands.org/
Potential Limitations	Wetland Type Applicability	All	Specific modules are available for individual wetland types
	Images or Multi-Media Required	Images Required	----
	Degree of Impact / Disturbance	Low Disturbance	----
	Vegetation Height Limitation	No Limitations	----
	Appropriate for Tidal / Wet Habitats	Yes	----
	Tide Height	Low tide preferred	Must be able to view attributes within intertidal habitat areas
	Regional or Broad Implementation *	Almost Always Used	----
	Potential for Hazards / Risk	Low to No Risk	----
	Restrictions	Special Status Species	----

** based on monitoring literature review*

APPENDIX 7.1B

Basic Information Sheet: Perennial Estuarine Wetlands

Assessment Area Name:	
Project Name:	
Assessment Area ID #:	
Project Site ID #:	**Date:**
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:			**Date:**
Attribute 1: Buffer and Landscape Context (pp. 8-14)			**Comments**
Aquatic Area Abundance (D)	Alpha.	Numeric	
Buffer (based on sub-metrics A-C)			
Buffer submetric A: Percent of AA with Buffer	Alpha.	Numeric	
Buffer submetric B: Average Buffer Width			
Buffer submetric C: Buffer Condition			
Raw Attribute Score = D+[C x (A x B)^{½}]^{½}			**Final Attribute Score = (Raw Score/24) x 100**
Attribute 2: Hydrology Attribute (pp. 15-19)			
	Alpha.	Numeric	
Water Source			
Hydroperiod			
Hydrologic Connectivity			
Raw Attribute Score = sum of numeric scores			**Final Attribute Score = (Raw Score/36) x 100**
Attribute 3: Physical Structure Attribute (pp. 20-25)			
	Alpha.	Numeric	
Structural Patch Richness			
Topographic Complexity			
Raw Attribute Score = sum of numeric scores			**Final Attribute Score = (Raw Score/24) x 100**
Attribute 4: Biotic Structure Attribute (pp. 26-34)			
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 *(numeric average of submetrics A-C)*			
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)			

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	

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: _____ %

Worksheet for calculating average buffer width of AA

Line	**Buffer Width (m)**
A	
B	
C	
D	
E	
F	
G	
H	
Average Buffer Width ***Round to the nearest integer***	

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**
Large Woody Debris	**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	**1**
Shellfish beds (living)	**1**
Soil cracks	**1**
Standing snags (at least 3 m tall)	**1**
Submerged vegetation	**1**
Total Possible	**16**
No. Observed Patch Types (enter here and use in Table 14 below)	

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

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 *Round to the nearest whole number (integer)* (enter here and use in Table 18)	

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. Each zone should comprise as least 5% of the AA. 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)**

Table 21: Wetland disturbances and conversions.

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

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		

APPENDIX 7.1C