Internet of Water (IoW)

Overview of IoW Coalition and Update on Core Technology

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Center for Geospatial Solutions, Lincoln Institute of Land Policy

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Internet of Water COALITION

The Main Idea

New Information & Insights

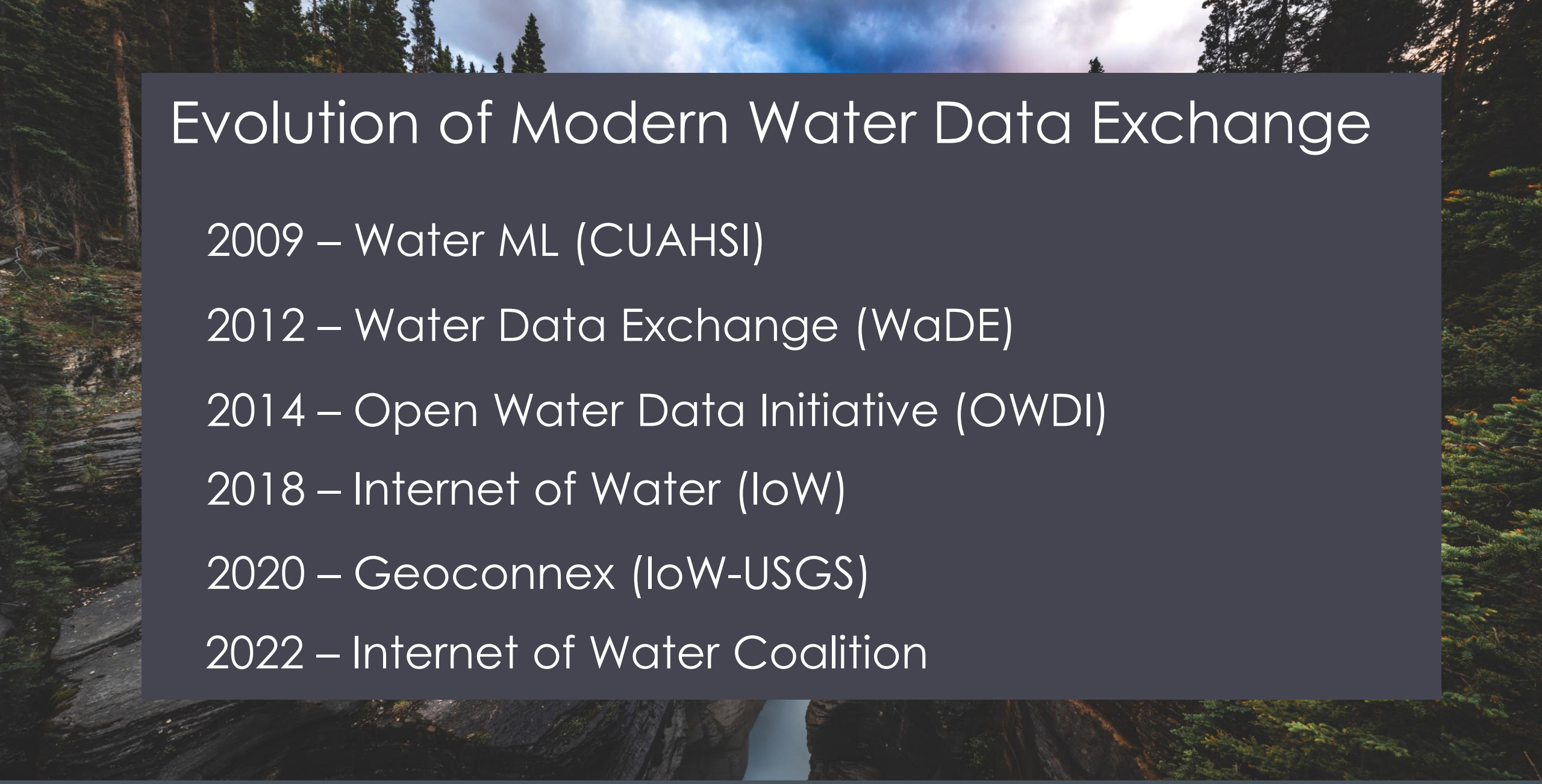
Improved Decision-making in the Water Community

Better Water Management Outcomes

Healthy Communities & Ecosystems

Internet of Water

Discoverable, Accessible, & Usable Water Data



Evolution of Modern Water Data Exchange

2009 – Water ML (CUAHSI)

2012 – Water Data Exchange (WaDE)

2014 – Open Water Data Initiative (OWDI)

2018 – Internet of Water (IoW)

2020 – Geoconnex (IoW-USGS)

2022 – Internet of Water Coalition

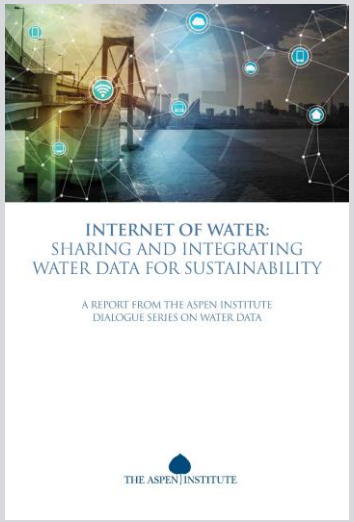
IoW - From Report to Project to Coalition

2018 - 2022

2017

2022

Aspen Institute Report



IoW Start-Up Project

Internet of Water

Duke
NICHOLAS INSTITUTE
for ENERGY, ENVIRONMENT
& SUSTAINABILITY

IoW Coalition

Internet of Water
COALITION

LINCOLN INSTITUTE
OF LAND POLICY

Duke
NICHOLAS INSTITUTE
for ENERGY, ENVIRONMENT
& SUSTAINABILITY

CUAHSI

WESTERN STATES
WATER COUNCIL

WATER DATA
COLLABORATIVE

IoW at Lincoln Institute - Center for Geospatial Solutions

Acts as a service center for the IoW community, supporting the IoW Coalition of non-profits, states, and other organizations

Supports DOE, USGS, and other Federal agencies, as well as emerging Federal roundtable

Provides support for long-term operations of IoW technologies

New Technologies

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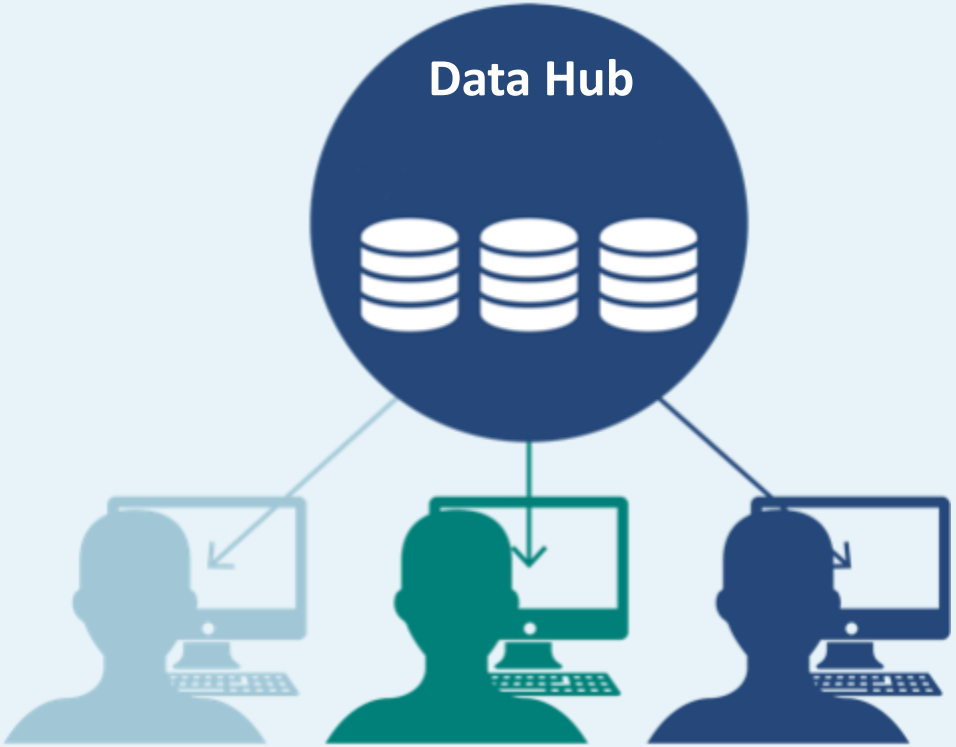
Geographic and Thematic Hubs



WESTERN STATES WATER COUNCIL

CUAHSI
universities allied for water research

Water Data Collaborative

TX

NM

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Approach: HubKit

- The Core Idea
- Open Source Software components that allow data providers to
  - Format their data according to IoW standards
  - Publish data via IoW standard APIs
  - Publish metadata to geoconnex

Hubkit

- Low-cost, versatile ‘toolkit’ with 4 data management components:

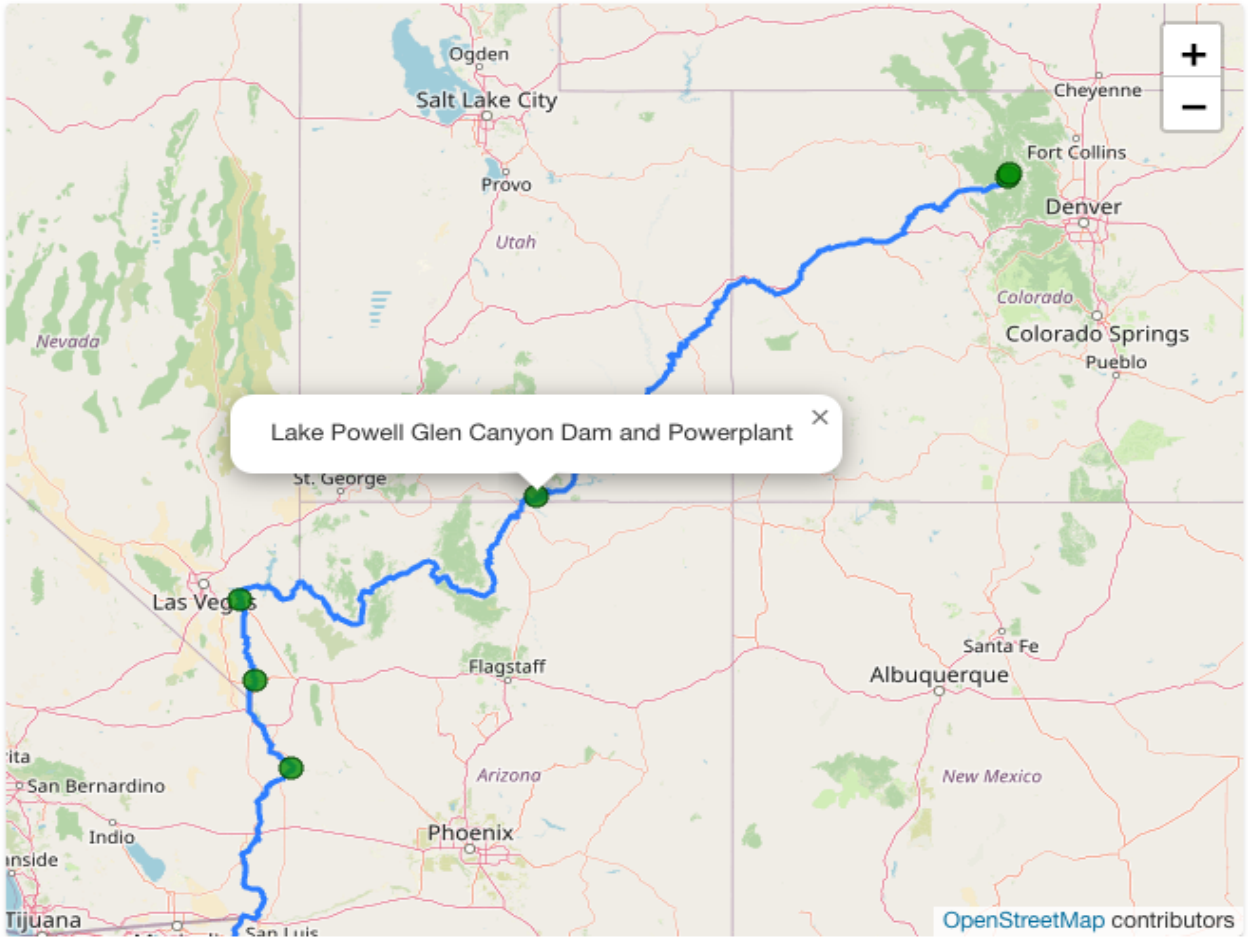
1. Data ingestion
2. Data standardization
3. Data access automation (with an API)
4. Data publication on the web

← Lake Powell Glen Canyon Da... DATA

LATEST VALUES

from 2023-03-20T07:00:00Z

Lake/reservoir release - powerplant	7978.35 cfs
Lake/reservoir elevation	3520.98 ft
Lake/reservoir storage	5316380 af
Lake/reservoir evaporation	204.253 af
Lake/reservoir inflow	8082.29 cfs
Lake/reservoir inflow - unregulated	9007.87 cfs
Lake/reservoir bank storage	4479000 af
Lake/reservoir inflow	16031 af



In 2020, IoW and USGS began developing a key concept, Geoconnex, based on earlier USGS research

Geoconnex

Before Geoconnex

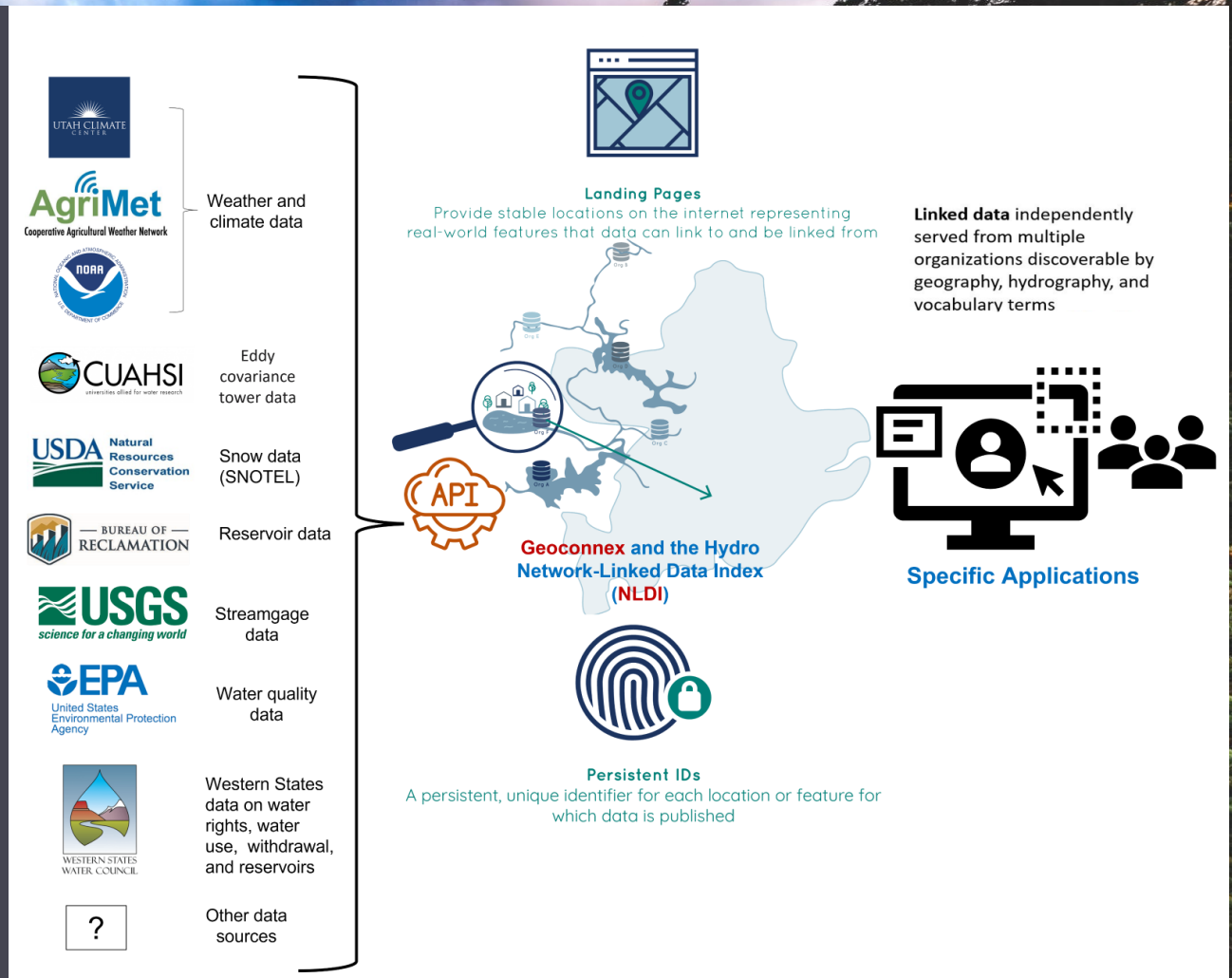
Online search reveals few relevant data sources

After Geoconnex

Online search reveals all relevant data sources

Essential Need

At completion, users will have easy access to comprehensive water data for any specific query for a given location:



Audience Definitions

- **Audience 0:** Fully automated machines for data indexing (e.g. Google, OpenAI/GPT trainers)
- **Audience 1:** Data providers
  - Data managers for agencies that manage water data
- **Audience 2:** Data users
  - Primary data analysts who process data or make tools to create information for decision-makers

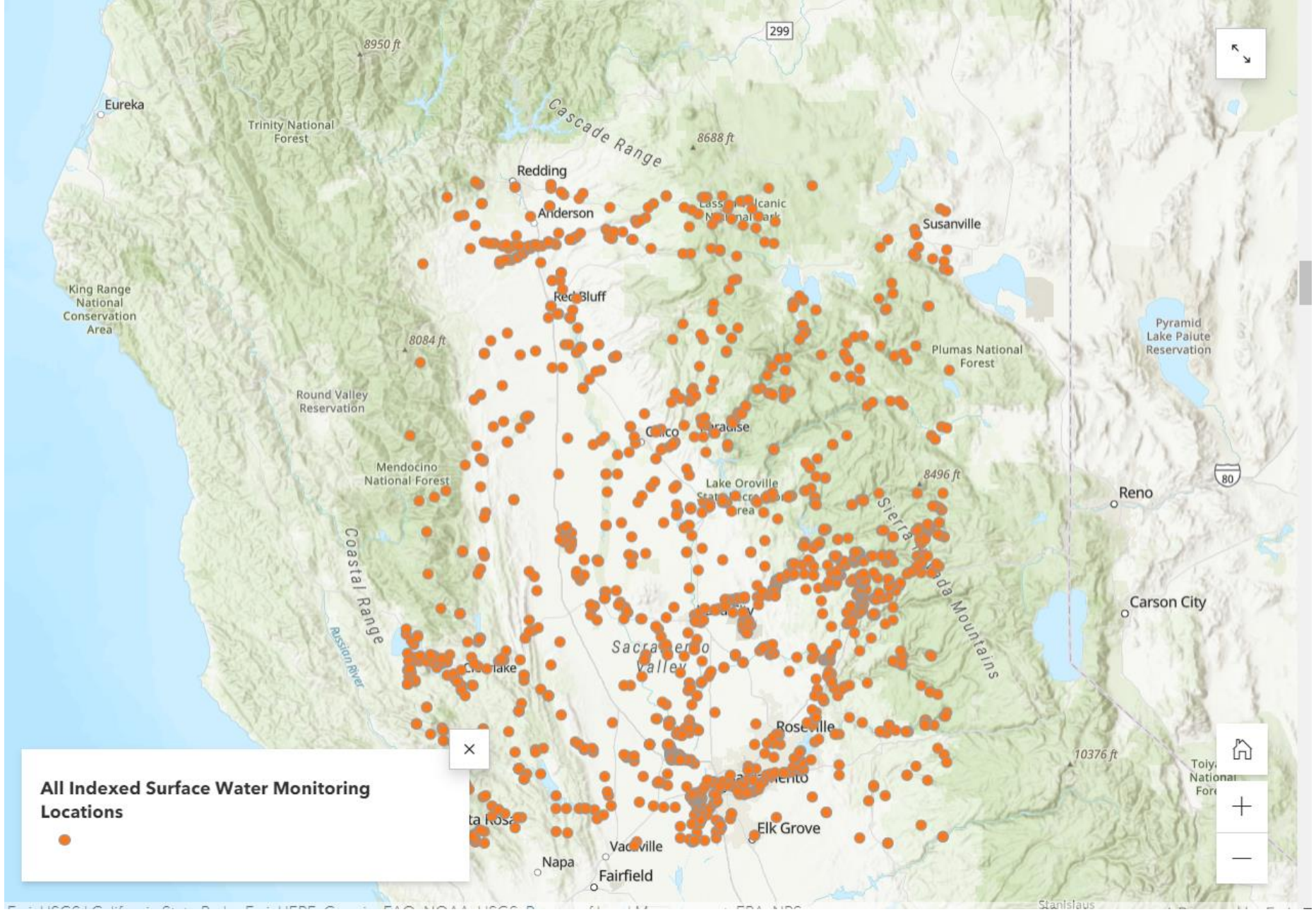
Approach: Geoconnex.us

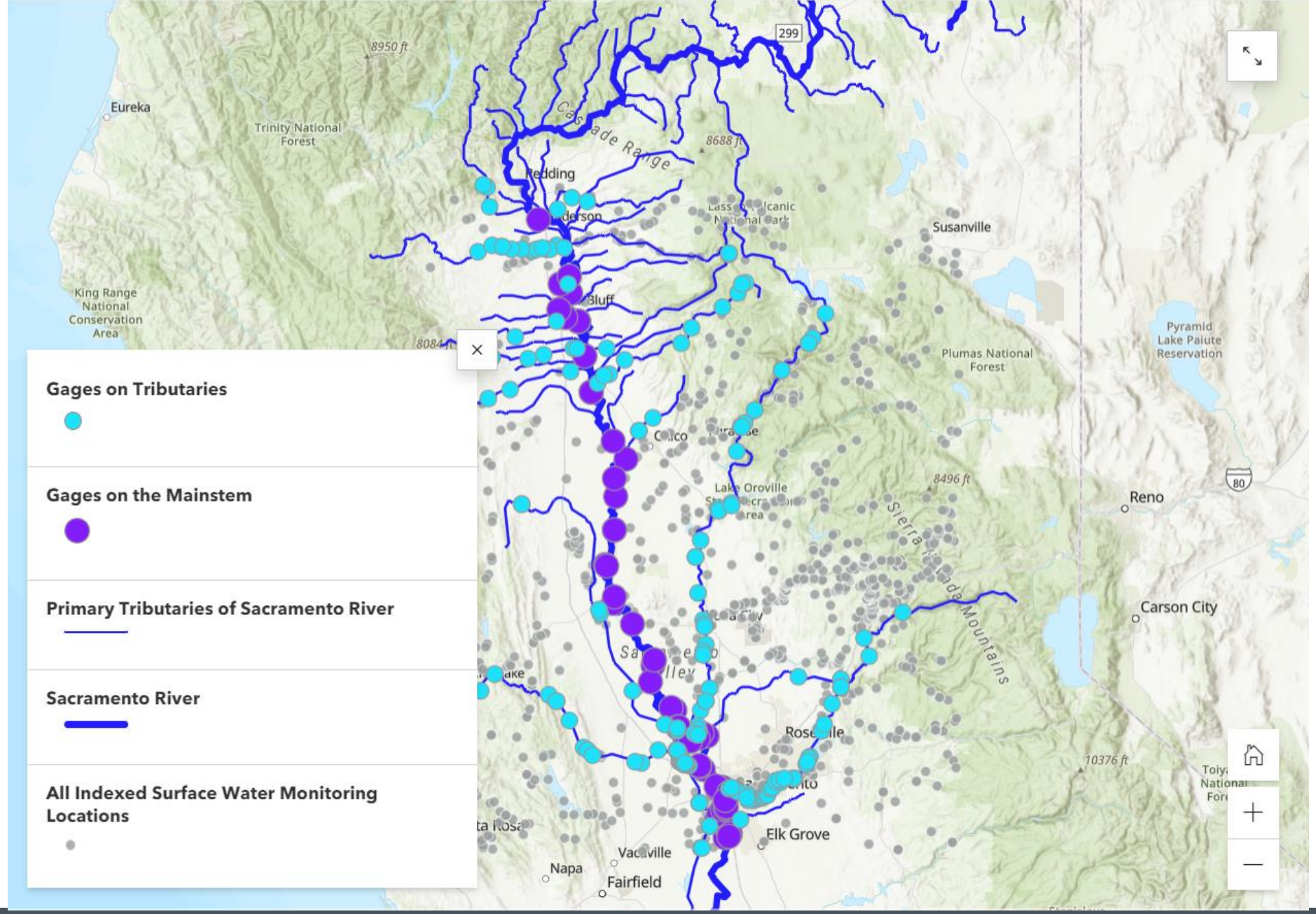
- The Core Idea: Metadata Management and Publication

- Data providers should publish **metadata** that specifies in a standard format:
  - What is the data about (e.g. a specific place, river, aquifer, piece of infrastructure, jurisdiction, etc)
  - What variables does the data provider collect (e.g. water level, flow, temperature, salinity)
  - The time period and frequency of data collection for each variable
  - How that data was collected/modeled/forecasted and its quality
  - Where to find the data
  - How the data is formatted

Approach: Geoconnex.us

- Back-end Technical components
  - **Infrastructure:**
    - **1. Persistent identifiers:** A comprehensive list of places that one or more entities have data about
    - **2. Reference feature server:** A way to retrieve the list of places so that Audience 1 can “tag” their data
  - **Standards:** for Audience 1 to publish metadata
    - **3. For geospatial coordinates**
    - **4. For Hydrologic location (river)**
    - **5. For data characteristics (variables, period of record, data quality, format)**
  - **Metadata Library**: Ways for Audience 2 to discover metadata across data providers
    - **6. Knowledge Graph:** The database
    - **7. Harvester:** The software that gets data from data providers and puts in the Knowledge Graph
    - **8. Monitoring Tool:** A high-level summary of the amount of various data types available in the system


All Indexed Surface Water Monitoring Locations
Eureka
Trinity National Forest
Redding
Anderson
Susanville
Red Bluff
King Range National Conservation Area
Round Valley Reservation
Mendocino National Forest
Plumas National Forest
Pyramid Lake Paiute Reservation
Lake Oroville
Reno
Carson City
Coastal Range
Cascade Range
Sacramento Valley
Sierra Nevada Mountains
Elk Grove
Napa
Fairfield
Vacaville
8950 ft
8688 ft
8084 ft
8496 ft
10376 ft
299
80


Gages on Tributaries
Gages on the Mainstem
Primary Tributaries of Sacramento River
Sacramento River
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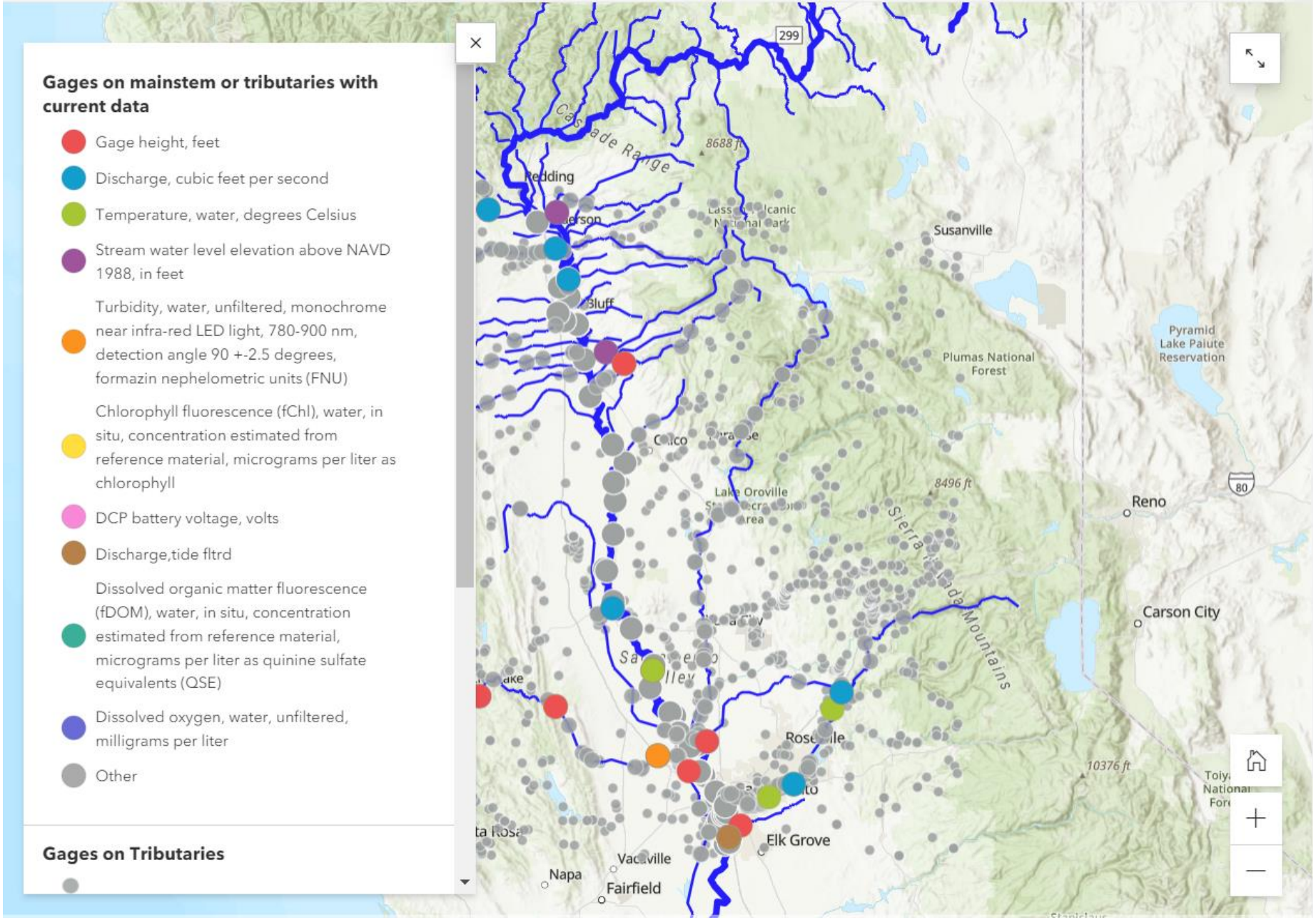
Gages on mainstem or tributaries with current data
Gage height, feet
Discharge, cubic feet per second
Temperature, water, degrees Celsius
Stream water level elevation above NAVD 1988, in feet
Turbidity, water, unfiltered, monochrome near infra-red LED light, 780-900 nm, detection angle 90 +-2.5 degrees, formazin nephelometric units (FNU)
Chlorophyll fluorescence (fChl), water, in situ, concentration estimated from reference material, micrograms per liter as chlorophyll
DCP battery voltage, volts
Discharge,tide fltrd
Dissolved organic matter fluorescence (fDOM), water, in situ, concentration estimated from reference material, micrograms per liter as quinine sulfate equivalents (QSE)
Dissolved oxygen, water, unfiltered, milligrams per liter
Other
Gages on Tributaries
299
Cascade Range
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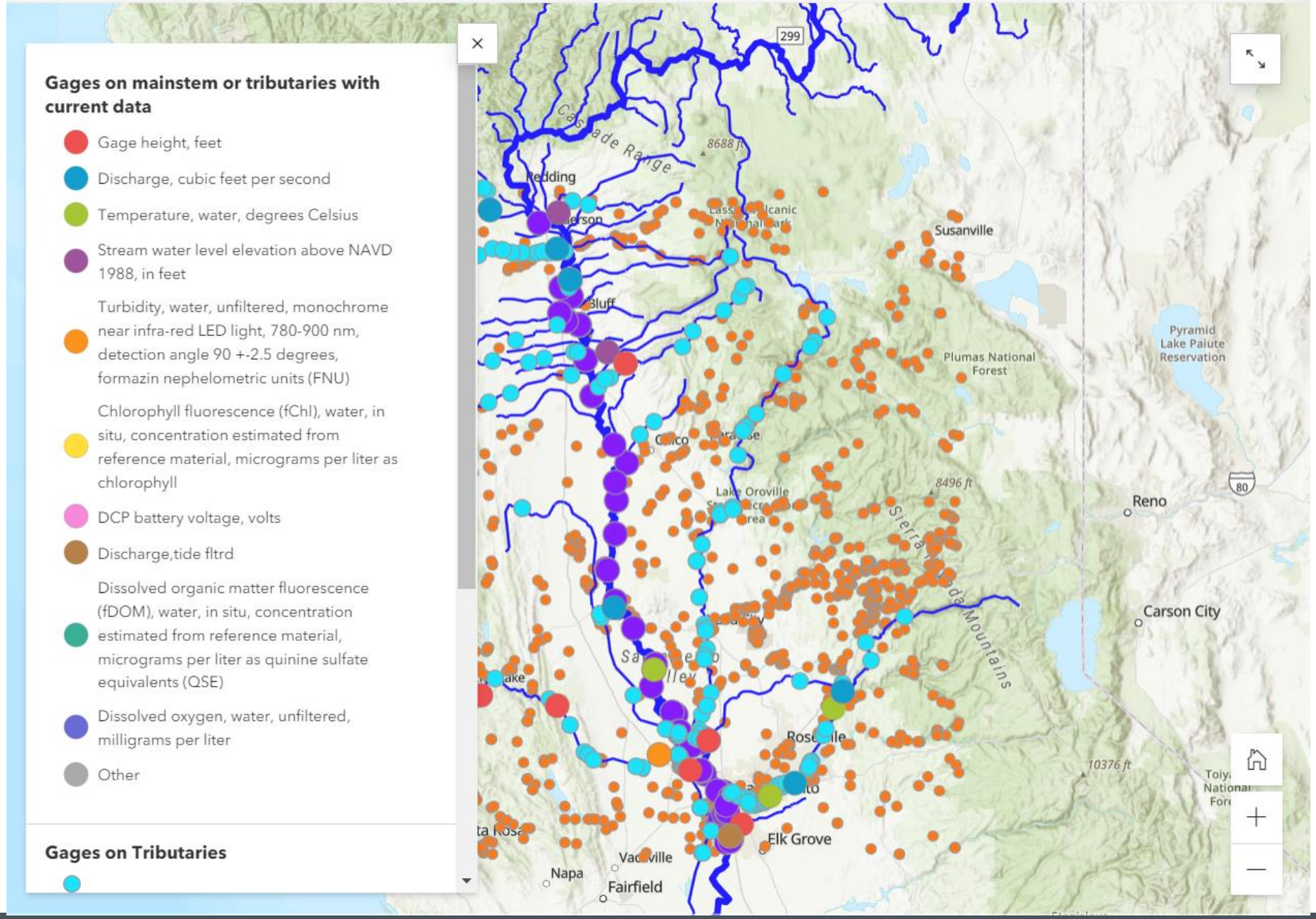
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Status of the Data

- Significant growth:
  - September 2021 - 1.1 million references
  - September 2022 - 3.3 million references
  - March 2023 – **5.8 million references!**

- Utility and comprehensiveness enhance with more additions, providing greater value

Internet of Water COALITION

internetofwater.org

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