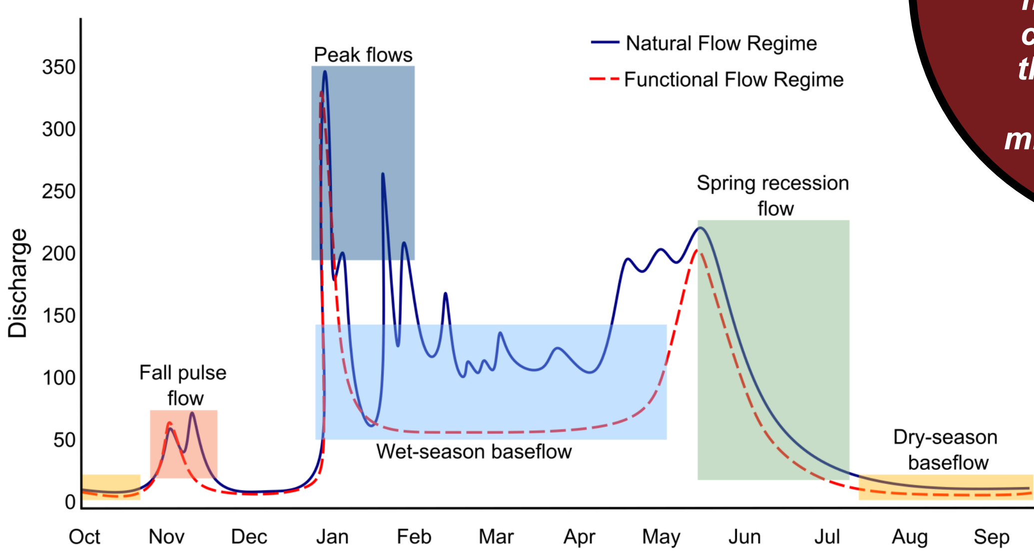
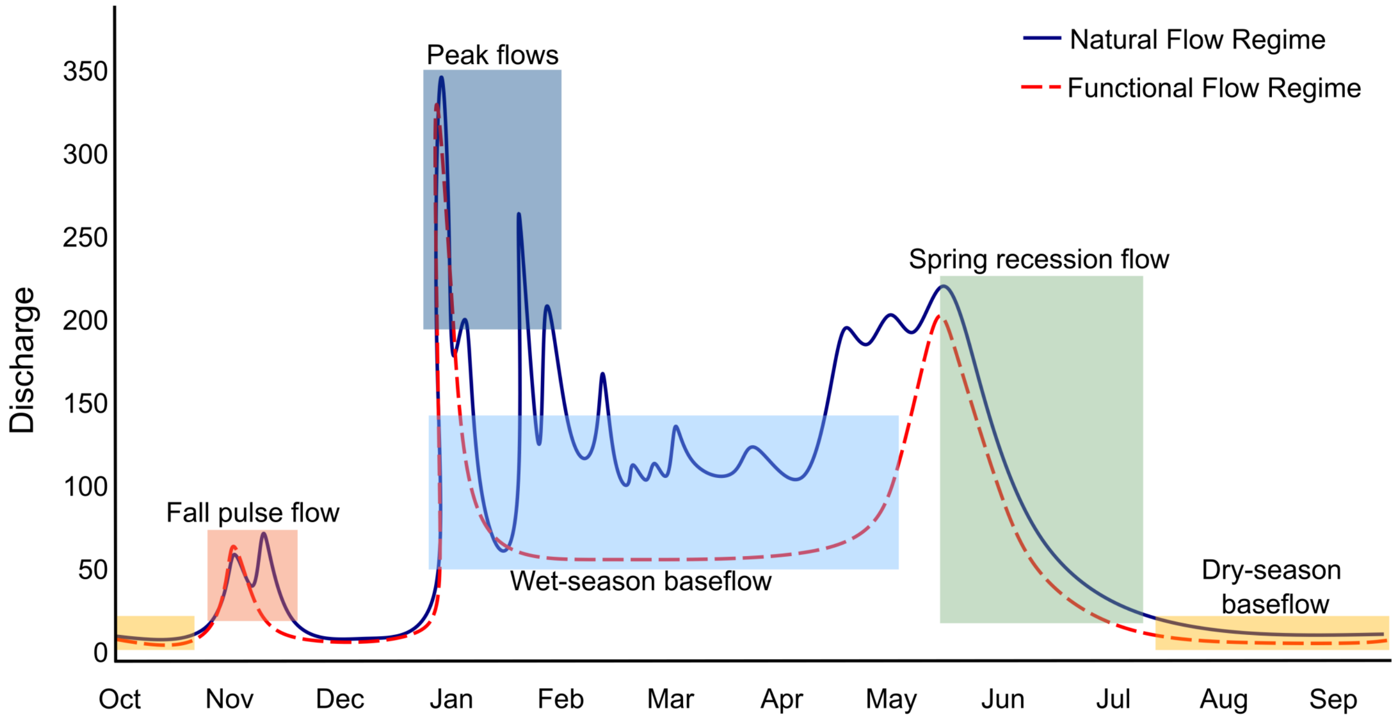
What are Functional Flows?

Functional flows are elements of the natural flow regime that perform distinct ecological and geomorphic functions and support the specific life history and habitat needs of native species (Yarnell et al. 2015; Yarnell et al. 2020). These flows can be used to represent water needed for the environment. In California, functional flow components include the **fall pulse flow**, the **wet-season baseflow**, **peak flows**, the **spring recession flow**, and the **dry-season baseflow** (see page 2).

A functional flows approach to streamflow management relies on the preservation of the five functional flow components rather than the full natural flow regime or a minimum flow value.



Functional Flow Components



The **FALL PULSE FLOW** is triggered by the first major storm event following the dry season. This flow represents the transition from the dry to wet season and serves important functions, such as moving nutrients downstream, improving water quality, increasing soil moisture, and re-establishing connectivity between the stream channel and the riparian zone. This flow also signals species to migrate or spawn. For example, in the Central Valley, fall pulse flows initiate the upstream migration of fall-run Chinook salmon (Kiernan et al. 2012). Depending on the region, these flows may not occur every year.

PEAK FLOWS are large-scale disturbances responsible for significant sediment transport, activating and inundating the floodplain, and maintaining and restructuring the river channel. These peak flows maintain habitat diversity over the long term, provide migratory and spawning cues for native species, initiate riparian successional processes, and limit vegetation and non-native aquatic species encroachment. For example, the abundance of non-native species such as brown trout and sunfish has been observed to be negatively impacted by the presence of peak flow events during the winter (Kiernan and Moyle 2012).

The **WET-SEASON BASEFLOW** is defined by a prolonged period of elevated baseflow between winter storms. These higher flows support movement, provide habitat for species that migrate and over-winter in streams, and recharge groundwater. For example, on many coastal streams in California, high wet-season flows promote salmonid migration through riffles and low-flow barriers (Grantham 2013).

The **SPRING RECESSION FLOW** represents the transition between the wet and dry season. This gradually receding flow redistributes sediment mobilized by the higher flows earlier in the year and cues reproduction and migration of native species. For example, gradual recession flows promote amphibian spawning as well as cottonwood recruitment and germination in riparian areas (Yarnell et al. 2010).

The **DRY-SEASON BASEFLOW** is the low flow that occurs annually and favors native species that have adapted to withstand these biologically-stressful periods. For example, stoneflies and other aquatic insects delay growth and development during the dry season to reduce mortality (Lytle and Poff 2004). These low flows may also restrict the connectivity and availability of instream habitat, and lead to declines in water quality.

While the five natural functional components of flows are common to California's streams, their magnitude, timing, frequency, duration, and rate of change vary regionally and reflect the natural variation in flows across the state. For example, in the Sierra Nevada, the spring recession flow component is fed by snowmelt following the winter and has a larger magnitude and longer duration than the spring recession in small, rain-driven streams on the North Coast.

Functional flows explicitly highlight seasonal flow variation, however interannual variability in flows is another key attribute of the functional flows approach. Characteristics of functional flow components vary by water year type (dry, moderate, wet years), with, for example, higher flows and more peak flow events in wet years, and shorter and drier wet seasons in dry years.

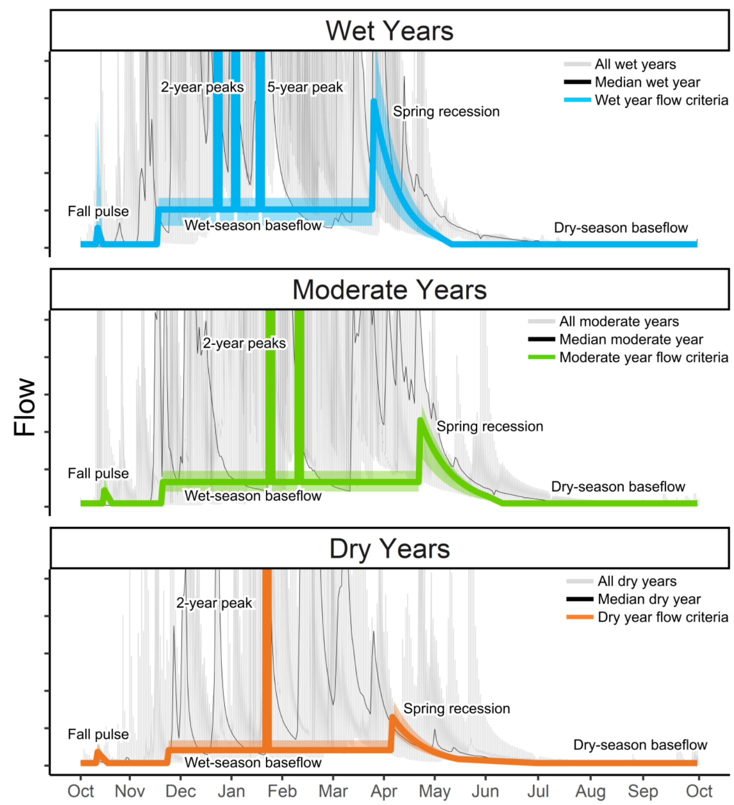
Collectively, functional flows interact with physical habitat, water quality, and biological processes to sustain the ecosystem functions that ultimately control the structure and health of ecological communities over time.

Functional Flows and the Instream Flow Program

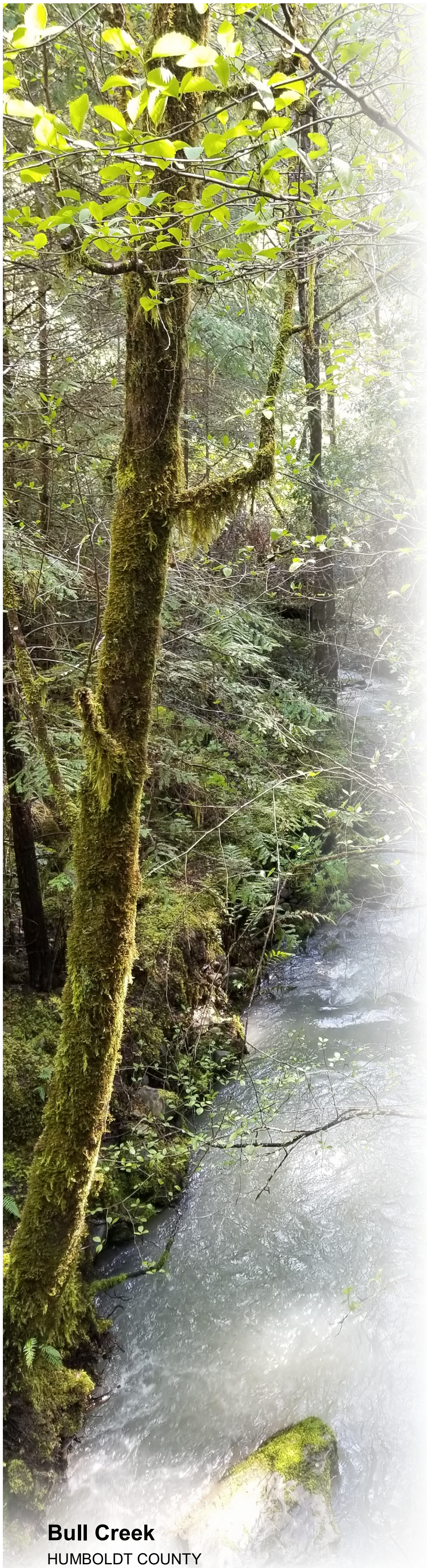
The functional flows approach provides the basis for a larger statewide effort, the California Environmental Flows Framework (CEFF), which provides guidance and a set of tools for establishing ecological flow criteria in California.

The Instream Flow Program is implementing the functional flows approach and using CEFF products in several types of studies. In the Watershed-Wide Instream Flow Criteria reports, functional flows provide information about key elements of the flow regime for watersheds of interest, and, in combination with site-specific data, functional flows are used to develop ecological flow criteria.

The functional flows approach is also used in technical flow studies to inform the development of draft instream flow recommendations, such as those developed for the Ventura River. The Instream Flow Program will continue to use the functional flows approach in future work.



Right: Flow criteria developed by the Instream Flow Program using the functional flows approach



Bull Creek
HUMBOLDT COUNTY

Resources

For more information about the California Environmental Flows Framework, visit:

https://ceff.ucdavis.edu.

For more information on the Instream Flow Program's Watershed Criteria Reports, visit:

https://wildlife.ca.gov/Conservation/Watersheds/Instream-Flow/Watershed-Criteria.

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