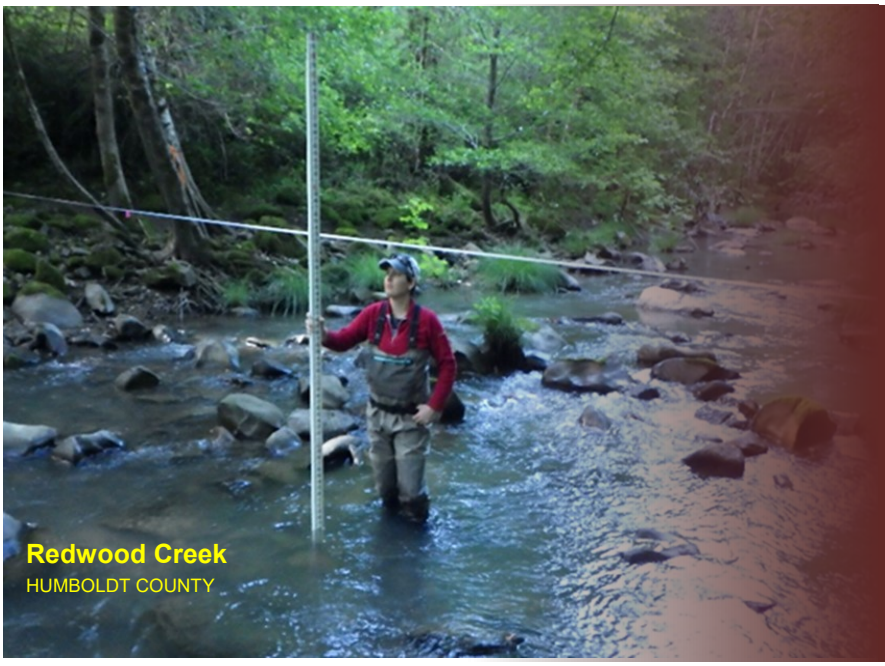
Introducing

Watershed Flow Criteria

Watershed Criteria Reports address an important data gap in California by providing scientifically robust instream flow information that spans entire watersheds for fish, wildlife, and their habitats.

In the face of complex water challenges and limited information on instream flow needs, the California Department of Fish and Wildlife (CDFW) is tasked with identifying ecological flow criteria that are protective of fish, wildlife, and the habitats that support them. A variety of established site- and species-specific field methods provide detailed flow regime information, however these approaches are time-intensive and can be prohibitively expensive at regional or watershed scales. By contrast, many rapid assessment approaches establish minimum flows that do not capture seasonal or interannual variation.

In response to these challenges, CDFW has developed a standardized approach to identify watershed-wide instream flow criteria that can be developed quickly and cost-effectively. The approach also incorporates essential components of a natural flow regime, rather than a single minimum flow. This fact sheet is intended to describe the "Watershed-Wide Instream Flow Criteria Reports" (Watershed Criteria Reports) and outline how they compare to the types of instream flow studies that CDFW has previously conducted.



1. What are the Components of Watershed Criteria Reports?

Watershed Criteria Reports evaluate important aspects of the natural hydrograph and provide flow information that can be used in water management decisions, permitting conditions, and environmental planning. The components included in each Watershed Criteria Report are outlined on Page 2. For more in-depth explanation of each component, please see the *Overview of Watershed-Wide Instream Flow Criteria Report Methodology* (CDFW 2021).

Figure 1. Watershed Criteria Report components.

FLOW VARIATION:
Using gage data, this analysis examines hydrographs for three different water year types to demonstrate the range of flows that occur in the watershed. If gage data are not available for the study stream, gage data from a surrogate stream may be used.

MEDIAN NATURAL FLOWS:
Natural flows represent the flow that would be present in the absence of land use and water diversion impacts to natural hydrology. Median natural flows are determined using the California Natural Flows Database (Zimmerman et al. 2020).

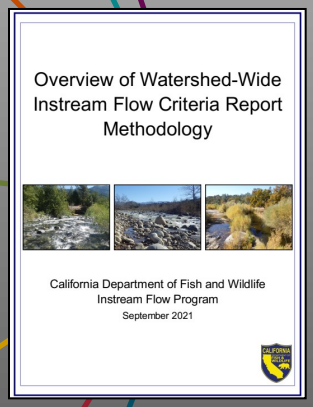
FUNCTIONAL FLOWS:
Functional flows provide information about the key elements of the flow regime (i.e., fall pulse flow, wet-season baseflow, peak magnitude flows, spring recession flow, and dry season baseflow). These components are essential to a flow regime that sustains ecological function over time (Yarnell et al. 2015; CEFF TWG 2021; Yarnell et al. 2020). For more information on functional flows, see the *Functional Flows Fact Sheet* (CDFW 2021).

ECOSYSTEM BASEFLOWS:
Ecosystem baseflows are monthly baseflows that preserve a healthy stream ecosystem. These are calculated as a percentage of monthly and annual natural flows and vary throughout the year (Tessmann 1980).

SALMONID HABITAT OPTIMUM FLOWS:
Salmonid habitat optimum flows provide optimal access to preferred salmonid habitat. This section presents the optimal discharge for select salmonid life stages for each stream reach.

SENSITIVE PERIOD INDICATOR FLOWS:
Sensitive period indicator flows can be used to identify the sensitive low-flow period. When stream flow drops below the sensitive period indicator, fish and benthic macroinvertebrates may be particularly sensitive to additional water reductions and other stressors (e.g., poor water quality) (Annear et al. 2004; CDFW 2017). These flows are determined using a field-based analysis.

SALMONID PASSAGE FLOWS:
Salmonid passage flows provide enough water for salmonids to cross riffles, which are typically the shallowest part of a channel. These flows are determined using a field-based analysis (CDFW 2018).



The results from these analyses are used to inform the development of watershed-wide flow criteria for select reaches of interest within the study watershed. Functional flows provide the basis for the criteria and are used in conjunction with sensitive period indicator flows and salmonid passage flows when these data are available. Flow criteria are provided by water year type and at the weekly or seasonal timestep.

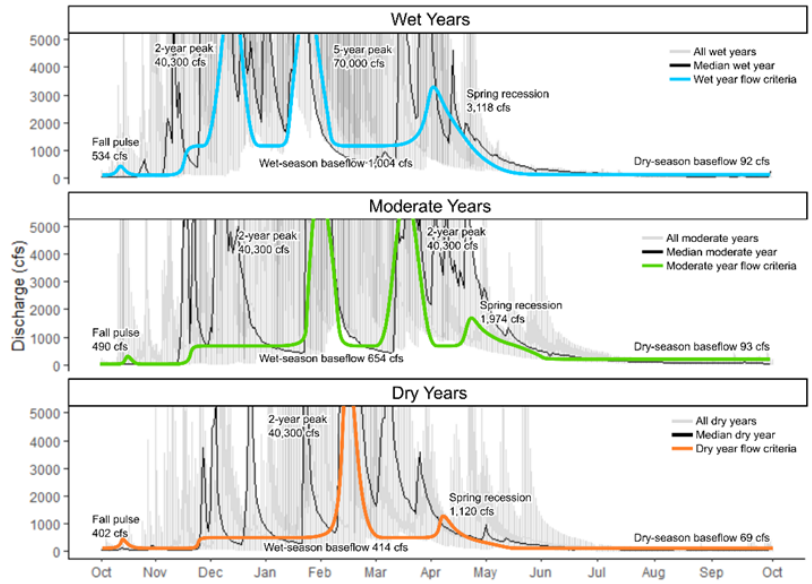


Figure 2. Example flow criteria from a Watershed Criteria Report.

2. Are Site-Specific and Watershed Criteria Comparable?

Yes. Site-specific and watershed-wide flow criteria generally contain the same or similar components of an annual flow regime.

Site-specific criteria are typically developed in response to study questions pertaining to specific species and life stages. They are used when general watershed information does not satisfy study plan questions or objectives. These studies often require development and calibration of complex hydraulic habitat models. The process of developing these models is often time- and fieldwork-intensive.

A primary difference between site-specific criteria and watershed-wide flow criteria is often the use of complex hydraulic habitat modeling and intensive field data collection.

Watershed-wide flow criteria, on the other hand, do not typically require hydraulic habitat models, and instead are conducted through broad scale analysis using hydrologic tools combined with limited field data. Watershed-wide flow criteria allow CDFW to quickly provide high-quality information on instream flow needs for watersheds and associated tributaries throughout the state.

The two approaches, while similar, differ in terms of cost, time requirements, and site access. Flow criteria developed in the Watershed Criteria Reports may be supplemented with additional site-specific data when available. CDFW will continue to develop site-specific criteria where necessary, but watershed-wide flow criteria provide CDFW with an additional pathway for providing valuable instream flow information to stakeholders. A comparison of characteristics and components of site-specific and watershed-wide flow criteria is outlined below.

CHARACTERISTICS & CONSIDERATIONS	SITE-SPECIFIC CRITERIA	WATERSHED CRITERIA
SITE ACCESS	Required	Not Required
ON-STREAM FLOW GAGE	Typically Required	Not Required
METHOD SELECTION	Question-Driven	Standardized
MODELING APPROACH	Hydraulic Habitat Models	Statistical Models
TYPE OF DATA COLLECTION	Site-Specific Field Data	Statewide Datasets/Limited Field Data
UTILIZED ON COMPLEX SITES	Yes	No
ASSESSES STREAM GAINS AND LOSSES	Yes	No

3. Are Watershed Criteria Part of a Larger Statewide Framework?

Yes. CDFW is partnering in the development of the California Environmental Flows Framework (CEFF), which is a statewide approach for determining ecological flow criteria and environmental flow recommendations (CEFF TWG 2021). CEFF is being developed by the Environmental Flows Technical Workgroup, a subgroup of the California Water Quality Monitoring Council. Both CEFF and the Watershed Criteria Reports use the same foundational method, the functional flows approach, as well as recently developed tools (e.g., modeled unimpaired flows, modeled functional flows).

4. Are Watershed Criteria Well-Substantiated?

Yes. When developing watershed-wide flow criteria, the Instream Flow Program uses a combination of standard methods and recently developed tools/approaches that have been published in the peer-reviewed scientific literature. These methods provide stakeholders with systematic, rigorous, and defensible information that can be applied to water resource management decisions statewide. The Instream Flow Program has a robust quality assurance (QA) program to ensure that complete and consistent data are used to establish flow criteria. The QA program provides guidance and reduces variability in approaches to study planning, design, data collection, and reporting. With the support of the QA program, both site-specific criteria and watershed criteria produce defensible data of known and documented quality. As new information and tools are developed, the criteria may be supplemented and/or revised.

Mark West Creek
SONOMA COUNTY

5. What are the Intended Uses of Watershed Flow Criteria?

Watershed Criteria Reports can be used by agencies, water managers, non-governmental organizations, and the public as a tool for consideration in water management planning. Watershed-wide flow criteria may address differing study objectives so that flow prescriptions can be tailored to the ecological management goals for a particular stream or watershed. Watershed criteria can be used when intensive site-specific data and hydraulic habitat models are not warranted or are cost prohibitive, where site access is restricted, or where information must be developed quickly for water management decisions. Watershed-wide flow criteria may be used to support CDFW regions and programs, including development of proposed streamflow requirements for Public Resources Code §10000-10005 priority streams, State of California Water Action Plan flow information, to meet the requirements of the California Water Resiliency Portfolio, and to inform water management planning.

For more information, please contact the CDFW Statewide Instream Flow Program: InstreamFlow@wildlife.ca.gov

CRITERIA USAGE	SITE-SPECIFIC CRITERIA	WATERSHED CRITERIA
PERMITTING	✓	✓
WATER RIGHTS	✓	✓
BYPASS FLOWS	✓	✓
GRANT PROJECTS	✓	✓
STREAM CONDITION ASSESSMENTS	✓	✓
RESTORATION	✓	✓

Canoe Creek
HUMBOLDT COUNTY

References

Annear, T., I. Chisholm, H. Beecher, A. Locke, P. Aarrestad, C. Coomer, C. Estes, J. Hunt, R. Jacobson, G. Jobsis, J. Kauffman, J. Marshall, K. Mayes, G. Smith, R. Wentworth and C. Stalnaker (2004). Instream flows for riverine resource stewardship. Revised edition. Instream Flow Council, Cheyenne, WY.

CDFW (2017). Low-flow threshold fact sheet. California Department of Fish and Wildlife, Instream Flow Program (CDFW), Sacramento, CA. Available: https://www.wildlife.ca.gov/Conservation/Watersheds/Instream-Flow.

CDFW (2018). Standard operating procedure for the habitat retention method in California. California Department of Fish and Wildlife, Instream Flow Program (CDFW), Sacramento, CA. CDFW-IFP-006, version 2. Available: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=128310.

CDFW (2021). Functional flows fact sheet. California Department of Fish and Wildlife, Instream Flow Program (CDFW), West Sacramento, CA. Available: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=193620&inline.

CEFF TWG (2021). California Environmental Flows Framework [webpage]. California Environmental Flows Framework (CEFF) Technical Working Group (TWG), Davis, CA. Available: https://ceff.ucdavis.edu. Accessed: May 19, 2021.

Tessmann, S. A. (1980). Environmental assessment, technical appendix E, Reconnaissance elements of the western Dakotas region of South Dakota study. South Dakota State University, Water Resources Research Institute, Brookings, SD.

Yarnell, S. M., G. E. Petts, J. C. Schmidt, A. A. Whipple, E. E. Beller, C. N. Dahm, P. Goodwin and J. H. Viers (2015). Functional Flows in Modified Riverscapes: Hydrographs, Habitats and Opportunities. BioScience 65(10): 963-972.

Yarnell, S. M., E. D. Stein, J. A. Webb, T. Grantham, R. A. Lusardi, J. Zimmerman, R. A. Peek, B. A. Lane, J. Howard and S. Sandoval-Solis (2020). A functional flows approach to selecting ecologically relevant flow metrics for environmental flow applications. River Research and Applications 36(2): 318-324.

Zimmerman, J. K. H., D. M. Carlisle, J. T. May, K. R. Klausmeyer, T. E. Grantham, L. R. Brown and J. K. Howard (2020). California Unimpaired Flows Database v2.0. The Nature Conservancy, San Francisco, CA. Available: https://rivers.codefornature.org. Accessed: August 14, 2020.