Functional Flow Metrics from Predicted Daily Existing Flows

Summary

This dataset contains functional flow metrics derived from predicted daily Existing (Actual) streamflow for river and stream reaches across California. Metrics are calculated using the Functional Flows Calculator (https://flowcalculator.codefornature.org) framework to summarize key components of the annual flow regime, including magnitude, timing, duration, frequency, and rates of change.

Metrics are provided for most stream segments in California as represented in the NHD+ Medium Resolution Flowline dataset and are indexed using the unique COMID identifier for each reach. Functional flow metrics are summarized for water years 2002–2022 and reported for all years combined, as well as for wet, moderate, and dry water year types.

These data are intended to support statewide analyses of flow regime structure and alteration, ecological flow assessments, and conservation planning applications where observed streamflow data are sparse or unavailable.

Limitations and Disclaimer: Predictions are not provided for approximately 1% of NHD+ flowlines where drainage area attributes were missing or inconsistent between NHD+ metadata and watershed delineation. This dataset is derived entirely from modeled Existing flows, not observed streamflow. Internal testing indicated that functional flow metrics derived from the Existing flows model performed poorly and did not represent metrics calculated from observed streamflow well. Nash–Sutcliffe Efficiency (NSE) values ranged from approximately -0.34 to -2.17, where negative NSE values indicate poor model performance relative to the observed mean. In addition, an accuracy assessment of predicted functional flow alteration classes at 63 stream gages indicated the correct alteration type was predicted only 54% of the time. As a result, statewide patterns of modeled functional flow alteration may be inaccurate or misleading. Users should apply these data with caution, avoid over-interpreting fine-scale spatial patterns, and review the accompanying accuracy documentation prior to use.

Description

The Nature Conservancy calculated functional flow metrics from the Existing (Actual) flows model to characterize the seasonal structure and variability of streamflow regimes across California. Functional flow metrics translate continuous daily flow time

series into ecologically meaningful indicators describing key flow components such as wet-season baseflows, peak flows, spring recession, and dry-season low flows.

Metrics were computed by applying the python Functional Flows Calculator (https://github.com/tnc-ca-geo/python-flow-calculator) to the predicted mean daily Existing flows time series for each NHD+ reach. For each reach and metric, values were summarized across multiple water years to produce percentile-based distributions representing long-term variability. Metrics are reported separately for all years, wet (calculated as the wettest one third of years when ranked by average annual predicted flow), dry (calculated as the driest one third of years when ranked by average annual predicted flow) and moderate (the remaining one third of years) water year types. In some water years, there was insufficient information to calculate a given functional flow metric (e.g., there is no predicted flow event that would qualify as a fall pulse flow), so not all flow metrics are calculated for all water years. If there were fewer than 5 water years with sufficient data to calculate the functional flow metric for a given water year type, this summary stats are excluded from this dataset due to a small sample size. This dataset includes Existing flow conditions only and does not include functional flow metrics derived from unimpaired or natural flow predictions.

Date

Temporal coverage: October 1, 2001 – September 30, 2022 (Water Years 2002–2022)

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Point of Contact

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Field Definitions

The data are distributed as comma-separated values (CSV) files summarized by COMID, functional flow metric, and water year type. Fields include:

- **comid** – Unique identifier for the NHD+ Medium Resolution flowline (reach).
- **ffm** – Functional flow metric identifier (e.g., dry-season duration, spring magnitude, wet-season baseflow timing).
- **wyt** – Water year type used for metric summarization (all, wet, moderate, dry).
- **p10** – 10th percentile of the metric value across modeled years.
- **p25** – 25th percentile of the metric value across modeled years.
- **p50** – 50th percentile (median) of the metric value across modeled years.
- **p75** – 75th percentile of the metric value across modeled years.

- **p90** – 90th percentile of the metric value across modeled years.
- **unit** – Units of the functional flow metric (e.g., cubic feet per second, days, water year day, occurrences, percent).
- **source** – Source dataset used to calculate metrics (modeled_existing_daily).
- **modeled_years** – Number of water years contributing to the summary statistics.
- **modeled_year_start** – First water year included in the summary.
- **modeled_year_end** – Last water year included in the summary.

Percentile values represent interannual variability across modeled years and do not represent uncertainty of individual daily flow predictions.

Abbreviation Definitions

- **comid** – Unique identifier for NHD+ flowline features.
- **ffm** – Functional flow metric code (see list below).
- **wyt** – Water year type (all, wet, moderate, dry).
- **cfs** – Cubic feet per second.

Functional flow metric codes:

- **ds_dur_ws** (days) — Dry-season duration: Dry-season baseflow duration (# of days from start of dry season to start of wet season)
- **ds_mag_50** (cfs) — Dry-season baseflow: 50th percentile of daily flow within dry season
- **ds_mag_90** (cfs) — Dry-season high baseflow: 90th percentile of daily flow within dry season
- **ds_tim** (water year day) — Dry-season start: Dry-season baseflow start timing (water year day of dry season)
- **fa_dur** (days) — Fall pulse duration: Duration of fall pulse event
- **fa_mag** (cfs) — Fall pulse magnitude: Peak magnitude of fall pulse event (maximum daily peak flow during event)
- **fa_tim** (water year day) — Fall pulse start: Water year day of fall pulse event peak
- **peak_dur_2** (days) — 2-year flood duration: Seasonal duration of 2-year recurrence interval peak flow (cumulative number of days in which this peak flow magnitude is exceeded)
- **peak_dur_5** (days) — 5-year flood duration: Seasonal duration of 5-year recurrence interval peak flow (cumulative number of days in which this peak flow magnitude is exceeded)
- **peak_fre_2** (occurrences) — 2-year flood frequency: Frequency of 2-year recurrence interval peak flow within a season
- **peak_fre_5** (occurrences) — 5-year flood frequency: Frequency of 5-year recurrence interval peak flow within a season

- **sp_dur** (days) — Spring duration: Spring flow recession duration (# of days from start of spring to start of dry-season baseflow period)
- **sp_mag** (cfs) — Spring recession magnitude: Spring recession magnitude (daily flow on start date of spring-flow period, 4 days after last wet-season peak)
- **sp_roc** (percent) — Spring rate of change: Spring flow recession rate (median daily rate of change over decreasing periods during the recession)
- **sp_tim** (water year day) — Spring start: Start date of spring in water year days
- **wet_bfl_dur** (days) — Wet-season duration: Wet-season baseflow duration (# of days from start of wet-season to start of spring season)
- **wet_bfl_mag_10** (cfs) — Wet-season baseflow: Magnitude of wet-season baseflows (10th percentile of daily flows within that season, including peak flow events)
- **wet_bfl_mag_50** (cfs) — Wet-season median flow: Magnitude of wet-season baseflows (50th percentile of daily flows within that season, including peak flow events)
- **wet_tim** (water year day) — Wet-season start: Start date of wet-season in water year days

Access Constraints

None.

Use Constraints

None. Users are requested to use the following citation when using these data:

The Nature Conservancy. Functional Flow Metrics from Predicted Daily Existing Flows, Version 1.0.0. 2026. San Francisco, CA. https://rivers.codefornature.org/#/data. (Date Accessed).

Data Distribution

The dataset is distributed by The Nature Conservancy as downloadable CSV files via the **Data** page and API at https://rivers.codefornature.org/#/data.

Progress

Complete.

Update Frequency

As needed.

Keywords

Functional flows; ecological flow metrics; streamflow alteration; hydrology; Existing flows; California

Projection

Not applicable. (Tabular data linked to NHD+ flowline identifiers.)

Datum

Not applicable.