Development of Rapid Streamflow Duration Assessment Methods for Nationwide Coverage

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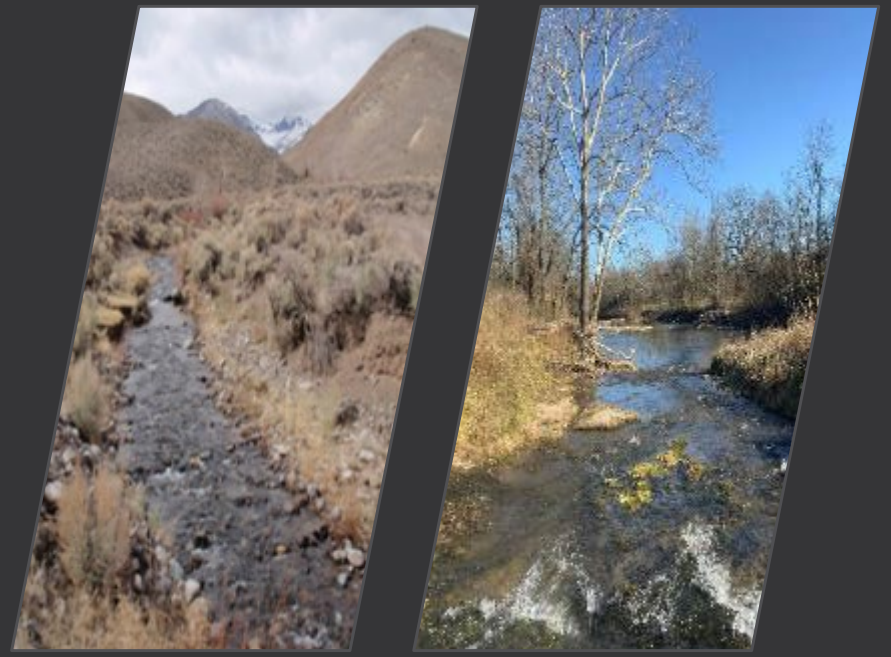

National Association of Wetland Managers Webinar

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The ideas and opinions expressed herein are those of the authors and do not reflect official USEPA position or policy.

Presentation Topics

- Introduction and Background
- Development of Streamflow Duration Assessment Methods (SDAMs)
- Overview of Regional SDAMs
- Next Steps in Development of SDAMs
- Opportunity for Refined Regionalization

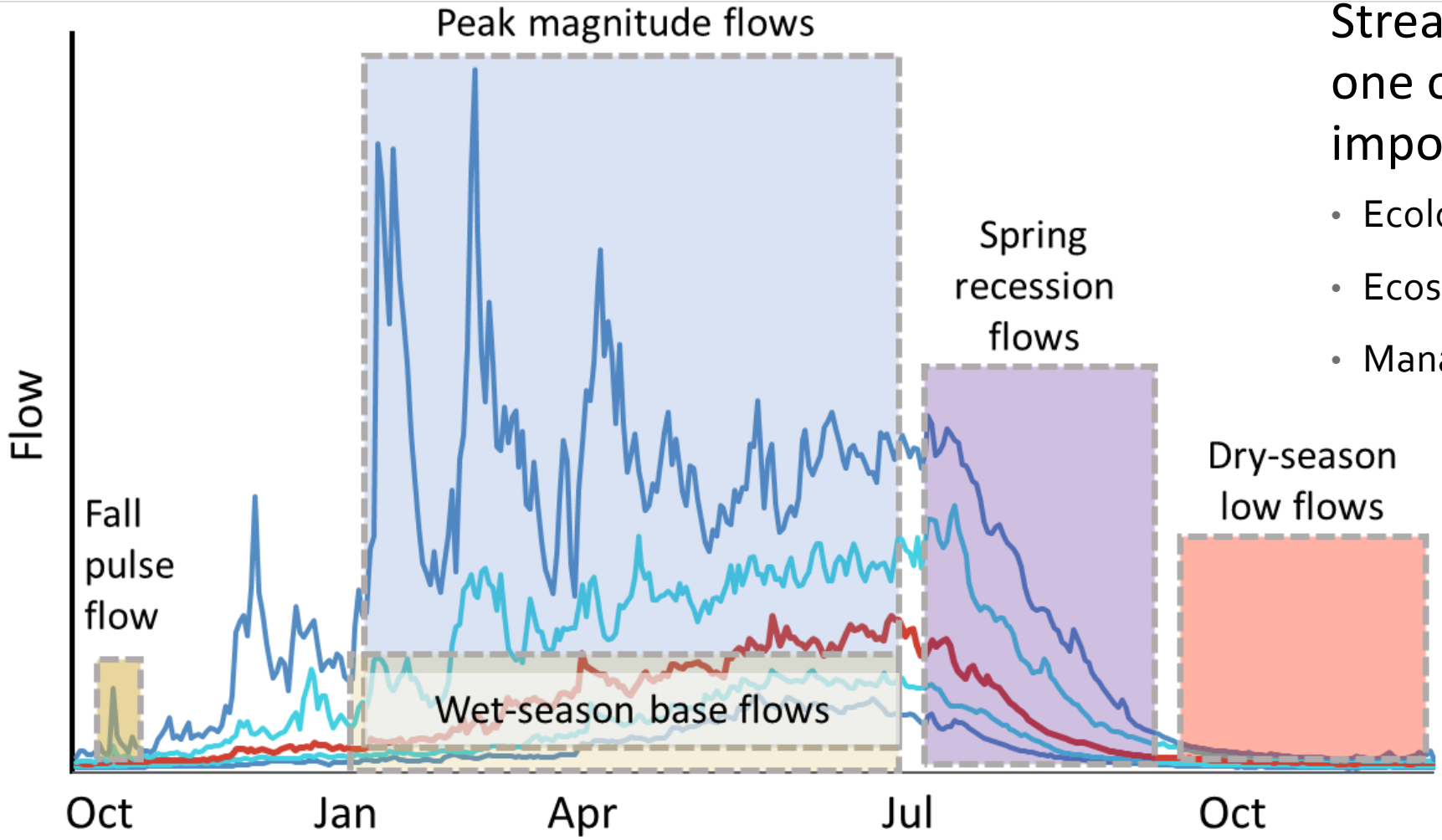
What is streamflow?

Streamflow is movement of water in a confined channel.

Streamflow is different from:

- Standing surface water
- Subsurface flow
- Seepage

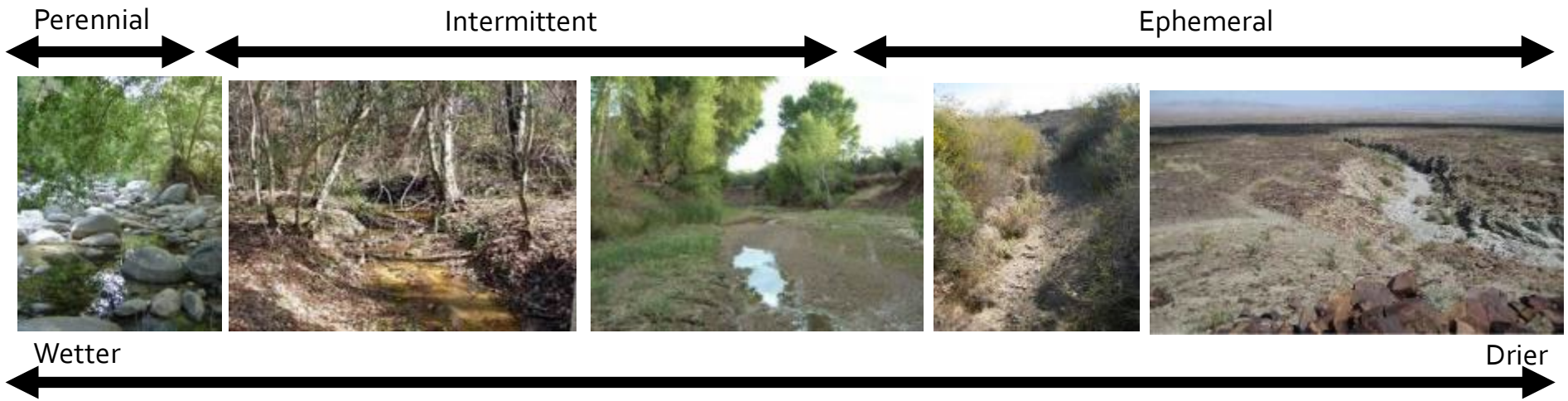
There are many ways to characterize streamflow



Streamflow duration is one of the most important:

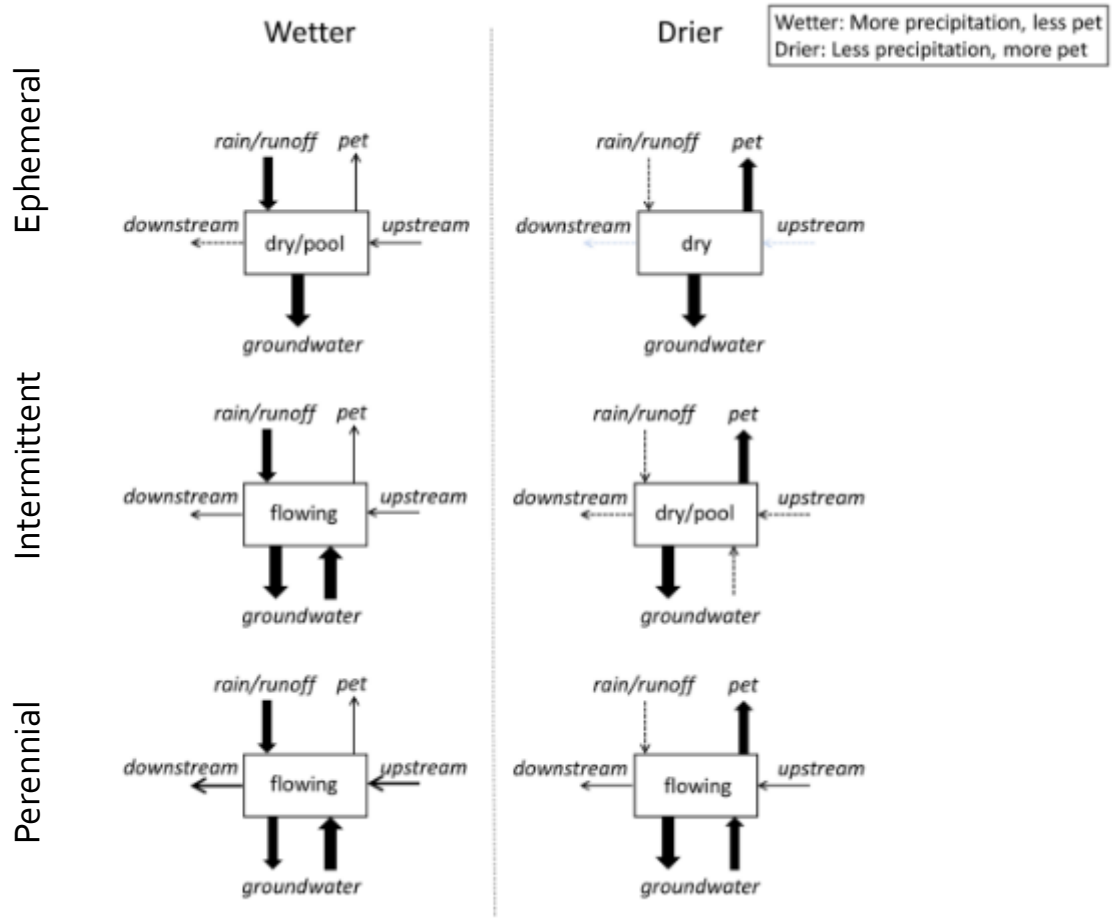
- Ecology
- Ecosystem functions
- Management

Streamflow duration exists on a continuum



- There are many terms to describe and classify this continuum:
  - Three classes (perennial, intermittent, ephemeral) widely used in the U.S. for academic and management purposes.
  - There are no universally accepted definitions for these classes, but they are generally assumed to reflect typical regimes at a reach over many years under present-day conditions.
- Multiple dimensions characterize this continuum including:
  - Length of flow
  - Predictability
  - Timing of flow

Streamflow duration is dictated by changes in a reach's water inputs and outputs



Fritz et al. (2020)

Inputs:

- Discharge from upstream
- Discharge from groundwater
- Rainfall/runoff

Outputs:

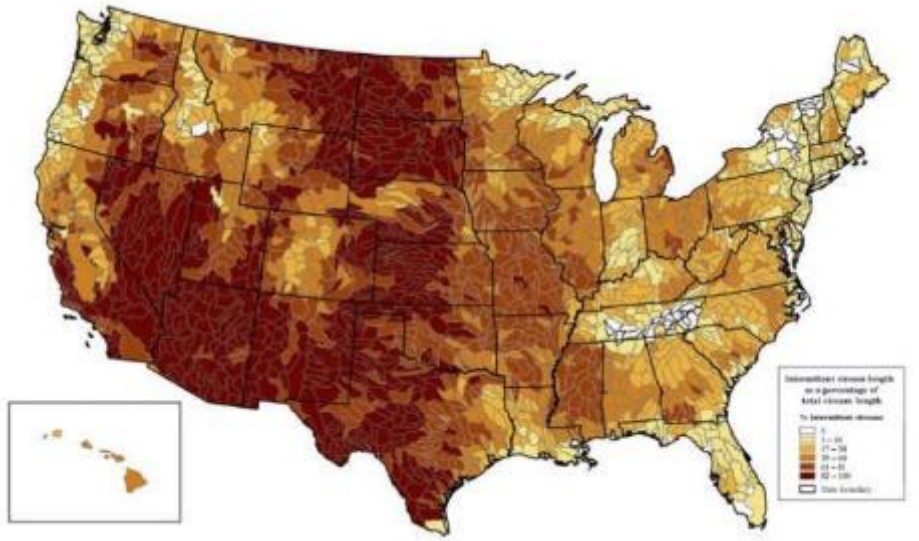
- Discharge to downstream
- Groundwater percolation
- Potential evapotranspiration (pet)

What is a Streamflow Duration Assessment Method (SDAM)?

A rapid, field-based method for classifying the flow duration of a stream reach.

- *Field-based*: Based on observations of indicators, not on hydrological models.

- *Rapid*: Can be completed in a single site visit. No long-term data collection required.



Intermittent and ephemeral stream length in the U.S. (Nadeau & Rains 2007)

What are indicators?

- Easy to measure properties of an ecosystem that let us infer hard-to-measure properties.
- Streamflow duration indicators
  - May include geomorphological, hydrological, biological and geospatial measures
  - May reflect:
    - **Controls** on streamflow duration (e.g., streambed substrate composition)
    - **Responses** to streamflow duration (e.g., hydrophytic plants)
    - **Associations** with streamflow duration (e.g., sinuosity)
  - Indicators that reflect long-term conditions are favored (e.g., long-lived plants) over those that are more transient or reflect only recent conditions (e.g., presence of water).

Why do we need SDAMs?

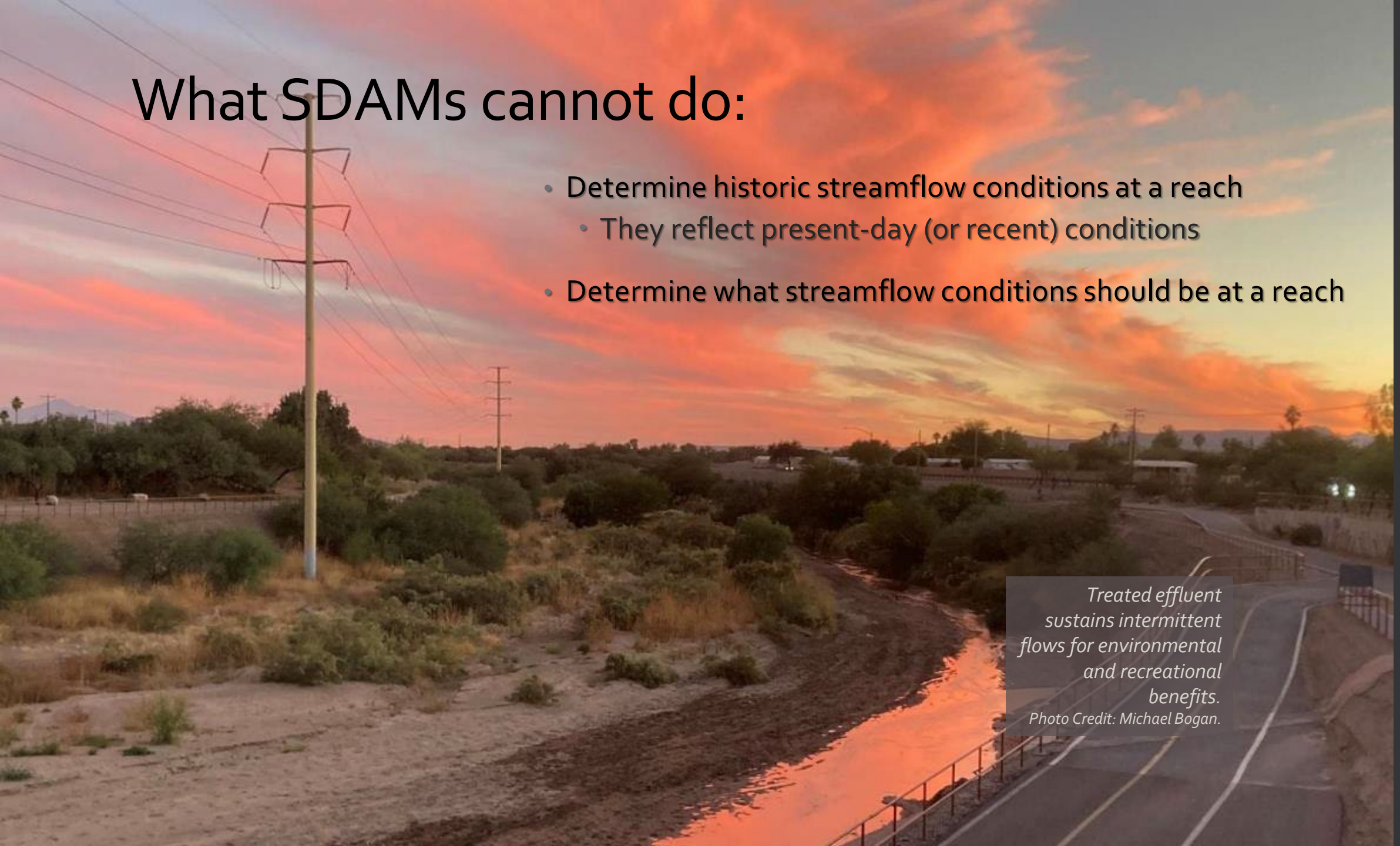
- Streamflow duration is one of the most ecologically important aspects of a stream's hydrology
- Informs several regulatory and management decisions (e.g., determining jurisdiction under the Clean Water Act, applying Water Quality Standards)
- Long-term hydrologic data to classify streamflow is collected at only a small number of sites (e.g., USGS stream gages)
- Rapid field-based SDAMs can classify streams when hydrologic data are lacking

Applying an SDAM is *not* a jurisdictional determination under the Clean Water Act

- Jurisdictional determinations are based on current regulatory guidance and policy
- Jurisdictional determinations for some aquatic resources require timely streamflow duration information, which SDAMs can provide
- SDAM results alone do not constitute jurisdictional determinations
- SDAMs have other management and research applications (e.g., setting restoration goals, assessing water quality, etc.)

What SDAMs cannot do:

- Determine historic streamflow conditions at a reach
  - They reflect present-day (or recent) conditions
- Determine what streamflow conditions should be at a reach



Treated effluent sustains intermittent flows for environmental and recreational benefits.
Photo Credit: Michael Bogan.

SDAMs classify stream reaches into 3 categories

Perennial

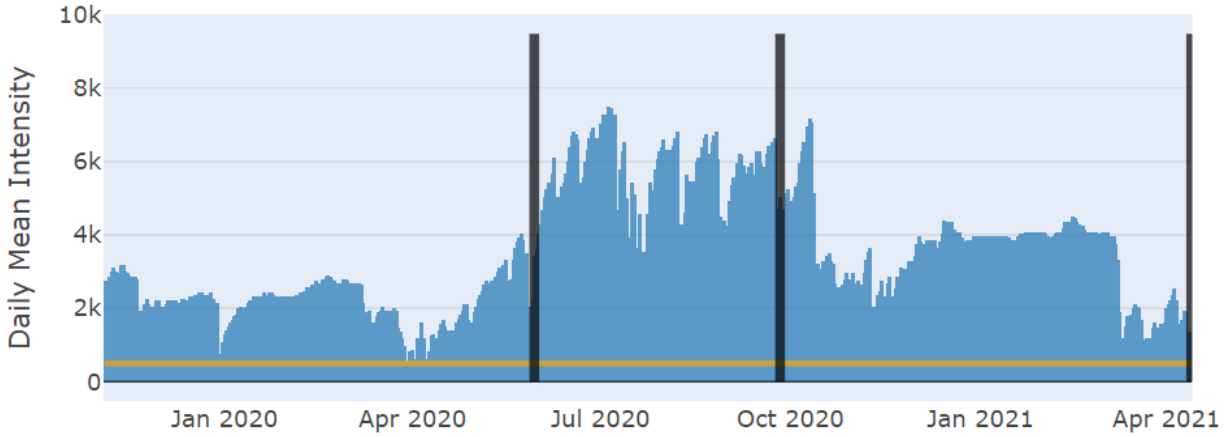
Intermittent

Ephemeral

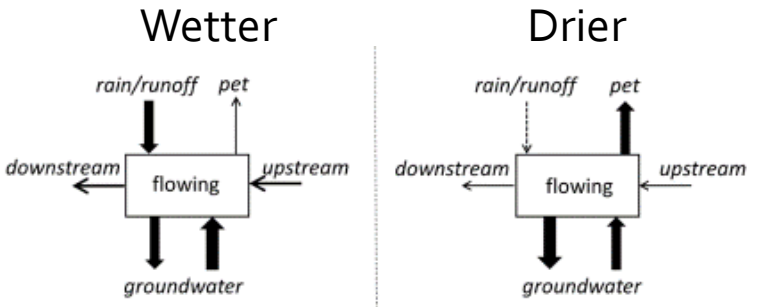
Method outputs include a fourth category - At Least Intermittent

Perennial streams

- *Perennial reaches* contain flowing water continuously during year of normal rainfall, often with the streambed located below the water table for most of the year. Groundwater supplies the baseflow for perennial reaches, but the flow is also supplemented by stormwater runoff or snowmelt.

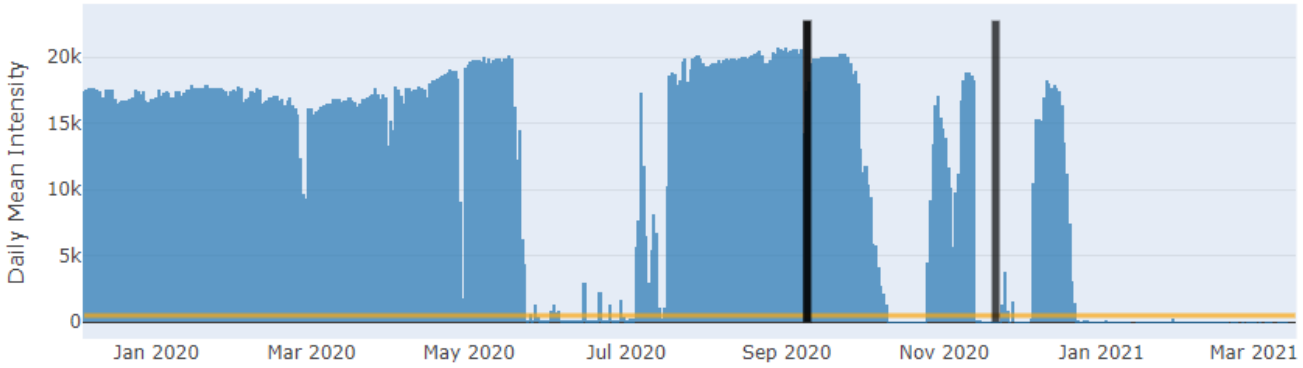


Tributary to Trout Brook, Chequamegon National Forest, WI (STIC logger); blue areas above yellow calibration line indicate streamflow

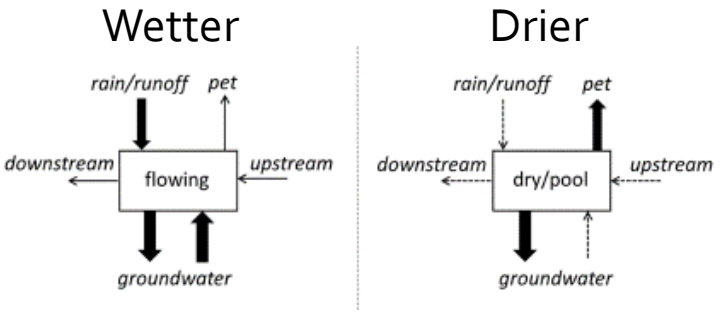


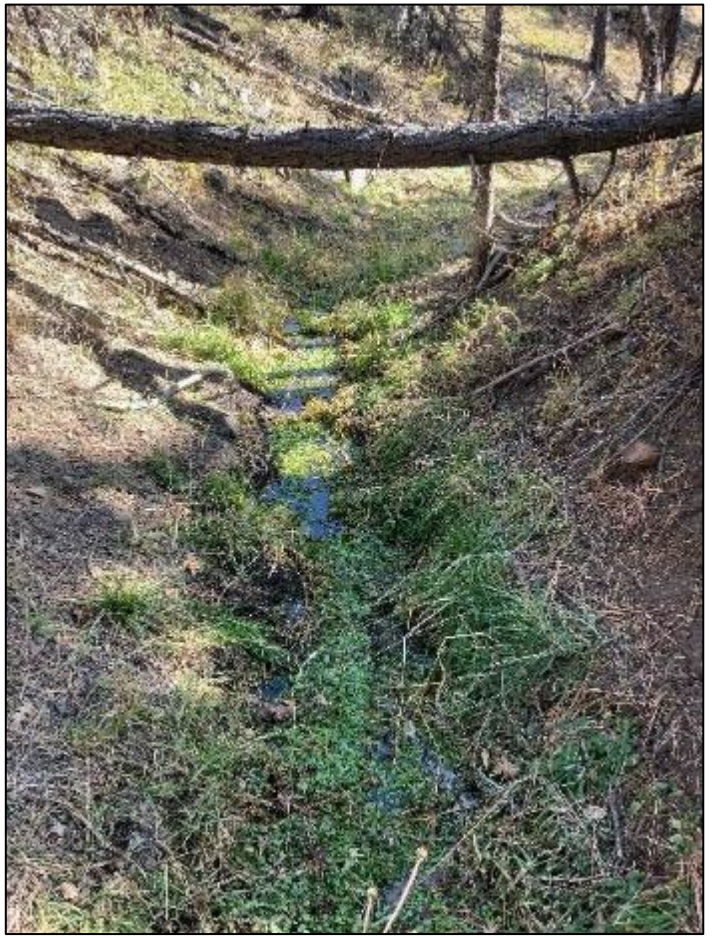
Intermittent streams

- *Intermittent reaches* are channels that contain flowing water for only part of the year, typically during the wet season, where the streambed may be below the water table and/or where the snowmelt from surrounding uplands provides sustained flow. The flow may vary greatly with stormwater runoff.



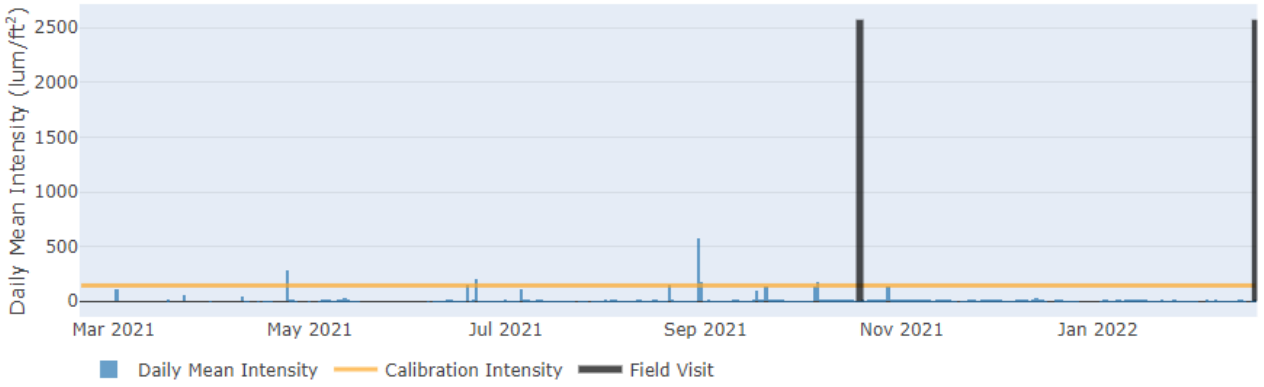
Flume Canyon, Lincoln National Forest, NM (STIC logger); blue areas above yellow calibration line indicate streamflow



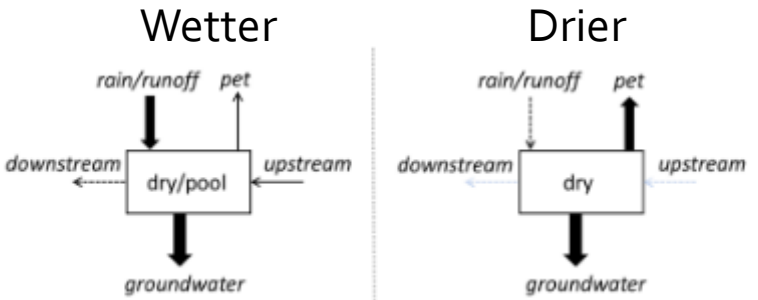


Ephemeral streams

- *Ephemeral reaches* flow only in direct response to precipitation. Water typically flows only during and shortly after large precipitation events, the streambed is always above the water table, and stormwater runoff is the primary water source.



UT to Blue Creek, Blackwater State Forest, FL (STIC logger); blue areas above yellow calibration line indicate streamflow



SDAM Development by EPA and the Corps

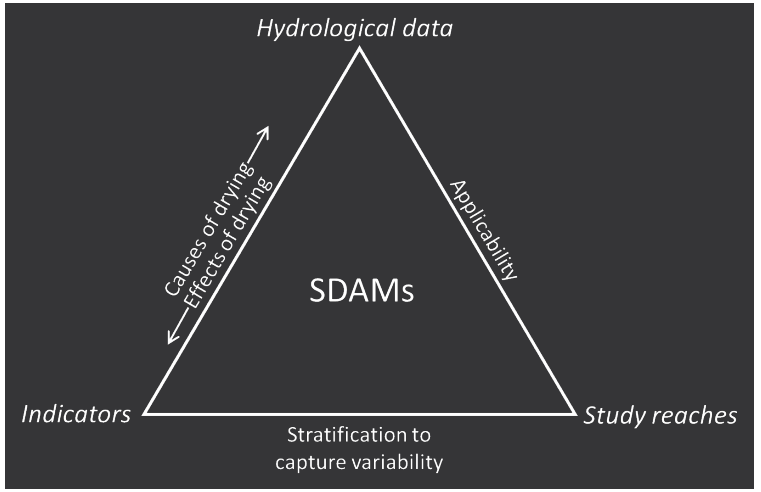
Project Goals & Objectives

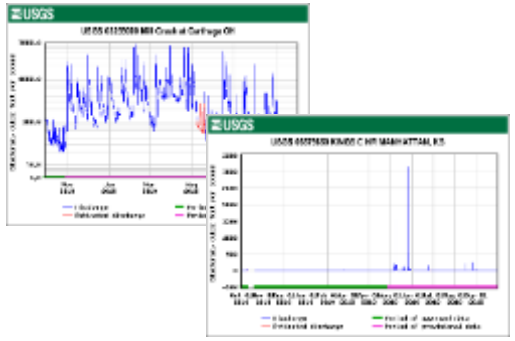
- Develop robust SDAMs, at appropriate regional scales, for use nationwide
- Identify and test existing and candidate indicators of streamflow duration
- Conduct validation studies that result in accurate, consistent, and defensible SDAMs
- Contribute to our understanding of intermittent and ephemeral streams
- Support more efficient, accurate, and defensible jurisdictional determinations

Map of regions identified in the USACE Ordinary High Water Mark (OHWM) Scientific Support Document (Northern Plains, Southern Plains, Northeast, Southeast), USACE National Wetland Plant List (Arid West, Western Mountains) and the Pacific Northwest SDAM.

Key pieces to SDAM development

- Study sites across range of flow conditions, representative of region
- Direct classification of hydrology to determine actual flow duration class
  - Gage data
  - Data loggers, wildlife camera imagery
  - Recurrent visits
- Suite of indicators measured (geomorphology, hydrology, and biology)





Electrical resistance (ER) and temperature data logger

water

MDPI

Review

Classifying Streamflow Duration: The Scientific Basis and an Operational Framework for Method Development

Ken M. Fritz [1,*], Tracie-Lynn Nadeau [2,3], Julia E. Kelso [3,4], Whitney S. Beck [3], Raphael D. Mazor [5], Rachel A. Harrington [3,†] and Brian J. Topping [3]

(Fritz et al. 2020)

SDAM Development Steps (Fritz et al. 2020)

Preparation

- Establish Technical Advisory Committee
- Establish Streamflow Duration Classes
- Conduct Literature Review
- Outreach to Regional Experts
- Identify Candidate Indicators
- Identify and Classify Candidate Sites
- Develop Data Collection Protocols

Data Collection

- Field Indicator Data Collection
- GIS Indicator Data Collection
- Confirmation of Hydrology

Data Analysis

- Screening Analysis of Indicators
- Assemble Interim SDAM (model)
- Single Indicator Selection

Method Evaluation

- Make Data Publicly Available
- Public Release of Interim SDAM
- Feedback and Revision Opportunities
- Final SDAM

Implementation

- Training Materials and User Guide
- Train-the-Trainer
- Establish Practitioner Network

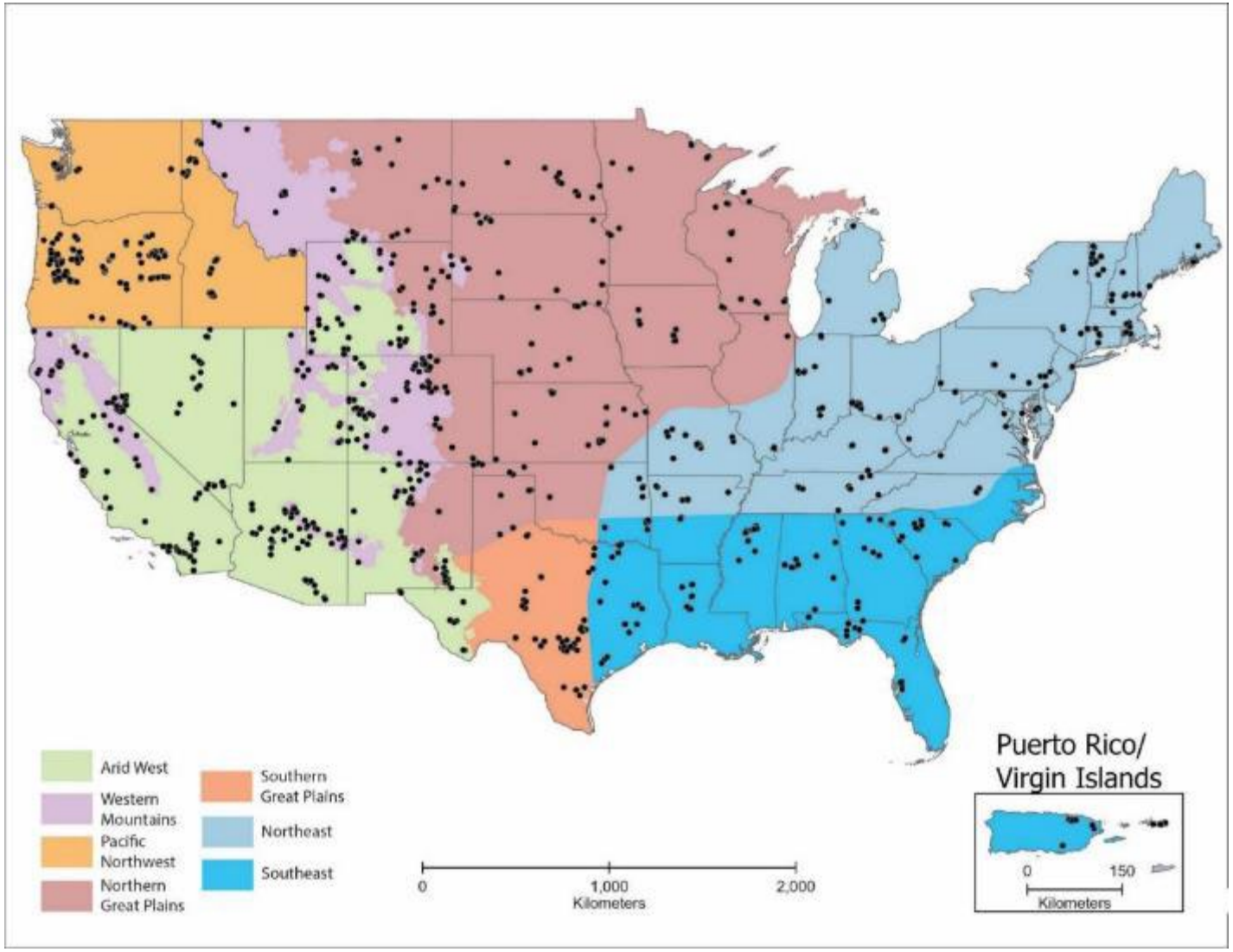
Collaborative Effort with Corps

EPA HQ
EPA ORD
EPA Regions

Corps HQ
Corps ERDC
Corps Districts

Contractor support
- Data collection
- Data analysis
- Training

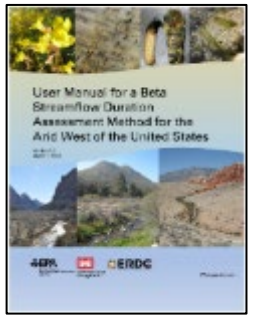
SDAM Study Reaches (~1300 total)

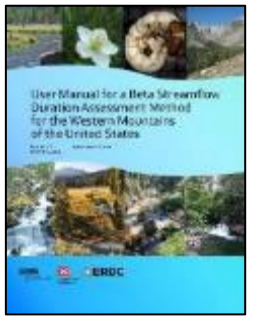


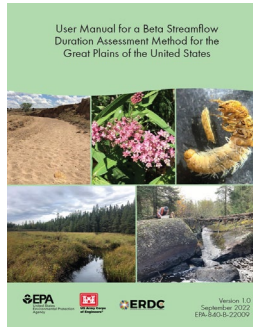
- PNW (2008-11)
  - 264 (70 instr in OR)
- AW (2018-19, 2021-2023)
  - 177 (100 instr)
- WM (2019-20, 2021-2023)
  - 205 (100 instr)
- GP (2019-22)
  - 293 (182 instr)
- N+S East (2020-23)
  - 389 (238 instr)

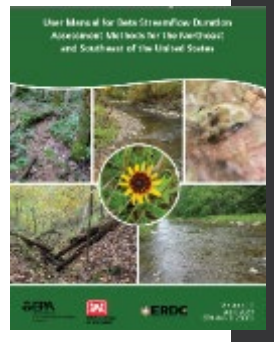
- AK (TBD)
- HI (TBD)

Why "Beta" SDAMs?

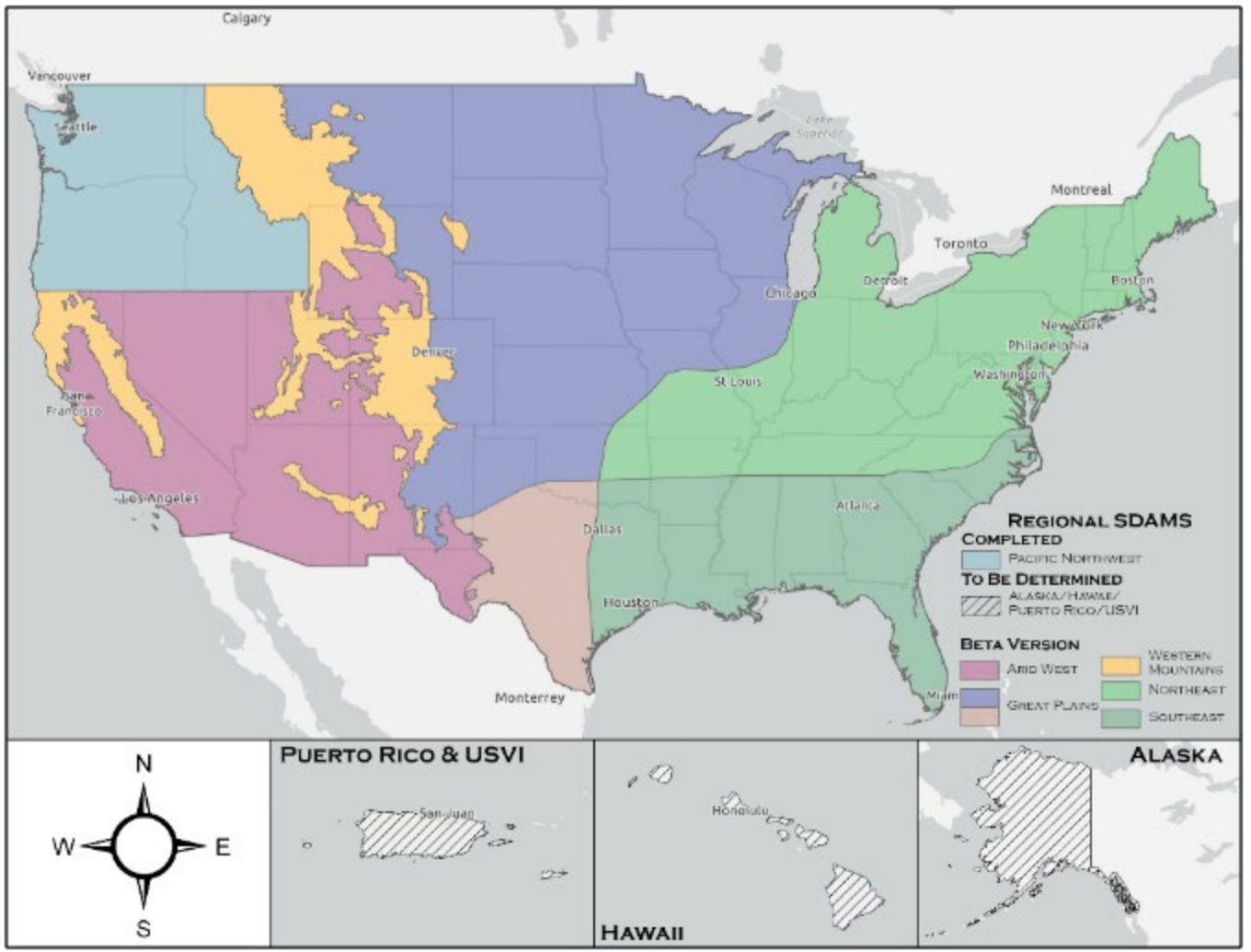






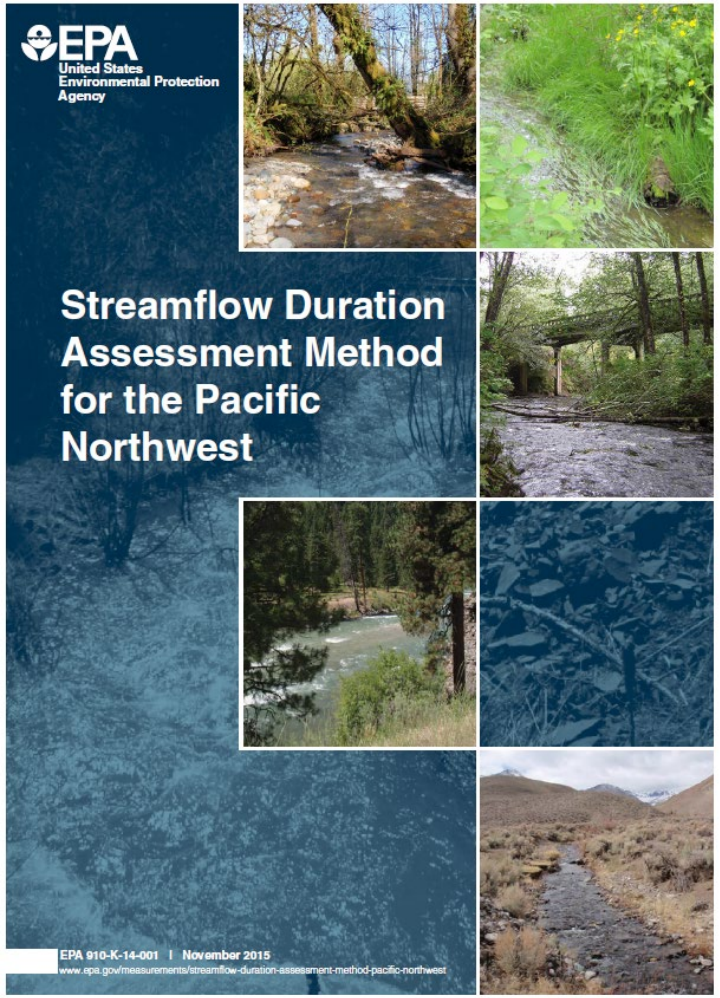


- Each is part of a national effort following an established operational framework for method development.
- One-year (minimum) implementation period to garner feedback from regulatory staff and user community to inform final SDAMs.
- Additional data (i.e., from additional site visits, including sites not initially used for development of a beta method) may be included to inform final SDAMs.



Overview of Regional SDAMs

SDAM for the Pacific Northwest (November 2015)



Environmental Management (2015) 56:34–53
DOI 10.1007/s00267-015-0466-4

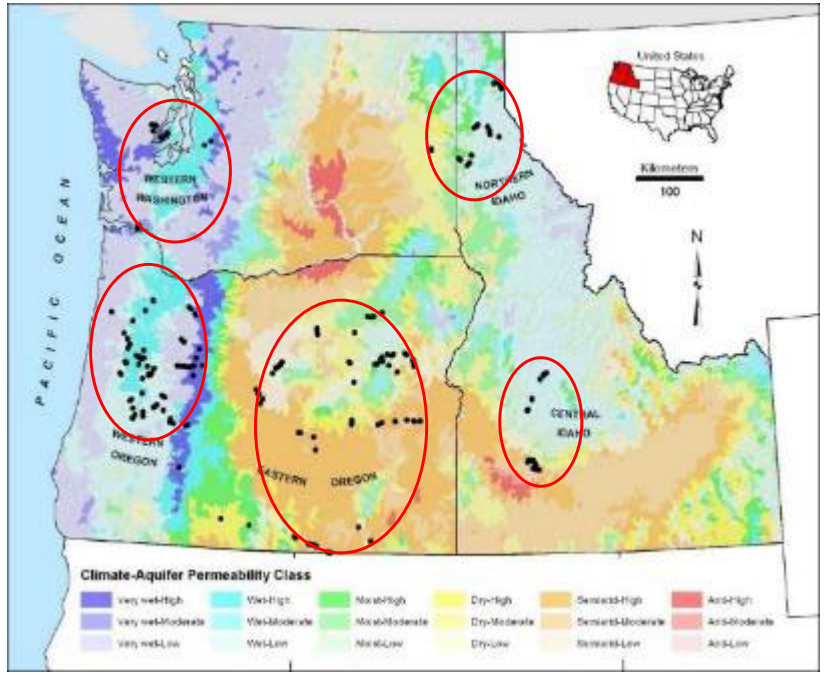
RESEARCH

Validation of Rapid Assessment Methods to Determine Streamflow Duration Classes in the Pacific Northwest, USA

Tracie-Lynn Nadeau[1] · Scott G. Leibowitz[2] · Parker J. Wigington Jr.[2] · Joseph L. Ebersole[2] · Ken M. Fritz[3] · Robert A. Coulombe[4] · Randy L. Comeleo[2] · Karen A. Blocksom[2]

SDAM Pacific Northwest – Validation Study

- Multi-year, iterative, three-state study
- 264 study streams
- Diverse Hydrological Landscapes
- Wet/dry season sampling
- Equal number ephemeral, intermittent, perennial study reaches
- 43 Indicators tested
- Machine learning evaluation resulted in a decision tree using a subset of indicators

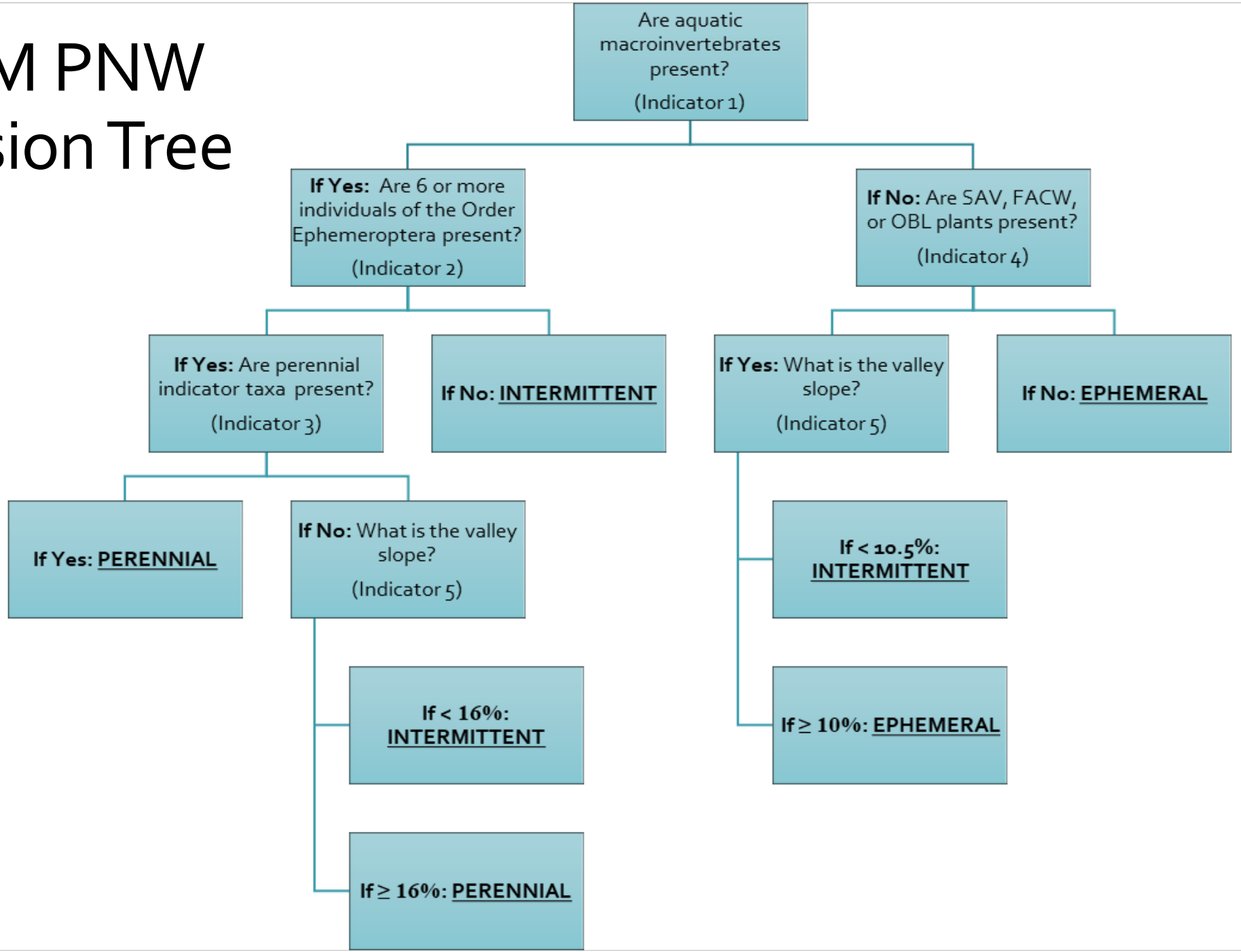


SDAM PNW is based on 5 indicators:

Not all 5 indicators are needed to classify a site:

1. Presence of aquatic macroinvertebrates
   - Including shells, cases, etc., in dry channels
2. Abundance of Ephemeroptera
3. Presence of perennial indicator macroinvertebrate taxa
   - ~20 families, but in PNW, Perlidae stoneflies and *Juga* snails were most useful
4. Presence of FACW/OBL/SAV plants
5. Slope
   - Very steep (>10.5%) ephemeral streams may support FACW plants
   - Very steep (>16%) perennial streams may lack indicator taxa

SDAM PNW Decision Tree



SDAM PNW– Single Indicators of At Least Intermittent (ALI) streamflow duration

Herpetological Species

Species	Common Name	Water-Dependent Life Stages			
		Eggs	Larva / Tadpole	Juve.	Adult
Aquatic Salamanders					
Ambystoma gracile	Northwest Salamander	OBL	OBL	FACW	FACW
Ambystoma macrodactylum	Long-toed Salamander	OBL	OBL	FACW	FACW
Ambystoma tigrinum	Tiger Salamander (rare)	OBL	OBL	FACW	FACW
Taricha granulosa	Roughskin Newt	OBL	OBL	FAC	FAC
Dicamptodon copei	Cope's Giant Salamander	OBL	OBL	OBL	OBL
Dicamptodon tenebrosus	Pacific Giant Salamander	OBL	OBL	OBL	FACW
Rhyacotriton spp.	Torrent Salamanders (rare)	OBL	OBL	OBL	OBL
Frogs and Toads					
Ascaphus truei	Tailed Frog	OBL	OBL	OBL	OBL
Spea intermontana	Great Basin Spadefoot	OBL	OBL	FAC	FAC
Bufo boreas	Western Toad	OBL	OBL	FAC	FAC
Bufo woodhousii	Woodhouse's Toad	OBL	OBL	FAC	FAC
Pseudacris regilla	Pacific Treefrog	OBL	OBL	FACW	FAC
Rana aurora	Red-Legged Frog	OBL	OBL	FACW	FACW
Rana boylii	Foothill Yellow-Legged Frog	OBL	OBL	OBL	OBL
Rana cascadae	Cascades Frog	OBL	OBL	FACW	FACW
Rana catesbeiana	Bullfrog	OBL	OBL	FACW	FACW
Rana pretiosa	Oregon Spotted Frog	OBL	OBL	OBL	OBL
Rana luteiventris	Columbia Spotted Frog	OBL	OBL	OBL	OBL
Snakes					
Thamnophis atratus	Western Aquatic Garter Snake (SW Oregon)			OBL	OBL
Thamnophis elegans	Wandering Garter Snake			FACW	FACW
Thamnophis sirtalis	Common Garter Snake			FACW	FACW

1. Fish (non-mosquito fish)

OR

2. One or more individuals of an amphibian or snake life stage (adult, juvenile, larva, or eggs)

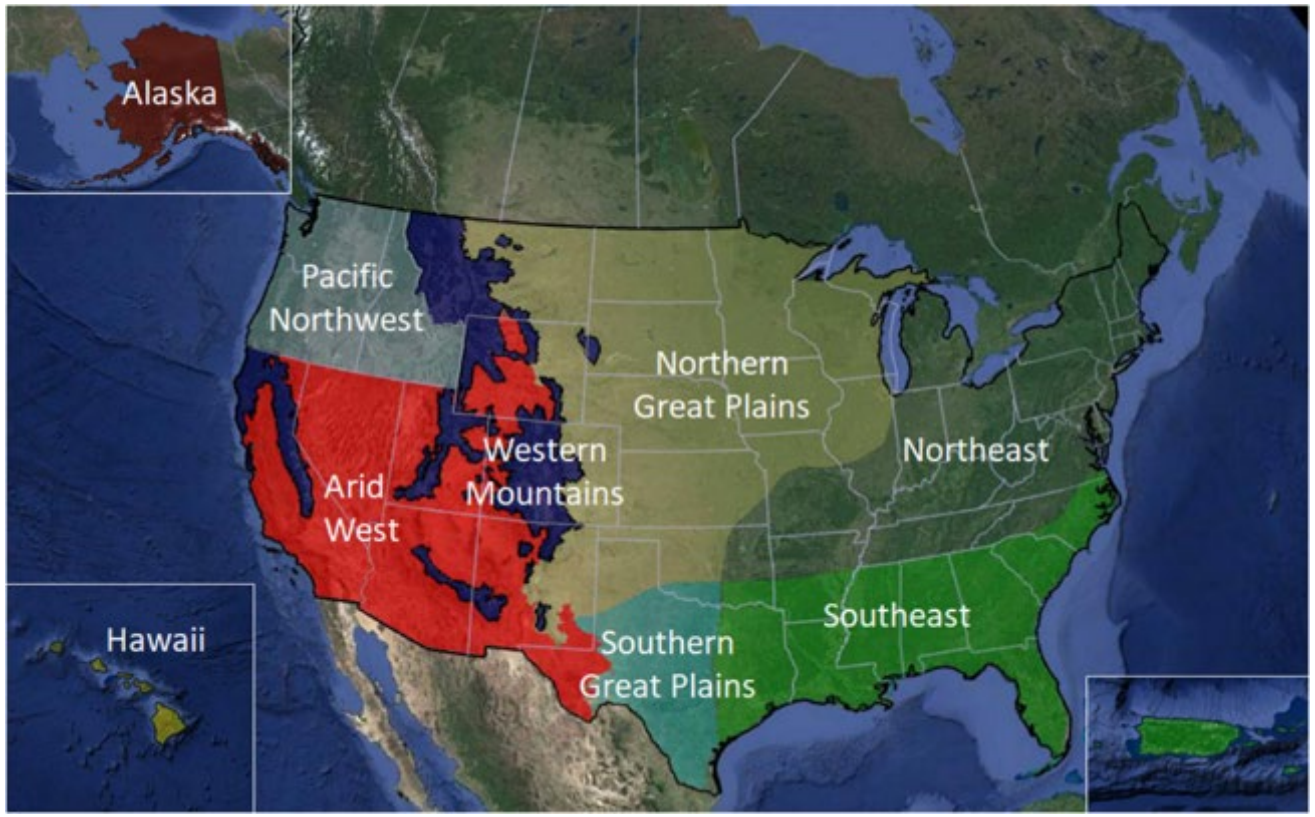
ACCURACY (%)	SINGLE INDICATOR	
	Herpetological life history stages	Fish
ALL	*Presence I/P streams* 48.5	42.8
	Presence Accuracy 97.1	100

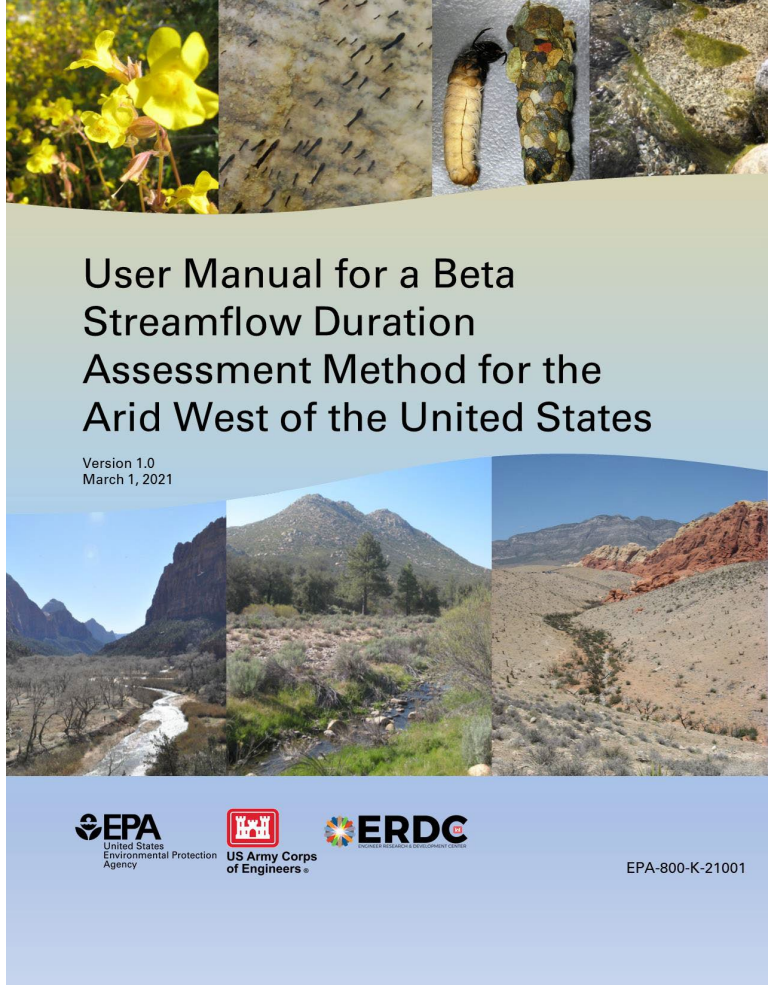
SDAM PNW Accuracy

ACCURACY (%)		Perennial / Intermittent / Ephemeral (Ephemeral vs. At Least Intermittent)
ALL		83.9 (93.8)
REGION	Central Idaho	80.0 (88.3)
	Northern Idaho	73.2 (89.3)
	Eastern Oregon	91.5 (97.2)
	Western Oregon	81.1 (92.8)
	Western Washington	83.9 (96.4)
CLIMATE CLASS	Dry	86.8 (96.1)
	Semiarid	91.7 (94.0)
	Moist	91.4 (100.0)
	Wet	77.4 (89.9)
	Very Wet	84.3 (96.1)
SEASON	Summer-dry	83.7 (92.8)
	Winter-wet	84.1 (94.7)

(Nadeau et al. 2015)

Beta SDAM for the Arid West (March 2021)





water
MDPI
Article

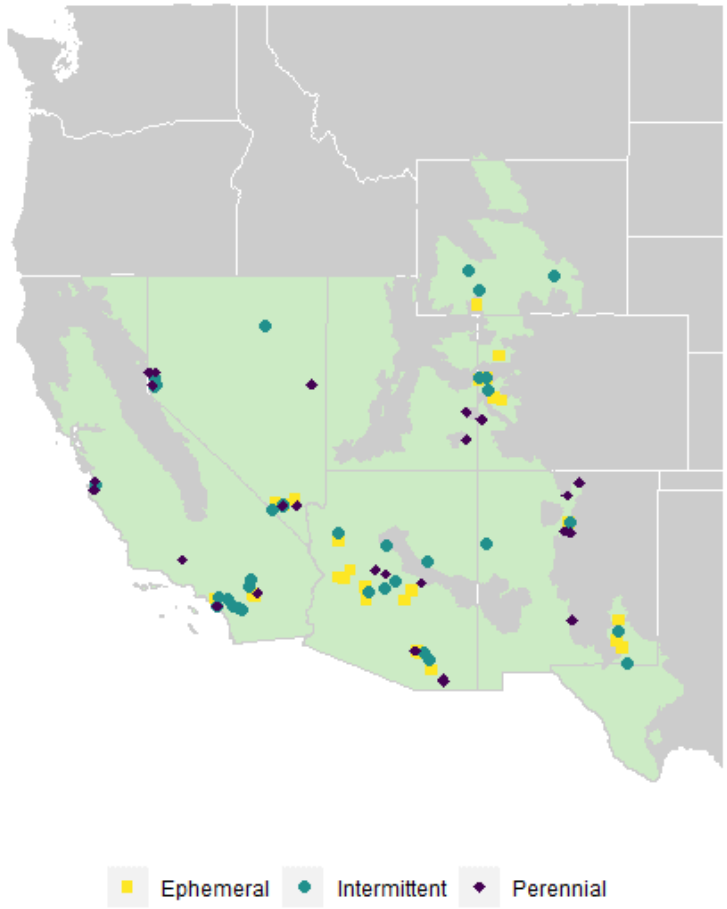
Implementing an Operational Framework to Develop a Streamflow Duration Assessment Method: A Case Study from the Arid West United States

Raphael D. Mazor [1,*], Brian J. Topping [2], Tracie-Lynn Nadeau [3], Ken M. Fritz [4], Julia E. Kelso [2,5], Rachel A. Harrington [6], Whitney S. Beck [2], Kenneth S. McCune [1], Aaron O. Allen [7], Robert Leidy [8], James T. Robb [9] and Gabrielle C. L. David [10]

Beta SDAM AW Method Development

- Identify candidate indicators through review of technical literature (McCune and Mazor 2019)
  - 12 geomorphological (e.g., riffle frequency)
  - 14 hydrological (e.g., hydric soils)
  - 15 biological (e.g., fish abundance)
- Identify candidate study sites through literature review, reviewing hydrologic databases, and consulting local experts
- Collect indicators at 89 study sites
  - 30 ephemeral, 34 intermittent, 25 perennial
- Create machine learning statistical model to predict class from indicators
- Refine and simplify the final beta method

Beta SDAM AW study sites



Beta SDAM AW is based on 5 biological indicators:

1. How many hydrophytic plant species are there in the channel, or within a half-channel width of the channel?
   - None (0), few (1-2), or many (3+)
2. How many aquatic invertebrate individuals were collected?
   - None (0), few (1-19) or many (20+)
3. Is there evidence of aquatic stages of Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa?
   - Yes, No
4. Is there evidence of algal growth on the streambed?
   - Yes, No
5. Are there single indicators of intermittent or perennial streamflow duration?
   - Fish present, or algal cover ≥ 10%

Beta SDAM AW Classification Table

Use the table to obtain classification:

- Ephemeral
- Intermittent
- Perennial
- At least intermittent (i.e., not ephemeral)
- Need more information (confident classification not possible with beta method)

Accuracy:

- Perennial vs. Intermittent vs. Ephemeral – 56%
- Ephemeral vs. At Least Intermittent – 81%

1. Hydrophytic plant species	2. Aquatic invertebrates	3. EPT taxa	4. Algae	5. Single indicators • fish present • algae cover > 10%	Classification
None	None	Absent	Absent	Absent	**Ephemeral**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
	Few (1-19)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
Few (1-2)	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present	Absent		**At least intermittent**
			Present		**Intermittent**
Many (3+)	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent			**At least intermittent**
		Present			**Perennial**
	Many (20+)	Absent			**At least intermittent**
		Present			**Perennial**

Beta SDAM AW Single indicators

- Fish presence and algal cover ≥10% are treated as single indicators:
  - They can override preliminary classifications of *Ephemeral* and *Need more information* with *At least intermittent*

- Single indicators are ***not*** an off-ramp to stop collecting data:
  - More precise classifications (e.g., perennial, intermittent) may be attained
  - Other information provided by SDAM AW may be useful for informing determinations

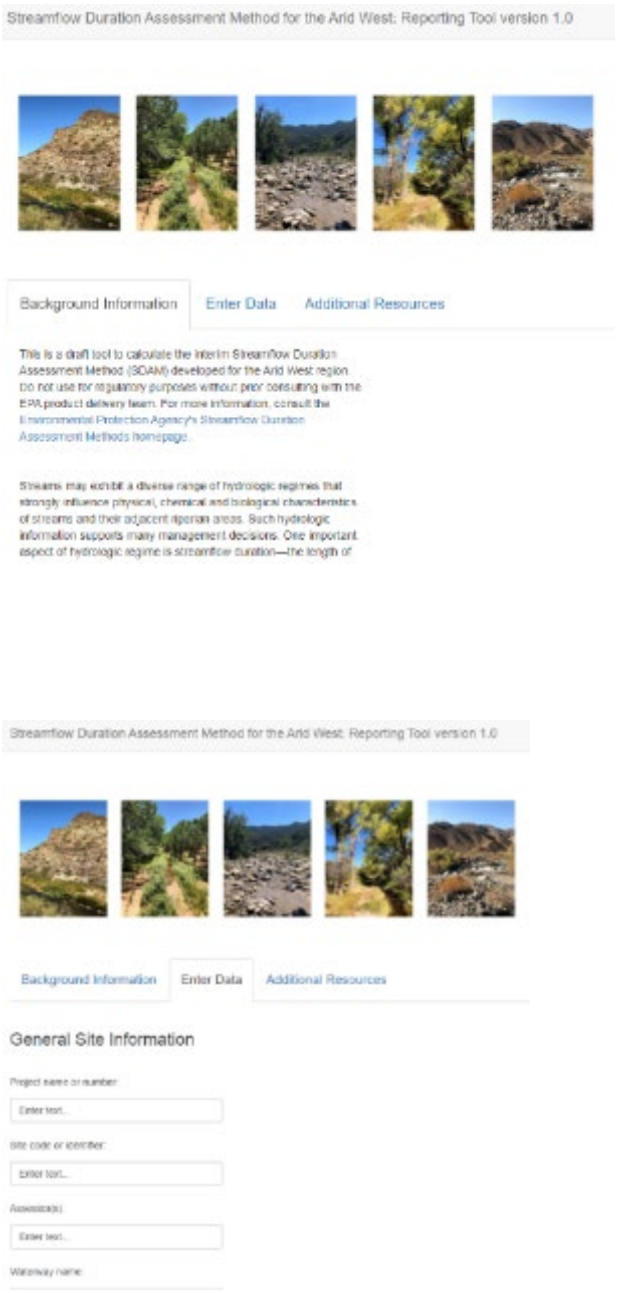
Beta SDAM AW Supplemental Information

- Not a formal part of the SDAM AW, and not required to make a classification.
- Additional information may bolster evidence supporting a classification.
- If *Need more information* classification is obtained, supplemental information lends evidence that may improve the classification.
- We recommend that these be documented during any assessment.
  - Presence of aquatic or semi-aquatic amphibians and reptiles
  - Aquatic invertebrate families that prefer perennial streams
  - Presence of iron-oxidizing fungi and bacteria

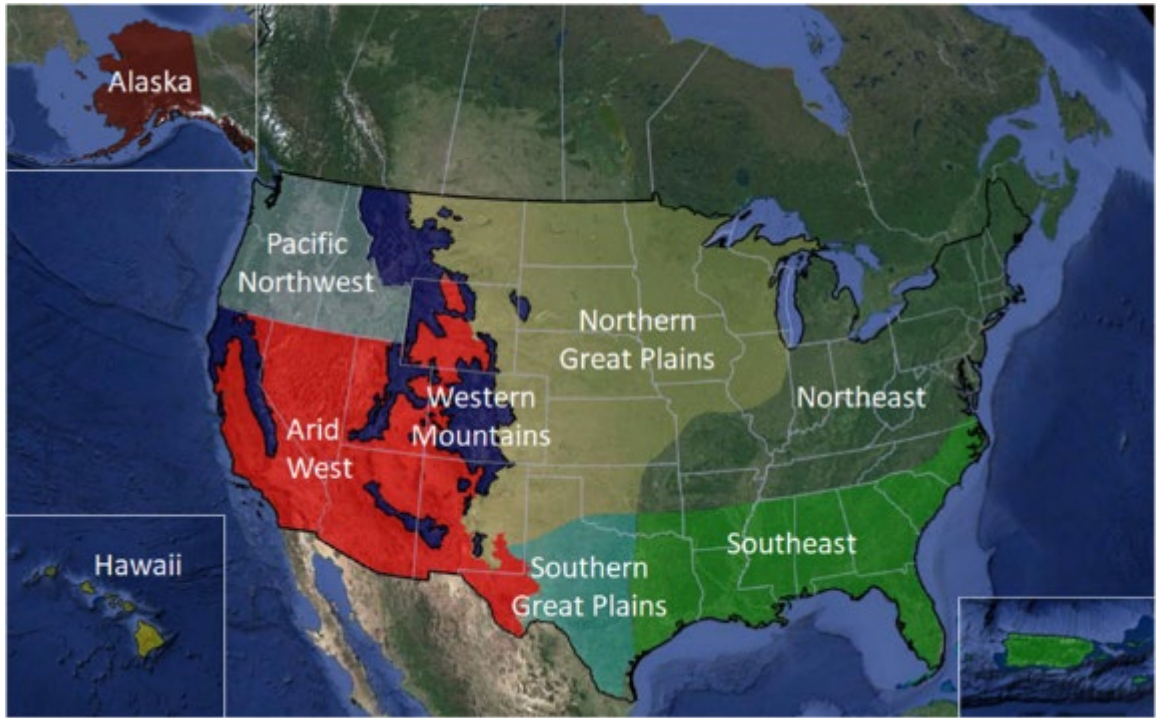
Preparing a report

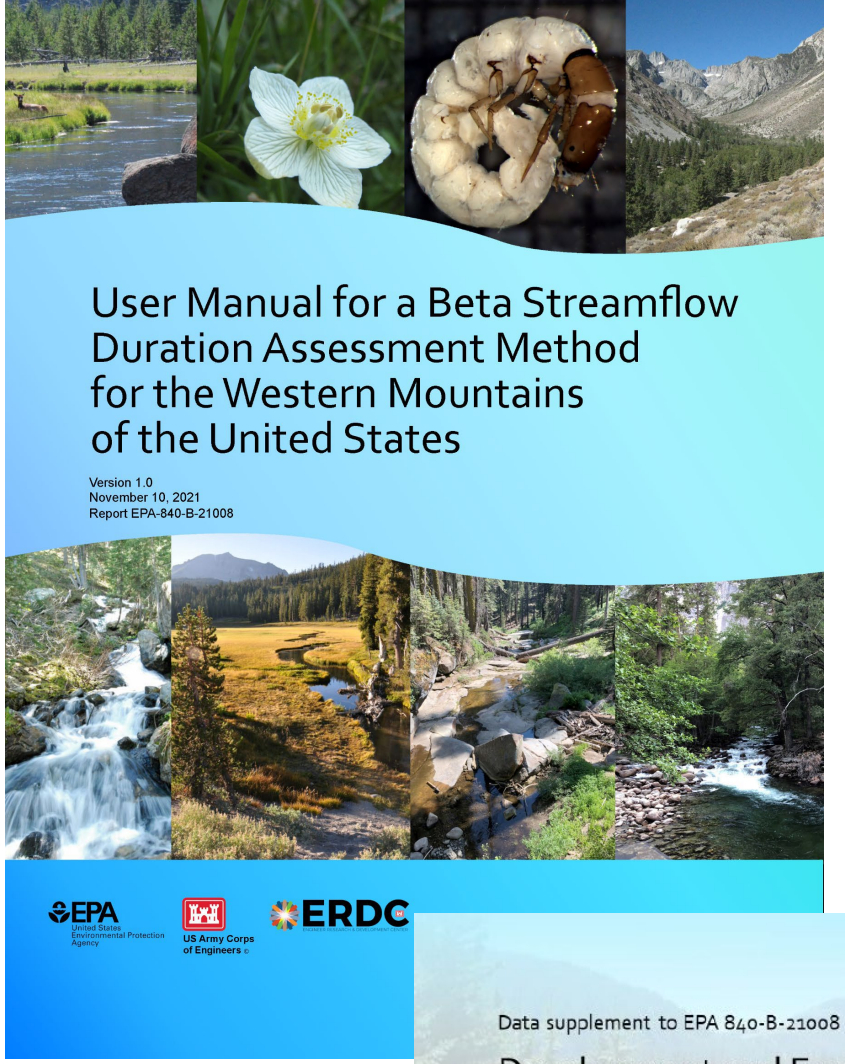
- Online Report Generating Tool allows reporting of data in a standardized format
- Upload data + photos to create a PDF that contains final classification
- No information is saved or transmitted to EPA or any other agency

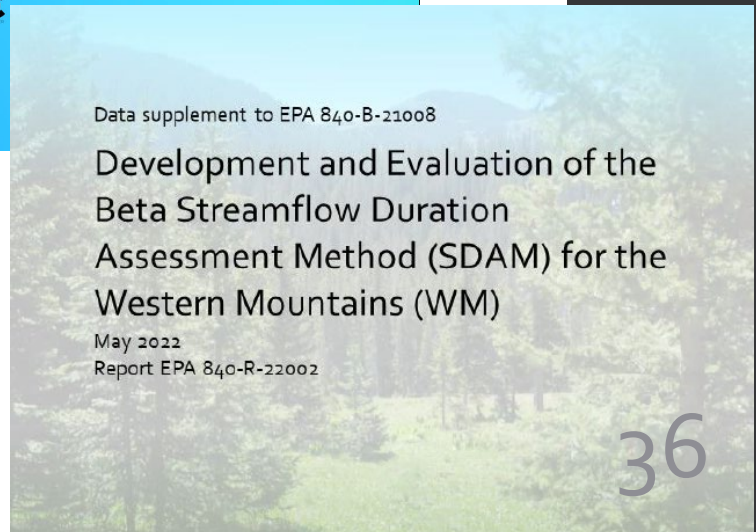
https://sccwrp.shinyapps.io/beta_awsdam_report/



Beta SDAM for the Western Mountains (November 2021)



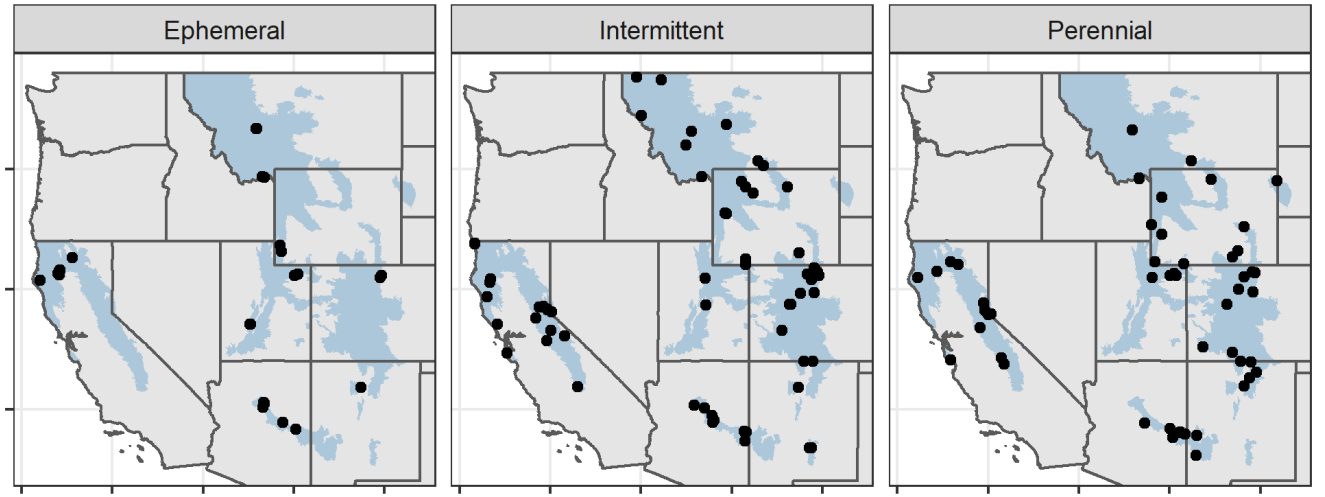




Beta SDAM WM Method Development

- Identify candidate indicators through review of technical literature (Mazor and McCune 2021)
  - 7 geomorphological (e.g., riffle frequency)
  - 8 hydrological (e.g., hydric soils)
  - 37 biological (e.g., fish abundance)
  - 20 geospatial (e.g., annual precipitation)
- Identify candidate study reaches through literature review, reviewing hydrologic databases, and consulting local experts

SDAM WM study sites



- Collect indicators at 149 study reaches
  - 31 ephemeral, 66 intermittent, 52 perennial
  - Deploy loggers at and revisit 48 reaches three times each
- Create machine learning statistical model to predict class from indicators
- Refine and simplify the final beta method

Beta SDAM WM is based on 8 indicators:

Six indicators are measured in the **field**:

Biological indicators

1. Abundance and richness of aquatic invertebrates
2. Algal cover on the streambed
3. Fish abundance
4. Differences in vegetation between the channel and surrounding uplands

Geomorphological indicators

5. Bankfull channel width
6. Sinuosity

Two indicators are measured by **GIS** using a web application:

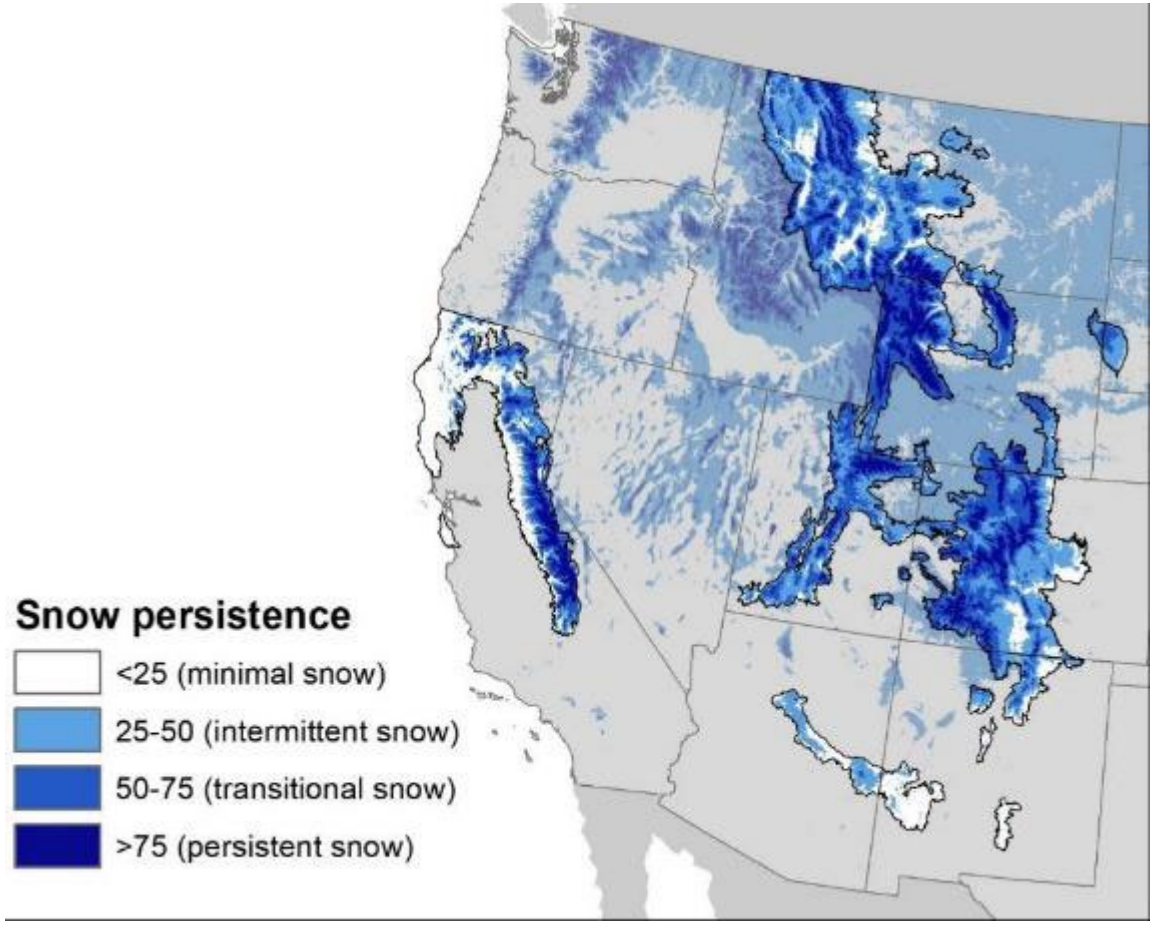
Climatic

7. Long-term precipitation
8. Long-term mean annual maximum air temperature

Snow persistence affects how indicators are interpreted

- Snow persistence is fraction of time (January 1 – July 3) when snow is present on the ground:
  - Average over 2000 – 2020
  - Above 25% persistence = snow influenced
- Snow influence is strong in:
  - Northern Rockies
  - Central Rockies
  - Higher elevations of the Sierra Nevada
- Snow influence is minimal in:
  - California's North Coast, Sierra Nevada foothills
  - Arizona & New Mexico mountains
  - Portions of Colorado, Montana

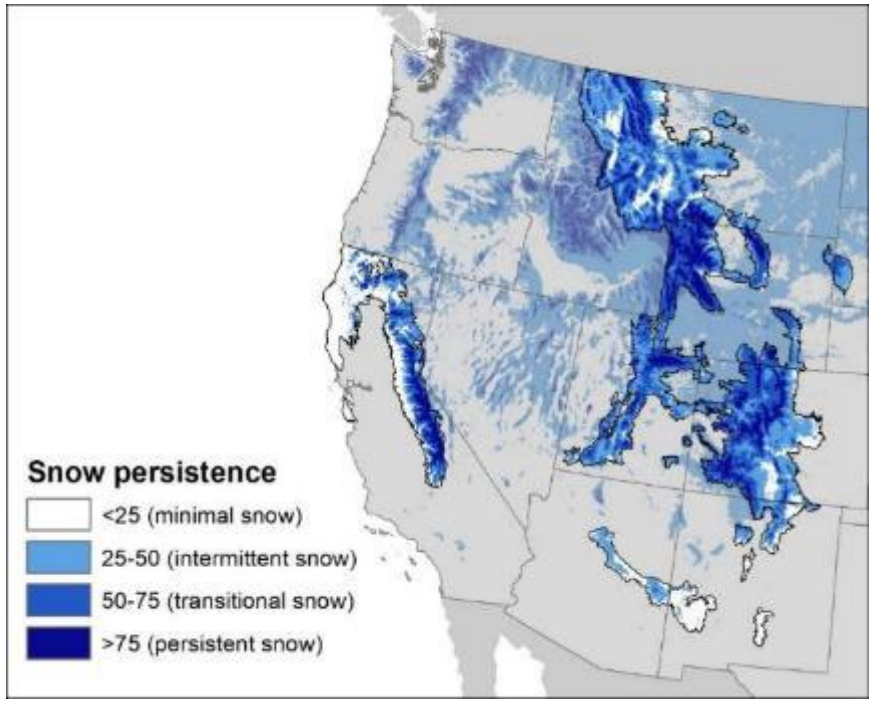
Snow influence is determined using the Beta SDAM WM web application



(Hammond et al. 2017)

Snow persistence affects how indicators are interpreted

Snow-influenced areas	Non-snow influenced areas
Aquatic invertebrates • Total abundance • Abundance & number of perennial indicator families	**Aquatic invertebrates** • Abundance of mayflies • Number of perennial indicator families
Algal cover on the streambed	**Algal cover on the streambed**
Fish presence	**Fish abundance**
	Differences in vegetation
Bankfull channel width	**Bankfull channel width**
	Sinuosity
Climate • October precipitation	**Climate** • May precipitation • Annual max air temperature



Accuracy:

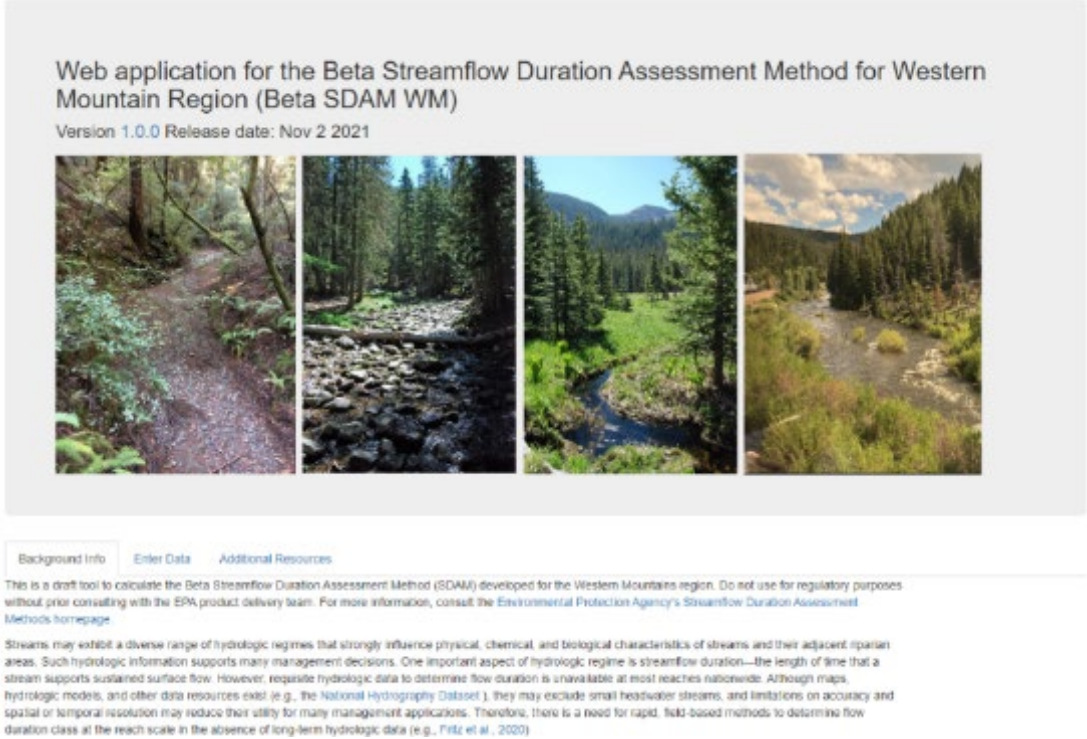
- Perennial vs. Intermittent vs. Ephemeral - 53%
- Ephemeral vs. At Least Intermittent - 88 %

Data interpretation

The web application is required:

- Calculates geospatial metrics
- Determines if reach in a snow-influenced area
- Runs the appropriate statistical model to interpret field data
- Provides one of four possible classifications:
  - Ephemeral
  - Intermittent
  - Perennial
  - At Least Intermittent (i.e., not ephemeral)

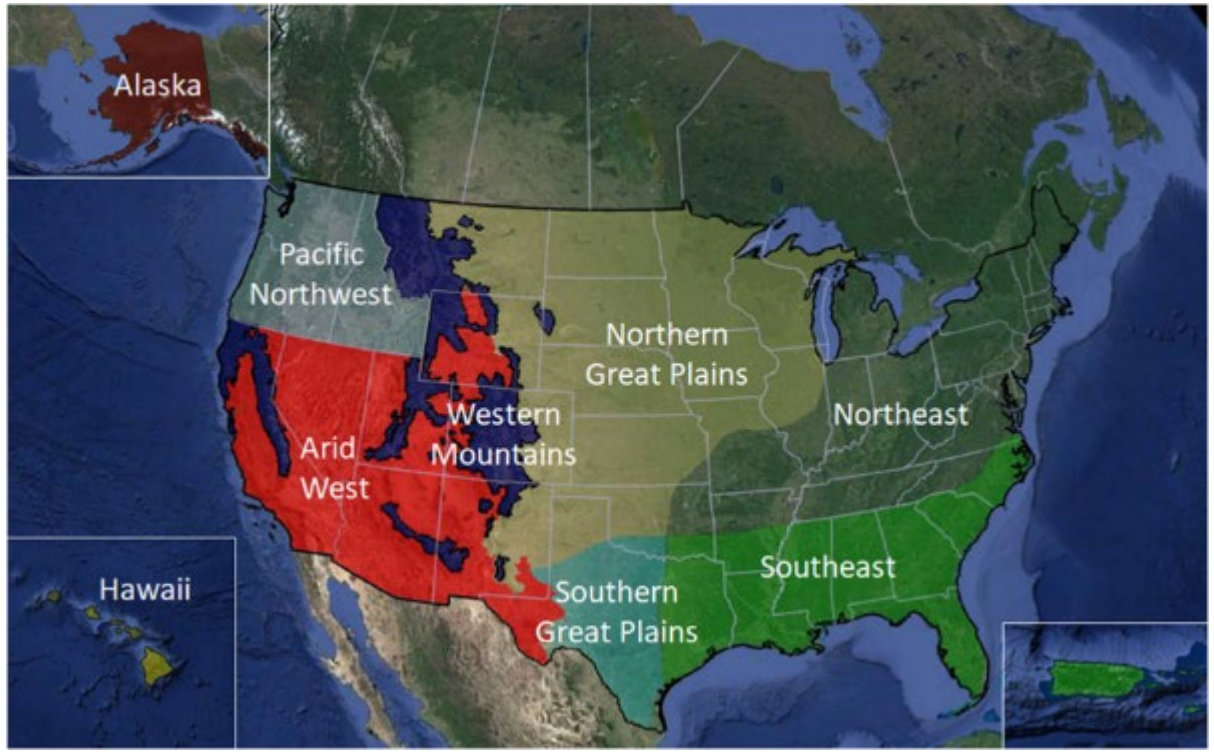
https://sccwrp.shinyapps.io/beta_sdam_wm/

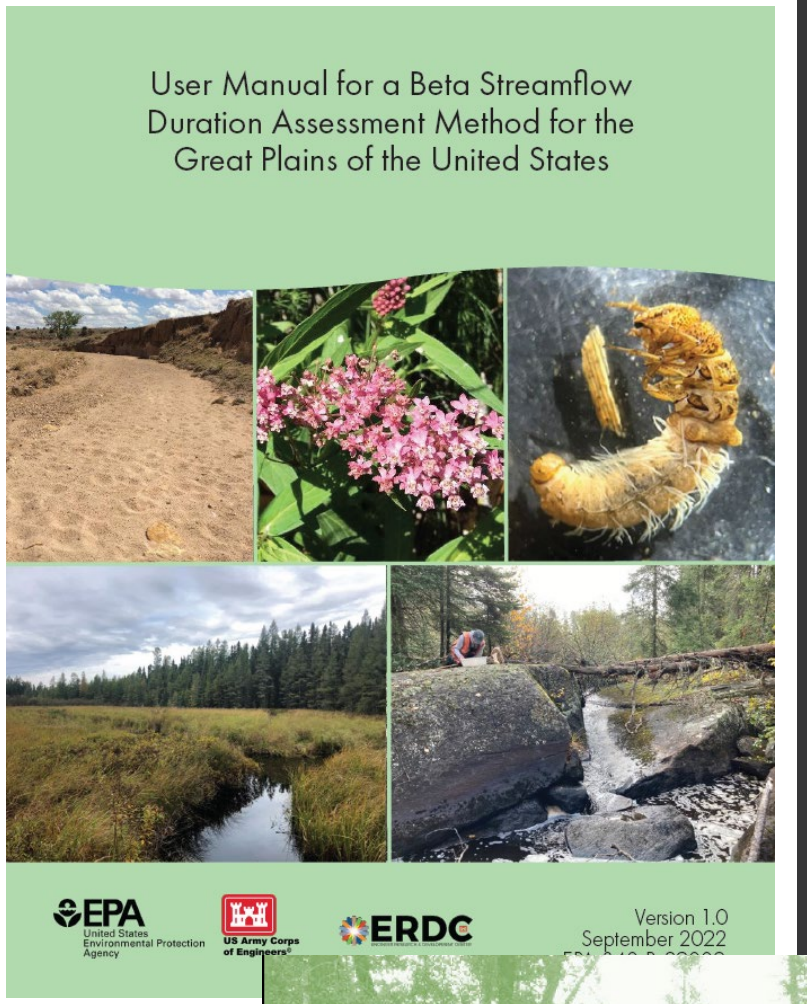


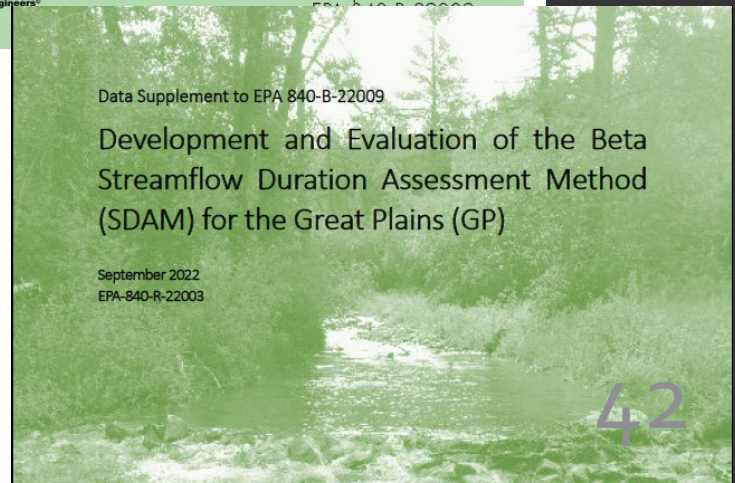
Supplemental Information

- Not a formal part of the Beta SDAM WM
- May bolster evidence supporting a classification
- Recommend documenting during any assessment:
  - Indicators required for classifying the site under the opposite snow-influenced area
  - Presence of iron-oxidizing fungi and bacteria

Beta SDAM for the Great Plains (September 2022)

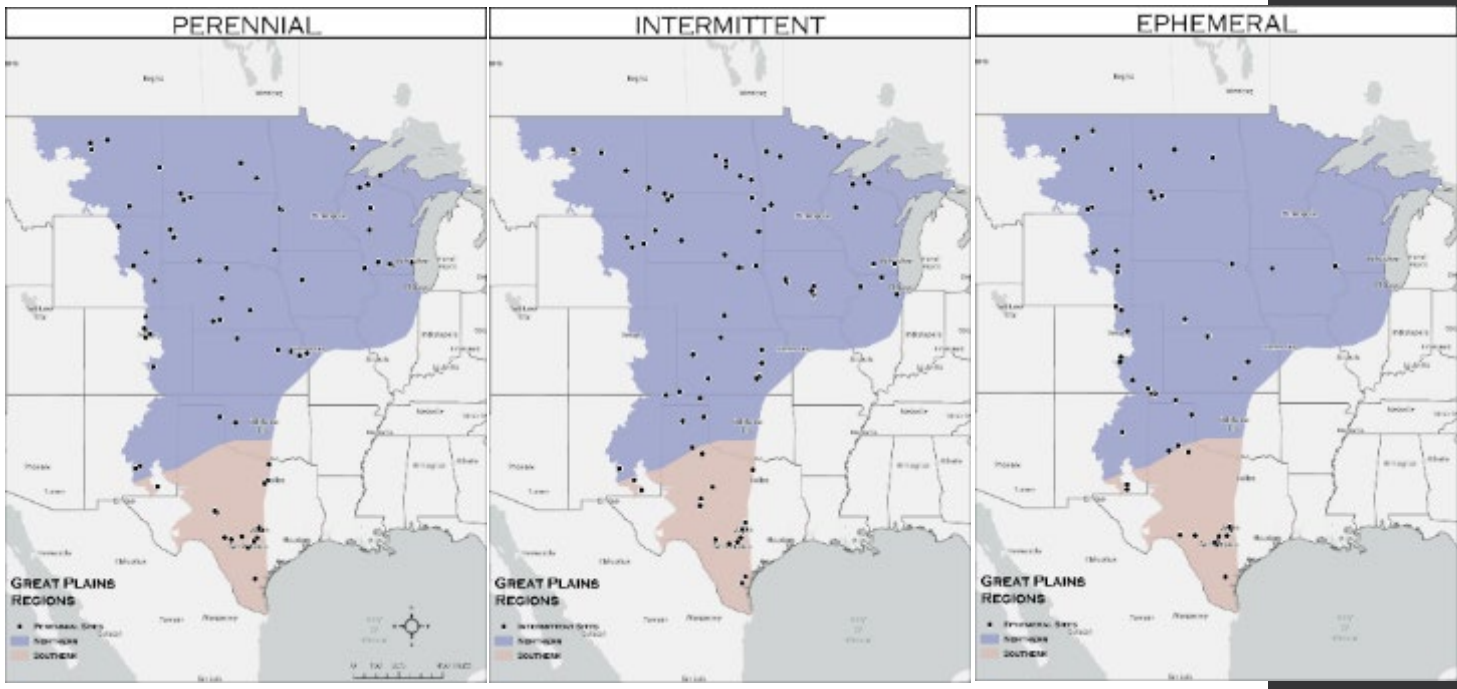






Beta SDAM GP Method Development

- Identify candidate indicators through review of technical literature (James et al. 2022) and existing SDAMs (NMED 2011)
  - 6 geomorphological (e.g., slope)
  - 8 hydrological (e.g., hydric soils)
  - 13 biological (e.g., fish abundance)
  - Geospatial indicators identified later
- Identify candidate study reaches through literature review, reviewing hydrologic databases, and consulting local experts



- Collect indicators at 293 study reaches; 251 reaches ultimately used to calibrate the beta model
  - 71 ephemeral, 100 intermittent, 80 perennial
  - Deploy loggers at 60% of these (152); 148 'baseline' reaches were re-visited up to 3 times
- Create machine learning statistical model to predict class from indicators
- Refine and simplify the final beta method

Beta SDAM GP is based on 9 indicators:

Eight indicators are measured in the **field**:

Biological indicators

1. Ephemeroptera, Plecoptera, Trichoptera (EPT) family richness
2. Percent shading
3. Number of hydrophytic plant species
4. Absence of rooted upland plants in the streambed

Geomorphological indicators

5. **Bankfull channel width**
6. **Sinuosity**
7. Floodplain and channel dimensions
8. Particle size or stream substrate sorting

One indicator is measured by **GIS** using a web application:

Regional

9. Northern or Southern Great Plains

Underlined indicator is used in the beta SDAM AW

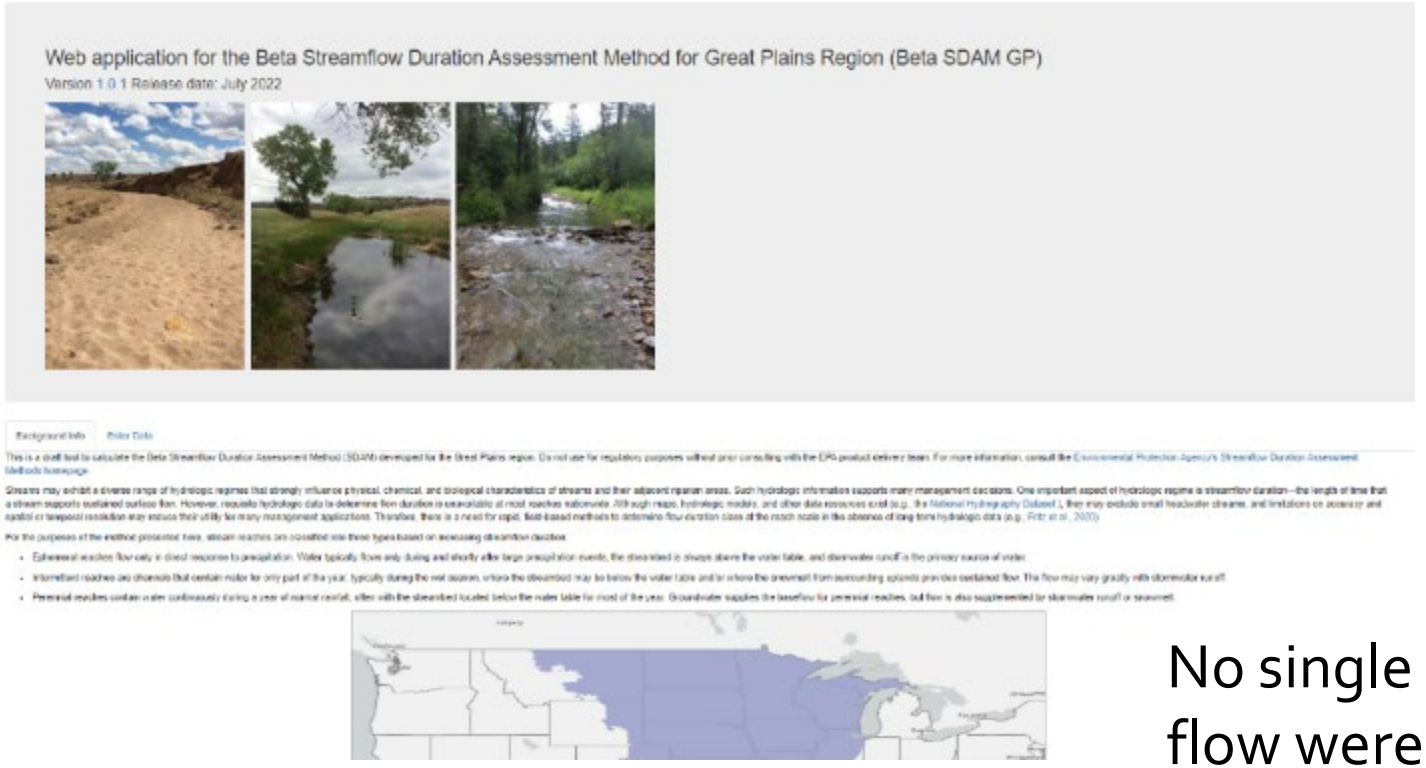
Bold indicators are used in the beta SDAM WM

Accuracy:

- Perennial vs. Intermittent vs. Ephemeral - 68%
- Ephemeral vs. At Least Intermittent - 87 %

Data Interpretation

The web application is required to obtain one of four classifications:

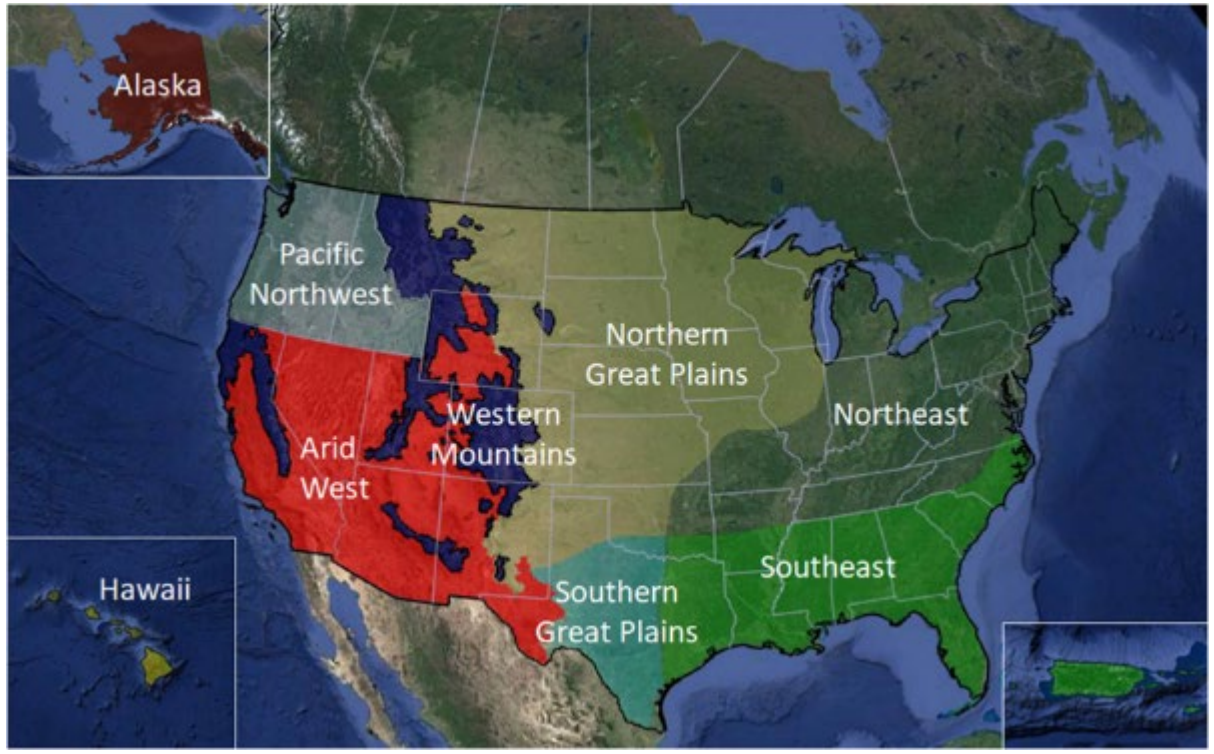


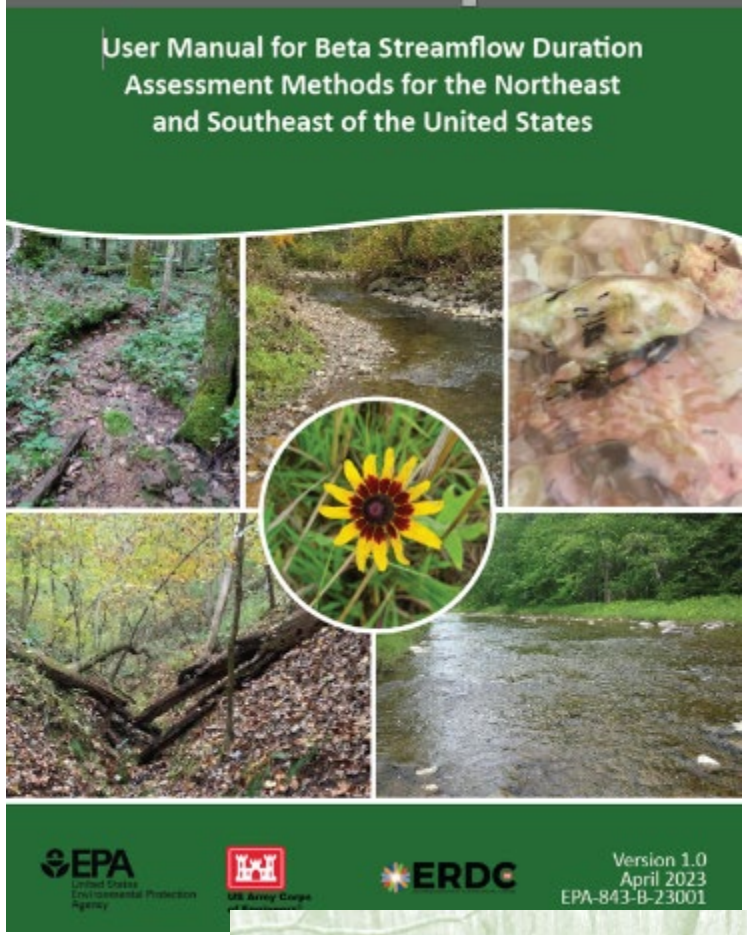
- Ephemeral
- Intermittent
- Perennial
- At Least Intermittent (i.e., not ephemeral)

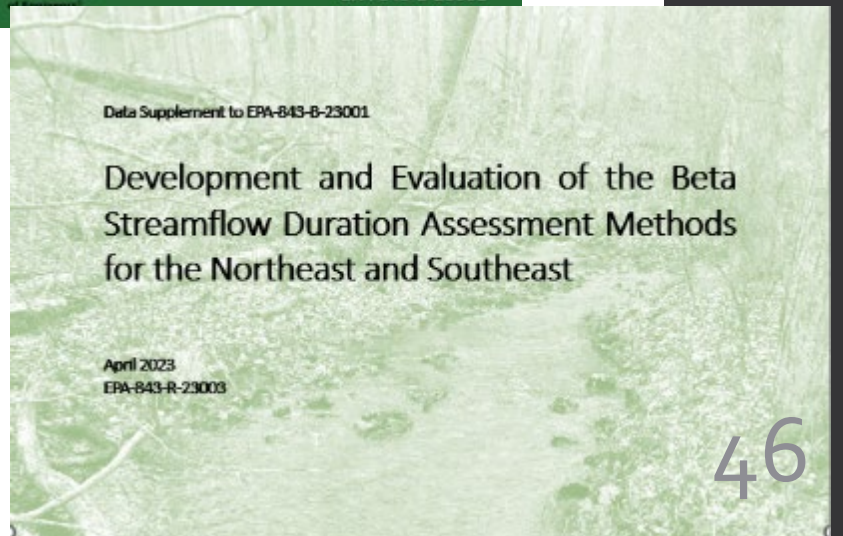
No single indicators of at least intermittent flow were identified for use in the Great Plains.

https://ecosystemplanningrestoration.shinyapps.io/beta_sdam_gp/

Beta SDAMs for the Northeast & Southeast (April 2023)







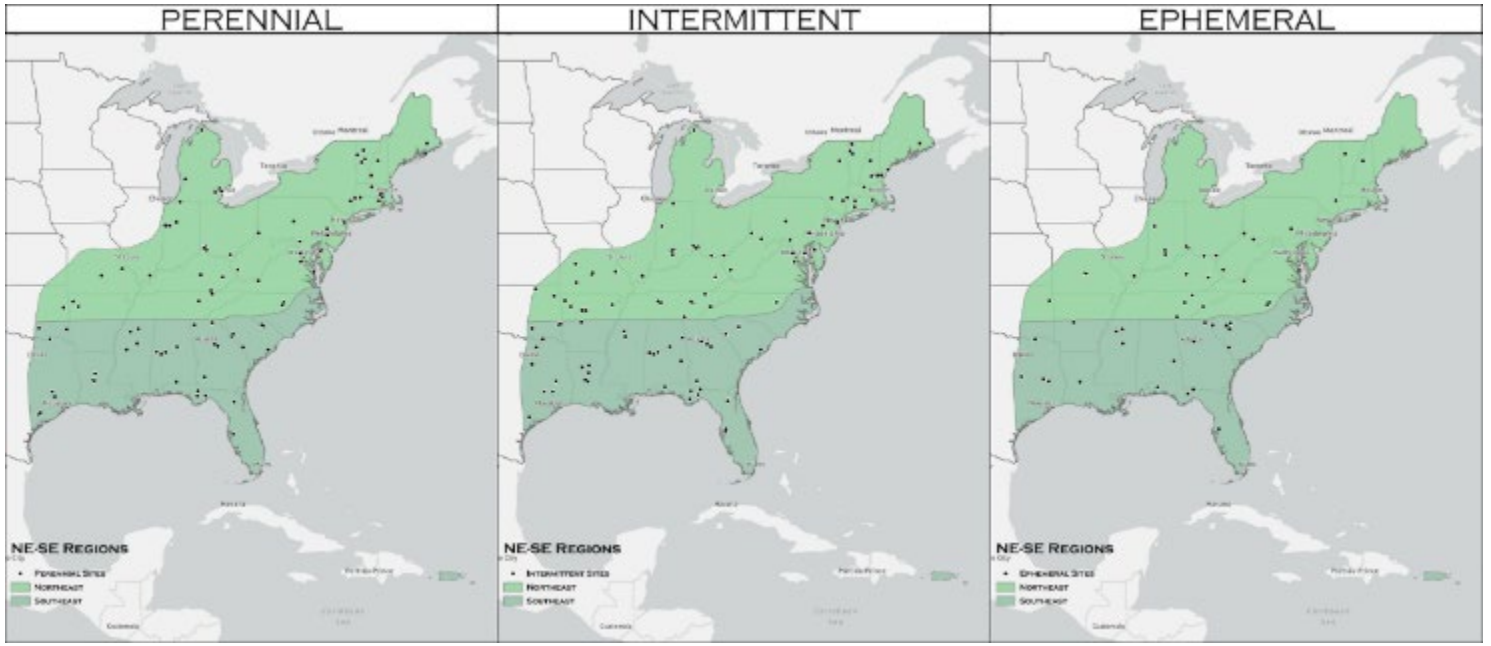
Beta SDAM NE & SE Method Development

- Collect indicator data at 388 study reaches; 336 reaches (shown below) ultimately used to calibrate the beta models
  - 71 ephemeral, 150 intermittent, 115 perennial
  - Flow class determined using loggers at 60% of these (200)—instrumented reaches were re-visited up to 3 times
  - Data collected at Caribbean sites (Puerto Rico & USVI) not used in beta method development

- Create machine learning statistical model(s) to predict flow class from indicators
- Refine and simplify the final beta methods

Flow Class	NE	SE
Ephemeral	37	34
Intermittent	85	65
Perennial	66	49

SDAM NE & SE calibration sites



SDAM NE and SE Indicators

Ten (10) total indicators: NE uses 8 indicators and SE uses 7 indicators, with 5 indicators overlapping. Four (4) indicators also used in beta SDAM GP (**in bold**).

Type of Indicator	Indicators	Region	Where Measured
Biological	Benthic Macroinvertebrate (BMI) Score	Both	Field
	Total BMI Abundance	SE only	
	Percent Shading	NE only	
	Absence of rooted upland plants in streambed	Both	
Geomorphological	**Bankfull channel width**	Both	
	Natural Valley	NE only	
	Channel Slope	NE only	
	Particle size of stream substrate	SE only	
Geospatial	Drainage area	Both	Desktop
	Average Precipitation	NE (Aug-Oct) SE (May-July)	Web application

Accuracy:

- Perennial vs. Intermittent vs. Ephemeral – NE 72%, SE 70%
- Ephemeral vs. At Least Intermittent - NE 92%, SE 91%

Data Interpretation

- A web application is required to obtain classifications for both the SDAM NE and SE - https://ecosystemplanningrestoration.shinyapps.io/beta_sdam_nese/
- The web application automatically determines if a reach will be evaluated with the beta SDAM NE or SE based on input coordinates.
- The web application runs a statistical model to interpret field data provided by the user to obtain one of four possible classifications:
  - Ephemeral
  - Intermittent
  - Perennial
  - At Least Intermittent
- Previous beta SDAMs (GP, AW, WM, PNW) use the same 4 classes, although the SDAM AW can also result in a *Need more information* classification.
- No single indicators of at least intermittent flow were identified for use in the NE and SE.

What about using SDAMs in..?

Modified Channels were included among study reaches.

Long-Term Disturbances

- Non-point source pollution, effluent discharge, habitat alteration, etc., may affect some Indicators, but are some tolerant species (e.g., caddisflies).

Short-Term (Pulse) Disturbances

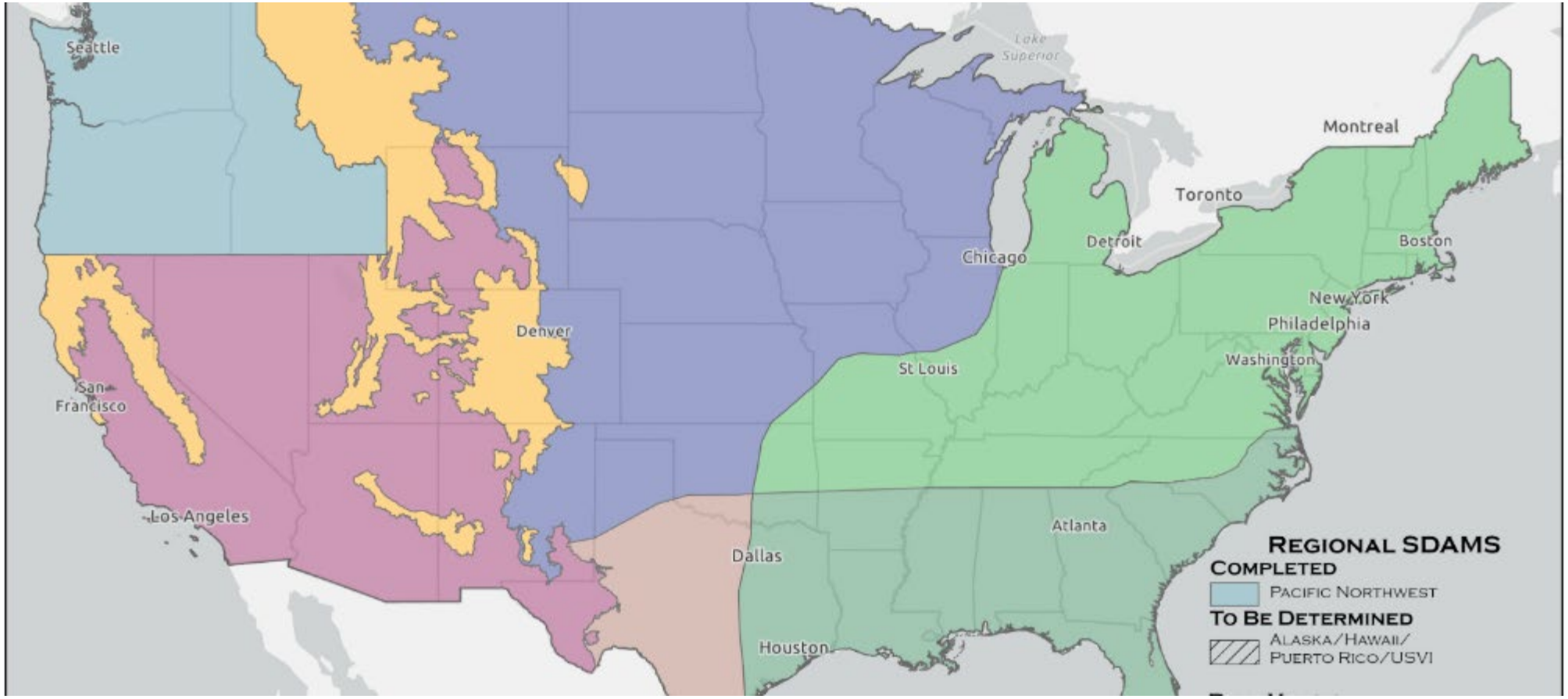
- Disturbances that change streamflow duration class (e.g., diversions, large discharges) will likely result in the new class being identified if sufficient time has passed.
- Veg clearing, grazing, floods, dam operations, re-grading, etc., can temporarily remove indicators from an assessment reach.
- Most indicators are resilient or rebound quickly, but some may be harder to measure.

All Seasons

- Peak growing season is best - indicators are easiest to observe and measure.
- Assessments can take place during dry or flowing conditions.

How do the SDAMs compare?

	Northeast/Southeast (beta)	Great Plains (beta)	Western Mountains (beta)	Arid West (beta)	Pacific Northwest
Types of indicators	Biological, geomorphological, and geospatial	Biological, geomorphological, and regional location	Biological, geomorphological, and climatic	Biological	Biological and geomorphological
Single indicators?	None	None	Fish	Fish Algal cover ≥10%	Fish Aquatic life stages of snakes or amphibians
Type of tool	Random forest model	Random forest model	Random forest model	Classification table (simplified from random forest model)	Decision tree (simplified from random forest model)
Stratification	Region	None	Snow-influence	None	None
Classifications	Perennial, intermittent, ephemeral, and at least intermittent.	Perennial, intermittent, ephemeral, and at least intermittent.	Perennial, intermittent, ephemeral, and at least intermittent.	Perennial, intermittent, ephemeral, at least intermittent, and need more information.	Perennial, intermittent, ephemeral, and at least intermittent.
Aquatic invertebrate identification	Required at Family, Order, or Class level depending on taxon	Required at Family level	Required at Family level	Required at Order level	Required at Family level
Hydrophytic plant identification	Upland plants only (FAC, FACU, UPL, or NI)	Required	None	Required	Required
Field time required	Up to 2 hours	Up to 2 hours	Up to 2 hours	Up to 2 hours	Up to 2 hours



Next Steps for SDAM Development

The Work Ahead

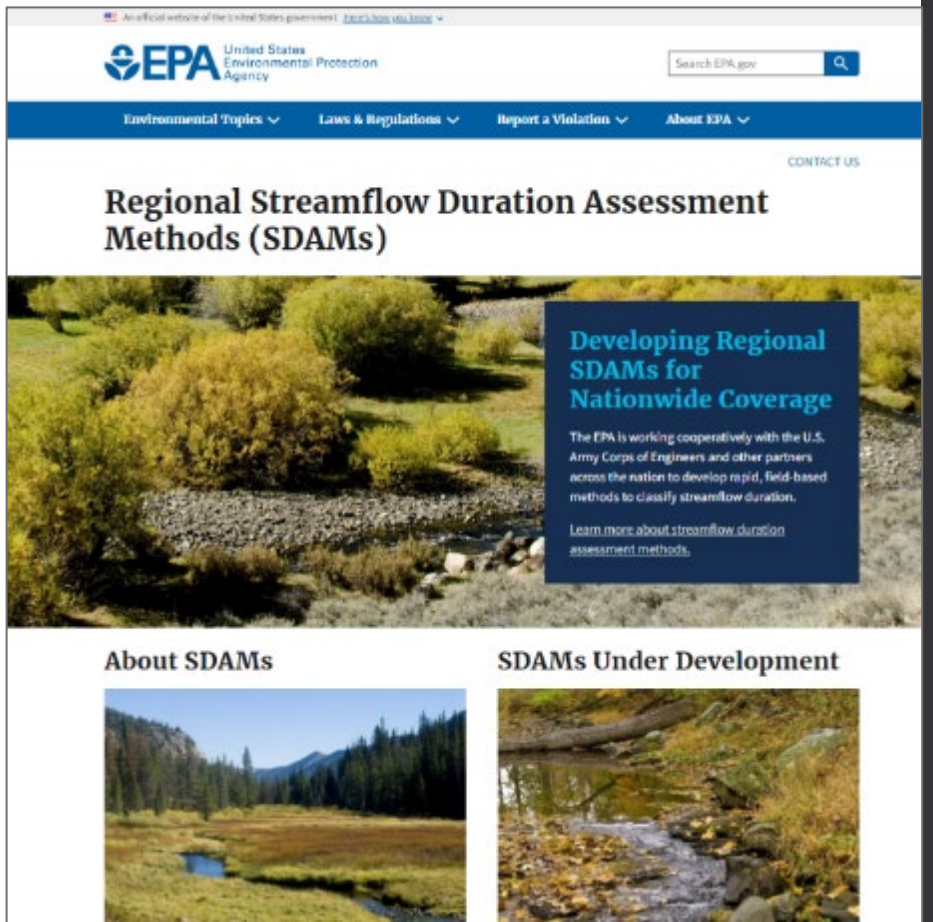
- Preparation for producing final SDAMs across conterminous US
  - Reevaluate Regional boundaries, including existing final method for the Pacific Northwest
  - Incorporate the additional data collected from across the country
  - Review and address feedback from use and implementation of beta SDAMs
- Final SDAMs for conterminous US
- Train the trainers in EPA Regions and Corps Districts on final SDAMs
- Publications describing SDAM development, analyses, and results supporting final SDAMs

SDAM Regional Method Status

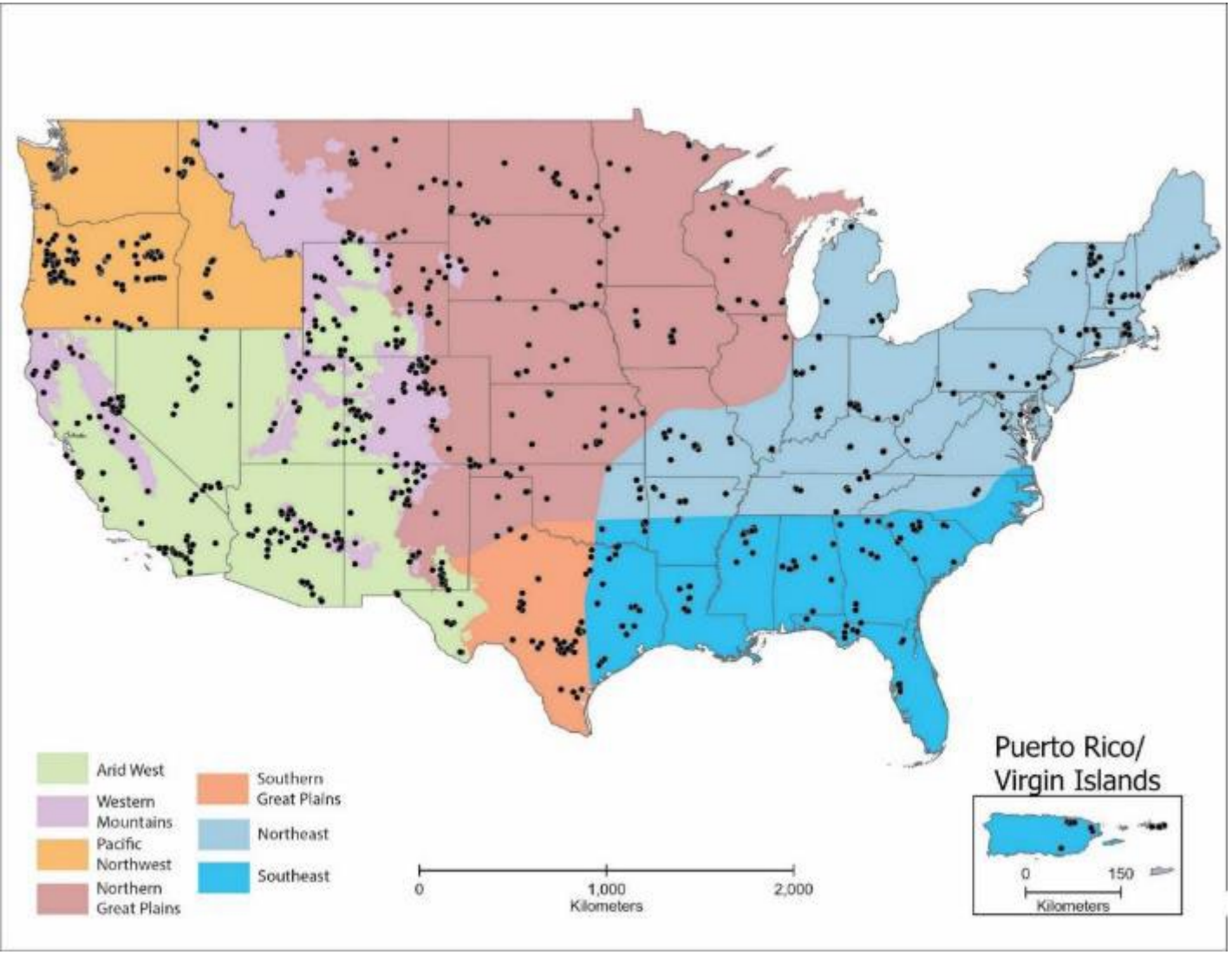
Geographic Region	Current Step	Data Collection / Beta Method Development	Beta Method Rollout	Final Method Rollout
Pacific Northwest	Finalized	Published	-	Final Implemented 2015
Arid West	Beta	Beta method published	March 2021	Summer/Fall 2023
Western Mountains	Beta	Beta method published	December 2021	Fall 2023
Great Plains	Beta	Beta method published	September 2022	Fall/Winter 2023
Northeast/ Southeast	Beta	Beta method published	April 2023	Spring 2024
Alaska	Preparation	TBD?	TBD?	TBD?
Hawaii	Preparation	TBD?	TBD?	TBD?

Getting more info about SDAMs

- Reach out to EPA and Corps contacts for regional methods
- **Provide feedback on the beta methods**
- Learn about development of final methods
- Access the data used to develop each SDAM
- https://www.epa.gov/streamflow-duration-assessment



SDAM Development Studies: Data



- Nationwide scale
- The link to the data for each regional method can be found on the relevant regional method page:
  - https://www.epa.gov/streamflow-duration-assessment
- All of the data can also be found on HydroShare at:
  - https://www.hydroshare.org/user/6515/
- Opportunity for finer scale coverage
- Intensification studies at state or regional scale

Why Consider an Intensification Study?

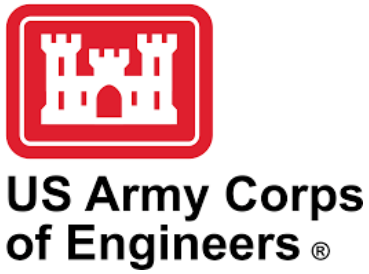
- Support development of state, tribal, or locally specific SDAMs
- Inform resource management needs of state, tribal, or local programs (e.g., state or local ordinances, water quality standards)

What Assistance is Available?

EPA can assist with:

- Standardized field and laboratory protocols
- Rigorous quality assurance protocols
- Intensification study designs

Team Acknowledgements



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