State Water Resources Control Board

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TO: Gerald W. Bowes, Ph.D.
Manager, Cal/EPA Scientific Peer Review Program
Office of Research, Planning and Performance

FROM: Bill Orme, Chief
401 Certification and Wetland Program
DIVISION OF WATER QUALITY

DATE: SEP 17 2009

SUBJECT: REQUEST FOR EXTERNAL PEER REVIEWERS: PROPOSED ACCEPTANCE OF THE CALIFORNIA RAPID ASSESSMENT METHOD (CRAM) BY THE STATE WATER RESOURCES CONTROL BOARD AS THE APPROVED MEANS OF ASSESSING WETLAND CONDITION.

The purpose of this peer review is to determine if the CRAM model and CRAM's procedures to identify, characterize, and measure California wetland conditions, are based on sound scientific knowledge, methods, and practices.

On April 15, 2008, the State Water Board approved resolution no. 2008-0026 mandating the development of a policy to protect wetlands. The policy is to include "...an assessment method for collecting wetland data to monitor progress toward wetland protection and to evaluate program development." State Water Board staff proposes that CRAM be recommended for this purpose.

CRAM is an assessment method that has been under development since 2001. It was developed to be used for various purposes, such as wetland management, research, and State and federal regulation.

CRAM was developed through the collaboration of academic and professional contributors, who have critiqued the method over the years. A recent review of CRAM by U.S. Army Corps of Engineers scientists has also been conducted at the request of CRAM's developers. Peer review for publication of some research pertaining to CRAM was conducted by the various journals cited in this peer review request. Despite this body of review and revision, no fully independent peer review of CRAM has been conducted to date.

Because the proposed CRAM for wetlands involves several scientific disciplines, we request that you solicit reviewers with expertise in the following areas:

Wetland science, including expertise in wetland ecology, wetland modeling, wetland assessment, delineation and classification, hydrologic processes, seasonal wetlands, wetland functions, and wetland restoration.

2. Stream science, including expertise in fluvial geomorphology, channel-floodplain dynamics, headwater streams, riparian plant communities, stream functions, and stream bioengineering and other restoration techniques.

3. Watershed management, including expertise in stormwater management, non-point source pollution control strategies, aquatic resource protection, surface water-groundwater interactions, and evaluation of cumulative effects.

Included with this cover letter are four attachments as follows:

1. Attachment 1: Highlights of CRAM
2. Attachment 2: Scientific Issues To Be Addressed By Peer Reviewers
3. Attachment 3: Persons Involved In Developing CRAM Directly or Indirectly
4. Attachment 4: References

The material to be reviewed is available now.

The CRAM documents to be reviewed include the CRAM User's Manual, three Field User's Guides (for estuarine, riverine and depressional wetlands), and the Technical Bulletin for Agency-Specific Guidance.

In Attachment 2, each of the 32 issues which provide focus for the review is cross-referenced to:

(1) Specific language in one or more of the CRAM documents including the User's Manual, the three Field User's Guides, and the Technical Bulletin for Agency-Specific Guidance; and
(2) references identified in Attachment 4 and provided in separate three-ring binder to be forwarded to reviewers.

In certain circumstances, the reference may be a recognized published textbook on the subject but a photocopy of the title page is provided in the binder.

We request the peer review be completed within 30 days. We also request that any communication from the reviewers be addressed to Dr. Gerald Bowes, who can be reached at (916) 341-5567 or via email at gbowes@waterboards.ca.gov. Likewise, all communication from the State Water Board to the reviewers will be through Dr. Bowes.

Attachments (4)

cc: Elizabeth L. Haven
Assistant Deputy Directory
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Ken Harris, Manager
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Division of Water Quality

Attachment 1

HIGHLIGHTS

CALIFORNIA RAPID ASSESSMENT METHOD FOR WETLANDS

I. Need

Large amounts of public funds and energy are being directed to protect and create California wetlands. The results often are disappointing and difficult to assess. Mitigation projects to replace destroyed wetlands have had variable results.

On April 15, 2008, the State Water Board approved Resolution no. 2008-0026 requiring development of a policy to protect wetlands and riparian areas. This resolution emphasizes the need to evaluate the condition of wetlands now and into the future.

The California Rapid Assessment Method for Wetlands (CRAM) is a method to assess and monitor wetland condition statewide. It is designed to be scientifically defensible, standardized, rapid, and cost-effective. It is expected that teams of 2-4 qualified individuals can conduct the necessary field work for CRAM in no more than 4 hours for a given site. It has been verified that CRAM assessments are "repeatable" in that separate teams have been shown to obtain similar assessments on the same site.

The need for a wetlands assessment and monitoring strategy is underscored by the many state and federal agencies who have helped design and test CRAM over the past nine years: California Department of Fish and Game (CDFG); California Coastal Commission; U.S. Environmental Protection Agency (USEPA); U.S. Army Corps of Engineers (USACE); National Oceanic and Atmospheric Administration-National Marine Fisheries Service (NOAA-NMFS), U.S. Fish and Wildlife Service (USFWS) along with many academic and local government contributors.

II. The Nuts and Bolts of It

The primary documentation for CRAM is the CRAM for Wetlands Users Manual and its associated field guides. CRAM is based on a growing body of scientific literature describing rapid assessment of environmental conditions. CRAM's developers believe "None of the existing rapid assessment methods other than CRAM can be applied equally well to all kinds of wetlands in California" (CRAM Manual, Chap. 1.2).

Separate CRAM procedures have been, or are being developed for each of the following seven wetland classes (based on Hydro-Geomorphic Assessment Method (HGM) classes):

1. estuarine,
2. riverine,

3. depressional,
4. slope,
5. lacustrine,
6. playa
7. vernal pools

The first three of these will be covered by this requested external review. These are the only procedures now available for public use. The remainder will be developed sometime over the next few years.

For each wetland class, four features ("attributes") are evaluated in the field and given separate numeric scores:

1. Buffer and Landscape Context;
2. Hydrology;
3. Physical Structure;
4. Biotic Structure.

The individual scores can reveal the source of stressors to a wetland's health. The overall score indicates the condition of the wetland.

III. Phased Implementation

The development of the CRAM procedure for each wetland class will be refined over time. This will allow for CRAM application to more complex settings.

Attachment 2

DESCRIPTION OF SCIENTIFIC TOPICS TO BE ADDRESSED BY REVIEWERS

The statute mandate for external scientific peer review (Health and Safety Code Section 57004) states that the reviewer's responsibility is to determine whether the scientific portion of the proposed rule is based upon "*sound scientific knowledge, methods, and practices.*"

We request that you make this determination for each of the following issues that constitute the scientific basis of CRAM. An explanatory statement is provided for each issue to focus the review.

For those work products which are not proposed rules, as with the subject of this review, reviewers must measure the quality of the product with respect to the same exacting standard as if it was subject to Health and Safety Code Section 57004 requirements.

This Attachment 2 consists of 32 issues which the reviewers are asked to address.

The issues are essentially statements of principles, assumptions, and conclusions. The issues are arranged in five groups according to the relevant chapters of the following basic references:

1. ***California Rapid Assessment Method for Wetlands User's Manual version 5.0.2*** **(cited below as the CRAM Manual). (1. Collins, et al., 2008a)**
2. **CRAM Estuarine, Riverine and Depressional Wetlands Field Books (2,3,4, Collins, et al., 2008b,c,d).**
3. ***Using CRAM To Assess Wetland Projects As An Element of Regulatory And Management Programs Technical Bulletin- June 5, 2009*** **(Technical Bulletin) (5. CWMW, 2009).**

In addition, each issue includes reference where appropriate. Literature references, are numbered in order of citation, and presented in Attachment 4.

GOAL AND USES OF CRAM

CRAM is designed to provide information about the condition of wetlands and to identify the sources of stress that may adversely affect them.

Goal of CRAM*: 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.*

The CRAM Manual (1) and the CWMW Technical Bulletin (5) list various appropriate and inappropriate uses of CRAM. These recommendations are presented in Table 1:

TABLE 1:

Recommended Appropriate Uses of CRAM

a. Ambient assessment of wetland condition.
b. Monitoring of ecological reserves, mitigation banks, wildlife refuges or similar management units. Evaluation of wetland Beneficial Uses.
c. Evaluation of pre-project conditions at potential impact sites.
d. Evaluation of impacts associated with unauthorized (enforcement) actions.
e. Evaluation of pre-project conditions at potential mitigation or restoration sites.
f. Assessment of performance/success of mitigation or restoration sites.
g. Assessment of compliance of mitigation sites with required targets or performance criteria.
h. Comparison of proposed alternatives for regulatory or restoration planning purposes.

Generally Inappropriate Uses of CRAM

a. Jurisdictional determinations.
b. Focused species or threatened and endangered species monitoring.
c. Evaluation of specific management questions that call for Level 3 monitoring.
d. Evaluation of compliance with water quality objectives.
e. Assessment of mechanisms or processes of wetland function (diagnostic evaluation of wetland function).
f. Assessment of wetland values. It has been well documented that wetlands provide a variety of values that are beneficial to people, such as floodflow attenuation, aesthetics, and contaminant sequestration. CRAM is designed to evaluate the ecological condition of a wetland in terms of its ability to support characteristic plants and animals. Human use values cannot be appropriately assessed using CRAM.
g. Use of CRAM metric descriptors as stand-alone project design templates. While the narrative descriptions of best attainable conditions for the CRAM metrics can be used as general guidelines for overall project designs, they do not account for site-specific constraints and opportunities or design objectives. Because CRAM has been calibrated against statewide conditions, it is not appropriate to design a specific project based on the descriptions contained within each metric.

ISSUES TO BE REVIEWED

The Basis of CRAM

GROUP 1 ISSUES: (related to CRAM Manual Executive Summary and Chapter 1; Technical Bulletin Sections 1, 2 and 3)

1. **After reviewing the Topics in this request, please comment on the recommended appropriate and inappropriate uses of CRAM listed in Table 1. (CRAM Executive Summary, Ch. 1.3; Technical Bulletin Sec. 3B-C)**

2. **The U.S. Environmental Protection Agency has developed a three-level approach for wetland assessment. The design provides that each level builds on the previous one, and adds more specific information. Level 1 data is usually generated from aerial photos and maps for the purposes of inventory and planning; Level 2 data is collected in the field using rapid assessment methods; Level 3 includes data of a specific type to assess site specific concerns or validate methods or conclusions. CRAM is designed to be a Level 2 assessment tool to evaluate the overall condition of wetlands and to assess impacts of human activities that stress the local wetland ecology. (CRAM Executive Summary, Ch. 1.2)**

This framework is summarized in a USEPA technical paper (6. USEPA, 2002). This framework is more fully explained by Kentula (7. 2007) Stein, etal (8. 2007) and in other USEPA publications (9., 2003; 6., 2006)

3. **CRAM's wetland classification system is reliable for use throughout California (CRAM Ch. 1.5 & 3.2.2; Technical Bulletin, Sec. 3.A)**

GROUP 2 ISSUES: (related to CRAM Manual Chapters 2, 5, and Appendix III; Technical Bulletin Sections 2, 3, and 4)

4. **Sources of stress or pressure affecting the condition or state of wetlands are identified in CRAM. This design facilitates management *responses* to prevent or mitigate undesirable effects. CRAM assumes that the "pressure-state-response" (PSR) model applies to wetland**

assessment and monitoring and that this framework may be used in CRAM to evaluate the state, or condition, of wetlands (CRAM Ch. 2.2.1).

CRAM utilizes the Pressure-State-Response model (PSR) of adaptive management 11. Holling 1978, 12. Bormann *et al*. 1994, 13. Pinter *et al.* 1999).

5. **CRAM assumes that ecological conditions can be evaluated based on a fixed set of observable indicators, and that conditions respond to variation in natural and anthropogenic stress in a predictable manner. (CRAM Ch. 2.2.2 - 2.2.3)**

These assumptions are common to most wetland rapid assessment methods (14. Fennessy *et al*. 2004,).

6. **In CRAM, wetland 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. CRAM assumes that wetland condition is based on an evaluation of wetland location, form and structure. (CRAM, Ch. 2.2.3, Appendix III – Glossary)**

7. **As part of the CRAM assessment, a checklist is provided that characterizes stressors as to their likely effect on wetland condition. It is assumed that the stressor checklist can be used by researchers and managers to explore possible relationships between condition and stress, and to identify actions to counter stressor effects. (CRAM, Ch. 2.2.1.5).**

8. **CRAM accepts the primary assumption that the condition of a wetland is determined by interactions among internal and external hydrologic, biologic (biotic), and physical (abiotic) processes, as presented by Brinson,(15, 1993) and others (e.g., 16. Barbour, 1995). CRAM is based on a series of assumptions about how wetland 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 tend to mediate the effects of climate, geology, and land use on the quantity and quality of water and**

sediment. 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 . *(*CRAM, Ch. 2.2,3 *).*

Most of the structure of CRAM is found in these assumptions. (17. Collins, pers. comm.., 2008e)

9. **Metrics are measurable components of the four wetland attributes recognized by CRAM: Buffer and landscape context, hydrology, physical structure, and biotic structure. The metrics used in CRAM are ecologically meaningful, field-based measures that record the potential range of conditions in a wetland's hydrology, physical structure, biotic structure, and adjacent landscape, and are formulated to have a response to variations in stress that is distinguishable from natural variation. (CRAM, Ch. 2.3.1 and 2.1).**

CRAM metrics are field-based, ecologically meaningful, and have a dose-dependent response to stress that can be distinguished from natural variation across a stressor gradient (18. Fennessy, et al., 2004; 19. Fennessy, et al, 2007; 20. National Research Council, 2001; 16).

10. **CRAM has "modules" for each major wetland type. A module is developed in a nine step process organized into three phases: basic design, calibration, and validation. This developmental framework results in a valid Level 2 assessment method.(CRAM, Ch. 2.3)**

This design process is discussed in greater detail by Sutula, et al. (21. 2006a; 22. 2006b), Stein, et al. (23. 2009; 24, 2007) and in the CRAM Quality Assurance – Quality Control Plan (CQAQC; 25 Collins, etal 2005). This process is consistent with recommendations published by various authors (26. Hruby, et al.,1999; 27. Hruby, 2001;19).

11. **Calibration is a process whereby iterative adjustments to the CRAM wetland classification system and metrics are made through multiple field tests. Through repeated field evaluations, the descriptions of the range of potential conditions are adjusted in relation to each other. These exercises are repeated until the calibrations for all metrics work**

together to provide results that are replicable by any observers in any similar wetland. (CRAM Ch. 2.3.2)

The calibration phase begins with the Regional Teams selecting sets of wetlands that clearly represented a broad range of conditions. Data from these assessments were used to adjust the number of metrics and the number of alternative states of some metrics, and to revise the text of the CRAM assessment forms and within the CRAM Users Manual (25).

12. **CRAM's condition-based rapid assessments can be expected to reliably discriminate between wetlands of moderately different condition classes, after appropriate data collection, QA, calibration and validation of a sufficient body of data. (CRAM, Ch. 2.3.2; Technical Bulletin Sec. 3.J)**

13. **Procedures are in place to refine CRAM metrics through calibration studies to improve discrimination between wetlands exhibiting moderate differences in condition. (CRAM, Ch. 2.3.3; 25).**

The USACE review of CRAM notes that "…[the] statewide generalization approach and the combination of all metrics into a single grand condition score may not produce sufficient discrimination among wetlands of moderately different condition classes to be useful in some situations." (28. Klimas, 2008). This concern is addressed through specified calibration and validation procedures (Technical Bulletin, Sec, 4.E), although it is understood that the precision of CRAM scores has limits.

14. **The stated within-team and between-team precision of CRAM of plus or minus 10% for attribute scores and overall site scores is acceptable for Level 2 conditional assessments of wetlands. (CRAM, Ch. 2.3.2; Technical Bulletin, Sec. 4.B).**

CRAM precision is calculated as the average difference in CRAM scores independently produced by different trained practitioners or teams of trained practitioners for the same wetland area and assessment period. Precision is calculated for CRAM metrics, attributes, and for the overall site or index score.

The latest version of CRAM sets the precision target for attribute and overall scores at ±10%. More recent guidance incorporates the same precision targets as part of the process for determining the number of required assessments (Technical Bulletin, Sec. 4.B).

Statistical limits of confidence are currently being calculated for estuarine wetlands in four coastal regions based on the 2007 statewide survey of estuarine wetland condition using CRAM. The results will help practitioners quantify the probability that two CRAM scores are statistically different, and will enable CRAM practitioners to compare individual scores to ambient condition with known statistical confidence (17, 23).

15. The maximum CRAM score for a wetland type represents the best achievable condition for that wetland type in California. (CRAM, Executive Summary; Ch. 3.5, 3.8, Technical Bulletin Sec. 3.J.).

Best Achievable Condition is defined as the state exhibited by selected sites that have been subject to the least levels of anthropogenic stress. This criteria is consistent with widely accepted recommendations on the selection of reference sites (29. Stoddard, 2006; 16). The overall score for a given wetland therefore indicates how it is doing relative to the best achievable conditions for that wetland type in the state.

16. Validation is defined as "…the process of documenting relationships between CRAM results and independent measures of condition in order to establish [CRAM's] defensibility as a meaningful and repeatable measure of wetland condition." (23). Overall performance of CRAM is validated by evaluating the relationship of metric scores and attribute scores to Level 3 data of key indicators of selected wetland services (e.g., natural values, water quality) (CRAM, Ch. 2.3.3)

CRAM validation work has emphasized a "weight of evidence approach." CRAM data are compared to multiple lines of independent observations to make inferences or reach conclusions about environmental systems or stressors (23). This involves regressing CRAM metric and attribute scores on Level 3 data that are sensitive to changes in wetland condition. This agrees with the process recommended by Fennessy (18, 19) and is also consistent with Hruby's conclusions (26, 27).

17. CRAM scores are not invalidated by natural stochastic changes inherent in all natural systems. (CRAM, Ch. 2.2.2- 2.2.3)

An individual CRAM score represents only the condition of a site on the day of assessment. CRAM assumes that "…geology and climate govern natural disturbance, whereas land use accounts for anthropogenic stress." (CRAM, Ch. 2.3.3). Natural stochastic changes inherent in all natural systems (30. Hruby, 2006), especially riverine systems, do not invalidate or otherwise adversely affect assessment data and scores

produced by CRAM, when practitioners exercise good professional judgment in analyzing scores.

18. CRAM scores do not provide measures of human value or importance.

Assessments of wetland condition that quantify the wetlands capacity to perform various functions, such as CRAM, do not rate the value of the assessed wetland. Rather, value is assumed to be found in the diversity of ecological services provided by a wetland (CRAM, Ch. 2.2.4; Technical Bulletin, Sec. 3.C). As such, a low scoring wetland may have high value to man based on a number of other considerations, such scarcity of certain wetland types.

GROUP 3 ISSUES: (related to CRAM Manual Chapters 1.3, and Technical Bulletin Sections 2,3, and 4)

19. CRAM scores will be used to adjust metrics as needed to remove any systematic bias against particular kinds of wetlands, or their natural settings. (CRAM Ch. 1.5, 3.2.2.1;Technical Bulletin Sec. 3A)

Validation efforts have established that CRAM is applicable throughout the range of environmental conditions commonly encountered in California (21; 23). However, since CRAM metrics give higher weight to structural complexity, there may be a bias against wetlands that naturally exhibit less complexity, such as vernal pools, mud flats, or riverine wetlands headwater areas. In addition, CRAM assessments in riverine systems that have been subject to recent channel disturbance are problematic. Instances may also exist where a positive bias might result in CRAM scores that are higher than site conditions might dictate under Level 3 assessment. Therefore, future adjustments in CRAM metrics may be necessary to remove systematic bias(Technical Bulletin, Sec. 3.A; ,23).

20. The selection of CRAM reference sites for all conditions of wetlands is based on "best professional judgment" of regional teams. Selected reference sites exhibit a wide range of condition, from poor to best achievable condition (Technical Bulletin, Sec. 4.C).

Reference sites for all wetland classes and conditions will continue to be established. Reference sites will exhibit a range of conditions from poor to "best achievable condition." (19, 29) Reference sites will be used for calibration and validation studies, and training.

21. **"Best Achievable Condition" reference sites are used to define the highest standard for the type of wetland being assessed. This reference standard becomes the point against which the range of wetland conditions can be judged from highest to lowest, and thus becomes the basis of individual CRAM metric scores. (CRAM, Ch. 3.8.1) Therefore, any two scores for the same type of wetland can be compared to each other because they are based on the same statewide standard (Technical Bulletin, Sec. 3.J).**

22. **The same scores for different wetlands of the same type do probably represent the same overall condition and functional capacity (CRAM, Ch. 3.8.1; Technical Bulletin Sec. 2, 3B, 3J).**

23. **Predictions of future conditions of wetlands may be possible through statistical analysis of CRAM reference site data and other CRAM data. (CRAM, Ch. 3.8.1).**

A U.S. Army Corps of Engineers (USACE, or Corps) review of CRAM notes that:

> "Some of the most important potential applications of assessment approaches involve projecting future conditions to calculate specific gains or losses for with- and without-project scenarios, mitigation site development, and management effects. The data needed to develop such trajectories are best assembled as part of the reference data collection process (28. Klimas 2006), and are not currently a focus of CRAM development. However, given the stated intention of the CRAM developers to actively maintain, build, and use the database to improve the approach, it seems appropriate that one important target would be to develop recovery trajectories suitable for generating future scenarios under conditions of interest to planning and regulatory offices of the Corps, EPA, and State agencies." (31. Klimas, 2006)

Klimas also states that:

> "A full evaluation of competing impact and mitigation scenarios requires projection of future conditions… No tools [are] provided for adapting CRAM for use in such situations… To be fair, most other existing assessment systems are equally unsuited to the task… To a certain extent, this weakness in CRAM may be addressed over time as the database grows and new information is applied to the refinement of CRAM…"
>
> In light of these comments, it should be noted that: " As with any assessment method, the ability of CRAM to detect change depends on the size of the change relative to the precision of CRAM." (Technical Bulletin, Sec. 5.C)

24. CRAM Quality Assurance/Quality Control (QA/QC) procedures are consistent with sound scientific data management practices. Methods specified are sufficient to assure consistency in the statewide collection of data over time. (CRAM Ch. 3.8.2)

The QA/QC goals and procedures are specified for each step in CRAM developmental process (25, Technical Bulletin Sec. 4). Training and certification programs for practitioners of CRAM are under development as part of the CRAM Quality Assurance Project Plan (23, 25, Technical Bulletin Sec. 3.H).

Classification, Sampling and Attribute Scoring Procedures with CRAM

The general procedure for using CRAM consists of eight steps. Significant elements of this procedure are discussed below. Reviewers are, of course, invited to comment on any or all of the steps or parts of steps that comprise CRAM's procedure.

Step 1 - Assemble background information about the management of the wetland.

Step 2 - Classify the wetland using this manual (see Section 3.2 and Figure 3.2).

Step 3 - Verify the appropriate season and other timing aspects of field assessment.

Step 4 - Estimate the boundary of the Assessment Areas (AA) (subject to field verification).

Step 5 - Conduct 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 Quality Assurance Procedures.

Step 8 - Upload CRAM results into regional and statewide information system.

CRAM's wetland and riparian classes were developed based on the National Research Council's (NRC) recommendations, and to be consistent with the National Wetlands Inventory (NWI) and the State Wetland Inventory (still under development). (CRAM, Ch. 3.2, Figure 3.2).

GROUP 4 ISSUES: (see CRAM Manual Chapters 2,3,4, Appendix I; Technical Bulletin Sections 2,3, 4, and 5)

25. **In regards to Step 2 above: Further refinement and subdivision of CRAM's wetland classes could take place over time based on wider data collection and analysis. Following CRAM's developmental procedures, meaningful conditional assessment scores for these new wetland classes can continue to be obtained (CRAM, Ch. 2.3.3; Technical Bulletin Sec. 3.A).**

26. **In regards to Step 4 above: AA's, as defined through criteria listed in Chapter 3 of the CRAM Manual, are a valid sample type and size for**

determining wetland condition (CRAM, Ch. 3.5, Technical Bulletin Sec. 5).

The AA is the portion of a wetland that is assessed using CRAM an AA might include all of a small wetland in its entirety, but in most cases the wetland will be larger than the AA. Steps for delineating AA's are summarized in Table 3.5 in CRAM, Ch. 3.5: Special criteria for delineation of AA's for Riverine and Vernal Pool wetlands are also described.

27. **In regards to Step 4 above: The ambient assessment sampling and the project assessment sampling methods for CRAM may both be expected to provide valid, repeatable results (CRAM, Ch. 3.5.3, Appendix I).**

Separate sampling methods are prescribed for project assessments vs. ambient assessments. Ambient assessment sampling is described in CRAM, Ch. 3.5. Project assessment sampling is discussed in CRAM, Ch. 3.5 and App. 1. The same rules for delineating AA's pertain to both of these purposes for using CRAM. However, they may require different numbers of AA's.

28. **In regards to Step 7 above: CRAM metric scoring, as described in Chapter 4 of the CRAM manual, is based choosing the most appropriate narrative description of the state or condition of the metric being observed in the field, ranging from low to high ecological service. CRAM yields an overall AA score based on the individual scores of the attributes and their metrics (CRAM, Ch. 3.8.1).**

The metrics are organized into 4 main categories (termed "attributes"): (1) Landscape context and buffer, (2) hydrology, (3) physical structure and (4) biotic structure (CRAM, Executive Summary). These four categories are commonly recognized as being "universal" attributes of wetlands (18,21). CRAM has standardized these metrics and narrative descriptions across all wetland types as much as possible (CRAM, Ch. 3.8.1).

The Readiness of CRAM Modules for Specific Wetland Types

GROUP 5 ISSUES: (related to CRAM Estuarine and Riverine Wetland Field Books)

A. CRAM for Estuarine and Riverine Wetlands

29. CRAM reliably evaluates the condition of estuarine and riverine wetlands in California.

The CRAM Field Guides for Estuarine and Riverine systems, as presented in the respective Field Guides for those modules (2,3), provide details on application of CRAM to those ecosystems. Recent validation studies have shown that Estuarine and Riverine CRAM scores correlate well with a variety of more intensive Level 3 data sets (23).

30. In cases where the physical findings indicating the top of the stream bank where the stream flow would enter the active flood plain (bankfull indicators) are obscured or unreliable due to channel disturbance, CRAM adequately addresses the uncertainty of using bankfull width by applying a sensitivity test when determining the metric score in the hydrologic connectivity section (29).

B. Depressional Wetlands

31. CRAM can be expected to reliably evaluate the condition of depressional wetlands, assuming continued development according to CRAM's developmental process.

The CRAM Field Guide for Depressional Wetlands is available (4). This module has not undergone the level of calibration and validation work that has been given to the Estuarine and Riverine modules. It is at an earlier stage of development, and is expected to be validated and calibrated as the data is collected on additional assessment sites. Despite this limitation, the Depressional module is ready for use as prescribed in the Technical Bulletin and by Sutula (21), and is expected to provide reliable data if the CRAM developmental process is continued.

C. Slope, Playa, Lacustrine, and Vernal Pool Wetlands

32. The development of CRAM for these four wetland types has not progressed as far as those listed above. If the same developmental process is applied to these four types, then a similar outcome is anticipated resulting in CRAM for these types. (CRAM, Ch. 1, 2)

Field manuals for slope, playa, lacustrine and vernal pool wetlands are under development, using the methodology described in CRAM, Ch. 1 through 4, and as discussed in Topic 1 above. Additional data collection is underway. It is expected that these modules will be ready for wider use over the next few years.

The Big Picture

Reviewers are not limited to addressing only the specific issues presented above, and are asked to contemplate the following questions.

> **(a) In reading the CRAM Manuals and Field Guides, the Technical Bulletin CRAM Implementation Technical Bulletin, the CRAM Quality Assurance/Quality Control plan, the supporting information at www.cramwetlands.org, and proposed implementation language, are there any additional scientific issues that are part of the scientific basis of CRAM not described above? If so, please comment with respect to the statute language given above in the first three paragraphs of Attachment 2.**
>
> **(b) Taken as a whole, is the scientific portion of CRAM based upon sound scientific knowledge, methods, and practices?**

Reviewers should also note that some proposed actions may rely significantly on professional judgment where available scientific data are not as extensive as desired to support the statute requirement for absolute scientific rigor. In these situations, the proposed course of action is favored over no action.

The preceding guidance will ensure that reviewers have an opportunity to comment on all aspects of the scientific basis CRAM. At the same time, reviewers also should recognize that the Board has an obligation to consider and respond to all feedback on the scientific portions of CRAM. Because of this obligation, reviewers are encouraged to focus feedback on the scientific issues highlighted.

Attachment 3

PERSONS AND AGENCIES INVOLVED IN DEVELOPING CRAM DIRECTLY OR INDIRECTLY

Persons and agencies directly or indirectly involved; i.e., persons who have reviewed or commented on CRAM, or who have provided specific feedback on scientific or technical issues relating to CRAM, are listed below. Persons who may have participated in more than one capacity may be listed more than once.

Core Team (Principal Investigators)
(Affliiations identified below)

Joshua N. Collins, Ph.D., San Francisco Estuary Institute (1)
Eric Stein, Dr. Env., Southern California Coastal Water Research Project (2)
Martha Sutula, Ph.D., Southern California Coastal Water Research Project (2)
Ross Clark, California Coastal Commission (3)
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Attachment 4

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All references, except texts, will be provided in 3-ring binder to reviewers.

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