California Central Valley Groundwater-Surface Water Simulation Model – Fine Grid (C2VSimFG) Web Application Tool

Presented By:

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SGMO, Model and Tools Support Section, &

***Tom Heinzer**, Consultant*

Michael Thomas Group

CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER
MANAGEMENT OFFICE

Overview

I. Purpose of the C2VSimFG Web Application

II. Explore Groundwater, Subsidence and Stream Hydrographs

III. Explore the Surface and Subsurface Budgets

IV. Explore the Zone Budgets

V. Web Application Architecture

VI. Research Tools

VII. Next Steps

- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- User Manual
- Quick Tutorial
- C2VSimFG
- IWFM Version
- Contact Us

Depending on model output, here you can visualize results like:

Groundwater hydrographs

Groundwater hydrographs at a node and layer

Subsidence hydrographs

Stream hydrographs

Hydrographs | Budgets | Zone Budgets

Model:

C2VSimFG_v1.5_iwfm2024

Hydrograph Type:

Select

Purpose of the C2VSimFG Web Application

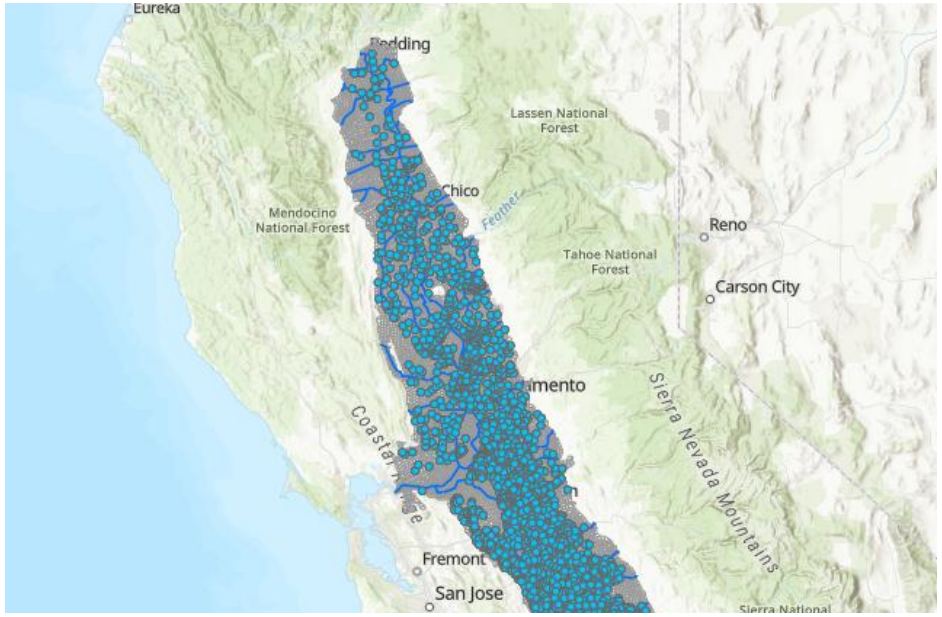
- Interactive, utility tool to show the results of the C2VSimFG with little to no modeling experience needed
- Targeted Audience: Groundwater Sustainability Agencies (GSA's), consultants, and general public
- Able to use the model results right away

Explore Groundwater, Subsidence and Stream Hydrographs

- Able to generate:
  - Groundwater Hydrograph
  - Groundwater Hydrograph at Node and Layer
  - Subsidence Hydrograph
  - Stream Hydrograph

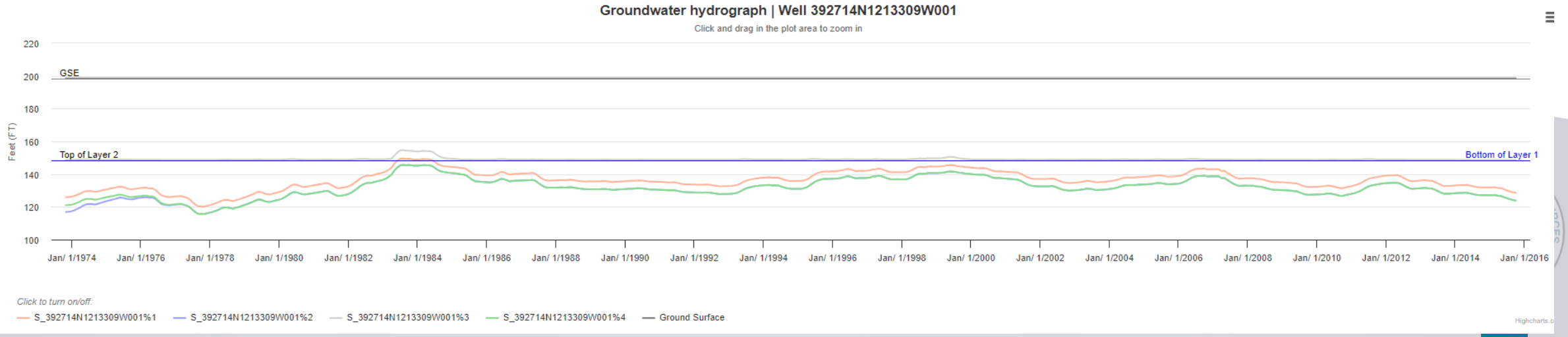
Groundwater Hydrographs

- Shows the C2VSimFG simulated groundwater elevations over time for all layers or a specific model layer
- At a simulated groundwater observation well location



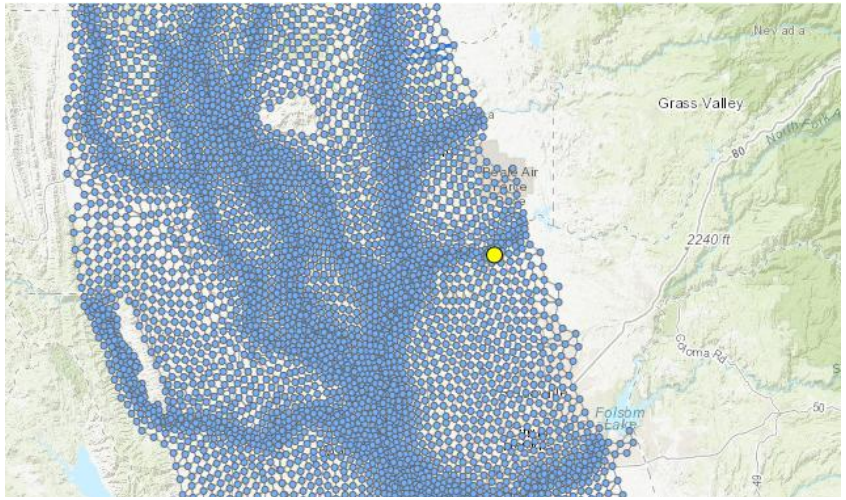
Go to top | Remove this chart | Turn on all chart series

View all model layers



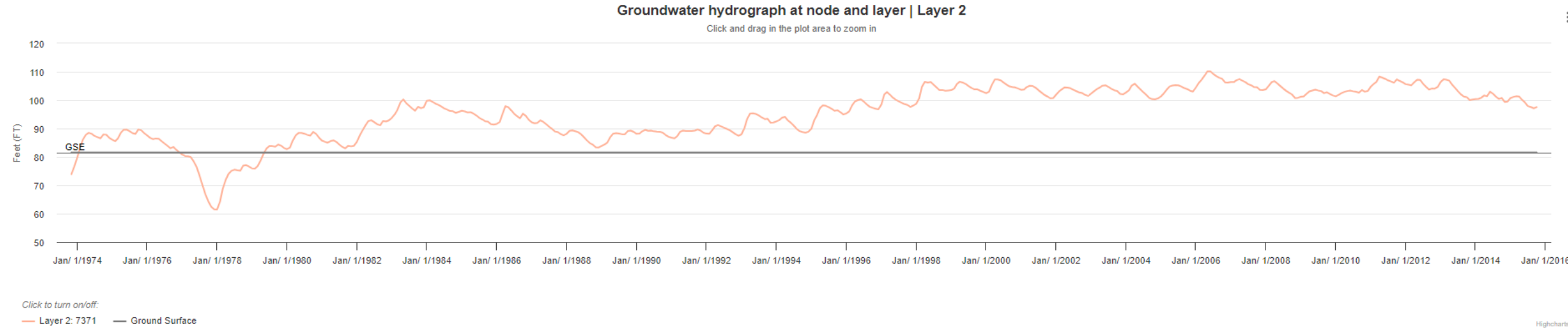
Groundwater Hydrographs at Node and Layer

- Generate a chart of the groundwater elevation over time at a specific groundwater node and model layer



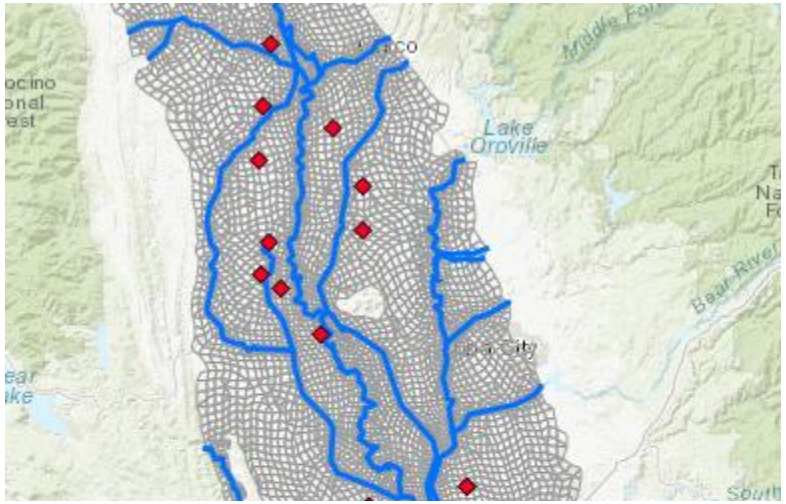
Go to top | Remove this chart | Turn on all chart series

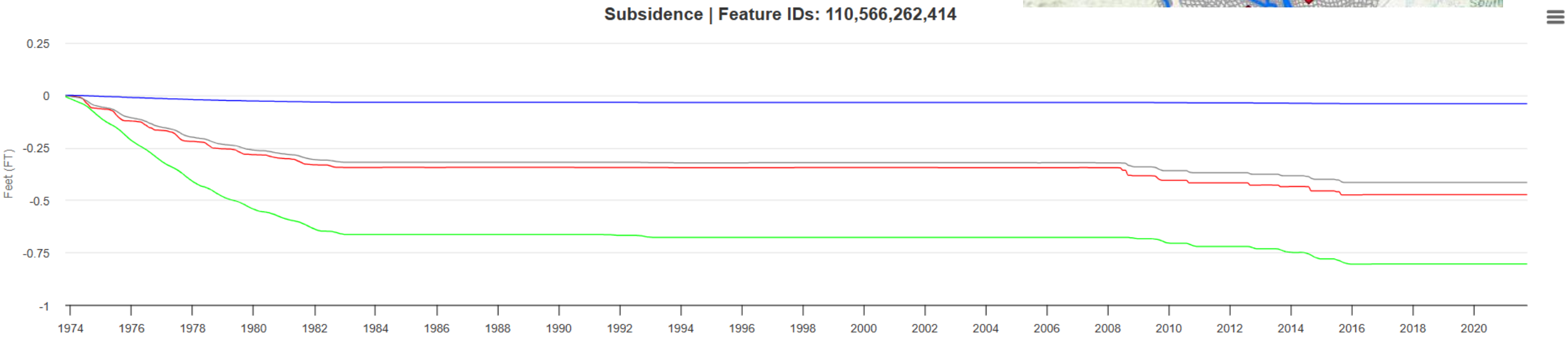
View all model layers



Subsidence Hydrographs

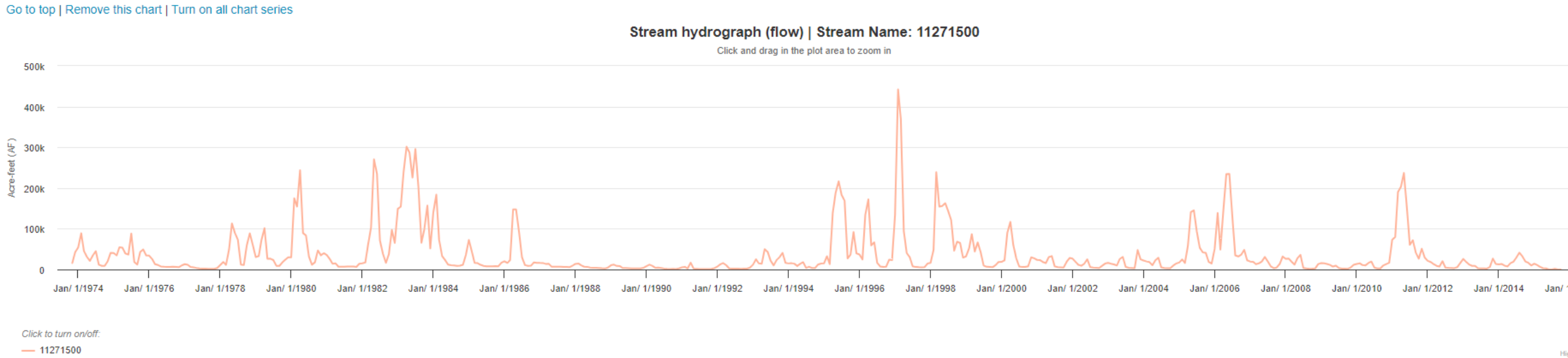
- Generates the subsidence hydrograph at a specific GPS station
- GPS stations from DWR & USGS Extensometers, USGS InSAR, and continuous UNAVCO PBO GPS





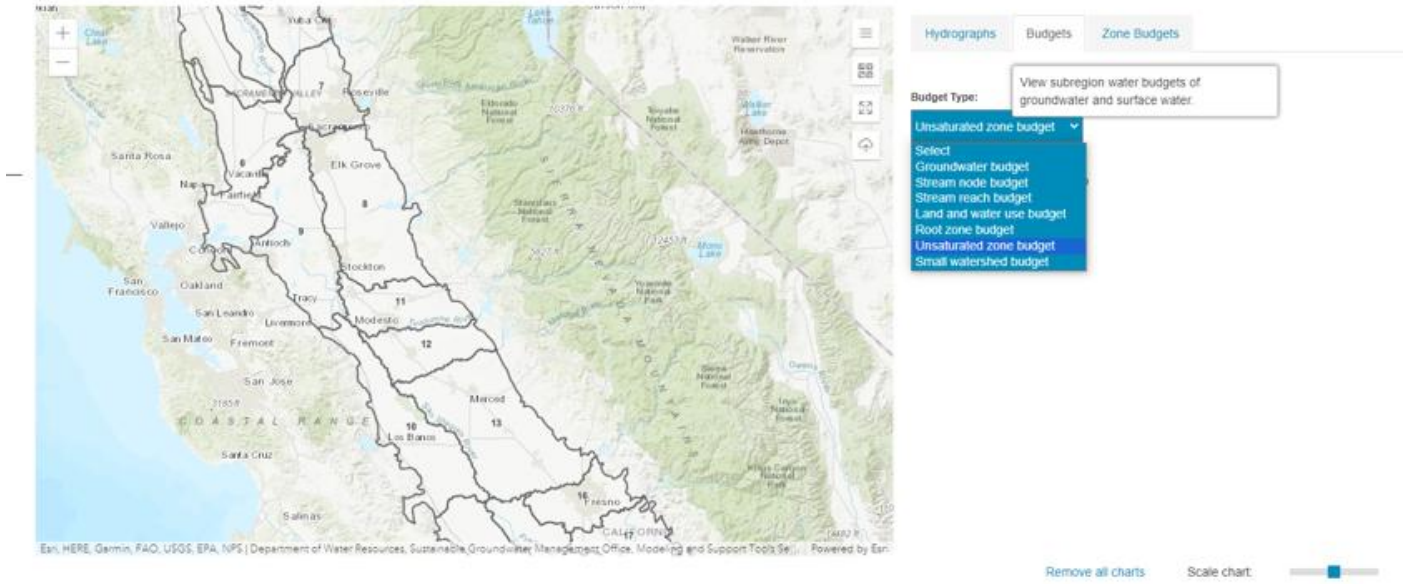
Stream Hydrographs

- Generating the stream hydrograph at specific stream gauge



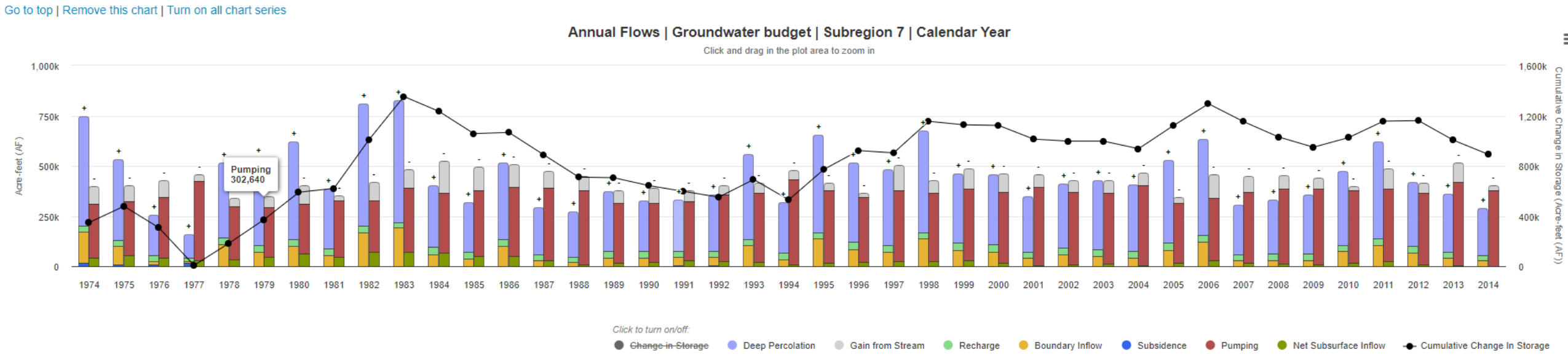
Budgets

- Able to Generate:
  - ➢Groundwater Budgets
  - ➢Stream Node Budgets
  - ➢Stream Reach Budgets
  - ➢Land and Water Use Budgets
  - ➢Root Zone Budgets
  - ➢Unsaturated Zone Budgets
  - ➢Small Watershed Budgets



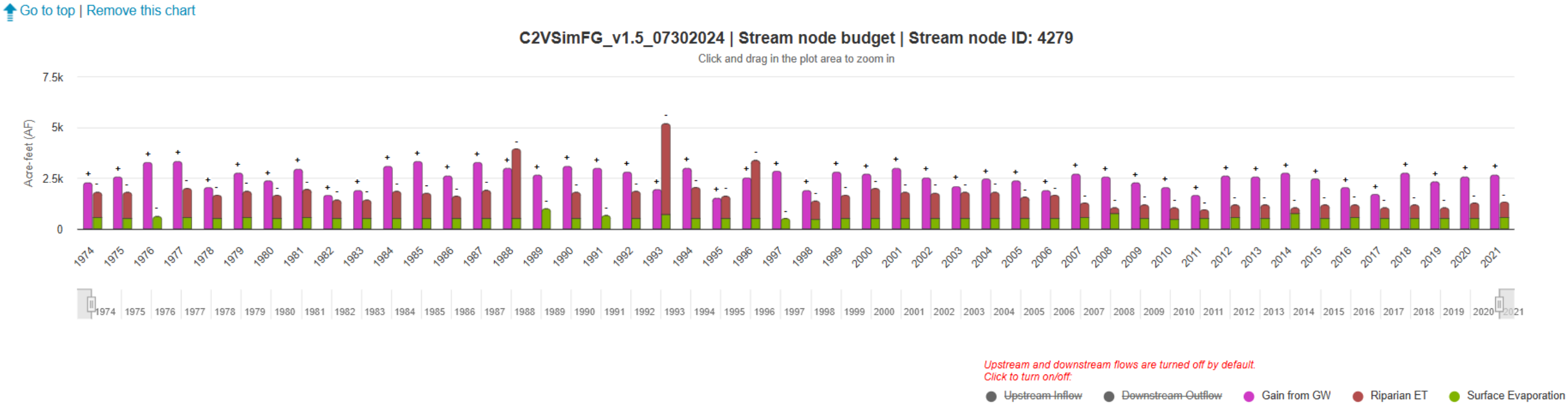
Groundwater Budget

- Generate the inflow and outflow components of groundwater and the cumulative change in storage



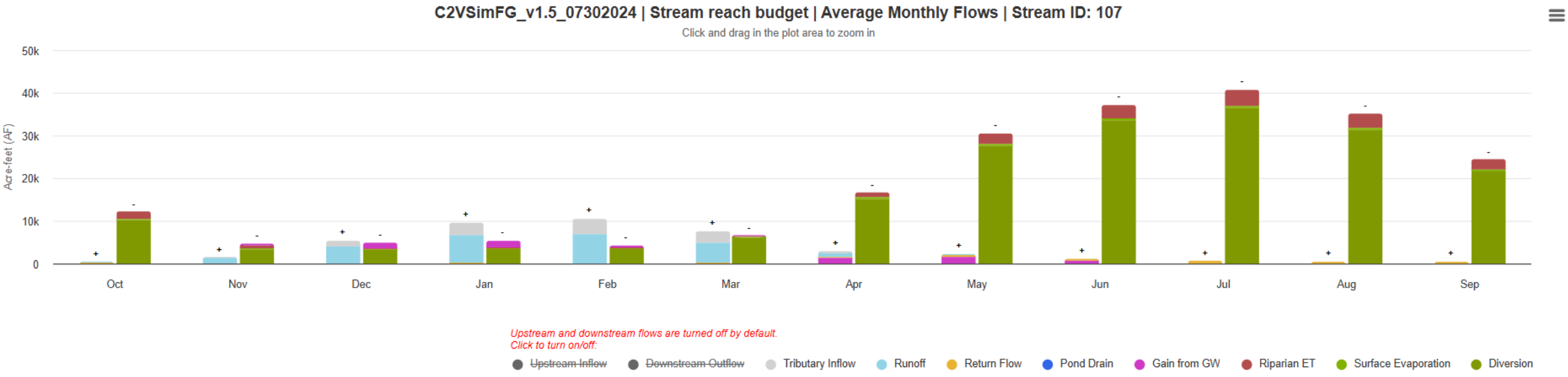
Stream Node Budget

- Generate the inflow and outflow components of the surface water at specific stream node



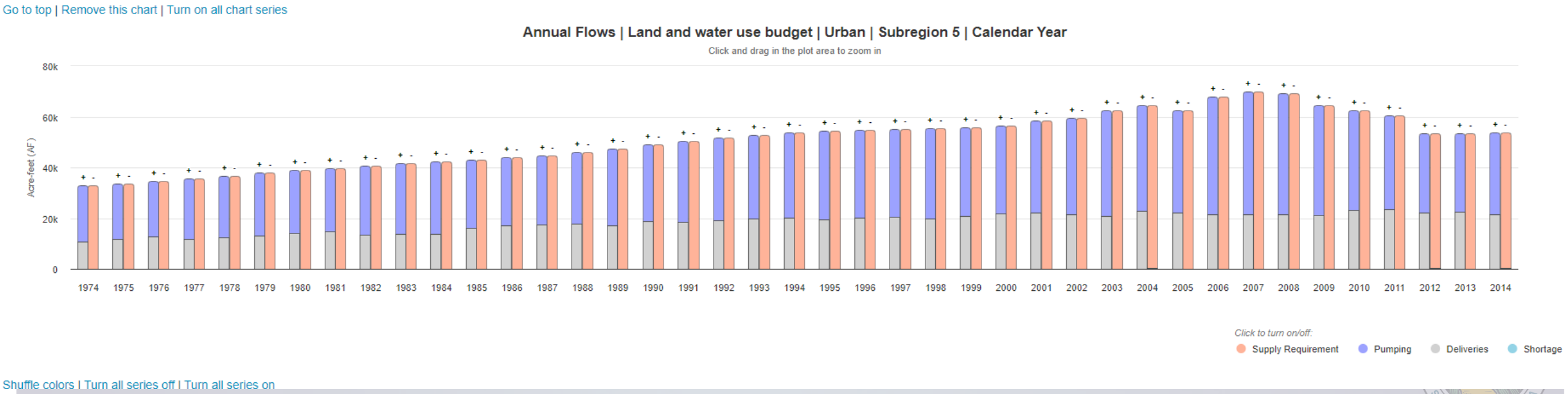
Stream Reach Budget

- Generate the inflow and outflow components of the surface water at specific stream reach



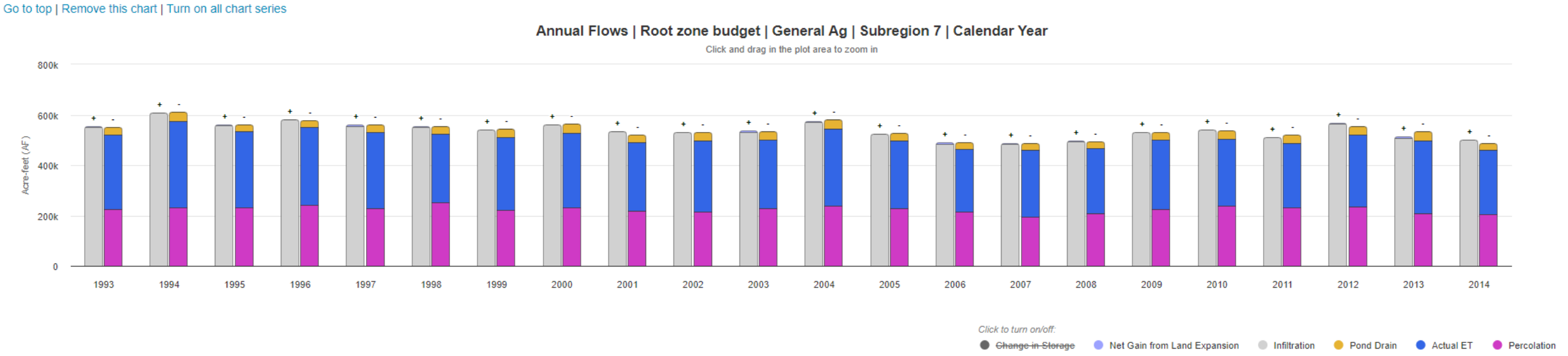
Land and Water Use Budget

- Generate the supplies and demands required for agricultural requirements within a specific subregion and land use (e.g., General Ag, Urban).



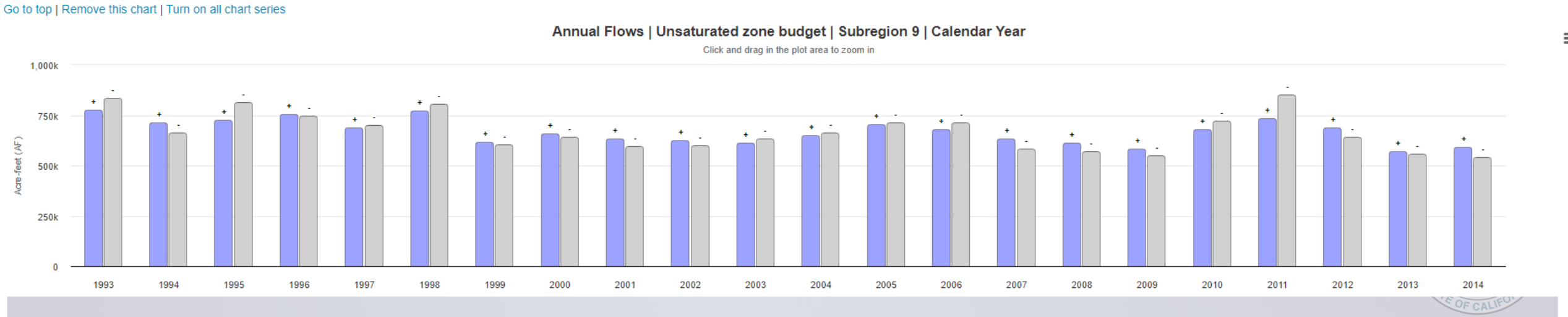
Root Zone Budget

- Generate the inflow and outflow components of the root zone budget within a specific subregion and land use (e.g., General Ag, Urban, Native and Riparian Veg).



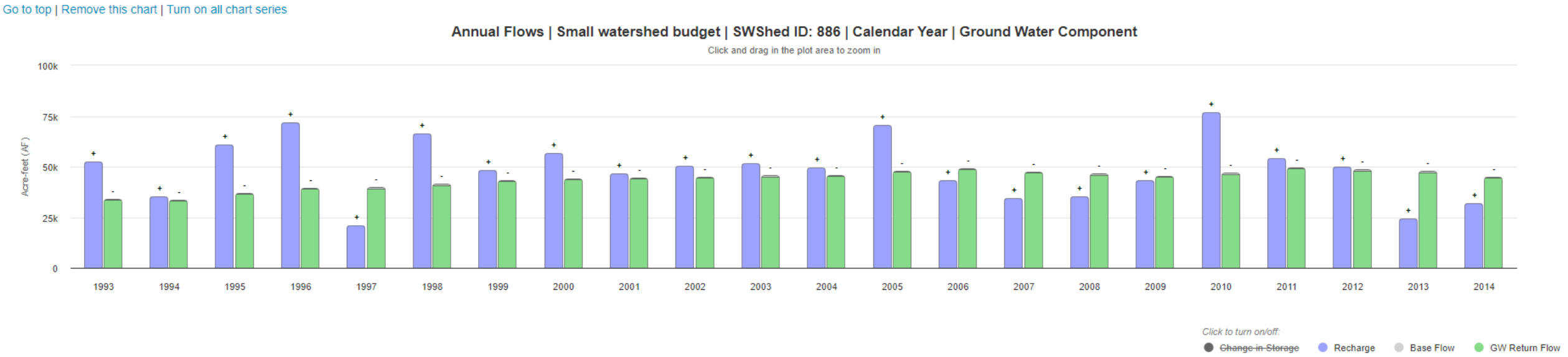
Unsaturated Zone Budget

- Generate the inflow and outflow components of the unsaturated zone budget within a specific subregion and land use (e.g., General Ag, Urban, Native and Riparian Veg).



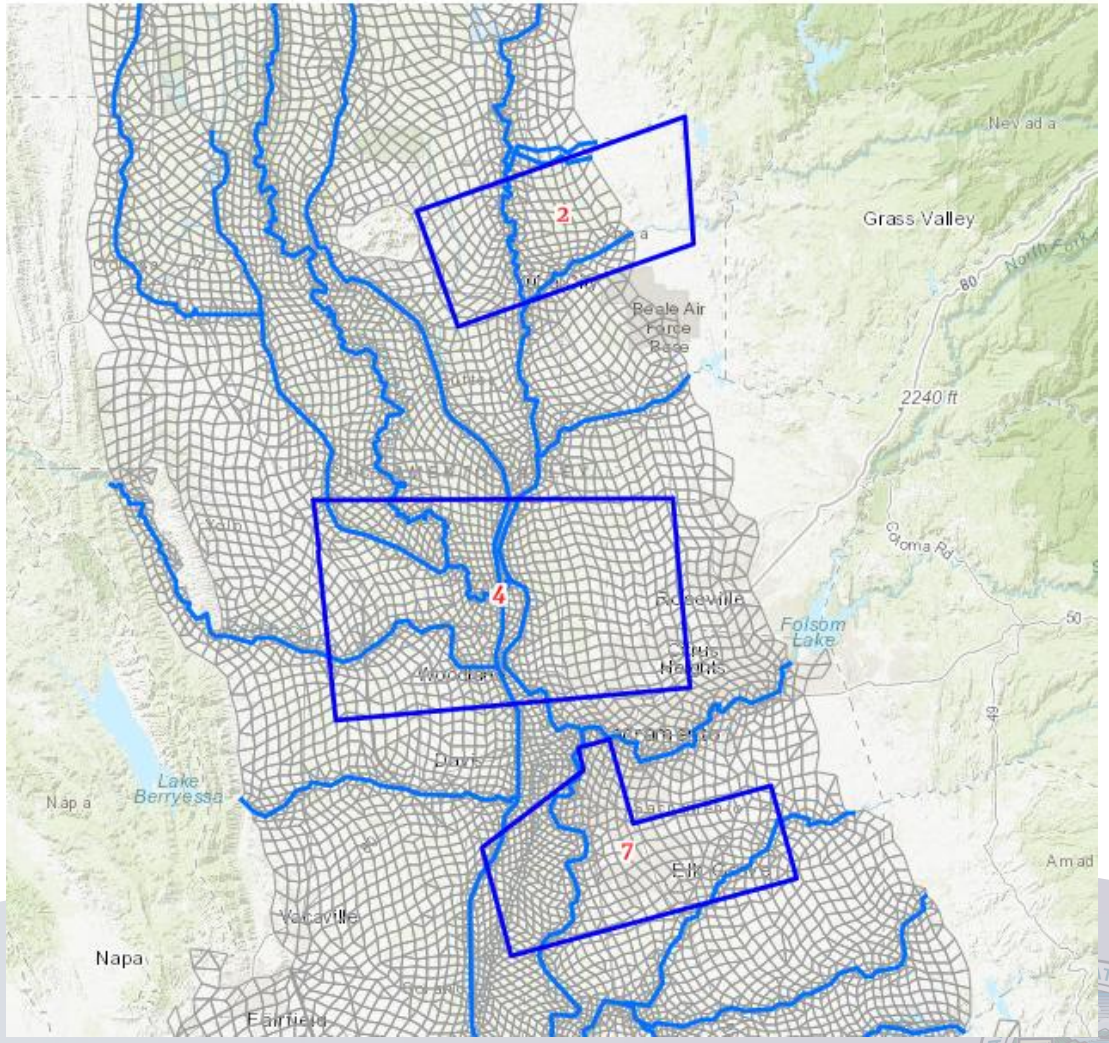
Small Watershed Budgets

- Generate the inflow and outflow components of a specific small watershed for groundwater or root zone components.



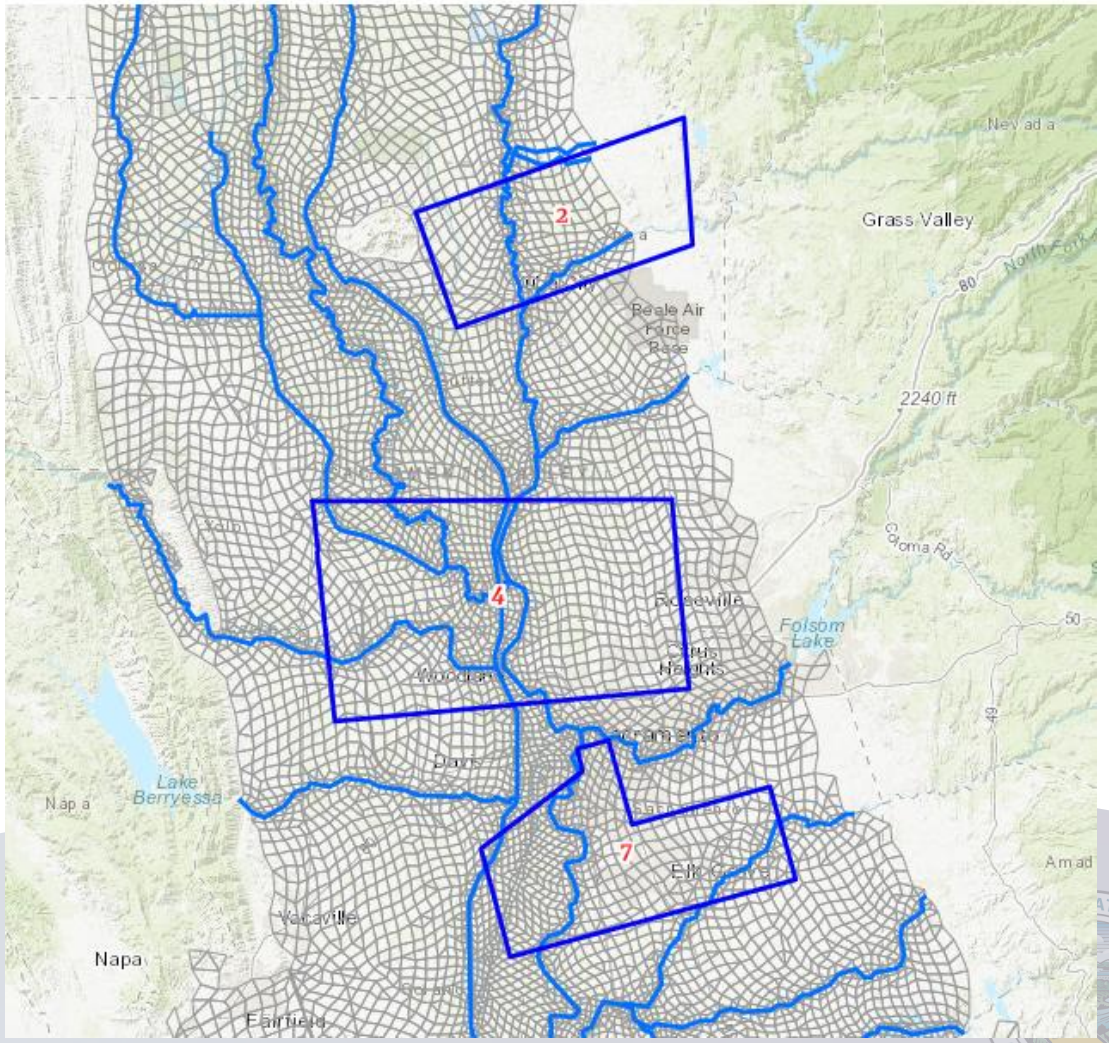
Zone Budgets

- Upload a shapefile in a zip folder
- Requirements:
  - Coordinates - UTM Zone 10
  - Less than 2 MB
  - Needs to have an integer, zone field



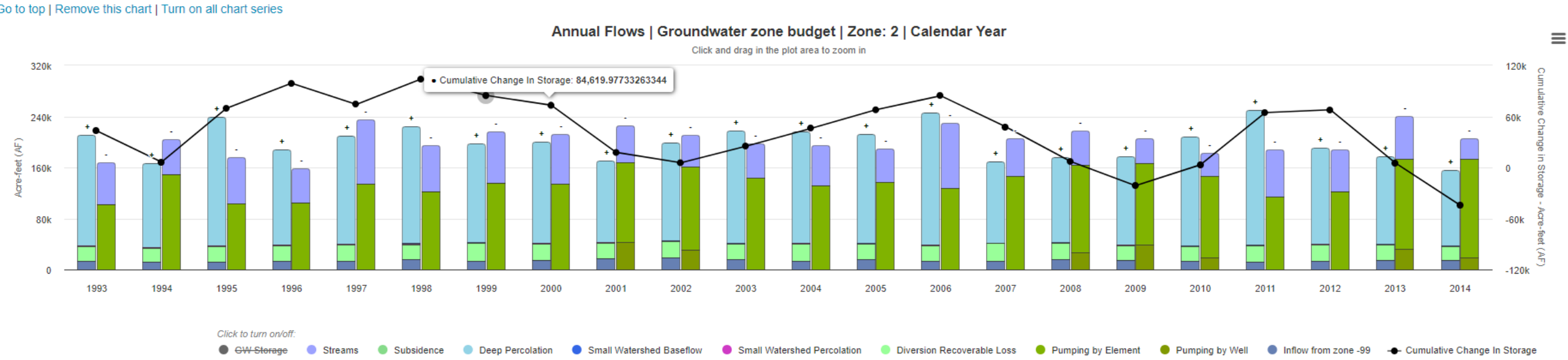
Zone Budgets

- Able to generate:
  - ➢Groundwater Zone Budget
  - ➢Land and Water Use Budget
  - ➢Root Zone Budget
  - ➢Unsaturated Zone Budget



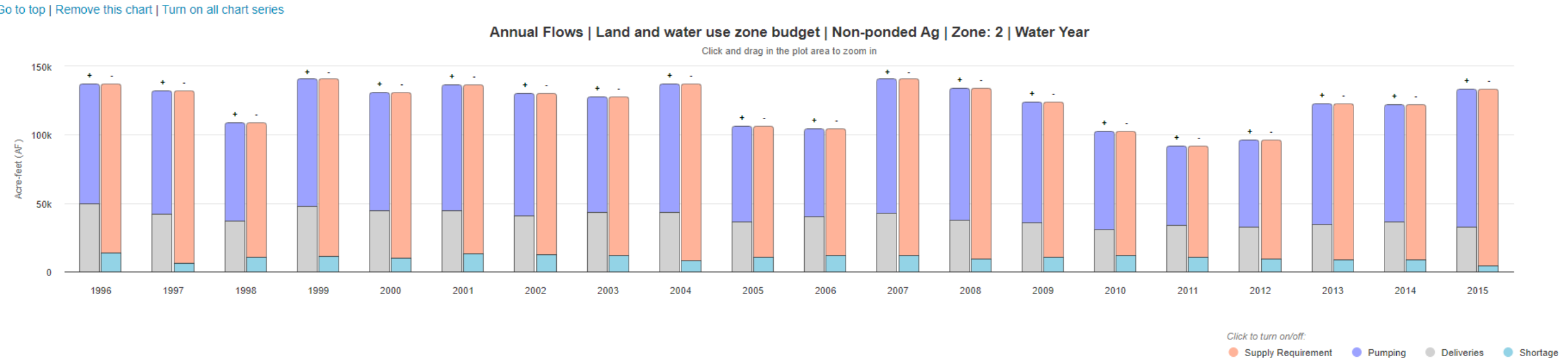
Groundwater Zone Budgets

- Generates the inflows and outflows of the groundwater budget within a specific area of interest



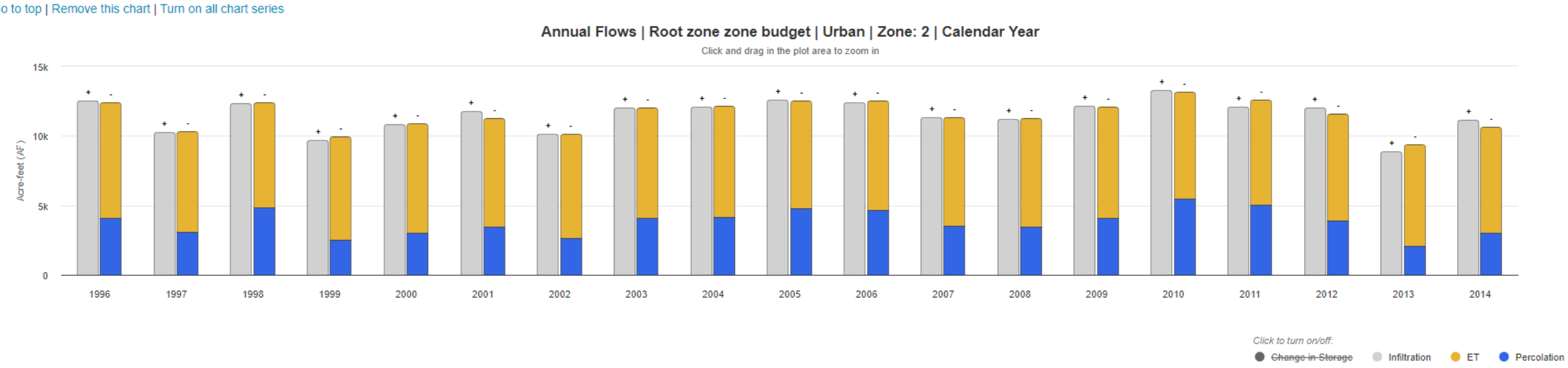
Land and Water Use Zone Budgets

- Generate the agricultural requirements, demand and supply for specific zone and land use/crop type
- e.g., Urban, Non-ponded Ag, Rice (ponded Ag), Refuge



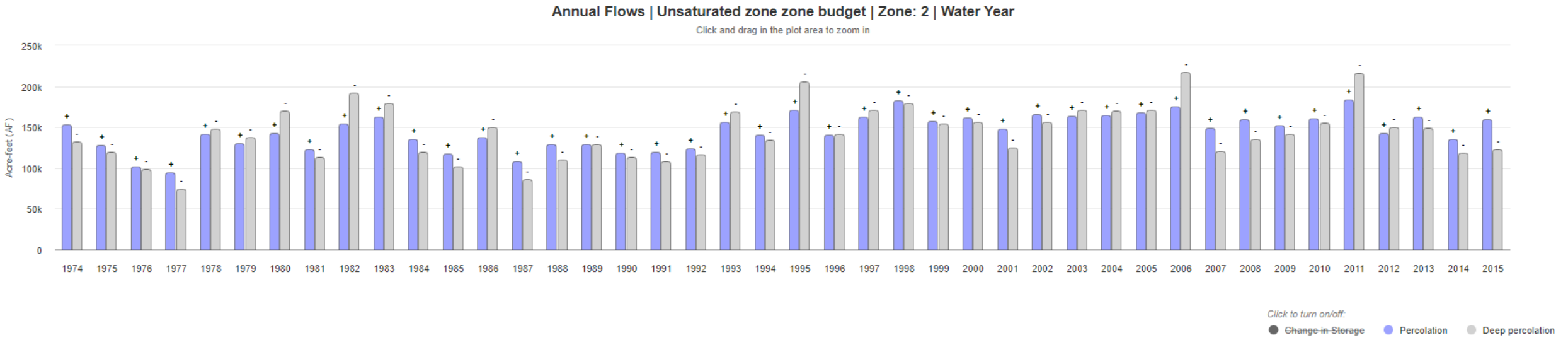
Root Zone Water Budget

- Generates the inflows and outflows of the root zone water budget for specific zone's land use/crop types
- e.g., Urban, Non-ponded Ag, Rice, Refuge



Unsaturated Zone Zone Budget

- Generates the inflows and outflows of the unsaturated zone for specific area of interest



Architecting the IWFM Visualization Tool

Development Platform

How it works

Research

IDE and Components

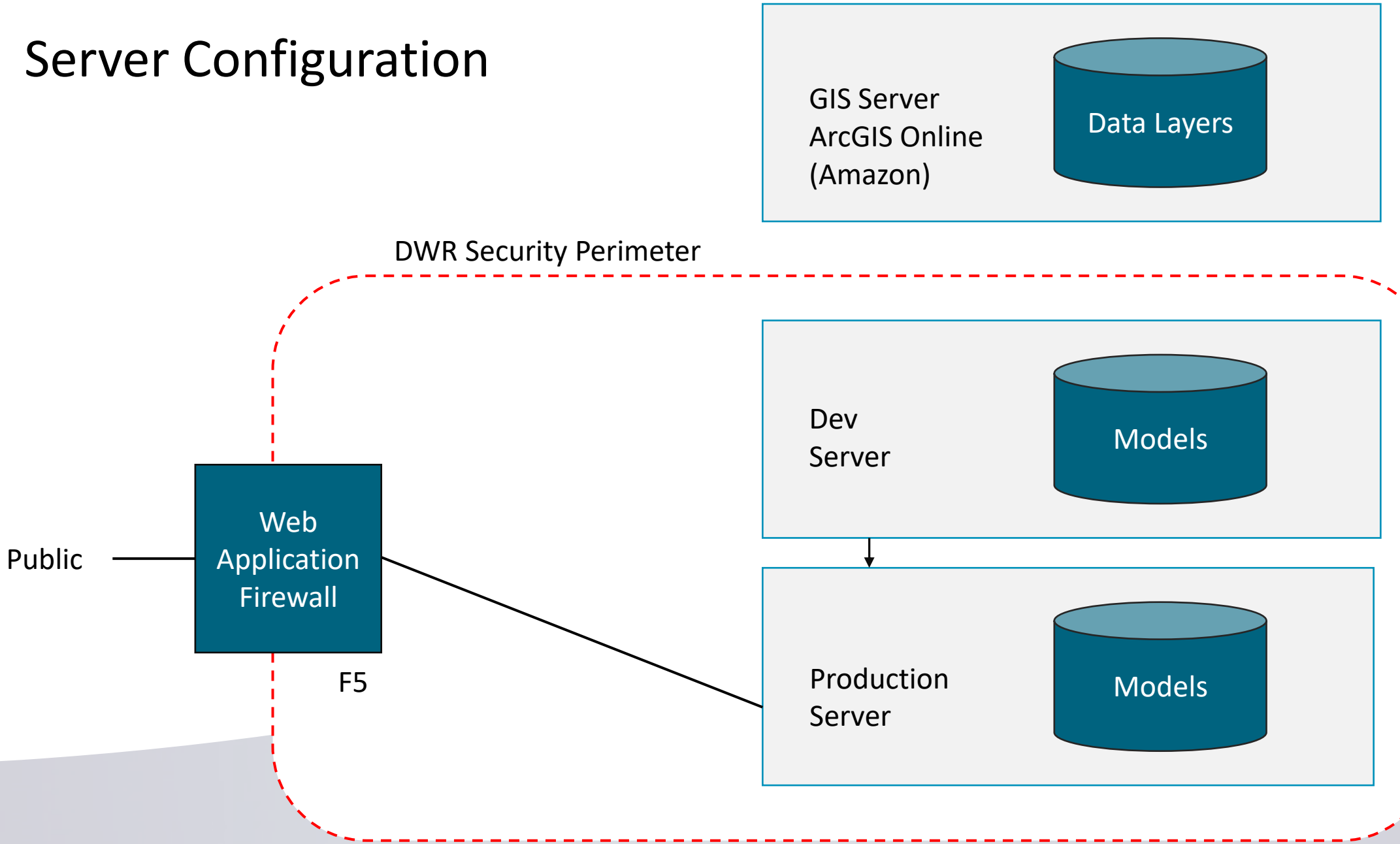
VISUAL STUDIO 2022

IWFM DLL

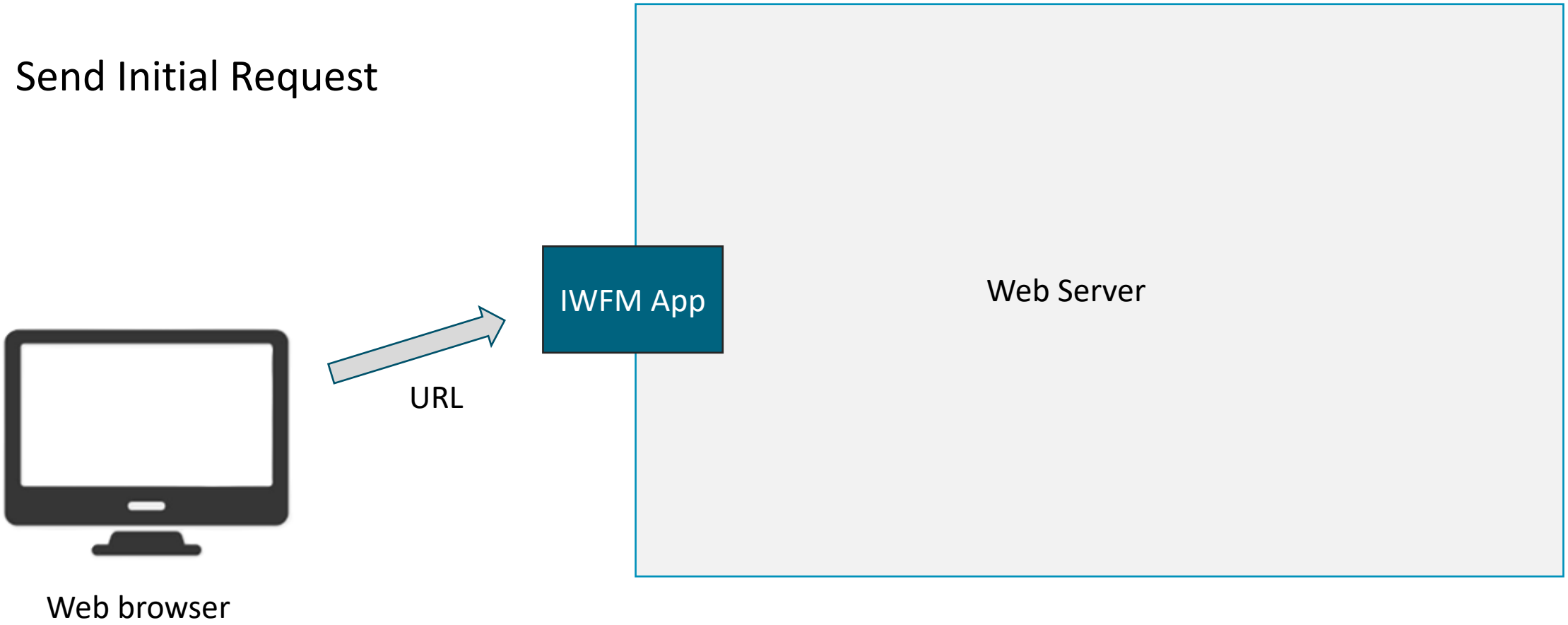
HIGHCHARTS

ArcGIS Online

Server Configuration



Send Initial Request



Receive Web App Code

Web browser

HTML
Javascript

IWFM App

Web Server

Ask For GIS Data (mesh, etc.)

Web browser

REST
Endpoint

IWFM App

Web Server

GIS Model
Data Layers

GIS Server

Receive GIS Data

Web browser

Model GIS Data
Tiled Images

IWFM App

Web Server

GIS Model
Data Layers

GIS Server

- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

Simulated Groundwater Observation Well:

378270N1210717W001_Layer1
378270N1210717W001_Layer2
378270N1210717W001_Layer3
378270N1210717W001_Layer4

Hydrographs | Budgets | Zone Budgets

Model: C2VSimFG_v1.5

From Date: 10/31/1973_24:00

Hydrograph Type: Groundwater hydrograph

To Date: 09/30/2021_24:00

Layer: All

Length: Feet (FT)

Area: Acre (AC)

Volume: Acre-feet (AF)

☐ **Add to chart**

☑ **Add observations**

Output interval: 1MON

Retrieve Data

Remove all charts

Scale chart:

Ask For Budget Chart

Web browser

IWFM App

IWFM DLL

Web Server

C2VSim Model 1

HDF5

C2VSim Model 2

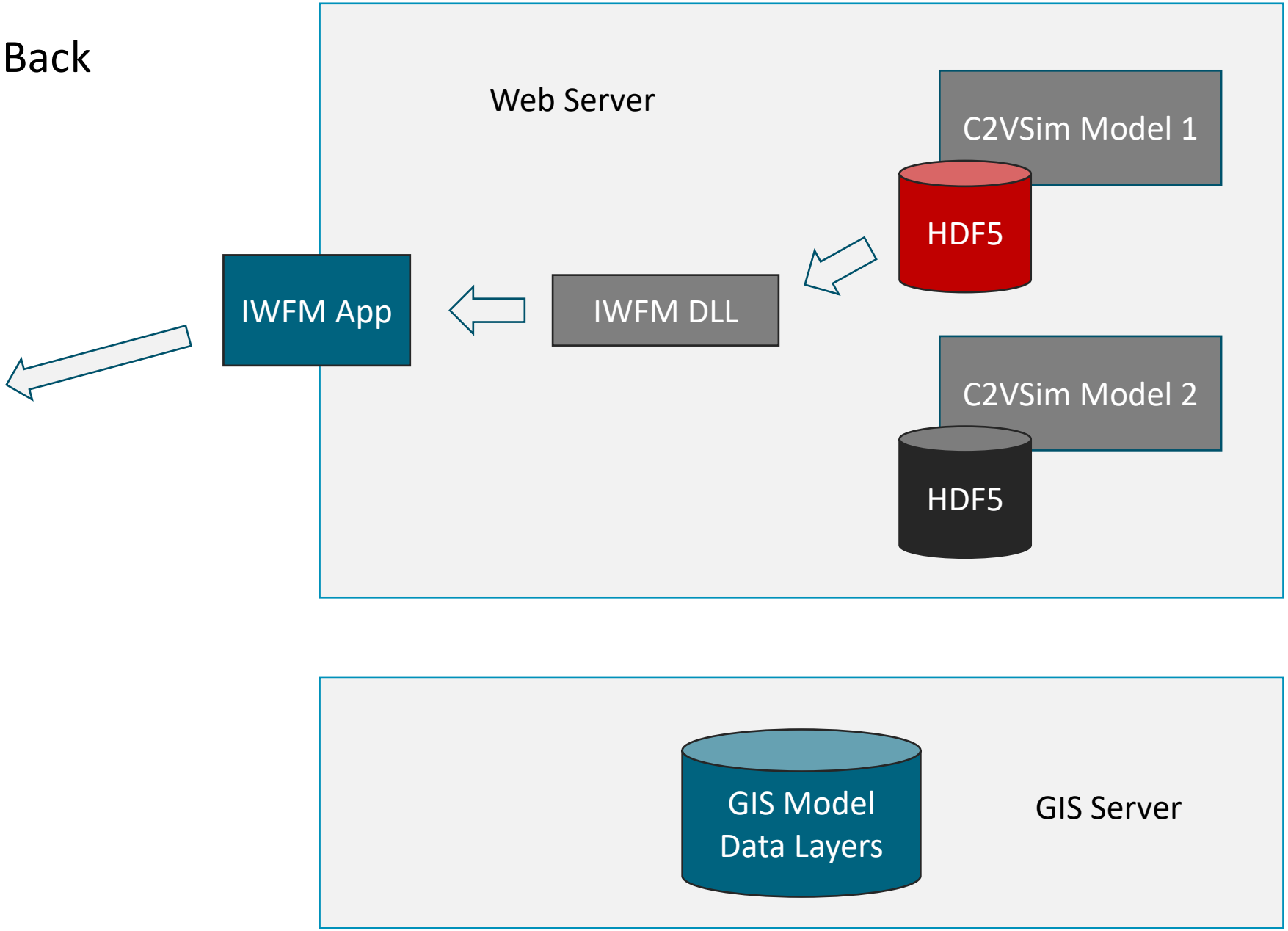
HDF5

GIS Model
Data Layers

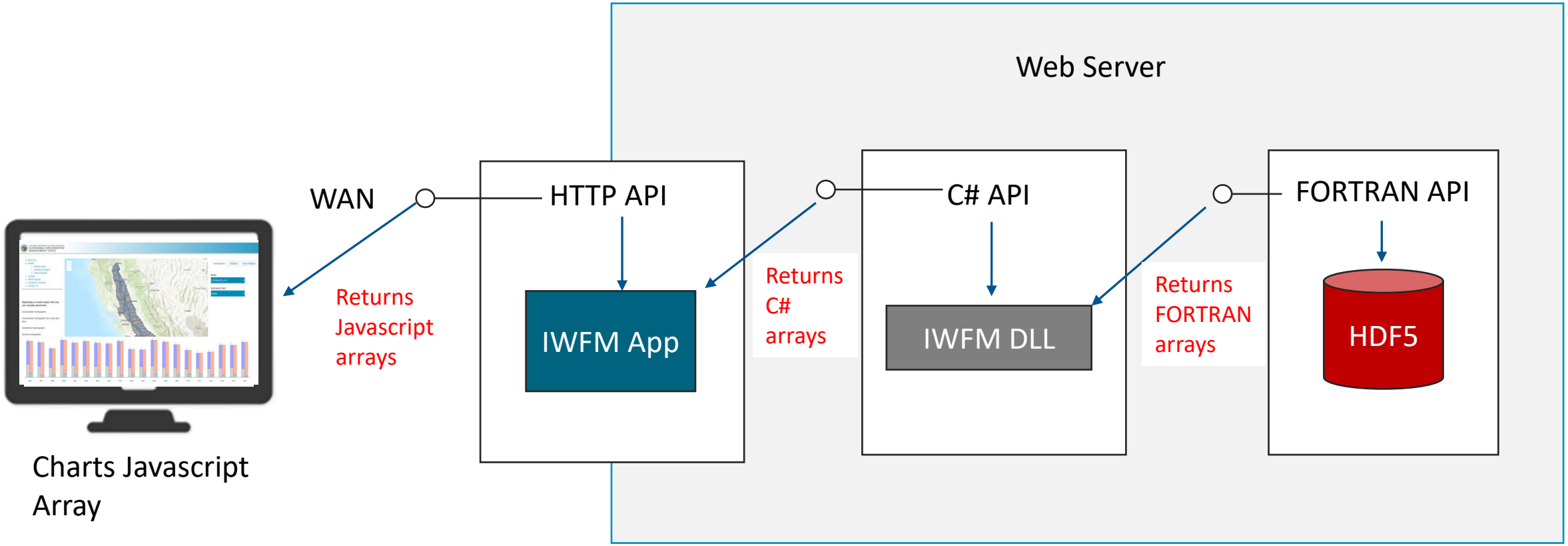
GIS Server

Get Budget Chart Back

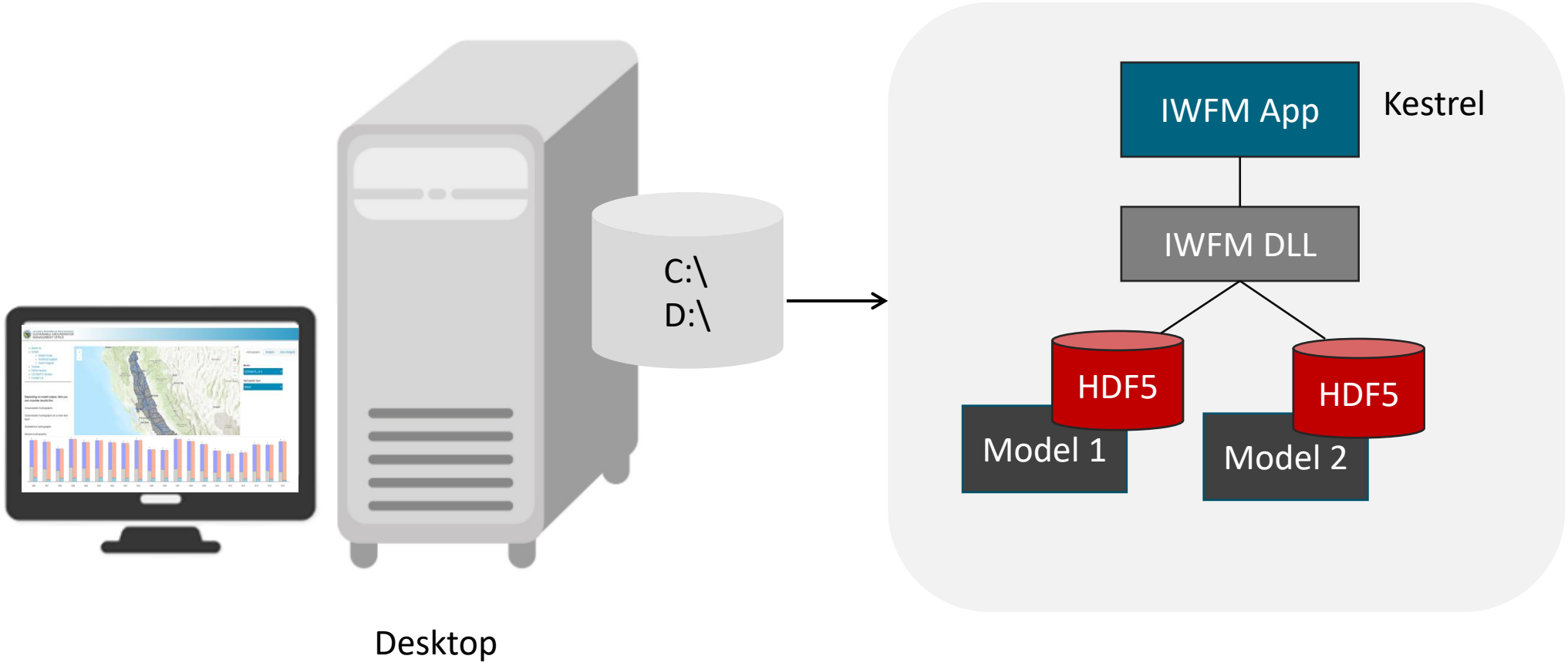
Web browser



Receiving Results



Running On The Desktop - .Net Core



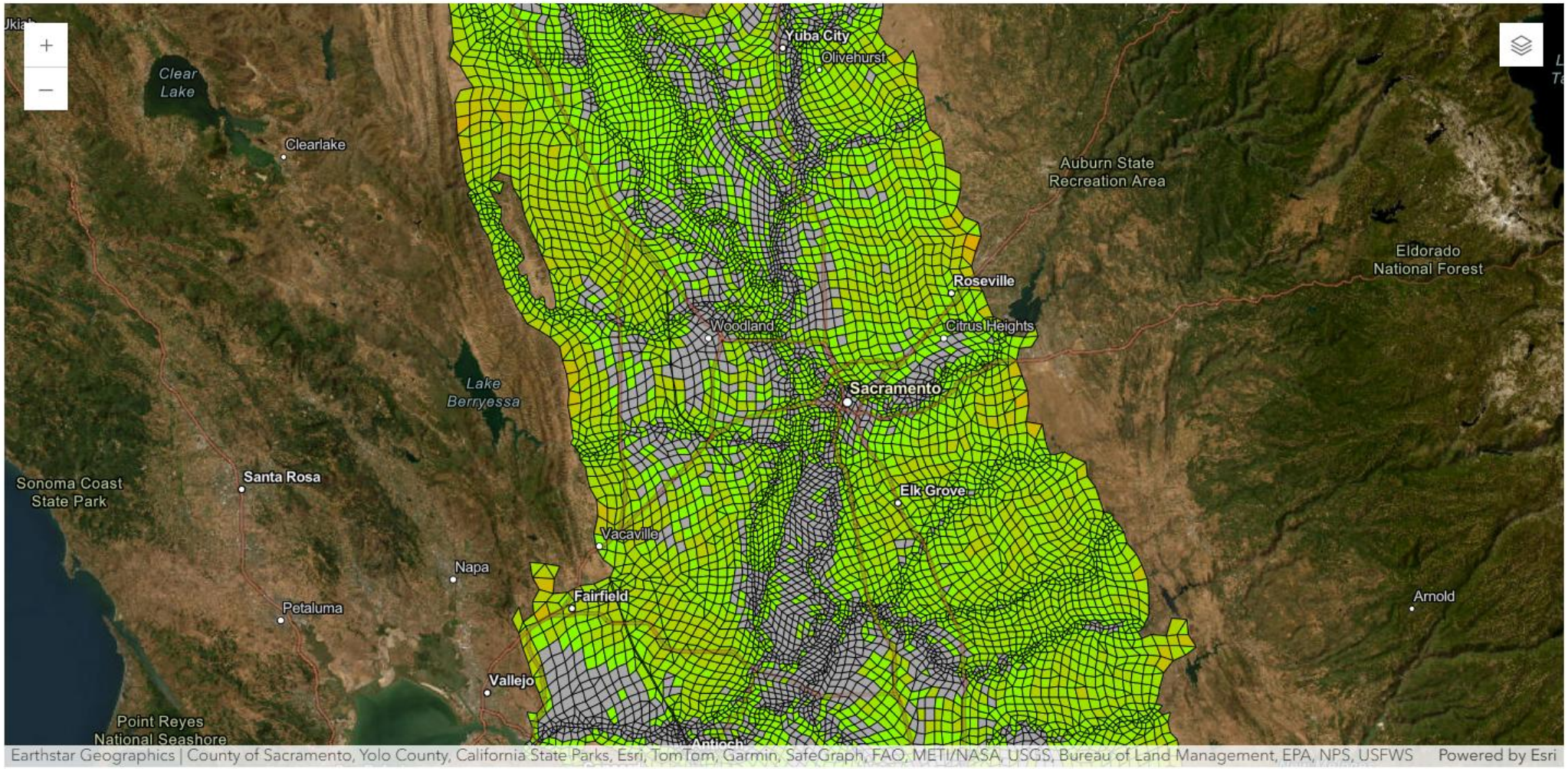
CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

Land Use Areas

Item assignment complete

Model:

C2VSimFG_v1.5_07302024



LU Type:

NVRV

LU:

Native vegetation

Date:

10/31/1973_24:00

Retrieve Data

Opacity:

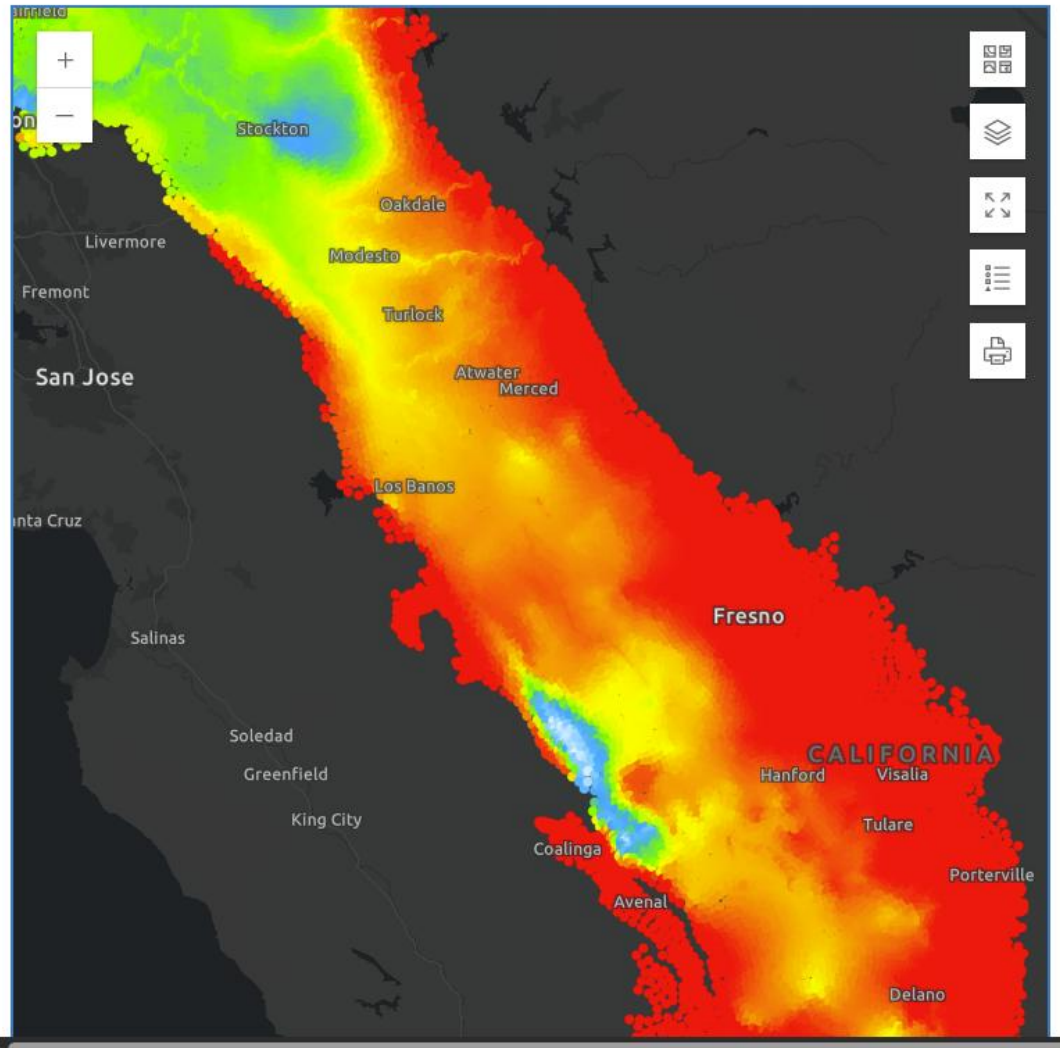
CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

Date: 10/31/1973_24:00

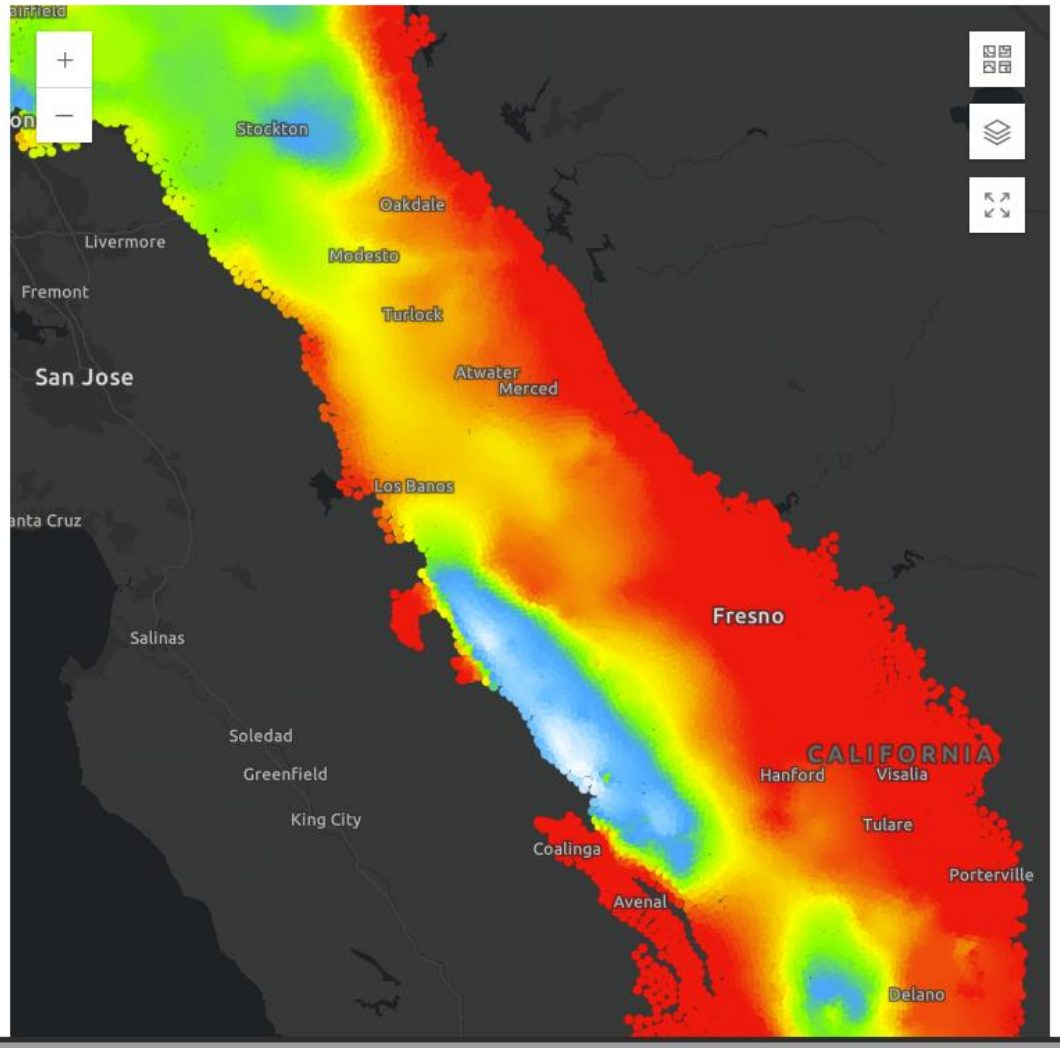
Head Differences Between Models

All features acquired

Model: C2VSimFG_v1.5_07302024 | Layer: Layer 1 | Update Map | Labels | Contours



Model: C2VSimFG_v1.5_07302024 | Layer: Layer 4 | Update Map | Labels | Contours



Compare Models

Base Contour: -180

Contour Interval: 20

Upper limit: 180

Regenerate Contours

Contour Color:

Line Weight: 1.5

CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

Date:
10/31/1973_24:00

Head Differences Between Models

All features acquired

Model:
C2VSimFG_v1.5_07302024

Layer:
Layer 1

Update Map

80

Labels
Contours

Model:
C2VSimFG_v1.5_07302024

Layer:
Layer 4

Update Map

100

Labels
Contours

Compare Models

Base Contour:
-180

Contour Interval:
20

Upper limit:
180

Regenerate Contours

Contour Color:

Line Weight:
1.5

Head Difference

Go Back

Positive
1295.20

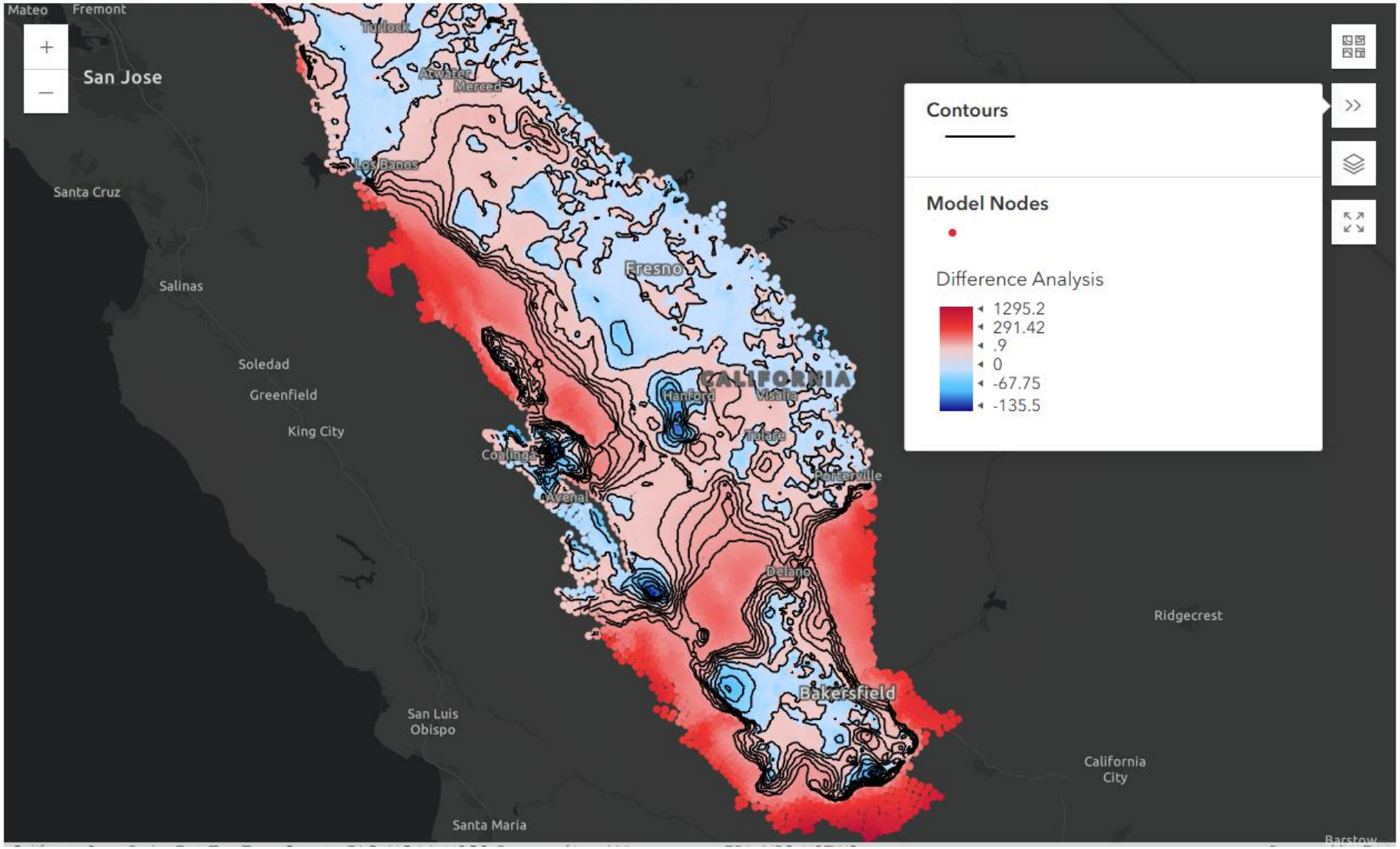
0
291.42

Negative
-135.50

0
-67.75

Size:

C2VSimFG_v1.5_07302024 | Layer 1 - C2VSimFG_v1.5_07302024 | Layer 4



- [ ] Labels
- [x] Contours
- [ ] Contour highlights

Base Contour:
-100

Contour Interval:
40

Upper limit:
100

Regenerate Contours

Contour Color:

Line Weight:
1

Next Steps

- Public Release version 1.0
  - Using the most updated C2VSimFG v1.5
  - Using the most updated IWFM DLL - 2025
  - Public release: Spring / Summer 2025
- Version 1.5
  - Incorporating model comparisons tools

Acknowledgements:

- Tom Heinzer
- Can Dogrul
- Lan Liang
- Guobiao Huang
- Craig Altare
- Uditha Bandara
- Tyler Hatch
- DWR/SGMO Reviewers

Thank You!
Questions?

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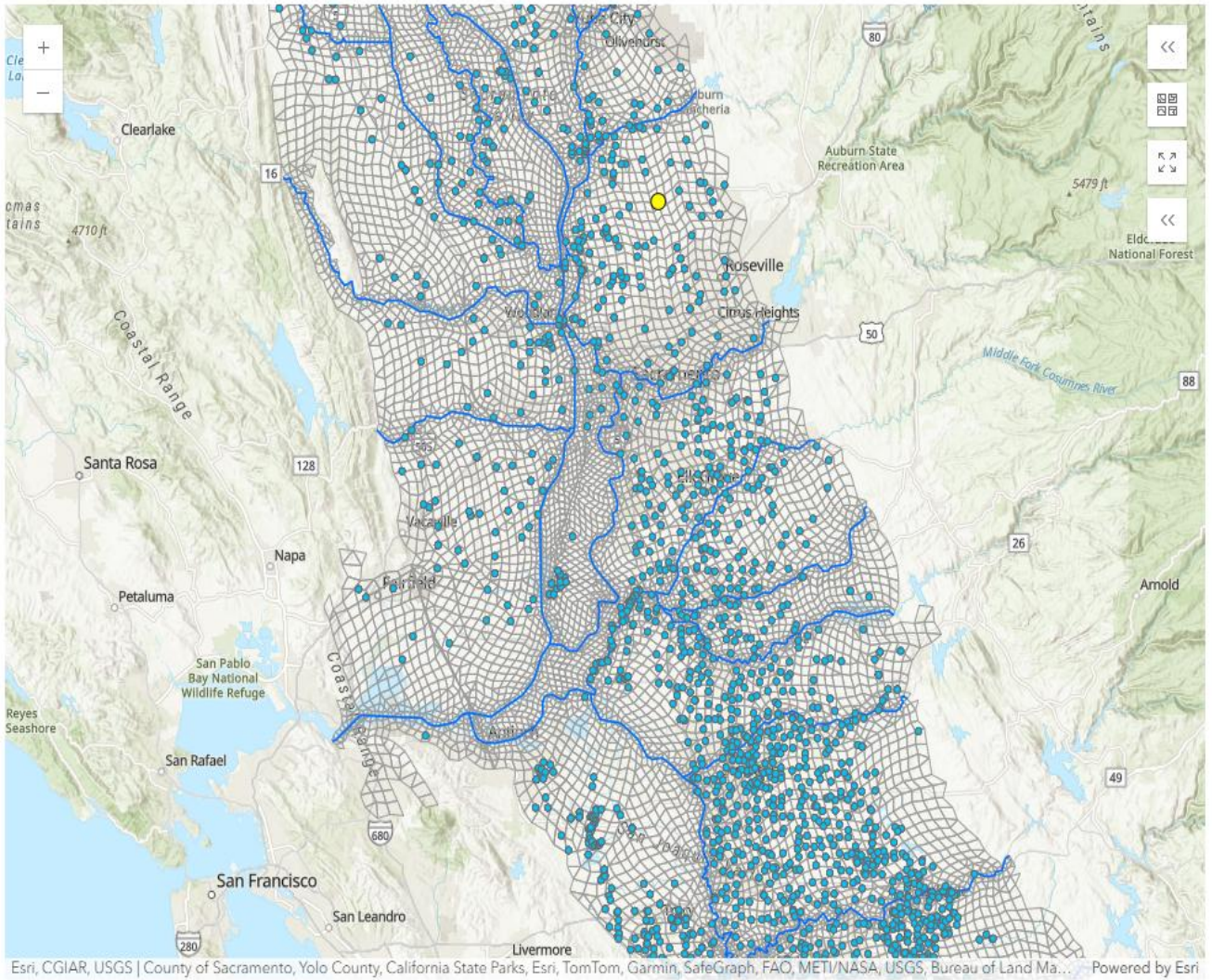
Simulated Groundwater Observation Well:

388674N1214243W001_Layer1
388674N1214243W001_Layer2
388674N1214243W001_Layer3
388674N1214243W001_Layer4



Hydrographs | Budgets | Zone Budgets

Model: C2VSimFG_v1.5

Hydrograph Type: Groundwater hydrograph

Layer: All

☐ Add observations

Retrieve Data

From Date: 10/31/1973_24:00

To Date: 09/30/2021_24:00

Length: Feet (FT)

Area: Acre (AC)

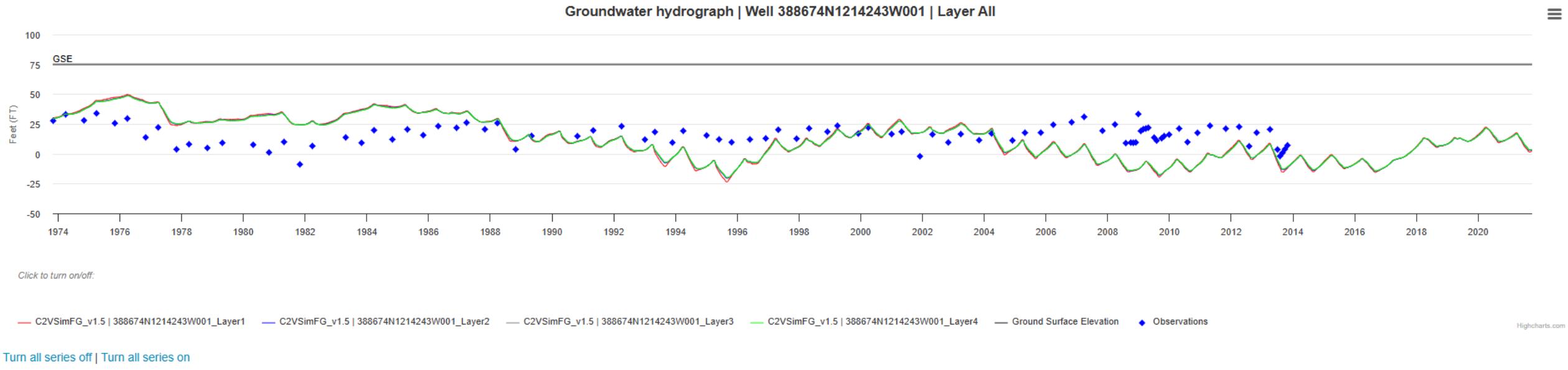
Volume: Acre-feet (AF)

Output interval: 1MON

Groundwater Hydrograph (version 1.5)

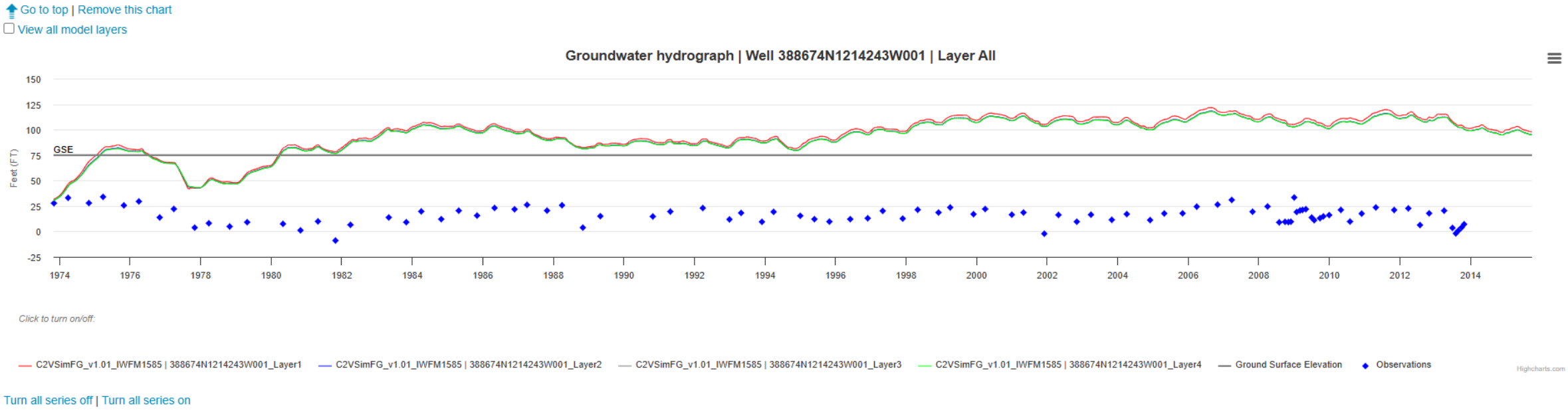
Go to top | Remove this chart

View all model layers



Turn all series off | Turn all series on

Groundwater Hydrograph (version 1.01)



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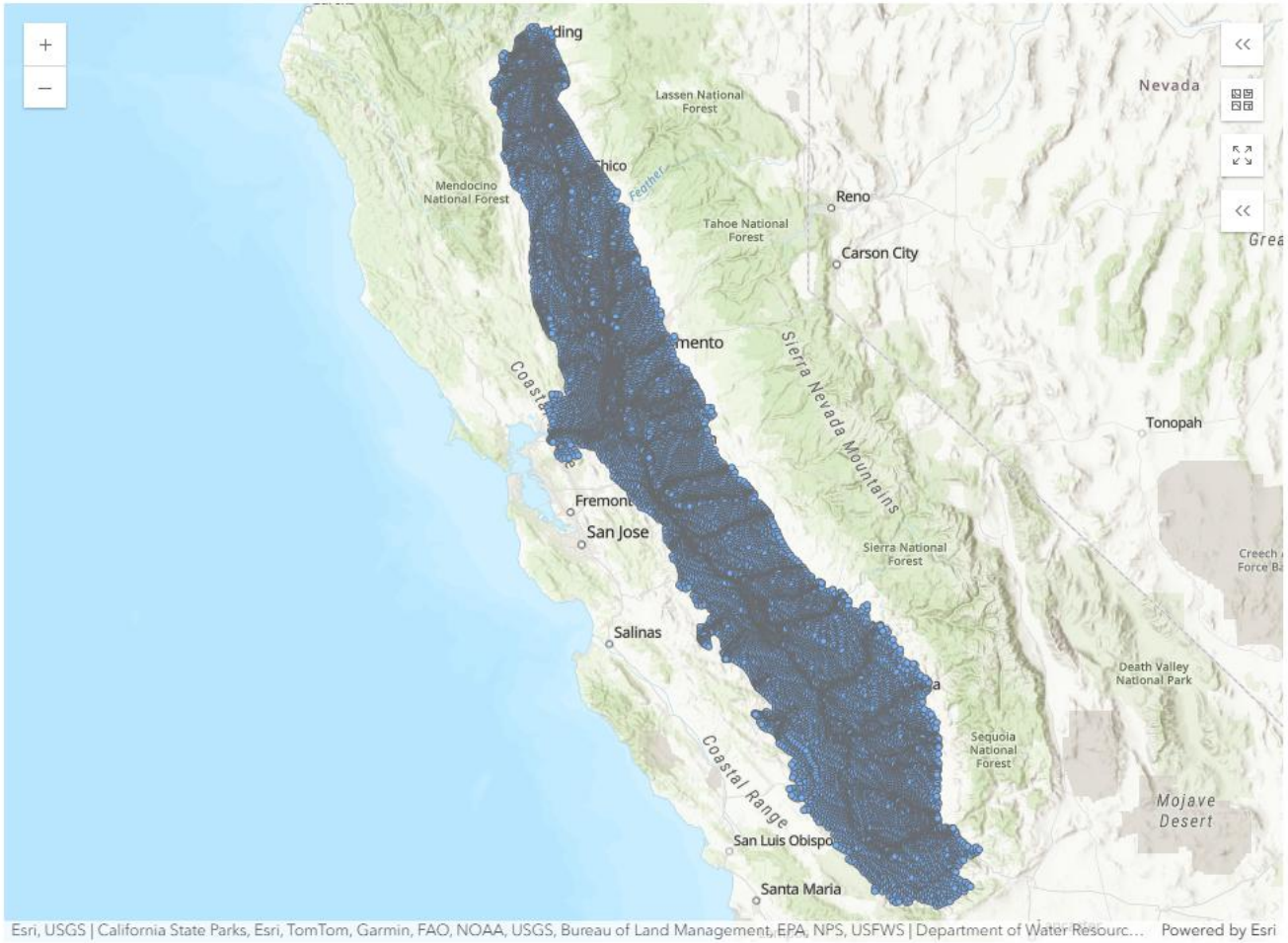

Hydrographs | Budgets | Zone Budgets | Comparisons

Model:

C2VSimFG_v1.5

Hydrograph Type:

Groundwater hydrograph at node

Select model node
Zoom-in to view labels

Remove all charts

Scale chart:

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  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
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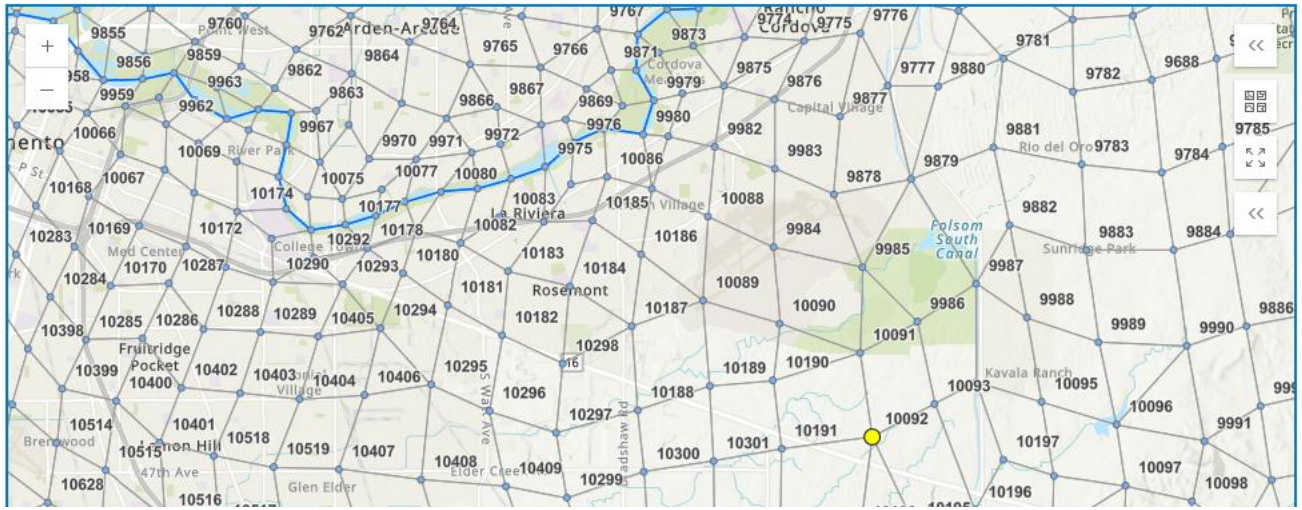
GW head node & layer
Node ID: 10092



Hydrographs | Budgets | Zone Budgets | Comparisons

Model: C2VSimFG_v1.5

From Date: 10/31/1973_24:00

Hydrograph Type: Groundwater hydrograph at node

To Date: 09/30/2021_24:00

Layer: Layer 1

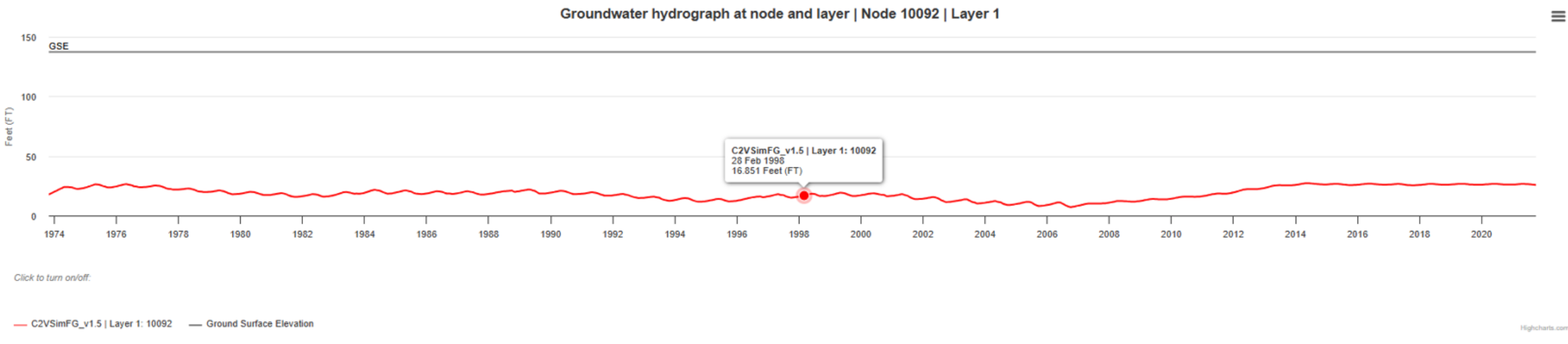
Length: Feet (FT)

Area: Acre (AC)

Volume: Acre-feet (AF)

Go to top | Remove this chart

View all model layers

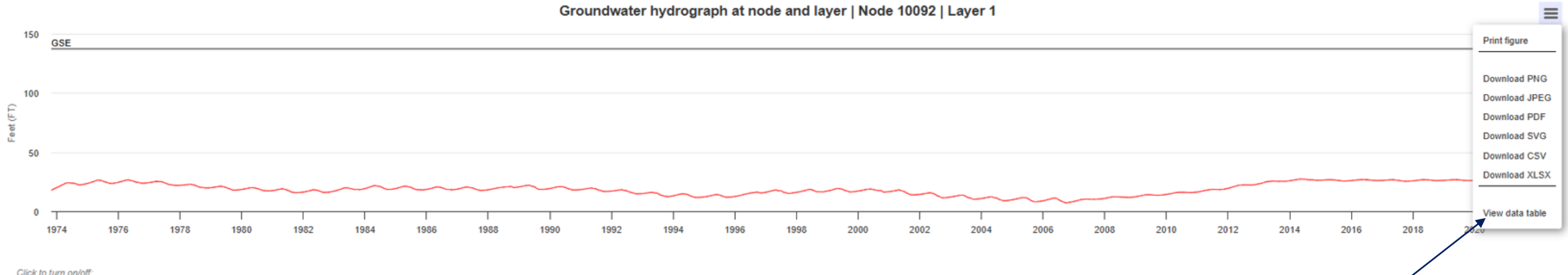


Turn all series off | Turn all series on

Print and Download Chart or View Data Table

Go to top | Remove this chart

View all model layers



Turn all series off | Turn all series on

Groundwater hydrograph at node and layer | Node 10092 | Layer 1		
DateTime	C2VSimFG_v1.5 | Layer 1: 10092	Ground Surface Elevation
1973-10-31 00:00:00	17.77	137.24999945580552
1973-11-30 00:00:00	18.81	137.24999945580552
1973-12-31 00:00:00	19.902	137.24999945580552
1974-01-31 00:00:00	20.975	137.24999945580552
1974-02-28 00:00:00	22.012	137.24999945580552
1974-03-31 00:00:00	23.022	137.24999945580552
1974-04-30 00:00:00	23.982	137.24999945580552
1974-05-31 00:00:00	24.057	137.24999945580552
1974-06-30 00:00:00	23.829	137.24999945580552
1974-07-31 00:00:00	23.602	137.24999945580552

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- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

GW head node & layer
Node ID: 10092

Hydrographs | Budgets | Zone Budgets | Comparisons

Model: C2VSimFG_v1.5

Hydrograph Type: Groundwater hydrograph at node

Layer: Layer 1

From Date: 10/31/1973_24:00

To Date: 09/30/2021_24:00

Length: Feet (FT)

Area: Acre (AC)

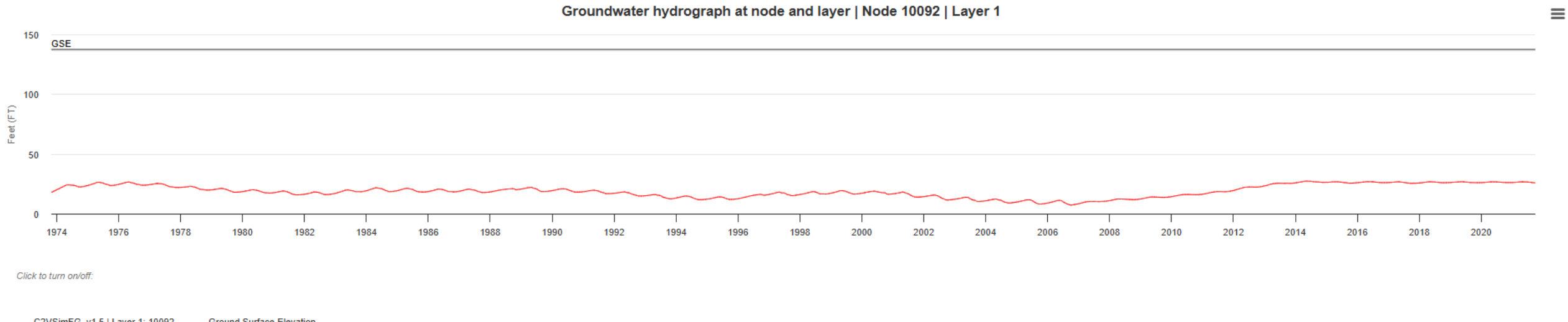
Volume: Acre-feet (AF)

Output interval: 1MON

Retrieve Data

Go to top | Remove this chart

View all model layers



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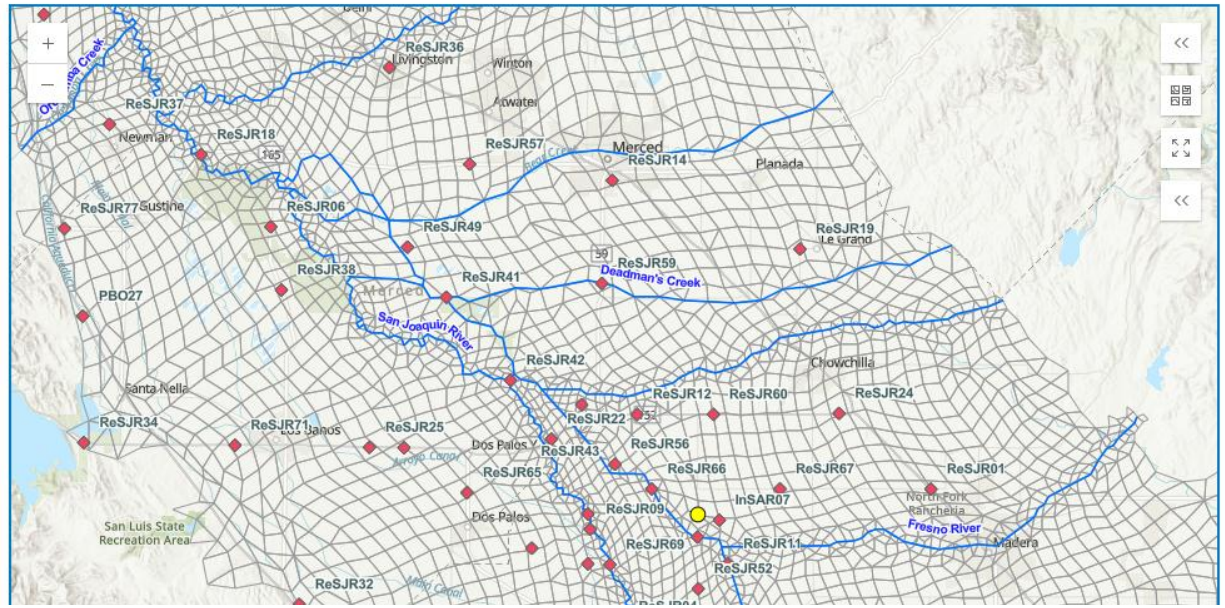
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

- About Us
- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us



Hydrographs | Budgets | Zone Budgets | Comparisons

Model: C2VSimFG_v1.5

Hydrograph Type: Subsidence hydrograph

Add to chart

Retrieve Data

From Date: 10/31/1973_24:00

To Date: 09/30/2021_24:00

Length: Feet (FT)

Area: Acre (AC)

Volume: Acre-feet (AF)

Output interval: 1MON

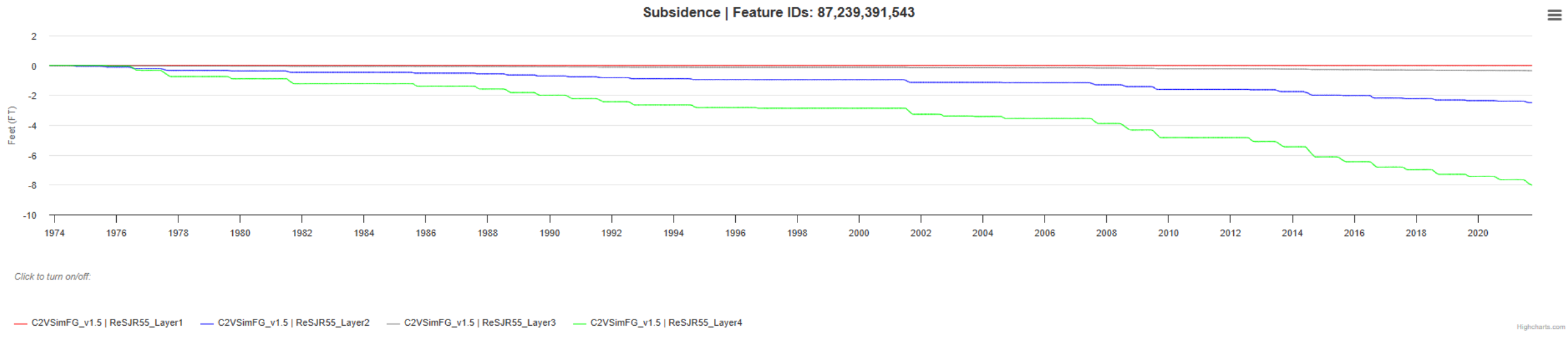
Name: ReSJR55_Layer1
Subsidence ID: 87

Name: ReSJR55_Layer2
Subsidence ID: 239

Name: ReSJR55_Layer3
Subsidence ID: 391

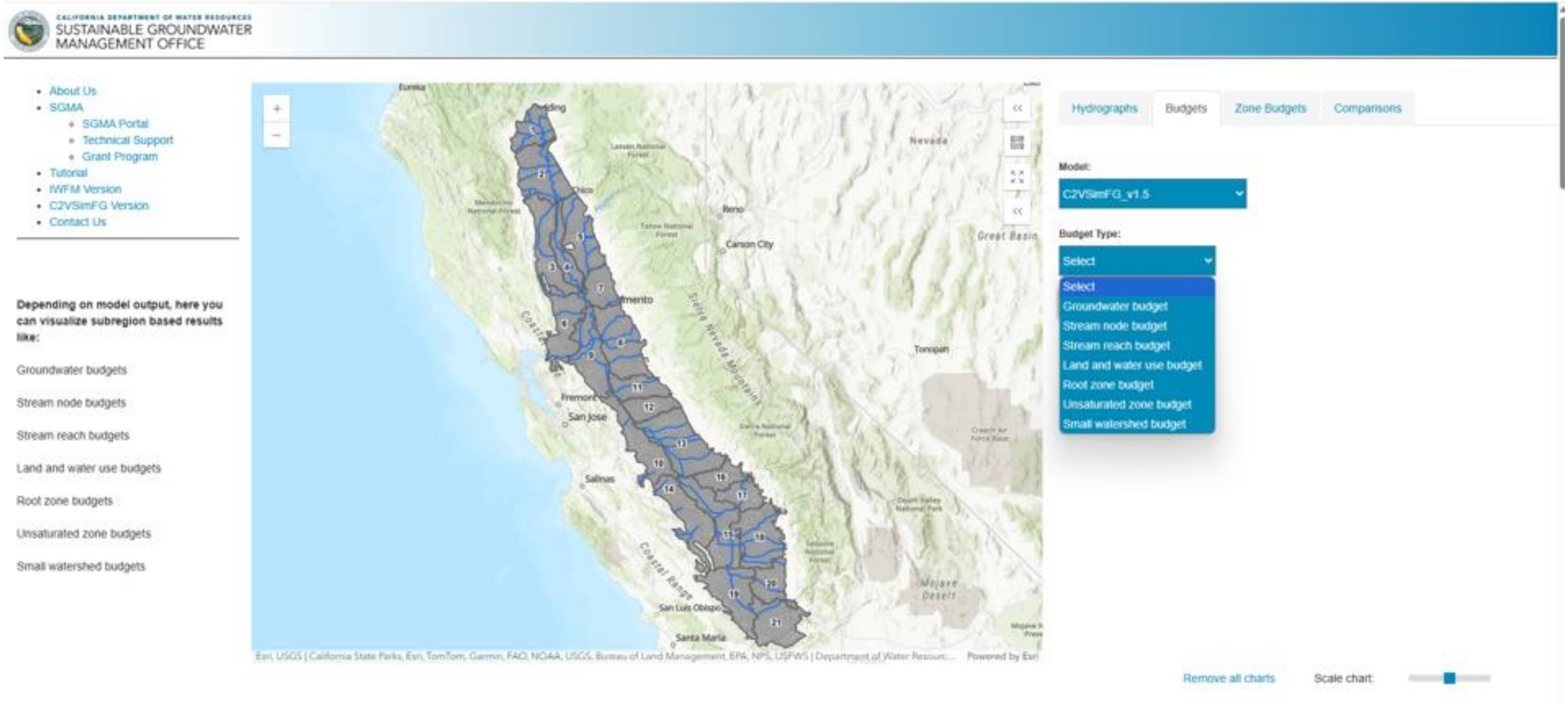
Name: ReSJR55_Layer4
Subsidence ID: 543

Go to top | Remove this chart



Turn all series off | Turn all series on

Budgets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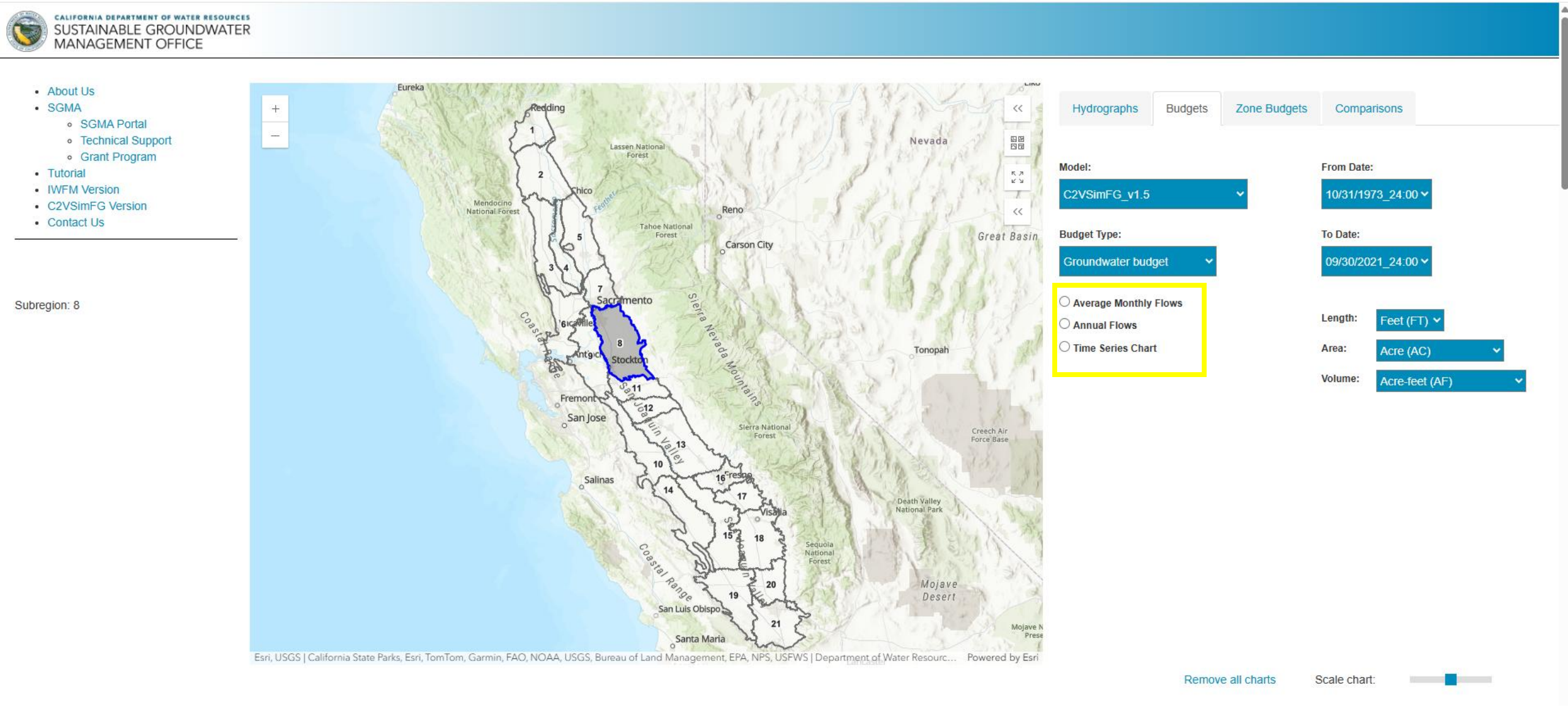
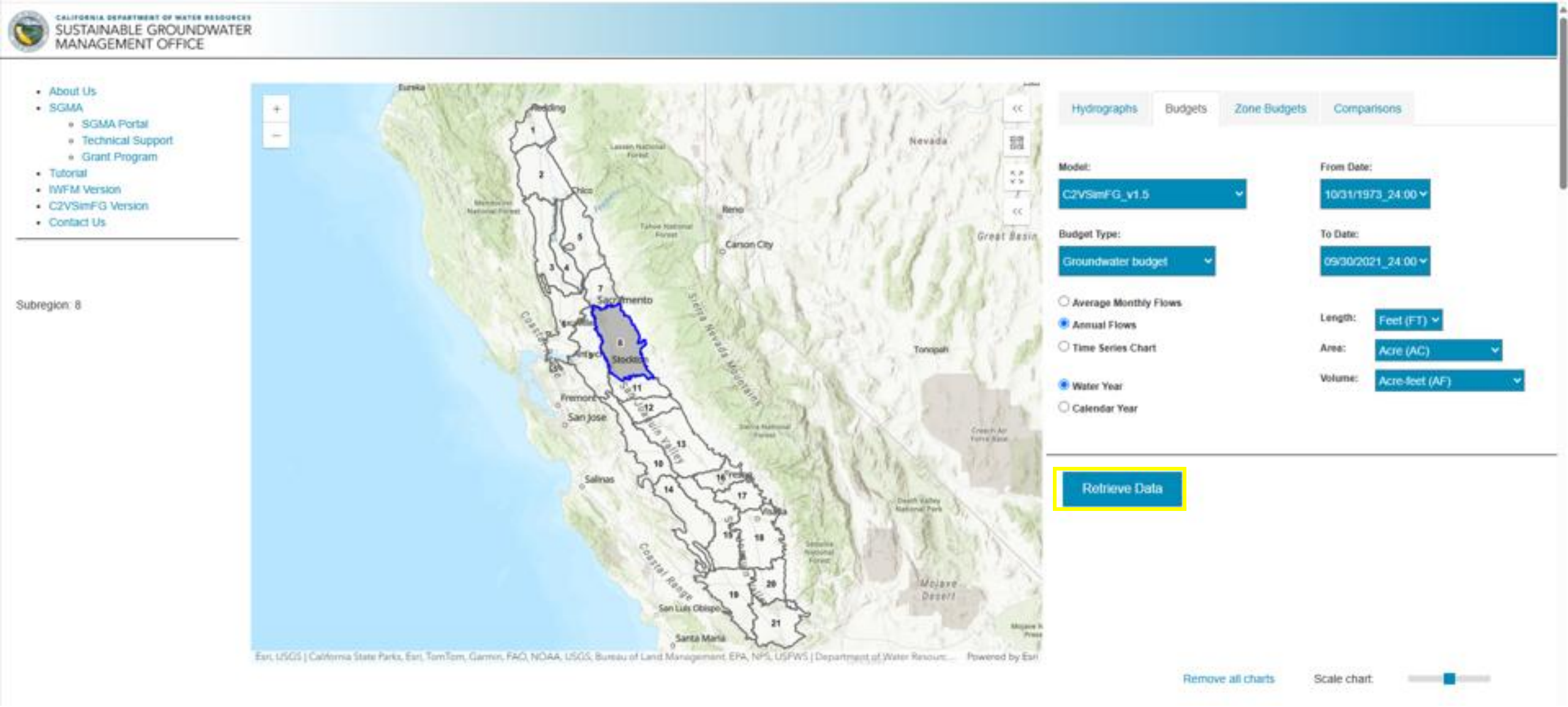
SGMA
SGMA Portal
Technical Support
Grant Program
Tutorial
IWFM Version
C2VSimFG Version
Contact Us
Depending on model output, here you can visualize subregion based results like:
Groundwater budgets
Stream node budgets
Stream reach budgets
Land and water use budgets
Root zone budgets
Unsaturated zone budgets
Small watershed budgets
Hydrographs
Budgets
Zone Budgets
Comparisons
Model:
C2VSimFG_v1.5
Budget Type:
Select
Select
Groundwater budget
Stream node budget
Stream reach budget
Land and water use budget
Root zone budget
Unsaturated zone budget
Small watershed budget
Remove all charts
Scale chart:
Eureka
Redding
Chico
Reno
Carson City
Nevada
Great Basin
Sacramento
Fremont
San Jose
Salinas
Tonopah
San Luis Obispo
Santa Maria
Coastal Range
Sierra Nevada Mountains
Mojave Desert
Esri, USGS | California State Parks, Esri, TomTom, Garmin, FAO, NOAA, USGS, Bureau of Land Management, EPA, NPS, USFWS | Department of Water Resour...
Powered by Esri

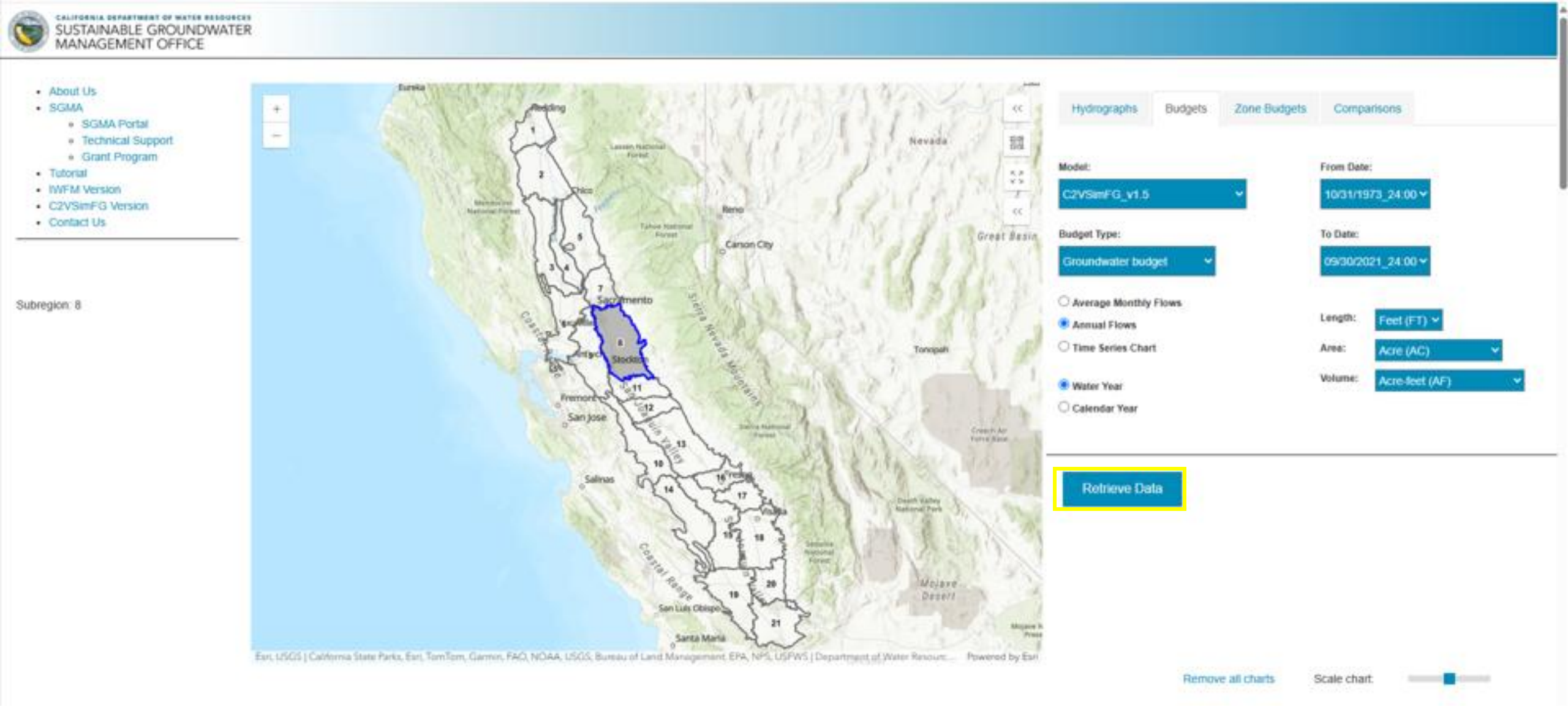
Groundwater Budgets



Groundwater Budgets

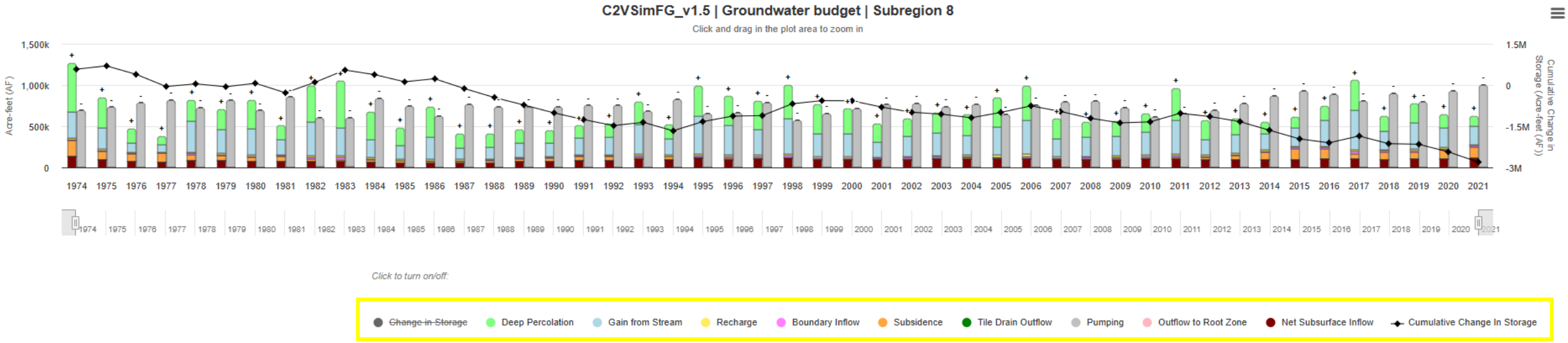


Groundwater Budgets



Groundwater Budgets

Go to top | Remove this chart



Turn all series off | Turn all series on

All zero: Gain from Lake, Subsurface Irrigation

Stream Budget

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SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

- About Us
- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

Stream node: 4202

Hydrographs | Budgets | Zone Budgets | Comparisons

Model:

C2VSimFG_v1.5

Budget Type:

Stream node budget

Select a stream node

Remove all charts

Scale chart:

Stream Budget

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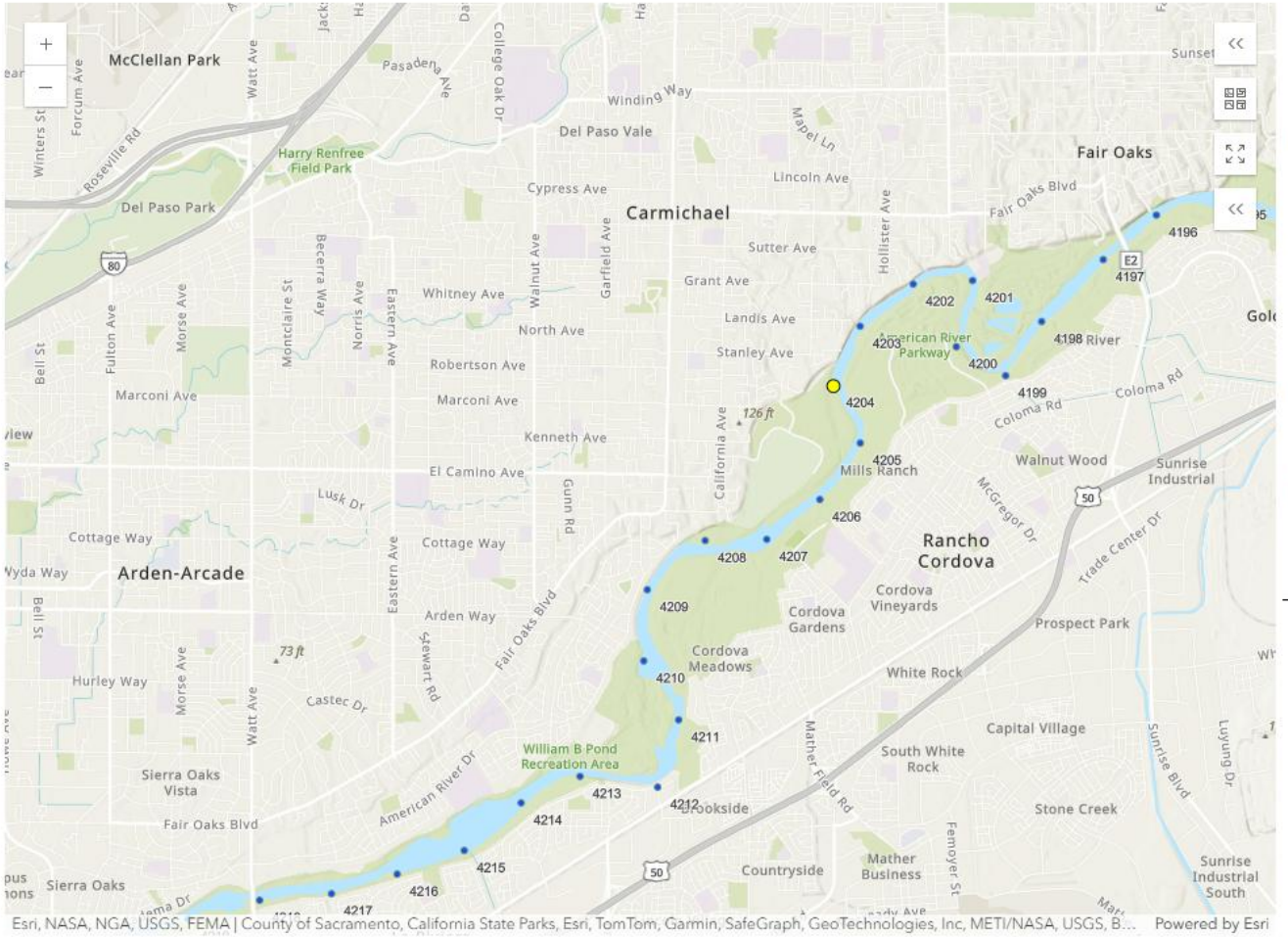
- About Us
- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

Stream node: 4204



Hydrographs | Budgets | Zone Budgets | Comparisons

Model: C2VSimFG_v1.5

Budget Type: Stream node budget

- Average Monthly Flows
- Annual Flows
- Time Series Chart

- Water Year
- Calendar Year

From Date: 10/31/1973_24:00

To Date: 09/30/2021_24:00

Length: Feet (FT)

Area: Acre (AC)

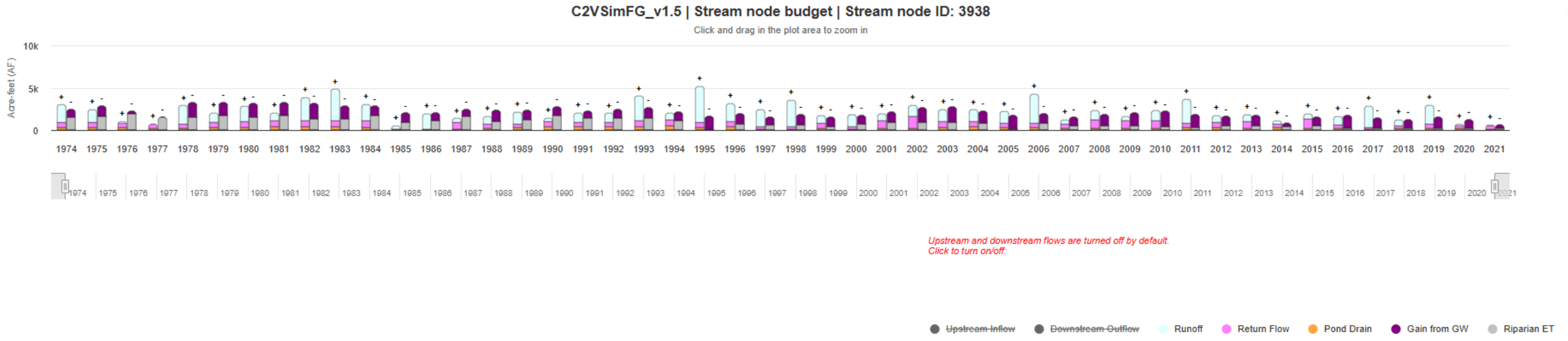
Volume: Acre-feet (AF)

Retrieve Data

Remove all charts Scale chart:

Stream Budget

Go to top | Remove this chart



Turn all series off | Turn all series on

All zero: Tributary Inflow, Tile Drain, Gain from Lake, Surface Evaporation, Diversion, Bypass Flow

Stream Reach Budget

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SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

- About Us
- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

Stream node: 3469

Hydrographs | Budgets | Zone Budgets | Comparisons

Model:

C2VSimFG_v1.5

Budget Type:

Stream reach budget

Select a stream reach

Remove all charts

Scale chart:

Stream Reach Budget

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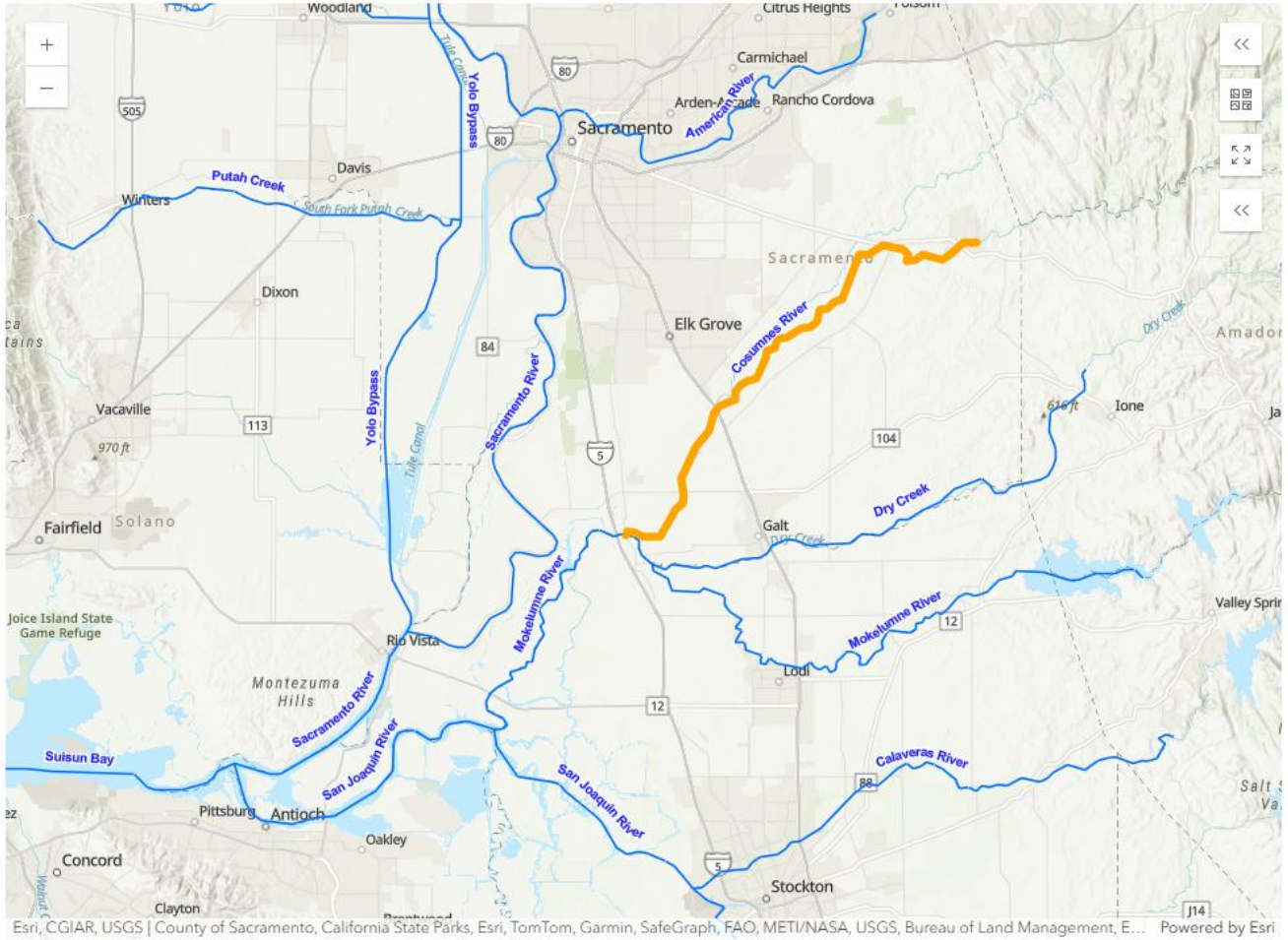
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

- About Us
- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

Stream reach: 51
Stream name: Cosumnes River



Hydrographs | Budgets | Zone Budgets | Comparisons

Model: C2VSimFG_v1.5

From Date: 10/31/1973_24:00

Budget Type: Stream reach budget

To Date: 09/30/2021_24:00

- ○ Average Monthly Flows
- ◉ Annual Flows
- ○ Time Series Chart

Length: Feet (FT)
Area: Acre (AC)
Volume: Acre-feet (AF)

- ◉ Water Year
- ○ Calendar Year

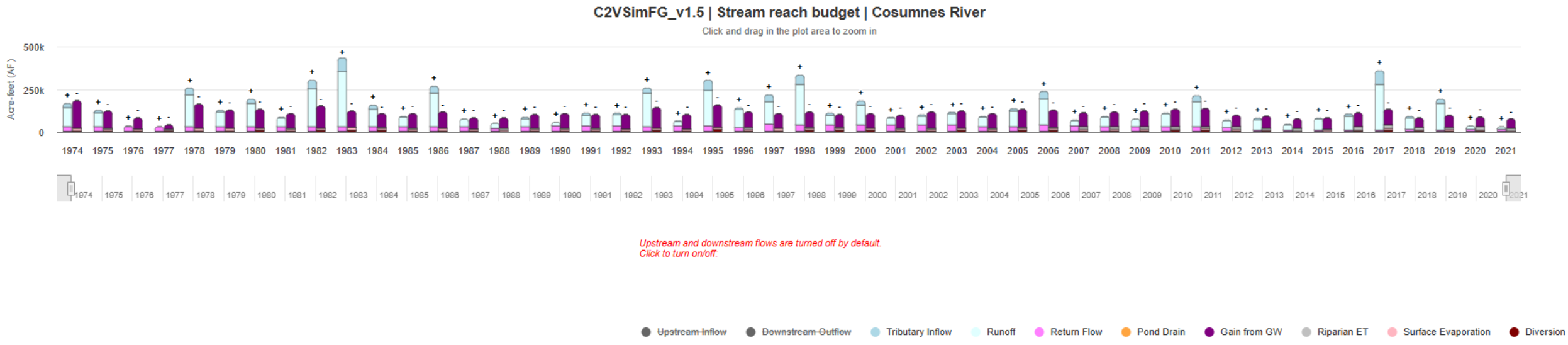
Retrieve Data

Remove all charts Scale chart:

Stream Reach Budget

- Upstream and downstream flows are turned off by default

Go to top | Remove this chart



Turn all series off | Turn all series on

All zero: Tile Drain, Gain from Lake, Bypass Flow

Land and Water Use Budget

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- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

Stream reach: 51
Stream name: Cosumnes River

Hydrographs | Budgets | Zone Budgets | Comparisons

Model: C2VSimFG_v1.5

Budget Type: Land and water use budget

Select a subregion

Remove all charts Scale chart:

Land and Water Use Budget

- About Us
- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

Hydrographs | Budgets | Zone Budgets | Comparisons

Model:

C2VSimFG_v1.5

Budget Type:

Land and water use budget

Select a subregion

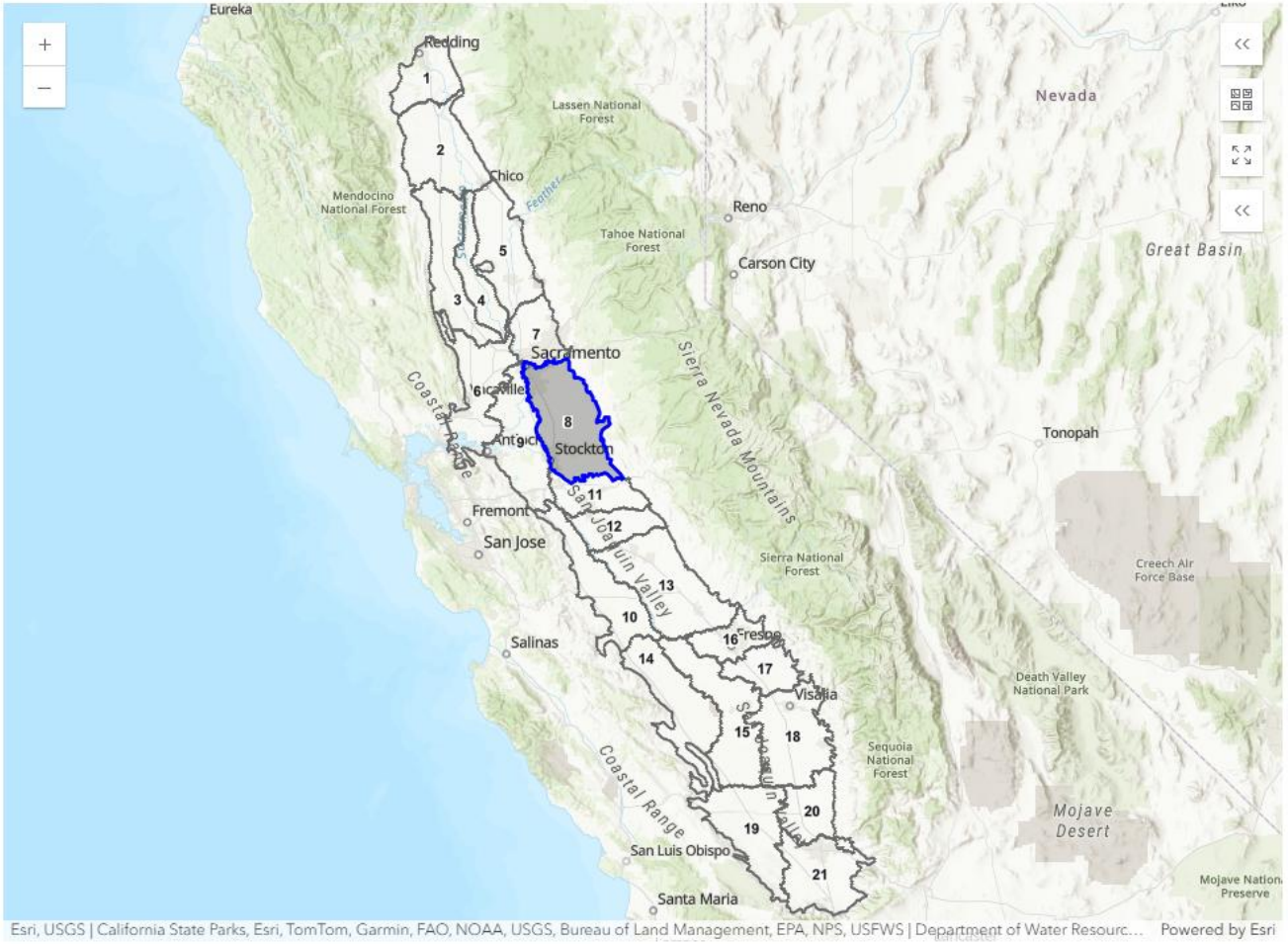
Remove all charts Scale chart:

Land and Water Use Budget

CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

- About Us
- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

Subregion: 8



Hydrographs | Budgets | Zone Budgets | Comparisons

Model: C2VSimFG_v1.5

From Date: 10/31/1973_24:00

Budget Type: Land and water use budget

To Date: 09/30/2021_24:00

- (○) Average Monthly Flows
- (●) Annual Flows
- (○) Time Series Chart

Length: Feet (FT)
Area: Acre (AC)
Volume: Acre-feet (AF)

- (●) Water Year
- (○) Calendar Year

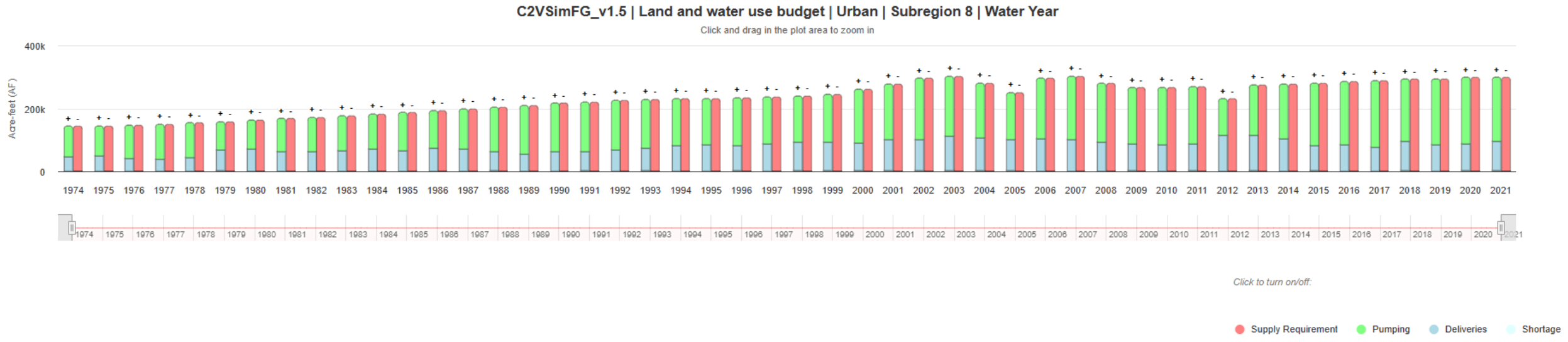
Land Use Type: Urban

Retrieve Data

Remove all charts Scale chart:

Land and Water Use Budget

Go to top | Remove this chart

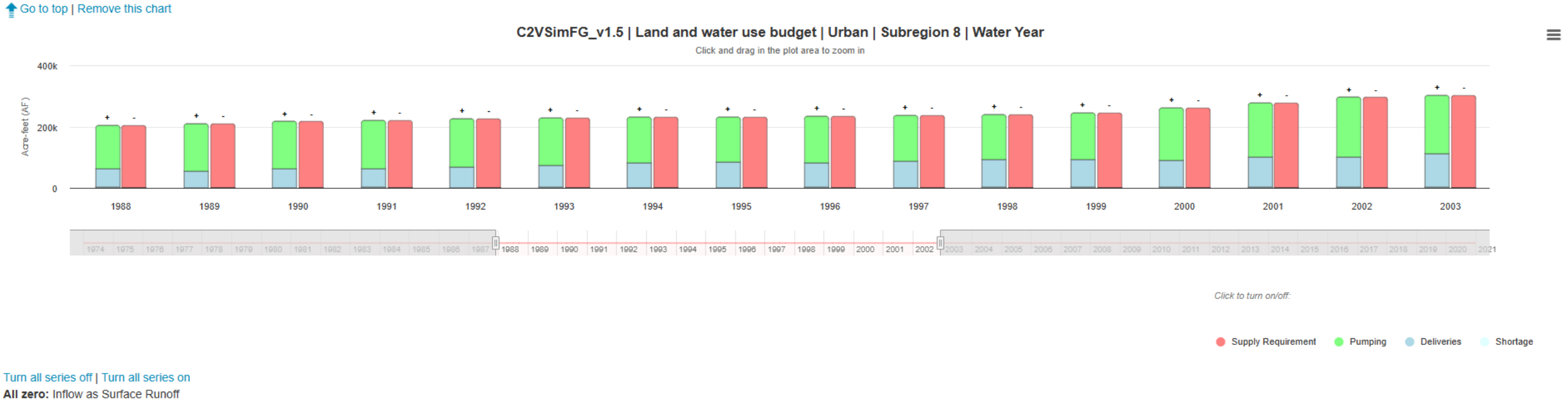


Turn all series off | Turn all series on

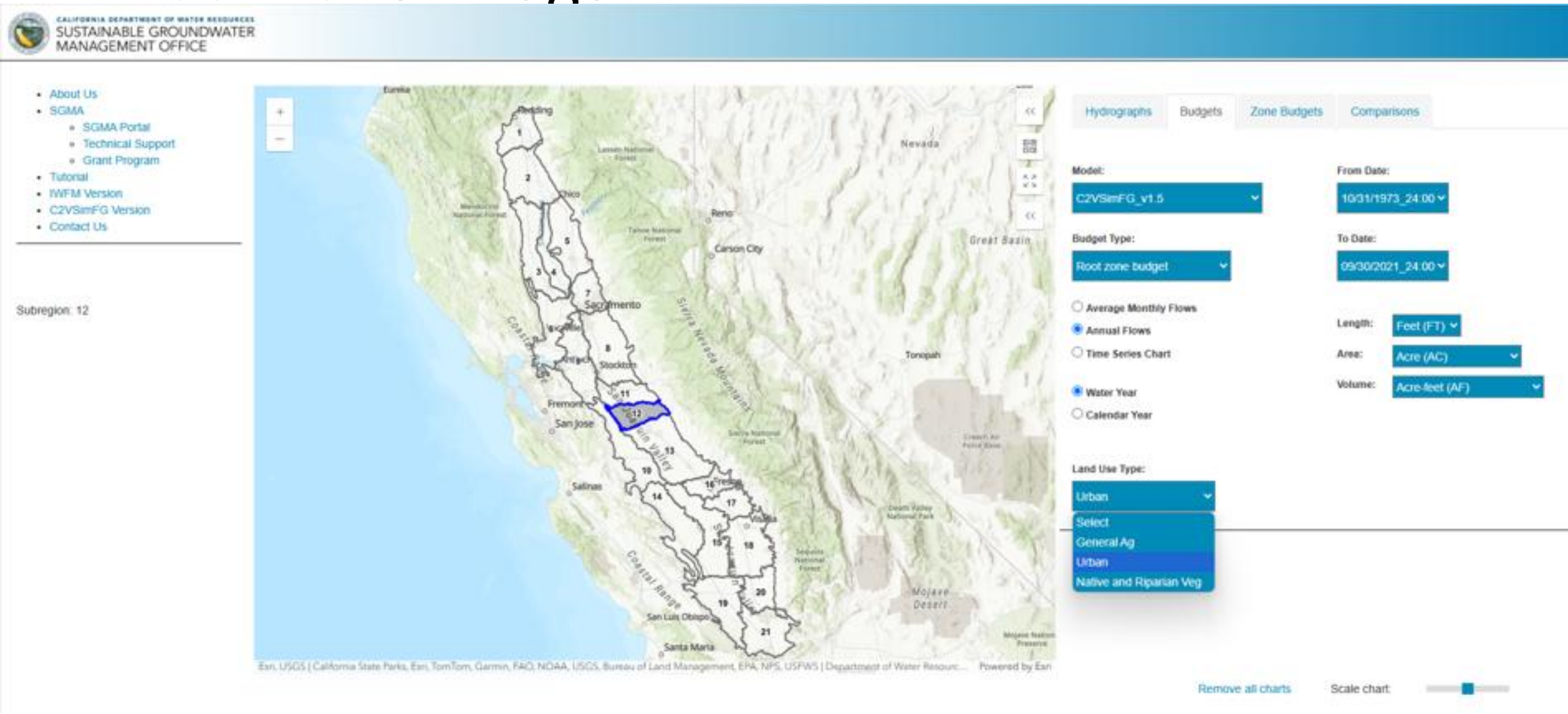
All zero: Inflow as Surface Runoff

Land and Water Use Budget

- Zoom into the chart

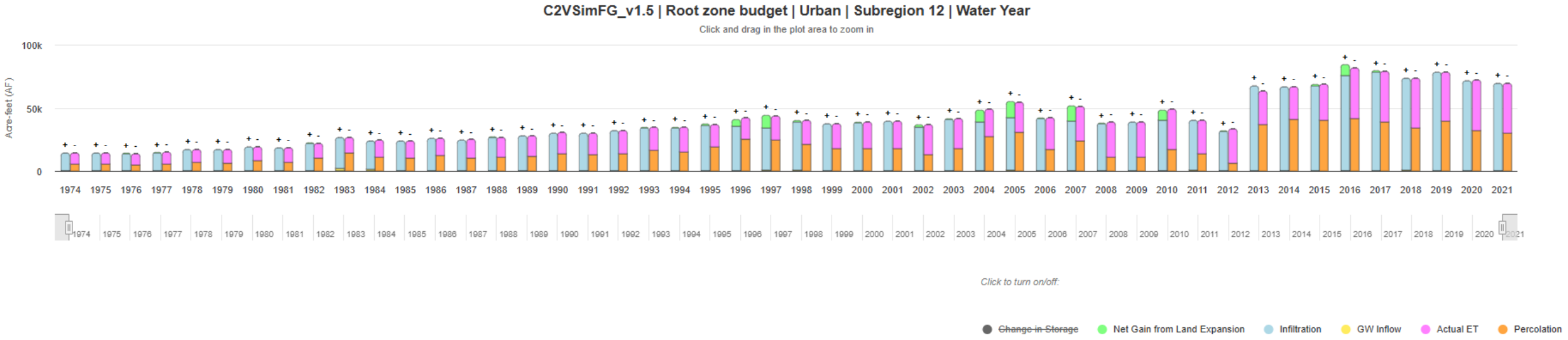


Root Zone Budget



Root Zone Budget

Go to top | Remove this chart



Turn all series off | Turn all series on

All zero: Other Inflow

Unsaturated Zone Budget

CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

- About Us
- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

Subregion: 11

Hydrographs | Budgets | Zone Budgets | Comparisons

Model: C2VSimFG_v1.5

From Date: 10/31/1973_24:00

Budget Type: Unsaturated zone budget

To Date: 09/30/2021_24:00

- (○) Average Monthly Flows
- (●) Annual Flows
- (○) Time Series Chart

Length: Feet (FT)

Area: Acre (AC)

Volume: Acre-feet (AF)

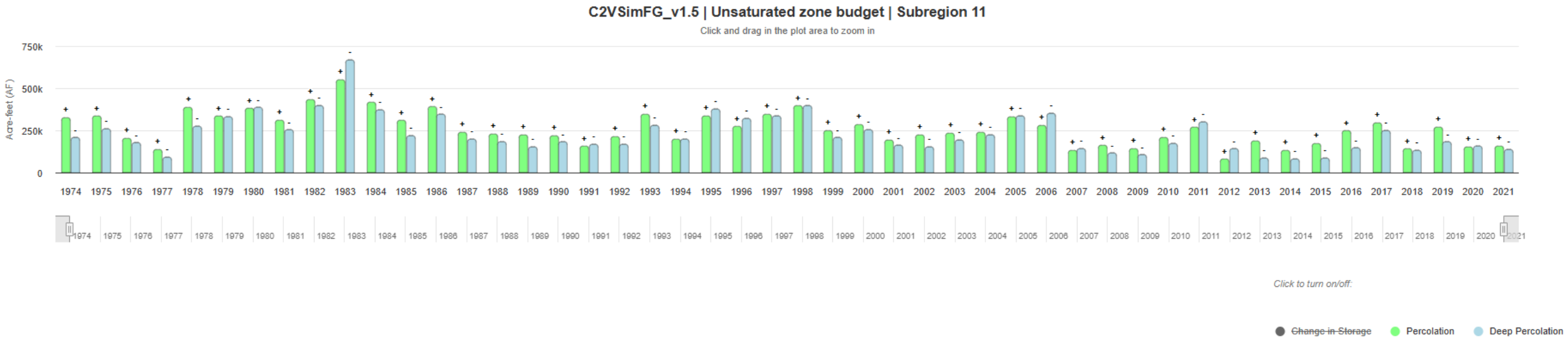
- (●) Water Year
- (○) Calendar Year

Retrieve Data

Remove all charts Scale chart:

Unsaturated Zone Budget

Go to top | Remove this chart



Turn all series off | Turn all series on

All zero:

Small Water Budget

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SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

- About Us
- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

Hydrographs | Budgets | Zone Budgets | Comparisons

Model:

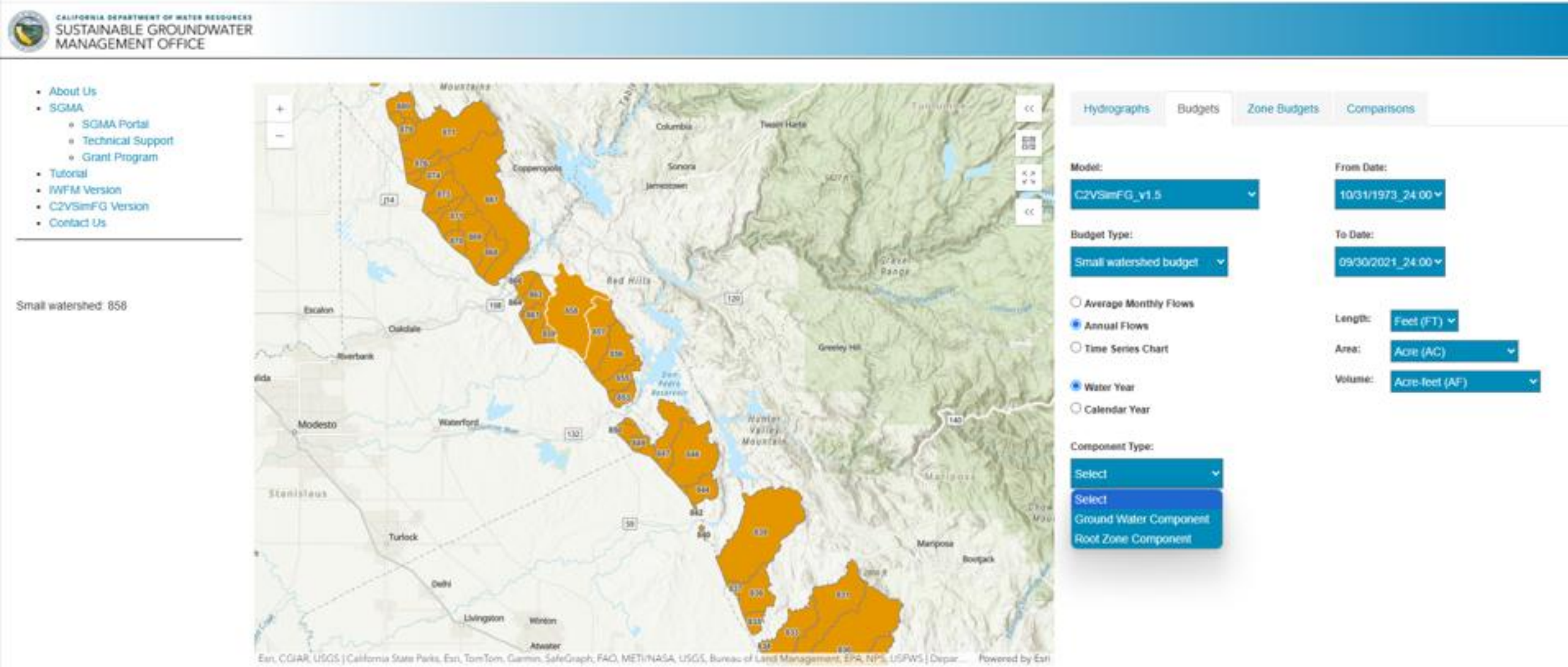
C2VSimFG_v1.5

Budget Type:

Small watershed budget

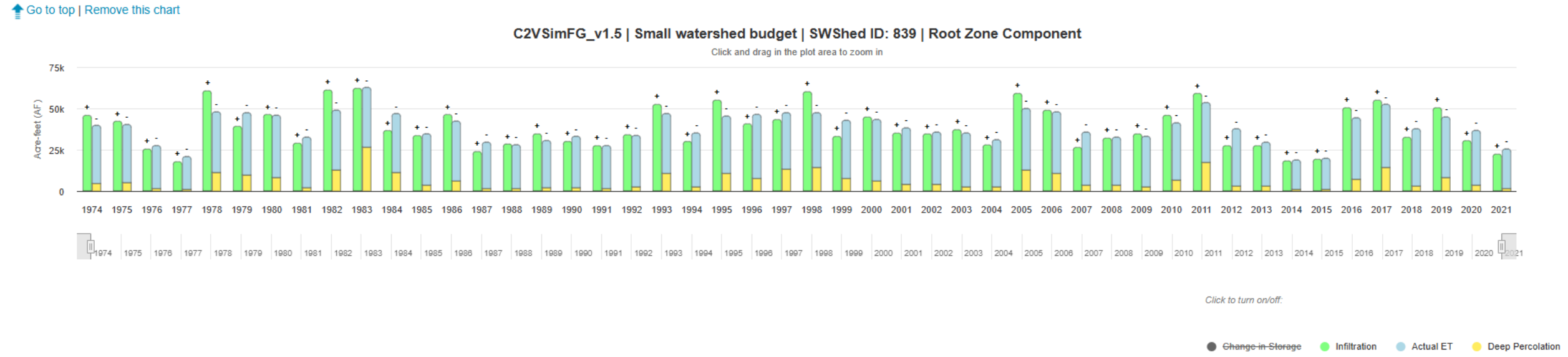
Select a watershed

Small Water Budget



Small Water Budget

- Groundwater Component
- Root Zone Component



Zonal Budget

CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

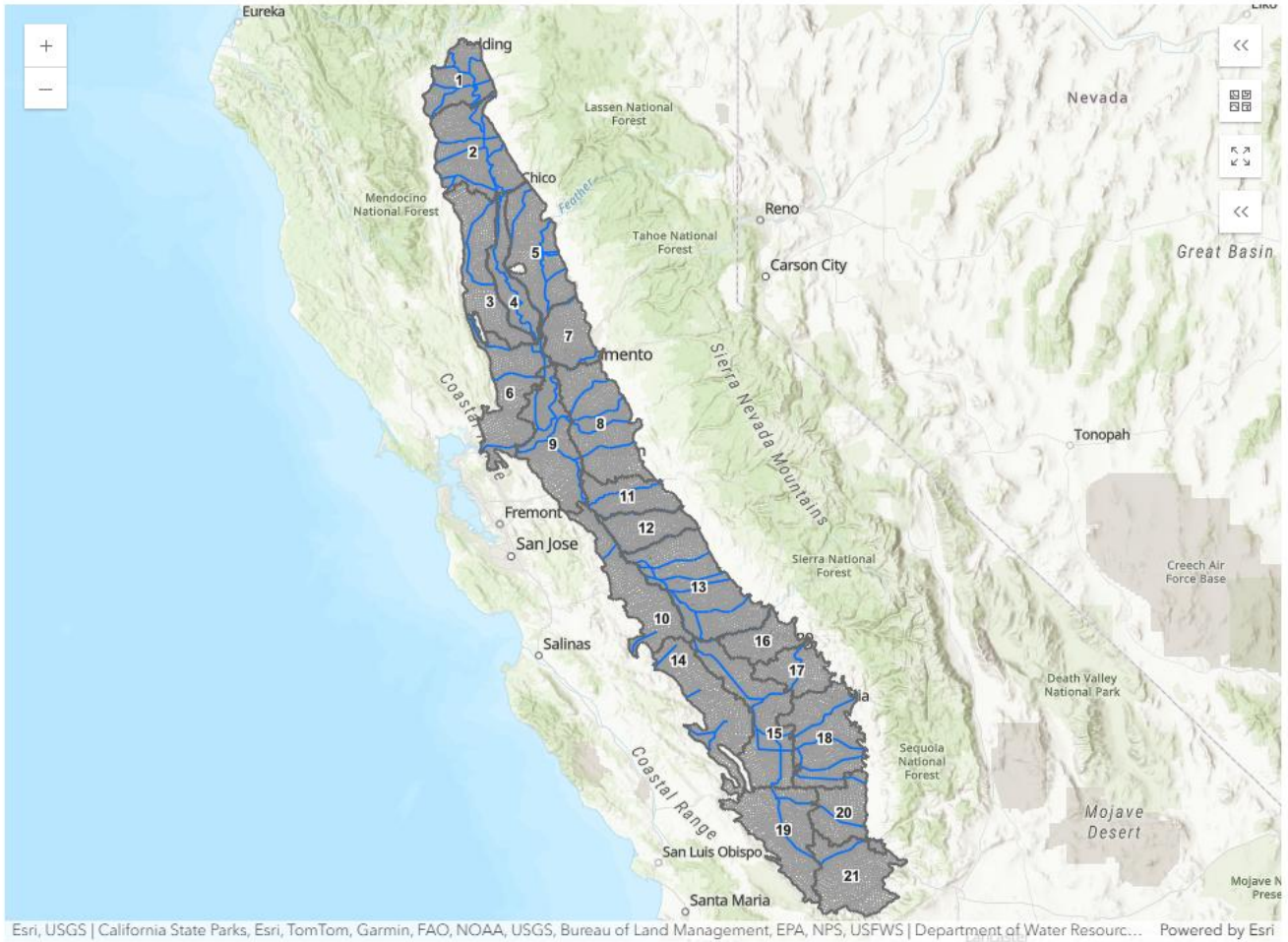
- About Us
- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

Here you can upload and view a zone budget for a custom zone.

Start by uploading your zone(s)

The upload file must be a valid shape file that is zipped

Please use the following projection: NAD 1983 UTM Zone 10N



Hydrographs | Budgets | Zone Budgets | Comparisons

Please upload a zipped GIS shapefile that represents your custom zones.

The shapefile must have an integer field that identifies your zone(s), less than 2Mb, and be in UTM Zone 10.

Choose File No file chosen

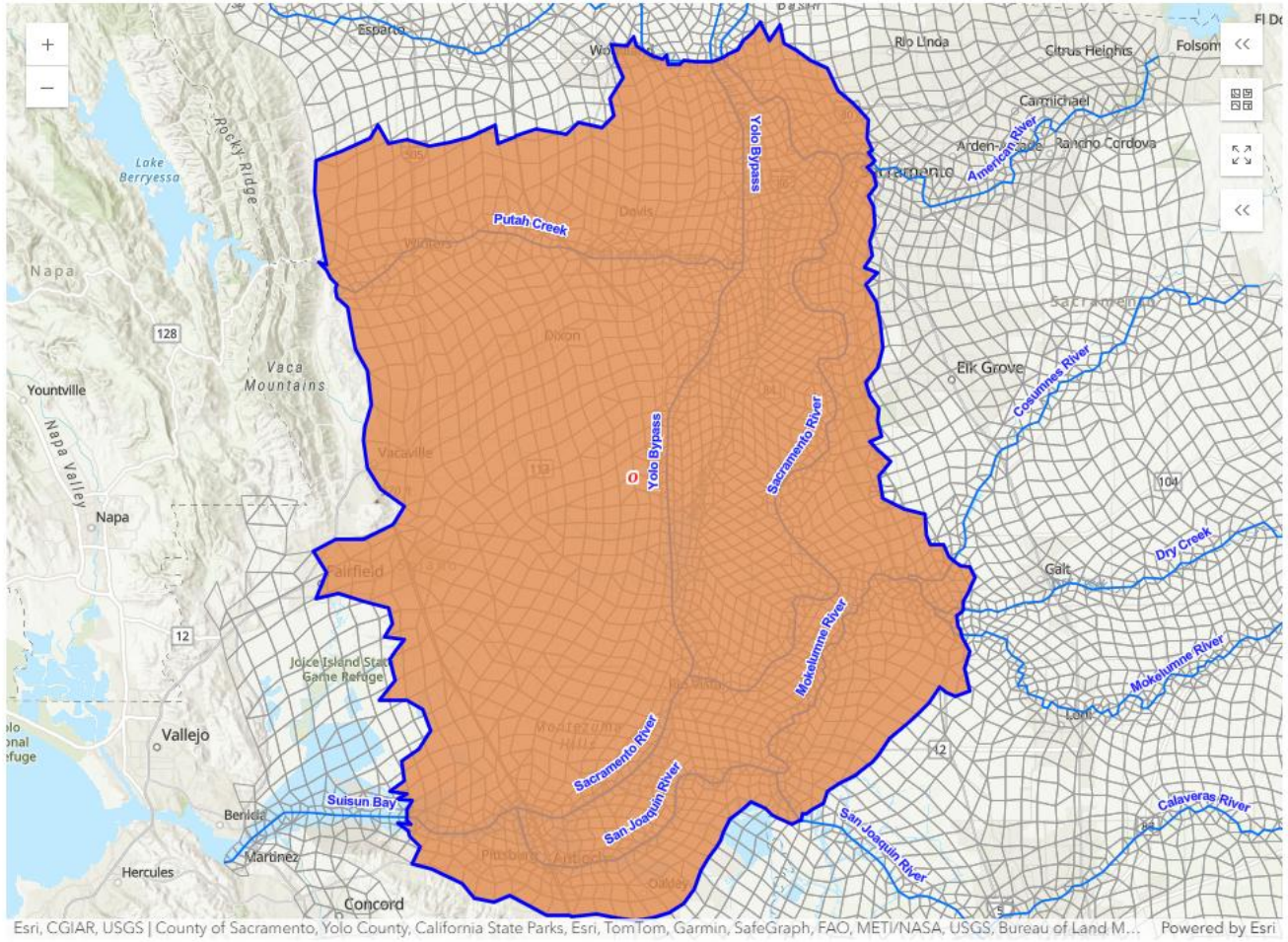
Remove all charts Scale chart:

Zonal Budget

CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

- About Us
- SGMA
  - SGMA Portal
  - Technical Support
  - Grant Program
- Tutorial
- IWFM Version
- C2VSimFG Version
- Contact Us

Zone: 0



Hydrographs | Budgets | Zone Budgets | Comparisons

Zone Field (must be integer):

FID

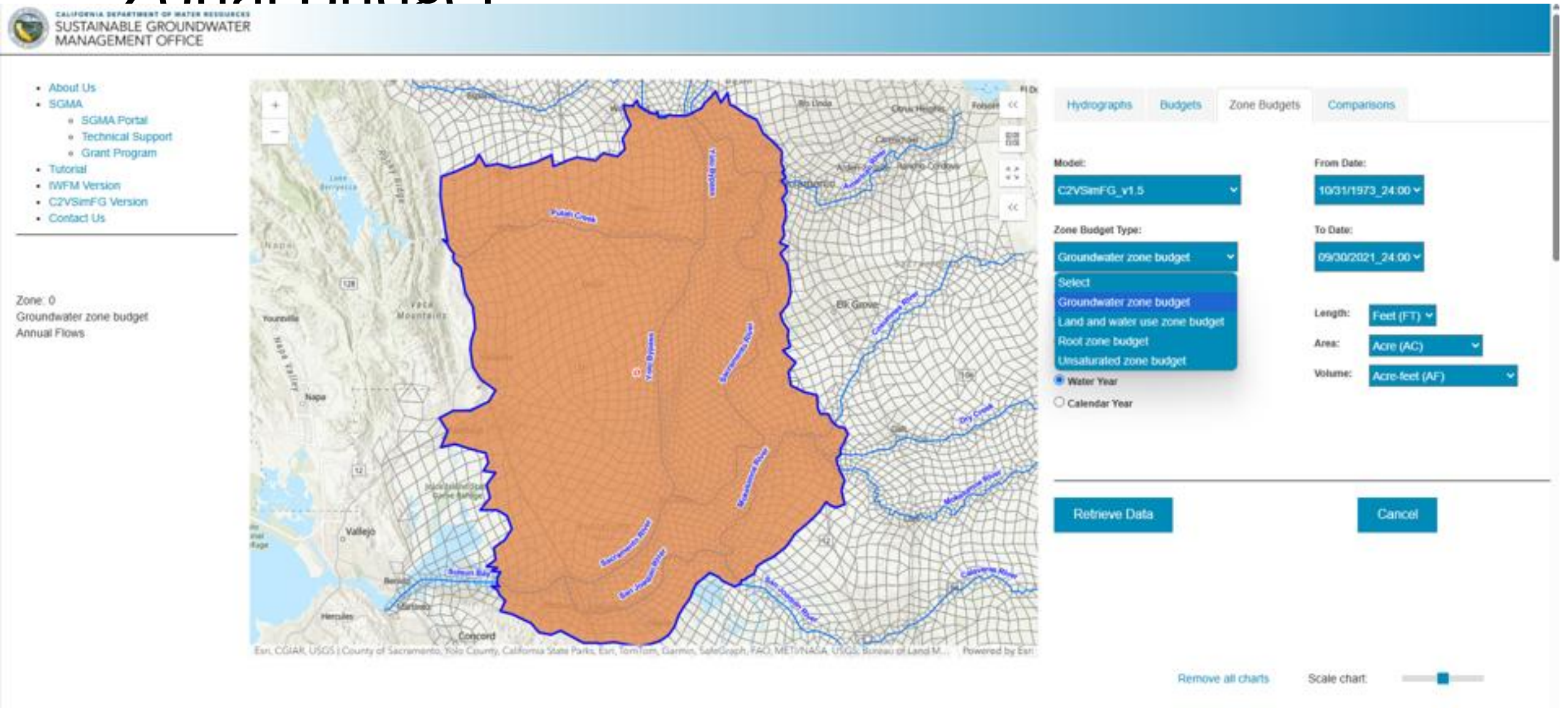
Continue

Reset

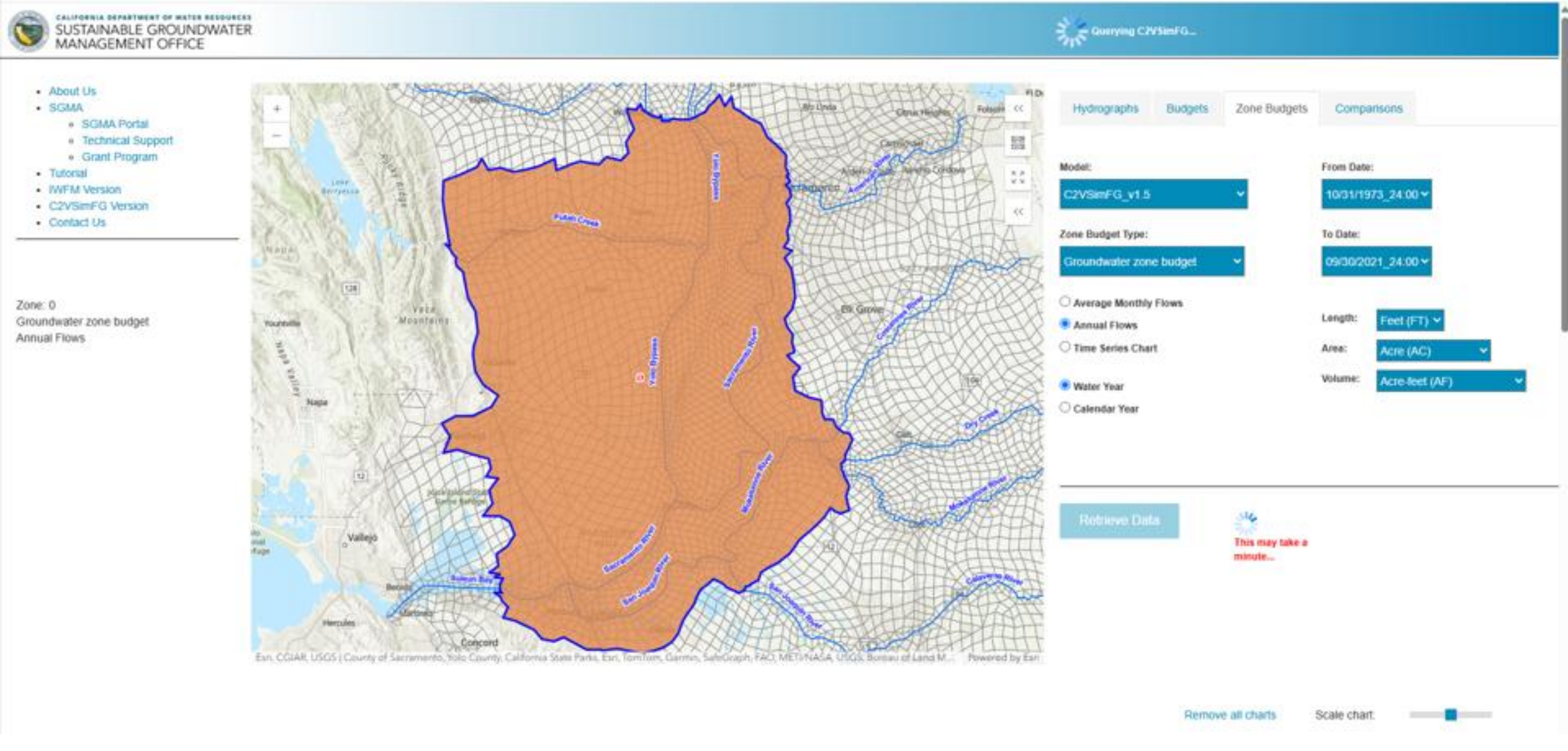
Remove all charts

Scale chart:

Zonal Budget

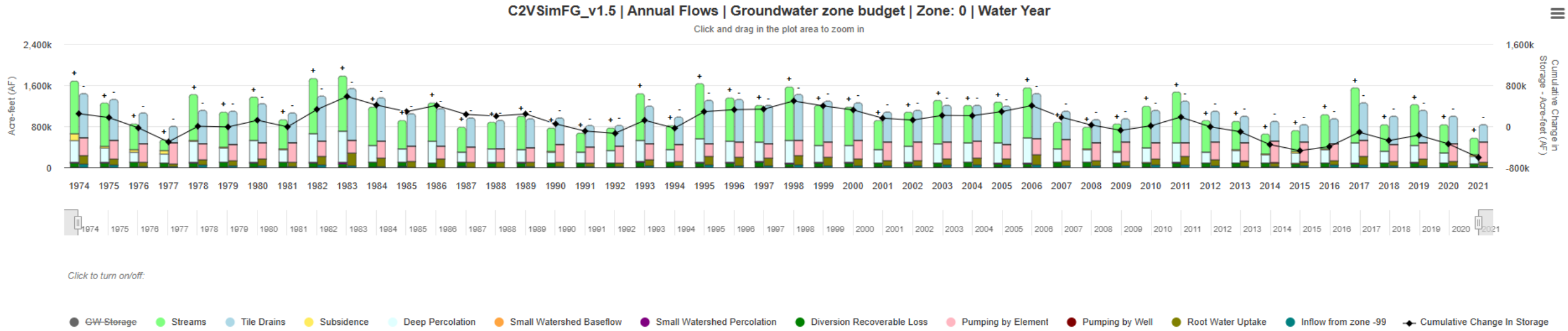


Zonal Budget



Zonal Budget

Go to top | Remove this chart



Turn all series off | Turn all series on

All zero: Constrained General Head BC, Bypass Recoverable Loss