Dear Ann, Jill, Mike, and Brian:

Thank you for your thoughtful and thought provoking comments on CRAM. While many of the points you made are interesting and will be of value as we continue to refine this rapid assessment method, it appears that some misunderstanding of the method and its proposed uses and applications have emerged. This is perhaps from a lack of exposure to CRAM and its development. I like to think our day of training has helped clarify some of those points, and for this reason, I thank you for your time in that pursuit.

In any case, I will attempt to respond to some of the key issues you raised. First, it appears you have a fundamental misunderstanding of EPA's Level 123 Framework. I have attached a file of our technical framework at the end of this message, which indicates that Level 1 inventories are simply GIS assessments of the extent and distribution of aquatic resources with associated land use layers. Certainly other information can go into a Level 1 assessment, but the most common use of the term in wetland monitoring refers to such well know GIS-based inventories as the National Wetland Inventory or, here in CA, the Statewide Wetland Inventory. As I am sure you know, the Riparian Habitat Joint Venture is also completing an inventory for riparian habitats for all of California.

By contrast, your lists on pages 6 and 7 represent a comprehensive compilation of information needs. This kind of information would be useful for watershed studies, TMDLs, or other intensive analyses of river processes. I fail to see how it would fit into a rapid assessment method. The goal with CRAM is to perform an assessment in half a day with an equal amount of office preparation. Even if these data were available for all sites, I am not aware of any systematic means of translating the data into a condition or "functional assessment" score unless it was done in the context of a Level-3 research program. Only rarely are these data applied in the 404 or 401 programs. Exceptions I can think of include large, complicated restoration or mitigation projects (e.g., Hamilton marsh restoration, Montezuma project, or the South Bay Salt Pond program).

You take significant issue with the fact that CRAM is a "condition" assessment and does not measure important wetland or river functions. Among others, Fennessy et al. (2004) discuss the relationship between function and condition. I have also attached their paper. In particular, I call attention to this section in which they state:

> "Condition can be defined as the relative ability of a wetland to support and maintain its complexity and capacity for self-organization with respect to species composition, physico-chemical characteristics and functional processes as compared to wetlands of a similar class without human alterations. Ultimately, condition results from the integration of the chemical, physical and biological processes that maintain the system over time. Methods best suited to measure condition reflect this by providing a quantitative measure describing where a wetland lies on the continuum ranging from full ecological integrity (or the least impacted condition) to highly impaired (poor condition). A single numeric score

is the result. This score is not meant to measure absolute value or have intrinsic meaning, but allow comparisons between wetlands to be made….

"From an ecological standpoint, wetlands perform a wide variety of functions at a hierarchy of scales ranging from the specific (e.g., nitrogen retention) to the more encompassing (e.g., biogeochemical cycling) as a result of their physical, chemical and biological attributes. At the highest level of this hierarchy is the maintenance of ecological integrity, the function that encompasses all ecosystem structure and processes (Figure 2, Smith et. al., 1995). ***The link between function and condition lies in the assumption that ecological integrity is an integrating "super" function of wetlands.*** If condition is excellent (i.e., equal to reference condition), then the ecological integrity of the wetland is intact and the functions typical of that wetland type will also occur at reference levels.[1] (Emphasis added.)

In the process of developing CRAM, we adopted this basic approach and it is reflected the conceptual model (see Figure 2.1 of the CRAM manual).

On page 7 of your paper, you state that "custom designed" assessment strategies must be developed to assess restoration projects. In the CRAM manual, and certainly as we provide training across the state, we underscore the important fact that CRAM is not intended to replace mitigation or restoration monitoring (except for possibly very small projects where little is required). In our Prospectus and now in the CRAM Manual, there is a statement on intended uses that I think should provide some comfort to those, like you, who will want to see Level 3 data used in the analysis of project performance, be it for restoration or in permit compliance monitoring.

What are the possible applications of CRAM

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

Additional applications could include: (1) *preliminary* assessments to determine the need for more traditional intensive analysis or monitoring, (2) providing *supplemental* information during the evaluation of wetland condition to aid in regulatory review under Section 401 and 404 of the Clean Water Act, the Coastal Zone Management Act, Section 1600 of the Fish and Game code, or local government wetland regulations, and (3) *assisting* in the monitoring and

[1] Fennessy, M.S., A.D. Jacobs, and M.E. Kentula. 2004. Review of Rapid Methods for Assessing Wetland Condition. EPA/620/R-04/009. U.S. Environmental Protection Agency, Washington, D.C.

> assessment of restoration or mitigation projects by providing a rapid means of checking progress along a particular restoration trajectory. CRAM is *not* intended to replace any existing tools or approaches to monitoring or assessement, and will be used at the discretion of each individual agency to complement preferred approaches. Typically, wetland impact analysis and compensatory mitigation planning and monitoring for larger wetland areas that exhibit more complex physical and biological functions will require more information than CRAM will be able to provide.

It seems perfectly reasonable to expect the regulatory agencies could ask project proponents to supplement mitigation or restoration monitoring with CRAM scores. It could be a quick way for 404 and 401 staffs to determine if sites are progressing, and it would "level the playing field" in that consultants would be required to provide this minimum data for each project. Detailed monitoring reports could still be used to determine if specific requirements are being met (e.g., T&E support, water quality standards), but CRAM scores will integrate these functions and provide a rapid way of charting "ecological trajectories" of restoration or mitigation sites.

On the subject of urban stream performance, I think it's important to recognize that EPA has been a long-time supporter of urban stream restoration and volunteer monitoring. Nothing there has changes. We do not believe that the development of rapid assessment tools in any way undermines our support of wetland and stream restoration. To the contrary, we would like to think that it can only help by bringing accessible tools to practitioners and citizen volunteers so they can readily understand project performance. I do not think there are any disagreements about the value of restoring streams in urban environments, as the water quality, habitat, and societal benefits are well understood.

Where we might disagree is in the application of CRAM scores in such a setting. I think that if you had obtained a pre-construction CRAM score at your restoration site in Berkeley, it would have been considerably lower that a post-project assessment score. That difference would represent the "functional lift" you provided to the site through the stream restoration practices you put in place. Would that site rank as high as a reference stream in a more pristine condition? No, and that is both consistent with the literature and logical. The data on impervious cover alone show that there is a greater degree of water quality impairment in an urbanized stream setting as compared to a similar stream in a park setting. To claim that an assessment method that is sensitive to these changes in condition would undermine your entire stream and wetland protection policy is, in my view, a stretch.

Just recently, we provided CRAM training (riverine) to some staff from RB 5, DWR, US Army Corps, and DFG, along with representatives of the Sacramento Watersheds Action Group and a local consulting firm in Redding. The site was a section of Sulphur Creek where DWR has funded SWAG to restore a steelhead-supporting reach. The score was 73, which is very good considering construction in the project reach assessed was completed a year ago. Had CRAM been run at the site prior to construction, it is easy to imagine the score would have been very low, as there has been much disturbance from past mining and recent urbanization in the upper parts of the watershed. The difference

in scores would represent that all important "functional lift." In any case, SWAG was very pleased with the results and felt CRAM fairly evaluated the site. Over time, the site will likely continue to score higher, up to an asymptotic value. This is consistent with the literature, which tends to show that, for any wetland function in a restoration or mitigation site, it will perform up to about 80% of the function in a naturally occurring site (see Kentula, M.E., R.P. Brooks, S.E. Gwin, C.C. Holland, A. Sherman, and J.C. Sifneos, 1993. An Approach to Improving Decision Making in Wetland Restoration and Creation. Island Press, Washington, D.C.)

Furthermore, if CRAM were biased in urban settings, I am confident the scientists who have scrutinized the method and have done extensive testing across the highly urbanized LA Basin and in the San Diego area would have pointed out these problems by now. In fact, quite the opposite is the case. For example, CRAM has been run in an ambient survey in the San Gabriel River watershed with good correlations to other Level 3 data taken concurrently.

I contend it is the difference in scores that should be of importance to practitioners and managers, and not the absolute score itself. Many of your concerns about how urban streams will score in CRAM assessments can be addressed in the all-important *interpretation* of the scores. Any tool can be misused and misinterpreted. Furthermore, CRAM software will allow for stratification of data in analyzing scores by geographic regions. One will be able to compare urban streams with others of the same type.

You maintain that CRAM is not peer reviewed. In fact, CRAM has been developed over four years with input of over 50 scientists across the State, representing agencies, academia, and private sector consultants. In addition, staff from EPA's Office of Research and Development have participated in a technical oversight role throughout the process. In 2006, the CRAM PI team published an article in the Journal of the American Water Resources Association (Sutula et al, 2006) describing the conceptual approach to CRAM.

More recently, we have taken several steps to begin the process of getting additional peer review. I have been working with Wade Eakle of the Pacific Division of the US Army Corps of Engineers who is looking into the possibility of the Corps's research group of doing a peer review. At Wade's request, I provided the scientists at the Engineer Research and Development Center with a list of questions to guide their review (see below).

The PI team is also writing a paper on how CRAM was calibrated for estuarine and riverine sites. This is in manuscript form and will be submitted to a journal for publication in a few months. On top of that, Drs. Rich Ambrose and John Callaway were contracted by the SWRCB to use CRAM to assess project sites across the state (full report at http://www.waterboards.ca.gov/cwa401/docs/wetlandmitstudy_rpt.pdf). They are well-published wetland scientists and have found CRAM to be a robust tool. The PI team consists of wetland scientists (PhD and Master's degrees), with lots of experience in wetland and river systems. Plus, their teams consisted of experienced wetland and stream

practitioners. All of these people were given guidance by a steering committee of about 20 representatives of state and federal government as well as academia. The Science Panel of the Southern California Wetland Recovery Project has adopted CRAM. While this is not formal peer review, this represents an enormous amount of technical scrutiny and evaluation.

Is CRAM perfect? No. I don't believe any method is perfect. For example, in CRAM we admit in the manual that CRAM has potential weaknesses in headwater streams in arid area:

> For the purposes of conducting a CRAM assessment there is a practical limitation to the applicability of the method in low order (i.e., headwaters) streams in arid environments. CRAM metrics are based on observable physical and biological features of the area being assessed. Low order streams in arid environments will, by their nature, often lack these features. For example, complex plant communities with horizontal and vertical structure may not occur. Similarly, topographic complexity may be inherently low. It is important that CRAM scores not appear to artificially "devalue" these systems based on their natural simplicity. Therefore, while CRAM assessments can be done in these systems, the results will be tracked carefully over the next year or more to ascertain if, and if so, how CRAM should be revised to apply as well to these systems as any others. To facilitate this analysis, practitioners are asked to note on the CRAM riverine site information sheet if the site is an ephemeral, headwater system.

Users of CRAM will be able to provide input and comments on all aspects of the method using an online data form (which is almost completed and on the website). We expect to review these annually and make any revisions as necessary. For this reason, I encourage you to go to the field and run CRAM at the sites where you hypothesize it won't work well. We welcome your constructive criticisms and would find particularly valuable ways in which the tool could be refined to address any concerns you may continue to have with the method.

Finally, as I mentioned above, the riverine and estuarine portions of CRAM were subjected to fairly rigorous calibration exercises under the guidance of a statistician from Oregon State University. Dr. Don Stevens has extensive experience with establishing ambient and project monitoring programs, and assisted EPA with its EMAP program for many years. The PI team used data from DFGs wadeable streams monitoring and MAPS (Monitoring Avian Productivity and Survivorship) to perform these statistical analyses. I have included some graphics in the message below that show some of these results in which the benthic macroinvertebrate IBI scores correlate well with CRAM overall and landscape attribute scores. I note that SWAMP has also funded Moss Landing Marine Labs to run CRAM scores at the same time DFG wadeable streams data are being collected this summer. This will allow for further analyses of correlations between CRAM and PHAB variables.

In conclusion, we believe that CRAM does provide a valuable tool to assist evaluation for a variety wetland monitoring and assessment needs. Moreover, it has been developed in a collaborative, open process, and will be continually refined as our knowledge and understanding continues to improve. We remain open to your constructive criticism of CRAM, and you can trust that I have shared your comments with the entire PI team.

SIGNED:

Paul Jones
US EPA, Region 9, Wetlands Regulatory Office

Additional Information

EPA's Technical Framework on Level 123
See attachment in email or go to:
http://www.epa.gov/owow/wetlands/pdf/techfram_pr.pdf

Peer review questions for ERDC (Corps)
1. Given the stated limitations of CRAM, does this method have useful applications in the 404 program? If so, where specifically? For example, would CRAM results be useful in impact site evaluations, compensatory mitigation monitoring, siting of mitigation projects through site-specific condition assessment, or in ambient watershed-level analyses. Might CRAM be used in evaluating mitigation banking for either pre- or post-project condition assessments?

2. Does the CRAM wetland typology adequately cover the wetland types found within the State of California?

3. Within the context of the conceptual model, do the four main attributes of CRAM (landscape, hydrology, physical structure, biotic structure) capture the primary wetland functions that should be measured in a rapid protocol?

4. Are the metrics and their respective "alternative states" sufficiently specific to capture the range of wetland condition encountered in the field in a rapid assessment? Are the narrative descriptions of the alternative states actually mutually exclusive?

5. Given the fact that the riverine and estuarine parts of CRAM have been validated using independent data from the CA SWAMP Bioassessment Protocol and from the Monitoring Avian Productivity and Survivorship (MAPS) Program, and the regressions show consistent positive correlations with CRAM scores, are there other parts of the CRAM method that should be prioritized to receive a similar analysis? If so, which ones and which datasets could be applied? Alternatively, will feedback from CRAM users over time suffice for further revisions to the method?

6. Typically, 404 permit applicants are required to develop detailed compensatory mitigation monitoring plans and to report on progress toward specific performance standards on a periodic basis. Can CRAM scores supplement, or in some cases, replace this type of compliance monitoring? If so, what might be the circumstances under which the Corps could ask for CRAM data (e.g., size of project, NWPs, etc.)? Should CRAM be categorically disallowed for any types of wetlands or projects?

7. The CRAM manual specifically cautions users concerning the application of the method in headwater streams in arid regions. Does ERDC have recommendations for how to modify the method to make it more applicable to these kinds of waters (first and second order intermittent and ephemeral channels in arid areas)?

8. What are the weakest and strongest elements of CRAM? How can improvements be made to specific attributes, metrics or submetrics?

9. In the riverine section of CRAM, users are asked to assess both banks if the stream is wadeable; however, once the stream or river is not wadeable, only one side of the bank is to be evaluated. Does this impart a bias against larger systems? If so, what might be a way to resolve this issue?

10. The selection of the assessment area (AA) in CRAM is a critical step. Should a fixed AA size be adopted for each wetland type or should it remain flexible within the limitations currently established?

11. The stressor checklist is designed to document in the field what anthropogenic stressors are present and likely to have a negative or significantly detrimental effect on wetland conditions. With that information, wetland managers might be able to target corrective or restoration actions to improve a particular wetland's condition. Also, it will permit data analysis of relationships between CRAM scores and stress in watersheds, counties, and other geographic regions of interest. Do these lists capture the range of stresses and perturbations on wetlands? Is there any way to make them more useful?

12. In CRAM, metric scores are combined into attribute scores, and those, in turn are combined into an overall score. Internal to that, a combination rule is used in the Landscape attribute to calculate a score for that attribute. Are these defensible and appropriate?

Selected Calibration Data

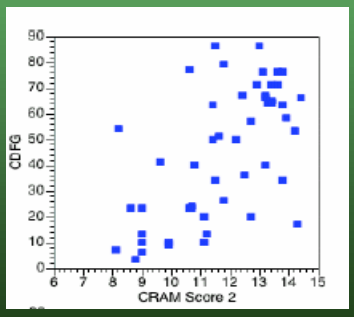
Significant Correlations
Riverine CRAM and Level 3 Data

CRAM Score	Level 3 Data	r-value	p-value
Landscape	Benthic IBI	+.59	.001
	Non-riparian avian richness	+.39	.01
Hydrology	Total avian richness	+.32	.04
Physical	CDFG Benthic IBI	+.35	.01
	Non-riparian avian reproductive success	-.38	.02
Biotic	Benthic IBI	+.40	.003
Overall	Benthic IBI	+.62	.001
	riparian avian richness	-.43	.006

Example CRAM Validation (correlation with Level 3 data)

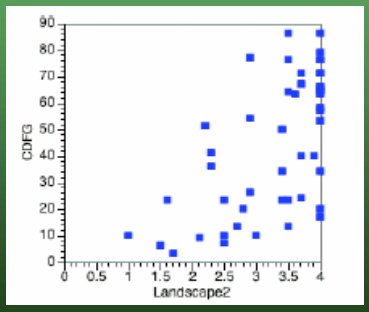
CDFG Macro-invertebrate IBI correlations

Overall CRAM Score



p = 0.001
r = .66

Landscape Attribute



p = 0.001
r = .60