Introducing

Watershed Flow Criteria

Watershed Criteria 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 instream flow criteria (flow criteria) to provide ecological flow regime prescriptions that are protective of fish, wildlife, and the habitats that support them. Ecological flows are the flows necessary to sustain aquatic and riparian ecosystems throughout the entire river corridor (CDFW 2018a). There are many established site- and species-specific field methods that provide detailed flow regime information, but these approaches are time-intensive and can be prohibitively expensive at regional or watershed scales. By contrast, many rapid assessment approaches require unimpaired hydrology to establish a single minimum flow that does not incorporate natural flow variations.

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

1. What are Watershed Flow Criteria?

Watershed Flow Criteria (also referenced here as Watershed Criteria) are complementary to site-specific approaches and can provide opportune information to water managers and water allocation decision-making processes.

Watershed Criteria are developed using existing hydrologic and modeling tools that estimate natural monthly flows and a broad array of functional flow components needed for ecosystem structure and function (Yarnell et al. 2015). These tools are combined with desktop methods and site-specific information to produce comprehensive annual flow regimes at the watershed scale.

2. What are the Components of Watershed Criteria?

Watershed Criteria evaluate many important aspects of the natural hydrograph and provide robust flow regime information that can be used in water management decisions, permitting conditions, and environmental planning. The components included in each Watershed Criteria document are outlined below. For more in-depth explanation of each component, please see the *Overview of Analysis for Instream Flow Regime Criteria on a Watershed Scale* (CDFW 2019).

FLOW VARIATION:
Using existing 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. Any annual flow regime should take into consideration the natural flow regime in order to protect or restore ecosystems and their functions.

NATURAL FLOWS:
Natural flows represent the flow that would be present in the absence of land use and water diversion impacts to natural hydrology. Natural flows are determined using the estimated Natural Flows Database for California (Zimmerman et al. 2019).

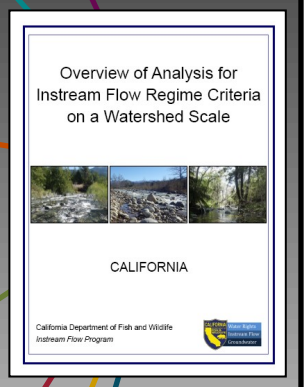
FUNCTIONAL FLOWS:
Functional flows provide information about the key elements of the flow regime (i.e., fall pulse flows, wet-season baseflows, peak magnitude flows, spring recession flows, and dry season baseflows). These components are essential to a flow regime that sustains ecological function over time (CEFF TWG 2019; Yarnell et al. 2015).

ECOSYSTEM BASEFLOWS:
Ecosystem baseflows are calculated by month using the Tessmann adaptation of the Tennant method (Tennant 1976, Tessmann 1980) to identify monthly instream flows needed to sustain aquatic ecosystems.

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).

SALMONID HABITAT OPTIMUM FLOWS:
The Hatfield-Bruce equations (Hatfield & Bruce 2000) estimate habitat optimum flows for a variety of salmonid species and life stages. These flows maximize the amount of habitat by salmonid species and life stage.

SALMONID PASSAGE FLOWS:
Salmonid passage flows are developed using the Standard Operating Procedure for the Habitat Retention Method in California (CDFW 2018b). This field-based method is used to identify flows that meet minimum hydraulic criteria for average depth, average velocity, and wetted perimeter at the hydraulic control of a riffle. Passage criteria, such as minimum body depth, are used to set thresholds suitable for steelhead passage.



3. Are Site-Specific and Watershed Criteria Comparable?

Yes. Site-specific criteria and Watershed 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. Site-specific evaluations are highly accurate and calibrated to individual study reaches, however these studies can span several years from study planning to final reporting.

A primary difference between site-specific criteria and Watershed Criteria is often the use of complex hydraulic habitat modeling.

Watershed Criteria, on the other hand, do not typically require hydraulic habitat models, and instead are conducted through broad scale analysis using hydrologic and regional regression modeling tools combined with limited field data. Watershed 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, do differ in terms of cost, time requirements, and site access. Some components of the Watershed Criteria analysis may be substituted with more refined flow criteria when site-specific data are necessary to provide more detailed species- and life-stage-specific flow regime information. CDFW will continue to develop site-specific criteria where necessary, but Watershed 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 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

4. 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 (see the CDFW CEFF Fact Sheet, CDFW 2018a). CEFF is being developed by the Environmental Flows Technical Workgroup (Eflows TWG), a subgroup of the California Water Quality Monitoring Council. In addition to CDFW, the Eflows TWG comprises representatives from state and federal agencies, academia, non-profit organizations, and other stakeholder groups. CDFW's Watershed Criteria use core foundational approaches (e.g., functional flow components) and recently developed tools (e.g., modeled predictions of unimpaired flows) of the CEFF, along with other standard methods to identify flow criteria on a watershed scale.

5. Are Watershed Criteria Well-Substantiated?

Yes. When developing Watershed 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. Watershed Criteria are based on the best available science. As new information and tools are developed, the criteria may be supplemented and/or revised.

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

Watershed Criteria provide multiple flow criteria components to 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. CDFW may use Watershed Criteria as a tool to support CDFW regions and programs, including development of proposed streamflow requirements for Public Resources Code §10000-10005 priority streams and State of California Water Action Plan flow information, and to inform water management planning.

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

7. Who is the Intended Audience for Watershed Flow Criteria?

The intended audience includes agencies, water managers, non-governmental organizations, and the public. Water managers should consider all available information when making determinations for applying instream flow criteria. To help with this task, CDFW provides Watershed Criteria as tools for consideration in water management planning. This approach may be implemented, if appropriate, under the specific circumstances of a watershed, stream, or informational need. A Watershed Criteria report, in and of itself, should not be considered to provide binding guidelines, establish legal compliance, or ensure project success.

For more information, please contact CDFW Statewide Instream Flow Coordinator Brionna Drescher:

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