Public Utilities

Groundwater Sustainability Plan: Technical Peer Review

Monthly and Annual Bias Correction of Basin Characterization Model Surface Water Inflows

Subject	Monthly and Annual Bias Correction of Basin Characterization Model Surface Water Inflows	
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Date	October 5, 2020	
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The purpose of this handout is to provide in advance of the October 8th Technical Peer Review (TPR) meeting a description of an approach that has been implemented to process stream inflows into the Groundwater Sustainability Plan (GSP) numerical integrated flow model (GSP Model). The information provided herein has been prepared by Jacobs Engineering Group, Inc. (Jacobs) on behalf of the San Pasqual Valley (SPV) Groundwater Sustainability Agency (GSA). Jacobs is using this information to help develop the GSP Model, which will be used to prepare historical, current, and projected water budgets for inclusion in the SPV GSP.

Background

During the July 9th Technical Peer Review (TPR) meeting, an approach was presented to utilize results from the U.S. Geological Survey (USGS) Basin Characterization Model (BCM) to develop stream inflows for selected contributing catchments to the GSP Model domain. Feedback received from TPR members highlighted the uncalibrated nature of the BCM runoff estimates and the potential limitations in directly using them for the GSP Model. In consideration of TPR member feedback and the advantages of using the BCM to characterize both historical and projected hydrology, an approach has been implemented to adjust for BCM-related biases that are relevant to the area represented by the GSP Model domain.

The bias-correction process described herein includes the development of monthly and annual adjustment factors to modify the simulated response of the contributing catchments to be more consistent with historical measured monthly and annual streamflows. These adjustment factors are then used to develop historical stream inflows from ungauged catchments and projected stream inflows from all contributing catchments into the GSP Model domain. Where historical records of stream inflows are available, these data will be used directly as stream inflows in the historical GSP Model simulation. The following sections describe the bias-correction process in more detail.

Monthly and Annual Adjustment Factor Development

The implemented bias-correction process requires measured streamflow data and BCM runoff aggregated across the contributing catchment area corresponding to the USGS stream gage location. An approach was implemented to develop monthly and annual water year (WY) type adjustment factors for

the Santa Ysabel Creek catchment (green), Guejito Creek catchment (orange), and the Santa Maria Creek catchment (purple) as shown in Exhibit 1. These catchments were selected because of the existence of the associated stream gages and the measured streamflow data available for these locations. The WY type includes designating each WY as wet, above average, normal, dry, or critical.

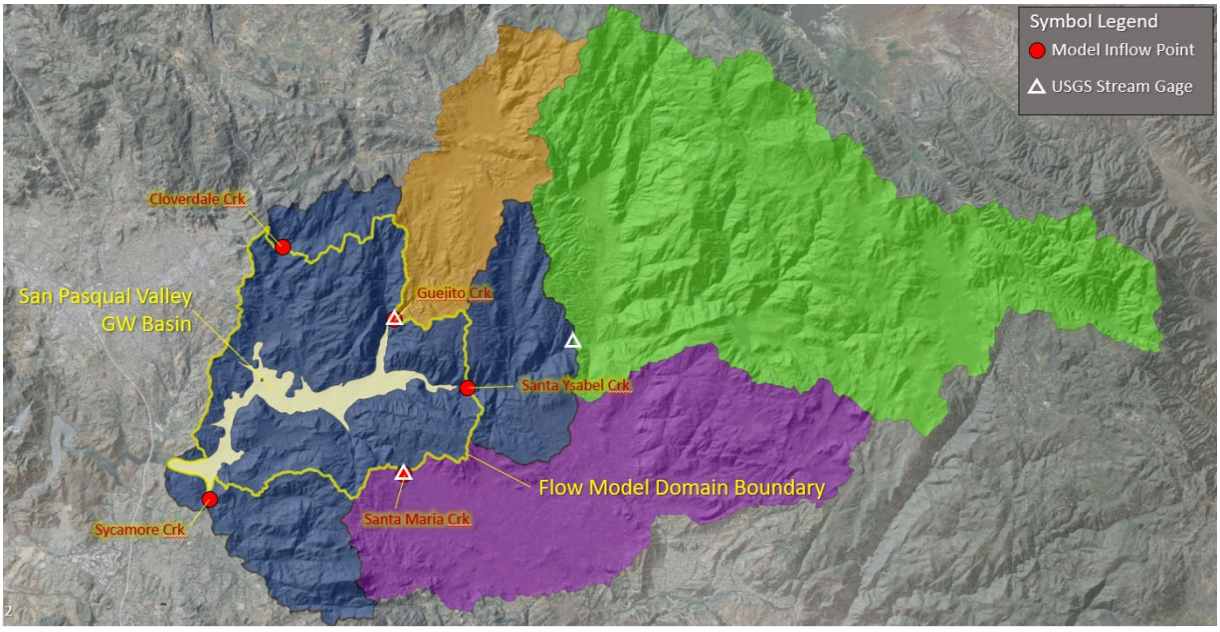

Exhibit 1. Model Inflow Points, USGS Stream Gage Locations, and Contributing Catchments

The first step in the bias-correction process is to apply a monthly average adjustment factor for each month in the historical simulation period (i.e., WY 2005 through WY 2019). Applying monthly adjustments to the BCM runoff estimates results in better alignment of the modeled timing and magnitude of streamflows with the measured streamflows. Monthly average adjustment factors are developed by calculating the monthly average values of measured streamflow and BCM simulated runoff. A ratio is then calculated, for each month, as the measured monthly average streamflow divided by the BCM simulated runoff monthly average. This ratio is then multiplied against the original BCM simulated runoff for every month in the historical simulation period, resulting in a monthly adjusted BCM runoff dataset. Table 1 lists the monthly adjustment factors.

The second step in the bias-correction process is to calculate WY type-specific annual averages of measured streamflow and BCM monthly adjusted runoff for the historical simulation period. An adjustment factor is then calculated, for each WY type, based on the ratio of measured streamflow to BCM monthly adjusted runoff. WY type annual adjustment factors are then applied to the corresponding WY types of the BCM monthly-adjusted runoff to adjust the overall annual volume. Table 2 lists the annual adjustment factors by WY type.

Exhibits 2 through 4 present various summary plots that highlight the two-step bias correction approach that has been implemented for Santa Ysabel Creek, Guejito Creek, and Santa Maria Creek. The two-step approach works to strike a balance between matching the monthly timing and annual volume of streamflow. Although the match is not perfect on a monthly and annual basis, there is good consistency between bias-corrected and measured total cumulative streamflows, which is an important aspect of long-term water supply planning.

Table 1. Monthly BCM Adjustment Factors

Month	Santa Ysabel Creek Monthly Adjustment Factor	Guejito Creek Monthly Adjustment Factor	Santa Maria Creek Monthly Adjustment Factor
Oct	0.20	1.10	0.20
Nov	0.20	1.60	0.20
Dec	0.30	0.60	0.40
Jan	0.20	0.50	0.40
Feb	0.20	0.40	0.30
Mar	1.70	2.90	1.40
Apr	1.90	6.50	1.30
May	17.80	47.00	1.70
Jun	1.00	1.00	1.00
Jul	1.00	1.00	18.00
Aug	1.00	1.00	1.00
Sep	1.00	1.00	1.00

Table 2. Annual BCM Adjustment Factors

Water Year Type	Santa Ysabel Creek Annual Adjustment Factor	Guejito Creek Annual Adjustment Factor	Santa Maria Creek Annual Adjustment Factor
Wet	1.24	1.04	1.14
Above Normal	0.77	0.78	0.94
Normal	1.25	1.26	1.00
Dry	0.55	1.24	0.94
Critical	0.03	0.08	0.03

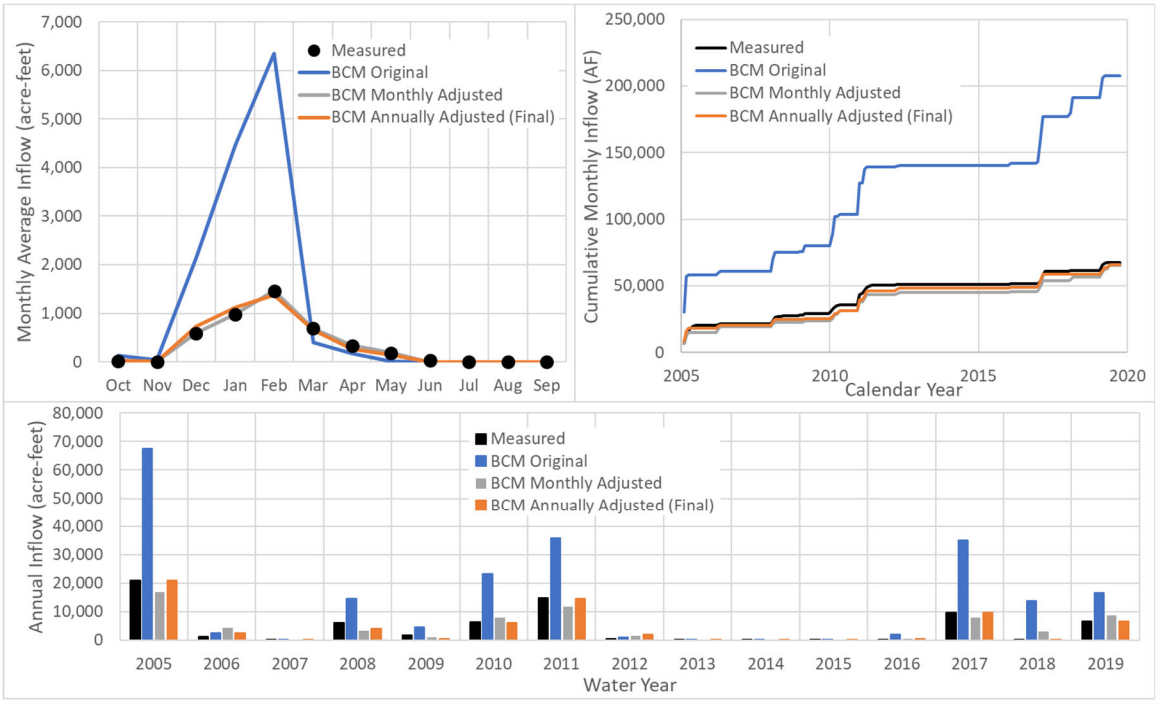

Exhibit 3. Santa Ysabel Creek Monthly and Annual Stream Inflow Adjustment

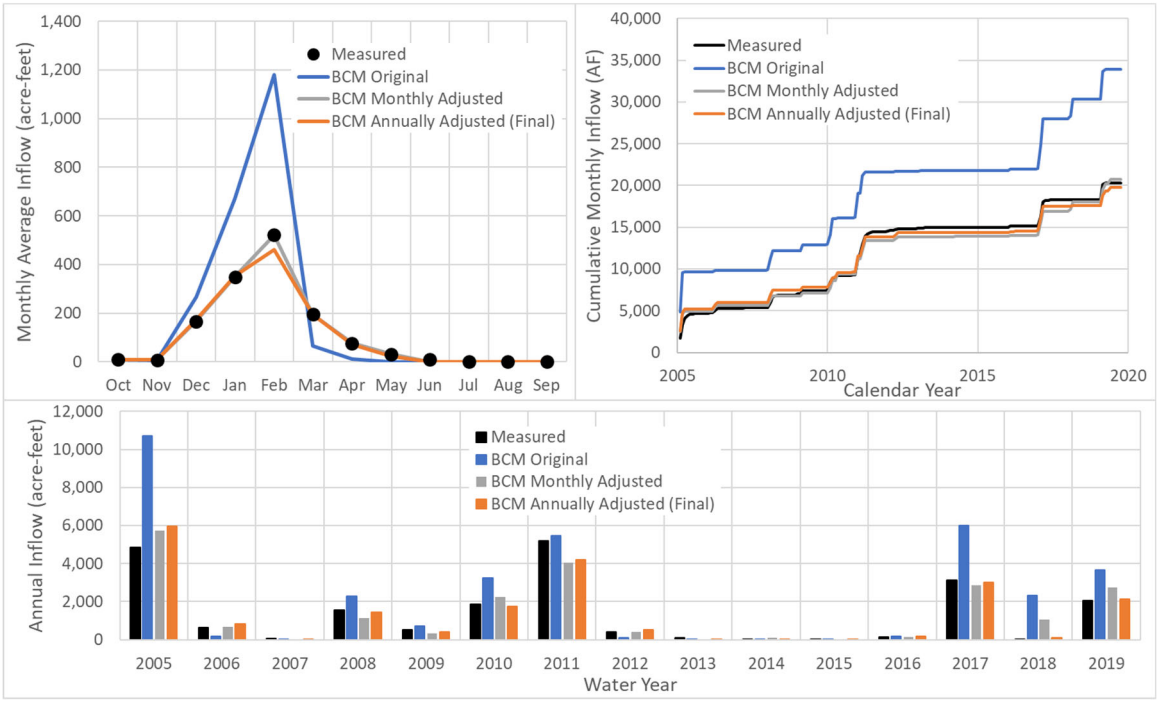

Exhibit 2. Guejito Creek Monthly and Annual Stream Inflow Adjustment

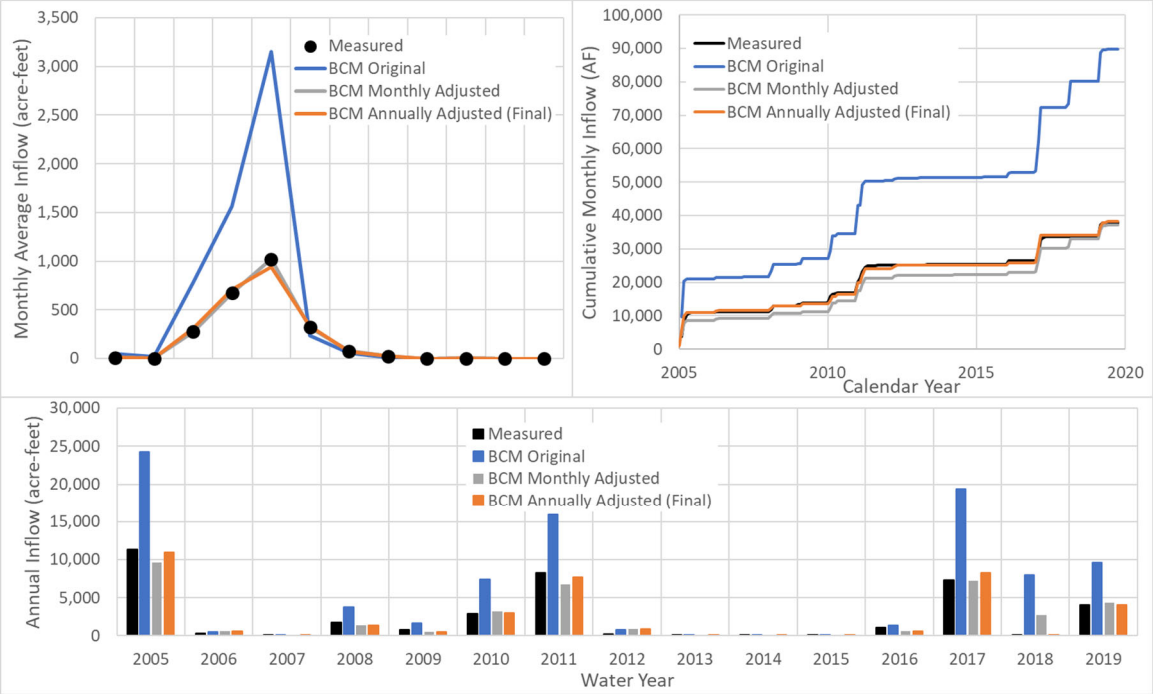

Exhibit 4. Santa Maria Creek Monthly and Annual Stream Inflow Adjustment

Application of Adjustment Factors to Ungauged Watersheds

To develop stream inflows for ungauged watersheds, the monthly and WY adjustment factors, developed for gauged catchments, are applied to the original BCM runoff from ungauged catchments. For the GSP Model, the Santa Ysabel Creek adjustment factors are applied to the catchment contributing to the Santa Ysabel inflow point, Guejito Creek adjustment factors are applied to the Cloverdale Creek inflow point, and Santa Maria adjustment factors are applied to the Sycamore Creek inflow point. Exhibits 5 through 7 present the final-adjusted BCM runoff after applying to the monthly and annual-adjustment factors. Through application of adjustment factors the streamflow characteristics from the ungauged watersheds will be similar to the neighboring watershed. However, the overall magnitude of stream inflows will be scaled based on the ungauged catchment area.

Application of Adjustment Factors for Future Stream Inflows

The other important aspect to consider is that regardless of the availability of measured stream inflows in the past, no measured streamflows are available in the future. So a method must be developed to project future stream inflows under climate-change conditions. The BCM has already been used by the USGS to compute runoff associated with the California-relevant global climate models (GCMs). The adjustment factors described herein will also be used to bias-correct the BCM-projected runoff as well; thereby providing a consistent method for estimating stream inflows under climate-change conditions for the projections that will be used to help develop sustainable management criteria for the GSP.

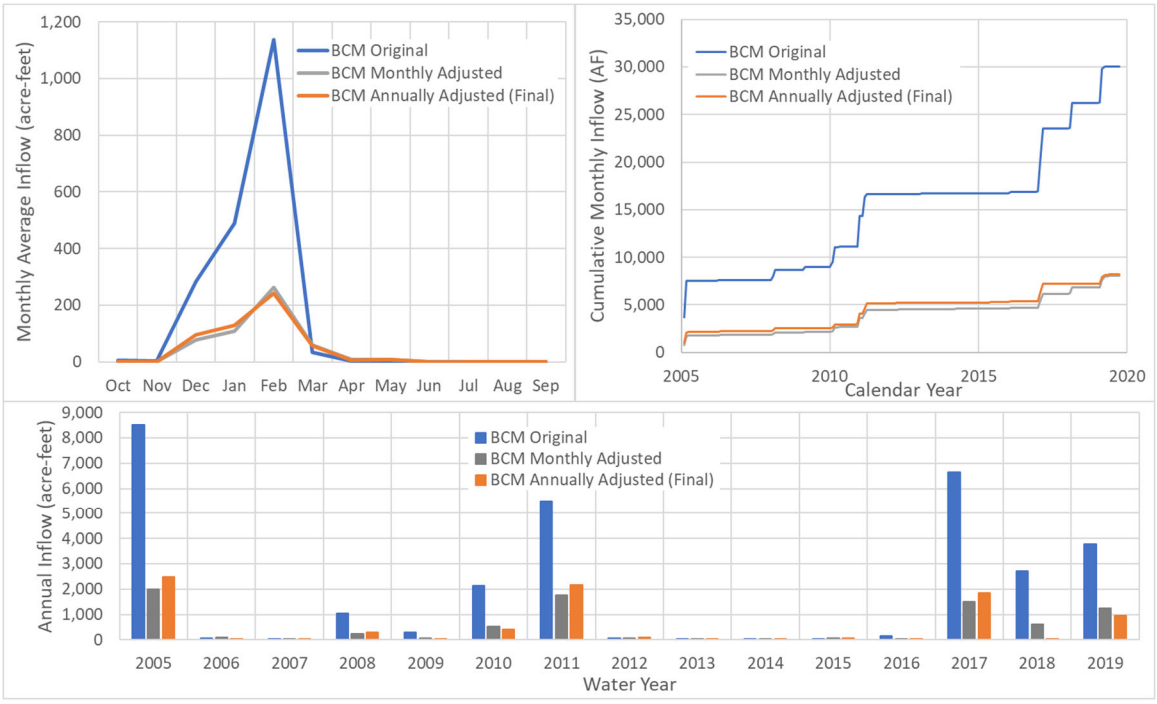

Exhibit 5. Ungauged Santa Ysabel Creek Monthly and Annual Stream Inflow Adjustment

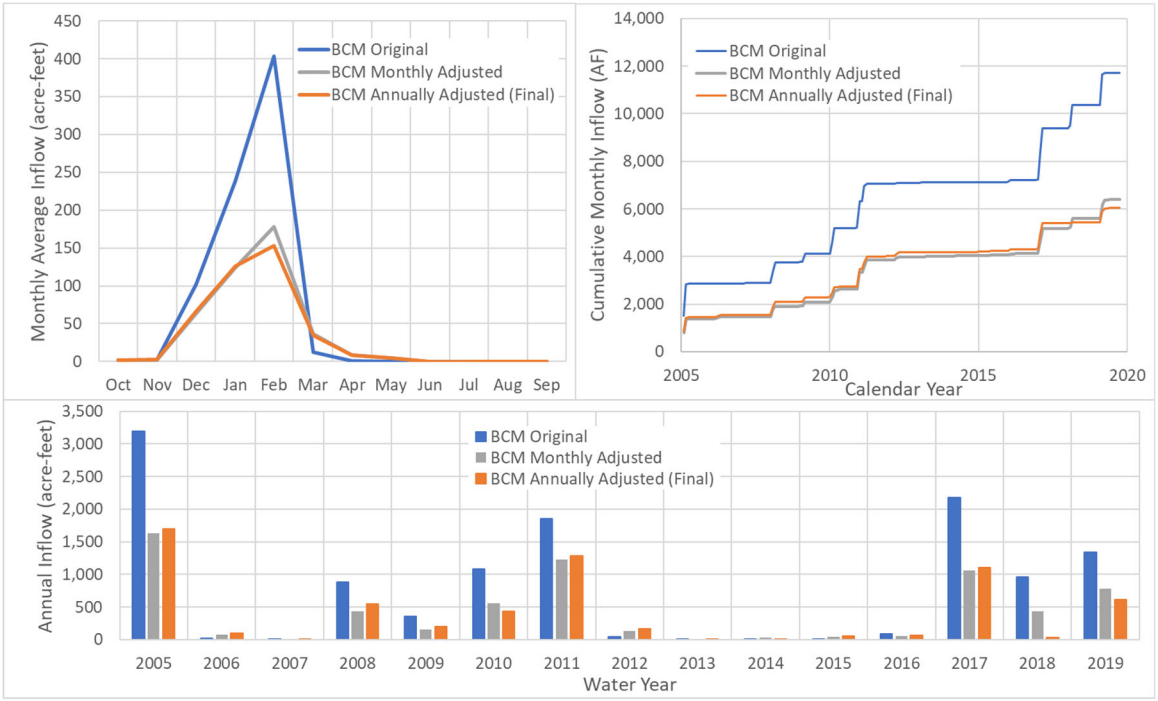

Exhibit 6. Cloverdale Creek Monthly and Annual Stream Inflow Adjustment

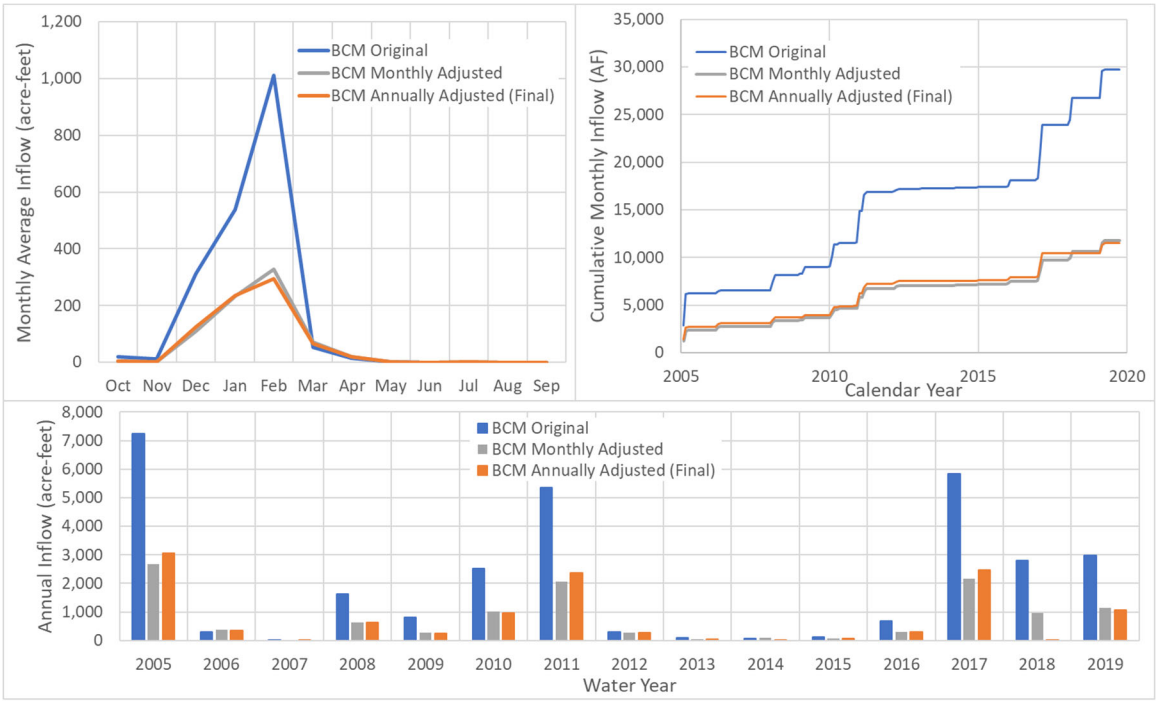

Exhibit 7. Sycamore Creek Monthly and Annual Stream Inflow Adjustment