

Water Supply and Demand Assessment Demand Methodology

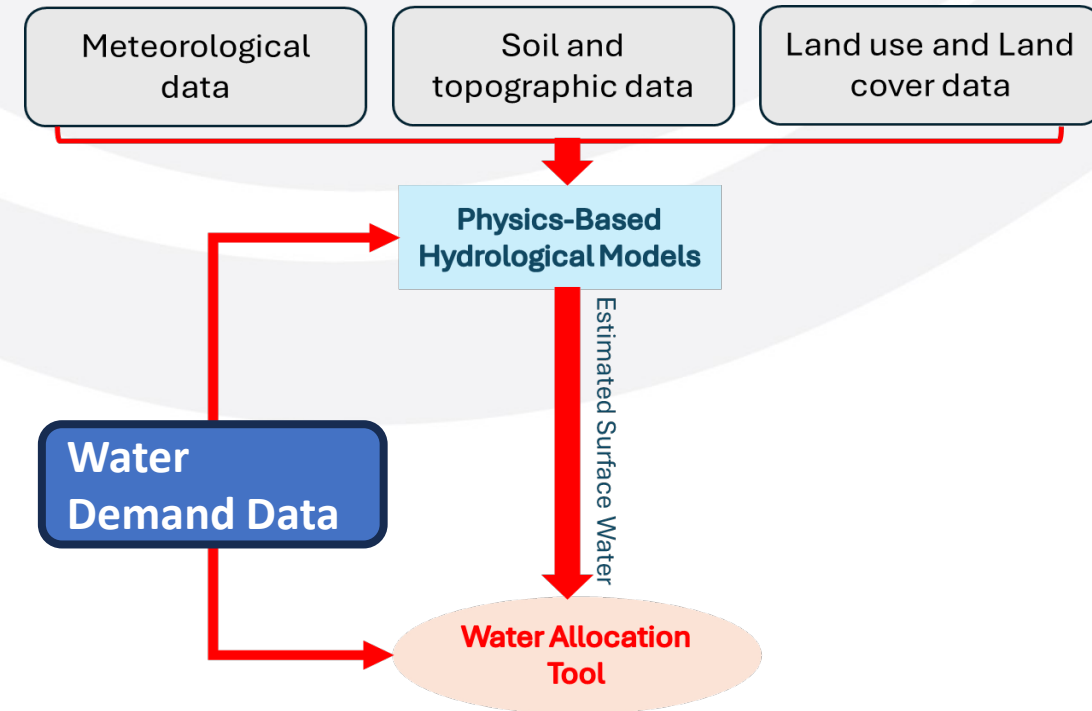
Payman Alemi and Aakash Prashar
3/13/2025



Watershed Supply and Demand Modeling

Assessing water availability using DWRAT (Drought Water Right Allocation Tool)

- Meteorological data are used to run hydrologic models that represent the “water supply” in watershed
- Staff clean and process the diversion data (from annual water use reports) to develop a dataset that represents “water demand”
- The tool allocates available supply to water right holders based on the water right priority date, demand, and forecasted flow data on a monthly basis



Demand Procedure Summary

- Collect eWRIMS data
- GIS Preprocessing*
 - Identify PODs that divert from the watershed
- Duplicate Reporting Errors
 - Review instances of duplicate annual totals
- Unit Conversion Errors
 - Check for unit errors
- Check Empty Reports*
 - Fix incomplete reports
- Assign Sub-Basins*
 - Use POD locations to assign demand values to watershed sub-basins
- The full detailed procedure is described by this pair of documents--these are the web versions of our demand manuals, which are always evolving and dynamic, but they are accurate as of 5/7/2025 with the caveat that our internal process relies on a combination of GitHub and SharePoint—to make the process reproducible for non-Water Boards users, we made all the input data available through GitHub alone.
- [Demand Dataset Procedure 2025-05-07.pdf](#)
- [SDA GIS Full Manual Review Methodology 2025-05-07.pdf](#)
- All the scripts are on the SDA DWRAT_DataScraping GitHub repository (under the sub-repo Demand):
https://github.com/CAWaterBoardDataCenter/DWRAT_DataScraping

eWRIMS Data Gathering

- Uses an R script to pull six eWRIMS flat files from ReportManager to construct our demand dataset
- Dataset filters
 - Active PODs only
 - Certain types of water rights
 - Certain water right statuses

Water Right Types

INCLUDED

- Appropriative
 - Federal Claims
 - Federal Stockponds
 - Registration Cannabis
 - Registration Domestic
 - Registration Irrigation
 - Registration Livestock
 - Statement of Div and Use
 - Stockpond
 - **Blank types ("")**
- All included water right types and statuses were borrowed from the Division's original demand dataset cleanup methodology that was developed during the last drought—SDA did not alter this criteria
 - Some of the excluded right types are obvious, but for types and statuses we were uncertain about, we consulted staff who worked on the original methodology for the reasoning



(Only these are explicitly mentioned and extracted from the flat file)

Excluded Water Right Types and Why?

EXCLUDED

- **Adjudicated:** —these filings are generally subject to a watermaster, and the reporting is done through the watermaster, not through RMS.
- **Appropriative (State Filing):** these filings are held just for later use but are not actual appropriations.
- **Cert of Right – Power:** these filings are unusual water because they grant users the ability to divert water for power generation but are non-consumptive, this water is likely accounted for by other water rights.
- **Groundwater Recordation (G#####):** these are our groundwater rights that pertain to only 4 counties in Southern California—our methodology only applies to surface water.
- **Non Jurisdictional (NJ#####):** Unfortunately, the actual documents associated with these rights are unavailable online, but based on the name and lack of reporting in eWRIMS, SDA assumed that these rights should be excluded from its analysis. Enforcement uses “NJs” as placeholders to handle investigations of potential surface water diversions with an initially unknown basis of right.
- **Not Determined (UN#####, CMPLT-#####):** These filings appear to be administrative records associated with complaints and investigations. While there are face values associated with some of these records, they will likely be accounted for in other water rights OR are under investigation for inclusion in a water right.

Excluded Water Right Types and Why? (cont.)

- **Section 12 File:** These filings appear to be very old municipal recordations, and some of them appear to have been updated with, or at least associated with, statements. Only thirteen Section 12 filings appear in eWRIMS, but a few have significant diversion rates (250 -5,000 AF/day), but with minimal information on file electronically and a total absence of water usage reporting, analysis is difficult.
- **Temporary Permit:** There's only 1 in eWRIMS and it appears to deal with groundwater storage from flood control operations.
- **Waste Water Change:** Since there are no face values, diversion information, and PODs associated with these filings, we excluded them.

Water Right Statuses

INCLUDED

- Active
- Certified
- Claimed
- Claimed - Local Oversight
- Completed
- Licensed
- Permitted
- Registered
- **Blank types ("")**



(Only these are explicitly mentioned and extracted from the flat file)

Excluded Water Right Statuses and Why?

EXCLUDED

- **Adjudicated**—adjudicated rights are already captured under other water rights.
- **Cancelled**—these rights are no longer active—we only analyze active rights.
- **Closed**—these rights are no longer active.
- **Inactive**—these rights are no longer active*
- **Pending**—these rights are not yet active, so any diversions are illegal. Illegal diversions should not restrict the right of legal diverters.
- **Rejected**—the Division rejected these rights so they never became active.
- **Revoked**—these rights are no longer active because they were revoked either voluntarily or involuntarily.

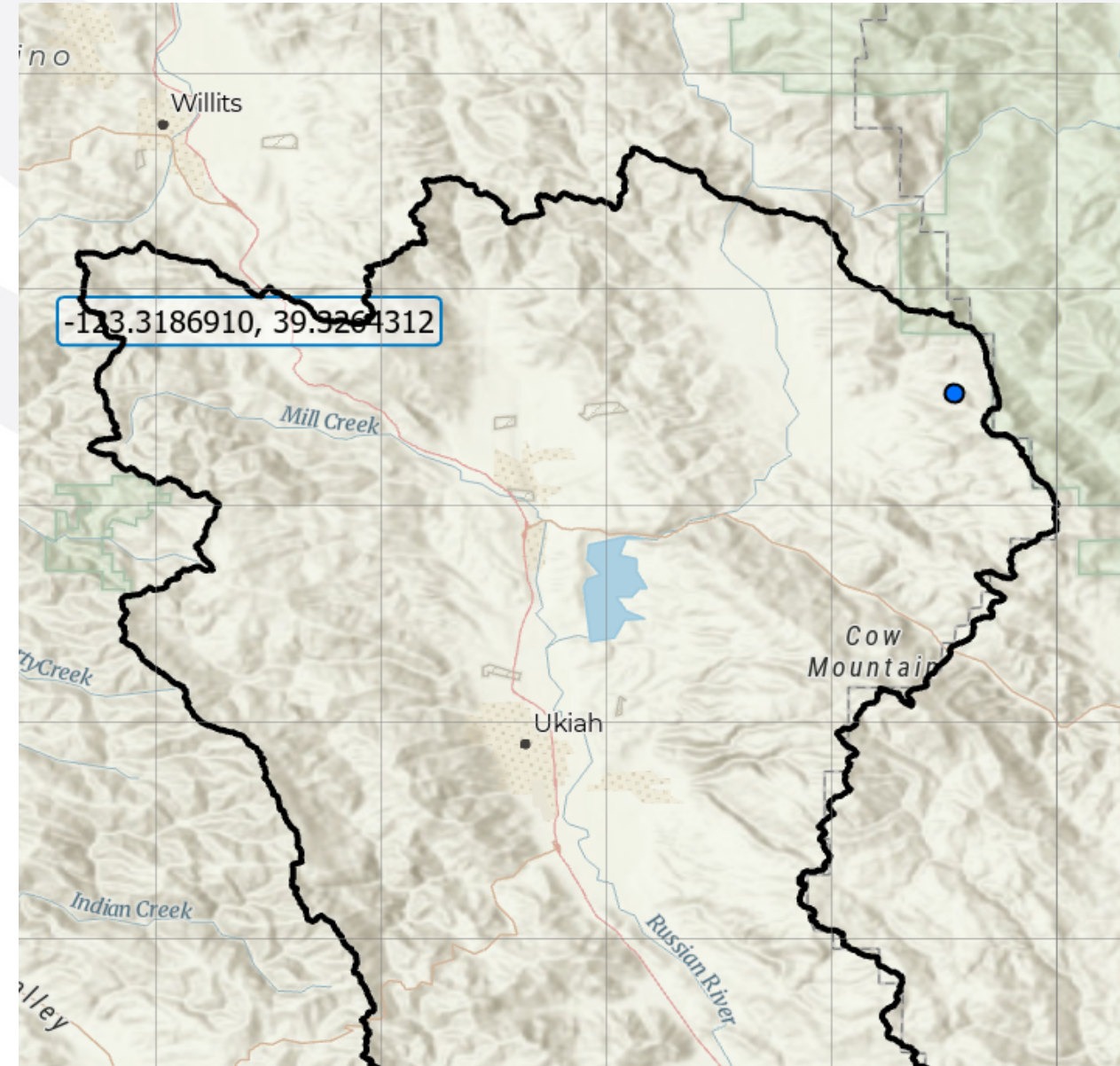
GIS Pre-Processing—Why Do We Do It?

- eWRIMS data is not 100% reliable—PODs are occasionally **misplotted**, which can significantly distort DWRAT's water allocation predictions.
- Original water rights documentation is treated as the source of truth for the actual location of the PODs.
- Common misplotting scenarios:
 1. PODs plotted *inside* the watershed but actually located *outside*—remove from the dataset.
 2. PODs plotted *outside* the watershed but actually located *inside*—add to the dataset.
 3. PODs plotted *inside* the watershed but *hydrologically disconnected*—remove from the dataset.
 4. PODs plotted *outside* the watershed but *hydrologically connected*—add to the dataset.
- For watersheds with thousands of PODs where a full manual review isn't feasible, we decided to just review a subset of the PODs along the boundary—more on that later.

Misplotting Scenario 1

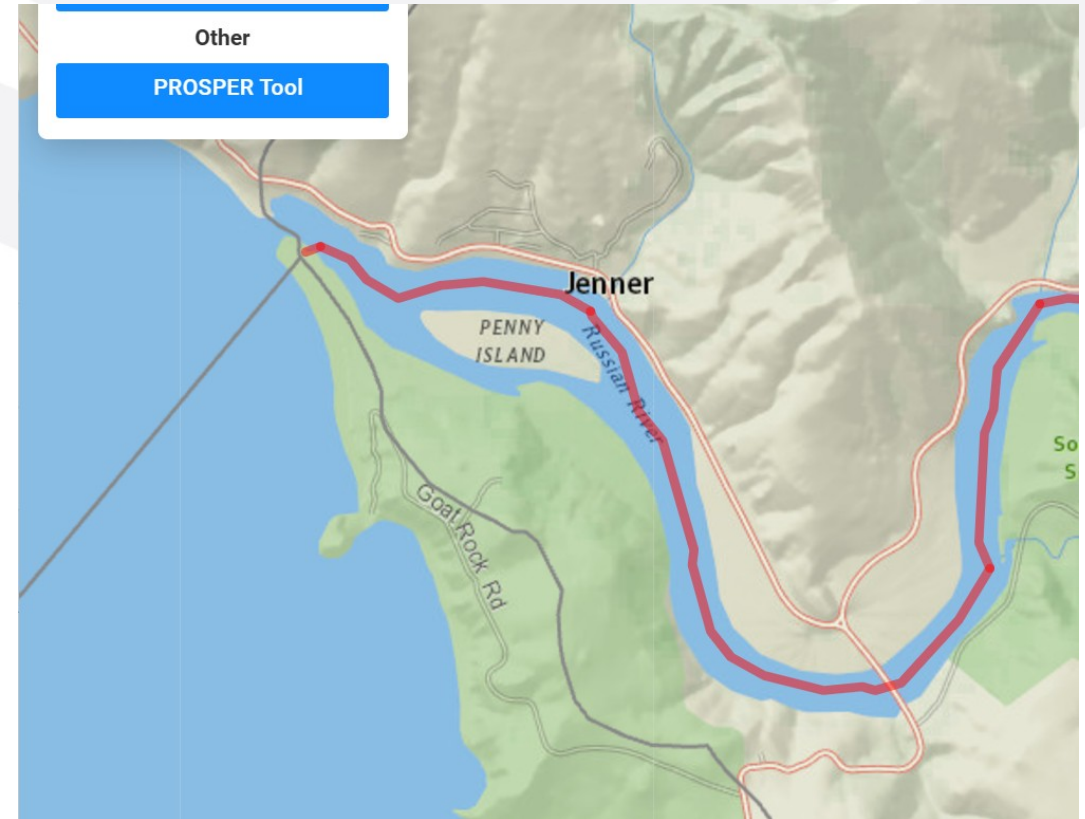
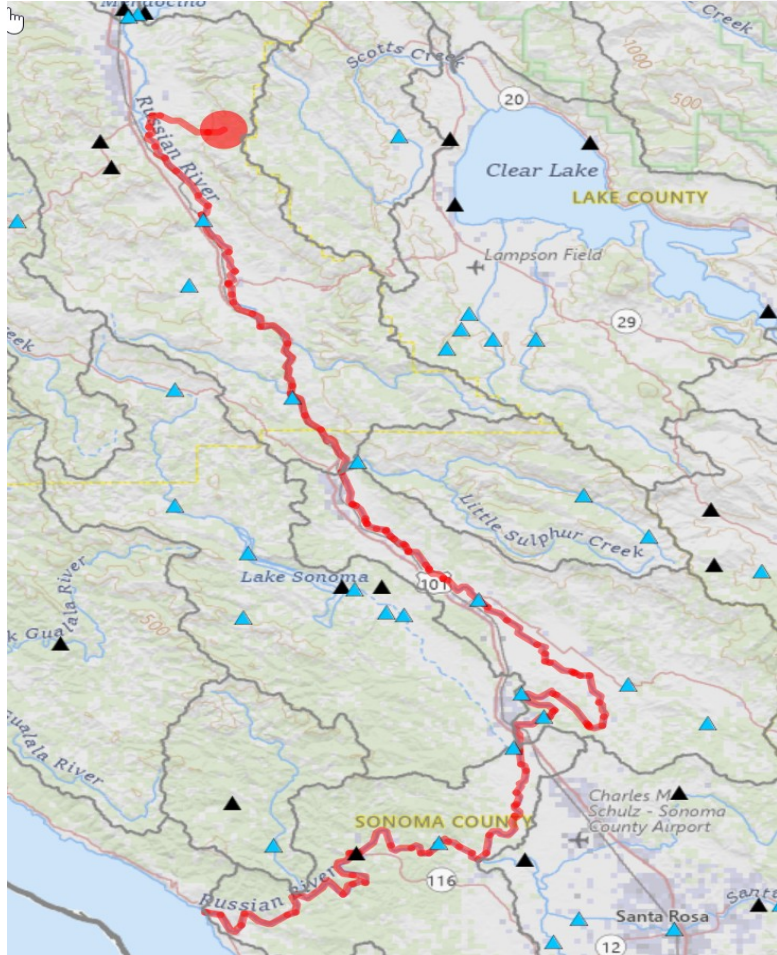
[View Map](#)

This POD corresponds to C005834, which is plotted incorrectly within the Russian River watershed, but according to the original certificate, it actually is in Colusa County! Our procedure is to remove such PODS from the dataset and correct the coordinates in eWRIMS.



USGS StreamStats Tool

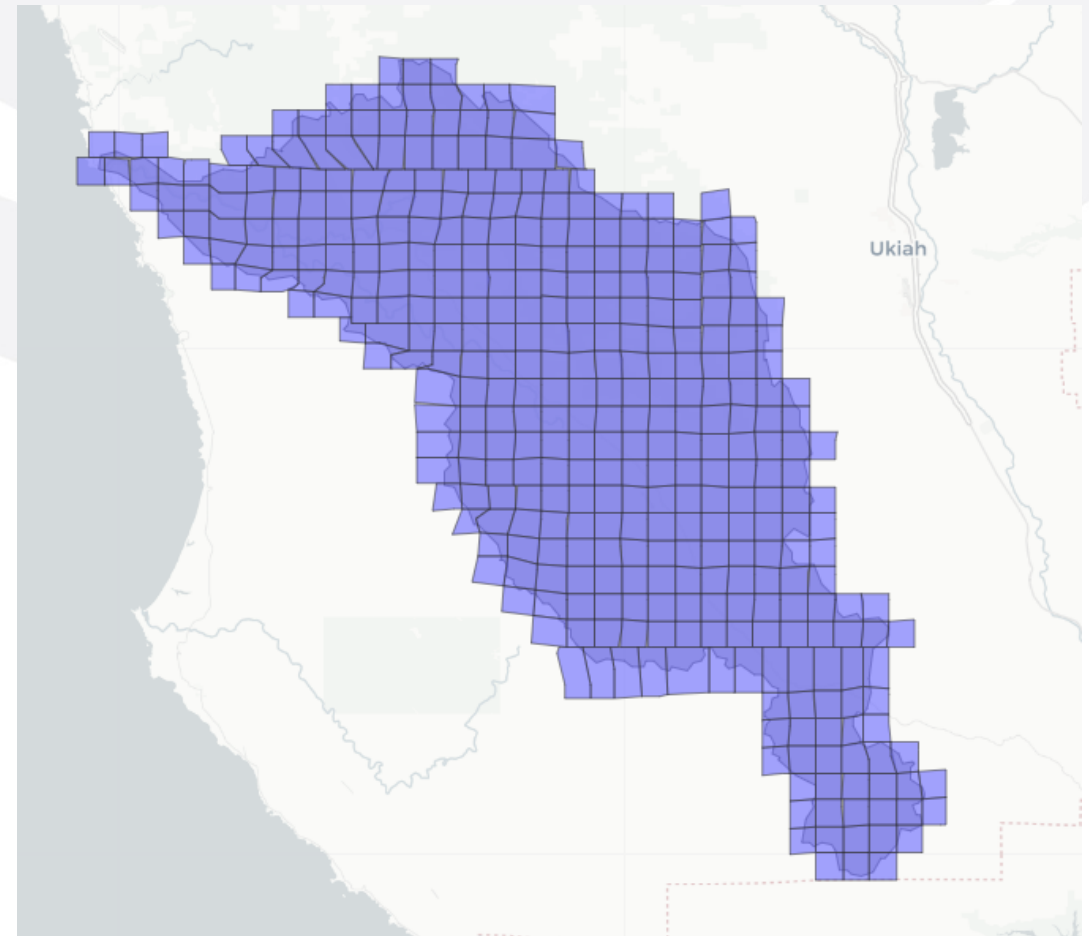
- <https://streamstats.usgs.gov/ss/>
- We enter the coordinates of the POD of interest into the search box, and the Flow tool will draw a flow path



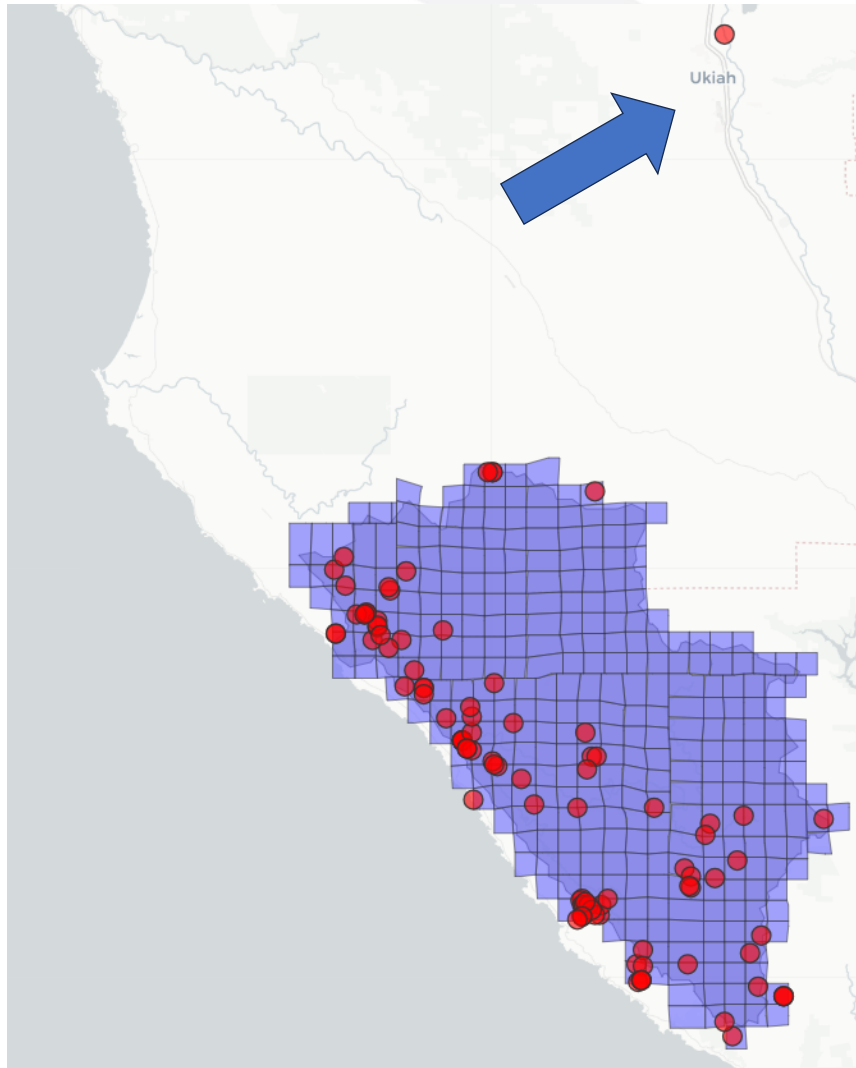
POD Flagging Method: PLSS Sections

[View Map](#)

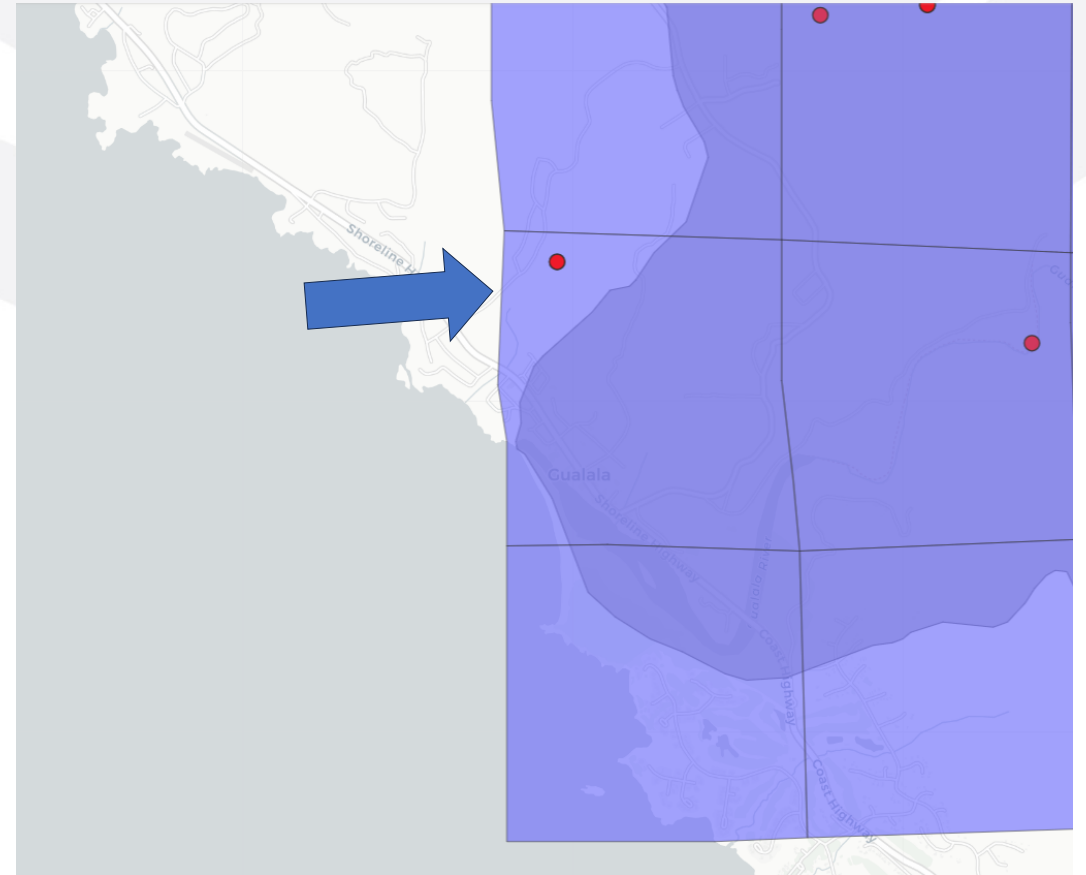
- Script finds the PLSS sections that intersect with the watershed
- Flags the PODs whose PLSS information matches one of these sections
- Flags the PODs whose geographic coordinates place them within one of these sections



POD Flagging Method: PLSS Sections



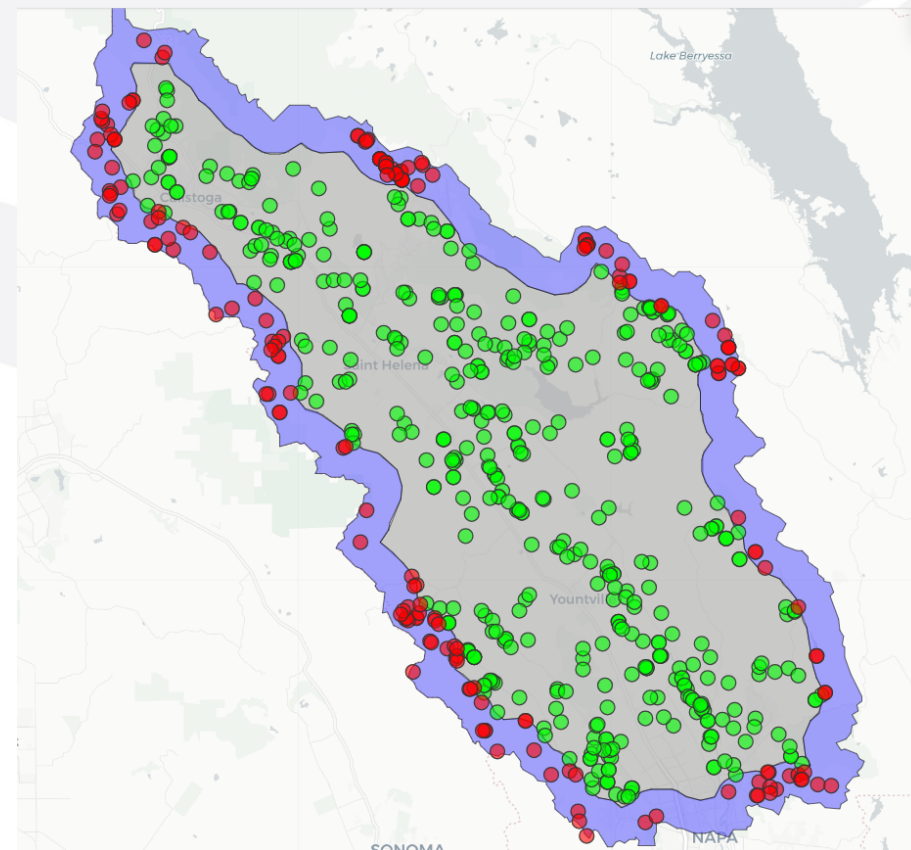
[View Map](#)



POD Flagging Method: Coordinate Overlap

[View Map](#)

- Script flags the PODs whose eWRIMS geographic coordinates overlap with the watershed boundary
- Distinguishes between PODs that are less than one mile within the watershed and at least one mile within the watershed

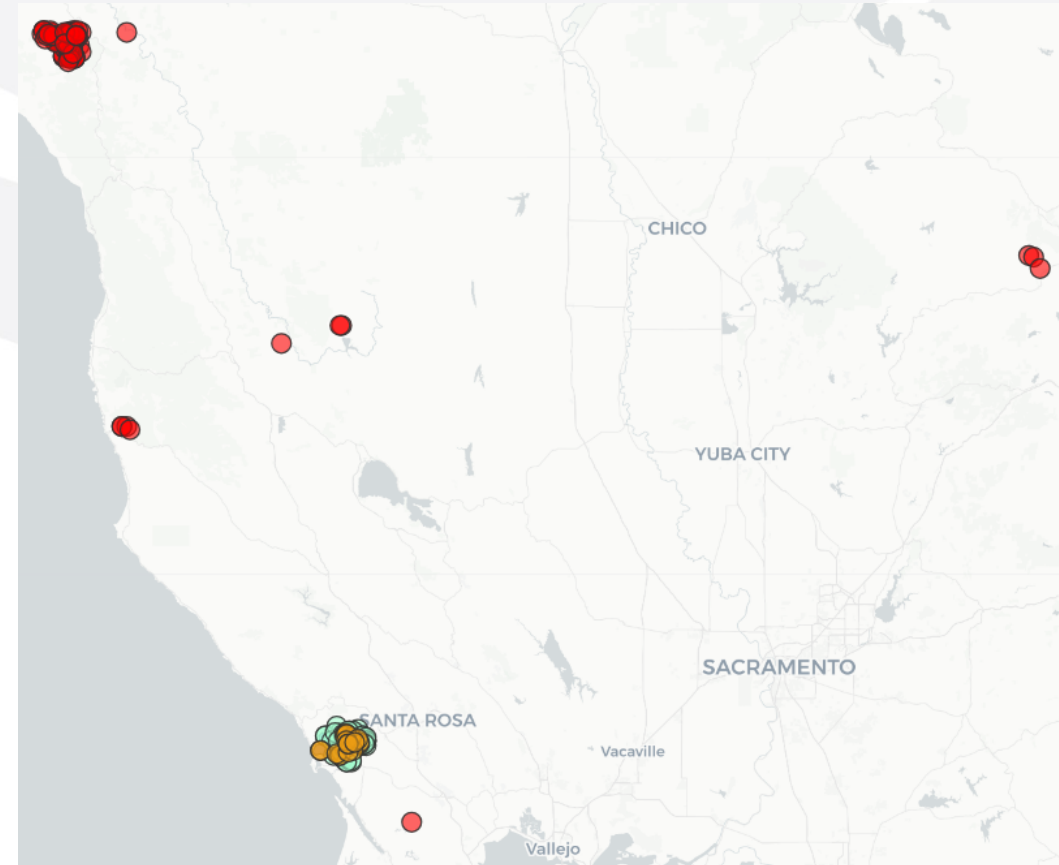


(The purple polygon is a one-mile buffer *on the inside* of the watershed)

POD Flagging Method: Search Strings

[View Map](#)

- Script searches the eWRIMS “WATERSHED”, “SOURCE_NAME”, and “TRIB_DESC” fields for mentions of the watershed
- Usefulness varies by watershed
 - “Gualala” yields no additional matches over what was already flagged
 - “Salmon Creek” doubles the number of flagged PODs



Questions to Ask During the GIS Review Process

- Does the report (the original statement, application, and other documents uploaded to eWRIMS) have POD coordinates (“Report Coordinates”) that match the coordinates in eWRIMS GIS (“eWRIMS Coordinates”)?
- Often, the report doesn’t provide POD coordinates in latitude and longitude decimal degrees—there are several layers of difficulty that we might have to sort through

STATE OF CALIFORNIA
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
STATE WATER RESOURCES CONTROL BOARD

DIVISION OF WATER RIGHTS

PERMIT FOR DIVERSION AND USE OF WATER

PERMIT 20828

Application 30245 of Carolyn L. Pride

4026 Spring Mountain Road, St. Helena, CA 94574

filed on April 19, 1993, has been approved by the State Water Resources Control Board
SUBJECT TO PRIOR RIGHTS and to the limitations and conditions of this permit.

Permittee is hereby authorized to divert and use water as follows:

1. Source: Unnamed Stream
Tributary to: Ritchie Creek thence
Napa River thence
San Pablo Bay
Report_Source_Creek
Report_Tributary
Report_Thence
Report_Section
Report_Township
Report_Range
Report_Meridian

| 2. Location of point of diversion | 40-acre subdivision of public land survey or projection thereof | Section | Township | Range | Base and Meridian |
|---|---|---------|----------|-------|-------------------|
| North 1,000 feet and West 1,500 feet from SE corner of Section 19 | SW 1/4 of SE 1/4 | 19 | 8N | 6W | MD |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

County of Napa

SWRCB 14 (6-94)

Section 1: Type of Claim

(Select all that apply to the type of claim(s) under which you are diverting water)

☒ Riparian ☐ Pre-1914 ☐ Court Decree ☐ Pending Appropriative Application ☐ Pueblo ☐ Other: _____

*If you checked Court Decree, Pending Appropriative Application, or Other, list the Decree Number, Application ID Number or Status or provide an explanation

List any related existing water rights, if applicable (e.g. Appropriative Water Right ID: A012345)

Section 2: Water Course Description

Water Course Name at the Point of Diversion (POD)

Mill Creek

Water Course is tributary to

Russian River

Report_Tributary

This report lacks a Report_Thence field, so leave it blank in the spreadsheet.

Section 3: Point of Diversion and Legal Land Description

Provide the location of the POD using one of the following methods (check one box and enter data if applicable)

☒ Latitude/Longitude Measurements: Latitude: 39.119400 Longitude: -123.119660

☐ California Coordinate System (NAD1983) North: Report_Northing East: Report_Easting Zone: Report_Longitude

☐ USGS Topographic Map with Point of Diversion labeled on map (if checked, map must identify same or nearest)

Assessor's Parcel Number (APN) where Point of Diversion is located (if APN has been assigned)

189-070-24-00

Report_APN

County

Mendocino

Report_Meridian

Provide Public Land Description to nearest 40 acres (if assigned)

SW 1/4 of the NE 1/4 of Section 31 Township 15N Range 11W B&M Mount Diablo

Report_QQ_Section

Report_Q_Section

Report_Section

Report_Township

Report_Range

Section 4:

(Check boxes indicating each map to be provided)

Identify the location of the place of use on a specific United States Geological Survey (USGS) Topographic Map, or County Assessor's parcel map or any other maps with identifiable landmarks. If assigned, provide the public land description to the nearest 40-acre subdivision and the assessor's parcel number.

☐ USGS Topographic Map ☐ County Assessor's Parcel Map ☒ Map with identifiable landmarks

Provide a general description of the area in which the water was used (e.g. Domestic water supply for house, and irrigated crops, campground, etc.)

Domestic water supply

Assessor's Parcel Number(s), where the water was used (if APNs have been assigned)

189-070-24-00

Section 5: Purpose of Use Description

(Select all that apply)

☐ Irrigation
Number of acres:

☒ Domestic
Maximum number of persons served:

2

☐ Stock watering
Number and type of stock:

☐ Other
Explain:

S027304

Final POD List

- After a thorough manual GIS Review, we now have a **Final POD List** that tells us who's diverting from the watershed
- Now we need to QAQC the eWRIMS diversion data to assign accurate annual demand values to each water right

Duplicate Reporting Errors

- Parties with multiple water rights sometimes report the same values in different rights' submissions for the same year
- If they are splitting their total water usage equally among the reports, that's okay for our purpose
- If they are repeating their total water usage in each report, that is a duplication error
 - Causes an overestimation of their demand

Duplicate Reporting Errors Manual Review

- Review the reports flagged by the script in a spreadsheet
- Revisions specified using the commands in [QAQC Action Dictionary.xlsx](#)
 - Standardization avoids having multiple conditional statements in the scripts to handle the same action specified with different wording:
 - Keep Direct Diversion values only
 - Keep direct only
 - Keep direct
- Example:
 - [NV Duplicate Reports Manual Review.xlsx](#)

Duplicate Record Example

| APPLICATION_NUMBI | YEAI | DIVERSION_TYP | PARTY_I | AnnualTo | QAQC_Action_Ta | QAQC_Reason | Staff |
|-------------------|------|---------------|---------|----------|----------------|--|--------|
| D031685 | 2017 | STORAGE | 546420 | 1.166177 | Keep One | One right is for domestic use, and the other is for irrigation. But they report the exact same values every year in almost every section. Even in 2012, when they reported for just one right, these same exact values were used. I think 380,000 gallons per year is enough for both uses, so one should be zeroed out. | Aakash |
| S016036 | 2017 | STORAGE | 546420 | 1.166177 | Keep One | One right is for domestic use, and the other is for irrigation. But they report the exact same values every year in almost every section. Even in 2012, when they reported for just one right, these same exact values were used. I think 380,000 gallons per year is enough for both uses, so one should be zeroed out. | Aakash |

(Excerpt from [D031685](#))

| | | | |
|-------------------|---|----------|----------|
| Total | 0 | 1.166177 | 1.166177 |
| Type of Diversion | Diversion to Storage Only | | |
| Comments | We use the water for domestic home use and for watering orchard and vegetable gardens | | |

(Excerpt from [S016036](#))

| 3. Purpose of Use | |
|-------------------|--|
| Domestic | family of 5 plus vegetable and orchard |
| Irrigation | |

Duplicate Record **False Flag** Example

| APPLICATION_NUMBE | DIVERSION_TYF | PARTY_I | ADJ_YEA | AnnualTot | QAQC_Action_Take | QAQC_Reason | Staff |
|-------------------|---------------|---------|---------|-----------|------------------|--|--------------|
| C001167 | DIRECT | 426065 | 2020 | 0.37 | None | The report states that the water use for each of the 4 ponds was estimated by dividing the total water use for the 120 cows (15 gallons per day) by 4. | Payman Alemi |
| C001169 | DIRECT | 426065 | 2020 | 0.37 | None | The report states that the water use for each of the 4 ponds was estimated by dividing the total water use for the 120 cows (15 gallons per day) by 4. | Payman Alemi |
| C001171 | DIRECT | 426065 | 2020 | 0.37 | None | The report states that the water use for each of the 4 ponds was estimated by dividing the total water use for the 120 cows (15 gallons per day) by 4. | Payman Alemi |
| C001172 | DIRECT | 426065 | 2020 | 0.37 | None | The report states that the water use for each of the 4 ponds was estimated by dividing the total water use for the 120 cows (15 gallons per day) by 4. | Payman Alemi |
| | | | | | | | |

Unit Conversion Errors

- The scripts compare annual total volumes to a “reference value”
 - Face Value
 - Initial Diversion Amount
 - Median Annual Total
 - Average Annual Total
- Reports are flagged if their total volumes are “different enough” from any of the reference values
 - 100 times greater or smaller than a reference value
 - More than 100 AF absolute difference from a reference value (average/median only)

Unit Conversion Errors Manual Review

- Flagged reports reviewed in a spreadsheet
- Revisions specified using the commands in [QAQC Action Dictionary.xlsx](#)
 - Standardization avoids having multiple conditional statements in the scripts to handle the same action specified in different language:
 - Convert from gallons to AF
 - Convert from Gallon to Acre-Feet
 - Convert from Gal to AF
- Examples:
 - [NV Expected Demand Units QAQC.xlsx](#)
 - [NV Expected Demand Units QAQC Median Based.xlsx](#)

Unit Conversion Error Example

| APPLICATION_N ▼ | YEAR ▼ | YEAR_TOTAL ▼ | FACE_VALU ▼ | IniDiv_C ▼ | QAQC_Action_Taker ▼ | QAQC_Reason ▼ | Staff ▼ |
|-----------------|--------|--------------|-------------|------------|----------------------------------|--|---------|
| S027721 | 2018 | 67860 | 0 | 0.1996 | Convert from gallons to AF (All) | The Use values in the report are approximately equal to these diversion values once the diversion values are converted from gallons to AF. | Aakash |

(Excerpt from [S027721](#))

| 6. Amount of Water Diverted and Used | | | |
|--------------------------------------|--------------------------------------|---|--------------------------------------|
| Month | Amount directly diverted (Acre-Feet) | Amount diverted or collected to storage (Acre-Feet) | Amount beneficially used (Acre-Feet) |
| January | 1550 | 0 | 0.005 |
| February | 2750 | 0 | 0.01 |
| March | 3540 | 0 | 0.01 |
| April | 5760 | 0 | 0.02 |
| May | 6900 | 0 | 0.02 |
| June | 8900 | 0 | 0.03 |
| July | 14400 | 0 | 0.04 |
| August | 8200 | 0 | 0.03 |
| September | 5440 | 0 | 0.02 |
| October | 5570 | 0 | 0.02 |
| November | 1280 | 0 | 0.003 |
| December | 3570 | 0 | 0.01 |
| Total | 67860 | 0 | 0.218 |
| Type of Diversion | Direct Diversion Only | | |
| Comments | | | |

Unit Conversion **False Flag** Example

| | A | B | C | D | E | U | V |
|---|--------------------|------|----------------------|-------------------|------------------------|--|--------|
| | APPLICATION_NUMBER | YEAR | CALENDAR_YEAR_TO_TAL | FACE_VALUE_AMOUNT | IniDiv_Converted_to_AF | QAQC_Reason | Staff |
| 7 | S021399 | 2017 | 0.1 | 0 | 887.7522 | Multiple years with no diversion and this is a frost protection right, so low diversions are reasonable. | Payman |
| 8 | S021399 | 2018 | 0.02 | 0 | 887.7522 | Multiple years with no diversion and this is a frost protection right, so low diversions are reasonable. | Payman |
| 9 | S021399 | 2020 | 0.76 | 0 | 887.7522 | Multiple years with no diversion and this is a frost protection right, so low diversions are reasonable. | Payman |
| 0 | S021399 | 2021 | 0.83 | 0 | 887.7522 | Multiple years with no diversion and this is a frost protection right, so low diversions are reasonable. | Payman |

Empty Reports

- Addresses reports that have a total, but lack monthly volumes
 - Example: [D030908](#)
 - By default, “NA” values are excluded from the final averages
- Replace “NA” monthly volumes with a value based on the total reported usage
- Example:
 - [NV Empty Reports Manual Review.xlsx](#)

| Amount of Water Diverted | |
|--------------------------|---|
| Month | Amount diverted or collected to storage (Acre-Feet/Gallons) |
| January | |
| February | |
| March | |
| April | |
| May | |
| June | |
| July | |
| August | |
| September | |
| October | |
| November | |
| December | |
| Total | 0 0 |
| Comments | |

Implementing QAQC Changes

- [Master spreadsheet](#) with SharePoint filepaths
- R scripts automatically check this spreadsheet to get the corresponding files listed for that watershed
- Standardized actions are read and interpreted by the code

| Info | | | | |
|------|---------------|----|---|--|
| IND | NAME | ID | QAQC_UNIT_CONVERSION_ERRORS_SPREADSHEET_PATH | QAQC_UNIT_CONVERSION_ERRORS_WORKSHEET_NAME |
| 1 | Russian River | RR | SOPs + Documentation\3. Demand Data\SDU Methodology\Non-GIS_Manual_Reviews\RR_Expected_Demand_Unit | Corrected Data |
| 2 | Navarro River | NV | Program Watersheds\1. Watershed Folders\Navarro River\Data\Demand QAQC\NV_Expected_Demand_Units_QA | Sheet 1 |
| 3 | Napa River | NR | Program Watersheds\1. Watershed Folders\Napa River\Data\Manual Review\NR_Expected_Demand_Units_QAQC | Sheet 1 |
| 4 | Butte Creek | BC | Program Watersheds\1. Watershed Folders\Butte Creek\Data\Demand\BC_Expected_Demand_Units_QAQC.xlsx | Sheet 1 |

Sub-Basin Assignment

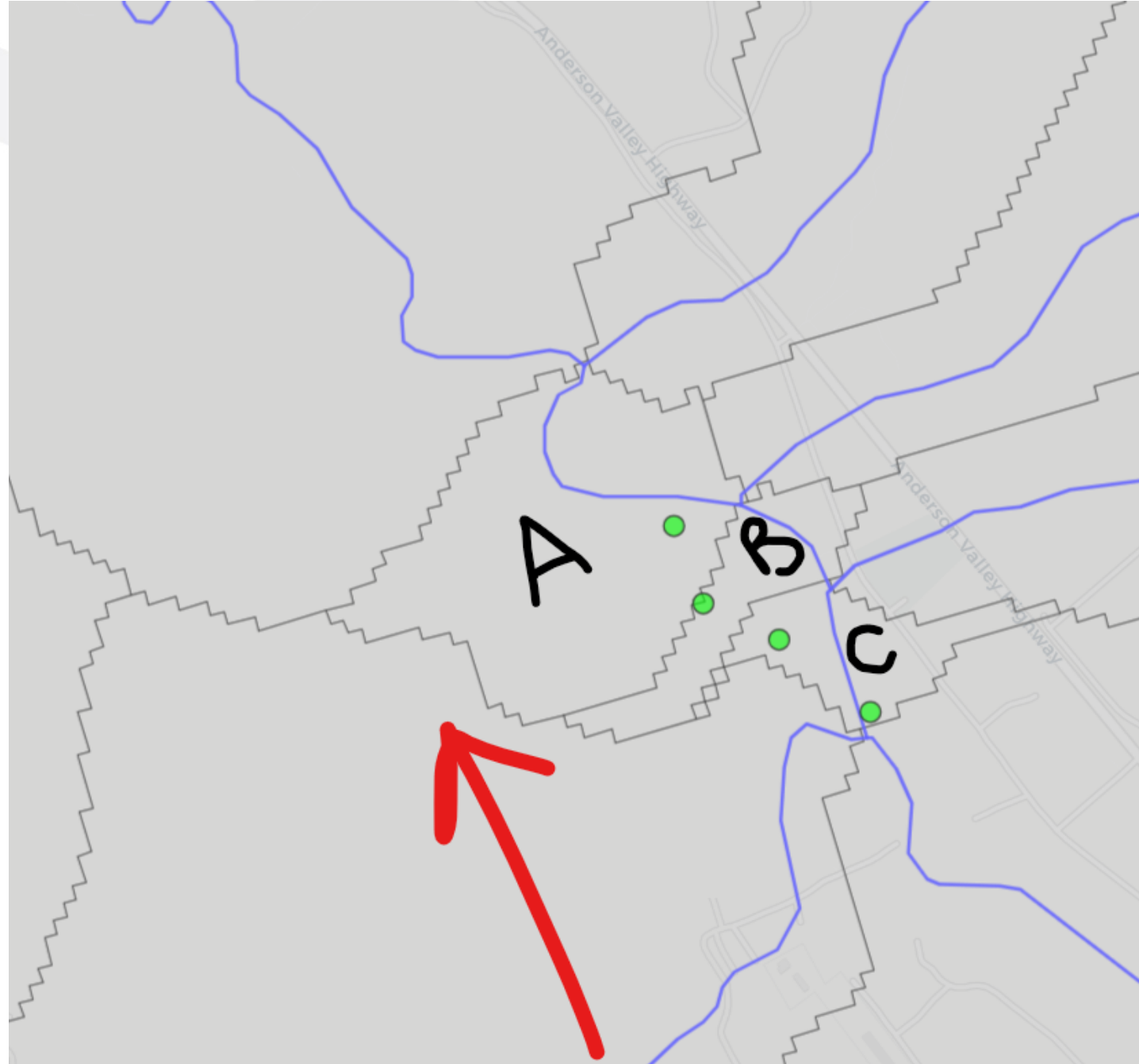
- Assign users' withdrawals to sub-basins in the watershed
 - DWRAT assesses water availability at the sub-basin level
- Water rights with multiple PODs in different sub-basins require additional processing
 - Sub-basin assignment relies on the **watershed connectivity matrix** and “**water right splitting**”

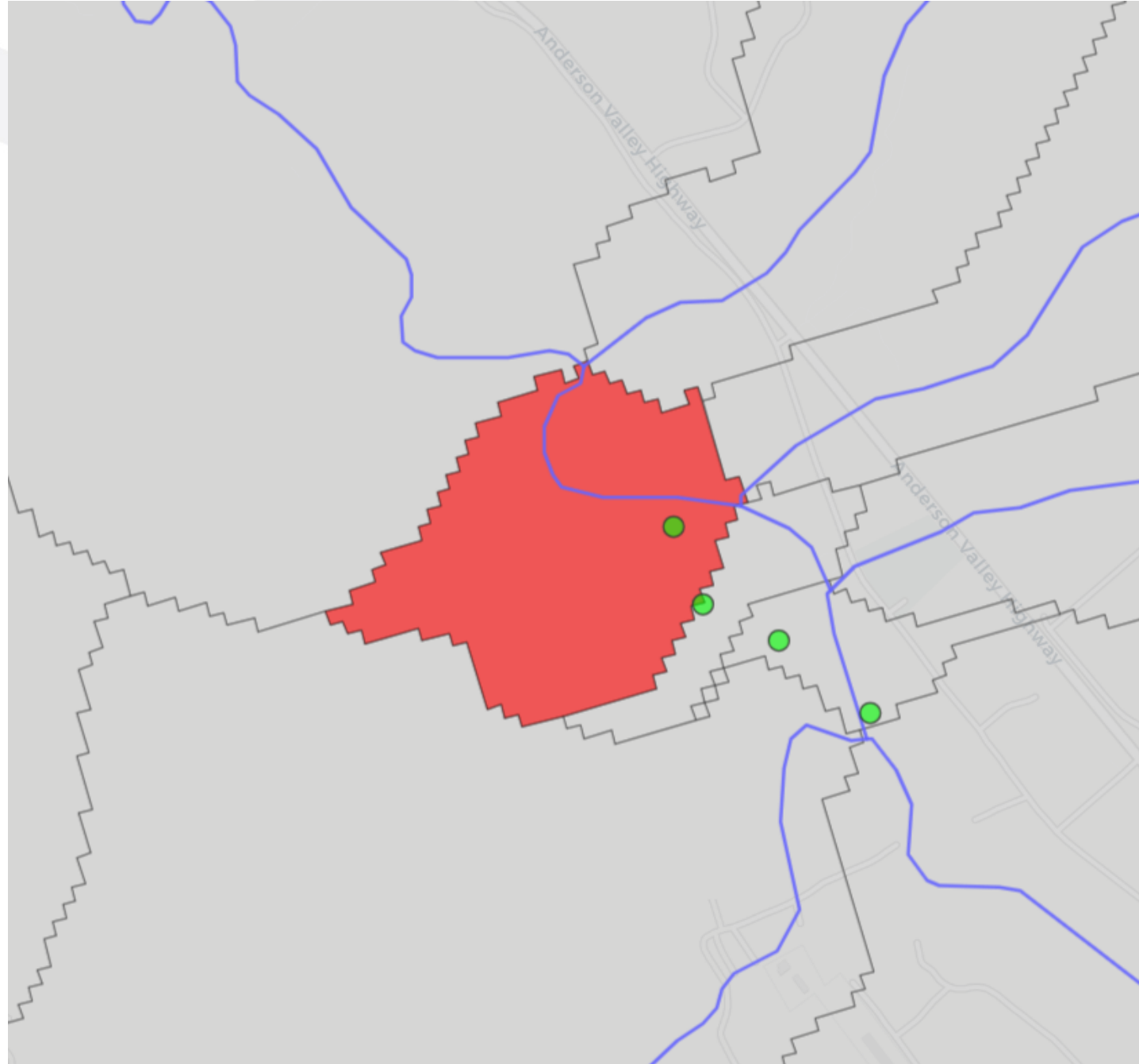
Flow from [Row]
eventually drains into
[Column]

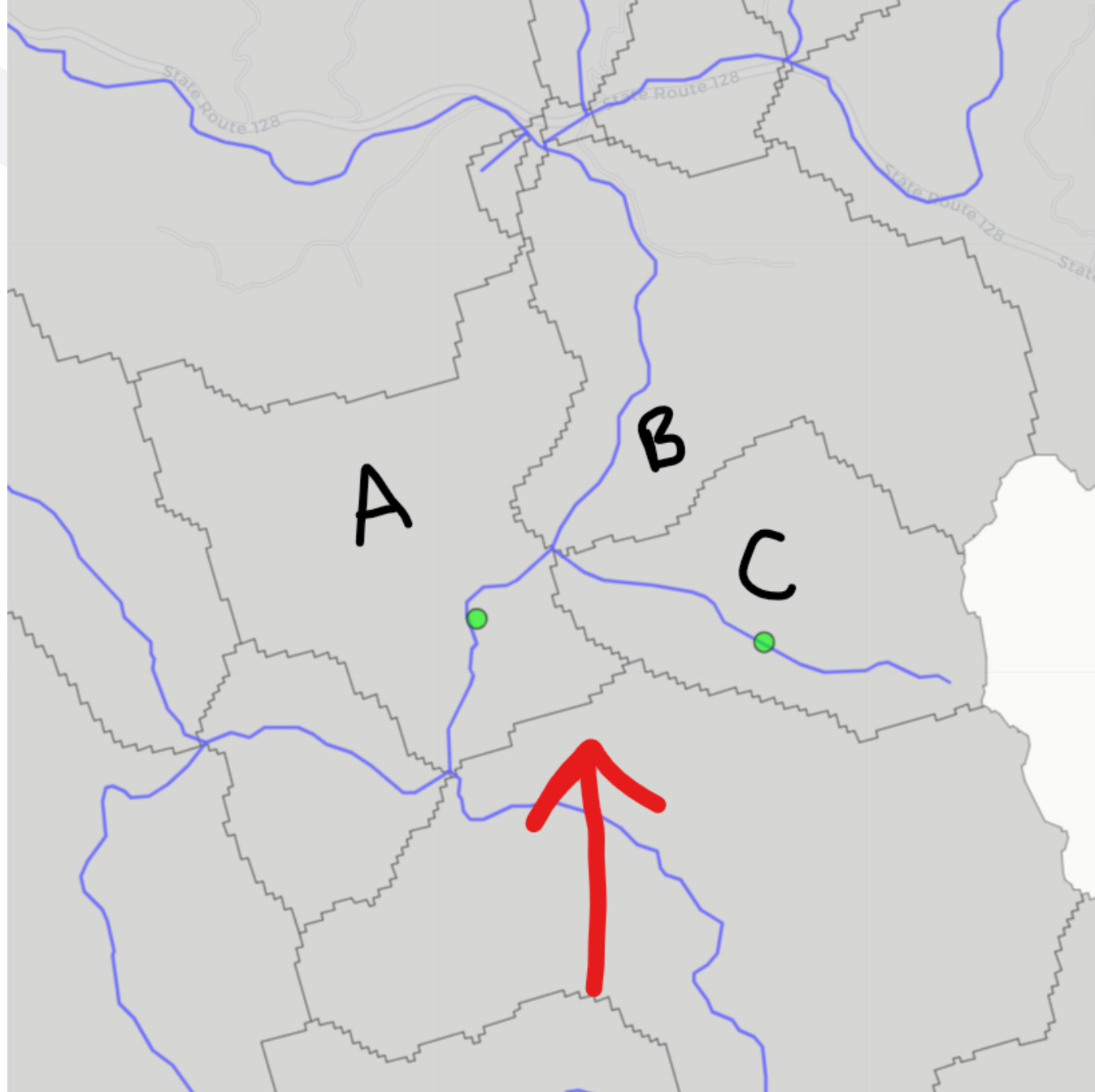
| BASIN | A | B | C |
|-------|---|---|---|
| A | 1 | 0 | 0 |
| B | 1 | 1 | 0 |
| C | 1 | 0 | 1 |

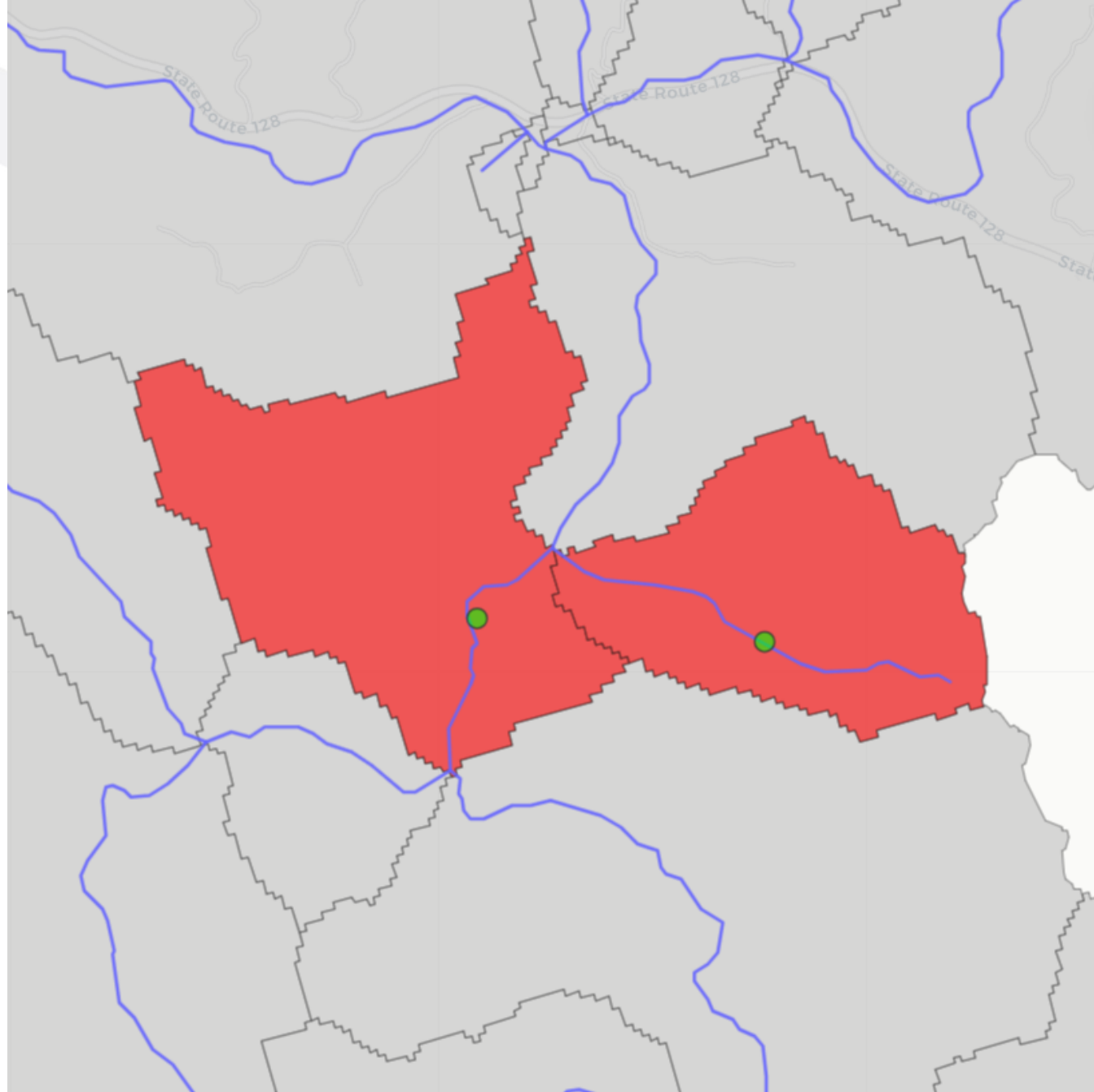
Sub-Basin Assignment Script Algorithm

- Assignment based on geographic coordinates and overlapping sub-basin location
- In cases of multiple PODs in different sub-basins:
 - If the PODs are in the same flow path, the most downstream sub-basin is chosen
 - If the PODs are in disconnected sub-basins, the water right is split into sub-rights, and one sub-right is assigned to each sub-basin
 - Their diversion data is proportioned based on the sub-basin drainage areas (including the areas of upstream sub-basins)
 - If both of the above cases apply (PODs in multiple sub-basins with some in the same flow path), the minimum number of sub-basins is identified, and the water right is split between them









Master Demand Table

- Final Result: CSV with **average monthly demand values** for each right with respect to the reporting timeframe selected for analysis
- This CSV serves as the demand input for DWRAT
- The Master Demand Table is not static—as more reporting data becomes available, staff periodically update it for each watershed
- Example
 - [NV 2017 2023 MDT 2025-02-05.csv](#)

Current Progress

