DRAFT TECHNICAL MEMORANDUM

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TO:	Kinney County Groundwater Conservation District, Board of Directors
FROM:	Vince Clause, PG Freese and Nichols, Inc.
SUBJECT:	Frameworks to Revise the Desired Future Conditions in GMA7
PROJECT:	KGD25636 – FY26 Hydrogeological Consulting Services
DATE:	January 21, 2026

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1.00 INTRODUCTION

Freese and Nichols, Inc. (FNI) has prepared this technical memorandum for the Kinney County Groundwater Conservation District (KCGCD) to support continued use of best available science in the joint planning process for Desired Future Conditions (DFCs). This memorandum summarizes high-level findings from relevant datasets and prior studies and presents a set of Desired Future Condition frameworks for the KCGCD Board to consider as it evaluates potential revisions to the existing Desired Future Condition. This work was completed under FY26 Hydrogeological Consulting Services, Task 2: Support Desired Future Conditions Joint Planning, authorized on August 23, 2025, under the Master Services Agreement between KCGCD and FNI.

Note on scope relative to the December 12, 2025 draft memorandum. The analysis presented in this memo differs from the draft memorandum dated December 12, 2025. The December 12 draft focused on developing an analytical approach to revise Modeled Available Groundwater (MAG) using the currently adopted Desired Future Condition for the Edwards-Trinity (Plateau) Aquifer in GMA 7 in Kinney County. Since that time, KCGCD has directed FNI to explore potential frameworks associated with a revised Desired Future Condition, and the evaluation framework has been expanded accordingly. Key differences include the following:

- **Broader use of available information.** The analysis is not limited to the period for which measured groundwater pumping records are available. Estimated pumping compiled by Green (2012) was incorporated into the analysis.
- **Updated reference conditions.** The analysis is not tied to end-of-year conditions at Las Moras Springs.
- **Newly incorporated spring discharge data.** Since December 12, 2025, additional spring discharge information was obtained from the International Boundary and Water Commission, as documented in LBG-Guyton Associates (2010) and tabulated by Hutchison (2023), covering 1957 through 1965. This eight-year interval coincides with a relatively wet period in Kinney County based on the Palmer Drought Severity Index.
- **Analytical limitations.** In the absence of a calibrated groundwater flow model, some more complex relationships (e.g., pumping volumes and spring discharge response) are evaluated using simplified statistical methods (e.g., correlation) rather than process-based simulations.

Together, these refinements are intended to better inform discussion of potential Desired Future Condition frameworks. For additional information on Joint Groundwater Planning, See Section 7.0.

2.00 DATA AND METHODS

2.01 DATA INVESTIGATED

The following datasets were reviewed for use in evaluating factors associated with discharge at Las Moras Springs:

Las Moras Springs Discharge

- Bennet and Sayre (1962)
- LBG-Guyton (2010) as tabulated by Hutchison (2023)
- USGS (2025a and 2025b)

Climate

- Precipitation, gross evaporation, and net evaporation (TWDB, 2025)
- Oceanic Nino Index anomaly (NOAA, 2025)
- Palmer Drought Severity Index (NOAA, 2026)

Groundwater Pumping Volumes

- EcoKai (2025a)
- Green (2012)

Static Water Levels

- EcoKai (2025b and 2025c)

2.02 CORRELATION APPROACH

To screen for statistical relationships between each dataset and Las Moras Springs discharge, we applied the following workflow:

1. **Time-step matching ("data resampling"):** Las Moras Springs discharge data were resampled to match the observation frequency of the dataset being evaluated.
    a. *Example:* Precipitation data from Quad-807 are reported monthly, therefore, Las Moras Springs discharge data was resampled to a monthly frequency for comparison.
2. **Dataset pairing:** Each dataset of interest was paired with the resampled discharge time series over the period of overlapping record.
3. **Regression screening:** A simple linear regression was fit between the paired dataset values and spring discharge.
4. **Fit Statistic:** The coefficient of determination (R^2) was calculated and recorded as a consistent screening statistic across datasets.

References to supporting sections are provided below.

- For summary information (tables and graphs) on each dataset, see Section 5.00.
- For correlation results with Las Moras Spring discharge, see Section 6.00.

DRAFT

2.03 LAS MORAS SPRINGS DISCHARGE SUMMARY DATA

Discharge measurements for Las Moras Springs span the period from 1900 through 2025. Over the full record, the average ("mean") daily discharge is 17.7 cubic feet per second (cfs), and the median daily discharge is 12.6 cfs (Table 1). Data coverage is uneven through time. The most continuous and complete portion of the record begins in 2003 and continues through 2025, when monitoring is generally available on a consistent basis.

To support comparisons among periods of interest, summary statistics for daily mean discharge are presented for three drought periods and the Scenario 3 period in Table 2. To characterize longer-term conditions and reduce short-term variability ("noise"), annual mean discharge was also computed using 2-, 5-, and 7-year moving window averages. Summary statistics for these moving-window annual series are provided in Table 3.

Data completeness note. Monthly and annual mean values were calculated from the available daily mean values for each month or year. During the historical period, some months or years include only limited measurements. Consequently, monthly and annual statistics may be disproportionately influenced by the earlier, discontinuous portions of the record, whereas daily mean statistics are more strongly influenced by the recent period of continuous monitoring.

Table 1. Summary statistics from measured discharge at Las Moras Springs from the period of record (1900 to 2025). (Min. = minimum, Max. = maximum, and Std. Dev. = standard deviation)

	Count	Min.	25%	Median	Mean	75%	Max.	Std. Dev.
Daily mean[1], cfs*	8,635	0.0	5.5	12.6	17.7	27.7	62.7	14.5
Monthly mean[2], cfs*	951	0.0	9.4	16.1	20.0	30.8	60.7	13.4
Annual mean[3], cfs*	97	3.1	11.8	18.7	19.7	26.8	51.0	10.3

[1] – Daily mean discharge represents the mean flow for a given day (cfs) based on measurements available for that date (or the reported daily mean discharge value, where applicable).
[2] – Monthly mean discharge is the arithmetic average of the daily mean values within a given month.
[3] – Annual mean discharge is the arithmetic average of the available daily mean values within each calendar year.
* - Month or years with limited measurements may be represented by as few as one daily value; therefore, monthly and annual means are weighted toward earlier, discontinuous portions of the record, whereas daily means are weighted toward more recent observations where monitoring is more continuous.

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Table 2. Las Moras Springs daily mean discharge (cfs) during periods of interest.*

Period	Count	Min.	25%	Median	Mean	75%	Max.	Std. Dev.
Scenario 3 (1950 to 2005)	1,418	0.0	20.0	26.6	28.4	40.0	61.3	12.6
Drought of Record (1950 to 1957)	49	2.8	7.6	10.1	15.6	18.4	49.7	12.3
2011 Drought (2009 to 2015)	2,433	0.0	4.5	8.2	11.3	13.3	62.7	10.1
Recent Drought (2020 to 2025)	2,127	0.0	1.4	5.1	7.0	9.9	40.7	7.3

* - Reported values differ from those in the December 12, 2025 draft memo due to the revised scope described in Section 1.0.

Table 3. Las Moras Springs annual mean discharge (cfs) from moving-window averages (1900 to 2025).

Moving-Window Annual Average	Count	Min.	25%	Median	Mean	75%	Max.	Std. Dev.
2-year moving average	90	4.5	15.3	19.9	19.8	24.0	48.3	8.0
5-year moving average	84	6.0	17.7	20.0	20.2	22.6	36.0	5.5
7-year moving average	82	10.9	17.8	20.1	20.4	23.2	29.9	4.2
10-year moving average	79	14.8	18.6	20.5	20.5	22.0	26.0	2.8

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2.04 CLIMATE DATA

Palmer Drought Severity Index (PDSI) plain-language note. The Palmer Drought Severity Index (PDSI) describes how unusually wet or dry an area is based on recent weather conditions. It uses precipitation and temperature to estimate moisture conditions, where positive values indicate wetter than normal conditions and negative values indicate drier than normal conditions. Larger values represent more extreme conditions. Because PDSI reflects accumulated conditions over the course of weeks to months, it responds more slowly than precipitation alone.

Among the climate data evaluated, Las Moras Springs discharge exhibited the strongest correlation with the PDSI (Table 4). Average daily discharge during wet conditions (PDSI > 1) was 31.7 cfs, while average daily discharge during dry conditions (PDSI < -1) was 11.3 cfs (Table 5). Over the PDSI period of record, conditions in Kinney County are most often ("median") characterized as an 'incipient dry spell' (Table 6).

Table 4. Summary statistics for monthly precipitation, gross and net evaporation, the Palmer Drought Severity Index, and the Oceanic Nino Index (ONI) Anomaly.

Climatic Data Type	Count	Min.	25%	Median	Mean	75%	Max.	Std. Dev.	Correlation with Las Moras Springs mean monthly discharge (cfs)
Precipitation, in[1]	858	0.0	0.8	1.7	2.1	2.9	16.2	1.8	0.08
Gross Evaporation, in[1]	858	1.2	3.5	5.5	5.7	7.5	14.4	2.6	0.06
Net Evaporation, in[1]	858	-8.3	1.5	3.3	3.6	5.6	13.7	3.1	0.13
PDSI[2]	1,511	-5.5	-2.2	-0.7	-0.3	1.6	8.3	2.6	0.52
ONI Anomaly[3]	909	-2.03	-0.56	-0.06	0.01	0.53	2.64	0.83	0.01

[1] – TWDB (2025)
[2] – NOAA (2026)
[3] – NOAA (2025)

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Table 5. Las Moras Springs monthly mean discharge (cfs) during different climatic conditions based on the Palmer Drought Severity Index (PDSI).

PDSI Condition	Count	Min.	25%	Median	Mean	75%	Max.	Std. Dev.
Wet conditions (PDSI >= 1)	290	0.0	22.5	33.9	31.7	40.5	60.7	12.0
Dry Conditions (PDSI =< -1)	410	0.0	5.6	9.7	11.3	14.8	49.1	8.3
Extremely Wet (PDSI >= 4)	72	22.2	38.2	41.9	42.2	47.1	60.7	8.1
Very Wet (3 <= PDSI < 4)	48	19.9	30.2	37.6	36.3	41.5	51.1	7.7
Moderate Wet (2 <= PDSI < 3)	71	0.0	19.2	30.8	28.2	35.7	49.8	10.9
Slightly Wet (1 <= PDSI < 2)	99	5.2	14.8	24.2	24.2	33.3	41.7	10.4
Incipient Wet Spell (0.5 <= PDSI < 1)	49	0.9	10.1	15.5	18.2	25.4	47.4	10.6
Near Normal (-0.5 < PDSI < 0.5)	110	0.4	11.6	18.5	21.0	30.6	47.1	11.5
Incipient Dry Spell (-0.5 >= PDSI > -1)	86	2.8	13.6	19.7	21.4	28.3	42.9	9.9
Mild Drought (-1 >= PDSI > -2)	138	1.5	9.3	13.7	15.6	19.4	49.1	8.9
Moderate Drought (-2 >= PDSI > -3)	144	0.0	5.9	9.8	11.0	13.4	43.2	7.6
Severe Drought (-3 >= PDSI > -4)	88	0.0	4.3	6.8	7.8	9.9	27.9	5.6
Extreme Drought (-4 >= PDSI)	40	0.0	2.3	4.8	5.8	7.1	23.1	5.6

Table 6. Summary statistics for the Palmer Drought Severity Index in Kinney County.

Measured Timeframe	Count	Min	25%	Median	Mean	75%	Max	Std Dev
Mean Monthly PDSI	1,511	-5.5	-2.2	-0.7	-0.3	1.6	8.3	2.6
2-Year Window Moving Average	1,488	-4.4	-1.1	-0.2	-0.3	0.6	4.9	1.6
5-Year Window Moving Average	1,452	-3.5	-0.7	-0.1	-0.2	0.4	2.6	1.0
7-Year Window Moving Average	1,428	-3.1	-0.5	0.0	-0.2	0.3	1.0	0.8
10-Year Window Moving Average	1,392	-2.2	-0.4	-0.1	-0.2	0.2	0.8	0.5

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2.05 GROUNDWATER PUMPING VOLUMES

From the data evaluated, average groundwater pumping in Kinney County is 7,329 acre-feet per year (ac-ft/yr), with annual estimates ranging from 2,301 to 14,973 ac-ft/yr (Table 7). Maximum reported annual groundwater pumping volumes occurred prior to metered reporting. Groundwater pumping estimates reported from Green (2012) are compiled from two datasets. For years with values reported in both datasets, the two estimates were averaged to produce a single annual pumping value.

Table 7. Summary statistics for annual groundwater pumping in Kinney County.

	Count	Min	25%	Median	Mean	75%	Max	Std Dev	Correlation with Las Moras Springs mean annual discharge (cfs)
Estimated and Measured[1]	47	2,301	4,928	6,915	7,329	9,663	14,973	2,838	0.20
GMA 7[2]	22	2,999	4,185	4,773	5,748	7,585	10,089	2,262	0.16
GMA 10[2]	22	12	71	245	372	513	1,376	393	0.21

[1] – Estimated and measured values include available annual measurements for Kinney County and are non-differentiated by location or aquifer.

[2] – GMA 7 and 10 records are based on data provided by Kinney County and were assigned to GMA 7 or 10 by FNI based on spatial designation. These results are not differentiated by aquifer.

2.06 INITIAL STATIC WATER LEVEL OBSERATIONS

Initial Static Water Level note. The information presented in this section is preliminary. Additional data screening, cleansing and QA/QC are needed to increase confidence in any interpretation and conclusions. Correlations presented here should not be interpreted as causation, and a lack of correlation should not be interpreted as evidence that no relationship exists. This section is included to demonstrate that static water levels in some Kinney County wells correlate strongly with Las Moras discharge along the "bowling alley," as described by Mr. Jim Burton.

Daily mean static water level data from each available dataset were paired with Las Moras Springs daily mean discharge records over periods of overlapping record. The paired data were evaluated by cross-plotting mean daily static water level versus mean daily discharge, and an R^2 value was calculated to quantify the strength of a linear relationship. Because R^2 reflects a linear correlation, some well plots that show a non-linear correlation were also evaluated for a potential 'critical threshold'. This 'critical threshold' resembles an "elbow" or "cliff" in the plotted relationship and could signal a static water level below which Las Moras Springs is more likely to stop flowing. The complete set of static water level and discharge cross-plots are provided in Section 6.05.

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2.07 STACKED GRAPHS DEMONSTRATING LAS MORAS SPRINGS DISCHARGE, CLIMATE DATA, AND GROUNDWATER PUMPING VOLUMES.

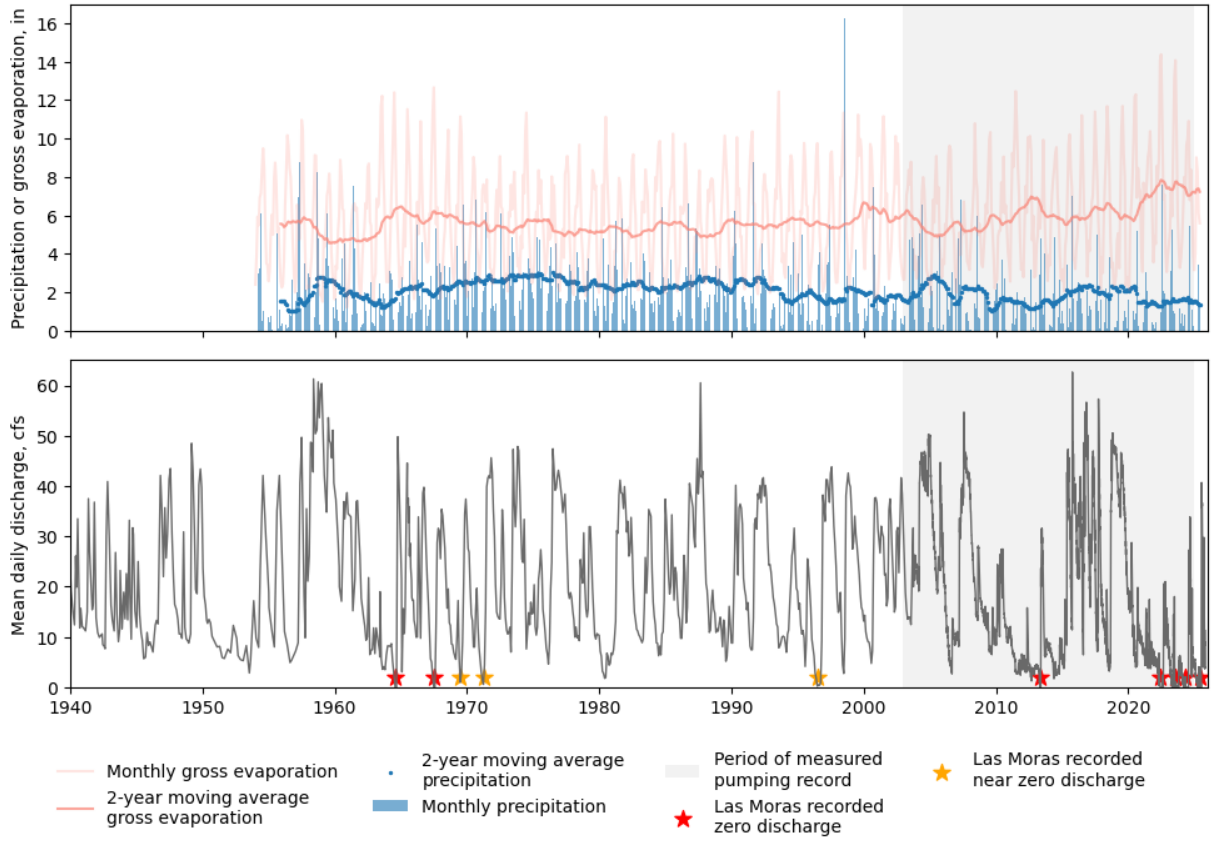

Figure 1. Las Moras Springs discharge, gross evaporation, and precipitation.

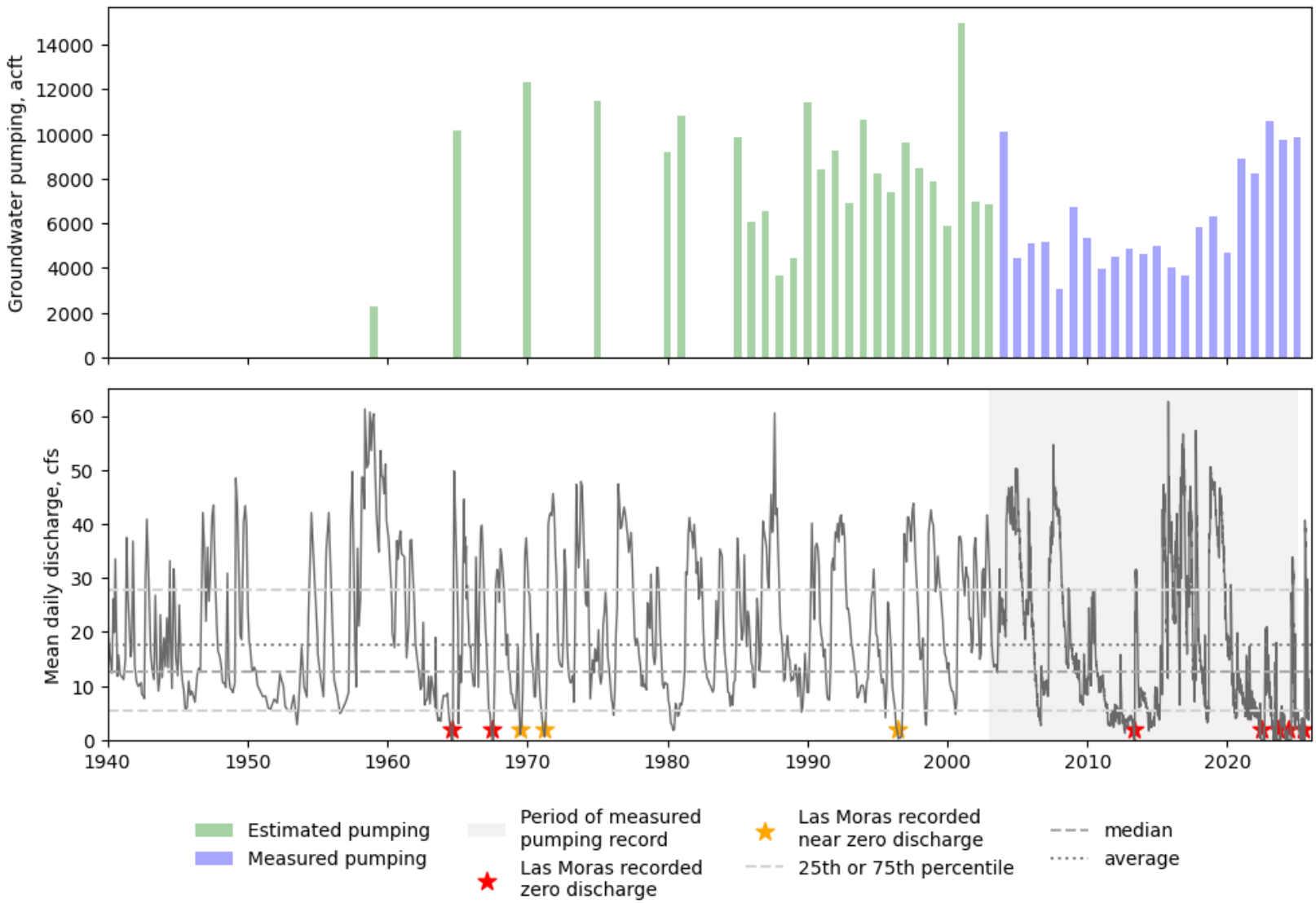

Figure 2. Las Moras Springs discharge and groundwater pumping volumes.

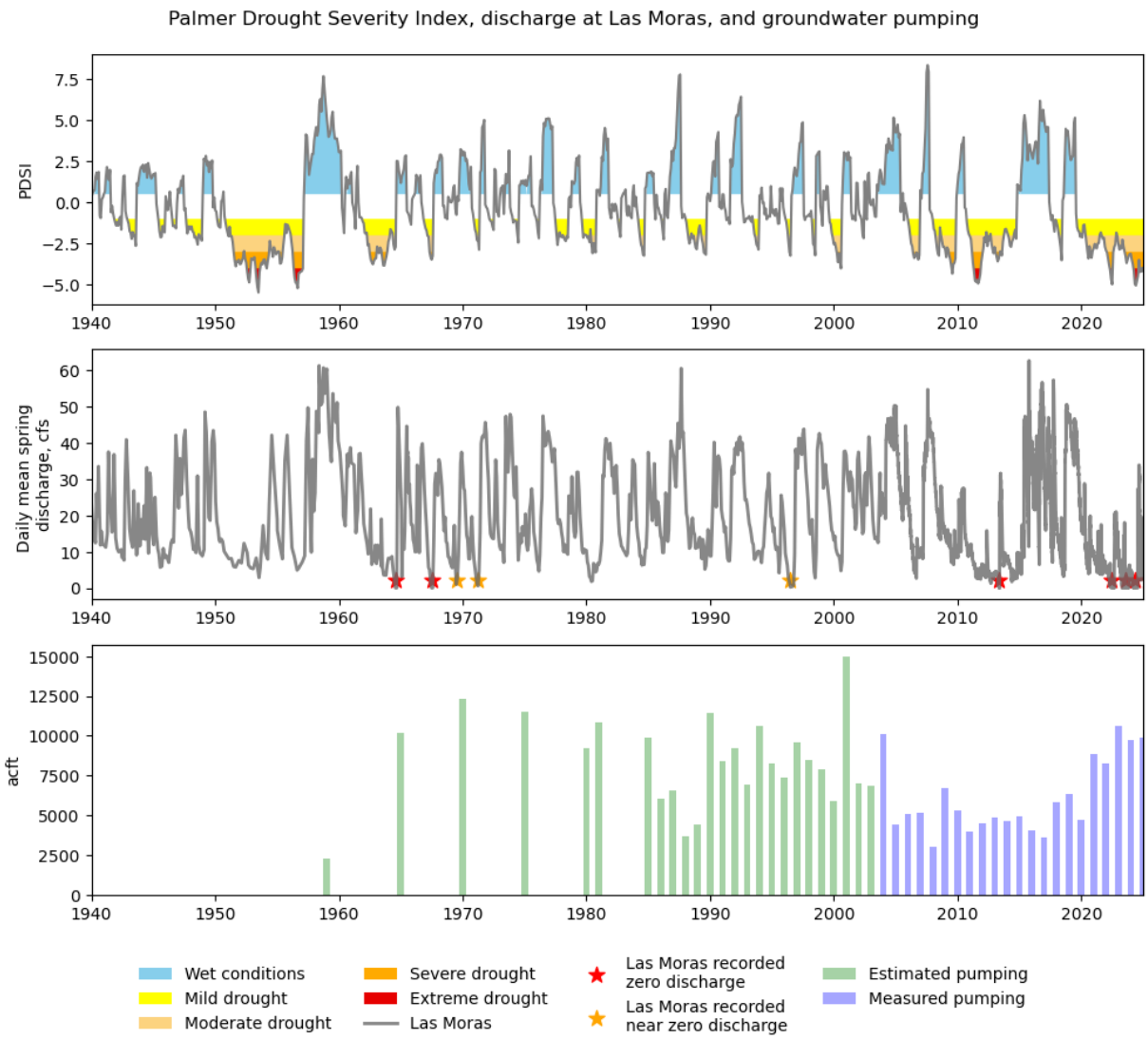

Figure 3. Palmer Drought Severity Index, Las Moras Springs discharge, and groundwater pumping volumes.

3.00 DFC EXPLORATORY FRAMEWORKS FOR A REVISED DESIRED FUTURE CONDITION FOR THE EDWARDS-TRINITY (PLATEAU) IN GMA 7 (KINNEY COUNTY)

The frameworks below are provided to support Board discussion of potential revisions to the Desired Future Condition. These frameworks assume the Kinney County GCD Board is interested in a spring discharge-based Desired Future Condition tied to discharge at Las Moras Springs. If the Board does not wish to pursue a spring discharge-based Desired Future Condition, it may elect to develop alternative Desired Future Condition language not included in this memorandum.

Implementation note (applies to all frameworks). Each framework includes placeholders (e.g. ##.#, #-years) that should be populated with the Board-selected threshold(s), and evaluation period(s). The frameworks presented herein are based on, and constrained by, the datasets currently available to the District. Additional or alternative Desired Future Condition formulations may not be feasible without improved data coverage and/or enhanced monitoring. The set of frameworks is intentionally limited at this stage to promote focused, productive dialogue, without resolving implementation details (e.g. a 2080 planning horizon, Modeled Available Groundwater formulation, regulatory compliance procedures). Final Desired Future Condition language should be developed with careful attention to definitions, measurement methods, and compliance evaluation so that the adopted Desired Future Condition is clear, measurable, enforceable, and implementable.

Desired Future Conditions definition. Under 31 TAC §356.10(11), a DFC is "the desired, quantified condition of groundwater resources (such as water levels, spring flows, or volumes) within a groundwater management area at one or more specified future times as defined by district representatives within a groundwater management area as part of the joint planning process".

Plain language explanation. A Desired Future Condition is a quantified management objective describing desired future aquifer conditions. Once adopted through joint planning, it serves as a policy goal that guides a GCD's management strategies, planning assumptions, and development of rules and permitting criteria.

3.01 DFC FRAMEWORKS TO EXPLORE

A. One-tiered spring discharge metric

Daily mean spring discharge measured at Las Moras Springs shall not be less than ##.# cfs when averaged over #-years/months/days.

<u>Description</u>

- A single, clearly defined spring discharge threshold over a defined averaging period (e.g., daily, monthly, annual, or multi-year moving average).

<u>Example desired future condition statements (illustrative, for discussion only)</u>

- Daily mean spring discharge measured at Las Moras Springs shall not be less than 17.7 cfs when averaged over 5-years.
- Monthly mean spring discharge measured at Las Moras Springs shall not be less than 7.0 cfs when averaged over a rolling 16-month period.

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Pros

- Straightforward metric and compliance determination.
- If a lower threshold target is selected (e.g., drought-period central tendency), the Desired Future Condition is more likely to be met during extended dry periods.
- Multi-year averaging reduces sensitivity to short-term variability and better accommodates climate-driven fluctuations.

Cons

- If the threshold is set near long-term mean conditions, the Desired Future Condition may be difficult to achieve during drought.
- If the selected threshold is too low, it may inadvertently support less conservative groundwater use while still "meeting" the Desired Future Condition.
- Multi-year averaging may still not be achieved under prolonged moderate-to-exceptional droughts that persist beyond the averaging window.
- If compliance hinges on a long window, there may be less urgency to respond to early warning signals, while a short window may drive overly reactive management.
- An average-based metric may allow short-term duration "dry" or no-flow spring conditions while the average remains above the threshold.
- Due to measurement methods, runoff during rainfall events may temporarily inflate the actual spring discharge measurement over a short-time frame.

Board-selectable alternatives

- Use different spring discharge statistics (e.g., median daily discharge, monthly mean, or percentile-based target such as the 25th percentile).
- Modify the compliance window (e.g., 1-year, 2-year, 7-year, or 10-year moving average).

Example of similar DFC language (for reference)

- Clearwater UWCD in GMA 8 – "Maintain at least 100 acre-feet per month of stream/spring flow in Salado Creek during a repeat of the drought of record" (adopted 11/4/2021 for the Edwards (BFZ) Aquifer; TWDB, 2026)

B. Multi-tiered spring discharge metric with drought definition

Daily mean spring discharge measured at Las Moras Springs shall not be less than ##.# cfs when averaged over #-years/months/days, except during drought conditions. During drought conditions, as defined by a Palmer Drought Severity Index of less than # on average over a #-month period, daily mean spring discharge measured at Las Moras Springs shall not be less than ##.# cfs.

Description

- A spring discharge threshold evaluated over a defined averaging period under typical conditions, with an alternate (lower) spring-discharge threshold applied during clearly defined drought conditions (based on a specified drought indicator, threshold, and averaging window).

Example desired future condition statements (illustrative, for discussion only)

- Daily mean spring discharge measured at Las Moras Springs shall not be less than 20 cfs when averaged over 5-years except during drought conditions. During drought conditions, as defined by a Palmer Drought Severity Index of less than -1 on average over a 12-month period, daily mean spring discharge measured at Las Moras Springs shall not be less than 5.7 cfs.

Pros

- Allows differentiated targets for drought versus non-drought climatic conditions.
- Explicitly recognizes that spring discharge behavior differs between normal and drought periods, which can make the Desired Future Condition more attainable and technically defensible.
- Provides a defined basis for drought management actions (e.g., drought-stage triggers and groundwater production reductions) tied to a defined drought indicator.

Cons

- More complex language and compliance determination than a one-tiered metric, which may be more difficult to communicate.
- PDSI responds slowly to changing conditions which may lead to disjointed management following extremely wet/dry shifts. For this reason, tier transition rules should also be considered (e.g., drought status persists for X months before switching tiers).
- Achieving the drought-tier target may require groundwater production reductions during drought conditions.
- An average-based metric may still allow short-term "dry" or no-flow spring conditions while the average remains above the threshold.
- Due to measurement methods, runoff during rainfall events may temporarily inflate the actual spring discharge measurement over a short-time frame.

Board-selectable alternatives

- Use different spring discharge statistics (e.g., median daily discharge, monthly mean, or percentile-based target such as the 25th percentile).
- Use different drought indicators (e.g., Precipitation deficit), drought thresholds, and/or drought averaging windows.
- Modify the compliance window (e.g., 1-year, 2-year, 7-year, or 10-year moving average).
- If preventing "dry" or no-flow conditions is a priority, the Board can consider adding on "no more than # consecutive days or zero flow."

Example of similar DFC language (for reference)

- Barton Springs/Edwards CD in GMA 10 – "Springflow at Barton Springs during average recharge conditions shall be no less than 49.7 cfs averaged over an 84 month (7-year) period; and springflow of Barton Springs during extreme drought conditions, including those as severe as a recurrence of the 1950s drought of record, shall be no less than 6.5 cfs average on a monthly basis." (adopted 10/26/2022 for the Edwards (BFZ) Aquifer; TWDB, 2026).

C. Static water level in index-wells metric

The water level in [Well Name/ID] shall be greater than #### feet above mean sea level when averaged over a #-year period.

Framework C note. Although this framework does not explicitly include spring discharge in the condition statement, several wells have been identified that correlate strongly with Las Moras Springs discharge.

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Description

- A Desired Future Condition based on maintaining groundwater levels in one or more clearly identified "index" wells above a specific threshold, evaluated over a defined averaging period.

Example desired future condition statements (illustrative, for discussion only)

- The water level in well 70-45-503 (Monitor Well # 1 / City of Brackettville Well # 1) shall be greater than 1,105 feet above mean sea level on average over a 5-year period.

Pros

- Relatively straightforward to interpret and evaluate for compliance.
- Can be directly tied to groundwater production management (e.g. drought state or curtailment triggers tied to measured/static water levels in monitor wells).
- Can be monitored/tracked real-time by District without reliance on external monitoring.
- Can be designed/selected to minimize pumping interference from nearby wells (e.g. interference that MUD wells currently exert on spring pool).
- A water level average considers conditions below the dry or no-flow spring stage, better highlighting the magnitude of drawdown during these periods.

Cons

- Without a robust, calibrated groundwater flow model, translating a water level-based Desired Future Condition into Modeled Available Groundwater in a technically defensible manner may be challenging.
- Average-based water level metrics may still allow short-term "dry" or no-flow spring conditions while the average remains above the threshold.
- Index wells should ideally be owned by the District or other public entities, not private property owners.
- Additional analysis is needed to support index well selection, thresholds, and interference.

Board-selectable alternatives

- The Board may select different wells or different static water level targets. The below wells appear to be suitable for a static water level based desired future condition that correlates well with Las Moras Springs discharge. **Note:** M002, M070, and M081 have static water levels that are influenced by pumping from the well or by a neighboring well. Ideally, a monitor well with minimal influence would be selected.
    - M002 – Lindsey Ranch: preliminary threshold ~1,110 feet above mean sea level
    - M070 – EH2B-02 Rose: preliminary threshold ~1,105 feet above mean sea level
    - M081 – Gomez No. 1: preliminary threshold ~1,110 feet above mean sea level
    - O001 – Tularosa Well: preliminary threshold ~1,193 feet above mean sea level.

Example of similar DFC language (for reference)

- Kinney County GCD in GMA 10 – "The water level in well 70-38-902 shall not fall below 1,184 ft mean sea level" (adopted 10/26/2022 for the Edwards (BFZ) Aquifer; TWDB, 2026)

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D. Multi-statistic spring discharge metric (mean + median / percentile)

Spring discharge at Las Moras Springs shall be maintained such that the annual average discharge is not less than ##.# cfs, and the median (or percentile-based statistic such as the 25th percentile) discharge is not less than ##.# cfs, evaluated over #-years/months.

Framework D note. Although this framework follows the existing Desired Future Condition structure for Kinney County in Groundwater Management Area – 7 for the Edwards Trinity (Plateau) Aquifer, with additional refinement, this approach can be improved.

Description

- A spring discharge-based Desired Future Condition that uses two complementary statistics (e.g. mean and median).

Pros

- Reduce the chance that compliance is driven by short-lived spikes (e.g. runoff-related measurement spikes) or masked by averaging.
- Retains the simplicity and clarity of a spring discharge-based Desired Future Condition while adding a second compliance check that better reflects typical conditions.

Cons

- More complex, mixed structure requires tracking of two metrics.
- May still allow short-term "dry" or no-flow spring conditions while the average/median remains above the threshold.

Board-selectable alternatives

- The Board may use a different secondary statistics (e.g., 25th percentile, or minimum monthly mean).
- The Board may choose a separate evaluation window(s) (e.g., mean over 5 years plus median over 5 years, or mean annual plus median monthly).
- If preventing "dry" or no-flow conditions the Board can consider adding on "no more than # consecutive days or zero flow".

Example of similar DFC language (for reference)

- The existing GMA 7 Kinney County Desired Future Condition approach explicitly uses both average and median flow at Las Moras Springs.

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4.00 REFERENCES

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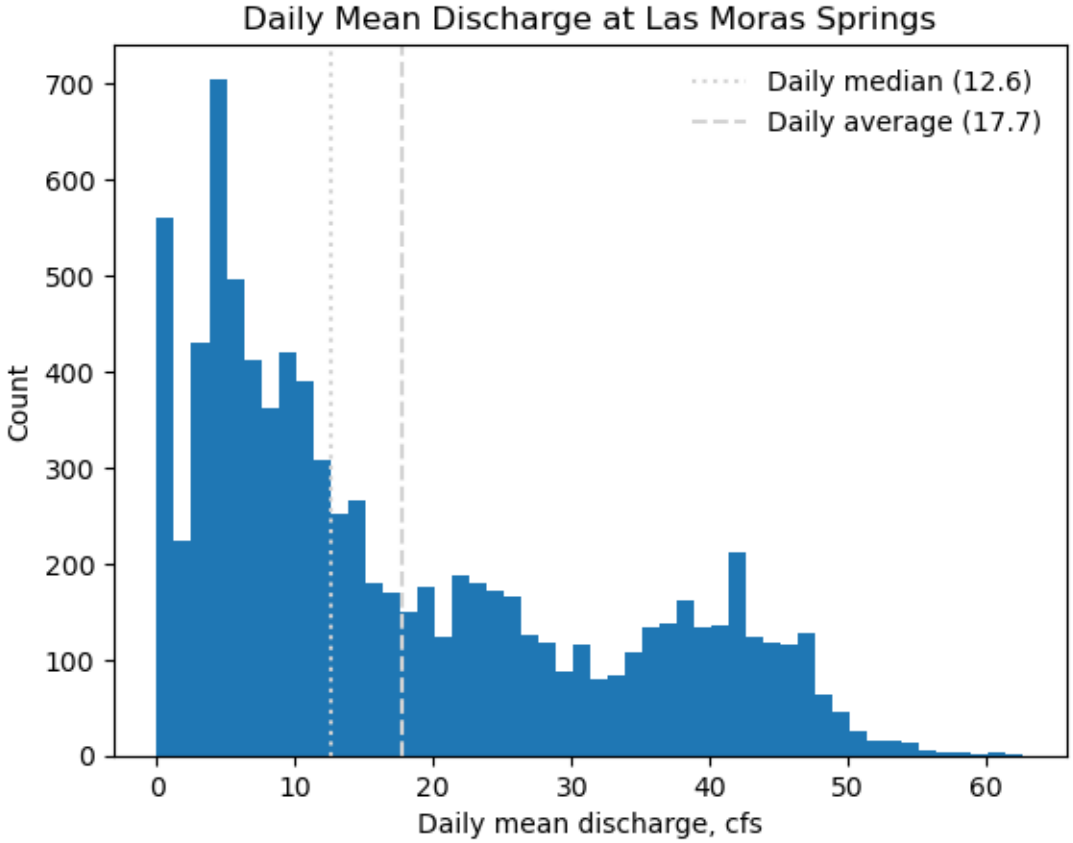
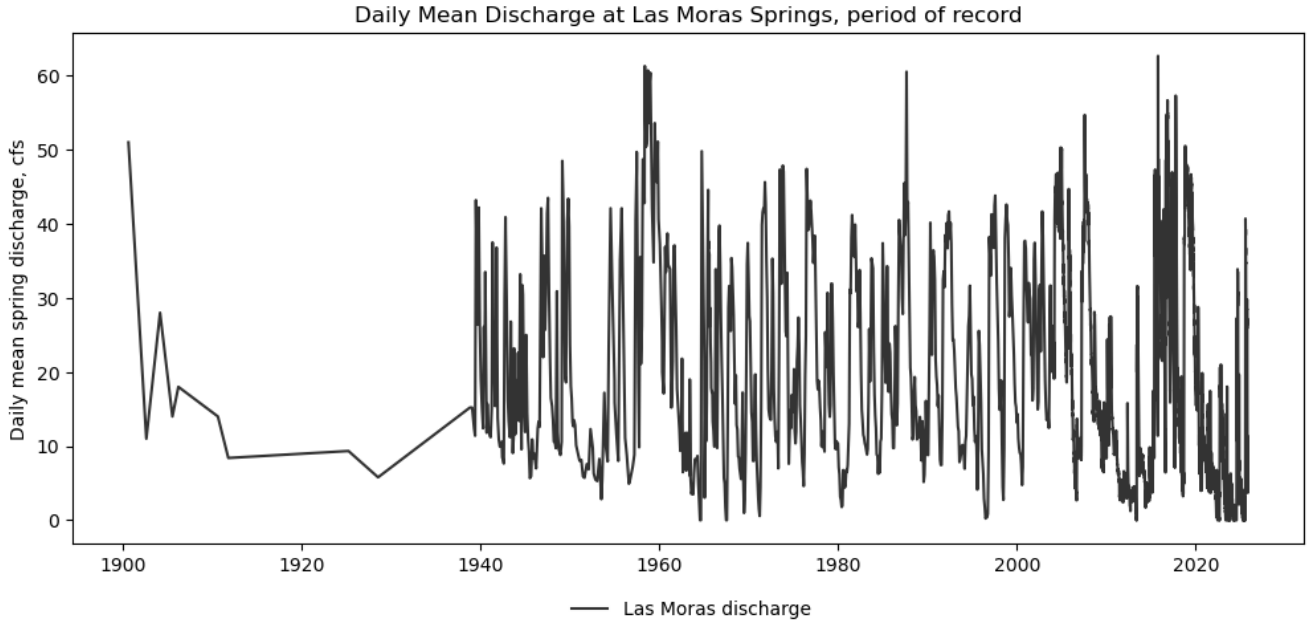
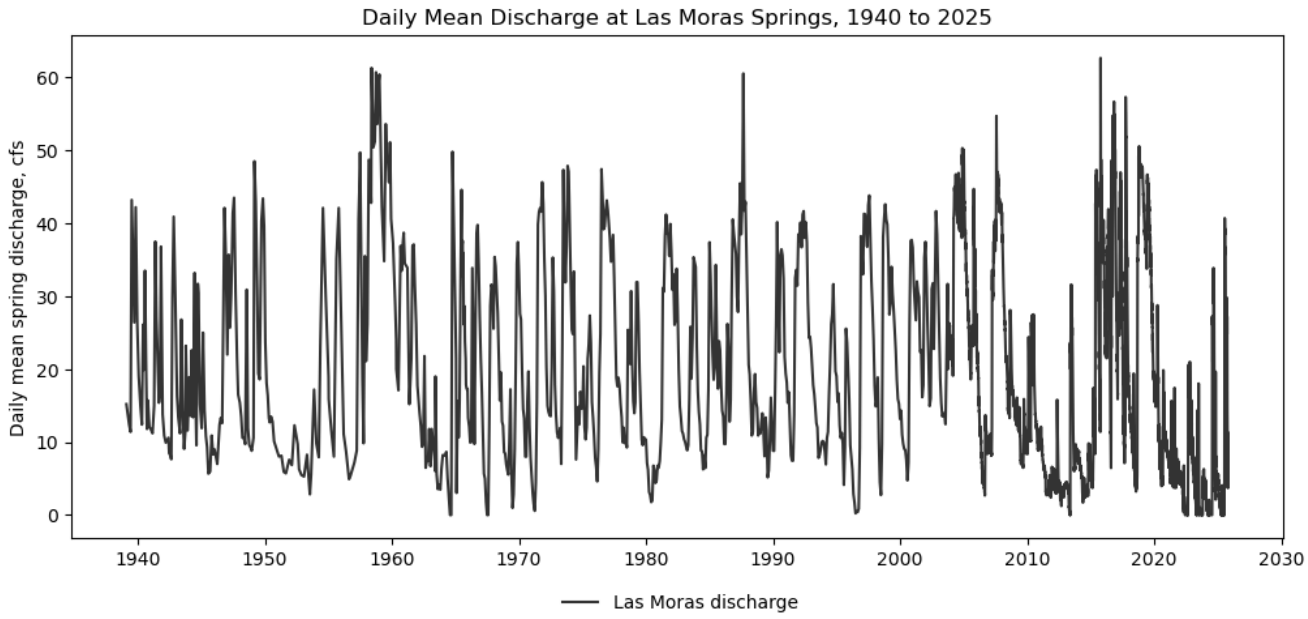
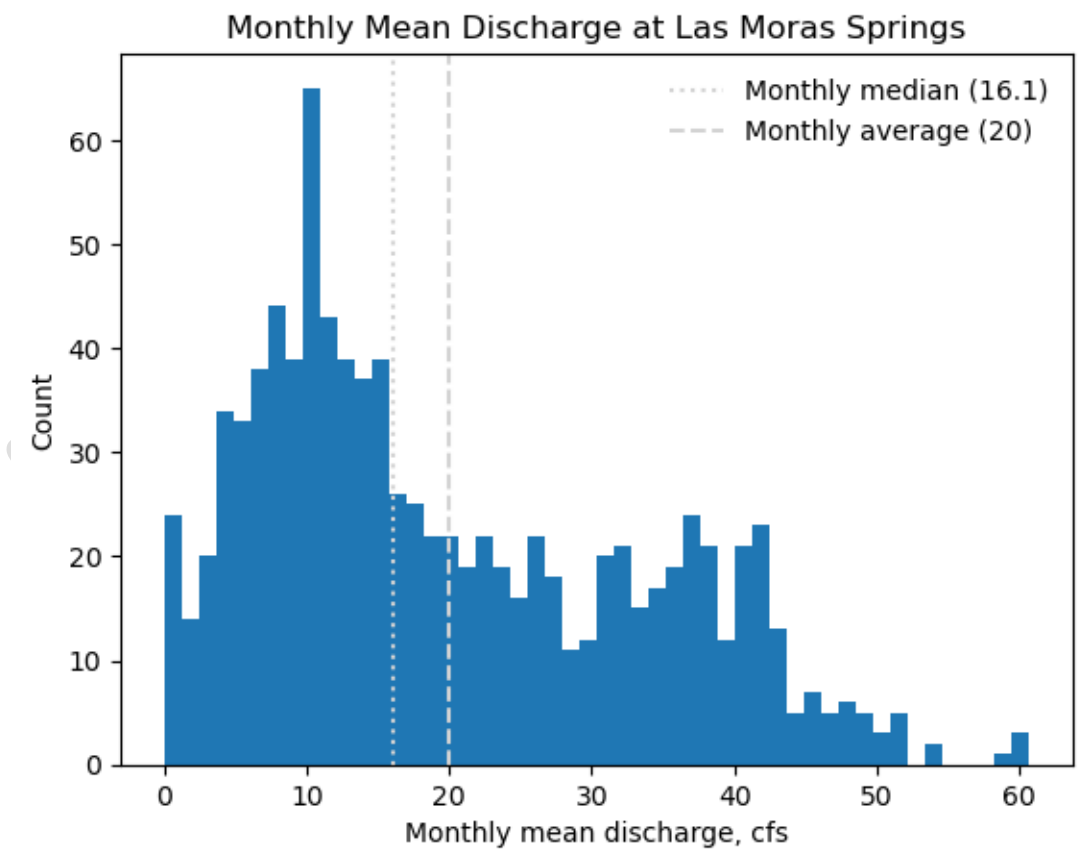
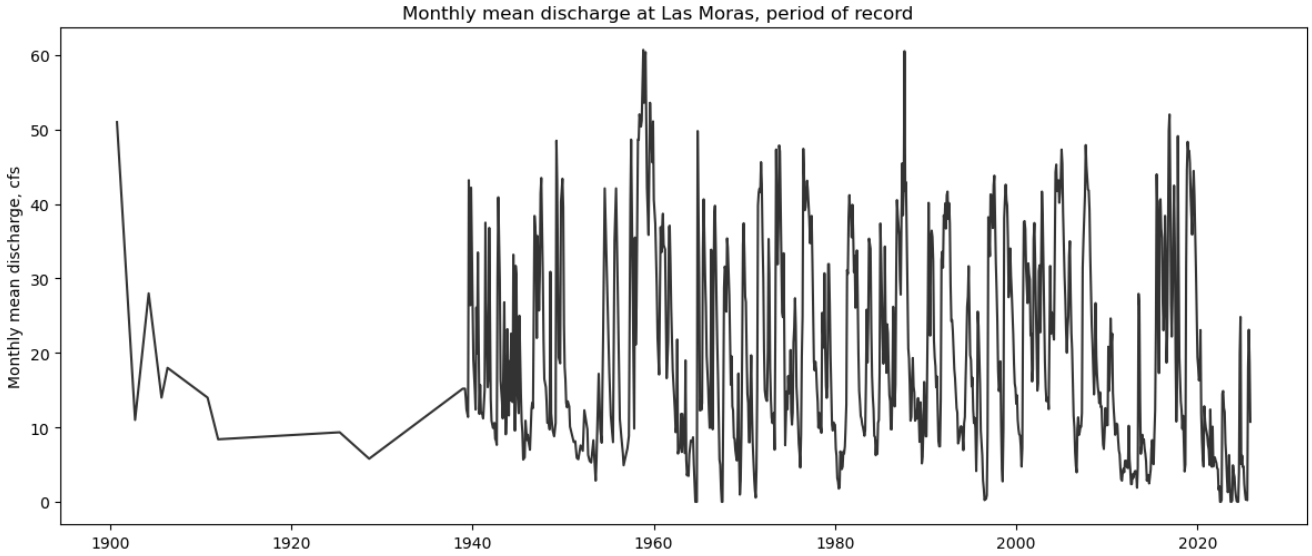
5.00 APPENDIX A – SUMMARY TABLES AND GRAPHS

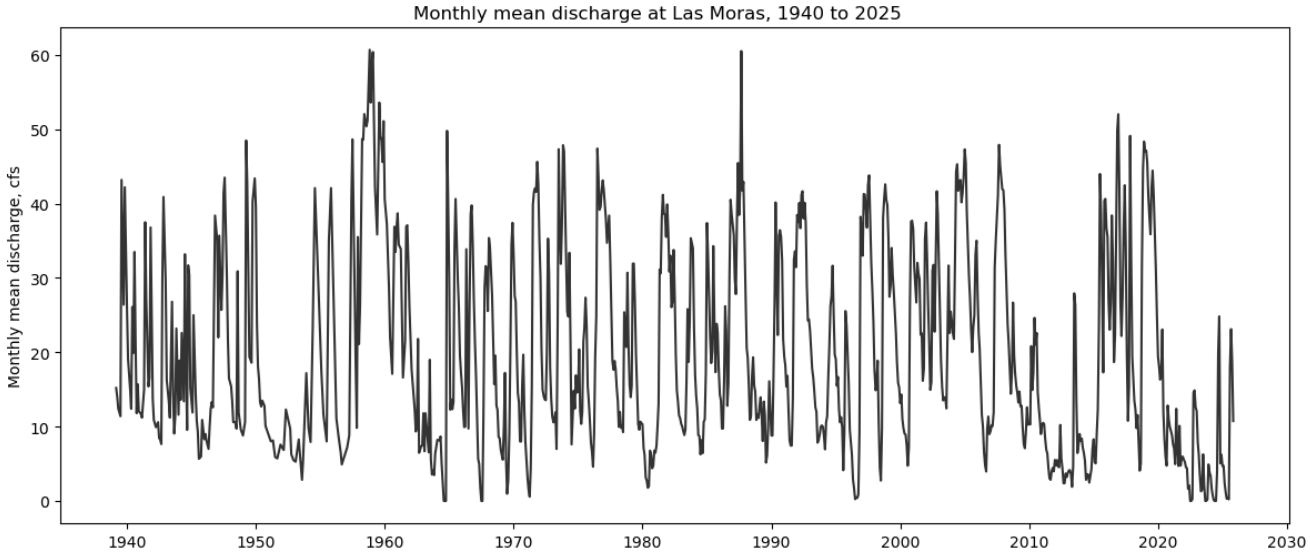


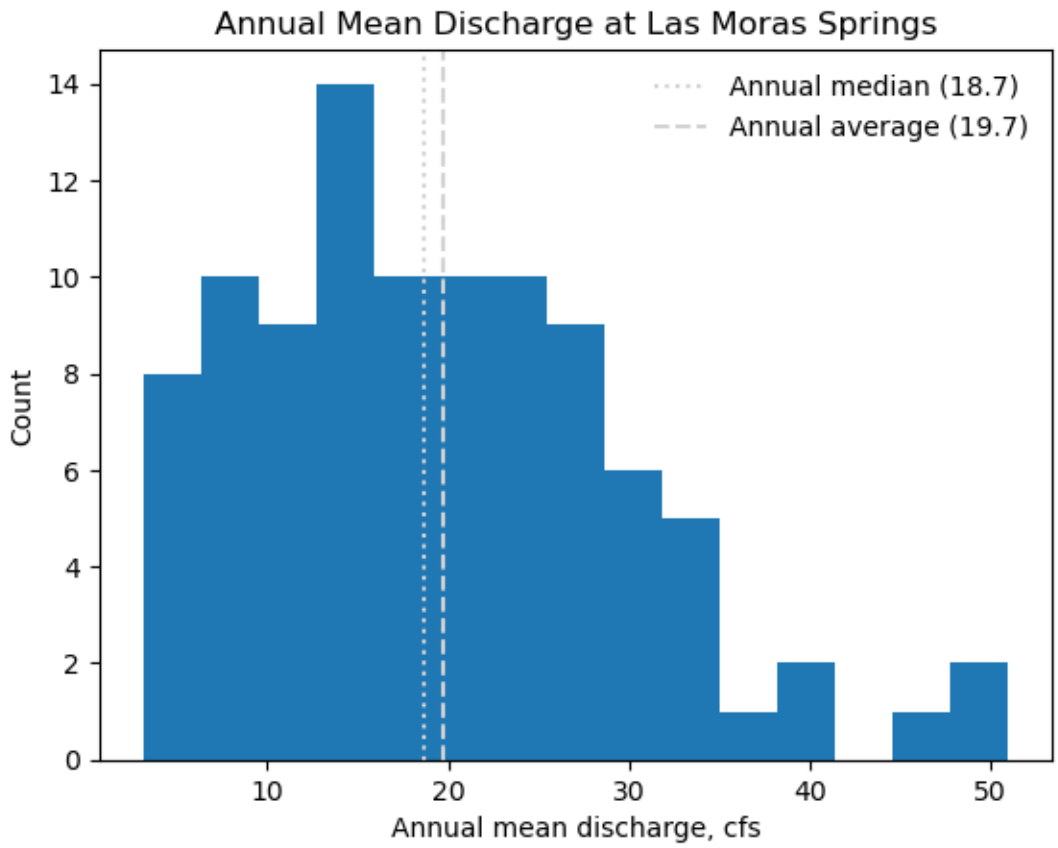



Daily Mean Discharge at Las Moras Springs, 1940 to 2025
Daily mean spring discharge, cfs
0
10
20
30
40
50
60
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
Las Moras discharge


Monthly Mean Discharge at Las Moras Springs
Monthly median (16.1)
Monthly average (20)
Count
0
10
20
30
40
50
60
Monthly mean discharge, cfs


Monthly mean discharge at Las Moras, period of record
Monthly mean discharge, cfs
0
10
20
30
40
50
60
1900
1920
1940
1960
1980
2000
2020


Monthly mean discharge at Las Moras, 1940 to 2025
Monthly mean discharge, cfs
0
10
20
30
40
50
60
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030


Annual Mean Discharge at Las Moras Springs
Annual median (18.7)
Annual average (19.7)
Count
0
2
4
6
8
10
12
14
10
20
30
40
50
Annual mean discharge, cfs

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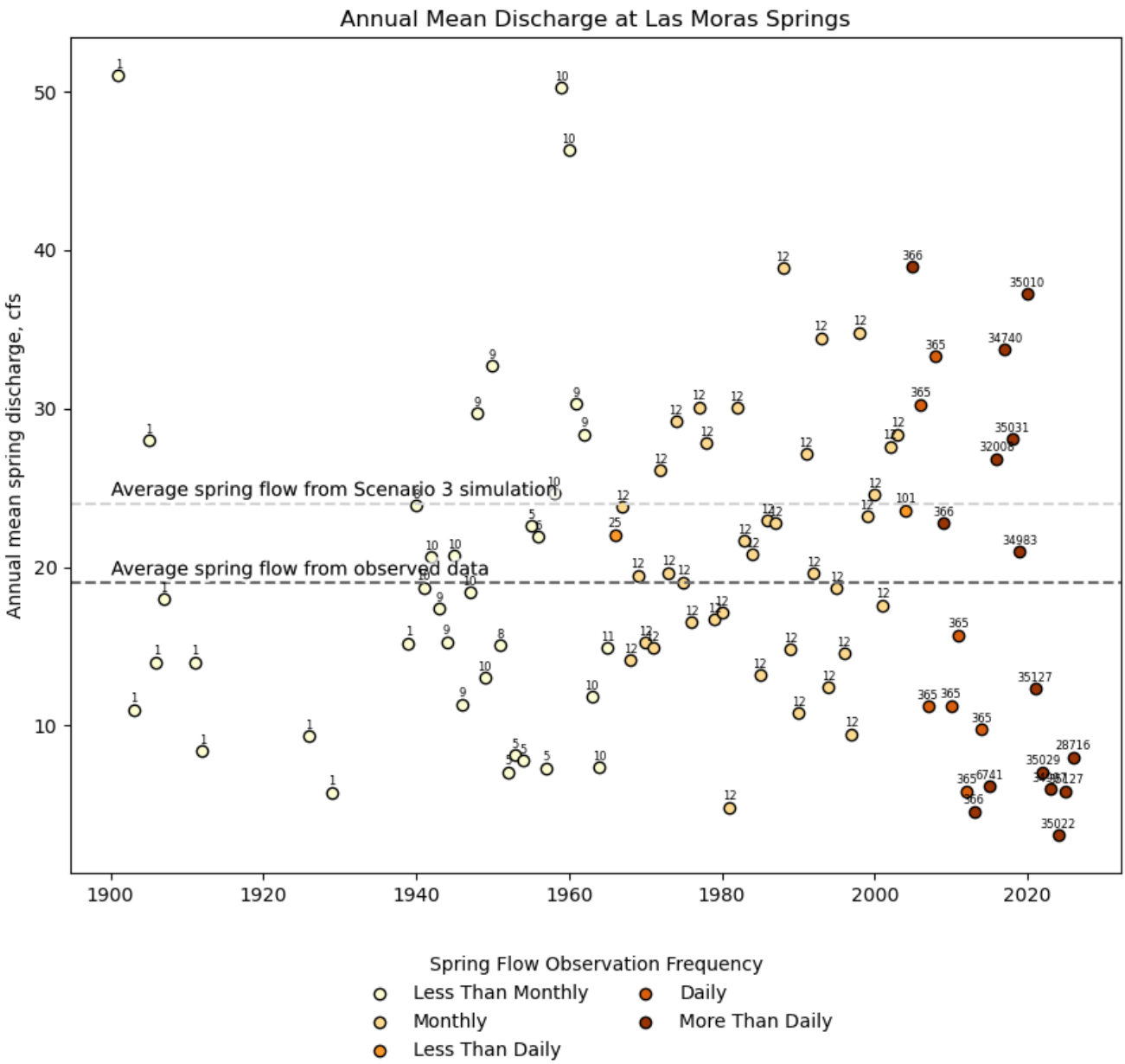
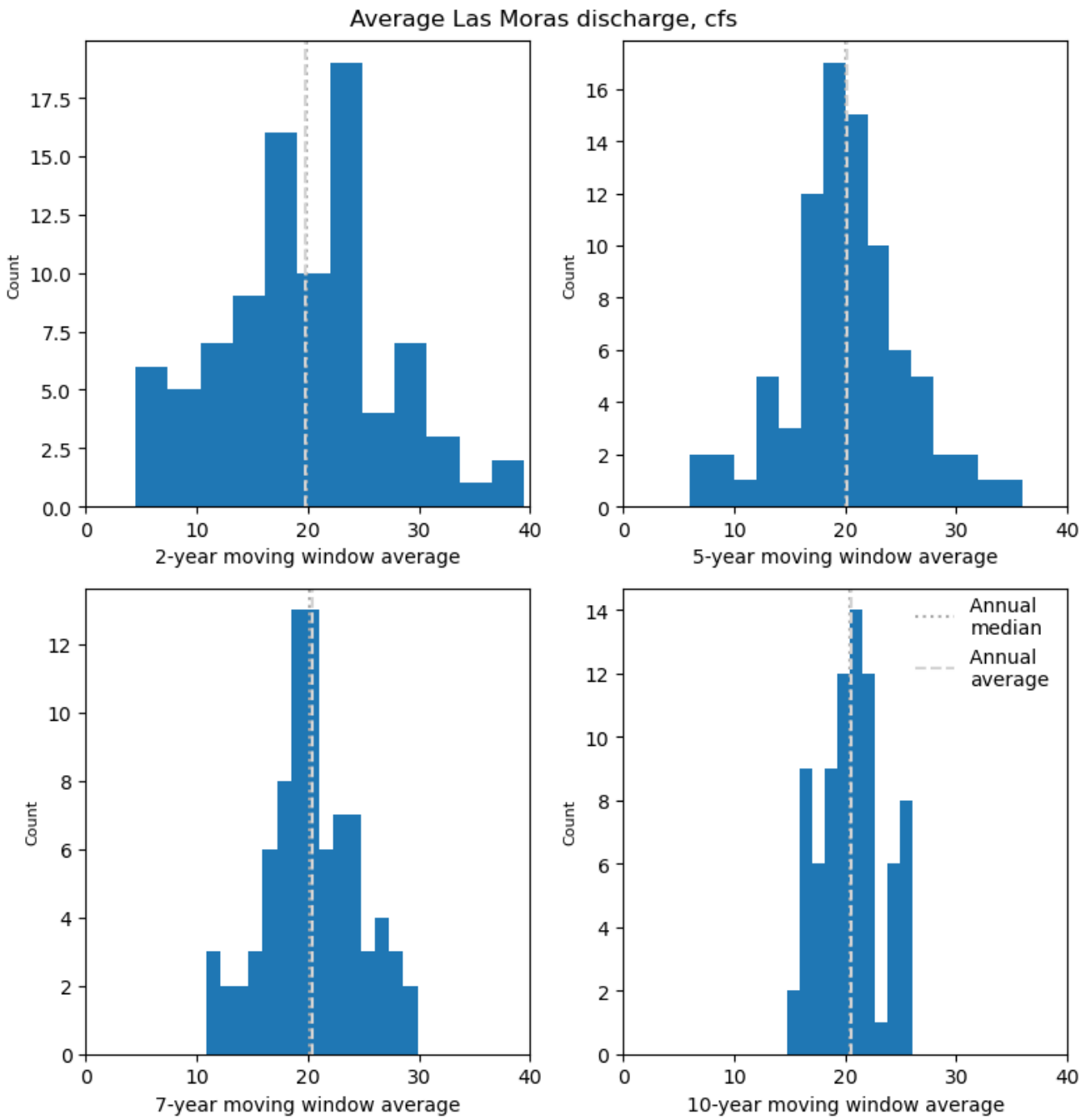

Annual Mean Discharge at Las Moras Springs
Annual mean spring discharge, cfs
Average spring flow from Scenario 3 simulation
Average spring flow from observed data
Spring Flow Observation Frequency
Less Than Monthly
Monthly
Less Than Daily
Daily
More Than Daily


Average Las Moras discharge, cfs
Count
2-year moving window average
5-year moving window average
7-year moving window average
10-year moving window average
Annual median
Annual average

5.01 QUAD-807 CLIMATE DATA

Table 8. Summary statistics (1954 to 2025) for precipitation, gross evaporation, and net evaporation from Quad-807.

	Count	Min.	25%	Median	Mean	75%	Max.	Std. Dev.
Precipitation, in	858	0.0	0.8	1.7	2.1	2.9	16.2	1.8
Gross Evaporation, in	858	1.2	3.5	5.5	5.7	7.5	14.4	2.6
Net Evaporation, in	858	-8.3	1.5	3.3	3.6	5.6	13.7	3.1

Table 9. Summary statistics from moving window analyses from Quad-807 data.

	Count	Min.	25%	Median	Mean	75%	Max.	Std. Dev.
Precipitation, 2-year	835	1.0	1.7	2.2	2.1	2.5	3.1	0.5
Precipitation, 5-year	799	1.3	1.8	2.1	2.1	2.4	2.9	0.4
Precipitation, 7-year	775	1.4	1.9	2.0	2.1	2.4	2.8	0.3
Precipitation, 10-year	739	1.6	1.9	2.1	2.1	2.4	2.7	0.3
Gross Evaporation, 2-year	835	4.6	5.3	5.6	5.7	6.0	7.9	0.6
Gross Evaporation, 5-year	799	4.7	5.3	5.5	5.7	6.0	7.5	0.5
Gross Evaporation, 7-year	775	5.0	5.4	5.6	5.7	5.9	7.0	0.4
Gross Evaporation, 10-year	739	5.2	5.4	5.6	5.6	5.8	6.8	0.3
Net Evaporation, 2-year	835	1.9	2.9	3.5	3.6	4.2	6.6	1.0
Net Evaporation, 5-year	799	2.4	2.9	3.5	3.6	4.0	6.0	0.7
Net Evaporation, 7-year	775	2.5	2.9	3.4	3.5	4.0	5.3	0.7
Net Evaporation, 10-year	739	2.6	3.0	3.5	3.5	3.9	5.1	0.6

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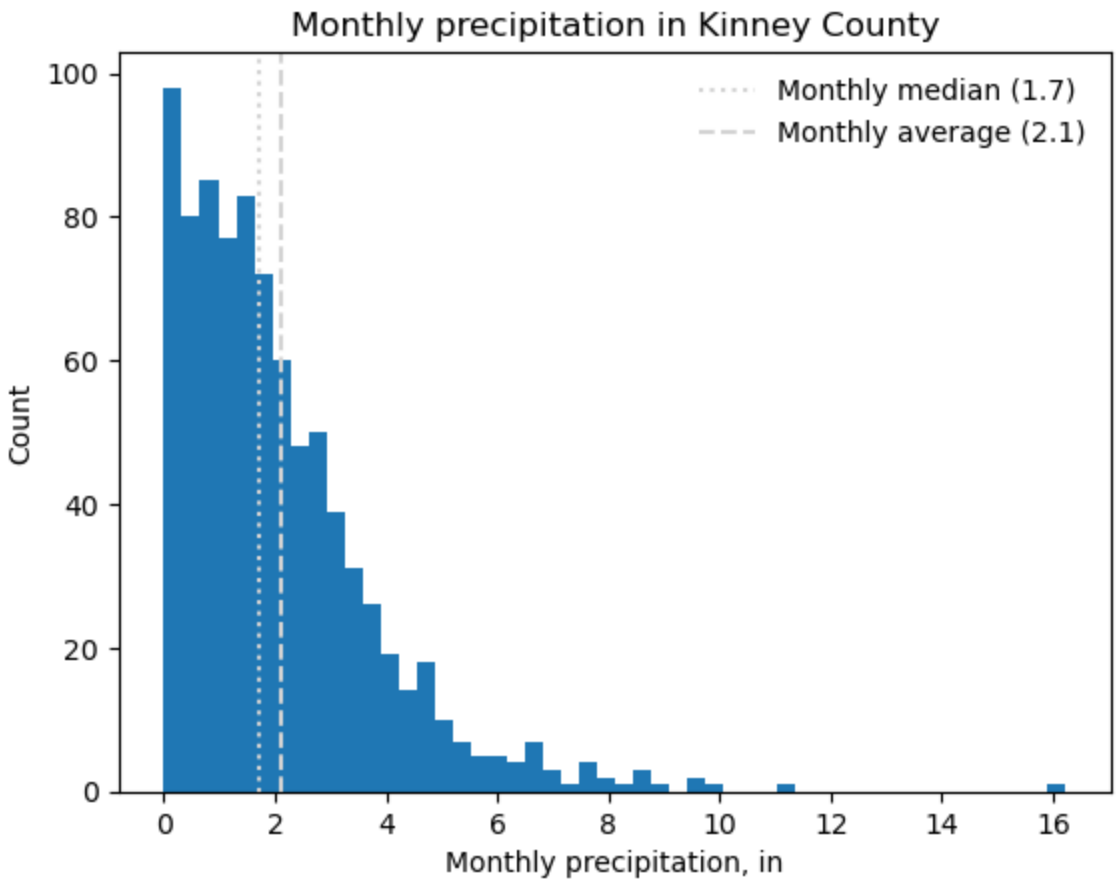
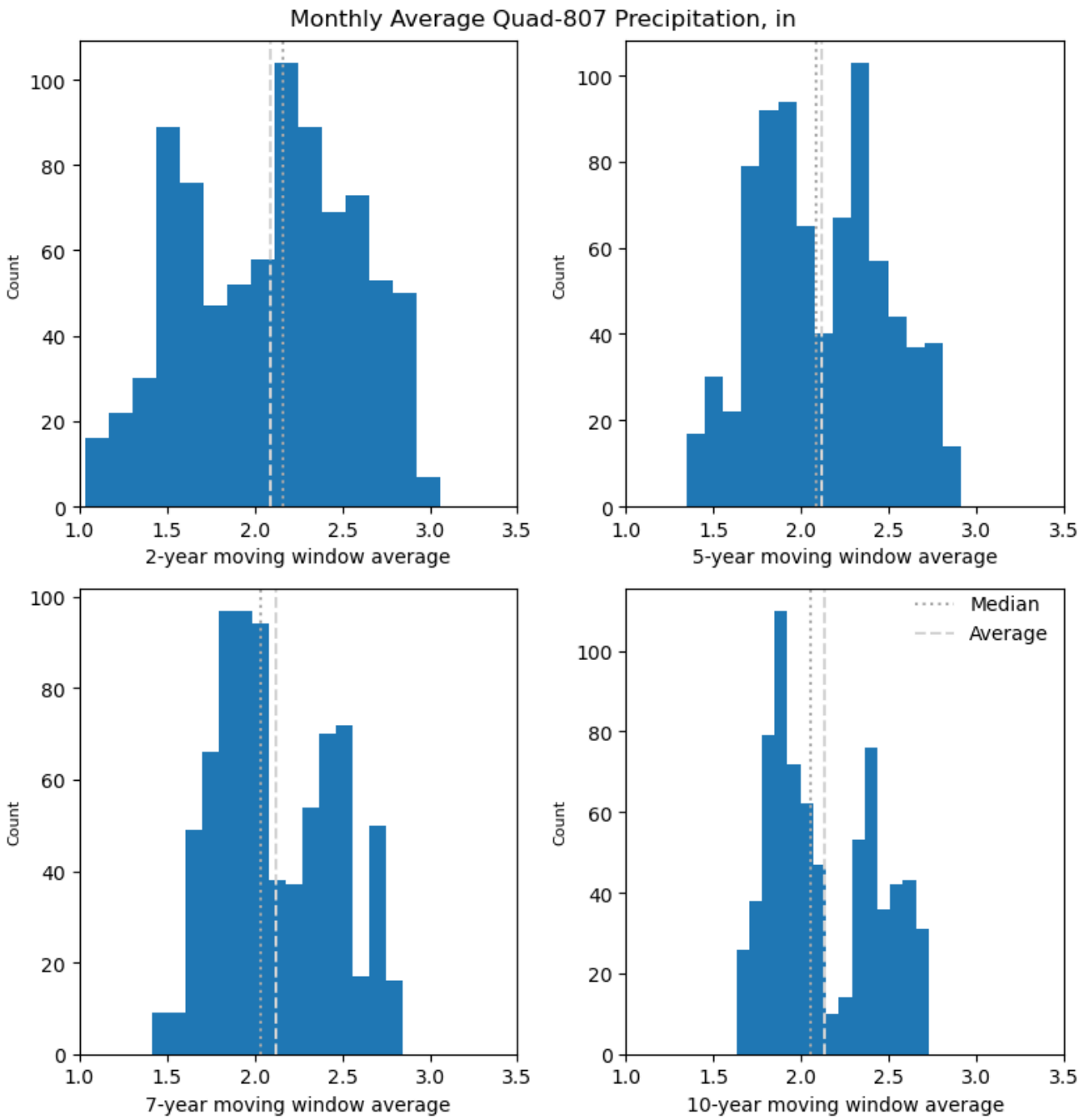
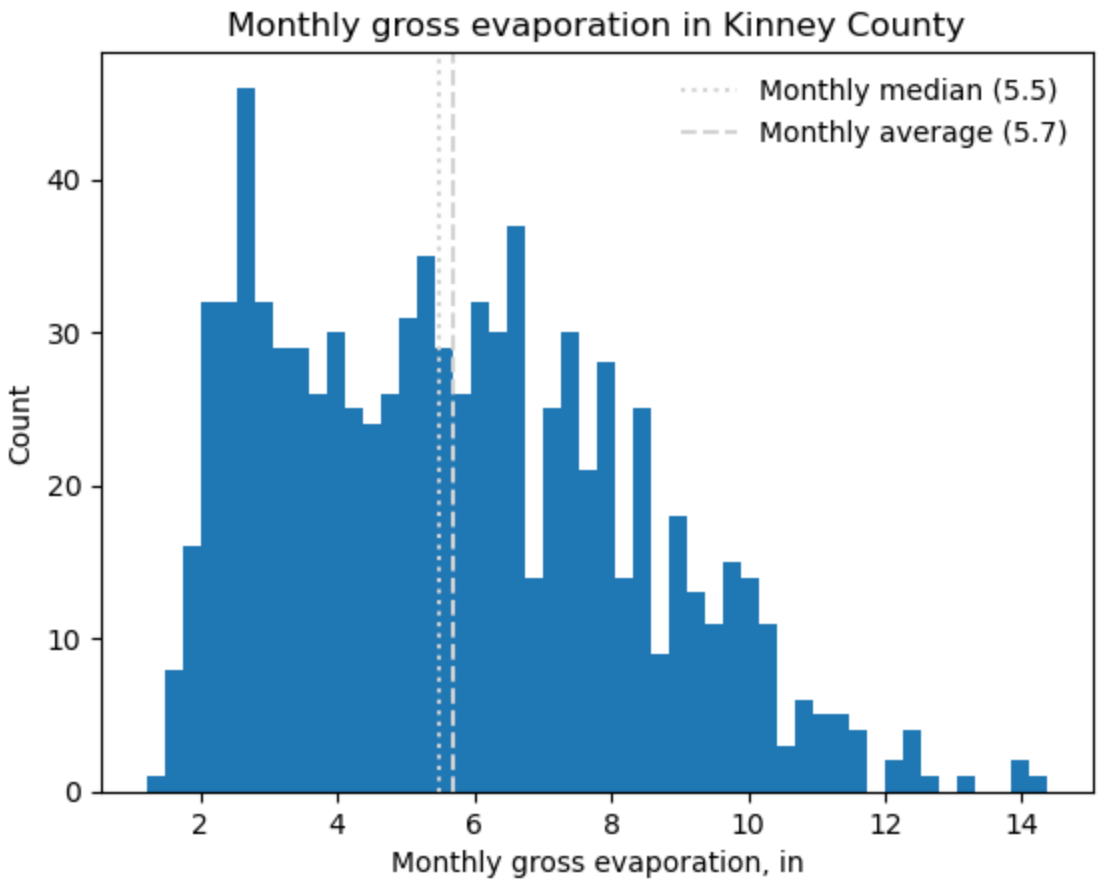
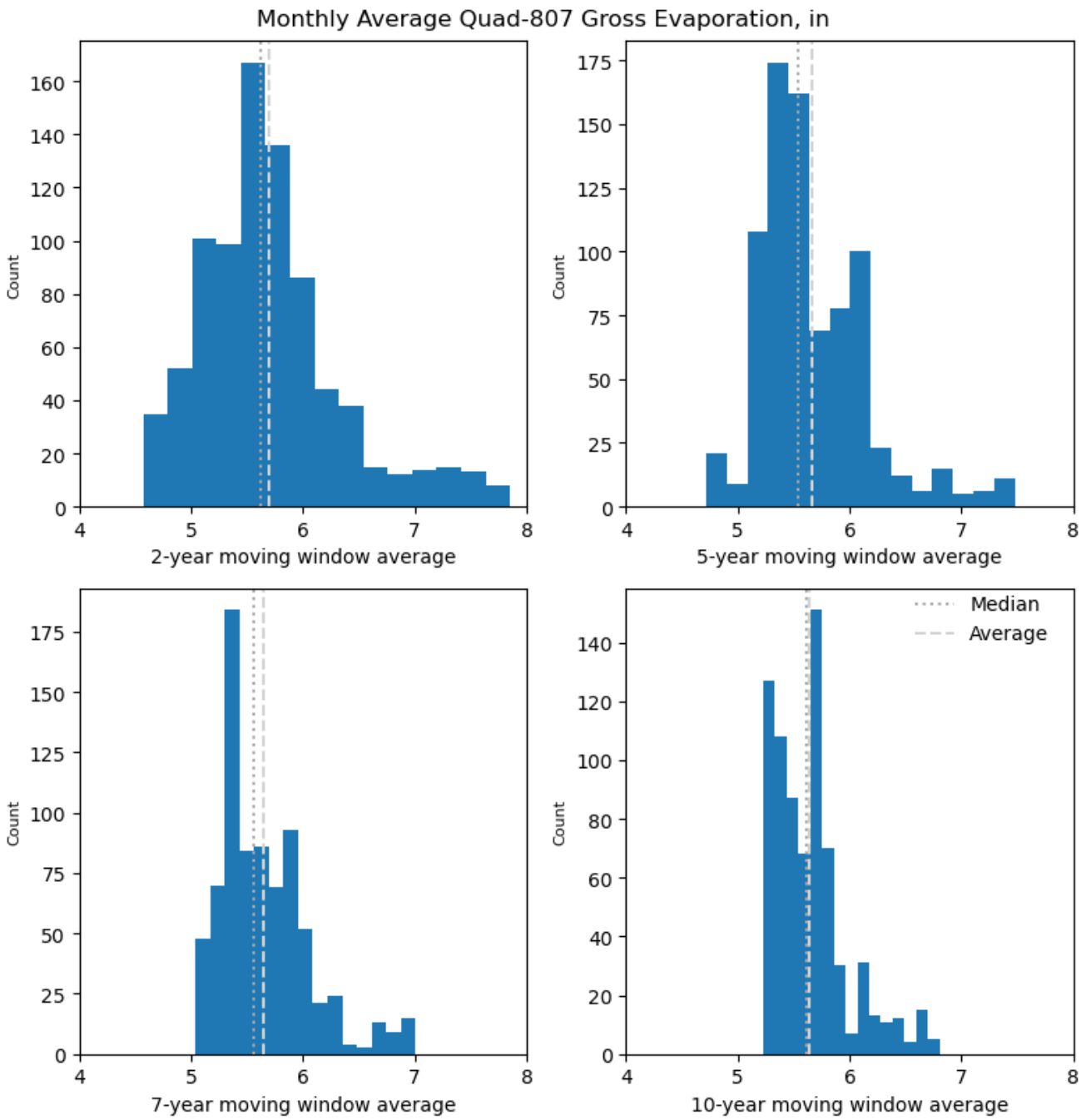

Monthly precipitation in Kinney County
Monthly median (1.7)
Monthly average (2.1)
Count
Monthly precipitation, in
0
20
40
60
80
100
0
2
4
6
8
10
12
14
16

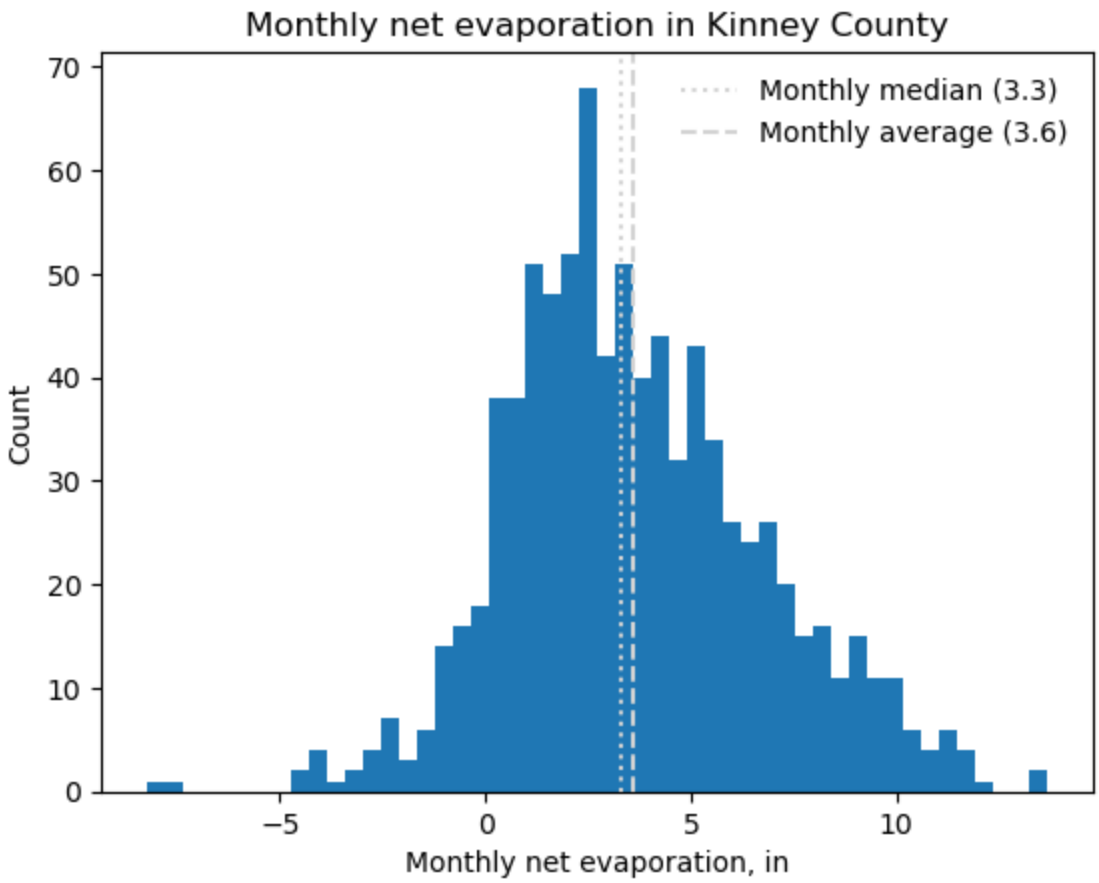
DRAFT


Monthly Average Quad-807 Precipitation, in
Count
2-year moving window average
5-year moving window average
7-year moving window average
10-year moving window average
Median
Average

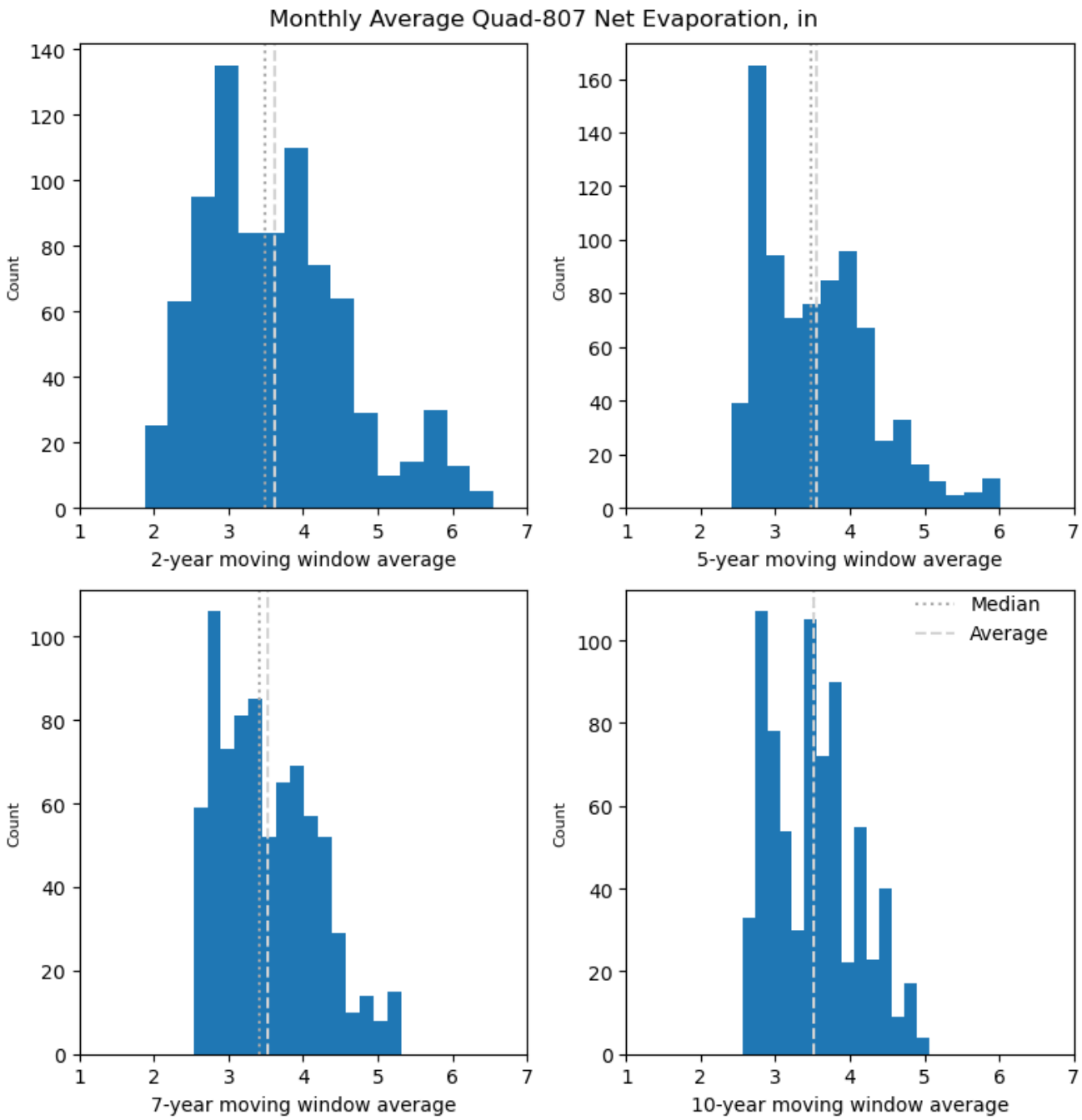

Monthly gross evaporation in Kinney County
Monthly median (5.5)
Monthly average (5.7)
Count
0
10
20
30
40
2
4
6
8
10
12
14
Monthly gross evaporation, in

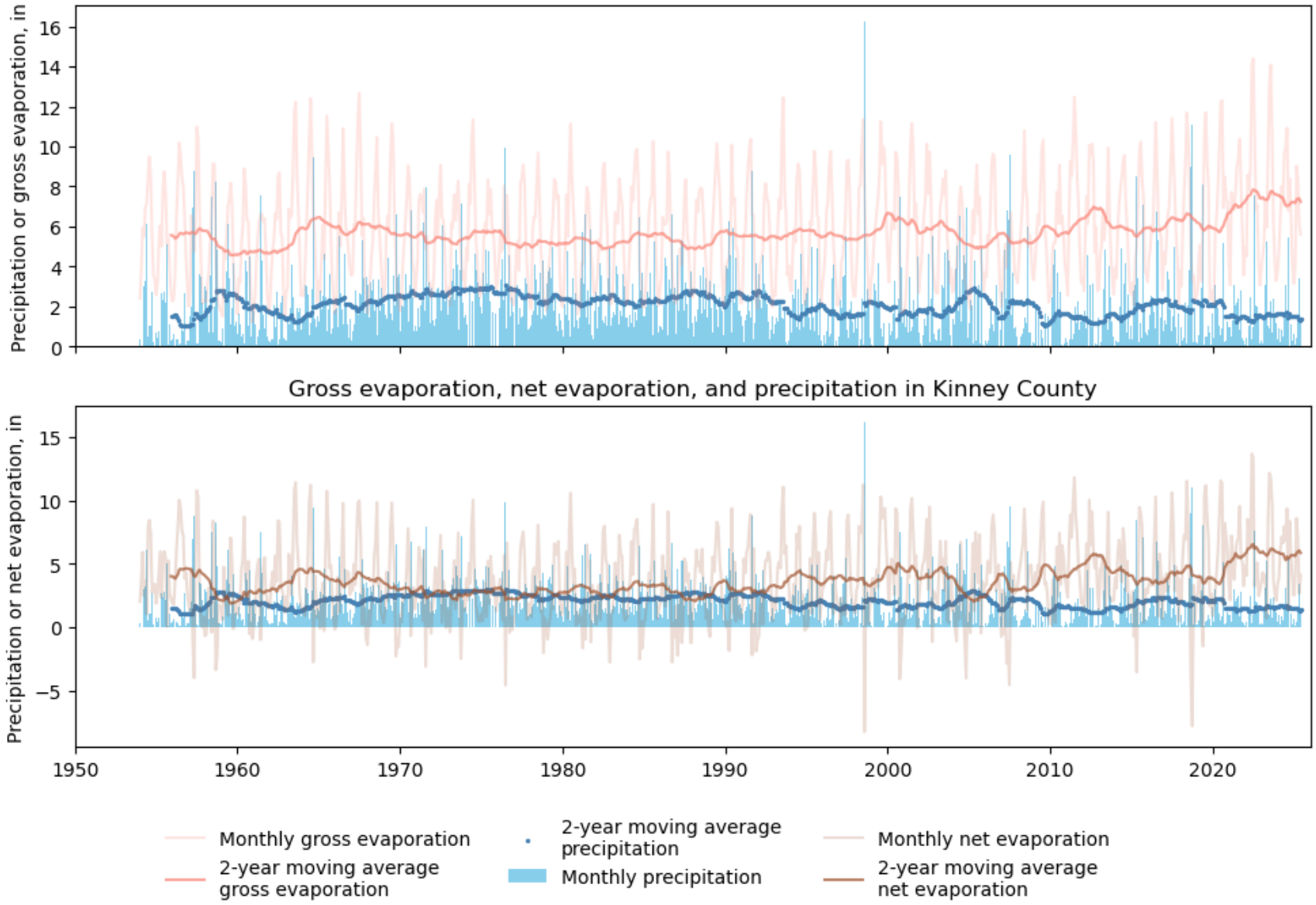
DRAFT


Monthly Average Quad-807 Gross Evaporation, in
Count
2-year moving window average
5-year moving window average
7-year moving window average
10-year moving window average
Median
Average

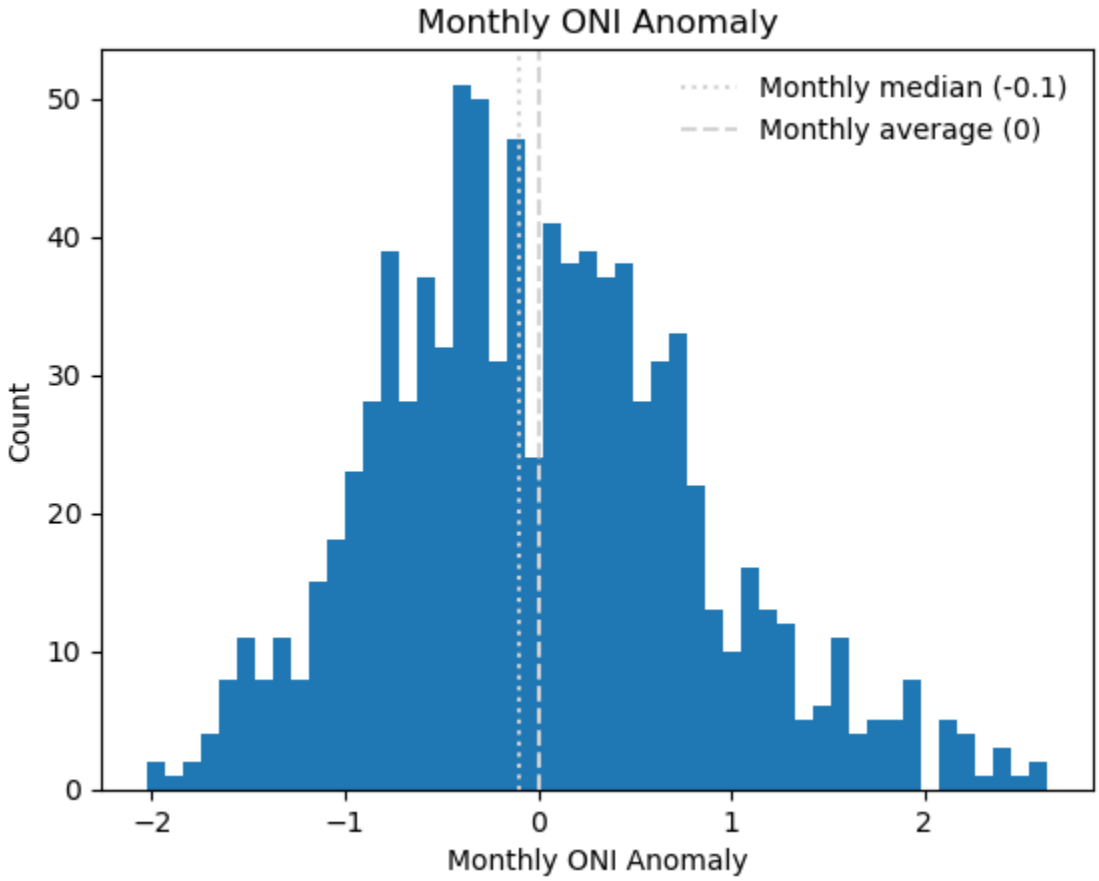

Monthly net evaporation in Kinney County
Monthly median (3.3)
Monthly average (3.6)
Count
Monthly net evaporation, in
70
60
50
40
30
20
10
0
−5
0
5
10

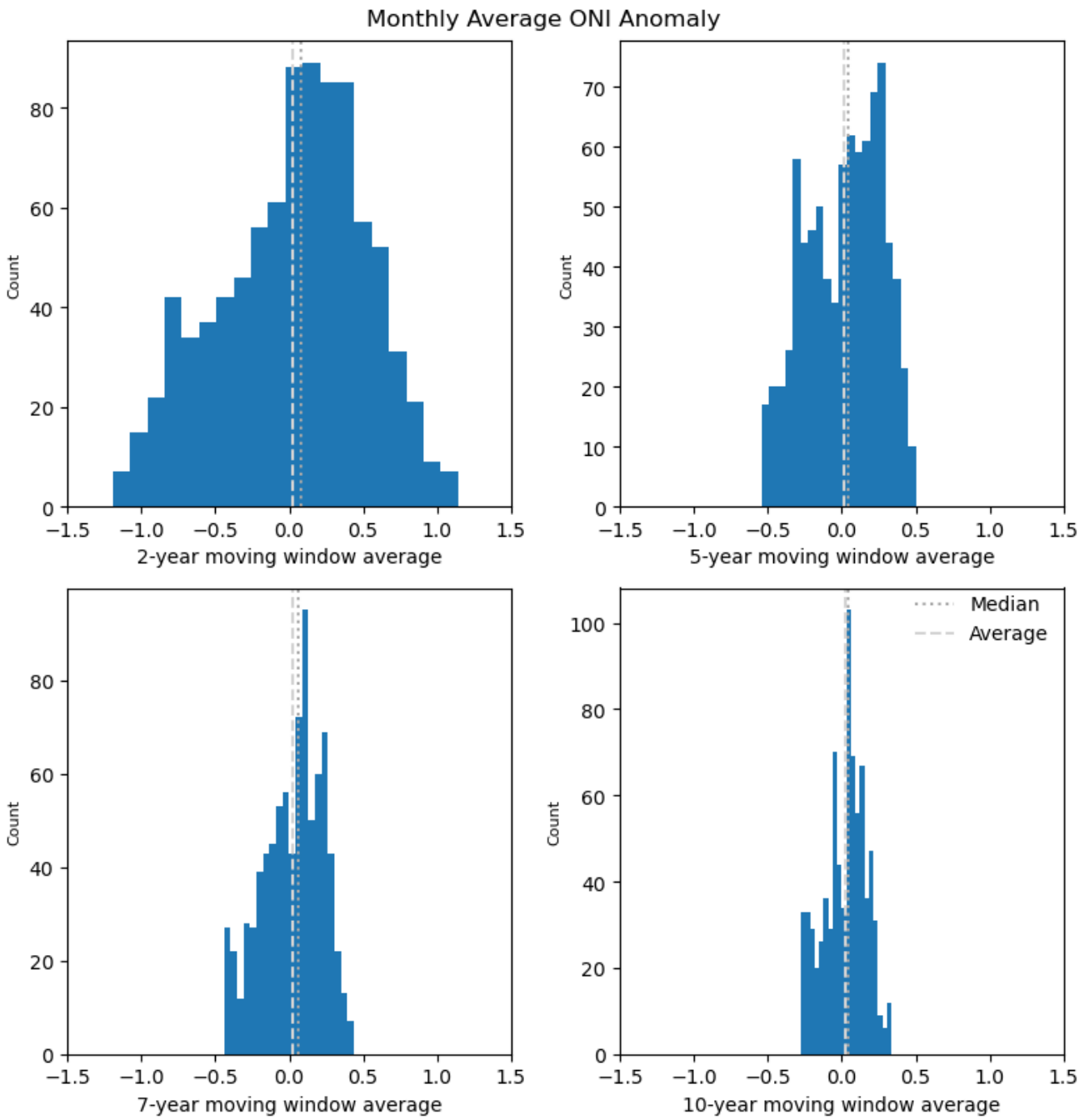
DRAFT

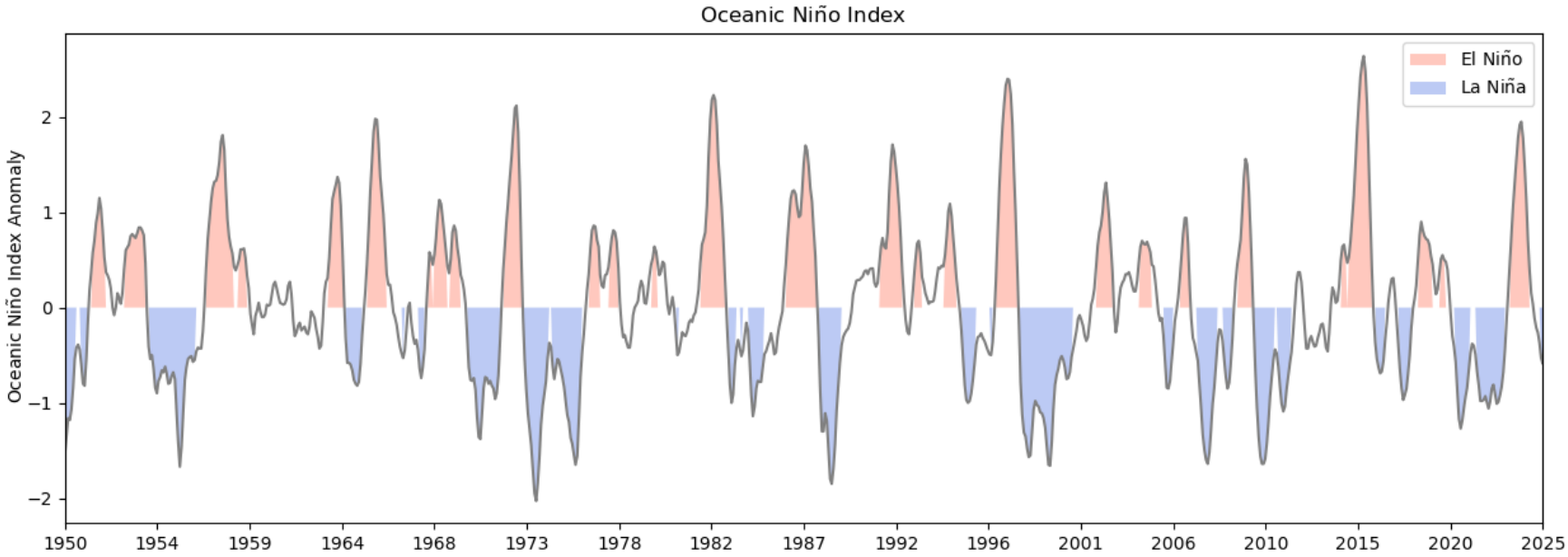

Monthly Average Quad-807 Net Evaporation, in
Count
2-year moving window average
5-year moving window average
7-year moving window average
10-year moving window average
Median
Average


Precipitation or gross evaporation, in
0
2
4
6
8
10
12
14
16
Gross evaporation, net evaporation, and precipitation in Kinney County
Precipitation or net evaporation, in
−5
0
5
10
15
1950
1960
1970
1980
1990
2000
2010
2020
Monthly gross evaporation
2-year moving average gross evaporation
2-year moving average precipitation
Monthly precipitation
Monthly net evaporation
2-year moving average net evaporation

5.02 OCEANIC NIÑO INDEX ANOMALY




Monthly Average ONI Anomaly
Count
2-year moving window average
5-year moving window average
7-year moving window average
10-year moving window average
Median
Average


Oceanic Niño Index
El Niño
La Niña
Oceanic Niño Index Anomaly
2
1
0
−1
−2
1950
1954
1959
1964
1968
1973
1978
1982
1987
1992
1996
2001
2006
2010
2015
2020
2025

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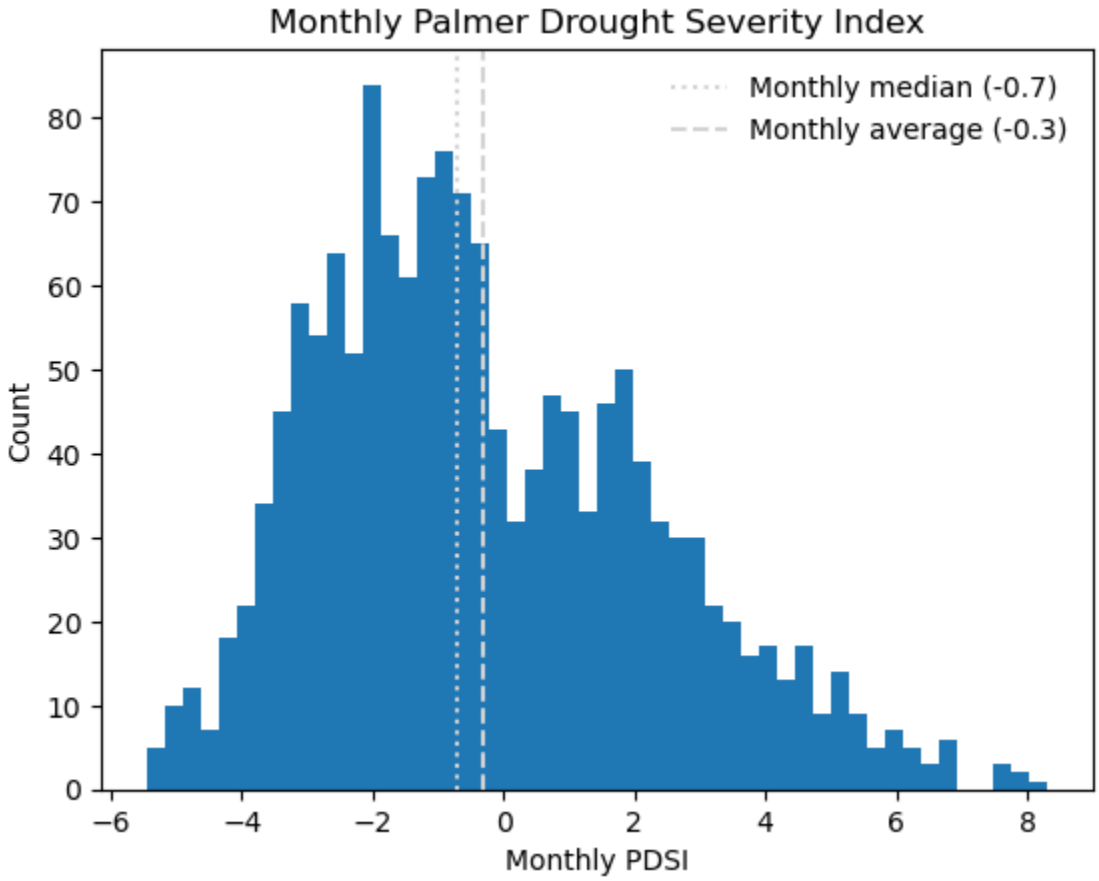
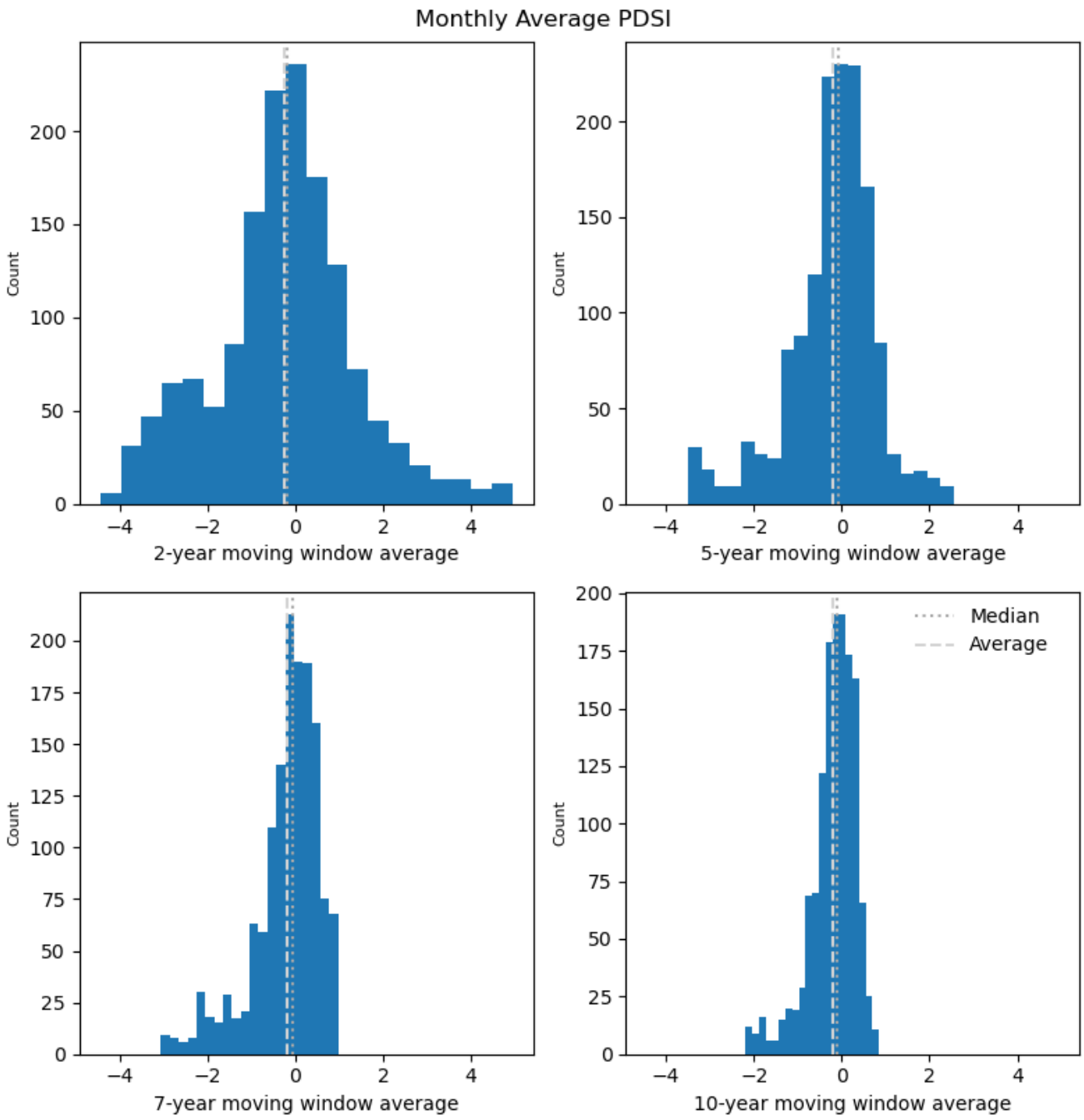
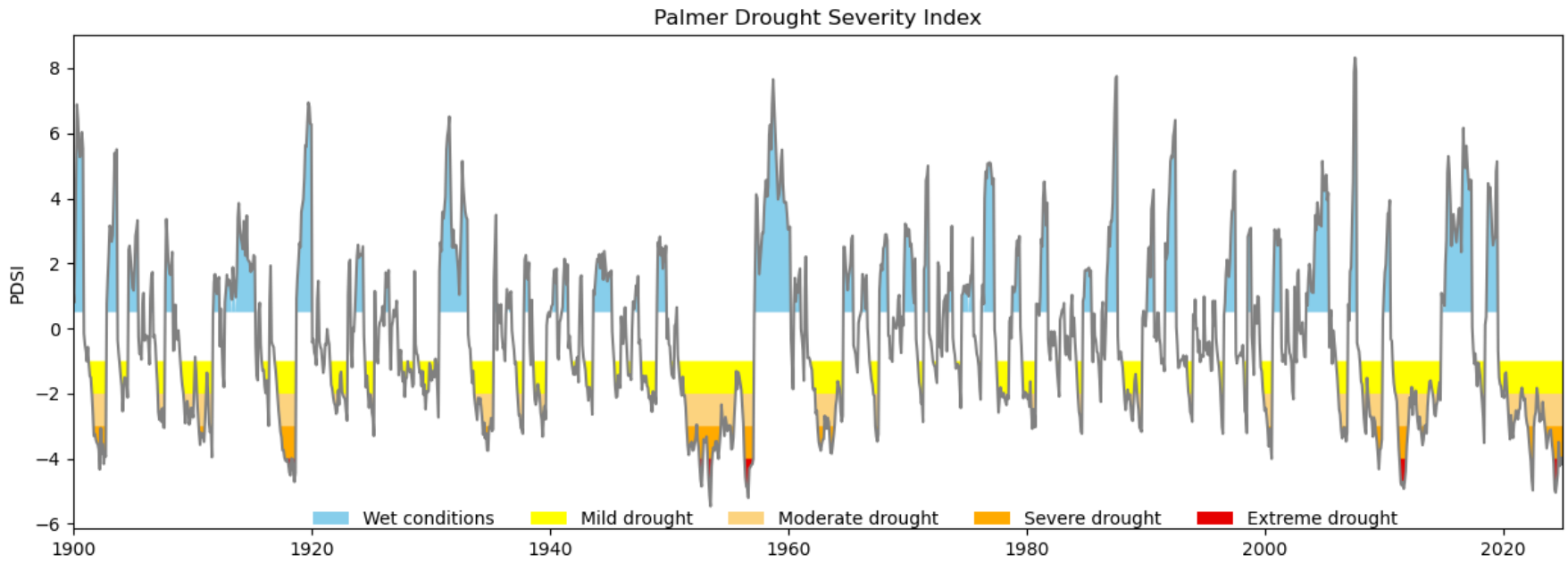
5.03 PALMER DROUGHT SEVERITY INDEX




Monthly Average PDSI
Count
2-year moving window average
5-year moving window average
7-year moving window average
10-year moving window average
Median
Average


Palmer Drought Severity Index
PDSI
8
6
4
2
0
−2
−4
−6
1900
1920
1940
1960
1980
2000
2020
Wet conditions
Mild drought
Moderate drought
Severe drought
Extreme drought

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5.04 GROUNDWATER PUMPING VOLUMES

Summary statistics for measured groundwater volumes by aquifer and GMA 7 in Kinney County.

	Count	Min.	25%	Median	Mean	75%	Max.	Std. Dev.
Edwards	22	2,868	4,416	4,850	5,649	6,963	9,590	1,996
Austin Chalk	22	3	40	175	327	500	1,009	353
Other	22	5	12	42	68	119	222	66
Unknown	22	0	0	8	51	41	551	124
GMA 7 Edwards	22	2,824	3,886	4,643	5,288	6,744	9,071	1,927
GMA 7 Austin Chalk	22	3	40	175	316	487	1,009	351
GMA 7 Other	22	5	12	42	68	119	222	66
GMA 7 Unknown	22	0	0	8	51	41	551	124

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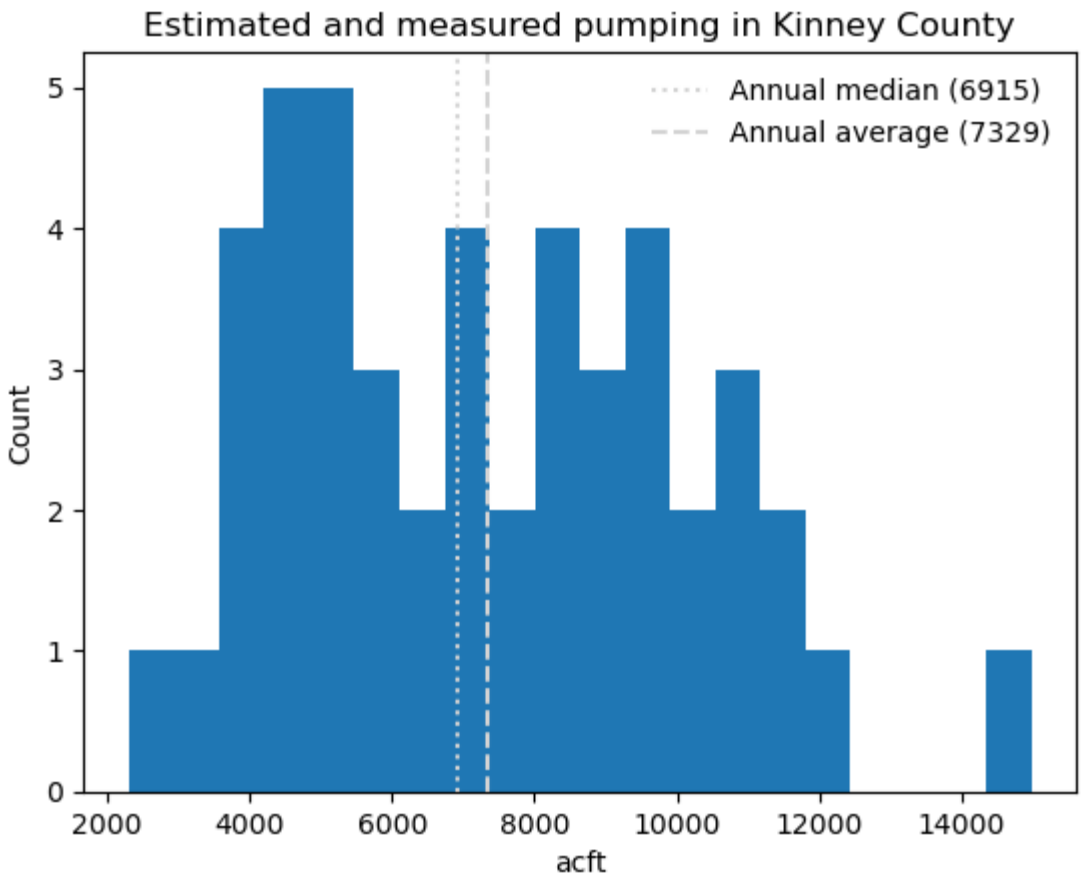
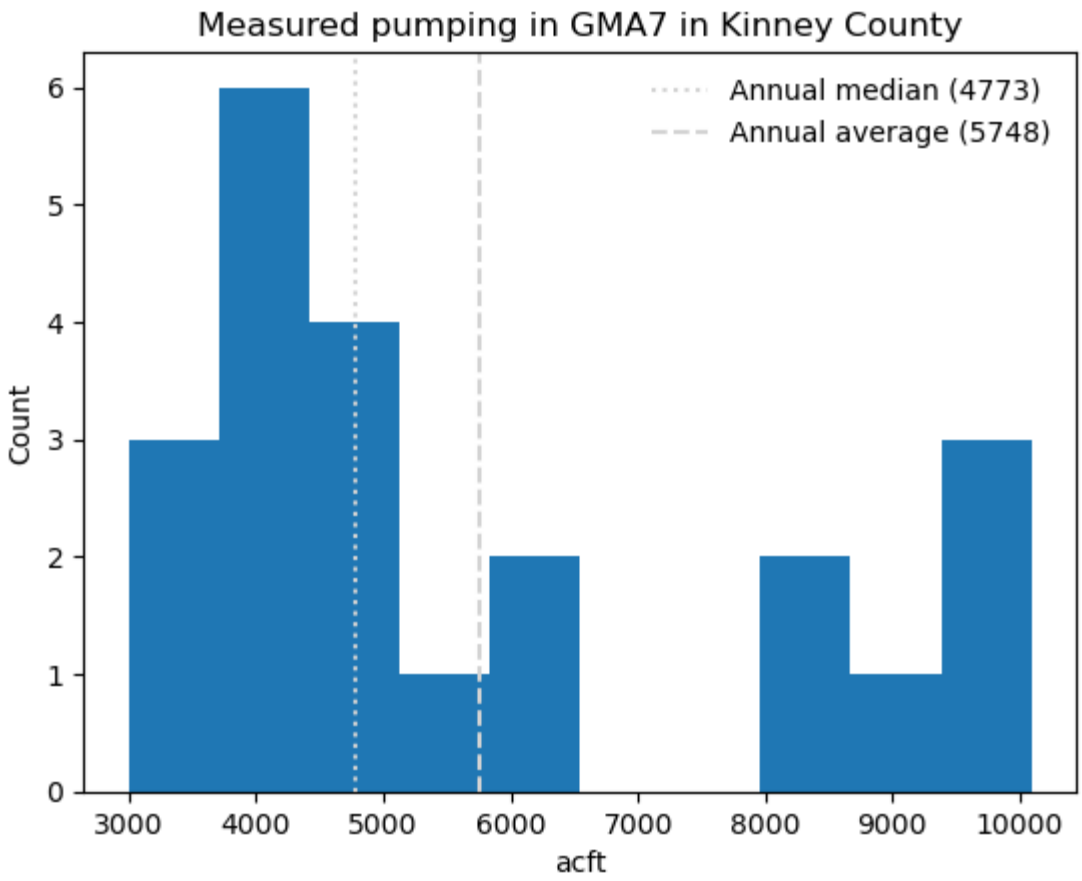
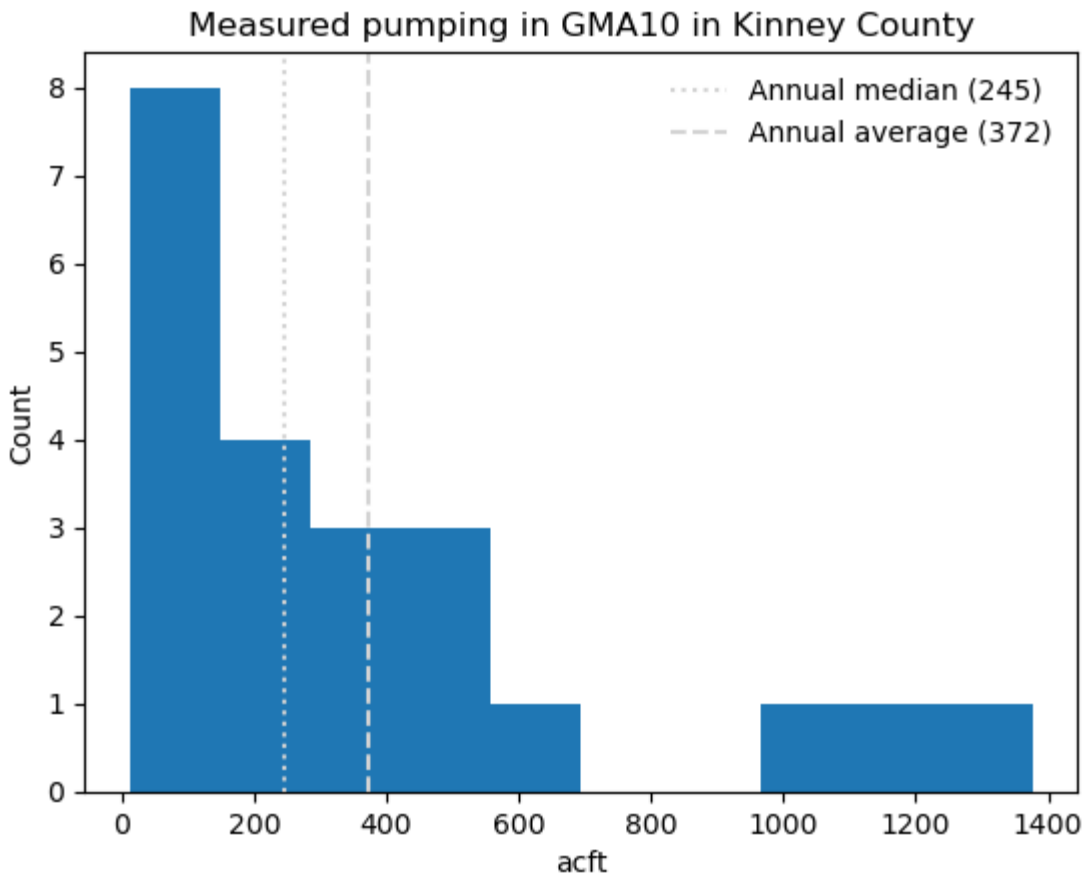
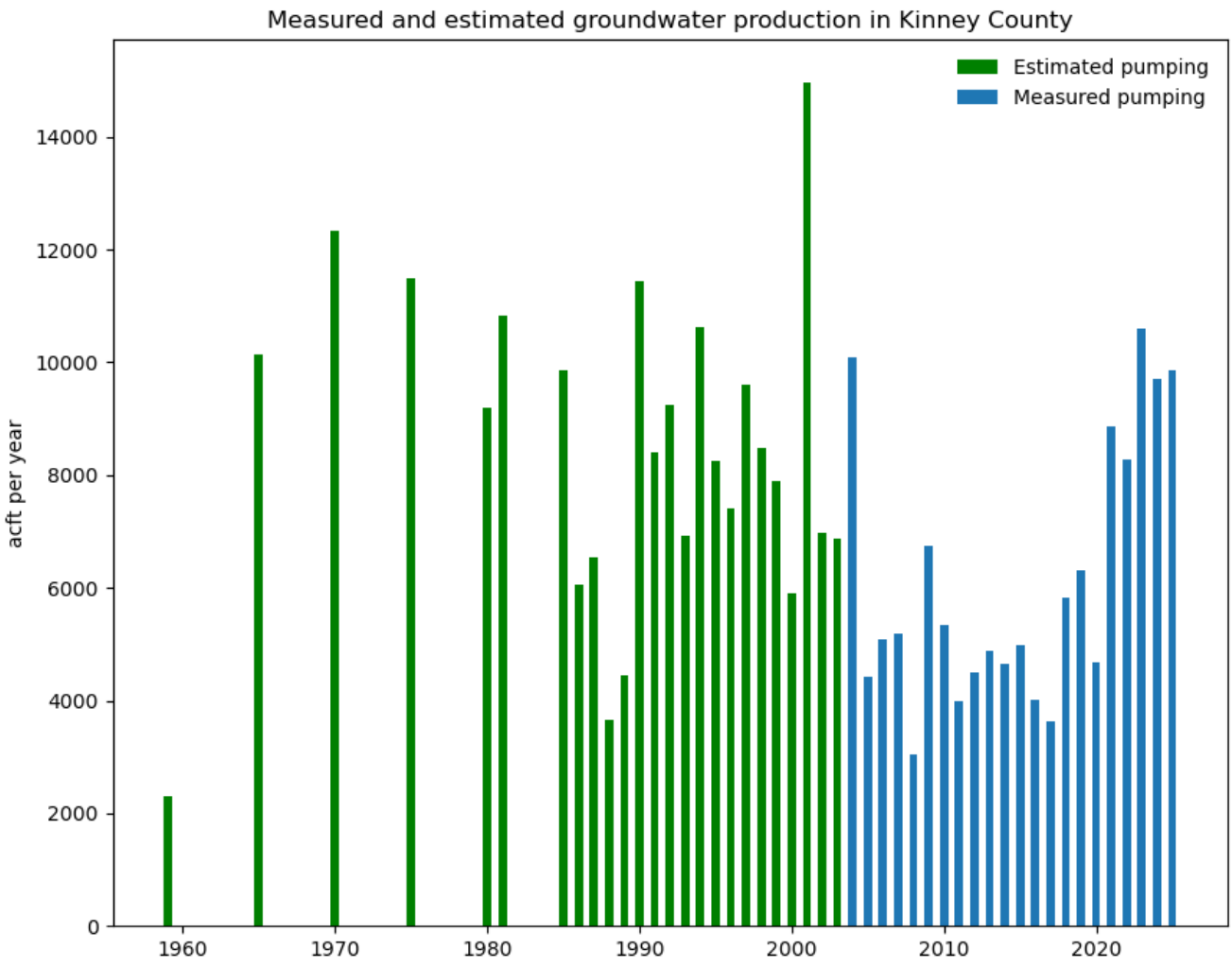

Estimated and measured pumping in Kinney County
Annual median (6915)
Annual average (7329)
Count
acft
0
1
2
3
4
5
2000
4000
6000
8000
10000
12000
14000

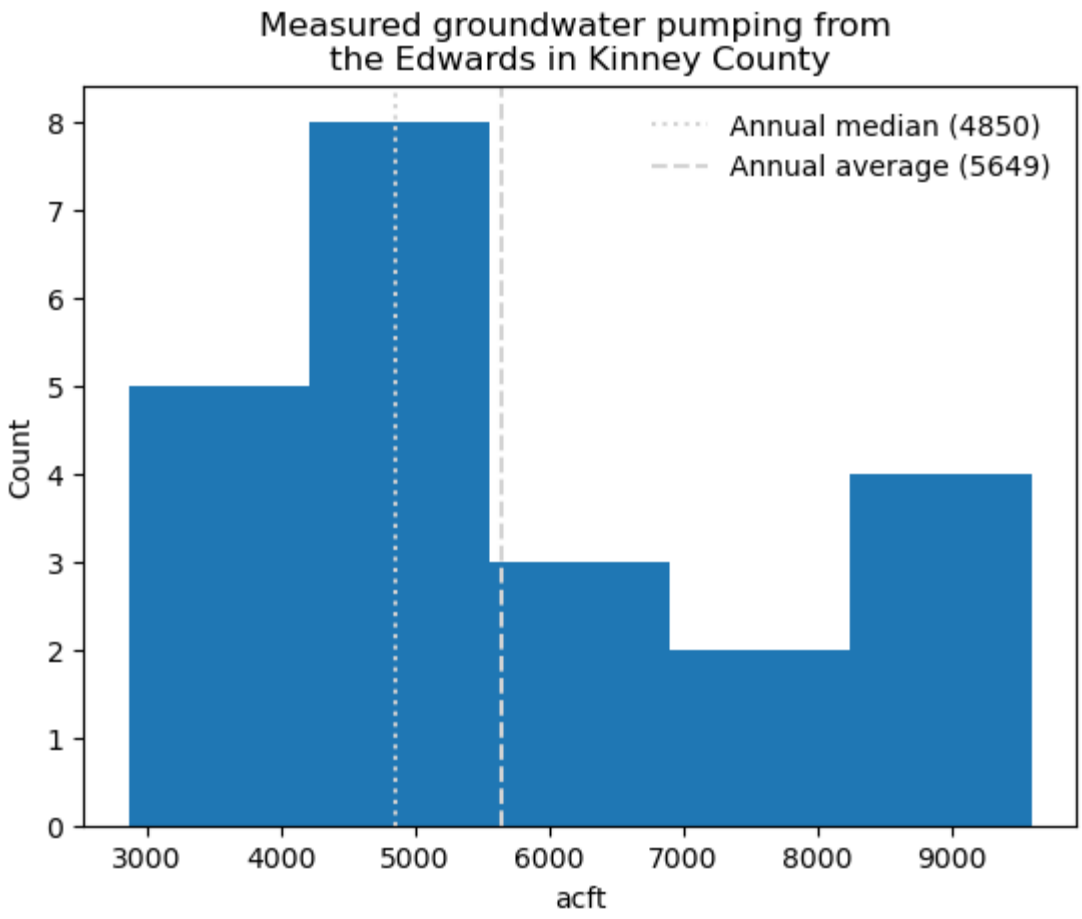

Measured pumping in GMA7 in Kinney County
Annual median (4773)
Annual average (5748)
Count
acft
0
1
2
3
4
5
6
3000
4000
5000
6000
7000
8000
9000
10000

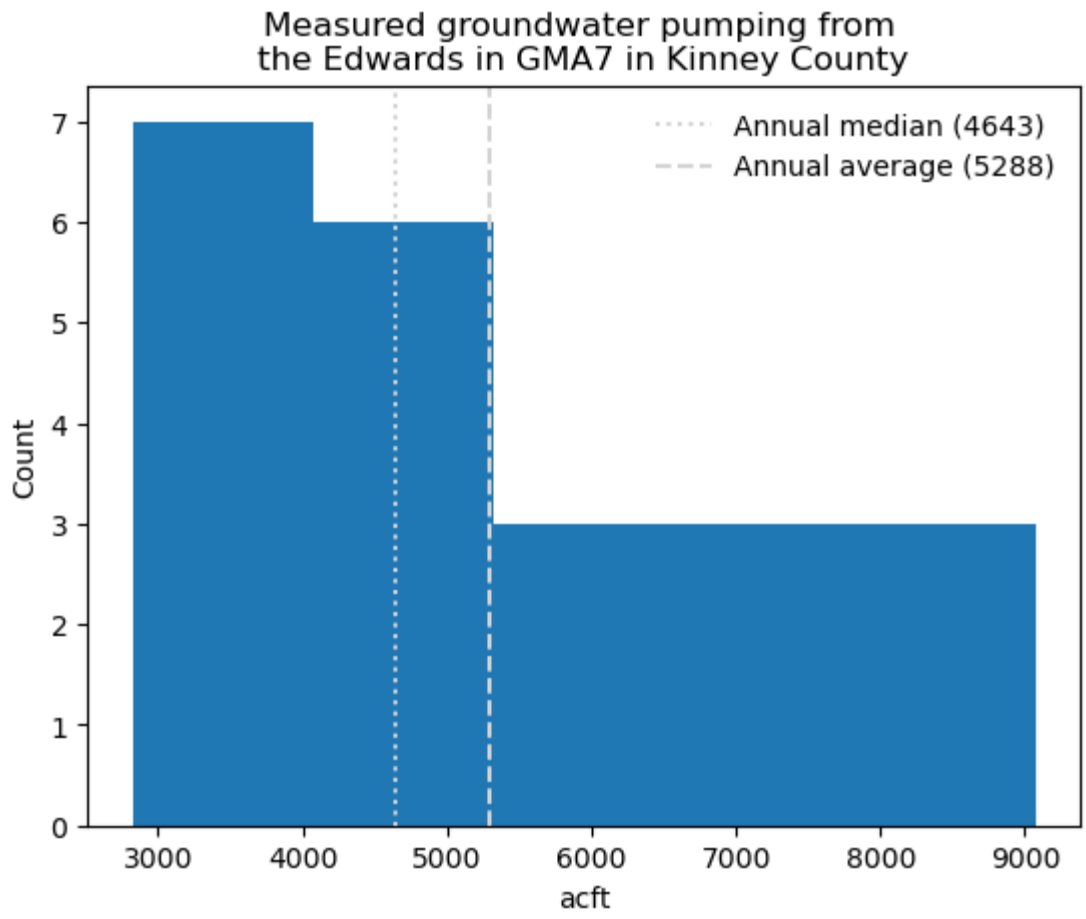
DRAFT

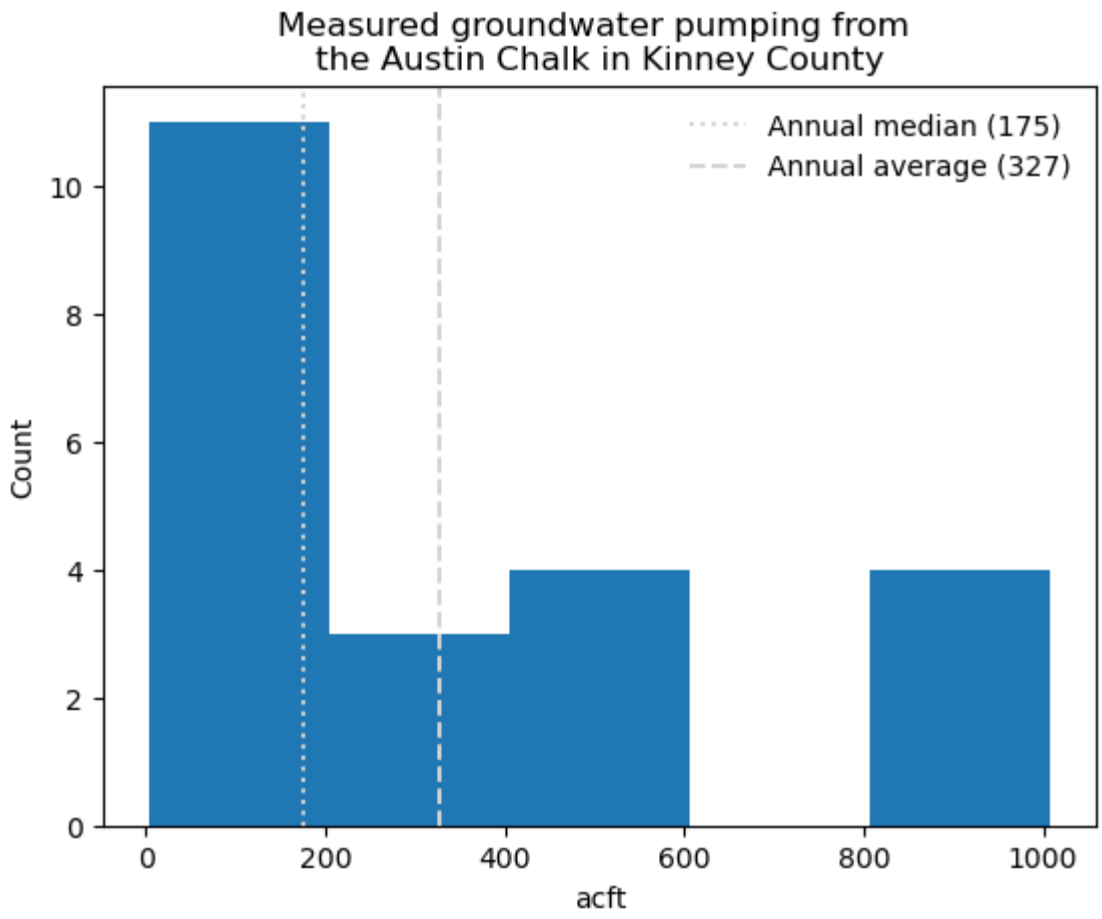

Measured pumping in GMA10 in Kinney County
Annual median (245)
Annual average (372)
Count
acft
0
1
2
3
4
5
6
7
8
0
200
400
600
800
1000
1200
1400

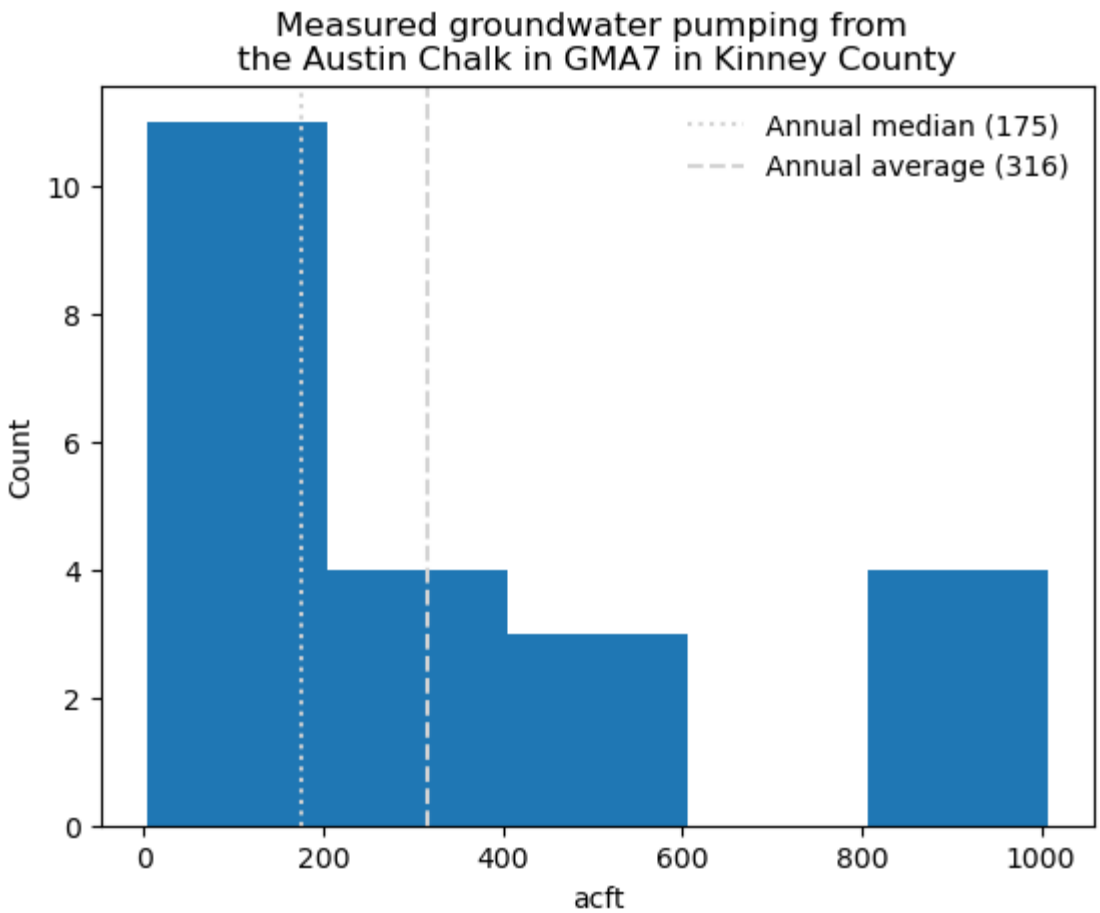
DRAFT

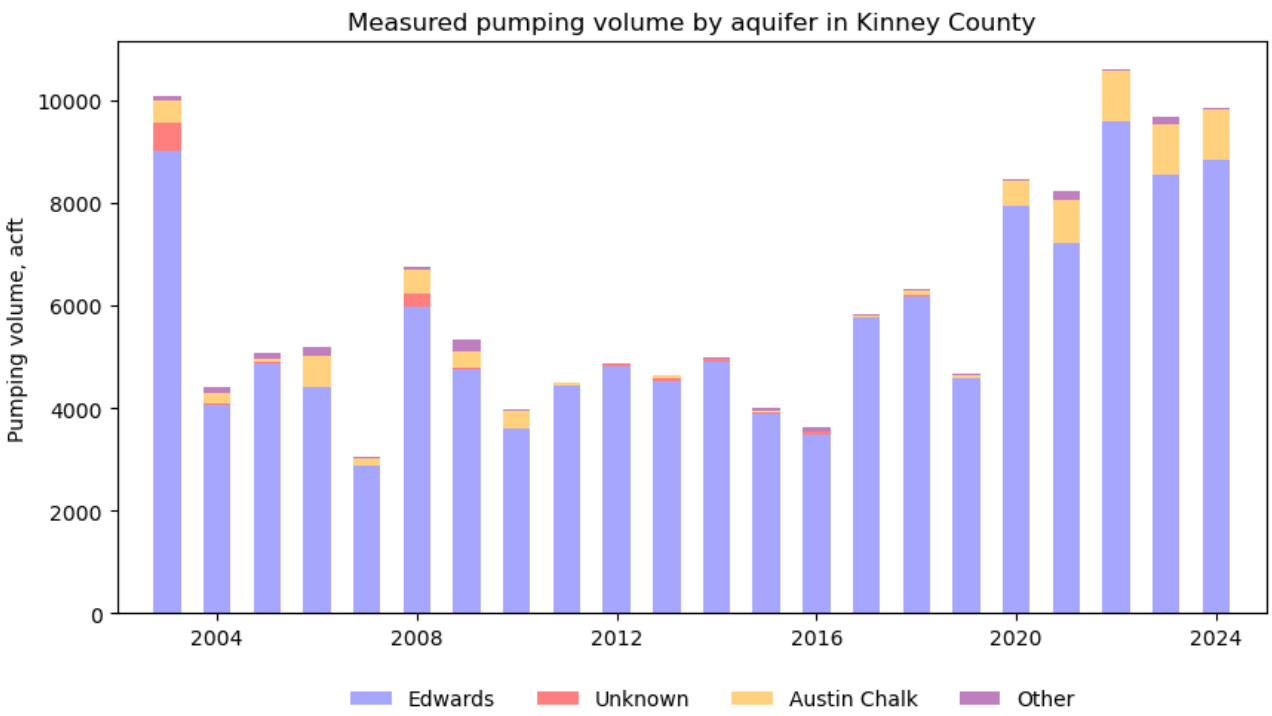

Measured and estimated groundwater production in Kinney County
Estimated pumping
Measured pumping
acft per year
0
2000
4000
6000
8000
10000
12000
14000
1960
1970
1980
1990
2000
2010
2020

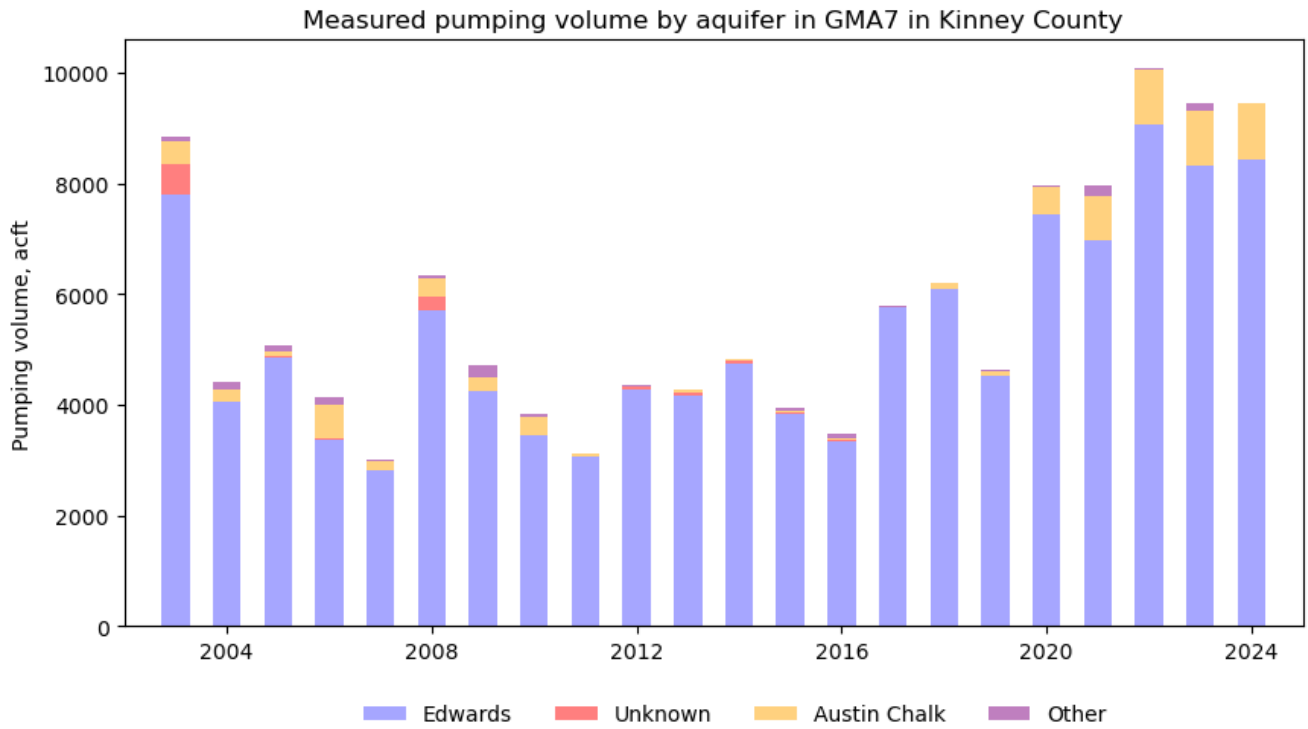

Measured groundwater pumping from
the Edwards in Kinney County
Annual median (4850)
Annual average (5649)
Count
acft
0
1
2
3
4
5
6
7
8
3000
4000
5000
6000
7000
8000
9000

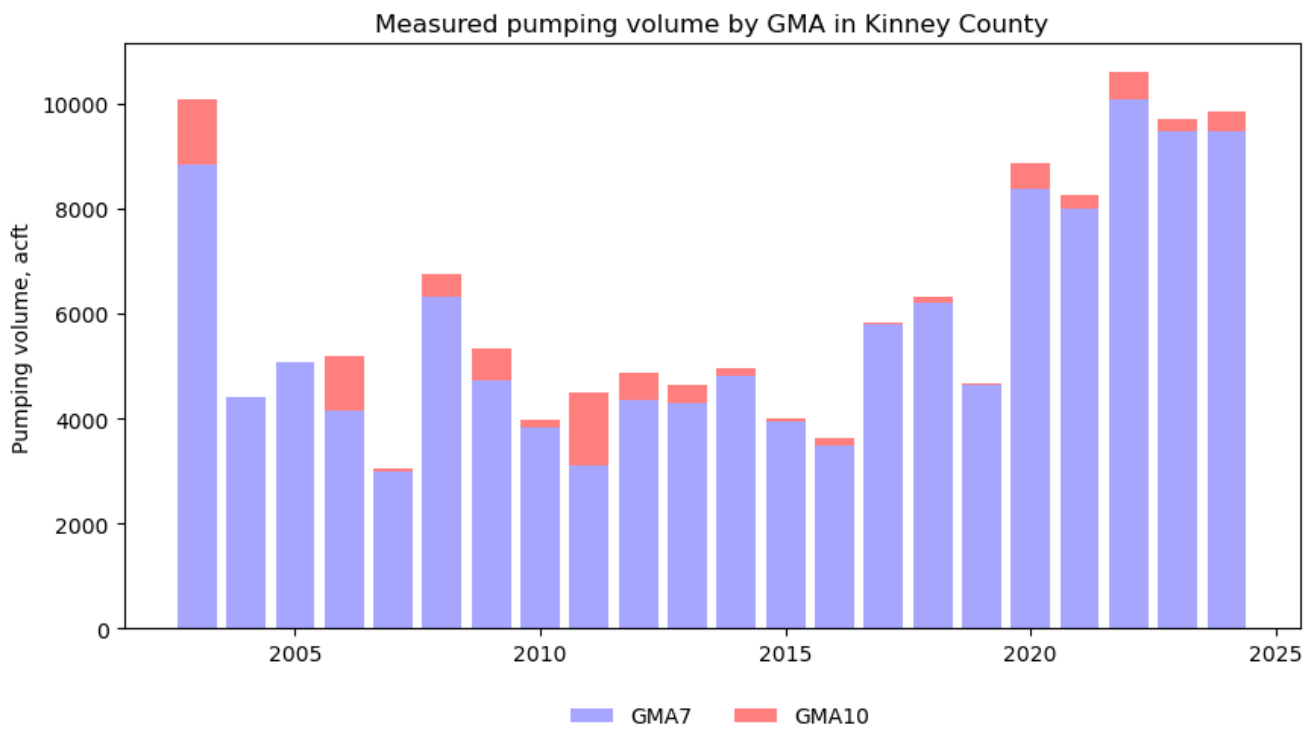

Measured groundwater pumping from
the Edwards in GMA7 in Kinney County
Annual median (4643)
Annual average (5288)
Count
acft
0
1
2
3
4
5
6
7
3000
4000
5000
6000
7000
8000
9000


Measured groundwater pumping from
the Austin Chalk in Kinney County
Annual median (175)
Annual average (327)
Count
0
2
4
6
8
10
0
200
400
600
800
1000
acft


Measured groundwater pumping from
the Austin Chalk in GMA7 in Kinney County
Annual median (175)
Annual average (316)
Count
acft
0
2
4
6
8
10
0
200
400
600
800
1000

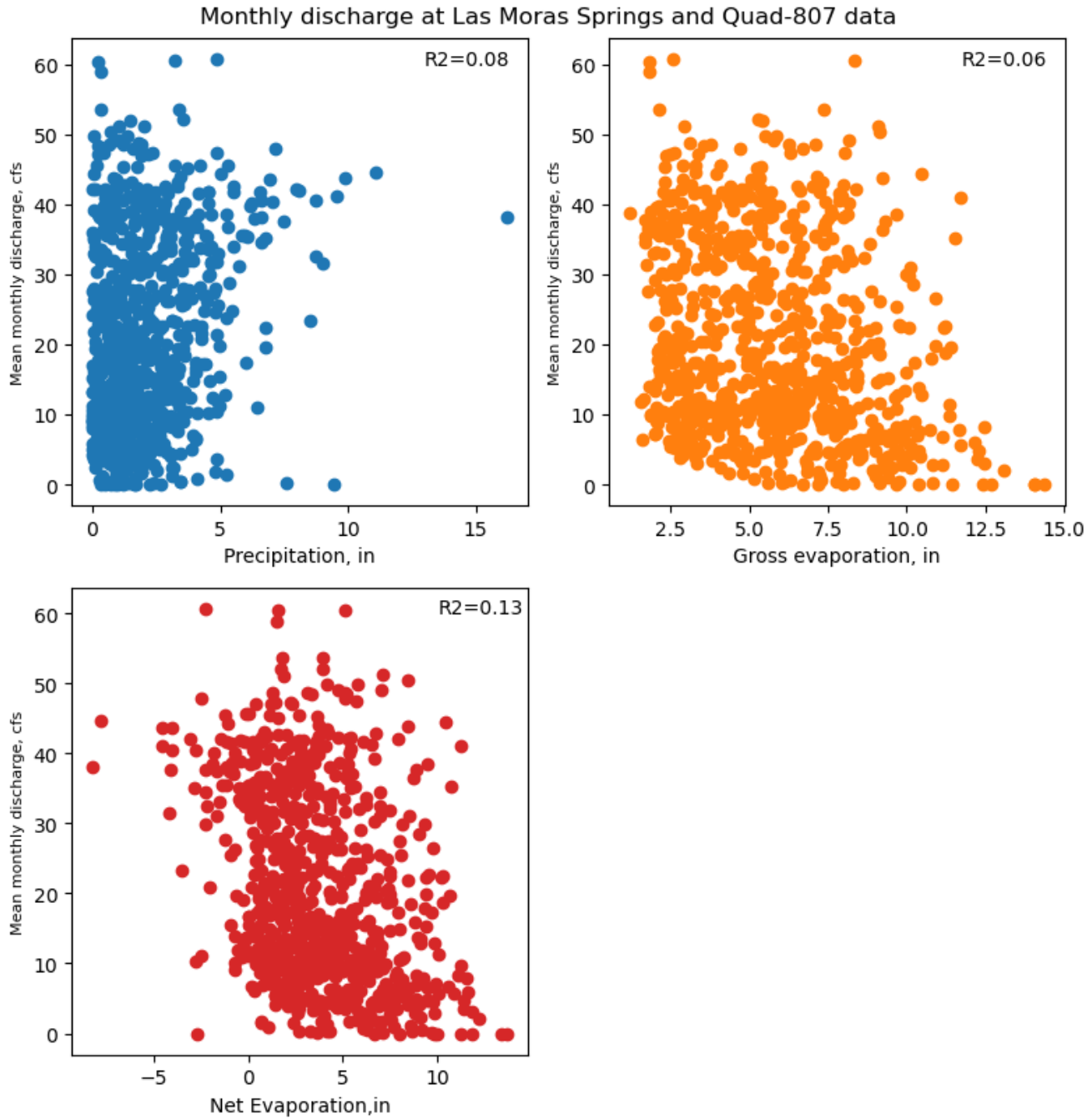

Measured pumping volume by aquifer in Kinney County
Pumping volume, acft
0
2000
4000
6000
8000
10000
2004
2008
2012
2016
2020
2024
Edwards
Unknown
Austin Chalk
Other

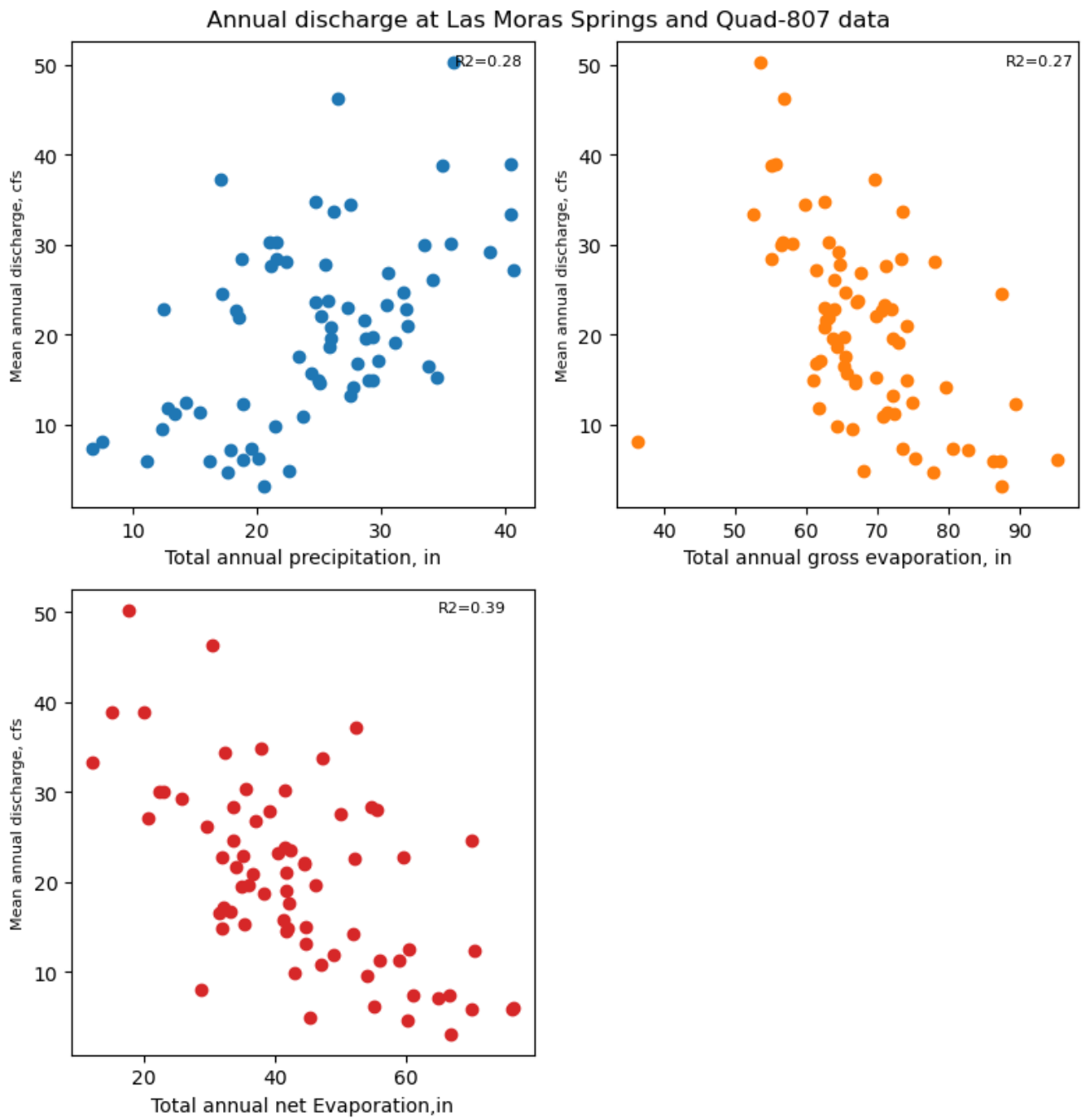

Measured pumping volume by aquifer in GMA7 in Kinney County
Pumping volume, acft
0
2000
4000
6000
8000
10000
2004
2008
2012
2016
2020
2024
Edwards
Unknown
Austin Chalk
Other

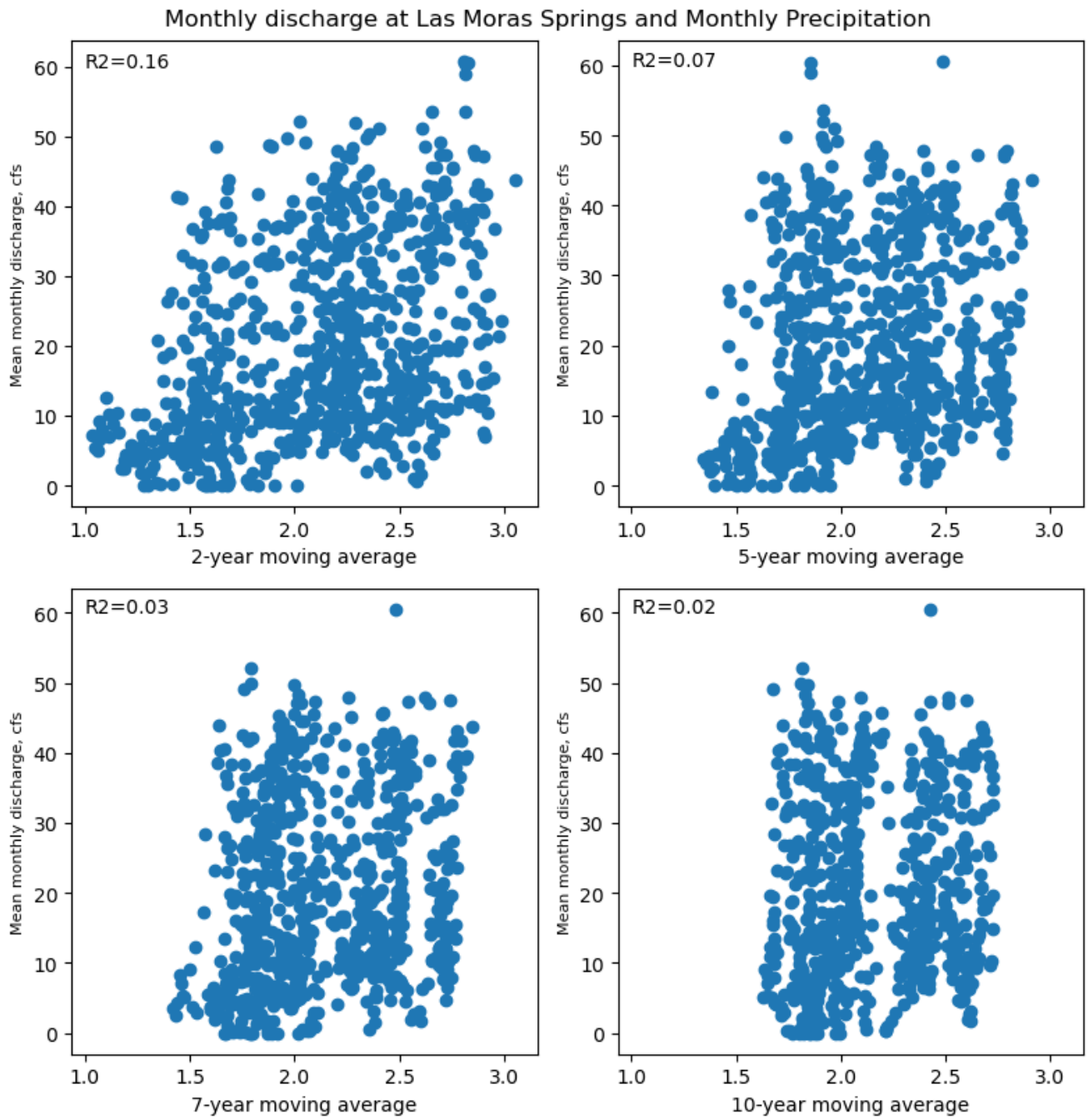

Measured pumping volume by GMA in Kinney County
Pumping volume, acft
0
2000
4000
6000
8000
10000
2005
2010
2015
2020
2025
GMA7
GMA10

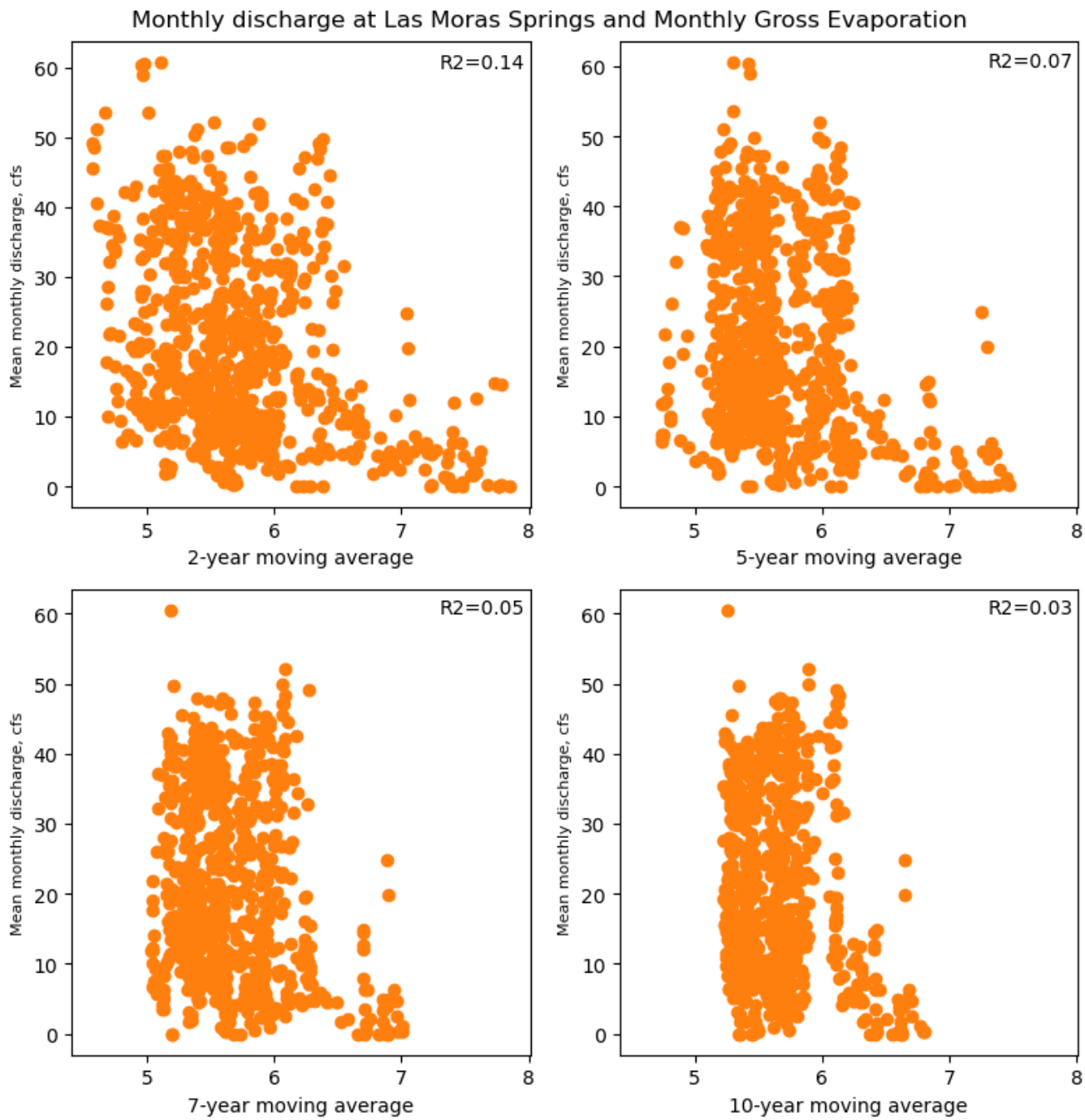
6.00 APPENDIX B – LAS MORAS SPRINGS DISCHARGE CORRELATION DATA AND GRAPHS

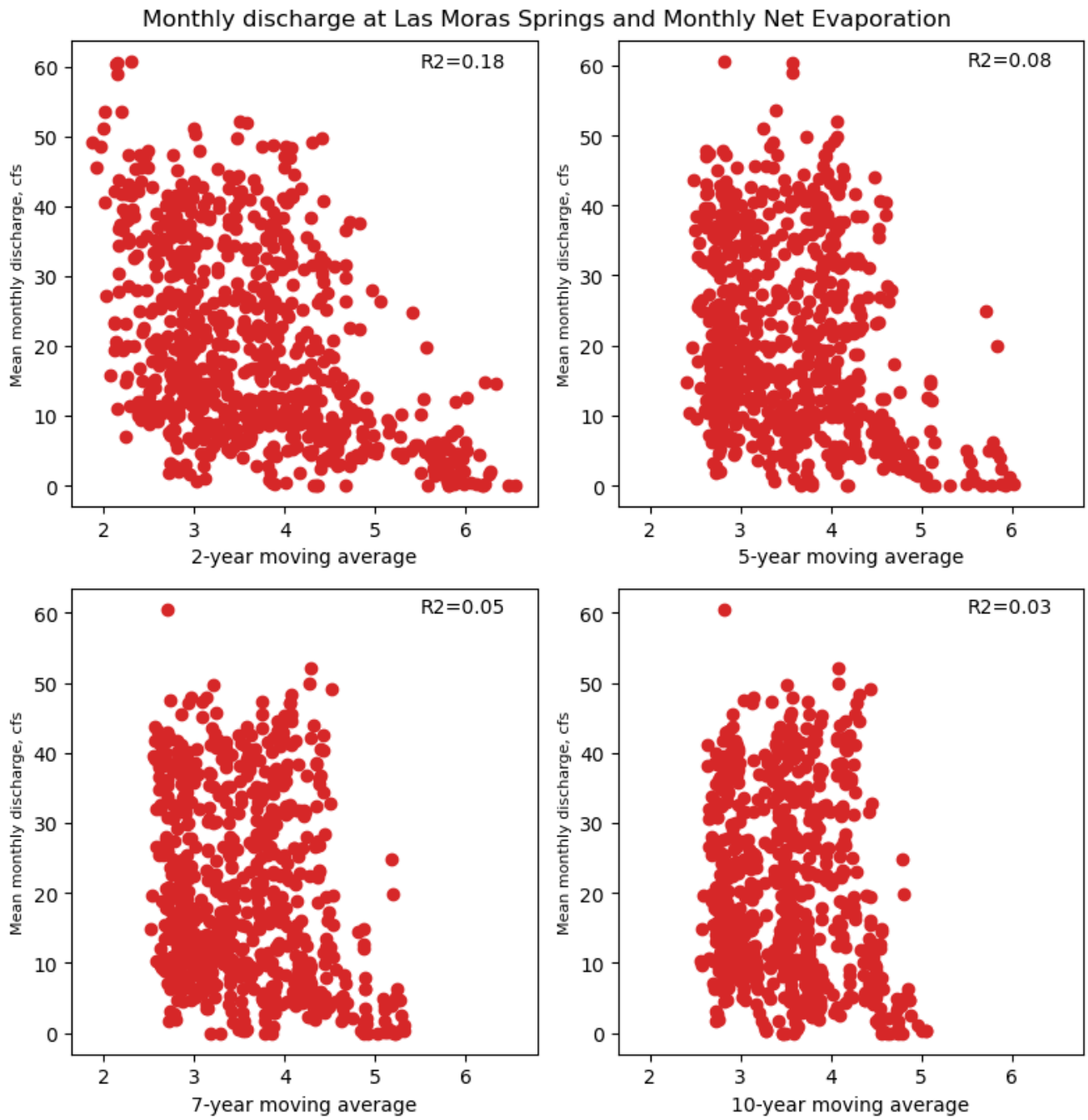
6.01 LAS MORAS AND QUAD-807



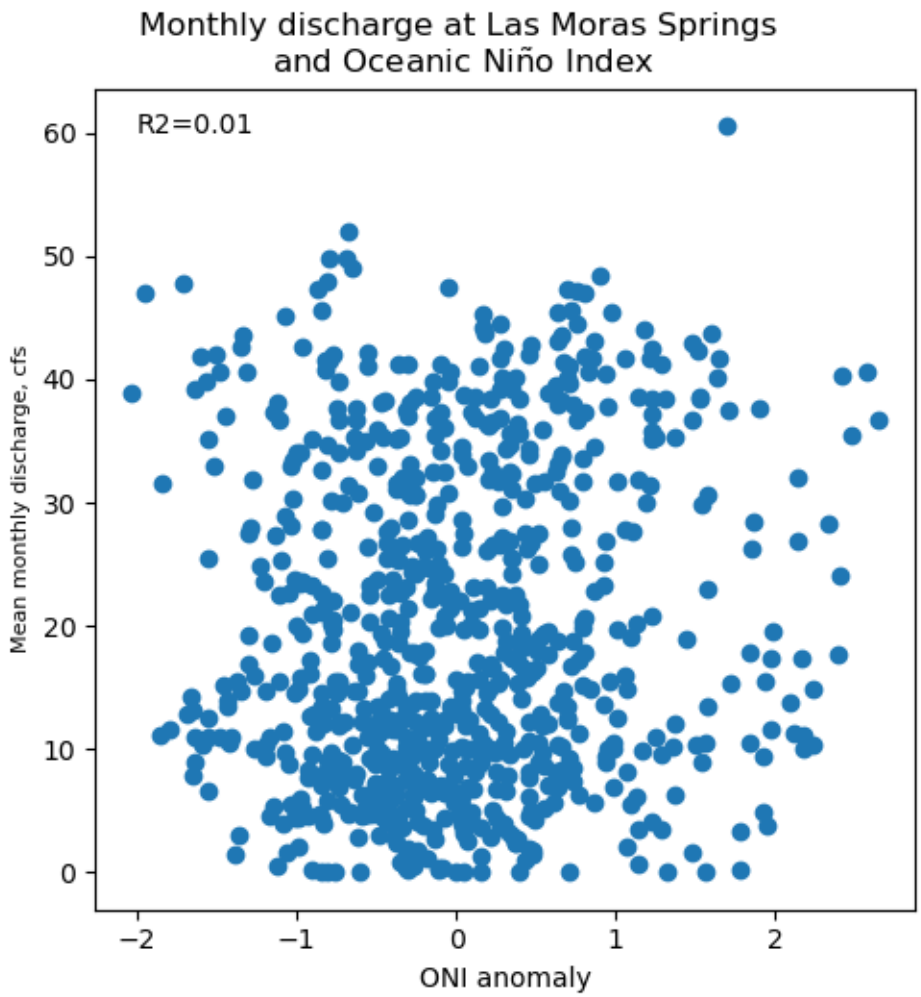

Annual discharge at Las Moras Springs and Quad-807 data
R2=0.28
Mean annual discharge, cfs
Total annual precipitation, in
R2=0.27
Mean annual discharge, cfs
Total annual gross evaporation, in
R2=0.39
Mean annual discharge, cfs
Total annual net Evaporation,in

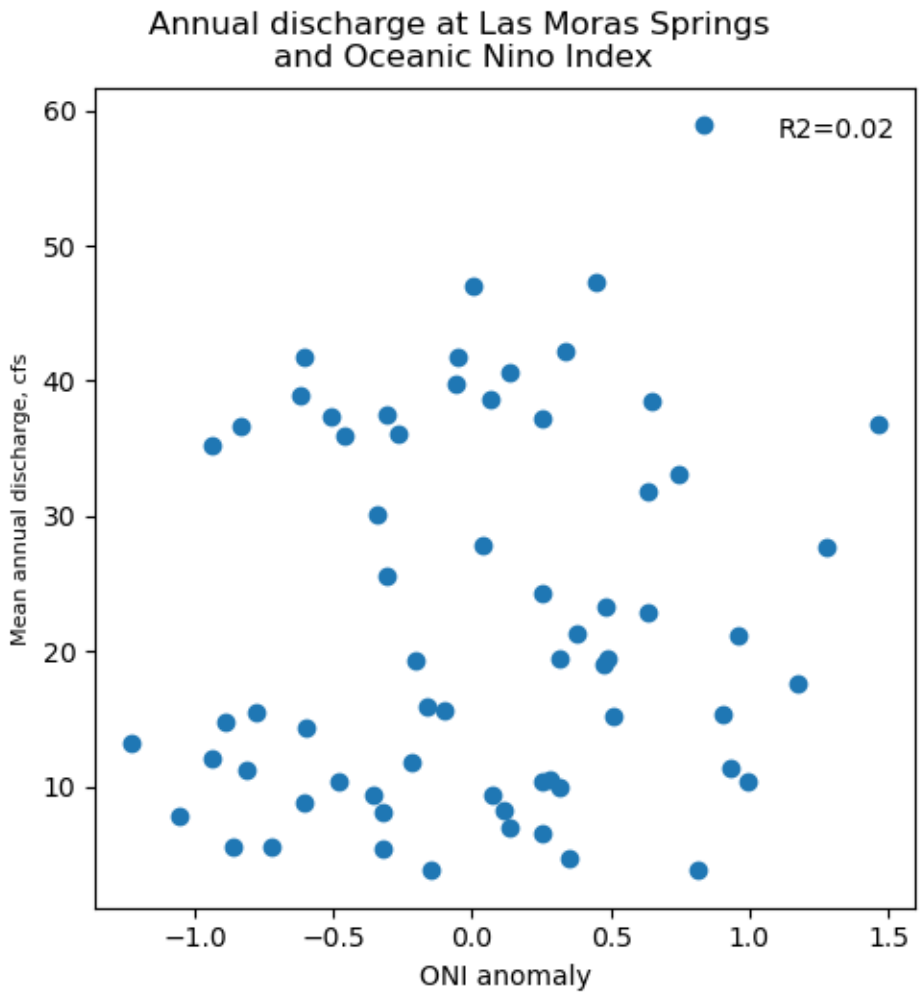

Monthly discharge at Las Moras Springs and Monthly Precipitation
R2=0.16
R2=0.07
R2=0.03
R2=0.02
Mean monthly discharge, cfs
2-year moving average
5-year moving average
7-year moving average
10-year moving average

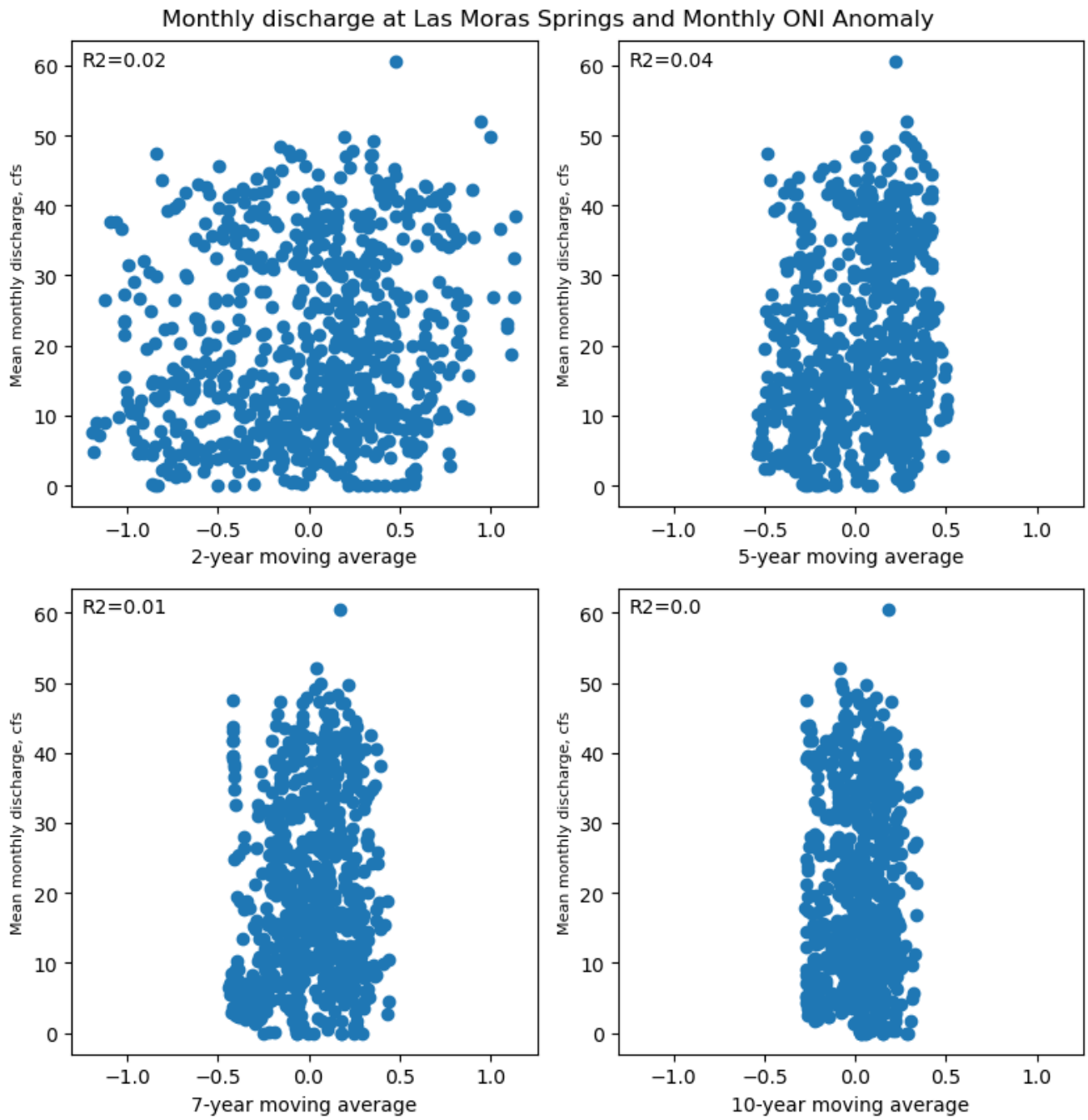

Monthly discharge at Las Moras Springs and Monthly Gross Evaporation
R2=0.14
R2=0.07
R2=0.05
R2=0.03
Mean monthly discharge, cfs
2-year moving average
5-year moving average
7-year moving average
10-year moving average


Monthly discharge at Las Moras Springs and Monthly Net Evaporation
R2=0.18
R2=0.08
R2=0.05
R2=0.03
Mean monthly discharge, cfs
2-year moving average
5-year moving average
7-year moving average
10-year moving average

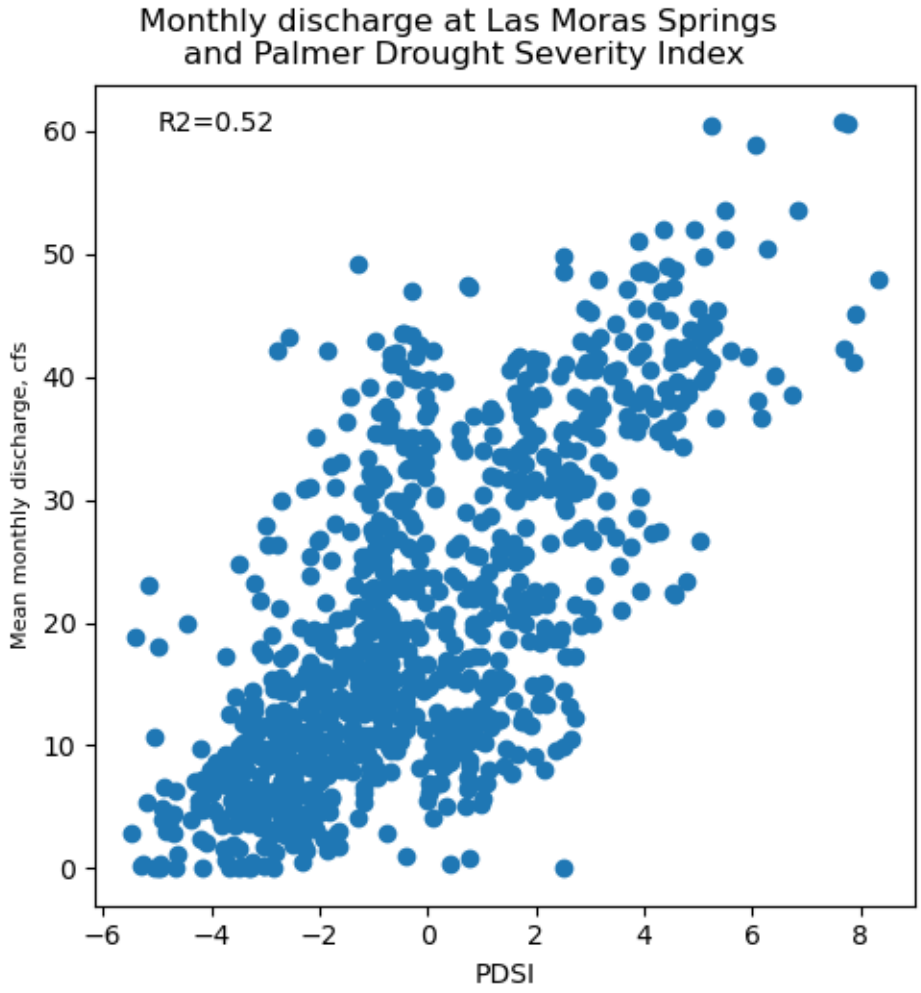
6.02 LAS MORAS AND OCEANIC NIÑO INDEX

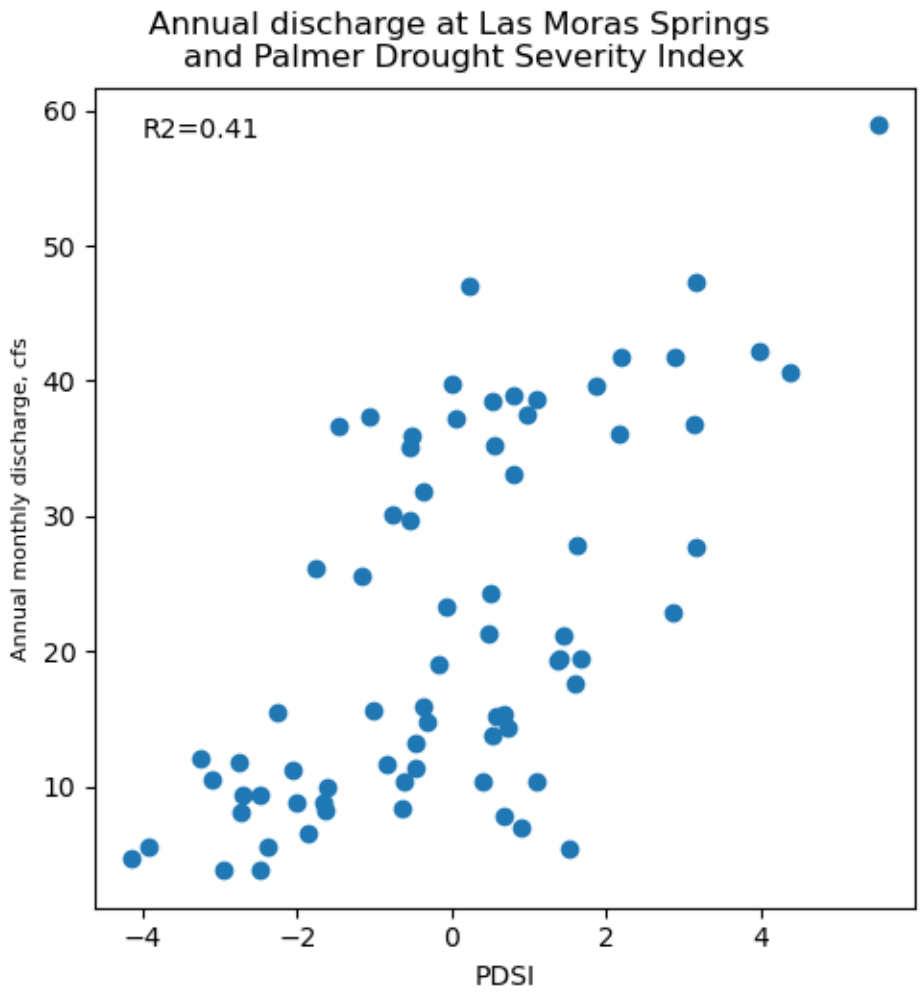


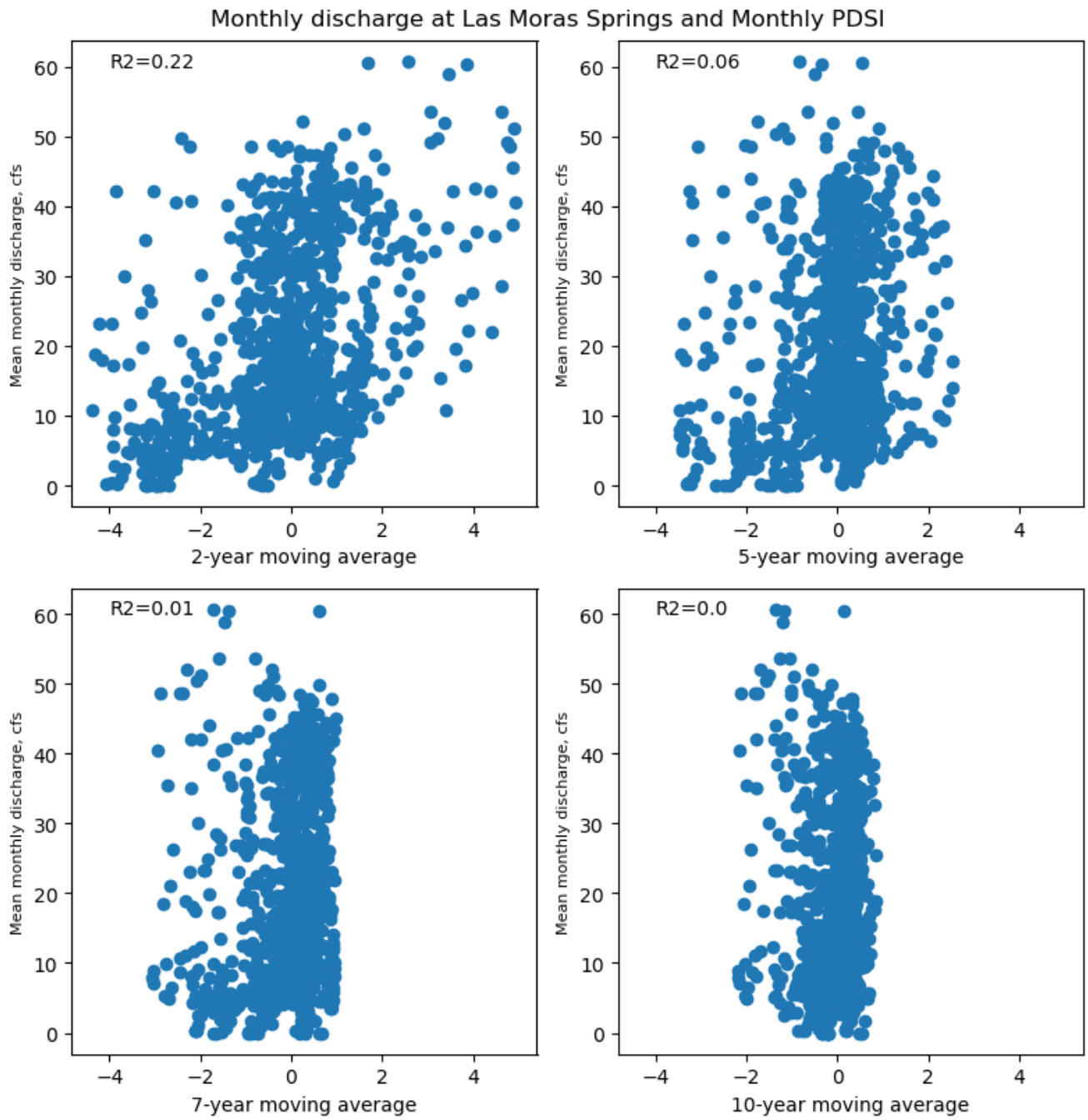

Annual discharge at Las Moras Springs
and Oceanic Nino Index
R2=0.02
Mean annual discharge, cfs
ONI anomaly
60
50
40
30
20
10
−1.0
−0.5
0.0
0.5
1.0
1.5


Monthly discharge at Las Moras Springs and Monthly ONI Anomaly
R2=0.02
R2=0.04
R2=0.01
R2=0.0
Mean monthly discharge, cfs
2-year moving average
5-year moving average
7-year moving average
10-year moving average

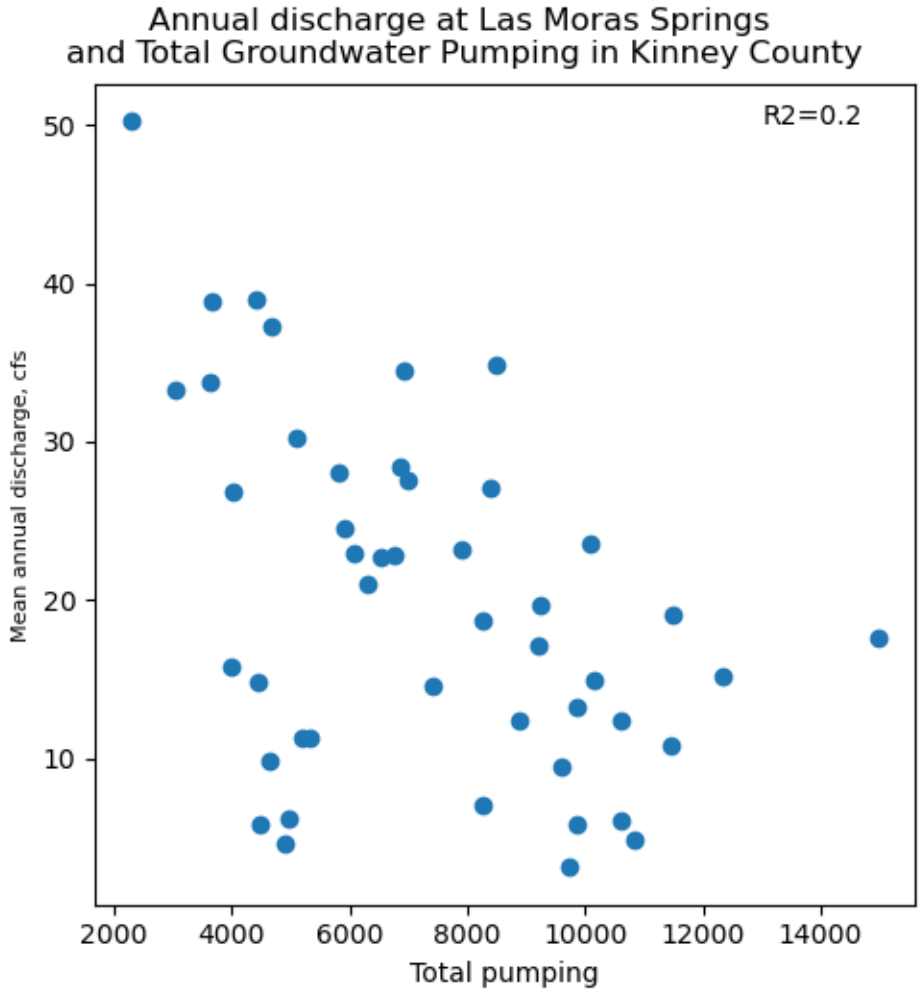
6.03 LAS MORAS AND PALMER DROUGHT SEVERITY INDEX

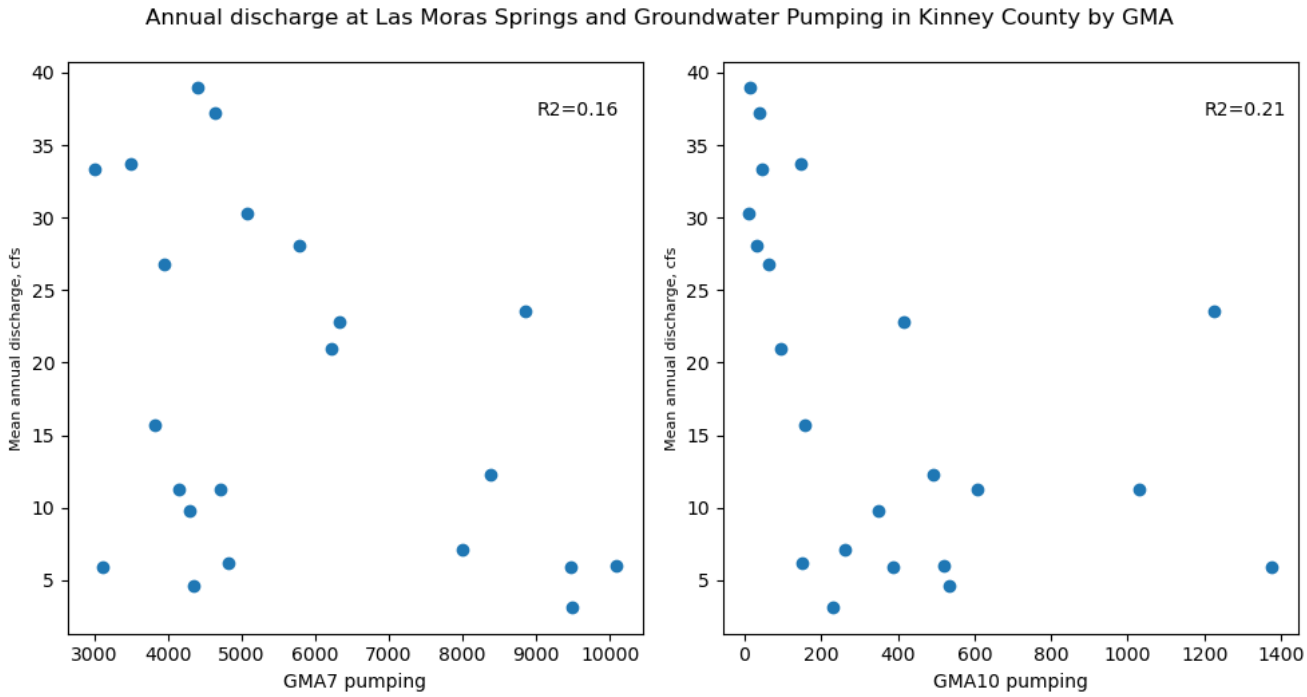



Annual discharge at Las Moras Springs
and Palmer Drought Severity Index
R2=0.41
Annual monthly discharge, cfs
PDSI
60
50
40
30
20
10
−4
−2
0
2
4

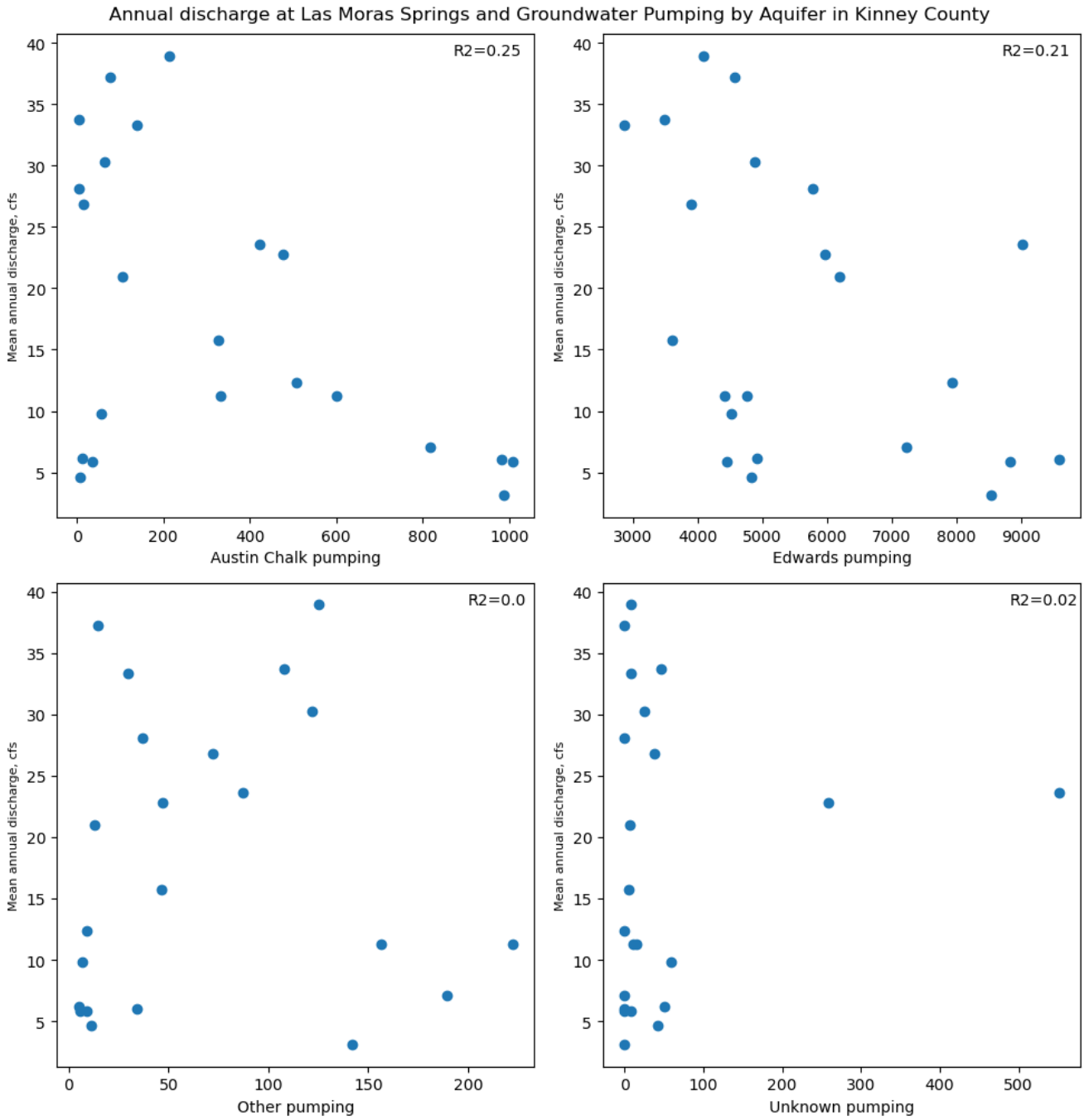

Monthly discharge at Las Moras Springs and Monthly PDSI
R2=0.22
R2=0.06
R2=0.01
R2=0.0
Mean monthly discharge, cfs
2-year moving average
5-year moving average
7-year moving average
10-year moving average

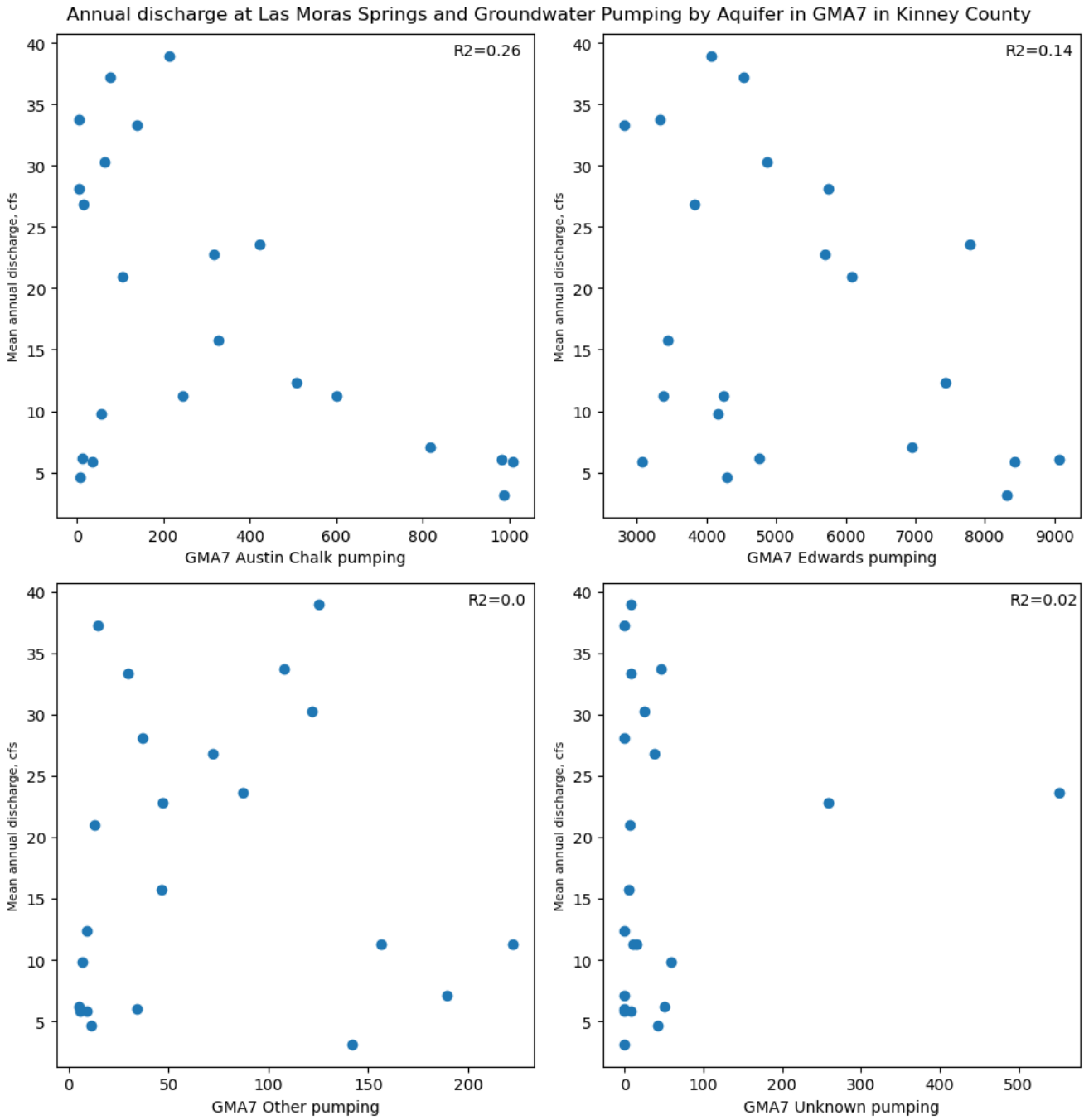
6.04 LAS MORAS AND GROUNDWATER PUMPING VOLUMES



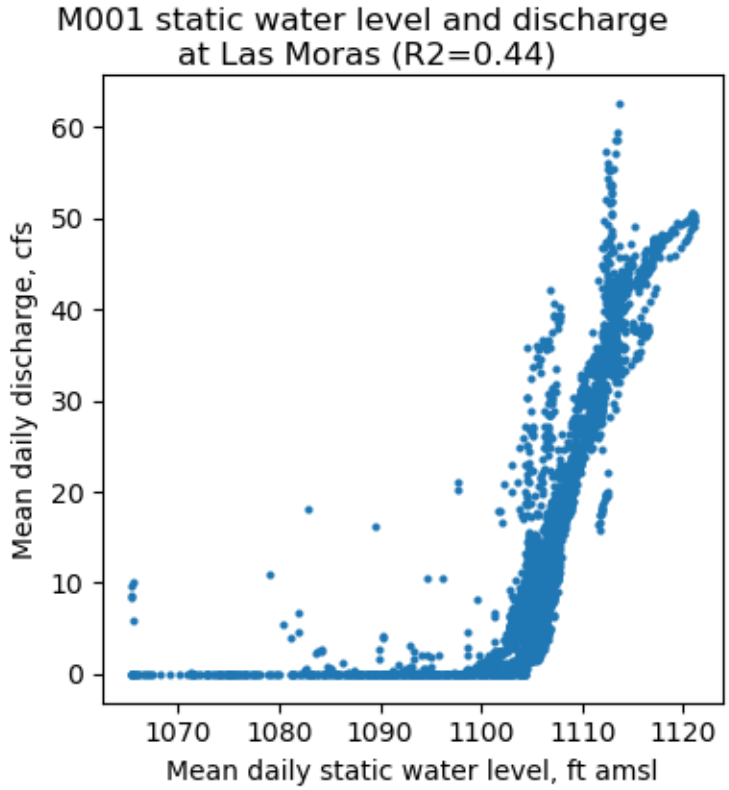

Annual discharge at Las Moras Springs and Groundwater Pumping in Kinney County by GMA
R2=0.16
Mean annual discharge, cfs
GMA7 pumping
R2=0.21
Mean annual discharge, cfs
GMA10 pumping

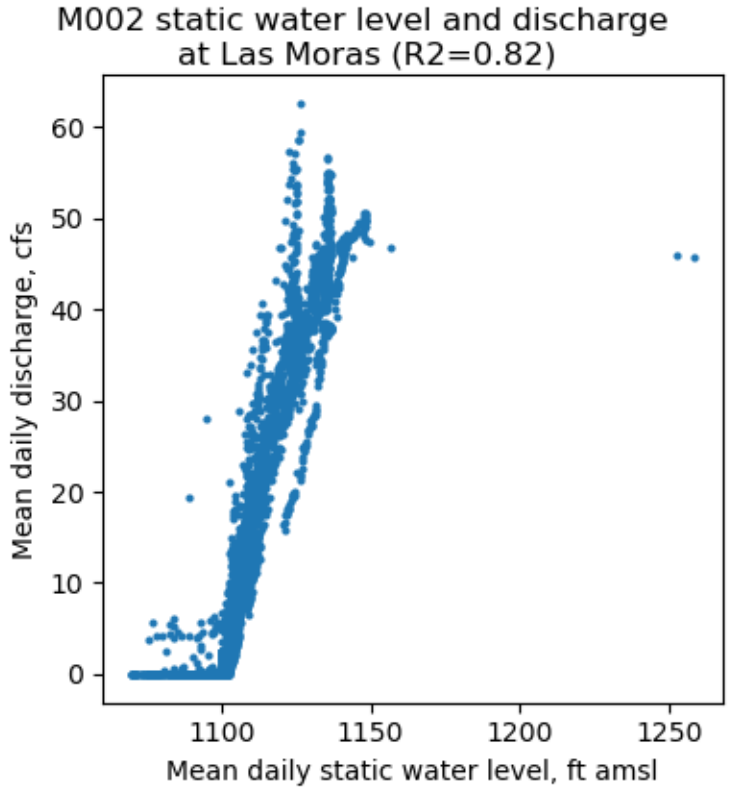
DRAFT

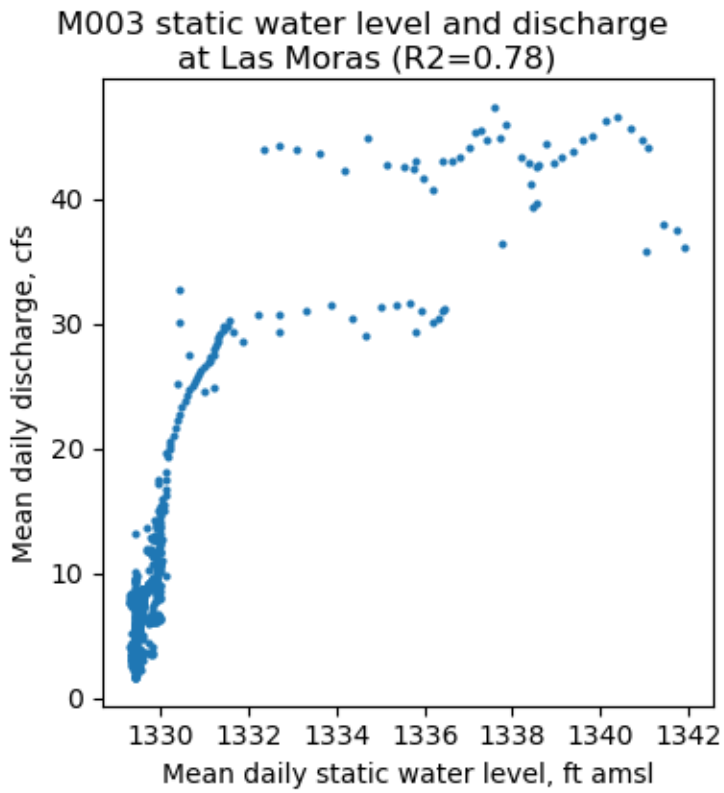

Annual discharge at Las Moras Springs and Groundwater Pumping by Aquifer in Kinney County
R2=0.25
Mean annual discharge, cfs
Austin Chalk pumping
R2=0.21
Mean annual discharge, cfs
Edwards pumping
R2=0.0
Mean annual discharge, cfs
Other pumping
R2=0.02
Mean annual discharge, cfs
Unknown pumping

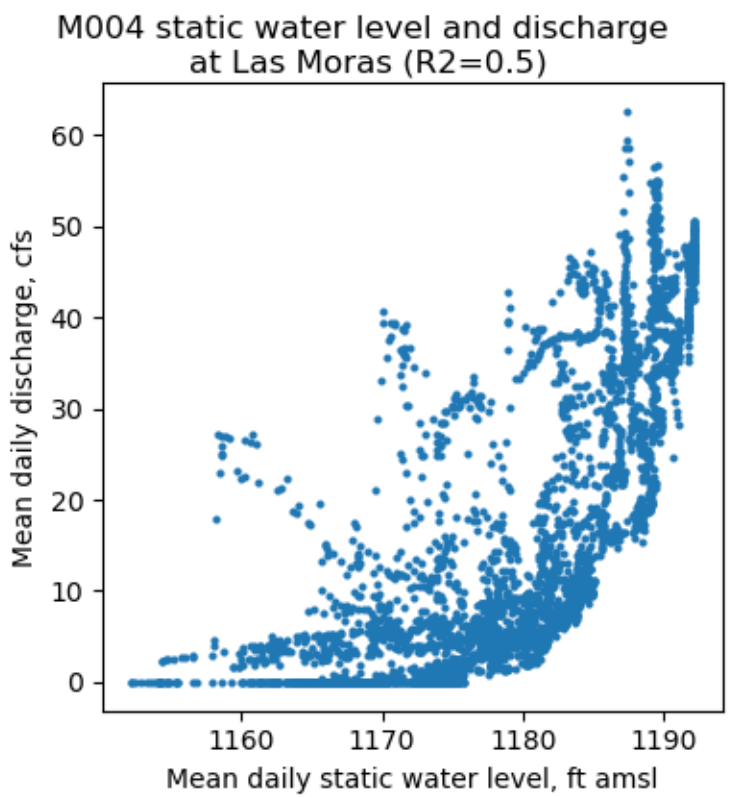

Annual discharge at Las Moras Springs and Groundwater Pumping by Aquifer in GMA7 in Kinney County
R2=0.26
Mean annual discharge, cfs
GMA7 Austin Chalk pumping
R2=0.14
Mean annual discharge, cfs
GMA7 Edwards pumping
R2=0.0
Mean annual discharge, cfs
GMA7 Other pumping
R2=0.02
Mean annual discharge, cfs
GMA7 Unknown pumping

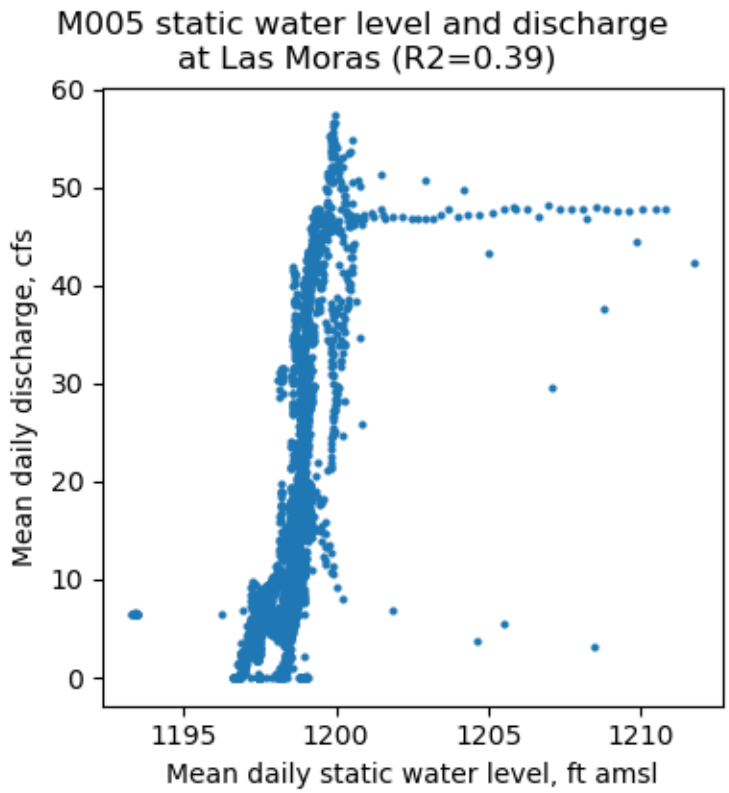
6.05 LAS MORAS AND STATIC WATER LEVEL

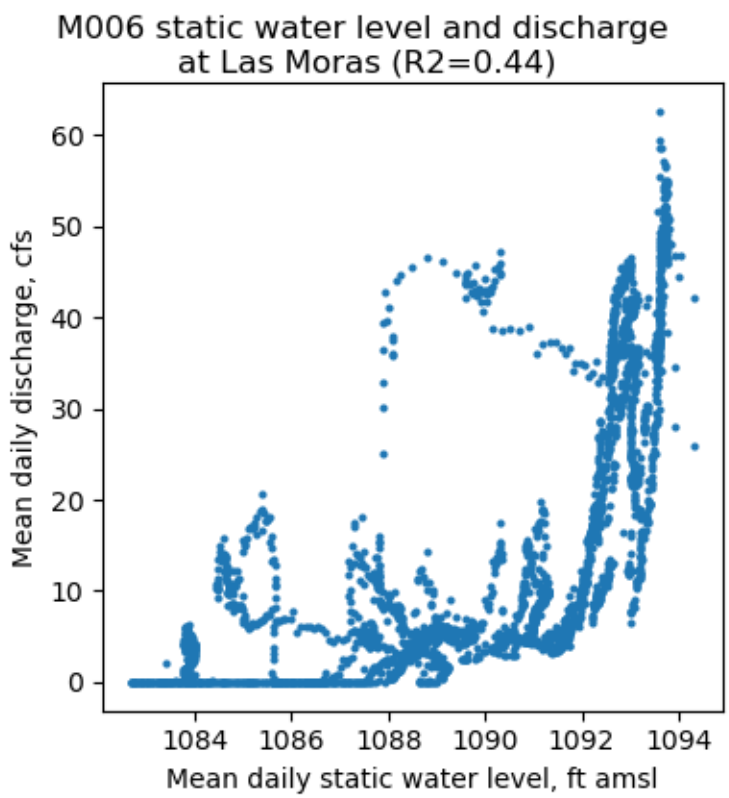


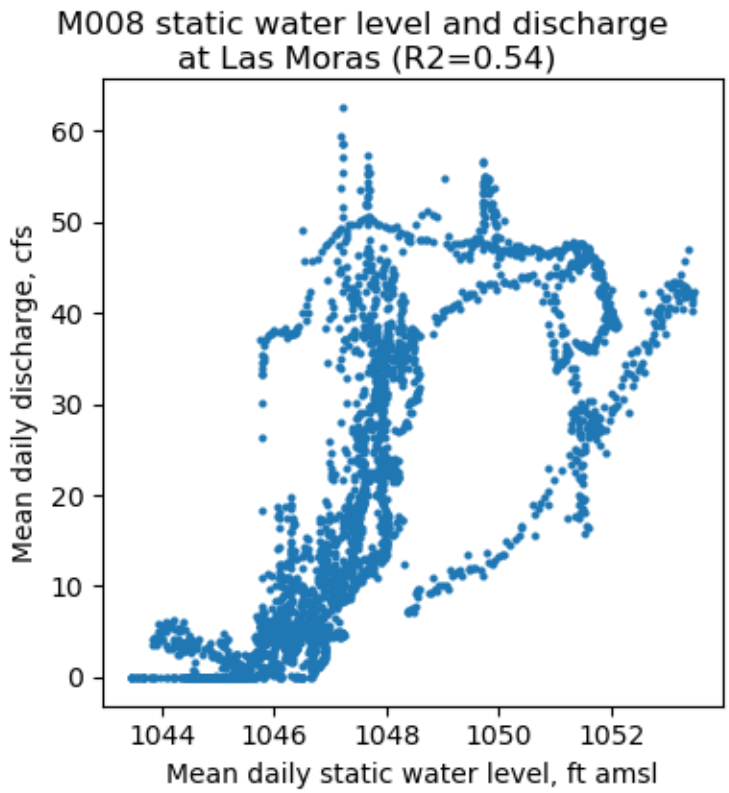


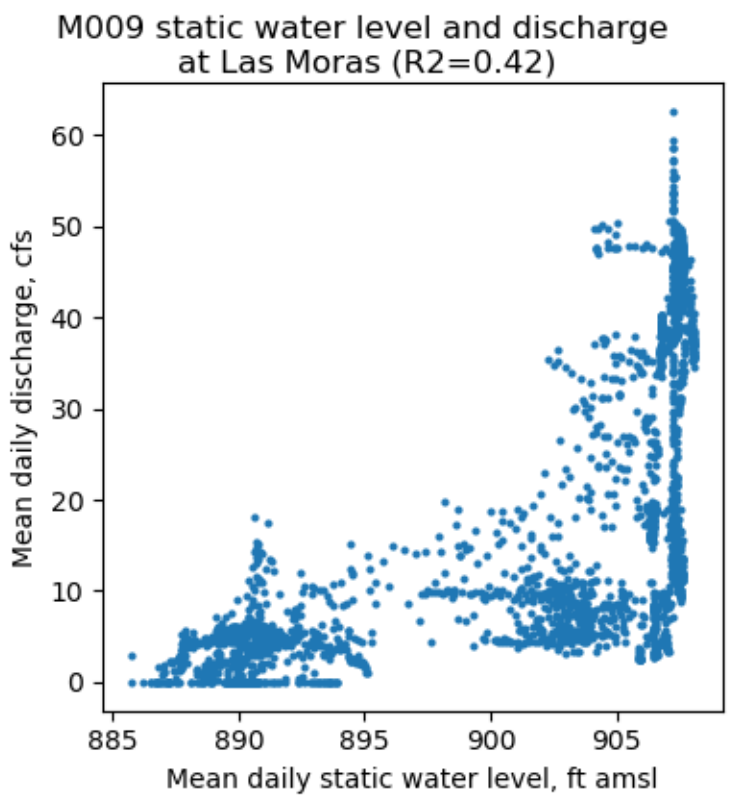

M003 static water level and discharge
at Las Moras (R2=0.78)
Mean daily discharge, cfs
0
10
20
30
40
1330
1332
1334
1336
1338
1340
1342
Mean daily static water level, ft amsl

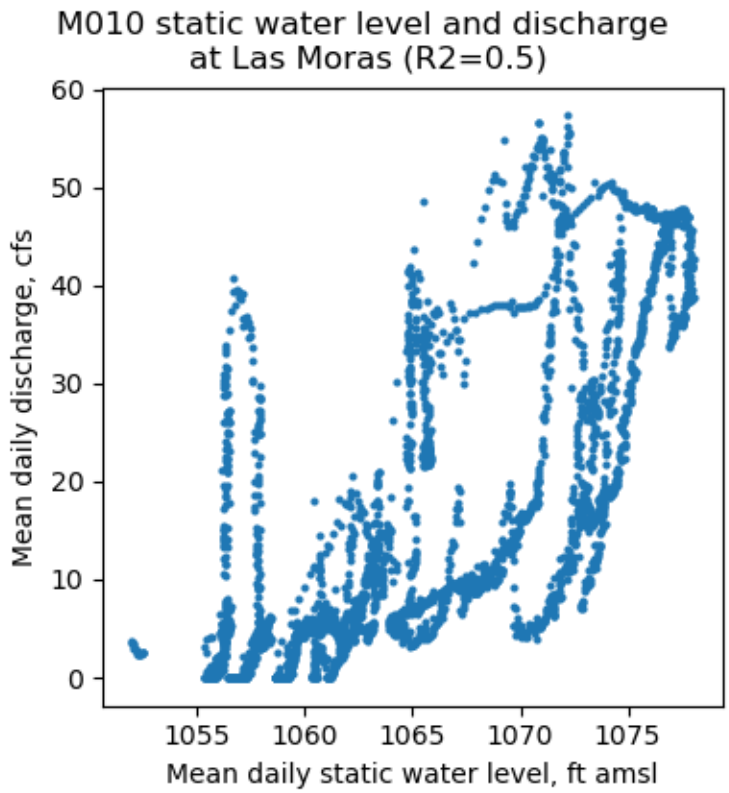

M004 static water level and discharge
at Las Moras (R2=0.5)
Mean daily discharge, cfs
0
10
20
30
40
50
60
1160
1170
1180
1190
Mean daily static water level, ft amsl

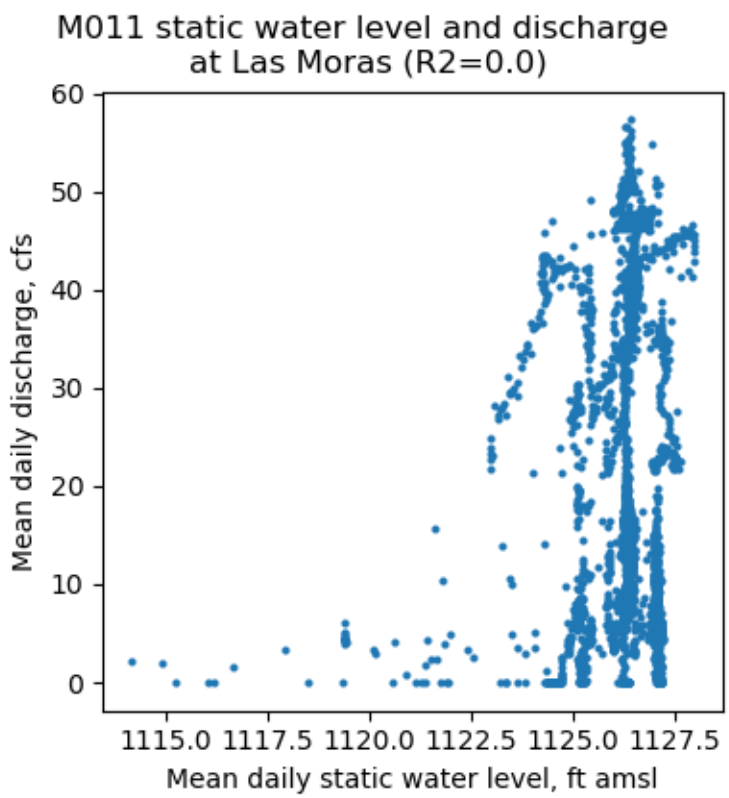

M005 static water level and discharge
at Las Moras (R2=0.39)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1195
1200
1205
1210

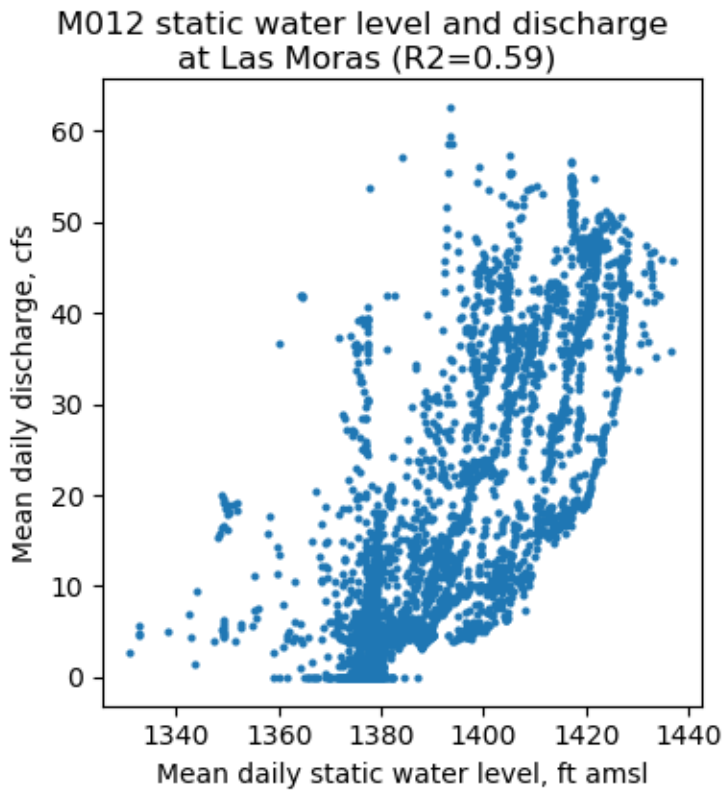

M006 static water level and discharge
at Las Moras (R2=0.44)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1084
1086
1088
1090
1092
1094

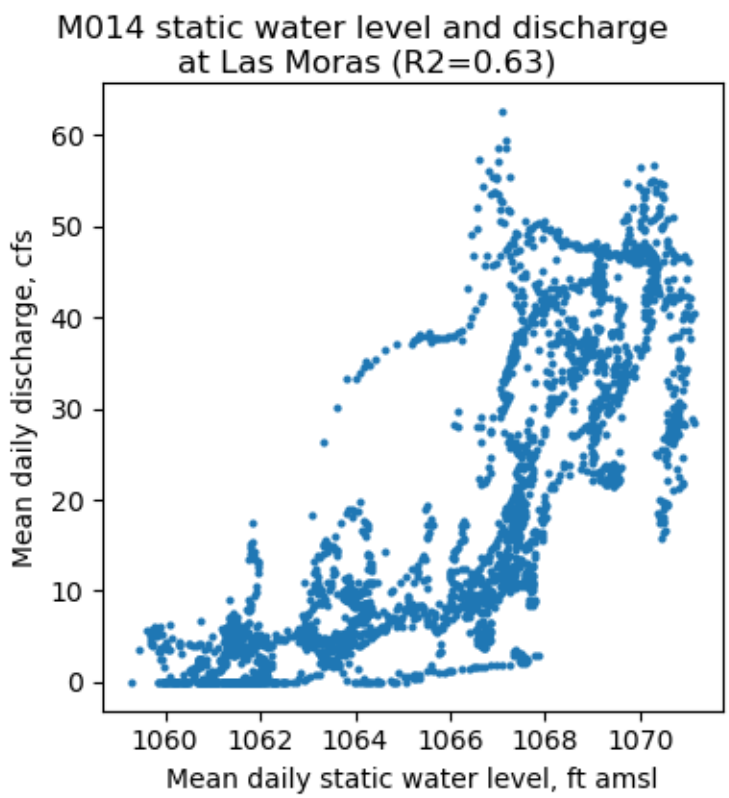

M008 static water level and discharge
at Las Moras (R2=0.54)
Mean daily discharge, cfs
0
10
20
30
40
50
60
1044
1046
1048
1050
1052
Mean daily static water level, ft amsl

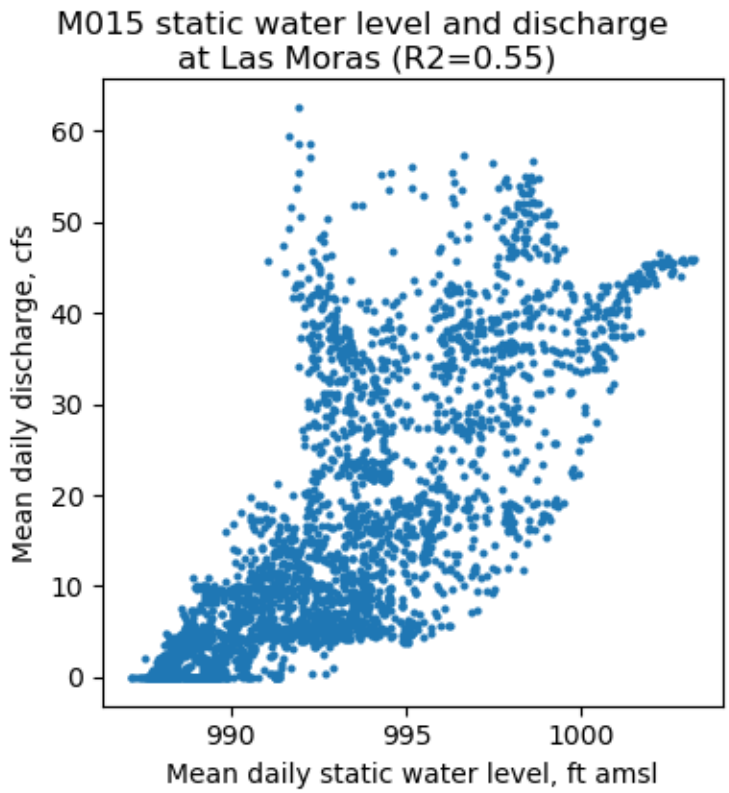

M009 static water level and discharge
at Las Moras (R2=0.42)
Mean daily discharge, cfs
0
10
20
30
40
50
60
885
890
895
900
905
Mean daily static water level, ft amsl

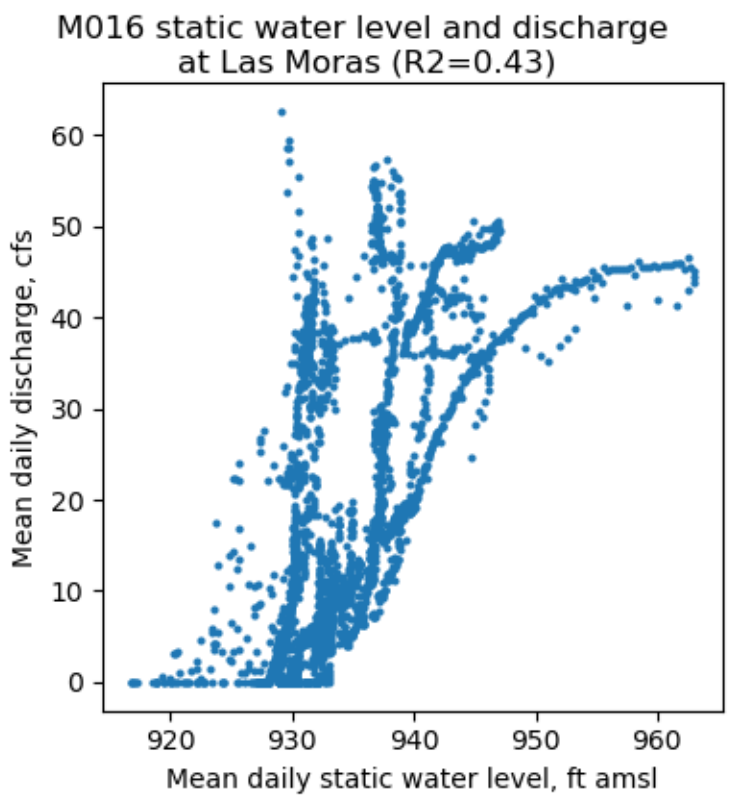

M010 static water level and discharge
at Las Moras (R2=0.5)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1055
1060
1065
1070
1075

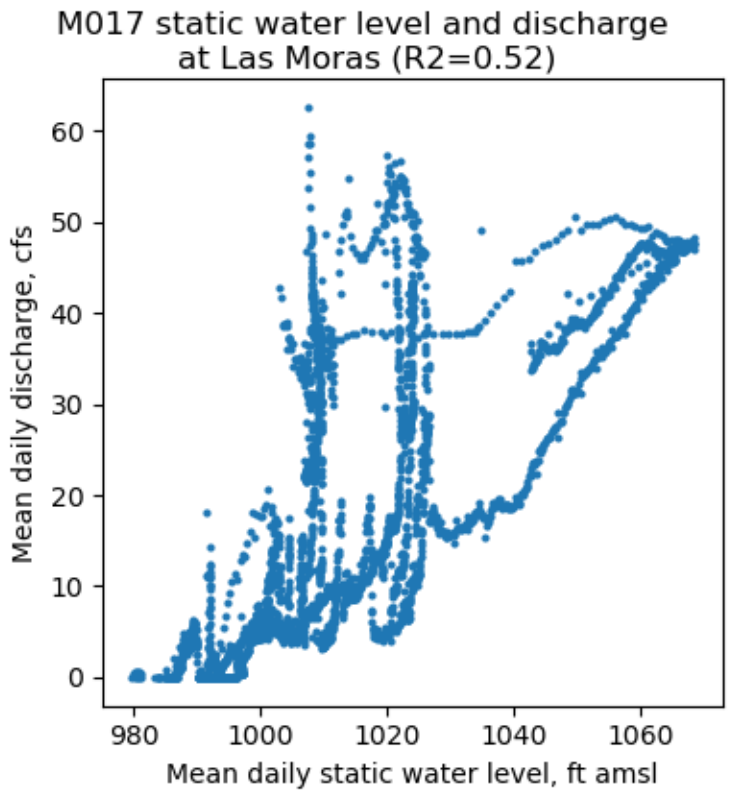

M011 static water level and discharge
at Las Moras (R2=0.0)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1115.0
1117.5
1120.0
1122.5
1125.0
1127.5

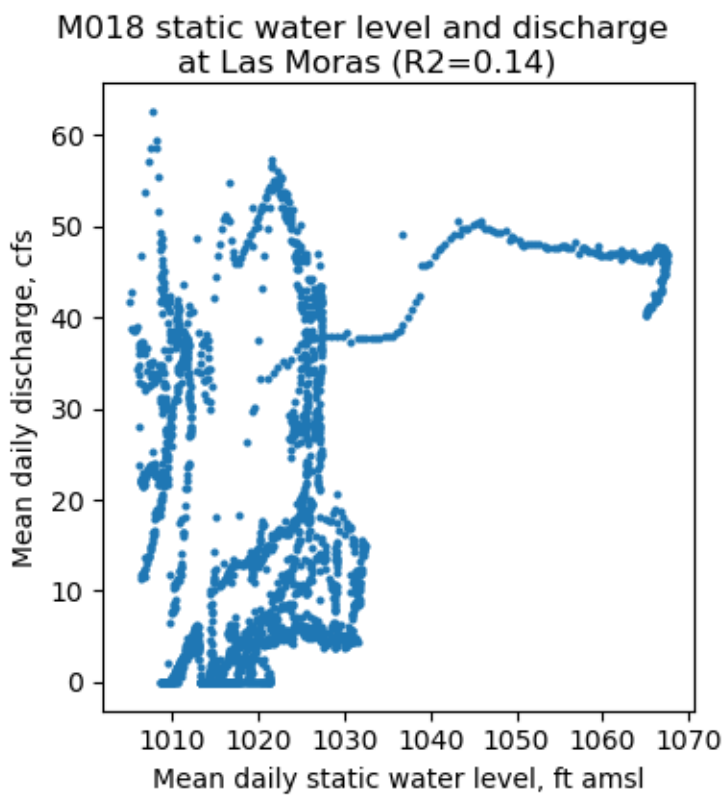

M012 static water level and discharge
at Las Moras (R2=0.59)
Mean daily discharge, cfs
0
10
20
30
40
50
60
1340
1360
1380
1400
1420
1440
Mean daily static water level, ft amsl

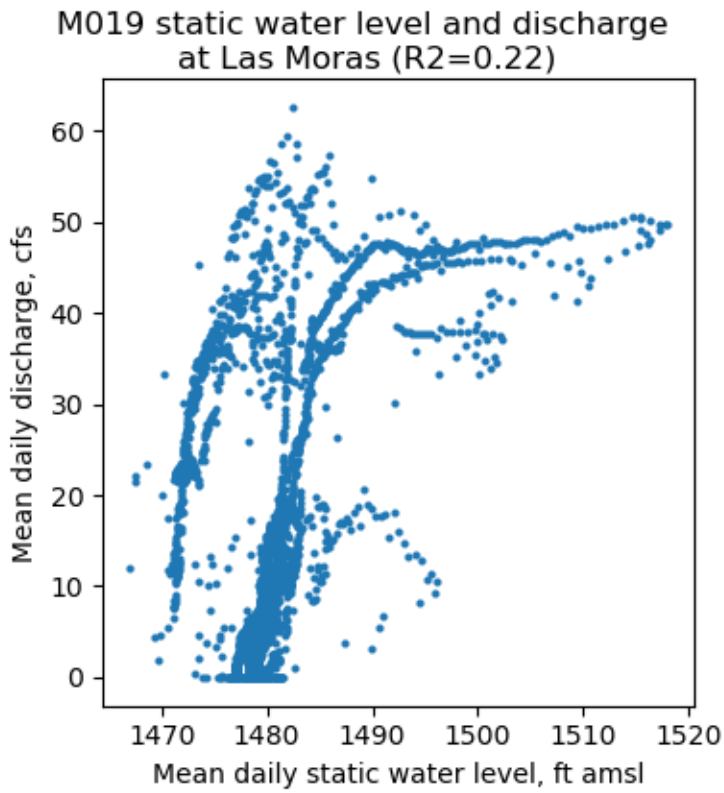

M014 static water level and discharge
at Las Moras (R2=0.63)
Mean daily discharge, cfs
0
10
20
30
40
50
60
1060
1062
1064
1066
1068
1070
Mean daily static water level, ft amsl

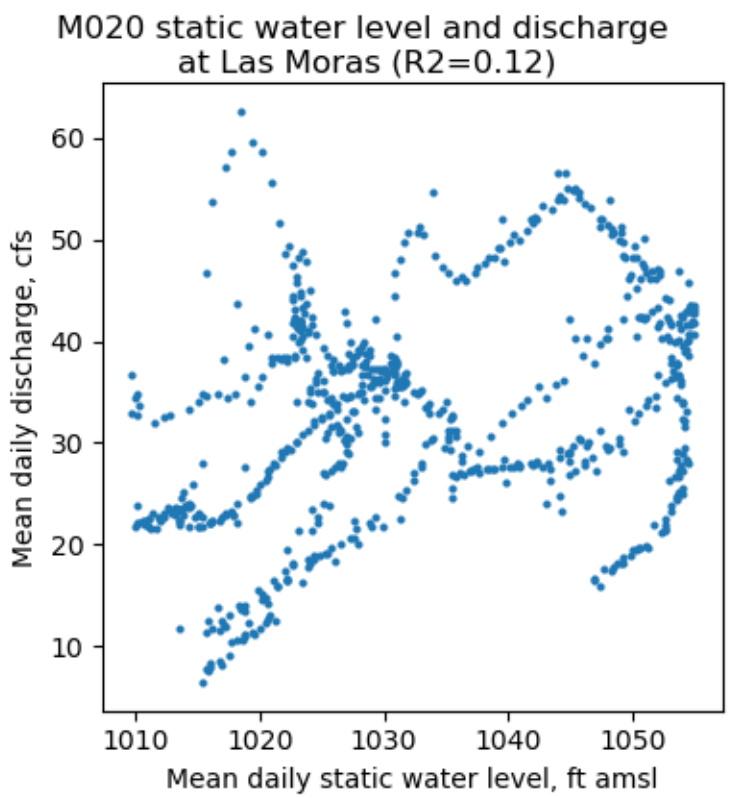

M015 static water level and discharge
at Las Moras (R2=0.55)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
990
995
1000

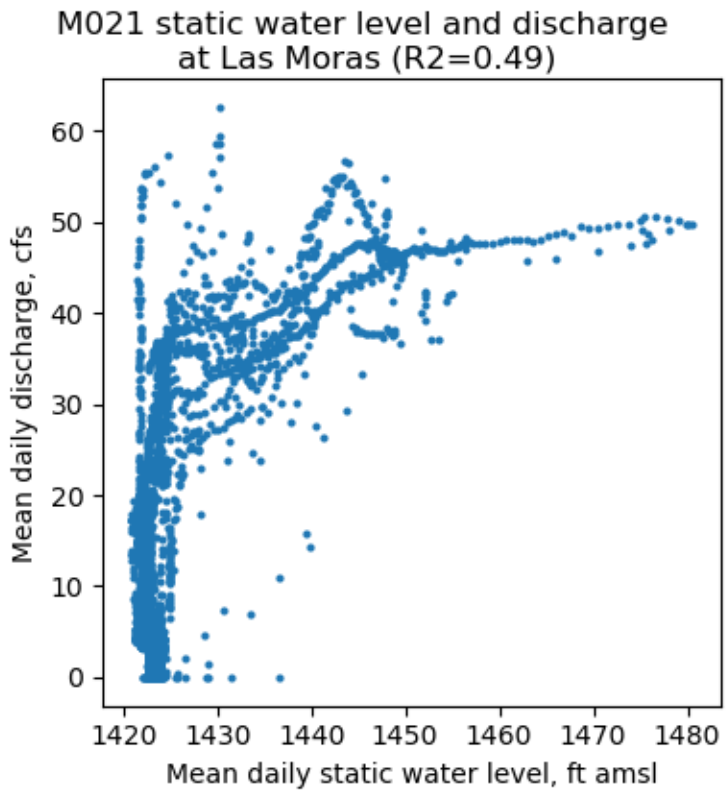

M016 static water level and discharge
at Las Moras (R2=0.43)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
920
930
940
950
960

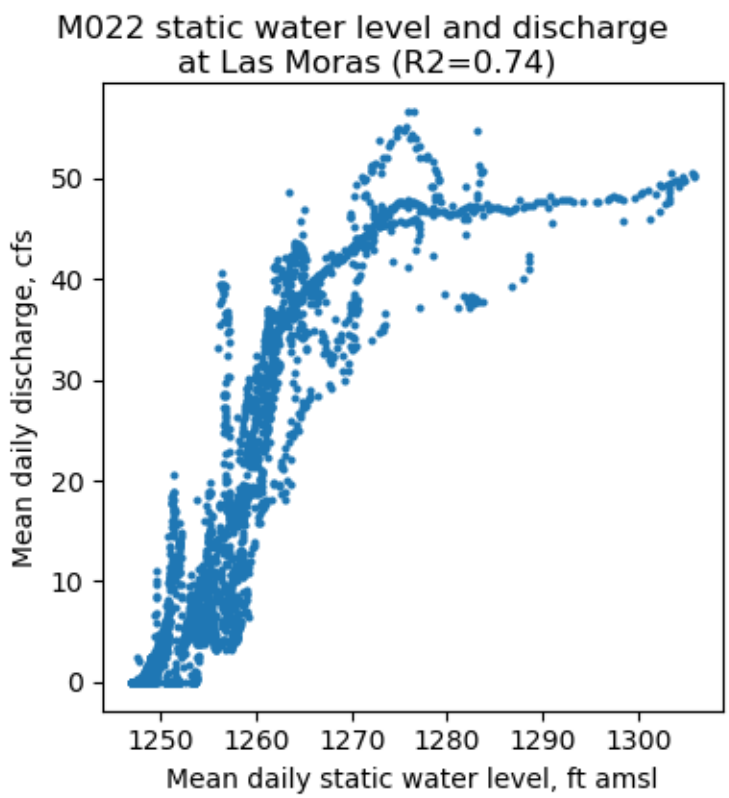

M017 static water level and discharge
at Las Moras (R2=0.52)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
980
1000
1020
1040
1060

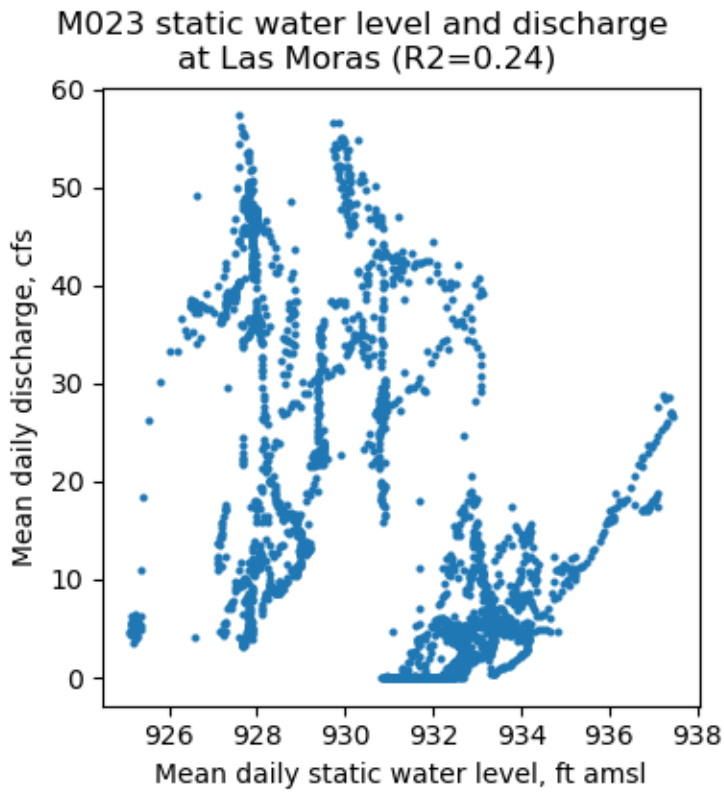

M018 static water level and discharge
at Las Moras (R2=0.14)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1010
1020
1030
1040
1050
1060
1070

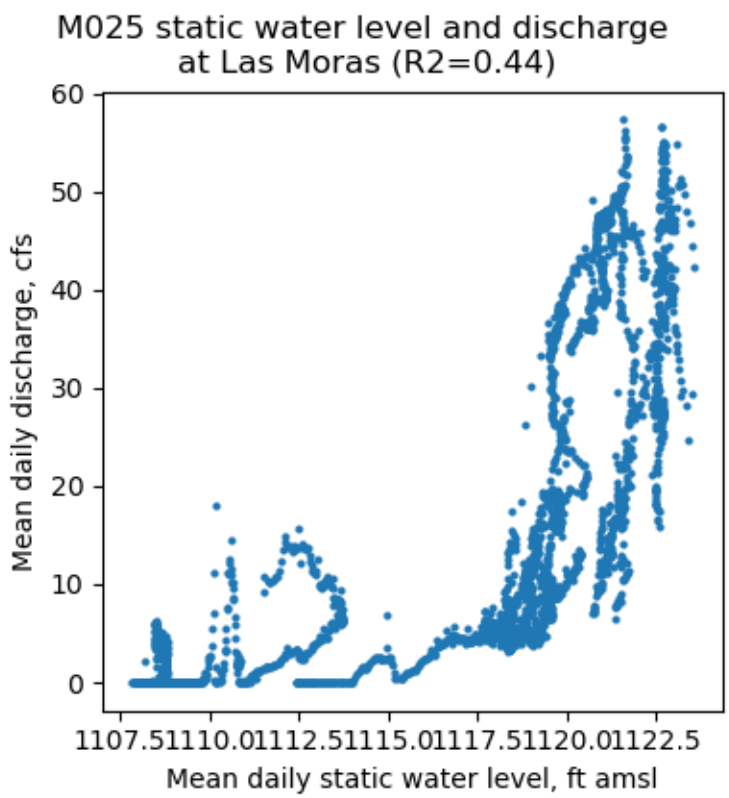

M019 static water level and discharge
at Las Moras (R2=0.22)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1470
1480
1490
1500
1510
1520

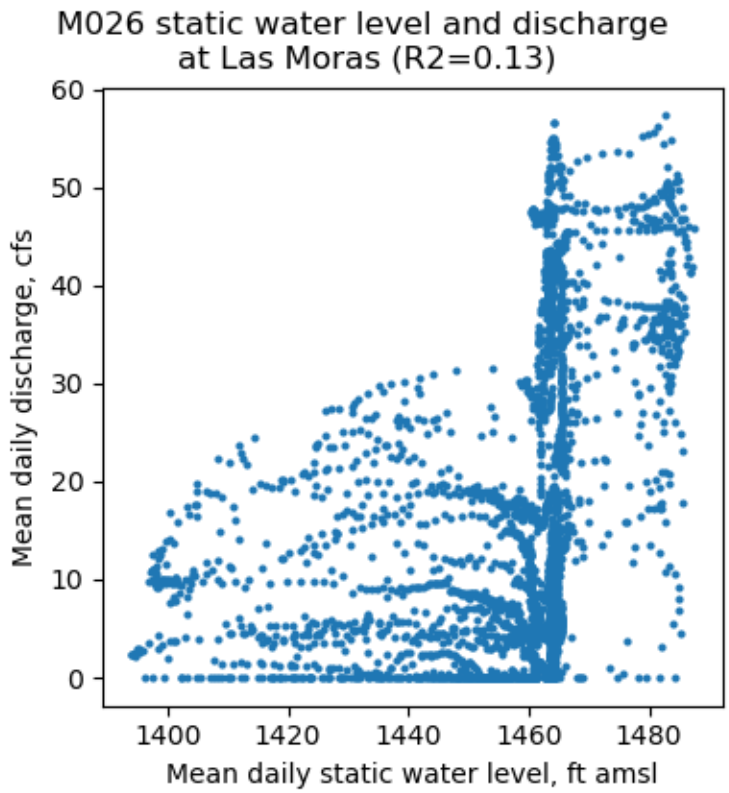

M020 static water level and discharge
at Las Moras (R2=0.12)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
10
20
30
40
50
60
1010
1020
1030
1040
1050

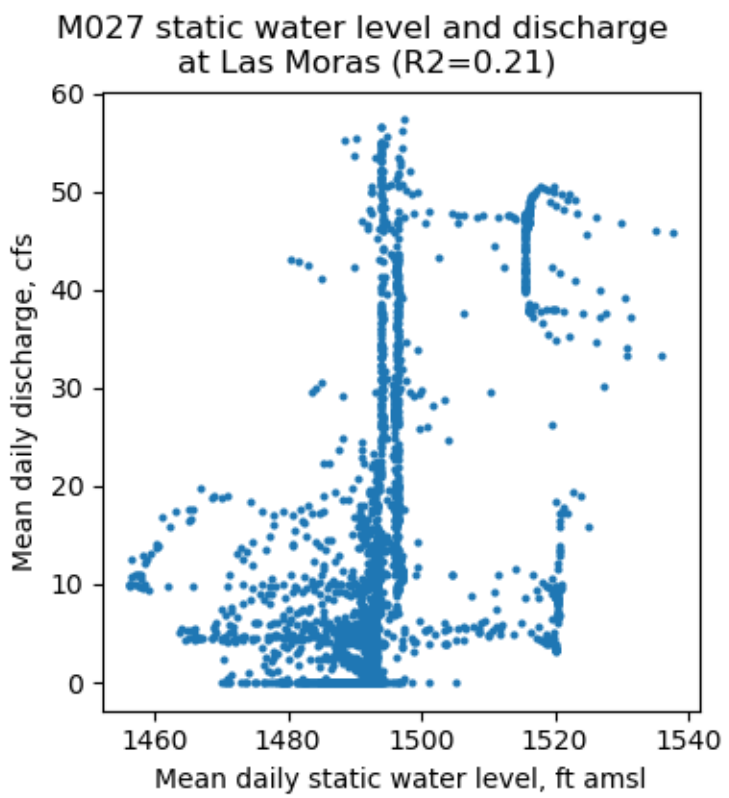

M021 static water level and discharge
at Las Moras (R2=0.49)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1420
1430
1440
1450
1460
1470
1480

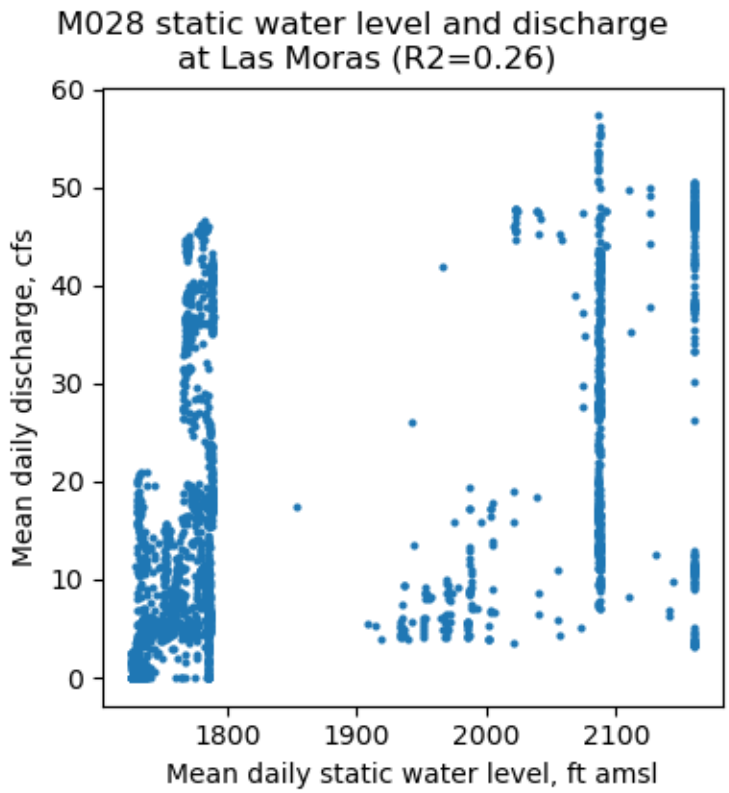

M022 static water level and discharge
at Las Moras (R2=0.74)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
1250
1260
1270
1280
1290
1300

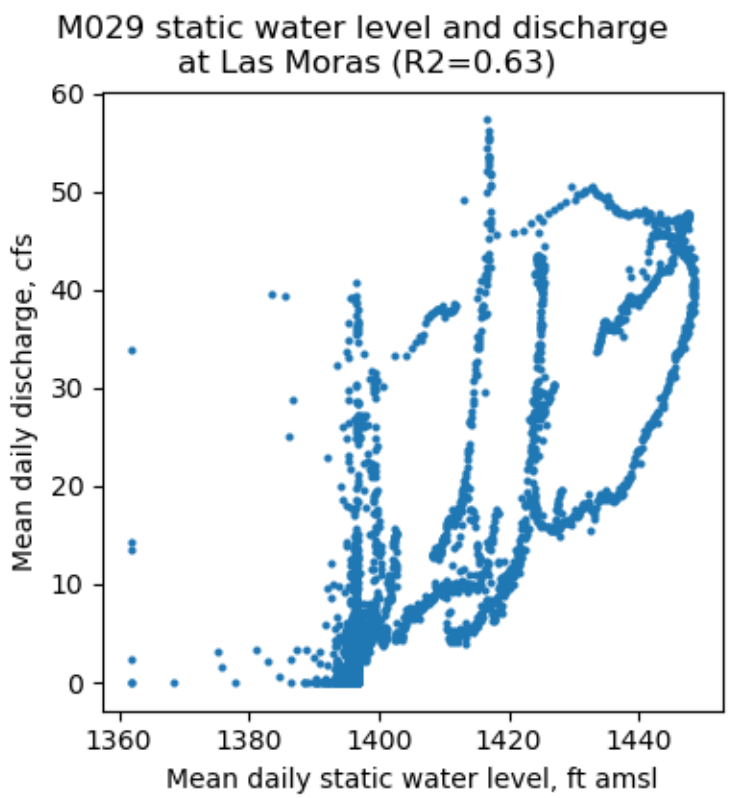

M023 static water level and discharge
at Las Moras (R2=0.24)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
926
928
930
932
934
936
938

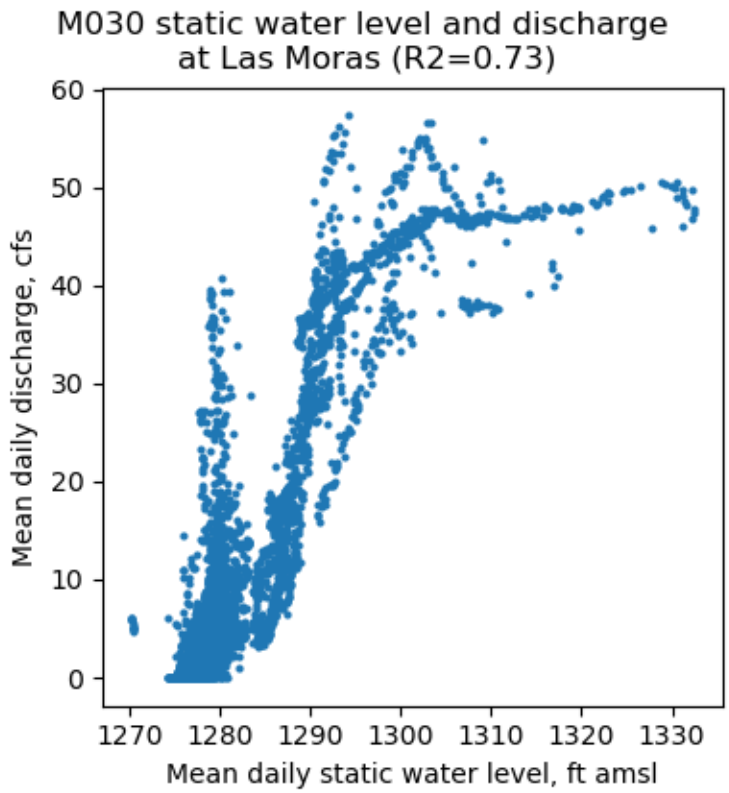

M025 static water level and discharge
at Las Moras (R2=0.44)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1107.5
1110.0
1112.5
1115.0
1117.5
1120.0
1122.5

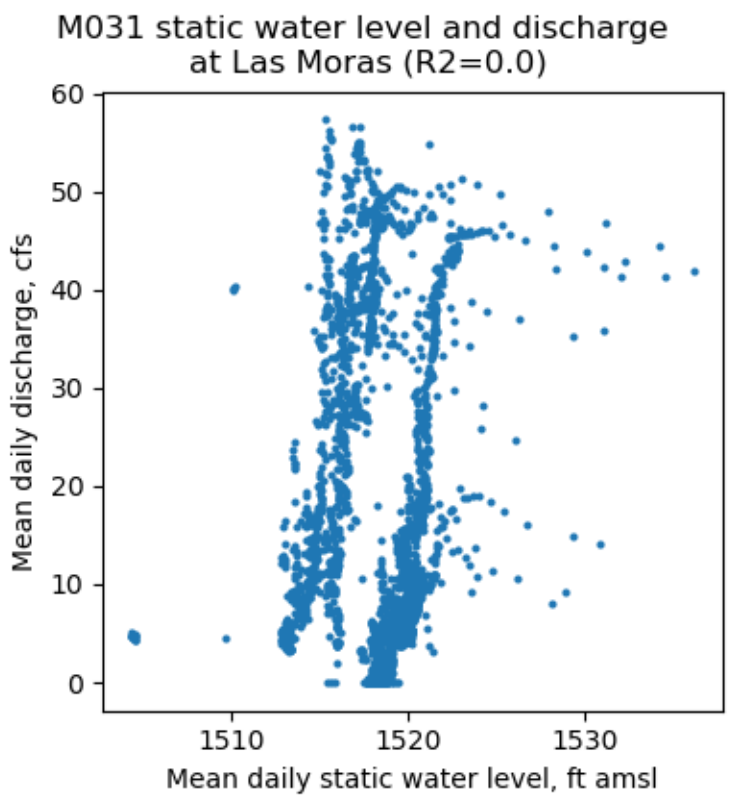

M026 static water level and discharge
at Las Moras (R2=0.13)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1400
1420
1440
1460
1480

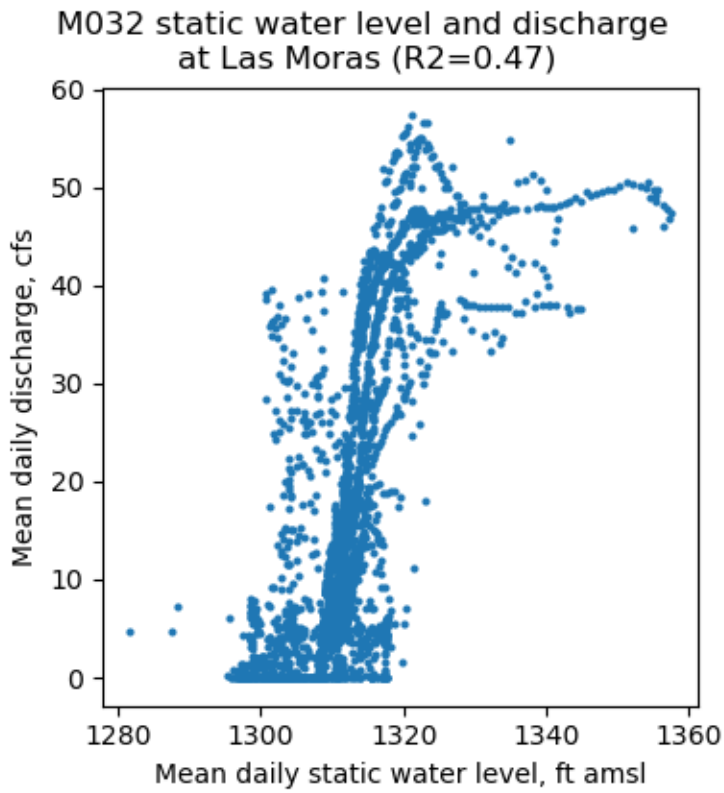

M027 static water level and discharge
at Las Moras (R2=0.21)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1460
1480
1500
1520
1540

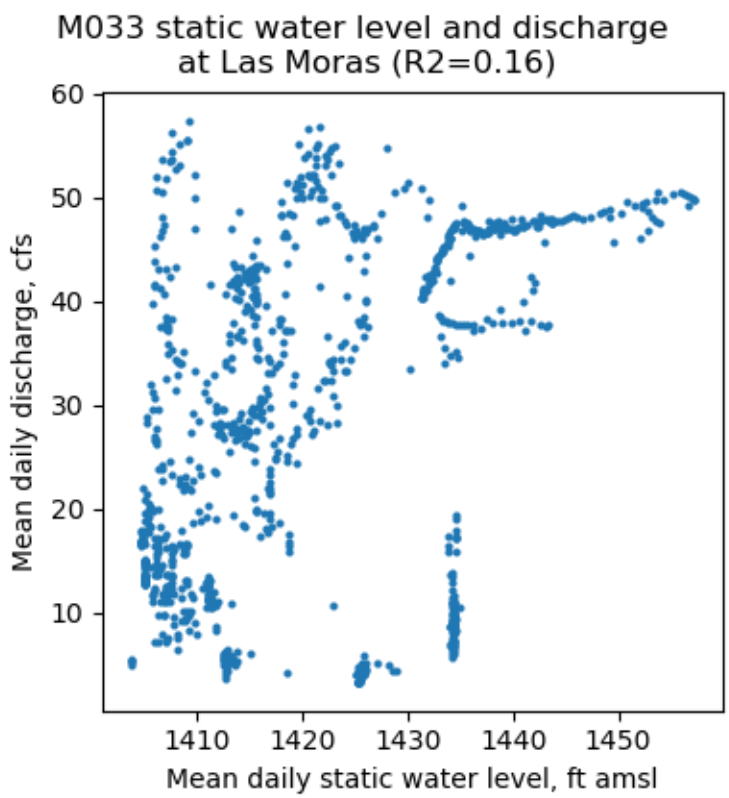

M028 static water level and discharge
at Las Moras (R2=0.26)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1800
1900
2000
2100

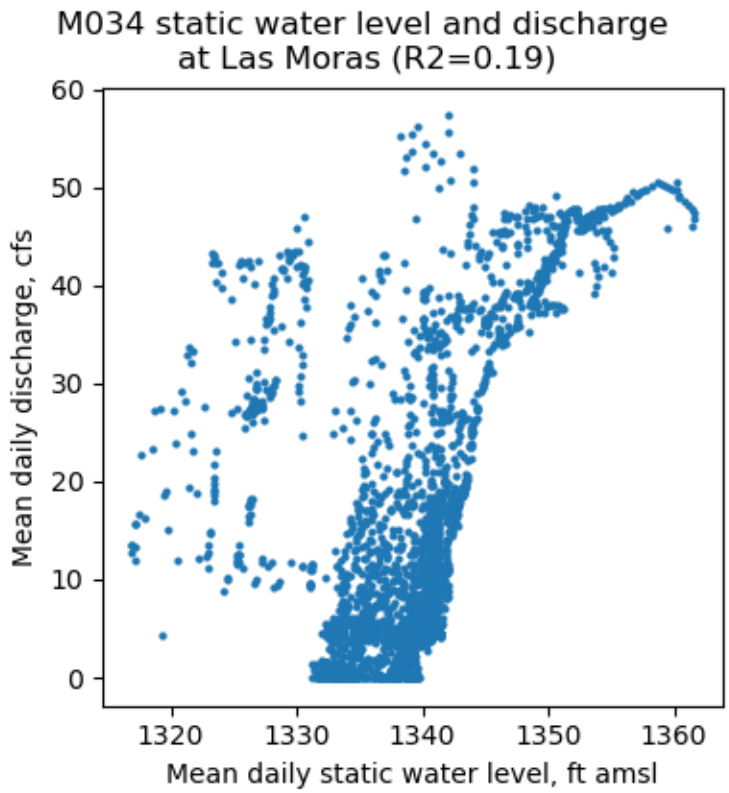

M029 static water level and discharge
at Las Moras (R2=0.63)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1360
1380
1400
1420
1440

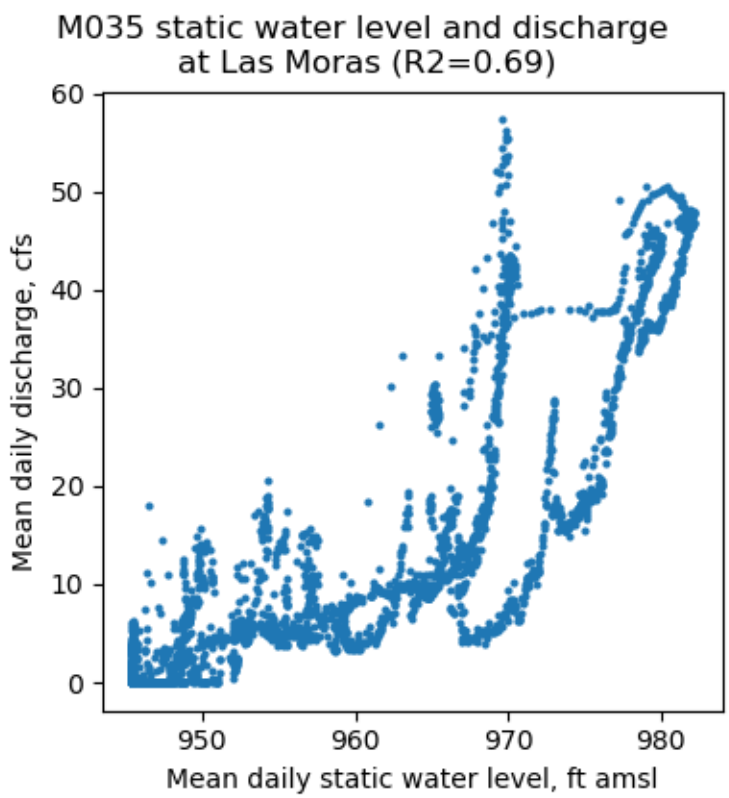

M030 static water level and discharge
at Las Moras (R2=0.73)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1270
1280
1290
1300
1310
1320
1330

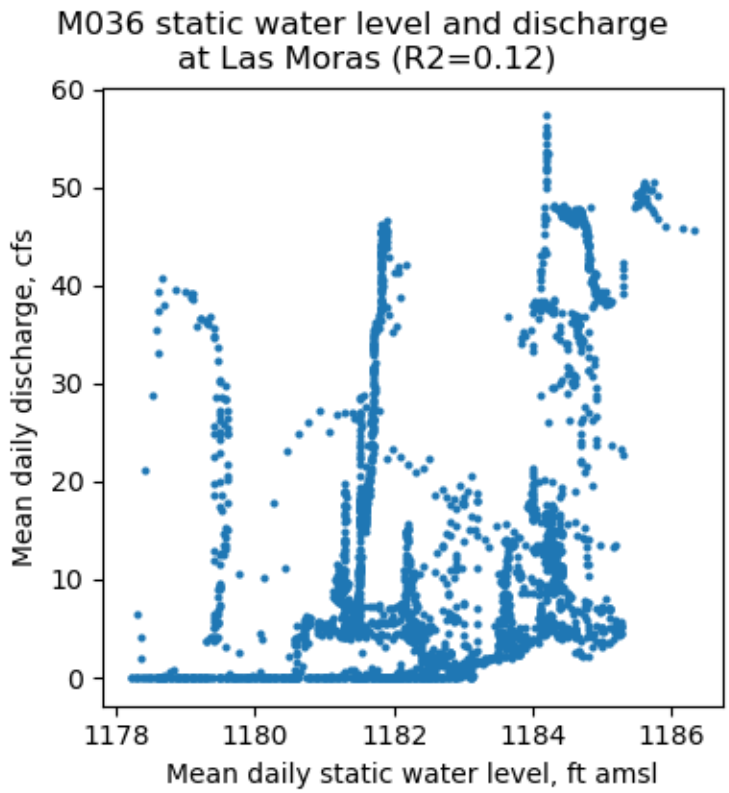

M031 static water level and discharge
at Las Moras (R2=0.0)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1510
1520
1530

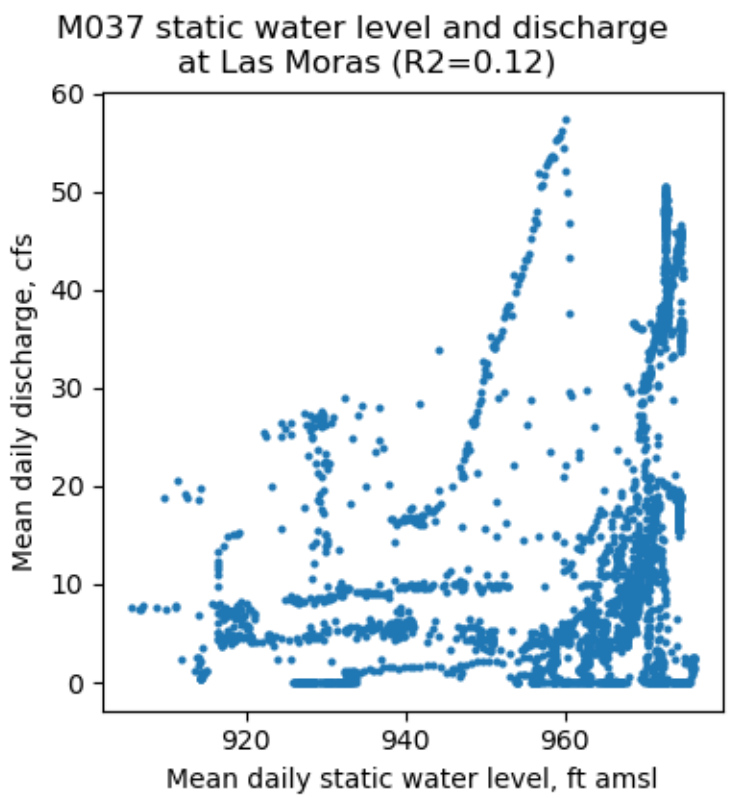

M032 static water level and discharge
at Las Moras (R2=0.47)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1280
1300
1320
1340
1360

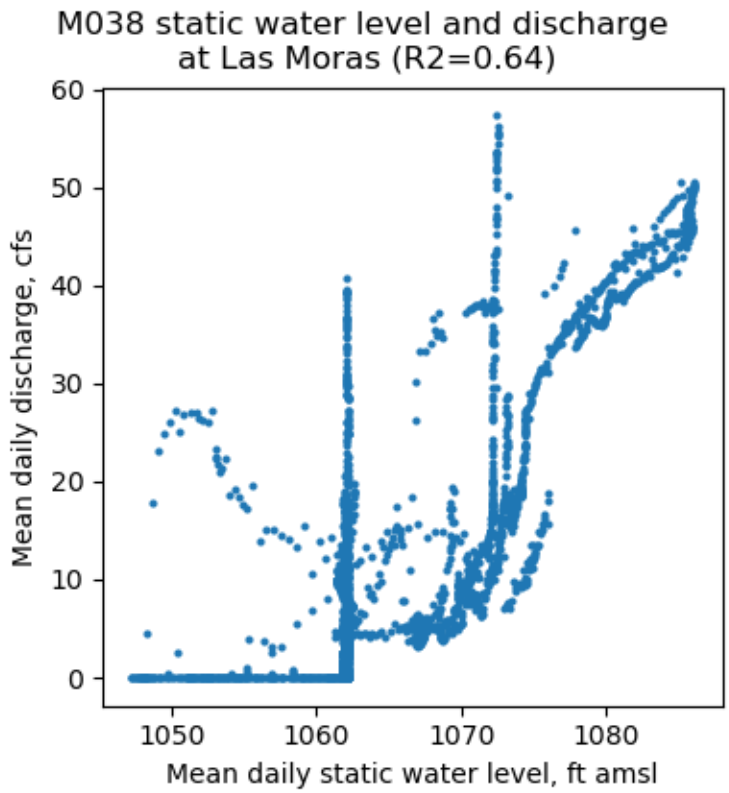

M033 static water level and discharge
at Las Moras (R2=0.16)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
10
20
30
40
50
60
1410
1420
1430
1440
1450

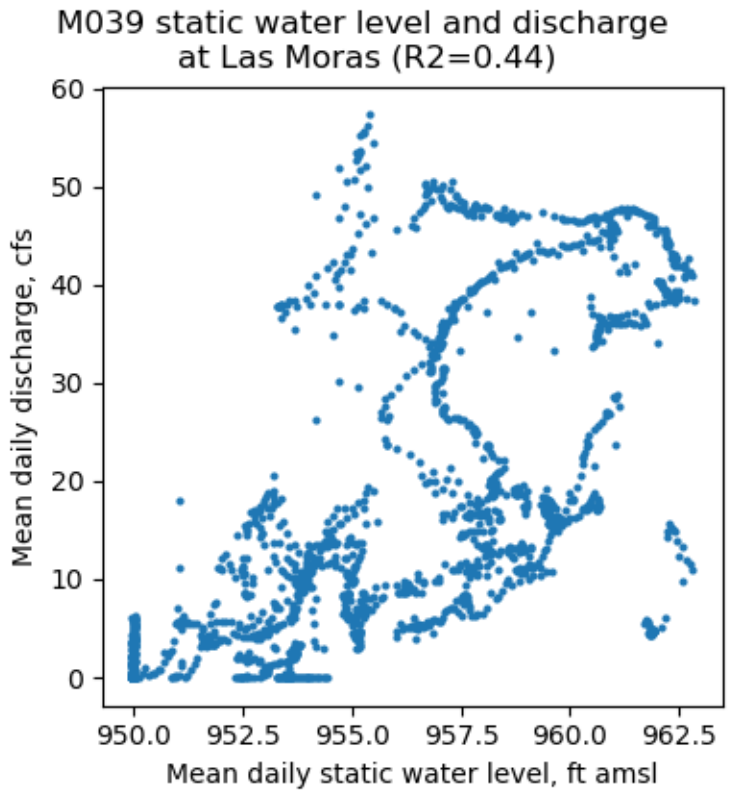

M034 static water level and discharge
at Las Moras (R2=0.19)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1320
1330
1340
1350
1360

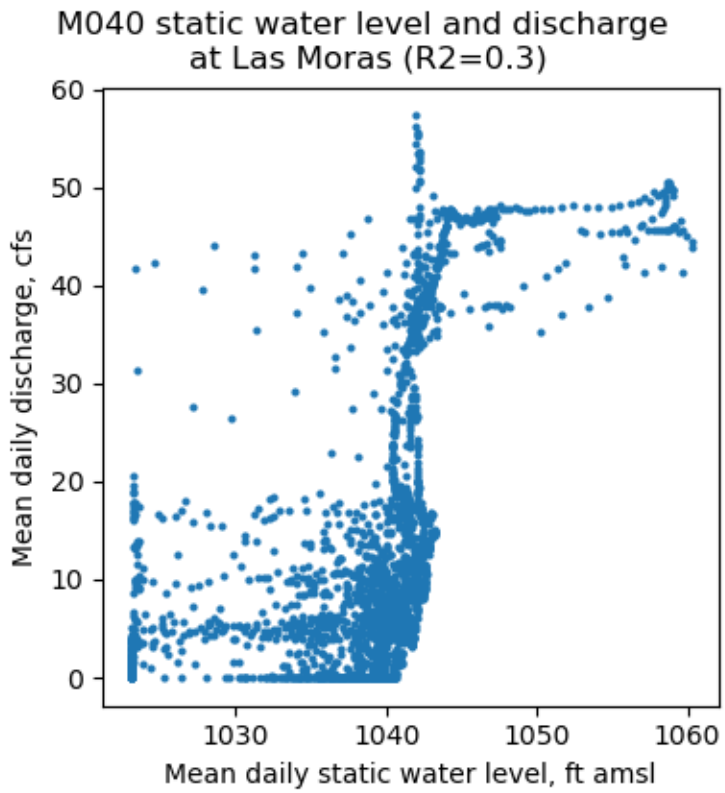

M035 static water level and discharge
at Las Moras (R2=0.69)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
950
960
970
980

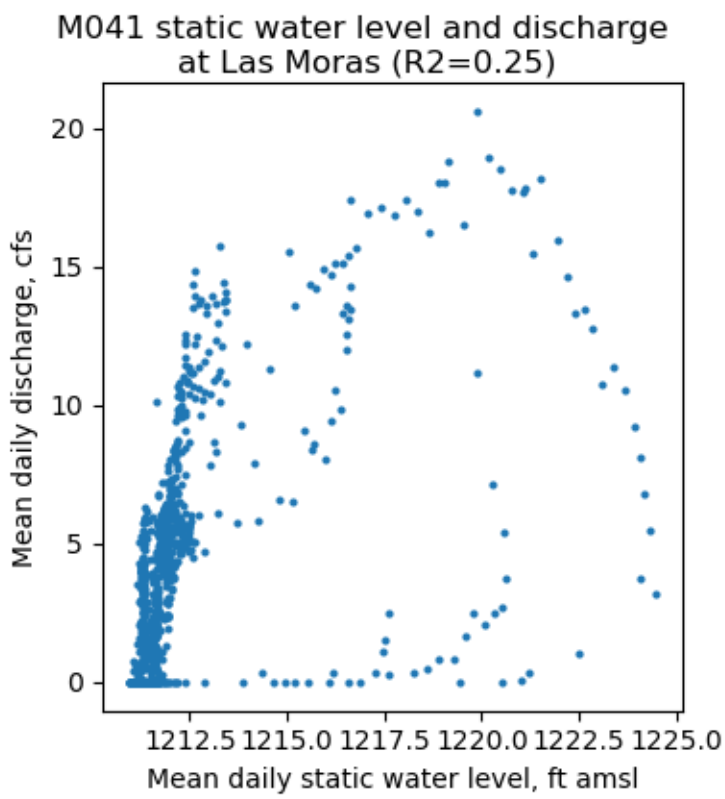

M036 static water level and discharge
at Las Moras (R2=0.12)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1178
1180
1182
1184
1186

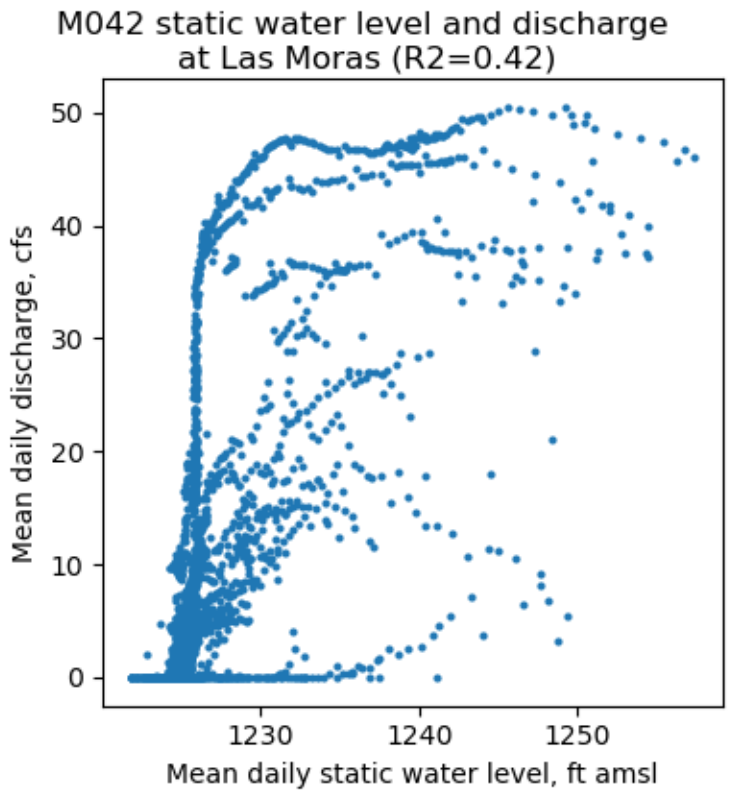

M037 static water level and discharge
at Las Moras (R2=0.12)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
920
940
960

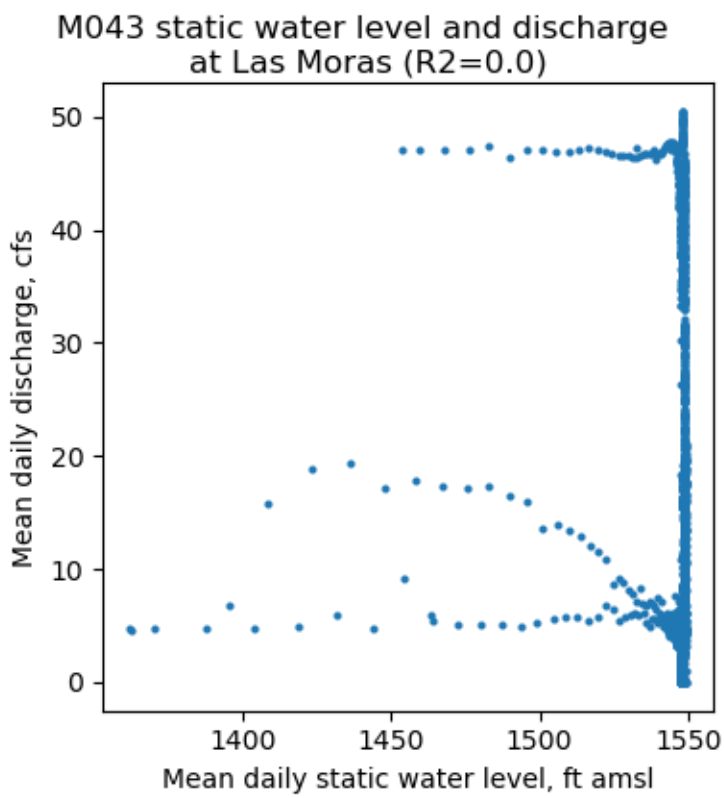

M038 static water level and discharge
at Las Moras (R2=0.64)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1050
1060
1070
1080

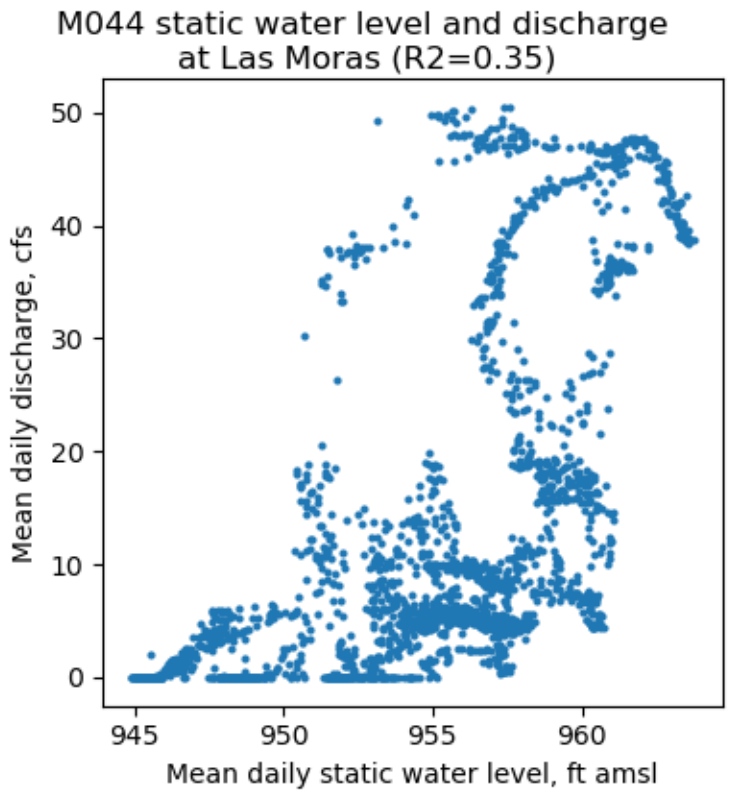

M039 static water level and discharge
at Las Moras (R2=0.44)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
950.0
952.5
955.0
957.5
960.0
962.5

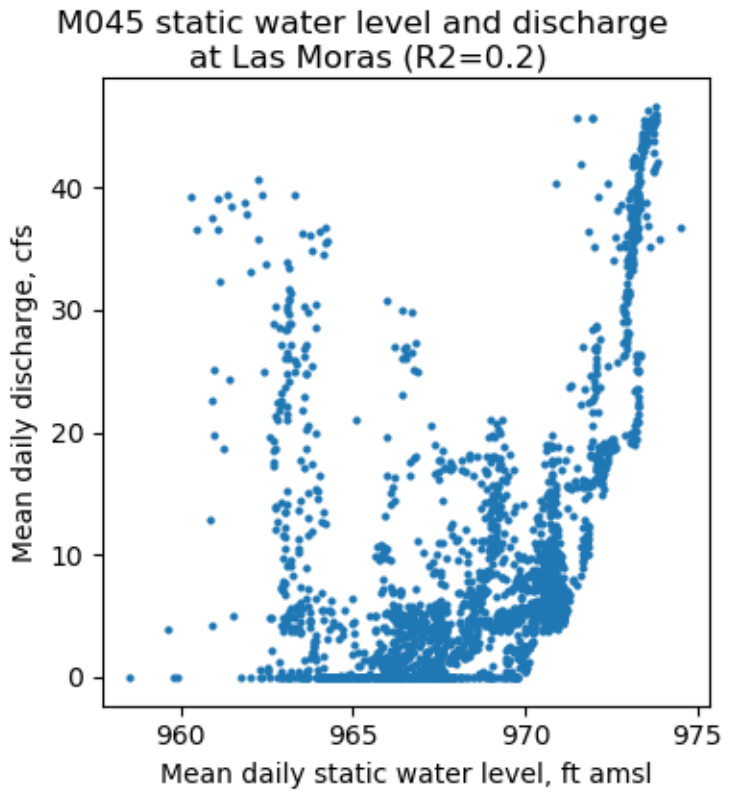

M040 static water level and discharge
at Las Moras (R2=0.3)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1030
1040
1050
1060

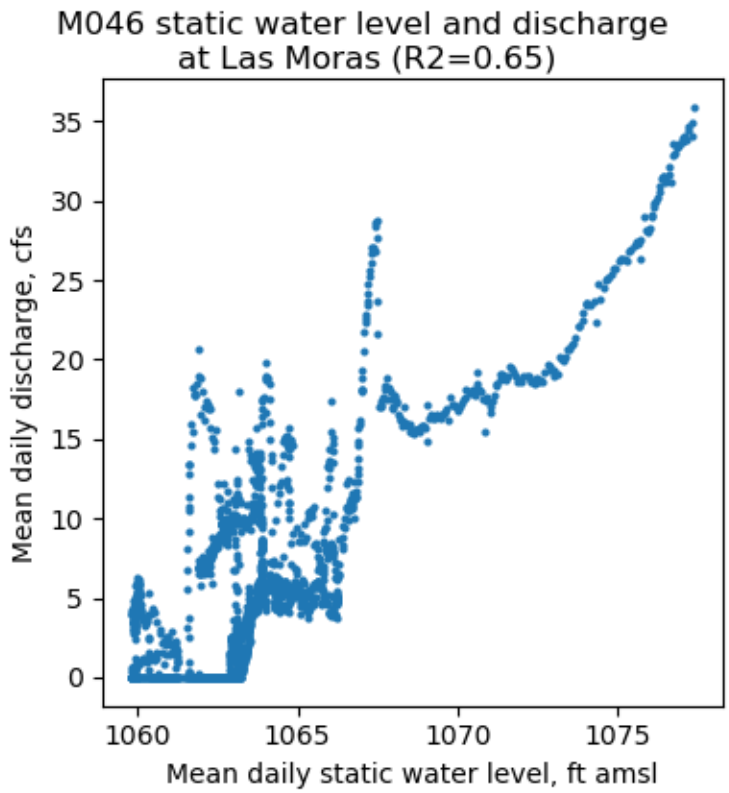

M041 static water level and discharge
at Las Moras (R2=0.25)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
1212.5
1215.0
1217.5
1220.0
1222.5
1225.0

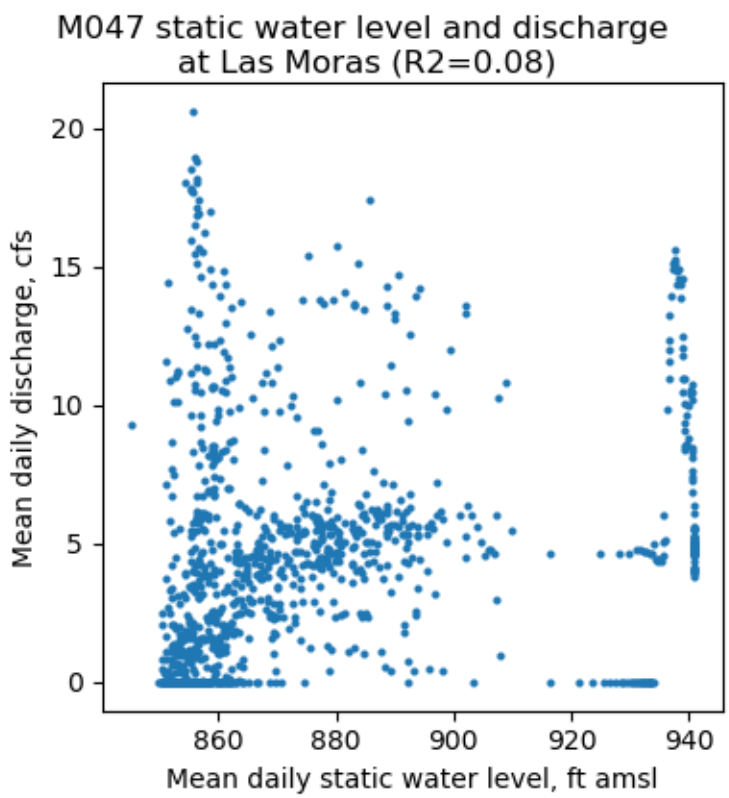

M042 static water level and discharge
at Las Moras (R2=0.42)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
1230
1240
1250

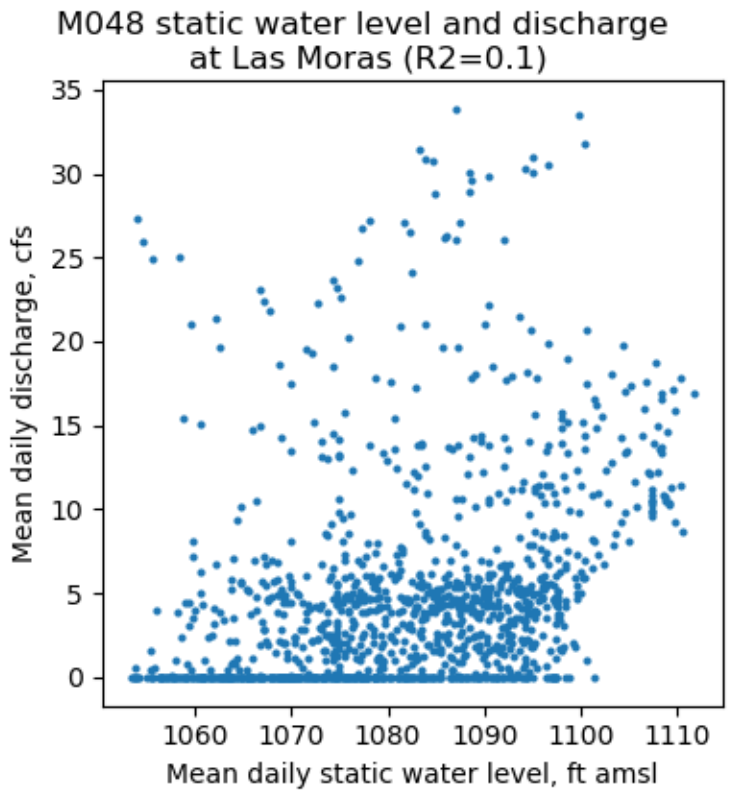

M043 static water level and discharge
at Las Moras (R2=0.0)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
1400
1450
1500
1550

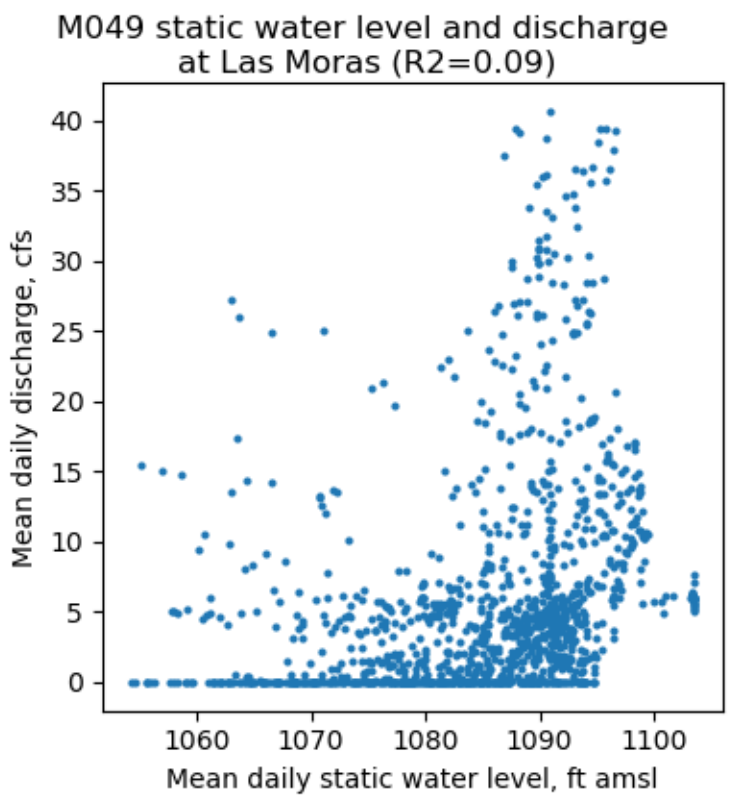

M044 static water level and discharge
at Las Moras (R2=0.35)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
945
950
955
960

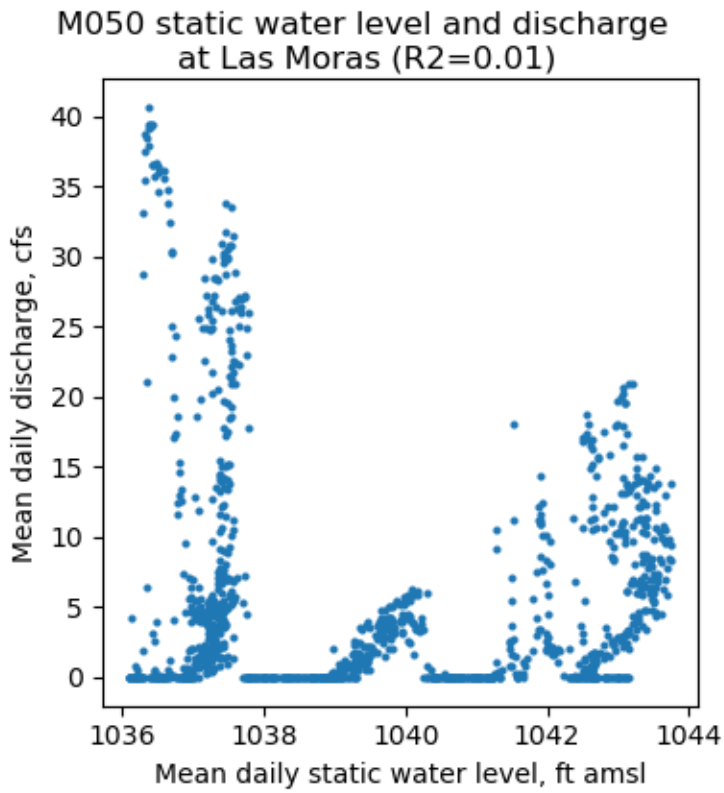

M045 static water level and discharge
at Las Moras (R2=0.2)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
960
965
970
975

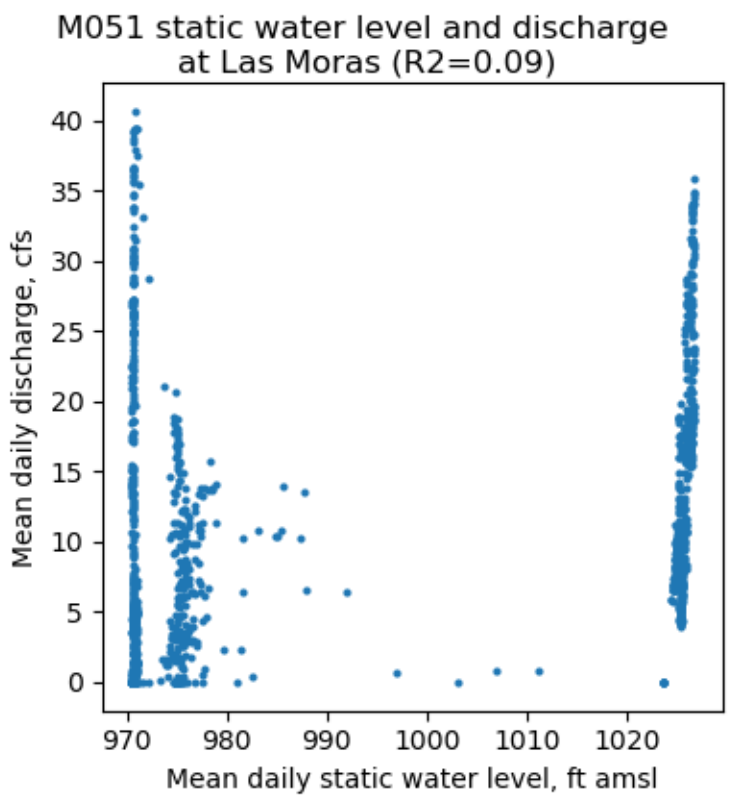

M046 static water level and discharge
at Las Moras (R2=0.65)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
1060
1065
1070
1075

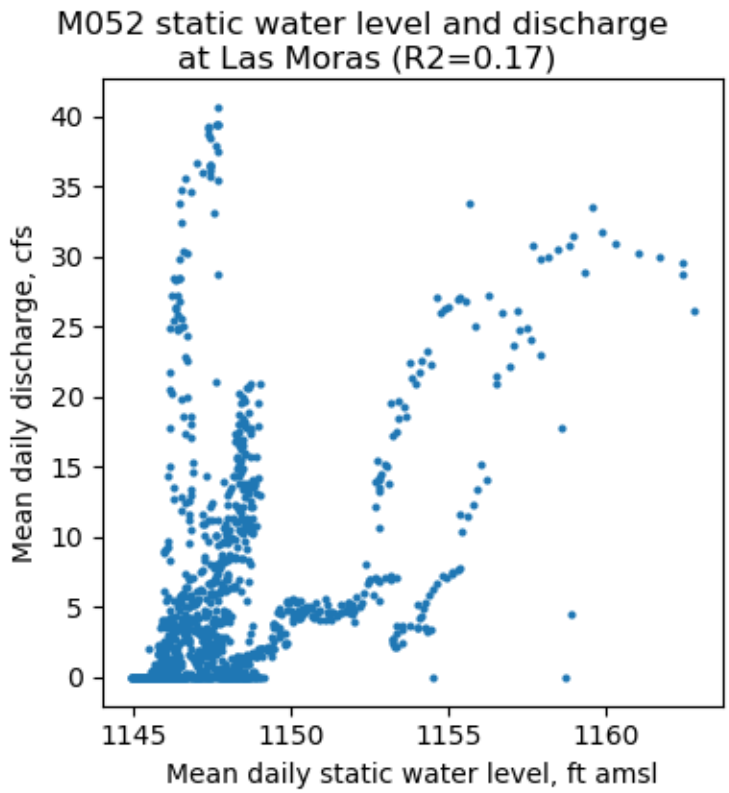

M047 static water level and discharge
at Las Moras (R2=0.08)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
860
880
900
920
940

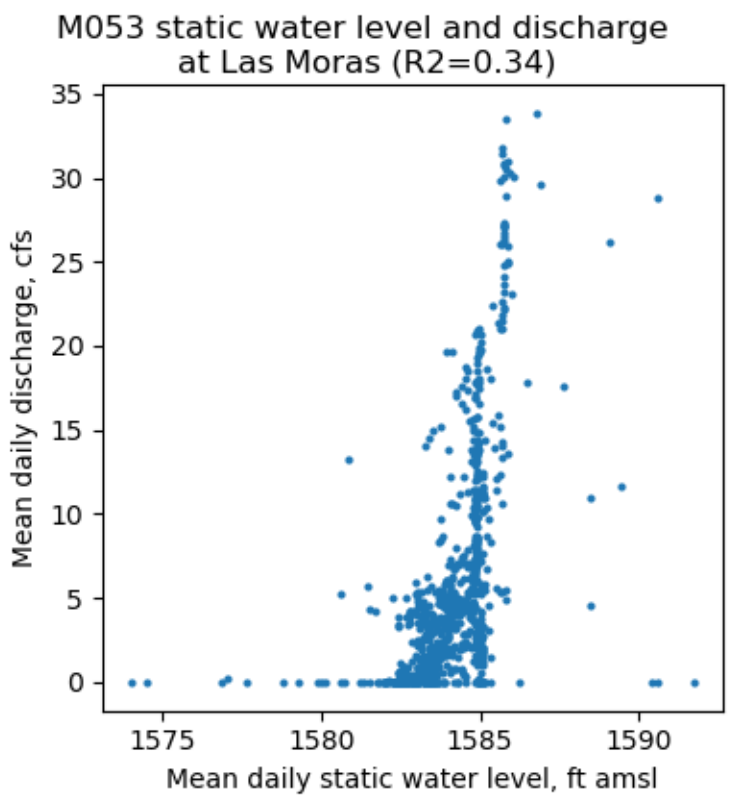

M048 static water level and discharge
at Las Moras (R2=0.1)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
1060
1070
1080
1090
1100
1110

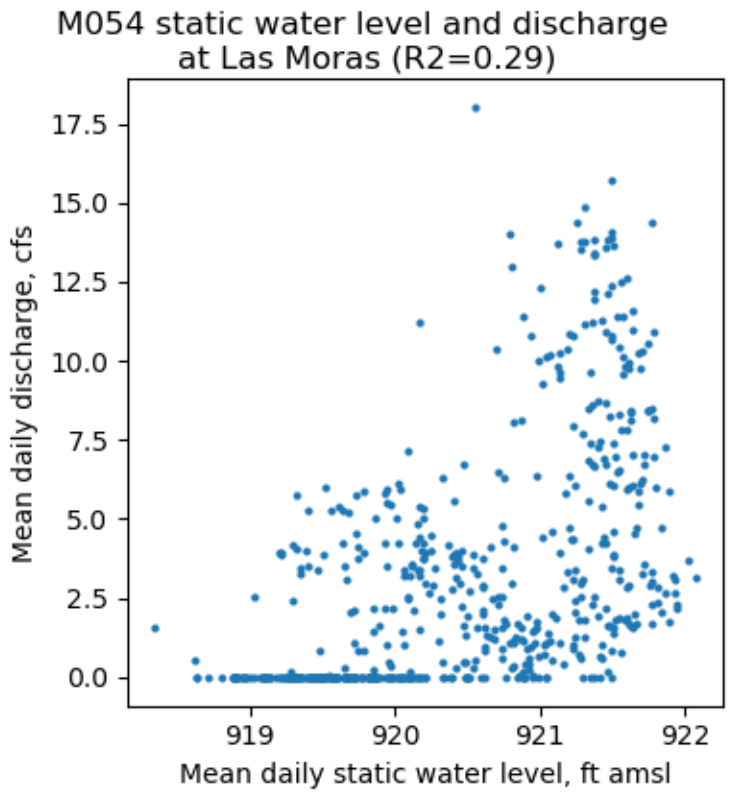

M049 static water level and discharge
at Las Moras (R2=0.09)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1060
1070
1080
1090
1100

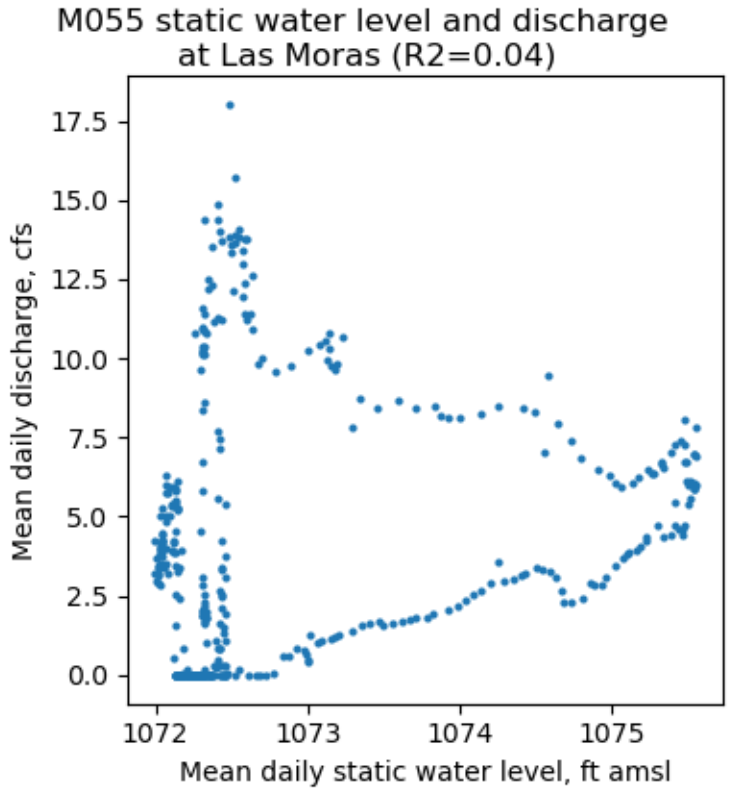

M050 static water level and discharge
at Las Moras (R2=0.01)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1036
1038
1040
1042
1044

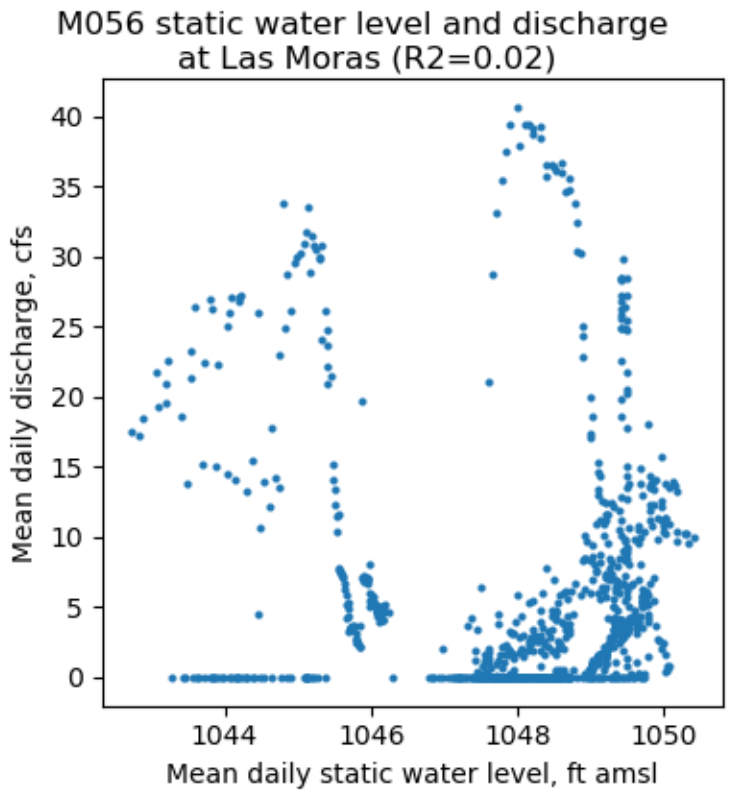

M051 static water level and discharge
at Las Moras (R2=0.09)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
970
980
990
1000
1010
1020

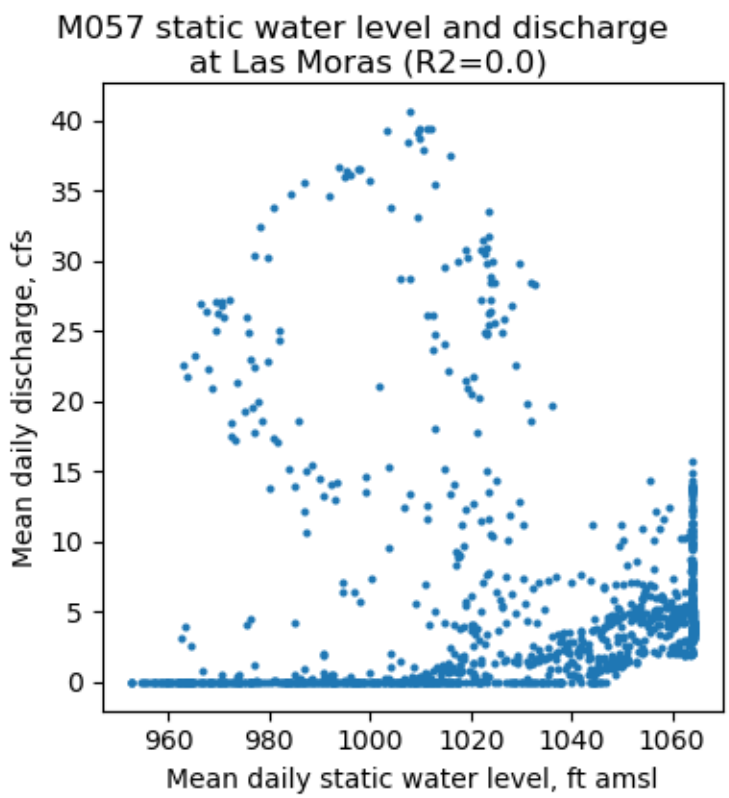

M052 static water level and discharge
at Las Moras (R2=0.17)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1145
1150
1155
1160

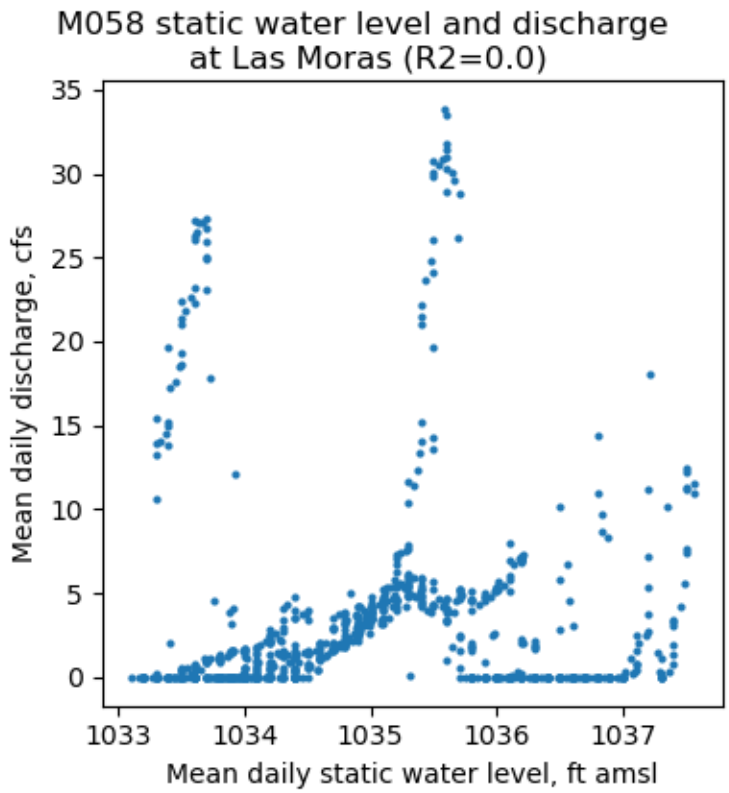

M053 static water level and discharge
at Las Moras (R2=0.34)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
1575
1580
1585
1590

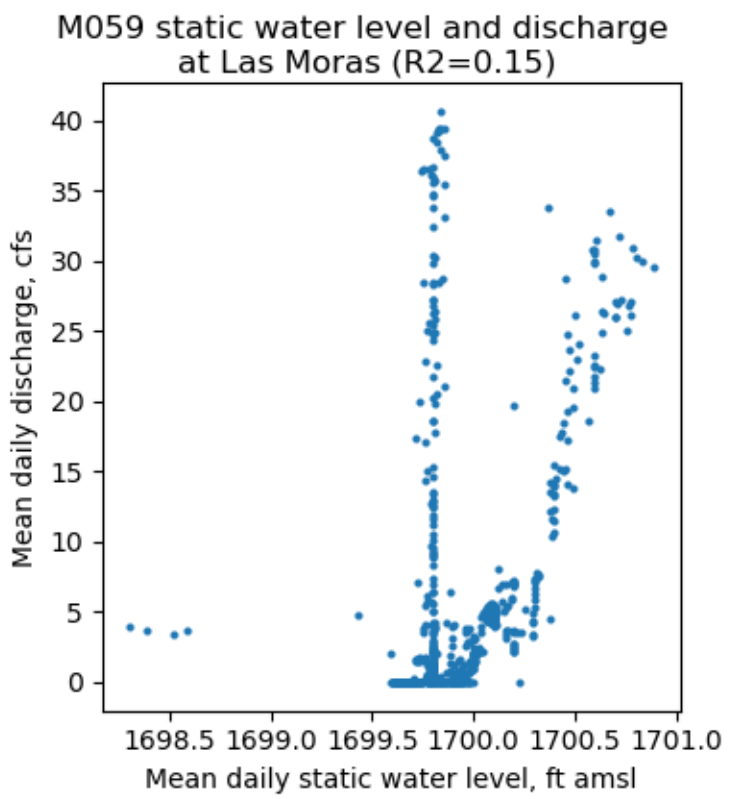

M054 static water level and discharge
at Las Moras (R2=0.29)
Mean daily discharge, cfs
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
919
920
921
922
Mean daily static water level, ft amsl

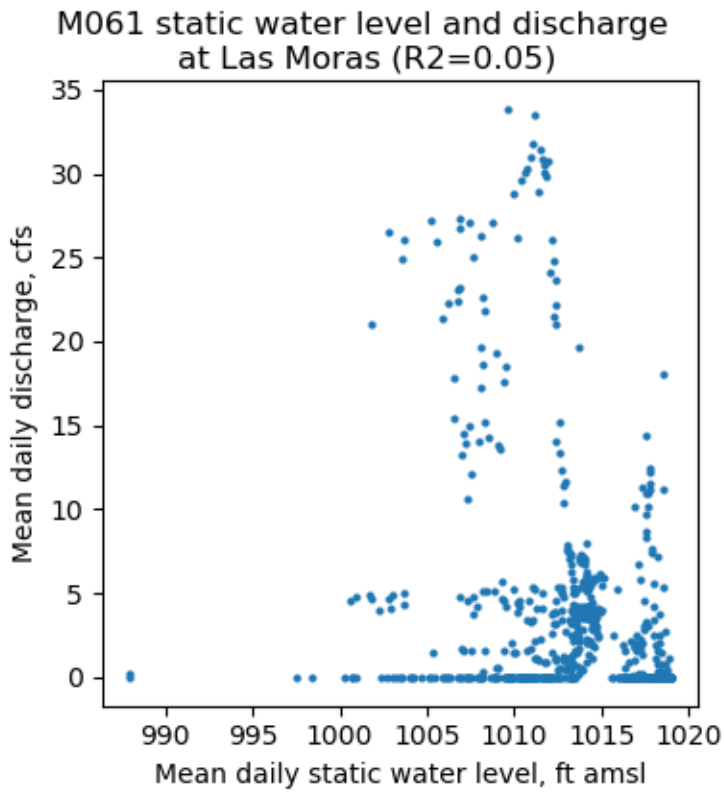

M055 static water level and discharge
at Las Moras (R2=0.04)
Mean daily discharge, cfs
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
1072
1073
1074
1075
Mean daily static water level, ft amsl

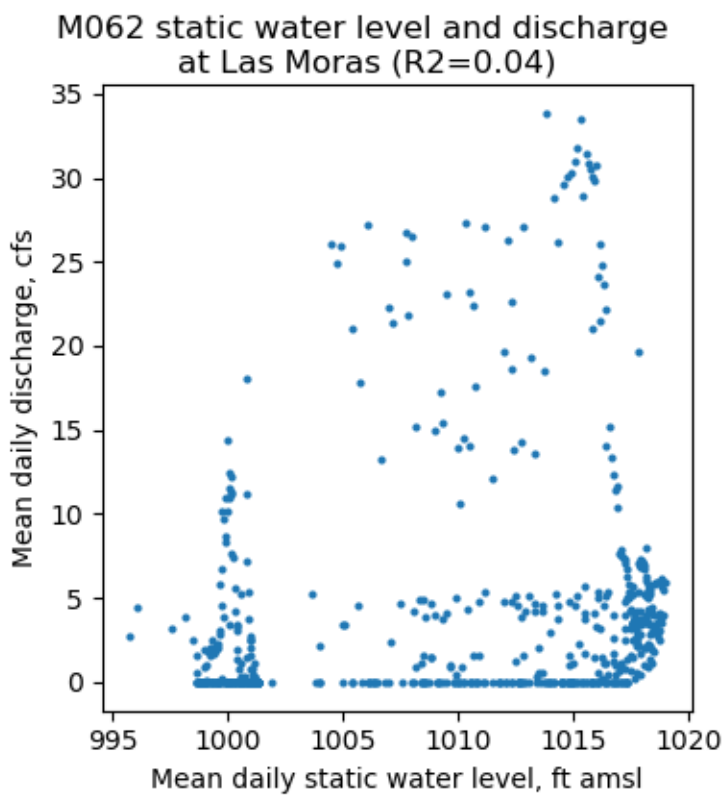

M056 static water level and discharge
at Las Moras (R2=0.02)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1044
1046
1048
1050

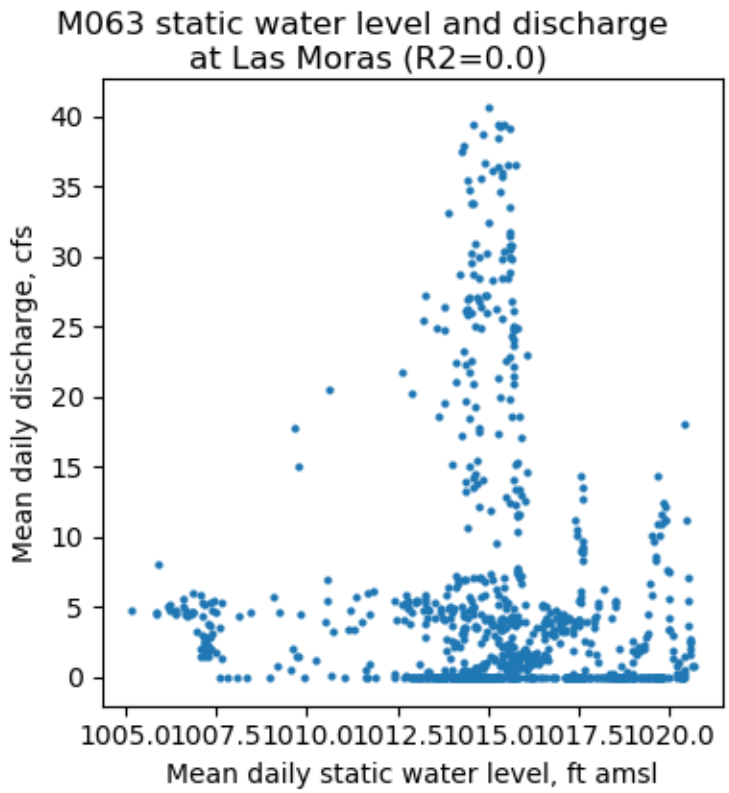

M057 static water level and discharge
at Las Moras (R2=0.0)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
960
980
1000
1020
1040
1060

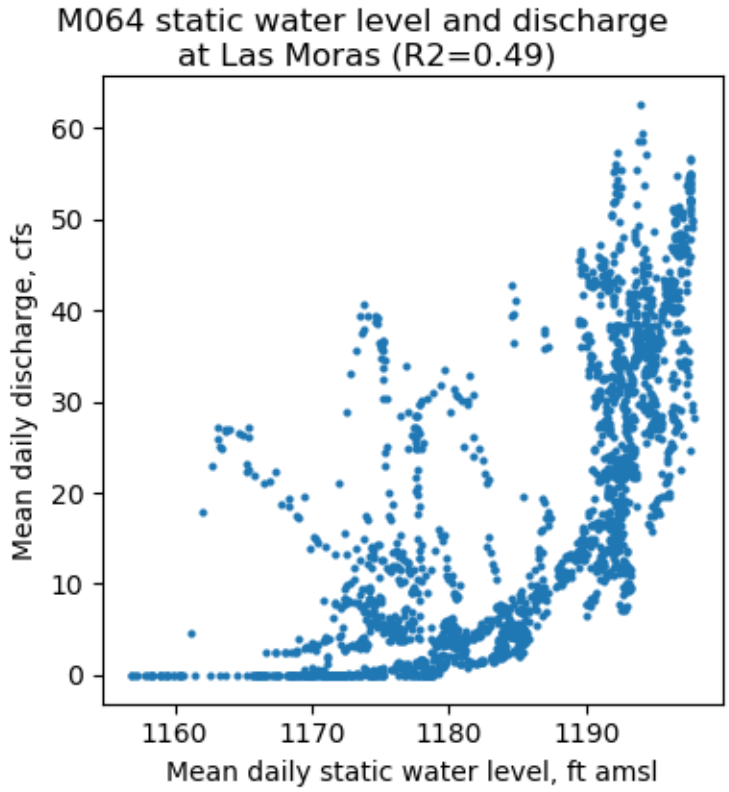

M058 static water level and discharge
at Las Moras (R2=0.0)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
1033
1034
1035
1036
1037

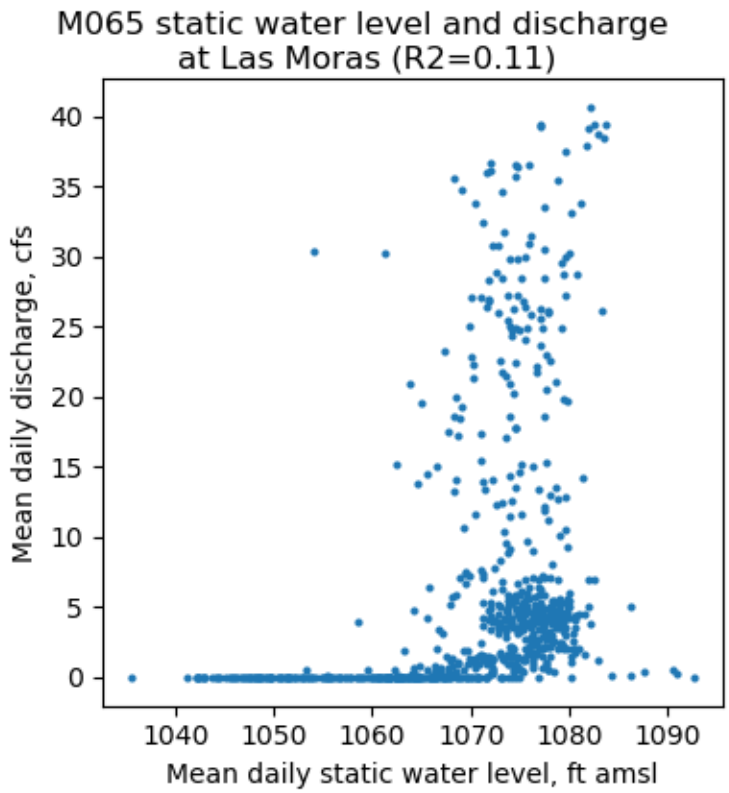

M059 static water level and discharge
at Las Moras (R2=0.15)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1698.5
1699.0
1699.5
1700.0
1700.5
1701.0

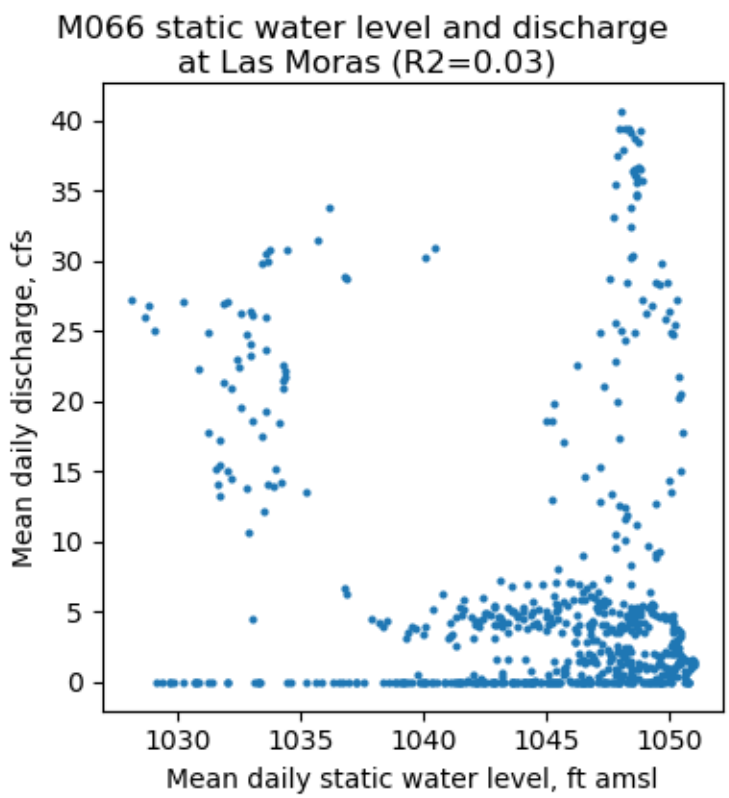

M061 static water level and discharge
at Las Moras (R2=0.05)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
35
30
25
20
15
10
5
0
990
995
1000
1005
1010
1015
1020

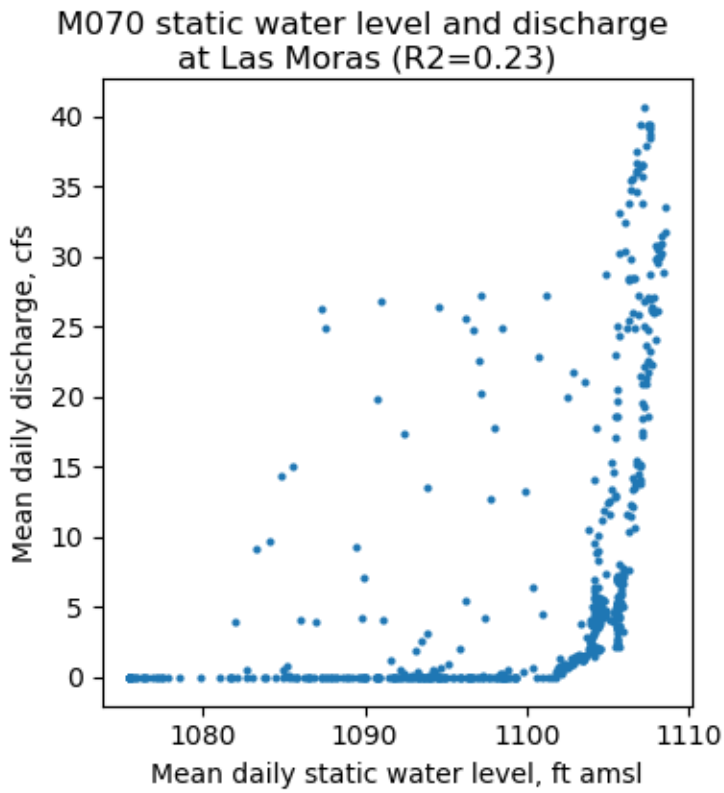

M062 static water level and discharge
at Las Moras (R2=0.04)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
35
30
25
20
15
10
5
0
995
1000
1005
1010
1015
1020

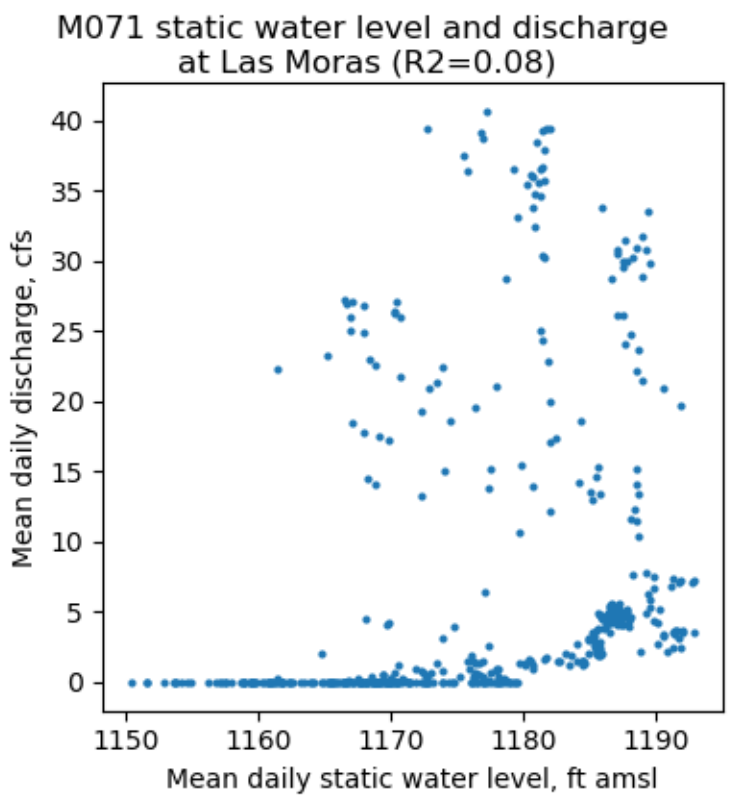

M063 static water level and discharge
at Las Moras (R2=0.0)
Mean daily discharge, cfs
0
5
10
15
20
25
30
35
40
1005.0
1007.5
1010.0
1012.5
1015.0
1017.5
1020.0
Mean daily static water level, ft amsl

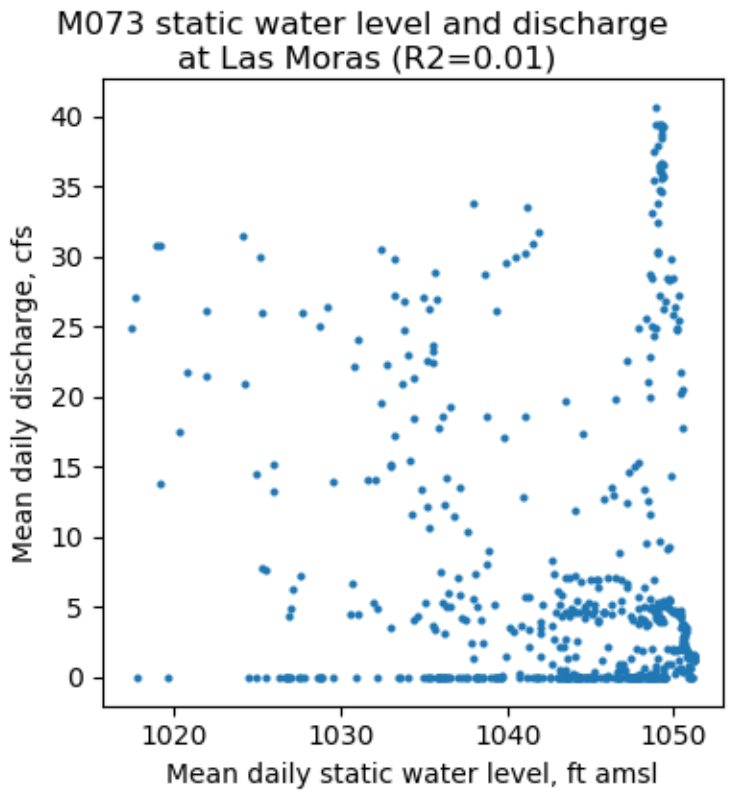

M064 static water level and discharge
at Las Moras (R2=0.49)
Mean daily discharge, cfs
0
10
20
30
40
50
60
1160
1170
1180
1190
Mean daily static water level, ft amsl

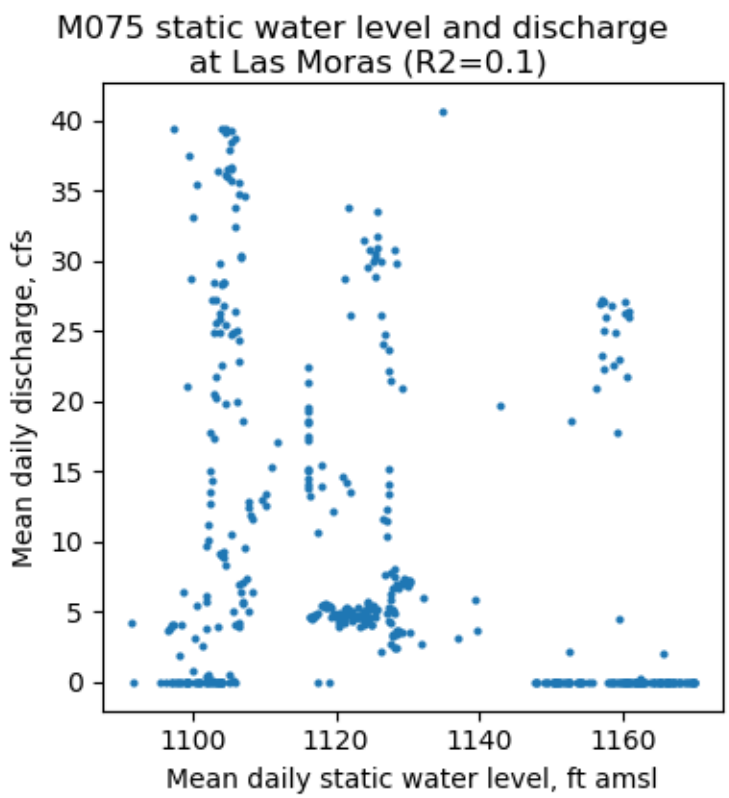

M065 static water level and discharge
at Las Moras (R2=0.11)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1040
1050
1060
1070
1080
1090

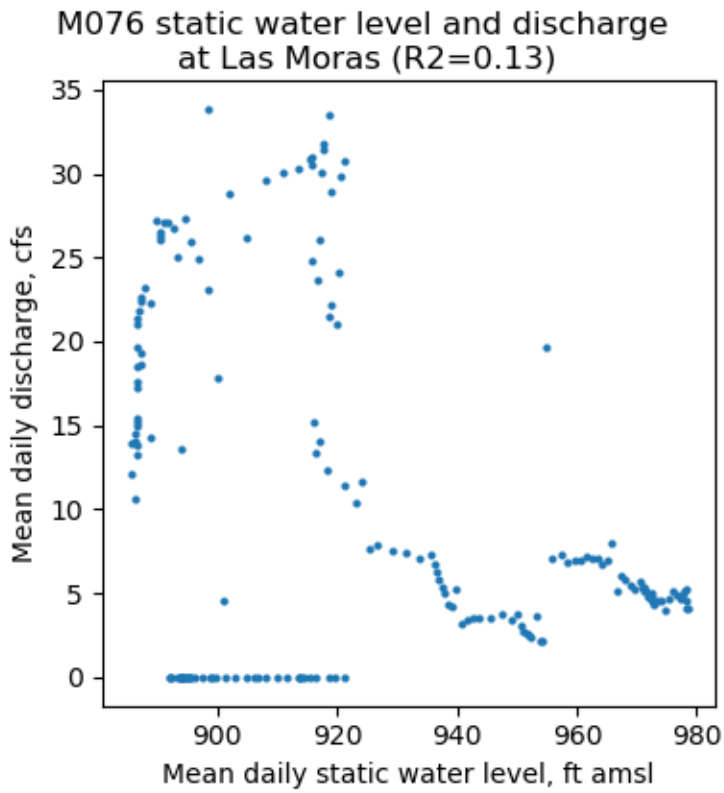

M066 static water level and discharge
at Las Moras (R2=0.03)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1030
1035
1040
1045
1050

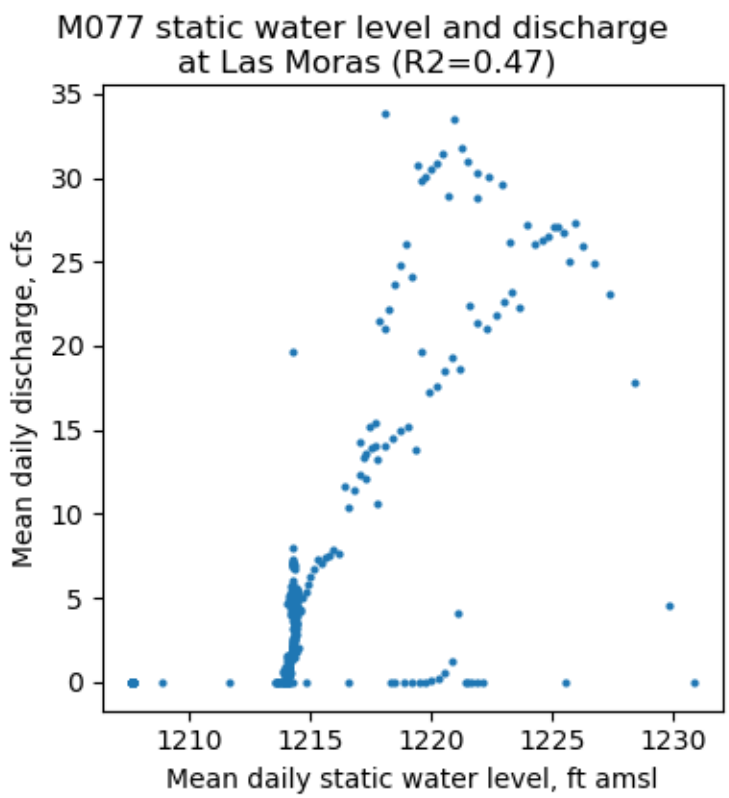

M070 static water level and discharge
at Las Moras (R2=0.23)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1080
1090
1100
1110

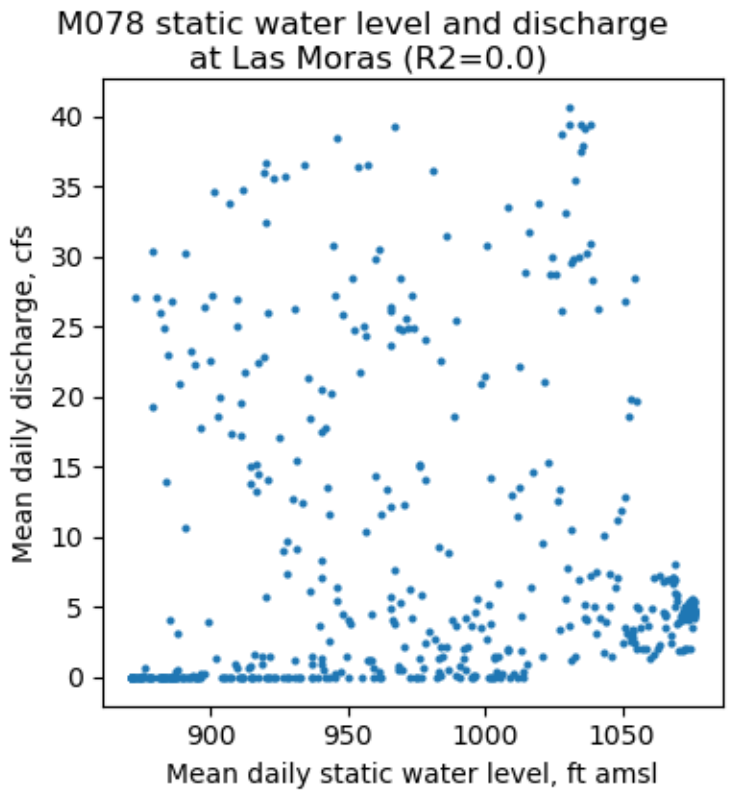

M071 static water level and discharge
at Las Moras (R2=0.08)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1150
1160
1170
1180
1190

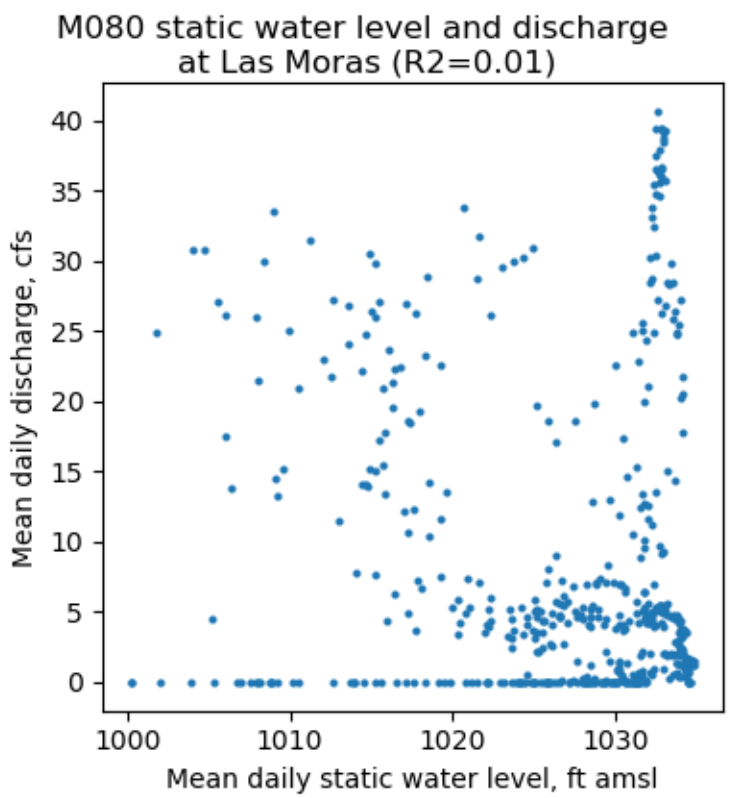

M073 static water level and discharge
at Las Moras (R2=0.01)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1020
1030
1040
1050

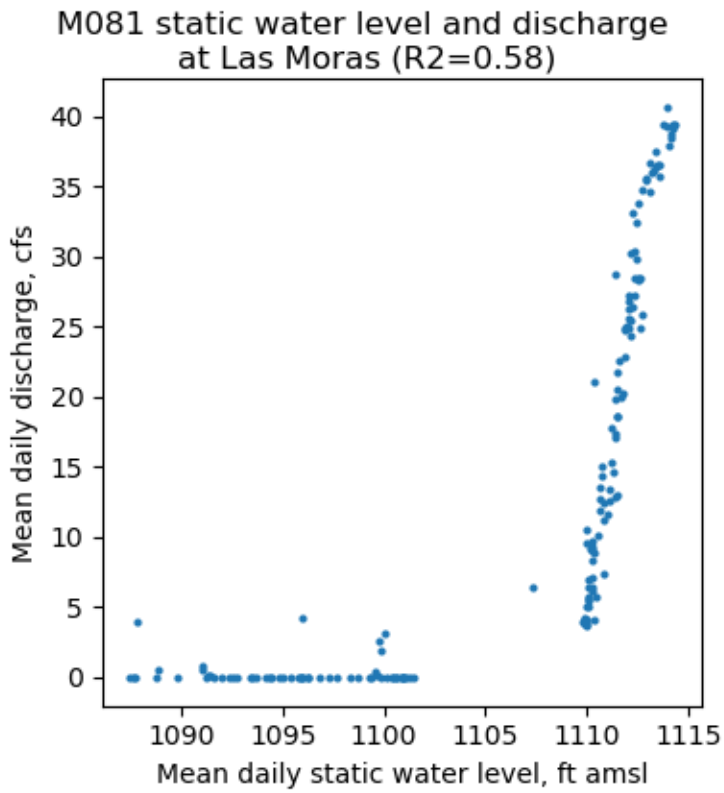

M075 static water level and discharge
at Las Moras (R2=0.1)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1100
1120
1140
1160

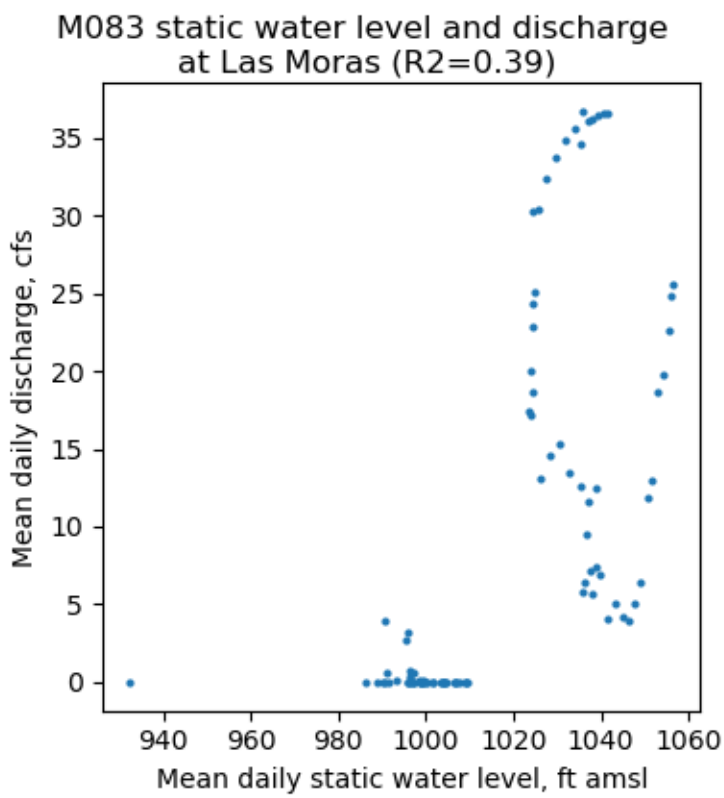

M076 static water level and discharge
at Las Moras (R2=0.13)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
900
920
940
960
980

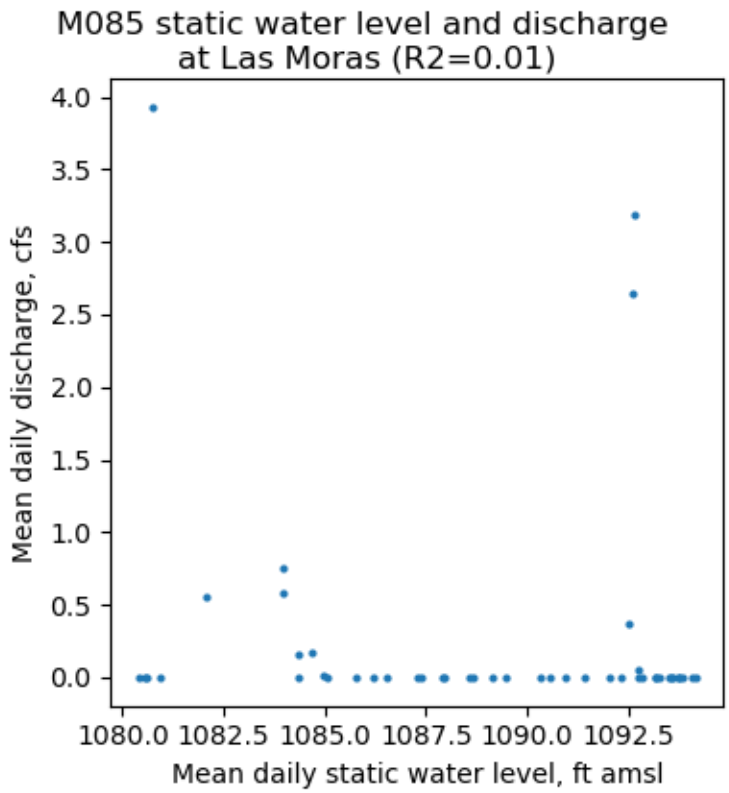

M077 static water level and discharge
at Las Moras (R2=0.47)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
1210
1215
1220
1225
1230

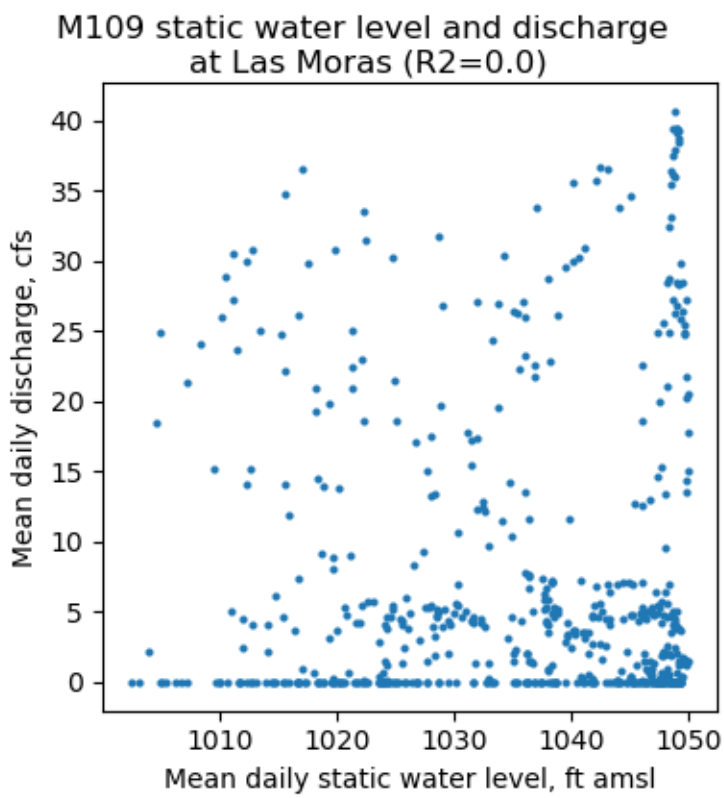

M078 static water level and discharge
at Las Moras (R2=0.0)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
900
950
1000
1050

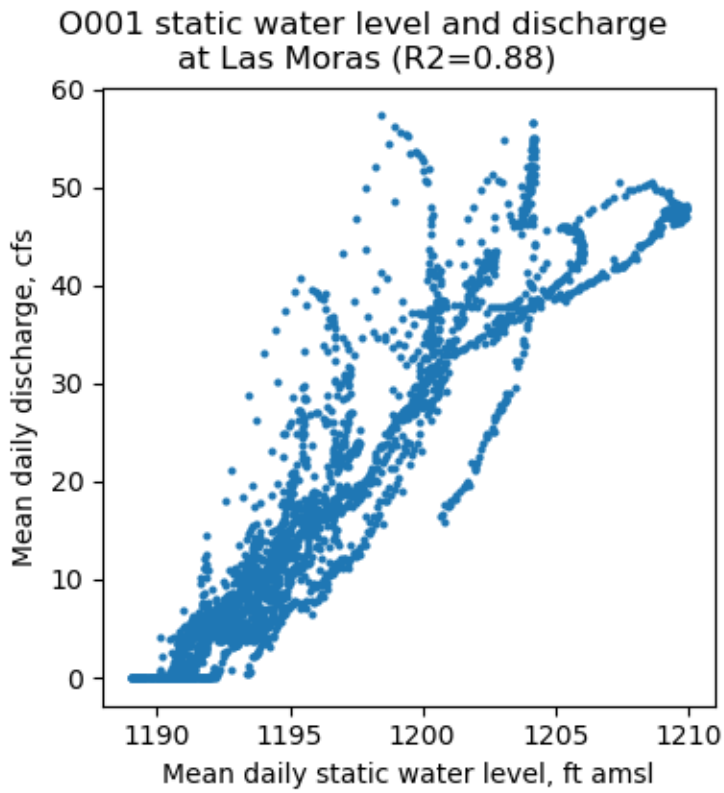

M080 static water level and discharge
at Las Moras (R2=0.01)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1000
1010
1020
1030

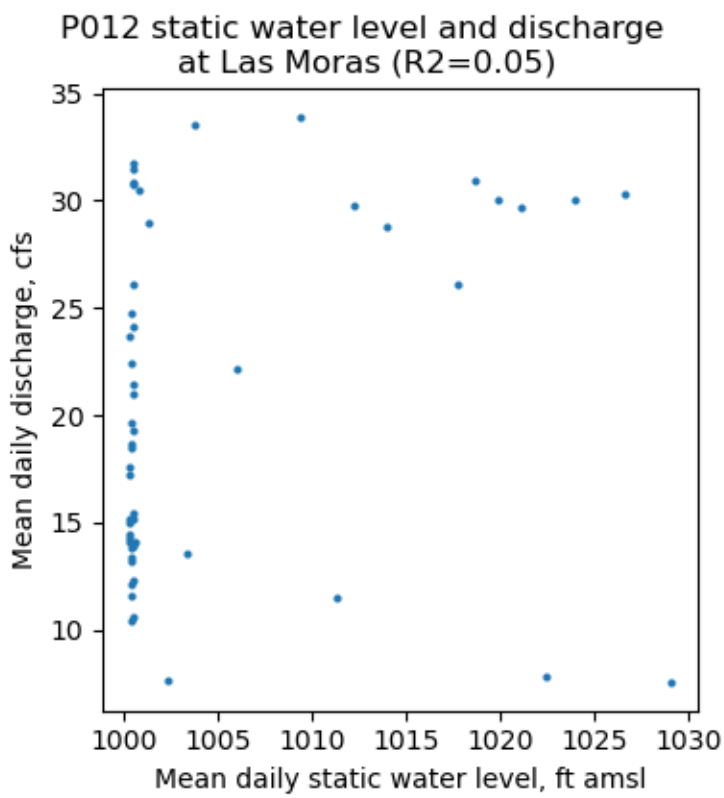

M081 static water level and discharge
at Las Moras (R2=0.58)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1090
1095
1100
1105
1110
1115

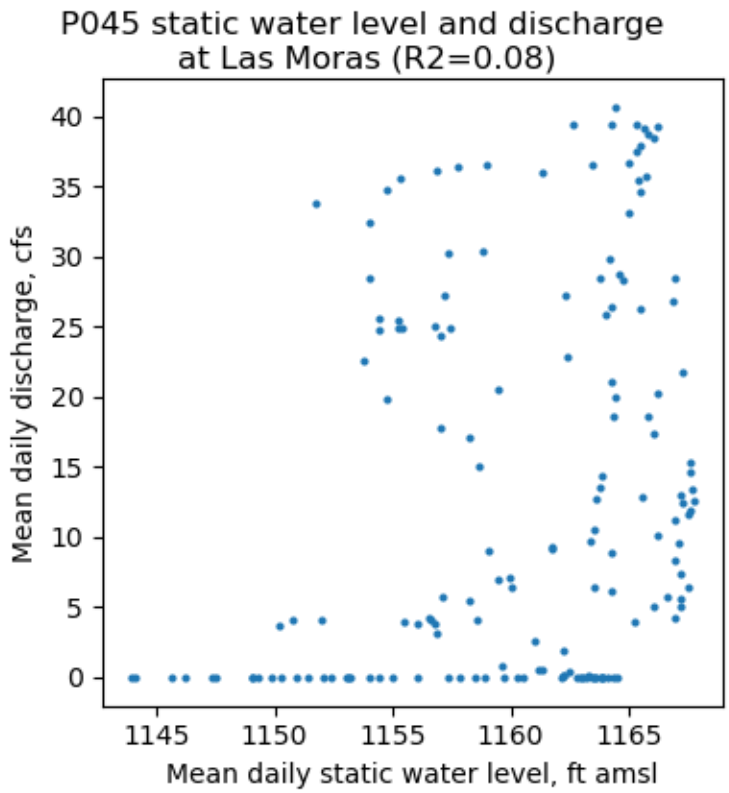

M083 static water level and discharge
at Las Moras (R2=0.39)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
940
960
980
1000
1020
1040
1060

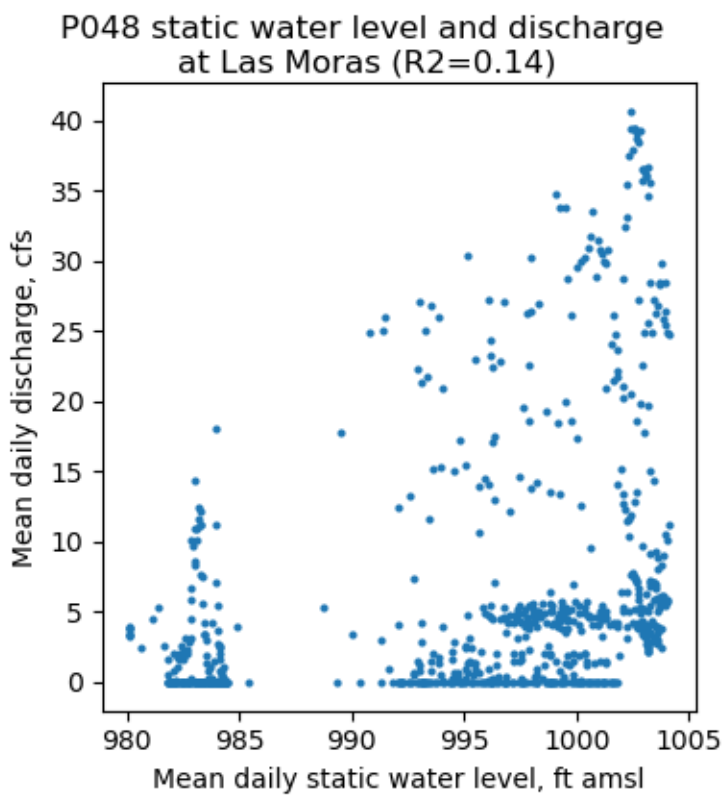

M085 static water level and discharge
at Las Moras (R2=0.01)
Mean daily discharge, cfs
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1080.0
1082.5
1085.0
1087.5
1090.0
1092.5
Mean daily static water level, ft amsl

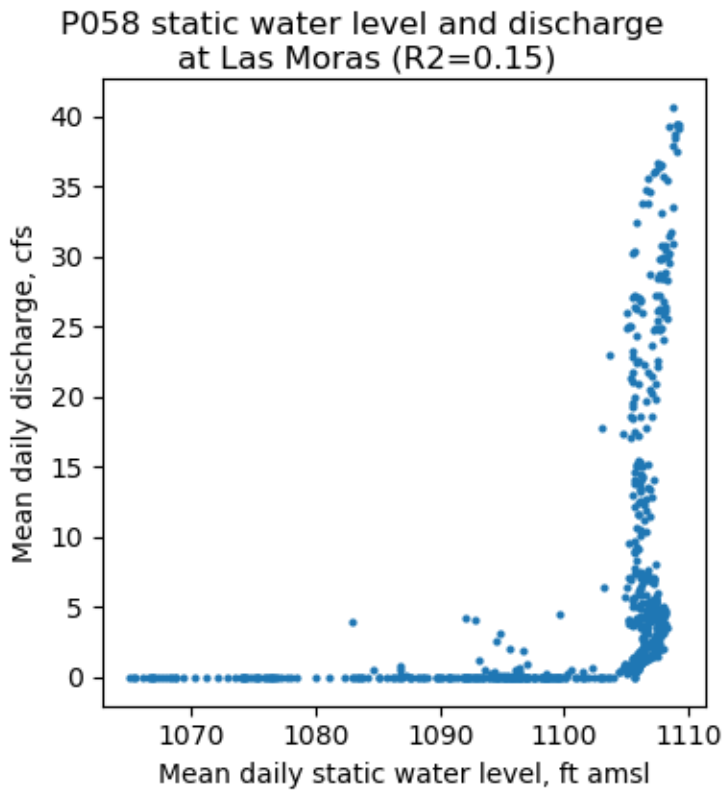

M109 static water level and discharge
at Las Moras (R2=0.0)
Mean daily discharge, cfs
40
35
30
25
20
15
10
5
0
1010
1020
1030
1040
1050
Mean daily static water level, ft amsl

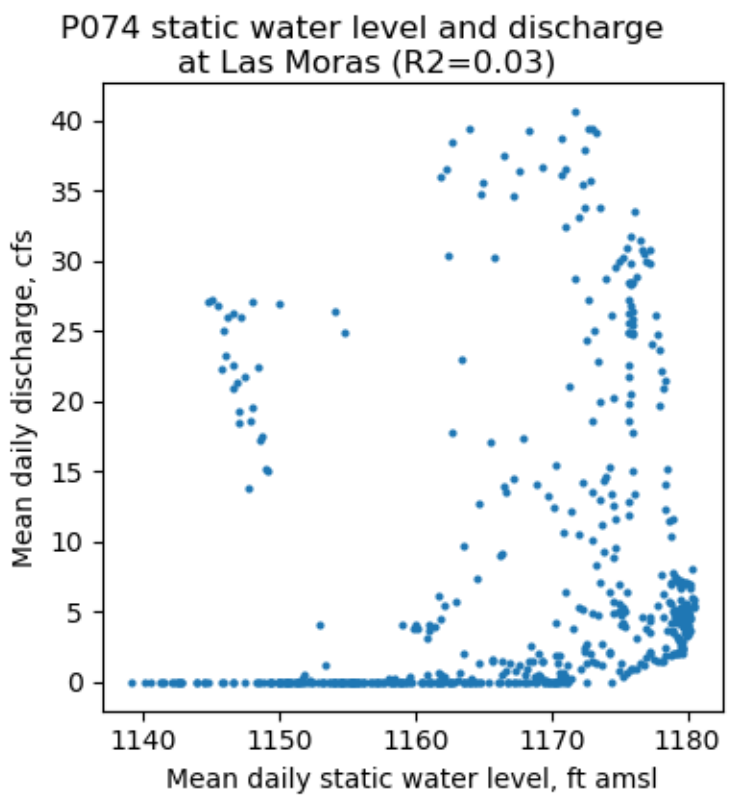

O001 static water level and discharge
at Las Moras (R2=0.88)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
10
20
30
40
50
60
1190
1195
1200
1205
1210

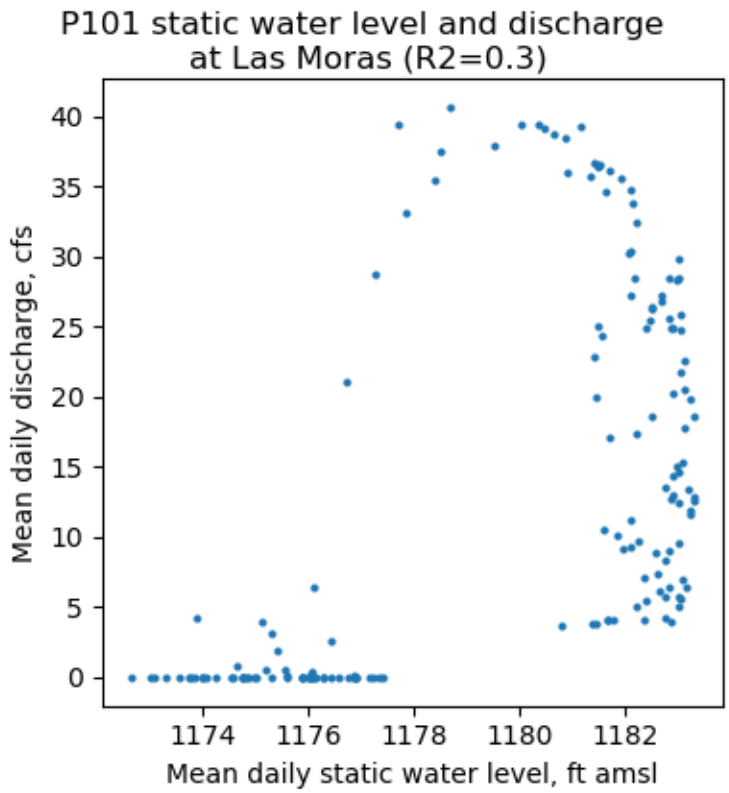

P012 static water level and discharge
at Las Moras (R2=0.05)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
10
15
20
25
30
35
1000
1005
1010
1015
1020
1025
1030

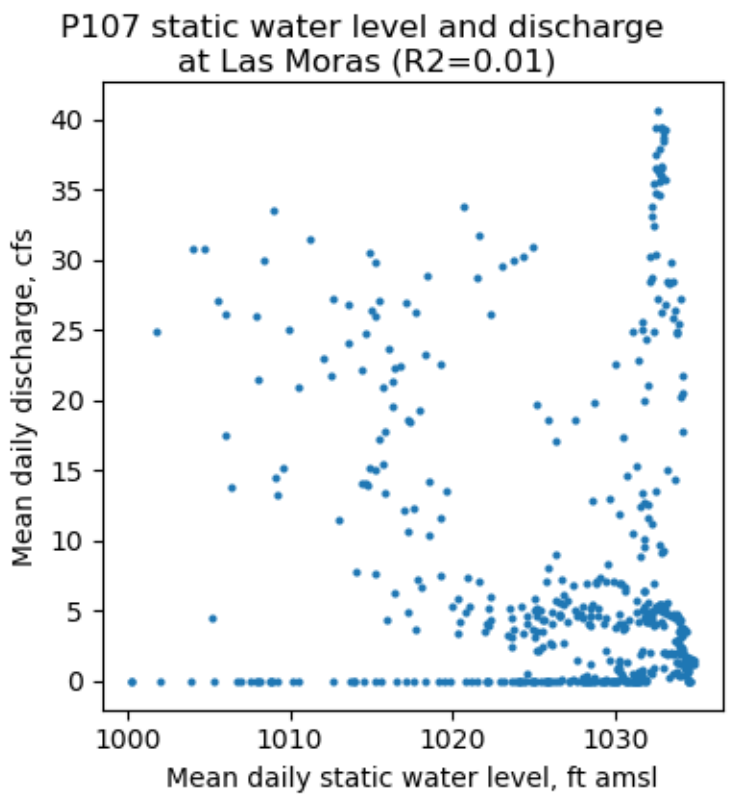

P045 static water level and discharge
at Las Moras (R2=0.08)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1145
1150
1155
1160
1165


P048 static water level and discharge
at Las Moras (R2=0.14)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
980
985
990
995
1000
1005


P058 static water level and discharge
at Las Moras (R2=0.15)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1070
1080
1090
1100
1110

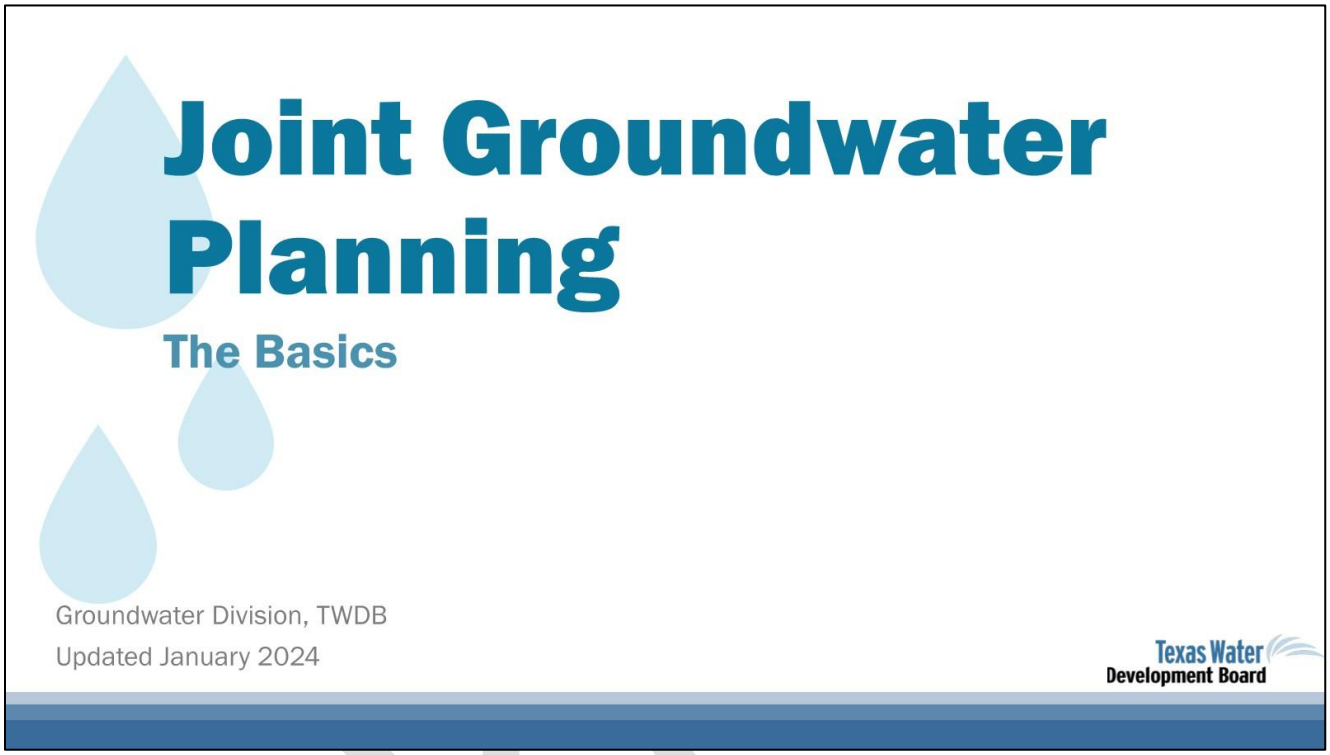

P074 static water level and discharge
at Las Moras (R2=0.03)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1140
1150
1160
1170
1180


P101 static water level and discharge
at Las Moras (R2=0.3)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1174
1176
1178
1180
1182


P107 static water level and discharge
at Las Moras (R2=0.01)
Mean daily discharge, cfs
Mean daily static water level, ft amsl
0
5
10
15
20
25
30
35
40
1000
1010
1020
1030

7.00 APPENDIX C – TEXAS WATER DEVELOPMENT BOARD PRESENTATION ENTITLED "JOINT GROUNDWATER PLANNING – THE BASICS"

https://www.twdb.texas.gov/groundwater/docs/JointGroundwaterPlanningBasics_2024_acc.pdf



DRAFT

This presentation was created by TWDB Groundwater Division staff for general educational purposes.

We hope this slide deck is useful in communicating the joint groundwater planning process, and the steps required to get from desired future conditions to modeled available groundwater.

DRAFT

We'll cover...

- Groundwater management areas
- What is joint groundwater planning?
- What does the desired future condition process look like?

DRAFT

GMAs, GAMs, MAGs…OMG!

GCD	Groundwater conservation district
GMA	Groundwater management area
DFC	Desired future condition
TWDB	Texas Water Development Board
GAM	Groundwater availability model
MAG	Modeled available groundwater
RWPG	Regional water planning group

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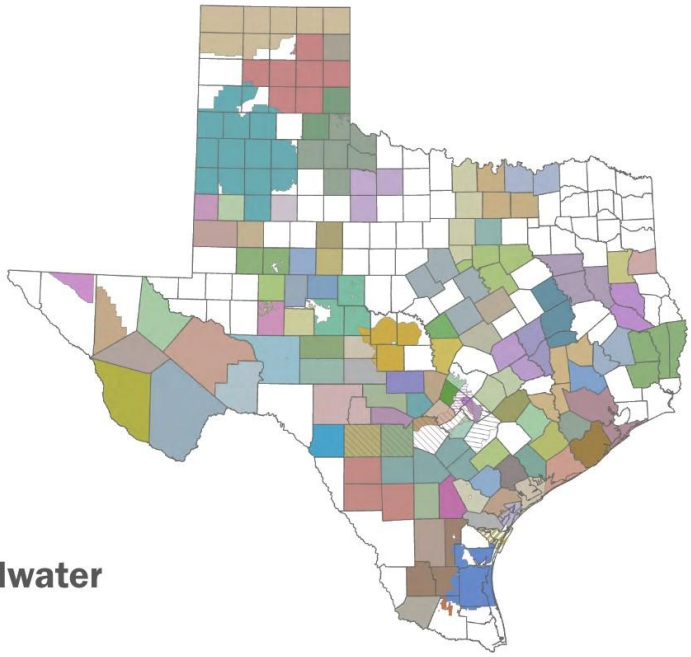
Groundwater management areas

DRAFT

Groundwater conservation districts (GCDs)



Preferred method of groundwater management in Texas

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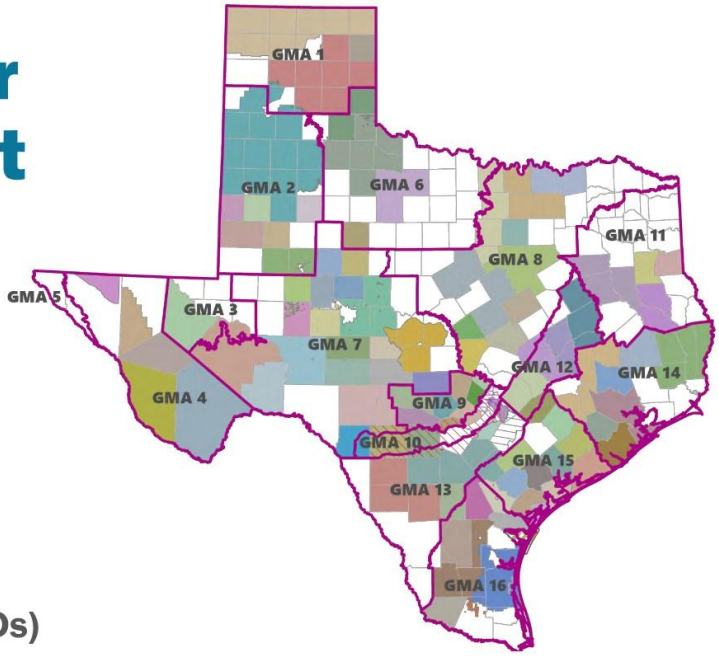
Groundwater management areas (GMAs)



Groups of groundwater conservation district (GCDs)

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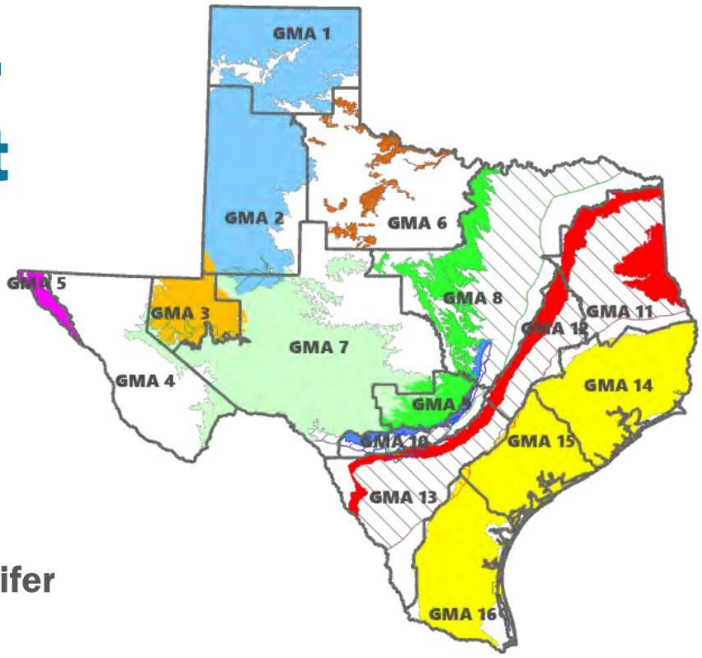
Groundwater management areas (GMAs)



Generally follow major aquifer boundaries

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The TWDB maintains webpages for each groundwater management area.

And many GMAs also have their own websites to share information with the public.

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Joint Groundwater Planning

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What is joint planning?

District representatives in a GMA meet at least annually to:

- conduct joint planning
- propose to adopt new or amended desired future conditions
- review management plans and GMA accomplishments

Texas Water Code § 36.108

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Most joint planning activities are related to

desired future conditions (DFCs)

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Desired future conditions

DFCs

Broad policy goal

Quantitative description

Updated at least every 5 years

Used to determine future groundwater availability

Texas Water Code § 36.108

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Desired future conditions

DFCs

Drawdown, springflow, storage volume, etc.

For relevant aquifers

May be established for:

- aquifer
- aquifer subdivision
- geologic strata
- geographic area

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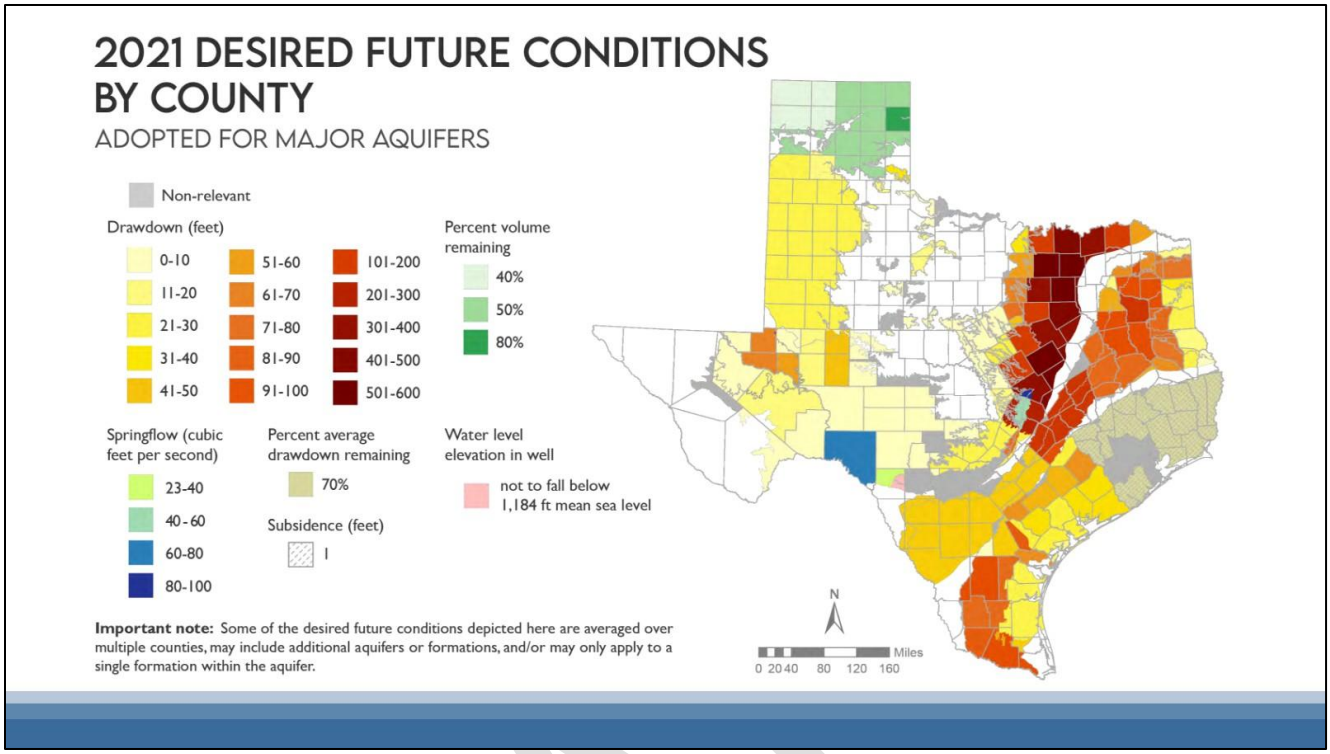
2021 DESIRED FUTURE CONDITIONS BY COUNTY
ADOPTED FOR MAJOR AQUIFERS
Non-relevant
Drawdown (feet)
0-10
11-20
21-30
31-40
41-50
51-60
61-70
71-80
81-90
91-100
101-200
201-300
301-400
401-500
501-600
Percent volume remaining
40%
50%
80%
Springflow (cubic feet per second)
23-40
40-60
60-80
80-100
Percent average drawdown remaining
70%
Subsidence (feet)
1
Water level elevation in well
not to fall below 1,184 ft mean sea level
Important note: Some of the desired future conditions depicted here are averaged over multiple counties, may include additional aquifers or formations, and/or may only apply to a single formation within the aquifer.
N
Miles
0 20 40 80 120 160

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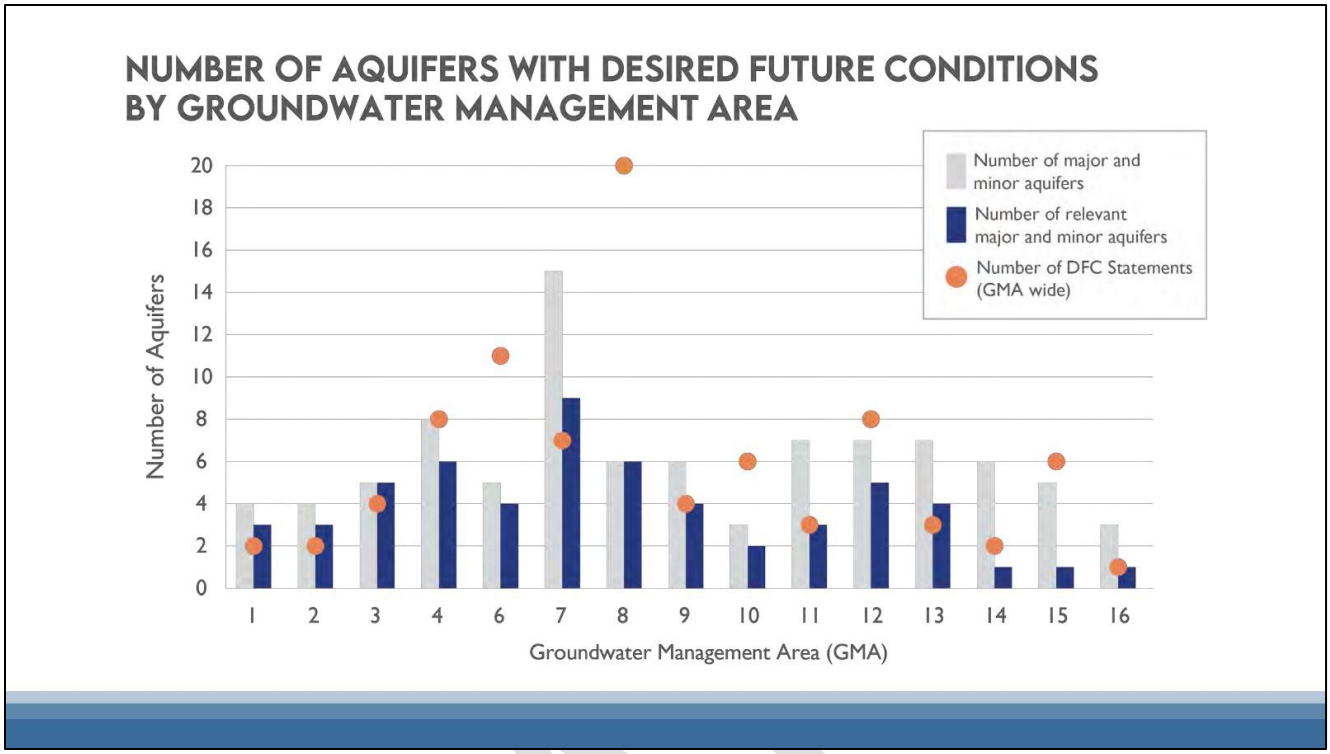
NUMBER OF AQUIFERS WITH DESIRED FUTURE CONDITIONS BY GROUNDWATER MANAGEMENT AREA
Number of major and minor aquifers
Number of relevant major and minor aquifers
Number of DFC Statements (GMA wide)
Number of Aquifers
0
2
4
6
8
10
12
14
16
18
20
1
2
3
4
6
7
8
9
10
11
12
13
14
15
16
Groundwater Management Area (GMA)

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Relevant vs. Non-relevant
for joint planning purposes

Relevant

Official major or minor aquifers or any local aquifers deemed relevant by GMA

Non-relevant

Parts of a relevant aquifer that do not warrant a DFC based on aquifer characteristics, GW demands, and current GW uses

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Non-relevant
an unfortunate name

Technical justification required

Local aquifer management is still happening

Regional water planning groups determine groundwater availability

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Why DFCs matter

Districts must manage production to achieve desired future conditions

A criteria for GCD planning and rule making

Results in modeled available groundwater that can be used to evaluate permit applications

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Why DFCs matter

Modeled available groundwater = water availability components that feed into regional water plans and state water plan

Influence policy and resource management decisions that affect all Texans

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DFC Process

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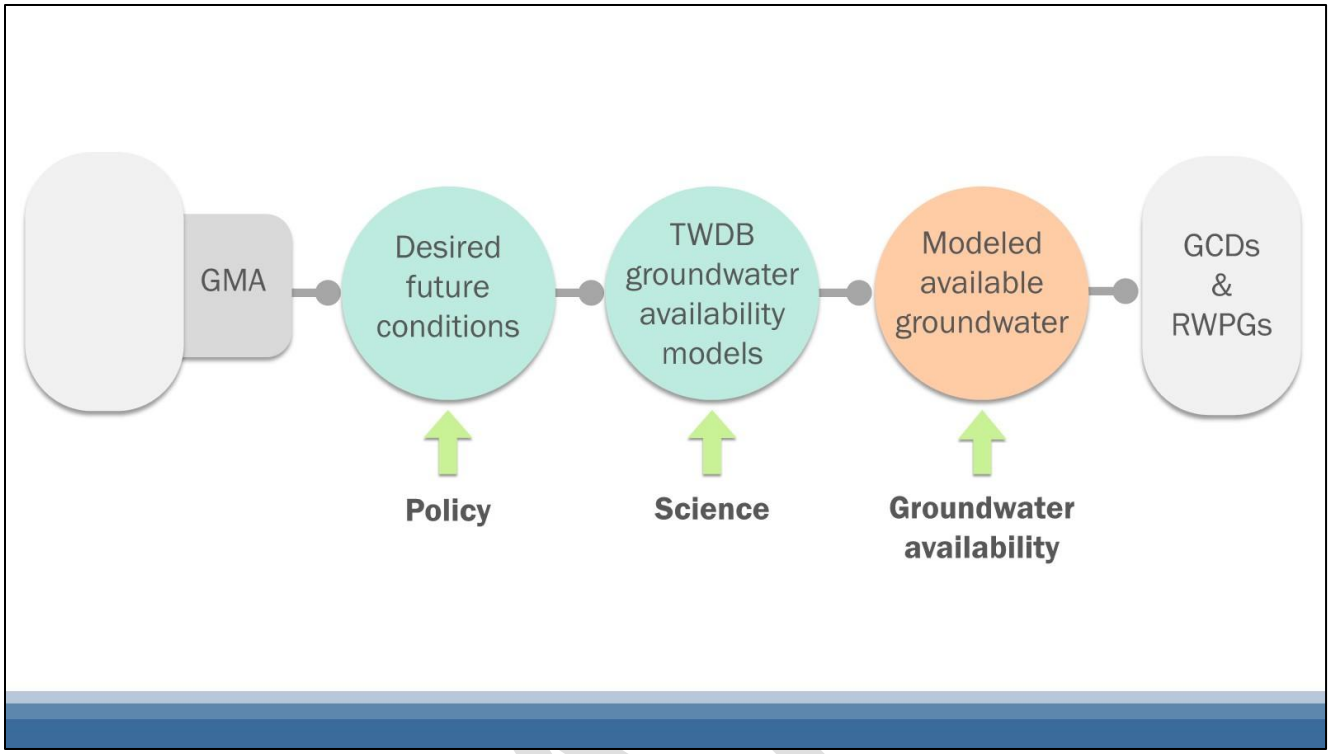
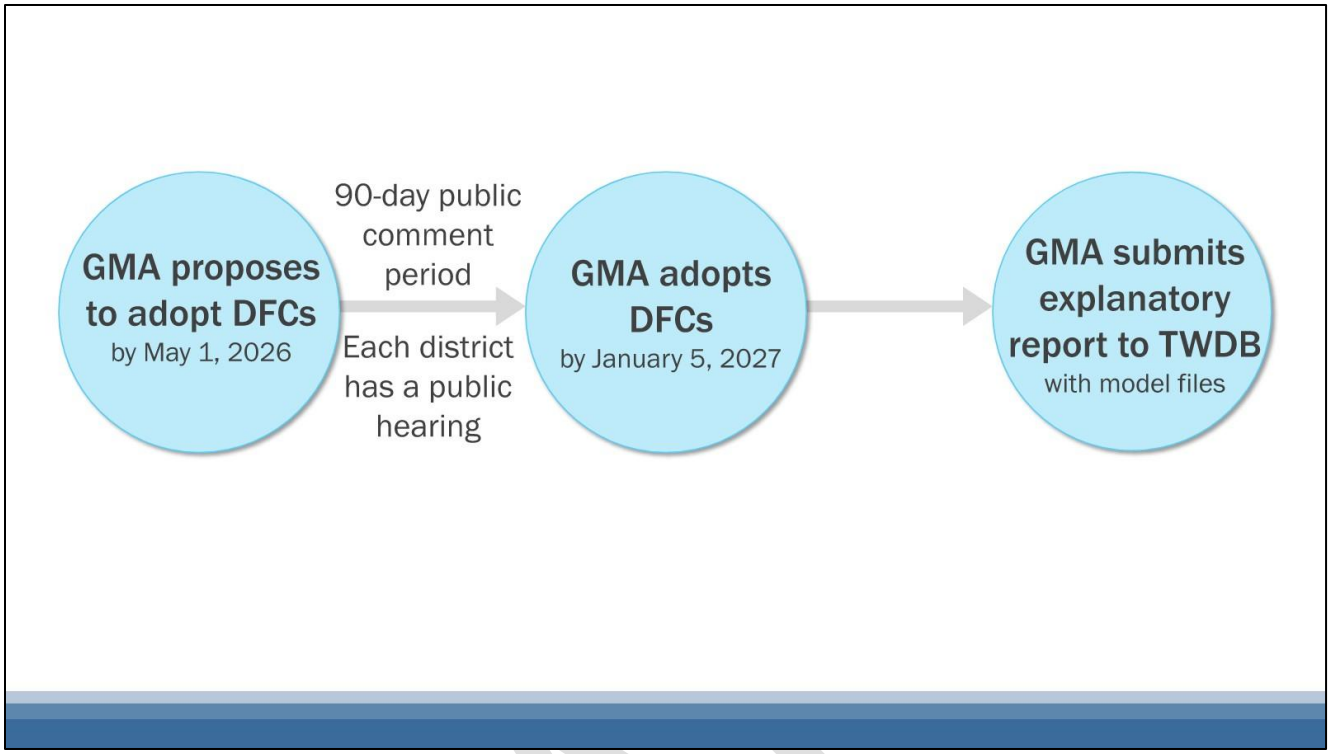
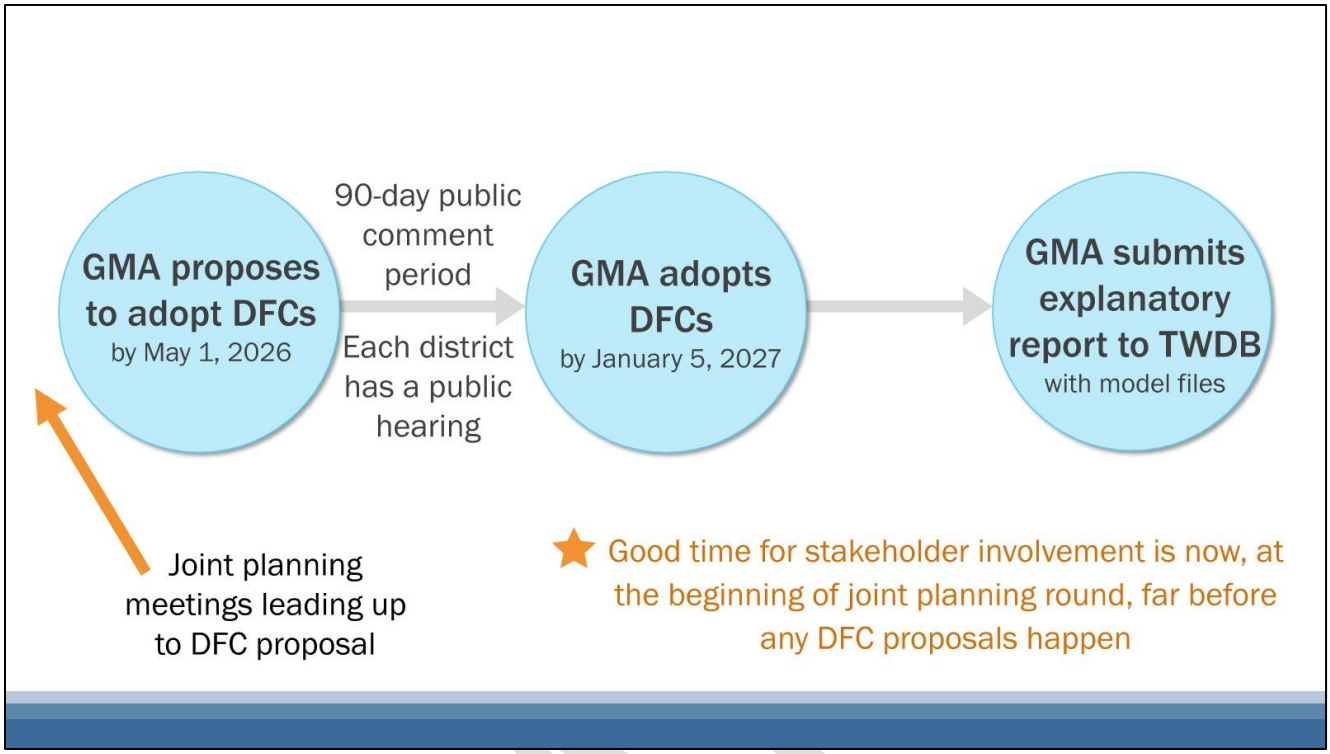

GMA
Desired future conditions
TWDB groundwater availability models
Modeled available groundwater
GCDs & RWPGs
Policy
Science
Groundwater availability

DRAFT


GMA proposes to adopt DFCs
by May 1, 2026
90-day public comment period
Each district has a public hearing
GMA adopts DFCs
by January 5, 2027
GMA submits explanatory report to TWDB
with model files

DRAFT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Joint planning meetings leading up to DFC proposal
Good time for stakeholder involvement is now, at the beginning of joint planning round, far before any DFC proposals happen

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GMA proposes to adopt DFCs
by May 1, 2026

9 factors

Aquifer uses and conditions	Environmental impacts	Property rights
State water plan	Land subsidence	Feasibility
Hydrologic conditions	Socioeconomics	Any other information

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GMA proposes to adopt DFCs
by May 1, 2026

A balancing act

Highest practicable level of groundwater production

Conservation, preservation, protection, recharging, prevention of waste of groundwater, and control of subsidence

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GMA proposes to adopt DFCs
by May 1, 2026

Assessing DFC scenarios

GMAs often hire consultants to use groundwater availability models to assess various DFC scenarios

★ Active participation in the process could get a scenario you want to see on the decision table.

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GMA submits explanatory report to TWDB
with model files

DFC Explanatory Report

Needs to include

- Each desired future condition
- Policy and technical justification
- Consideration of 9 factors
- Other desired future conditions considered and why those were not adopted
- Discussion of recommendations from advisory committees and relevant public comments
- Non-relevant aquifer documentation

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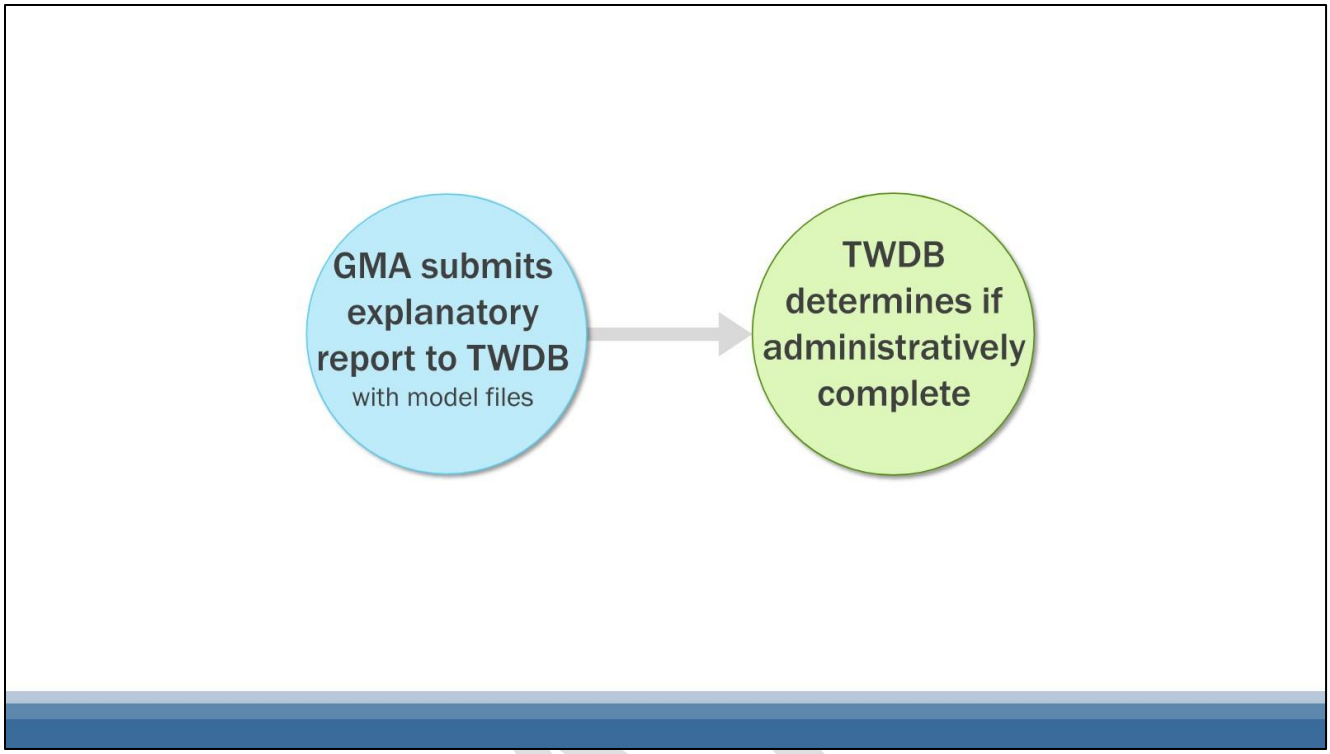
GMA submits explanatory report to TWDB
with model files
TWDB determines if administratively complete

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Modeled available groundwater
MAG

Amount of water that may be produced on an average annual basis to achieve a desired future condition

Calculated by the TWDB using GAMs

Used in permitting decisions, among other information

Provided to regional water planning areas as groundwater availability

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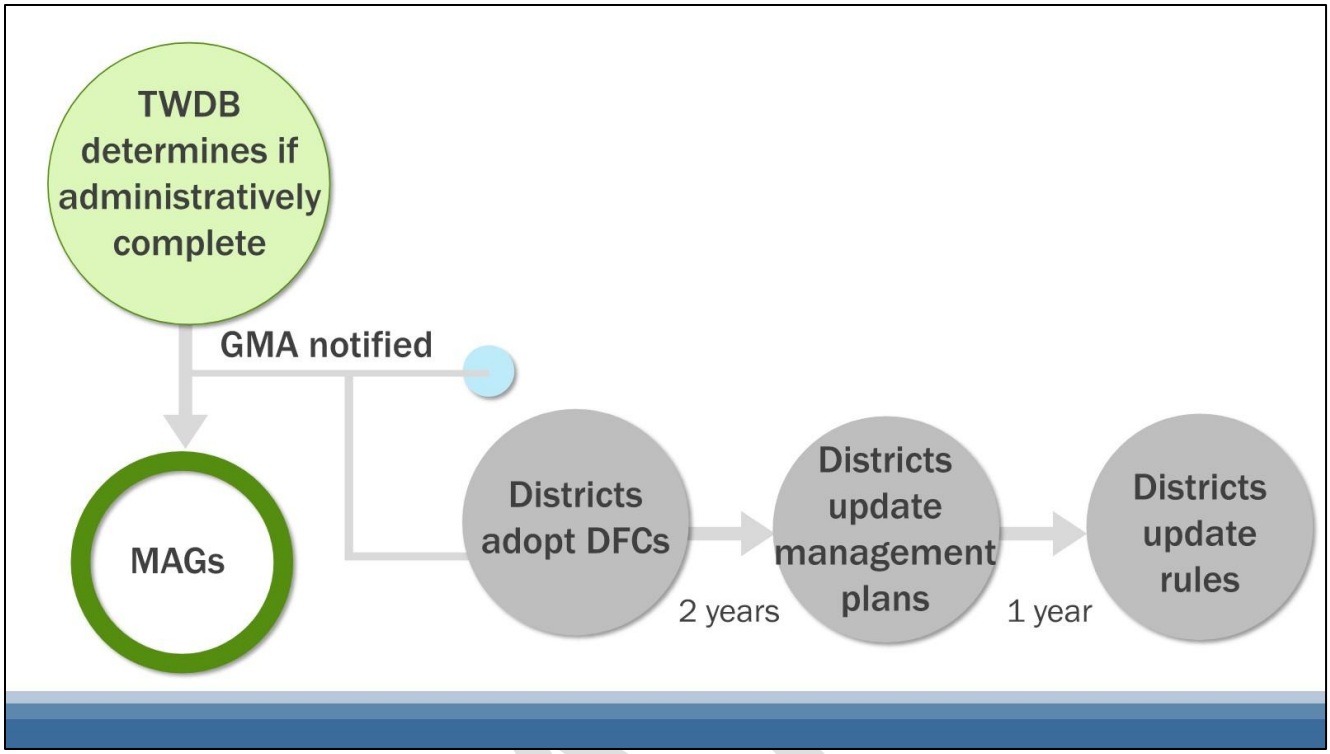
TWDB determines if administratively complete
GMA notified
MAGs
Districts adopt DFCs
2 years
Districts update management plans
1 year
Districts update rules

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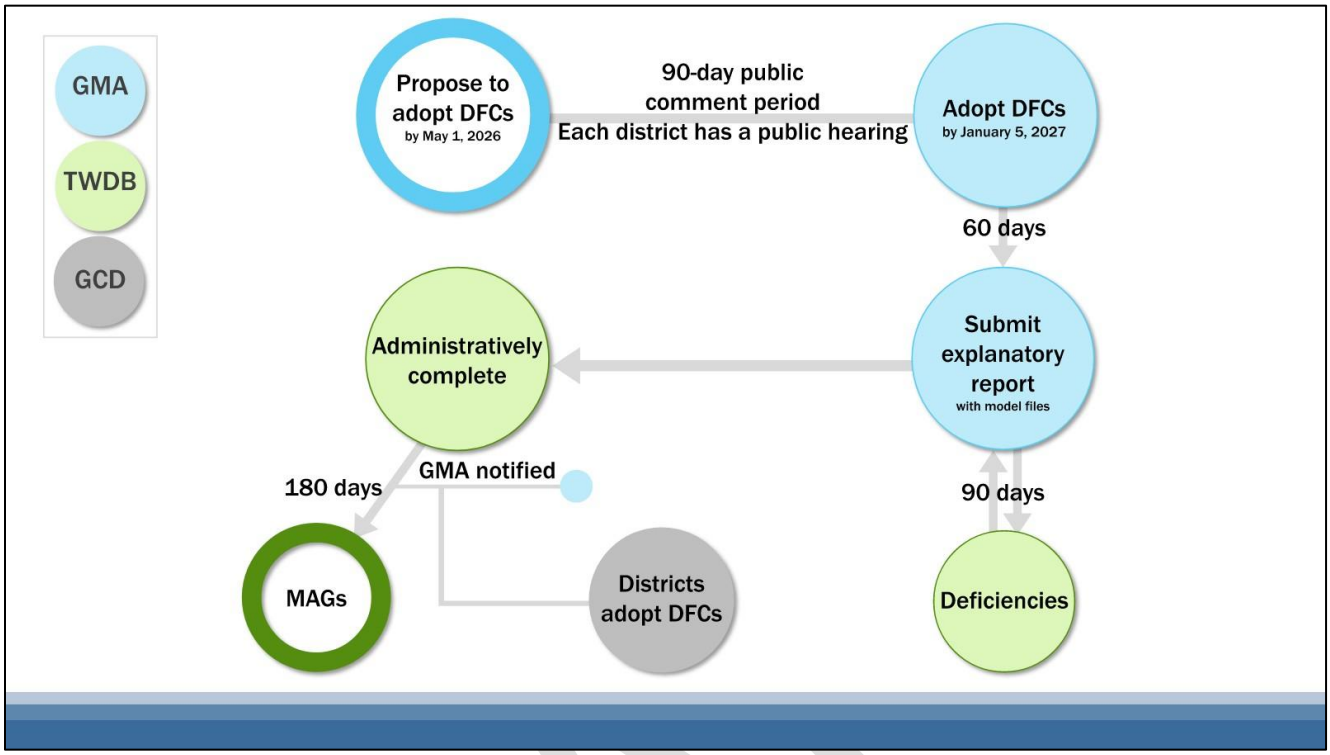
GMA
TWDB
GCD
Propose to adopt DFCs
by May 1, 2026
90-day public comment period
Each district has a public hearing
Adopt DFCs
by January 5, 2027
60 days
Submit explanatory report
with model files
90 days
Deficiencies
Administratively complete
GMA notified
180 days
MAGs
Districts adopt DFCs

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TWDB DFC Resources

DFC webpage

Guidance documents

2021 joint planning documents

Groundwater Technical Assistance staff

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Texas Water Development Board

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