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Causal Assessment Evaluation and Guidance for California

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EXECUTIVE SUMMARY

This document is intended for staff of regulated and regulatory agencies in California challenged with identifying the cause of degraded biological condition in streams and rivers that have been classified as impacted by the State Water Board's proposed biological integrity (biointegrity) plan. The goal of this document is to provide guidance to these individuals, most of whom are not biologists, on strategies and approaches for discerning the stressor(s) responsible for impacting the biological community (termed Causal Assessment). This document is not a cookbook providing step-by-step instructions for conducting a Causal Assessment, although we do provide resource information for such detailed instructions. Nor does this document supersede the need for a qualified biologist to conduct the necessary technical work. This document does provide the information for regulatory and regulated staff to understand what is necessary for conducting a proper Causal Assessment, the general framework so they know what to evaluate when selecting a contractor, and how to properly interpret the information presented in a Causal Assessment report. Finally, based on four case studies from different parts of the state, this document evaluates the US Environmental Protection Agency's Causal Analysis/Diagnostic Decision Information System (www.epa.gov/CADDIS). Associated strengths and shortcomings of CADDIS for California are presented to provide regulated and regulatory agencies a path forward for improving future Causal Assessments.

The CADDIS Causal Assessment process centers on five steps of Stressor Identification (USEPA 2000a).

1) **Define the case**: identify the exact biological alteration to be diagnosed at the site of impact, called the test site, including where and when. Important considerations will include what sites should be used as "comparators" for discerning differences in biology relative to changing stressor levels.

2) **List candidate causes**: create a list of all possible stressors that could be responsible for the biological change(s) observed. Candidate causes must be proximal (i.e., copper, pyrethroid pesticide, flow alteration, temperature, etc.); generic stressors or sources (i.e., land use type) are insufficient. For each candidate cause, a conceptual diagram (i.e., flow chart from sources to biological endpoint) should be constructed.

3) **Evaluate data from the case**: inventory all available biological and stressor data from test and comparator sites. Apply different lines of evidence to the data (i.e., spatial temporal co-occurrence, stressor-response, etc.) and score the results according to strength of evidence.

4) **Evaluate data from elsewhere**: identify data from other locations pertinent to the candidate causes including the peer-reviewed literature, nearby monitoring data from other watersheds, test and comparator site data from other time periods, etc. Apply the different lines of evidence and score the results according to strength of evidence.

5) **Identify the probable causes**: summarize the strength of evidence scores from the different lines of evidence for both data from within the case and elsewhere looking for consistency.

Our evaluation of CADDIS for California was positive, and we recommend its use provided stakeholders recognize its limitations. In our four test cases, we identified a subset of candidate causes, albeit with varying degrees of confidence. Equally as important, we identified several unlikely candidate causes, enabling stakeholders to bypass non-issues and focus follow-up work on candidate causes of greatest importance. However, some candidate causes were left undiagnosed when insufficient, uncertain, or contradicting evidence emerged. Subsequently, iterative steps in diagnosing and confirming candidate causes will likely result, especially where multiple stressors can result in cumulative impacts. It is clear that communication between regulated and regulatory staff will be a key to the success of any Causal Assessment, for which CADDIS is particularly well-suited.

There are at least three important considerations when adapting CADDIS to California. First is selecting appropriate comparator sites. Comparator sites are a key ingredient of the Causal Assessment approach. They enable the comparison of data relevant to candidate causes between the impacted site of interest (the test site) and a site with higher quality condition. The traditional localized (i.e., upstream-downstream) approach to selecting comparator sites met with limited success in California, largely because of the ubiquitously altered watersheds in our four test cases. However, California has a robust statewide data set encompassing nearly every habitat type in the state, which was used for developing the biointegrity numerical scoring tools including uninfluenced reference sites. This data set represents a potentially powerful tool for selecting comparator sites previously unavailable anywhere else in the nation. Future Causal Assessments should utilize the statewide data set and additional effort should focus on automating the comparator site selection process for objectively incorporating this unique resource.

Second is the distinction between evaluating data from within the case versus data from elsewhere. Data from within the case provides the primary lines of evidence for evaluating candidate causes (i.e., spatial-temporal co-occurrence, stressor-response from the field). Data from outside the case provides context for interpreting these primary lines of evidence, such as ensuring concentrations are high enough to induce biological effects (stressor-response from other field studies or from the laboratory). When comparator sites are inadequate for revealing meaningful lines of evidence from within the case, such as in our case studies from California, data from outside the case still provided the necessary information for evaluating candidate causes. Therefore, additional work to develop new assessment tools such as species sensitivity distributions, tolerance intervals, dose-response studies, relative risk distributions, or *in-situ* stressor-response curves will dramatically improve the utilization of data from elsewhere.

The third important consideration is summarizing the case. Oftentimes, this may be the only piece of documentation that managers will ever see. Incorporating the myriad of data analytical results for the numerous lines of evidence can be overwhelming. Narrative summary tables are used herein for our four case studies, which can be very descriptive and are consistent with CADDIS guidance. However, the narrative summaries lack much of the quantitative attributes stakeholders would prefer when making important decisions, so future efforts should develop methods or approaches for providing certainty in the diagnostic outcome.

Currently, Causal Assessments are not necessarily simple or straightforward. It must be recognized that there is a learning curve associated with implementation of any new process. As more Causal Assessments are conducted and experience gained, and new assessment tools are developed, Causal Assessments will become more efficient and informative. Ultimately, we forecast the evolution of a streamlined Causal Assessment process.

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