

Naval Facilities Engineering Systems Command Hawaii

Groundwater Flow Model Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O‘ahu, Hawai‘i

May 17, 2023

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Acronyms and Abbreviations

%	percent
°C	degree Celsius
AOC	Administrative Order on Consent
BWS	Board of Water Supply, City and County of Honolulu
CF&T	contaminant fate and transport
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLN	connected linear network
CSM	conceptual site model
CUDEM	Continuously Updated Digital Elevation Model
DLNR	Department of Land and Natural Resources, State of Hawai‘i
DOH	Department of Health, State of Hawai‘i
EPA	Environmental Protection Agency, United States
EVS	Earth Volumetric Studio
ft	foot/feet
ft/d	feet per day
ft/ft	feet per feet
ft^2	square feet
ft^3	cubic feet
ft^3/d	cubic feet per day
GHB	general head boundary
GUI	graphical user interface
GWFM	groundwater flow model
HDMW	Hālawa Deep Monitor Well
HUC	Hydrologic Unit Code
JBPHH	Joint Base Pearl Harbor-Hickam
Kh	horizontal hydraulic conductivity
Kv	vertical hydraulic conductivity
Kx	hydraulic conductivity in the down-dip direction
Ky	hydraulic conductivity in the cross-dip direction
Kz	hydraulic conductivity in the vertical direction
mg/L	milligrams per liter
mgd	million gallons per day
msl	mean sea level
(b)(3)	(b)(3)
NSZD	natural source-zone depletion
OWDF	Oily Waste Disposal Facility
PCB	Prescribed Concentration Boundary
RA	Regulatory Agency
(b)	(b)(3)
RMSE	root mean square error

(b)(3)

SME	subject matter expert
SOW	Statement of Work
SPM	Special Purpose Meeting
U.S.	United States
USGS	United States Geological Survey
VSM	vadose zone model

1.0 Introduction

The documented interim groundwater flow model (GWFM) presented herein was performed as part of the Comprehensive Long-Term Environmental Action Navy (CLEAN) V Program under contract number N62742-17-D-1800, contract task order N6274222F0106. This document is one of three technical memoranda delivered to the Navy with "best available" models to be submitted to the Regulatory Agencies (RAs) June 30, 2023. The first two memoranda detail the GWFM and the vadose zone model (VZM). The contaminant fate and transport (CF&T) model, which is based on the preliminary "best available" GWFM results in June 2023, as distinguished from the final 2024 model, will be delivered to the Navy on June 30, 2023. Final models will be delivered Sept 30, 2024. The purpose of the "best available" models is meant to facilitate defueling, whereas the final 2024 model is meant to fulfill the 2015 Red Hill Administrative Order on Consent (EPA Region 9 and DOH 2015) requirements.

The Facility is located along Red Hill ridge between South Hālawa Valley and Moanalua Valley on the island of Oʻahu, Hawaiʻi. The study area is shown on Figure 1-1 (figures are compiled after Section 8 References). The Facility includes 20 steel-lined concrete underground storage tanks located in the unsaturated zone above the water table that store various fuels (e.g., jet, diesel) as described in the Red Hill Conceptual Site Model (CSM) report (DON 2019). Previous investigations have indicated evidence of petroleum hydrocarbons in the rock beneath the tanks and in the underlying aquifer. This aquifer supplies drinking water to the Navy, other military branches, and the community via water supply well (b)(3) ((b)(3) [(b)]), (b)(3) ((b)(3)), City and County of Honolulu Board of Water Supply (BWS) municipal water supply wells Hālawa Shaft, Moanalua Wells, and other wells.

On January 23, 2014, the Navy reported to the Hawaiʻi State Department of Health (DOH) a fuel release of an estimated 27,000 gallons of Jet Fuel Propellant (JP)-8 from Tank 5 of the Facility's underground fuel storage tanks. The release occurred in December 2013 when placing the tank back in service following a 3-year tank inspection and refurbishment process.

The Administrative Order on Consent (AOC) in the Matter of the Red Hill Bulk Fuel Storage Facility (EPA Region 9 and DOH 2015) was issued in September 2015 following the aforementioned 2014 Tank 5 release. The AOC requires the United States (U.S.) Department of the Navy (Navy) and Defense Logistics Agency to take actions, subject to DOH and U.S. Environmental Protection Agency (EPA) approval, to address potential future fuel releases and to implement infrastructure improvements to protect human health and the environment.

Sections 6 and 7 of the AOC Statement of Work (SOW) specifically call for environmental investigations to characterize the subsurface pursuant to addressing current and future environmental and risk concerns. Several completed and ongoing environmental investigations have been and continue to be conducted to fulfill the requirements of Sections 6 and 7 of the AOC SOW. An interim groundwater flow model was developed (DON 2018, Appendix A). Further investigation (including but not limited to: completing detailed geologic and geophysical logging, groundwater sampling, and transducer studies) and modeling analysis were conducted to build on the 2018 interim modeling. The resulting groundwater flow model was published in the 2020 GWFM Report (DON 2020). This work expanded previous modeling work, incorporating data and insights from the RAs and related subject matter experts (SMEs) during meetings

listed in Attachment 1. The goal of the 2020 GWFM Report was to evaluate capture zones of various water supply wells and serve as the flow modeling foundation for CF&T modeling (as required by AOC SOW Section 7.2.2). According to the AOC, development of the CF&T models is to occur after the GWFM is approved. On March 17, 2022, DON received a letter disapproving the GWFM Report (EPA Region 9 and DOH 2022), citing deficiencies identified by the RAs' respective SMEs.

1.1 2021 Releases

After submittal of the GWFM Report, two additional releases from the Facility were documented in May and November of 2021:

- **May 2021 Release:** On May 6, 2021, a (b)(3) pipeline near Red Hill Tanks 18 and 20 was damaged during a fuel transfer procedure, fuel was released to the tunnel floor, and attempts were made to recover the fuel. It was later determined that fuel that was not recovered was pumped from a fire suppression retention system into a fire suppression recovery drain line and leach/holding tank. The fuel remained contained in the drain line and holding tank until the drain line was damaged on November 20, 2021.
- **November 2021 Release:** On November 20, 2021, fuel was released from the fire suppression recovery drain line, traveled along the concrete tunnel floor toward Adit 3, and collected in a groundwater sump near Adit 3 (Adit 3 Sump). A portion of the fuel was recovered from the sump; the remainder of the fuel entered the soil and volcanic bedrock near U.S. Department of the Navy Well (b)(3) ((b)(3)), from which some of the fuel entered the Joint Base Pearl Harbor-Hickam (JBPHH) Water Distribution System. (b)(3) ceased pumping and was isolated from the JBPHH Water Distribution System on November 28, 2021. BWS Hālawa Shaft and (b)(3) stopped pumping on December 3, 2021. Initial site characterization of the release areas has been completed; additional characterization, monitoring, and remediation efforts continue.

In response to these releases and associated potential risks, the Secretary of Defense made the decision to defuel and close the Facility (DoD 2022), which is scheduled to begin in fall of 2023 and be completed in 2024. Defueling refers to the removal of stored fuel and decommissioning of all fuel tanks and supply lines.

To assist in decision-making regarding defueling, the Navy is developing the model described in this technical memorandum to provide a foundation of preliminary "best available" GWFM results, along with a related VZM and CF&T model by June 30, 2023. The final modeling work will incorporate additional field work and analysis of data after June 2023 to complete the contracted work. The final model report will be delivered September 30, 2024. It will address RA comments from the 2022 review letter and comments received on the June 30, 2023 modeling work.

1.2 Disapproval of 2020 Numerical Groundwater Flow Model

The RAs reviewed the GWFM Report and prepared a joint letter from EPA and DOH (2022) that described the RAs' disapproval of the 2020 GWFM Report. A matrix of their comments is included as Attachment 2. RA comments were provided to the Navy in the following documentation:

- EPA and DOH letter to US Navy, Subject: Disapproval of the Groundwater Flow Model Report, dated March 17, 2022

- Attachment A: Joint Agency Deficiencies on the Groundwater Flow Model Report for the Red Hill Bulk Fuel Storage Facility, dated March 25, 2020, delivered to Navy March 17, 2022
- Attachment B: Hawaii Department of Health (DOH) SME Deficiencies Identified, Red Hill Groundwater Flow Model Report, dated December 3, 2020, delivered to Navy March 17, 2022
- Attachment C: EPA SME Deficiencies Identified, Red Hill Groundwater Flow Model Report, dated November 10, 2021, delivered to Navy March 17, 2022
- Attachment D: DOH Review: Navy Groundwater Flow Models & Related Issues with the Navy CSM for the Red Hill Facility, dated October 19, 2021, delivered to Navy March 17, 2022

The GWFM documented in this technical memorandum addresses many of the disapproval letter comments while delivering a Best Available model as one of three interim products to the RAs by June 30, 2023 in time for use during defueling efforts. Many of the RA comments have been addressed with the revised regional GWFM, while some comments, particularly those related to local-scale heterogeneity of the basalt, will require additional time, and will be addressed in the final 2024 GWFM. Attachment 2 summarizes the main groups of RA comments and outlines how each will be addressed in either the interim (June 30) GWFM or the final GWFM.

1.3 Study Objectives

The objectives of the three modeling components are:

- GWFM: AOC SOW Section 7.1 indicates that the flow model should "improve the understanding of the direction and rate of groundwater flow within the aquifers around the Facility."
- VZM: The vadose zone modeling will inform source-term conditions for the CF&T model.
- CF&T Modeling: AOC SOW Section 7.2 specifies that "the purpose of the Contaminant Fate and Transport Model Report is to utilize the Groundwater Flow Model to improve the understanding of the potential fate and transport, degradation, and transformation of contaminants that have been and could be released from the Facility."

Modeling work will build upon these general objectives and other specific objectives identified in the AOC. Specifically, a risk/vulnerability assessment (AOC SOW Section 8) will be completed using model simulations to provide modeled data and predictions (e.g., capture zones, dissolved-phase chemical distribution) to support that assessment and as part of the defueling and closure plan efforts. In accordance with the AOC, this assessment will provide information, data, and conclusions that can be used to update "the existing Groundwater Protection Plan to include response procedures and trigger points in the event that contamination from the Facility shows movement toward any drinking water well."

Finally, the modeling effort will be used to guide and inform the number and placement of groundwater monitoring wells required to adequately identify possible contaminant migration (AOC SOW Section 7.3).

2.0 Numerical Groundwater Flow Model

2.1 Approach

The objective of the numerical GWFM is to develop a tool to simulate groundwater flow, velocities, and gradients such that simulations can be completed to consider historical, current, and hypothetical future conditions. The flow model approach includes a hybrid regional and local-scale model. The local-scale model will be a nested grid model with increased spatial resolution within the larger regional model.

The regional GWFM was developed first to meet the objectives of simulating groundwater elevations, gradients, and water budget at the scale of the full model domain and to ensure consistency with the CSM for regional groundwater flow. The extent of the model domain remains the same as that of the 2020 GWFM and is shown on Figure 1-1. The regional GWFM was initially qualitatively calibrated to match the data and CSM for water budget and regional steady state water levels. Transient calibration was then performed for water levels collected in the 2017/2018 Synoptic Survey (USGS 2017) as well as water levels collected between the November 2021 release and the end of March 2022 (USGS 2022a; 2022b), considering various pumping rate changes, with additional consideration given to conceptual water balance calculations and geochemical proxies.

The second phase of the modeling task includes implementation of a nested grid, with finer resolution, within the regional model. The purpose of the grid refinement is to allow refined spatial resolution in the area where the most data are available and to provide detailed calculations at the scale of the Facility. Specifically, the grid refinement can represent site-specific geologic and hydrogeologic information at a finer scale than is possible with the regional flow model.

This numerical GWFM study is consistent with the following ASTM International standards:

- D5447-17 Standard Guide for Application of a Numerical Groundwater Flow Model to a Site-Specific Problem (2017)
- D5609-16 Standard Guide for Defining Boundary Conditions in Groundwater Flow Modeling (2016b)
- D5981M-18 Standard Guide for Calibrating a Groundwater Flow Model Application (2018)
- D5611-94 Standard Guide for Conducting a Sensitivity Analysis for a Groundwater Flow Model Application (2016a)
- D5718-13 Standard Guide for Documenting a Groundwater Flow Model Application (2013)

2.2 Geological Conceptual Site Model

In January 2023, AECOM prepared an updated CSM (DON 2023) with revisions specifically to the prior geologic framework. In that Technical Memorandum, revisions to the prior geologic framework originally presented in the 2019 CSM report (DON 2019) and the 2020 GWFM Report (DON 2020) were based on newly available data described below. Revisions made to the geologic CSM are based on the following:

- New data gathered during additional drilling activities since the 2019 CSM
- Comments from the RAs' March 2022 Disapproval Letter (EPA Region 9 and DOH 2022) related to representation of site geologic complexity

2.3 Hydrogeological Conceptual Model

Additional hydrogeological data collected since the submittal of the 2019 CSM report (DON 2019) include:

- Synoptic monitoring (December 2021 to February 2022) of groundwater elevations (USGS 2022a)
- Monitoring of water levels during the restart of (b) in January 2022 through April 2022. (b) pumping was re-started per the (b)(3) Recovery and Monitoring Plan (IDWST 2022)
- Oily Waste Disposal Facility (OWDF) synoptic monitoring of groundwater elevations from August 2022 to present per the Draft Summary of Groundwater Transducer Study (DON 2022a) and the Site Assessment Work Plan (DON 2021)

Future and planned additional field work includes:

- Water level data collection using pressure transducers to monitor aquifer response to revised (b) pumping per the (b) Flow Optimization Work Plan (DON 2022c)
- Geophysical surveying and in-well and tracer testing to be conducted by the University of Hawai'i under the Navy's Office of Naval Research program
- In-well testing to be conducted by the Navy and the U.S. Geological Survey (USGS) per the Draft Groundwater Flow and Velocity Evaluation Work Plan (DON 2022b) in concert with the University of Hawai'i
- Expanding the monitoring well network (DON 2022c)

These data will be incorporated into the 2024 deliverable.

2.3.1 Conceptual Water Budget

Approach

A conceptual regional water budget analysis was conducted to address RA comments in the disapproval letter regarding the need for meaningful water budget calculations in development of GWFM boundary conditions. The analysis covers the five watersheds surrounding Pearl Harbor as established by 12-digit Hydrologic Unit Code (HUC-12) watersheds from the National Hydrography Dataset (USGS 2022a) (Figure 2-1). The analysis area was based on conceptualized regional groundwater flow patterns (Oki 1998) and was selected assuming that recharge from precipitation is the only source of water over the entire area, with no groundwater flow occuring across its outer extents. The methodology includes summing the sources

and sinks of groundwater within each HUC-12 watershed and over the entire five-watershed analysis area.[1] The GWFM domain lies within this area, as shown on Figure 2-1. The goal of the water budget calculations is to estimate inflows and outflows from the model domain and across the model domain boundaries.

Groundwater sinks (i.e., groundwater discharge from the analysis area) include springs flows, water supply wells, and discharge to Pearl Harbor or the Pacific Ocean. Interactions between streams and groundwater were assumed to be negligible because stream beds above the basalt aquifer are generally much higher that the water table, and downward seepage from the streams is impeded by highly weathered old alluvium and weathered basalt (Oki 1998), as well as concrete-lined channels in some areas .

Results of the initial analysis demonstrated a reasonable water budget without a significant surplus or deficit over the entire area but significant surpluses and deficits within individual HUC-12 watersheds, indicating flow across the interior HUC-12 watershed boundaries. The next step in the analysis included incorporation of the GWFM domain, which split some HUC-12 boundaries into partial watersheds and accounting for flow across watershed boundaries, shown on Figure 2-2. This step allowed for estimation of inflows and outflows across the GWFM domain boundary.

Recharge

The spatial distribution of rainfall recharge to groundwater was assigned using USGS estimated values for average conditions from 1978 to 2007 (Engott et al. 2017). Figure 2-3 shows the distribution of recharge established by the USGS. Water budget calculations were performed for average conditions. Additional analysis was performed to account for variability of recharge based on deviations from average precipitation and is discussed further in Section 6.2.

Spring Discharge

Spring discharge was estimated using linear regression equations developed by Oki (1998) to correlate water levels in Well 3-2256-010 (‘Aiea Bay Well) and spring discharges near Pearl Harbor. The average water level in Well 3-2256-010 (16.45 feet [ft] mean sea level [msl]) was used to estimate spring discharges for the water budget calculations. The average water level was estimated for the same time period as the average recharge calculations.

Water Supply Well Discharge

The Hawai‘i State Department of Land and Natural Resources (DLNR) provided average water supply well pumping rates as of 2017, which were used for water budget calculations. Updated water supply well pumping rates for time periods of water level data were also provided and used later in the GWFM water budget development, discussed further in Section 4.2. Figure 2-1 shows the water wells which were

[1] Because the first nine digits of the HUC12 boundaries are the same (i.e., 200600000), the codes are hereafter referred to by only the last three digits.

included in the calculations, with symbol scaling proportional to pumping rates, and larger symbols corresponding to higher pumping rates.

Ocean and Pearl Harbor Discharge

Discharge of groundwater through the caprock to Pearl Harbor and the Pacific Ocean was estimated based on a two-dimensional Darcy-flux calculation:

$$Q = KiA$$

Where:

Q = discharge rate (cubic feet per day [ft^3/d])
K = hydraulic conductivity (ft/d)
i = hydraulic gradient (feet per feet [ft/ft])
A = area (ft^3)

To estimate caprock flux, a line was drawn along the extent of the caprock across the water budget area, as shown as the pink line labeled as "Caprock Extent" on Figure 2-4, a point was placed every 50 ft along the line, then additional flow lines were drawn from these points to the nearest point on Pearl Harbor or the Pacific Ocean. Along each flow line, the Darcy flux calculation was performed, then the discharge rate for each segment was summed within each watershed. Along each flow line, the effective hydraulic conductivity was derived from the geological map of O'ahu (Stearns 1939), calculating the proportion of each line transiting each geological unit. Each geologic unit was assigned a hydraulic conductivity value, then the average hydraulic conductivity along the flow line was calculated based on the following formula (Freeze and Cherry 1979):

$$K = \frac{d}{\sum_{i=1}^{n} \frac{d_i}{K_i}}$$

Where:

d = total length of line (ft)
d_i = length of line segment crossing a specific geologic unit (ft)
K_i = hydraulic conductivity of geologic unit (feet per day [ft/d])

Hydraulic conductivity values assumed for each geologic unit are summarized in Table 2-1.

Table 2-1: Hydraulic Conductivity Values Assumed for Caprock Discharge Calculations

Map Symbol [a]	Name	Rock Type	Hydraulic Conductivity (ft/d)	Source
Qa	Alluvium	Sand and gravel	5	(Hunt Jr. 1996)
Qbd	Beach deposits	Beach deposits	5	(Hunt Jr. 1996)
Qcrs	Lagoon and reef deposits	Limestone and mudstone	1000	(Hunt Jr. 1996; Oki 1998; 2005)
Qf	Fill	Manmade fill	1	(Domenico and Schwartz 1990)
Qol	Honolulu Volcanics (Rocky Hill)	Lava flows	4500	(Hunt Jr. 1996)
Qot	Honolulu Volcanics (Punchbowl)	Tuff	0.1	
Qotl	Honolulu Volcanics (Tantalus member, Sugar Loaf)	Lava flows	4500	
Qott	Honolulu Volcanics (Tantalus vent)	Vent deposits	0.1	
Qov	Honolulu Volcanics (Rocky Hill)	Vent deposits	0.1	
QTao	Older alluvium	Sand and gravel	0.1	
QTkl	Ko‘olau Basalt	Lava flows	4500	(Oki 1998)

Notes:
[a] Map symbols from Stearns (1939).

Figure 2-4 presents a visualization of the cross-section through which groundwater flows to Pearl Harbor or the Pacific Ocean. The simplified cross section schematic represents the assumptions used for the Pacific Ocean and Pearl Harbor discharge calculations. Hydraulic gradient was calculated by subtracting an assumed head in the aquifer that varies by watershed from a head of 0 ft msl in Pearl Harbor or the Pacific Ocean divided by the distance between the caprock extent and the discharge point. The area through which flow occurs was calculated as having a width of 50 ft, representing the distance between points and an assumed depth of 800 ft, which is the assumed approximate depth to the freshwater/saltwater interface. This calculation was completed for each segment and summed over all segments and for each watershed. The total groundwater discharging through caprock to surface water for each watershed is shown in Table 2-2.

Table 2-2: Caprock Discharge Estimates by HUC12 Watershed

HUC12 Watershed ID	Effective Hydraulic Conductivity (ft/d)	Total Caprock Discharge (mgd)
303	2.8	1.0
304	4.6	1.7
305	3.2	1.1
401	1.4	3.1
402	0.2	0.0
403	0.1	0.1
404	0.1	0.0
	Total	6.9

Notes: mgd – million gallons per day

Uncertainty in this calculation is primarily related to simplifying assumptions of 2-dimensional geometry, depth to the freshwater/saltwater interface and the hydraulic conductivity of the caprock. However, the objective of this calculation is to constrain the water budget estimates for modeling purposes. The analysis demonstrated that discharge to surface water is small relative to the spring flows and groundwater extraction; therefore, the relative accuracy of spring and well flows is more important to the model predictions than the flow to Pearl Harbor and the Pacific Ocean. Relatively large variations in caprock discharge estimates will result in only minor changes to the overall water budget.

Results

Table 2-3 tabulates the in- and out-flows for each HUC12 watershed. The calculations demonstrate that several watersheds have inflows that are greater than outflows (indicated in Table 2-3 as a surplus with a positive value). However, when summing over all the contributing watersheds, the inflows and outflows approach balance. This is likely due to flow between adjacent watersheds. The largest deficit of water (indicated as a negative value in Table 2-3), HUC-12 401, appears to be driven primarily by spring outflows, totaling approximately 32 million gallons per day (mgd). The caprock is also thinnest in this area, resulting in a higher estimated caprock discharge compared to adjacent watersheds, though it is still a relatively small portion of each water budget. Outflow to Pearl Harbor and the Pacific Ocean is limited by the relatively low hydraulic conductivity of the caprock compared to the basalt aquifer and comprises only about 3% of the total water budget. While approximately 65% of aquifer discharge occurs through water supply wells, the remaining 32% of discharge occurs through the springs.

Table 2-3: Average Water Budget for HUC12 Watersheds

HUC12 ID	Recharge		Total Inflow (mgd)	Spring Discharge		Well Discharge		Pearl Harbor/Ocean Discharge		Total Outflow (mgd)	Surplus/Deficit	
	Rate (mgd)	Percent of Total		Rate (mgd)	Percent of Total	Rate (mgd)	Percent of Total	Rate (mgd)	Percent of Total		Rate (mgd)	Percent of Total
304	23.5	100.0%	23.5	0.0	0.0%	(b)(3)	(b)(3)	1.66	6.8%	24.6	-1.1	-(b)(3)%
305	18.0	100.0%	18.0	0.0	0.0%	(b)(3)	(b)(3)	1.09	20.8%	5.2	12.8	243.5%
401	41.4	100.0%	41.4	31.9	38.5%	(b)(3)	(b)(3)	3.09	(b)(3)%	83.0	-41.6	-50.1%
402	51.8	100.0%	51.8	16.7	49.1%	(b)(3)	(b)(3)	0.03	0.1%	33.9	17.9	52.6%
403	60.5	100.0%	60.5	13.9	30.0%	(b)(3)	(b)(3)	0.09	0.2%	46.4	14.1	30.3%
Total	195.2	100.0%	195.2	62.5	32.4%	(b)(3)	(b)(3)	6.0	3.1%	193.2	2.0	1.0%

The conclusion of the water budget calculations is that groundwater converges regionally into HUC12 401, where the caprock is thin and the largest spring flows occur and that spring outflows and groundwater extraction for water supply are significantly larger components of the water budget than outflow to the Ocean and Pearl Harbor. Representation of the water budget for average conditions is shown on Figure 2-5.

2.3.2 Conceptual Water Budget – GWFM Domain

Similar water budget calculations were performed using the GWFM domain where it intersects the watersheds analyzed for water budget. Watersheds intersecting the GWFM domain were split as shown on Figure 2-2. Sinks and sources to each watershed were recalculated based on spatial location. Similar to the water budget calculations by HUC-12 watershed, a deficit of water resulted in the in the partial watershed for HUC-12 401 and surpluses resulted in the surrounding watersheds, including the GWFM domain, further supporting the conclusion that that groundwater converges on the springs to the northwest of the GWFM domain. Additionally, this implies that there is a component of groundwater flow that enters from the southeast and exits northwest of the GWFM domain. The water budget was then recalculated passing the surplus of water from one watershed to the next toward partial HUC-12 401. The end result is a discrepancy of in- and out-flows of 1.1 mgd, or an error of 0.6%. The results of the calculation are shown in Table 2-4. Figure 2-6 shows the model domain and inflows and outflows for average conditions. These water budget calculations provide a conceptual framework for groundwater flow and a foundation for subsequent calculations of water budget during each GWFM stress period, accounting for changes in stresses over time such as variations in pumping. This topic is discussed further in Section 4.2. These numbers provide a foundation for constraining the water budget in the GWFM.

Table 2-4: Water Budget Calculations for Average Conditions Within GWFM Domain

Watershed ID	Recharge (mgd)	Dike Region Inflow (mgd)	Spring Discharge (mgd)	Well Discharge (mgd)	Caprock Discharge (mgd)	Inflow from Adjacent Watershed (mgd)	Outflow to Adjacent Watershed (mgd)	Total Inflow (mgd)	Total Outflow (mgd)
304 (Partial)	18.0	—	0.0	(b)(3)	1.6	0.0	1.4	18.0	18.0
Model Domain	32.5	28.7	13.3	(b)(3)	2.4	1.4	8.7	62.6	62.6
401 (Partial)	3.2	—	21.4	(b)(3)	1.6	40.6	—	43.8	44.9
402	51.8	—	16.7	(b)	0.0	14.0	31.9	65.8	65.8
403	60.5	—	13.9	(b)	0.1	0.0	14.0	60.5	60.5
Total	166.0	28.7	65.3	(b)(3)	5.8	—	—	194.7	195.8

3.0 Numerical Model Development

3.1 Numerical Code Selection

Several criteria were considered in selection of the groundwater modeling software. First and foremost, the software needs to be capable of meeting project objectives and handling site-related complexities. Of particular importance is the ability of the model code to handle complex geometry with dipping and pinched

discontinuous geologic layers to accommodate incision of saprolite and valley fill into dipping basalt. The modeling code should also be robust enough to handle extreme parameter values that may be used to examine model sensitivity or extreme stresses that may be simulated to evaluate solute migration or influence zones of wells under reasonably conservative conditions; a robust simulator allows focus on hydrogeology, calibration, and understanding model behavior rather than evaluating/correcting for convergence or dry cell issues. Furthermore, the code needs to efficiently enable multiple simulations within a reasonable time period as required for model calibration and application. Finally, the model should be easy to access, develop, and process. A graphical user interface (GUI) that works with the model code greatly facilitates input and output of complex spatial and temporal information.

The MODFLOW-USG groundwater modeling code (Panday 2022; Panday et al. 2013) was selected to develop the numerical groundwater flow model. MODFLOW-USG is an open-source, public-domain groundwater flow modeling code released by USGS in 2013 to accommodate the flexibility of unstructured grids. The code can meet all study objectives and can accommodate the relevant features, events, and processes identified in the CSM. The upstream weighting formulation with Newton Raphson linearization provides robustness available in the MODFLOW-NWT (Niswonger, Panday, and Ibaraki 2011) version of the MODFLOW suite of codes. An unstructured discretization accommodates nested grids and quad-tree grid-block refinement, providing resolution only where required for optimal simulation efficiency. A public-domain particle tracking routine, mod-PATH3DU, for MODFLOW-USG available from SSPA[2] (2022) was used to evaluate migration pathways or well capture zones via forward and reverse particle tracking.

Transport simulation capabilities will be accommodated by USG-Transport, which is also available as an open-source, public domain software from the GSI Environmental website.[3] The software is further interfaced with the PEST software (Doherty 2015), which was used to assist with model calibration. Groundwater Vistas Version 8 (Rumbaugh and Rumbaugh 2020) was used as a GUI.

3.2 Model Grid

The numerical model domain remained the same as the 2020 GWFM. In the horizontal plane, uniform grid cells of 250 ft × 250 ft were used. The areas encompassing the tank farm, (b) , and Hālawa Shaft were refined with a nested grid of 25 ft × 25 ft. The domain grid cells were rotated from orthogonal to align with the dip azimuth and magnitude of the basalt, with a dip azimuth of 246 degrees and a dip magnitude of 4 degrees, agreed to in Special Purpose Meeting (SPM) #11 on January 10, 2023. The model domain and horizontal gridding are shown on Figure 3-1, with the nested grid shown in the inset. The top of the model grid is the ground surface topography, from a combination of lidar and the Continuously Updated Digital Elevation Model (CUDEM) (CIRES 2014). The bottom of the model domain is a no-flow boundary at the freshwater/saltwater interface, representing the 50% seawater concentration of chloride as simulated by Oki (2005), which is approximately 850–900 ft below the water table throughout much of the model domain,

[2] http://mp3du.sspa.com/
[3] https://www.gsi-net.com/en/component/k2/item/525-update-release-for-usg-transport.html

thinning in areas closest to Pearl Harbor and the Pacific Ocean. The freshwater/saltwater interface and model bottom elevations are shown on Figure 3-2 as elevation above mean sea level. Negative elevations indicate below mean sea level.

The GWFM is discretized into 36 layers, which represent stratigraphic layering through the first four layers, and dipping basalt in the remaining layers. Layers 1 and 2 represent valley fill, alluvium, and caprock, then Layers 3 and 4 represent saprolite. Layers 5 through 36 represent basalt where each layer dips at 4 degrees. Thicknesses of the basalt layers vary from 200 to 25 ft thick, with the finest vertical discretization beneath the Facility, (b) and Hālawa Shaft. Basalt layers pinch out when rising above 22 ft msl, just above the water table, to eliminate unnecessary cells within the unsaturated zone. Basalt layers also pinch out below the freshwater/saltwater interface. Cross sections of the numerical model grid setup are shown on Figure 3-3. The model grid setup includes 219,357 active cells before the addition of nested grid refinement, and 1,461,407 active cells with the nested grid refinement.

3.3 Boundary Conditions

Several boundary condition types were used to represent hydrogeological stresses in the GWFM including constant heads, specified fluxes, general head boundaries (GHBs), wells represented as vertical connected linear networks (CLN), and horizontal water production shafts represented as CLN polylines. Descriptions of each boundary condition implementations are provided below. Figure 3-4 shows model boundary condition layout in plan view.

3.3.1 Constant Heads

A constant head boundary represented Pearl Harbor and the Pacific Ocean using the MODFLOW CHD package. To correct for the effect of water density on piezometric head, equivalent freshwater head was calculated by subtracting the CUDEM bathymetry (CIRES 2014) from the average head value of 0 ft msl, then dividing by 40, assuming that seawater is 1.025 times the density of freshwater. Constant head cells are present only in Layer 1. Figure 3-4 shows the constant head boundary cells in dark blue.

3.3.2 Recharge

Recharge is represented as a specified flux using the RCH package. Recharge values at each model cell were calculated using a weighted volumetric average over each model cell based on average conditions recharge distribution over the period from 1978 to 2007 (Engott et al. 2017), as shown on Figure 2-3. Areal recharge into the model domain totaled 32.5 mgd, consistent with the water budget analysis discussed in Section 2.0. Recharge remained constant through all stress periods. Transient variation of recharge is discussed in Section 6.2.

3.3.3 Specified Flux

The northeast model boundary is set to align with the boundary of the dike region, located to the northwest of the model domain, which is a low permeability area with significantly elevated heads (Oki 1998). Inflow from the northeast dike region boundary is represented as a specified flux using the WEL package. The inflow from the dike region was calculated as the sum of average recharge within the contributing

topographic area to the northeast of the dike region boundary and outside the model boundary, totaling 28.7 mgd. Figure 3-4 shows specified flux boundary cells in red.

3.3.4 General Head Boundaries

GHBs represent groundwater flow to/from the basalt aquifer across lateral model boundaries to the southeast and northwest with the GHB package. The GHB package requires a groundwater elevation and conductance as input. Groundwater elevations were generated through the calibration process and were tested to verify the inputs aligned with estimated gradients along the model boundaries. Reported hydraulic gradients are approximately 1 ft per mile (Oki 1998). Along each boundary through the calibration process, the southeast GHB was assigned a gradient of 0.1 ft per mile, and the northwest GHB was assigned a gradient of 0.5 ft per mile. Conductance for the GHBs was set sufficiently high as to not restrict flow, with the flexibility to test conductance in calibration. Figure 3-4 shows GHB cells in light blue.

3.3.5 Connected Linear Networks

CLNs were used to represent water supply wells and tunnels with the CLN package. The advantage of the CLN package is in its simulation of vertical and horizontal conduit features such as wells and shafts. The simulated well may be screened in multiple groundwater model layers, and simulated shafts may cross multiple groundwater model cells in both the horizontal and vertical direction. Withdrawals are then applied to the CLN cell using the WEL package of MODFLOW to allow for appropriate distribution of flow through various model layers. Twenty vertical wells were included, while (b) and Hālawa Shaft were implemented using CLN polylines. (b) was divided into two connected polylines, with 80% of the flow defined in the eastern wing and 20% of the flow rate defined in the western wing, consistent with reporting from Stearns (1943). Hālawa Shaft was simulated as one CLN polyline. Although (b)(3) is know to be of shaft type construction, due to its distance from the Facility and relatively low pumping rate, it is simulated as a vertical CLN well. Flow rates for the pumping wells were assigned average values during each stress period based on data provided by DLNR, presented in Section 4.2. Wells and water supply tunnels represented by CLNs are shown on Figure 3-4.

4.0 Model Calibration

4.1 Approach

Model calibration was conducted using the PEST software (Doherty 2015). PEST is a non-linear inverse modeling program that automatically runs the MODFLOW-USG model multiple times, varying selected input parameters for each run until the difference between the model outputs and the site-specific observation targets is minimized (optimization). PEST targets included water levels, drawdowns in responses to pumping rate changes, flows to springs, and flows to Pearl Harbor/Pacific Ocean. Water level and flow rate information provides the model with the appropriate water budget. Water levels help to evaluate hydraulic gradients, which provide the model with information critical to the objectives of evaluating migration behavior of groundwater from beneath the Facility. Drawdown responses to changes in pumping provide the model with information useful for determining the hydrogeologic parameters (transmissivity, anisotropy, specific yield and specific storage) of the basalt, which are critical for evaluating flow velocity and direction.

Table 4-1 summarizes the target data used during the calibration process. The target groups are ranked by their final contribution to the objective function, or by the measure of error between observed and simulated values, which is minimized by the PEST software. Water level and drawdown data were parsed into hourly average water levels within 2 days of a pumping rate change and daily averages during other periods. Water levels measured between November 28, 2021 and January 15, 2022 were removed from the calibration data set due to the effect of significant precipitation events not accounted for in the model simulation. Drawdown was calculated for stress periods 2 through 6 based on the final water level in stress period 1, and drawdown for stress period 10 was calculated from the final water level simulated in stress period 9. Water levels in the caprock were sourced from other Navy projects. The caprock water levels were assigned in stress period 1 because the caprock water levels were stable throughout the simulation. Flux targets were derived from the water budget calculations described in Section 2.3.1.

Table 4-1: Summary of Model Calibration Target Data

Rank of Contribution to Objective Function	Phase	Parameter Type	Number of Target Data Points	Group	Description
1	2	Basal Aquifer Water Levels	9928	1	Water Levels from 2017/2018, 2021/2022
2	2	Basal Aquifer Drawdown	5393	1	Calculated from Water Levels from 2017/2018, 2021/2022
3	2	Deep Basal Aquifer Water Levels	1075	2	Water Levels from 2017/2018, 2021/2022
4	2	Deep Basal Aquifer Drawdowns	1002	2	Calculated from Water Levels from 2017/2018, 2021/2022
5	2	Saprolite/Confining Unit Water Levels	570	3	Water Levels from 2017/2018, 2021/2022
6	1	Caprock Water Levels	133	4	Collected from various Navy Projects across the model domain
7	1	Ocean/Pearl Harbor Flux	1	1	Estimated in Water Budget Calculations
8	2	Spring Flux	10	1	Estimated in Water Budget Calculations

A two-stage model calibration approach was selected to manage PEST run times and to prioritize more important targets related to the basal aquifer heads. The first stage focused on the flow through the caprock, including caprock water levels and discharge to the constant head boundary representing Pearl Harbor and the Pacific Ocean. The water budget analysis indicated that flow through the caprock is only a small portion of the overall flow in the domain; once initially calibrated, further adjustment of caprock parameters did not significantly change results or interactions with the basal aquifer. The second stage focused on

calibration of basal aquifer heads and drawdowns through adjustment of basalt parameters, GHB heads, and spring heads. Given uncertainties in the water budget calculations and the majority of inflows being fixed, water budget estimates in and out of the GHBs were not used as calibration targets to allow for a more optimal match to heads and drawdowns. Comparisons to estimates were made in post-processing.

4.2 Calibration Model Setup

The GWFM was assigned ten stress periods, encompassing the water level and drawdown data collected during the 2017/2018 synoptic monitoring (Mitchell and Oki 2018), the synoptic groundwater level survey from December 2021 (USGS 2022a), and the groundwater level monitoring from January to March 2022 (USGS 2022b). The stress periods are tabulated in Table 4-2. Rates defined for other water supply wells by stress period are shown in Table 4-3. All other inputs remained constant across all stress periods.

Water budget calculations as described in Section 2.3.1 were performed with updated pumping rates for each stress period. The results are shown in Table 4-4. The average water budget estimates described in Section 2.3 resulted in a relatively small error, or difference between the sum of inflows and sum of outflows of 2 mgd, or about 1% of the total water budget. When adjusting the water budget by stress period to account for pumping changes for these specific time periods, the error increased significantly to approximately 13–23 mgd surplus of water, or approximately 7–12% of the total 193 mgd accounted for in the water budget. During this period, precipitation was lower than average; however, this is not accounted for in the calibration model setup. Adjustment of recharge based on precipitation data is addressed further in the sensitivity analysis, where a scaling factor was applied to recharge to account for recent precipitation patterns, as discussed further in Section 6.2. The water budget calculations are generally intended to guide model behavior, but exact adherence to the estimated values is not necessary; therefore, the error associated with these calculations is considered acceptable.

Table 4-2: GWFM Stress Period Setup

Stress Period	Type	Description	Start Date	End Date	Duration (days)	Number of Time Steps
1	Steady State	(b) - (b) mgd; Hālawa Shaft - (b) mgd	1/9/18 9:00	1/10/18 9:00	1.00	1
2	Transient	(b) (b) Hālawa Shaft - (b) mgd	1/10/18 9:00	1/15/18 12:00	5.13	15
3	Transient	(b) - (b) mgd; Hālawa Shaft - (b) mgd	1/15/18 12:00	1/20/18 12:00	5.00	12
4	Transient	(b) - (b) mgd; Hālawa Shaft - (b) mgd	1/20/18 12:00	1/27/18 12:10	7.01	12
5	Transient	(b) - (b) mgd; Hālawa Shaft - (mgd	1/27/18 12:10	2/6/18 12:10	10.00	15
6	Transient	(b) - (b) mgd; Hālawa Shaft - (b) mgd	2/6/18 12:10	2/16/18 14:00	10.08	15
7	Steady State	(b) - (b) mgd; Hālawa Shaft - (b) mgd	2/16/18 14:00	11/28/21 12:00	1380.92	1
8	Transient	(b) (b) Hālawa Shaft - (b) mgd	11/28/21 12:00	12/2/21 12:00	4.00	10
9	Transient	(b) (b) Hālawa Shaft (b)	12/2/21 12:00	1/29/22 14:00	58.08	10
10	Transient	(b) - (b) mgd; Hālawa Shaft (b)	1/29/22 14:00	3/4/22 0:00	33.42	25

Table 4-3: Individual Water Supply Well Pumping Rates by Stress Period

Well Number	Well Name	Longitude	Latitude	Top of Well Screen (ft msl)	Bottom of Well Screen (ft msl)	Flow Rate by Stress Period (mgd)									
						SP1	SP2	SP3	SP4	SP5	SP6	SP7	SP8	SP9	SP10
3-2355-006	Aiea 1	-157.924	21.383	-32	-102	1.103	1.103	1.103	1.103	1.081	1.081	1.085	0.279	0.992	0.992
3-2355-003	Aiea Gulch 1	-157.915	21.386	16	-38	0.222	0.222	0.222	0.222	0.210	0.210	0.481	1.331	0.390	0.390
3-2255-032	(b)(3)	(b)(3)				0.706	0.706	0.706	0.706	0.706	0.706	0.706	0.706	0.000	0.000
3-2053-011	(b)(9)	(b)(3)				0.308	0.308	0.308	0.308	0.321	0.321	0.434	0.533	0.355	0.355
3-2255-037	Hālawa 2	-157.919	21.381	-29	-78	1.011	1.011	1.011	1.011	0.977	0.977	0.650	0.149	0.850	0.850
3-2154-001	Honolulu International Country Club	-157.901	21.354	-89	-280	0.283	0.283	0.283	0.283	0.283	0.283	0.380	0.266	0.293	0.293
3-2356-058	Kaamilo 1	-157.932	21.385	-43.3	-192.3	0.000	0.000	0.000	0.000	0.079	0.079	0.812	0.868	0.840	0.840
3-2355-009	Kalauao P1	-157.929	21.391	-61	-253.42	6.625	6.625	6.625	6.625	6.164	6.164	5.566	6.508	6.363	6.363
3-2052-008	Kalihi Shaft	-157.874	21.344	51.95	-4.86	8.697	8.697	8.697	8.697	8.669	8.669	7.334	7.981	8.430	8.430
3-2356-055	Kaonohi I-2	-157.937	21.394	-37	-290.89	1.063	1.063	1.063	1.063	0.986	0.986	1.005	1.375	1.076	1.076
3-2356-065	Kaonohi II-3	-157.944	21.388	-83	-223	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3-2356-070	Lau Farm	-157.941	21.384	39.65	-249.5	0.000	0.000	0.000	0.000	0.000	0.000	0.045	0.000	0.023	0.023
3-2153-002	Moanalua	-157.891	21.349	-59	-269	0.018	0.018	0.018	0.018	0.017	0.017	0.014	0.014	0.017	0.017
3-2153-010	Moanalua 1	-157.896	21.353	-114	-264	1.404	1.404	1.404	1.404	2.208	2.208	1.207	1.564	1.600	1.600
3-2356-054	Pearl C C Golf	-157.932	21.396	-21	-178	0.238	0.238	0.238	0.238	0.046	0.046	0.194	0.064	0.163	0.163
3-2153-007	TAMC (b)	(b)(3)				0.386	0.386	0.386	0.386	0.297	0.297	0.425	0.430	0.374	0.374
3-2455-002	Waimalu	-157.929	21.400	-12	-78	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3-2455-003	Waimalu	-157.929	21.399	-80	-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3-2356-060	Waimalu II-1	-157.946	21.390	-77	-217	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3-2355-016	WG Minami 2007	-157.929	21.399	-101.73	-202.17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Various DLNR email communications with AECOM in 2023

Table 4-4: Conceptual Water Budget for GWFM Domain by Stress Period

Stress Period	Recharge (mgd)	Dike Region Inflow (mgd)	Well Discharge (mgd)	Spring Discharge (mgd)	Caprock Discharge (mgd)	Inflow from Southeast GHB (mgd)	Outflow to Northwest GHB (mgd)	Total Inflows (mgd)	Total Outflows (mgd)
1	32.5	28.7	(b)(3)	13.6	2.4	2.8	16.0	64.0	(b)(3)
2	32.5	28.7		13.6	2.4	2.8	19.6	64.0	
3	32.5	28.7		13.5	2.4	2.8	12.0	64.0	
4	32.5	28.7		13.5	2.4	2.8	15.6	64.0	
5	32.5	28.7		13.7	2.4	4.7	24.1	65.9	
6	32.5	28.7		13.6	2.4	4.7	12.2	65.9	
7	32.5	28.7		13.4	2.4	4.1	17.4	65.3	
8	32.5	28.7		12.6	2.4	2.8	18.8	63.9	
9	32.5	28.7		13.7	2.4	0.5	23.8	61.7	
10	32.5	28.7		13.9	2.5	7.5	25.9	68.7	

4.3 Model Parameterization

As discussed in Section 3.2, there are 36 model layers representing many distinct hydrogeologic units. The major hydrogeologic units delineated within the model include the caprock, valley fill, volcanic tuff, saprolite, basalt, and basalt behaving as a confining unit. Details about the geologic setting are presented in the CSM report (DON 2019) and updated in the 2023 CSM Appendix E Addendum (DON 2023), with newly collected data summarized in Section 2.2.

The three-dimensional geological model constructed in Earth Volumetric Studio (EVS) version 2022.10.2 (C Tech 2022) was used to interpolate observed geologic data across the flow model domain to construct hydrogeological units. Data from the EVS model were transferred to the MODFLOW-USG grid by sampling the EVS model for each model cell. During the model calibration process, the caprock was further divided into alluvium and marine sediments, each of which consists of two layers, shallow with high permeability to match shallow water levels and deep with lower hydraulic conductivity to limit outflow through the caprock. Figures 4-1 and 4-2 show the model parameterization in plan view and cross section, respectively. The model was calibrated such that the hydrogeologic properties are constrained by reasonable ranges given field measurements, past studies, and professional judgement. These values are shown in Table 4-5. Parameter ranges were derived from the 2023 CSM Addendum Table 3 (DON 2023). Parameter ranges were often narrowed from previously published values to align with the CSM and anticipated behavior of the hydrogeologic system.

Table 4-5: Model Parameterization

Geologic Material/Feature	Parameter	Unit	Layer(s)	Minimum Value	Maximum Value	Calibrated/ Assigned Value
Caprock - Marine Sediments	Kh	ft/d	1	0.01	1,000	52
Caprock - Marine Sediments	Kh:Kv Ratio	—	1	5	100	10
Caprock - Marine Sediments	Kh	ft/d	2	0.01	10	0.1
Caprock - Marine Sediments	Kh:Kv Ratio	—	2	5	100	10
Caprock - Marine Sediments	Specific Storage	—	1–2	Not Calibrated		5.00E-05
Caprock - Marine Sediments	Specific Yield	%	1–2	Not Calibrated		15%
Caprock - Marine Sediments	Effective Porosity	%	1–2	Not Calibrated		15%
Caprock - Alluvium	Kh	ft/d	1	1	1,000	155
Caprock - Alluvium	Kh:Kv Ratio	—	1	5	100	10
Caprock - Alluvium	Kh	ft/d	2	0.01	10	0.1
Caprock - Alluvium	Kh:Kv Ratio	—	2	5	100	10
Caprock - Alluvium	Specific Storage	—	1–2	Not Calibrated		5.00E-05
Caprock - Alluvium	Specific Yield	%	1–2	Not Calibrated		15%

Geologic Material/Feature	Parameter	Unit	Layer(s)	Minimum Value	Maximum Value	Calibrated/ Assigned Value
Caprock - Alluvium	Effective Porosity	%	1–2	Not Calibrated		15%
Valley Fill	Kh	ft/d	1	1	1,000	155
Valley Fill	Kh:Kv Ratio	—	1	5	100	10
Valley Fill	Specific Storage	—	1–2	Not Calibrated		5.00E-05
Valley Fill	Specific Yield	%	1–2	Not Calibrated		15%
Valley Fill	Effective Porosity	%	1–2	Not Calibrated		15%
Volcanic Tuff	Kh	ft/d	1–36	Not Calibrated		0.001
Volcanic Tuff	Kh:Kv Ratio	—	1–36	Not Calibrated		1
Volcanic Tuff	Specific Storage	—	1–36	Not Calibrated		1.00E-05
Volcanic Tuff	Specific Yield	%	1–36	Not Calibrated		5%
Volcanic Tuff	Effective Porosity	%	1–36	Not Calibrated		5%
Saprolite	Kh	ft/d	1–35	1.00E-03	1	0.011
Saprolite	Kh:Kv Ratio	—	1–35	1	100	3.33
Saprolite	Specific Storage	—	1–36	Not Calibrated		1.00E-05
Saprolite	Specific Yield	%	1–36	Not Calibrated		5%
Saprolite	Effective Porosity	%	1–36	Not Calibrated		5%
Confining Unit (Basalt)	Kh	ft/d	11–25	1.00E-03	1	0.044
Confining Unit (Basalt)	Kh:Kv Ratio	—	11–25	1	100	3
Confining Unit (Basalt)	Specific Storage	—	1–36	Not Calibrated		1.00E-05
Confining Unit (Basalt)	Specific Yield	%	1–36	Not Calibrated		5%
Confining Unit (Basalt)	Effective Porosity	%	1–36	Not Calibrated		5%
Basalt	Kh	ft/d	1–36	1,000	20,000	12,714
Basalt	Kx:Ky (Horizontal Anisotropy Ratio)	—	1–36	2	100	20
Basalt	Kh:Kv Ratio	—	1–36	10	1000	44
Basalt	Specific Storage	—	1–36	Not Calibrated		1.00E-06
Basalt	Specific Yield	%	1–36	1%	15%	9.8%
Basalt	Effective Porosity	%	1–36	Not Calibrated1		1.5%
GHB - Southeast	Head	ft msl	36	-2 [a]	+2	19.58 to 19.97
GHB - Northwest	Head	ft msl	5–36	-2	+2	14.63 to 17.45
Spring	Head	ft msl	1–5	-3	+1	14.3
Hālawa Shaft	Skin Factor	—	CLN	0.01	50	8.7

Notes:
Effective porosity of basalt adjusted based on estimated groundwater velocities.
K_h horizontal conductivity
K_v vertical conductivity
K_x hydraulic conductivity in the down-dip direction
K_y hydraulic conductivity in the cross-dip direction
[a] Range in head values indicated addition of value on initial assigned head that varies across each GHB.

4.4 Evaluation of Model Calibration

The GWFM calibration was evaluated using multiple lines of evidence with both quantitative and qualitative approaches. Adequacy of model calibration is defined only in part by statistical metrics; other metrics are also important to the conclusions, predictions, and decisions derived from model results. Of particular importance are the accuracy of rates and directions of groundwater flow beneath the Facility, as well as the capture zones and water sources to (b) and Hālawa Shaft. Hydraulic gradients along Red Hill ridge are significant for assessing the potential capture of groundwater from beneath the Facility by (b) and were compared using plots of simulated versus observed values against distance from (b) . Hydrographs at each well were evaluated to compare the simulated and observed water levels over time. Water levels were converted to drawdown and compared to observed drawdowns for better estimation of hydraulic properties. The overall model water budget was compared to the estimated water budget presented in Table 4-4 to ensure consistency with the hydrogeological conceptual model. Chloride and temperature data were used to evaluate source water to (b) and Hālawa Shaft by estimated simulated concentrations using unit concentration source simulations. Documentation of all materials associated with evaluation of the model calibration, including calibration statistics, scatter plots, gradient plots, and hydrographs are presented in Attachment 3.

4.4.1 Calibration Statistics

Summary calibration statistics comparing observed and model-simulated values were evaluated to initially assess the model calibration, as shown in Table 4-6. Water levels were divided into four groups: group 1 for basal aquifer wells; group 2 for deep basal wells and wells with unconventional construction; group 3 for wells screened in the caprock or confining unit with elevated heads; and group 4 for wells located in the caprock. The primary focus of the calibration is on basal aquifer wells in group 1. Water levels from groups 2 through 4 were assigned lower weightings during the calibration process, and therefore did not achieve the same goodness of fit between simulated and observed. Basal aquifer water levels are further divided into two categories: water levels from 2017/2018 and those from 2021/2022. Cumulative statistics over all transient stress periods are presented for the basal aquifer as well.

Table 4-6: Summary of GWFM Calibration Statistics

Wells	Basal (Group 1)			Deep Wells (Group 2)	Confining Unit/ Saprolite (Group 3)	Caprock (Group 4)	Cumula-tive
Time Period	2017/2018	2021/2022	All	All	All	All	All
Residual Mean (ft)	-0.06	-0.01	-0.05	0.67	16.85	0.23	0.85
Absolute Residual Mean (ft)	0.17	0.21	0.20	0.68	19.17	1.47	1.18
Residual Standard Deviation (ft)	0.24	0.28	0.28	0.43	18.32	2.07	5.44
Sum of Squared Residuals (ft^2)	336.40	298.68	803.87	677.83	352854.62	574.19	354910.51
RMSE Error (ft)	0.25	0.28	0.28	0.79	24.88	2.08	5.51
Minimum Residual (ft)	-2.36	-0.78	-2.36	-0.75	-19.41	-4.44	-19.41
Maximum Residual (ft)	0.85	0.64	2.08	1.37	50.11	6.60	50.11
Number of Observations	5459	3915	9928	1075	570	133	11706
Range in Observations	7.14	3.26	7.19	4.26	97.94	6.85	116.87
Scaled Residual Standard Deviation (ft)	3.4%	8.5%	3.9%	10.0%	18.7%	30.3%	4.7%
Scaled Absolute Residual Mean (ft)	2.3%	6.5%	2.8%	16.0%	19.6%	21.5%	1.0%
Scaled RMSE Error (ft)	3.5%	8.5%	4.0%	18.6%	25.4%	30.3%	4.7%
Scaled Residual Mean (ft)	-0.8%	-0.2%	-0.6%	15.7%	17.2%	3.3%	0.7%
Correlation Coefficient	0.98	0.93	0.96	0.99	0.92	-0.16	0.95

Notes: RMSE = root mean square error

Calibration statistics for the basal aquifer wells in group 1 generally meet acceptable criteria for a model calibration. The mean of all residuals (observed minus simulated) is -0.05 ft with the root mean square error (RMSE) is 0.28 ft. When scaled over the range of observed heads, the scaled RMSE becomes 4.0%. Simulated match to the 2017/2018 observed water levels is generally better than that of the 2021/2022 water levels. Comparatively, the 2017/2018 targets have a 0.24-ft RMSE (3.4%) versus a 0.28-ft RMSE (8.5%). The range of observations in the 2021/2022 data set is 3.26 ft, significantly smaller than the 7.14-ft range for the 2017/2018 data set because the focus of the 2022 survey was on the wells in the Red Hill area.

Group 2 wells consist of wells with non-traditional well construction or wells that extend to the freshwater/saltwater interface, including HDMW2253-03, Hālawa Deep Monitor Well (HDMW) Chase Tube, Kaamilo Deep, and DH43. HDMW2253-03 is cased to a depth of 250 ft below ground surface (bgs), then is an open borehole to the freshwater/saltwater interface. Kaamilo Deep is also an open borehole to the saltwater interface. HDMW Chase Tube is an unscreened and unslotted pipe located next to HDMW2253-03 which extends to a depth of 215 ft bgs. Well construction information for DH43 is not

available (Juturna LLC 2014). Video survey of the well showed a solid casing with no slots or screen to a depth of 244 ft bgs, where the camera was blocked by an obstruction. A water level meter was either obstructed or reached the bottom of the borehole at a depth of 275.46 ft bgs. Well construction is unknown below 244 ft bgs. These wells were grouped together due to similar behavior and lower confidence in their representativeness of the basal aquifer. Water levels in these wells are consistently simulated lower than observed, indicated by a residual mean of 0.67 ft and a RMSE of 0.0.79 ft. A possible cause is effects of water density on water levels or non-traditional well construction, which may have resulted in a higher head measured head. These effects appear to be present only in these wells; therefore, their impacts to the overall conceptualization of groundwater flow do not appear to be significant.

Group 3 wells are wells screened in saprolite or in confining unit conditions, including RHMW(b) and multilevel well RHMW (b)(9) Water levels from other wells with elevated heads including RHMW (b) (b)(9) , and RHMW (b)(9) were only available during the period between November 28, 2021 and January 15, 2022 therefore, those water levels were not included in the calibration. RHMW(b) was believed to be screened in the basal aquifer but maintains a head of approximately (b) ft higher than the underlying basal aquifer and exhibits a muted response to pumping rate changes at (b) compared to what would be expected if it were screened fully in the basal aquifer, as evidenced by responses at RHMW(b) nearby. Simulated head values are only approximately 0.75 ft higher than nearby points in the adjacent basalt aquifer; however, this may be due to the model discretization at the target location, because the target is positioned in the first cell along the transition from basalt to basalt confining unit. In the adjacent confining unit cells farther from this transition, heads are significantly higher, replicating the impact of confining conditions in the general area. RHMW (b)(9) is a screened zone above the depth of good hydraulic communication with the basal aquifer and maintains a head of approximately 100 ft msl, though continuous water saturation was observed to the basal aquifer when installed. Simulated values at this target location are in the range of 66 ft msl. Although the residual is large, the saprolite and valley fill in this area acts as a relatively impermeable feature within and overlying the basal aquifer (Oki 1998), consistent with the simulated behavior in the model.

Group 4 includes 133 wells located in the shallow caprock, installed through various Navy projects.[4] The overall objective of including caprock water levels is to constrain the hydrogeological properties of the caprock to keep flooded model cells to a minimum while allowing the caprock to accept recharge both from precipitation and from the basal aquifer. Reasonable conceptualization of caprock interactions with the basal aquifer are necessary for the overall goals of the project but, accurate matching of water levels in the caprock is not considered necessary overall project objectives.

4.4.2 Scatter Plots of Simulated and Observed Heads

Scatter plots comparing simulated groundwater elevations to observed elevations are often used as an assessment of model calibration. Where simulated elevations exactly match the observations, the point falls along a central diagonal line. If they do fall off the line, the plotted points should spread equally above and below the perfect match line with no apparent bias in slope. The simulated versus observed head are presented on scatter plots and divided into 2017/2018 basal aquifer water levels (Chart 4-1), 2021/2022 basal aquifer water levels (Chart 4-2), and combined basal aquifer water levels (Chart 4-3). Scatter plots are also included in Attachment 3. In all plots, grayed out water levels belong to group 1 in the time period between November 28, 2021 and January 15, 2022 and group 2, while group 3 and group 4 water levels are not plotted because of their relatively lower importance and significantly greater ranges compared to the basal aquifer water levels.

[4] Group 4 sources:

- Focused Site Inspection at Various Geographic Study Areas, Pearl Harbor Naval Complex, Oahu, Hawaii. August 2004.
- Remedial Investigation Report for Subsurface Fuel, Shipyard Geographic Study Area, Pearl Harbor, Hawaii. August 2007.
- Remedial Alternatives Analysis, Tank 48, Joint Base Pearl Harbor-Hickam, Oahu, Hawaii. February 2012.
- Remedial Action Areas 11 and 13, Pearl Harbor Naval Complex Oahu, HI. July 2012.Remedial Investigation Confined Disposal Area Contaminated Soil Site, PHNC NPL Site, JBPHH, Waipio Peninsula, Oahu, HI. January 2023.Remedial Investigation Area Near Former UST BP-1 PHNC NPL Site JBPHH, Bishop Point, Oahu, HI. September 2015.Site Inspection Area North of Building 1754 PGNC NPL Site JBPHH, Oahu, Hawaii
- 2020 Annual Technical Memorandum Remedial Action Area 12 PHNC NPL Site JBPHH, Halawa-Main Gate, Oahu, Hawaii
- Revised Remedial Investigation Building 8 PHNC NPL Site JBPHH, PHNSY & IMF, Oahu, Hawaii
- Remedial Investigation Dry Docks Subsurface Fuel and PCBs on GW Site PHNC NPL Site JBPHH, PHNSY & IMF, Oahu, Hawaii. July 2017.Technical Memorandum SiteLF05 JBPHH, Oahu, Hawaii. April 2023.
- 2021 Annual Technical Memorandum Former Aiea Laundry Facility PHNC NPL Site JBPHH, Oahu, Hawaii. June 2022.
- 2019 Annual Technical Memorandum Former Aiea Laundry Facility JBPHH, Oahu, Hawaii. March 2020.
- Remedial Investigation Munitions Response Site West Loch Burn Pit (UXO 7) PHNC NPL Site NMC EAD DET PH JBPHH WL Annex, Oahu, Hawaii. August 2023.
- 2021 Annual Technical Memorandum Interim Monitoring Events 14 and 15 Remedial Action Area 12 JBPHH, Halawa Main Gate Oahu, Hawaii. April 2022.
- Draft Remedial Investigation Addendum Former PWC IWTP Site PHNC NPL Site JBPHH, Oahu, Hawaii. TBD.

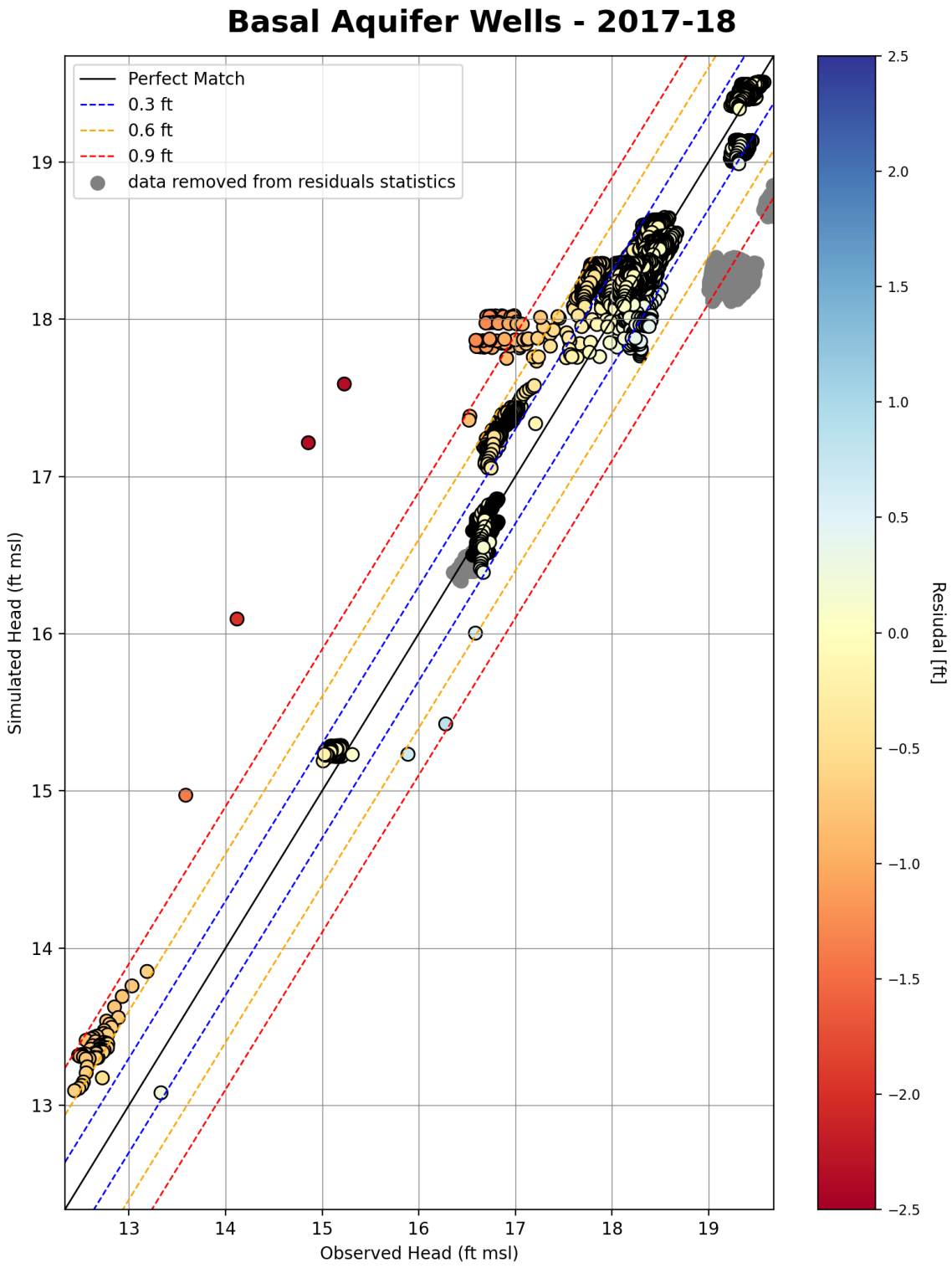


Chart 4-1: Simulated and Observed Heads for 2017/2018 Data

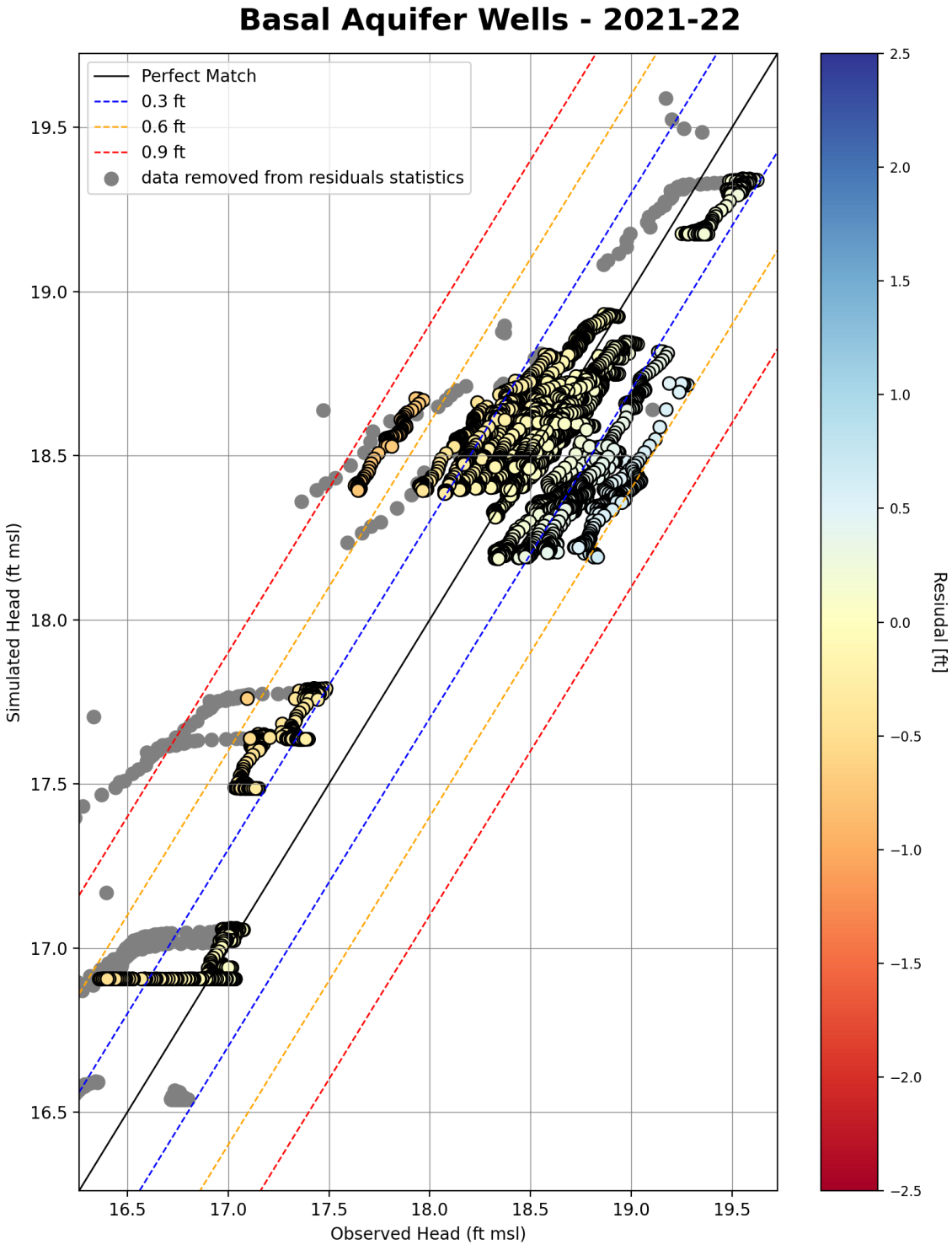


Chart 4-2: Simulated and Observed Heads for 2021/2022 Data

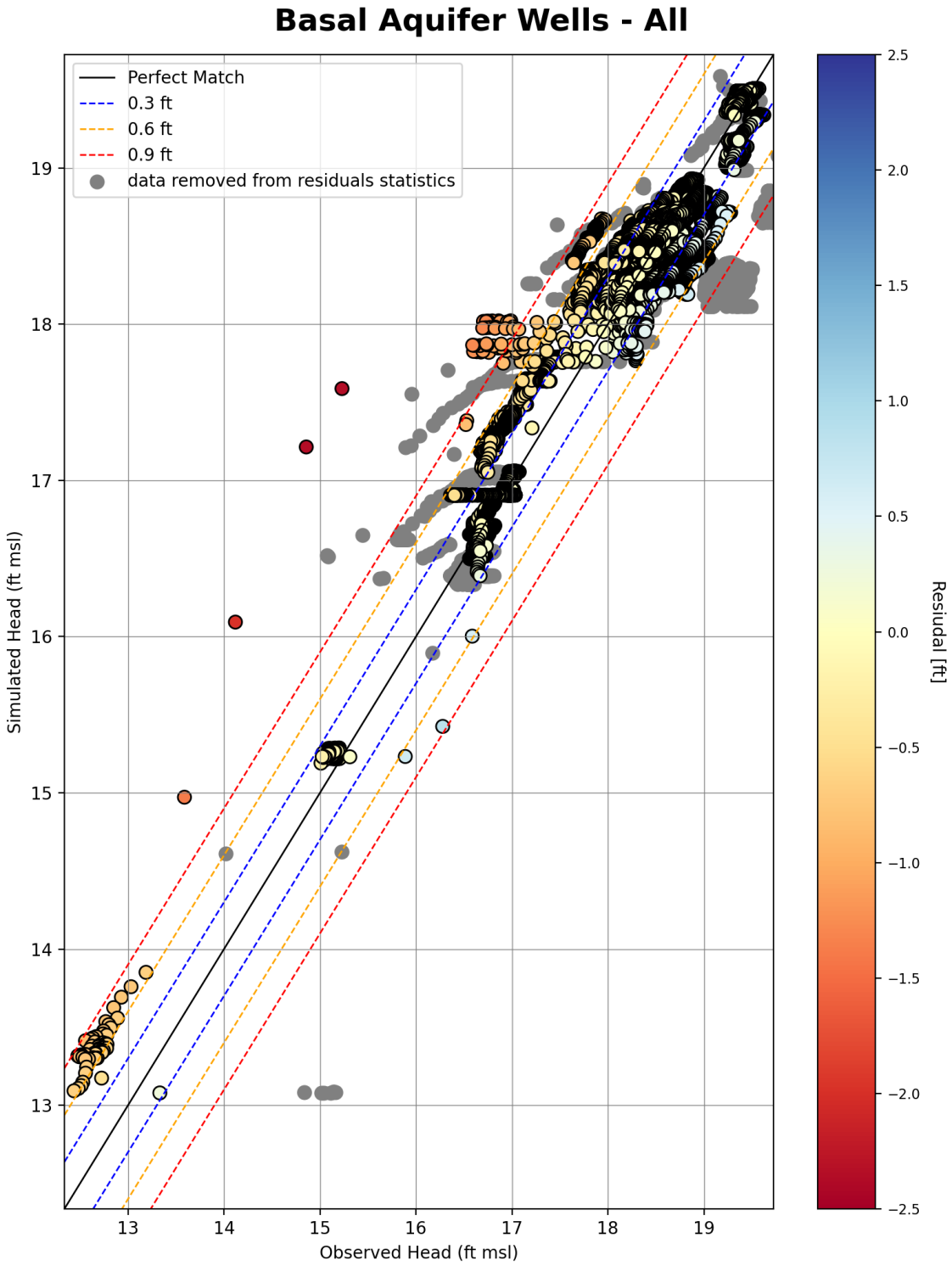


Chart 4-3: Simulated and Observed Heads for All Data

The 2017/2018 water levels generally fall along the match line without bias. The cluster of water levels simulated just below 18 ft msl, which exhibit a wider range of observed heads, are associated with (b) during stress periods 4 through 6. During this time period, (b) was operated in intervals generally ranging from 10 to 16 hours per day. The model simulation used a continuous average value for pumping rate, so the model does not simulate any observed short-term fluctuations that may be driven by short-term pumping rate variations. The four outlier water levels located above the -2.5 ft residual line belong to Hālawa Shaft. Water levels within Hālawa Shaft fluctuate significantly more than other water levels. Outlier water levels may be attributable to variations in pumping rates not captured by averaged modeled conditions.

The 2021/2022 water levels exhibit a larger spread around the perfect match line, while the slope of the points is similar to the perfect match line, indicating that the drawdown responses are matching well, but the magnitude of the residuals is greater as compared to the 2017/2018 data.

Combining the data into a single scatter plot demonstrates the same overall behavior as the individual plots, where the most significant outlier water levels either in residual magnitude or behavior are those measured in Hālawa Shaft and (b), which is expected due to variable pumping rates and the most extreme fluctuations of water levels occurring within pumping wells themselves.

4.4.3 Gradients Along Red Hill Ridge

Gradients along Red Hill ridge were compared by plotting simulated and observed water levels against distance from (b), which are presented in Attachment 3. Two sets of plots were constructed: wells along Red Hill ridge, including RHMW(b), RHMW(b), RHMW(b), and RHMW(b) and to the northwest of Red Hill ridge including RHMW(b), RHMW (b)(9), RHMW(b), and RHMW(b). A separate plot was made for each of four stress periods and each plot uses the last water level measurement within the respective stress period for comparison. Linear regression trend lines were fit through the data points to compare simulated and observed gradients. Stress periods and their associated pumping conditions analyzed were:

- Stress period 2 - (b) (b) and Hālawa Shaft on at (b) mgd
- Stress period 3 - (b) on at (b) mgd and Hālawa Shaft on at (b) mgd
- Stress period 9 - (b) (b) and Hālawa Shaft (b)
- Stress period 10 – (b) on at (b) mgd and Hālawa Shaft (b)

Gradients along Red Hill ridge were simulated very closely to observed gradients in stress periods 2 and 3 while stress periods 9 and 10 showed simulated gradients slightly flatter than observed. Magnitude of the gradient in stress period 2 was observed to be 1.67E-5 ft/ft compared to 2.05E-5 ft/ft simulated. Magnitude of the gradient in stress period 3 was observed to be 6.51E-5 ft/ft compared to 6.90E-5 ft/ft simulated. In stress period 9, the simulated gradient was flatter than observed, with an observed gradient of 5.44E-5 and a simulated gradient of 1.90E-5. During stress period 10, simulated gradients match reasonably well, with an observed gradient of 6.47E-5 and a simulated gradient of 4.76E-5.

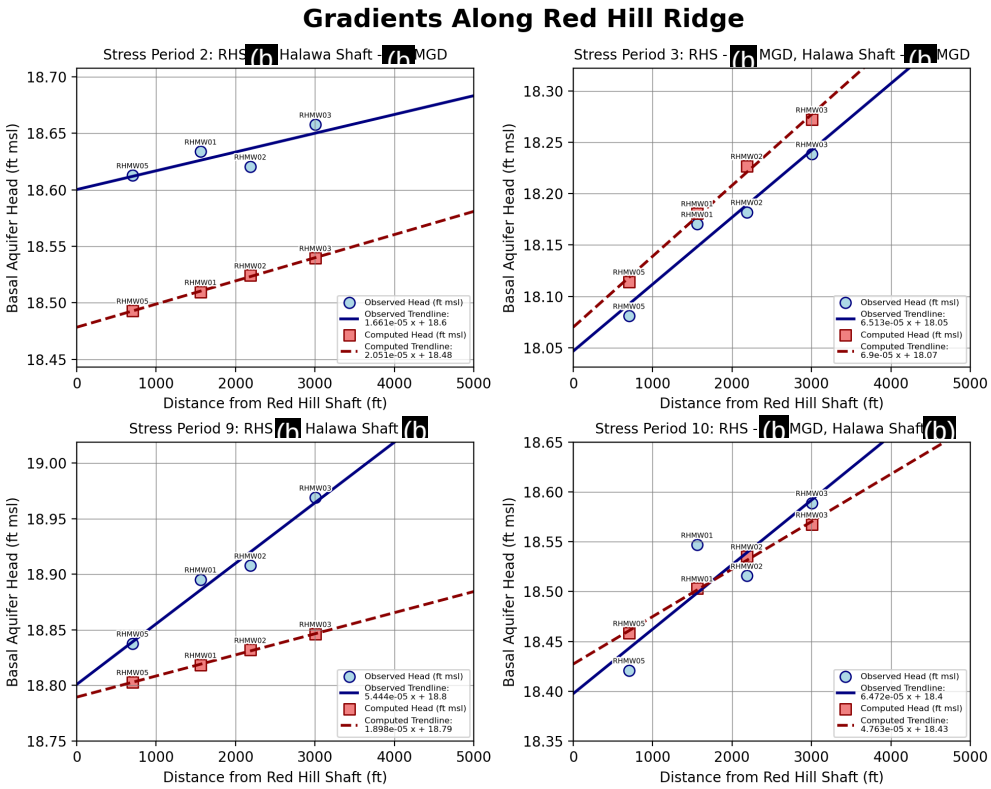


Chart 4-4: Hydraulic Gradients Along Red Hill Ridge

Gradients to the northwest of Red Hill ridge were simulated very closely in stress periods 3 and 10, whereas stress periods 2 and 9, when (b) was (b), showed very gentle or reverse gradients. Magnitude of the gradient in stress period 3 was observed to be 4.38E-5 ft/ft compared to 5.87E-5 ft/ft simulated. Magnitude of the gradient in stress period 10 was observed to be 5.97E-5 ft/ft compared to 3.74E-5 ft/ft simulated. In stress period 2, observed data indicated a negative gradient up the ridge of 1.20E-5, whereas the observed gradient down the ridge was 6.51E-6 ft/ft, which is approximately an order of magnitude lower than the scenarios with (b) on. In stress period 9, the opposite occurred where a gentle gradient of 1.10E-5 ft/ft down the ridge was observed and a negative gradient up the ridge of 1.10E5 ft/ft was simulated. In both these cases, there is some variability around the trendlines for actual simulated and observed water levels, indicating some uncertainty of the gradients calculated by linear regression. Overall, in stress periods 2 and 9, the concept of flatter gradients and the potential for negative gradients up the ridge is simulated, but in the opposite stress period as observed.

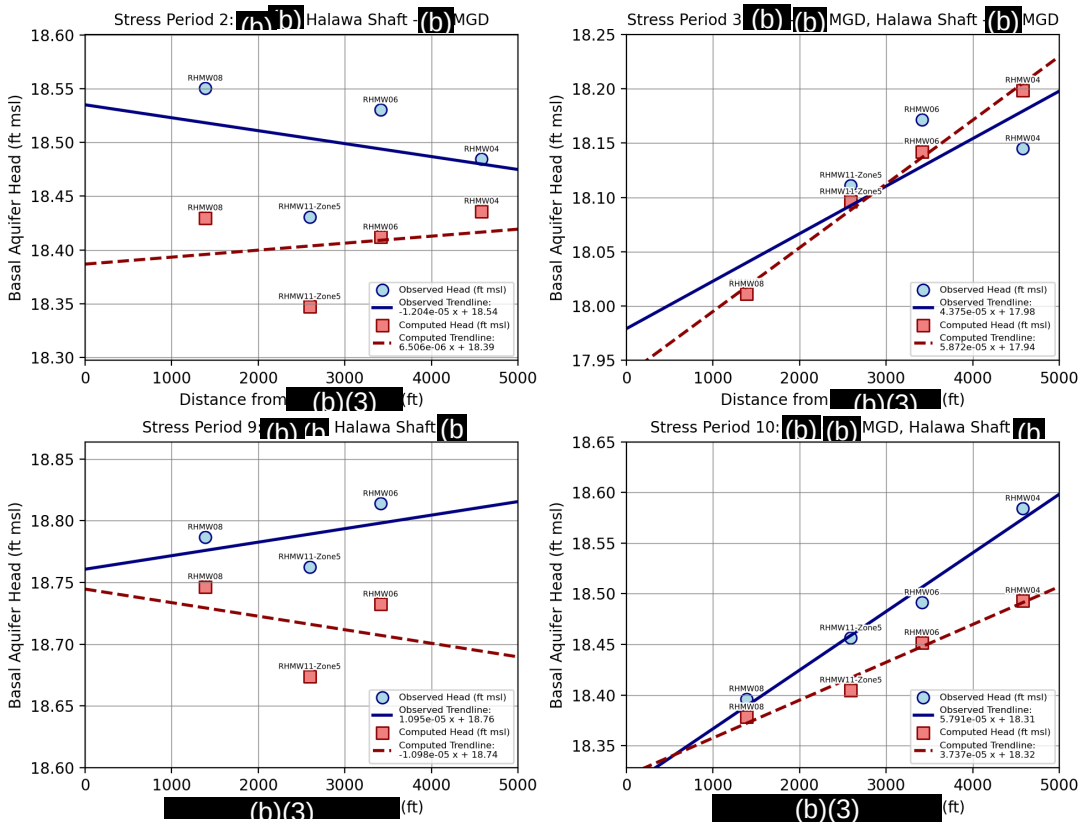


Chart 4-5: Hydraulic Gradients Northwest of Red Hill Ridge

4.4.4 Comparison to Water Level and Drawdown Hydrographs

Simulated versus observed hydrographs over time are presented in Attachment 3 for both water levels and drawdowns. When the model is calibrated, the simulated water levels over time (represented with the red dashed line) will approximate observed water level data, shown in gray in the background. Averaged water levels used as calibration targets are represented by blue dots. Drawdown-over-time plots isolate the aquifer responses to pumping changes. Drawdown was calculated by subtracting the difference between simulated and observed water levels at the start of the 2017/2018 and 2021/2022 data sets, removing the residual in initial water level. Matching water levels provides the model with better representation of flow directions and gradients, while matching drawdown facilitates better estimate of hydrogeologic properties of the basal aquifer by allowing a match to the aquifer responses to stress changes.

Most of calibration assessment focuses on water levels in wells in the vicinity of the Facility; however, reasonable representation of gradients is also necessary to capture the regional and local flow fields and water budget. Regional monitoring wells include Manaiki T24, Moanalua Deep, TAMC (b)(3) Hālawa TZ, ʻAiea Bay, Kaʻamilo Deep, Hālawa T45, (b)(3) MW, and TAMC (b) (2). Regional monitoring wells generally show muted responses to pumping, which is generally well represented in the model as evidenced by the hydrographs in Attachment 3. Additionally, average residual at each monitoring well is plotted on Figure 4-3, which shows no significant bias or trend in average residuals across the domain.

Water levels at wells within the vicinity of the Facility generally match magnitude and trend of the water levels and drawdown plots, although drawdown tends to be approximately 0.1 to 0.15 ft smaller than observed in response to startup of (b) (3). Water levels within (b) (3) itself fluctuate significantly due to cyclic pumping, while only average pumping rates are simulated. In general, water levels in (b) (3) are simulated slightly higher than the daily average of observed water levels.

OWDF wells were installed in 2021, after the 2017/2018 synoptic monitoring. Therefore, synoptic monitoring data are available only during 2021/2022. Simulated drawdown at the OWDF wells follow similar patterns to observed drawdowns; however, the simulated water levels are consistently lower than observed. The likely source of this is discrepancy is heterogeneities not explicitly represented in the model that result in perched or semi-perched observed water levels.

4.4.5 Comparison to Conceptual Water Budget

The simulated water budget at the end of each stress period was compared to the conceptual water budget calculations, as shown in Table 4-7. Several components of the water budget inform model boundary inputs including recharge, dike region inflow, and well discharge. Changes in storage were not considered in the conceptual water budget calculations, because they rely on water level changes over the entire domain, which is not easily estimated and obscured by other stress changes. Overall storage changes are a relatively small component of the water budget and within the error bracketing the water budget estimates. The transient model simulations do include storage changes, further demonstrating that they are a relatively small portion of the water budget by the end of each stress period.

Table 4-7: Comparison of Conceptual and Simulated Water Budget

Type	Stress Period	Recharge (mgd)	Dike Region Inflow (mgd)	Well Discharge (mgd)	Spring Discharge (mgd)	Caprock Discharge (mgd)	Inflow from Southeast (mgd)	Outflow to Northwest (mgd)	Storage (mgd)	Total Inflows (mgd)	Total Outflows (mgd)
Conceptual	1	32.5	28.7	(b)(3)	13.6	2.4	2.8	16.0	0.0	64.0	(b)(3)
Simulated		32.5	28.7		12.8	3.9	12.1	24.2	0.0	73.3	
Difference		0.0	0.0		-0.8	1.5	9.3	8.2	0.0	9.3	
Conceptual	2	32.5	28.7		13.6	2.4	2.8	19.6	0.0	64.0	
Simulated		32.5	28.7		13.0	3.9	11.1	24.7	-2.2	72.3	
Difference		0.0	0.0		-0.6	1.5	8.3	5.1	-2.2	8.3	
Conceptual	3	32.5	28.7		13.5	2.4	2.8	12.0	0.0	64.0	
Simulated		32.5	28.7		12.8	3.9	12.4	24.2	3.4	77.0	
Difference		0.0	0.0		-0.7	1.5	9.6	12.2	3.4	13.0	
Conceptual	4	32.5	28.7		13.5	2.4	2.8	15.6	0.0	64.0	
Simulated		32.5	28.7		12.8	3.9	12.4	23.9	-0.4	73.6	
Difference		0.0	0.0		-0.8	1.5	9.6	8.3	-0.4	9.6	
Conceptual	5	32.5	28.7		13.7	2.4	4.7	24.1	0.0	65.9	
Simulated		32.5	28.7		13.7	3.9	11.3	27.1	-2.0	72.5	
Difference		0.0	0.0		-0.1	1.6	6.6	3.1	-2.0	6.6	
Conceptual	6	32.5	28.7		13.6	2.4	4.7	12.2	0.0	65.9	
Simulated		32.5	28.7		12.4	3.9	13.1	23.0	2.8	77.1	
Difference		0.0	0.0		-1.2	1.5	8.4	10.9	2.8	11.2	
Conceptual	7	32.5	28.7		13.4	2.4	4.1	17.4	0.0	65.3	
Simulated		32.5	28.7		12.7	3.9	11.1	23.8	0.0	72.3	
Difference		0.0	0.0		-0.7	1.5	7.0	6.3	0.0	7.0	
Conceptual	8	32.5	28.7		12.6	2.4	2.8	18.8	0.0	63.9	
Simulated		32.5	28.7		12.7	3.9	11.3	23.5	-2.2	72.5	
Difference		0.0	0.0		0.1	1.5	8.6	4.7	-2.2	8.6	
Conceptual	9	32.5	28.7		13.7	2.4	0.5	23.8	0.0	61.7	
Simulated		32.5	28.7		14.2	3.9	8.2	29.3	-0.1	69.4	
Difference		0.0	0.0		0.6	1.5	7.7	5.5	-0.1	7.7	
Conceptual	10	32.5	28.7		13.9	2.5	7.5	25.9	0.0	68.7	
Simulated		32.5	28.7		13.7	3.9	10.3	27.6	0.0	71.4	
Difference		0.0	0.0		-0.2	1.4	2.8	1.7	0.0	2.8	

Note:
Orange shading indicates simulated values are greater than conceptual estimates.
Blue shading indicates simulated values are less than conceptual estimates.

Discharge to Pearl Harbor and the Pacific Ocean through the caprock was estimated to be 2.4 mgd and simulated to be 3.9 mgd, which did not fluctuate significantly by stress period, either in the conceptual or simulated water budgets. The majority of the simulated outflow to the Pacific Ocean and Pearl Harbor is due to recharge on the caprock itself, totaling approximately 3.5 mgd. Flow between the basal aquifer and caprock is simulated to be small, approximately 0.4 mgd.

Inflow from the southeast and outflow to the northwest were calculated during model calibration. The model simulations generally show increased flow in and out of the GHB to the southeast and northwest compared to conceptual estimates. Inflow from the southeast was estimated to range from 2.8 to 7.5 mgd, whereas simulated values ranged from 8.2 to 12.4 mgd. The overall impact on the water budget for the model domain is an increase in total inflows ranging from approximately 4% to 13%. Such deviations from the conceptual water budget estimates were considered reasonable given uncertainty in the assumptions associated with the water budget estimates. This provided the model calibration process to reach better agreement with known data such as water levels and drawdowns.

4.4.6 Evaluation of Source Water with Chloride and Temperature Data

Chloride concentration and temperature data were considered in evaluation of water sources to (b) and Hālawa Shaft. Generally, higher chloride concentrations and temperatures are attributed to source water in the downslope region, whereas lower chloride concentrations and temperatures are attributed to source water from the upslope region. Behavior of chloride concentrations were noted in the disapproval letter to be inconsistent with the simulated capture zones in the 2020 GWFM. This was addressed using chloride and temperature data as two lines of evidence to support estimates of source water to (b) and Hālawa Shaft.

To estimate the contribution from each source of water to the water supply shafts, a unit concentration, or a value of 1, was assigned to each contributing source boundary condition in separate steady-state simulations, then the final concentration at each shaft was compiled to represent the percentage of water from each boundary condition. The model was set with (b) pumping at (mgd and Hālawa Shaft at (b) mgd. Sources of water to the model were recharge, dike region inflow, the southeast GHB, and the freshwater/saltwater interface. The Prescribed Concentration Boundary (PCB) package in the MODFLOW-USG Transport code was used to implement the specified concentrations. In post-processing of the model results the percentage of water from each boundary condition was assigned an estimated chloride or temperature value based on available data. A weighted average concentration was calculated using the assigned value and percentage of contribution to estimate the chloride concentration and temperature in both water supply shafts. Simulated values were then compared to measured chloride concentrations and temperature within each shaft.

The simulations that considered boundary contributions to the two water supply shafts required adjustments to the model setup to account for potential contributions from the freshwater/saltwater interface. In the calibration model, the freshwater/saltwater interface was assumed to be a no-flow boundary; however, for this portion of the study, an additional layer was added along the bottom of the model where constant head and concentration cells were implemented. The head was assigned the value equal to the simulated head

without constant head boundary present. This allowed for assessment of upconing from the freshwater/saltwater interface to the water development shafts.

Chloride

Chloride concentrations were estimated based on the rainfall, runoff, and recharge rates defined in the USGS recharge coverage for O‘ahu (Engott et al. 2017).

Visher and Mink (1964) state that the chloride concentration in Honolulu coastal rainfall varied from 3.0 to 29 milligrams per liter (mg/L) for an average value of 16 mg/L. Average chloride concentration in the upland areas in the Kīpapa drainage basin, located to the northwest of the model domain, was 6.5 mg/L, making 11 mg/L a representative rainfall concentration. Assuming that chloride is a conservative species, the chloride concentration of the recharging water can be approximated by:

$$Chloride_{recharge}\left[\frac{mg}{l}\right] = 11\ \left[\frac{mg}{l}\right] * \frac{(rainfall\ \left[\frac{in}{yr}\right] - runoff\left[\frac{in}{yr}\right])}{recharge\left[\frac{in}{yr}\right]}$$

Application of this method to the USGS recharge coverage results in a chloride concentration in recharge of approximately 45 mg/L in the area beneath the Facility. Chloride concentrations in recharge gradually decrease up to the dike region. The dike region was assigned a chloride concentration of 30 mg/L, which results from application of this method to the rainfall concentration in the dike region in the dike region. The GHB to the southeast was assigned a chloride concentration of 40 mg/L. The freshwater/saltwater interface representing the bottom of the model was derived from the 50% chloride concentration of seawater, or 9,500 mg/L, as simulated by Oki (2005). This value as assigned to the freshwater/saltwater interface.

Temperature

Temperature of water in the rainfall, infiltration, and groundwater flow cycle is generally the lowest in rainfall, and changes thereafter lead to higher temperatures (Visher and Mink 1964). Groundwater temperature is generally correlated to average atmospheric temperature, where groundwater is coolest at higher elevations gradually increases as elevation decreases. The temperature of groundwater in the dike region is the coolest and was assigned a temperature of 19 degrees Celsius (°C) based on DLNR 2023 well data[5] and on average annual temperature. Average annual temperature at the Facility is approximately 24 °C. Given that much of the recharge and the southeast GHBs are located in the area between the dike region and the Facility, recharge and the southeast GHB were both assigned a temperature of 21.5 °C, midway between the bounding values of 19 and 24 °C. The freshwater/saltwater interface was assigned a temperature of 23 °C based on temperature profiles of HDMW2253-03.

[5] https://dlnr.hawaii.gov/cwrm/groundwater/wellinfo/

Results

The resulting percent of source contributions from the unit concentration simulations, their associated chloride concentration and temperature assumptions, as well as the weighted average of each, are shown in Table 4-8 and Table 4-9. The simulation demonstrates that chloride concentrations in either shaft can be dominated by a relatively small proportion (0.6 to 1.2%) of source water attributed to upconing from the freshwater/saltwater interface, while temperature is much less sensitive to freshwater/saltwater interface contributions and primarily driven by the coolest water flowing into the model domain from the dike region. Figure 4-4 shows a plan views of the unit concentration source simulation for the freshwater/saltwater interface in layer 18 where Hālawa Shaft is primarily located, demonstrating the effects of pumping on the potential chloride distribution in groundwater. Layer 18 pinches out below the freshwater/saltwater interface to the southwest where no concentrations are shown. To the northeast of the color flood, percentage contribution from the unit concentration is below 1%.

Table 4-8: Simulated (b) Source Water Contribution

Source	% Contribution	Chloride (mg/L)	Temperature (°C)
Rainfall Recharge	36.3%	45	21.5
GHB Southeast	34.2%	40	21.5
Dike Region	27.9%	30	19
Freshwater/saltwater interface	0.6%	9500	23
	Weighted Average	91	20.6

Table 4-9: Simulated Hālawa Shaft Source Water Contribution

Source	% Contribution	Chloride (mg/L)	Temperature (°C)
Recharge	49.8%	45	21.5
GHB Southeast	0.4%	40	21.5
Dike Region	48.6%	30	19
Freshwater/saltwater interface	1.2%	9500	23
	Weighted Average	150	20.3

A comparison of observed and simulated chloride concentrations and temperature are shown in Table 4-10. Average chloride concentrations at (b) and Hālawa Shaft are approximately 95 and 152 mg/L, respectively (EPA Region 9 and DOH 2022). Average temperatures at (b) and Hālawa Shaft are 20.9 and 20.3 °C, respectively. Data from the two shafts, however, show higher chloride at Hālawa Shaft, despite being farther upslope and farther along dip from the freshwater/saltwater interface, but lower temperature. The model simulations demonstrate how these seemingly conflicting interpretations of source water can be reconciled. The greater pumping rate at Hālawa Shaft may produce a greater contribution from upconing from the freshwater/saltwater interface at 1.2% of source water, compared to (b) where 0.6% of source water is attributed to the freshwater/saltwater interface. Figure 4-4 shows the results of the unit

concentration source simulation in layer 18 where the majority of Hālawa Shaft is located, demonstrating upconing from the freshwater/saltwater interface along dip. Hālawa Shaft then received a greater portion of its inflows from the dike region with 48.6%, compared to (b) with 27.6%, explaining the mechanism for cooler temperatures at Hālawa Shaft. Estimated chloride concentrations and temperatures at (b) and Hālawa Shaft compare well to observed data, and also replicate the relative differences of higher chloride but lower temperature at Hālawa Shaft.

Table 4-10: Comparison of Observed and Simulated Chloride Concentration and Temperature

	Chloride (mg/L)		Temperature (°C)	
Supply Well	**Observed**	**Simulated**	**Observed**	**Simulated**
(b)	95	91	20.9	20.6
Hālawa Shaft	152	150	20.3	20.3

The unit source simulations demonstrate that only a very small amount of water (0.6% to 1.2%) at the shafts is needed to explain the chloride concentrations but would not have a significant overall effect on the model simulation results. This indicates that the assumption of no-flow at the freshwater/saltwater interface is a reasonable simplifying assumption for the overall model objectives. Explicit simulation of the freshwater/saltwater interface would require significant structural changes to the GWFM, including addition of a significant number of layers and cells, which would increase computational requirements without impactful changes to the flow in and around the Facility.

Assumptions in this section and resulting estimates for chloride concentration and temperature are inherently non-unique and do not account for all possible processes that may affect chloride concentrations and temperature, such as higher/potentially higher chloride concentrations at OWDF and perched-zone groundwater, and the potential impacts from quarry operations and natural source-zone depletion (NSZD). Although simplifying assumptions that do not account for all processes (such as those listed above) are made for these estimates, the simulations and subsequent calculations demonstrate an explanation for the patterns of chloride concentrations and temperature between (b) and Hālawa Shaft. This evaluation adds confidence to the model calibration by explaining the mechanisms for two differing lines of evidence for groundwater source contributions to (b) and Hālawa Shaft.

5.0 Particle Tracking Simulations

Forward particle tracking was conducted with steady-state flow models under various pumping conditions from the water table beneath the tank farm to estimate the potential fate of a potential release. Particle tracking does not account for typical contaminant transport processes such as dispersion, sorption, and degradation. Particles were simulated using a grid spacing over the tank farm area. The four scenarios were constructed as follows:

- (b) pumping at (b) mgd, Hālawa Shaft pumping at (b) mgd, (b)(3) pumping at (b) mgd (Figure 5-1)
- (b) pumping at (mgd, Hālawa Shaft (b), (b)(3) pumping at (b) mgd (Figure 5-2)

- [redacted] Hālawa Shaft [redacted] (Figure 5-3)
- [redacted] Hālawa Shaft pumping at [redacted] mgd, [redacted] (Figure 5-4)

The first scenario represents [redacted] pumping at [redacted] mgd, Hālawa Shaft pumping at [redacted] mgd, and [redacted] pumping at [redacted] mgd. Of the three chosen scenarios, this represents conditions where Hālawa Shaft is most vulnerable, specifically where the significant pumping rate at Hālawa Shaft is mostly likely to extract groundwater from beneath the Facility. Figure 5-1 shows the simulation results for this scenario including the potentiometric surface, particle tracking pathlines, and 30-day travel-time tick marks. Particles are simulated to originate from the Facility. From there they move with a small component of flow to the west-northwest before heading predominantly in the southwest direction toward [redacted]. Travel time from the uppermost tanks to [redacted] was simulated to be approximately 80 days, and from the lowermost tanks was approximately 35 days.

The second scenario simulates [redacted] mgd withdrawal from [redacted], [redacted] mgd withdrawal from [redacted] and [redacted] from Hālawa Shaft. This scenario demonstrates the maximum capture of groundwater from beneath the Facility by [redacted] because Hālawa Shaft is not pumping. Figure 5-2 shows the simulation results for this scenario including the potentiometric surface, particle tracking pathlines, and 30-day travel-time tick marks. Particles from beneath the tank farm move slightly to the west-northwest, but all eventually migrate down-ridge, being captured by [redacted]. Results show only slight differences compared to the previous scenario in flow direction with a lesser component of flow to the northwest with Hālawa Shaft [redacted]. Travel time from the uppermost tanks to [redacted] was approximately 80 days, and from the lowermost tanks was approximately 35 days.

The third scenario simulates [redacted] at [redacted] and Hālawa Shaft. Figure 5-3 shows the simulation results for this scenario including the potentiometric surface, particle tracking pathlines, and 6-month travel-time tick marks. Particles from beneath the tank farm travel generally to the west-northwest, eventually discharging to Kalauao Springs. Particles travel beneath Pearl Harbor, but due to the low hydraulic conductivity of the caprock, they eventually discharge to the springs rather than Pearl Harbor. Travel time from the uppermost tanks to Kalauao Springs was approximately 3 years.

The fourth scenario simulates [redacted] from [redacted] or [redacted] and [redacted] mgd withdrawal from Hālawa Shaft, which represents a hypothetical and unlikely scenario in which the greatest risk is posed to Hālawa Shaft. Figure 5-4 shows the simulation results for this scenario including the potentiometric surface, particle tracking pathlines, and 6-month travel-time tick marks. Particles from beneath the tank farm generally travel to the west-northwest, eventually discharging to water supply wells between Hālawa Shaft and [redacted] or to the Kalauao Springs. Many particles travel beneath Pearl Harbor, but due to the low hydraulic conductivity of the caprock, they eventually discharge to the springs rather than Pearl Harbor. Travel time from the uppermost tanks to Kalauao Springs was approximately 3 years.

To demonstrate regional groundwater flow patterns without the influence of pumping from [redacted] and Hālawa Shaft, forward particle tracking was performed with 13 particles placed along the southeast GHB and dike region with [redacted] and Hālawa Shaft [redacted]. Figure 5-5 shows the simulation results for this scenario, including the potentiometric surface, particle tracking pathlines, and 1-year travel-time tick marks. The

particles pathlines are generally oriented to the west, oblique to the potentiometric surface contours due to the horizontal anisotropy of the aquifer. Particles in the southwest are pulled toward Kalihi Shaft, and the remainder of particles converge toward Kalauao Springs and the western section of the northwest GHB. The largest regional sinks for groundwater are Kalauao Springs and Waiau and Waimano Springs, located to the west-northwest of Kalauao Springs; therefore, particles converging on this area are consistent with the hydrogeological conceptual model.

6.0 Sensitivity Analysis

The impact of uncertainties, errors, and modeling assumptions was evaluated via a sensitivity analysis. A sensitivity analysis was conducted on parameter value bounds, conceptual uncertainties, and boundary stresses, where each sensitivity run was recalibrated with the PEST software. Each sensitivity simulation was evaluated for its impacts on the model calibration, acceptability of the calibrated basalt parameters based on literature values and professional judgement, and the predictive particle tracking results. All sensitivity scenarios were performed on the GWFM without nested grid refinement for flexibility of calibration and because of negligible differences in results prior to implementation of the nested grid. The analysis was performed in accordance with ASTM International Standard Designation D5611-94 (2016a). Each parameter was categorized as Type I, II, III, or IV sensitivity. Definitions for these parameter types are as follows:

- Type I Sensitivity—When variation of an input causes insignificant changes in the calibration residuals as well as the model's conclusions, then that model has a Type I sensitivity to the input. Type I sensitivity is of no concern because regardless of the value of the input, the conclusion will remain essentially the same.
- Type II Sensitivity—When variation of an input causes significant changes in the calibration residuals but insignificant changes in the model's conclusions, then that model has a Type II sensitivity to the input. Type II sensitivity is of no concern because regardless of the value of the input, the conclusion will also remain essentially the same.
- Type III Sensitivity—When variation of an input causes significant changes to both the calibration residuals and the model's conclusions, then that model has a Type III sensitivity to the input. Type III sensitivity is of no concern because, even though the model's conclusions change as a result of variation of the input, the parameters used in those simulations cause the model to become uncalibrated. Therefore, the calibration process eliminates those values from being considered to be realistic.
- Type IV Sensitivity—If, for some value of the input that is being varied, the model's conclusions are changed but the change in calibration residuals is insignificant, then the model has a Type IV sensitivity to that input. Type IV sensitivity can invalidate model results because over the range of that parameter in which the model can be considered calibrated, the conclusions of the model change. A Type IV sensitivity generally requires additional data collection to decrease the range of possible values of the parameter.

Seven sensitivity simulations were conducted with a varying assumption of inputs or constraints then compared to the base model calibration, referred to hereafter as Scenario 0. Calibration for each scenario was evaluated using RMSE, scaled RMSE, as well as matches to gradients along Red Hill ridge and to

hydrographs at each monitoring well. Matches to gradients along Red Hill ridge and the hydrographs were given a relative rank (i.e., not scales) compared to all of the sensitivity scenarios, including the base model calibration. During PEST calibration, parameter bounds were opened beyond acceptable values to evaluate what values are required for optimal calibration under each constraining assumption. After calibration, basalt parameters were evaluated to assess whether they lie in an acceptable range. Finally, predictive particle tracking was conducted under each of the three pumping configurations discussed in Section 5.0 to assess the capture by (b) (3) and risk to Hālawa Shaft and to guide characterization of each sensitivity type compared to Scenario 0 results. A summary of the changes to each simulation, model calibration, basalt parameters, particle tracking results, and sensitivity type characterization is presented in Table 6-1. Documentation of calibration evaluation for each sensitivity scenario is presented in Attachment 4.

Table 6-1: Summary of Sensitivity Analysis Results

Scenario	Changes	Statistics		Relative Rank		Hydraulic Properties of Basalt						(b) - (b) mgd, Hālawa Shaft - (b)(3) – (b) mgd		(b) - (b) mgd, Hālawa Shaft – (b)(3) – (b) mg	(b) - (b) Hālawa Shaft – (b)(3) - (b)	(b) – (b) Hālawa Shaft - (b) mgd (b)(3) - (b)	Sensitivity Type
		Basal Aquifer RMSE (ft)	Basal Aquifer Scaled RMSE (%)	Gradients Along Ridge	Hydro-graphs	Kx [a] (ft/d, down-dip)	Ky [b] (ft/d, cross-dip)	Horizontal Anisotropy Ratio	Kz [c] (ft/d, vertical)	Vertical Anisotropy Ratio	Specific Yield (%)	Full Capture of Particles at (b) ?	Arrival of Particles at Hālawa Shaft?	Full Capture of Particles at (b) ?	Destination of Particles	Destination of Particles	
0	Base calibration	0.28	4.0%	1	1	12,714	636	20	289	44	9.8	Yes	No	Yes	Springs	Springs, Pearl Harbor, other water supply wells	-
1	7-degree dip	0.86	11.9%	8	7	11,205	885	13	456	25	6.7	Yes	No	Yes	Northwest GHB	Northwest GHB, Springs	Type II
2	Apply scaling factor to recharge, update flux targets	0.32	4.6%	2	2	12,641	702	18	250	51	8.5	95% Capture - Particles discharge to (b)(3) , Pearl Harbor, Springs	No	Yes	Springs	Hālawa Shaft, Springs, Pearl Harbor	Type IV
3	Kx fixed at 4500 ft/d	0.34	4.8%	4	5	4,500	709	6	483	9	10.7	65% Capture - Particles escape to (b)(3) , other water supply wells, springs	No	90% Capture - Particles escape to Springs, Pearl Harbor	Springs, Pearl Harbor	Springs, Pearl Harbor, other water supply wells	Type III
4	Horizontal Anisotropy fixed at 3:1	0.37	5.1%	7	7	3,824	1275	3	929	4	9.8	20% Capture - Particles escape to Hālawa Shaft, (b)(3) , other water supply wells, springs	Yes	50% Capture - Particle escape to Pearl Harbor, Springs	(b)(3) , Springs	Hālawa Shaft, Springs, other water supply wells	Type III
5	Vertical Anisotropy fixed at 200:1	0.30	4.1%	5	4	17,812	891	20	89	200	10.5	Yes	No	Yes	Springs	Hālawa Shaft, (b)(3) , Springs	Type I
6	Eliminated dike flux (Assumes all recharge from dike region flows around dikes and into model domain from southeast)	0.32	(b) %	6	6	19,537	1227	16	116	168	8.5	90% Capture - Particles Escape to Hālawa Shaft	Yes	95% Capture - Particles Escape to Springs	(b)(3) , Springs	Hālawa Shaft, (b)(3) , Springs	Type III

Scenario	Changes	Statistics		Relative Rank		Hydraulic Properties of Basalt						[redacted] Hālawa Shaft - [redacted] mgd [redacted] – [redacted] mgd		[redacted] - [redacted] mgd, Hālawa Shaft – [redacted] [redacted] – [redacted] mg	[redacted] - [redacted] Hālawa Shaft – [redacted] [redacted] - [redacted]	[redacted] – [redacted] Hālawa Shaft - [redacted] mgd [redacted] - [redacted]	Sensitivity Type
		Basal Aquifer RMSE (ft)	Basal Aquifer Scaled RMSE (%)	Gradients Along Ridge	Hydro-graphs	Kx [a] (ft/d, down-dip)	Ky [b] (ft/d, cross-dip)	Horizontal Anisotropy Ratio	Kz [c] (ft/d, vertical)	Vertical Anisotropy Ratio	Specific Yield (%)	Full Capture of Particles at [redacted]?	Arrival of Particles at Hālawa Shaft?	Full Capture of Particles at [redacted]?	Destination of Particles	Destination of Particles	
7	Northwest Flow Direction Scenario	0.28	3.9%	3	3	10,234	554	18	7967	1.3	7.6	No Capture - Particles escape to [redacted], other water supply wells, springs, Pearl Harbor, northwest GHB	No	25% Capture - Particles escape to springs, Pearl Harbor, northwest GHB	Springs, Pearl Harbor	Hālawa Shaft, Springs, other water supply wells	Type IV

Notes:
Values in red indicate unacceptable hydraulic property values for basalt.
[a] Kx Hydraulic conductivity in the down-dip direction
[b] Ky Hydraulic conductivity in the cross-dip direction
[c] Kz Hydraulic conductivity in the vertical direction

6.1 Scenario 1 – 7-Degree Dip of Basalt

Scenario 1 changes the assumption of a 4-degree dip of the basalt used in Scenario 0 to a 7-degree dip. This change required rebuilding the model grid to align layer elevations with a 7-degree dip in basalt layers 5–36. All layers that were initially 25 ft thick in Scenario 0 were changed to 40 ft thick to prevent a vertical separation between model cells and their adjacent down-dip cell.

Basalt parameters of the scenario were reasonable, with only minor changes to horizontal hydraulic conductivity in the down-dip direction (K_x) with a value of approximately 11,200 ft/d and slightly higher hydraulic conductivity in the cross-dip direction (K_y) of about 880 ft/d and hydraulic conductivity in the vertical direction (K_z) of 456 ft/d. The resulting horizontal and vertical anisotropy ratios were 13 and 25, respectively.

The calibration statistics were worse than Scenario 0 with more than triple the RMSE from 0.28 ft in Scenario 0 to 0.86 ft. Scenario 1 also ranked last in the sensitivity analysis for both matches to gradients along the ridge and hydrographs.

Despite the significantly poorer calibration, both scenarios with (b) pumping at 4 mgd showed capture of all particles. Without (b) or Hālawa Shaft on, particles discharge to the northwest GHB rather than Kalauao Springs. This is the only scenario (aside from Scenario 0) with Hālawa Shaft pumping at (b) mgd and (b) and (b)(3) (b) where particles do not reach Hālawa Shaft. Because the calibration was significantly affected in this scenario but predictive results were not, it was characterized as a Type II sensitivity.

6.2 Scenario 2 – Scaled Recharge

Scenario 2 included scaled recharge and inflow from the dike region to correspond to the variability in precipitation over time. To estimate the impacts of precipitation variability on groundwater levels, the water levels at Well 3-2256-010 (‘Aiea Bay Well) were compared to rainfall from 1966 through 2022, and correlation coefficients were developed based on precipitation over a range of the previous 1 to 36 months at seven weather stations shown on Figure 2-1. The purpose of this exercise was to estimate the time period prior to any given water level where average precipitation has the strongest influence on the water levels. Correlation coefficients using moving monthly averages ranging from 1 to 36 months for several weather stations are plotted on Chart 6-1.

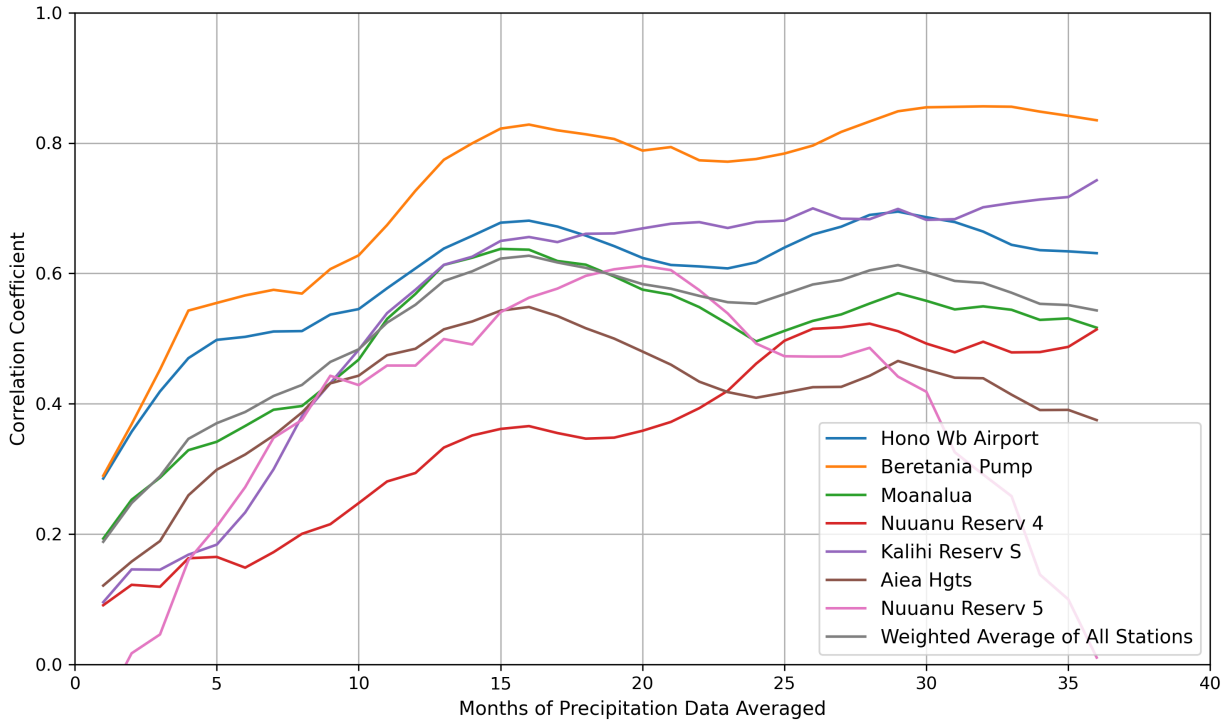


Chart 6-1: Correlation Between Precipitation and Water Levels

The analysis shows that the correlation of groundwater levels to preceding periods of rainfall increases steadily up to roughly a 16-month average and, depending on the location of the weather station, shows the strongest correlation generally between 16- and 30-month averages. This indicates that groundwater levels are more dependent on precipitation over the previous 1–2 years, rather than on more recent precipitation events. An additional water budget calculation was conducted using scaled recharge (Table 6-2), where the ratio of precipitation over the previous 24 months to average precipitation was then applied as a scaling factor to recharge.

Table 6-2: Recharge Scaling Factor by Stress Period

Stress Period	Recharge Scaling Factor
1	77.2%
2	77.2%
3	77.5%
4	77.5%
5	77.5%
6	85.1%
7	78.2%
8	78.2%
9	91.5%
10	82.5%

The 24-month period was selected based on Chart 6-1. Results indicated that error, or the difference between the sum of inflows and the sum of outflows over the regional water budget, after applying a scaling factor to recharge generally varied between a 2.5 mgd and 20 mgd deficit except for stress period 9, which had a surplus of 18 mgd. Percent error generally varied between -14% and 10%. The base water budget and water with scaled recharge generally bracket error in the calculations with bias toward a surplus without a scaling factor, and bias toward a deficit with scaled recharge. Actual precipitation during the periods of interest was generally lower than historical averages. If precipitation was higher than average, it is possible that the associated error in the water budget may be the opposite when comparing scaled vs. unscaled recharge values.

Despite differences in recharge and dike region inflows, basalt parameters calibrated similarly to Scenario 0, with a minor increase in RMSE from 0.28 to 0.32 ft. Matches to gradients along Red Hill ridge and hydrographs were very similar and were ranked 2 for both.

Predictive particle tracking runs with Hālawa Shaft pumping at (b) mgd, (b) pumping at (mgd, and (b)(3) pumping at (b) mgd indicated approximately 95% capture, with some particles from the uppermost tanks escaping capture to the northwest and discharging at either (b)(3), Pearl Harbor, or Kalauao Springs. Results from the configuration with Hālawa Shaft (b), (b) pumping at (b mgd, and (b)(3) pumping at (b) mgd, indicated full capture, and the configuration of (b), (b)(3), and Hālawa Shaft (b) showed discharge to Kalauao Springs, consistent with the results from Scenario 0.

Scenario 2 demonstrated that the model could be recalibrated with only minor impact to the quality of the fit to observations. Results of particle tracking were similar to those in Scenario 0 (except for the (b) and (b)(3) (b) and Hālawa Shaft pumping at (b) mgd configuration); however, approximately 5% of particles escaped capture of (b) to (b)(3), Pearl Harbor, or Kalauao Springs when Hālawa Shaft was pumping at (b) mgd. With (b) and (b)(3) (b) and Hālawa Shaft pumping at (b) mgd, approximately 25% of the particles arrived at Hālawa Shaft, with the remainder discharging to Pearl Harbor and Kalauao Springs. These results indicate that there is some uncertainty in whether full capture of groundwater underneath the tank farm can be achieved under that scenario; therefore, this scenario was characterized as a Type IV sensitivity.

6.3 Scenario 3 – K_x fixed at 4,500 ft/d

Scenario 3 assumed that the hydraulic conductivity in the down-dip direction (K_x) is 4,500 ft/d, equivalent to the value used by Oki (2005). The calibrated K_x of the basalt in Scenario 0 was approximately 13,000 ft/d. The purpose of this scenario is to investigate the potential effects of a lower K_x on model results. This parameter was fixed, then the other parameters were adjusted with PEST.

Resulting basalt parameters (except K_x,) were similar to Scenario 0, but the horizontal and vertical anisotropy ratios were significantly lower at 6 and 9, respectively, estimated using PEST. A vertical anisotropy ratio of 9 is considered to be too low and too significant of a deviation from published values, which generally range from 200 to 600 (Oki 1998), to be acceptable. While there is some significant uncertainty in vertical anisotropy ratio, and it cannot be directly measured, the depositional environment of the basalt would lead to higher vertical anisotropy than typically assumed. A vertical anisotropy value of

44 resulted from calibration in Scenario 0, which is also lower than reported values, but still represents significant anisotropy.

Calibration of Scenario 3 resulted in a slight increase in RMSE from 0.28 to 0.34 ft; however, gradients along Red Hill ridge and hydrograph behavior were not matched, receiving relative ranks of 4 and 5, respectively. Changes to the model calibration in this case were considered significant.

Predictive particle tracking runs with Hālawa Shaft pumping at (b)(3) mgd, (b)(3) pumping at (b)(3) mgd, and (b)(3) at (b)(3) mgd indicated approximately 65% capture, with some particles from the upper tanks escaping capture to the northwest and discharging at either (b)(3), other water supply wells, or Kalauao Springs. With Hālawa Shaft pumping (b)(3), (b)(3) pumping at (b)(3) mgd, and (b)(3) pumping at (b)(3) mgd, approximately 90% of particles were captured, with some particles from the uppermost tanks escaping capture to the northwest and discharging at either Pearl Harbor or Kalauao Springs. Results from the configurations of (b)(3), (b)(3), and Hālawa Shaft (b)(3) and of (b)(3) and (b)(3) (b)(3) with Hālawa Shaft at (b)(3) mgd showed discharge to Pearl Harbor and Kalauao Springs. However, with (b)(3) (b)(3) and Hālawa Shaft on at (b)(3) mgd, some particles discharged to water supply wells located between Hālawa Shaft and (b)(3).

Scenario 3 demonstrated that constraining the K_x to 4,500 ft/d had a negative impact to the model calibration as well as significant deviation from Scenario 0 with predictive particle tracking. Neither scenario with (b)(3) pumping at (b)(3) mgd achieved complete capture, with only 65% capture with Hālawa Shaft at (b)(3) mgd and 90% capture with Hālawa Shaft (b)(3). This also represents a significant difference from Scenario 0; therefore, Scenario 3 was assigned a Type III sensitivity. Additionally, it required an unacceptable vertical anisotropy ratio to achieve its optimal calibration, providing an additional line of evidence that this is not a likely scenario.

6.4 Scenario 4 – Horizontal Anisotropy Fixed at 3:1

Scenario 4 assumed that the ratio of K_x to K_y horizontal hydraulic conductivity is 3:1, equivalent to the ratio used by Oki (2005). The calibrated horizontal anisotropy ratio of the basalt in Scenario 0 was approximately 20:1, significantly higher than values used in previous modeling. The purpose of this scenario is to investigate the potential effects of a lower horizontal anisotropy ratio on model results. This ratio was fixed, then the model parameters were adjusted with PEST.

Resulting basalt parameters were significantly different than those in Scenario 0 including a K_x of 3,800 ft/d, which was significantly lower, but K_y and K_z values of approximately 1,300 and 930, which were significantly higher. The vertical anisotropy ratio from this calibration was 4, an unrealistically low value (Oki 1998; DON 2019).

Calibration of Scenario 3 resulted in an increase in RMSE from 0.28 to 0.37 ft; however, gradients down Red Hill ridge and hydrograph behavior were not matched, receiving relative ranks of 7 for both. Changes to the model calibration in this case were considered significant.

Predictive particle tracking runs with Hālawa Shaft pumping at (b)(3) mgd, (b)(3) pumping at (b)(3) mgd, and (b)(3) at (b)(3) mgd indicated approximately 20% capture, with other particles uncaptured to the northwest and discharging at either Hālawa Shaft, (b)(3), other water supply wells, or Kalauao Springs. With Hālawa

Shaft pumping (b), (b) pumping at 4 mgd and (b)(3) pumping at (b) mgd, approximately 50% of particles were captured, with particles from the upper tanks escaping capture to the northwest and discharging at either Pearl Harbor or Kalauao Springs. Results from the configuration of (b), (b)(3), and Hālawa Shaft (b) showed discharge to (b)(3) and Kalauao Springs. Results from the configuration of (b) and (b)(3) (b) and Hālawa Shaft at (b) mgd showed discharge to Hālawa Shaft, water supply wells located between Halawa Shaft and (b)(3), and Kalauao Springs.

Scenario 4 demonstrated that constraining the horizontal anisotropy ratio to 3:1 had a negative impact to the model calibration, as well as significant deviation from Scenario 0 with predictive particle tracking. Neither scenario with (b) pumping at 4 mgd achieved complete capture, with only 20% capture with Hālawa Shaft at 12 mgd and 50% capture with Hālawa Shaft (b). This also represents a significant difference from Scenario 0; therefore, Scenario 4 was assigned a Type III sensitivity. Additionally, it required an unacceptable vertical anisotropy ratio to achieve its optimal calibration, providing an additional line of evidence that this is not a likely scenario.

6.5 Scenario 5 – Vertical Anisotropy Fixed at 200:1

Scenario 5 assumed that the ratio of down-dip (K_x) to vertical (K_z) hydraulic conductivity is 200:1, lower than the 600:1 ratio used by Oki (2005), but consistent with other reported values (Visher and Mink 1964). The calibrated vertical anisotropy ratio of the basalt in Scenario 0 was approximately 44:1, lower than values used in previous modeling and reporting. The purpose of this scenario was to investigate the potential effects of a lower vertical anisotropy ratio on model results. This ratio was fixed, then the model parameters were adjusted with PEST.

Resulting basalt parameters included a K_x of about 17,800 ft/d and a K_y of about 890 ft/d, which were higher than Scenario 0, and a K_z value of approximately 90 ft/d, which was lower than Scenario 0. Resulting parameter values are considered within an acceptable range.

Calibration of Scenario 4 resulted in a relatively small increase in RMSE from 0.28 to 0.30 ft; however, gradients down Red Hill ridge and hydrograph behavior were not matched as well, receiving relative ranks of 4 and 5, respectively. Changes to the model calibration in this case were considered insignificant.

Both scenarios with (b) pumping at (mgd showed capture of all particles. Without (b) (b) particles discharge to Kalauao Springs. With (b) and (b)(3) (b) and Hālawa Shaft (b), discharge is to Hālawa Shaft, (b)(3), and Kalauao Springs. These results are consistent with those from Scenario 0.

Scenario 5 demonstrated that constraining the vertical anisotropy ratio had only a small impact to the model calibration, as well as no changes to the conclusions of predictive particle tracking compared to Scenario 0. This scenario was characterized as a Type I sensitivity, with no significant changes in calibration or predictive conclusions.

6.6 Scenario 6 – Eliminated Dike Region Flux

Scenario 6 assumed that the interface of the dike region and basalt is a no-flow boundary and that all recharge that occurs in the dike region flows in the direction of anisotropy until discharging into the basalt aquifer before flowing into the GWFM domain from the southwest. This was accomplished by setting the

dike region inflow to zero while maintaining the same boundary flux targets as in Scenario 0, then the model parameters were adjusted with PEST.

Resulting basalt parameters included a K_x of about 19,500 ft/d, which was higher than Scenario 0, a K_y of about 550 ft/d, K_z of approximately 116 ft/d, which were lower than Scenario 0. The horizontal anisotropy ratio was 16 and the vertical was 168. Resulting parameter values are considered within acceptable ranges.

Calibration of Scenario 6 resulted in a relatively small increase in RMSE from 0.28 to 0.32 ft; however, gradients down Red Hill ridge and hydrograph behavior were not matched, receiving relative ranks of 6 for both. Gradients down Red Hill ridge were noticeably steeper than observed along Red Hill ridge in this scenario. Changes to the model calibration in this case were considered significant due to the gradients down Red Hill ridge and hydrograph behavior.

Predictive particle tracking runs with Hālawa Shaft pumping at (b) mgd, (b) pumping at (mgd, and (b)(3) pumping at (b) mgd indicated approximately 90% capture, with some particles from the uppermost tanks escaping capture to the northwest discharging to Hālawa Shaft. Predictive particle tracking runs with Hālawa Shaft (b) and (b) pumping at (mgd indicated approximately 90% capture, with some particles from the uppermost tanks escaping capture to the northwest and discharging at Kalauao Springs. The configuration of no pumping at (b) , (b)(3) , and Hālawa Shaft showed particle tracks migrating from the tank farm to (b)(3) and Kalauao Springs. The configuration of (b) and (b)(3) (b) , and Hālawa Shaft on at (b) mgd showed particle tracks migrating from the tank farm to Hālawa Shaft, (b)(3) , and Kalauao Springs.

Scenario 6 demonstrated that removing the inflow from the dike region and assuming it enters the model from the southeastern GHB resulted in a statistically similar calibration, but significantly worse match to hydrographs and gradients down Red Hill ridge, with also significantly different results from predictive simulations where partial capture was achieved with (b) pumping at (mgd. Scenario 6 was characterized as a Type III sensitivity.

6.7 Scenario 7 – Northwest Flow Direction Scenario

Scenario 7 represents a scenario where flow direction targets were used to calibrate flow paths from the tank farm to Hālawa Shaft while calibrating the model parameters with PEST. Resulting basalt parameters included a K_x of about 10,200 ft/d, which was slightly lower than Scenario 0, a K_y of about 550 ft/d, also slightly lower than Scenario 0, and a K_z of approximately 8,000 ft/d, significantly higher than Scenario 0. The horizontal anisotropy ratio was 18 and the vertical was 1.3. The vertical hydraulic conductivity and vertical anisotropy ratio in this scenario are significantly outside of acceptable ranges.

Calibration of Scenario 7 resulted in the same RMSE and only slightly poorer matches to gradients down Red Hill ridge and hydrograph behavior, receiving relative ranks of 3 for both. Changes to the model calibration in this case were considered insignificant; however, an unreasonable vertical anisotropy ratio was required to do so.

Predictive particle tracking runs with Hālawa Shaft pumping at (b) mgd, (b) pumping at (mgd, and (b)(3) pumping at (b) mgd resulted in no capture at (b) , with particles discharging to (b)(3) and other water

supply wells, Pearl Harbor, Kalauao Springs, and the northwest GHB. No particles, however, discharged to Hālawa Shaft. Predictive particle tracking runs with Hālawa Shaft (b) and (b) pumping at (mgd indicated approximately 25% capture, with particles escaping capture to the northwest and discharging at Pearl Harbor, Kalauao Springs, and the northwest GHB. The configuration of (b) , (b)(3) , and Hālawa Shaft (b) showed discharge to Pearl Harbor and Kalauao Springs. The configuration of (b) and (b)(3) (b) and Hālawa Shaft (b)(3) showed discharge to Hālawa Shaft, water supply wells located between Hālawa Shaft and (b)(3) , and Kalauao Springs.

Scenario 7 demonstrated that the model was unable to achieve flow paths from the tank farm to Hālawa Shaft while maintaining acceptable calibration, even with parameter values outside of acceptable ranges; however, in this scenario, minimal capture of groundwater from under the tank farm by (b) occurred. The resulting calibration was acceptable, while predictive results were significantly different from Scenario 0. Scenario 6 was characterized as a type IV sensitivity; however, because an unreasonable vertical hydraulic conductivity was required to achieve the calibration, it is considered an unlikely scenario.

6.8 Sensitivity Analysis Summary

The sensitivity analysis conducted on the GWFM model was used to evaluate several assumptions and their impacts on both model calibration and particle tracking results. Seven scenarios were analyzed in comparison to the calibrated model described in Sections 2.0 through 5.0. Of the seven scenarios, three (2, 5, and 7) were able to achieve an acceptable calibration; however, of those, Scenario 7 required an unreasonable vertical hydraulic conductivity to do so. The other three scenarios (1, 3, 4, and 6) were not able to achieve an acceptable calibration based on the evaluation criteria presented in Section 4.4.

Particle tracking was performed with each model to demonstrate the range of outcomes under these scenarios and assess their likelihood based on calibration quality and validity of parameter values. Resulting particle tracks for all sensitivity scenarios under the three pumping configurations are overlaid on each other on Figures 6-1, 6-2, 6-3, and 6-4. Particle tracks with solid-colored lines indicate models with acceptable calibration and parameter ranges. Particle tracks with dashed lines indicate that model calibration was unacceptable. Particle tracks which are partially transparent indicate that unacceptable parameters were required for calibration. Scenarios where both calibration and parameter ranges were acceptable showed either full or 95% capture with (b) pumping at (mgd and Hālawa Shaft pumping at (b) mgd, and full capture with only (b) pumping at (mgd.

Scenarios with a lesser degree of capture generally were accompanied by poorer calibration quality or unacceptable parameters. In particular, the characteristic in simulations that appear most sensitive to generating particle tracks that escape capture is a low vertical anisotropy ratio, followed by a lower horizontal anisotropy ratio. The three scenarios that predicted the fewest particles captured by (b) all had vertical anisotropy ratios of less than 10, whereas all simulations with a vertical anisotropy over 10 showed at least 90% capture by (b) in either scenario.

7.0 Summary and Conclusions

The interim model documented in this report is responsive to many of the RA concerns outlined in the March 2022 disapproval letter (EPA Region 9 and DOH 2022). Several key issues are addressed including

regional water budget calculations to inform model boundary conditions, revised model gridding and layering, use of temperature and chloride to inform source water contributions to (b) (3) and Hālawa Shaft, and a revised model calibration approach that focuses on matching water levels and gradients. Issues not yet addressed generally relate to small-scale heterogeneity of the basalt, which will be incorporated into a later version of the model. Those future refinements will be accomplished through the use of multiple-point geostatistics and training images to generate multiple realizations of the basalt fabric. The purpose of this version of the GFWM is to address as many RA concerns as possible while improving the understanding of the direction and rate of groundwater flow within the aquifers around the Facility in support of the defueling efforts by the Navy.

This interim GWFM represents improvements on previous modeling efforts and provides the basis for additional refinements in future modeling efforts. Improvements over previous models include:

- Revised model grid that aligned basalt layer with dip azimuth and magnitude, and the principal directions of anisotropy
- Uniform model grid with nested grid refinement, which allows for changes to local refinement at later stages of the modeling process
- Conceptual water budget calculations to inform model boundary conditions inflows and outflows
- Incorporation of newly collected data into geological conceptual model
- Expanded water level data sets for calibration
- Improved matches to observed water levels
- Improved matches to gradients down Red Hill ridge
- Use of temperature and chloride data to assess sources of contribution to (b) (3) and Hālawa Shaft

The interim version of the GWFM documented in this technical memorandum used the MODFLOW-USG Transport (Panday 2022; Panday et al. 2013) code to discretize the model domain into 36 layers, the first two of which are alluvium, caprock, and valley fill, the next two are saprolite, and the final 34 represent the basalt. Model grid cells are aligned with the general regional dip azimuth of 246 degrees in plan view, and the basalt layers dip at 4 degrees, pinching out where intersected by valley fill, caprock, tuff, or saprolite. Revised boundary conditions were derived through regional water budget calculations estimating an anticipated range of inflows and outflows through each model boundary. The GWFM was parameterized using uniform hydraulic properties for the various hydrogeologic units, though the caprock was divided into alluvium and marine sediments and into shallow and deep zones.

The GWFM was calibrated using the PEST software (Doherty 2015), adjusting model parameter inputs to minimize the differences between simulated and observed water levels, drawdown, and fluxes. Evaluation of the model calibration was performed using multiple criteria including standard statistics comparing observed and simulated heads, scatter plots, gradients down Red Hill ridge, comparisons to water level and drawdown hydrographs, comparisons to conceptual water budget estimates, and comparisons to chloride concentrations and temperature of water from (b) (3) and Hālawa Shaft using unit concentration source simulations. After model calibration was complete, forward particle tracking from the water table beneath

the tank farm was conducted to estimate groundwater flow patterns under three pumping configurations: (b) pumping at 4 mgd and Hālawa Shaft pumping at (b) mgd, (b) pumping at (mgd and Hālawa Shaft (b), and (b) (b) and Hālawa Shaft (b).

A sensitivity analysis was conducted using the calibrated model as a base scenario to evaluate relative changes to model calibration and changes particle tracking results under each scenario. Seven scenarios were evaluated, each with different input assumptions or constraints. Each scenario was recalibrated with PEST under the prescribed conditions, and forward particle tracks were run for each of the three pumping configurations.

Significant conclusions from this modeling study include:

- The GWFM was well-calibrated to water levels such that preliminary scenarios could be considered.
  - The RMSE of the water levels was 0.28 ft, and the scaled RMSE was 4.0%, both considered acceptable values based on professional judgement within general model calibration guidelines (ASTM International, 2018).
  - The simulated and observed hydrographs for water levels and drawdown generally matched well, although some discrepancies may be attributable to local heterogeneities not accounted for in the current simplified (homogeneous anisotropic) parameterization of the basalt, and in temporal variations in stresses not accounted for in the current model.
  - Gradients along Red Hill ridge were generally well matched, as demonstrated in Attachment 3.
  - The model simulated water budget was generally consistent with the conceptual water budget described in Section 2.3.1, except with larger inflows into the southeast and out of the northwest model boundaries.
- Conceptual transport simulations using unit source concentration sources were performed to assess the contributions of water at (b) and Hālawa Shaft attributable to each water source, including recharge, inflow from the dike region, inflow from the southeast GHB, and inflow from the freshwater/saltwater interface. The freshwater/saltwater interface was added in these simulations only as a constant head boundary. Assumptions were made for the chloride concentration and temperature at each source and estimates of the chloride concentration and temperature at each shaft compared favorably to observed values.
  - The unit source simulations showed that a relatively small percentage of water drawn from the saltwater (0.6 to 1.2%) can significantly increase the concentration of chloride in the shaft, while temperature is much less sensitive to flow contributions from the freshwater/saltwater interface.
  - The observed pattern of higher chloride and lower temperatures at Hālawa Shaft, as compared to (b), was well matched by the model simulations and estimates.

- Forward particle tracking simulations were conducted to evaluate potential flow paths from beneath the Facility under a variety of stresses from (b) and Hālawa Shaft. Particle tracking does not account for contaminant transport processes such as dispersion, sorption, and degradation.
  - Forward particle tracks from the tank farm with (b) pumping at (mgd and Hālawa Shaft pumping at (b) mgd resulted in all particles being captured by (b) . Travel time from the upper region of the tank farm to (b) was approximately 80 days, and from the lowermost tanks was approximately 35 days.
  - Forward particle tracks from the tank farm with (b) pumping at (mgd and Hālawa Shaft (b) resulted in all particles being captured by (b) . Travel time from the upper region of the tank farm to (b) was approximately 80 days, and from the lowermost tanks was approximately 35 days.
  - Forward particle tracks from the tank farm with (b) (b) and Hālawa Shaft (b) resulted in the particles discharging at Kalauao Springs. Travel time from the tank farm to Kalauao Springs was approximately 3 years.
- A sensitivity analysis was conducted for seven scenarios. Of those seven scenarios, two were able to maintain an acceptable calibration without significant deviations from acceptable parameter ranges. Those two scenarios result in either full or 95% capture with (b) pumping at (mgd and Hālawa Shaft pumping at (b) mgd, and full capture with only (b) pumping at (mgd.
- Scenarios with a lesser degree of capture at (b) are associated with the use of vertical anisotropy ratios of less than 10, lower than the low end of the acceptable range for the basalt. Further characterization and understanding of vertical anisotropy are significantly important factors in determining the extent of capture by (b) .
- The sensitivity analysis indicates (b) operating at (mgd likely captures most the groundwater beneath the tank farm, but some uncertainty remains on whether groundwater under the entire footprint of the tank farm is captured under all expected conditions.
- As this is an interim deliverable, future work will include:
  - Incorporation of the stochastic basalt realizations into the nested grid
  - Use of VZM modeling in conjunction with the GWFM to inform CF&T modeling
  - Incorporation of newly collected field data
  - Informing future field work (potentially including in-well testing and inter-well tracer testing) to address uncertainties identified in modeling results

8.0 Model Limitations

GWFMs are necessarily simplified mathematical representations of complex natural systems. Because of this, there are limits to the accuracy with which groundwater systems can be simulated. These limitations must be recognized when using models and interpreting model results.

There are many sources of error and uncertainty in models. Model error commonly stems from practical limitations of grid spacing, time discretization, parameter structure, insufficient calibration data, and the effects of processes not simulated by the model. These factors, along with unavoidable error in observations, result in uncertainty in model predictions.

Specific sources of uncertainty for the Red Hill Facility Groundwater Flow and CF&T model include grid spacing and parameter structure. The 25 ft x 25 ft grid spacing of the regional flow model limits ability to simulate conditions on smaller spatial scales. The model layering may also impose some uncertainty on predictions as the model predicts groundwater elevations averaged over vertical distances. Additionally, the layer structure of this model assumes an average dip azimuth and dip magnitude of the basalt over the entire model domain, which dictates the layer structure. Actual dip azimuth and magnitude are quite variable in horizontal and vertical space and cannot be accurately estimated in all locations through field investigations. Hydraulic conductivities are known to vary over orders of magnitude in even relatively homogeneous systems. The basal aquifer beneath the facility is known to be heterogeneous with widely varying hydraulic properties of sub-units within the basalt which includes highly transmissible flow paths such as fractures, a-a' clinker, clinker bridges and lava tubes. For the GWFM presented herein, the simplifying assumption of equivalent porous media was made, implying that the aquifer behaves as a homogenous system of porous media rather than dual porosity with fracture flow and porous media flow. While this assumption is most valid at larger scales, using a uniform hydraulic conductivity does not capture local variations in groundwater flow. Stochastic renderings of the basalt will help to understand the heterogeneity and their impact on outcomes, but will primarily serve to bound the uncertainty, not determine the basaltic structure. The outcomes of the stochastic renderings will be presented in the final September 2024 modeling document.

Specification of model boundary conditions can have significant impacts on model calibration and predictive results. Boundary condition setup for the GWFM and the overall model water budget were guided by conceptual water budget calculations. Conceptual water budget calculations rely on several assumptions including average recharge estimated by the USGS, water supply well pumping rates reported by Hawai‘i DLNR, calculations of flux through the caprock, and estimated of spring discharge. The most significant source of uncertainty is the recharge estimates that were made for average conditions. Recent precipitation trends that deviate from average conditions will alter the water budget. Deviations in rainfall were assessed in the sensitivity analysis; however, the method by which recharge is scaled also caries uncertainty. The GWFM, in either case of average or scaled recharge, does not take into account individual storm events, which cause periodic rises in groundwater levels anywhere throughout the domain. The overall water budget cannot be accurately measured in the field, thus estimates of the water budget must be used, considering the uncertainties and broader implications, rather than seeking exact matches in model calibration.

Substantial data are available for the Facility and area around it to support model inputs and constrain the calibration. These data include core/geologic logs, groundwater levels, and calculated hydraulic conductivities. All this information constrains the model input parameter values during the calibration process, thus increasing the accuracy of the calibrated model. Less information is available outside the Facility area, but these areas are also less important for the project objectives. Model error and uncertainty

are not uniformly distributed. The model fit to observations is best where abundant data are available. Simulated conditions are more uncertain where data are sparse, such as unpopulated upland areas. The GWFM matches the data as well as practicable given the constraints of the conceptual model, grid, boundary conditions, and parameterization.

Calibration through PEST helps to quantify the values relative to an adequate calibration, and the sensitivity analysis helps to understand relative importance of inputs, but neither process is intended to predict hydraulic properties at any given location. In GWFMs, a common uncertainty is associated with non-unique solutions of recharge and hydraulic conductivity. That is, the same model calibration may be achieved with many combinations of hydraulic conductivity and recharge. For this GWFM, recharge remained fixed except where altered as an input in sensitivity analysis. Non-uniqueness of solutions still remains an issue, as a many combinations of other aquifer parameters may lead to similar model calibration results. The sensitivity analysis conducted for the GWFM is intended to demonstrate how various parameter and boundary condition changes and constraints may affect model predictions, and it highlights the parameters and assumptions most impactful on these results. While this does not eliminate uncertainty or non-uniqueness completely, it does reduce them.

The numerical results of the flow model have an associated but un-quantified uncertainty. The GWFM provides sensitivity analyses designed to provide insight into model outcomes for a range of model inputs. Understanding model limitations and uncertainty is a dynamic process, employing an adaptive approach refocusing on reducing model error and uncertainty as new calibration data are collected and used to refine the model. Even with the limitations described above, the GWFM is a useful tool to meet current needs and provides the basis for future improvements consistent with AOC objectives.

9.0 Path Forward

The Navy requested that an expedited set of models and modeling memoranda including groundwater flow, vadose zone, and CF&T models be completed by June 30, 2023. An expedited modeling path provides the Navy with a set of tools for decision making in the near-term with respect to tank defueling. These three documents (associated deliverable dates) include:

- GWFM
- Vadose Zone Model (VZM)
- CF&T modeling based on the GWFM

The June 30, 2023 deliverable will include these three model memoranda incorporated into one report. The VZM and GWFM model files will not be altered as of their May 2023 completions. The CF&T model will use the GWFM setup and results to simulate two historical releases. The VZM results will inform source term boundary conditions for the CF&T model. A history-matching process will be employed to adjust various parameters such as source concentrations, dispersivity, and porosity to approximate measured concentrations of total petroleum hydrocarbons, either in the oil (TPH-o) or diesel range (TPH-d). Data and detections in response to historical releases are limited, and matches will be qualitative and focused on the

general trends and directions of groundwater flow rather than actual concentrations at specific wells and specific times.

After June 30, 2023, the next formal deliverable will be a final modeling document to be delivered to the Navy in September 2024. All models will be updated prior to that deliverable in response to newly collected information, comments from RAs, and observations derived from this GWFM development. Ongoing and anticipated field studies that will yield data will be analyzed and interpreted to incorporate into the model, both qualitatively and quantitatively, which may include but not be limited to transducer data from the (b) (3) optimization study, in-well testing, and tracer studies.

The most significant change to the GWFM and CF&T model for the final deliverable will be the incorporation of stochastic basalt realizations into the nested grid area of the GWFM. This effort will help to understand the uncertainty related to the heterogeneous nature of the basalt. The approach generates many predictions (realizations) based on versions of the subsurface hydrogeology that are statistically similar and honor observations but represent possibilities in areas where no data exist. The analyses will use multiple point geostatistics with training images and include geostatistical evaluations of the distributions of key hydrostratigraphic units, particularly the sub-units of basalt and incorporate geostatistical realizations of the basalt heterogeneity within the area of interest (AOI). These renderings will be incorporated into the nested grid flow and CF&T models. For calibration and select predictive scenarios (i.e., water supply well extraction rates, and release scenarios), the GWFM and CF&T model will be run for several realizations. This will provide insight into the ranges of outcomes and will help direct future field efforts.

A more detailed summary of what is addressed in this GWFM and what will be addressed in the final deliverable is presented in Attachment 2.

10.0 References

ASTM International (ASTM). 2013. *Standard Guide for Documenting a Groundwater Flow Model Application*. D5718 − 13. West Conshohocken, PA.

———. 2016a. *Standard Guide for Conducting a Sensitivity Analysis for a Groundwater Flow Model Application*. D5611-94(2016). West Conshohocken, PA.

———. 2016b. *Standard Guide for Defining Boundary Conditions in Groundwater Flow Modeling*. D5609 − 16. West Conshohocken, PA.

———. 2017. *Application of a Numerical Groundwater Flow Model to a Site-Specific Problem*. D5447−17. West Conshohocken, PA.

———. 2018. *Standard Guide for Calibrating a Groundwater Flow Model Application*. D5981/D5981M - 18. West Conshohocken, PA.

C Tech Development Corporation. 2022. *Earth Volumetric Studio (EVS) Version 2022.10.2*.

Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado, Boulder. 2014. *Continuously Updated Digital Elevation Model (CUDEM) - 1/9 Arc-Second Resolution Bathymetric-Topographic Tiles: Hawaii.* NOAA National Centers for Environmental Information. Retrieved 12 15, 2022, from Https://Doi.Org/10.25921/Ds9v-Ky35.

Department of Defense, United States (DoD). 2022. *Defueling Plan, Red Hill Bulk Fuel Storage Facility, Oahu, Hawaii*. Prepared by Secretary of the Navy (SECNAV), in Coordination with Director, Defense Logistics Agency (DLA), on Behalf of DoD. June 30, 2022.

Doherty, J. 2015. *PEST: Model-Independent Parameter Estimation and Uncertainty Analysis*. Brisbane, Australia: Watermark Numerical Computing. http://pesthomepage.org/.

Domenico, P. A., and F. W. Schwartz. 1990. *Physical and Chemical Hydrogeology*. New York, NY: Wiley.

Department of the Navy (DON). 2018. *Groundwater Protection and Evaluation Considerations for the Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Oʻahu, Hawaiʻi; July 27, 2018, Revision 00*. Prepared by AECOM Technical Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA, under Naval Facilities Engineering Command, Hawaii, JBPHH HI.

———. 2019. *Conceptual Site Model, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Oʻahu, Hawaiʻi; June 30, 2019, Revision 01*. Prepared by AECOM Technical Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA, under Naval Facilities Engineering Command, Hawaii, JBPHH HI.

———. 2020. *Groundwater Flow Model Report, Red Hill Bulk Fuel Storage Facility, Joint Base Pearl Harbor-Hickam, Oʻahu, Hawaiʻi; March 25, 2020, Revision 00*. Prepared by AECOM Technical Services, Inc., Honolulu, HI. Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA, under Naval Facilities Engineering Command, Hawaii, JBPHH HI.

———. 2021. *Final Site Assessment Work Plan Red Hill Oily Waste Disposal Facility Joint Base Pearl Harbor-Hickam Oahu HI*. Prepared by AECOM Technical Services, Inc. JBPHH HI: Naval Facilities Engineering Systems Command, Hawaii. February.

———. 2022a. *Summary of Groundwater Transducer Study, Oily Waste Disposal Facility, Joint Base Pearl Harbor-Hickam, Oʻahu, Hawaiʻi.* July 28. JBPHH HI: Naval Facilities Engineering Command, Hawaii.

———. 2022b. *Draft Work Plan Groundwater Flow and Velocity Evaluation Red Hill Bulk Fuel Storage Facility Joint Base Pearl Harbor-Hickam Oʻahu HI*. Prepared by AECOM Technical Services, Inc. Honolulu, HI: Prepared for Defense Logistics Agency Energy, Fort Belvoir, VA, under Naval Facilities Engineering Systems Command, Hawaii. October.

———. 2022c. (b)(3) *Flow Optimization, Work Plan, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i*. Prepared for NAVFAC Hawaii by AECOM Technical Services Inc. October 26.

———. 2023. *Conceptual Site Model Appendix E Addendum: Geological Modeling Framework Technical Memorandum, Red Hill Bulk Fuel Storage Facility, JBPHH, O'ahu, Hawai'i*. Prepared for NAVFAC Hawaii by AECOM Technical Services Inc.

Engott, J. A., A. G. Johnson, M. Bassiouni, S. K. Izuka, and K. Rotzoll. 2017. *Spatially Distributed Groundwater Recharge for 2010 Land Cover Estimated Using a Water-Budget Model for the Island of O'ahu, Hawai'i (Version 2.0, December 2017)*. Scientific Investigations Report 2015–5010. Revised December 2017. Prepared in cooperation with the State of Hawai'i Commission on Water Resource Management and the City and County of Honolulu Board of Water Supply. U.S. Geological Survey.

Environmental Protection Agency, United States, Region 9; and Department of Health, State of Hawaii (EPA Region 9 and DOH). 2015. *Administrative Order on Consent In the Matter of Red Hill Bulk Fuel Storage Facility, EPA Docket No: RCRA 7003-R9-2015-01; DOH Docket No: 15-UST-EA-01*. September.

———. 2022. *Subject: Disapproval of the Groundwater Flow Model Report*. Letter from: Gabriela Carvalho, Red Hill Project Coordinator, US Environmental Protection Agency Region 9; and Roxanne Kwan, Interim Red Hill Project Coordinator, State of Hawaii Department of Health; to: CAPT Gordie Meyer, CEC, USN Regional Engineer, Navy Region Hawaii. March 17.

Freeze, R. A., and J. A. Cherry. 1979. *Groundwater*. Englewood Cliffs, NJ: Prentice Hall.

Hunt Jr., C. D. 1996. *Geohydrology of the Island of Oahu, Hawaii*. Professional Paper 1412-B. Regional Aquifer-System Analysis—Oahu, Hawaii. U.S. Geological Survey.

Interagency Drinking Water System Team (IDWST). 2022. (b)(3) *Recovery and Monitoring Plan (RHSRMP), JBPHH, O'ahu, Hawai'i*. Navy, Army, State of Hawaii Department of Health, and United States Environmental Protection Agency. January.

Juturna LLC. 2014. *Letter Report: Summary of Well Sampling Activities, BWS DH-43 No. 2253-02 and CWRM Halawa Deep Monitoring Well No. 2253-03, Red Hill Fuel Tank Facility Groundwater Contamination Evaluation*. Prepared for Kennedy/Jenks Consultants, Honolulu, HI. November 16.

Mitchell, J. N., and D. S. Oki. 2018. *Groundwater-Level, Groundwater-Temperature, and Barometric-Pressure Data, July 2017 to February 2018, Hālawa Area, O'ahu, Hawai'i*. USGS Open-File Report 2018–1147. Prepared in Cooperation with the U.S. Navy. Reston, VA: U.S. Geological Survey.

Niswonger, R. G., S. Panday, and M. Ibaraki. 2011. *MODFLOW-NWT, A Newton Formulation for MODFLOW-2005*. U.S. Geological Survey Techniques and Methods 6–A37.

Oki, D. S. 1998. *Geohydrology of the Central Oahu, Hawaii, Ground-Water Flow System and Numerical Simulation of the Effects of Additional Pumping*. Water-Resources Investigations Report 97–4276. Prepared in Cooperation with the Honolulu Board of Water Supply. U.S. Geological Survey.

———. 2005. *Numerical Simulation of the Effects of Low-Permeability Valley-Fill Barriers and the Redistribution of Ground-Water Withdrawals in the Pearl Harbor Area, Oahu, Hawaii*. Scientific Investigations Report 2005-5253. U.S. Geological Survey.

Panday, S. 2022. *USG-Transport Version 1.9.0: The Block-Centered Transport Process for MODFLOW-USG*. GSI Environmental. http://www.gsi-net.com/en/software/free-software/USG-Transport.html.

Panday, S., C. D. Langevin, R. G. Niswonger, M. Ibaraki, and J. D. Hughes. 2013. *MODFLOW–USG Version 1: An Unstructured Grid Version of MODFLOW for Simulating Groundwater Flow and Tightly Coupled Processes Using a Control Volume Finite-Difference Formulation*. U.S. Geological Survey Techniques and Methods, Book 6, Chap. A45. https://dx.doi.org/10.5066/F7R20ZFJ.

Rumbaugh, J., and D. Rumbaugh. 2020. *Groundwater Vistas Version 8*. Environmental Simulations, Inc.

Sherrod, D. R., J. M. Sinton, S. E. Watkins, and K. M. Brunt. 2007. "Geologic Map of the State of Hawai'i, Sheet 3—Island of O'ahu." Open-File Report 2007-1089.

S.S. Papadopulos & Associates, Inc. (SSPA). 2022. *Mod-PATH3DU: A Ground-Water Path and Travel-Time Simulator*. Bethesda, MD.

Stearns, H. T. 1939. *Geologic Map and Guide of the Island of Oahu, Hawaii*. Bulletin 2. Prepared in cooperation with the Geological Survey. Honolulu: Hawaii (Terr.) Department of Public Lands, Division of Hydrography.

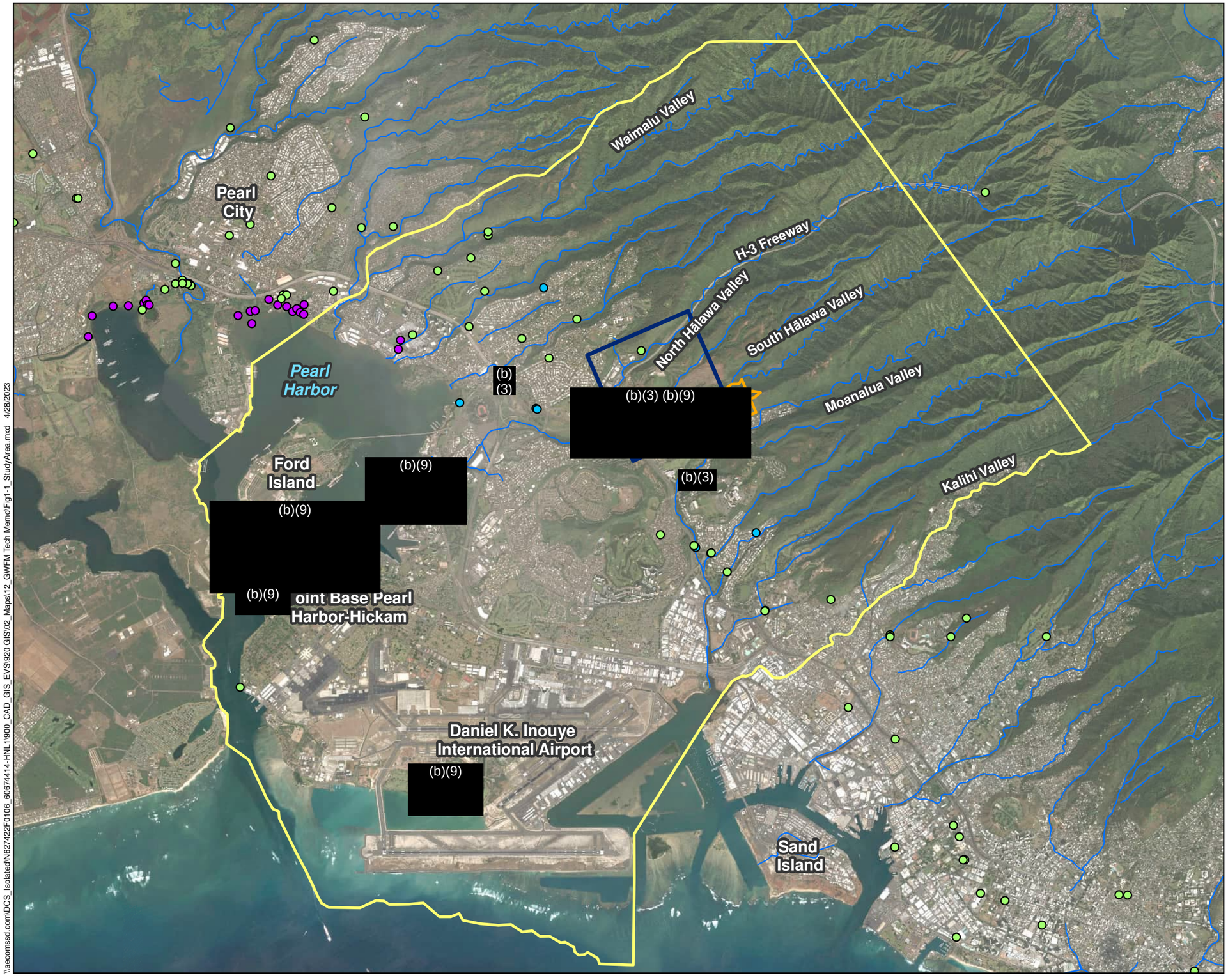
———. 1943. *Print of Log of* (b)(3) *Water Development Tunnel*. Letter from: H. T. Stearns, USGS Senior Geologist, to: O. E. Meizner, Geologist in Charge, USGS Division of Ground Water. Provided as Attachment to Stearns April 12, 1941 Report: A Maui-Type Well for the U. S. Navy at Red Hill, Oahu.

United States Geological Survey (USGS). 2017. *Final Synoptic Water Level Study Work Plan, Hālawa Area, O'ahu, Hawai'i*. Honolulu, HI: Pacific Islands Water Science Center. August 10.

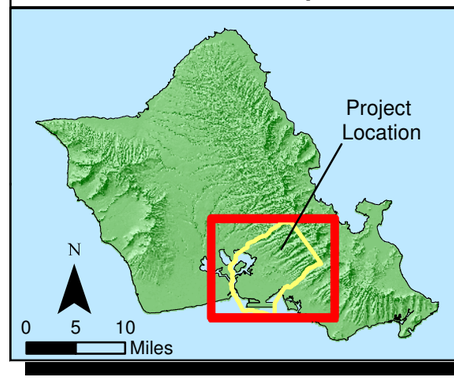
———. 2022a. *December 23, 2021, Red Hill Synoptic Groundwater-Level Survey, Hālawa Area, O'ahu, Hawai'i*. Open-File Report 2022–1018. By Rylen K. Nakama, Jackson N. Mitchell, and Delwyn S. Oki. Prepared in Cooperation with the U.S. Navy. doi.org/10.3133/ofr20221018.

———. 2022b. *January 18, 2022, Red Hill Synoptic Groundwater-Level Survey, Hālawa Area, O'ahu, Hawai'i*. Open-File Report 2022–1048. By Rylen K. Nakama, Jackson N. Mitchell, and Delwyn S. Oki. Prepared in Cooperation with the U.S. Navy. doi.org/10.3133/ofr20221048.

Visher, F. N., and J. F. Mink. 1964. *Ground-Water Resources in Southern Oahu, Hawaii*. Geological Survey Water Supply Paper 1778. Prepared in Cooperation with the State of Hawaii, Department of Land and Natural Resources, Division of Water and Land Development. U.S. Geological Survey.



Location Map



Legend

- Supply Well / Shaft
- Monitoring Well
- Spring
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Nested Grid
- Groundwater Flow Model Domain

Notes

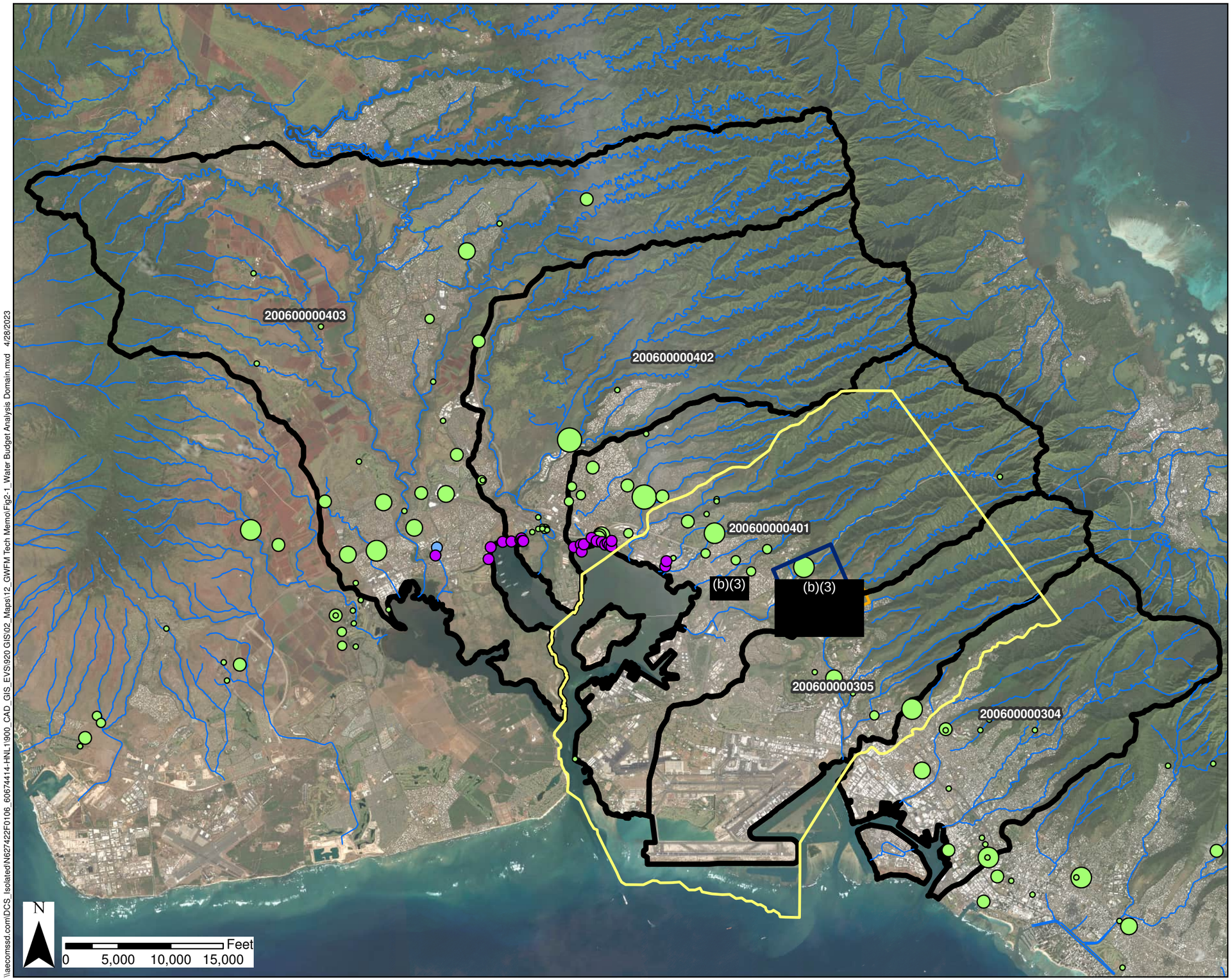
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Spring locations provided by USGS.
4. Water supply well locations provided by DLNR.

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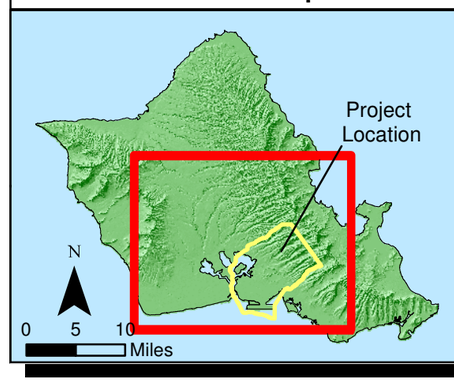
0 5,000 10,000 15,000 Feet

Figure 1-1
Groundwater Flow Model Domain and Study Area
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

\\aecomssd.com\DCS_Isolated\N627422F0106_60674414-HNL11900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig1-1_StudyArea.mxd 4/28/2023



Location Map



Legend

- Spring
- Weather Station

Water Supply Well / Shaft (MGD)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10.0
- 10.0 - 15.0

- Stream
- HUC-12 Watershed Boundary
- Red Hill Facility Boundary and Fuel Storage Tanks
- Nested Grid
- Groundwater Flow Model Domain
- 200600000305 USGS 12 Digit Hydrologic Unit Code

Notes

1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. HUC-12 = 12 Digit Hydrologic Unit Code.
4. Spring locations provided by USGS.
5. Water supply well locations provided by DLNR.
6. Weather station location provided by State of Hawaii.

Figure 2-1
Water Budget Analysis Area
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

\\aecomssd.com\DCS_Isolated\N627422F0106_60674414-HNL1\900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig2-1_Water Budget Analysis Domain.mxd 4/28/2023

200600000403

200600000402

200600000401 (Partial)

Uphill of Domain

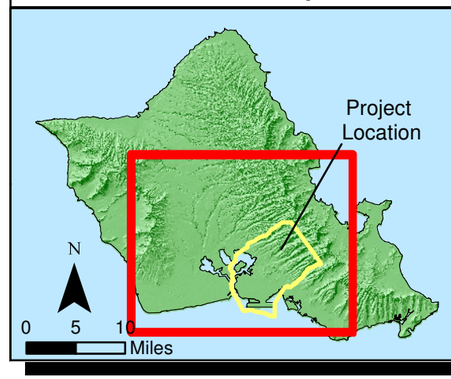
(b)(3)

(b)(9)

Model Domain

200600000304 (Partial)

Location Map



Legend

- Spring

Water Supply Well / Shaft (MGD)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10.0
- 10.0 - 15.0
- Stream
- Boundaries used for Model Domain Water Budget Calculations
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model

Notes

1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Spring locations provided by USGS.
4. Water supply well locations provided by DLNR.

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0 5,000 10,000 15,000 Feet

Figure 2-2
Water Budget Watersheds Including Model Domain Budget
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

\\aecomssd.com\DCS_Isolated\N627422F0106_60674414-HNL1\900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig2-2_Water Budget Watersheds including GWFM Domain.mxd 4/27/2023

(b)(3)

Legend

Average Recharge (inches per year)

0.0 - 1.0	18.2 - 21.5
1.1 - 2.8	21.6 - 25.9
2.9 - 4.8	26.0 - 31.2
4.9 - 6.4	31.3 - 38.6
6.5 - (b)	38.7 - 48.2
8.2 - 9.7	48.3 - 59.4
9.8 - 11.3	59.5 - 75.3
11.4 - 13.2	75.4 - 101.0
13.3 - 15.4	101.1 - 143.1
15.5 - 18.1	143.2 - 245.9

Stream

Red Hill Facility Boundary

Groundwater Flow Model Domain

Notes

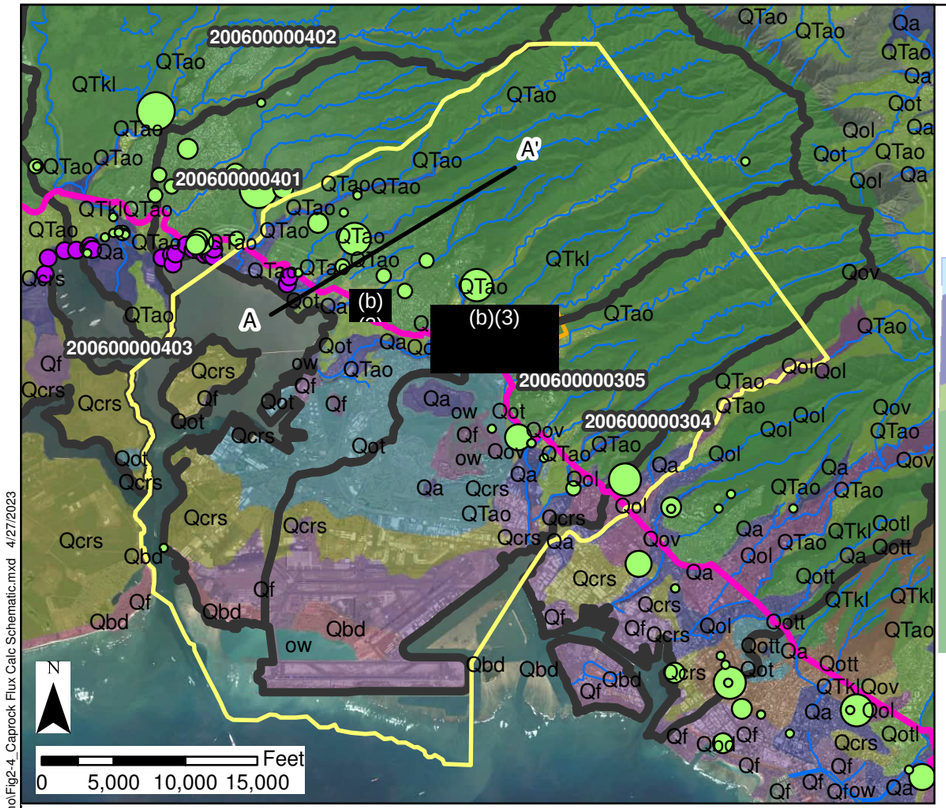
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Average Recharge conditions from 1978 to 2007 (Engott et al., 2017).

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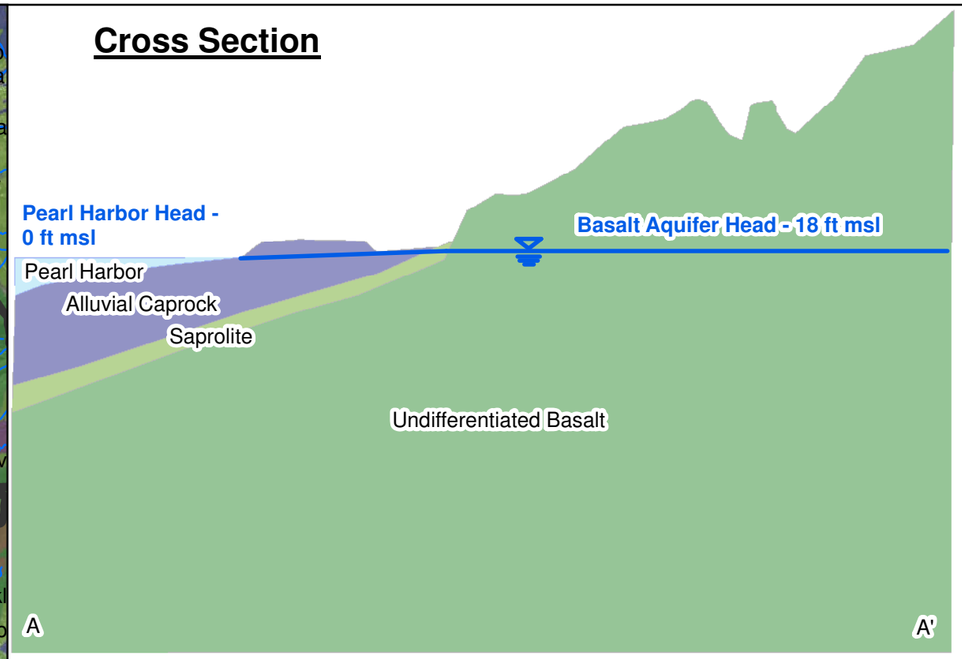
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\\aecomssd.com\DCS_Isolated\N627422F0106_60674414-HNL1\900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig2-3_Spatial Distribution of Recharge.mxd 4/27/2023

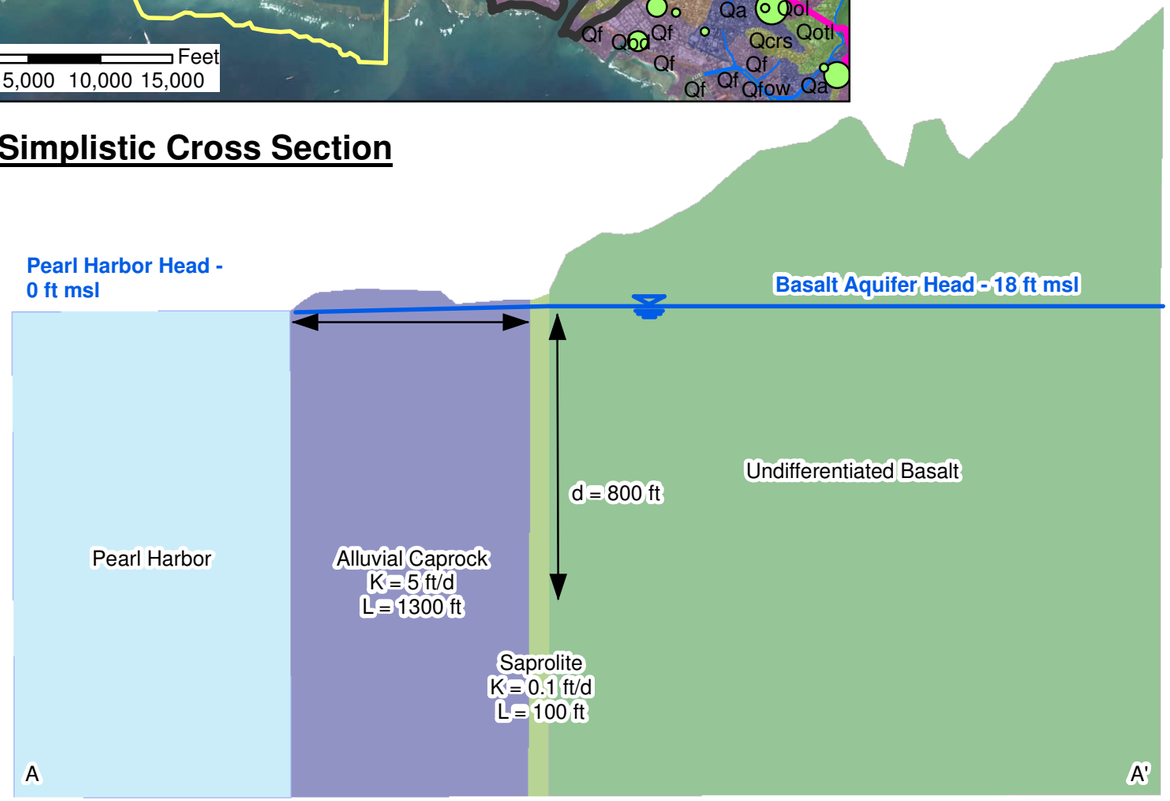
Figure 2-3
Spatial Distribution of Recharge
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI



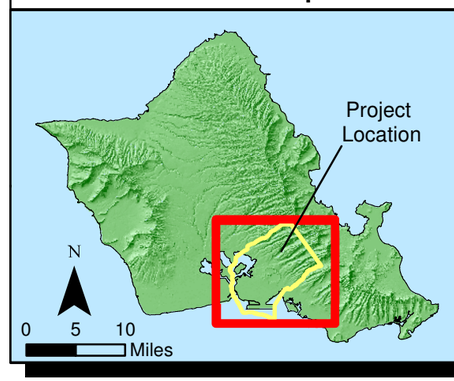
Cross Section



Simplistic Cross Section



Location Map



Legend

- Spring
- **Water Supply Well / Shaft (MGD)**
  - 0.0 - 0.5
  - 0.5 - 1.0
  - 1.0 - 2.0
  - 2.0 - 5.0
  - 5.0 - 10.0
  - 10.0 - 15.0
- Caprock Extent
- HUC-12 Watershed Boundary
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model Domain
- 200600000305 USGS 12 Digit Hydrologic Unit Code

Geological Units

- QTao, Older alluvium, Sand and gravel
- QTkl, Koolau Basalt, Lava flows
- Qa, Alluvium, Sand and gravel
- Qbd, Beach deposits, Beach deposits
- Qcrs, Lagoon and reef deposits, Limestone and mudstone
- Qf, Fill, Manmade fill
- Qol, Honolulu Volcanics, Lava flows
- Qot, Honolulu Volcanics, Tuff
- Qotl, Honolulu Volcanics, Lava flows
- Qott, Honolulu Volcanics, Vent deposits
- Qov, Honolulu Volcanics, Vent deposits
- ow, Open water, Open water

Notes

1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Geologic map from Sherrod et al 2007.
4. Spring locations provided by USGS.
5. Water supply well locations provided by DLNR.
6. HUC-12 = USGS Hydrologic Unit.
7. Caprock is present from the coast to the "caprock extent" ("makai of the caprock extent").

Figure 2-4
Caprock Flux Estimation
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

\\aecomssd.com\DCS_Isolated\N627422F0106_60674414-HNL1\900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig2-4_Caprock Flux Calc Schematic.mxd 4/27/2023

HUC12: 200600000403
Recharge: 60.5 MGD
Springs: 13.9 MGD
Wells: (b)(3)
Caprock Discharge: 0.09 MGD
Surplus: 14.1 MGD

HUC12: 200600000402
Recharge: 51.8 MGD
Springs: 16.7 MGD
Wells: (b)(3)
Caprock Discharge: 0.03 MGD
Surplus: 17.9 MGD

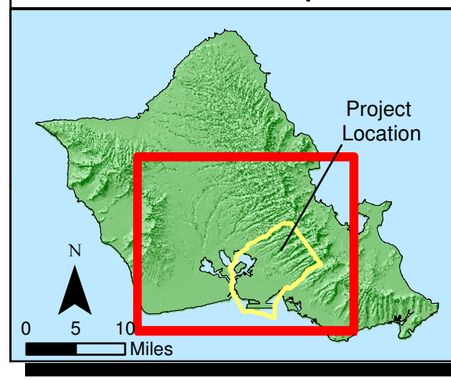
HUC12: 200600000401
Recharge: 41.4 MGD
Springs: 31.9 MGD
Wells: ((b)(3)
Caprock Discharge: 3.09 MGD
Deficit: -41.6 MGD

(b)
(b)(3)

HUC12: 200600000305
Recharge: 18.(b)(3)
Springs: 0.(b)(3)
Wells: (b)(3)
Caprock Discharge: 1.09 MGD
Surplus: 12.8 MGD

HUC12: 200600000304
Recharge: 23.5 MGD
Springs: 0.(b)(3)
Wells: (b)(3)
Caprock Discharge: 1.66 MGD
Deficit: -1.1 MGD

Location Map



Legend

- Spring
- Water Supply Well / Shaft (MGD)
  - 0.0 - 0.5
  - 0.5 - 1.0
  - 1.0 - 2.0
  - 2.0 - 5.0
  - 5.0 - 10.0
  - 10.0 - 15.0
- HUC12 Watershed Boundary
- Groundwater Flow Model Domain
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks

Notes

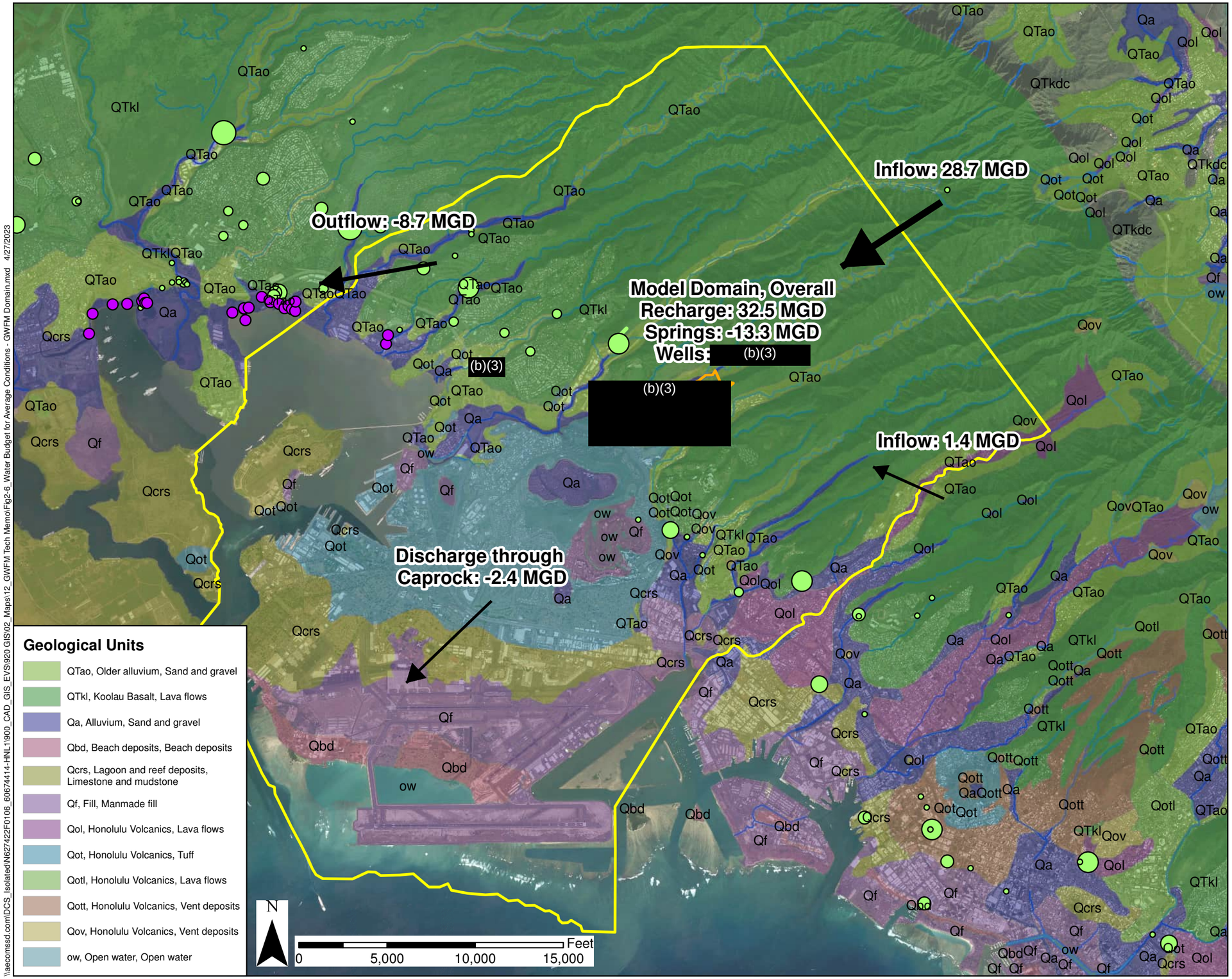
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Spring locations provided by USGS.
4. Water supply well locations provided by DLNR.
5. HUC-12 = USGS Hydrologic Unit.

N

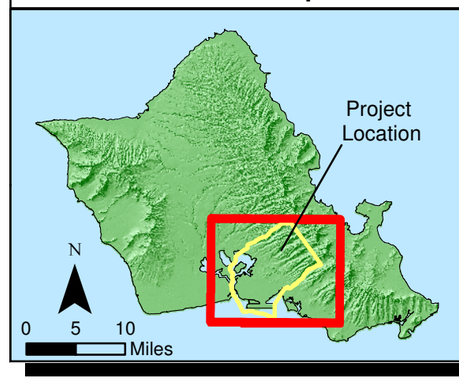
0 5,000 10,000 15,000 Feet

Figure 2-5
Water Budget for Watersheds in the Model Domain
HUC12 Watersheds
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

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Location Map



Legend

- Spring (Icon indicates location, only, and not magnitude of flow)

Water Supply Well / Shaft (MGD)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10.0
- 10.0 - 15.0
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model Domain

Geological Units

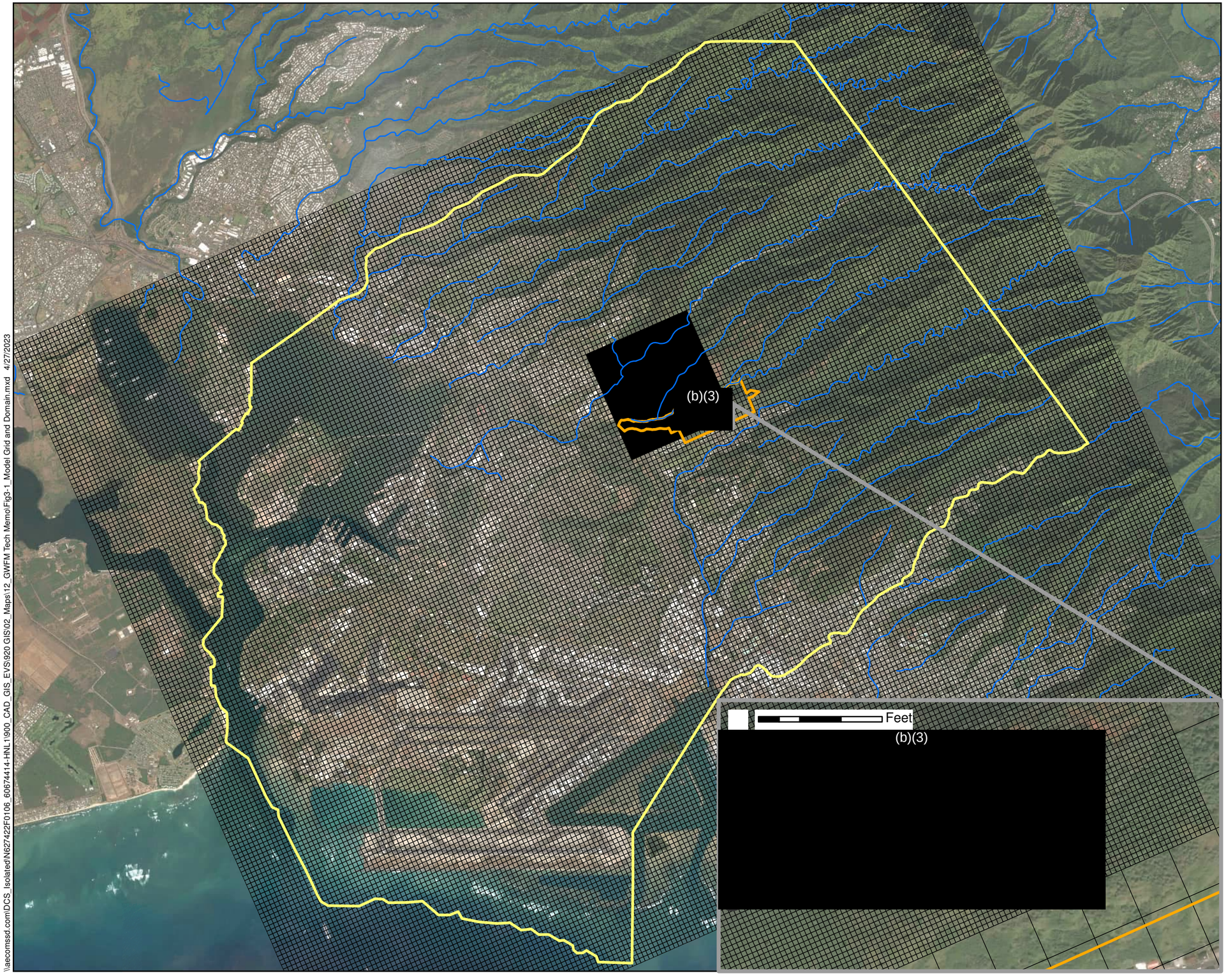
- QTao, Older alluvium, Sand and gravel
- QTkl, Koolau Basalt, Lava flows
- Qa, Alluvium, Sand and gravel
- Qbd, Beach deposits, Beach deposits
- Qcrs, Lagoon and reef deposits, Limestone and mudstone
- Qf, Fill, Manmade fill
- Qol, Honolulu Volcanics, Lava flows
- Qot, Honolulu Volcanics, Tuff
- Qotl, Honolulu Volcanics, Lava flows
- Qott, Honolulu Volcanics, Vent deposits
- Qov, Honolulu Volcanics, Vent deposits
- ow, Open water, Open water

Notes

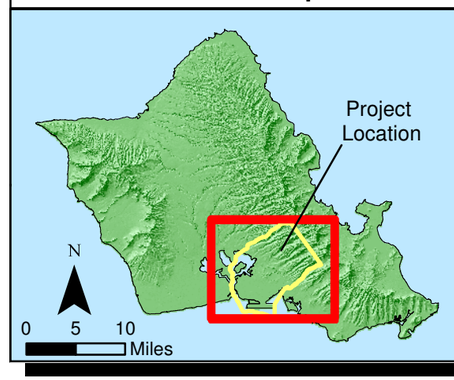
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Geologic map from Sherrod et al 2007.
4. Spring locations provided by USGS.
5. Water supply well locations provided by DLNR.
6. Water Levels from USGS Synoptic Survey, December 2021.
7. Spring flows estimated based on correlations to water level at Well 2256-10 (Oki, 1998).

Figure 2-6
Water Budget for Average Conditions - Model Domain
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

\\aecomssd.com\DCS_Isolated\N627422F0106_60674414-HNL1900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig2-6_Water Budget for Average Conditions - GWFM Domain.mxd 4/27/2023



Location Map



Legend

- Model Grid Cell (250 x 250 ft); Nested Grid Cell (25 x 25 ft)
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model Domain

Notes

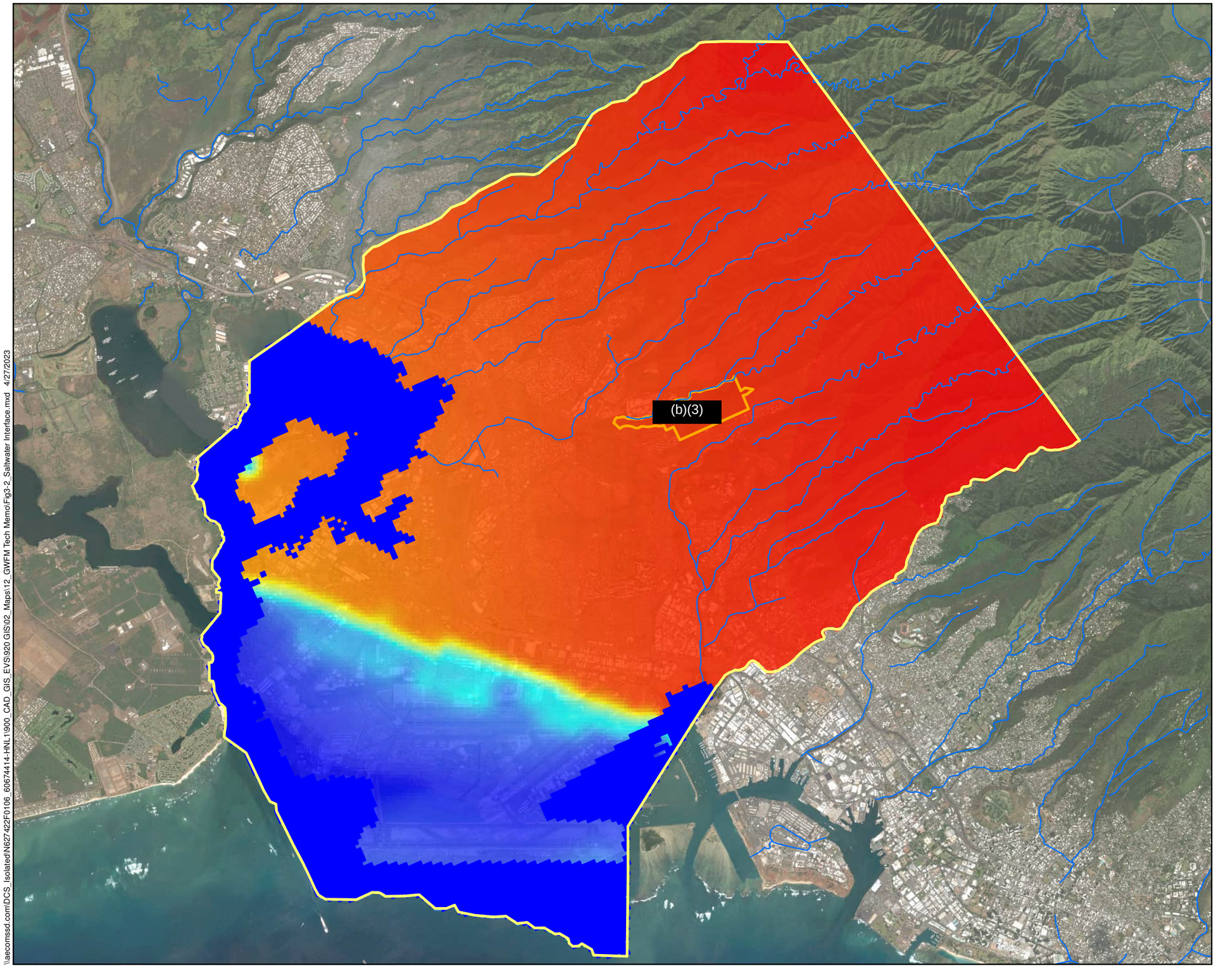
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015

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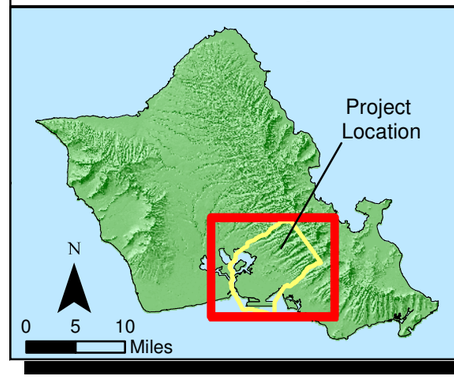
0 5,000 10,000 15,000 Feet

Figure 3-1
Model Grid and Domain
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

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Location Map



Legend

Saltwater Interface (Model Bottom) (ft msl)

0
-312
-604

Pacific Ocean / Pearl Harbor

Stream

Red Hill Facility Boundary and Fuel Storage Tanks

Groundwater Flow Model Domain

Notes

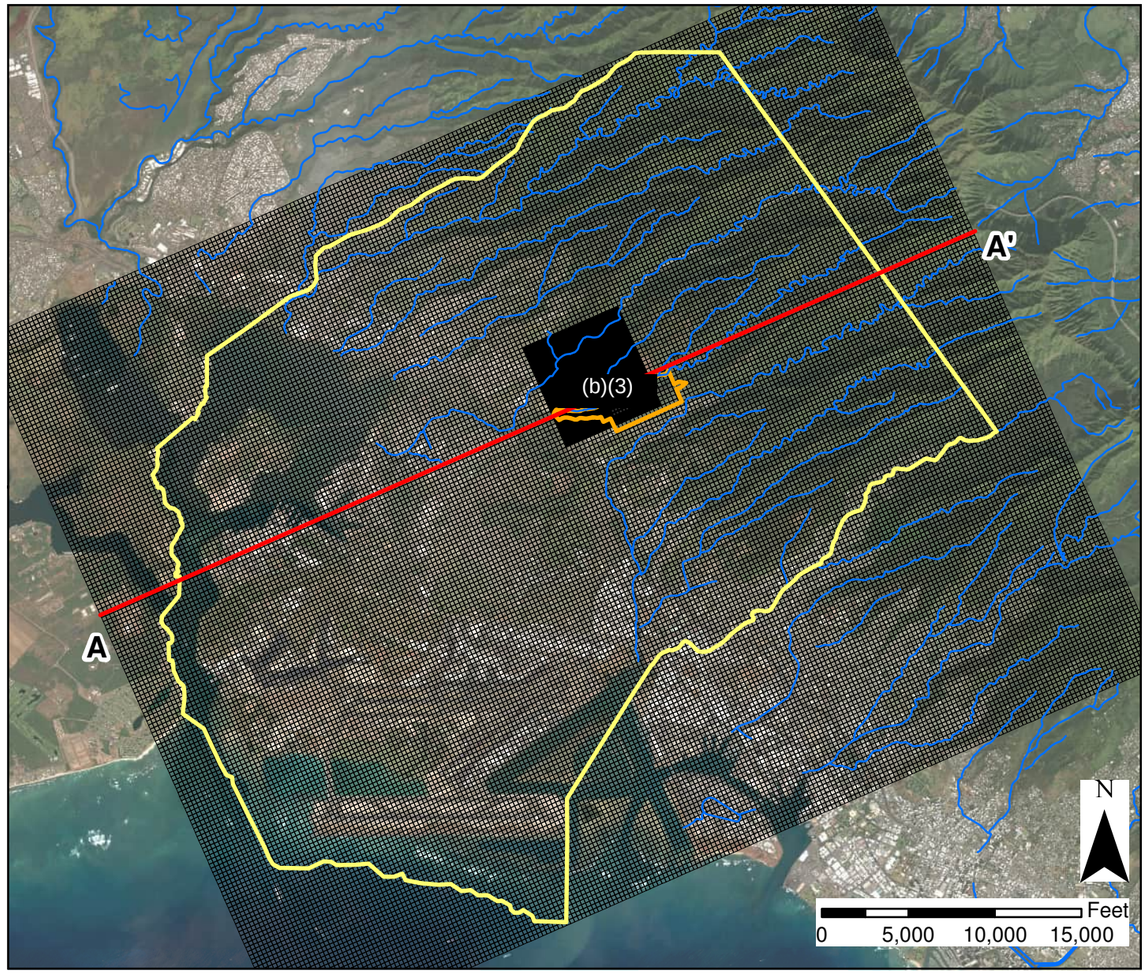
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2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015

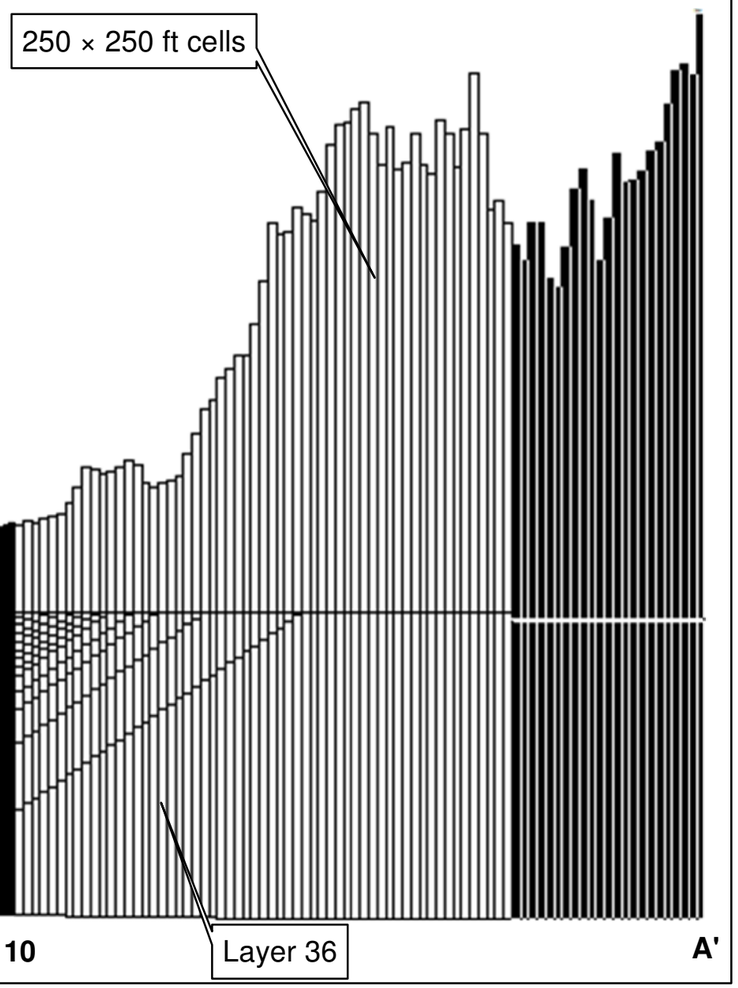
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0 5,000 10,000 15,000 Feet

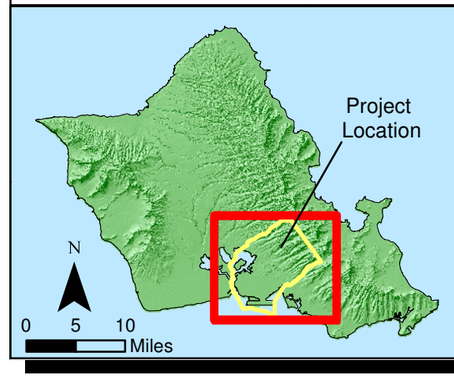
Figure 3-2
Freshwater/Saltwater Interface (Model Bottom)
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

\\aecomssd.com\DCS_Isolated\N627422F0106_60674414-HNL\1900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig3-2_Saltwater Interface.mxd 4/27/2023





Location Map



Legend

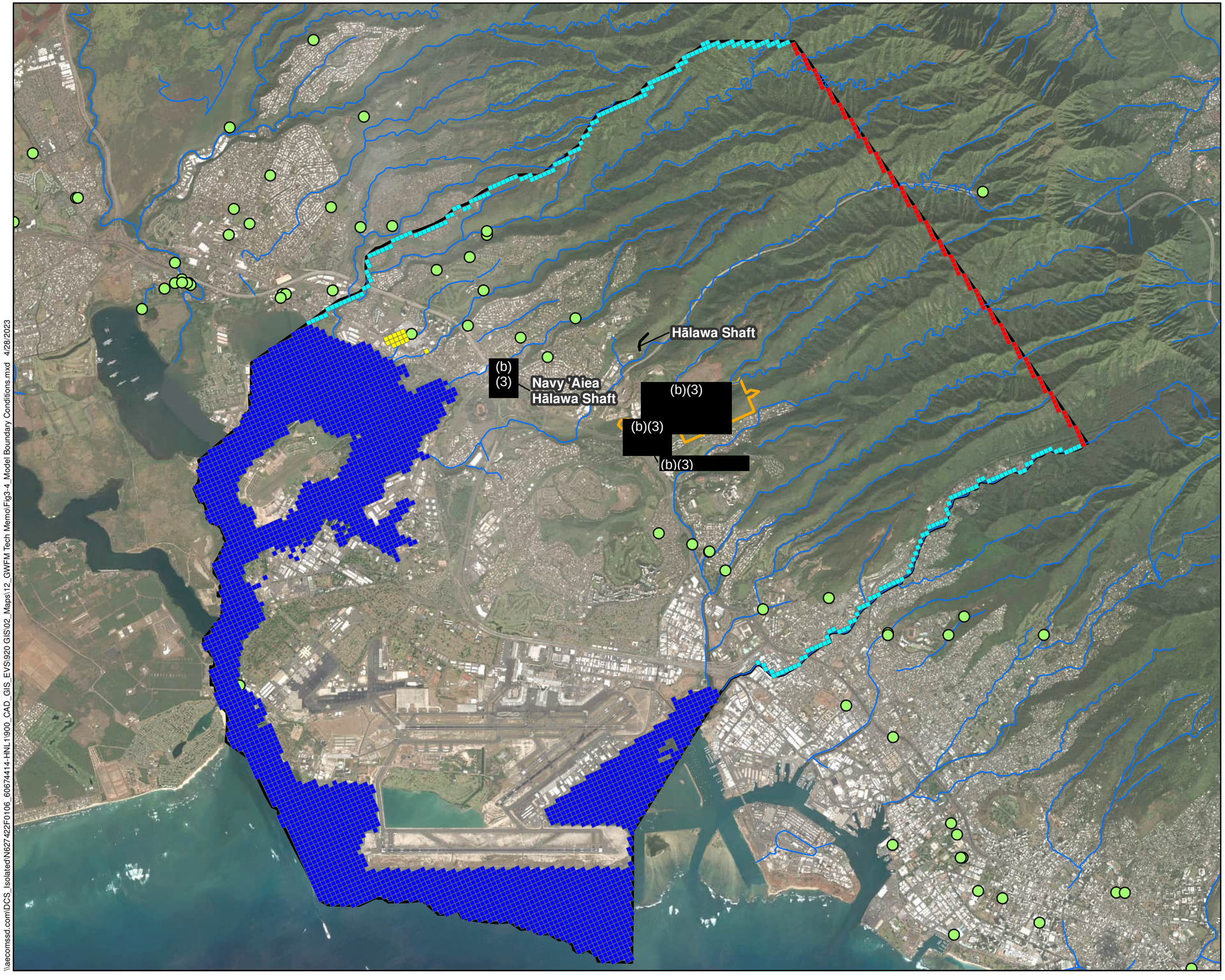
- Model Grid Cell
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model Domain

Notes

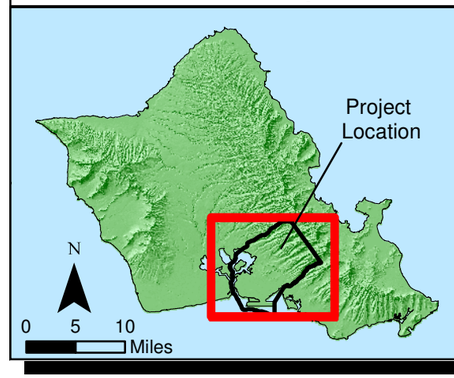
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015

Figure 3-3
Cross Section of Model Grid
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

\\aecomssd.com\DCS_Isolated\N627422F0106_606744\14-HNL11900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig3-3_Cross Sections of Model Grid.mxd 4/27/2023



Location Map



Legend

- Constant Heads (Layer 1 only)
- Drains
- Specified Flux
- General Head Bounadry
- Connected Linear Network Well
- Connected Linear Network Polyline
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model Domain

Notes

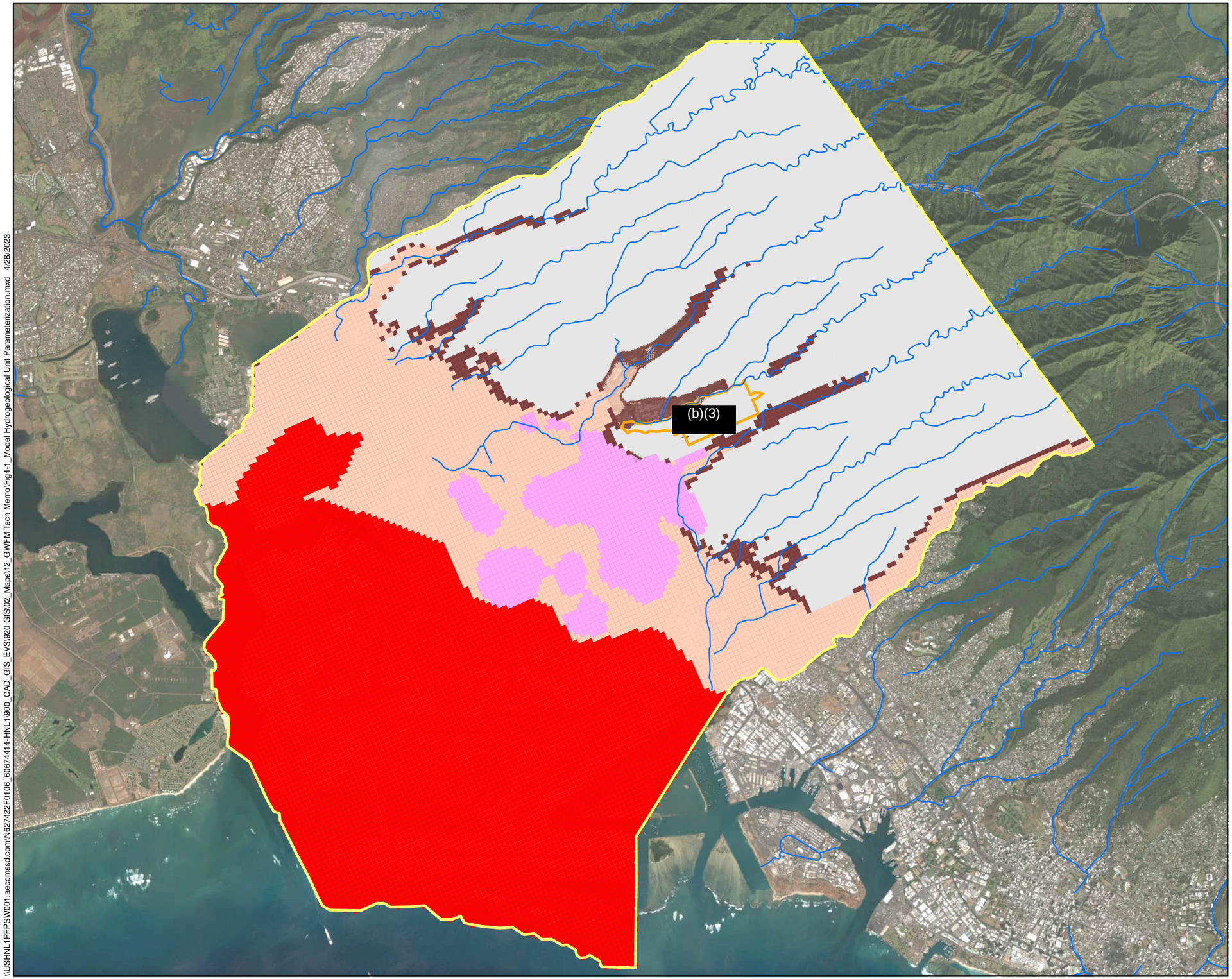
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
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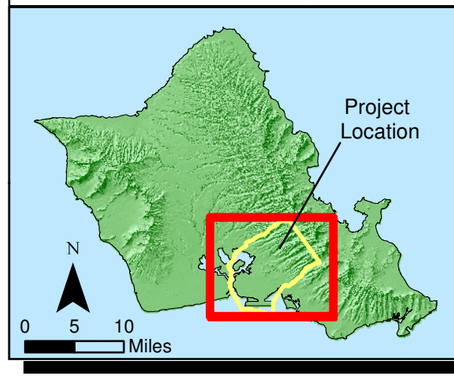
0 5,000 10,000 15,000 Feet

Figure 3-4
Model Boundary Conditions
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

\\aecomssd.com\DCS_Isolated\N627422F0106_60674414-HNL1900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig3-4_Model Boundary Conditions.mxd 4/28/2023



Location Map



Legend

Hydrogeologic Unit Parameterization for Layer 1

- Basalt
- Saprolite
- Caprock - Alluvium / Valley Fill
- Caprock - Marine Sediments
- Tuff
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model Domain

Notes

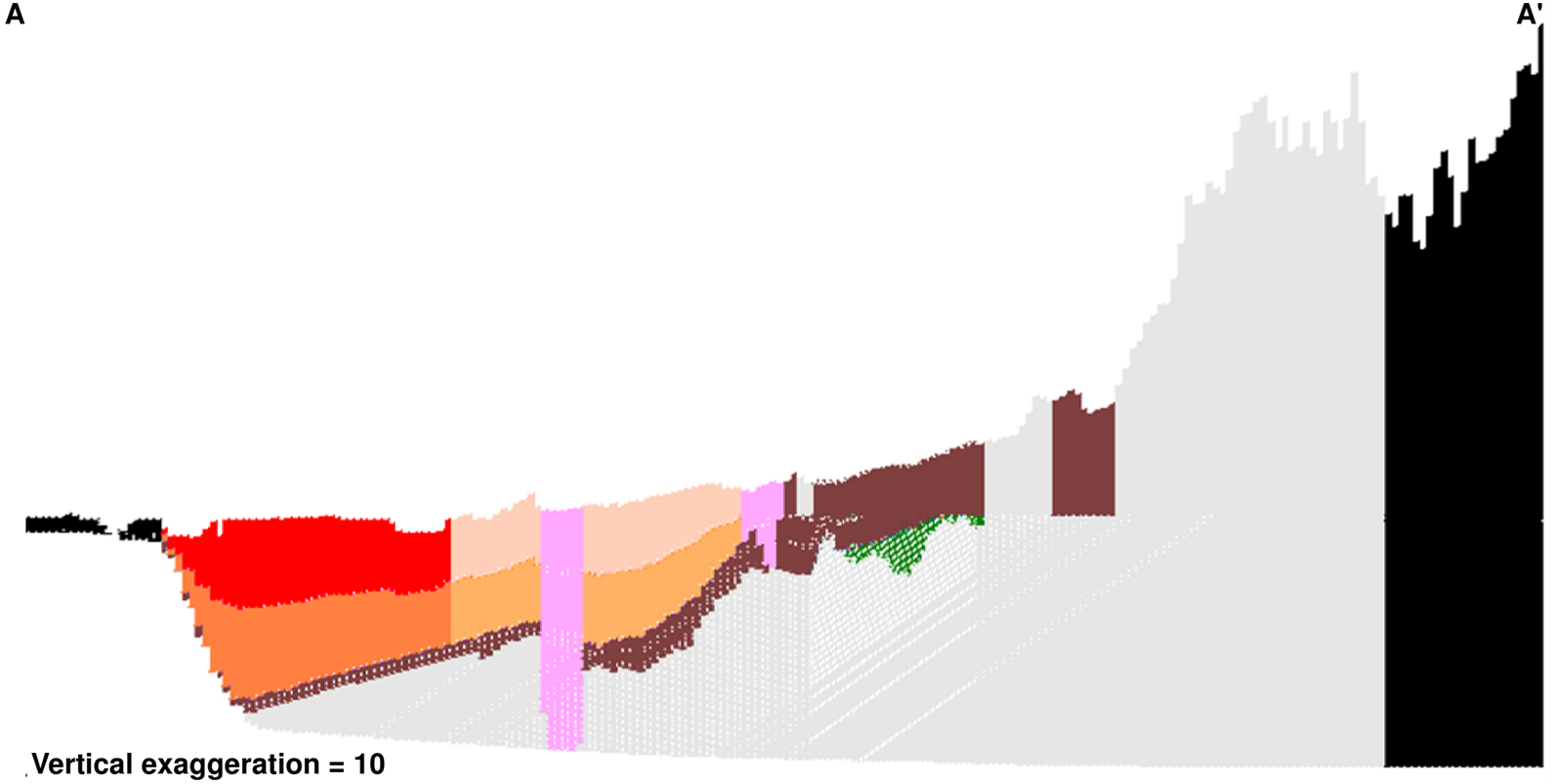
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2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015

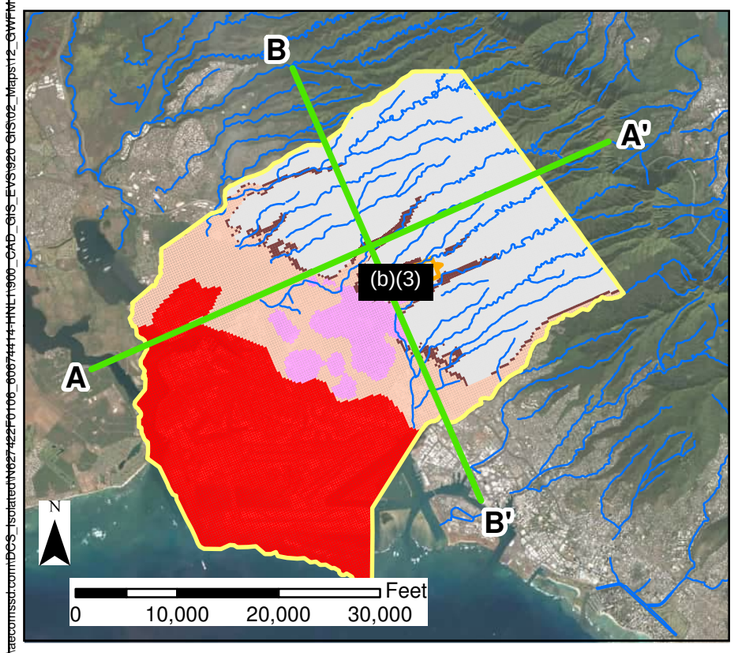
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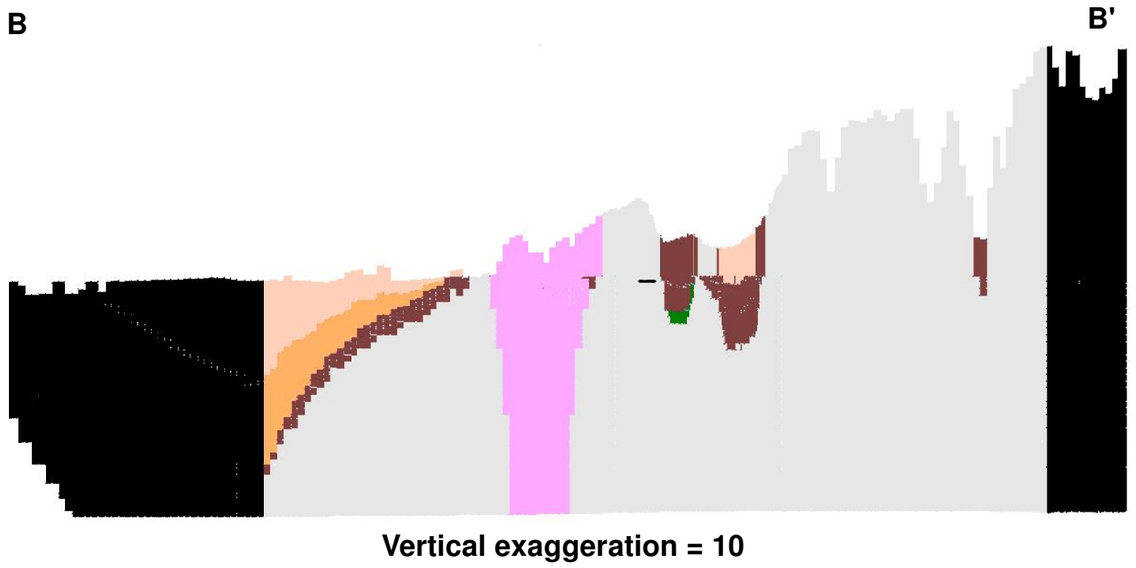
0 5,000 10,000 15,000 Feet

Figure 4-1
Model Hydrogeological Unit Parameterization
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

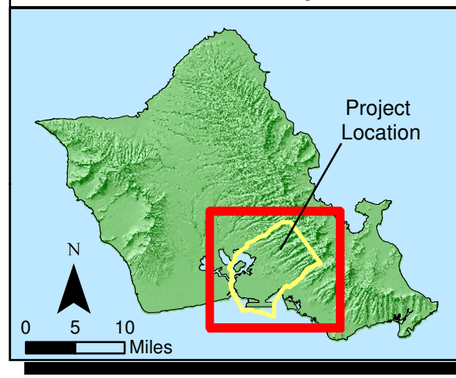
\\USHNL1PFPSW001.aecomssd.com\N627422F0106_60674414-HNL1900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig4-1_Model Hydrogeological Unit Parameterization.mxd 4/28/2023







Location Map



Legend

Hydrogeologic Unit Parameterization for Layer 1

- Basalt
- Saprolite
- Caprock - Alluvium/ Valley Fill
- Caprock - Marine Sediments
- Caprock - Deep Marine Sediments
- Tuff
- No Flow

- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model Domain

Notes

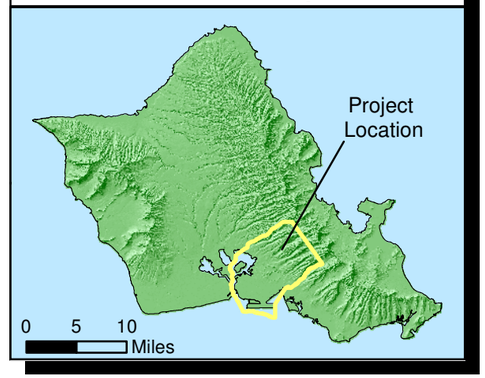
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015

Figure 4-2
Model Hydrogeological Unit Parameterization Cross Sections
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

\\ateamssd\comm\GIS_Isolated\Navy_422F0106_66074414_HNL1900_CAD_GIS_EVS\arc GIS\02_Maps\12_GWFM Tech Memo\Fig4-2_Model Hydrogeological Unit X-Section.mxd 4/26/2023



Location Map



Legend

Average Residual (feet)

- > -0.8 to 0.6
- > -0.6 to -0.4
- > -0.4 to -0.2
- > -0.2 to 0
- > 0 to 0.2
- > 0.2 to 0.4
- > 0.4 to 0.6
- > 0.6 to 0.8
- > 0.8 to 1.0

MW-53,-3.63 Well, Average Residual (feet)

Stream

Red Hill Facility Boundary

Groundwater Flow Model Domain

Notes

1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Residual = Observed Minus Simulated Head. Positive residuals indicate simulated heads are less than observed heads. Negative residuals indicate simulated heads are greater than observed heads.

N

Feet
0 1,000 2,000 3,000

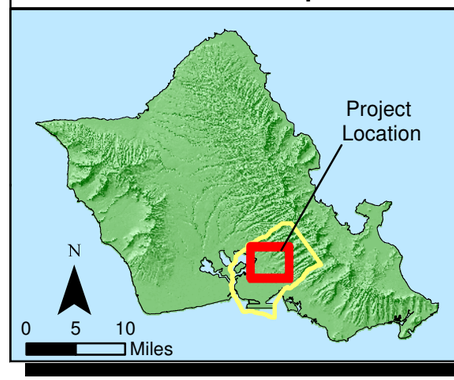
Figure 4-3
Average Residuals for
Basal Aquifer Wells (Group 1)
GWFM Technical Memorandum
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JBPHH, O'ahu, HI

\\aecomssd.com\DCS_Isolated\N627422F0106_60674414-HNL1\900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig4-3_Average Residuals.mxd 5/16/2023

(b)(3)

(b)(3)

Location Map



Legend

Percentage of Contribution from Saltwater Interface

- 0.01 - 0.10
- 0.11 - 0.20
- 0.21 - 0.30
- 0.31 - 0.40
- 0.41 - 0.50
- 0.51 - 0.60
- 0.61 - 0.70
- 0.71 - 0.80
- 0.81 - 0.90
- 0.91 - 1.00
- Water Development Shaft
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model Domain

Notes

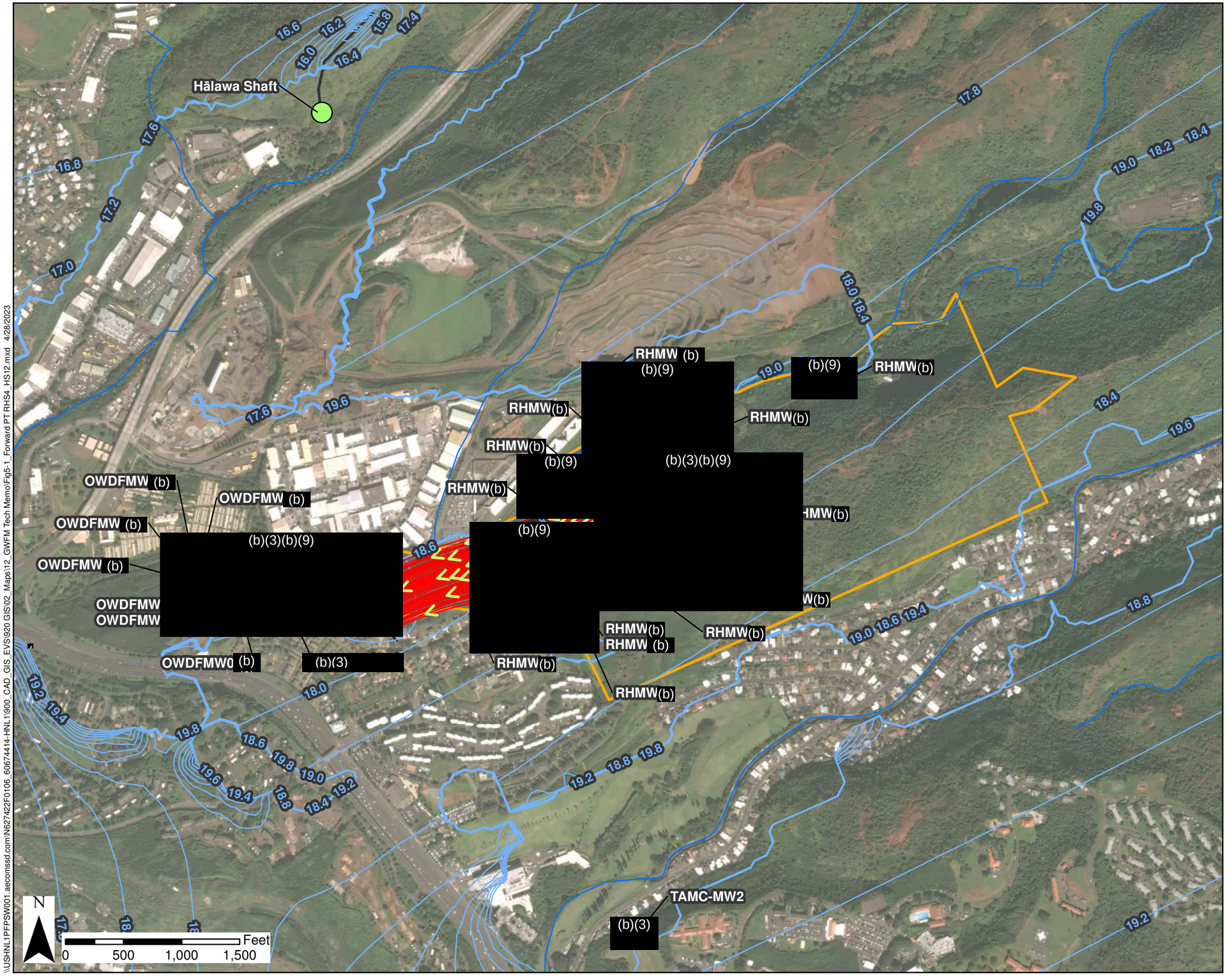
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015

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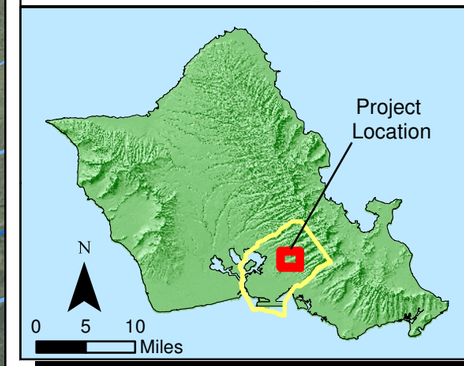
0 1,000 2,000 3,000 Feet

Figure 4-4
Simulation of Upconing from the Freshwater/Saltwater Interface (Layer 18)
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

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Location Map



Legend

Water Supply Well / Shaft (MGD)

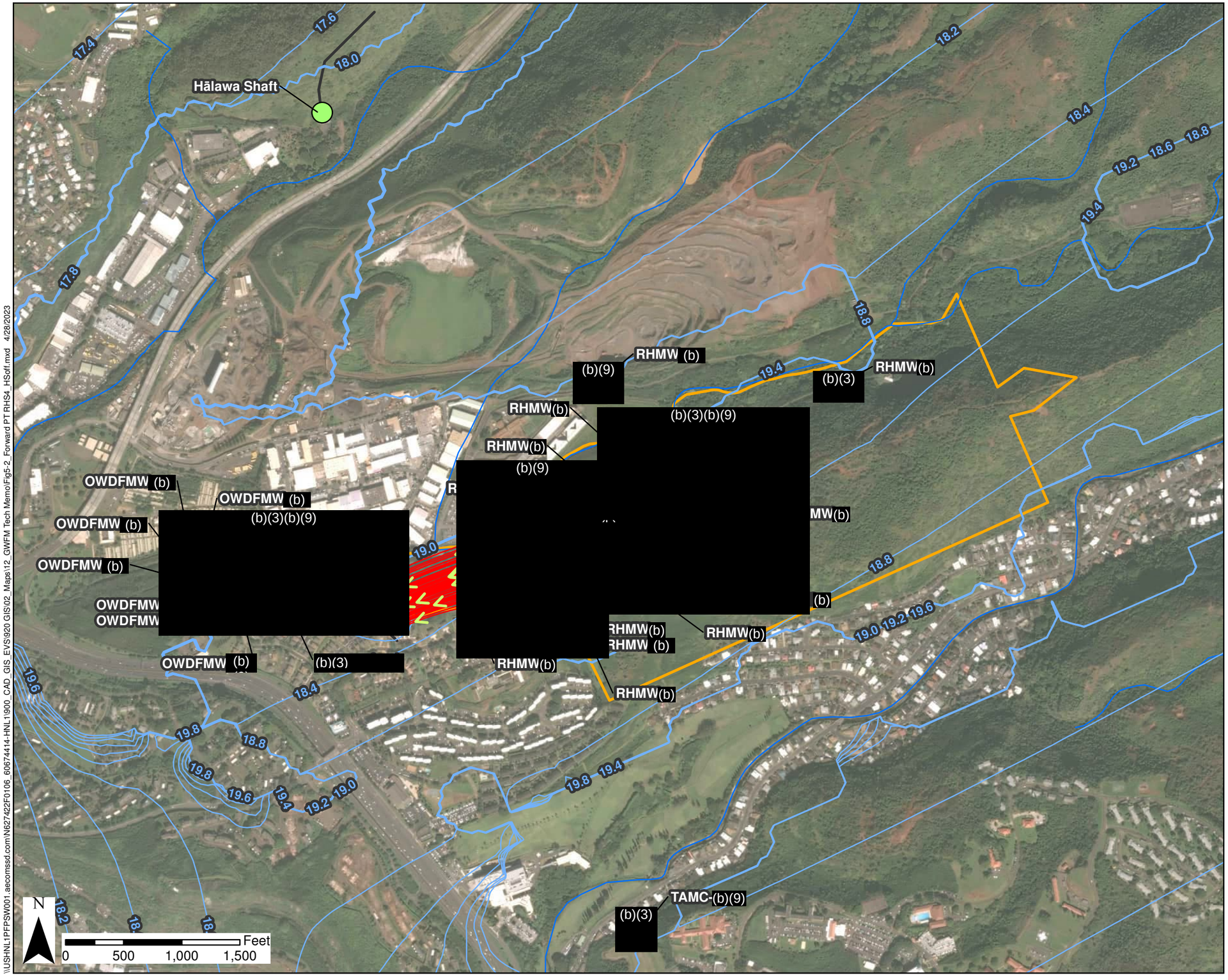
- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10.0
- 10.0 - 15.0
- Basal Aquifer Well (Group 1)
- 30-day travel time tick mark
- Forward Particle Track
- Potentiometric Surface (ft msl)
- Water Supply Shaft
- Stream
- Red Hill Facility Boundary
- Groundwater Flow Model Domain

Notes

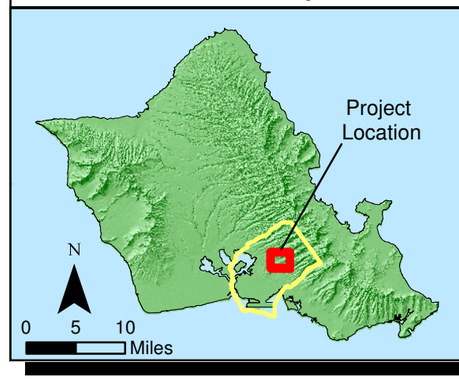
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Spring locations provided by USGS.
4. Water supply well locations provided by DLNR.

Figure 5-1
Forward Particle Tracking from Tank Farm - (b)(3) Pumping at (b) mgd, Hālawa Shaft Pumping at (b) mgd, Navy 'Aiea Hālawa Shaft Pumping at (b) mgd
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

\\USHNL1PFPSW001.aecomssd.com\N627422F0106_60674414-HNL1\900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig5-1_Forward PT RHS4_HS12.mxd 4/28/2023



Location Map



Legend

Water Supply Well / Shaft (MGD)

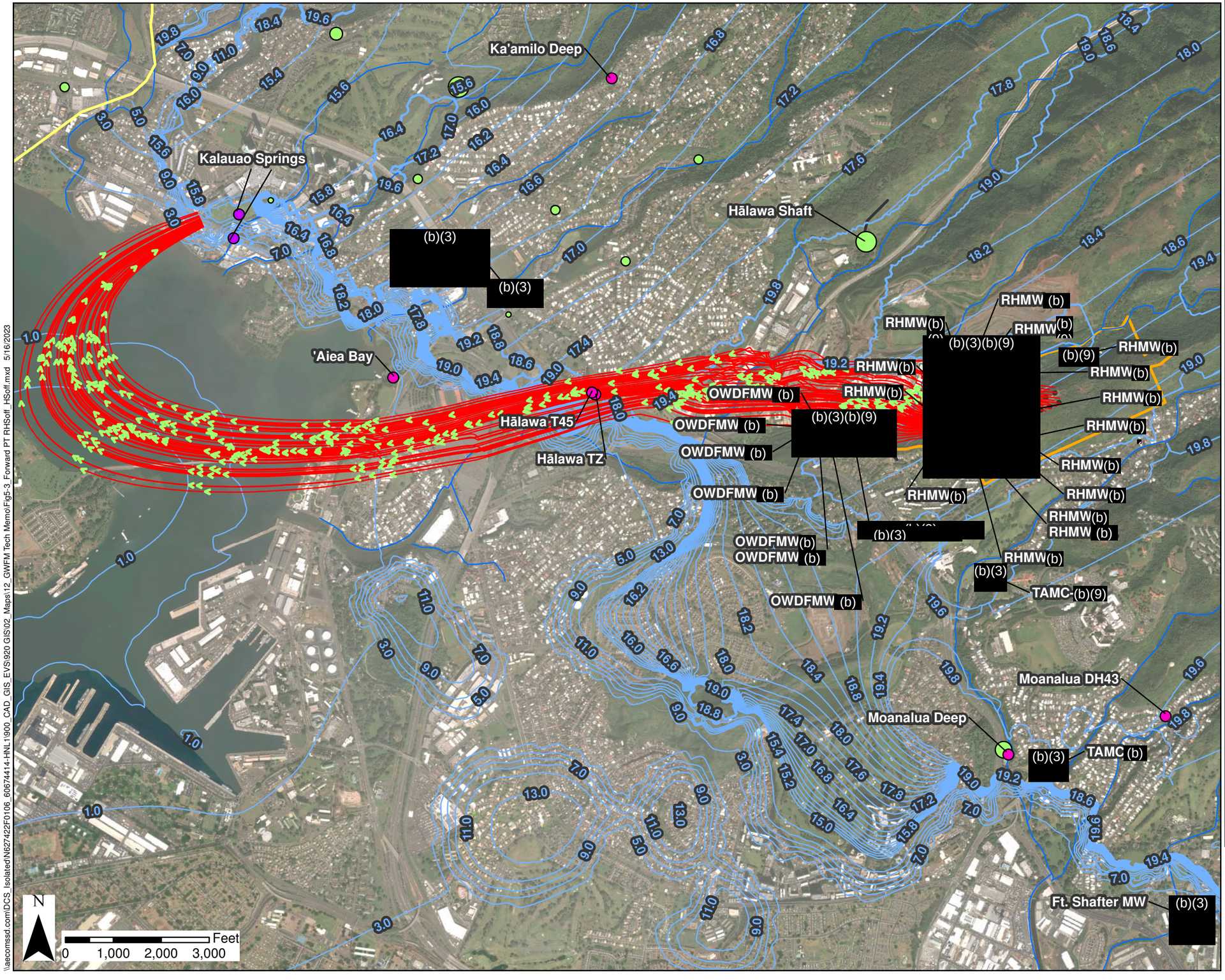
- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10.0
- 10.0 - 15.0
- Basal Aquifer Well (Group 1)
- 30-day travel time tick mark
- Forward Particle Tack
- Potentiometric Surface (ft msl)
- Water Supply Shaft
- Stream
- Red Hill Facility Boundary
- Groundwater Flow Model Domain

Notes

1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Spring locations provided by USGS.
4. Water supply well locations provided by DLNR.

Figure 5-2
Forward Particle Tracking from Tank Farm - (b)(3) Pumping at (mgd, Hālawa Shaft Pumping (b), Navy 'Aiea Hālawa Shaft Pumping at (b) mgd
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

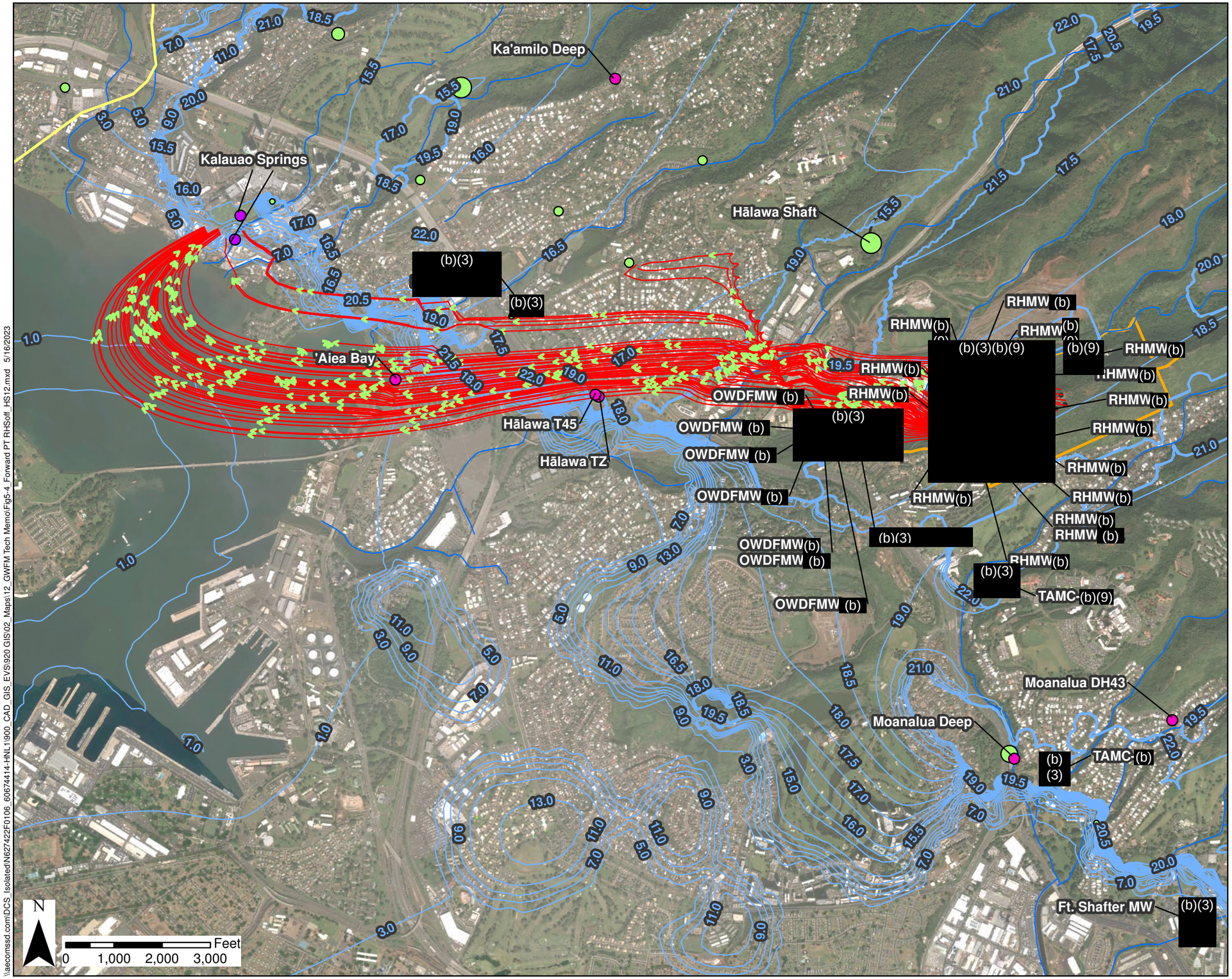
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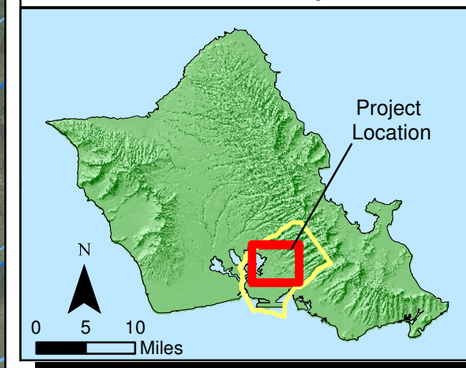


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(b)(3)

Figure 5-3
Forward Particle Tracking from Tank Farm - (b)(3) Pumping (b), Hālawa Shaft Pumping (b), (b)(3) Pumping (b)
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI





Legend

Water Supply Well / Shaft (MGD)

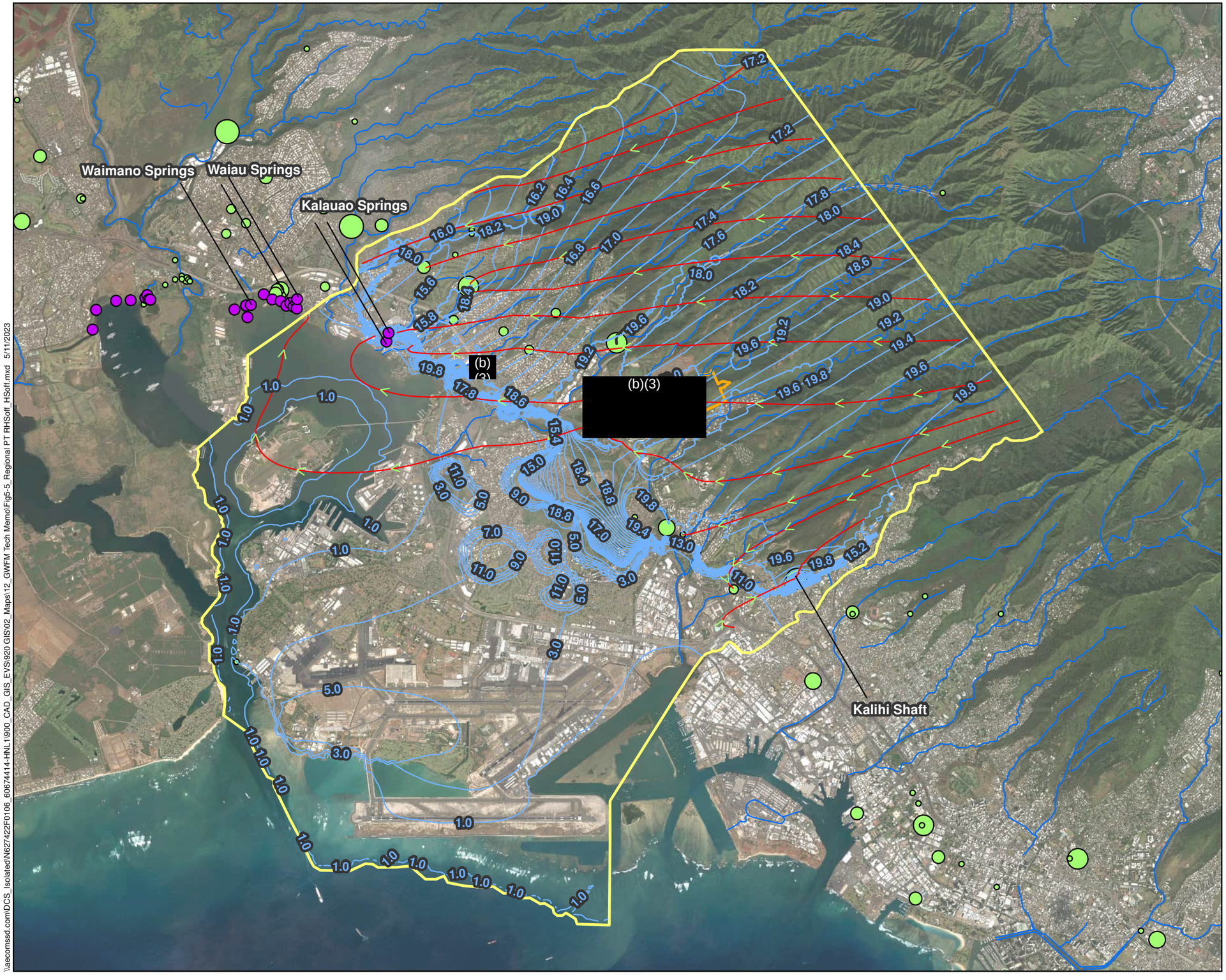
- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10.0
- 10.0 - 15.0
- Basal Aquifer Well (Group 1)
- Spring
- 6-month travel time tick mark
- Forward Particle Track
- Potentiometric Surface (ft msl)
- Water Supply Shaft
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model Domain

Notes

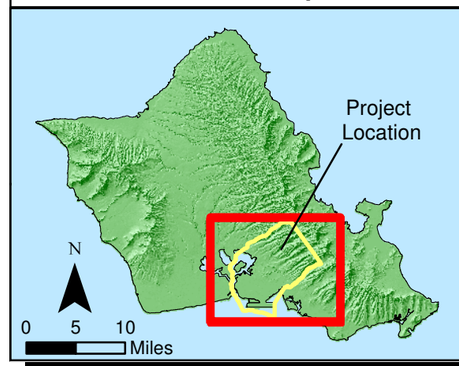
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Spring locations provided by USGS.
4. Water supply well locations provided by DLNR.

Figure 5-4
Forward Particle Tracking from Tank Farm - (b)(3) Pumping (b), Hālawa Shaft Pumping at (b) mgd, (b)(3) Pumping (b)
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

\\aecomssd.com\DCS_Isolated\N627422F0106_60674414-HNL1900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig5-4_Forward PT RHSoff_HS12.mxd 5/16/2023



Location Map



Legend

- Spring
- **Water Supply Well / Shaft (MGD)**
  - 0.0 - 0.5
  - 0.5 - 1.0
  - 1.0 - 2.0
  - 2.0 - 5.0
  - 5.0 - 10.0
  - 10.0 - 15.0
- 1-year travel time tick mark
- Forward Particle Track
- Potentiometric Surface (ft msl)
- Water Supply Shaft
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model Domain

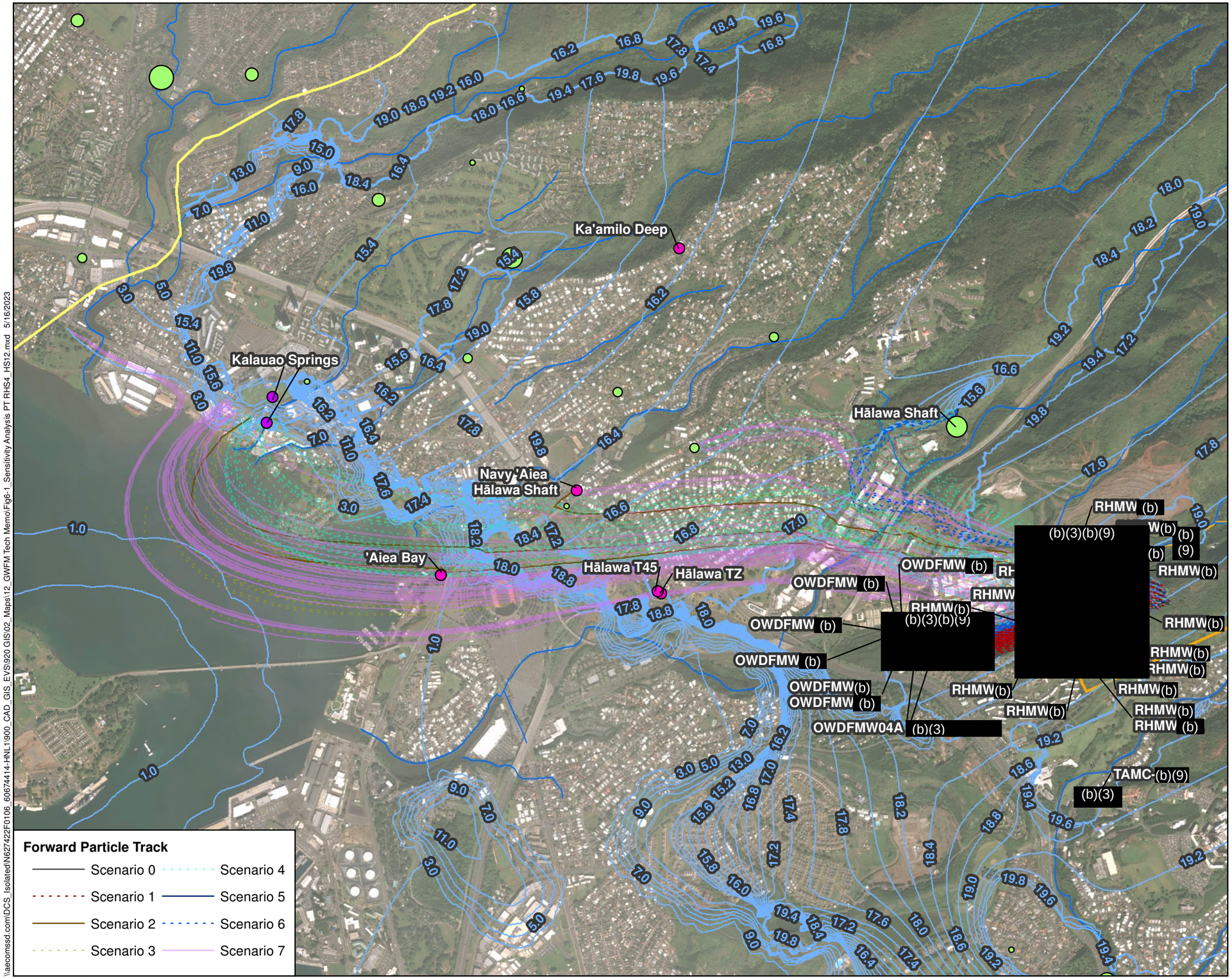
Notes

1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Spring locations provided by USGS.

N
0 4,000 8,000 12,000 Feet

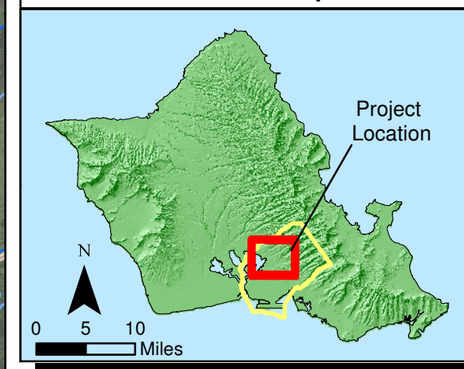
Figure 5-5
Regional Particle Tracking from Tank Farm - (b)(3) Pumping (b), Hālawa Shaft Pumping (b), (b)(3) Pumping (b)
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

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Location Map



Legend

Water Supply Well / Shaft (MGD)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10.0
- 10.0 - 15.0
- Basal Aquifer Well (Group 1)
- Spring
- Potentiometric Surface (ft msl)
- Water Supply Shaft
- Stream
- Red Hill Facility Boundary
- Groundwater Flow Model Domain

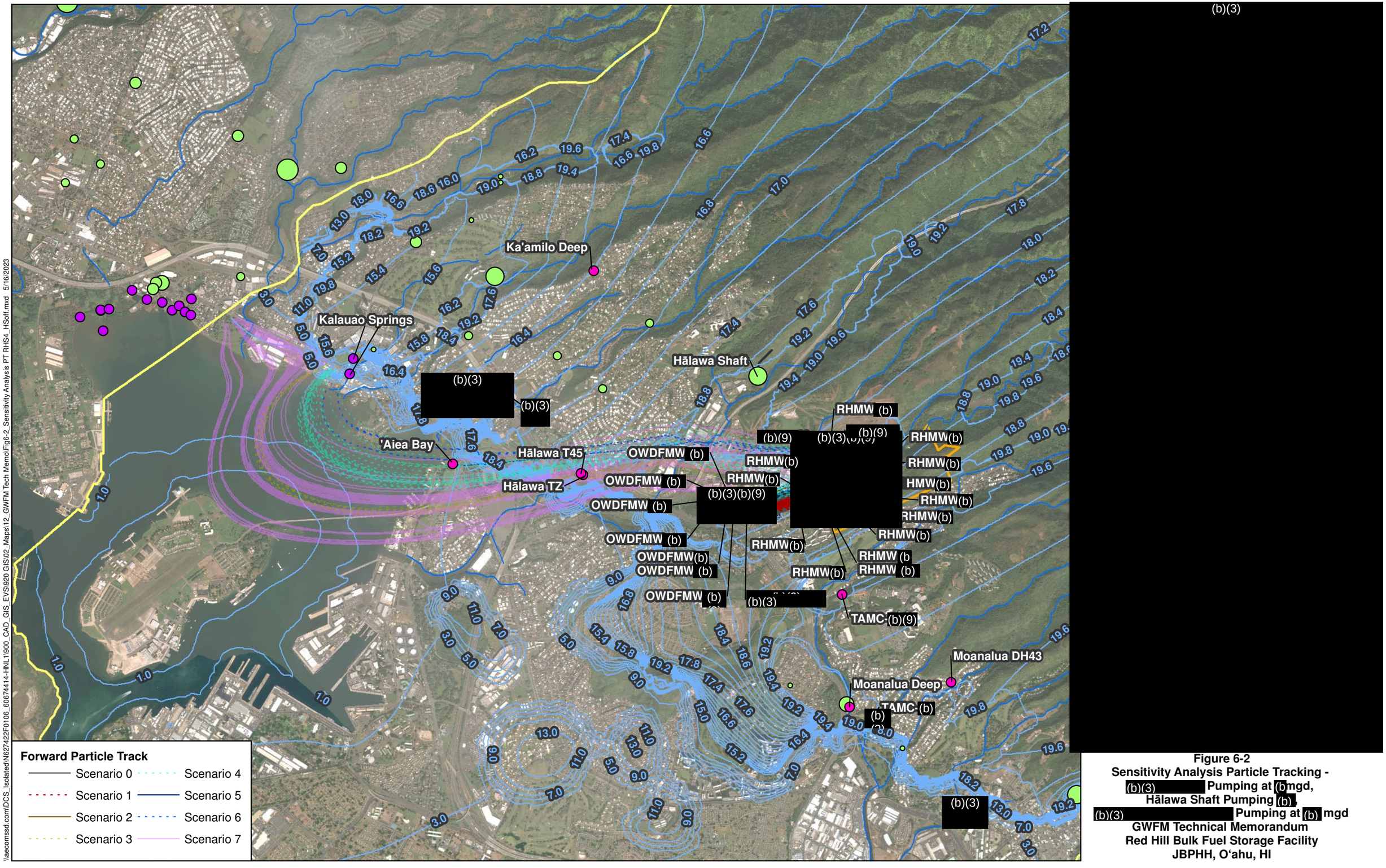
Notes

1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Spring locations provided by USGS.
4. Water supply well locations provided by DLNR.

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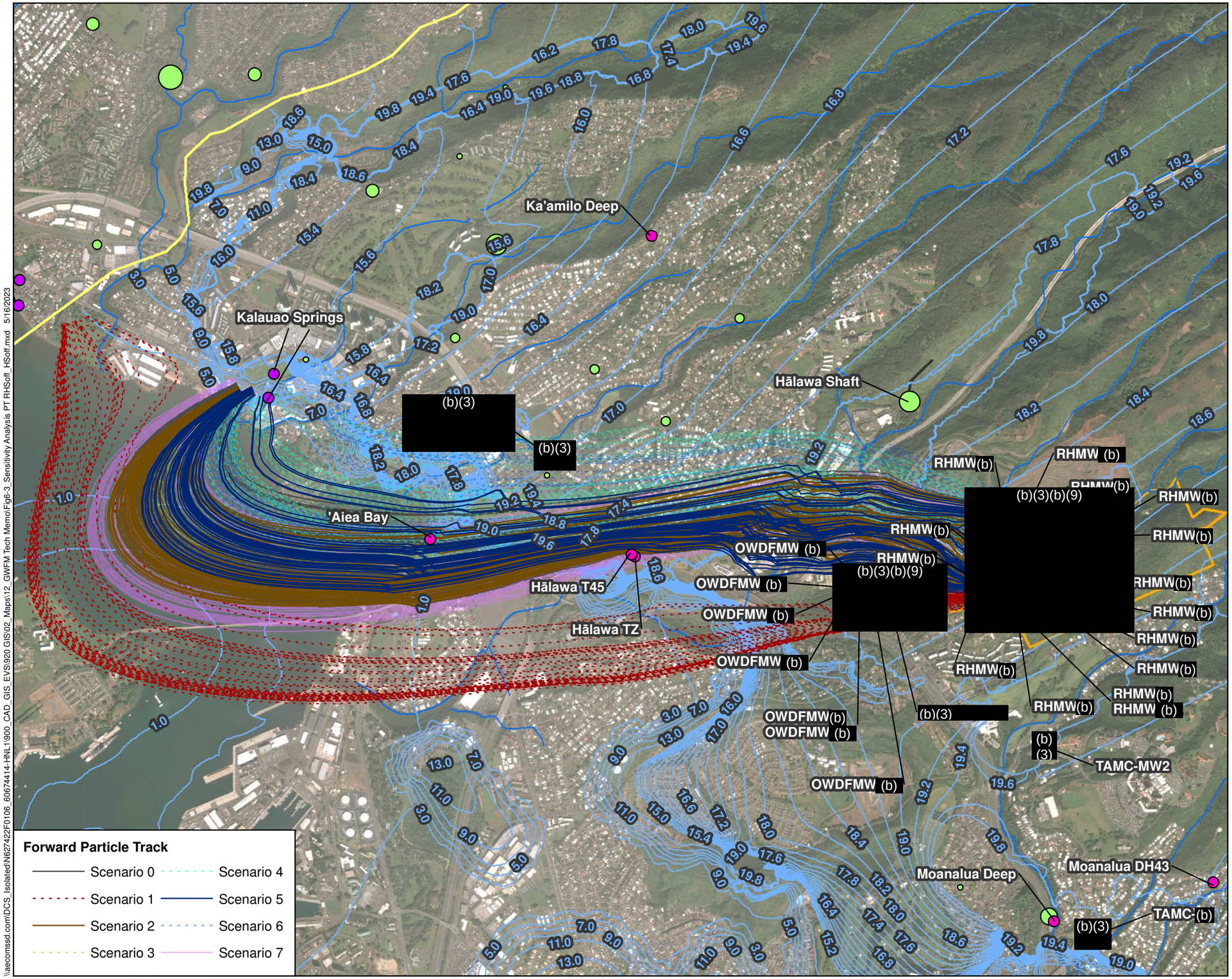
0 1,000 2,000 3,000 Feet

Figure 6-1
Sensitivity Analysis Particle Tracking - (b)(3) Pumping at (b) mgd, Hālawa Shaft Pumping at (b) mgd, (b)(3) Pumping at (b) mgd
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
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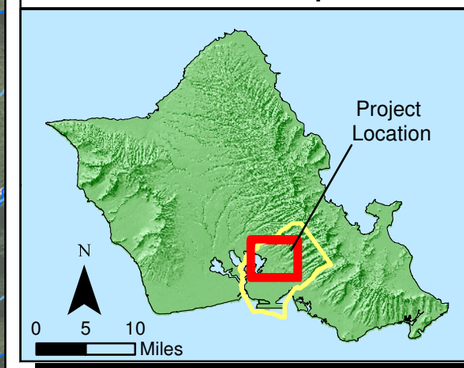


\\aecomssd.com\DCS_Isolated\N627422F0106_60674414-HNL1\900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig6-2_Sensitivity Analysis PT RHS4_HSoft.mxd 5/16/2023

Figure 6-2
Sensitivity Analysis Particle Tracking - (b)(3) Pumping at (b) mgd, Hālawa Shaft Pumping (b), (b)(3) Pumping at (b) mgd
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI



Location Map



Legend

Water Supply Well / Shaft (MGD)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10.0
- 10.0 - 15.0
- Basal Aquifer Well (Group 1)
- Spring
- Potentiometric Surface (ft msl)
- Water Supply Shaft
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model Domain

Notes

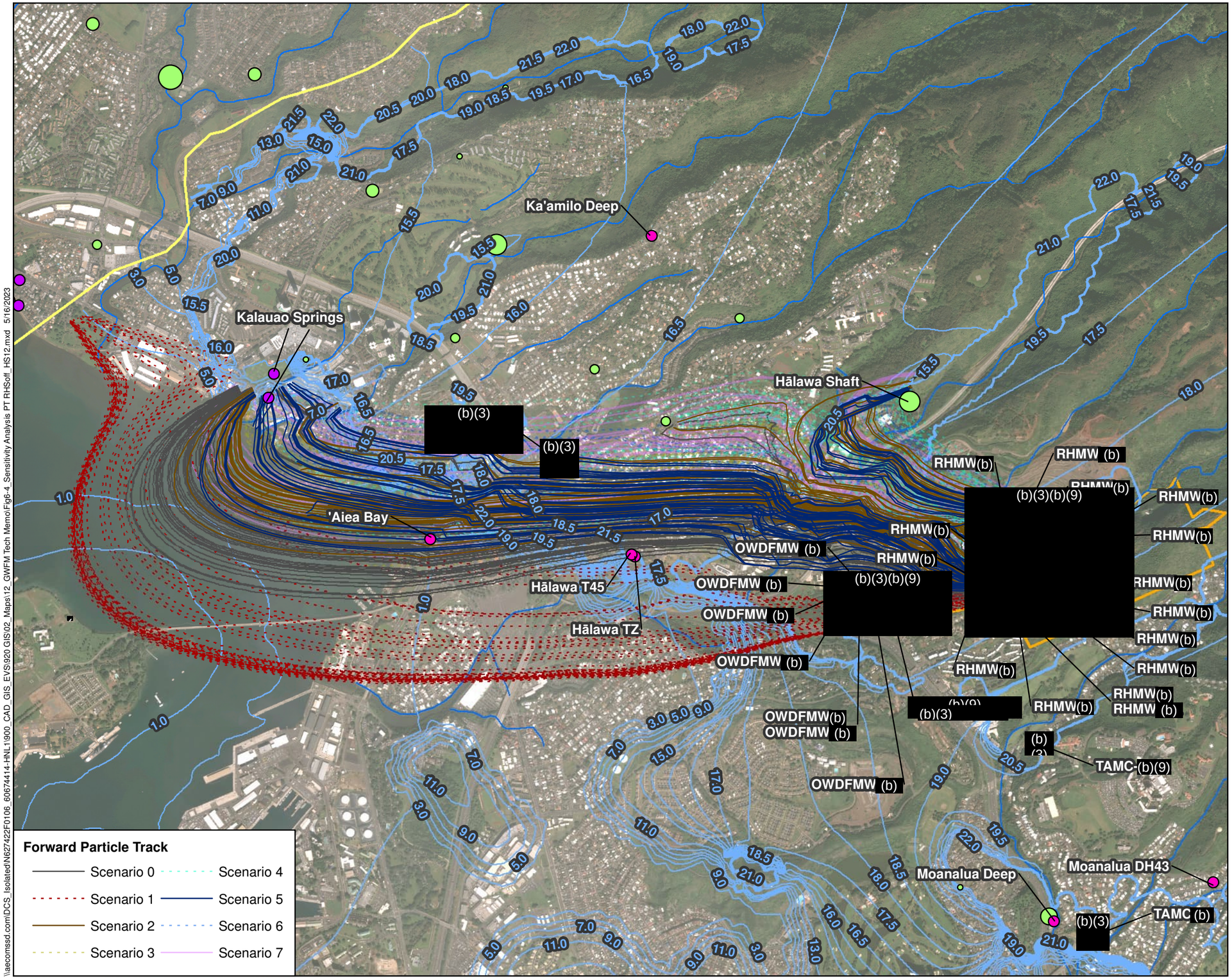
1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Spring locations provided by USGS.
4. Water supply well locations provided by DLNR.

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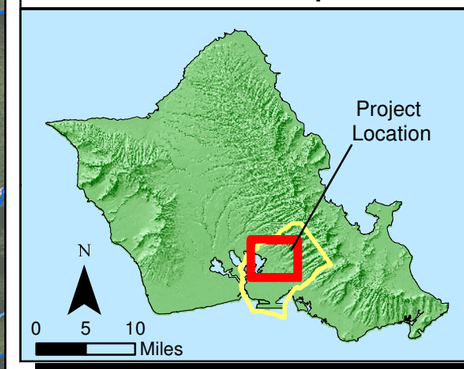
0 1,000 2,000 3,000 Feet

Figure 6-3
Sensitivity Analysis Particle Tracking -
(b)(3) Pumping (b)
Hālawa Shaft Pumping (b)
(b)(3) Pumping (b)
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

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Location Map



Legend

Water Supply Well / Shaft (MGD)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- 5.0 - 10.0
- 10.0 - 15.0
- Basal Aquifer Well (Group 1)
- Spring
- Potentiometric Surface (ft msl)
- Water Supply Shaft
- Stream
- Red Hill Facility Boundary and Fuel Storage Tanks
- Groundwater Flow Model Domain

Notes

1. Map projection: NAD 1983 Hawaii State Plane Zone 3 feet.
2. Base Map: DigitalGlobe, Inc. (DG) and NRCS. Publication_Date: 2015
3. Spring locations provided by USGS.
4. Water supply well locations provided by DLNR.

N

0 1,000 2,000 3,000 Feet

Figure 6-4
Sensitivity Analysis Particle Tracking - (b)(3) Pumping (b), Hālawa Shaft Pumping at (b) mgd, (b)(3) Pumping (b)
GWFM Technical Memorandum
Red Hill Bulk Fuel Storage Facility
JBPHH, O'ahu, HI

\\aecomssd.com\DCS_Isolated\N627422F0106_60674414-HNL1\900_CAD_GIS_EVS\920 GIS\02_Maps\12_GWFM Tech Memo\Fig6-4_Sensitivity Analysis PT RHSoff_HS12.mxd 5/16/2023

Attachment 1: Navy Groundwater Modeling Meetings and Calls with RAs and SMEs Since Submittal of March 2020 GWFM Report

Meeting Date	Meeting Topic
2020-05-15	Technical Working Group (TWG) Mtg #27 Model Report Feedback from EPA and DOH
2020-10-22	EPA-DOH Water Level Discussion
2021-04-28	TWG Mtg #38 Matt Becker Initial Call
2021-05-10	TWG Mtg #39 Groundwater Flow Model (GWFM) Regulatory Agency (RA) Comments
2021-06-03	TWG Mtg #40 GWFM RA Comment Follow Up
2021-07-08	TWG Mtg #41 DOH Geology Presentation
2021-07-16	TWG Mtg #42 Navy Presents In-Well Testing Approach
2021-07-27	TWG Mtg #43 In-Well Testing Objectives Refinement
2021-08-03	TWG Mtg #44 In-Well Objectives Refinement with Dr. Matt Becker
2021-08-26	TWG Mtg #45 In-Well Testing-Work Plan Comments
2021-10-18/19	Groundwater Modeling Working Group Mtg 16
2022-02-04	In-Well Test Path Forward with Dr. Becker
2022-05-04	Groundwater Model Check In-EPA-DOH
2022-05-09	Groundwater Model-Questions-Objectives-EPA-DOH
2022-05-26	Geological Conceptual Site Model (CSM) Kickoff
2022-09-14	Special Purpose Meeting (SPM) #03 Confining Units
2022-09-21	SPM #5 Stochastic Basalt Subtype Generation
2022-09-28	SPM #6 MODFLOW Model Setup
2022-10-25	SPM #8 In-Well Testing
2022-12-07	SPM #9 Geologic Fabric Explorer (GFE) Technical Support
2022-12-14	SPM #10 Geological CSM
2023-01-10	SPM #11 Strike & Dip
2023-01-13	SPM #13 GFE Mtg
2023-02-01	SPM #15 Tracer Study
2023-02-14	SPM #16 Modeling Schedule
2023-02-15	SPM #17 Dr. Becker In-Well Testing Work Plan Review
2023-03-01	SPM #18 Dr. Becker In-Well Testing Continued
2023-3-03	Flow Optimization-University of Hawai‘i Transducer Study
2023-03-15	SPM #20 Modeling RA Subject Matter Expert Perspective
2023-03-29	Small Group Vadose Zone Model (VZM) Meeting
2023-04-05	SPM #21 VZM

Attachment 2: Summary of RA Comments and Approach

Theme #	Theme	RA Comment #	Approach to Address RA Comment(s)	Addressed in Best Available Model
1	Basalt Representation	12	• Address via multiple renderings of basalt fabric using multipoint training images (local-scale basalt modeling using the Geologic Fabric Explorer [GFE]).	In development concurrently with the Best Available Model. To be incorporated in final model.
2	Boundary Conditions	28, 35, 52, 53, 54, 55, 60, 64, 65, 66, 70, 79	• Perform regional water balance calculations to estimate model water budget, boundary inflows/outflows. • Test various concepts and assess range of potential outcomes via sensitivity analysis. • Provide more detailed justification of boundary condition assignments.	✓
3	Data and Calibration	2, 3, 5, 6, 9, 10, 13, 17, 21, 25, 27, 29, 31, 36, 39, 43, 44, 45, 46, 56, 57, 61, 67, 68, 69, 72, 73, 74, 75, 76, 77, 78	• Primary focus on quasi-steady water levels/gradients, secondary focus on transient drawdown matching. • Model boundaries (particularly lateral boundaries) to better match regional groundwater gradients and supported by water balance calculations. • Replace previous multi-model approach with one model structure with multiple basalt fabric realizations. • Provide clear road map defining a successful flow model calibration. Ensure results are reproducible in review. • Geologic realizations may help explain observed "compartmentalization" of water level responses.	Partial - Comments addressed except those related to multiple basalt realizations and compartmentalization.
4	Documentation and Communications	58, 80, 81, 82, 83	• Frequent and transparent engagement with RAs and SMEs.	✓
5	Field Investigation	18, 19, 20, 23, 32, 33	• In-well testing program (and potentially a tracer test) has been proposed.	UH to perform tracer study. USGS and Navy/University of Hawaii conducting in-well testing. Results to be incorporated into final model (if available)
6	Geochemical Proxies	8, 38, 47, 48	• Evaluate chloride / temperature data. • Apply as additional lines of evidence for water balance calculations. • Use various strategies to apply mixing model calculations to model results.	✓

Theme #	Theme	RA Comment #	Approach to Address RA Comment(s)	Addressed in Best Available Model
7	Hydrostratigraphy	1, 15, 22, 40, 62, 71	• Revisit large-scale stratigraphic structures and incorporate new data. • EVS model updated with new borings and other data. • GFE with multiple point statistics and training images used to represent basalt heterogeneity.	✓
8	Model Layering	11, 59, 63	• Geologically independent gridding approach will be utilized with layers dipping with basalt.	✓
9	Parameter Ranges	7, 14, 26, 30, 34, 37, 49, 50, 51	• Will document anticipated / acceptable parameter ranges.	✓
10	Transient Modeling	4, 16, 24	• Capture zones simulated based on transient model calibration. Specific transient capture scenarios can be simulated.	✓

Attachment 3: Documentation of Model Calibration

Groundwater Flow Model Calibration Evaluation Documents

Head Calibration Statistics

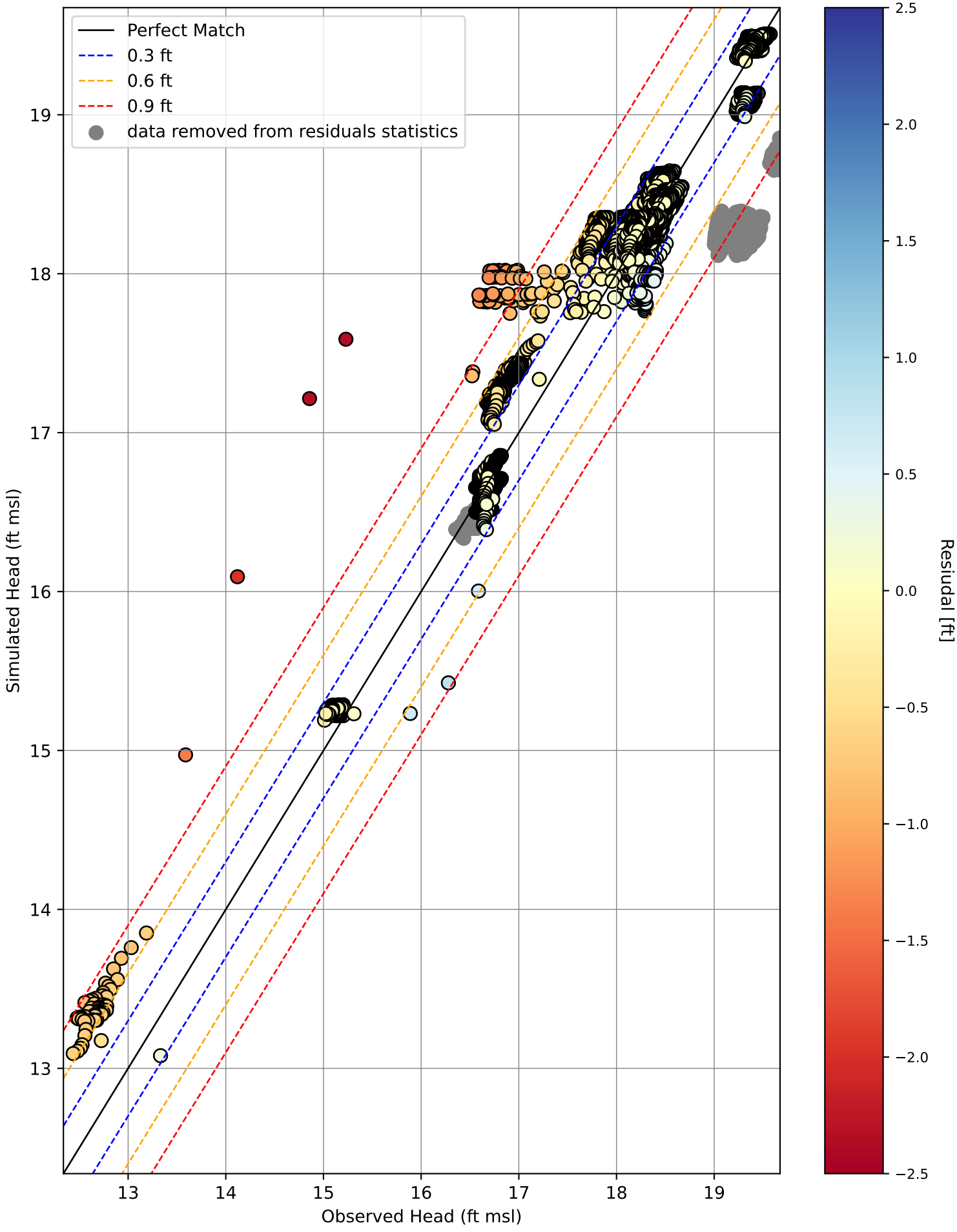
Wells	Basal Aquifer (Group 1)			Deep Wells (Group 2)	Confining Unit (Group 3)	Caprock (Group 4)	Cumulative
Time Period	**2017/2018**	**2021/2022**	**All**	**All**	**All**	**All**	**All**
Residual Mean (ft)	-0.06	-0.01	-0.05	0.67	16.85	0.23	0.85
Absolute Residual Mean (ft)	0.17	0.21	0.20	0.68	19.17	1.47	1.18
Residual Standard Deviation (ft)	0.24	0.28	0.28	0.43	18.32	2.07	5.44
Sum of Squared Residuals (ft2)	336.40	298.68	803.87	677.83	352854.62	574.19	354910.51
RMSE Error (ft)	0.25	0.28	0.28	0.79	24.88	2.08	5.51
Minimum Residual (ft)	-2.36	-0.78	-2.36	-0.75	-19.41	-4.44	-19.41
Maximum Residual (ft)	0.85	0.64	2.08	1.37	50.11	6.60	50.11
Number of Observations	5459	3915	9928	1075	570	133	11706
Range in Observations	7.14	3.26	7.19	4.26	97.94	6.85	116.87
Scaled Residual Standard Deviation (ft)	3.4%	8.5%	3.9%	10.0%	18.7%	30.3%	4.7%
Scaled Absolute Residual Mean (ft)	2.3%	6.5%	2.8%	16.0%	19.6%	21.5%	1.0%
Scaled RMSE Error (ft)	3.5%	8.5%	4.0%	18.6%	25.4%	30.3%	4.7%
Scaled Residual Mean (ft)	-0.8%	-0.2%	-0.6%	15.7%	17.2%	3.3%	(b)%
Correlation Coefficient	0.98	0.93	0.96	0.99	0.92	-0.16	0.95

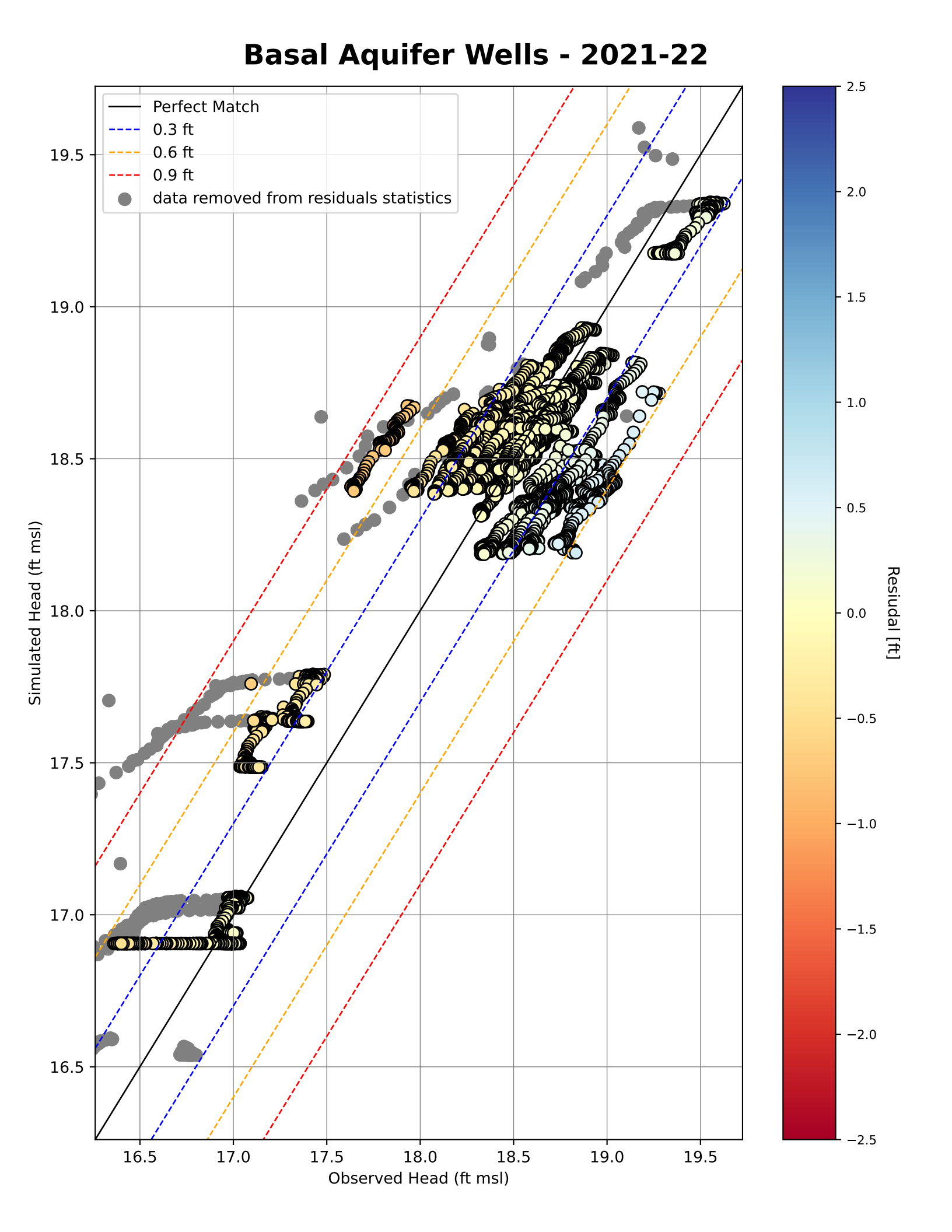
Drawdown Calibration Statistics

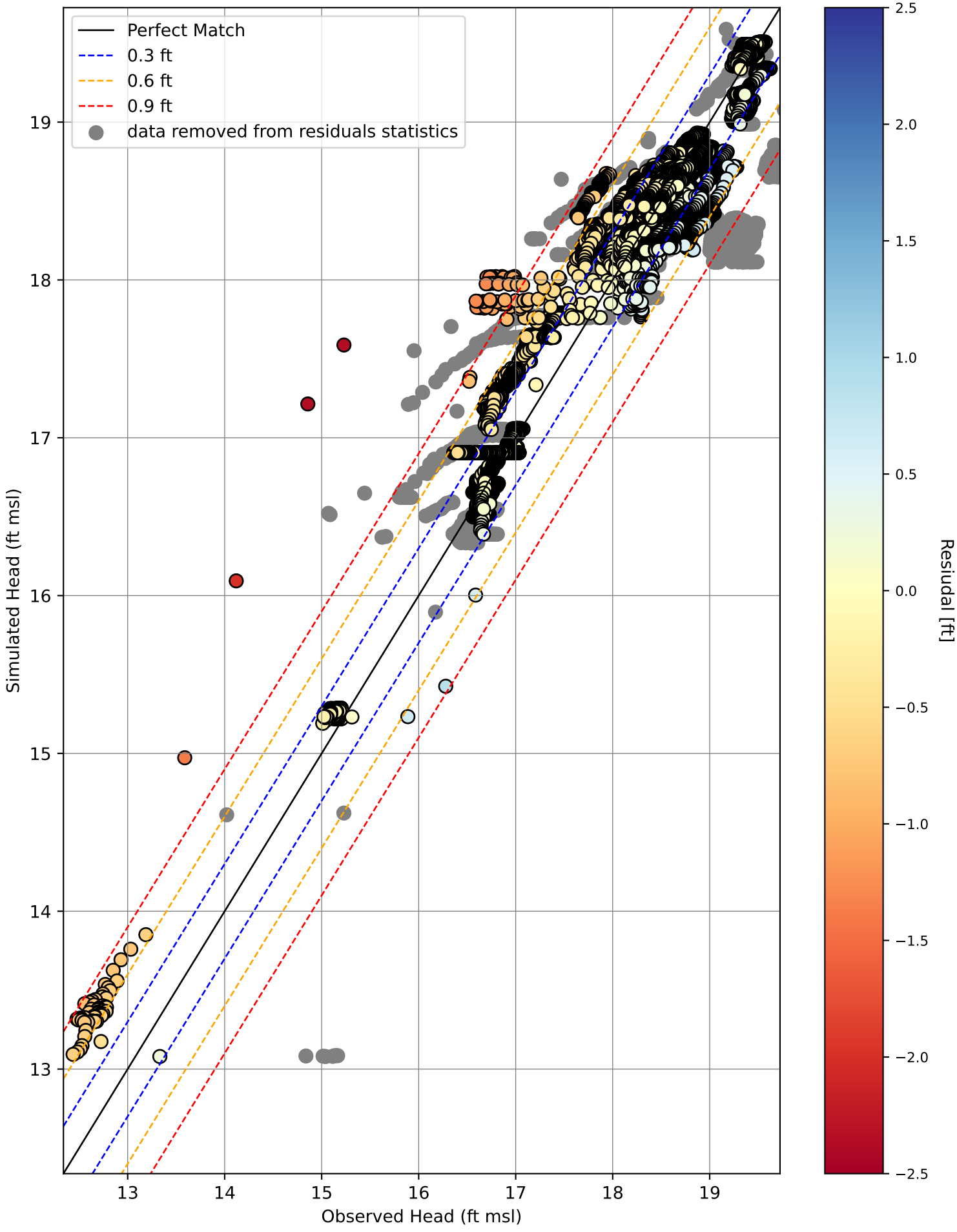
Wells	Basal Aquifer (Group 1)		
Time Period	**2017/2018**	**2021/2022**	**All**
Residual Mean (ft)	0.00	0.04	0.01
Absolute Residual Mean (ft)	0.09	0.06	0.08
Residual Standard Deviation (ft)	0.21	0.09	0.18
Sum of Squared Residuals (ft2)	246.29	35.26	281.55
RMSE Error (ft)	0.21	0.10	0.18
Minimum Residual (ft)	-1.79	-0.27	-1.79
Maximum Residual (ft)	2.30	0.49	2.30
Number of Observations	5393	3533	8926
Range in Observations	4.76	0.68	4.76
Scaled Residual Standard Deviation (ft)	(b) %	13.5%	(b) %
Scaled Absolute Residual Mean (ft)	2.0%	9.2%	1.7%
Scaled RMSE Error (ft)	(b) %	14.8%	(b) %
Scaled Residual Mean (ft)	-0.1%	6.1%	0.3%
Correlation Coefficient	0.83	0.72	0.85

Conceptual Water Budget Comparison

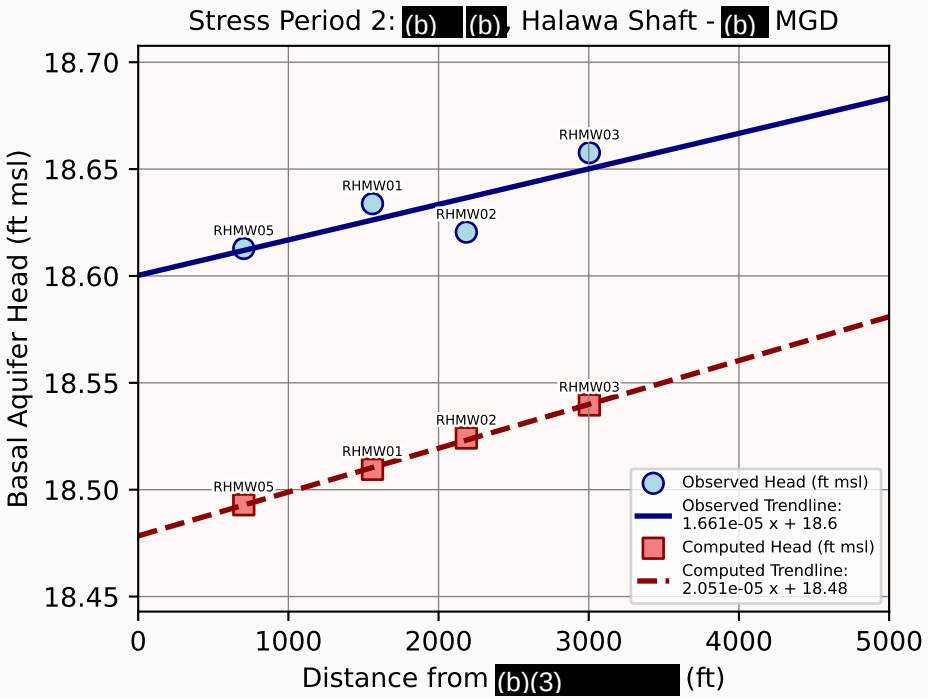
Type	Stress Period	Recharge (MGD)	Dike Region Inflow (MGD)	Well Discharge (MGD)	Spring Discharge (MGD)	Caprock Discharge (MGD)	Inflow from Adjacent Watershed (MGD)	Outflow to Adjacent Watershed (MGD)	Storage (MGD)	Total Inflows (MGD)	Total Outflows (MGD)
Conceptual	1	32.5	28.7	32.0	13.6	2.4	2.8	16.0	0.0	64.0	64.0
Simulated	1	32.5	28.7	32.3	12.8	3.9	(b)	24.2	0.0	73.3	73.3
Difference	1	0.0	0.0	0.3	-0.8	1.5	9.3	8.2	0.0	9.3	9.3
Conceptual	2	32.5	28.7	28.4	13.6	2.4	2.8	19.6	0.0	64.0	64.0
Simulated	2	32.5	28.7	28.4	13.0	3.9	11.2	24.7	-2.1	72.3	72.2
Difference	2	0.0	0.0	0.0	-0.6	1.5	8.3	5.1	-2.1	8.4	8.2
Conceptual	3	32.5	28.7	36.1	13.5	2.4	2.8	12.0	0.0	64.0	64.0
Simulated	3	32.5	28.7	36.1	12.8	3.9	12.4	24.2	3.3	76.9	77.1
Difference	3	0.0	0.0	0.0	-(b	1.5	9.6	12.2	3.3	12.9	13.1
Conceptual	4	32.5	28.7	32.4	13.5	2.4	2.8	15.6	0.0	64.0	64.0
Simulated	4	32.5	28.7	32.5	12.8	3.9	12.4	23.9	-0.3	73.6	73.3
Difference	4	0.0	0.0	0.0	-0.8	1.5	9.6	8.3	-0.3	9.6	9.3
Conceptual	5	32.5	28.7	25.7	13.7	2.4	4.7	24.1	0.0	65.9	65.9
Simulated	5	32.5	28.7	25.7	13.7	3.9	11.3	27.1	-1.9	72.5	72.4
Difference	5	0.0	0.0	0.0	-0.1	1.6	6.6	3.1	-1.9	6.6	6.5
Conceptual	6	32.5	28.7	37.7	13.6	2.4	4.7	12.2	0.0	65.9	65.9
Simulated	6	32.5	28.7	37.8	12.4	3.9	13.1	23.0	2.6	76.9	77.2
Difference	6	0.0	0.0	0.0	-1.2	1.5	8.4	10.9	2.6	11.0	11.3
Conceptual	7	32.5	28.7	32.0	13.4	2.4	4.1	17.4	0.0	65.3	65.3
Simulated	7	32.5	28.7	32.0	12.7	3.9	11.1	23.8	0.0	72.3	72.3
Difference	7	0.0	0.0	0.0	-(b	1.5	7.0	(b	0.0	7.0	7.0
Conceptual	8	32.5	28.7	30.1	12.6	2.4	2.8	18.8	0.0	63.9	63.9
Simulated	8	32.5	28.7	30.1	12.7	3.9	11.3	23.5	-2.2	72.5	72.5
Difference	8	0.0	0.0	0.0	0.1	1.5	8.6	4.7	-2.2	8.6	8.5
Conceptual	9	32.5	28.7	21.8	13.7	2.4	0.5	23.8	0.0	61.7	61.7
Simulated	9	32.5	28.7	21.8	14.2	3.9	8.2	29.3	-0.1	69.4	69.4
Difference	9	0.0	0.0	0.0	0.6	1.5	(b	5.5	-0.1	(b	(b
Conceptual	10	32.5	28.7	26.3	13.9	2.5	7.5	25.9	0.0	68.7	68.7
Simulated	10	32.5	28.7	26.3	13.7	3.9	10.2	27.6	0.0	71.4	71.6
Difference	10	0.0	0.0	0.0	-0.2	1.4	2.7	1.7	0.0	2.8	2.9

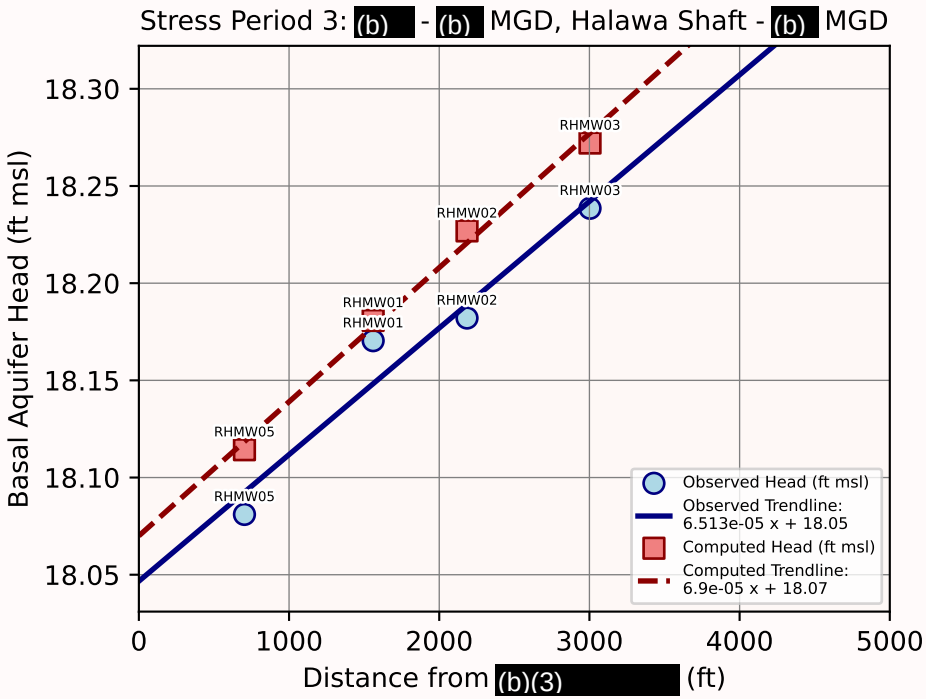

Basal Aquifer Wells - 2017-18
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

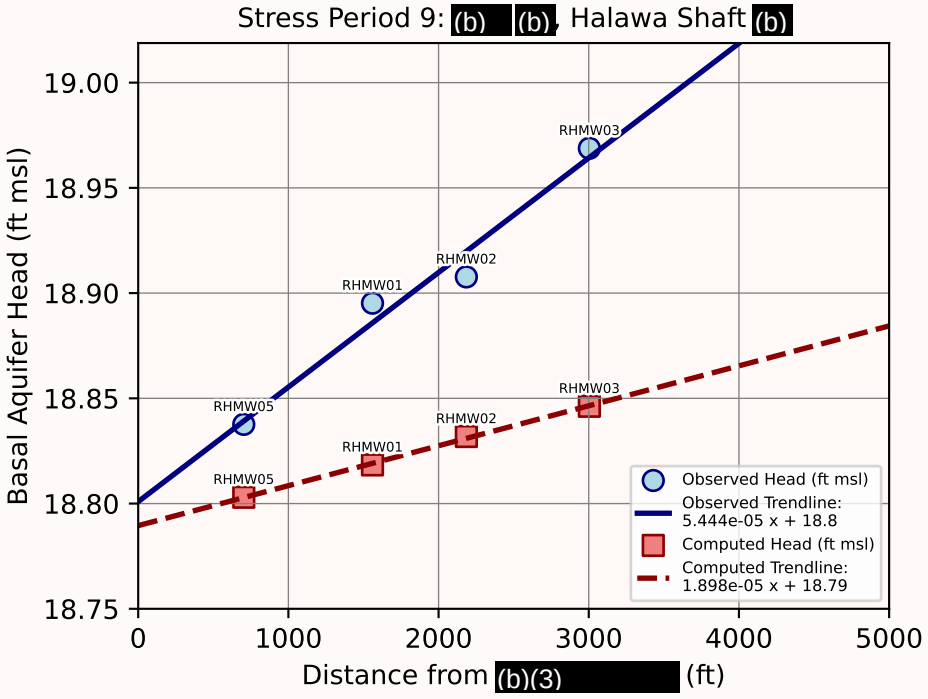

Basal Aquifer Wells - 2021-22
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
16.5
17.0
17.5
18.0
18.5
19.0
19.5
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

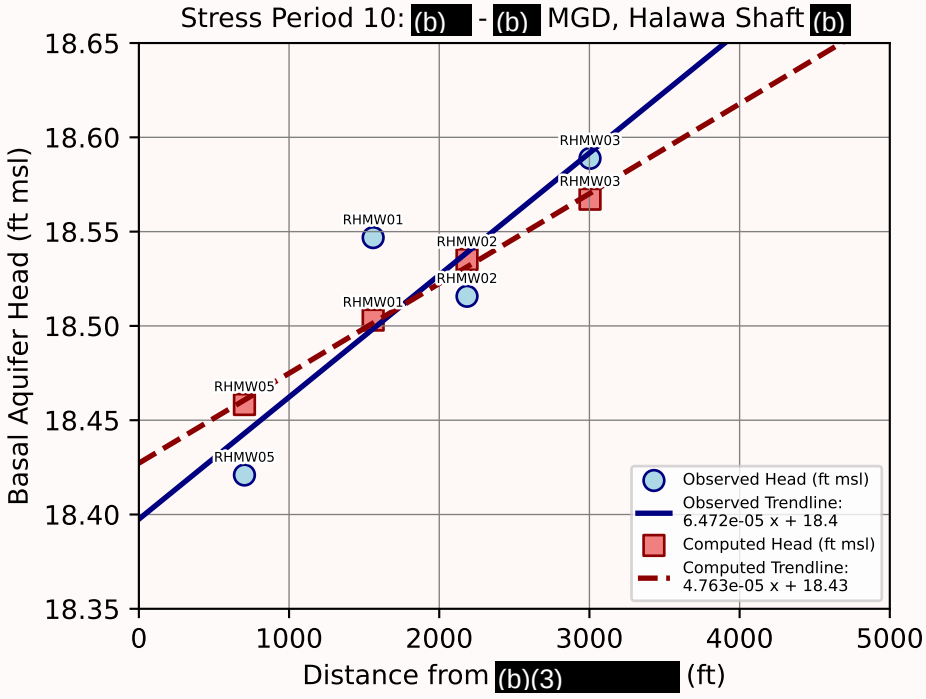

Basal Aquifer Wells - All
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

Gradients Along Red Hill Ridge

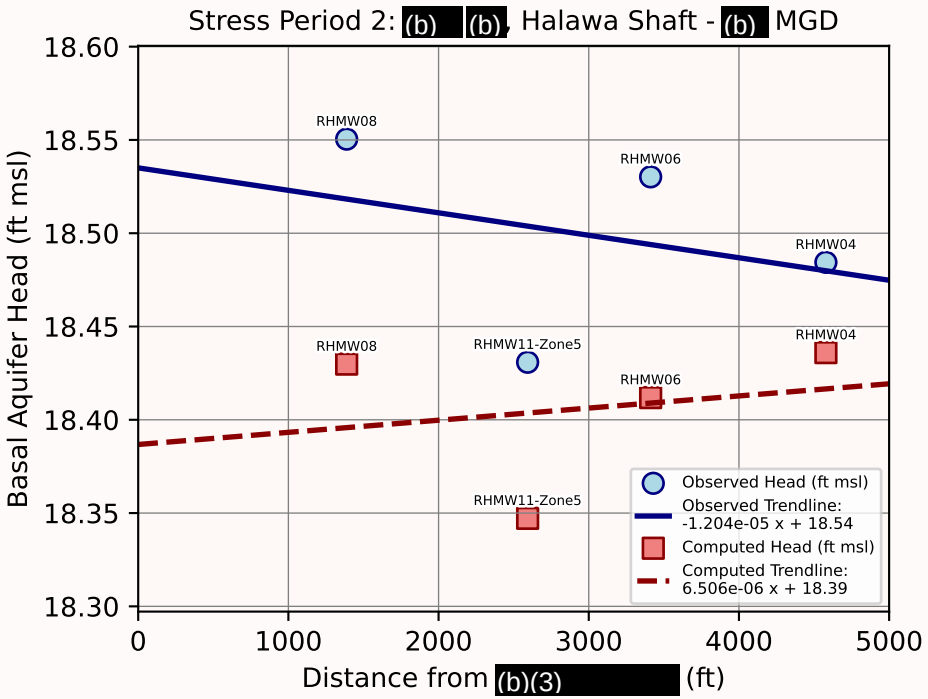


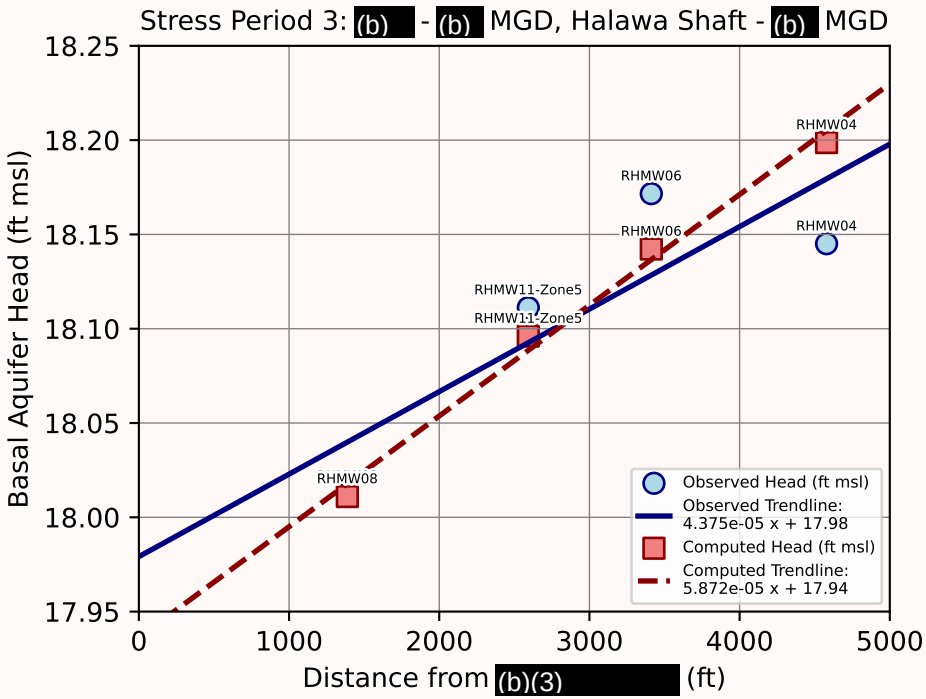


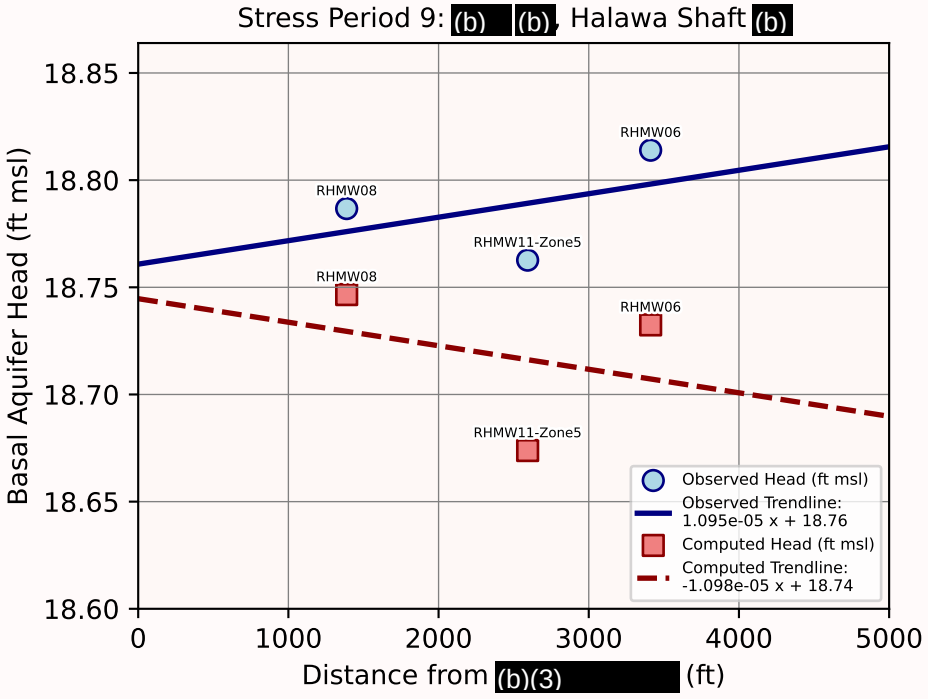


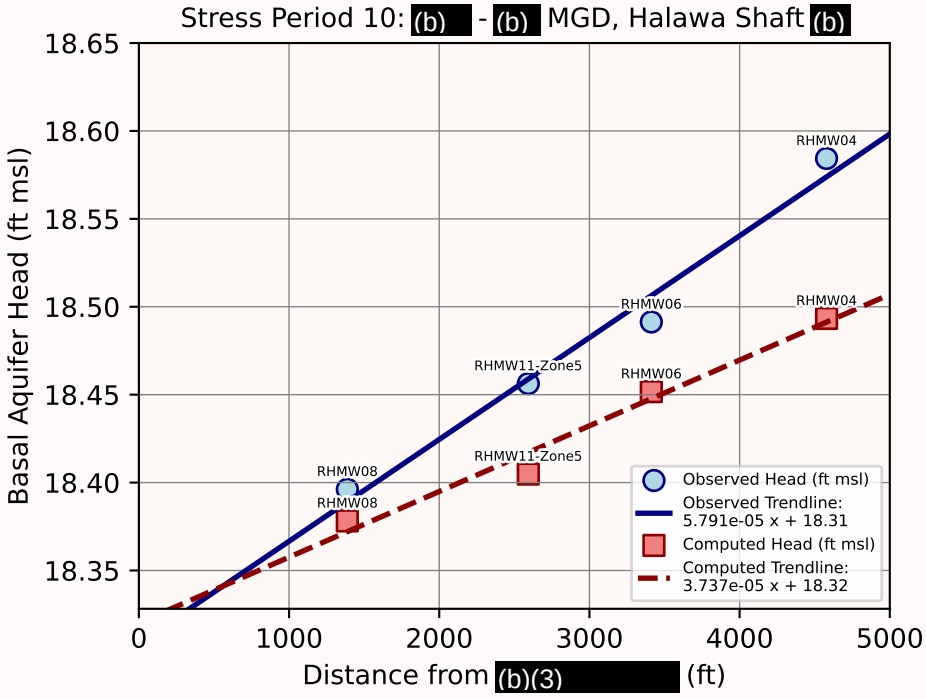


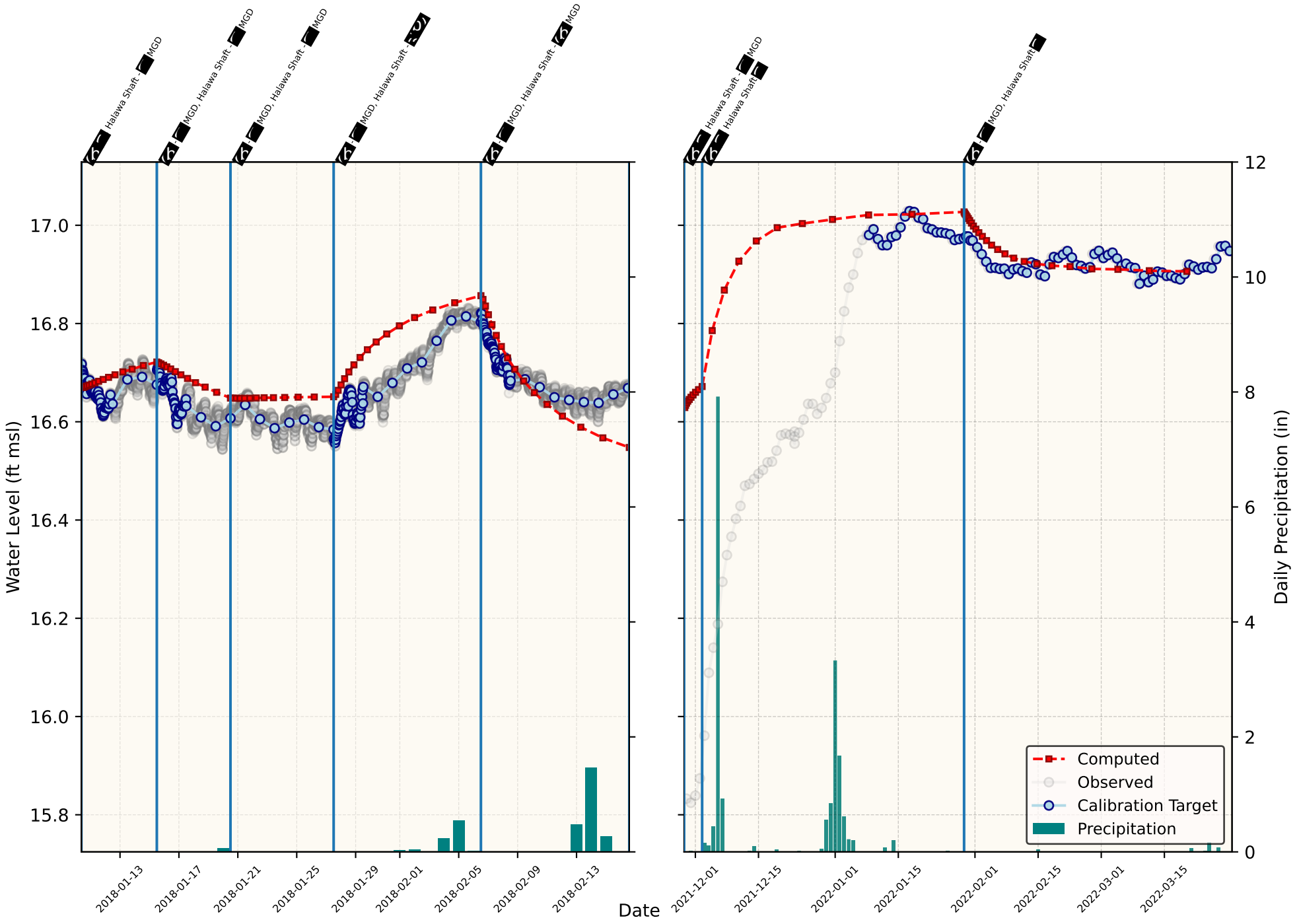
Gradients Northwest of Red Hill Ridge





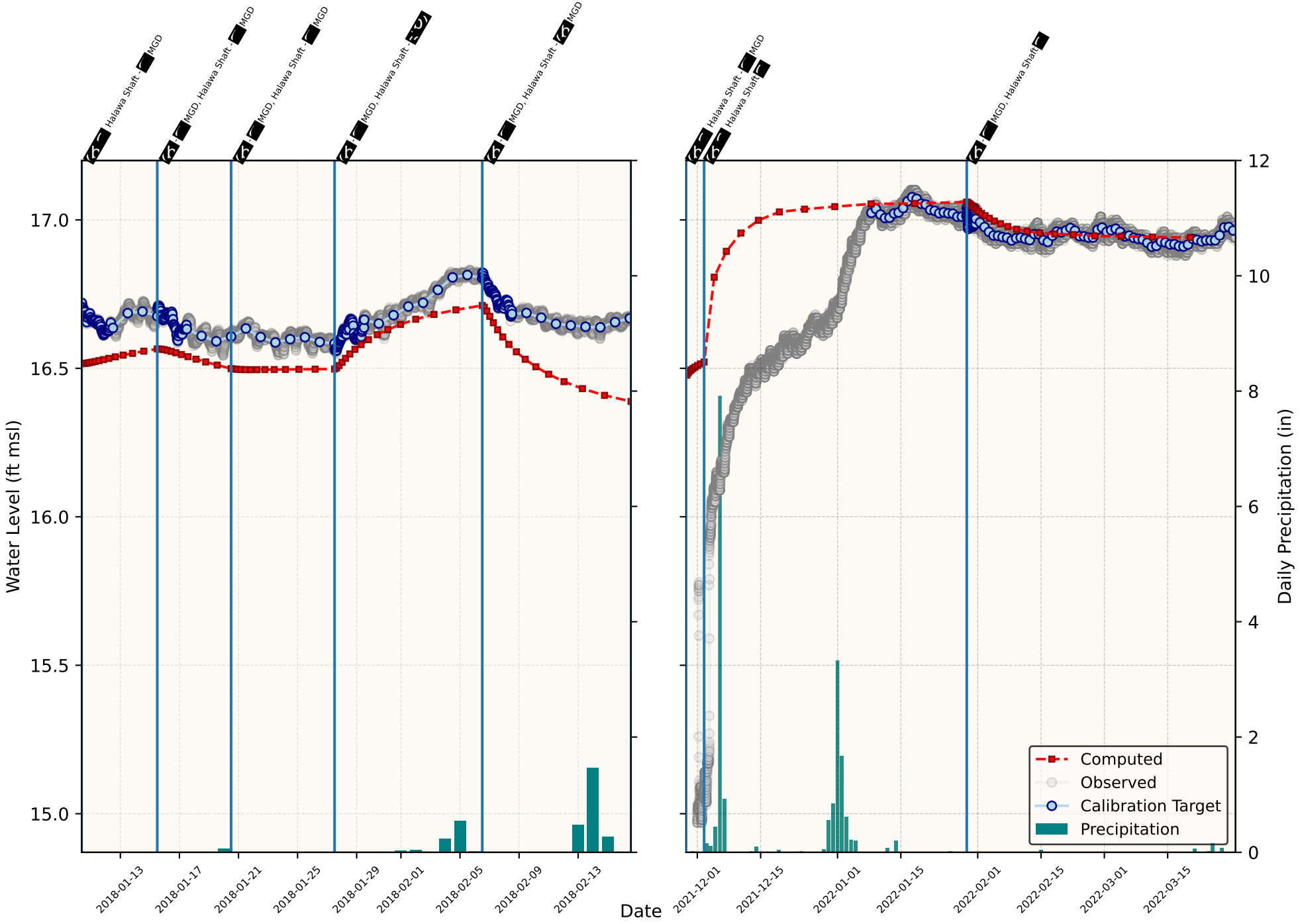


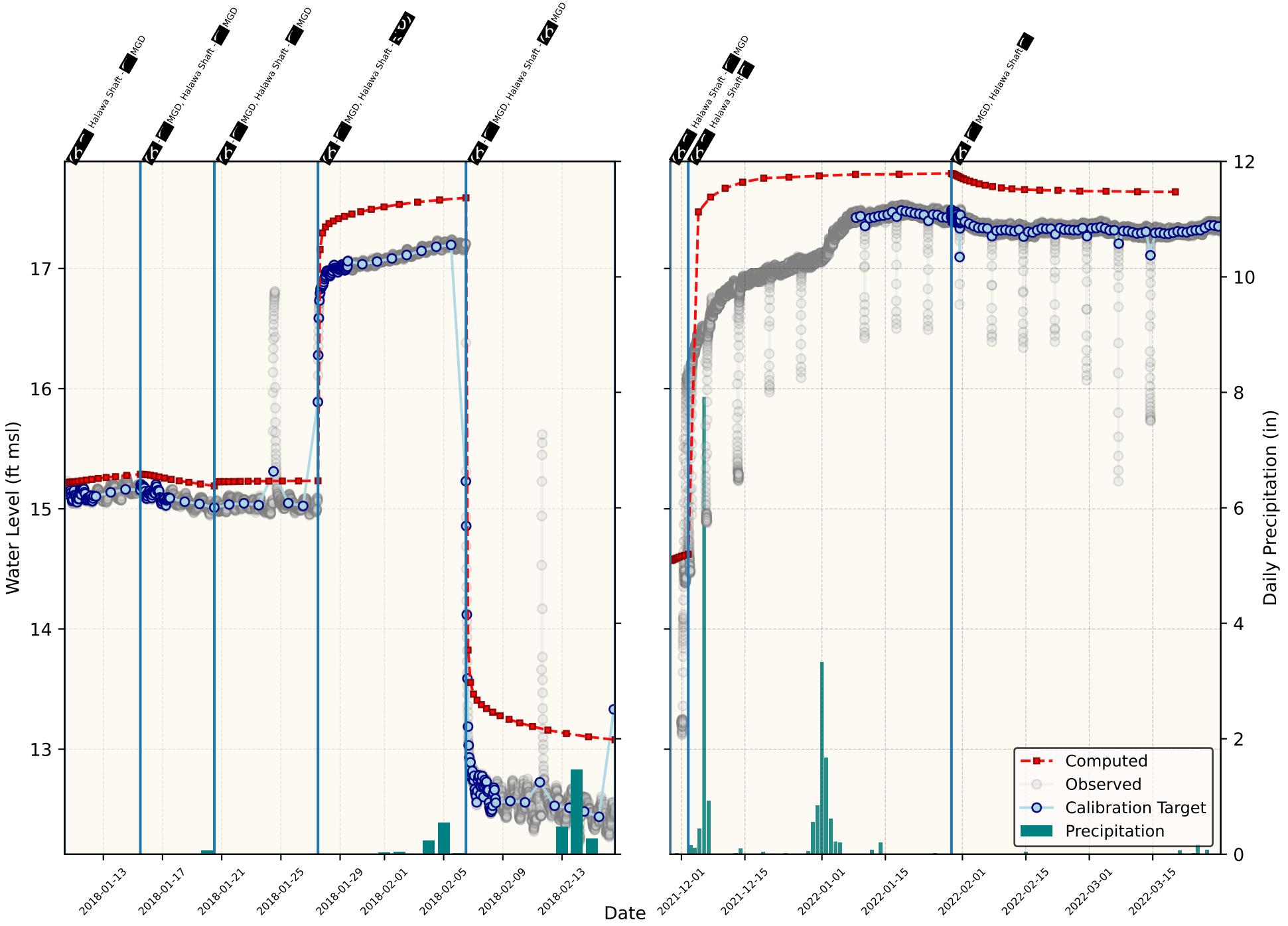


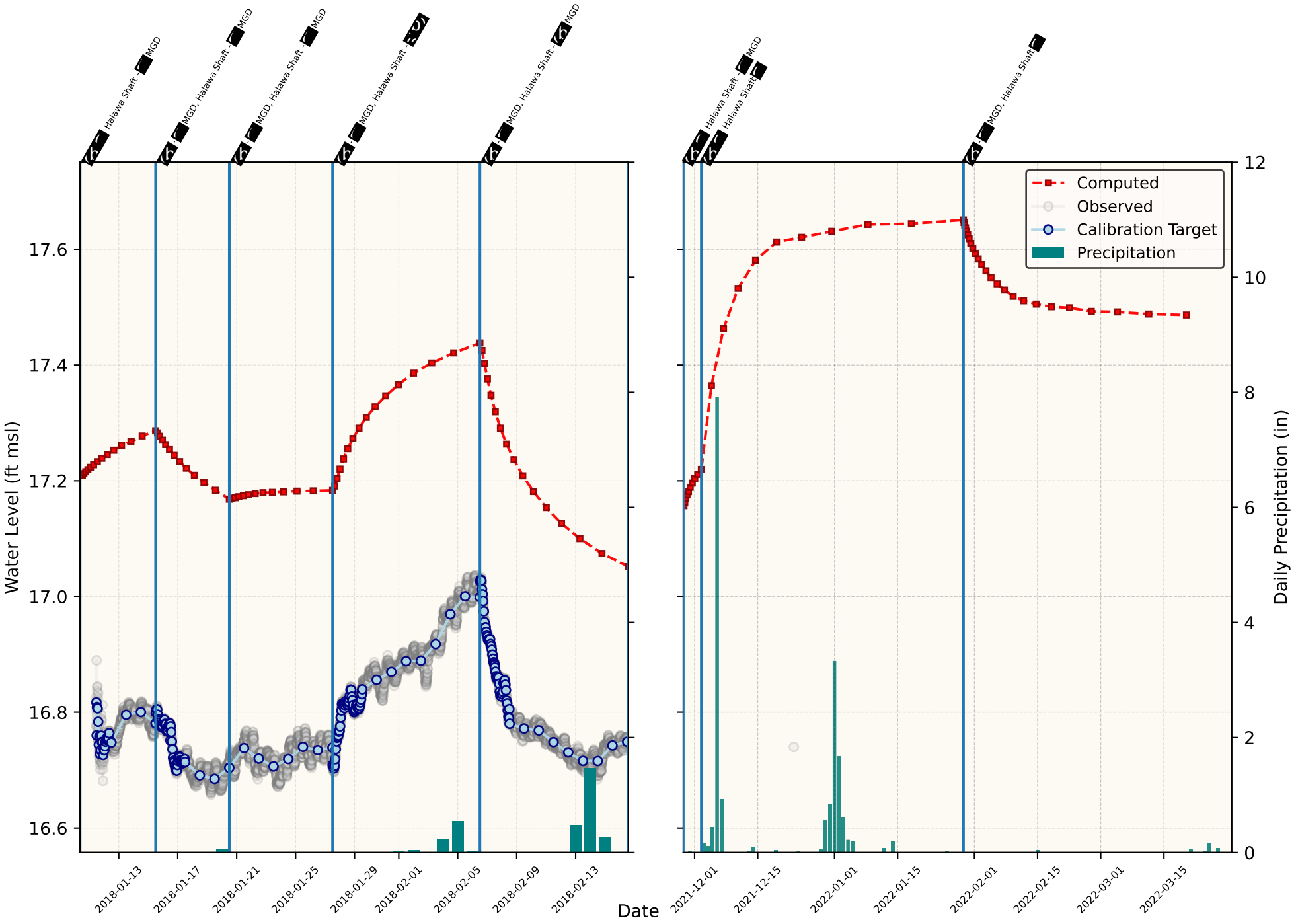

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

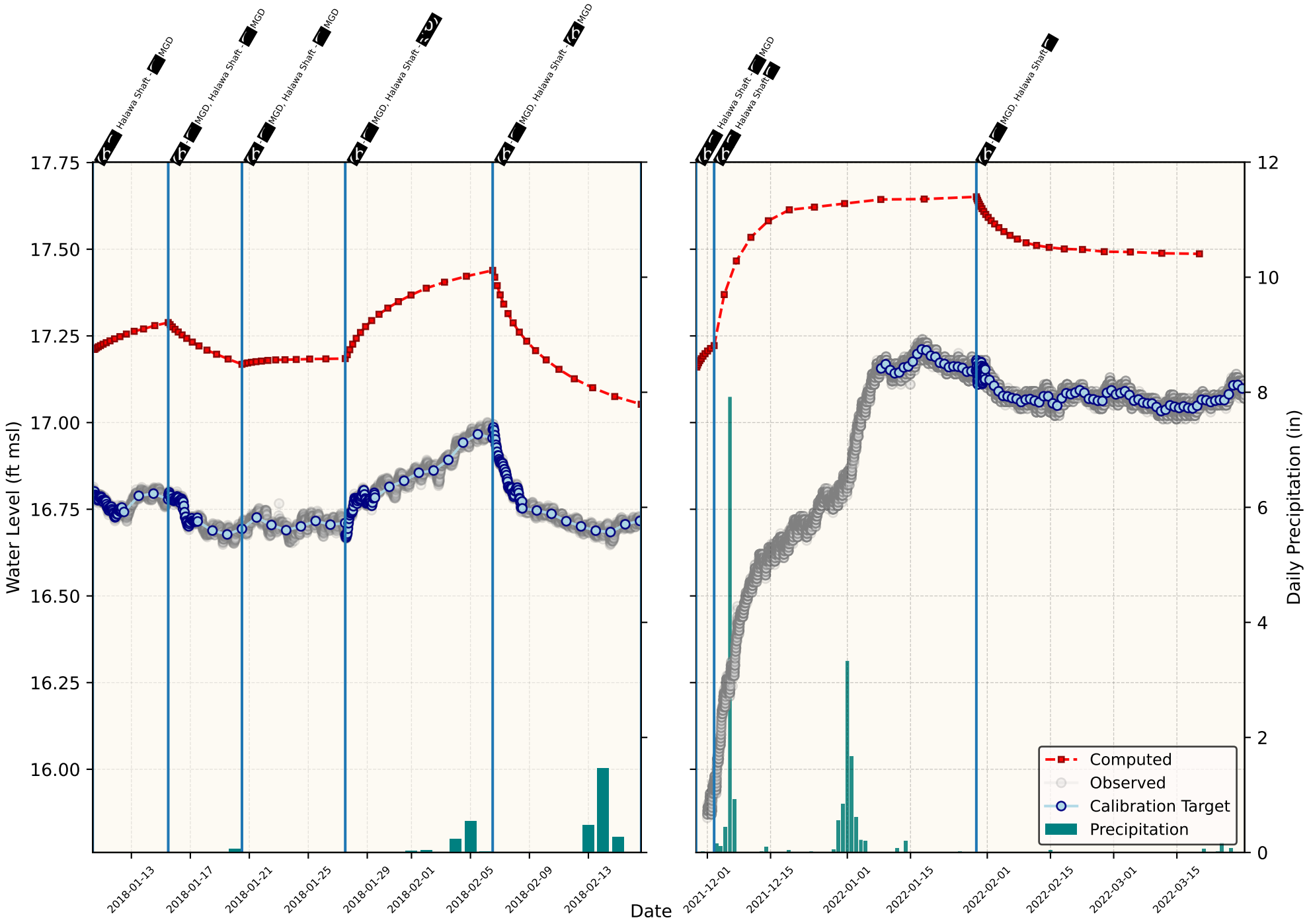
(b)(3) [redacted]

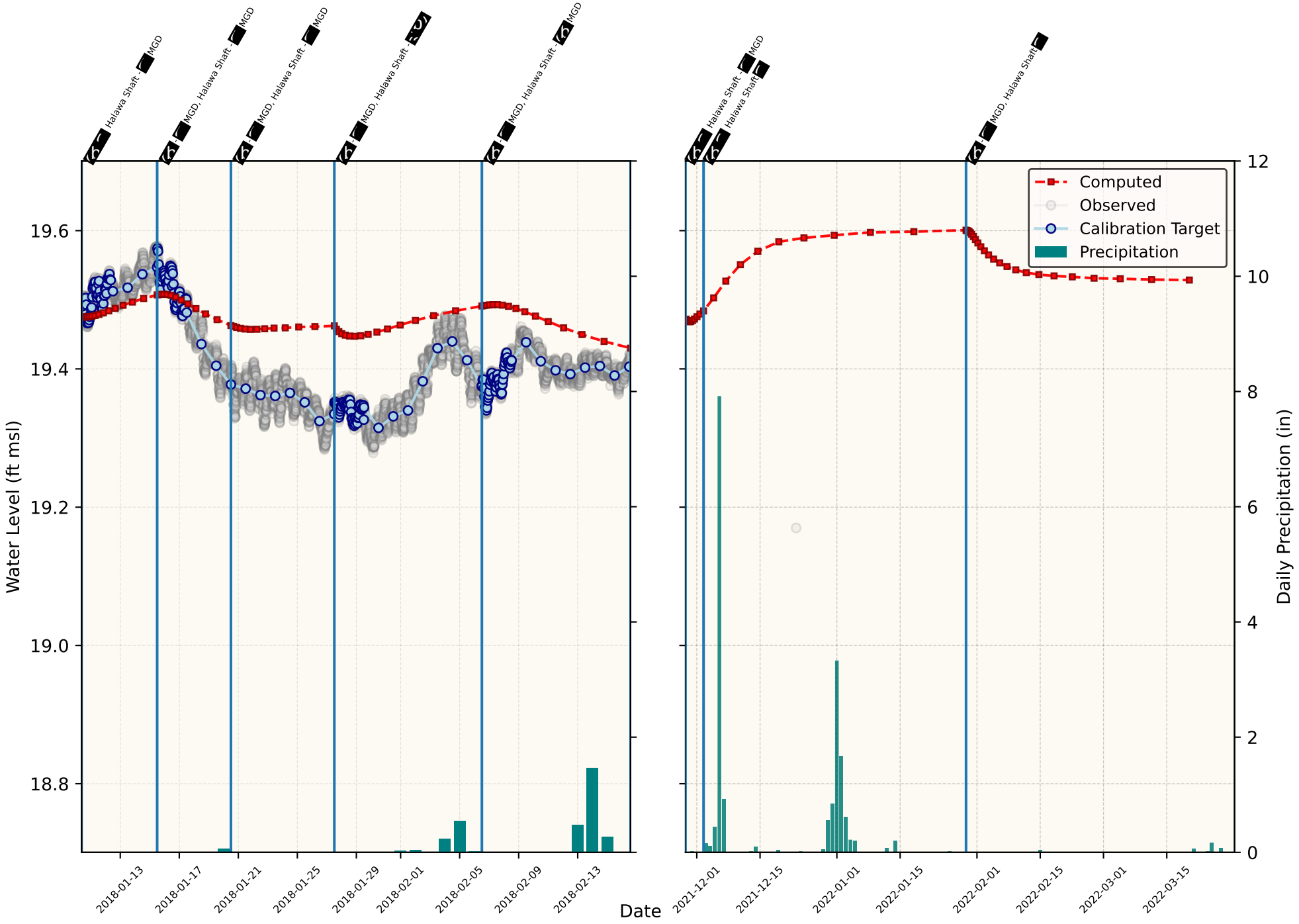
Group 1 - Basal Aquifer

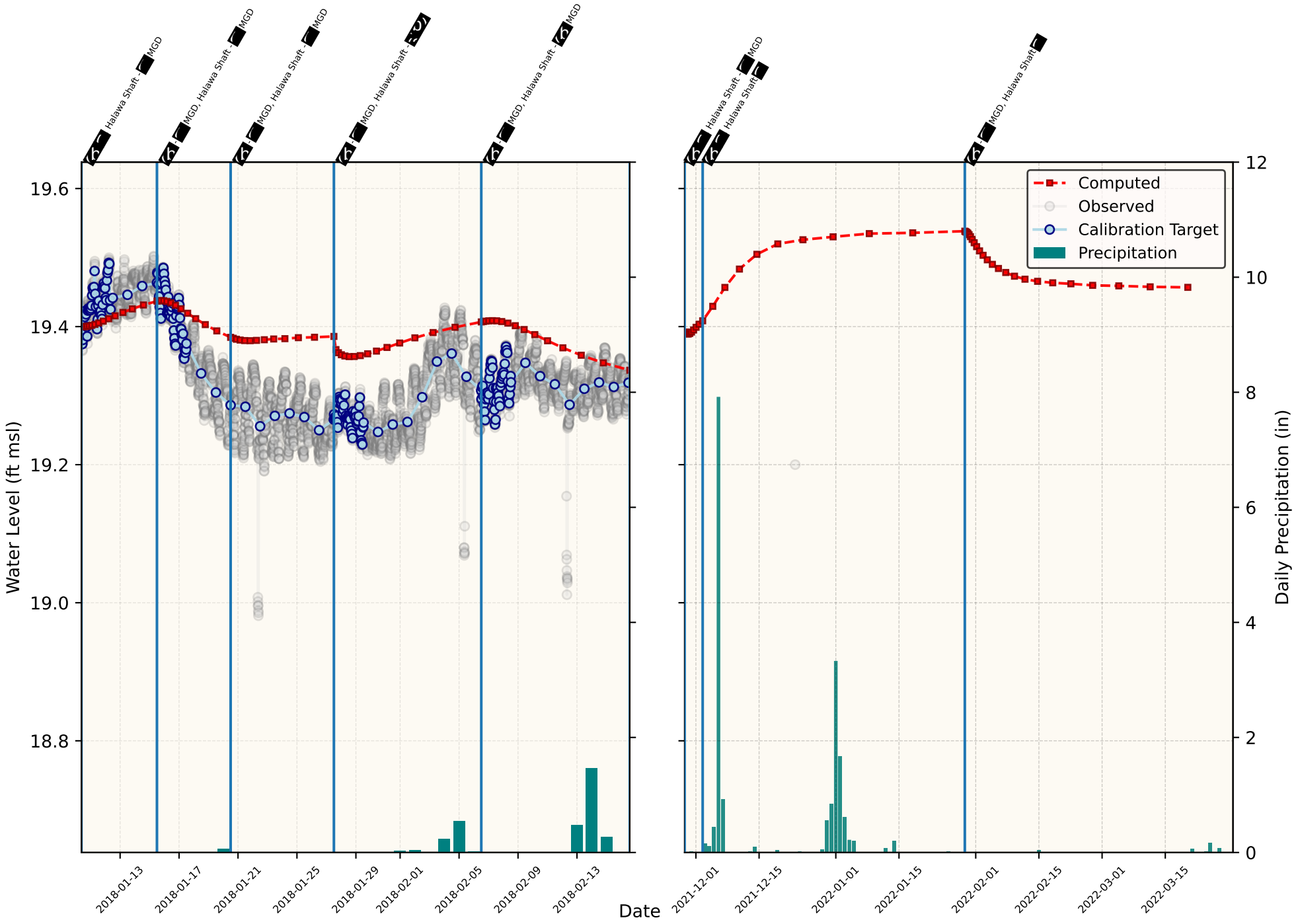


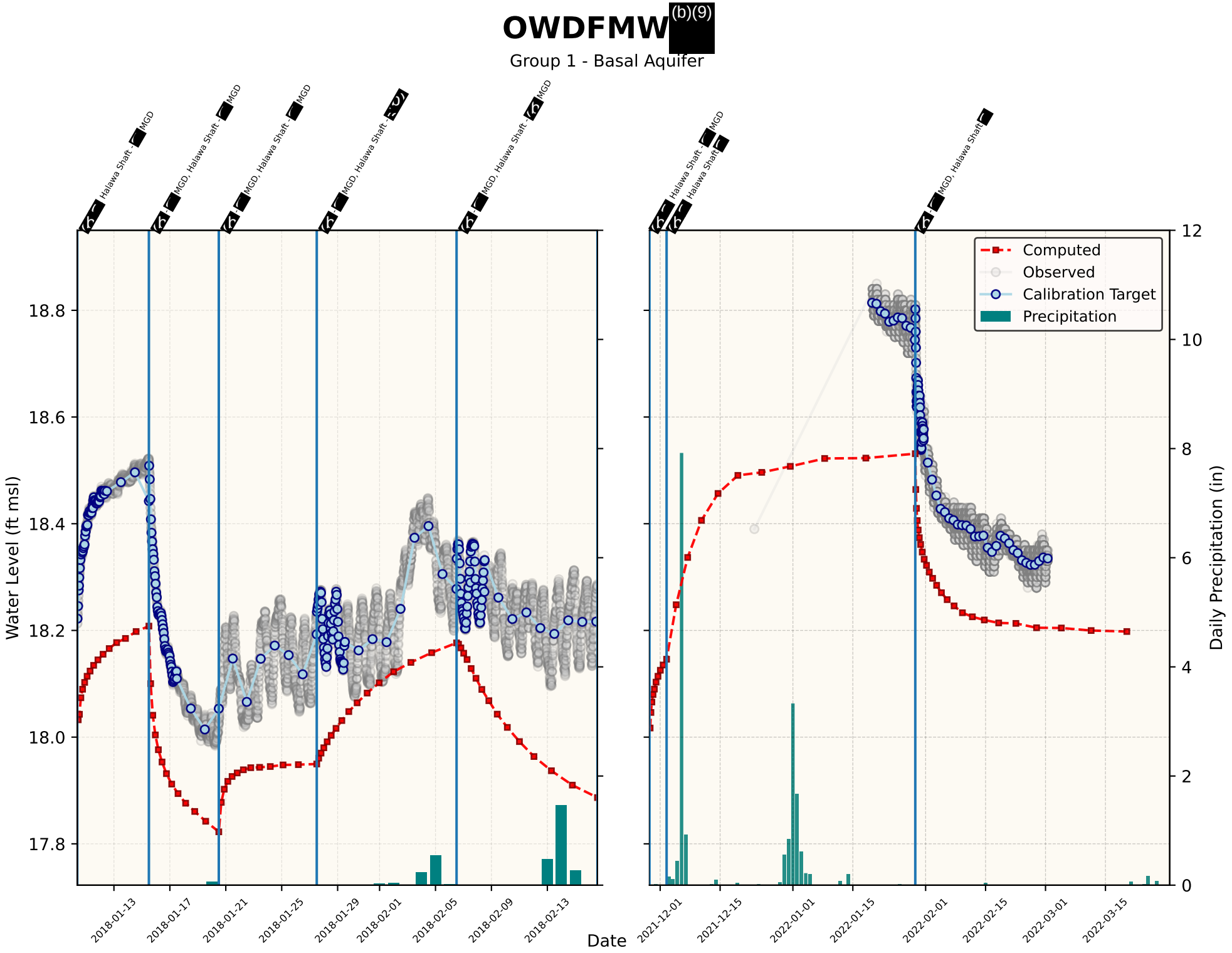

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft MGD
MGD, Halawa Shaft MGD
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

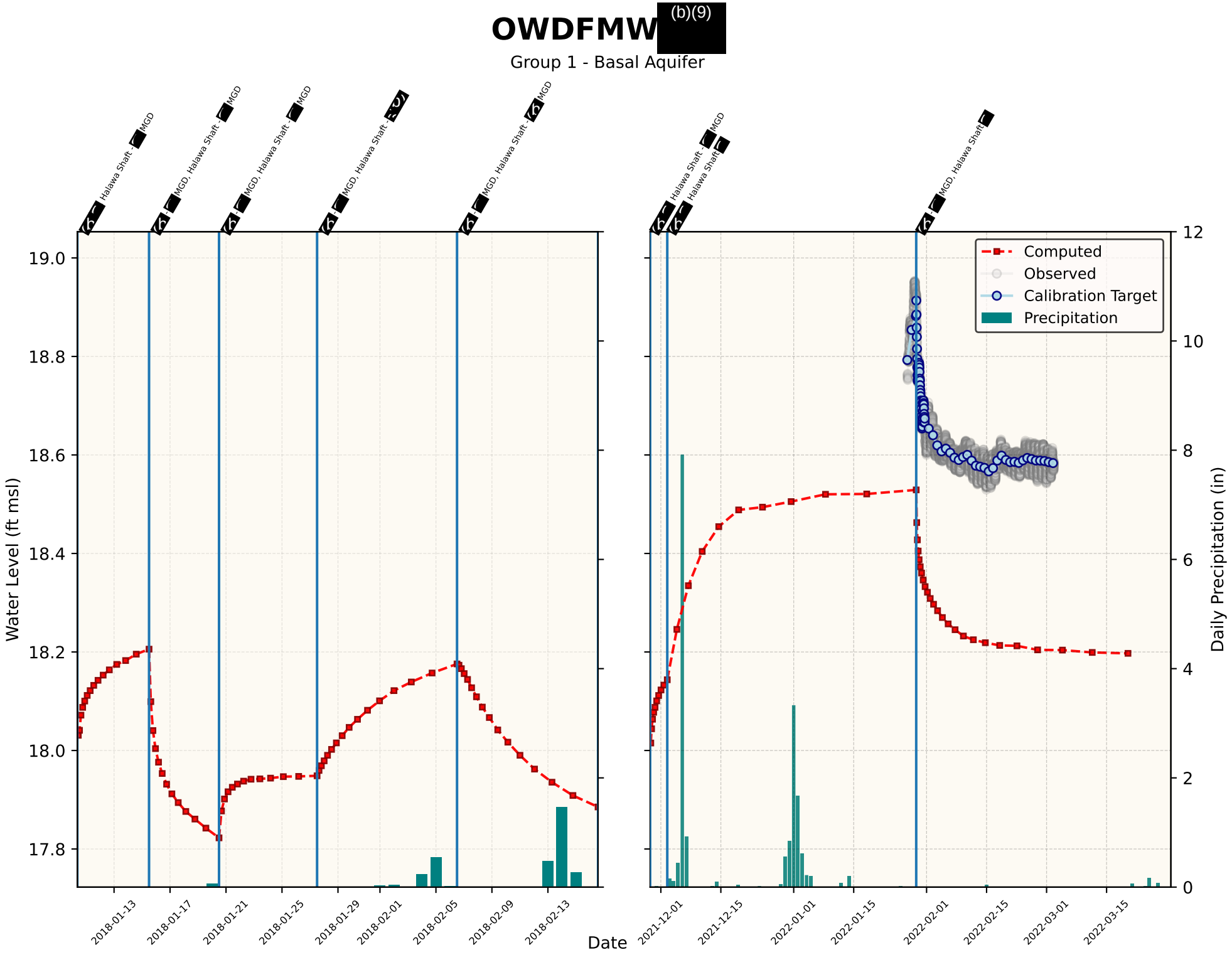

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
17.6
17.4
17.2
17.0
16.8
16.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

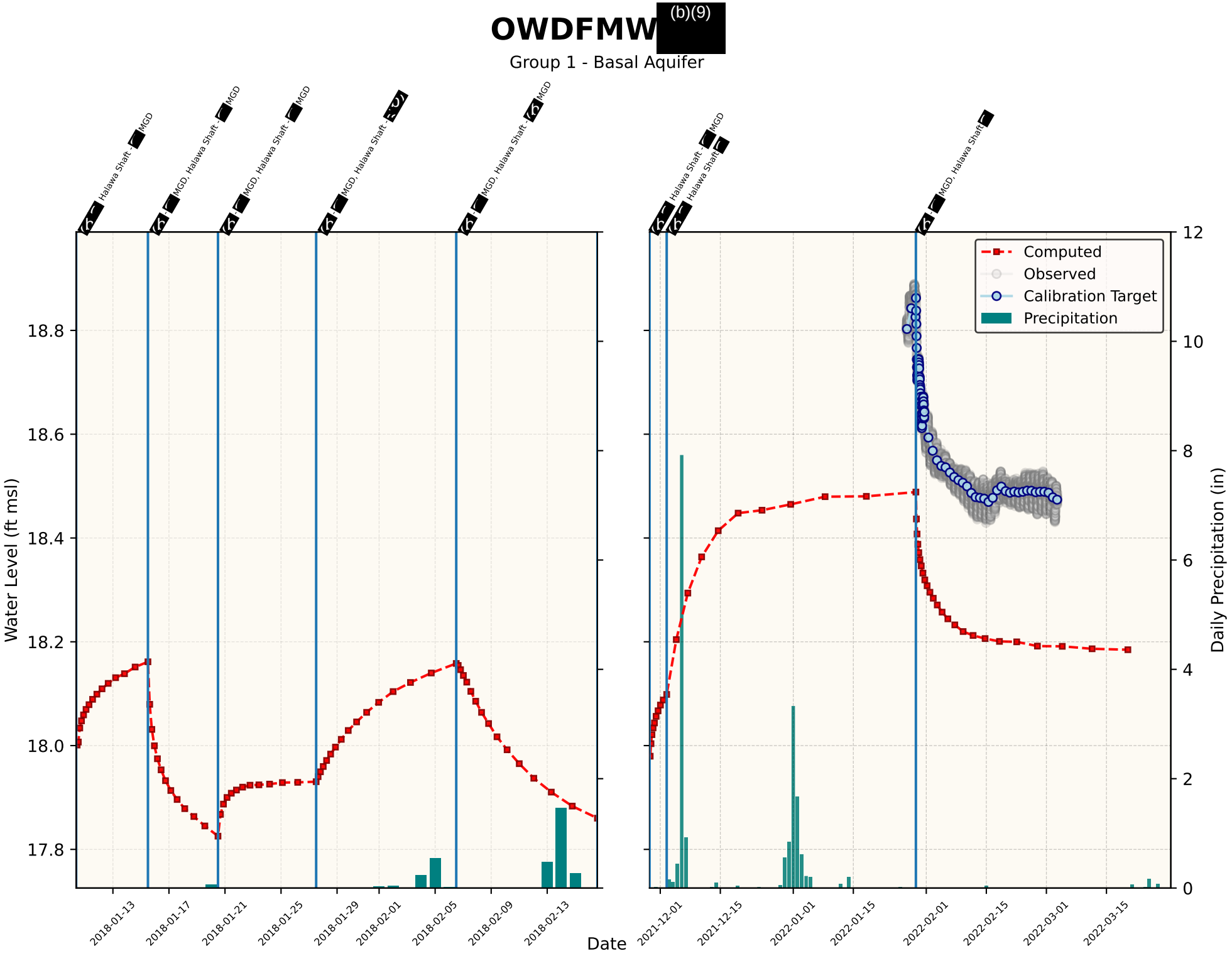

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

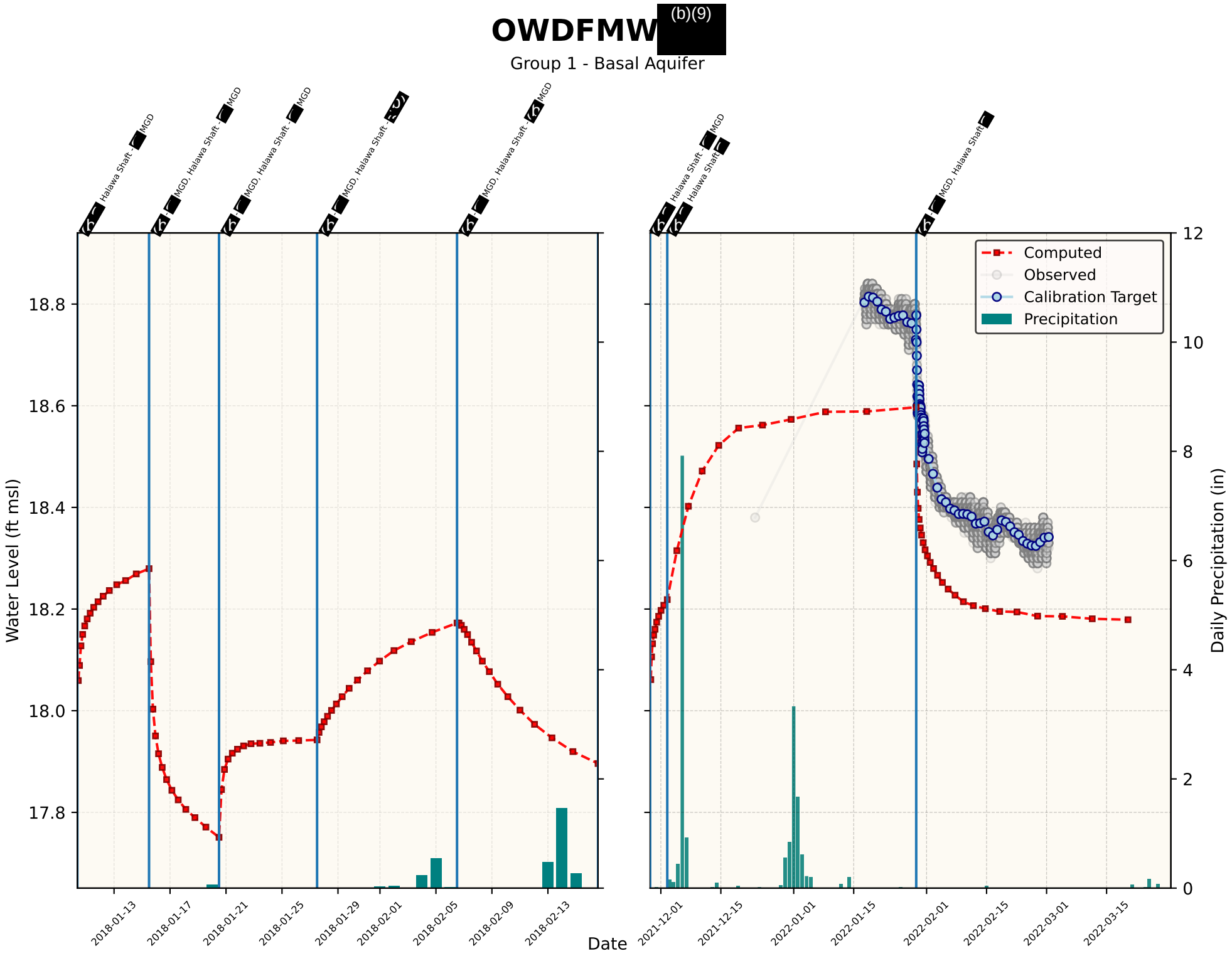

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.6
19.4
19.2
19.0
18.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

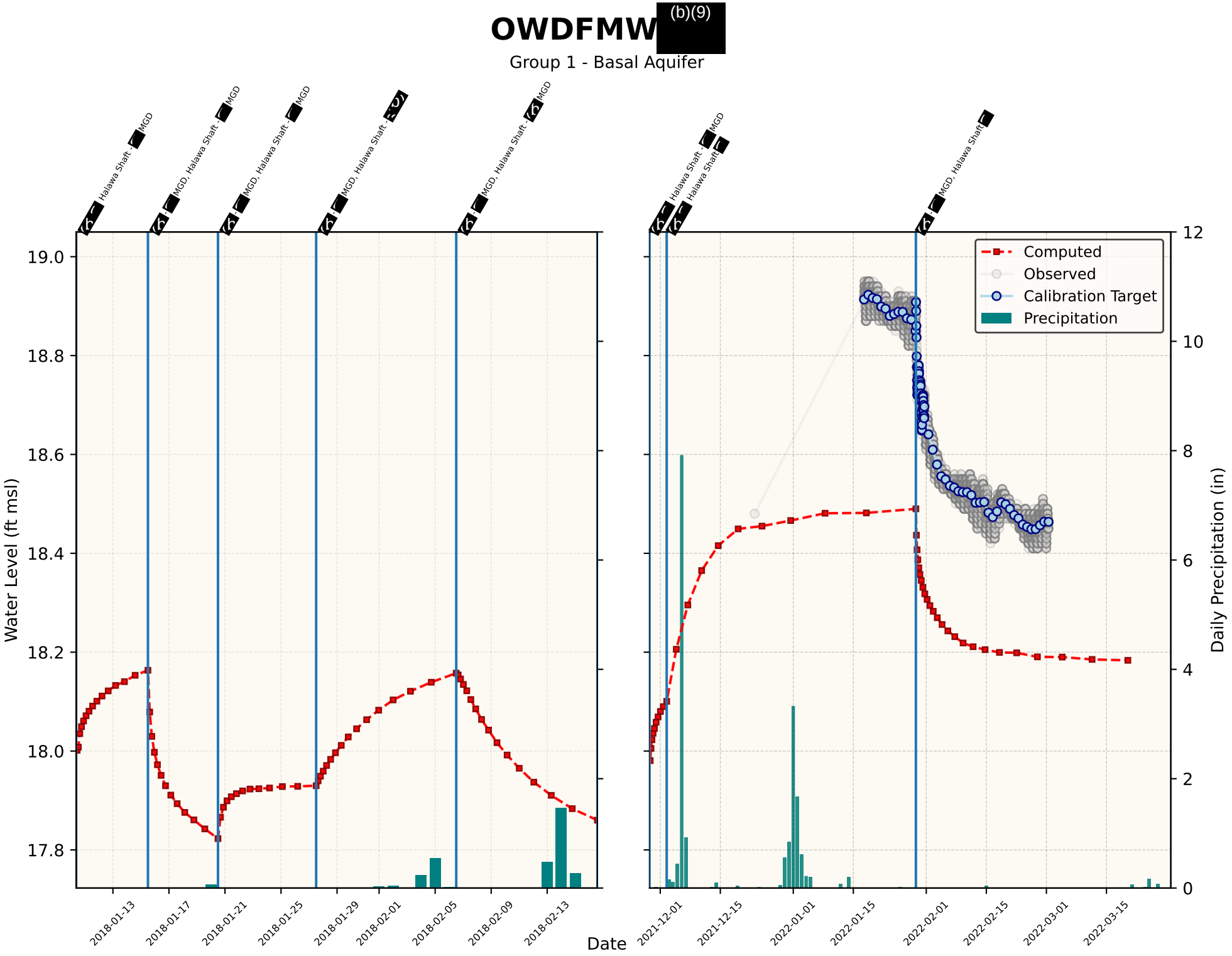

Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
19.6
19.4
19.2
19.0
18.8
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date

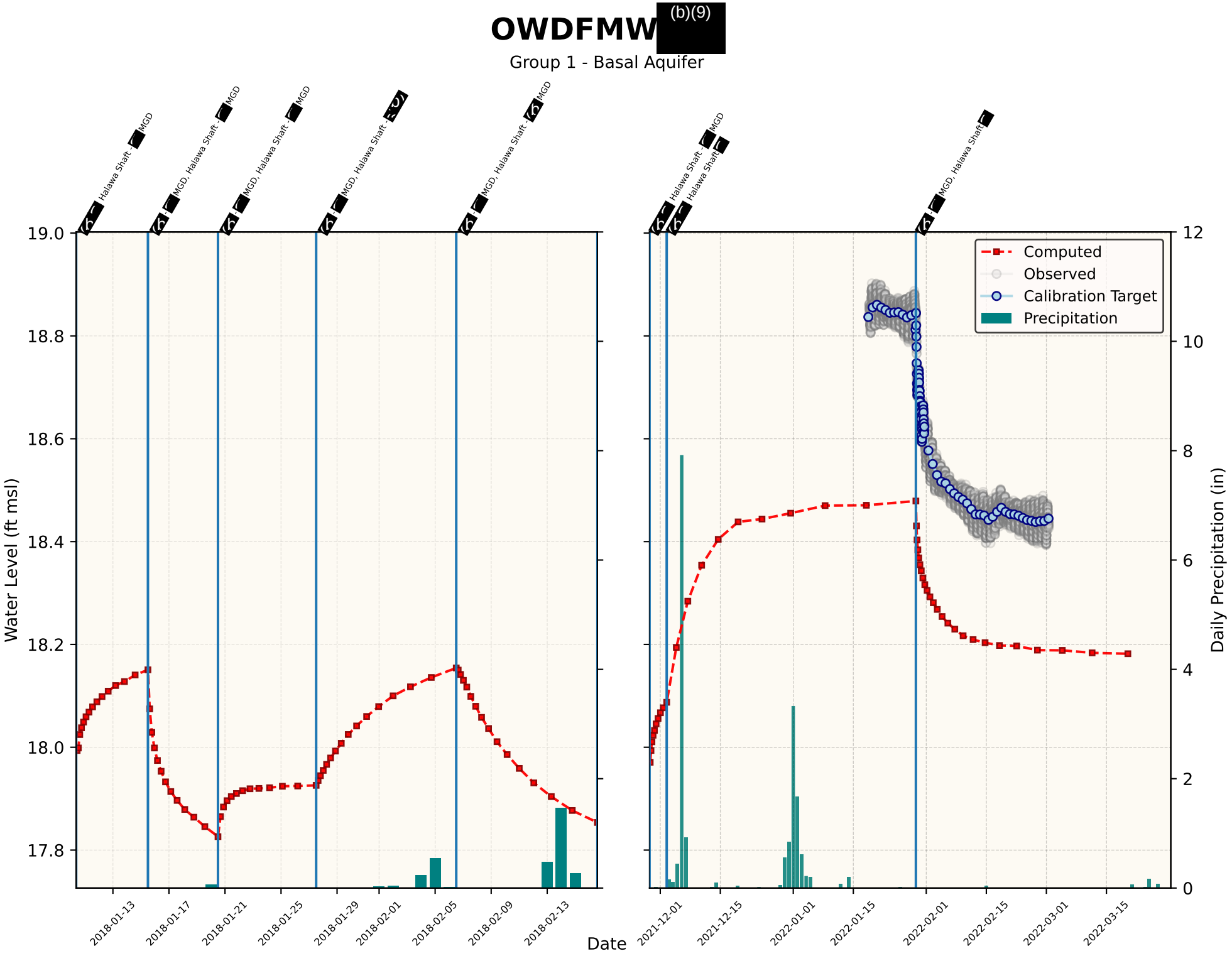

OWDFMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

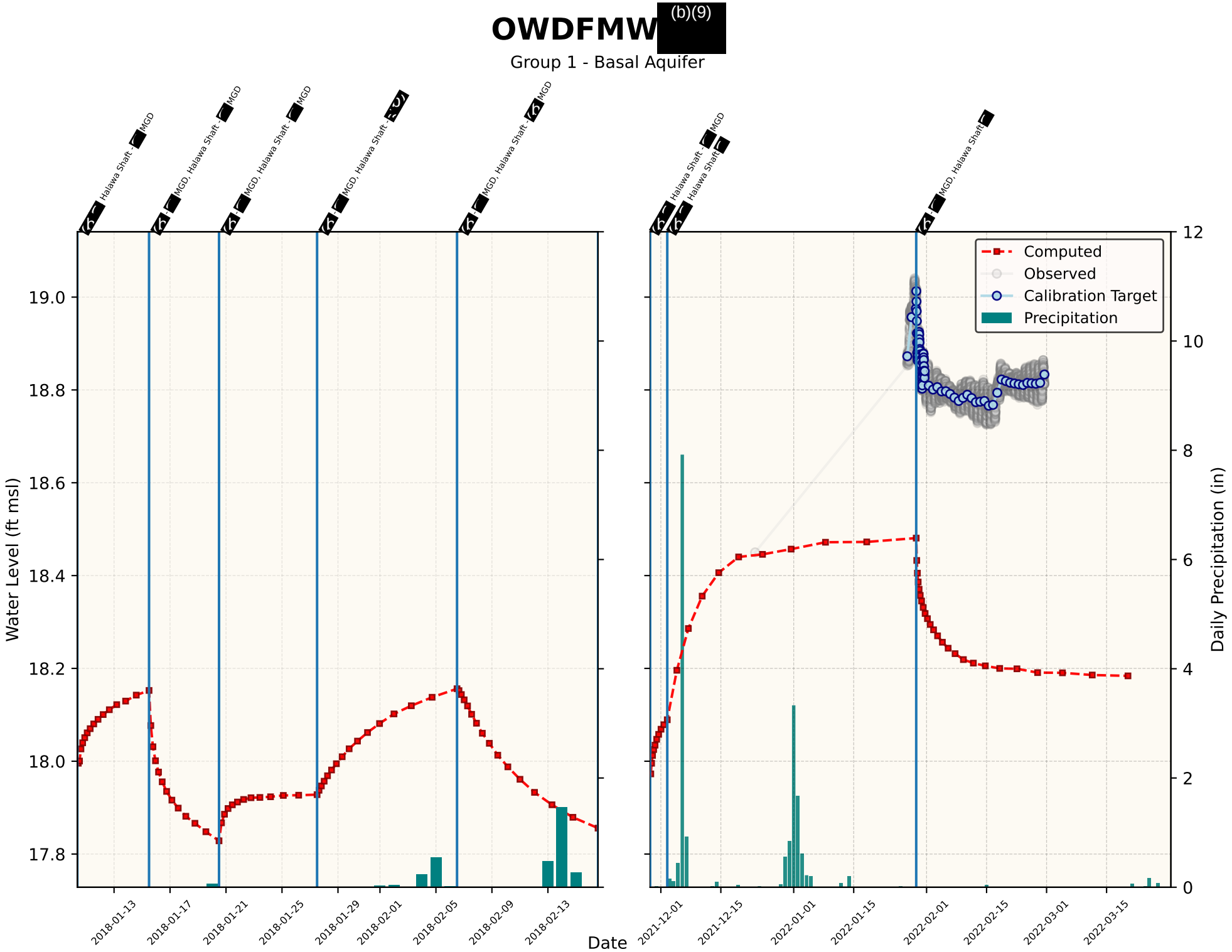

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
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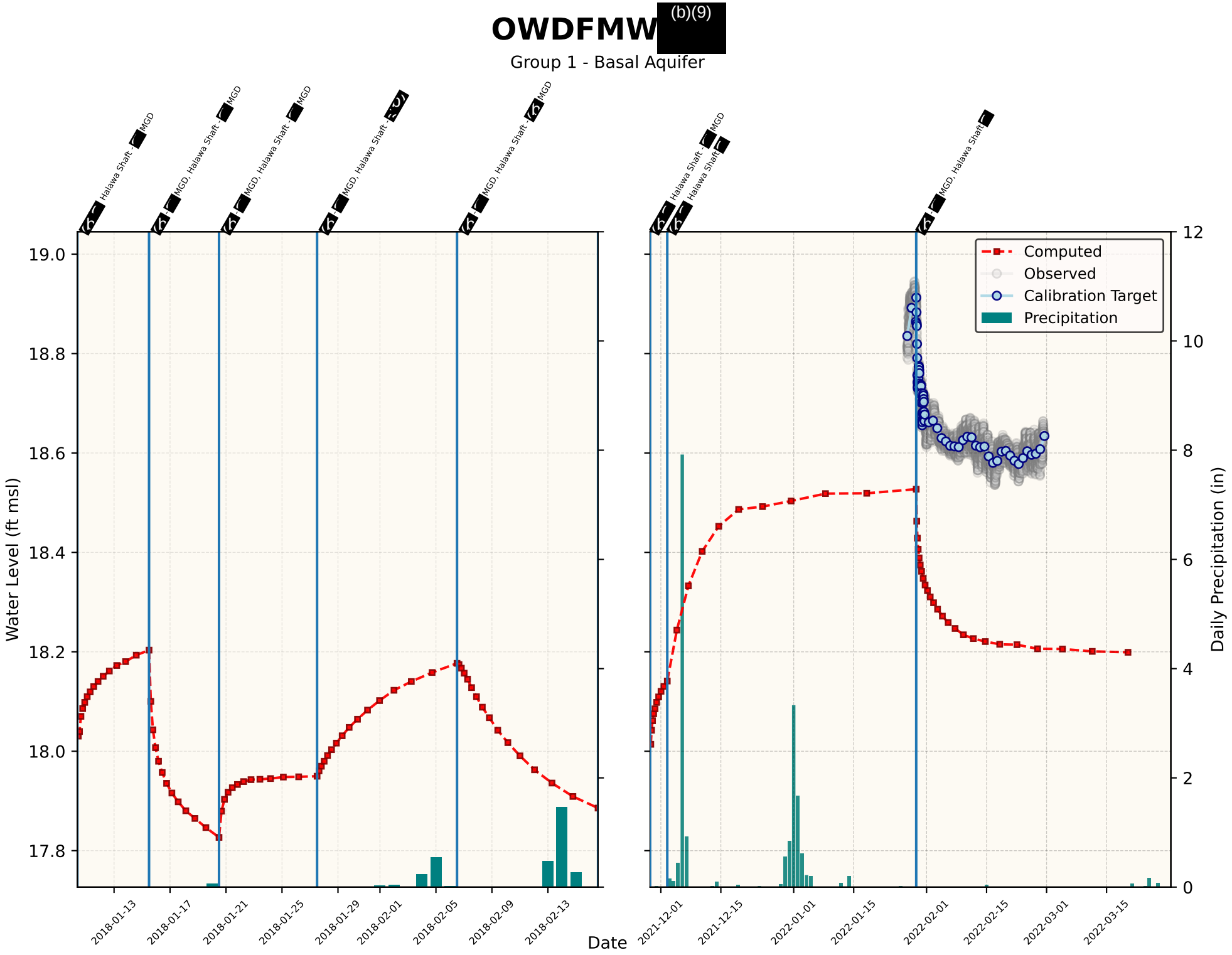

OWDFMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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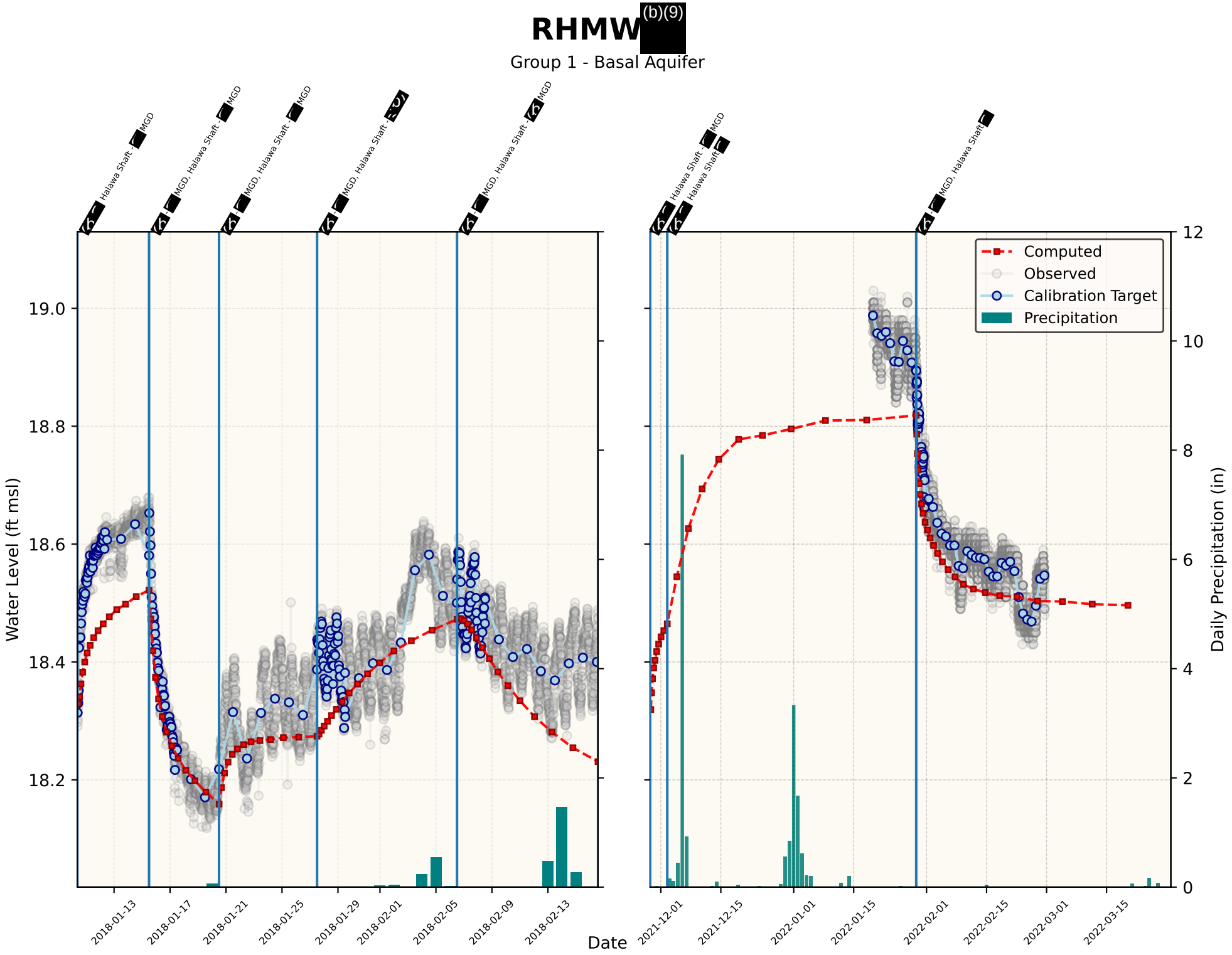

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
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OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
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MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
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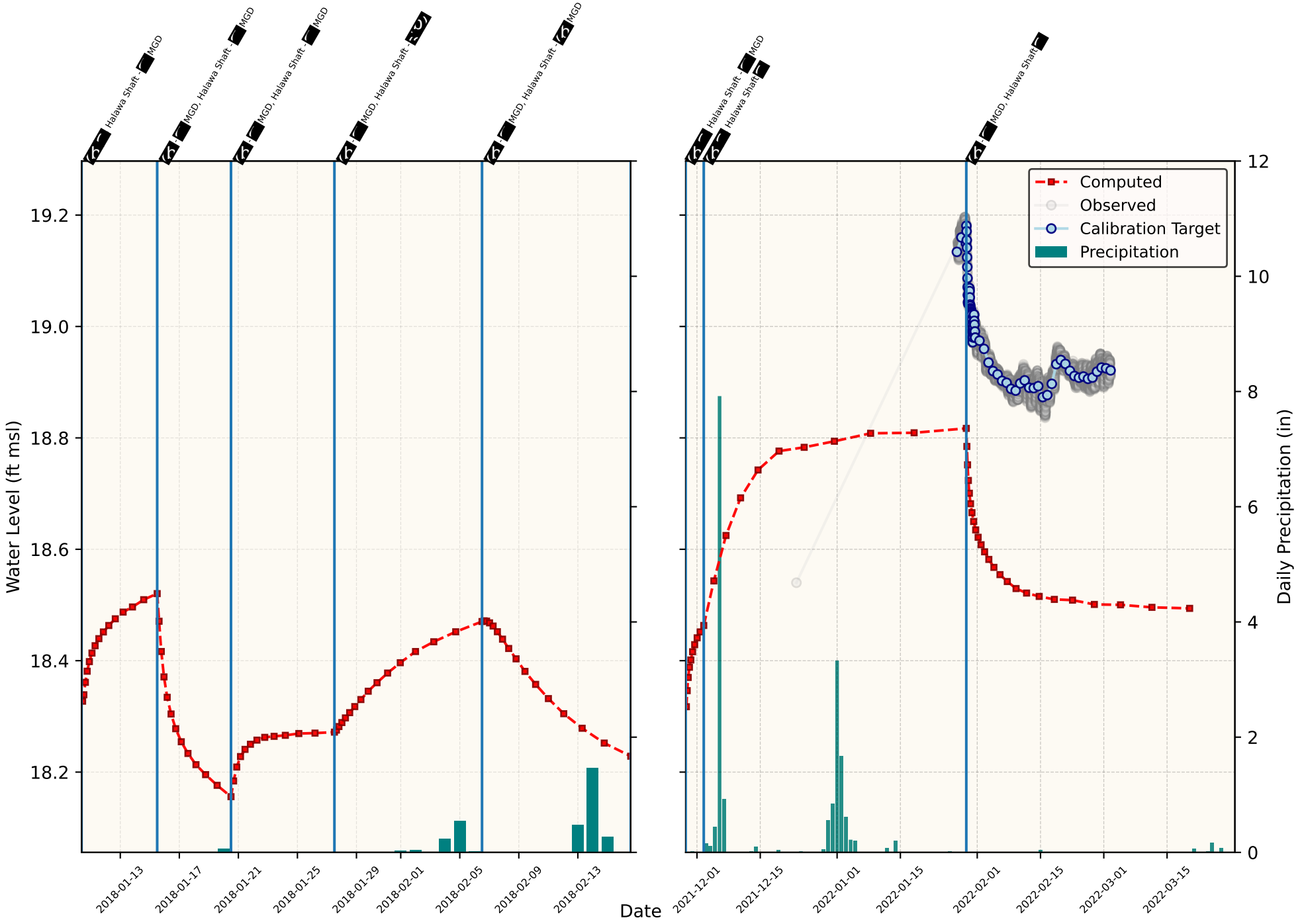

OWDFMW (b)(9)
Group 1 - Basal Aquifer
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Computed
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Water Level (ft msl)
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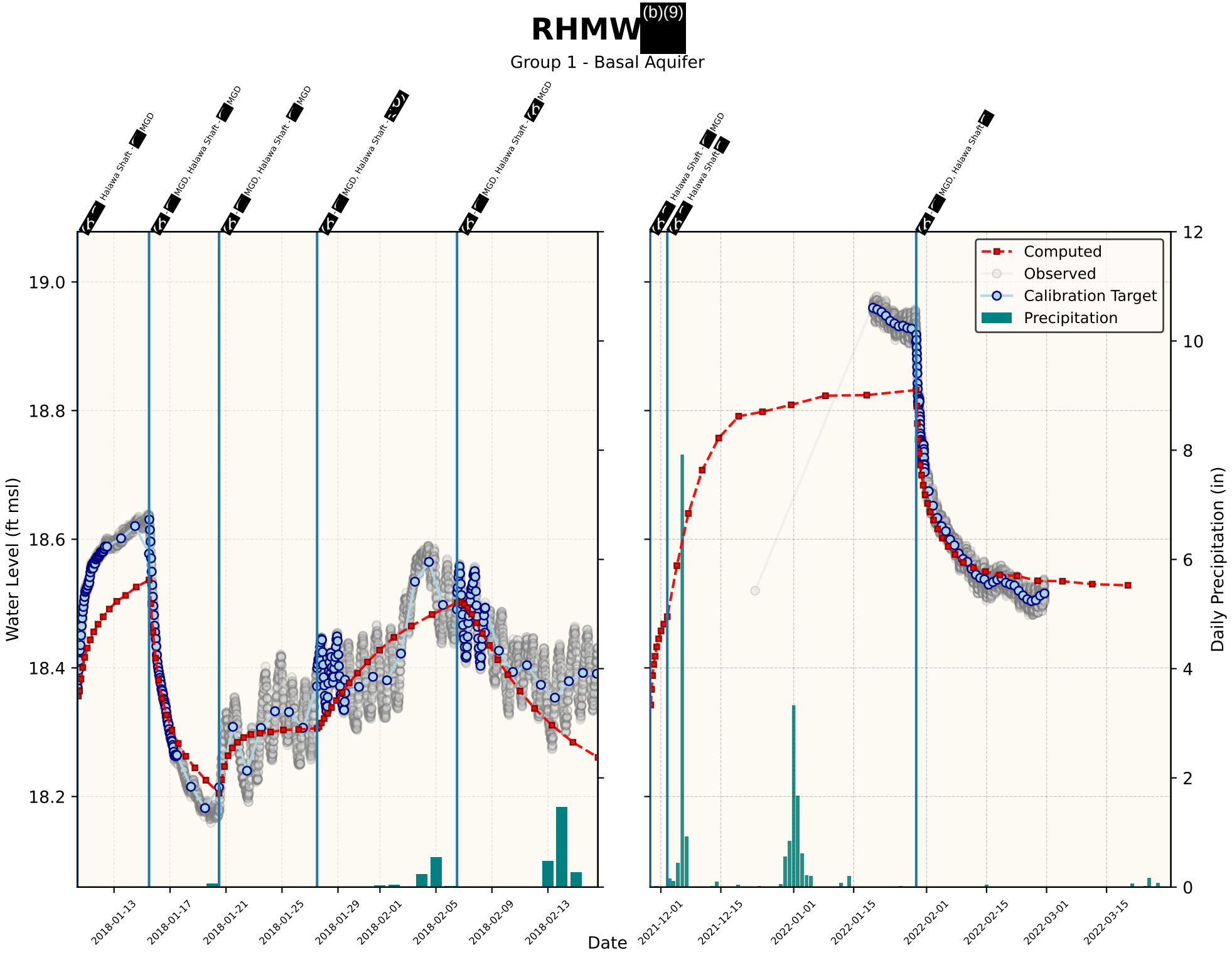

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
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Computed
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Precipitation
Water Level (ft msl)
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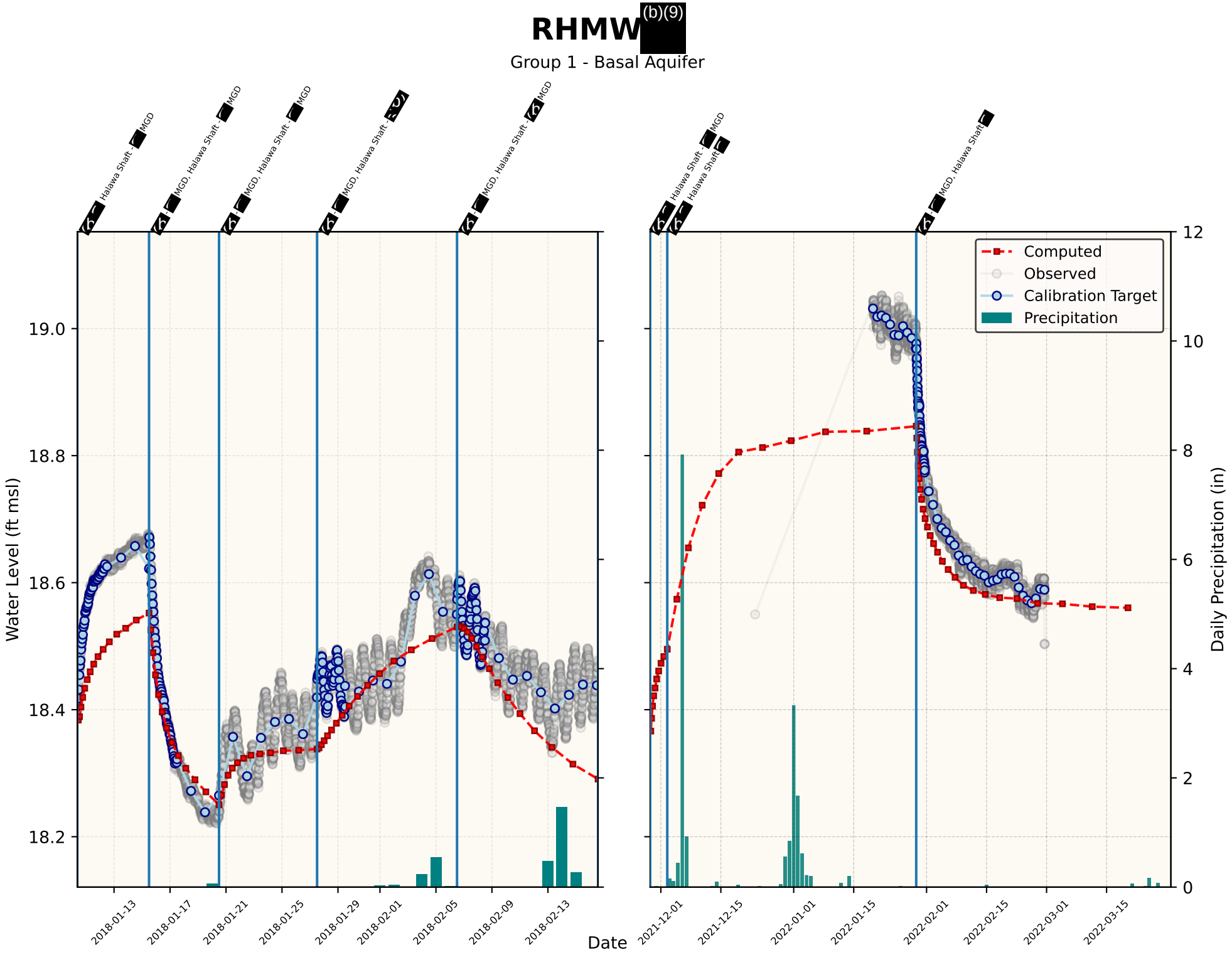

RHMW[redacted](b)(9)
Group 1 - Basal Aquifer
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Observed
Calibration Target
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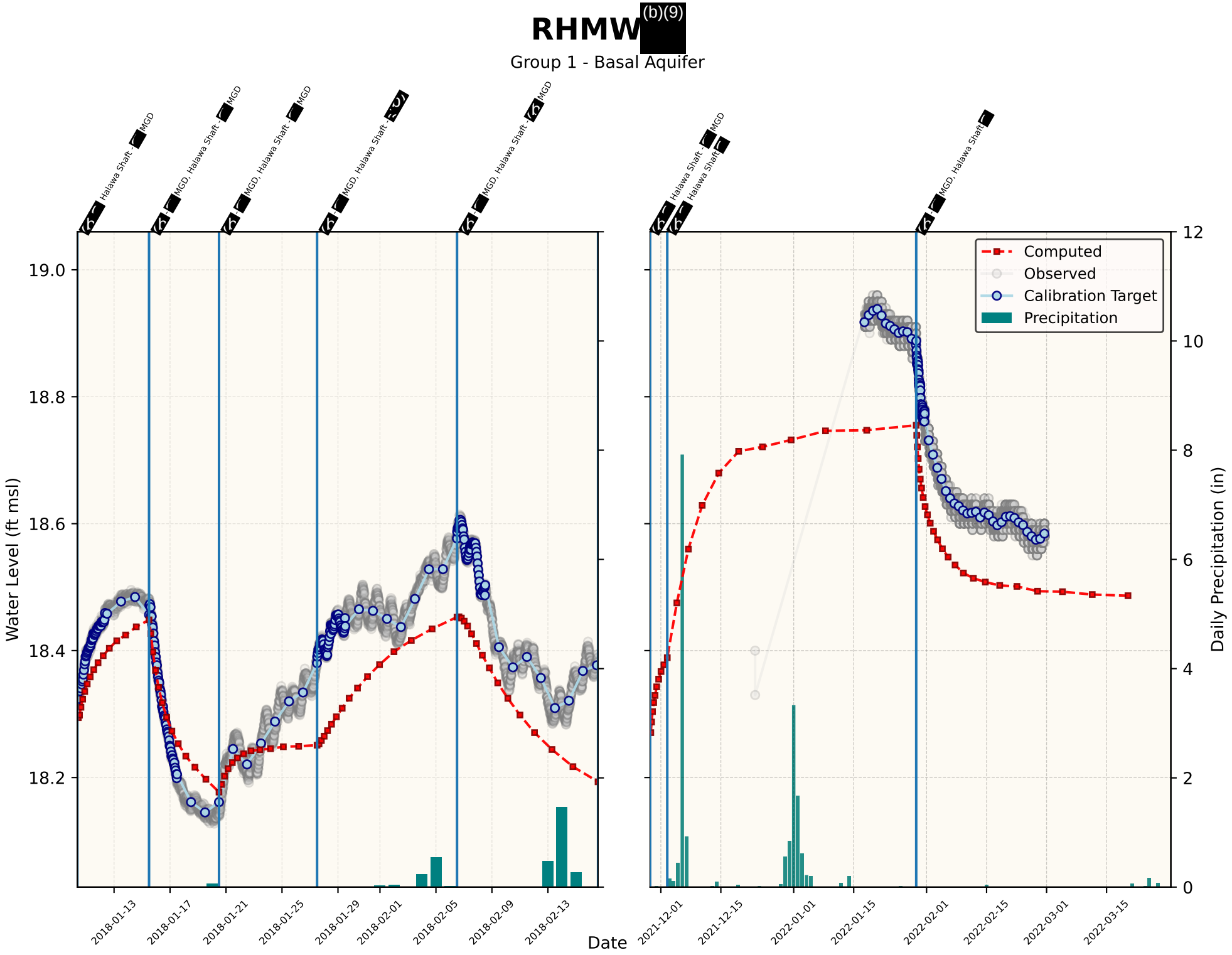
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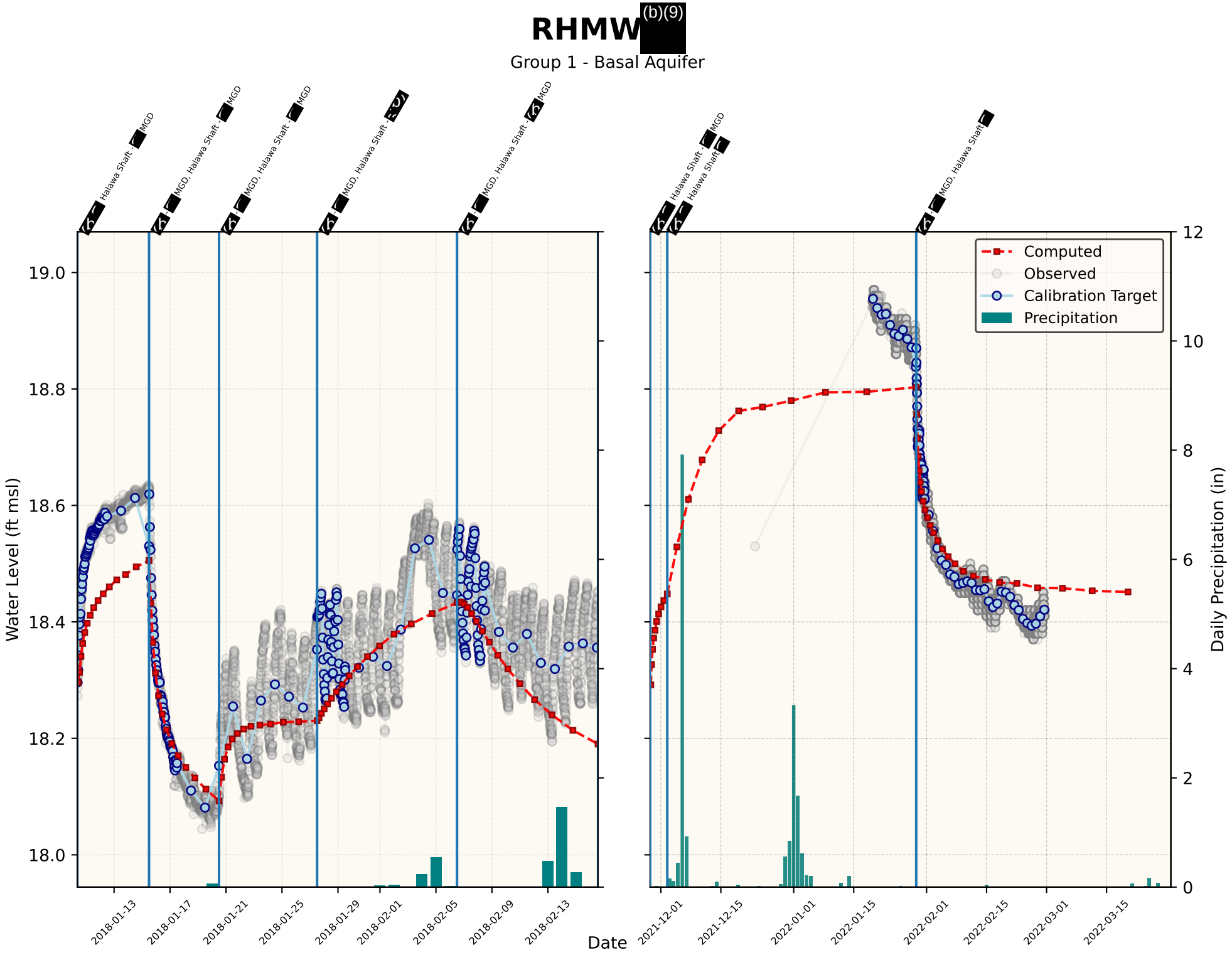
Group 1 - Basal Aquifer

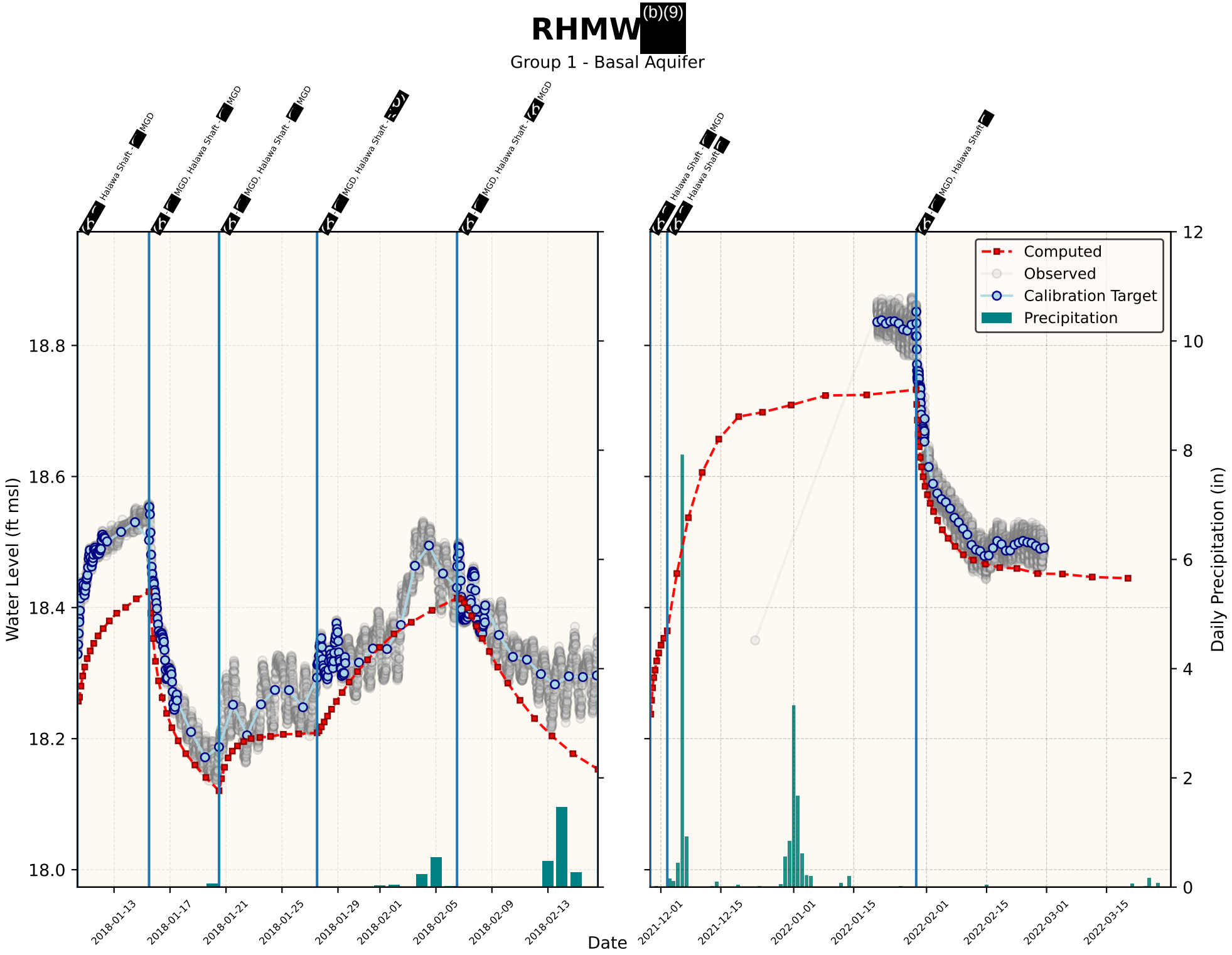


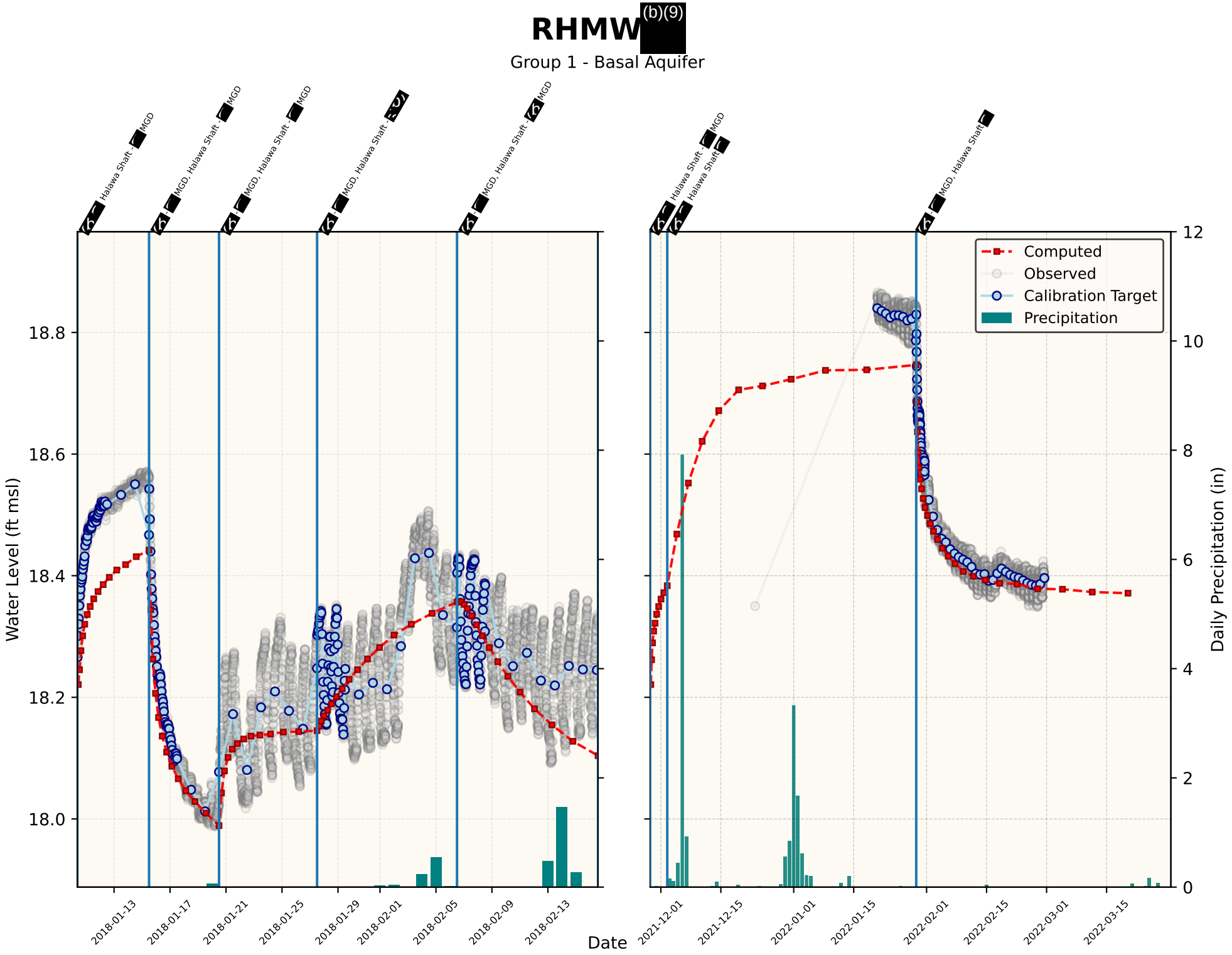

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
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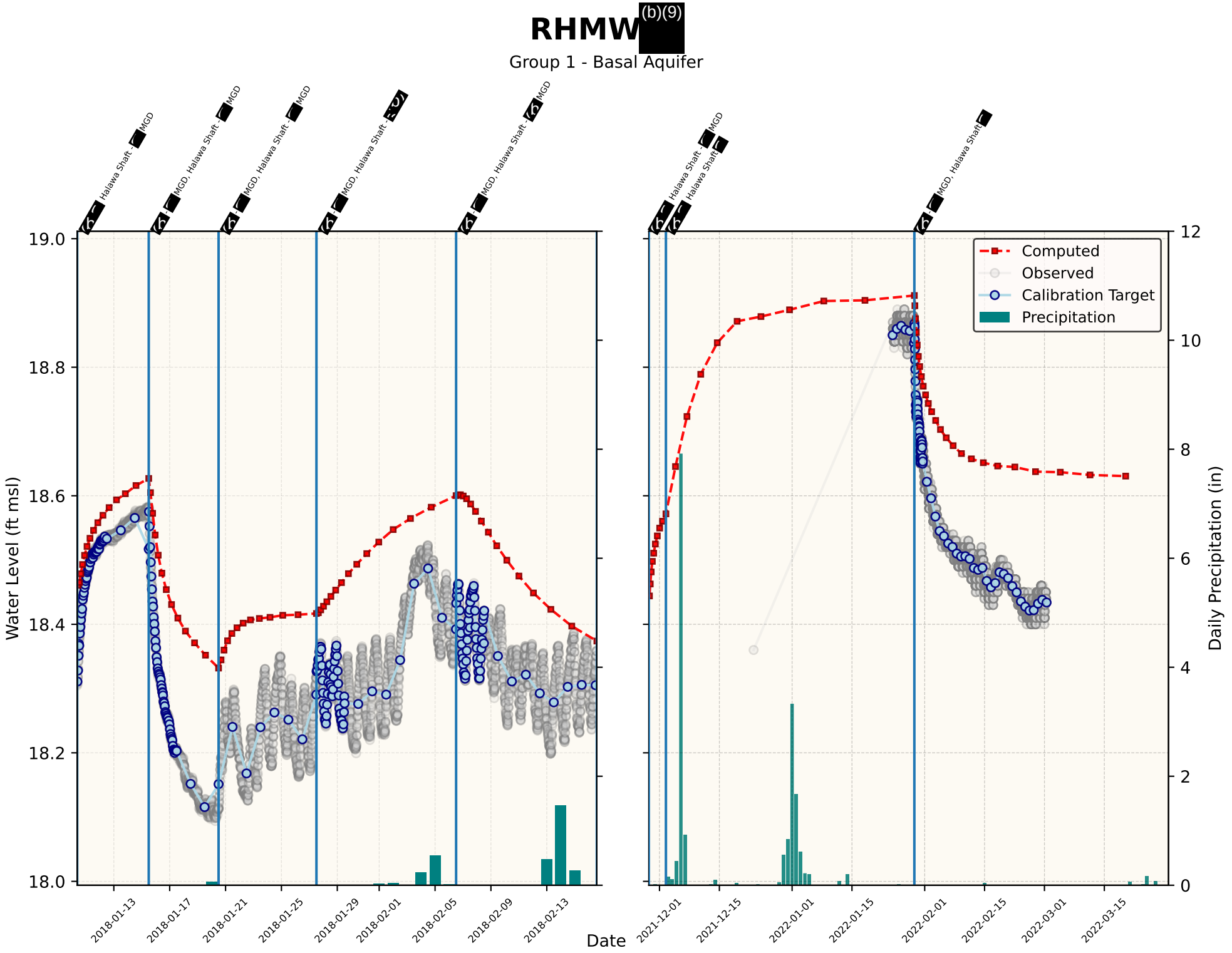

RHMW(b)(9)
Group 1 - Basal Aquifer
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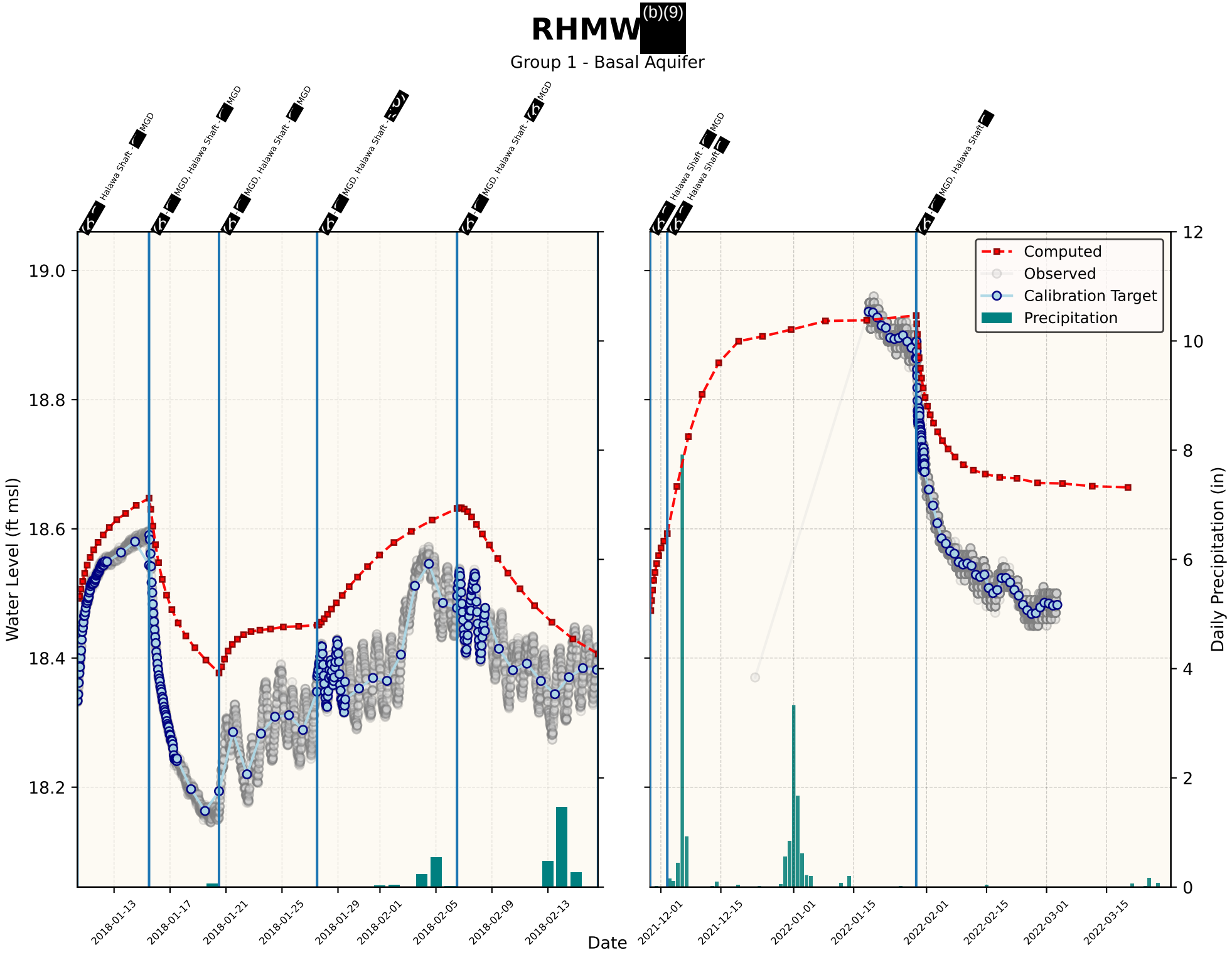

RHMW[redacted]
Group 1 - Basal Aquifer
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Computed
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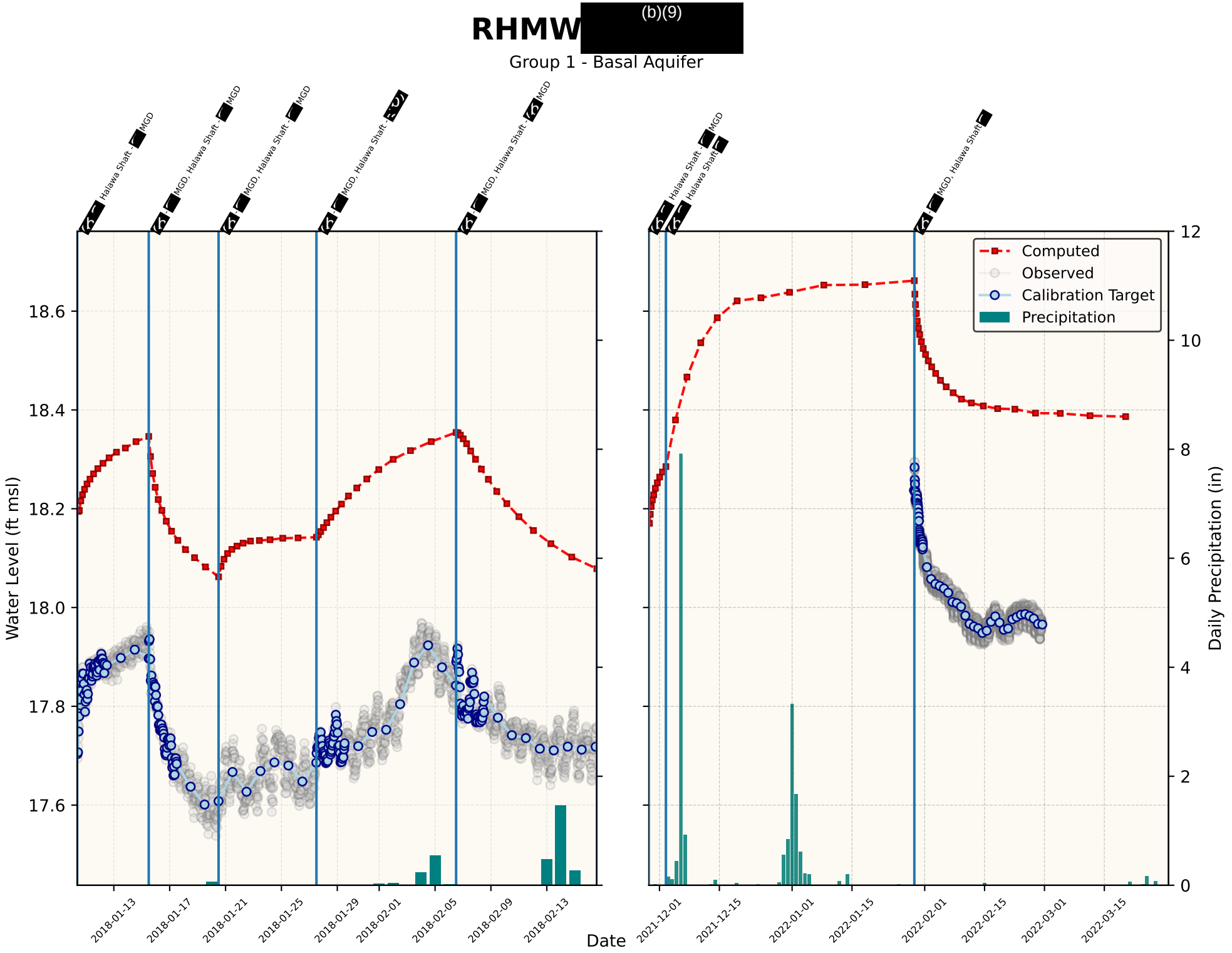

RHMW[redacted](b)(9)
Group 1 - Basal Aquifer
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Observed
Calibration Target
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Water Level (ft msl)
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RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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Computed
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Calibration Target
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Water Level (ft msl)
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RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
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MGD, Halawa Shaft
Computed
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Precipitation
Water Level (ft msl)
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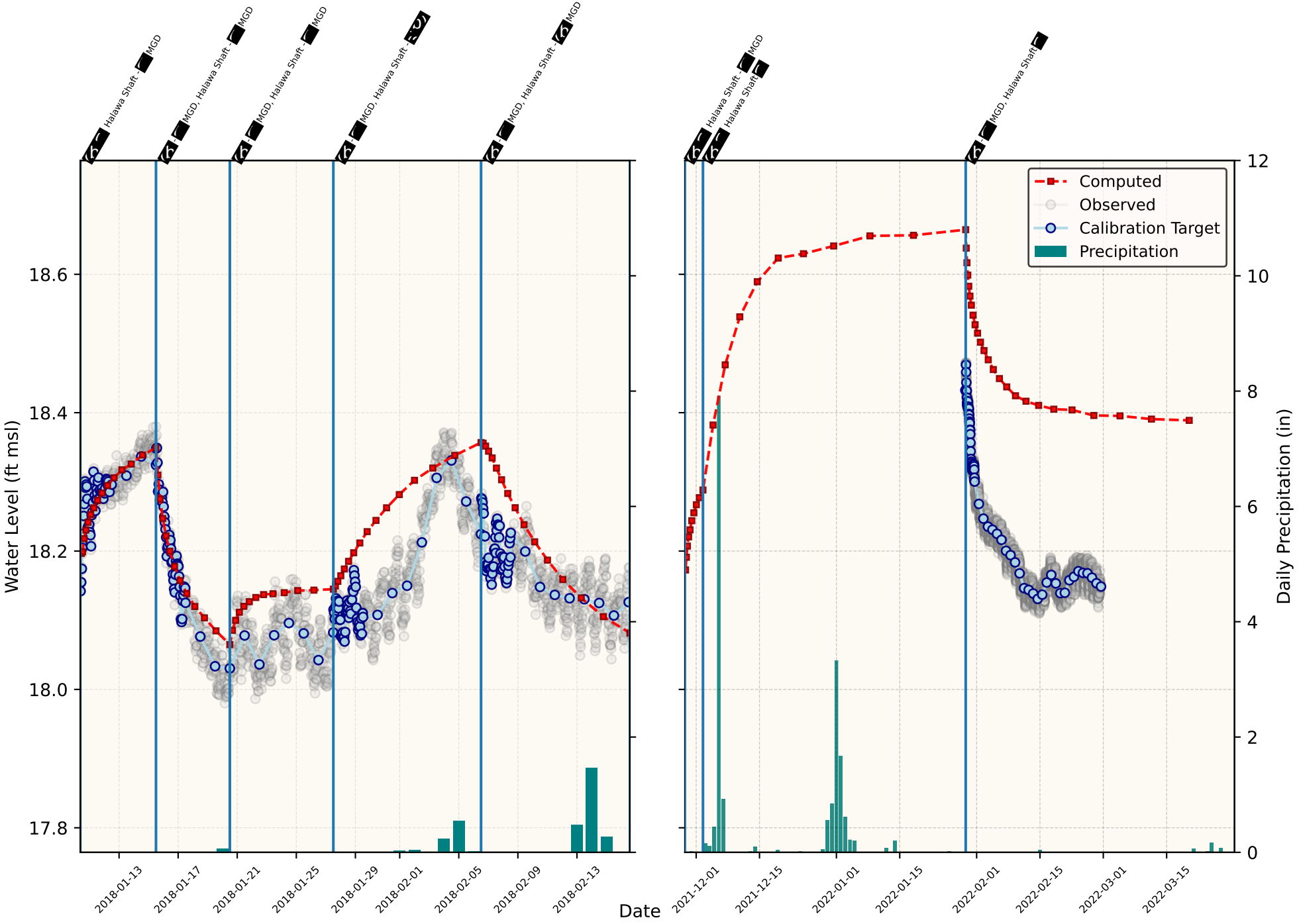

RHMW(b)(9)
Group 1 - Basal Aquifer
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Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
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RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
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Calibration Target
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RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
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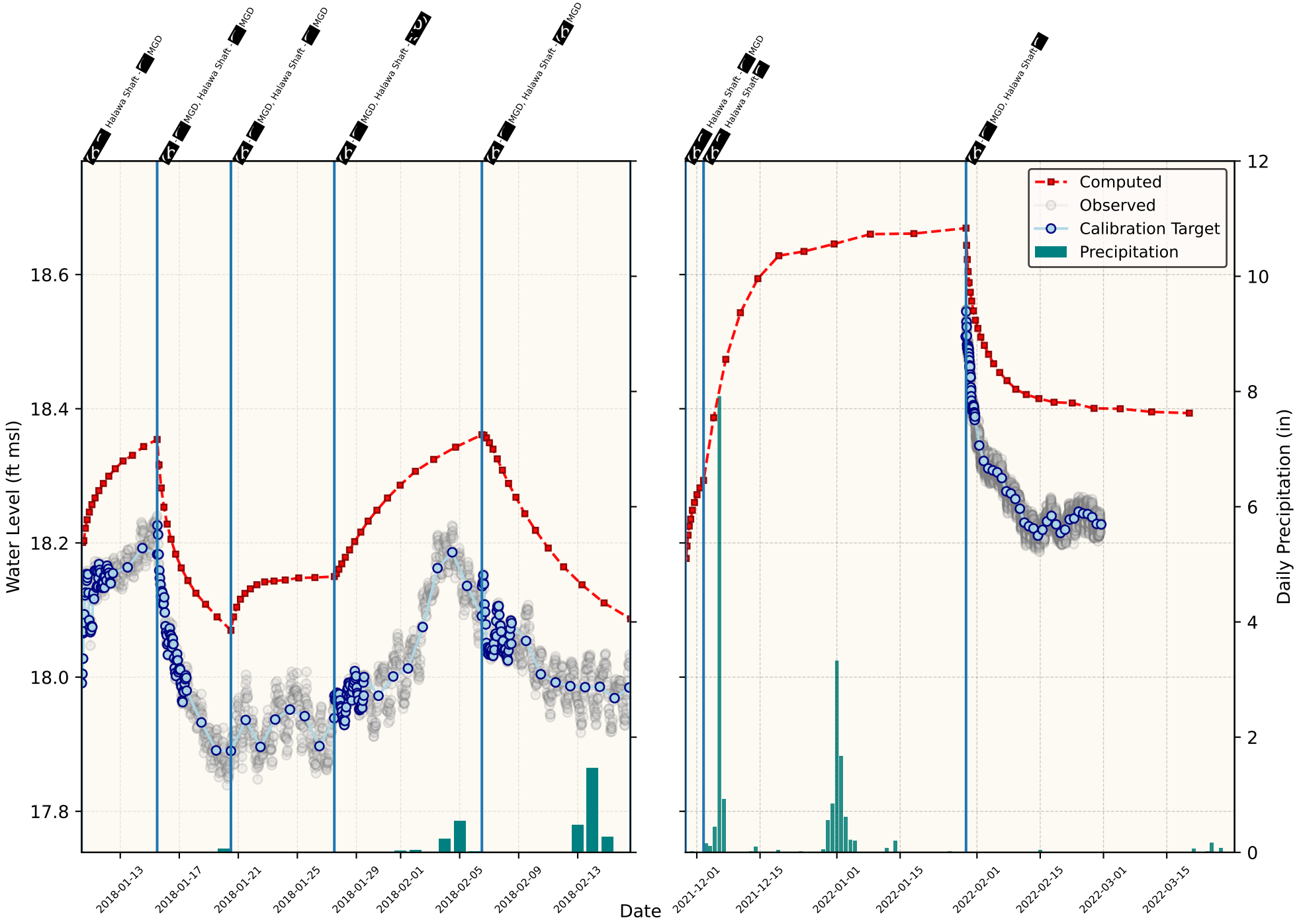
RHMW (b)(9)

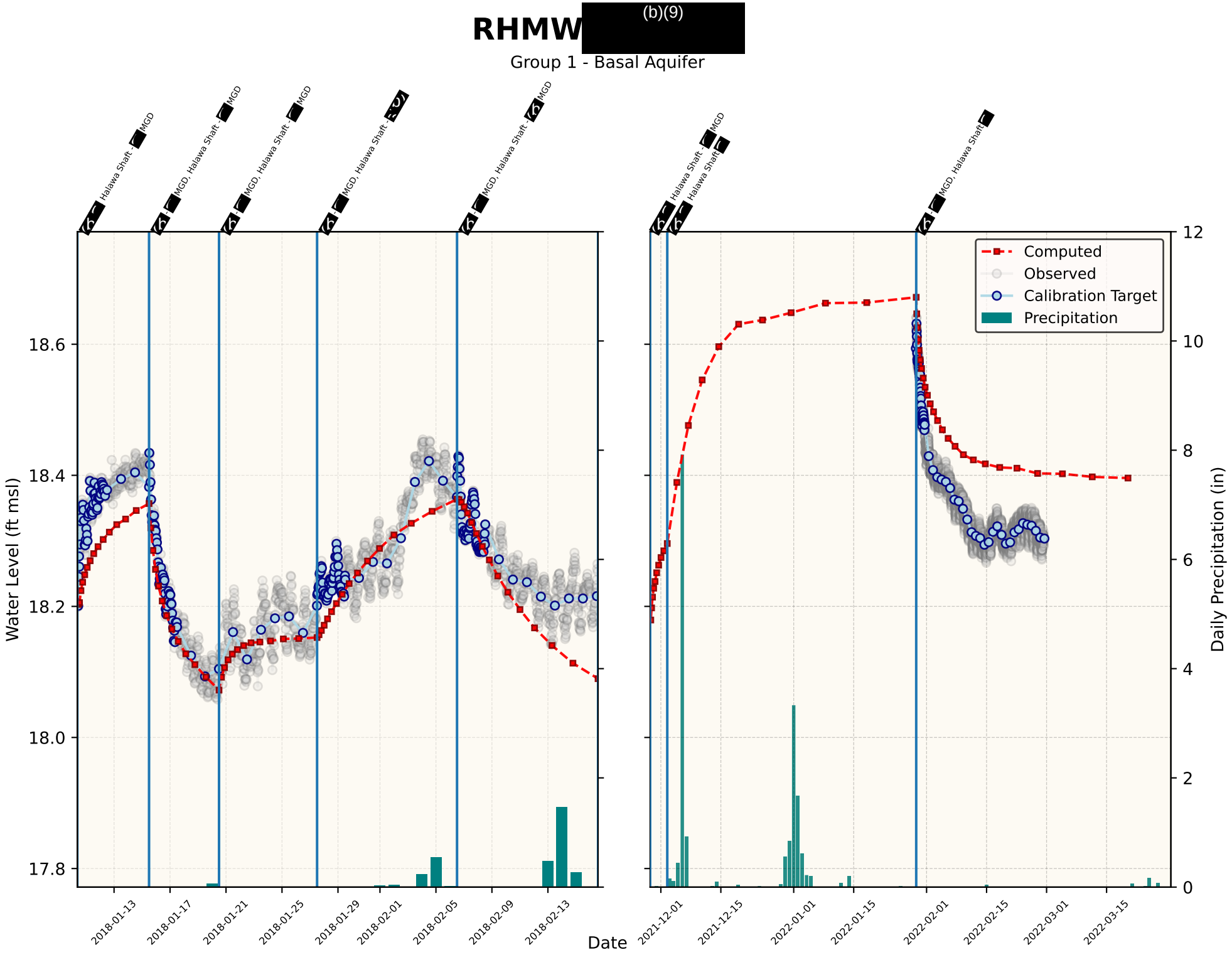
Group 1 - Basal Aquifer

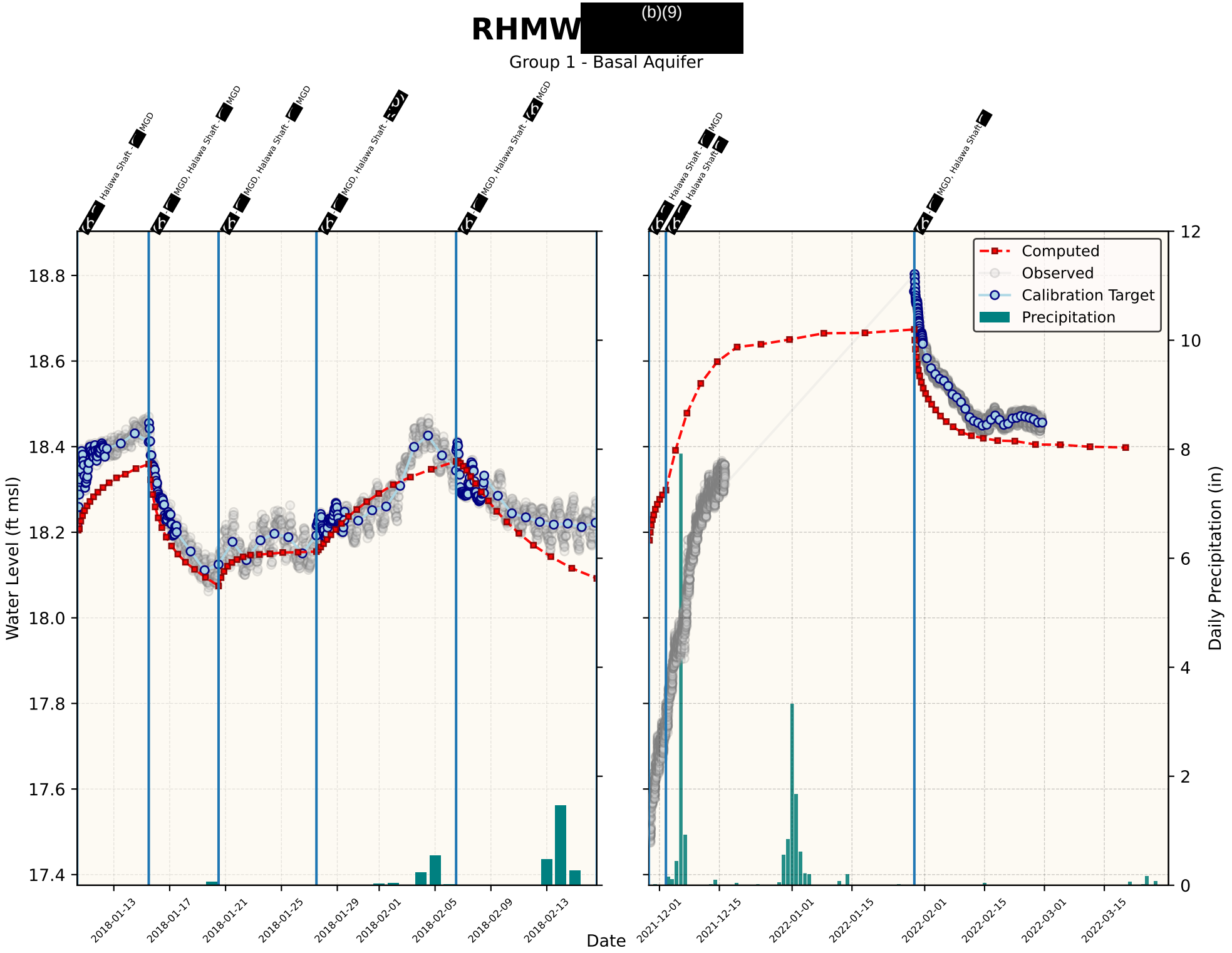


RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer

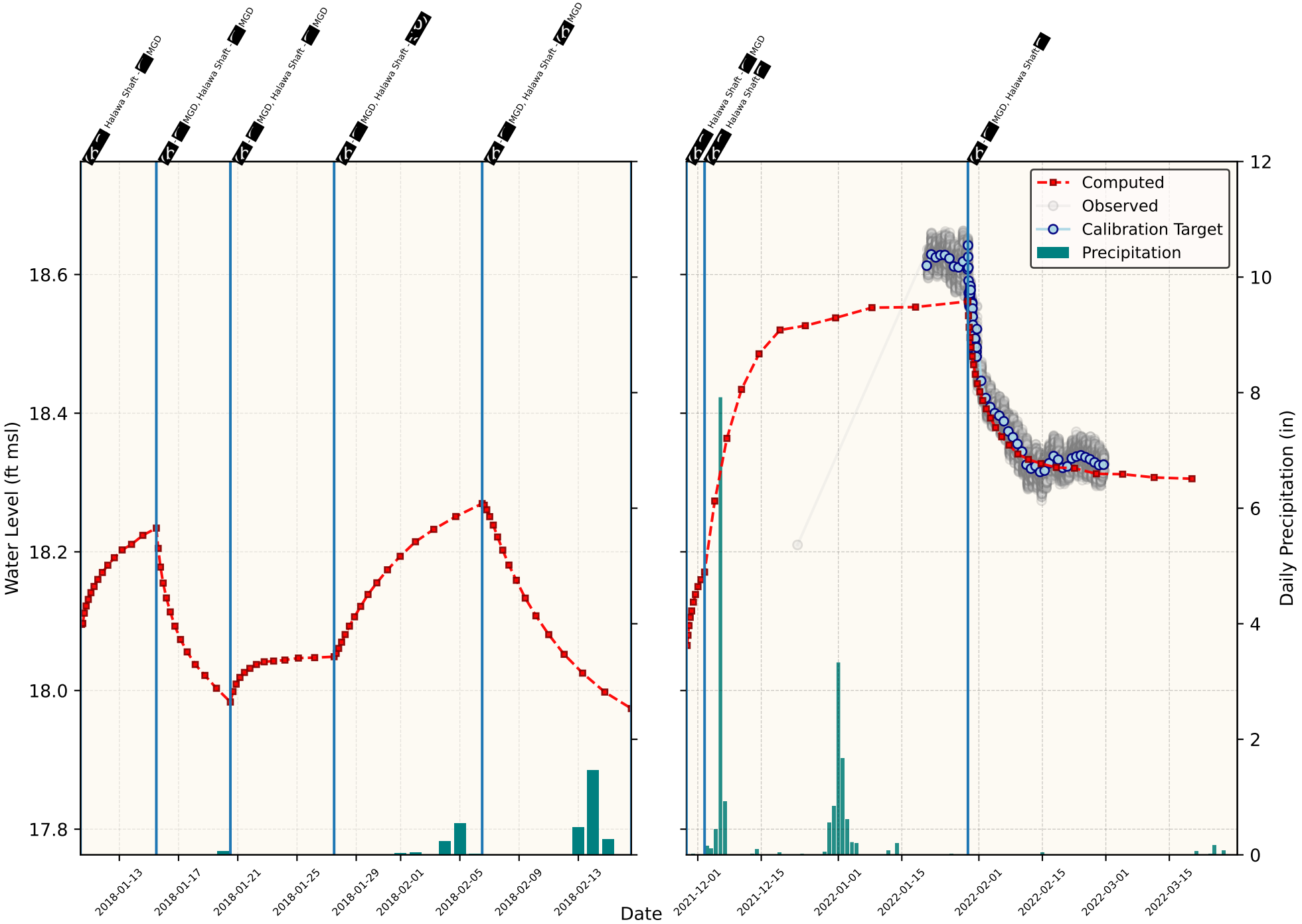


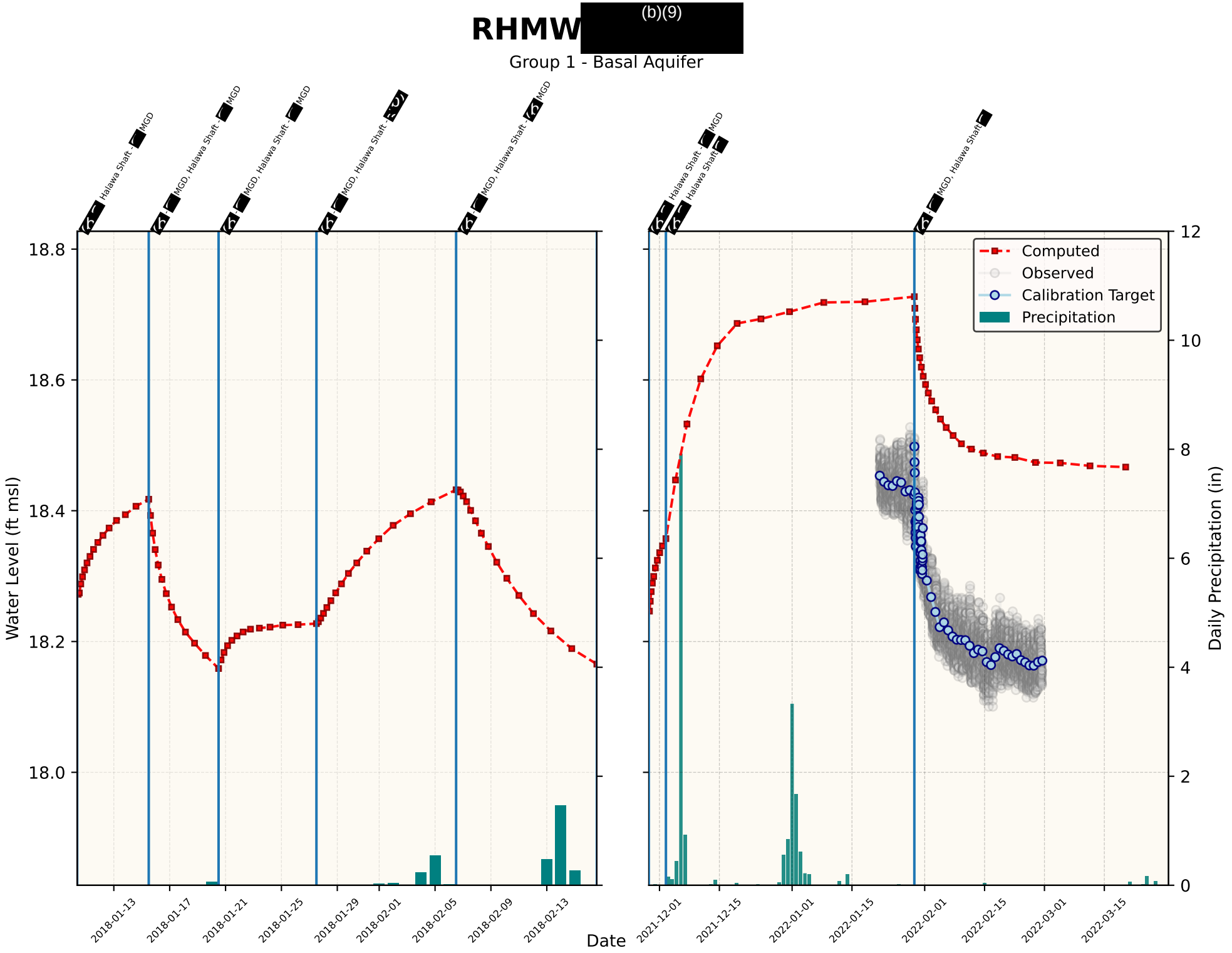

RHMW (b)(9)
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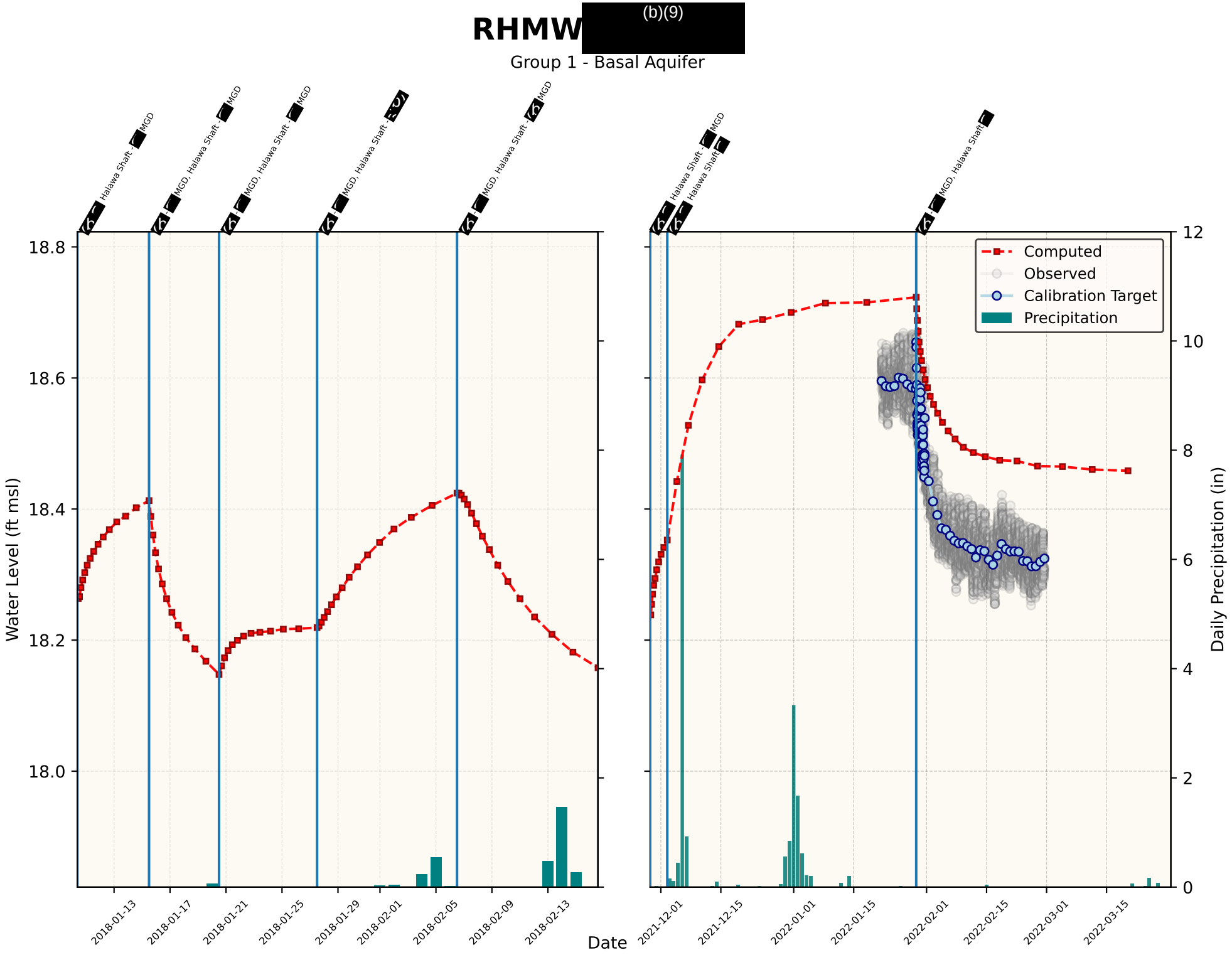

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18.0
17.8
17.6
17.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

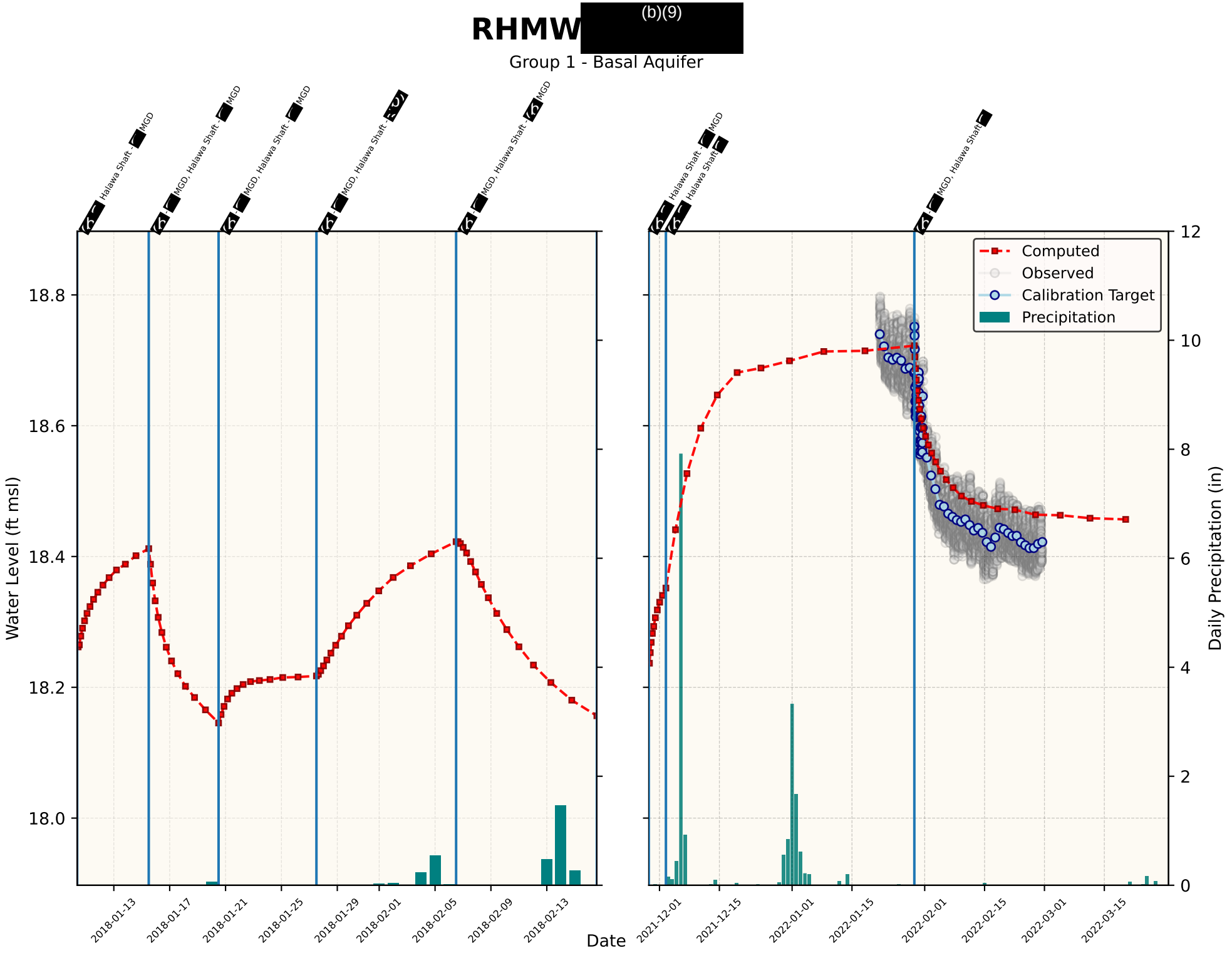
RHMW[redacted] (b)(9)

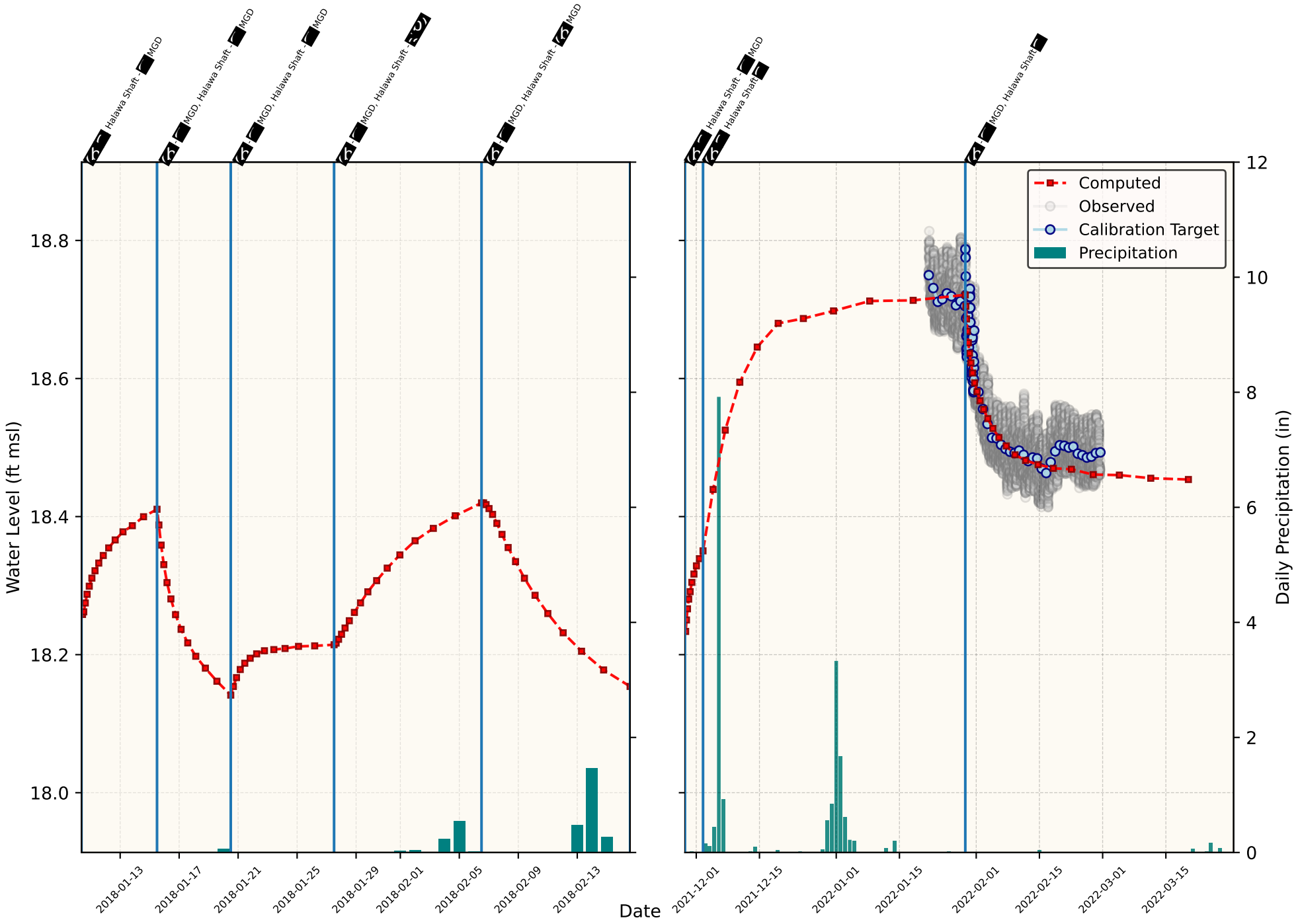
Group 1 - Basal Aquifer

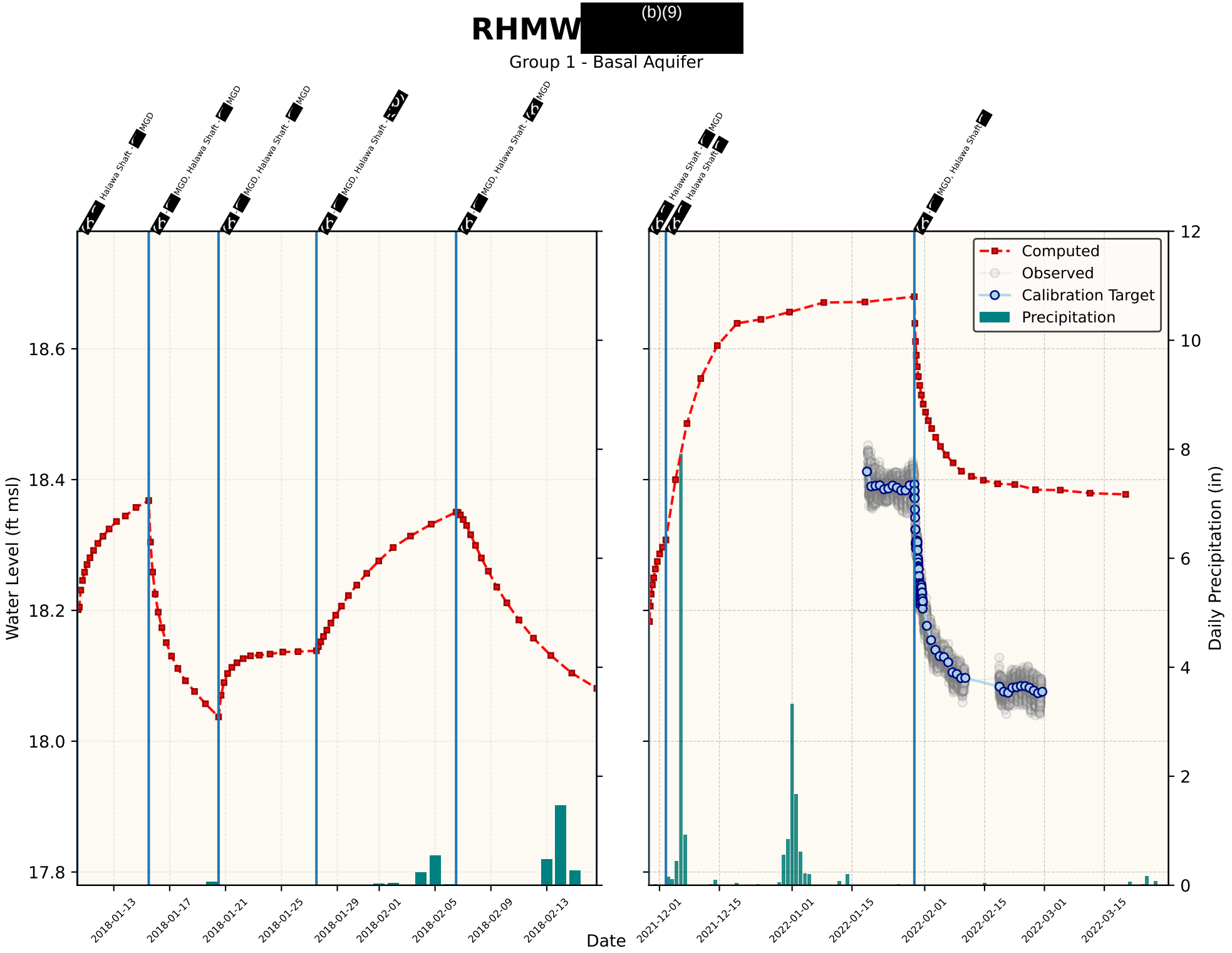


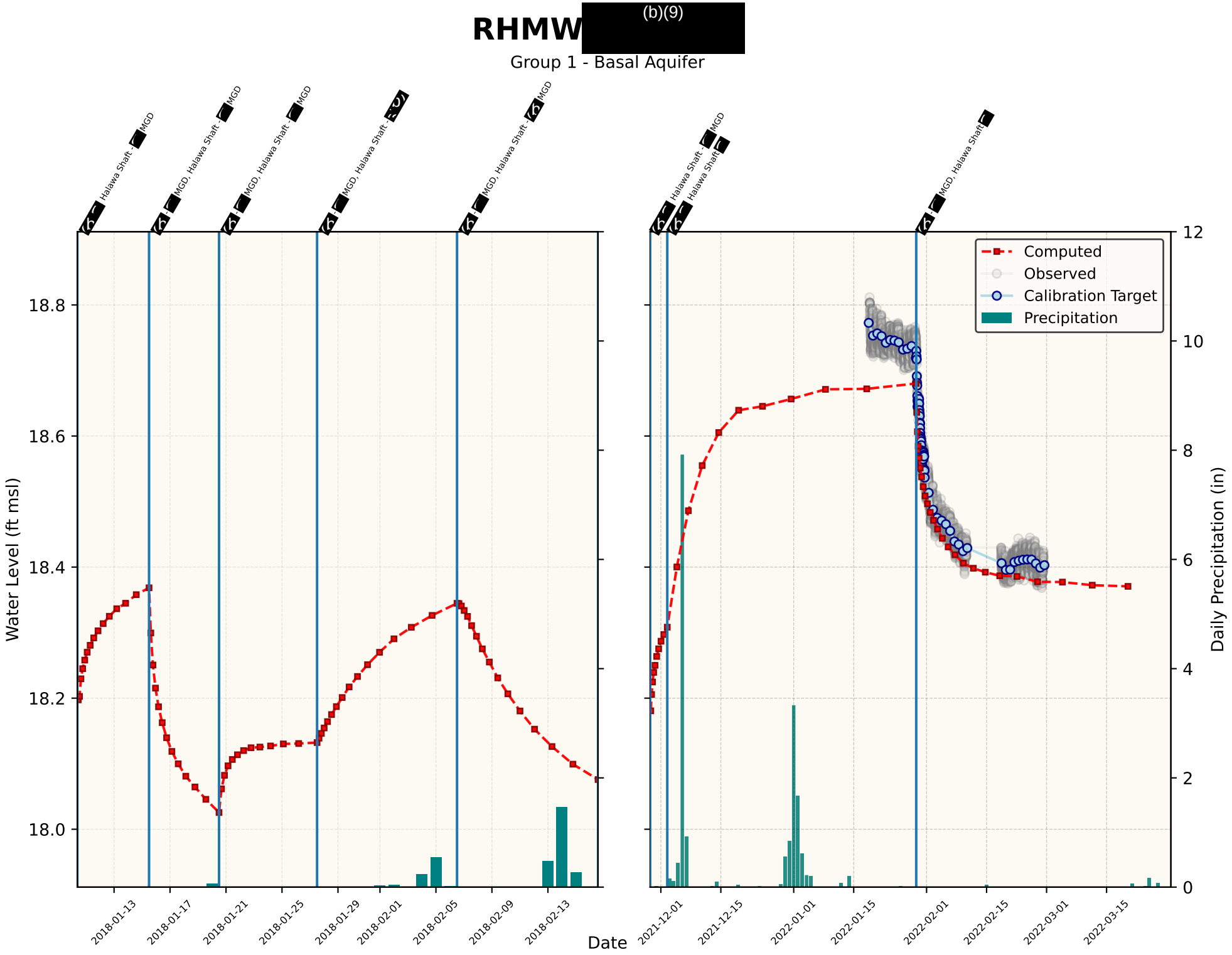

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

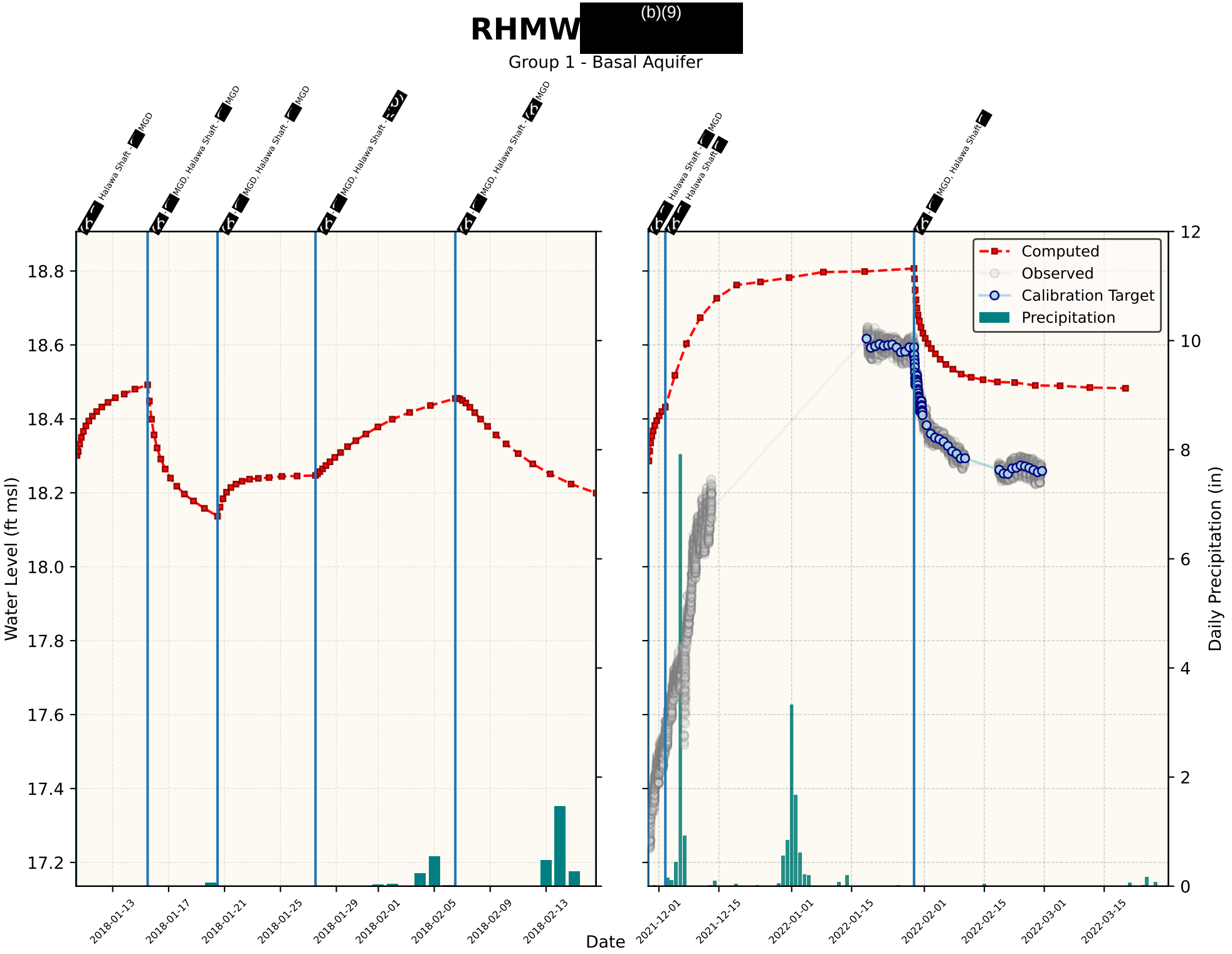

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-01-01
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

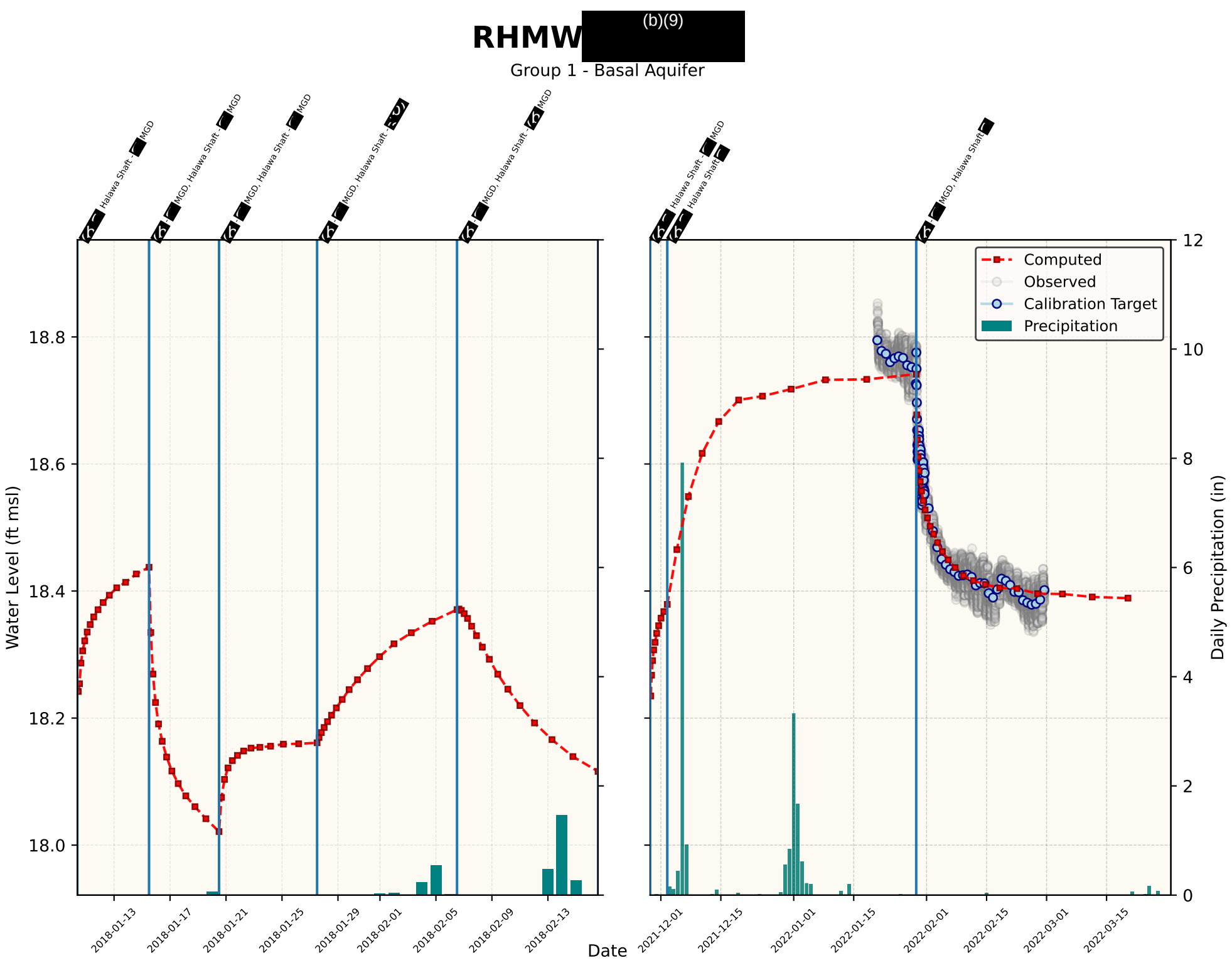

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

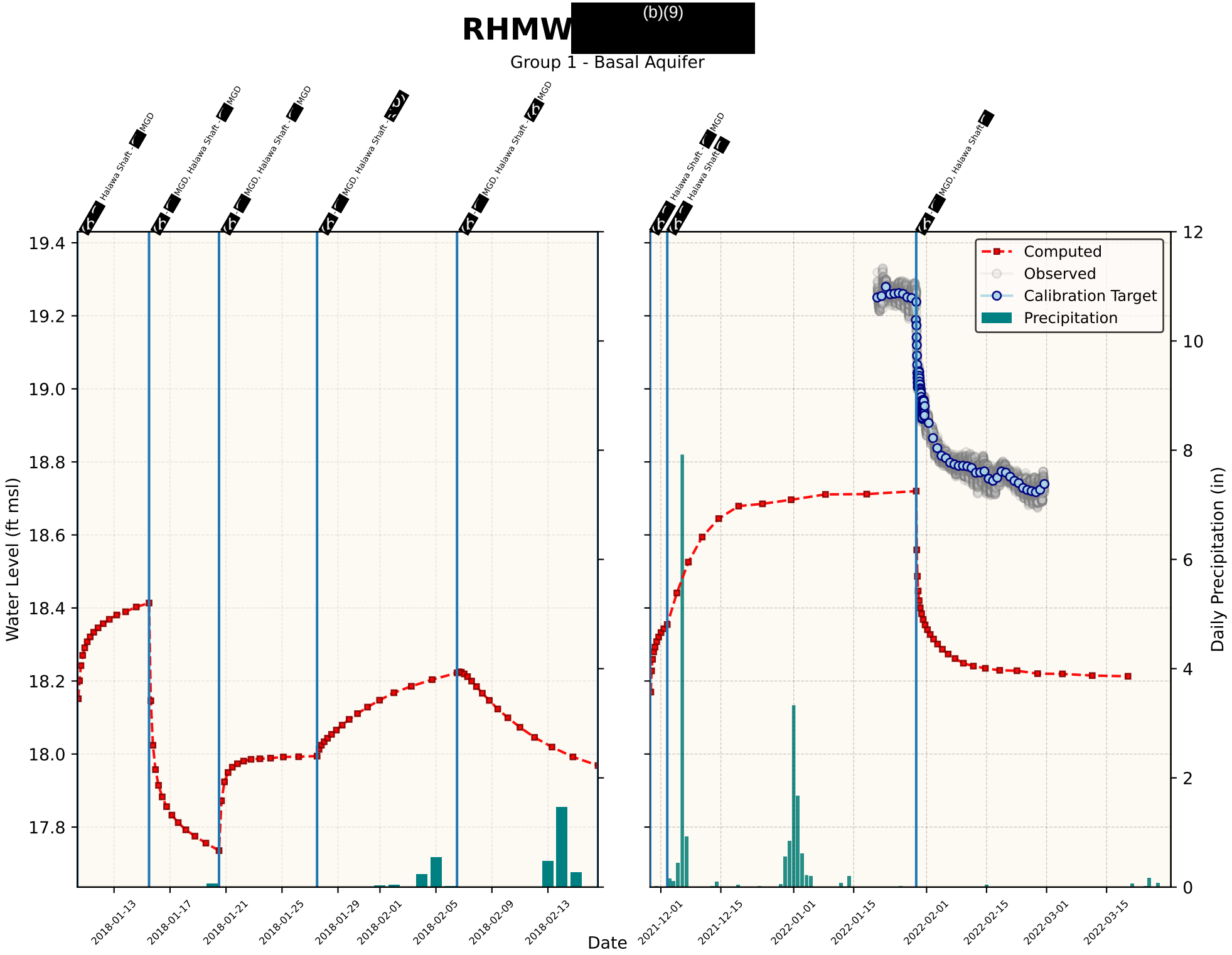

RHMW13-Zone4
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
18.8
18.6
18.4
18.2
18.0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation
Daily Precipitation (in)
12
10
8
6
4
2
0

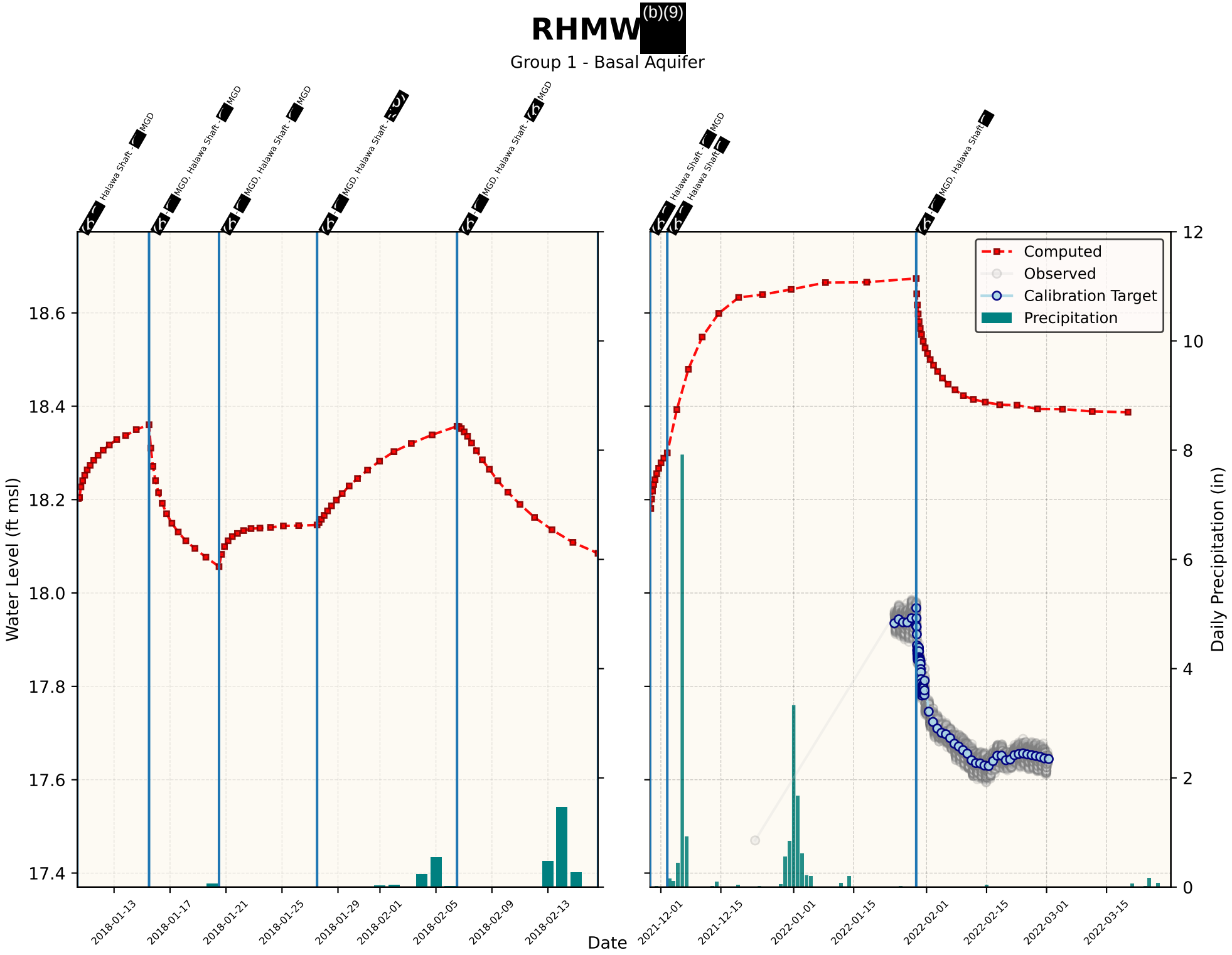

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-02-01
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2022-03-01
2022-03-15

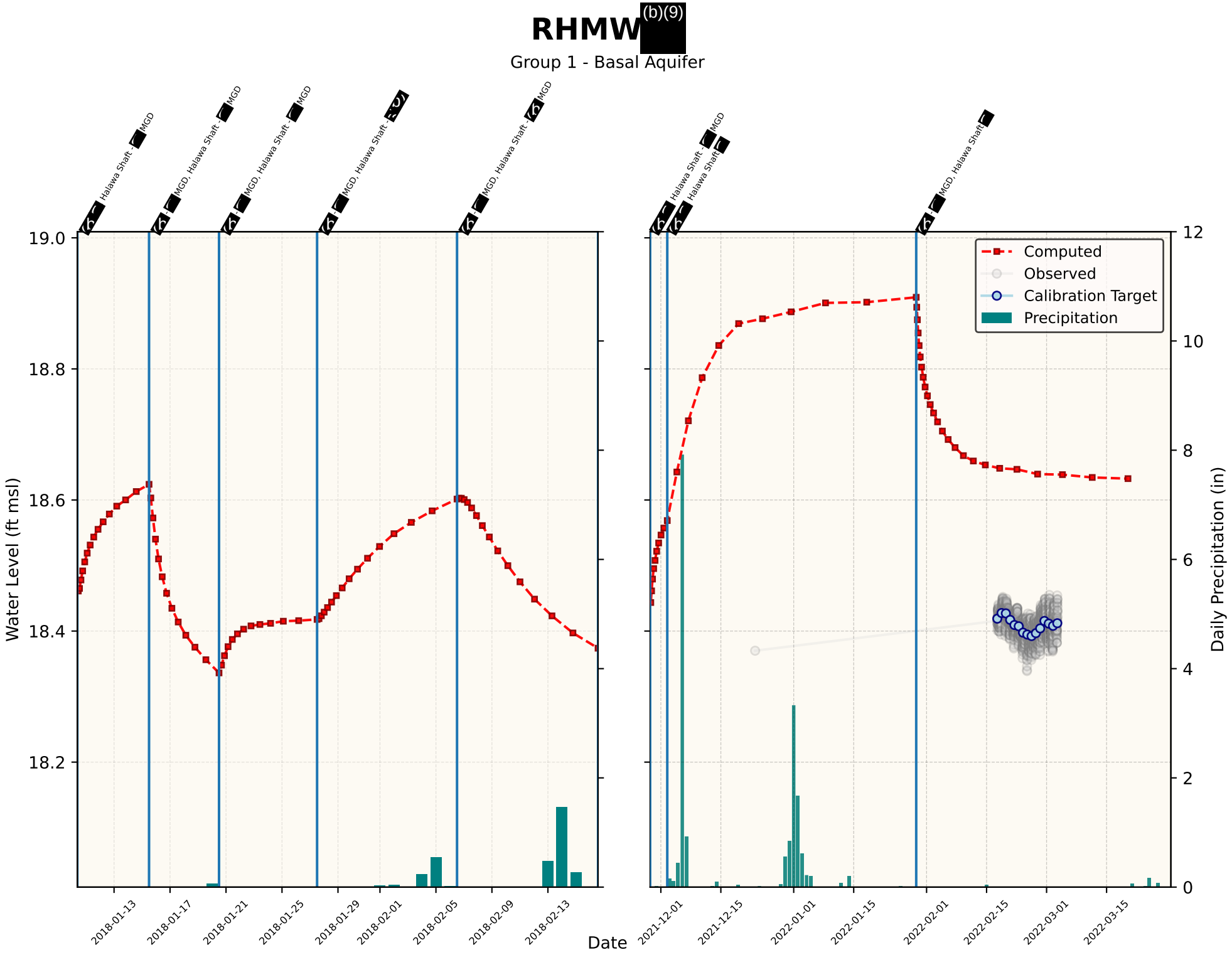

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.0
18.2
18.4
18.6
18.8
0
2
4
6
8
10
12
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
18.8
18.6
18.4
18.2
18.0
17.8
17.6
17.4
17.2
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation
Daily Precipitation (in)
12
10
8
6
4
2
0


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.0
18.2
18.4
18.6
18.8
0
2
4
6
8
10
12
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

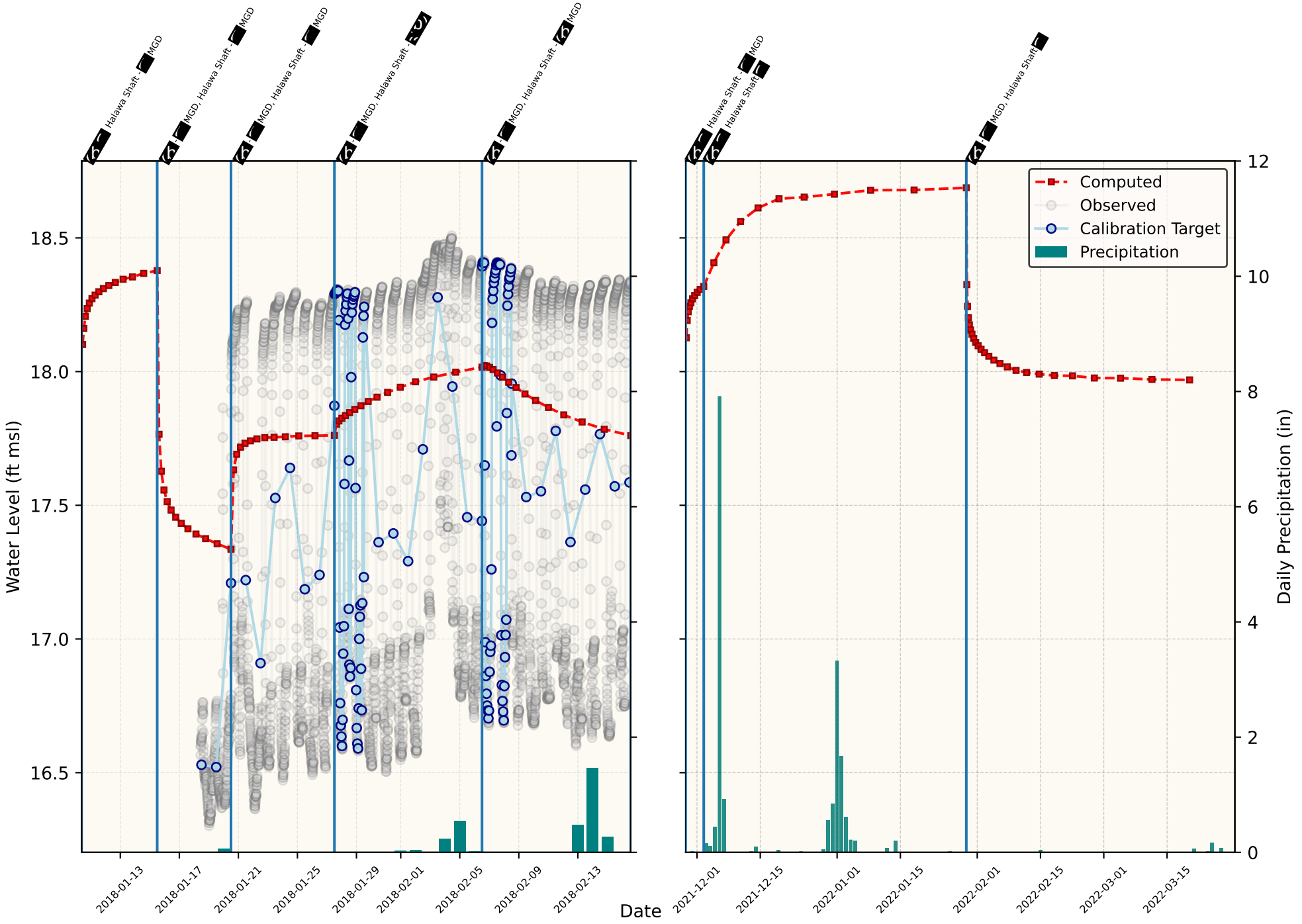

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.6
18.4
18.2
18.0
17.8
17.6
17.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

RHMW[redacted]

(b)(9)

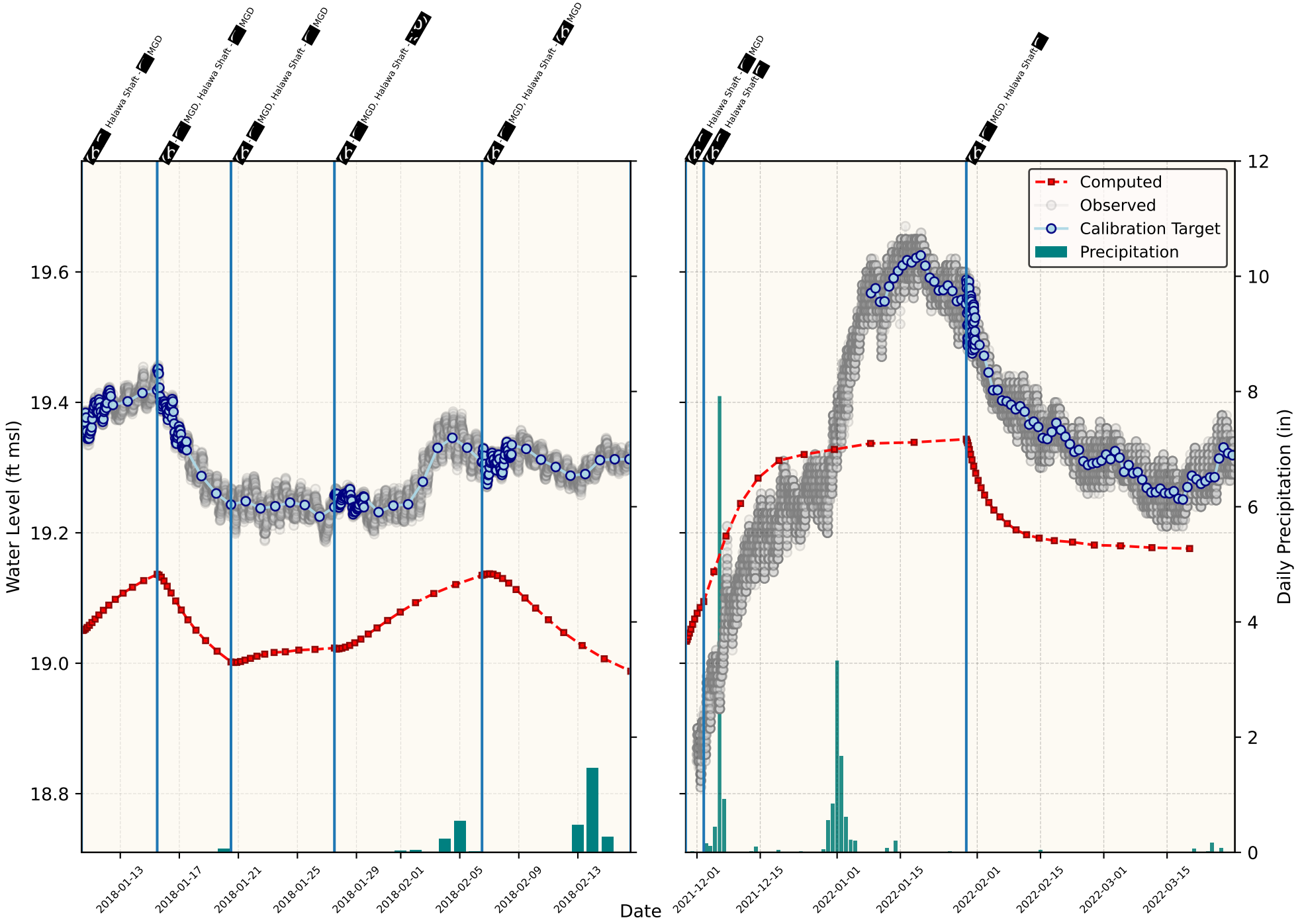
Group 1 - Basal Aquifer

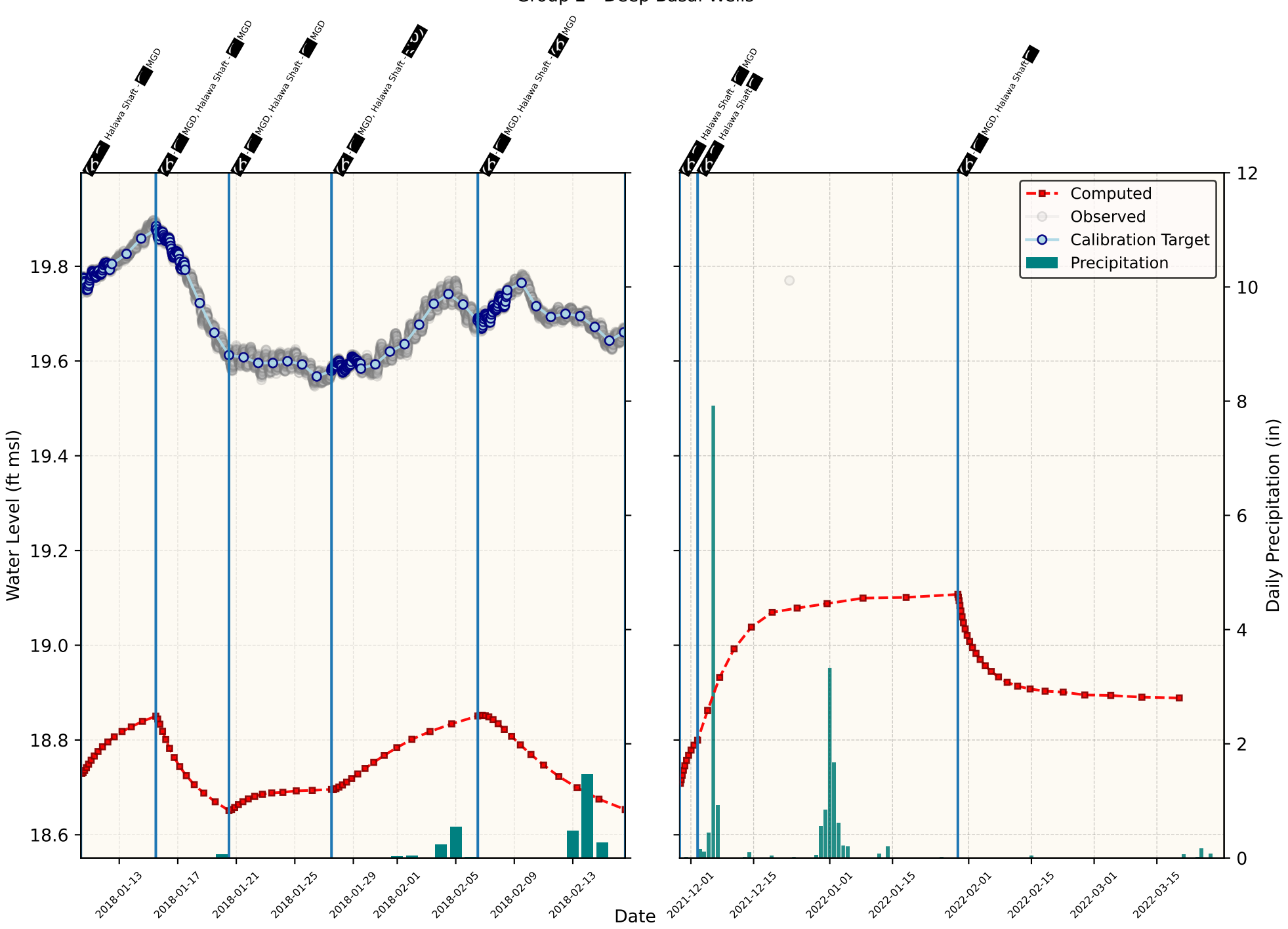


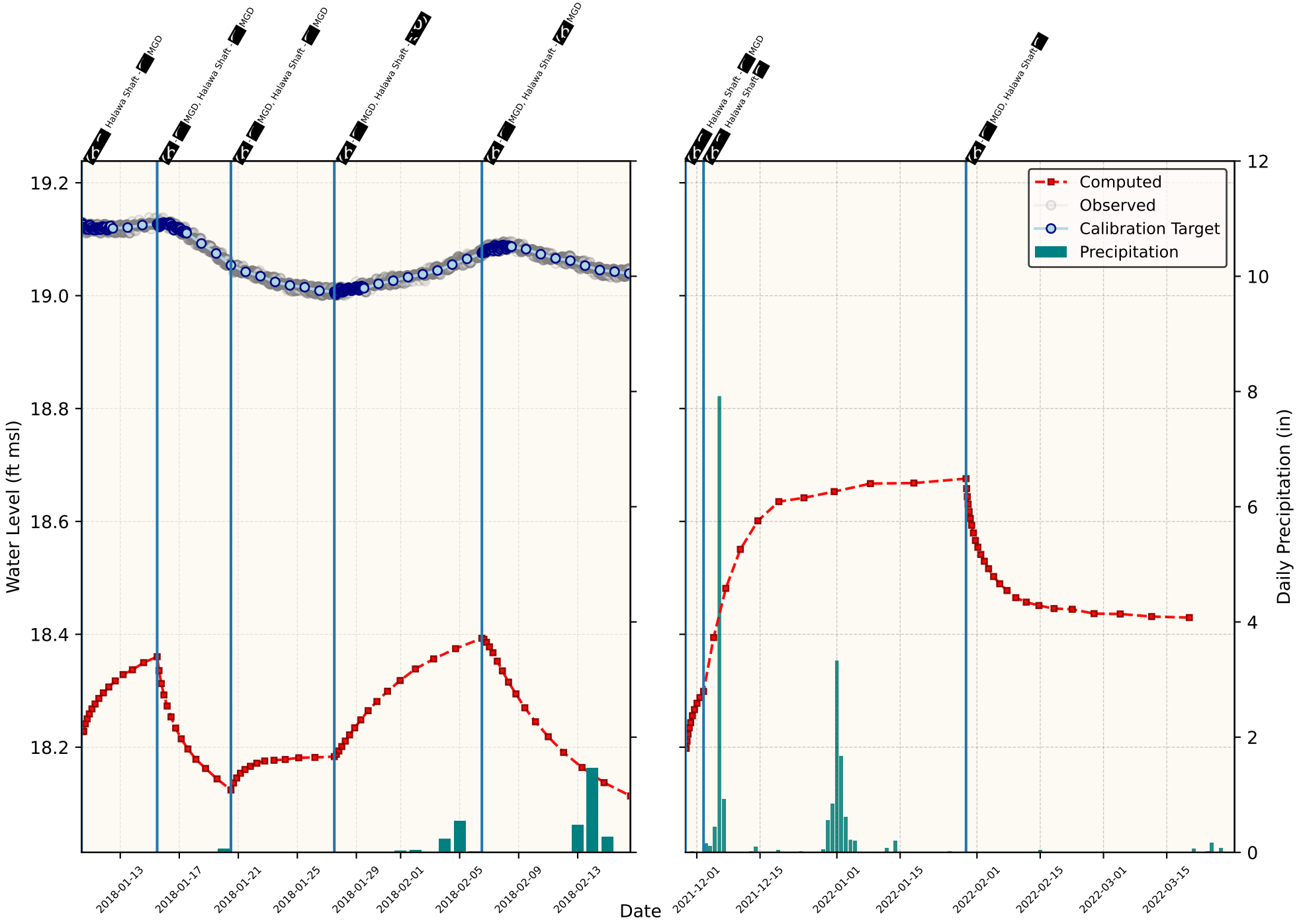
TAMC_[redacted]

(b)(9)

Group 1 - Basal Aquifer

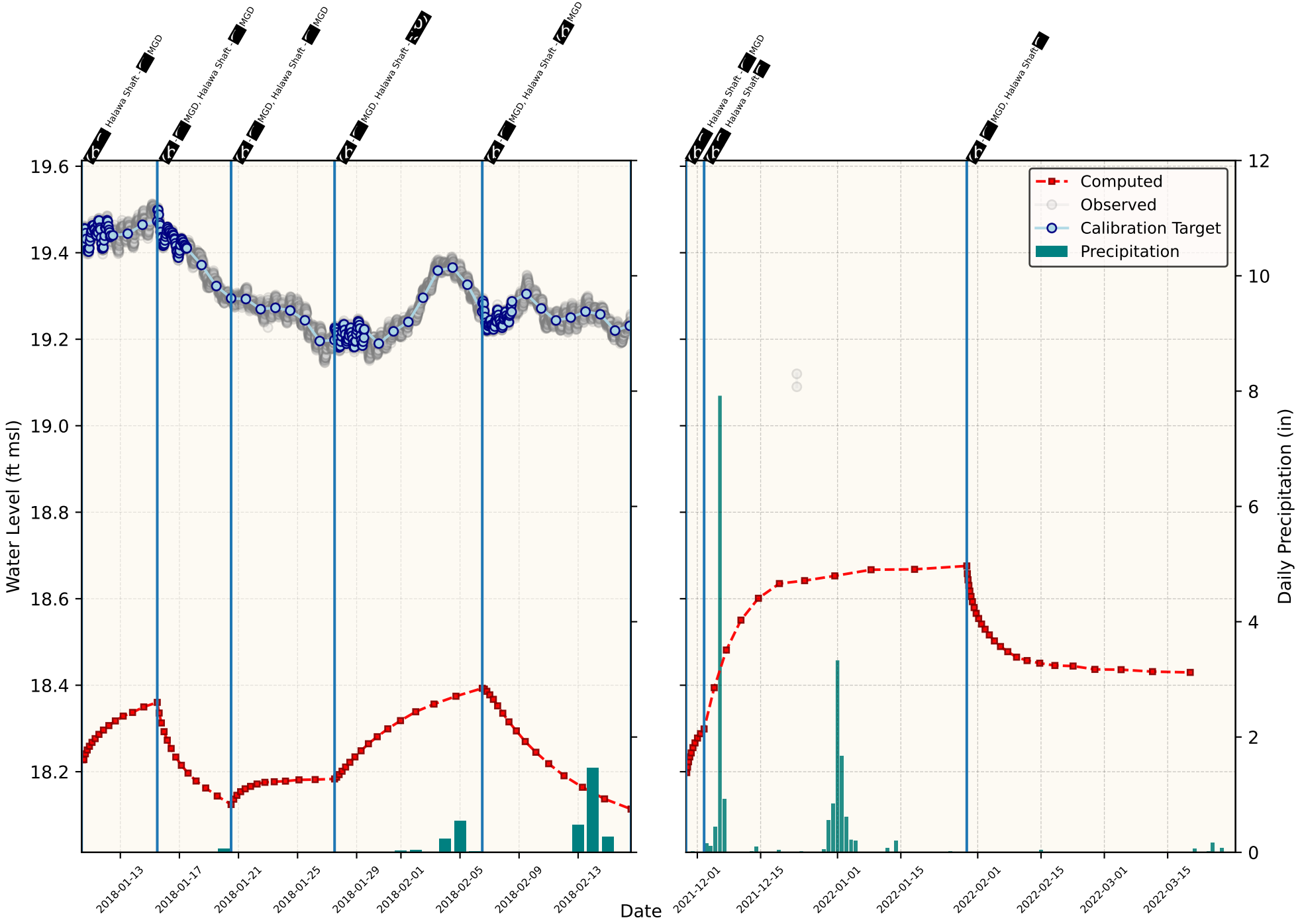



DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.8
19.6
19.4
19.2
19.0
18.8
18.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.2
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

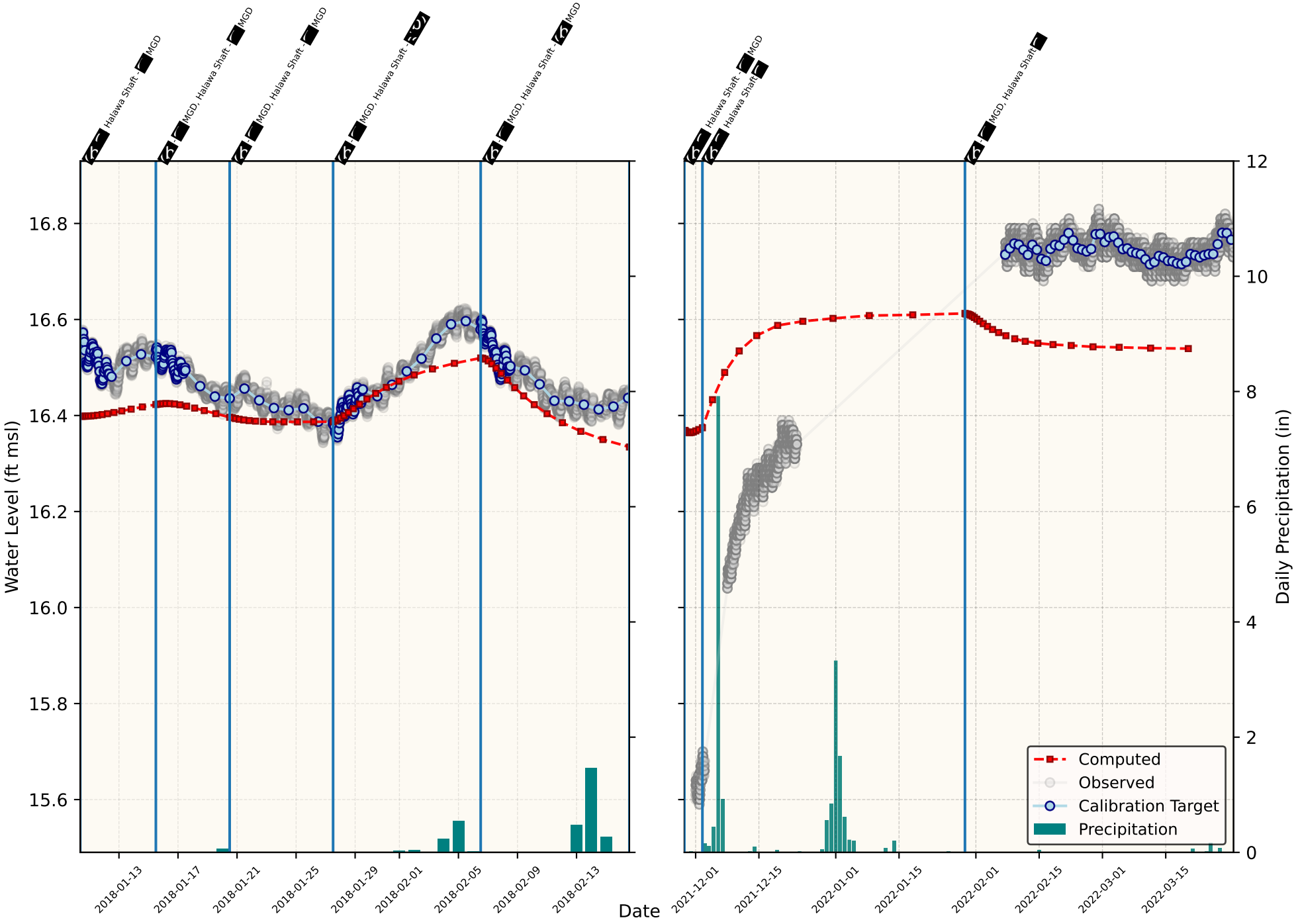
Halawa_Deep_Monitor_Well_HDMW2253-03

Group 2 - Deep Basal Wells



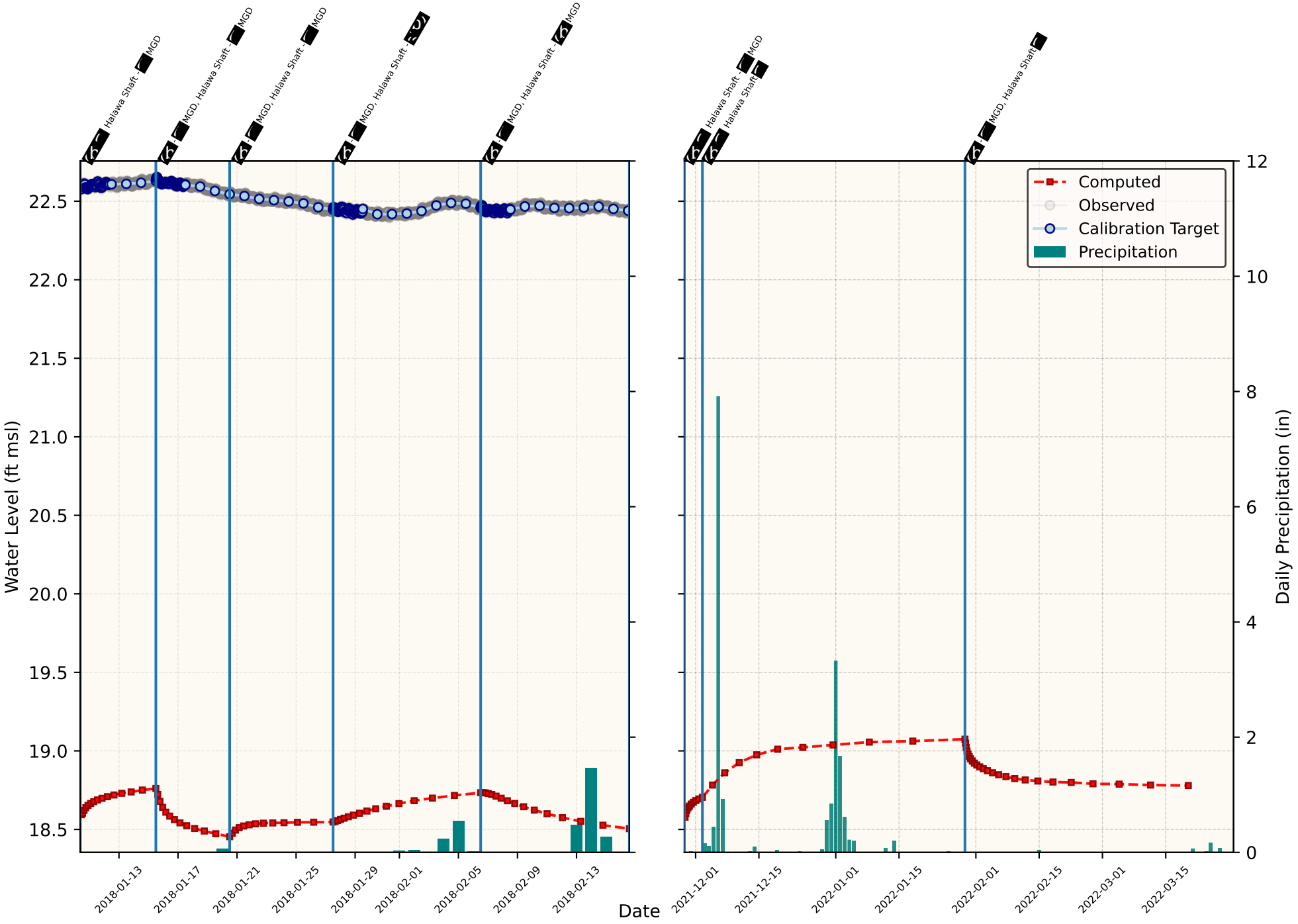
Kaamilo_Deep

Group 2 - Deep Basal Wells



RHMW[redacted]

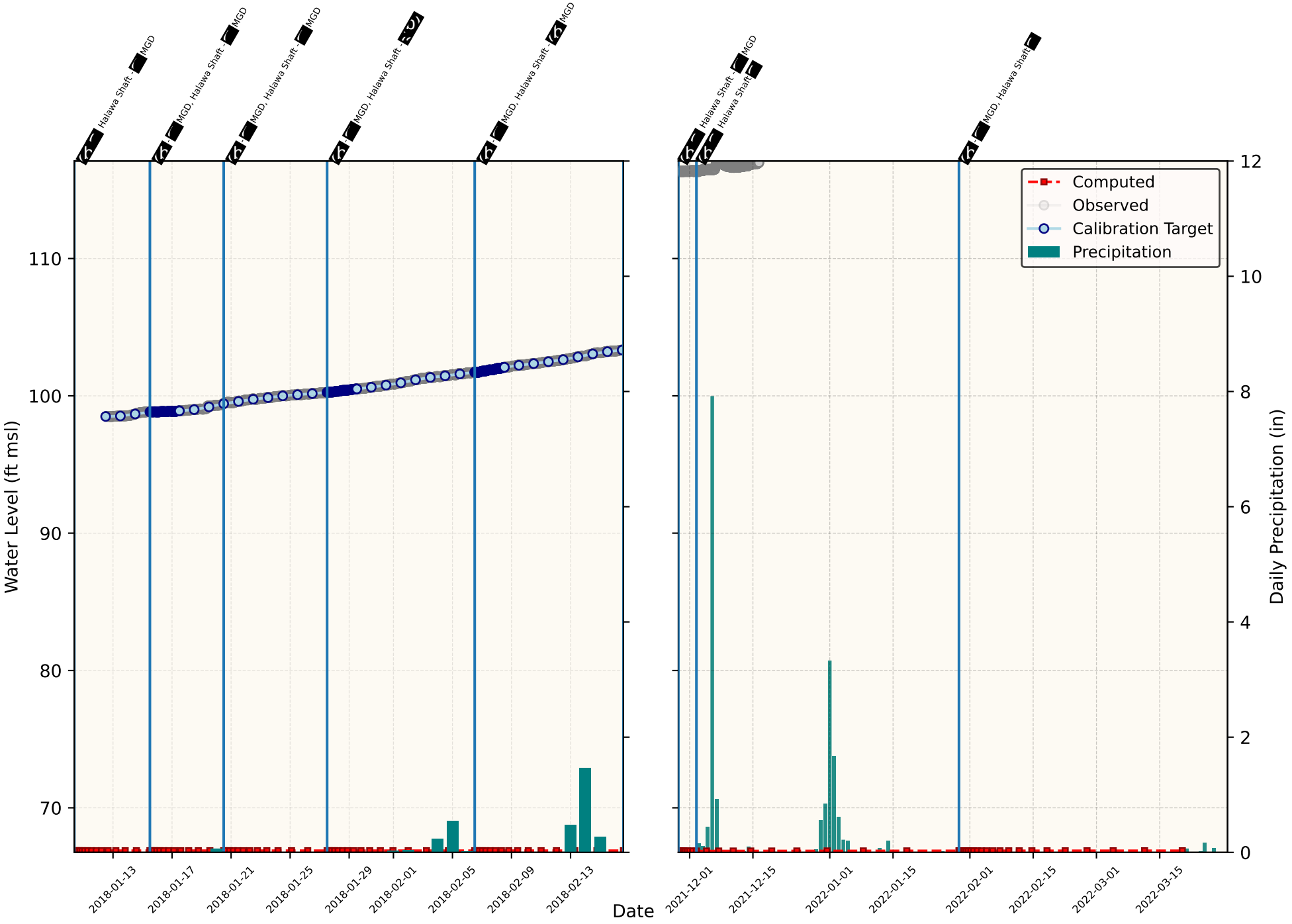
Group 3 - Saprolite/Confining Unit Well with Elevated Head

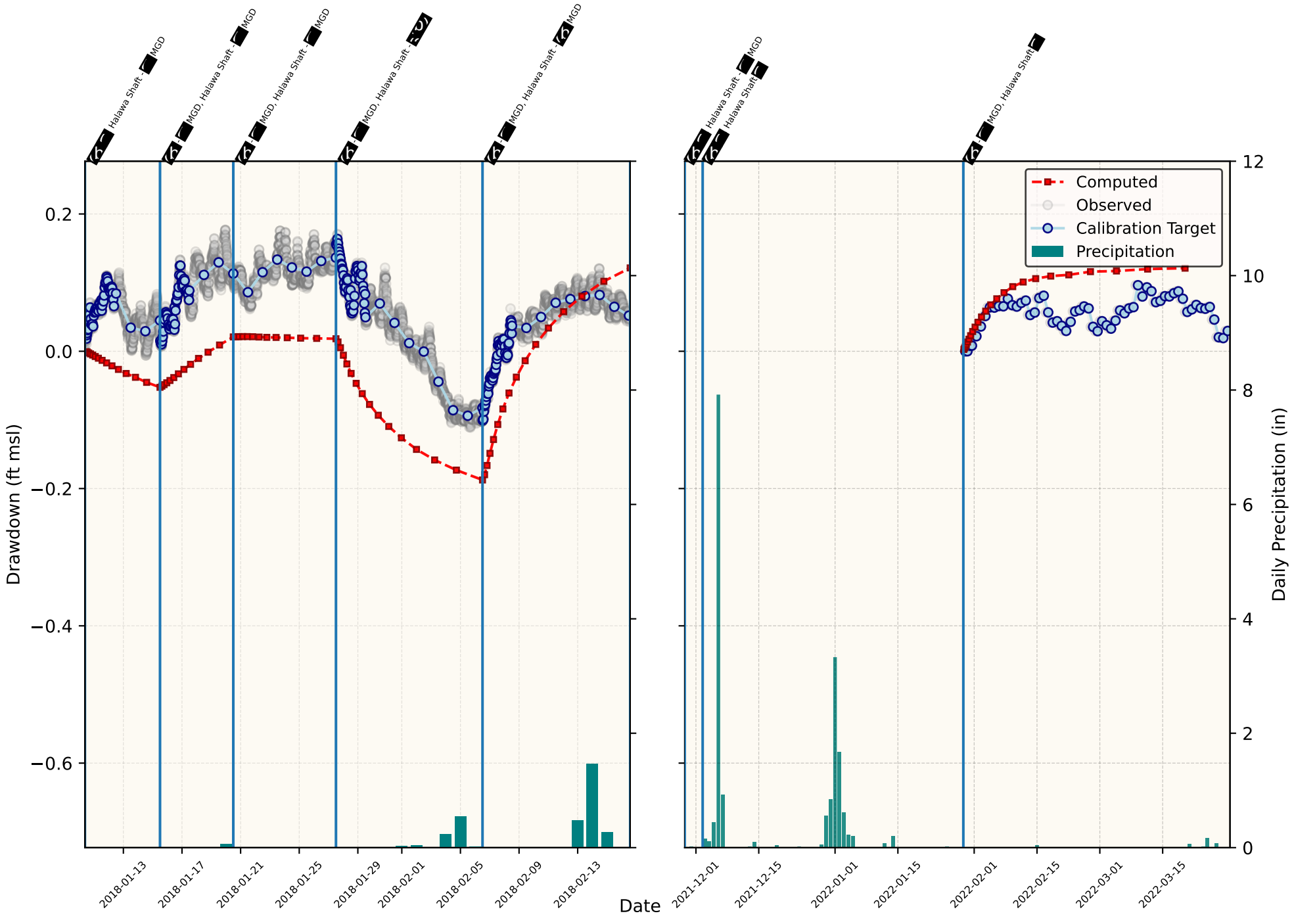


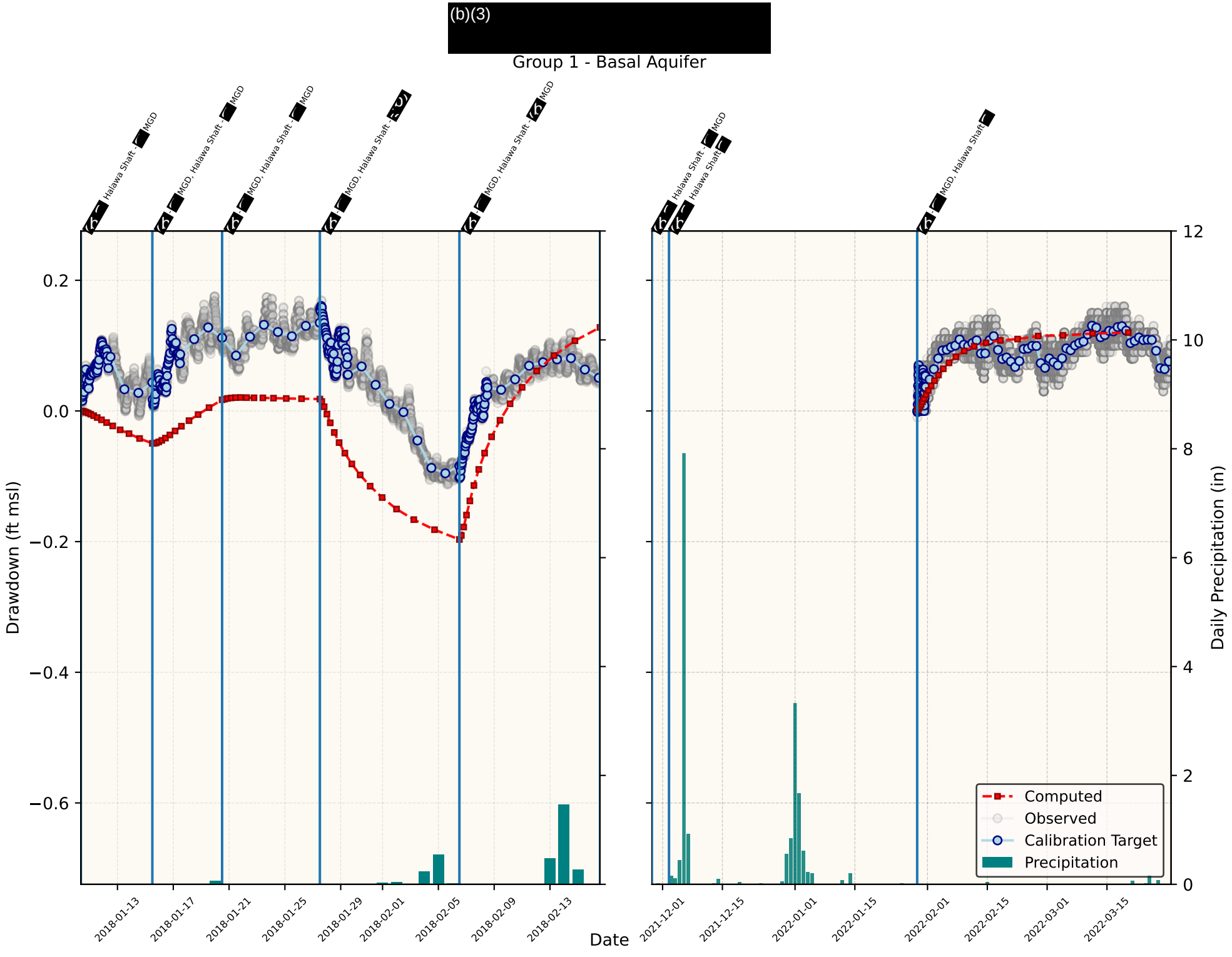
RHMW[redacted]

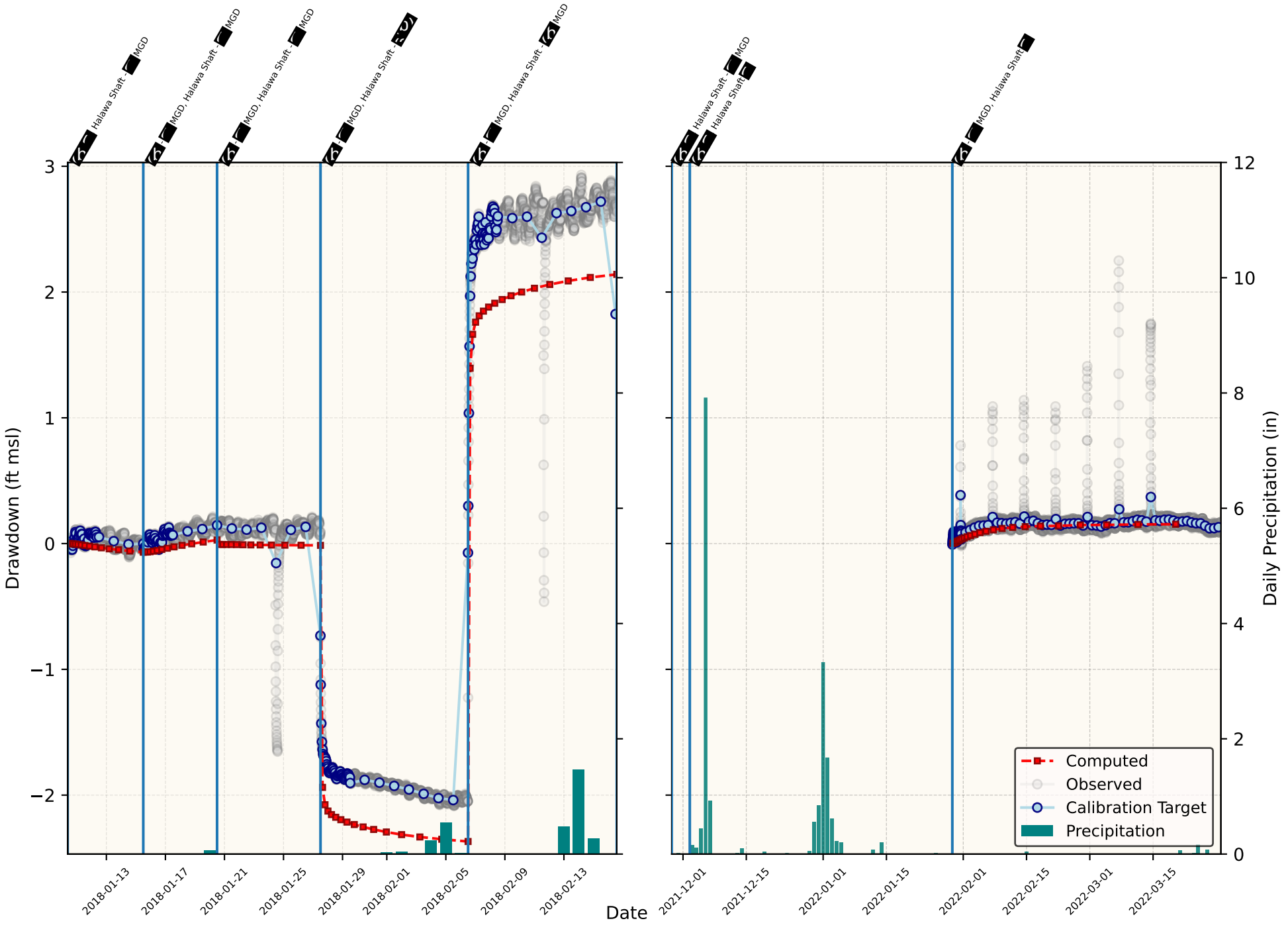
(b)(9)

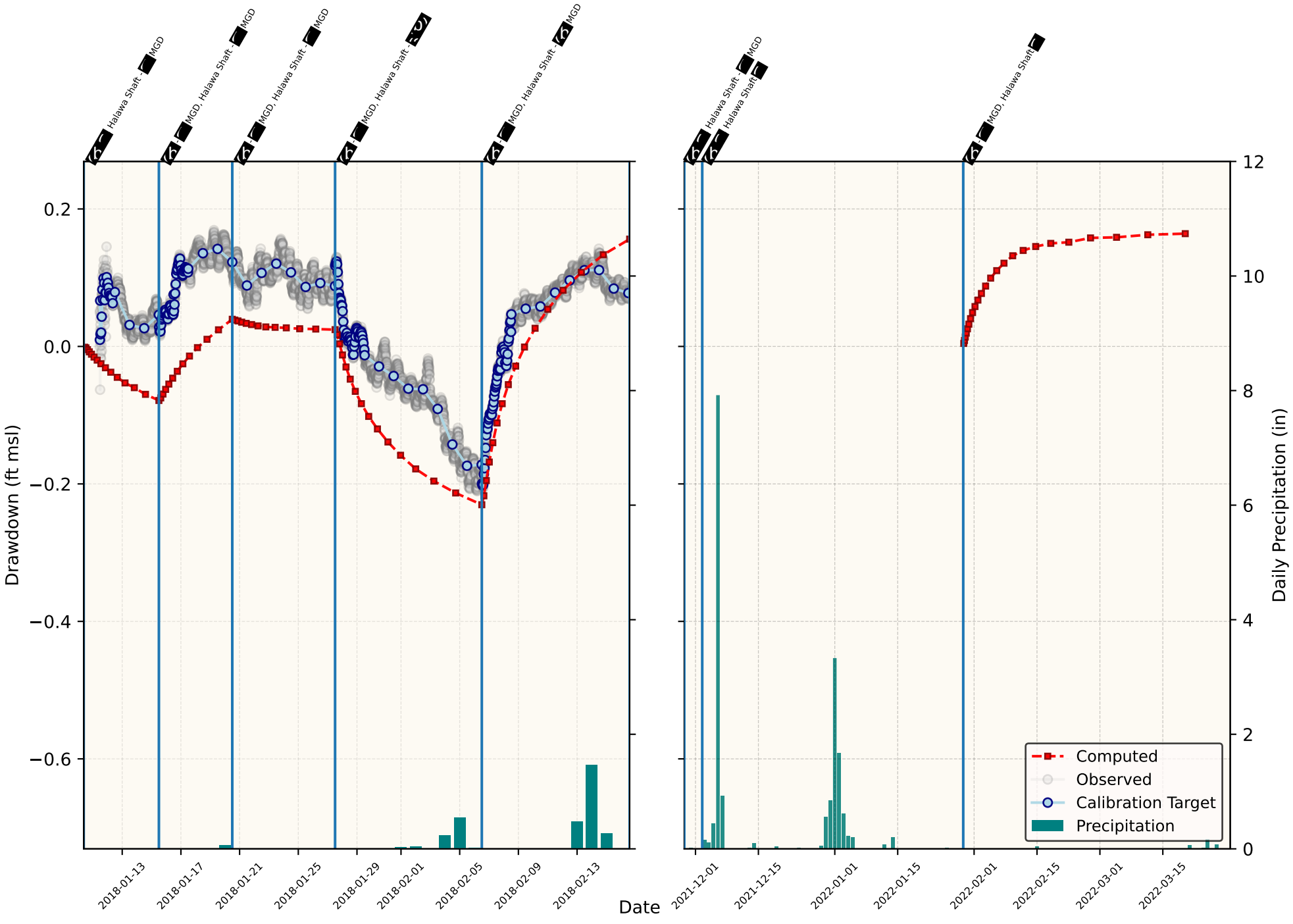
Group 3 - Saprolite/Confining Unit Well with Elevated Head

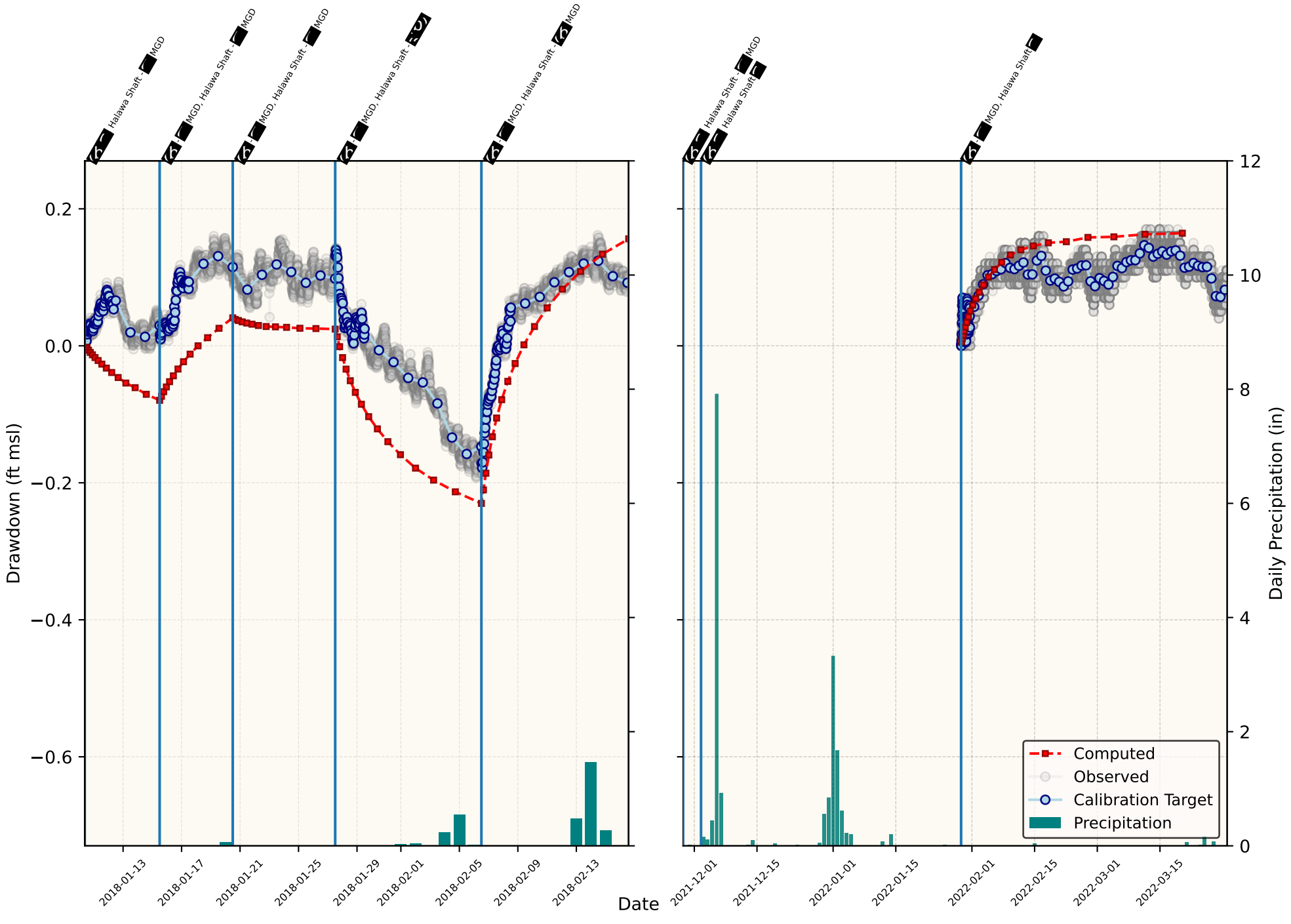


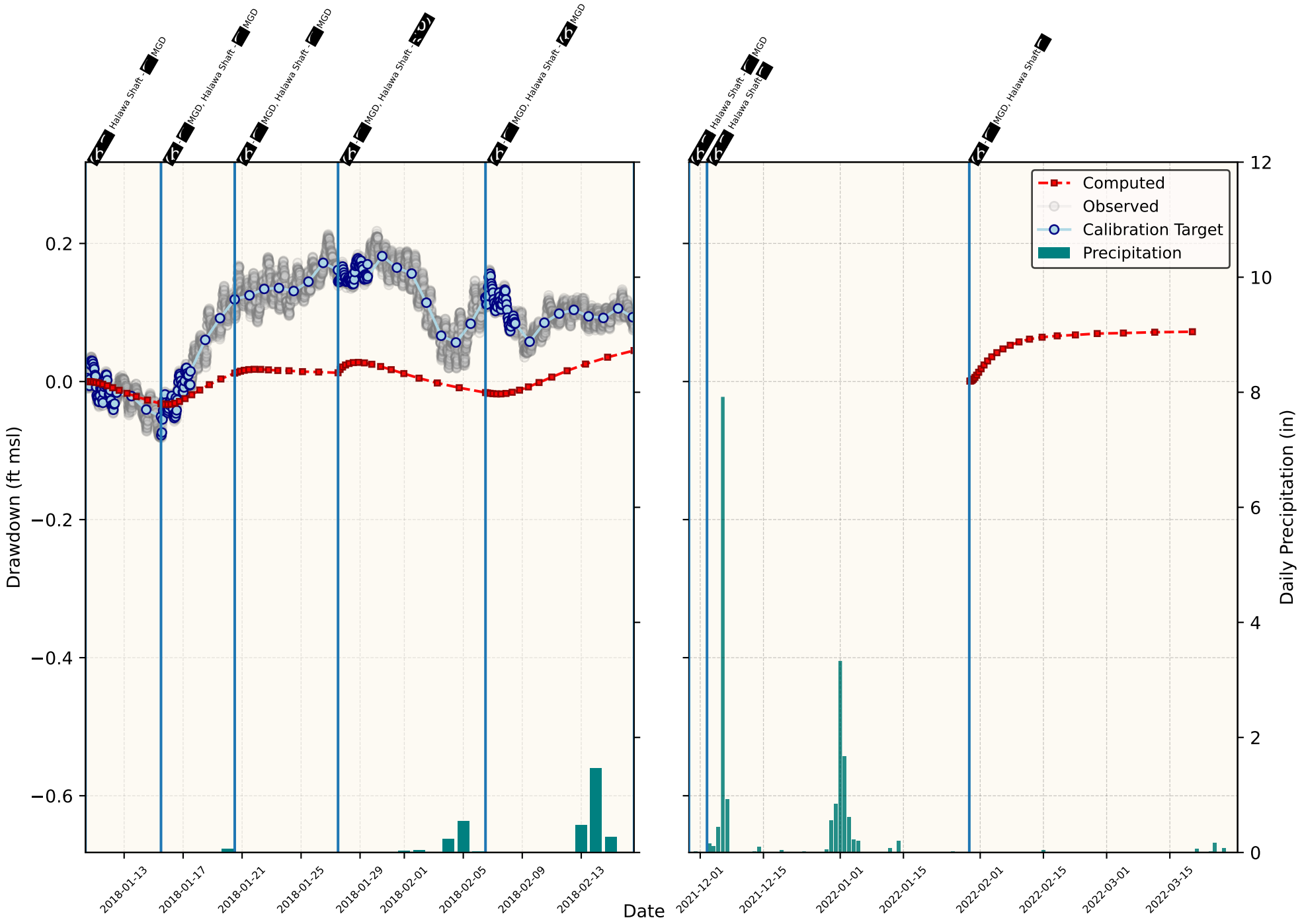

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-15
2022-03-01
2022-03-15

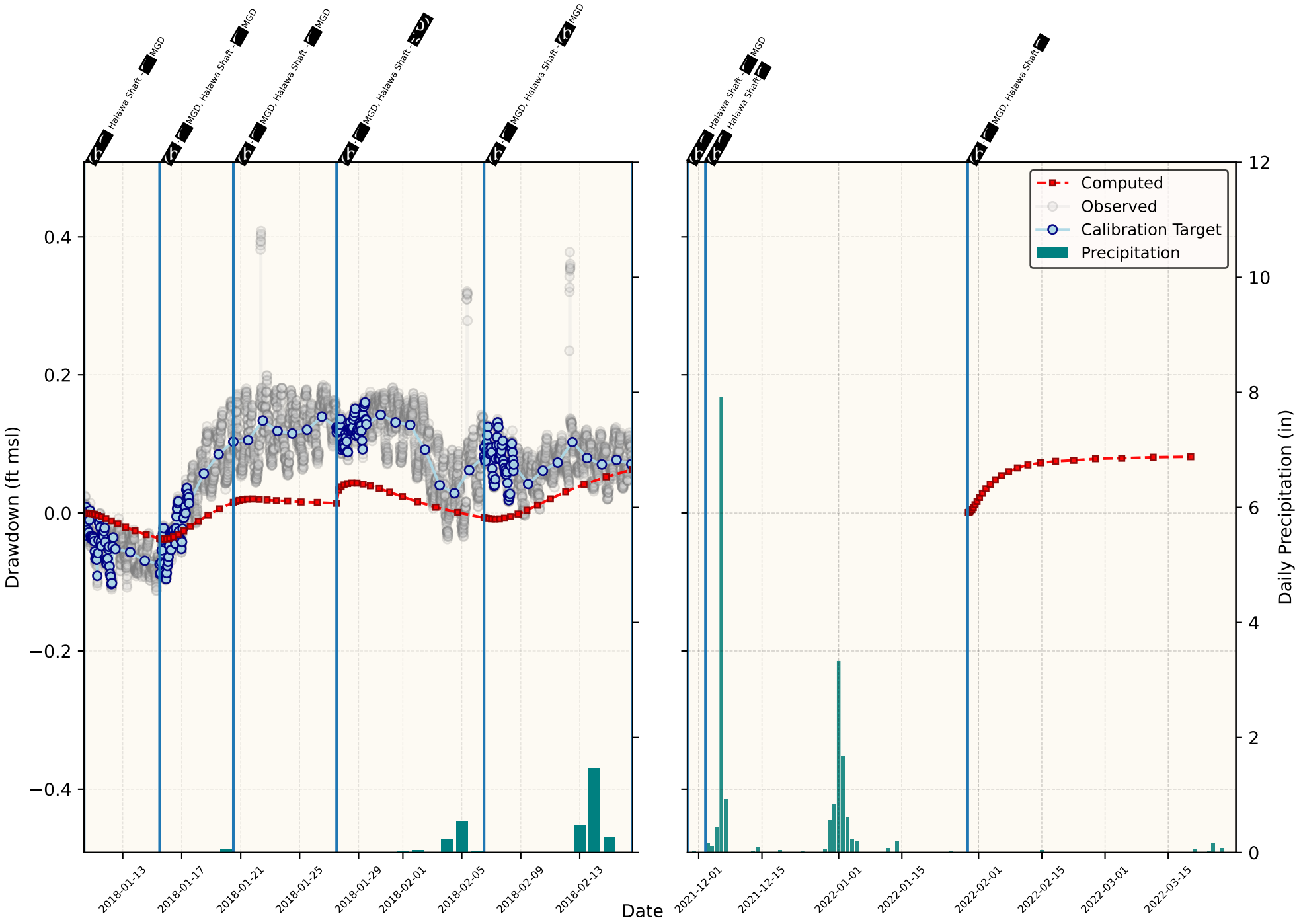

(b)(3)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

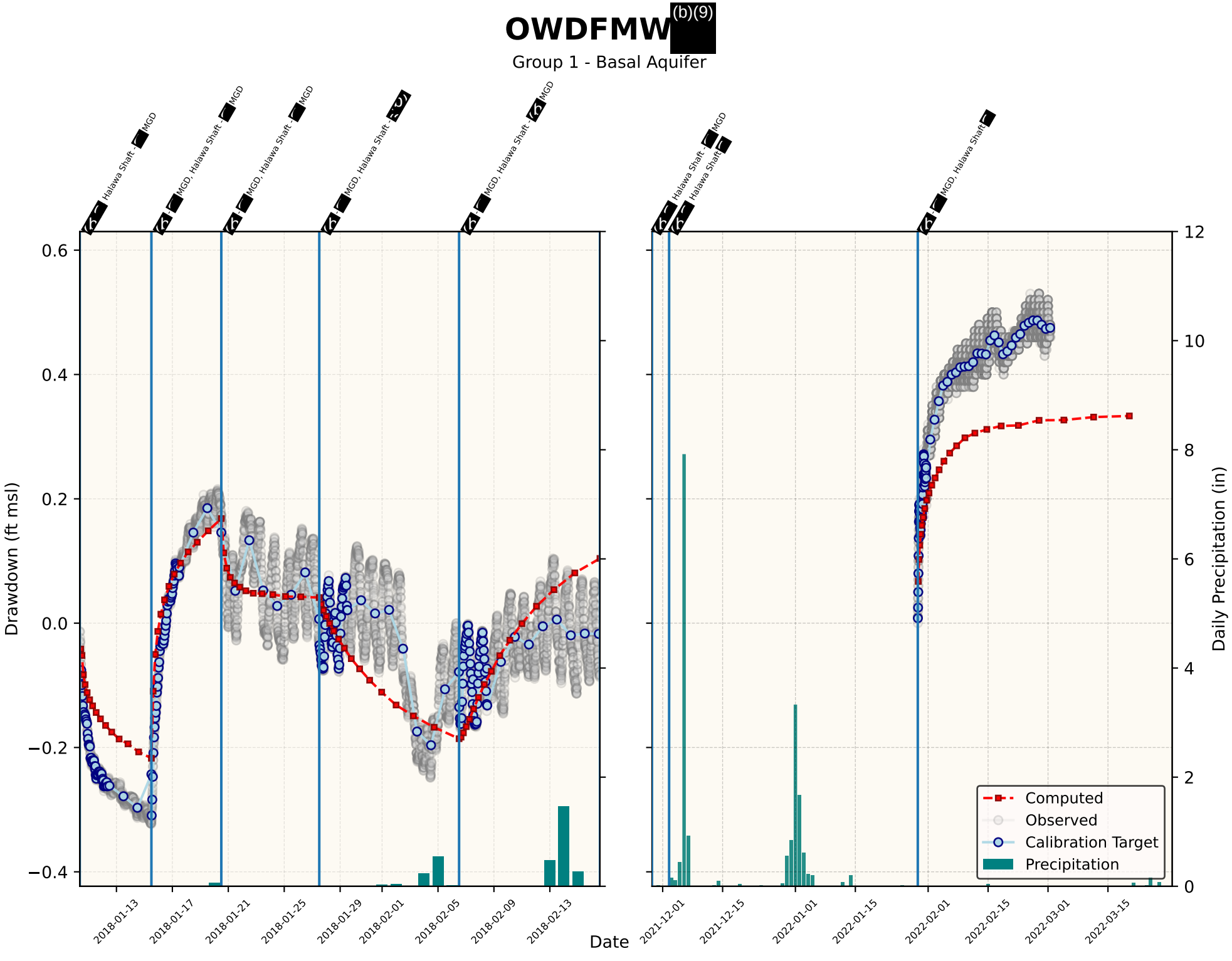

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
3
2
1
0
−1
−2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

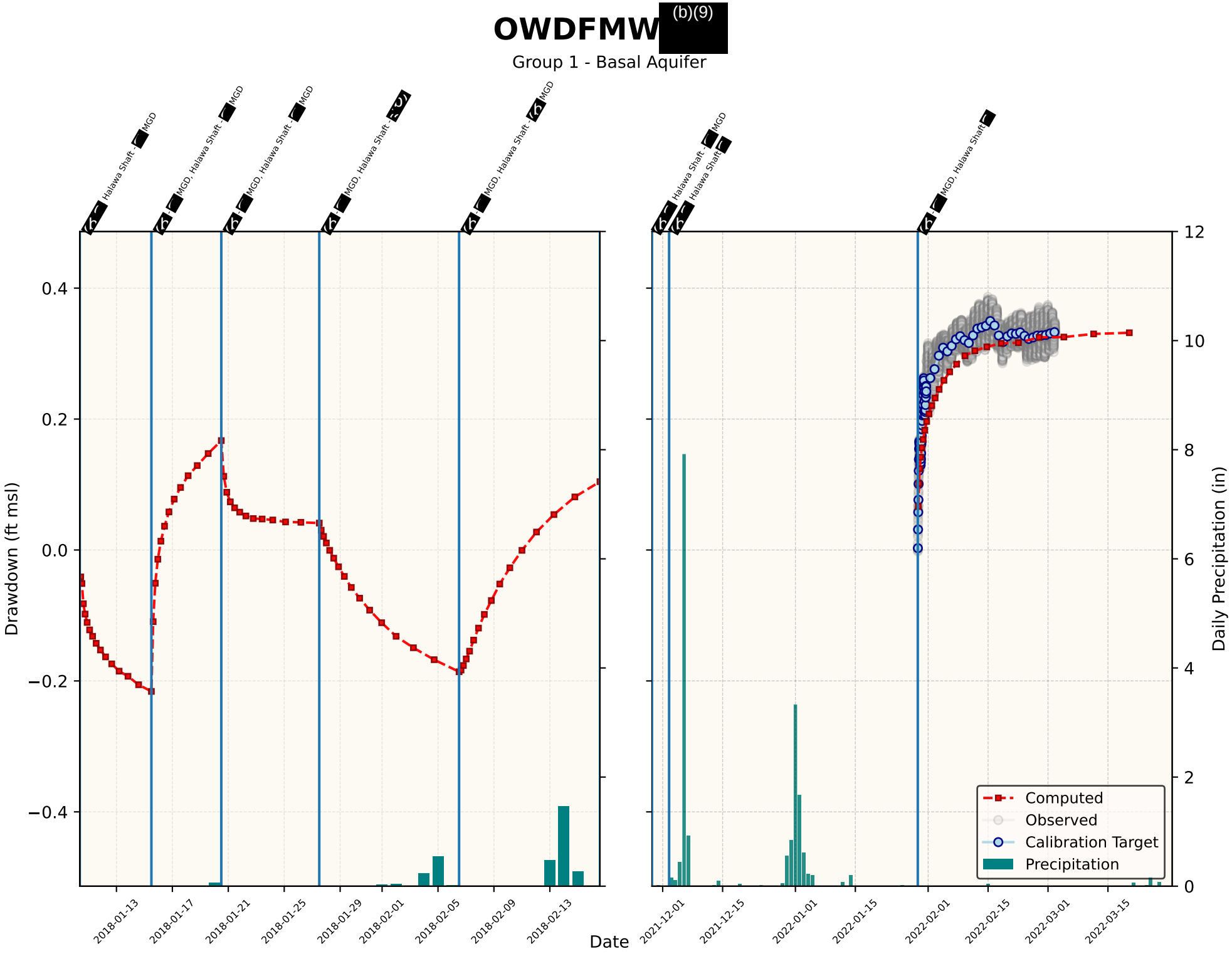

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

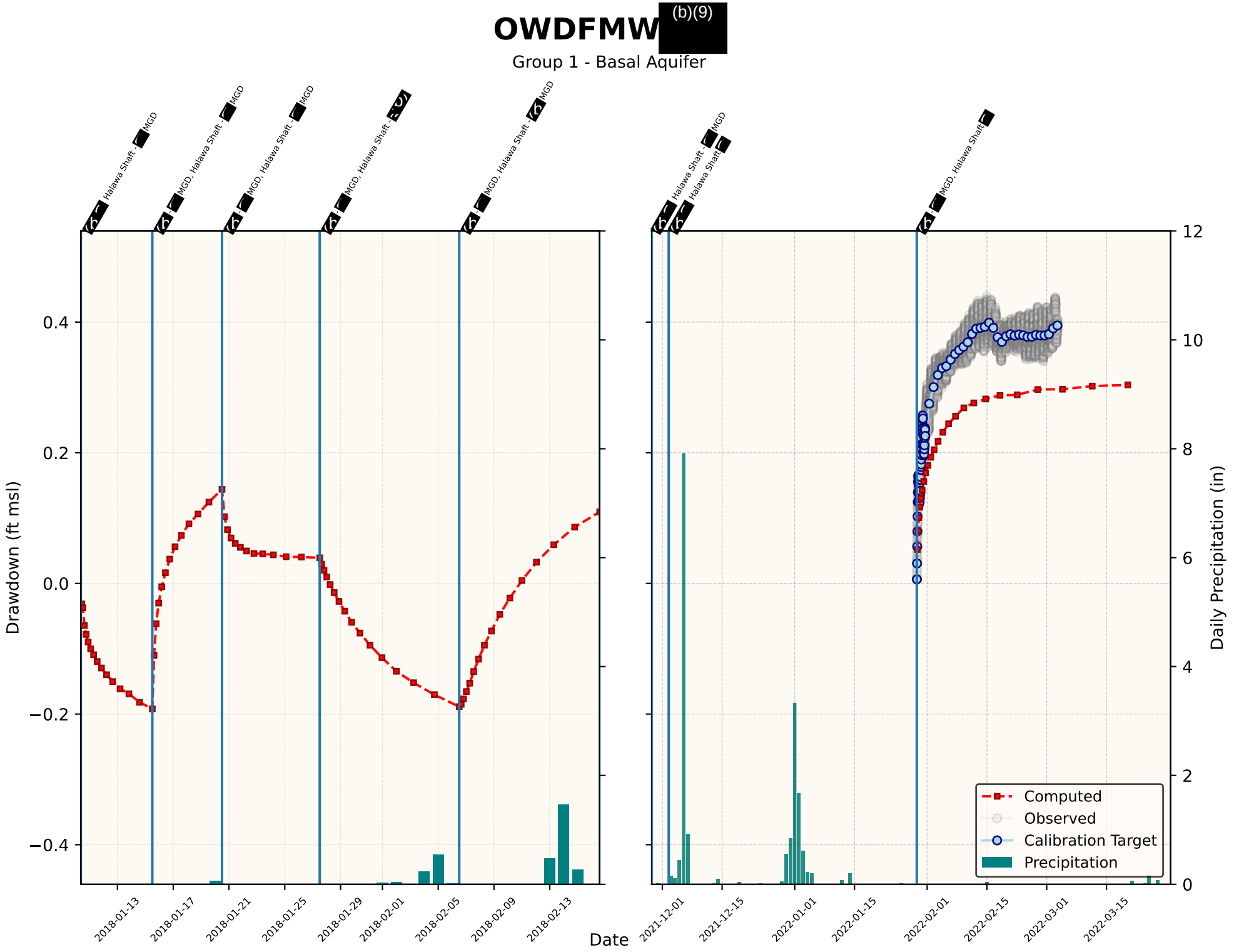

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

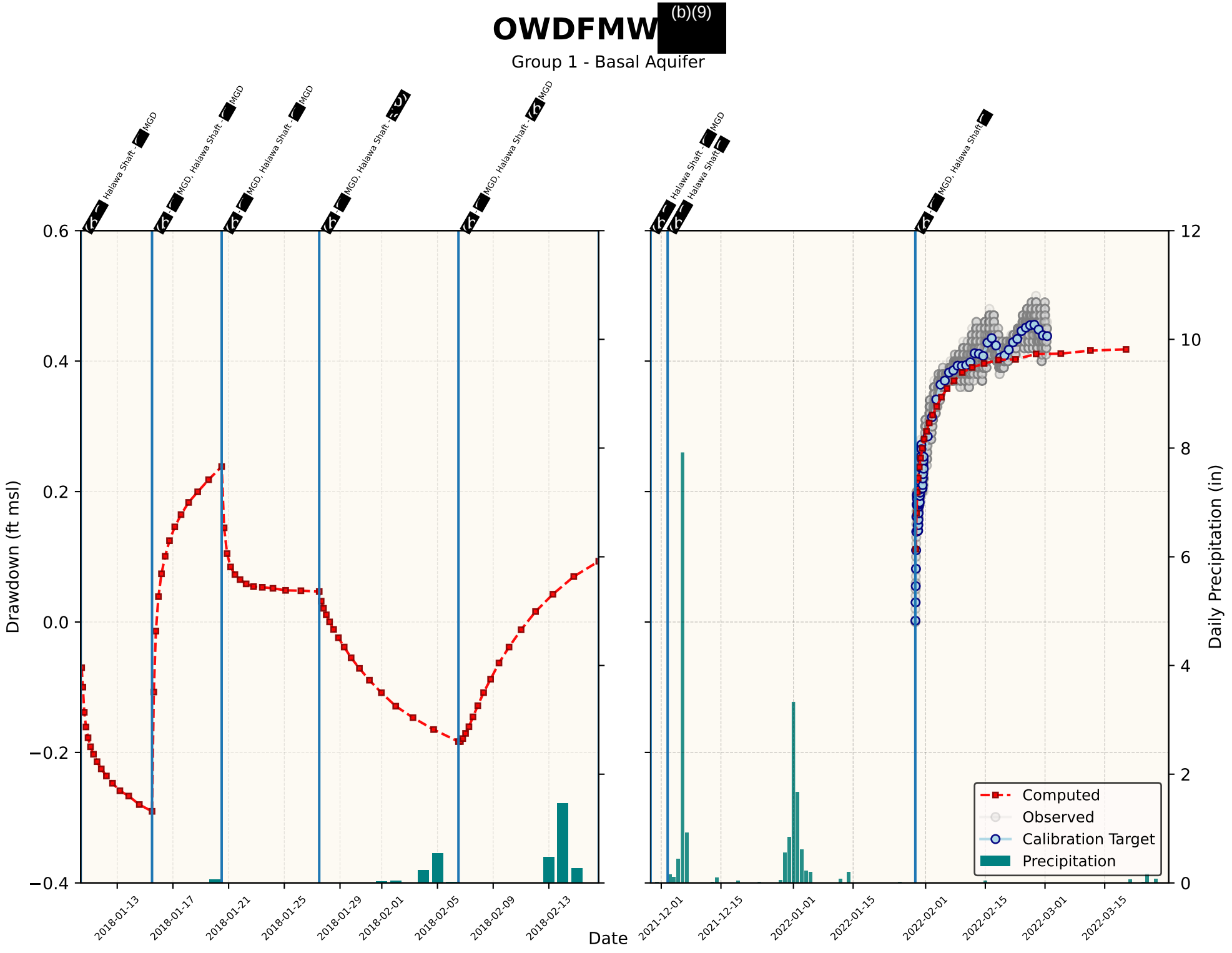

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
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2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

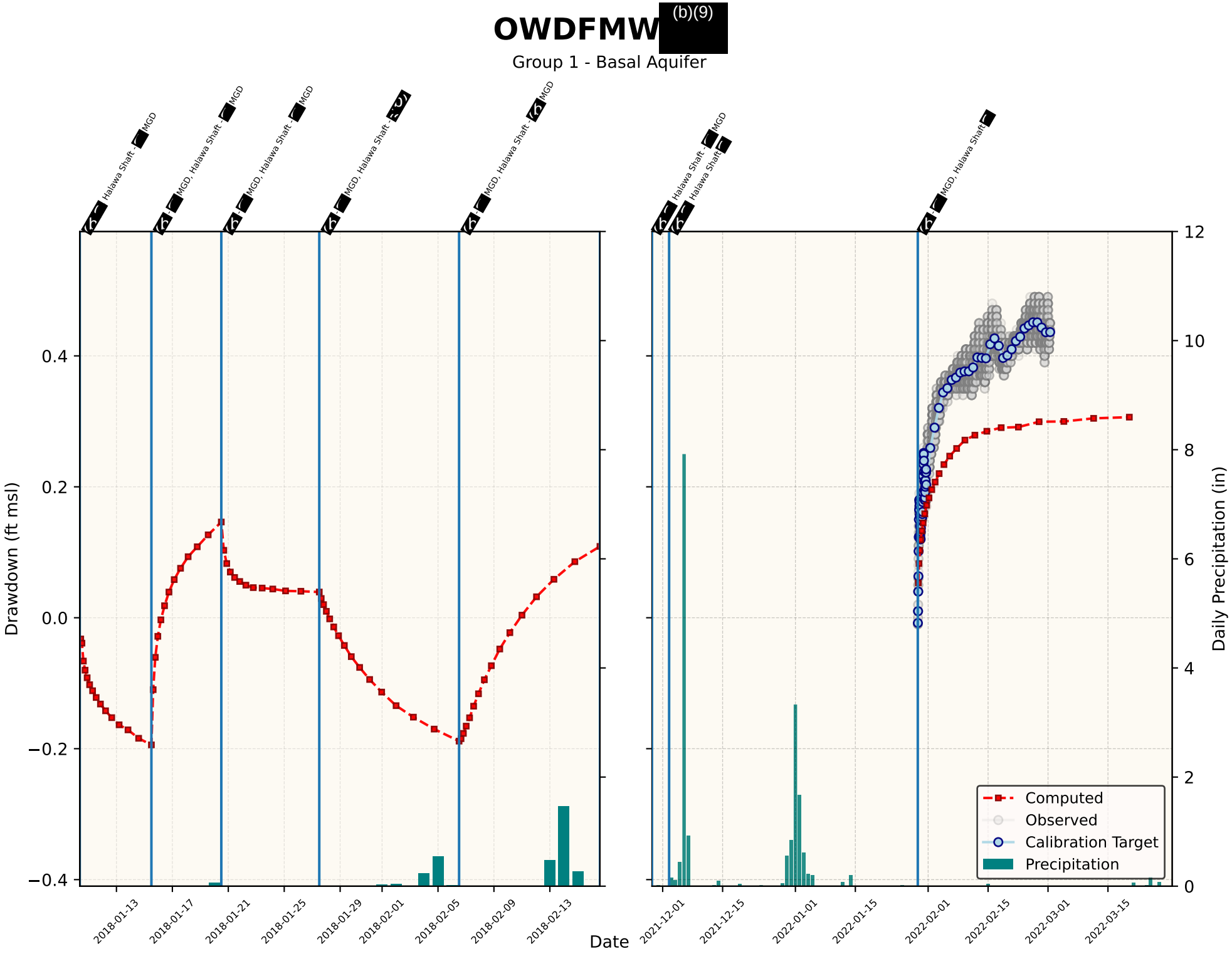

Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

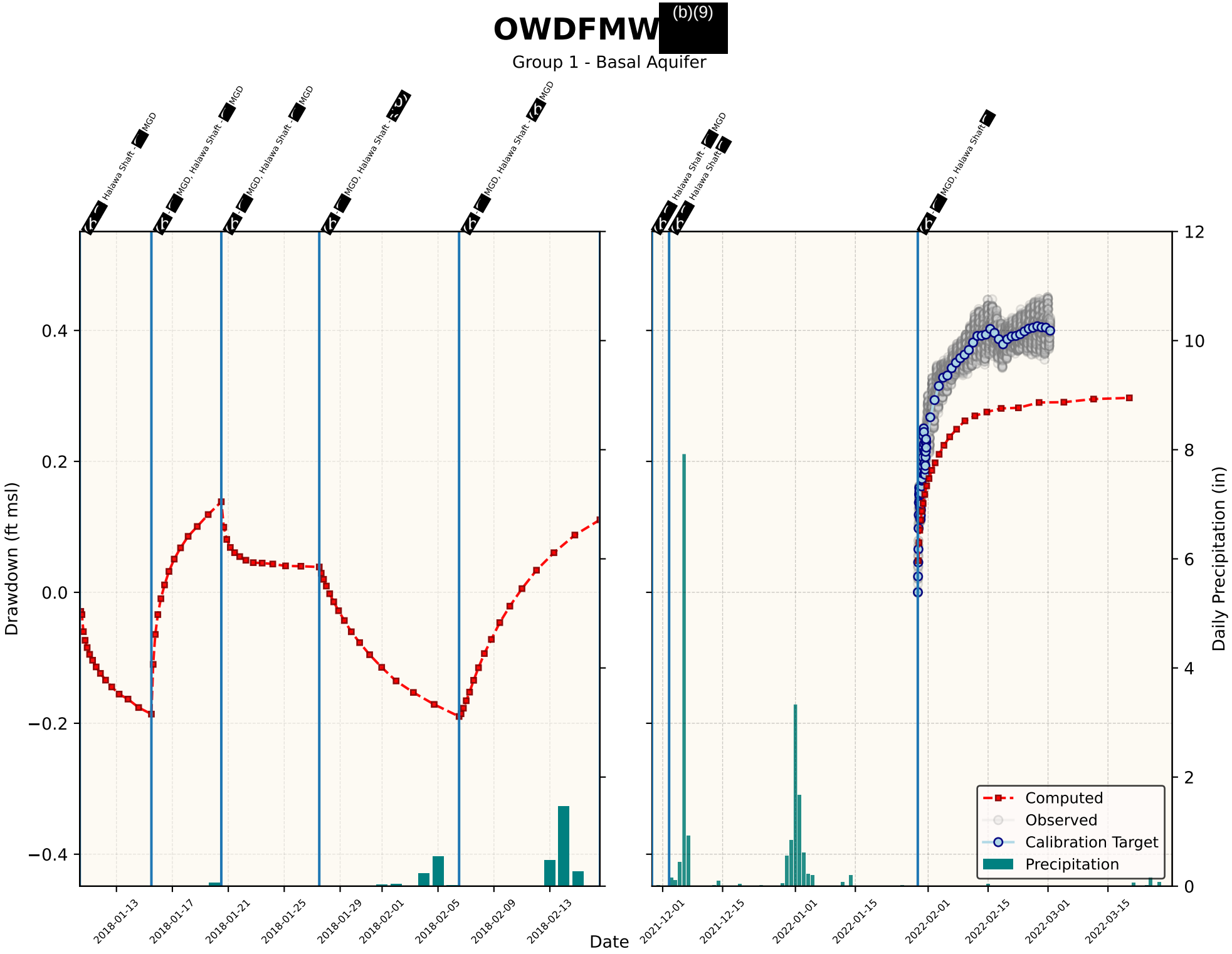

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

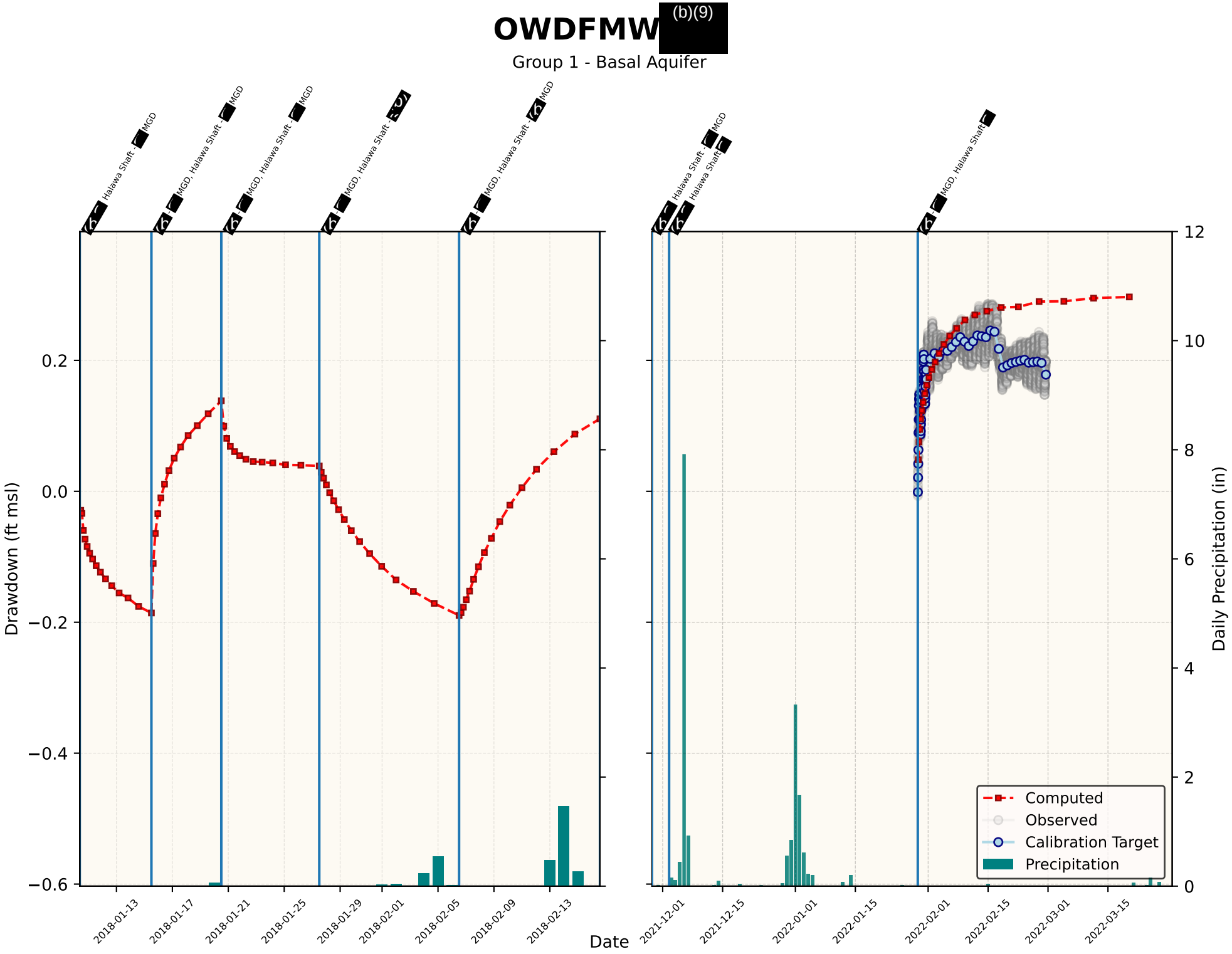

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
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2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

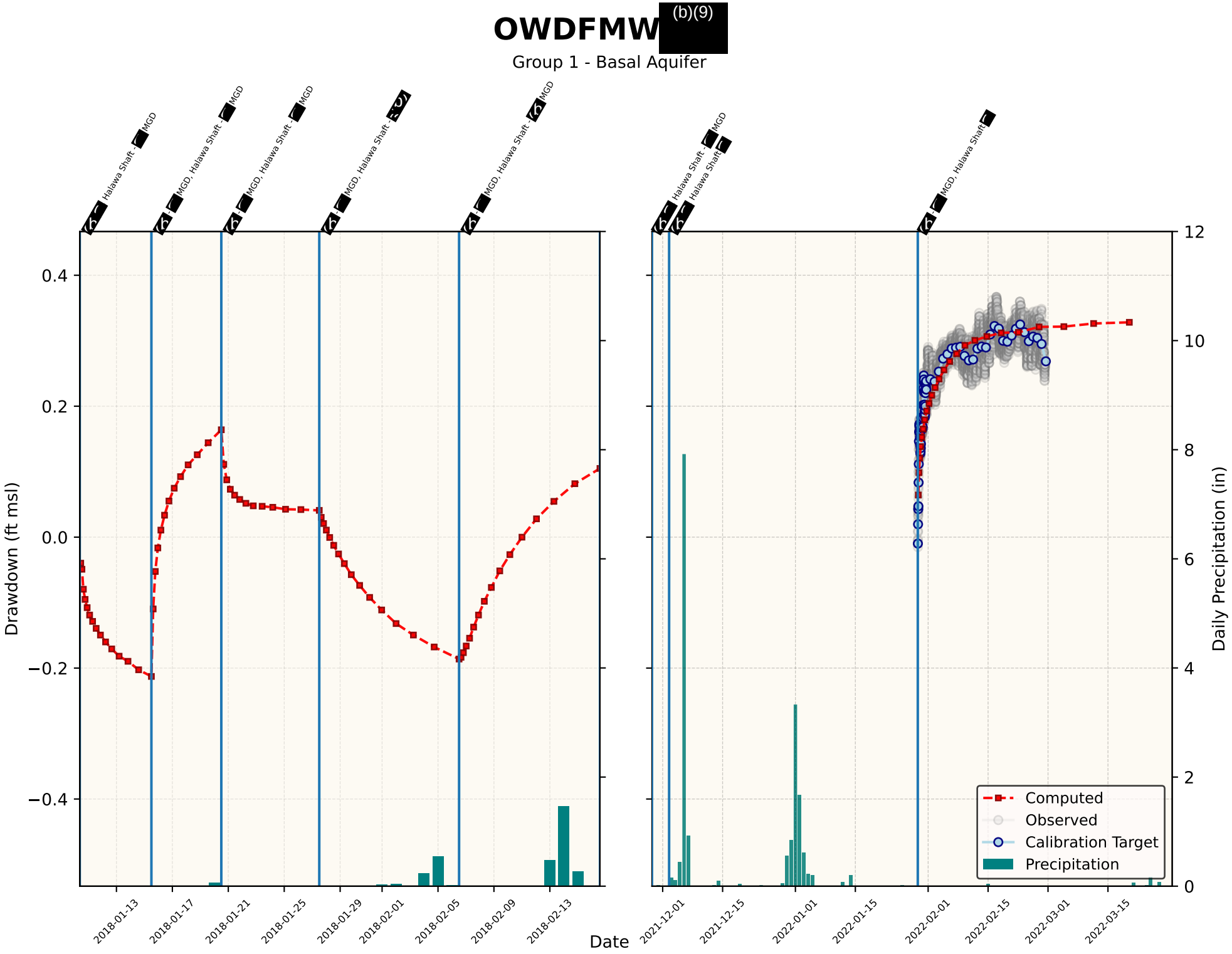

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

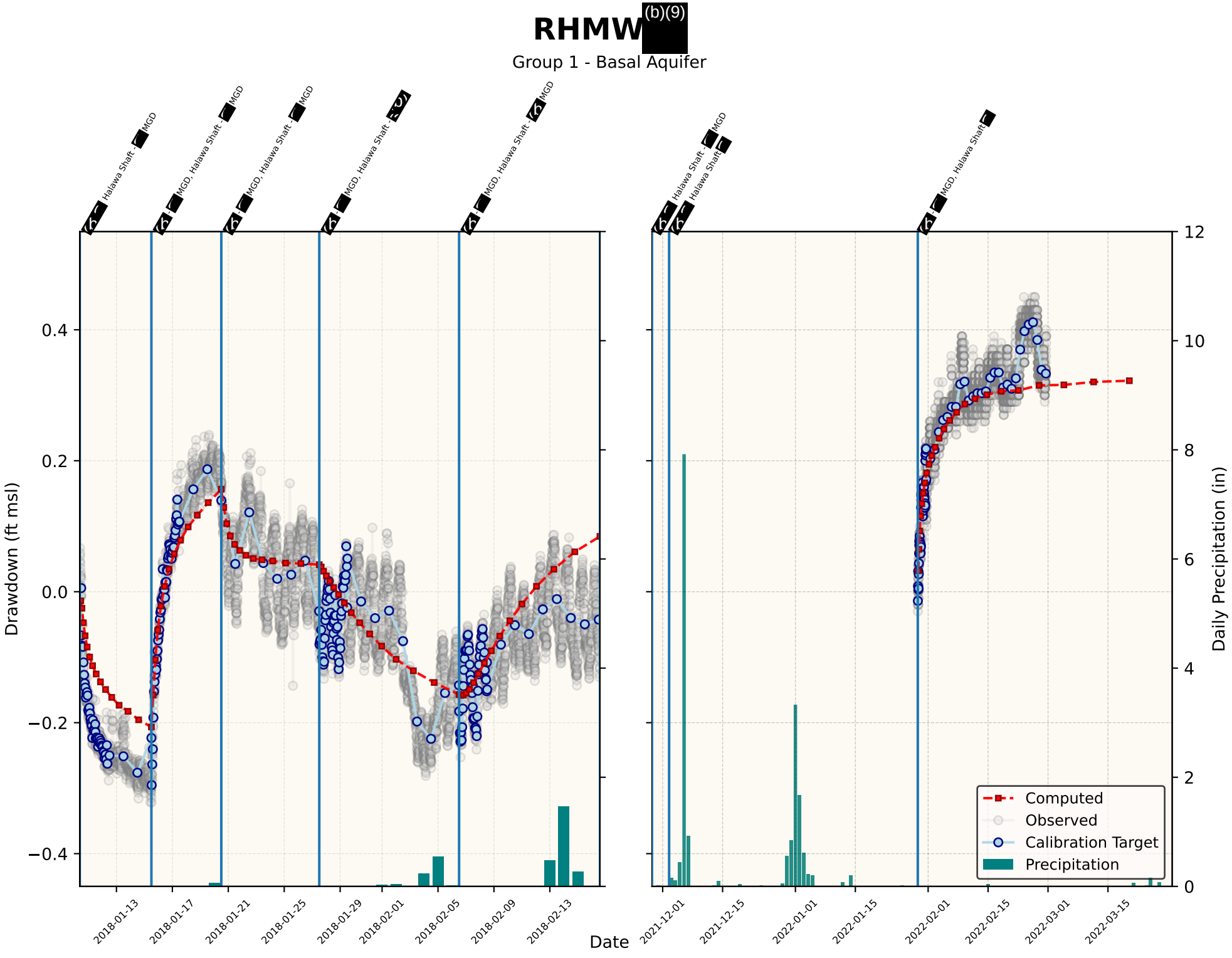

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

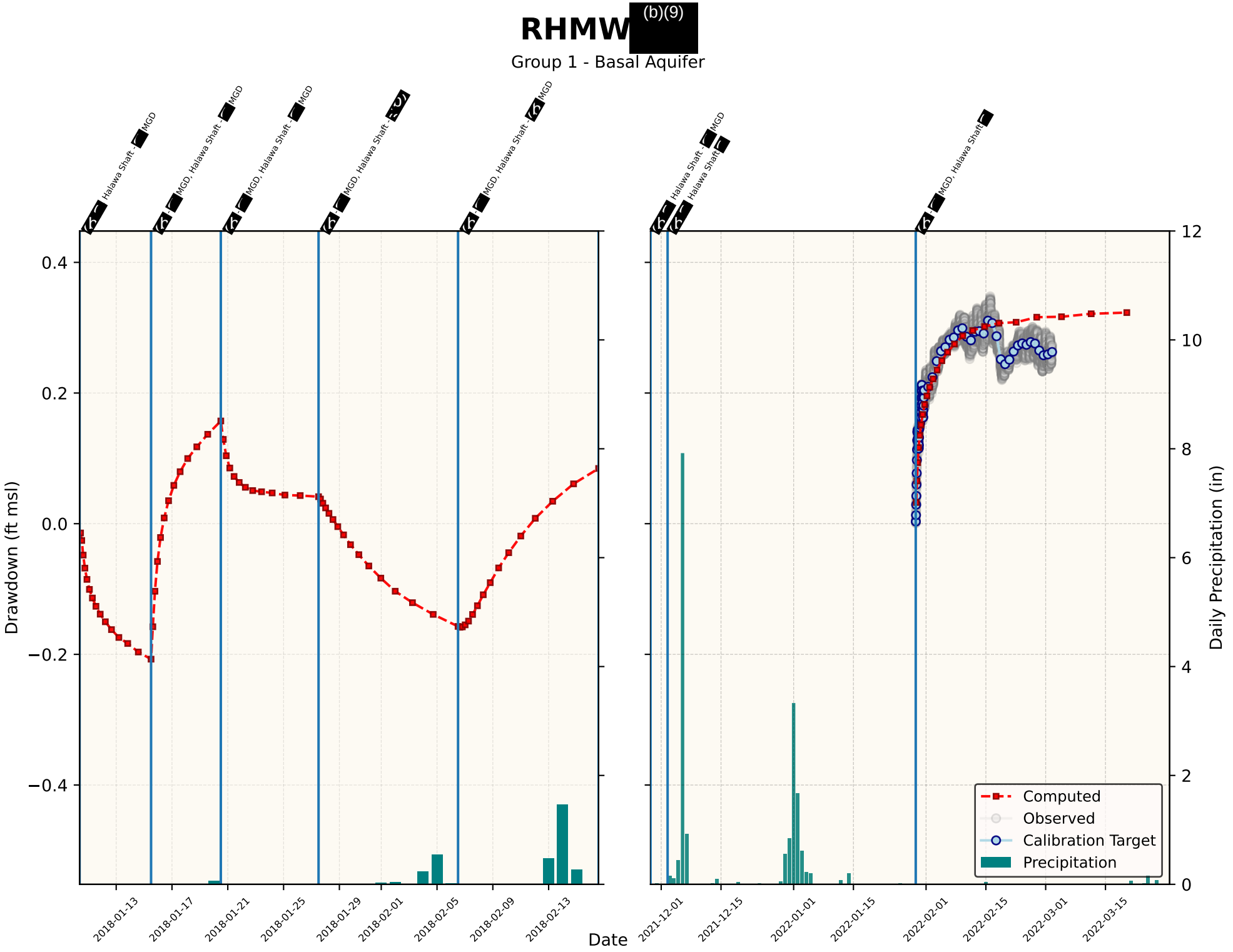

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation

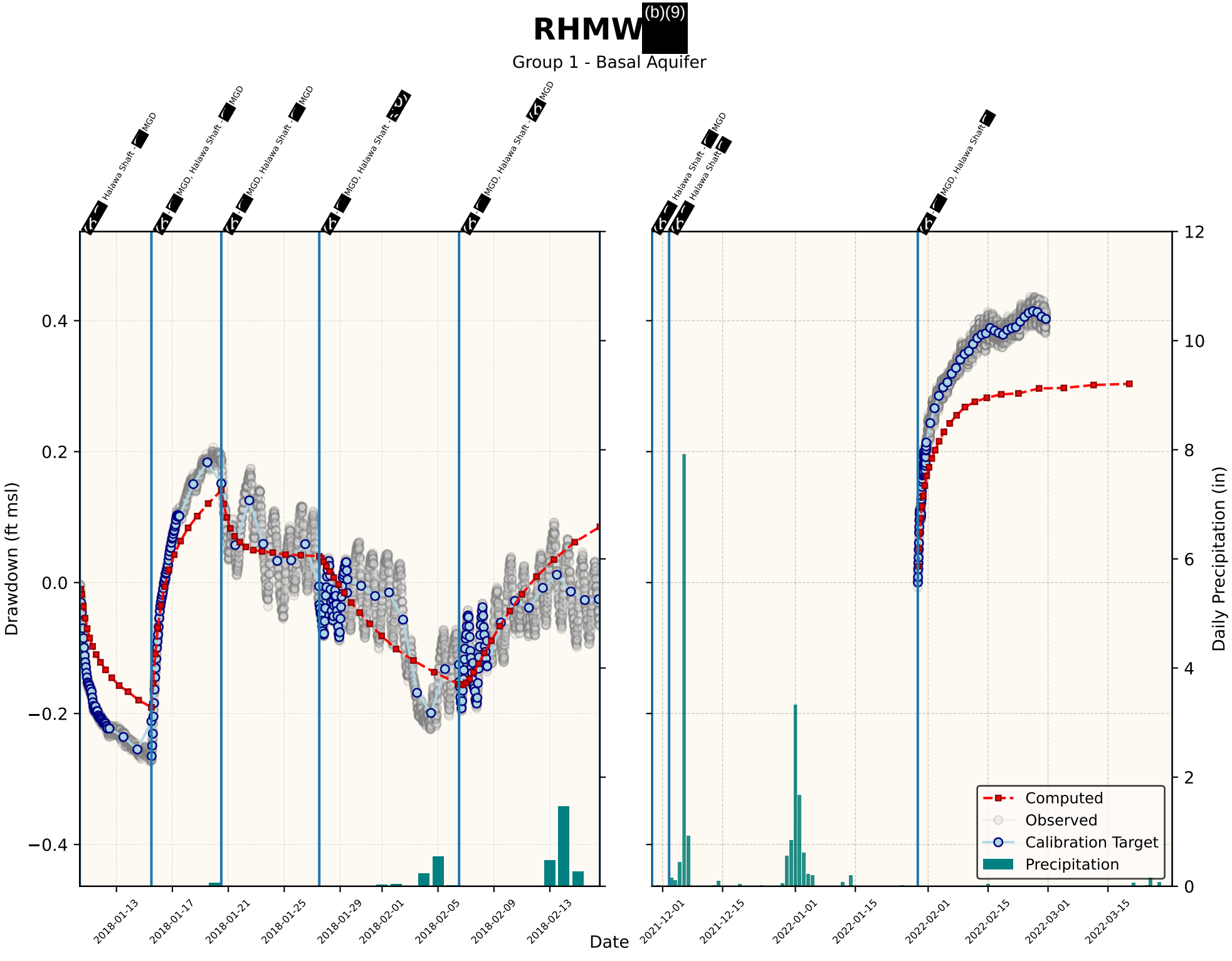

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

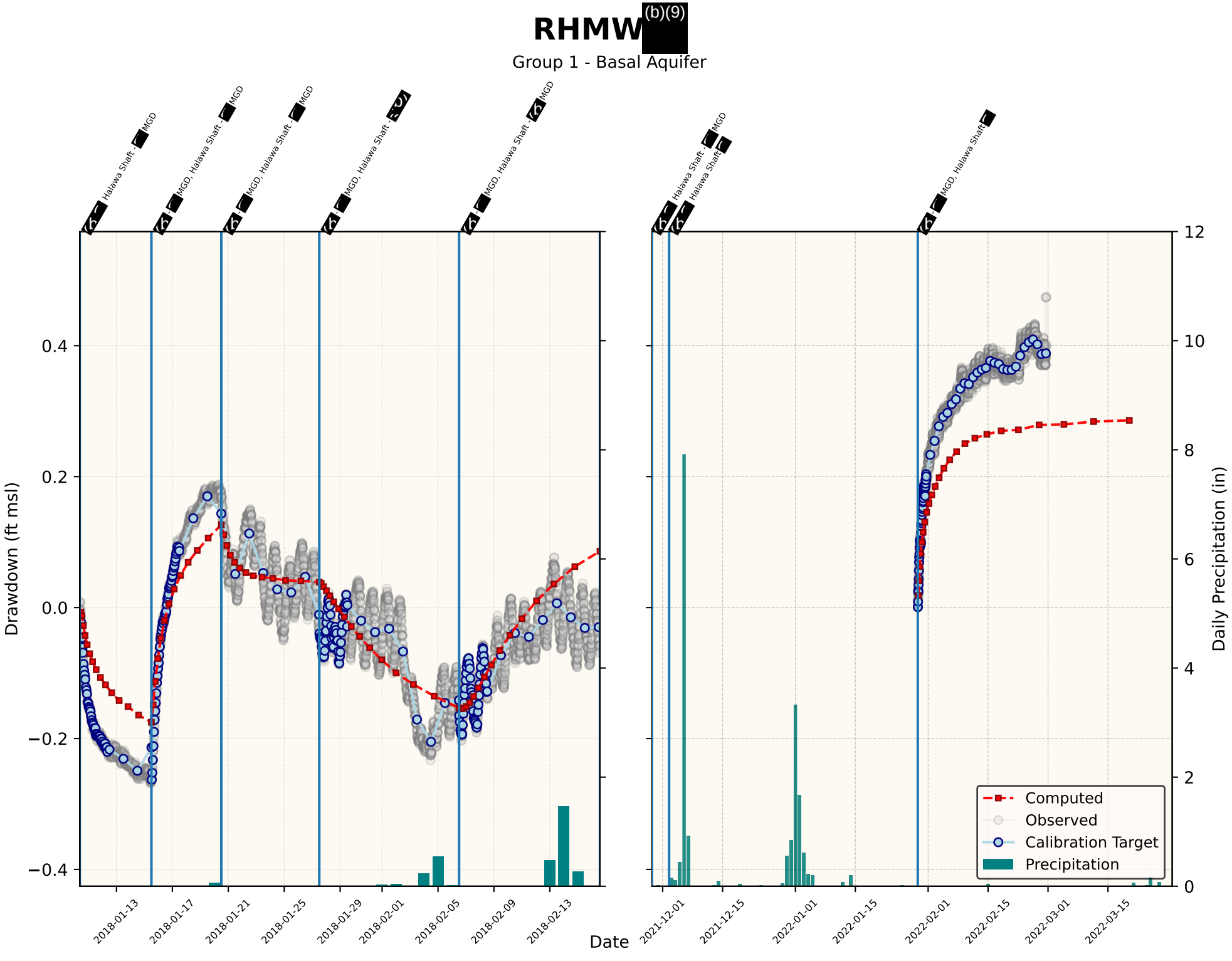

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.2
0.0
−0.2
−0.4
−0.6
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

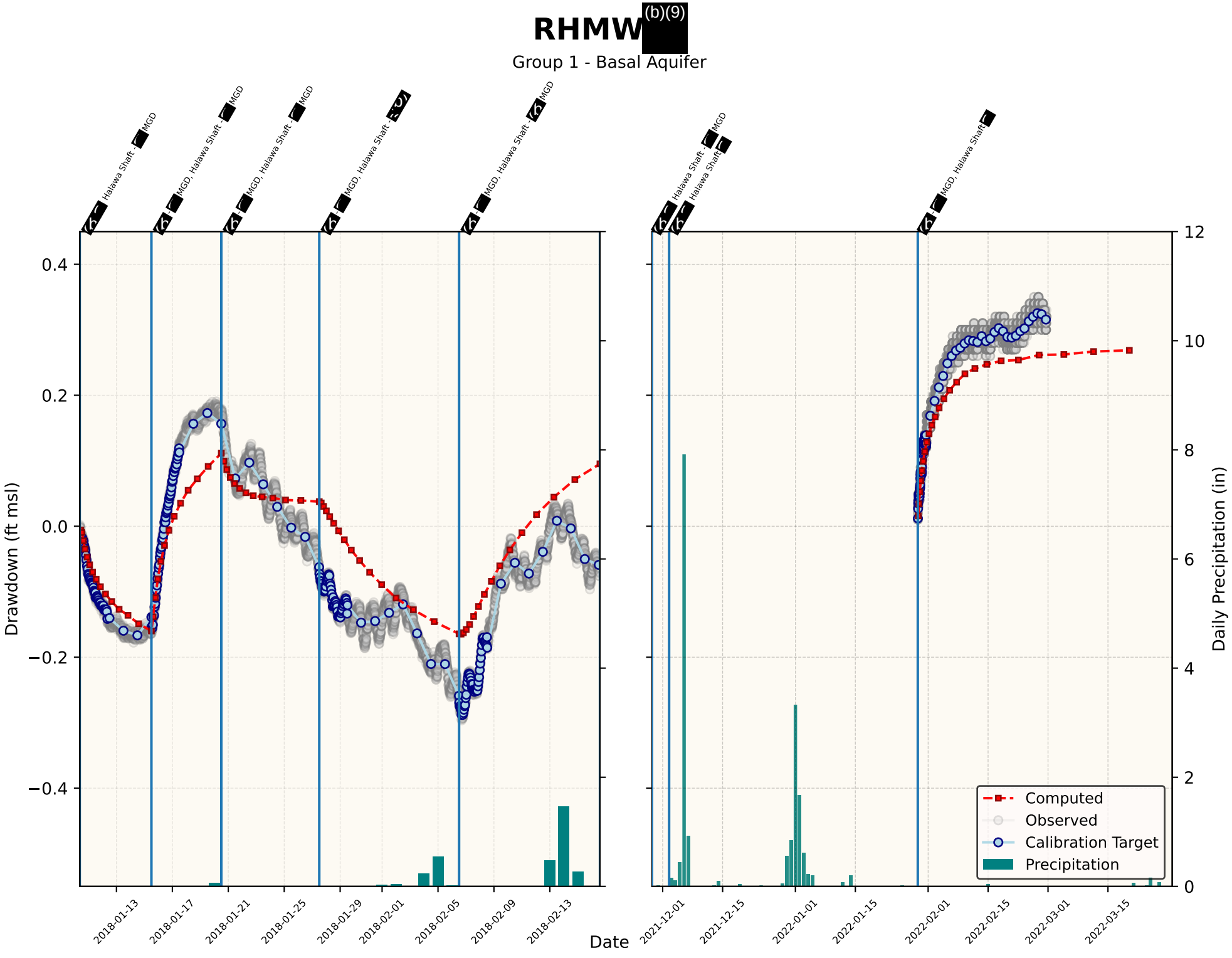

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

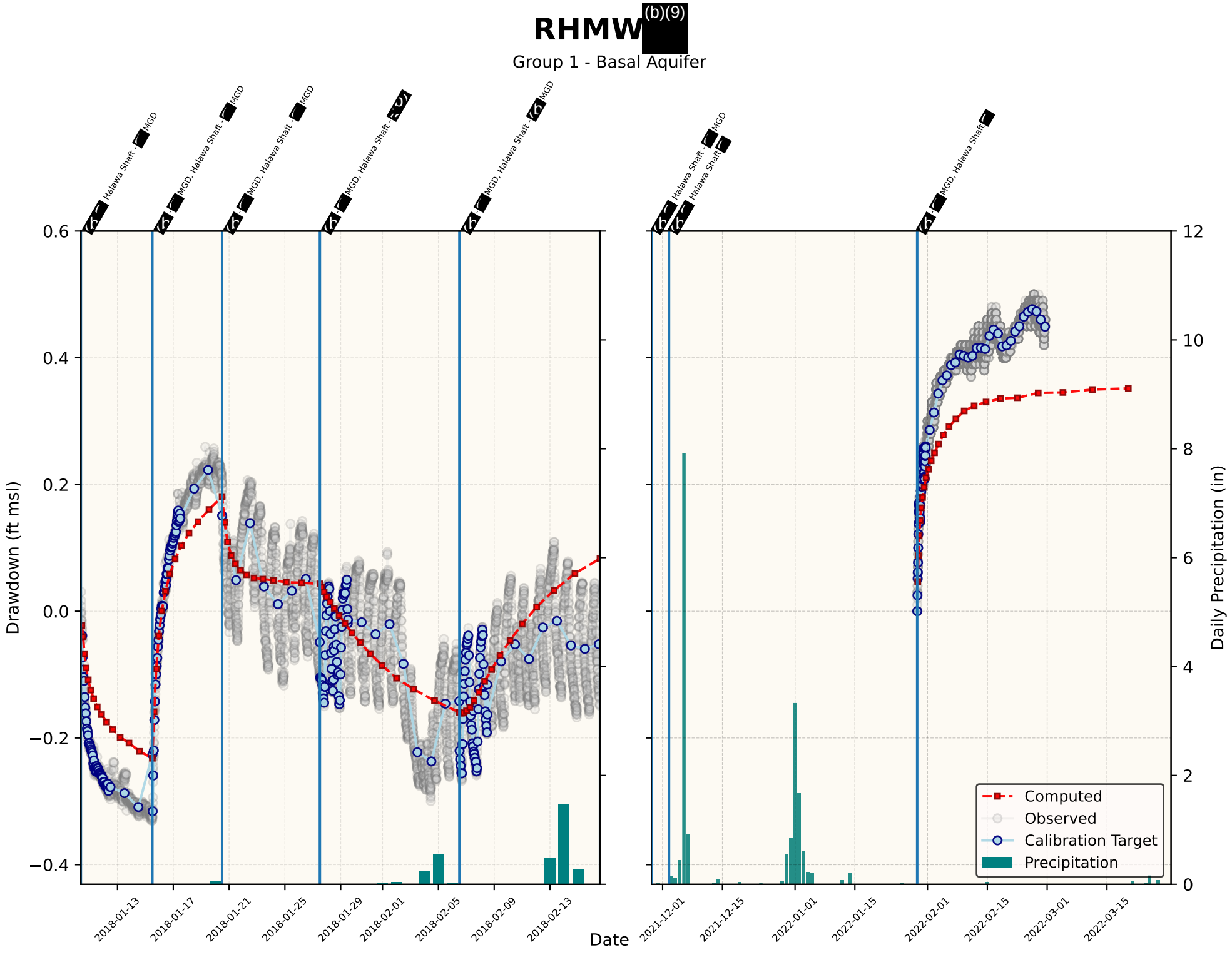

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation

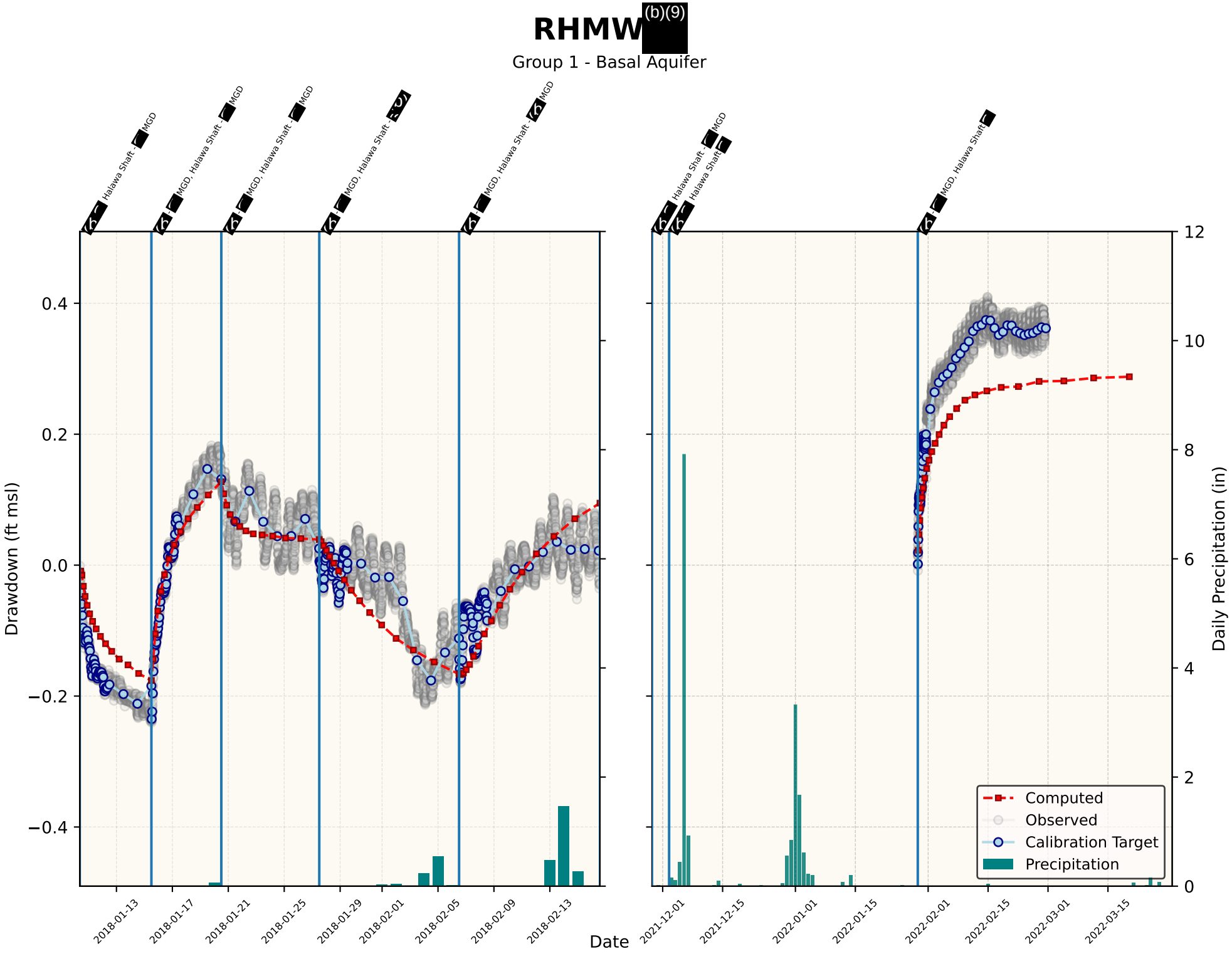

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
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2018-02-13
2021-12-01
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2022-03-01
2022-03-15

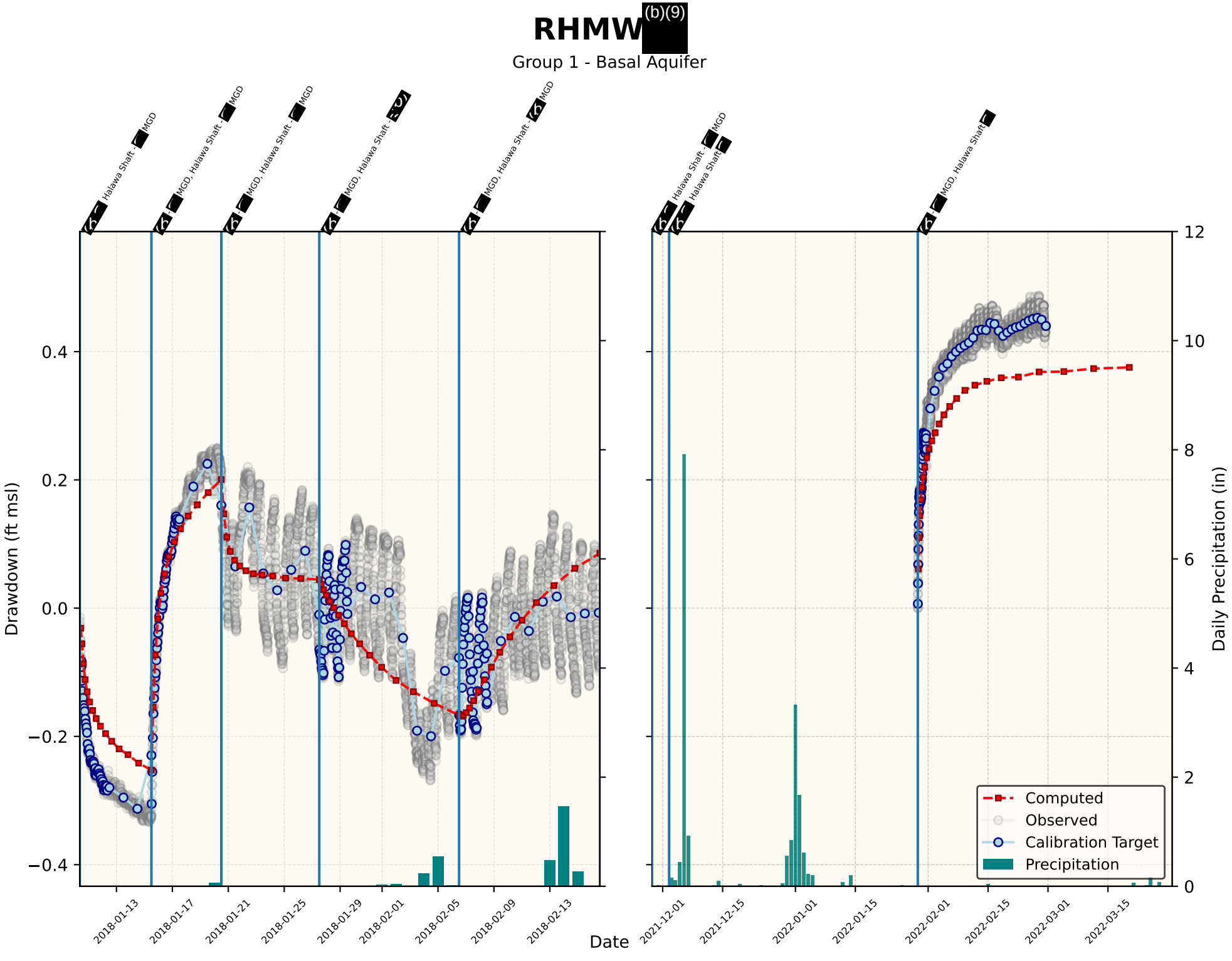

RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
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2018-02-13
2021-12-01
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2022-03-15

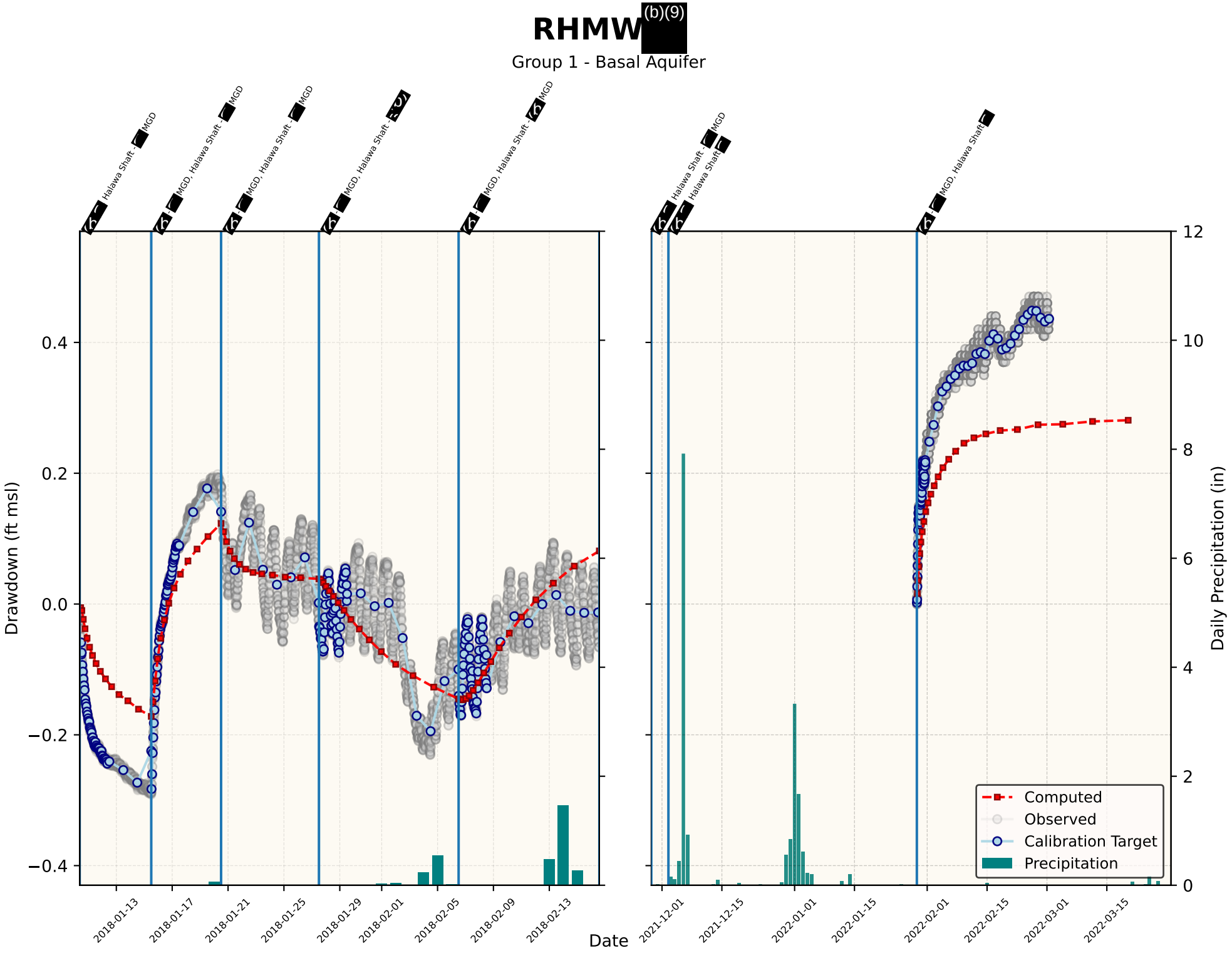

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

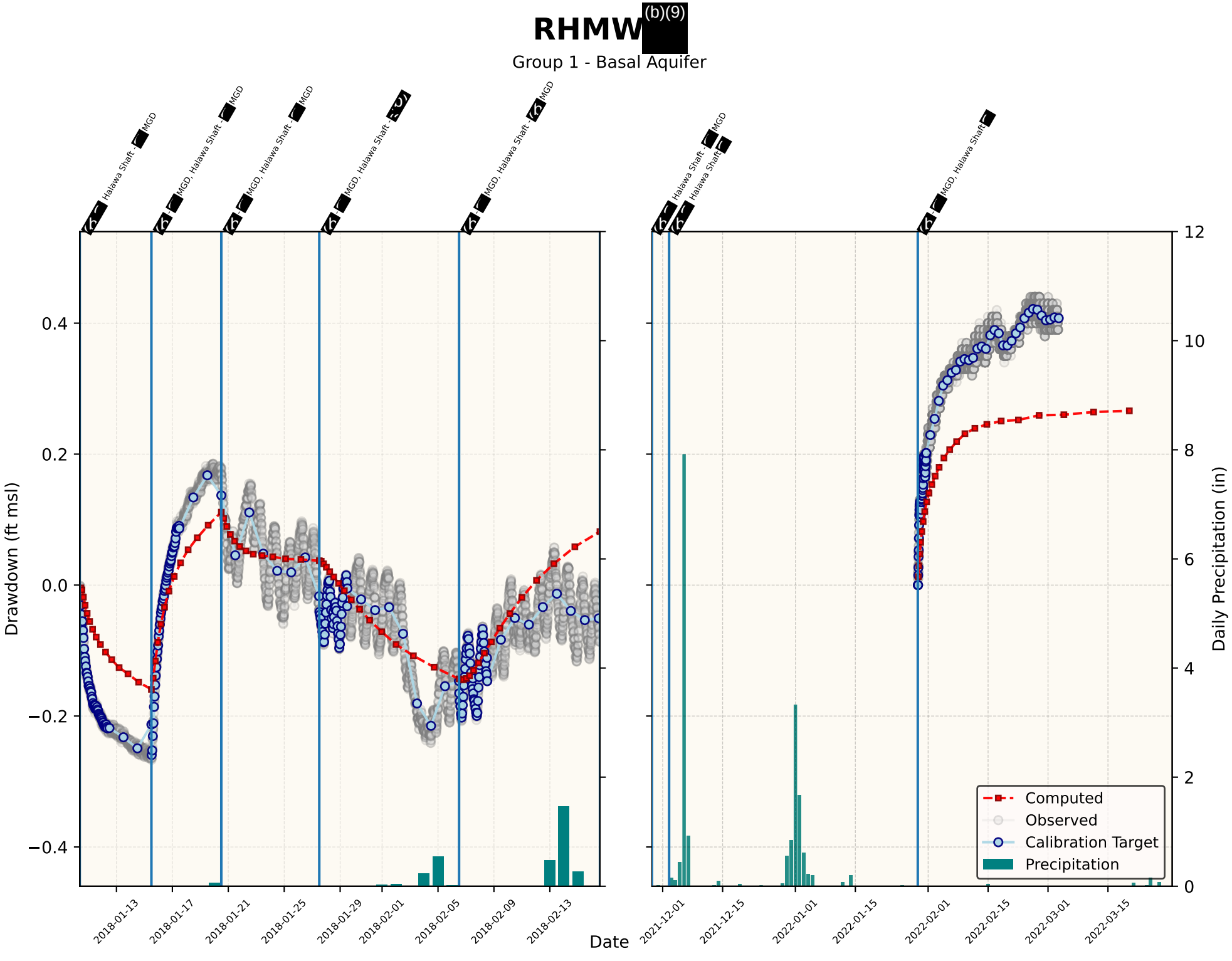

RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
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2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
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2021-12-01
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2022-03-15
Date

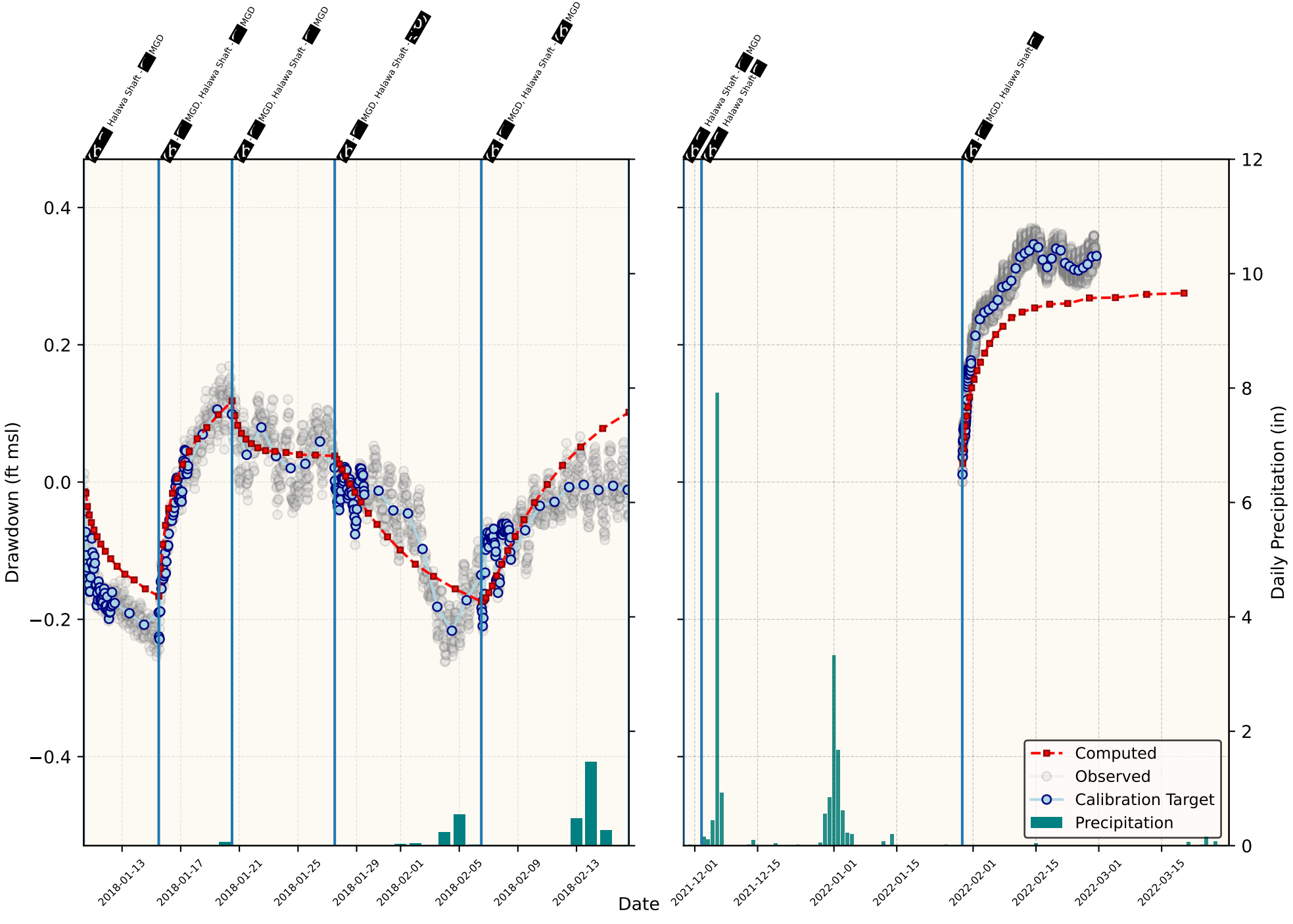

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
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2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

RHMW [redacted] (b)(9)

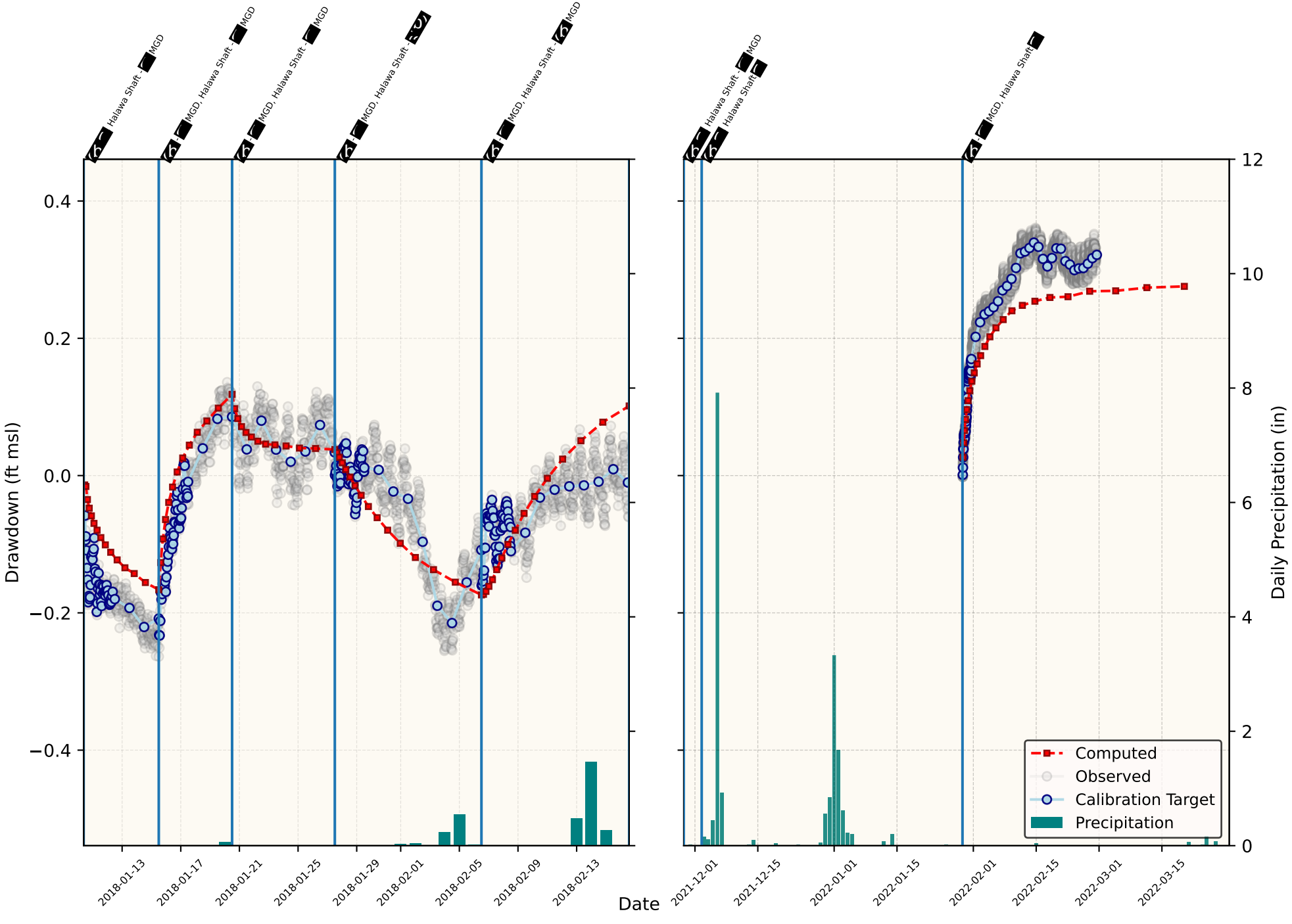
Group 1 - Basal Aquifer



RHMW [redacted]

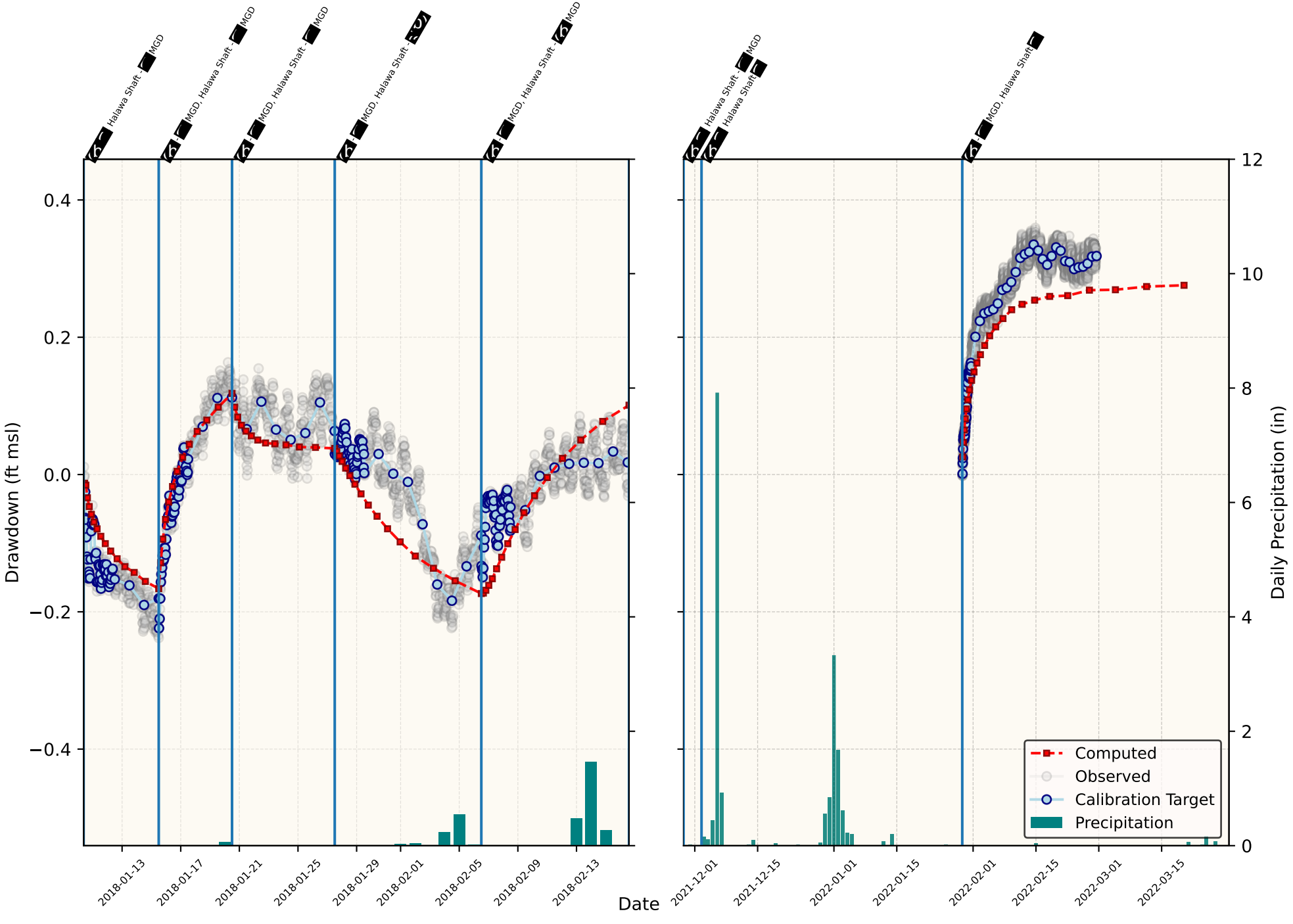
(b)(9)

Group 1 - Basal Aquifer



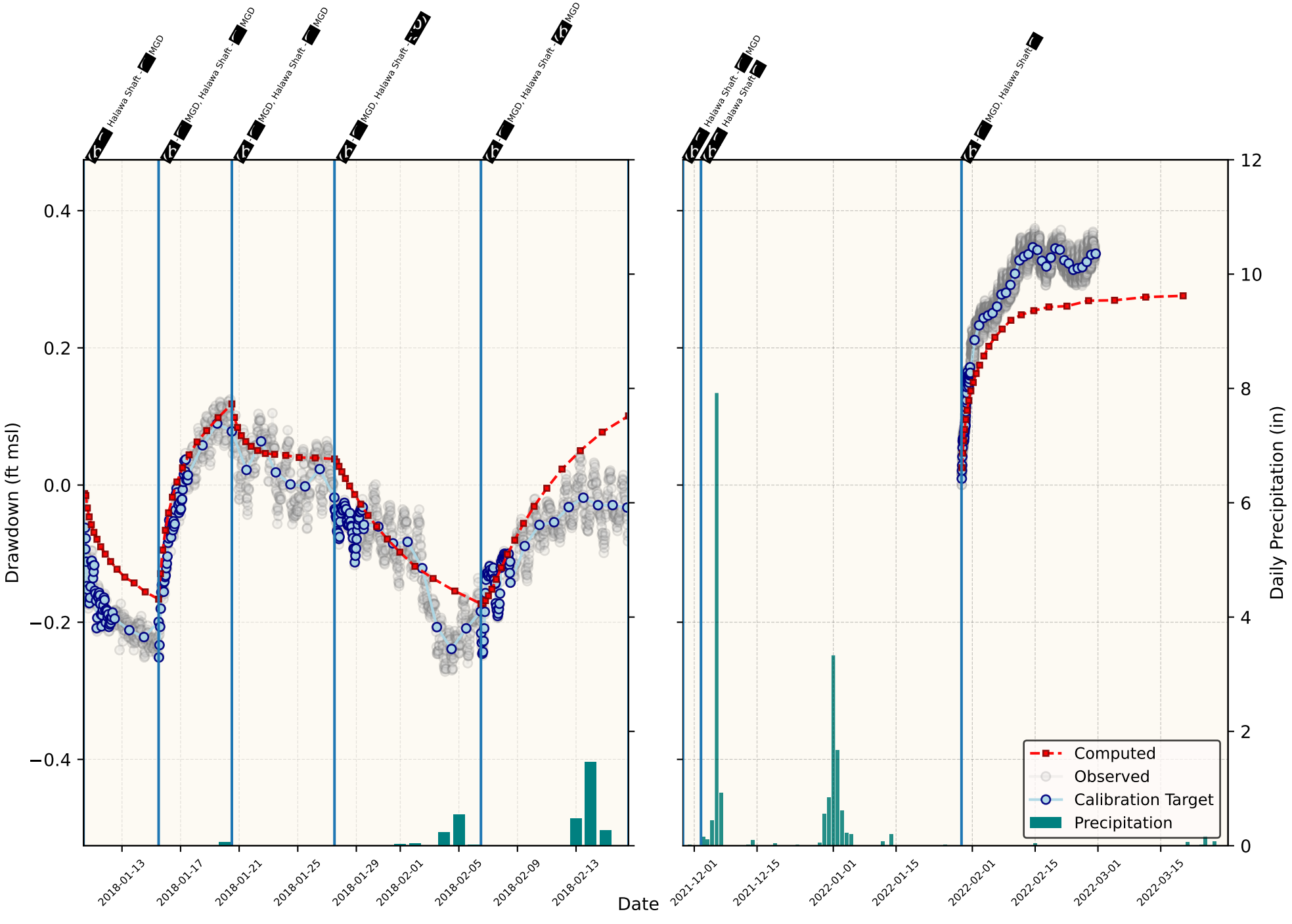
RHMW [redacted] (b)(9)

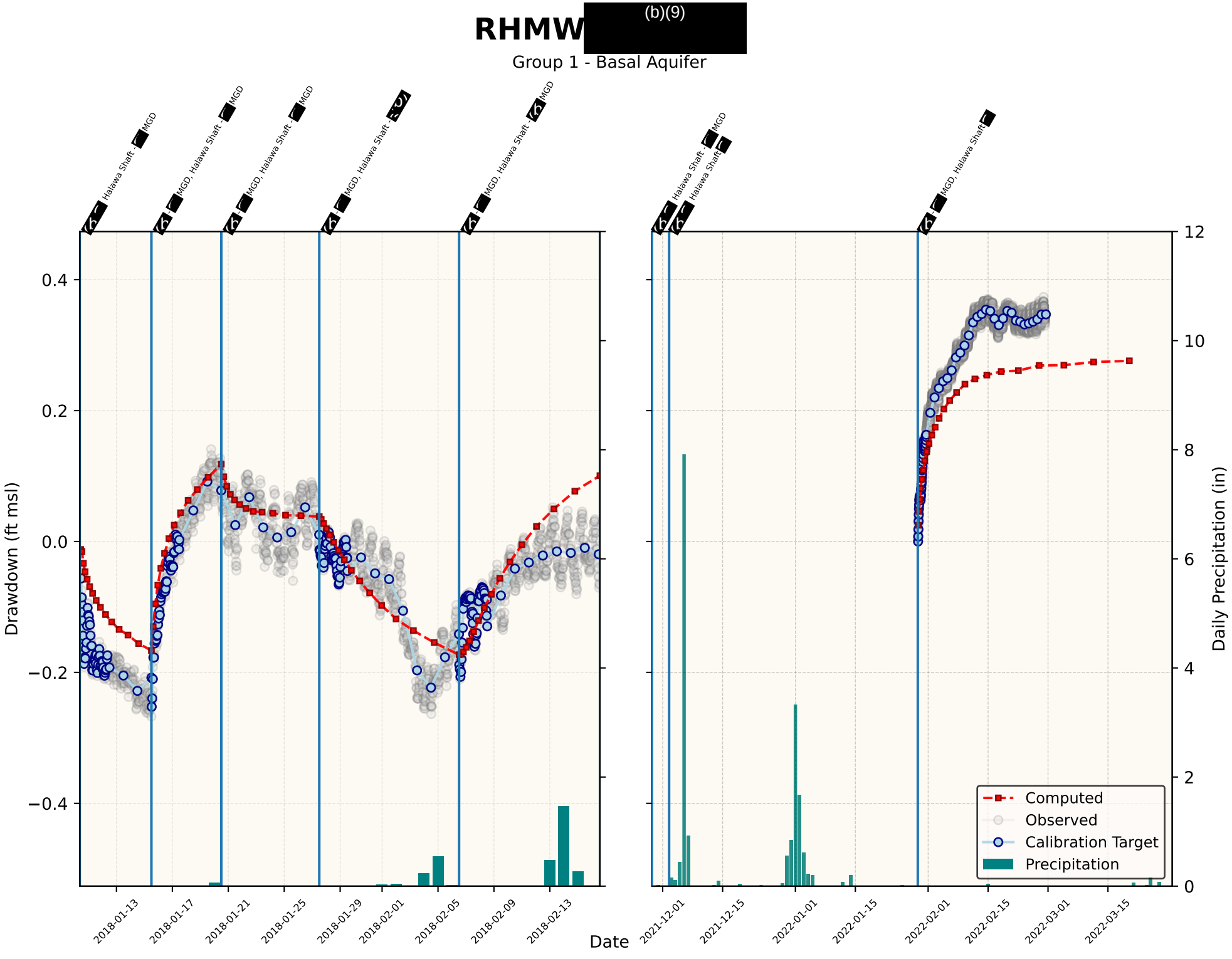
Group 1 - Basal Aquifer

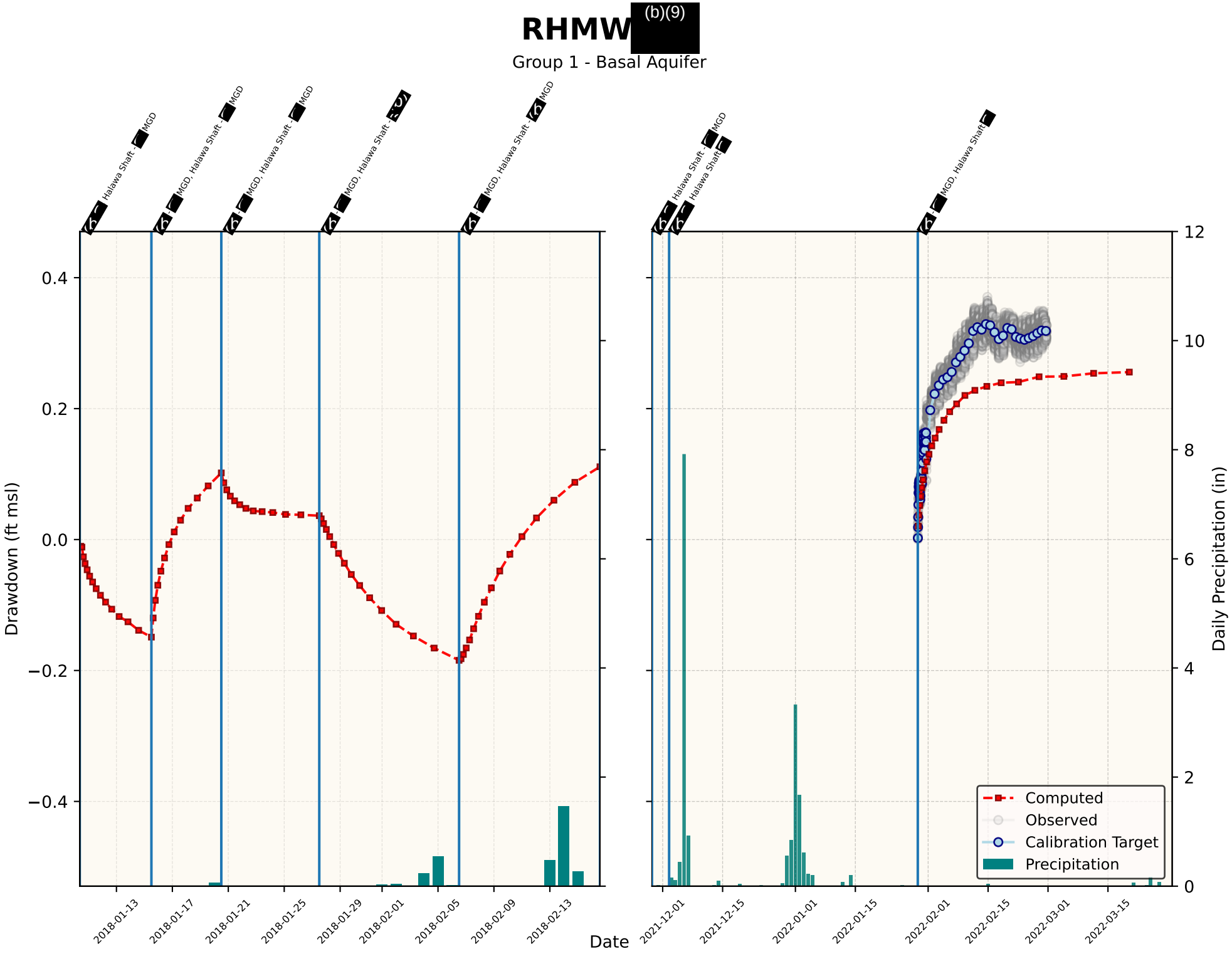


RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer

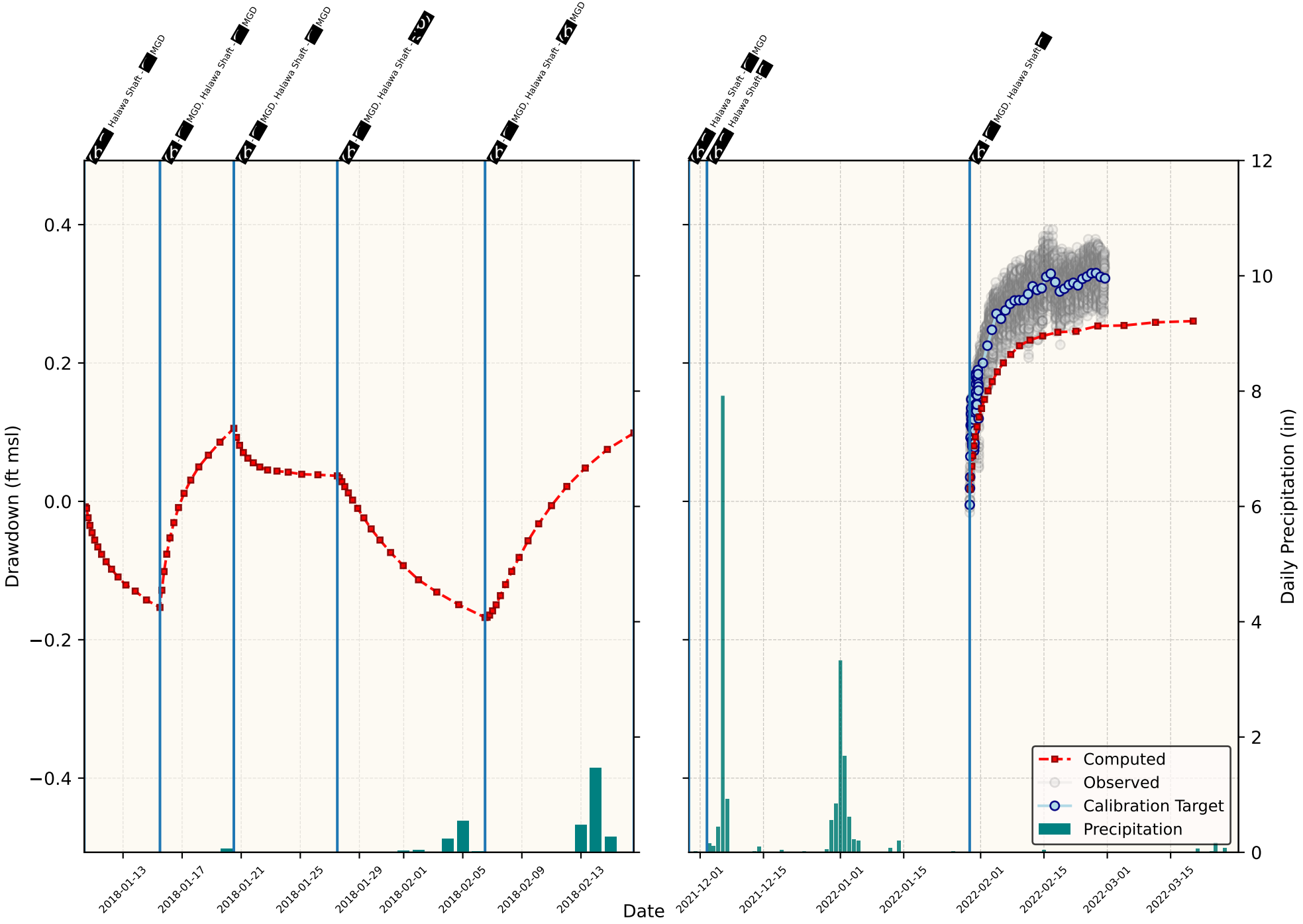



RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

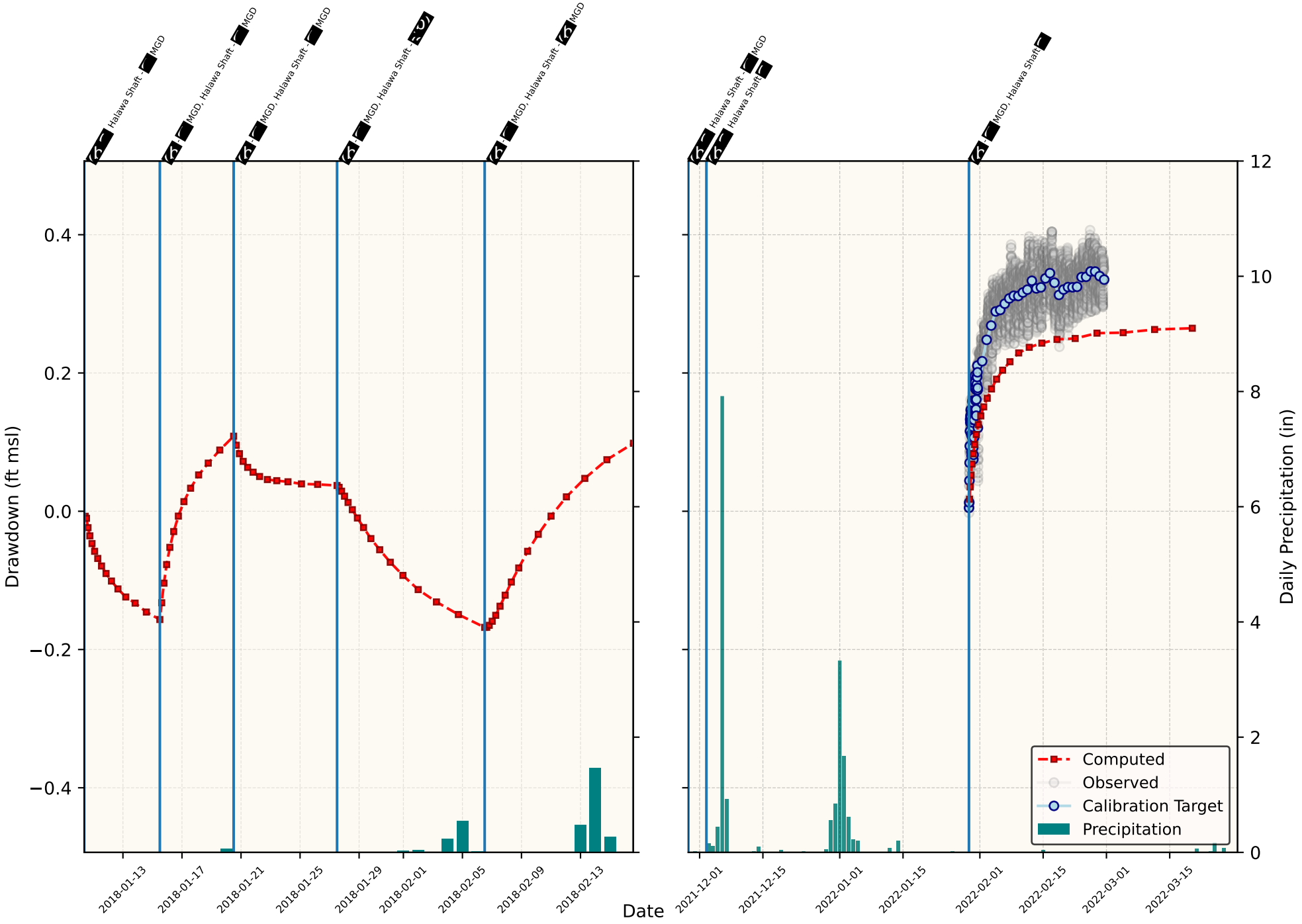
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



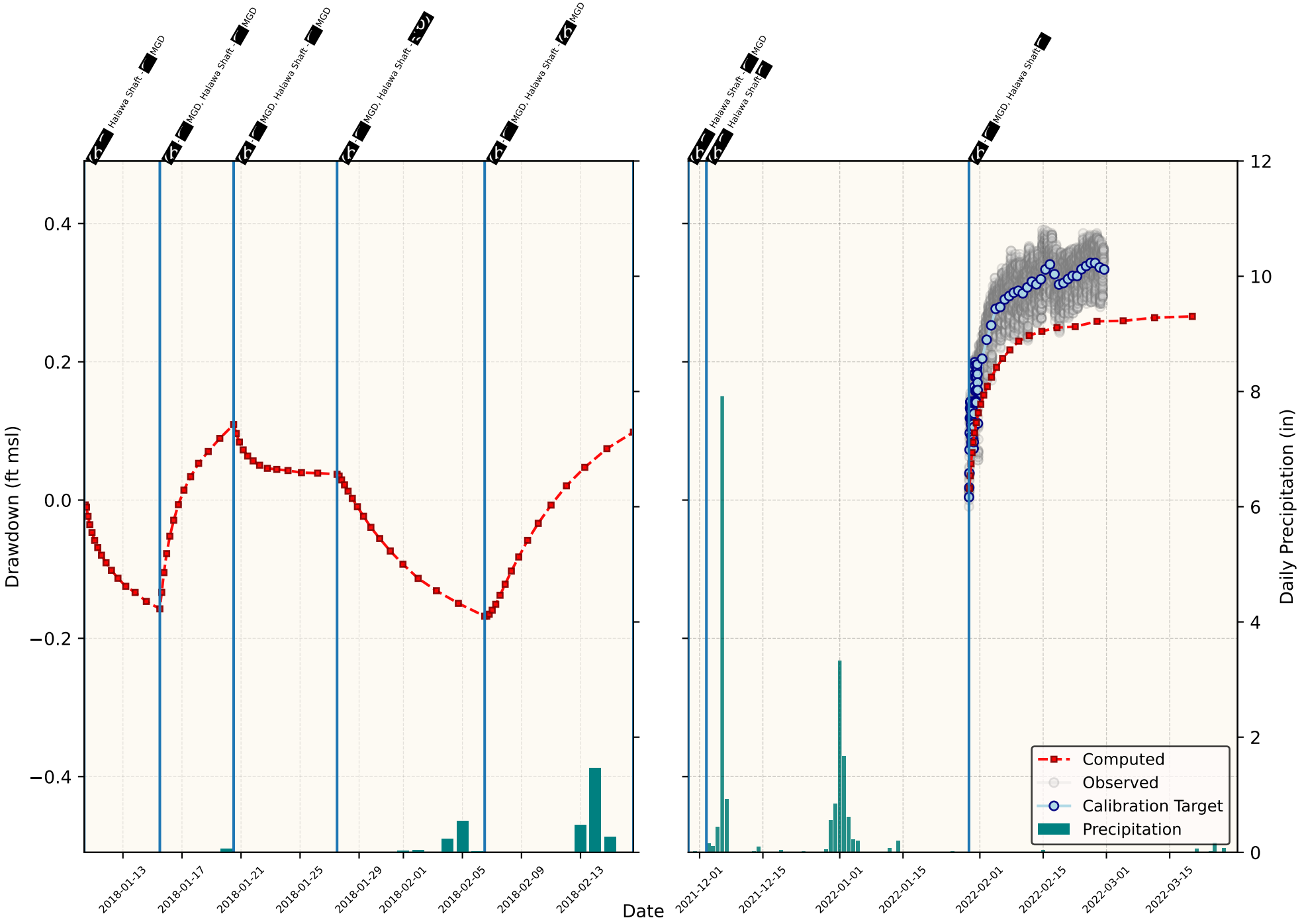
RHMW (b)(9)

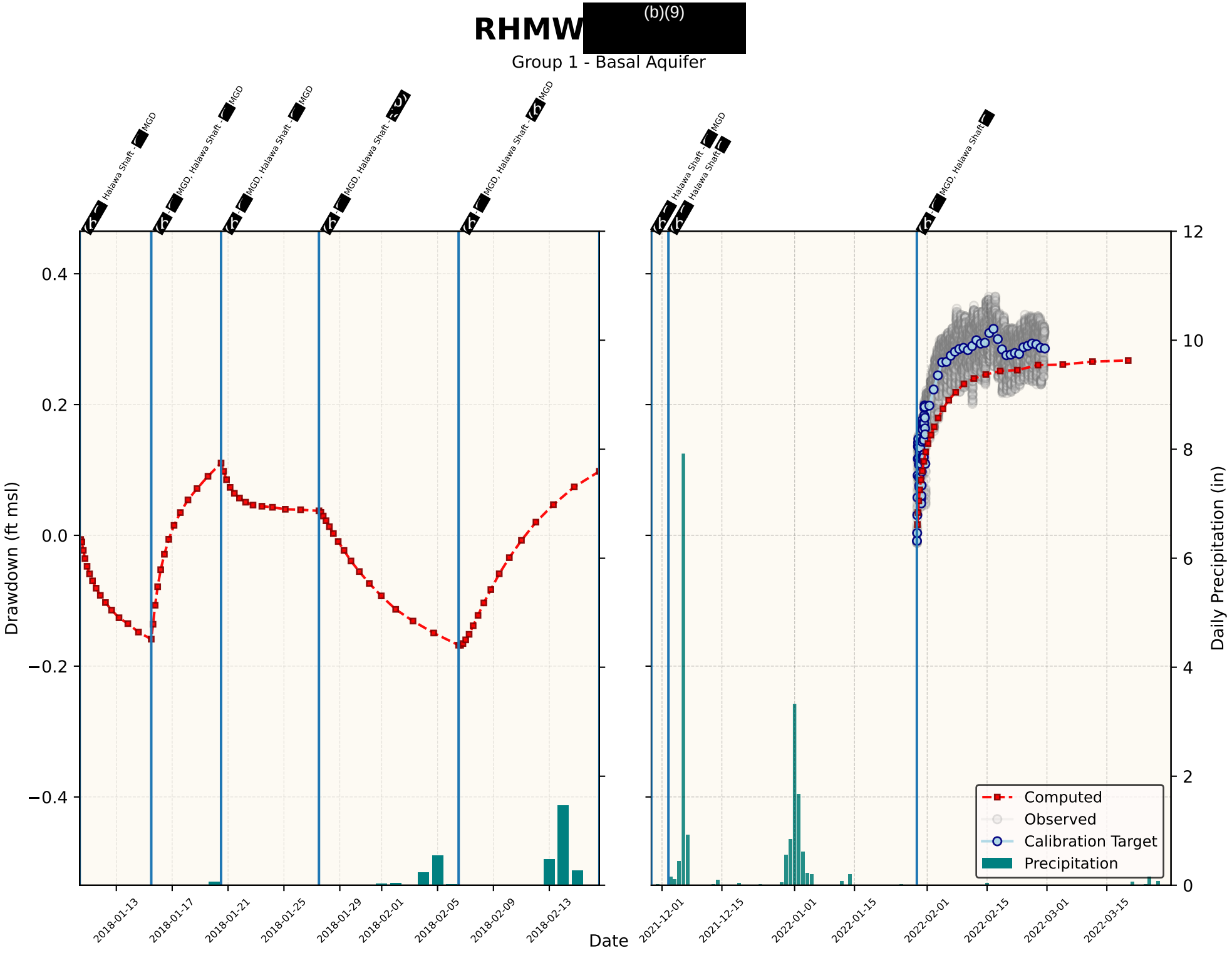
Group 1 - Basal Aquifer



RHMW [redacted] (b)(9)

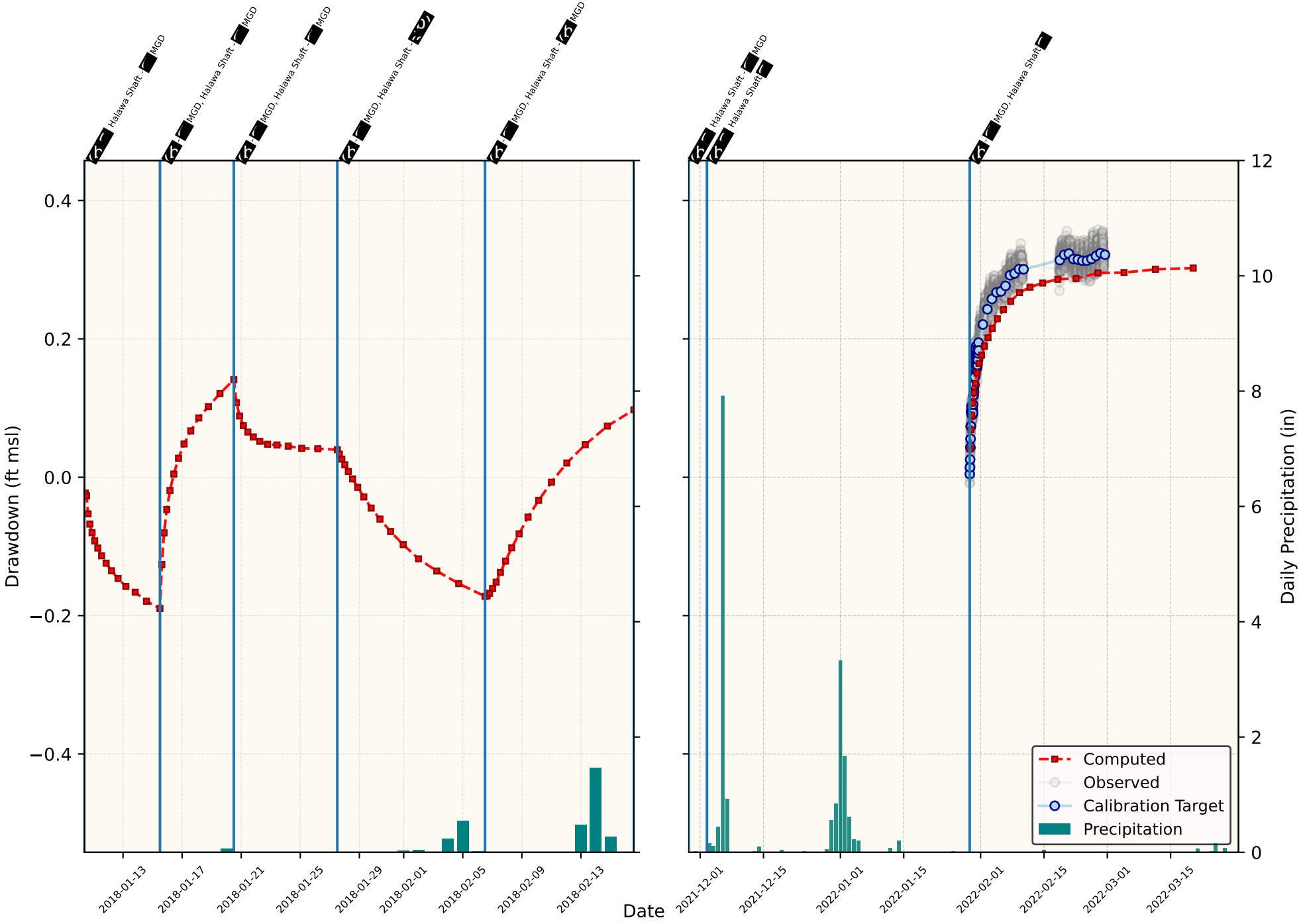
Group 1 - Basal Aquifer

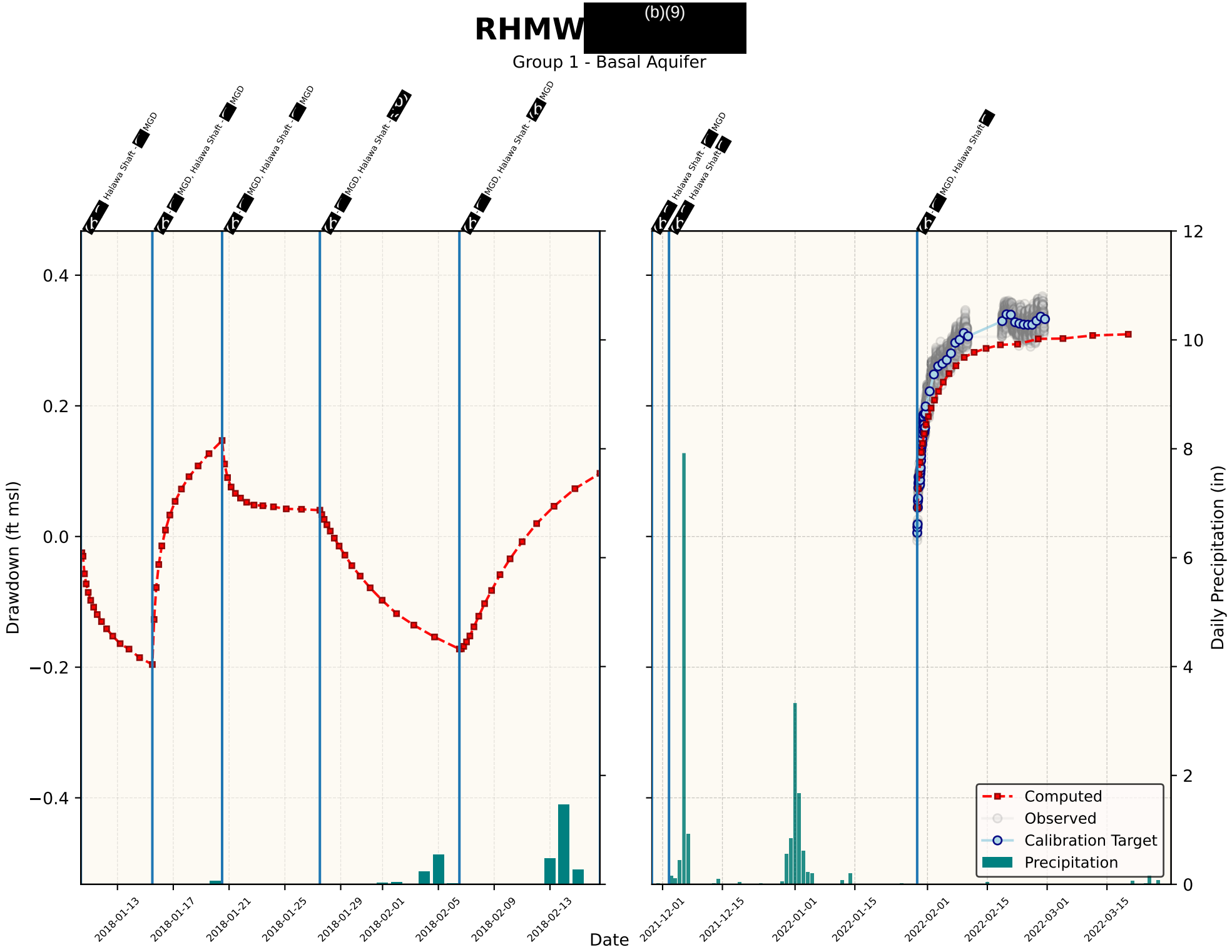


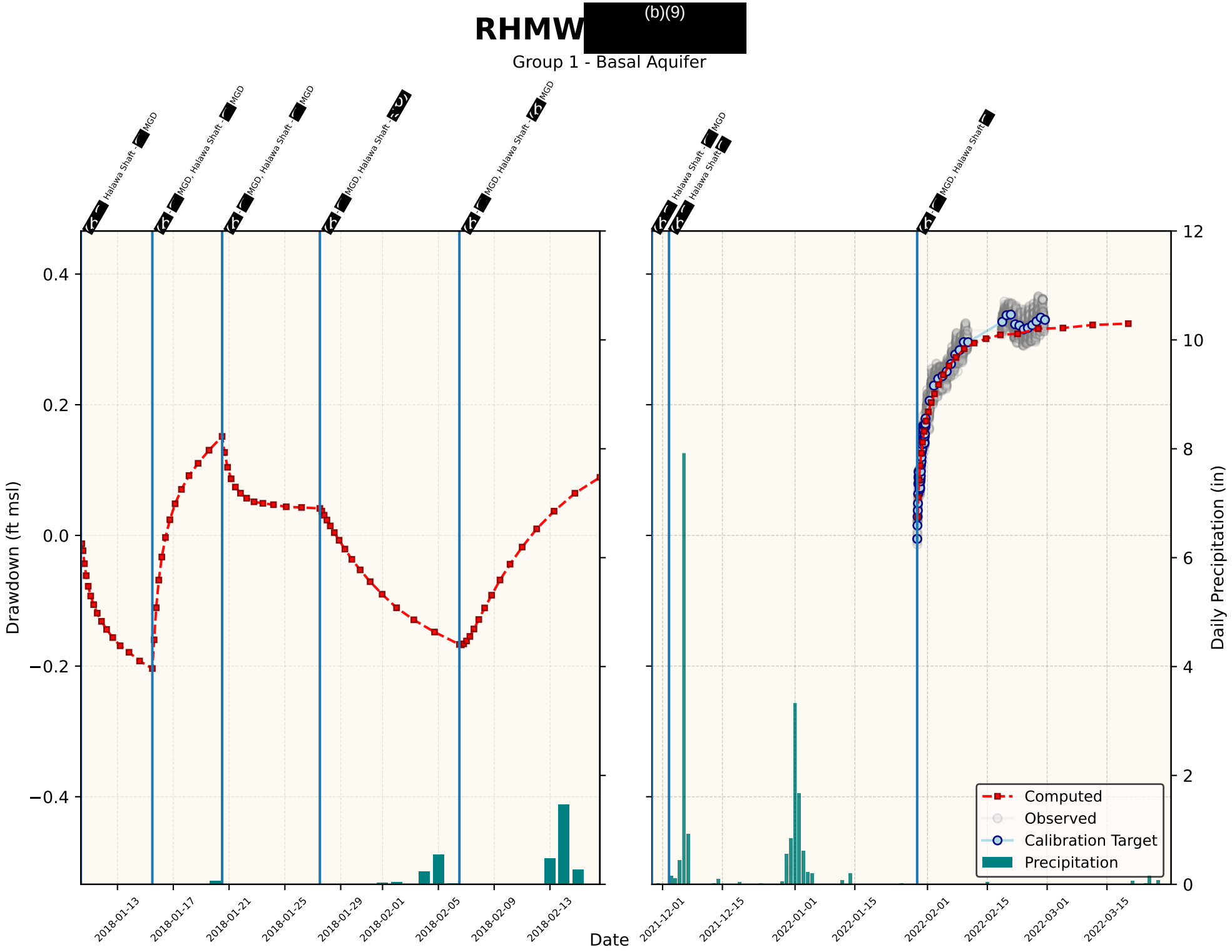

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

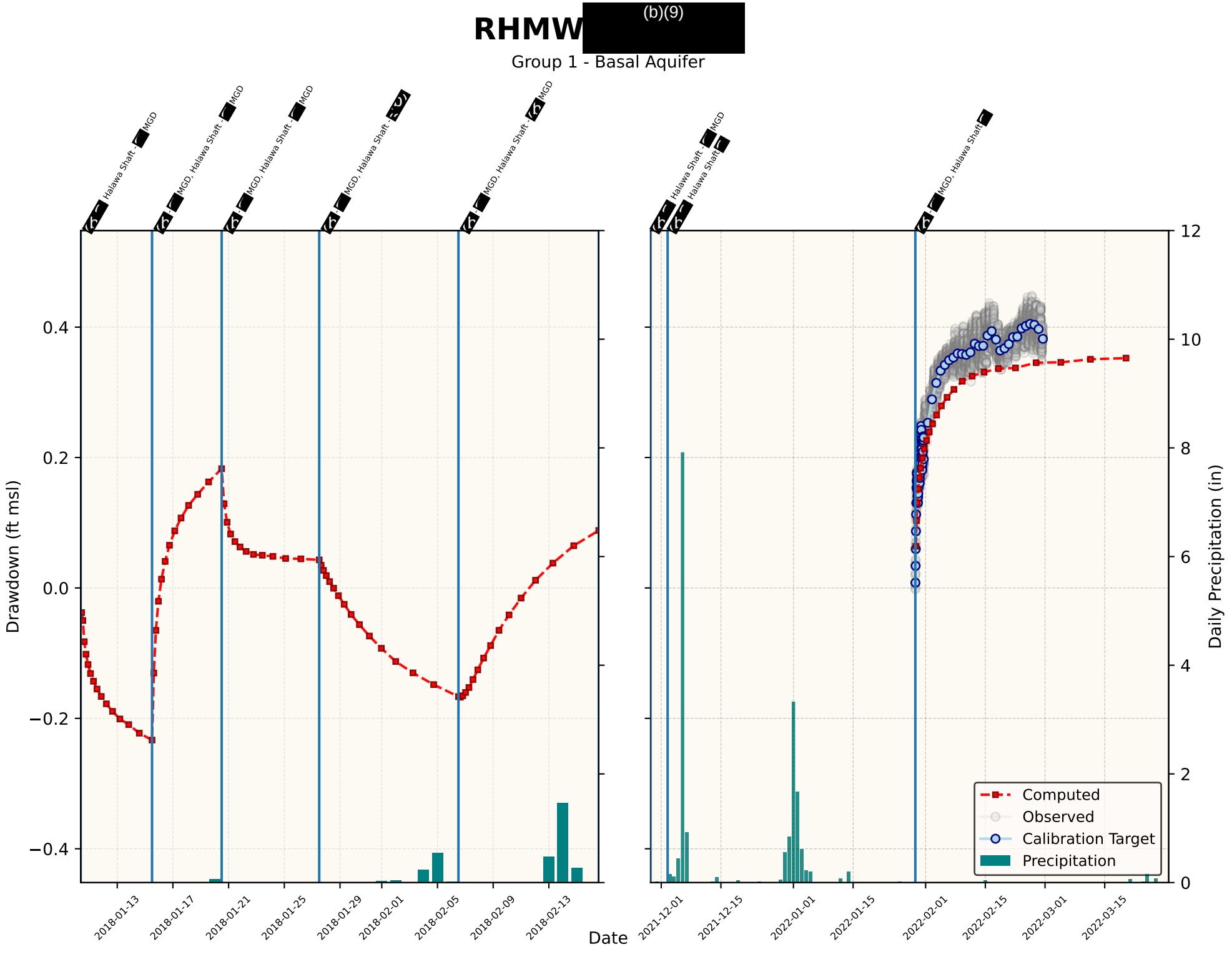
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



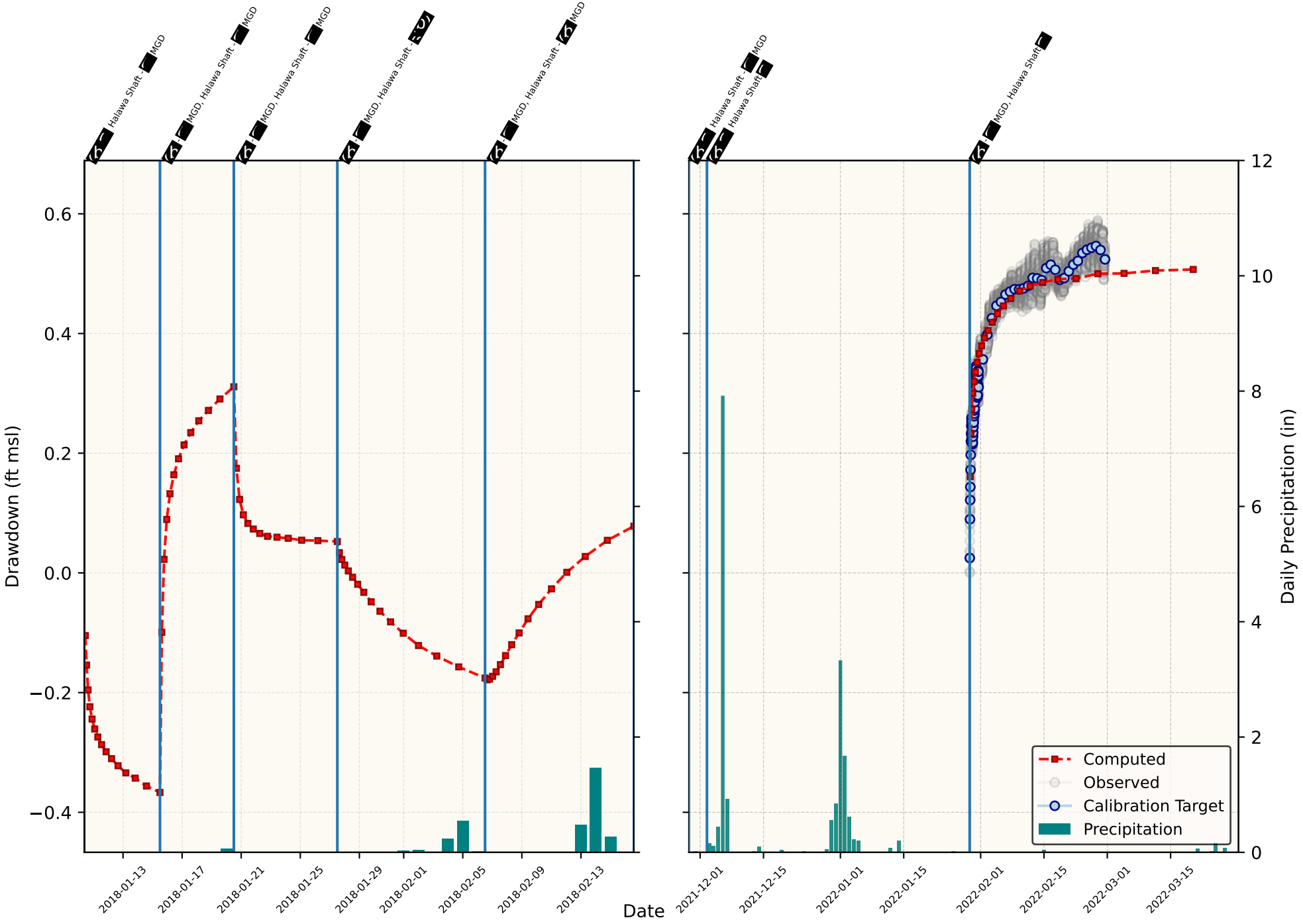

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

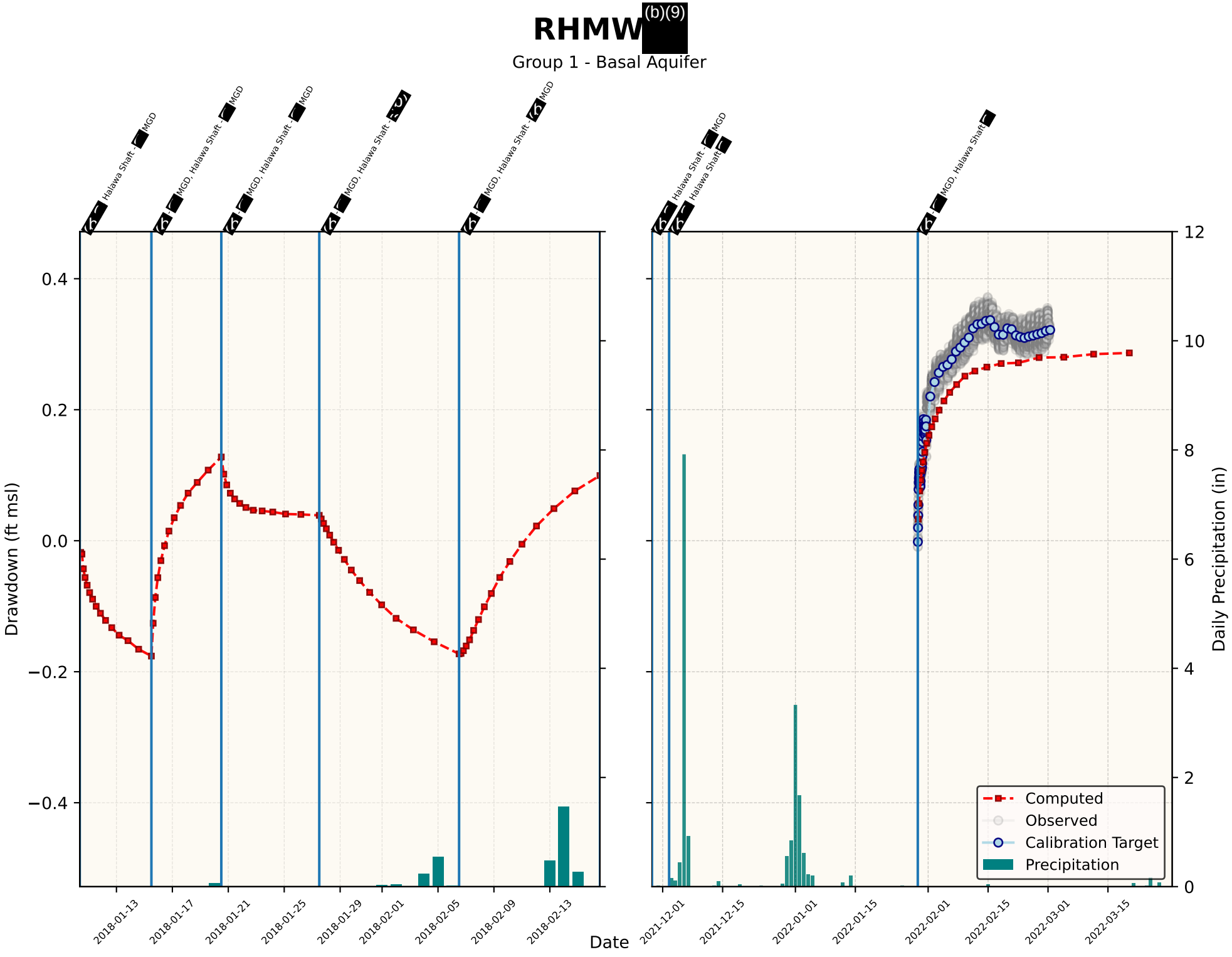

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-15
2022-03-01
2022-03-15

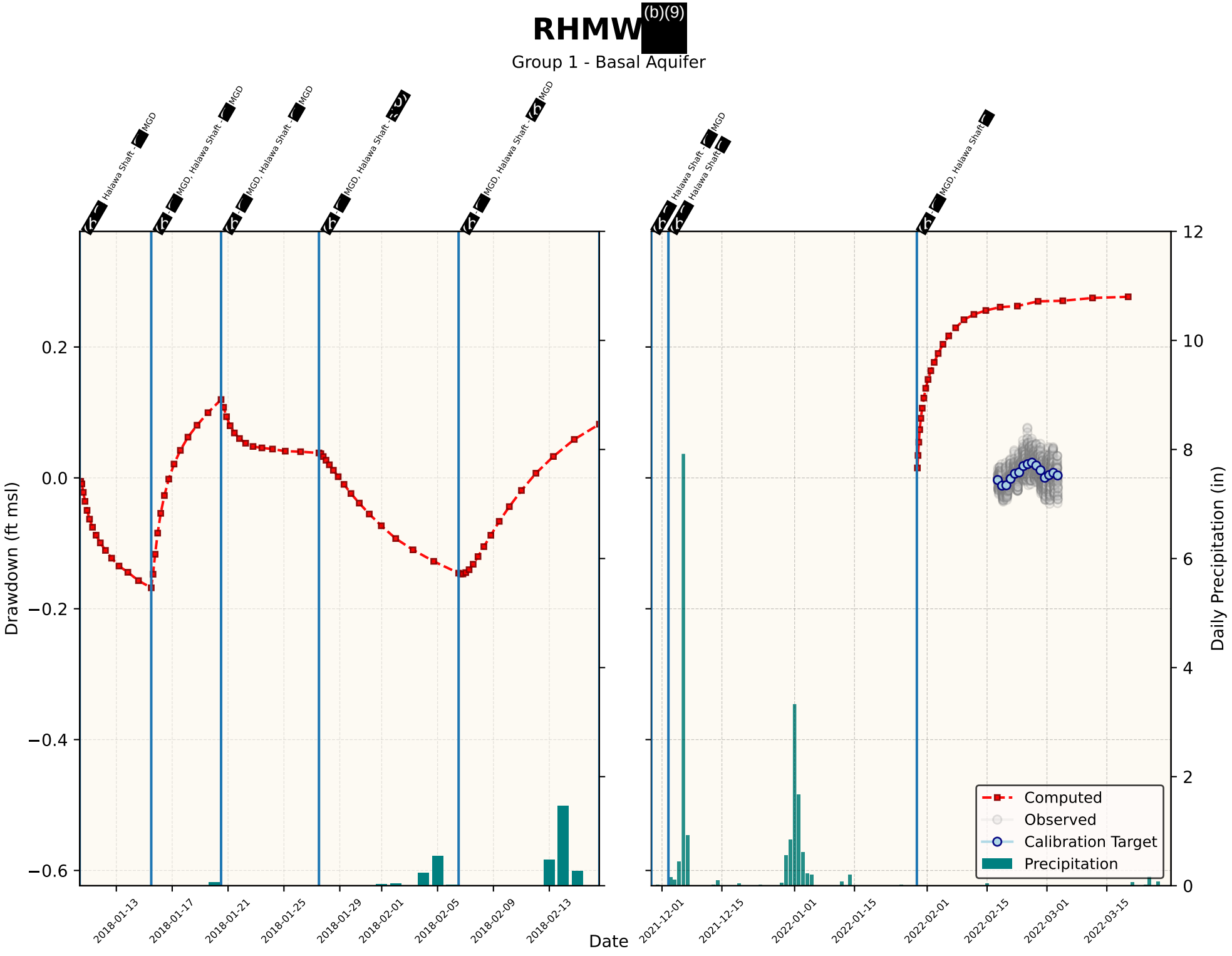

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer

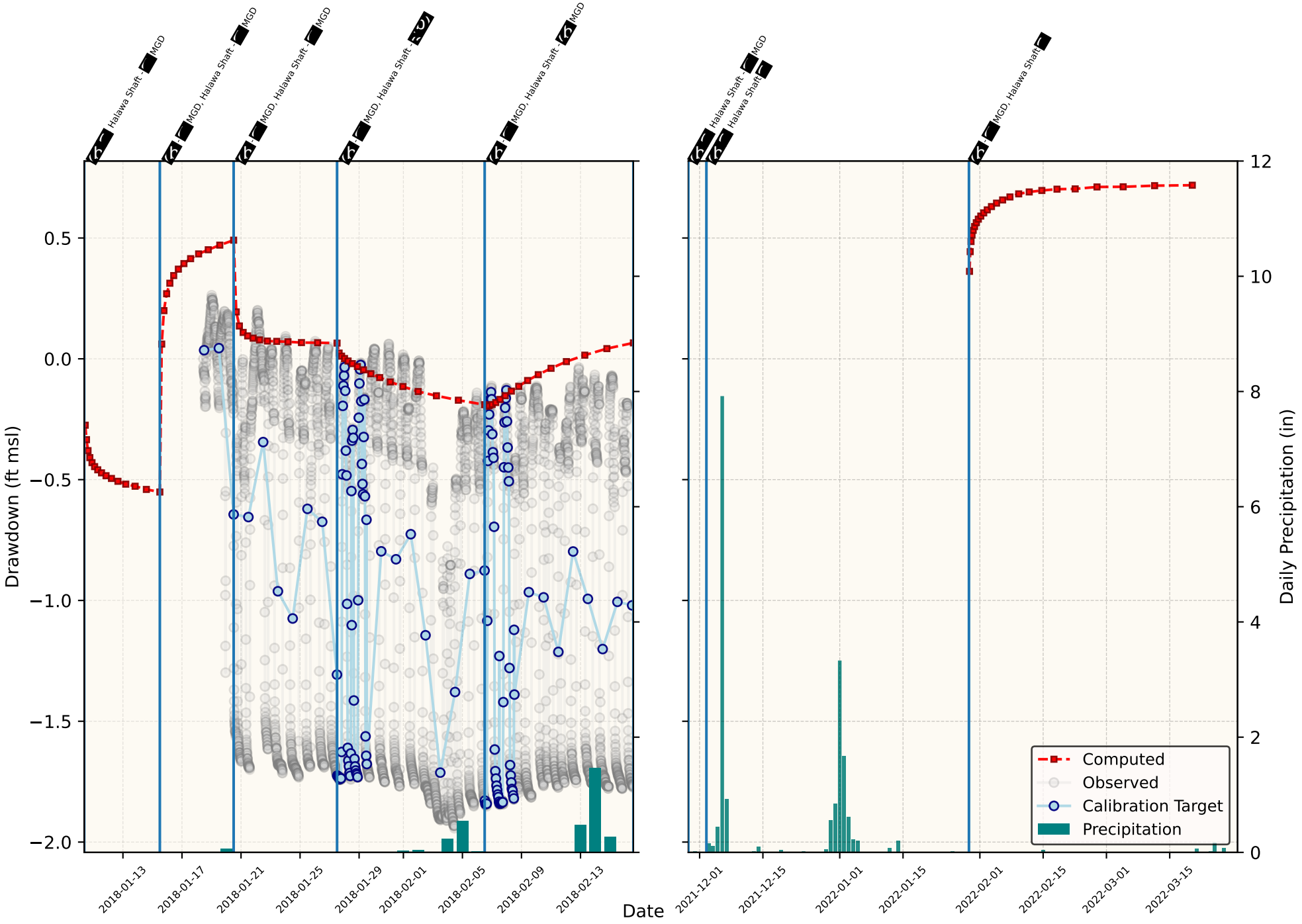


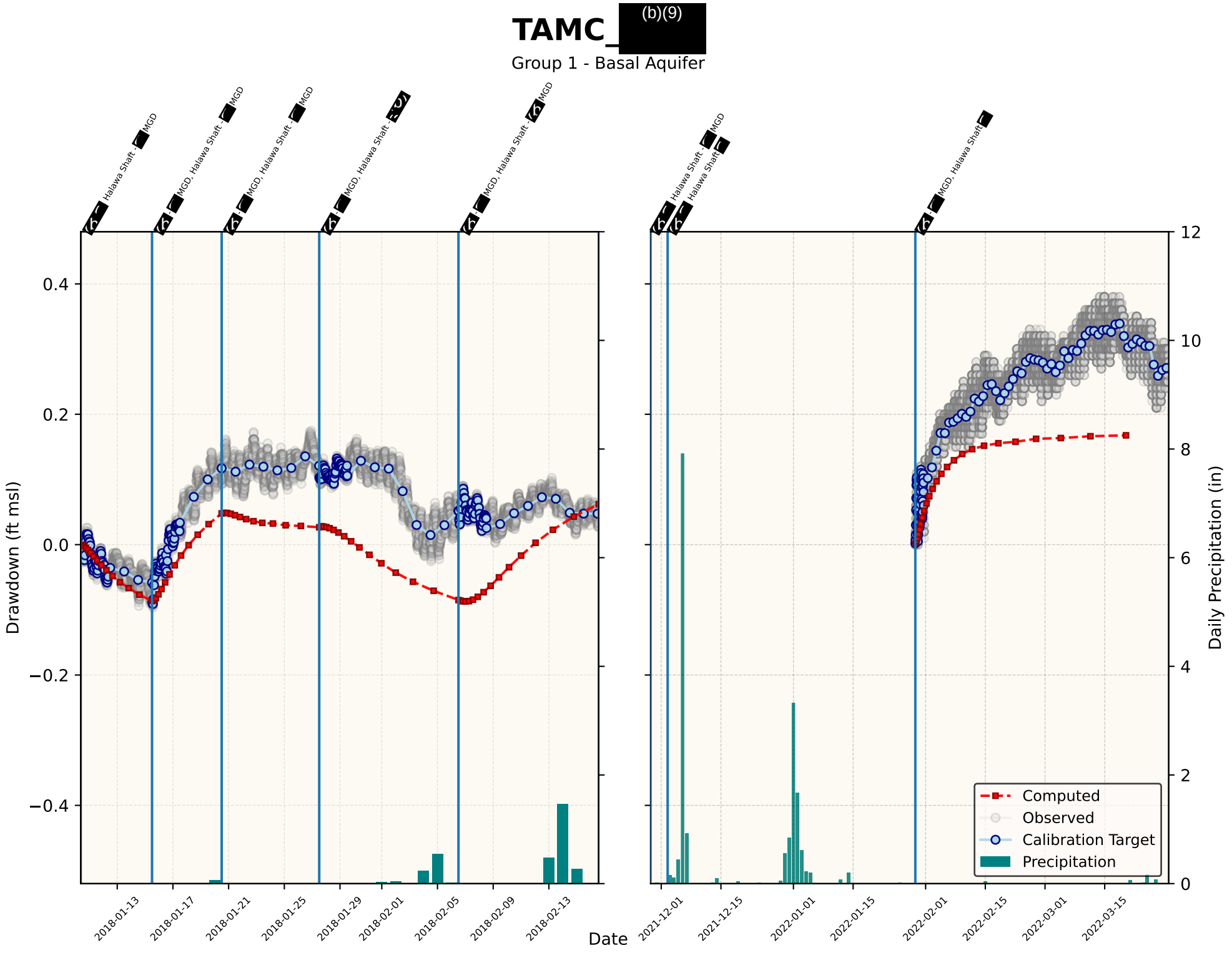

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

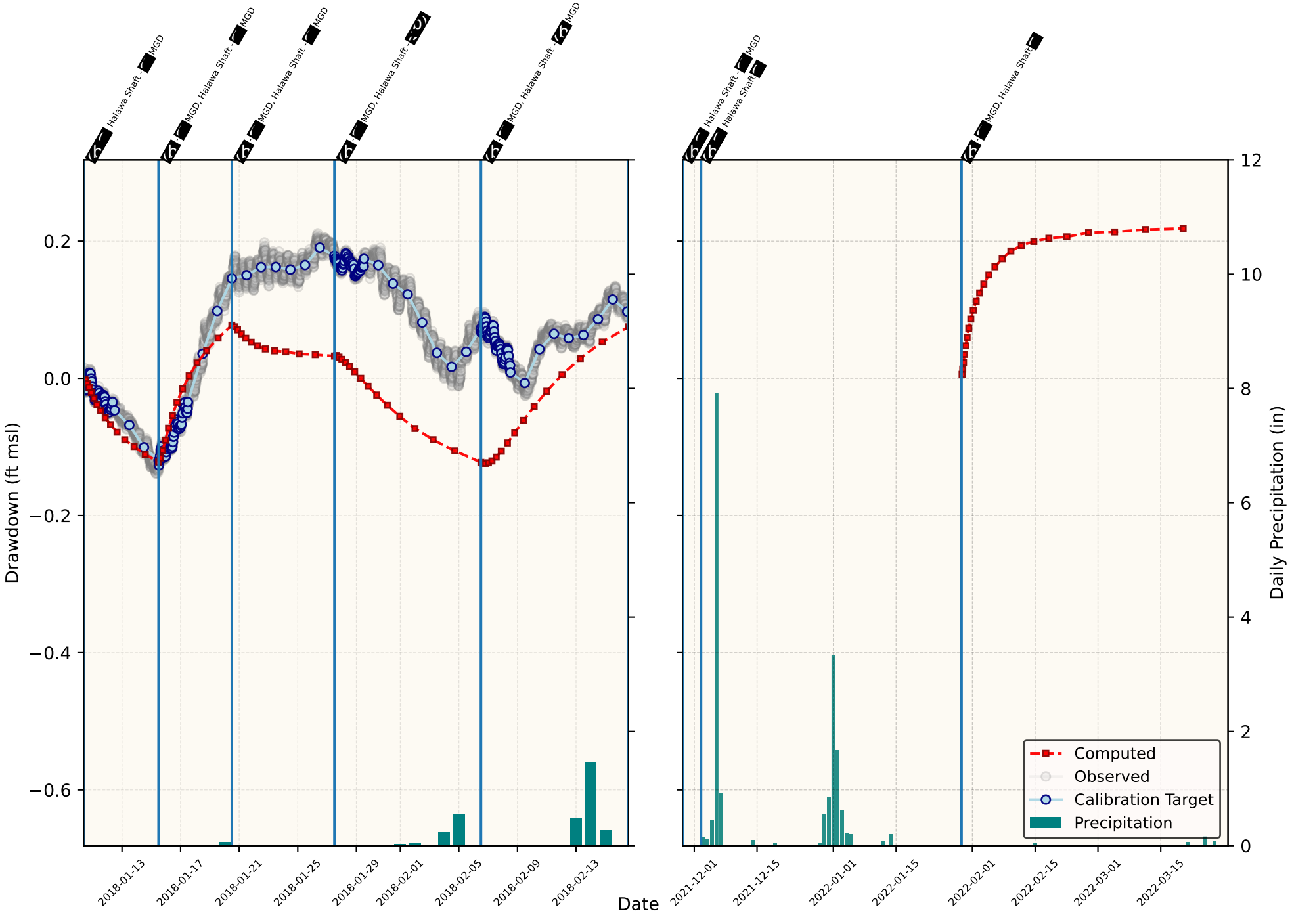

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.2
0.0
−0.2
−0.4
−0.6
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

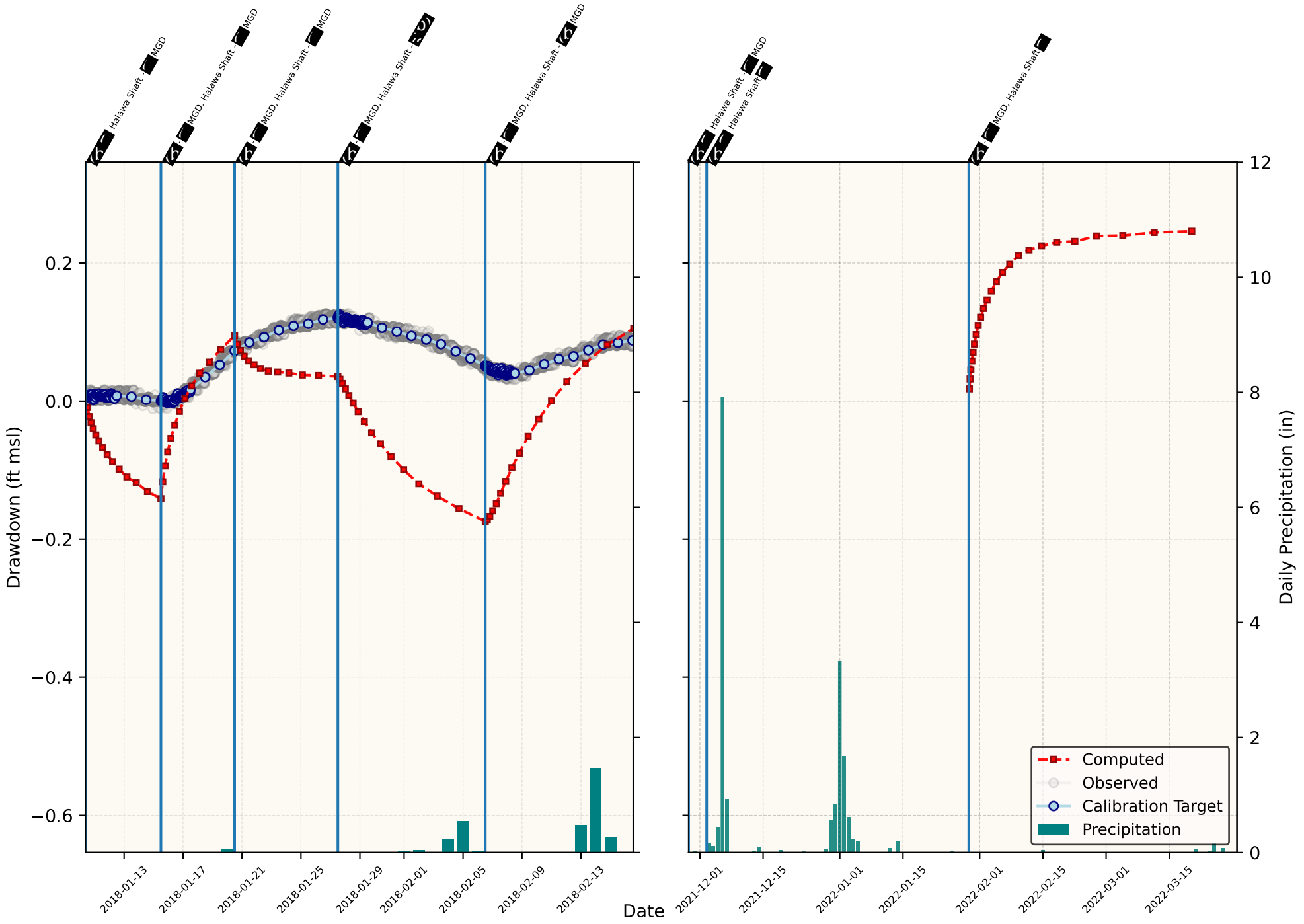
RHMW (b)(9)

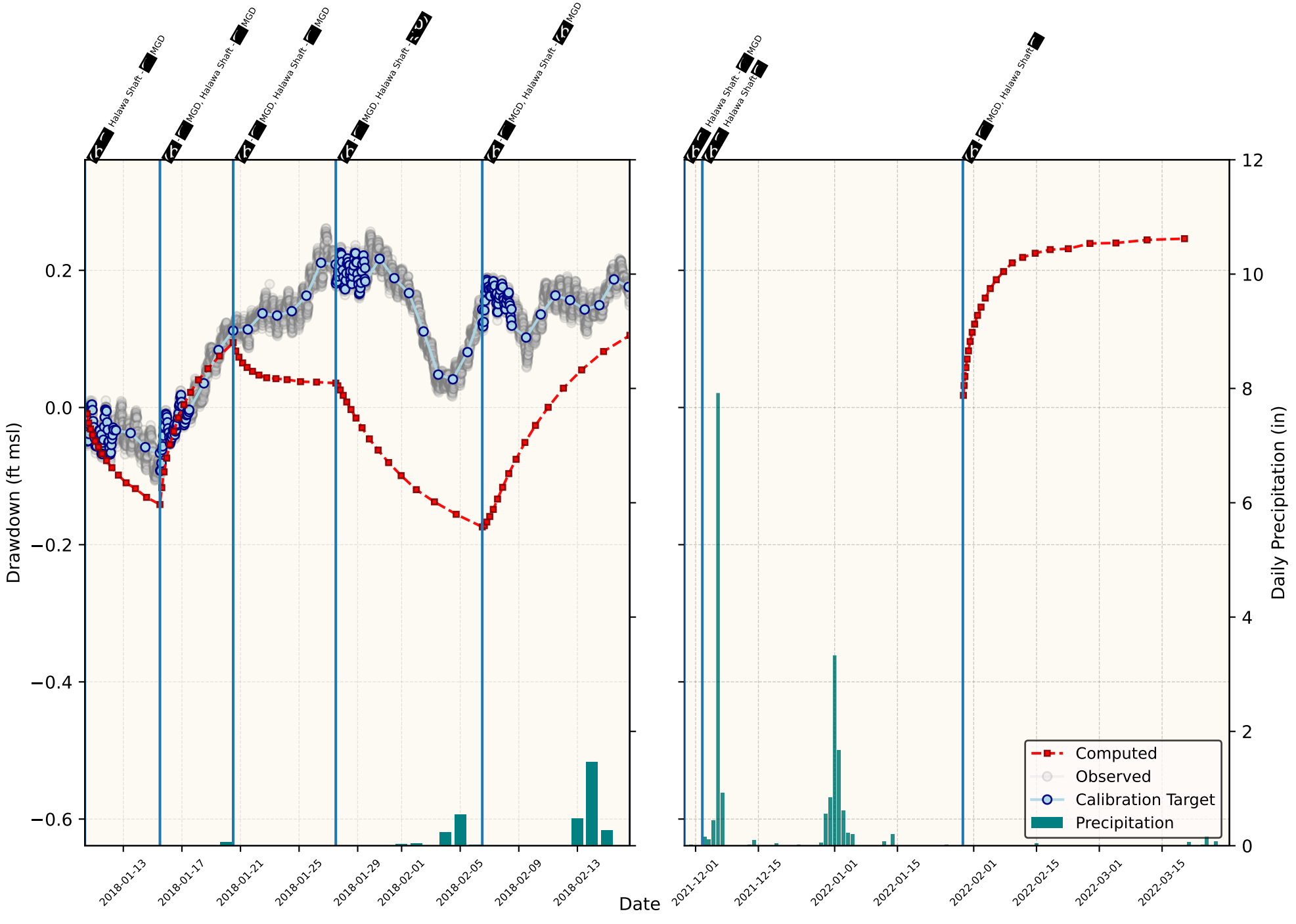
Group 1 - Basal Aquifer

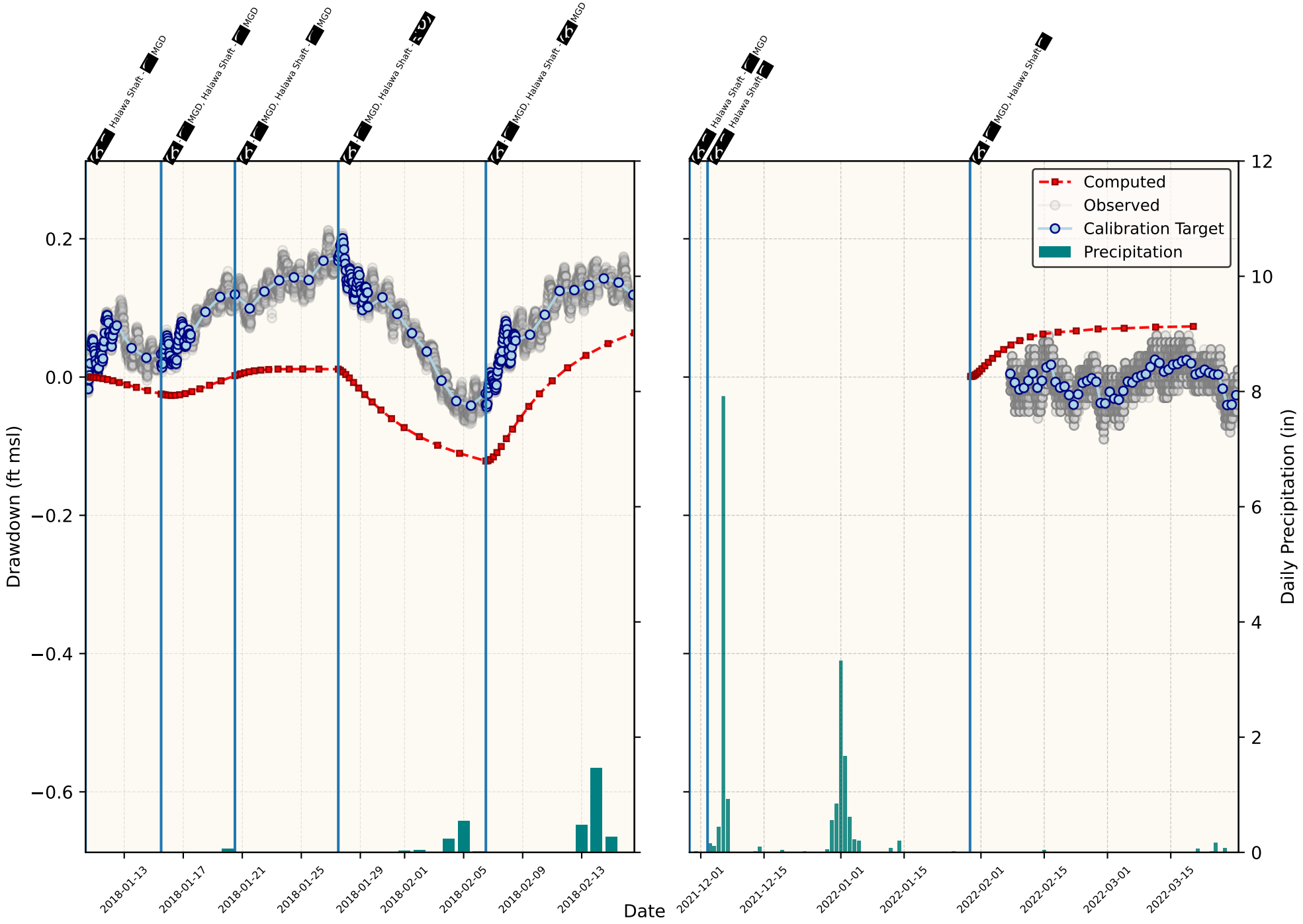



TAMC_ (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date


DH_43
Group 2 - Deep Basal Wells
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-15

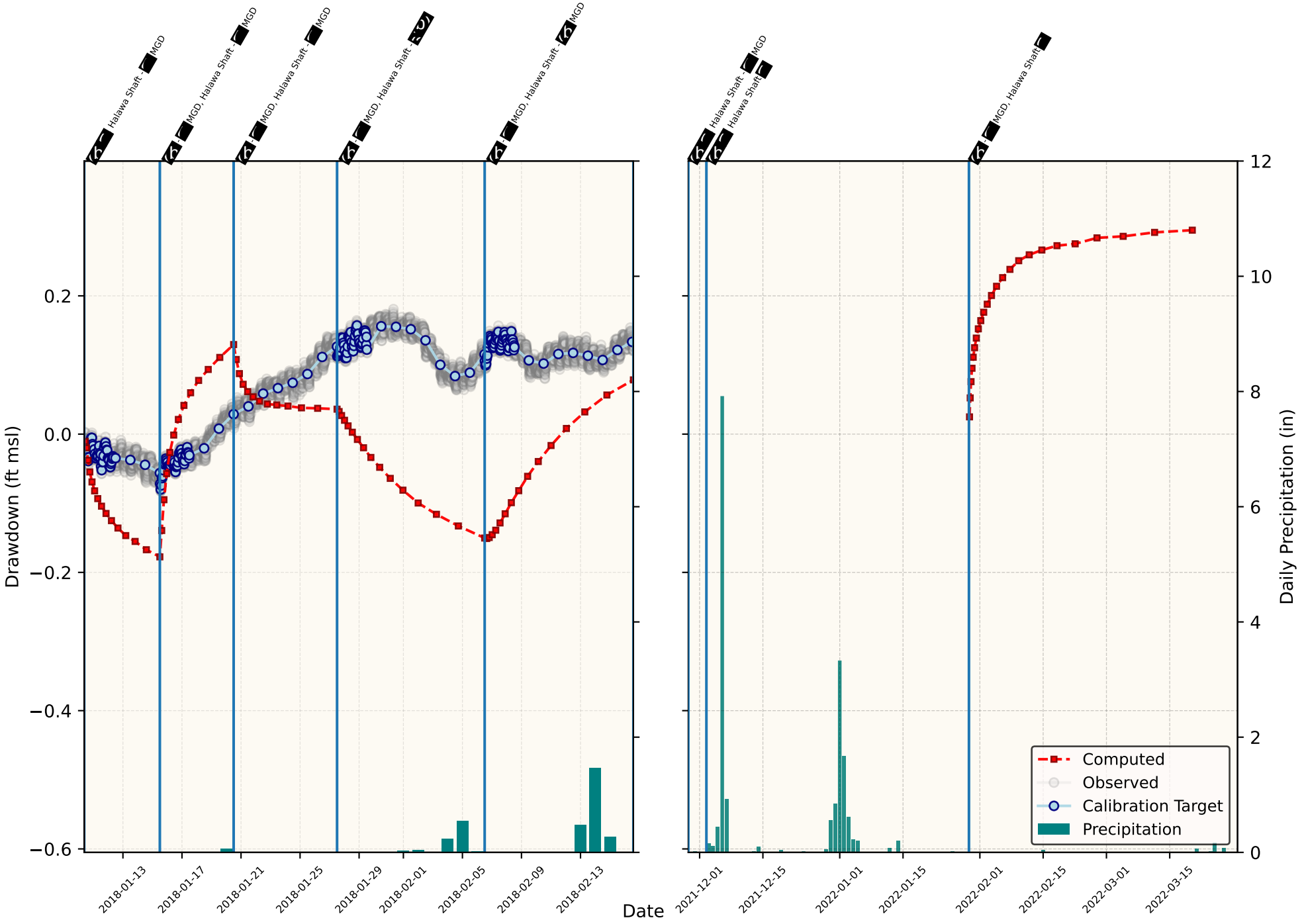

HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Halawa_Deep_Monitor_Well_HDMW2253-03
Group 2 - Deep Basal Wells
Halawa Shaft - MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-15
2022-03-01
2022-03-15

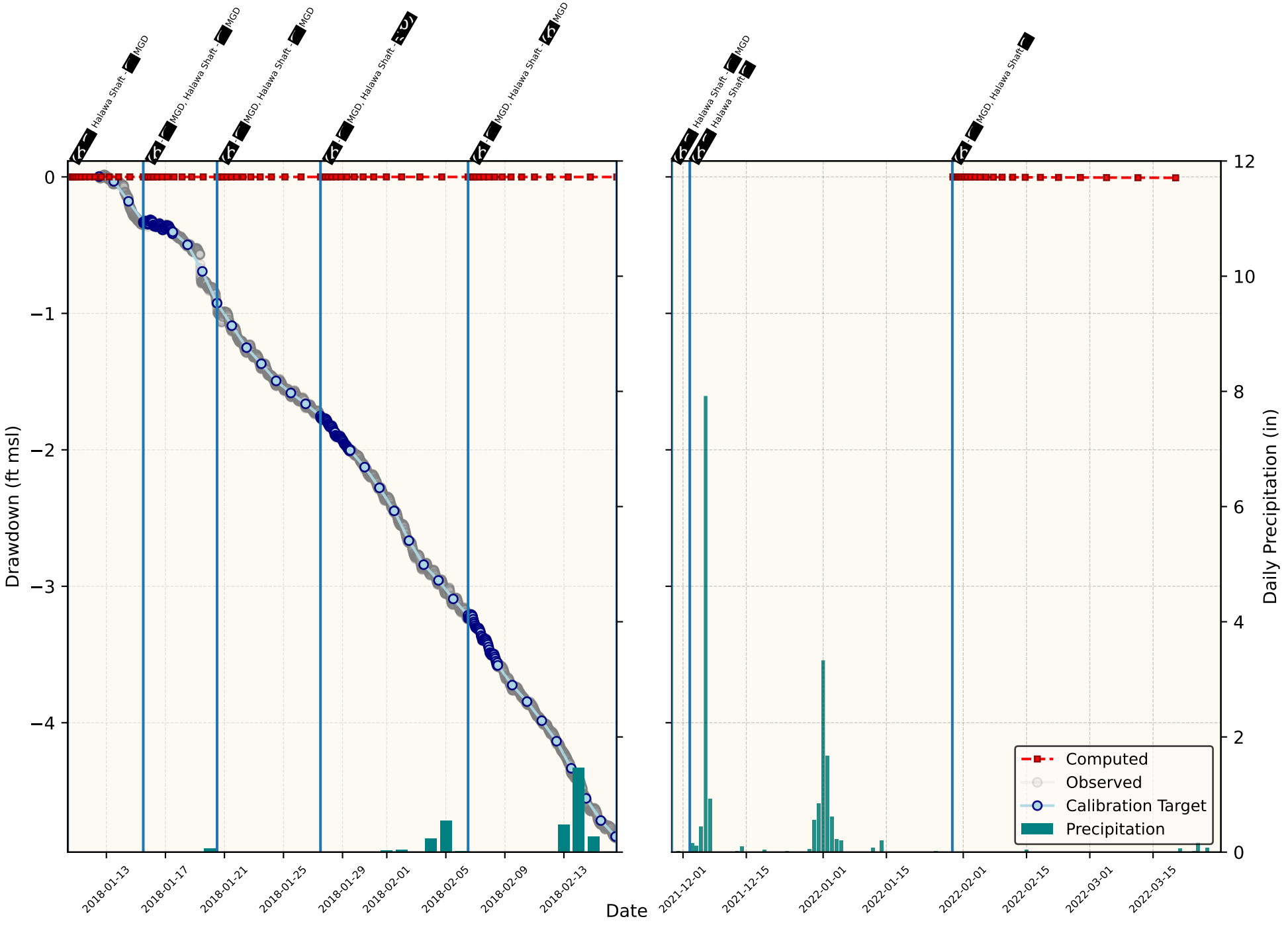
RHMW[redacted]

Group 3 - Saprolite/Confining Unit Well with Elevated Head



RHMW [redacted] (b)(9)

Group 3 - Saprolite/Confining Unit Well with Elevated Head



Attachment 4: Documentation of Sensitivity Analysis Scenario Calibration

Groundwater Flow Model Calibration Evaluation Documents Sensitivity Scenario 1

Head Calibration Statistics

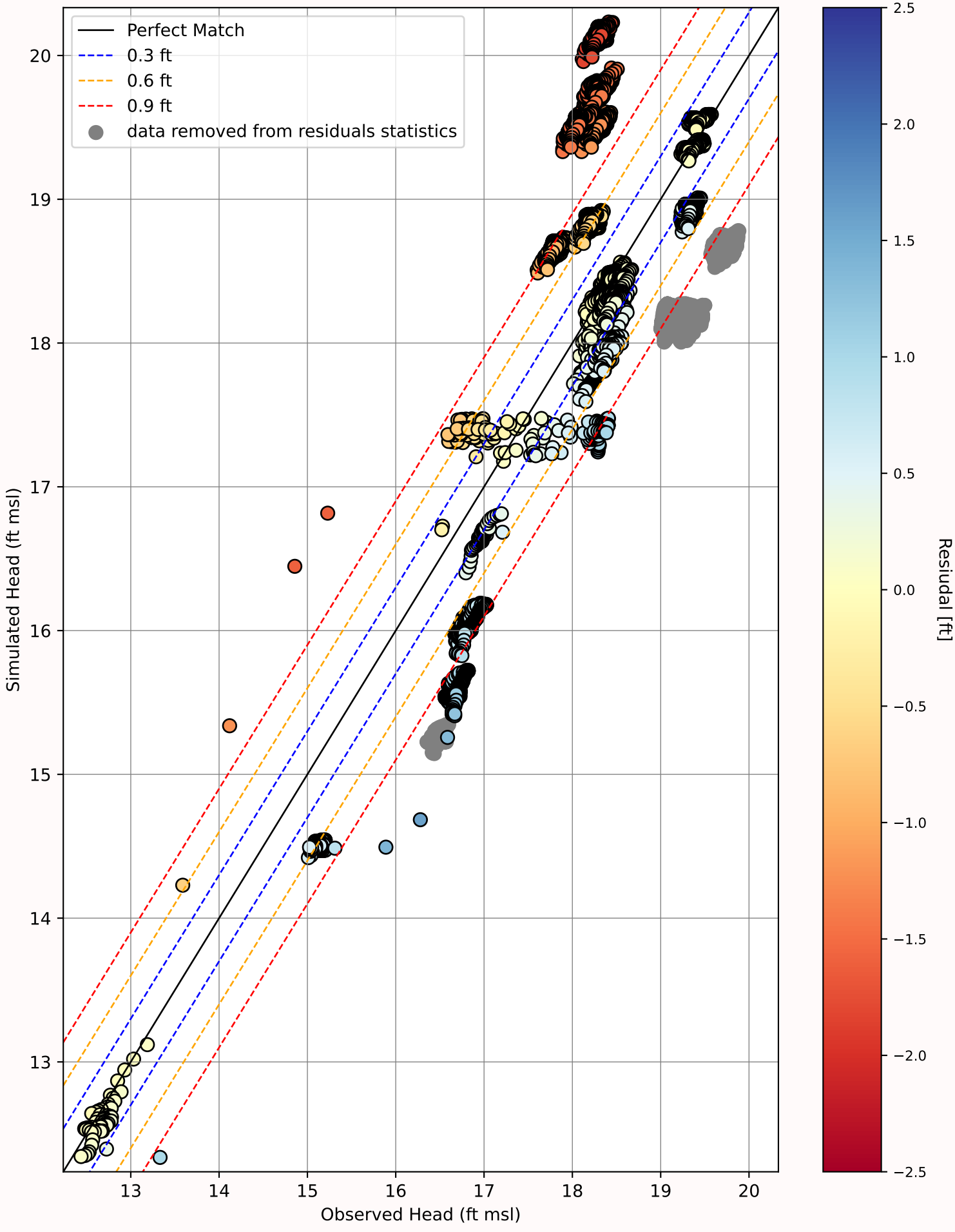
Wells	Basal Aquifer (Group 1)			Deep Wells (Group 2)	Confining Unit (Group 3)	Caprock (Group 4)	Cumulative
Time Period	**2017/2018**	**2021/2022**	**All**	**All**	**All**	**All**	**All**
Residual Mean (ft)	0.01	-0.09	-0.02	1.11	15.46	0.20	0.84
Absolute Residual Mean (ft)	0.52	0.75	0.62	1.11	17.85	1.48	1.51
Residual Standard Deviation (ft)	0.70	1.02	0.86	0.17	19.11	2.10	5.43
Sum of Squared Residuals (ft2)	2652.02	4076.03	7284.10	1360.88	343936.81	590.02	353171.81
RMSE Error (ft)	0.70	1.02	0.86	1.13	24.56	2.11	5.49
Minimum Residual (ft)	-1.61	-3.26	-3.92	0.41	-18.74	-4.53	-18.74
Maximum Residual (ft)	1.59	1.30	2.82	1.48	50.27	6.65	50.27
Number of Observations	5459	3915	9928	1075	570	133	11706
Range in Observations	7.14	3.26	7.19	4.26	97.94	6.85	116.87
Scaled Residual Standard Deviation (ft)	9.8%	31.1%	11.9%	4.1%	19.5%	30.7%	4.6%
Scaled Absolute Residual Mean (ft)	7.3%	23.1%	8.6%	26.1%	18.2%	21.7%	1.3%
Scaled RMSE Error (ft)	9.8%	31.3%	11.9%	26.4%	25.1%	30.8%	4.7%
Scaled Residual Mean (ft)	0.1%	-2.7%	-0.3%	26.1%	15.8%	3.0%	[illegible]%
Correlation Coefficient	0.88	0.75	0.83	0.99	0.92	-0.17	0.95

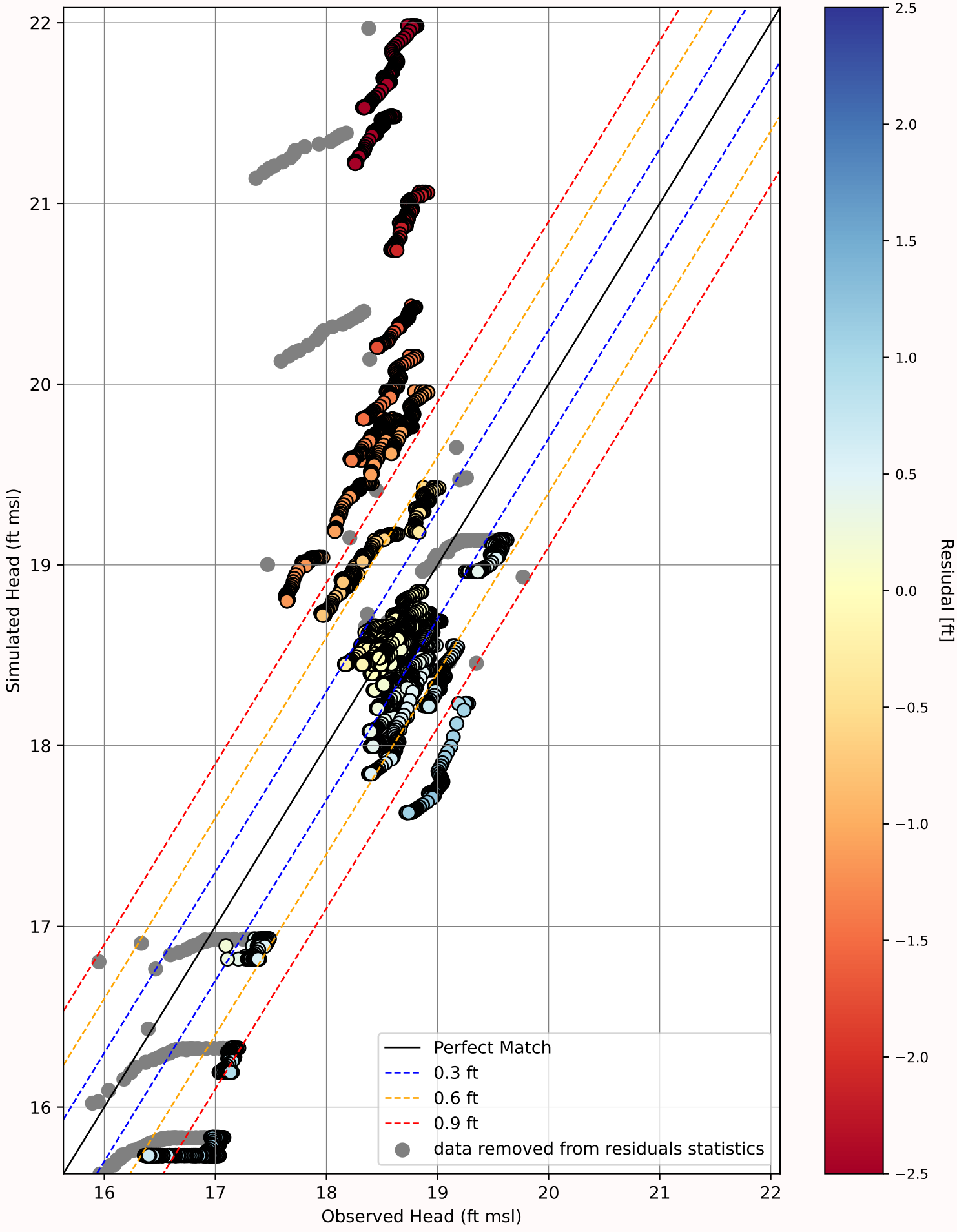
Drawdown Calibration Statistics

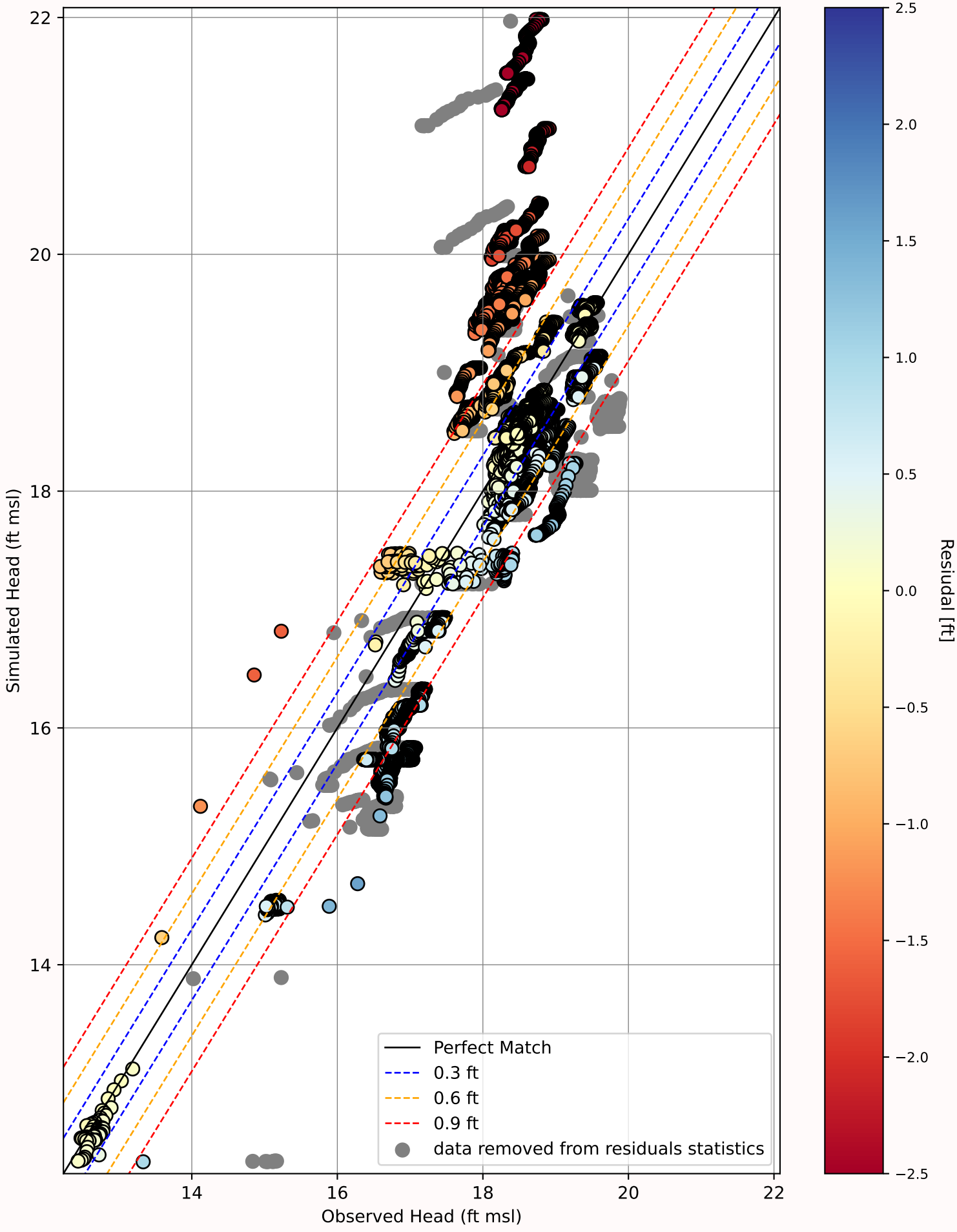
Wells	Basal Aquifer (Group 1)		
Time Period	**2017/2018**	**2021/2022**	**All**
Residual Mean (ft)	-0.01	-0.01	-0.01
Absolute Residual Mean (ft)	0.09	0.12	0.10
Residual Standard Deviation (ft)	0.21	0.35	0.28
Sum of Squared Residuals (ft2)	244.23	441.27	685.50
RMSE Error (ft)	0.21	0.35	0.28
Minimum Residual (ft)	-1.78	-2.33	-2.33
Maximum Residual (ft)	2.28	0.52	2.28
Number of Observations	5393	3533	8926
Range in Observations	4.76	0.68	4.76
Scaled Residual Standard Deviation (ft)	(b) %	52.3%	5.8%
Scaled Absolute Residual Mean (ft)	1.9%	18.1%	2.2%
Scaled RMSE Error (ft)	(b) %	52.3%	5.8%
Scaled Residual Mean (ft)	-0.2%	-0.9%	-0.1%
Correlation Coefficient	0.83	0.33	0.68

Conceptual Water Budget Comparison

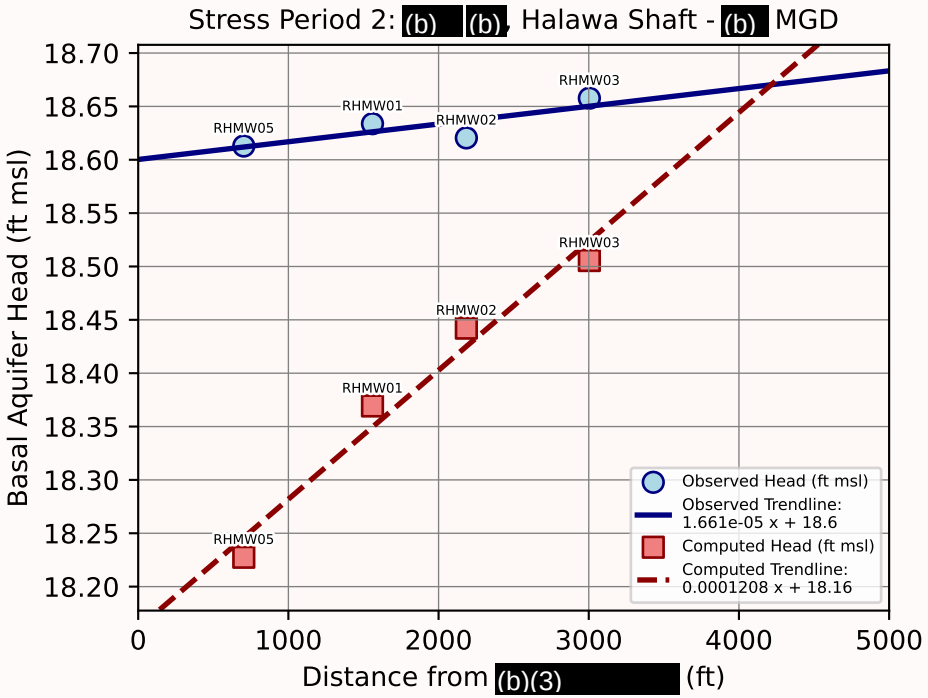
Type	Stress Period	Recharge (MGD)	Dike Region Inflow (MGD)	Well Discharge (MGD)	Spring Discharge (MGD)	Caprock Discharge (MGD)	Inflow from Adjacent Watershed (MGD)	Outflow to Adjacent Watershed (MGD)	Storage (MGD)	Total Inflows (MGD)	Total Outflows (MGD)
Conceptual	1	32.5	28.7	32.0	13.6	2.4	2.8	16.0	0.0	64.0	64.0
Simulated	1	32.5	28.7	32.3	13.1	(b	22.8	34.9	0.0	84.0	84.0
Difference	1	0.0	0.0	0.3	-0.5	1.2	20.0	18.9	0.0	20.0	20.0
Conceptual	2	32.5	28.7	28.4	13.6	2.4	2.8	19.6	0.0	64.0	64.0
Simulated	2	32.5	28.7	28.4	13.3	(b	21.3	36.1	-1.0	82.4	82.4
Difference	2	0.0	0.0	0.0	-0.3	1.2	18.4	16.4	-1.0	18.5	18.4
Conceptual	3	32.5	28.7	36.1	13.5	2.4	2.8	12.0	0.0	64.0	64.0
Simulated	3	32.5	28.7	36.1	13.0	(b	23.9	34.4	1.9	86.9	87.0
Difference	3	0.0	0.0	0.0	-0.5	1.2	21.1	22.3	1.9	22.9	23.0
Conceptual	4	32.5	28.7	32.4	13.5	2.4	2.8	15.6	0.0	64.0	64.0
Simulated	4	32.5	28.7	32.5	13.1	(b	23.1	34.6	-0.4	84.3	84.1
Difference	4	0.0	0.0	0.0	-0.5	1.2	20.3	19.0	-0.4	20.3	20.1
Conceptual	5	32.5	28.7	25.7	13.7	2.4	4.7	24.1	0.0	65.9	65.9
Simulated	5	32.5	28.7	25.7	13.7	(b	21.6	39.1	-0.5	82.8	82.7
Difference	5	0.0	0.0	0.0	0.0	1.2	16.8	15.1	-0.5	16.9	16.8
Conceptual	6	32.5	28.7	37.7	13.6	2.4	4.7	12.2	0.0	65.9	65.9
Simulated	6	32.5	28.7	37.8	12.7	(b	24.5	32.4	0.8	86.4	86.5
Difference	6	0.0	0.0	0.0	-0.9	1.2	19.7	20.3	0.8	20.5	20.6
Conceptual	7	32.5	28.7	32.0	13.4	2.4	4.1	17.4	0.0	65.3	65.3
Simulated	7	32.5	28.7	32.0	13.0	(b	21.8	34.4	0.0	83.0	83.0
Difference	7	0.0	0.0	0.0	-0.4	1.1	17.7	17.0	0.0	17.7	17.7
Conceptual	8	32.5	28.7	30.1	12.6	2.4	2.8	18.8	0.0	63.9	63.9
Simulated	8	32.5	28.7	30.1	13.1	(b	21.5	34.6	-1.2	82.7	82.6
Difference	8	0.0	0.0	0.0	0.5	1.2	18.7	15.8	-1.2	18.7	18.7
Conceptual	9	32.5	28.7	21.8	13.7	2.4	0.5	23.8	0.0	61.7	61.7
Simulated	9	32.5	28.7	21.8	13.9	(b	18.9	40.7	0.0	80.1	80.1
Difference	9	0.0	0.0	0.0	0.3	1.2	18.4	16.9	0.0	18.4	18.4
Conceptual	10	32.5	28.7	26.3	13.9	2.5	7.5	25.9	0.0	68.7	68.7
Simulated	10	32.5	28.7	26.3	13.6	(b	21.1	38.8	0.0	82.3	82.3
Difference	10	0.0	0.0	0.0	-0.3	1.1	13.6	12.9	0.0	13.6	13.7

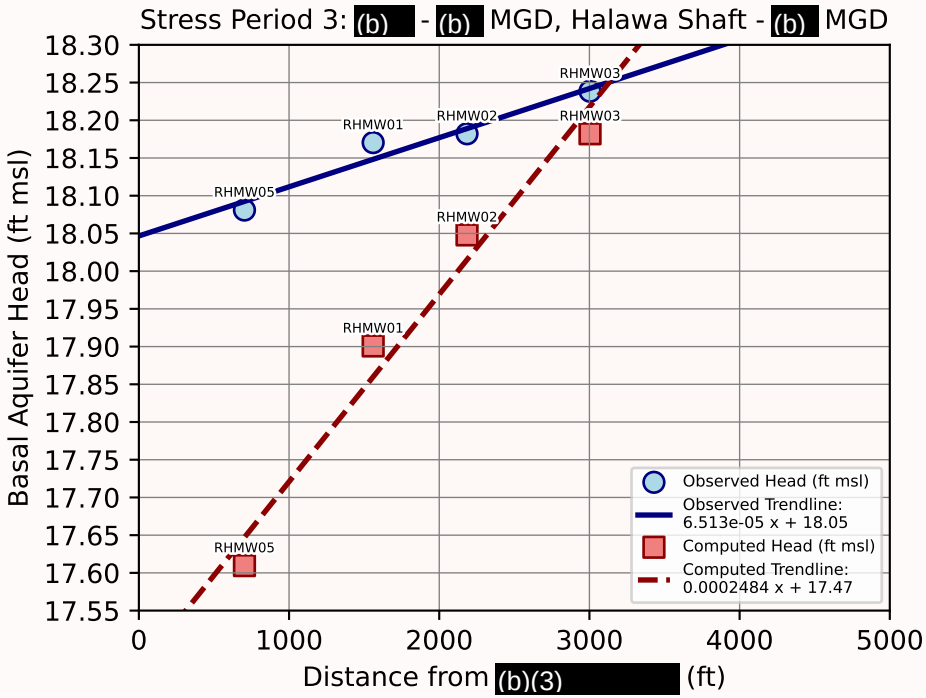

Basal Aquifer Wells - 2017-18
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
20
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

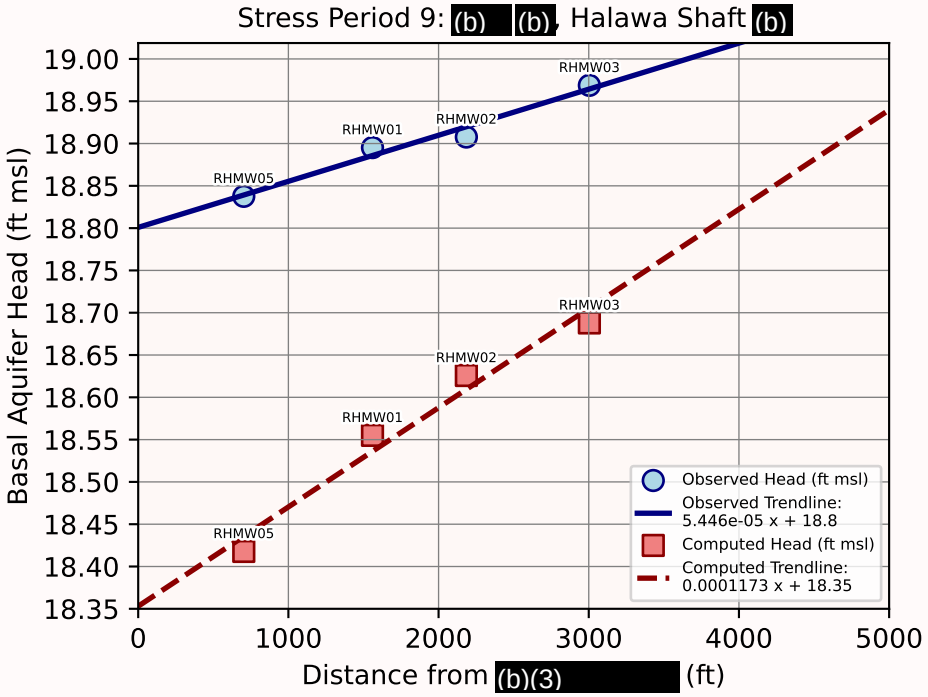

Basal Aquifer Wells - 2021-22
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics

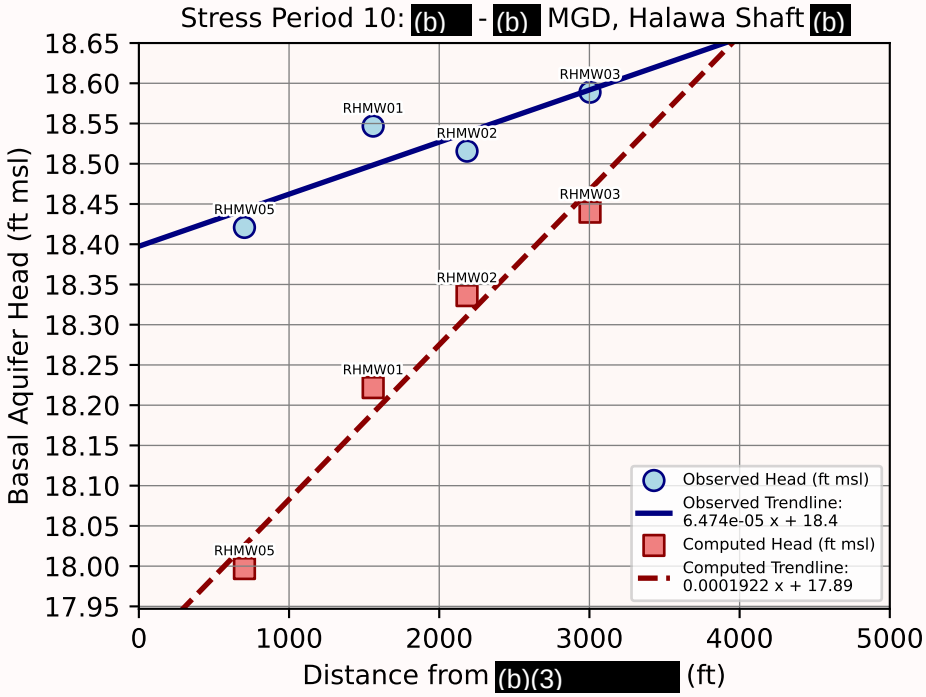

Basal Aquifer Wells - All
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics

Gradients Along Red Hill Ridge

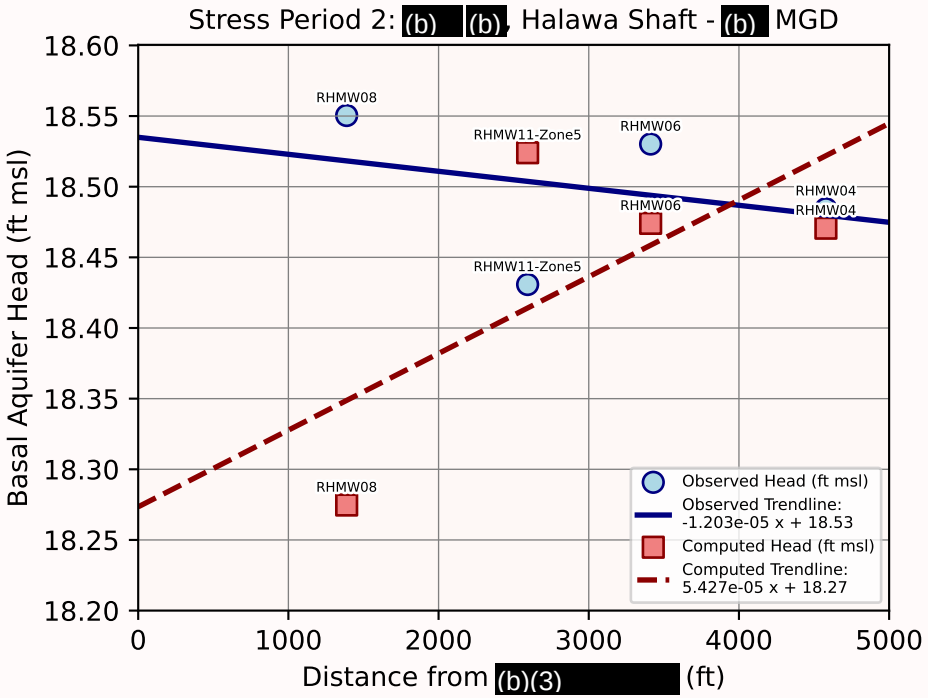


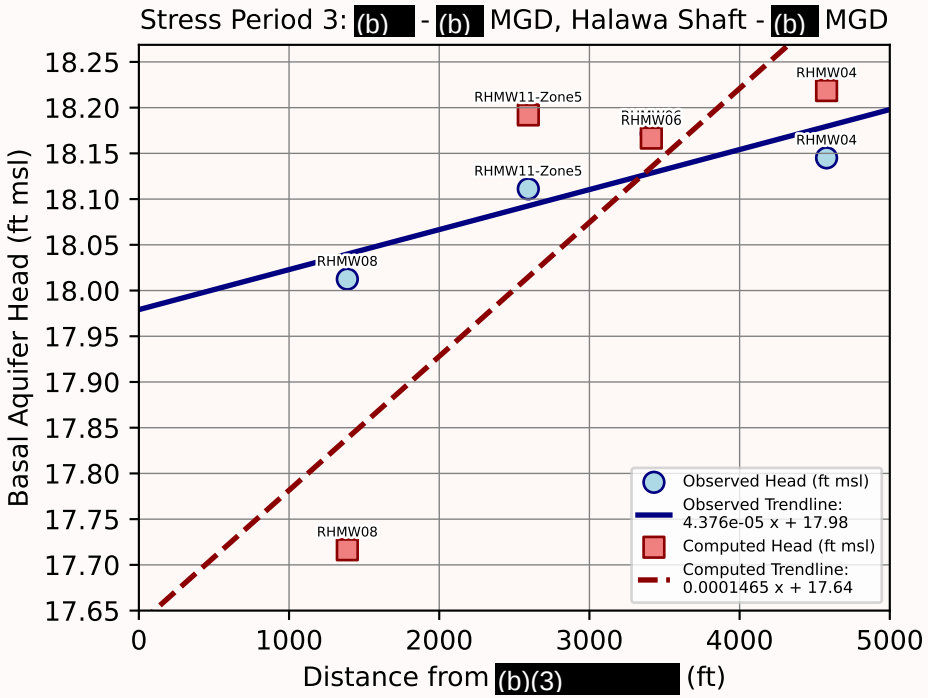


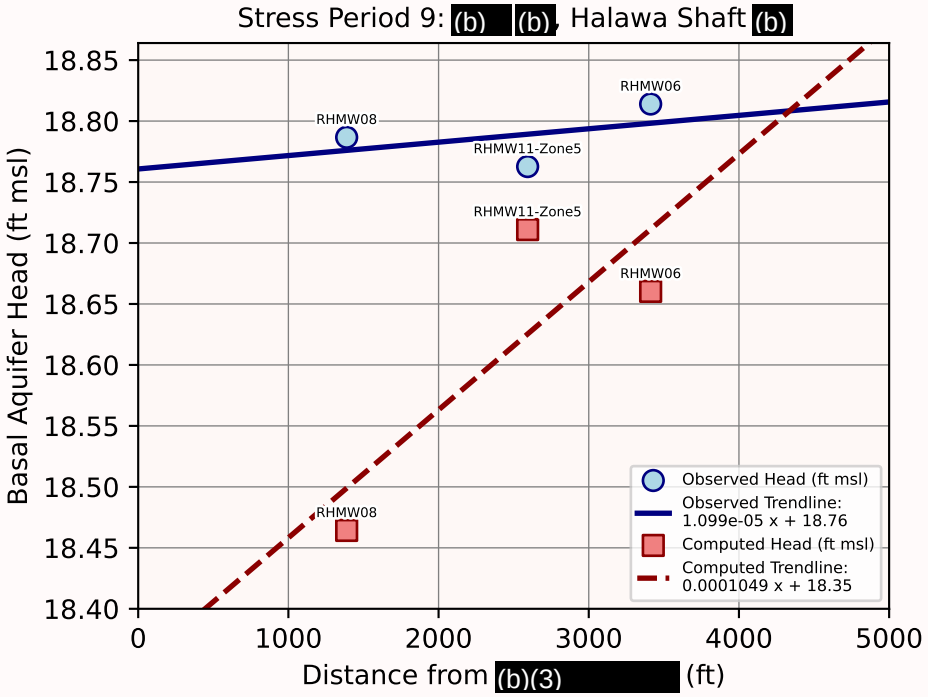


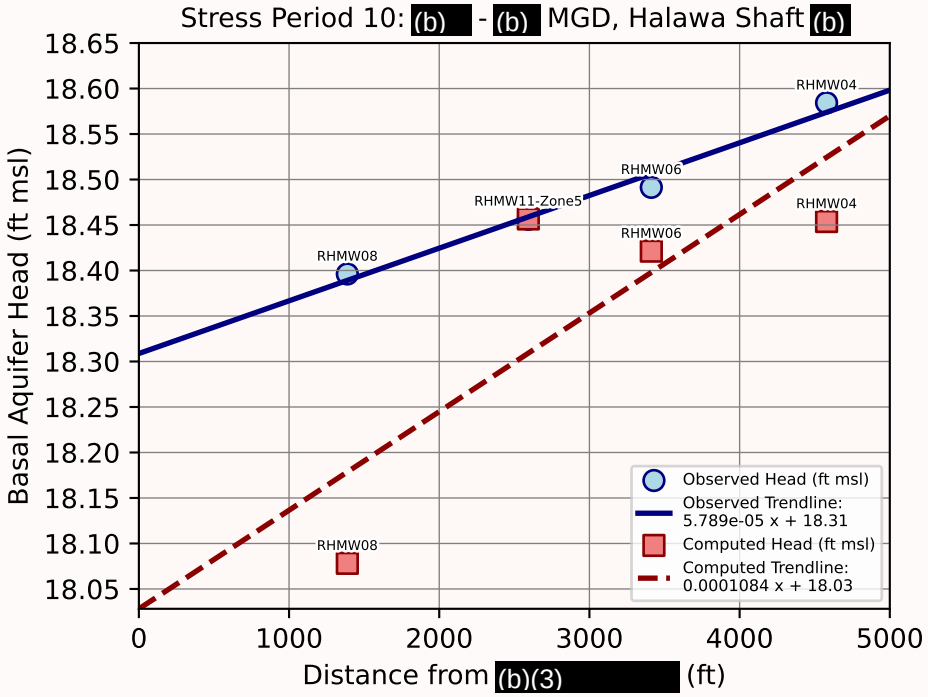


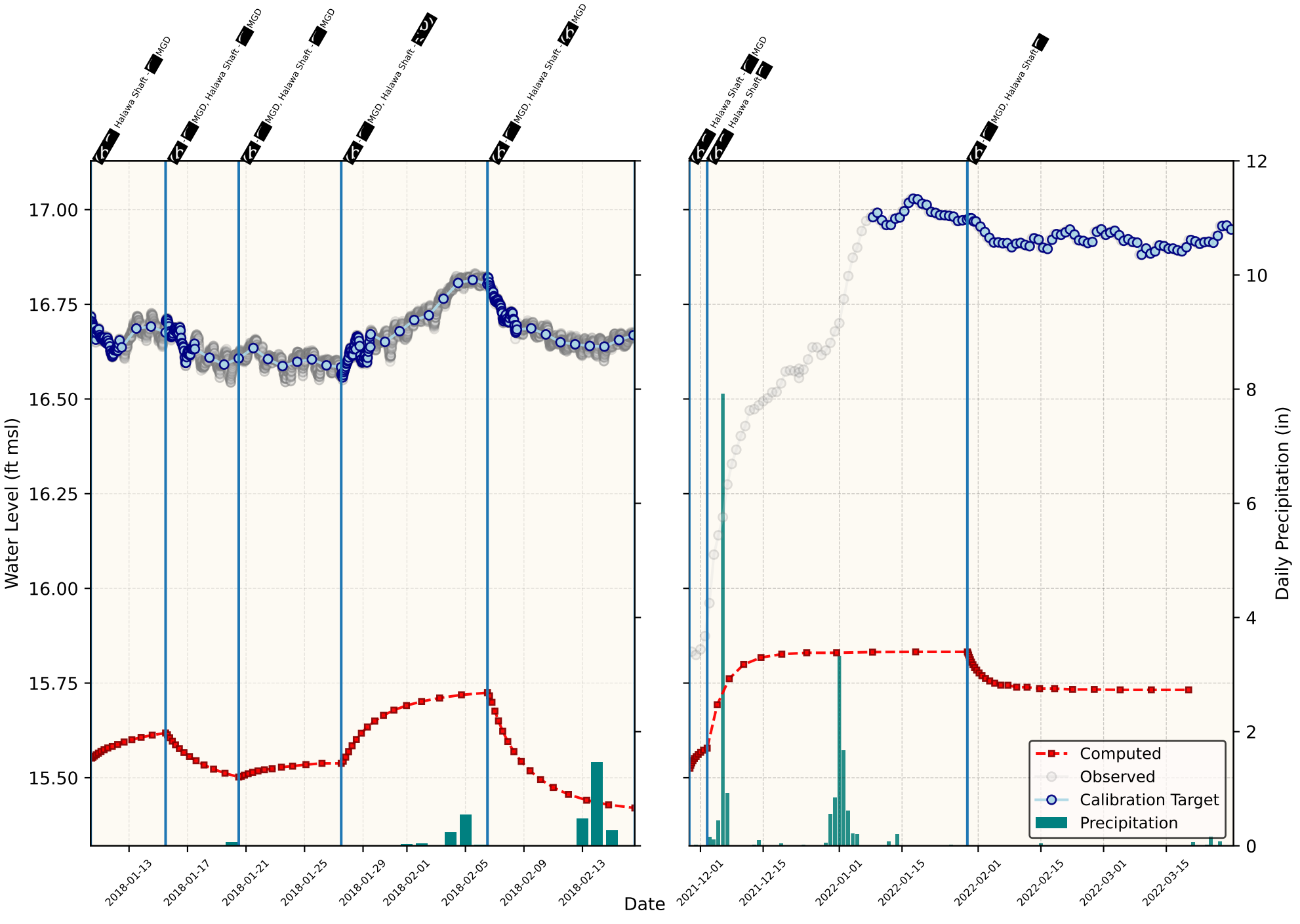
Gradients Northwest of Red Hill Ridge



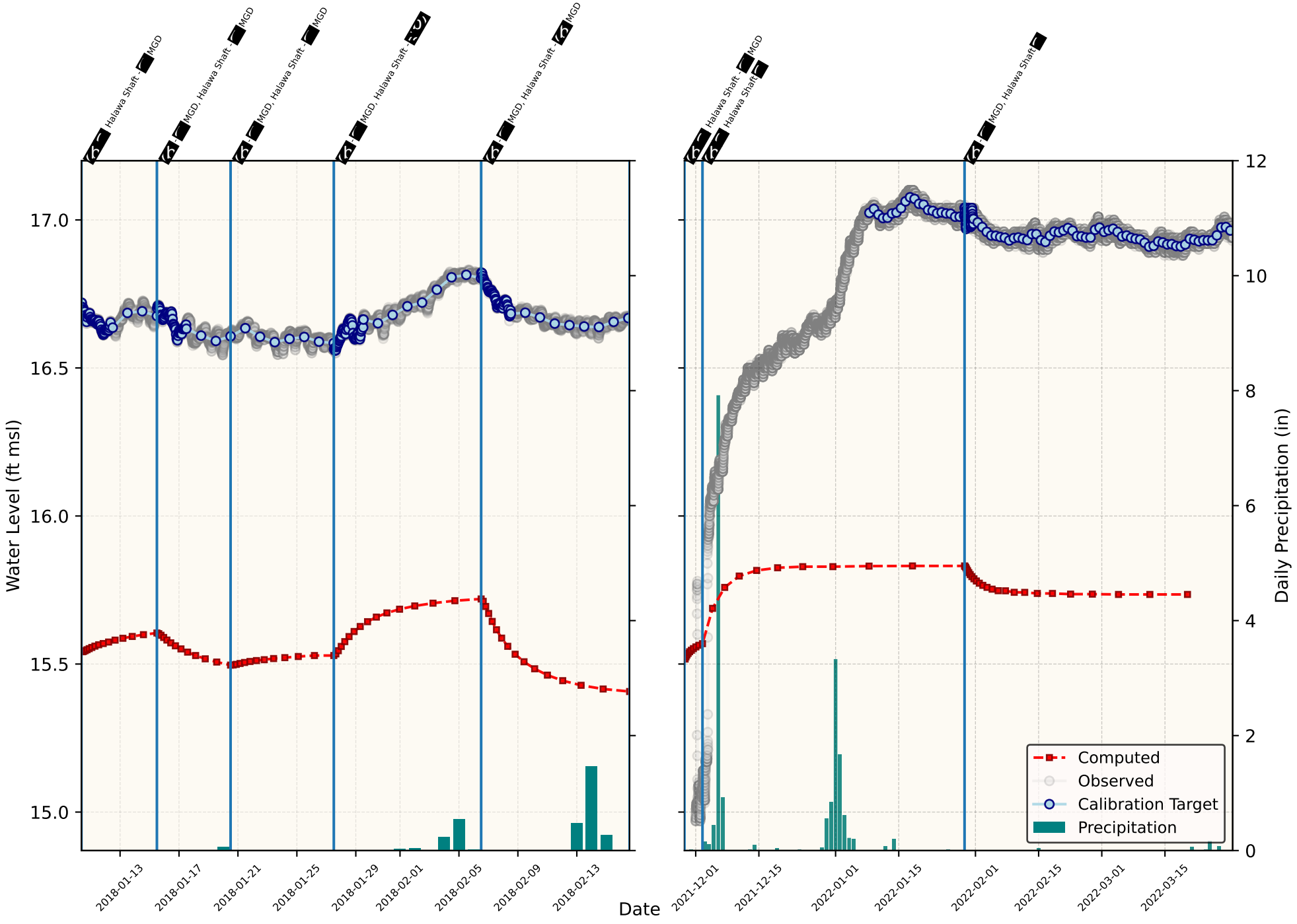


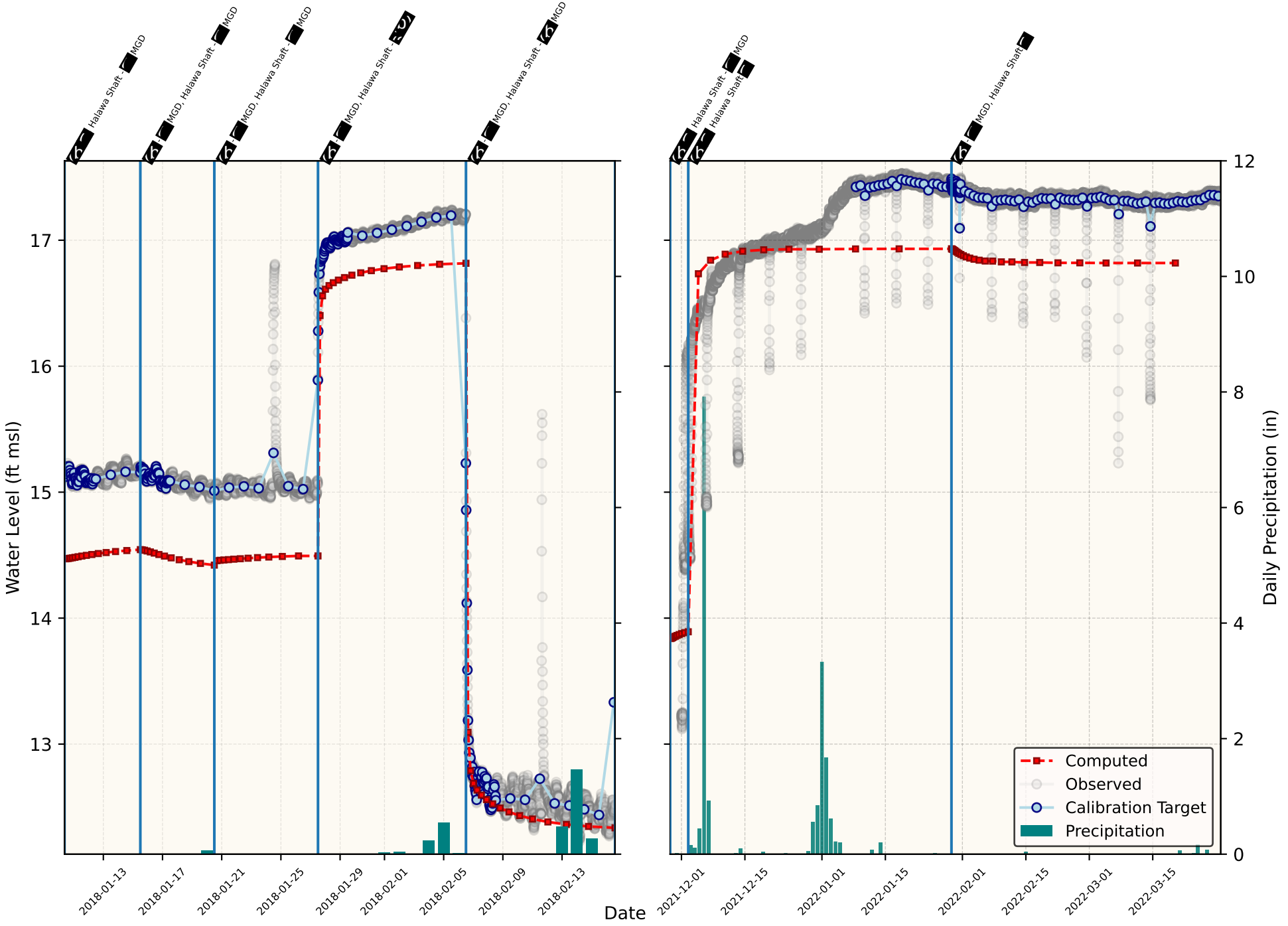


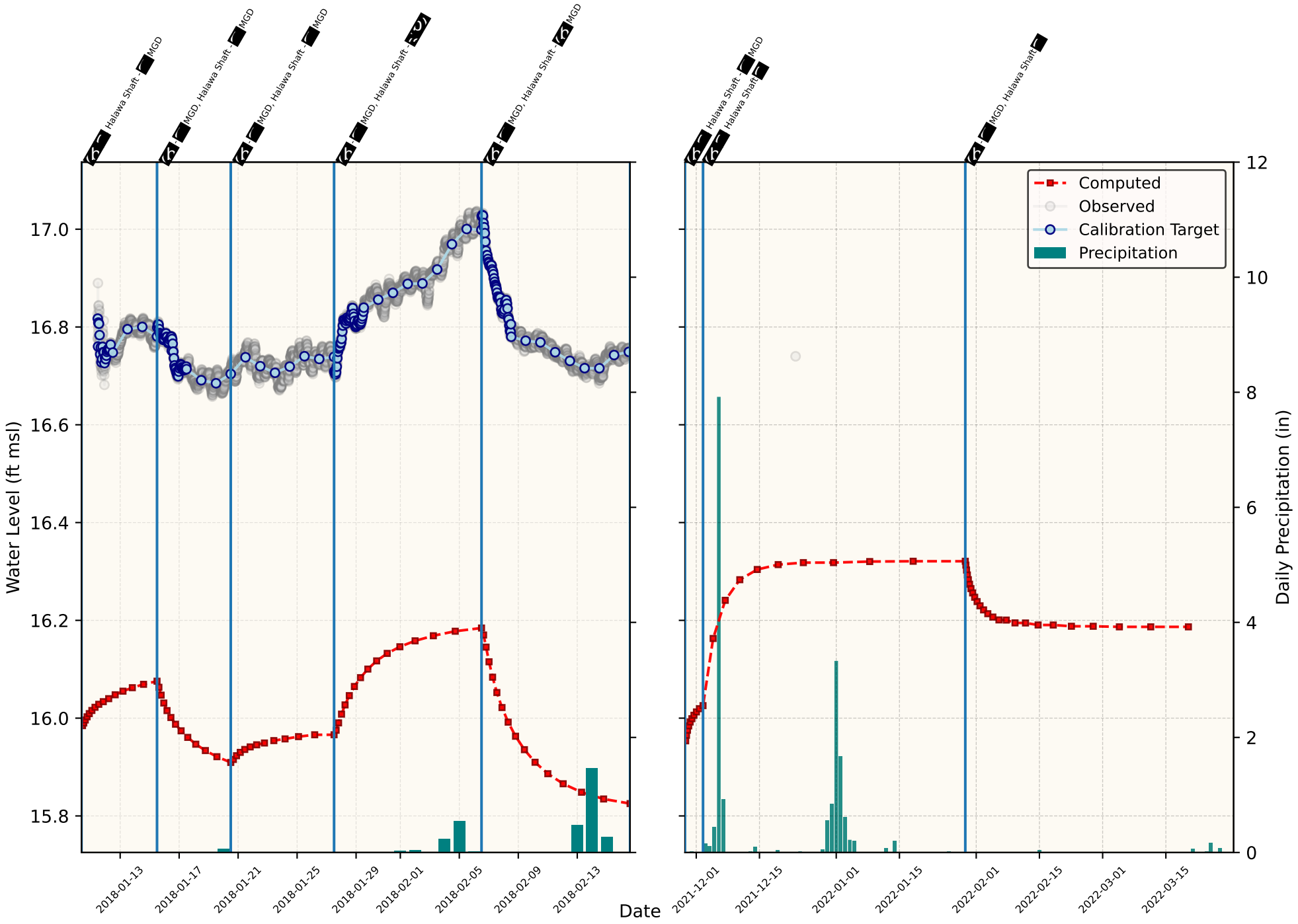


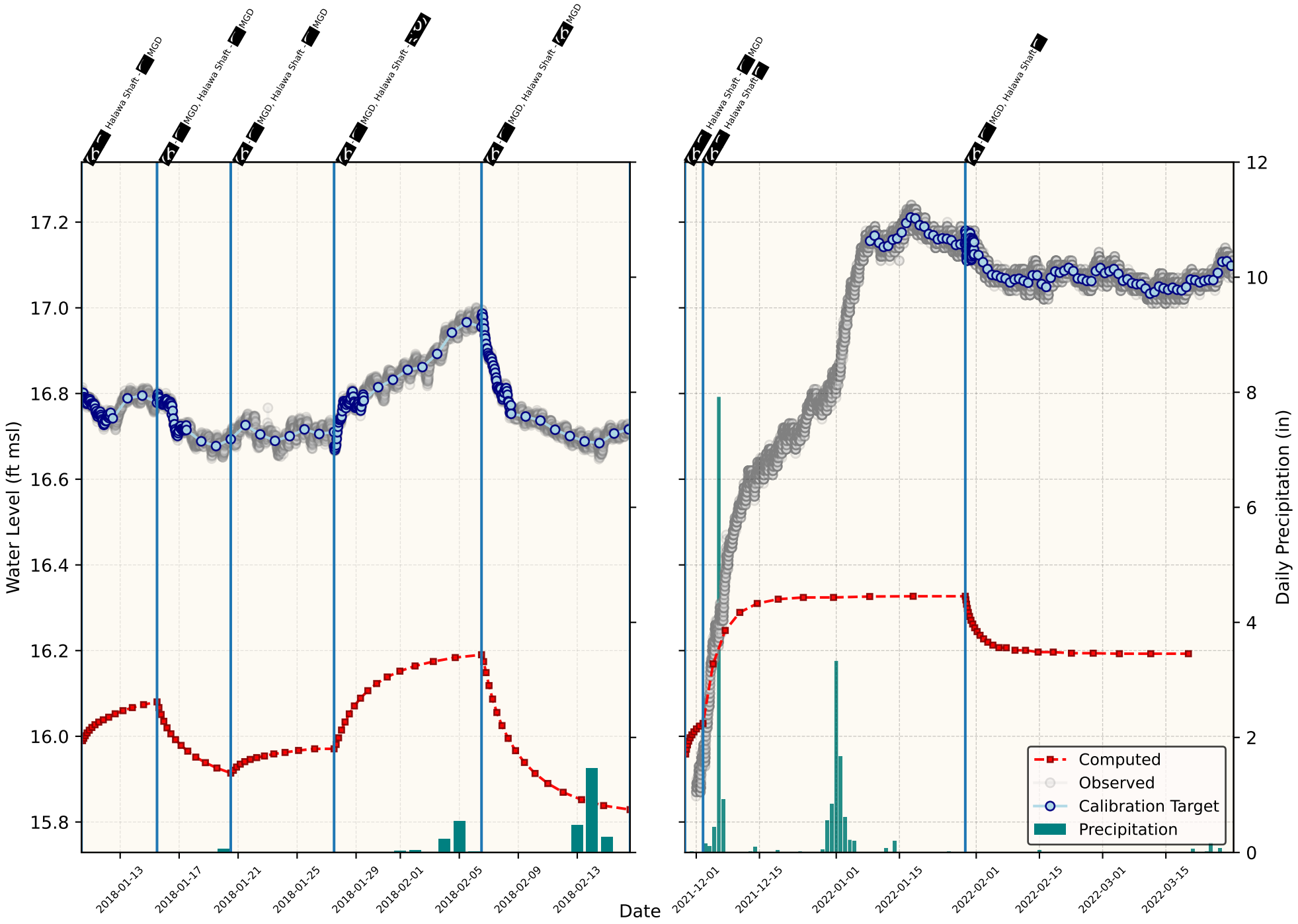

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
17.00
16.75
16.50
16.25
16.00
15.75
15.50
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date

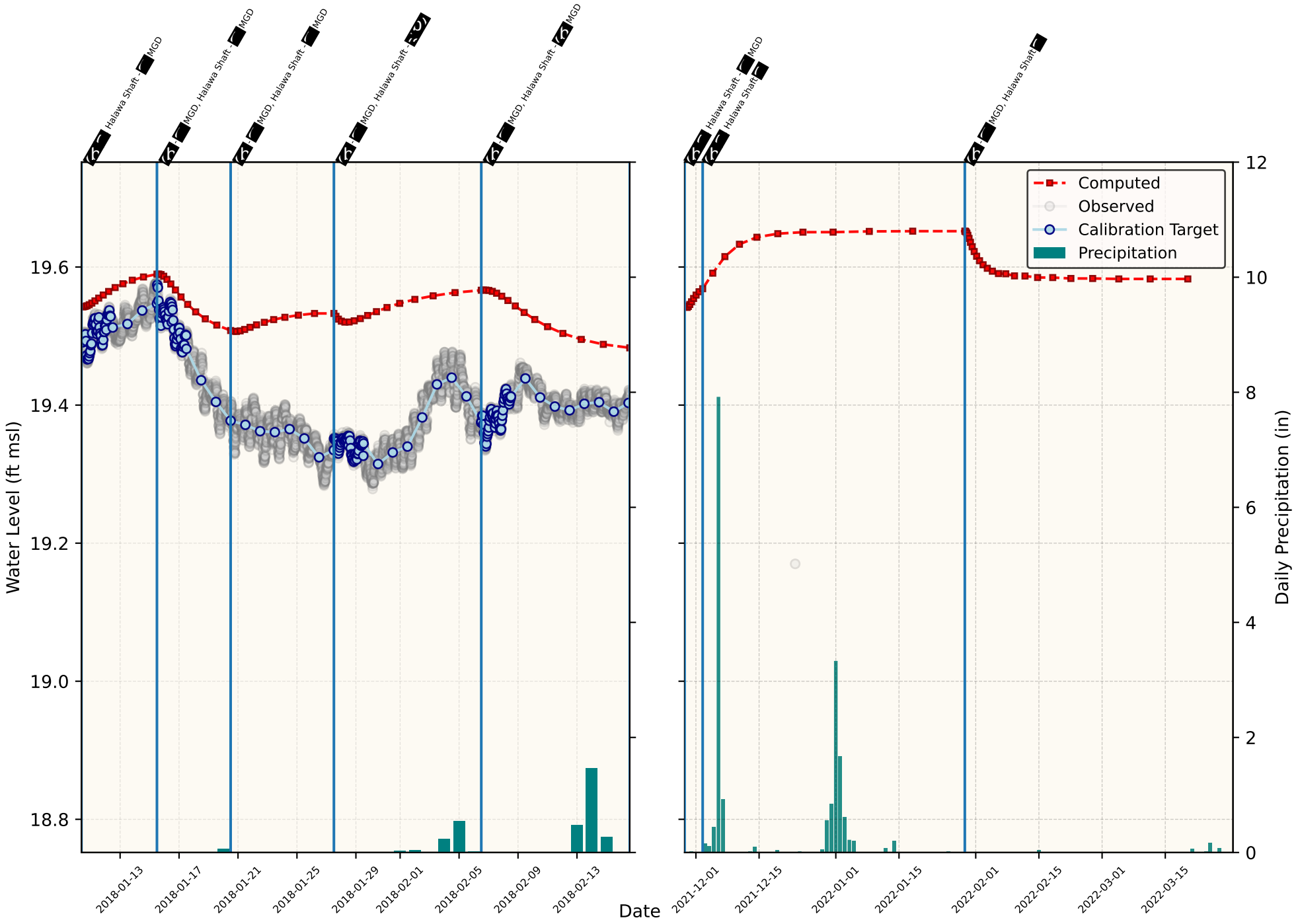
[redacted]

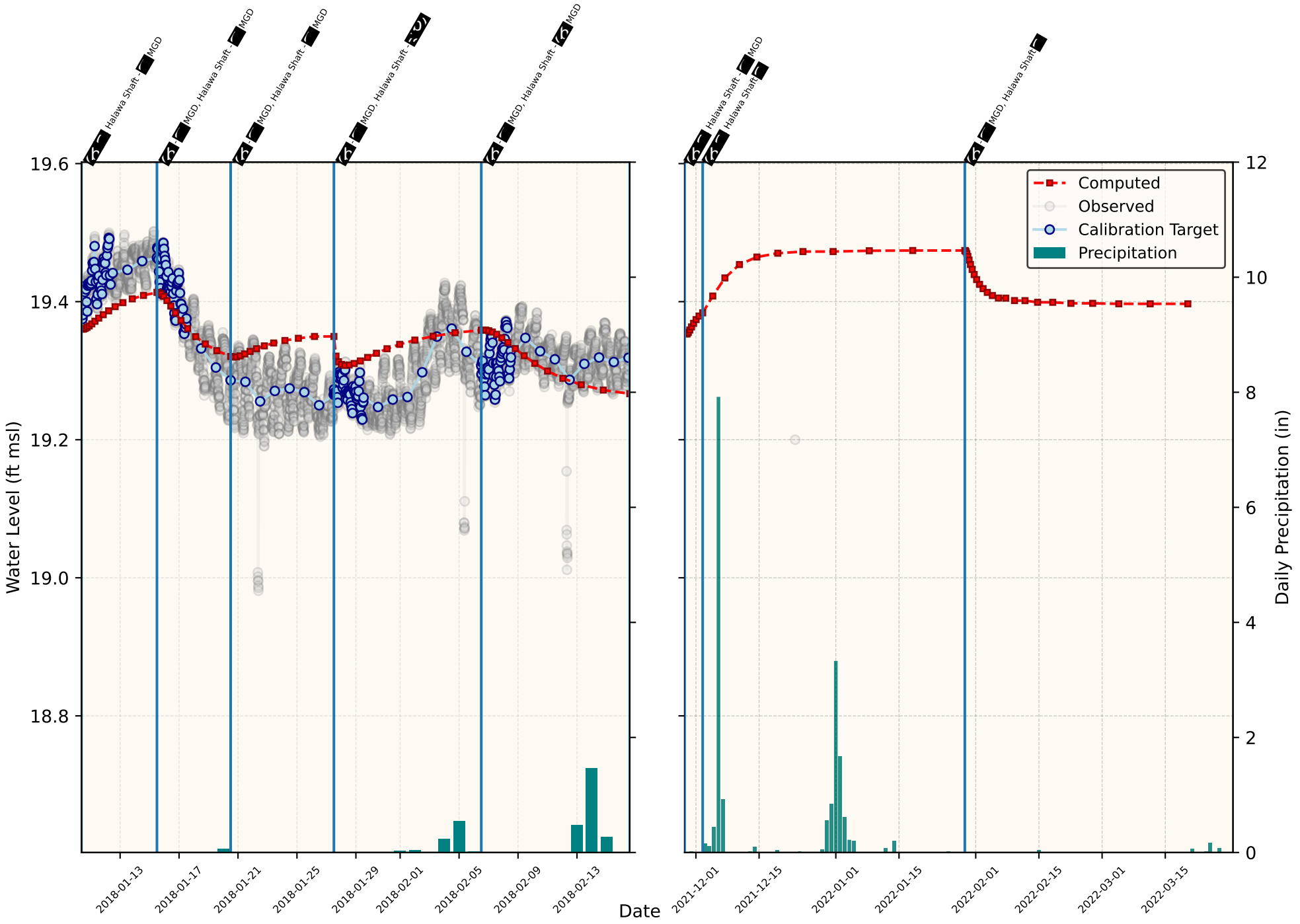

Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Water Level (ft msl)
17.0
16.5
16.0
15.5
15.0
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
17.0
16.8
16.6
16.4
16.2
16.0
15.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

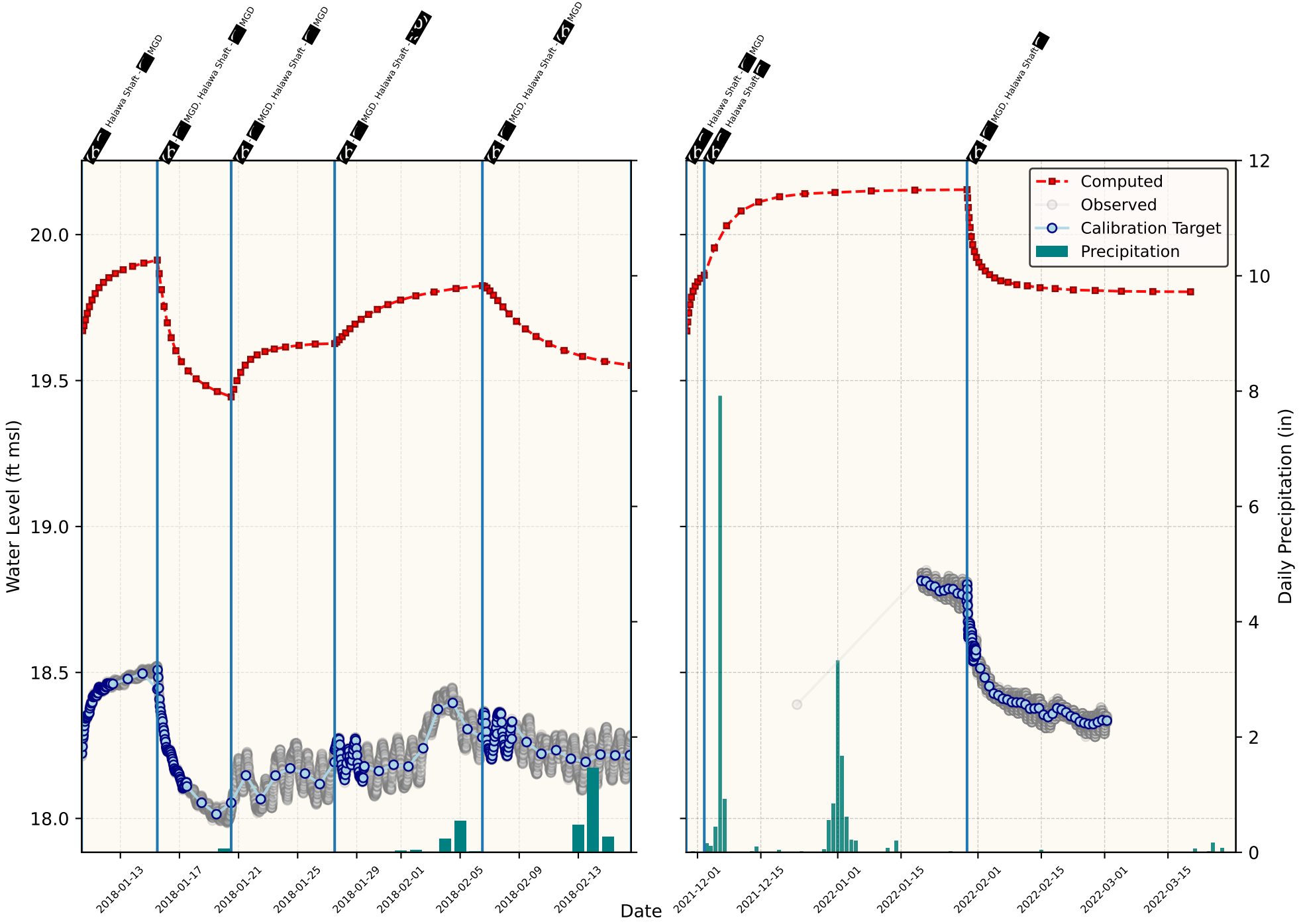

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

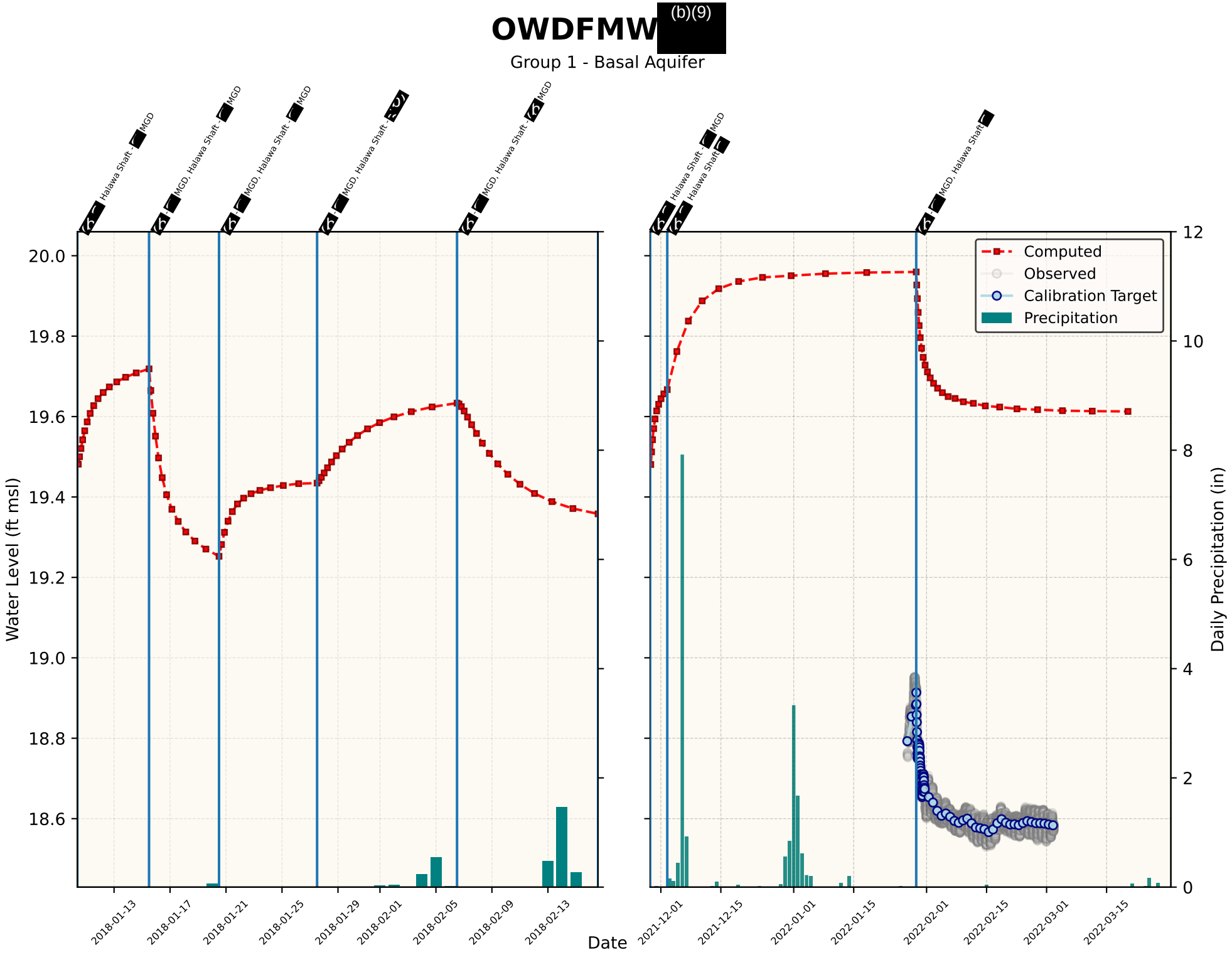

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.6
19.4
19.2
19.0
18.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

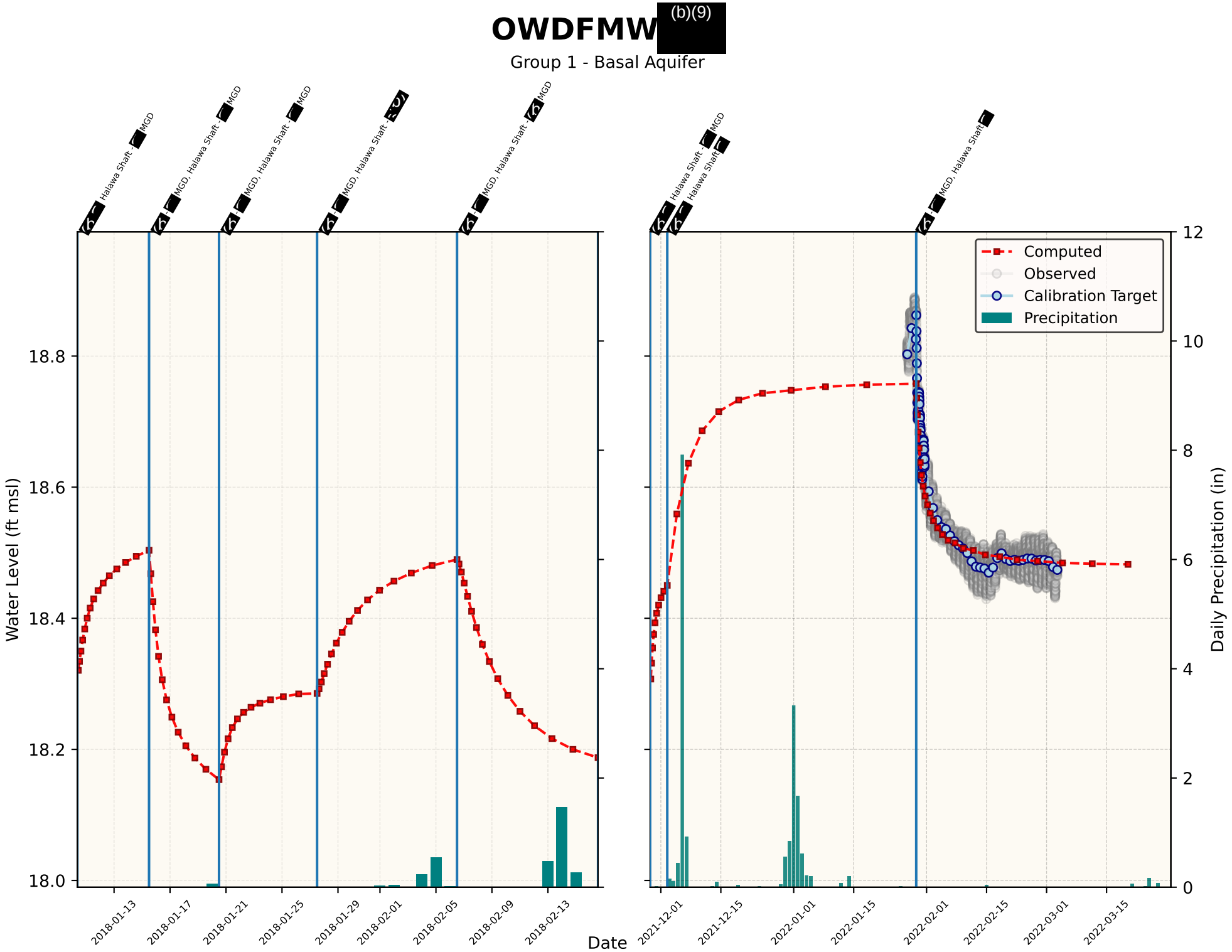

Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.6
19.4
19.2
19.0
18.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

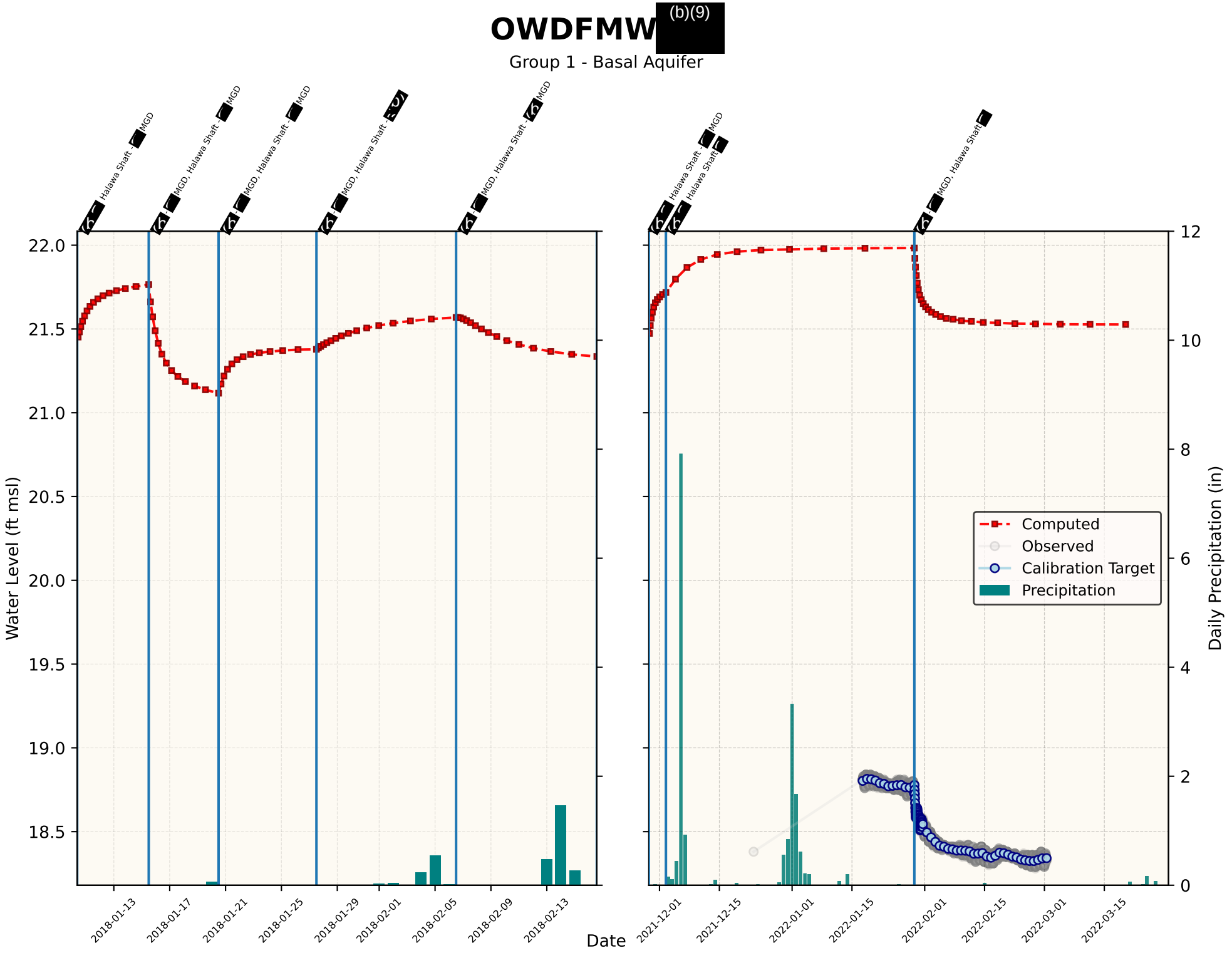
OWDFMW[redacted] (b)(9)

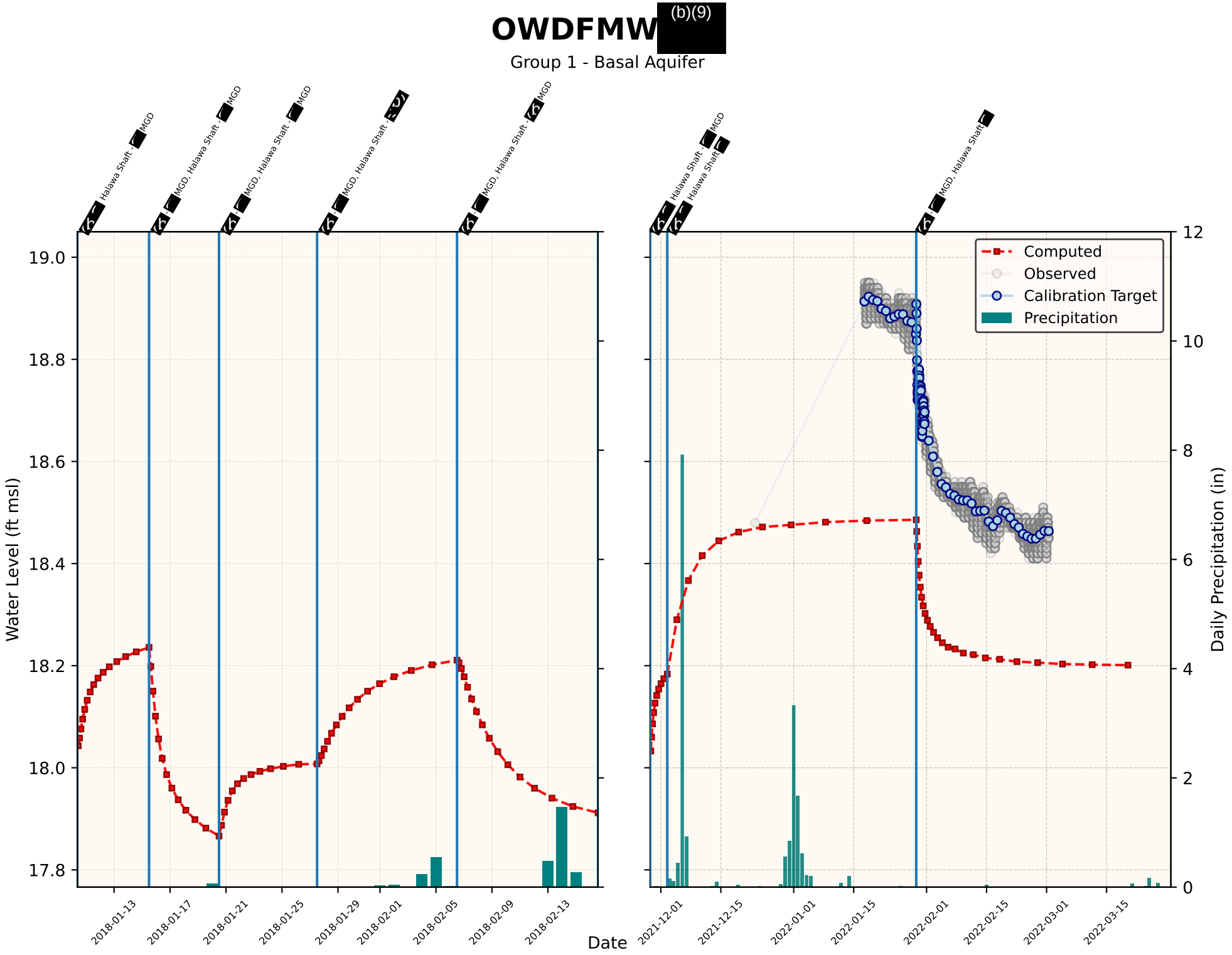
Group 1 - Basal Aquifer

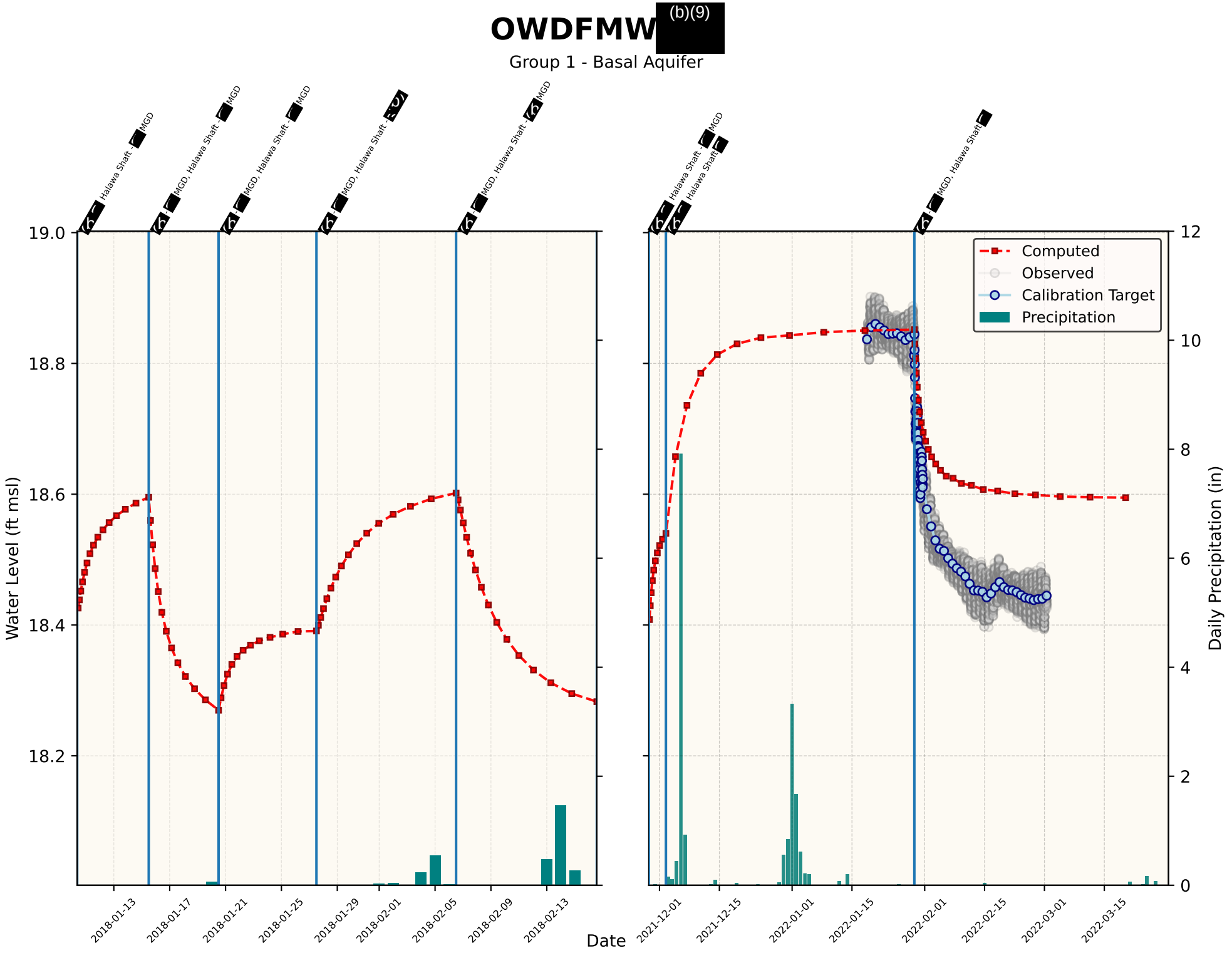


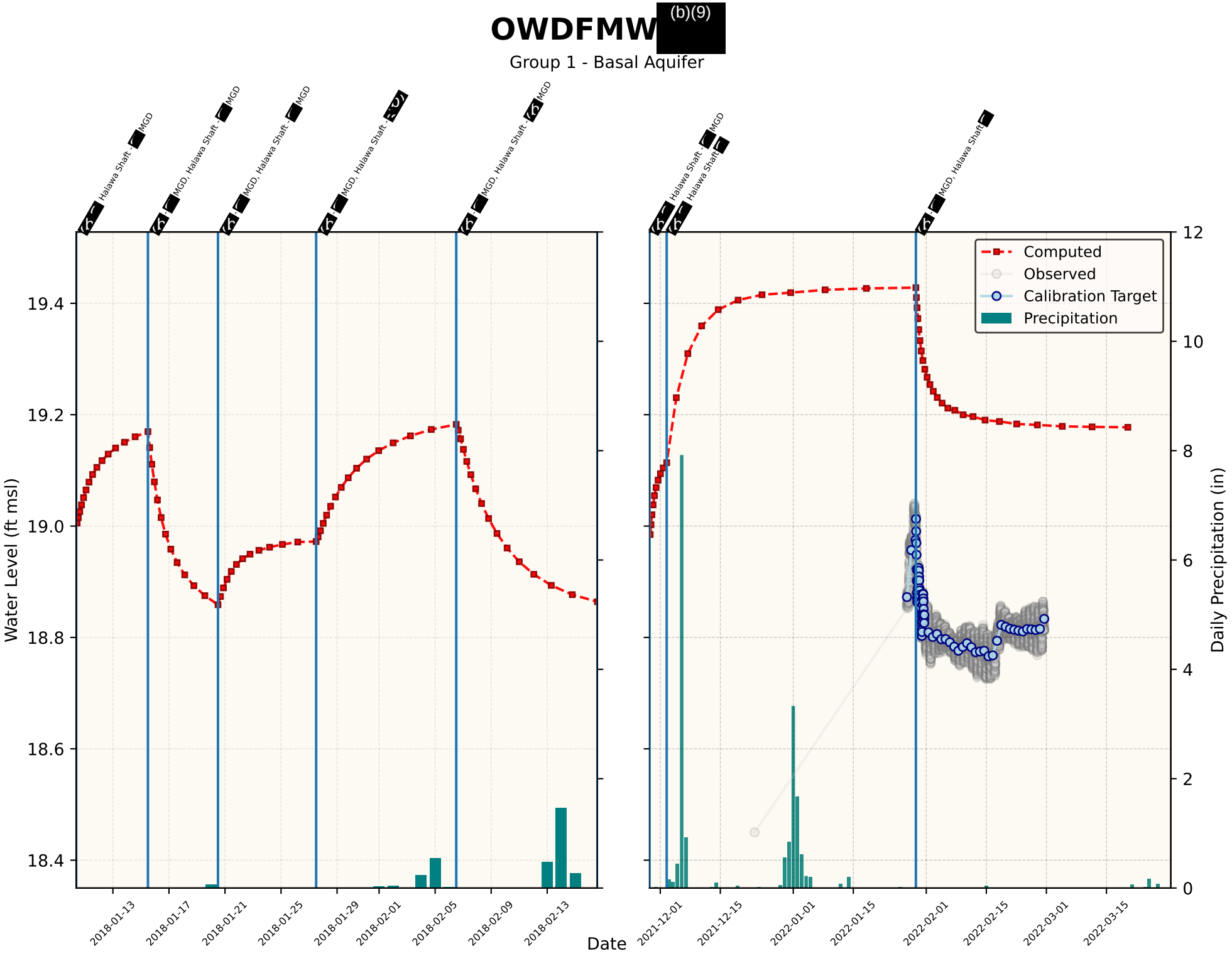

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
20.0
19.8
19.6
19.4
19.2
19.0
18.8
18.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

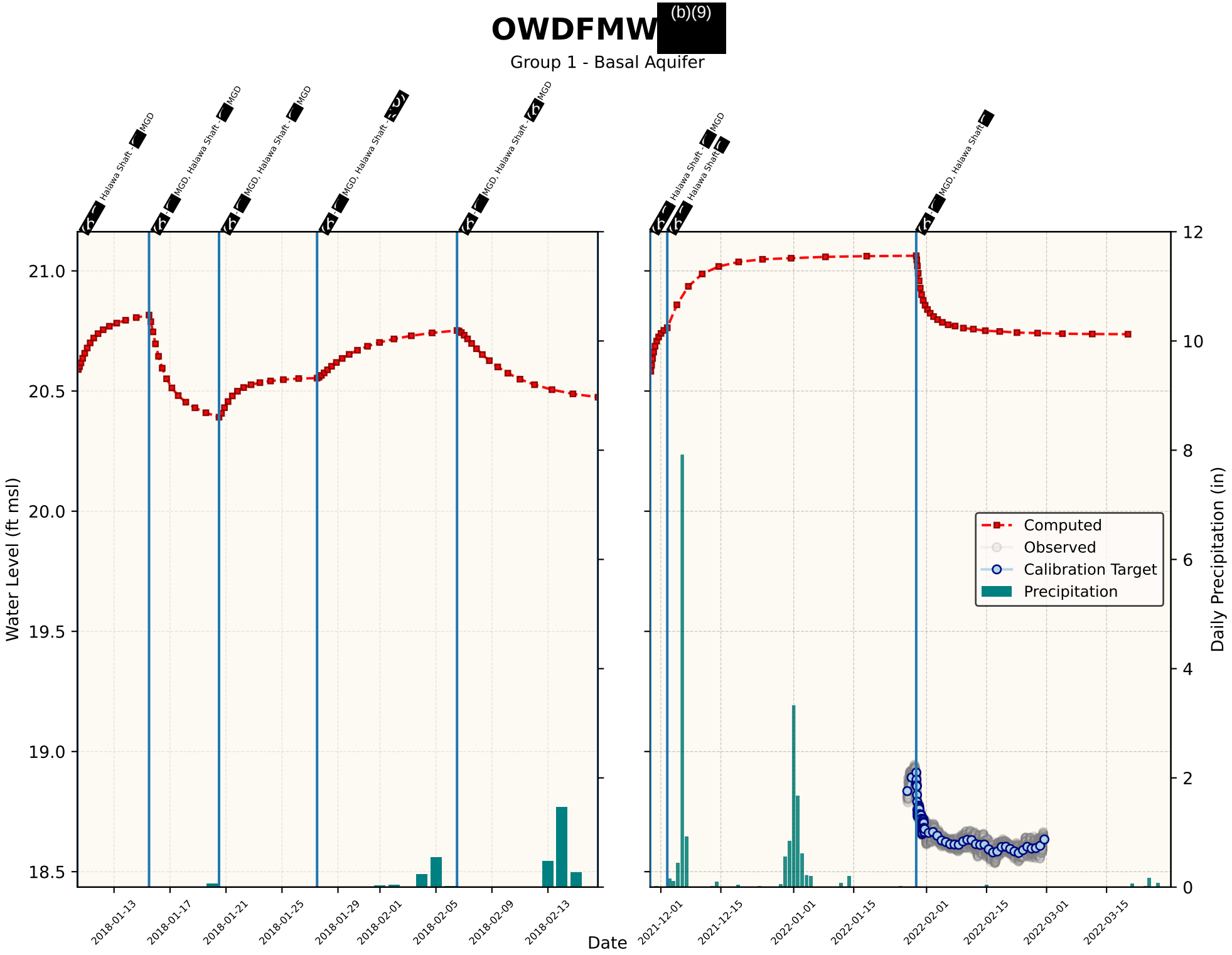

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.0
18.2
18.4
18.6
18.8
0
2
4
6
8
10
12
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

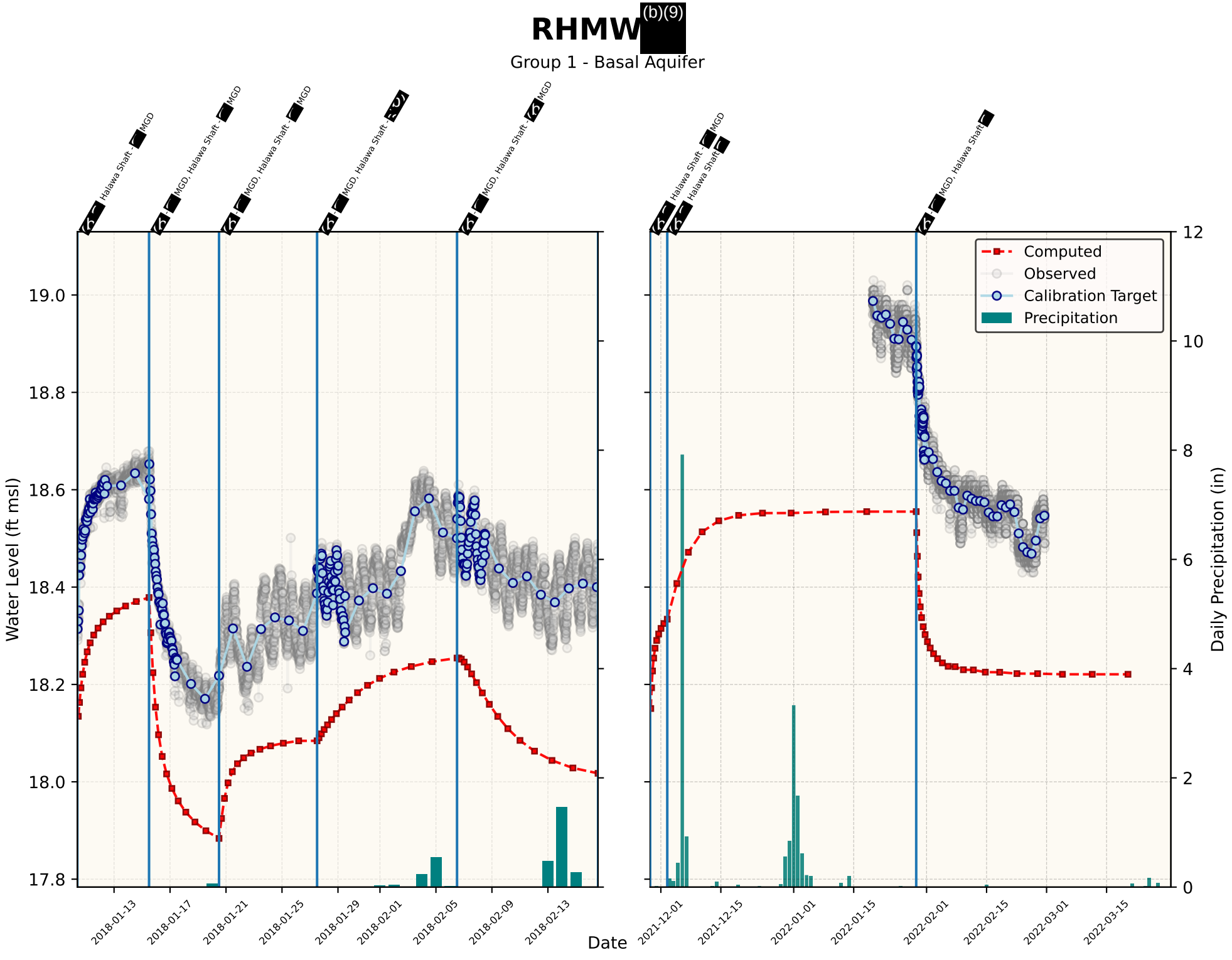

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

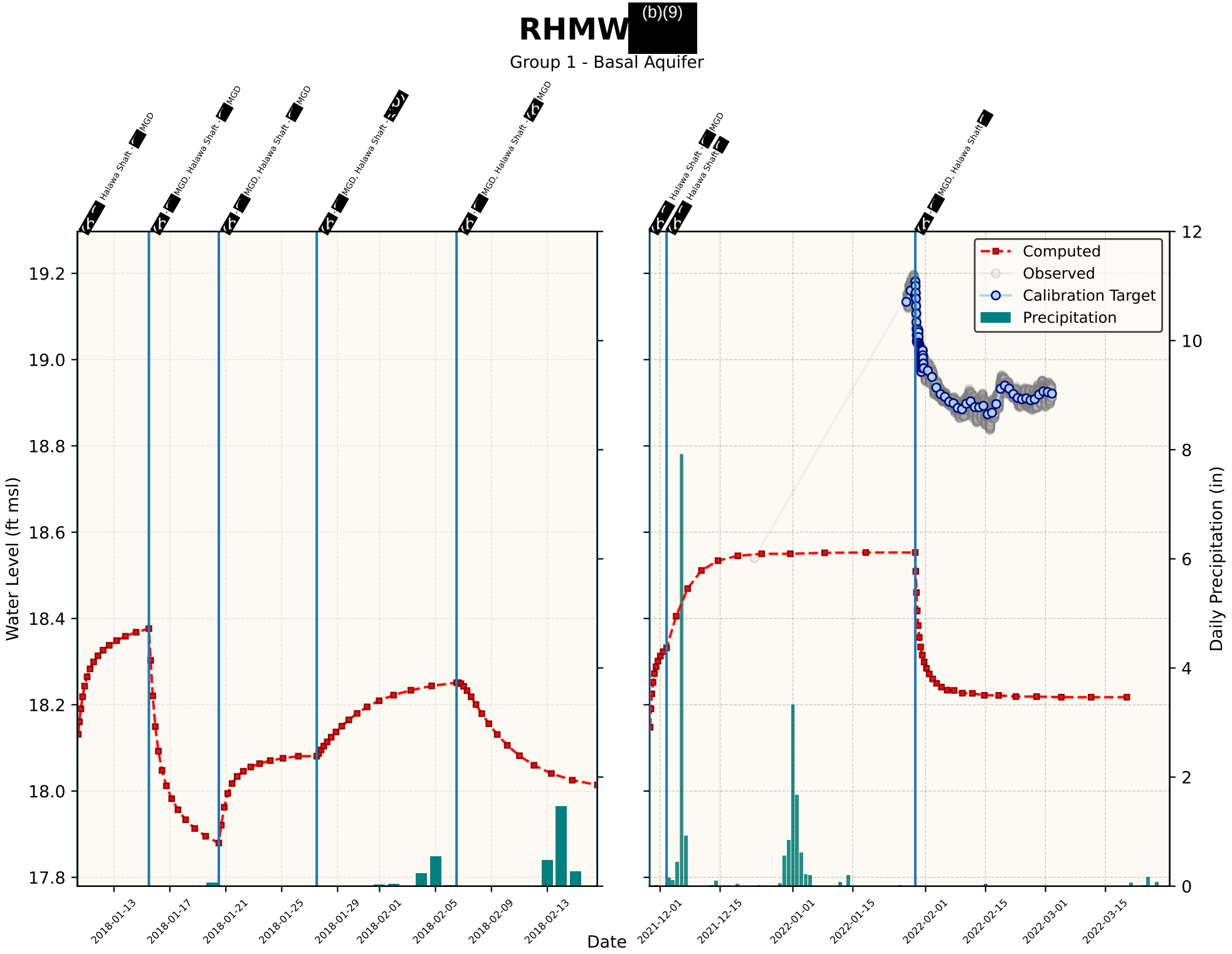

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

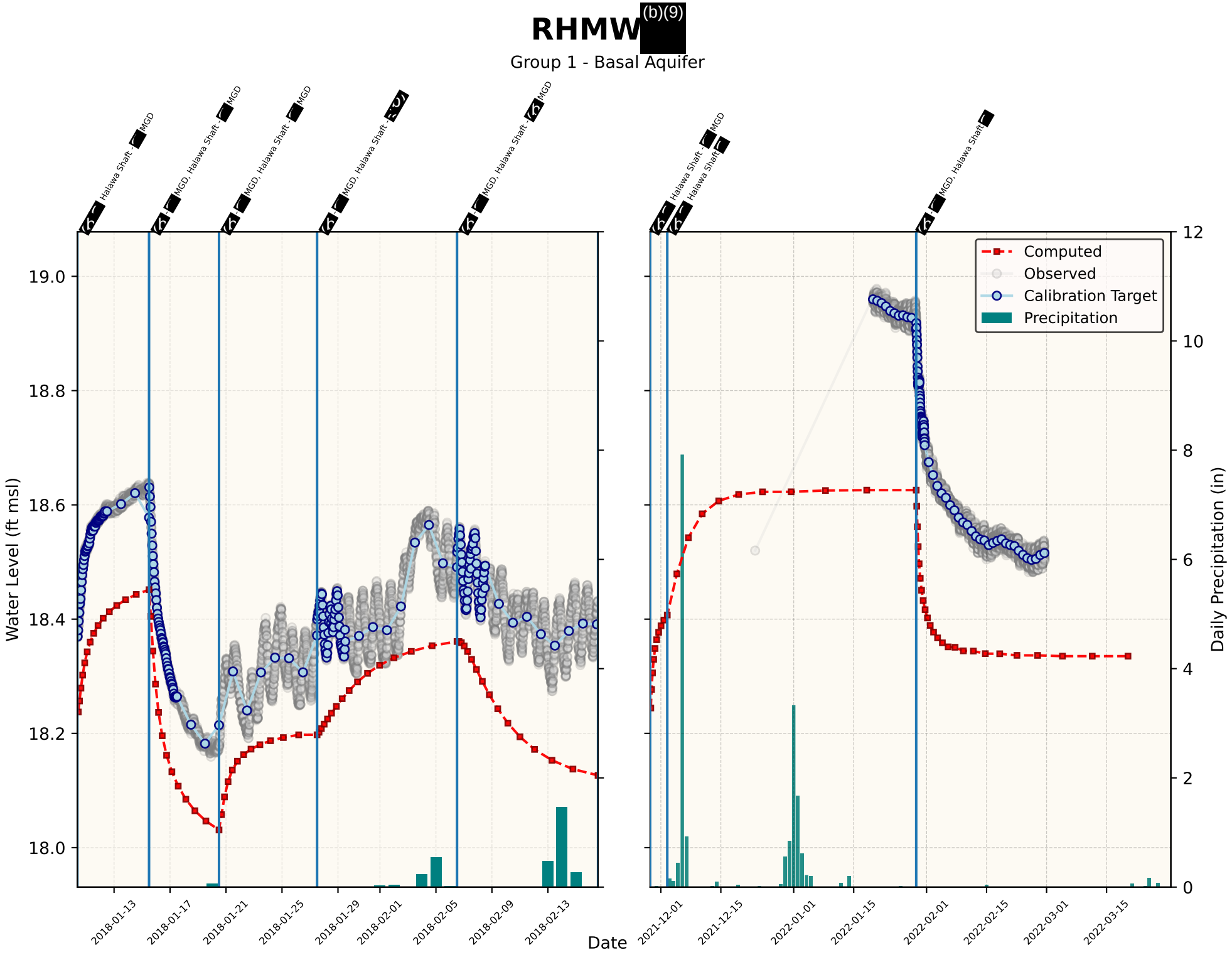

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-01-15
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2022-03-15

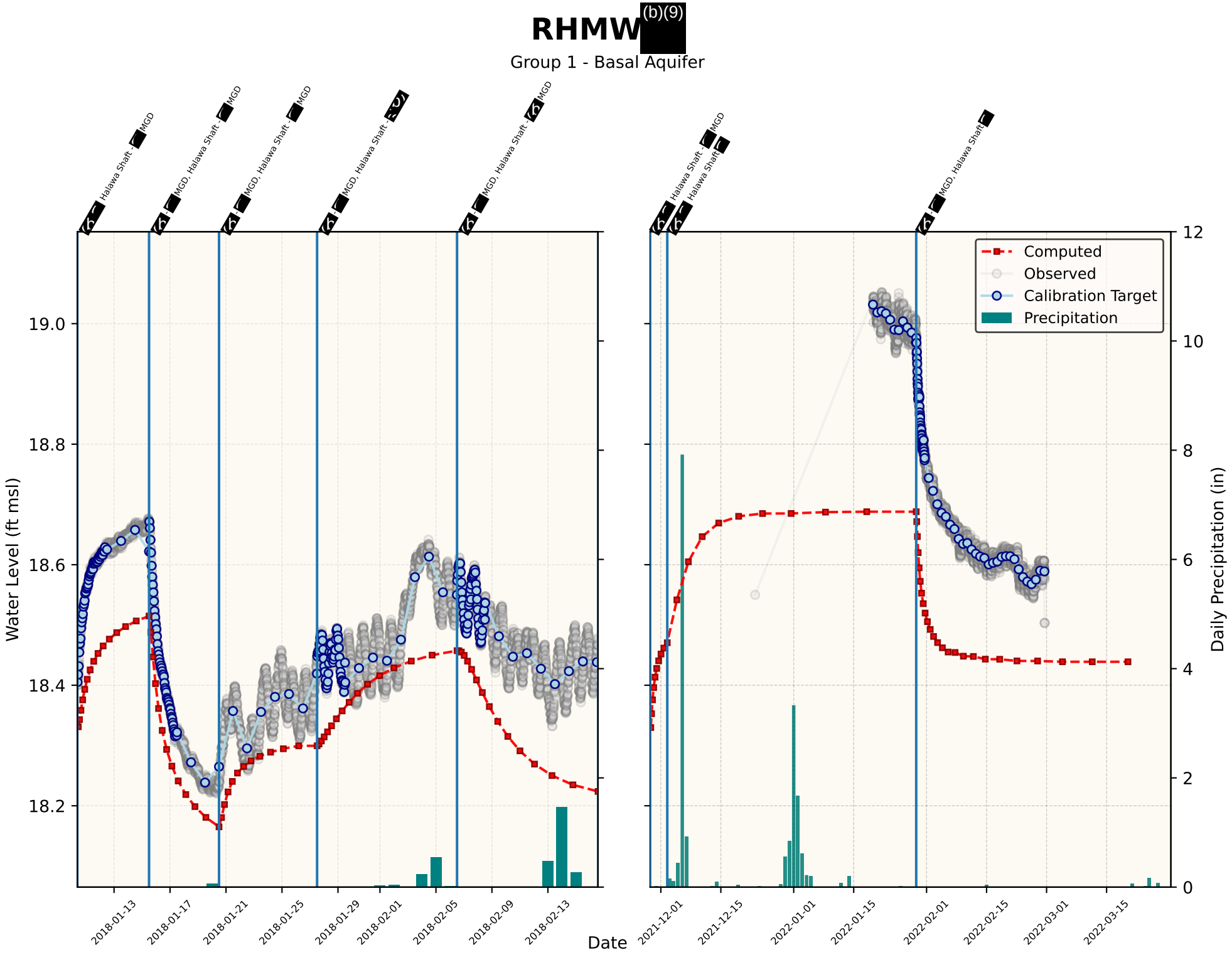

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

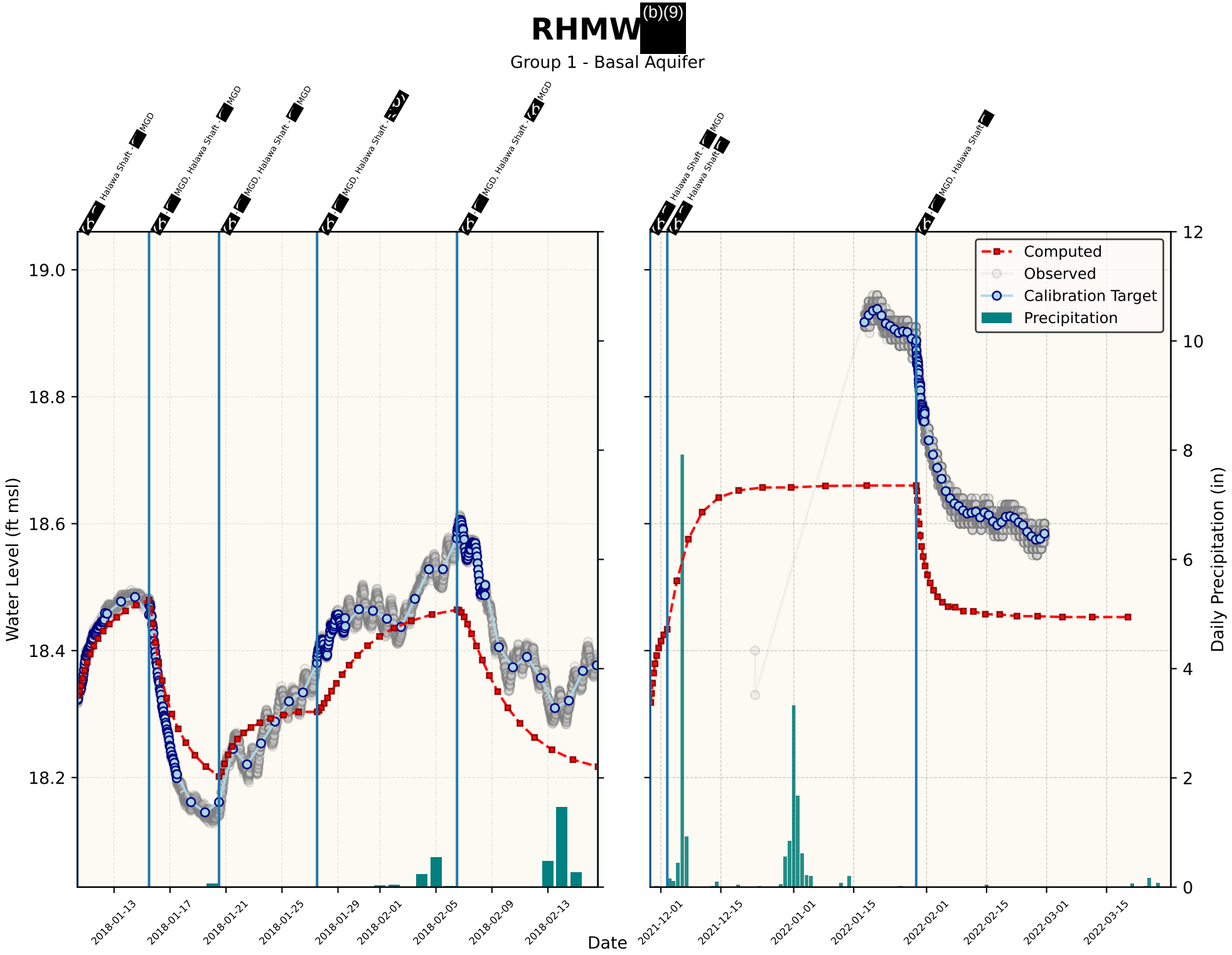

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

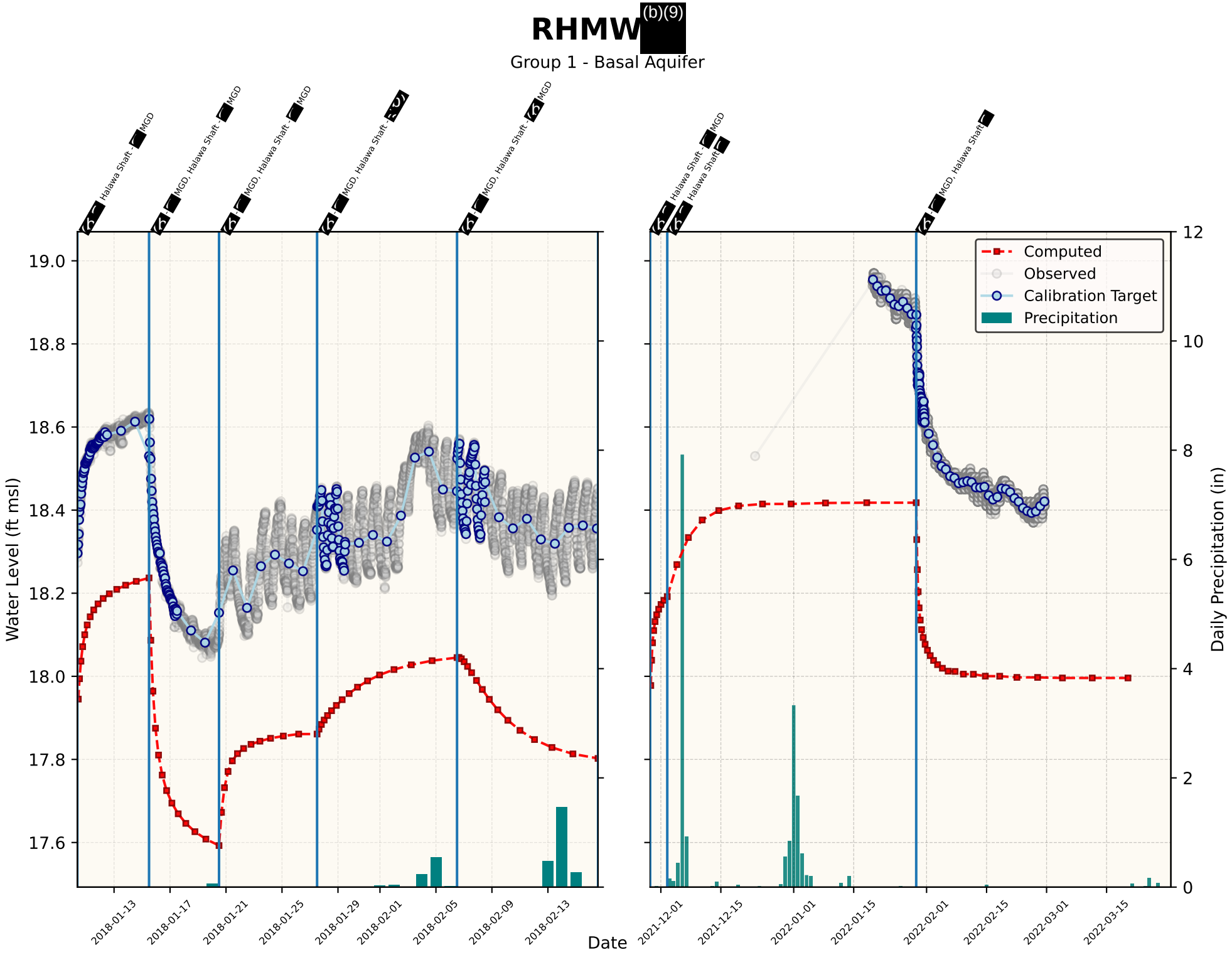

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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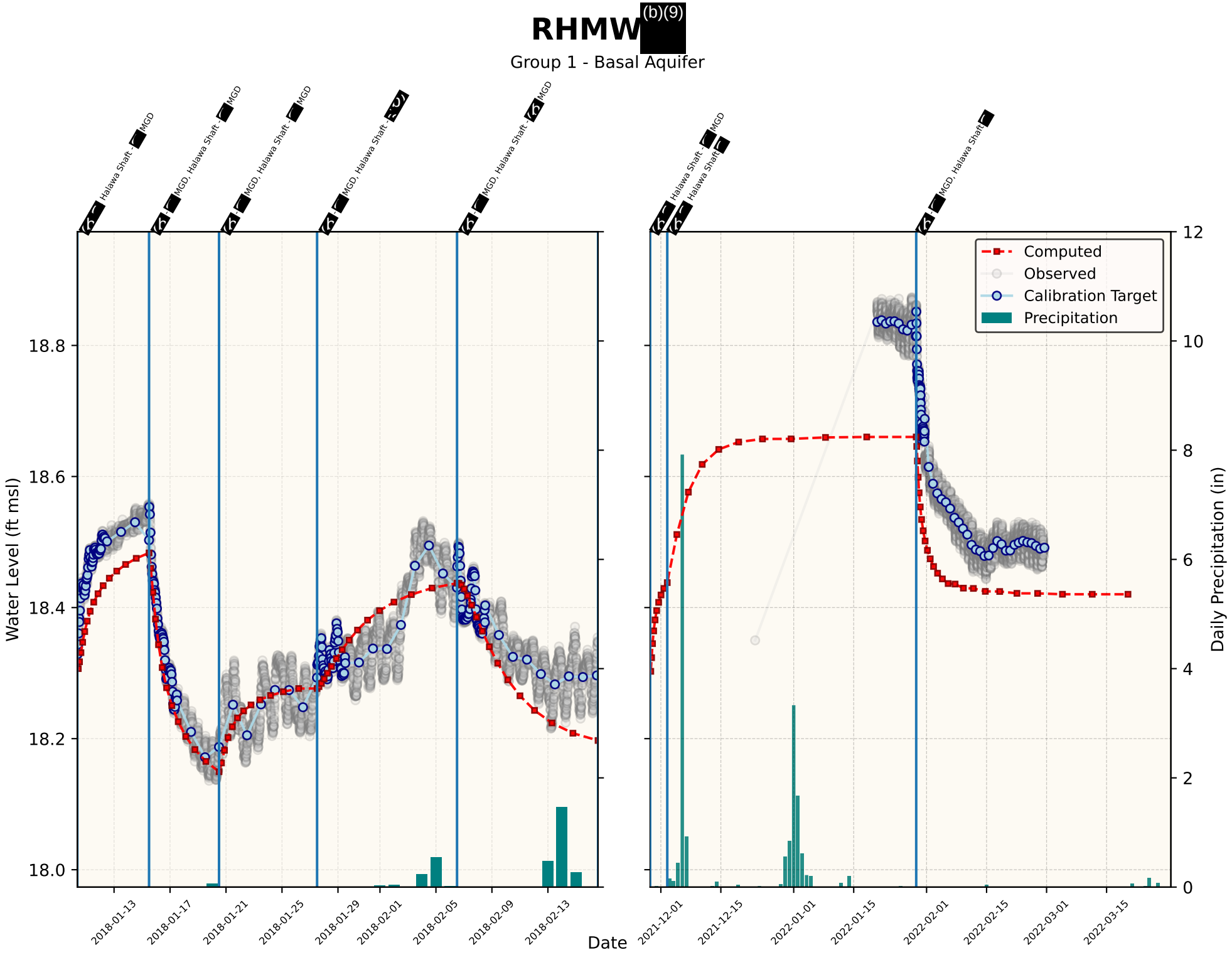

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.2
19.0
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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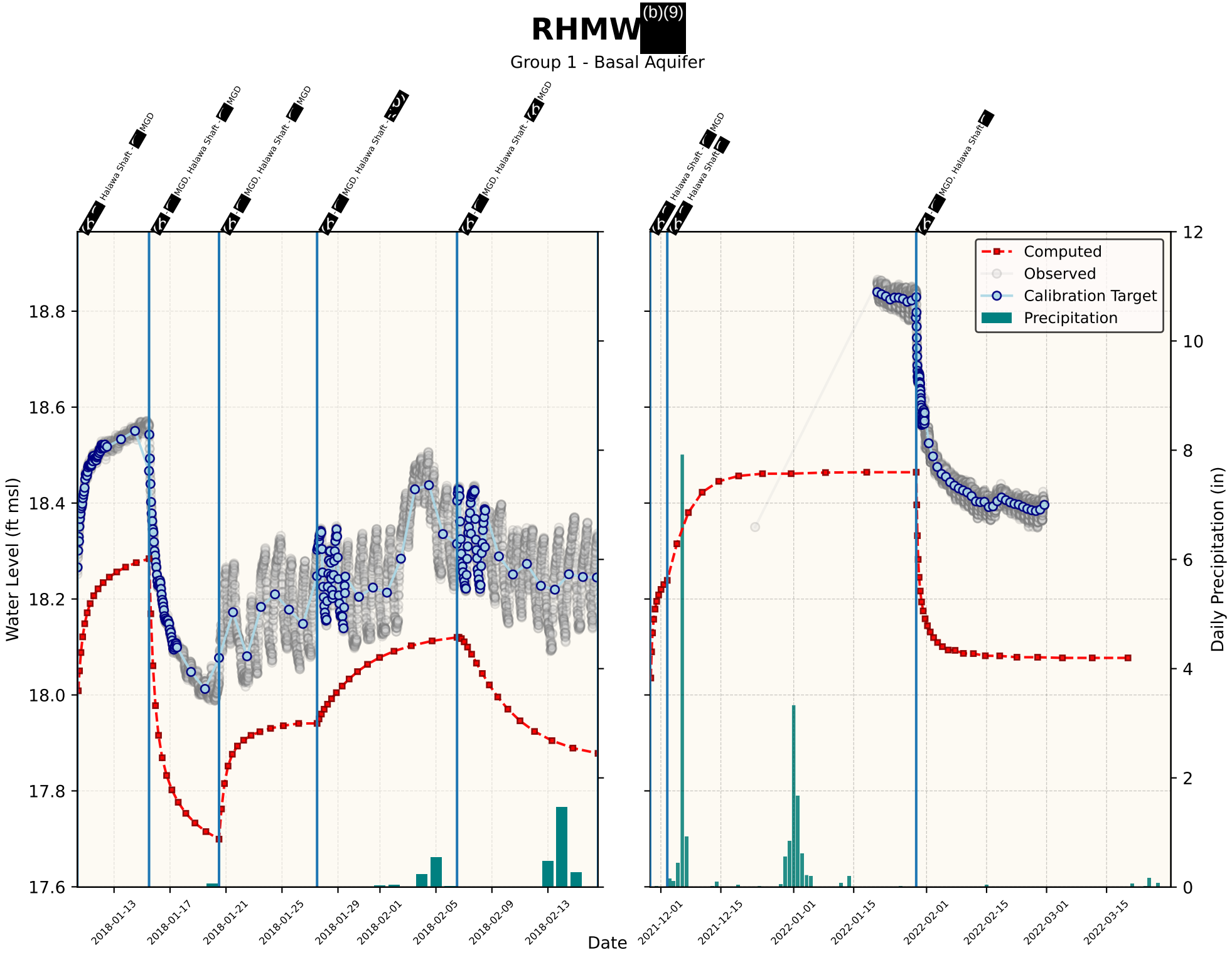

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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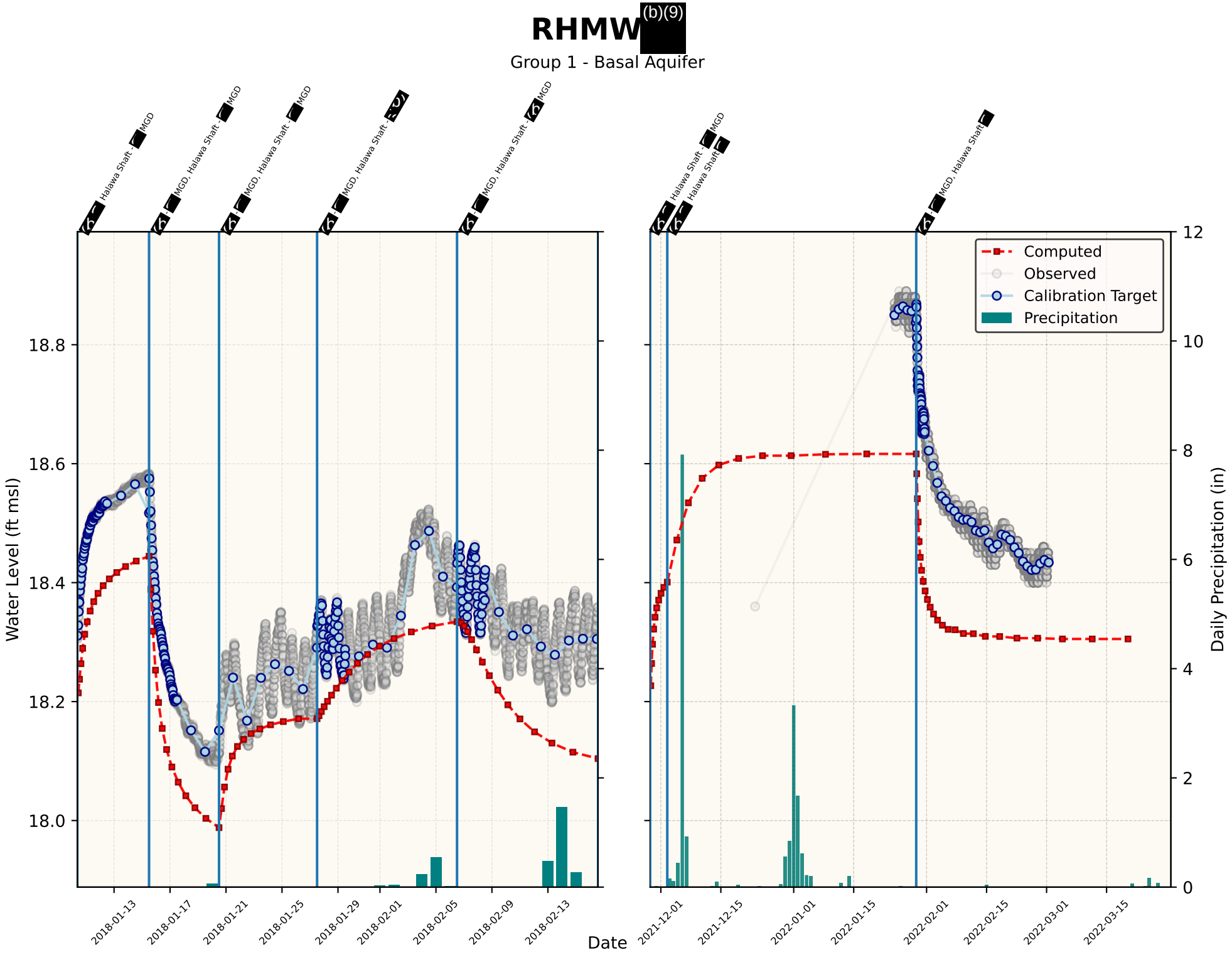

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-01
2022-03-15

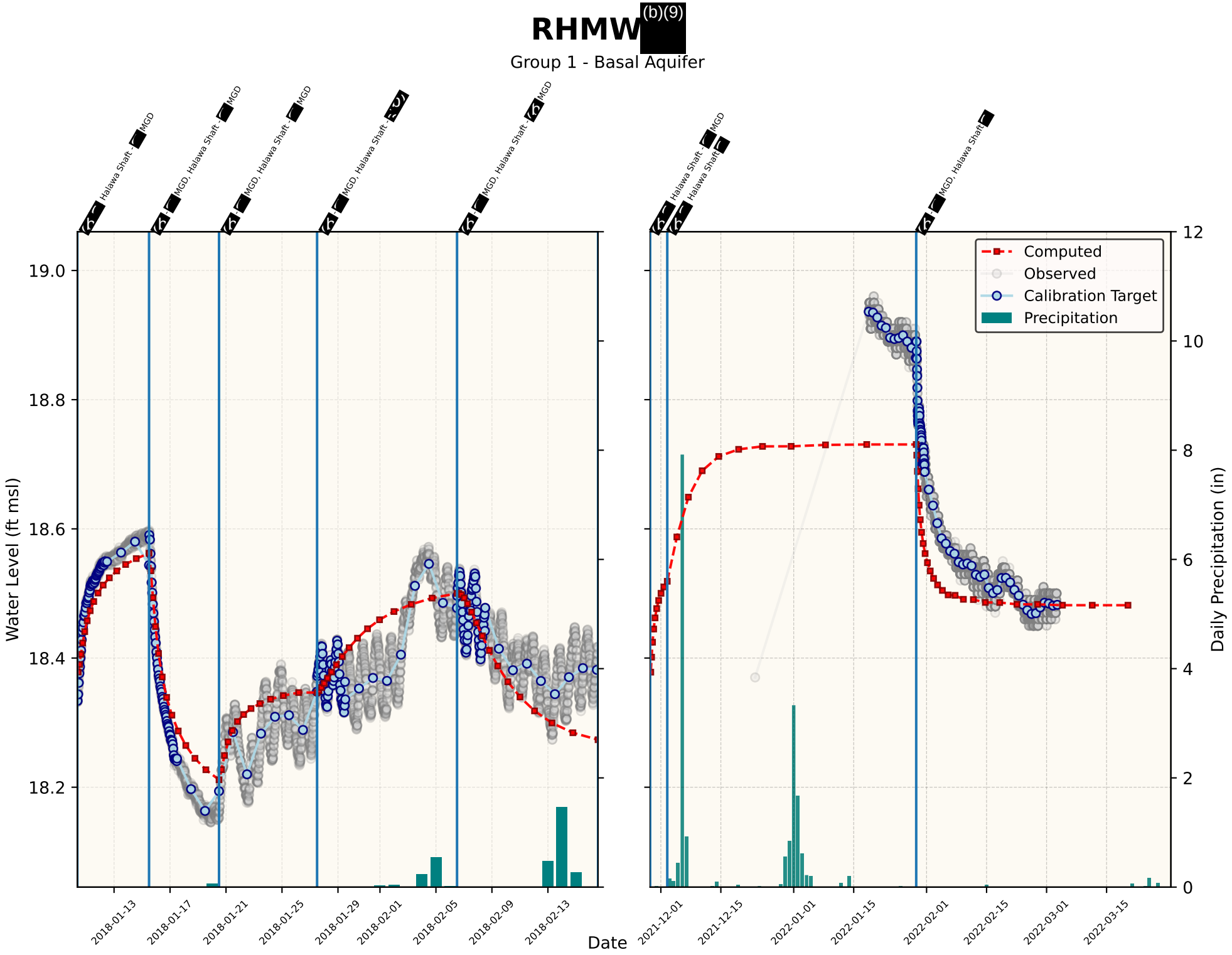

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
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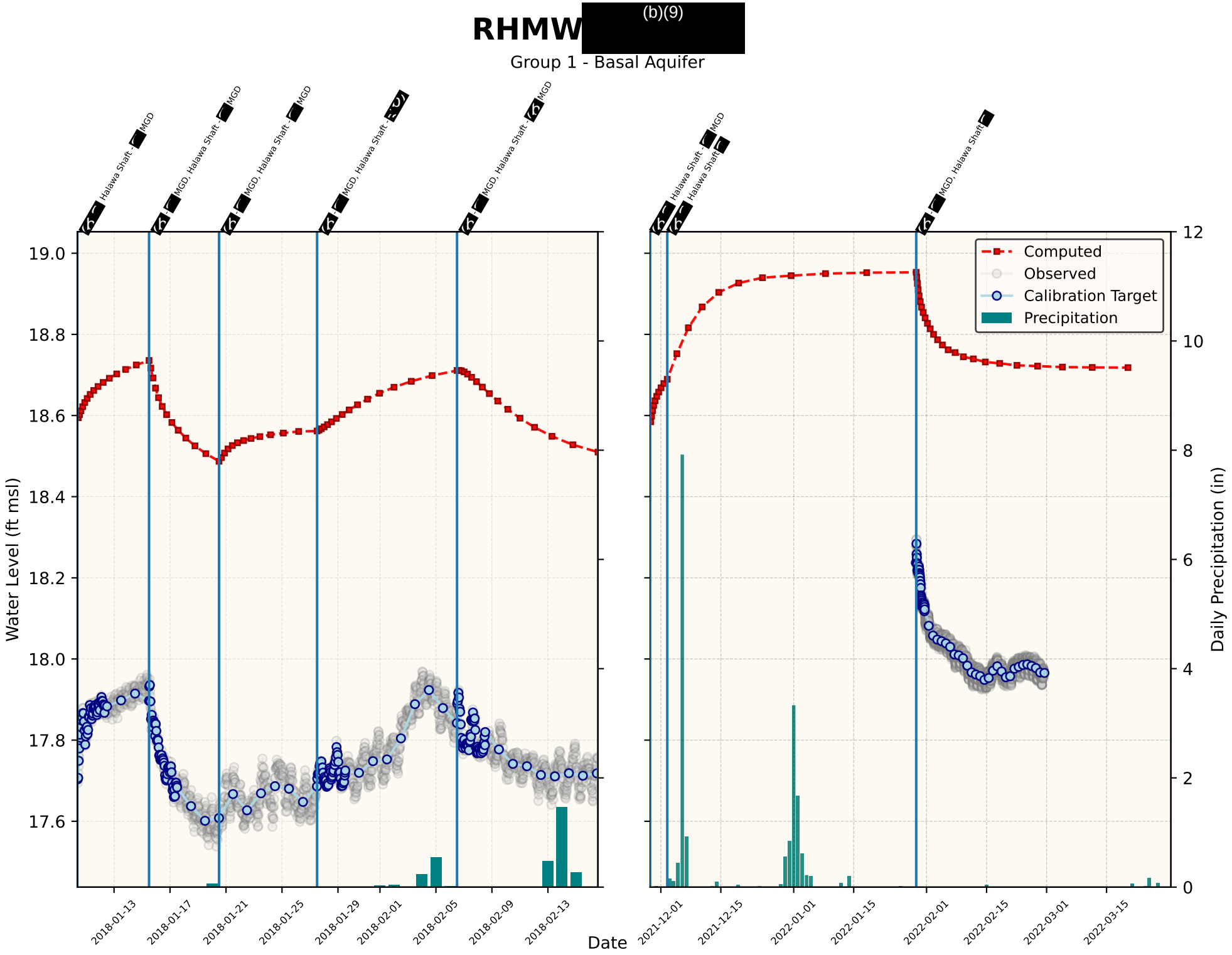

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.0
18.2
18.4
18.6
18.8
0
2
4
6
8
10
12
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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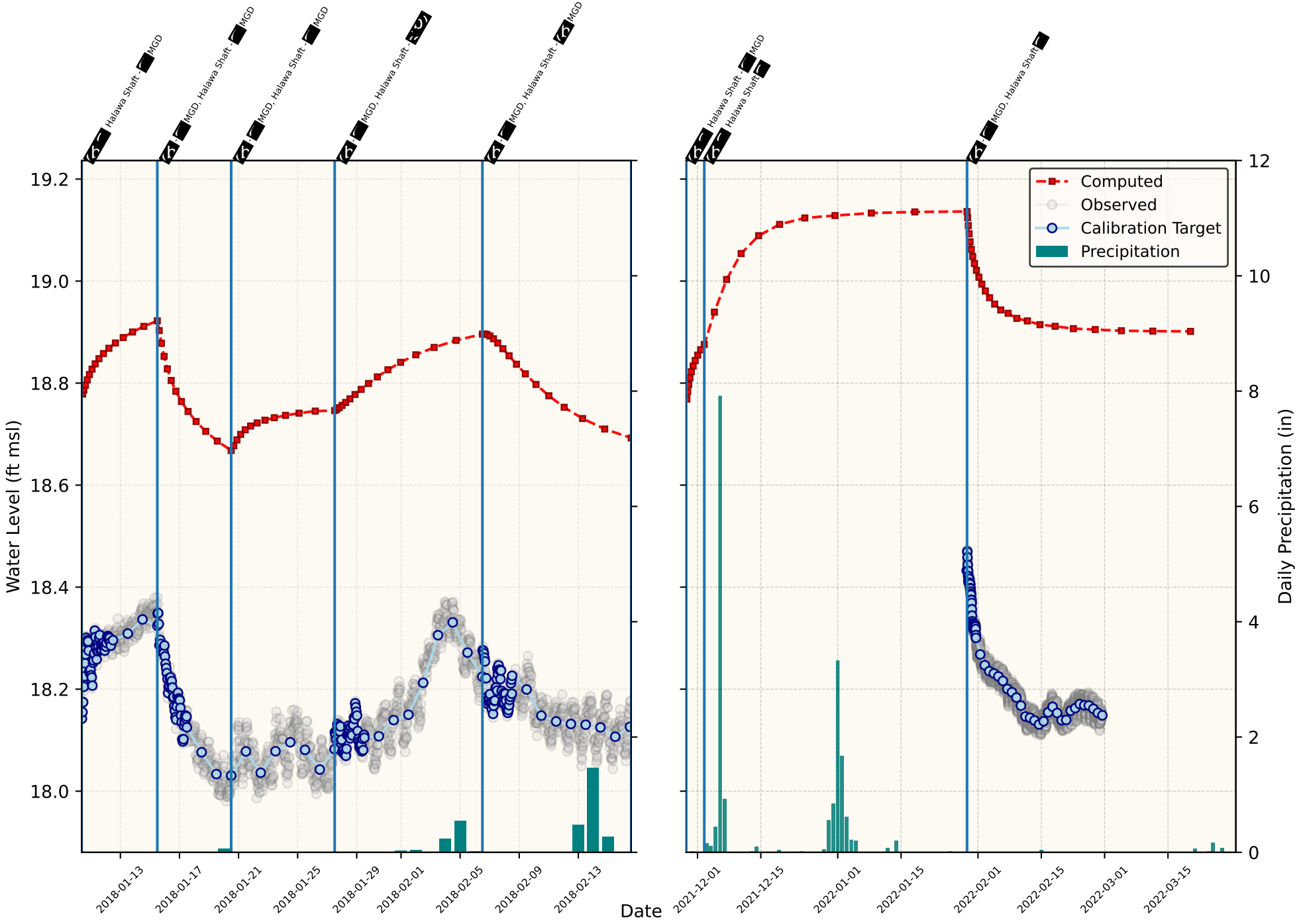

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.0
18.2
18.4
18.6
18.8
0
2
4
6
8
10
12
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
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2018-02-13
2021-12-01
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2022-02-01
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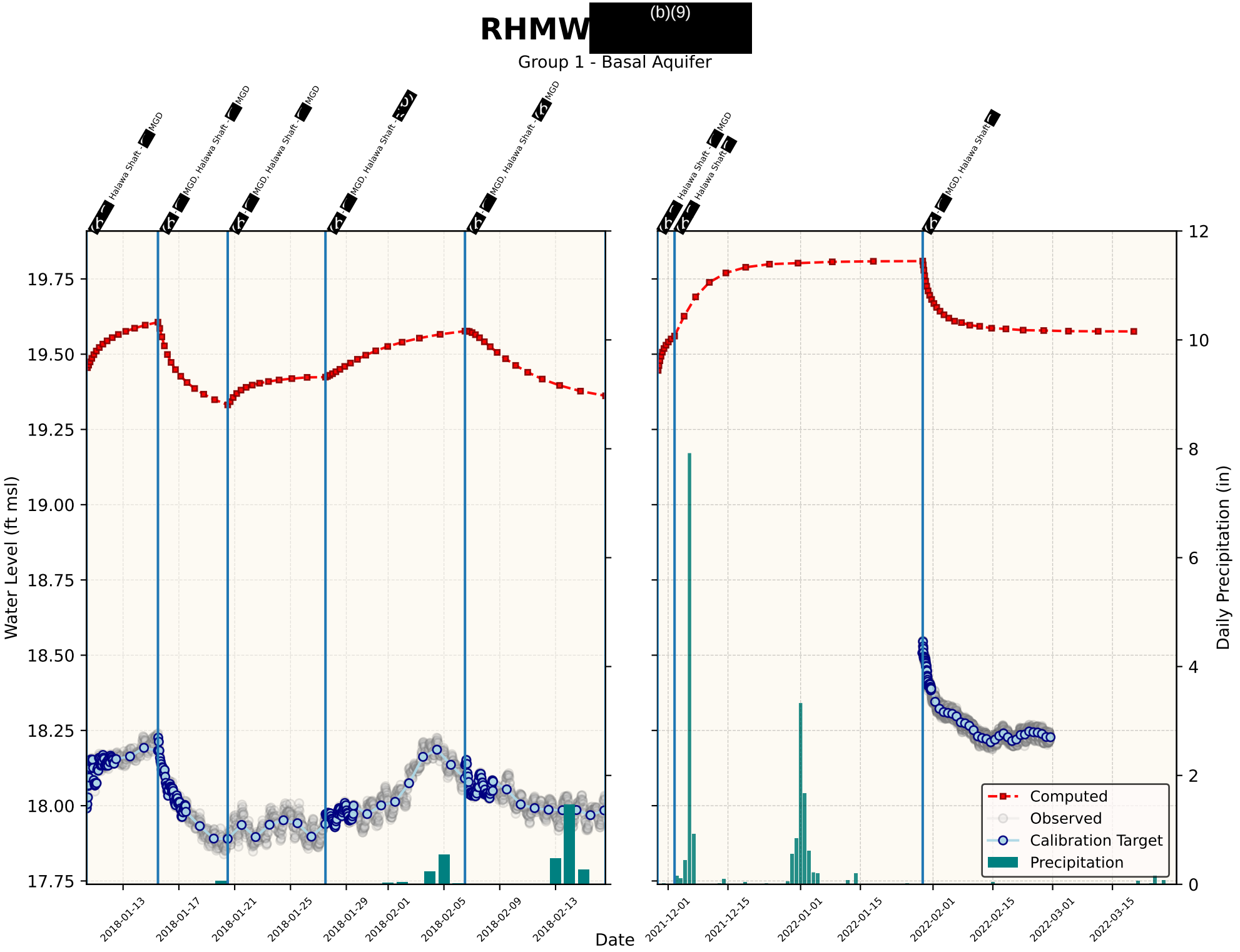

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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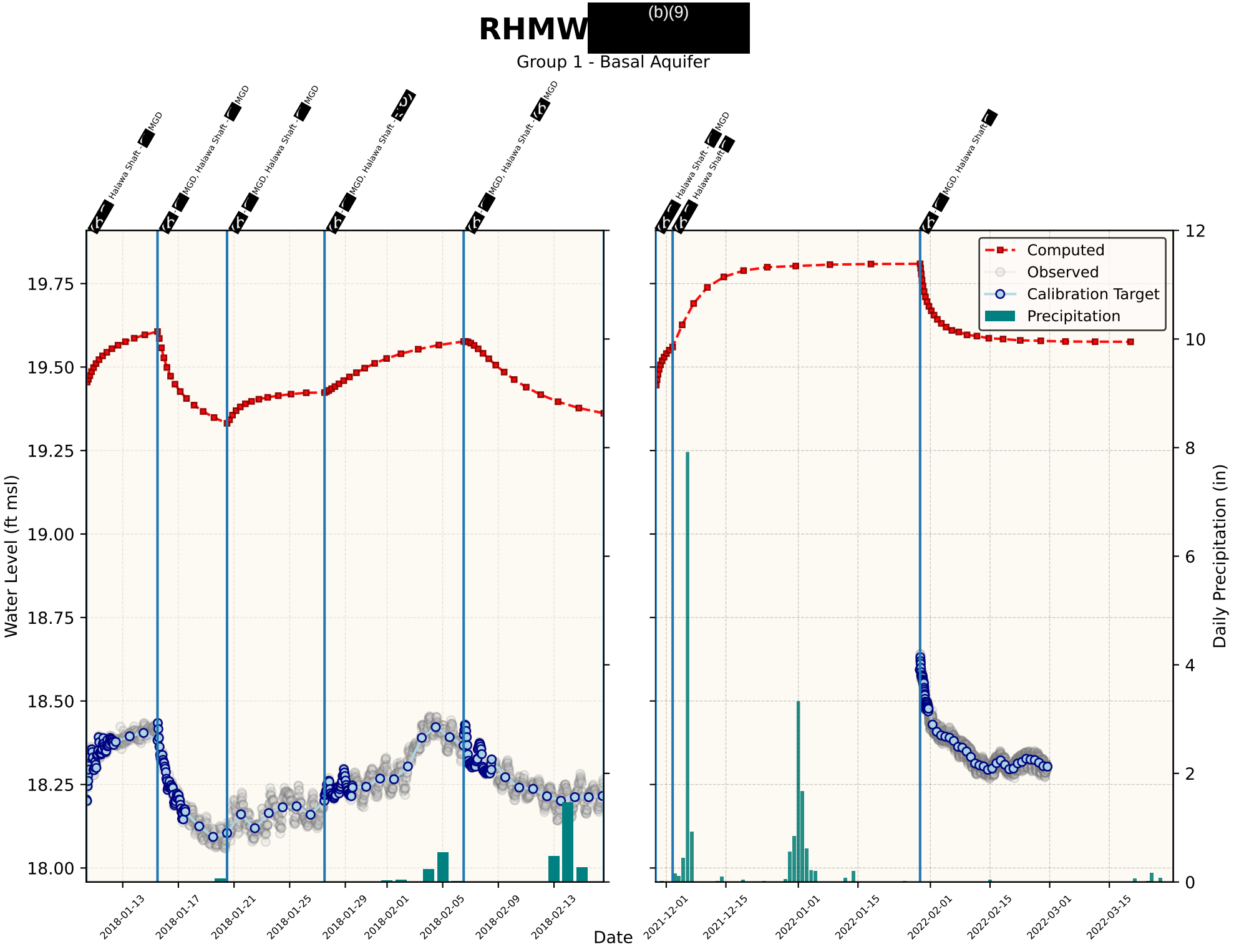

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-01
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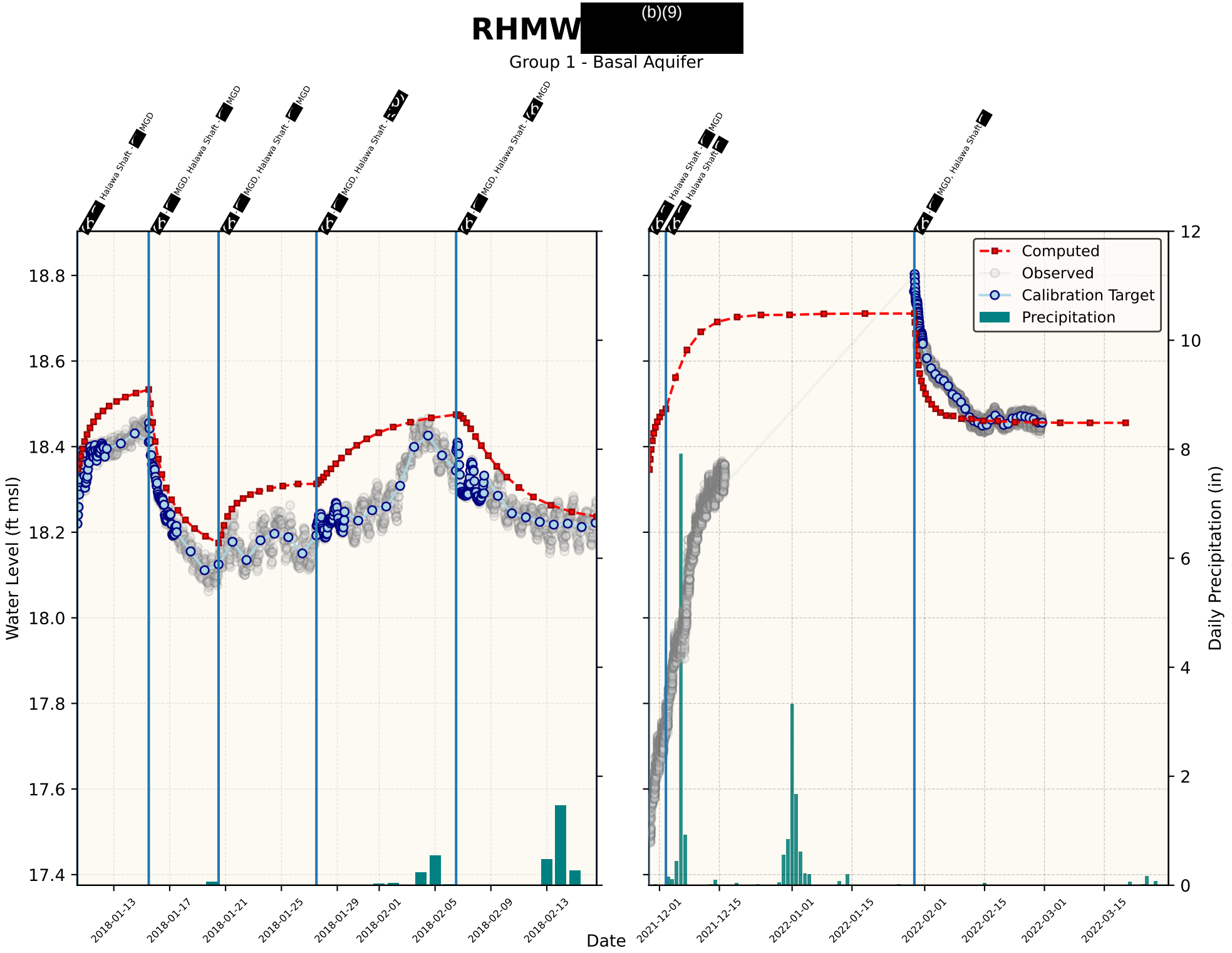
RHMW (b)(9)

Group 1 - Basal Aquifer



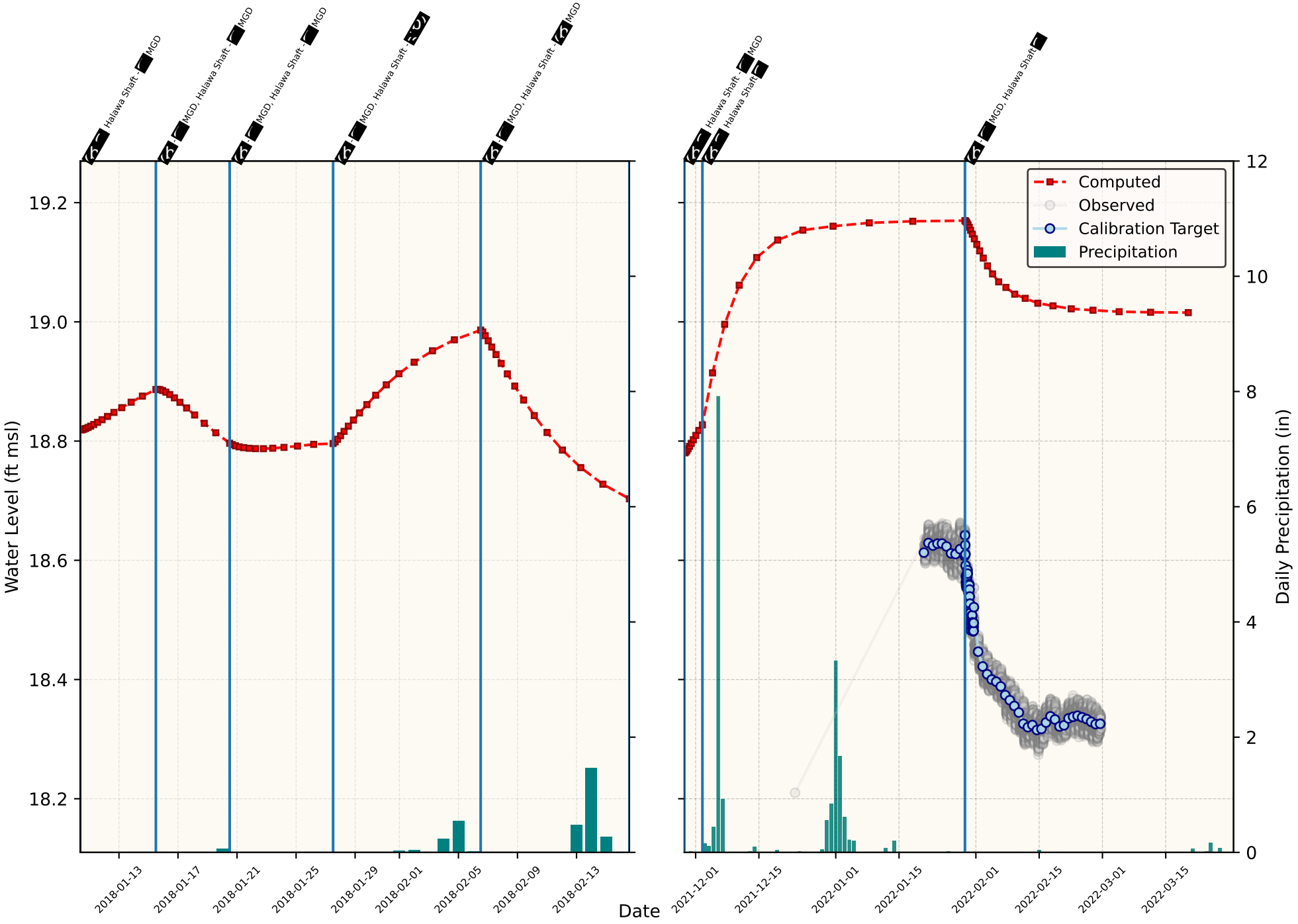

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Water Level (ft msl)
19.75
19.50
19.25
19.00
18.75
18.50
18.25
18.00
17.75
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
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2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

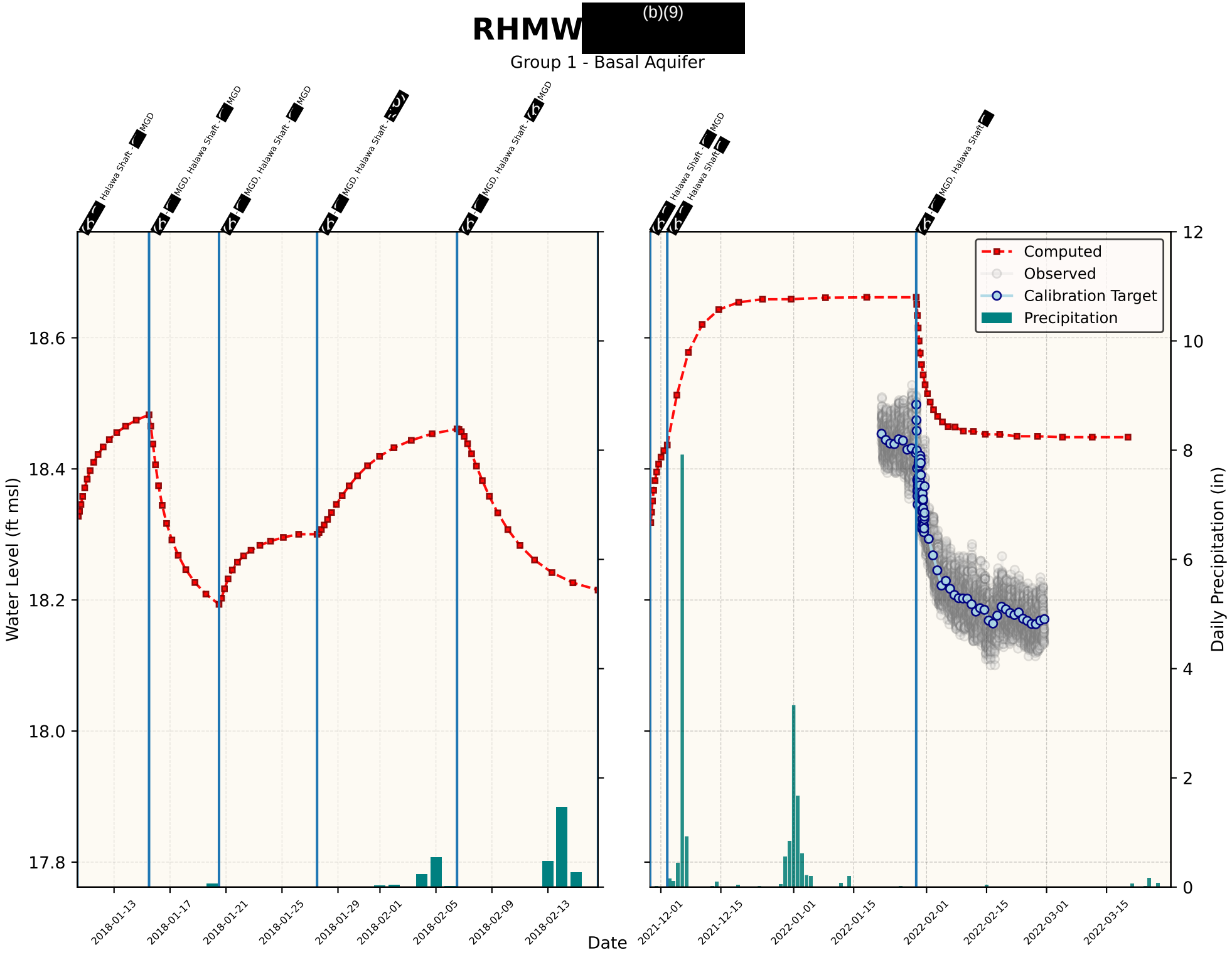

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.75
19.50
19.25
19.00
18.75
18.50
18.25
18.00
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
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2021-12-01
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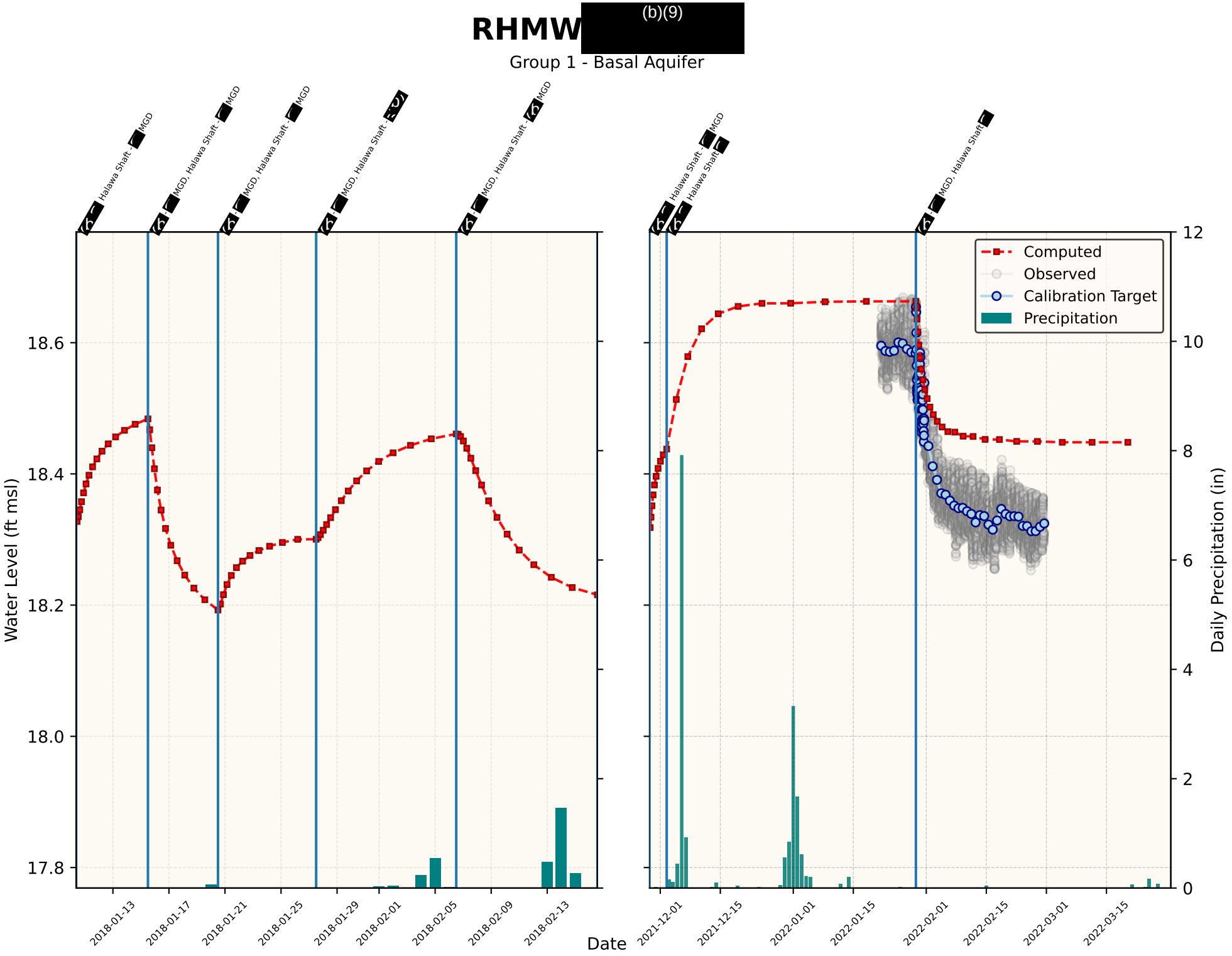

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
17.6
17.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
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2021-12-01
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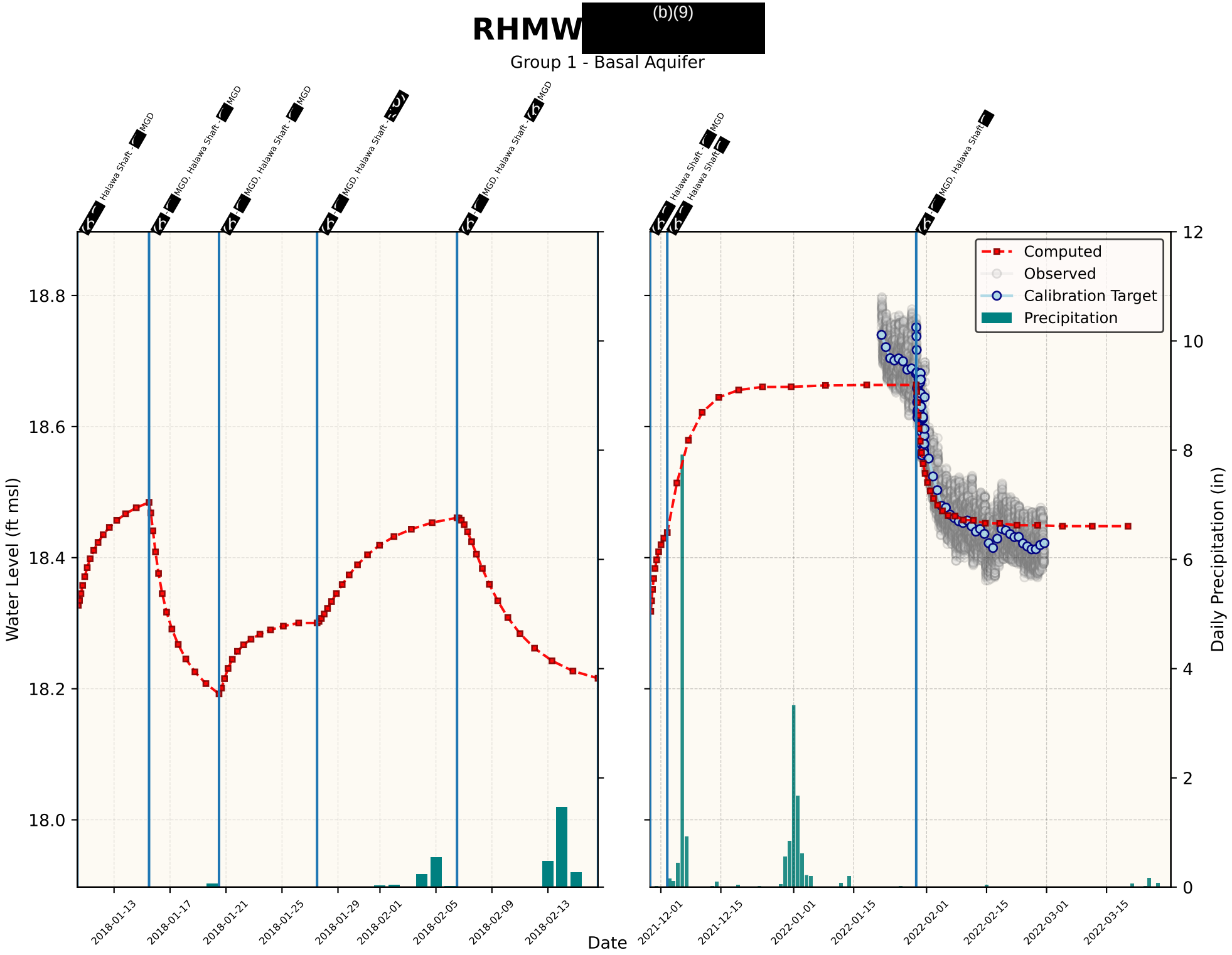
RHMW[redacted] (b)(9)

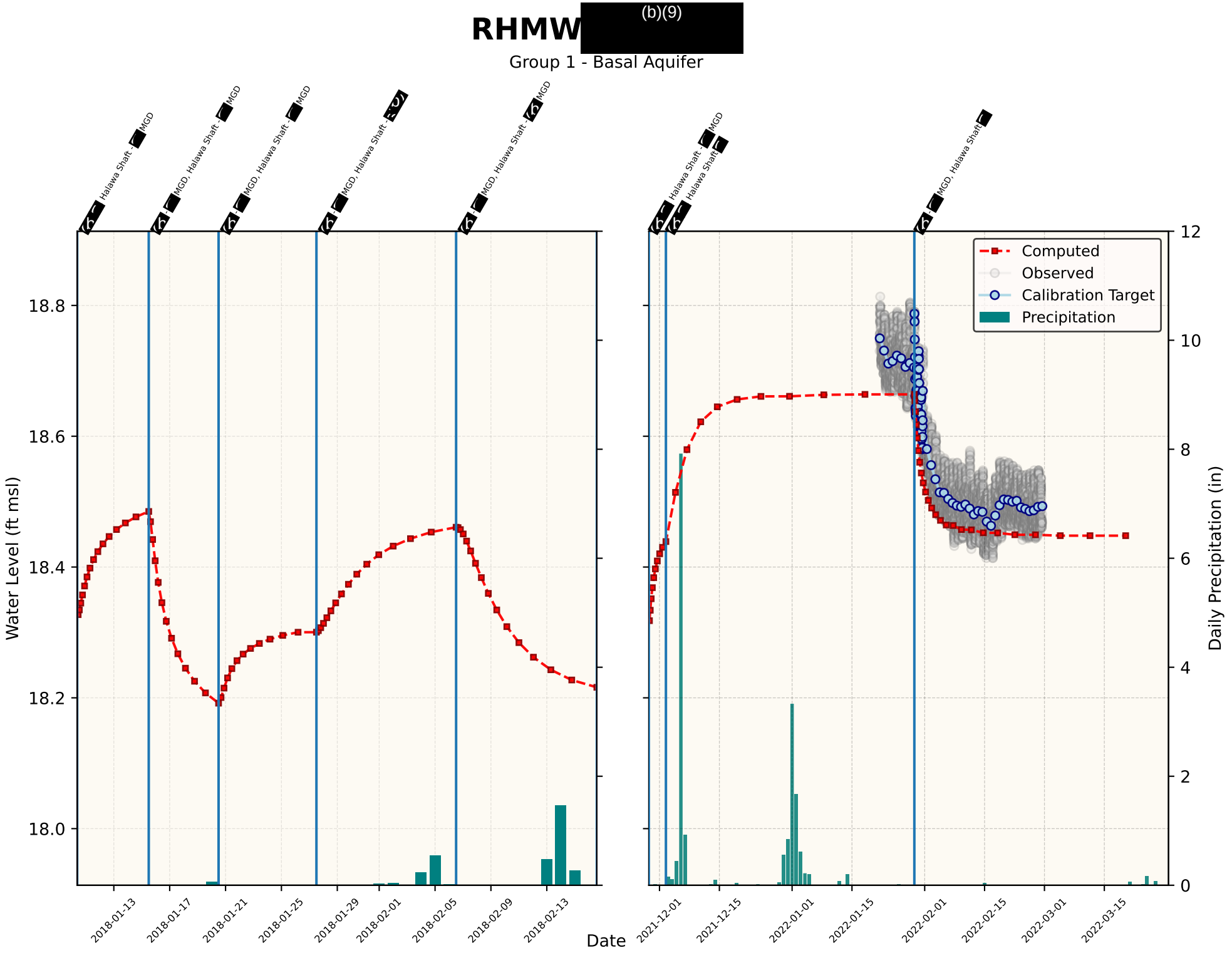
Group 1 - Basal Aquifer

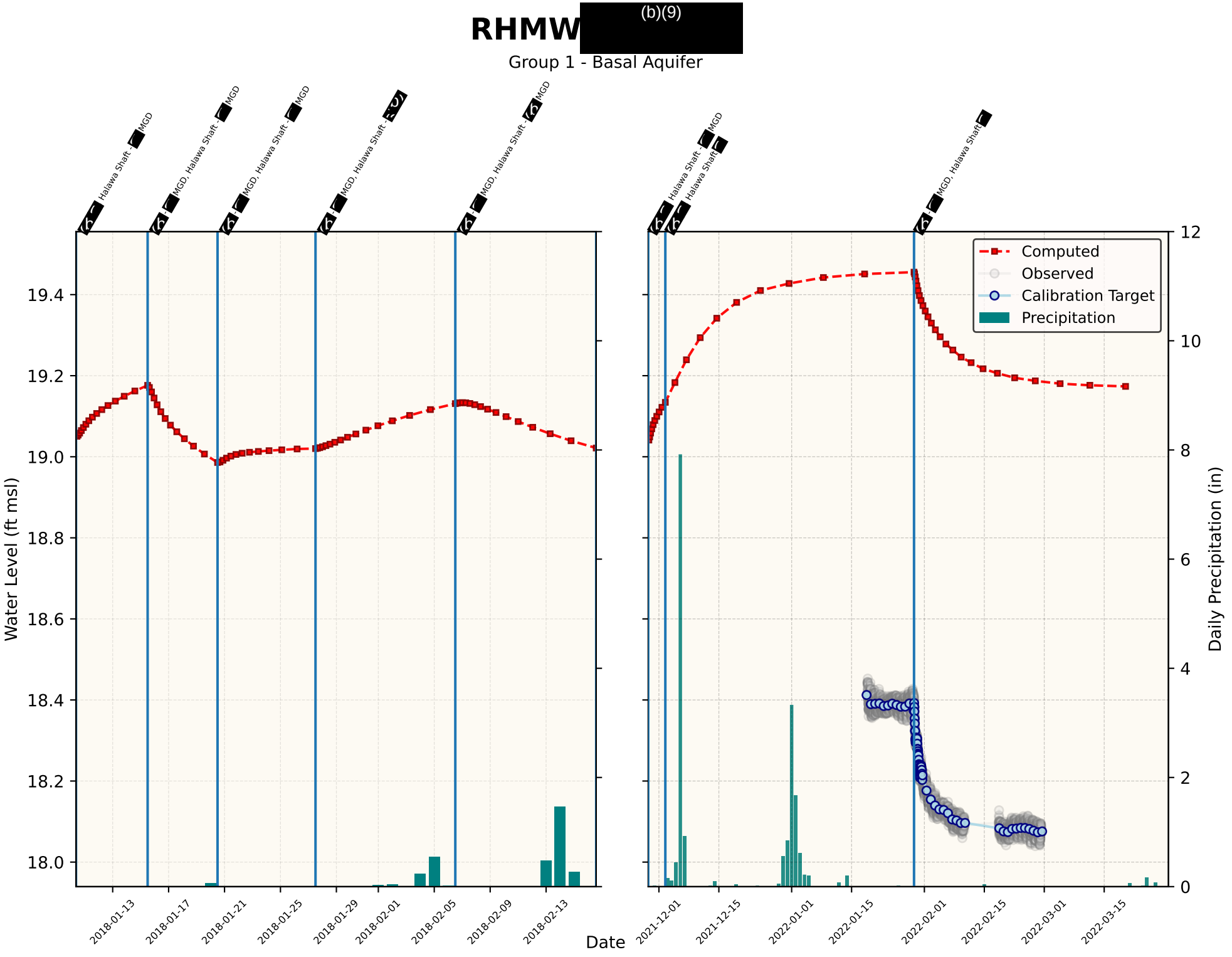


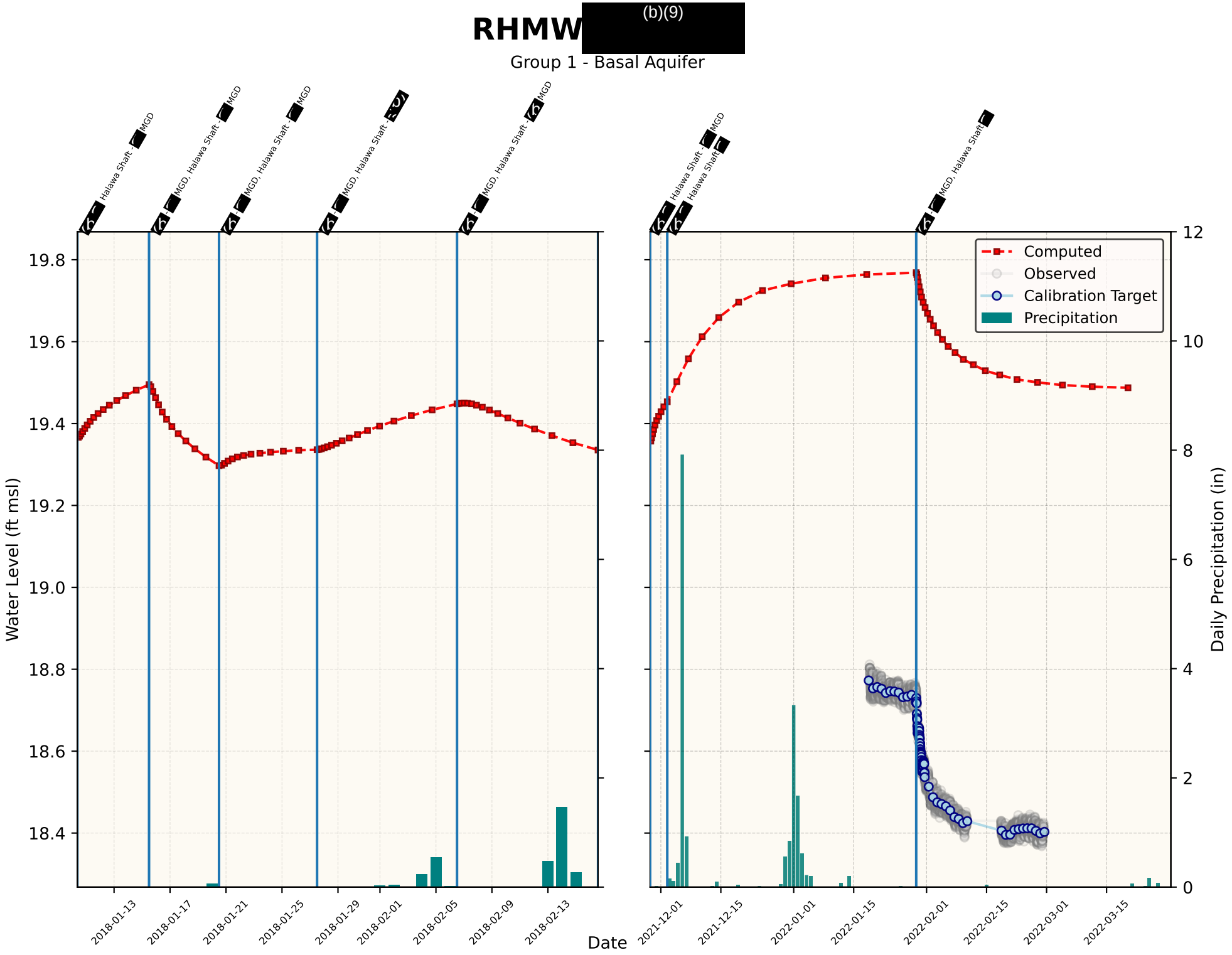

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
18.6
18.4
18.2
18.0
17.8
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
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2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

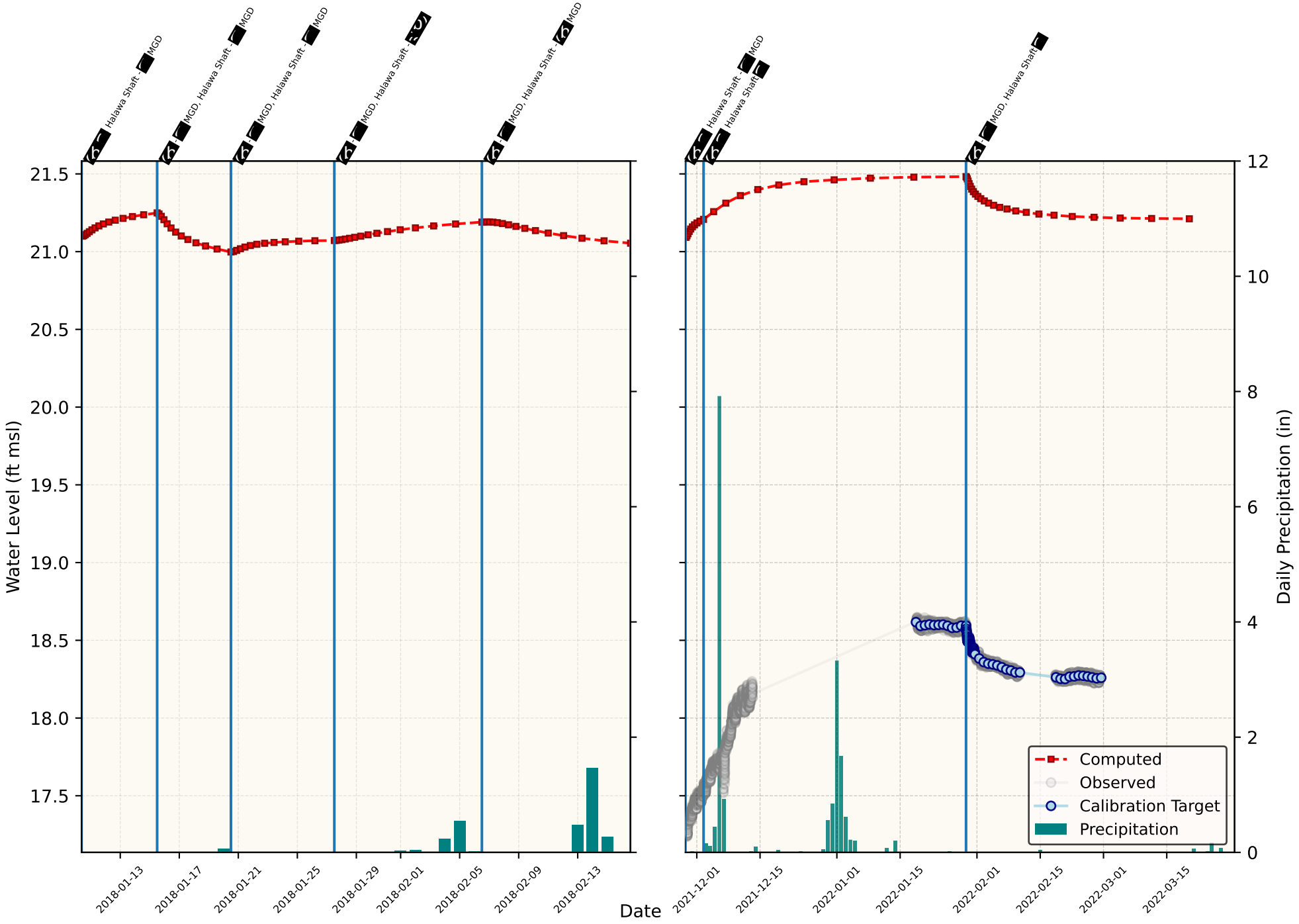

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
18.8
18.6
18.4
18.2
18.0
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date

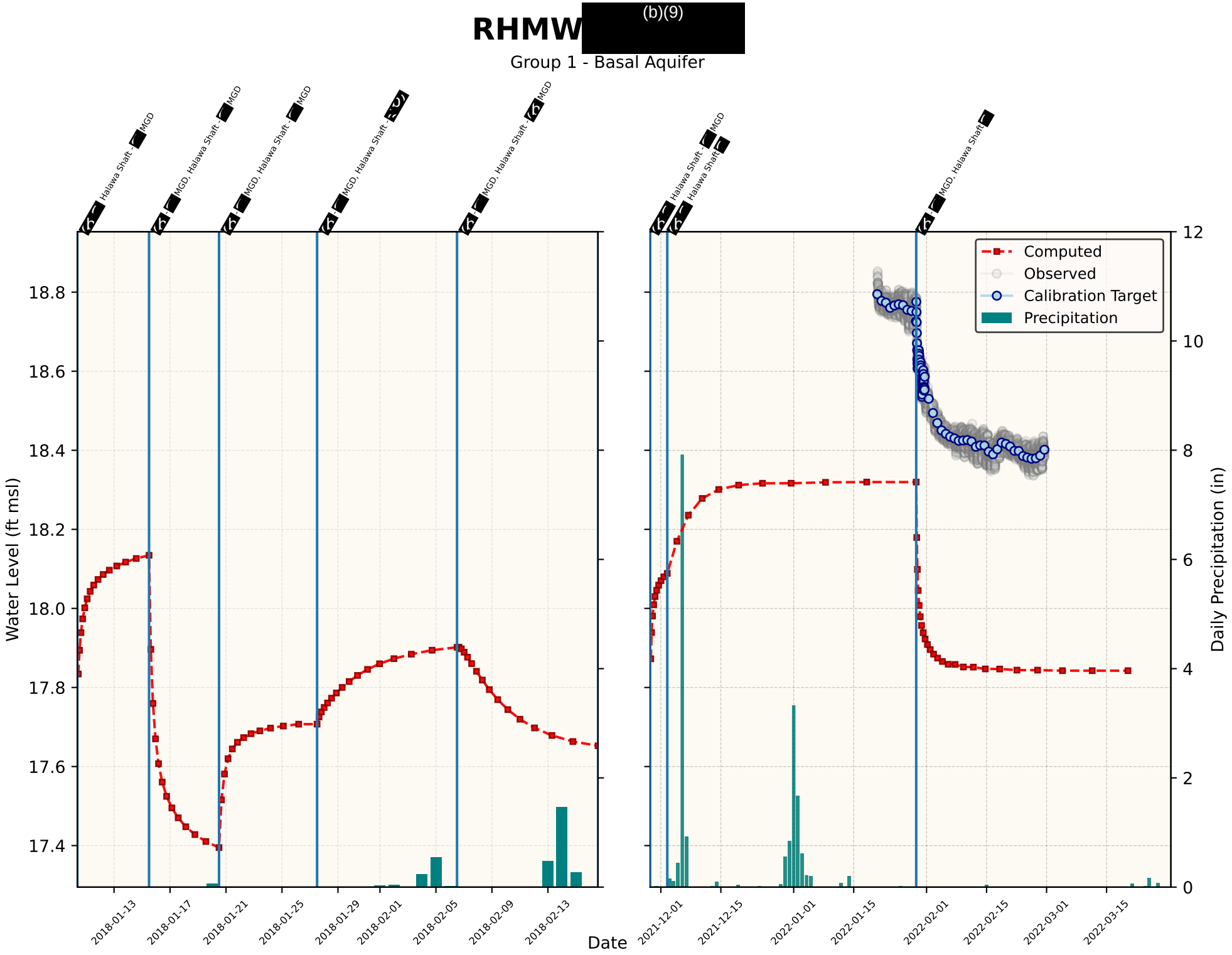

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.4
19.2
19.0
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

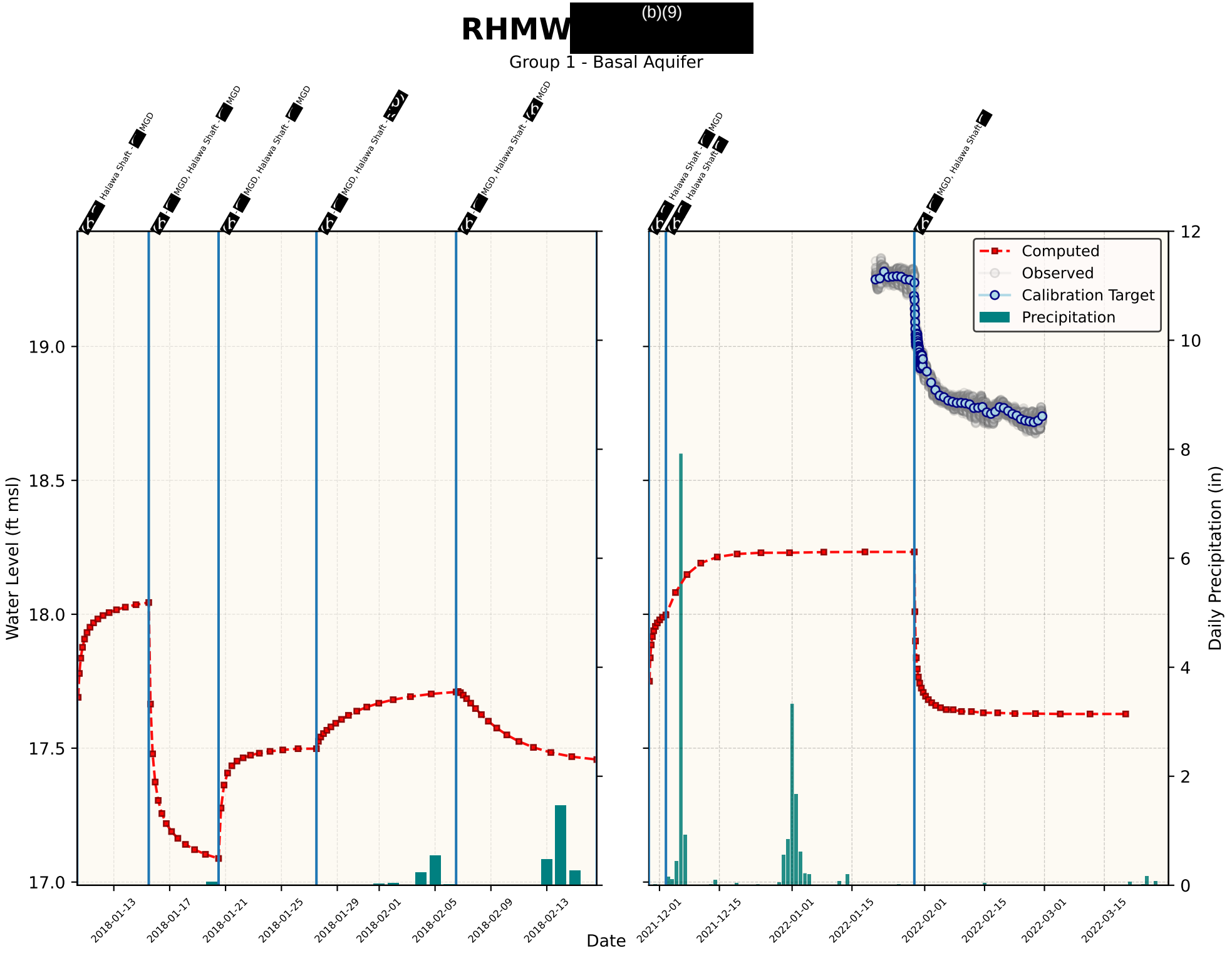

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.8
19.6
19.4
19.2
19.0
18.8
18.6
18.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

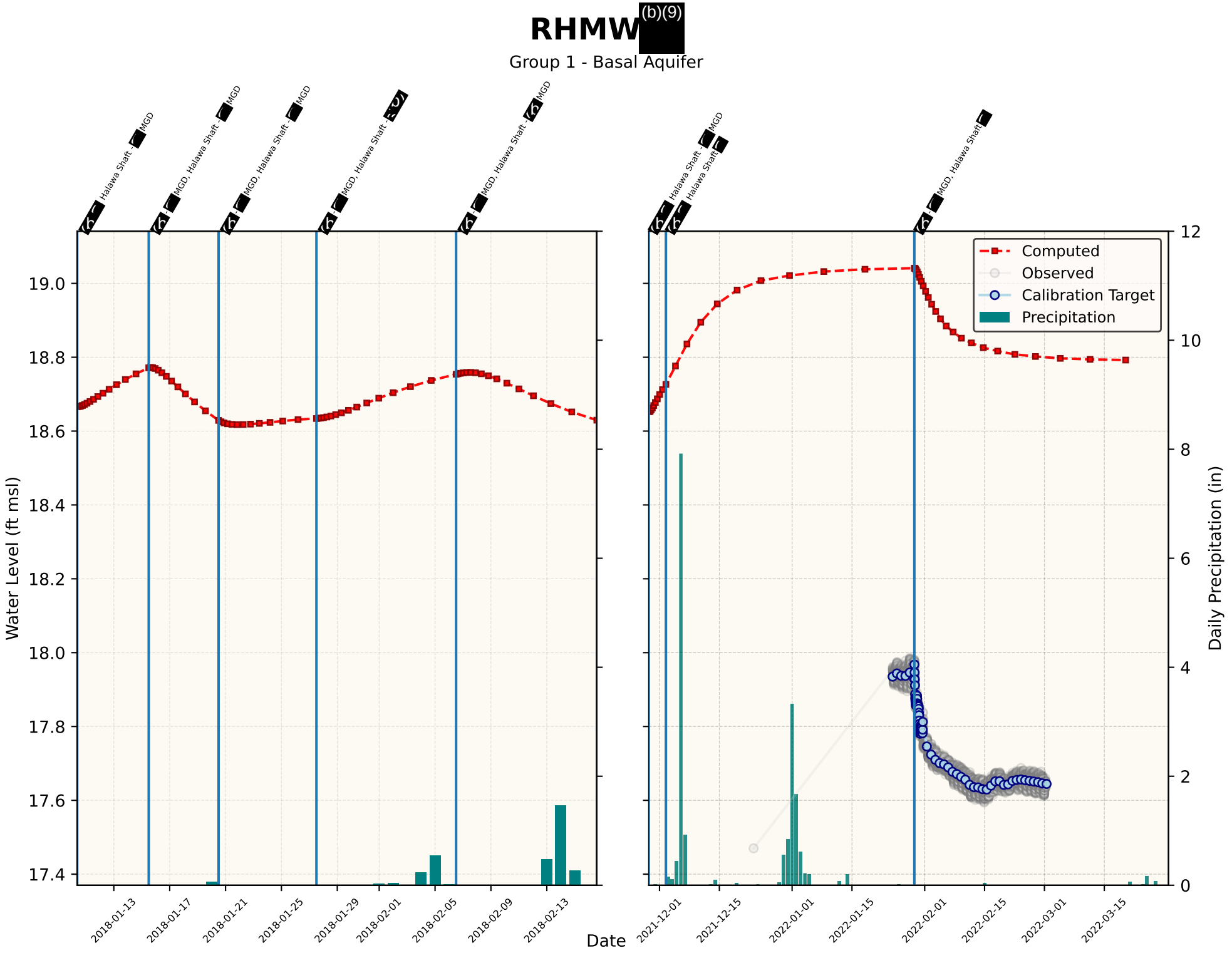
RHMW [redacted] (b)(9)

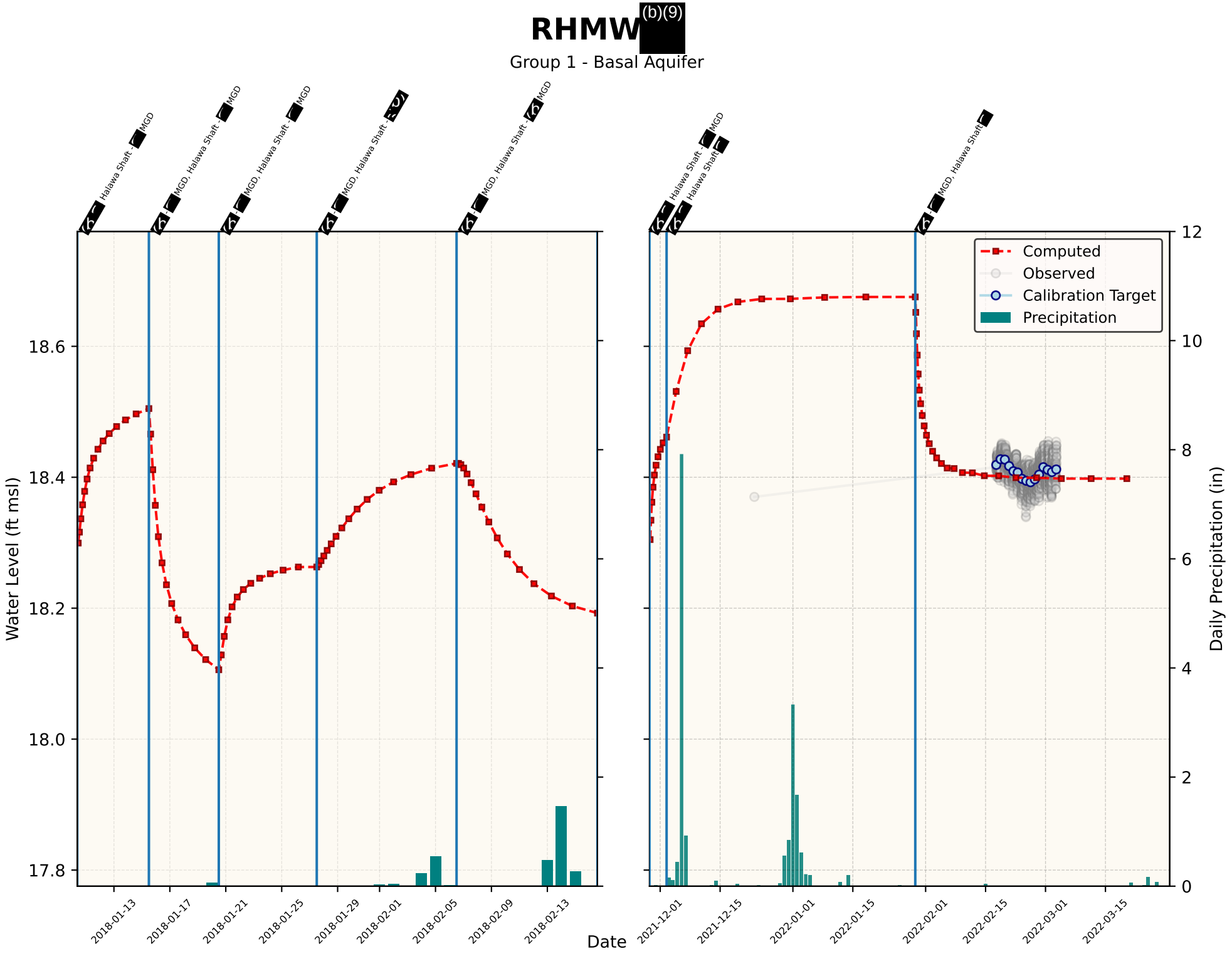
Group 1 - Basal Aquifer




RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
17.6
17.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

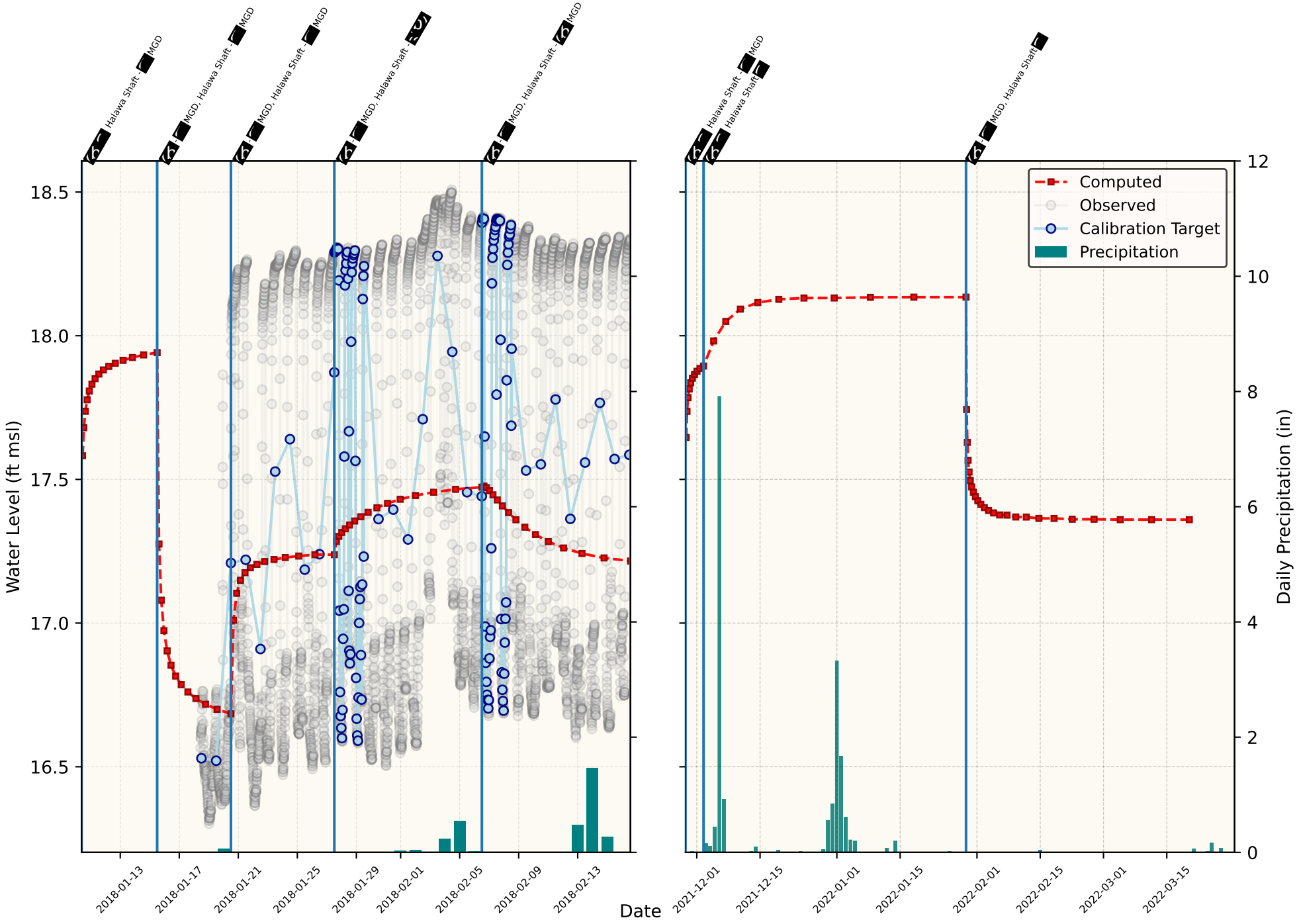

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.5
18.0
17.5
17.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

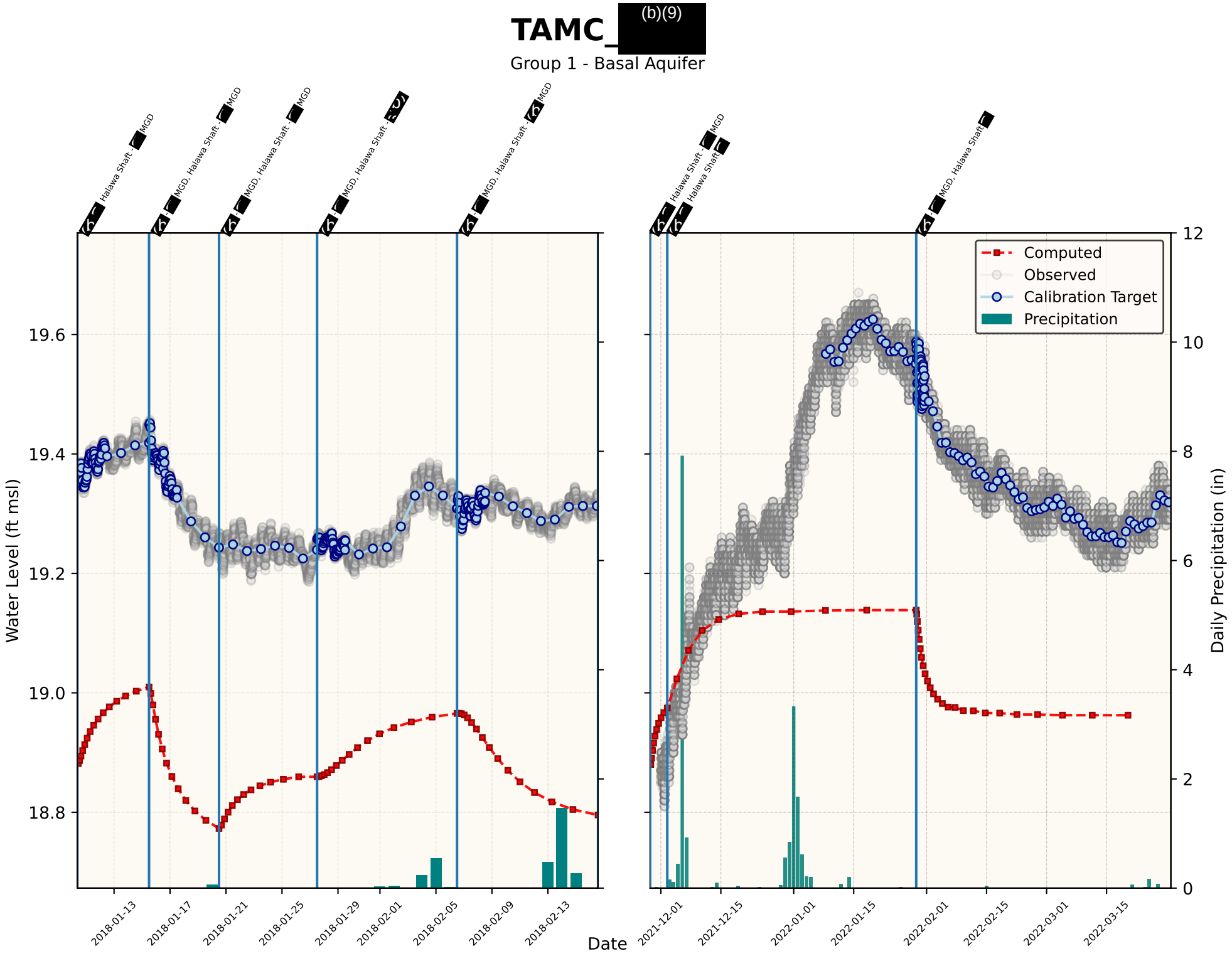

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
18.0
17.8
17.6
17.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

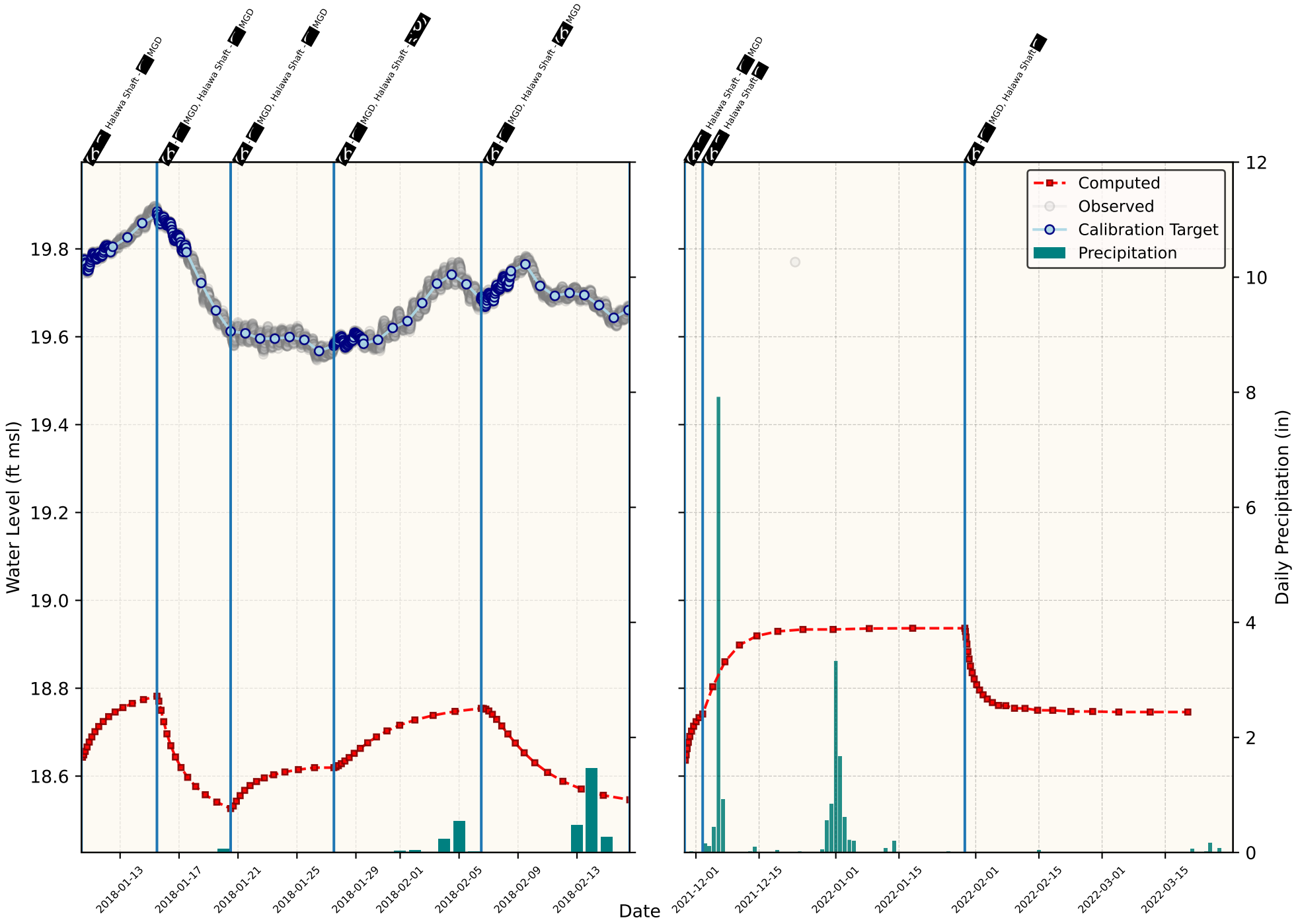

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

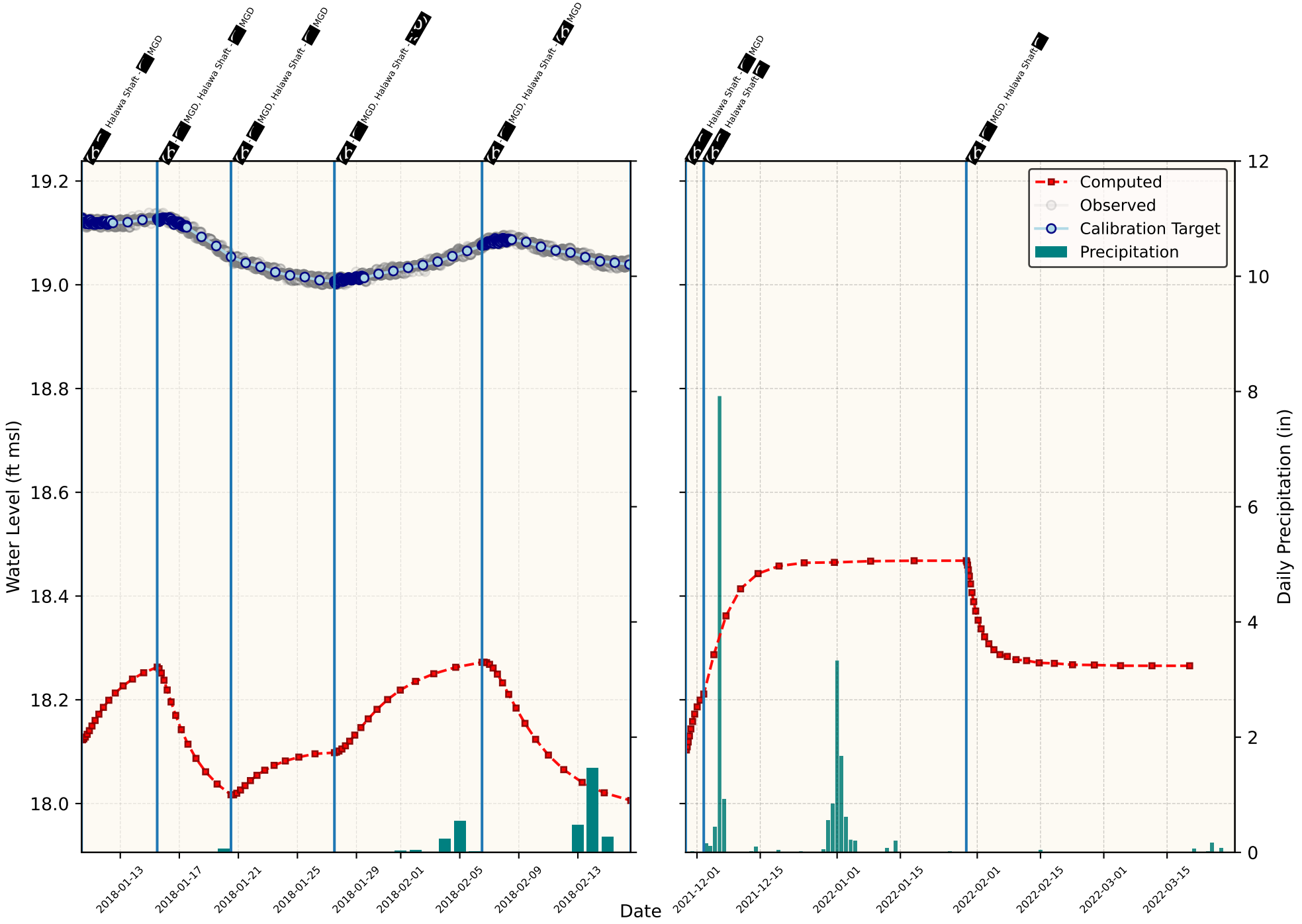
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



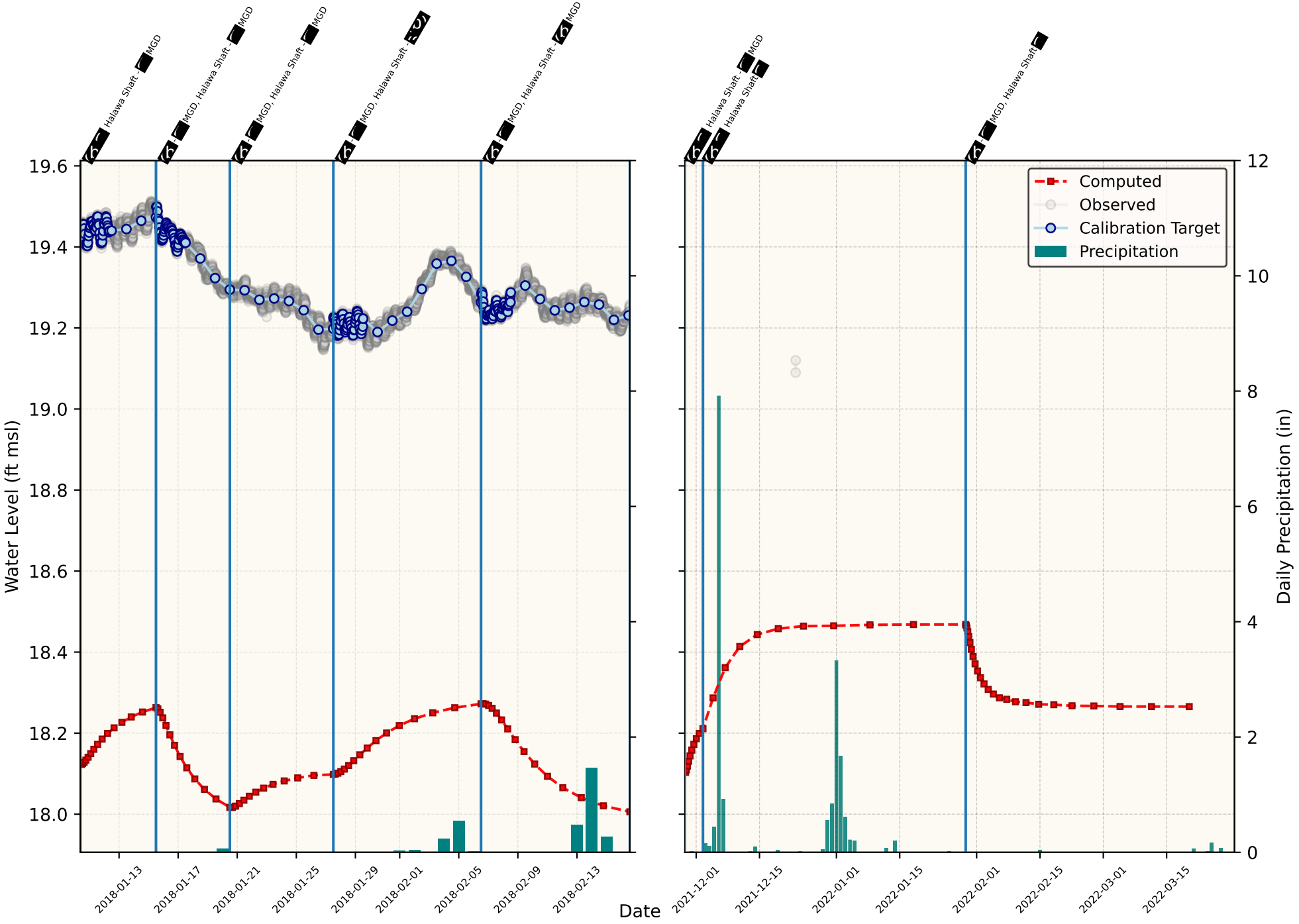

TAMC_ (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.6
19.4
19.2
19.0
18.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

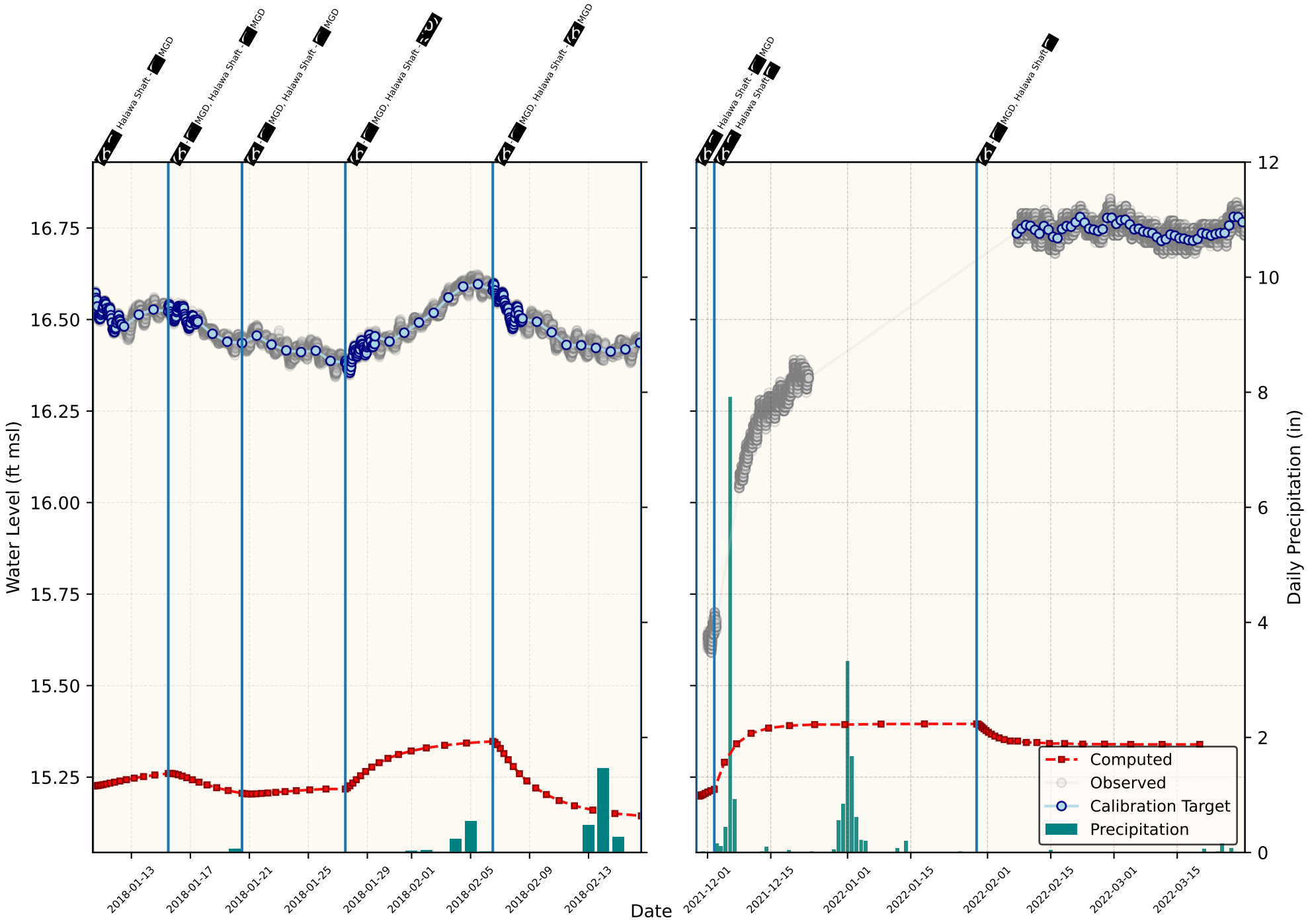

DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.8
19.6
19.4
19.2
19.0
18.8
18.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.2
19.0
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

Halawa_Deep_Monitor_Well_HDMW2253-03

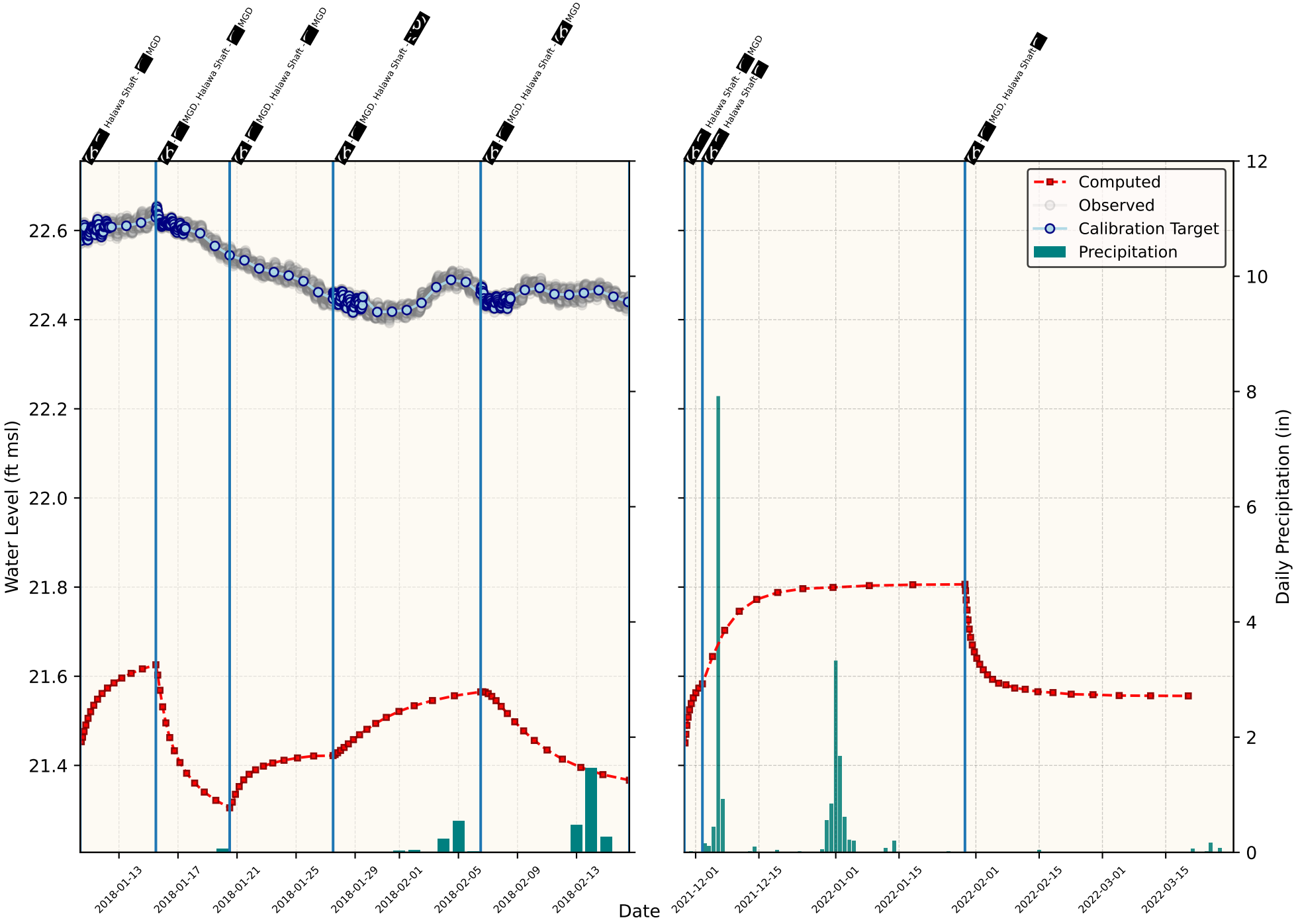
Group 2 - Deep Basal Wells




Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
16.75
16.50
16.25
16.00
15.75
15.50
15.25
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

RHMW[redacted] (b)(9)

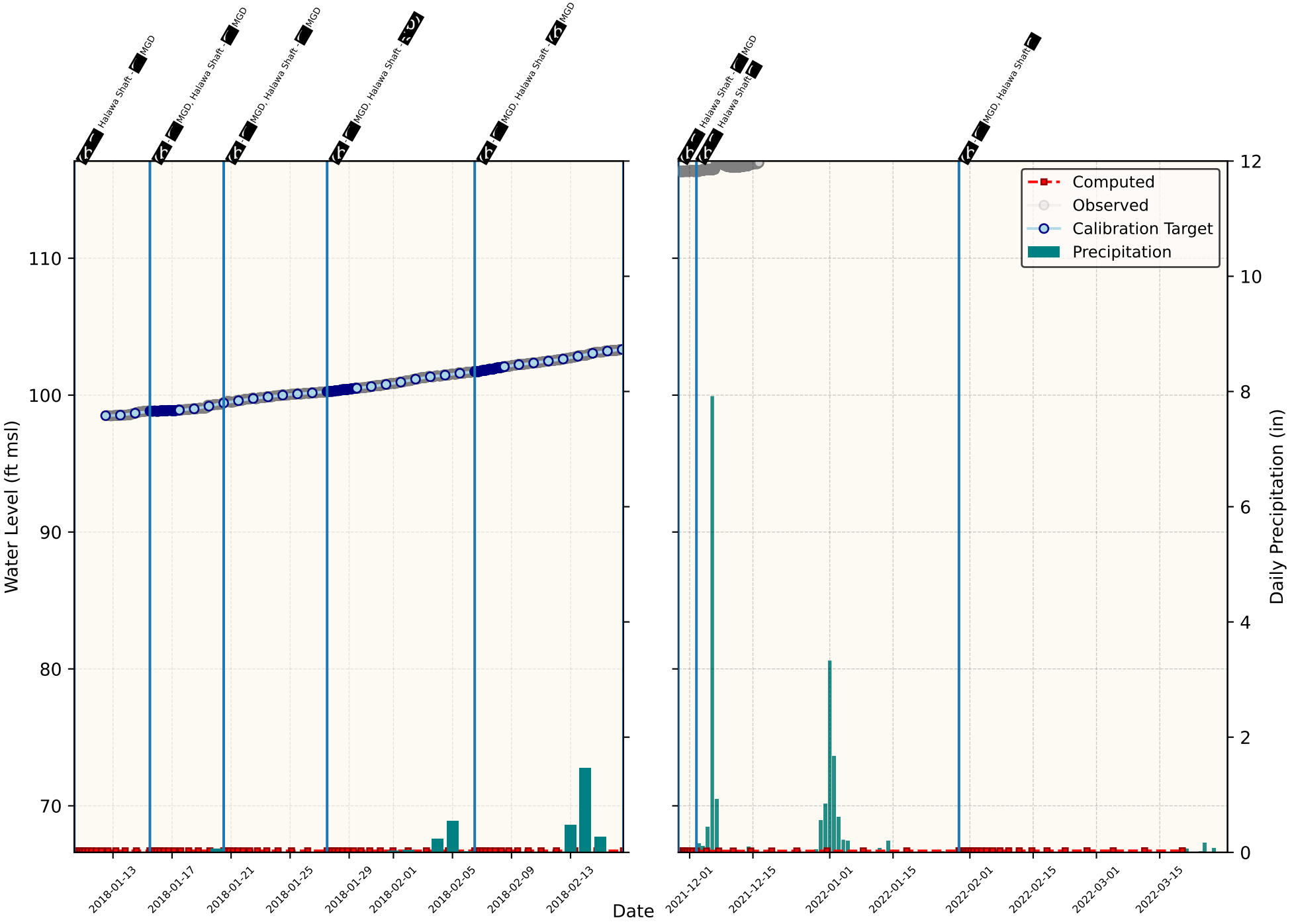
Group 3 - Saprolite/Confining Unit Well with Elevated Head

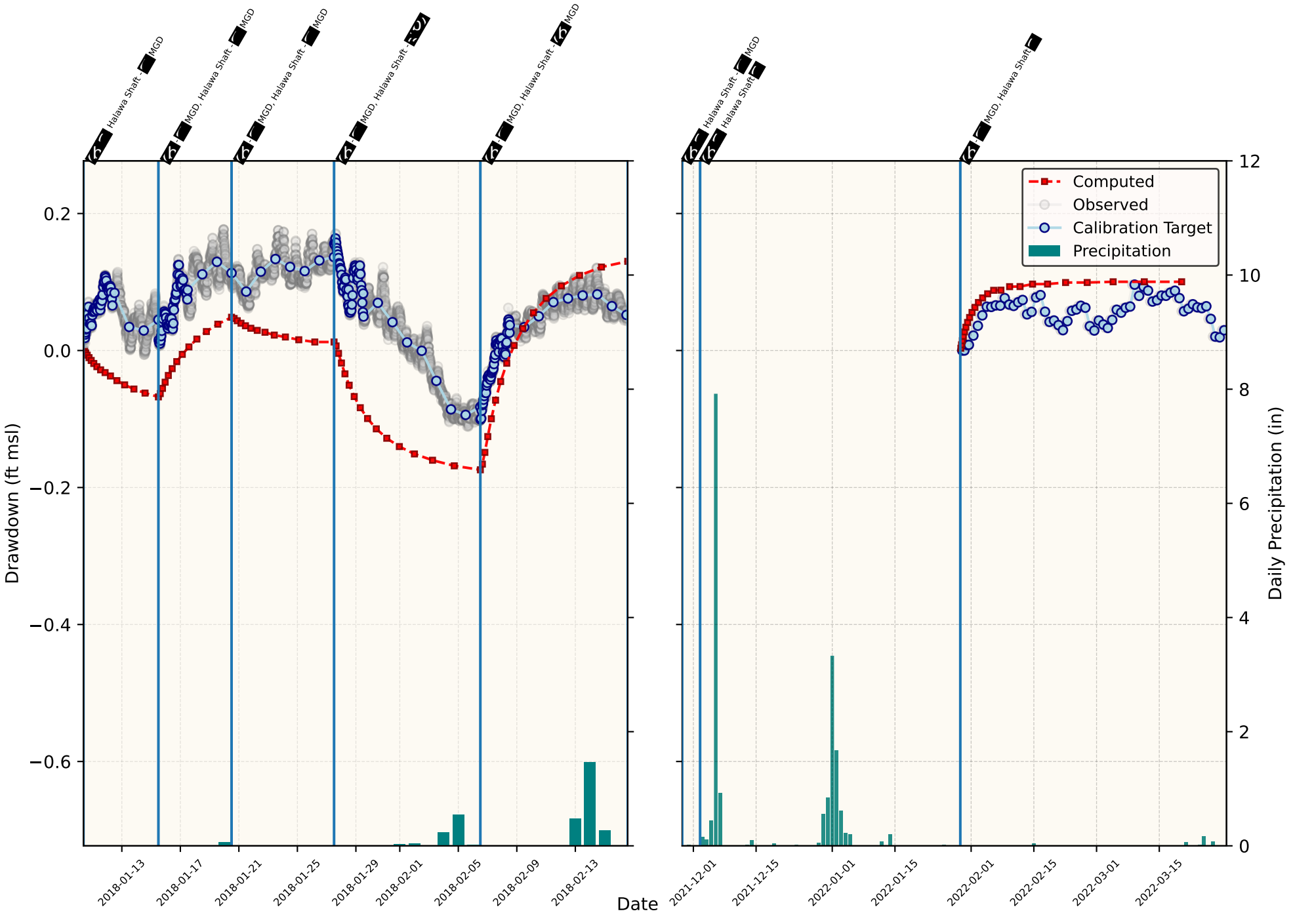


RHMW[redacted]

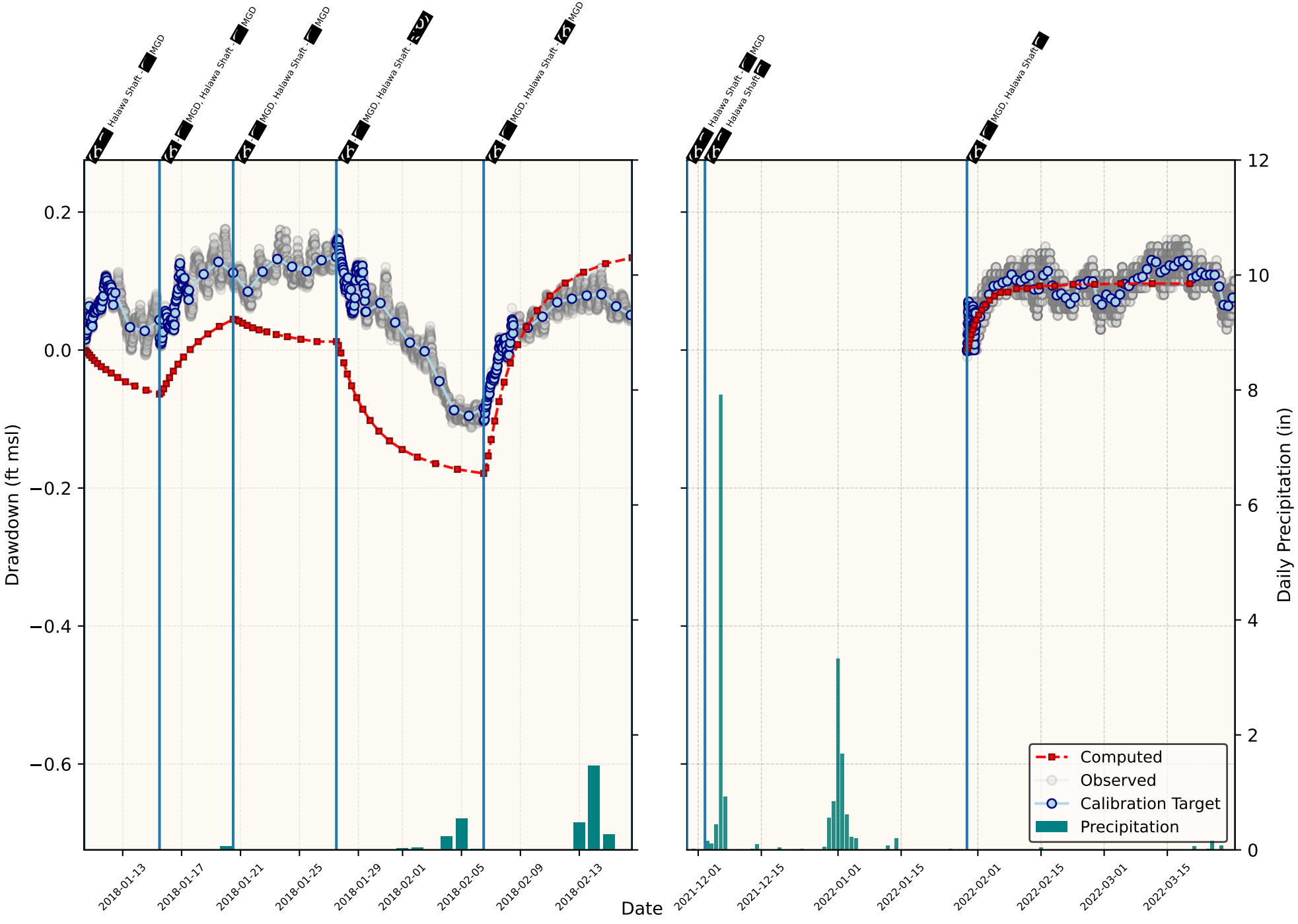
(b)(9)

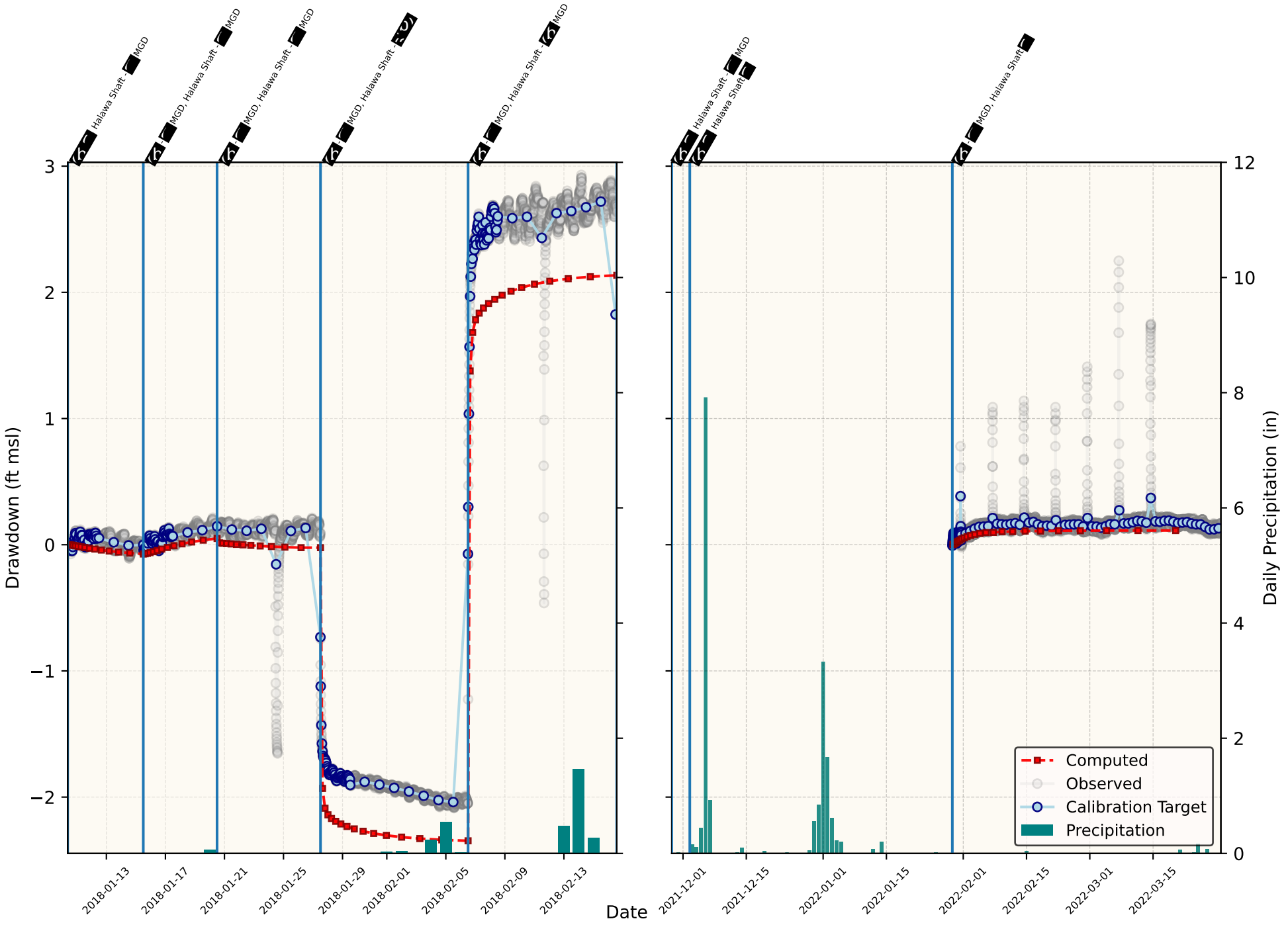
Group 3 - Saprolite/Confining Unit Well with Elevated Head

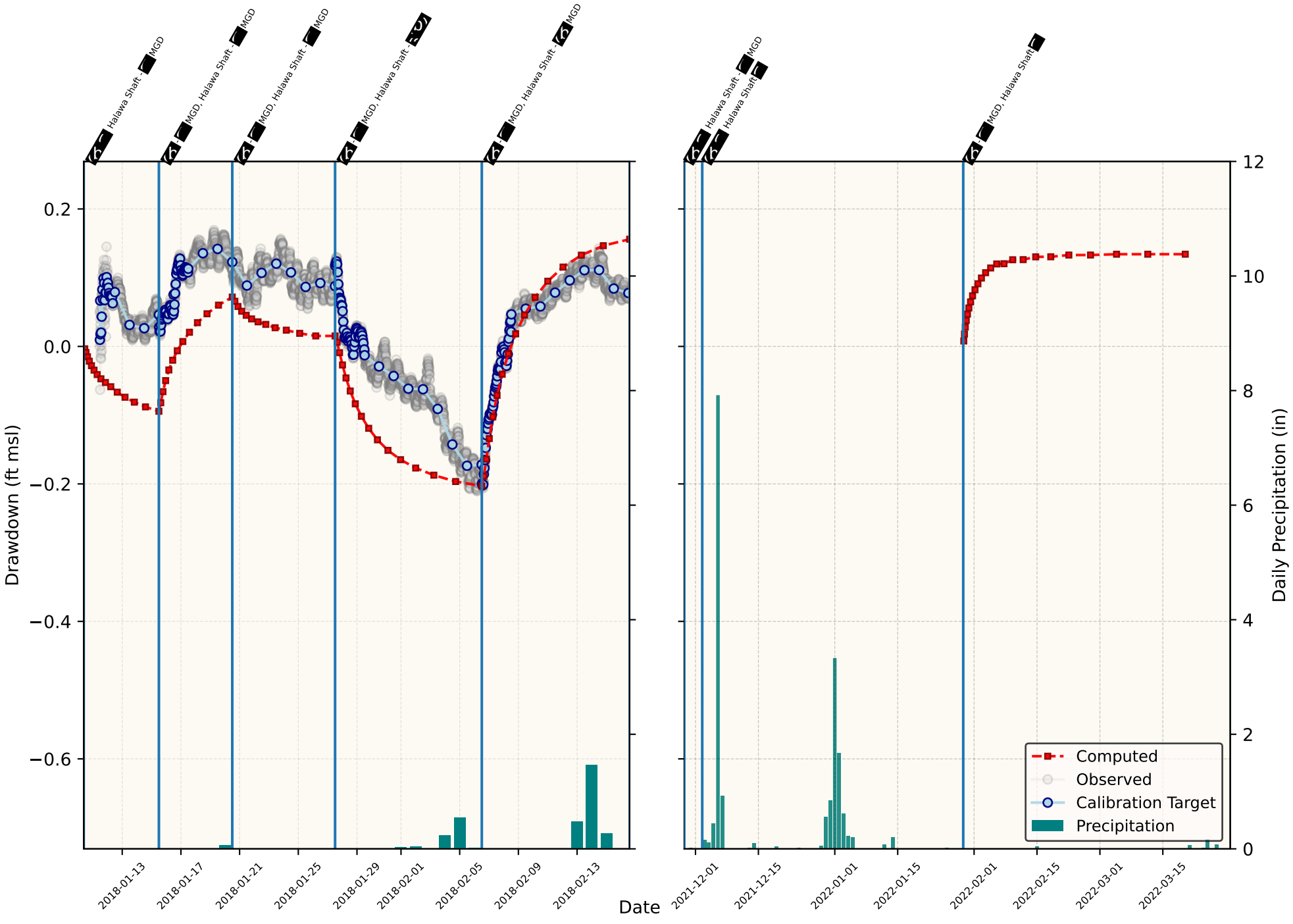


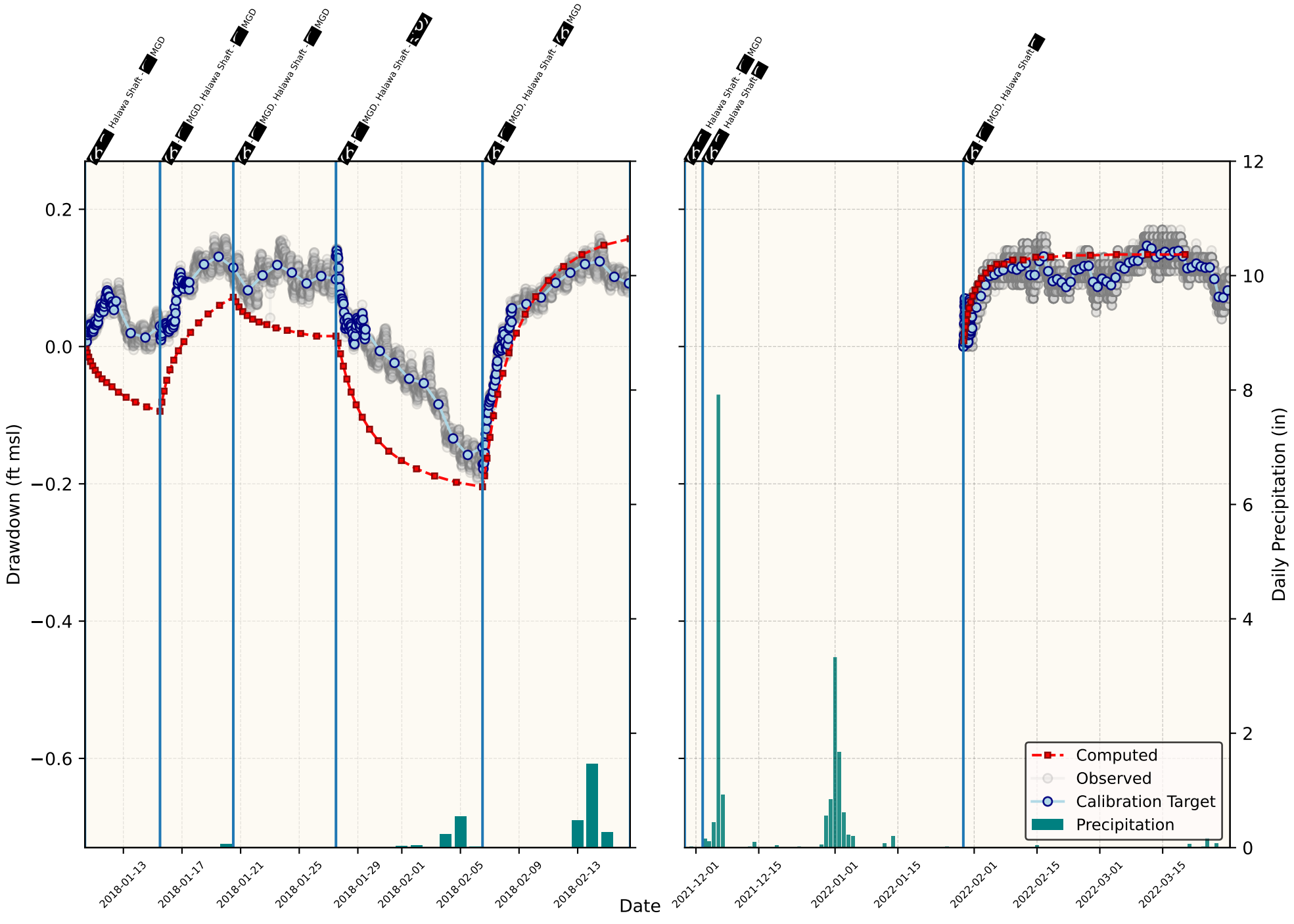

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

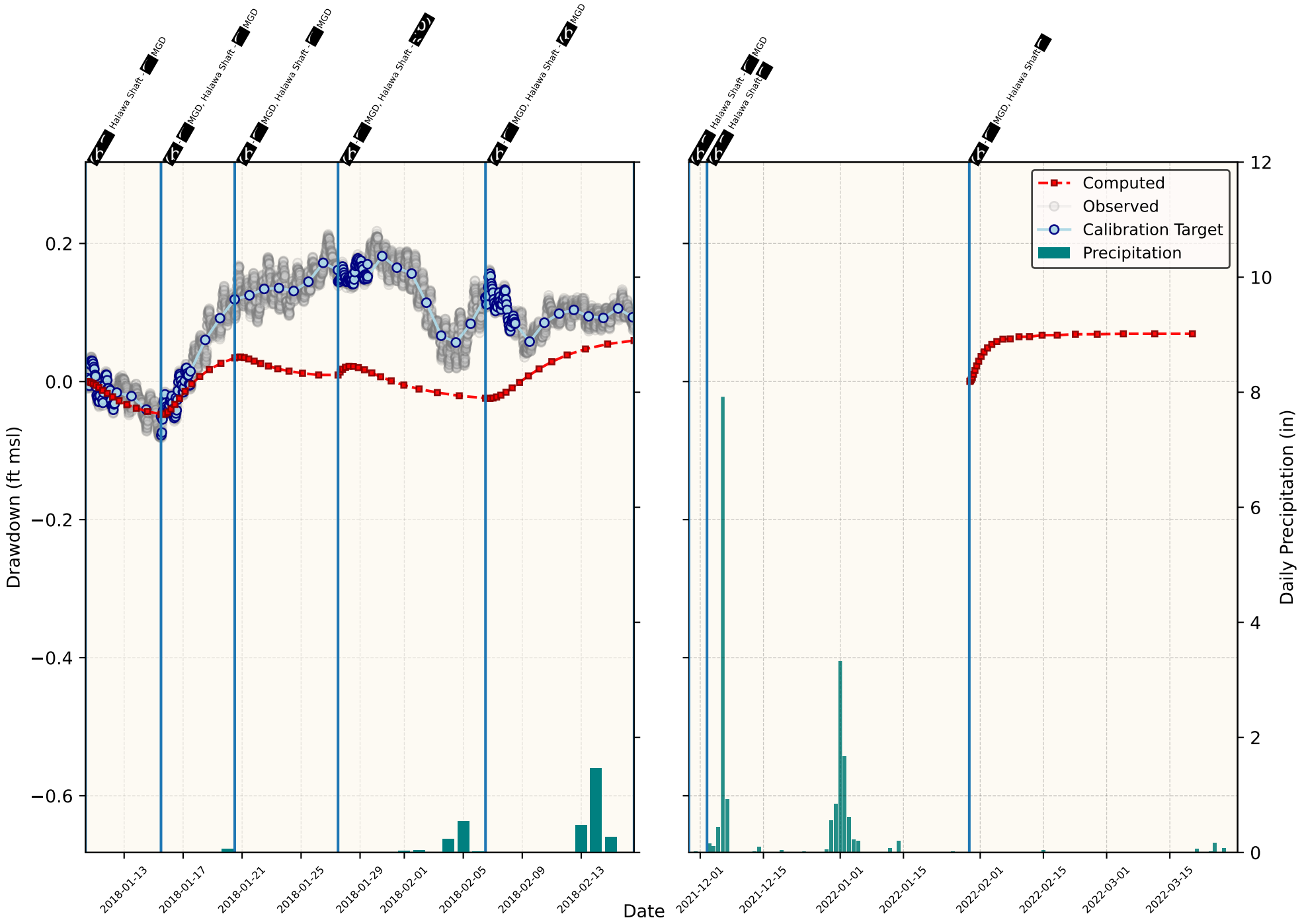
(b)(3) [redacted]

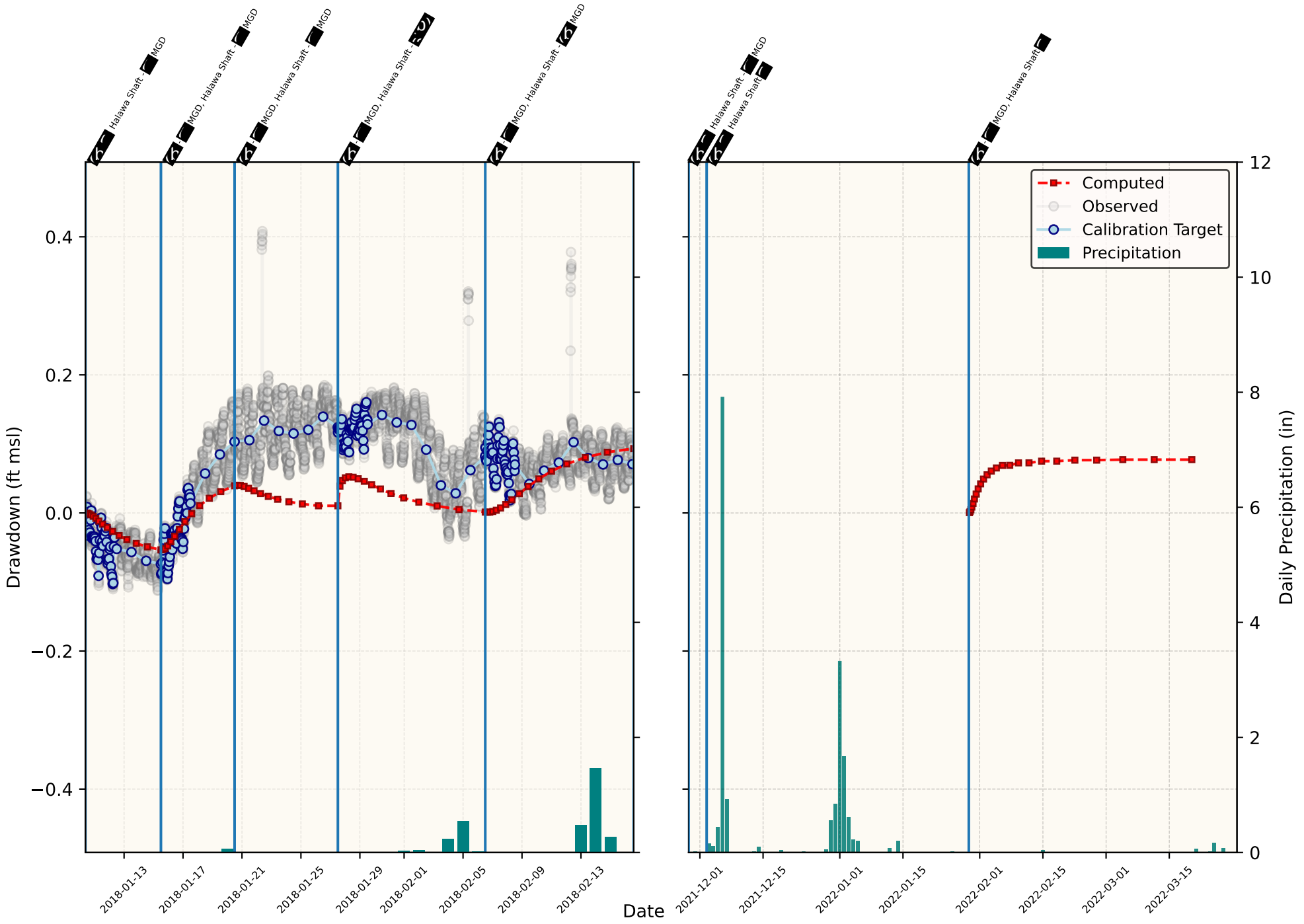

Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.2
0.0
−0.2
−0.4
−0.6
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

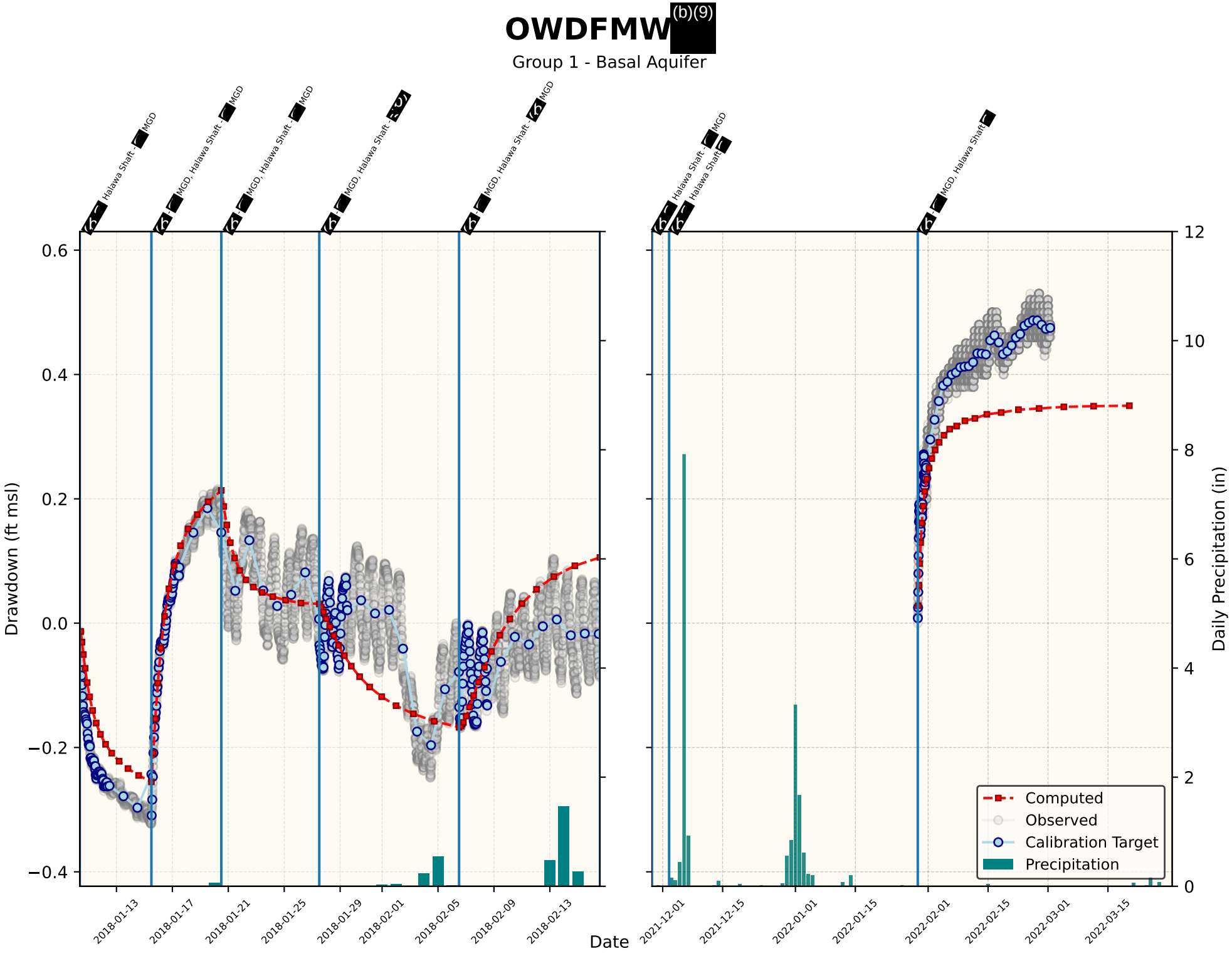

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
3
2
1
0
−1
−2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-02-15
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2022-03-15

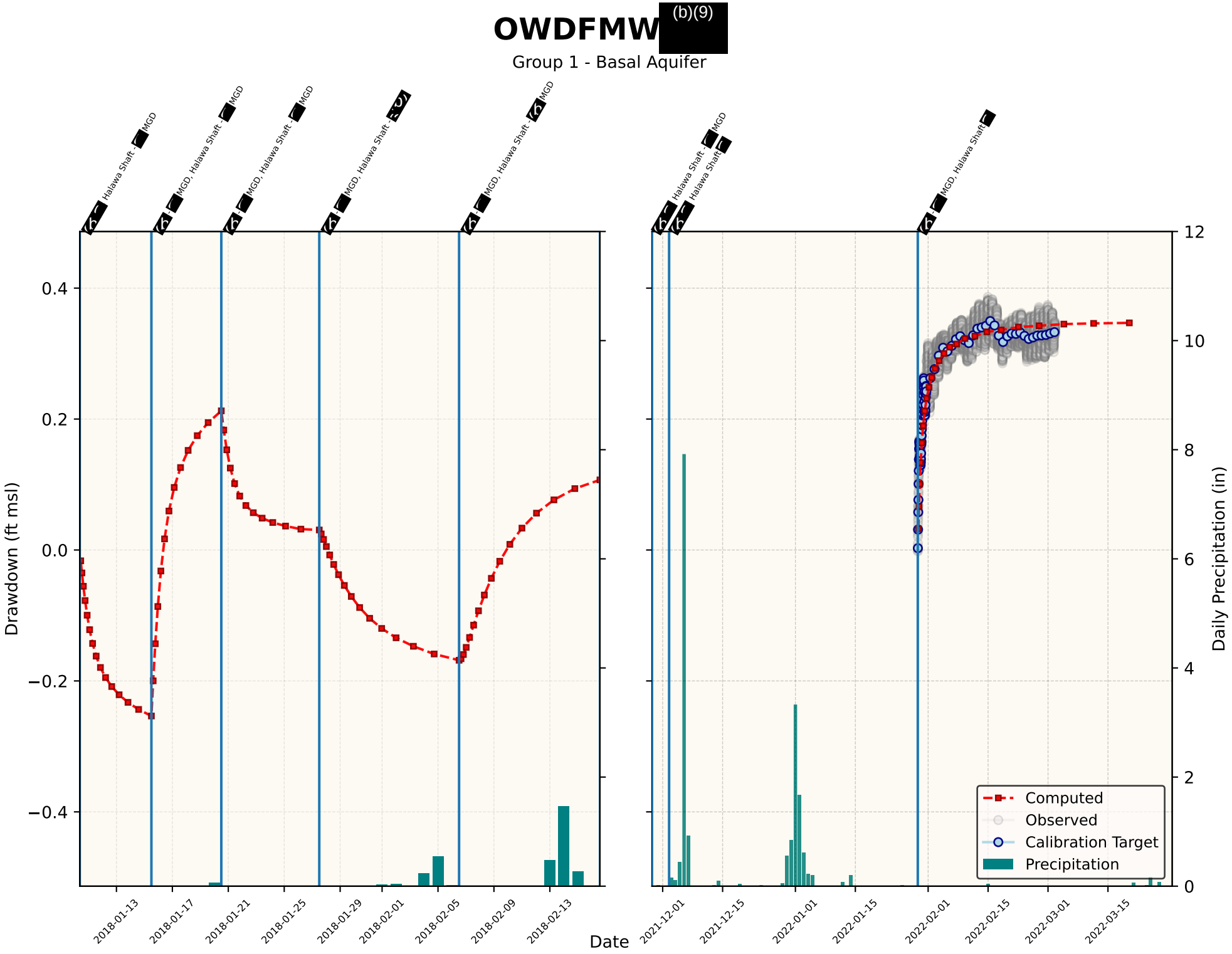

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

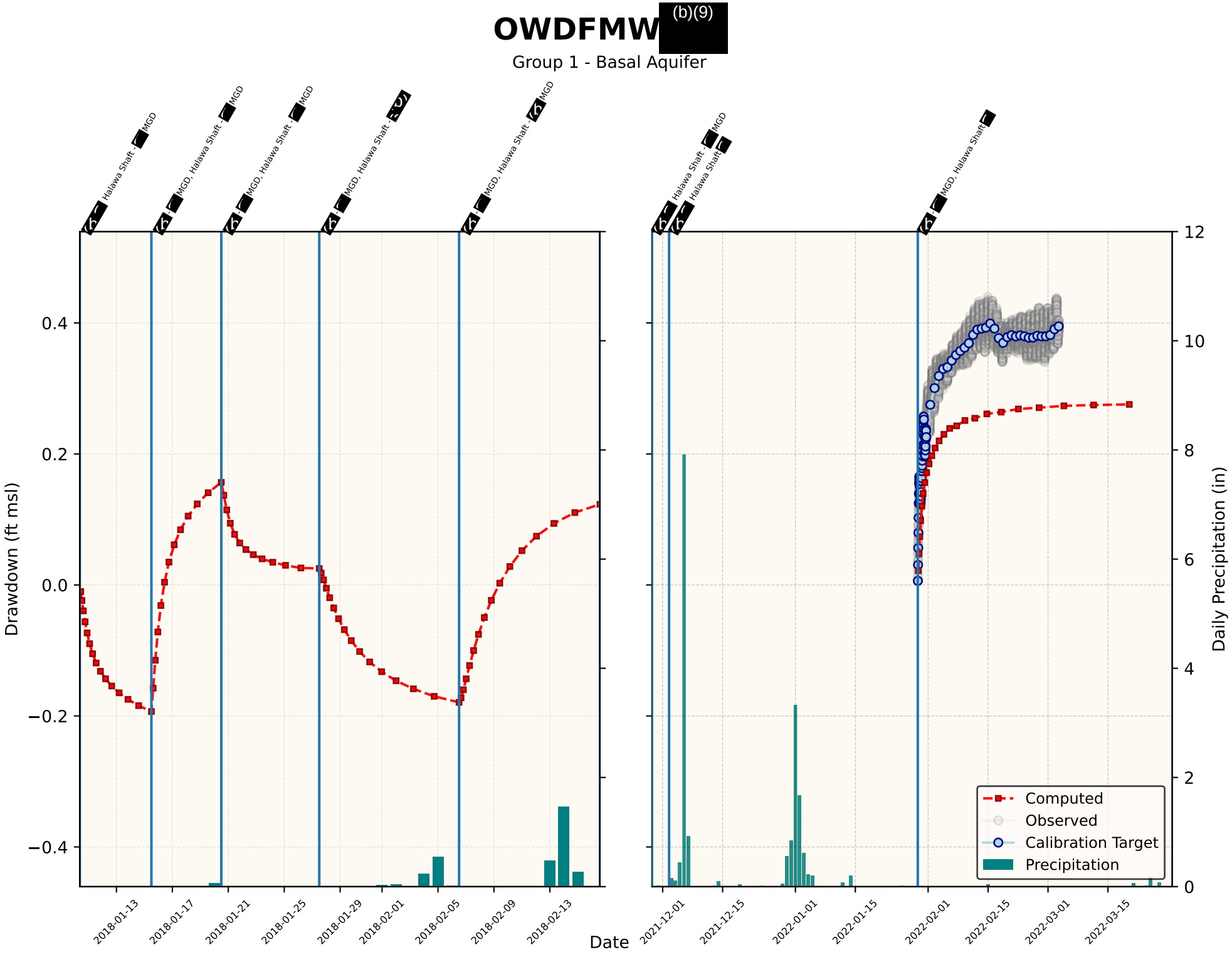

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

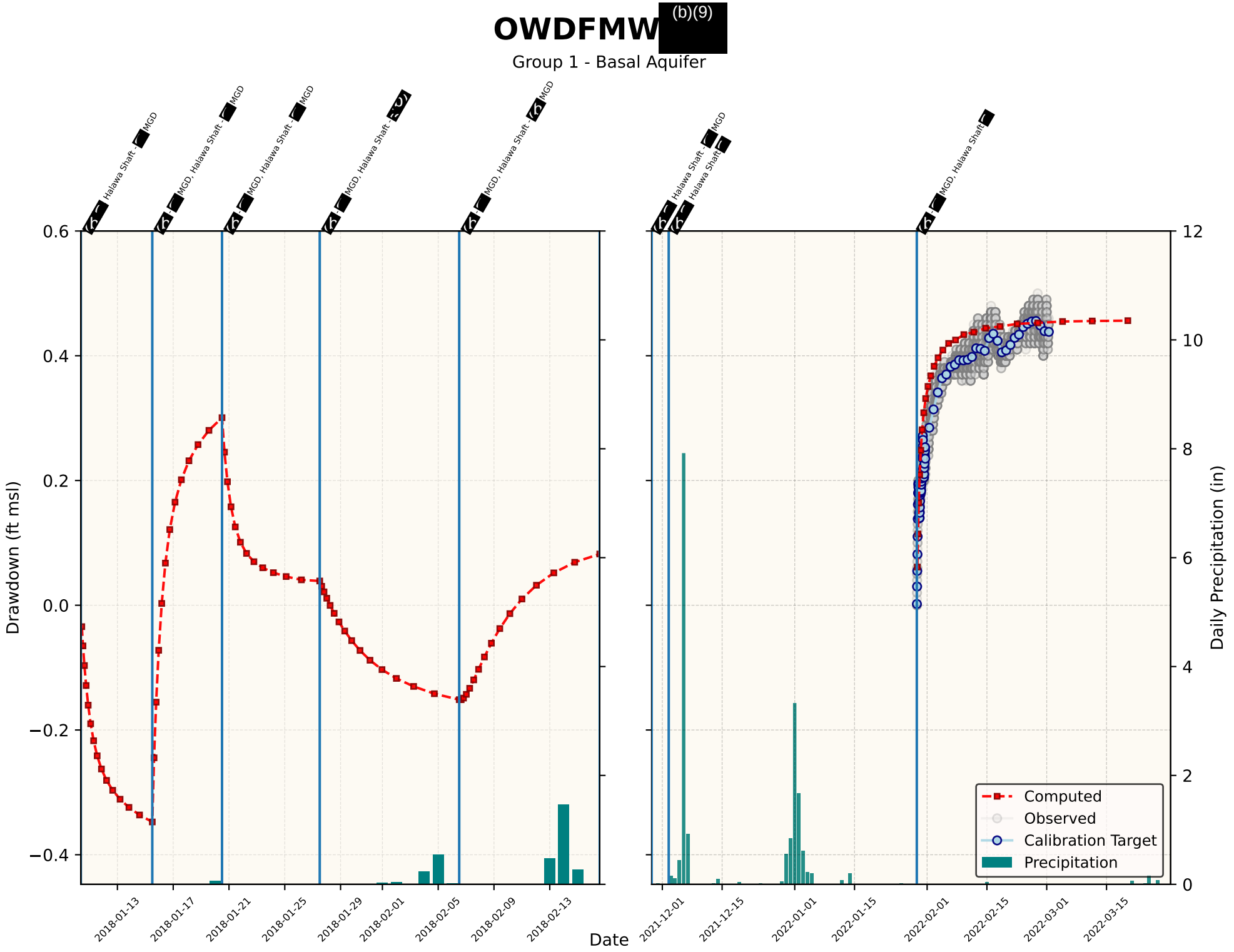

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


OWDFMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

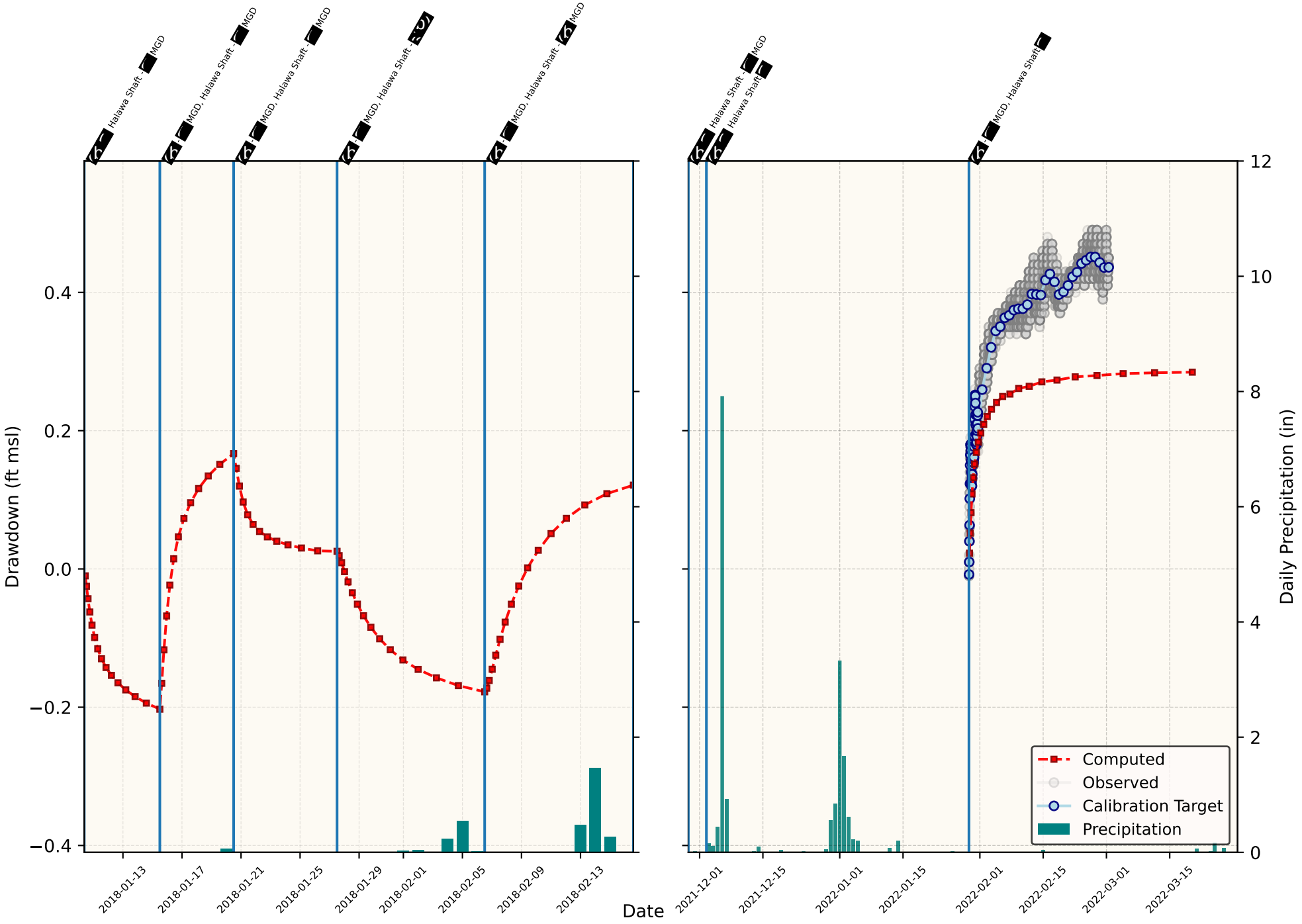

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

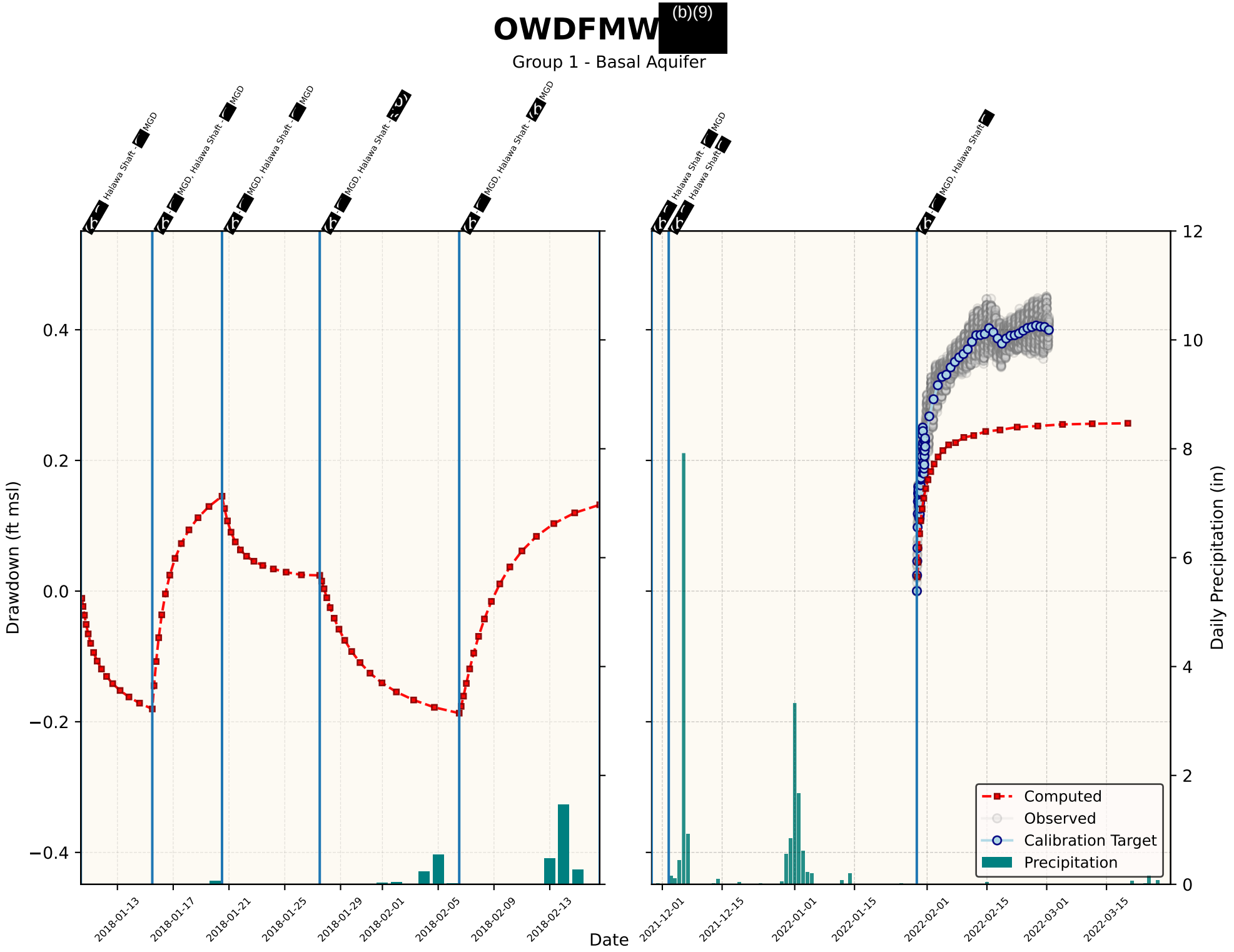

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

OWDFMW[redacted] (b)(9)

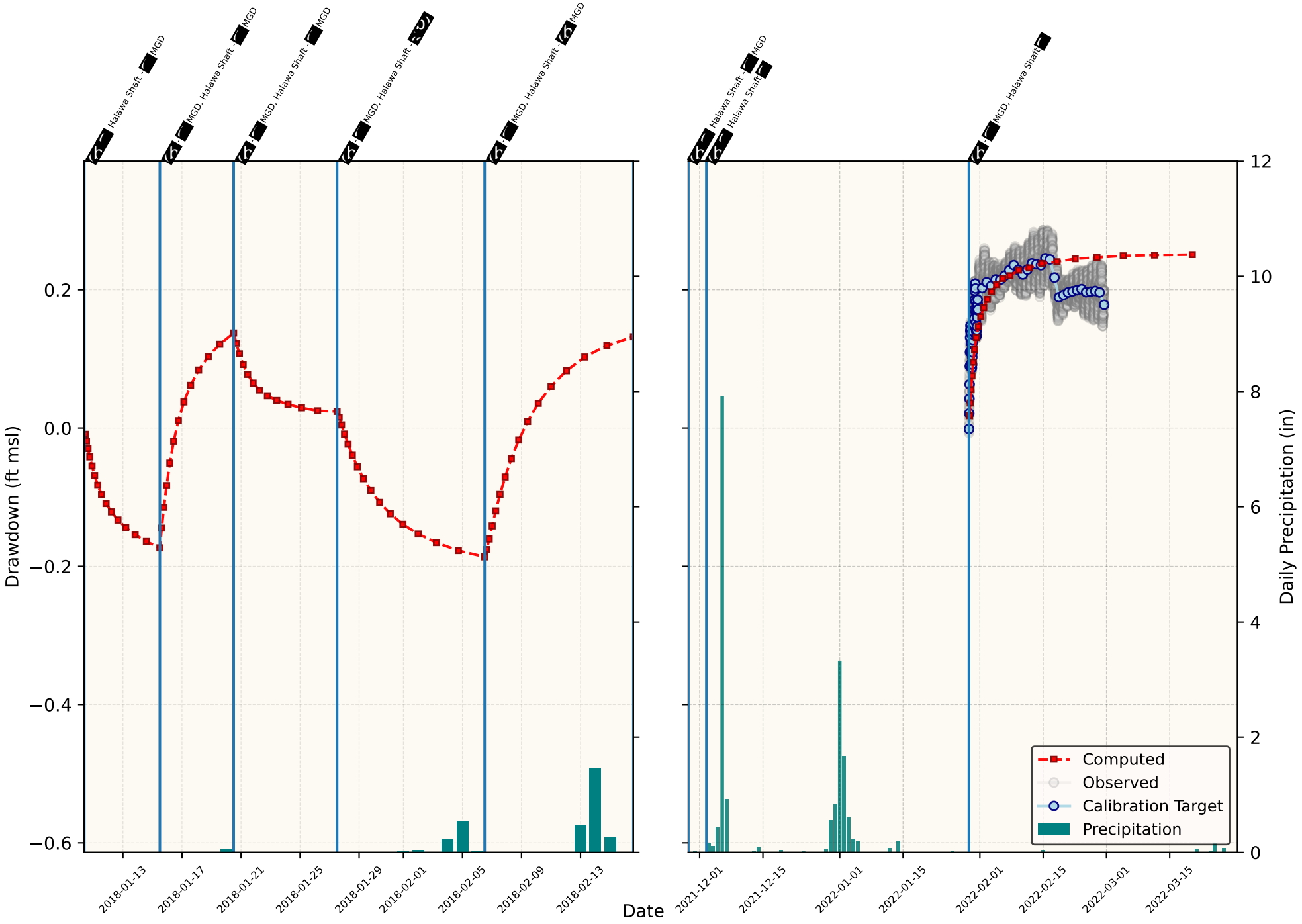
Group 1 - Basal Aquifer




OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

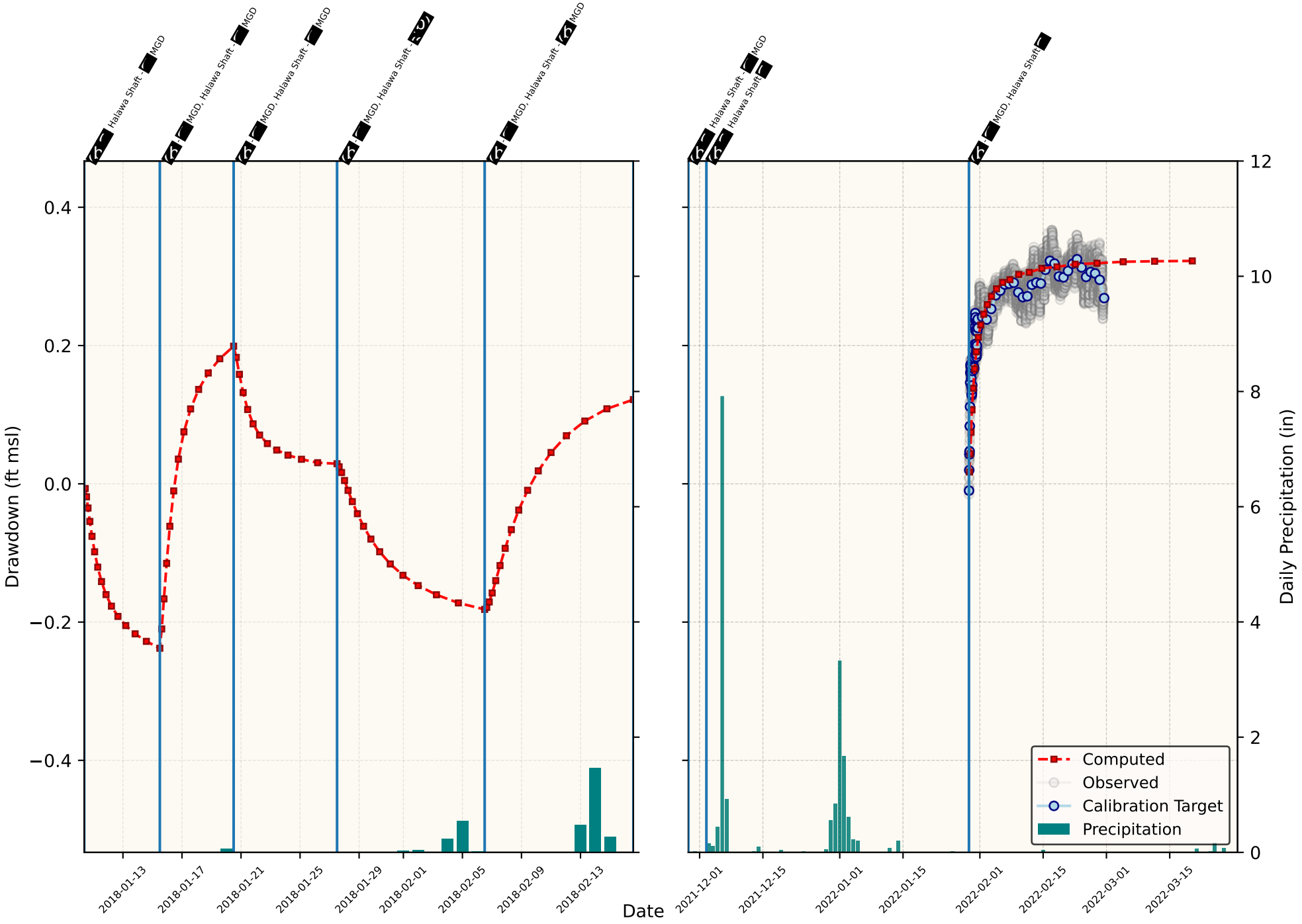
OWDFMW[redacted] (b)(9)

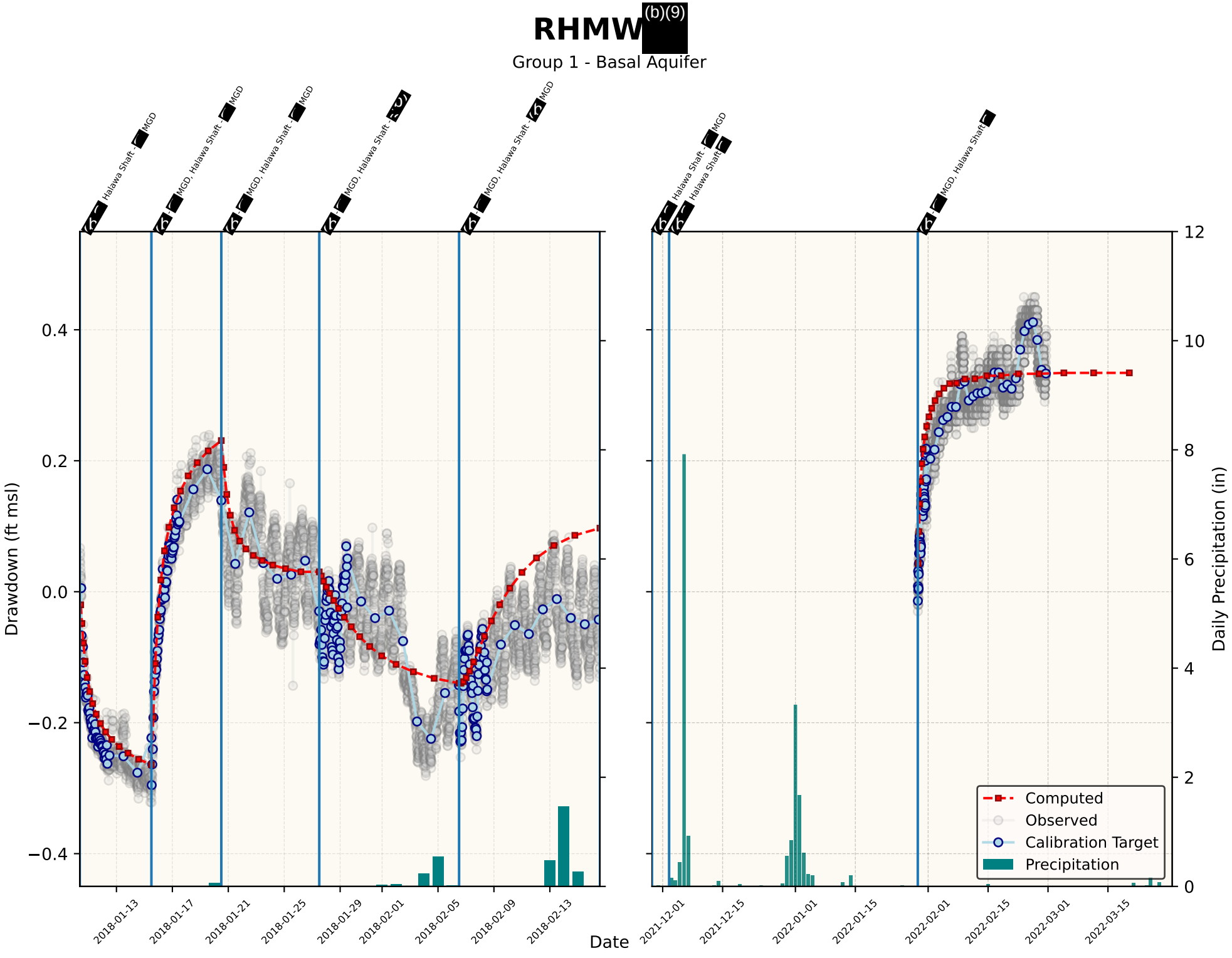
Group 1 - Basal Aquifer



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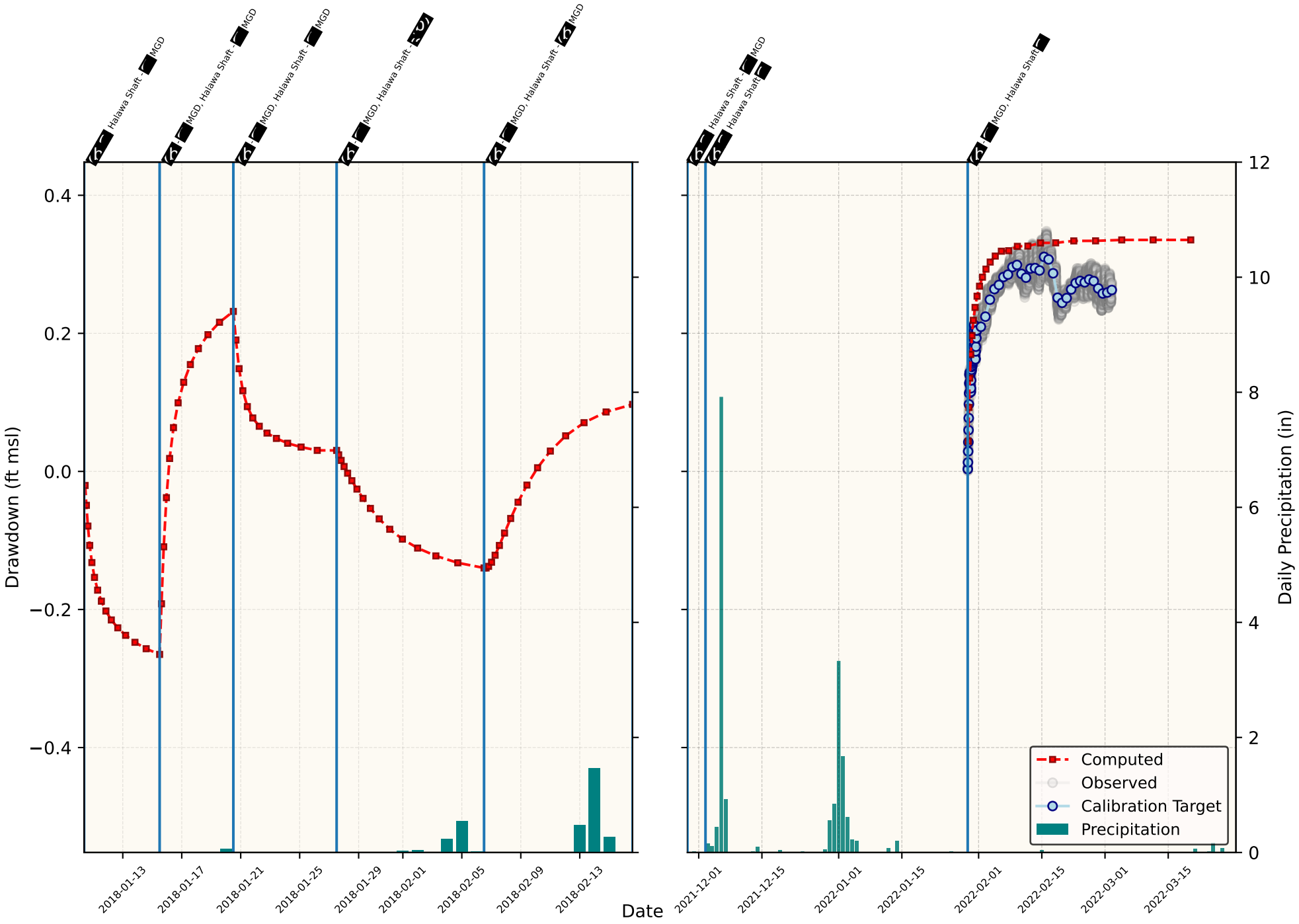
Group 1 - Basal Aquifer




RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
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2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

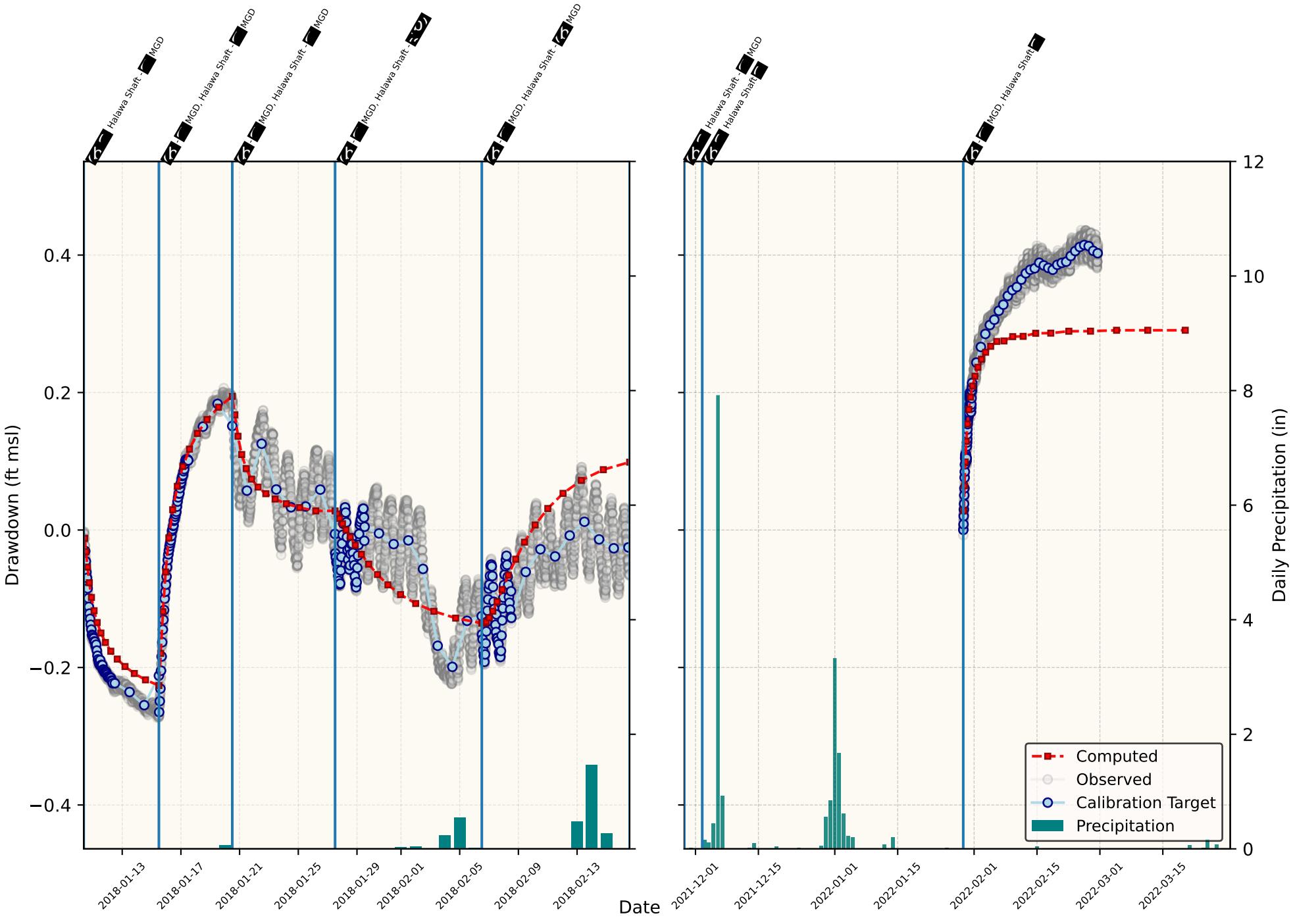
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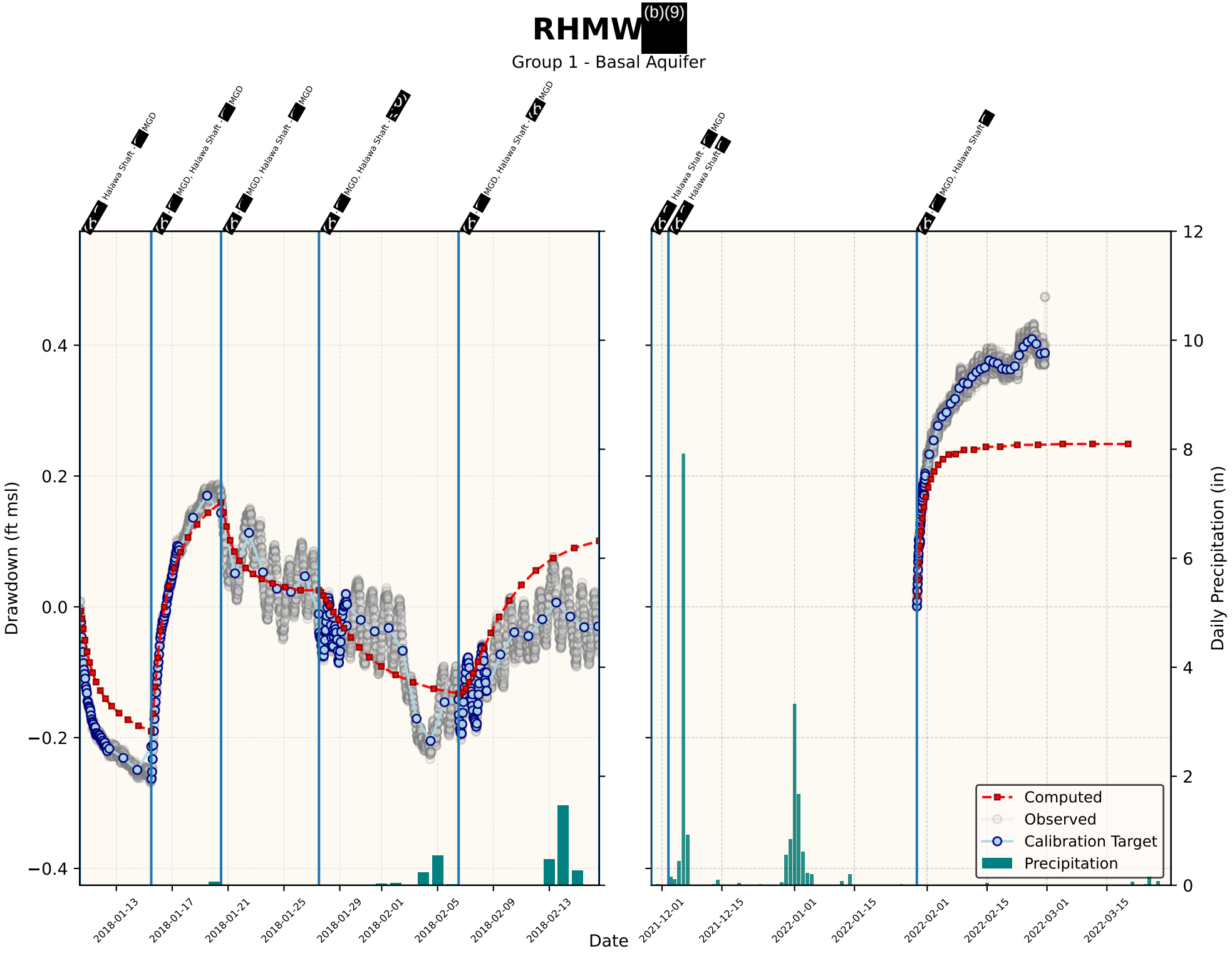
Group 1 - Basal Aquifer

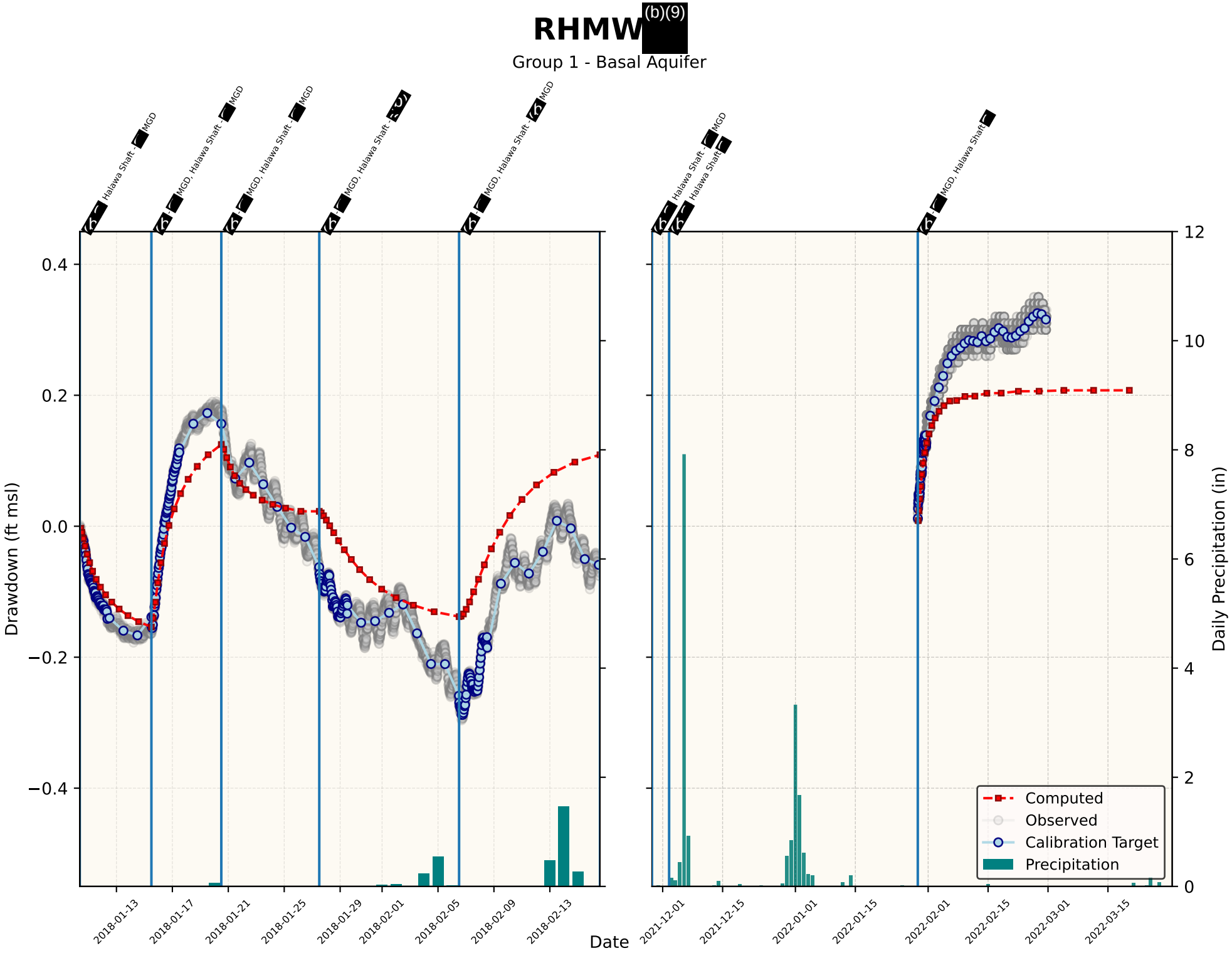


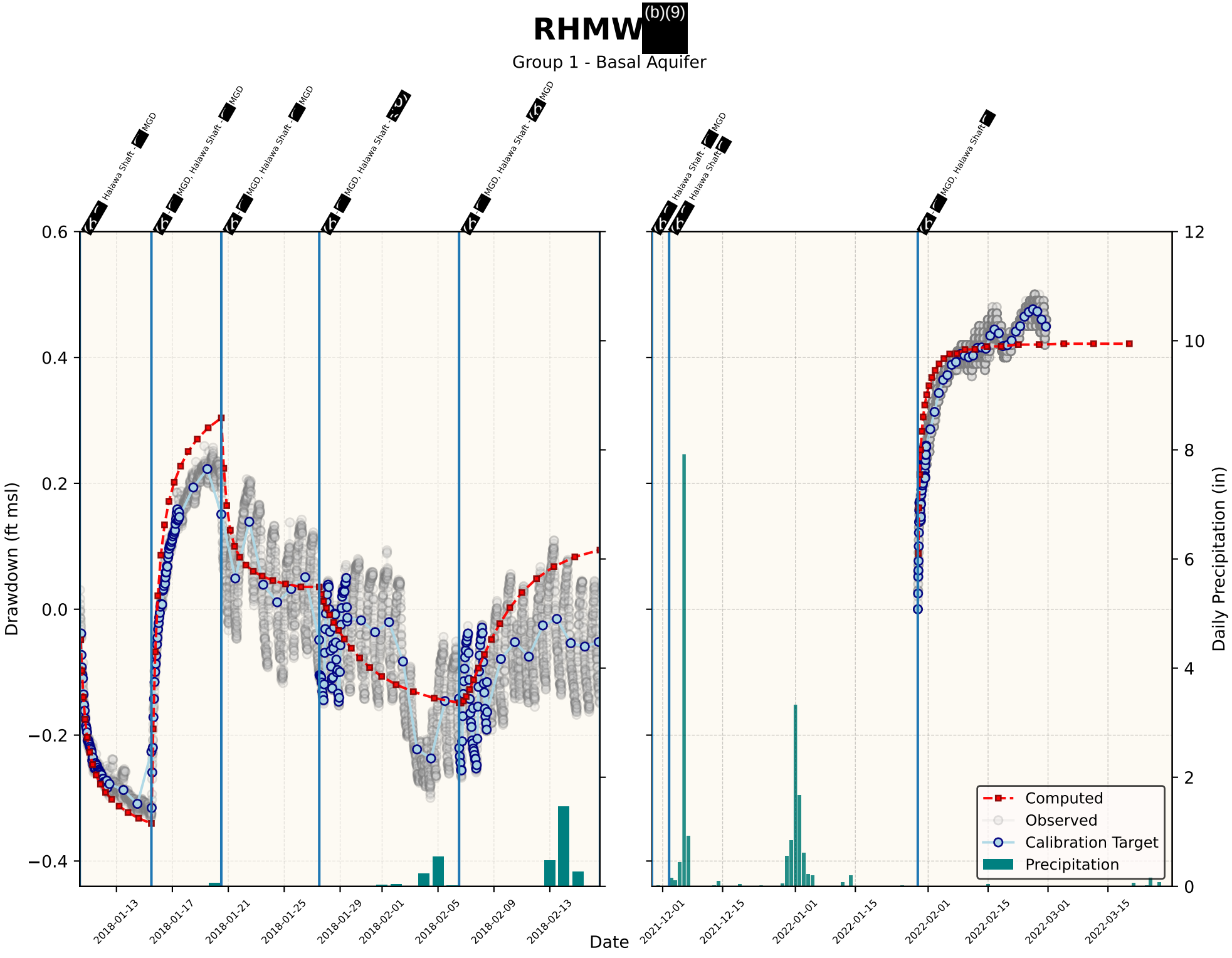
RHMW[redacted](b)(9)

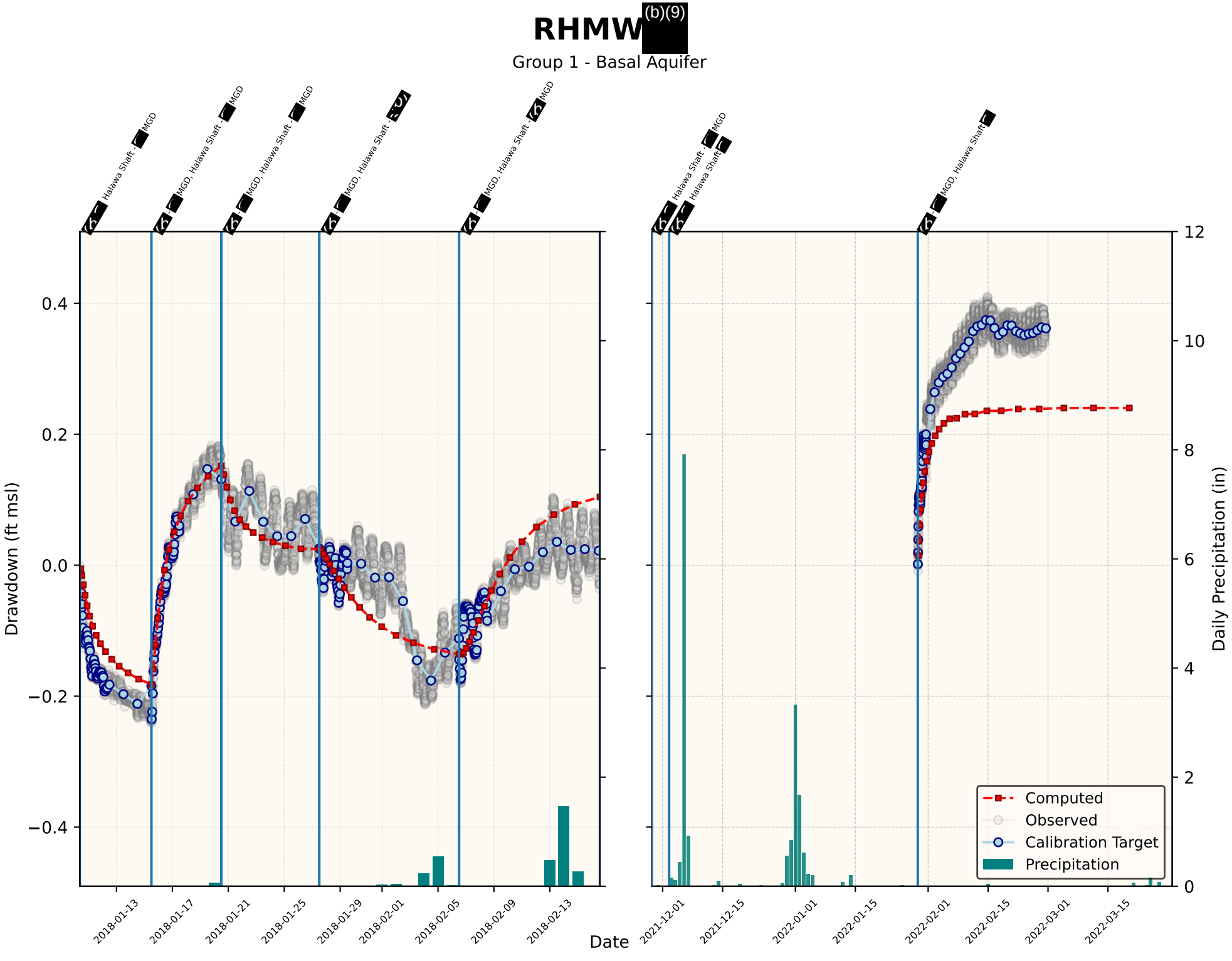
Group 1 - Basal Aquifer

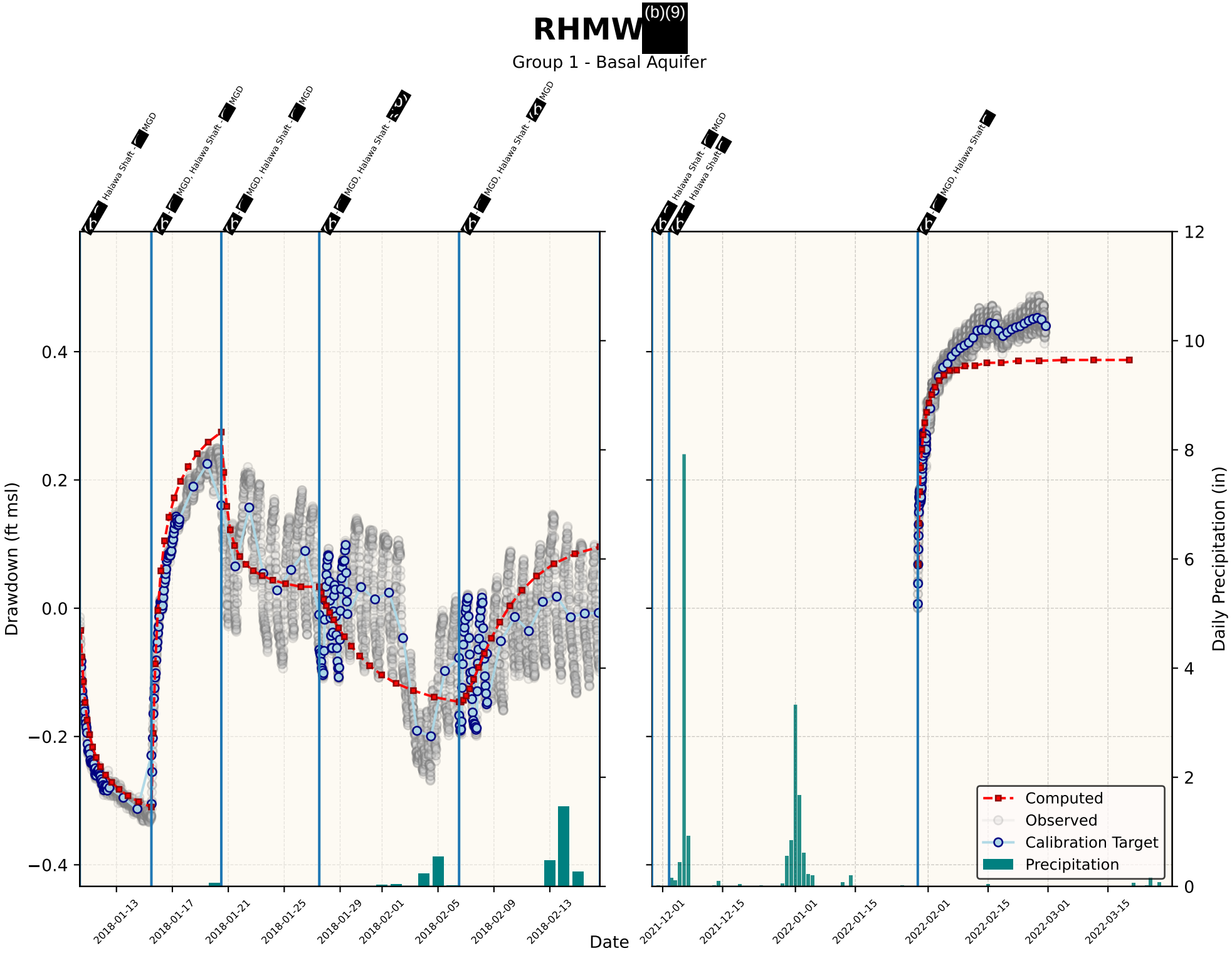


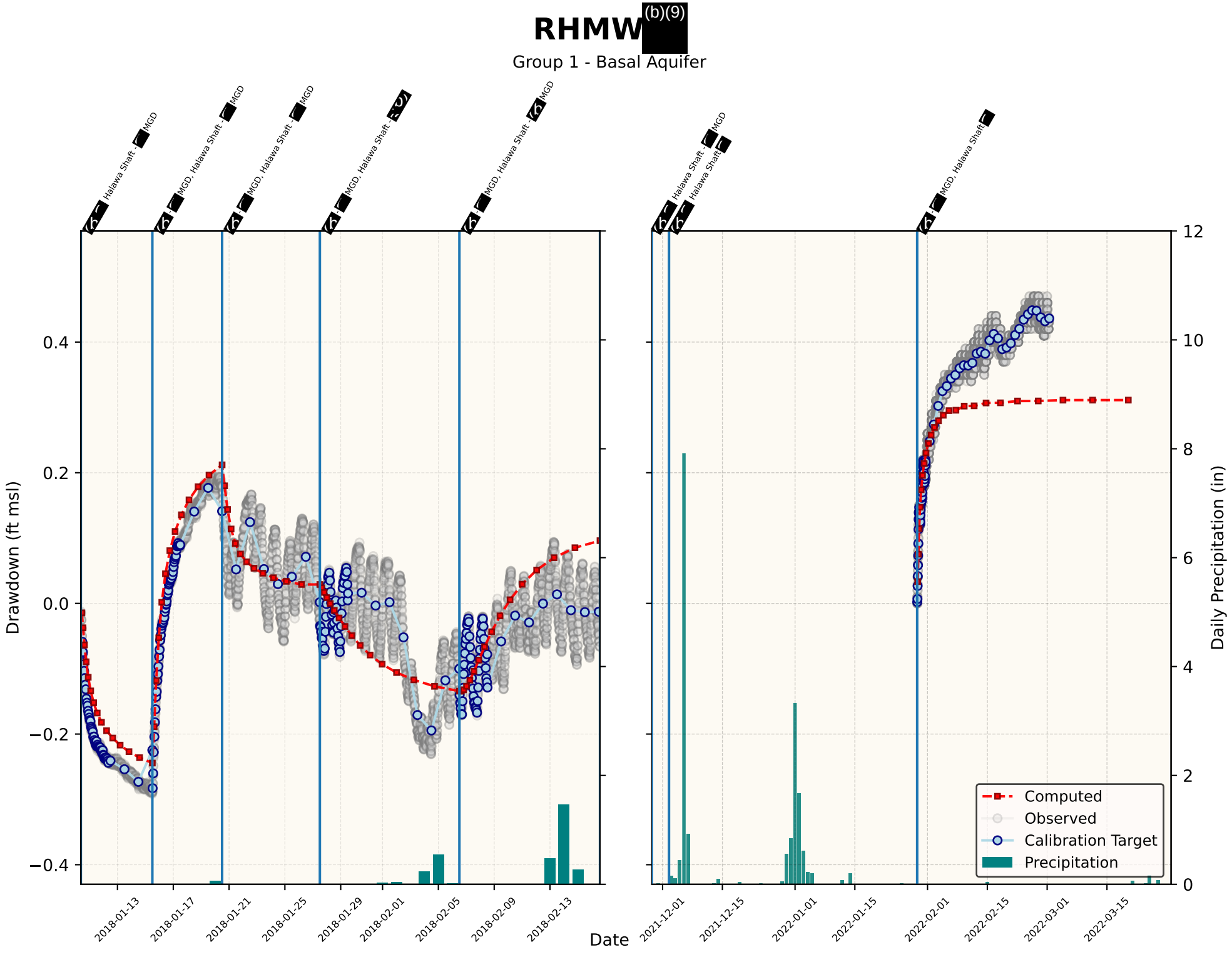

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

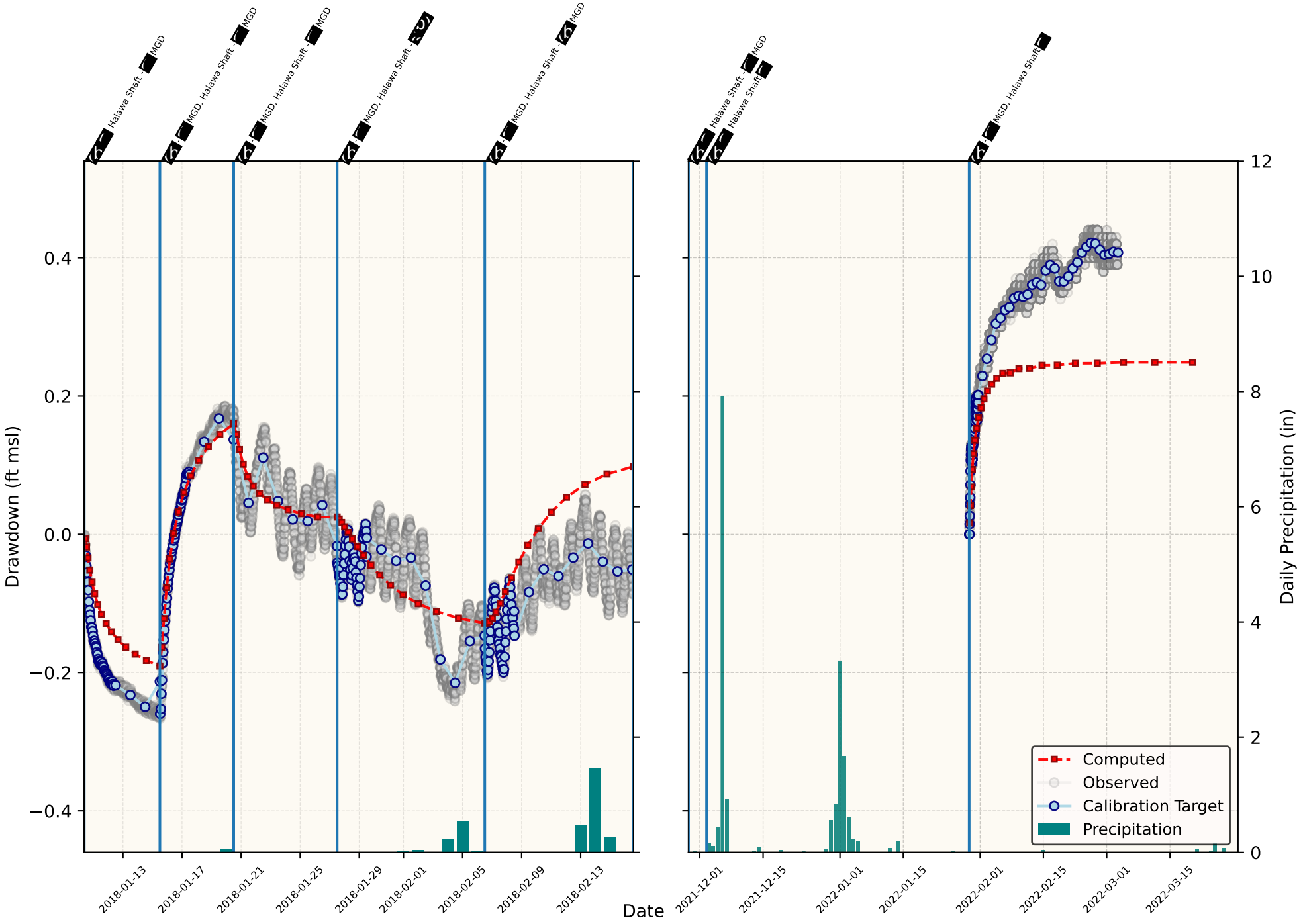

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
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2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

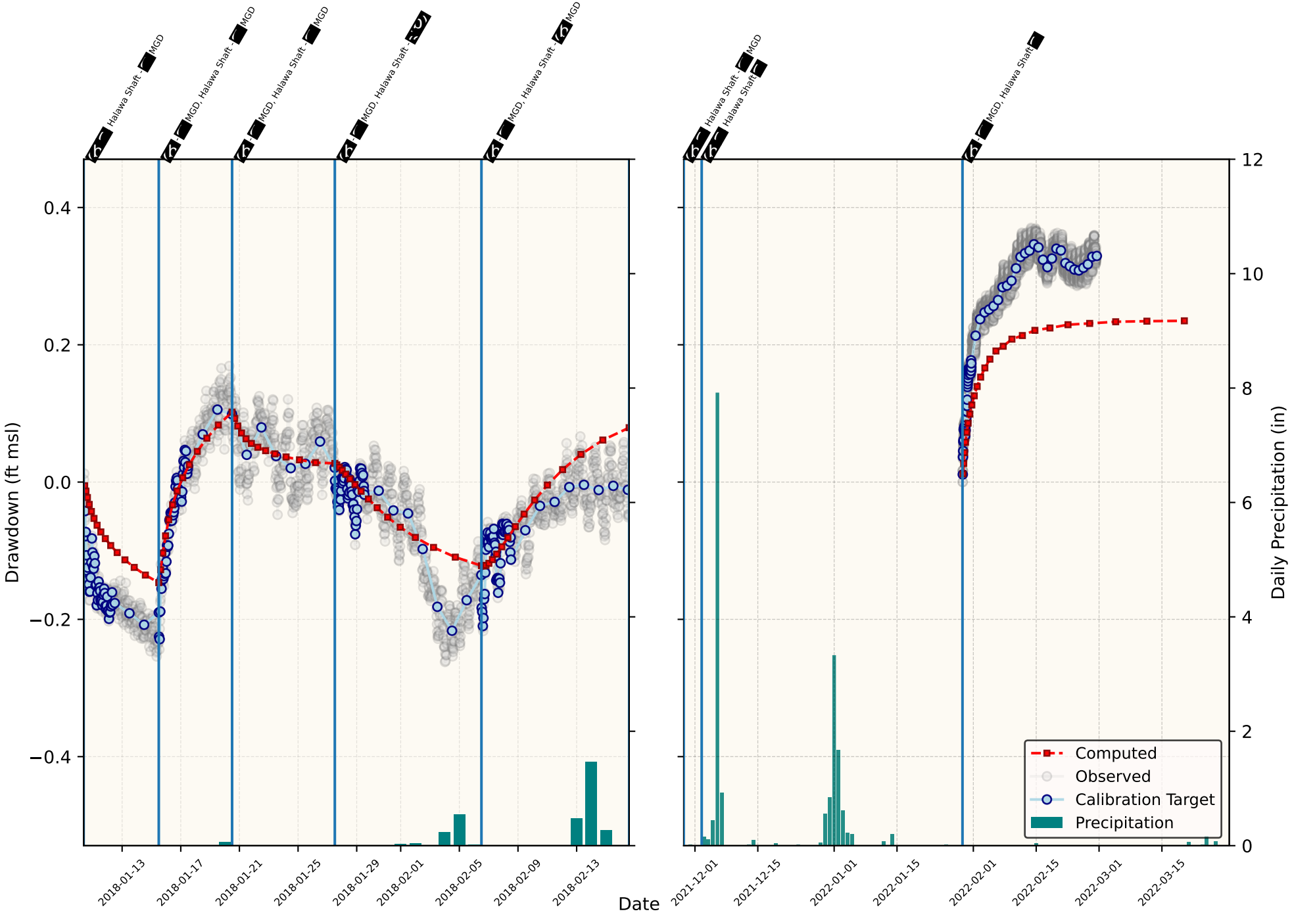
RHMW[redacted]

Group 1 - Basal Aquifer



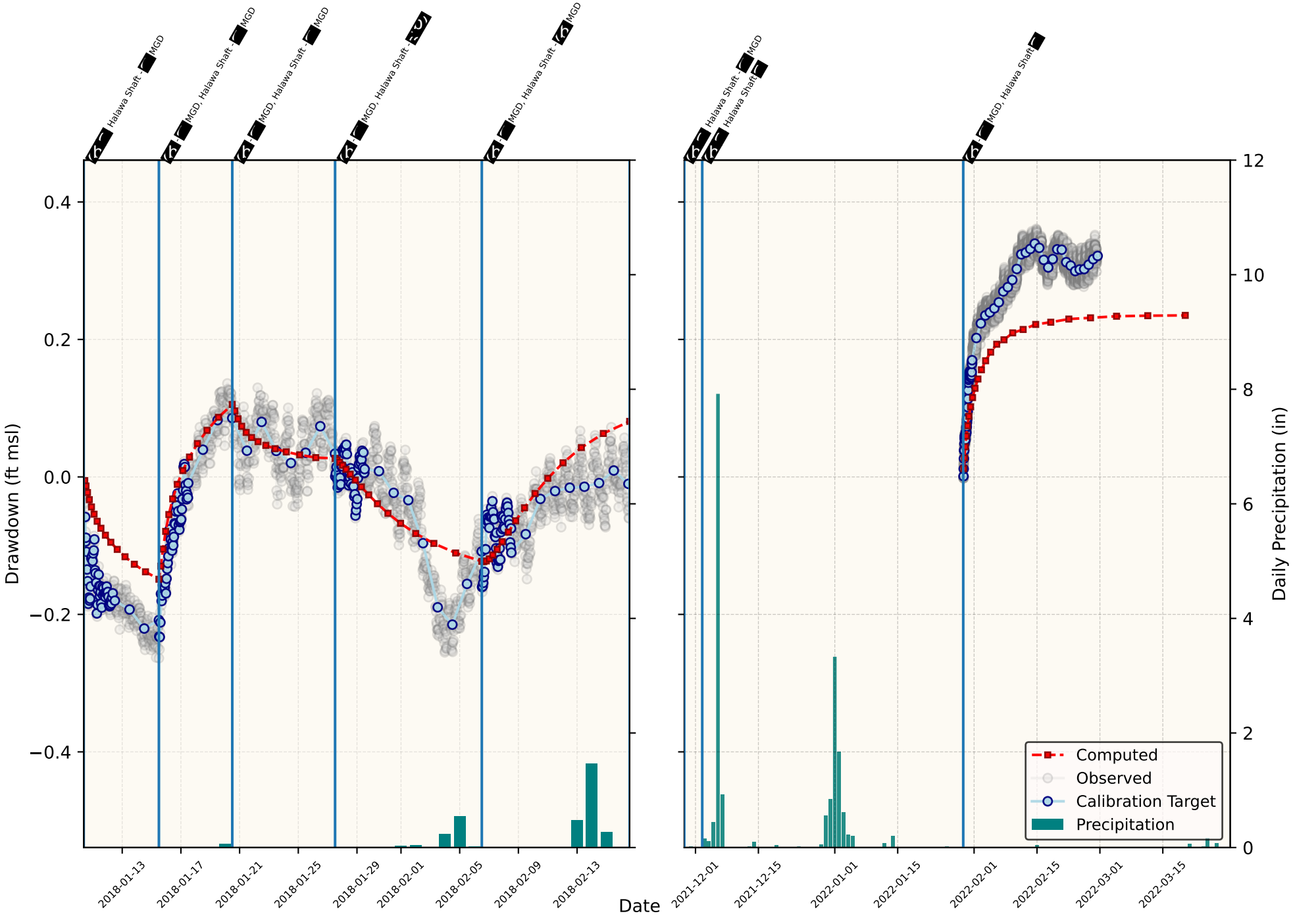
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



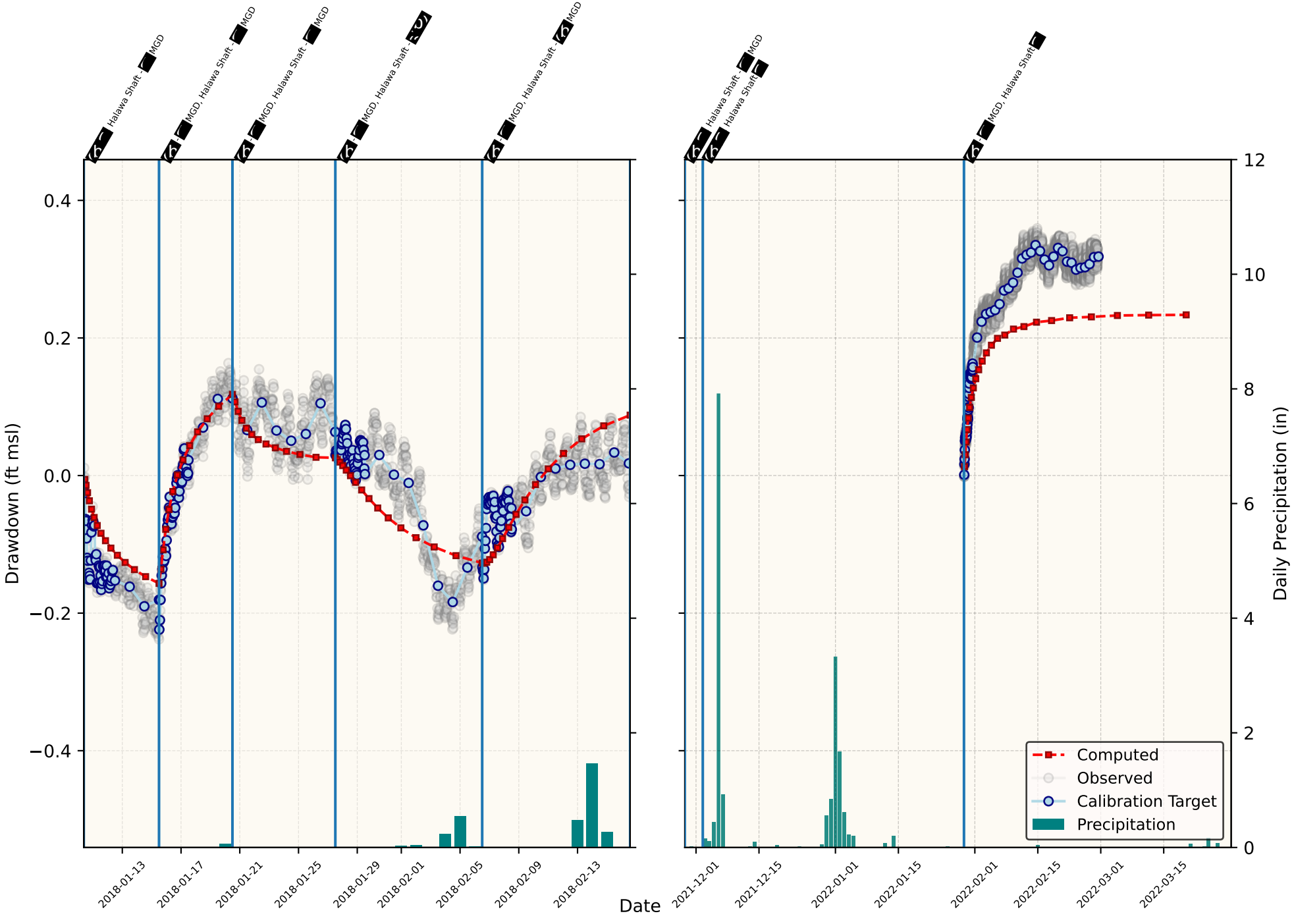
RHMW [redacted] (b)(9)

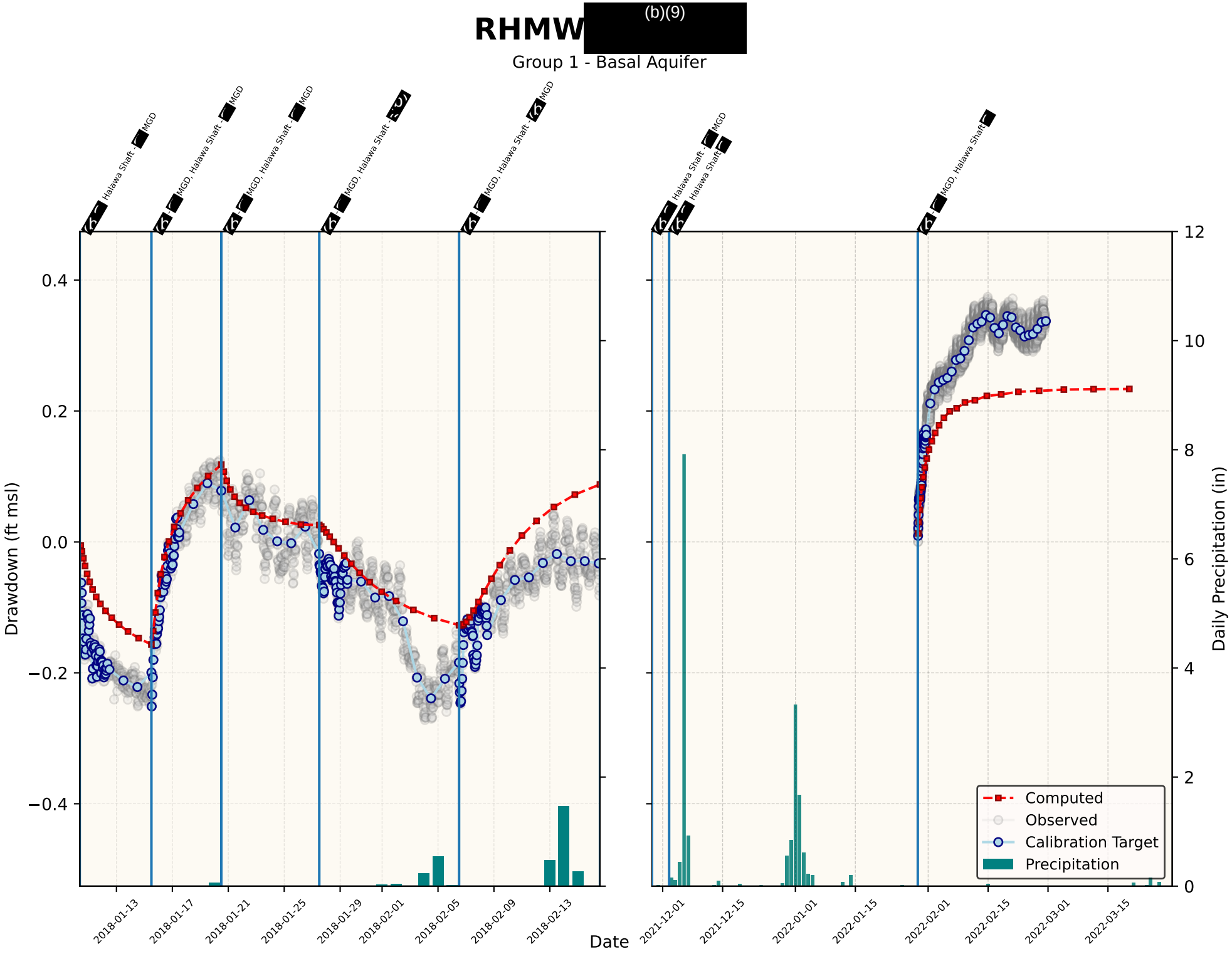
Group 1 - Basal Aquifer



RHMW [redacted] (b)(9)

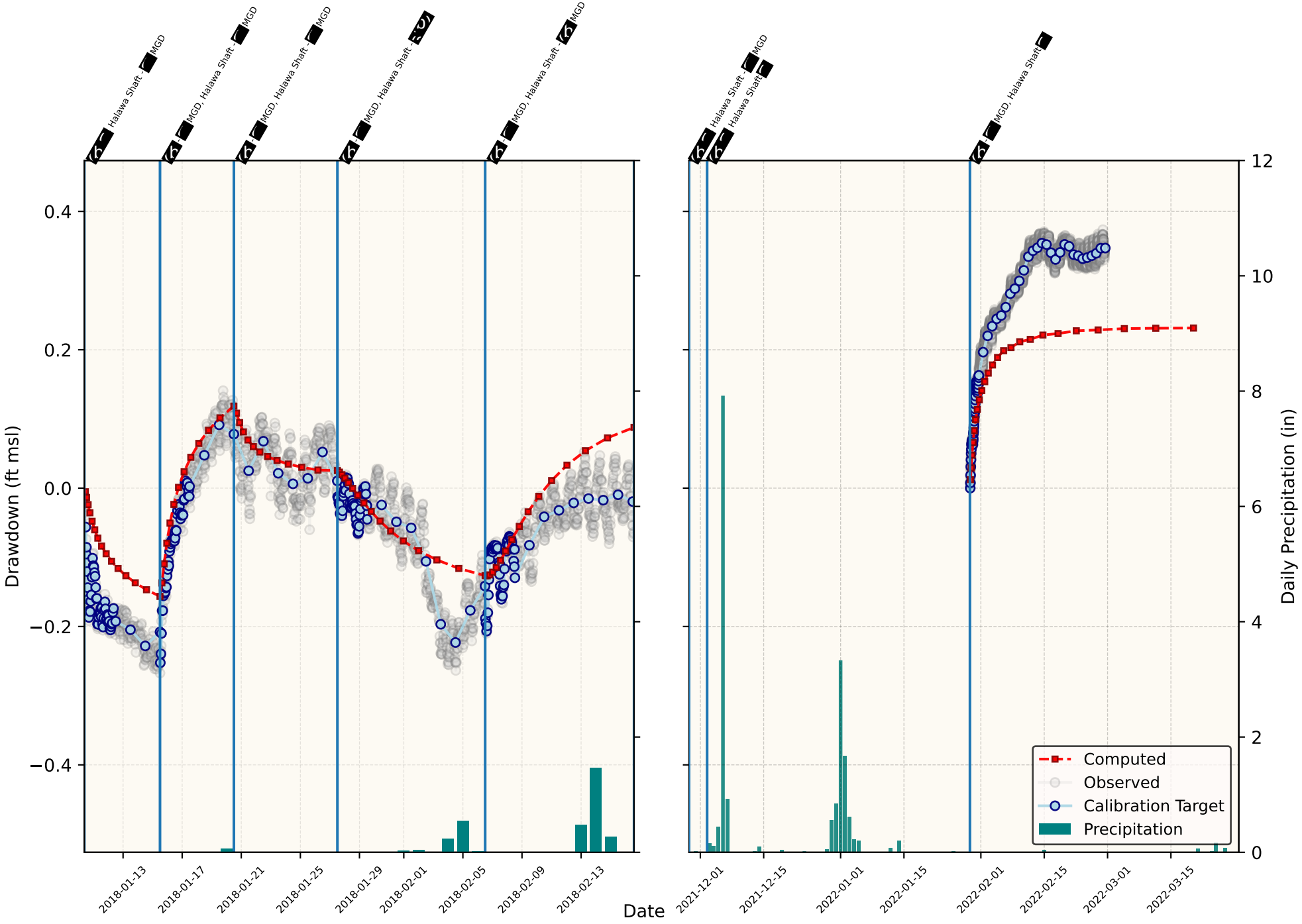
Group 1 - Basal Aquifer




RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-15
2022-03-01
2022-03-15

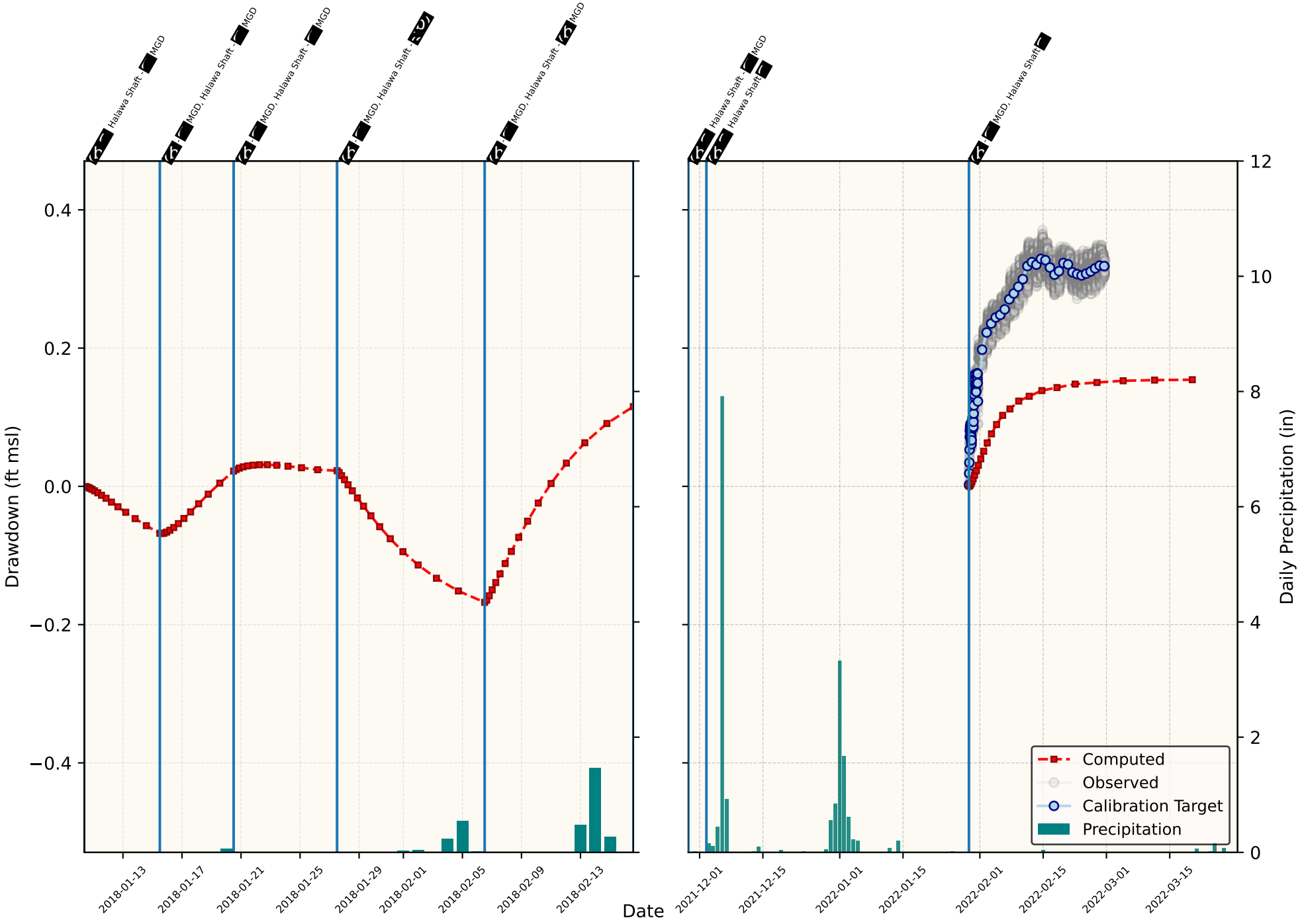
RHMW (b)(9)

Group 1 - Basal Aquifer



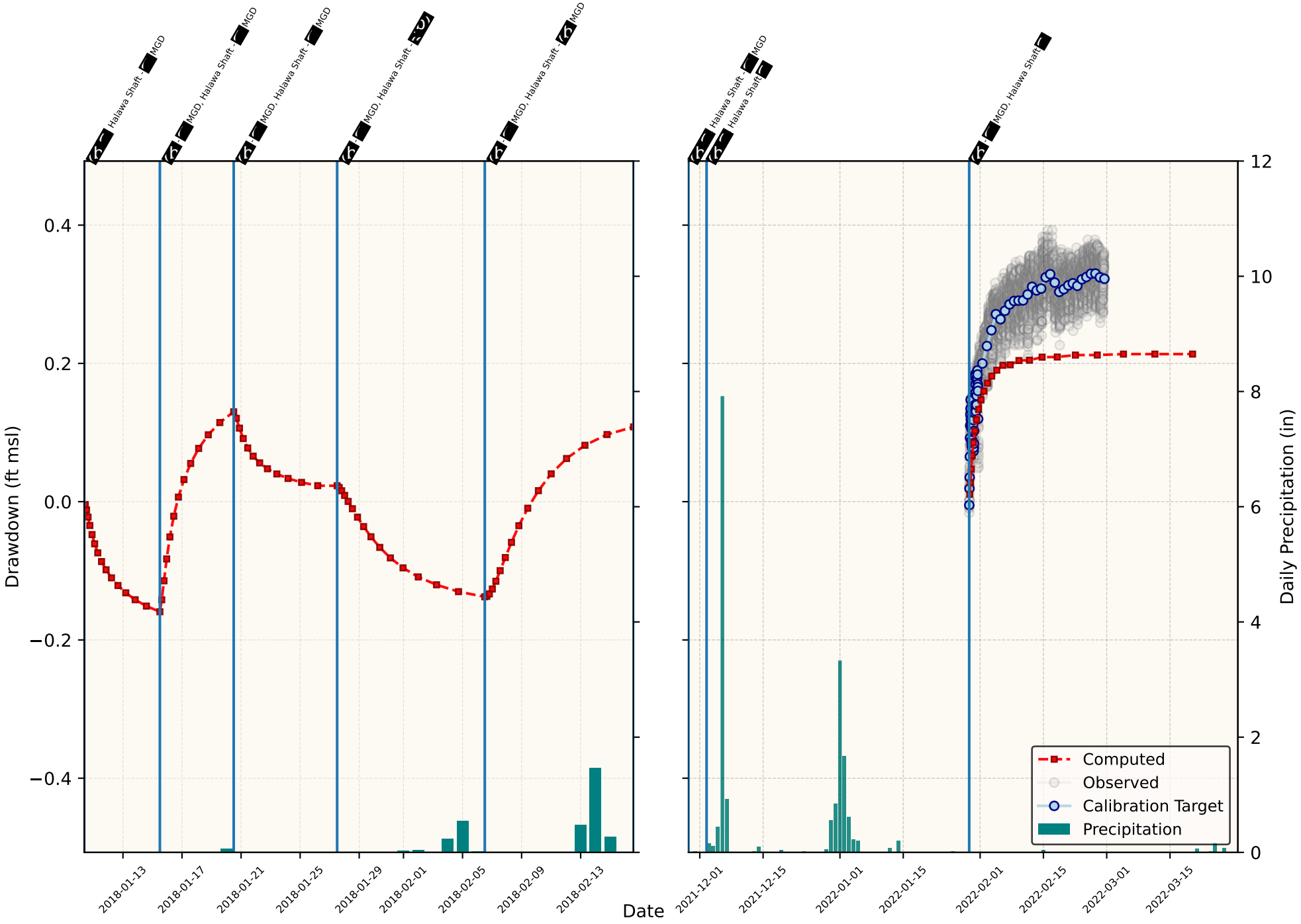
RHMW[redacted] (b)(9)

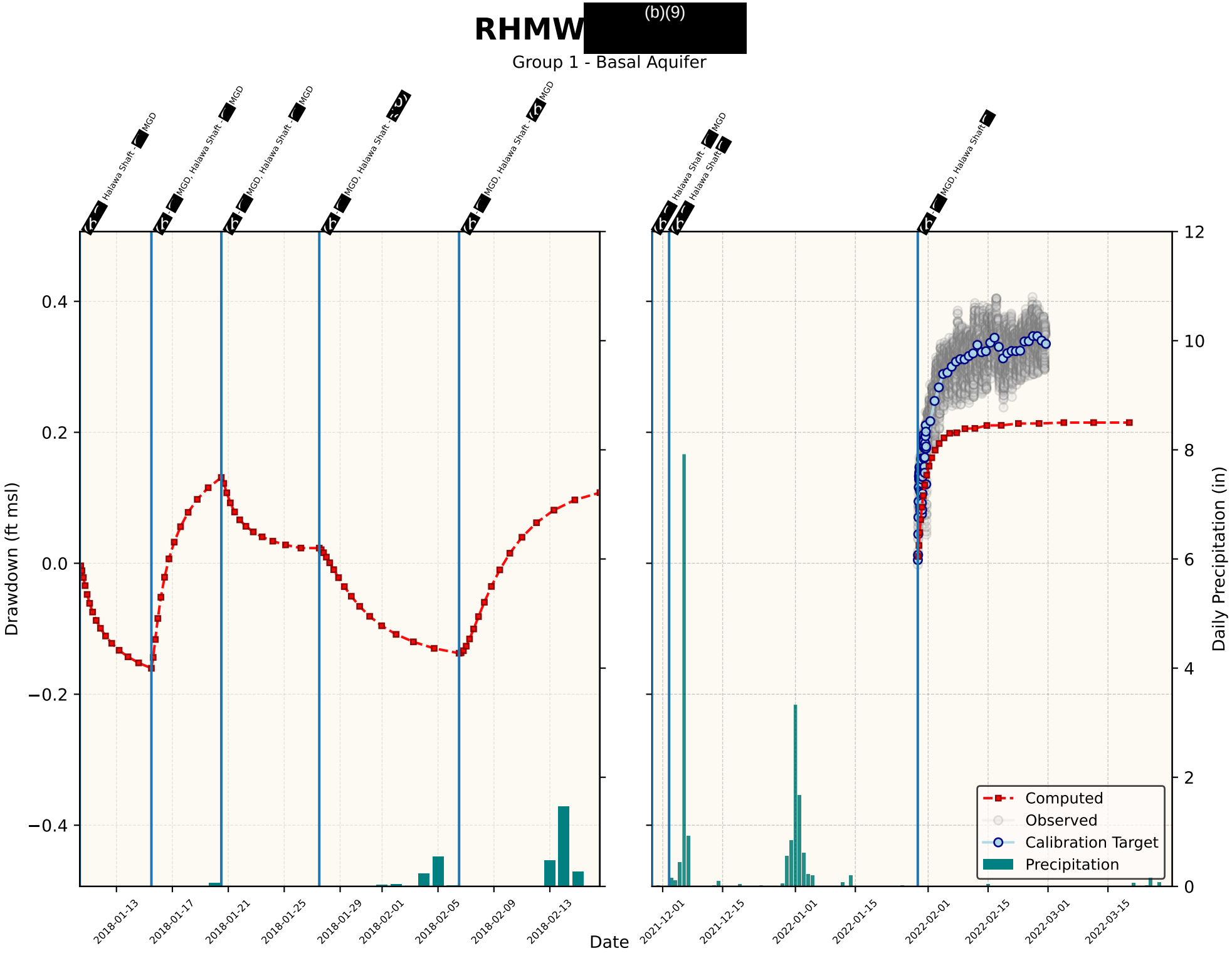
Group 1 - Basal Aquifer



RHMW [redacted] (b)(9)

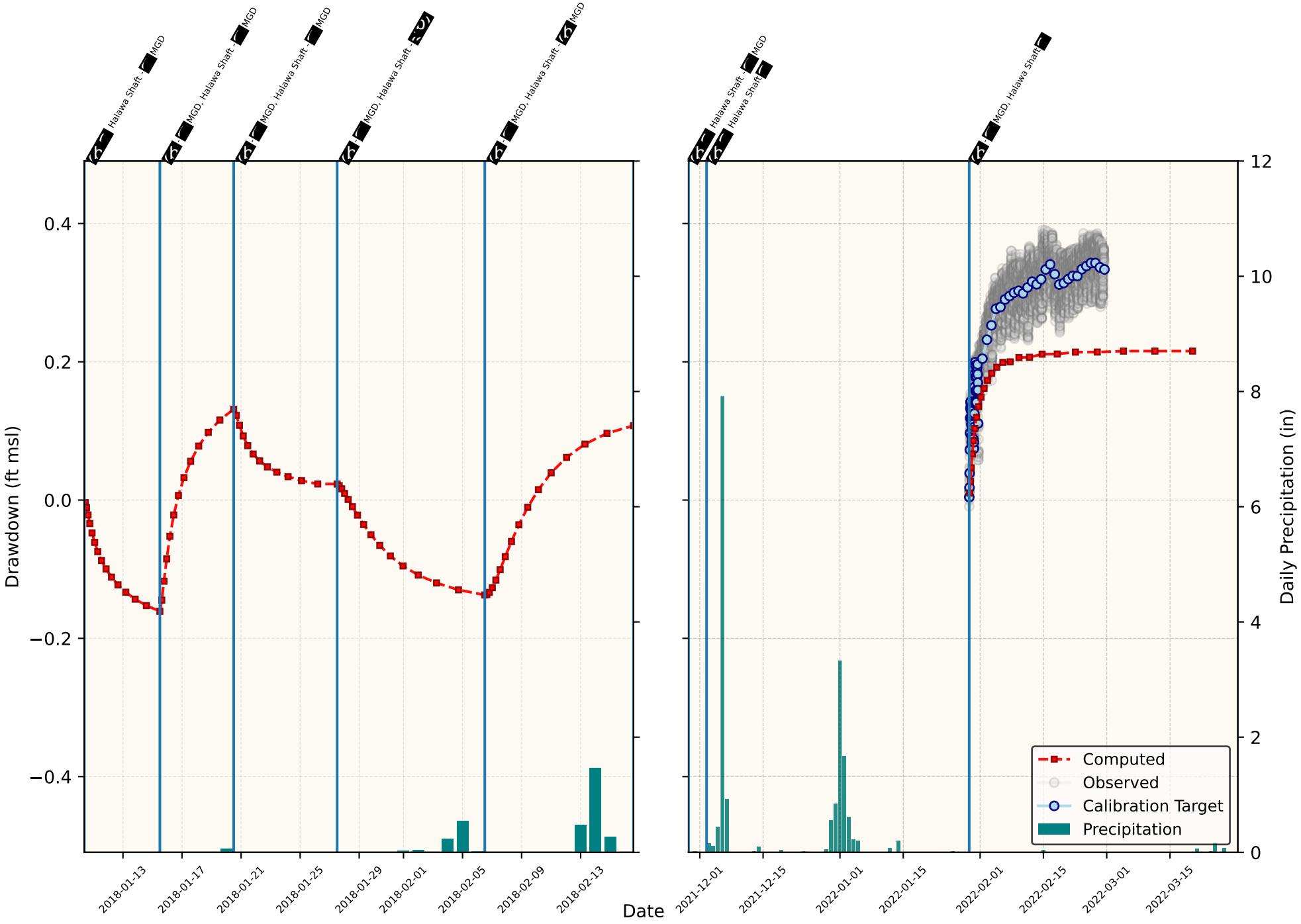
Group 1 - Basal Aquifer

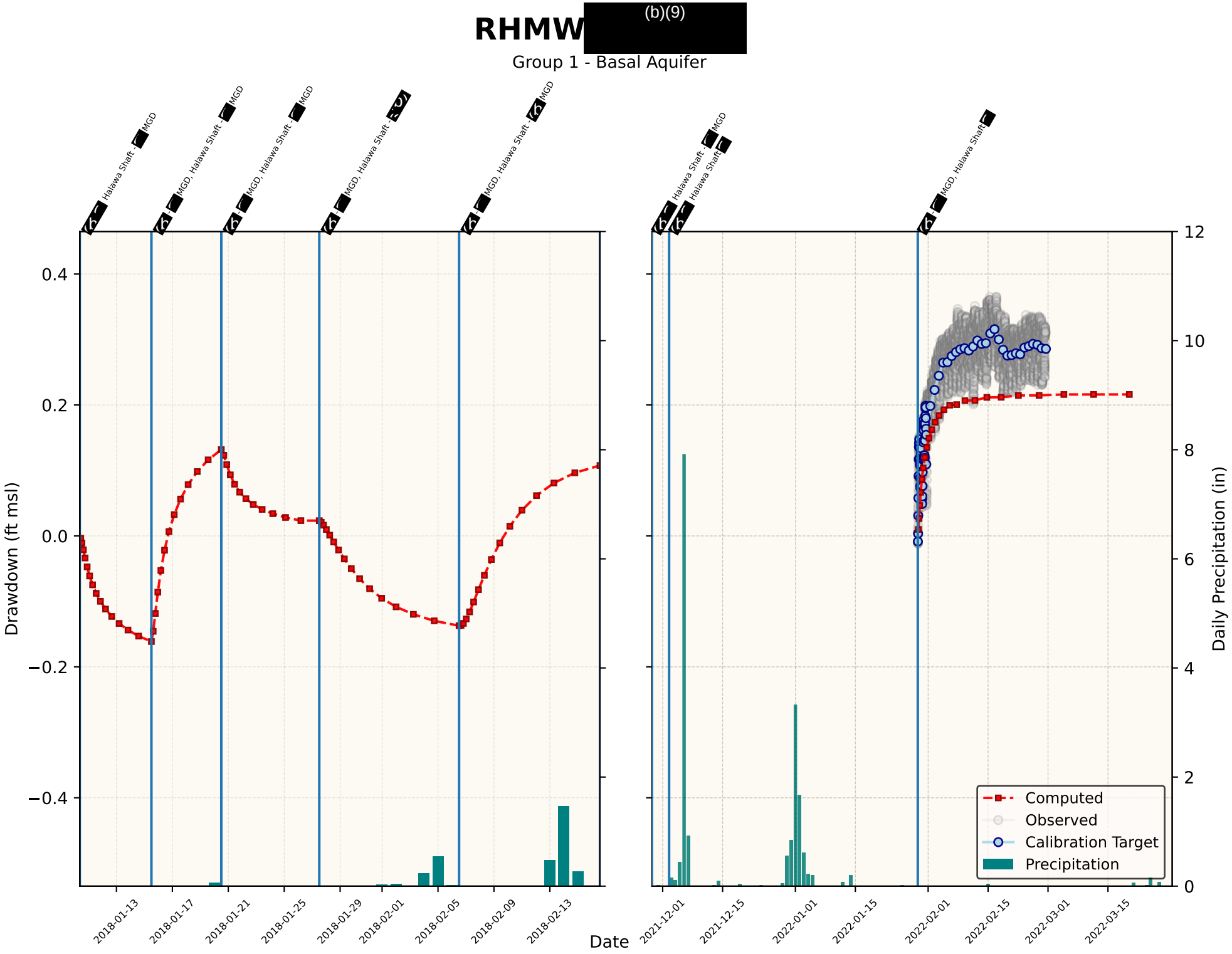


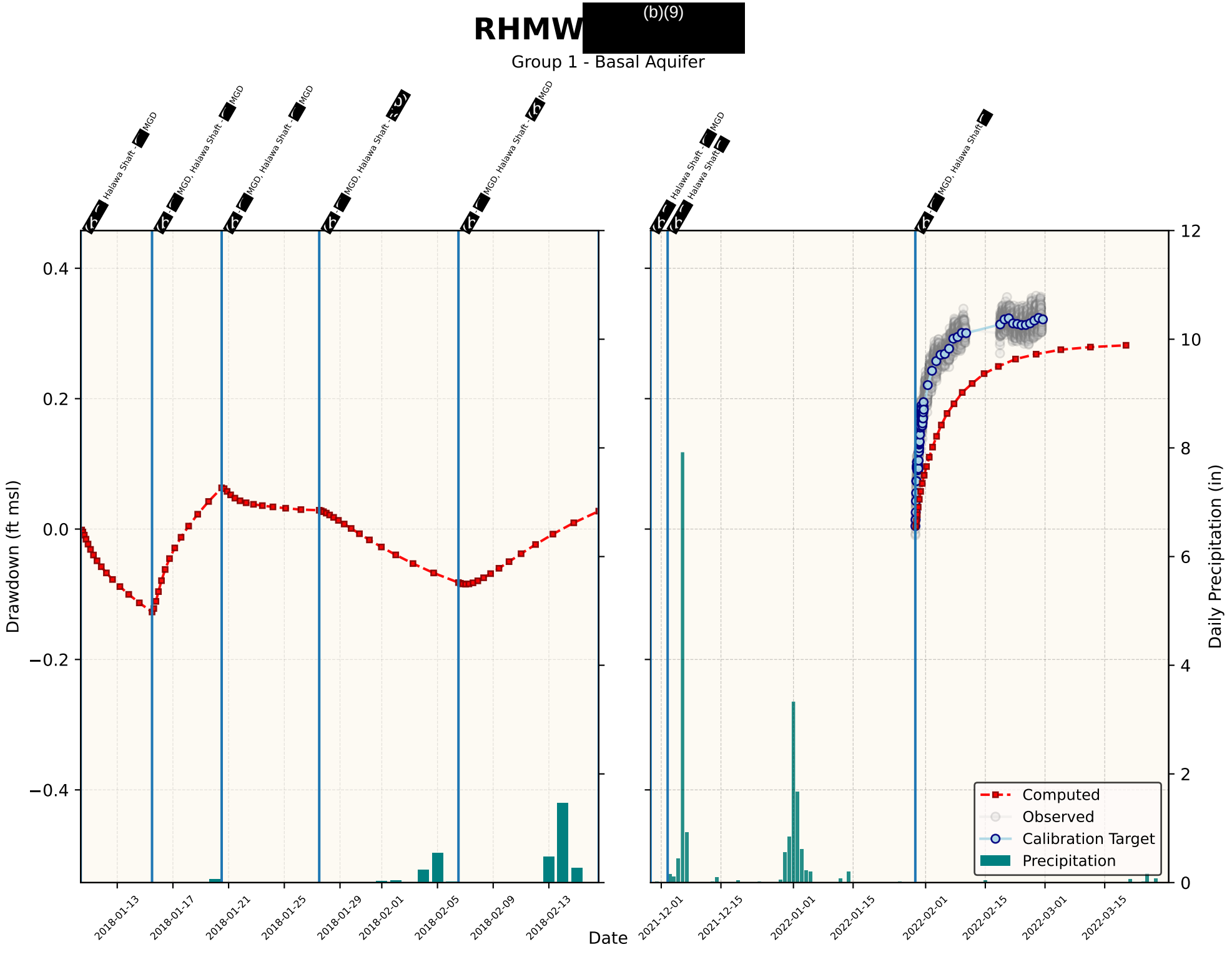

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
Date
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation

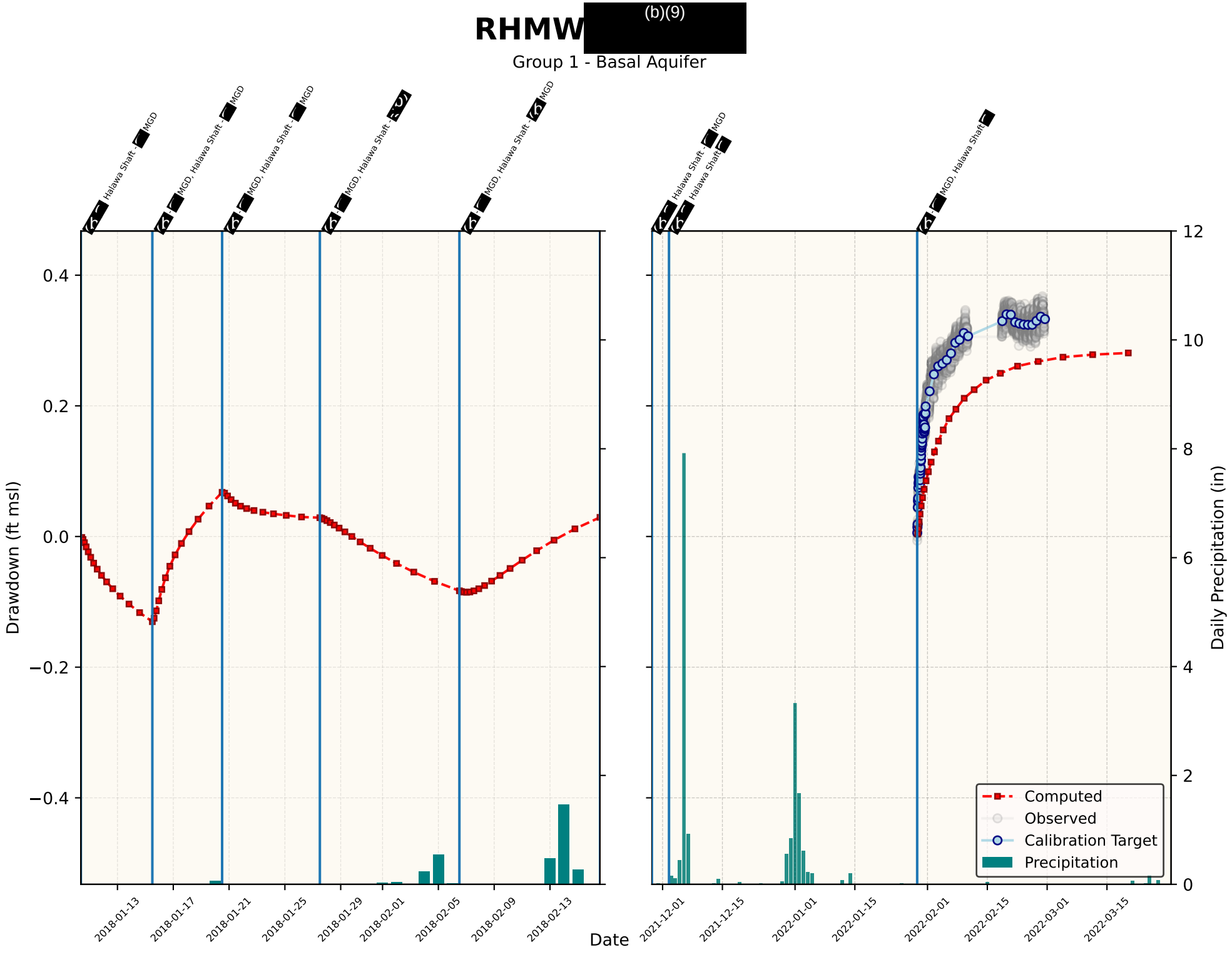
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



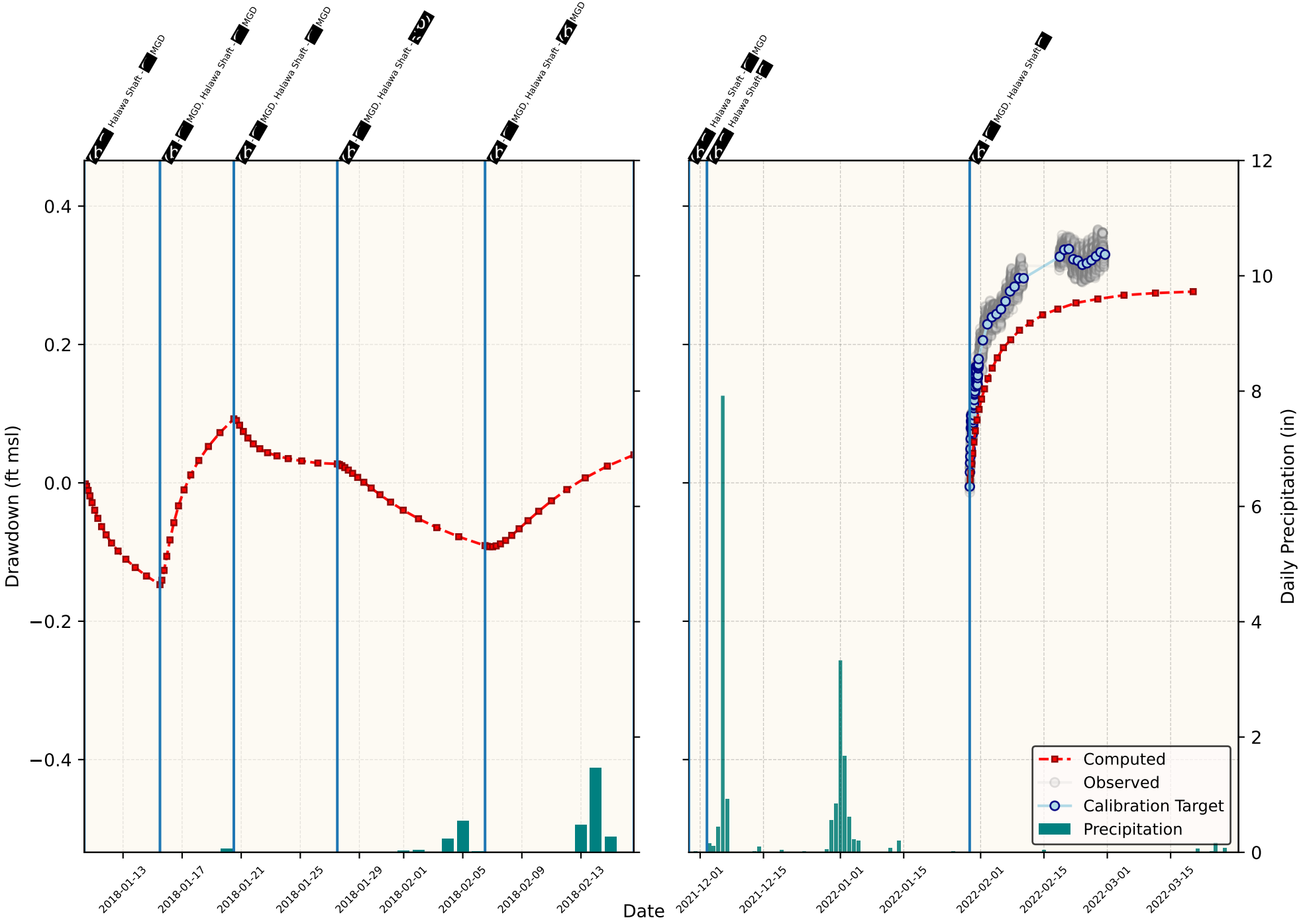

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
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2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

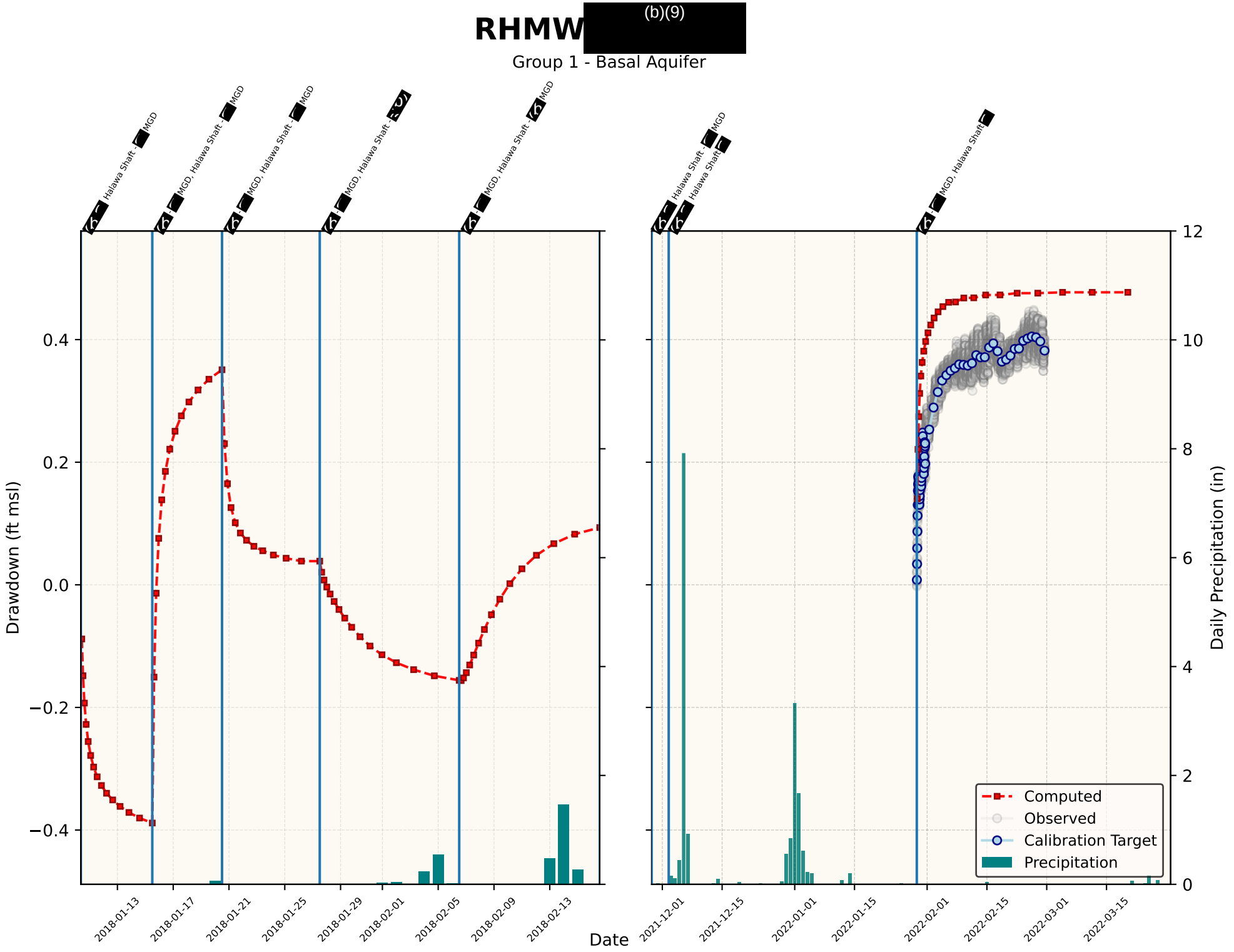

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

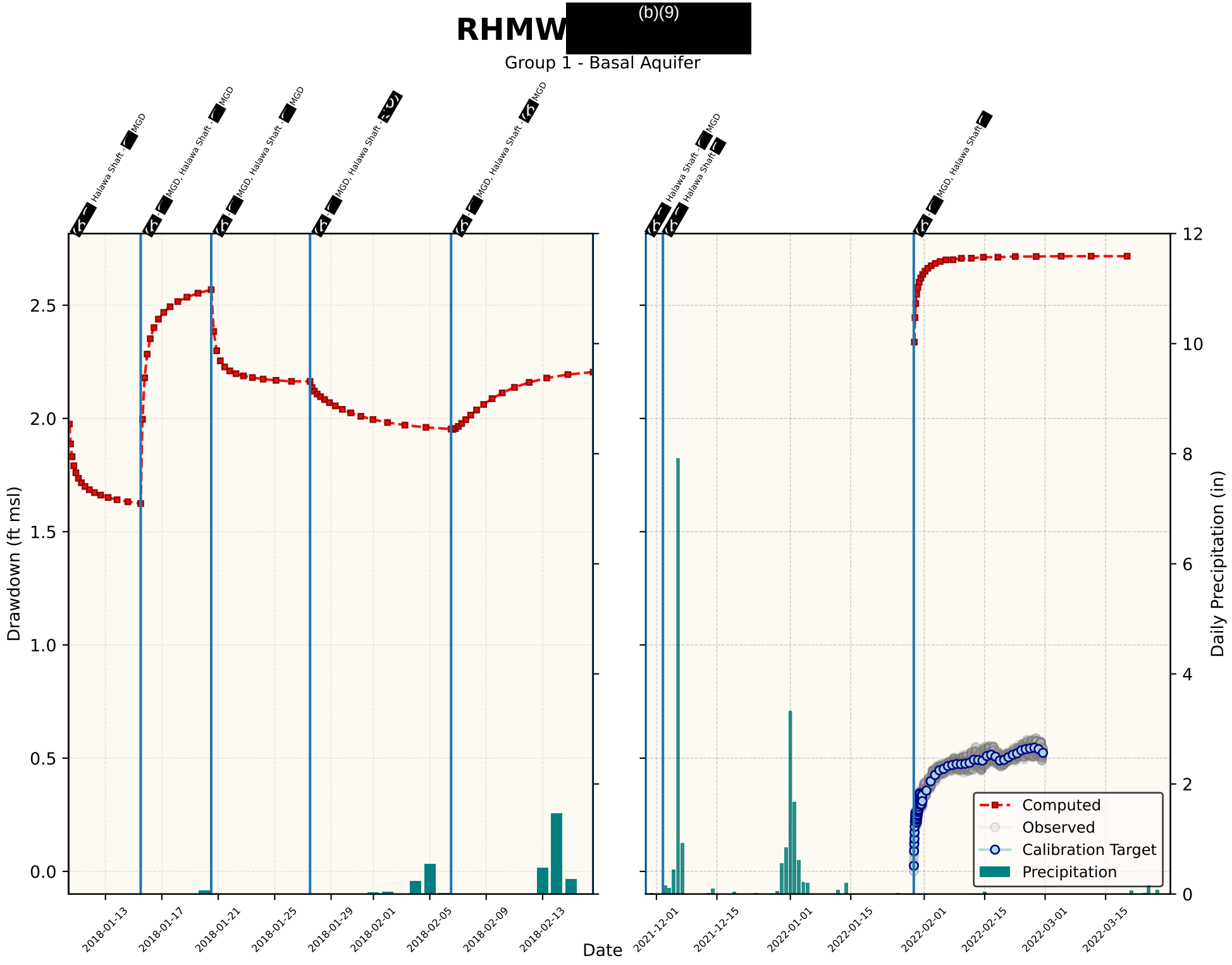

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

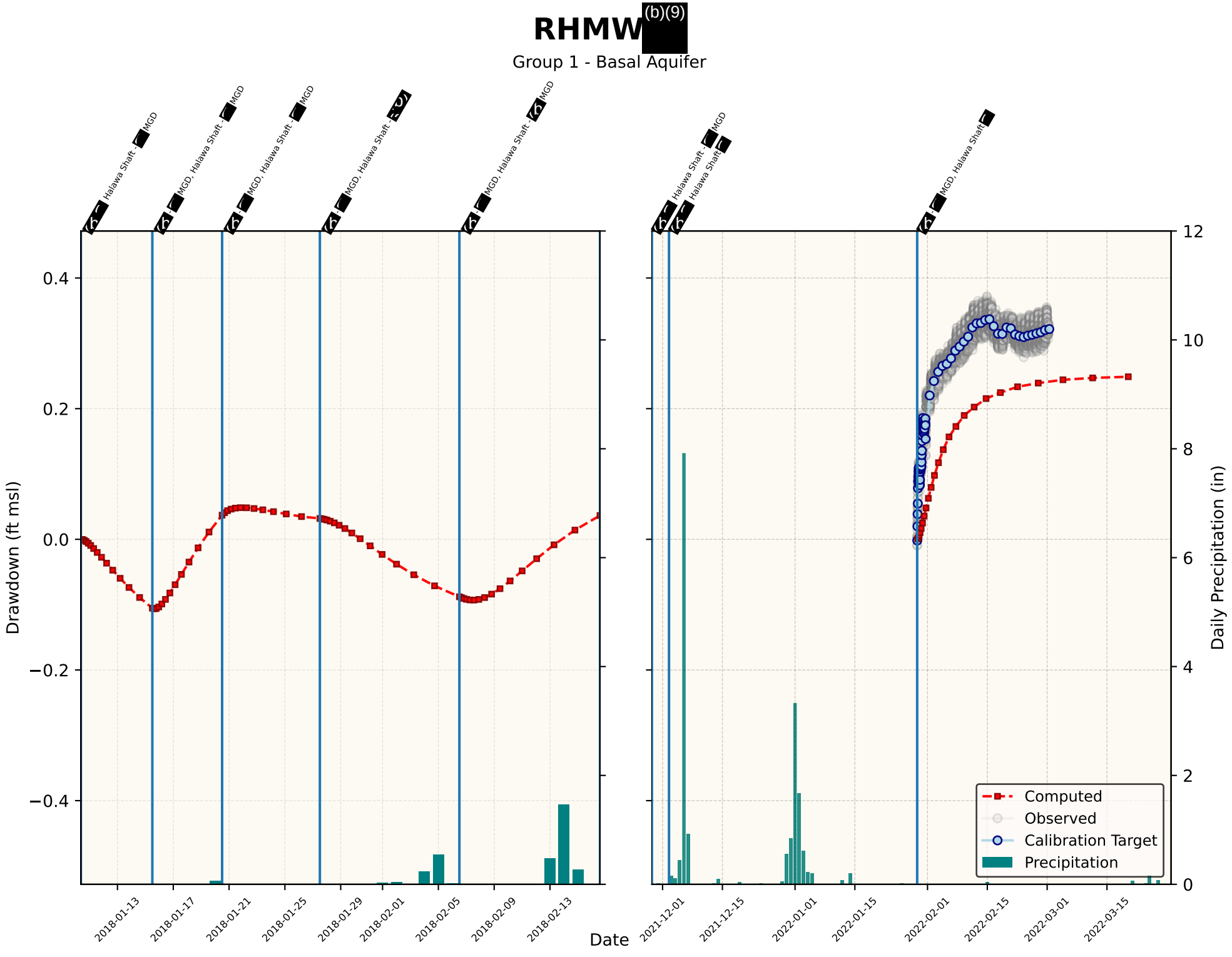
RHMW [redacted] (b)(9)

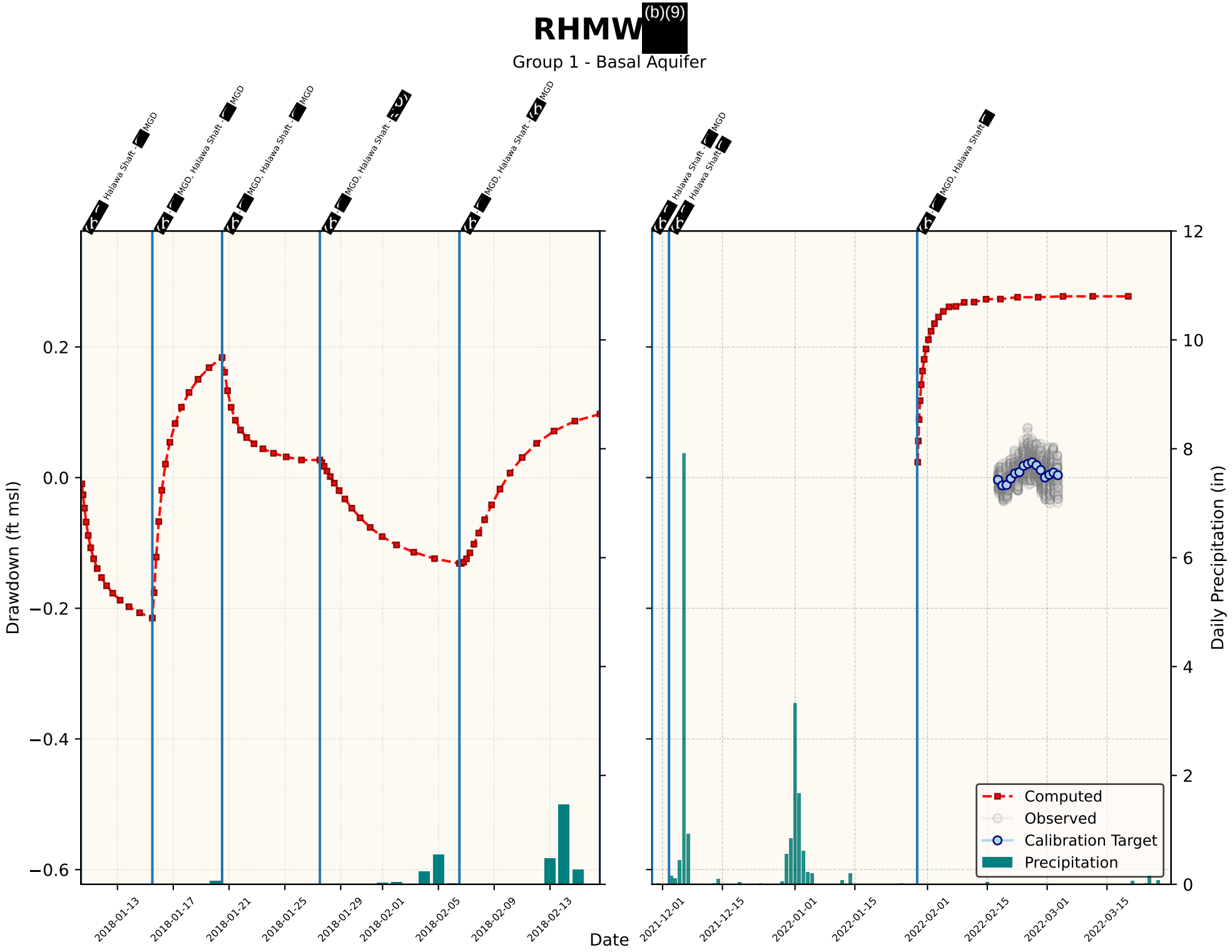
Group 1 - Basal Aquifer

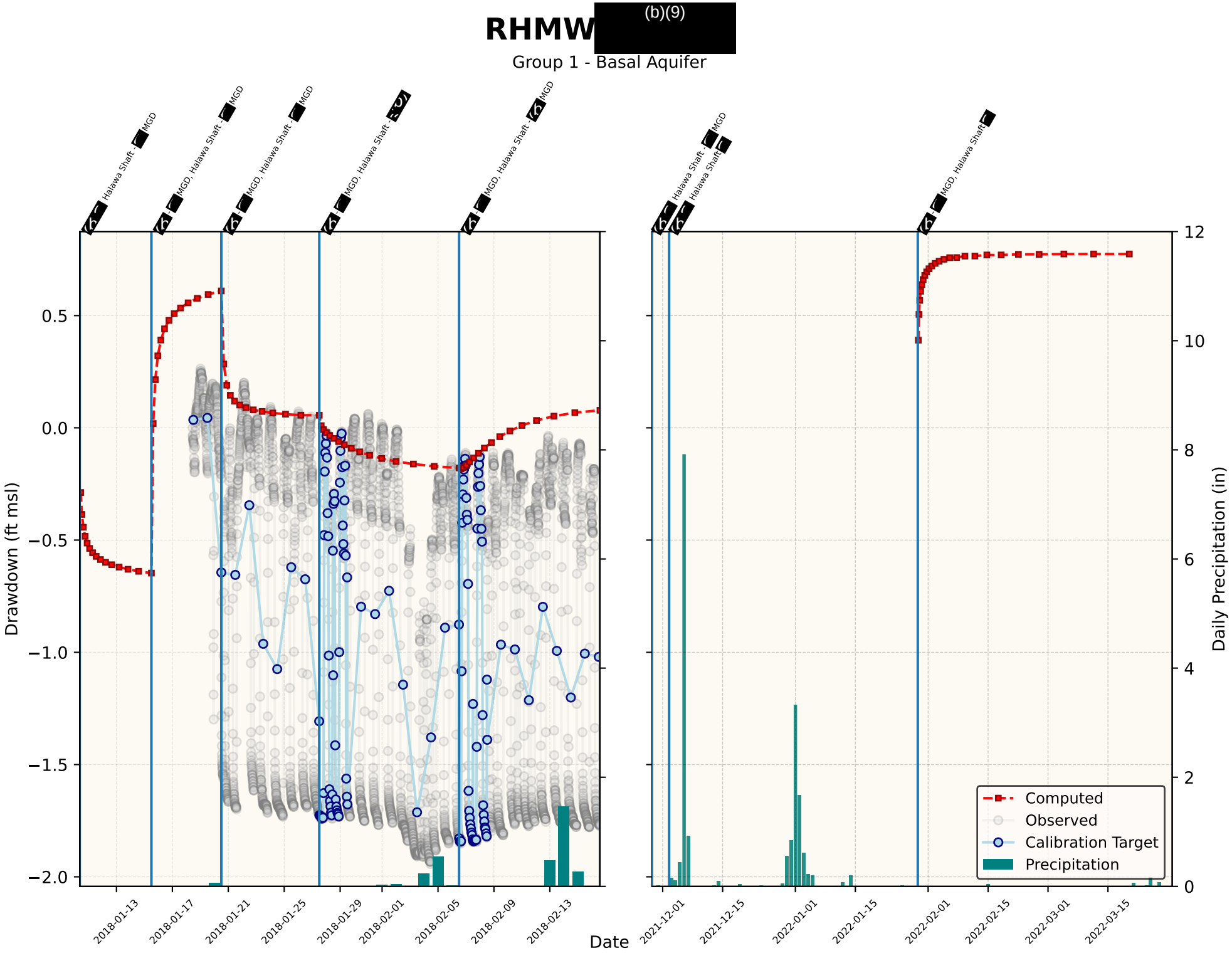


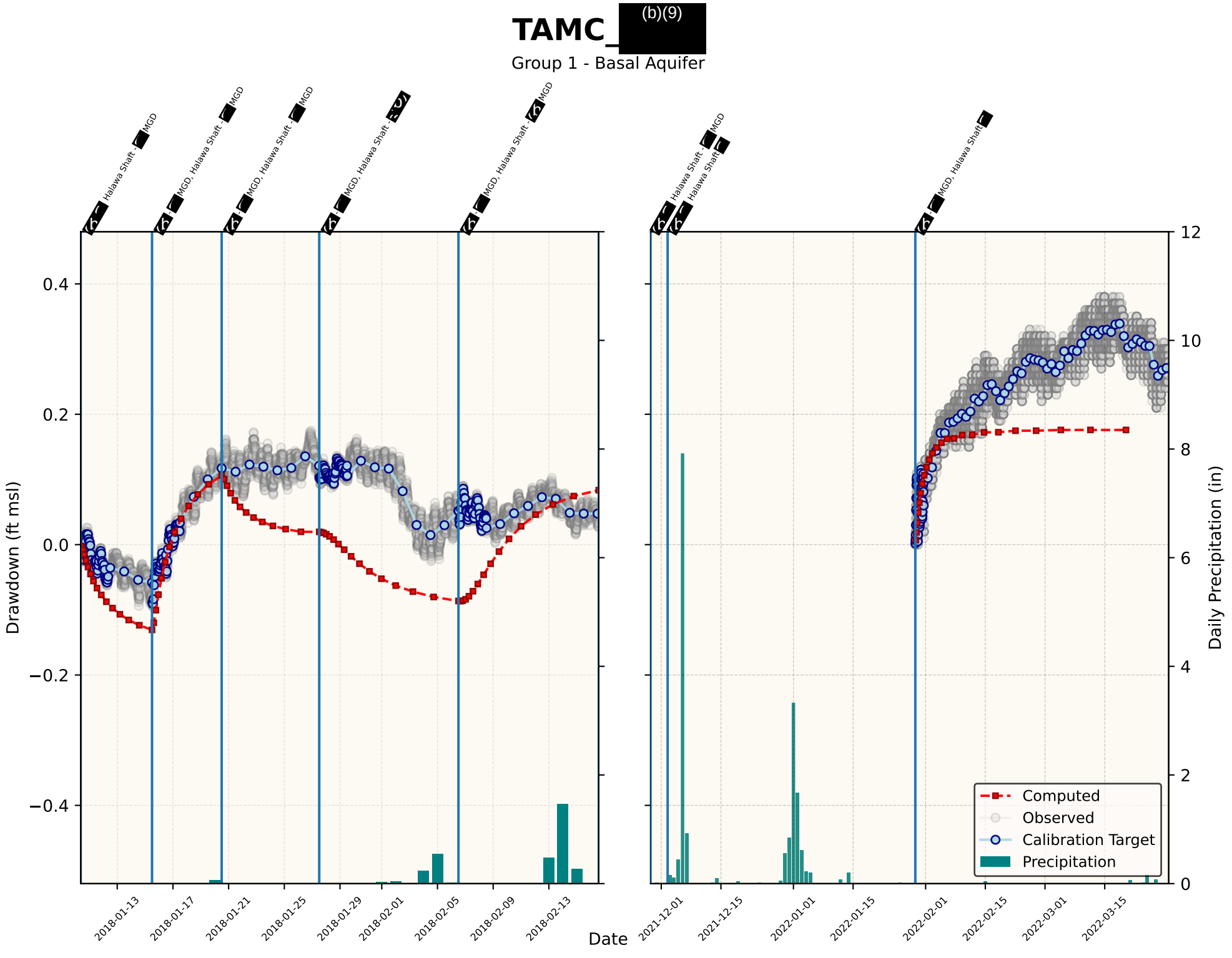

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

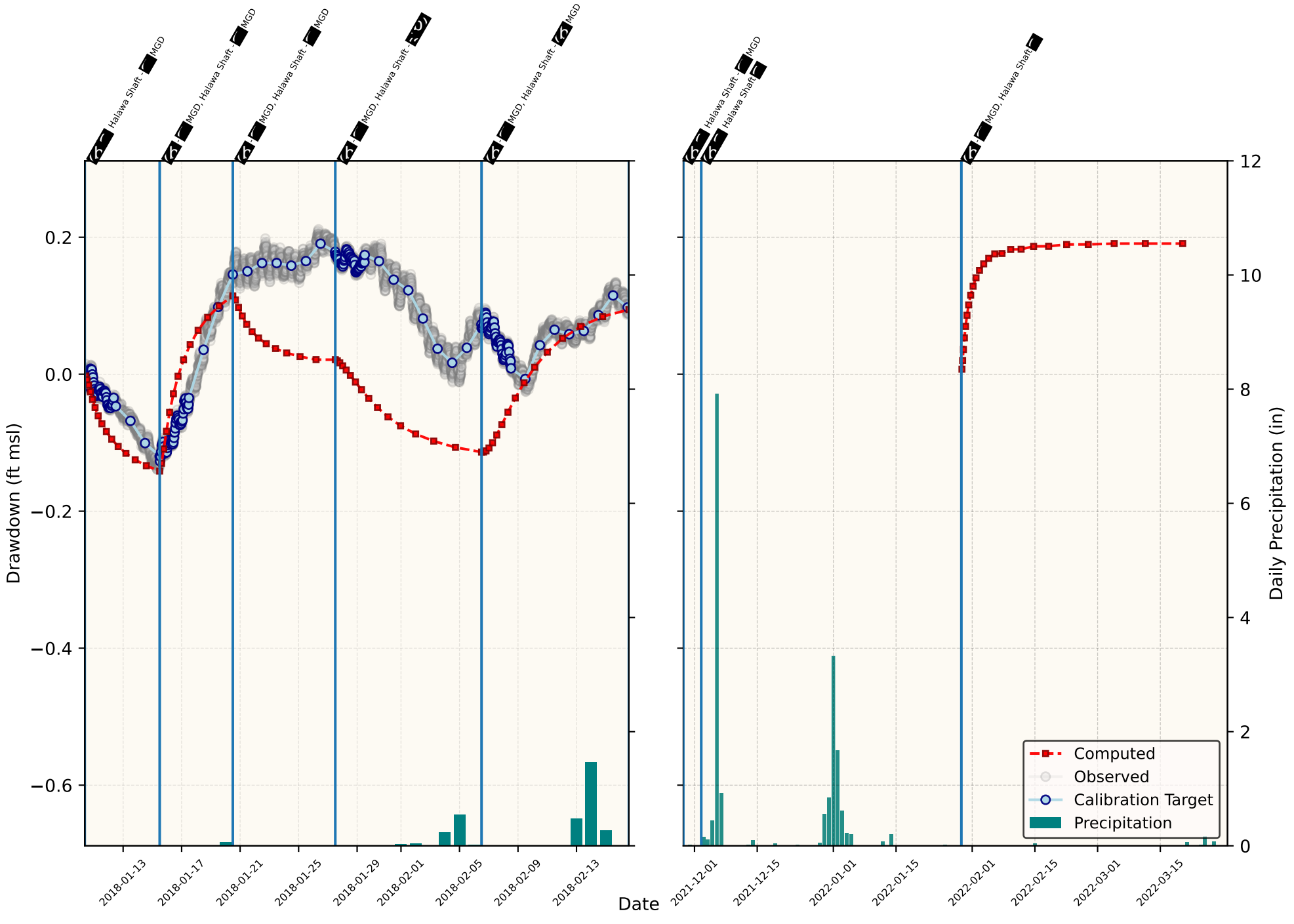

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

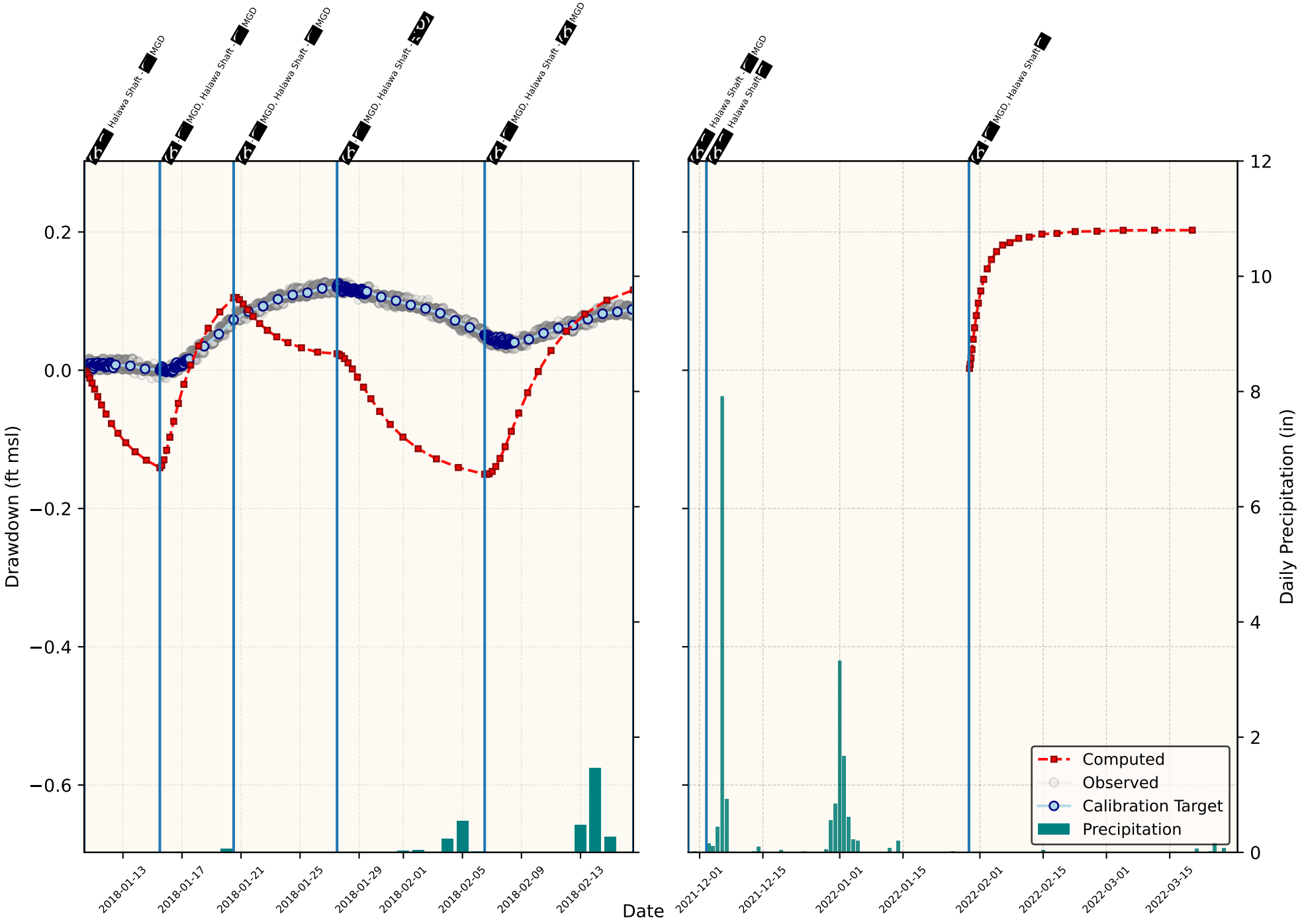

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

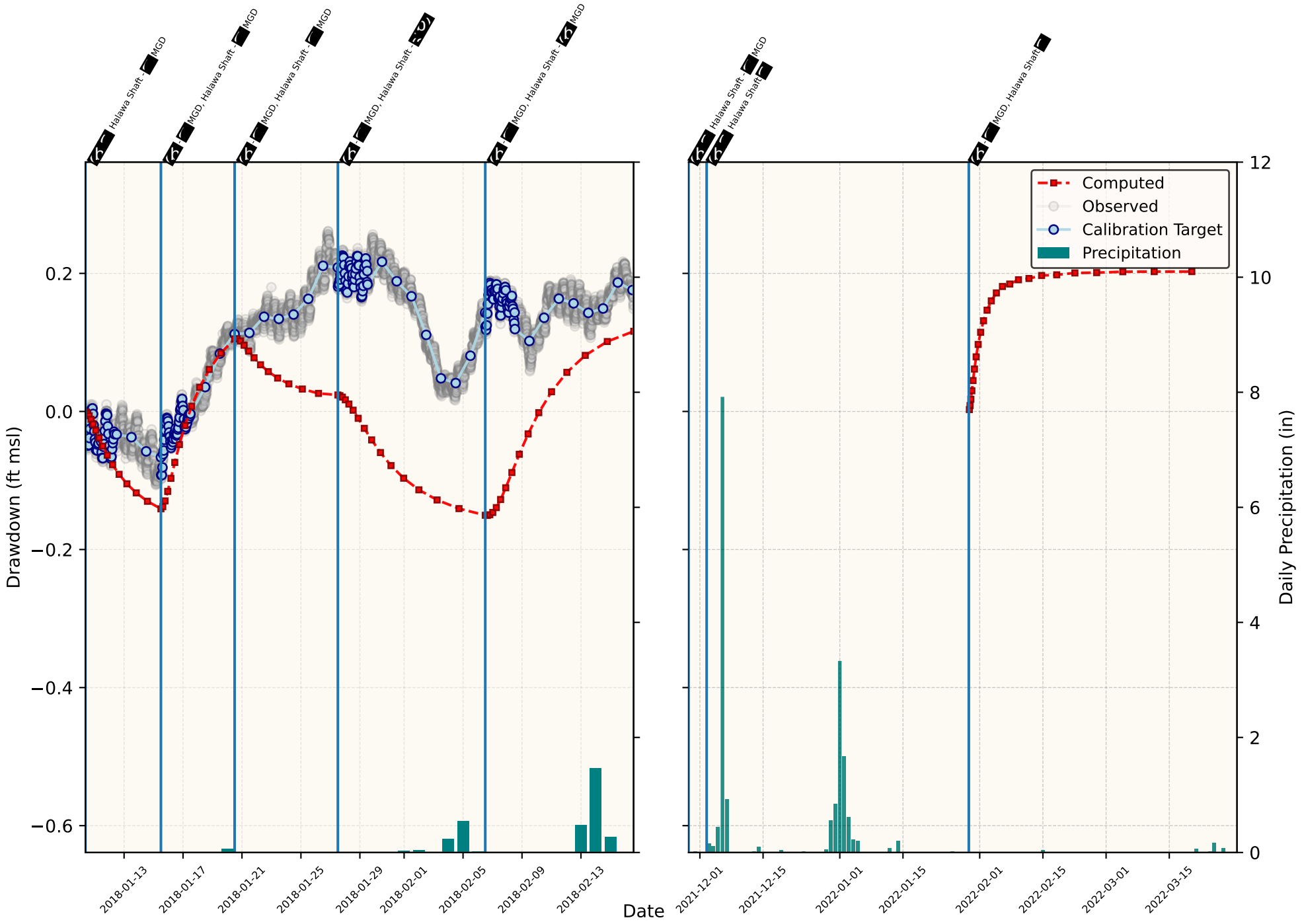

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation

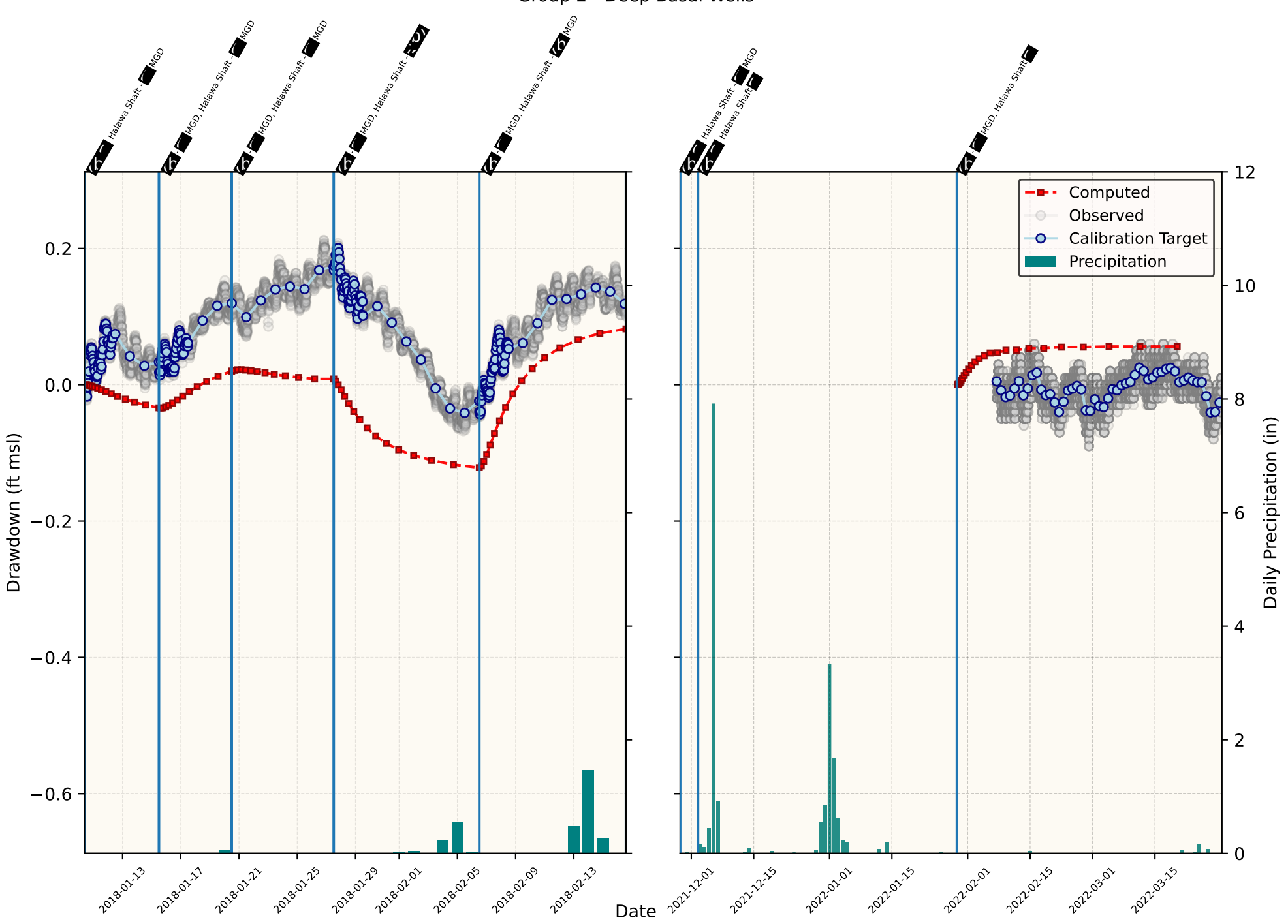

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft MGD
MGD, Halawa Shaft MGD
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.5
0.0
−0.5
−1.0
−1.5
−2.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


TAMC_ (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date


DH_43
Group 2 - Deep Basal Wells
Halawa Shaft 36 MGD
Halawa Shaft 36 MGD, Halawa Shaft 38 MGD
Halawa Shaft 36 MGD, Halawa Shaft 38 MGD
Halawa Shaft 36 MGD, Halawa Shaft 38 MGD
Halawa Shaft 36 MGD, Halawa Shaft 38 MGD
Halawa Shaft 36 MGD
Halawa Shaft 38 MGD
Halawa Shaft 36 MGD, Halawa Shaft 38 MGD
Drawdown (ft msl)
0.2
0.0
−0.2
−0.4
−0.6
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

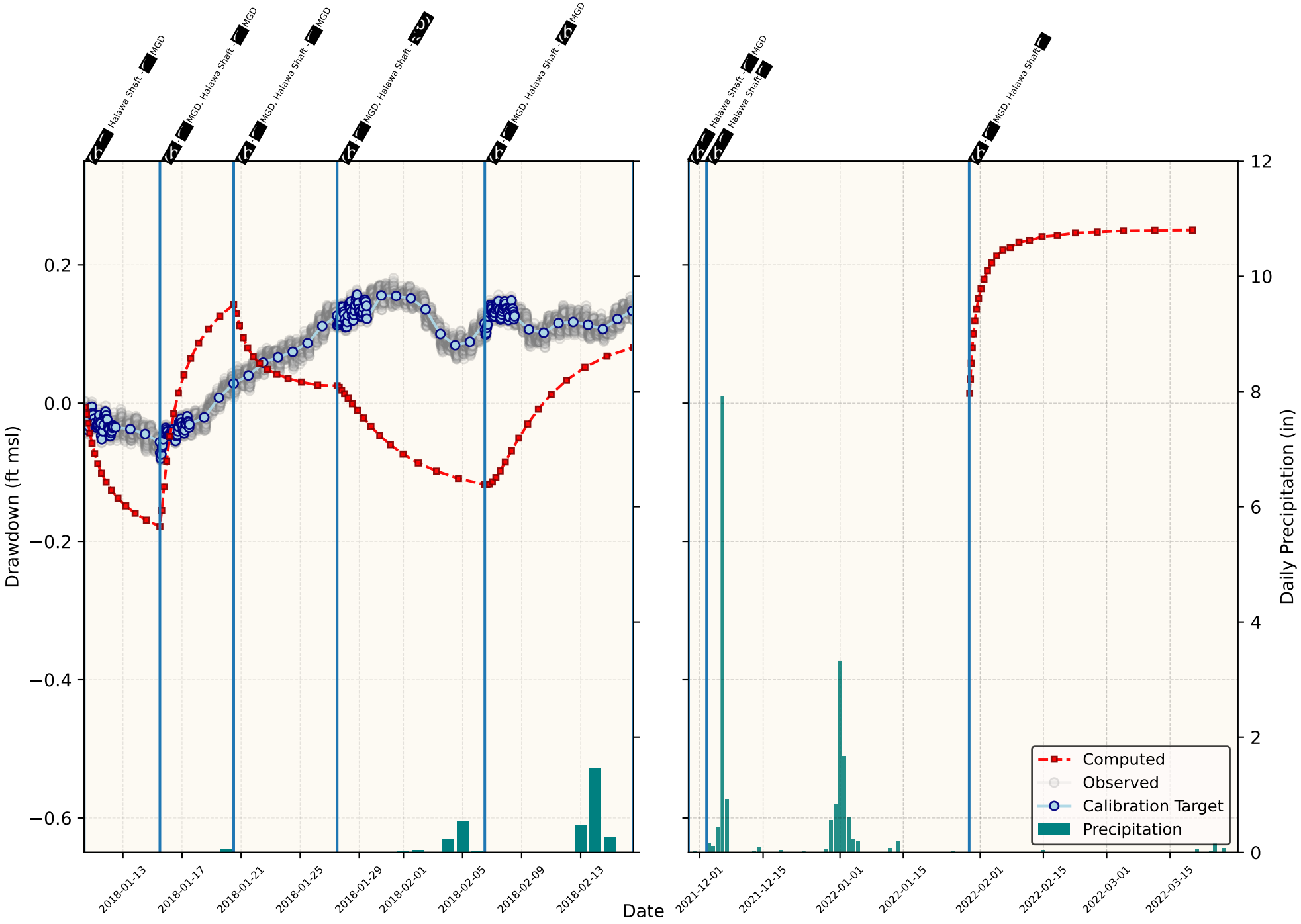

HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Halawa_Deep_Monitor_Well_HDMW2253-03
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

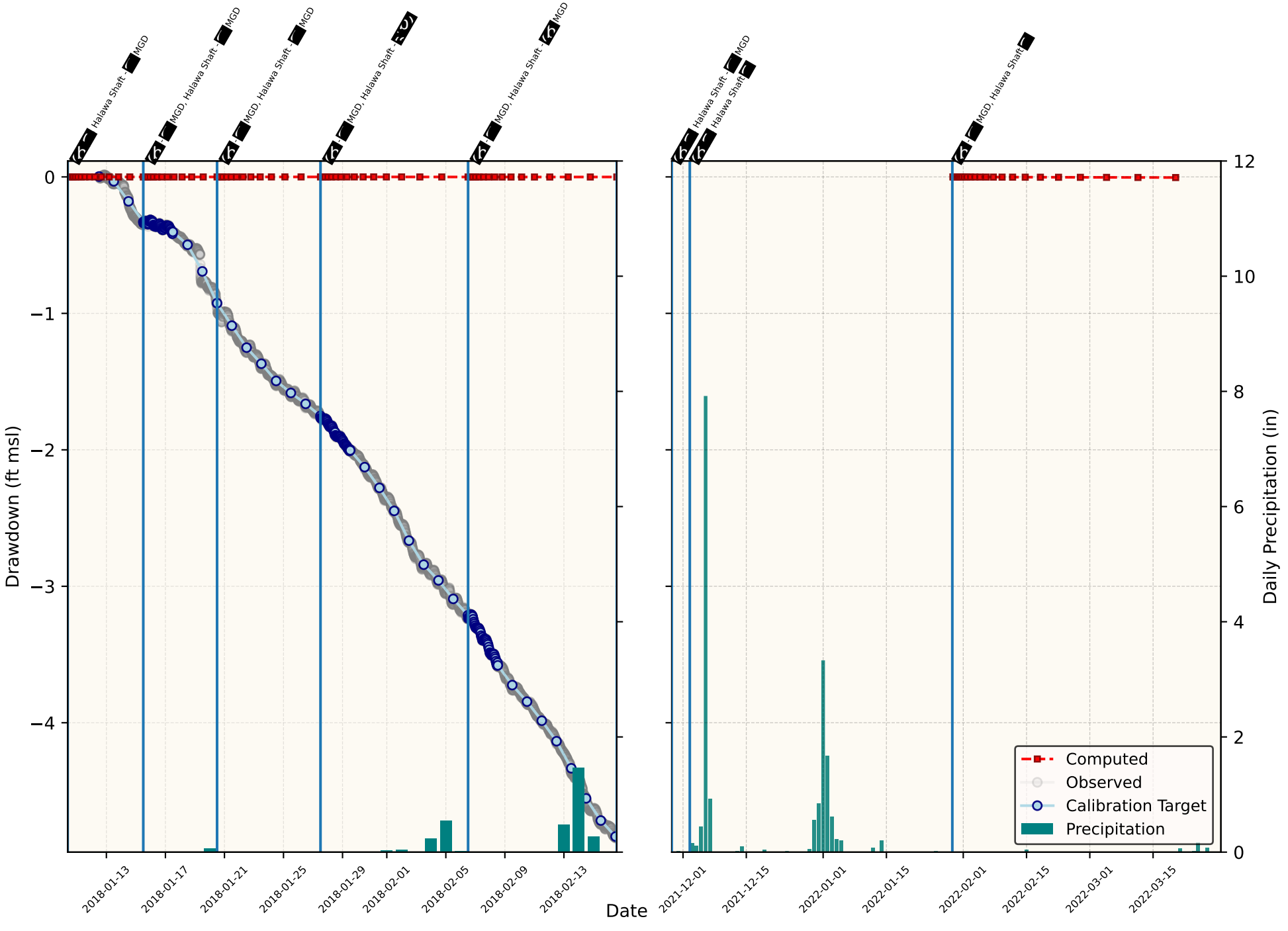
RHMW[redacted]

Group 3 - Saprolite/Confining Unit Well with Elevated Head



RHMW[redacted] (b)(9)

Group 3 - Saprolite/Confining Unit Well with Elevated Head



Groundwater Flow Model Calibration Evaluation Documents Sensitivity Scenario 2

Head Calibration Statistics

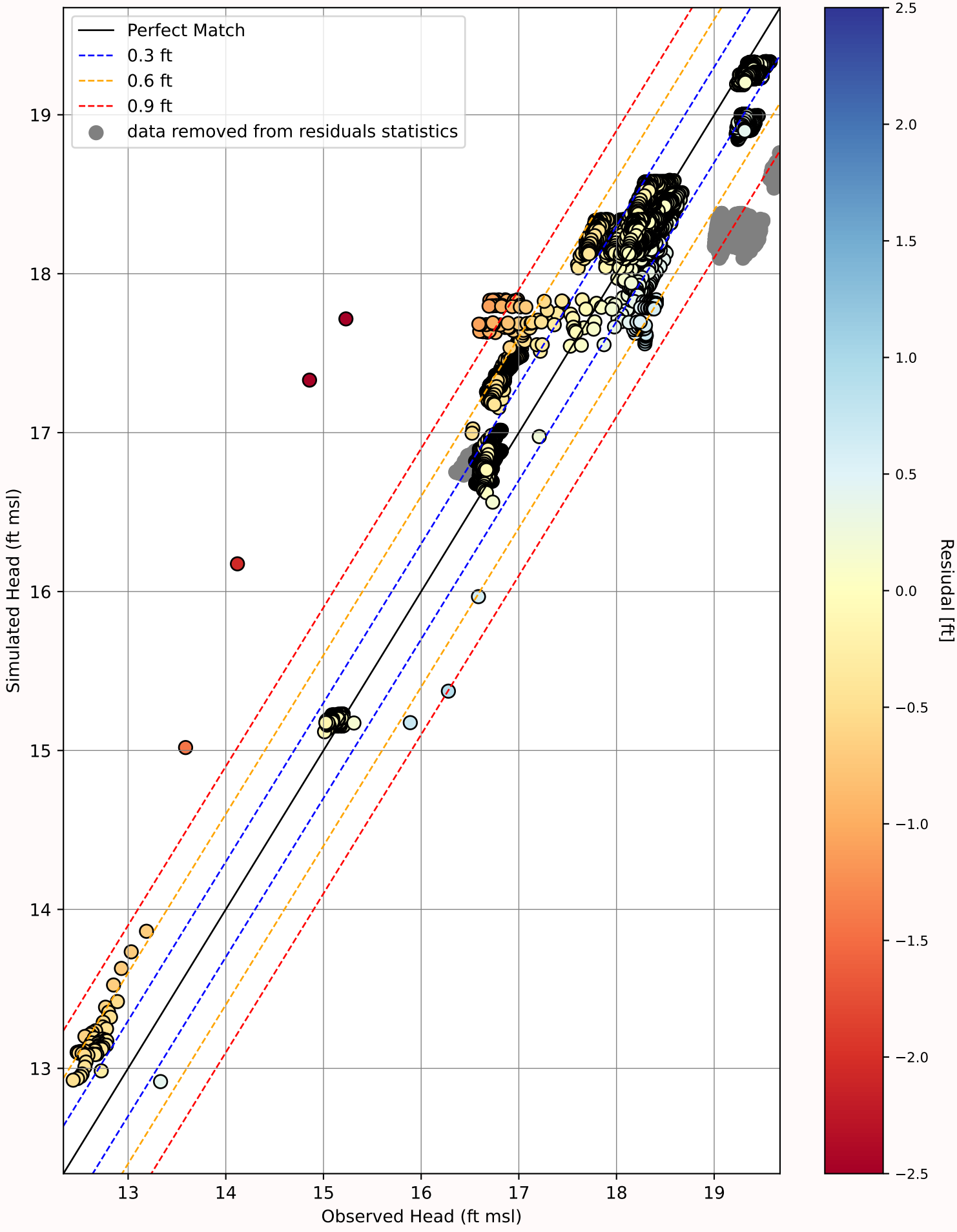
Wells	Basal Aquifer (Group 1)			Deep Wells (Group 2)	Confining Unit (Group 3)	Caprock (Group 4)	Cumulative
Time Period	2017/2018	2021/2022	All	All	All	All	All
Residual Mean (ft)	-0.04	-0.09	-0.08	0.57	19.46	0.42	0.94
Absolute Residual Mean (ft)	0.20	0.27	0.24	0.76	20.35	1.34	1.28
Residual Standard Deviation (ft)	0.27	0.32	0.32	0.61	21.41	1.79	6.33
Sum of Squared Residuals (ft2)	401.88	434.91	1081.64	761.09	476542.58	444.21	478829.52
RMSE Error (ft)	0.27	0.33	0.33	0.84	28.91	1.83	6.40
Minimum Residual (ft)	-2.49	-0.90	-2.49	-1.12	-9.87	-3.39	-9.87
Maximum Residual (ft)	0.91	0.68	2.24	1.33	57.81	6.65	57.81
Number of Observations	5459	3915	9928	1075	570	133	11706
Range in Observations	7.14	3.26	7.19	4.26	97.94	6.85	116.87
Scaled Residual Standard Deviation (ft)	3.8%	9.8%	(b)%	14.4%	21.9%	26.1%	5.4%
Scaled Absolute Residual Mean (ft)	2.8%	(b)%	3.4%	17.9%	20.8%	19.6%	1.1%
Scaled RMSE Error (ft)	3.8%	10.2%	4.6%	19.7%	29.5%	26.7%	5.5%
Scaled Residual Mean (ft)	-0.6%	-2.8%	-1.0%	13.5%	19.9%	6.1%	0.8%
Correlation Coefficient	0.97	0.91	0.95	0.99	0.93	-0.17	0.95

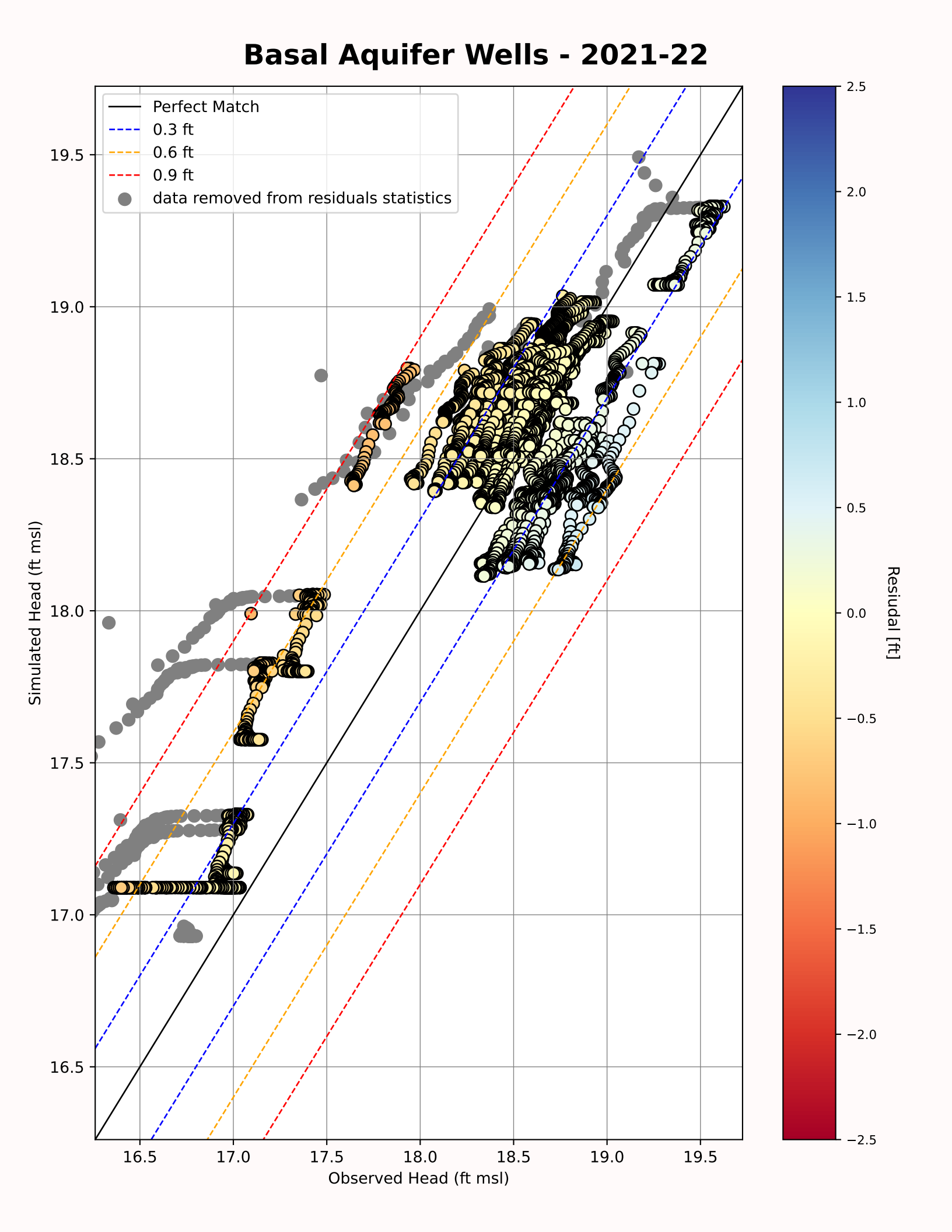
Drawdown Calibration Statistics

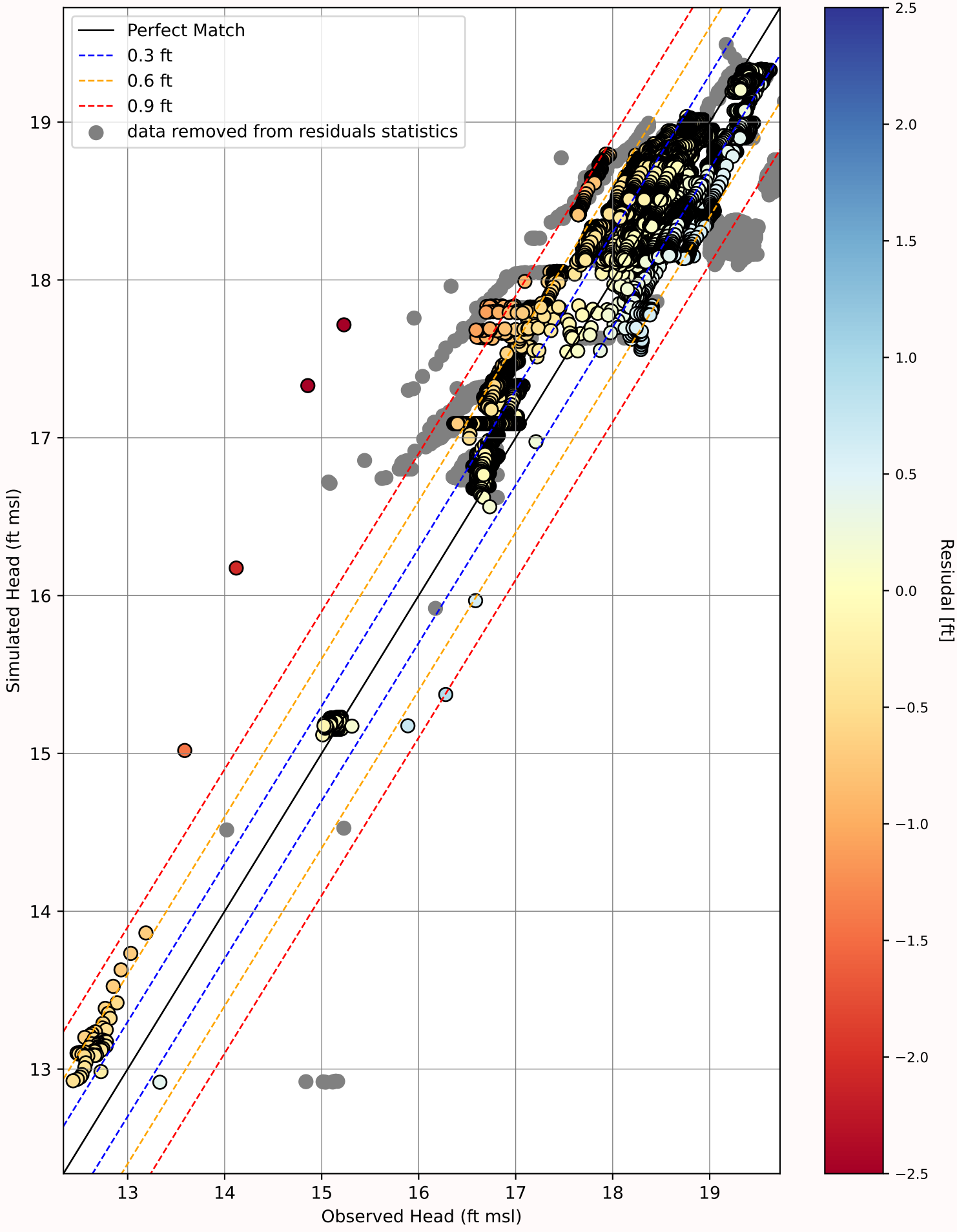
Wells	Basal Aquifer (Group 1)		
Time Period	**2017/2018**	**2021/2022**	**All**
Residual Mean (ft)	0.01	-0.02	0.00
Absolute Residual Mean (ft)	0.09	0.06	0.08
Residual Standard Deviation (ft)	0.21	0.10	0.18
Sum of Squared Residuals (ft2)	245.96	33.74	279.70
RMSE Error (ft)	0.21	0.10	0.18
Minimum Residual (ft)	-1.79	-0.38	-1.79
Maximum Residual (ft)	2.49	0.42	2.49
Number of Observations	5393	3533	8926
Range in Observations	4.76	0.68	4.76
Scaled Residual Standard Deviation (ft)	(b) %	14.3%	(b) %
Scaled Absolute Residual Mean (ft)	2.0%	9.0%	1.7%
Scaled RMSE Error (ft)	(b) %	14.5%	(b) %
Scaled Residual Mean (ft)	0.1%	-2.4%	-0.1%
Correlation Coefficient	0.83	0.73	0.85

Conceptual Water Budget Comparison

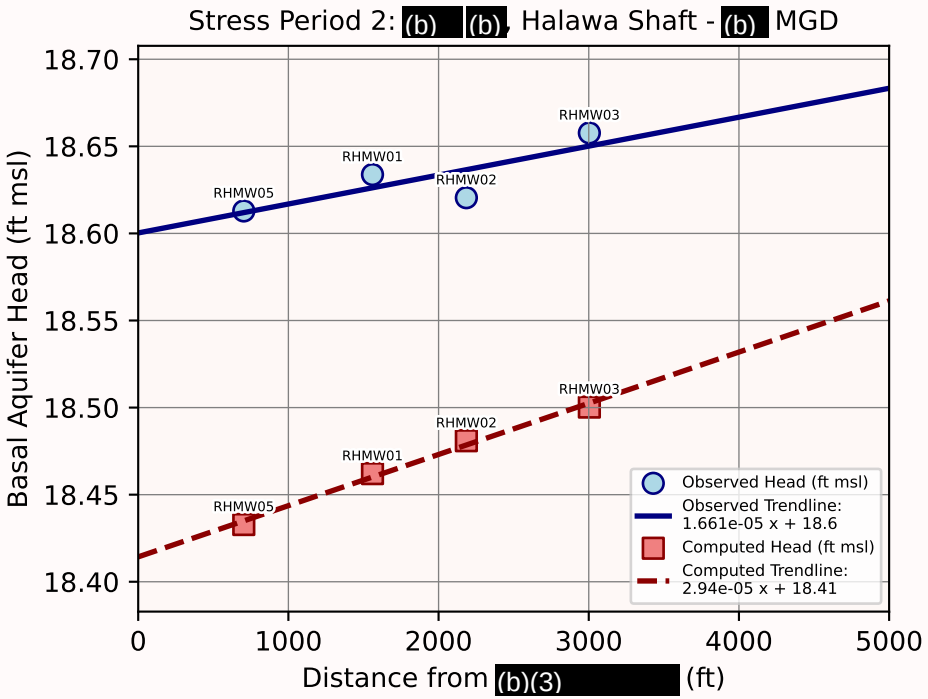
Type	Stress Period	Recharge (MGD)	Dike Region Inflow (MGD)	Well Discharge (MGD)	Spring Discharge (MGD)	Caprock Discharge (MGD)	Inflow from Adjacent Watershed (MGD)	Outflow to Adjacent Watershed (MGD)	Storage (MGD)	Total Inflows (MGD)	Total Outflows (MGD)
Conceptual	1	25.1	22.2	32.0	13.6	2.4	-1.3	-2.0	0.0	46.0	46.0
Simulated	1	25.1	22.2	32.3	14.6	3.4	14.9	11.9	0.0	62.1	62.2
Difference	1	0.0	0.0	0.3	0.9	1.0	16.2	14.0	0.0	16.2	16.3
Conceptual	2	25.1	22.2	28.4	13.6	2.4	-1.3	1.6	0.0	46.0	46.0
Simulated	2	25.1	22.2	28.4	14.8	3.4	13.8	12.7	-1.8	61.0	61.0
Difference	2	0.0	0.0	0.0	1.2	1.0	15.1	11.0	-1.8	15.1	15.1
Conceptual	3	25.2	22.3	36.1	13.5	2.4	-1.2	-5.7	0.0	46.2	46.2
Simulated	3	25.2	22.3	36.1	14.5	3.4	15.4	11.9	2.9	65.8	65.9
Difference	3	0.0	0.0	0.0	1.0	1.0	16.6	17.6	2.9	19.6	19.7
Conceptual	4	25.2	22.3	32.4	13.5	2.4	-1.2	-2.2	0.0	46.2	46.2
Simulated	4	25.2	22.3	32.5	14.5	3.4	15.2	11.7	-0.5	62.7	62.6
Difference	4	0.0	0.0	0.0	1.0	1.0	16.4	13.8	-0.5	16.5	16.4
Conceptual	5	25.2	22.3	25.7	13.7	2.4	(b	(b	0.0	48.1	48.1
Simulated	5	25.2	22.3	25.7	15.4	3.4	13.9	15.4	-1.3	61.3	61.2
Difference	5	0.0	0.0	0.0	1.7	1.0	13.2	9.1	-1.3	13.2	13.1
Conceptual	6	27.6	24.4	37.7	13.6	2.4	2.0	0.3	0.0	54.1	54.1
Simulated	6	27.6	24.4	37.8	14.4	3.4	14.6	12.4	1.3	67.9	68.0
Difference	6	0.0	0.0	0.0	0.8	1.1	12.5	(b)	1.3	13.8	13.9
Conceptual	7	25.4	22.4	32.0	13.4	2.4	0.2	0.2	0.0	48.0	48.0
Simulated	7	25.4	22.4	32.0	14.4	3.4	13.7	11.8	0.0	61.6	61.6
Difference	7	0.0	0.0	0.0	1.1	1.0	13.5	11.6	0.0	13.6	13.6
Conceptual	8	25.4	22.4	30.1	12.6	2.4	-1.2	1.6	0.0	46.7	46.7
Simulated	8	25.4	22.4	30.1	14.5	3.4	13.7	11.7	-1.8	61.6	61.6
Difference	8	0.0	0.0	0.0	1.9	1.0	14.9	10.1	-1.8	14.9	15.0
Conceptual	9	29.7	26.3	21.8	13.7	2.4	-1.0	17.1	0.0	55.0	55.0
Simulated	9	29.7	26.3	21.8	16.4	3.5	7.6	21.6	-0.4	63.6	63.7
Difference	9	0.0	0.0	0.0	2.8	1.1	8.7	(b	-0.4	8.7	8.8
Conceptual	10	26.8	23.7	26.3	13.9	2.5	4.4	(b)	0.0	54.8	54.8
Simulated	10	26.8	23.7	26.3	15.6	3.5	11.9	17.0	-0.1	62.3	62.5
Difference	10	0.0	0.0	0.0	1.6	1.0	7.5	4.9	-0.1	7.5	(b

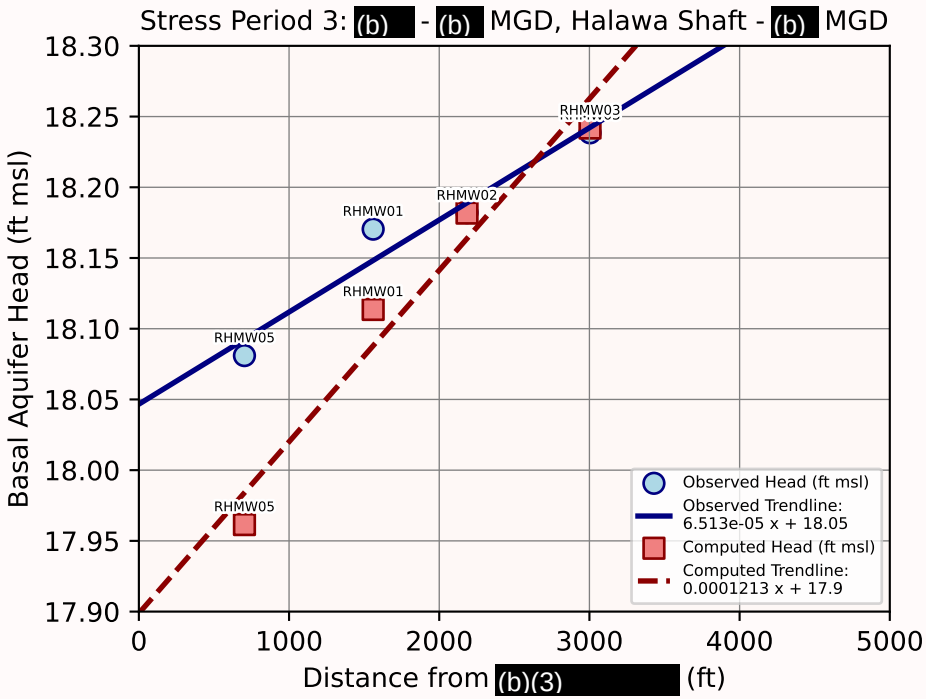

Basal Aquifer Wells - 2017-18
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

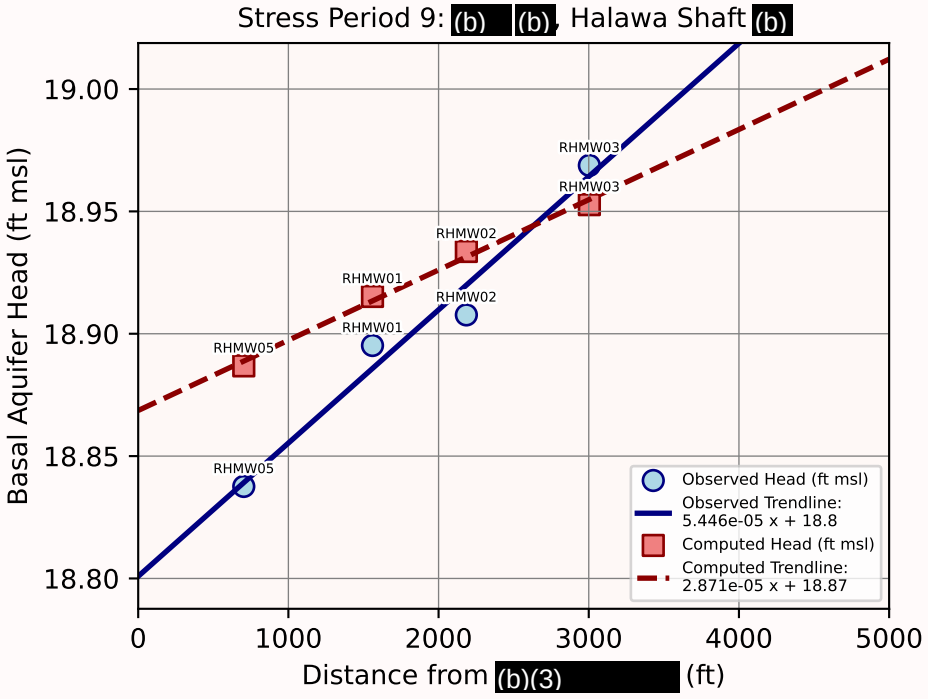

Basal Aquifer Wells - 2021-22
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
16.5
17.0
17.5
18.0
18.5
19.0
19.5
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

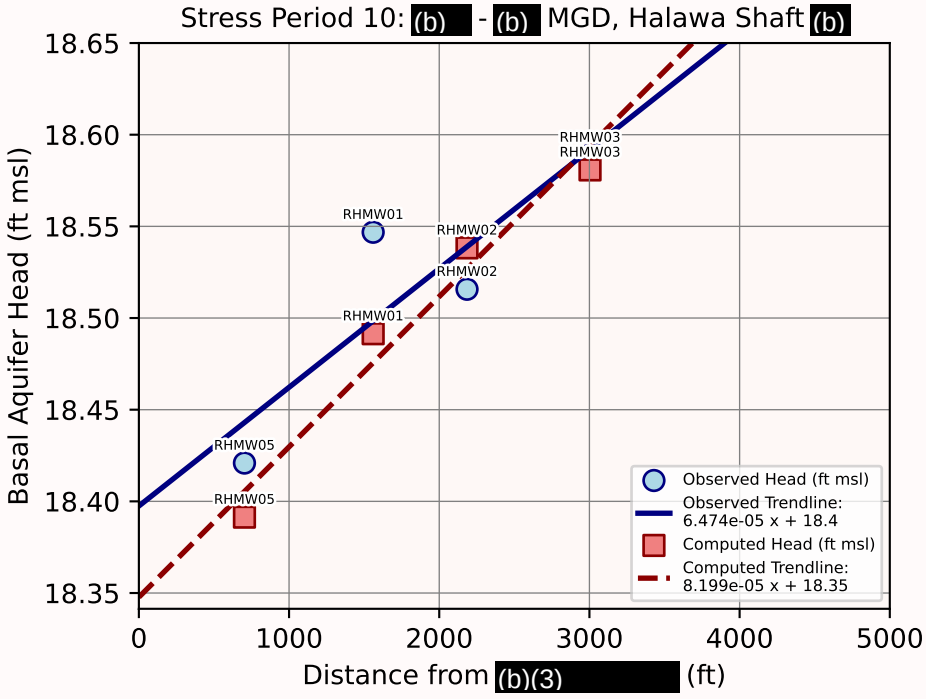

Basal Aquifer Wells - All
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

Gradients Along Red Hill Ridge

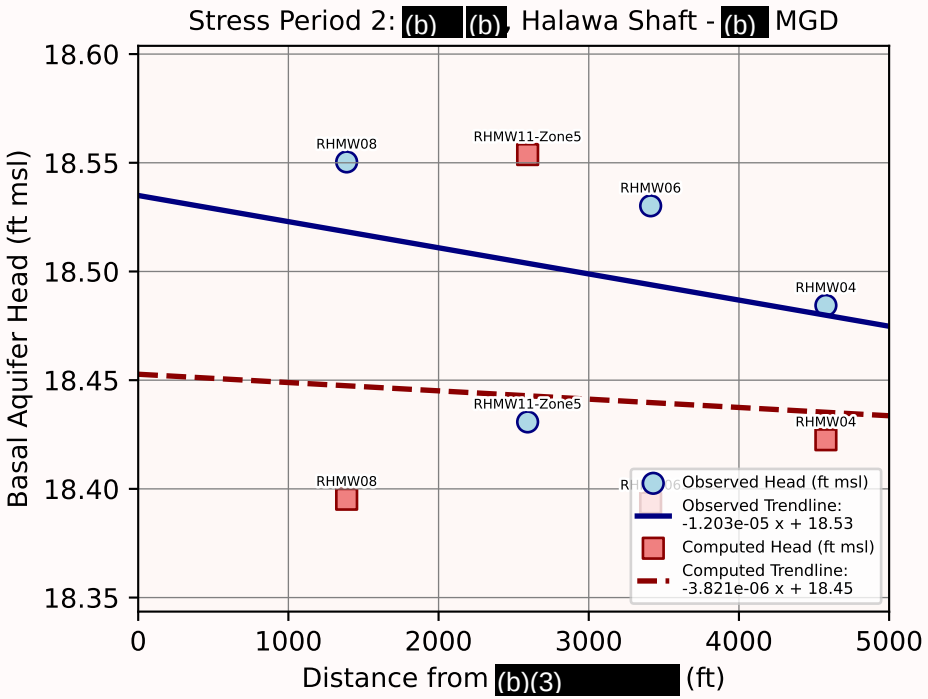


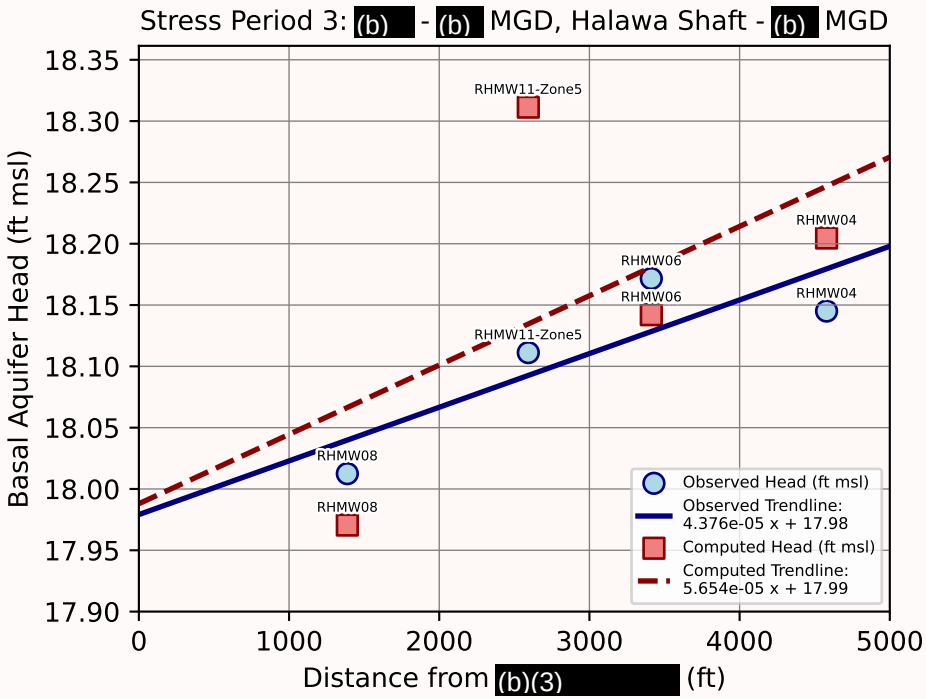


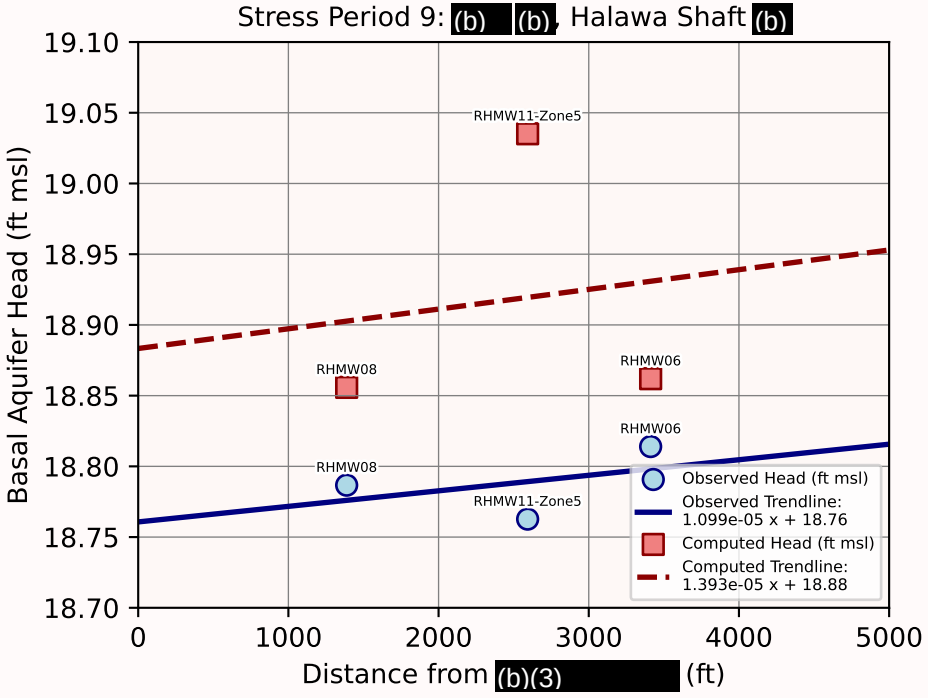


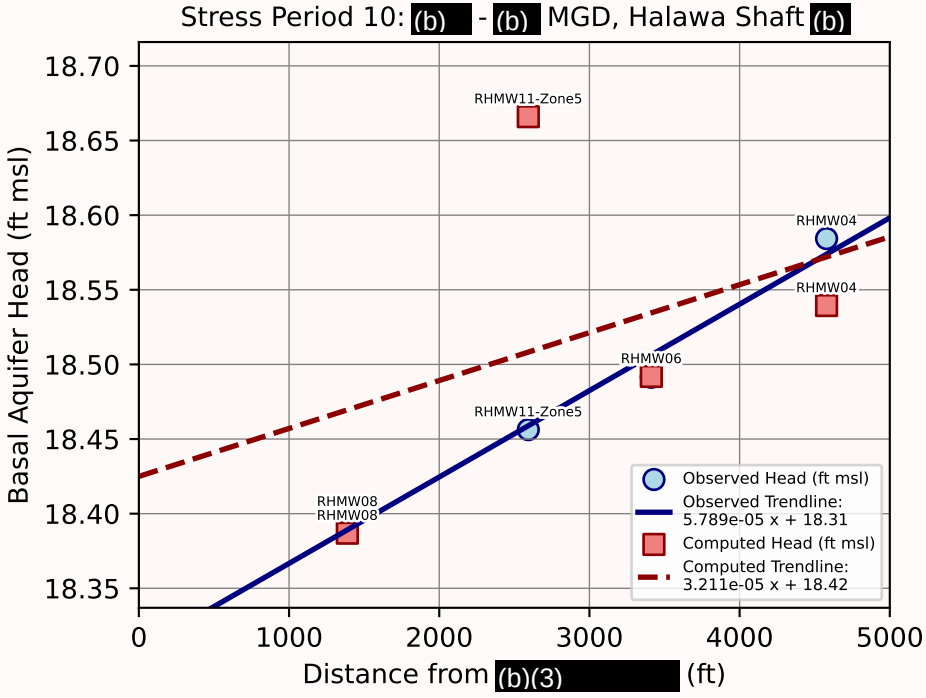


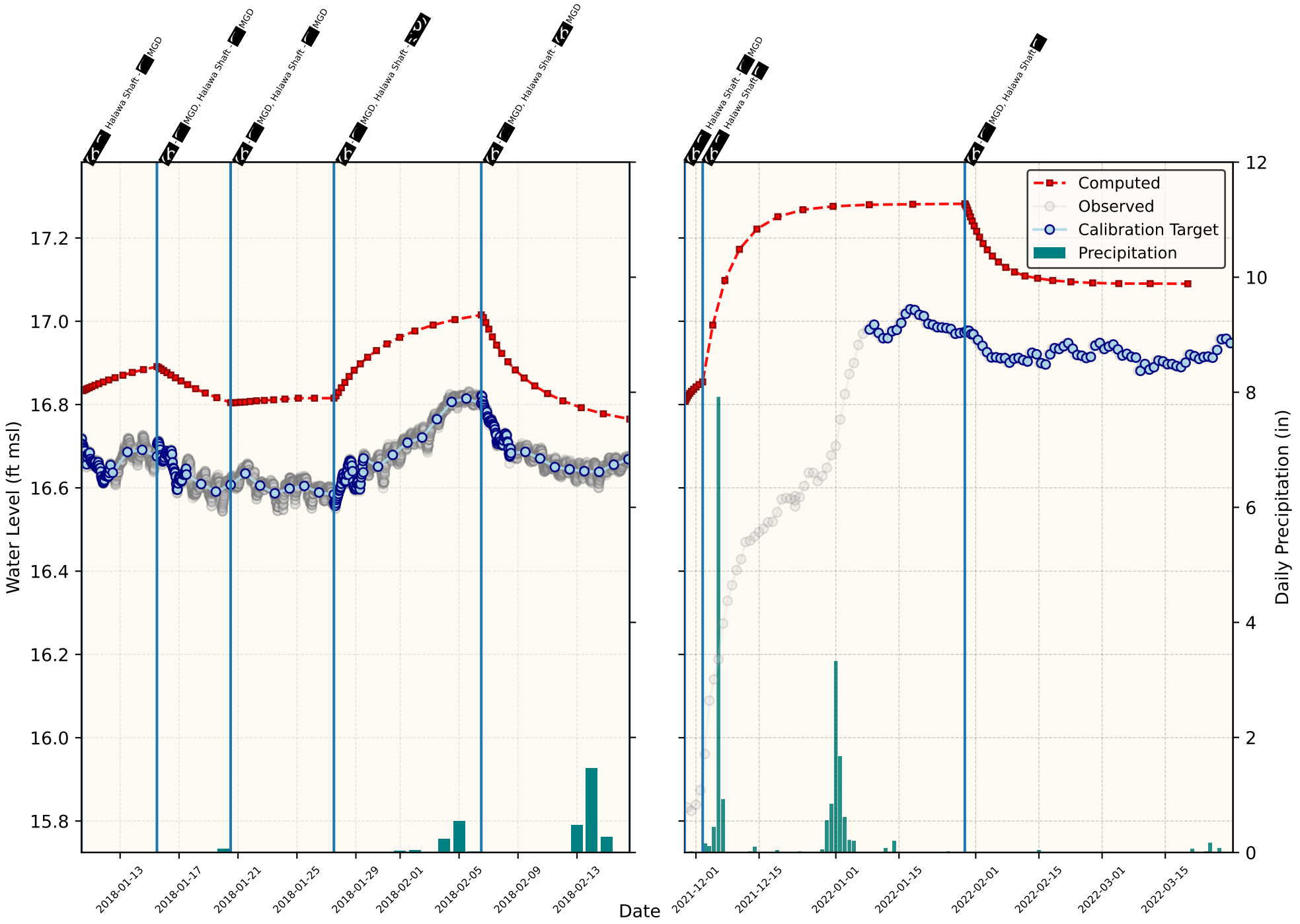
Gradients Northwest of Red Hill Ridge





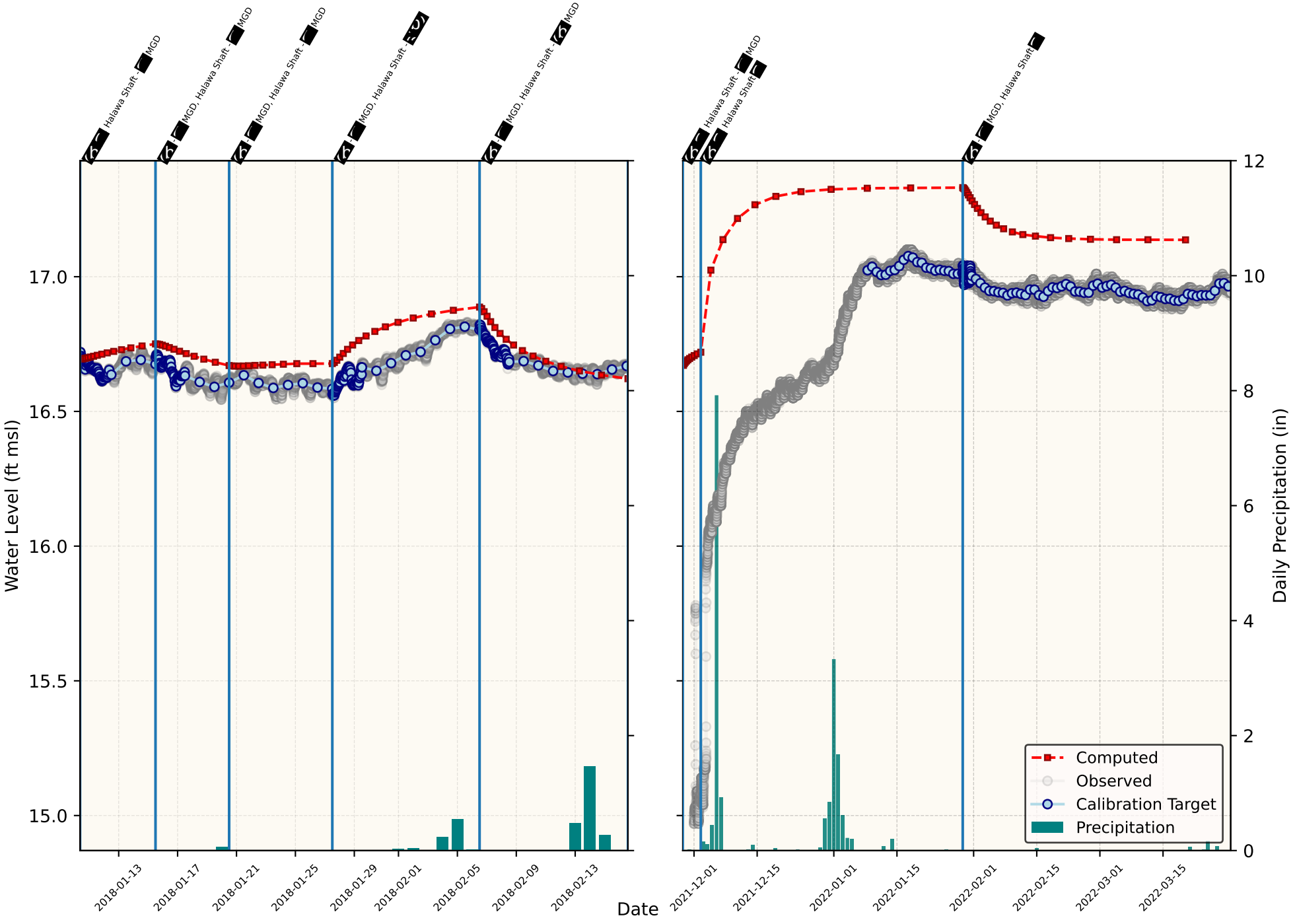


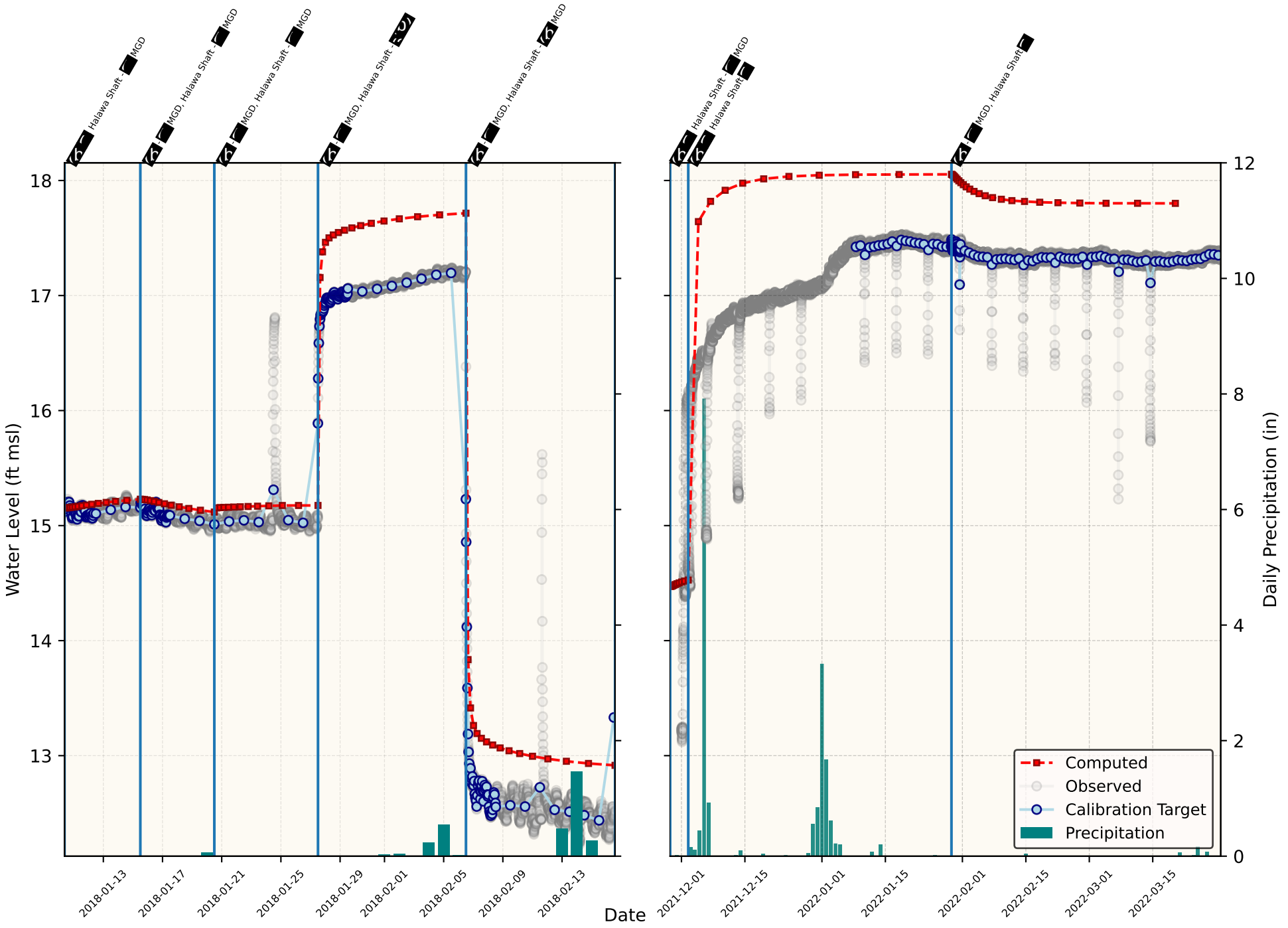


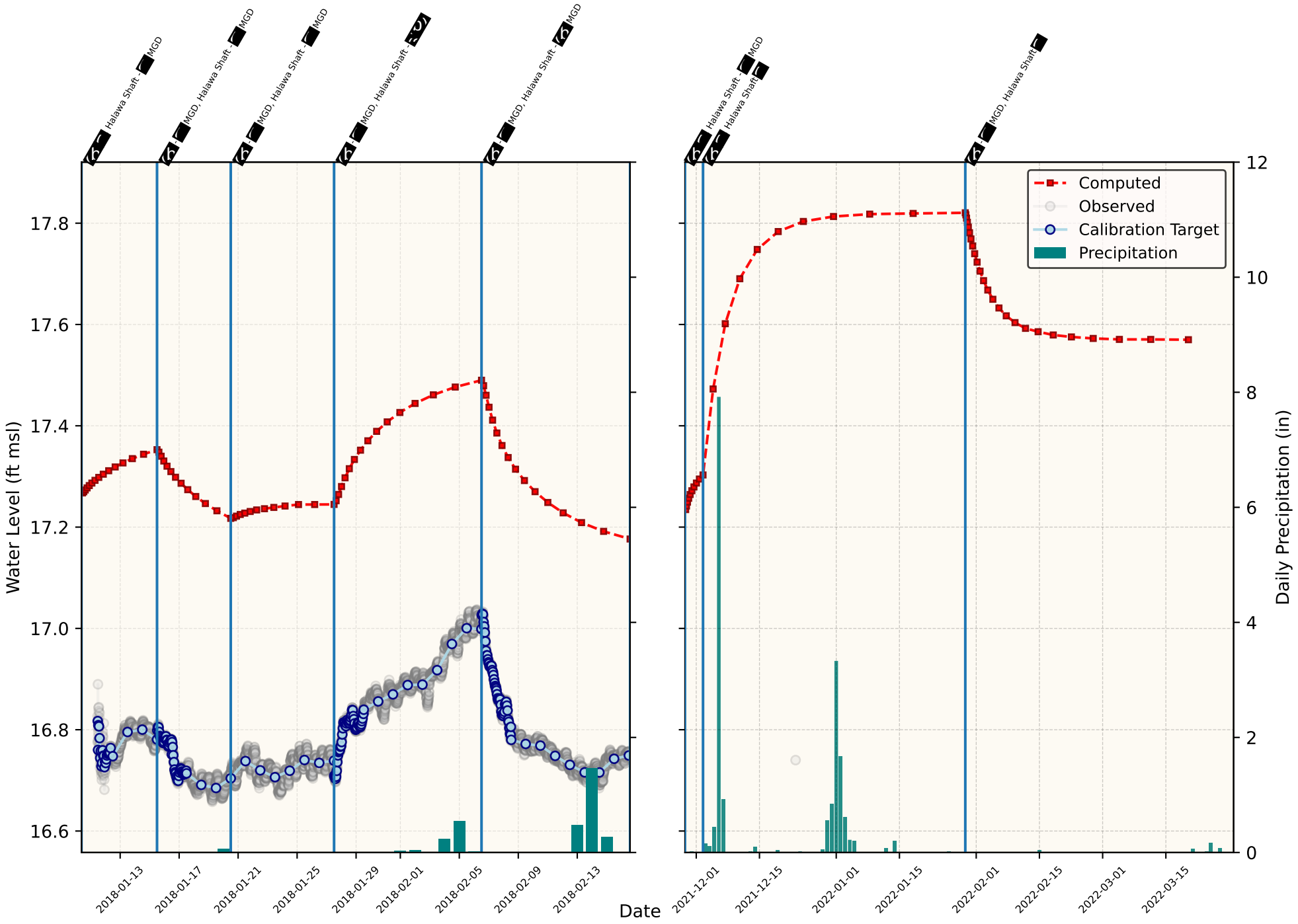

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
17.2
17.0
16.8
16.6
16.4
16.2
16.0
15.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

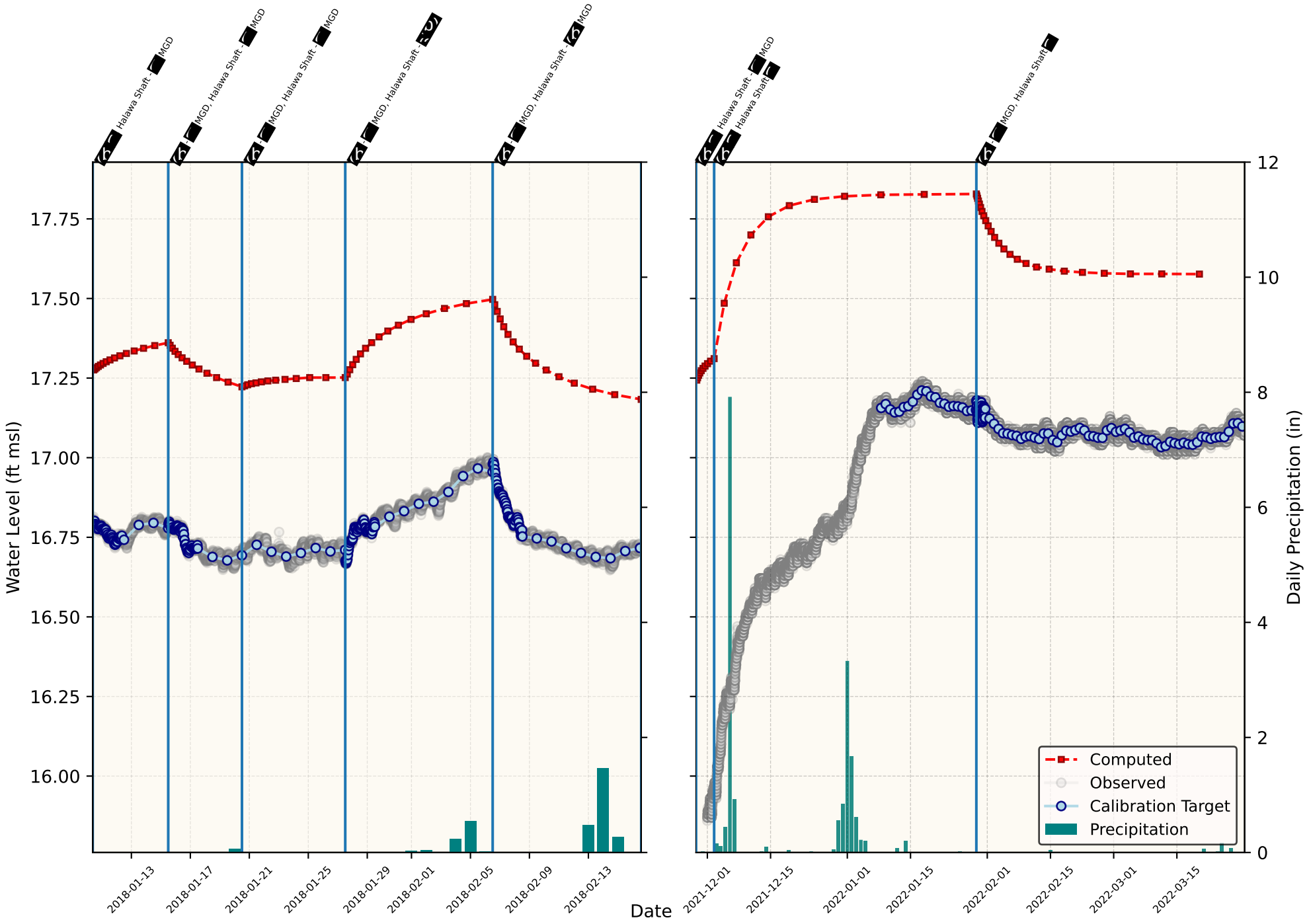
(b)(3) [redacted]

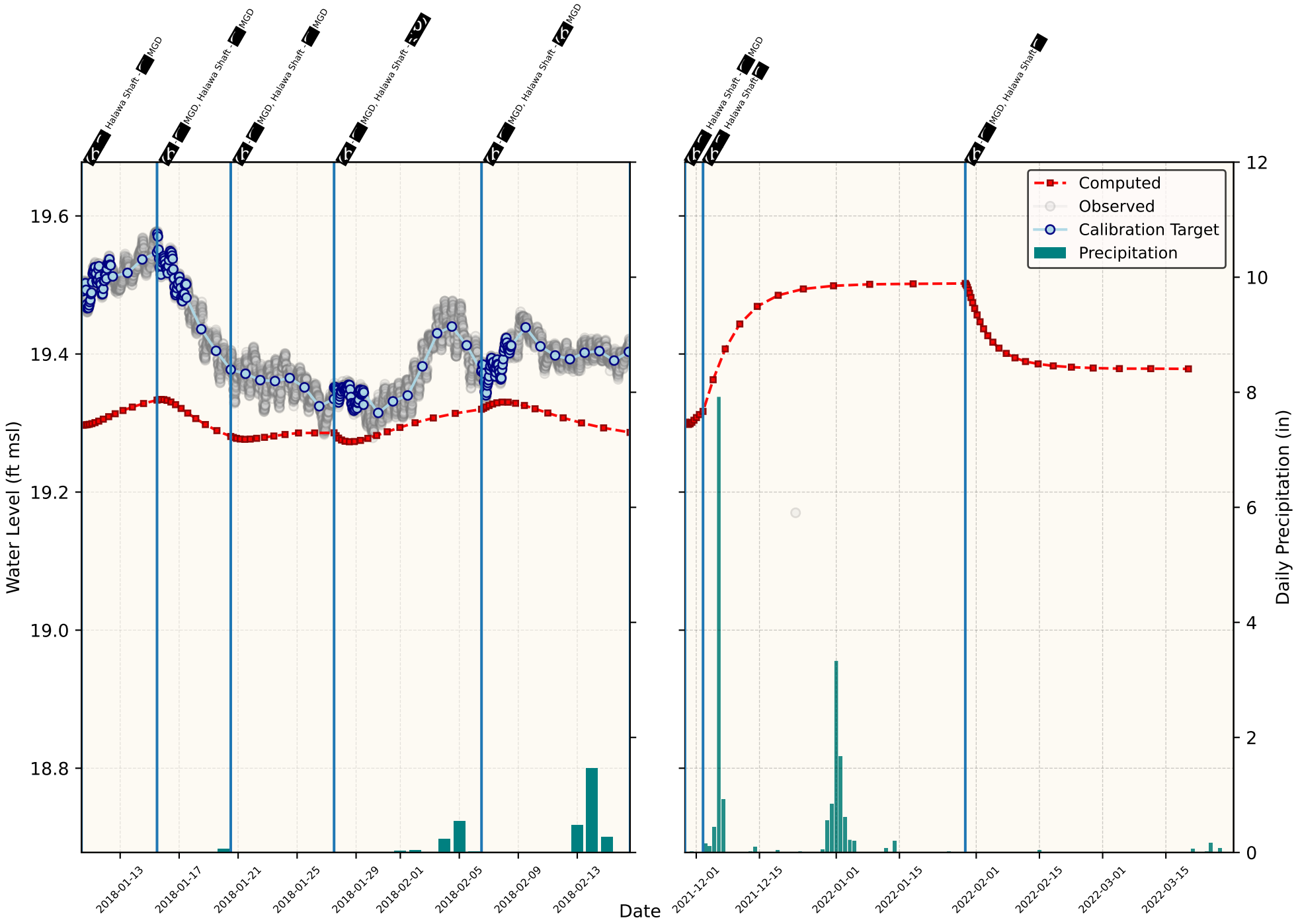
Group 1 - Basal Aquifer

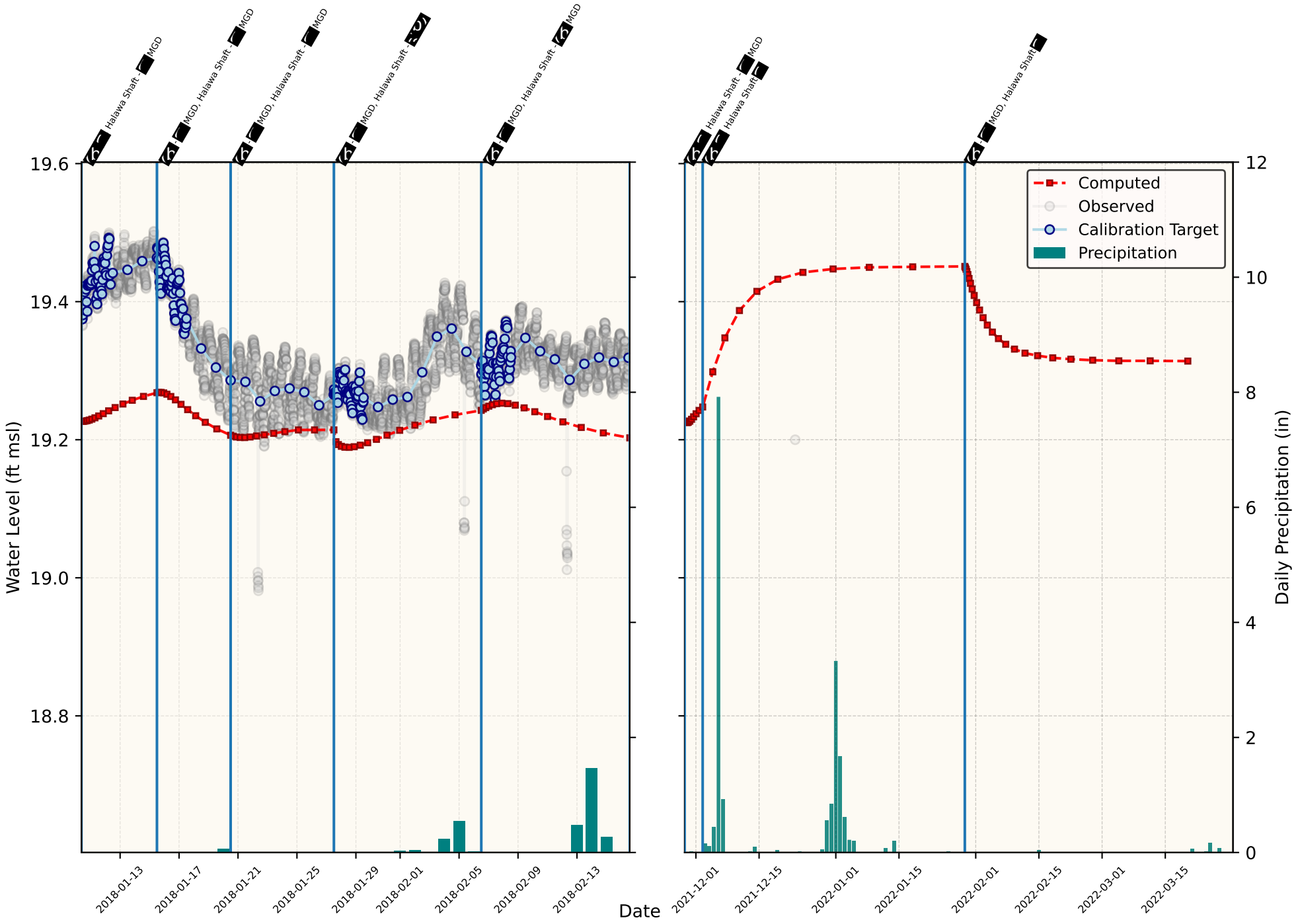


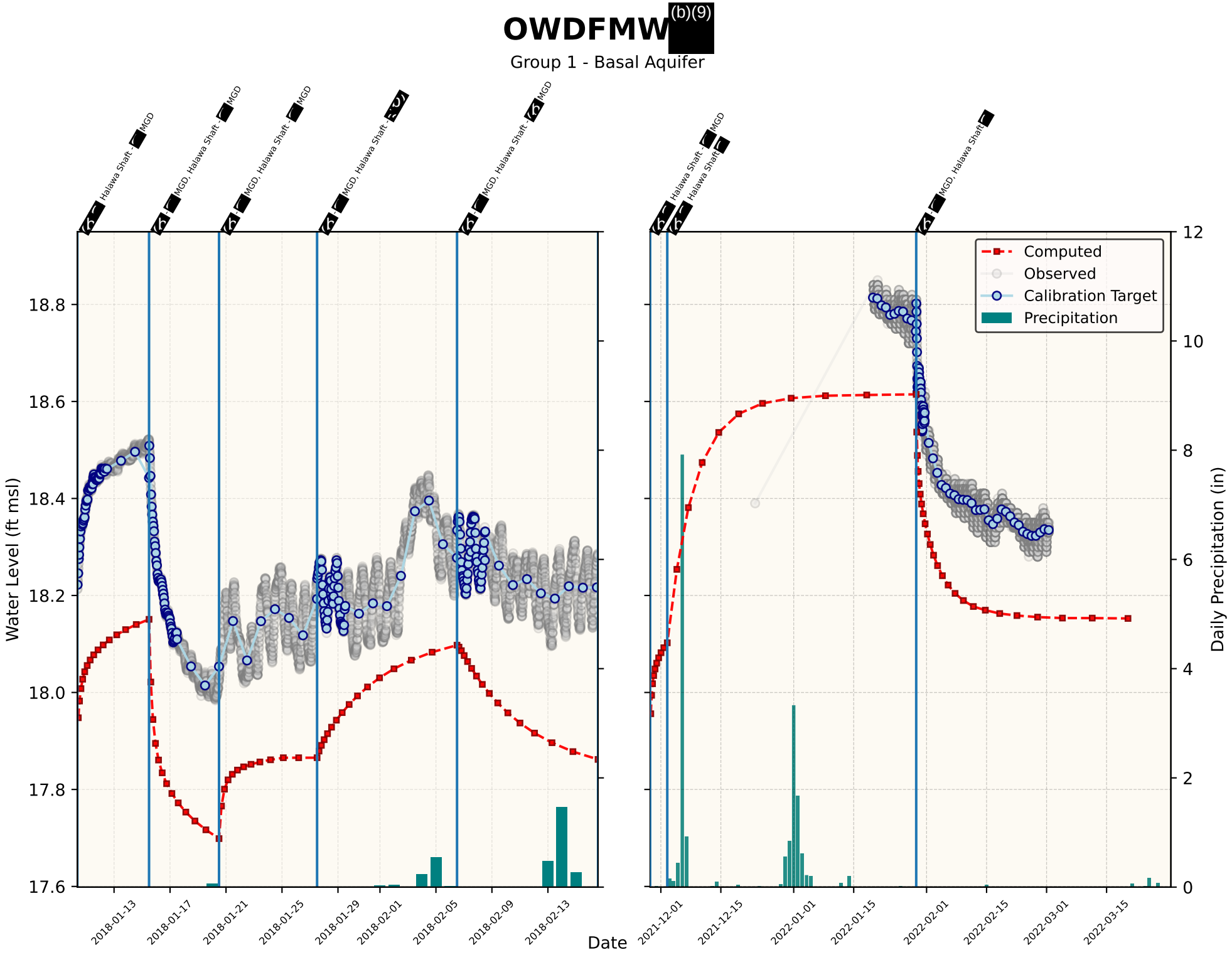

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

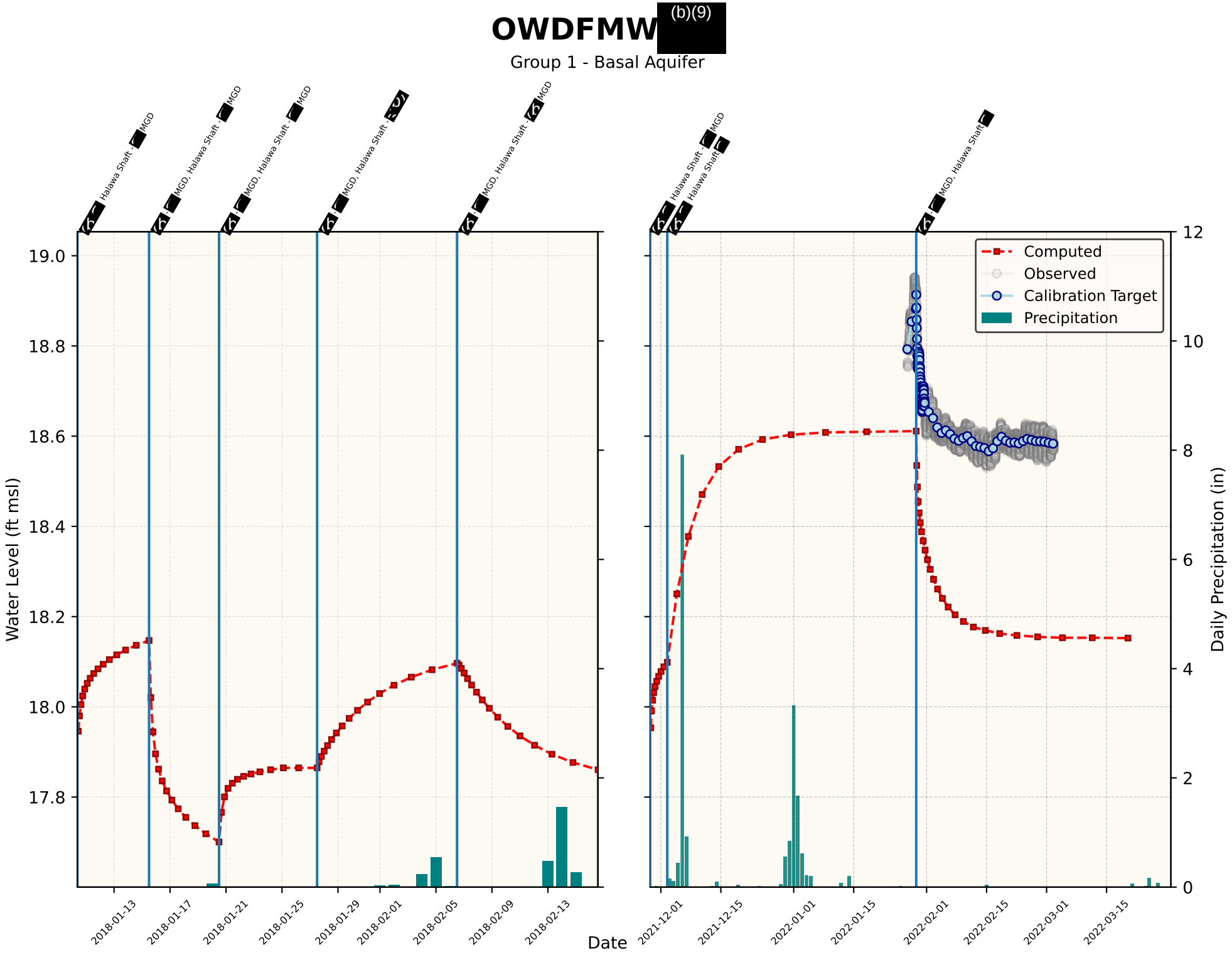

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
17.8
17.6
17.4
17.2
17.0
16.8
16.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

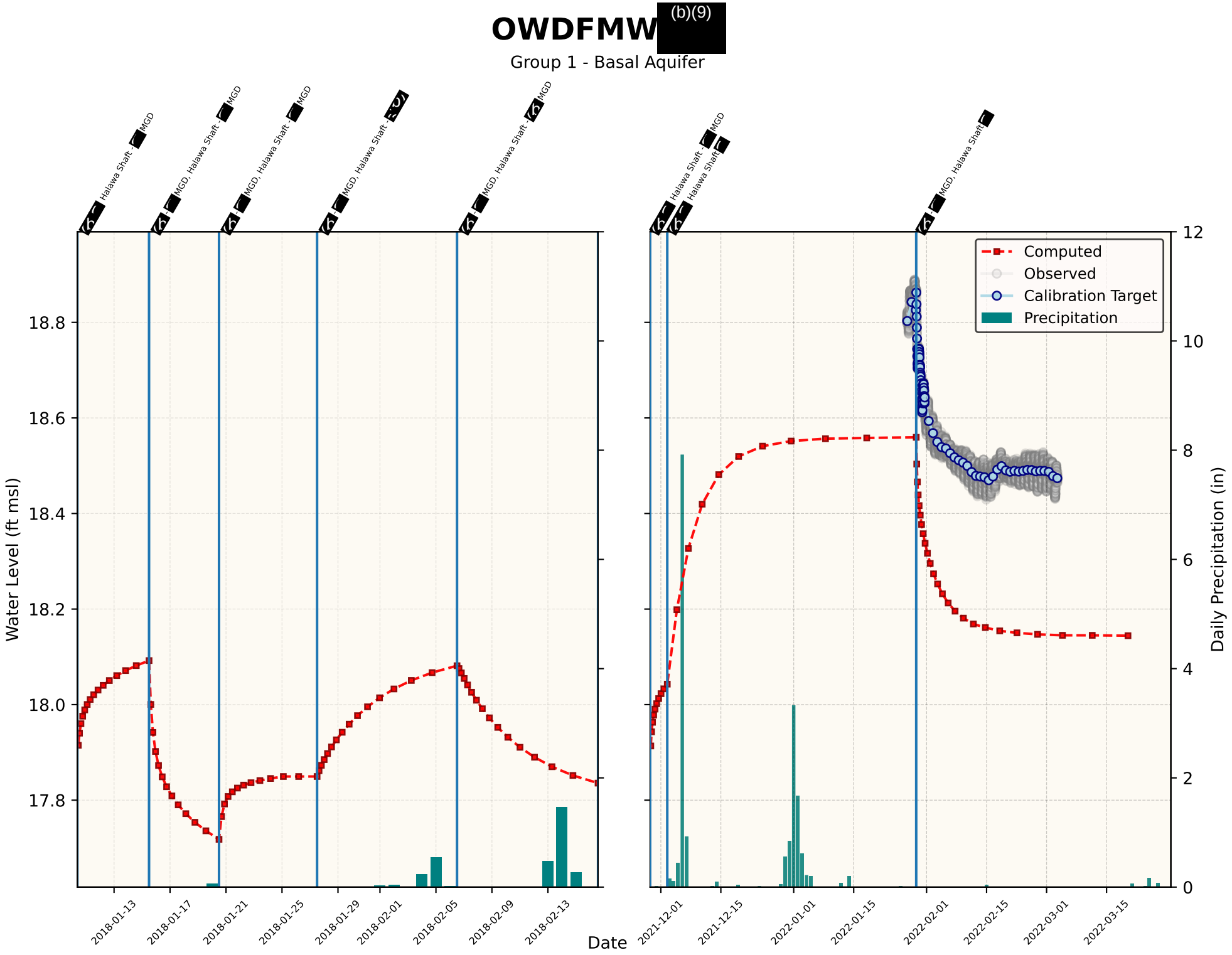

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.6
19.4
19.2
19.0
18.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
19.6
19.4
19.2
19.0
18.8
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date

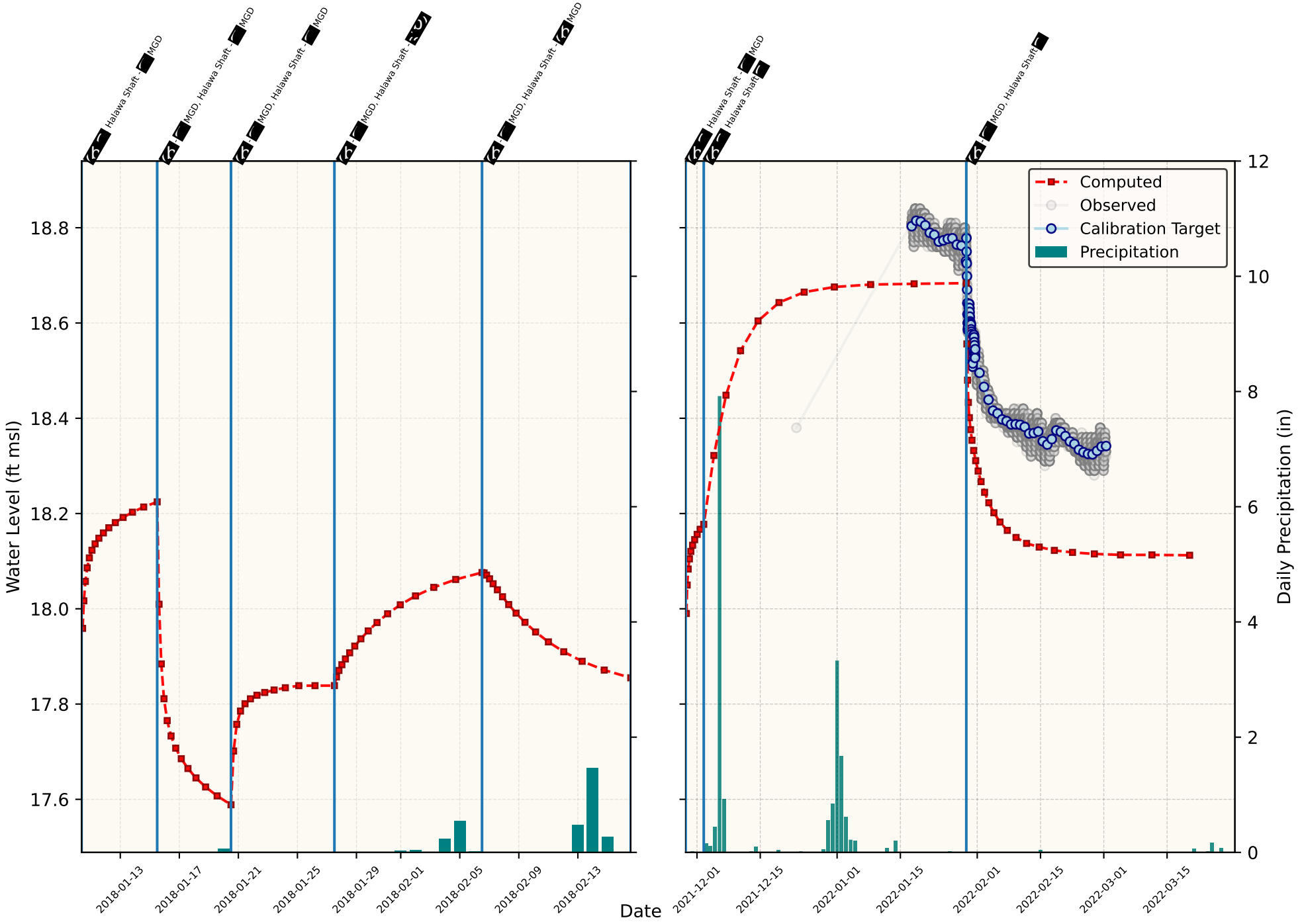

OWDFMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

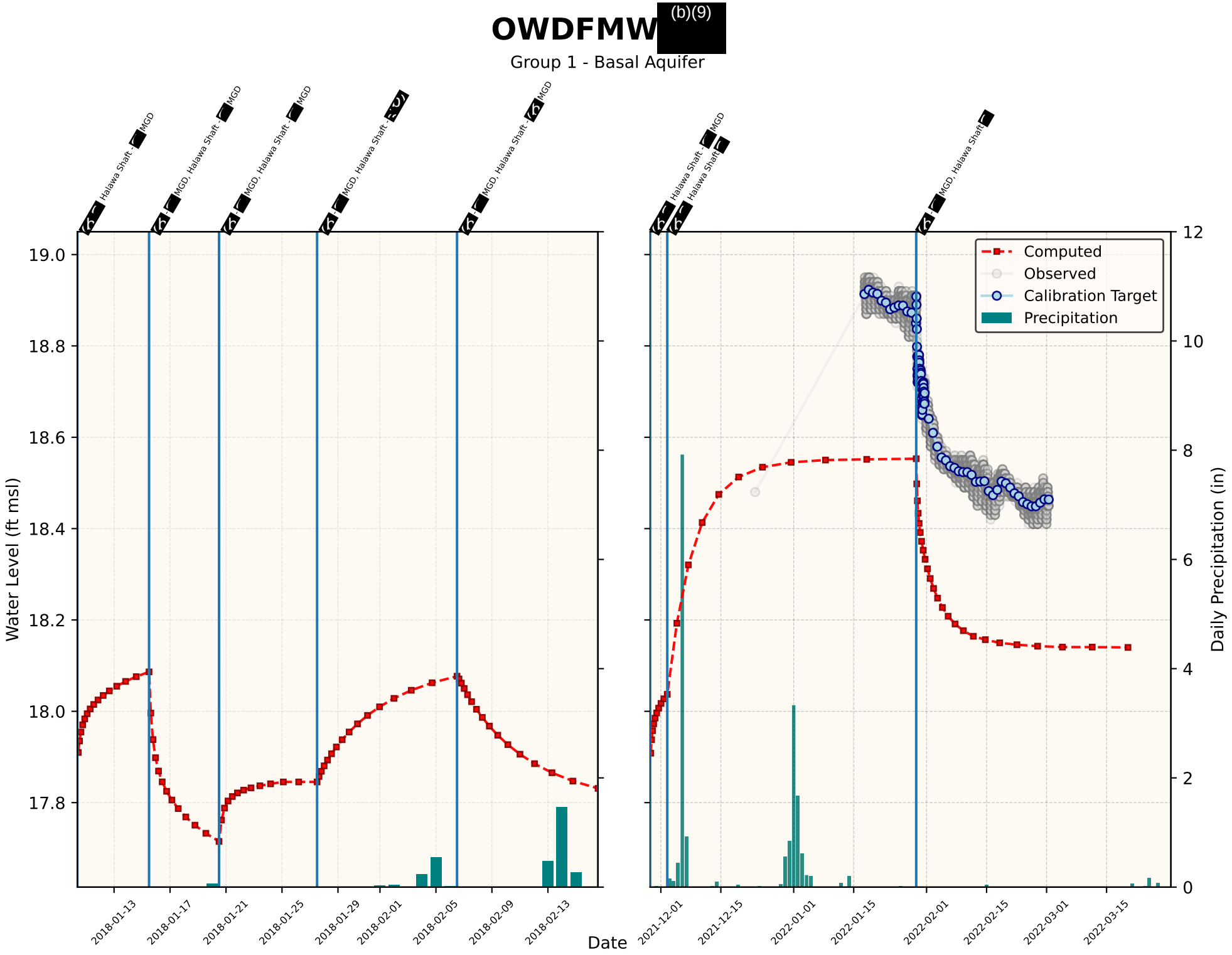

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

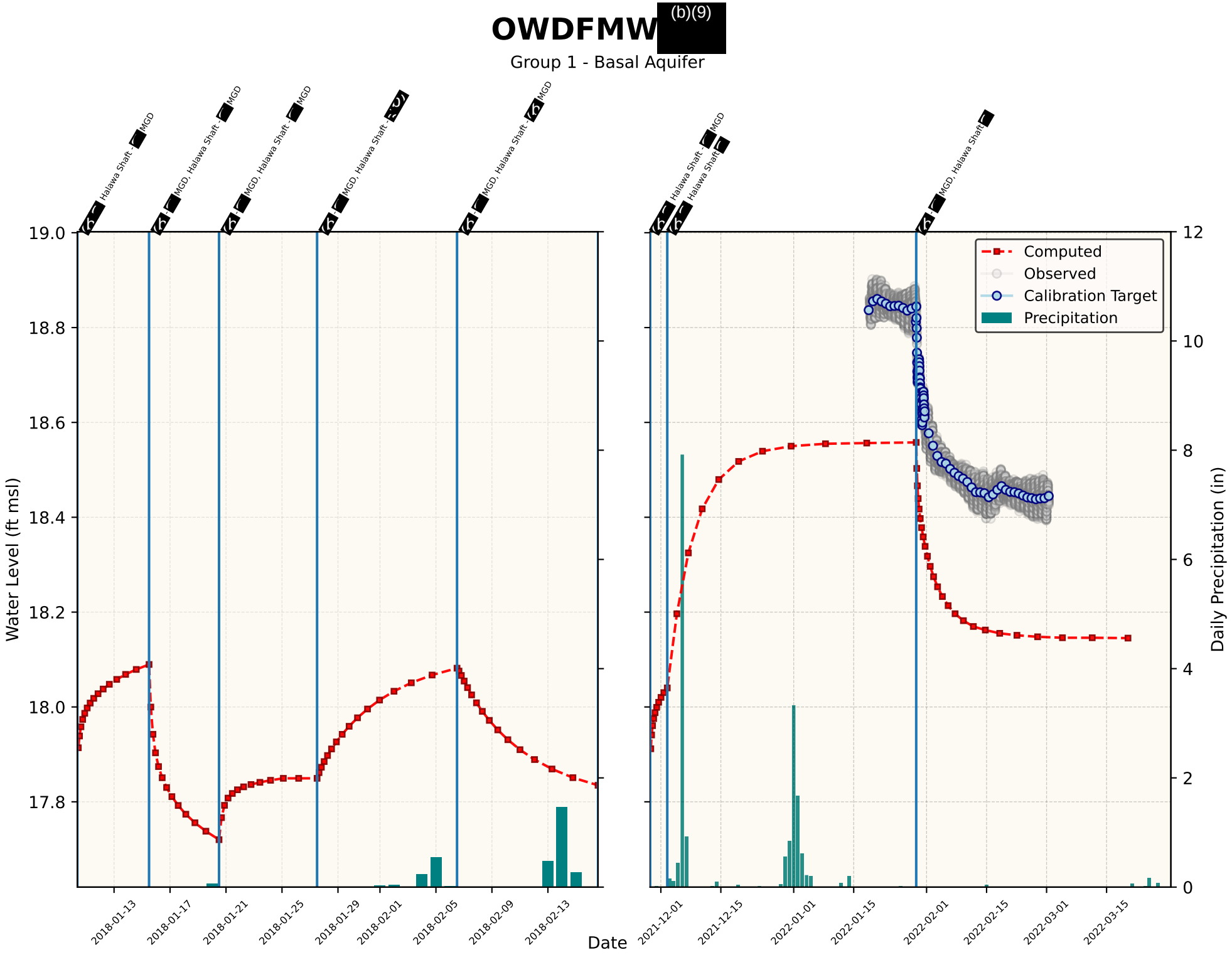

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
18.8
18.6
18.4
18.2
18.0
17.8
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation
Daily Precipitation (in)
0
2
4
6
8
10
12

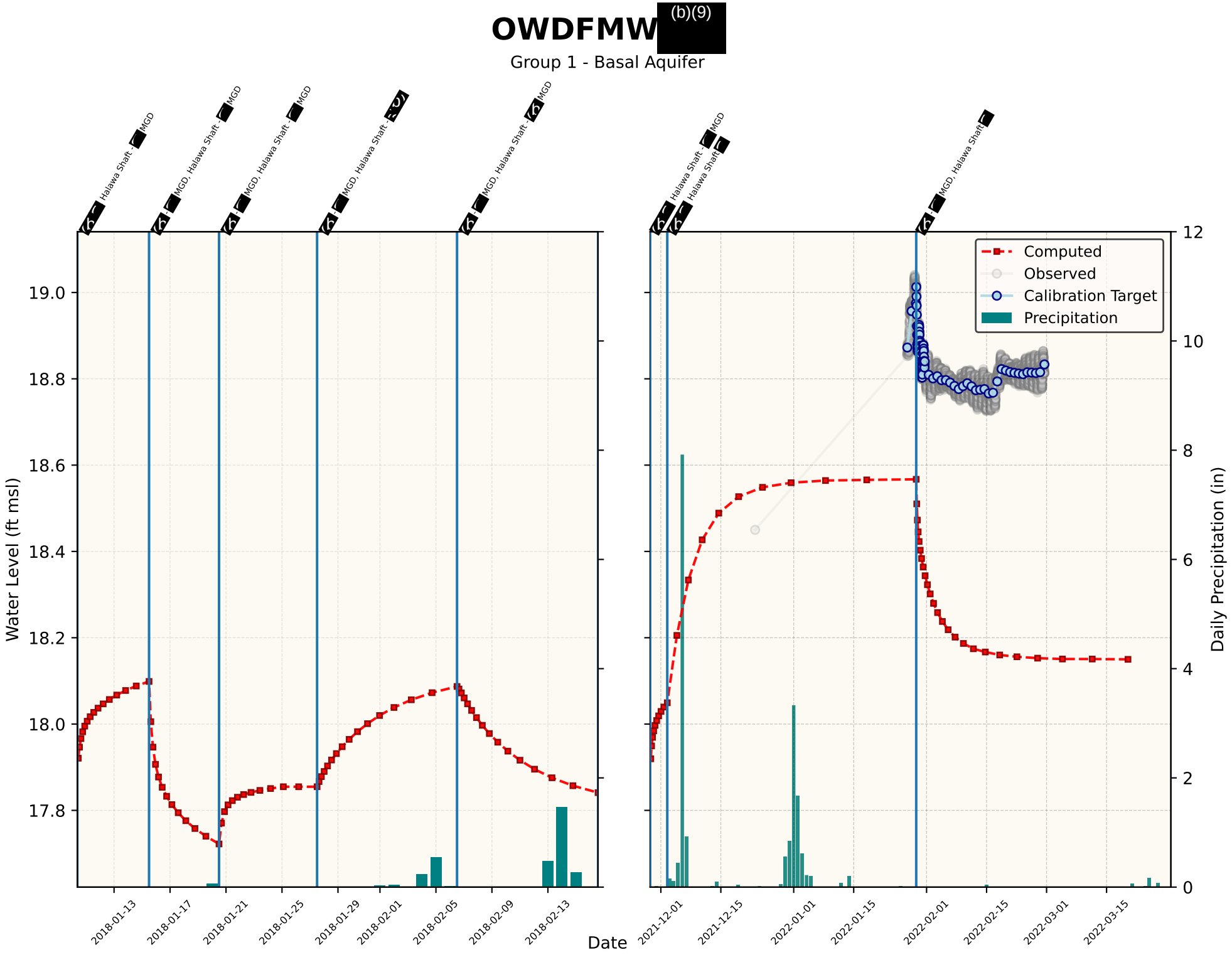
OWDFMW [redacted] (b)(9)

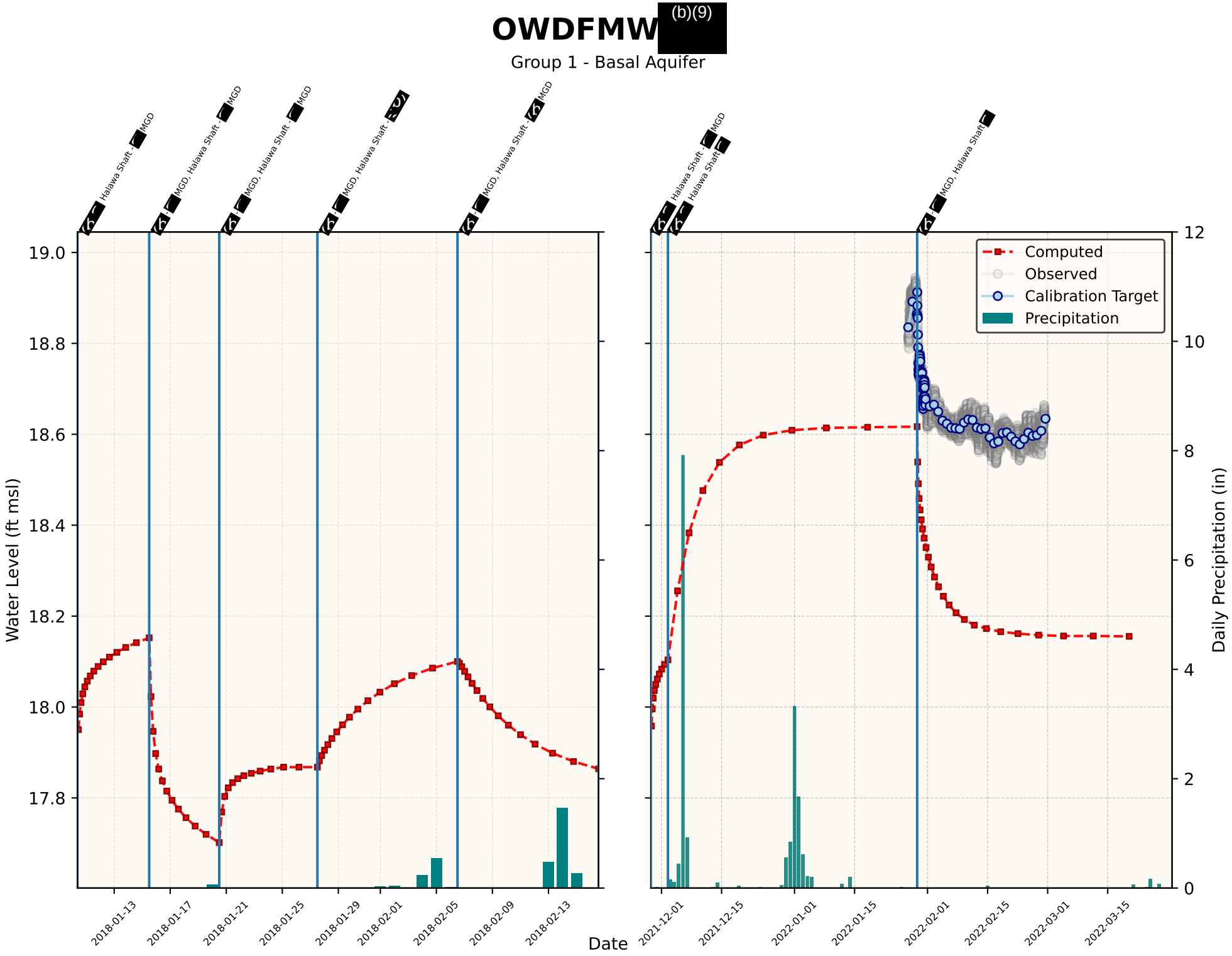
Group 1 - Basal Aquifer

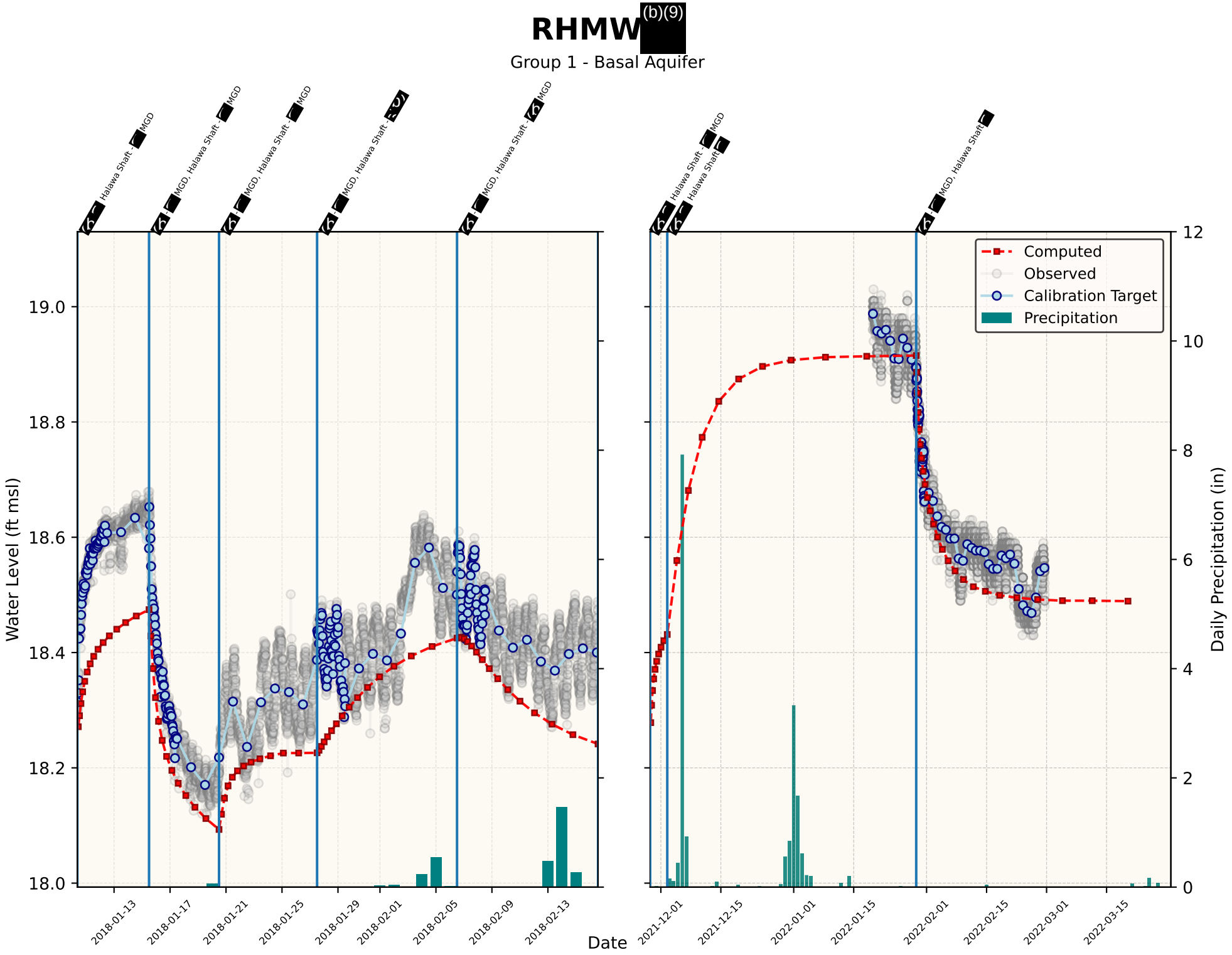


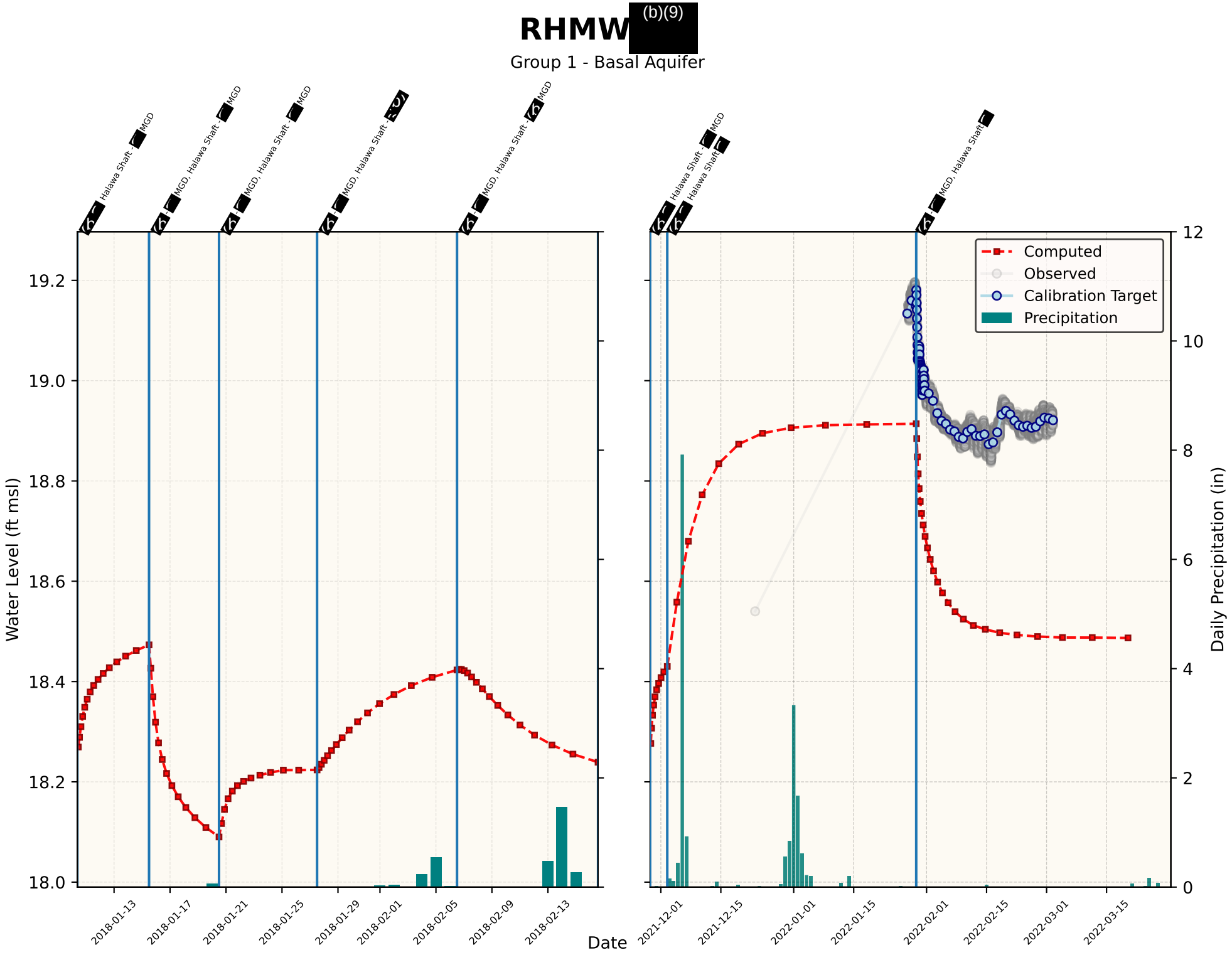

OWDFMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

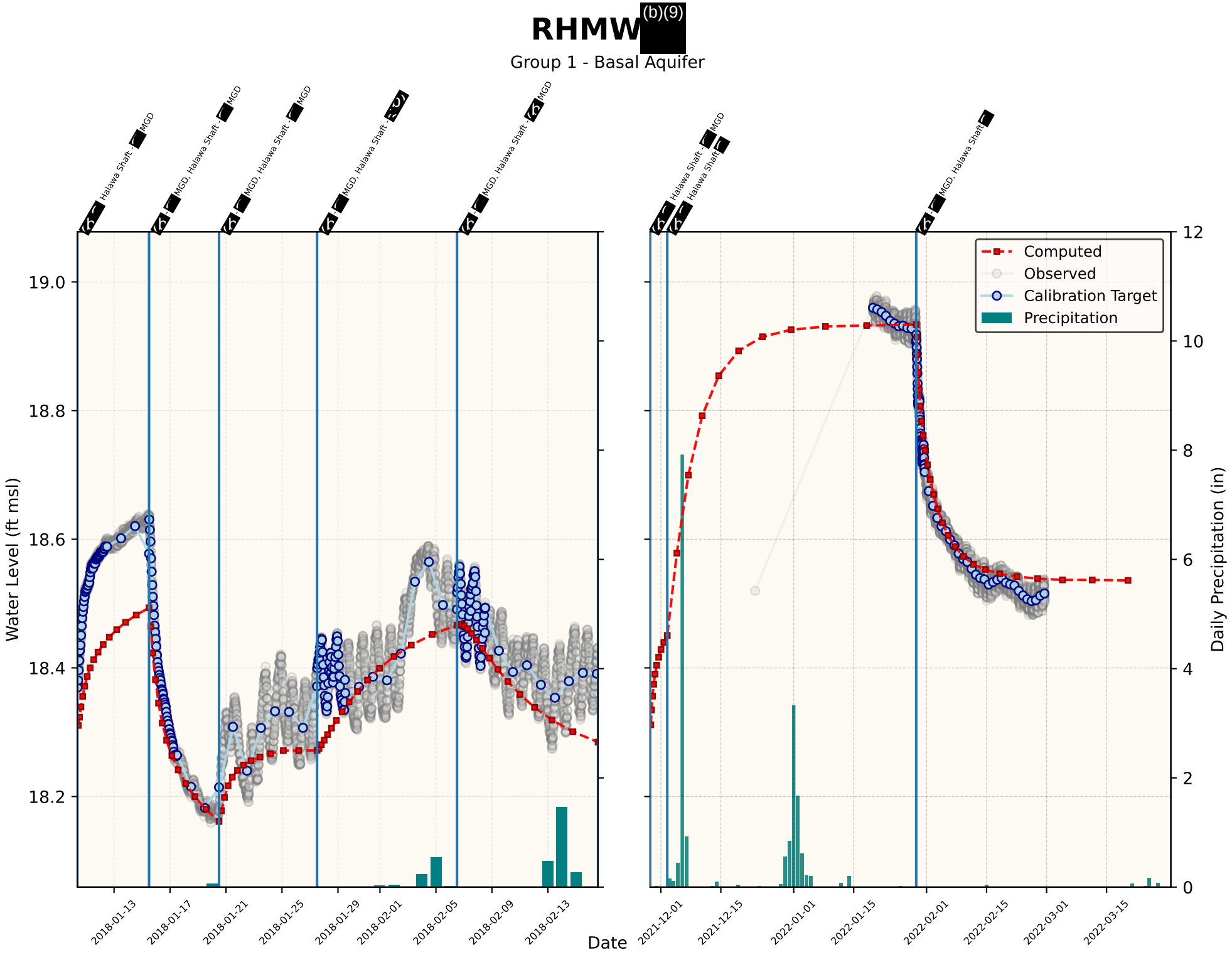

OWDFMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

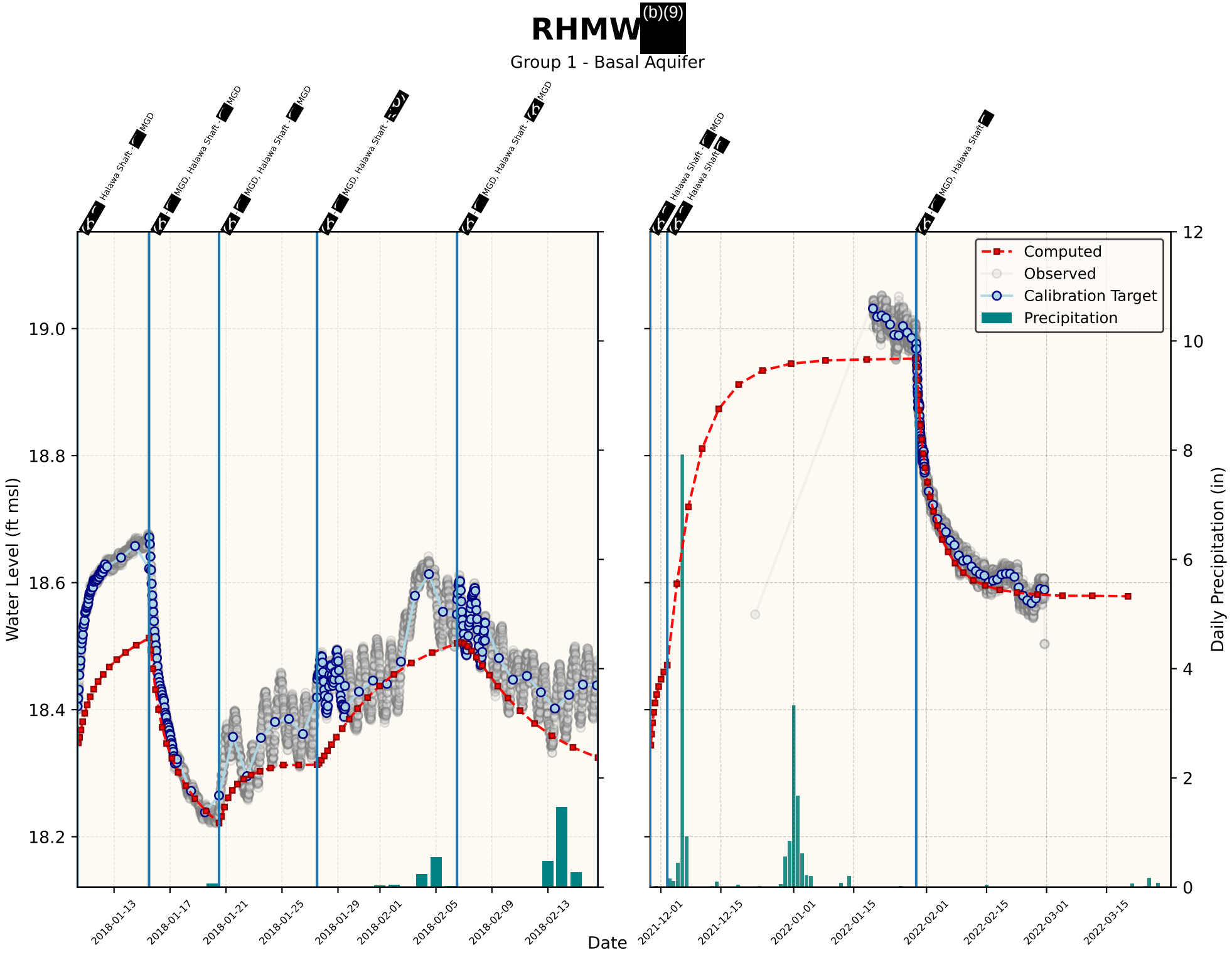

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

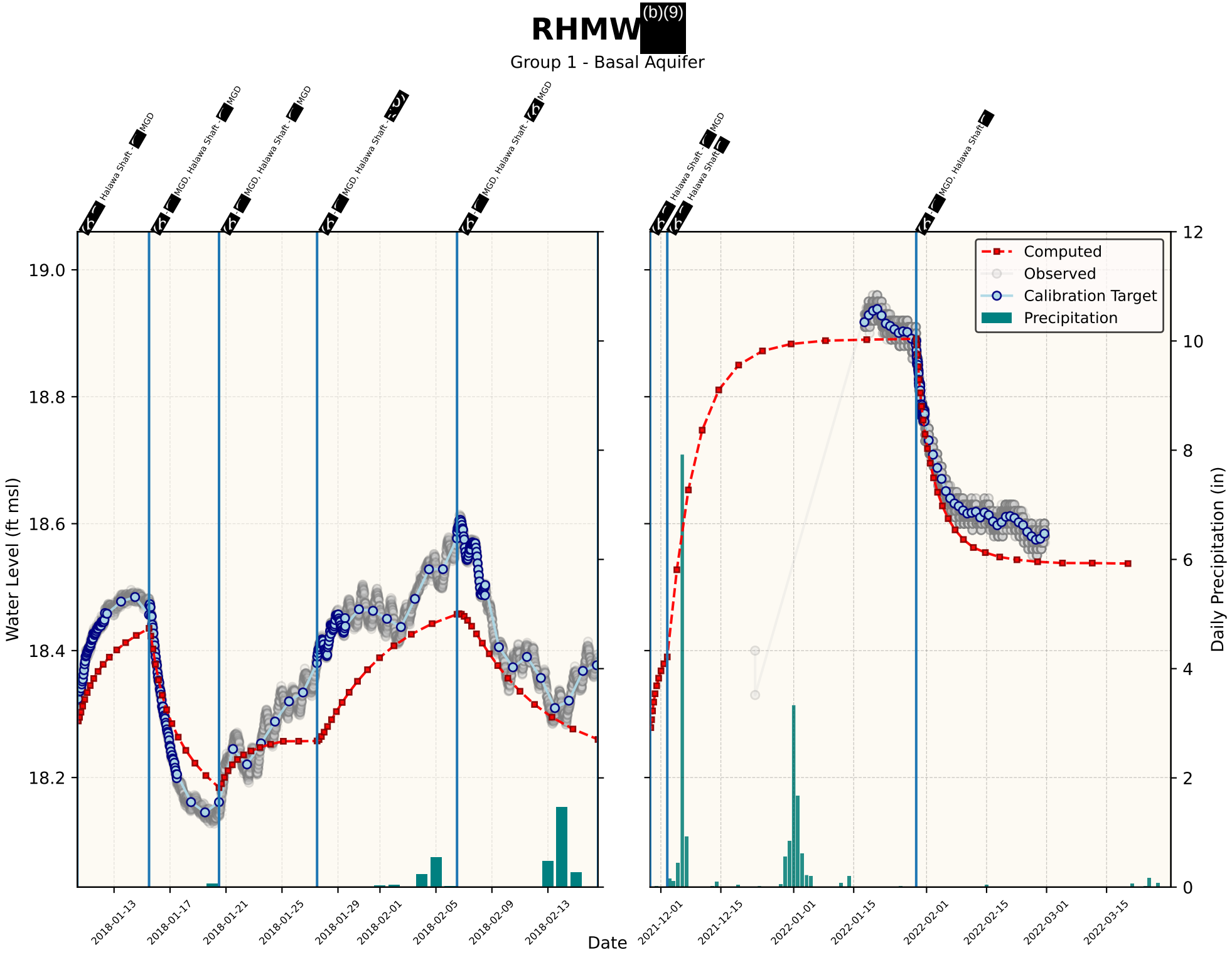

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

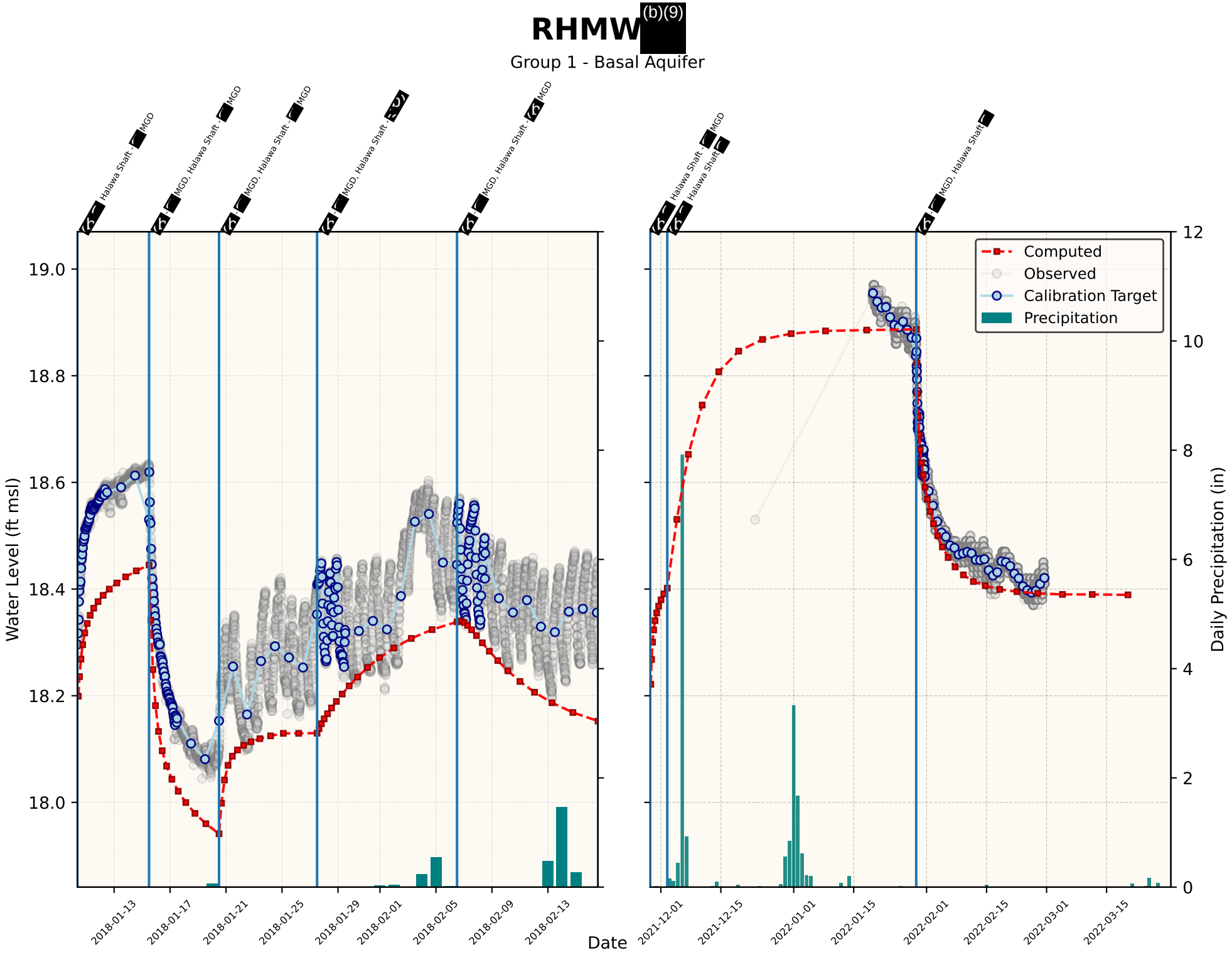

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

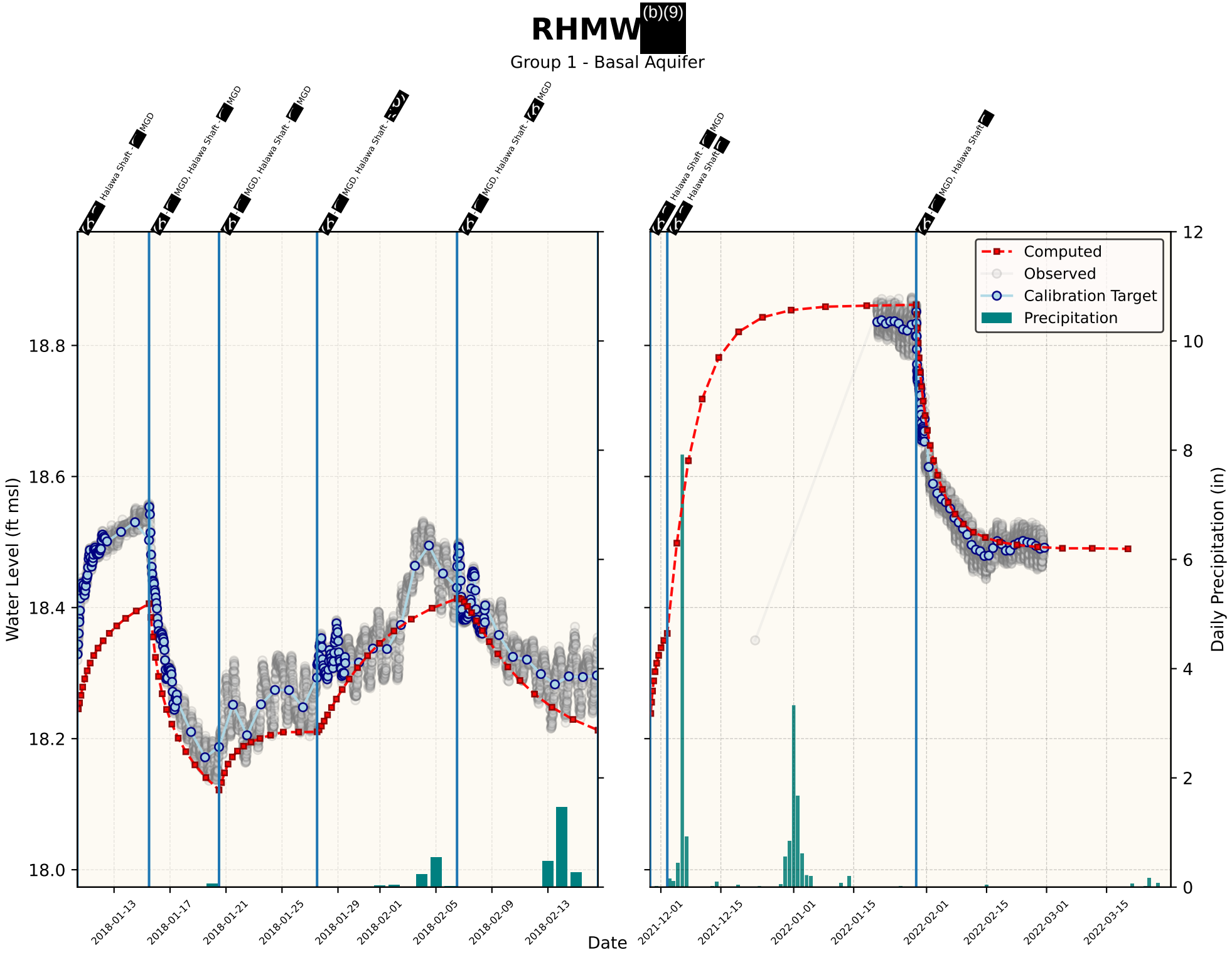

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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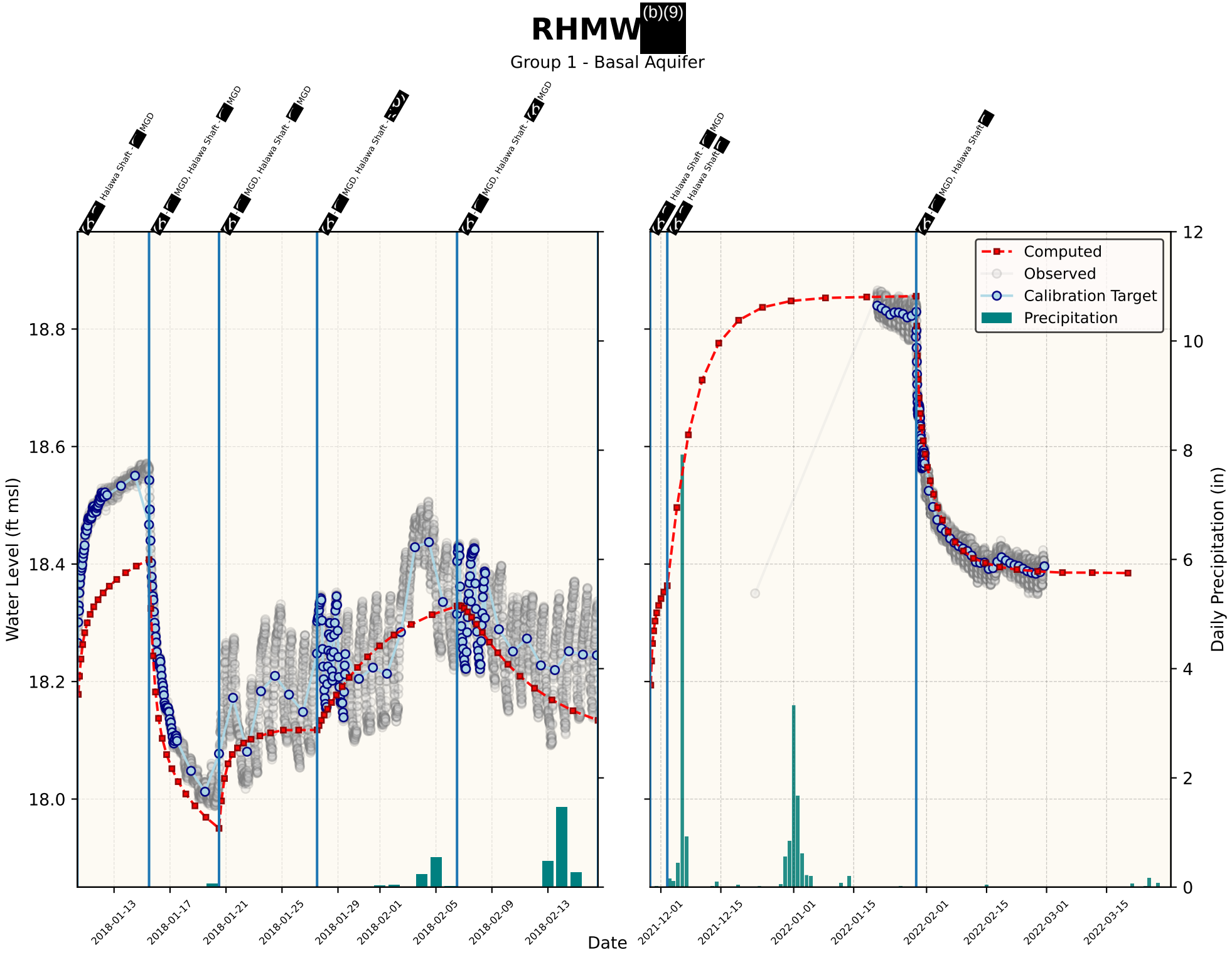

RHMW[redacted](b)(9)
Group 1 - Basal Aquifer
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Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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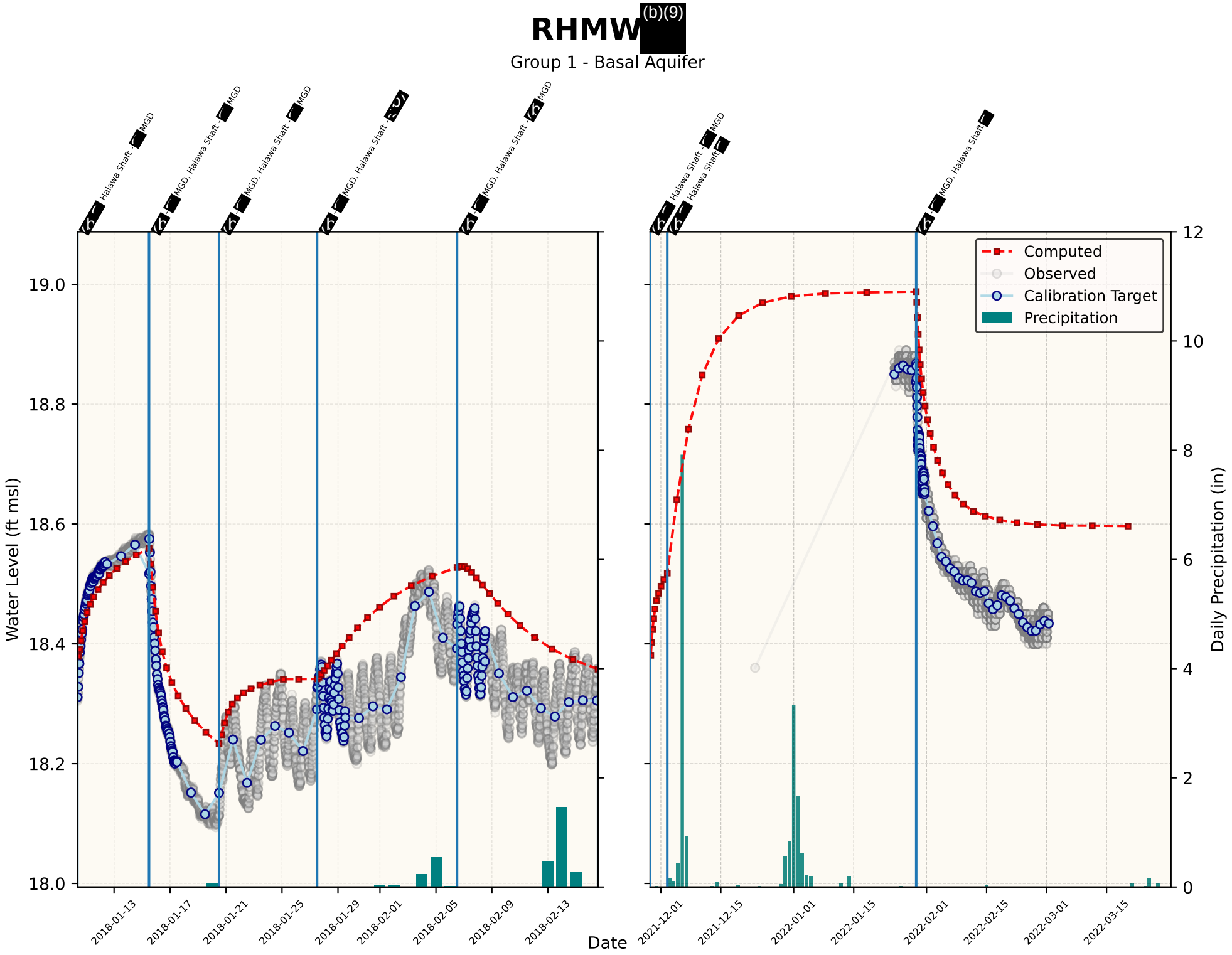

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
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MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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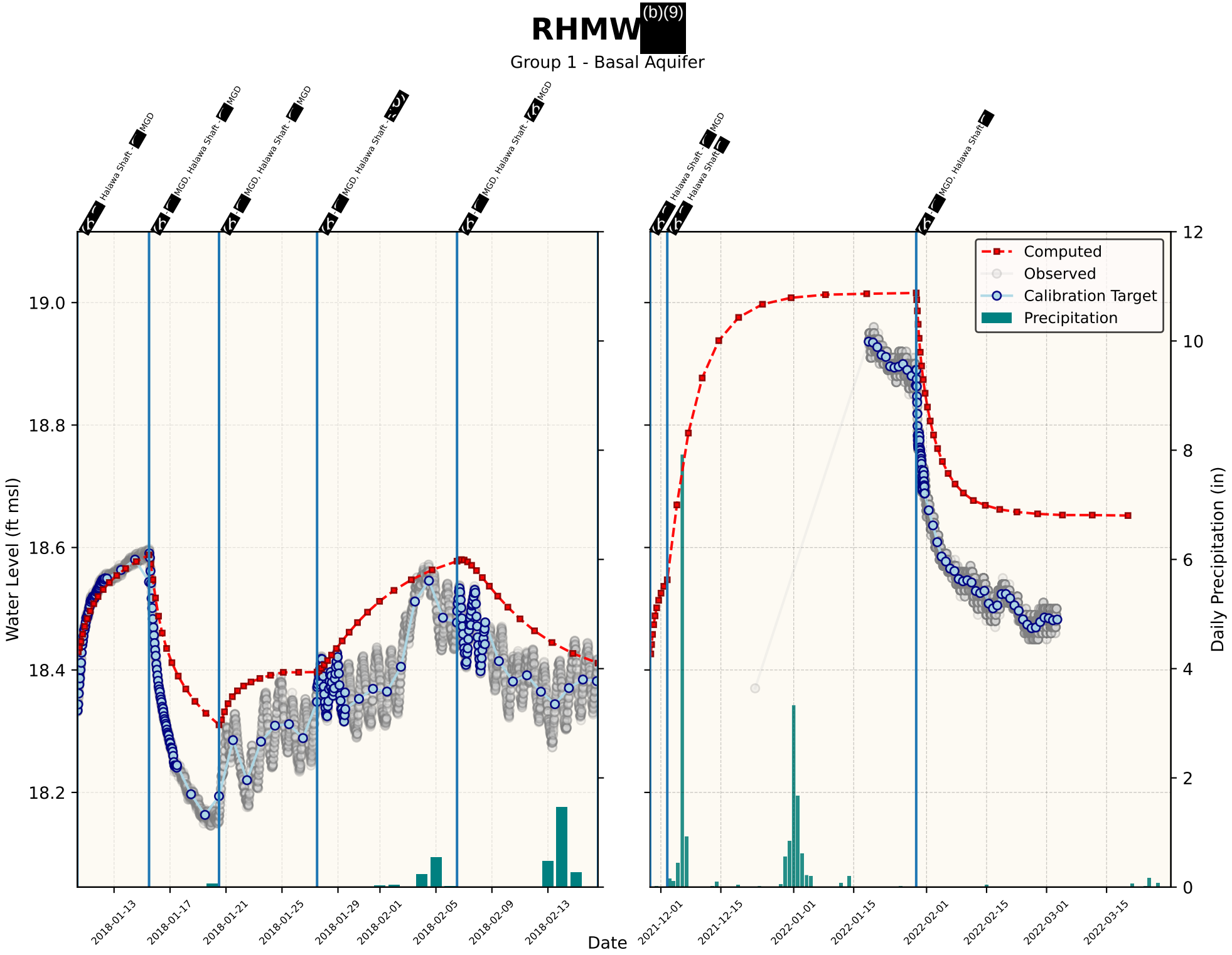

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Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
Computed
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Water Level (ft msl)
Daily Precipitation (in)
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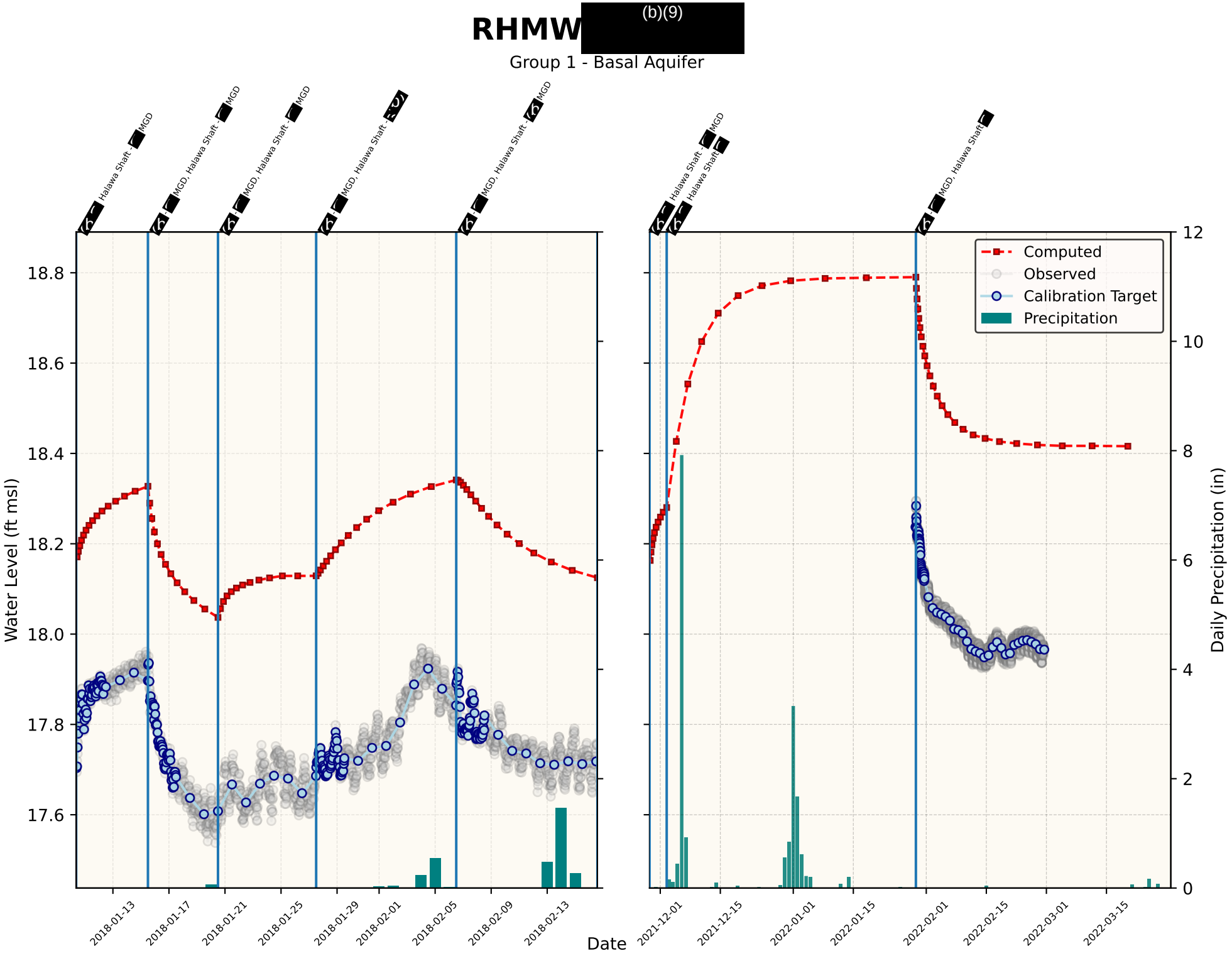

RHMW(b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
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RHMW(b)(9)
Group 1 - Basal Aquifer
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Computed
Observed
Calibration Target
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Water Level (ft msl)
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RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
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MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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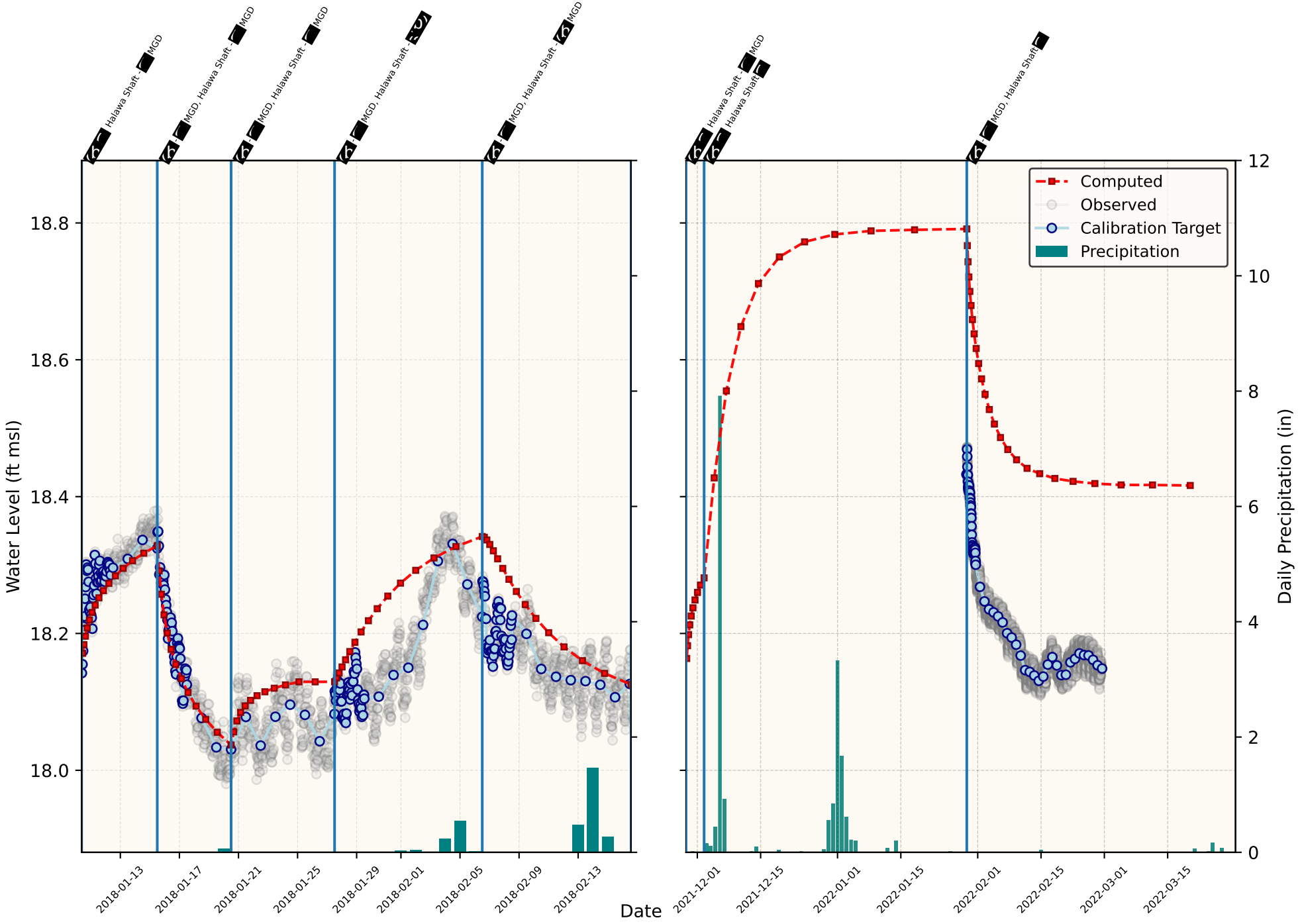

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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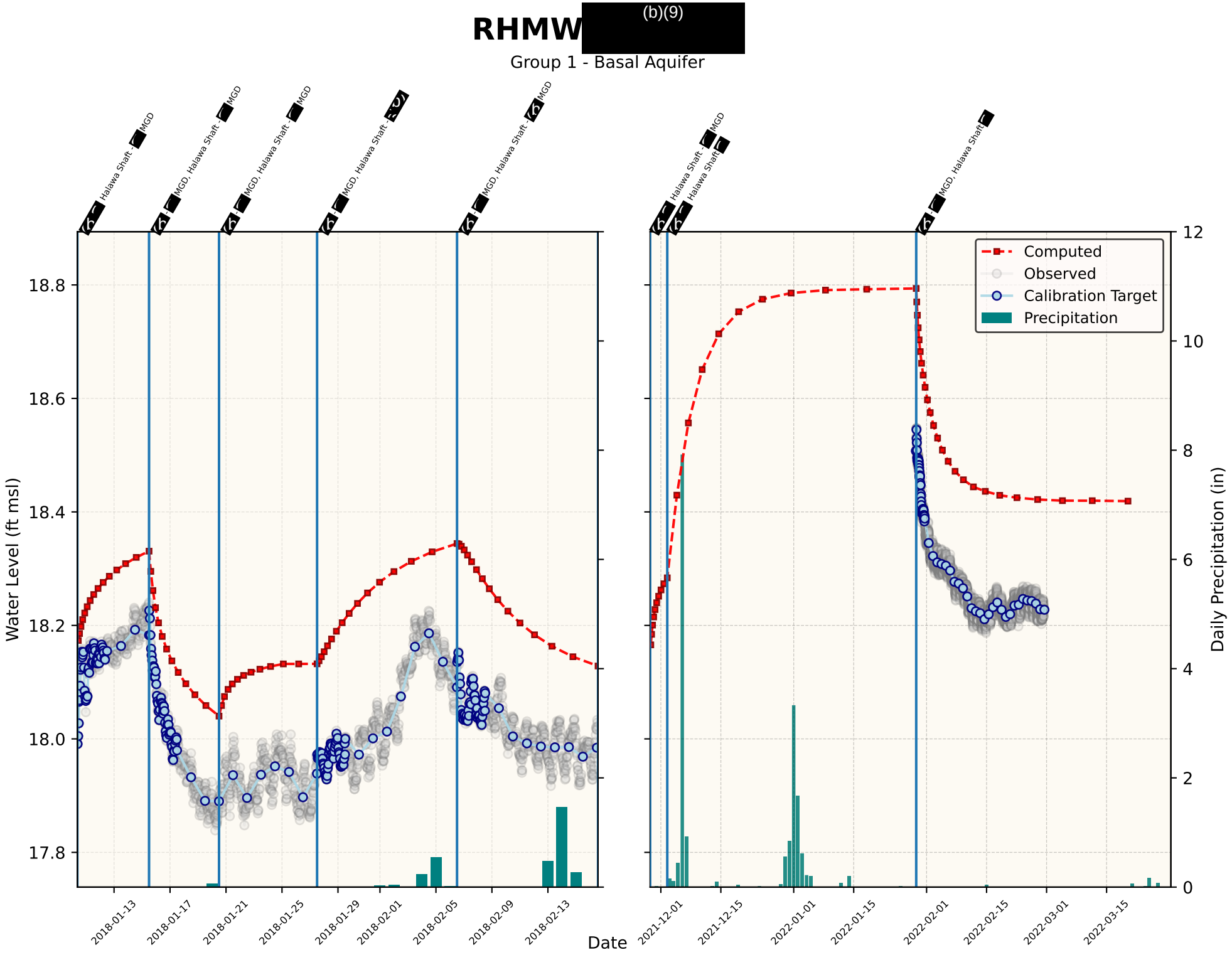

RHMW(b)(9)
Group 1 - Basal Aquifer
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Computed
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Water Level (ft msl)
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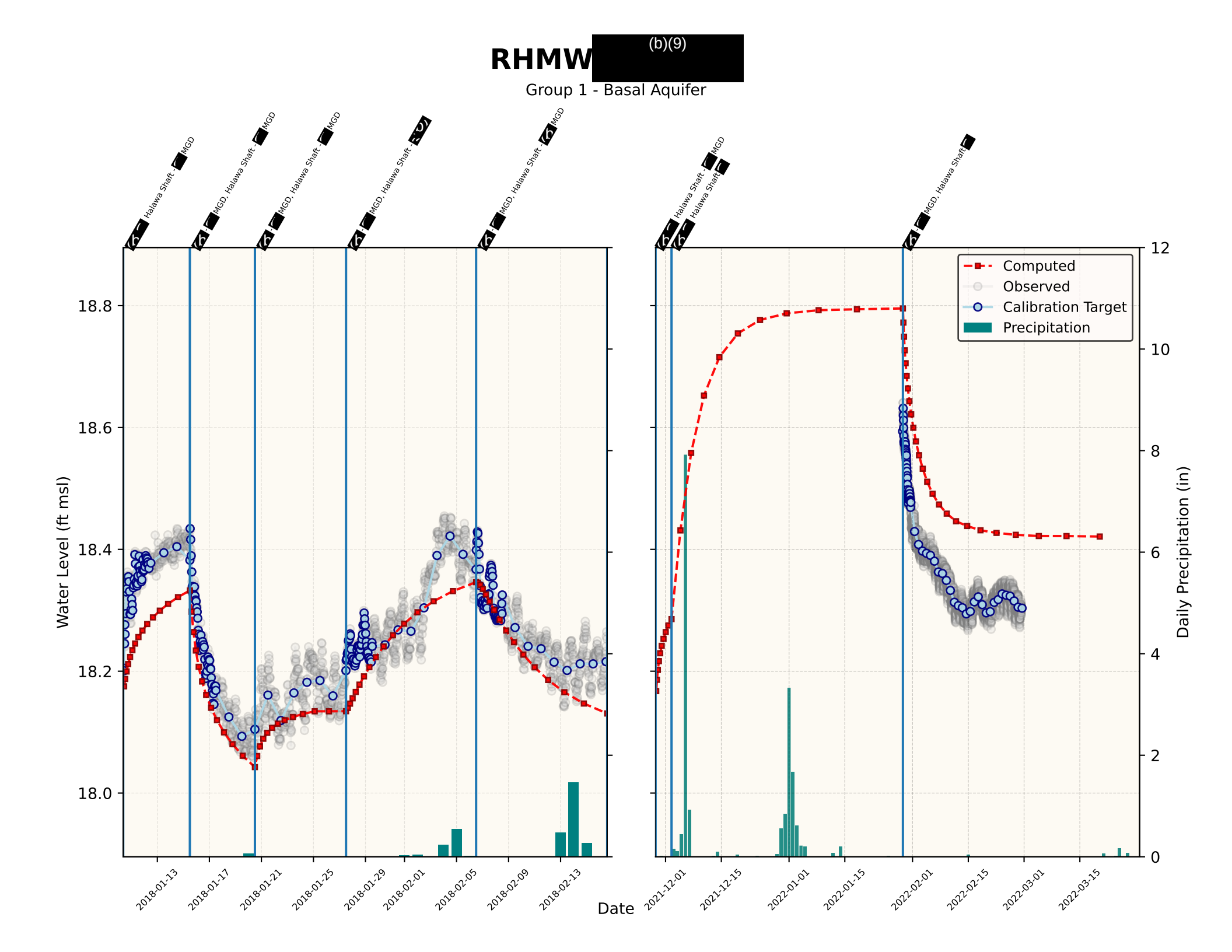

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer

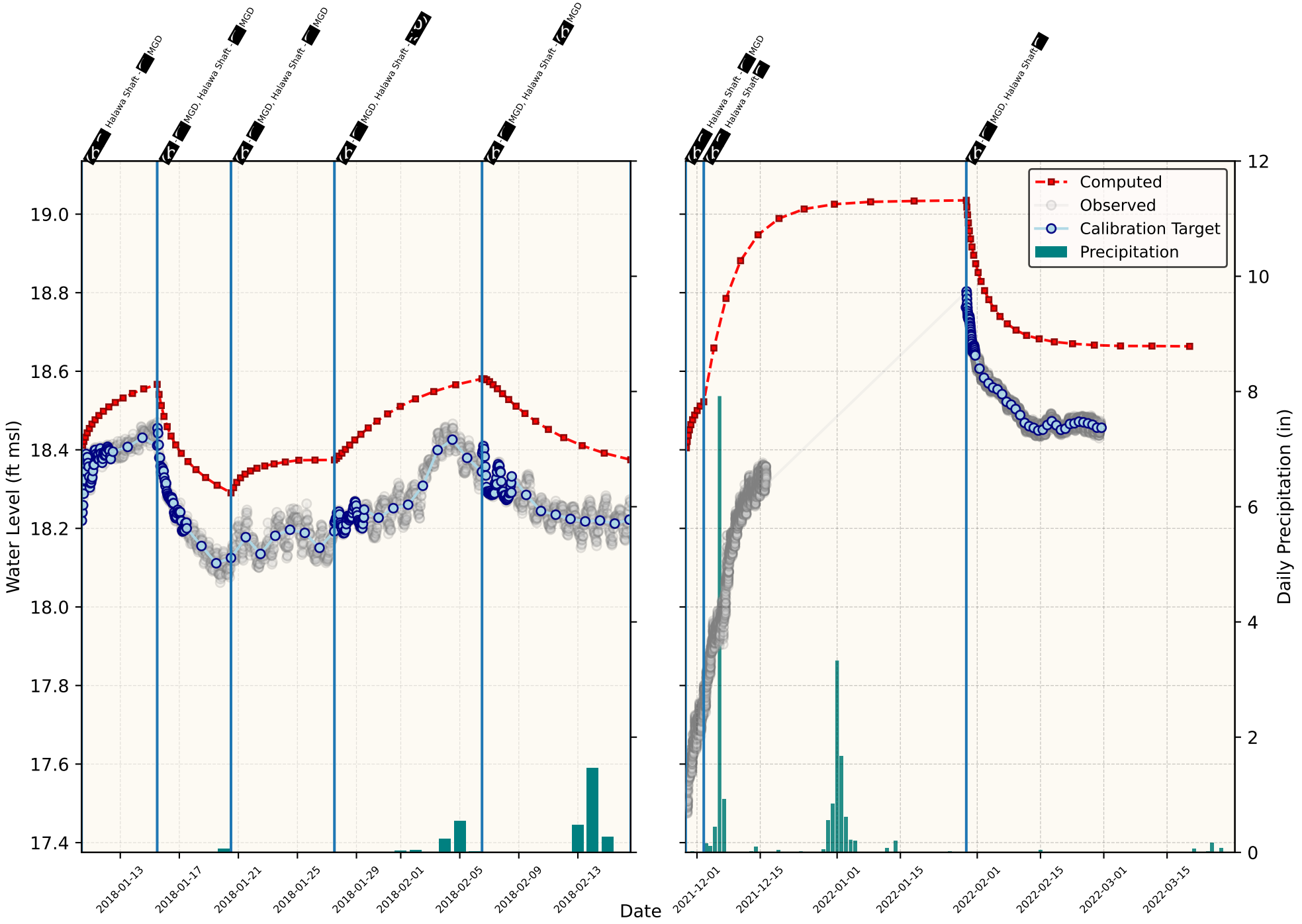



RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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Computed
Observed
Calibration Target
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Water Level (ft msl)
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RHMW (b)(9)
Group 1 - Basal Aquifer
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Computed
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Calibration Target
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Water Level (ft msl)
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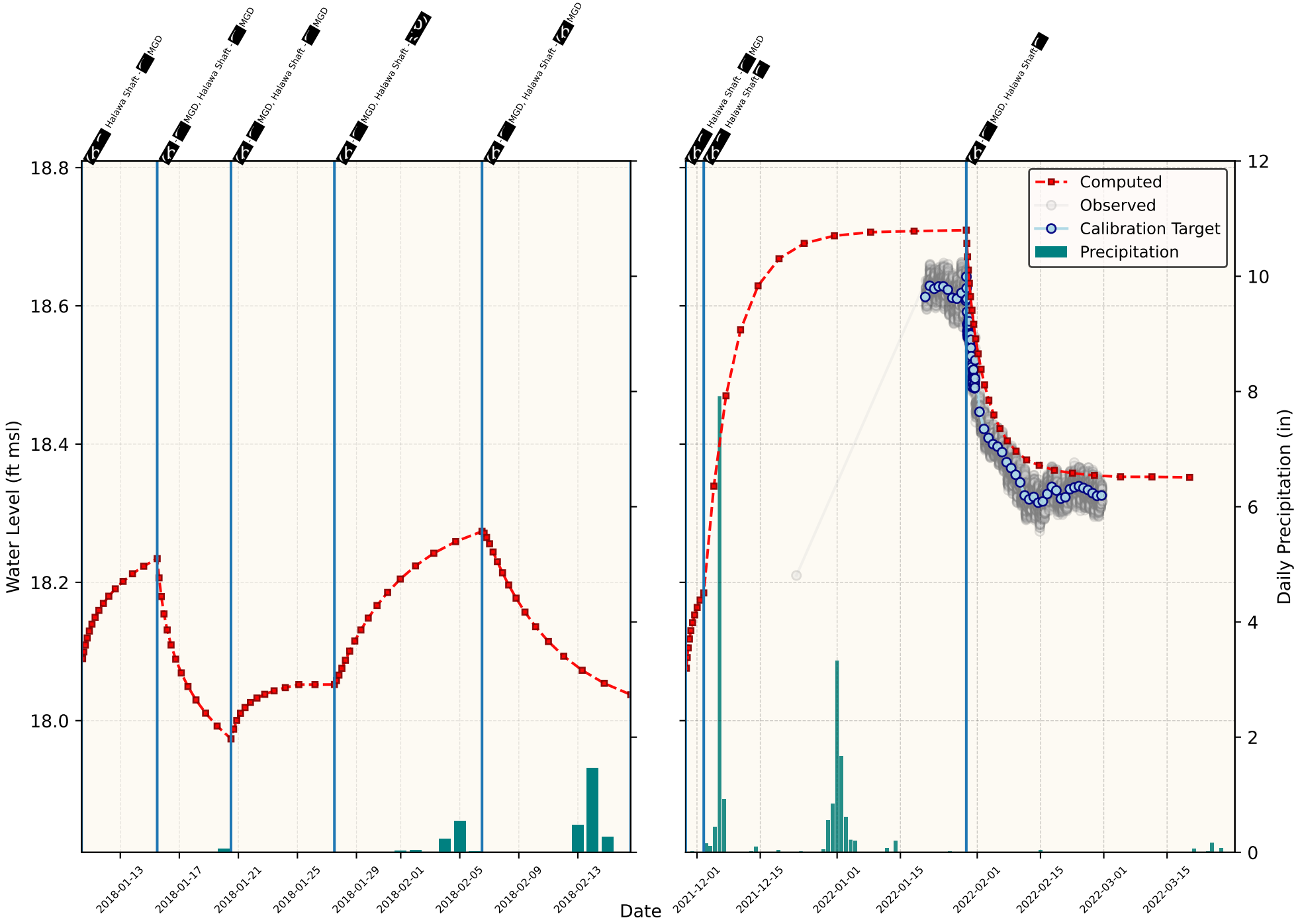
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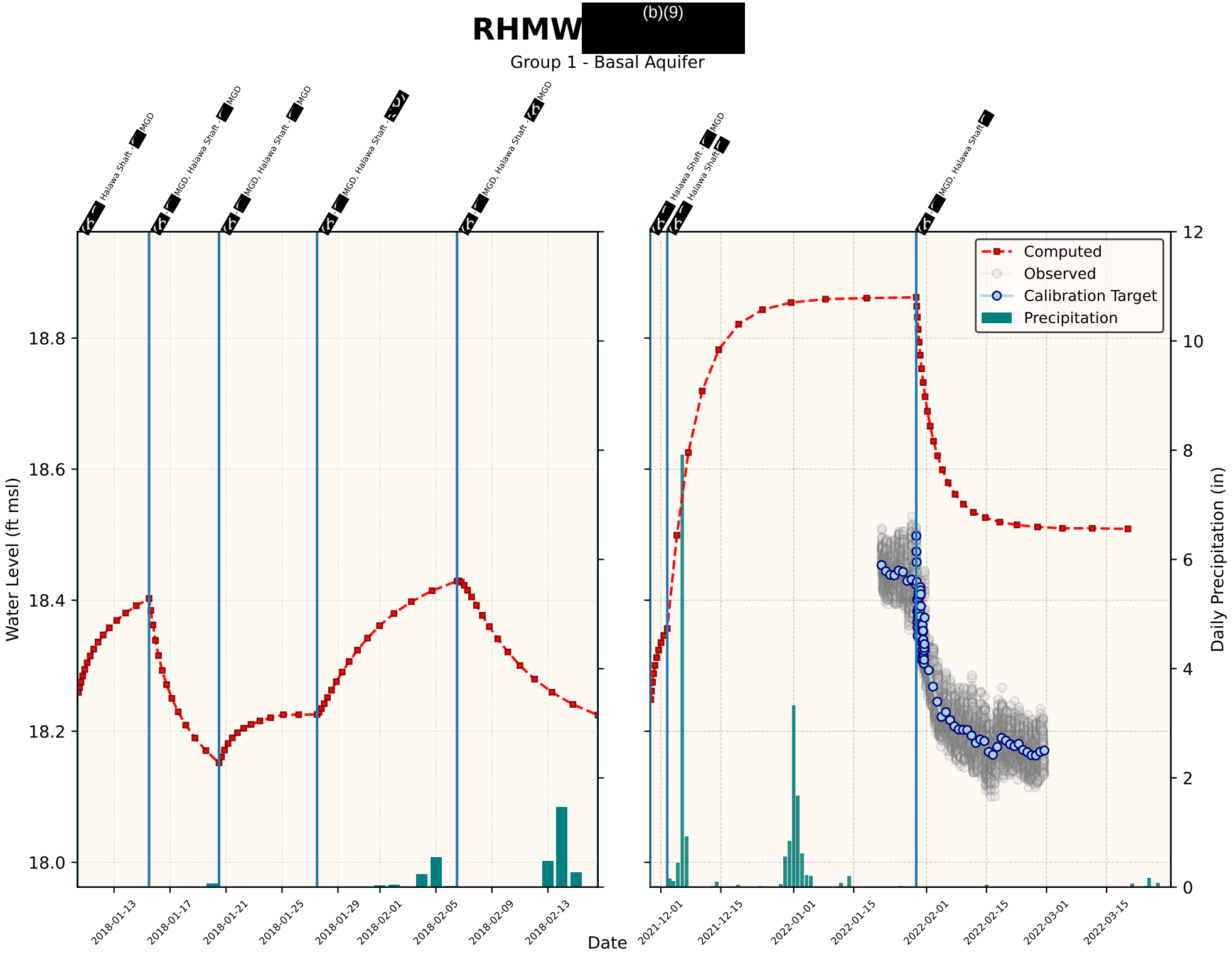
Group 1 - Basal Aquifer

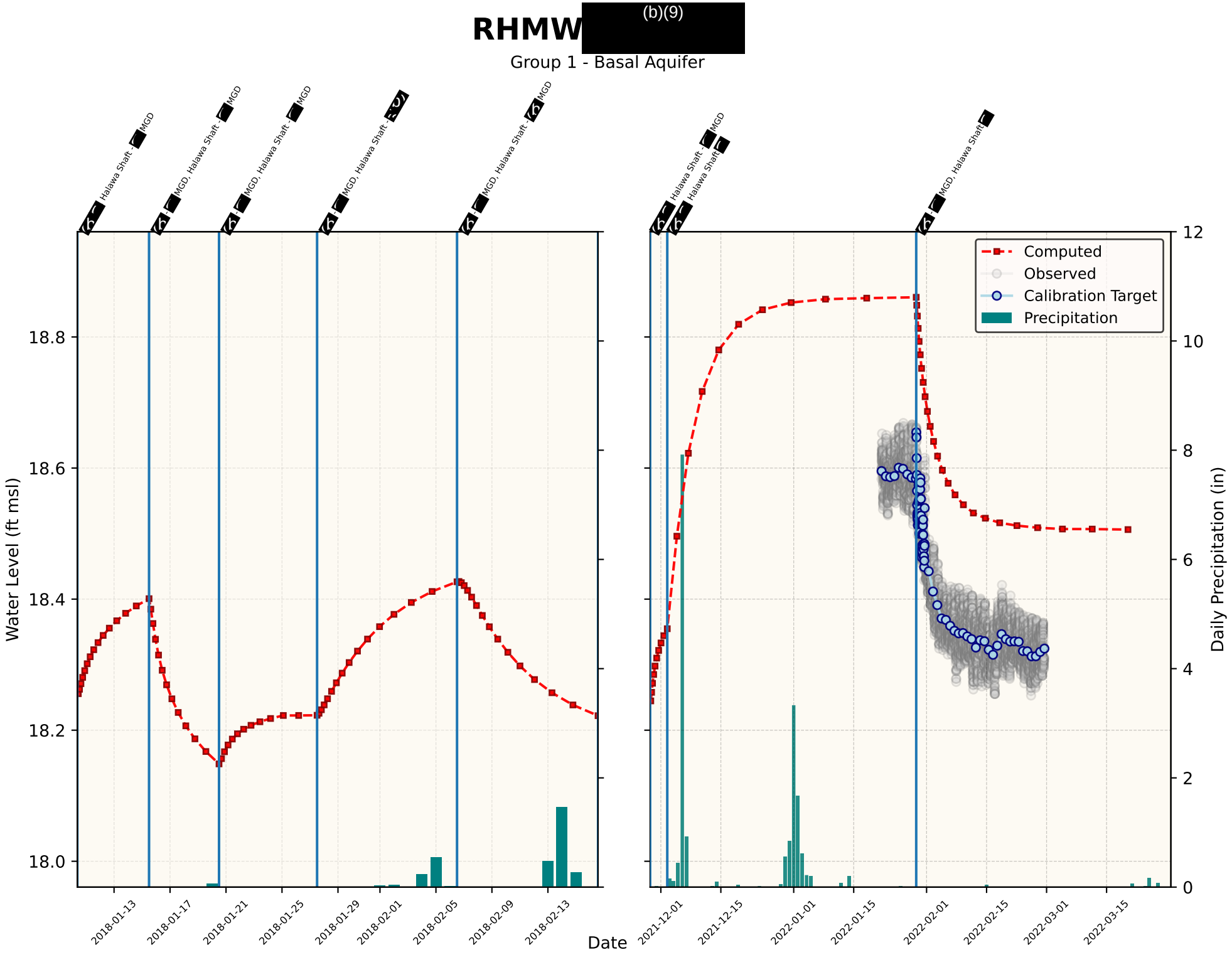


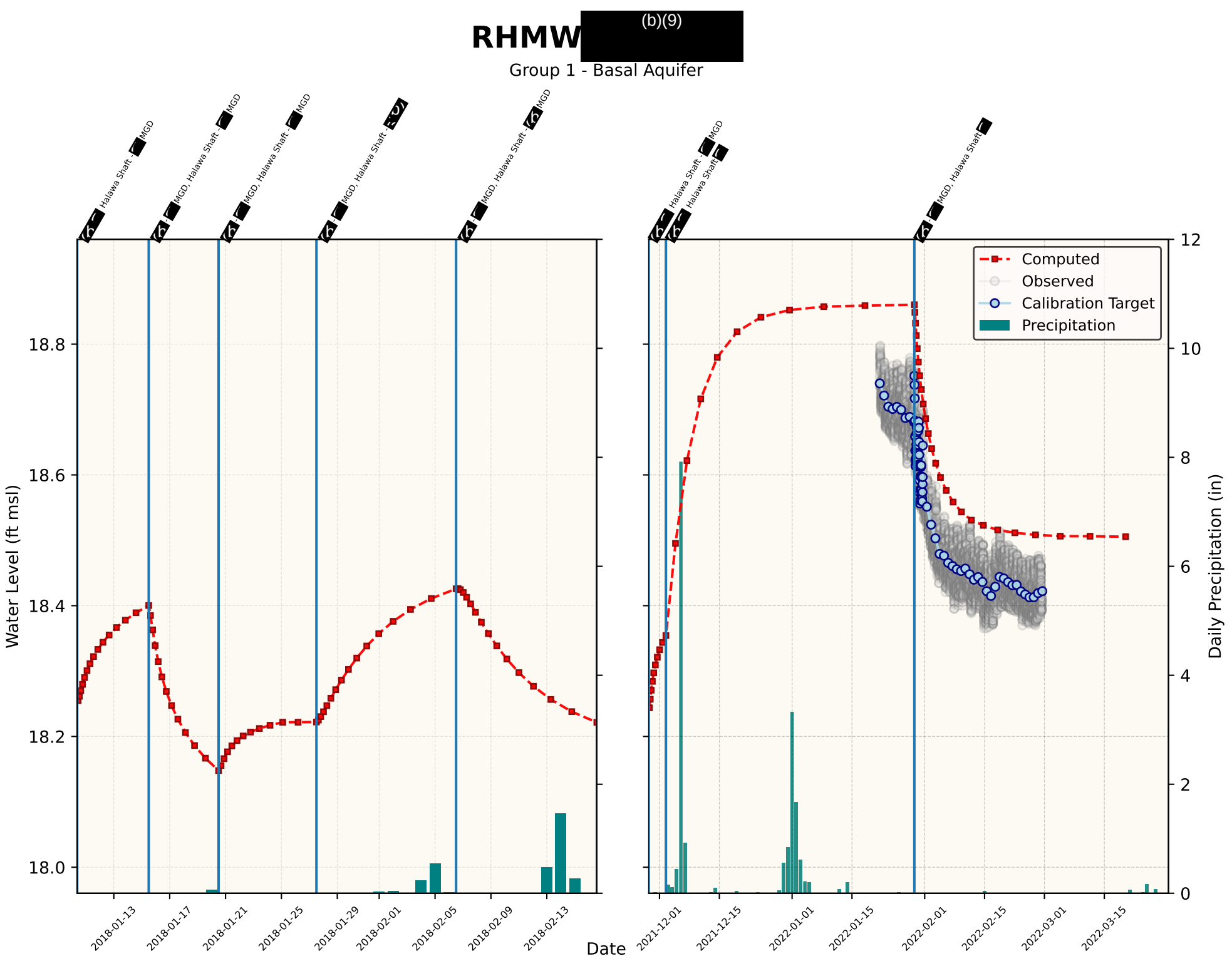
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Group 1 - Basal Aquifer



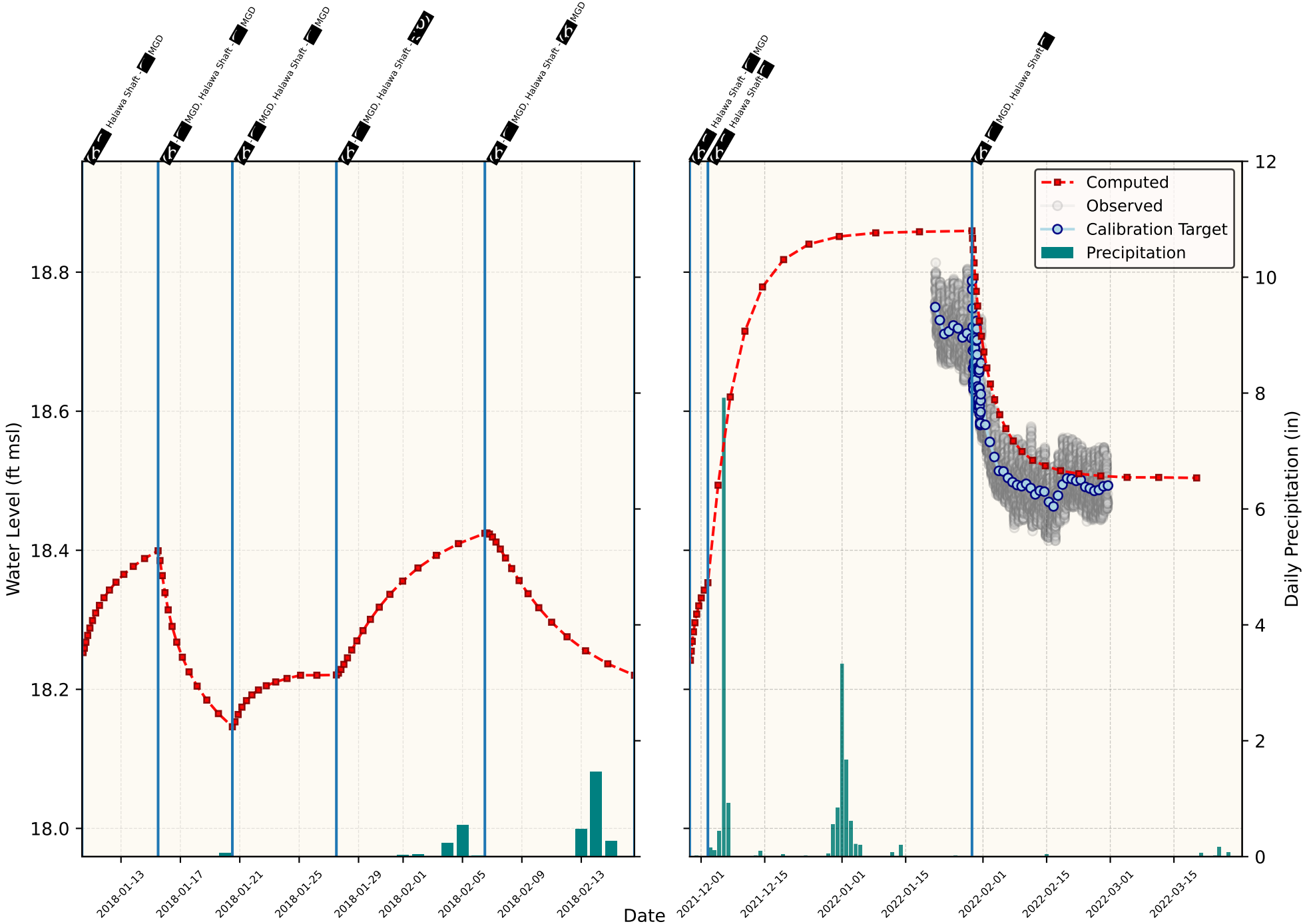

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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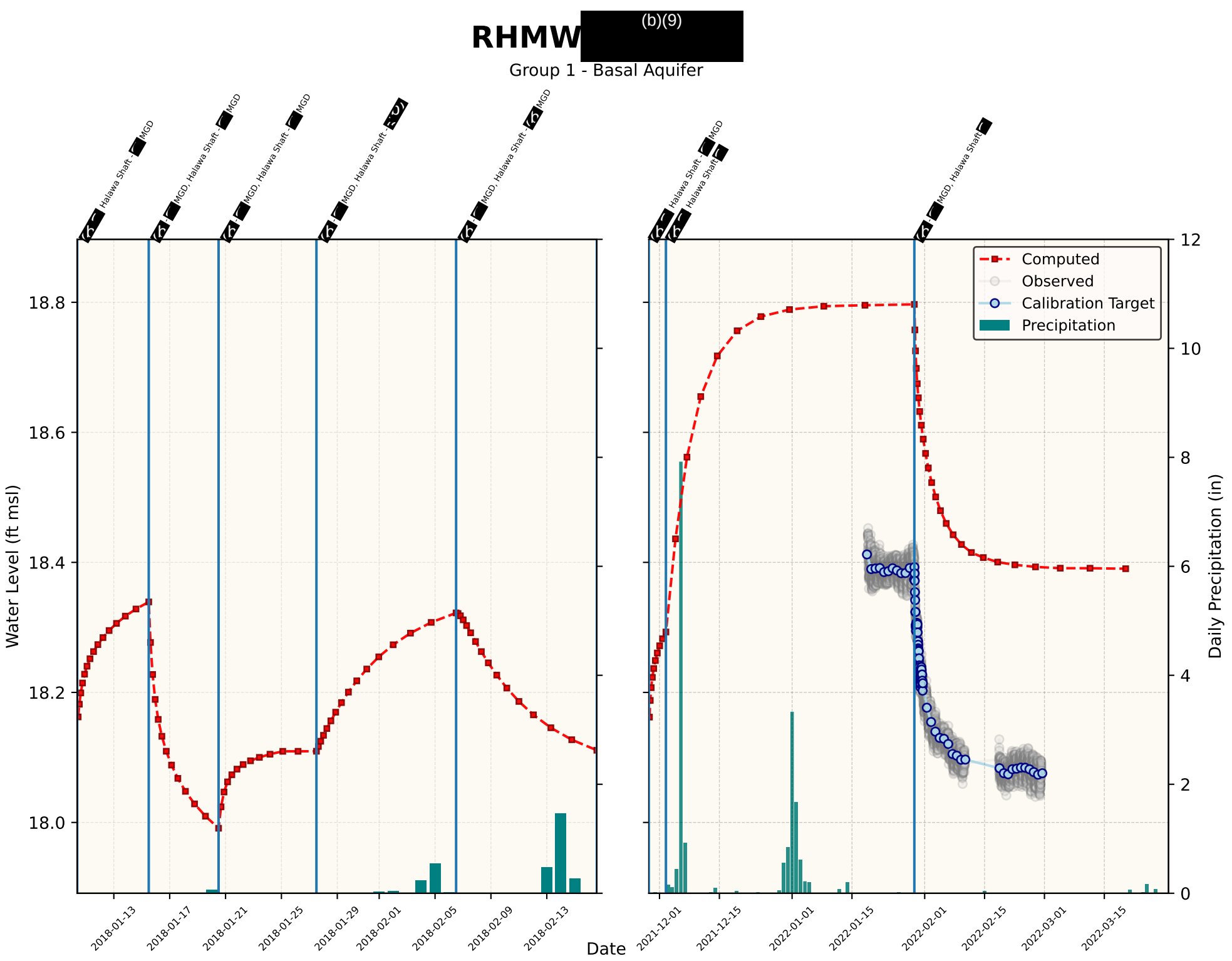

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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Computed
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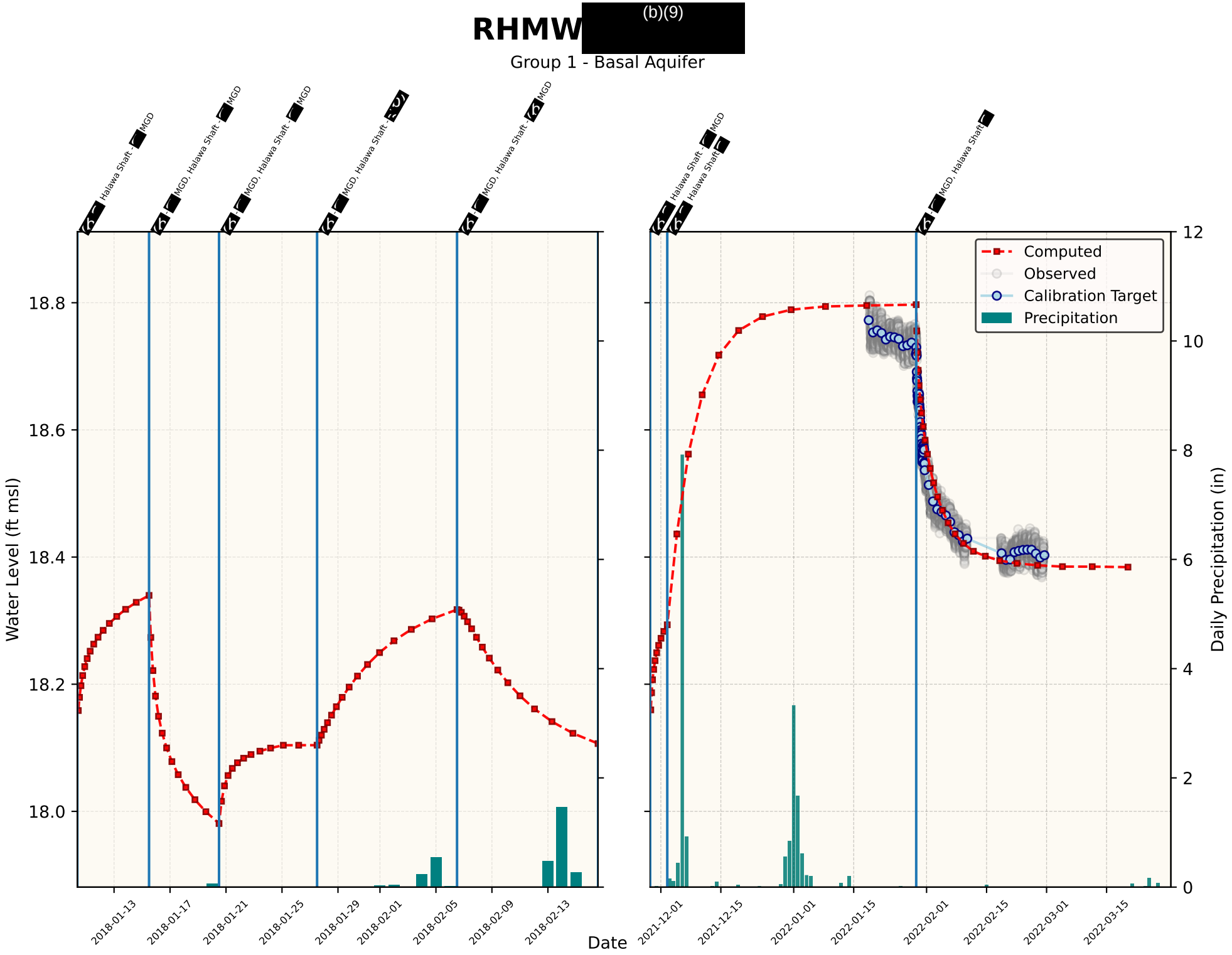

RHMW (b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft (b)(9)
Computed
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Calibration Target
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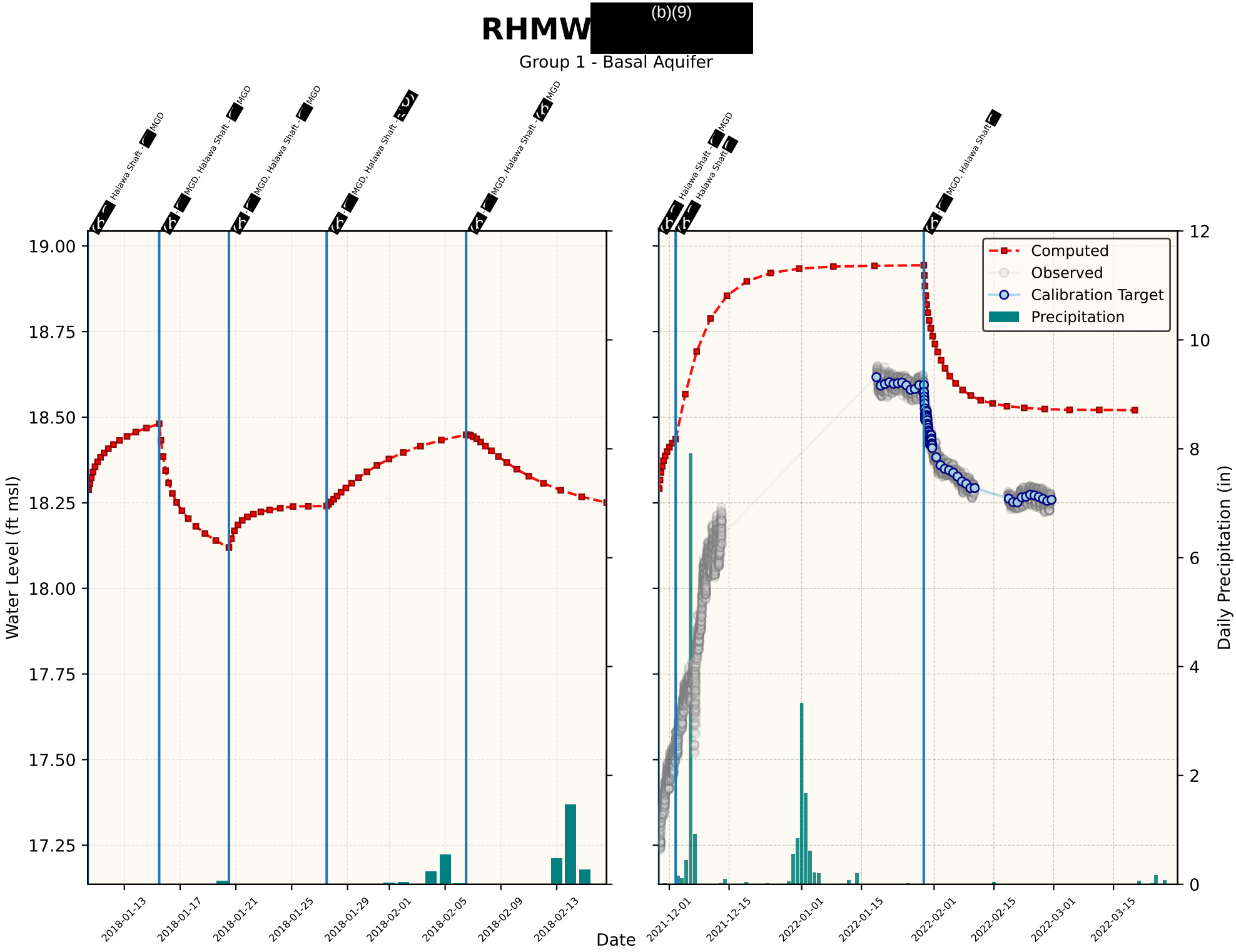
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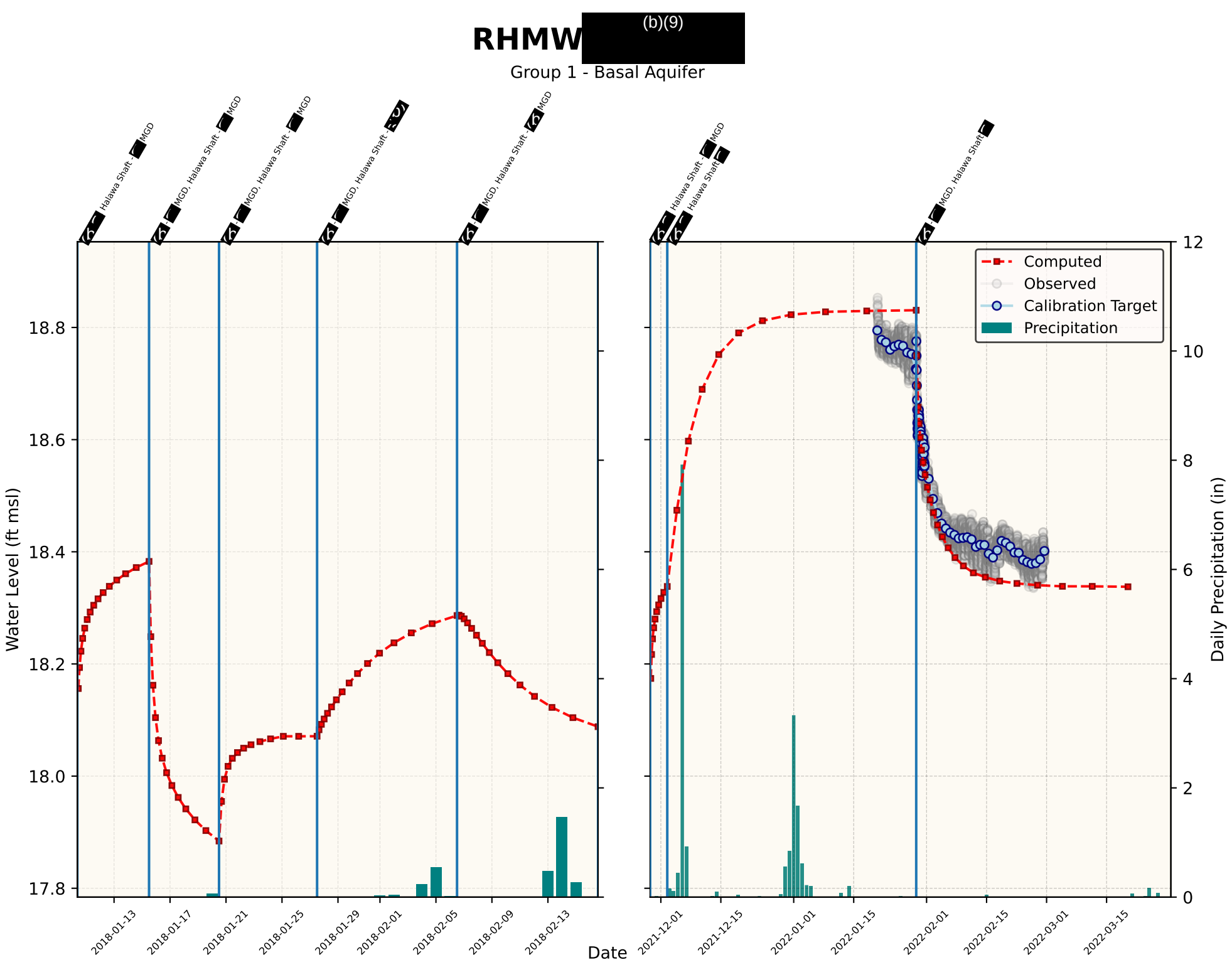
Group 1 - Basal Aquifer

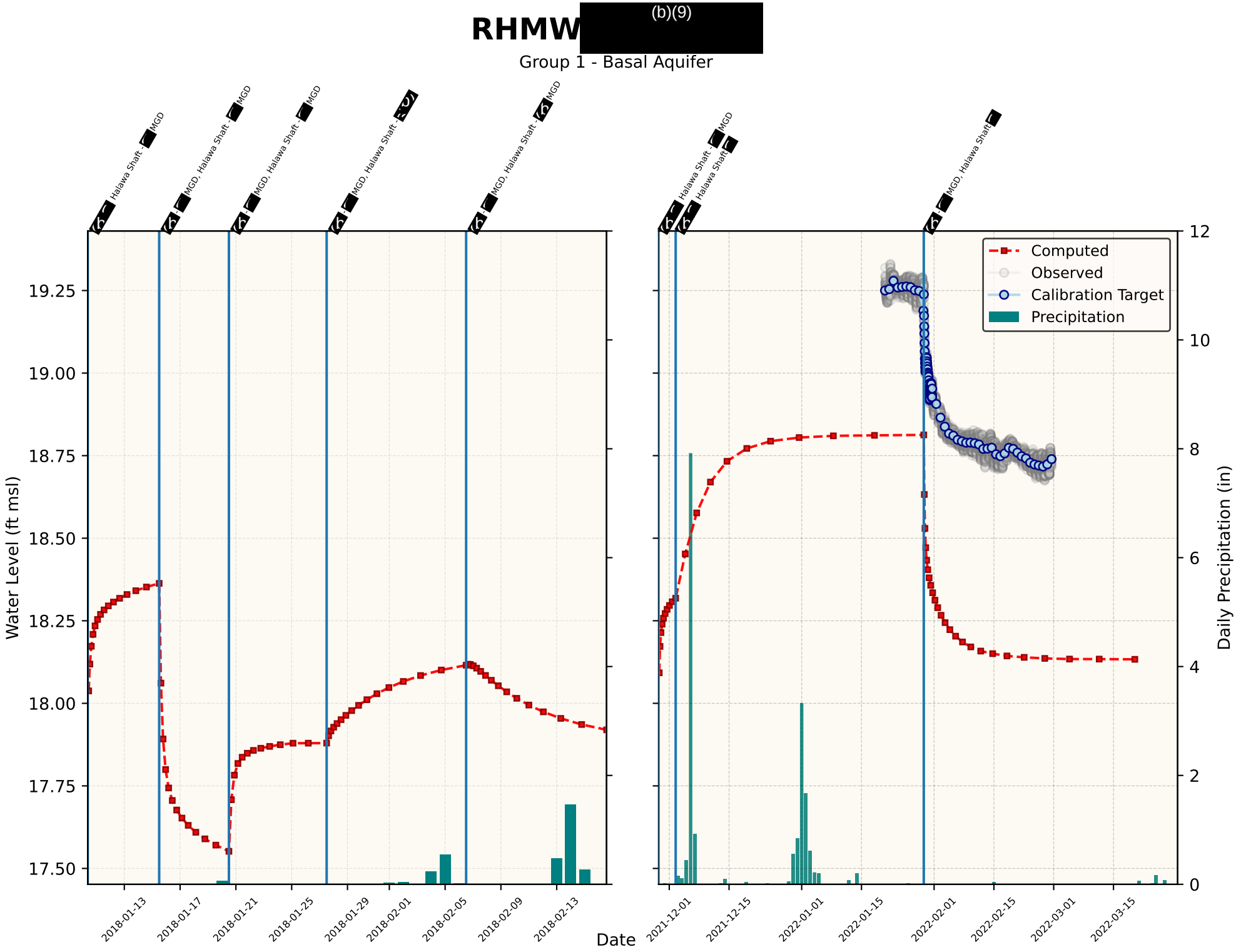


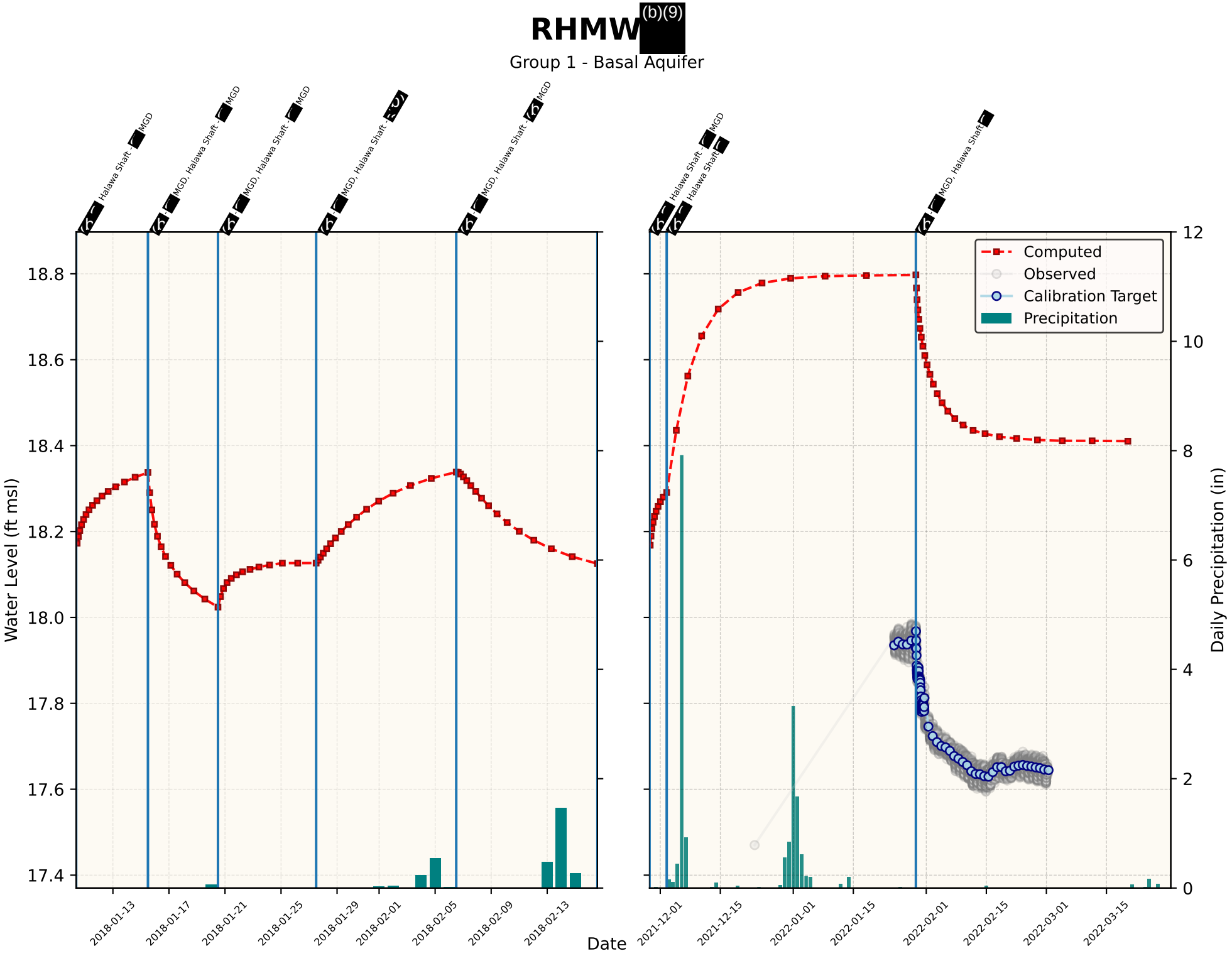

RHMW [redacted] (b)(9)
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Computed
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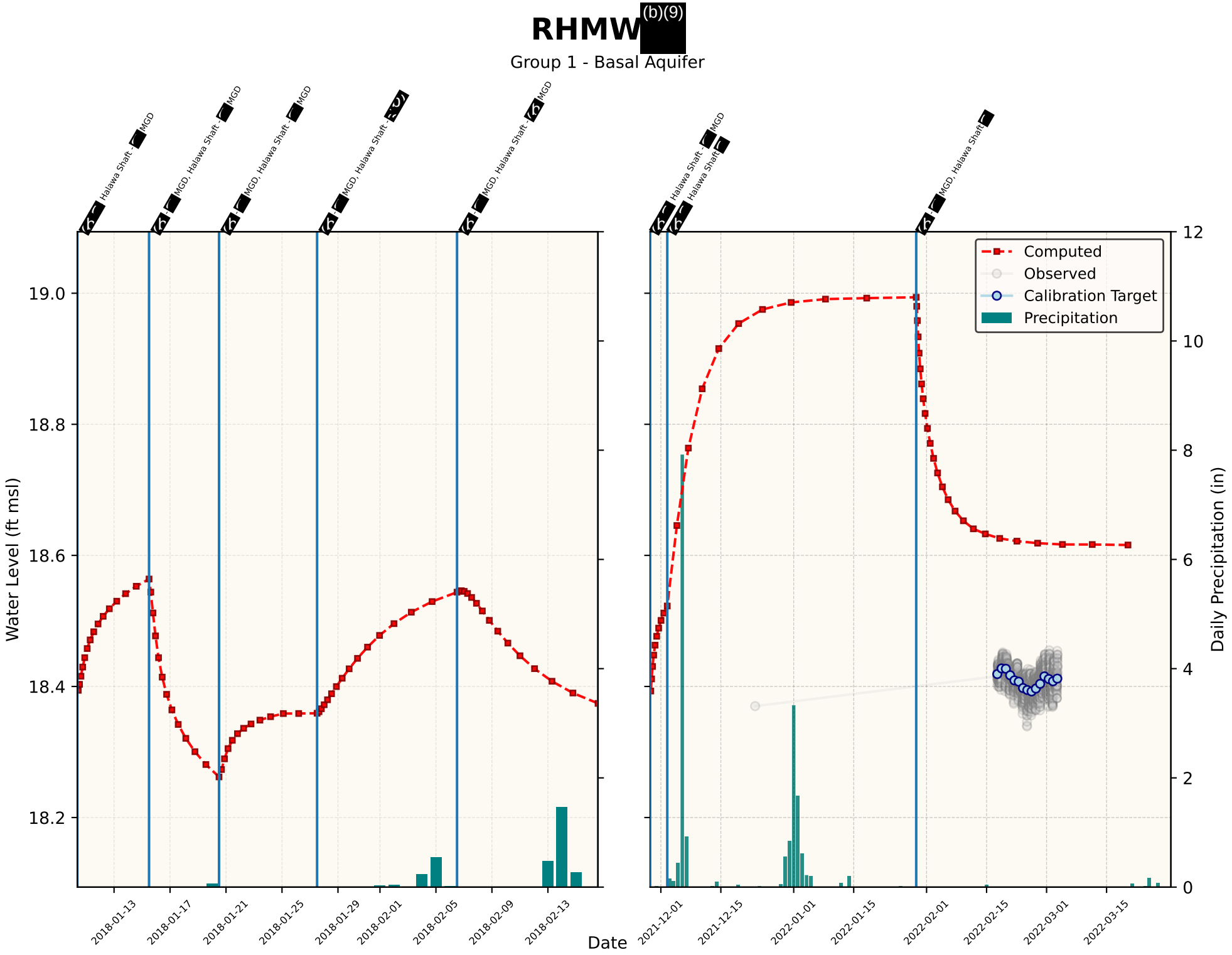

RHMW (b)(9)
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Computed
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Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.00
18.75
18.50
18.25
18.00
17.75
17.50
17.25
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

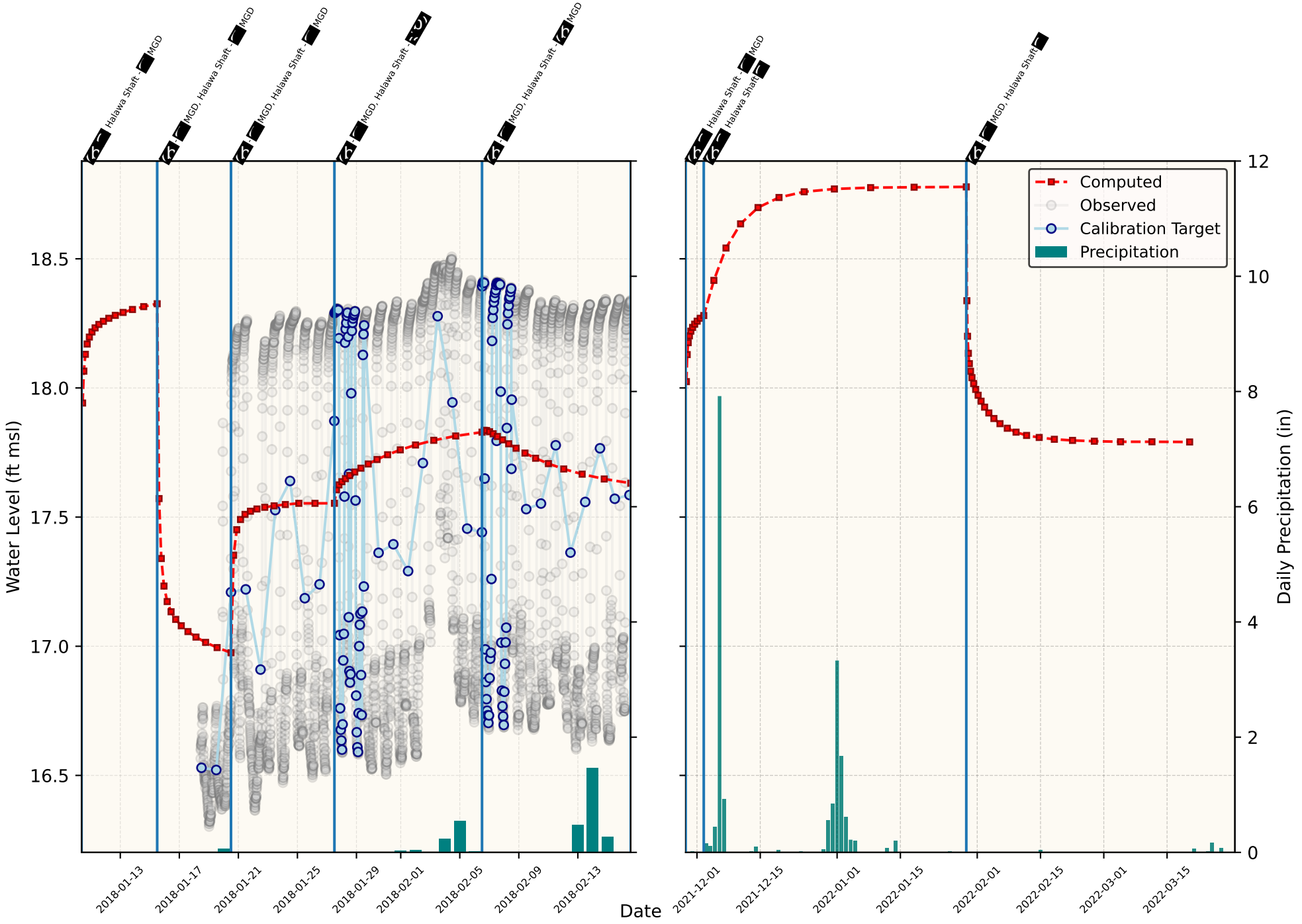

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.25
19.00
18.75
18.50
18.25
18.00
17.75
17.50
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
17.6
17.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

RHMW [redacted] (b)(9)

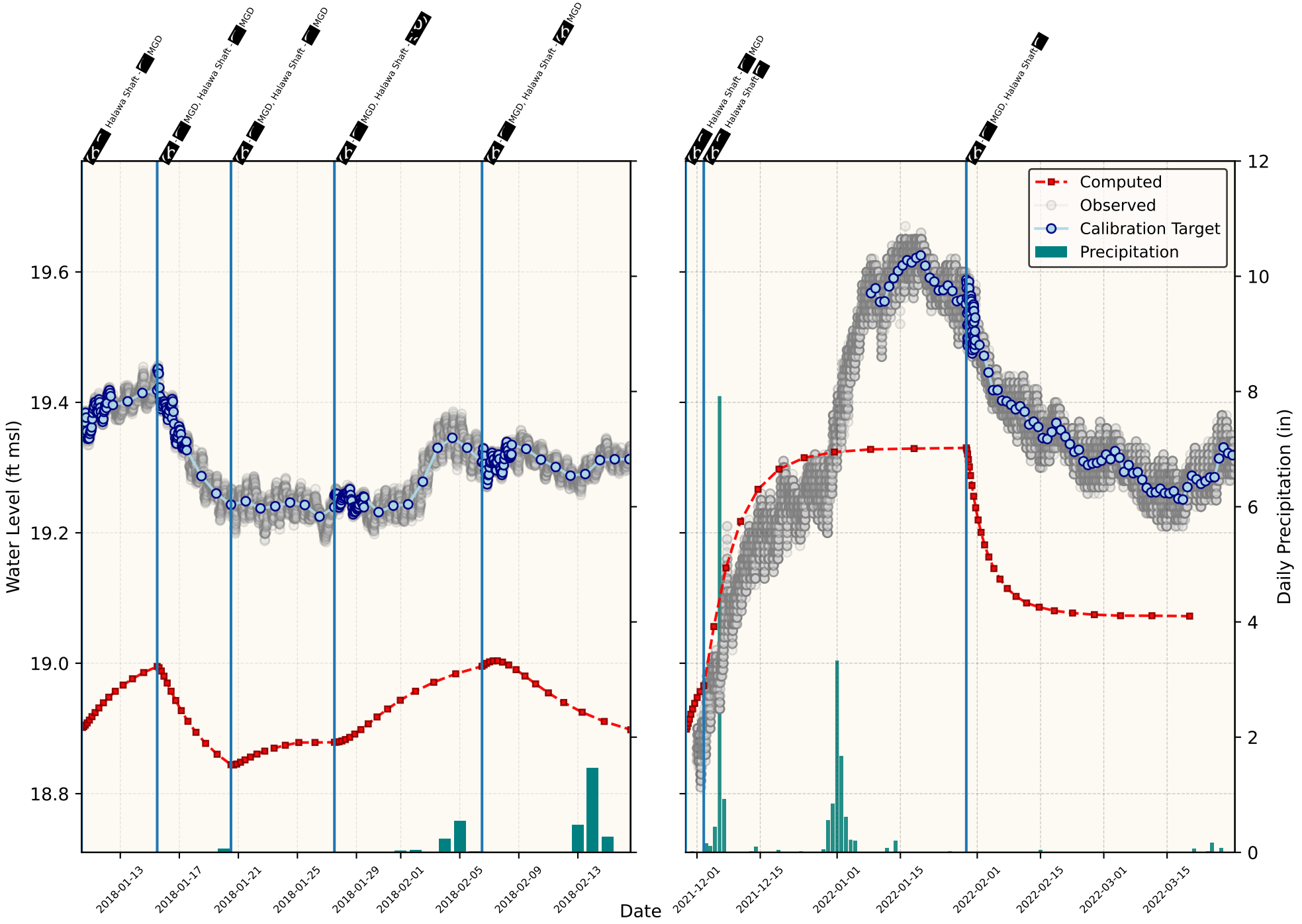
Group 1 - Basal Aquifer

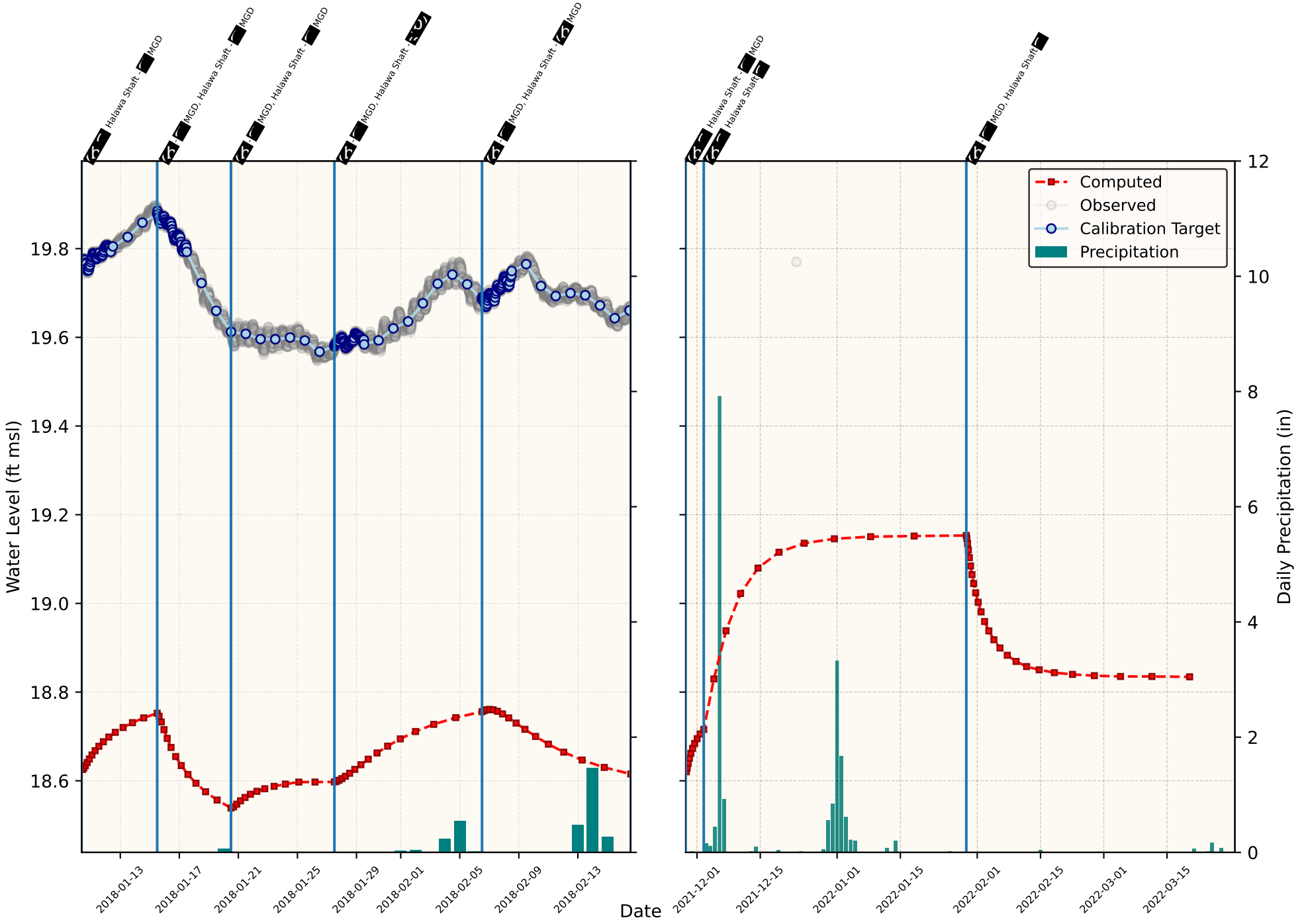


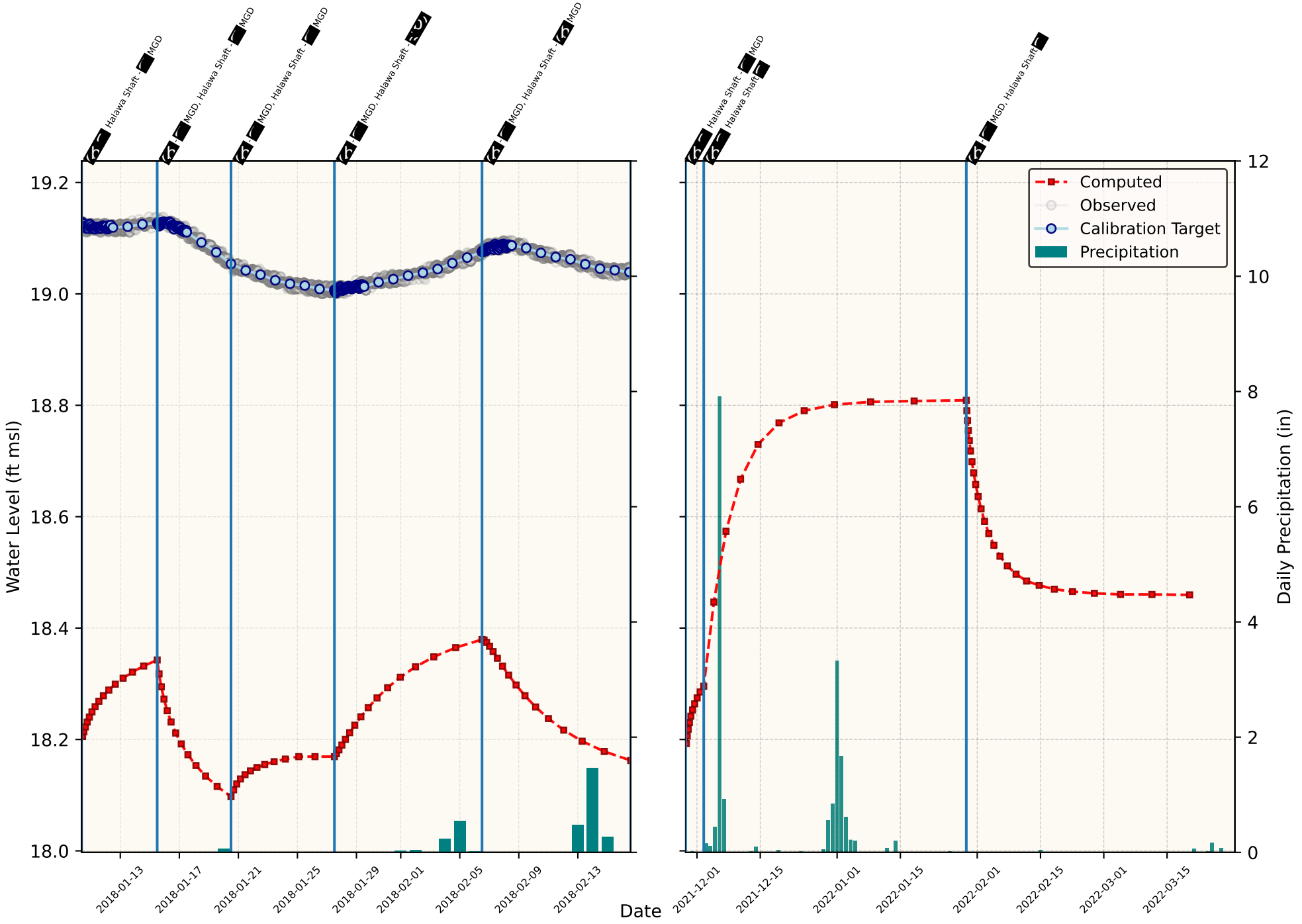
TAMC_[redacted]

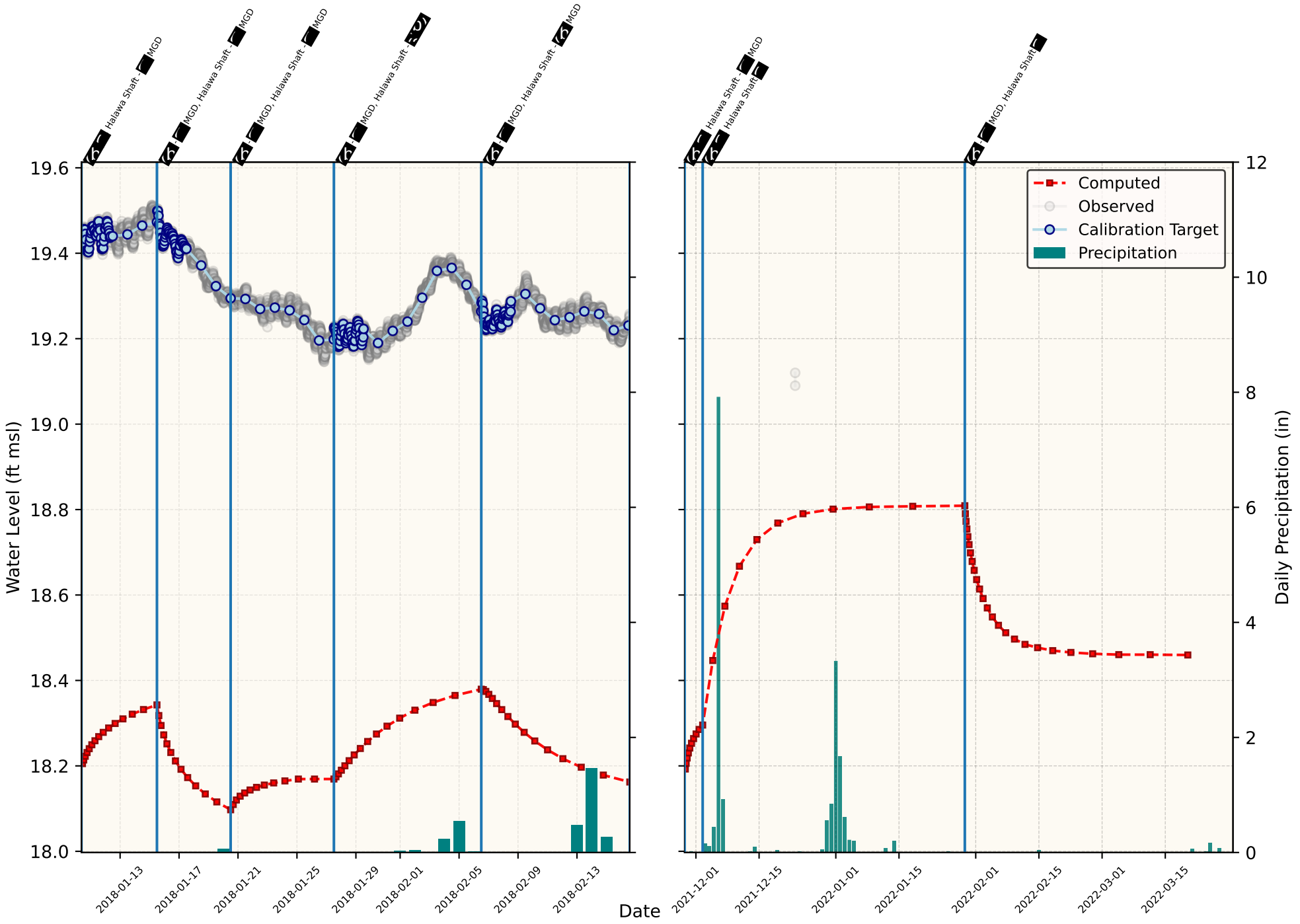
(b)(9)

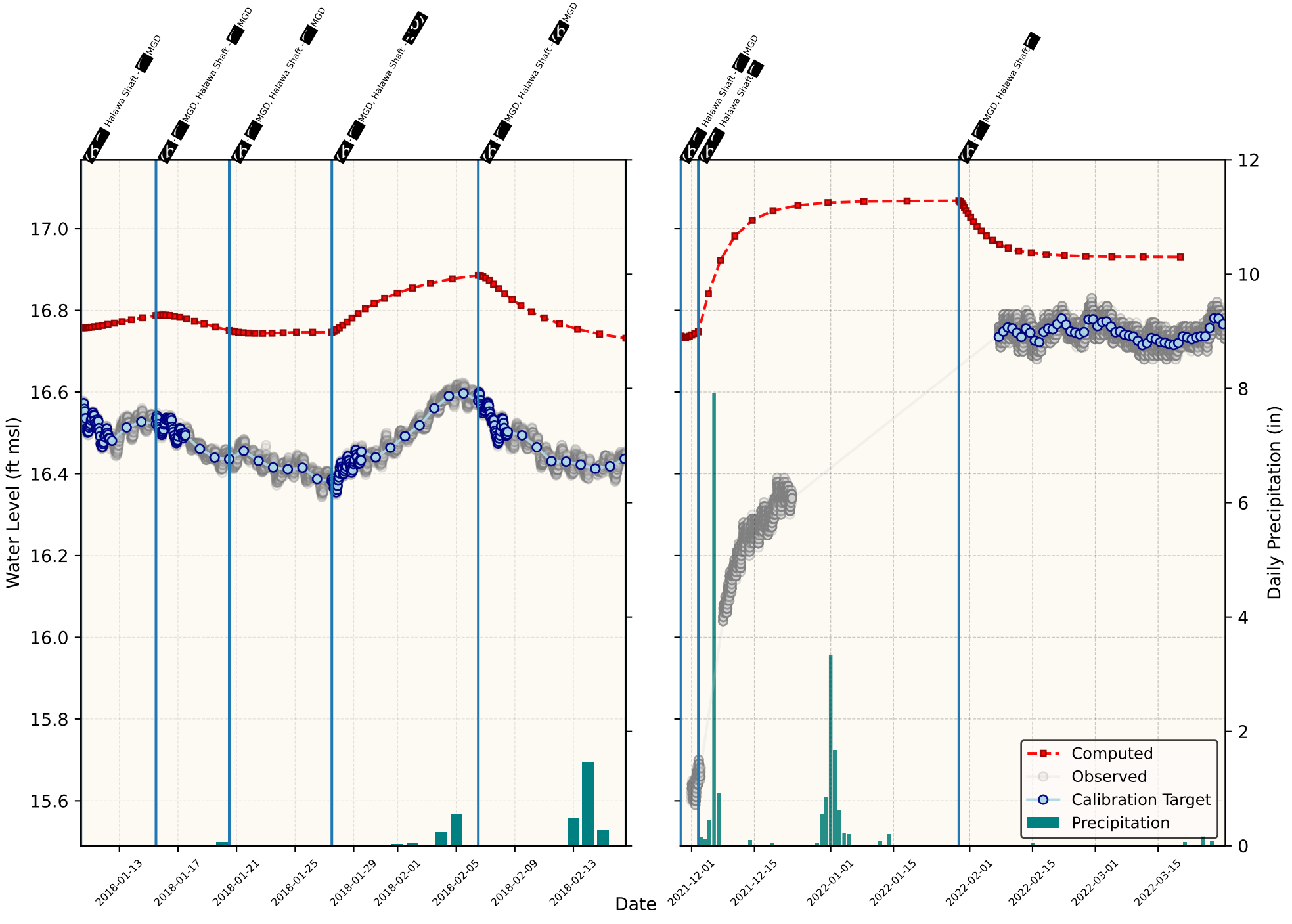
Group 1 - Basal Aquifer




DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.8
19.6
19.4
19.2
19.0
18.8
18.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

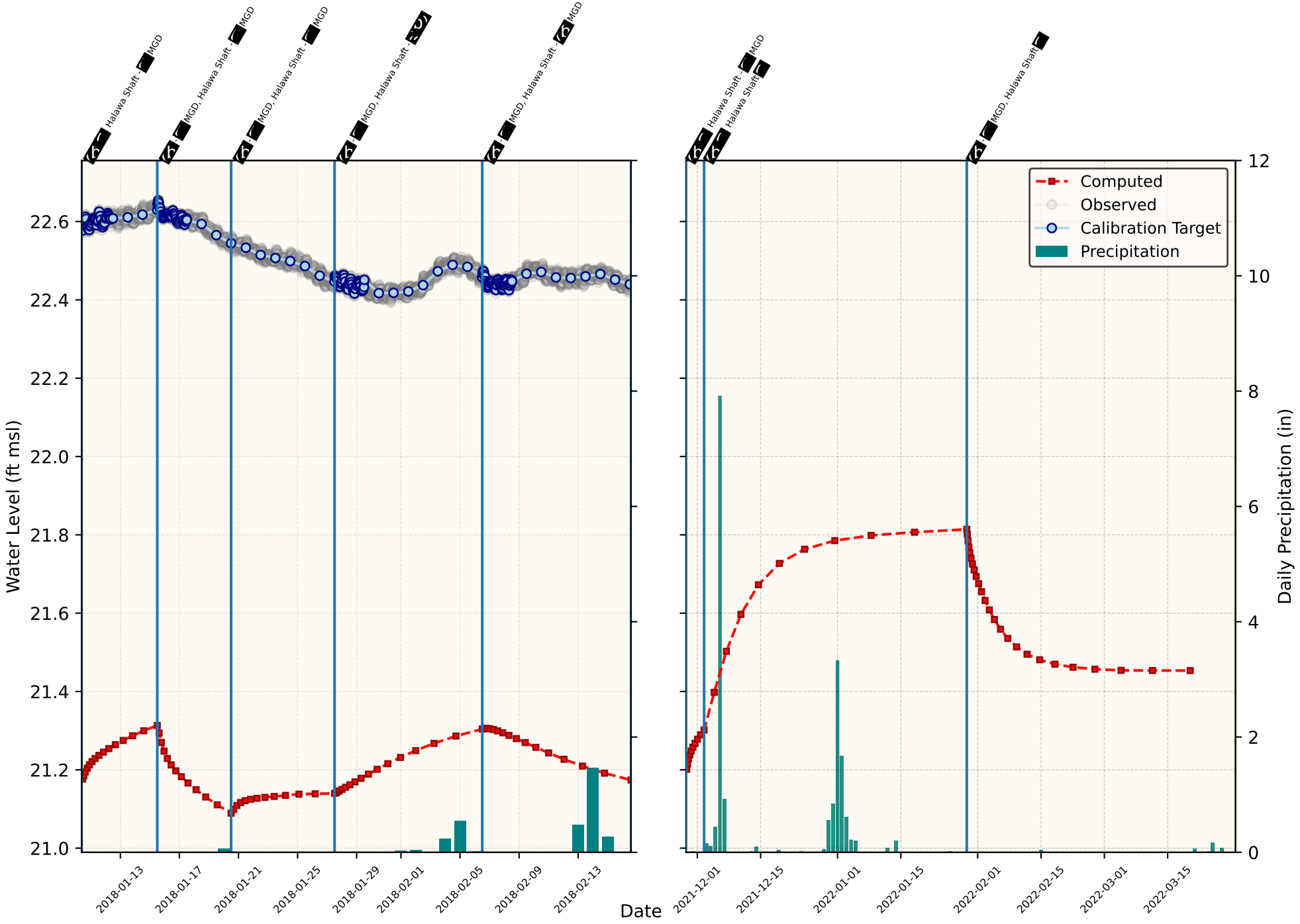

HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.2
19.0
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


Halawa_Deep_Monitor_Well_HDMW2253-03
Group 2 - Deep Basal Wells
Halawa Shaft 🡒 MGD
MGD, Halawa Shaft 🡒 MGD
MGD, Halawa Shaft 🡒 MGD
MGD, Halawa Shaft 🡒 MGD
MGD, Halawa Shaft 🡒 MGD
Halawa Shaft 🡒 MGD
Halawa Shaft 🡒
MGD, Halawa Shaft 🡒
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.6
19.4
19.2
19.0
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

RHMW[redacted] (b)(9)

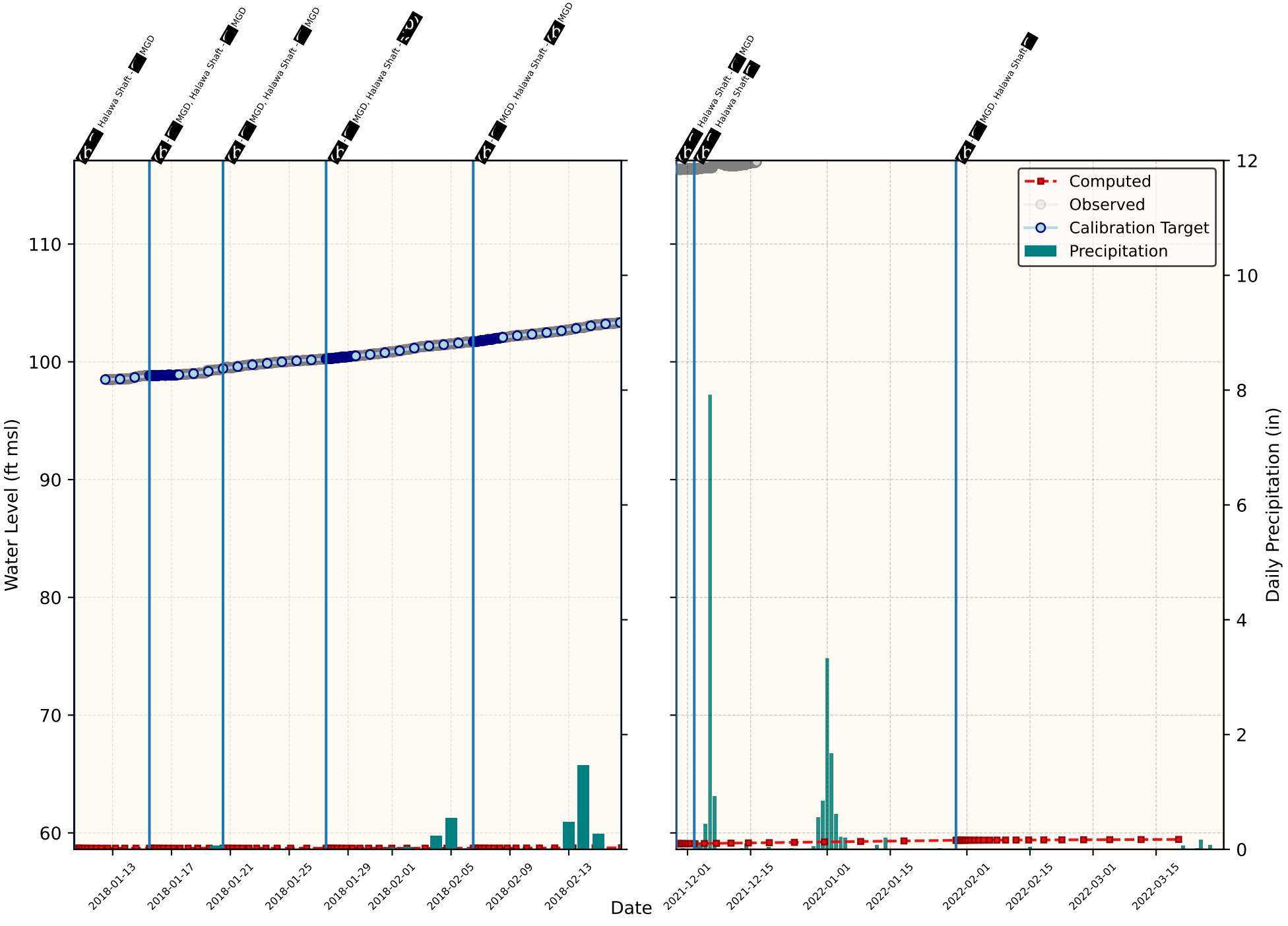
Group 3 - Saprolite/Confining Unit Well with Elevated Head

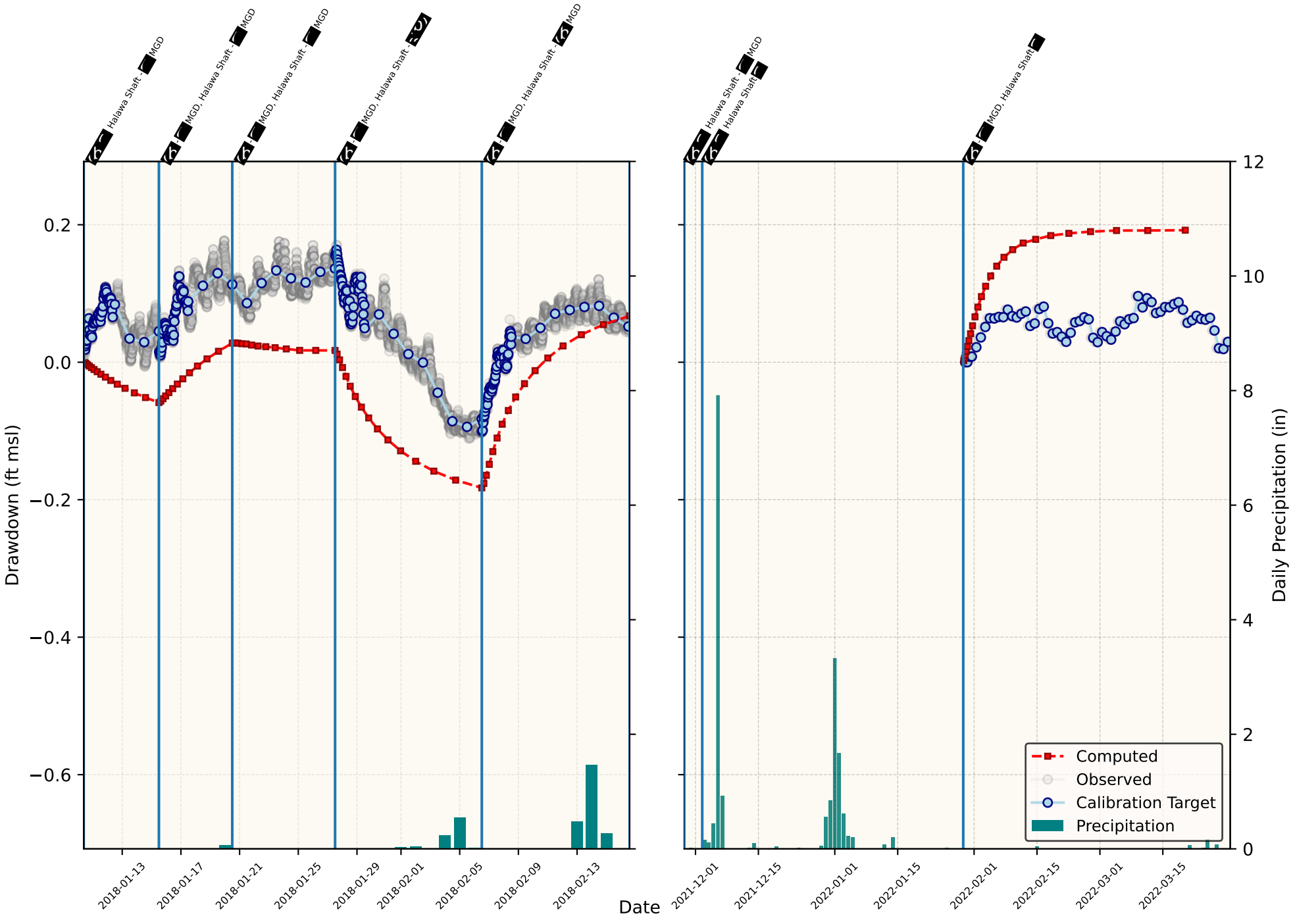


RHMW[redacted]

(b)(9)

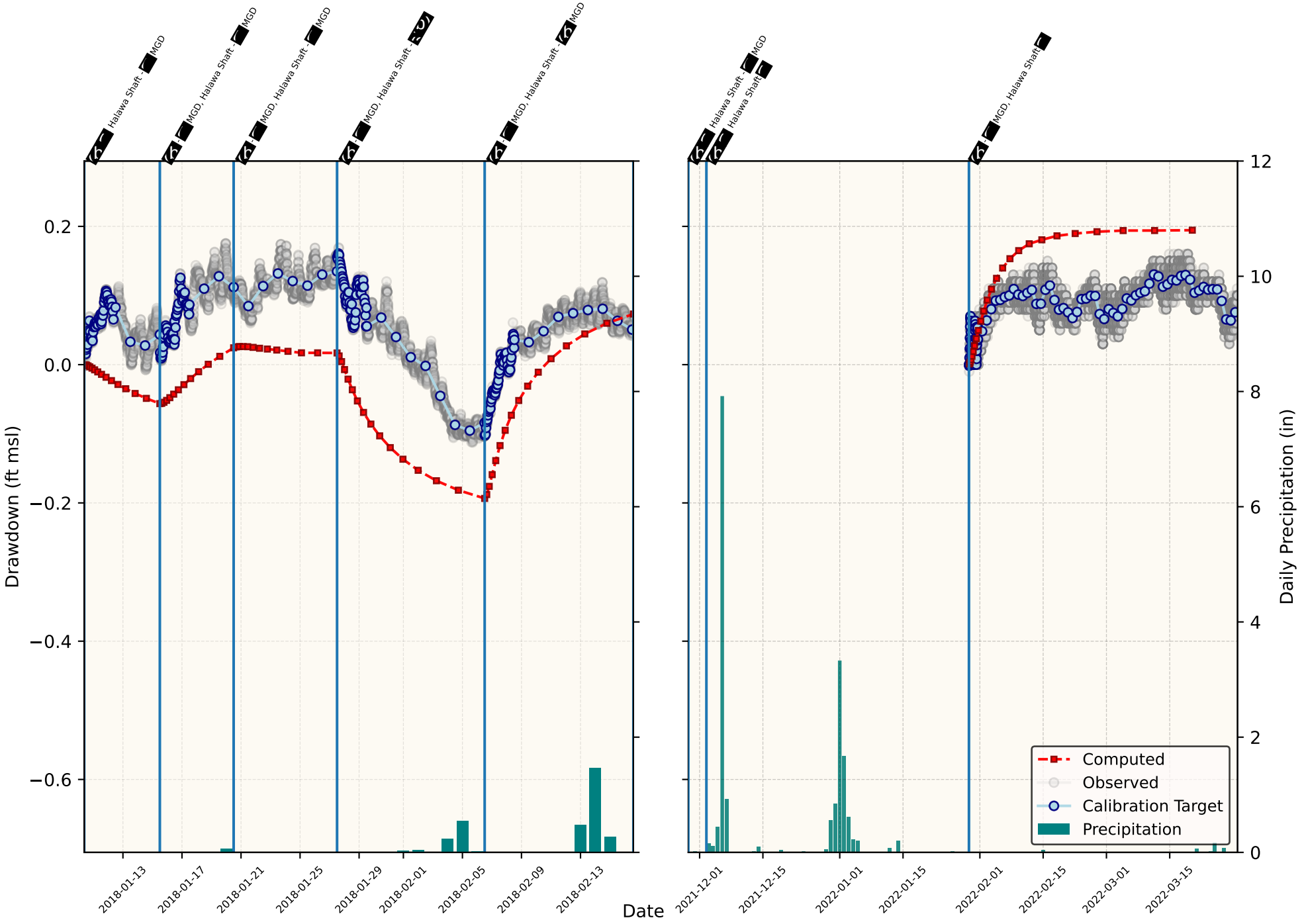
Group 3 - Saprolite/Confining Unit Well with Elevated Head

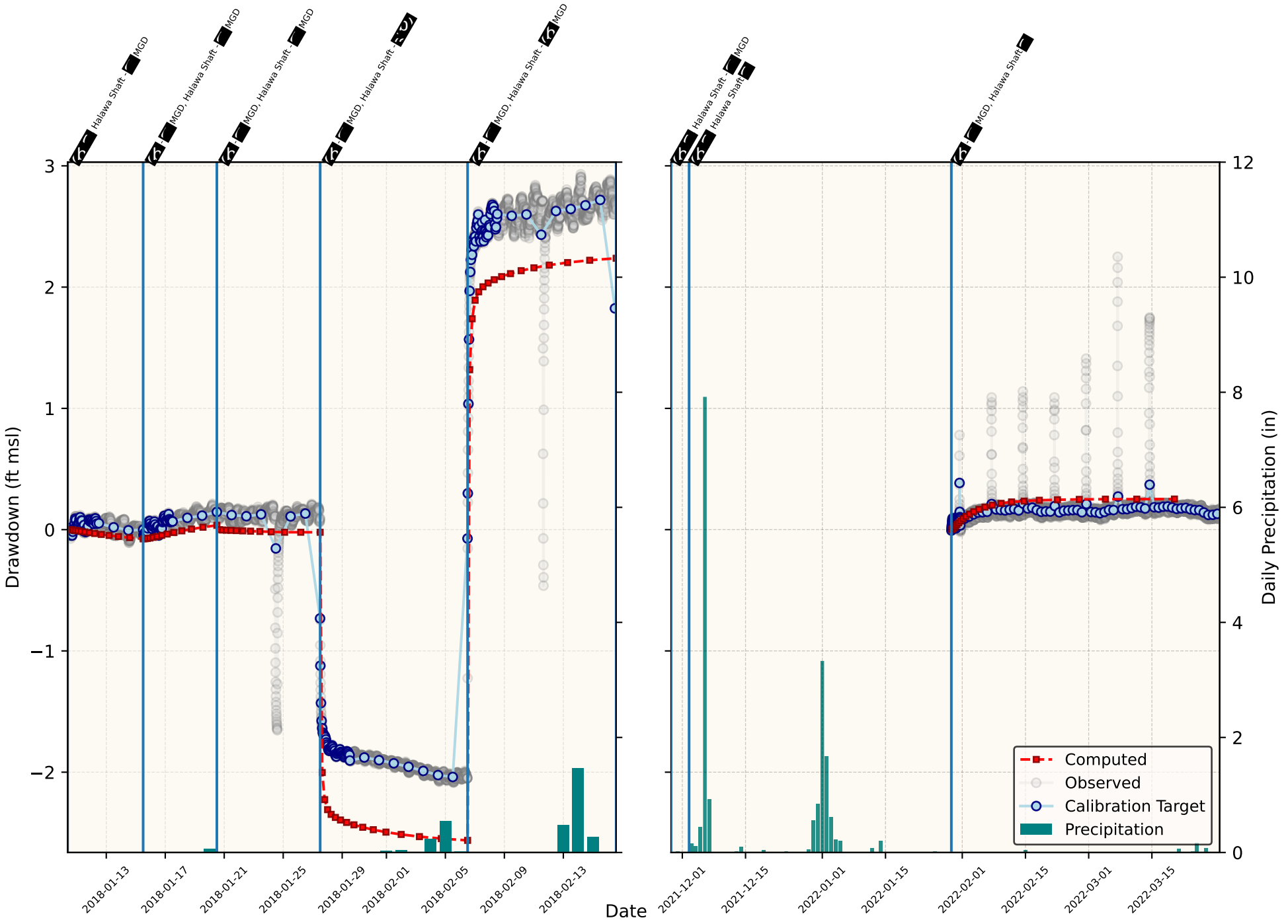


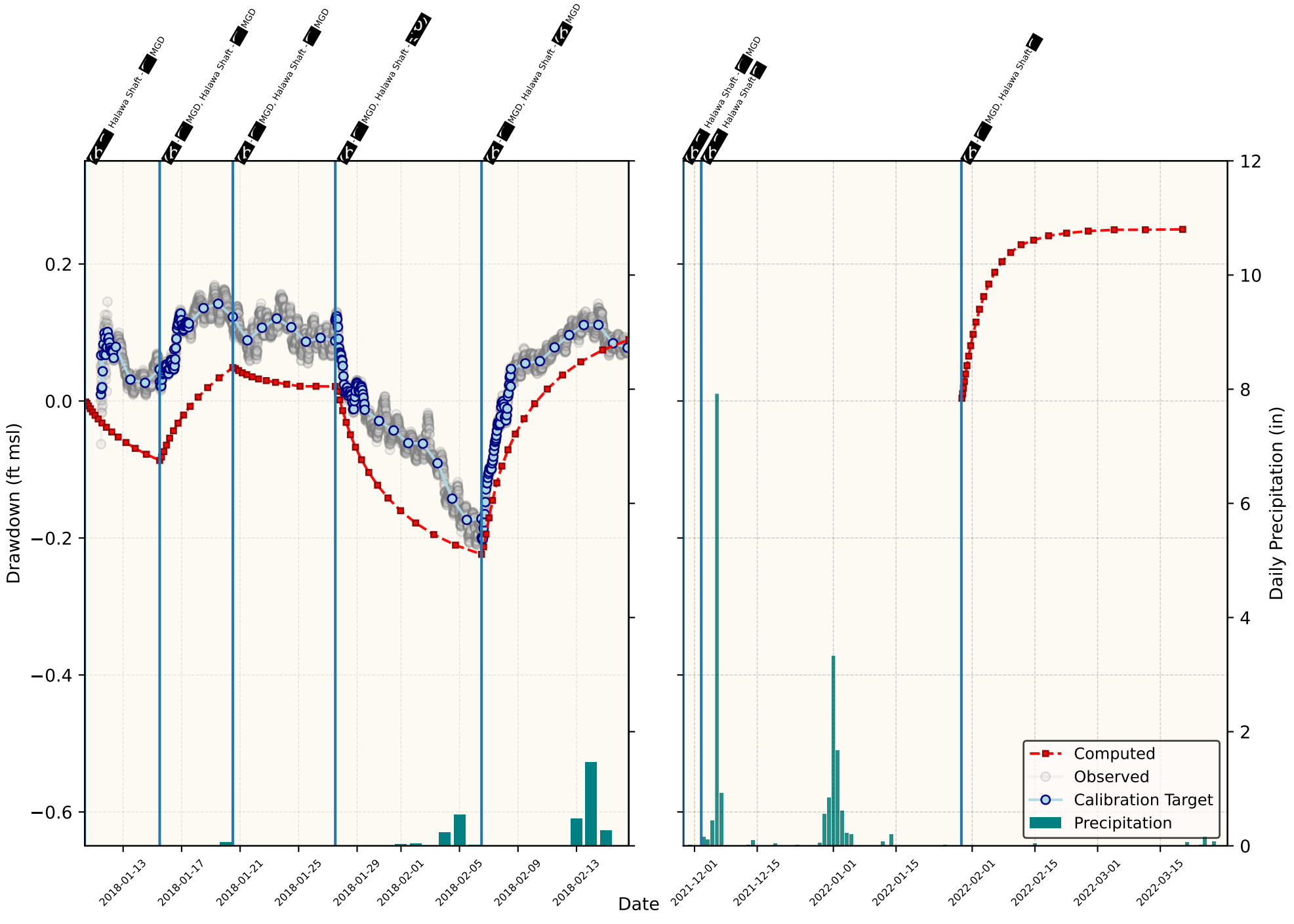

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

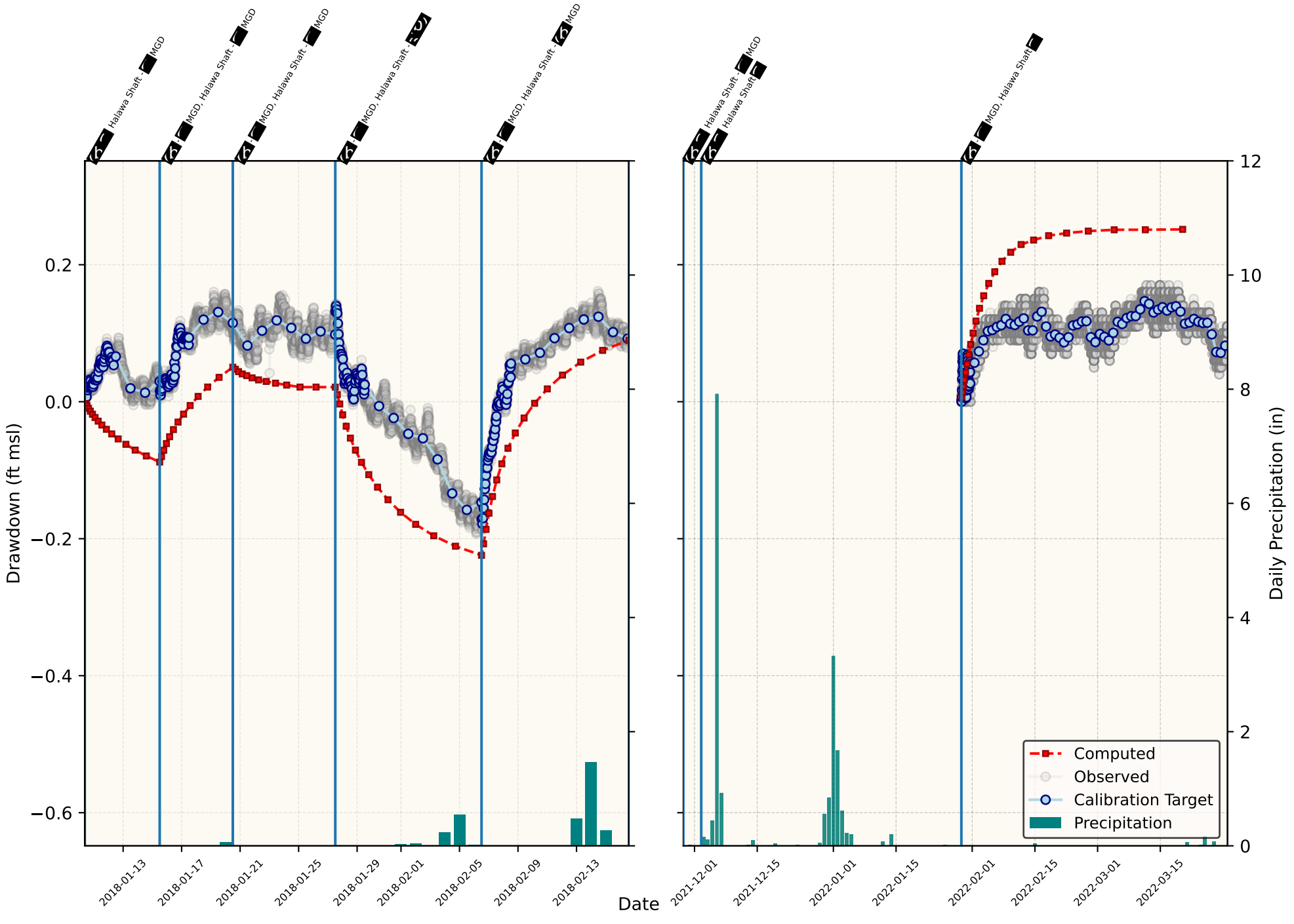
(b)(3) [redacted]

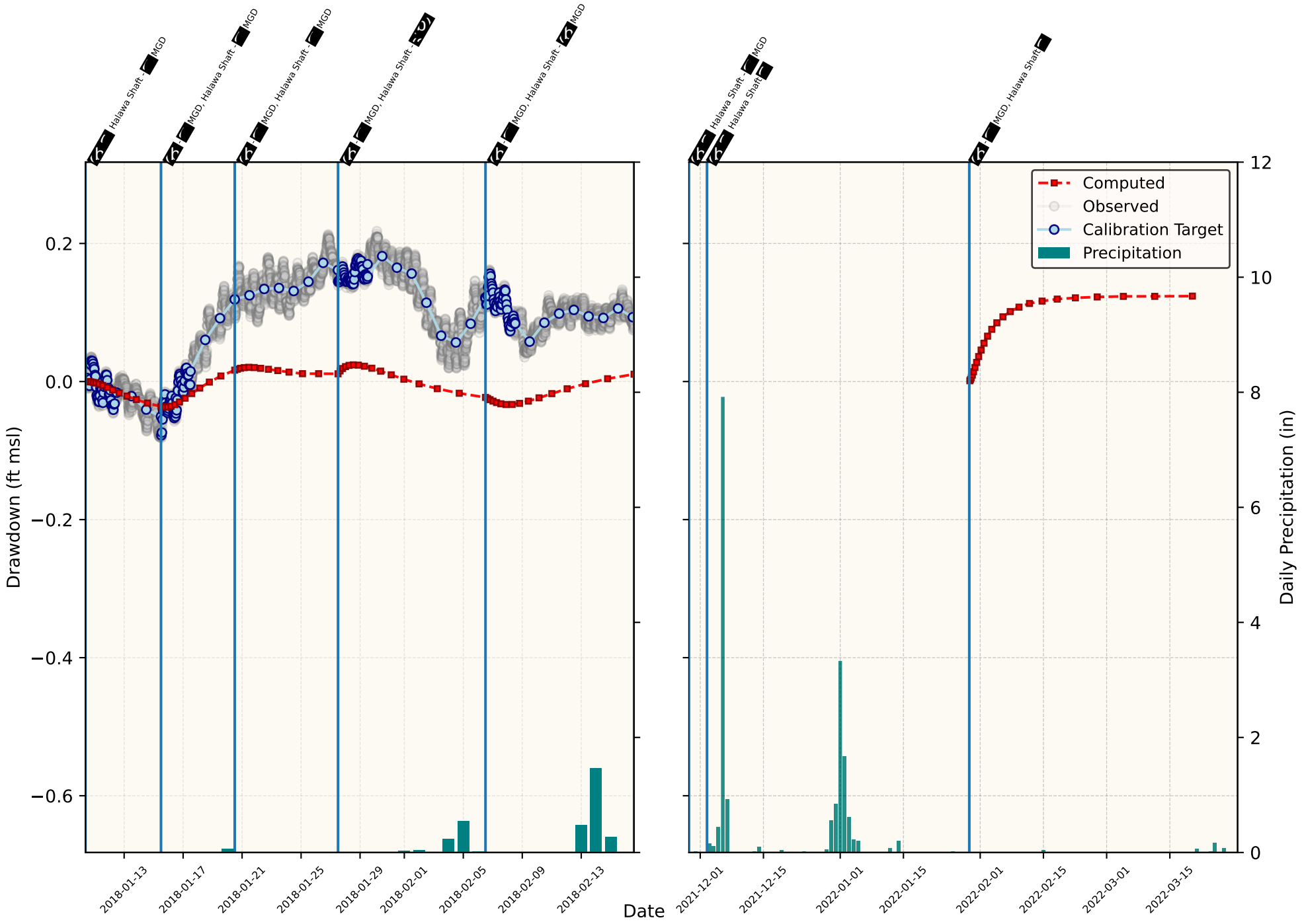
Group 1 - Basal Aquifer

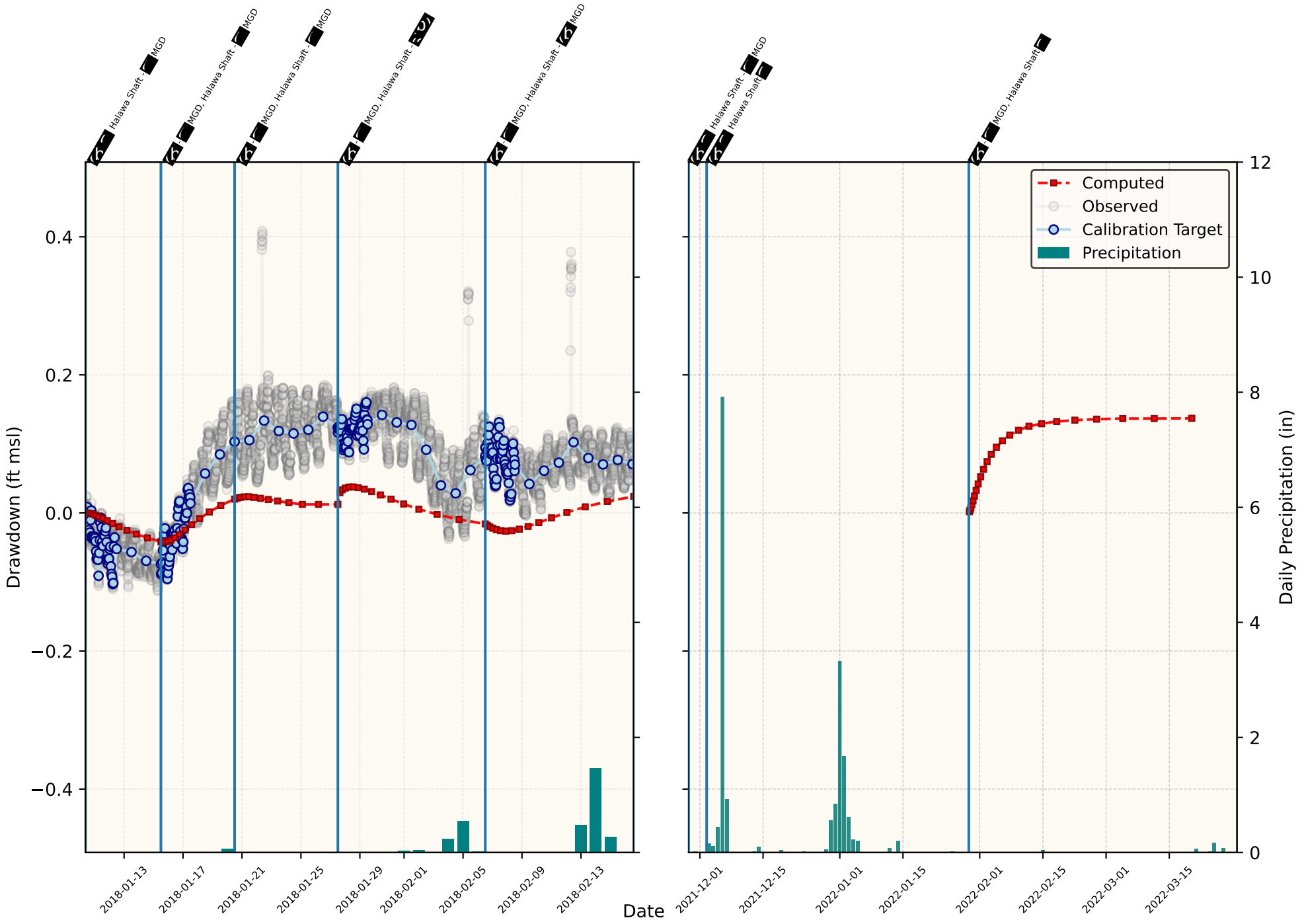


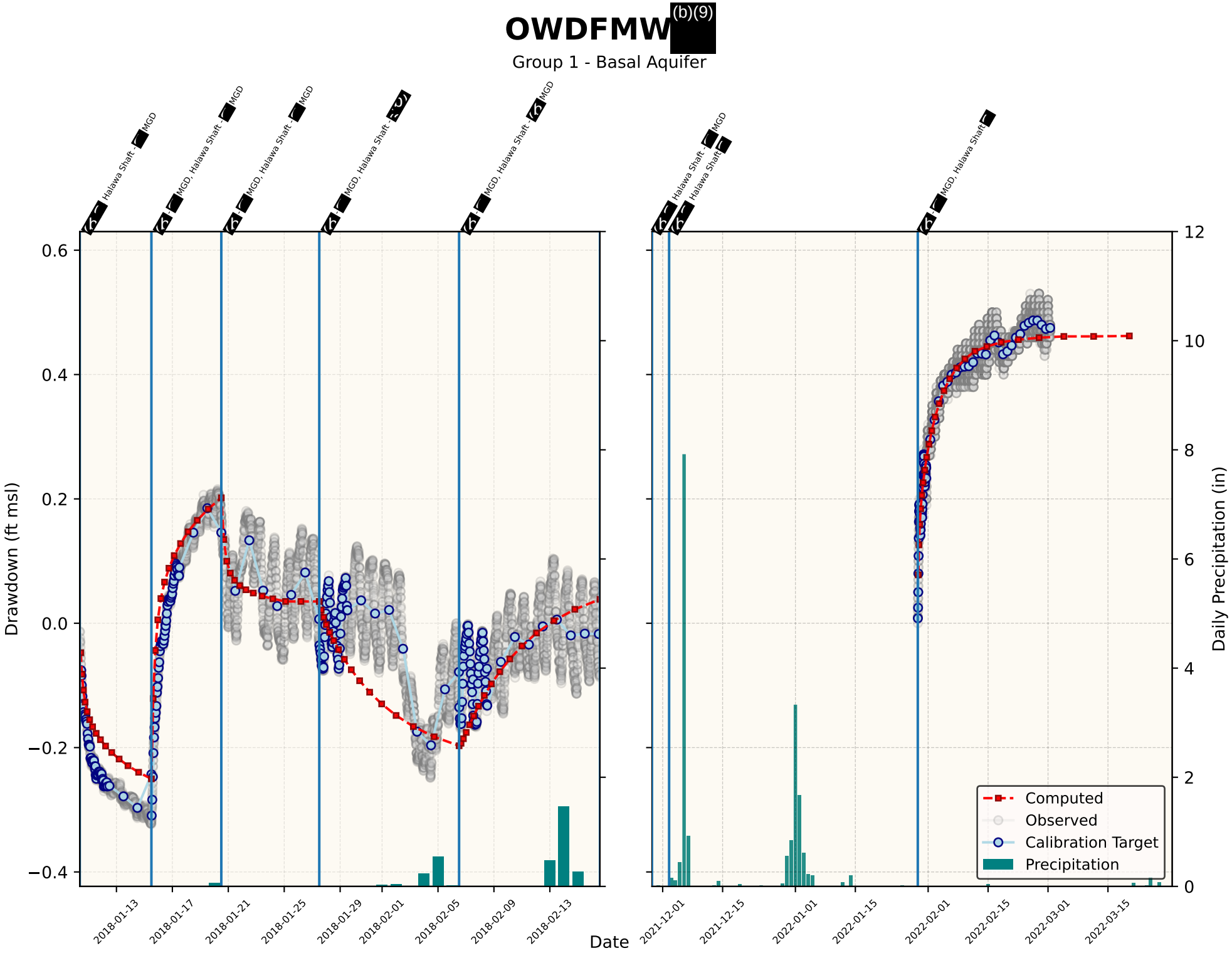

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

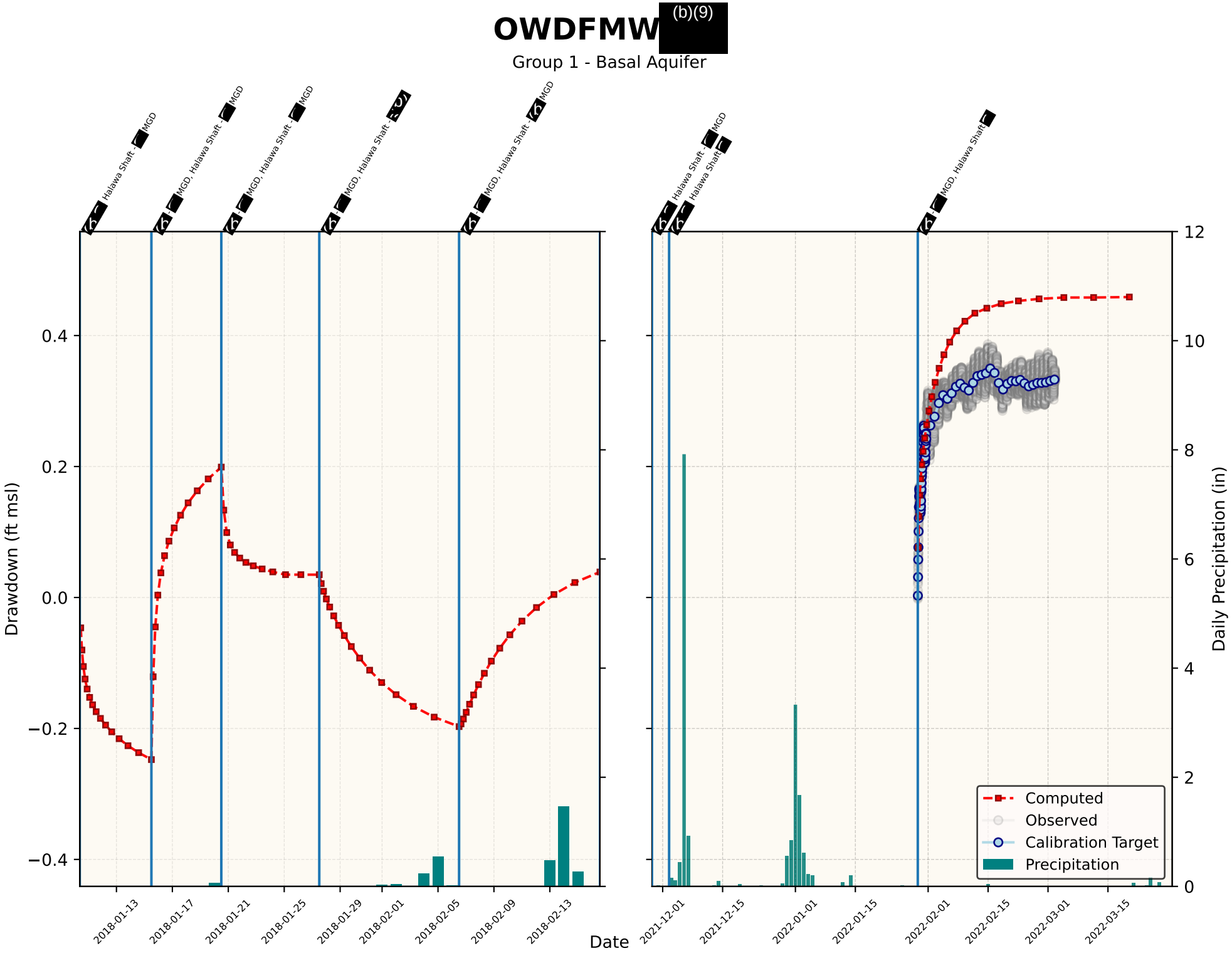

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

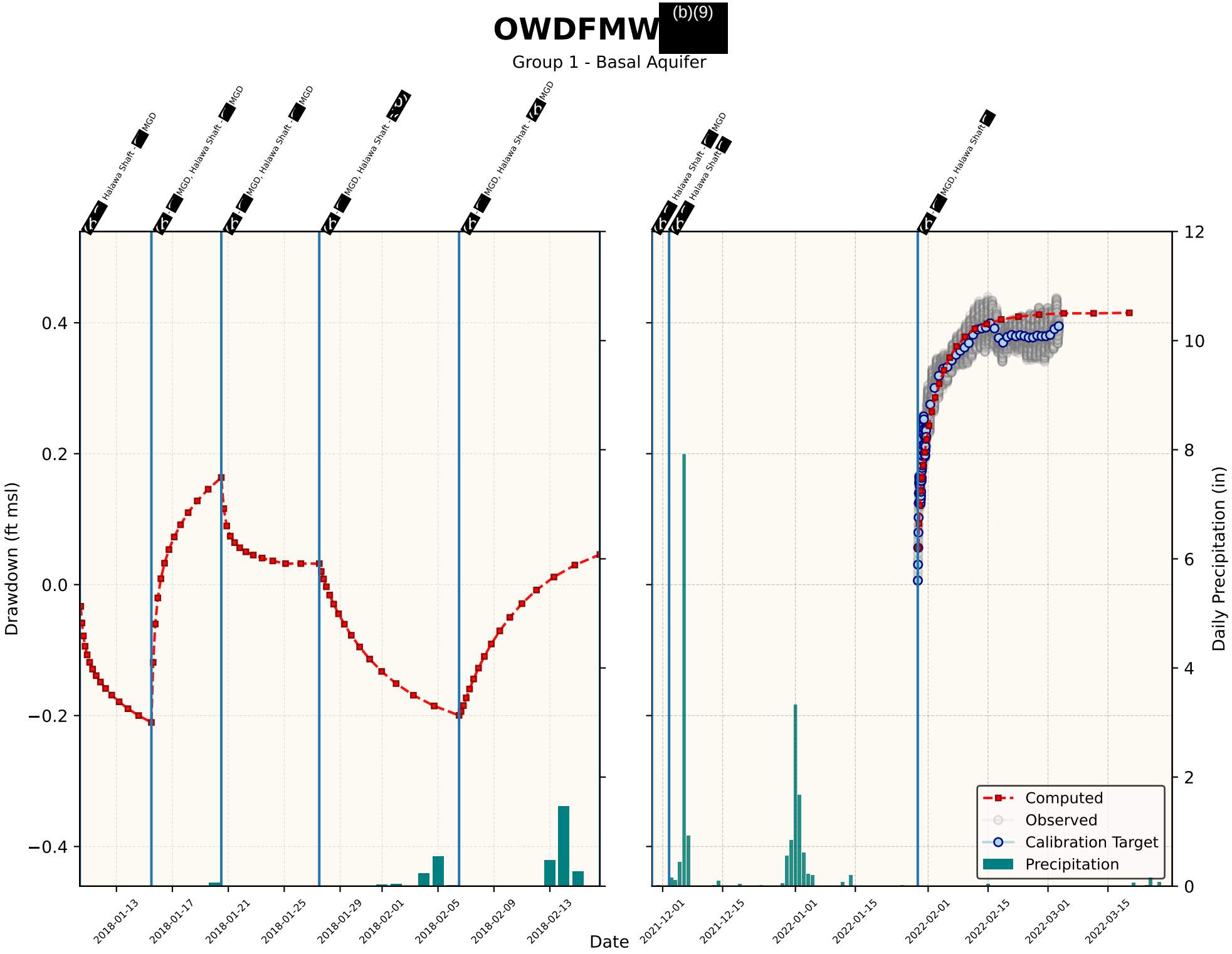

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

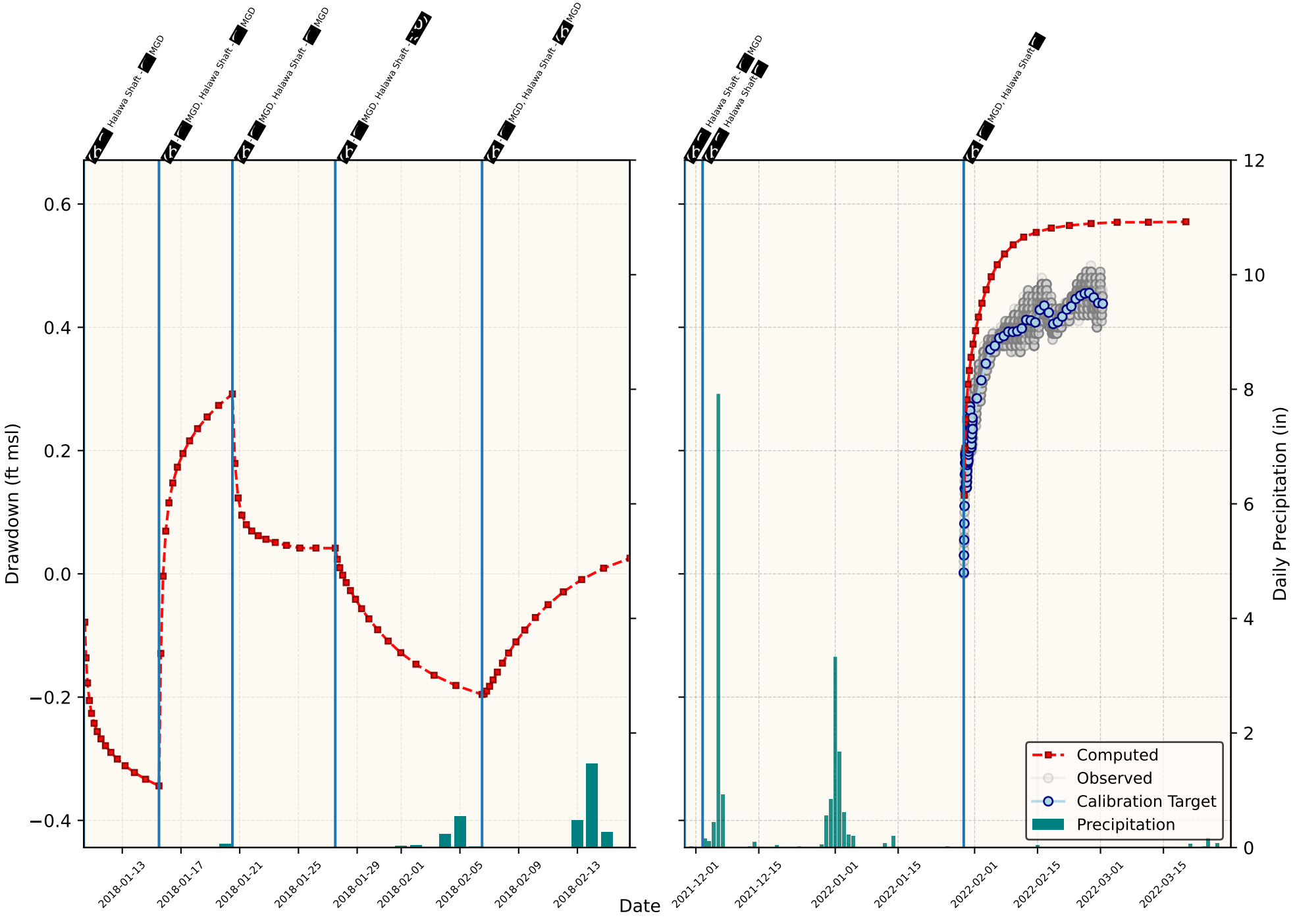

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
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2022-02-15
2022-03-01
2022-03-15

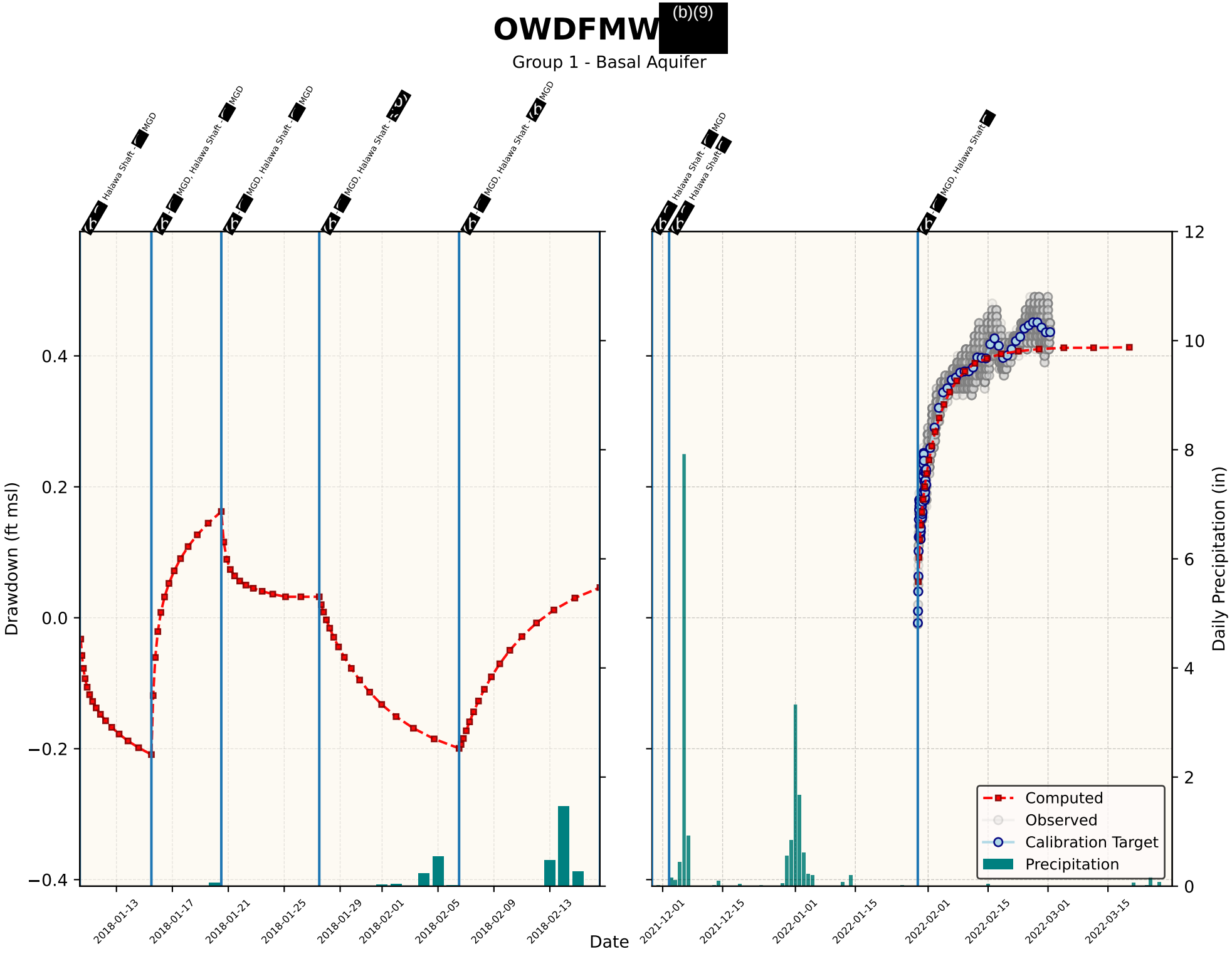

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

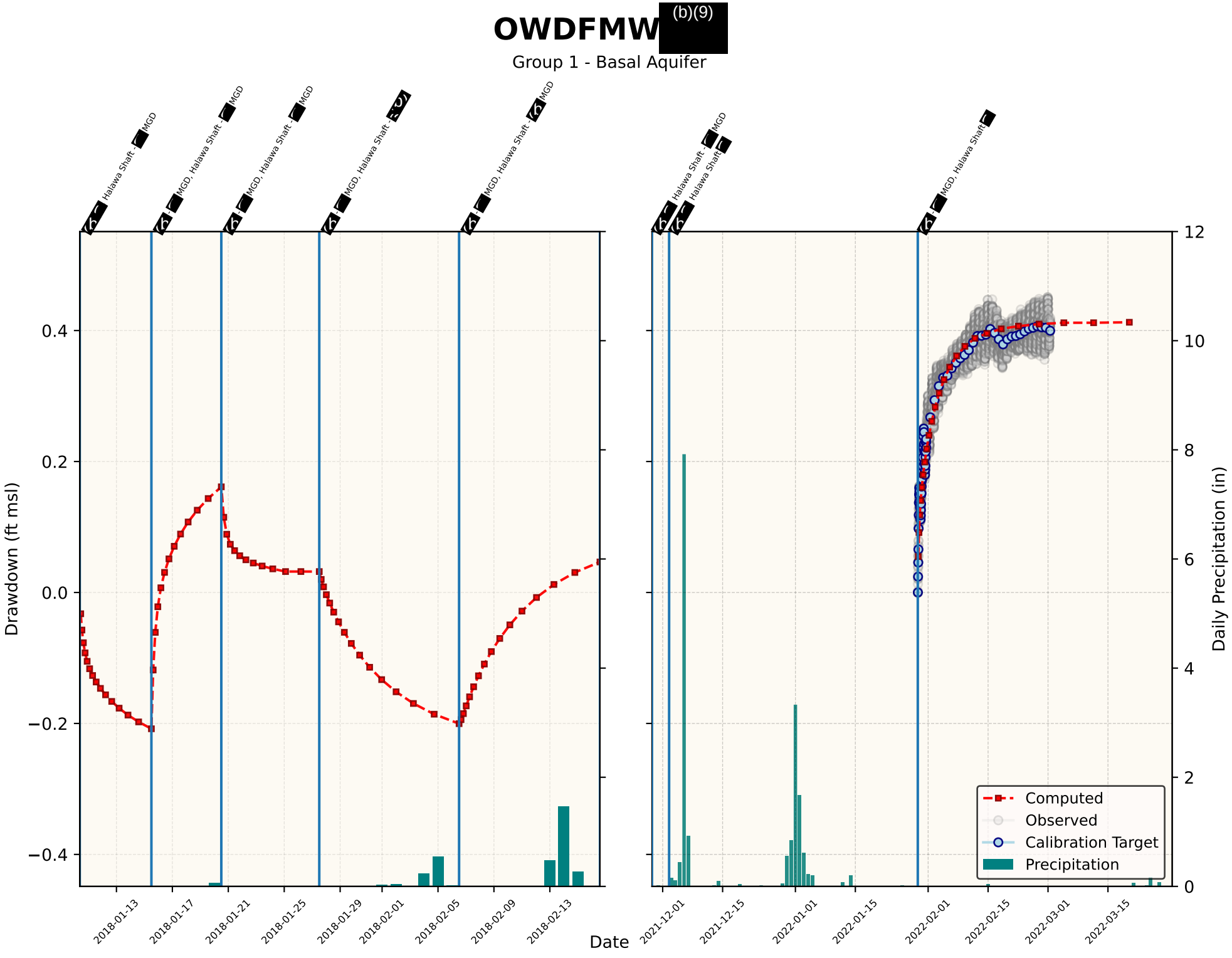

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

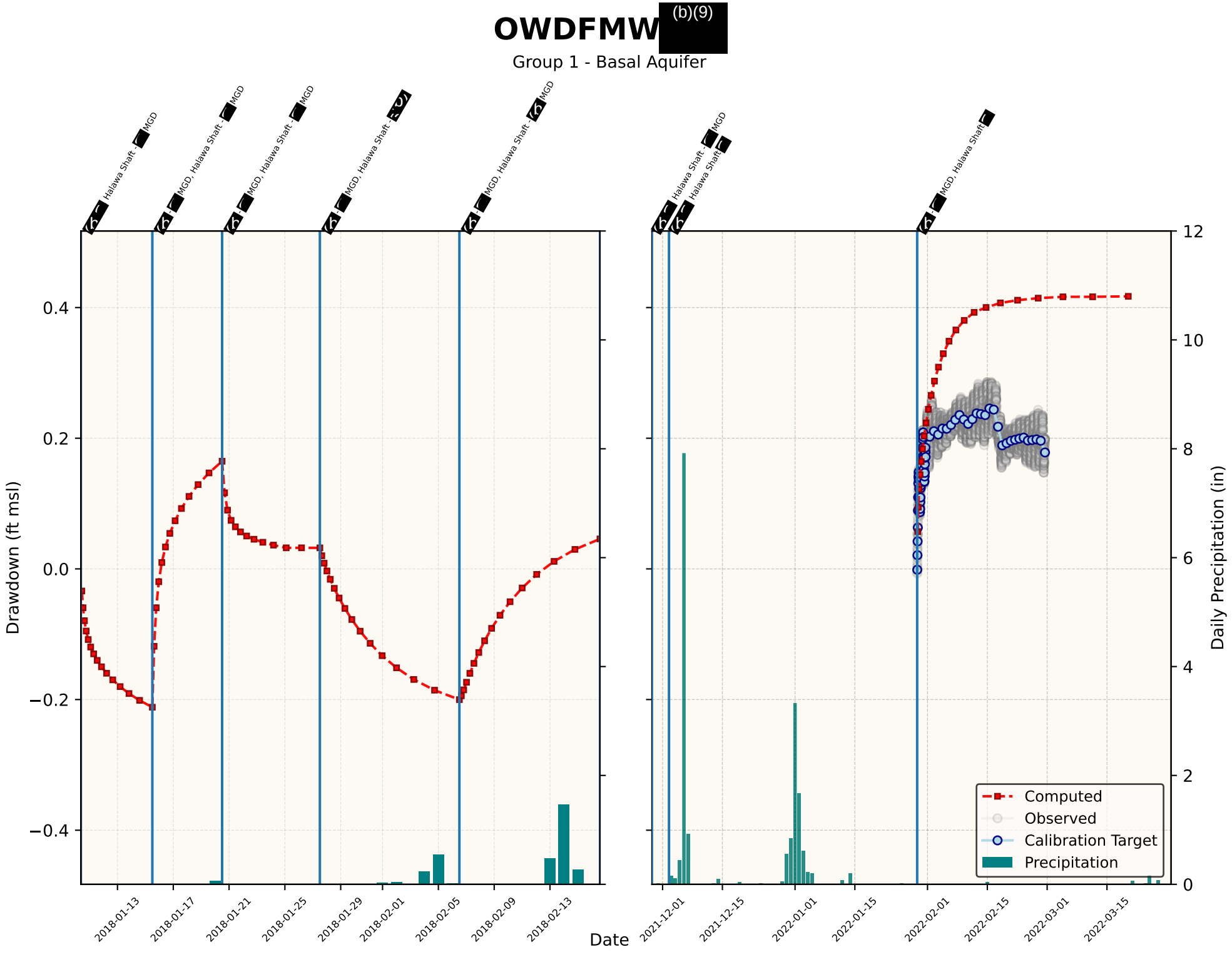
OWDFMW[redacted] (b)(9)

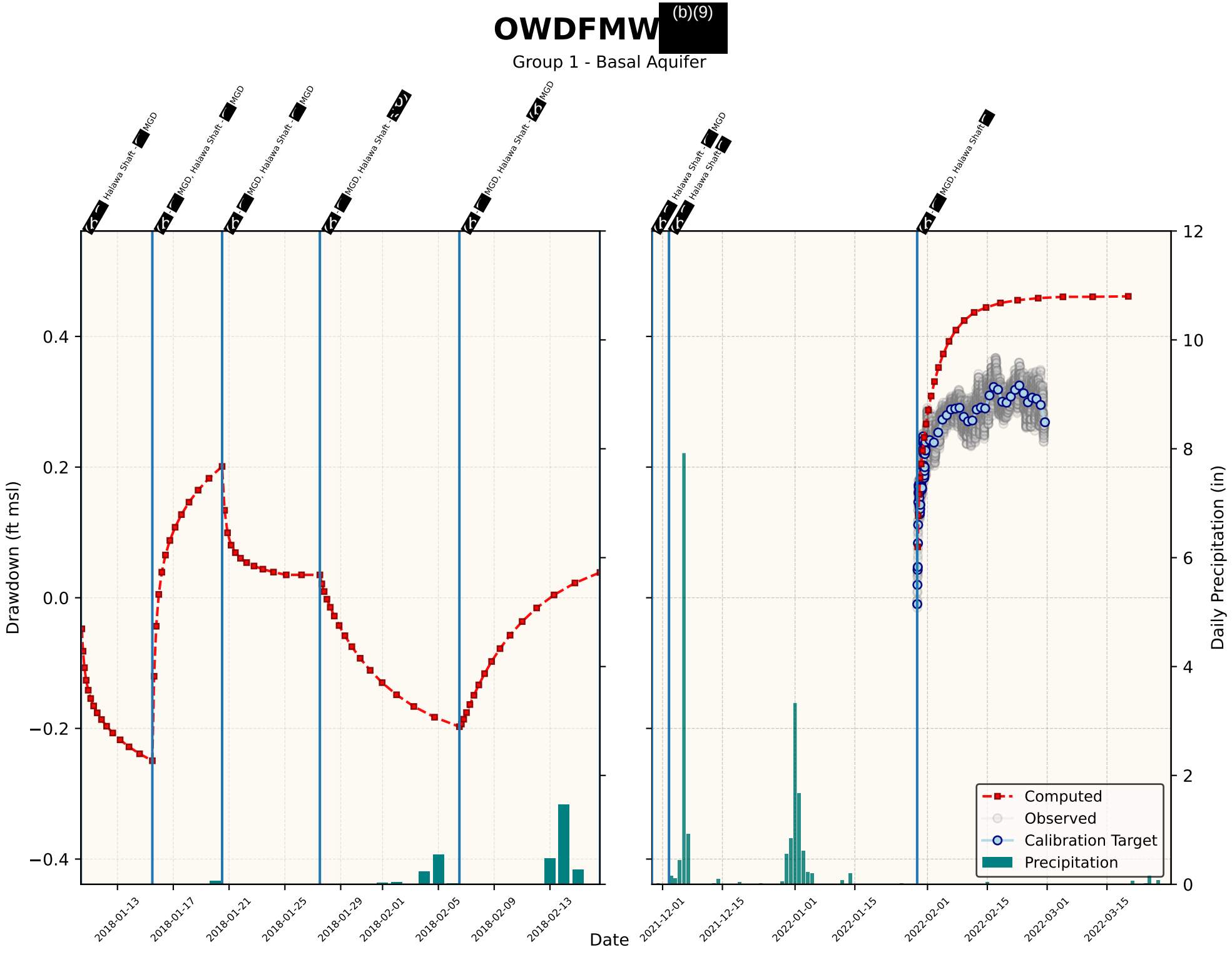
Group 1 - Basal Aquifer

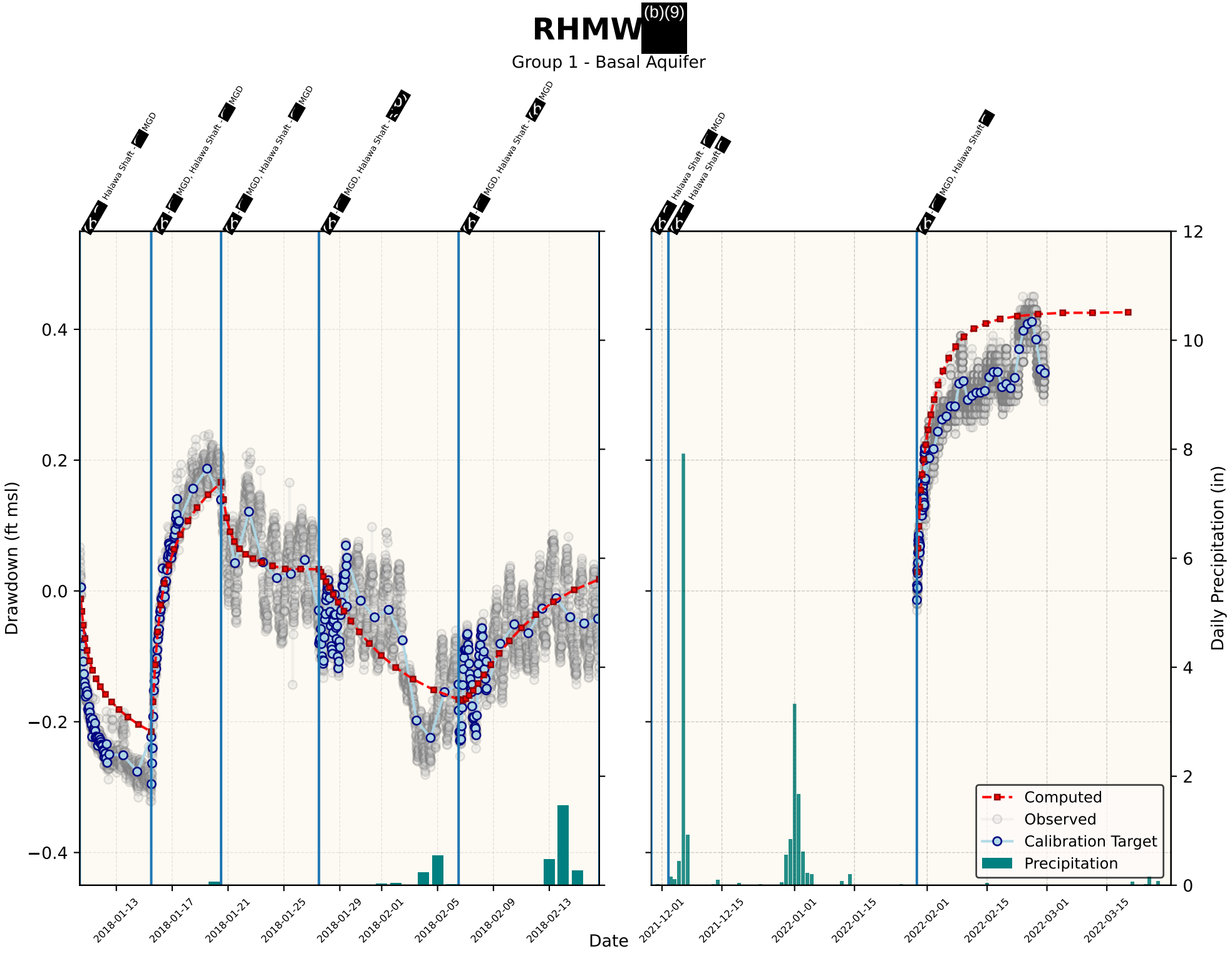



OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

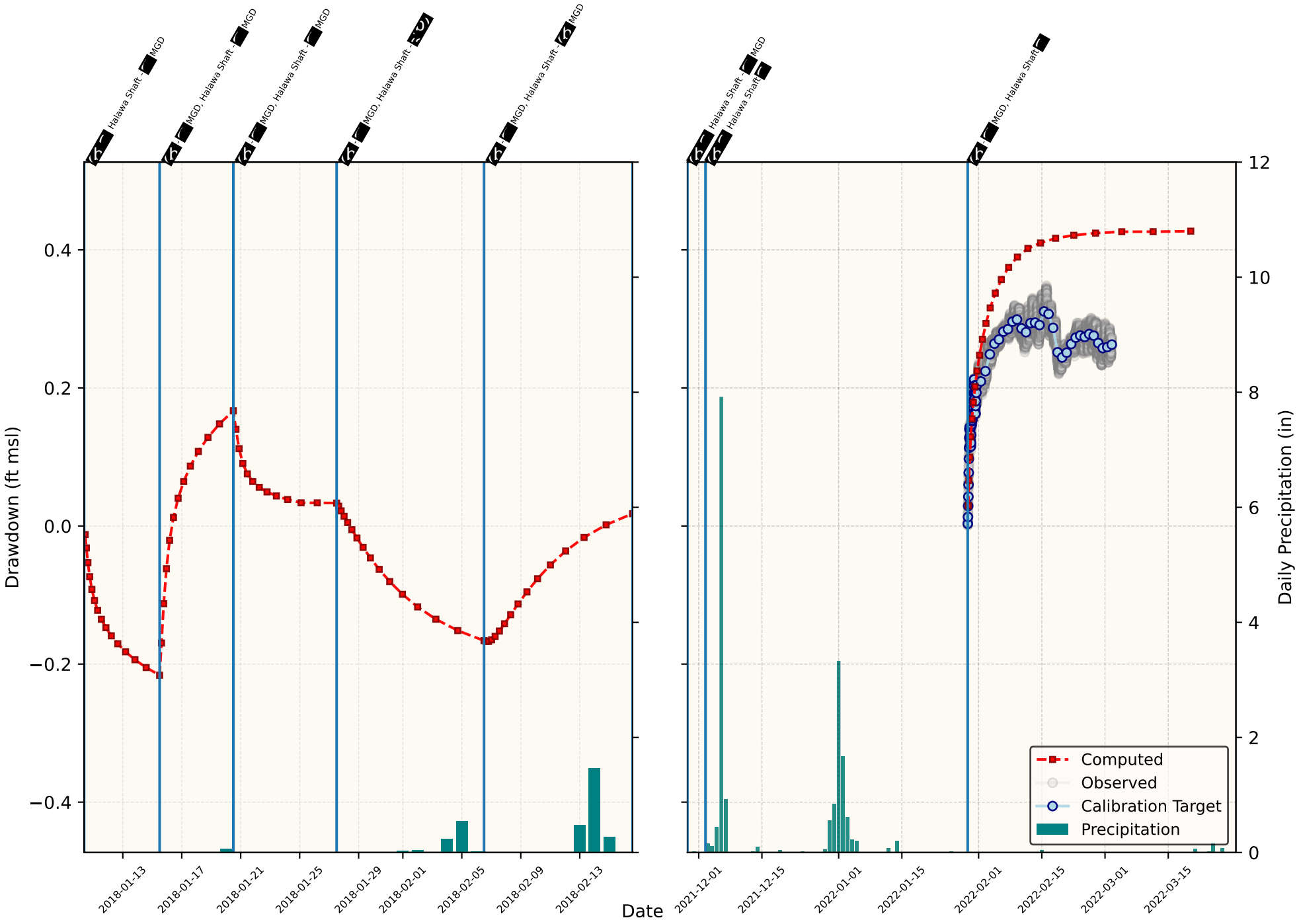

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-15
Date

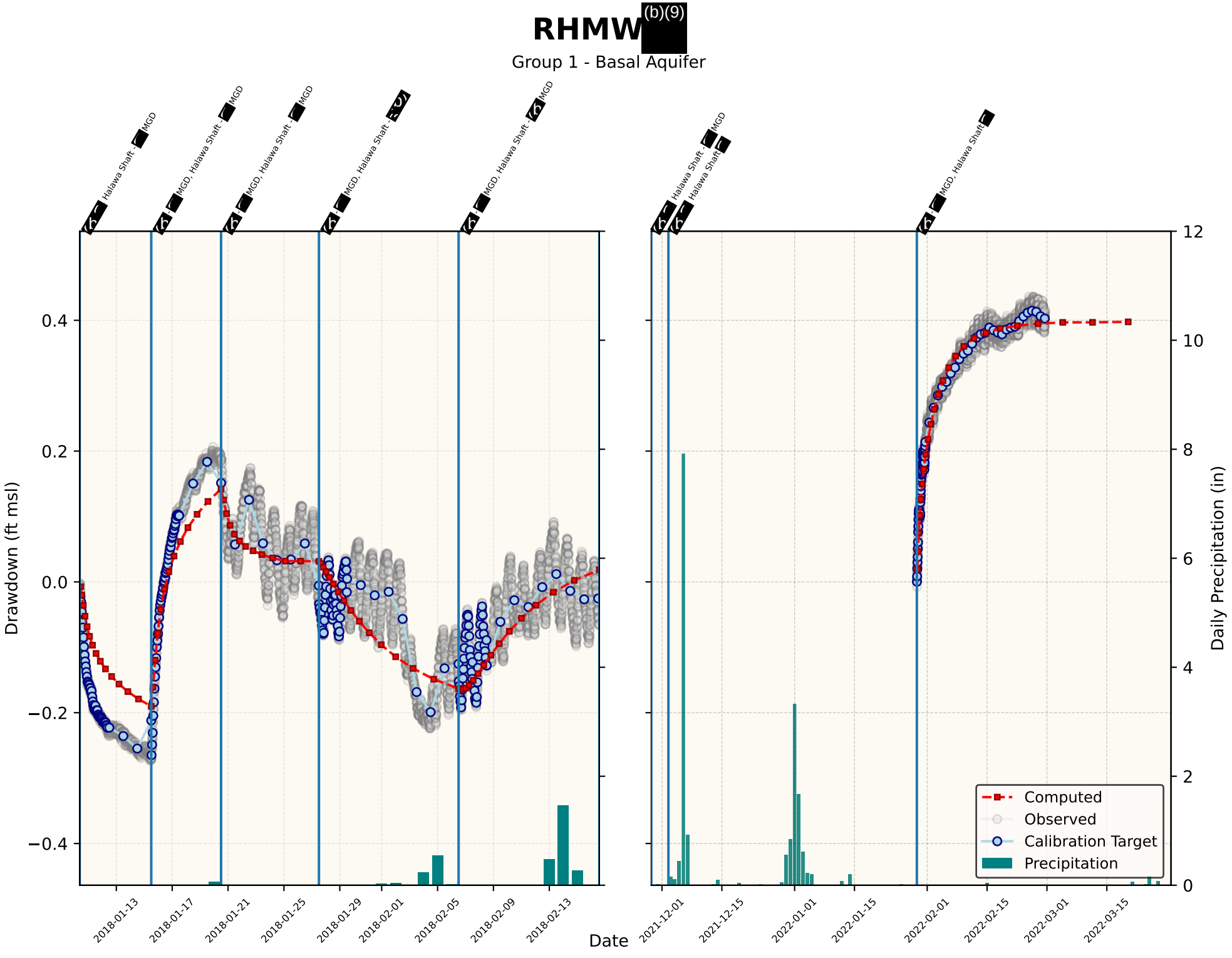

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

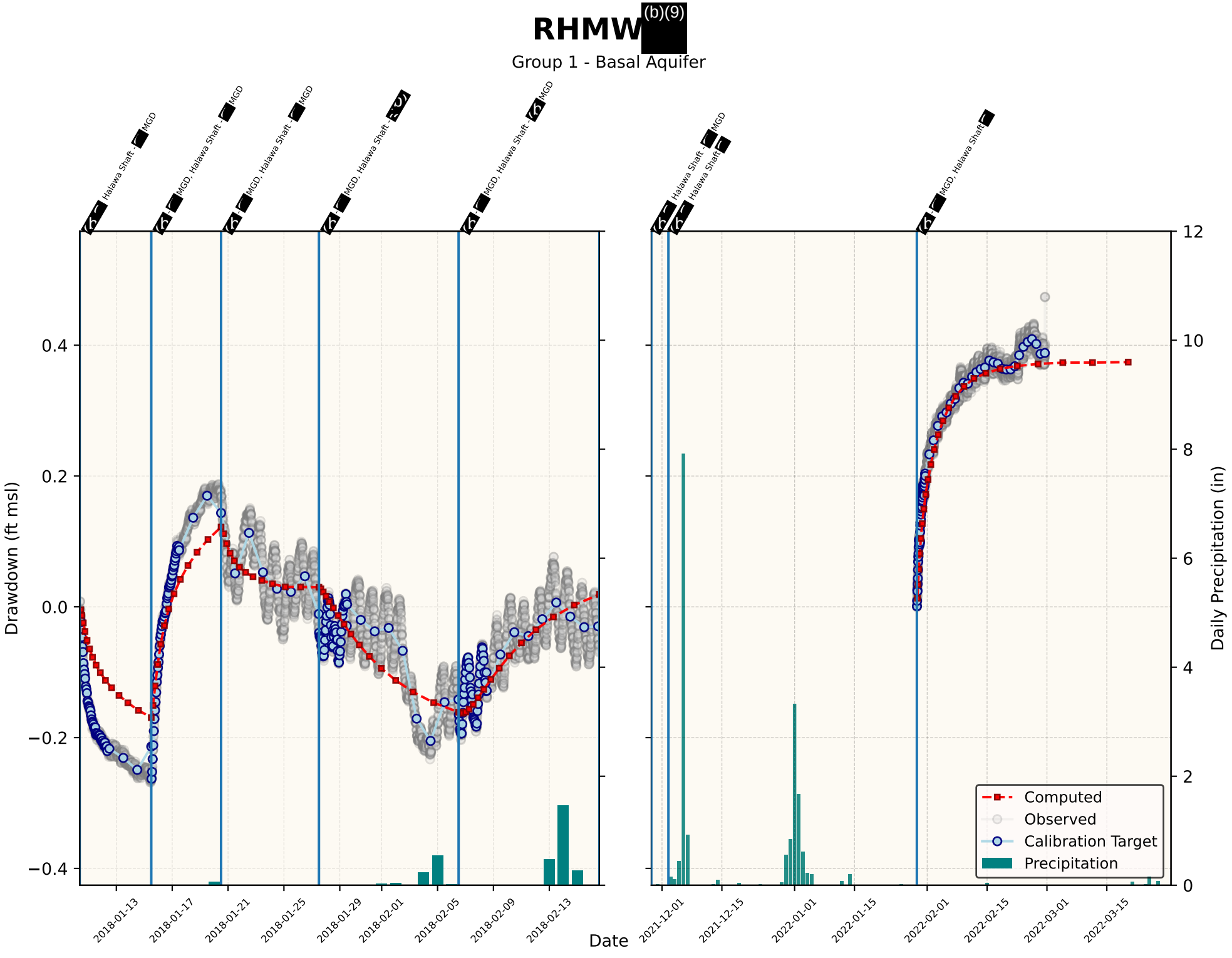

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

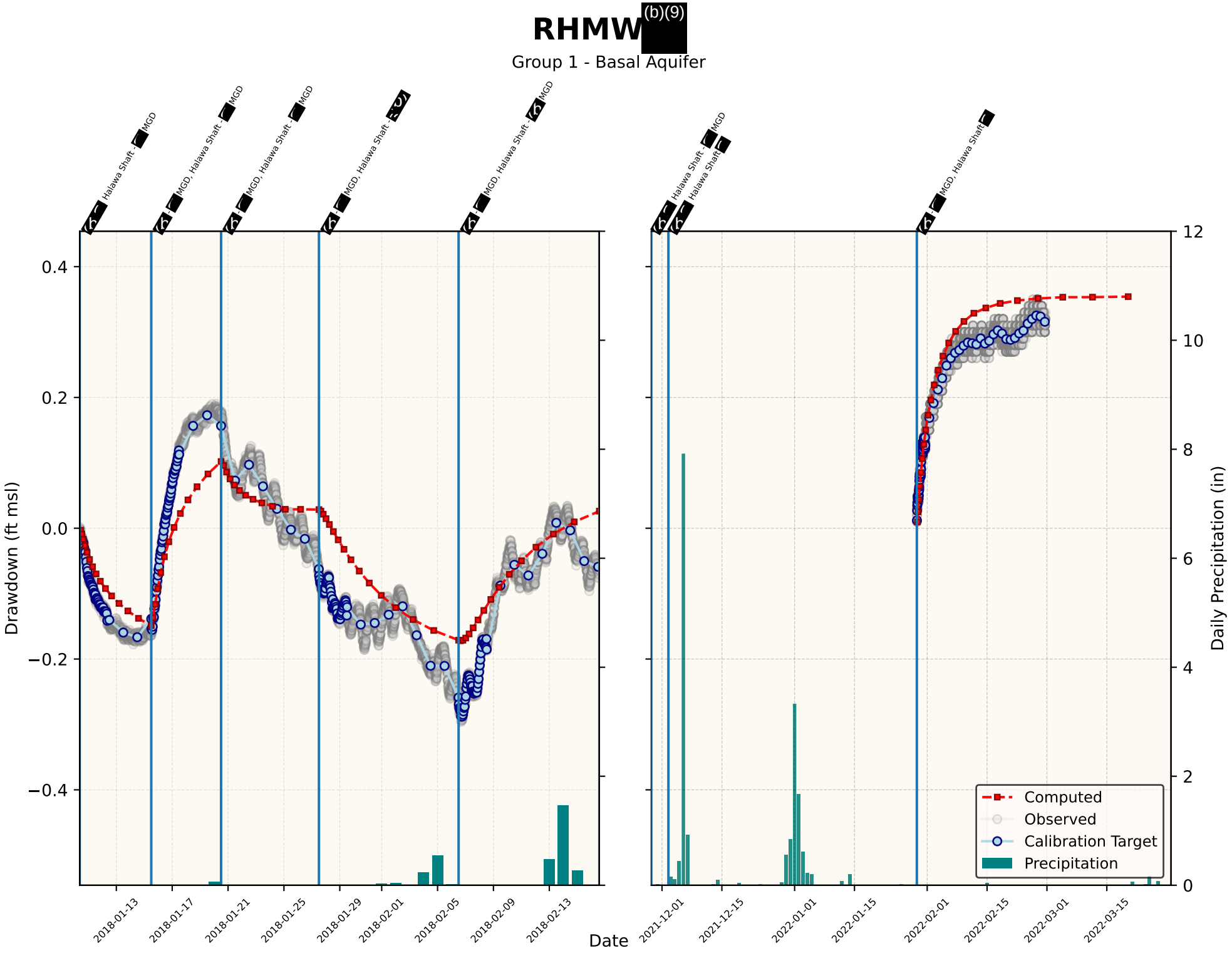
RHMW[redacted] (b)(9)

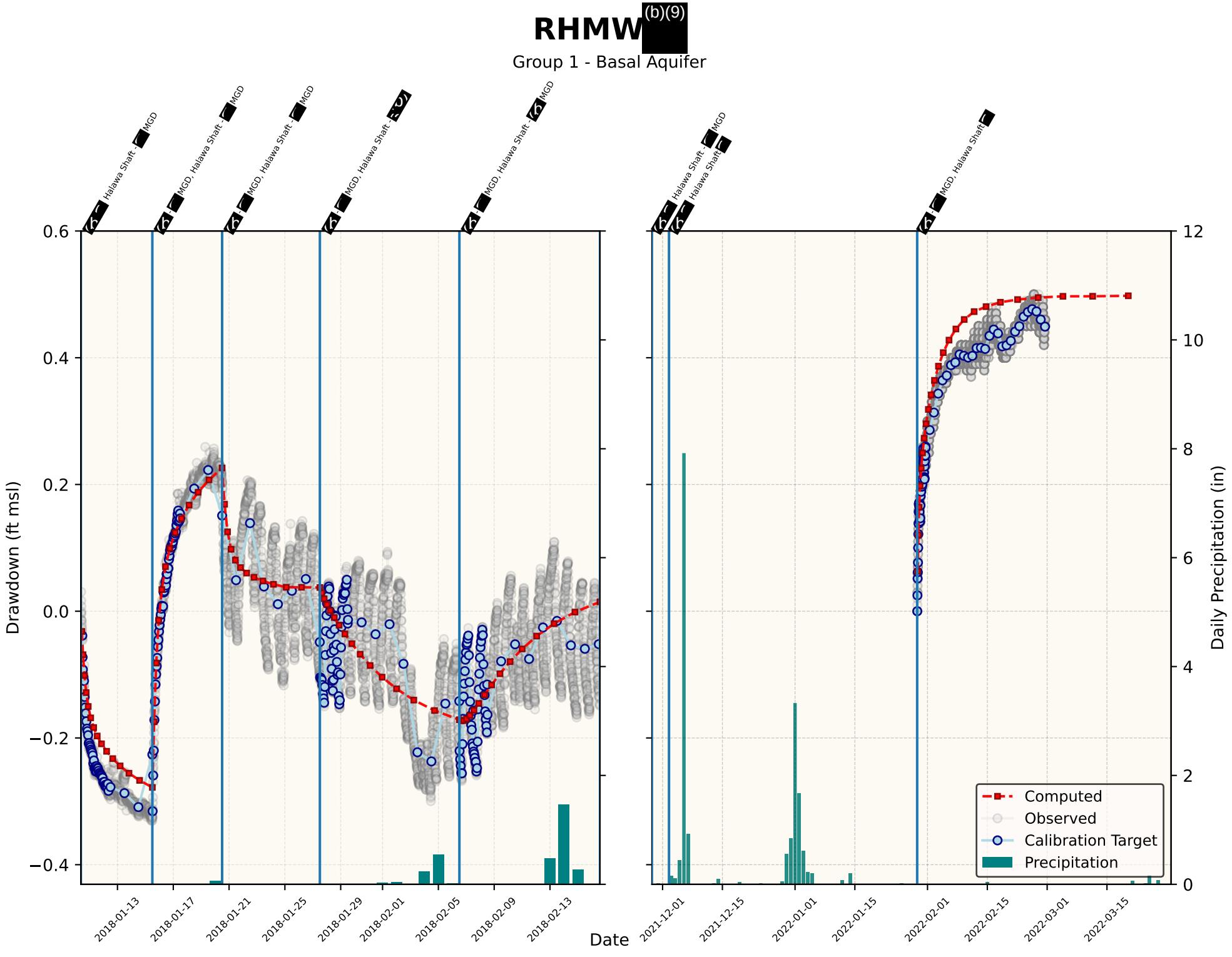
Group 1 - Basal Aquifer




RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
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2022-01-01
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2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

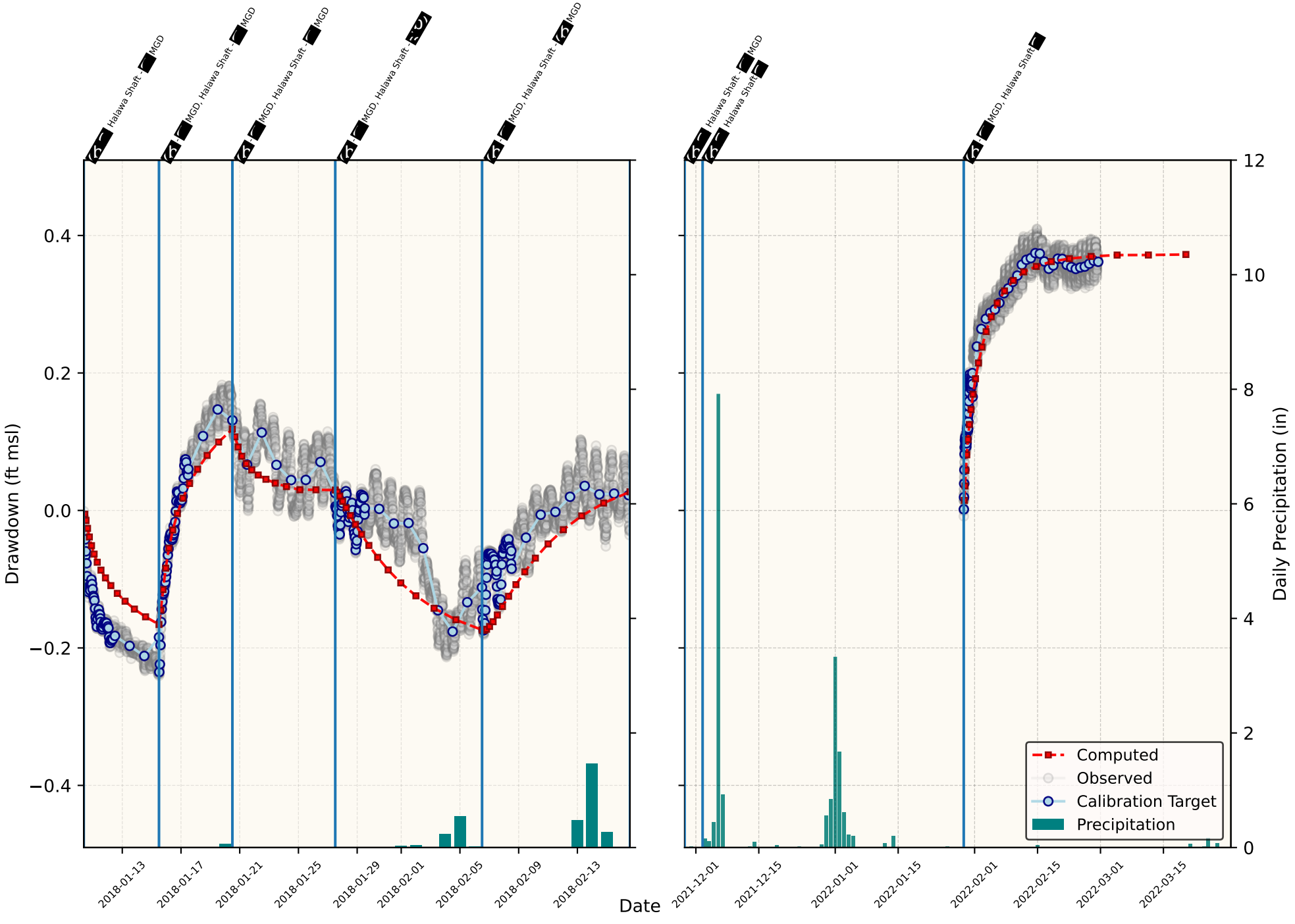

RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
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2022-01-01
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Date
Computed
Observed
Calibration Target
Precipitation

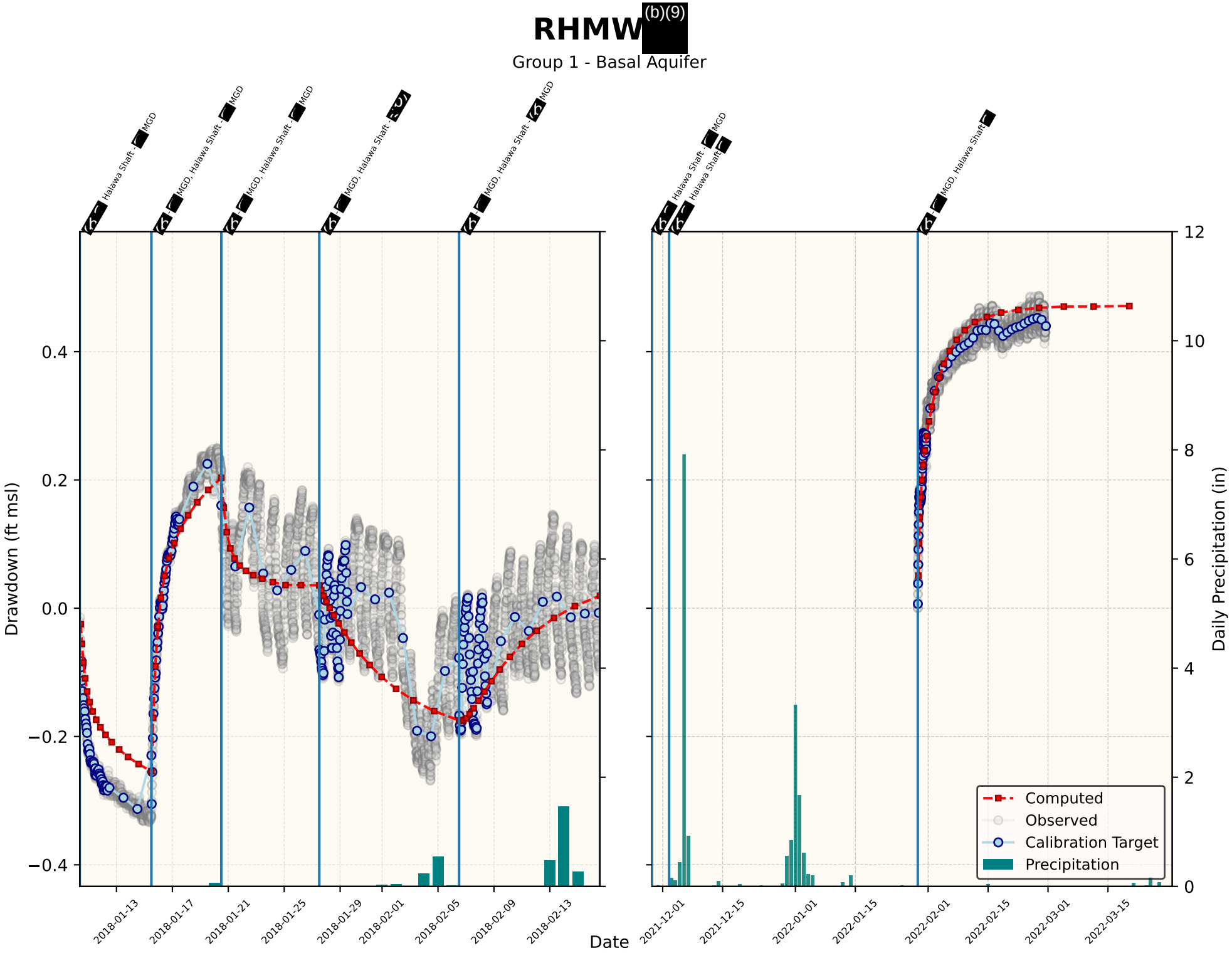

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

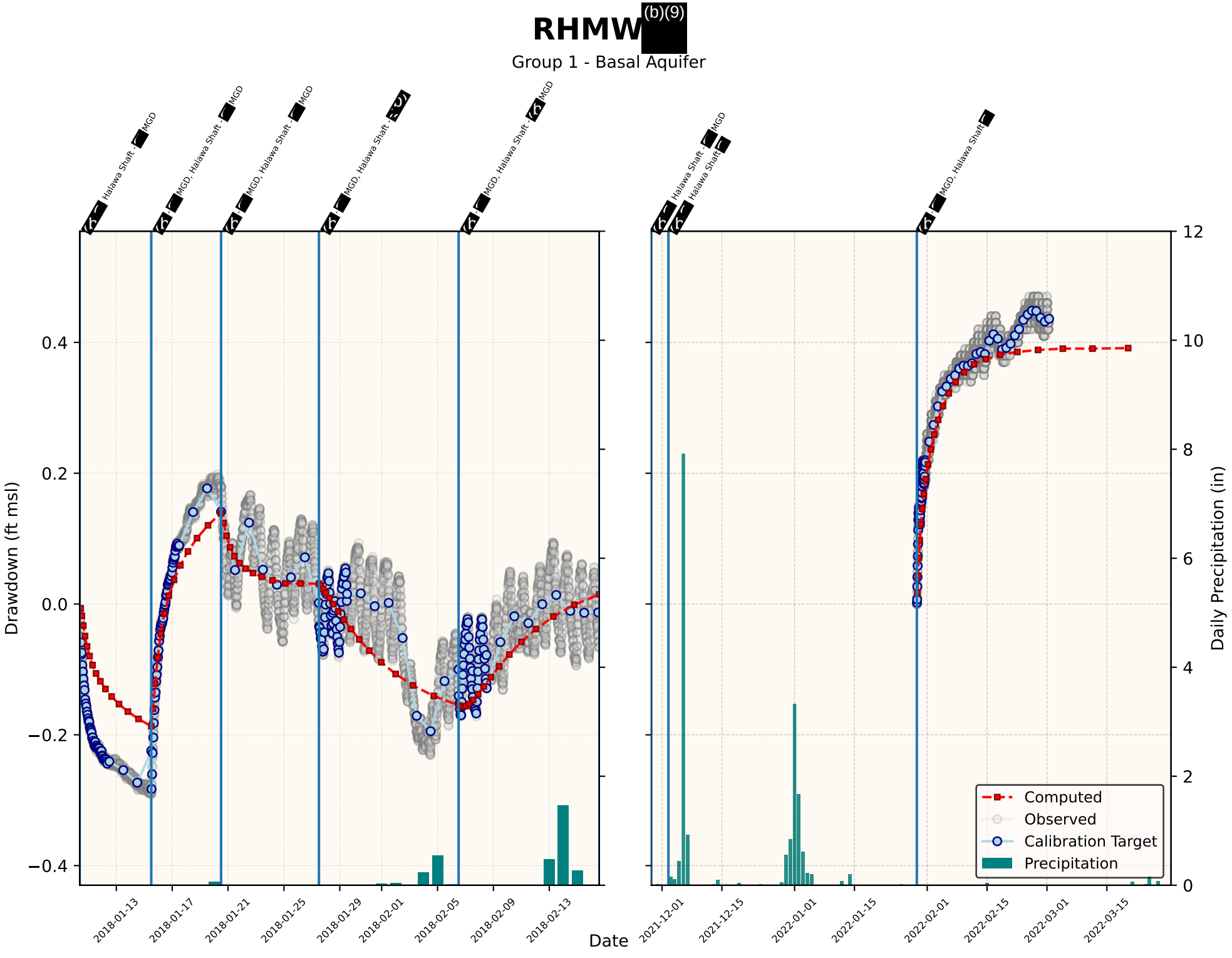

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-15
2022-03-01
2022-03-15

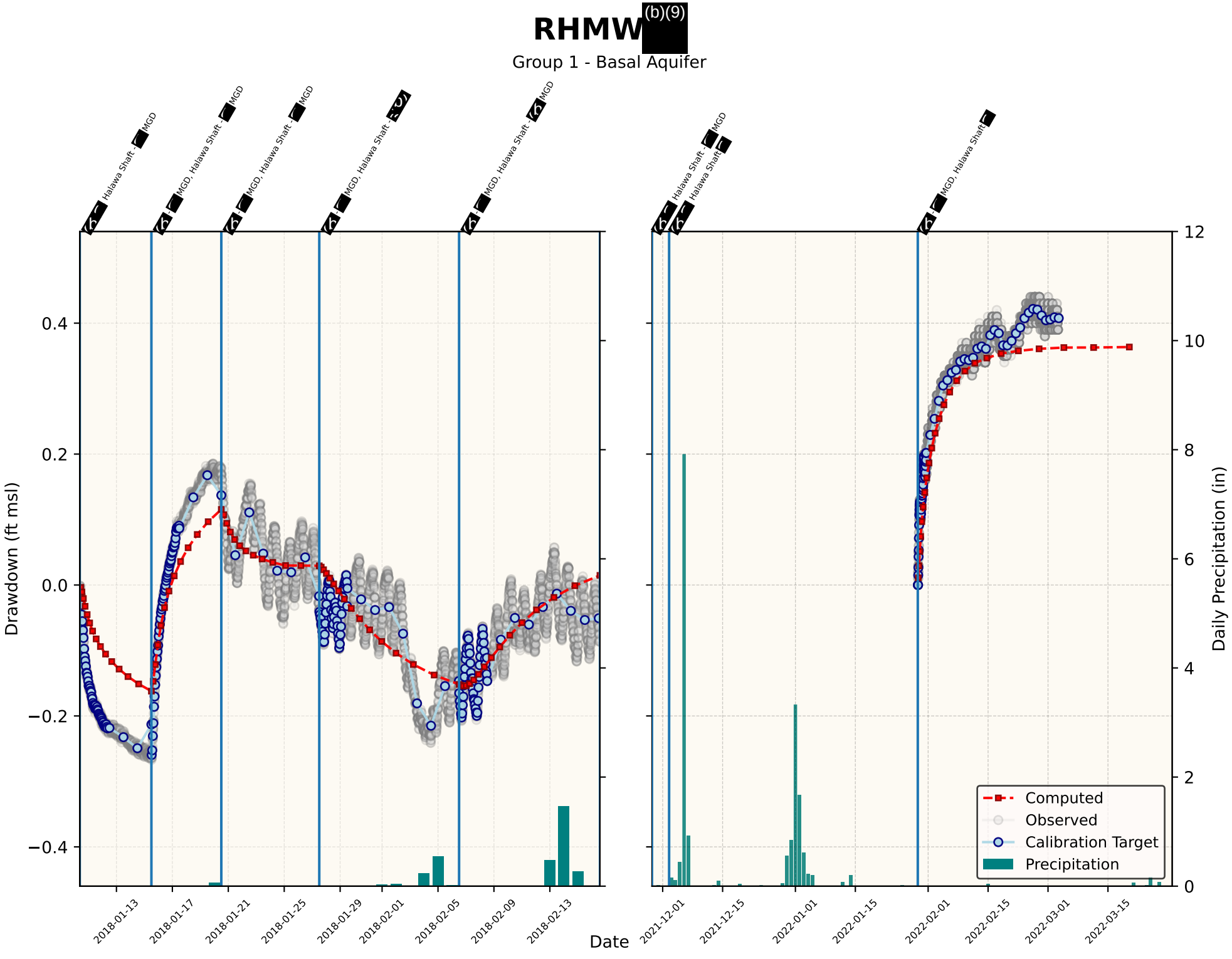
RHMW[redacted](b)(9)

Group 1 - Basal Aquifer



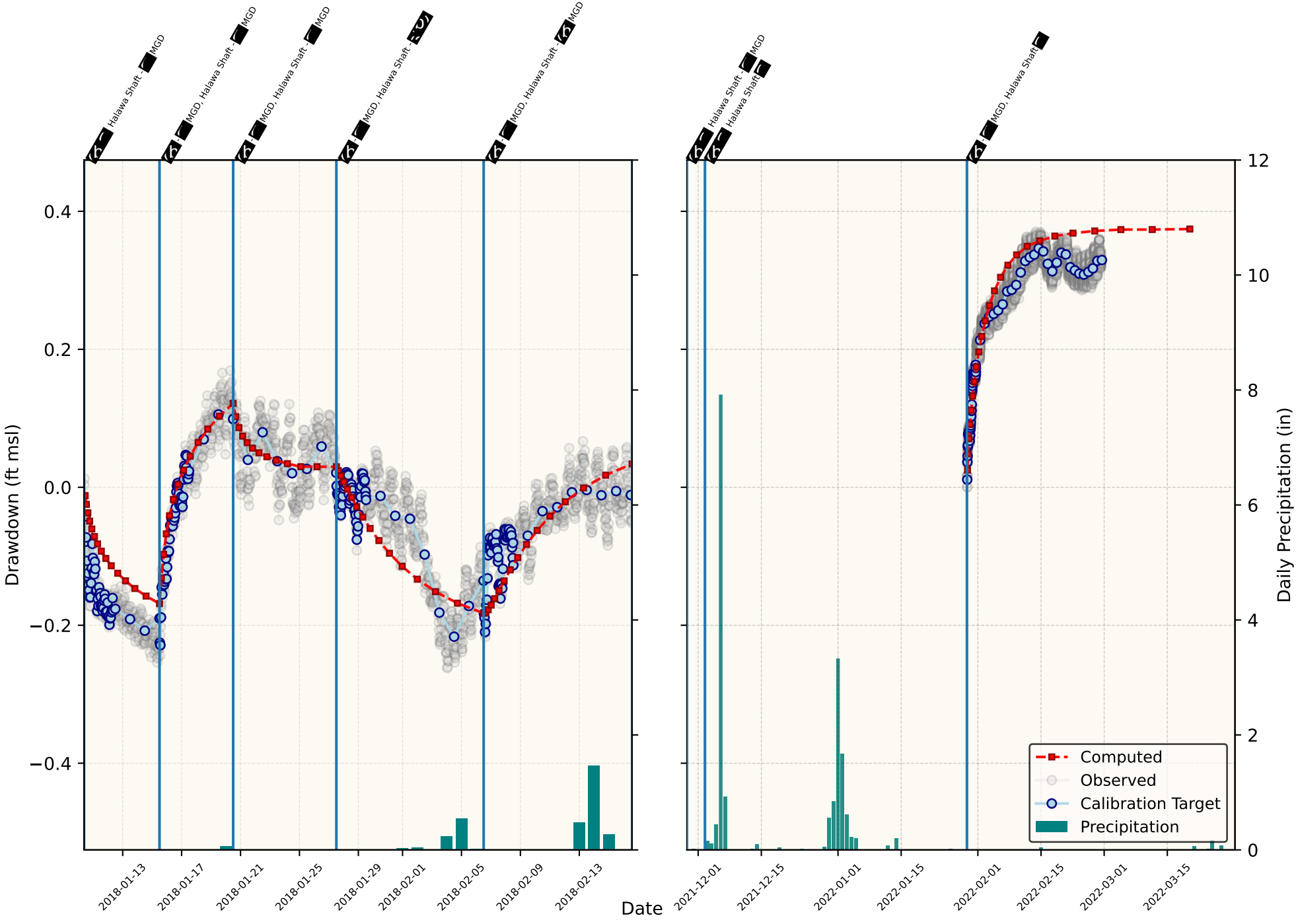

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW[redacted](b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

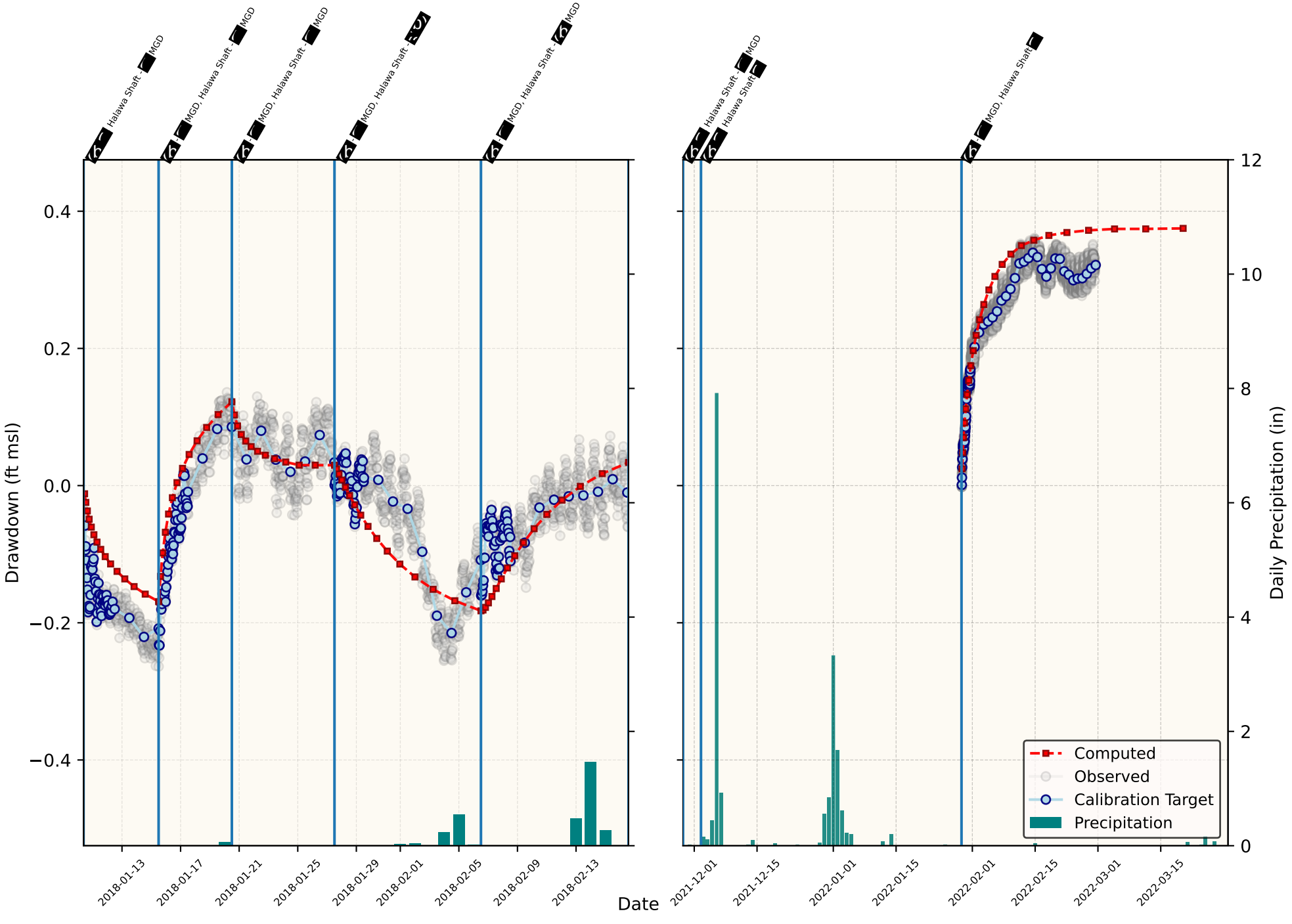
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



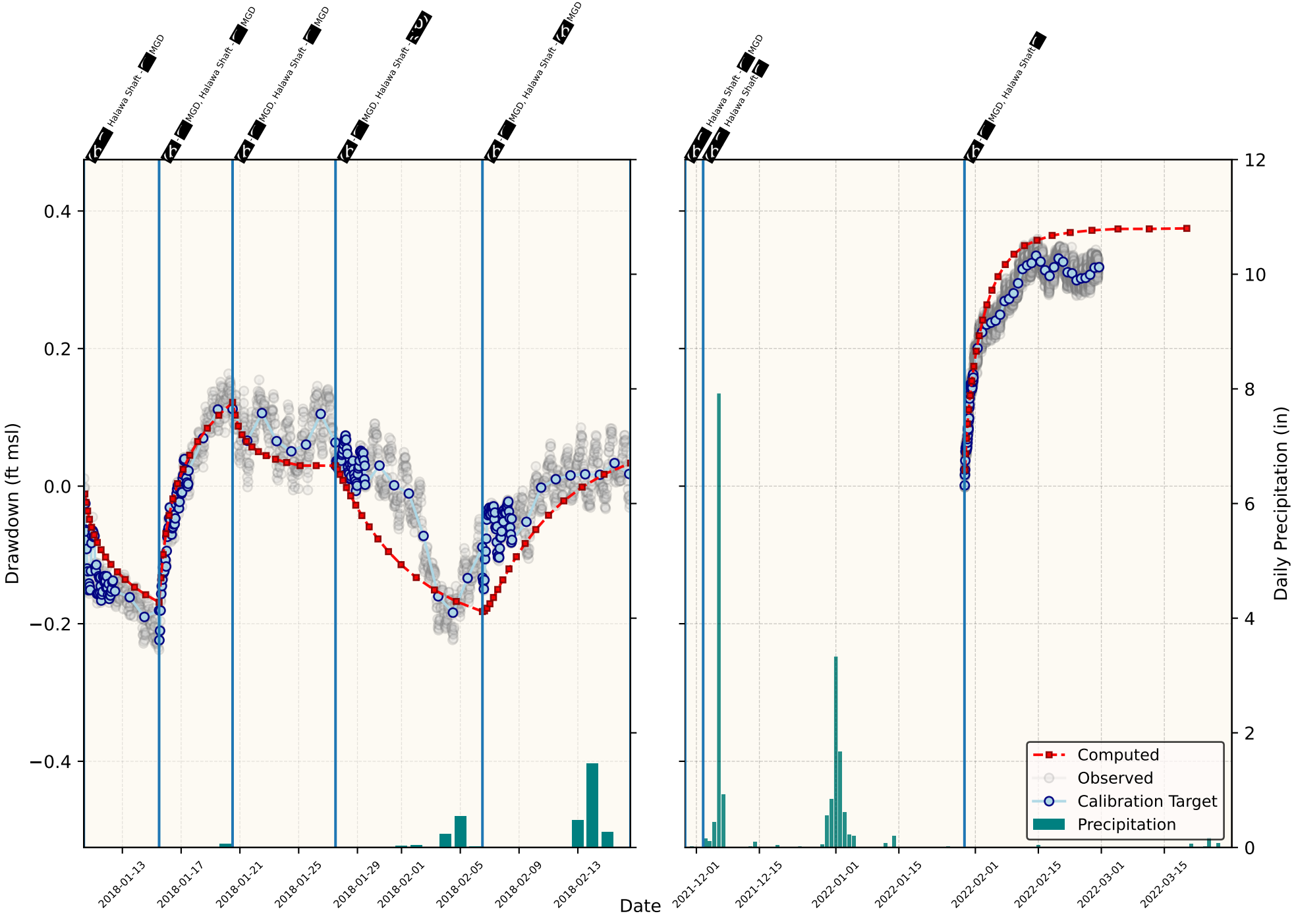
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



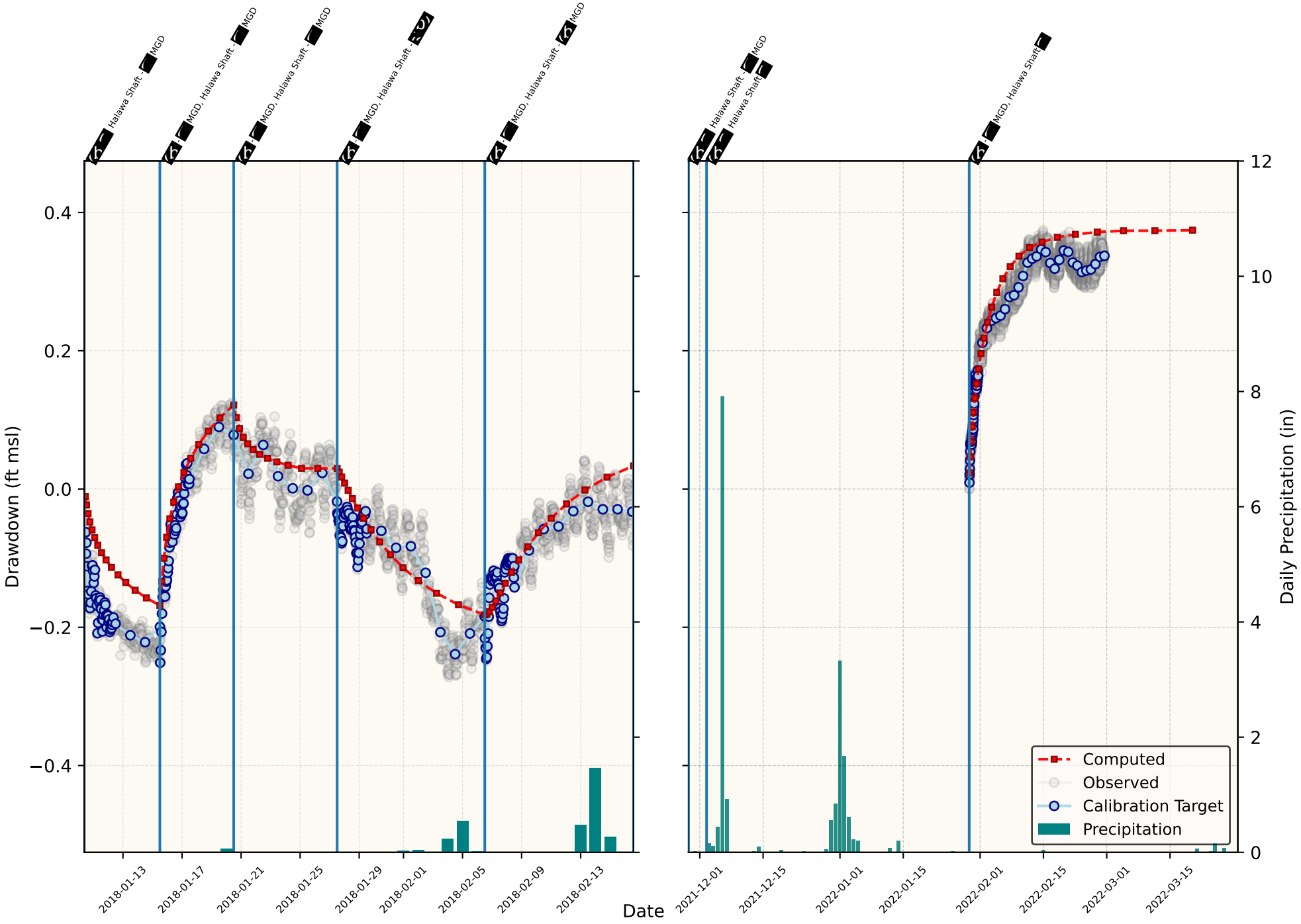
RHMW (b)(9)

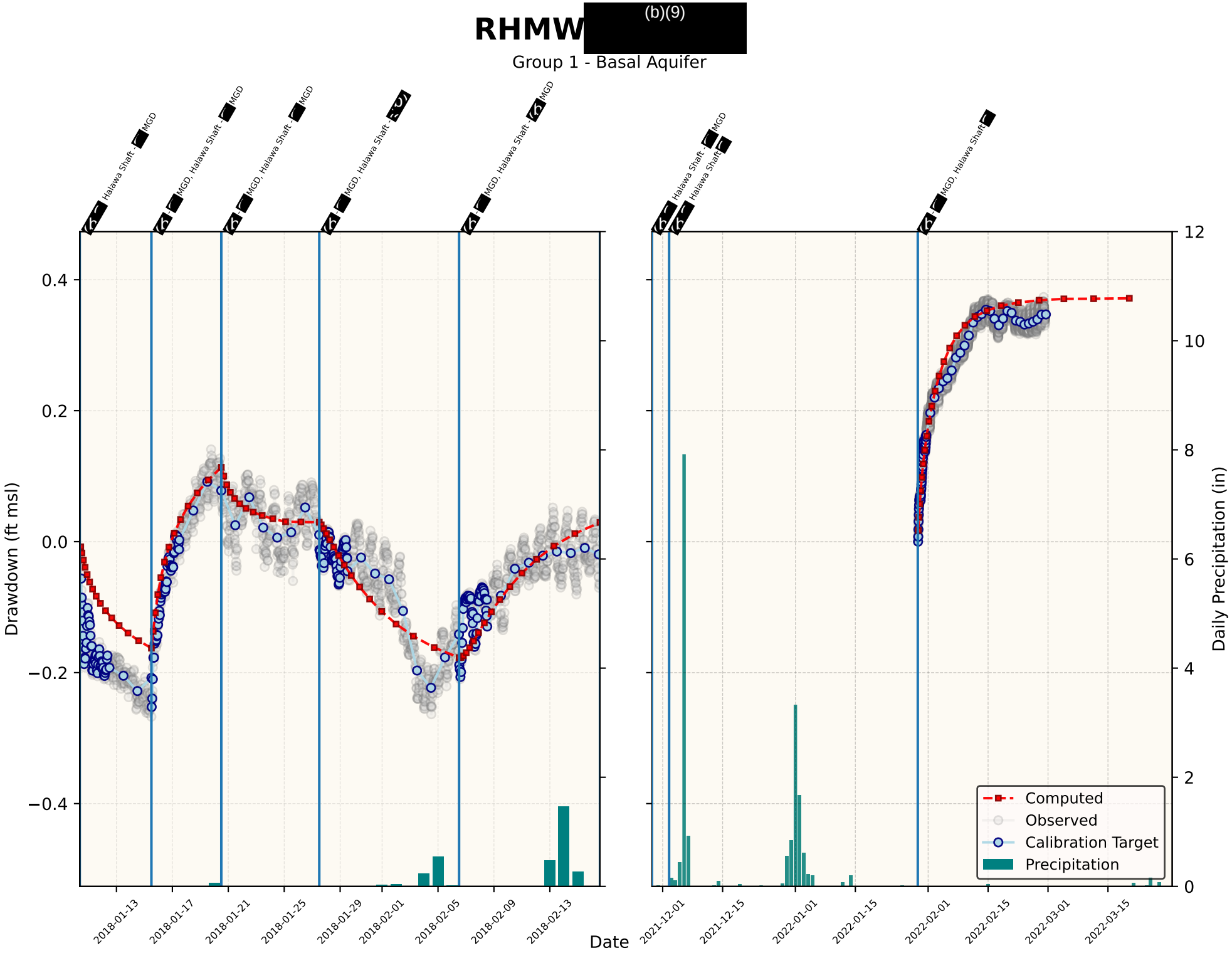
Group 1 - Basal Aquifer



RHMW [redacted] (b)(9)

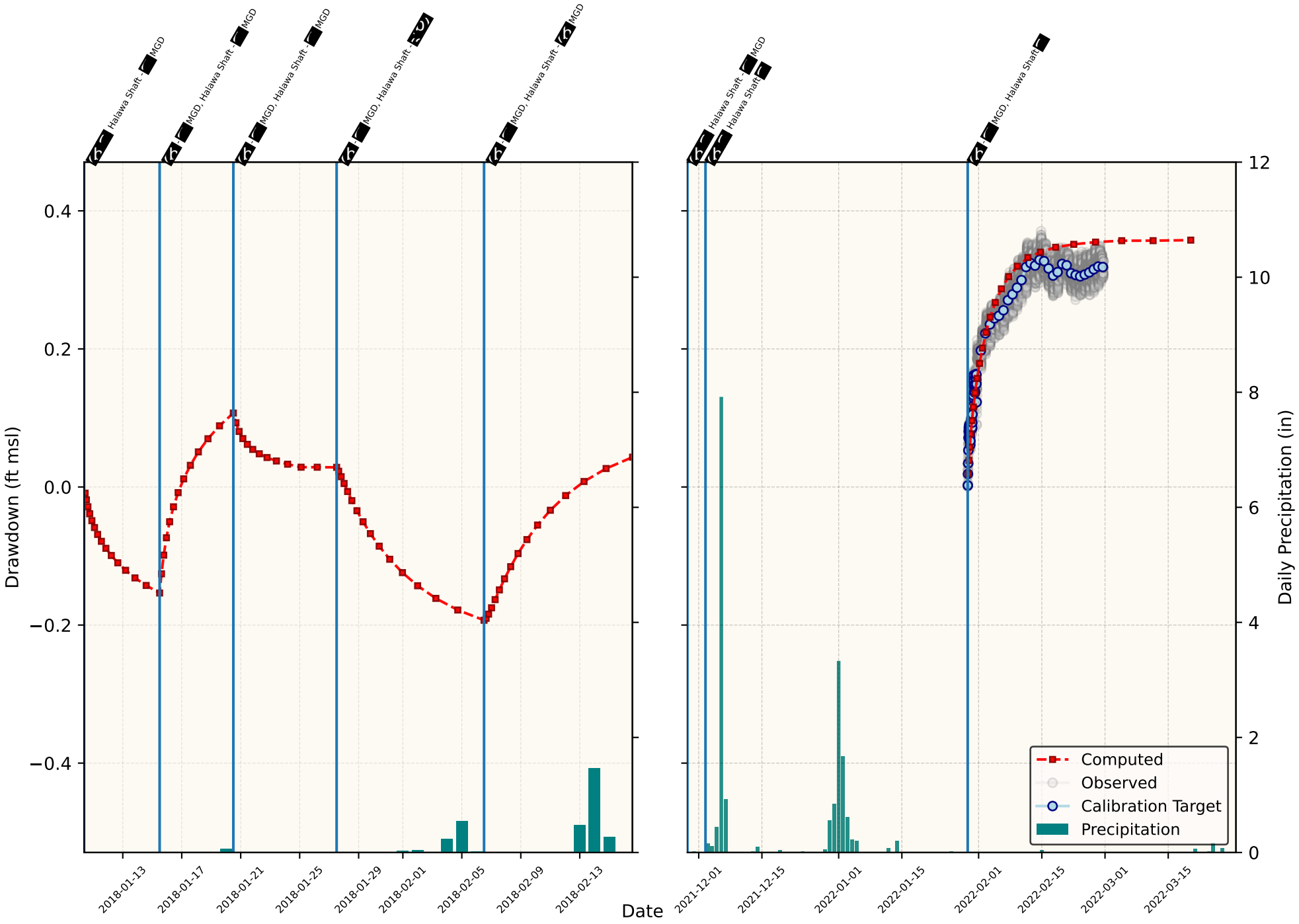
Group 1 - Basal Aquifer

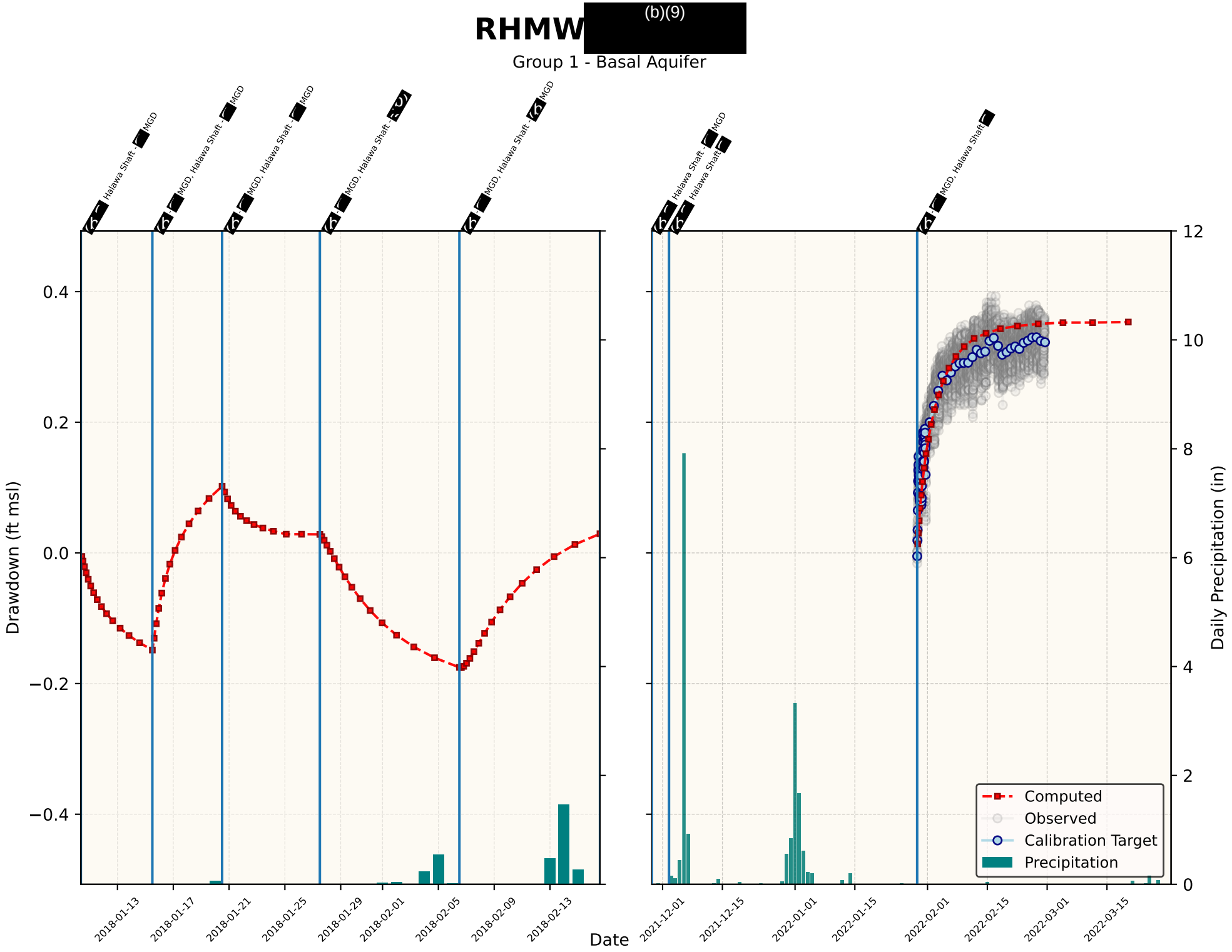


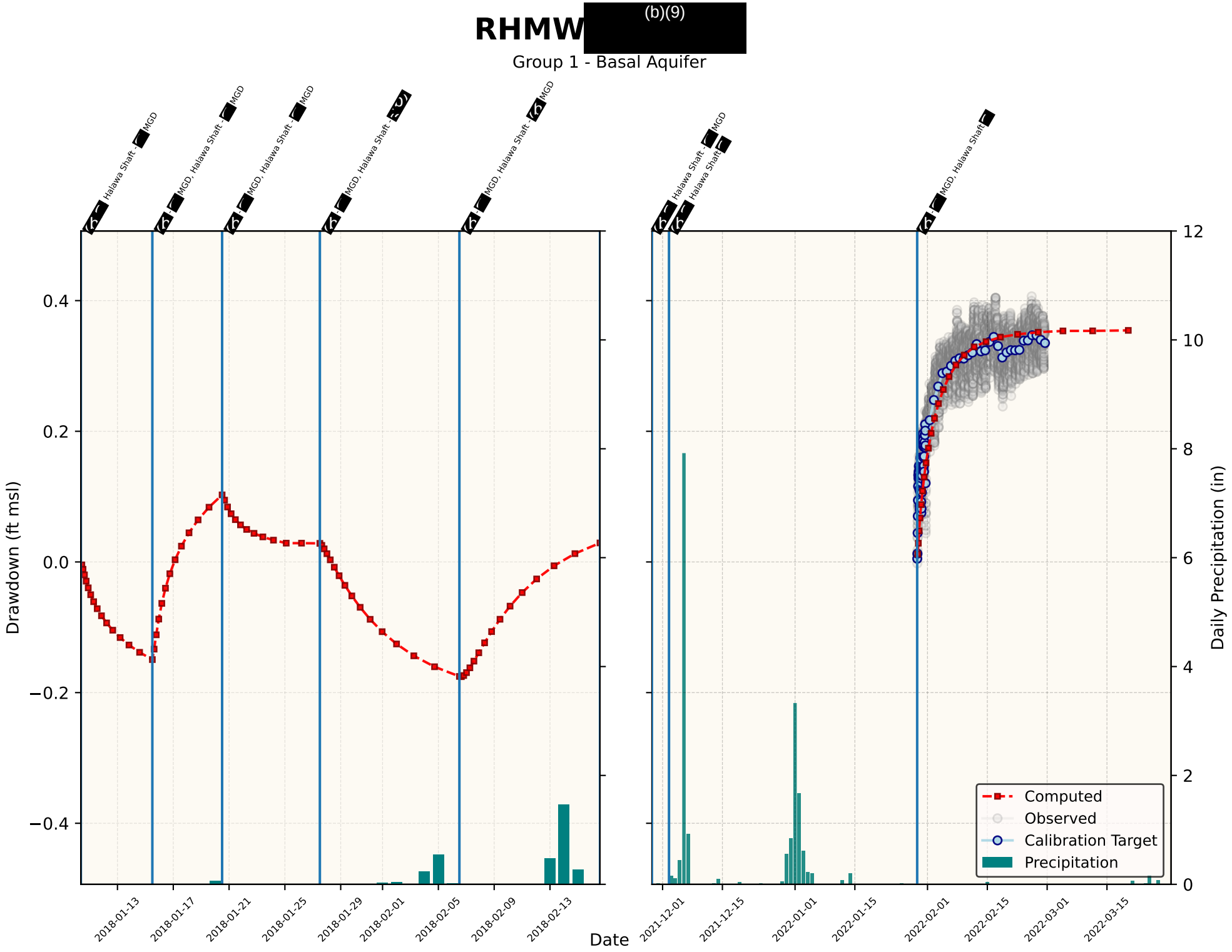

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-02-01
2022-02-15
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2022-03-15

RHMW[redacted] (b)(9)

Group 1 - Basal Aquifer

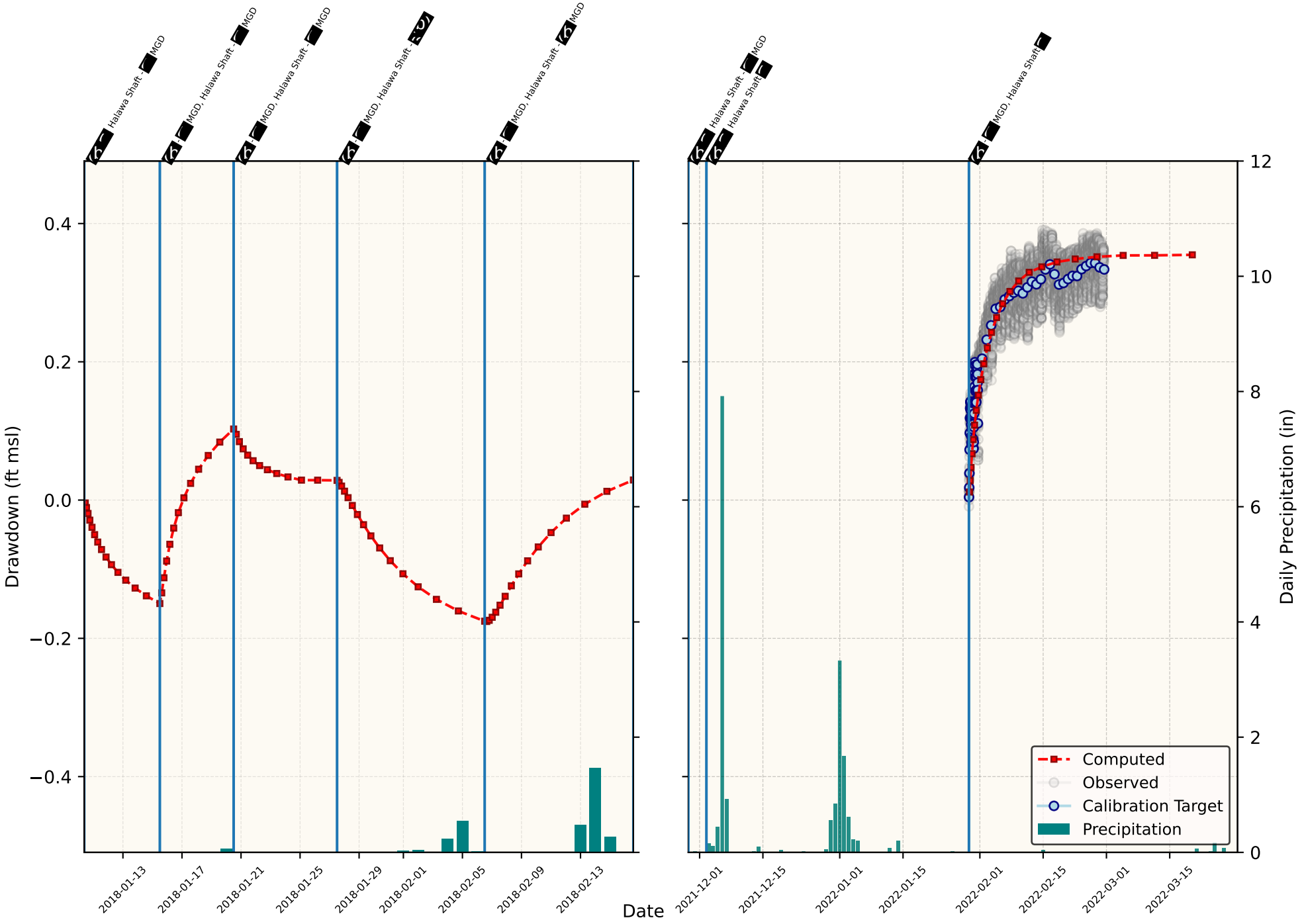


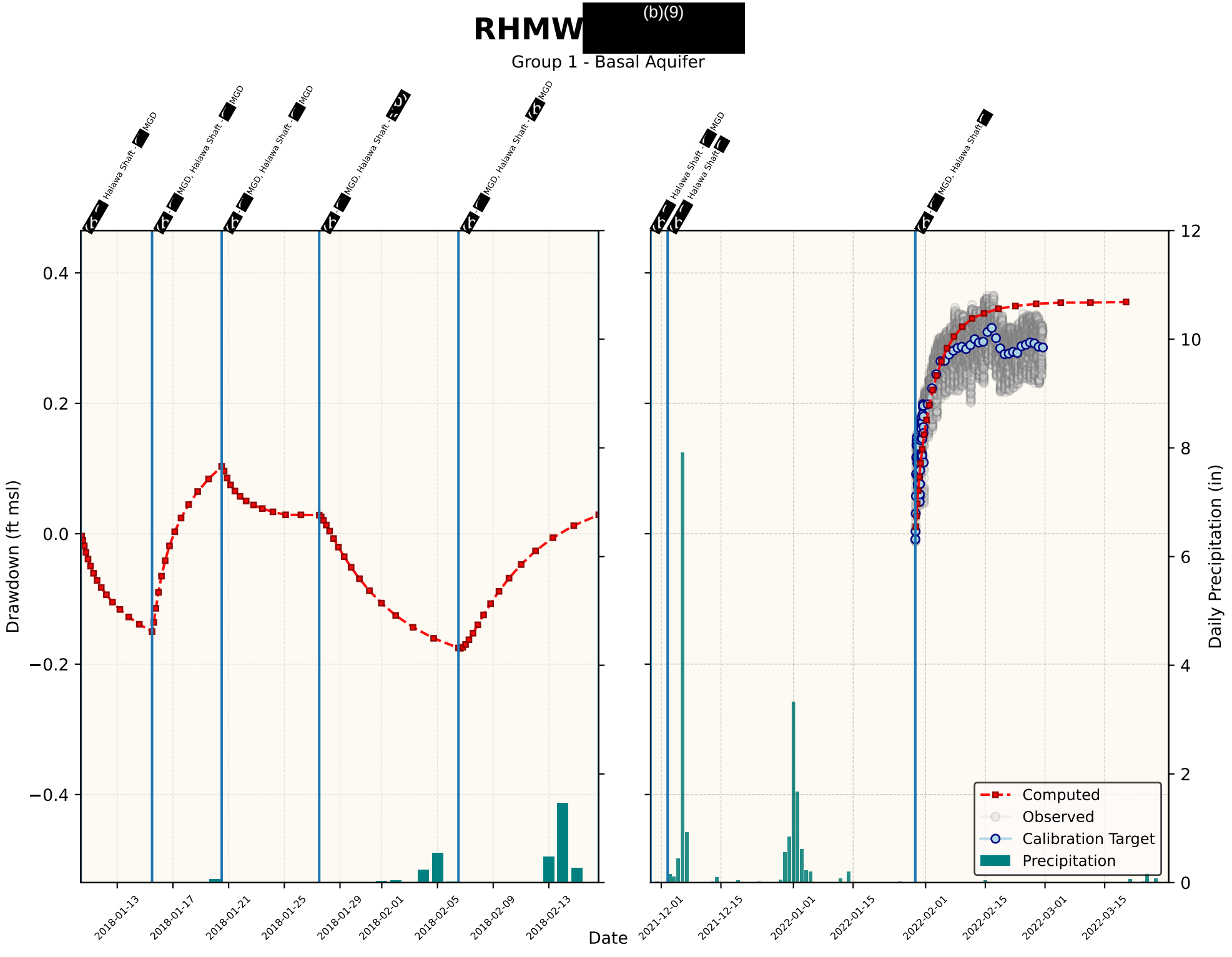

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
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2021-12-01
2021-12-15
2022-01-01
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2022-02-15
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2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

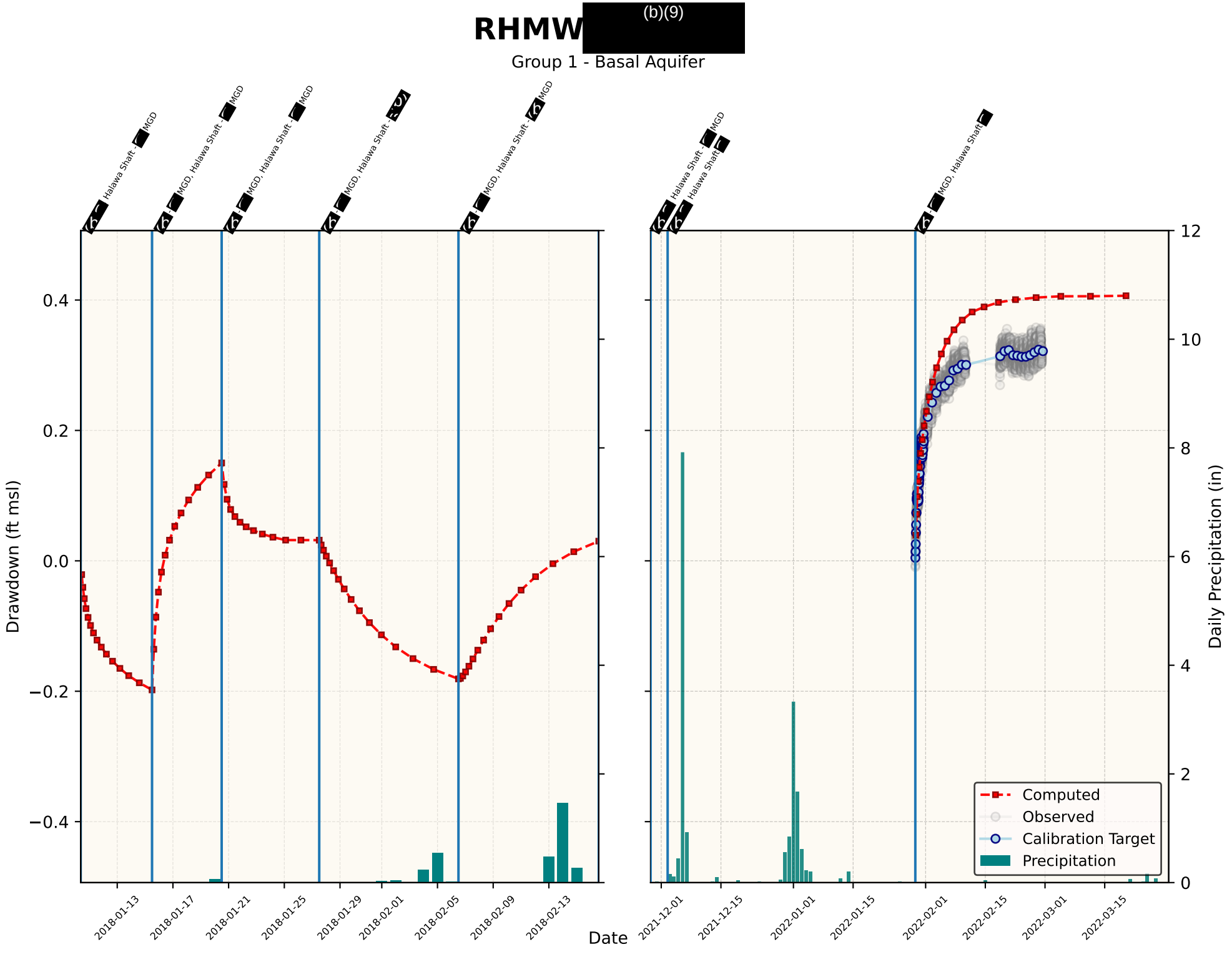

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
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Date
Computed
Observed
Calibration Target
Precipitation

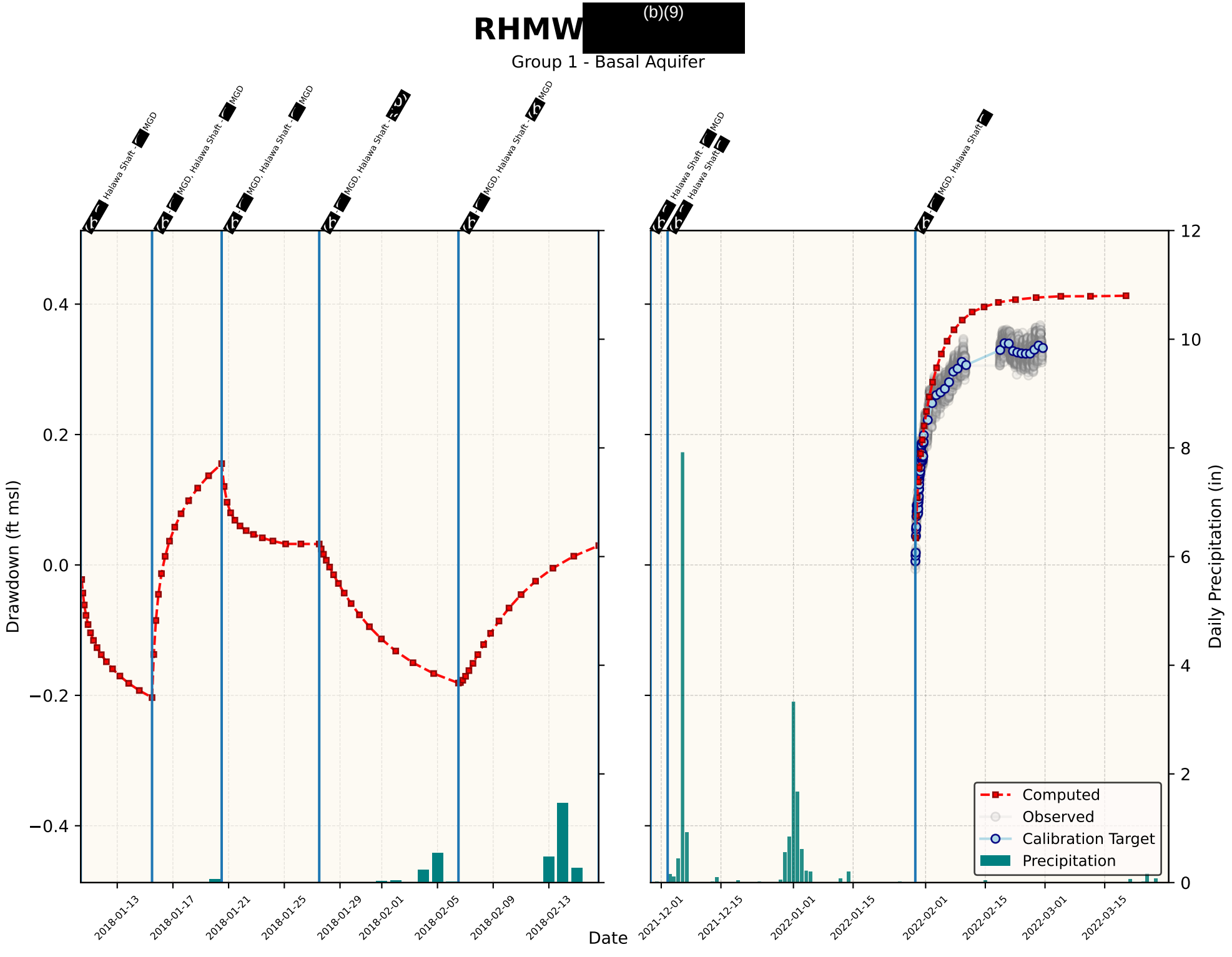
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



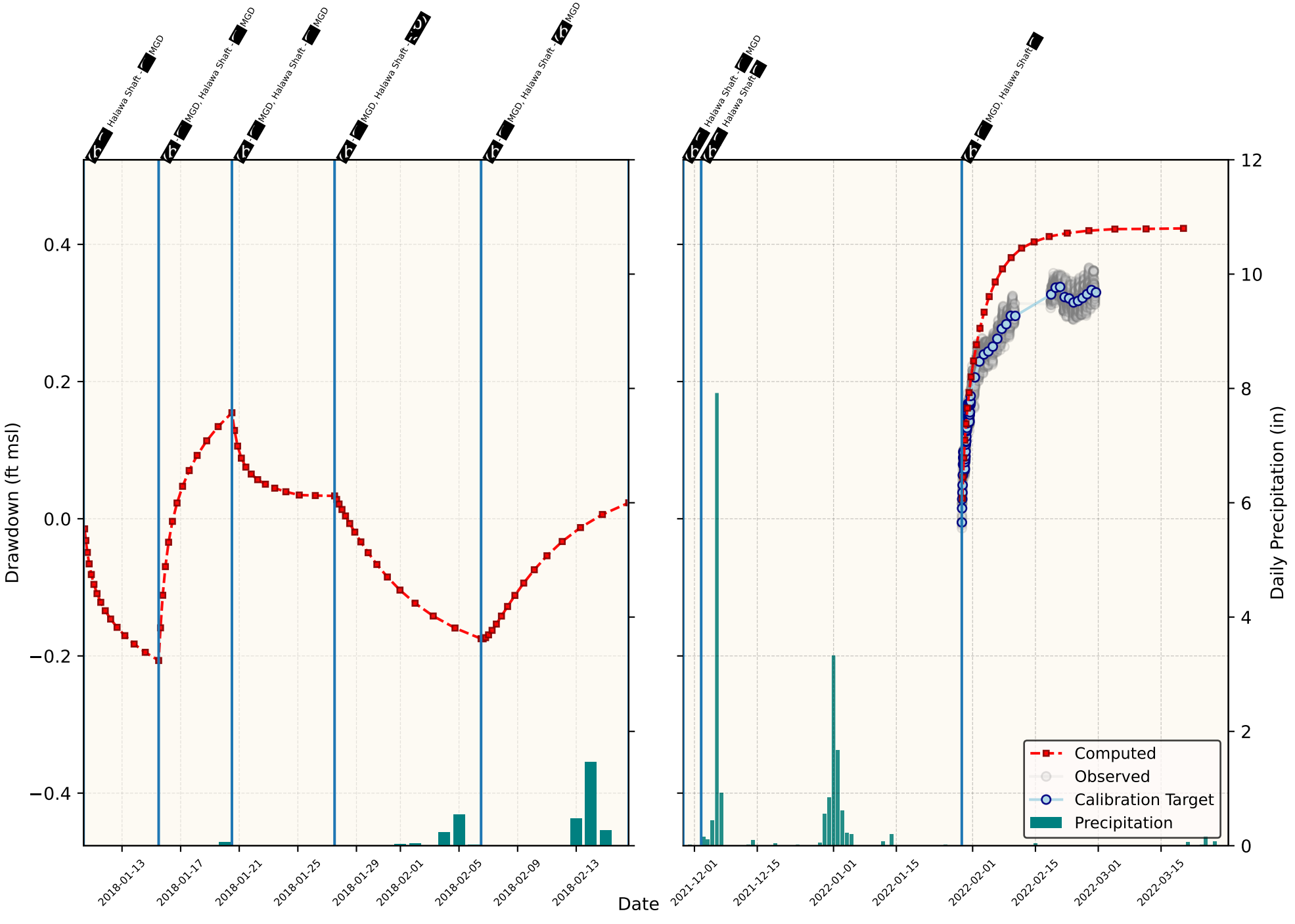

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
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2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation

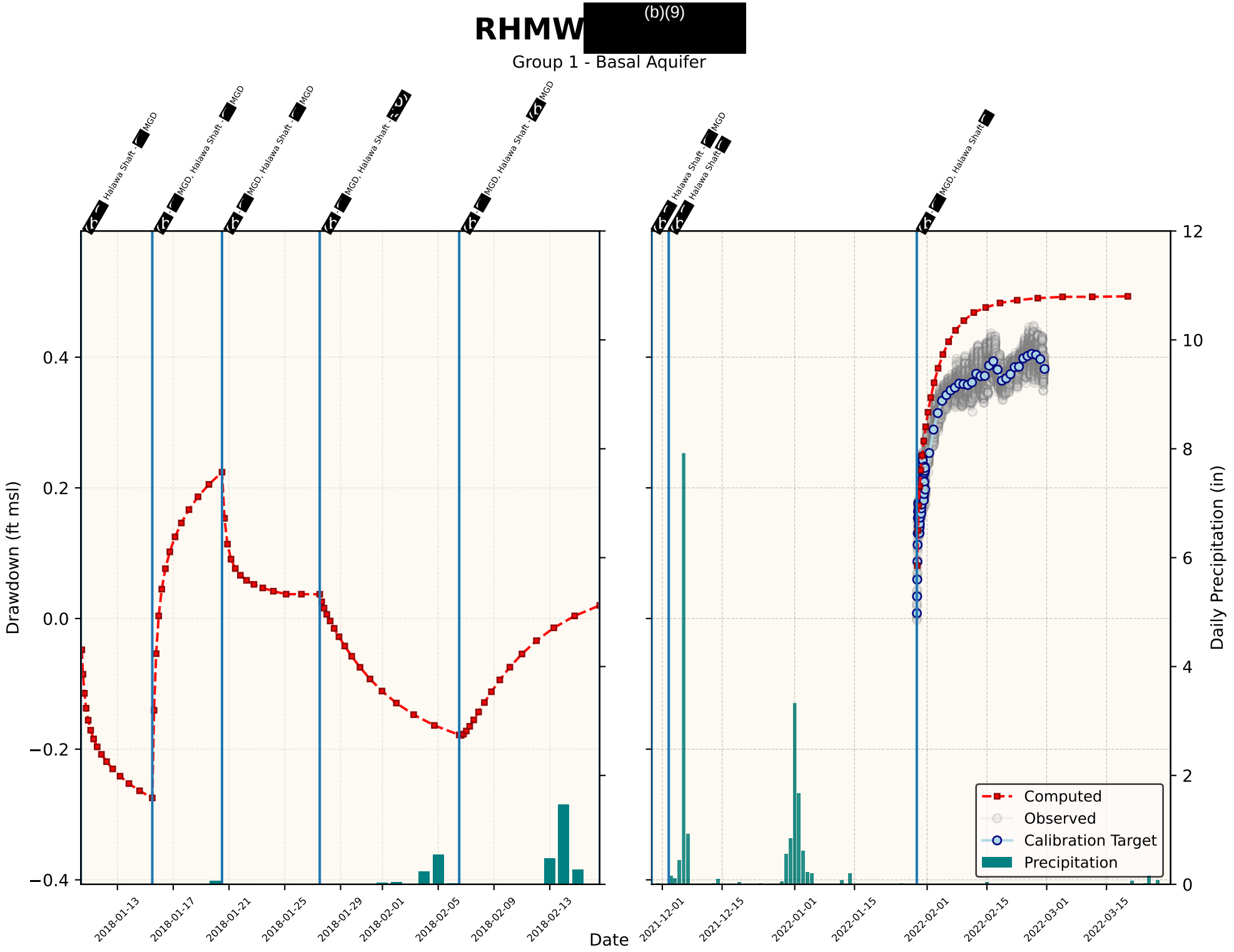

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

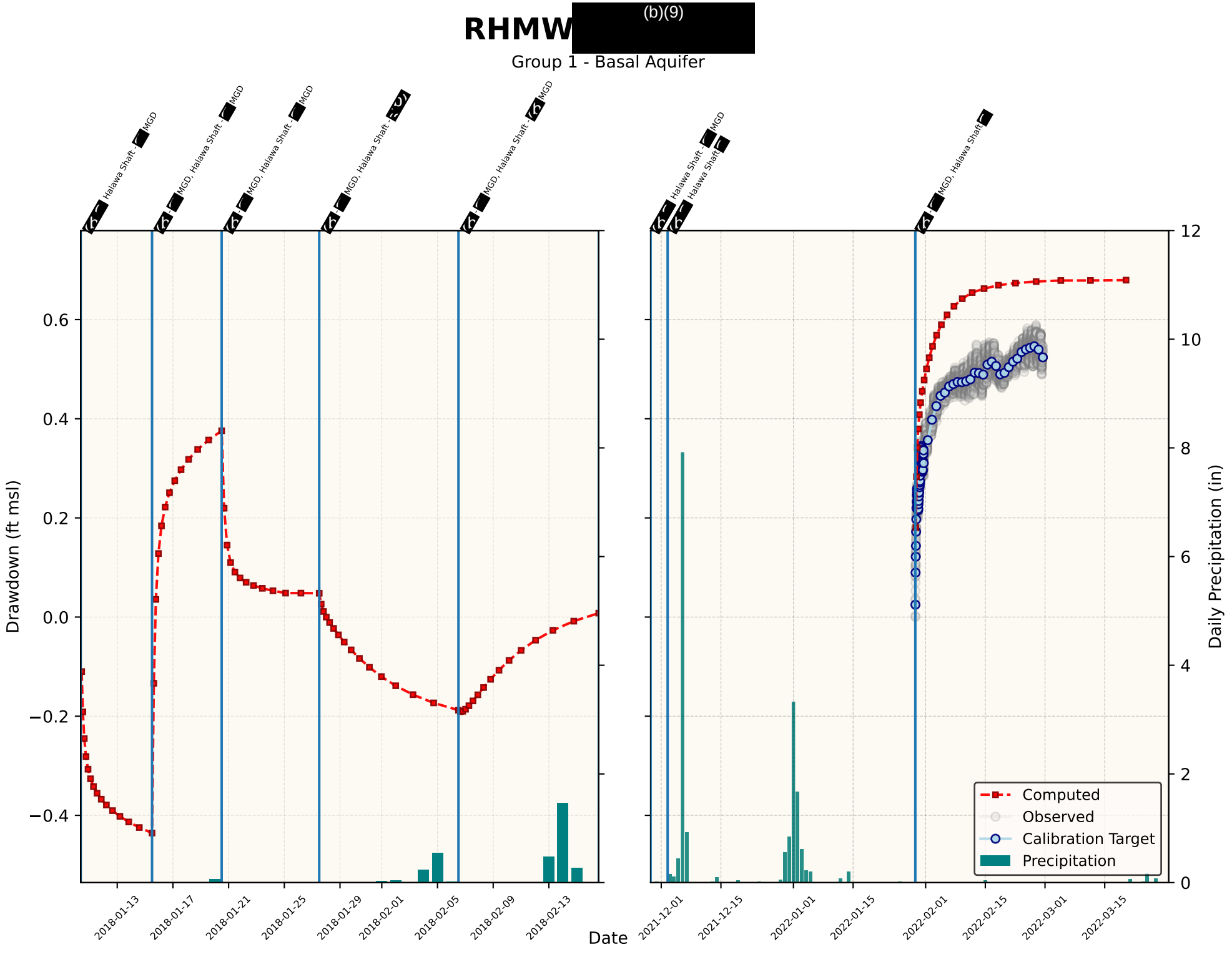

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
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2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation

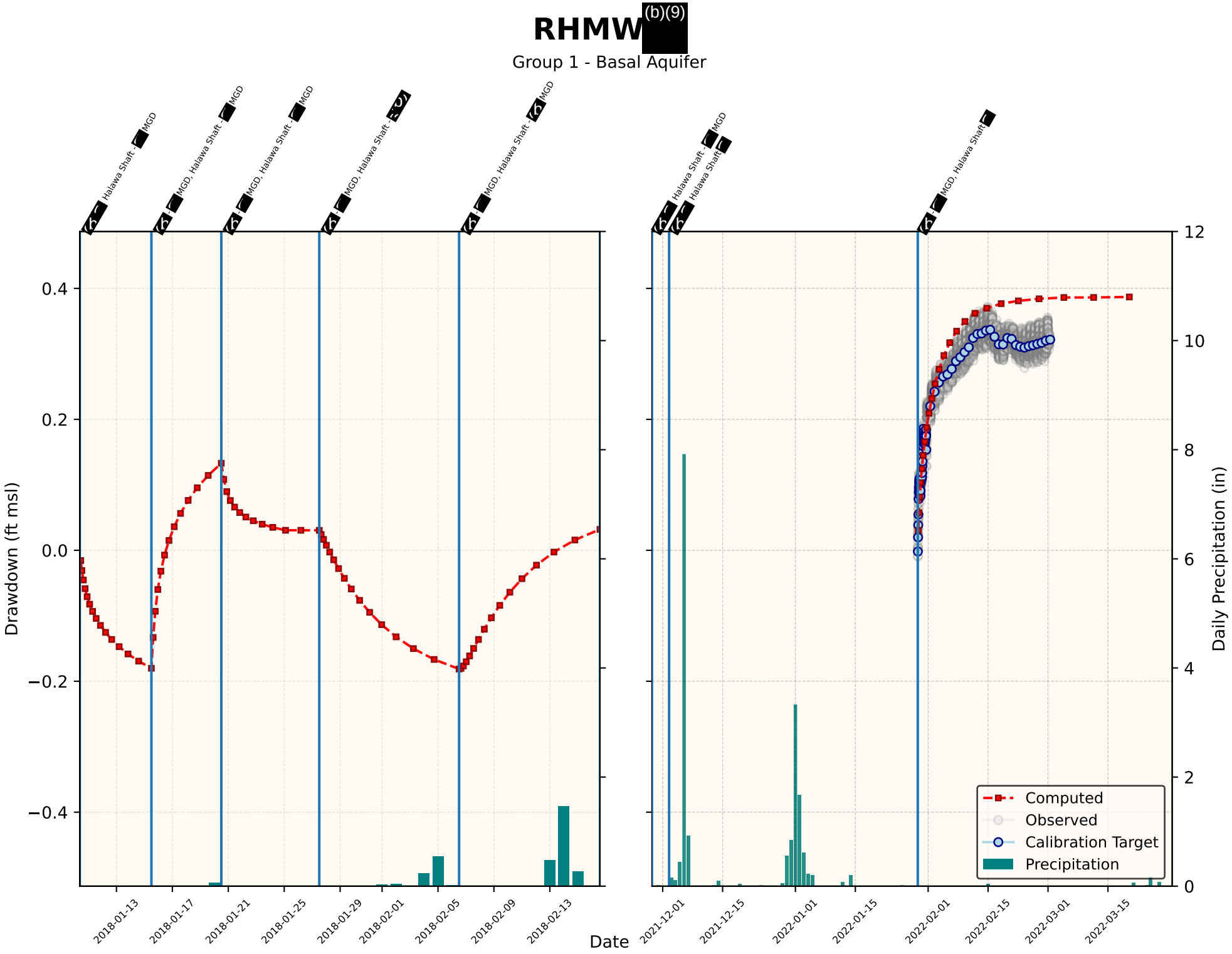
RHMW [redacted]

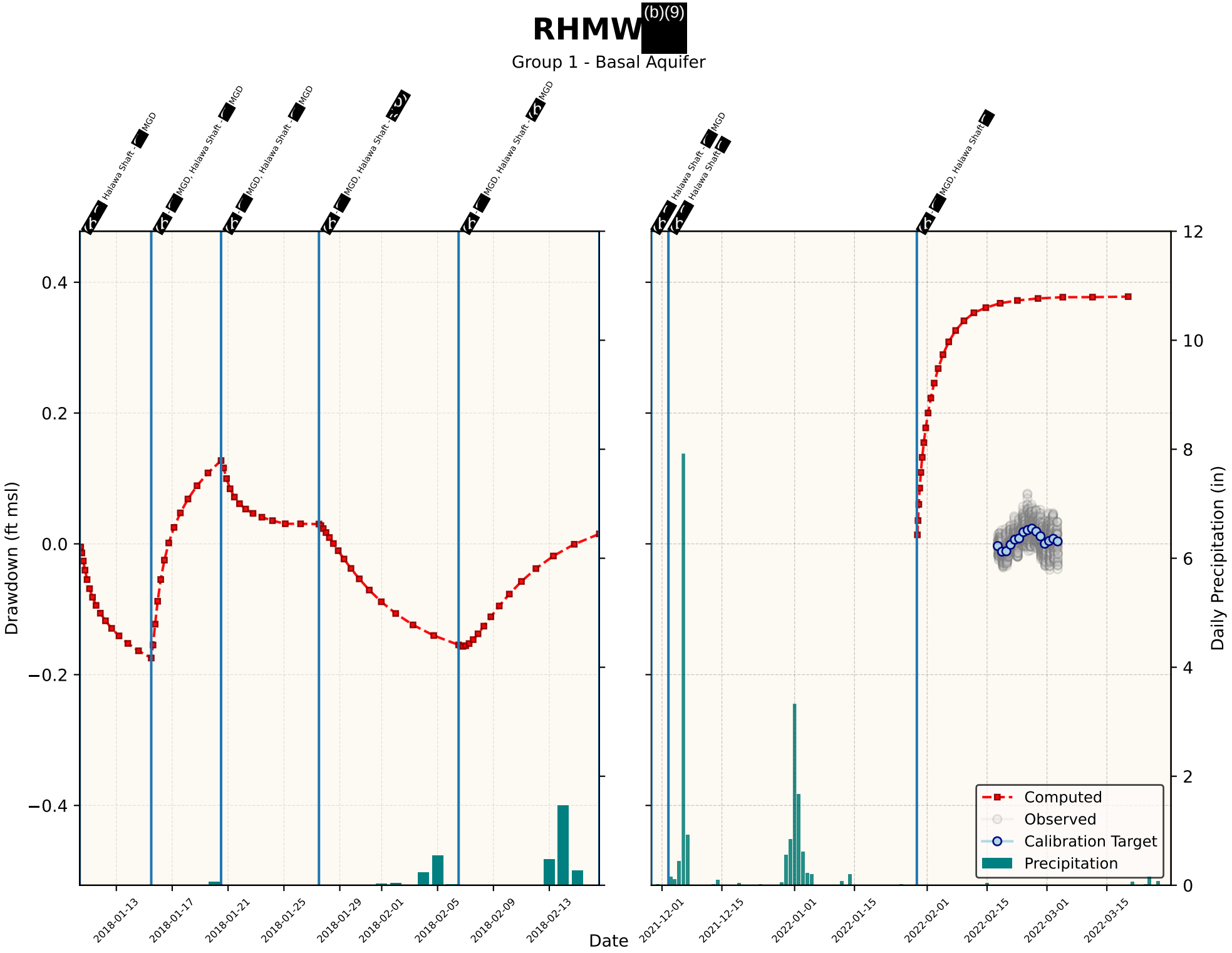
Group 1 - Basal Aquifer

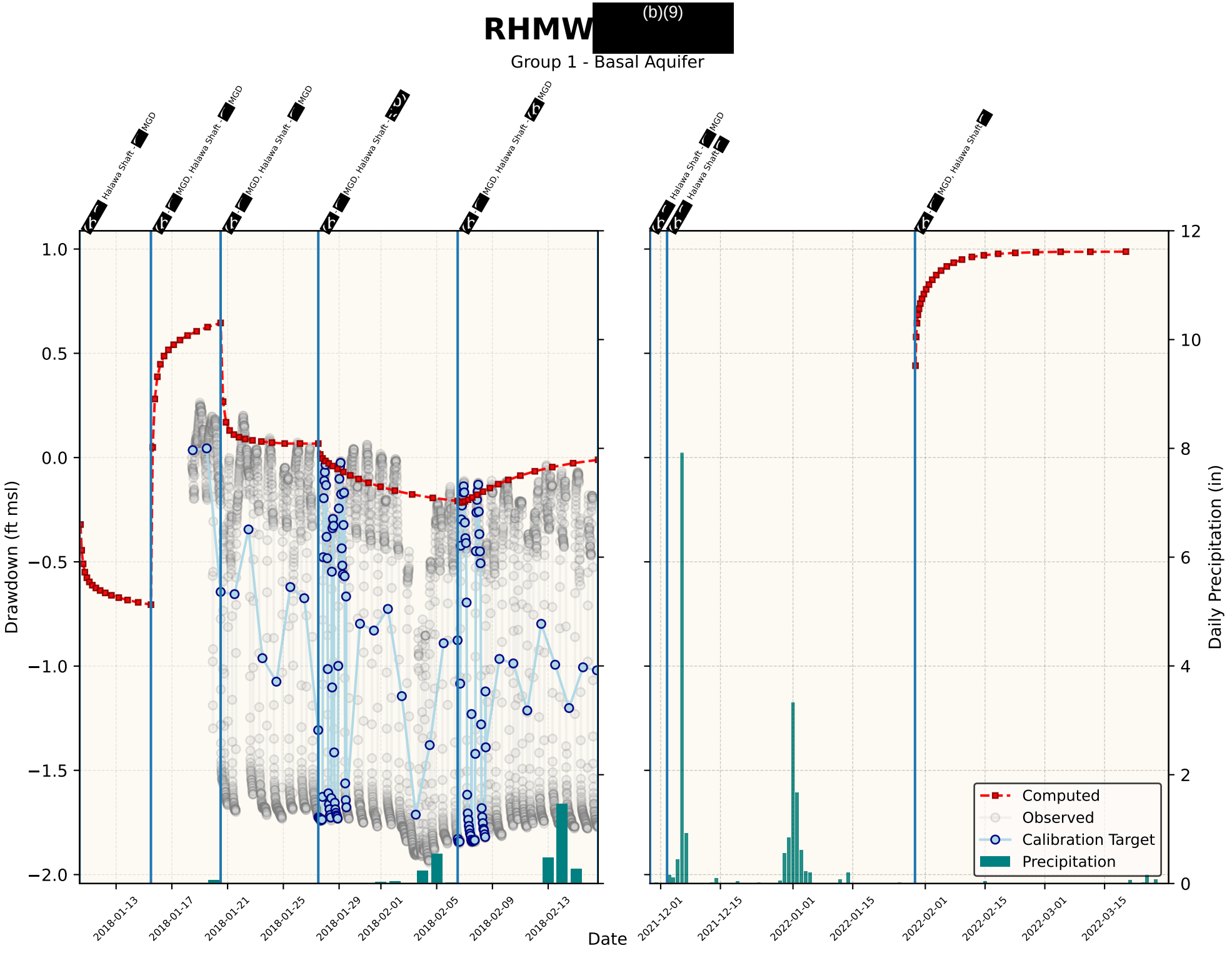



RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.6
0.4
0.2
0.0
−0.2
−0.4
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation

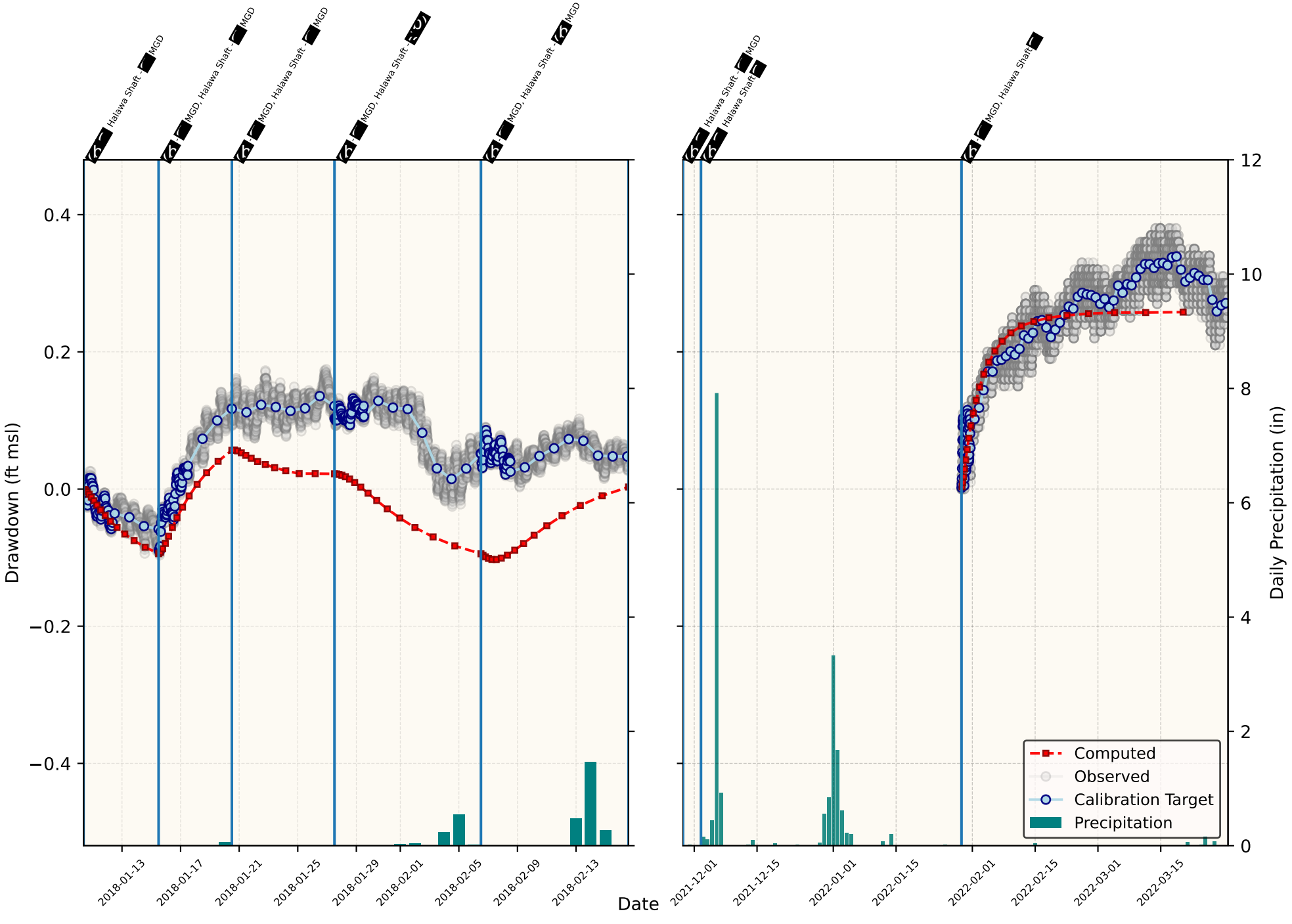

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

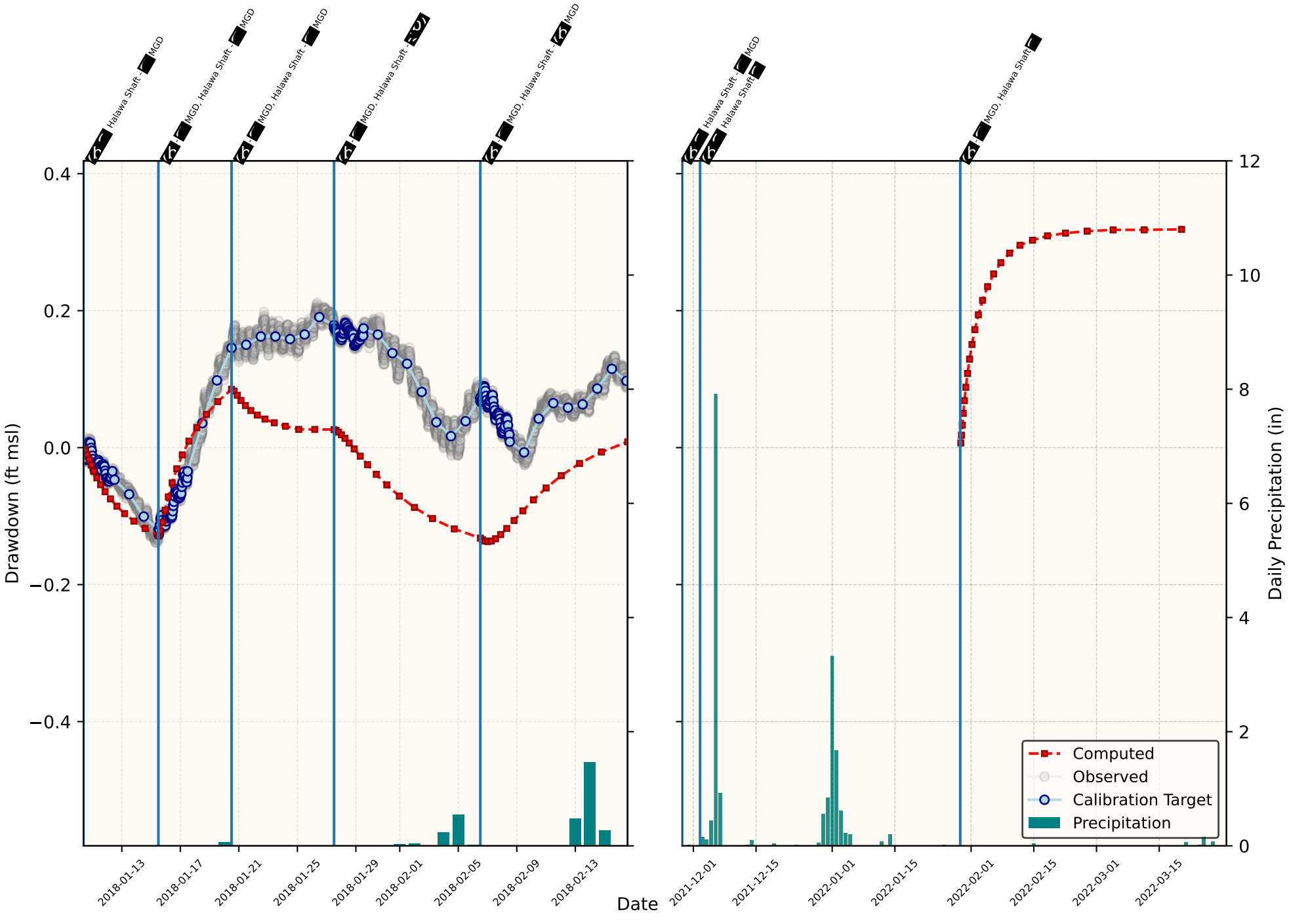

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

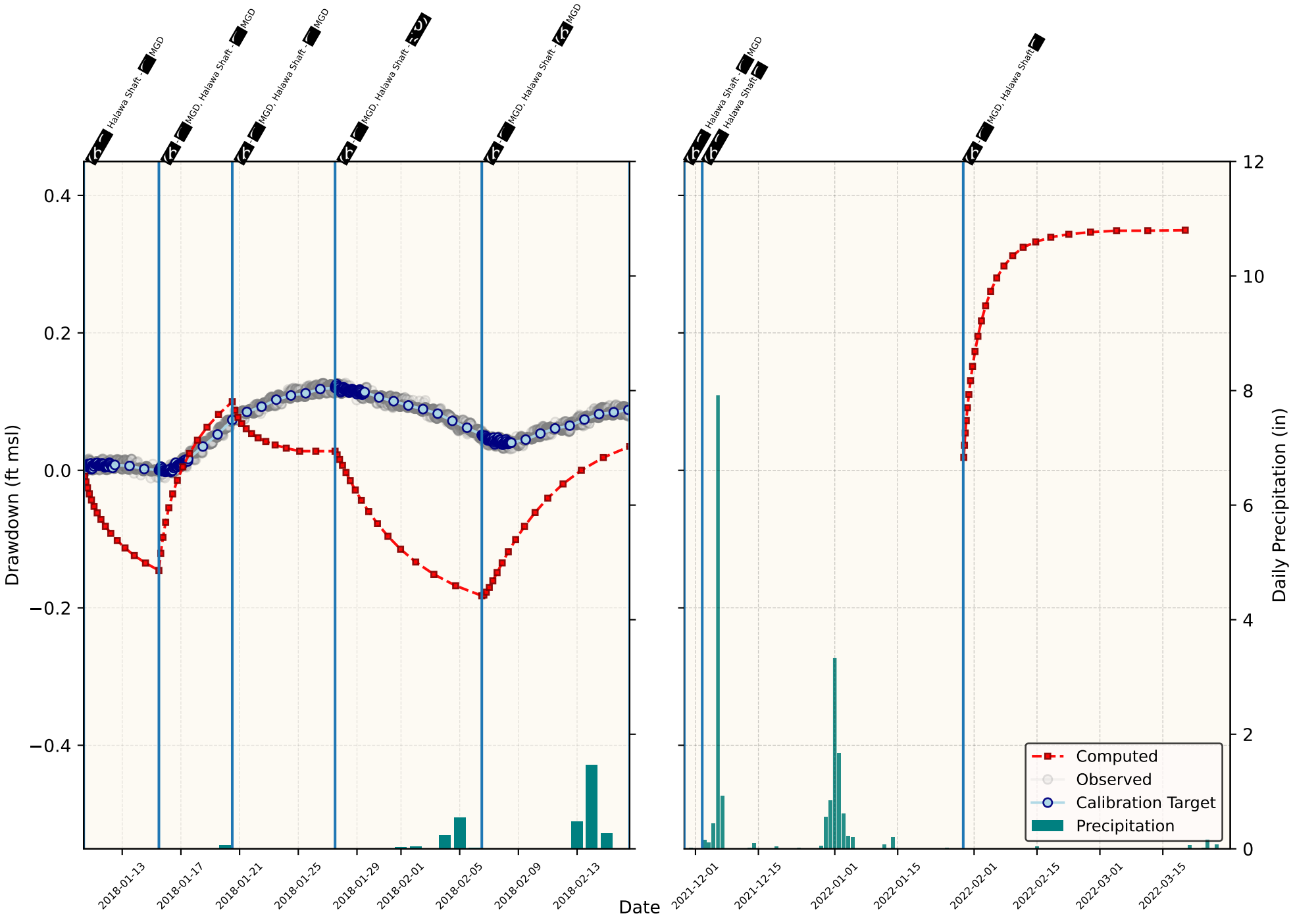

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

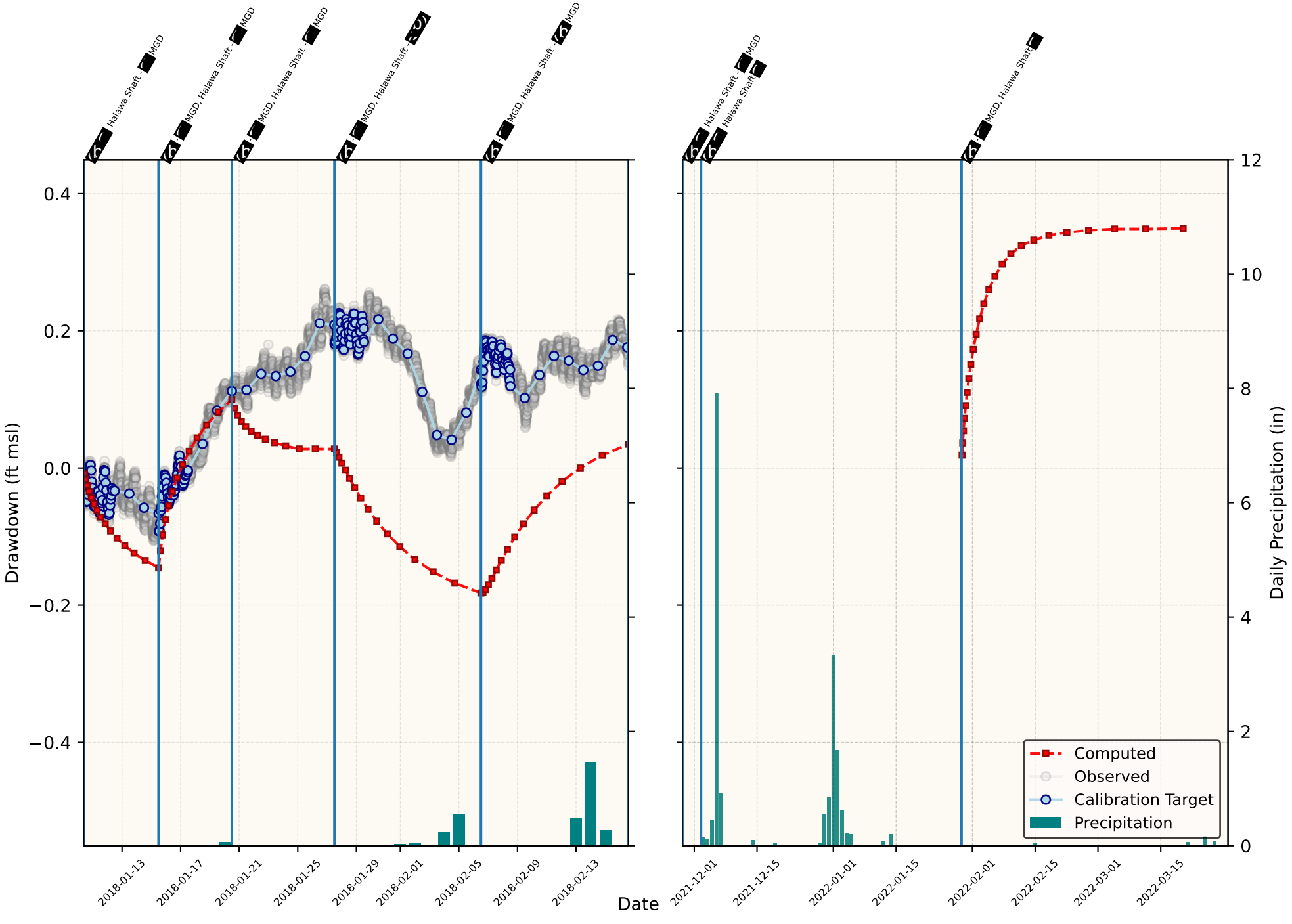
TAMC_[redacted]

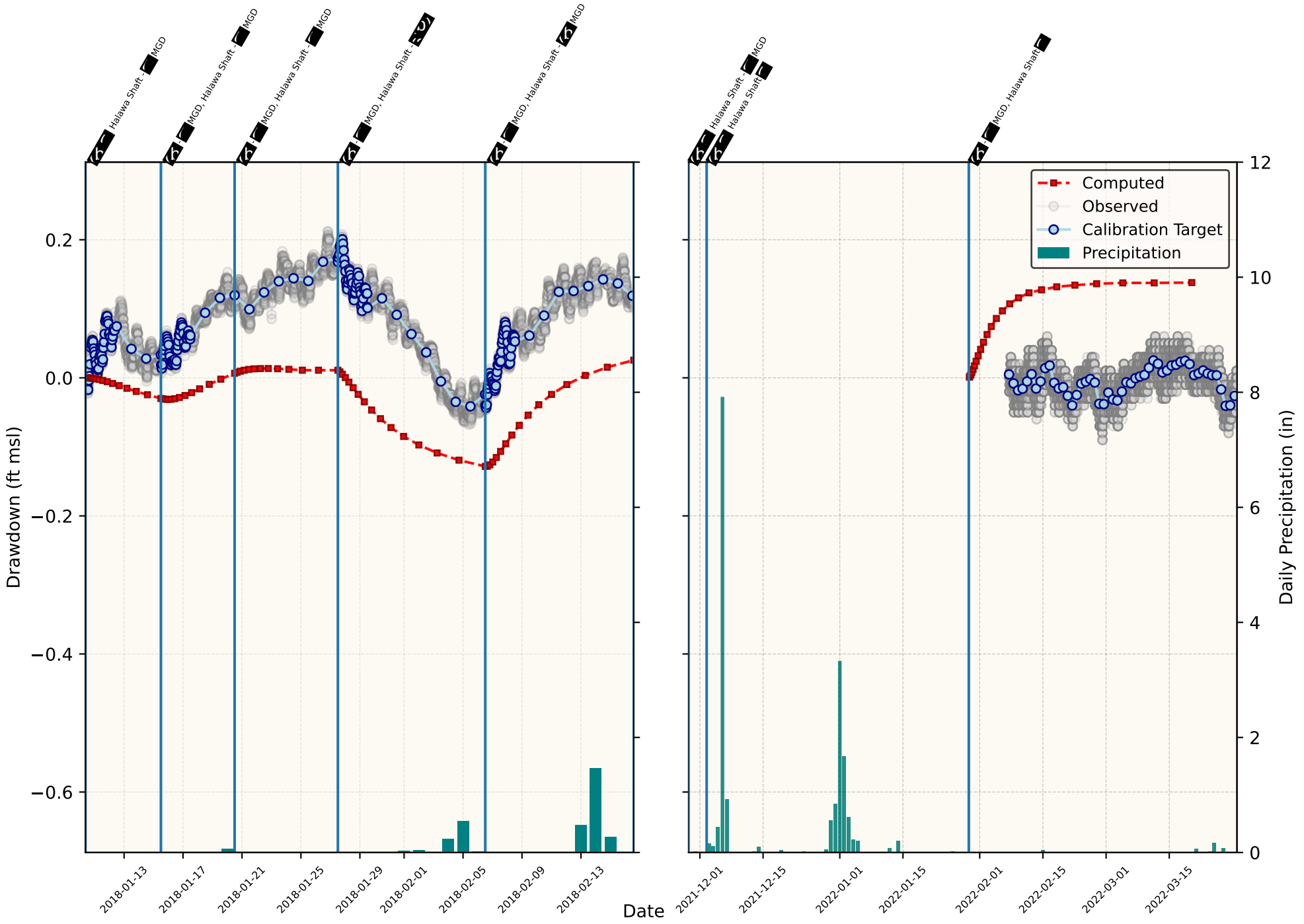
Group 1 - Basal Aquifer




DH_43
Group 2 - Deep Basal Wells
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

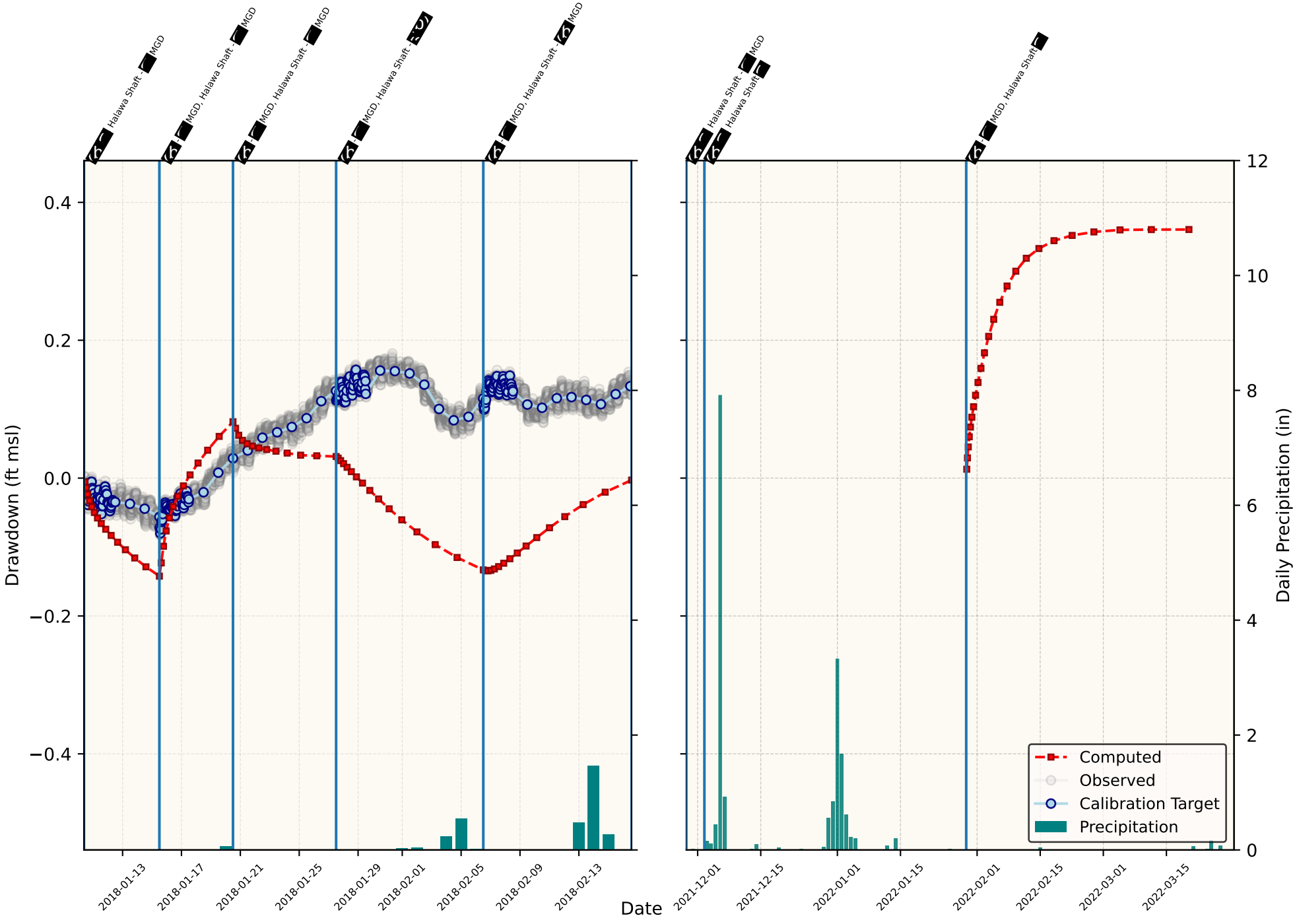

HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Halawa_Deep_Monitor_Well_HDMW2253-03
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

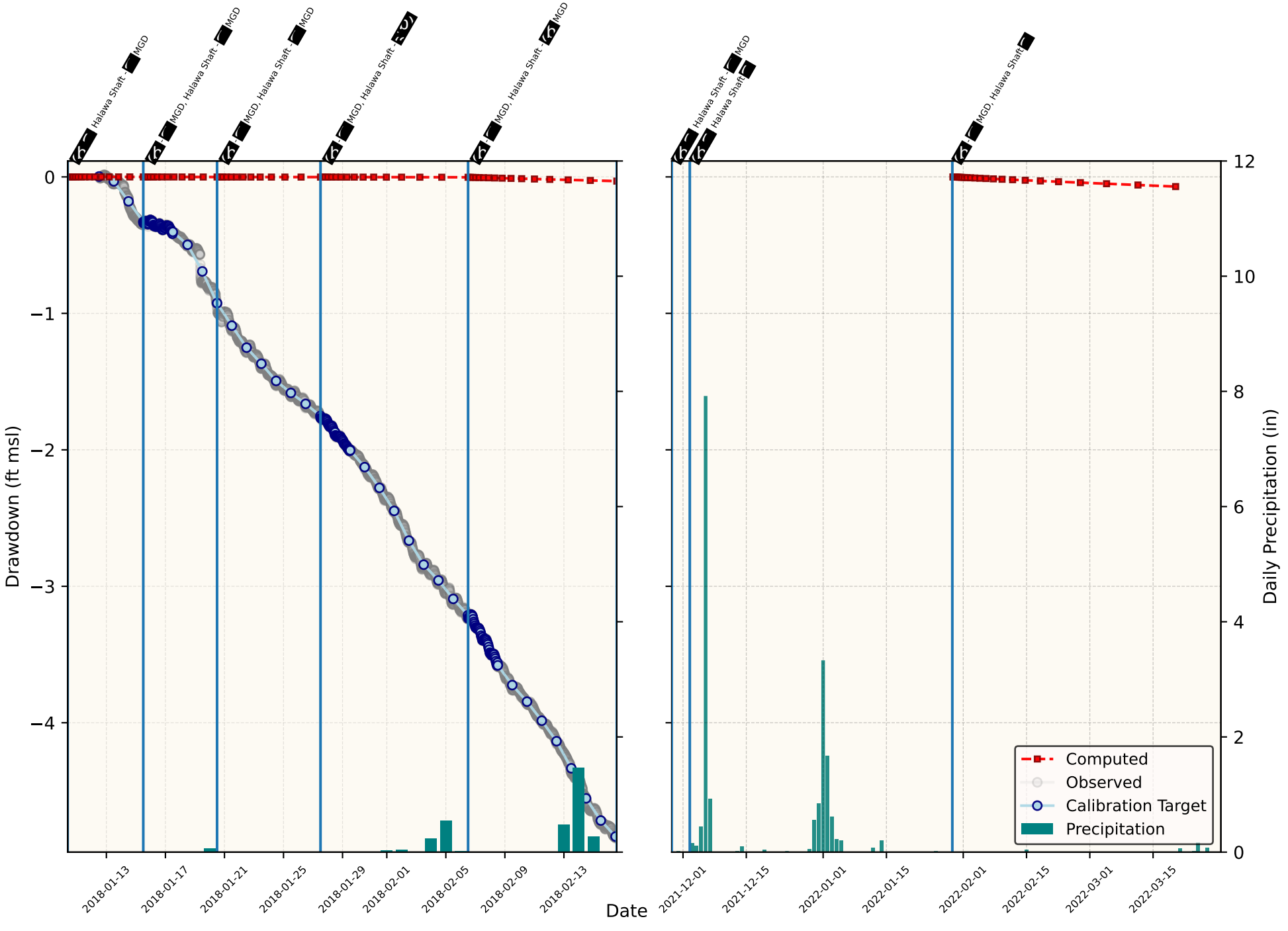
RHMW[redacted]

Group 3 - Saprolite/Confining Unit Well with Elevated Head



RHMW [redacted] (b)(9)

Group 3 - Saprolite/Confining Unit Well with Elevated Head



Groundwater Flow Model Calibration Evaluation Documents Sensitivity Scenario 3

Head Calibration Statistics

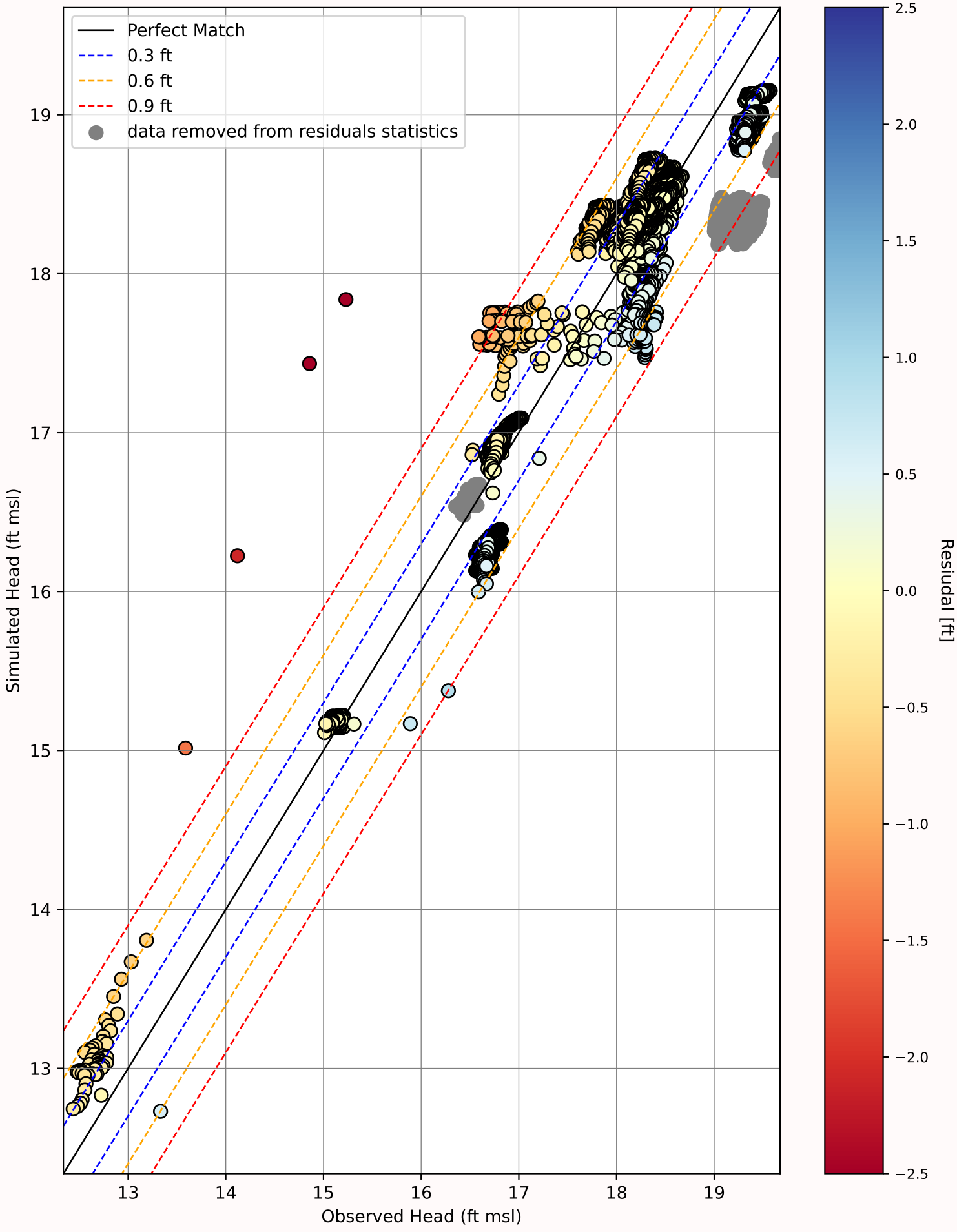
Wells	Basal Aquifer (Group 1)			Deep Wells (Group 2)	Confining Unit (Group 3)	Caprock (Group 4)	Cumulative
Time Period	2017/2018	2021/2022	All	All	All	All	All
Residual Mean (ft)	0.02	0.04	0.02	0.59	15.35	0.25	0.82
Absolute Residual Mean (ft)	0.23	0.29	0.26	0.64	17.13	1.46	1.13
Residual Standard Deviation (ft)	0.30	0.36	0.34	0.47	18.63	2.03	5.28
Sum of Squared Residuals (ft2)	482.49	510.82	1169.78	607.82	331700.36	553.84	334031.79
RMSE Error (ft)	0.30	0.36	0.34	0.75	24.12	2.04	5.34
Minimum Residual (ft)	-2.61	-0.93	-2.61	-0.89	-15.77	-4.29	-15.77
Maximum Residual (ft)	0.90	0.81	2.43	1.31	49.34	6.61	49.34
Number of Observations	5459	3915	9928	1075	570	133	11706
Range in Observations	7.14	3.26	7.19	4.26	97.94	6.85	116.87
Scaled Residual Standard Deviation (ft)	(b)%	11.0%	4.8%	11.1%	19.0%	29.7%	(b)%
Scaled Absolute Residual Mean (ft)	3.2%	9.0%	(b)%	15.0%	17.5%	21.3%	1.0%
Scaled RMSE Error (ft)	(b)%	11.1%	4.8%	17.6%	24.6%	29.8%	4.6%
Scaled Residual Mean (ft)	0.3%	1.2%	0.3%	13.7%	15.7%	(b)%	(b)%
Correlation Coefficient	0.96	0.89	0.93	0.99	0.93	-0.16	0.96

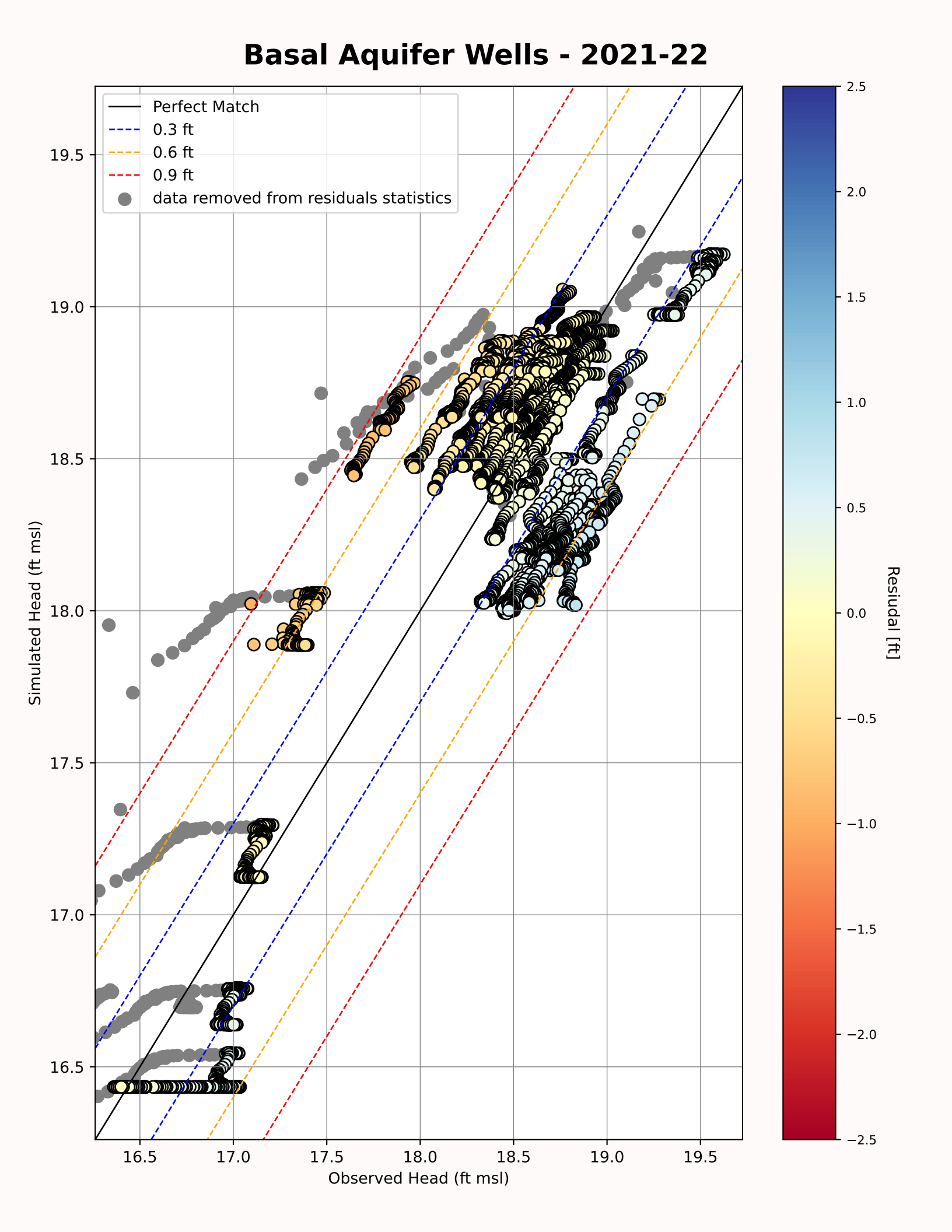
Drawdown Calibration Statistics

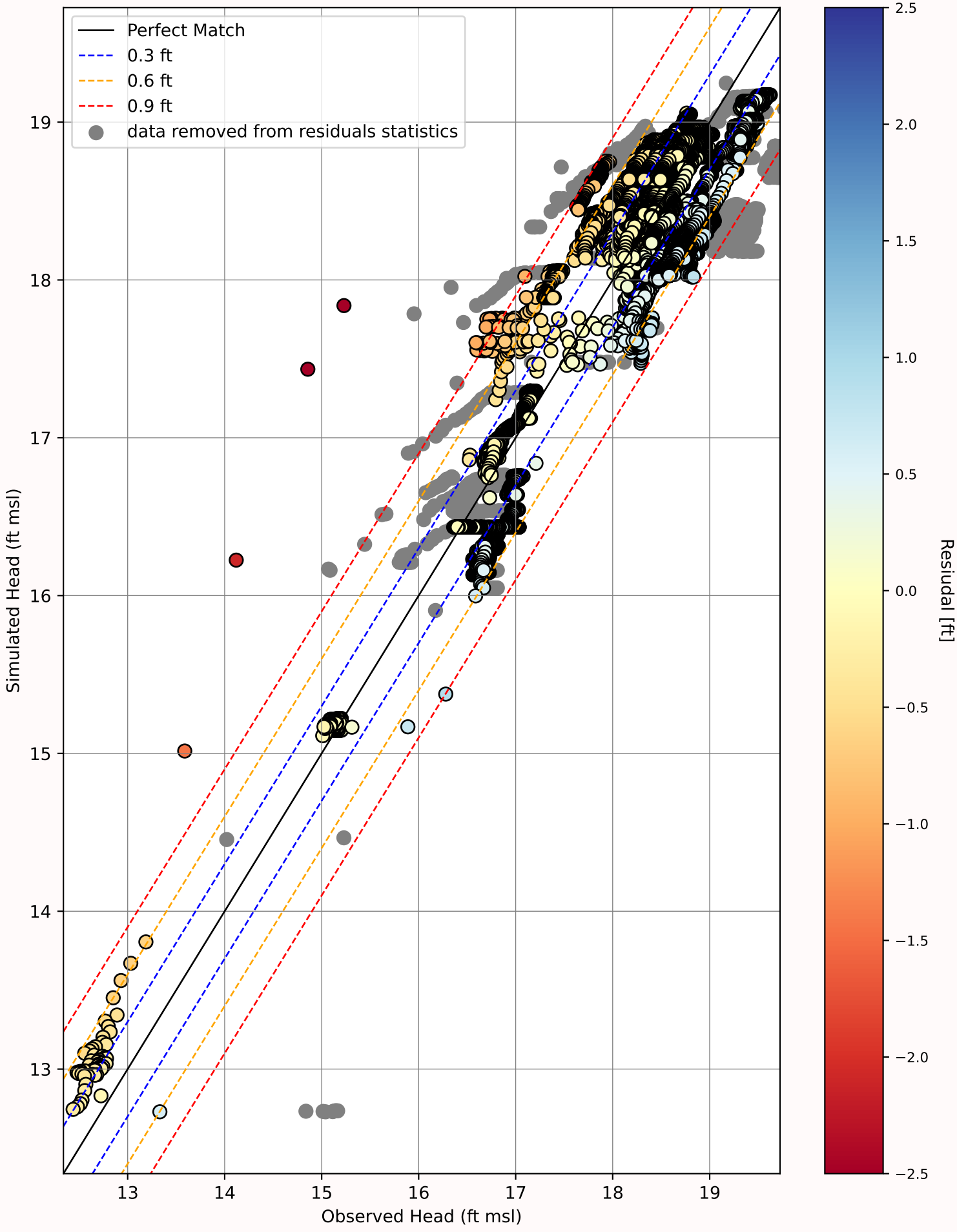
Wells	Basal Aquifer (Group 1)		
Time Period	**2017/2018**	**2021/2022**	**All**
Residual Mean (ft)	0.00	0.03	0.01
Absolute Residual Mean (ft)	0.09	0.06	0.08
Residual Standard Deviation (ft)	0.22	0.10	0.18
Sum of Squared Residuals (ft2)	250.27	35.85	286.12
RMSE Error (ft)	0.22	0.10	0.18
Minimum Residual (ft)	-1.79	-0.30	-1.79
Maximum Residual (ft)	2.62	0.50	2.62
Number of Observations	5393	3533	8926
Range in Observations	4.76	0.68	4.76
Scaled Residual Standard Deviation (ft)	(b) %	14.4%	3.8%
Scaled Absolute Residual Mean (ft)	2.0%	9.2%	1.7%
Scaled RMSE Error (ft)	(b) %	14.9%	3.8%
Scaled Residual Mean (ft)	0.0%	4.0%	0.2%
Correlation Coefficient	0.83	0.69	0.84

Conceptual Water Budget Comparison

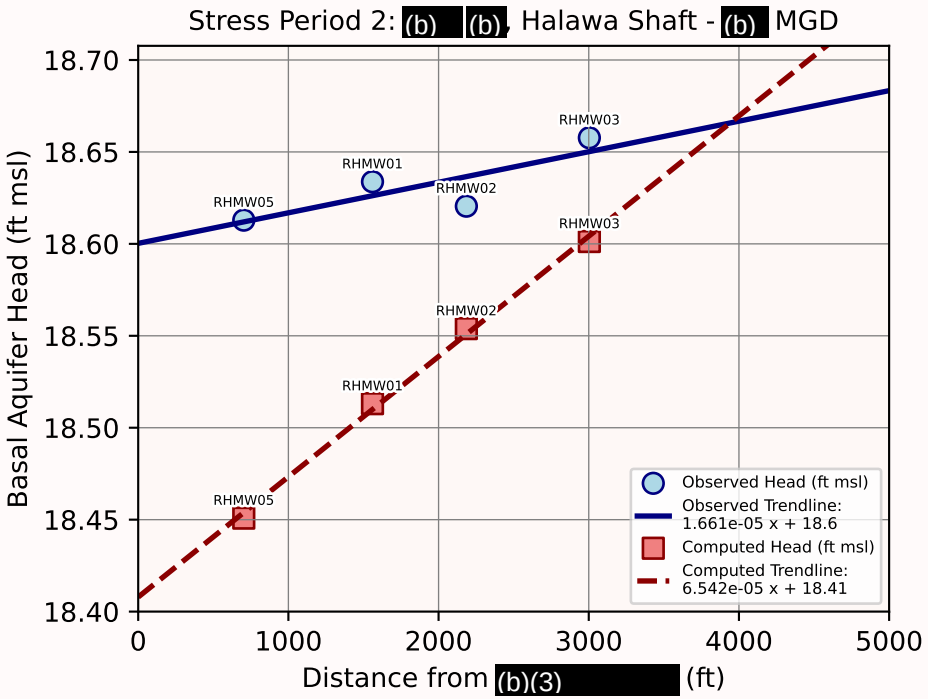
Type	Stress Period	Recharge (MGD)	Dike Region Inflow (MGD)	Well Discharge (MGD)	Spring Discharge (MGD)	Caprock Discharge (MGD)	Inflow from Adjacent Watershed (MGD)	Outflow to Adjacent Watershed (MGD)	Storage (MGD)	Total Inflows (MGD)	Total Outflows (MGD)
Conceptual	1	32.5	28.7	32.0	13.6	2.4	2.8	16.0	0.0	64.0	64.0
Simulated	1	32.5	28.7	32.1	13.1	3.9	(b	18.4	0.0	67.5	67.5
Difference	1	0.0	0.0	0.1	-0.5	1.5	3.5	2.4	0.0	3.5	3.5
Conceptual	2	32.5	28.7	28.4	13.6	2.4	2.8	19.6	0.0	64.0	64.0
Simulated	2	32.5	28.7	28.2	13.2	3.9	5.5	18.9	-2.4	66.7	66.6
Difference	2	0.0	0.0	-0.2	-0.4	1.5	2.7	-(b	-2.4	2.7	2.6
Conceptual	3	32.5	28.7	36.1	13.5	2.4	2.8	12.0	0.0	64.0	64.0
Simulated	3	32.5	28.7	35.9	13.0	3.9	6.5	18.5	(b	71.3	71.3
Difference	3	0.0	0.0	-0.2	-0.5	1.5	(b	6.4	(b	7.3	7.3
Conceptual	4	32.5	28.7	32.4	13.5	2.4	2.8	15.6	0.0	64.0	64.0
Simulated	4	32.5	28.7	32.3	13.0	3.9	6.6	18.1	-0.3	67.8	67.6
Difference	4	0.0	0.0	-0.2	-0.5	1.5	3.8	2.5	-0.3	3.8	(b
Conceptual	5	32.5	28.7	25.7	13.7	2.4	4.7	24.1	0.0	65.9	65.9
Simulated	5	32.5	28.7	25.6	13.7	3.9	5.6	21.3	-2.2	66.8	66.7
Difference	5	0.0	0.0	-0.1	0.0	1.5	0.9	-2.7	-2.2	0.9	0.9
Conceptual	6	32.5	28.7	37.7	13.6	2.4	4.7	12.2	0.0	65.9	65.9
Simulated	6	32.5	28.7	37.6	12.8	3.9	7.2	17.3	3.2	71.6	71.6
Difference	6	0.0	0.0	-0.1	-0.8	1.5	2.5	5.2	3.2	5.7	5.7
Conceptual	7	32.5	28.7	32.0	13.4	2.4	4.1	17.4	0.0	65.3	65.3
Simulated	7	32.5	28.7	32.0	12.9	3.9	5.6	18.0	0.0	66.7	66.7
Difference	7	0.0	0.0	0.0	-0.4	1.4	1.5	0.5	0.0	1.5	1.5
Conceptual	8	32.5	28.7	30.1	12.6	2.4	2.8	18.8	0.0	63.9	63.9
Simulated	8	32.5	28.7	30.1	13.0	3.9	5.8	17.7	-2.2	67.0	66.9
Difference	8	0.0	0.0	0.0	0.4	1.5	3.0	-1.1	-2.2	3.0	3.0
Conceptual	9	32.5	28.7	21.8	13.7	2.4	0.5	23.8	0.0	61.7	61.7
Simulated	9	32.5	28.7	21.8	14.2	3.9	2.6	23.8	-0.1	63.7	63.7
Difference	9	0.0	0.0	0.0	0.5	1.5	2.0	0.0	-0.1	2.1	2.1
Conceptual	10	32.5	28.7	26.3	13.9	2.5	7.5	25.9	0.0	68.7	68.7
Simulated	10	32.5	28.7	26.3	13.7	3.9	4.6	21.9	0.0	65.8	65.9
Difference	10	0.0	0.0	0.0	-0.2	1.4	-2.9	-4.0	0.0	-2.9	-2.8

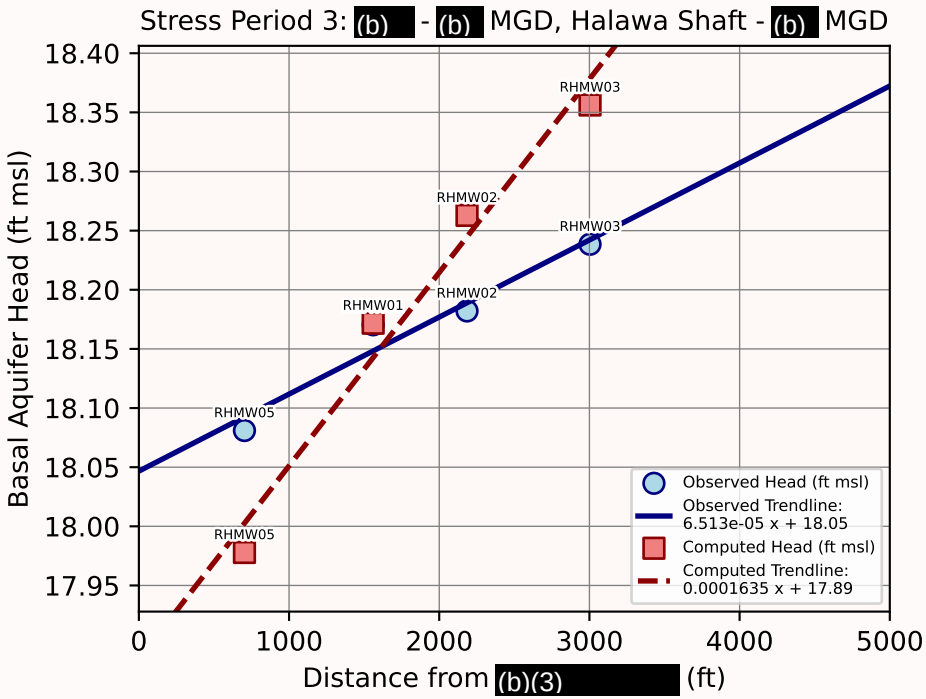

Basal Aquifer Wells - 2017-18
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

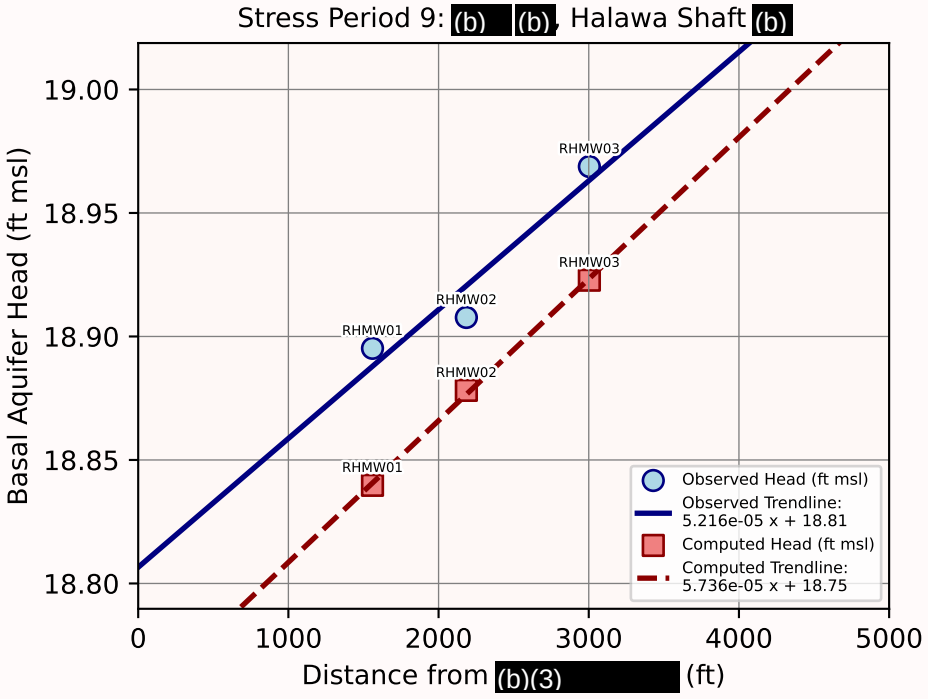

Basal Aquifer Wells - 2021-22
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
16.5
17.0
17.5
18.0
18.5
19.0
19.5
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

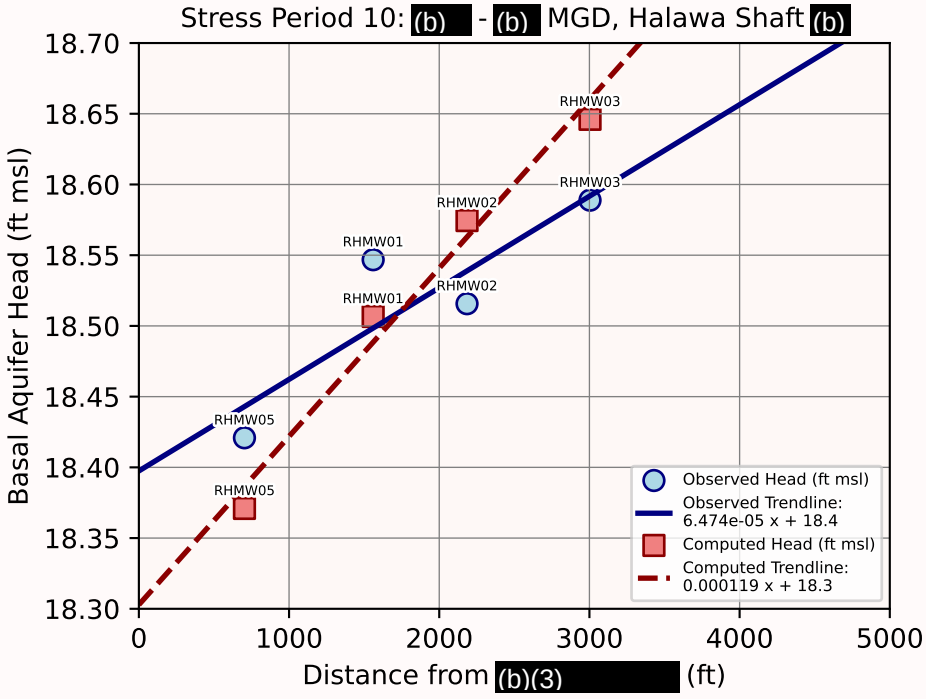

Basal Aquifer Wells - All
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

Gradients Along Red Hill Ridge

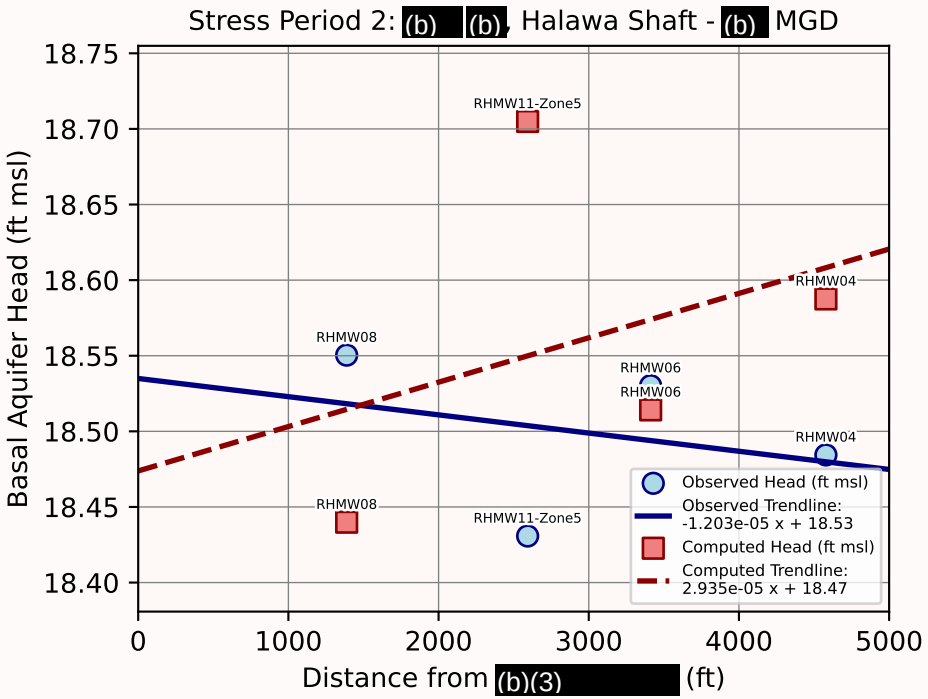


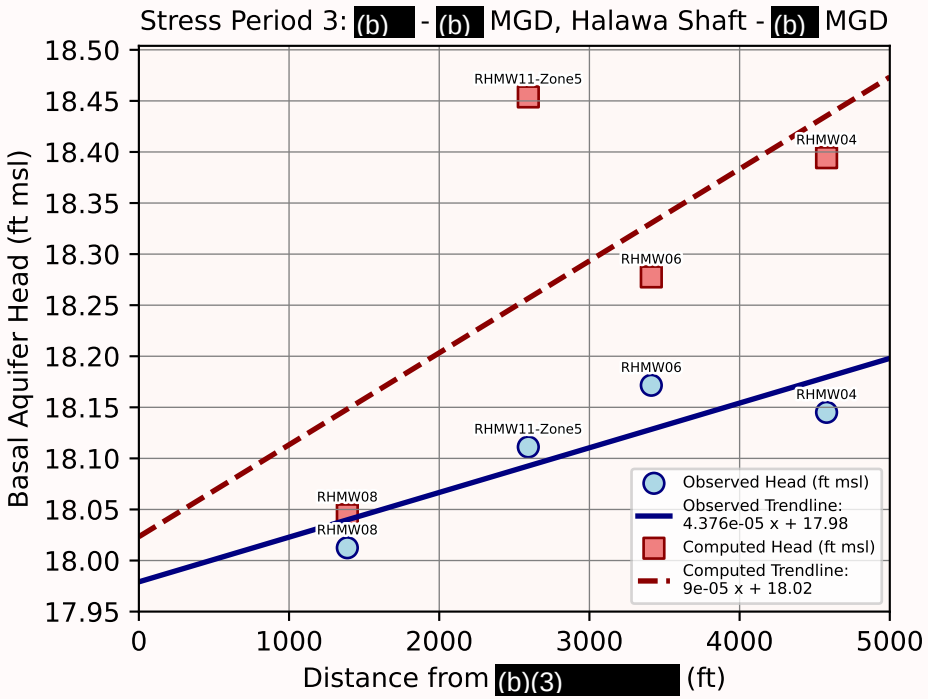


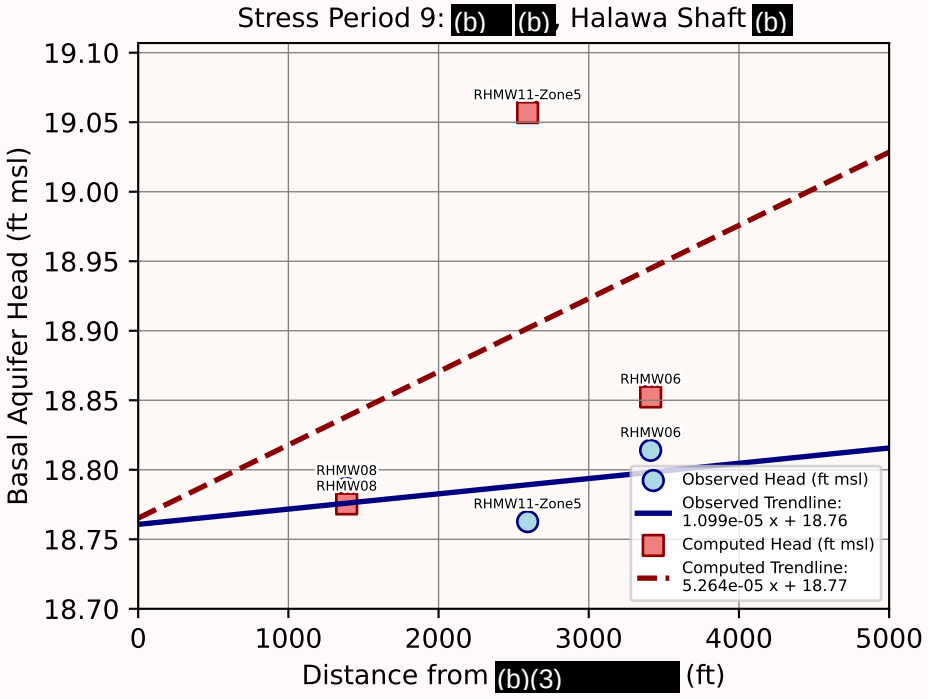


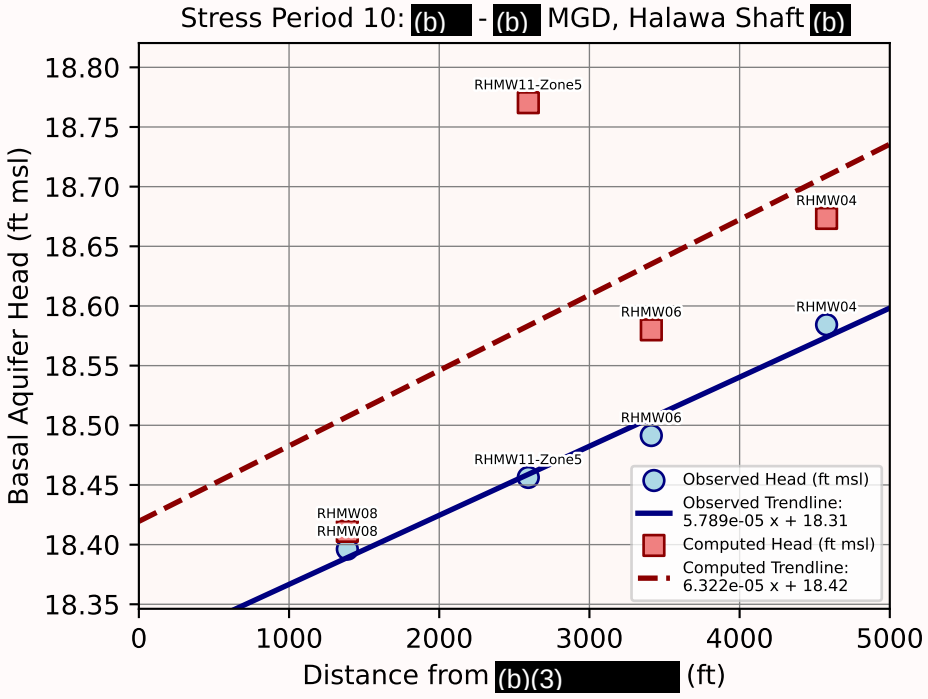


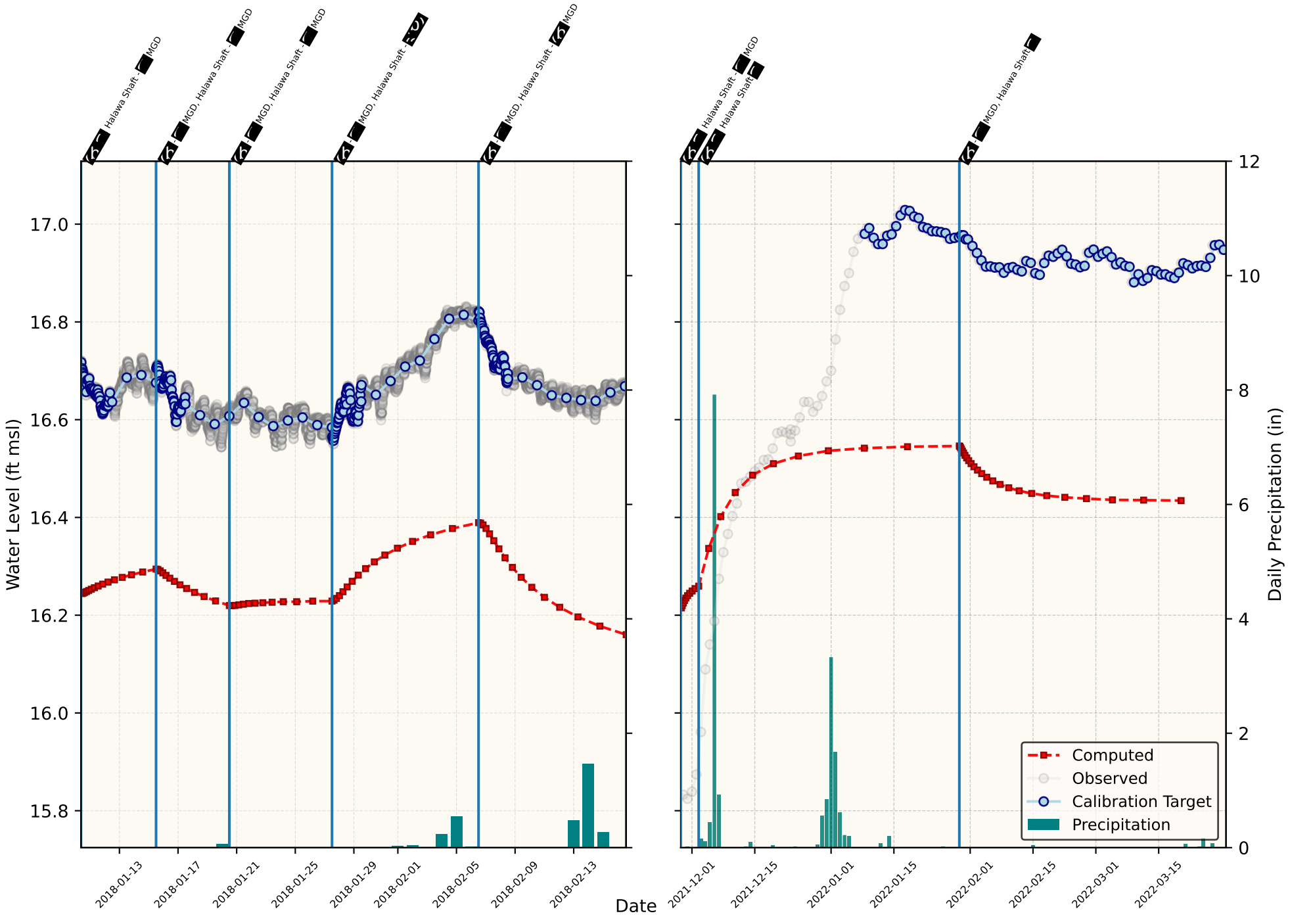
Gradients Northwest of Red Hill Ridge





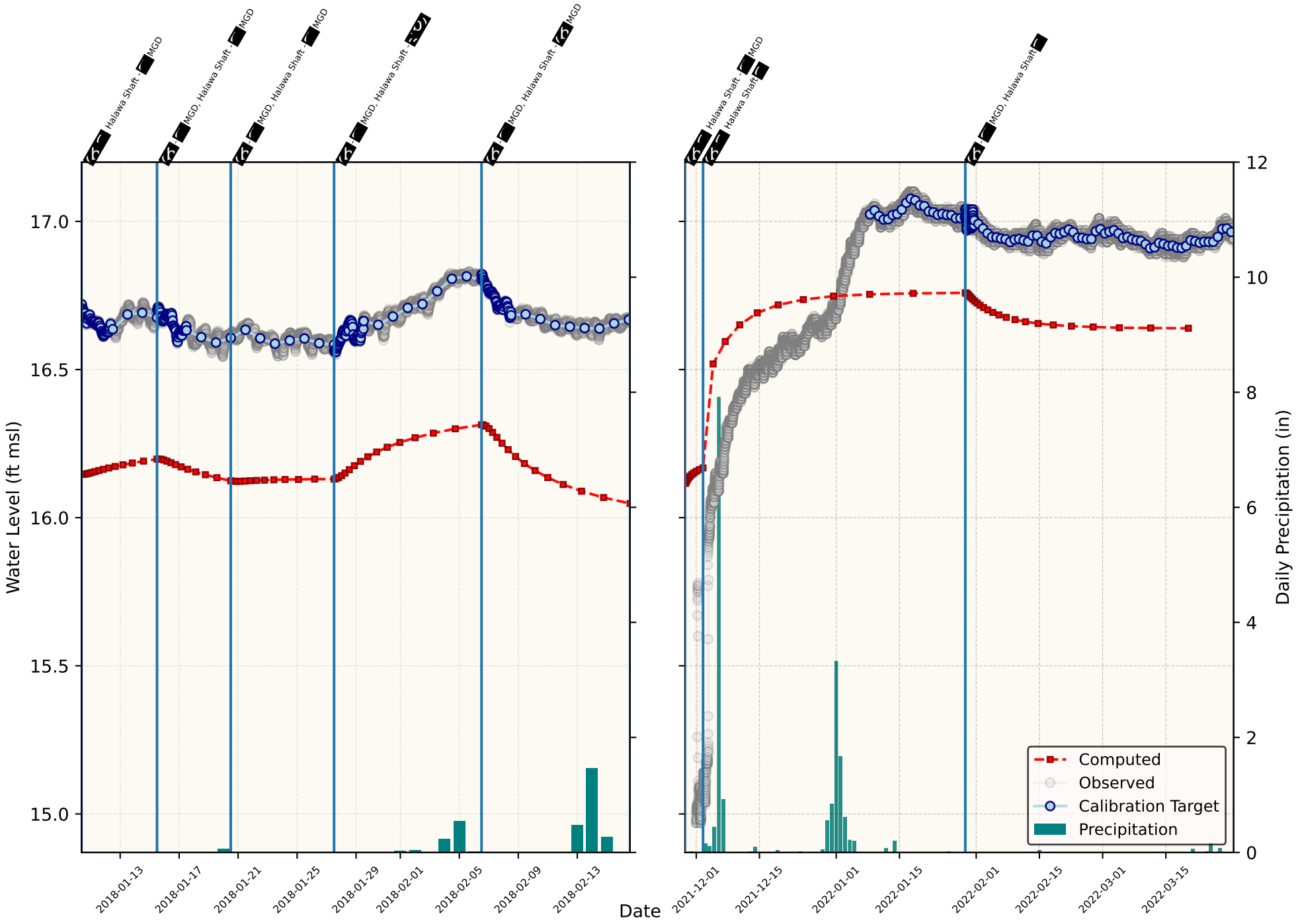


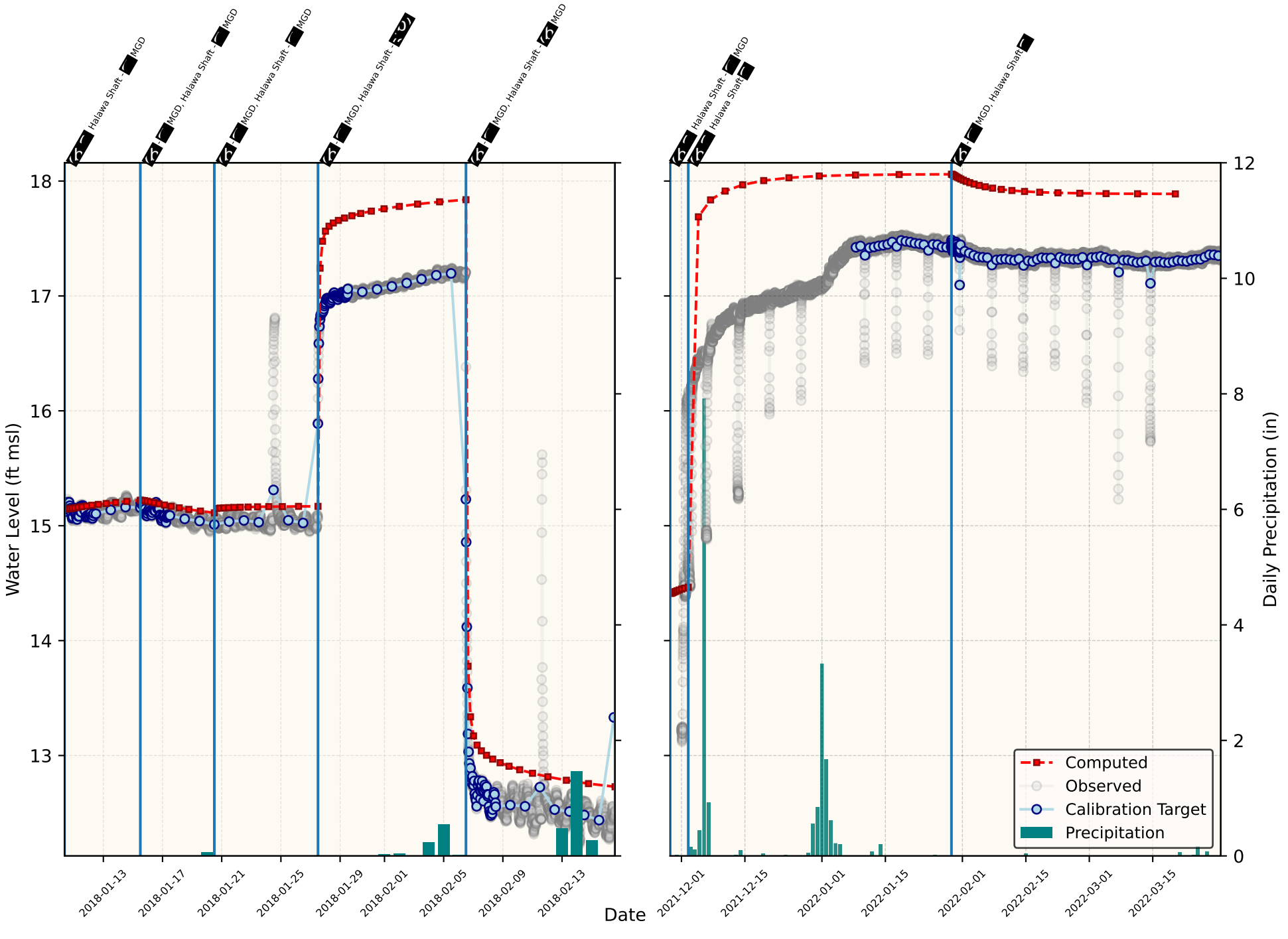


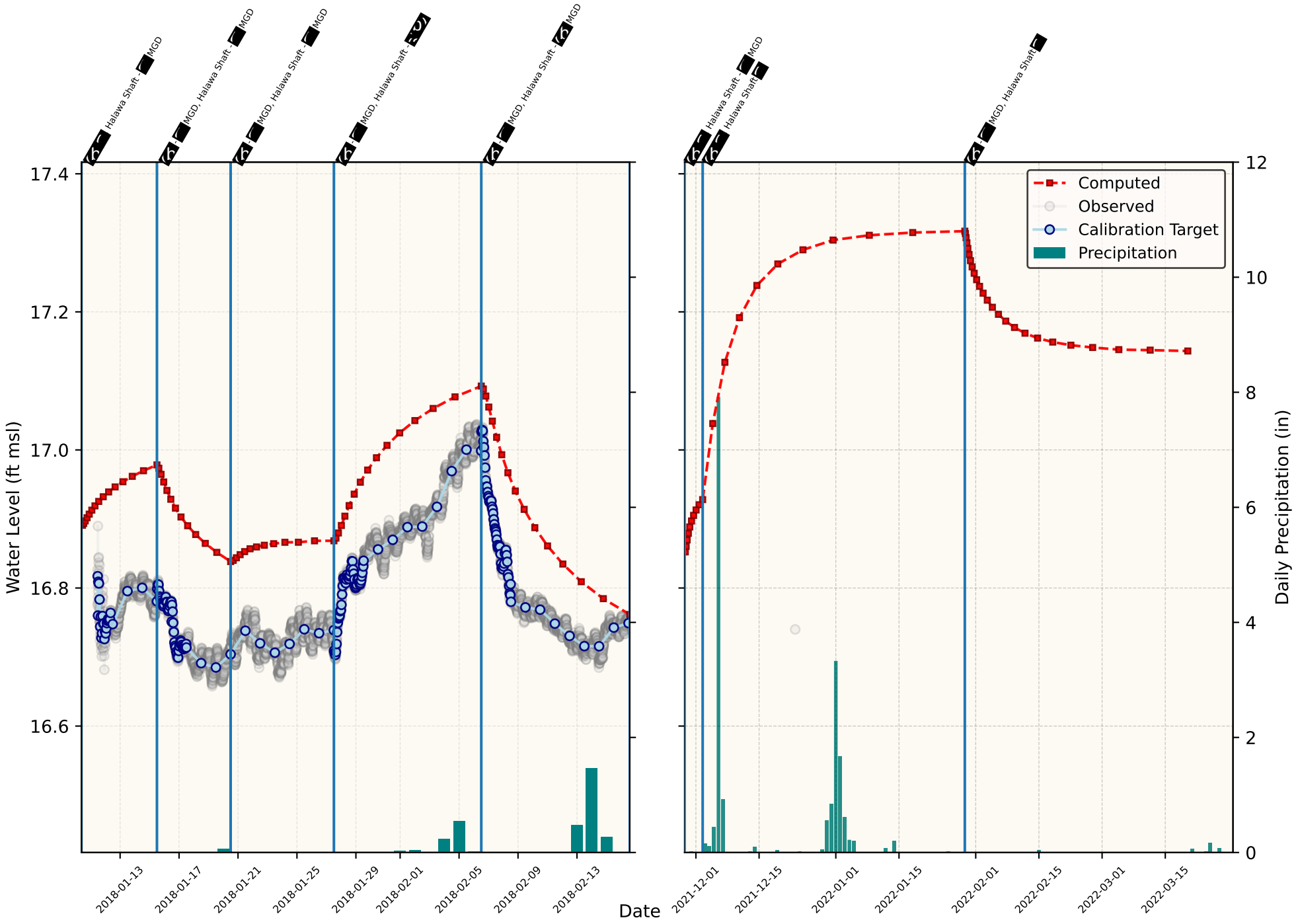

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

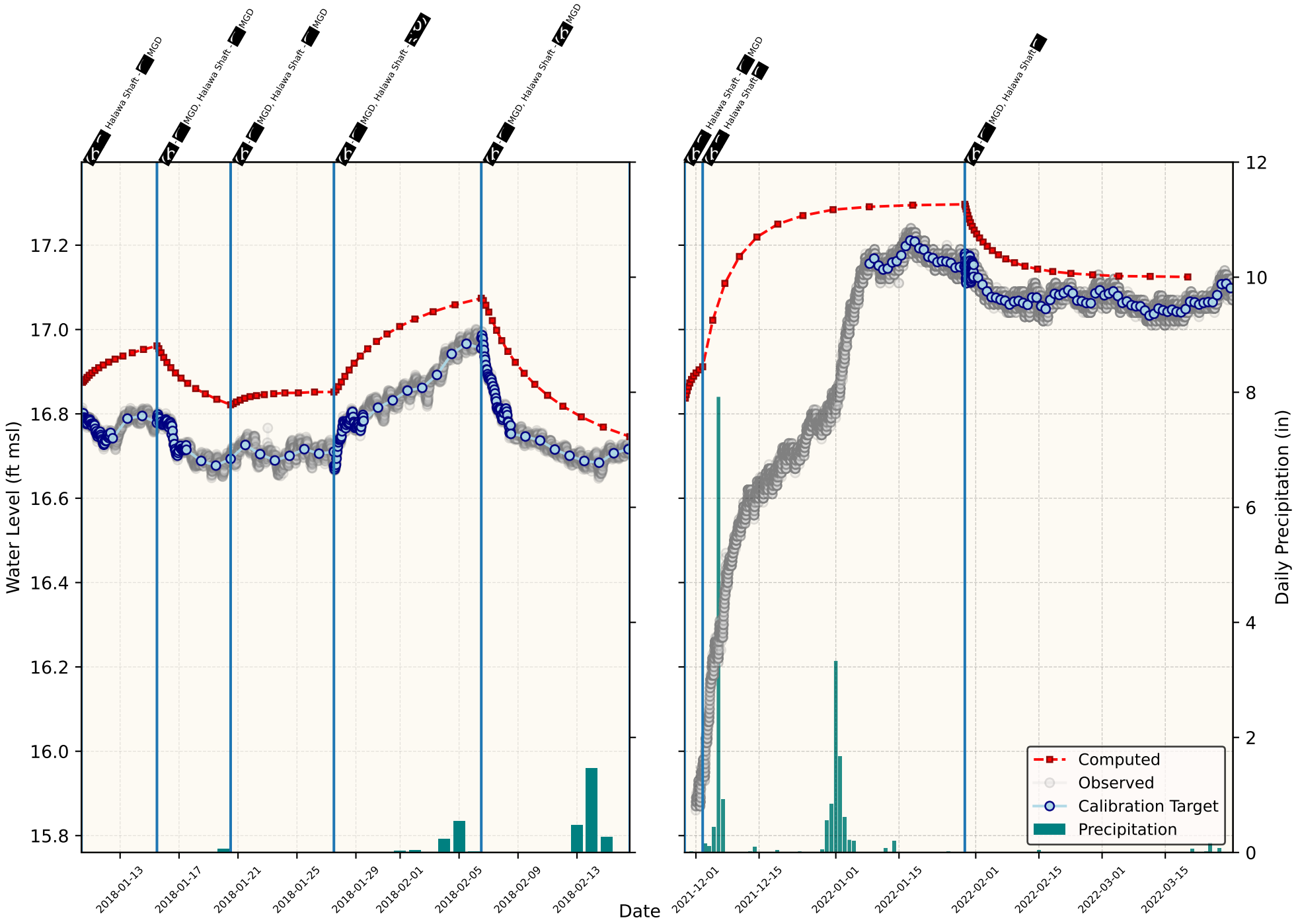
(b)(3) [redacted]

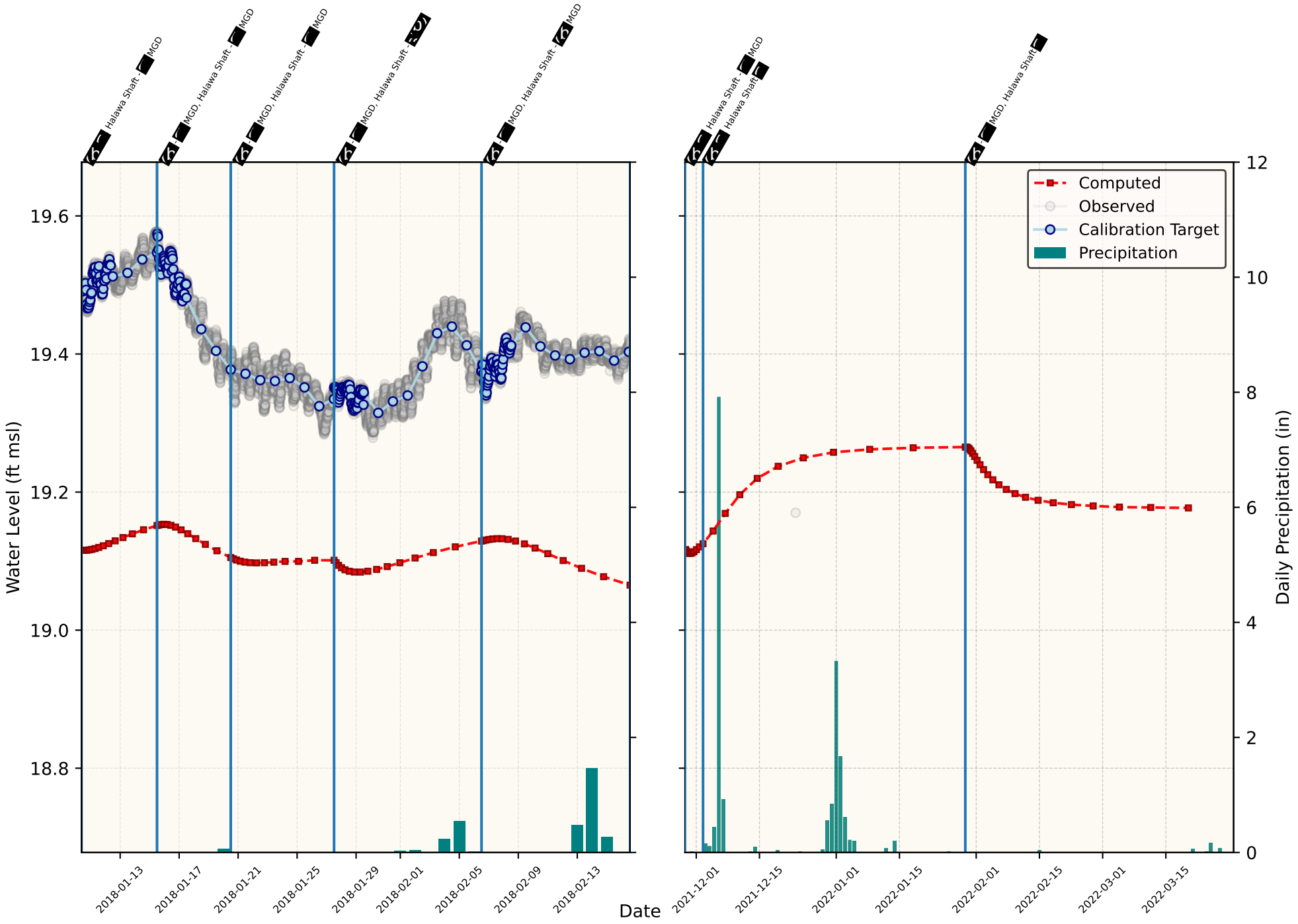
Group 1 - Basal Aquifer

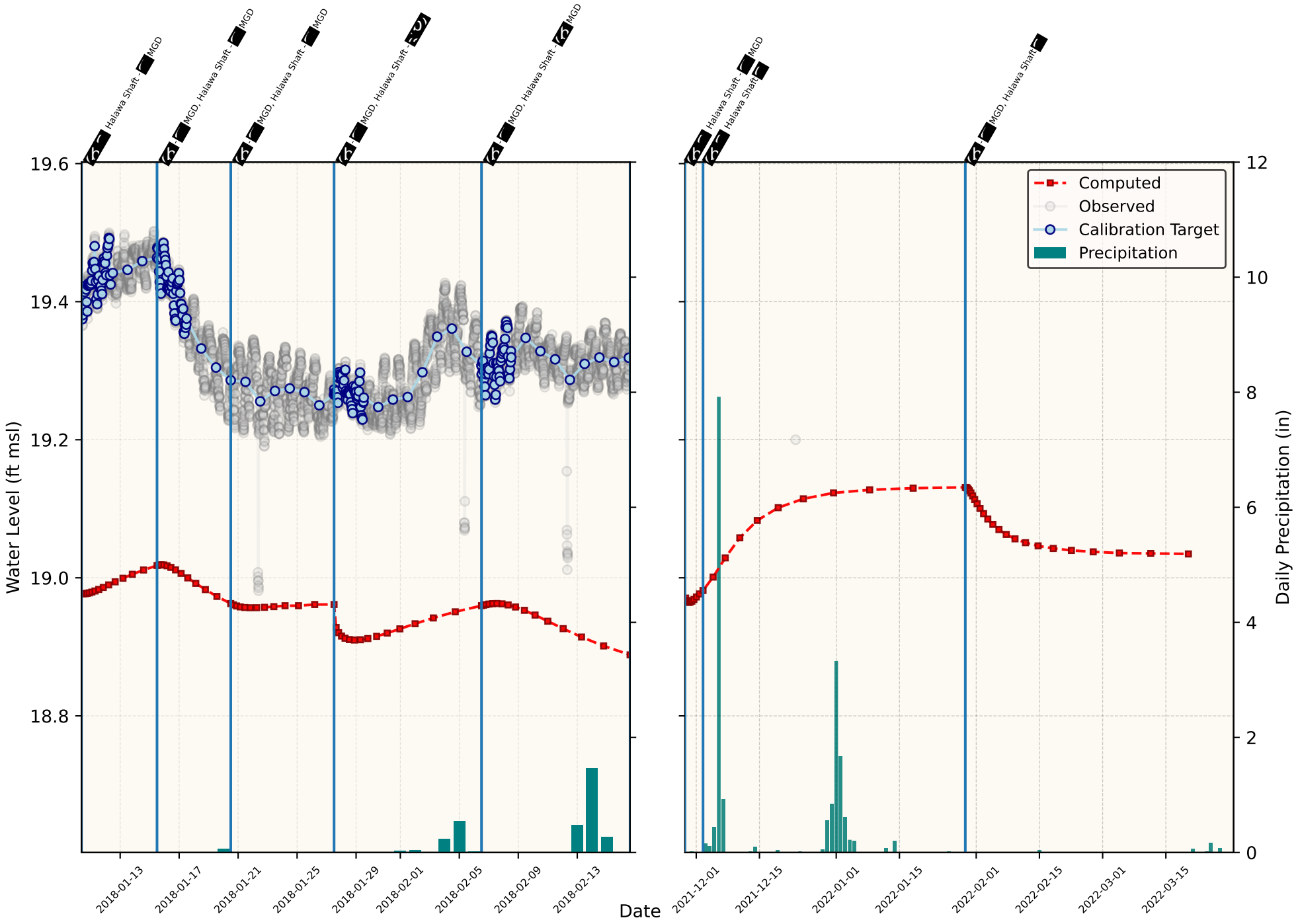


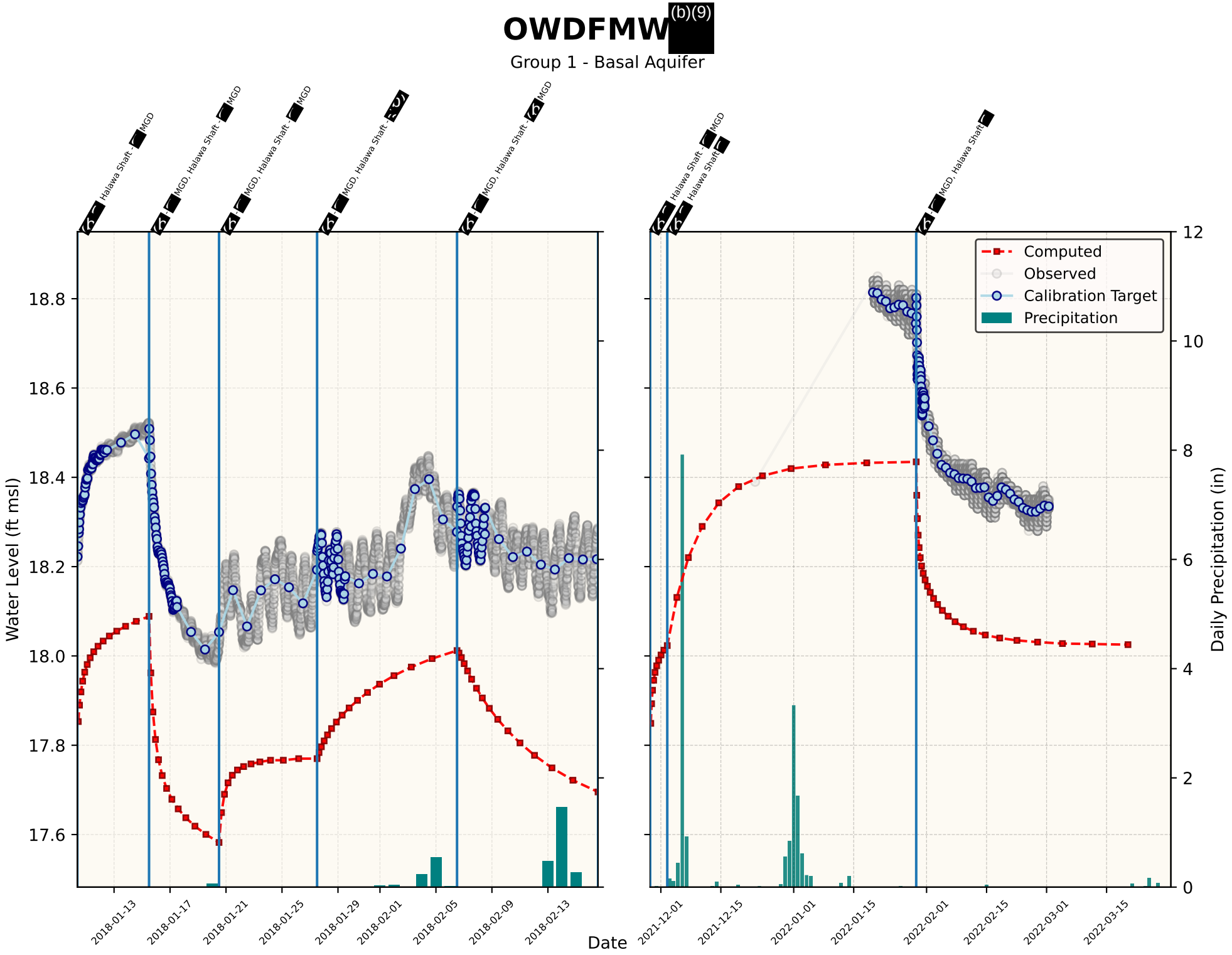

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

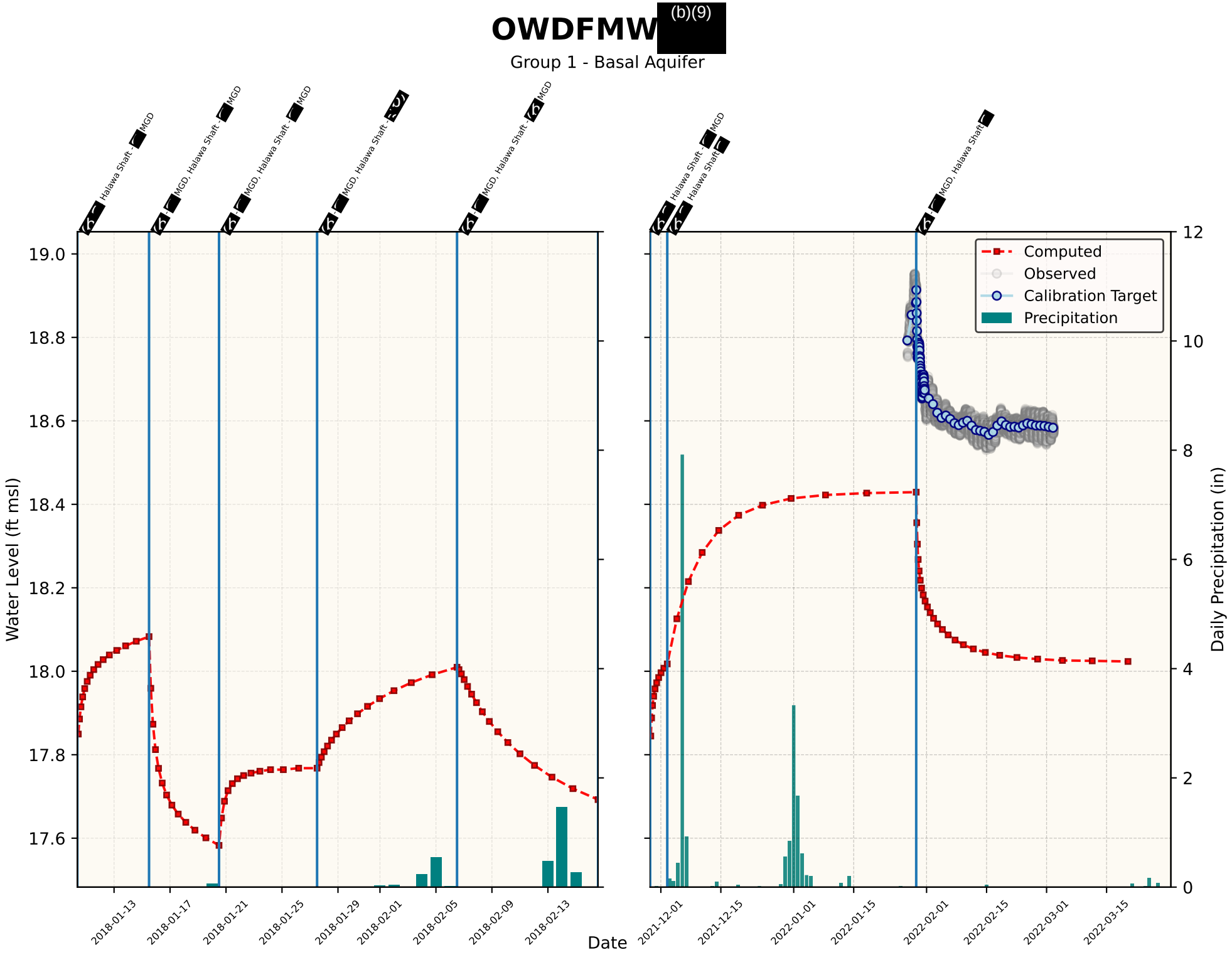

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
17.4
17.2
17.0
16.8
16.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

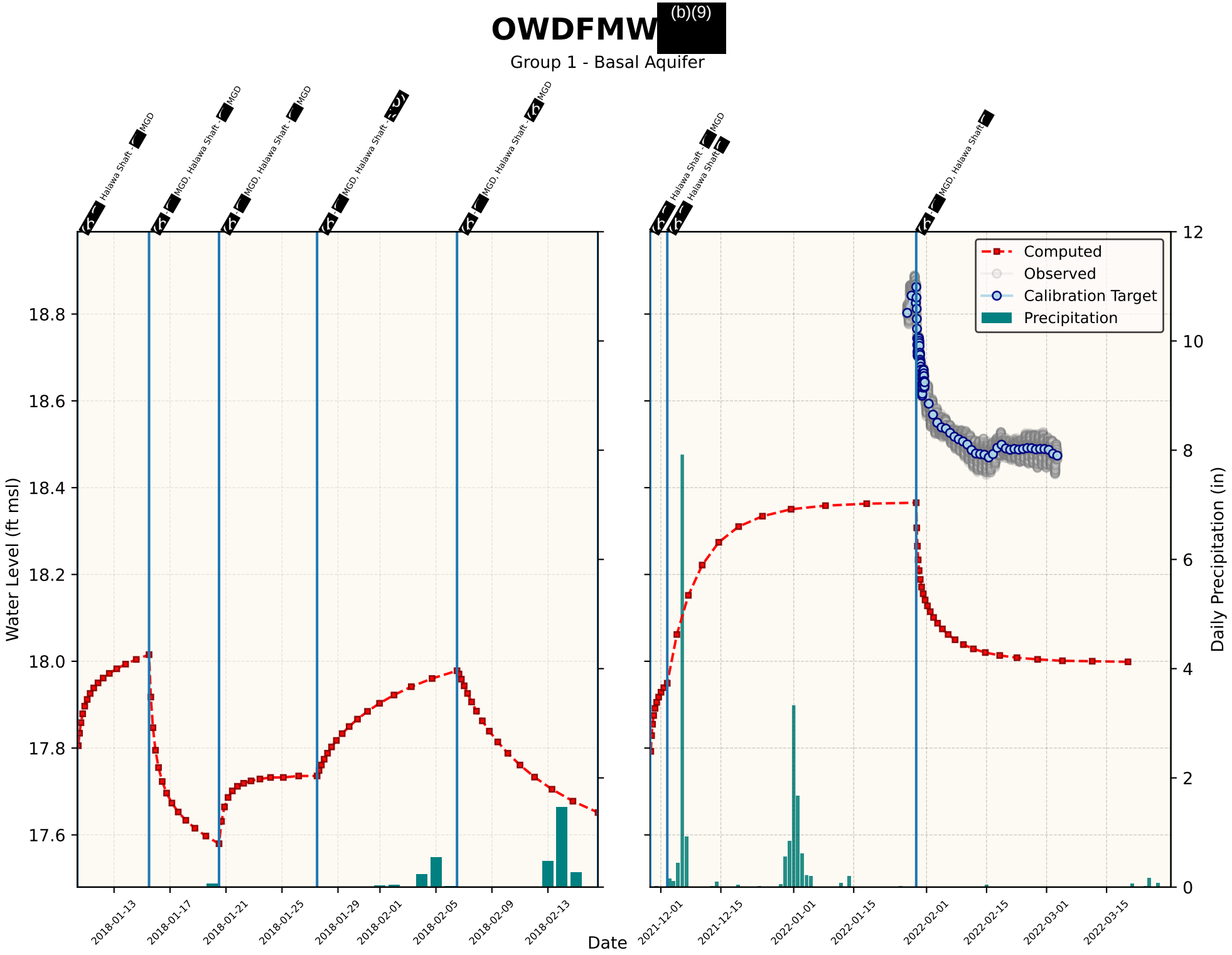

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

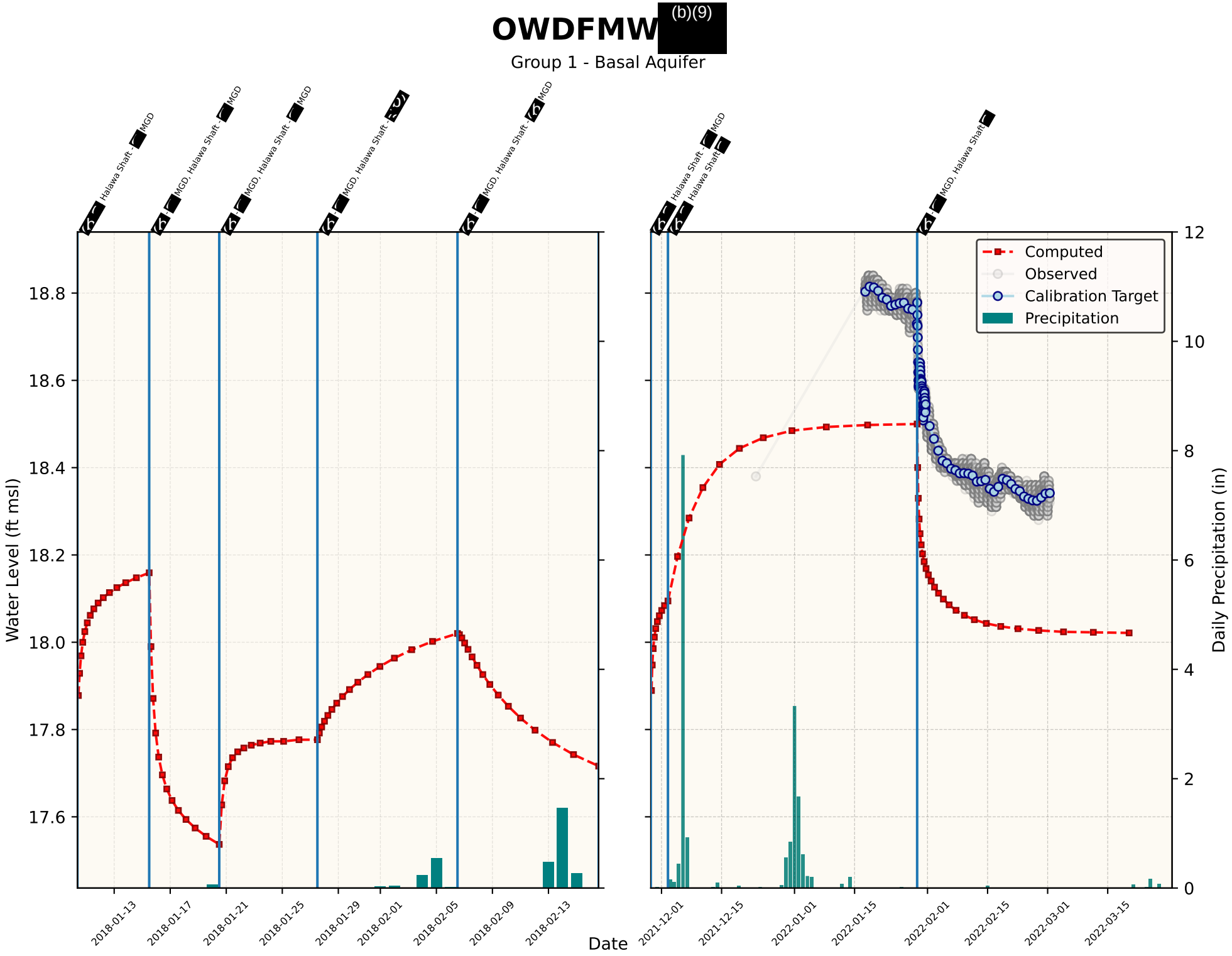

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.6
19.4
19.2
19.0
18.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.6
19.4
19.2
19.0
18.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


OWDFMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

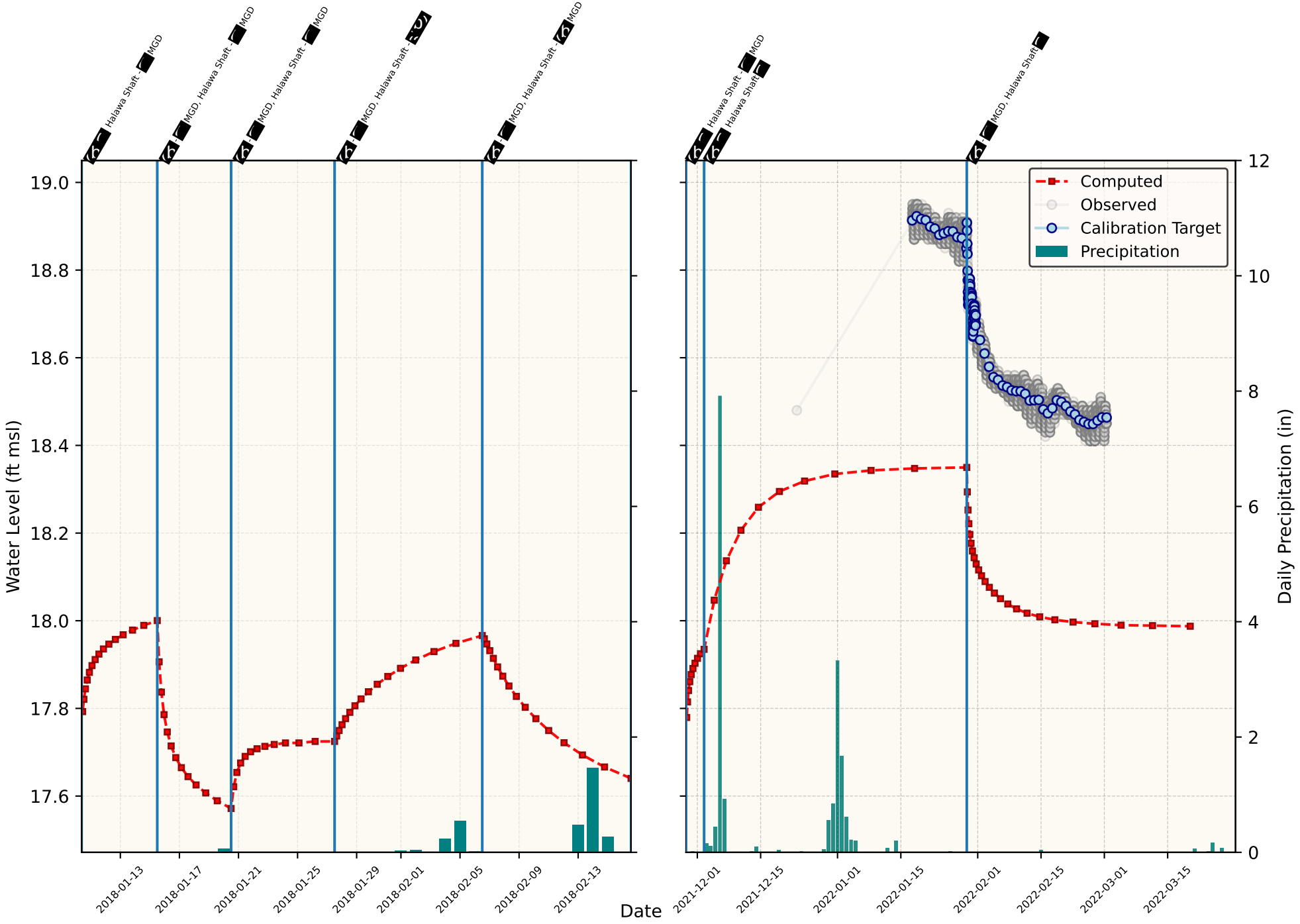

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

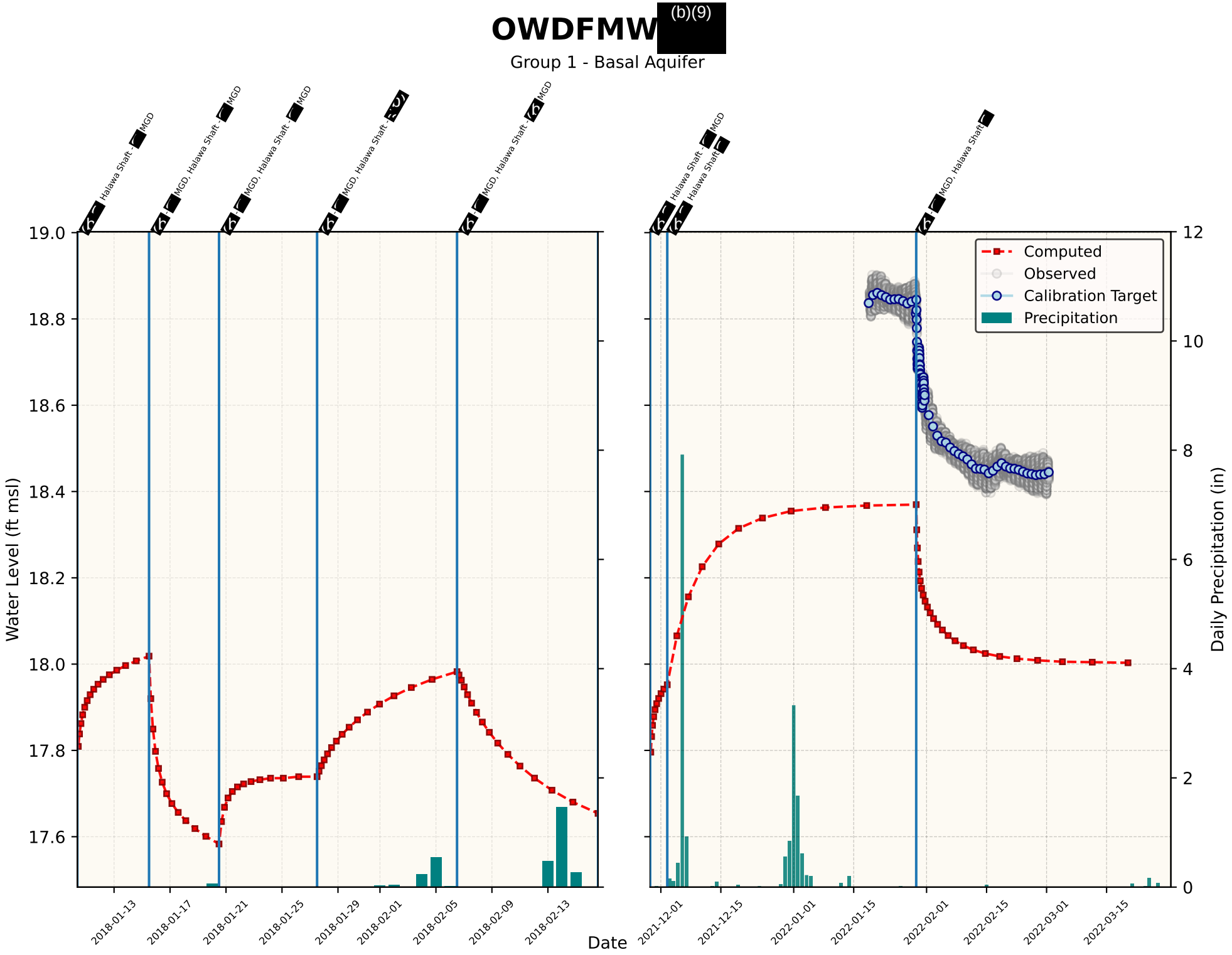

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

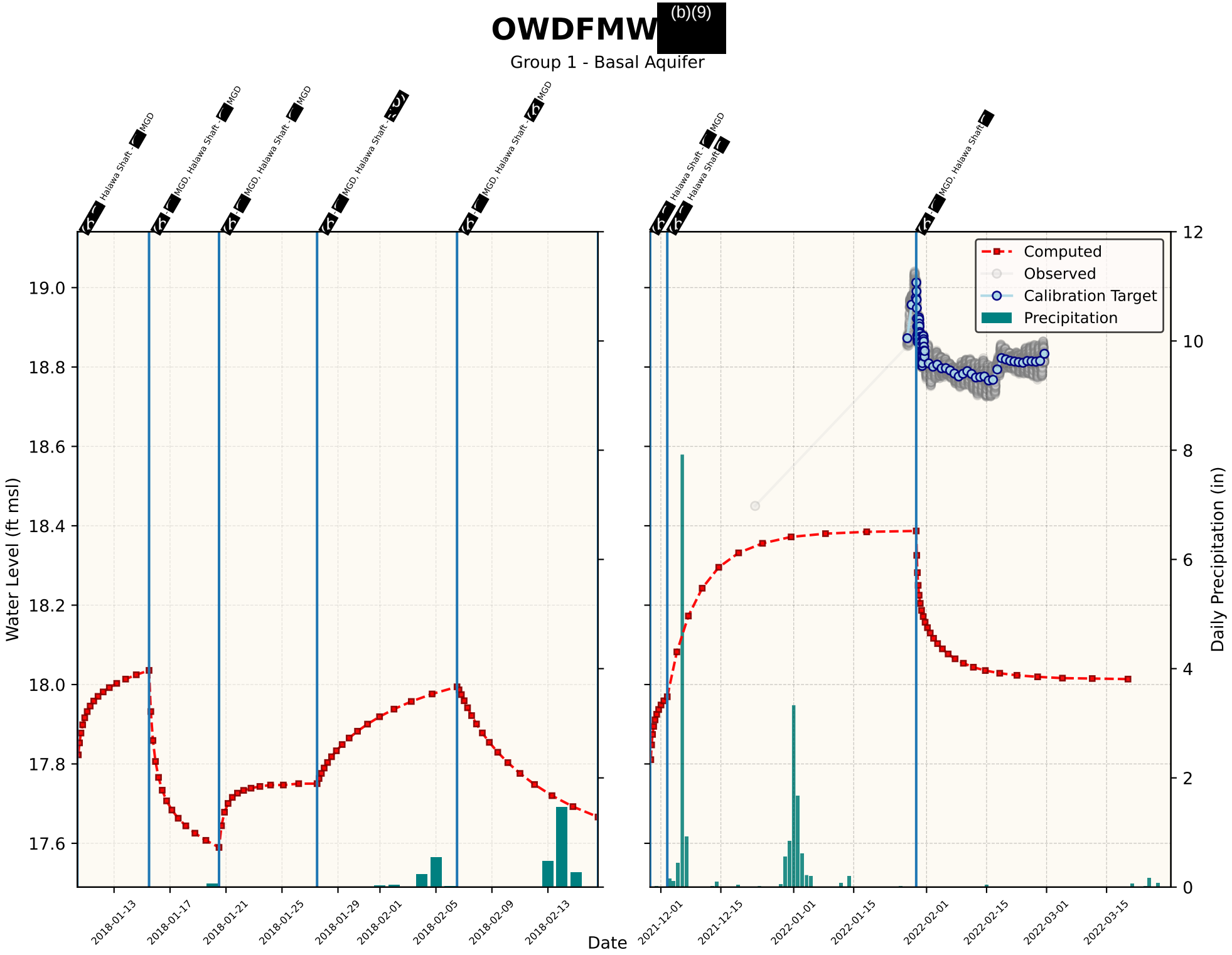

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

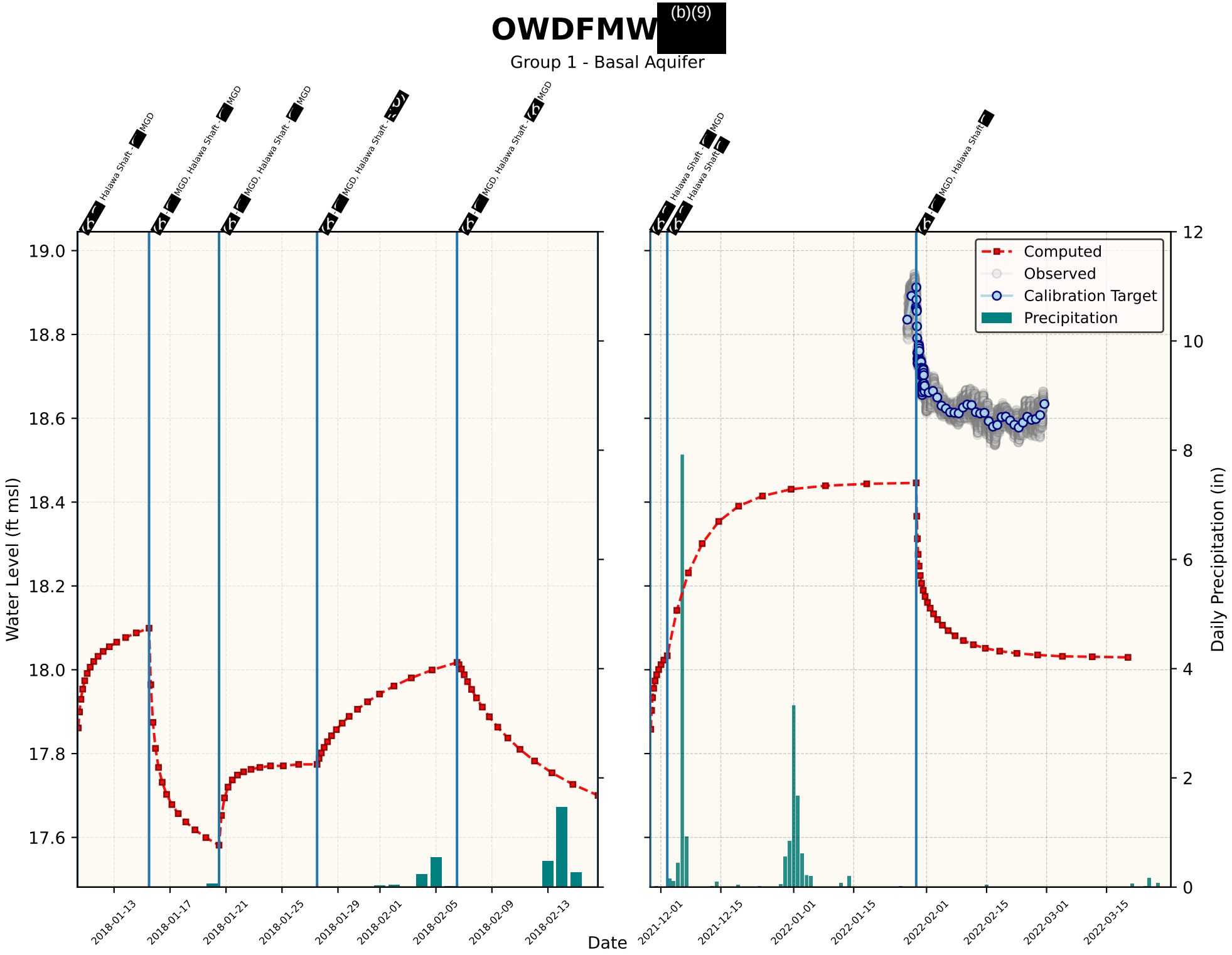
OWDFMW[redacted] (b)(9)

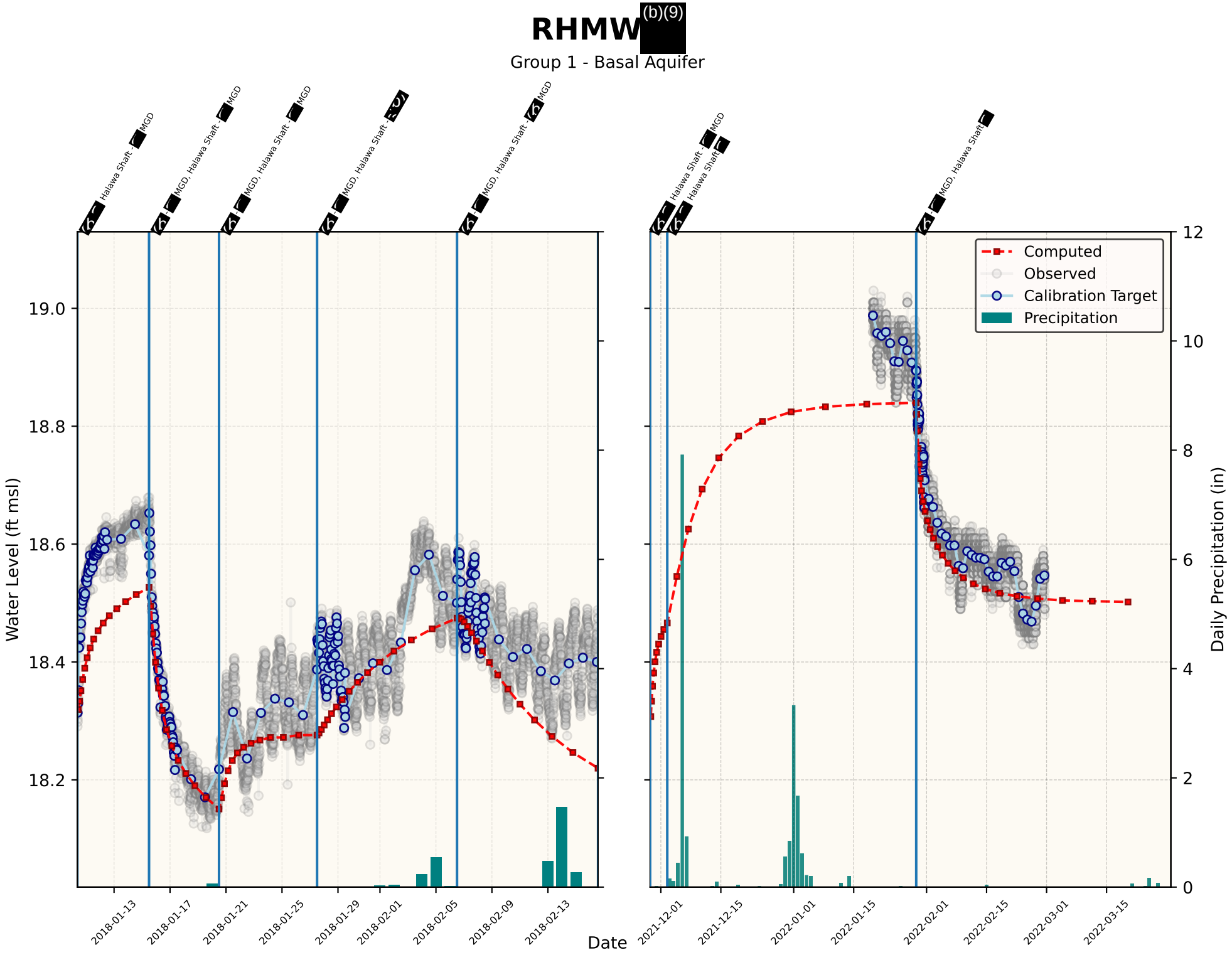
Group 1 - Basal Aquifer




OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

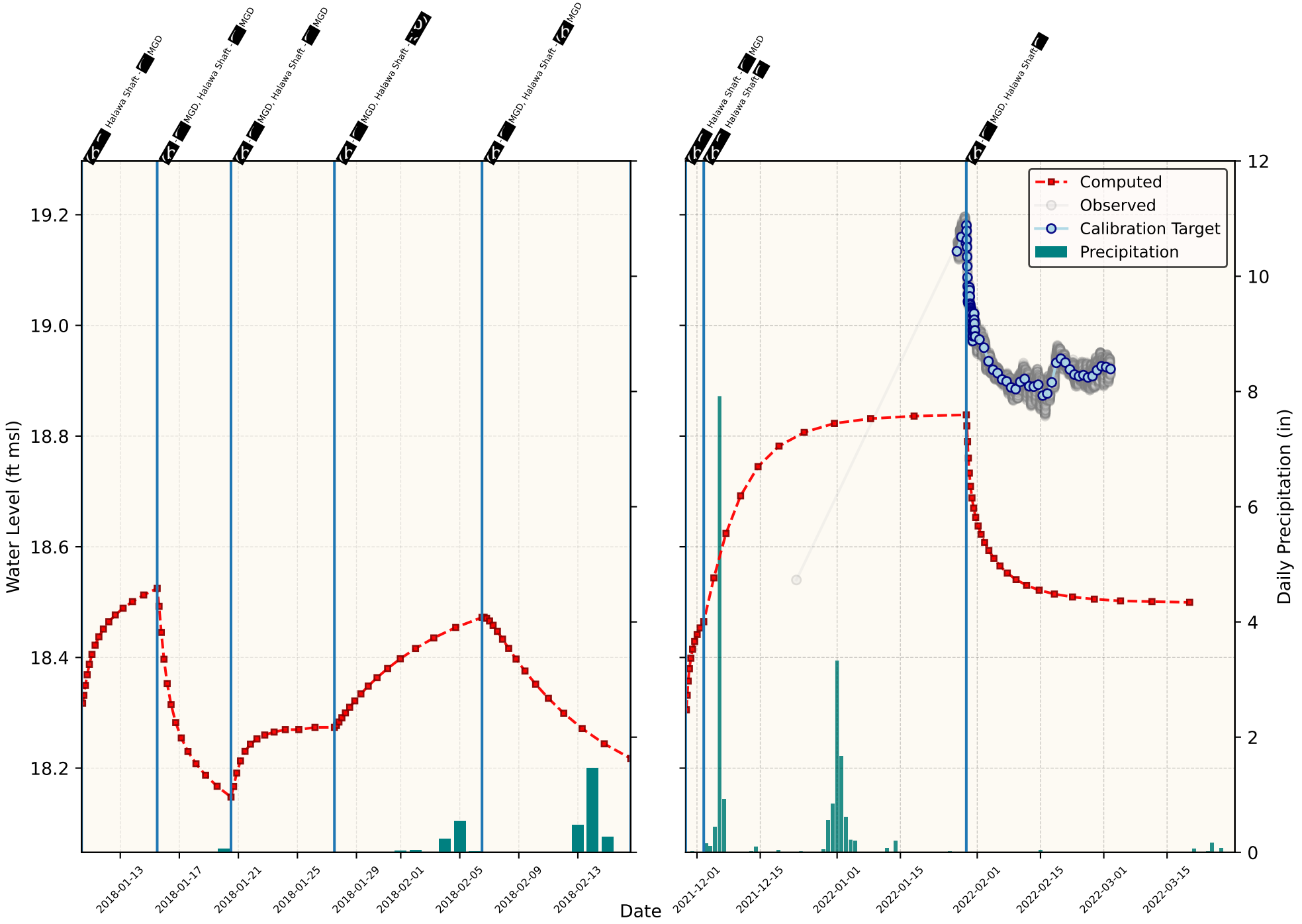

OWDFMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-15
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2022-03-15

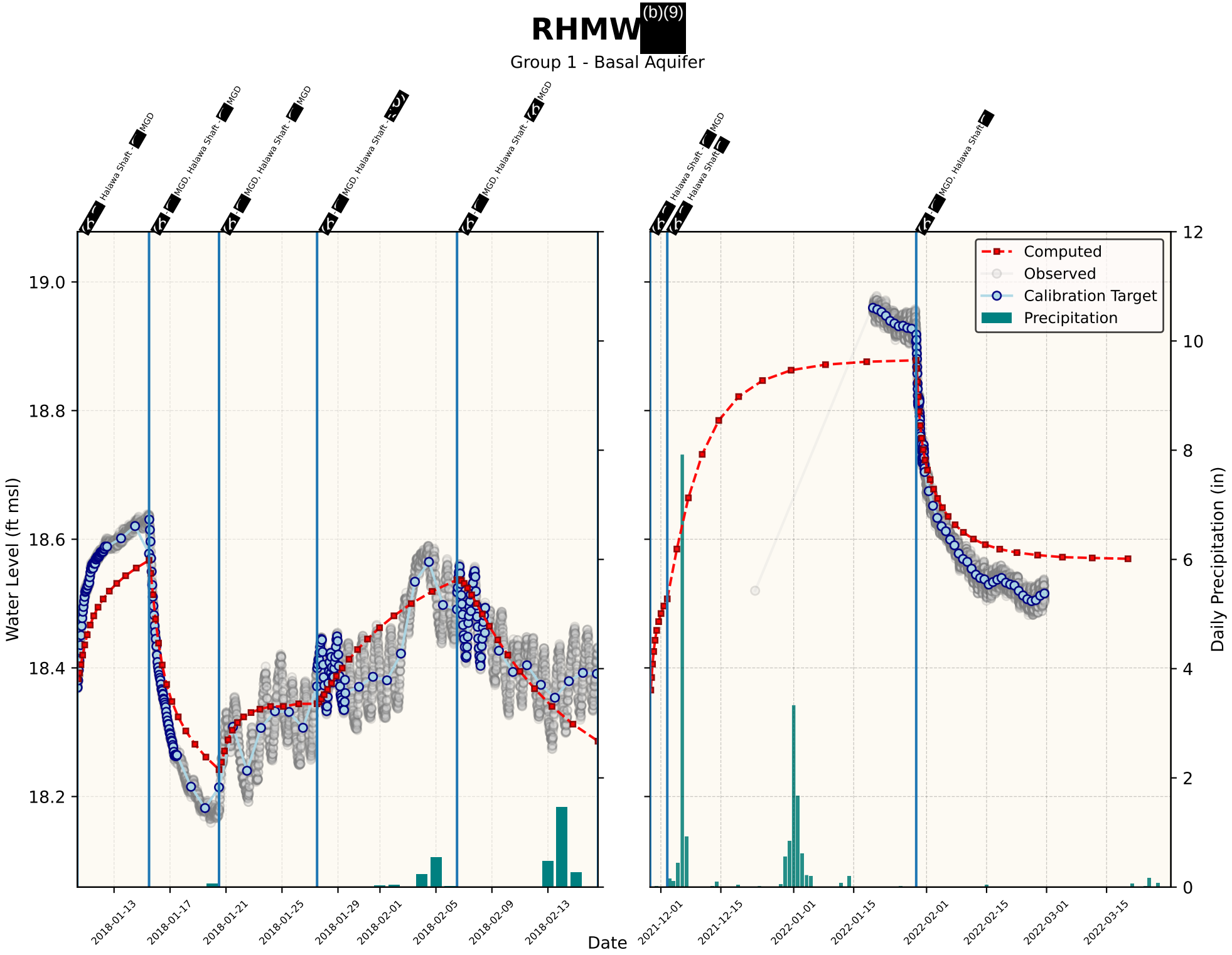

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-15
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2022-03-15

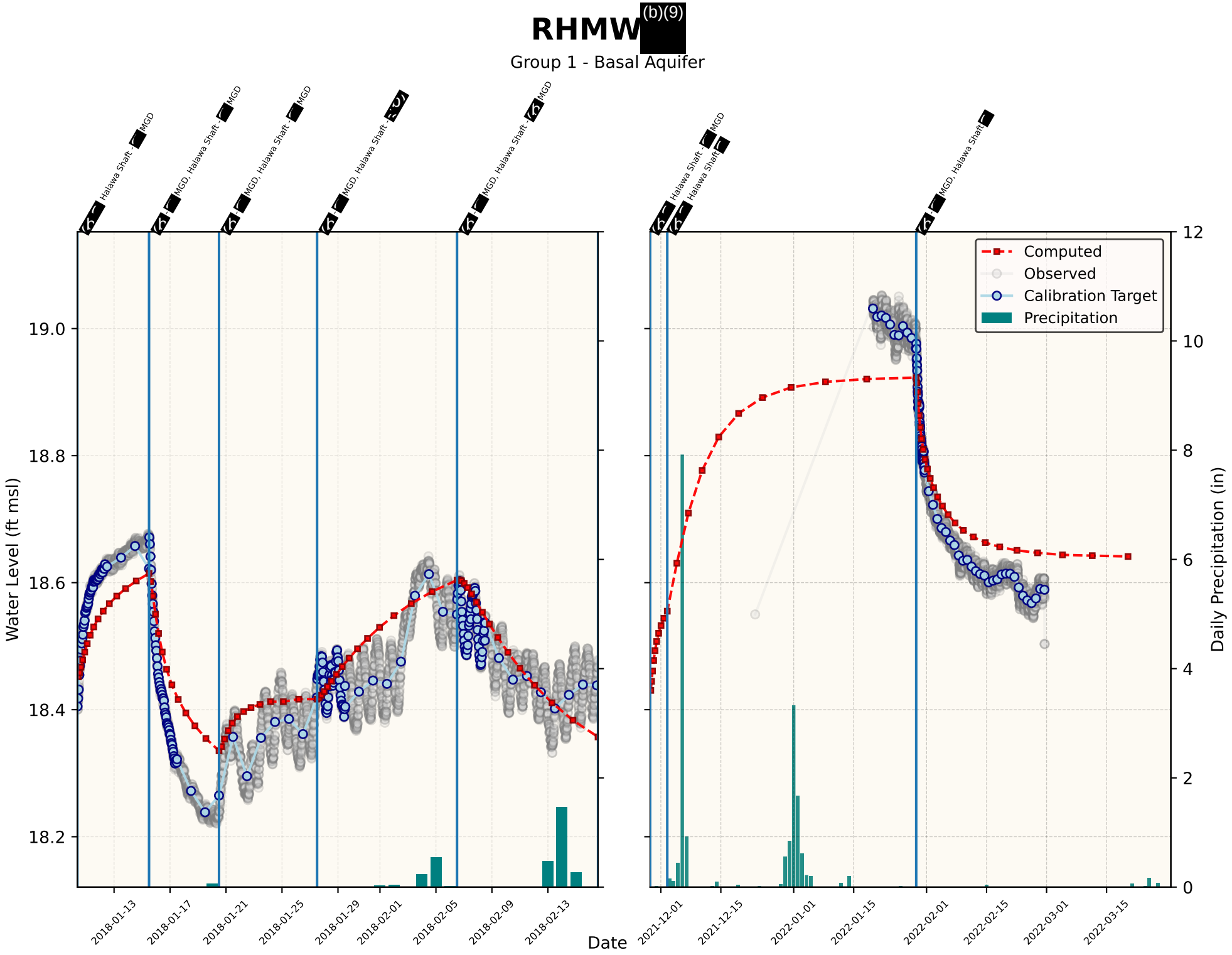

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-03-15

RHMW[redacted] (b)(9)

Group 1 - Basal Aquifer

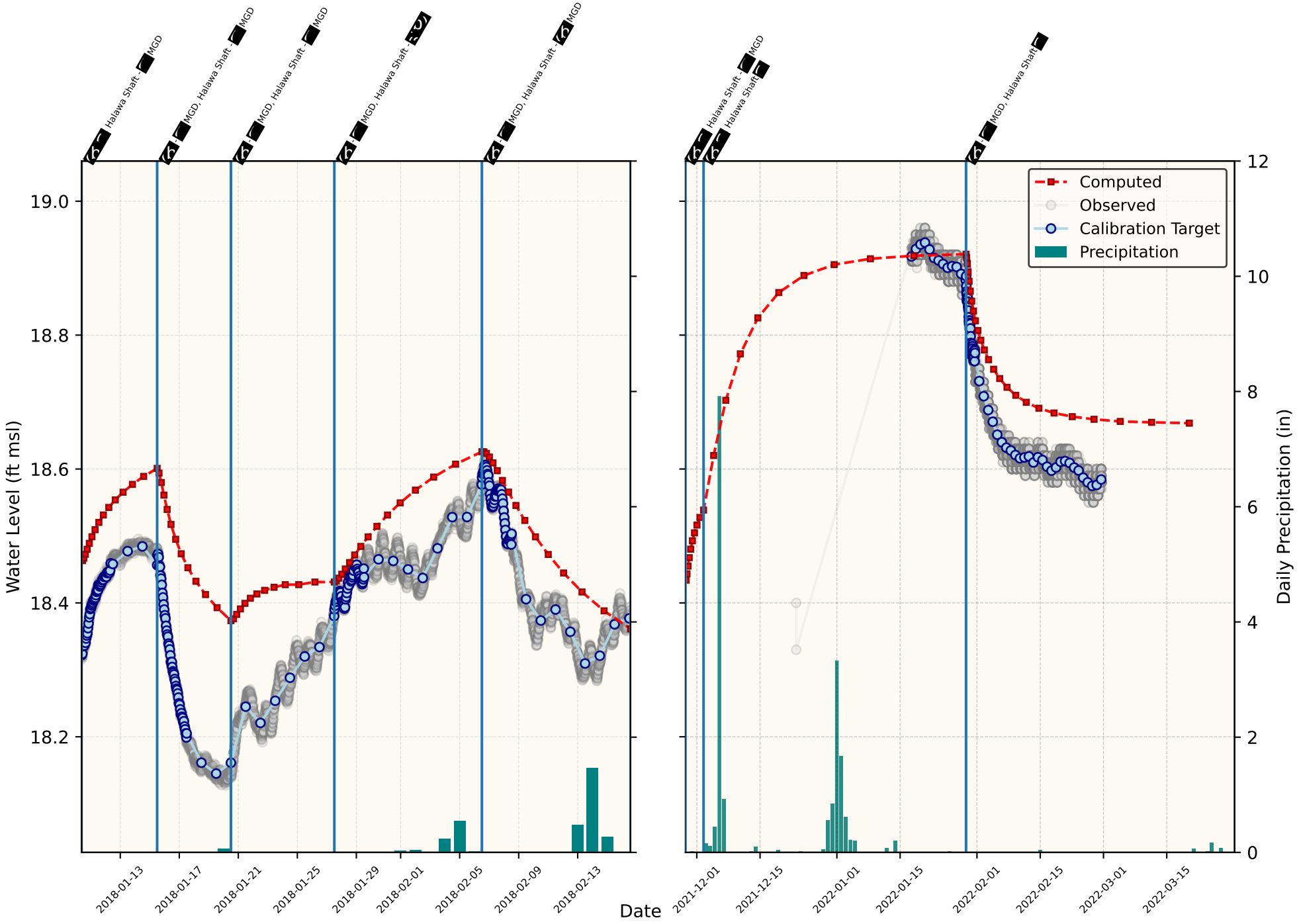


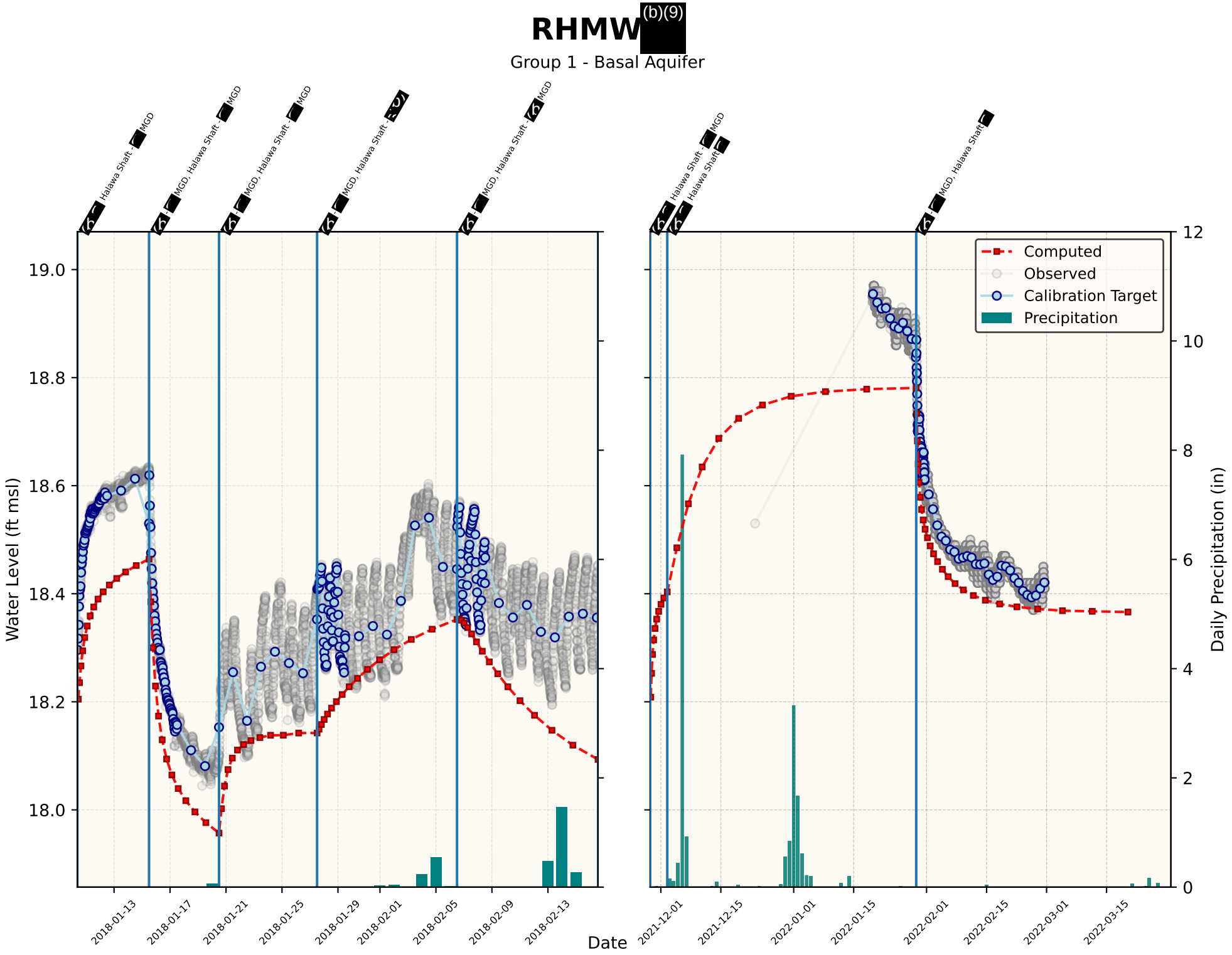

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-01
2022-03-15

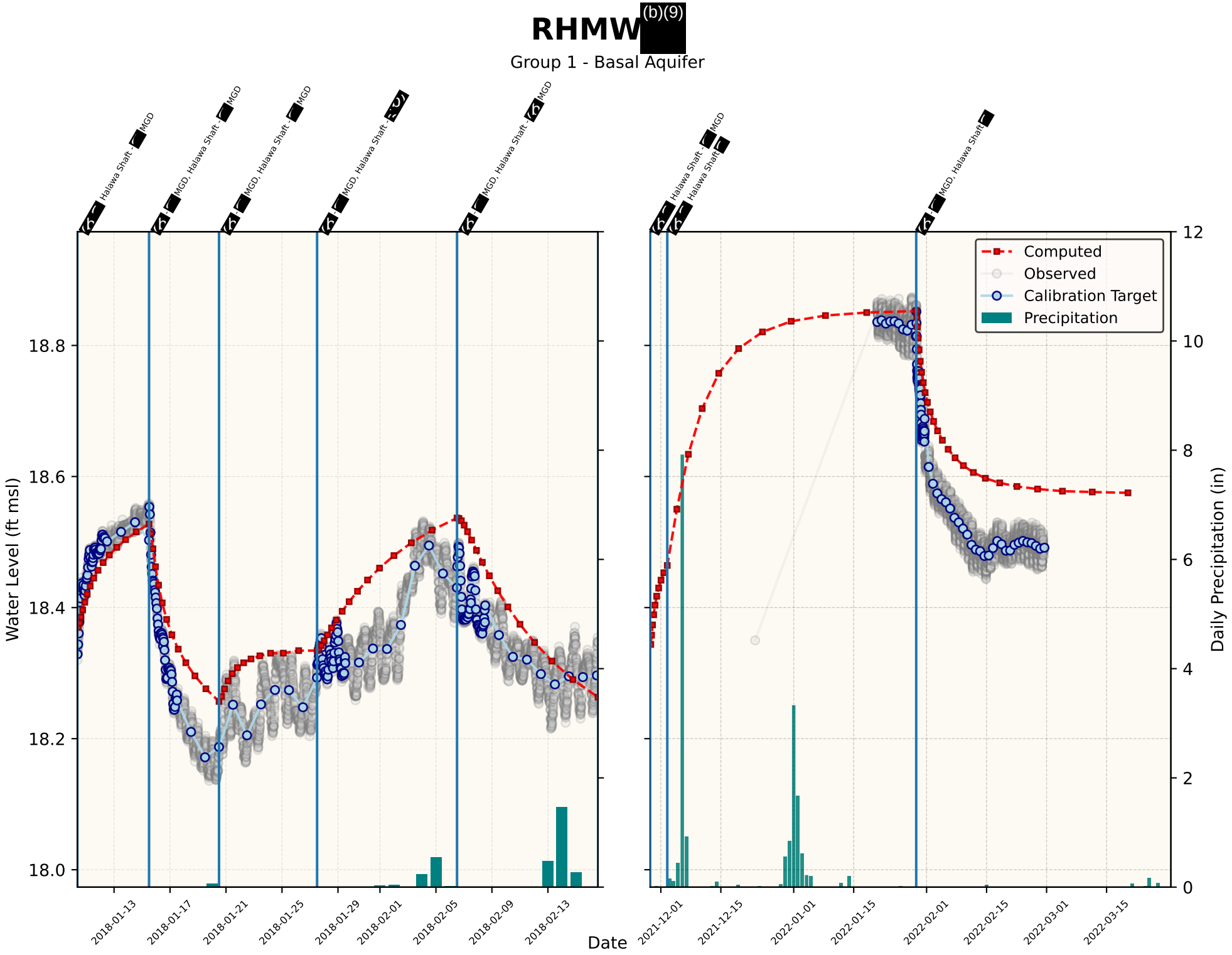

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-15
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2022-03-15

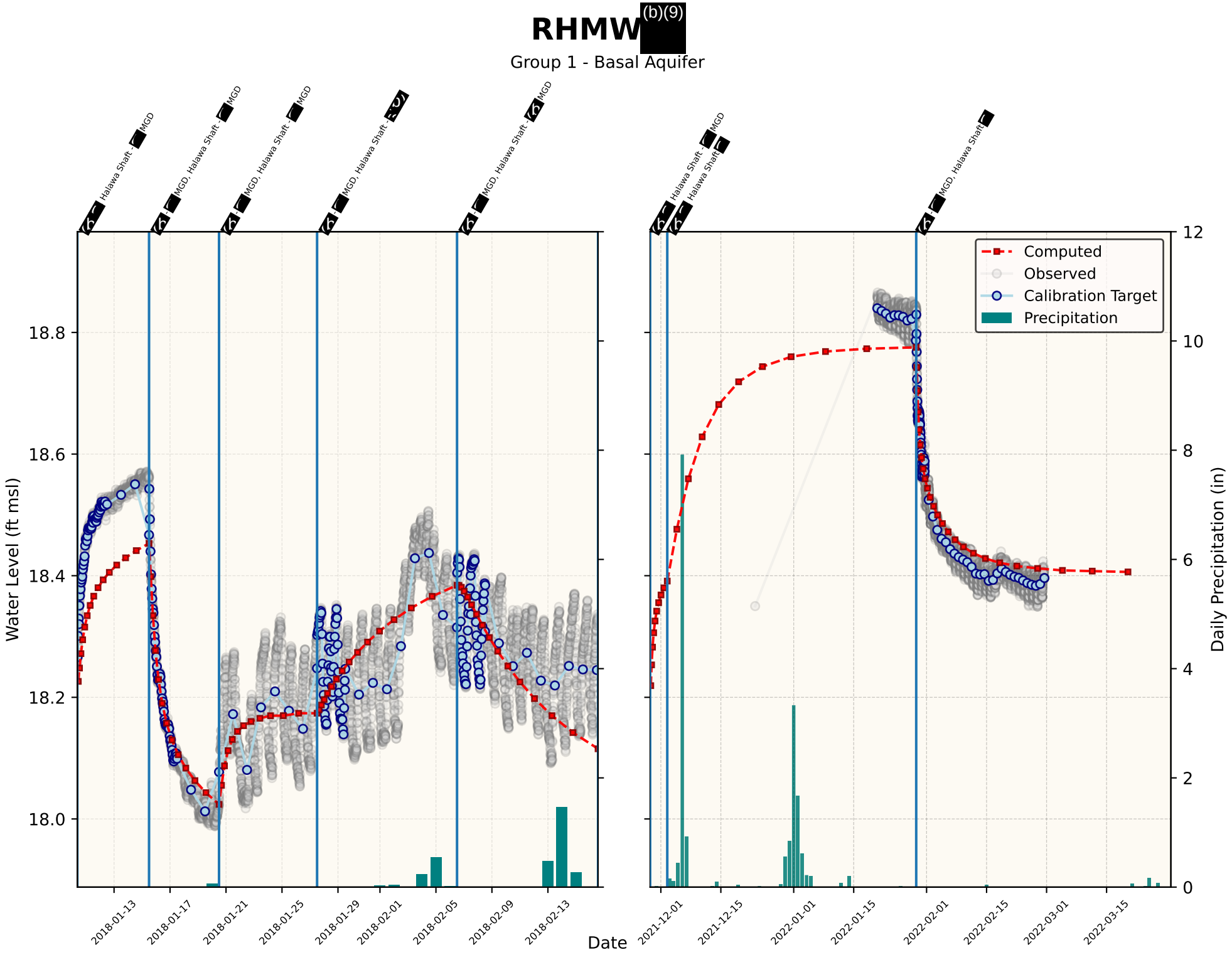
RHMW[redacted] (b)(9)

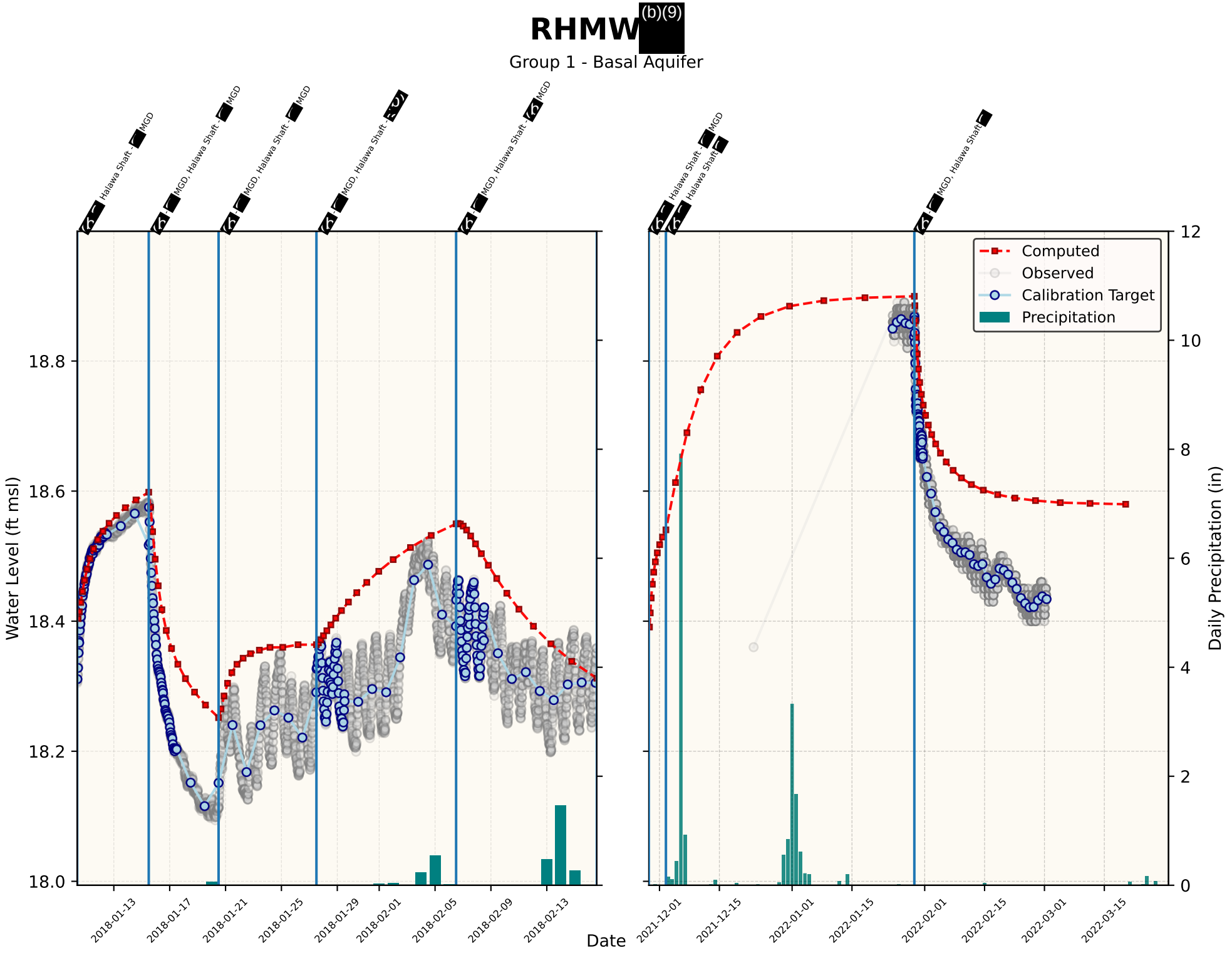
Group 1 - Basal Aquifer

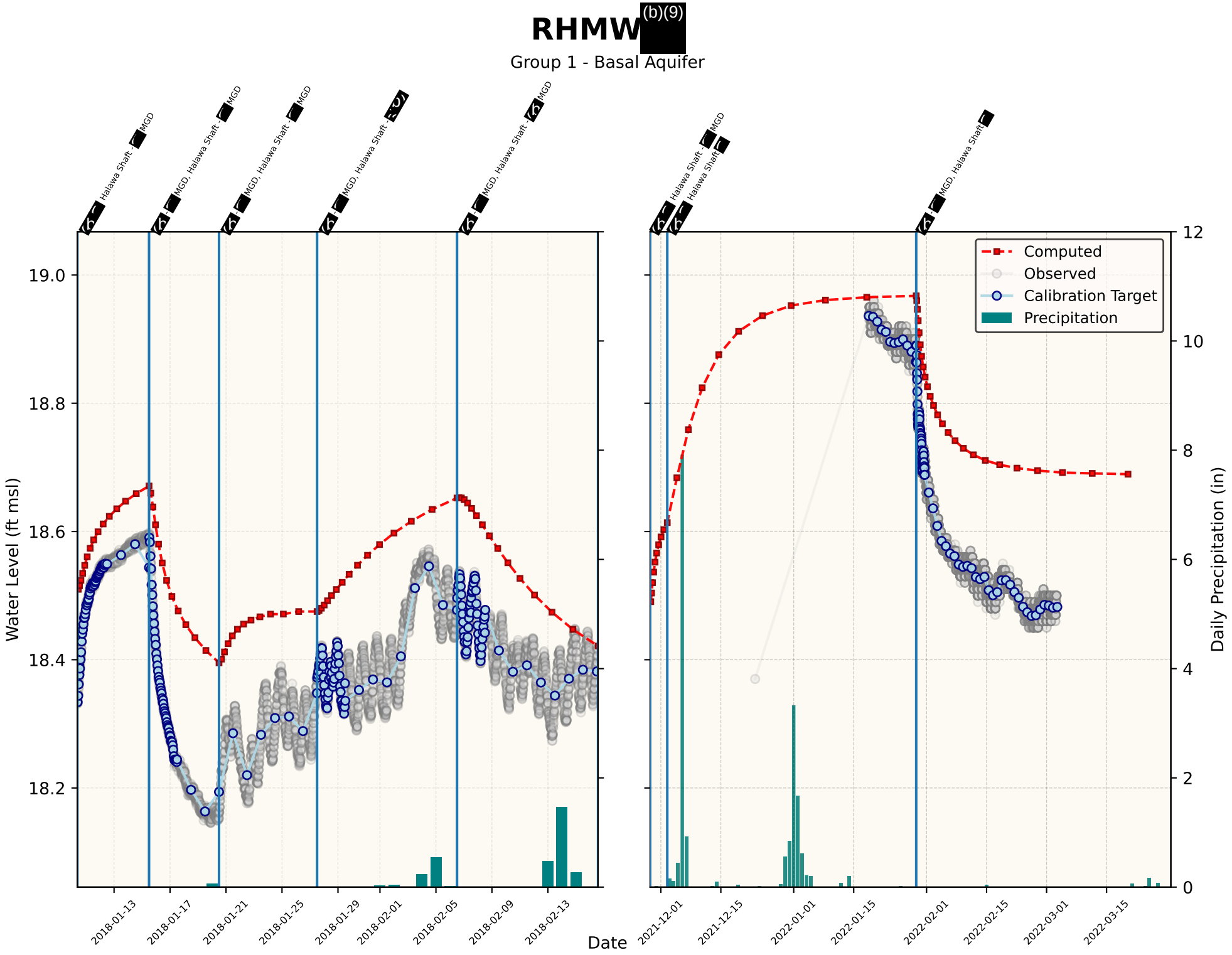


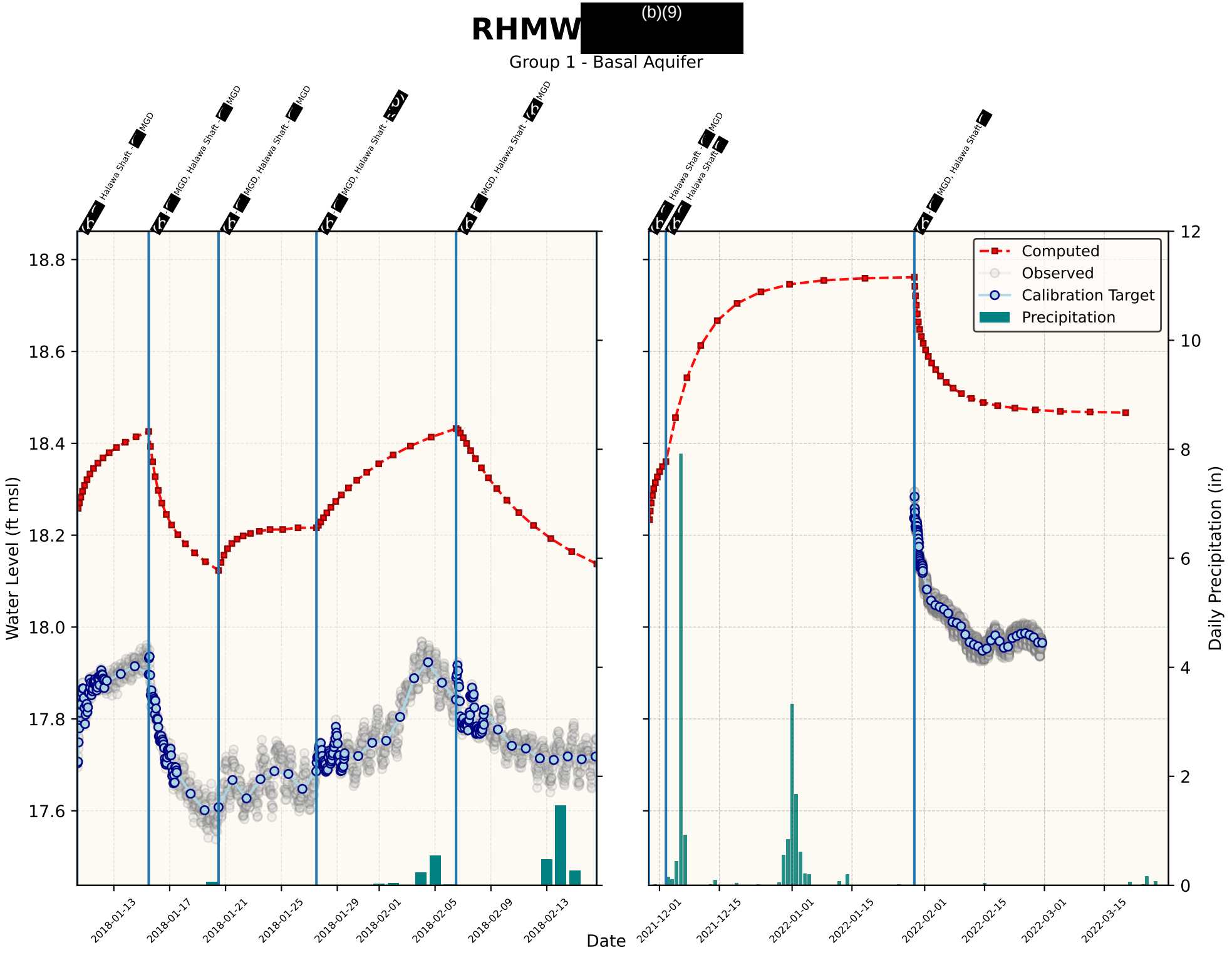

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Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted]
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Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
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18.4
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2022-03-15


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.0
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2018-01-13
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RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
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Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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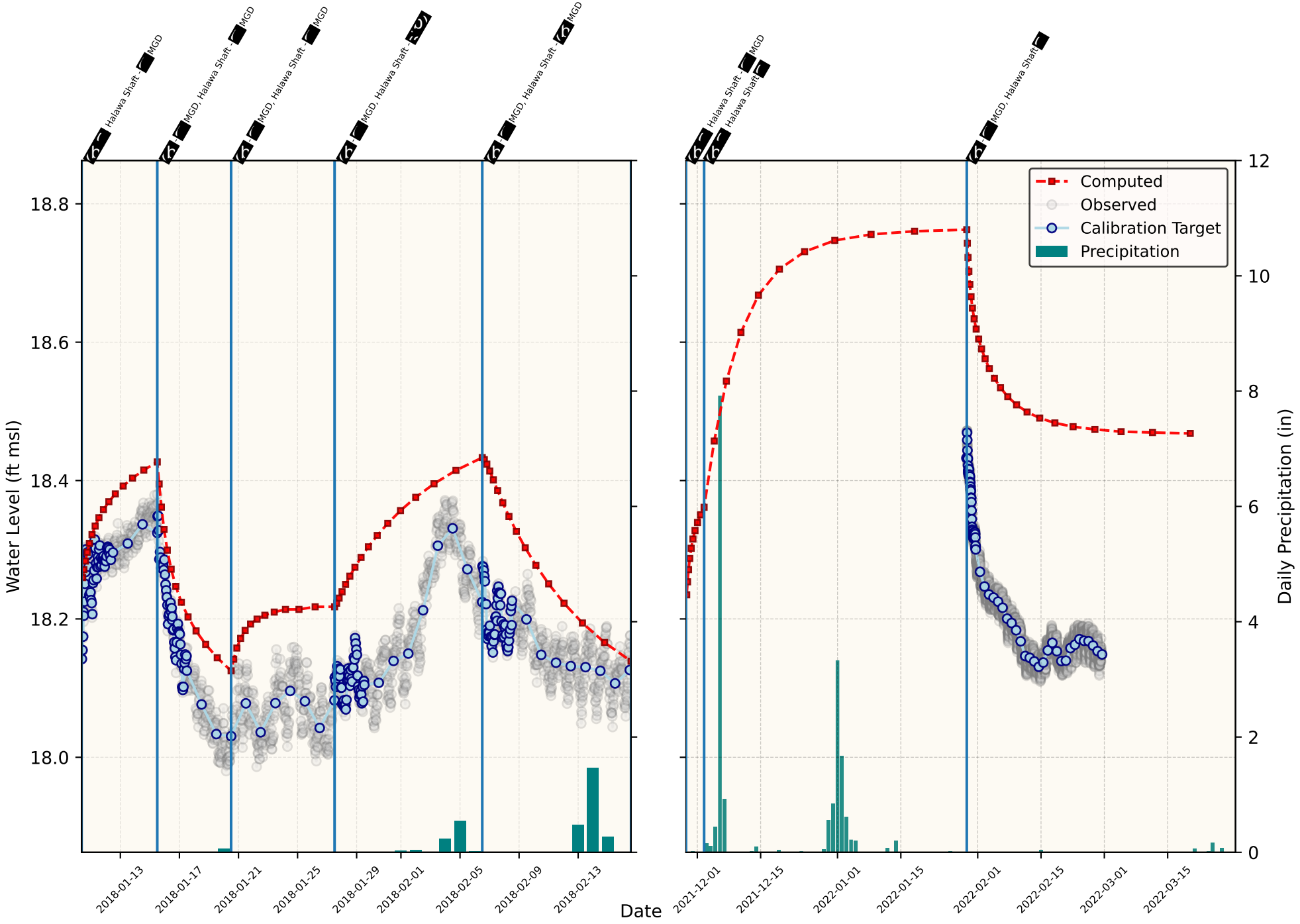

RHMW(b)(9)
Group 1 - Basal Aquifer
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Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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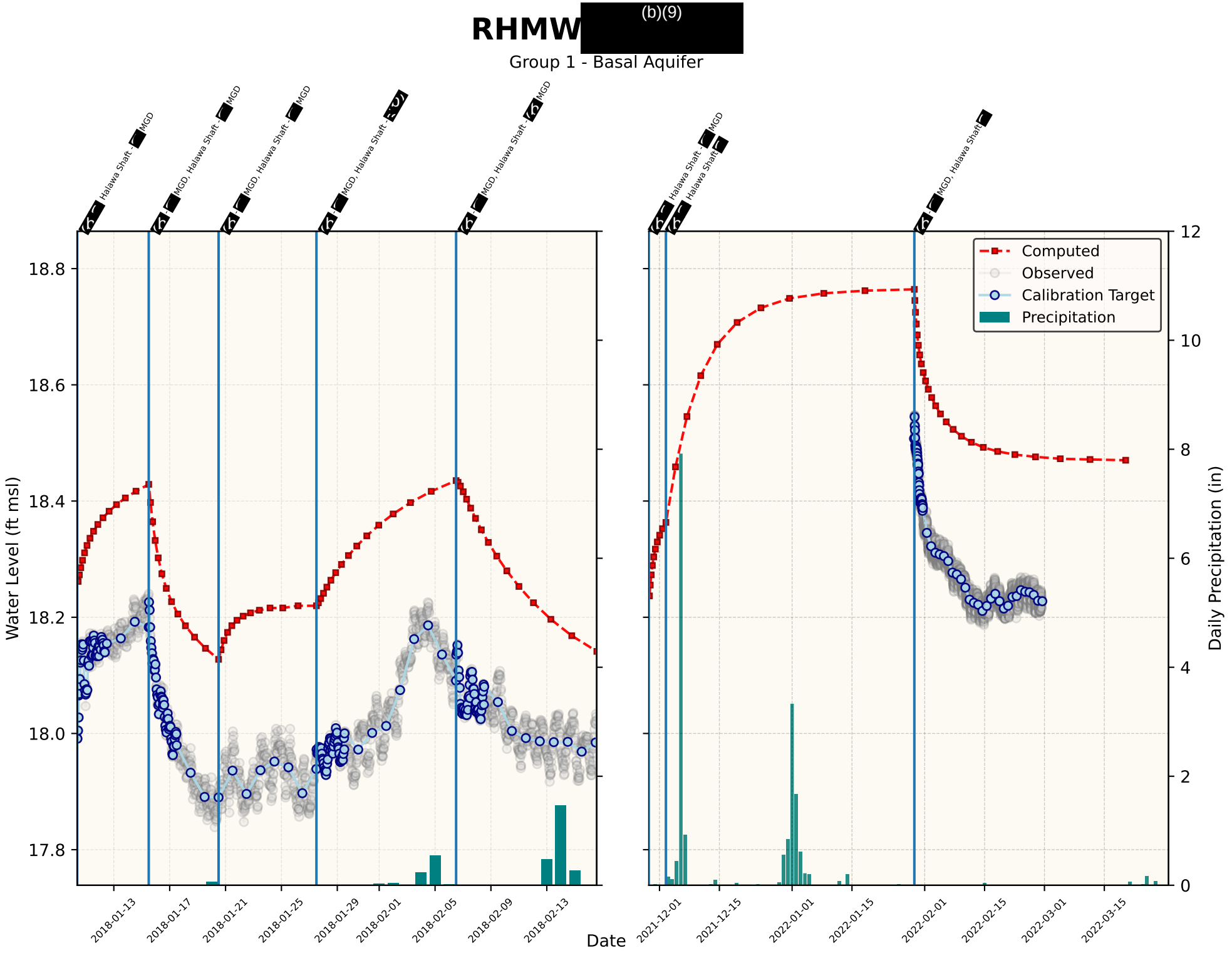

RHMW(b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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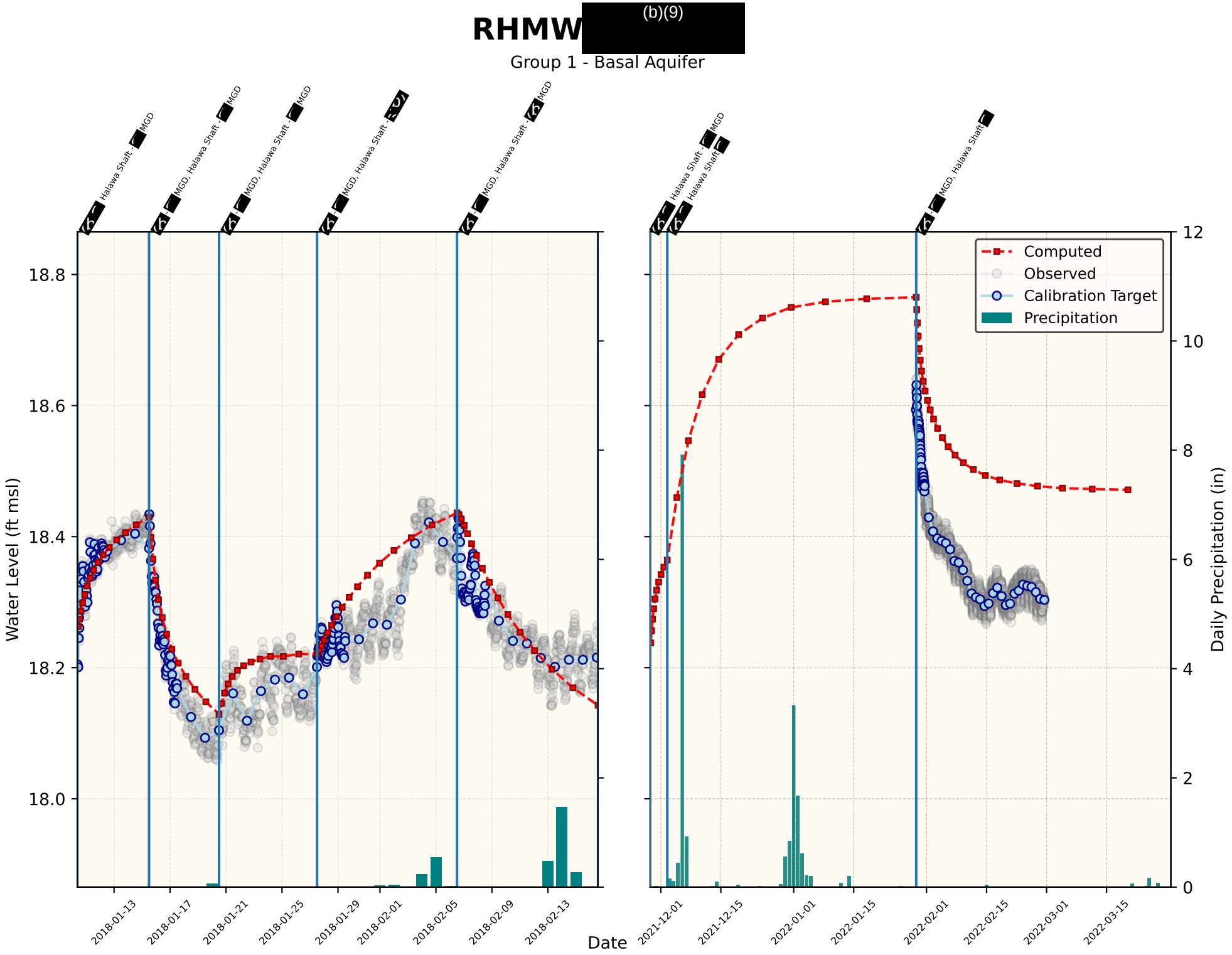

RHMW (b)(9)
Group 1 - Basal Aquifer
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Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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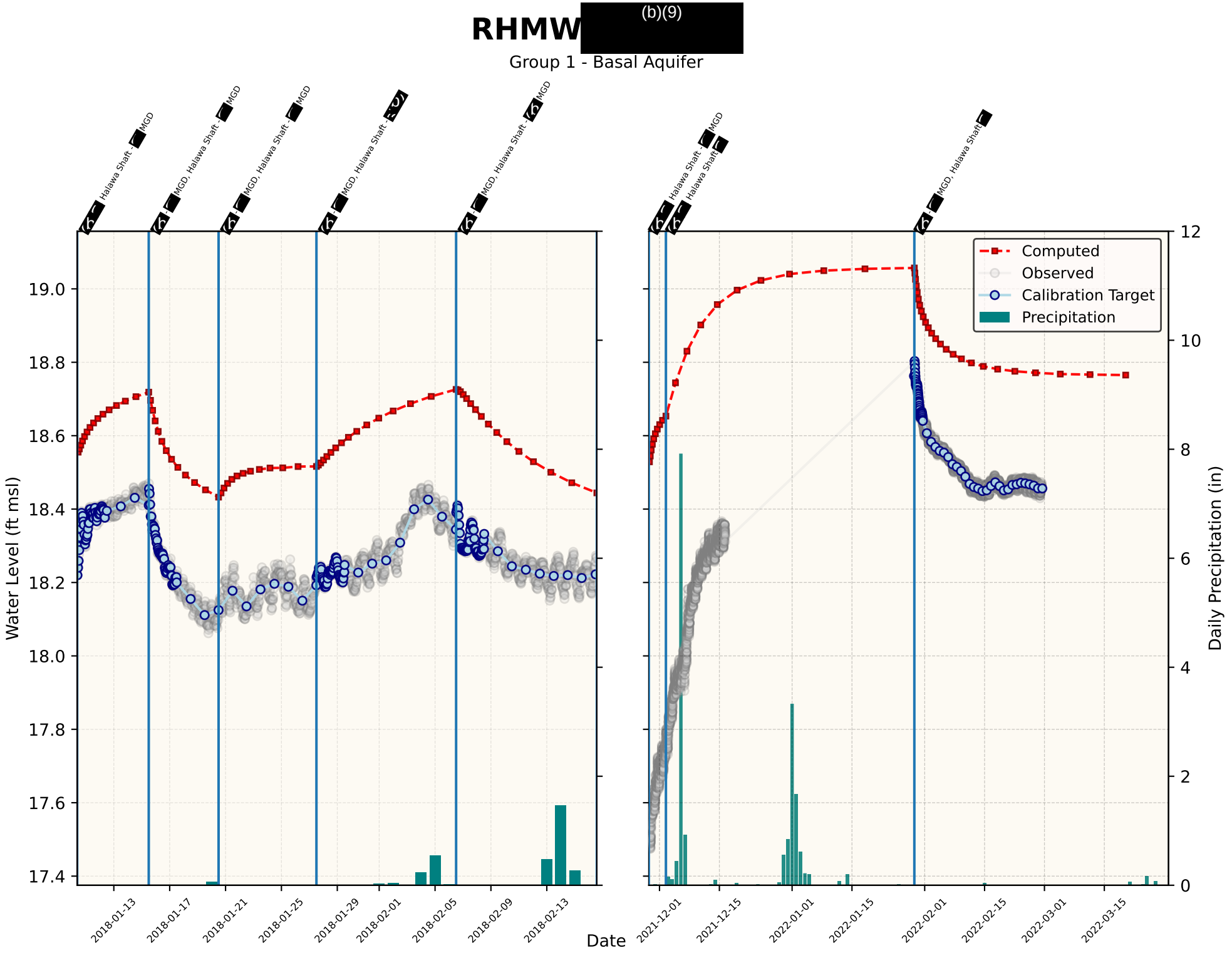
RHMW (b)(9)

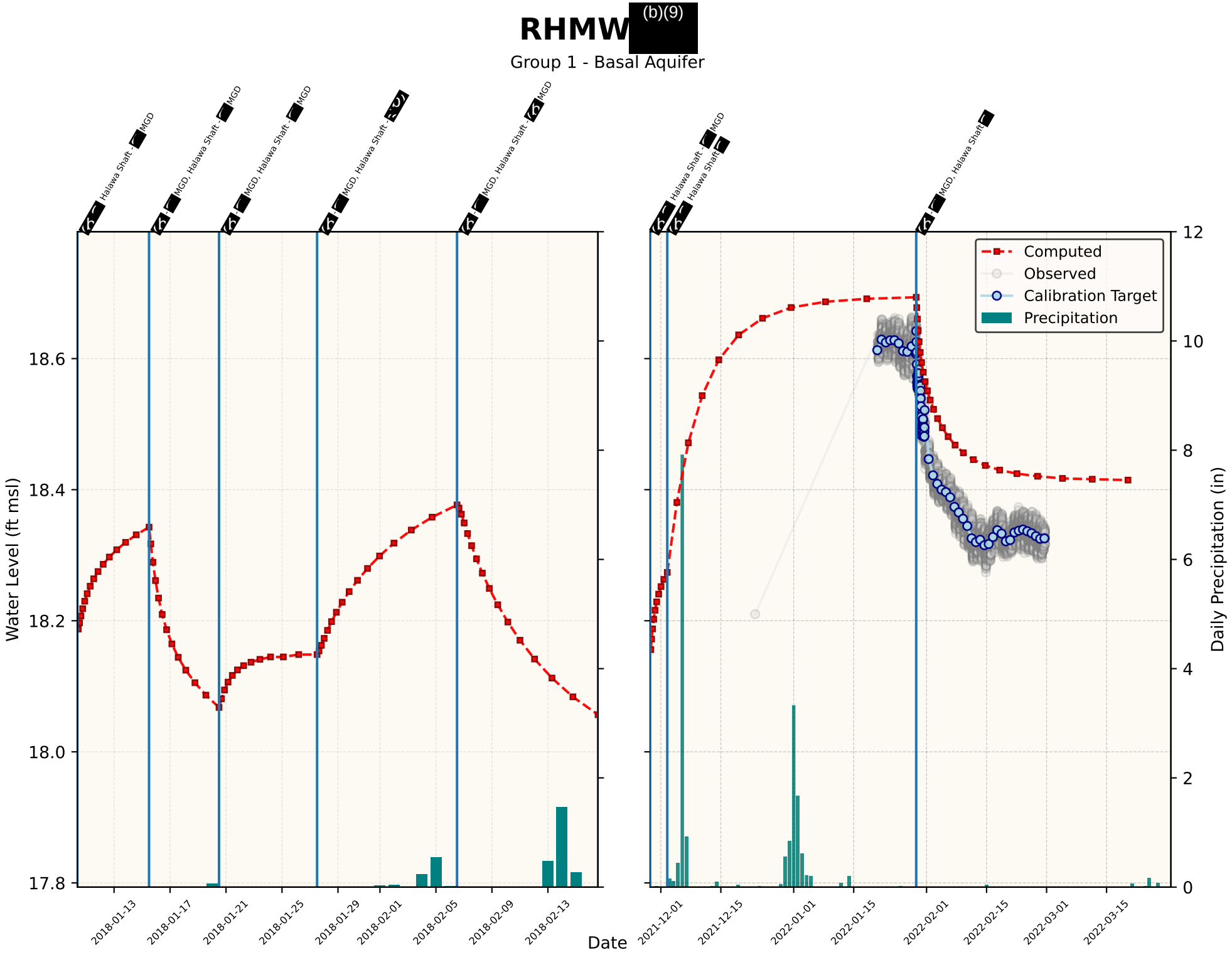
Group 1 - Basal Aquifer

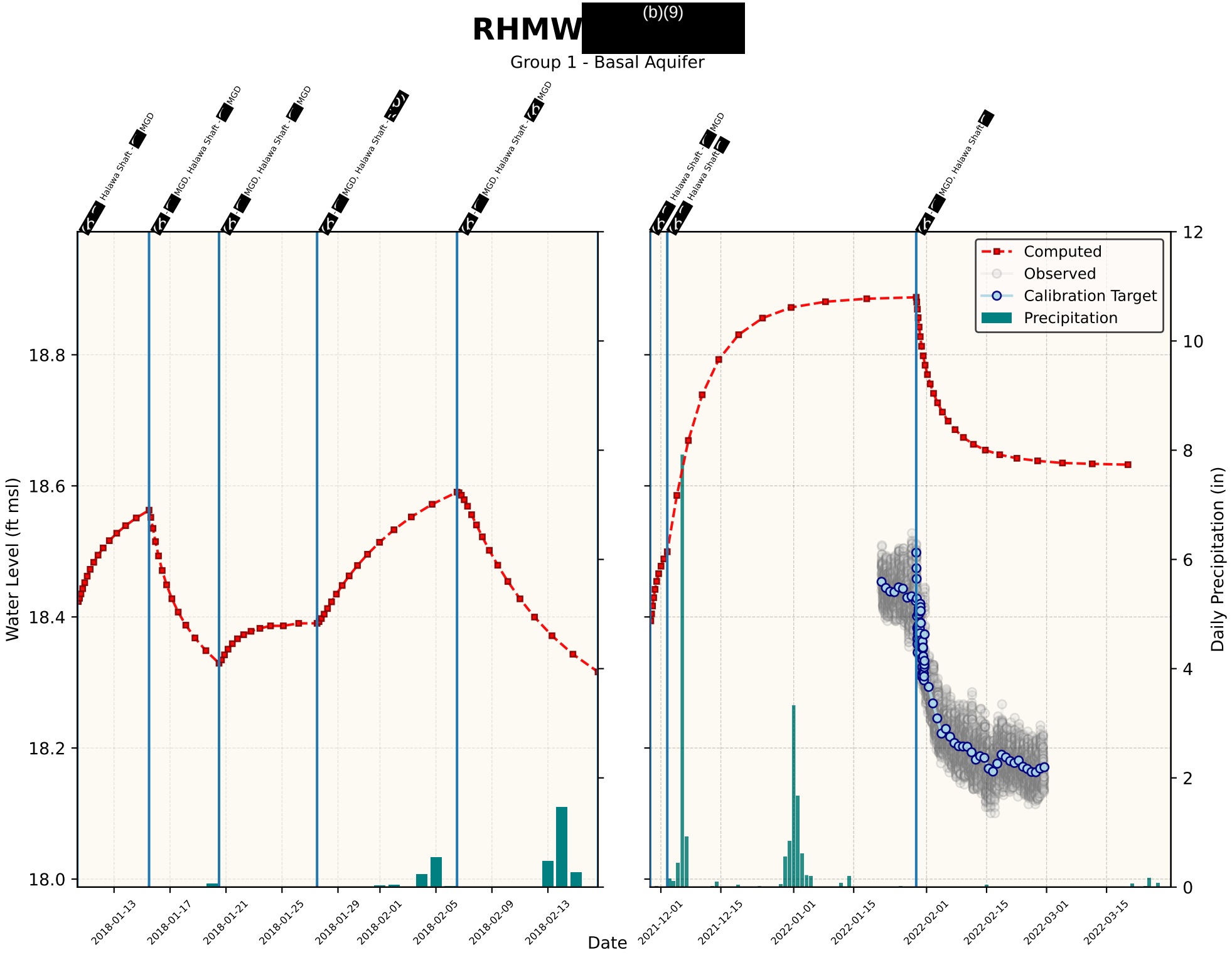


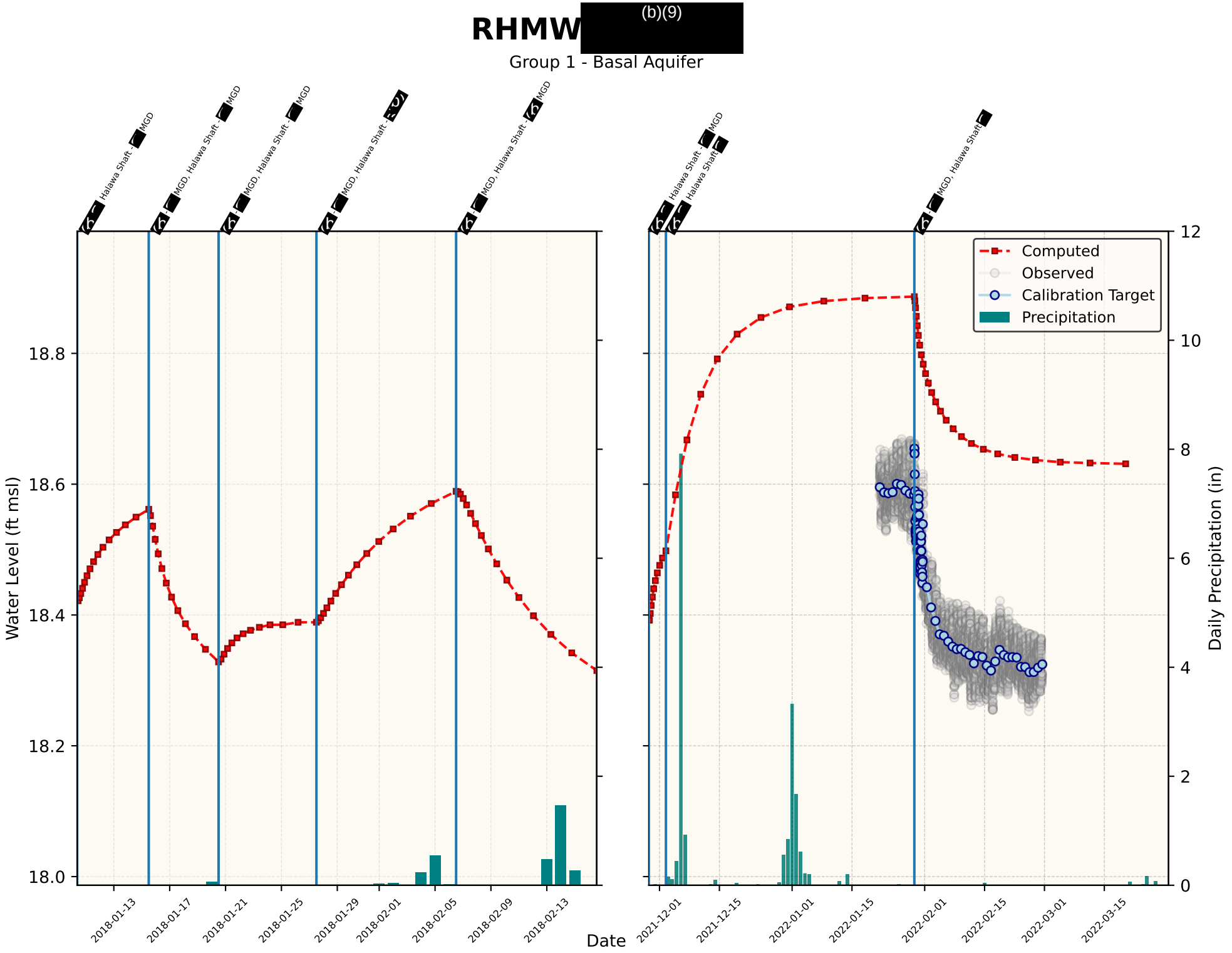

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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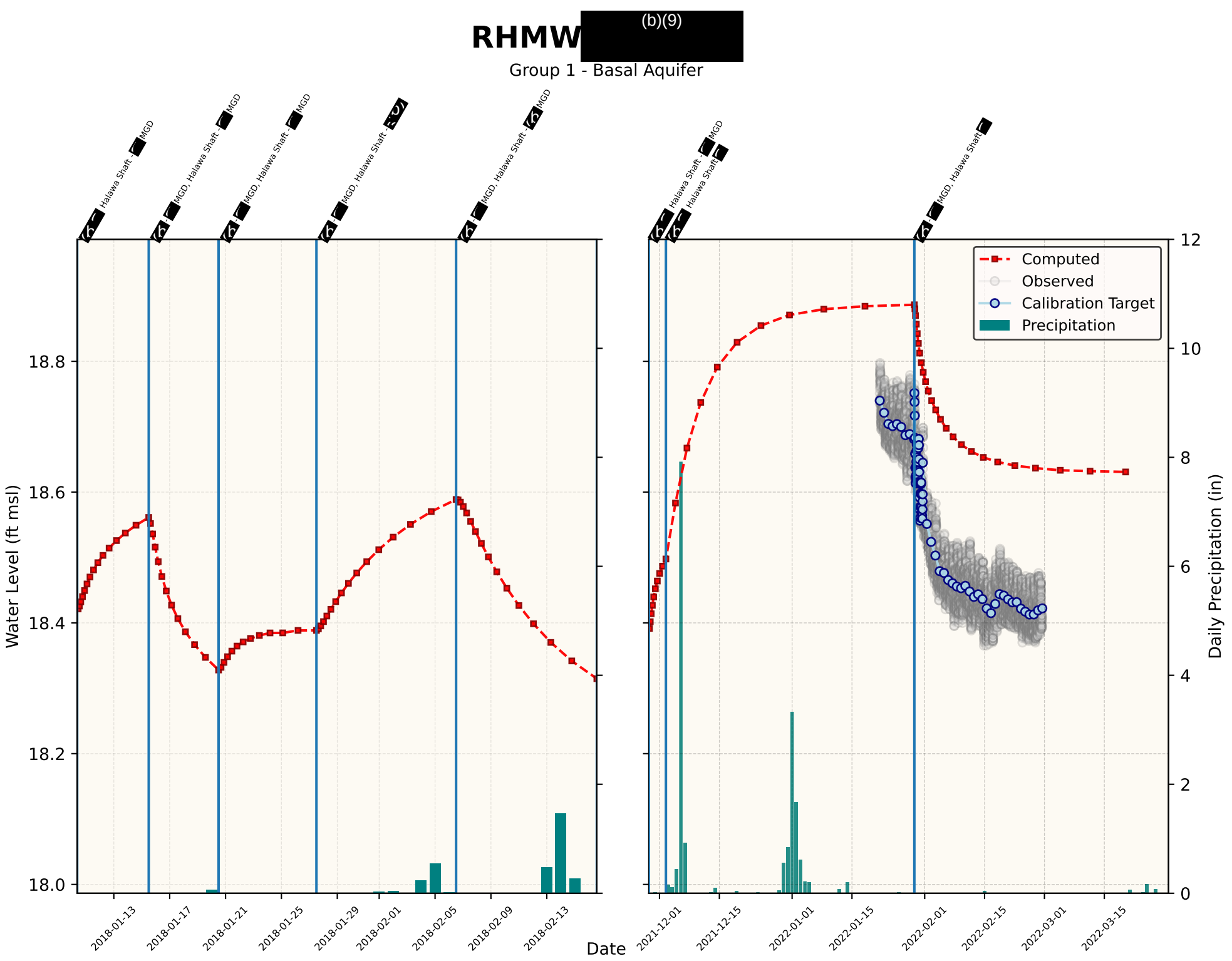

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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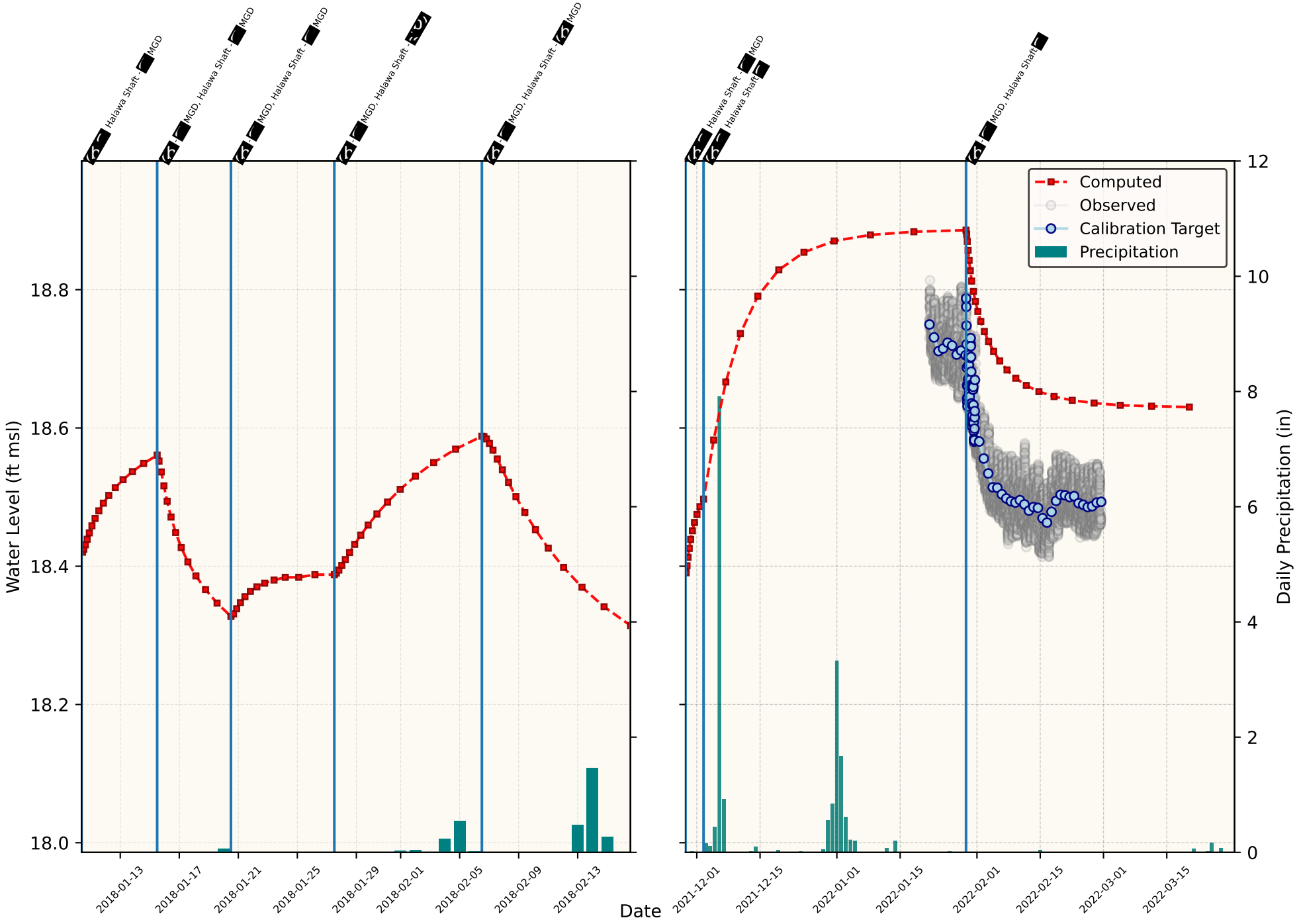

RHMW (b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft (b)(9) MGD
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Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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2021-12-01
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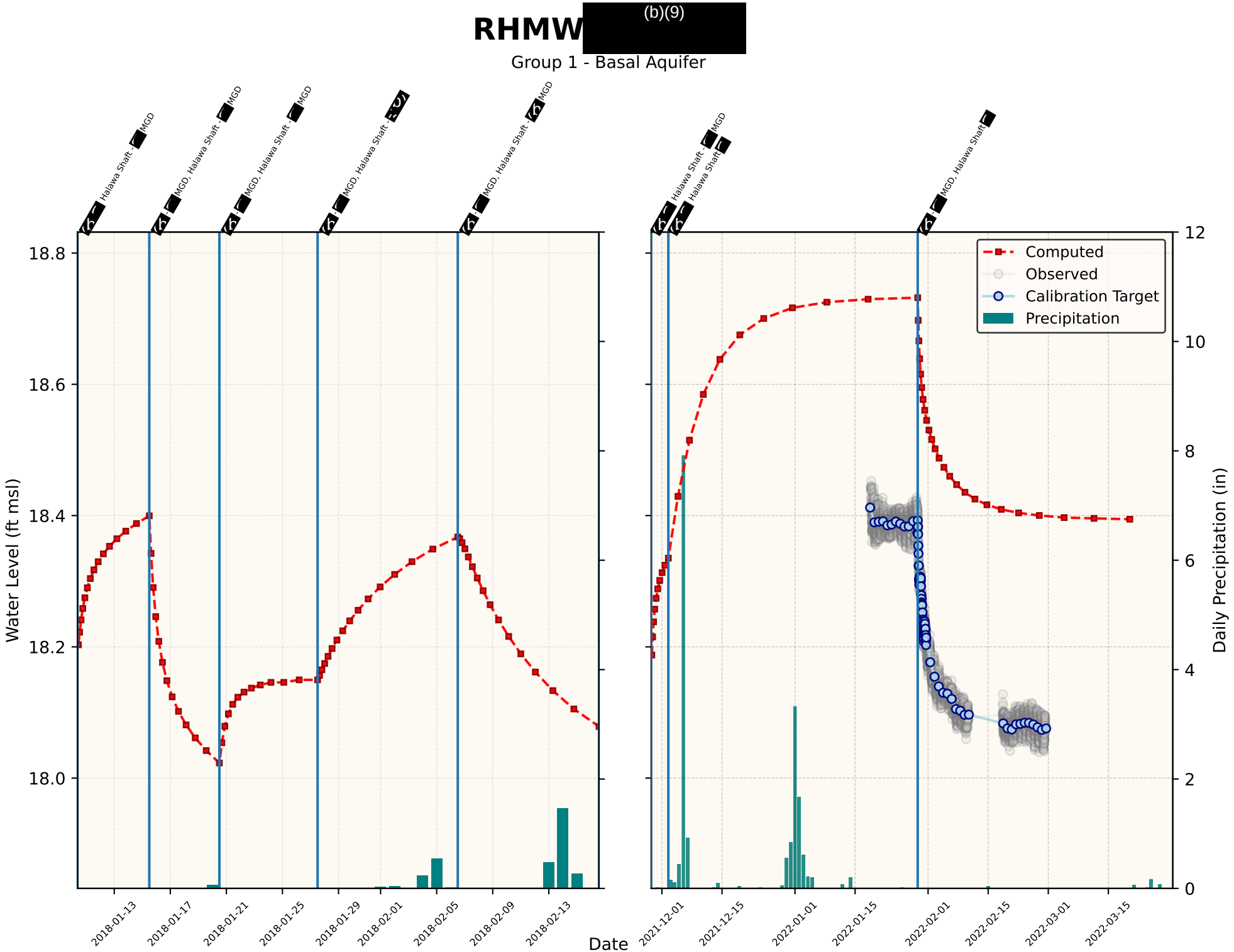

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
18.8
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18.2
18.0
Daily Precipitation (in)
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2018-01-21
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2022-03-15
Date


RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
18.8
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18.0
Daily Precipitation (in)
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2018-01-13
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RHMW[redacted] (b)(9)

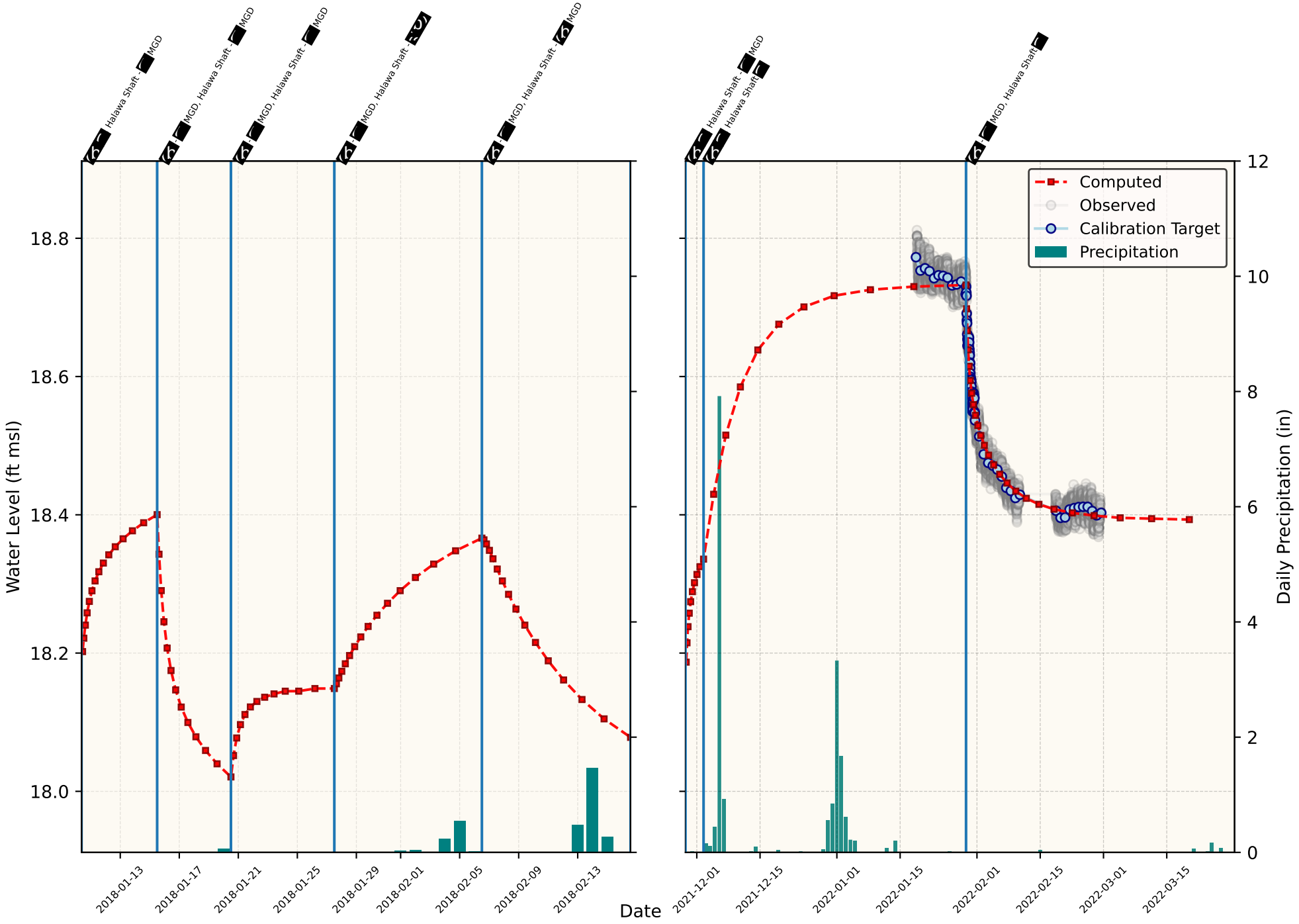
Group 1 - Basal Aquifer

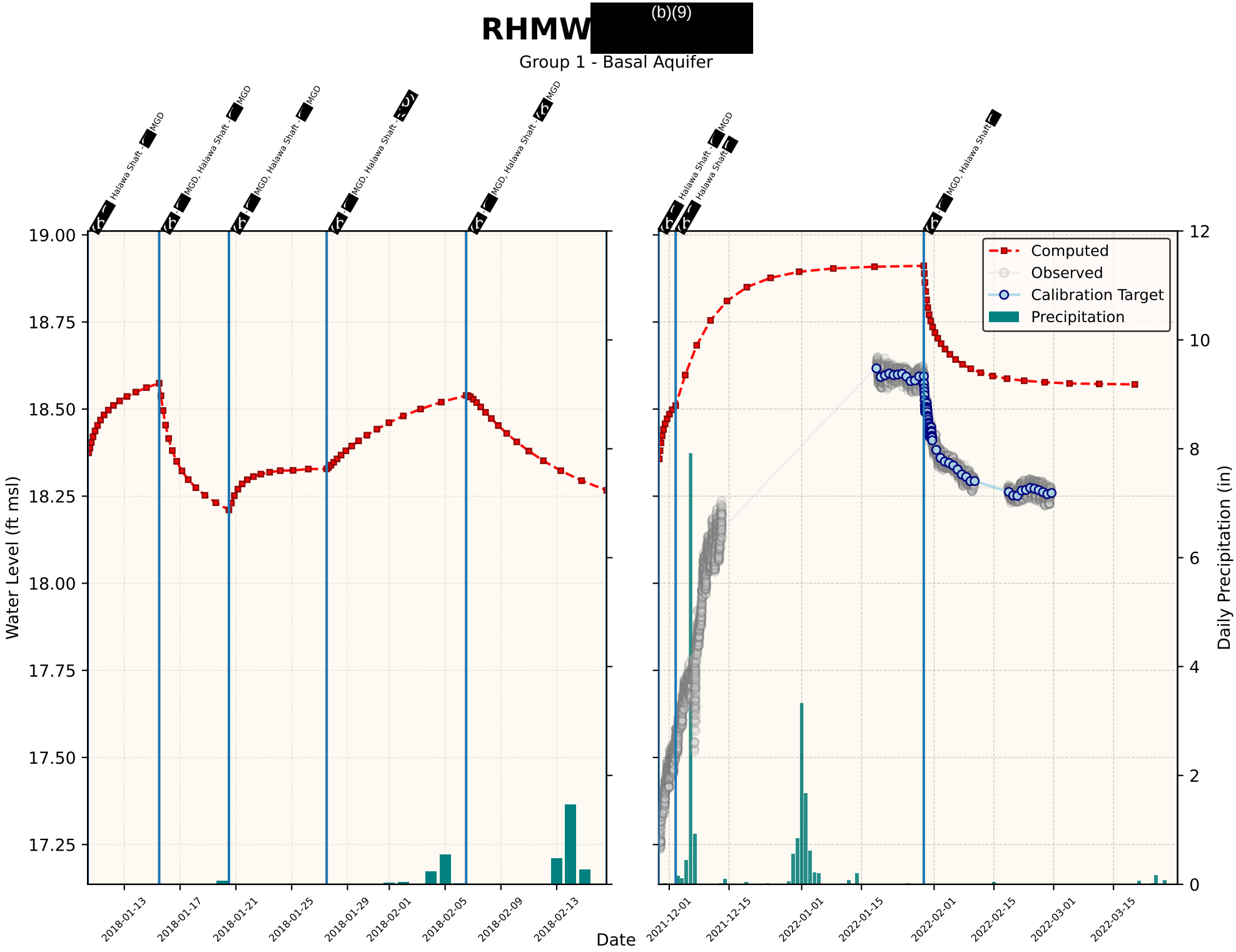



RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
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2018-01-13
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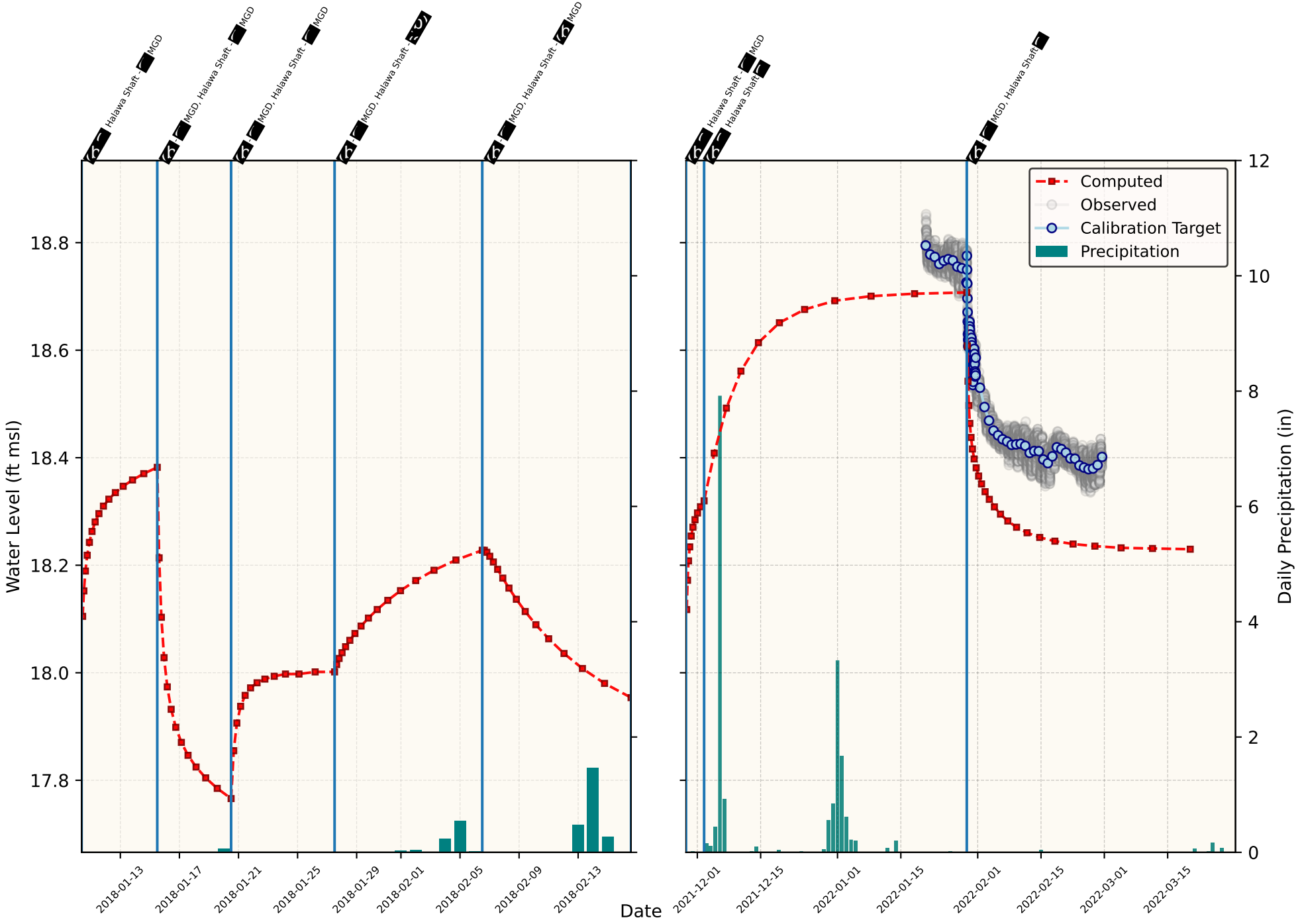
Group 1 - Basal Aquifer

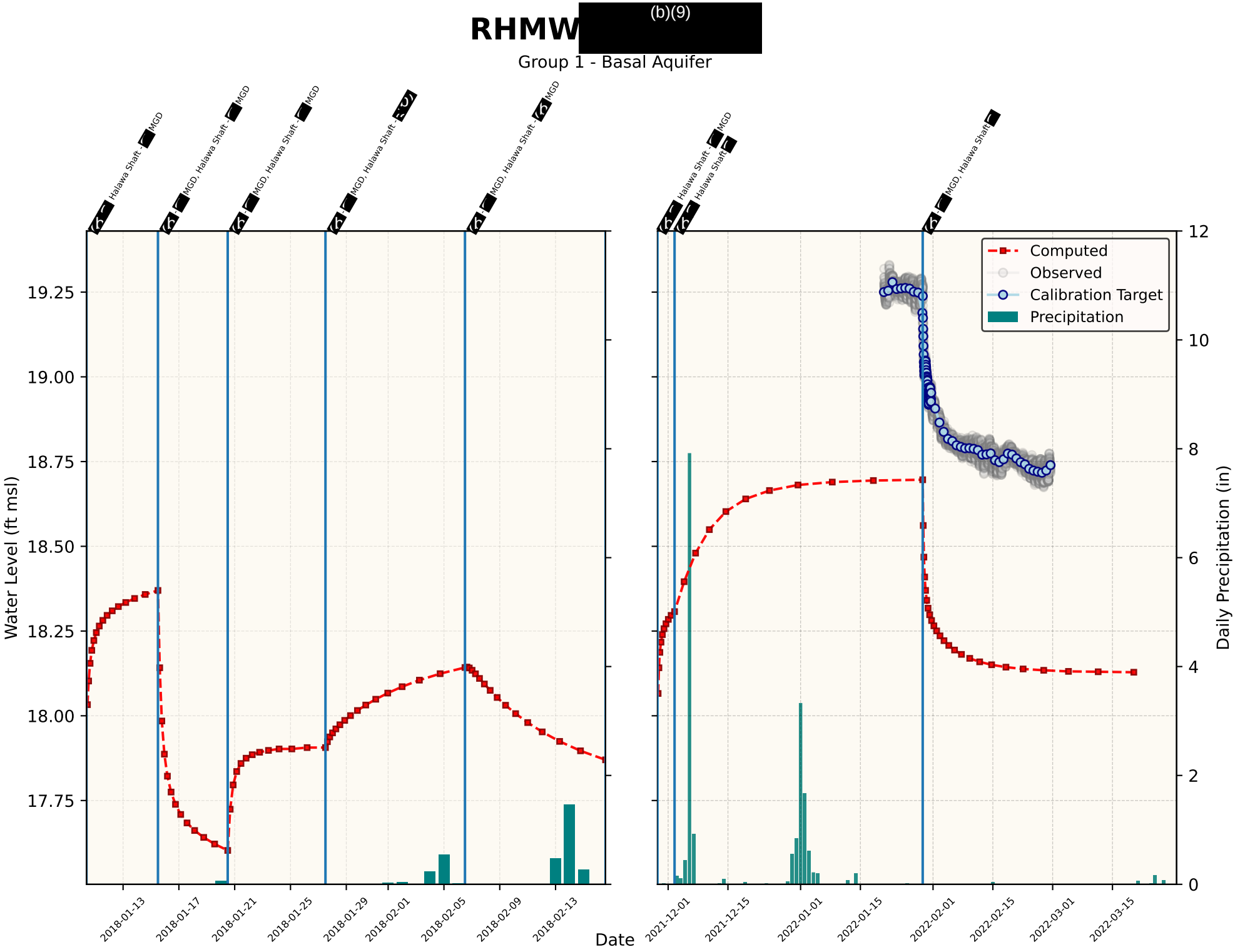


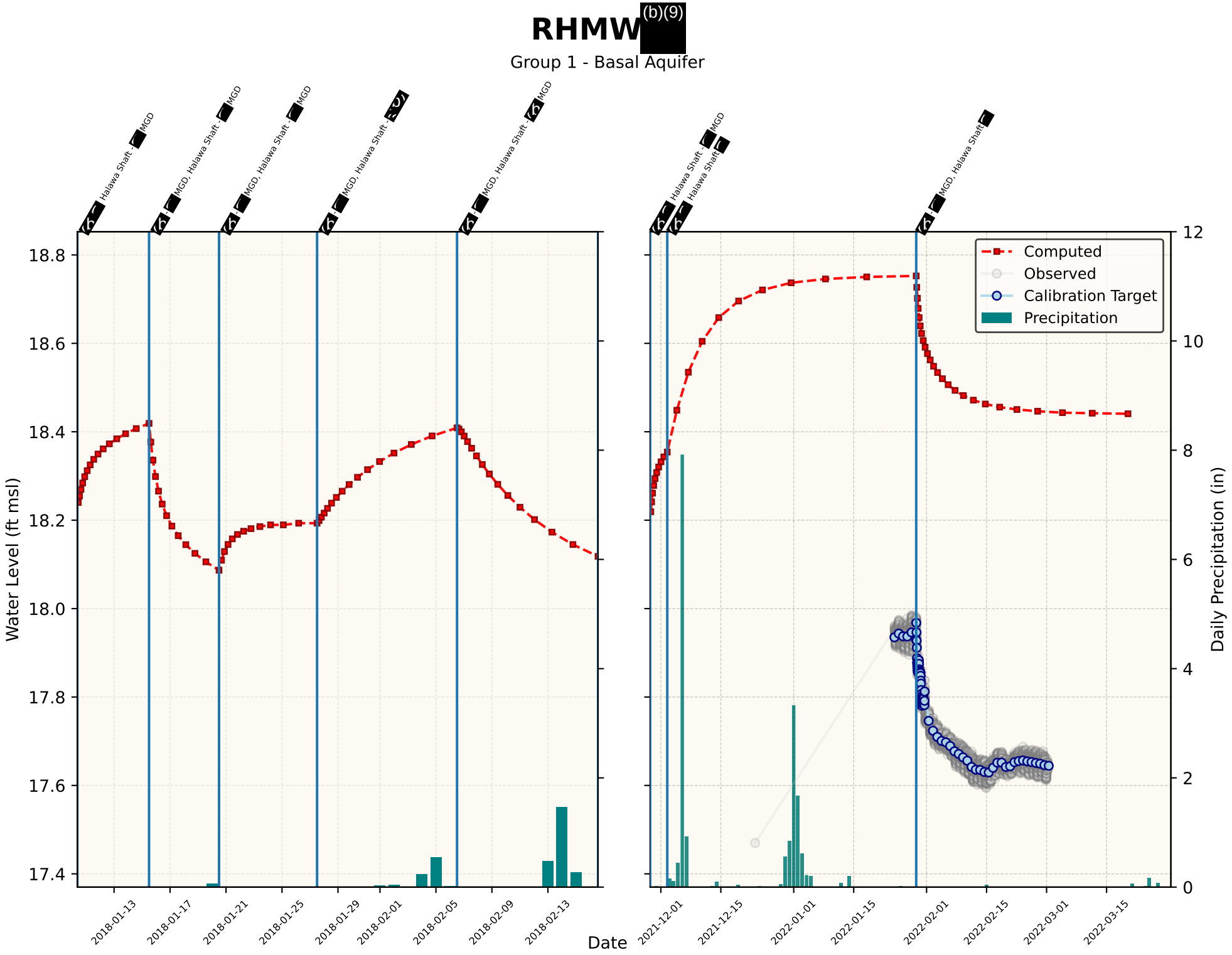

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.00
18.75
18.50
18.25
18.00
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17.25
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2018-01-13
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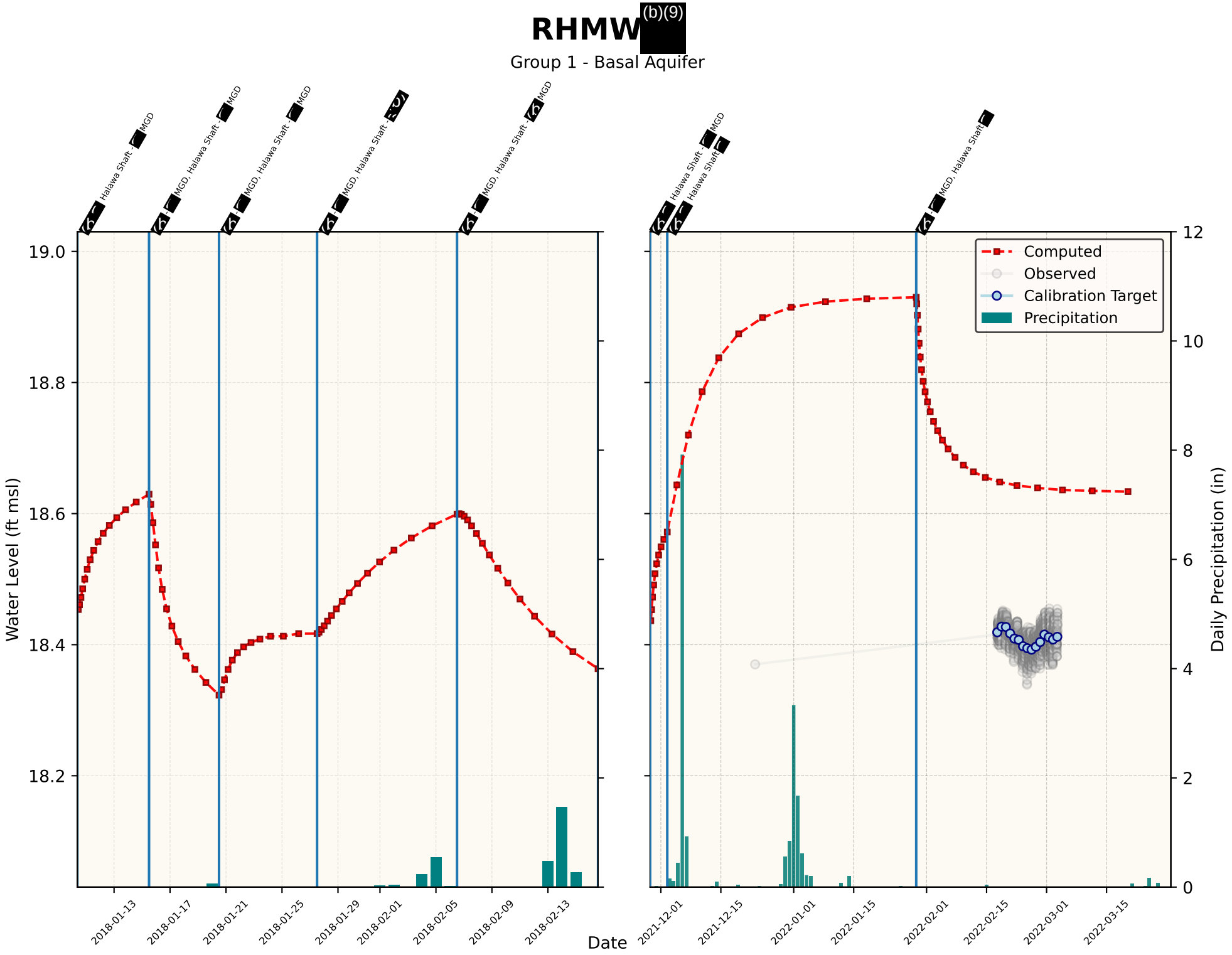
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Group 1 - Basal Aquifer



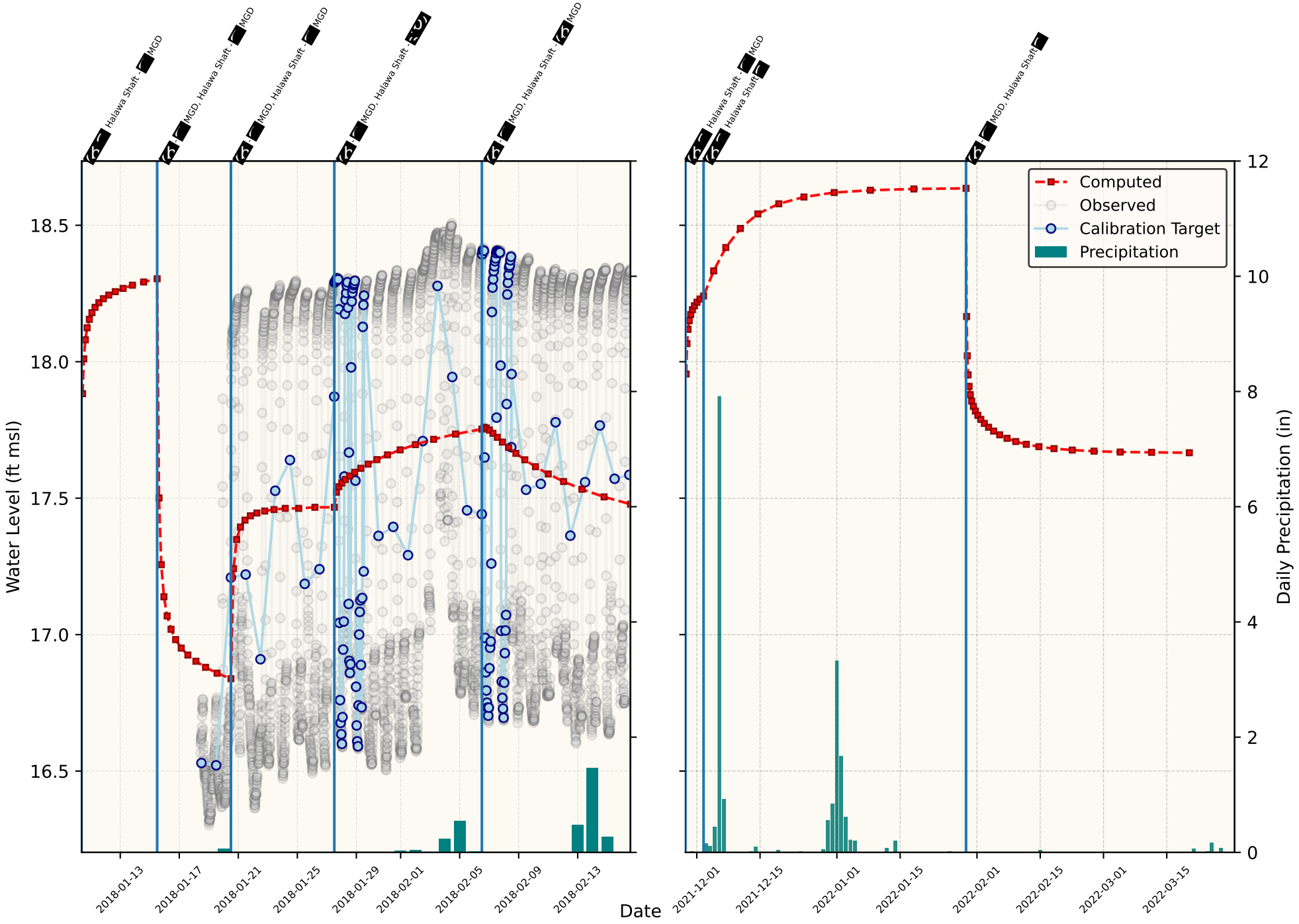

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
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MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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18.50
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18.00
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RHMW(b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
17.6
17.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

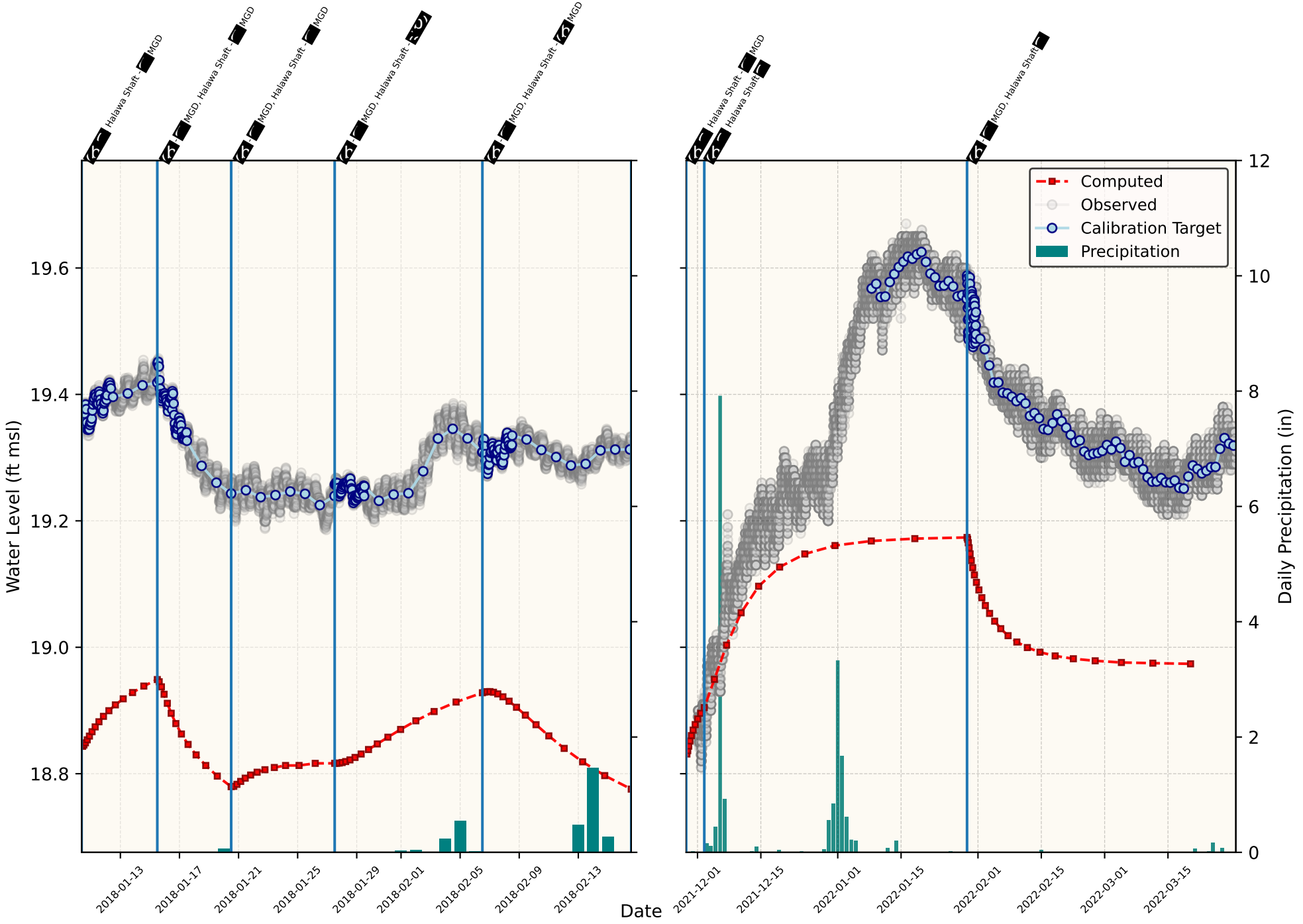
RHMW[(b)(9)redacted]

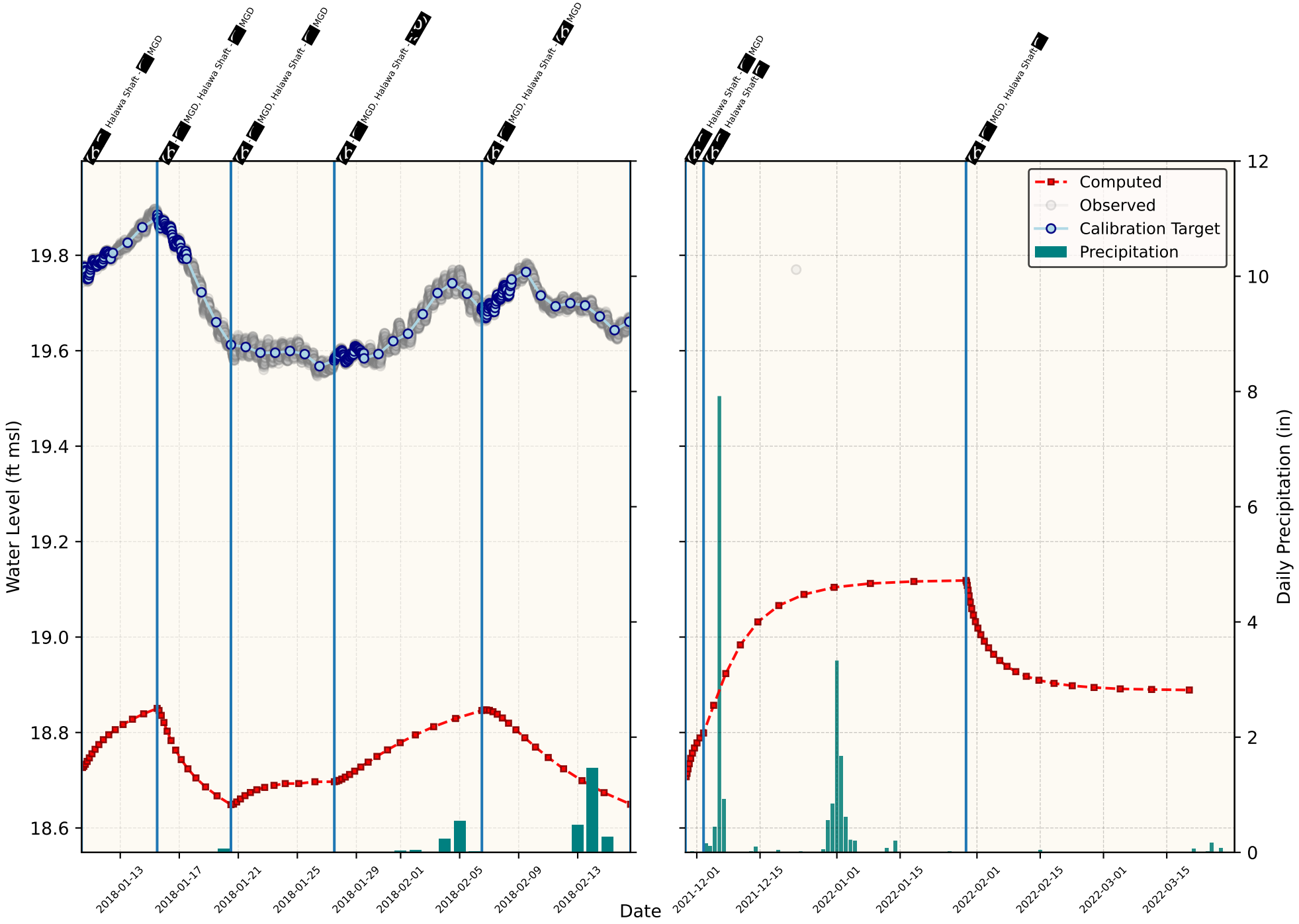
Group 1 - Basal Aquifer

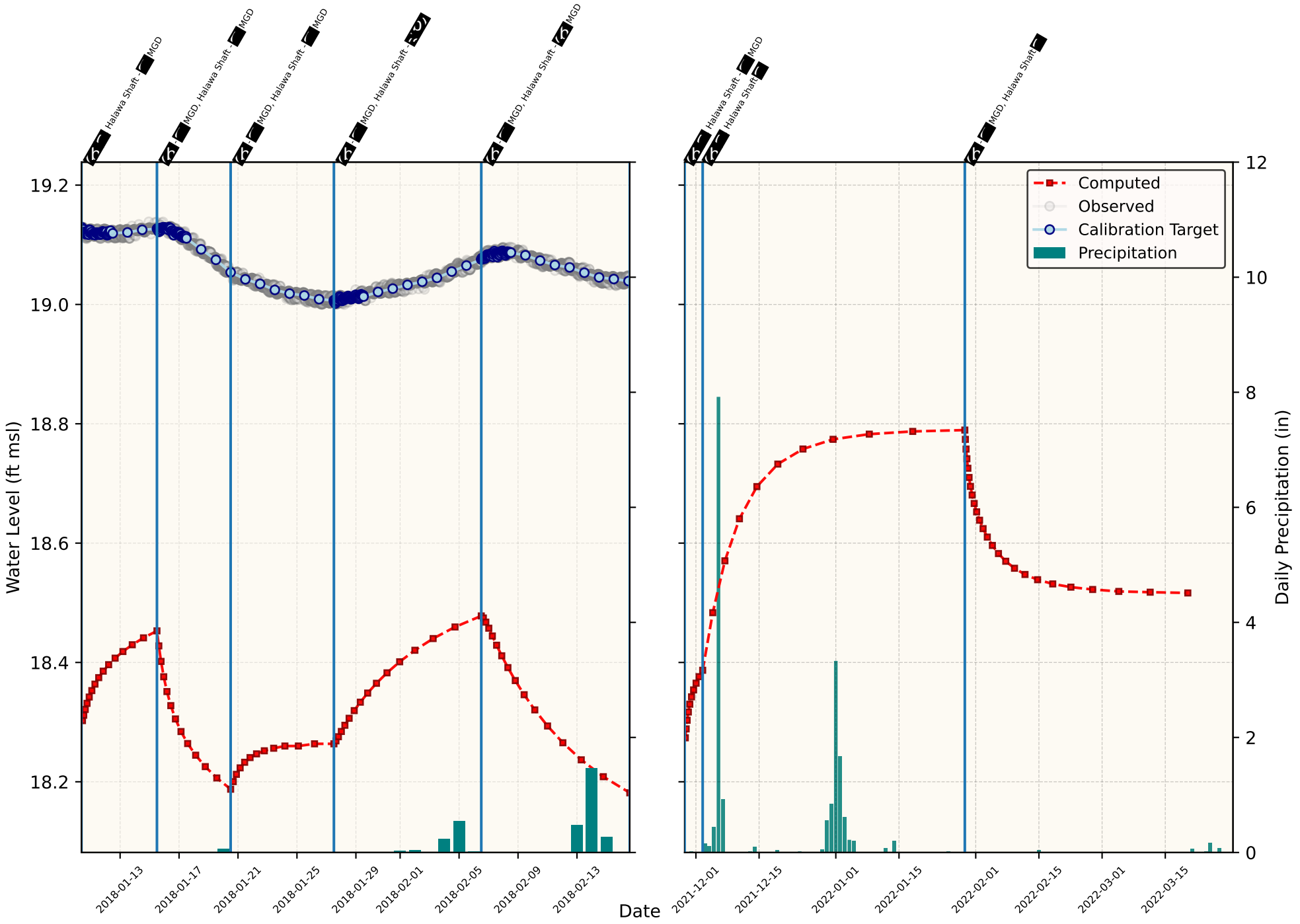


TAMC_[redacted] (b)(9)

Group 1 - Basal Aquifer

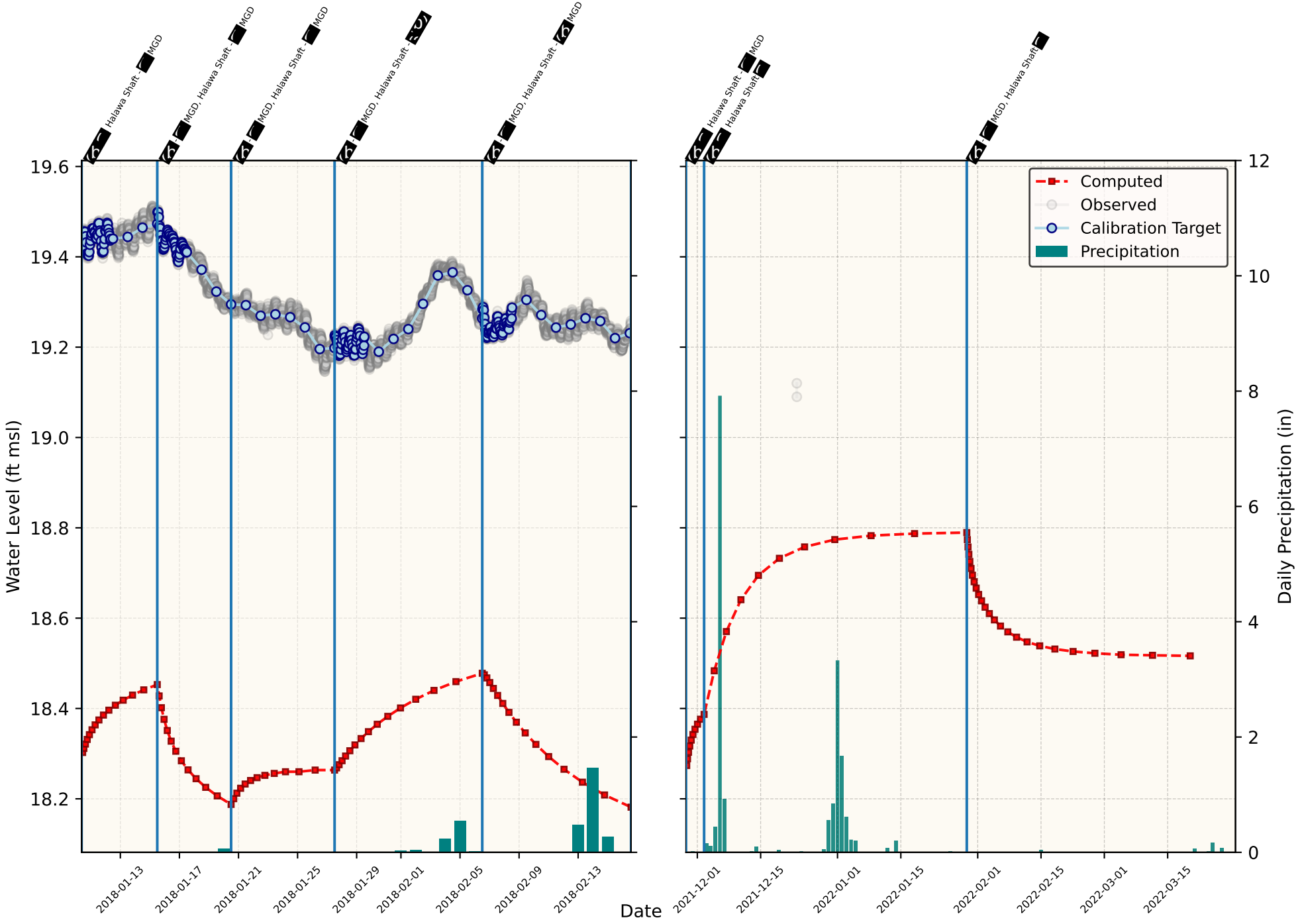



DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.8
19.6
19.4
19.2
19.0
18.8
18.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.2
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

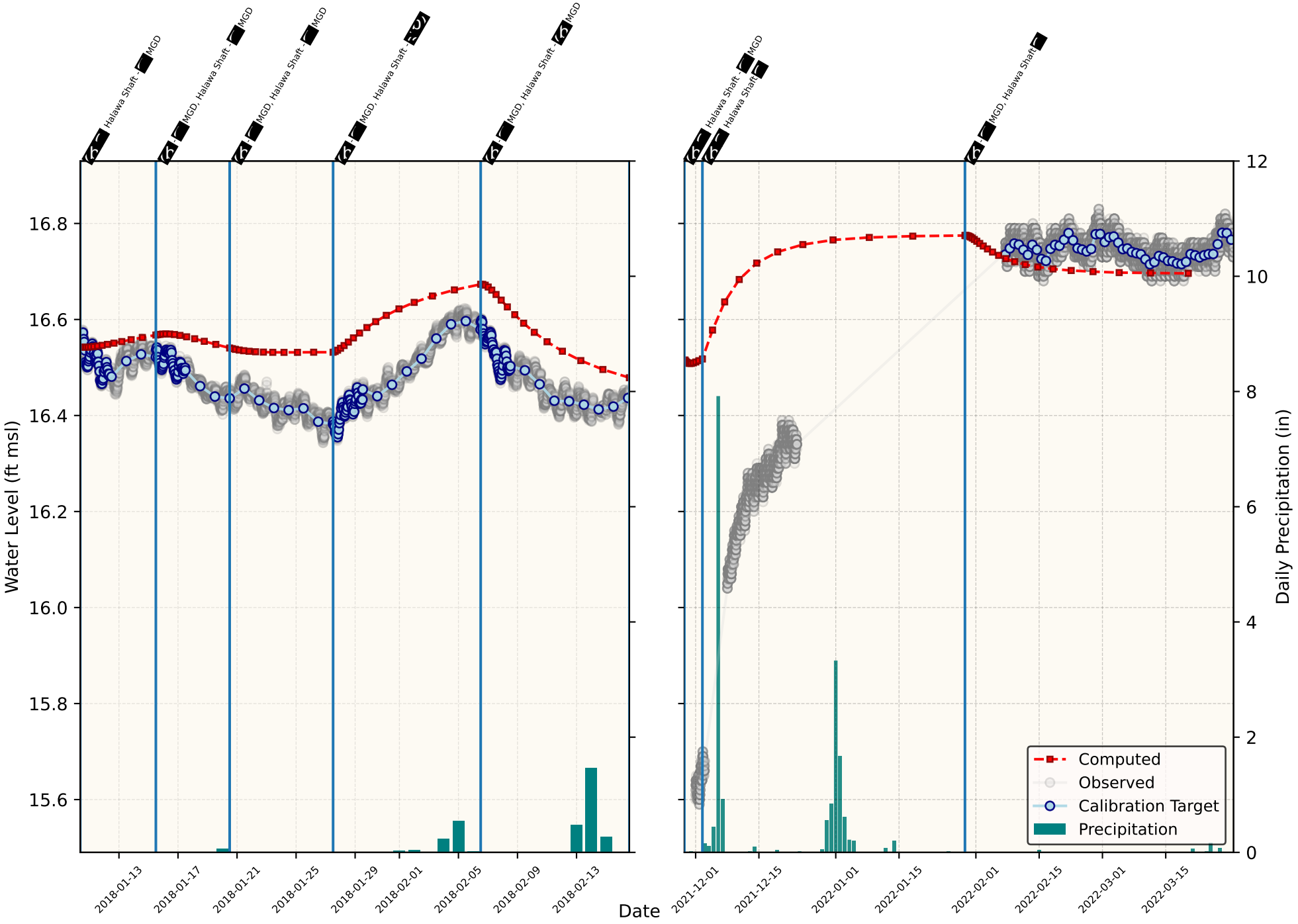
Halawa_Deep_Monitor_Well_HDMW2253-03

Group 2 - Deep Basal Wells



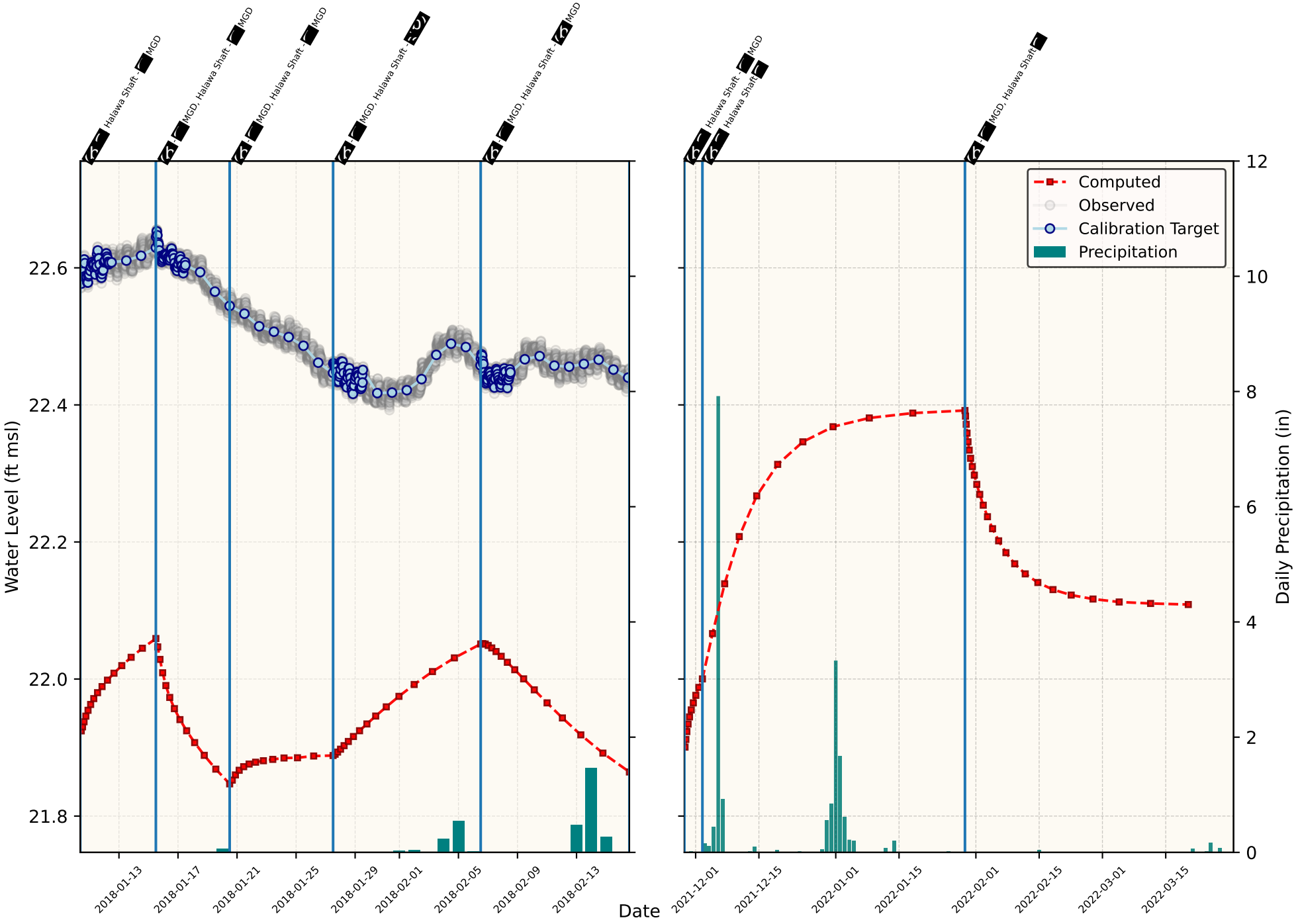
Kaamilo_Deep

Group 2 - Deep Basal Wells



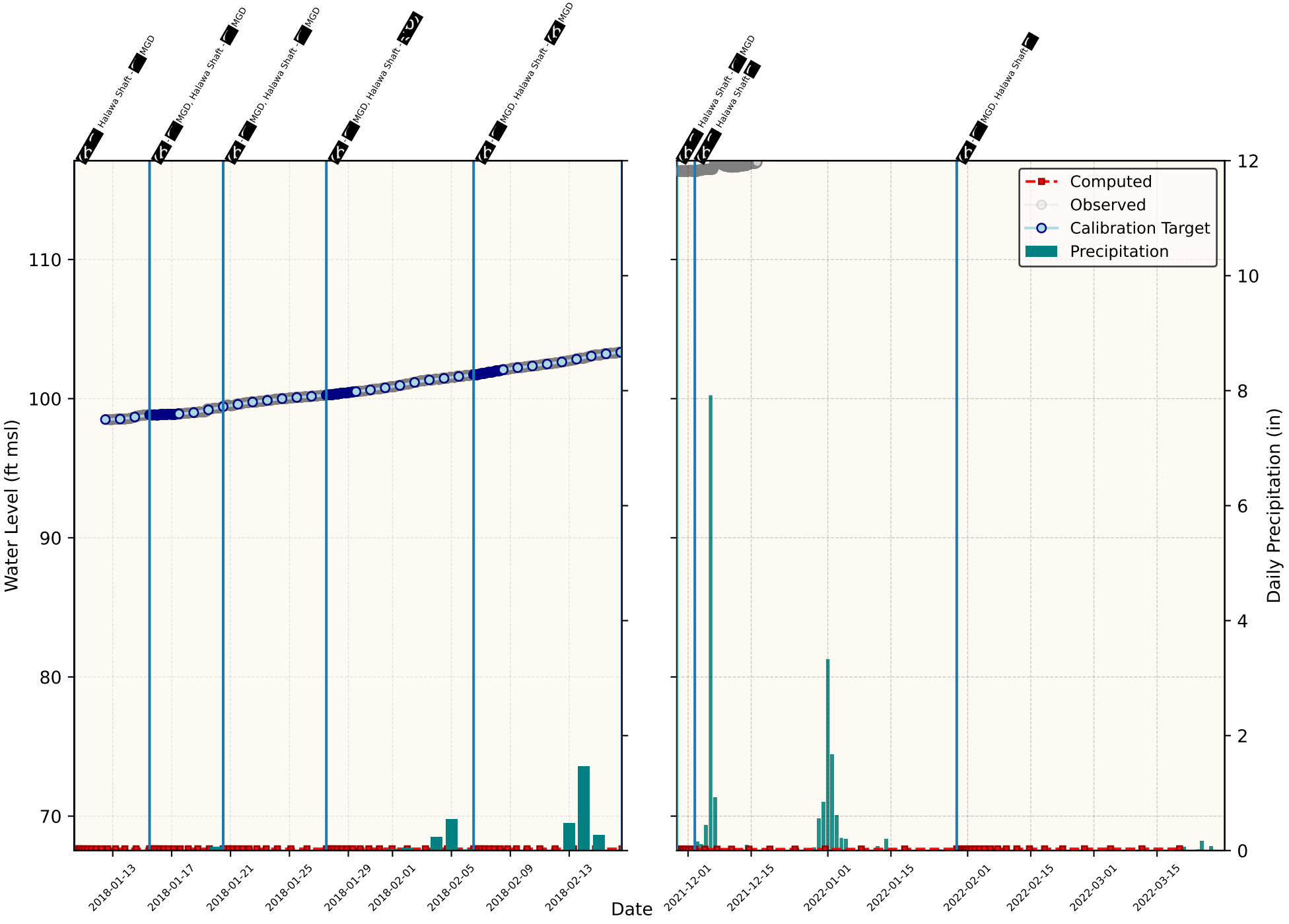
RHMW[redacted] (b)(9)

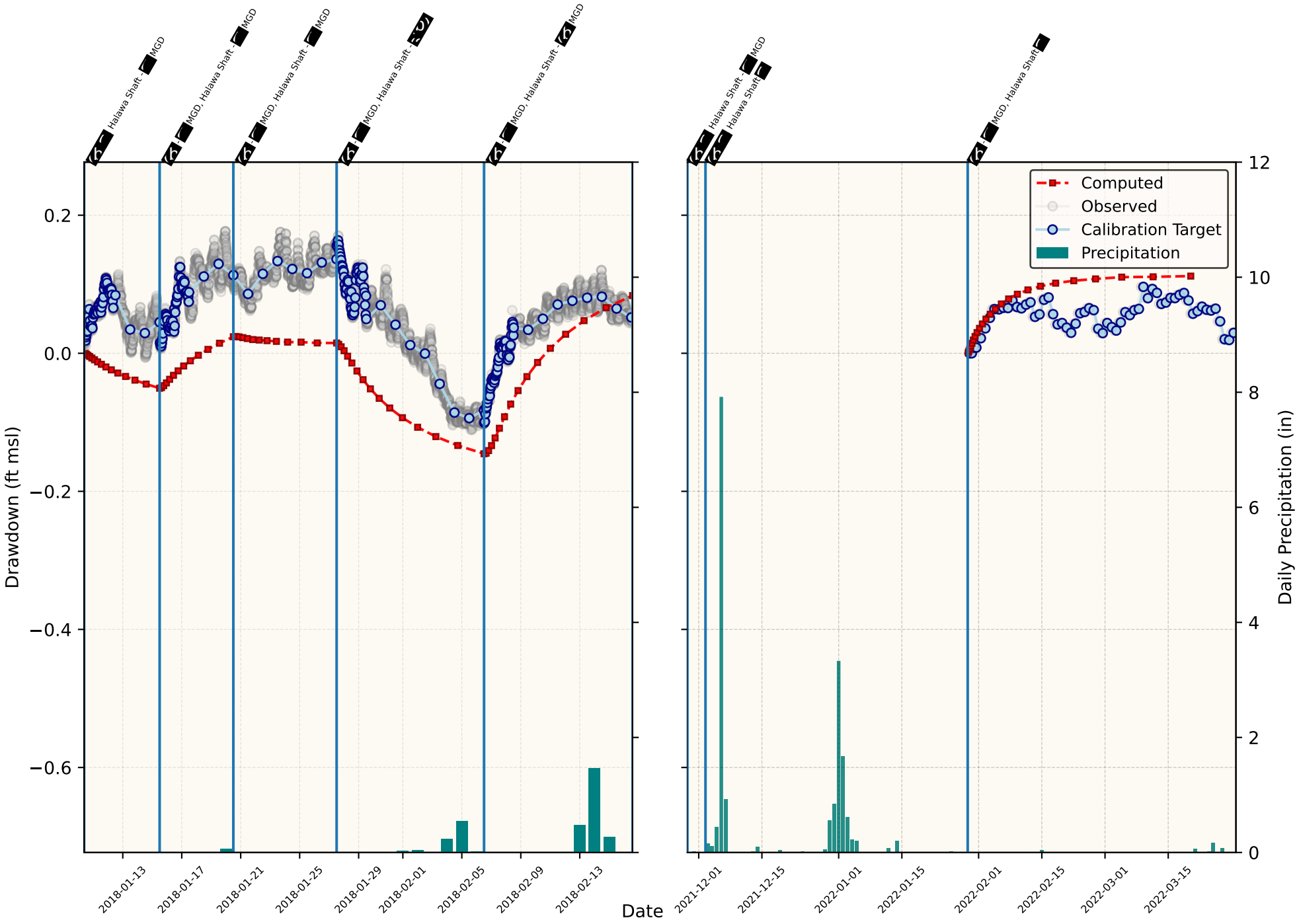
Group 3 - Saprolite/Confining Unit Well with Elevated Head



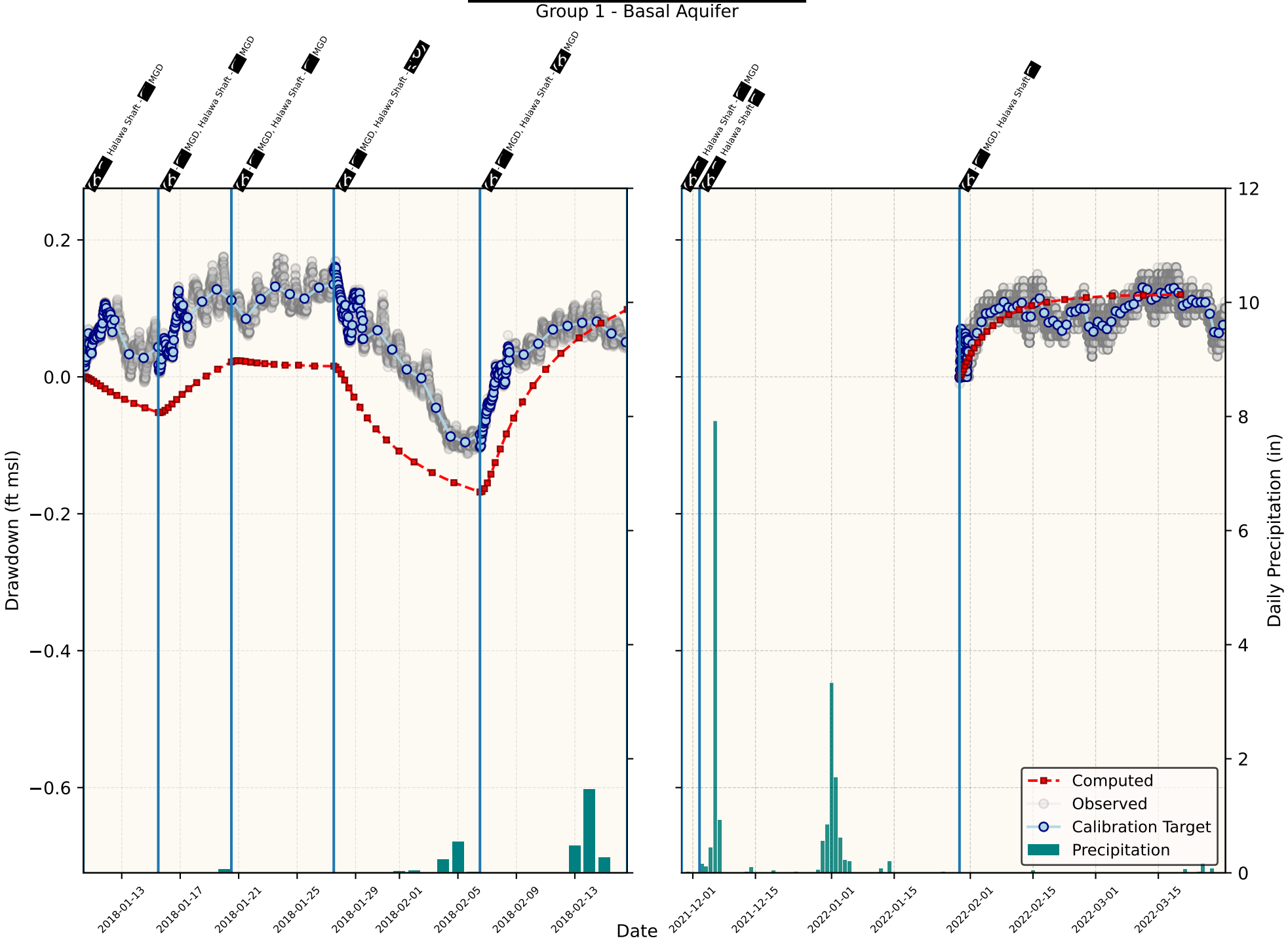
RHMW[redacted] (b)(9)

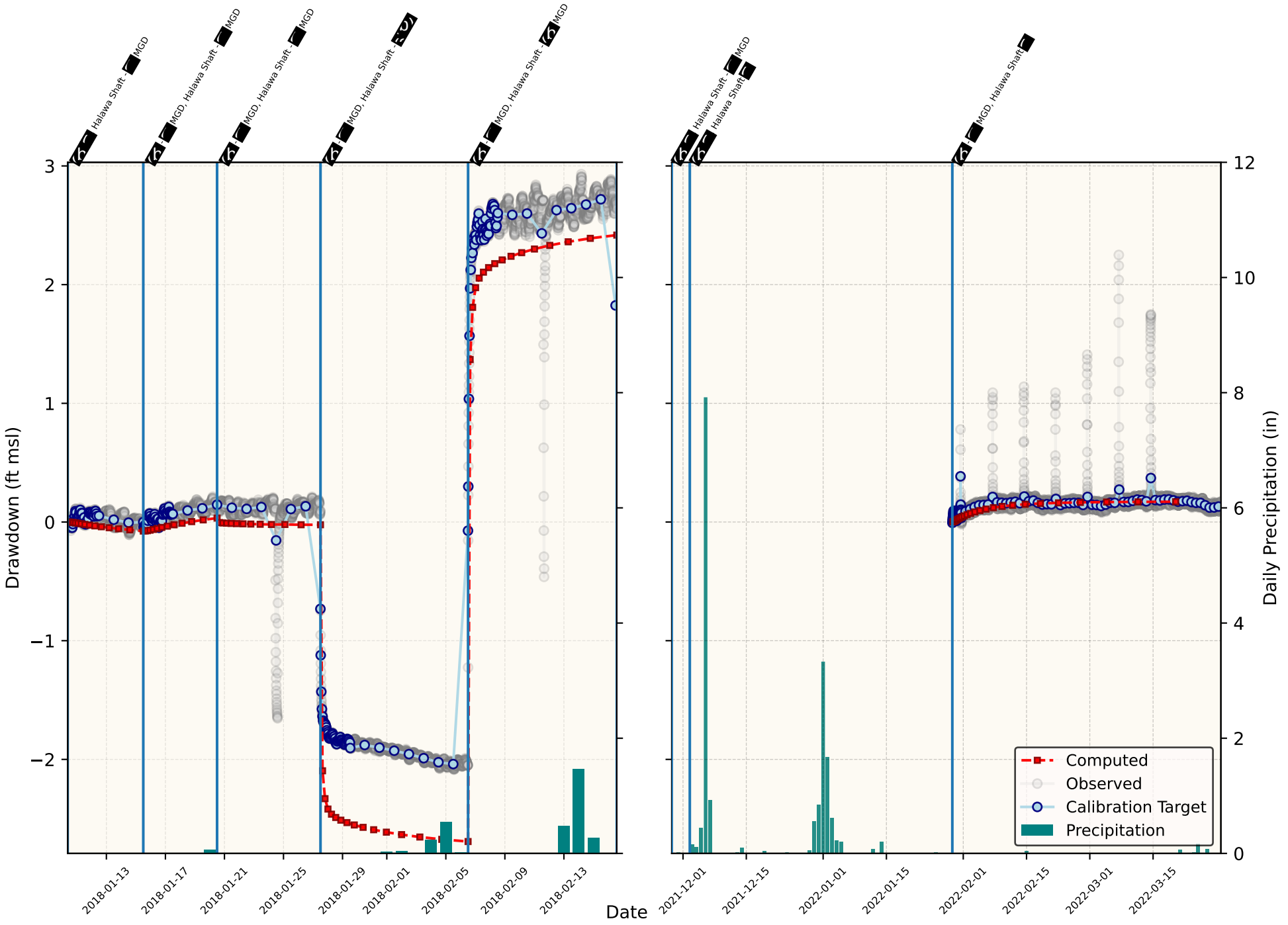
Group 3 - Saprolite/Confining Unit Well with Elevated Head

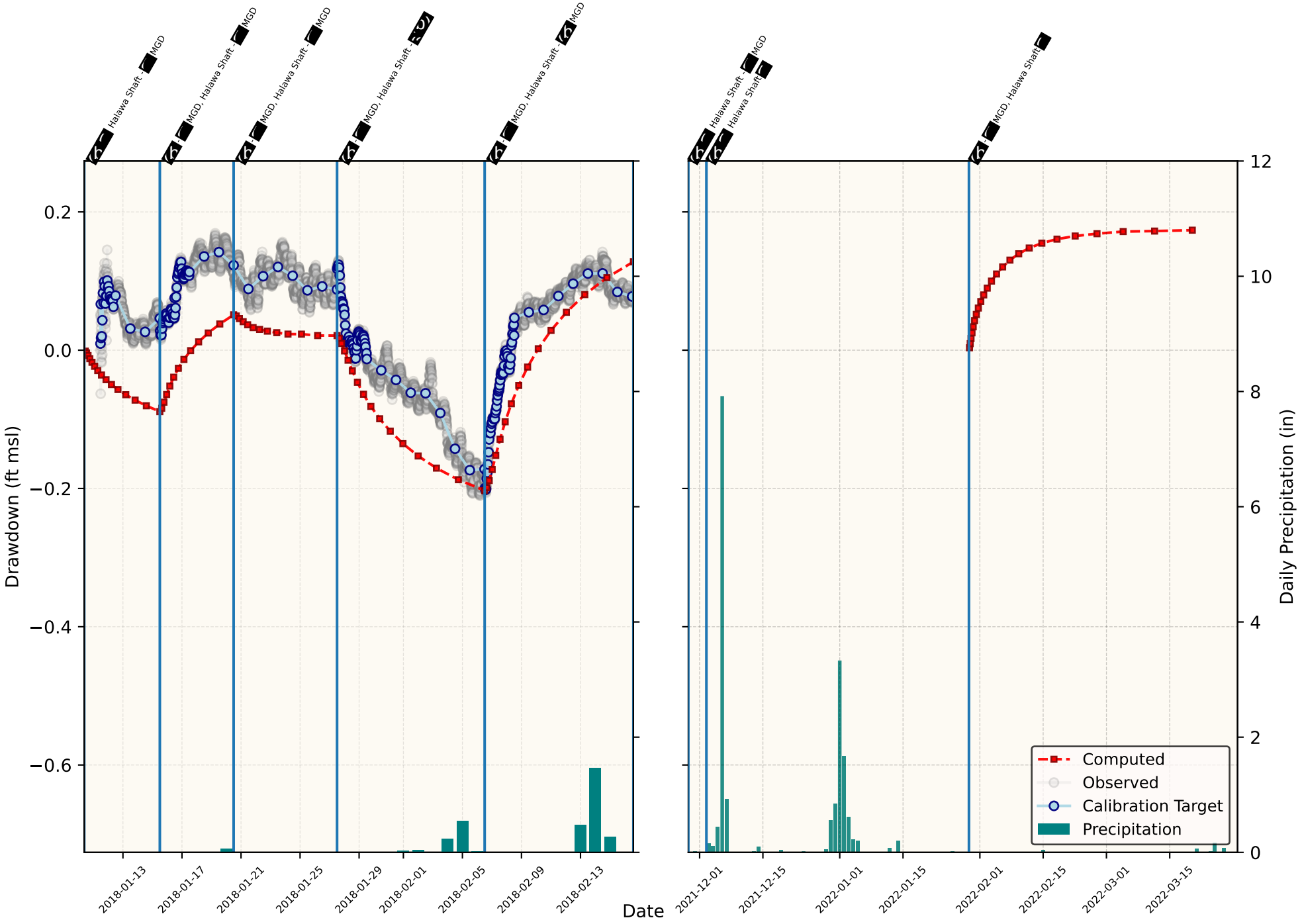


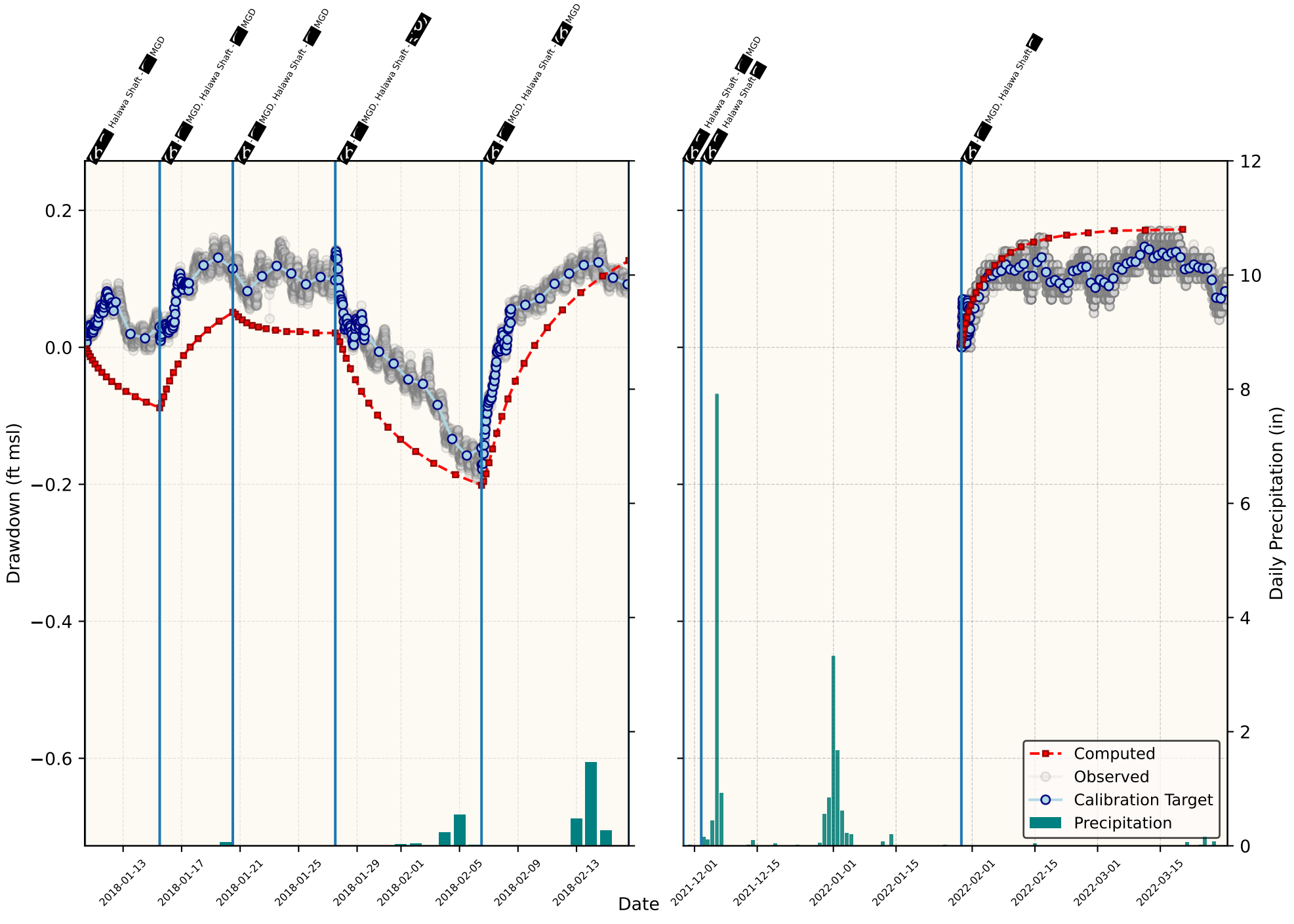

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
Halawa Shaft
MGD
Halawa Shaft
MGD
Halawa Shaft
MGD
Halawa Shaft
MGD
Halawa Shaft
MGD
Halawa Shaft
MGD
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

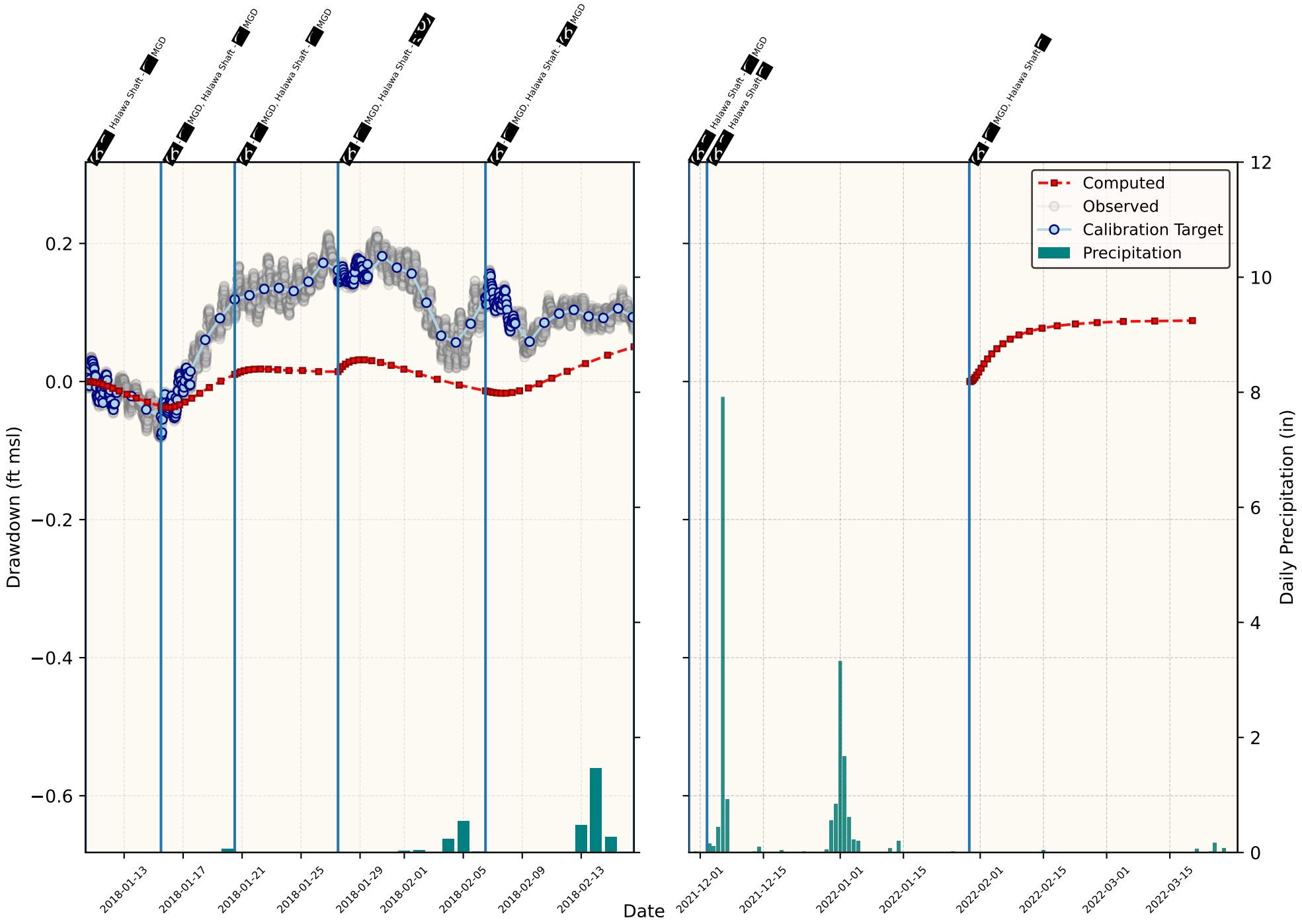
(b)(3)

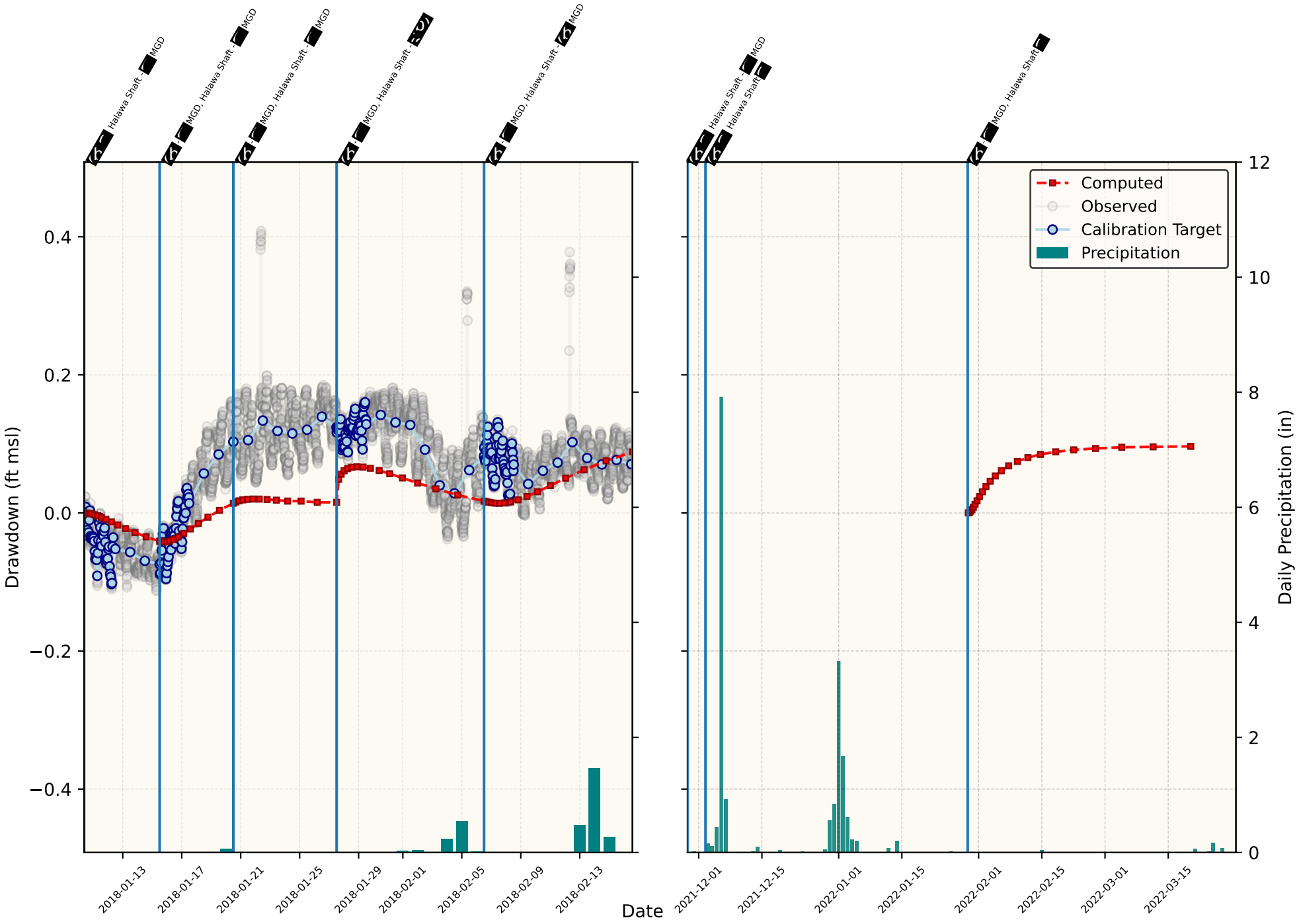

Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

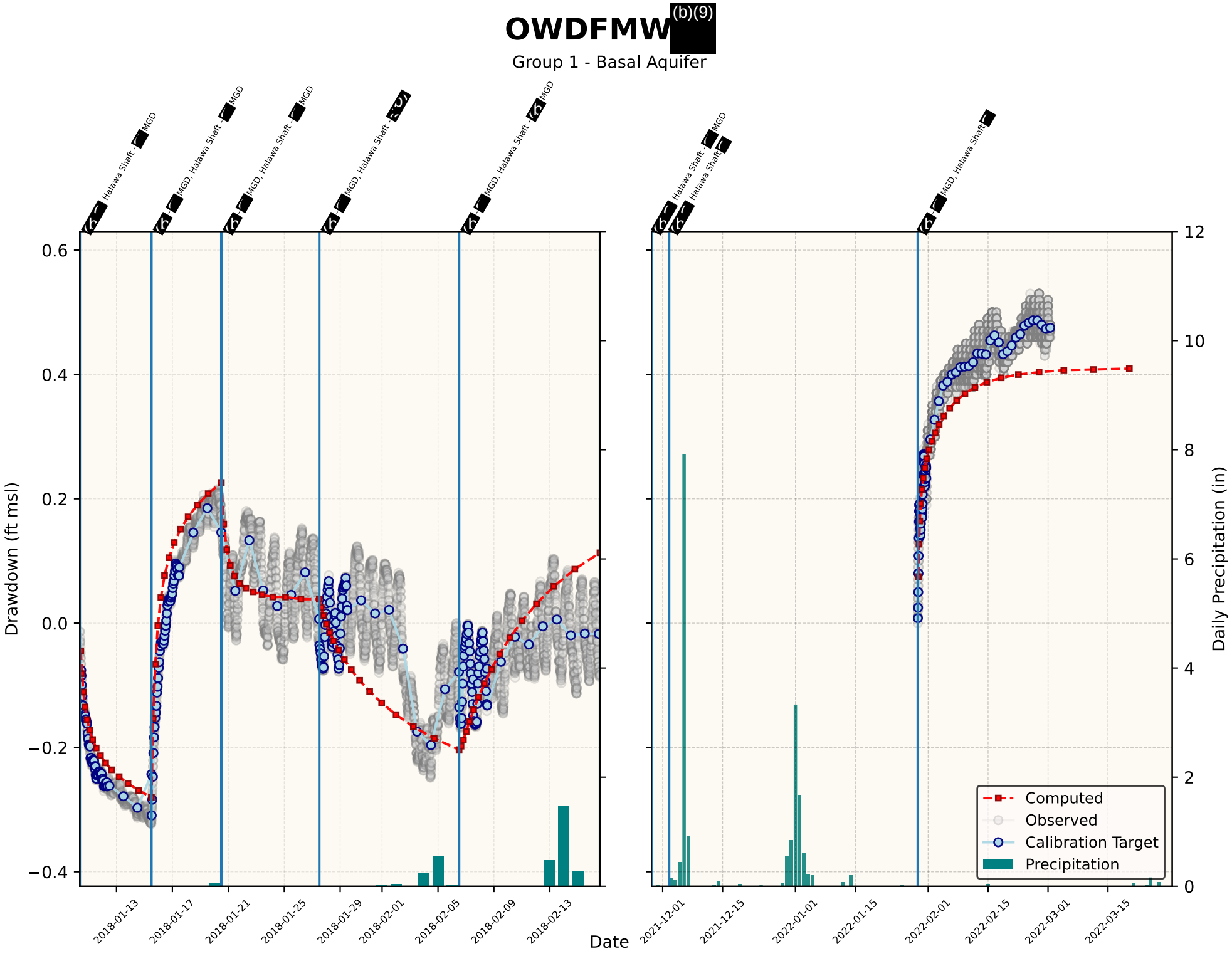

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
3
2
1
0
−1
−2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

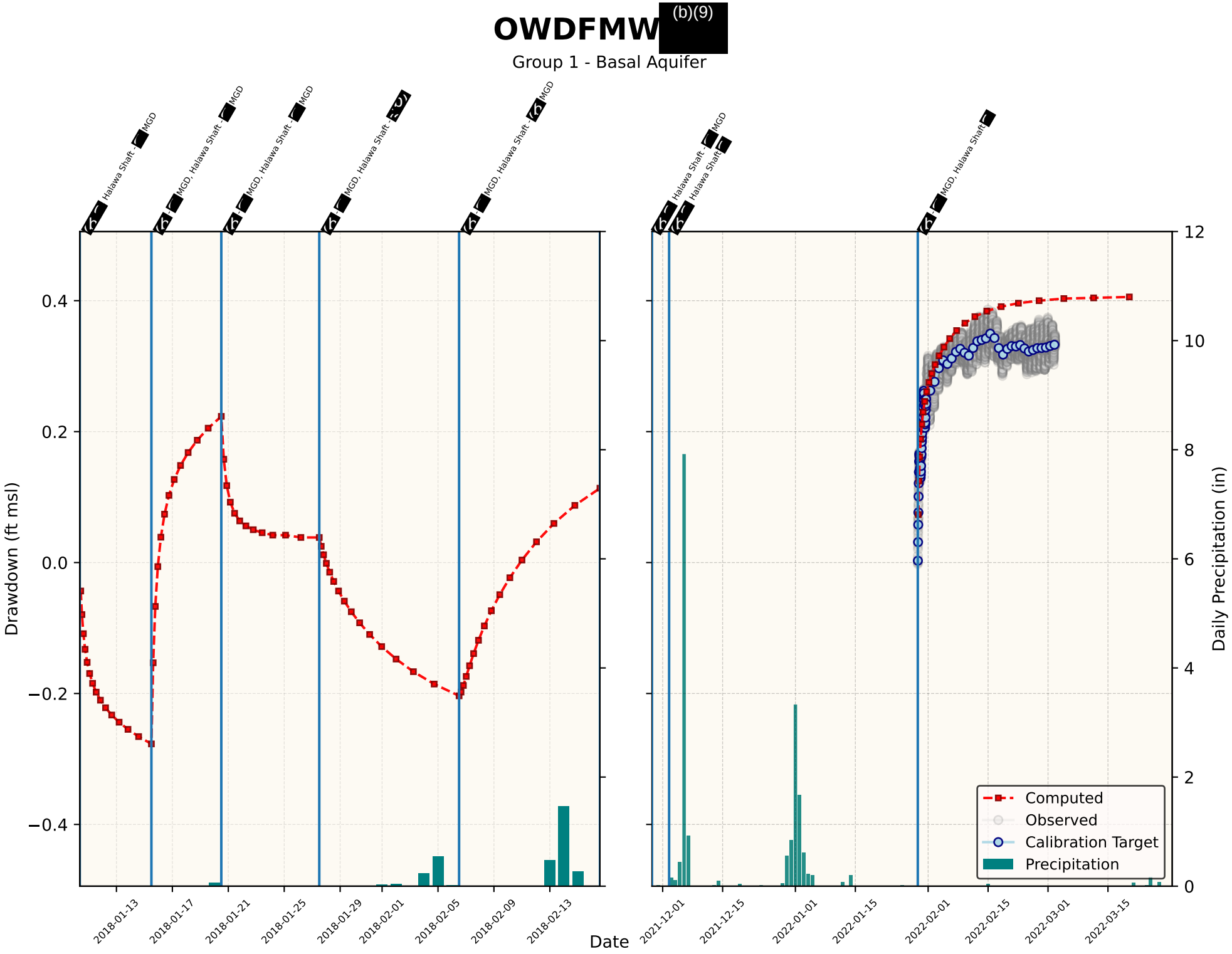

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

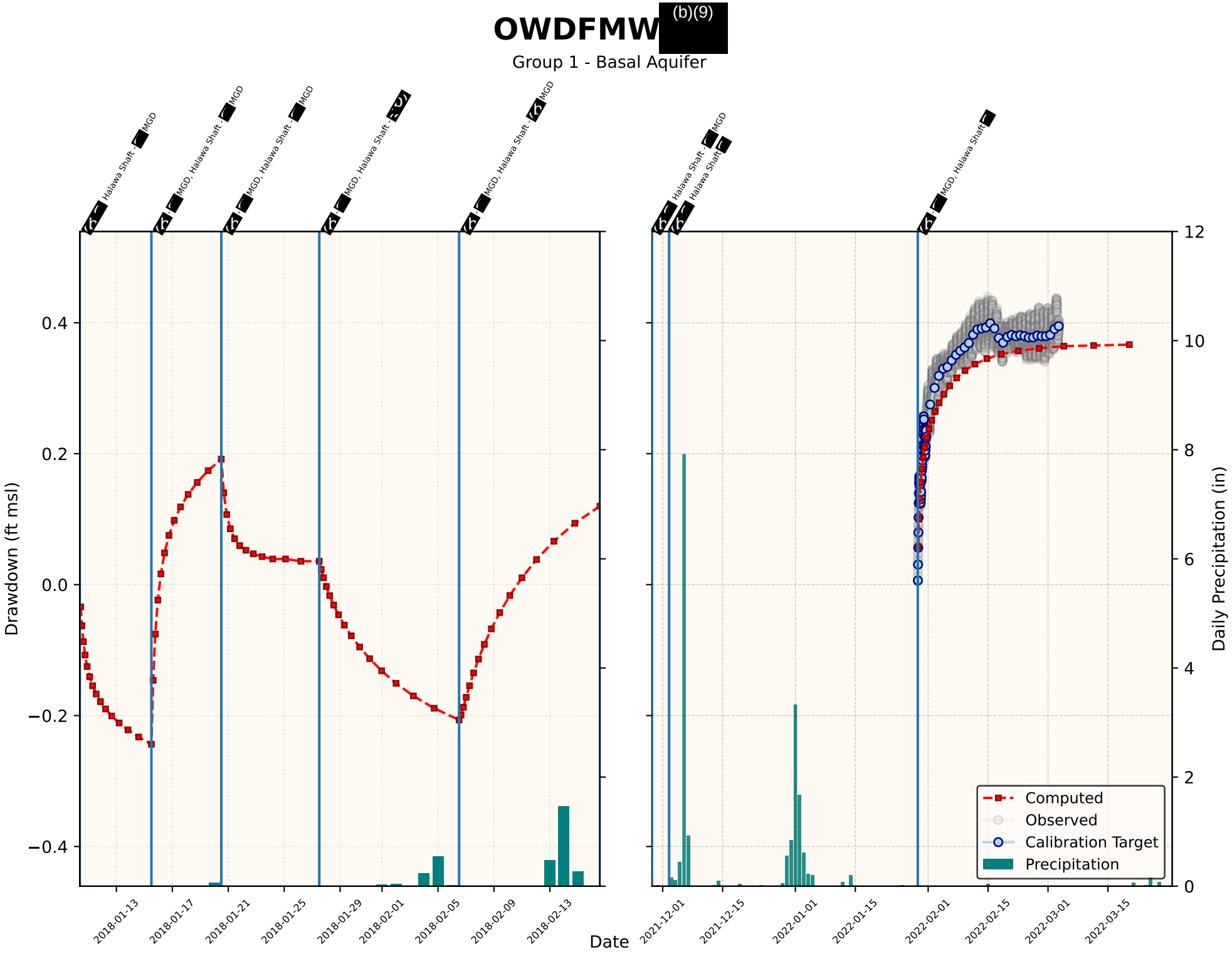

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

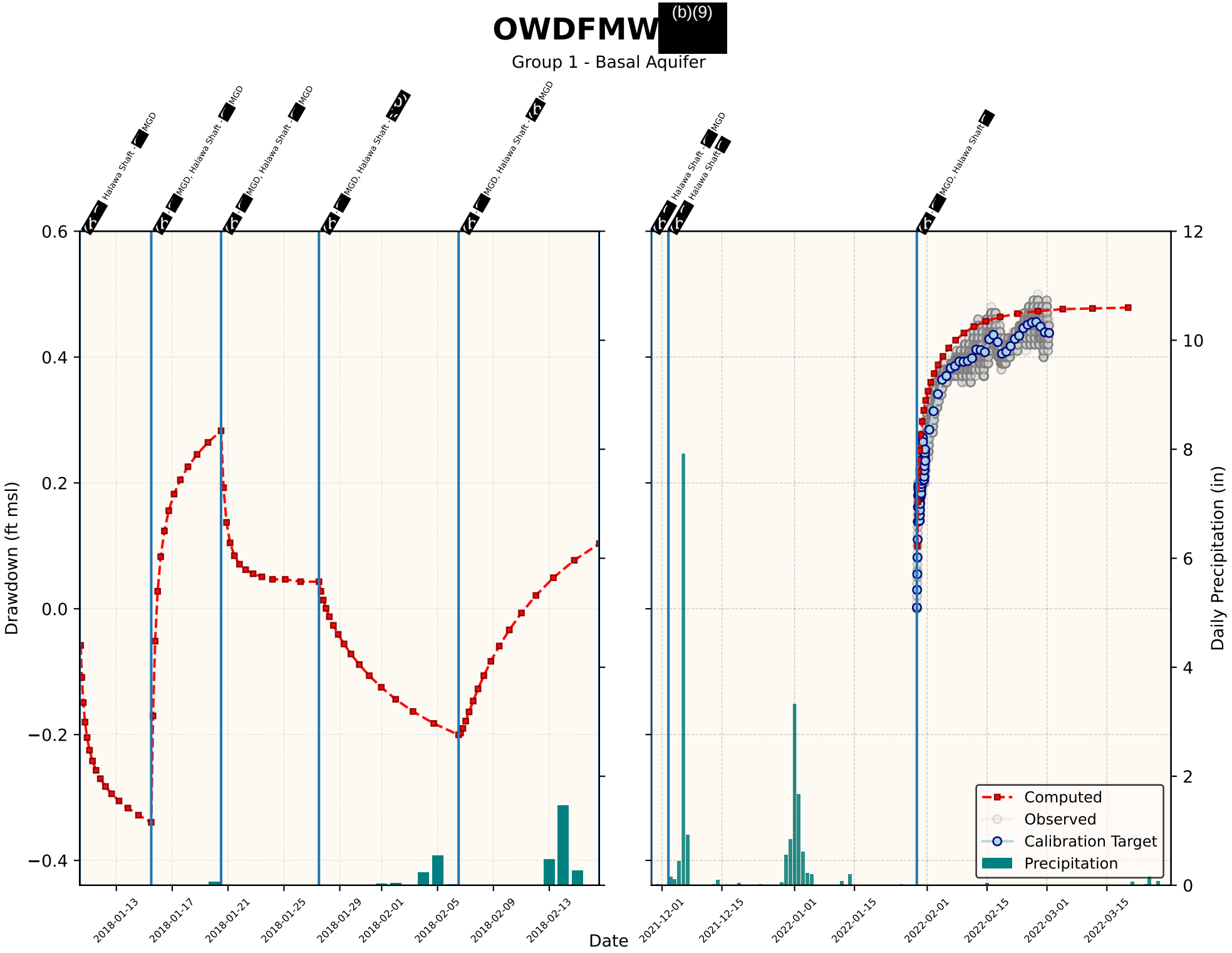

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

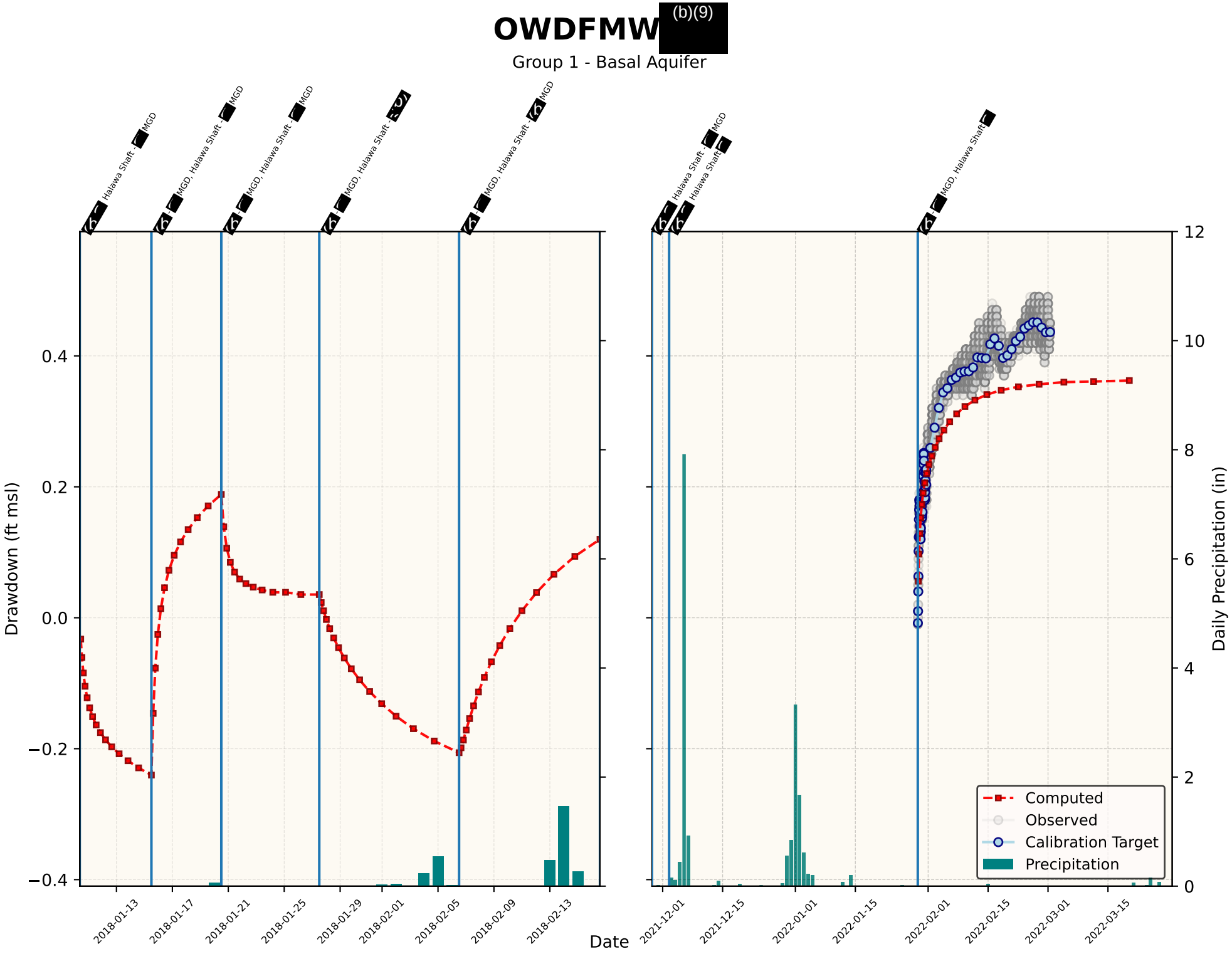

Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

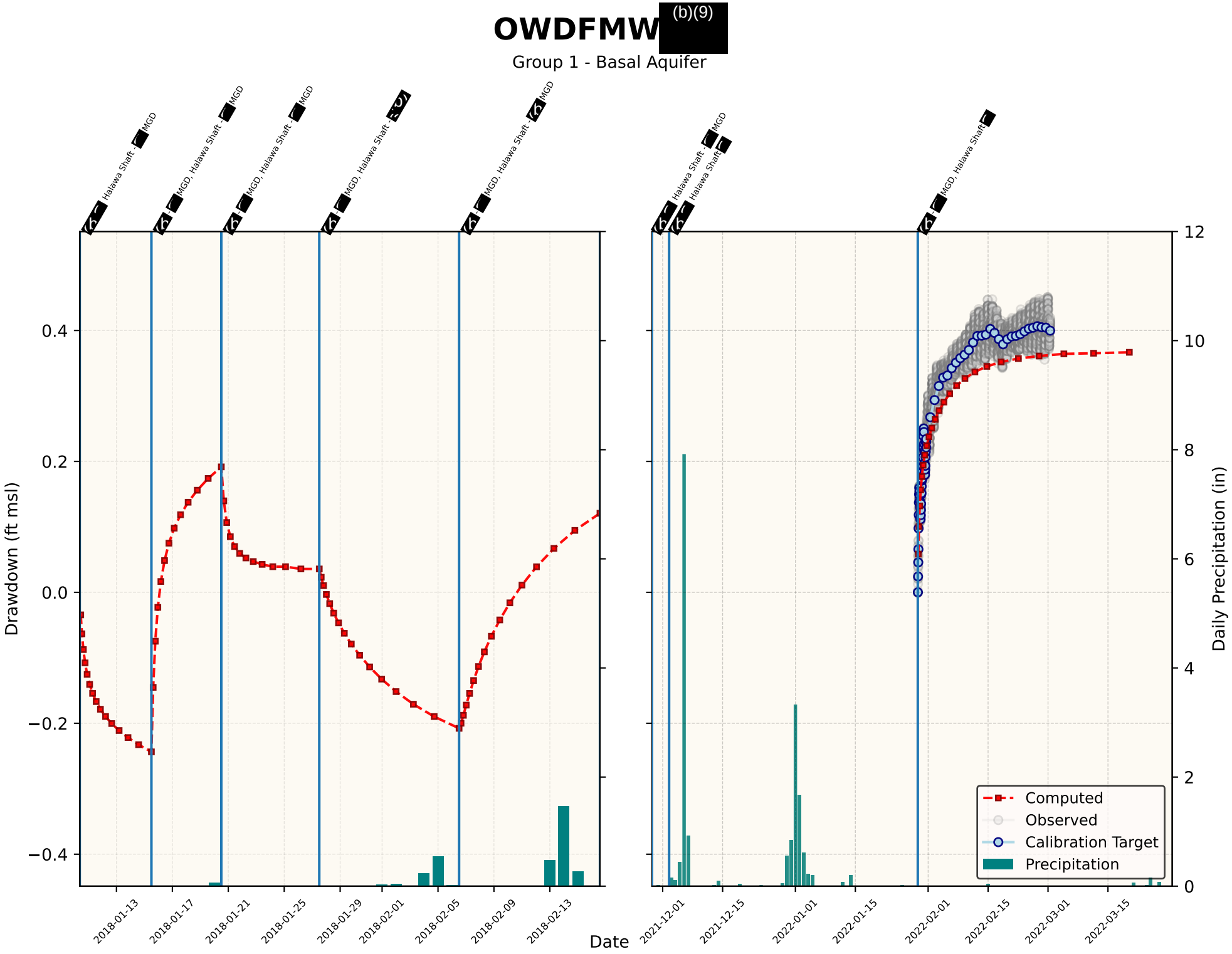

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation

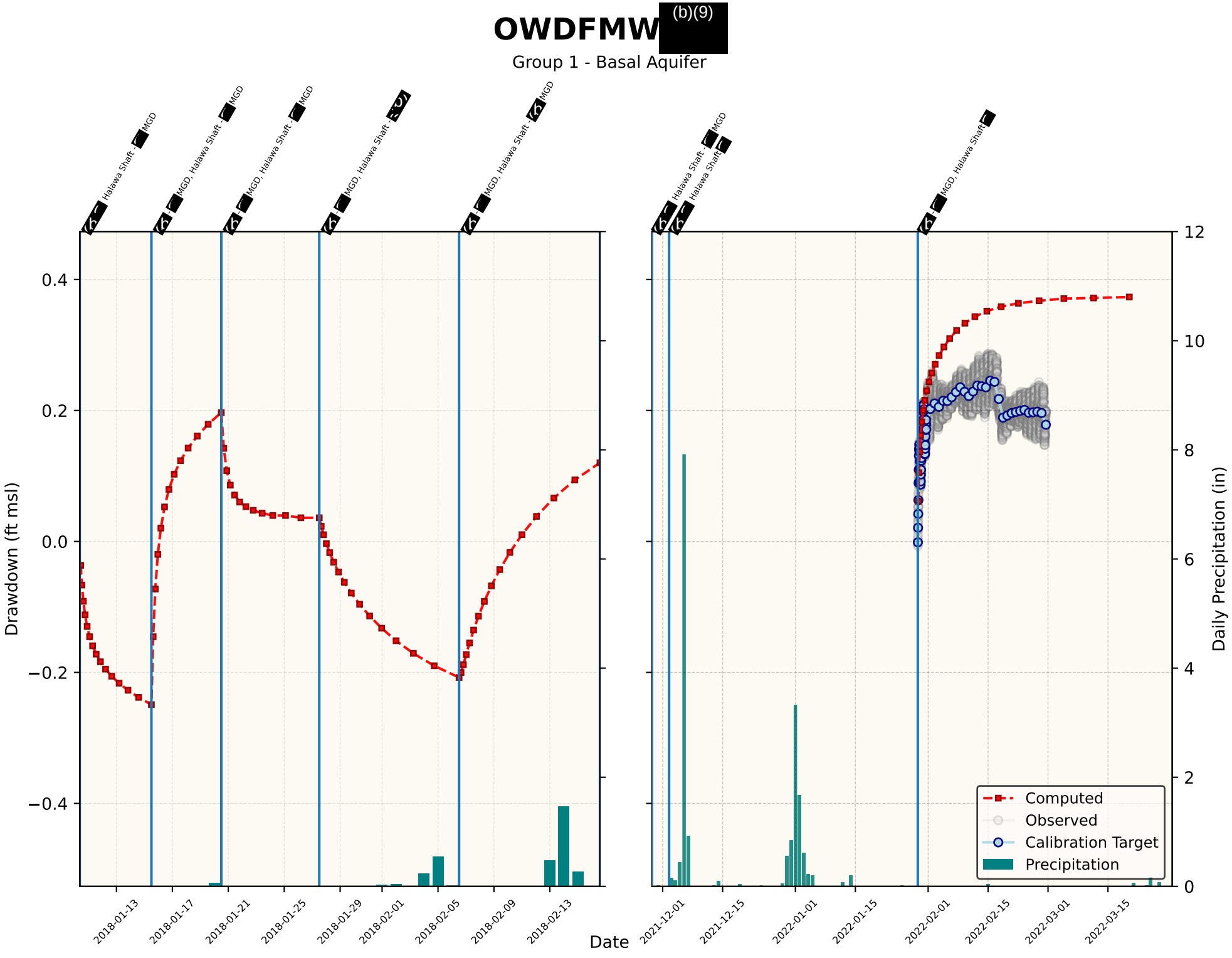

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

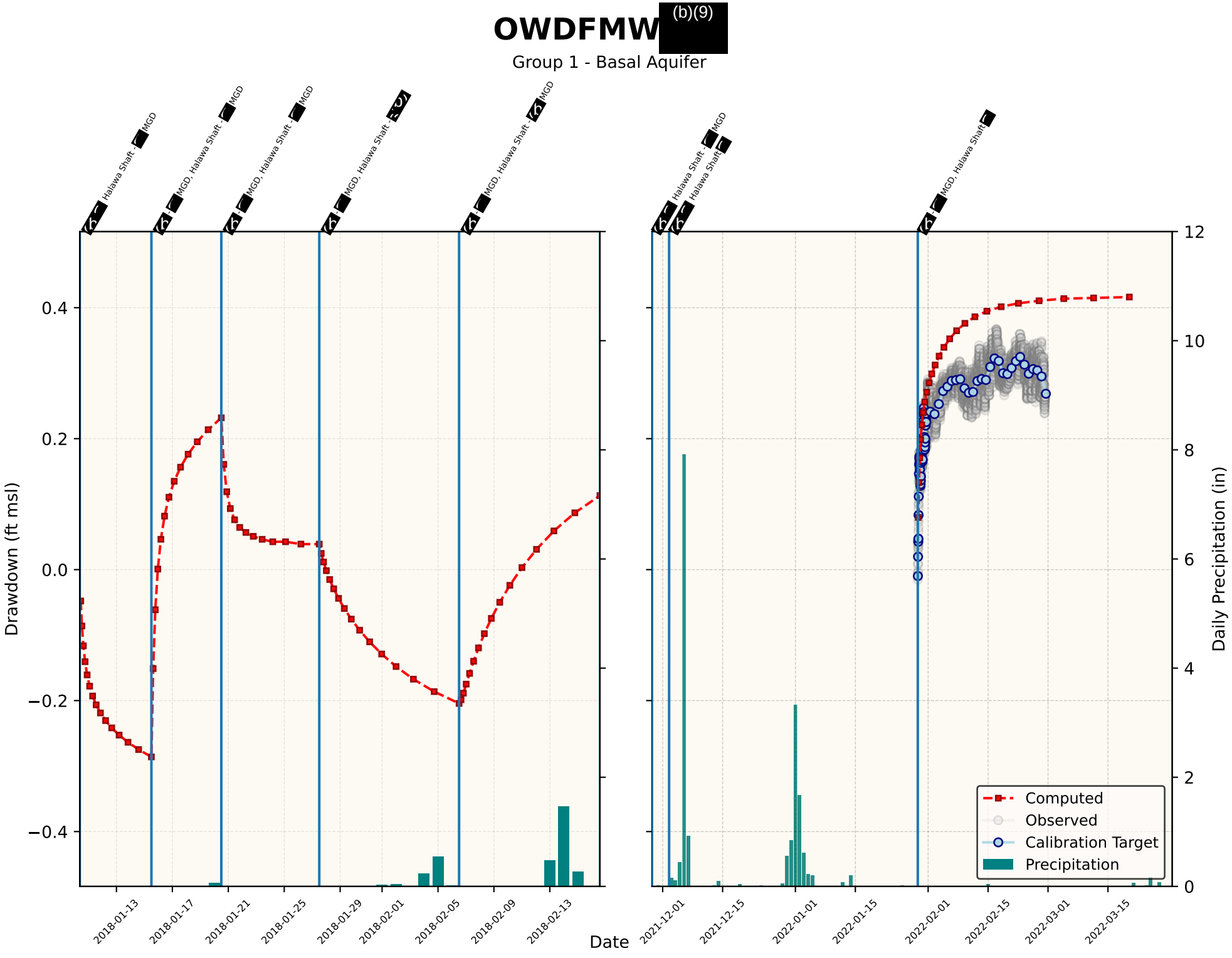

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

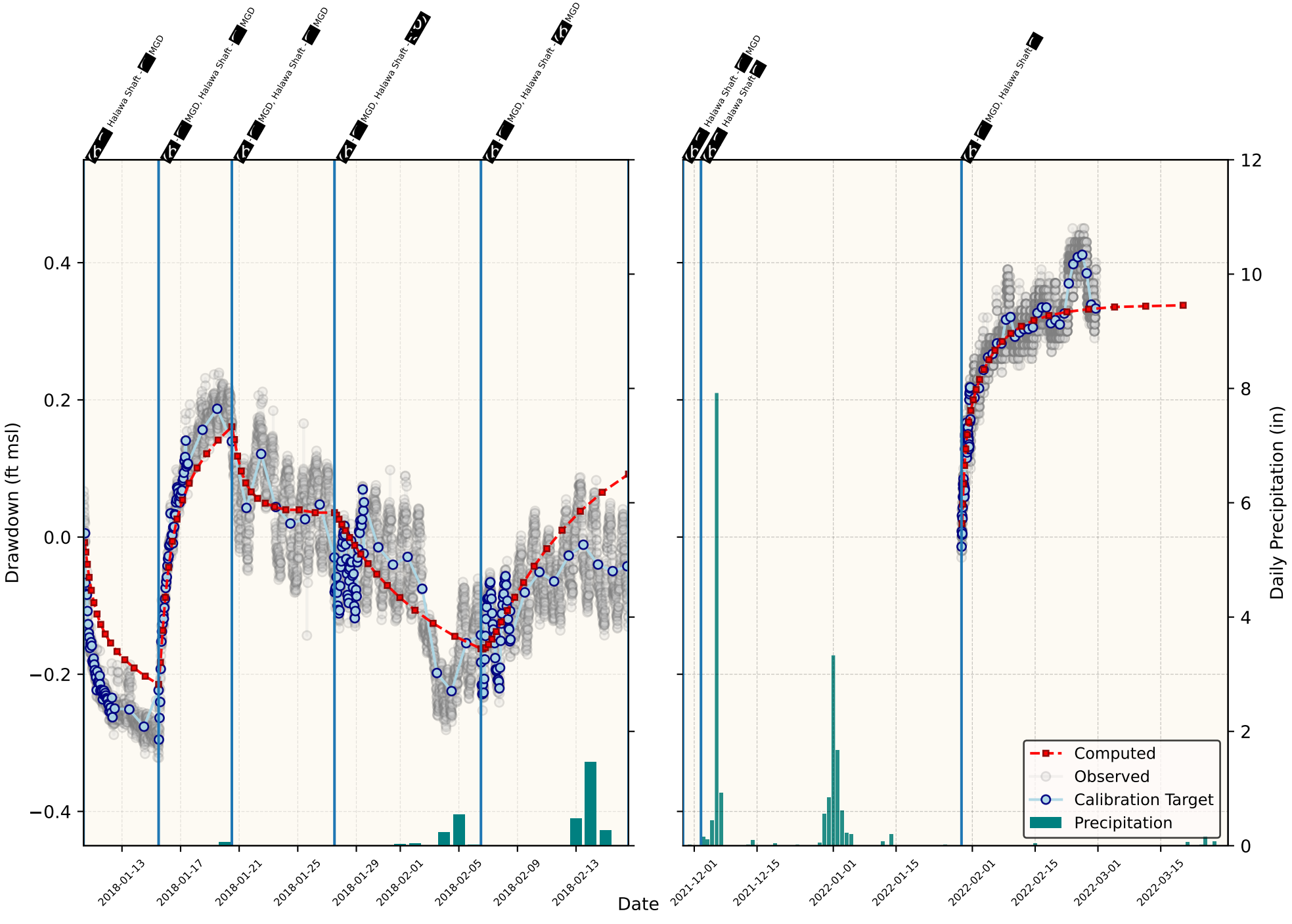

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

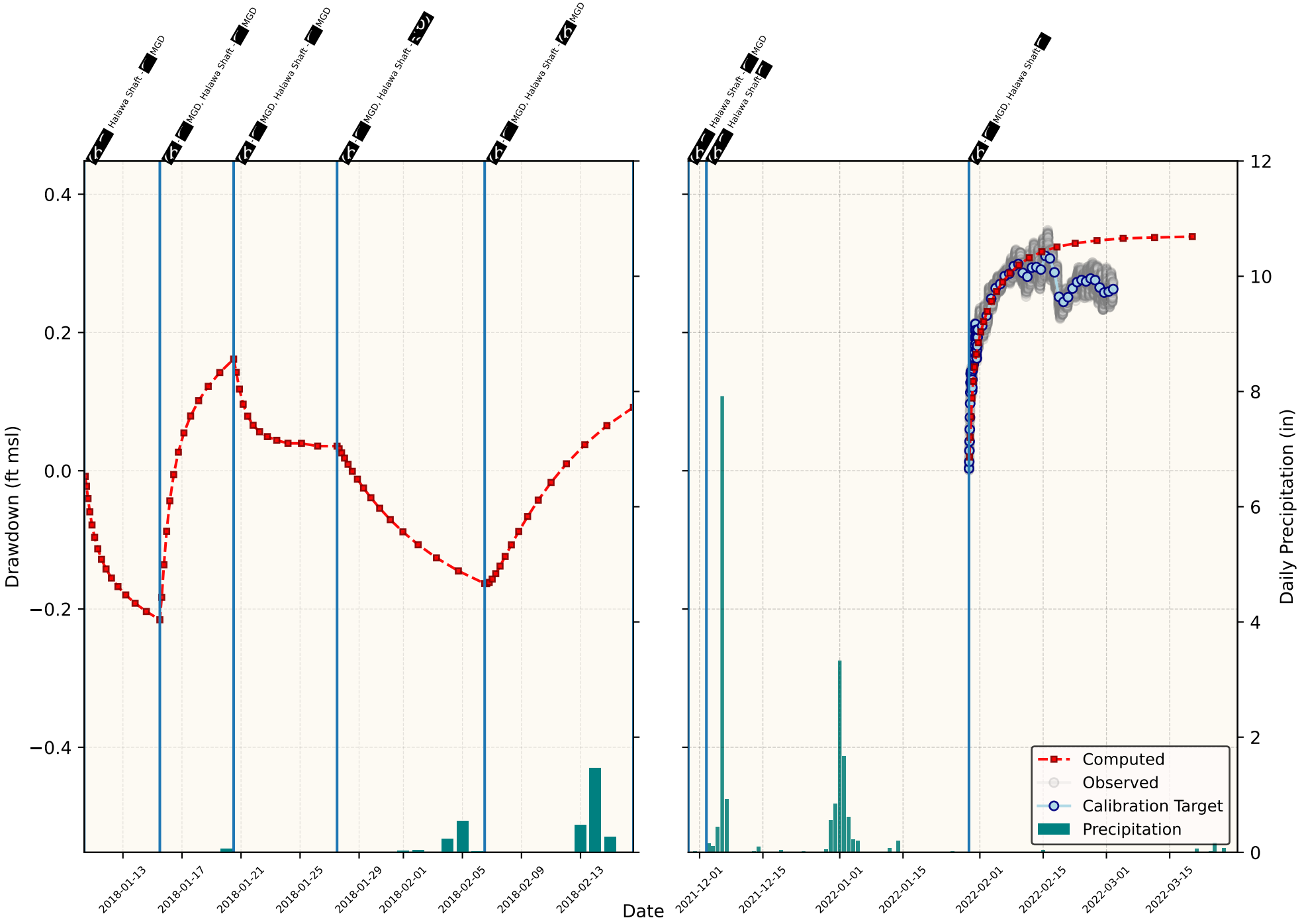
RHMW[redacted]

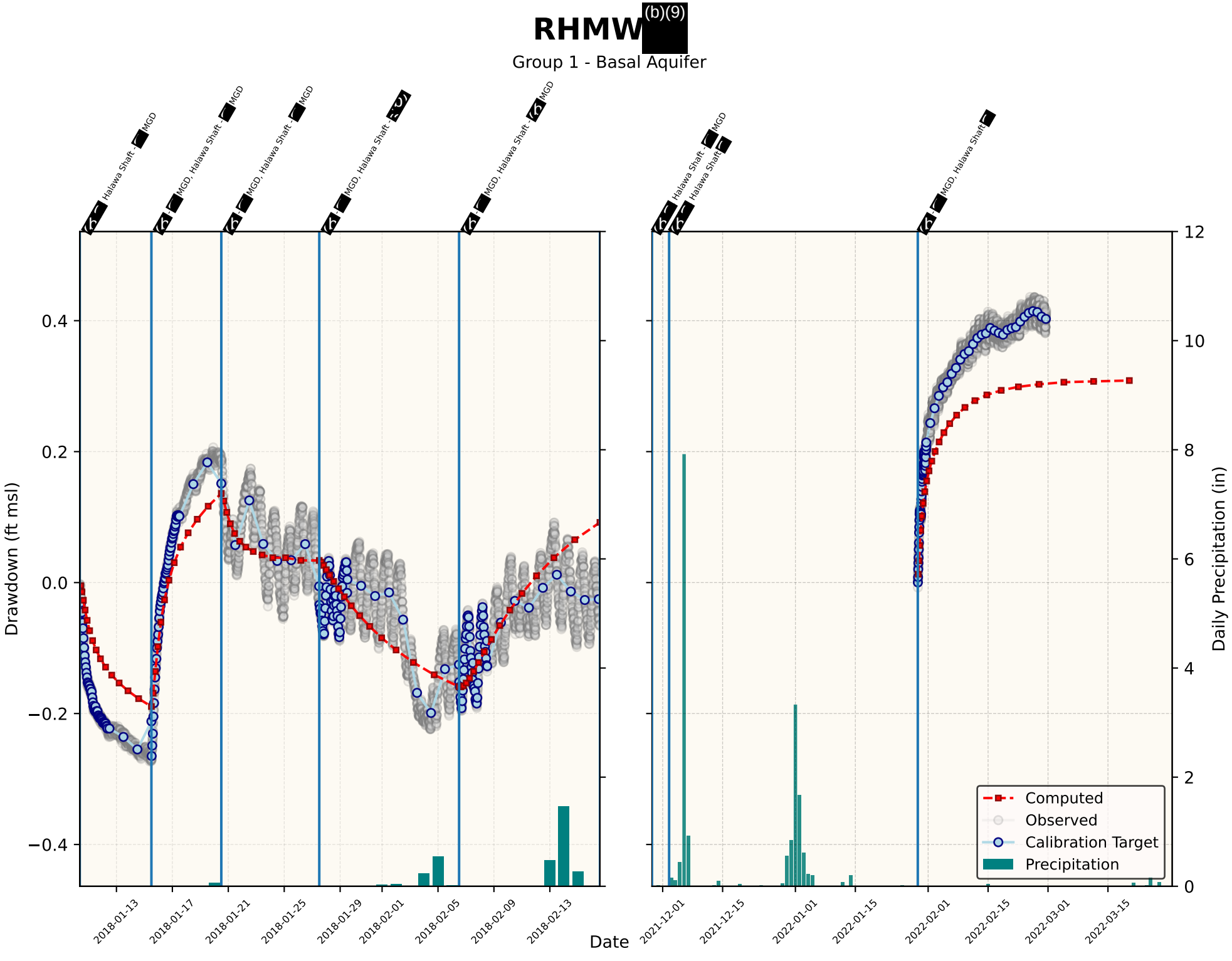
Group 1 - Basal Aquifer

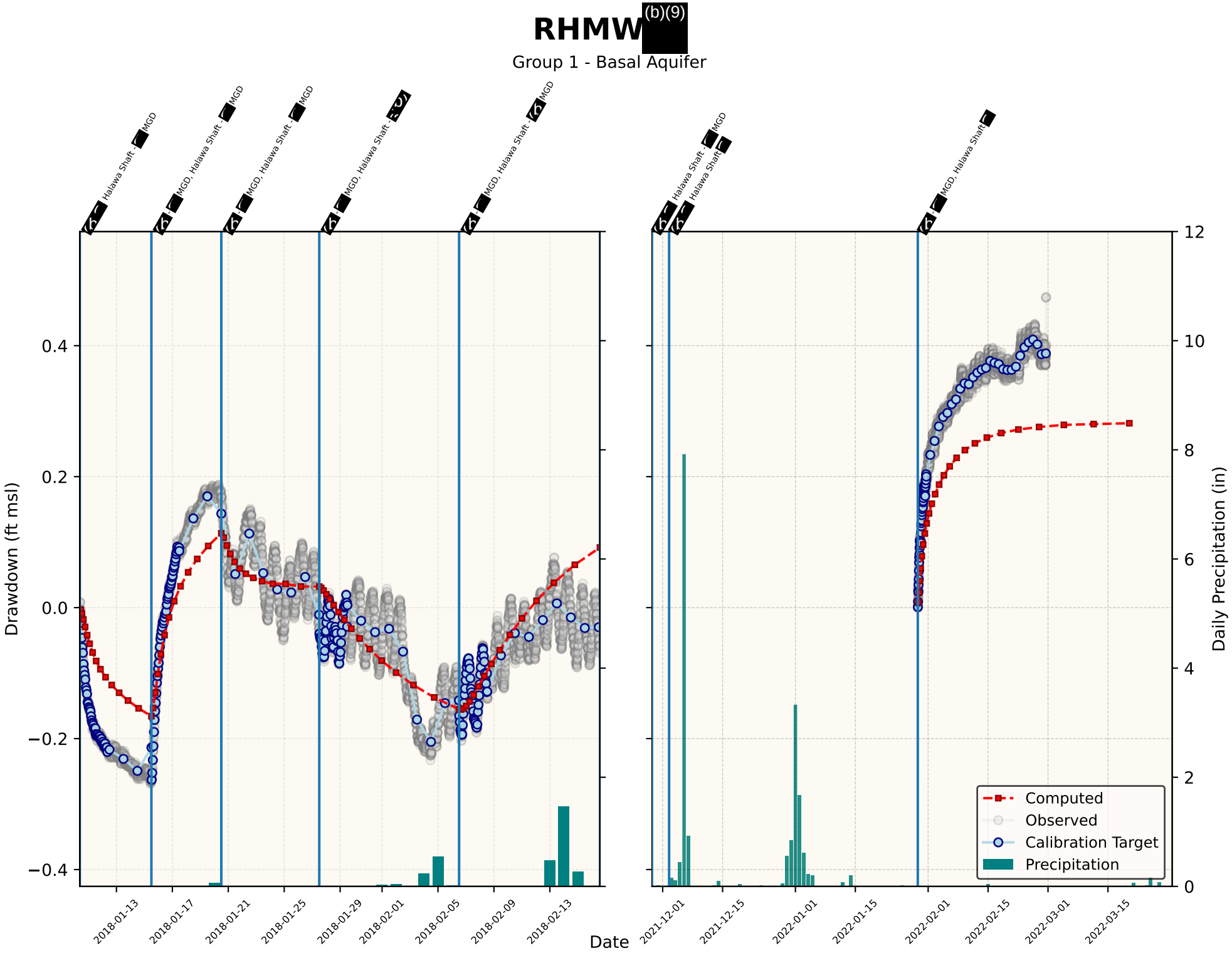


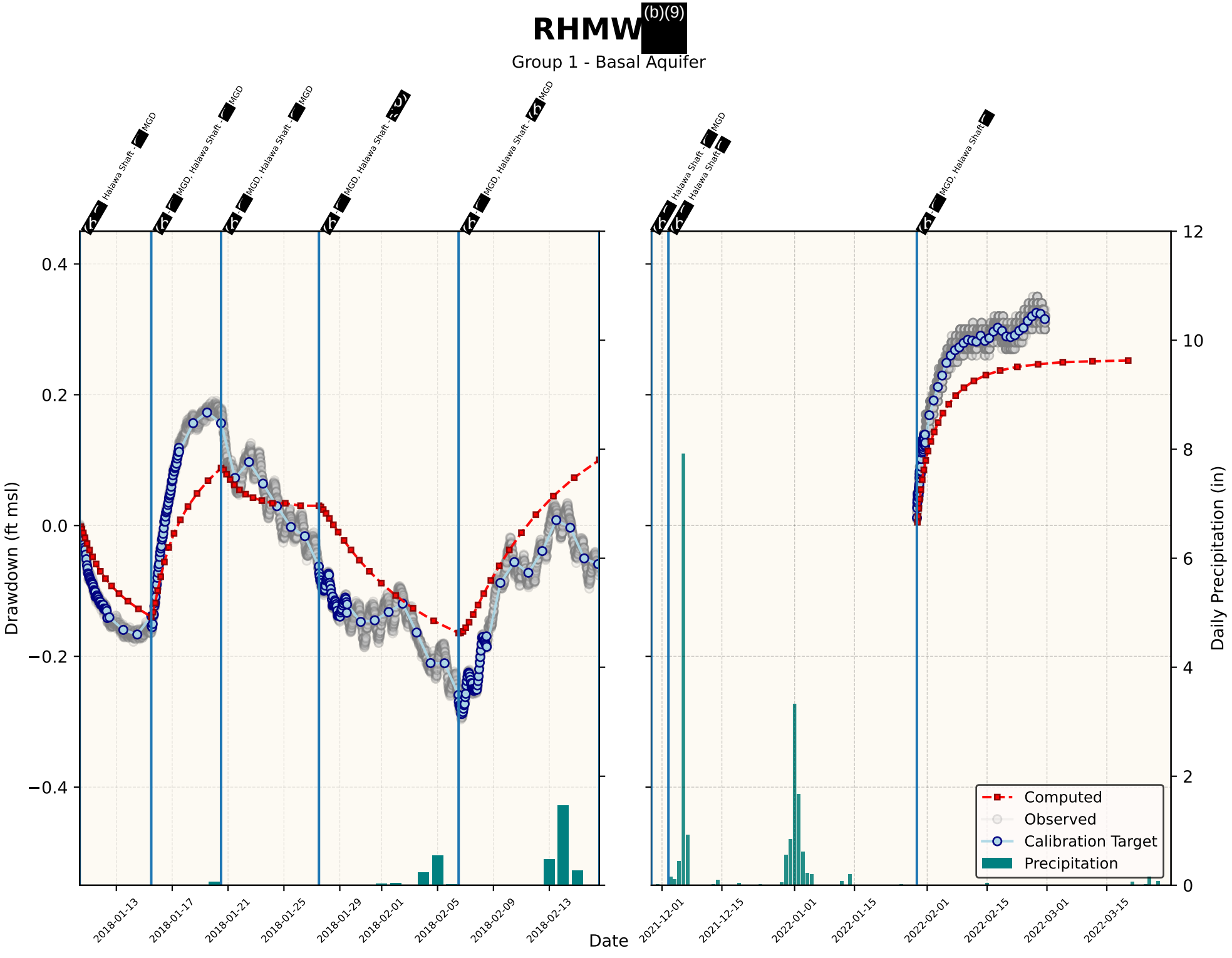
RHMW[redacted] (b)(9)

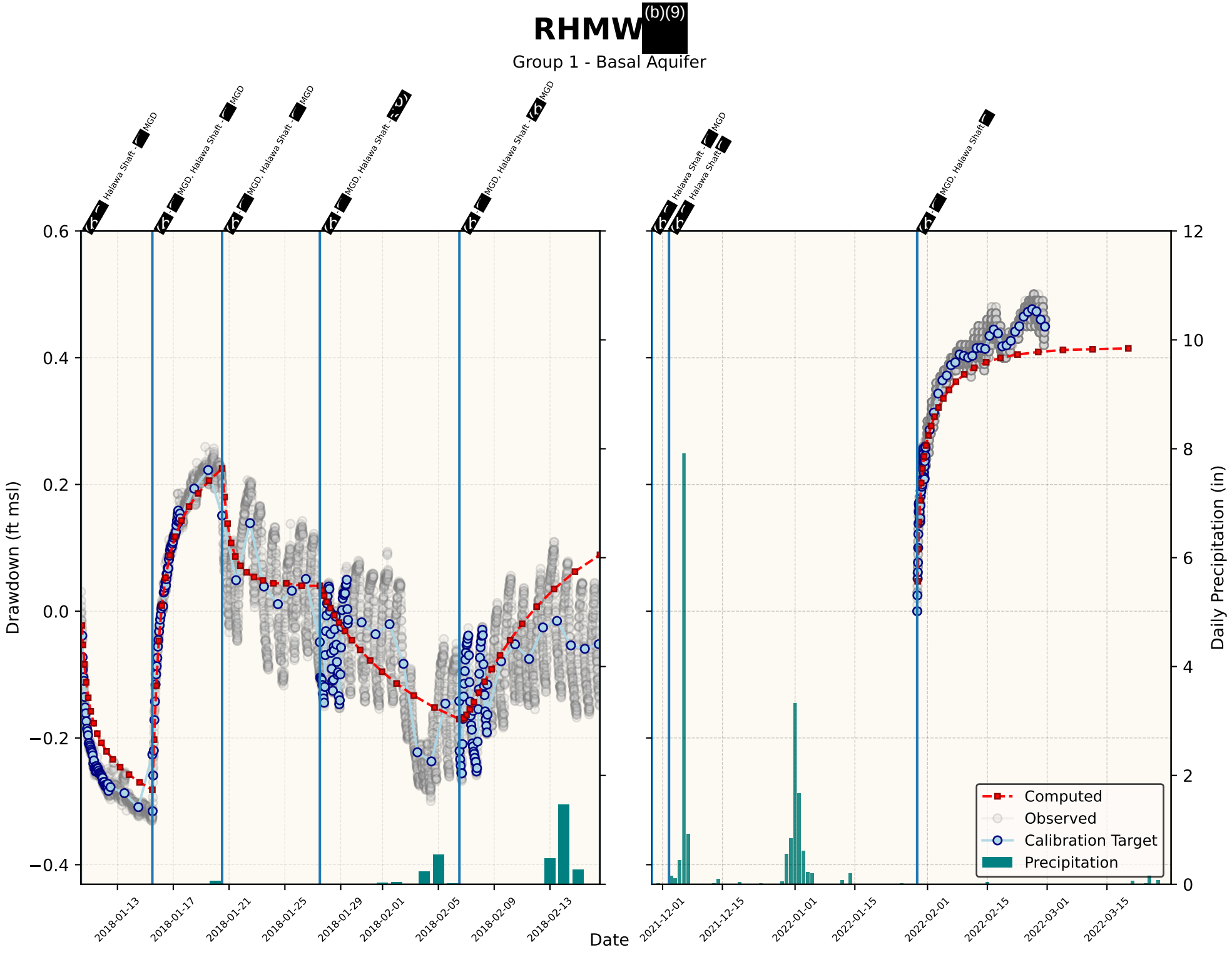
Group 1 - Basal Aquifer

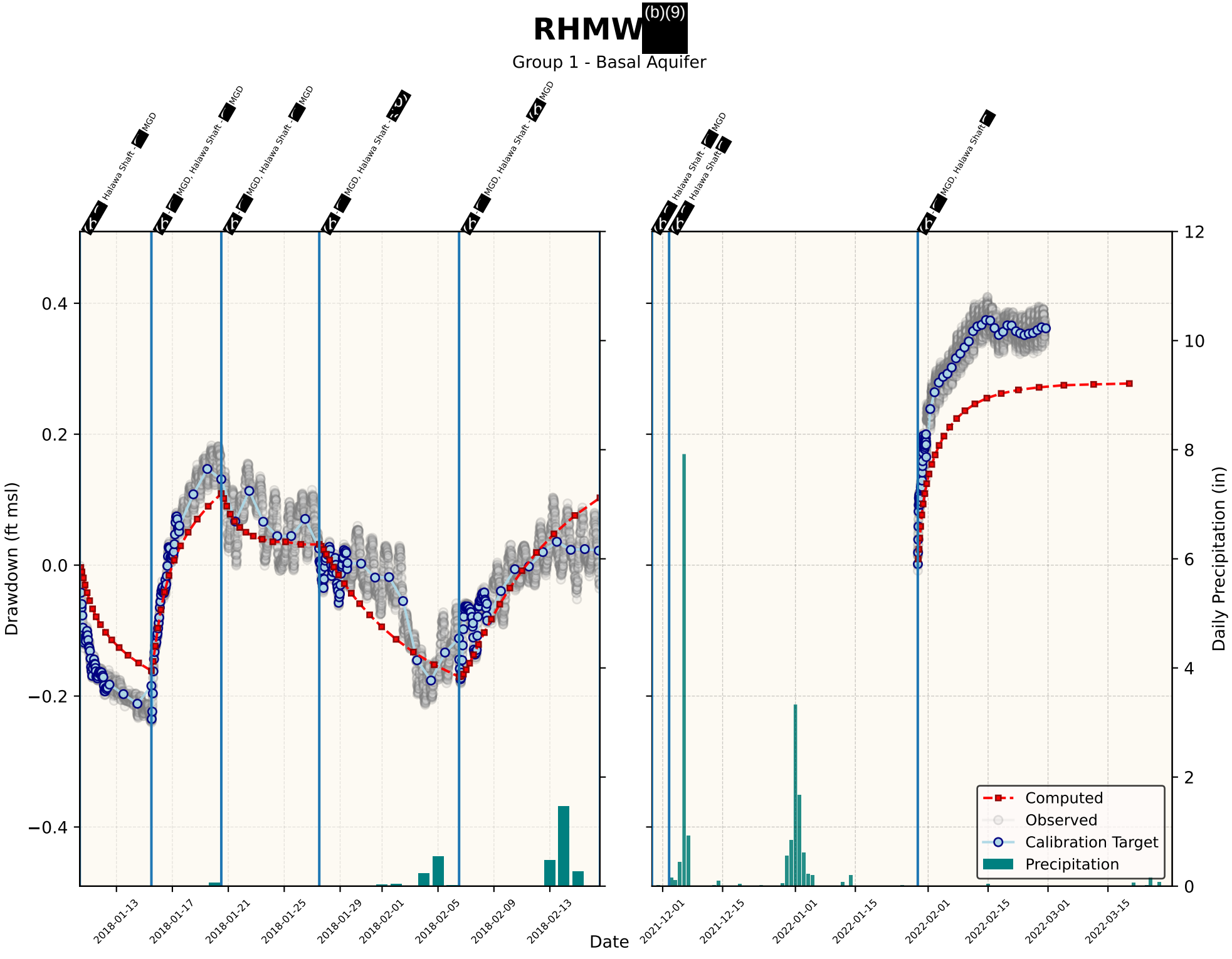


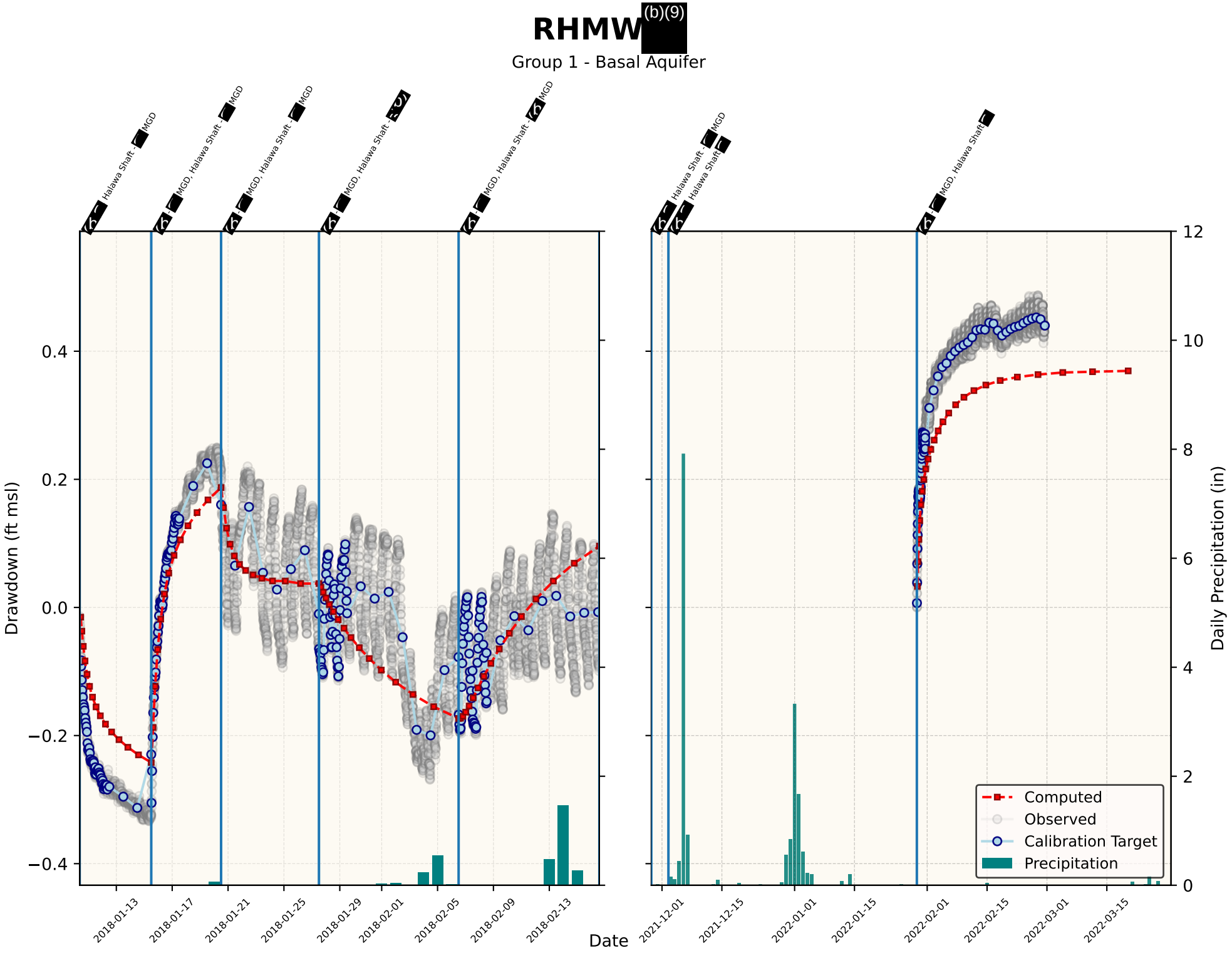

RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

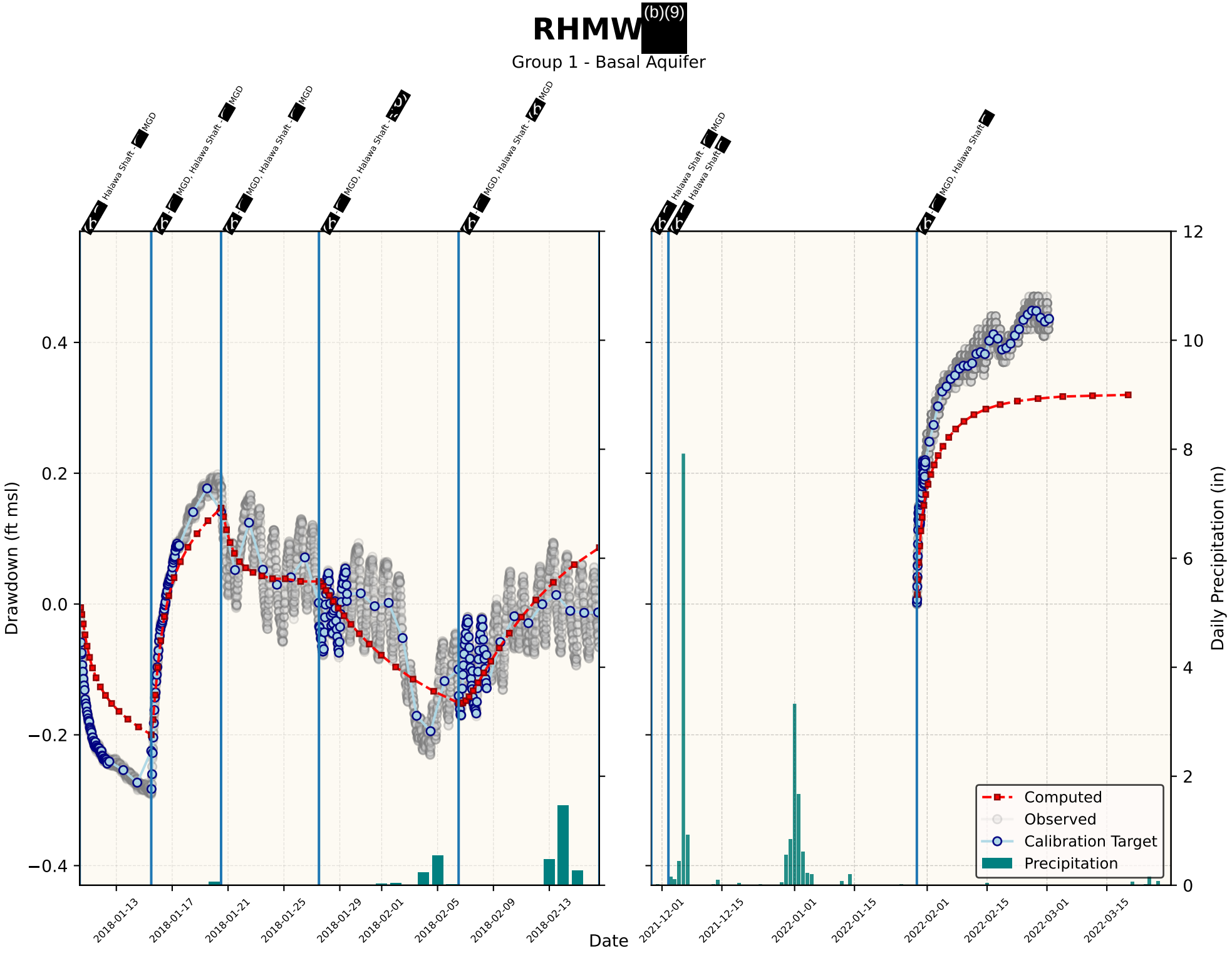

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

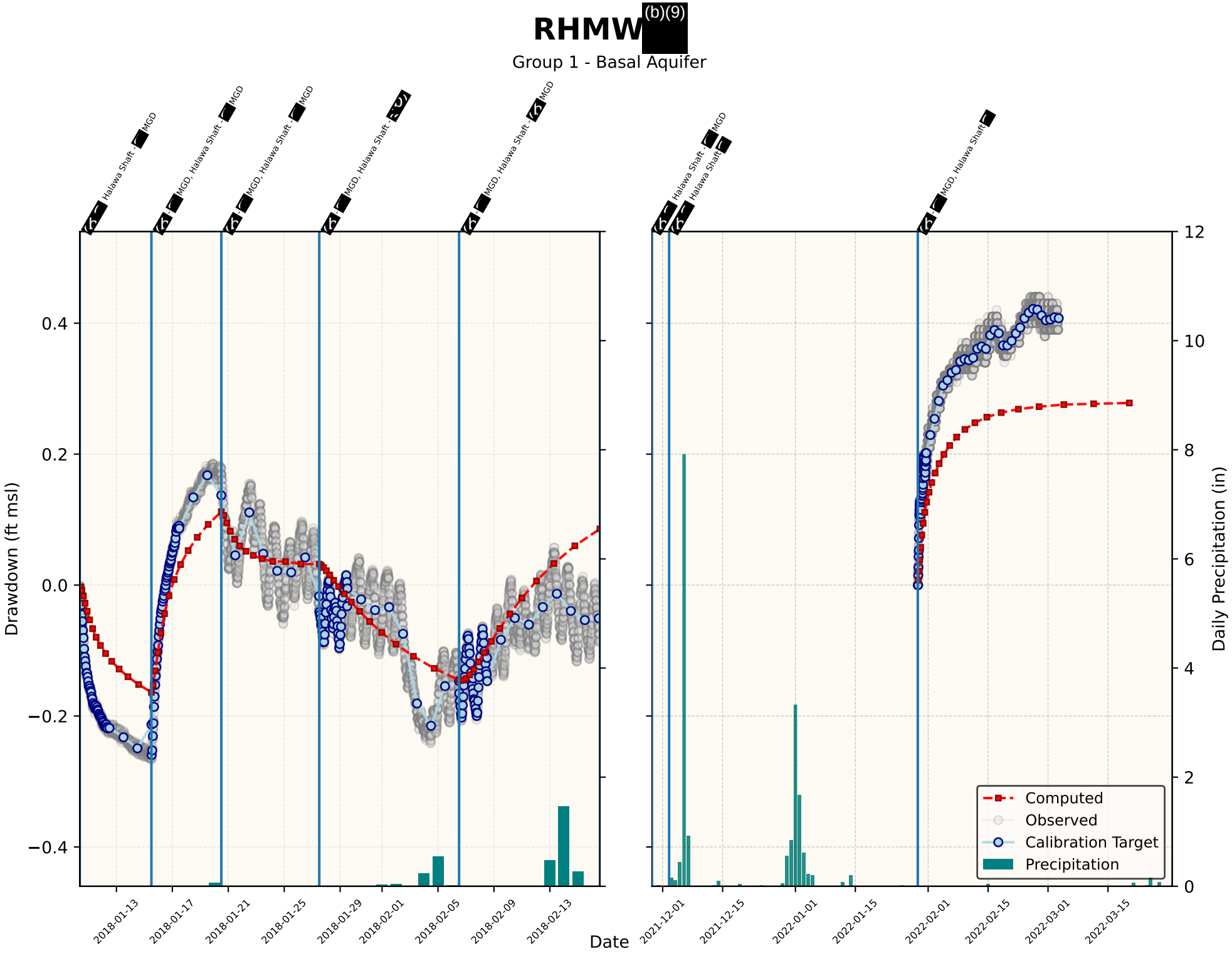

RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
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2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
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2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-01-01
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Date
Computed
Observed
Calibration Target
Precipitation

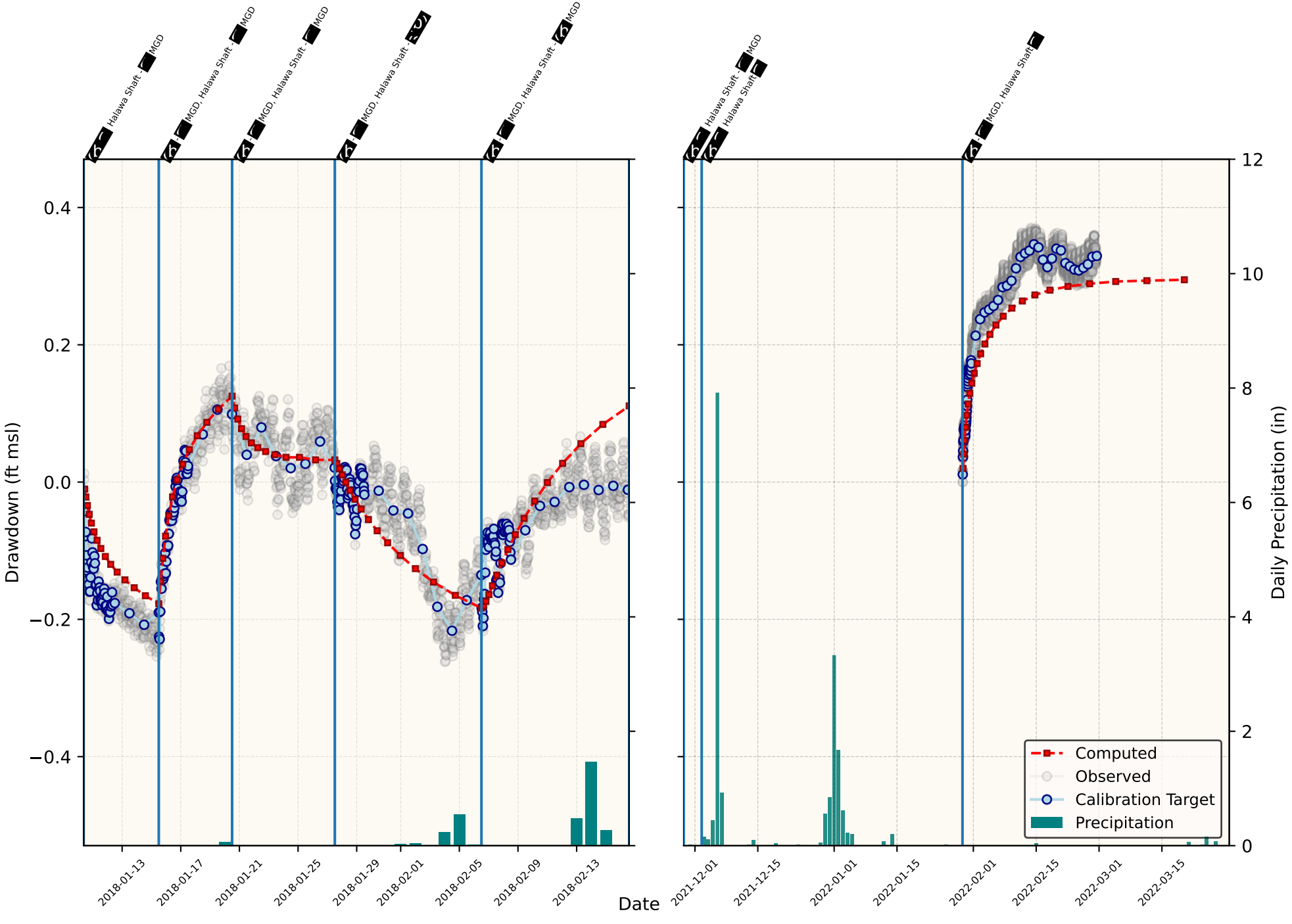

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
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2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date


RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-15
Date

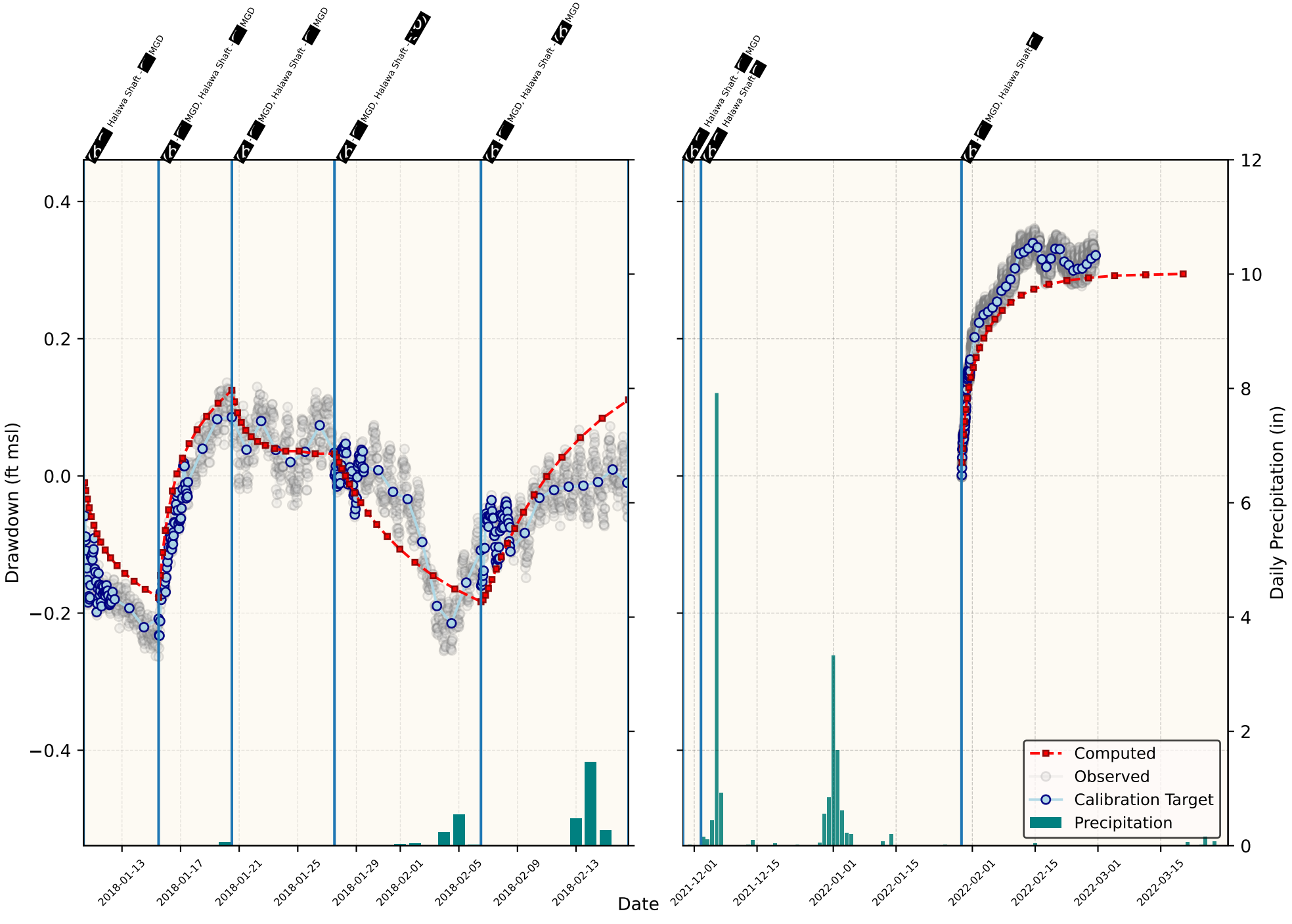
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



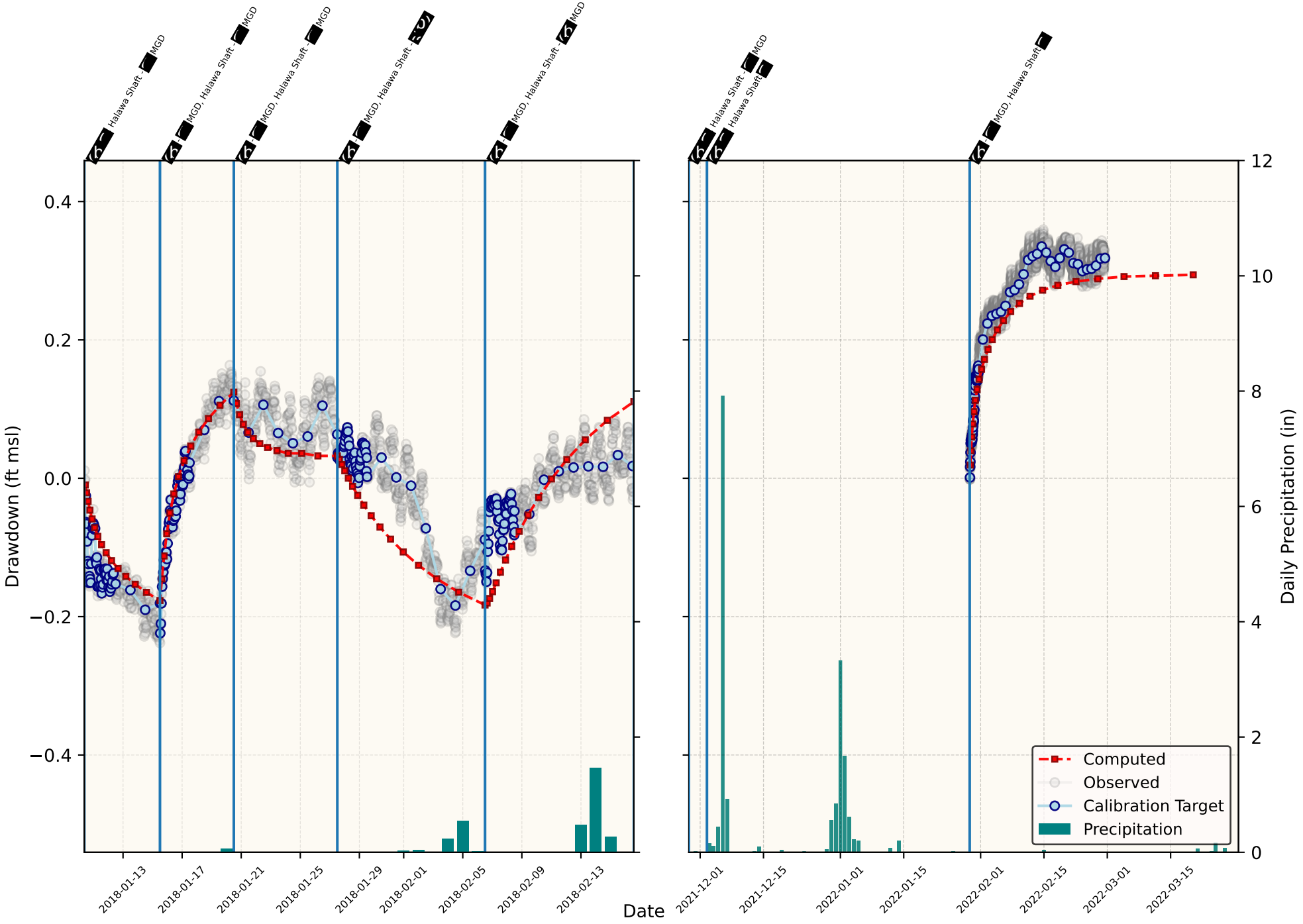
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



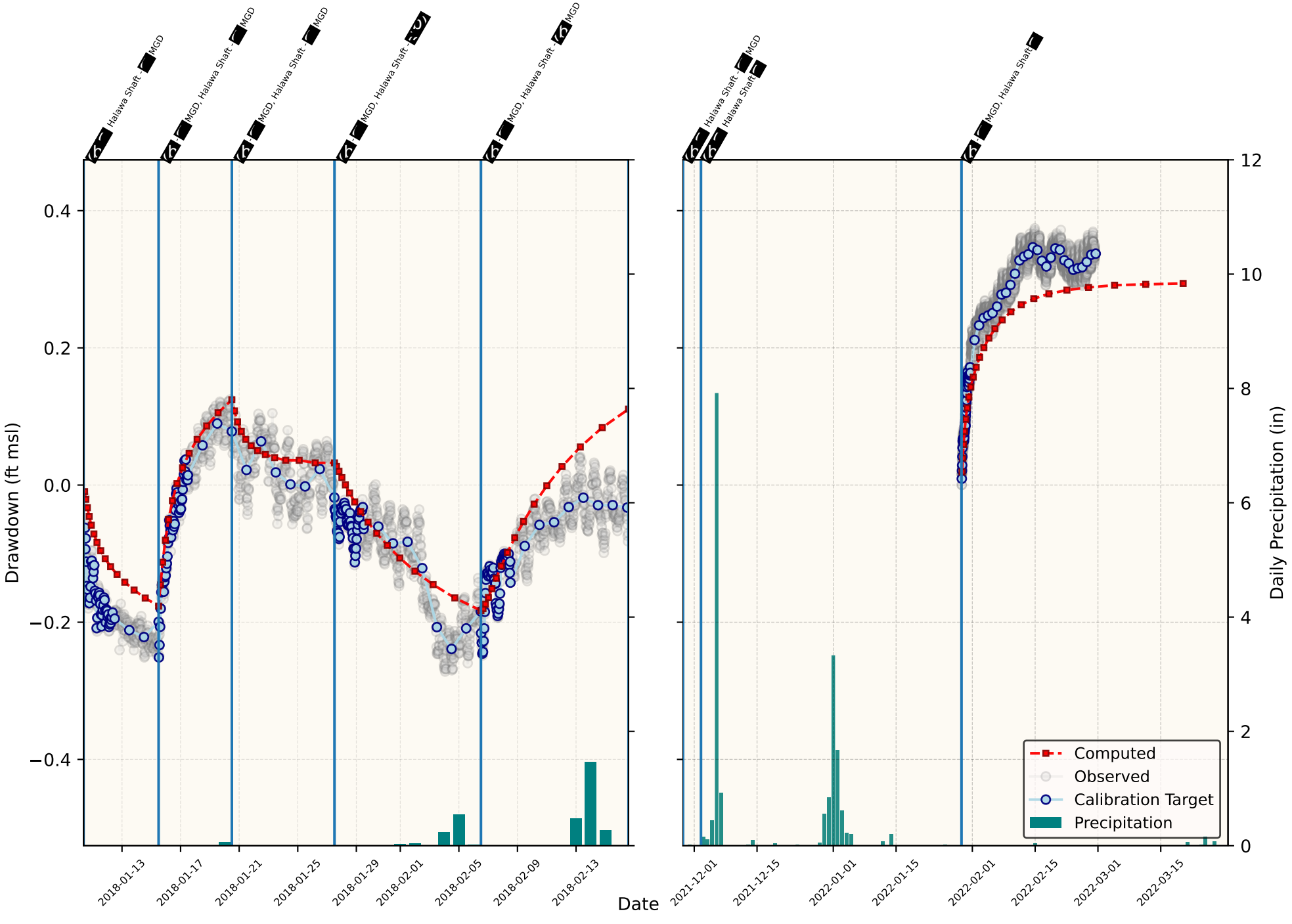
RHMW (b)(9)

Group 1 - Basal Aquifer



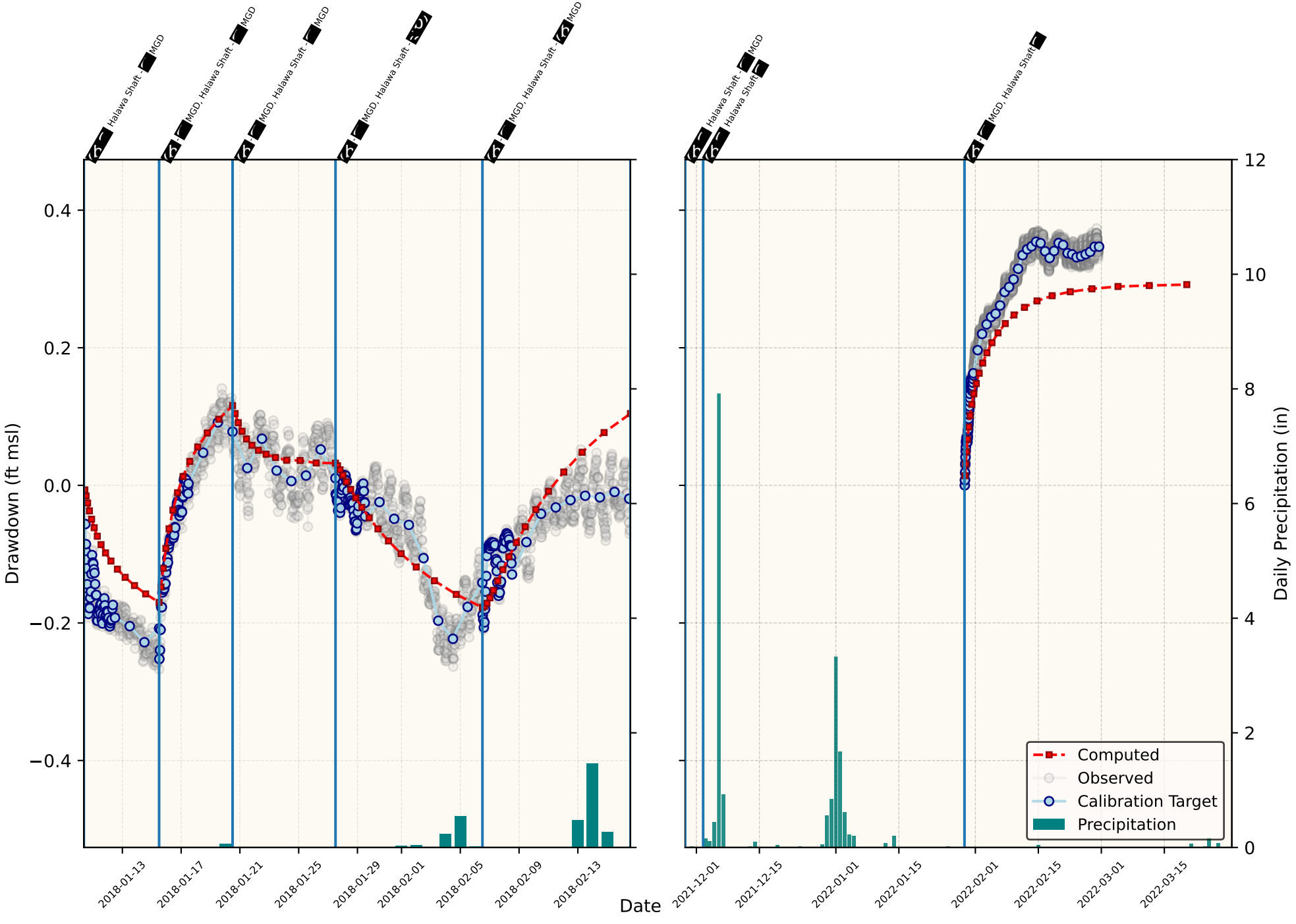
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



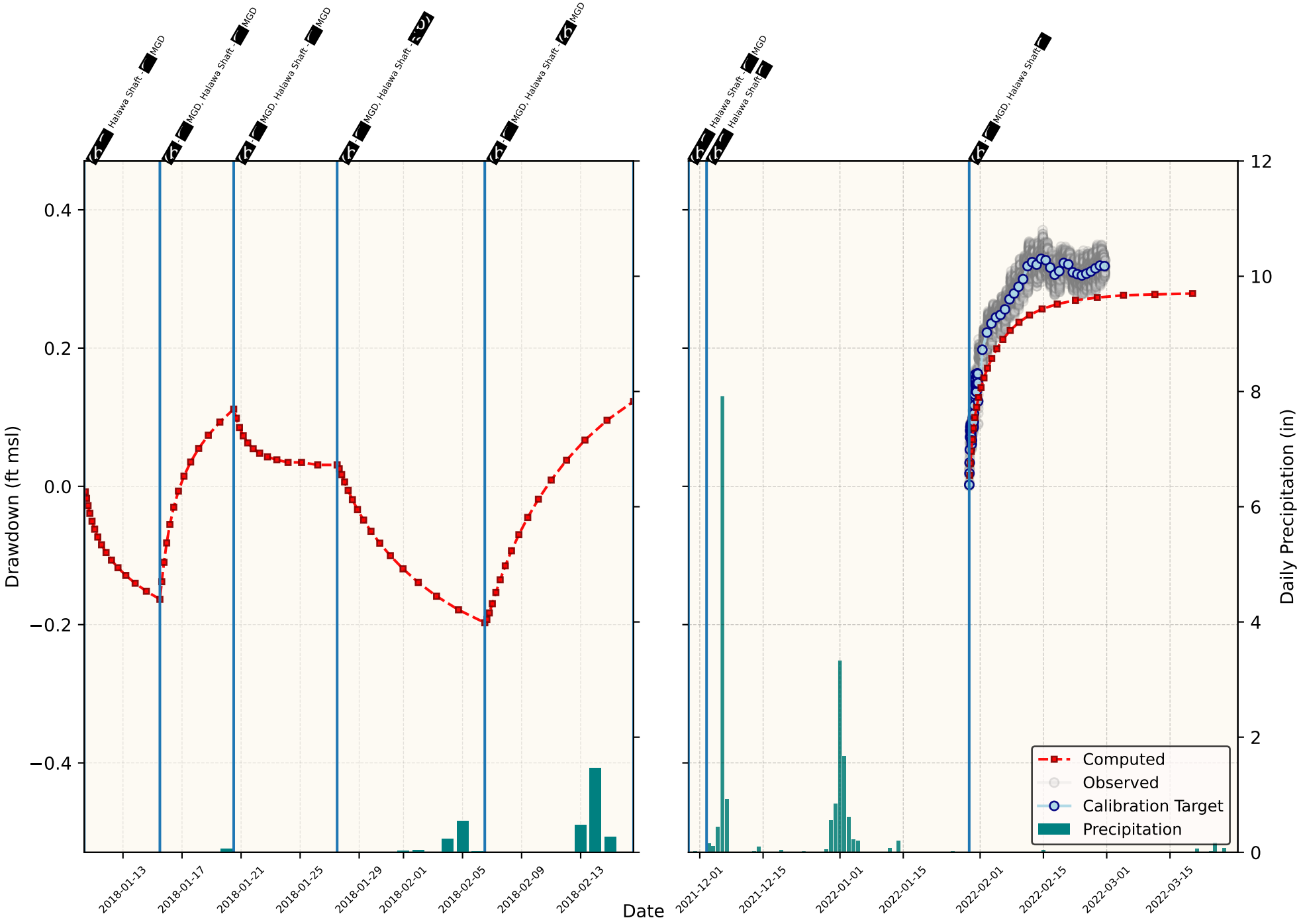
RHMW (b)(9)

Group 1 - Basal Aquifer



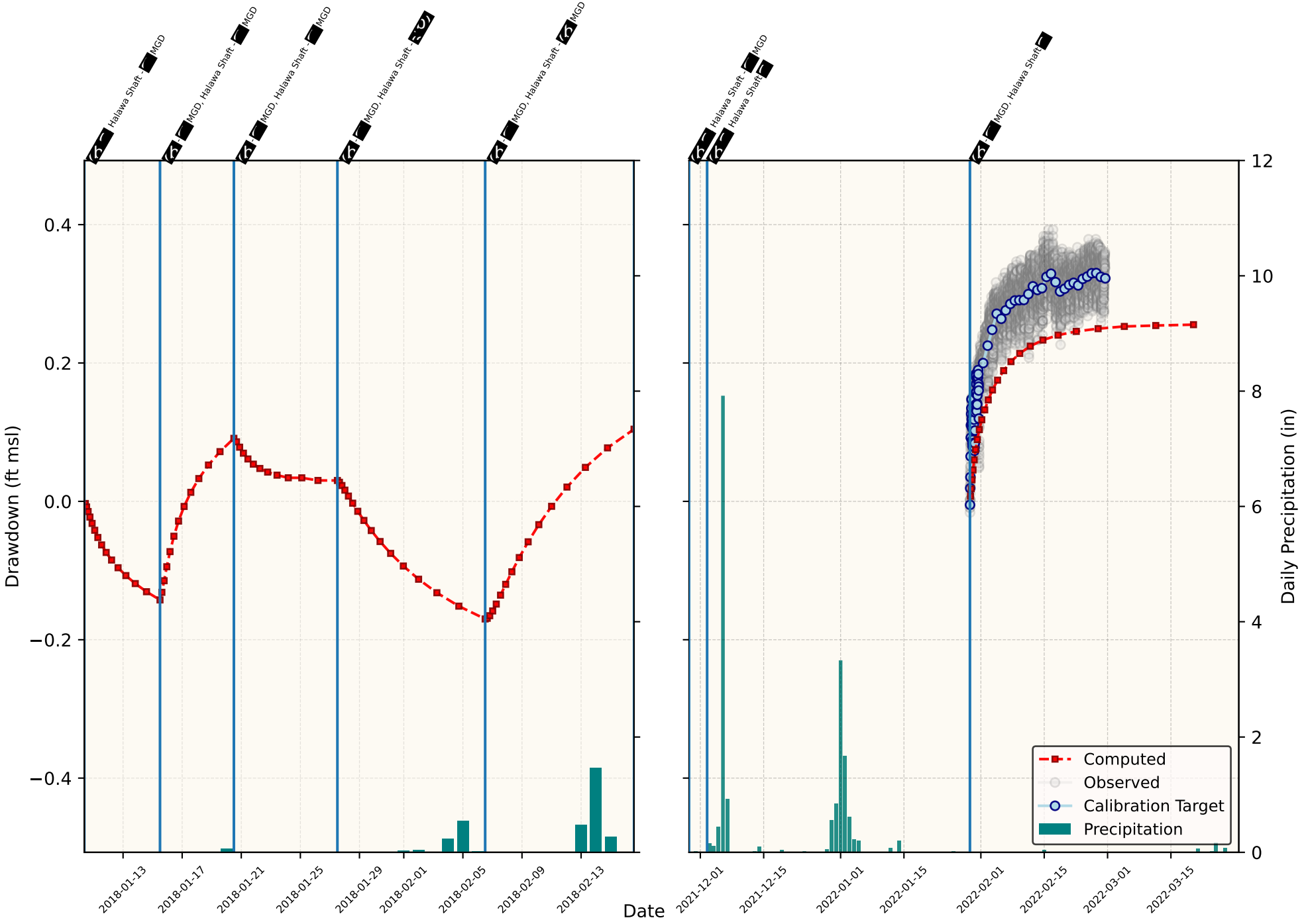
RHMW[redacted]

Group 1 - Basal Aquifer



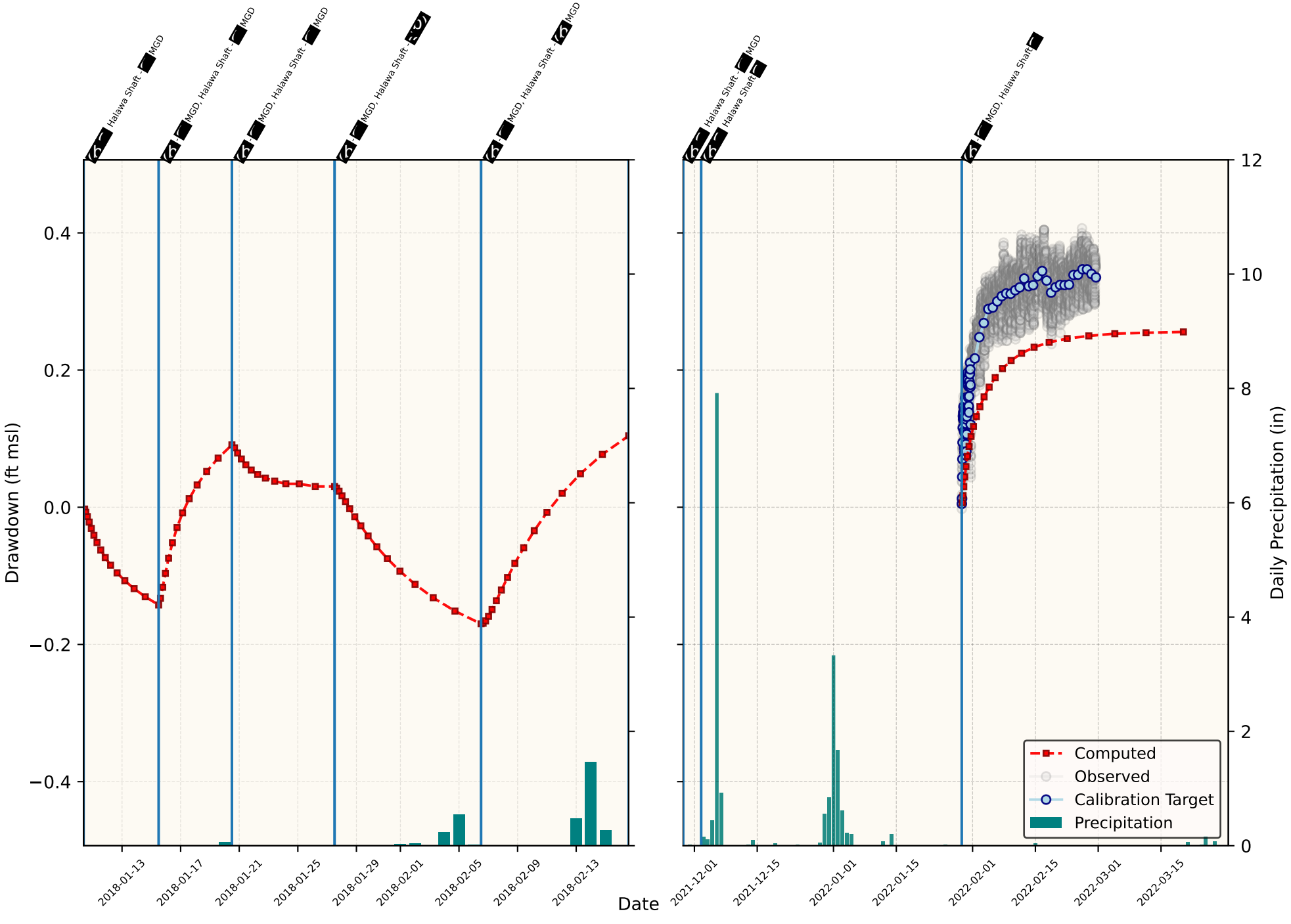
RHMW [redacted] (b)(9)

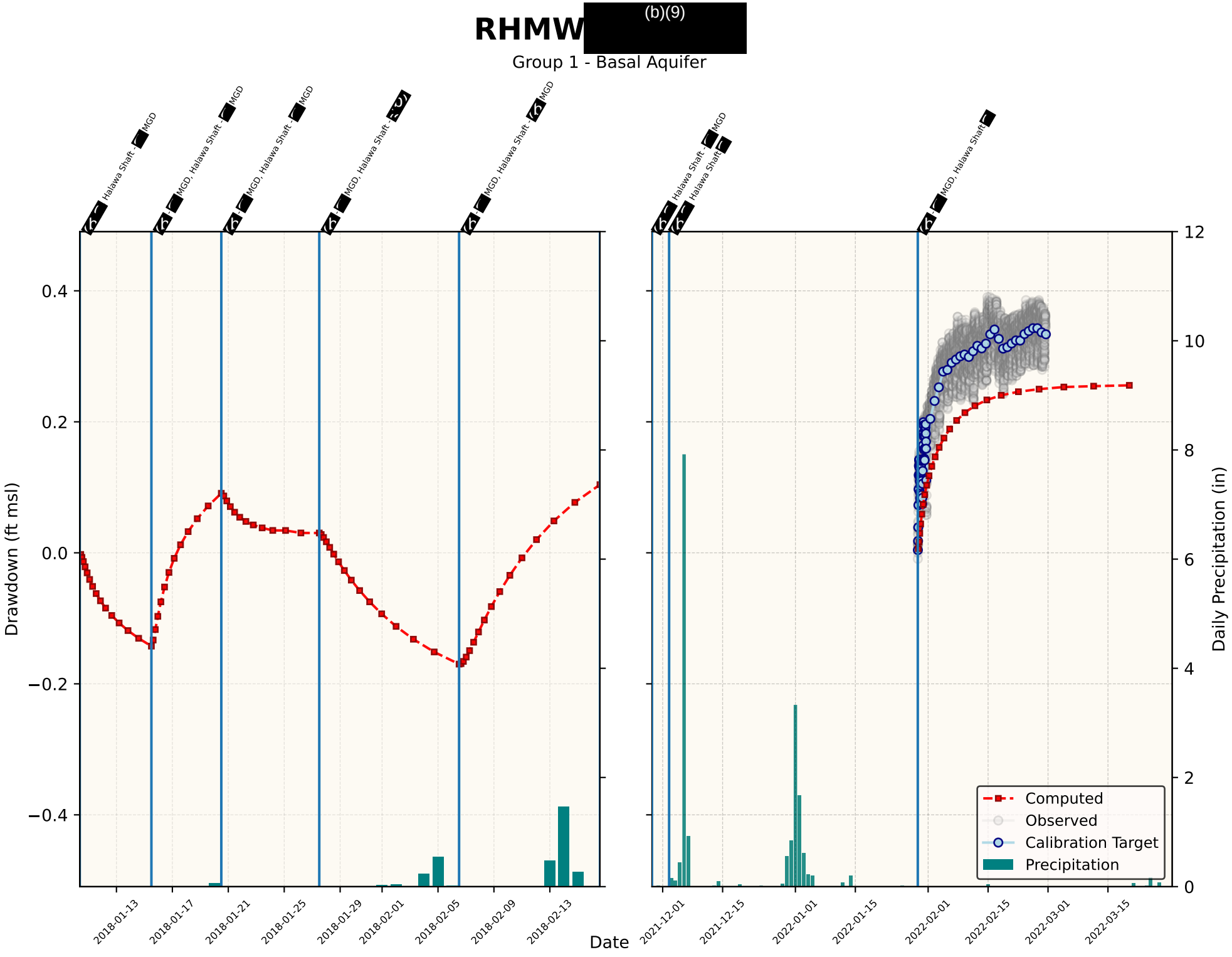
Group 1 - Basal Aquifer



RHMW [redacted] (b)(9)

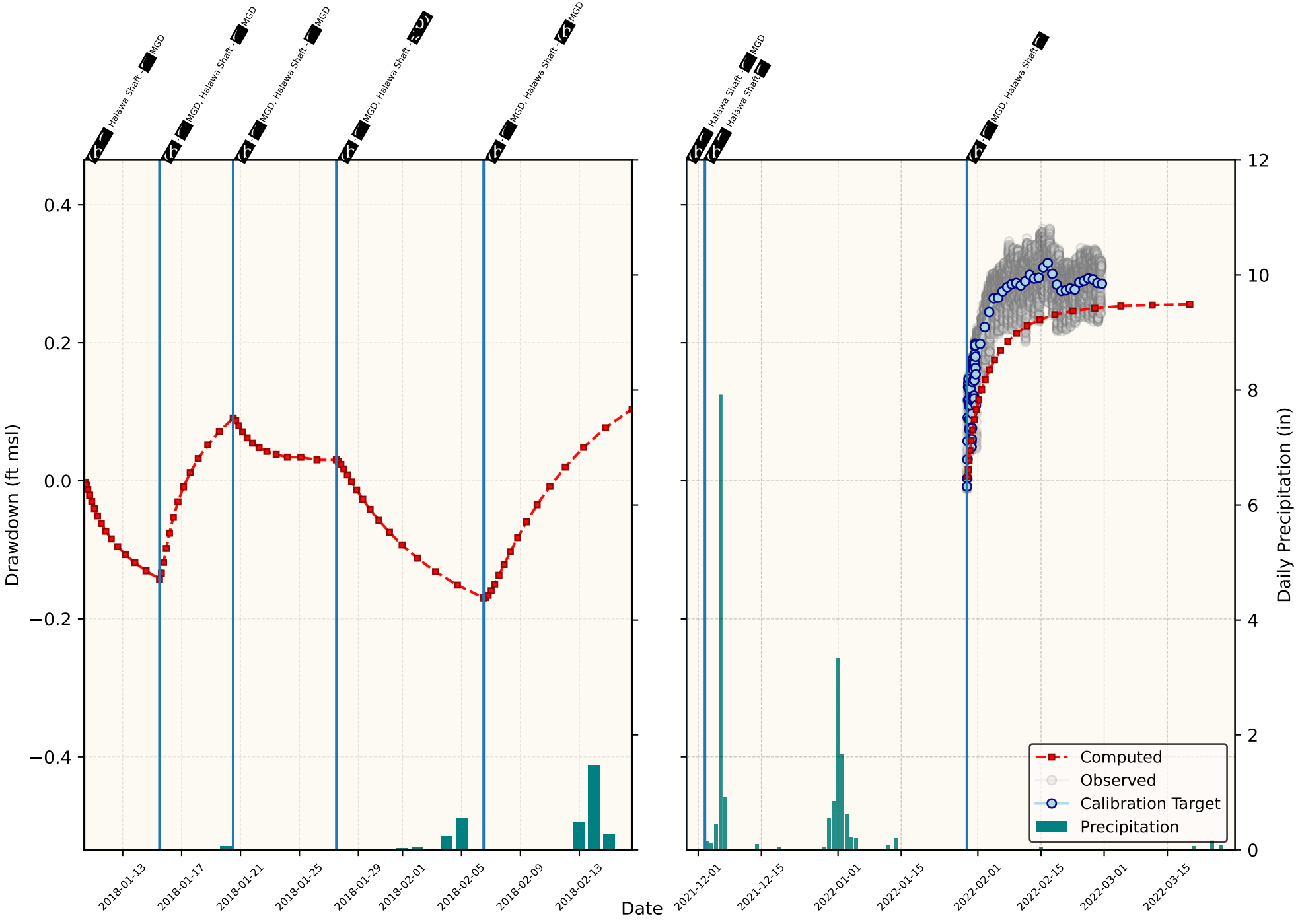
Group 1 - Basal Aquifer

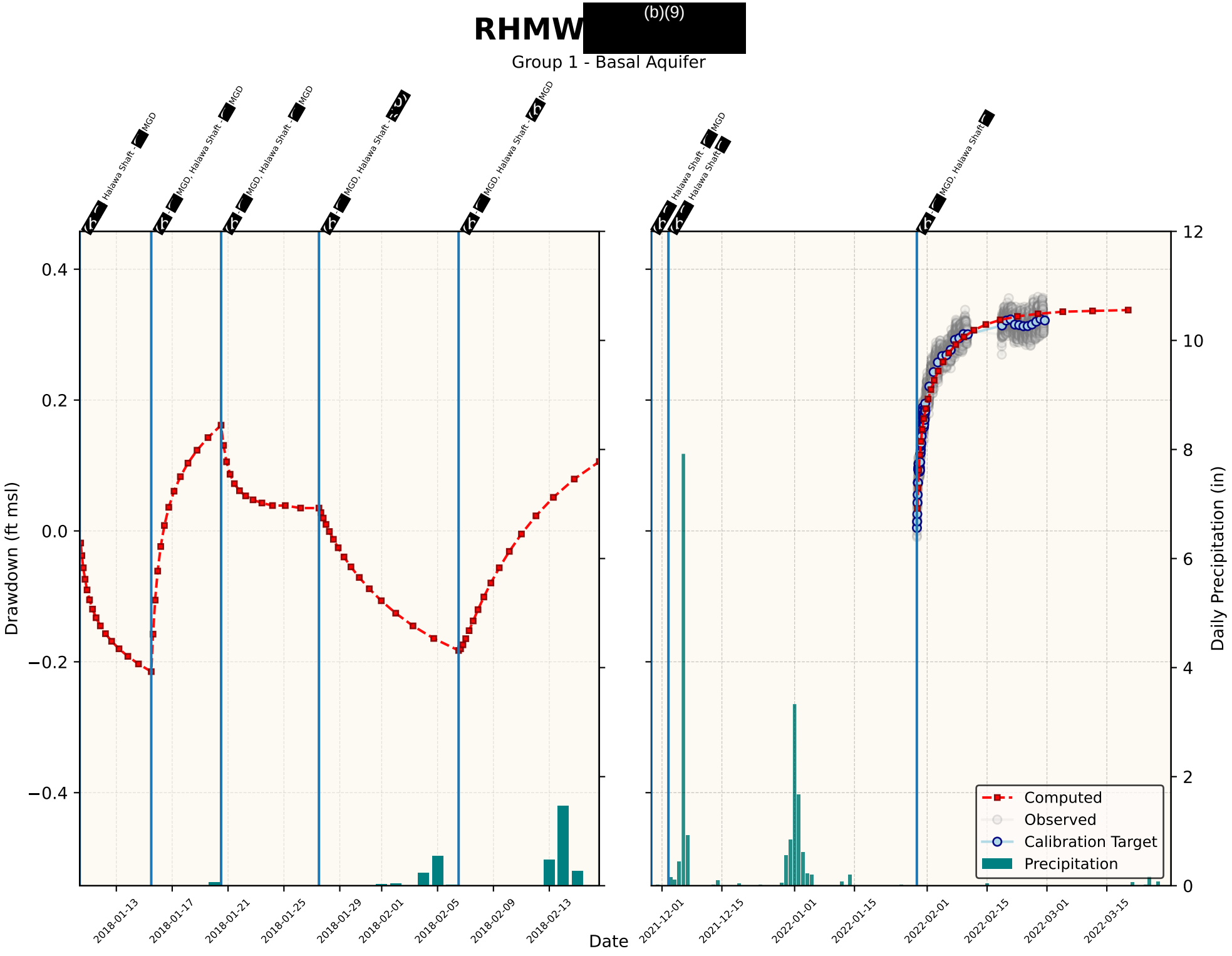


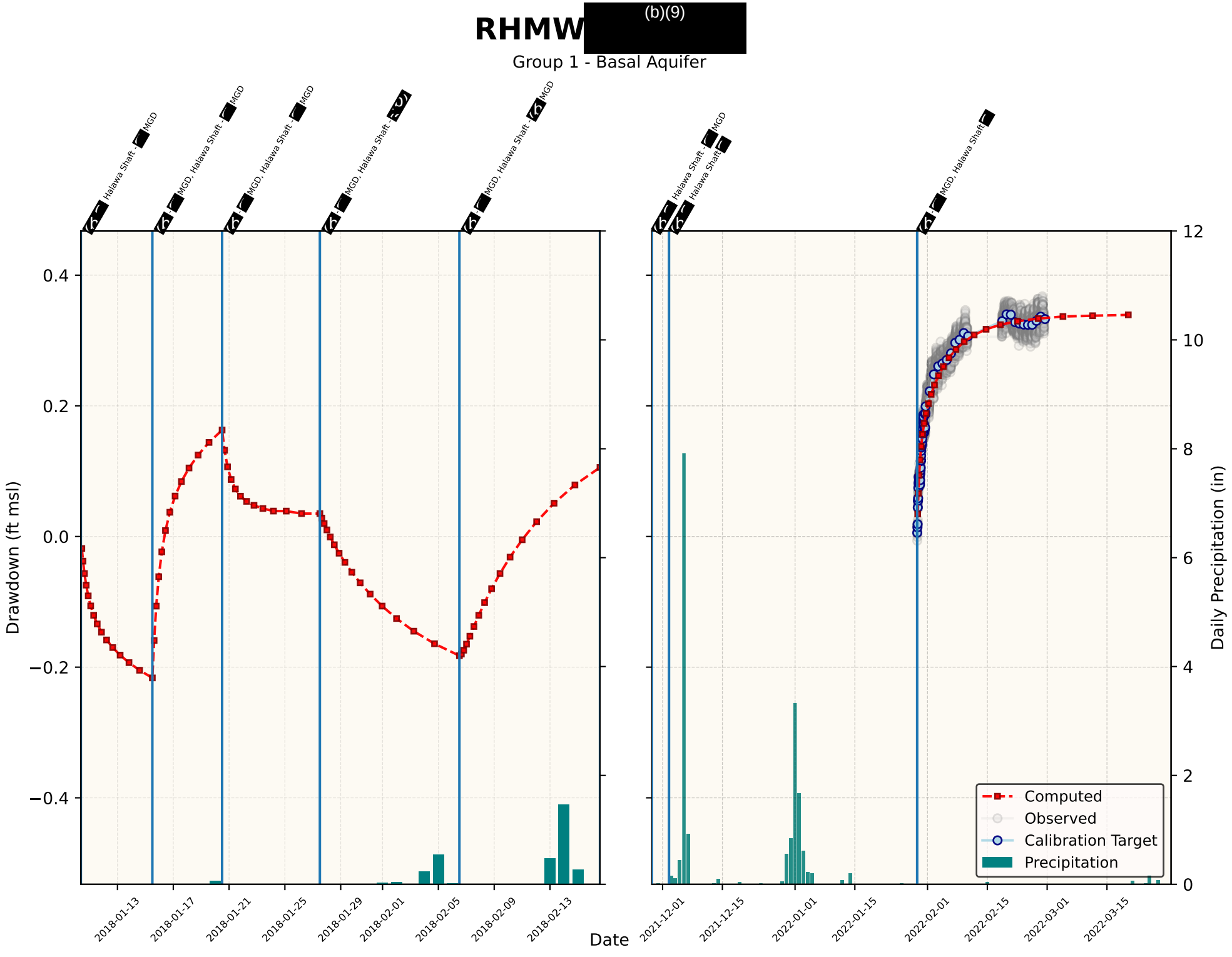

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

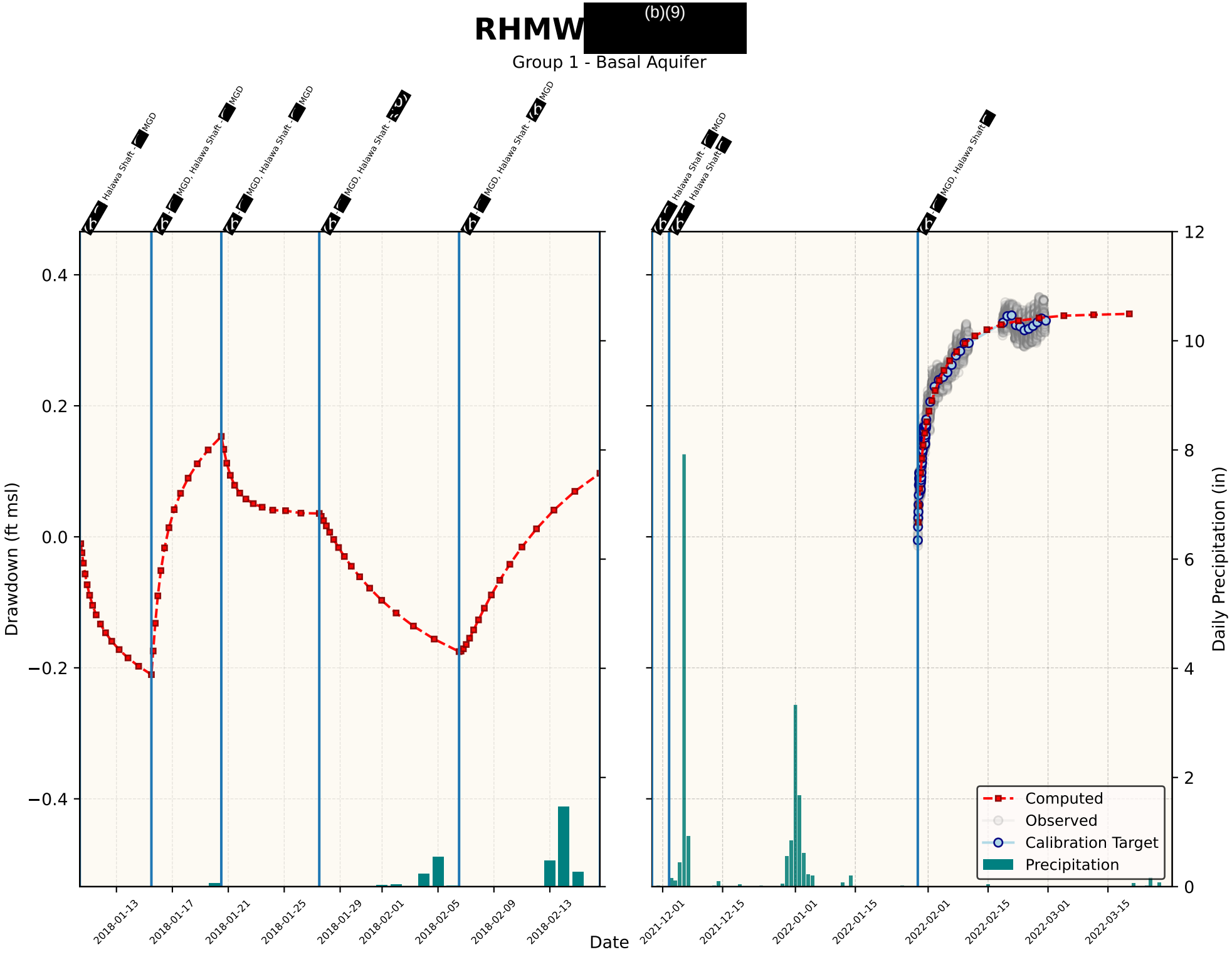
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



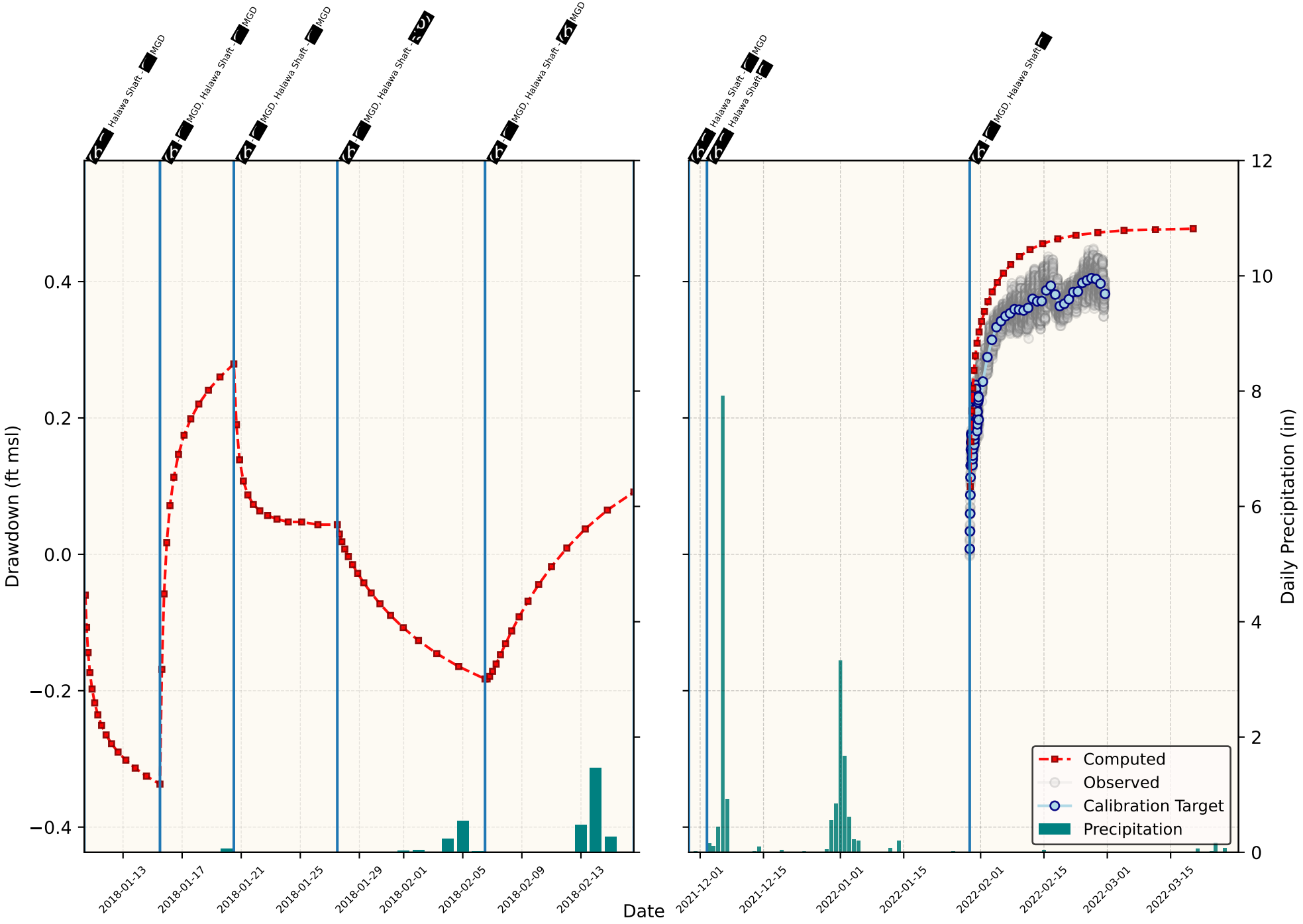

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
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2021-12-01
2021-12-15
2022-01-01
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2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

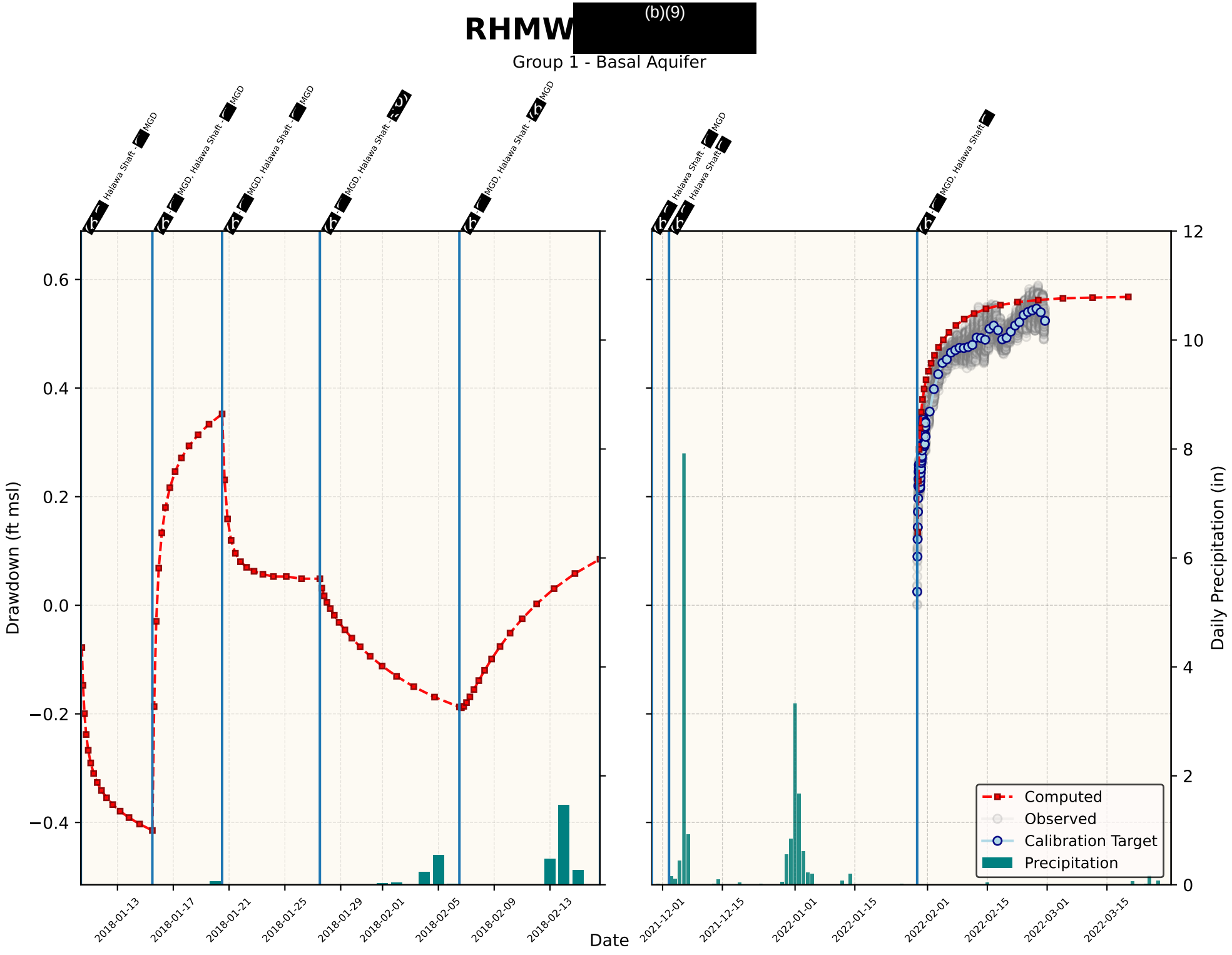

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
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2022-01-01
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2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

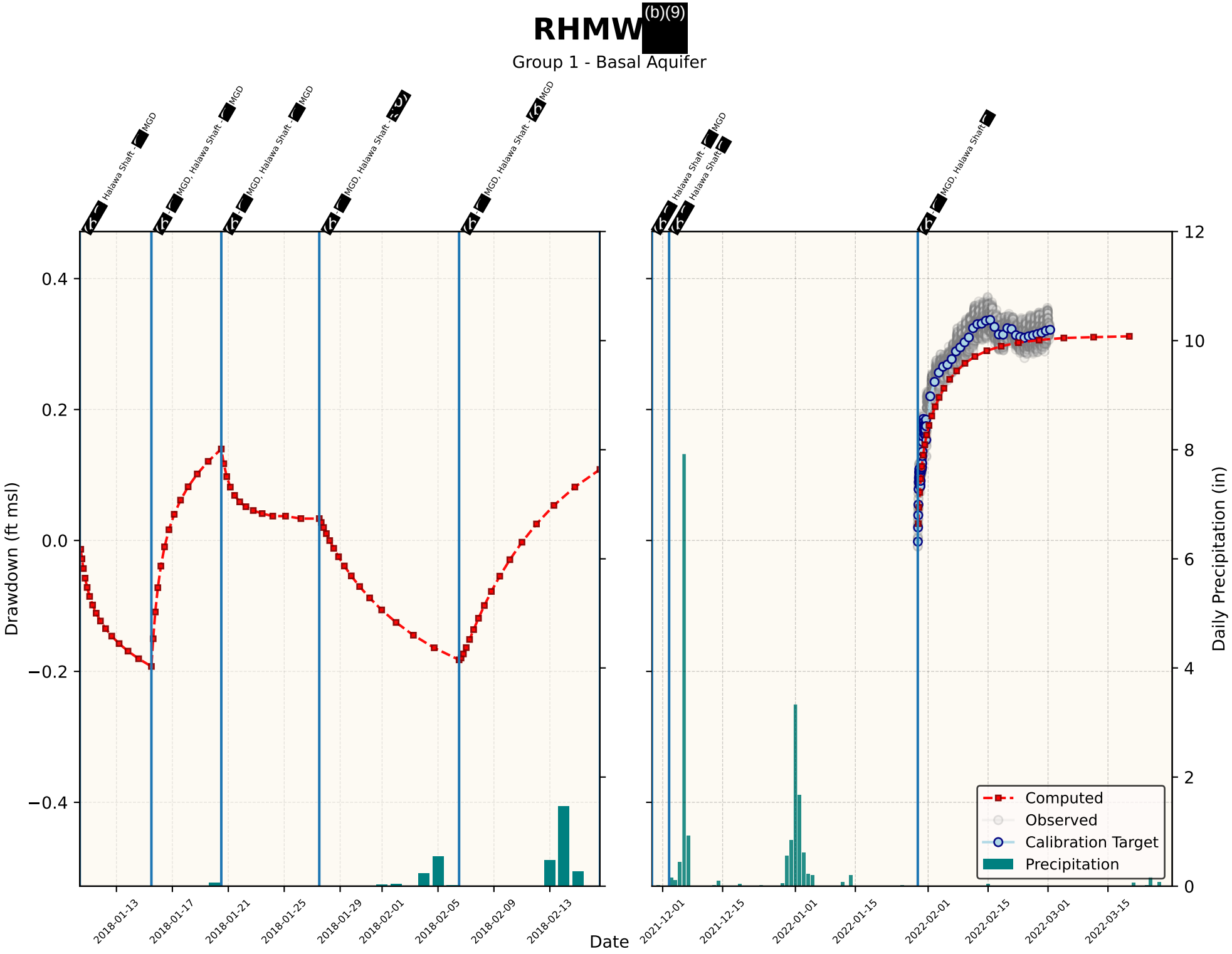

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
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2022-03-15

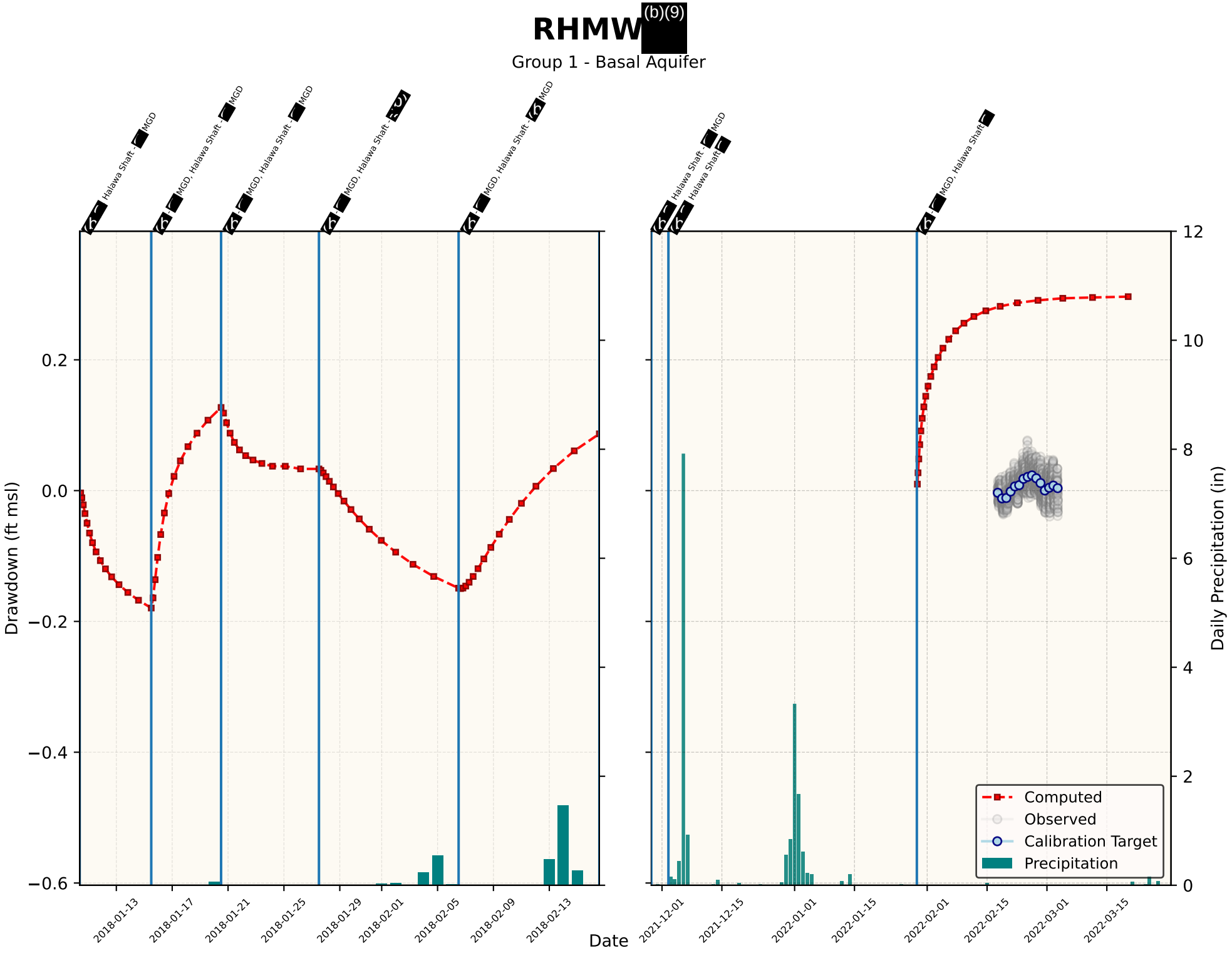
RHMW [redacted] (b)(9)

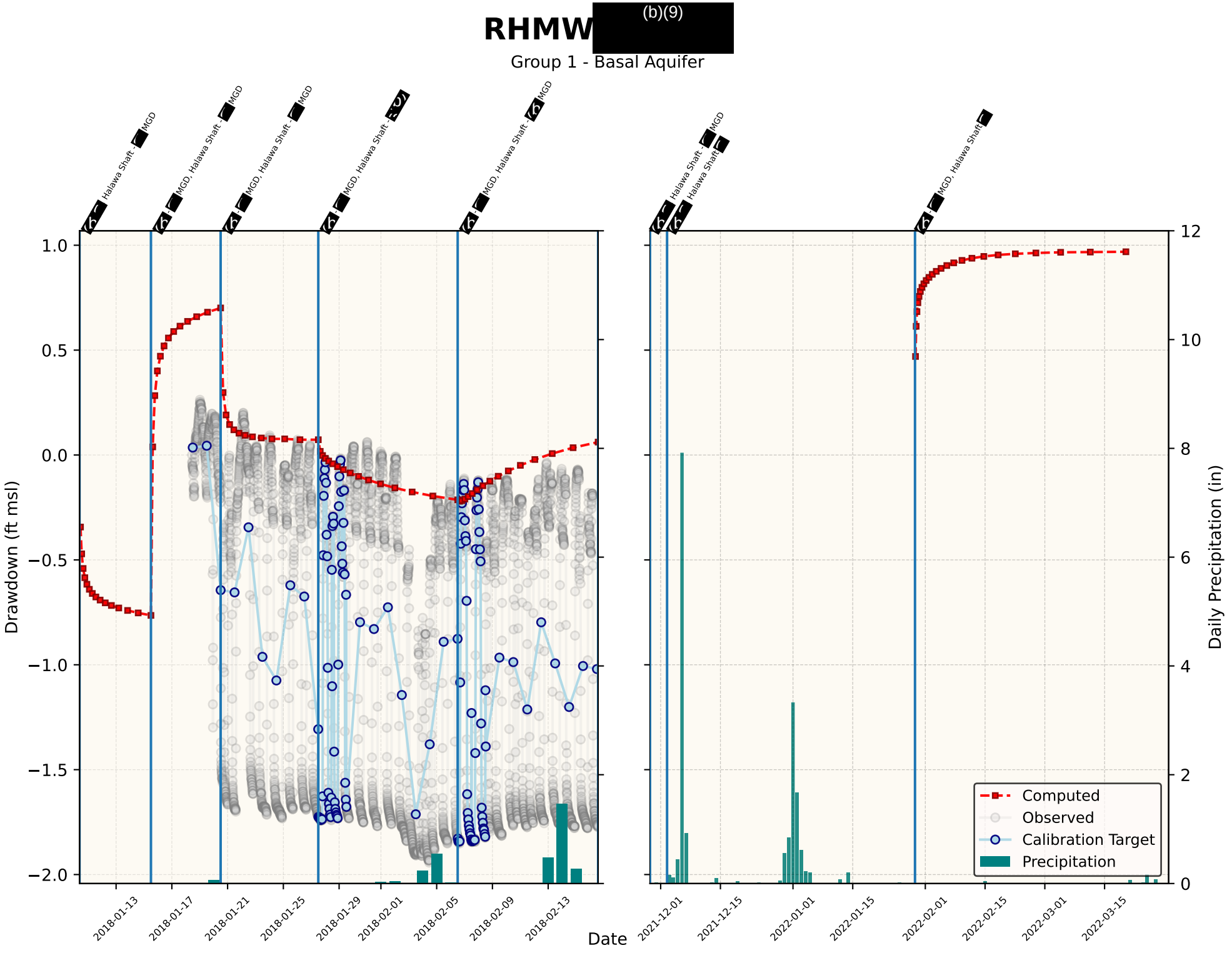
Group 1 - Basal Aquifer




RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.6
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

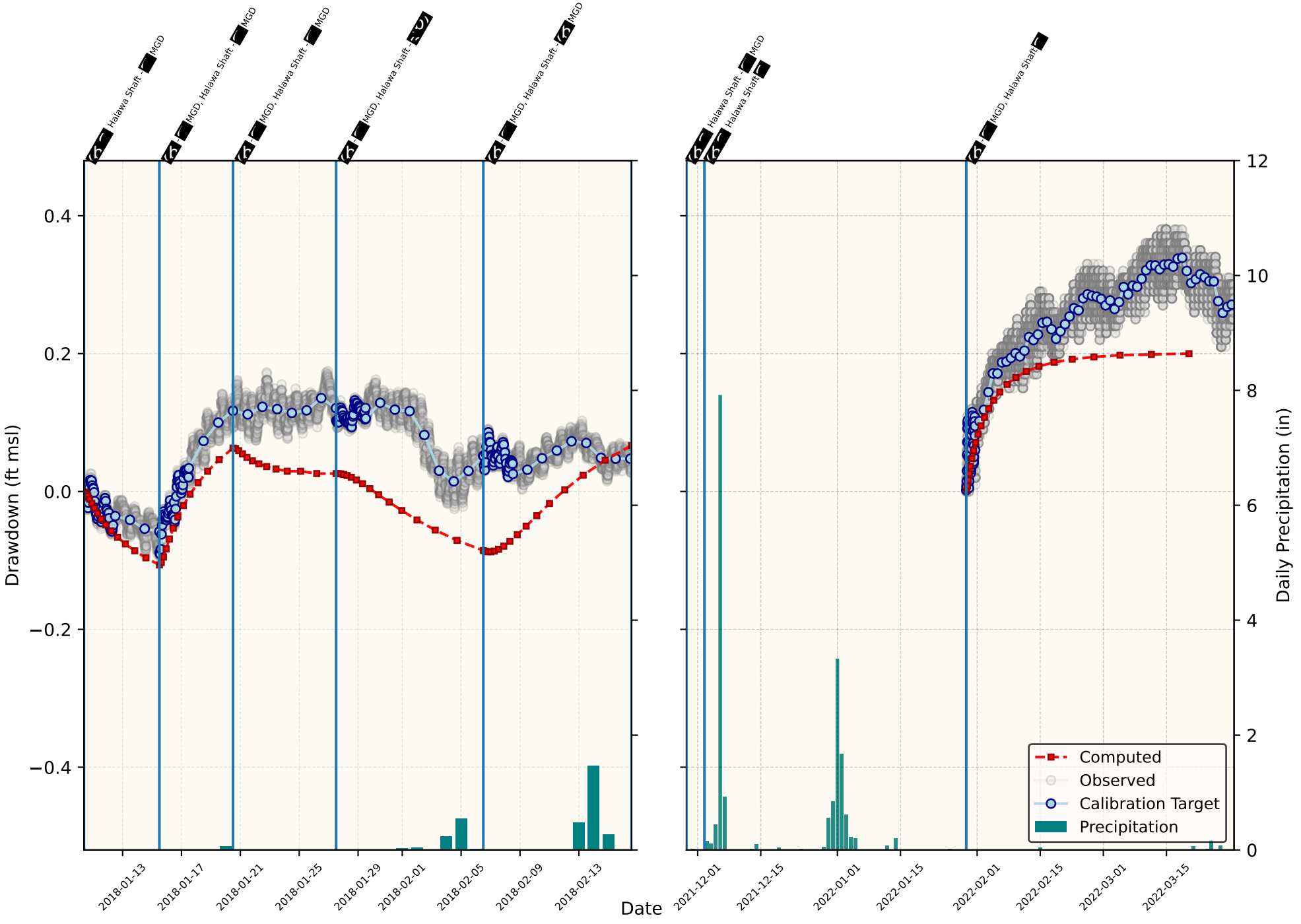

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.2
0.0
−0.2
−0.4
−0.6
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

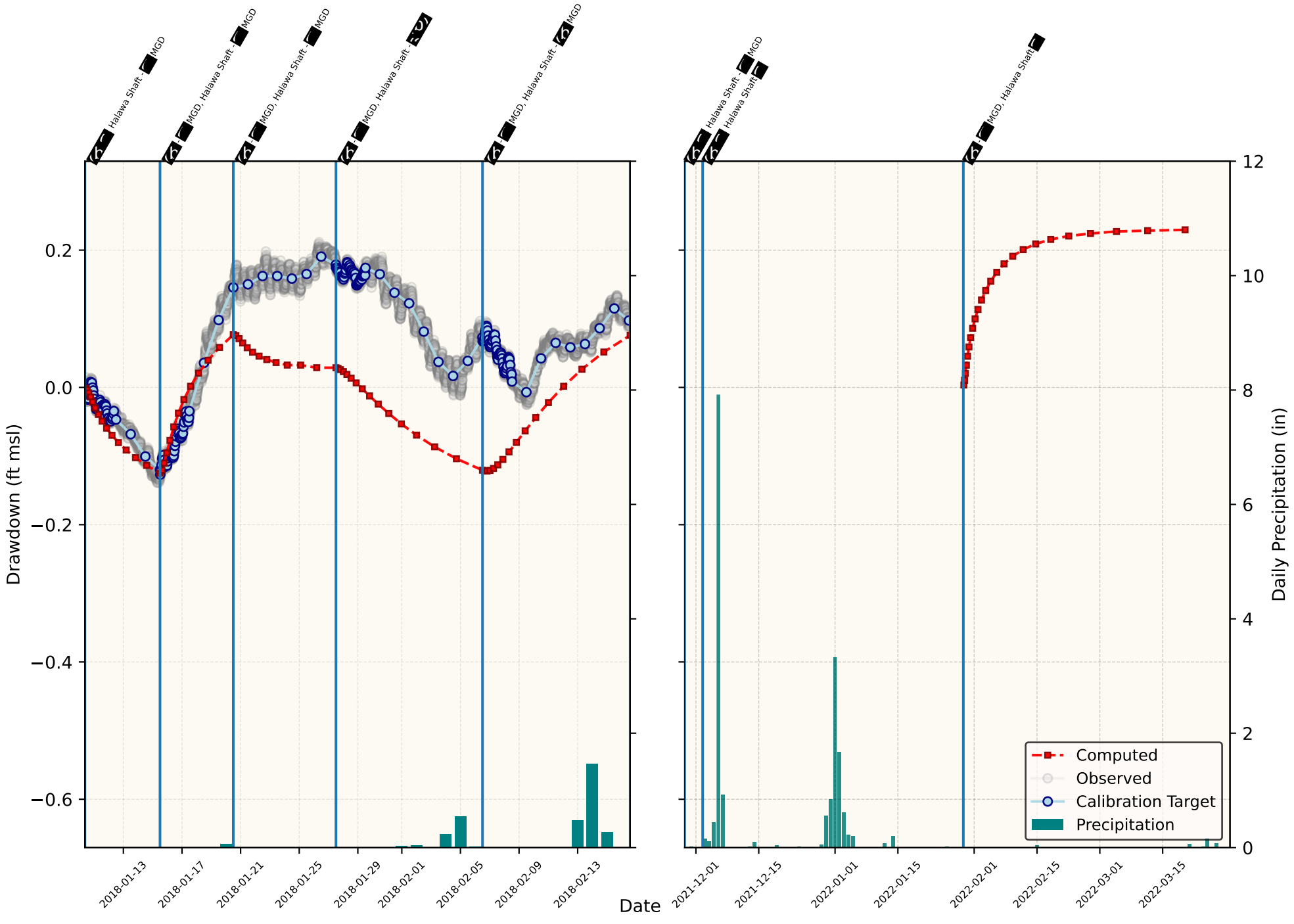

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

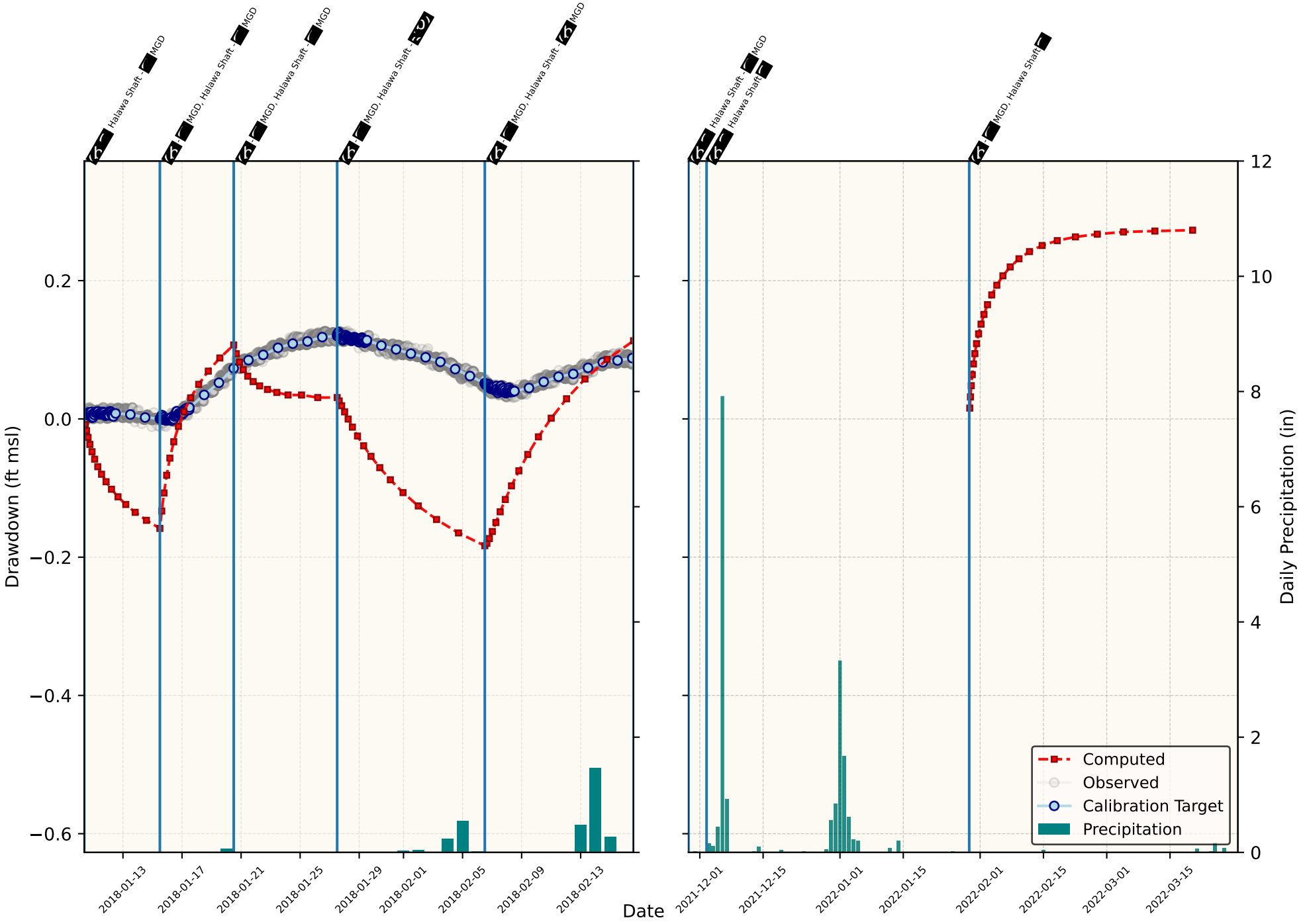
TAMC_[redacted]

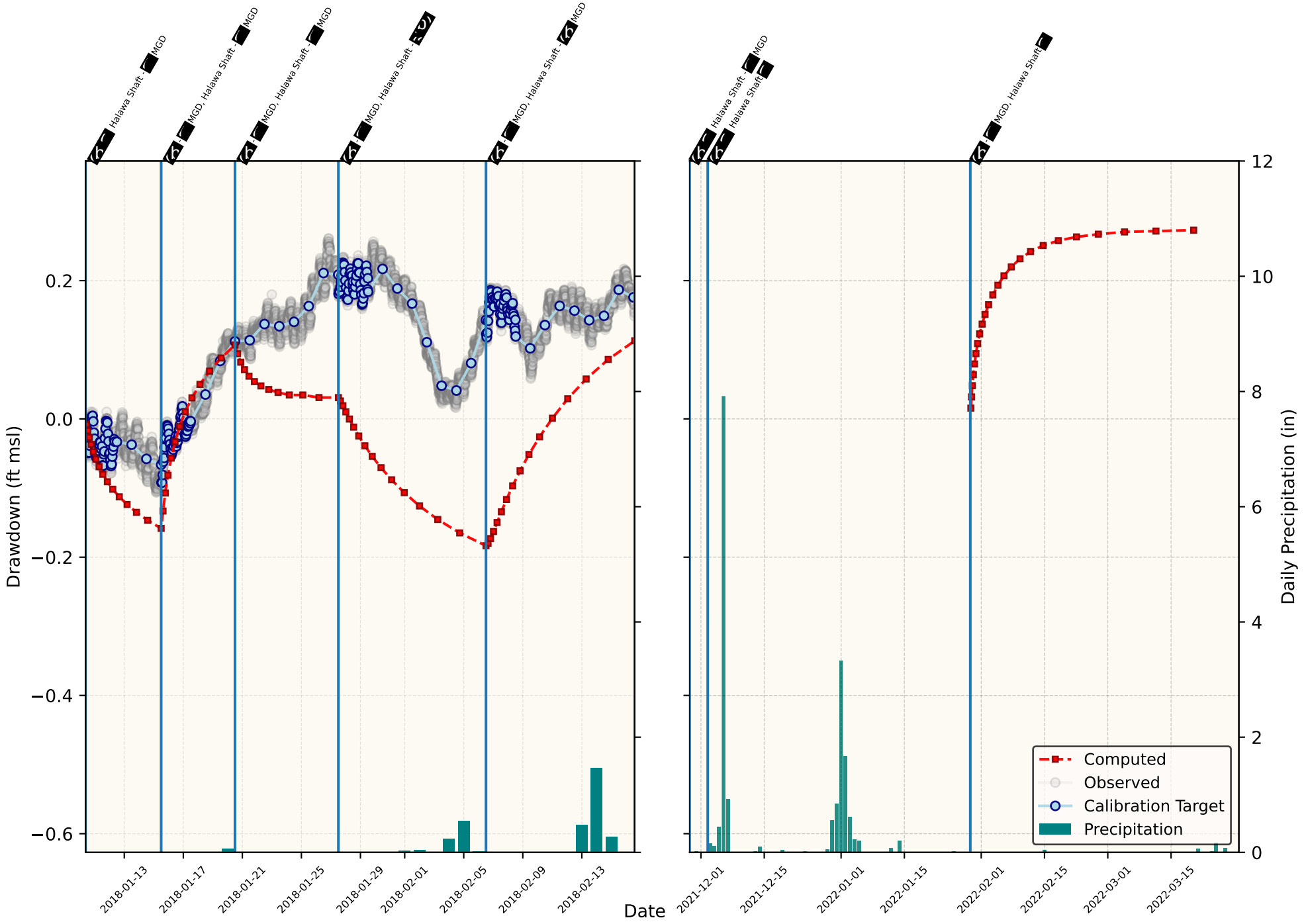
(b)(9)

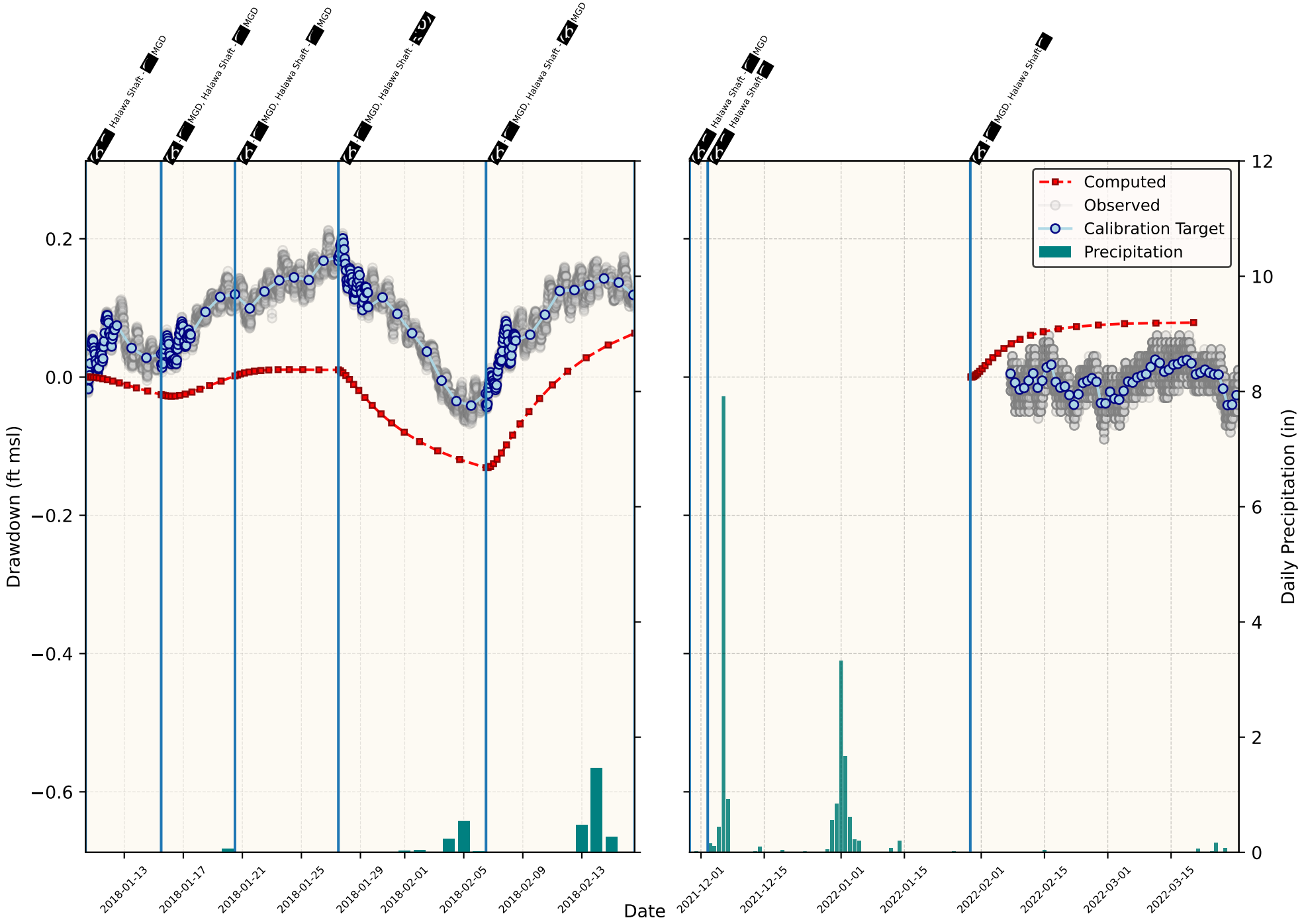
Group 1 - Basal Aquifer




DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

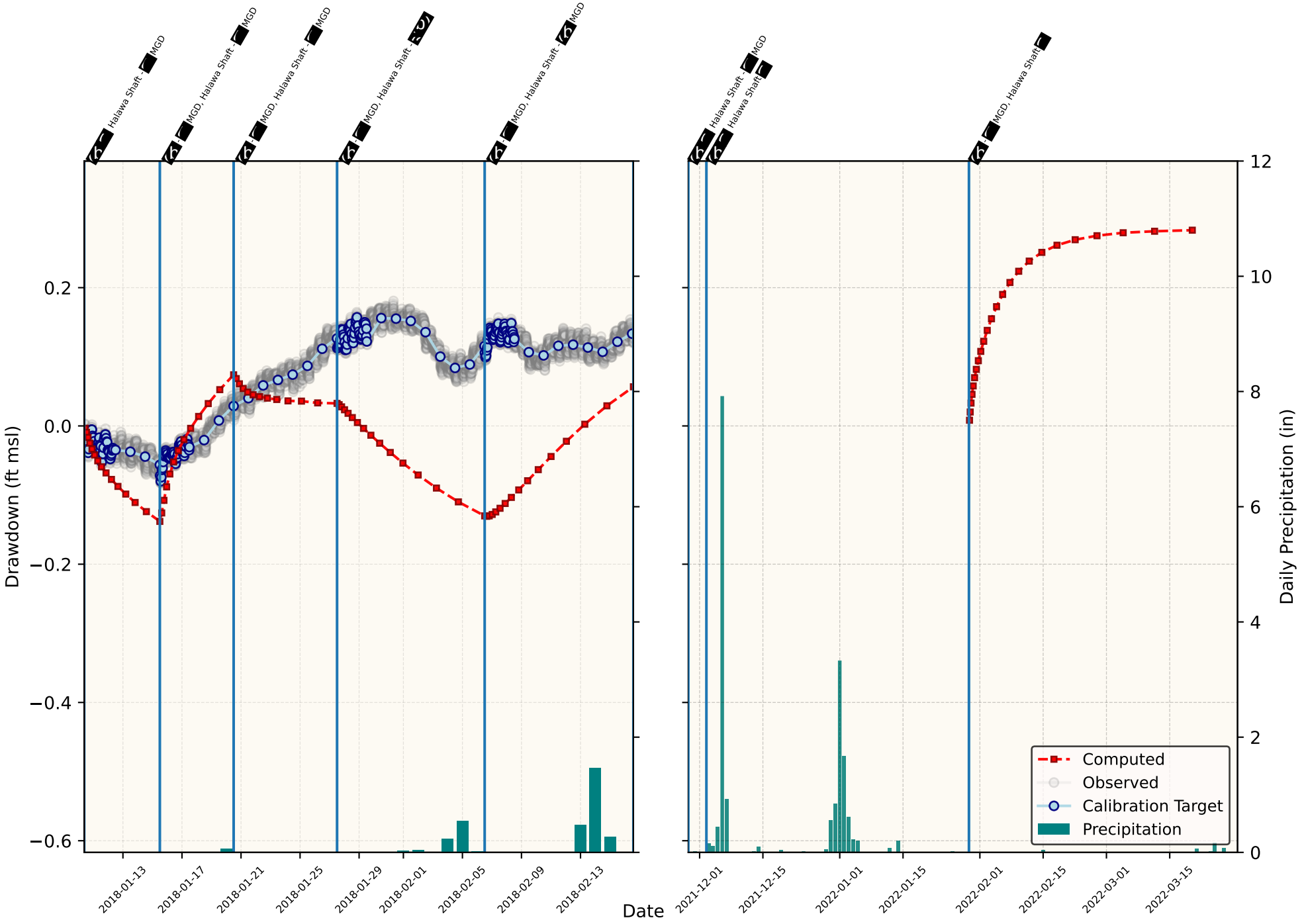

HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Halawa_Deep_Monitor_Well_HDMW2253-03
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
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2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

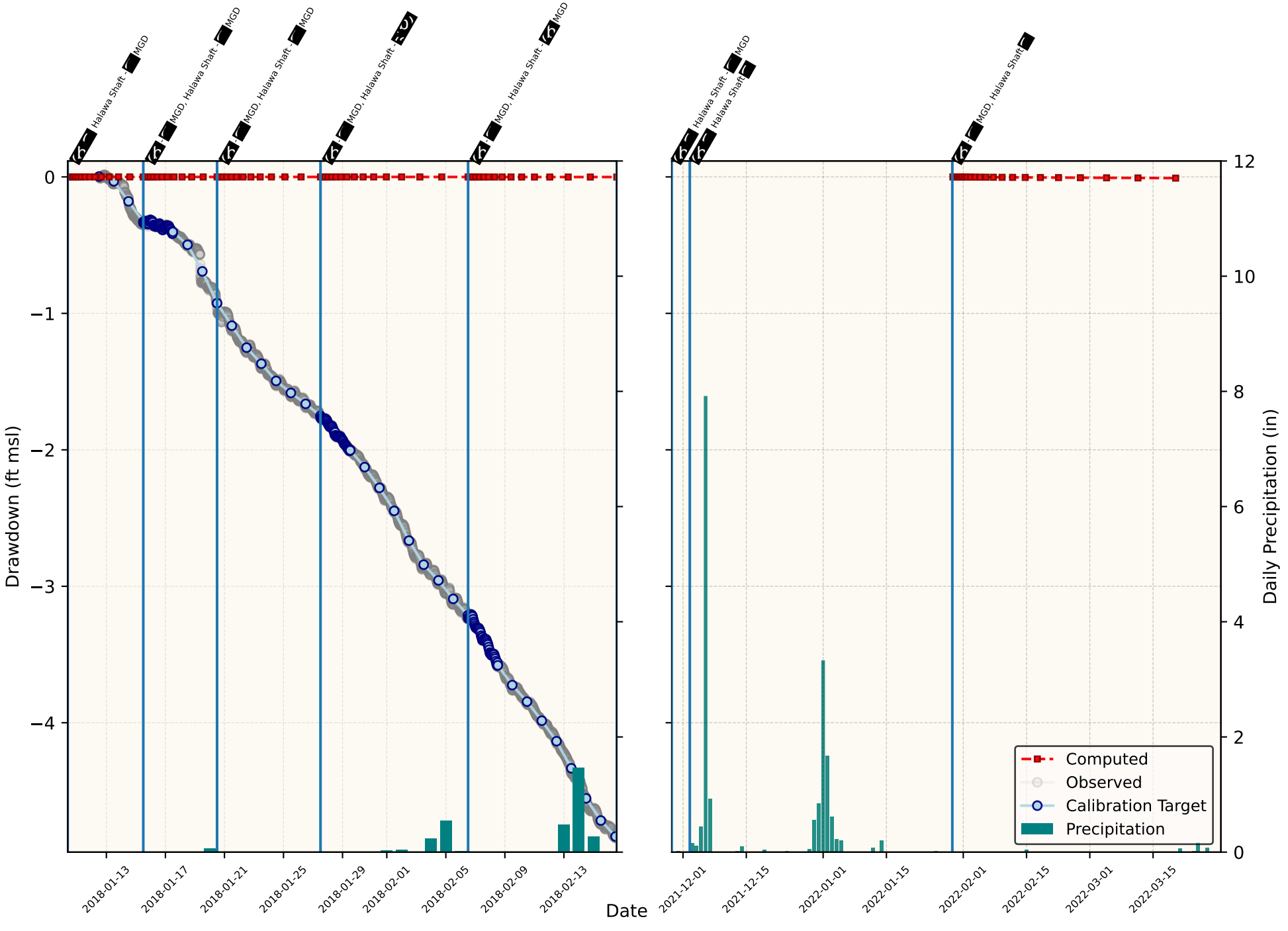
RHMW[redacted]

Group 3 - Saprolite/Confining Unit Well with Elevated Head



RHMW [redacted] (b)(9)

Group 3 - Saprolite/Confining Unit Well with Elevated Head



Groundwater Flow Model Calibration Evaluation Documents Sensitivity Scenario 4

Head Calibration Statistics

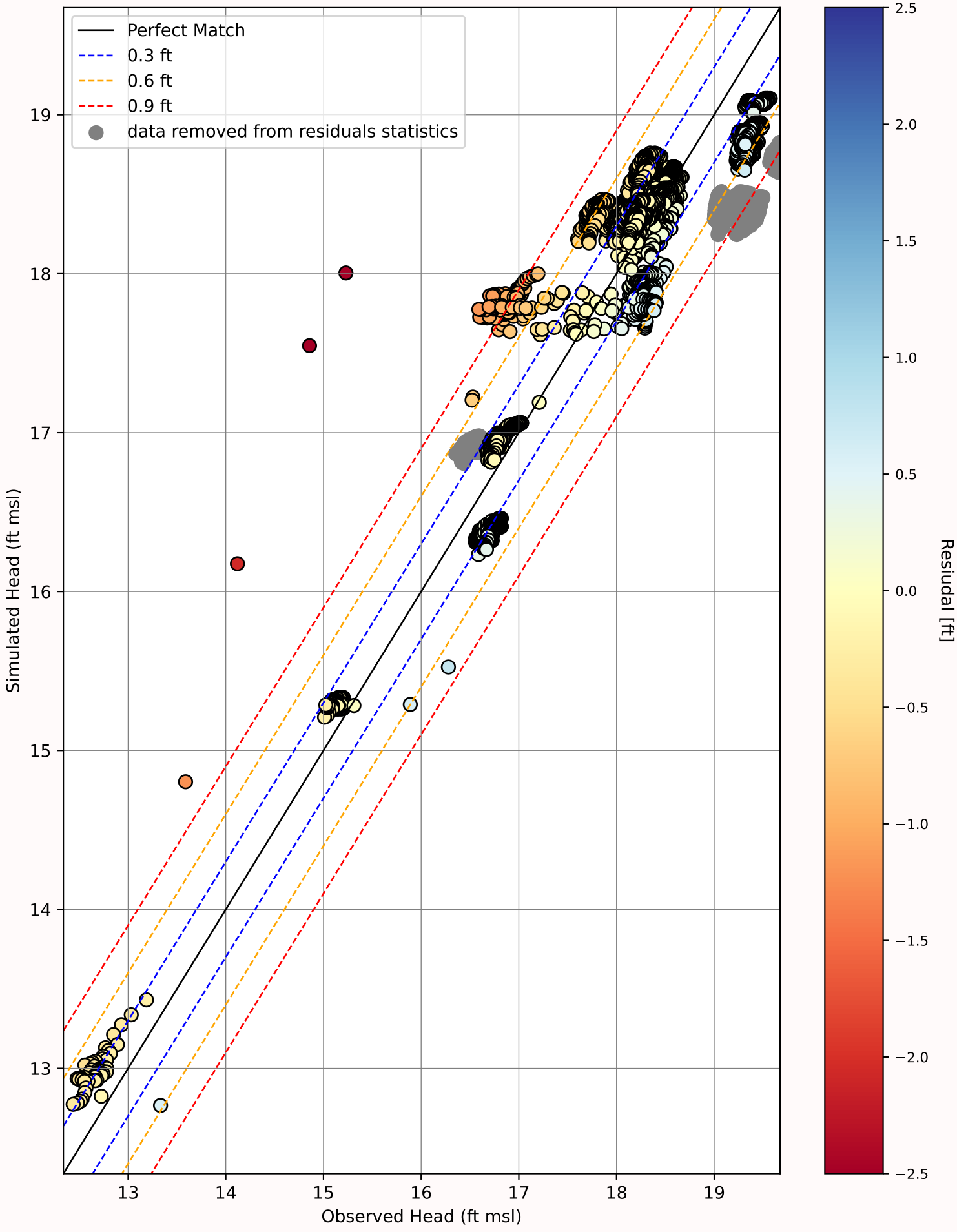
Wells	Basal Aquifer (Group 1)			Deep Wells (Group 2)	Confining Unit (Group 3)	Caprock (Group 4)	Cumulative
Time Period	**2017/2018**	**2021/2022**	**All**	**All**	**All**	**All**	**All**
Residual Mean (ft)	-0.01	0.11	0.04	0.47	15.31	0.25	0.82
Absolute Residual Mean (ft)	0.25	0.32	0.28	0.71	17.09	1.46	1.15
Residual Standard Deviation (ft)	0.32	0.38	0.37	0.60	18.63	2.03	5.27
Sum of Squared Residuals (ft2)	544.68	615.66	1349.99	620.73	330939.68	553.56	333463.96
RMSE Error (ft)	0.32	0.40	0.37	0.76	24.10	2.04	5.34
Minimum Residual (ft)	-2.77	-0.99	-2.77	-1.24	-15.82	-4.28	-15.82
Maximum Residual (ft)	0.75	0.86	2.39	1.24	49.29	6.61	49.29
Number of Observations	5459	3915	9928	1075	570	133	11706
Range in Observations	7.14	3.26	7.19	4.26	97.94	6.85	116.87
Scaled Residual Standard Deviation (ft)	4.4%	11.6%	5.1%	14.1%	19.0%	29.7%	(b)%
Scaled Absolute Residual Mean (ft)	3.4%	9.7%	3.9%	16.6%	17.5%	21.3%	1.0%
Scaled RMSE Error (ft)	4.4%	(b)%	5.1%	17.8%	24.6%	29.8%	4.6%
Scaled Residual Mean (ft)	-0.1%	3.5%	0.5%	10.9%	15.6%	(b)%	(b)%
Correlation Coefficient	0.95	0.87	0.92	0.99	0.93	-0.16	0.96

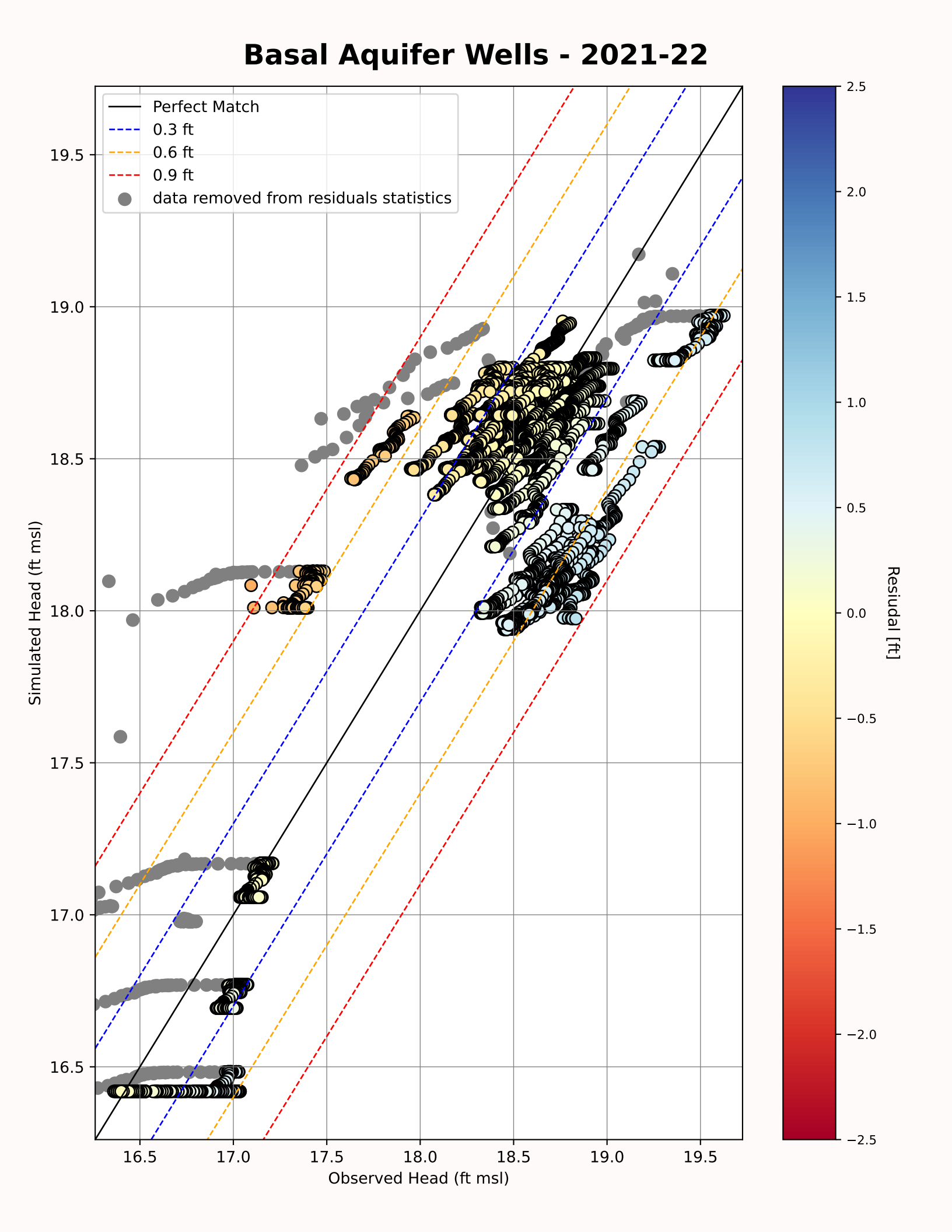
Drawdown Calibration Statistics

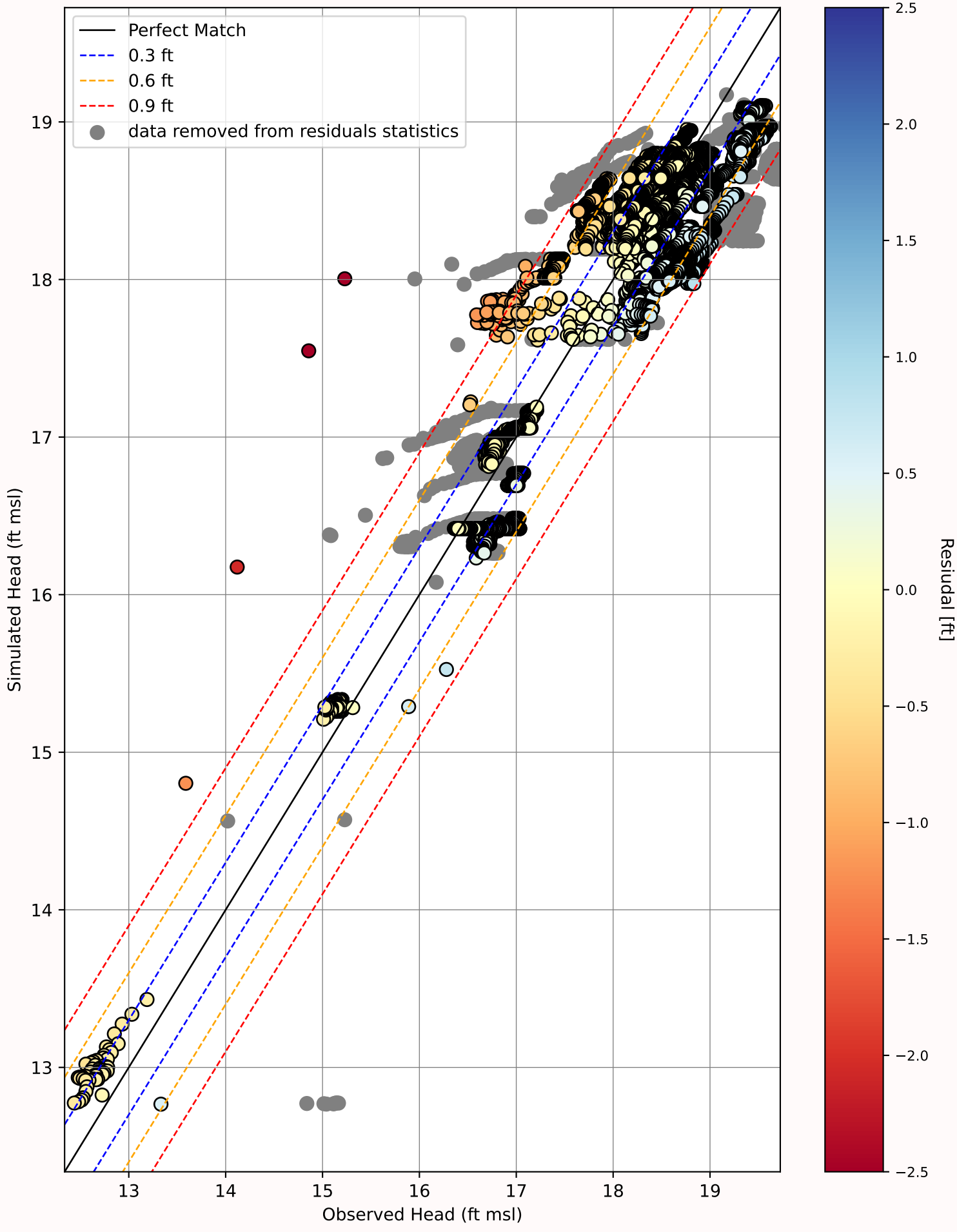
Wells	**Basal Aquifer (Group 1)**		
Time Period	**2017/2018**	**2021/2022**	**All**
Residual Mean (ft)	-0.02	0.07	0.02
Absolute Residual Mean (ft)	0.10	0.08	0.09
Residual Standard Deviation (ft)	0.22	0.10	0.19
Sum of Squared Residuals (ft2)	259.57	53.19	312.76
RMSE Error (ft)	0.22	0.12	0.19
Minimum Residual (ft)	-1.77	-0.21	-1.77
Maximum Residual (ft)	2.67	0.55	2.67
Number of Observations	5393	3533	8926
Range in Observations	4.76	0.68	4.76
Scaled Residual Standard Deviation (ft)	4.6%	14.9%	3.9%
Scaled Absolute Residual Mean (ft)	2.0%	12.0%	1.9%
Scaled RMSE Error (ft)	4.6%	18.2%	3.9%
Scaled Residual Mean (ft)	-0.3%	10.4%	0.4%
Correlation Coefficient	0.83	0.65	0.83

Conceptual Water Budget Comparison

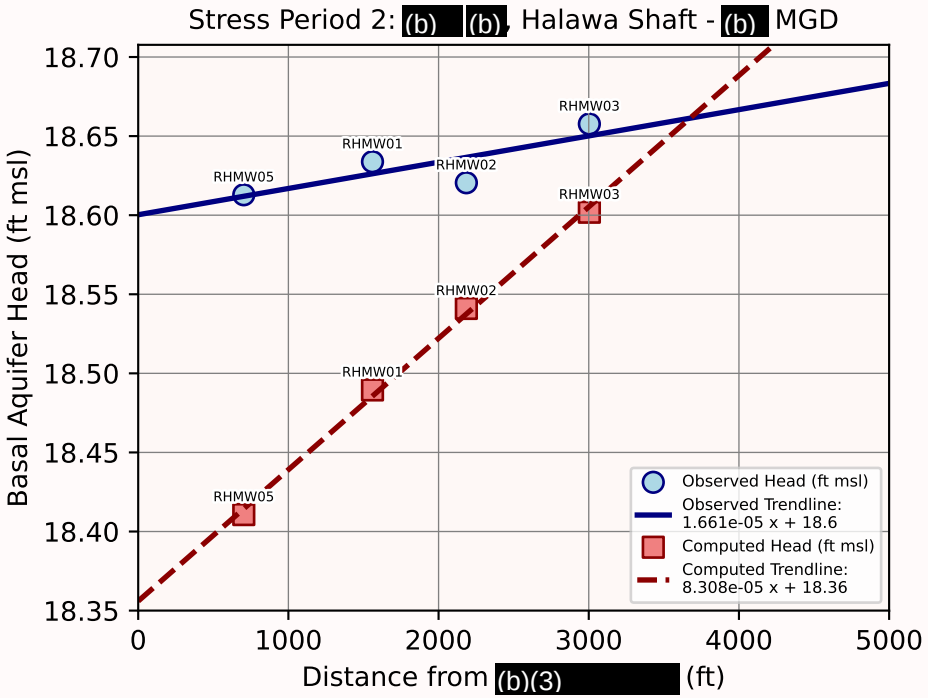
Type	Stress Period	Recharge (MGD)	Dike Region Inflow (MGD)	Well Discharge (MGD)	Spring Discharge (MGD)	Caprock Discharge (MGD)	Inflow from Adjacent Watershed (MGD)	Outflow to Adjacent Watershed (MGD)	Storage (MGD)	Total Inflows (MGD)	Total Outflows (MGD)
Conceptual	1	32.5	28.7	32.0	13.6	2.4	2.8	16.0	0.0	64.0	64.0
Simulated	1	32.5	28.7	32.3	13.3	3.9	9.9	21.6	0.0	71.1	71.1
Difference	1	0.0	0.0	0.3	-0.4	1.5	7.1	5.6	0.0	7.1	7.1
Conceptual	2	32.5	28.7	28.4	13.6	2.4	2.8	19.6	0.0	64.0	64.0
Simulated	2	32.5	28.7	28.4	13.4	3.9	8.8	22.7	-1.5	70.0	69.9
Difference	2	0.0	0.0	0.0	-0.2	1.5	6.0	3.0	-1.5	6.0	6.0
Conceptual	3	32.5	28.7	36.1	13.5	2.4	2.8	12.0	0.0	64.0	64.0
Simulated	3	32.5	28.7	36.1	13.2	3.9	10.6	21.2	2.6	74.3	74.4
Difference	3	0.0	0.0	0.0	-0.3	1.5	(b	9.2	2.6	10.3	10.4
Conceptual	4	32.5	28.7	32.4	13.5	2.4	2.8	15.6	0.0	64.0	64.0
Simulated	4	32.5	28.7	32.5	13.2	3.9	10.3	21.2	-0.6	71.5	71.4
Difference	4	0.0	0.0	0.0	-0.3	1.5	7.5	5.6	-0.6	7.5	7.4
Conceptual	5	32.5	28.7	25.7	13.7	2.4	4.7	24.1	0.0	65.9	65.9
Simulated	5	32.5	28.7	25.7	13.7	3.9	8.7	25.5	-0.9	69.9	69.8
Difference	5	0.0	0.0	0.0	0.0	1.5	4.0	1.4	-0.9	4.0	3.9
Conceptual	6	32.5	28.7	37.7	13.6	2.4	4.7	12.2	0.0	65.9	65.9
Simulated	6	32.5	28.7	37.8	13.0	3.9	11.5	19.5	1.5	74.2	74.2
Difference	6	0.0	0.0	0.0	-0.6	1.5	6.8	7.3	1.5	8.3	8.3
Conceptual	7	32.5	28.7	32.0	13.4	2.4	4.1	17.4	0.0	65.3	65.3
Simulated	7	32.5	28.7	32.0	13.2	3.9	9.1	21.2	0.0	70.3	70.3
Difference	7	0.0	0.0	0.0	-0.2	1.5	5.0	3.8	0.0	5.0	5.0
Conceptual	8	32.5	28.7	30.1	12.6	2.4	2.8	18.8	0.0	63.9	63.9
Simulated	8	32.5	28.7	30.1	13.2	3.9	9.1	21.3	-1.5	70.2	70.1
Difference	8	0.0	0.0	0.0	(b	1.5	(b	2.5	-1.5	(b	(b
Conceptual	9	32.5	28.7	21.8	13.7	2.4	0.5	23.8	0.0	61.7	61.7
Simulated	9	32.5	28.7	21.8	14.0	3.9	6.0	27.5	0.0	67.2	67.2
Difference	9	0.0	0.0	0.0	0.3	1.5	5.5	(b	0.0	5.5	5.5
Conceptual	10	32.5	28.7	26.3	13.9	2.5	7.5	25.9	0.0	68.7	68.7
Simulated	10	32.5	28.7	26.3	13.7	3.9	8.0	25.4	0.0	69.2	69.3
Difference	10	0.0	0.0	0.0	-0.3	1.4	0.5	-0.5	0.0	0.6	0.6

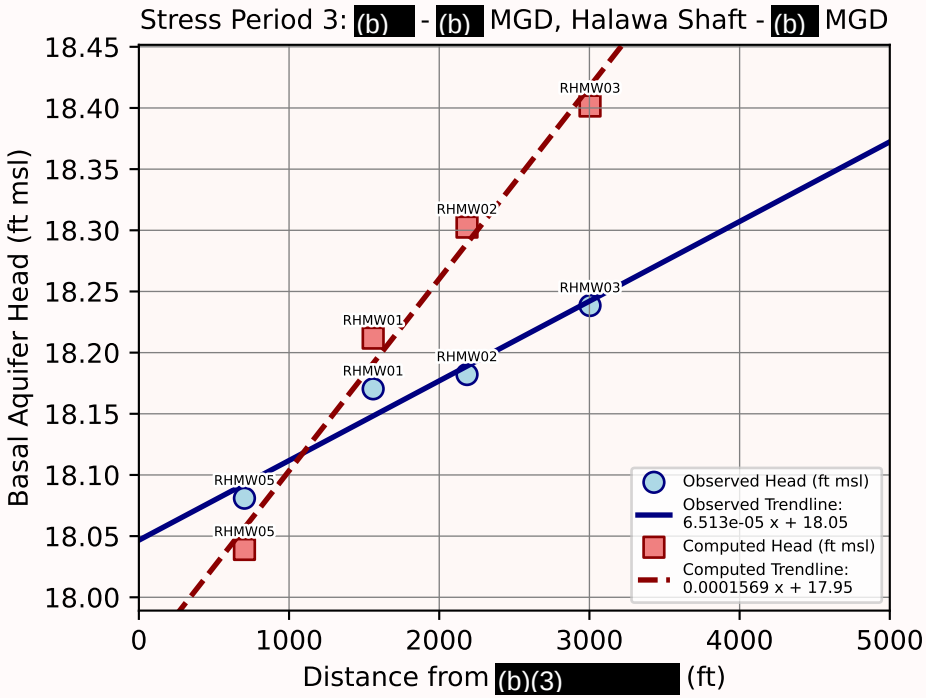

Basal Aquifer Wells - 2017-18
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

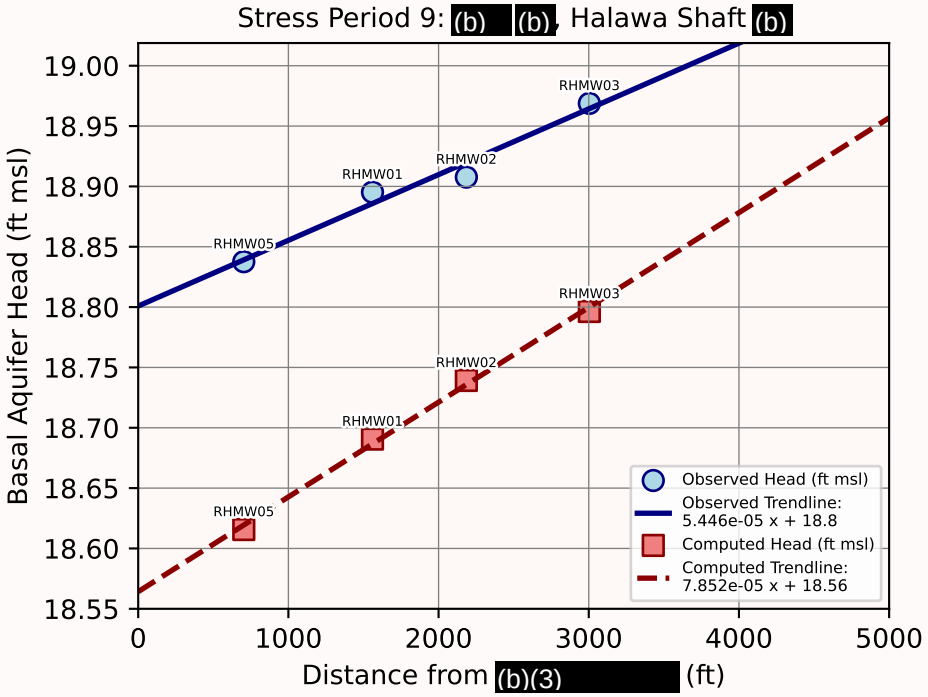

Basal Aquifer Wells - 2021-22
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
16.5
17.0
17.5
18.0
18.5
19.0
19.5
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

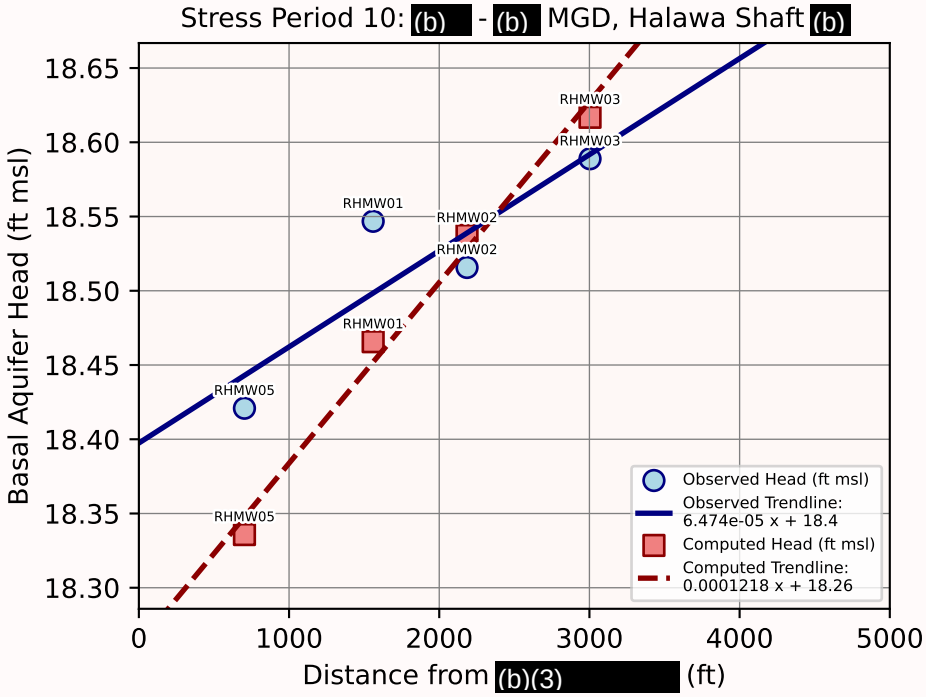

Basal Aquifer Wells - All
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

Gradients Along Red Hill Ridge

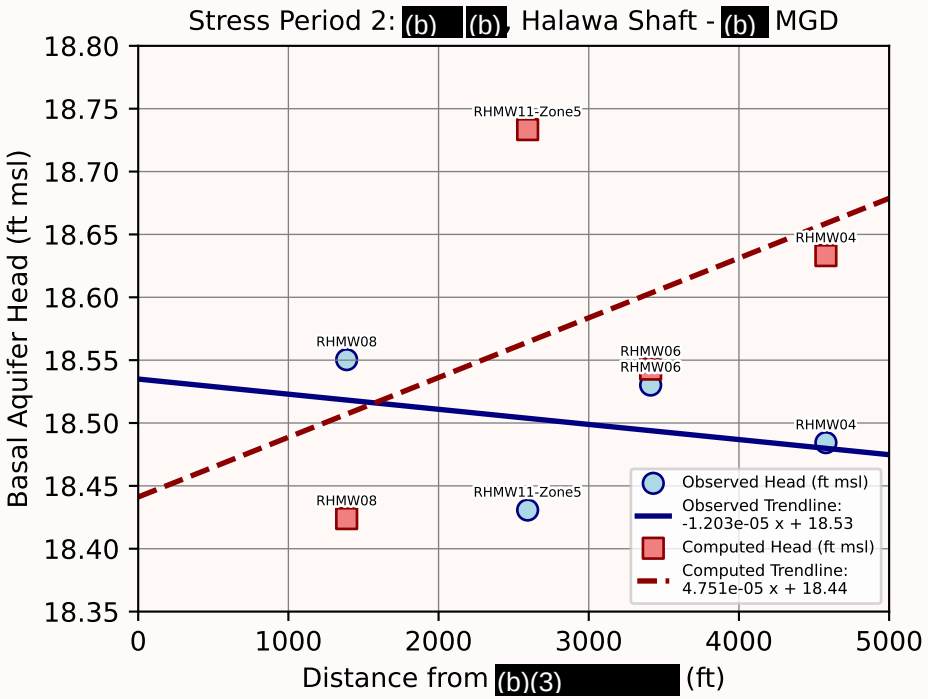


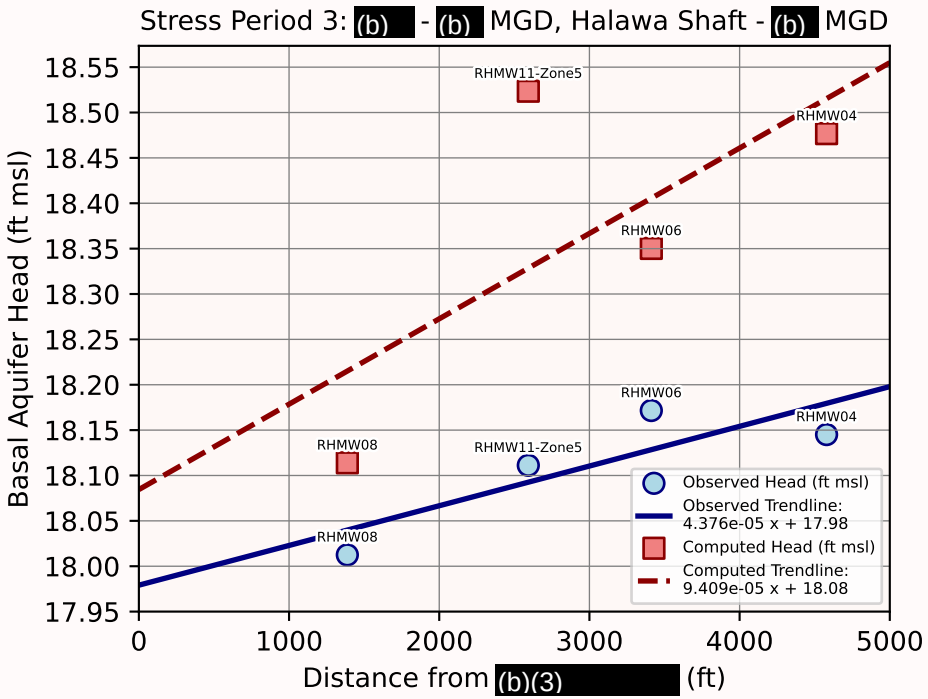


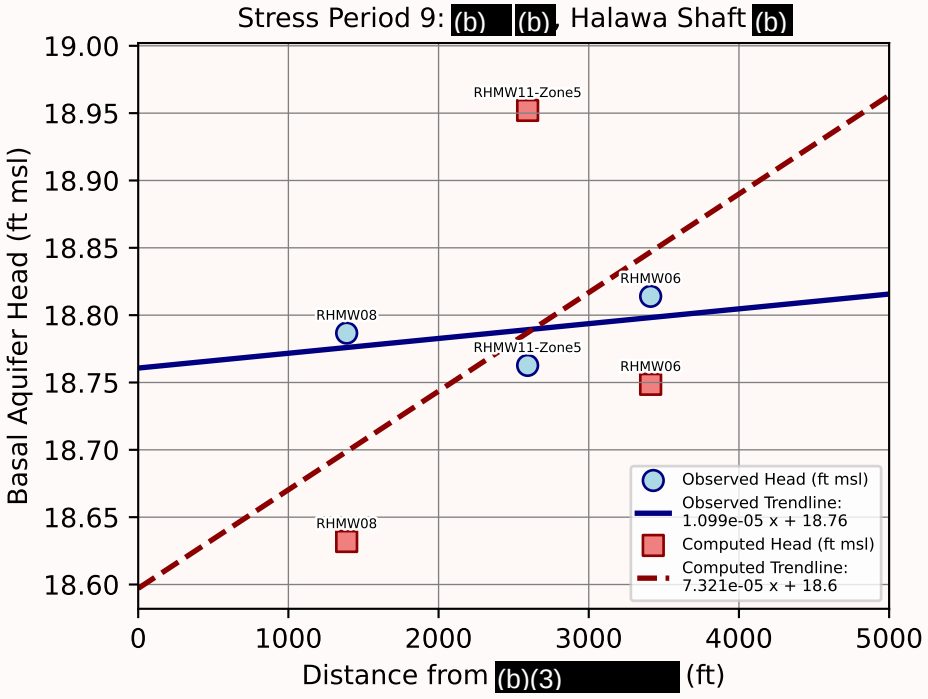


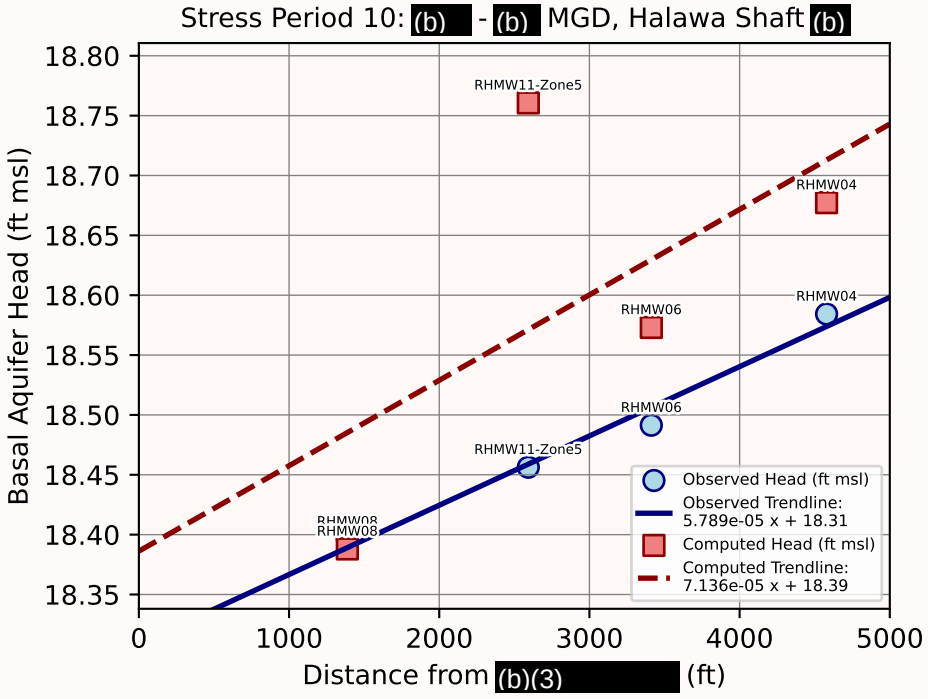


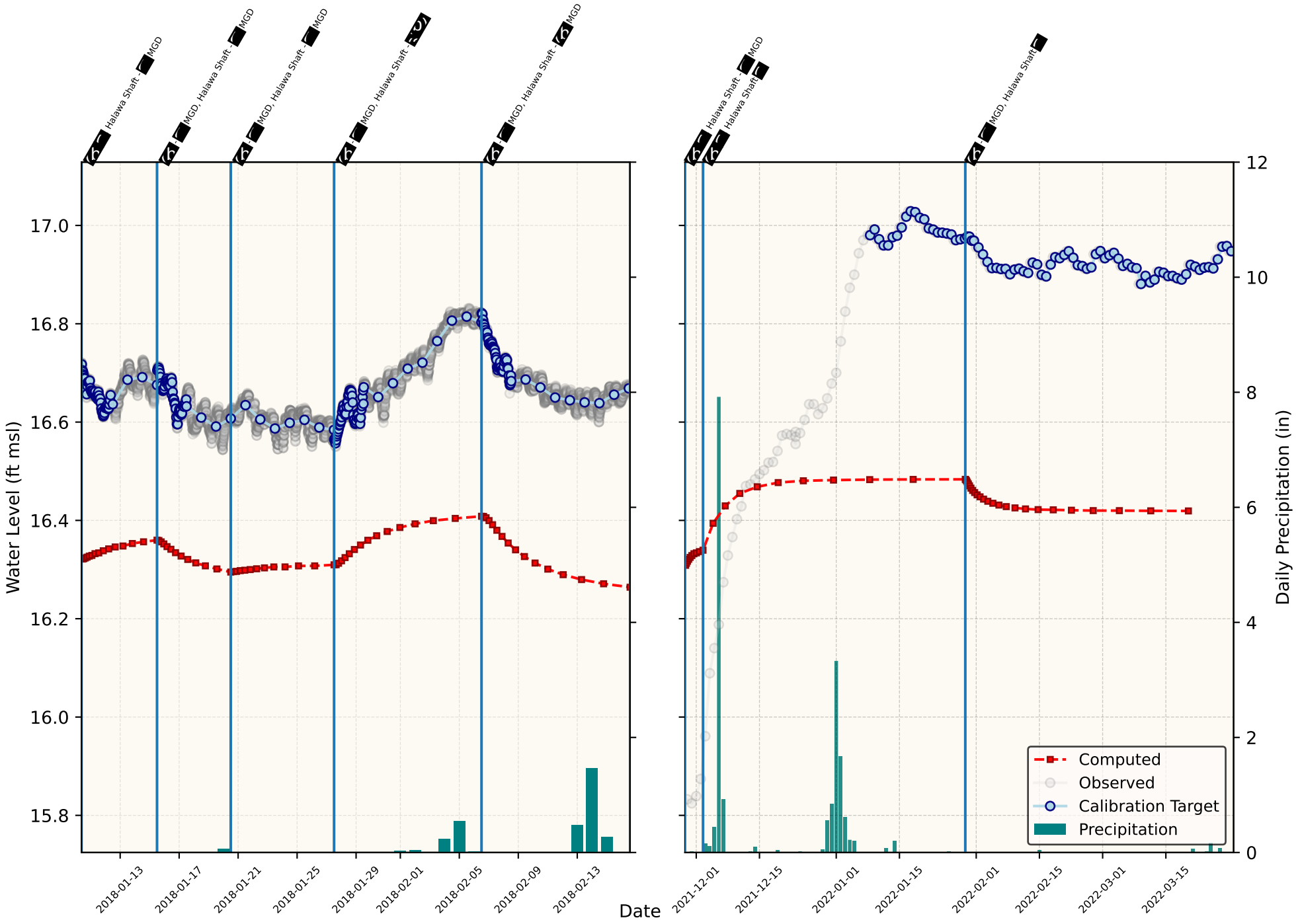
Gradients Northwest of Red Hill Ridge



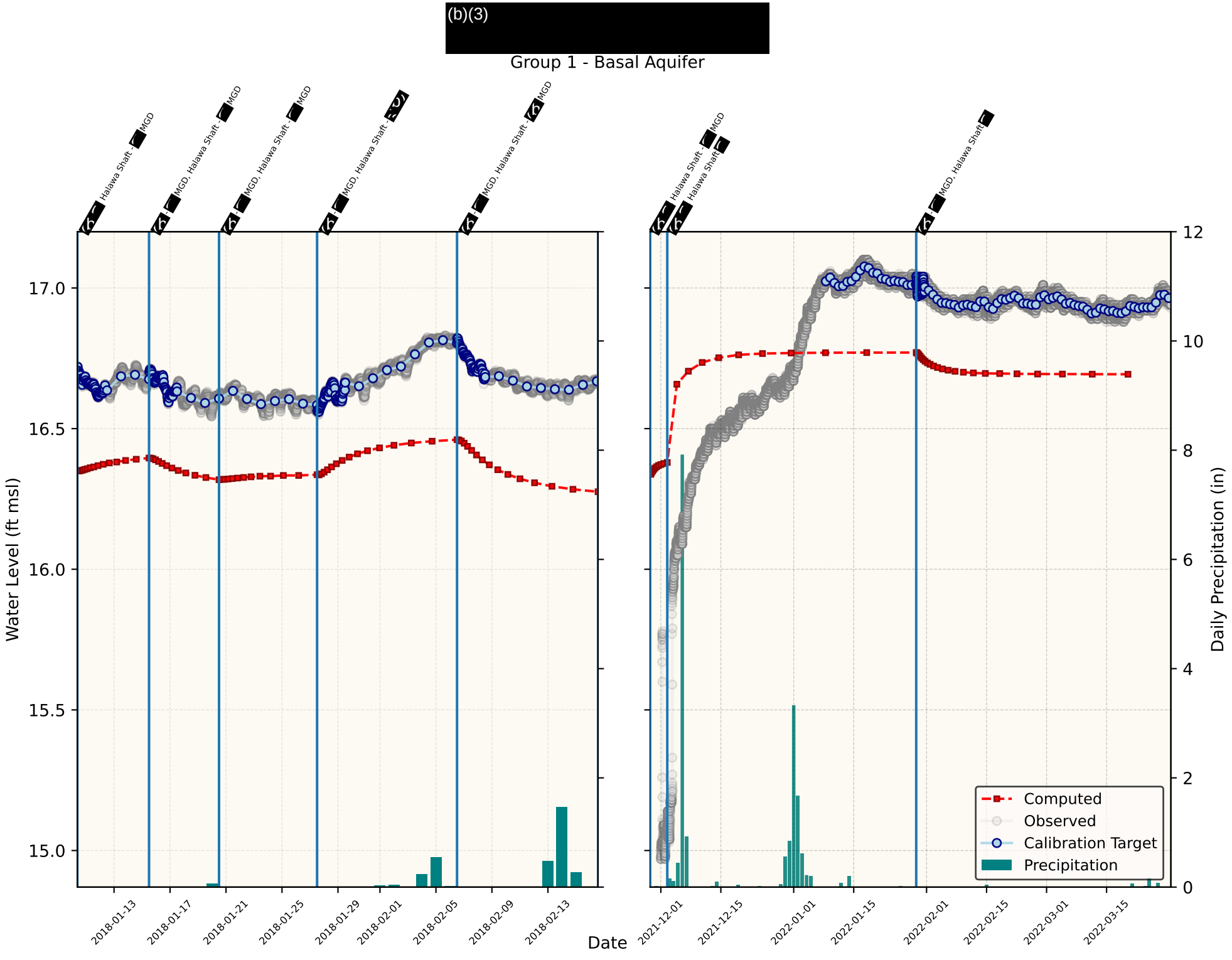


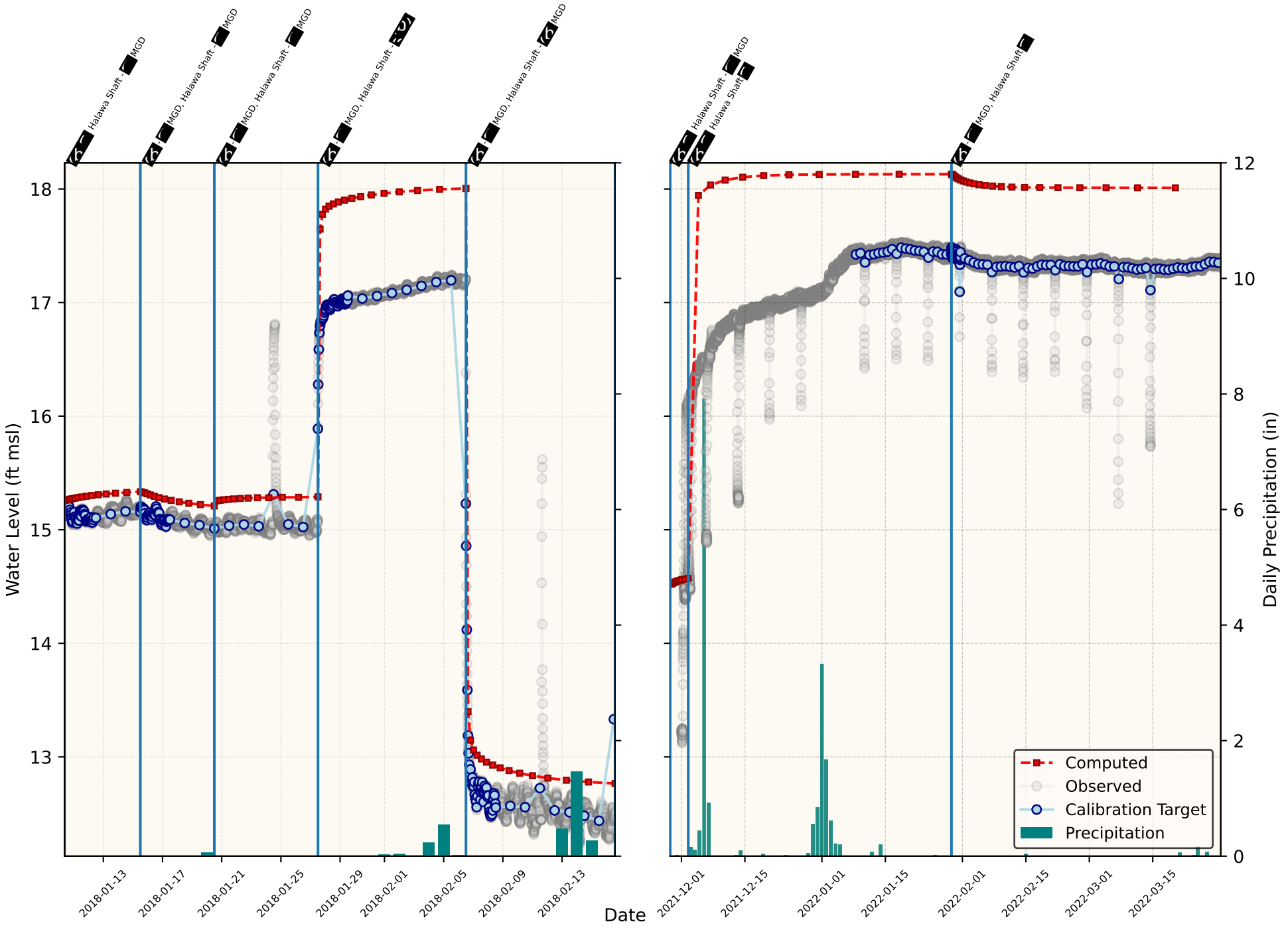


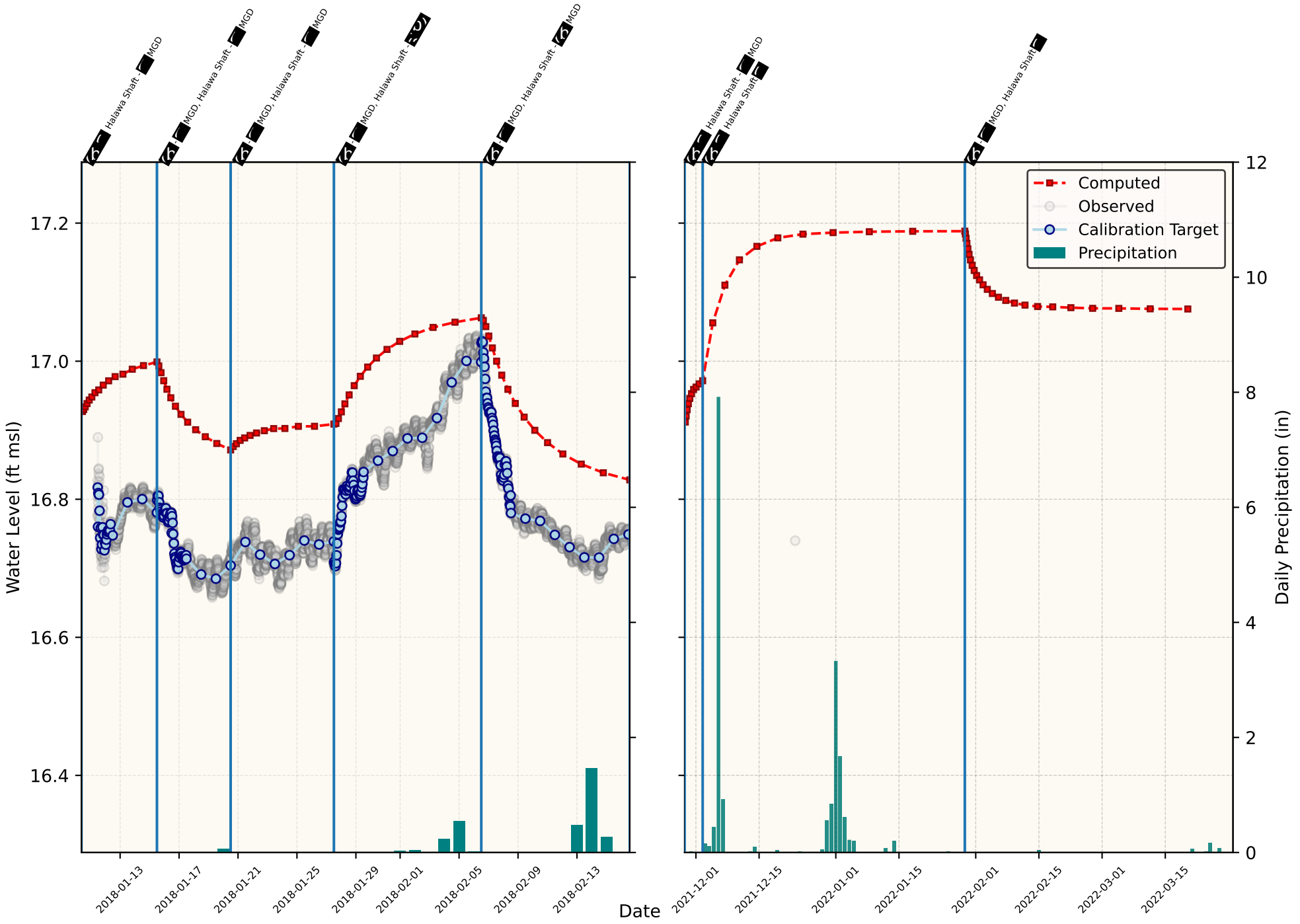


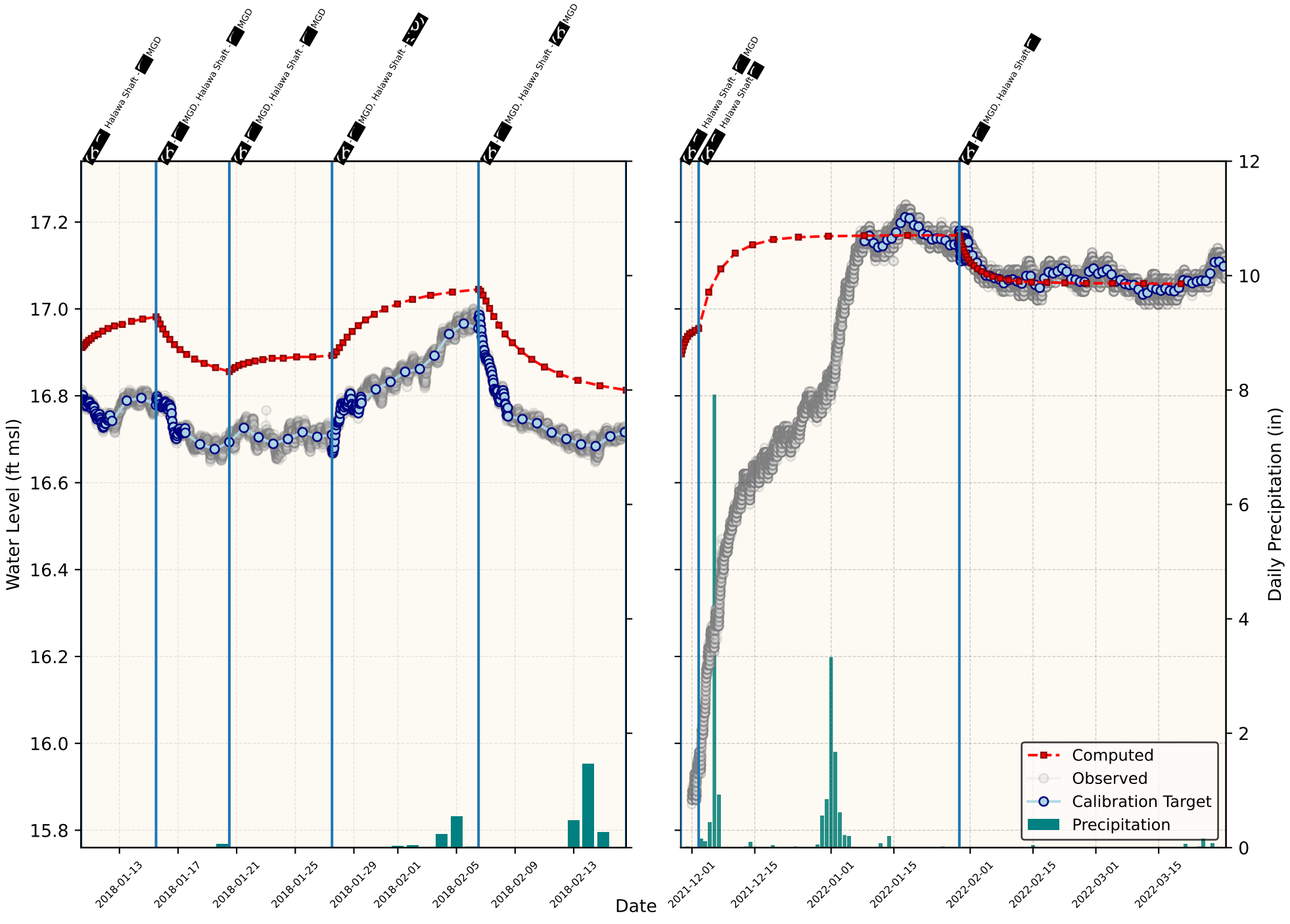

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

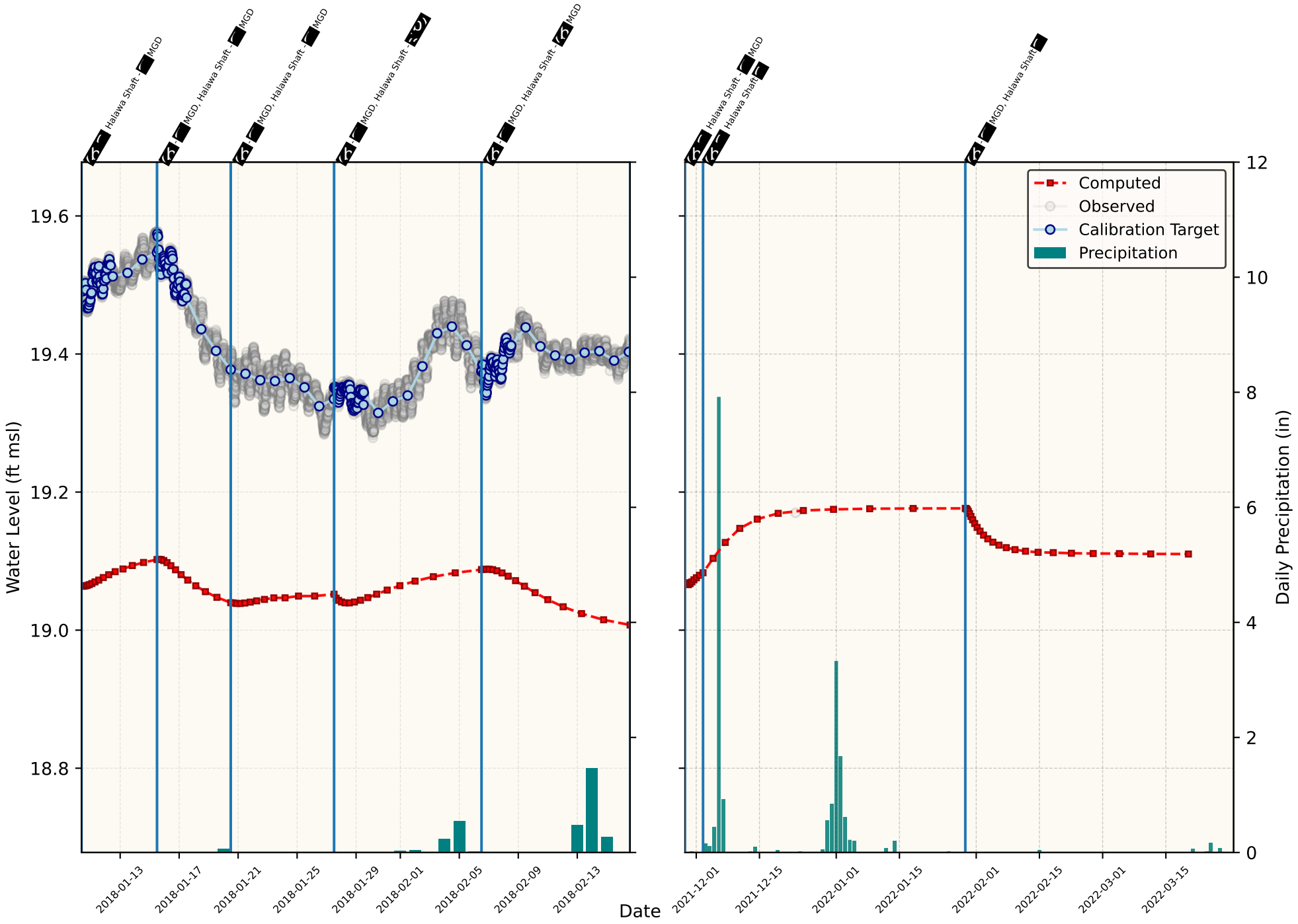
(b)(3) [redacted]

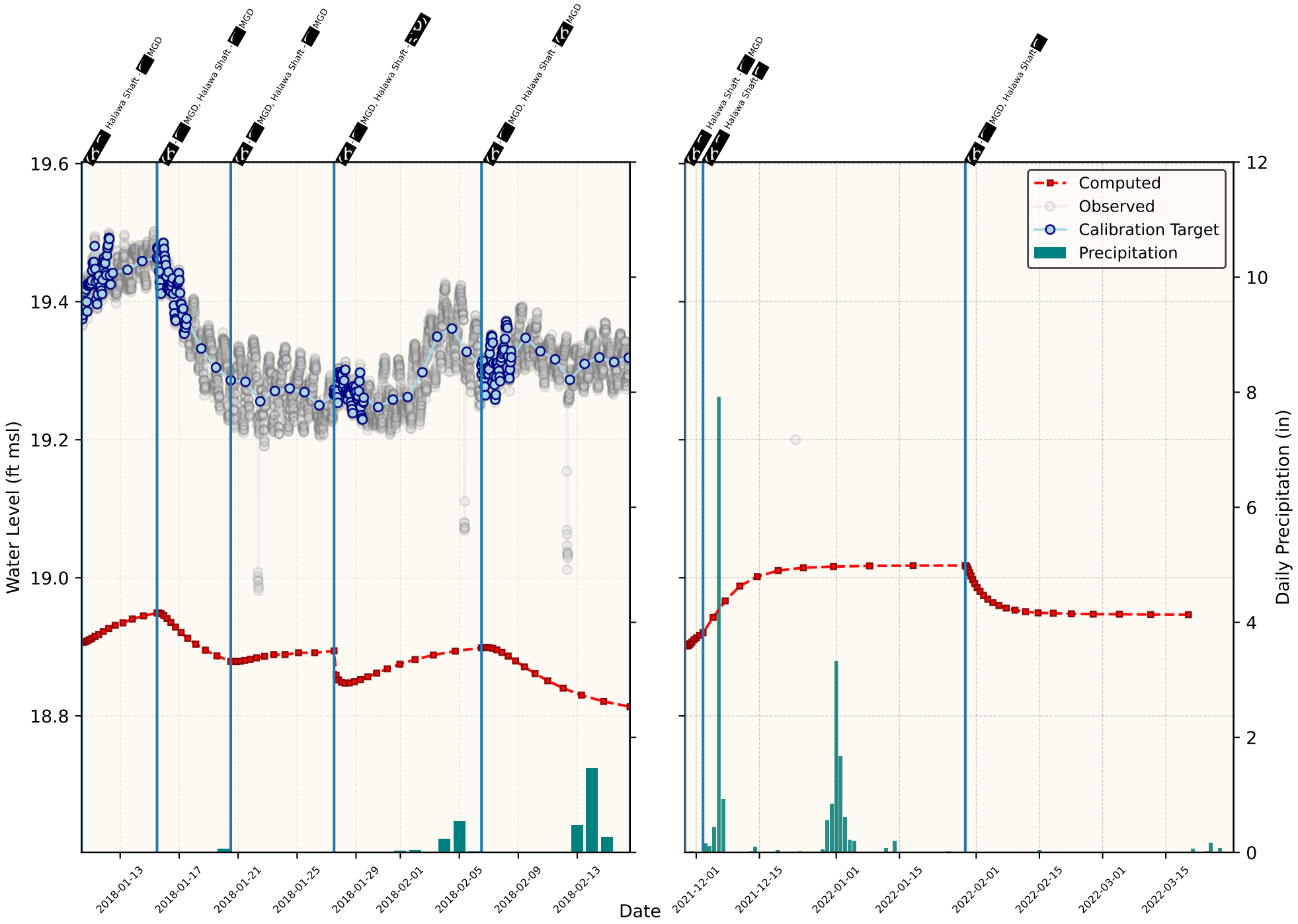

Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Water Level (ft msl)
17.0
16.5
16.0
15.5
15.0
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

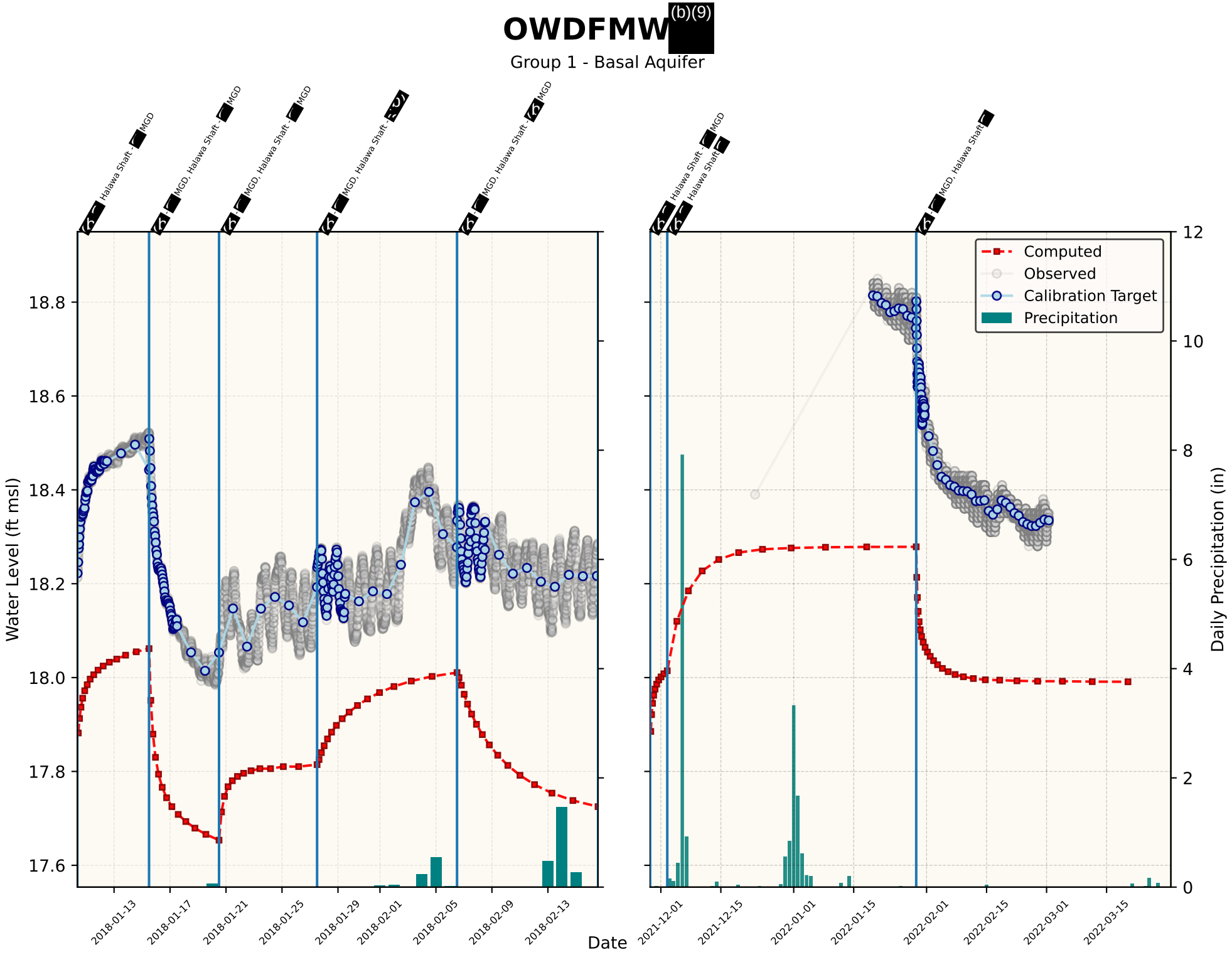

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

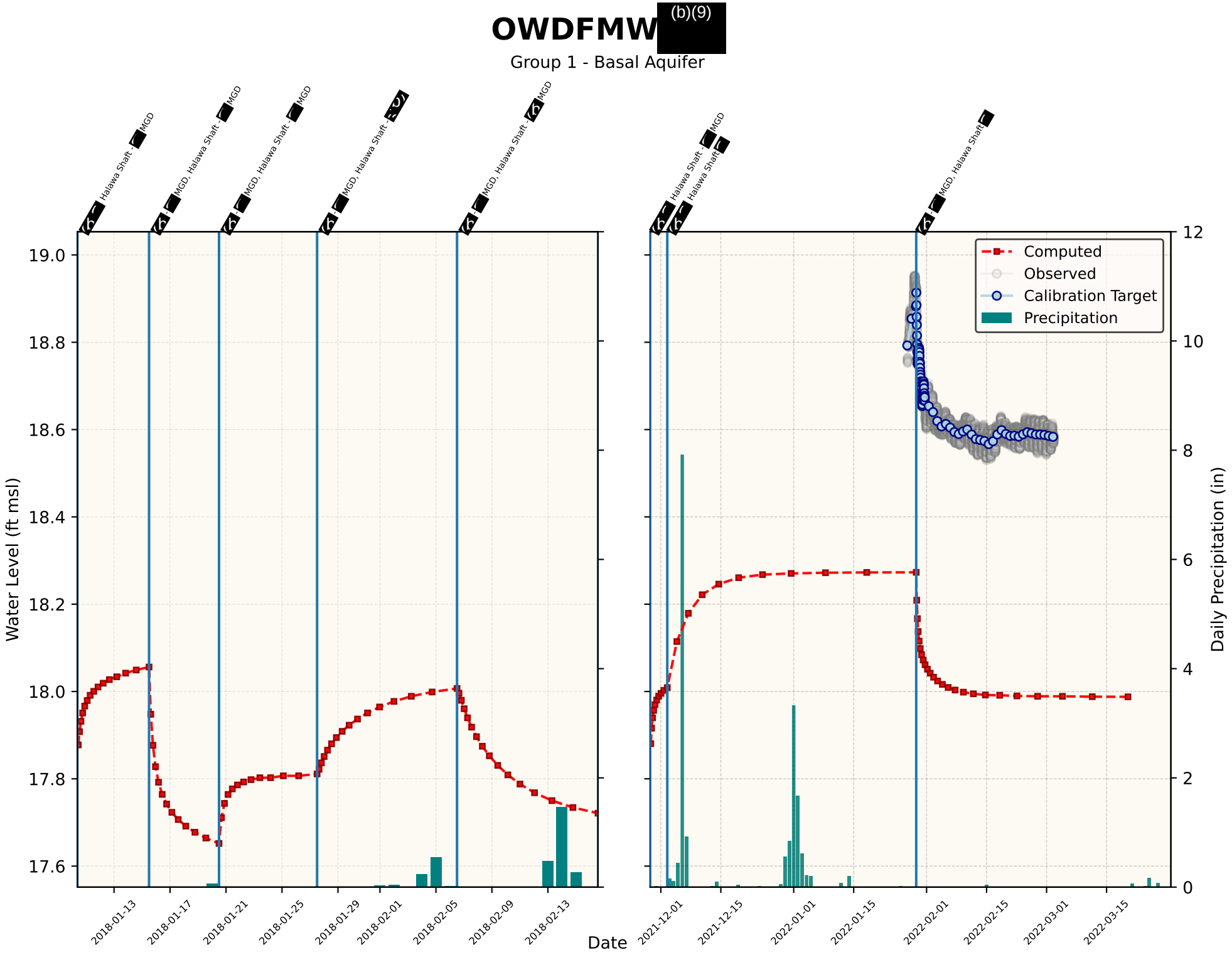

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft 0 MGD
MGD, Halawa Shaft 0 MGD
MGD, Halawa Shaft 0 MGD
MGD, Halawa Shaft 0 MGD
MGD, Halawa Shaft 0 MGD
Halawa Shaft 0 MGD
Halawa Shaft 0 MGD
MGD, Halawa Shaft 0 MGD
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
17.2
17.0
16.8
16.6
16.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

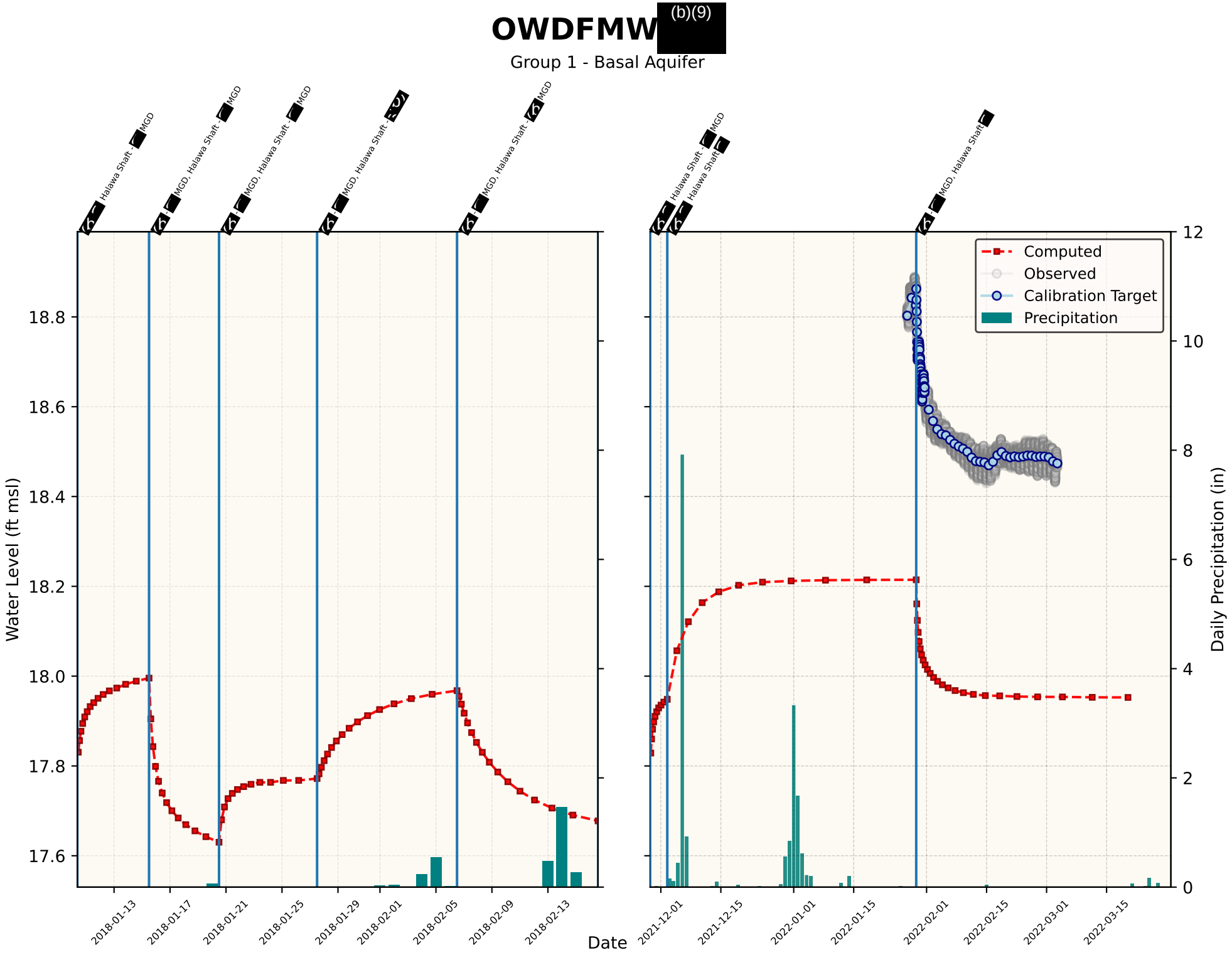

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

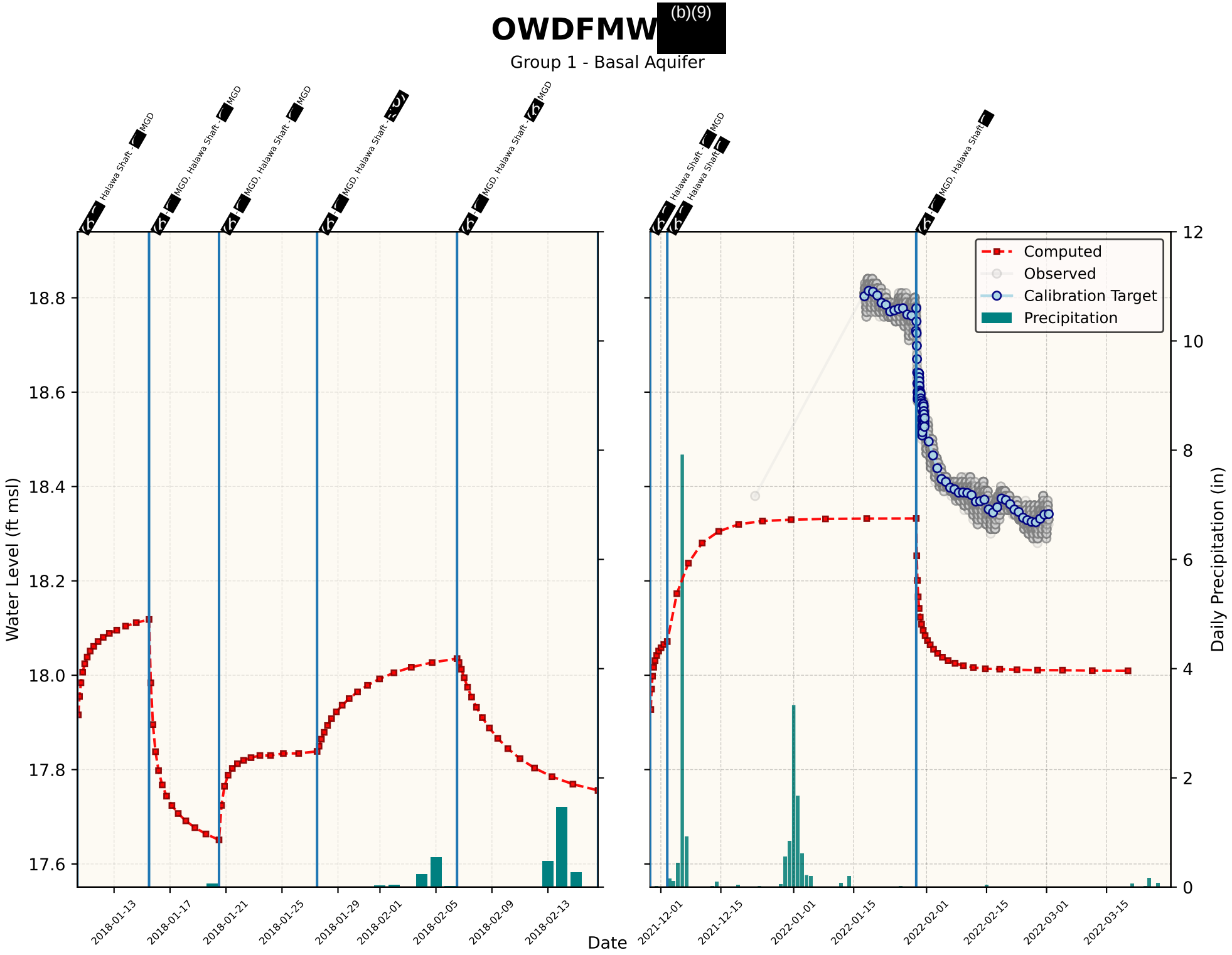

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.6
19.4
19.2
19.0
18.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

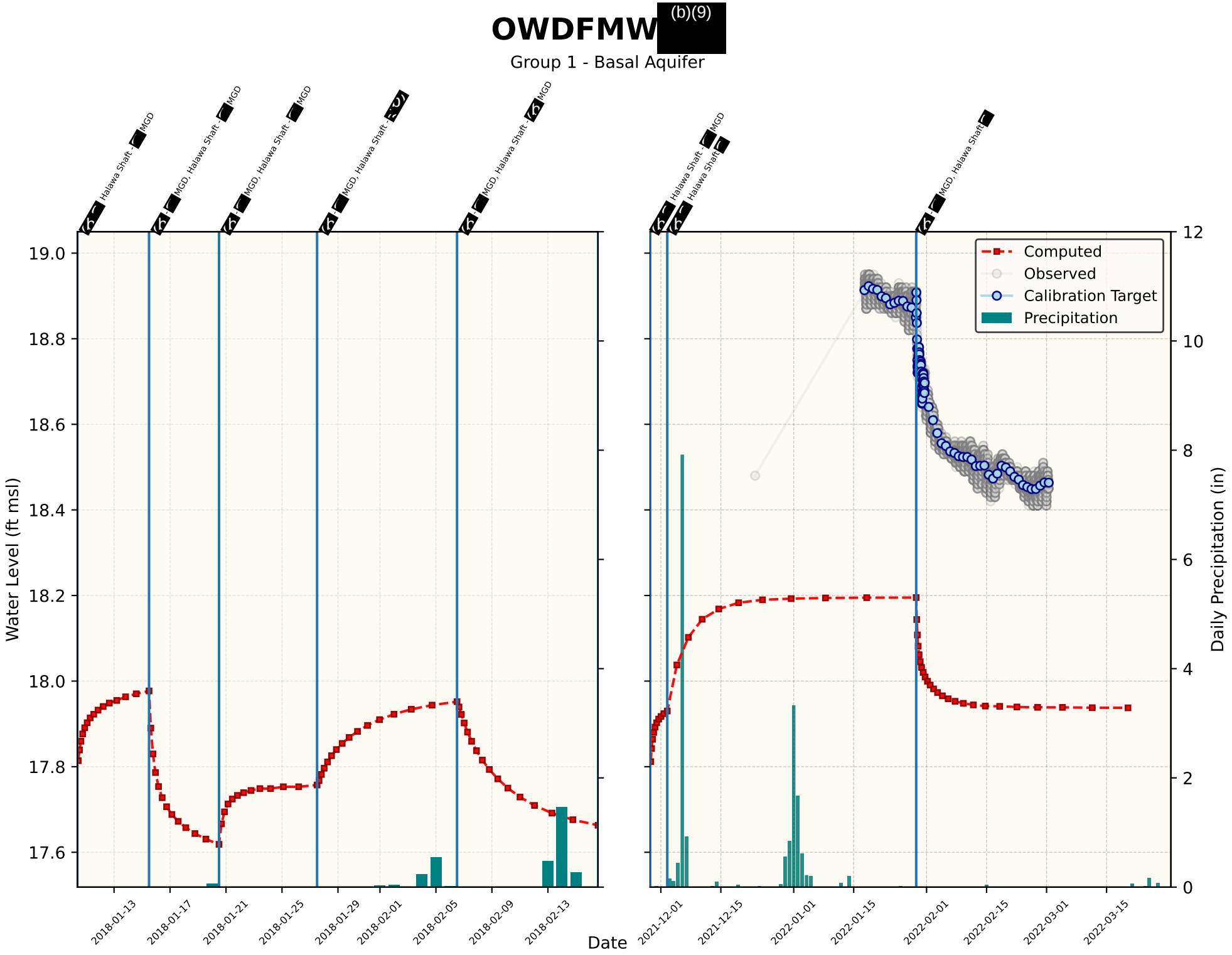

Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.6
19.4
19.2
19.0
18.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

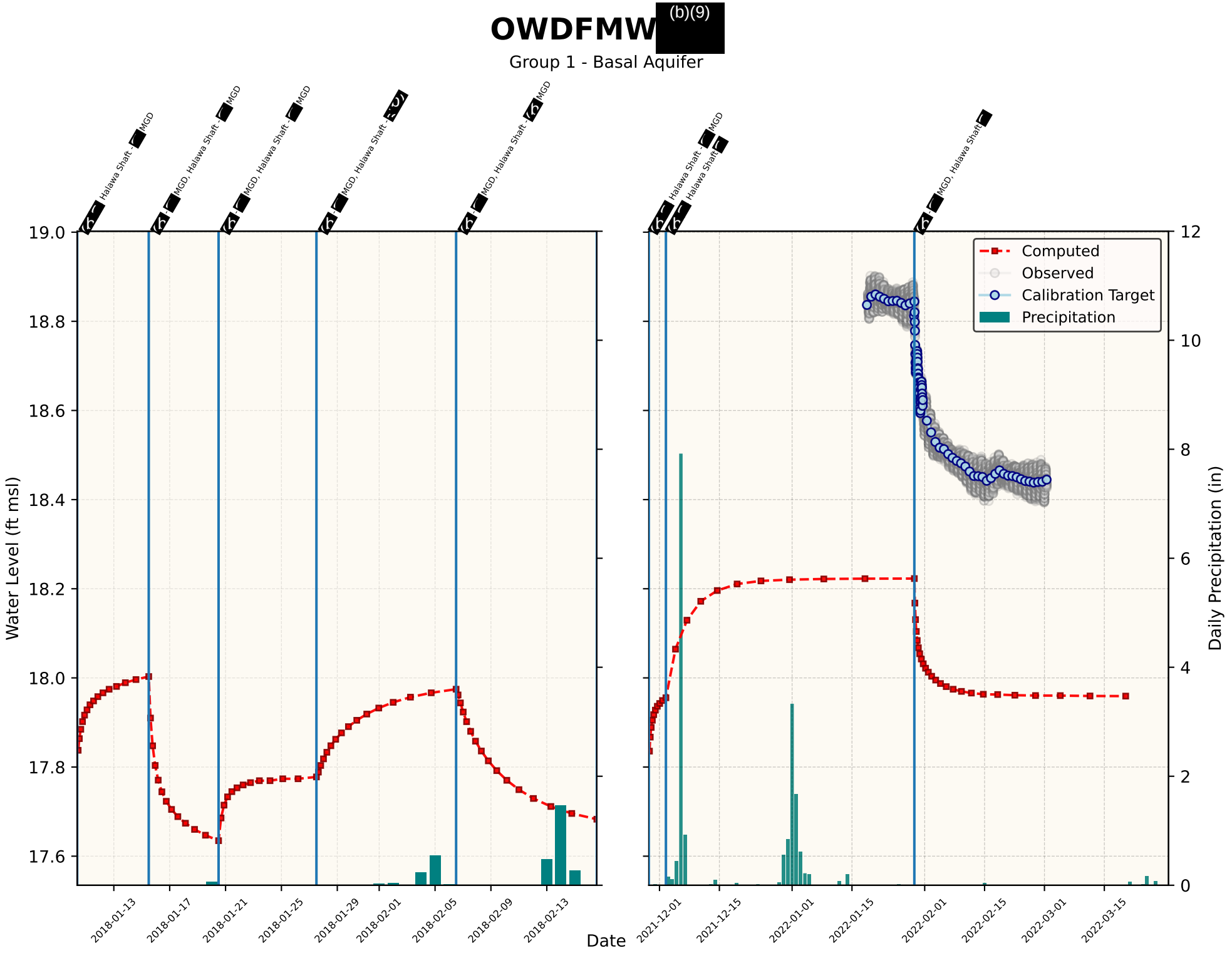

OWDFMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

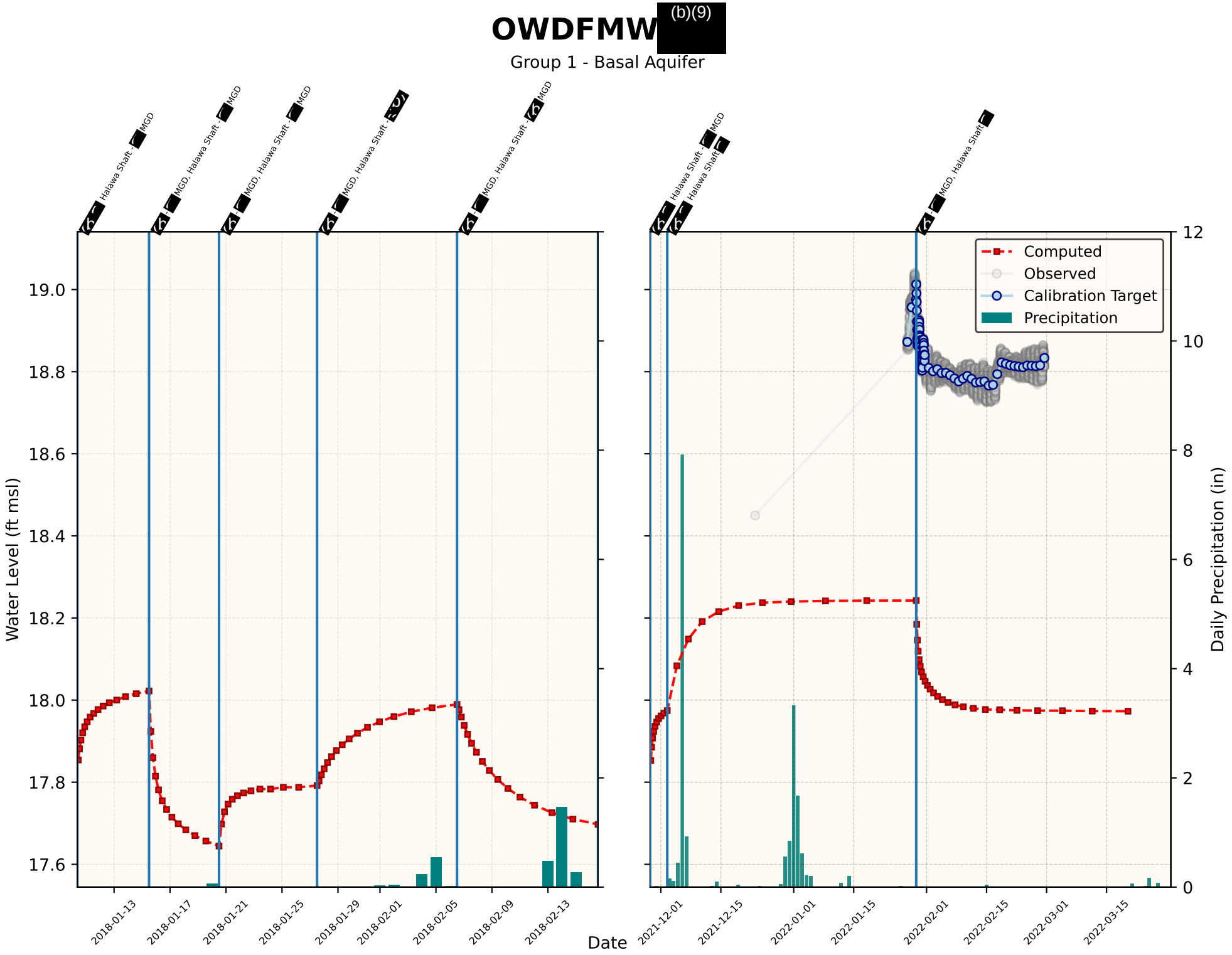

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

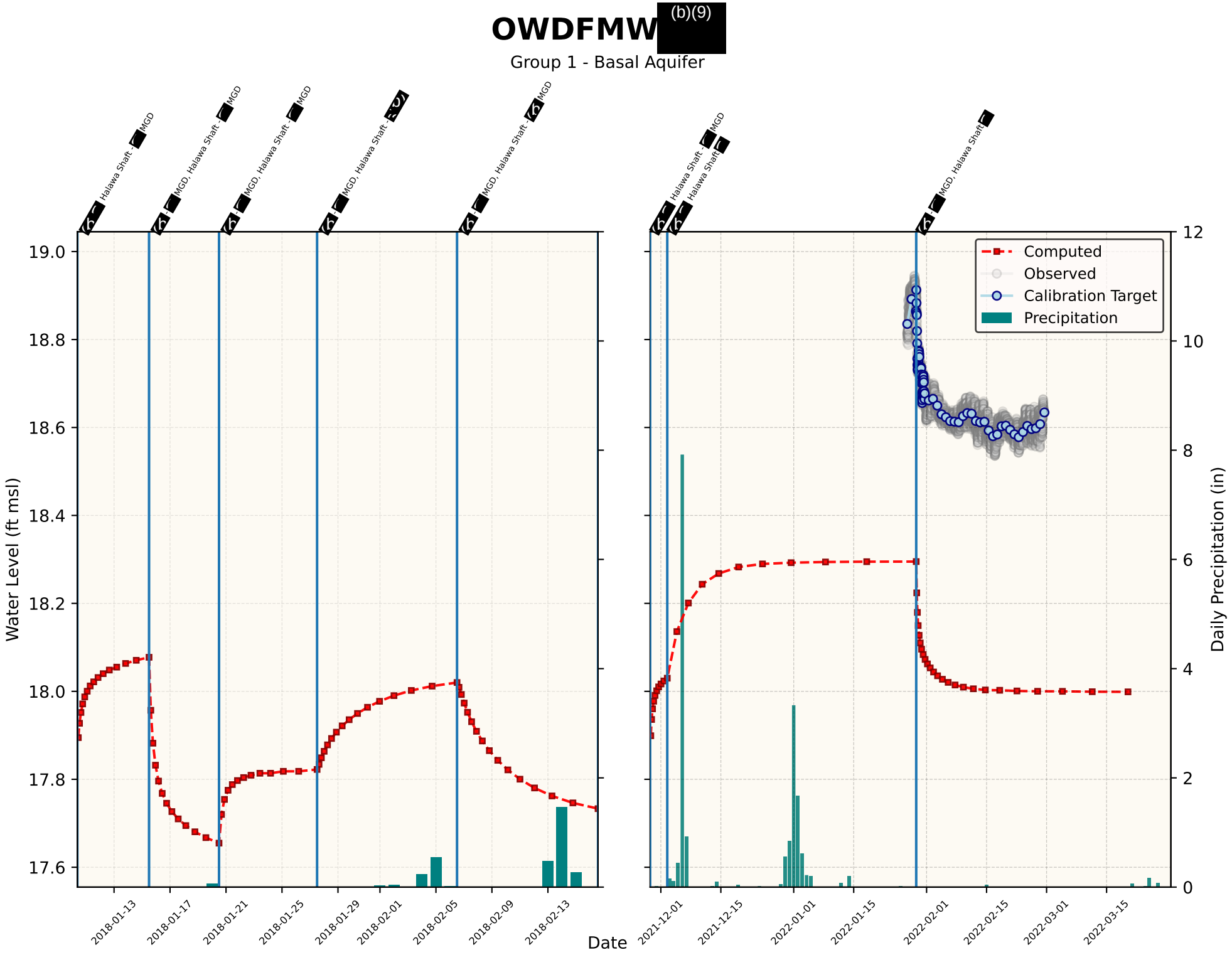

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-02-15
2022-03-01
2022-03-15

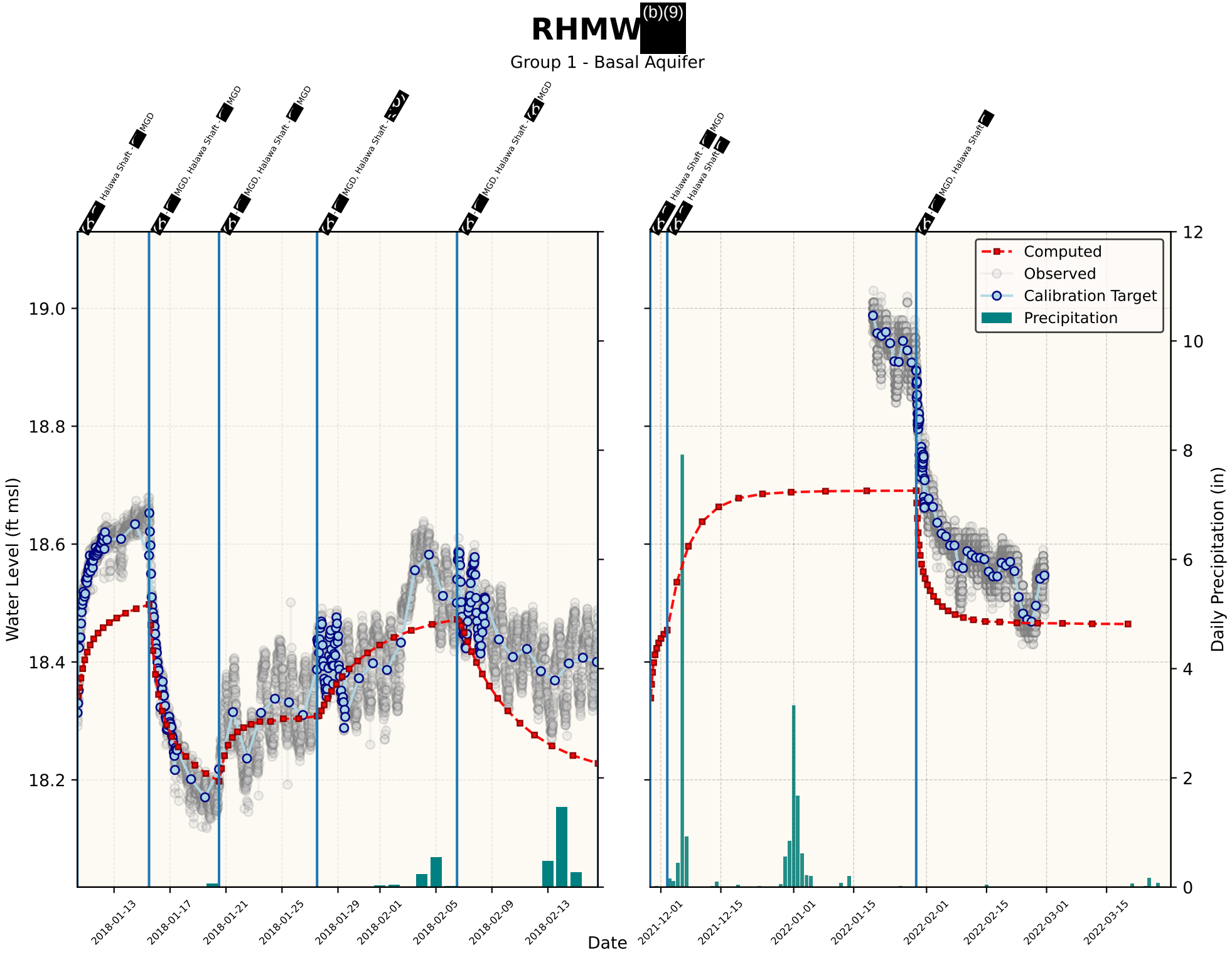

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
18.8
18.6
18.4
18.2
18.0
17.8
17.6
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation
Daily Precipitation (in)
12
10
8
6
4
2
0


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-15

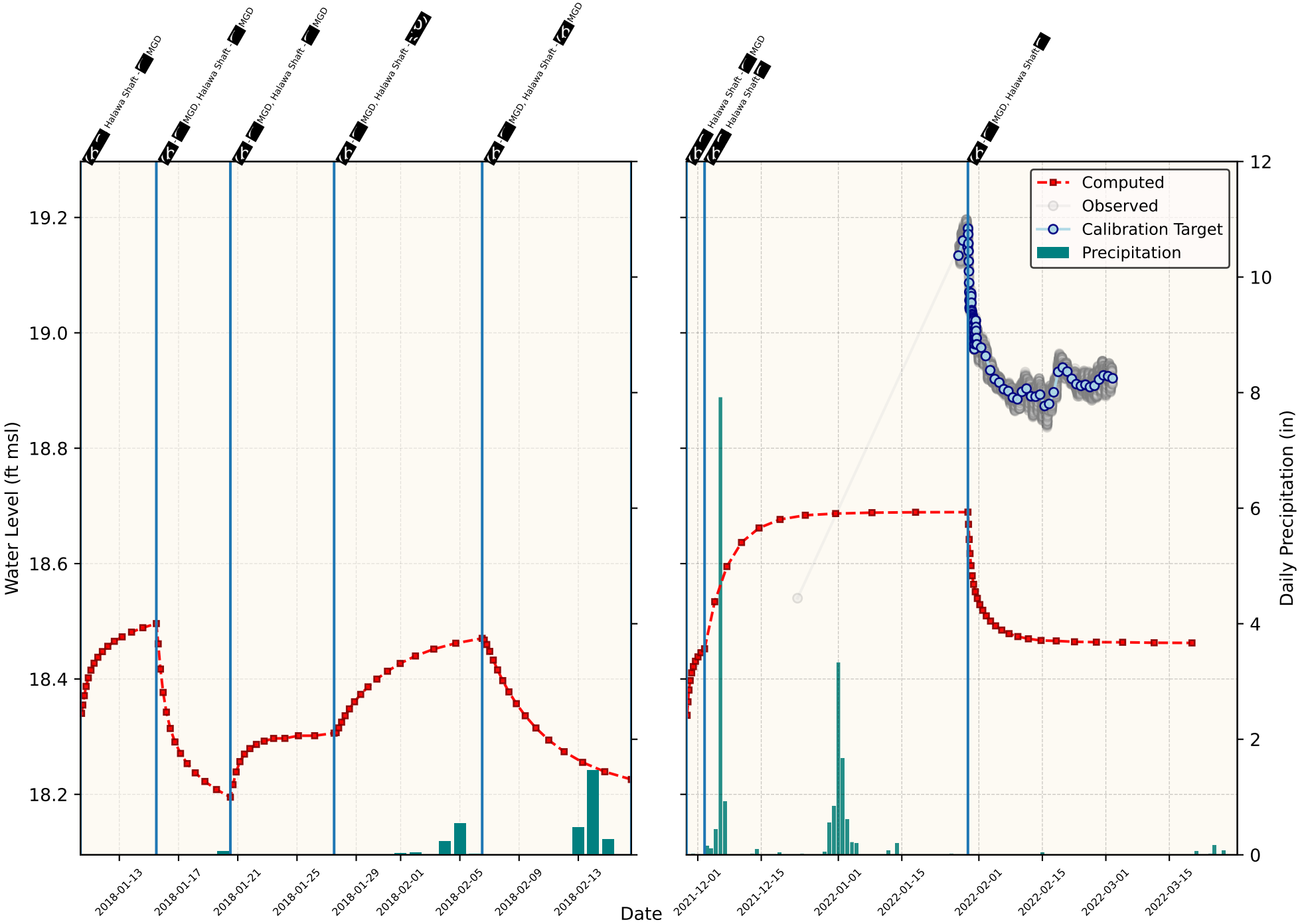

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
19.0
18.8
18.6
18.4
18.2
18.0
17.8
17.6
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation
Daily Precipitation (in)
12
10
8
6
4
2
0

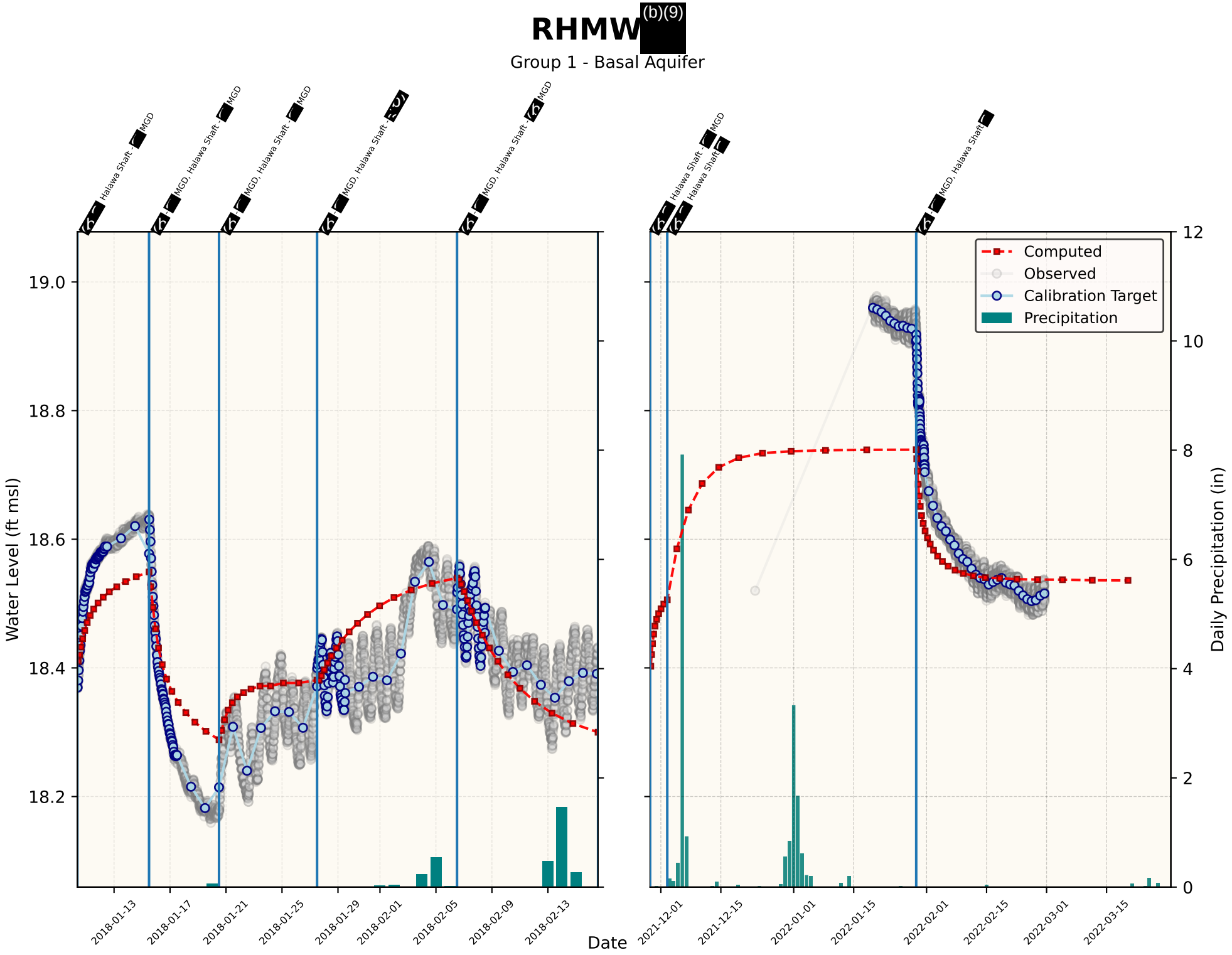

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
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2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-01-01
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2022-02-01
2022-02-15
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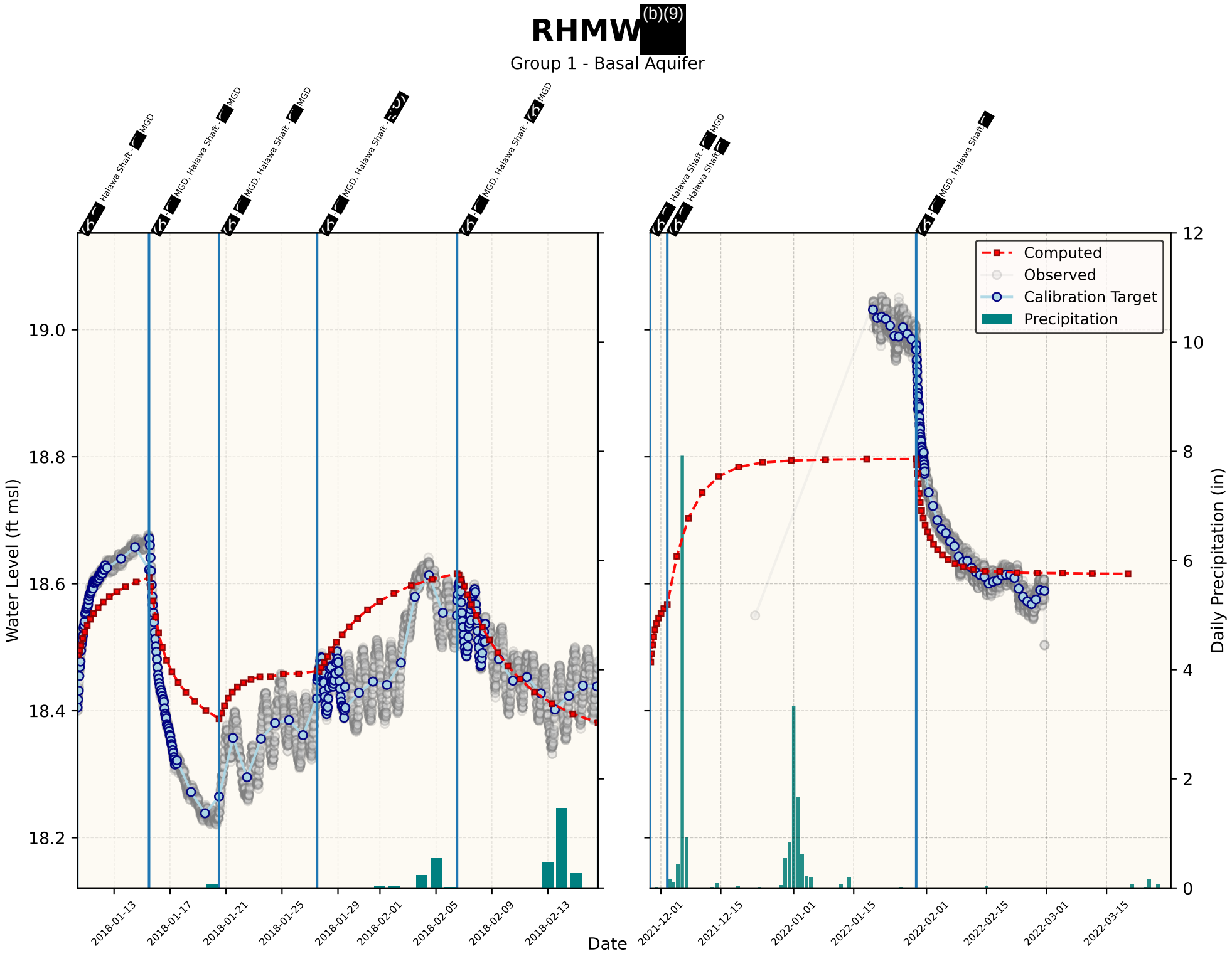

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
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2022-02-01
2022-02-15
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2022-03-15

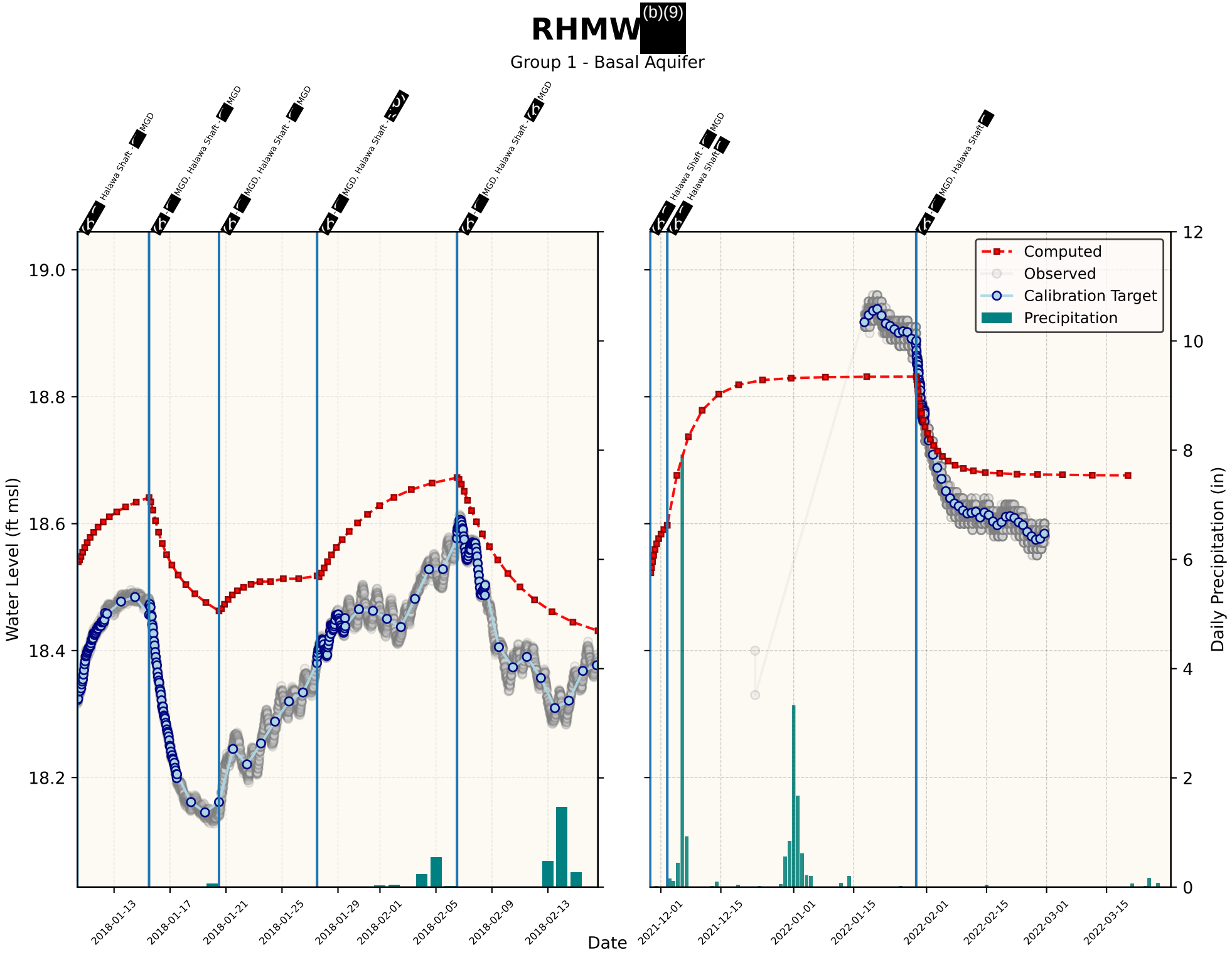
RHMW[redacted] (b)(9)

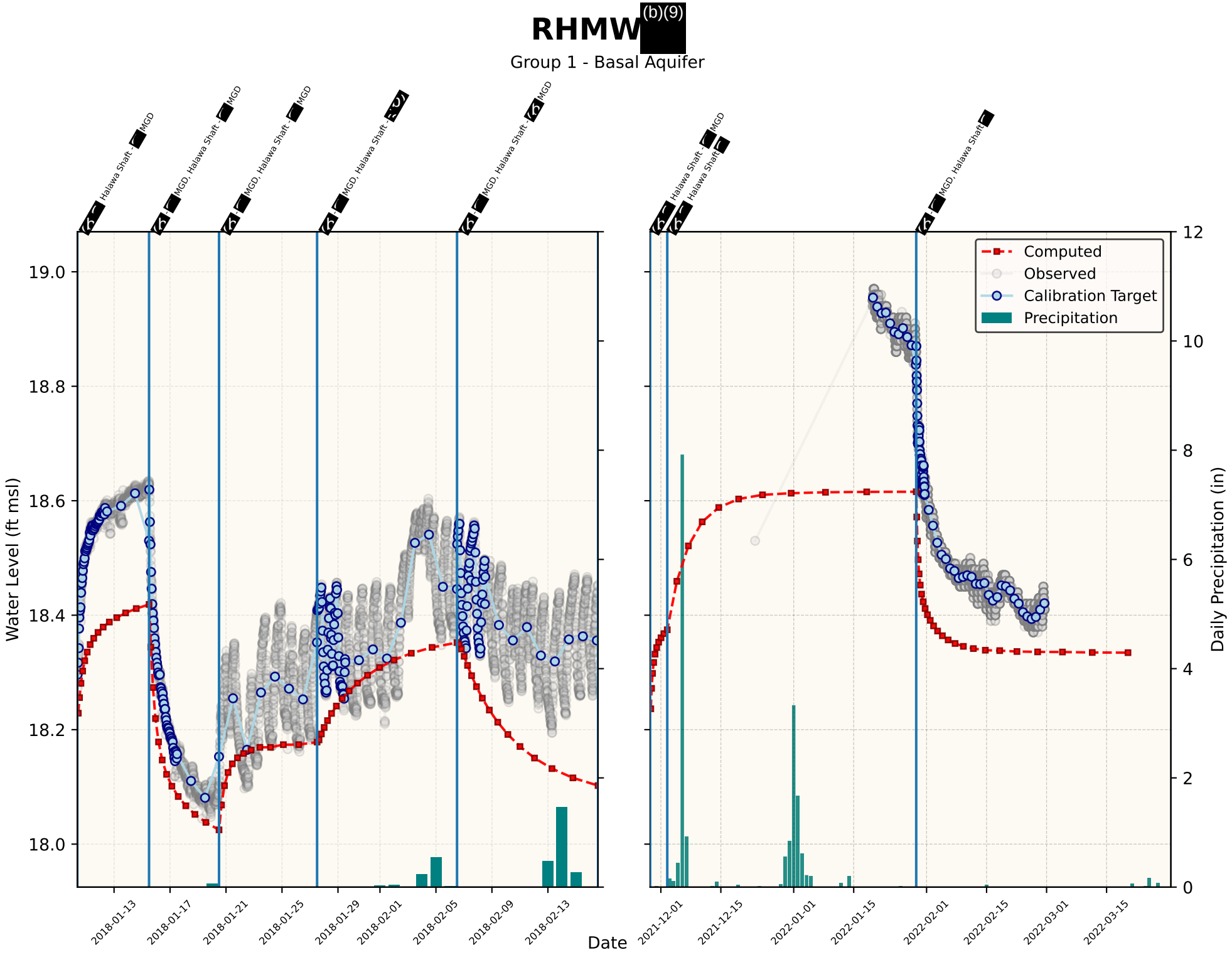
Group 1 - Basal Aquifer

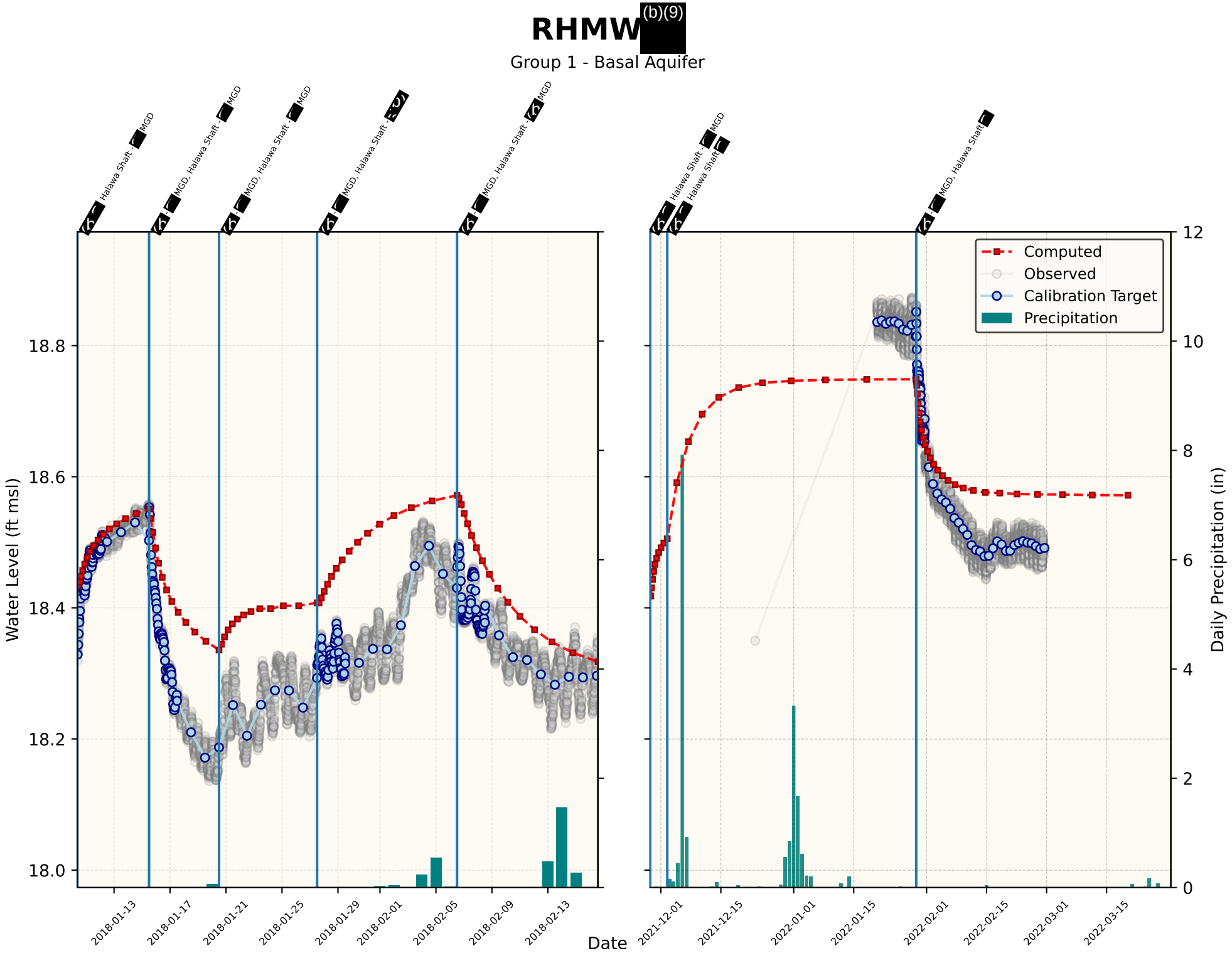


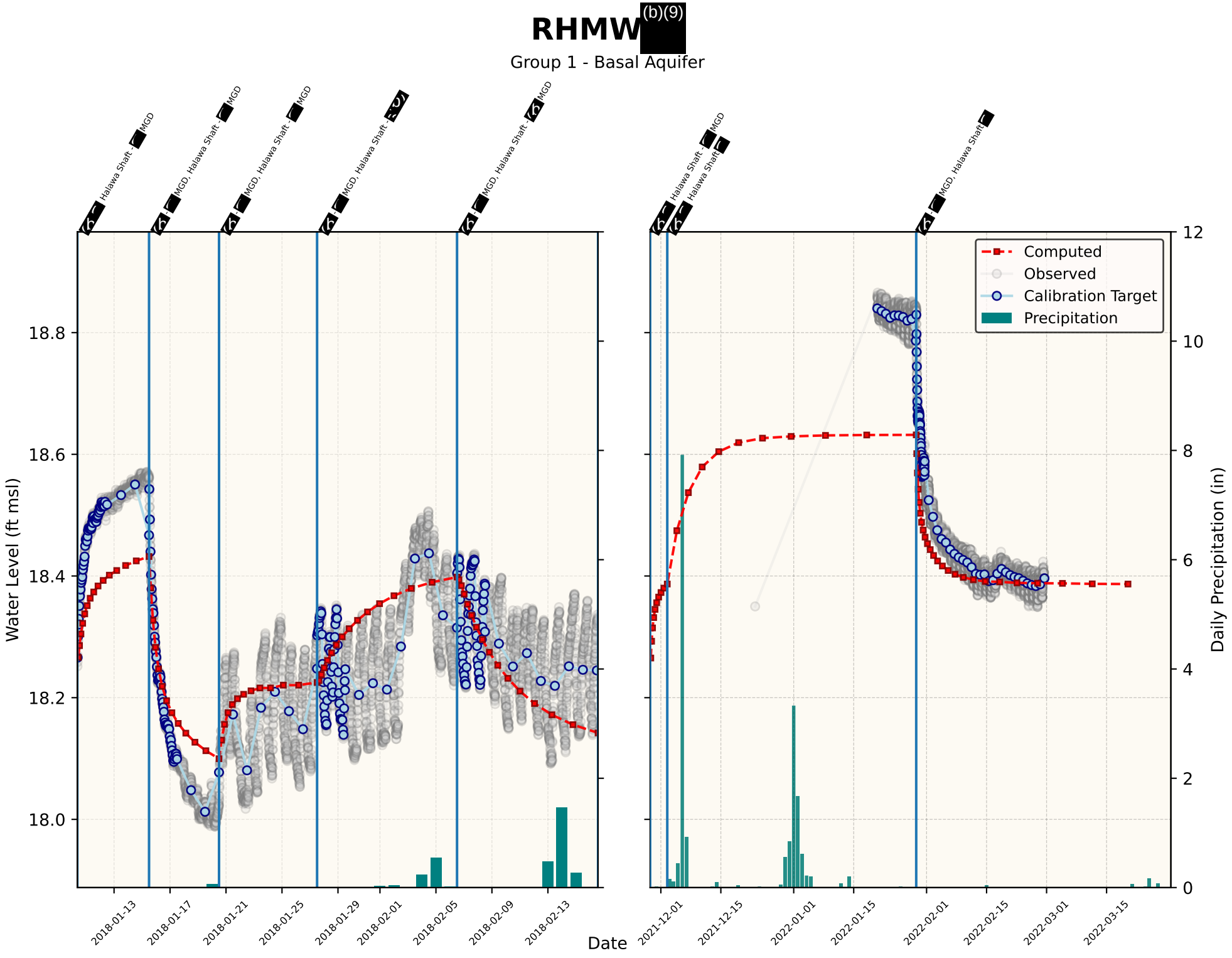

RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-15
2022-03-01
2022-03-15

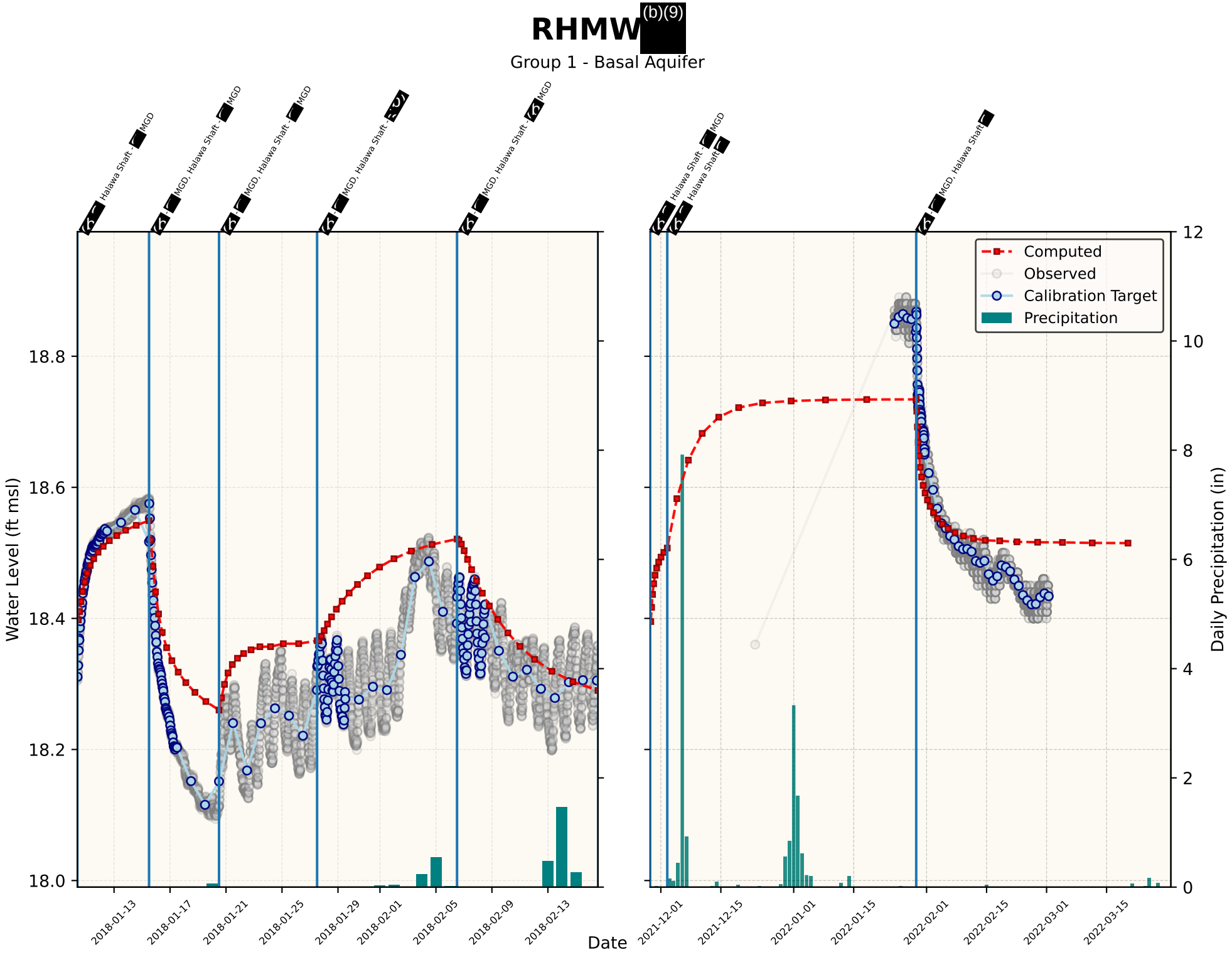

RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-01
2022-03-15

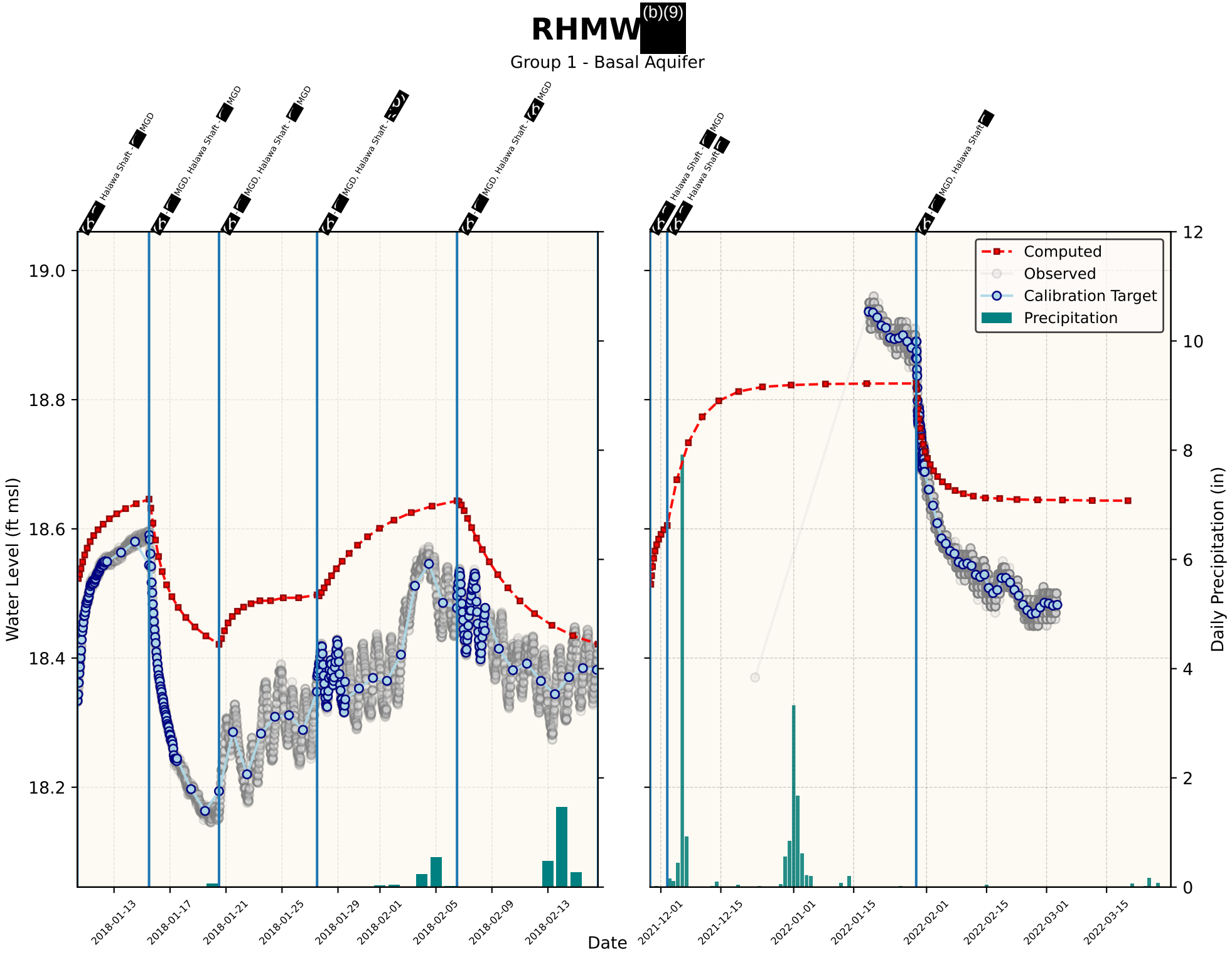

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
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2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-01
2022-03-15

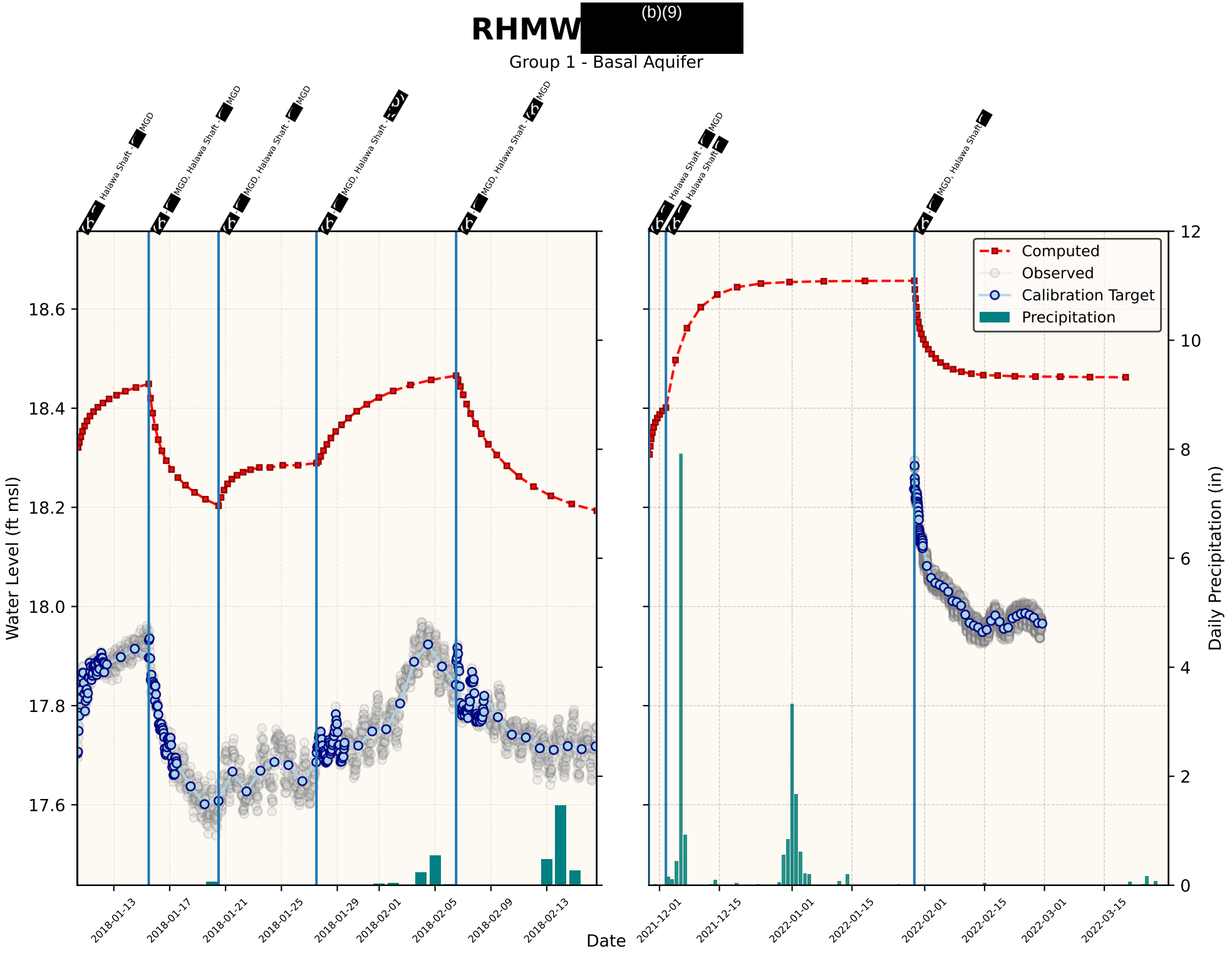

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
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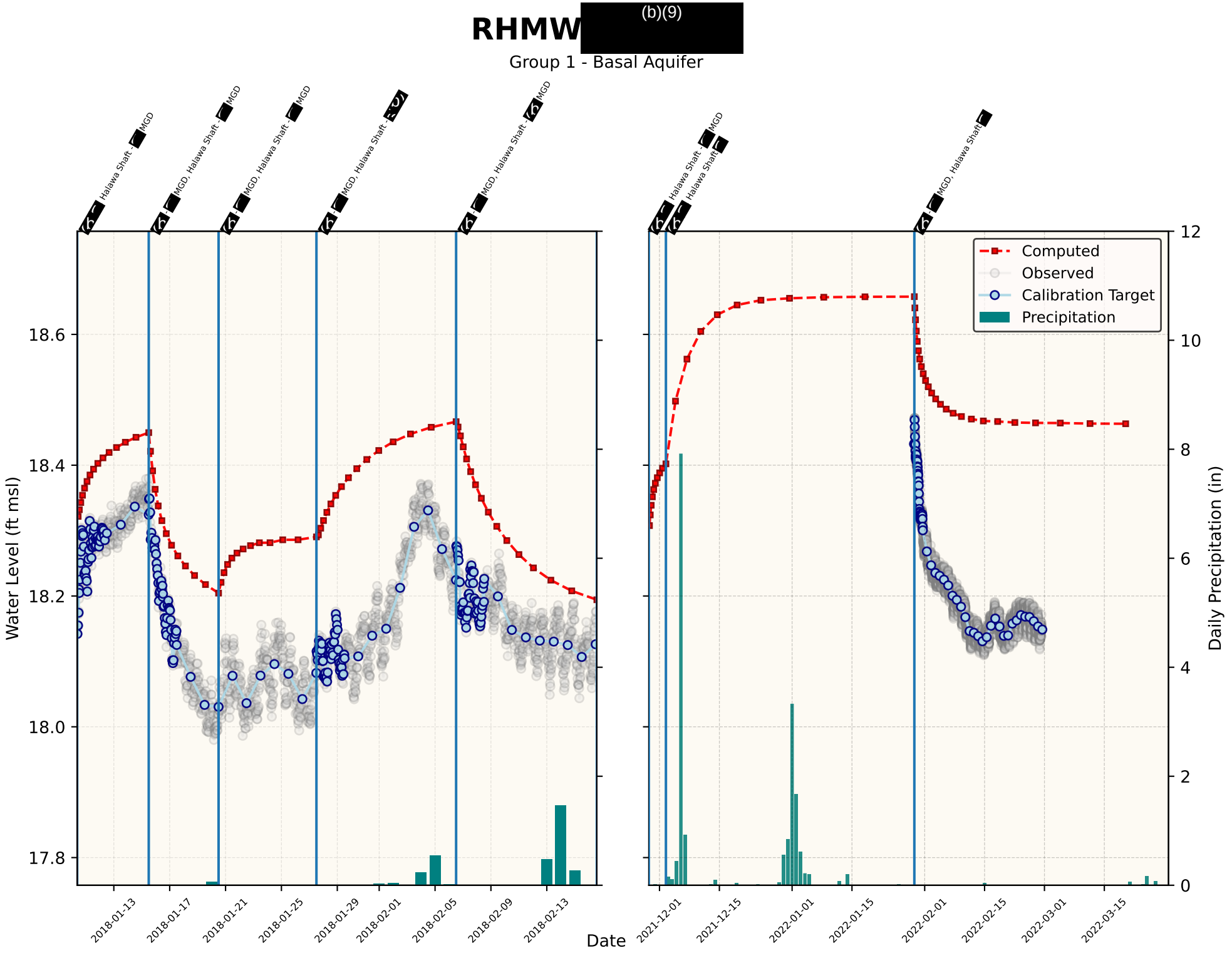

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted]
Computed
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Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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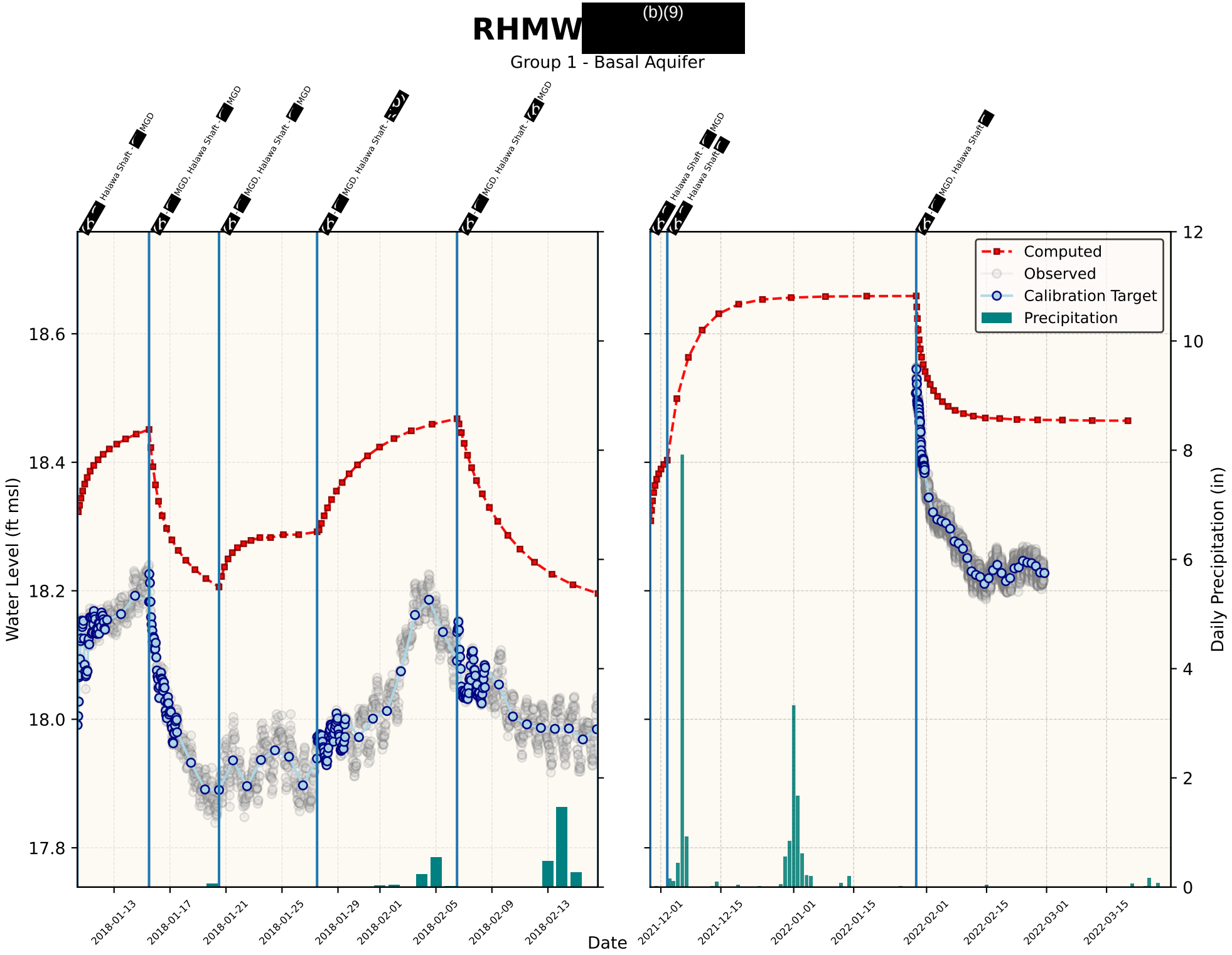

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(b)(9)
Group 1 - Basal Aquifer
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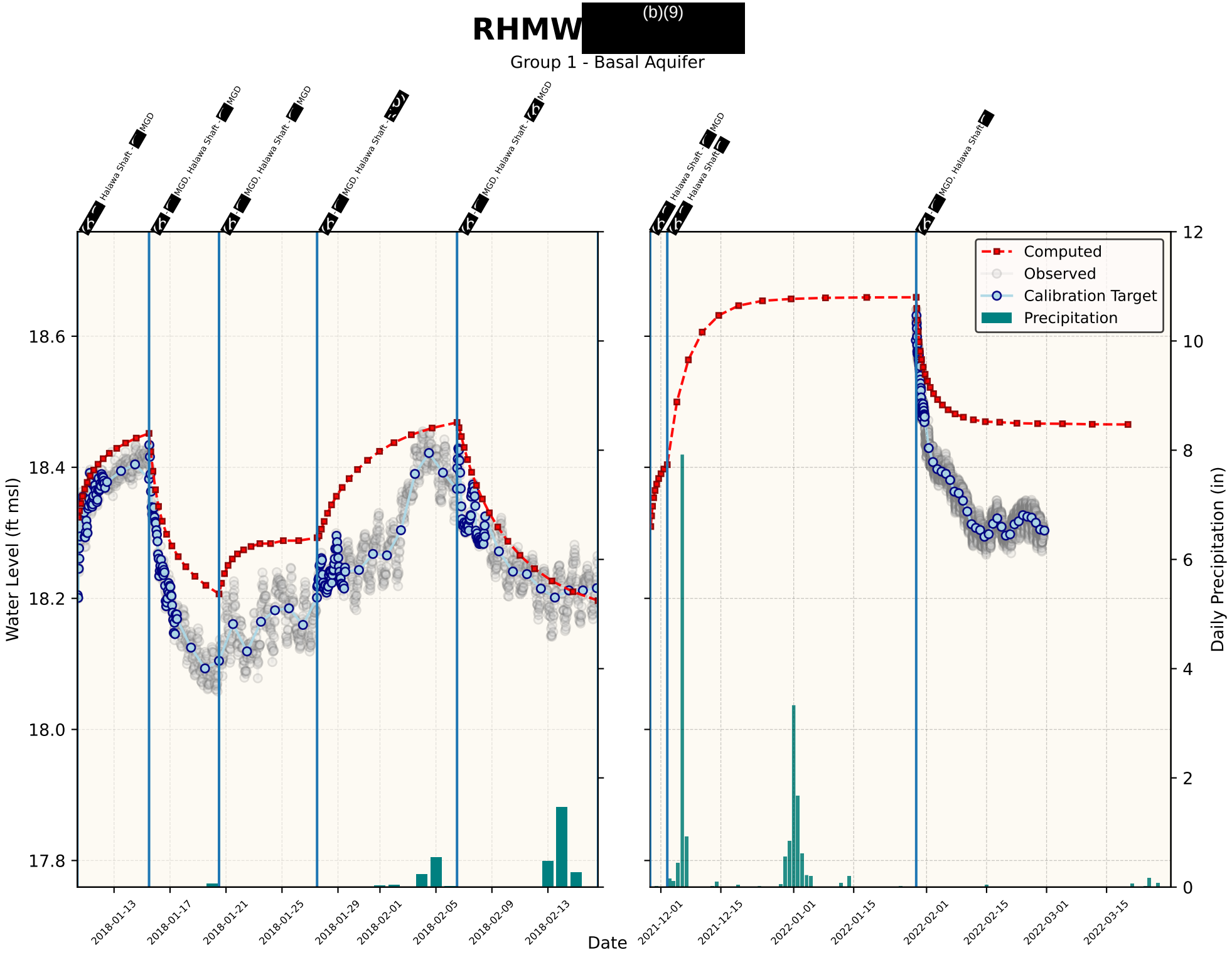

RHMW(b)(9)
Group 1 - Basal Aquifer
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RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
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RHMW (b)(9)
Group 1 - Basal Aquifer
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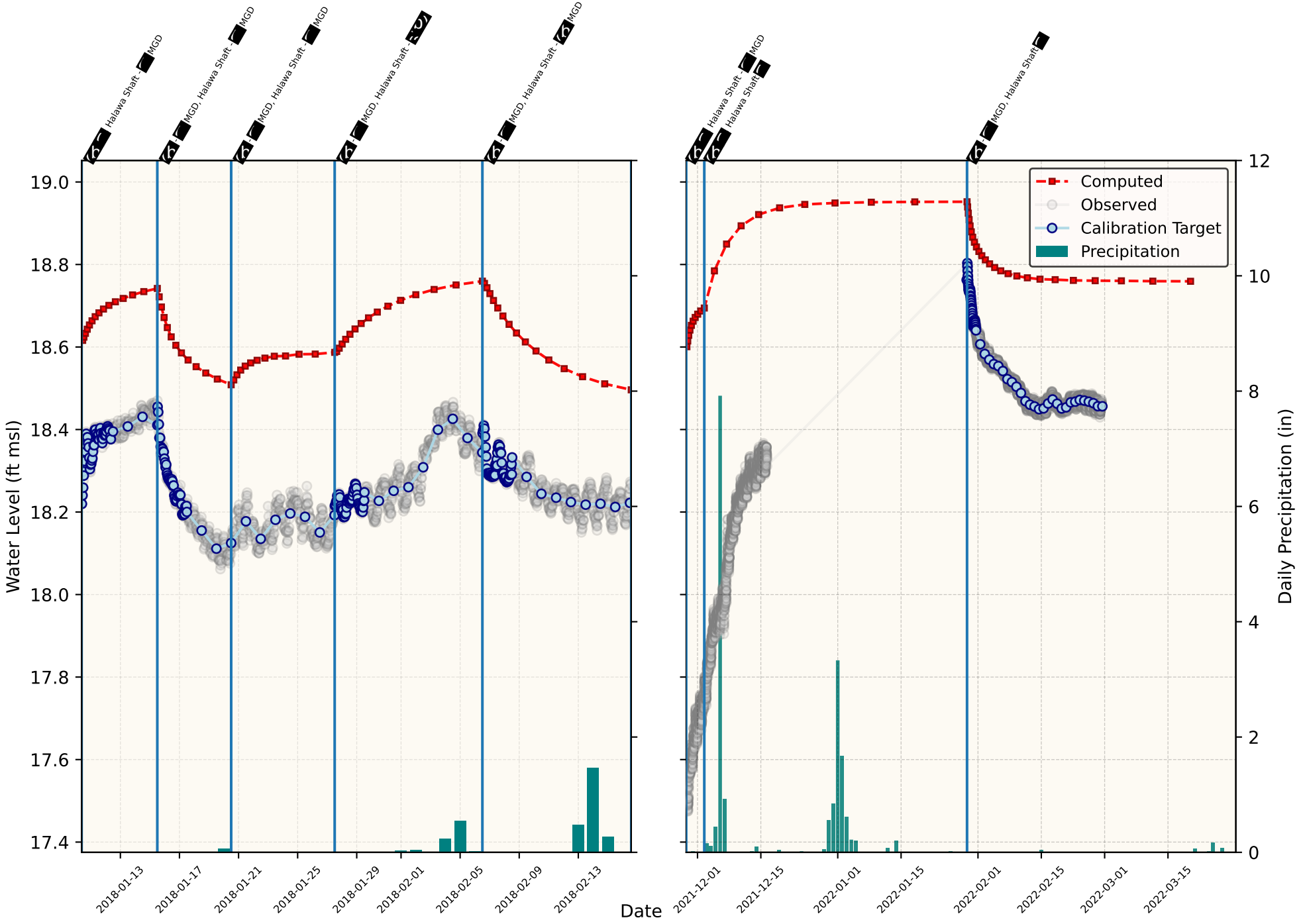

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
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Water Level (ft msl)
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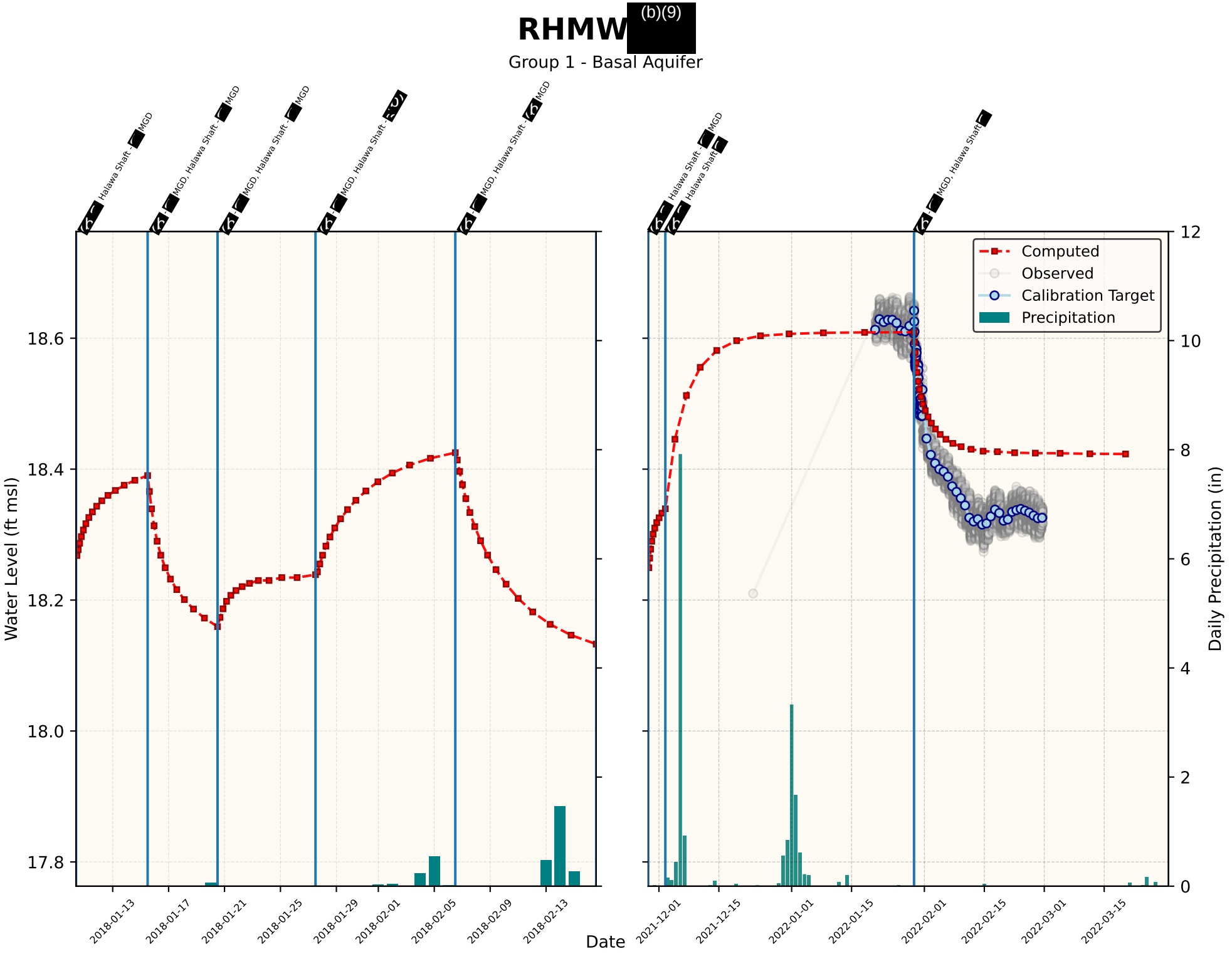

RHMW (b)(9)
Group 1 - Basal Aquifer
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Water Level (ft msl)
Daily Precipitation (in)
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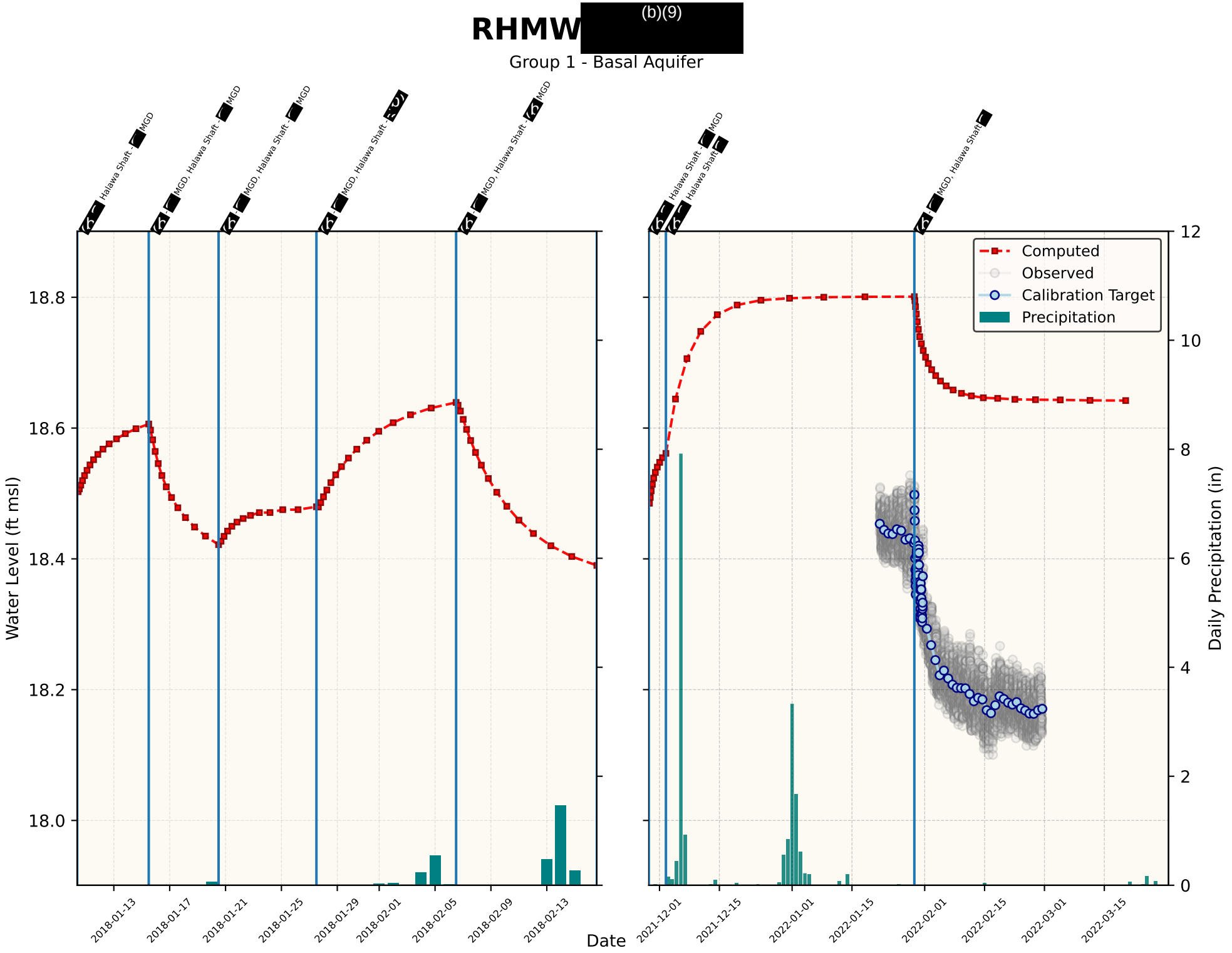

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
Computed
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Calibration Target
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Water Level (ft msl)
Daily Precipitation (in)
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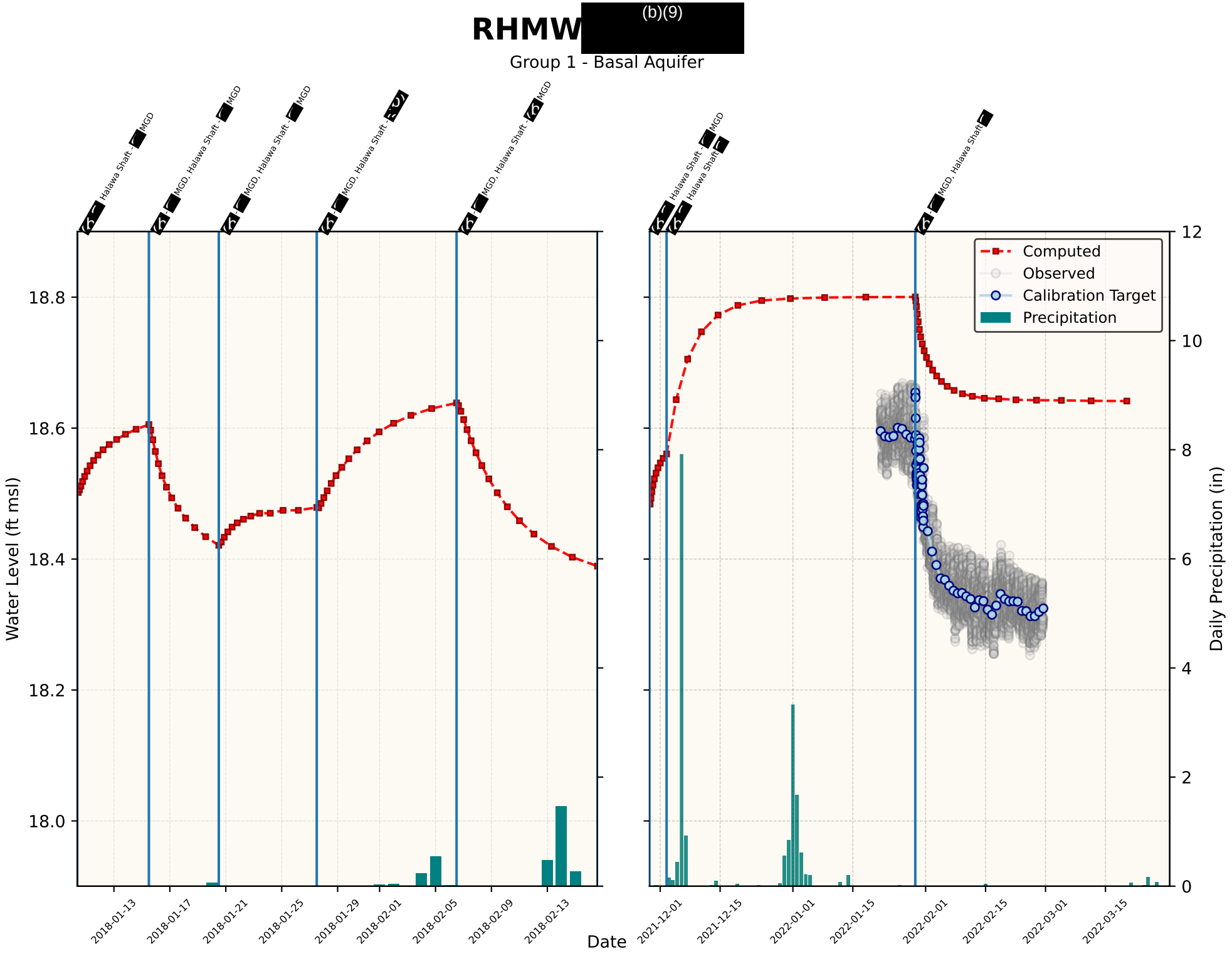
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



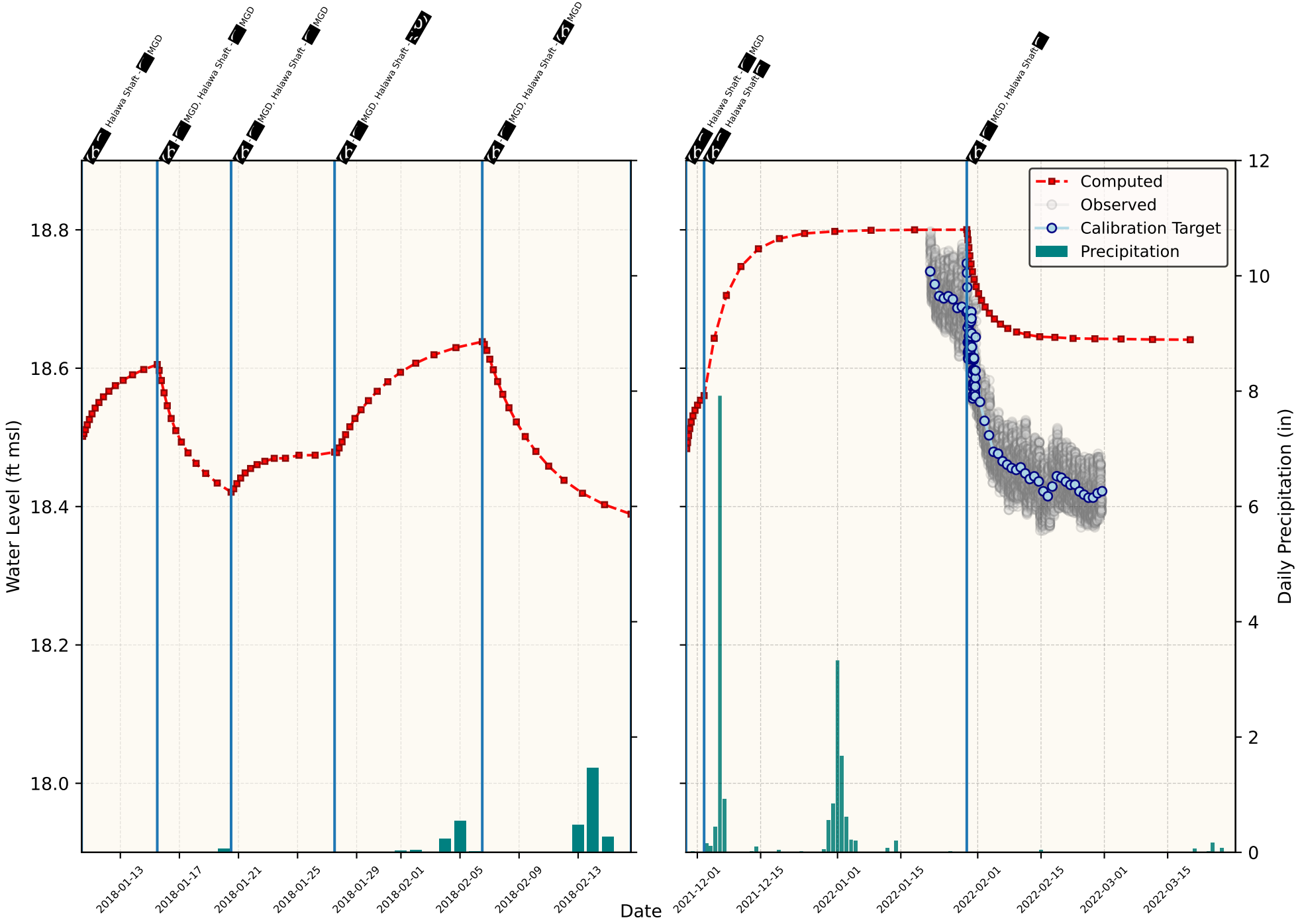

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
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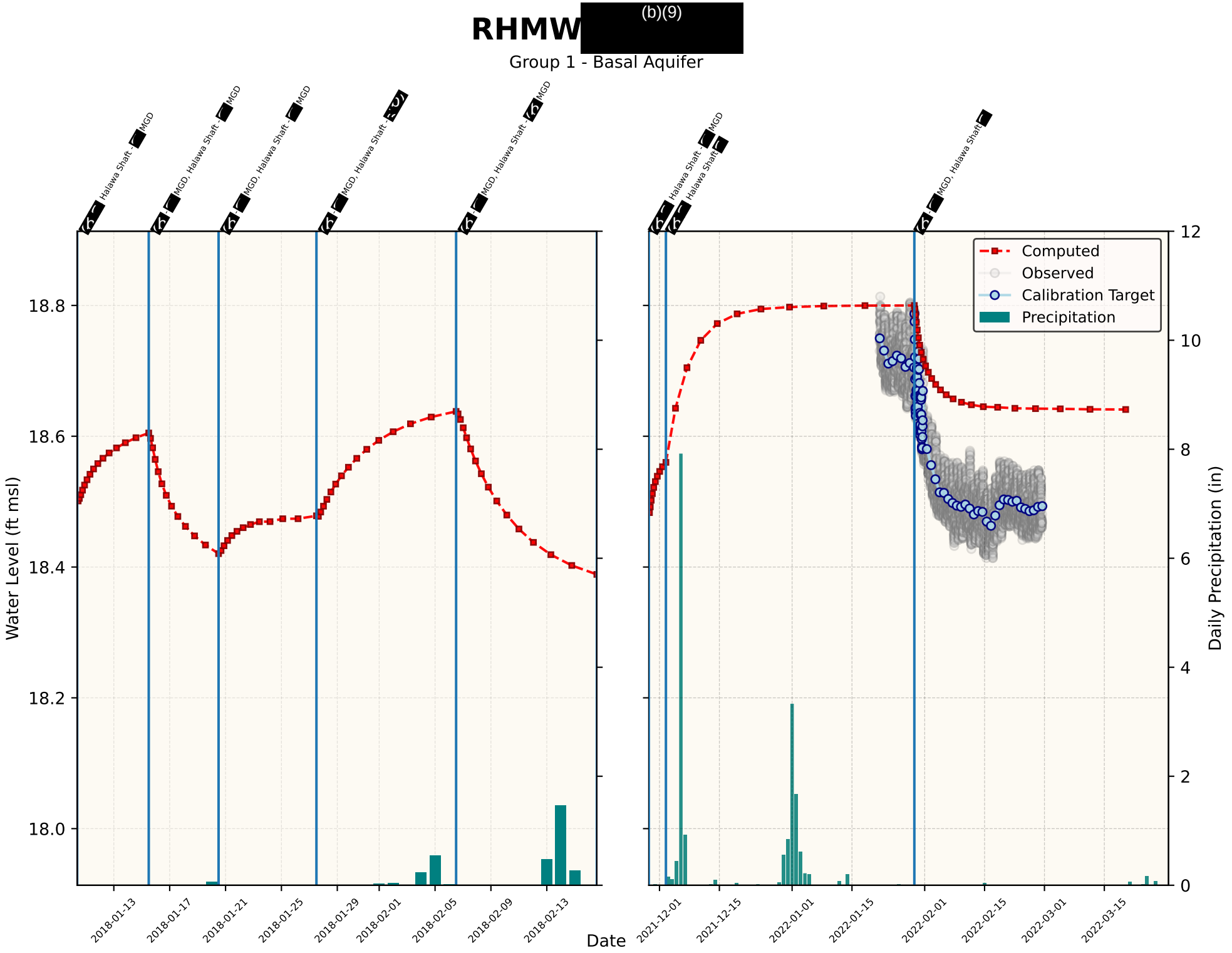

RHMW (b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft (b)(9)
Computed
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Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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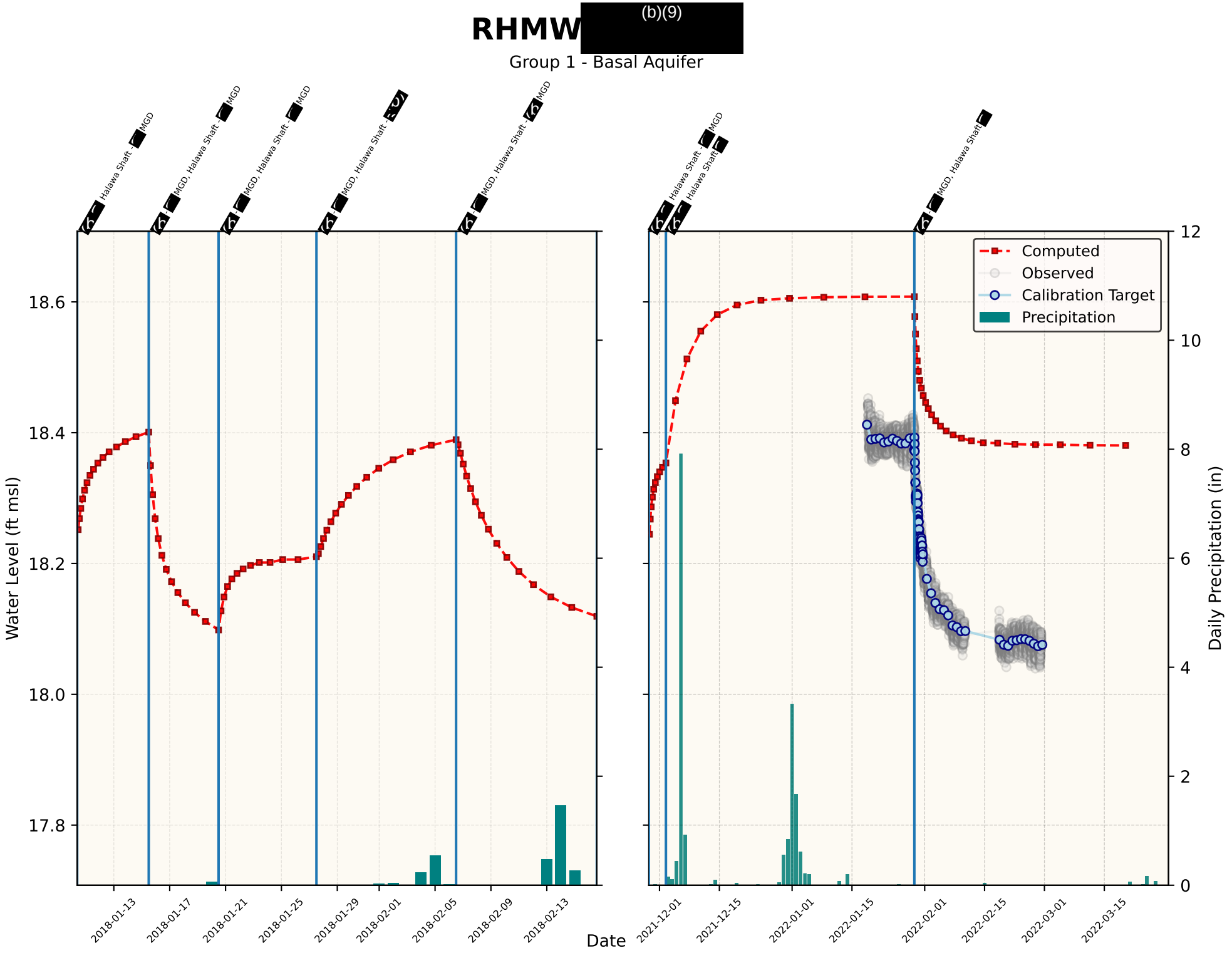

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
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MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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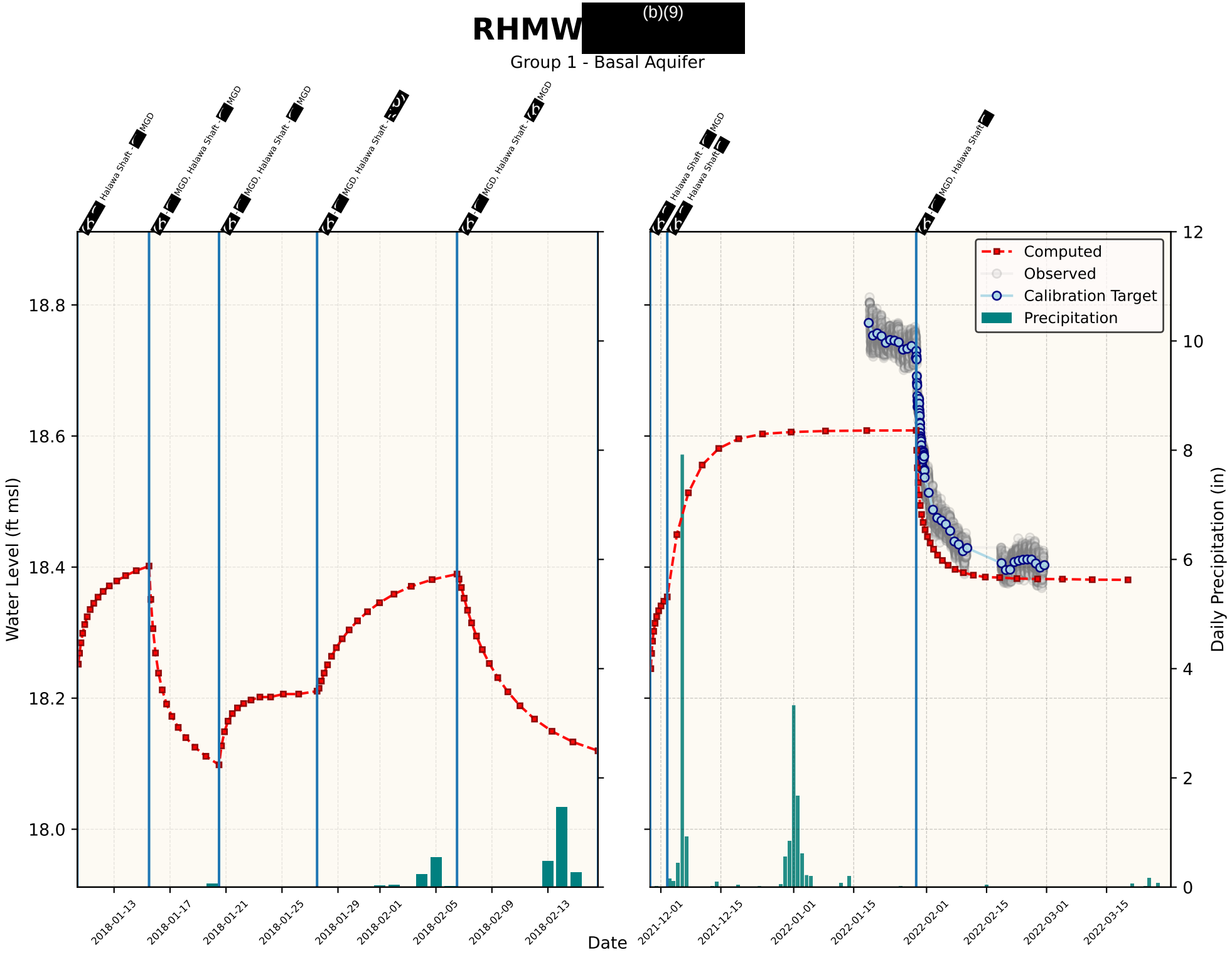
RHMW (b)(9)

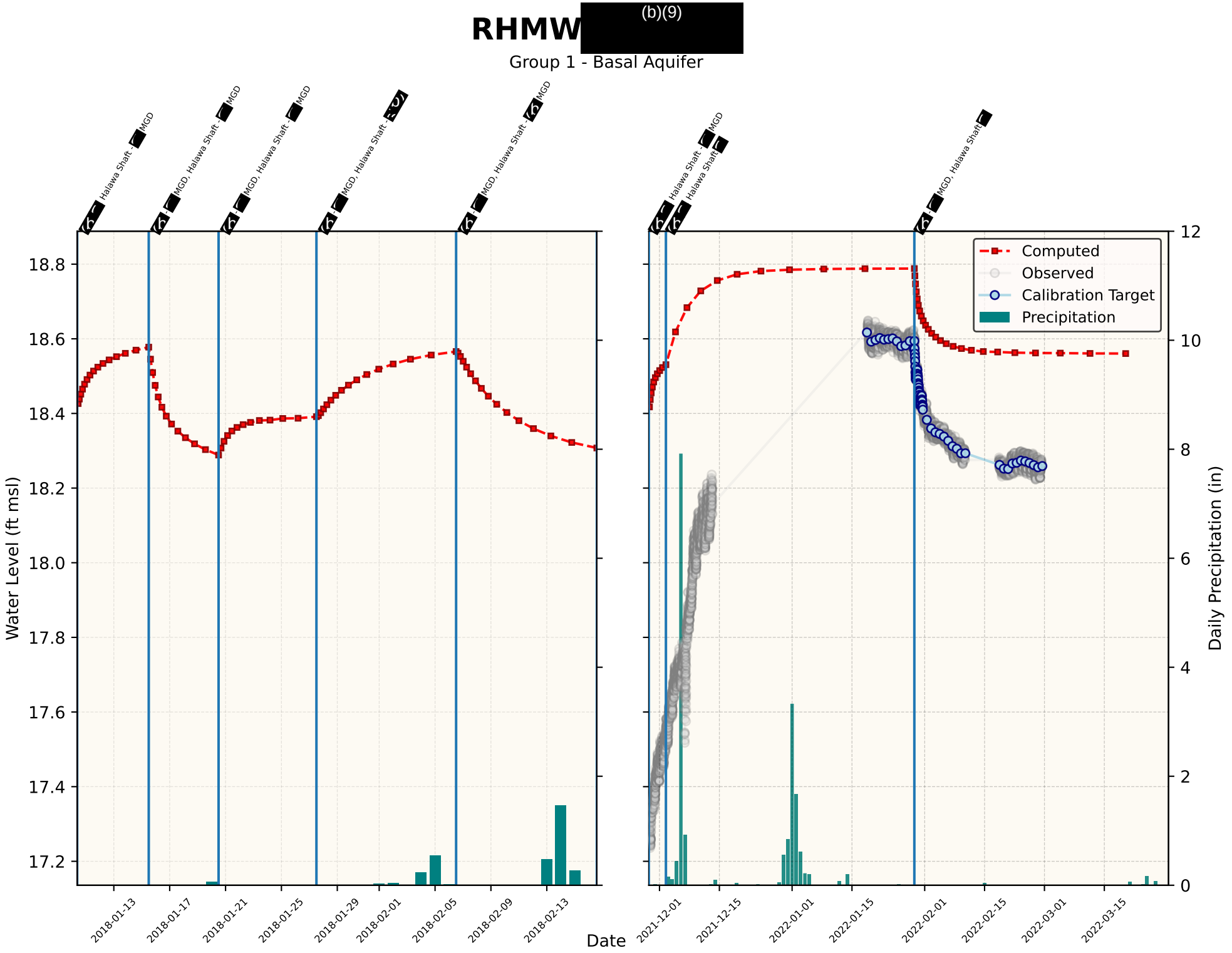
Group 1 - Basal Aquifer

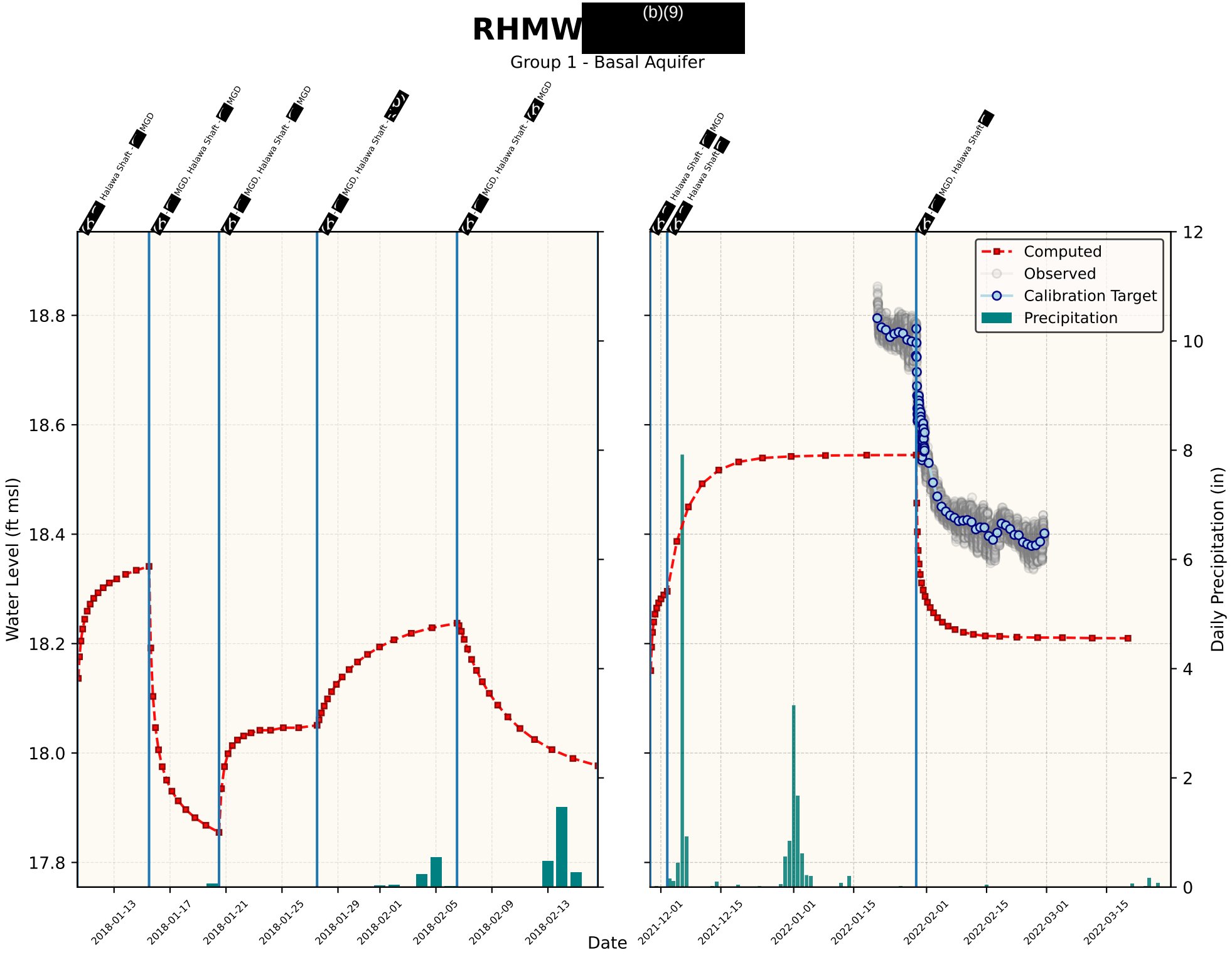


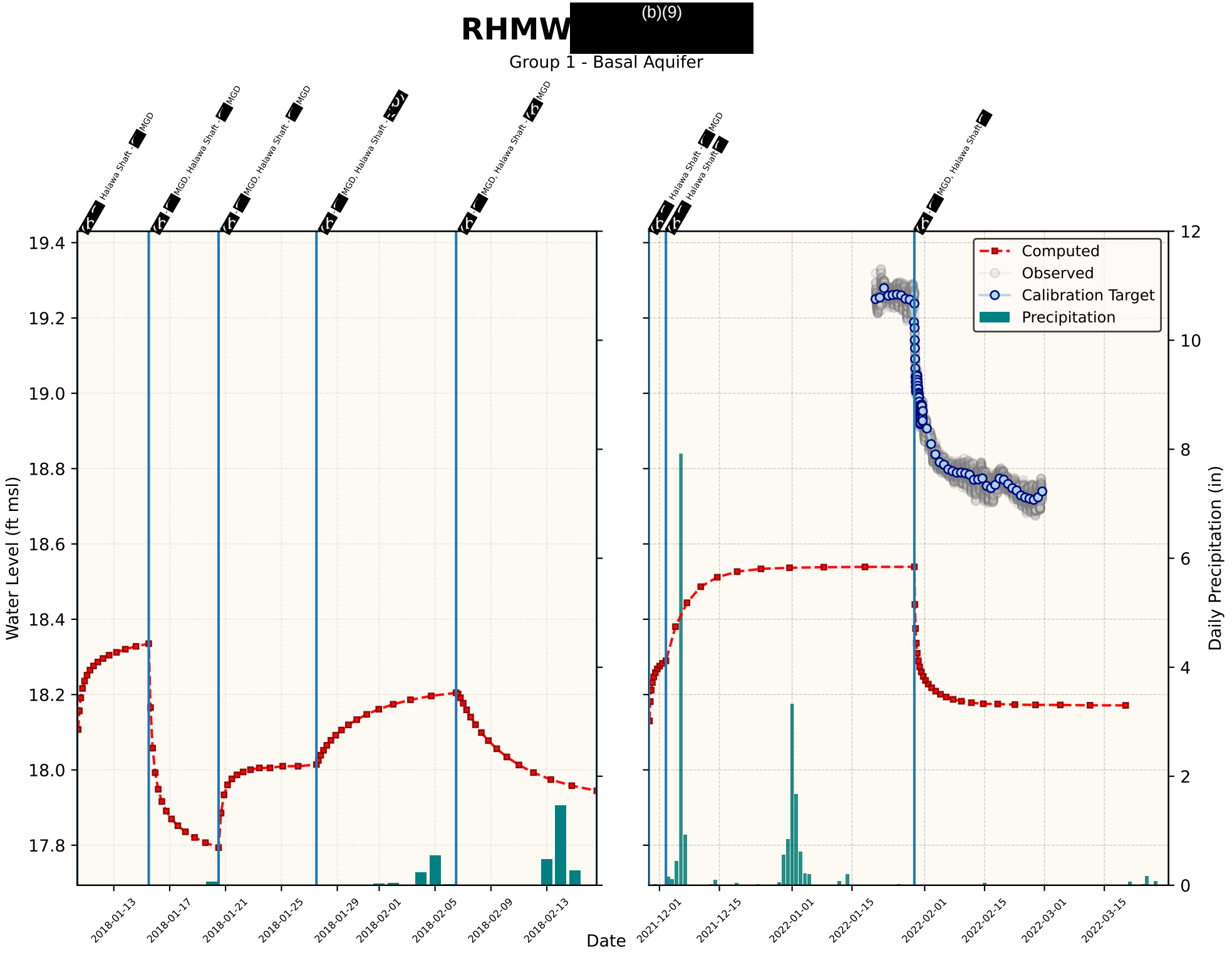

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
Water Level (ft msl)
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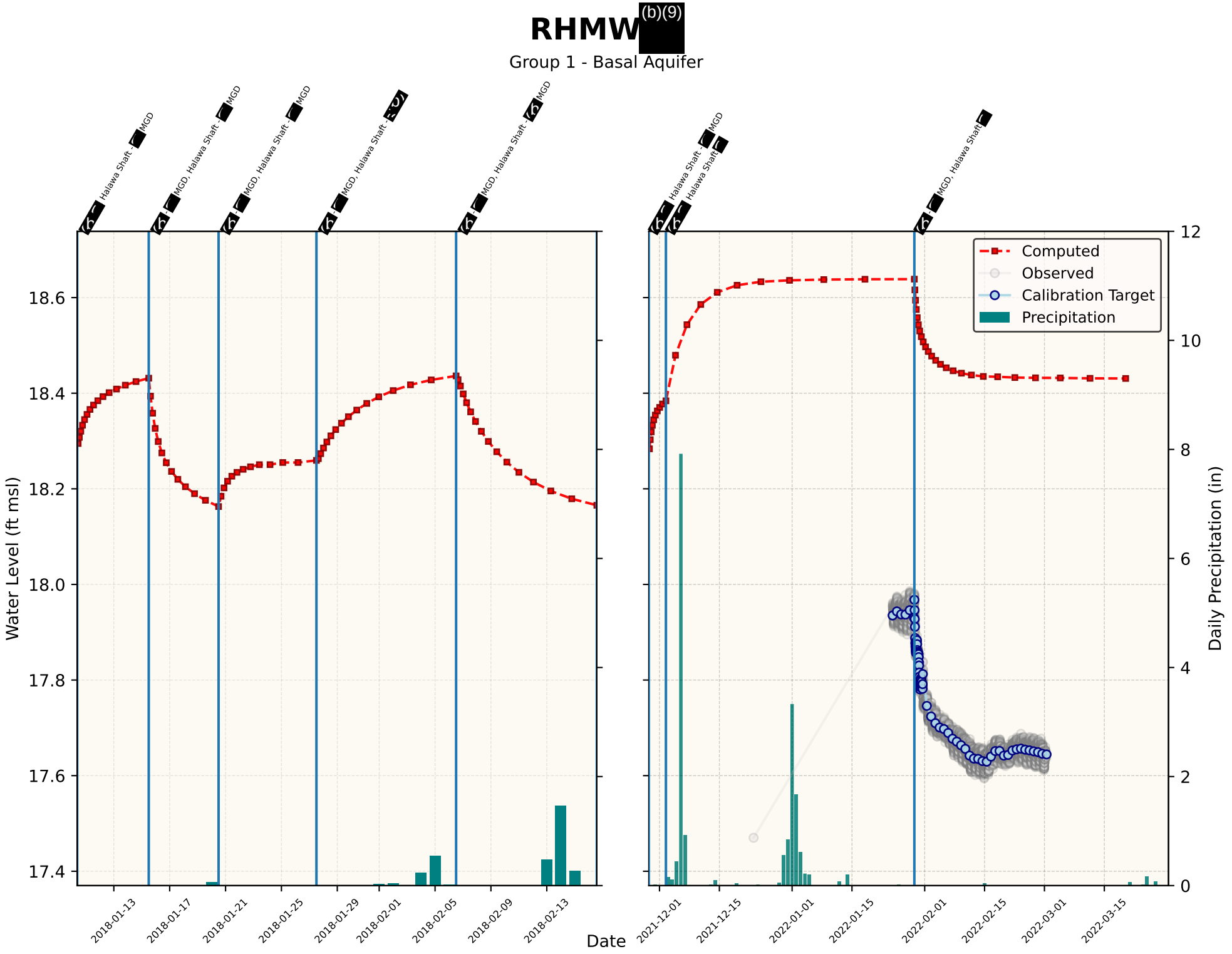

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
Computed
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Water Level (ft msl)
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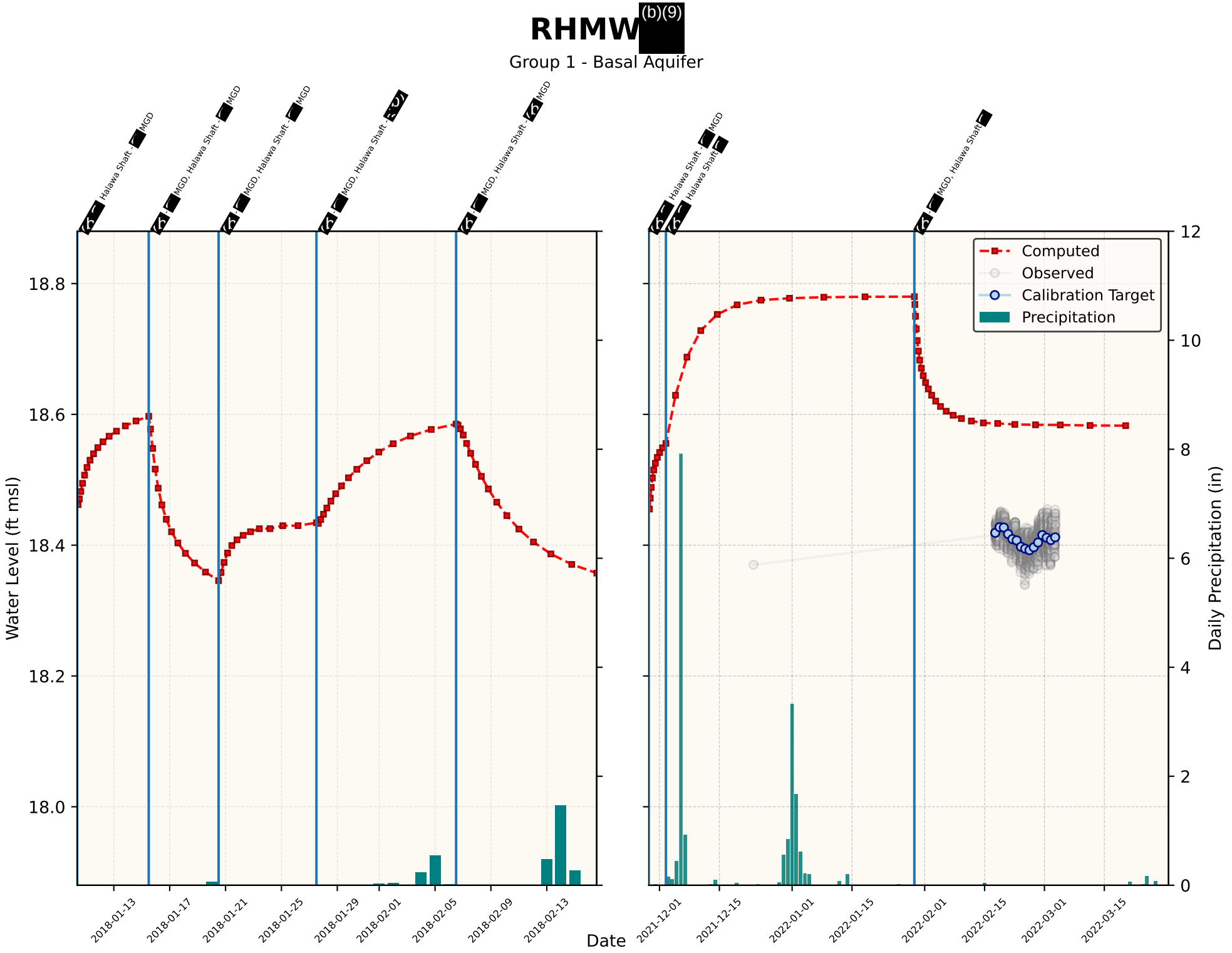

RHMW (b)(9)
Group 1 - Basal Aquifer
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Observed
Calibration Target
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RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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Computed
Observed
Calibration Target
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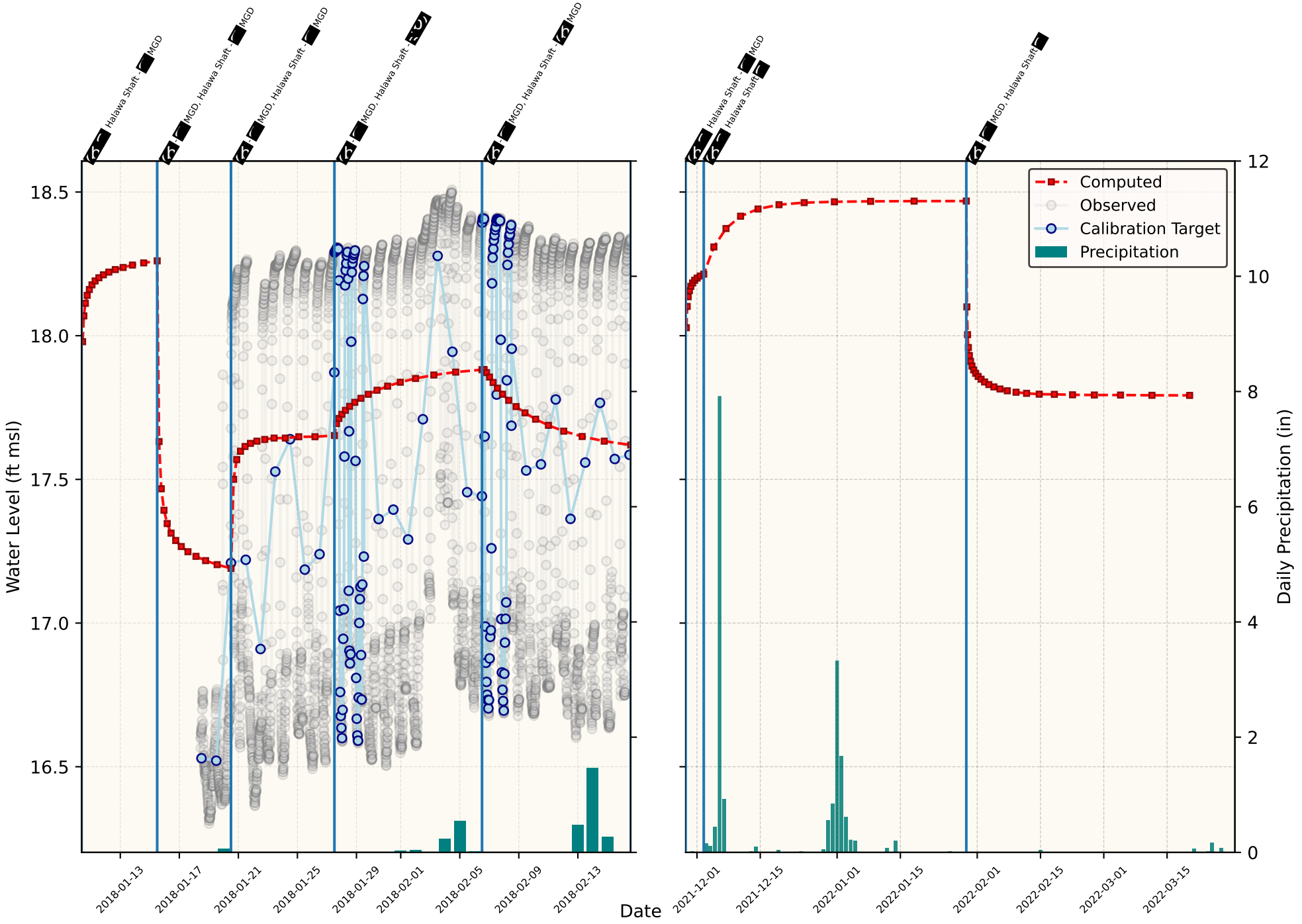

RHMW (b)(9)
Group 1 - Basal Aquifer
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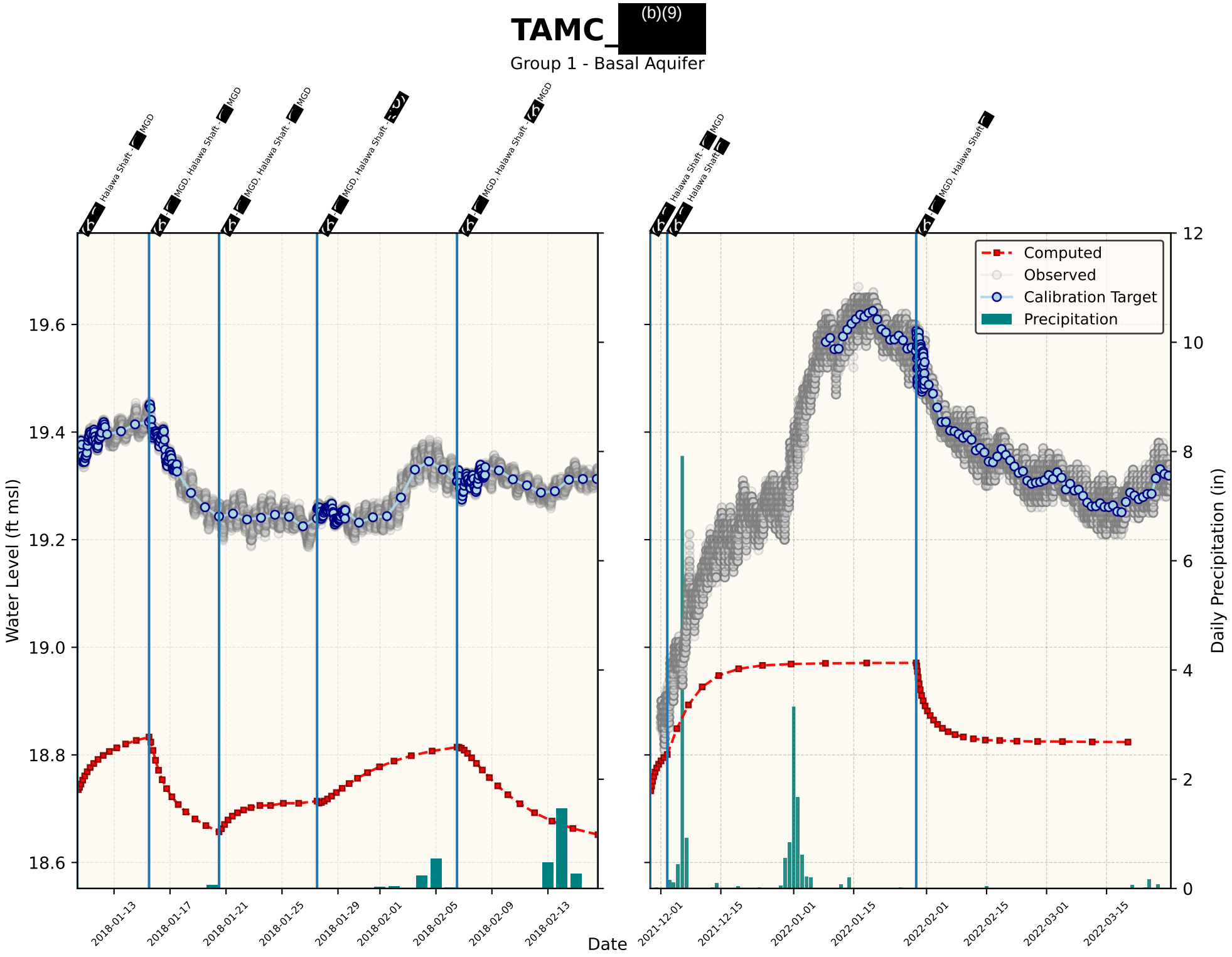

RHMW(b)(9)
Group 1 - Basal Aquifer
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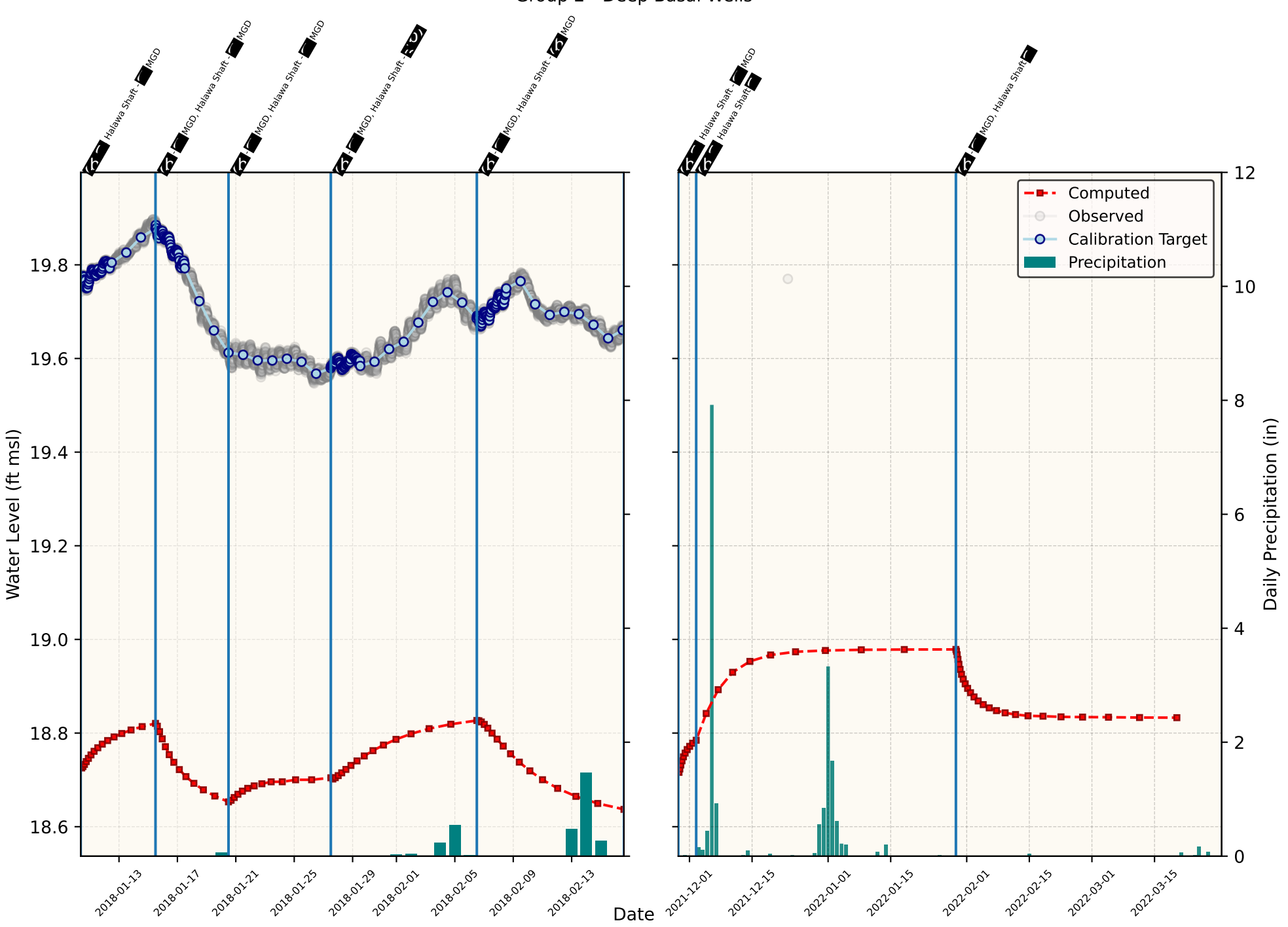

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

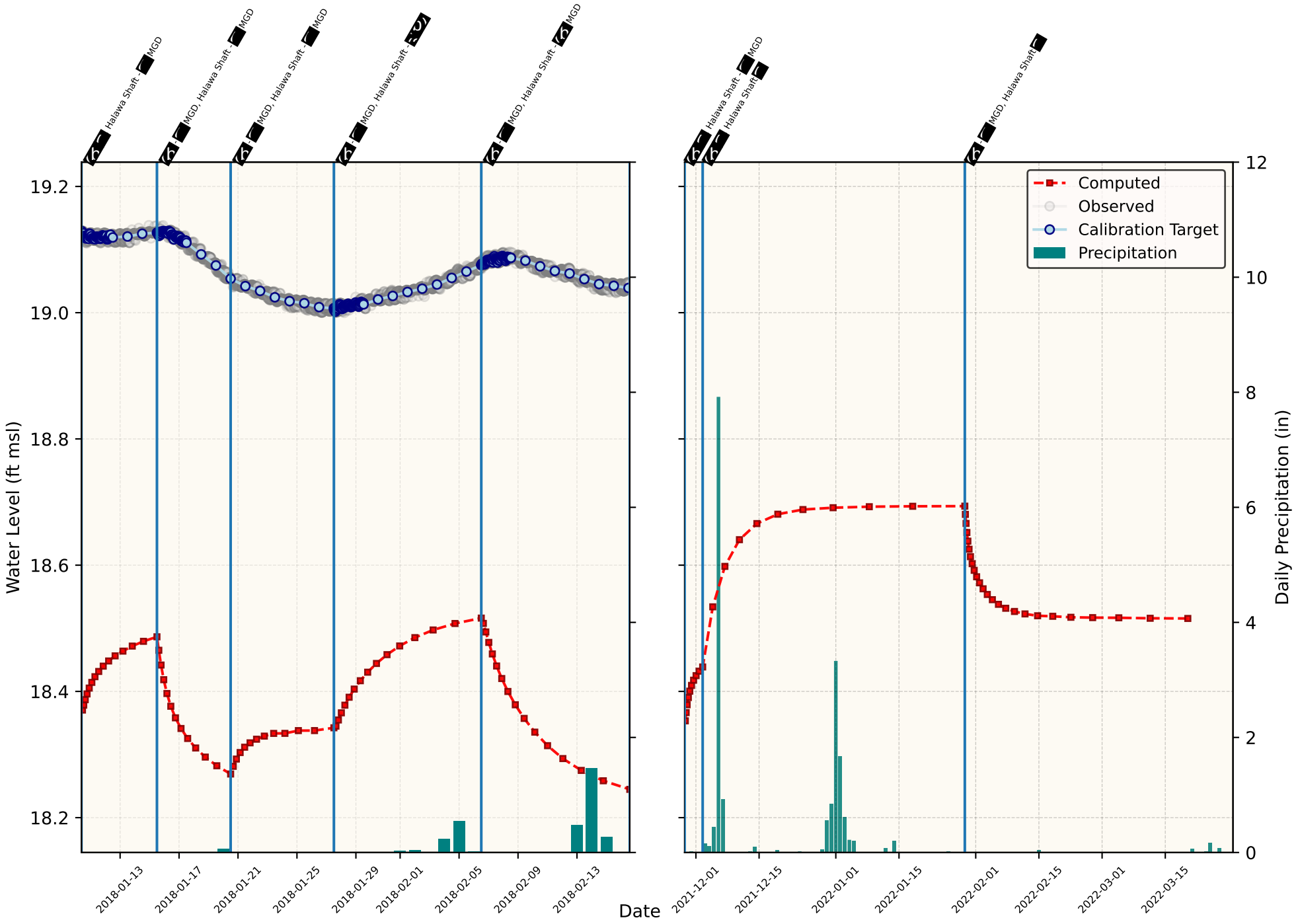
RHMW[(b)(9)]

Group 1 - Basal Aquifer



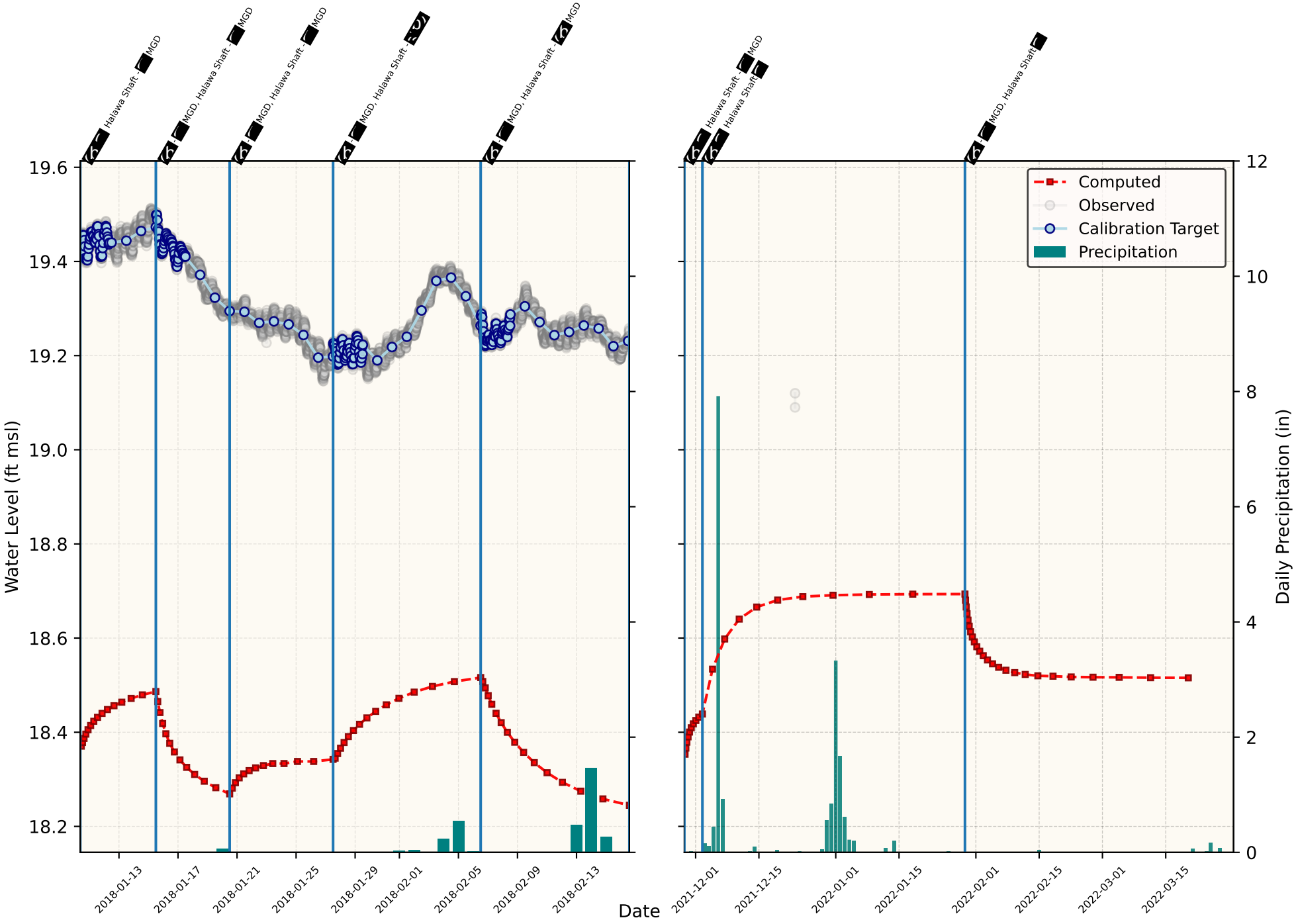

TAMC_ (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.6
19.4
19.2
19.0
18.8
18.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

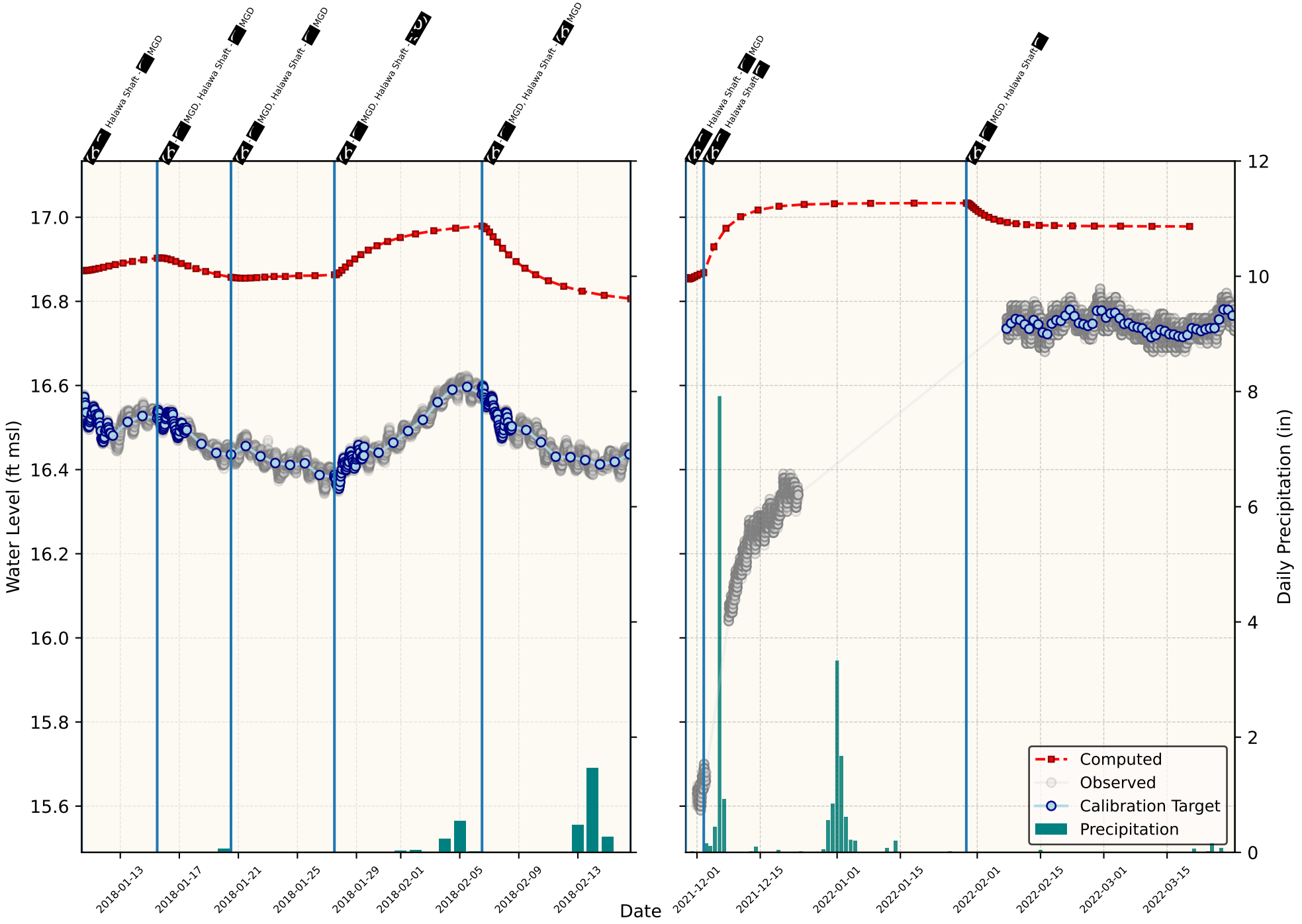

DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.8
19.6
19.4
19.2
19.0
18.8
18.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.2
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

Halawa_Deep_Monitor_Well_HDMW2253-03

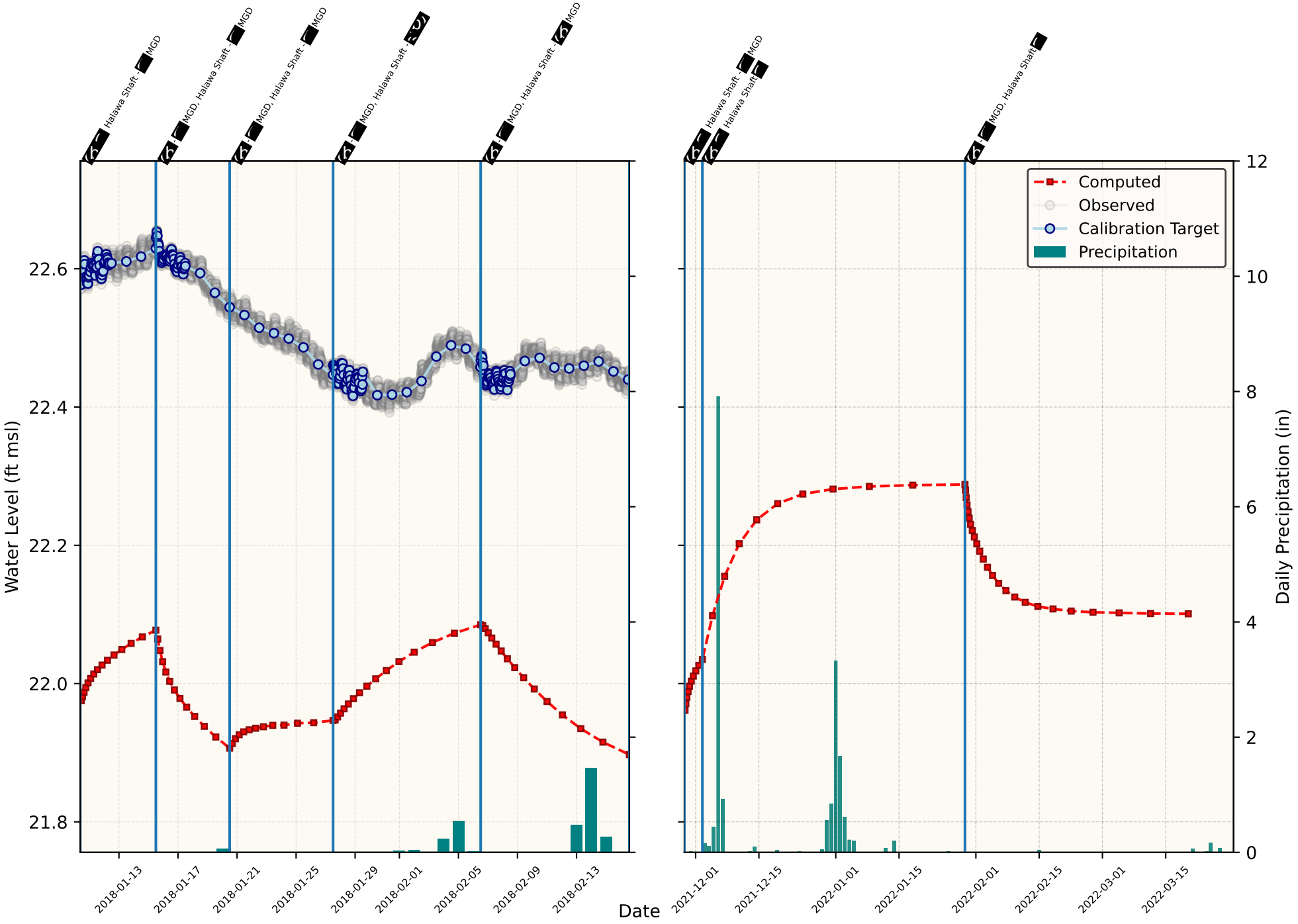
Group 2 - Deep Basal Wells




Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

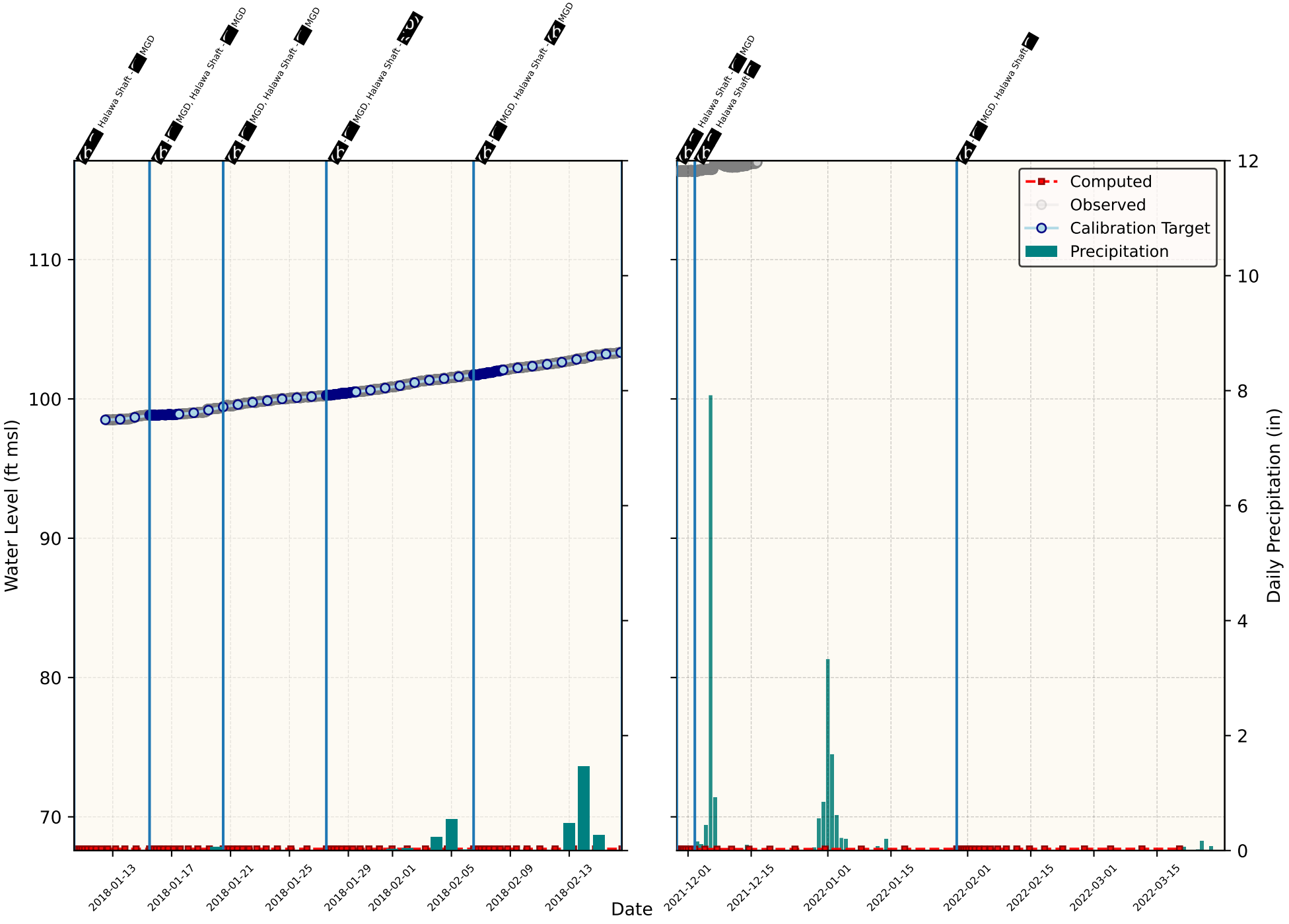
RHMW[redacted]

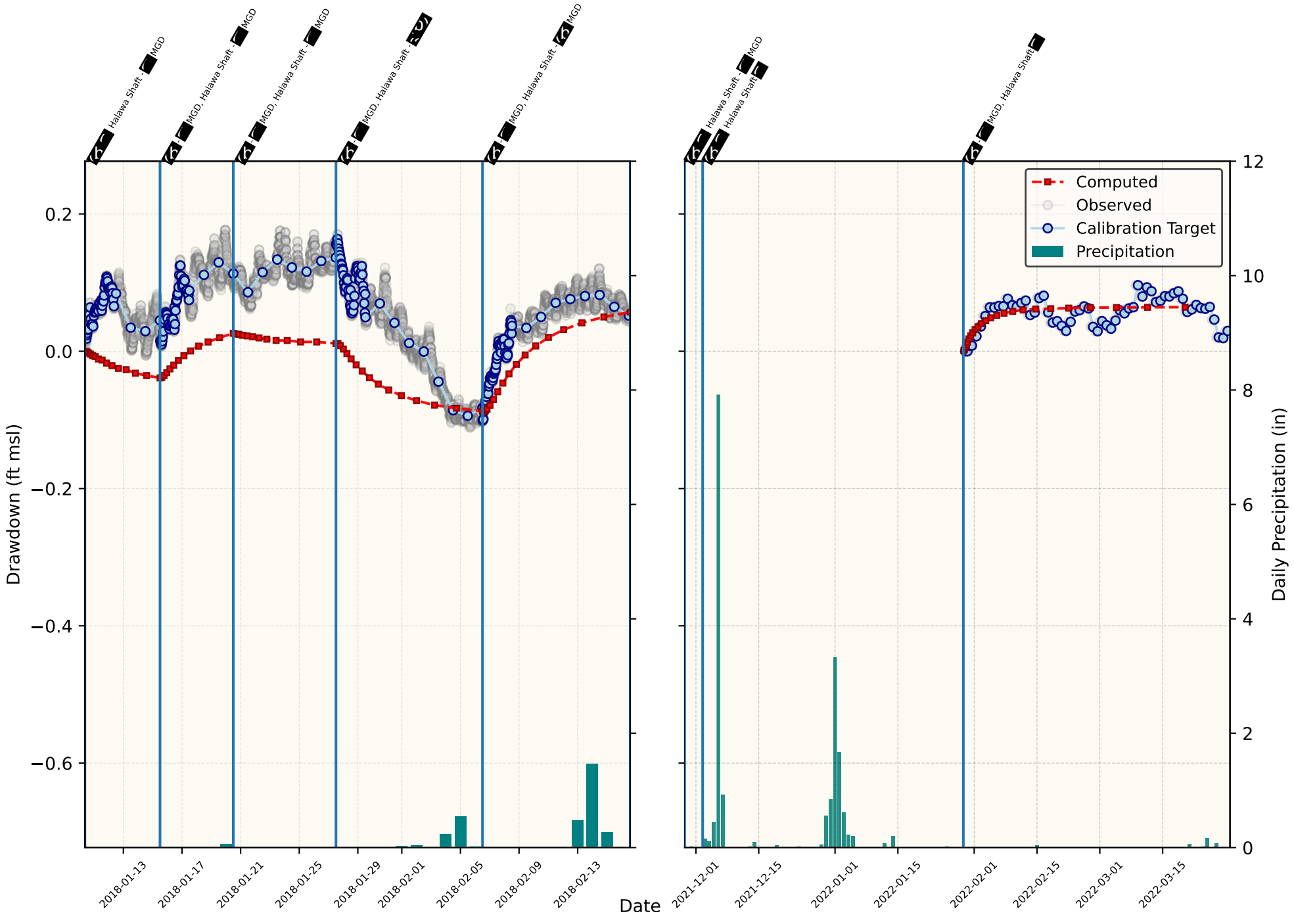
Group 3 - Saprolite/Confining Unit Well with Elevated Head

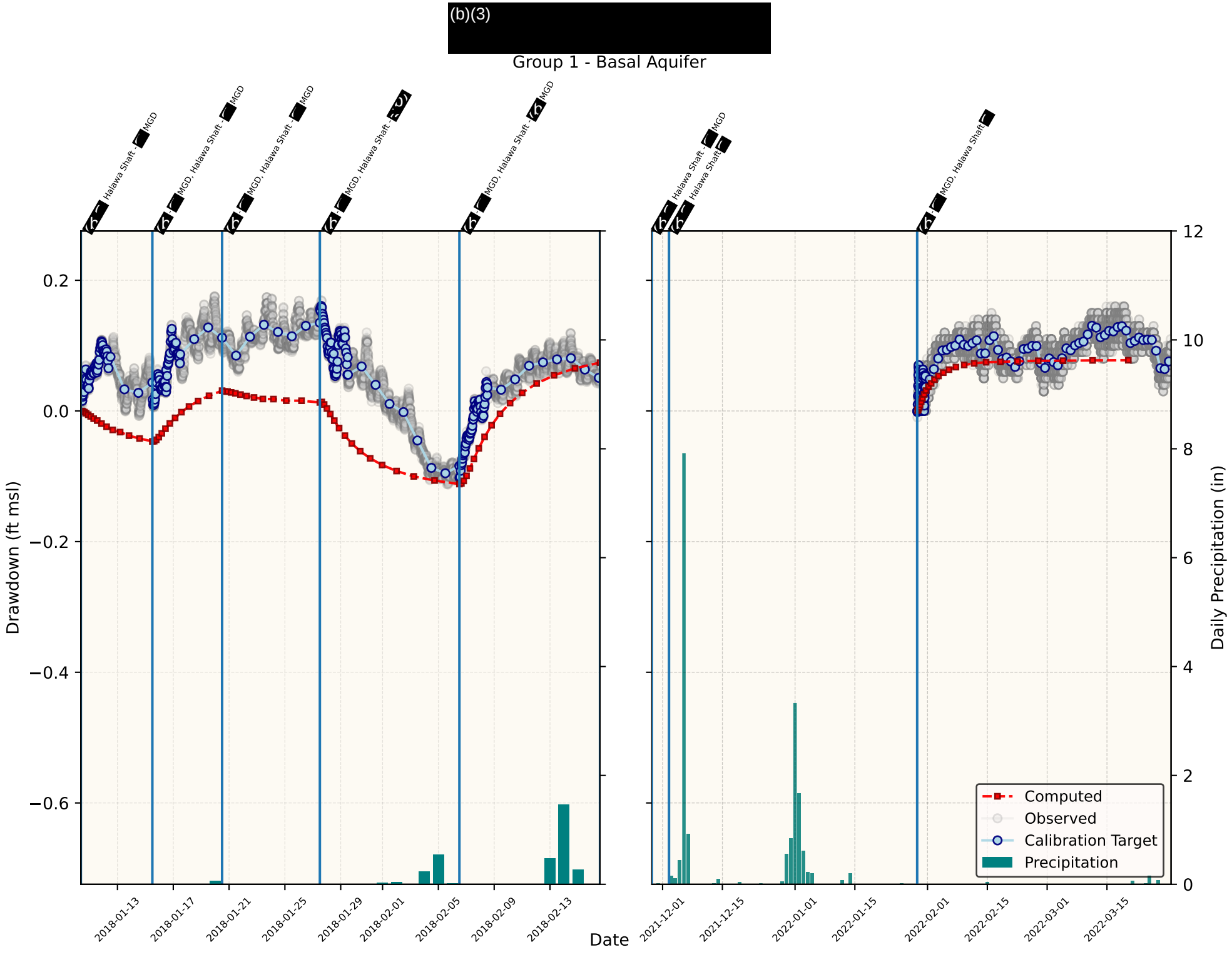


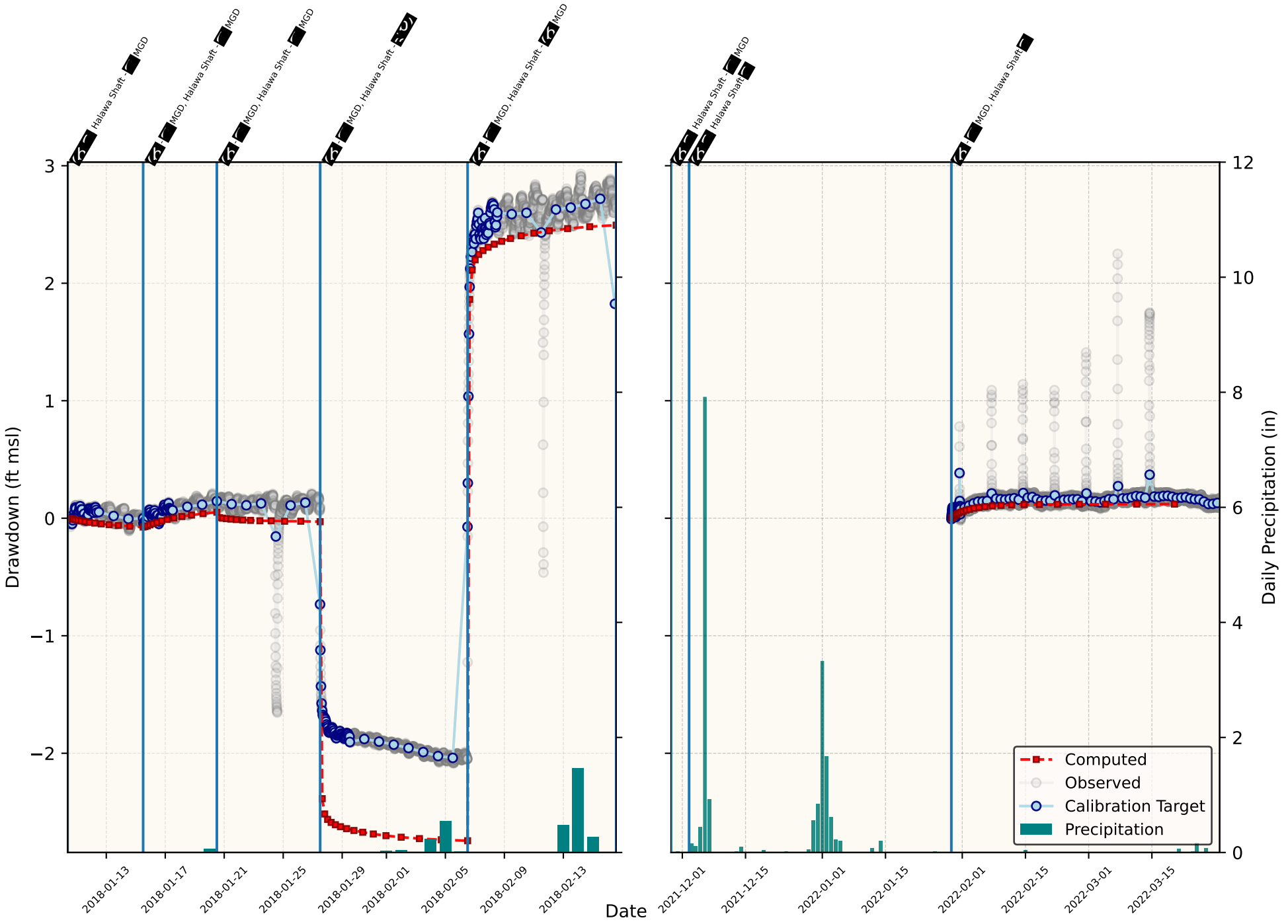
RHMW[redacted] (b)(9)

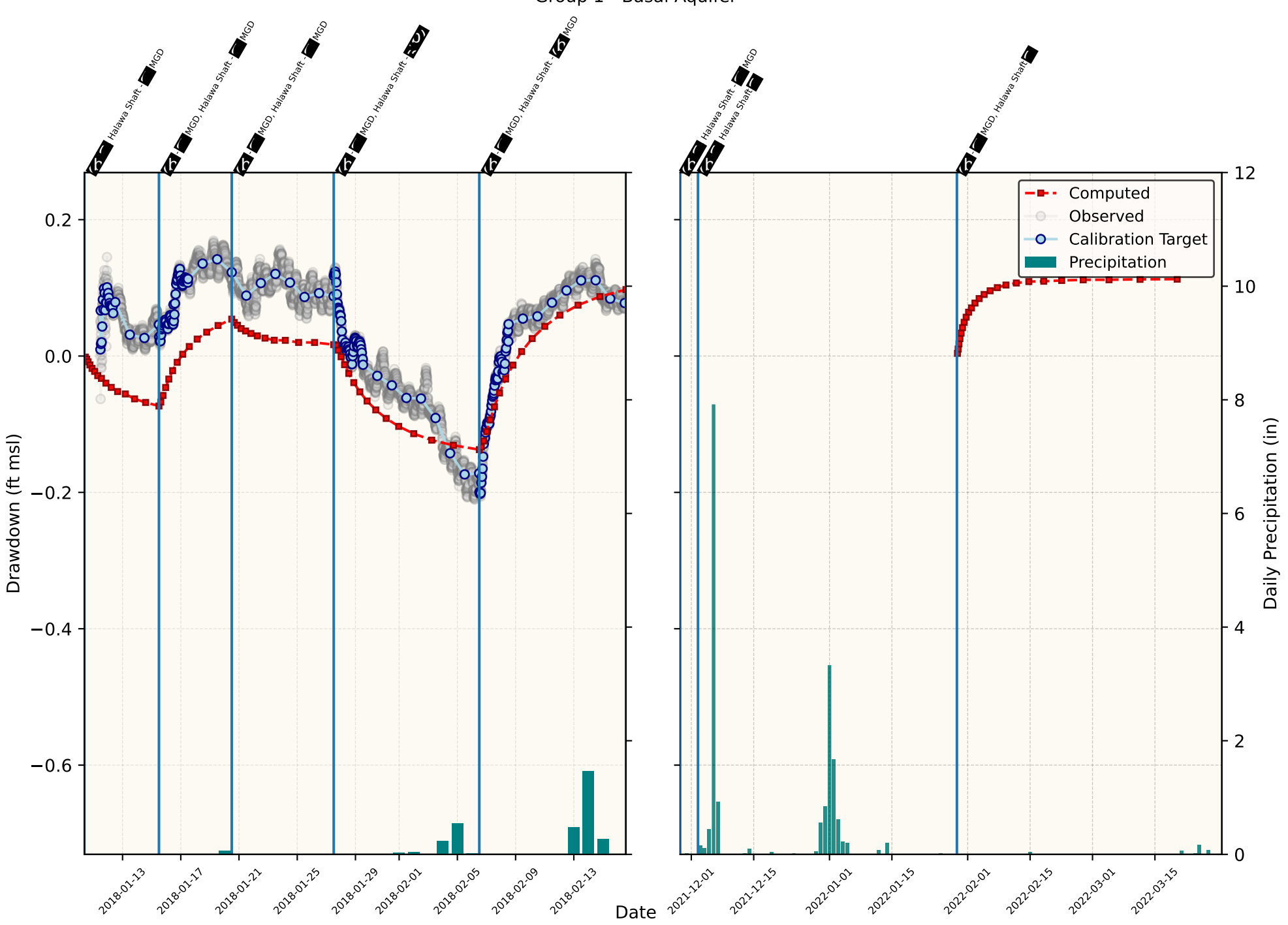
Group 3 - Saprolite/Confining Unit Well with Elevated Head

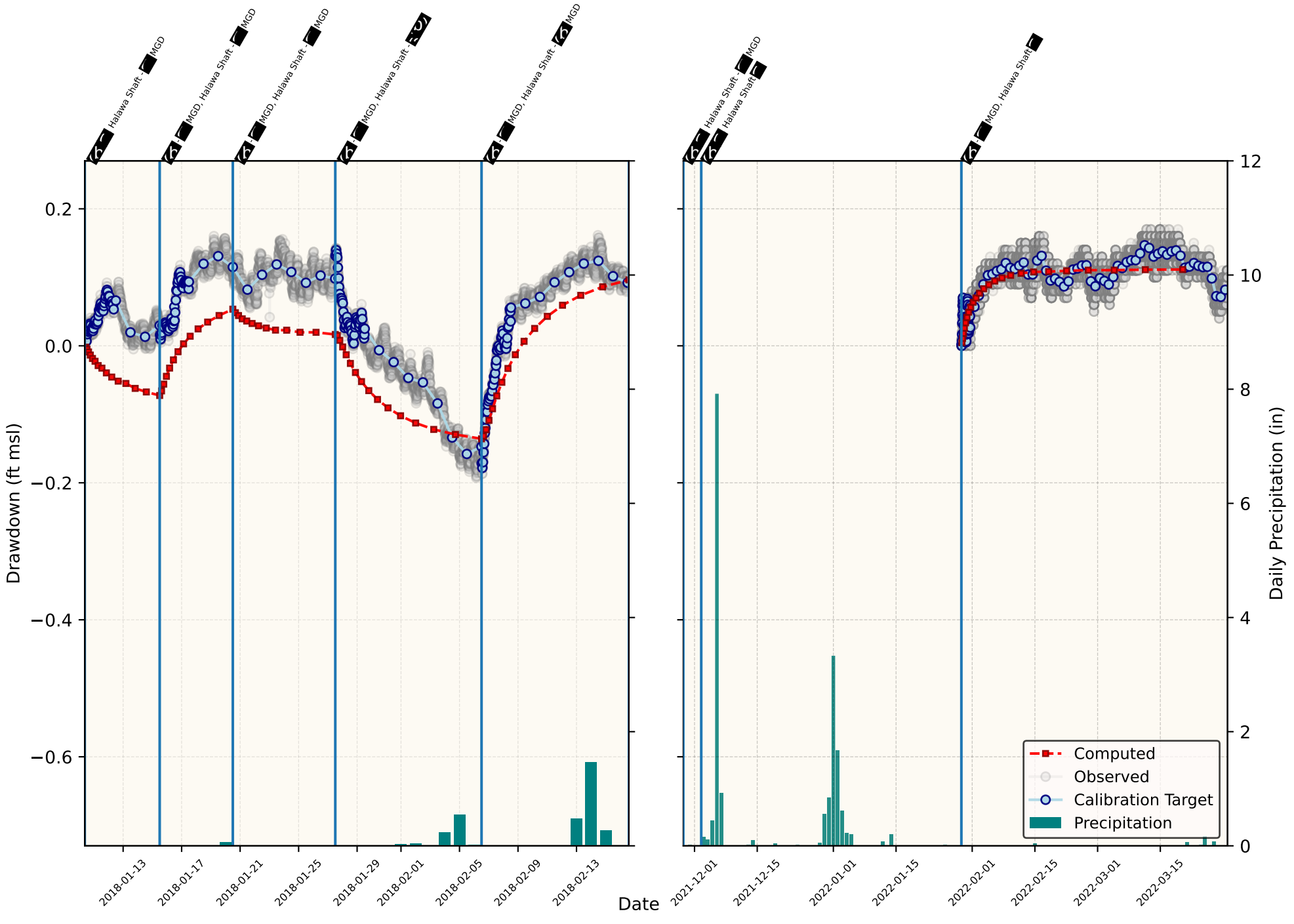


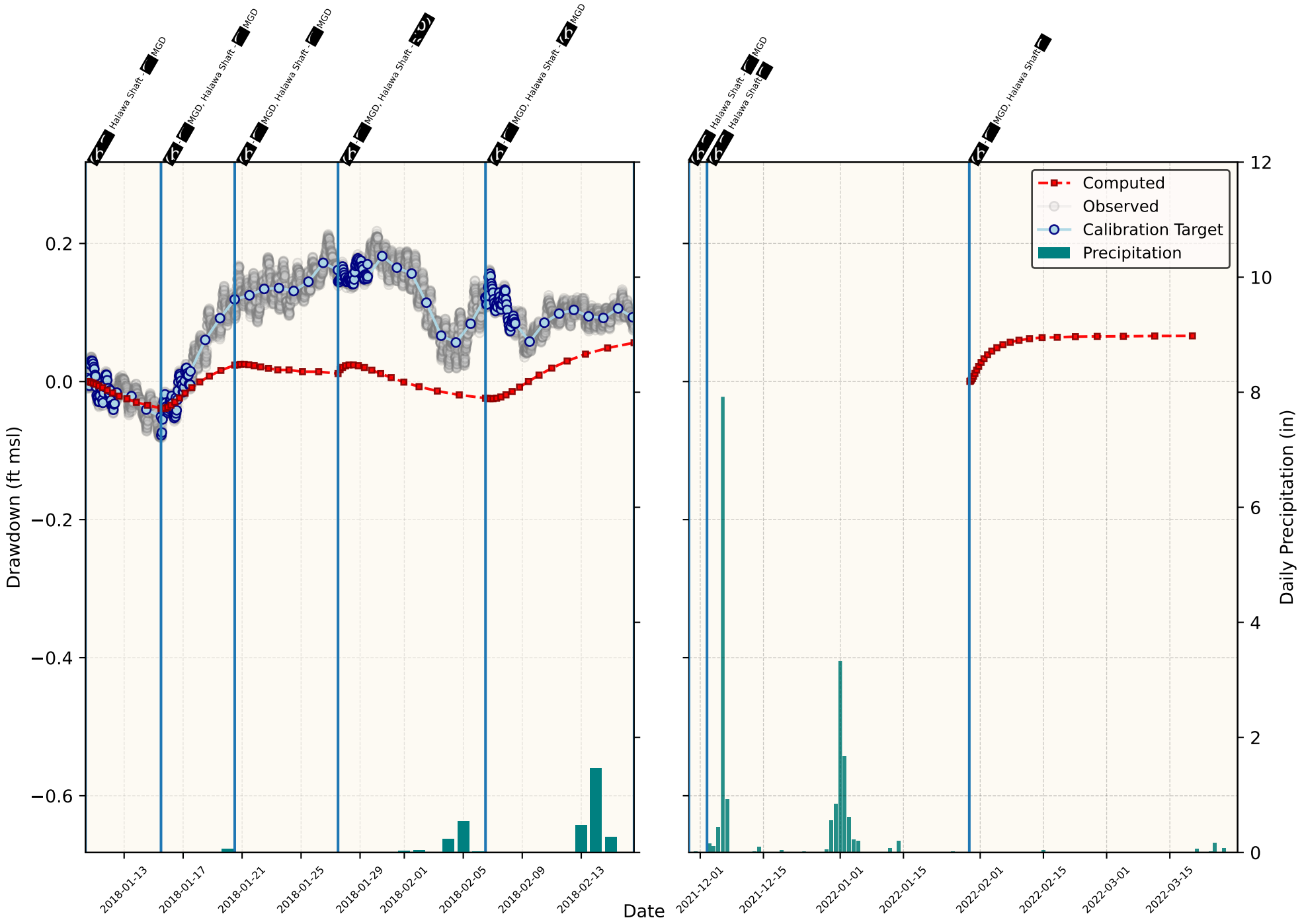

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

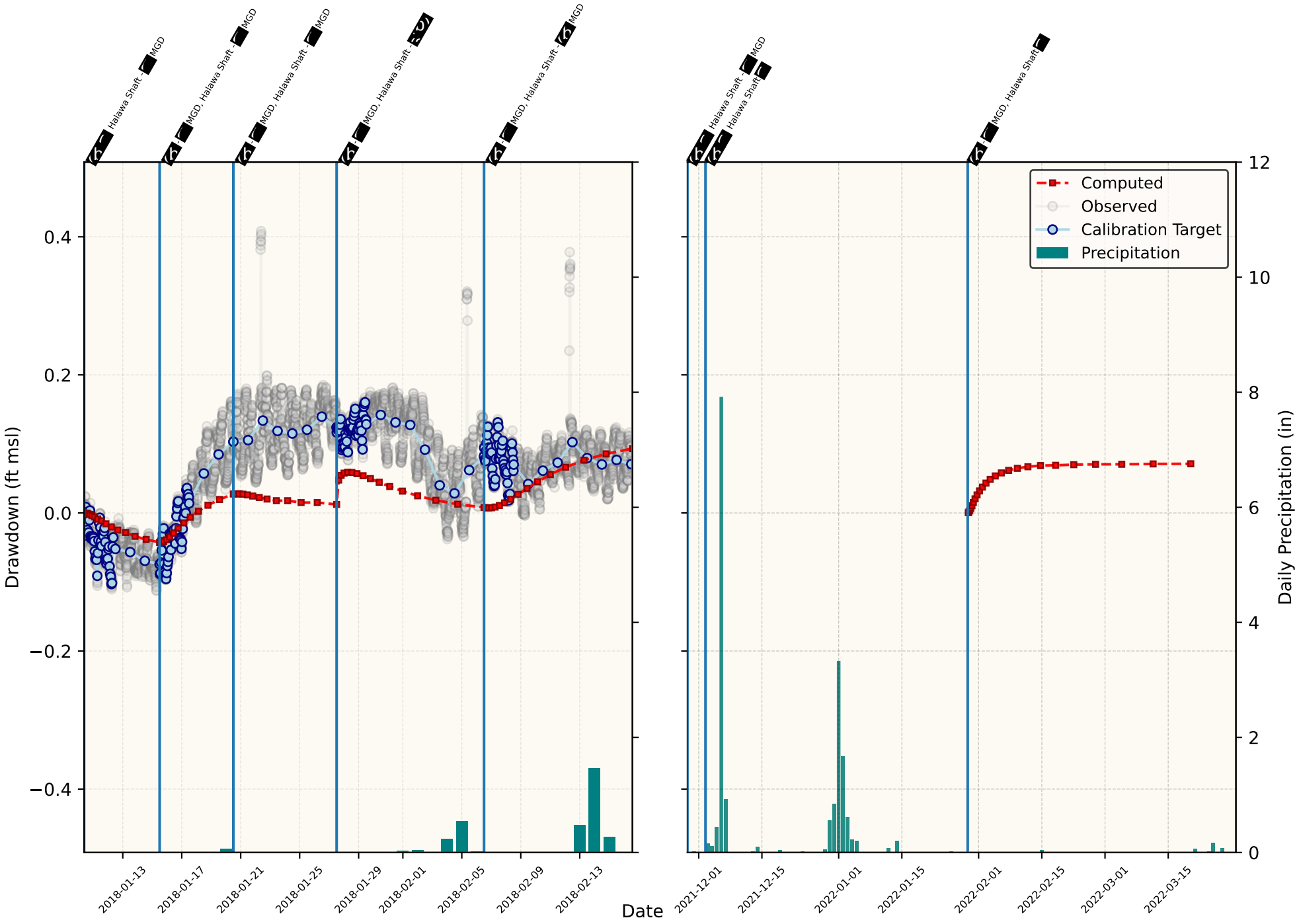

(b)(3)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

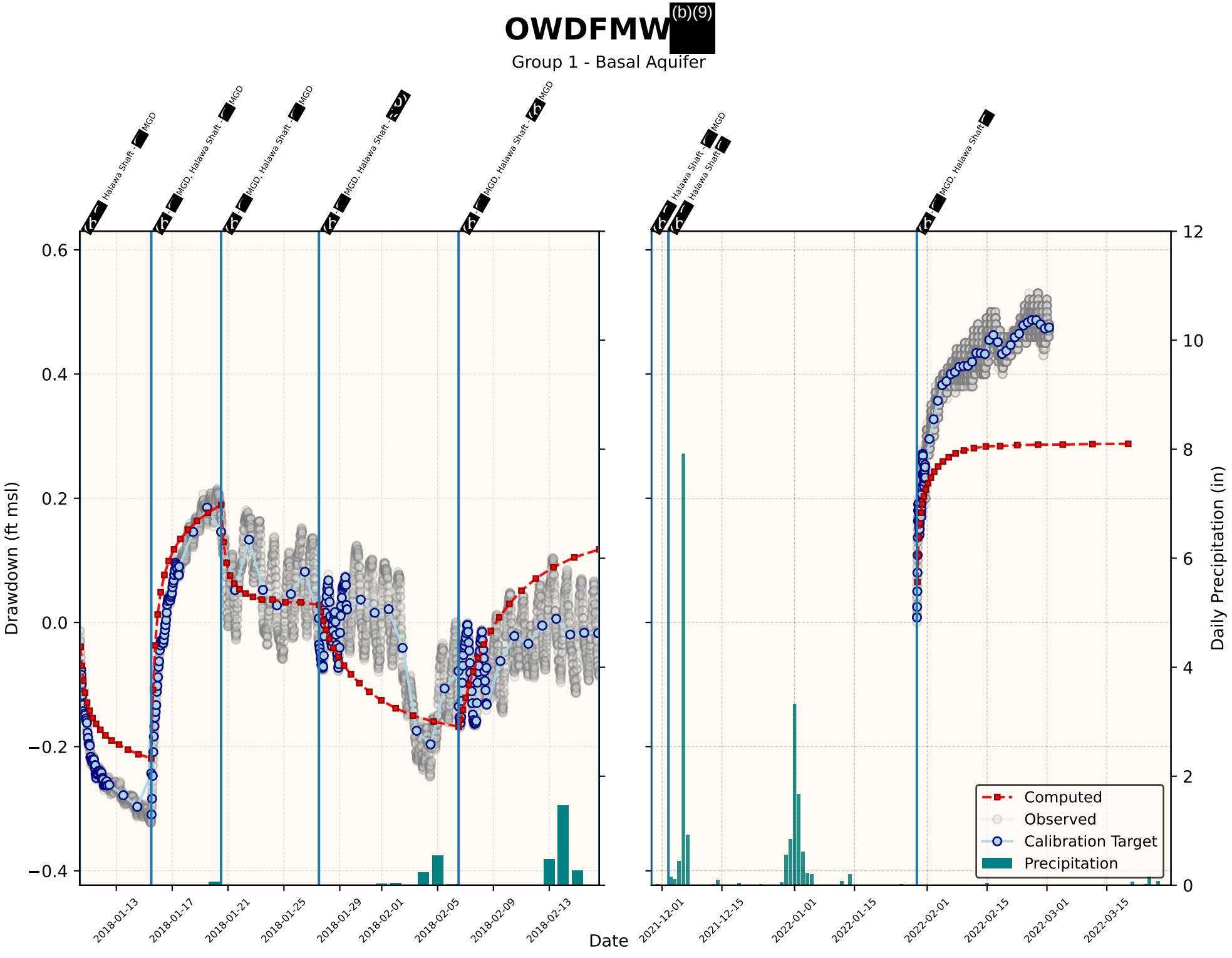

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

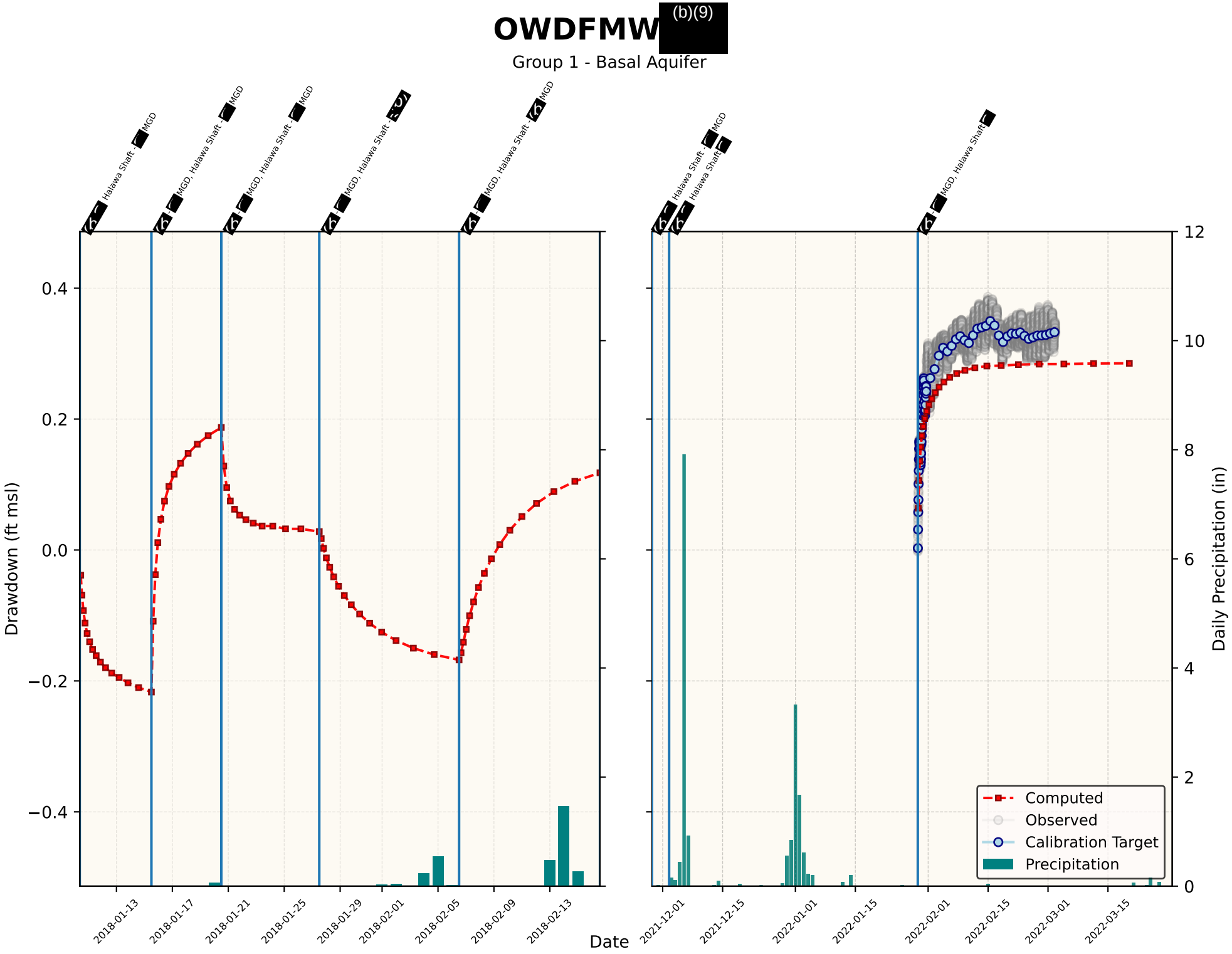

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

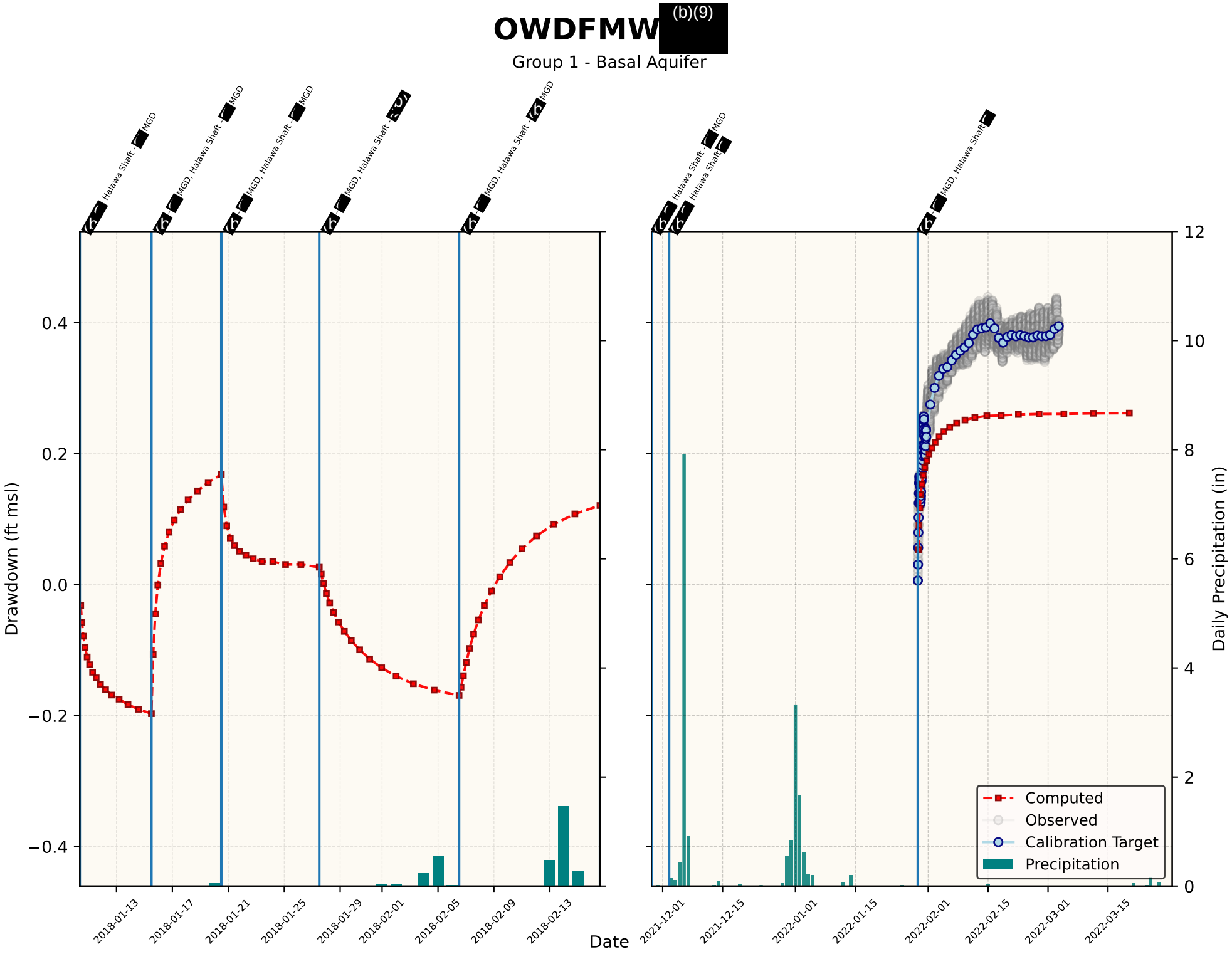

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

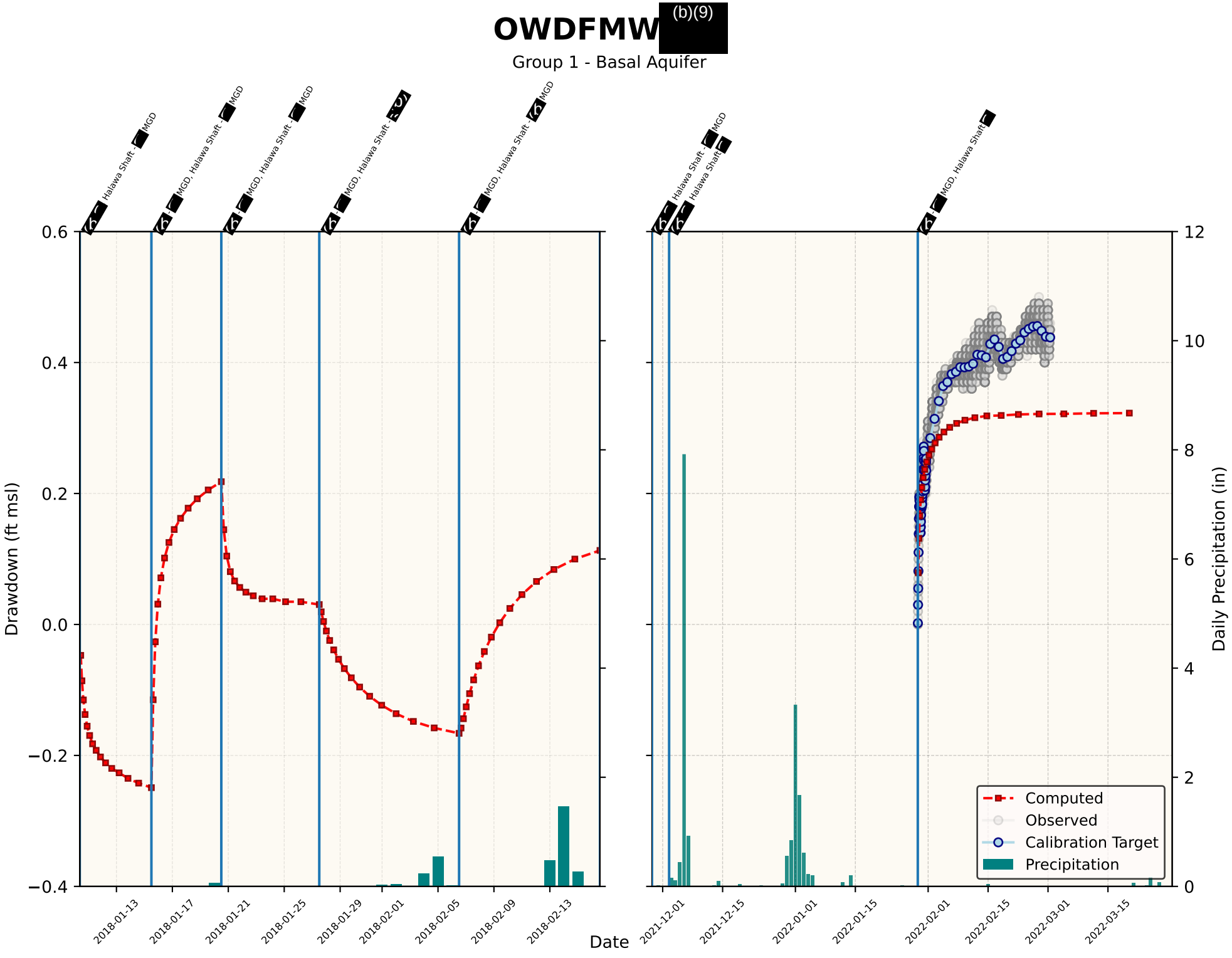

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

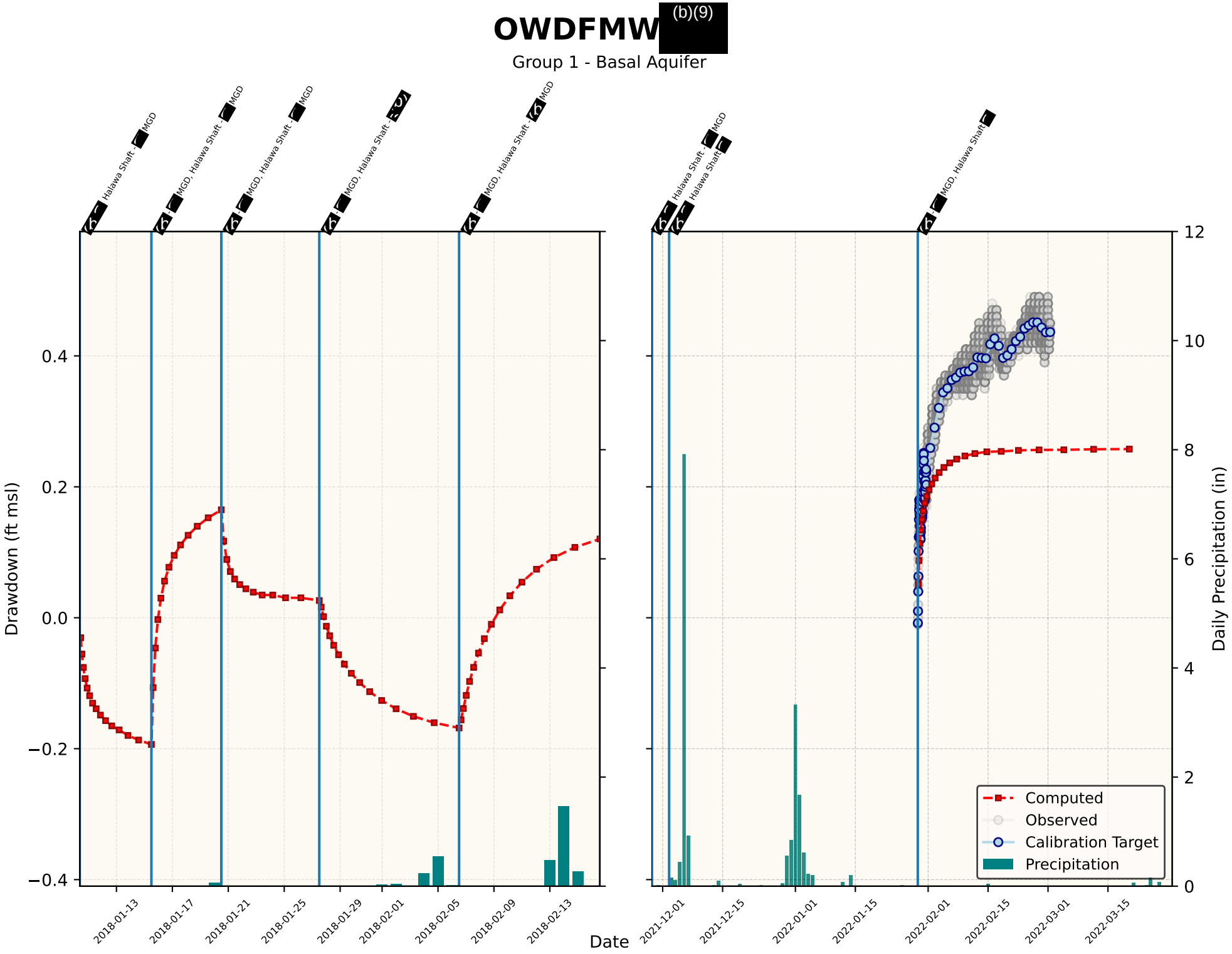

Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

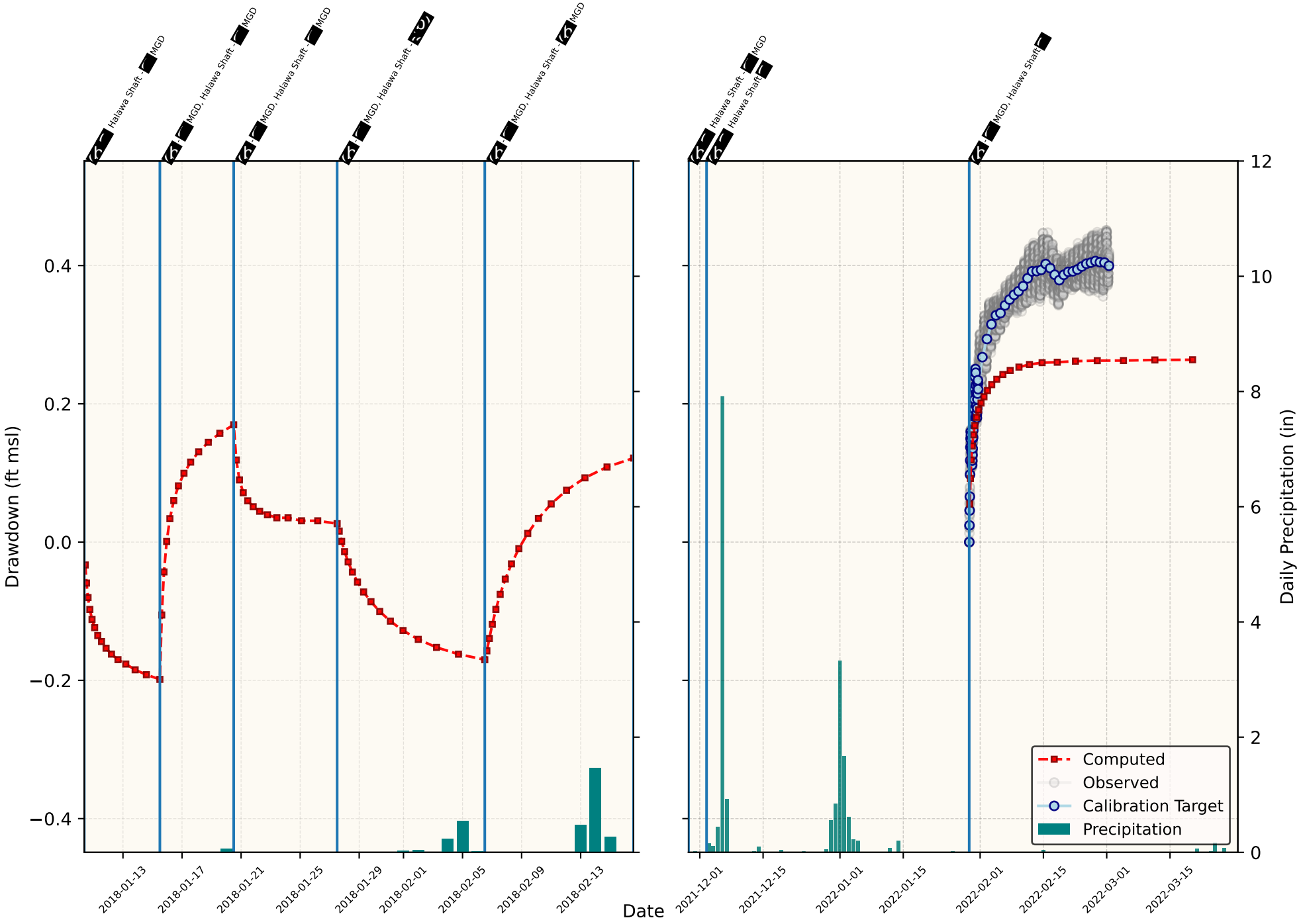

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

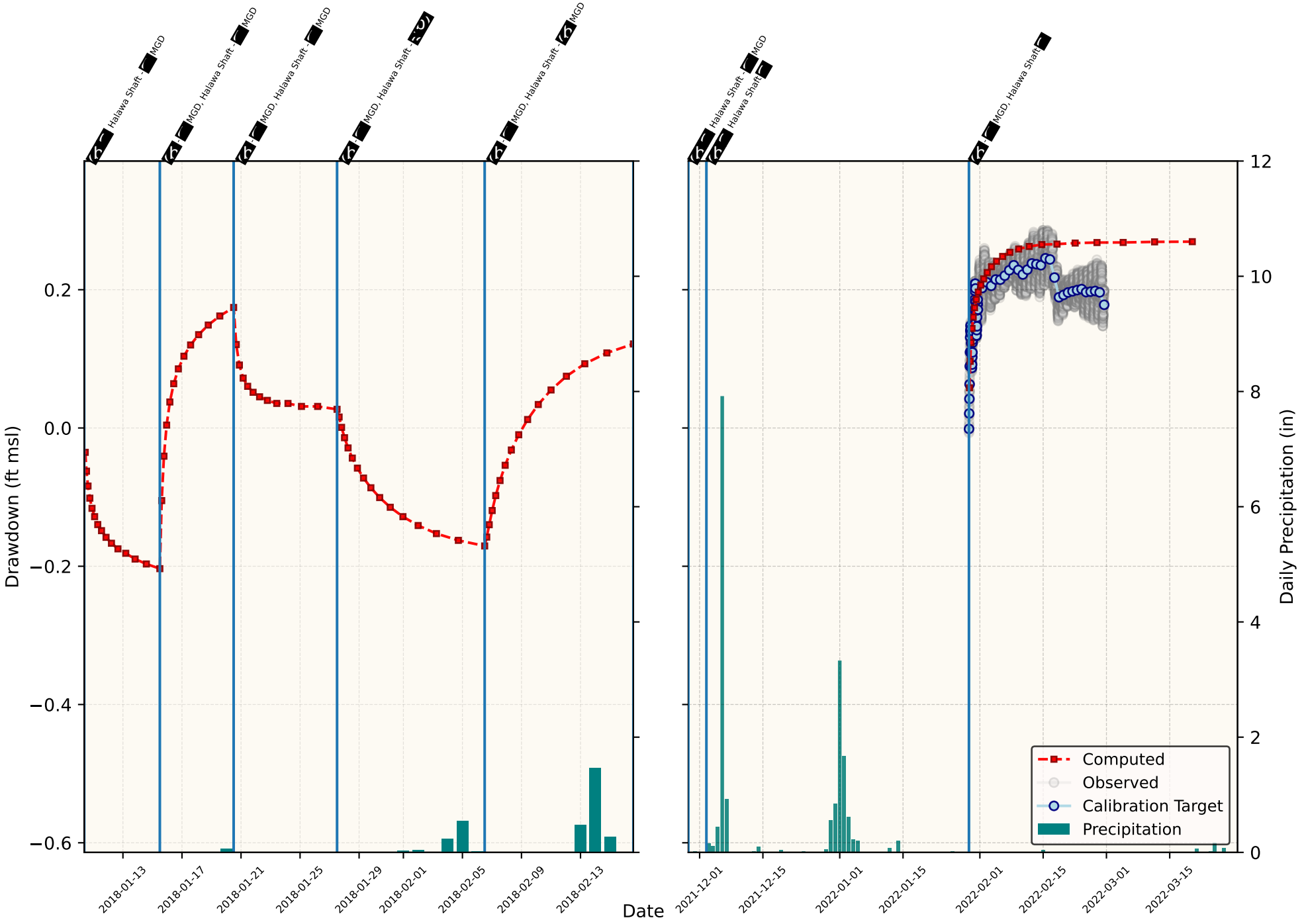
OWDFMW [redacted] (b)(9)

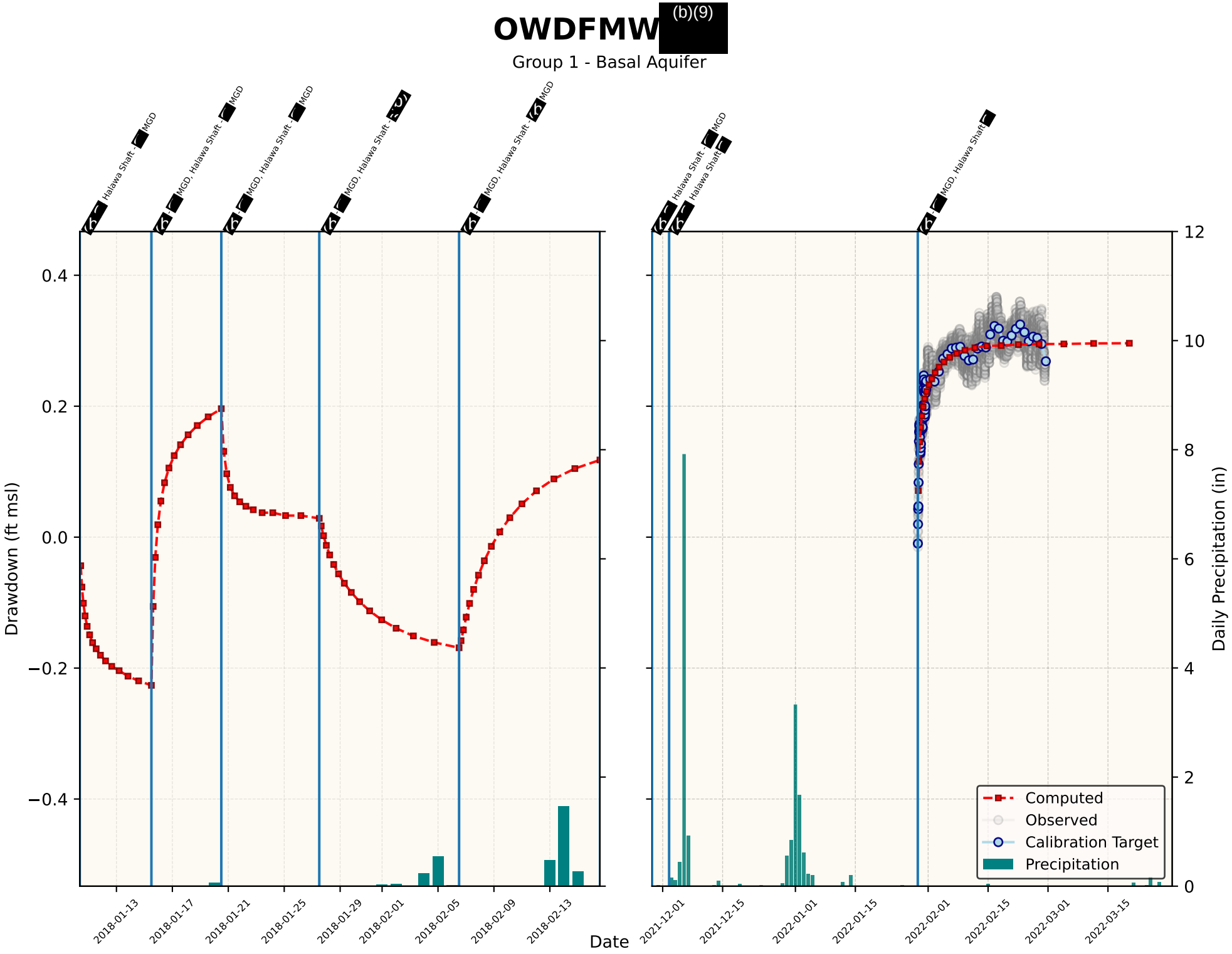
Group 1 - Basal Aquifer

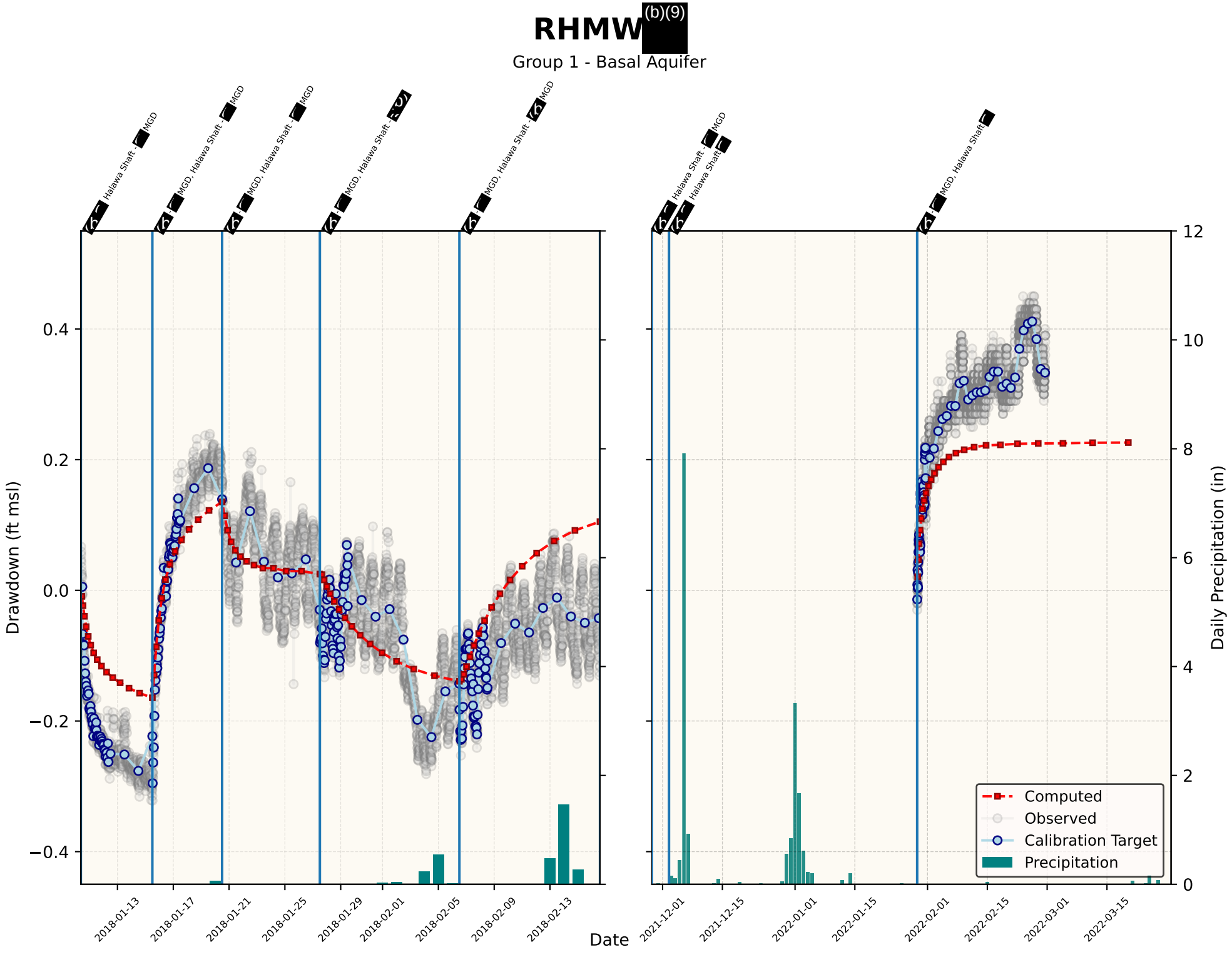


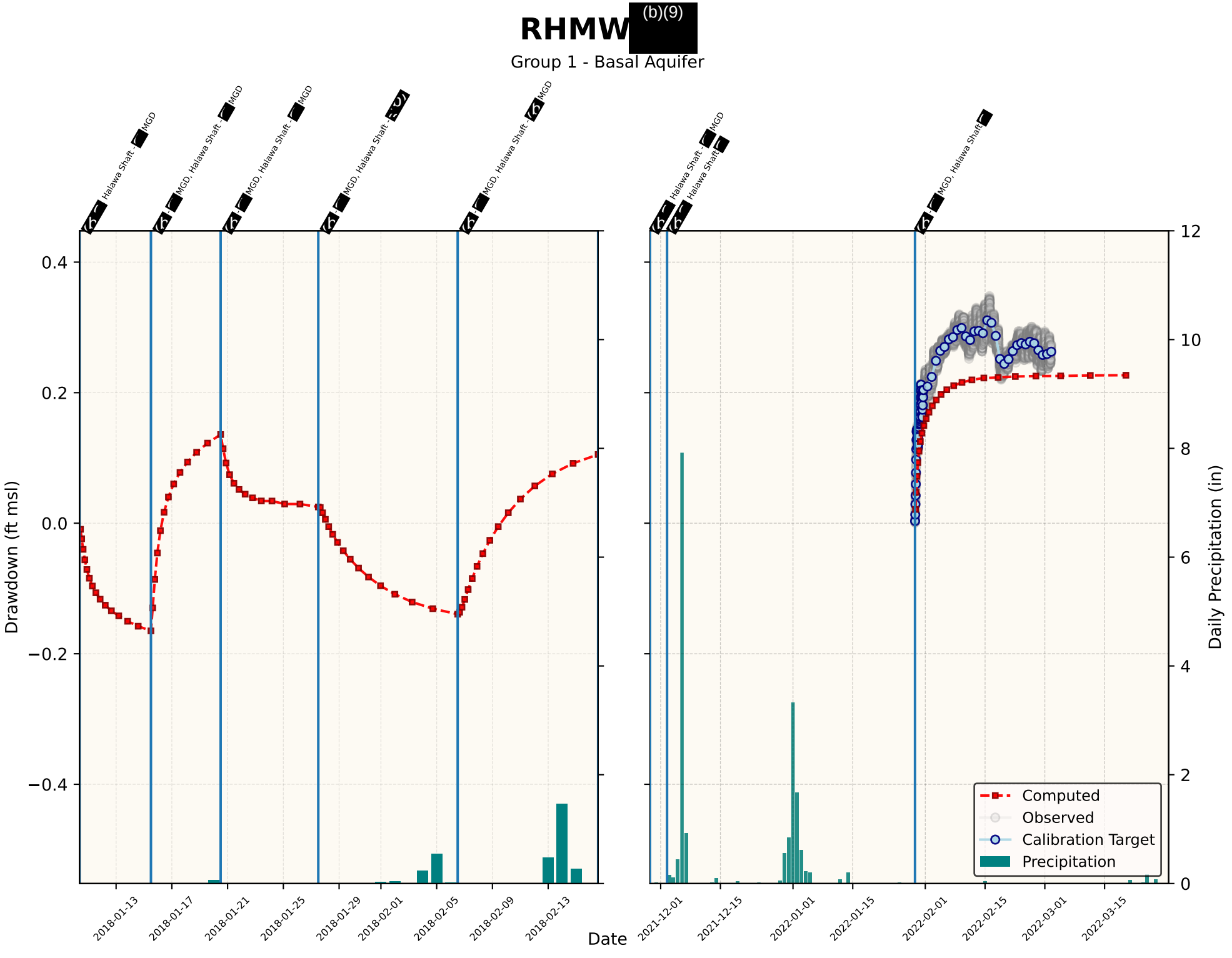
OWDFMW [redacted] (b)(9)

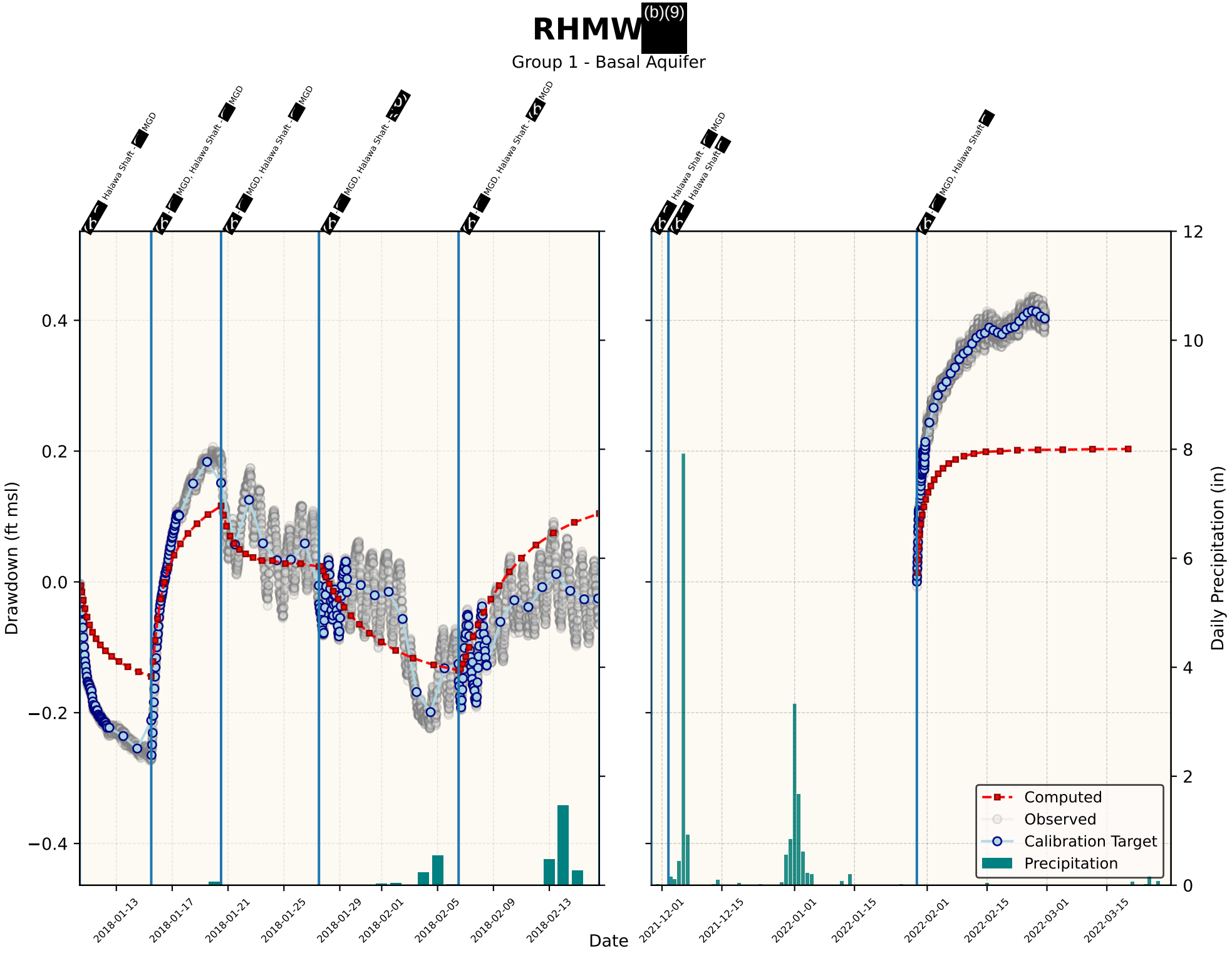
Group 1 - Basal Aquifer

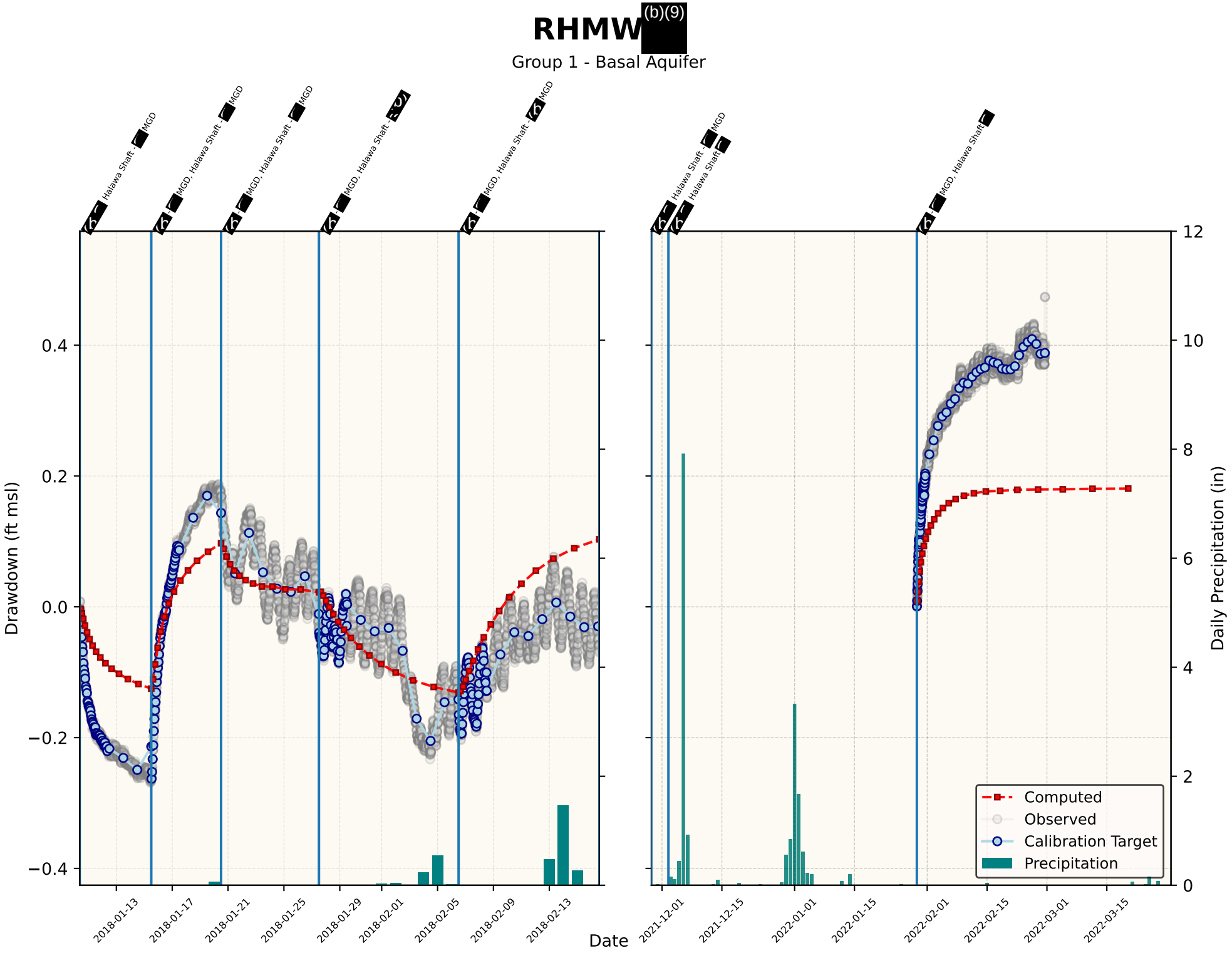



OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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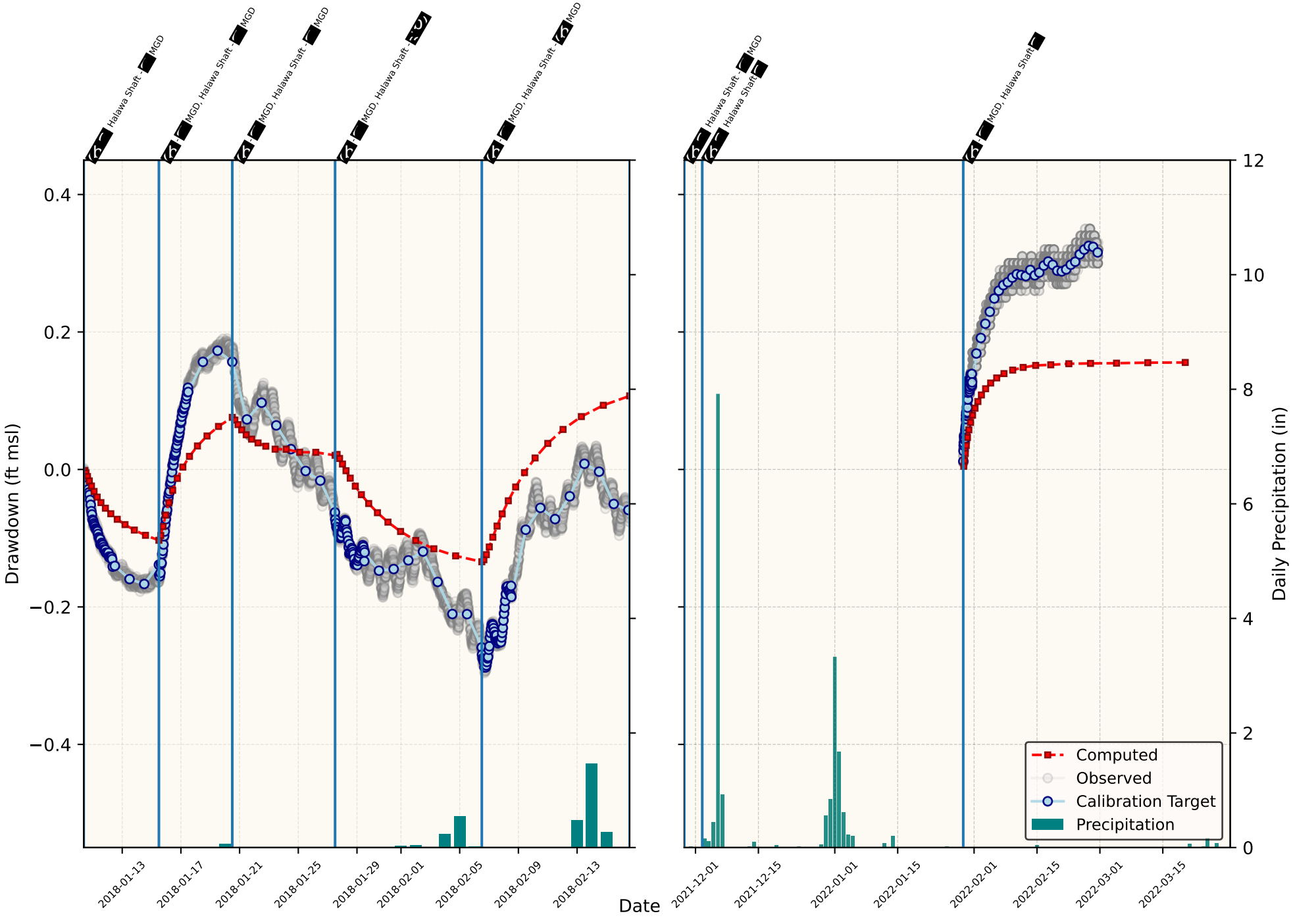

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

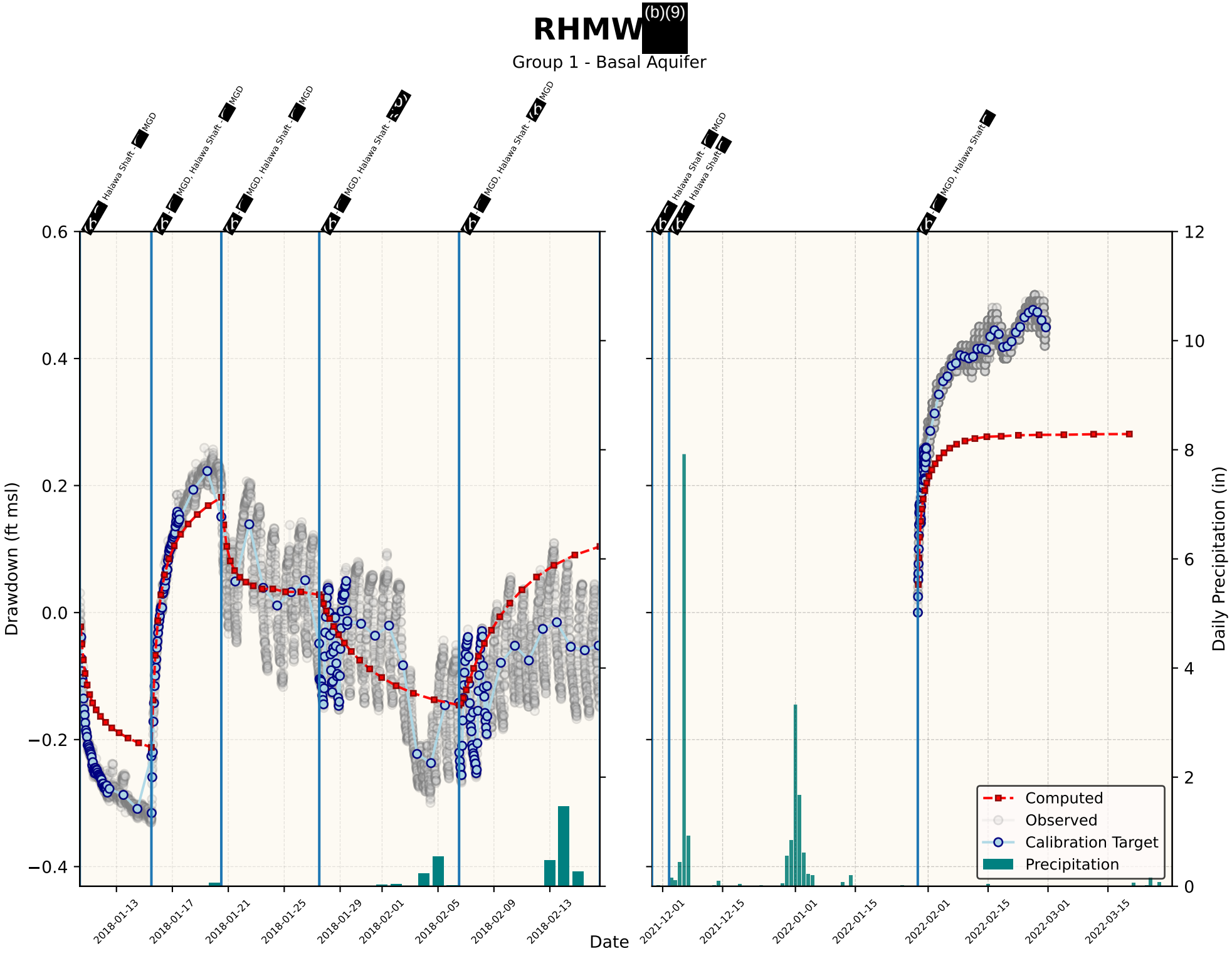

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

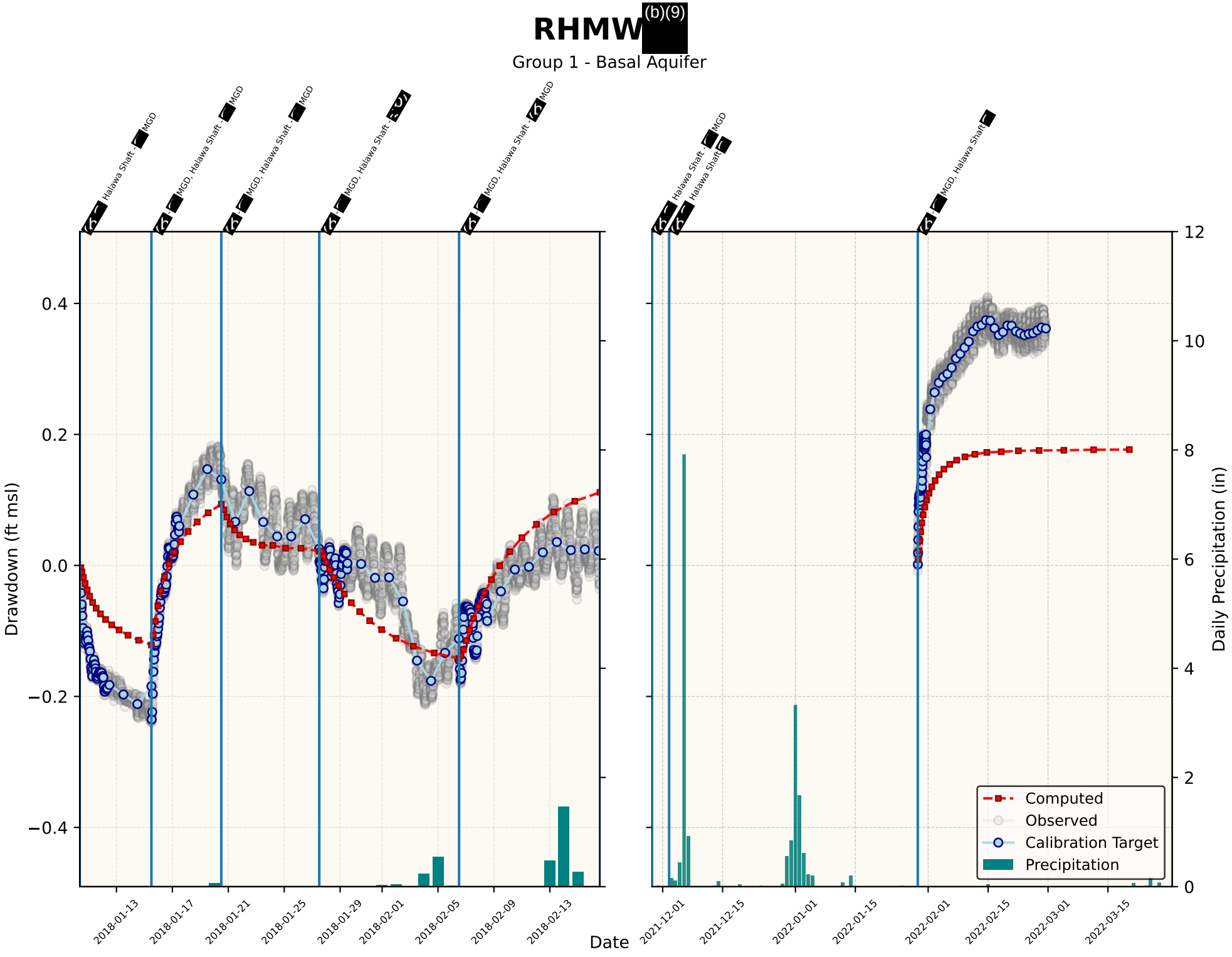

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-15
Date

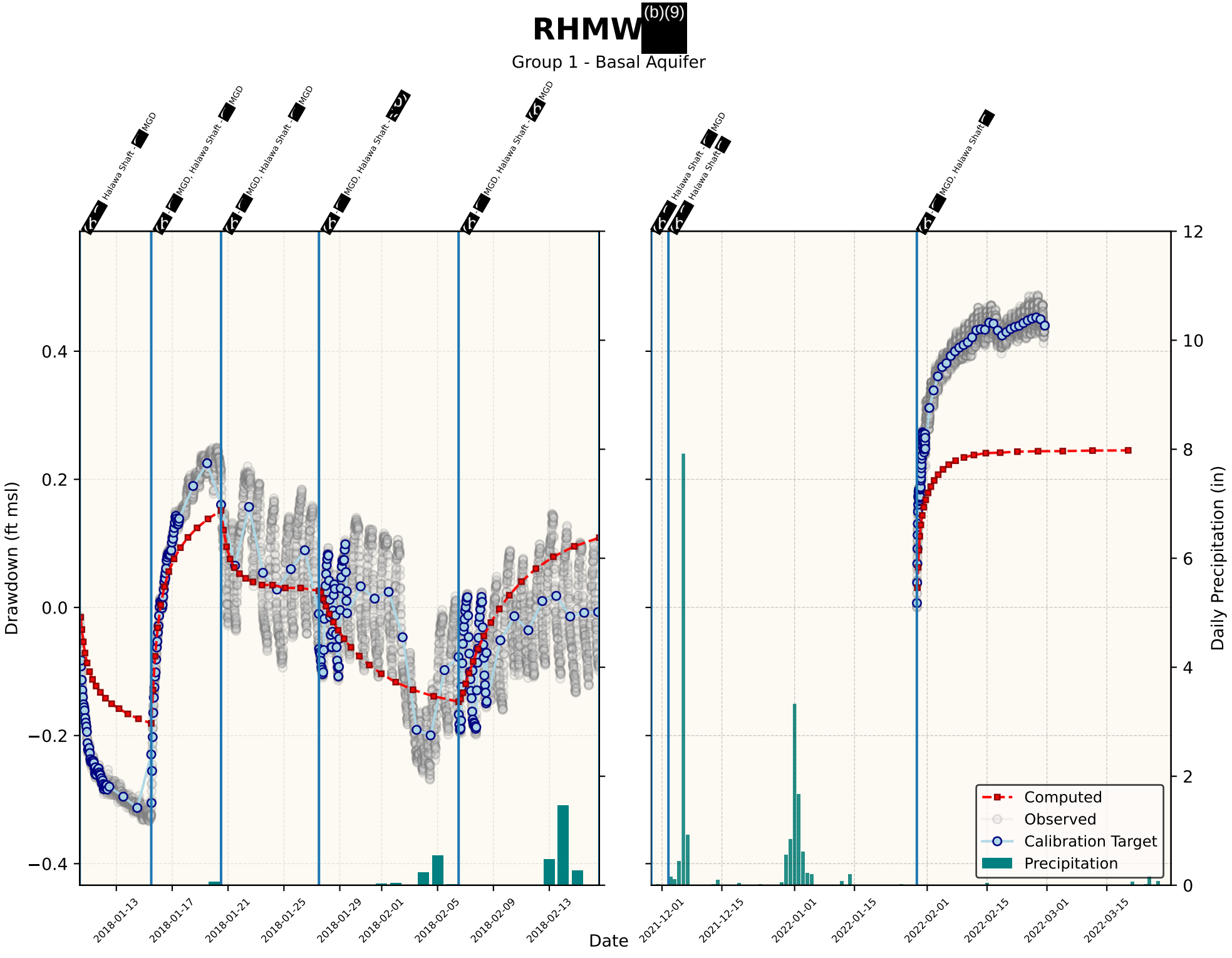
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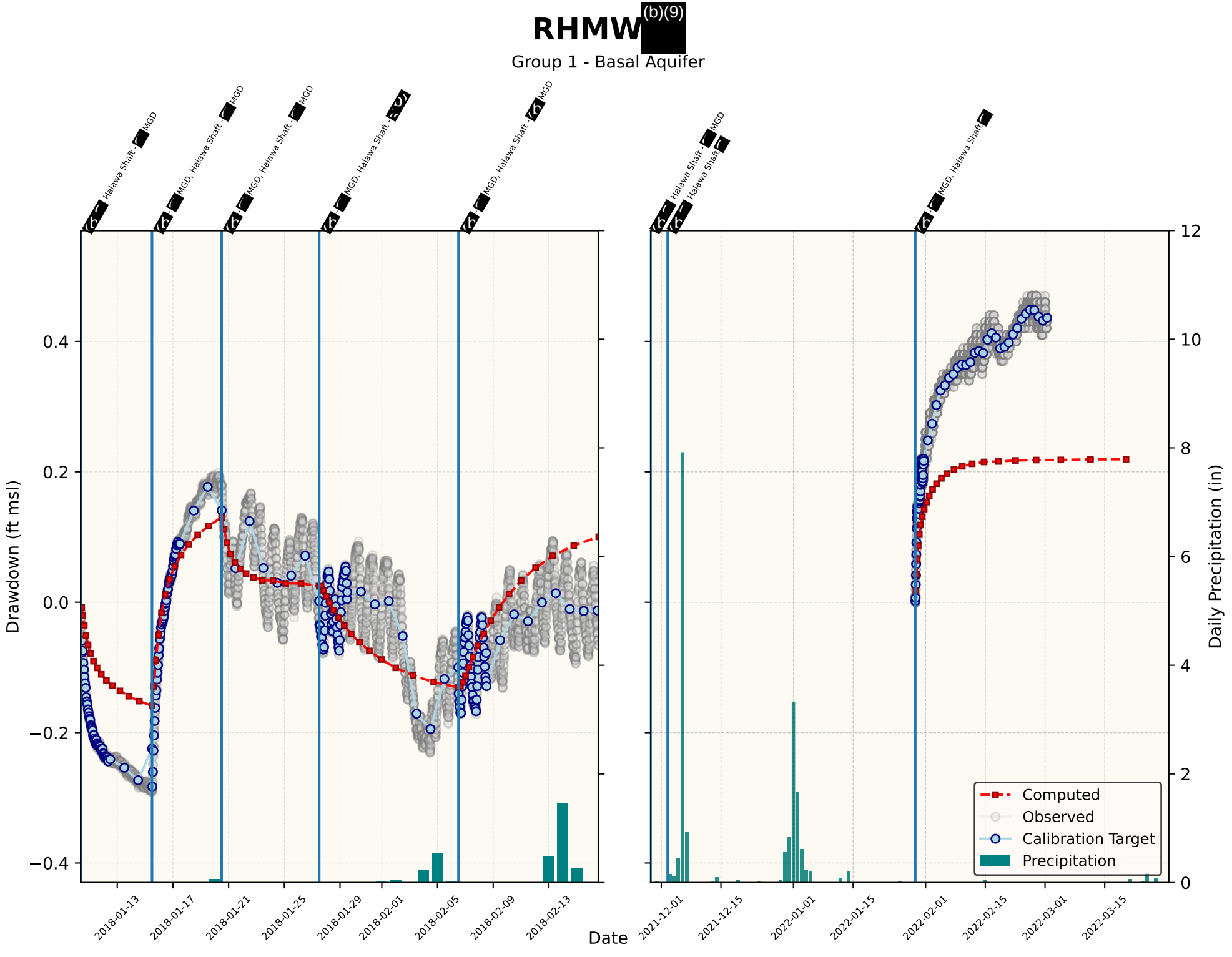
Group 1 - Basal Aquifer

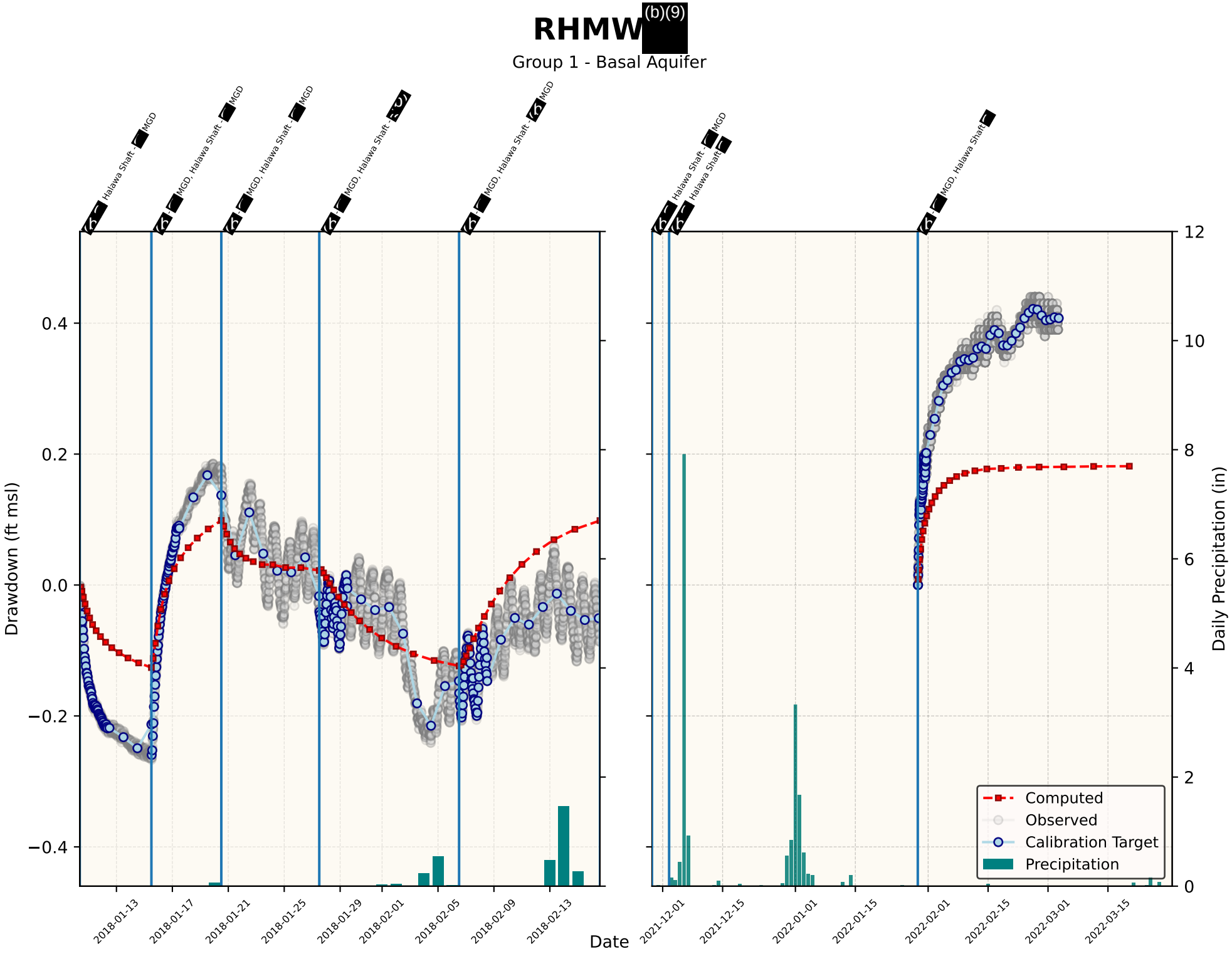



RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-15
2022-03-01
2022-03-15

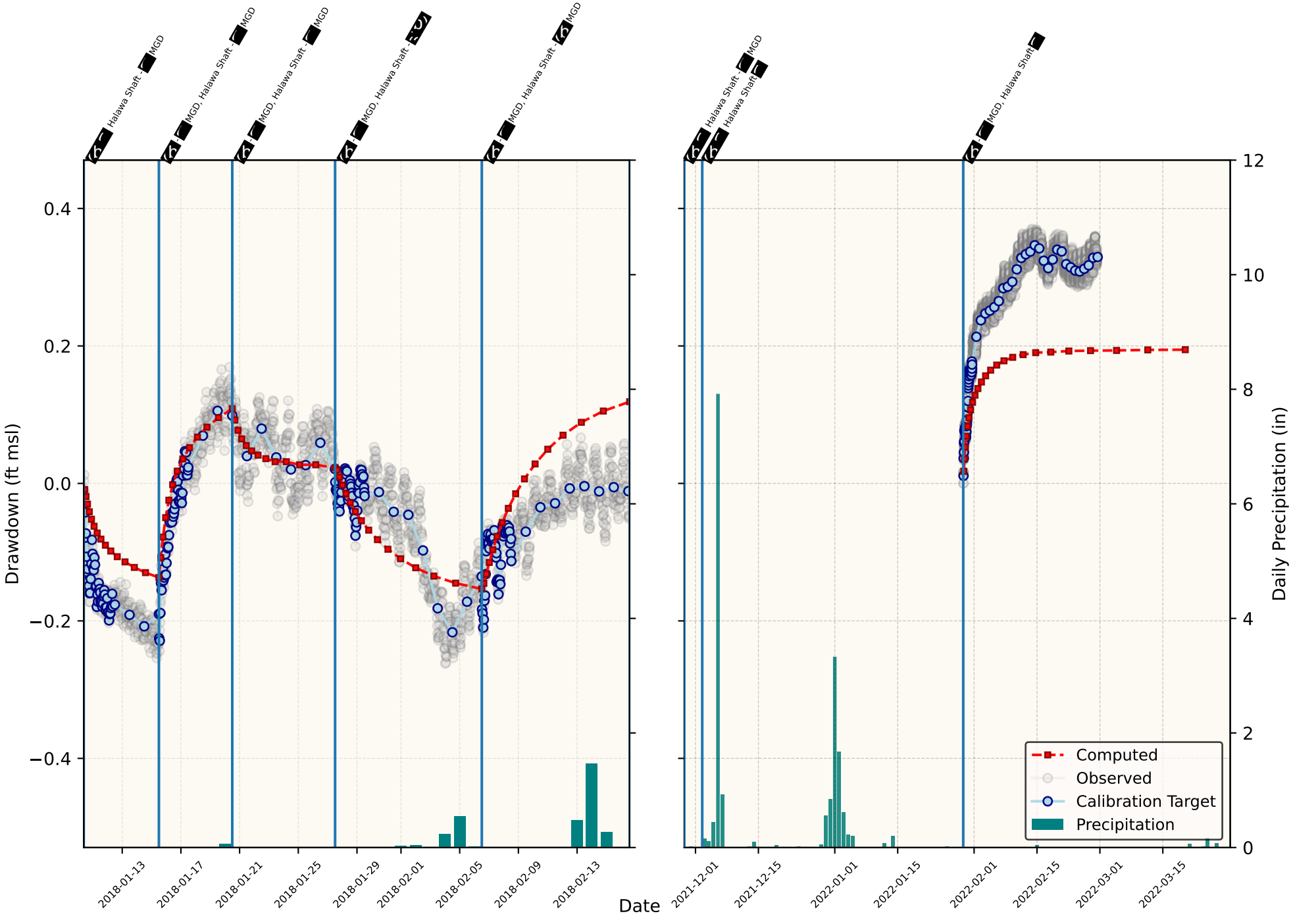

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW[redacted](b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date


RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

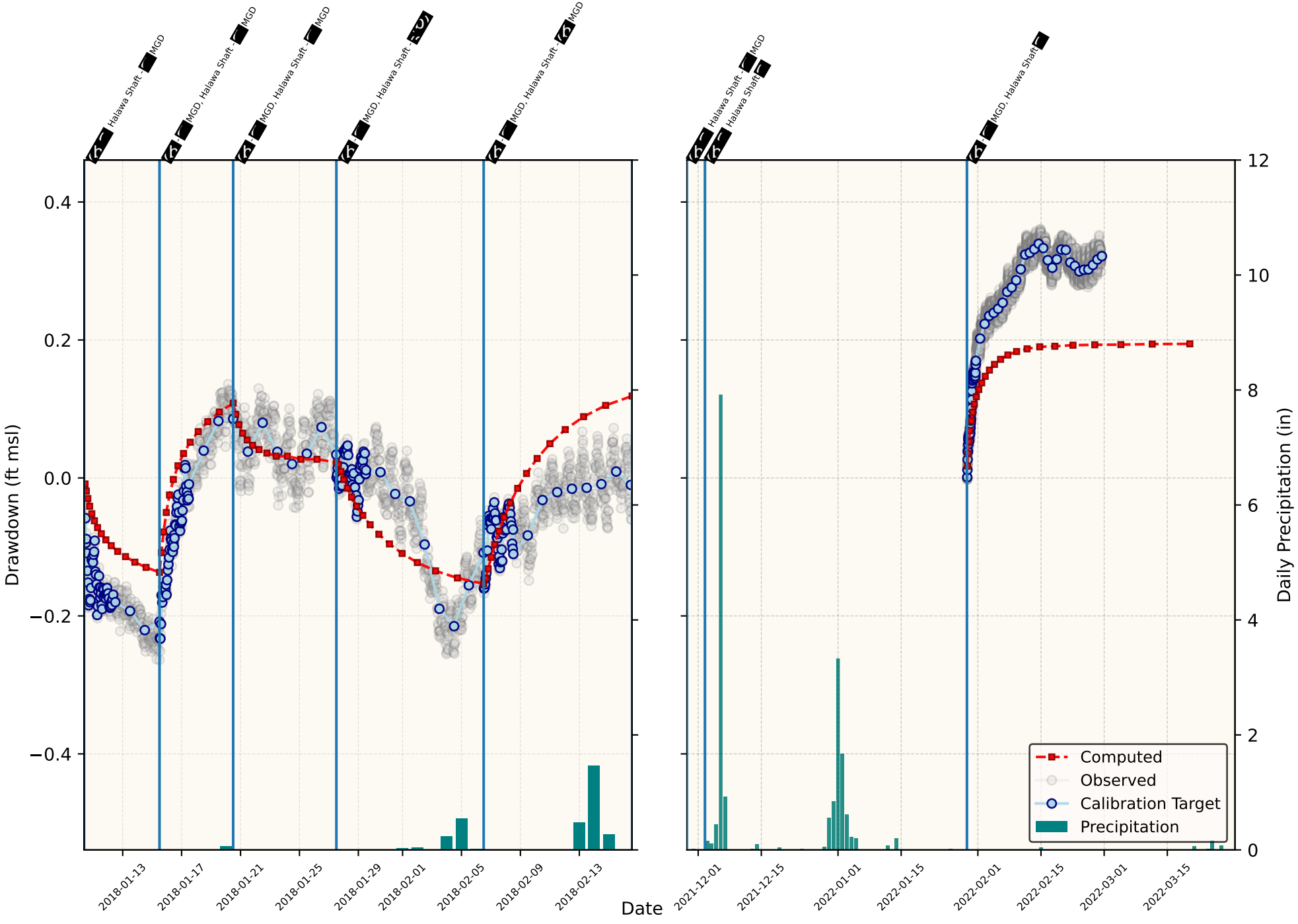
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



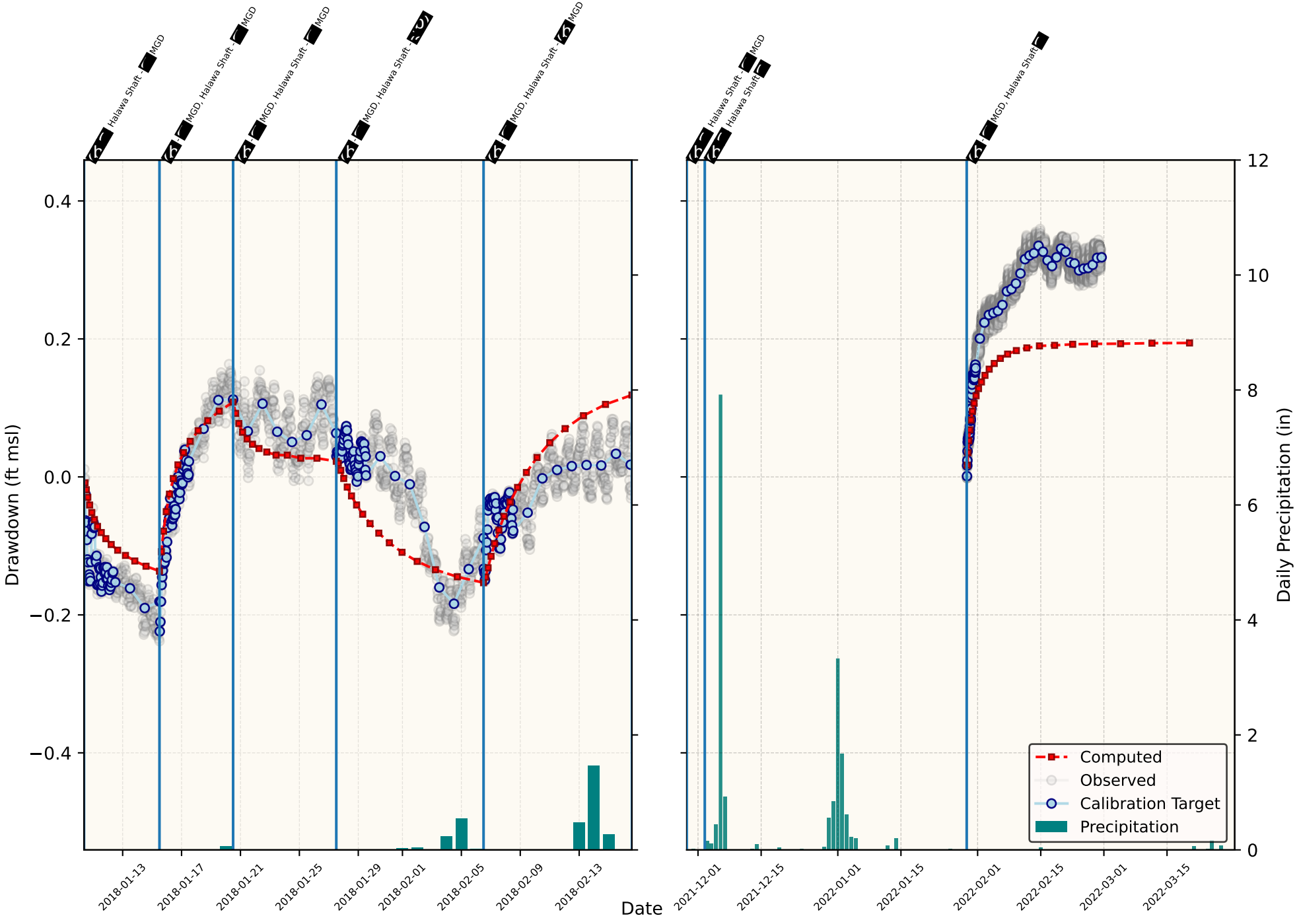
RHMW [redacted]

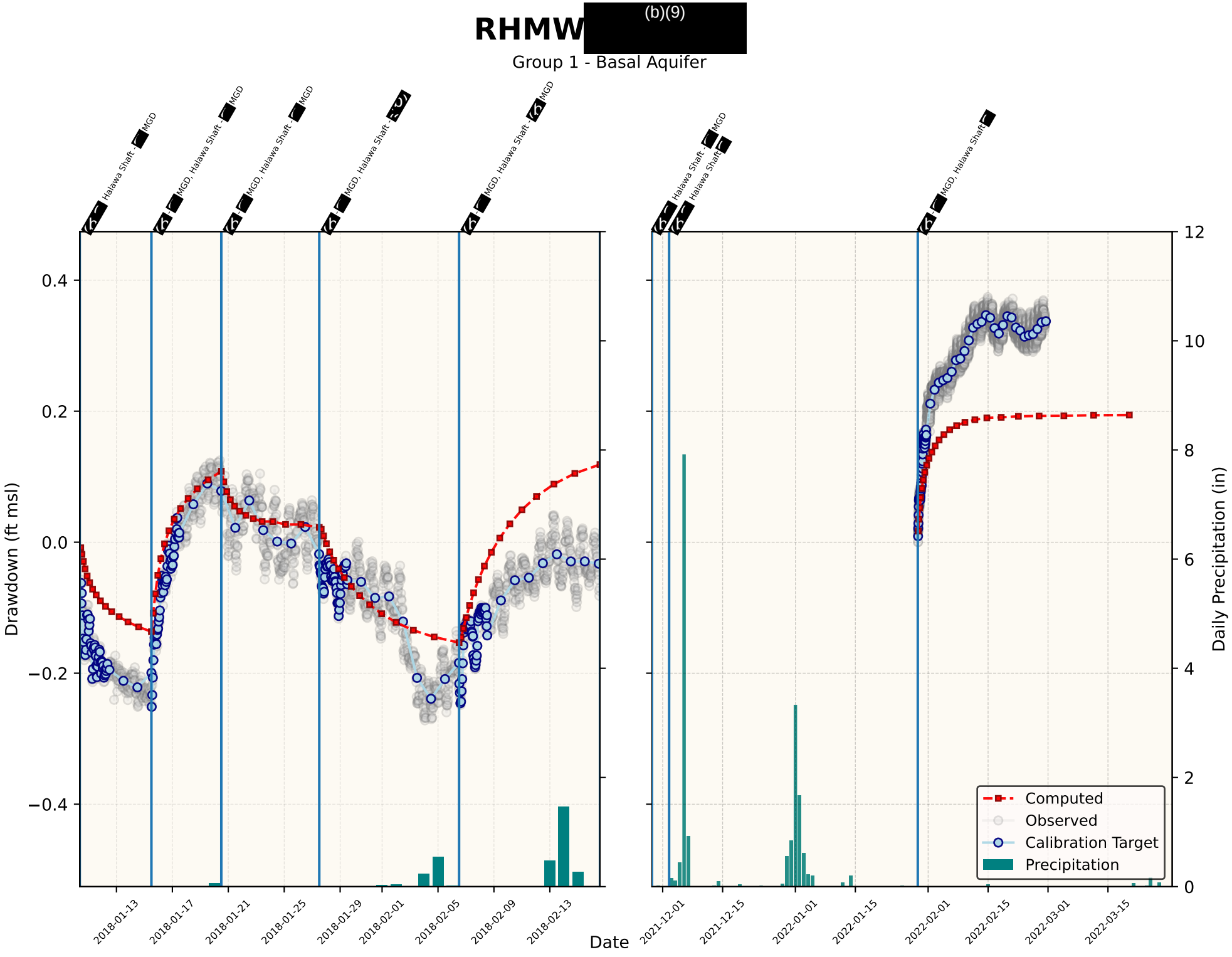
Group 1 - Basal Aquifer



RHMW [redacted] (b)(9)

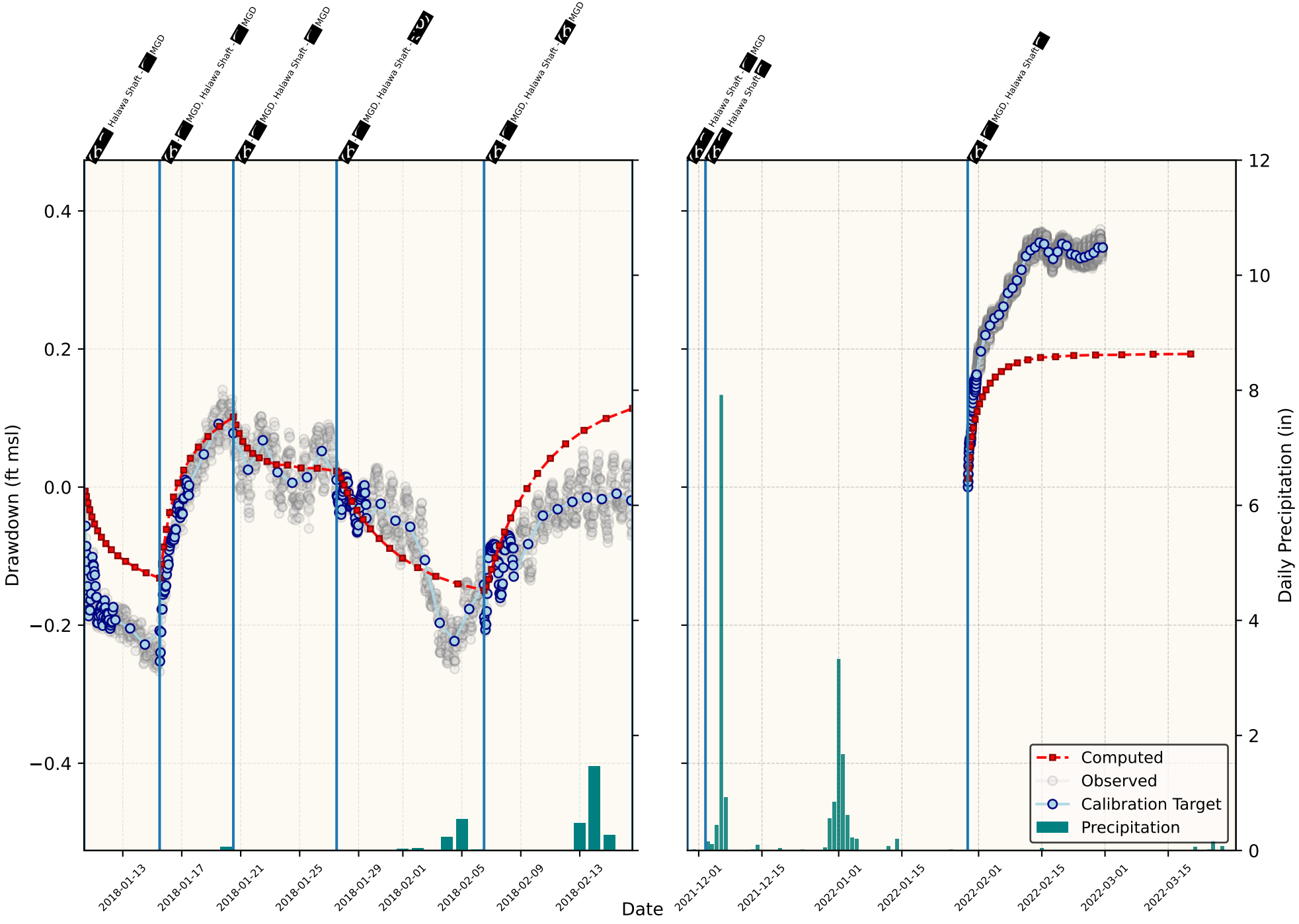
Group 1 - Basal Aquifer




RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
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2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation

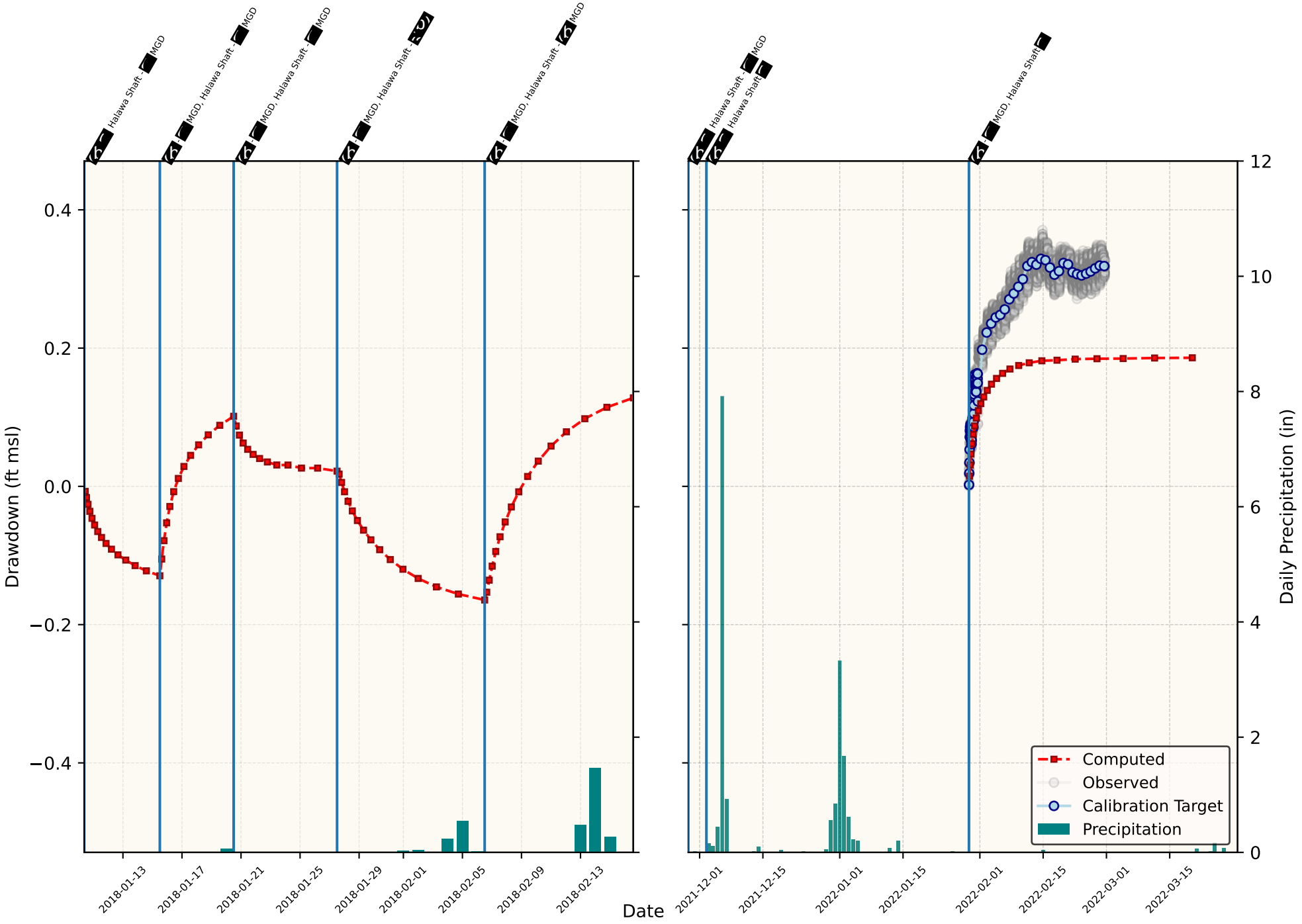
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



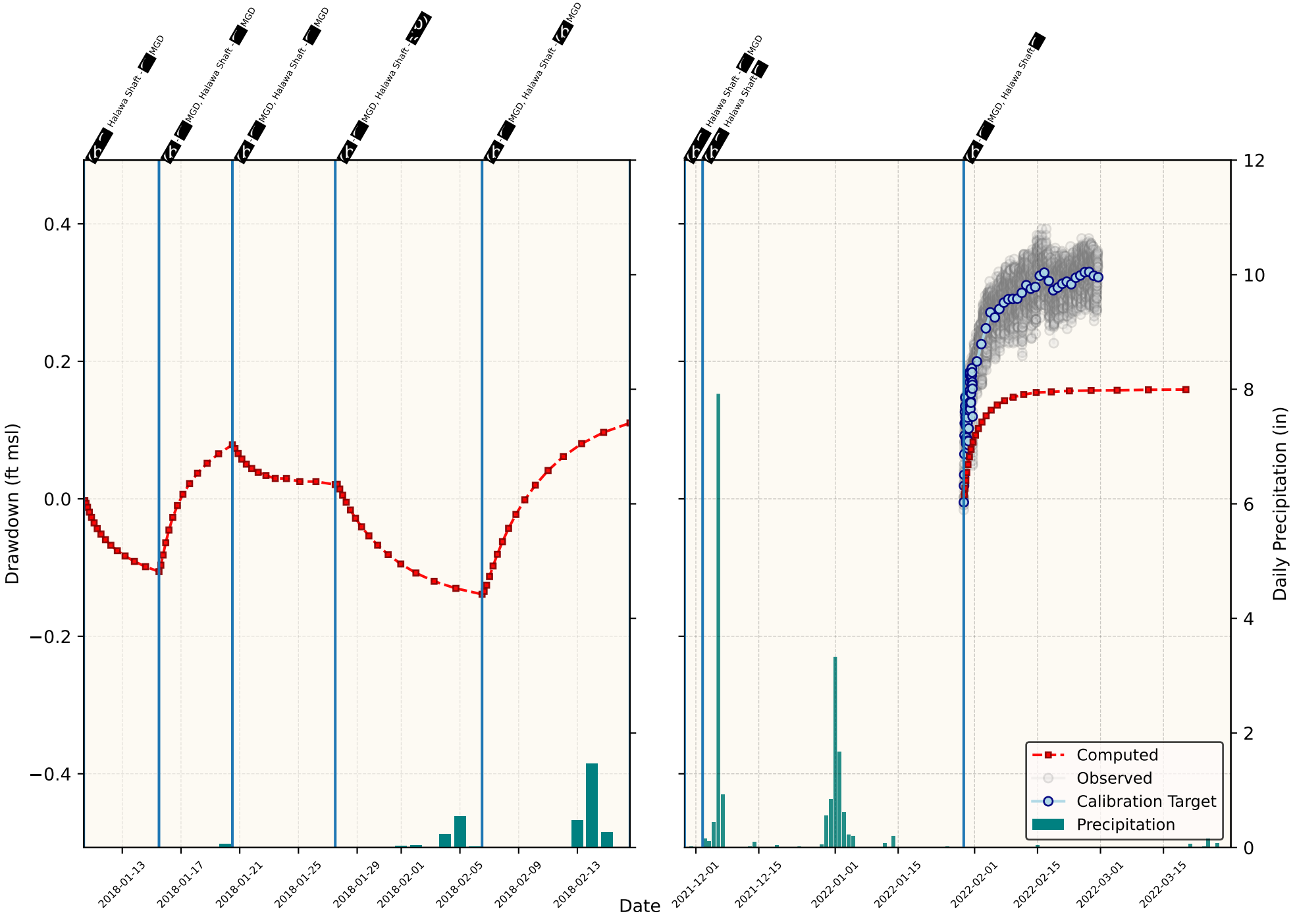
RHMW[redacted] (b)(9)

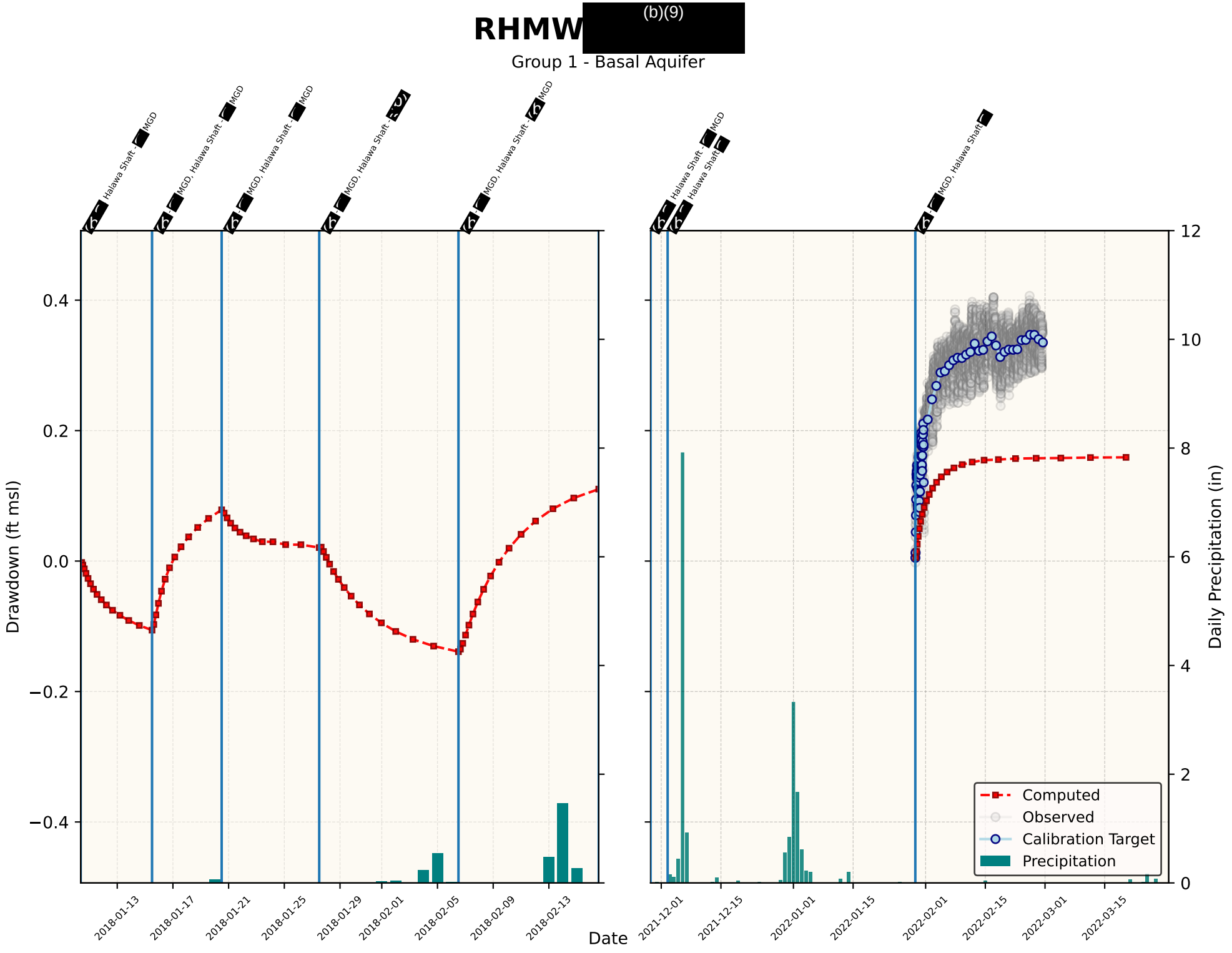
Group 1 - Basal Aquifer

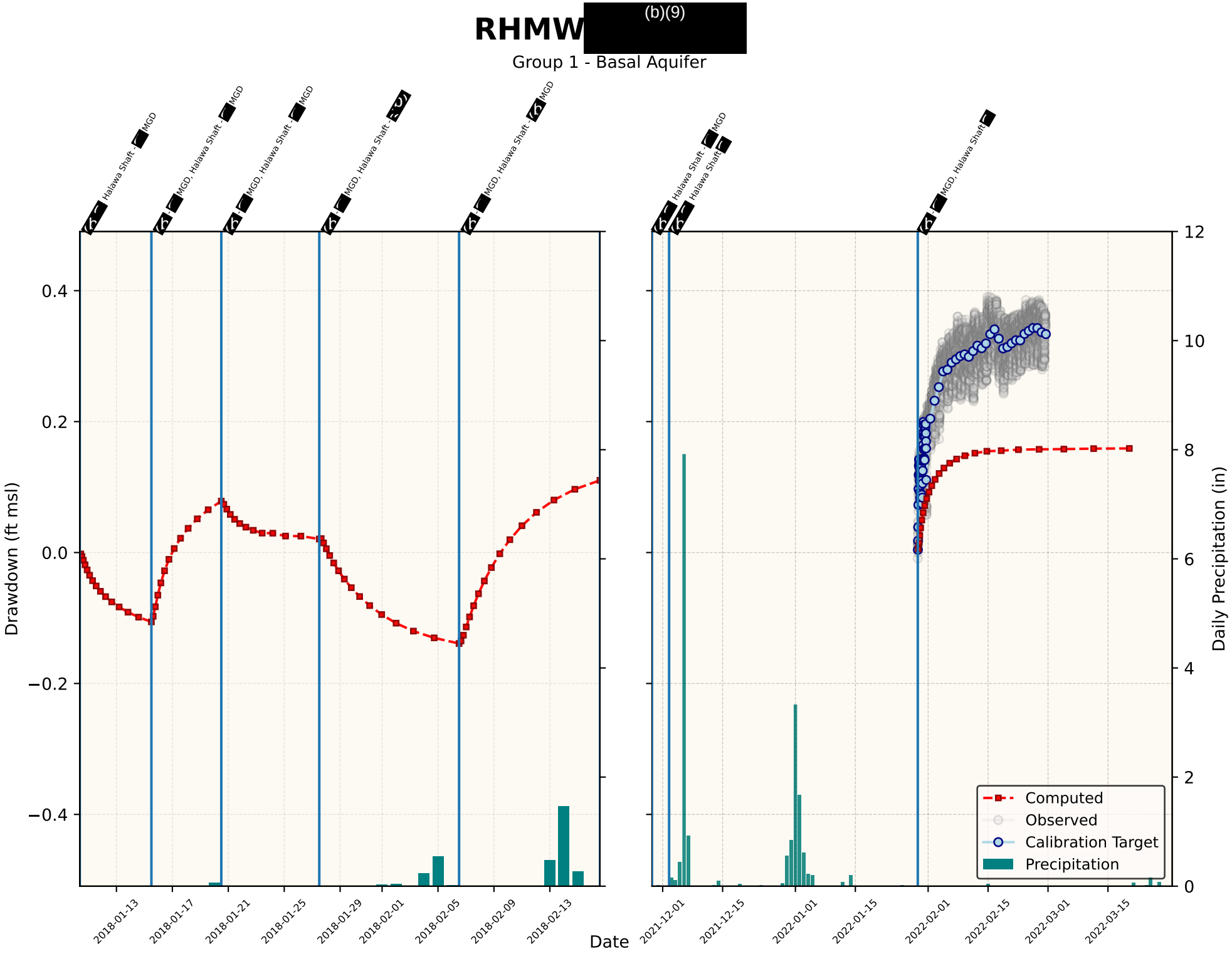


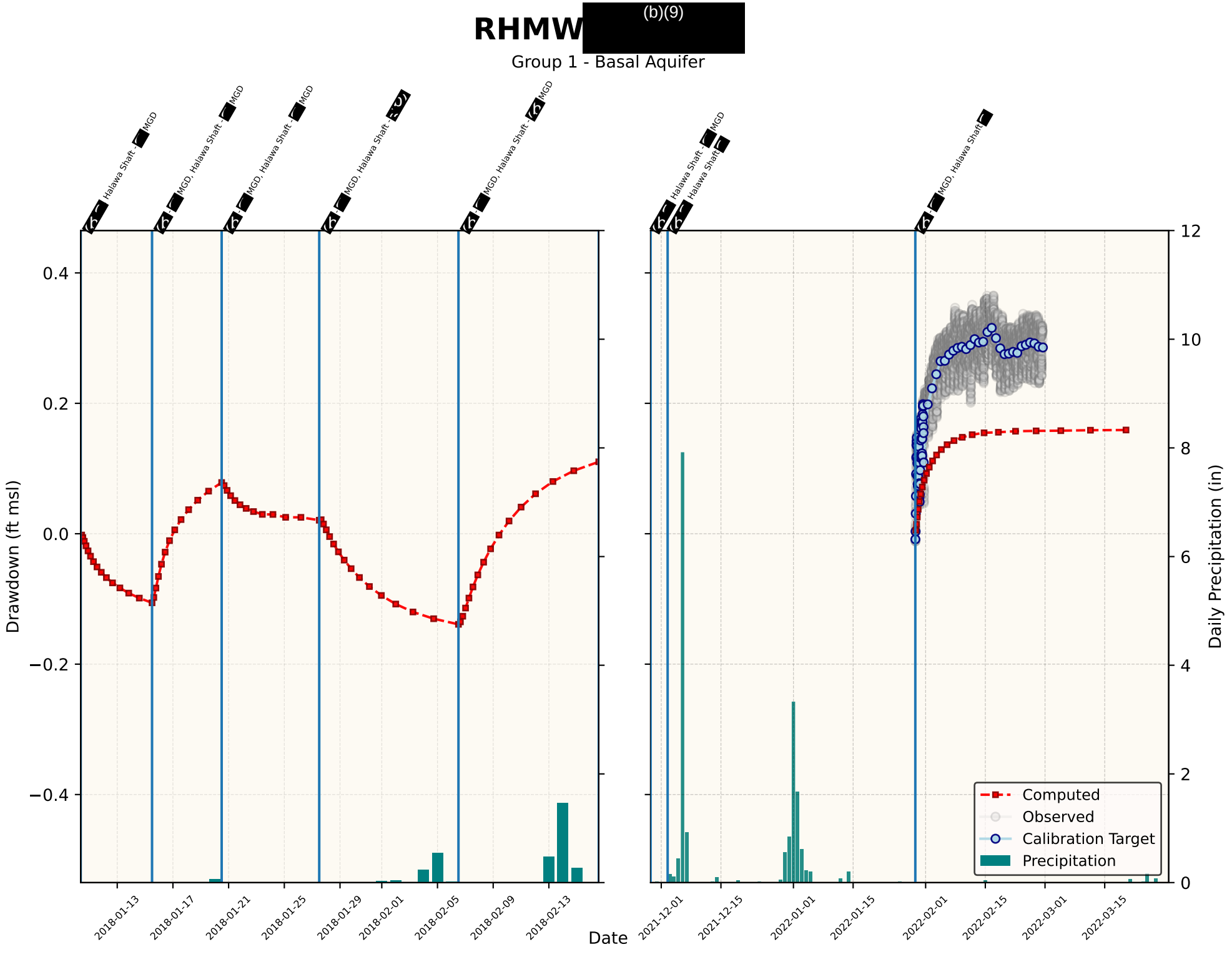
RHMW [redacted] (b)(9)

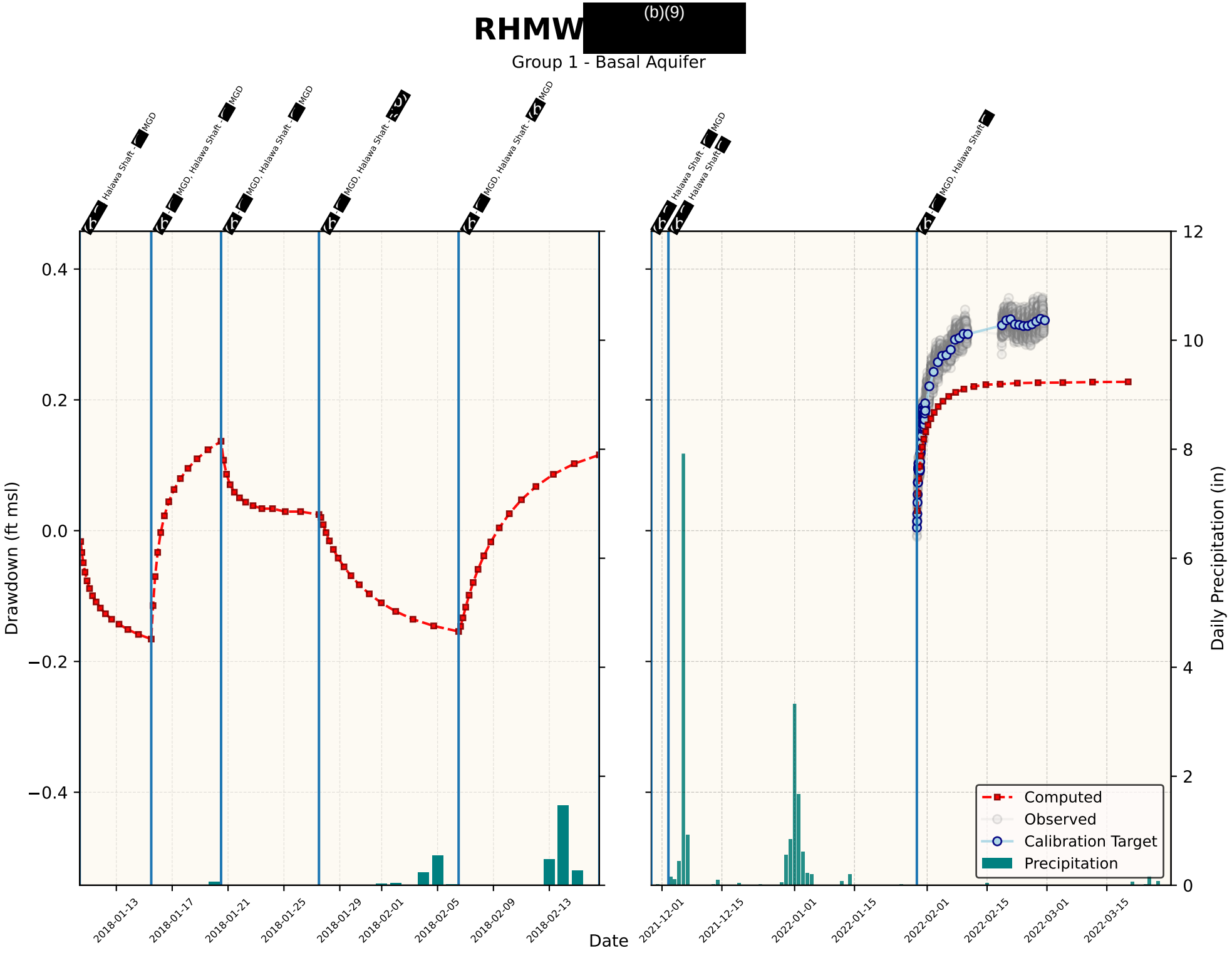
Group 1 - Basal Aquifer




RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

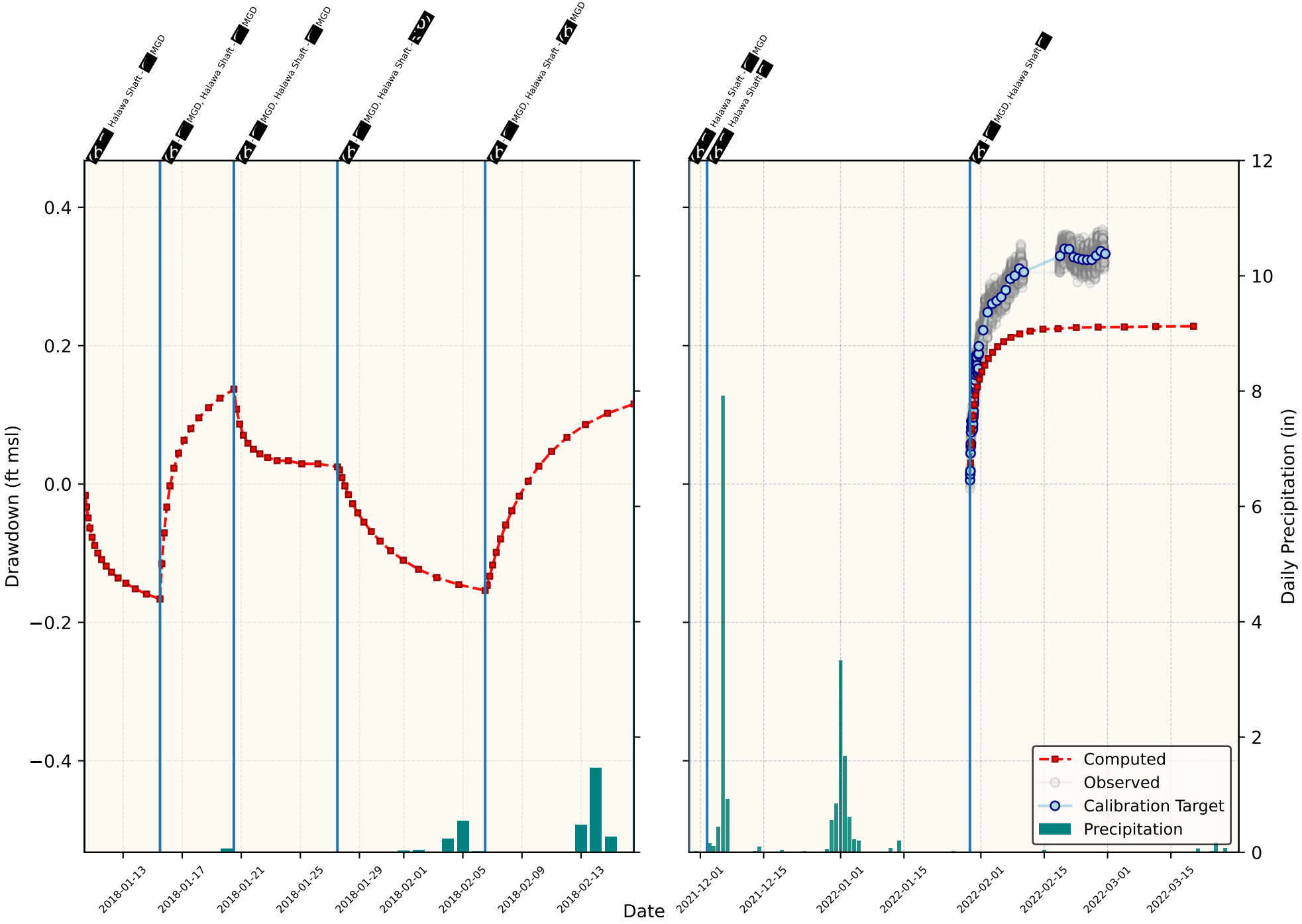

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
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2022-01-01
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2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

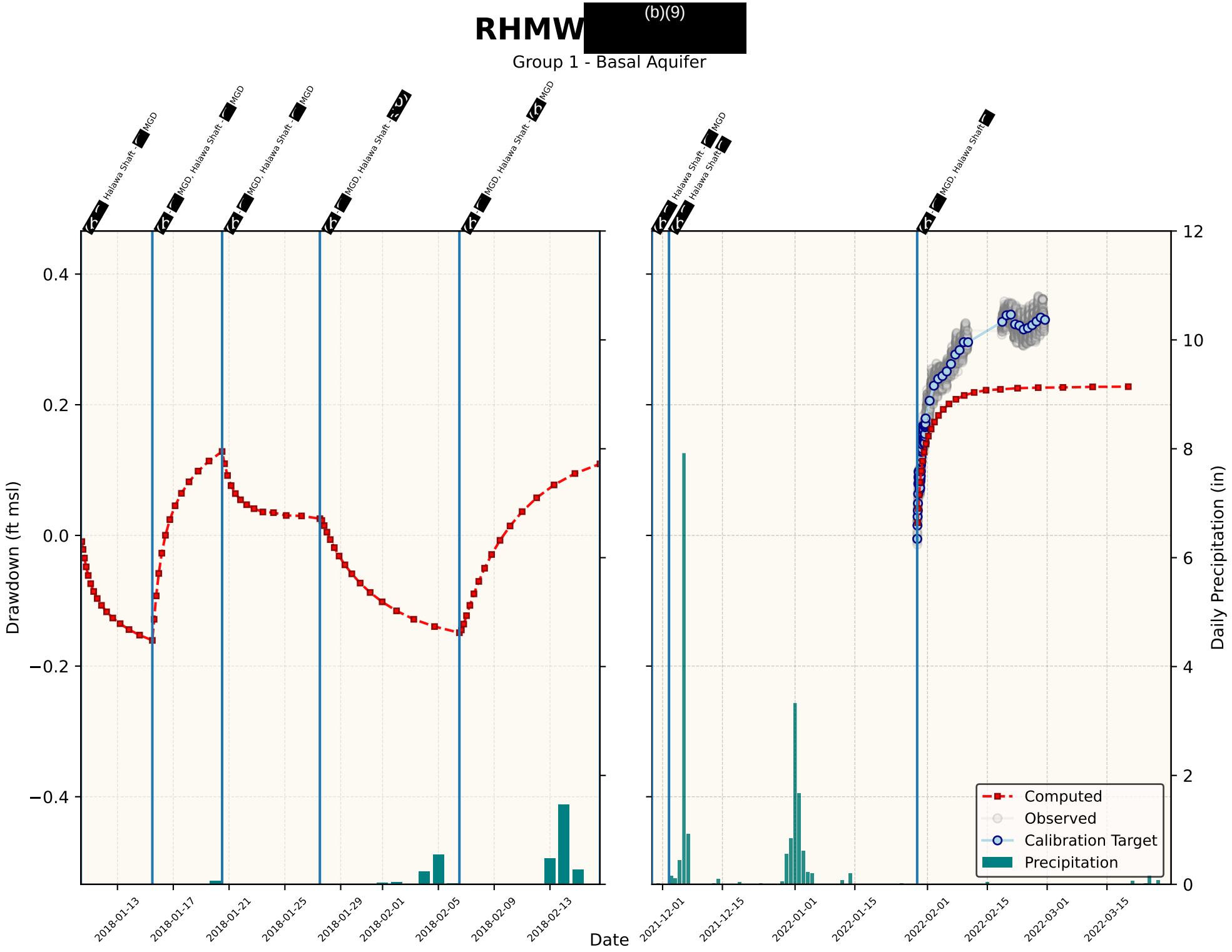

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
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2021-12-01
2021-12-15
2022-01-01
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2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

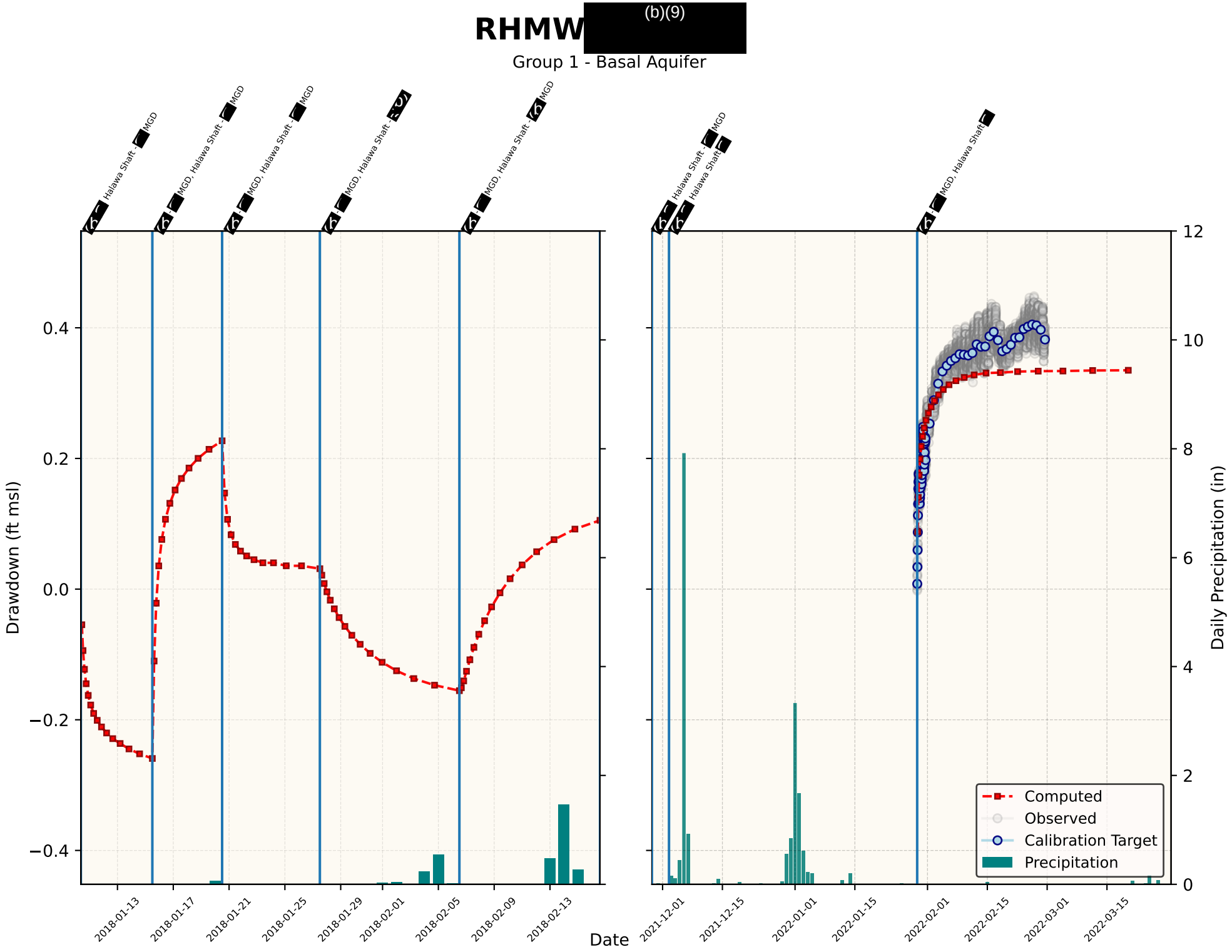

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
[redacted] Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] Halawa Shaft [redacted] MGD
[redacted] Halawa Shaft [redacted]
[redacted] MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
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2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation

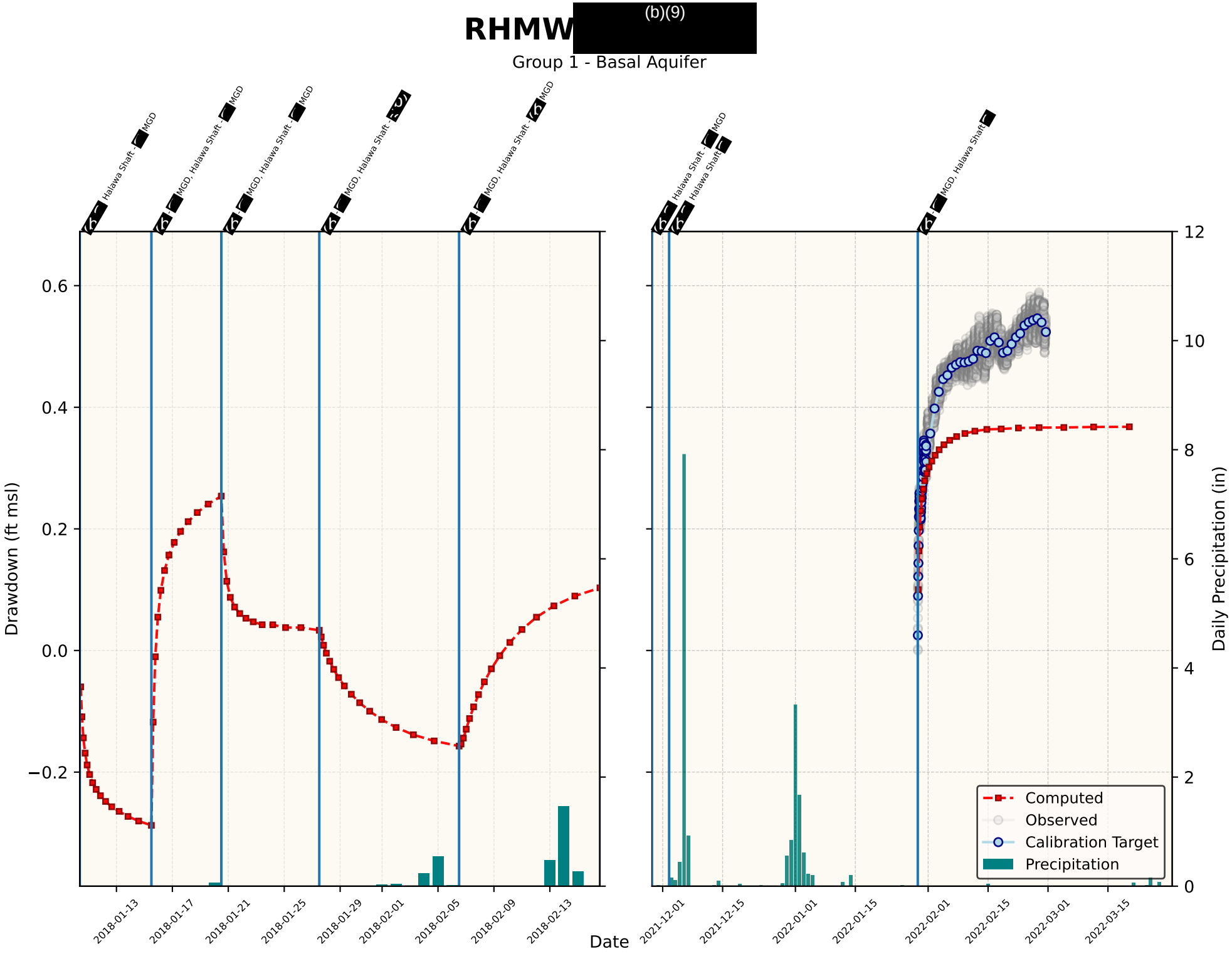
RHMW [redacted] (b)(9)

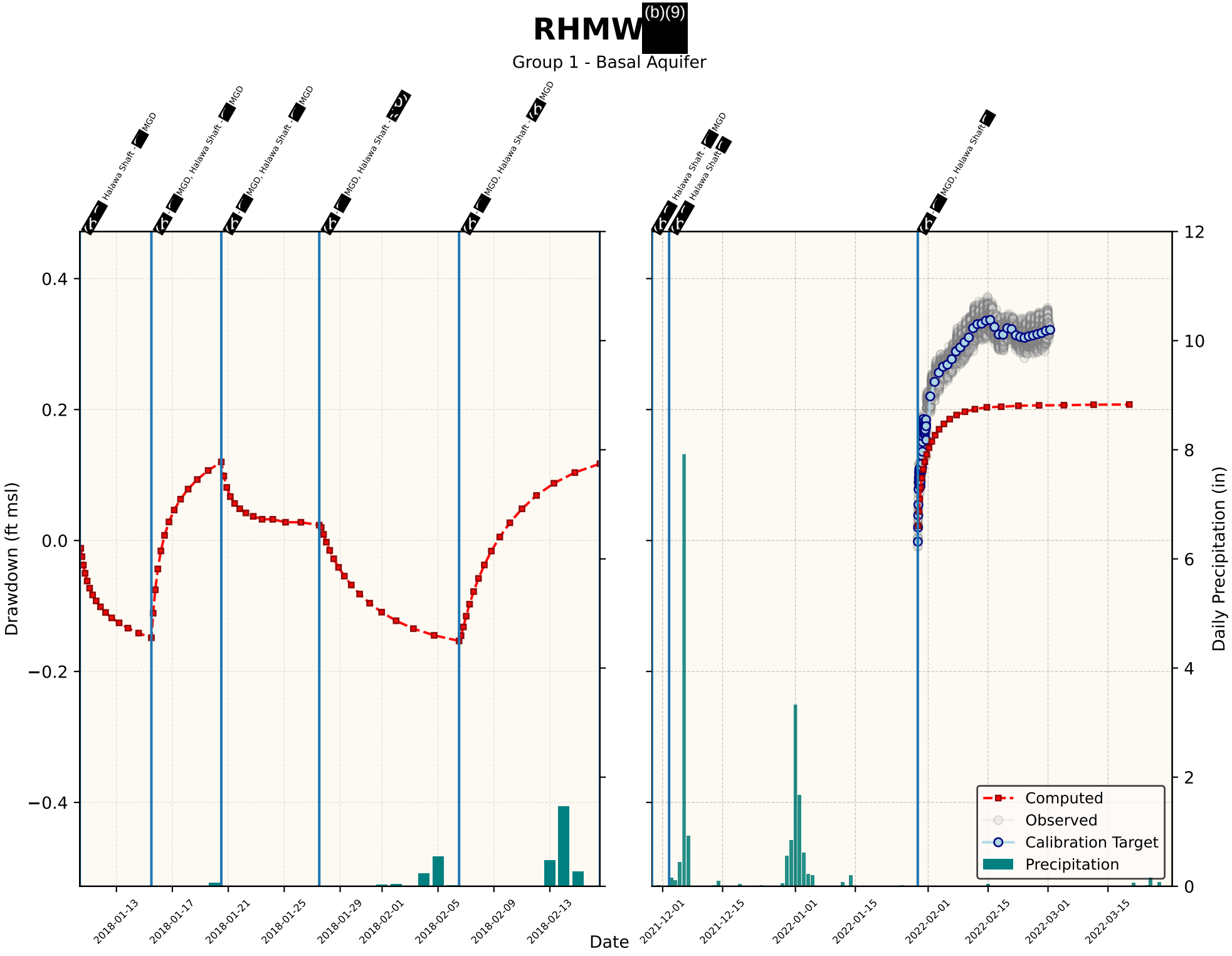
Group 1 - Basal Aquifer

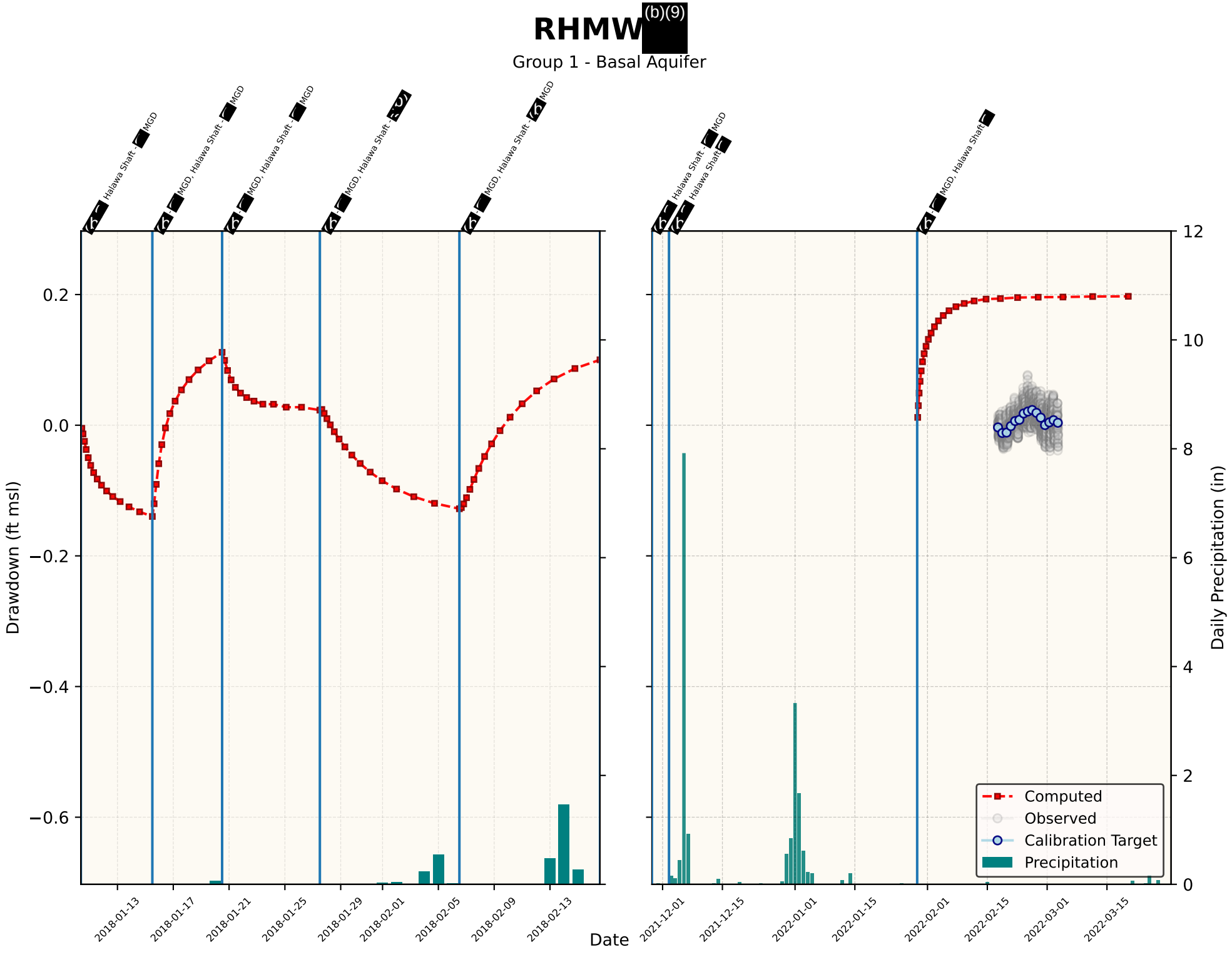



RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
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2022-01-01
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2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

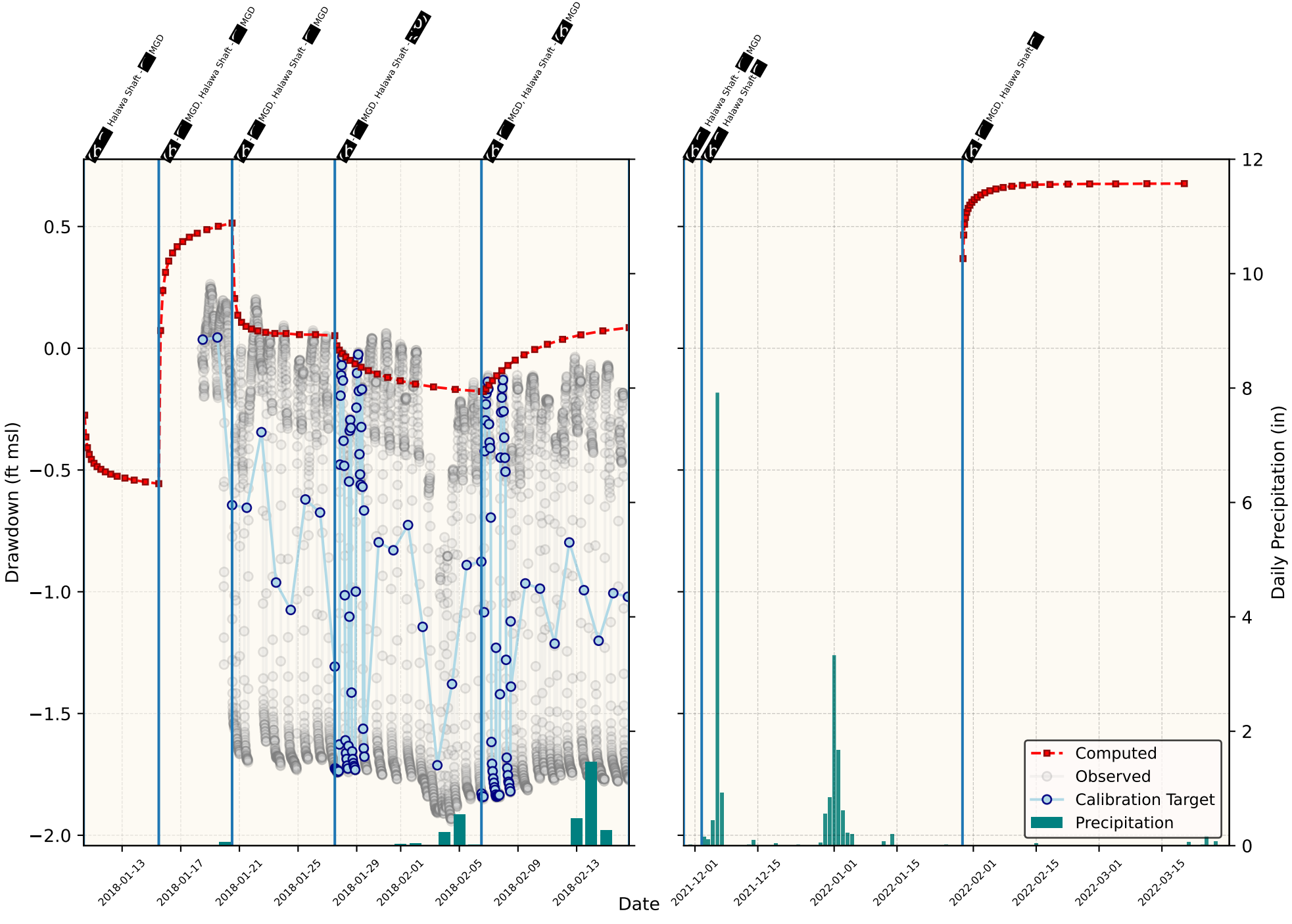

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.6
0.4
0.2
0.0
−0.2
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
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2021-12-01
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2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.2
0.0
−0.2
−0.4
−0.6
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

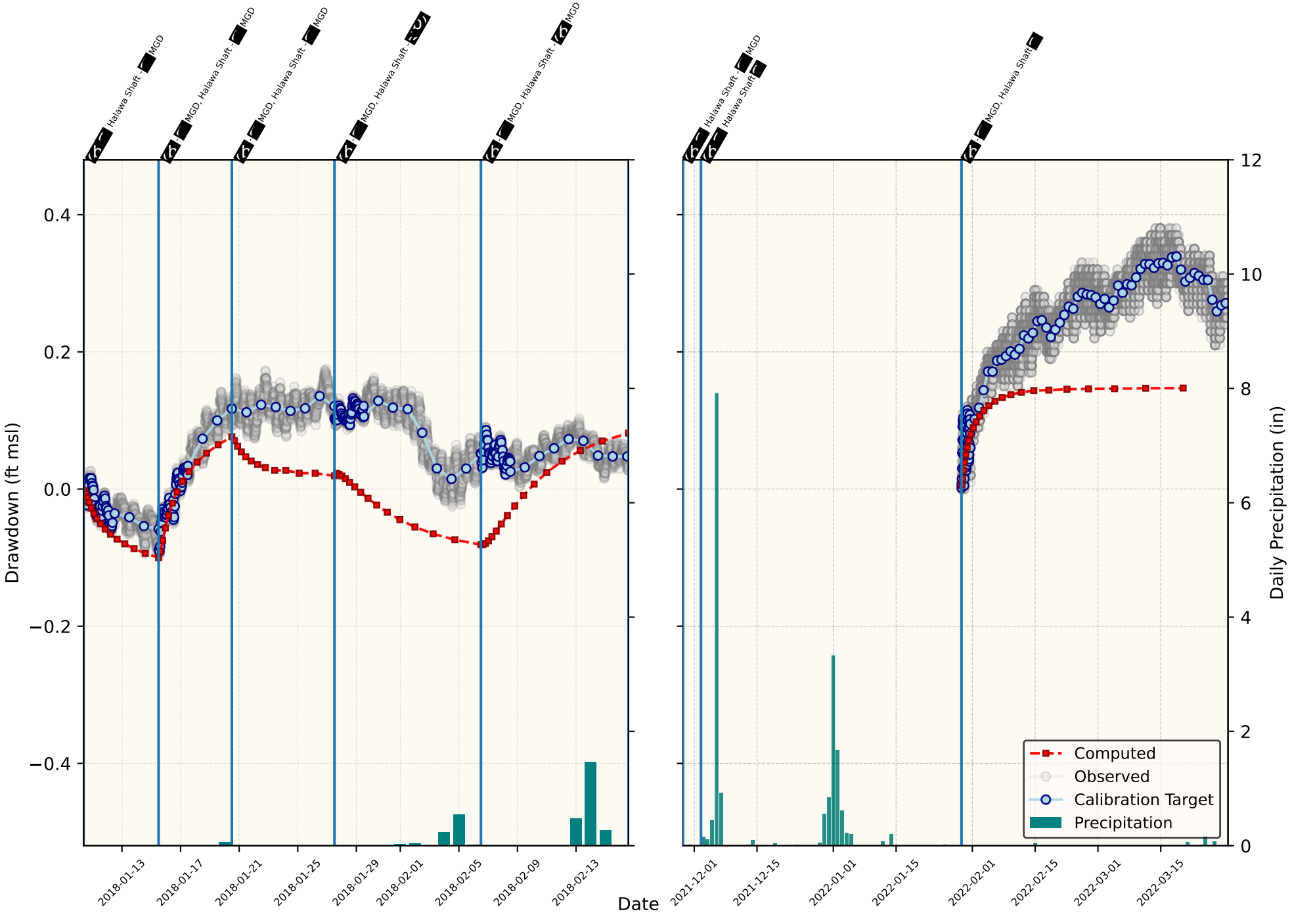
RHMW [redacted] (b)(9)

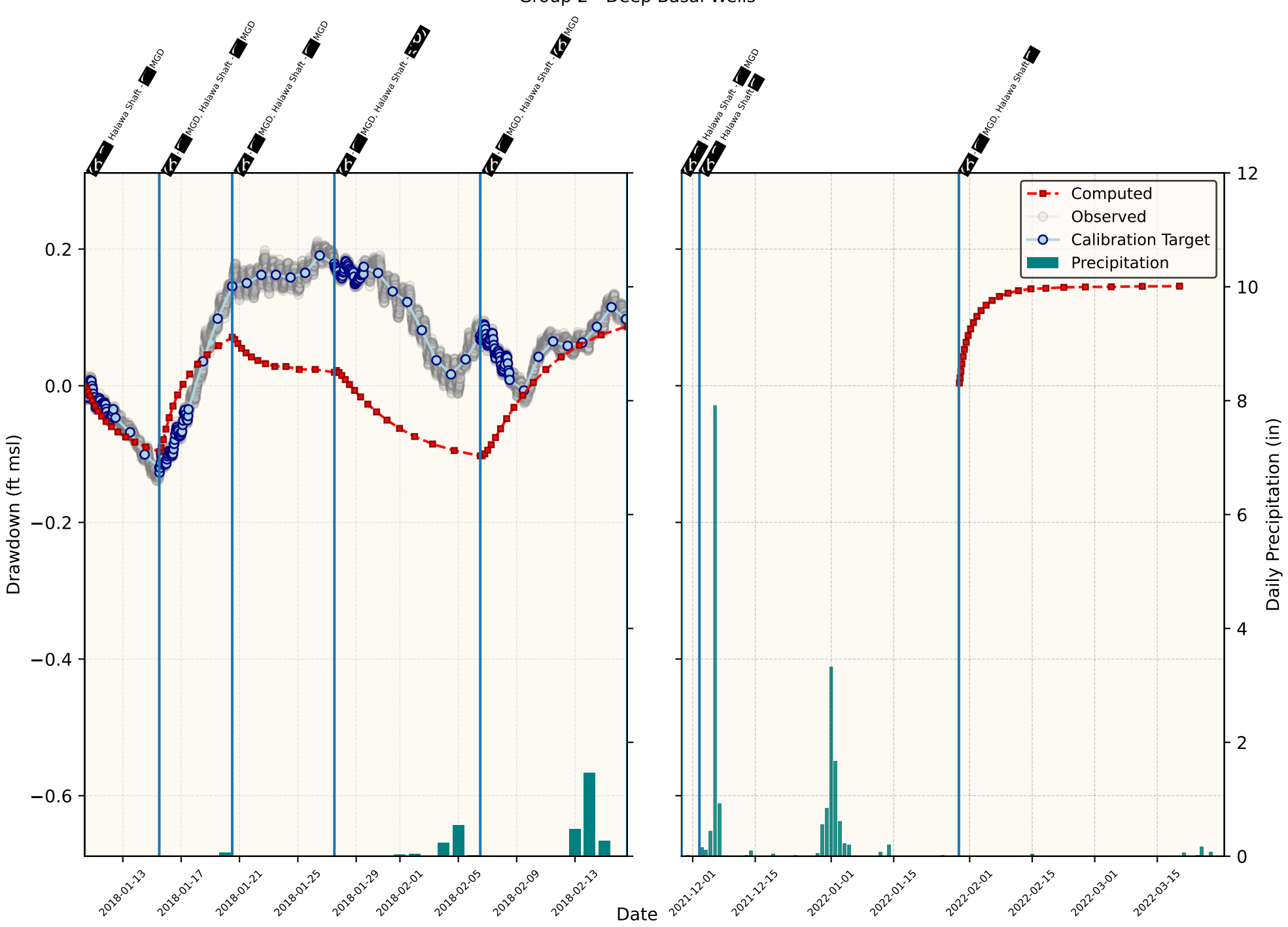
Group 1 - Basal Aquifer

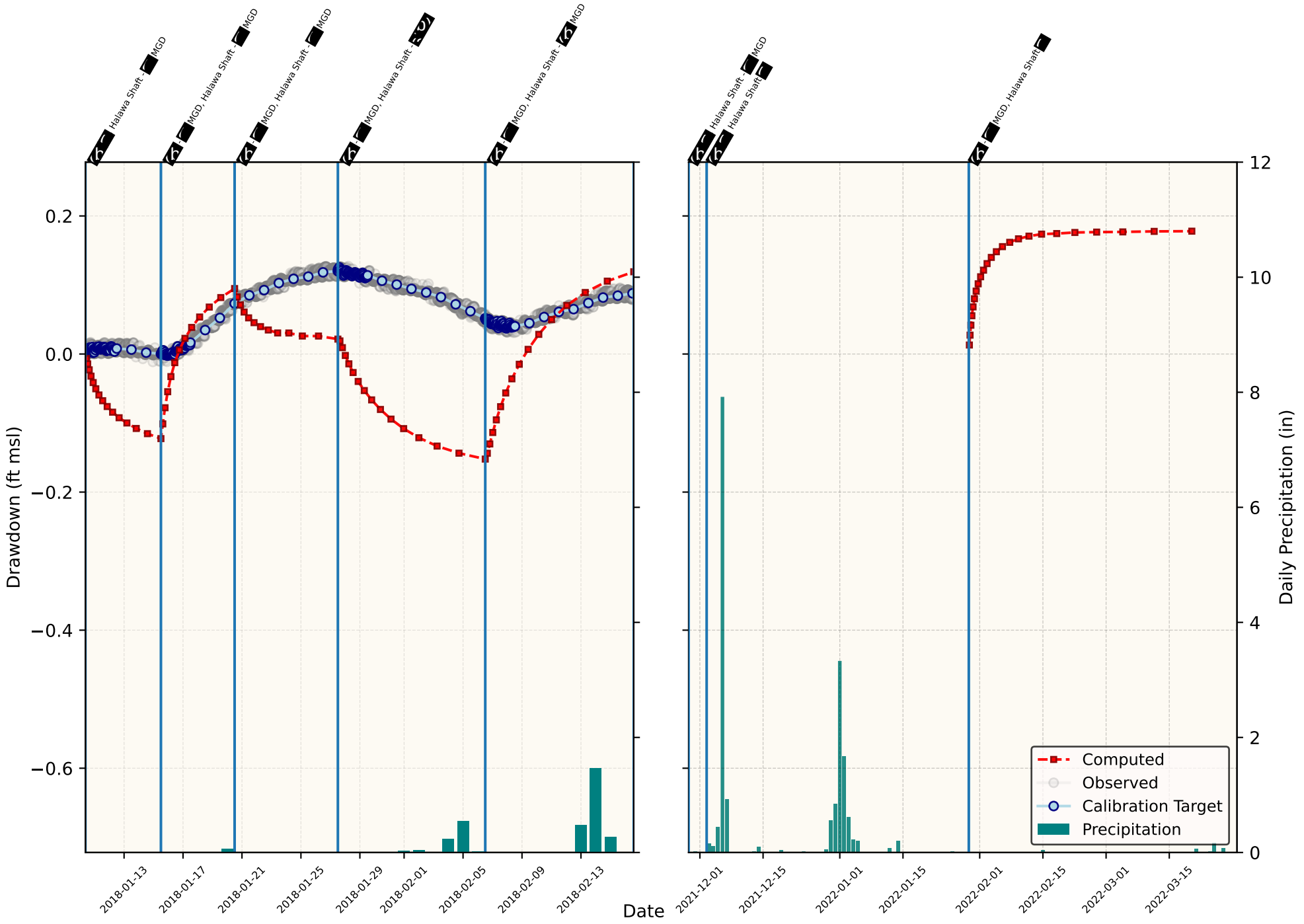


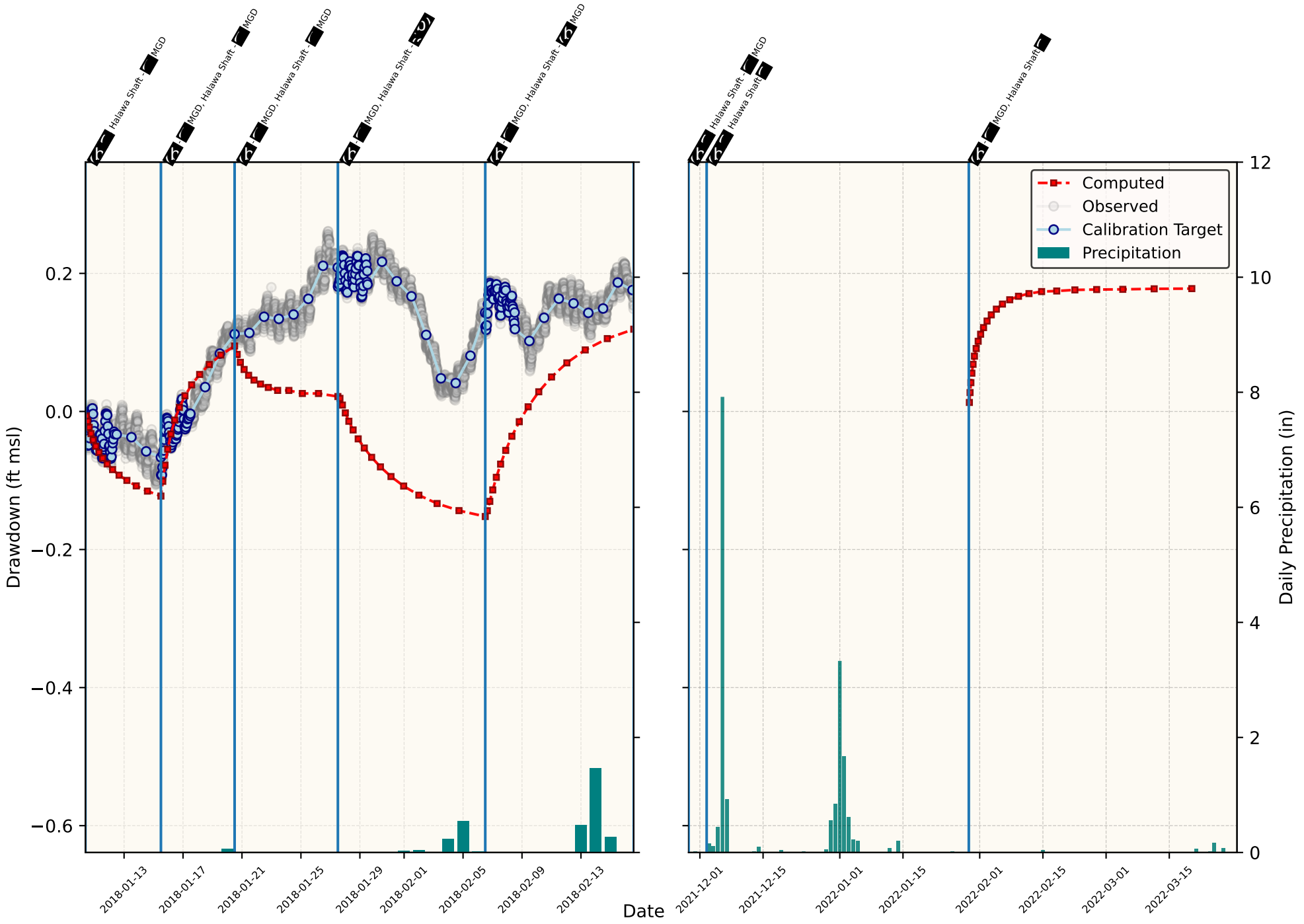
TAMC_[redacted] (b)(9)

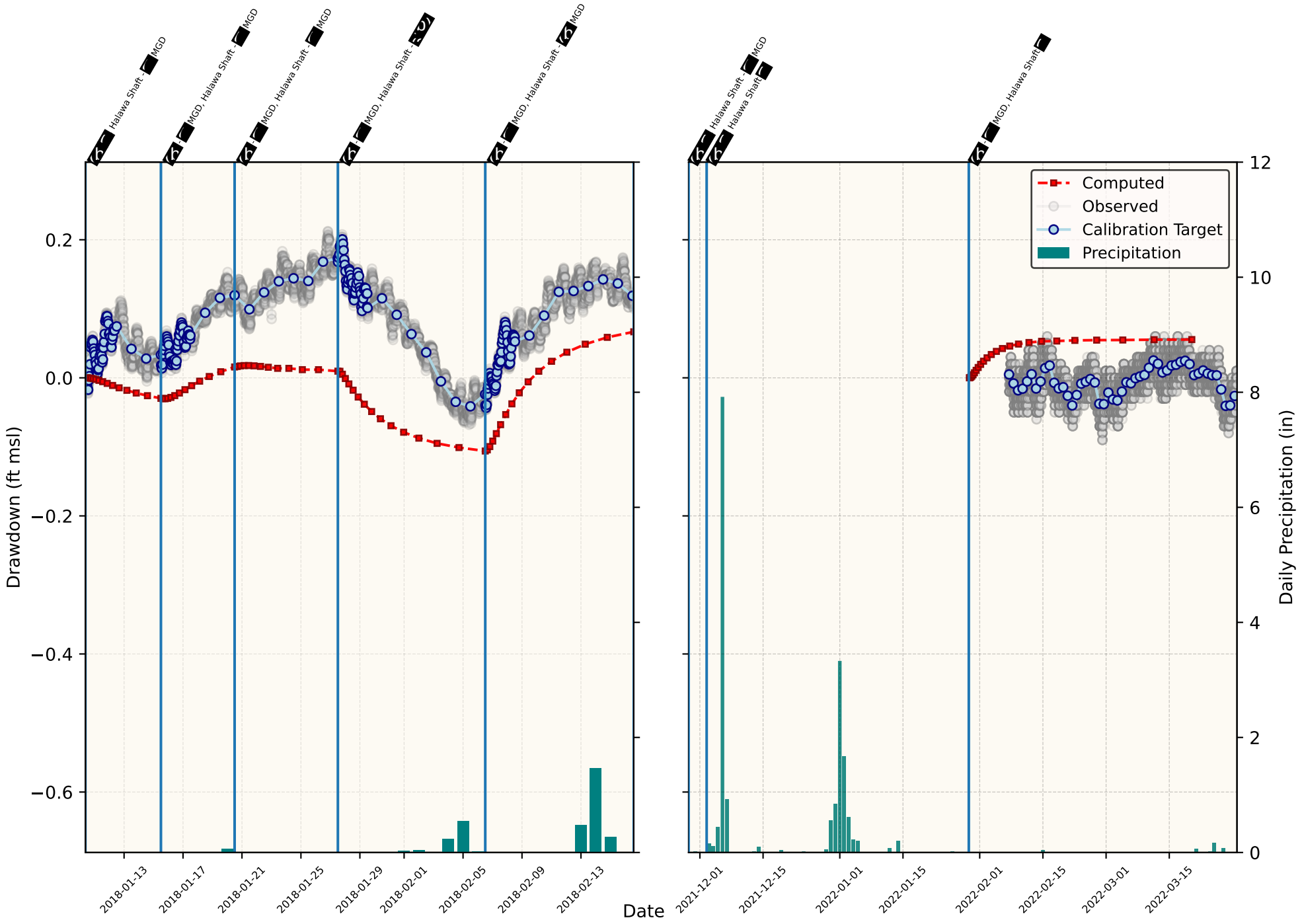
Group 1 - Basal Aquifer




DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

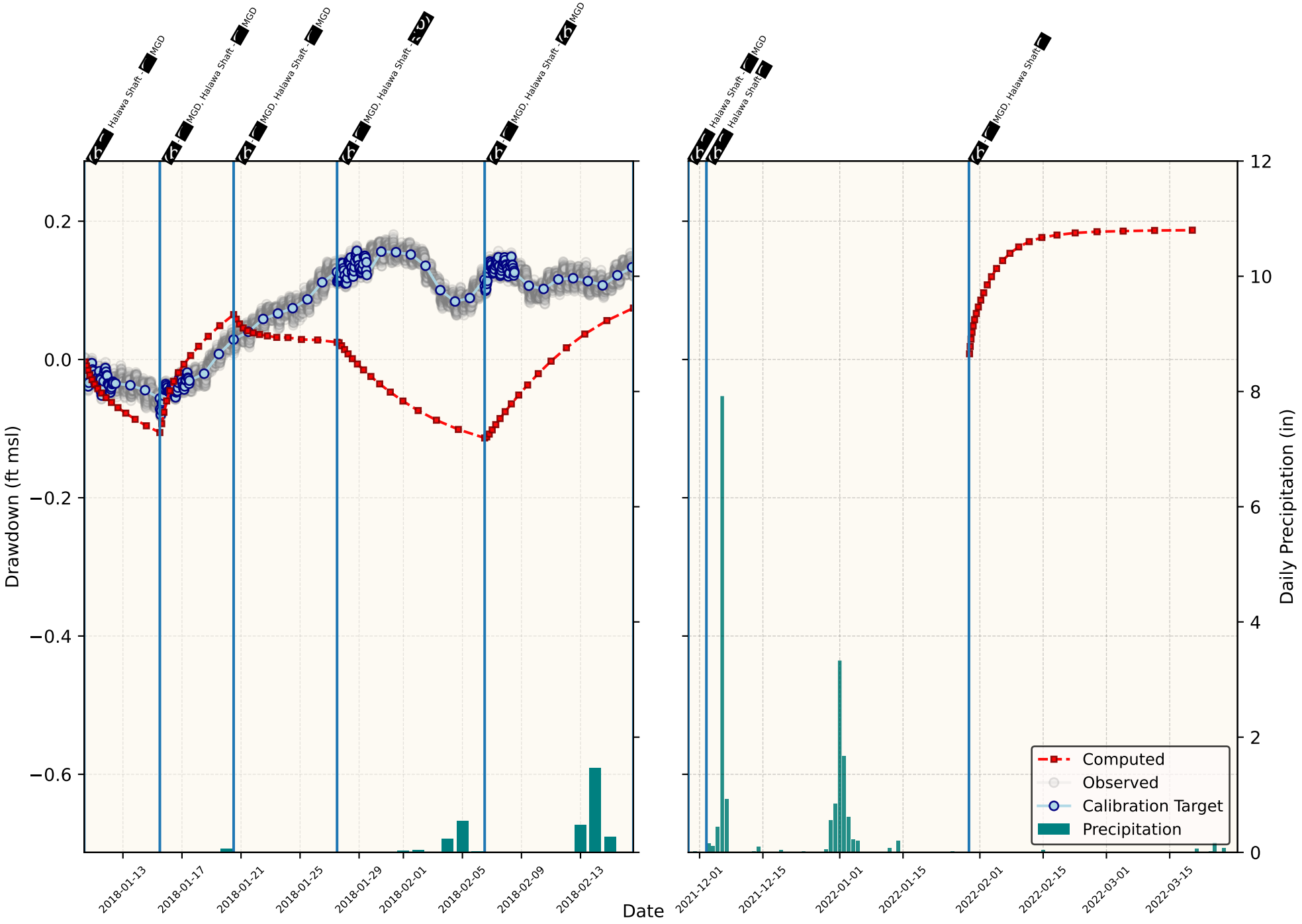

HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Halawa_Deep_Monitor_Well_HDMW2253-03
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

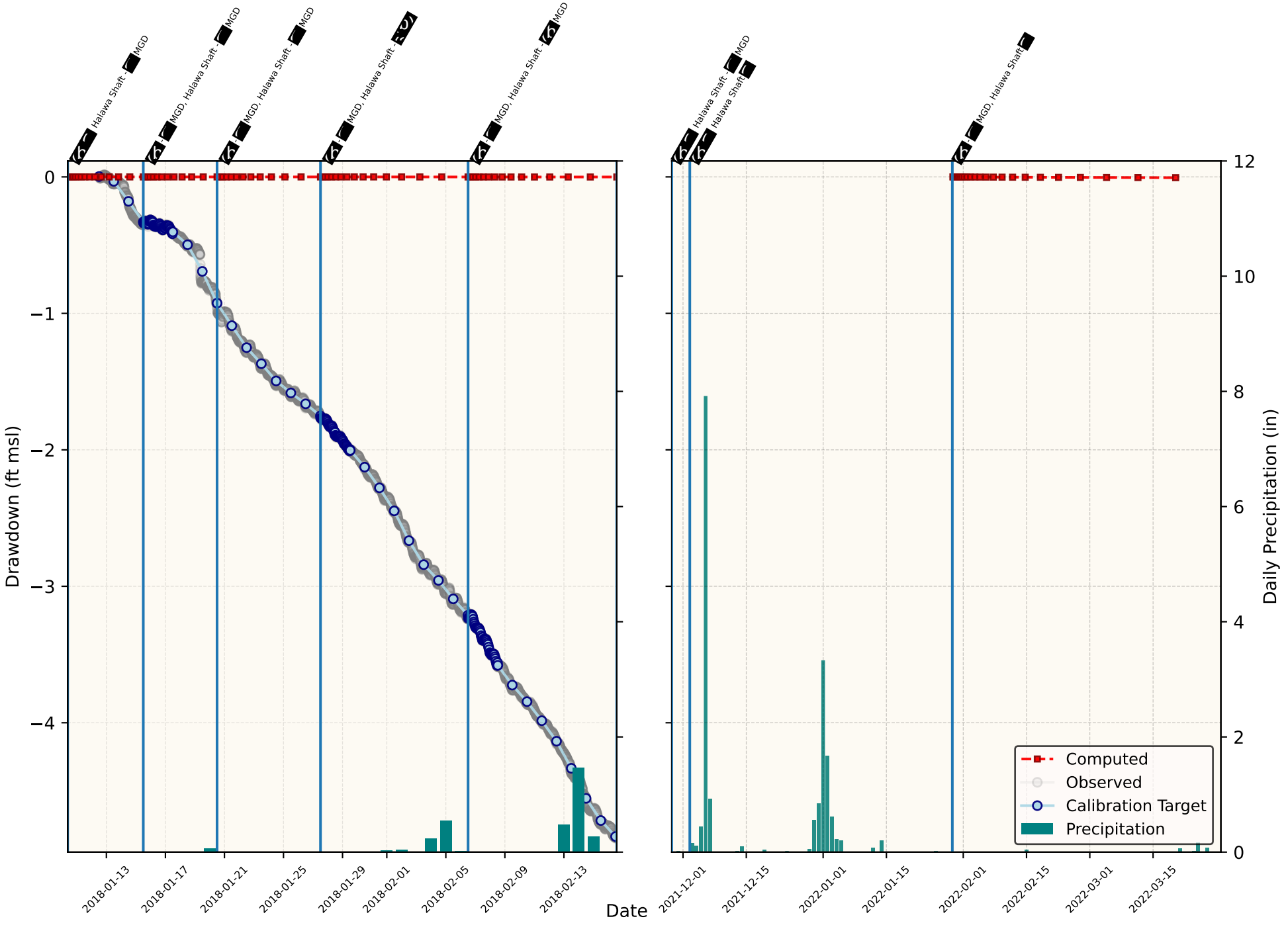
RHMW[redacted]

Group 3 - Saprolite/Confining Unit Well with Elevated Head



RHMW[redacted] (b)(9)

Group 3 - Saprolite/Confining Unit Well with Elevated Head



Groundwater Flow Model Calibration Evaluation Documents Sensitivity Scenario 5

Head Calibration Statistics

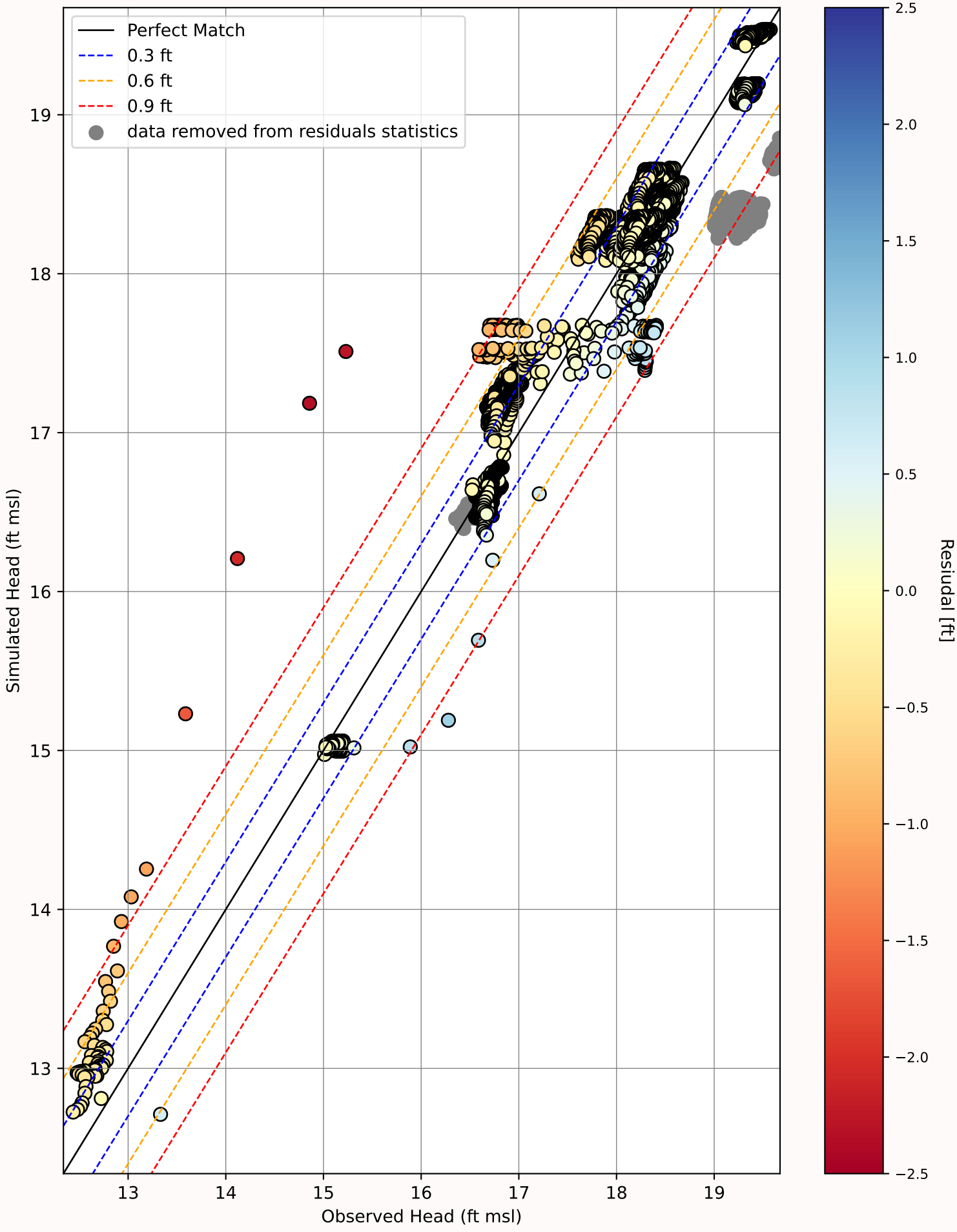
Wells	Basal Aquifer (Group 1)			Deep Wells (Group 2)	Confining Unit (Group 3)	Caprock (Group 4)	Cumulative
Time Period	**2017/2018**	**2021/2022**	**All**	**All**	**All**	**All**	**All**
Residual Mean (ft)	-0.05	0.03	-0.02	0.60	15.37	0.23	0.79
Absolute Residual Mean (ft)	0.18	0.24	0.22	0.62	17.15	1.47	1.09
Residual Standard Deviation (ft)	0.24	0.31	0.30	0.43	18.61	2.07	5.28
Sum of Squared Residuals (ft2)	323.59	375.20	876.10	582.75	331834.51	573.82	333867.17
RMSE Error (ft)	0.24	0.31	0.30	0.74	24.13	2.08	5.34
Minimum Residual (ft)	-2.33	-0.78	-2.33	-0.81	-15.78	-4.44	-15.78
Maximum Residual (ft)	1.09	0.85	2.45	1.27	49.33	6.60	49.33
Number of Observations	5459	3915	9928	1075	570	133	11706
Range in Observations	7.14	3.26	7.19	4.26	97.94	6.85	116.87
Scaled Residual Standard Deviation (ft)	3.3%	9.4%	4.1%	10.0%	19.0%	30.3%	(b)%
Scaled Absolute Residual Mean (ft)	2.5%	7.4%	3.0%	14.6%	17.5%	21.5%	0.9%
Scaled RMSE Error (ft)	3.4%	9.5%	4.1%	17.3%	24.6%	30.3%	4.6%
Scaled Residual Mean (ft)	-(b)%	0.9%	-0.3%	14.1%	15.7%	3.3%	(b)%
Correlation Coefficient	0.97	0.91	0.95	0.99	0.93	-0.16	0.96

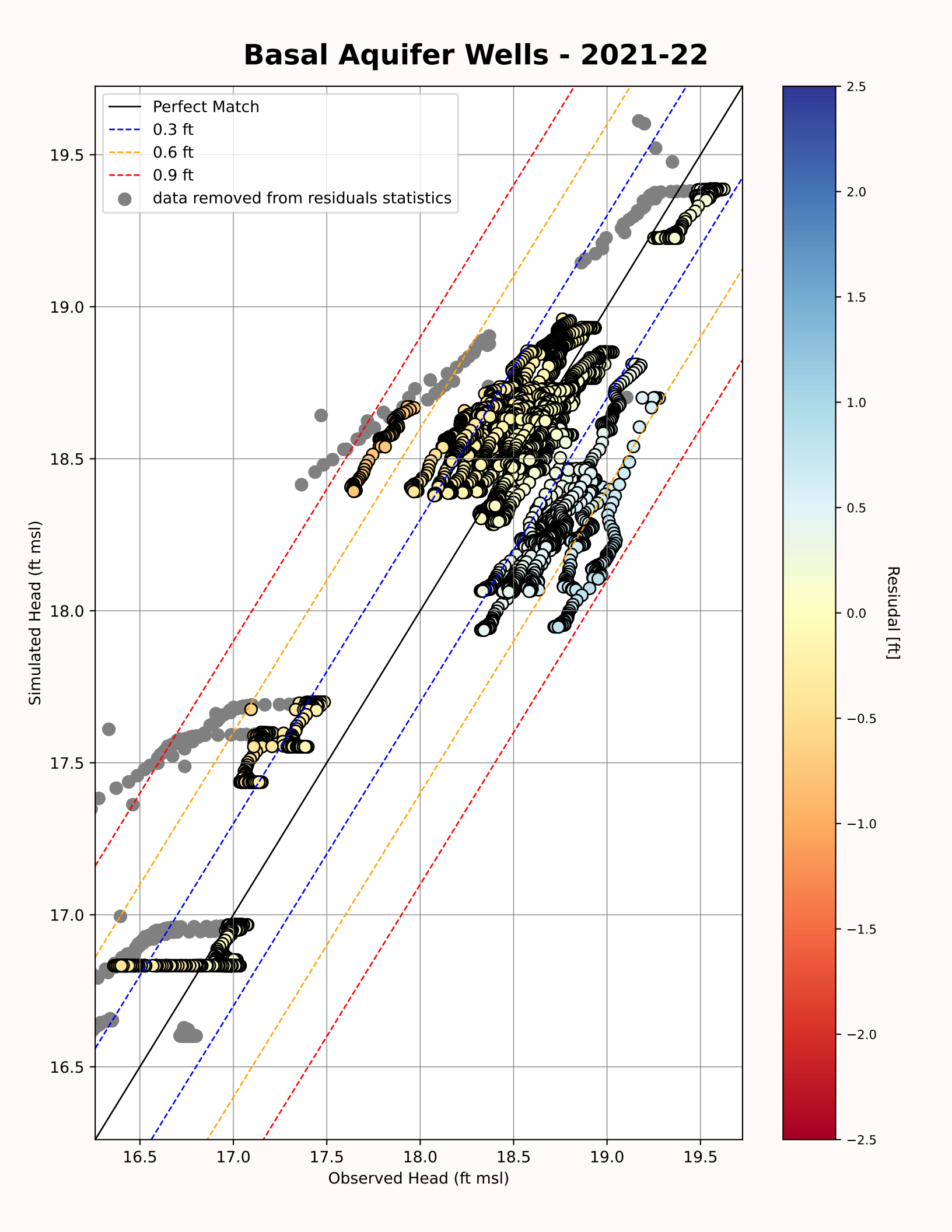
Drawdown Calibration Statistics

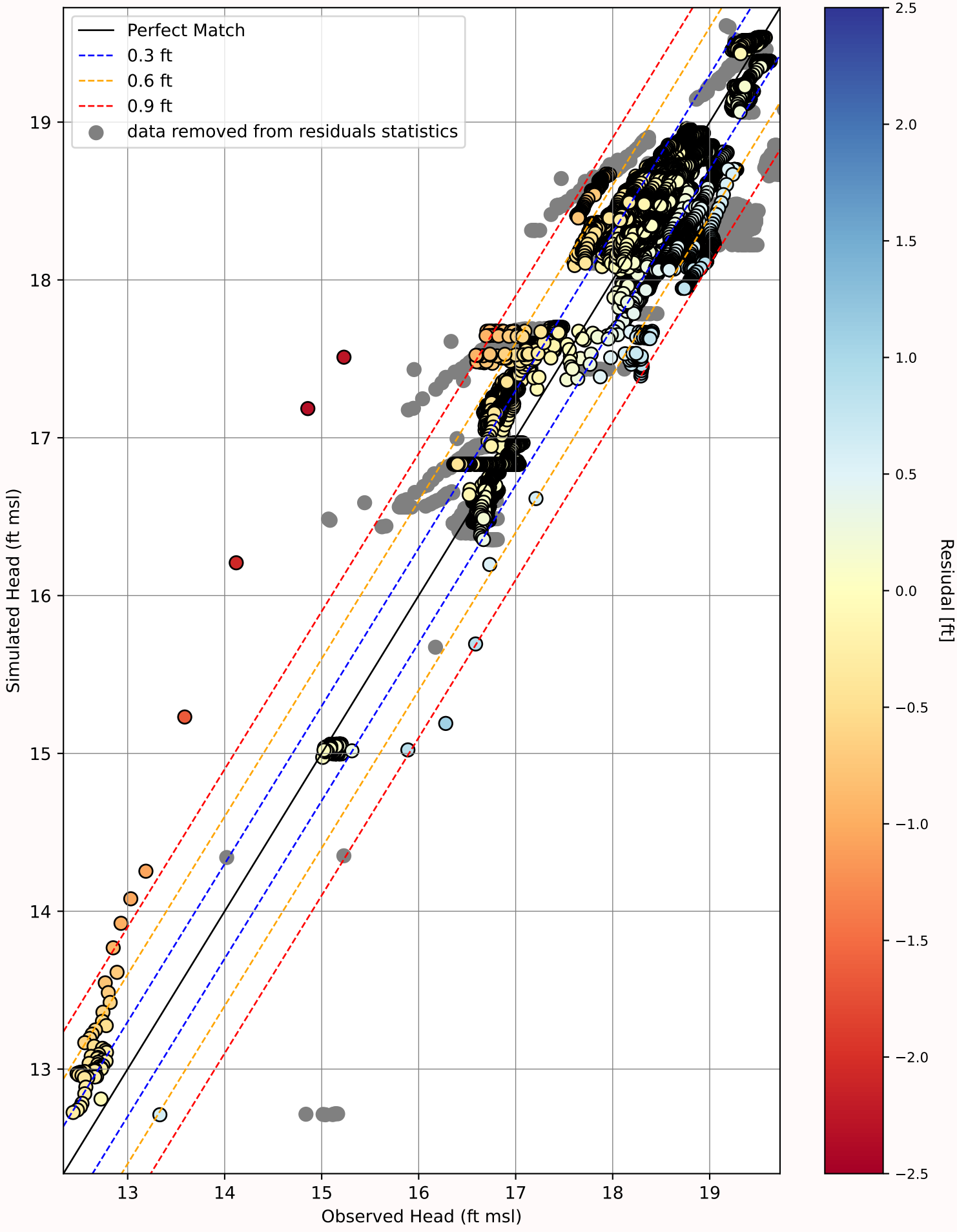
Wells	Basal Aquifer (Group 1)		
Time Period	**2017/2018**	**2021/2022**	**All**
Residual Mean (ft)	0.00	0.02	0.01
Absolute Residual Mean (ft)	0.09	0.07	0.08
Residual Standard Deviation (ft)	0.22	0.11	0.18
Sum of Squared Residuals (ft2)	252.34	42.74	295.08
RMSE Error (ft)	0.22	0.11	0.18
Minimum Residual (ft)	-1.80	-0.31	-1.80
Maximum Residual (ft)	2.49	0.50	2.49
Number of Observations	5393	3533	8926
Range in Observations	4.76	0.68	4.76
Scaled Residual Standard Deviation (ft)	(b) %	15.9%	3.8%
Scaled Absolute Residual Mean (ft)	2.0%	10.5%	1.8%
Scaled RMSE Error (ft)	(b) %	16.3%	3.8%
Scaled Residual Mean (ft)	0.0%	3.5%	0.2%
Correlation Coefficient	0.82	0.67	0.84

Conceptual Water Budget Comparison

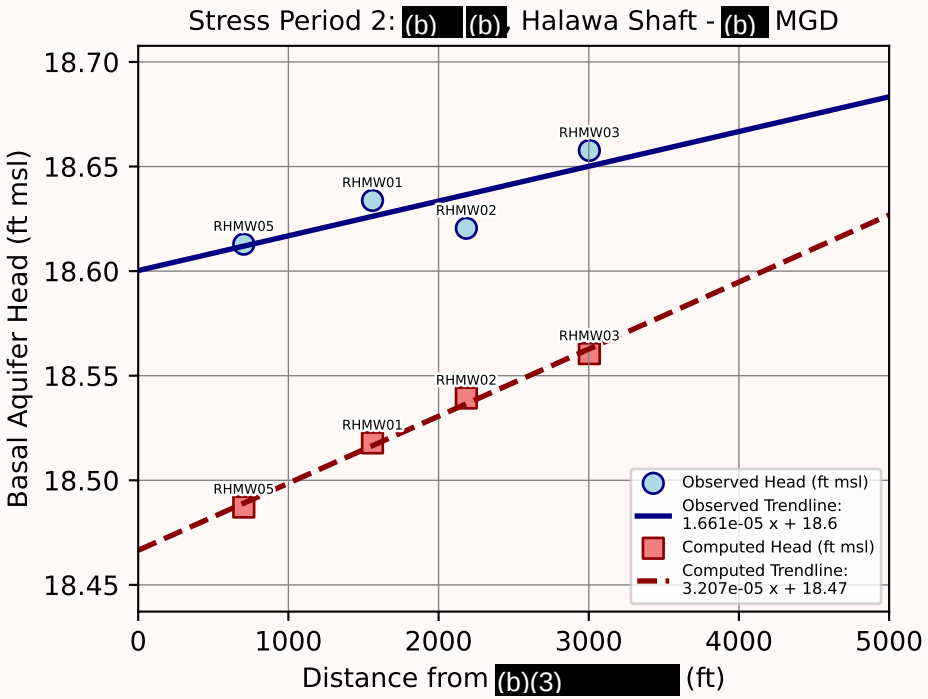
Type	Stress Period	Recharge (MGD)	Dike Region Inflow (MGD)	Well Discharge (MGD)	Spring Discharge (MGD)	Caprock Discharge (MGD)	Inflow from Adjacent Watershed (MGD)	Outflow to Adjacent Watershed (MGD)	Storage (MGD)	Total Inflows (MGD)	Total Outflows (MGD)
Conceptual	1	32.5	28.7	32.0	13.6	2.4	2.8	16.0	0.0	64.0	64.0
Simulated	1	32.5	28.7	32.3	12.2	3.9	13.2	25.3	0.0	74.4	73.7
Difference	1	0.0	0.0	0.3	-1.4	1.5	10.4	9.3	0.0	10.4	9.7
Conceptual	2	32.5	28.7	28.4	13.6	2.4	2.8	19.6	0.0	64.0	64.0
Simulated	2	32.5	28.7	28.4	12.4	3.9	12.3	25.8	-1.4	73.5	71.9
Difference	2	0.0	0.0	0.0	-1.2	1.5	9.5	(b	-1.4	9.5	7.9
Conceptual	3	32.5	28.7	36.1	13.5	2.4	2.8	12.0	0.0	64.0	64.0
Simulated	3	32.5	28.7	36.1	(b)	3.9	13.6	25.3	2.4	77.2	77.4
Difference	3	0.0	0.0	0.0	-1.4	1.5	10.7	13.3	2.4	13.2	13.4
Conceptual	4	32.5	28.7	32.4	13.5	2.4	2.8	15.6	0.0	64.0	64.0
Simulated	4	32.5	28.7	32.5	(b)	3.9	13.5	25.0	-0.1	74.7	73.6
Difference	4	0.0	0.0	0.0	-1.4	1.5	10.7	9.4	-0.1	10.7	9.7
Conceptual	5	32.5	28.7	25.7	13.7	2.4	4.7	24.1	0.0	65.9	65.9
Simulated	5	32.5	28.7	25.7	12.8	3.9	12.5	28.4	-0.8	73.7	71.8
Difference	5	0.0	0.0	0.0	-0.9	1.5	7.8	4.4	-0.8	7.8	5.9
Conceptual	6	32.5	28.7	37.7	13.6	2.4	4.7	12.2	0.0	65.9	65.9
Simulated	6	32.5	28.7	37.8	11.8	3.9	14.3	24.0	1.3	76.7	77.5
Difference	6	0.0	0.0	0.0	-1.8	1.5	9.5	11.9	1.3	10.8	11.6
Conceptual	7	32.5	28.7	32.0	13.4	2.4	4.1	17.4	0.0	65.3	65.3
Simulated	7	32.5	28.7	32.0	(b)	3.9	12.3	24.8	0.0	73.5	72.8
Difference	7	0.0	0.0	0.0	-1.3	1.5	8.2	7.4	0.0	8.2	7.5
Conceptual	8	32.5	28.7	30.1	12.6	2.4	2.8	18.8	0.0	63.9	63.9
Simulated	8	32.5	28.7	30.1	(b)	3.9	12.5	24.6	-1.5	73.6	72.3
Difference	8	0.0	0.0	0.0	-0.4	1.5	9.7	5.8	-1.5	9.7	8.4
Conceptual	9	32.5	28.7	21.8	13.7	2.4	0.5	23.8	0.0	61.7	61.7
Simulated	9	32.5	28.7	21.8	13.1	3.9	9.4	30.7	0.0	70.6	69.6
Difference	9	0.0	0.0	0.0	-0.6	1.5	8.9	6.9	0.0	8.9	7.9
Conceptual	10	32.5	28.7	26.3	13.9	2.5	7.5	25.9	0.0	68.7	68.7
Simulated	10	32.5	28.7	26.3	12.8	3.9	11.5	28.8	0.0	72.7	71.8
Difference	10	0.0	0.0	0.0	-1.2	1.4	4.0	2.9	0.0	4.0	3.2

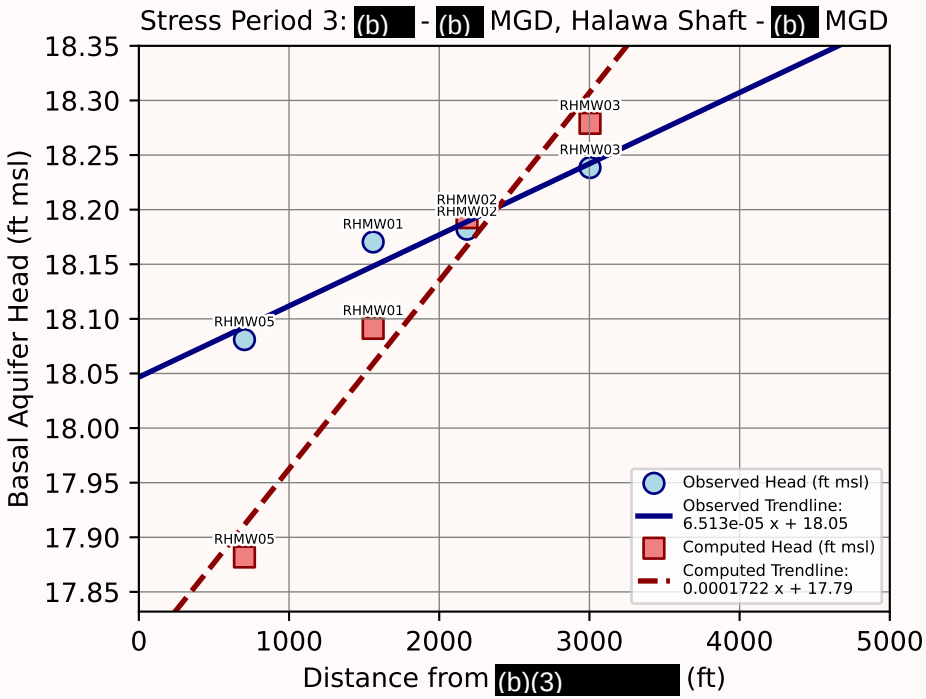

Basal Aquifer Wells - 2017-18
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

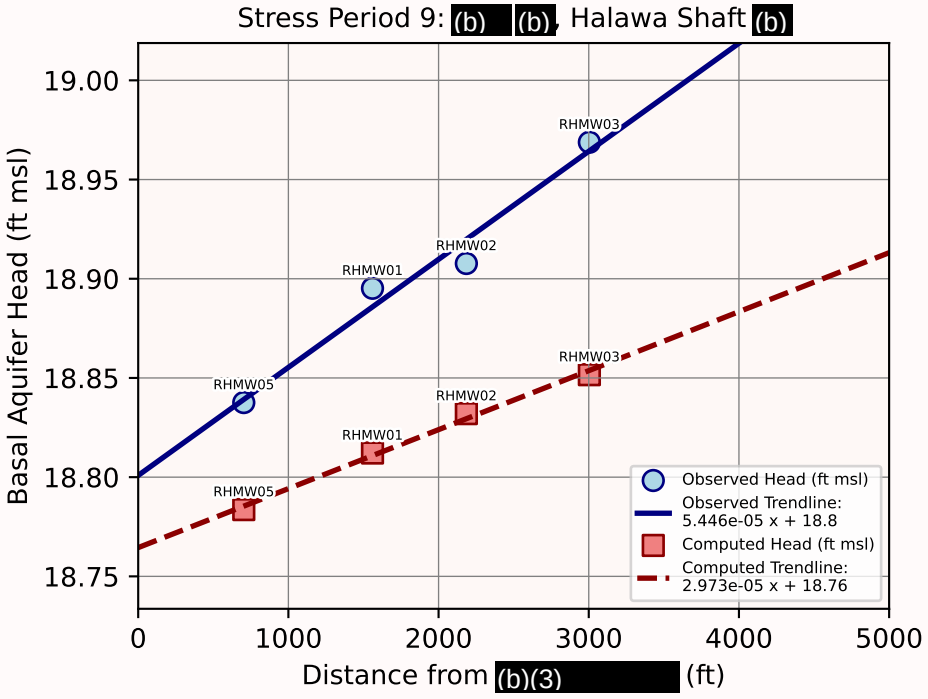

Basal Aquifer Wells - 2021-22
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
16.5
17.0
17.5
18.0
18.5
19.0
19.5
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

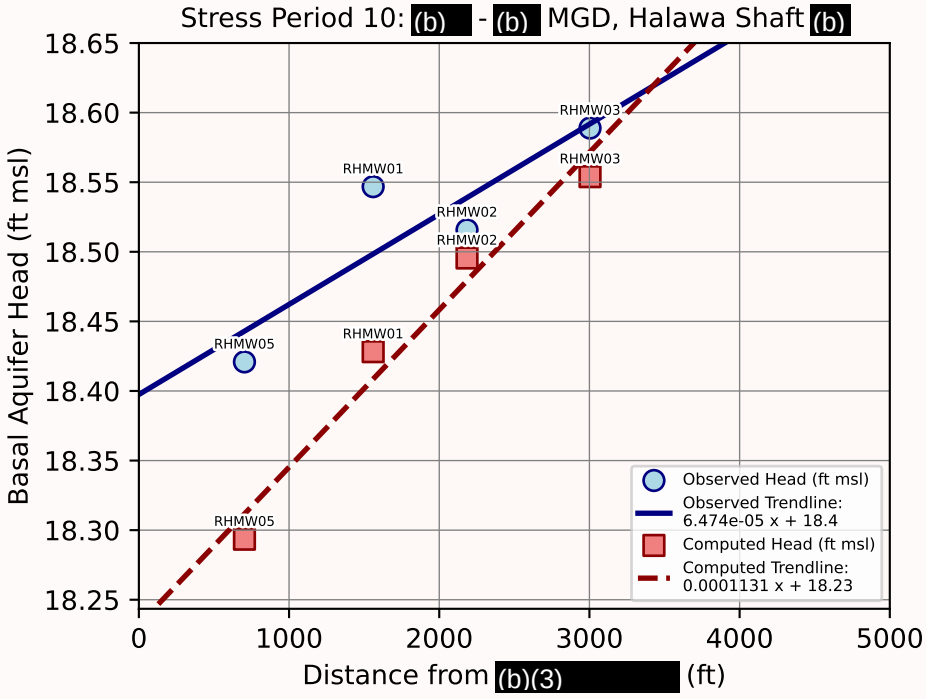

Basal Aquifer Wells - All
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

Gradients Along Red Hill Ridge

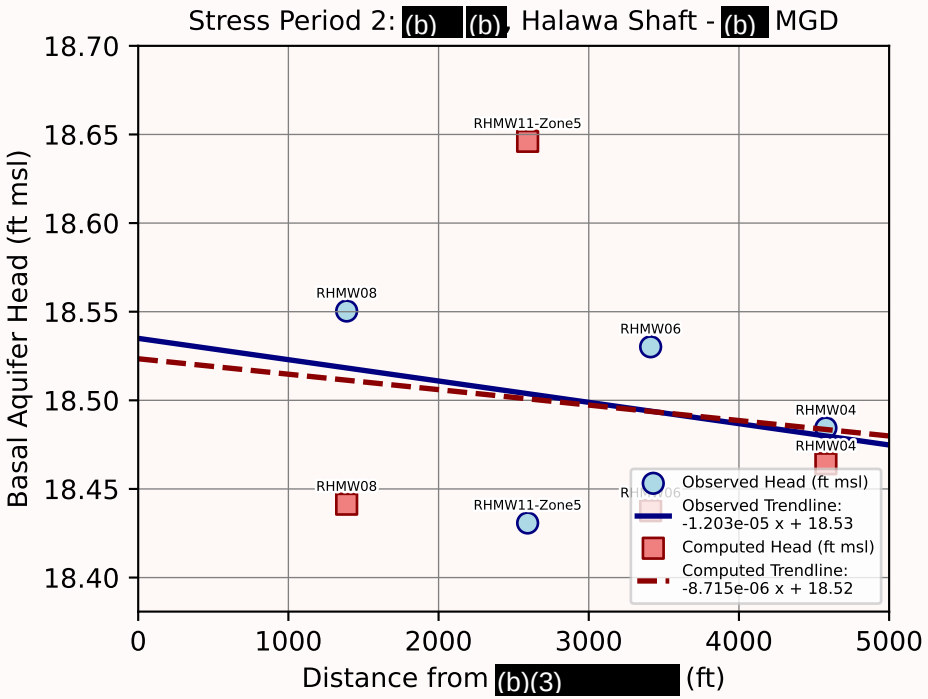


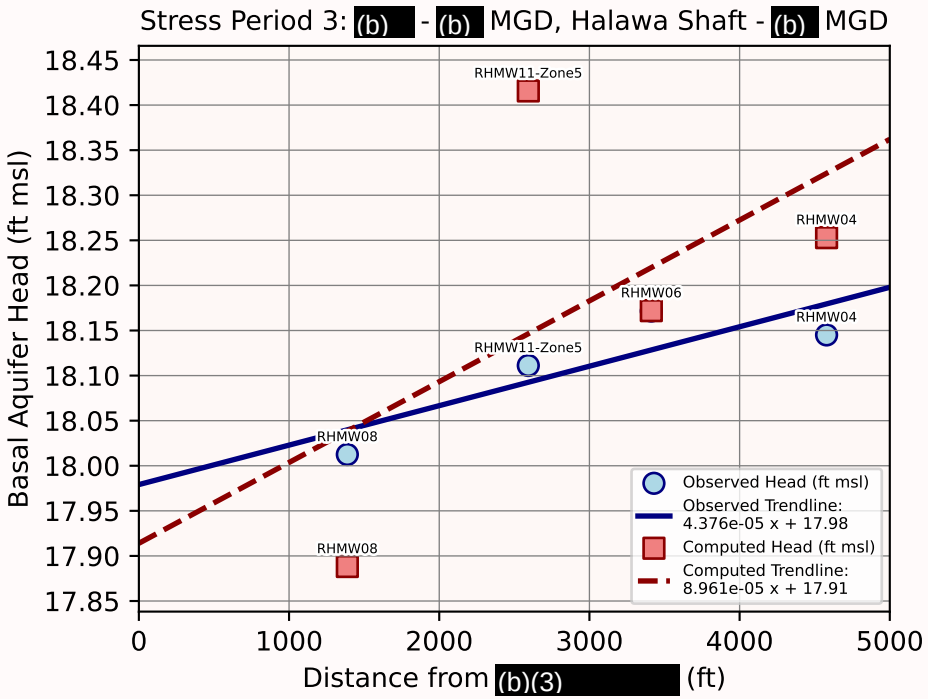


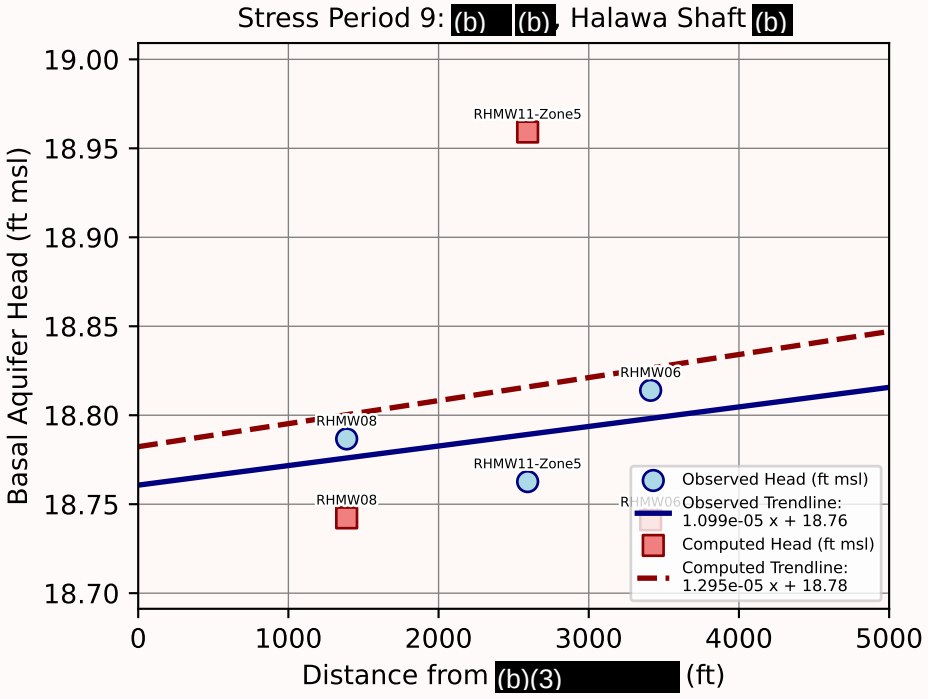


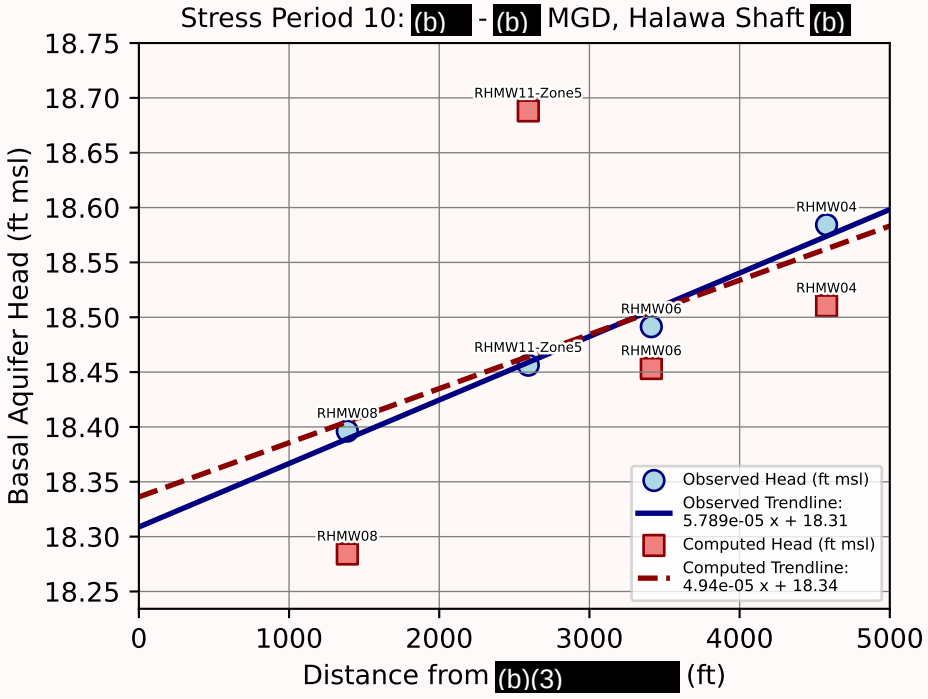


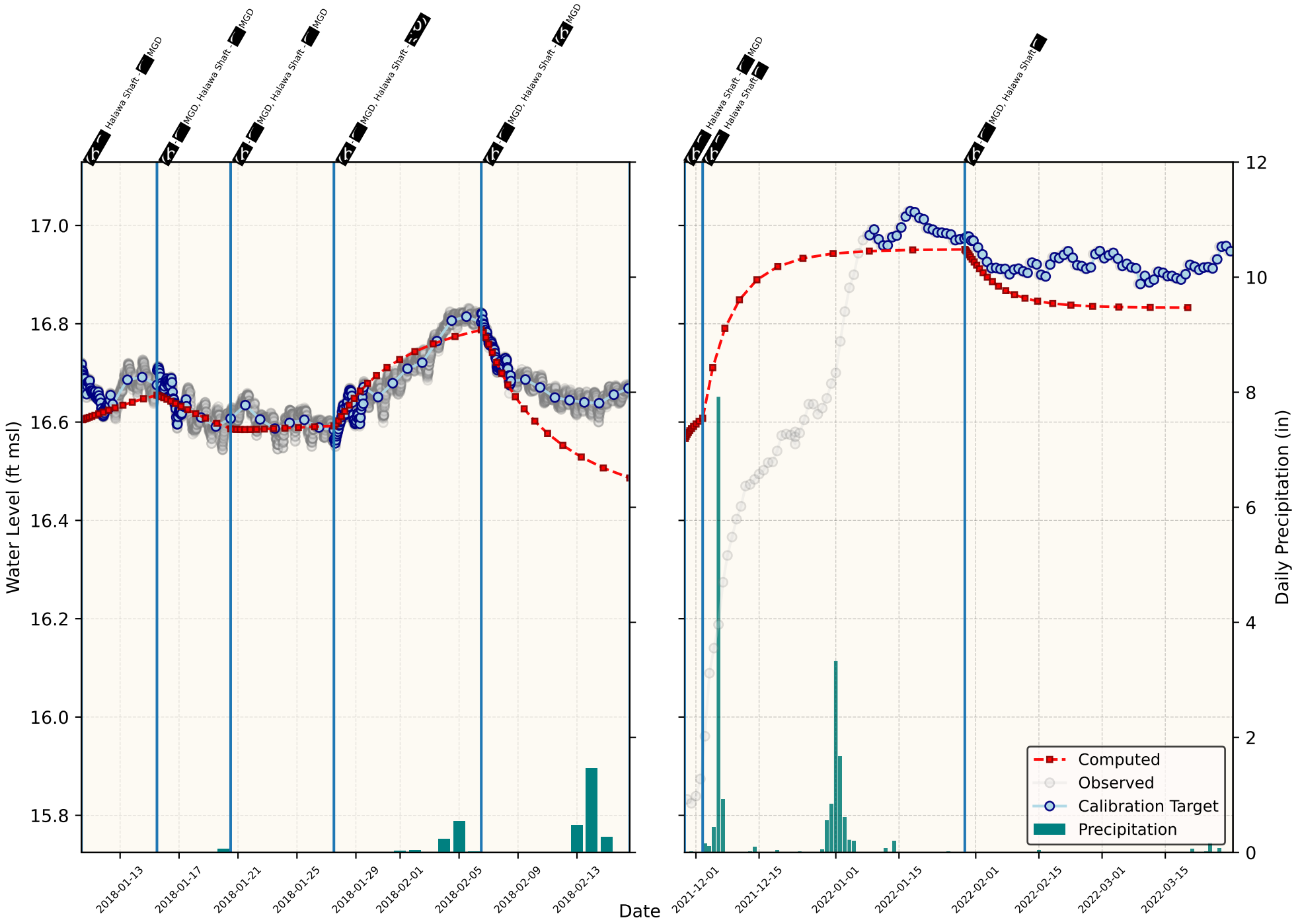
Gradients Northwest of Red Hill Ridge





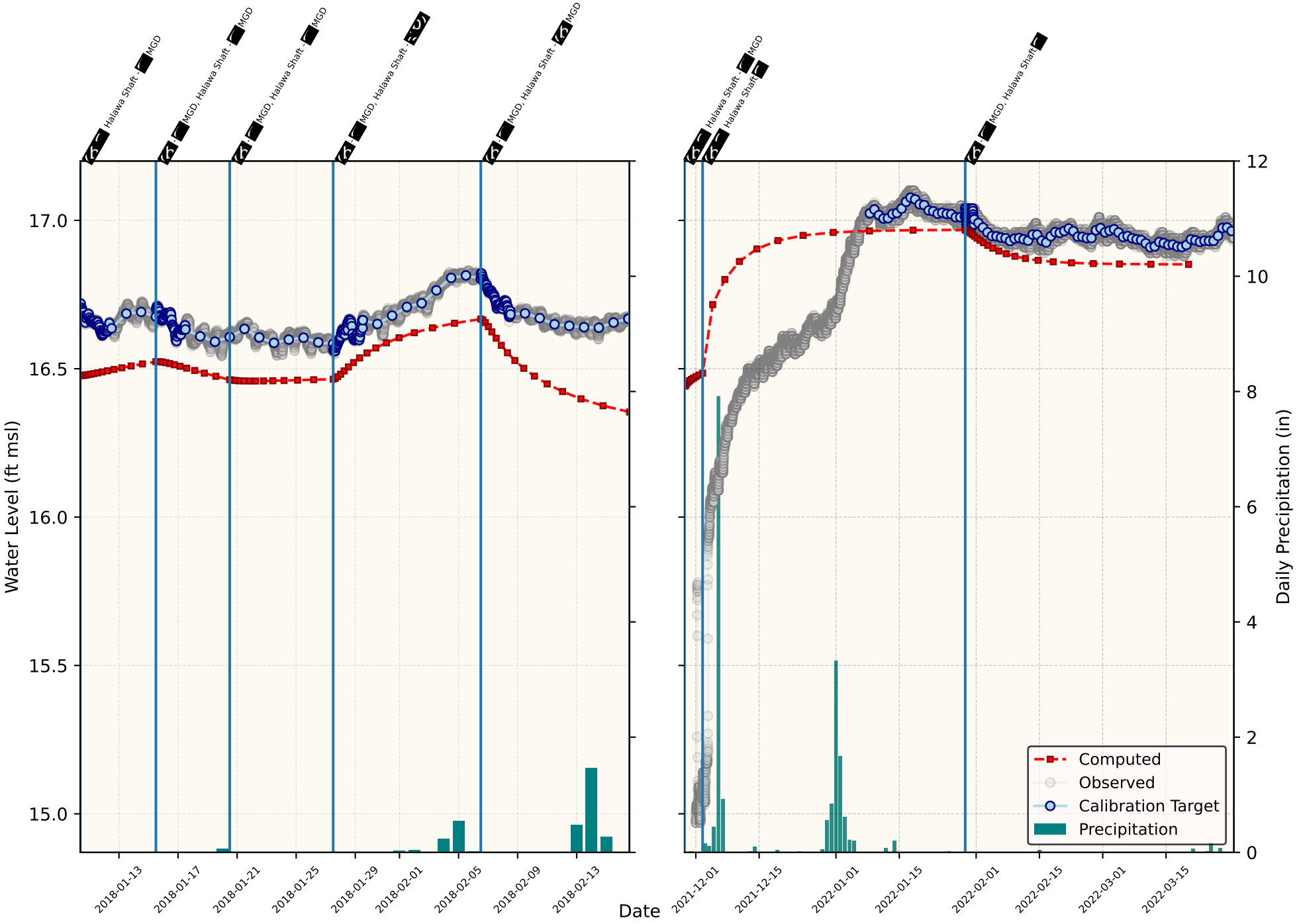


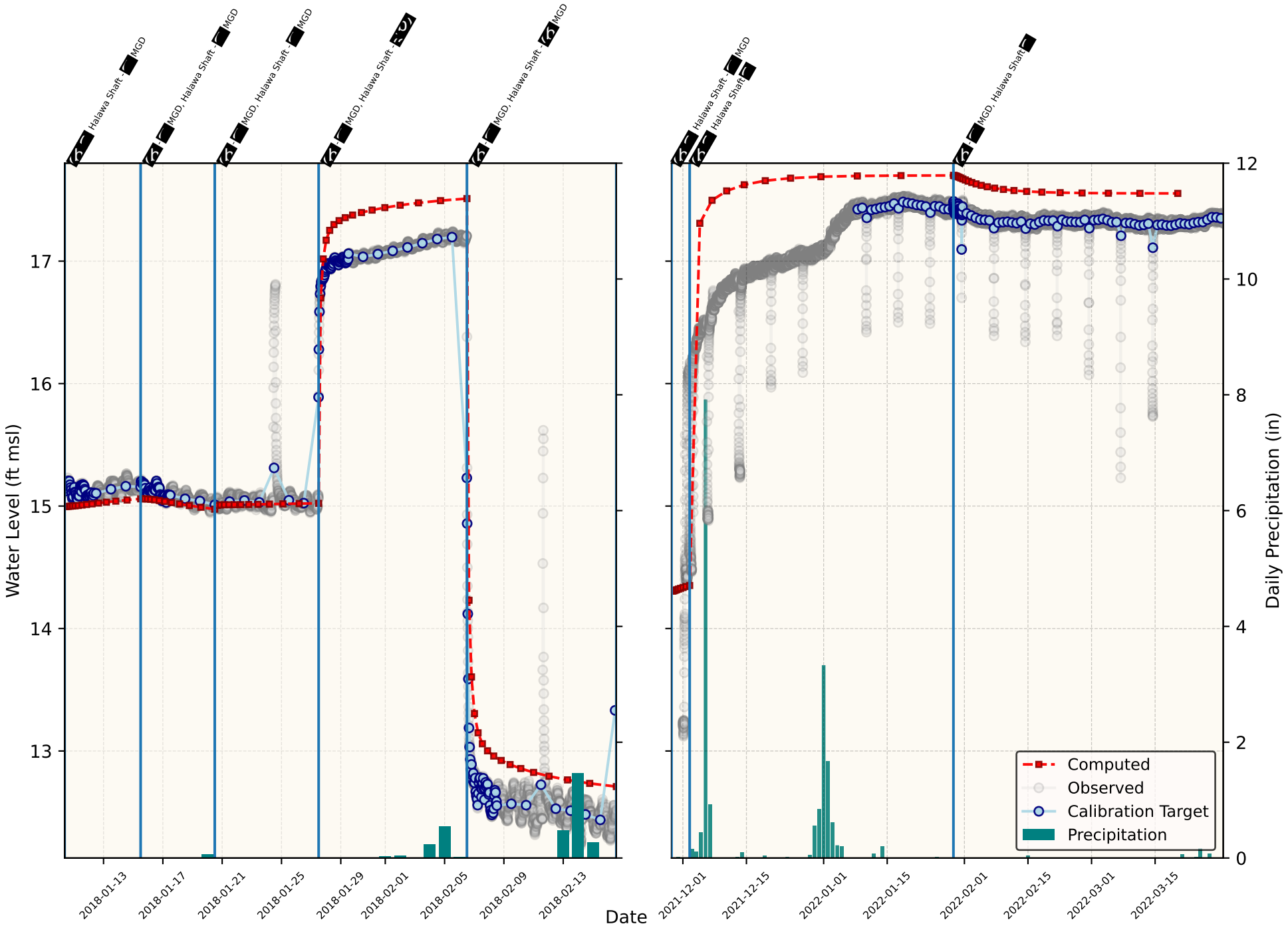


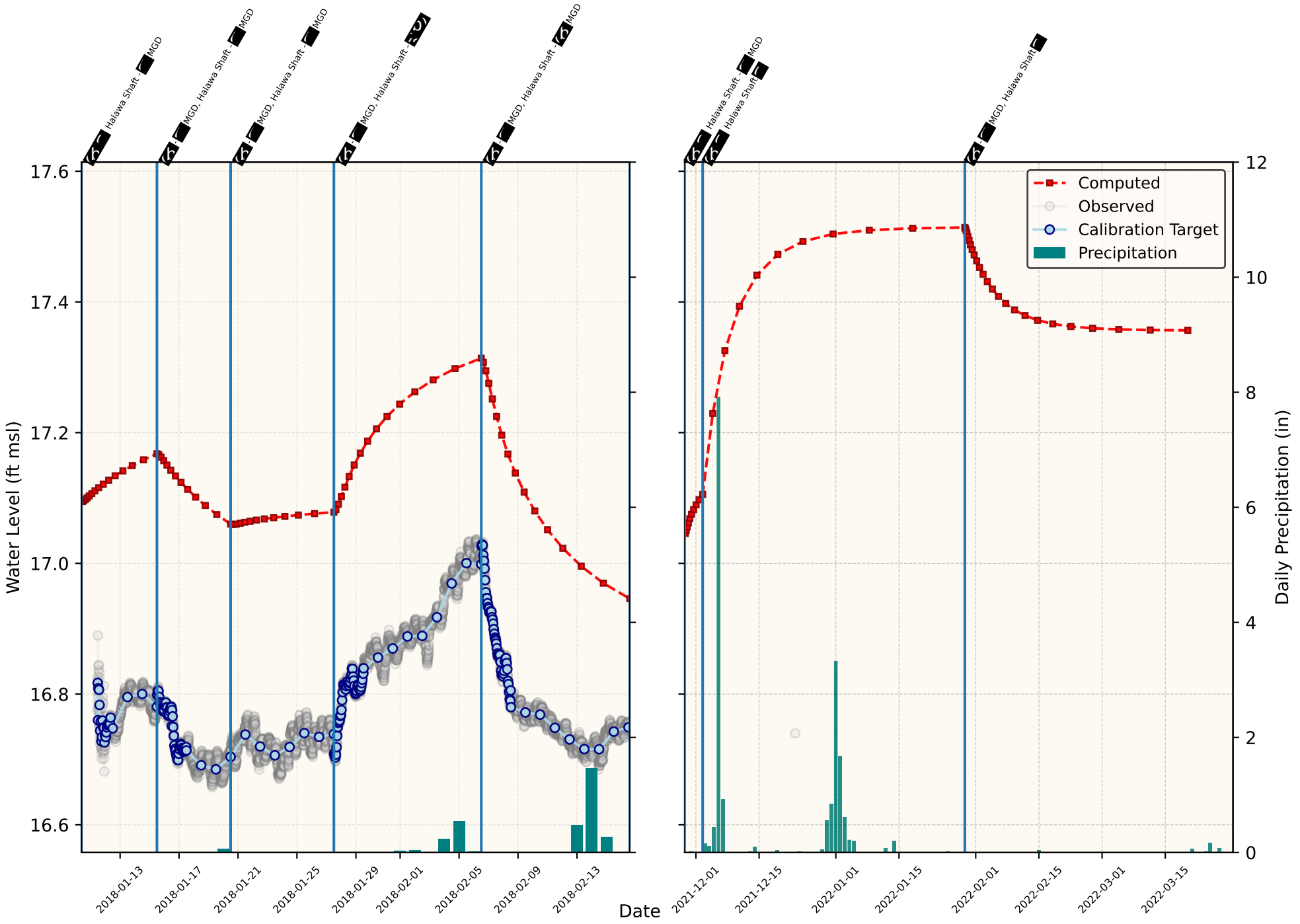

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

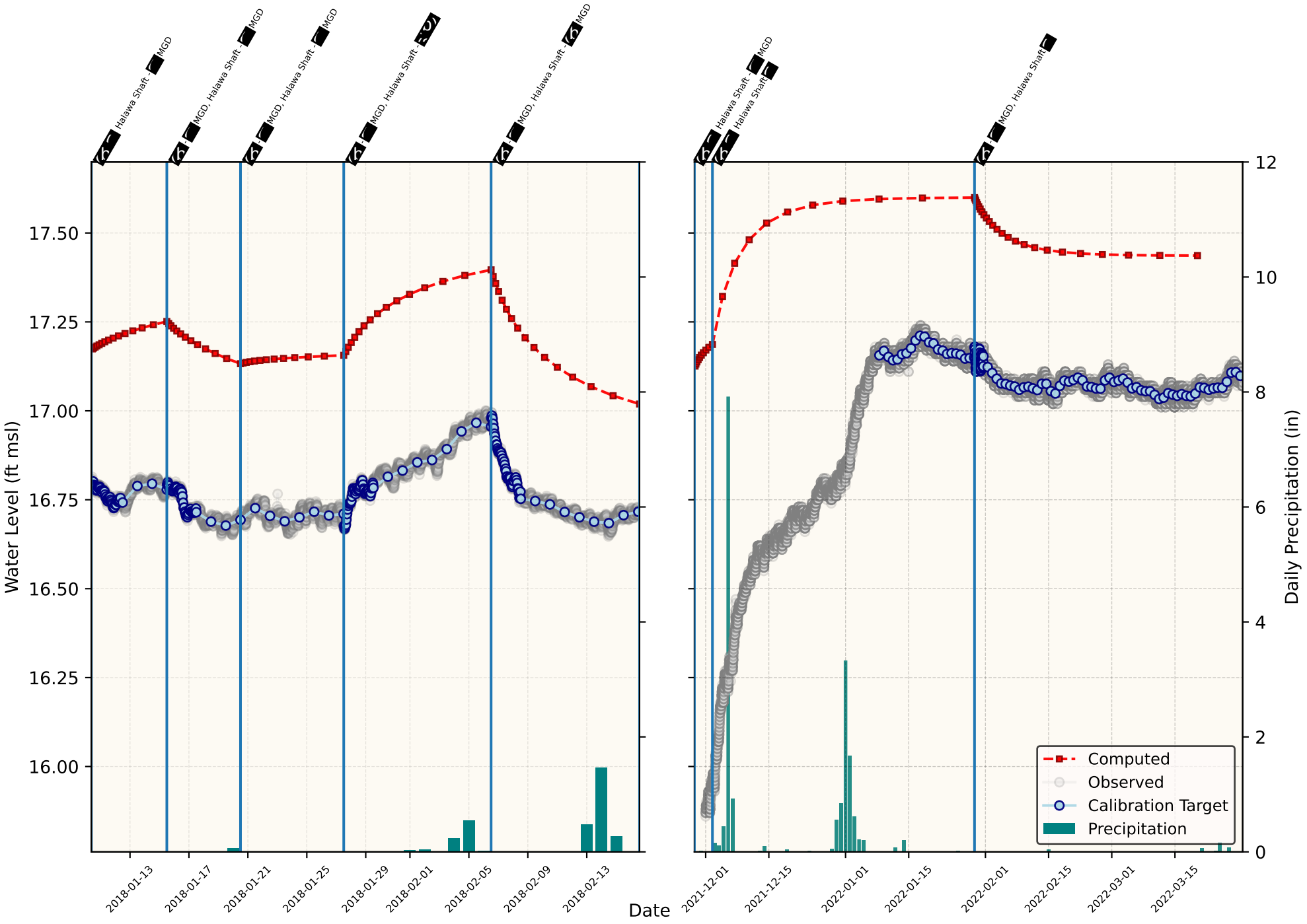
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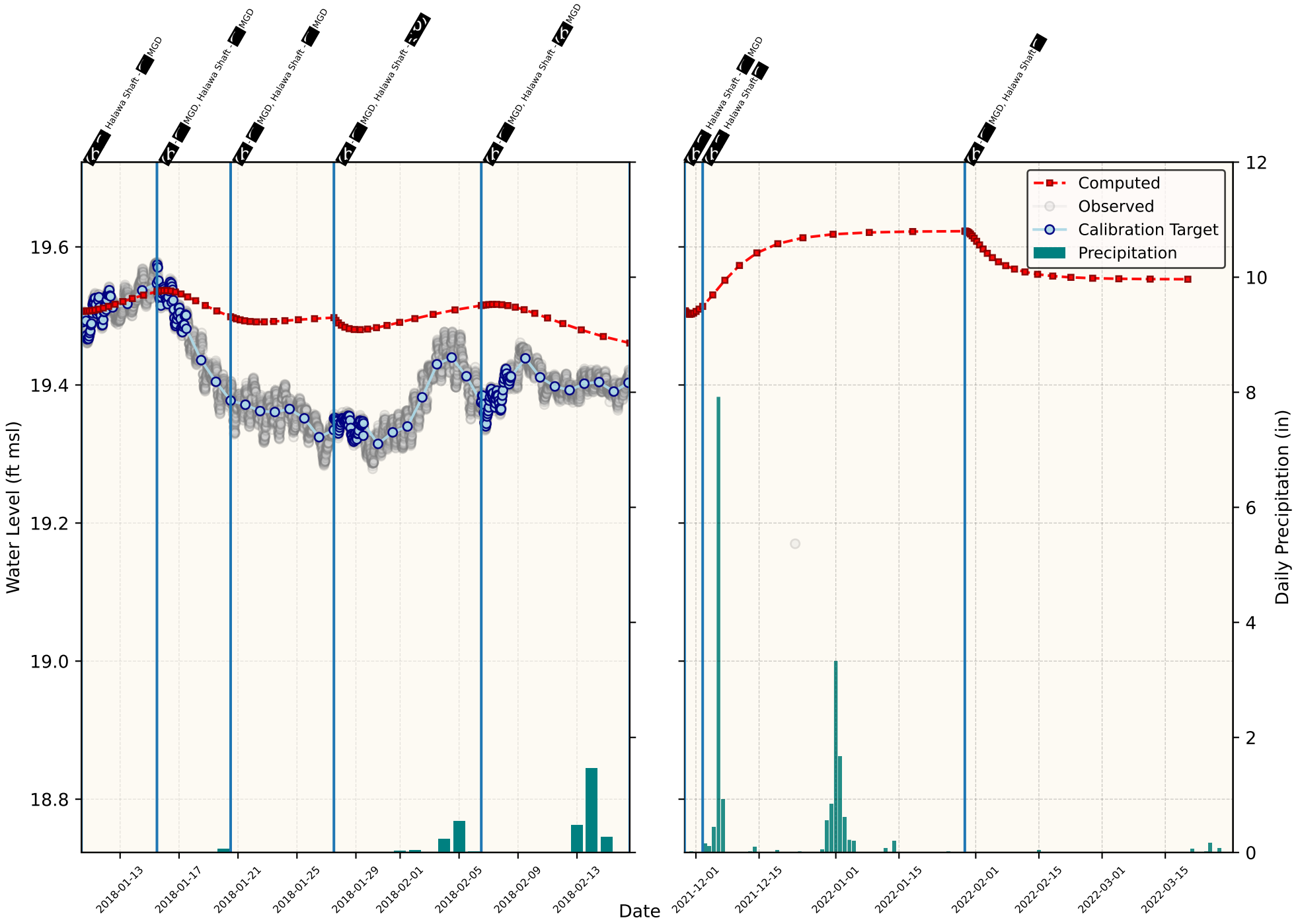
Group 1 - Basal Aquifer




Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

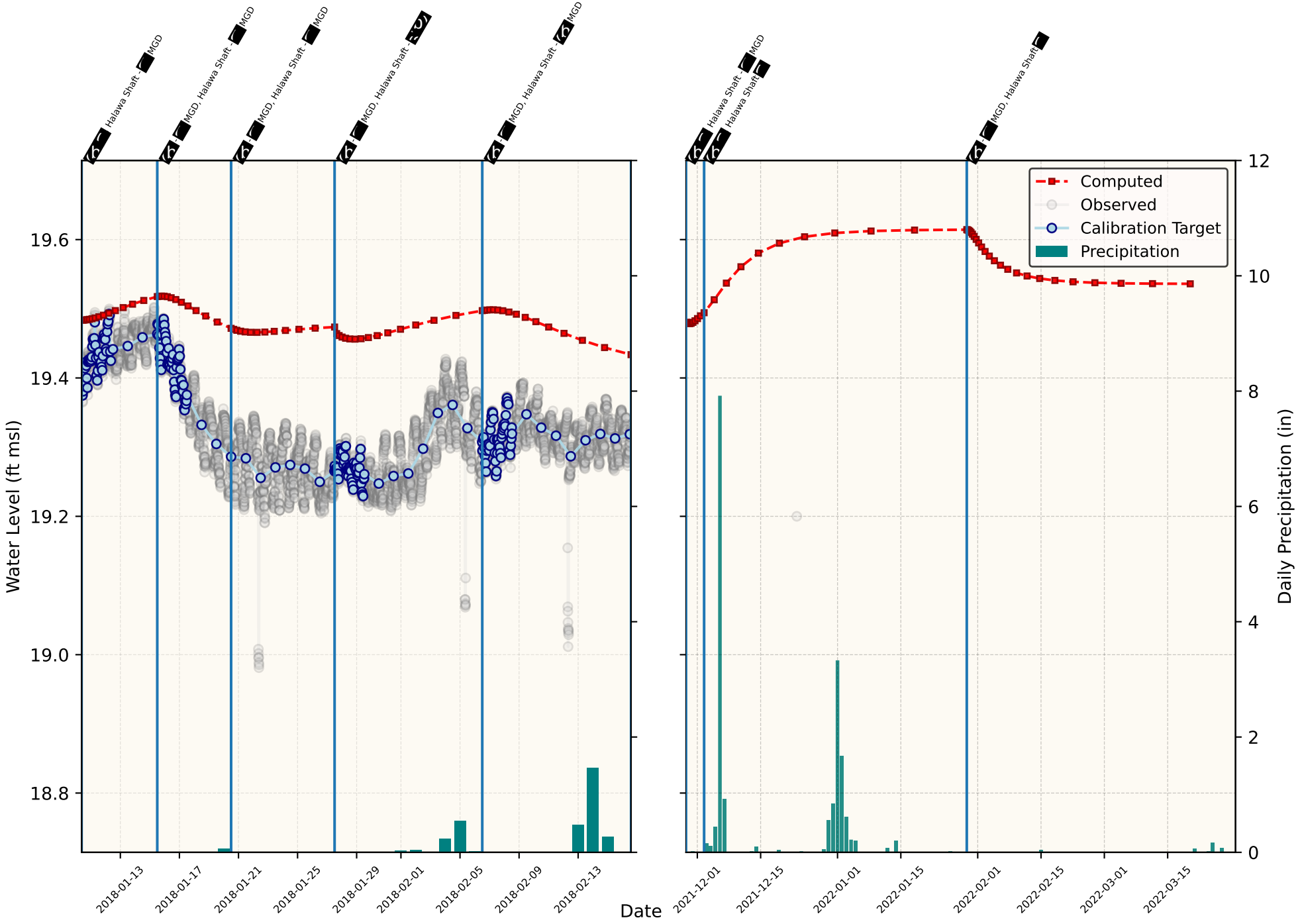

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
17.6
17.4
17.2
17.0
16.8
16.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

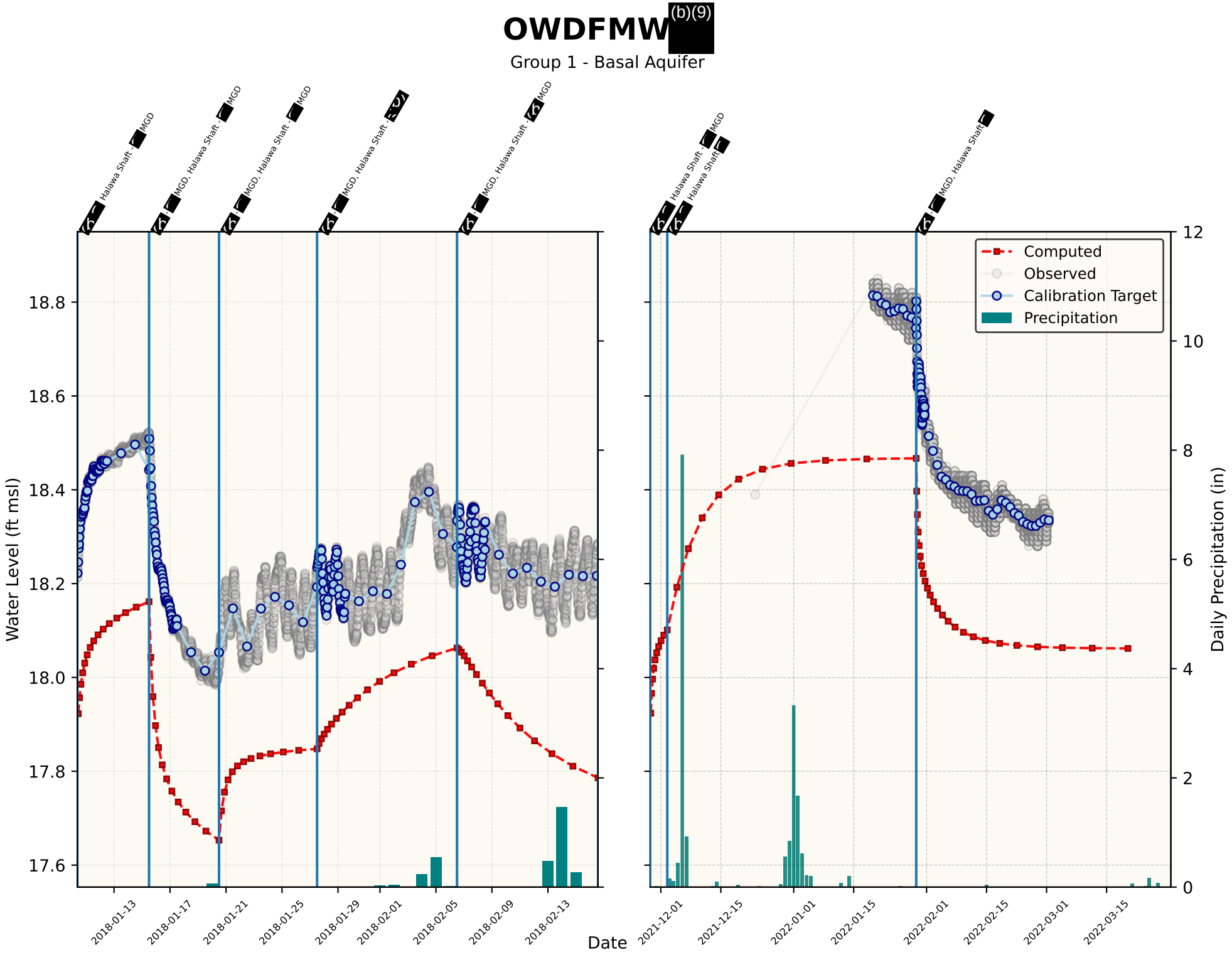

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
17.50
17.25
17.00
16.75
16.50
16.25
16.00
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-15
Date

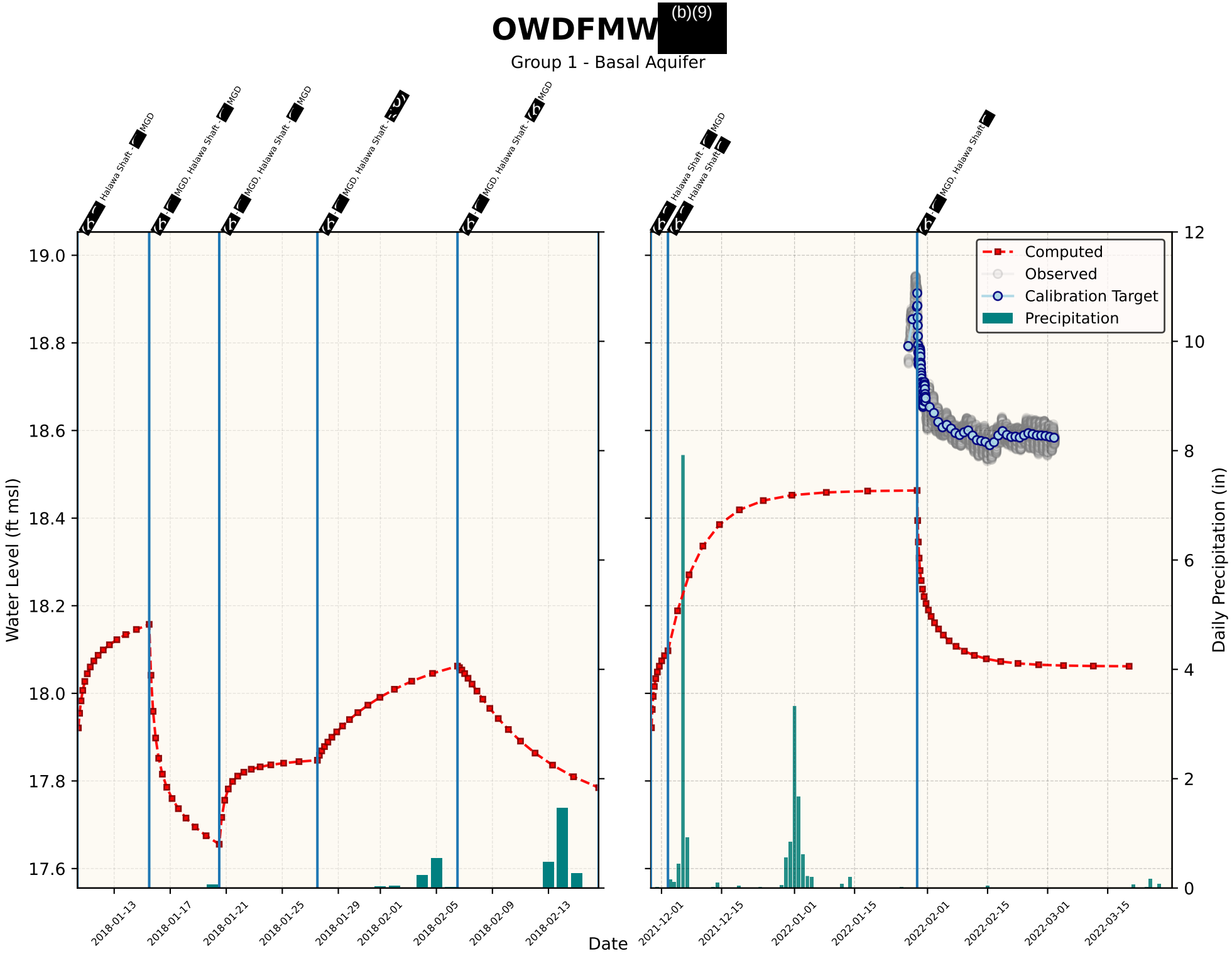

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.6
19.4
19.2
19.0
18.8
12
10
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2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
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2021-12-01
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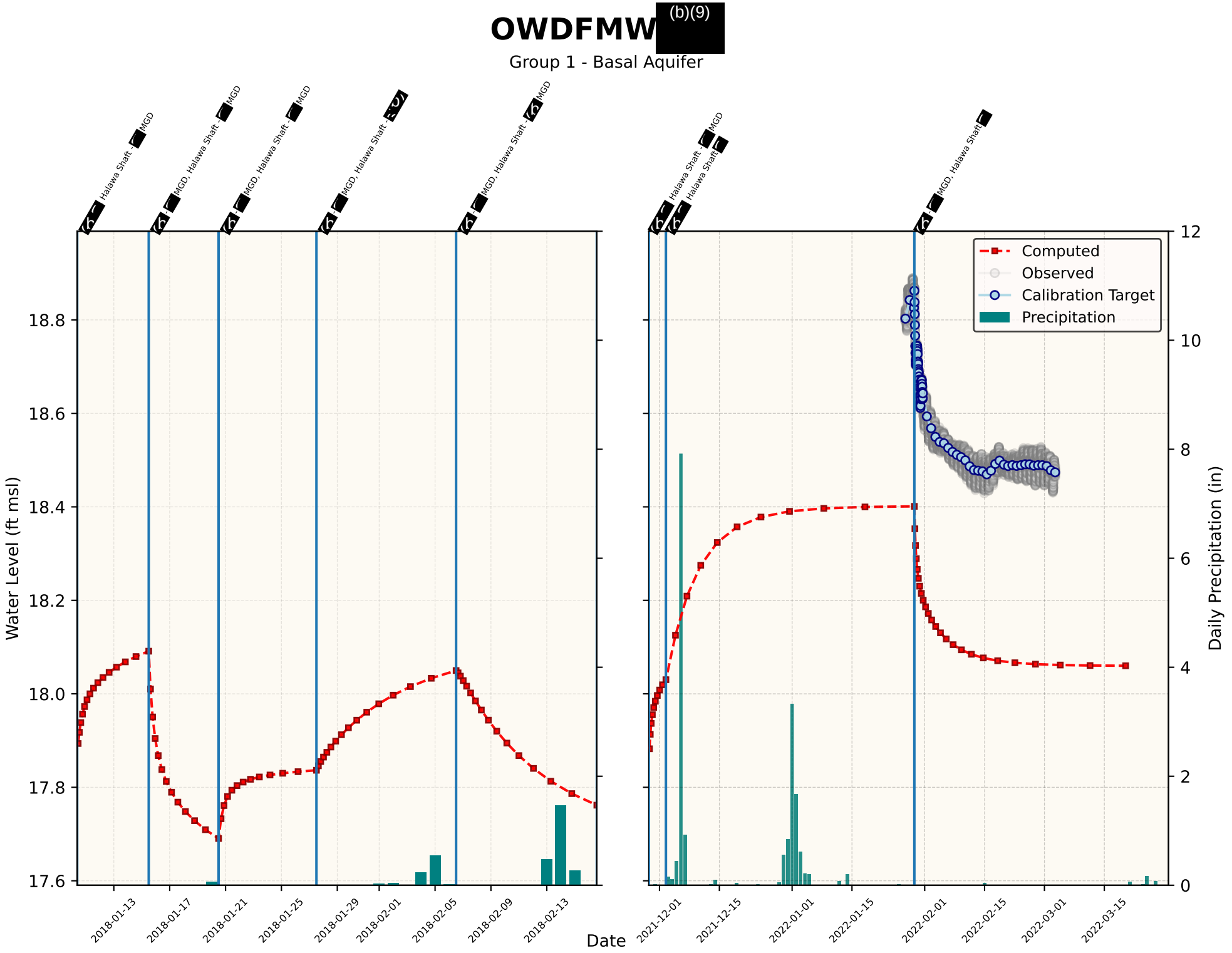
Moanalua_Deep

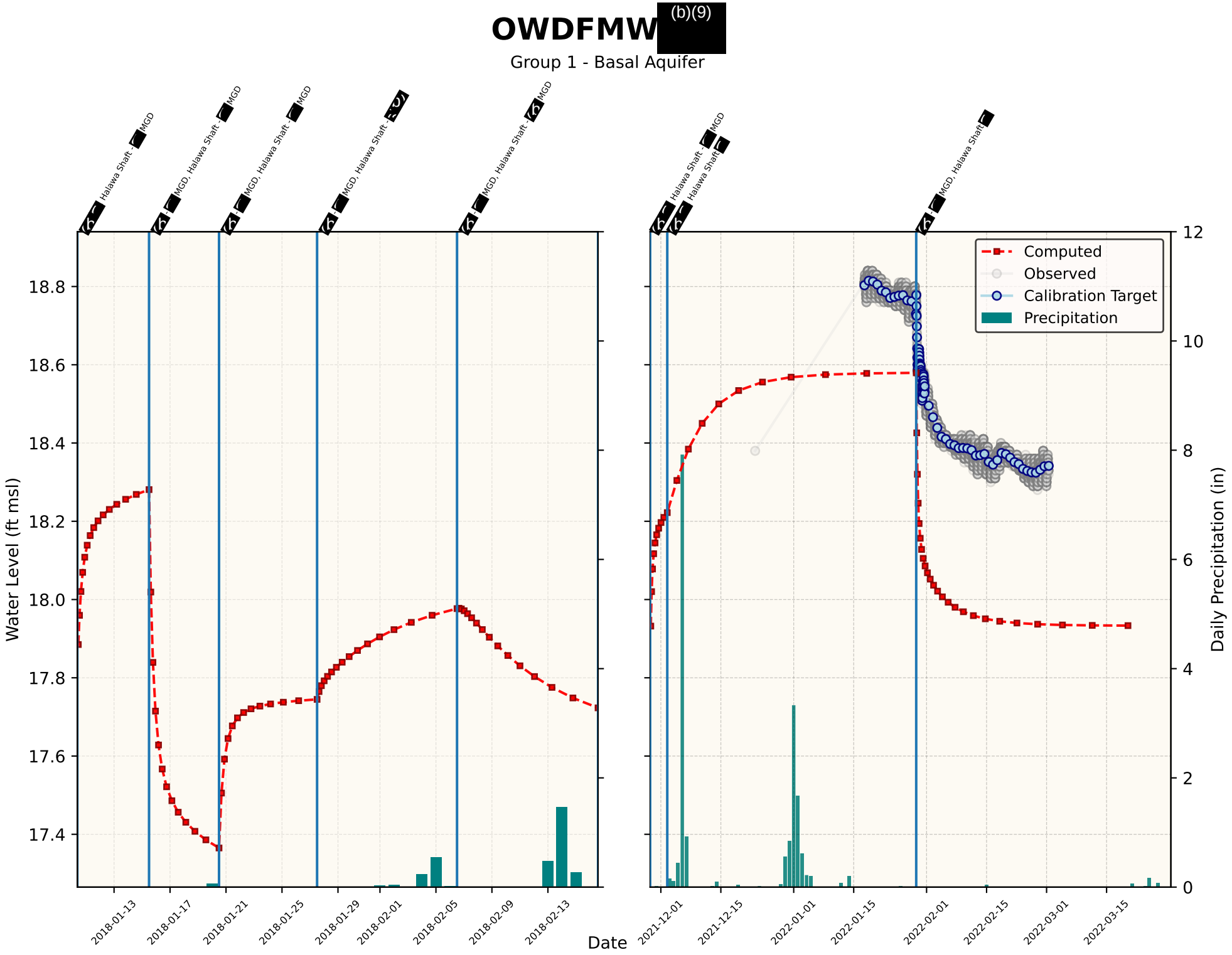
Group 1 - Basal Aquifer

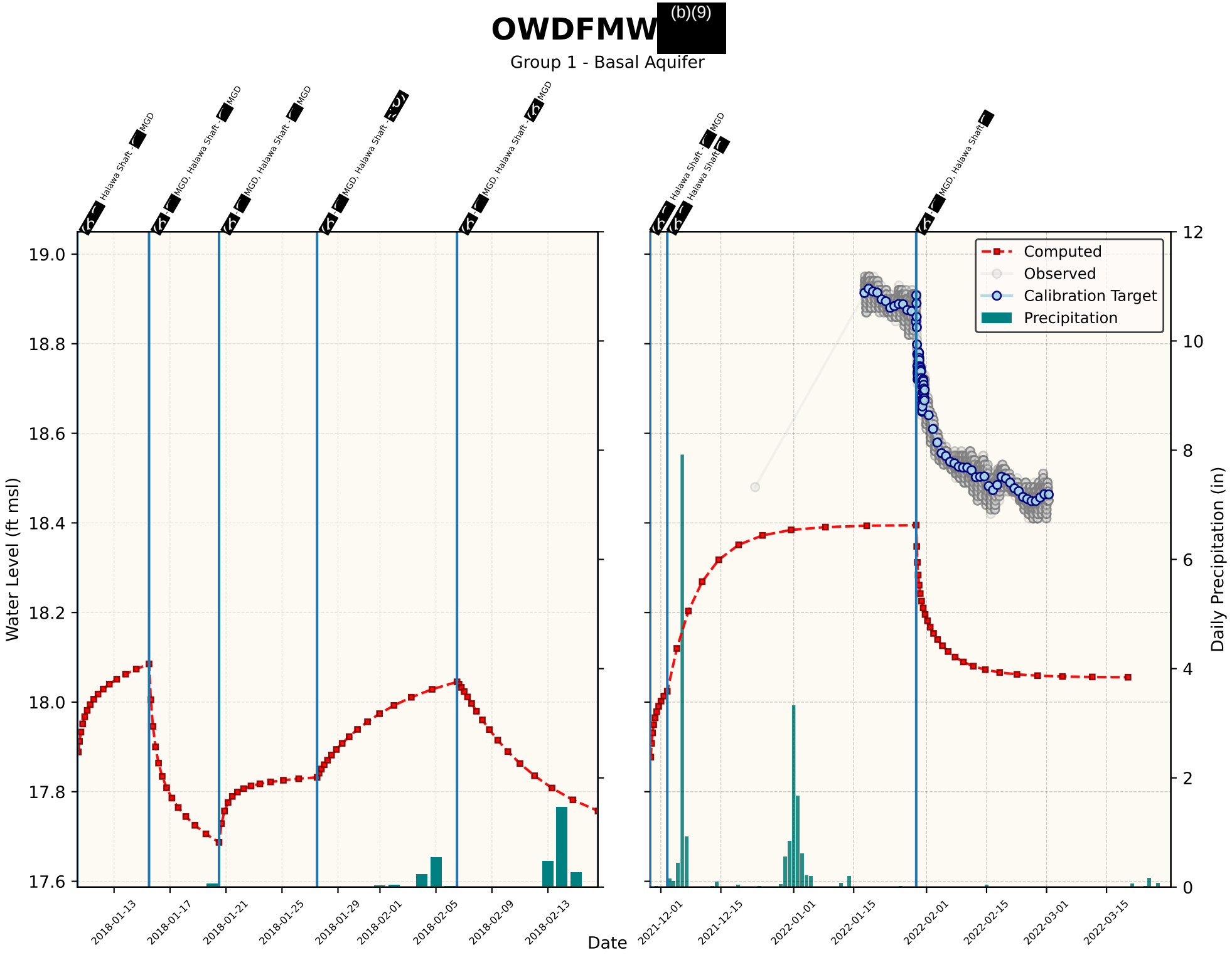


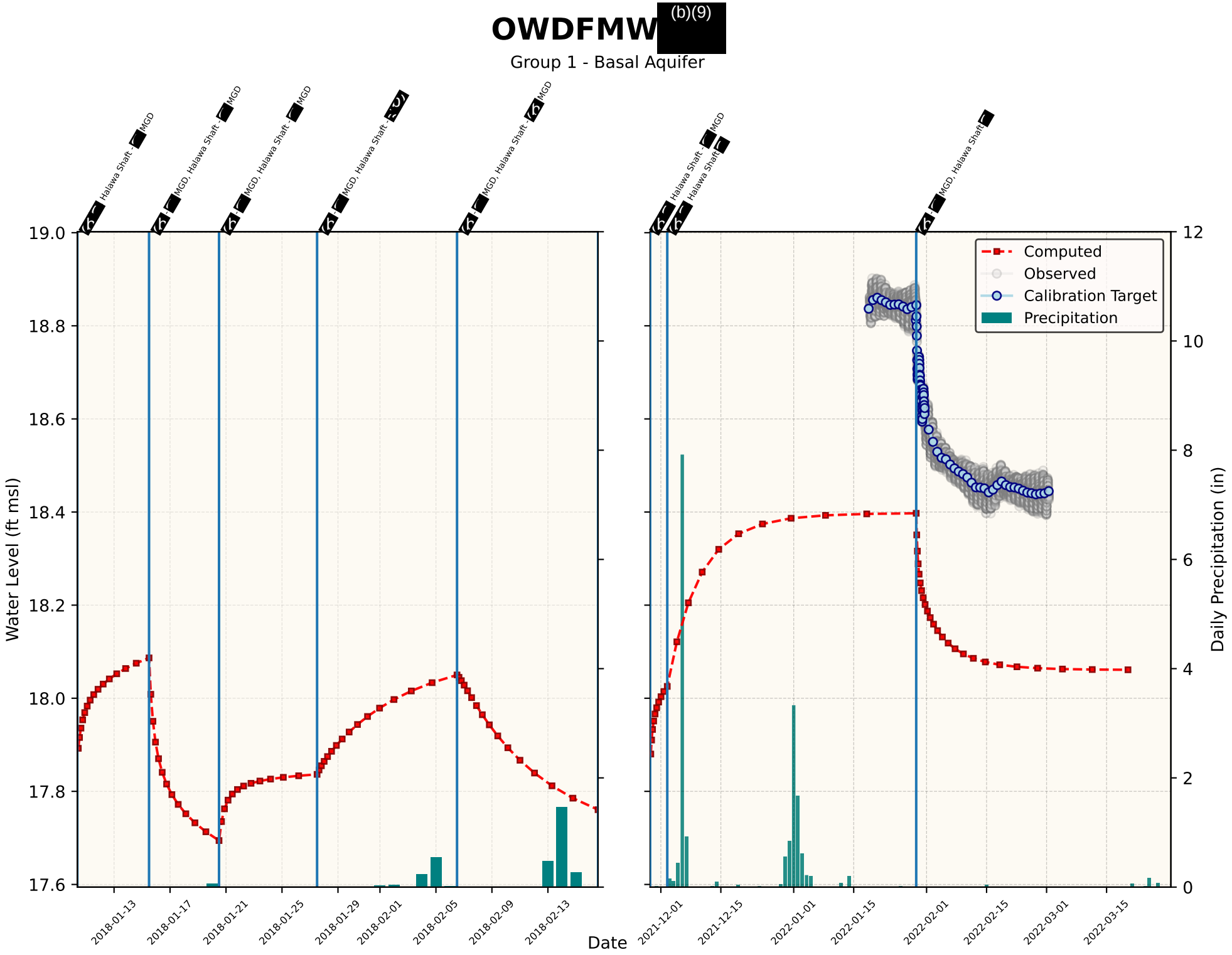

OWDFMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
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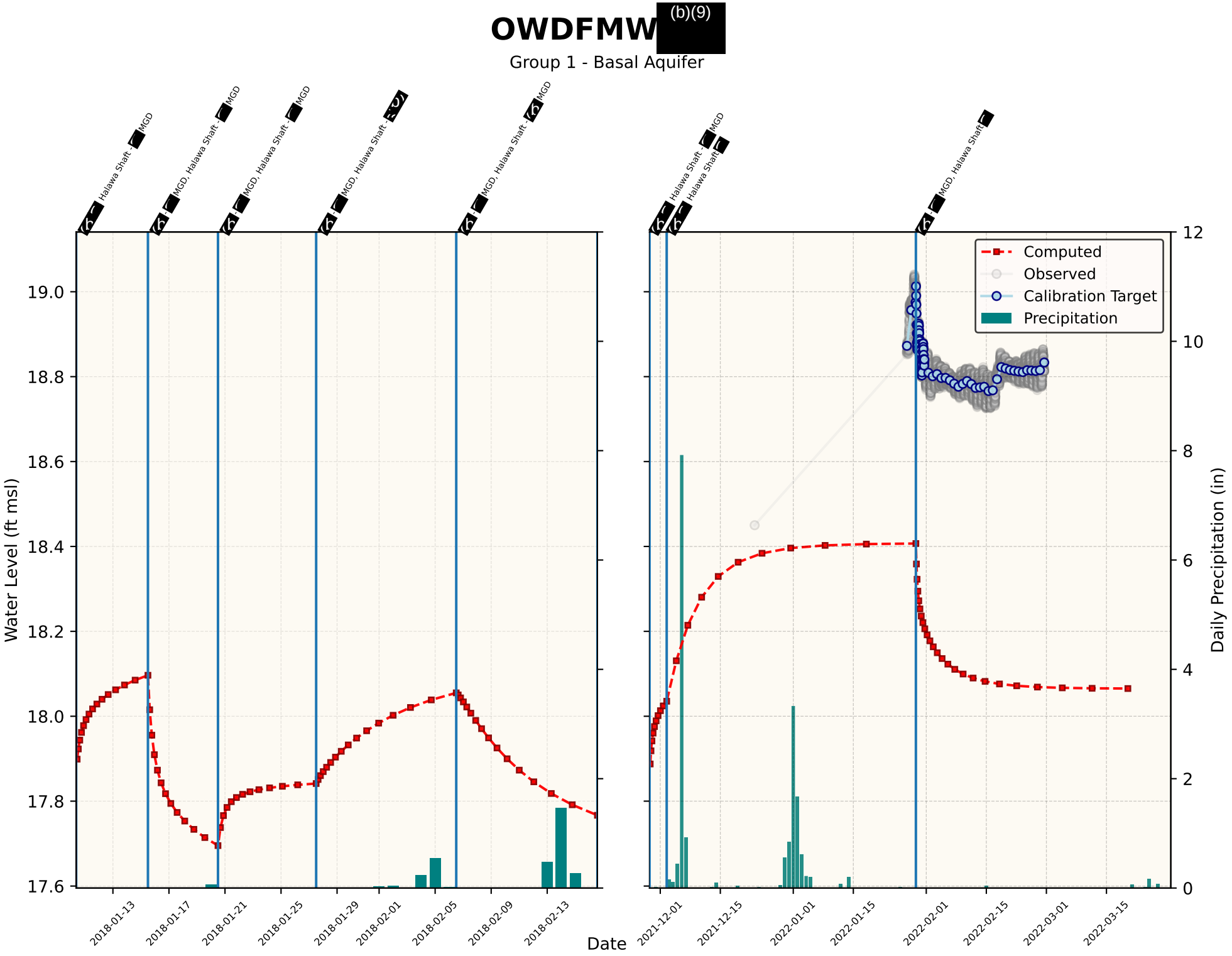

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
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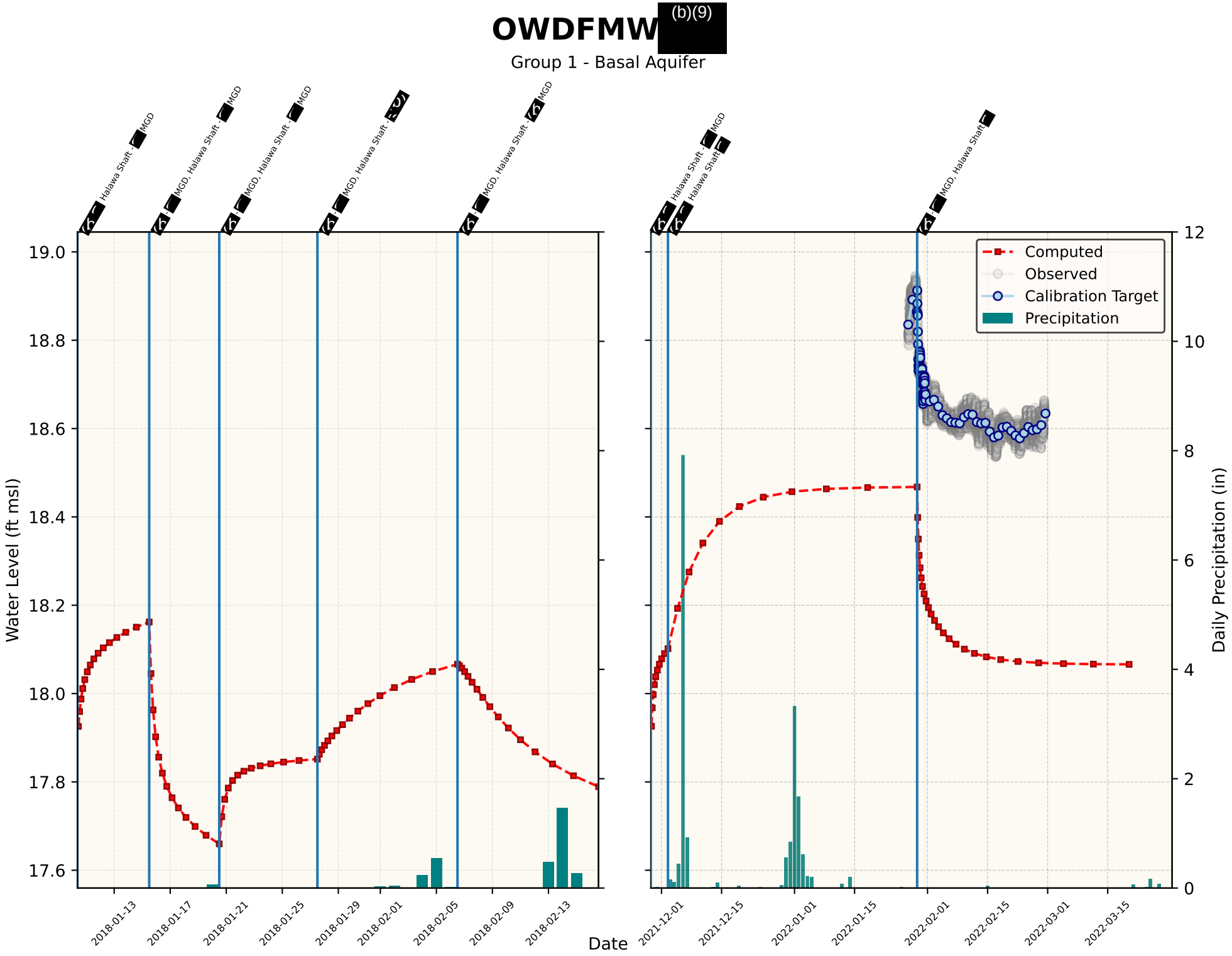

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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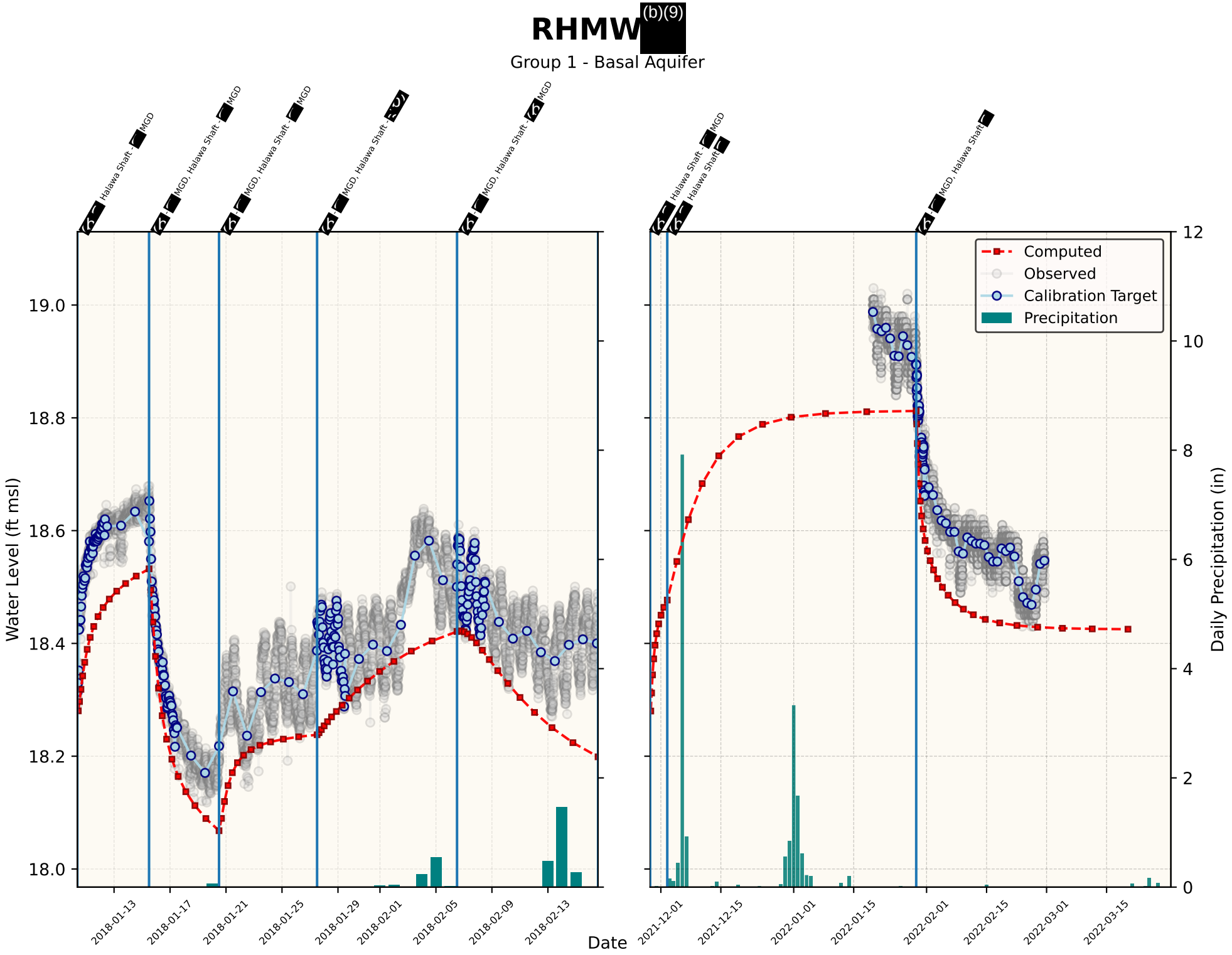

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
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Computed
Observed
Calibration Target
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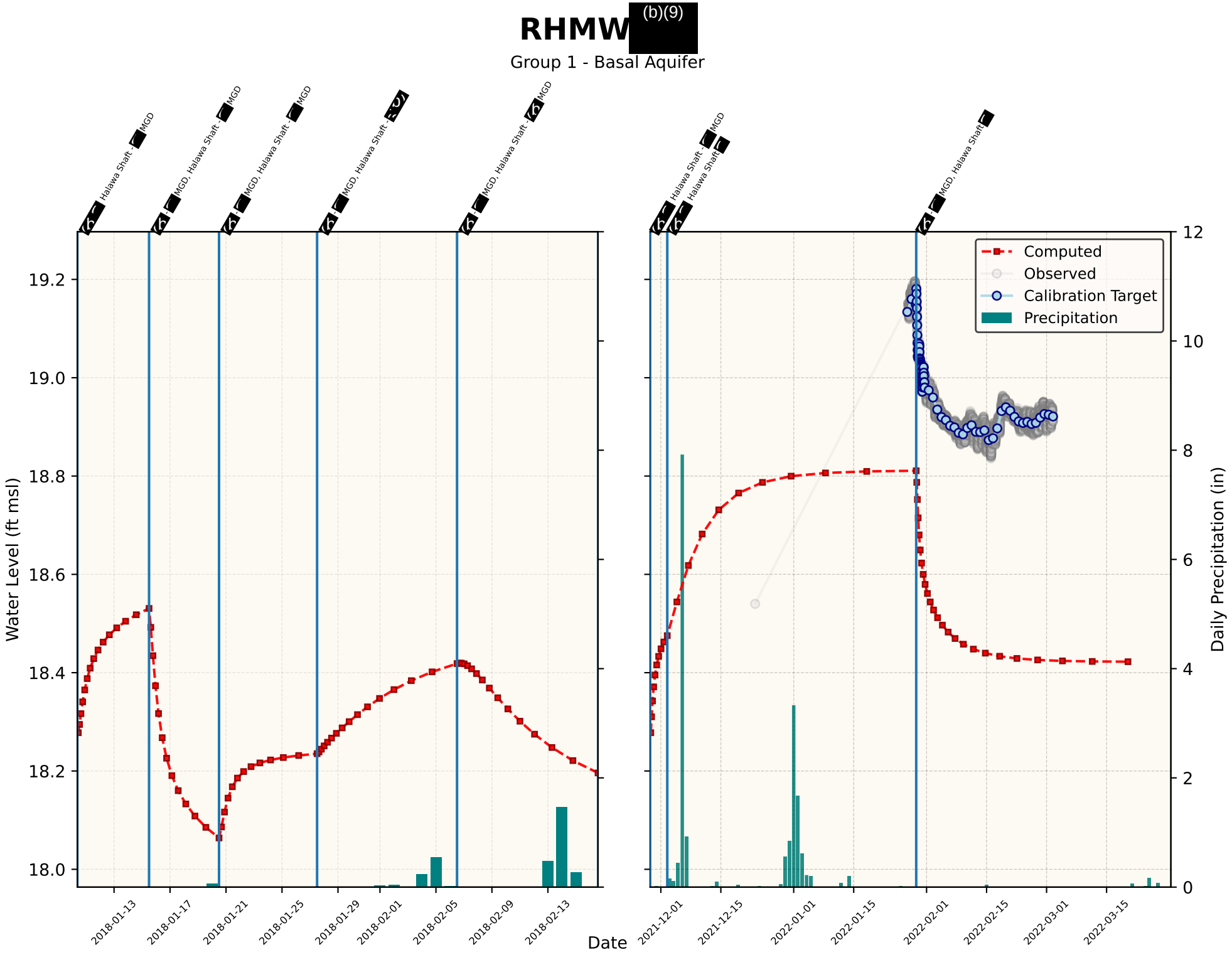

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
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OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
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OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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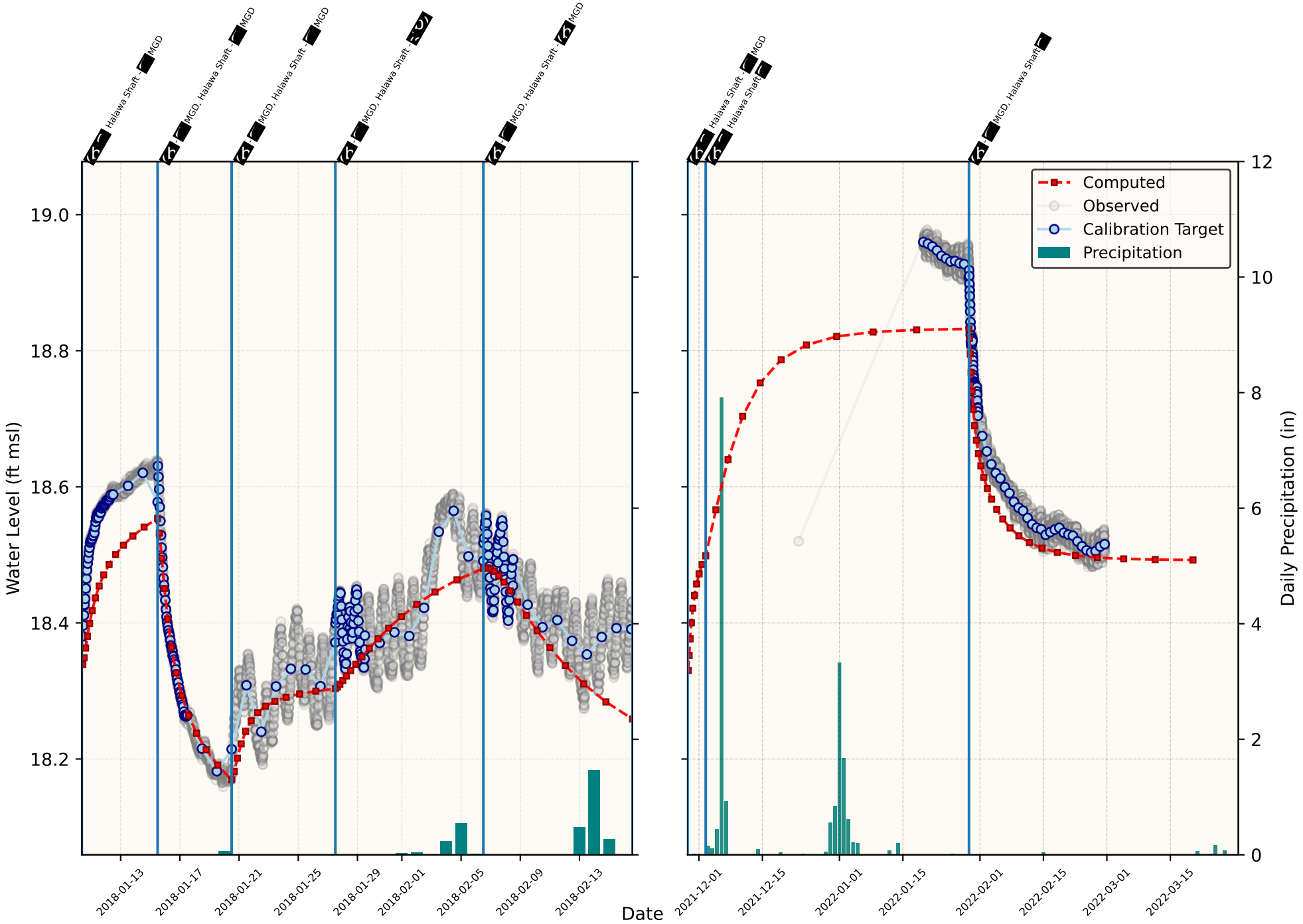

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
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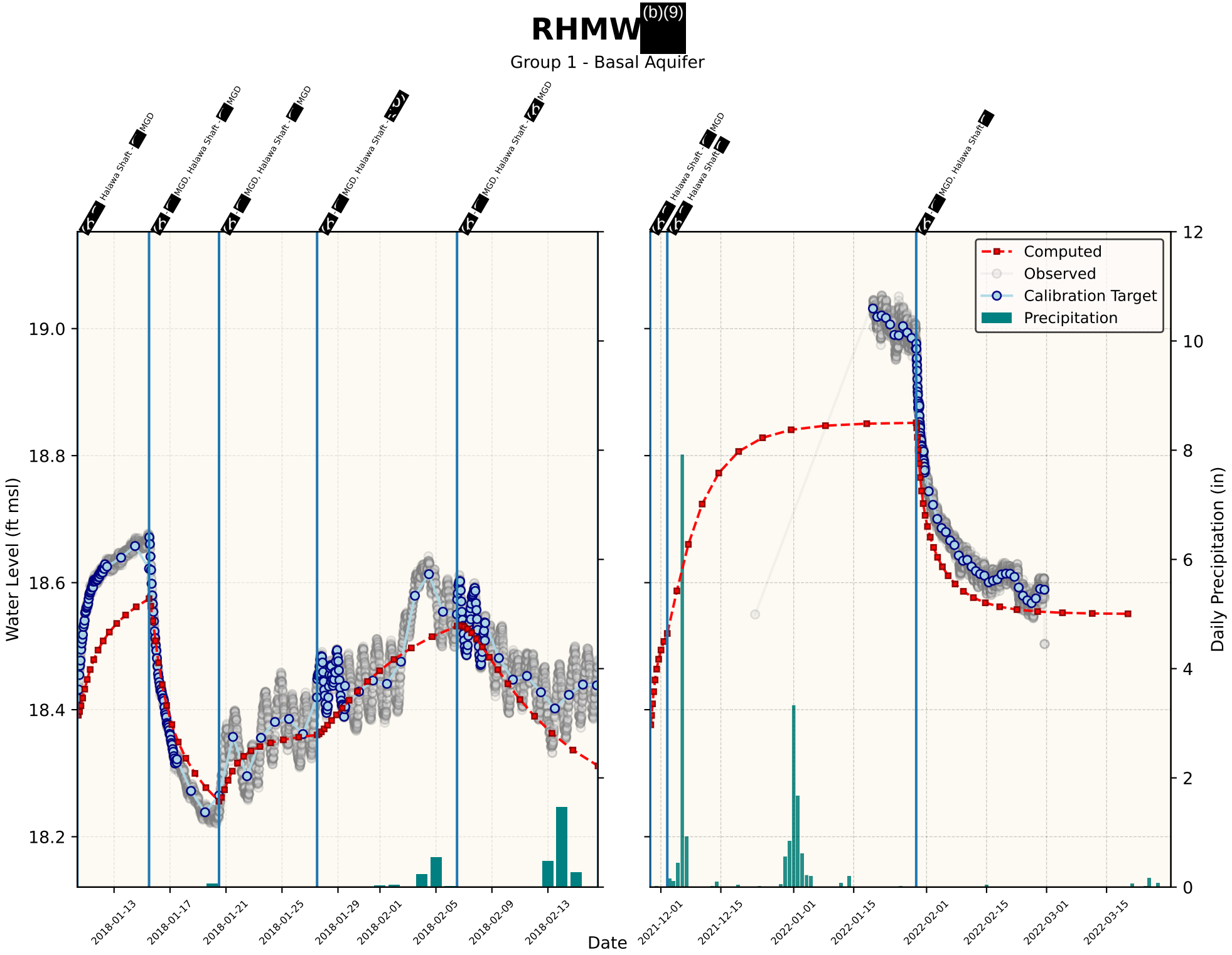

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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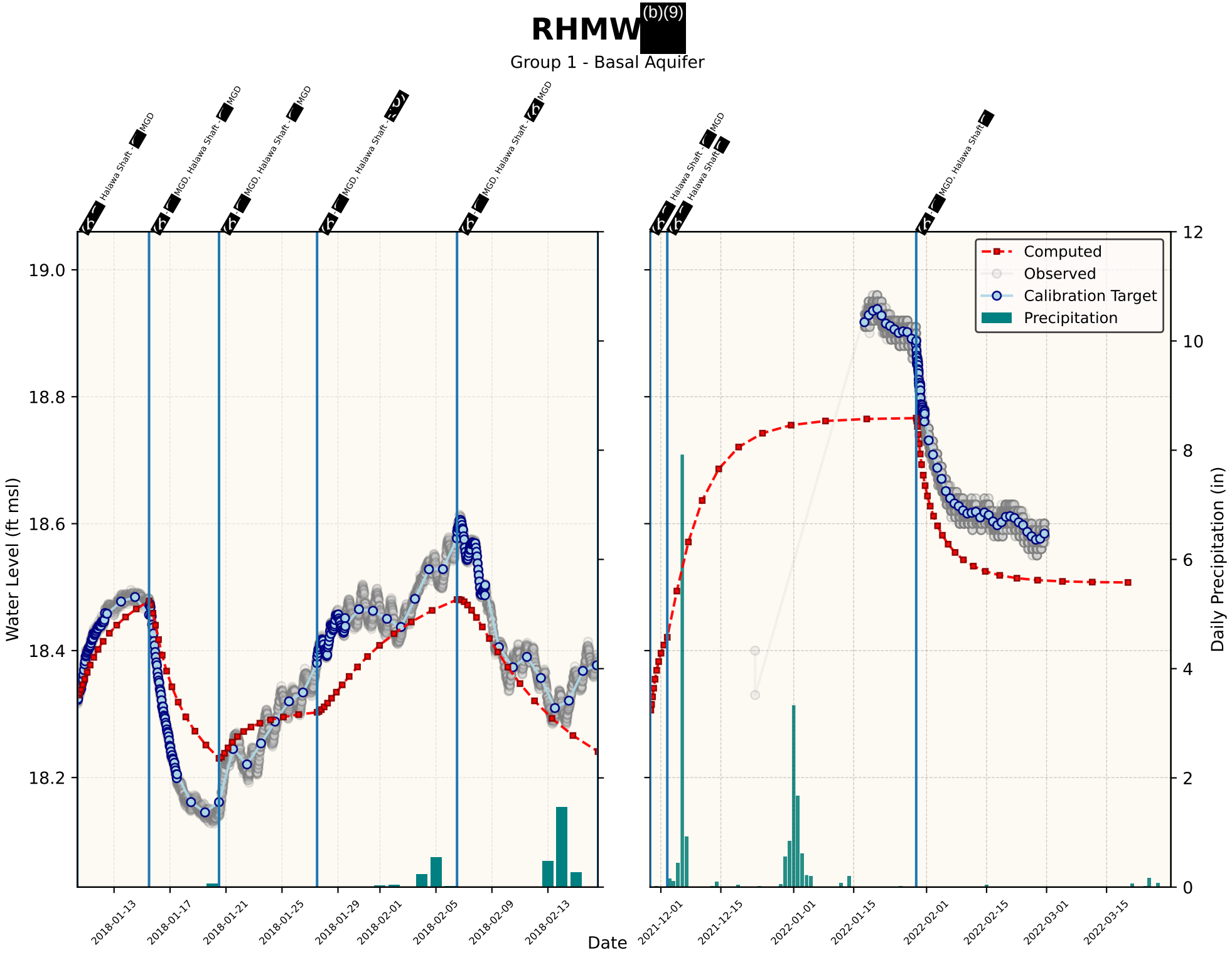

RHMW (b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.2
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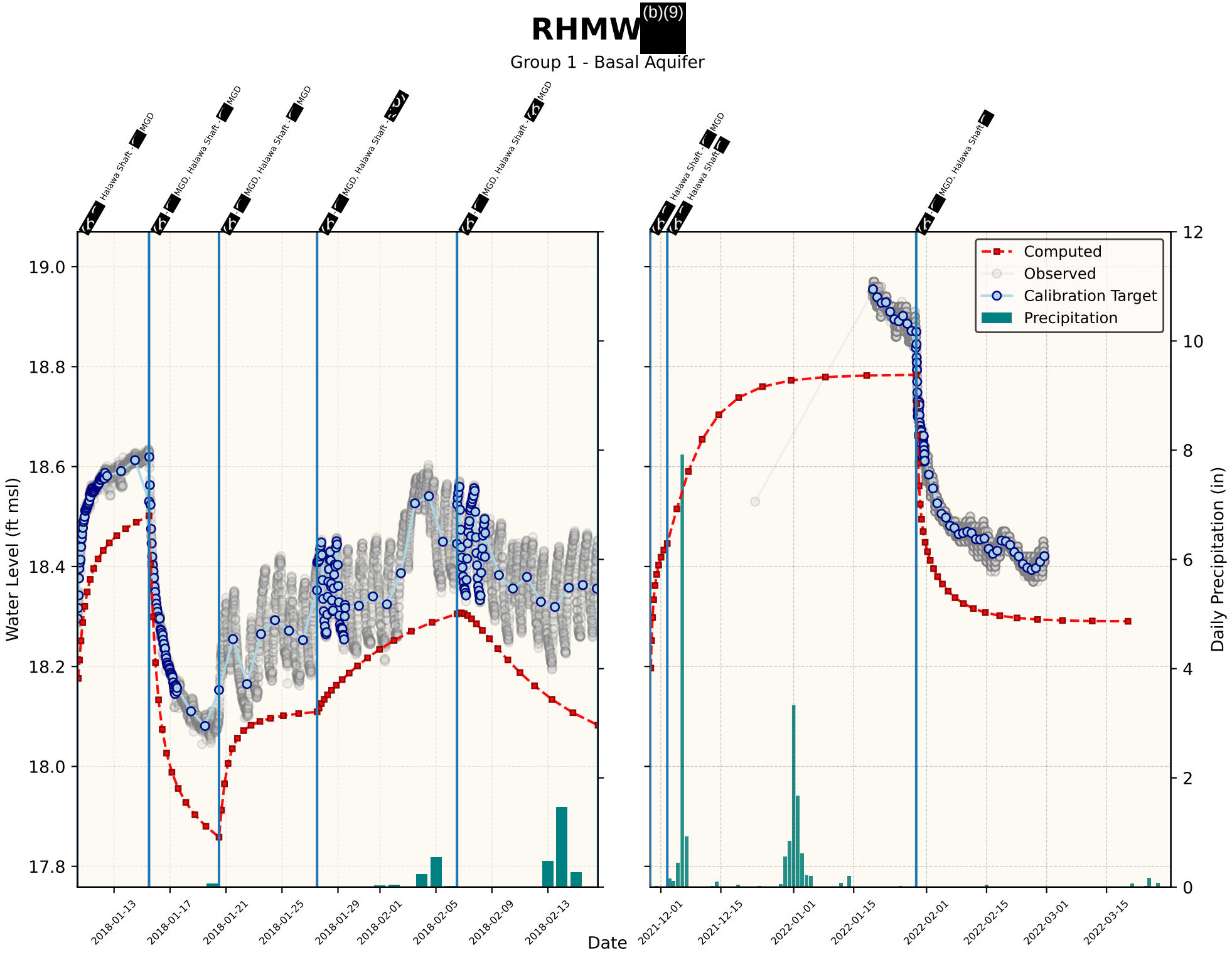
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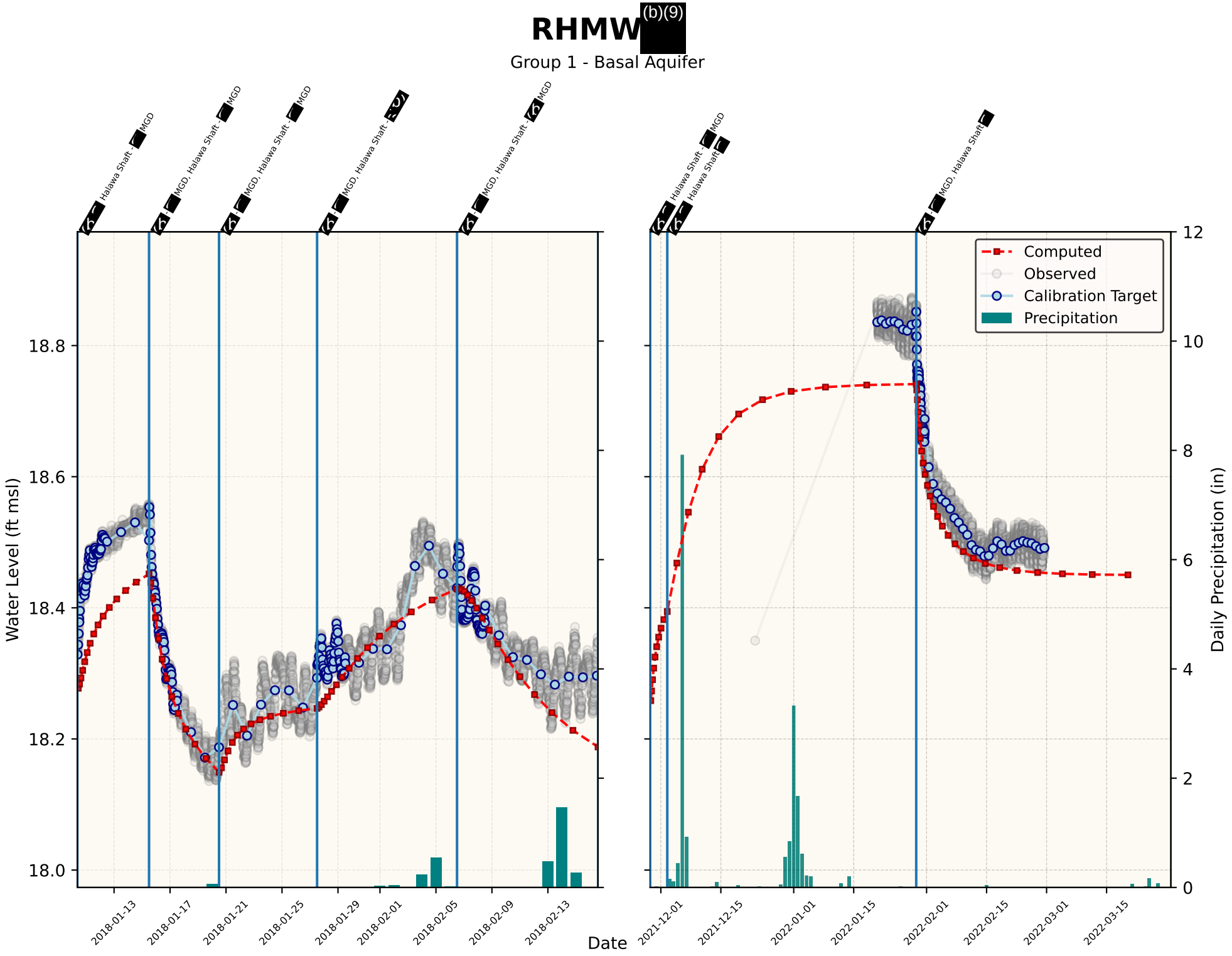
Group 1 - Basal Aquifer

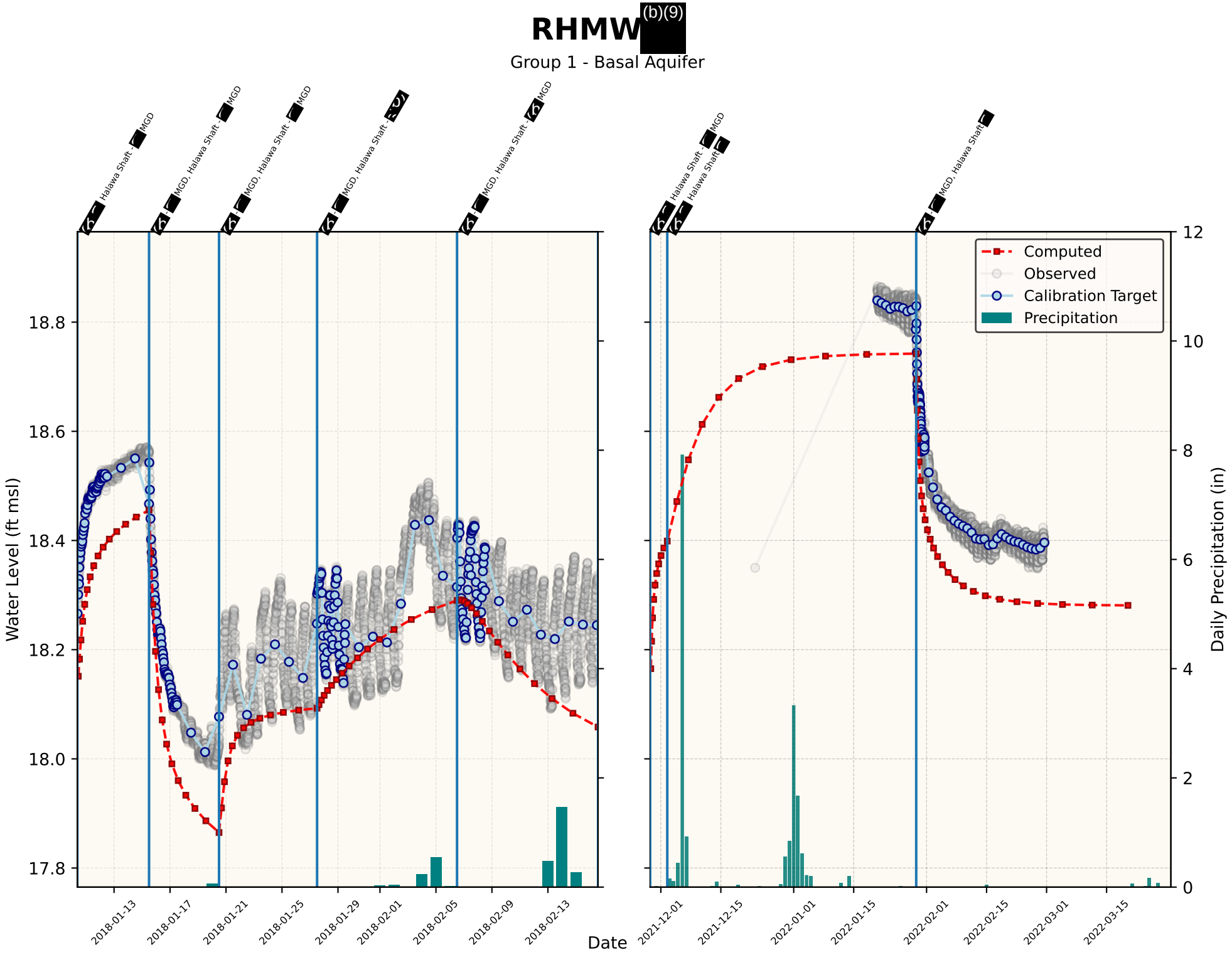


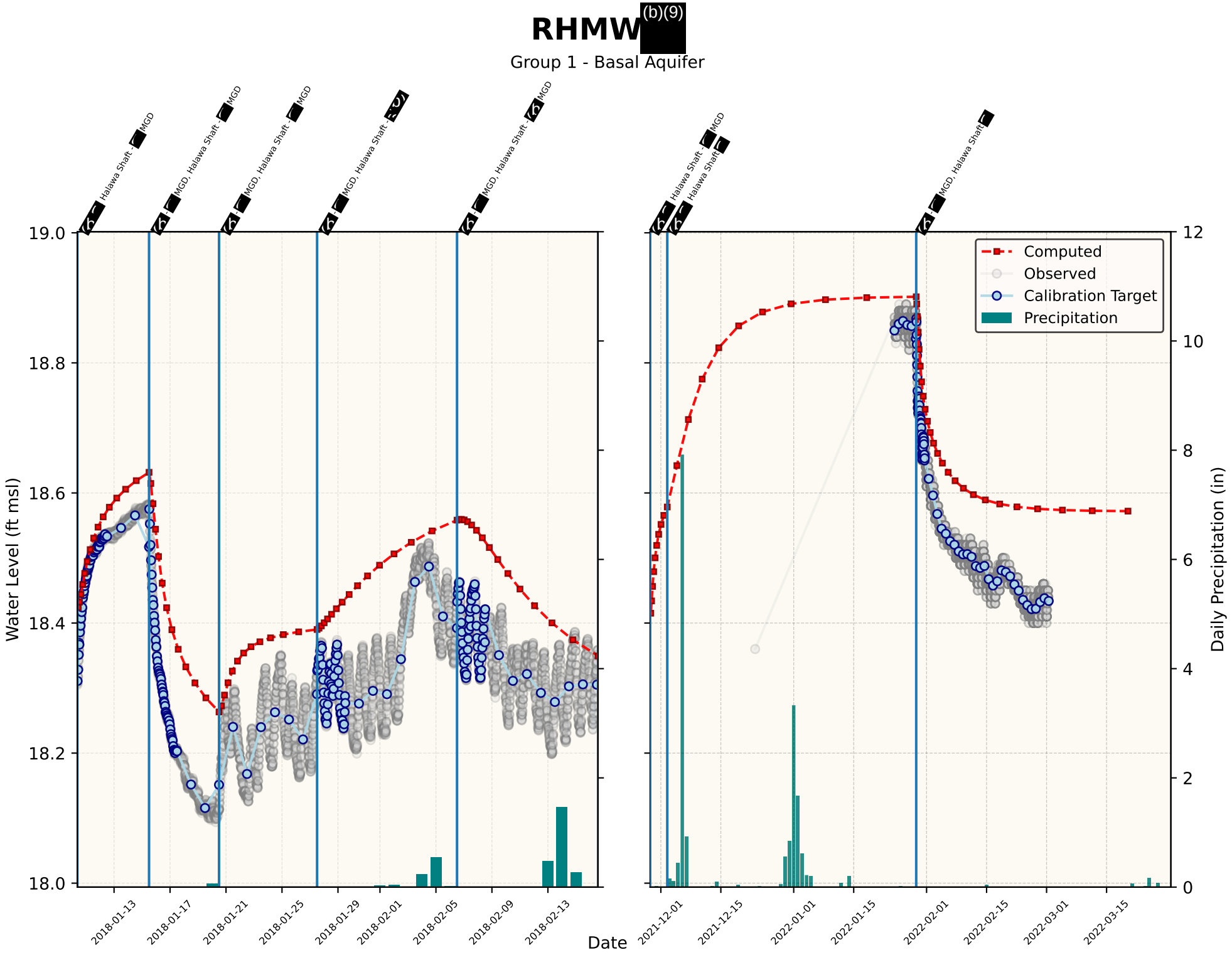

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
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Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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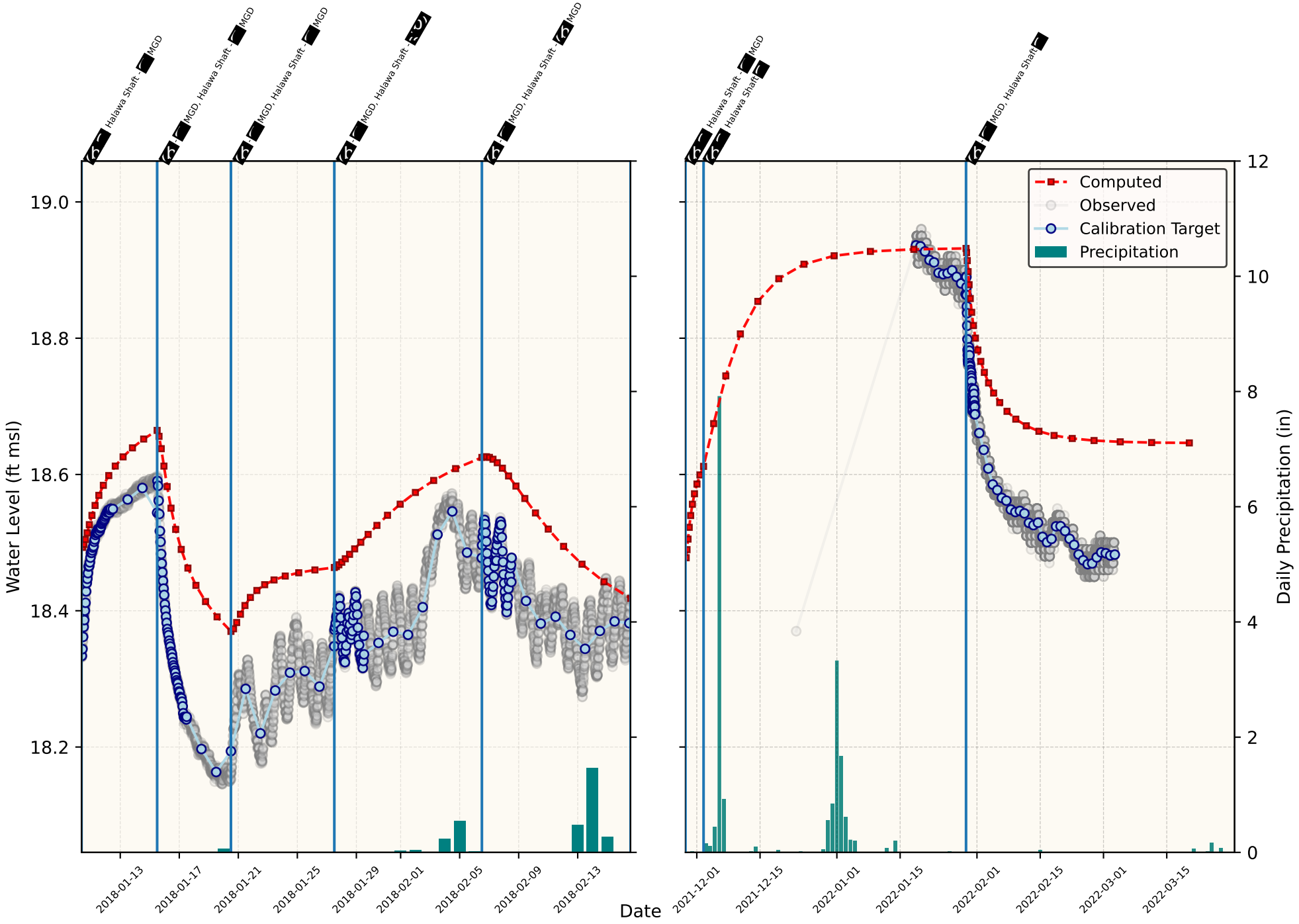

RHMW[redacted](b)(9)
Group 1 - Basal Aquifer
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Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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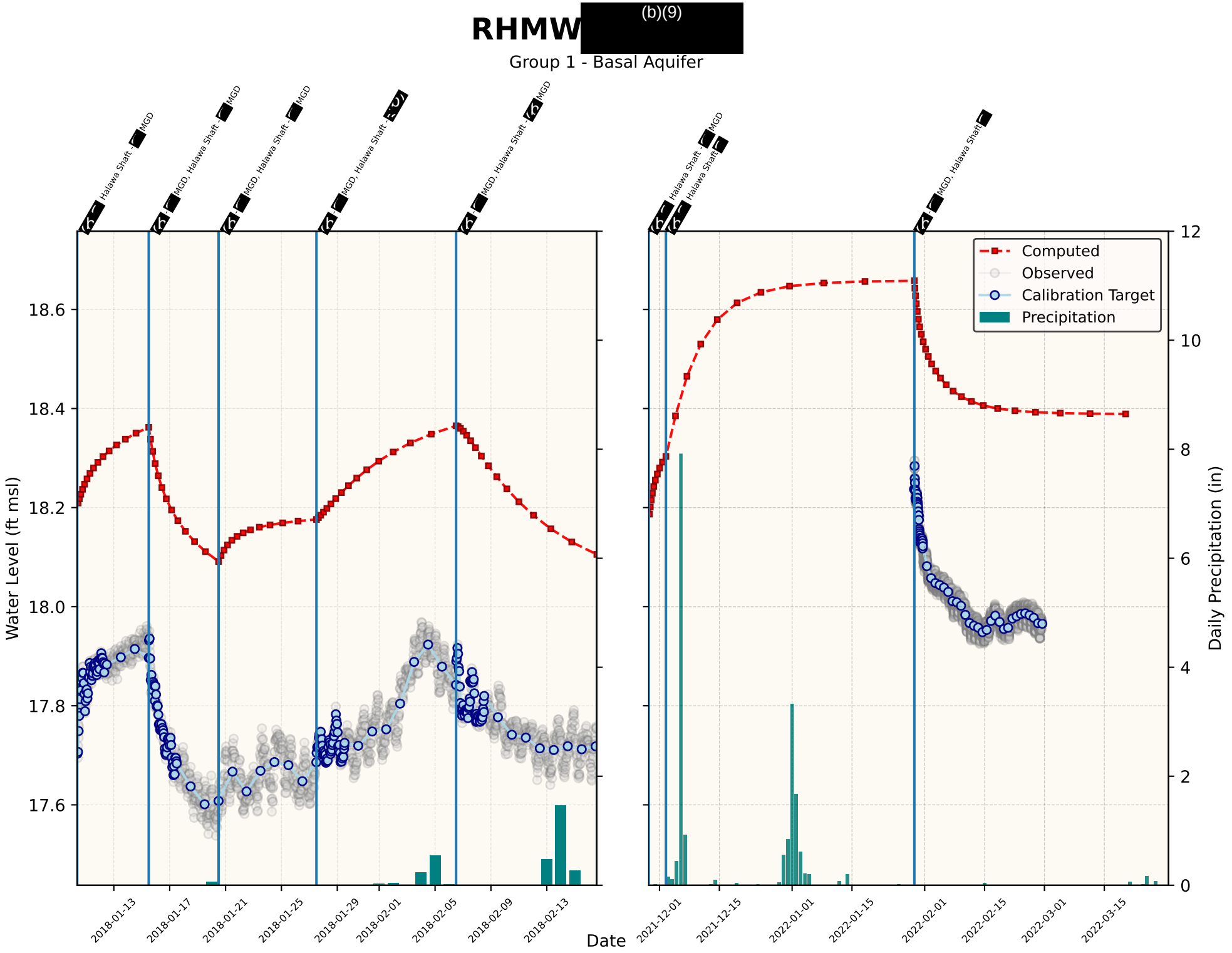

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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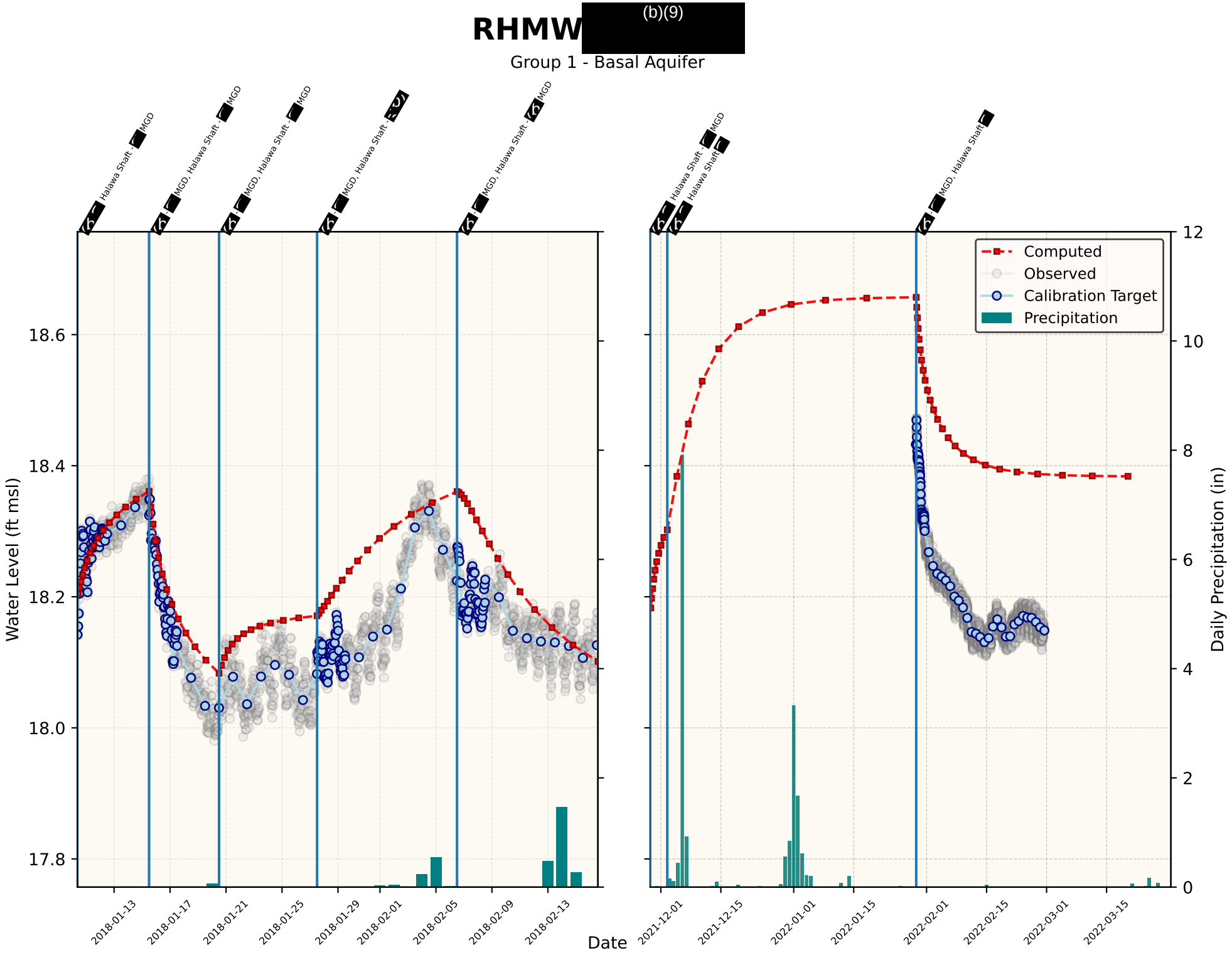

RHMW(b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
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RHMW[redacted] (b)(9)

Group 1 - Basal Aquifer

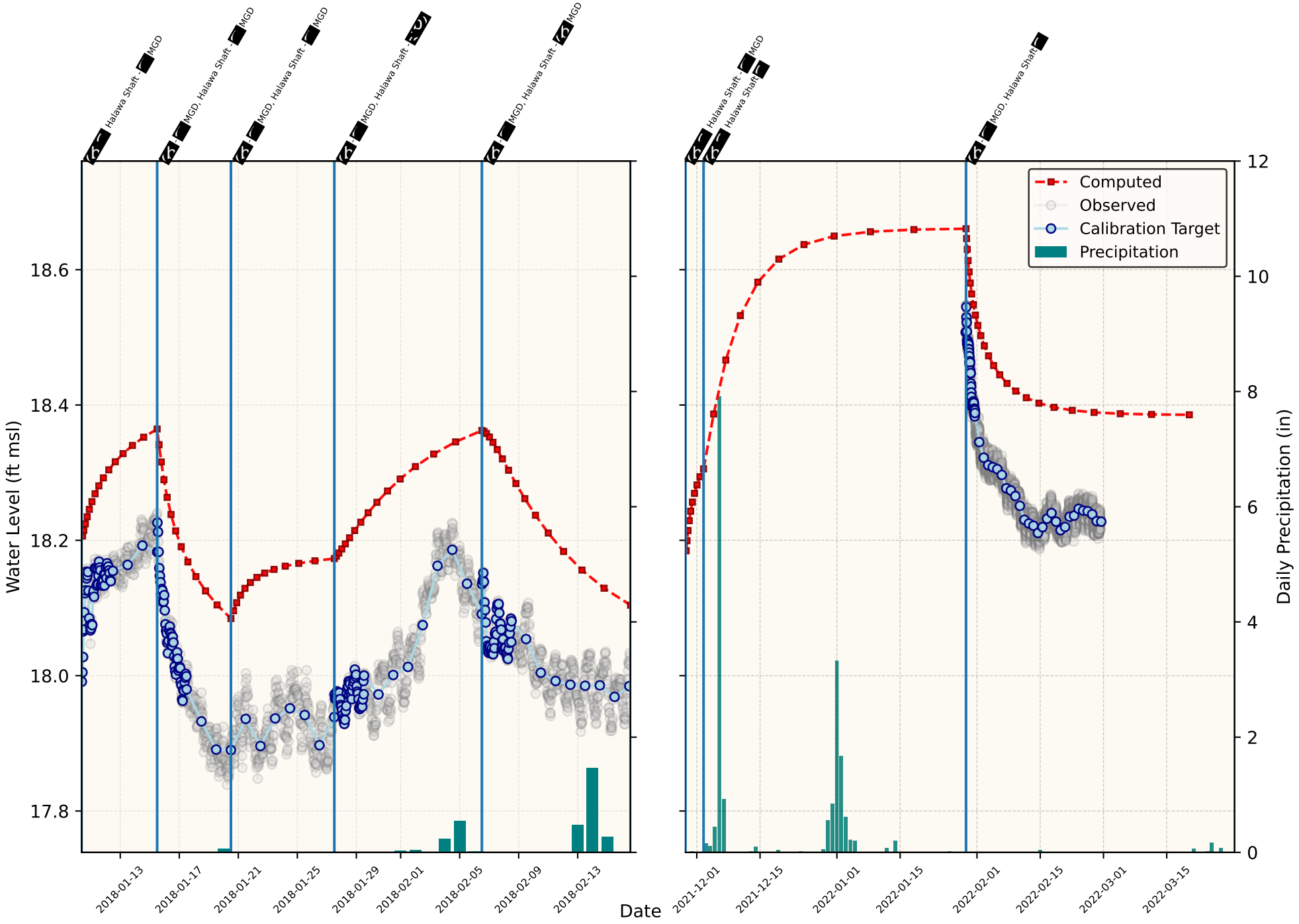



RHMW [redacted] (b)(9)
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MGD, Halawa Shaft [redacted]
Computed
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Calibration Target
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Water Level (ft msl)
Daily Precipitation (in)
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4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-15

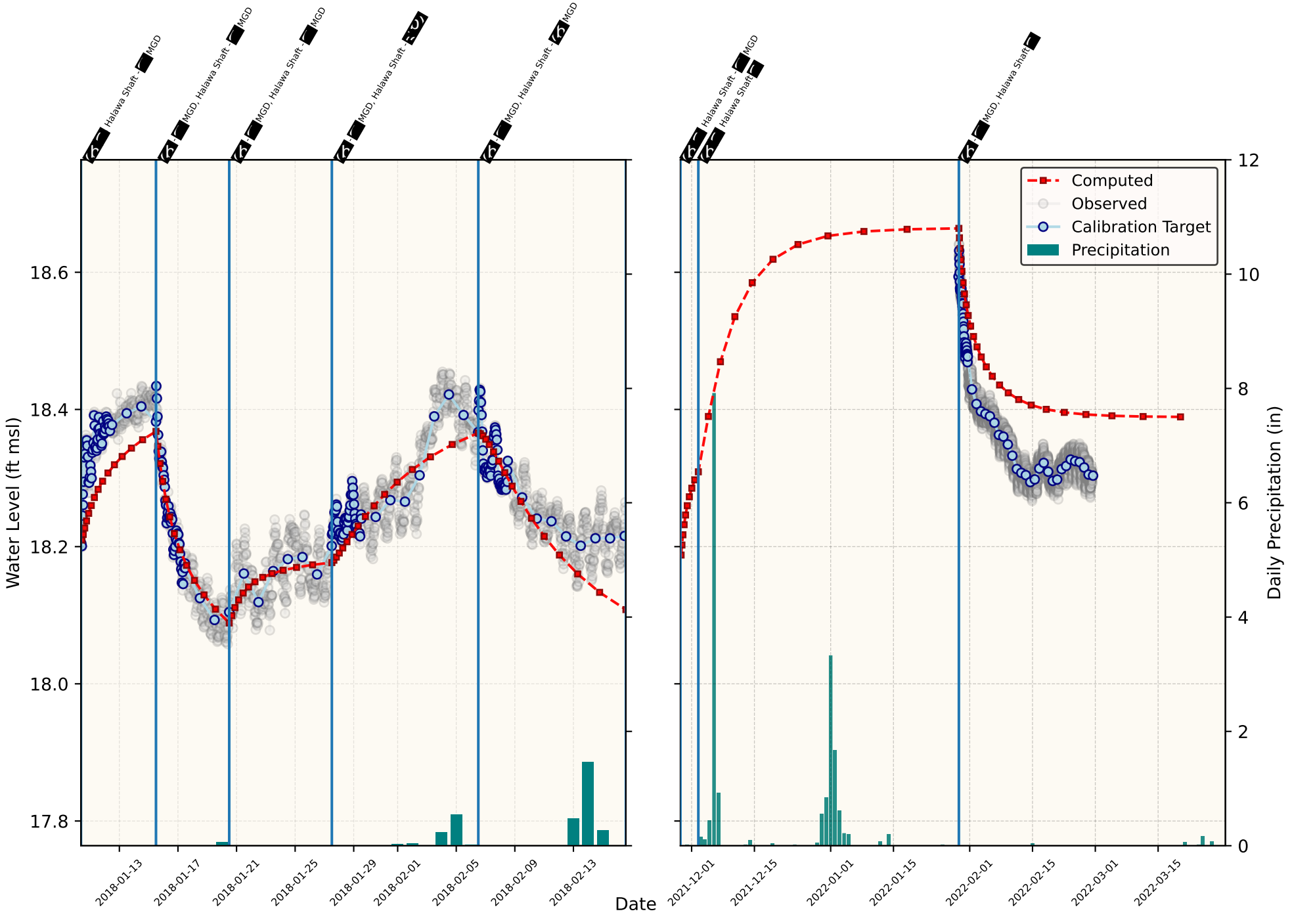
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



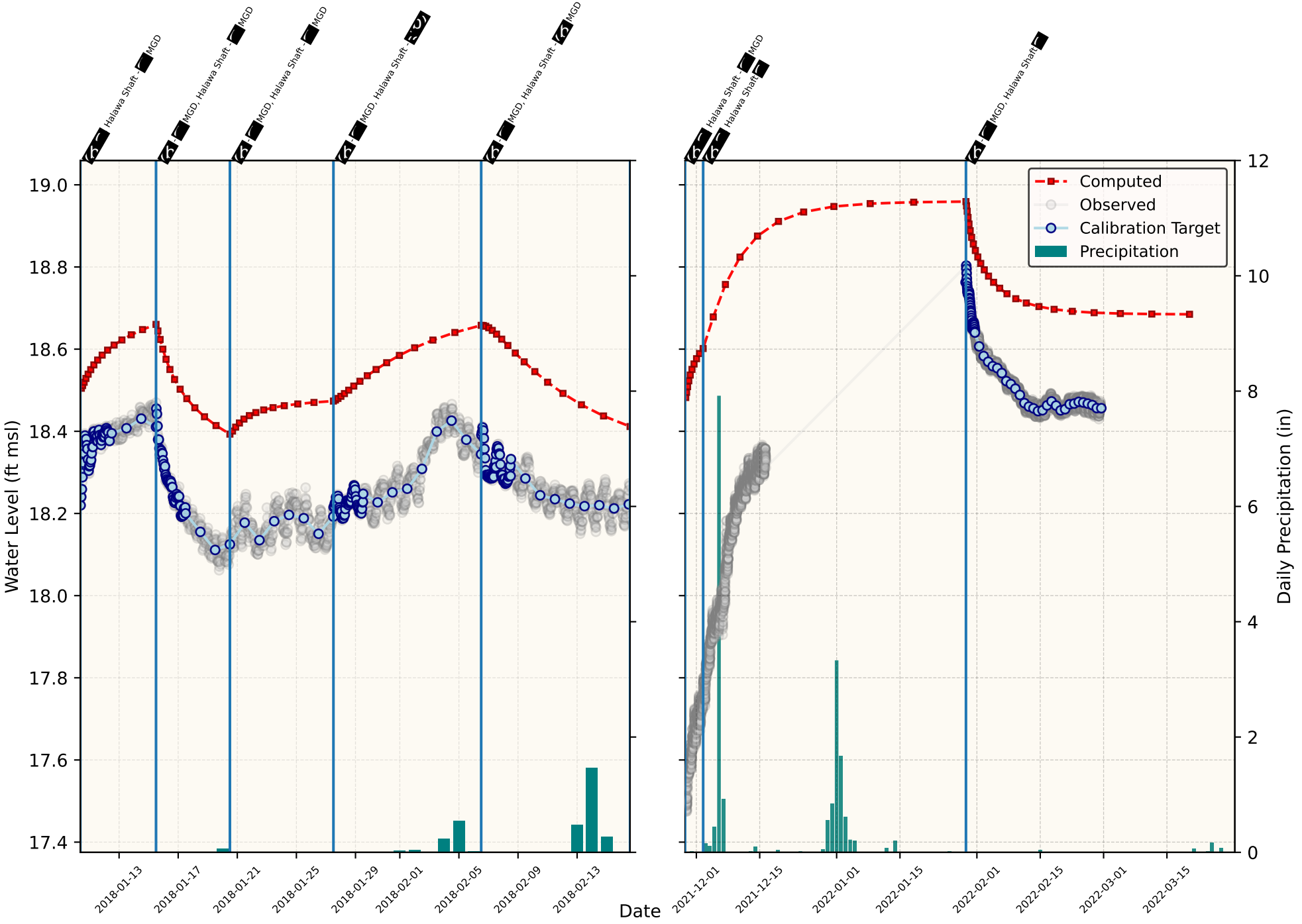
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



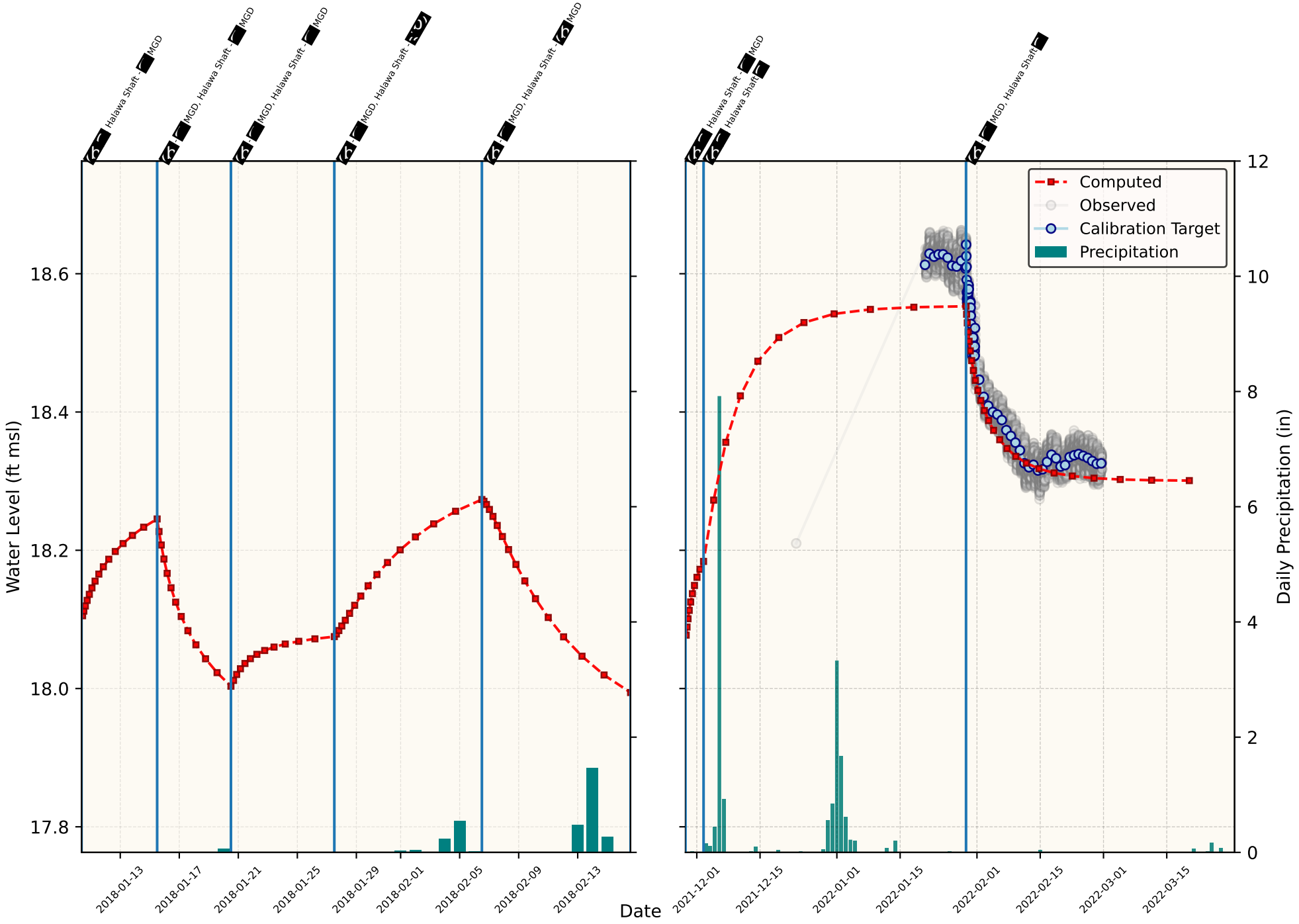
RHMW [redacted] (b)(9)

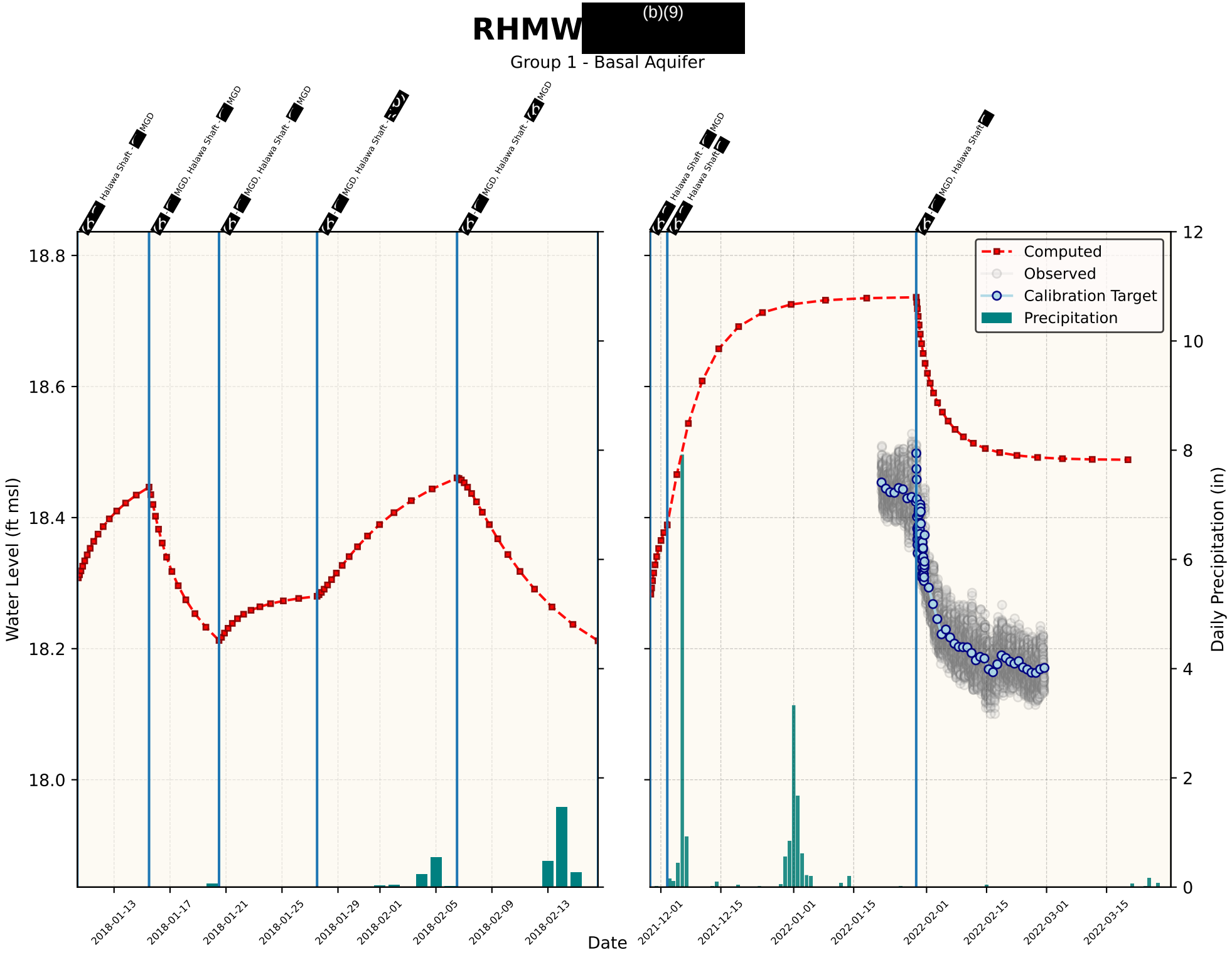
Group 1 - Basal Aquifer



RHMW[redacted] (b)(9)

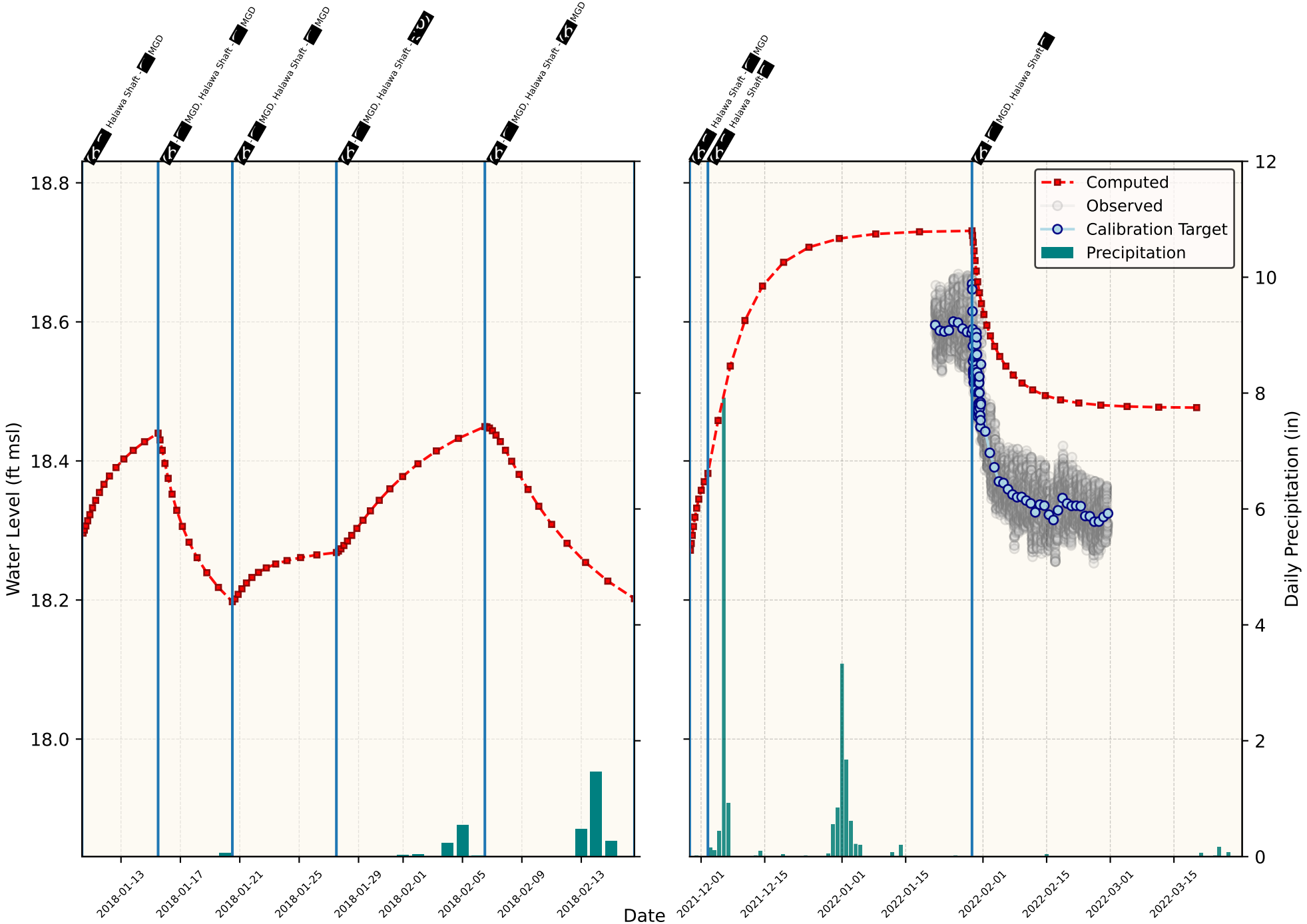
Group 1 - Basal Aquifer

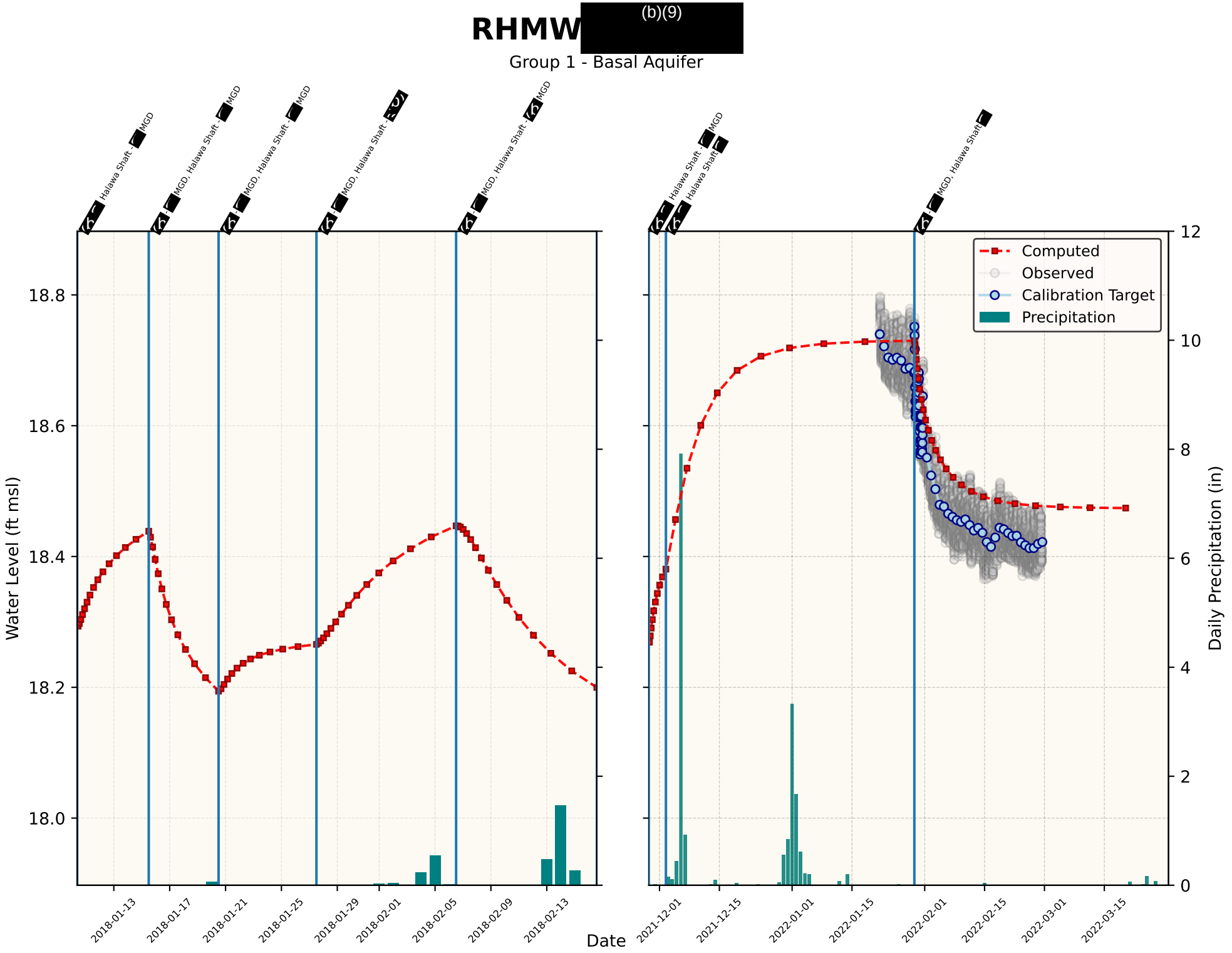



RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
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2022-02-01
2022-02-15
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2022-03-15

RHMW [redacted] (b)(9)

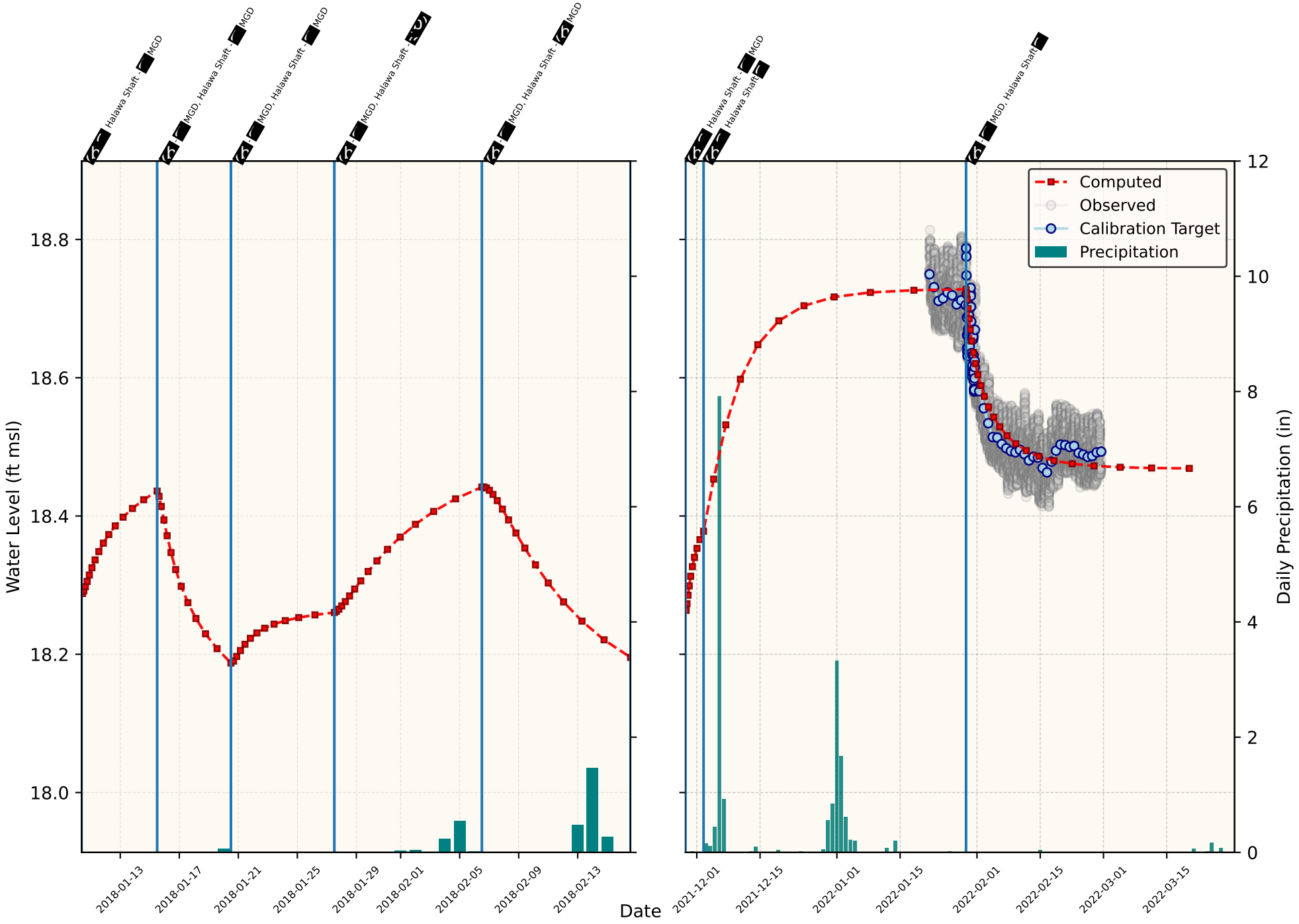
Group 1 - Basal Aquifer

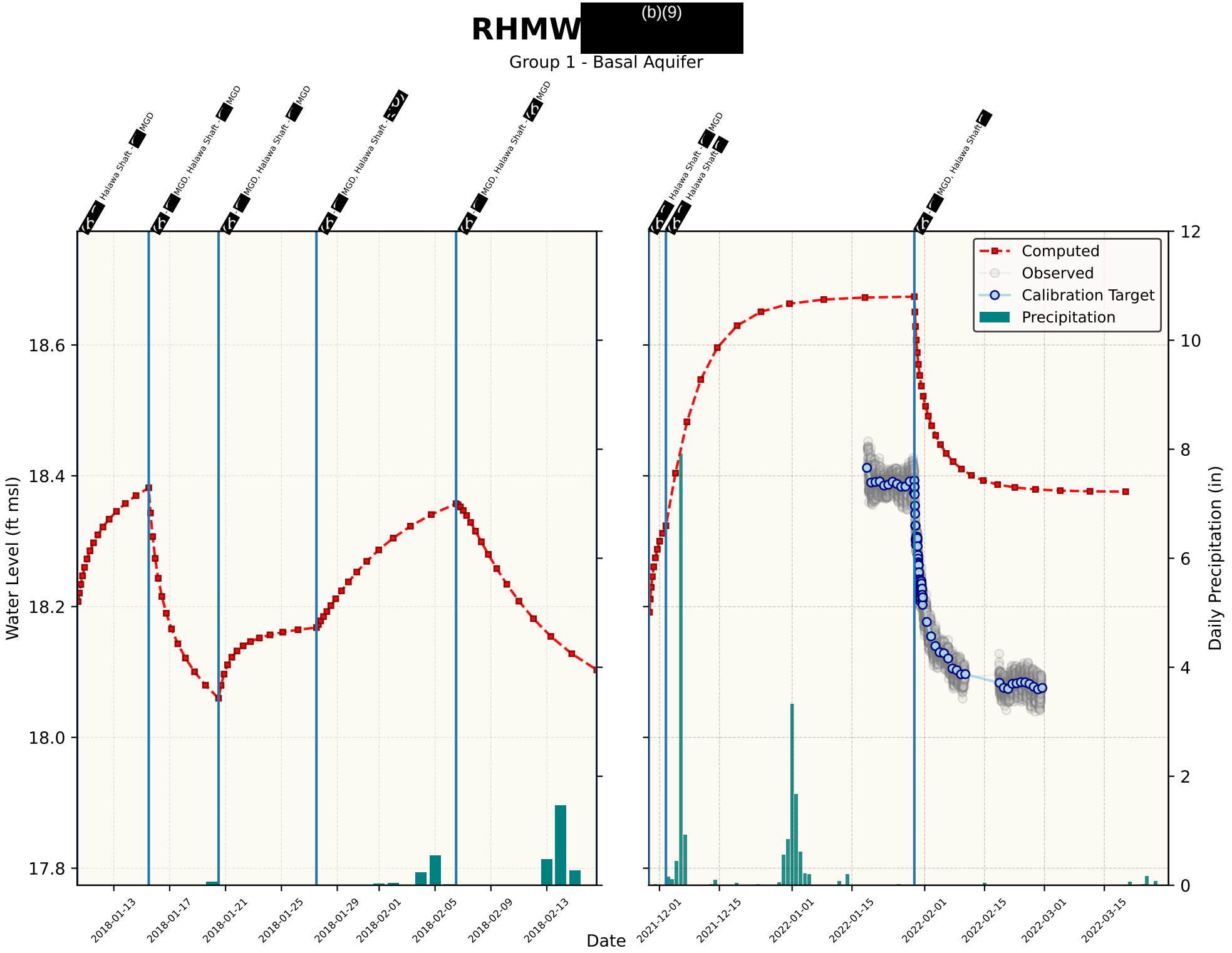


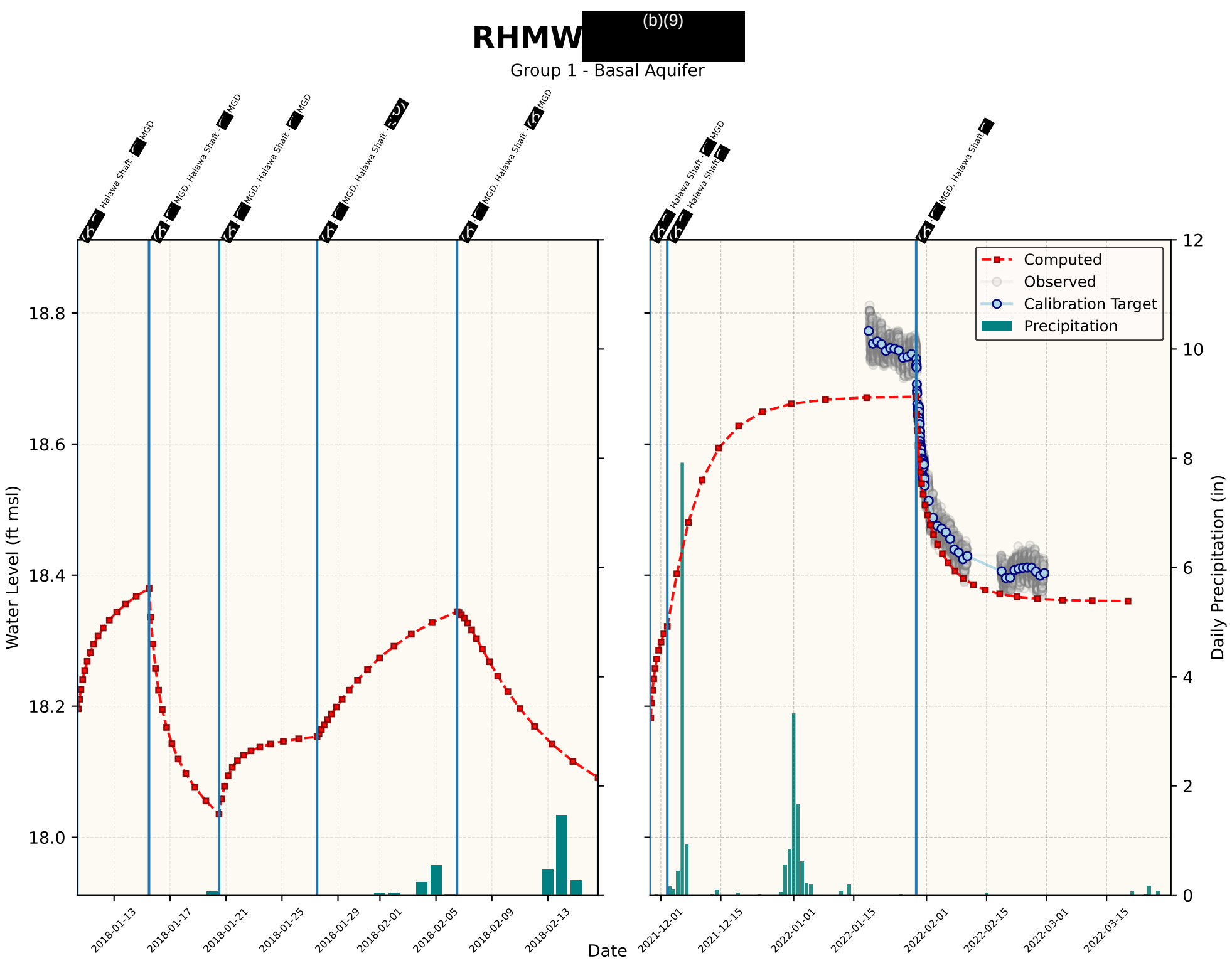

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

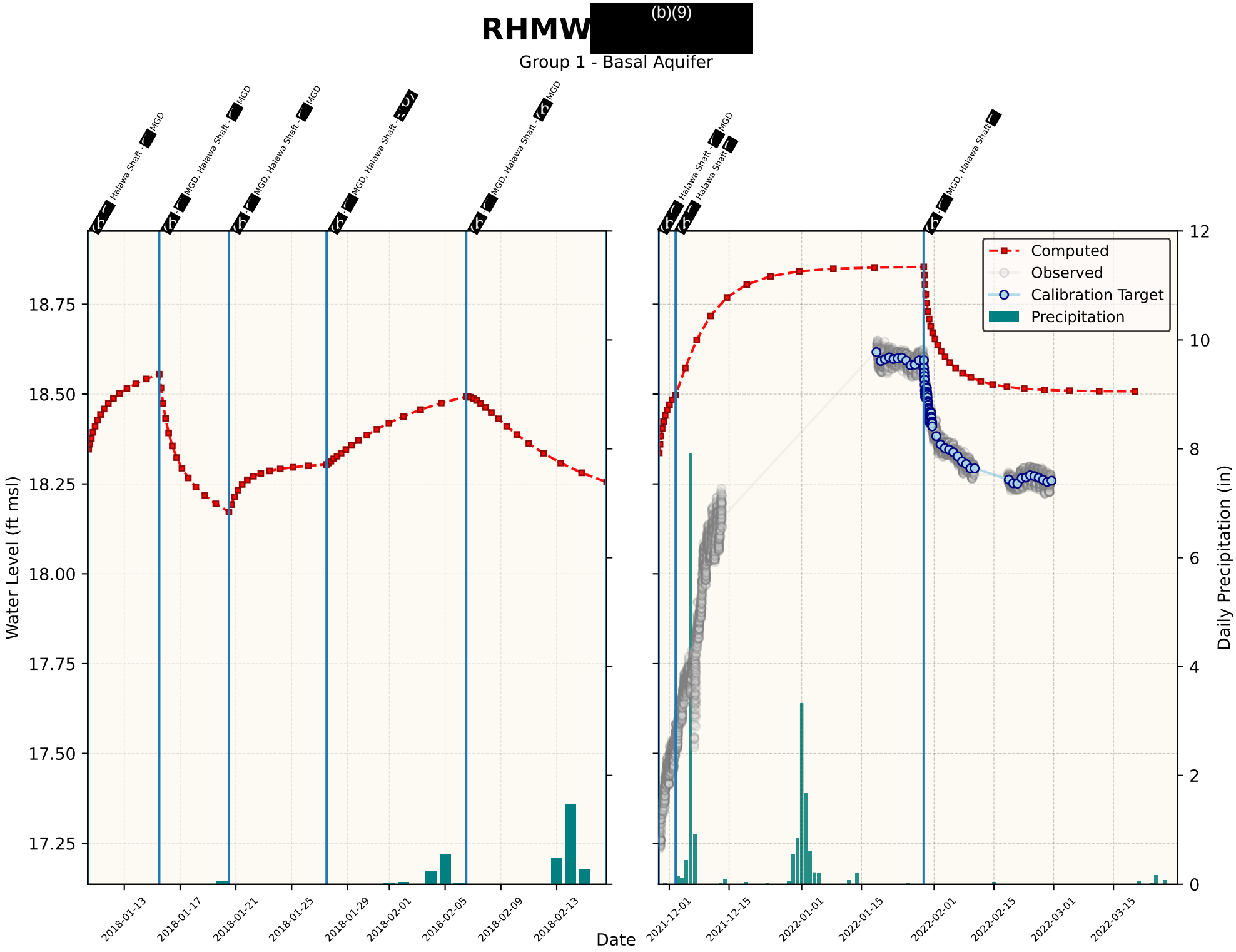
RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer



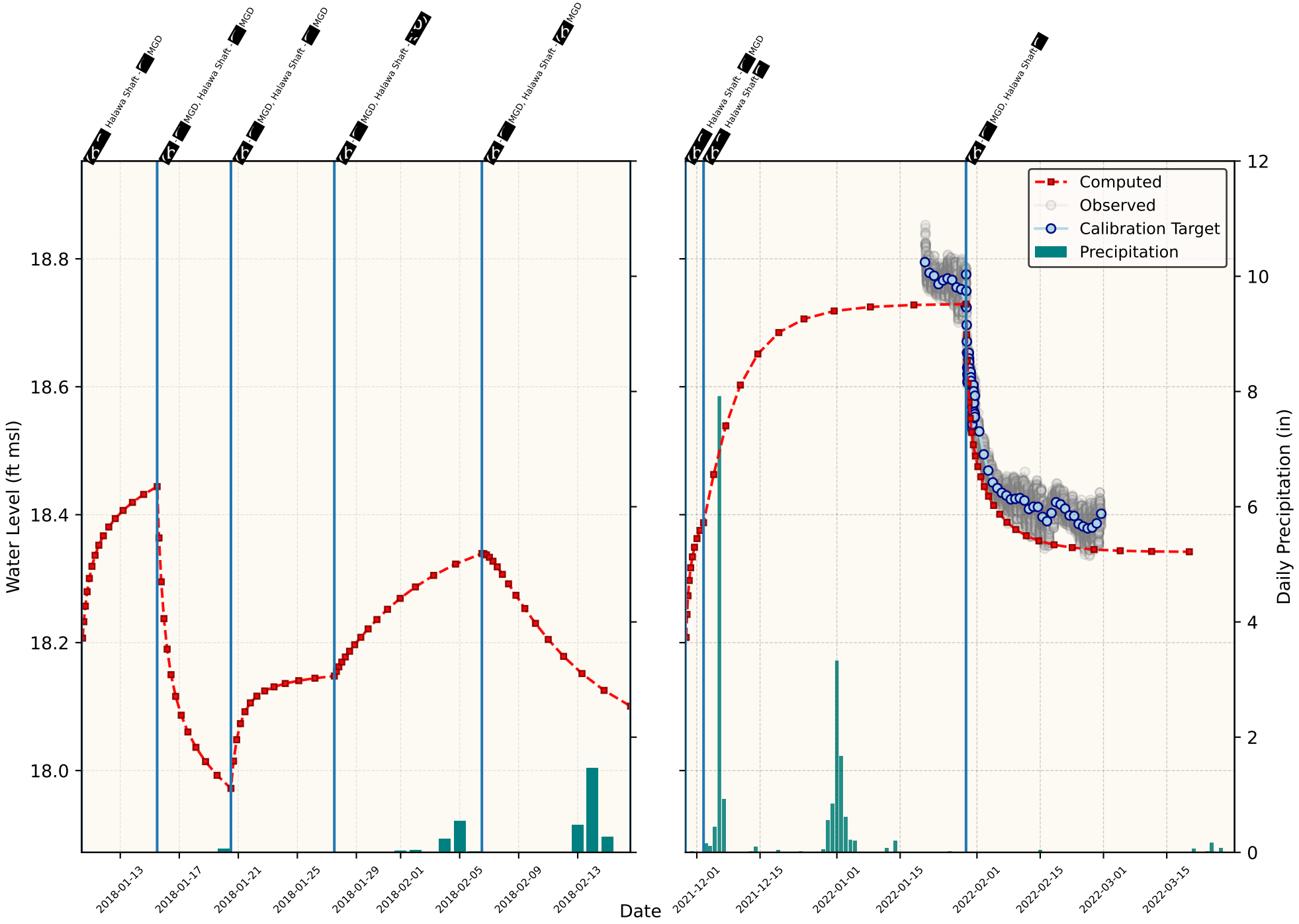

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

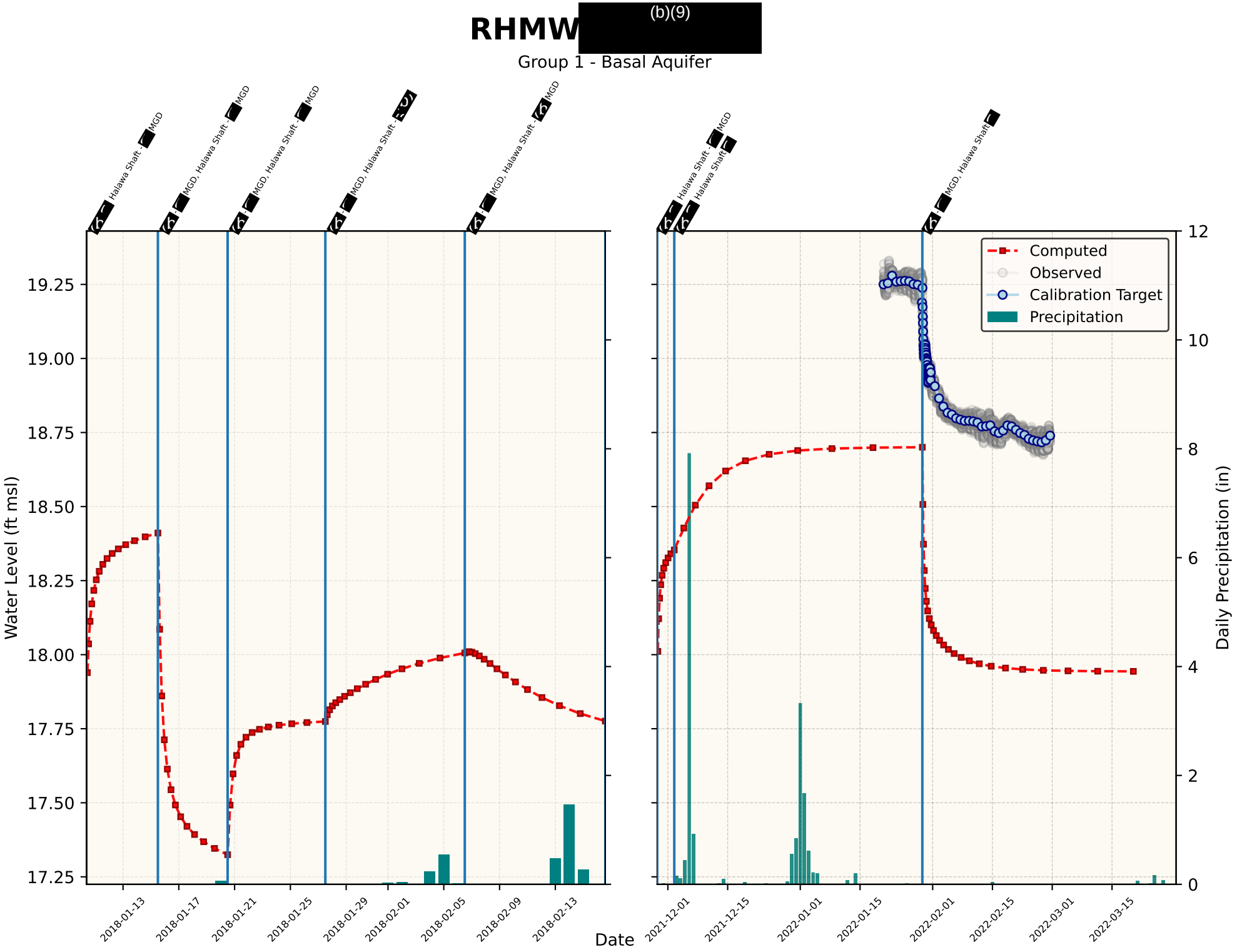

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

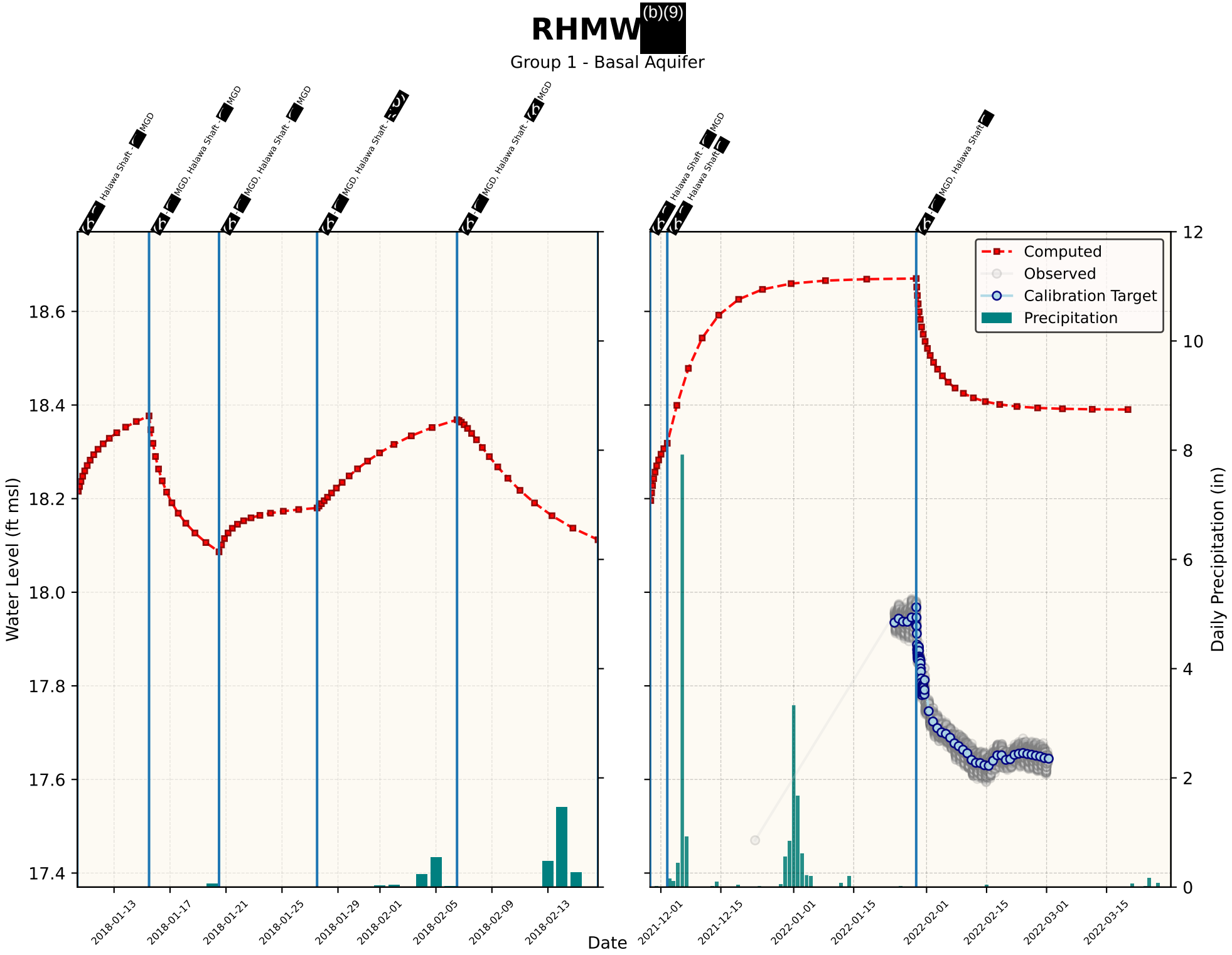

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.75
18.50
18.25
18.00
17.75
17.50
17.25
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-01-01
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

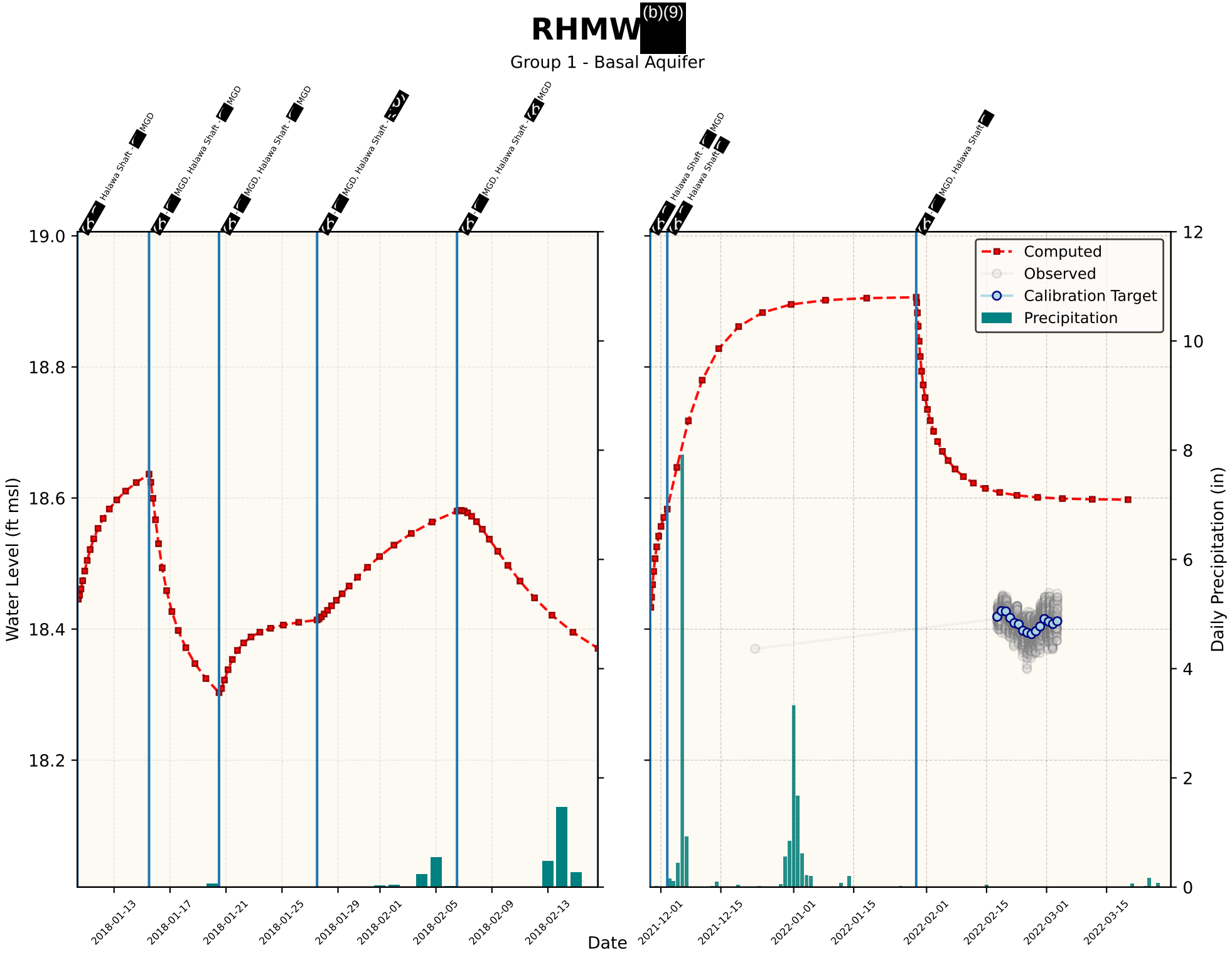
RHMW [redacted] (b)(9)

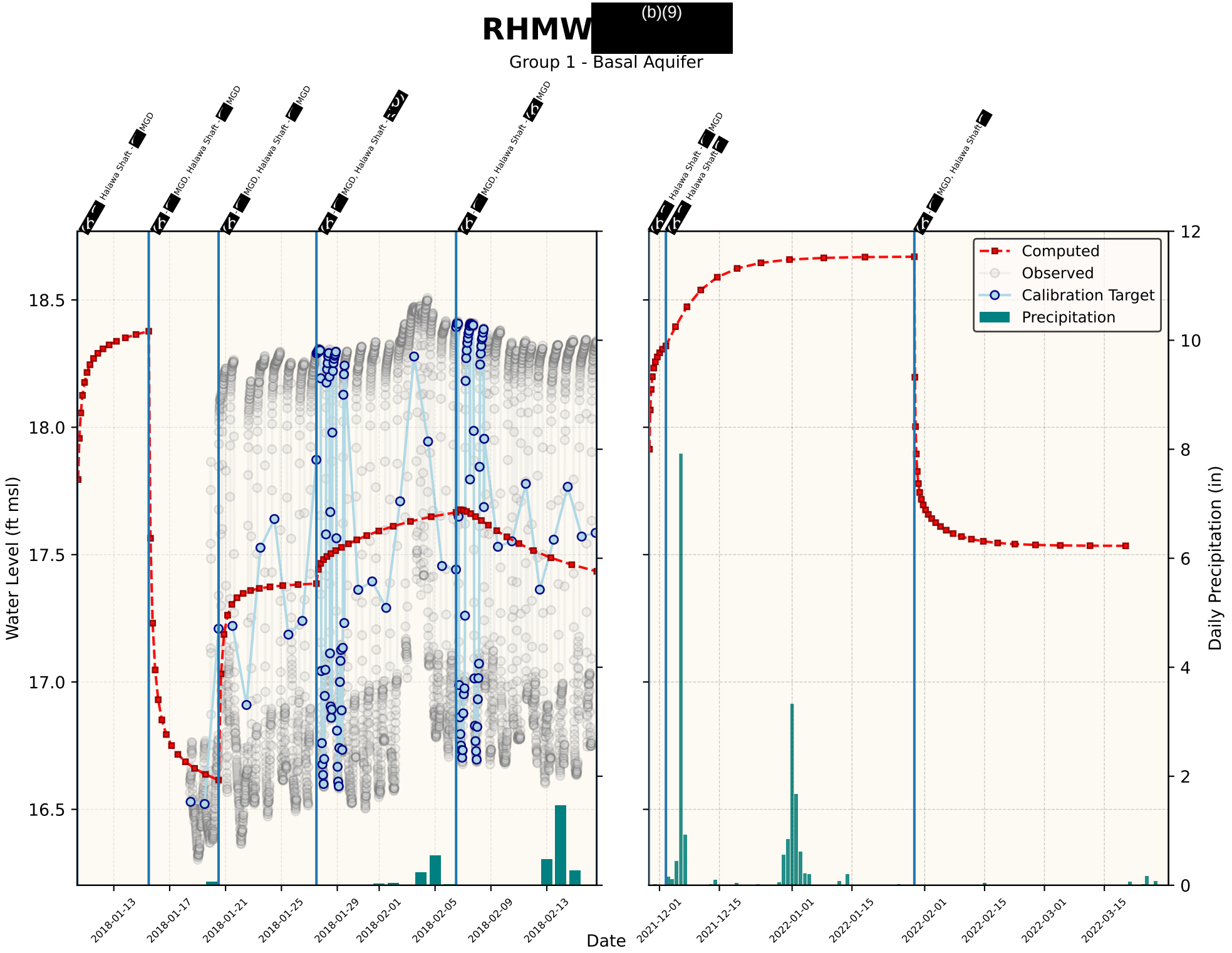
Group 1 - Basal Aquifer




RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
19.25
19.00
18.75
18.50
18.25
18.00
17.75
17.50
17.25
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation
Daily Precipitation (in)
12
10
8
6
4
2
0

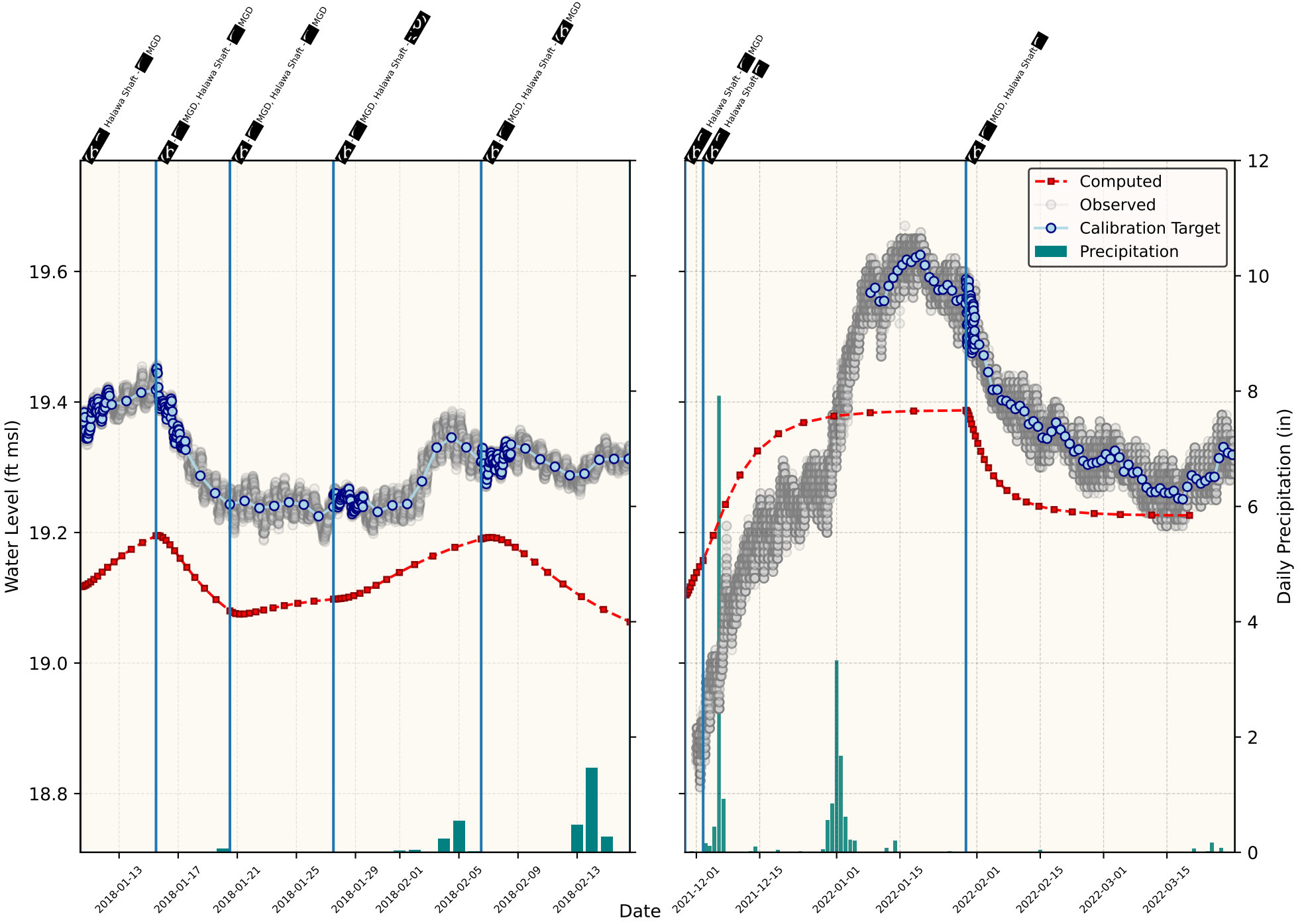

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.6
18.4
18.2
18.0
17.8
17.6
17.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

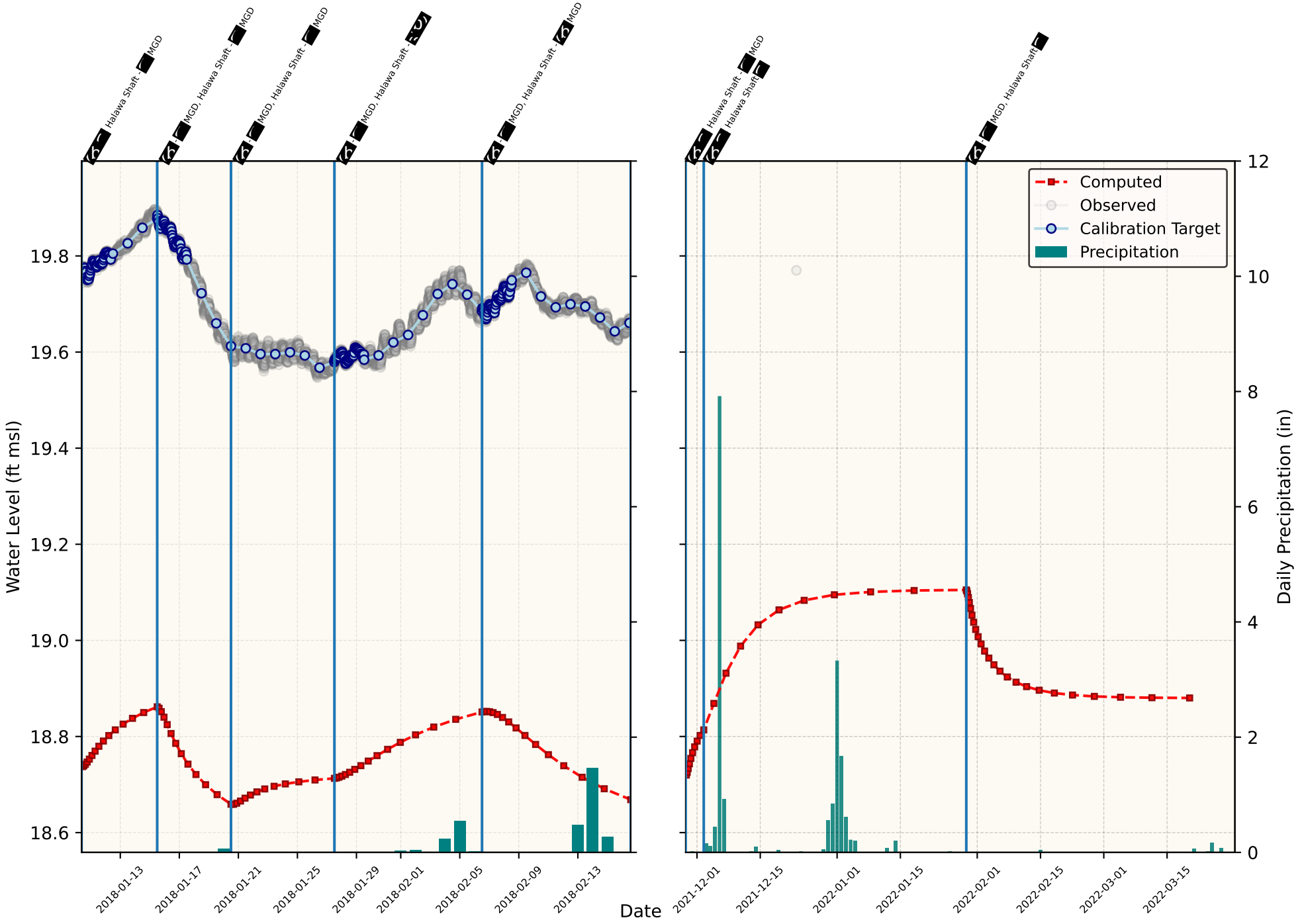

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
Halawa Shaft
MGD
Halawa Shaft
MGD
Halawa Shaft
MGD
Halawa Shaft
MGD
Halawa Shaft
Halawa Shaft
MGD
Halawa Shaft
MGD
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

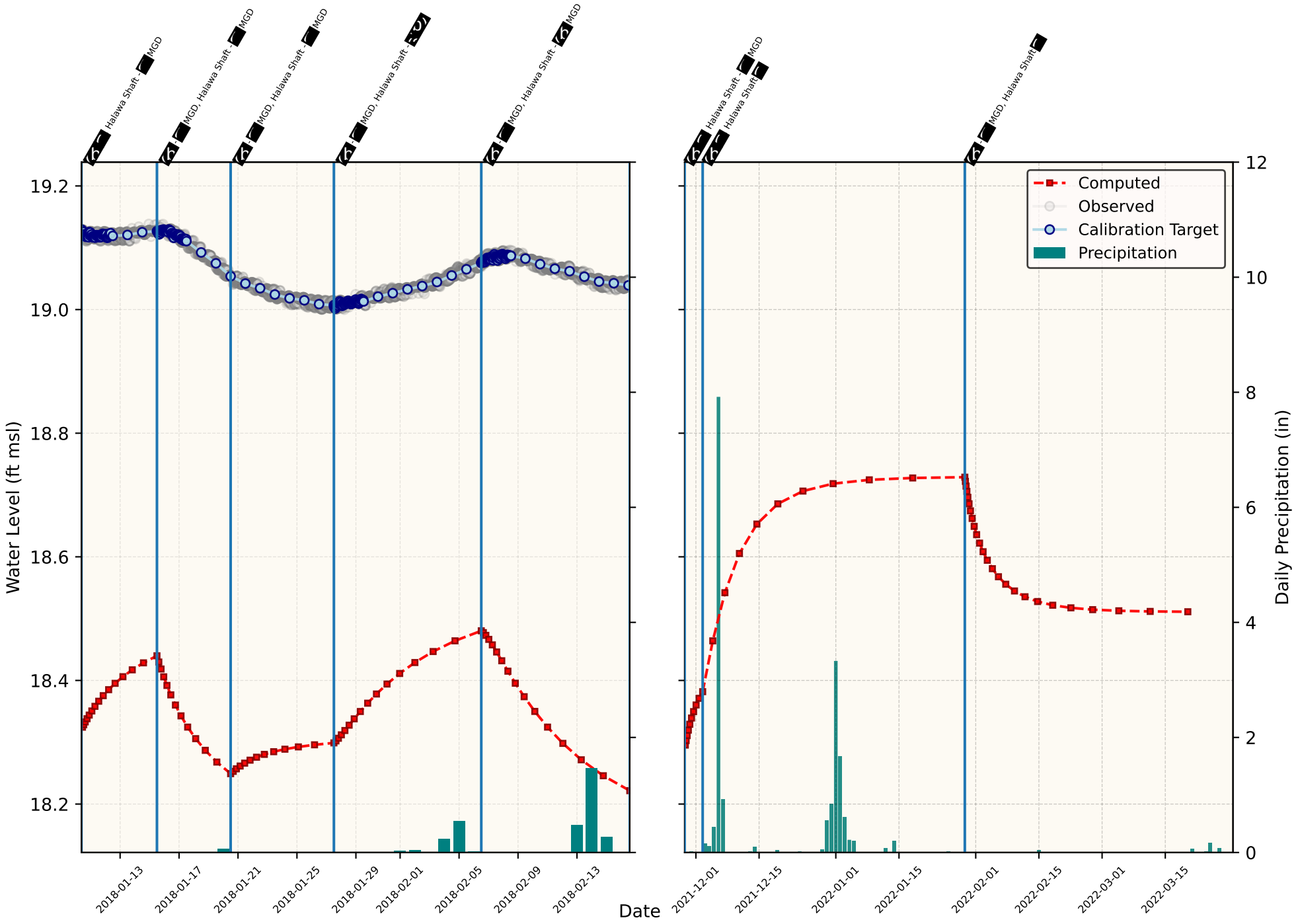

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.5
18.0
17.5
17.0
16.5
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

TAMC [redacted] (b)(9)

Group 1 - Basal Aquifer

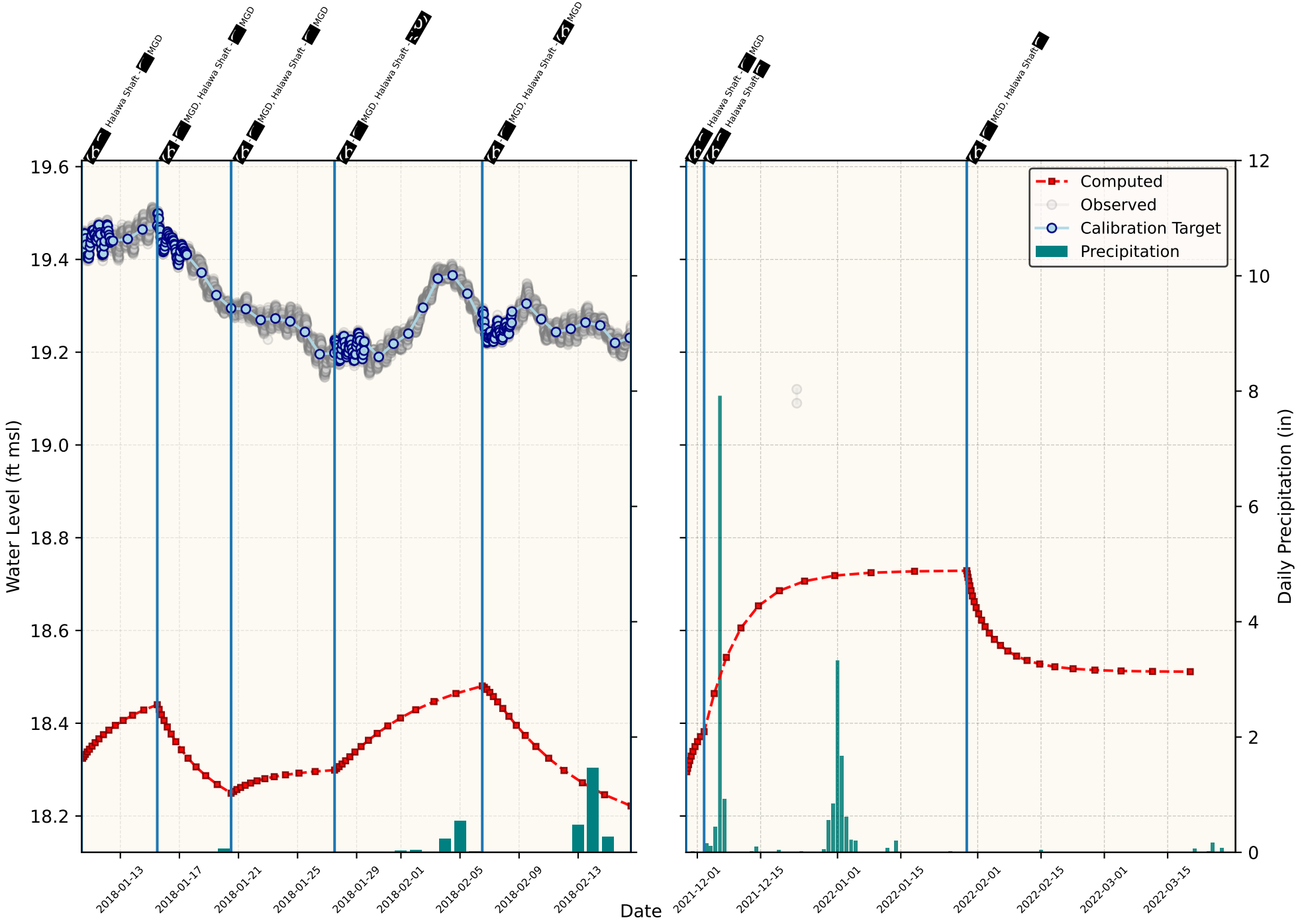



DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.8
19.6
19.4
19.2
19.0
18.8
18.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.2
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

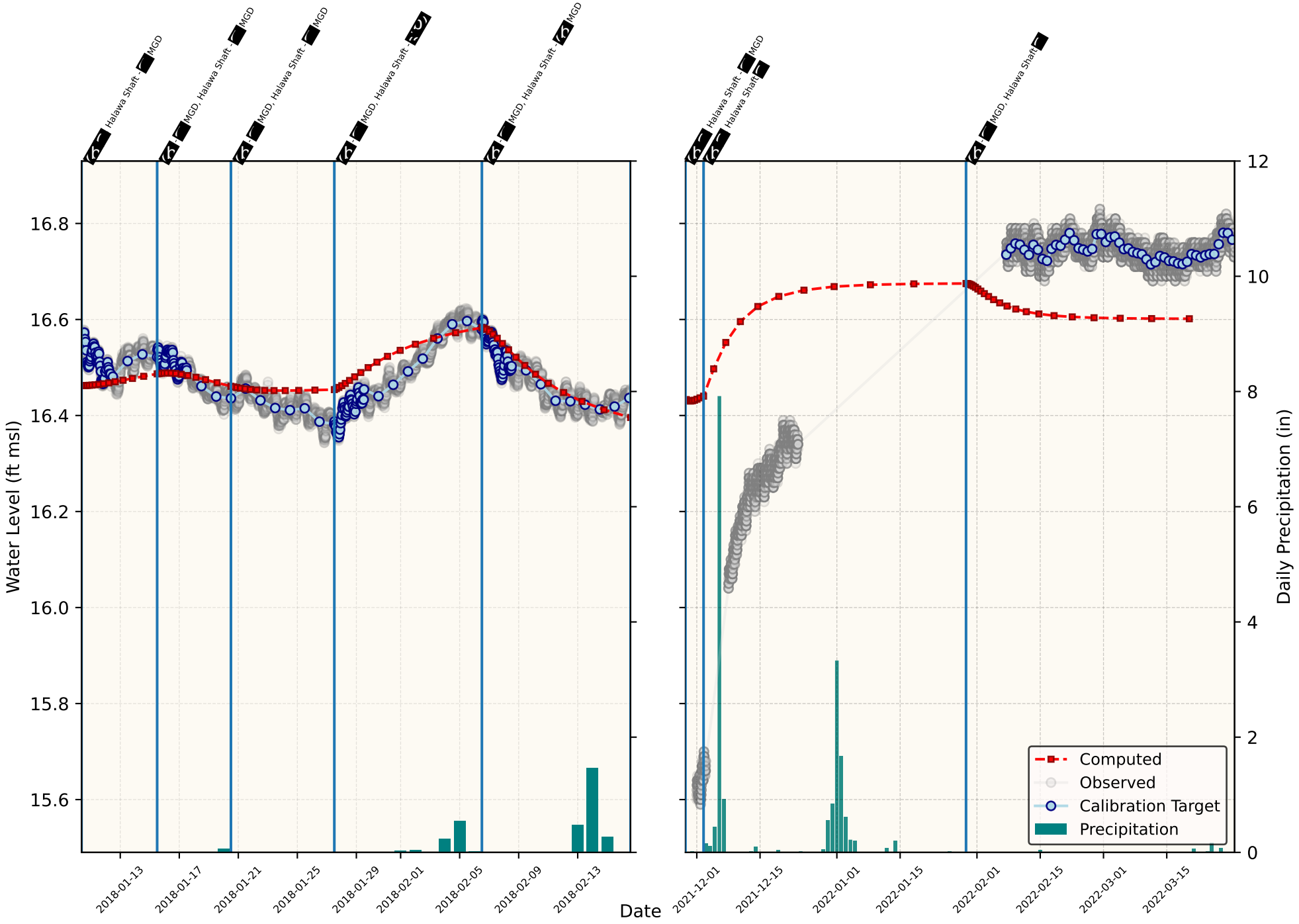
Halawa_Deep_Monitor_Well_HDMW2253-03

Group 2 - Deep Basal Wells



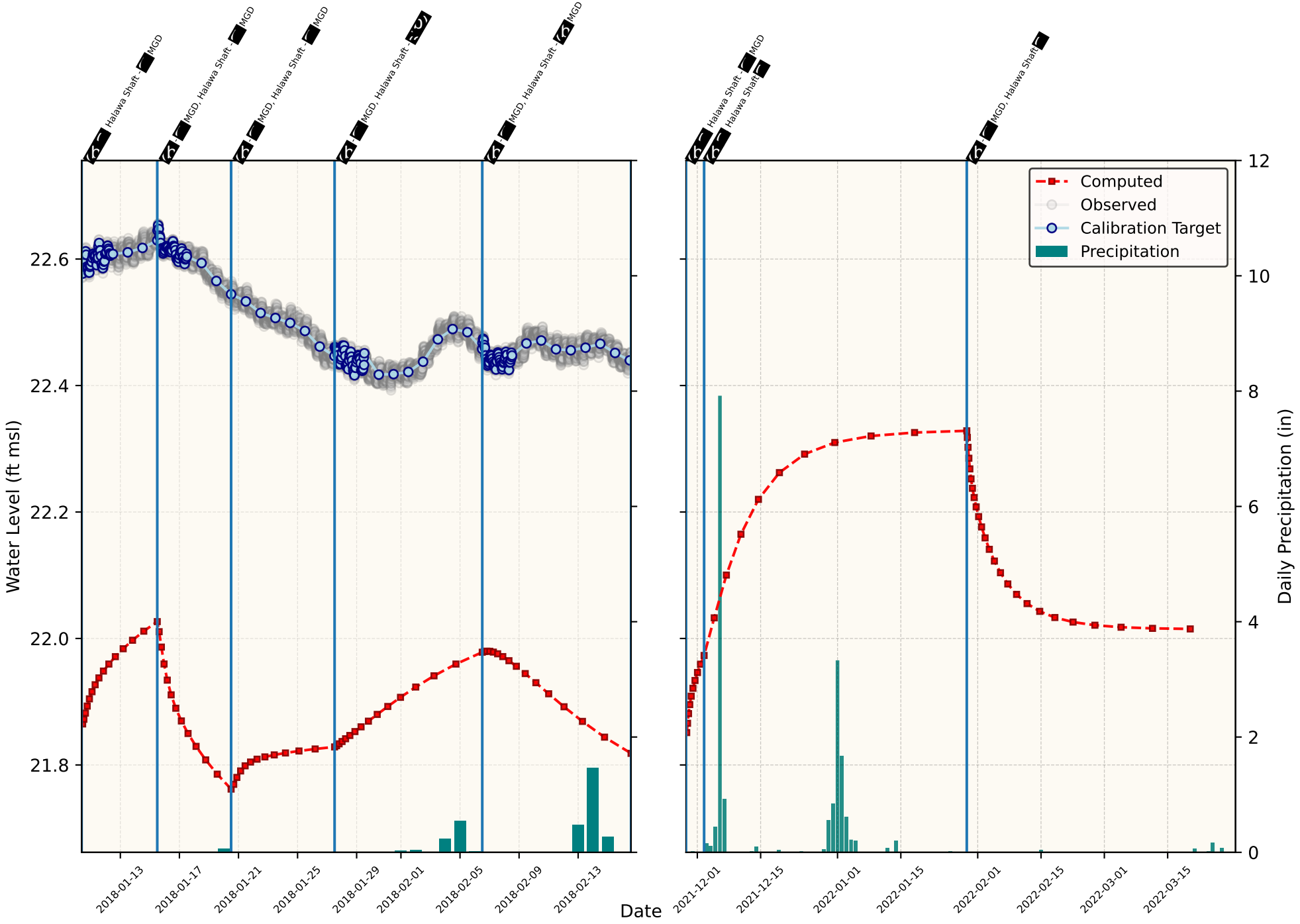
Kaamilo_Deep

Group 2 - Deep Basal Wells



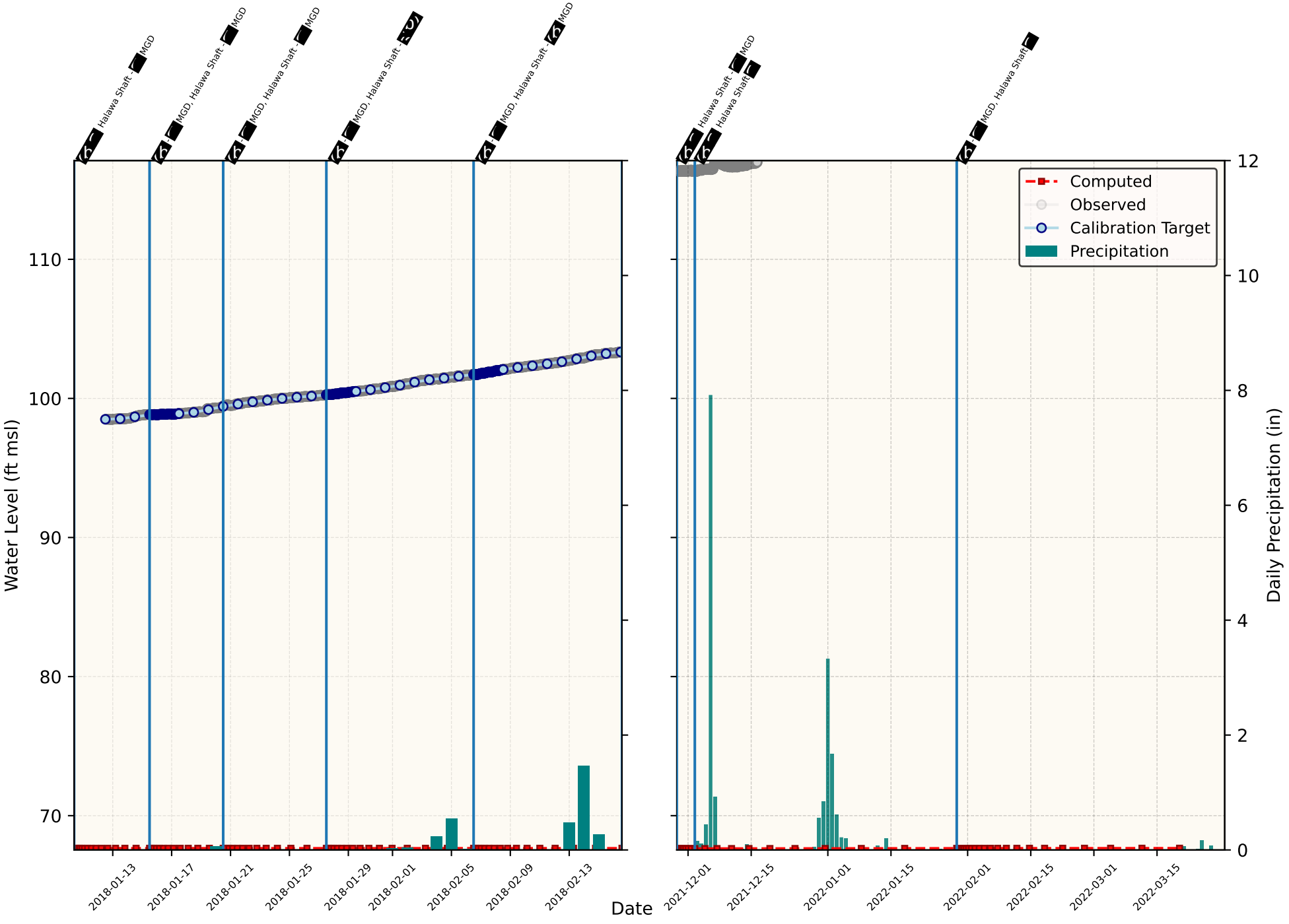
RHMW[redacted]

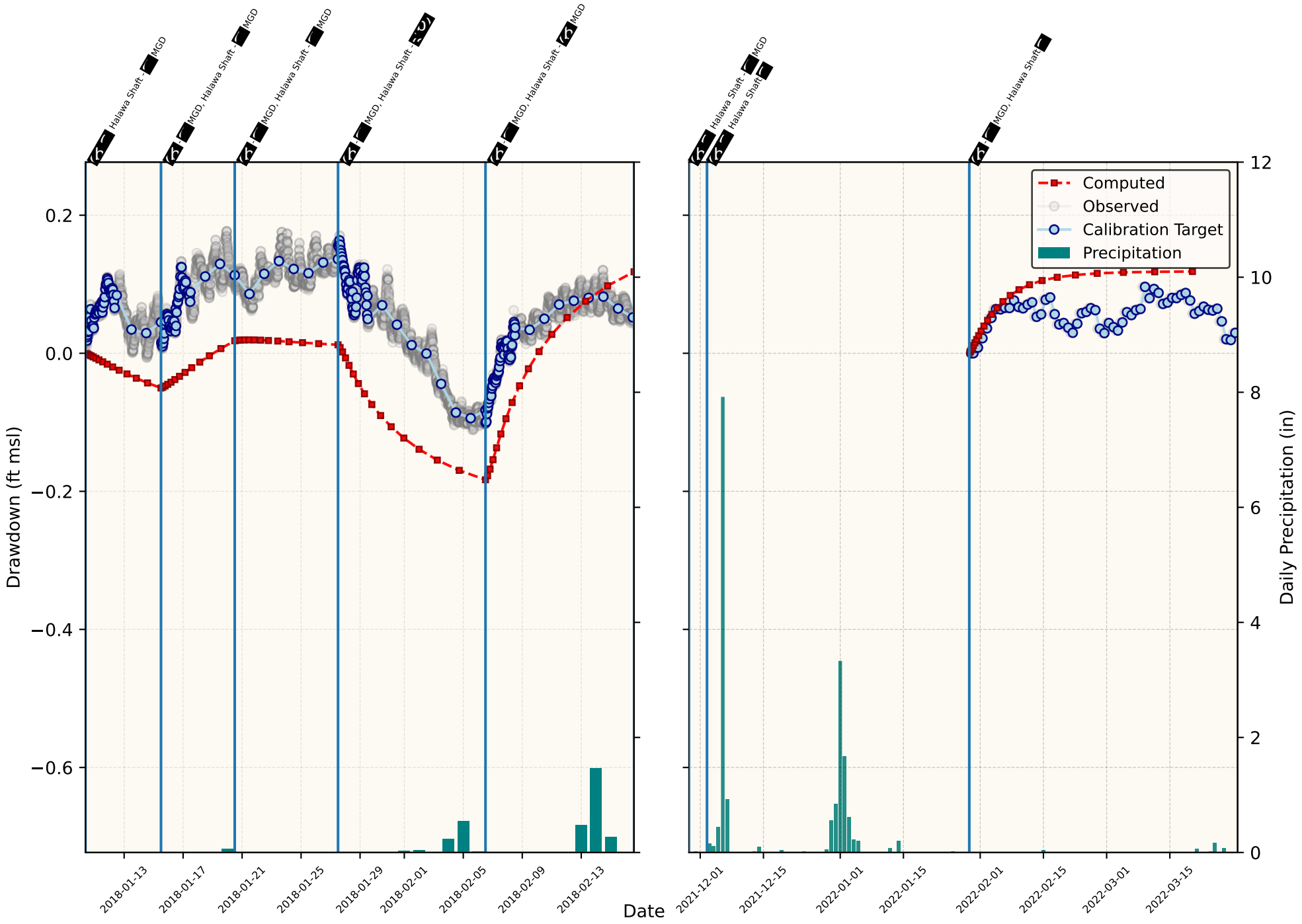
Group 3 - Saprolite/Confining Unit Well with Elevated Head



RHMW[redacted] (b)(9)

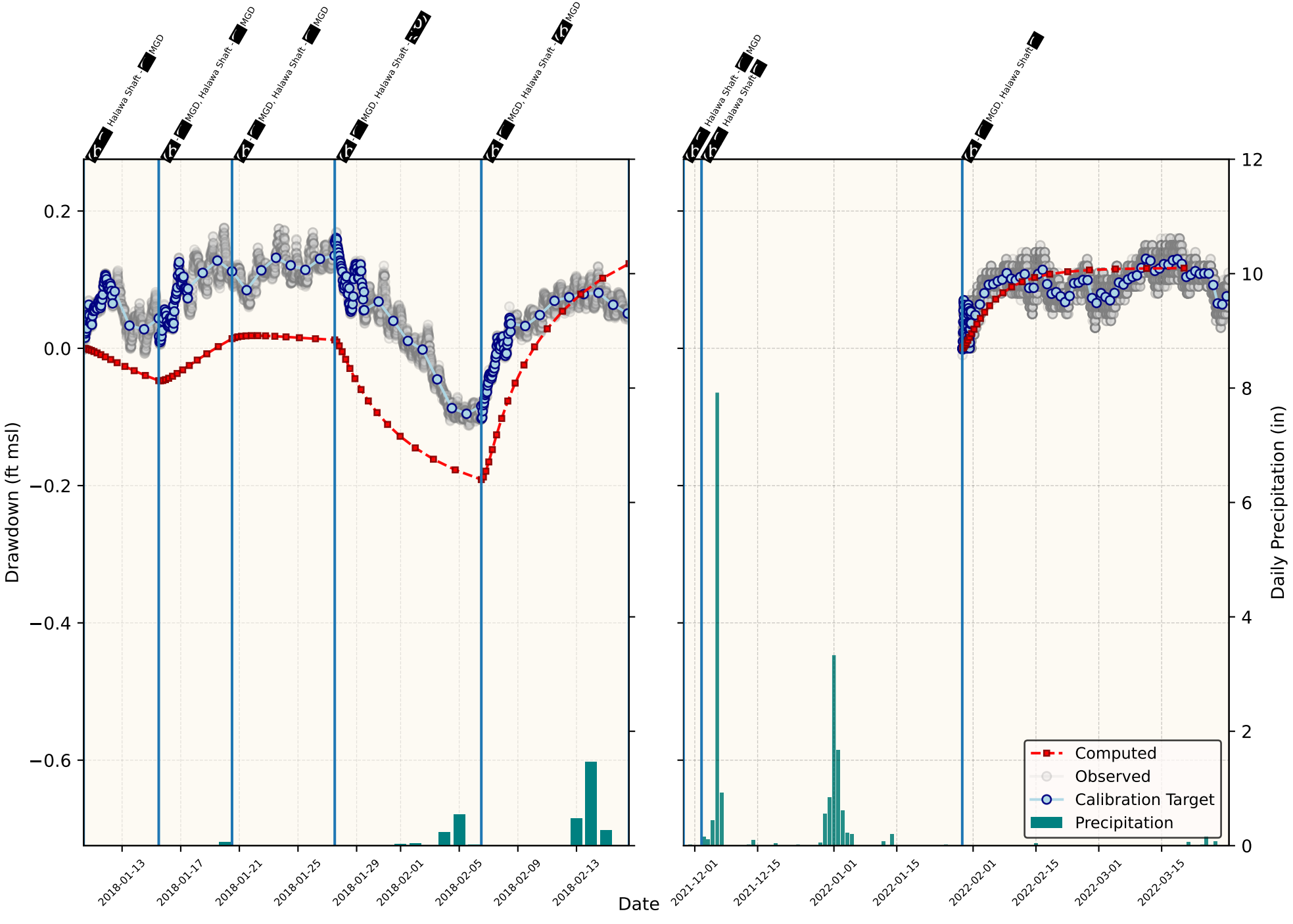
Group 3 - Saprolite/Confining Unit Well with Elevated Head

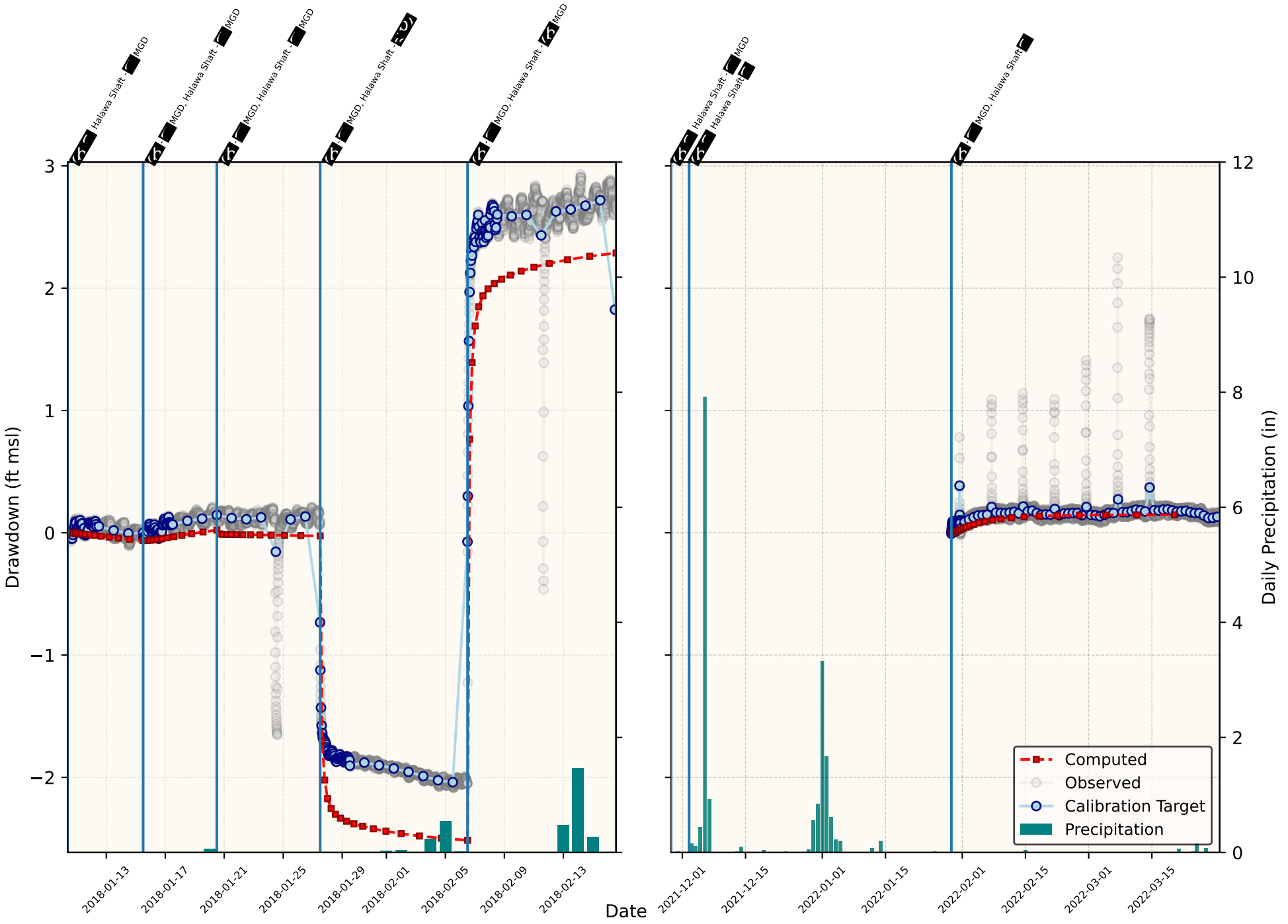


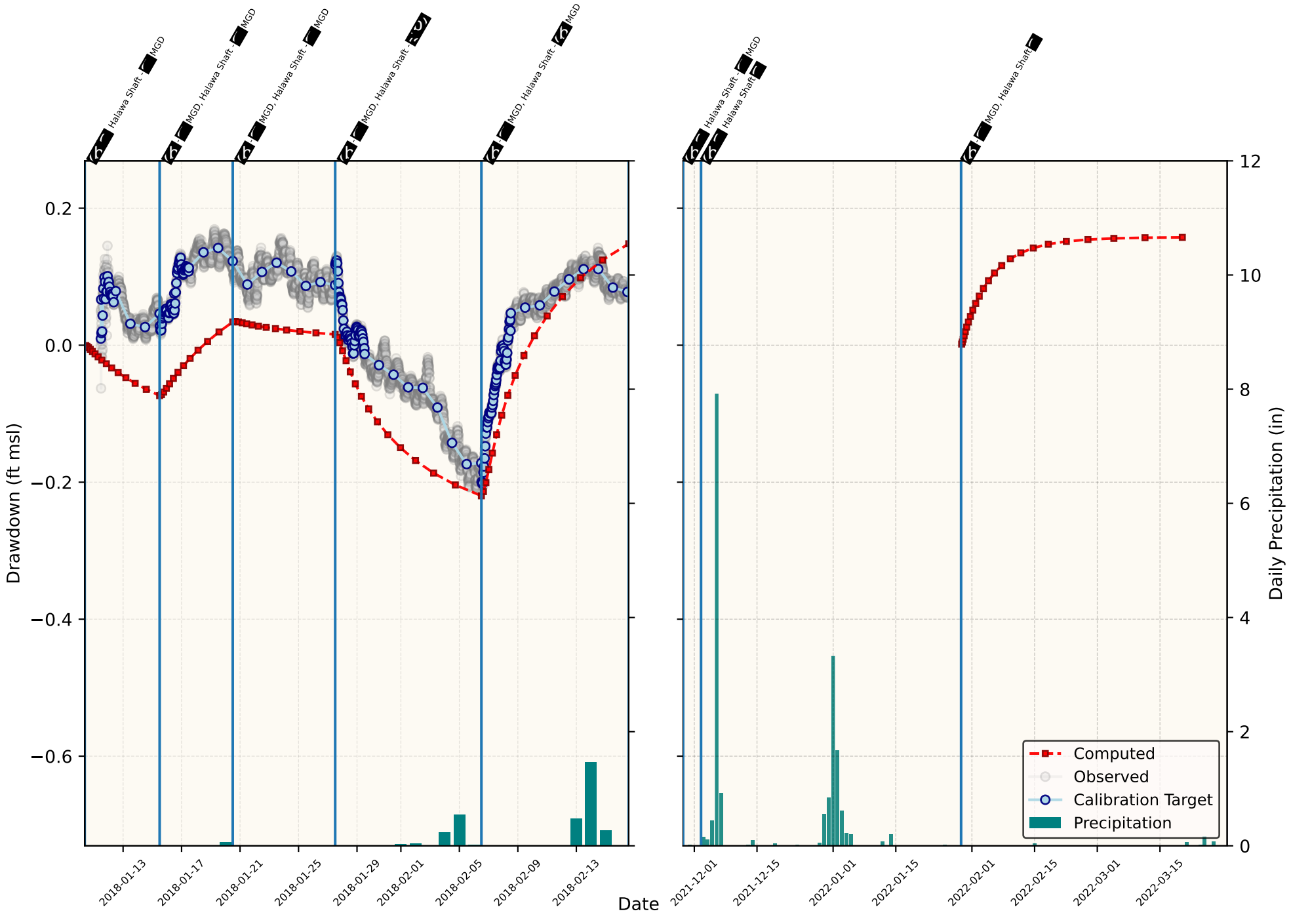

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-15

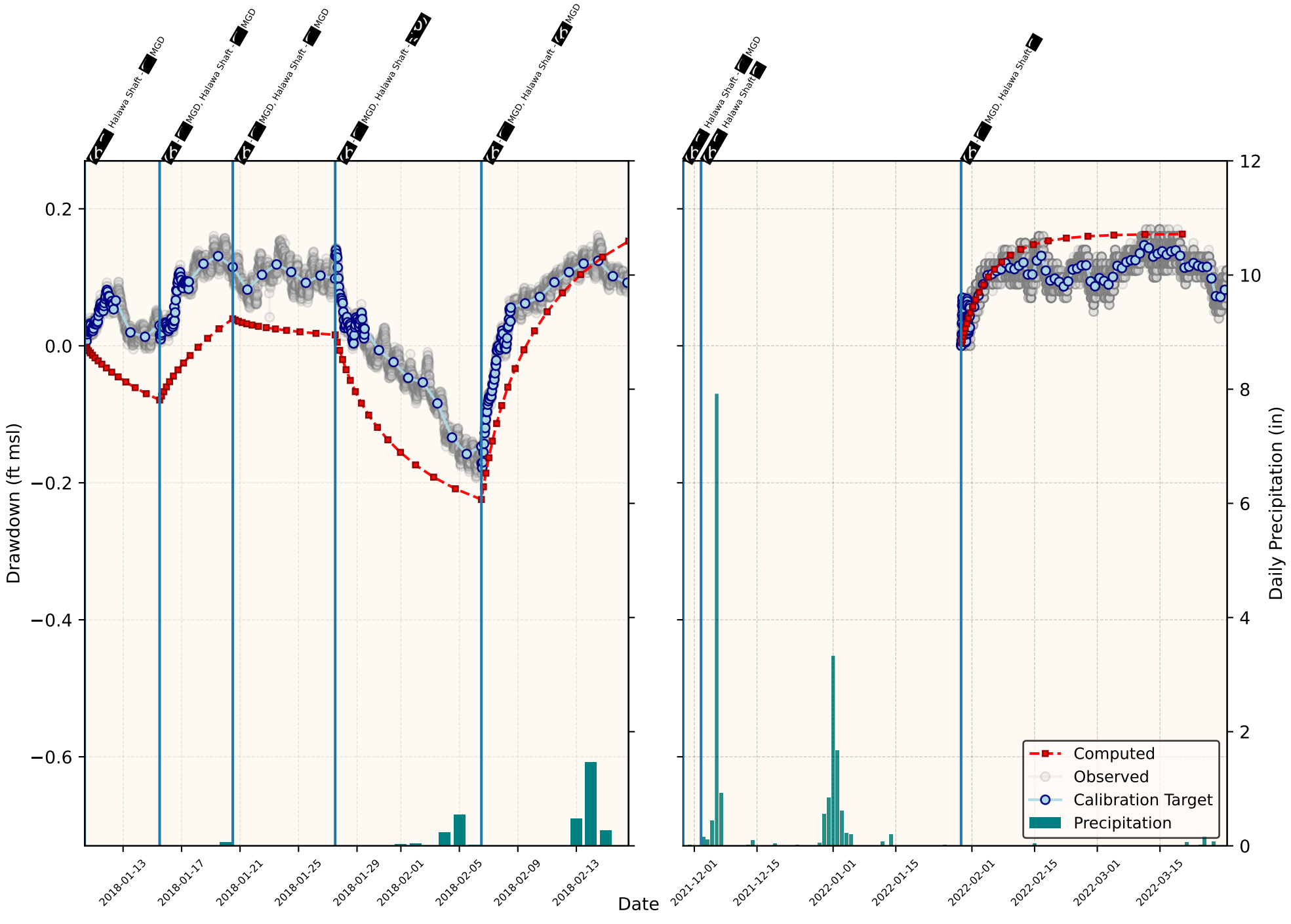
(b)(3) [redacted]

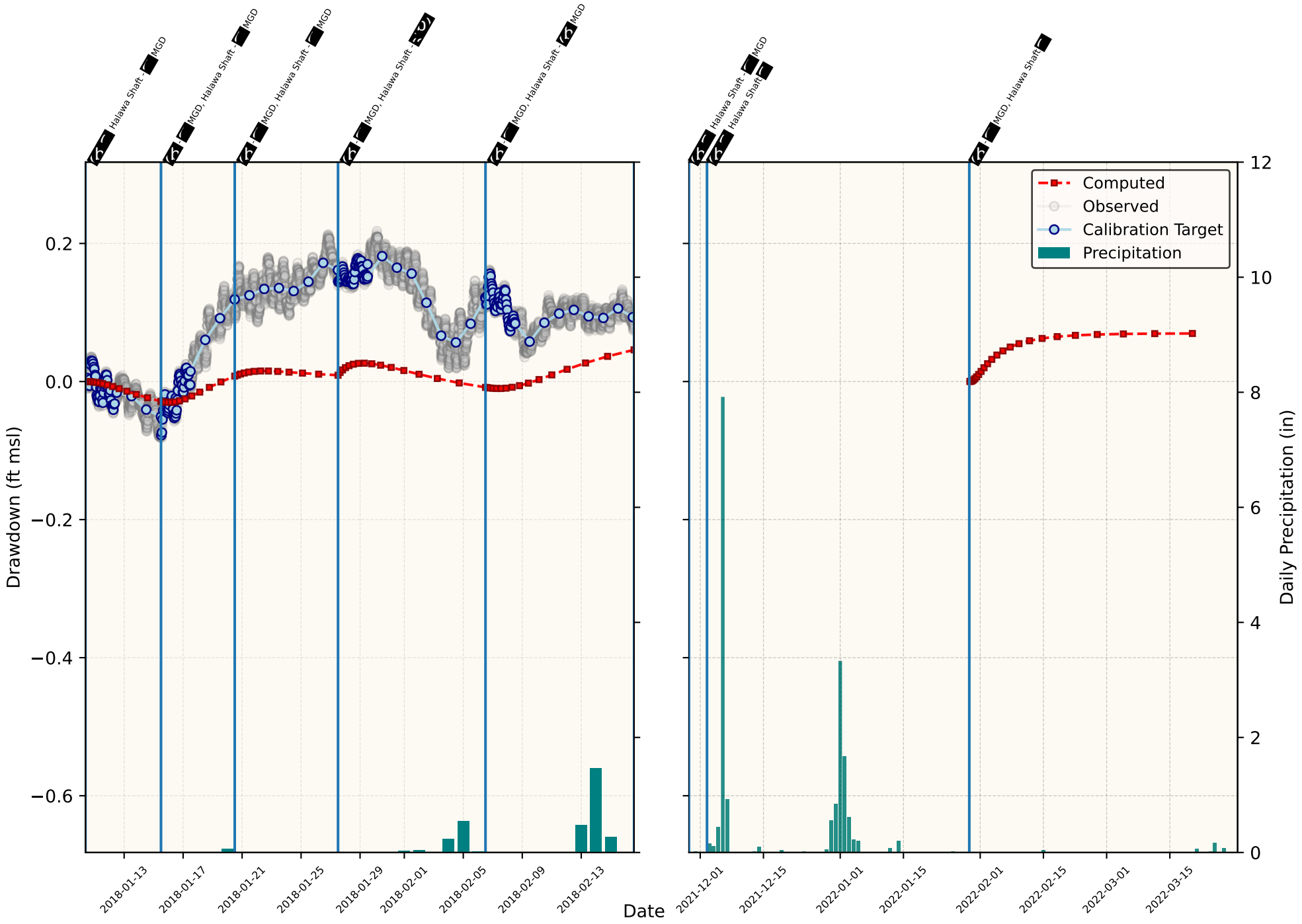
Group 1 - Basal Aquifer

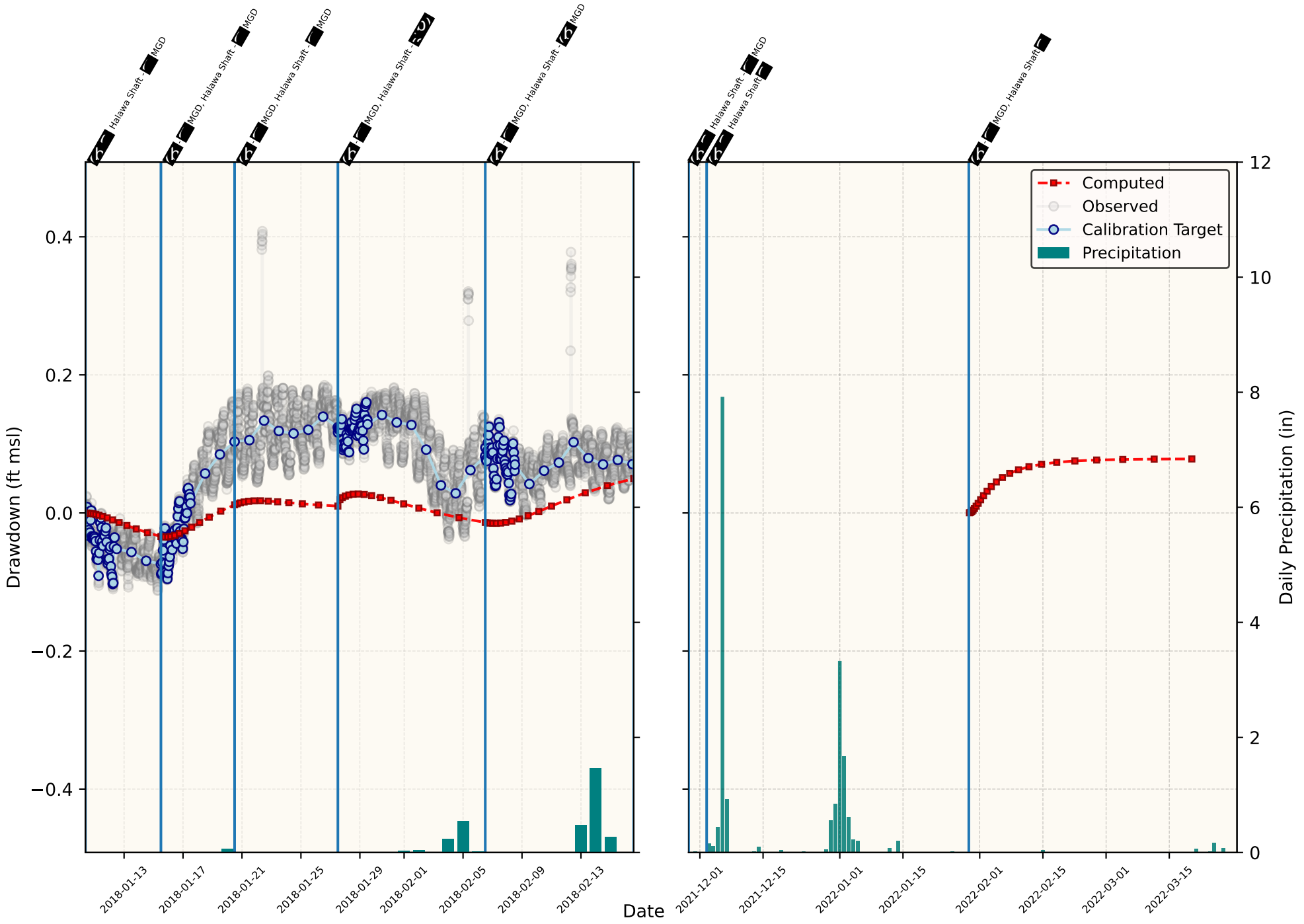


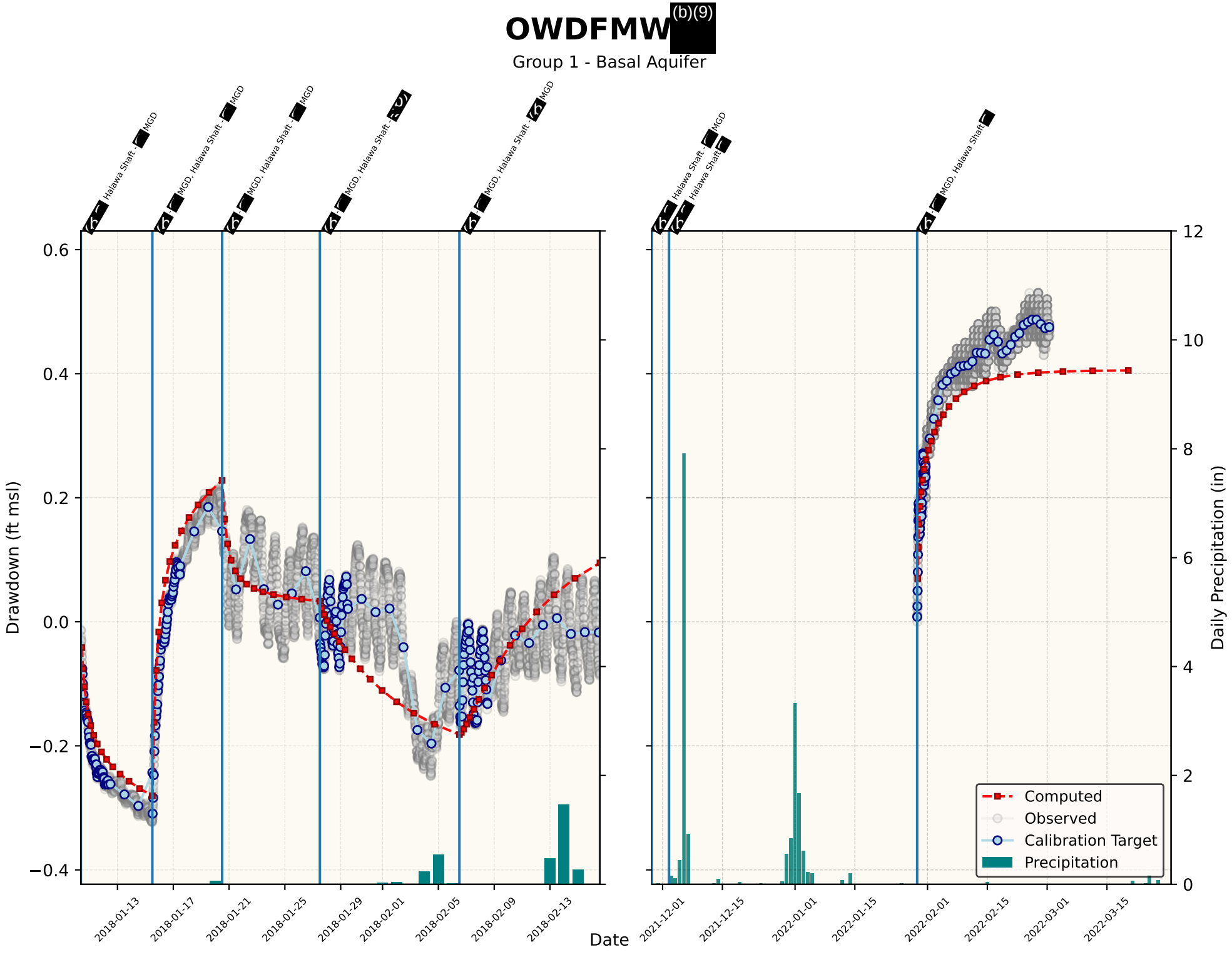

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

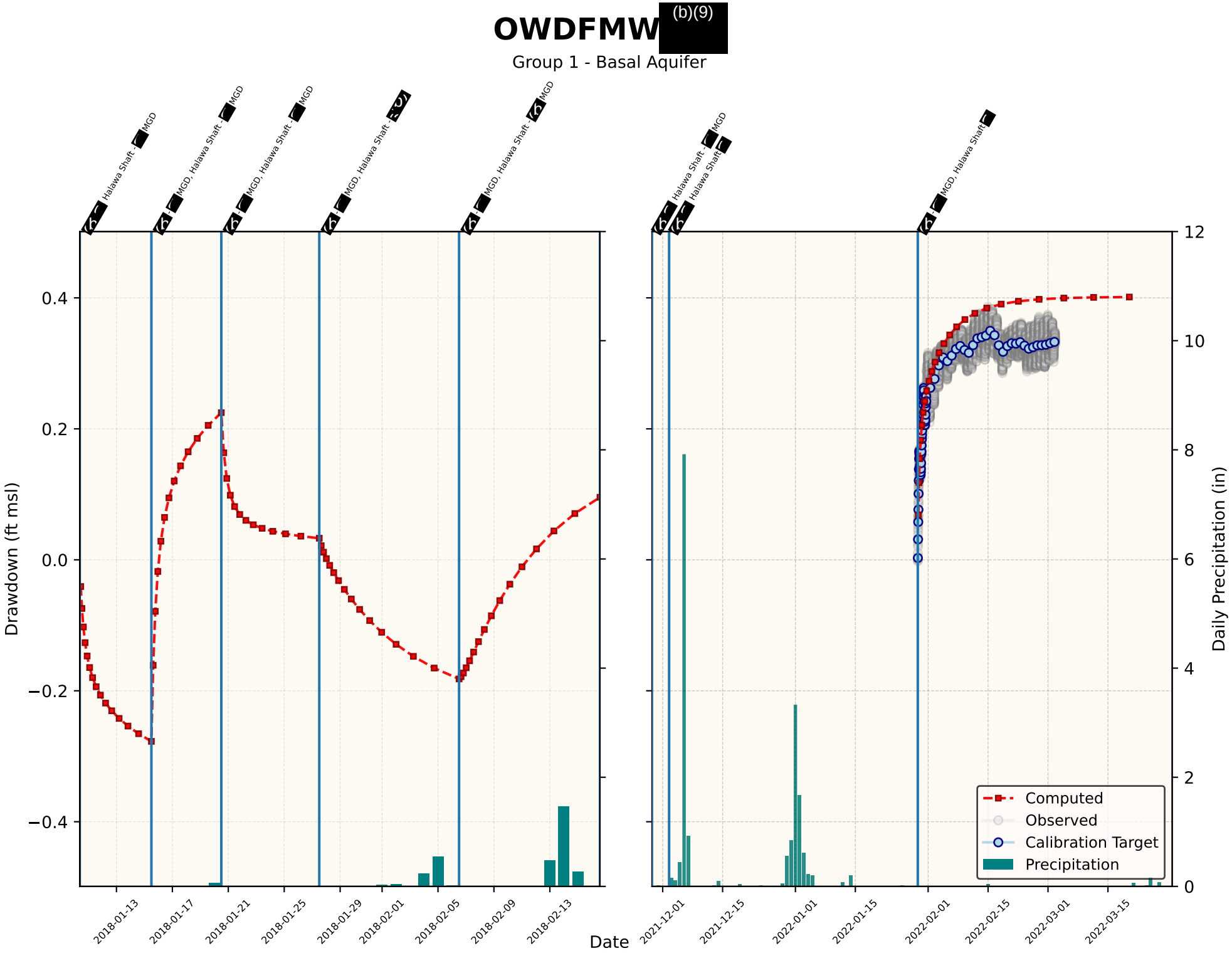

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

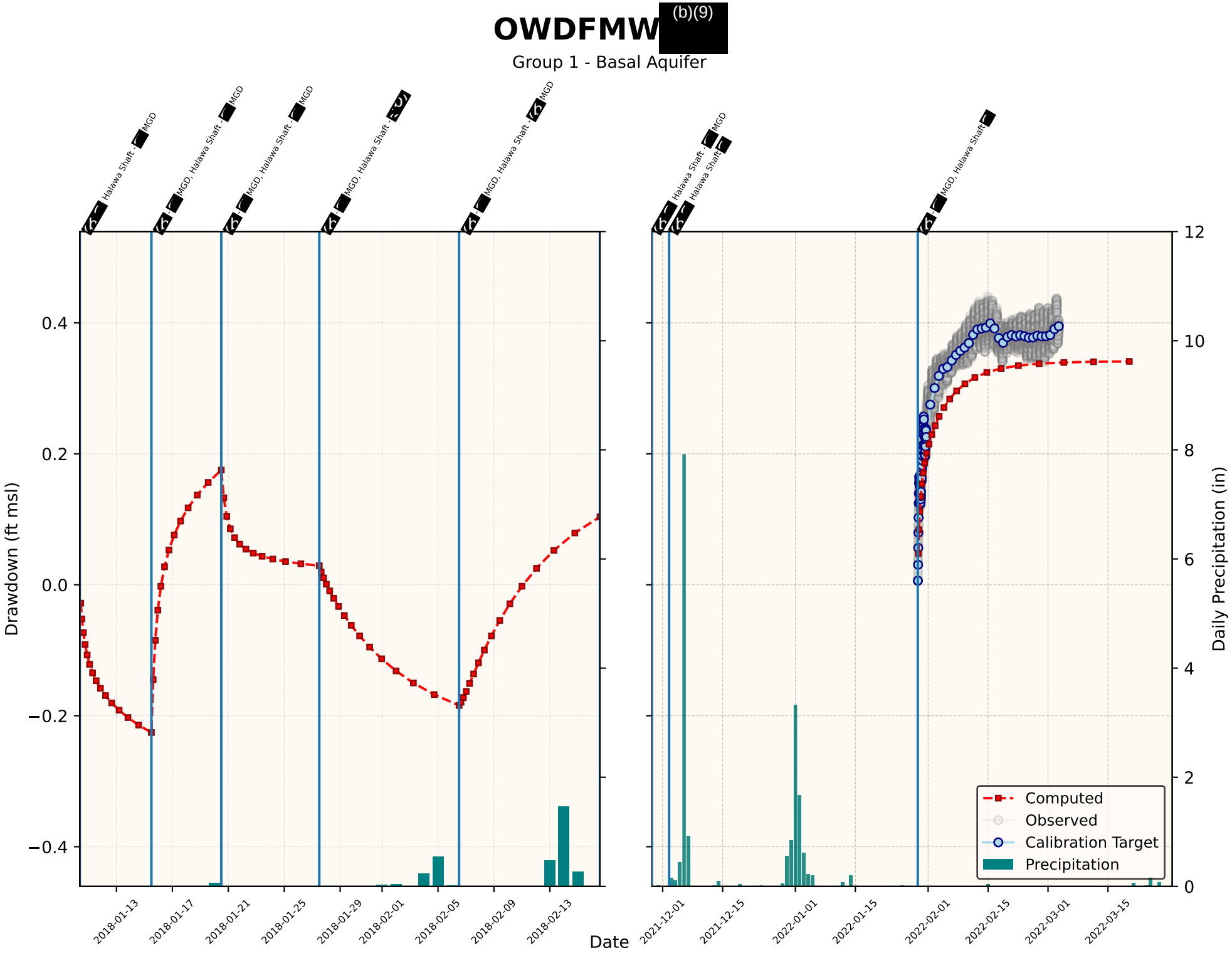

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

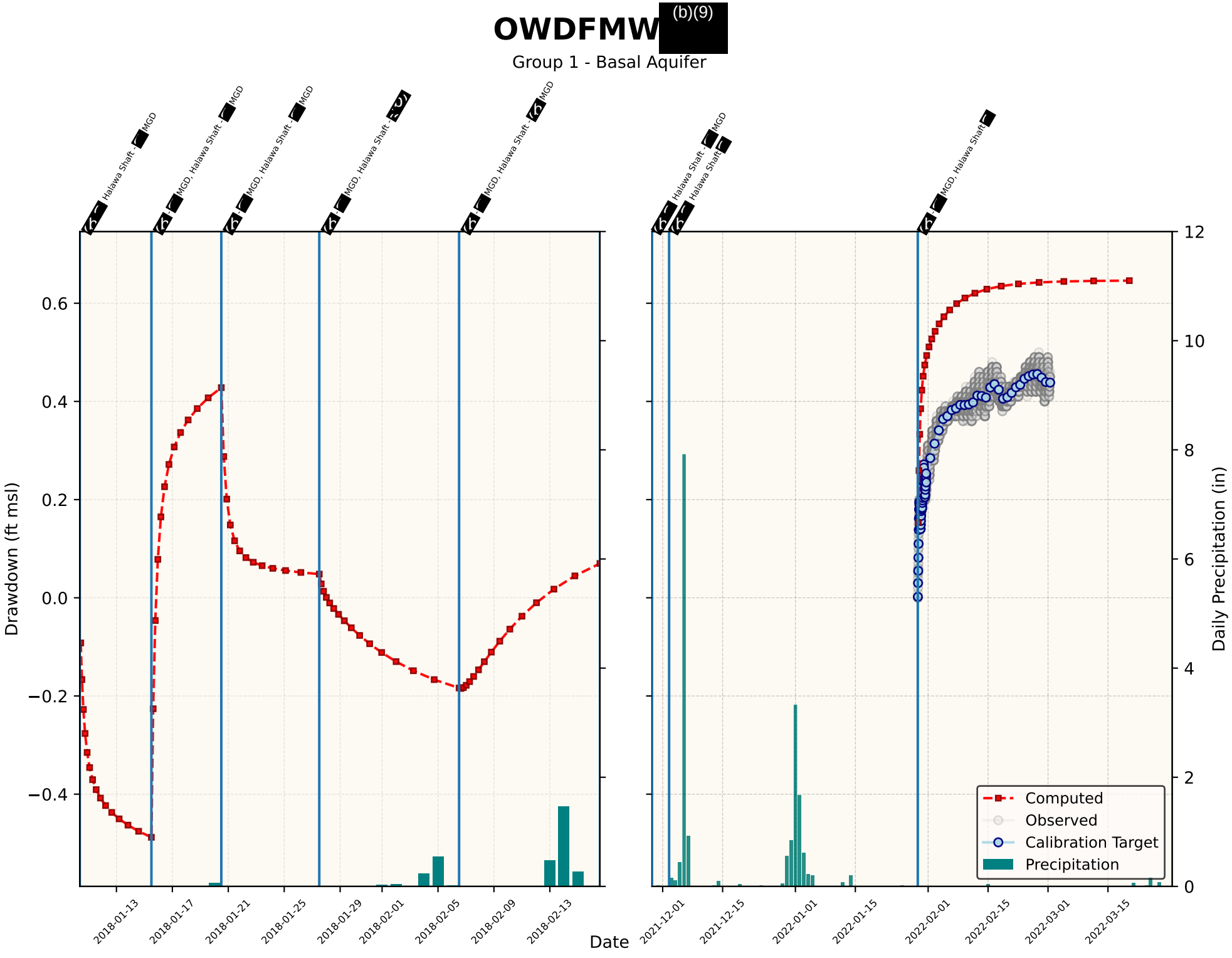

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
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2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

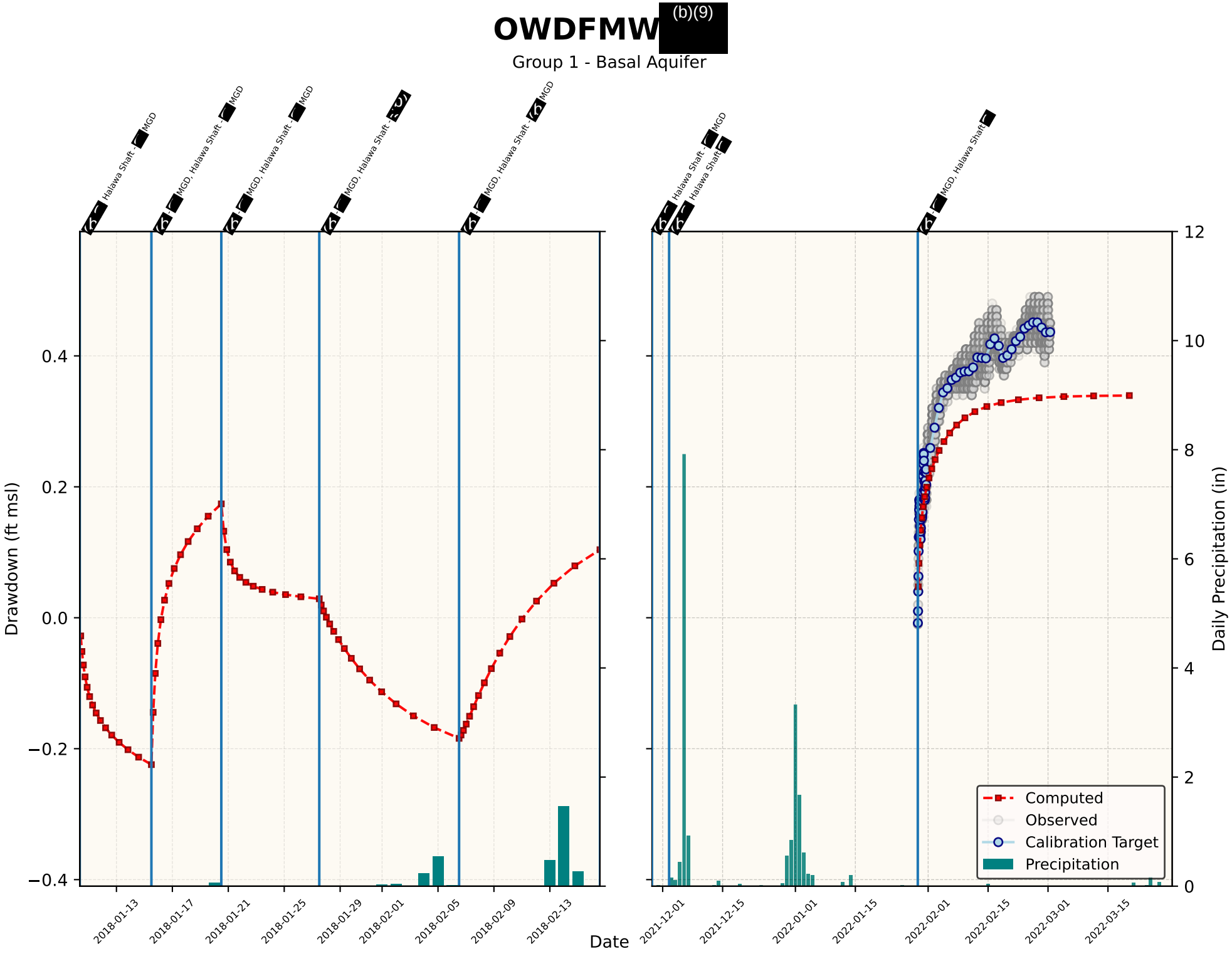

Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

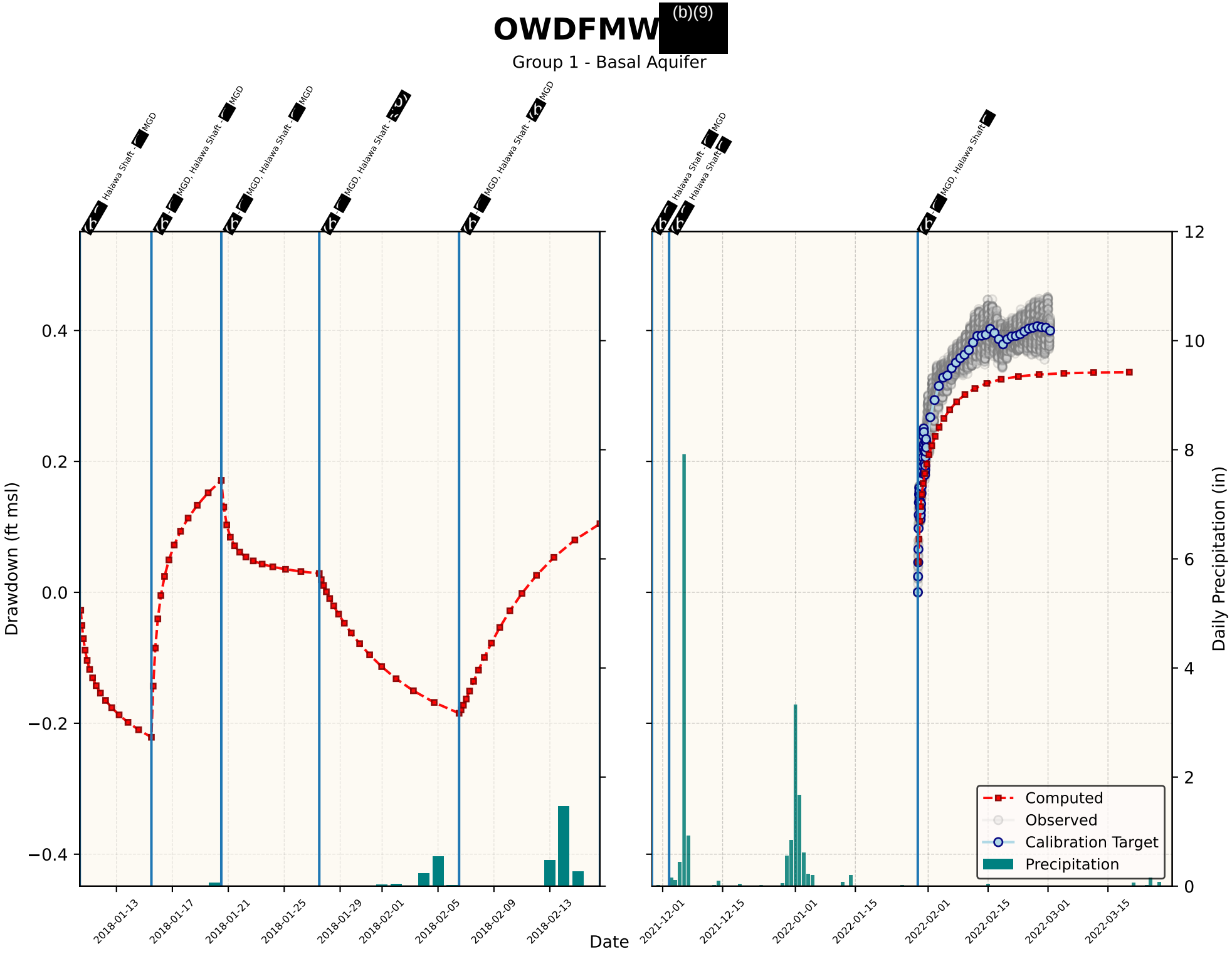

OWDFMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

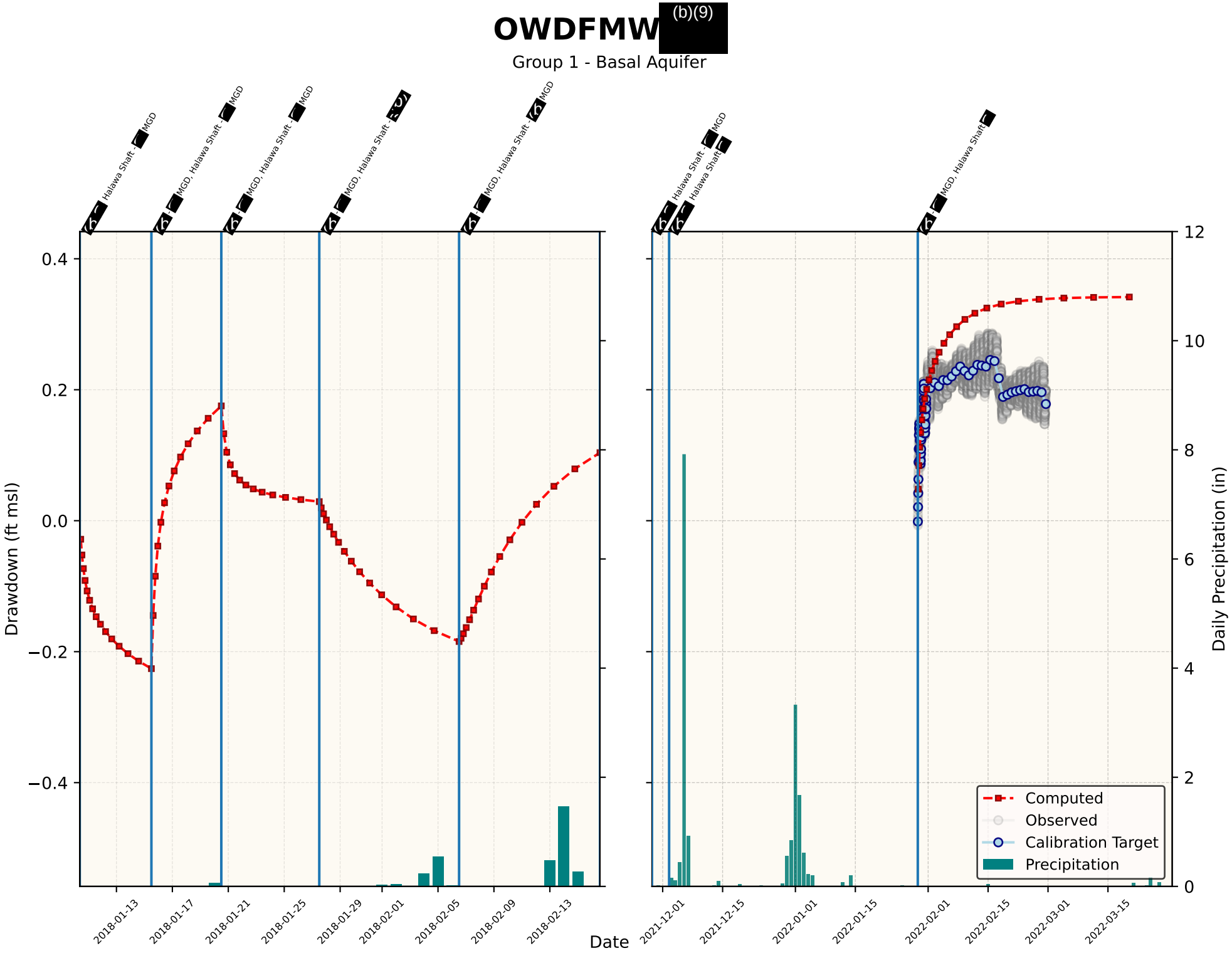

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

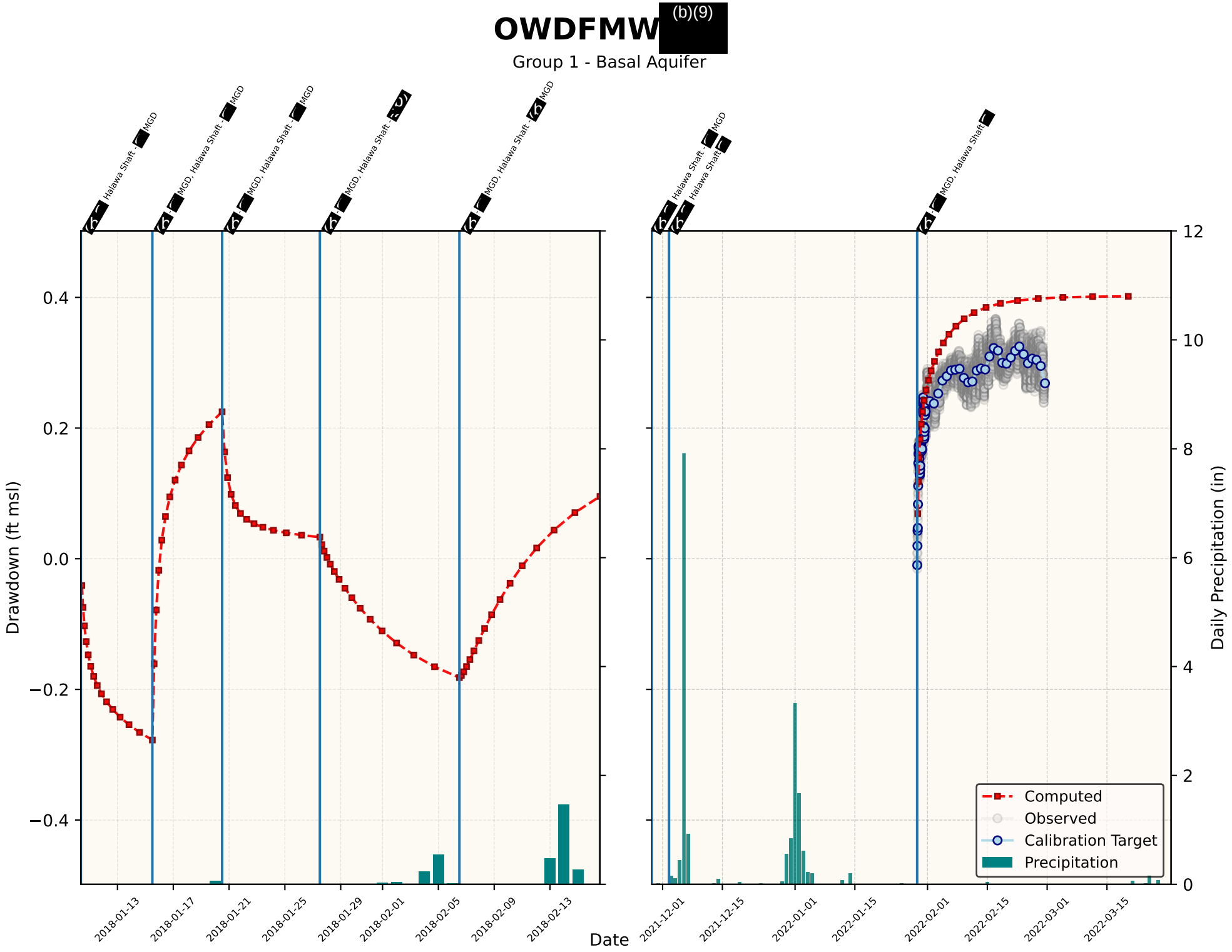

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

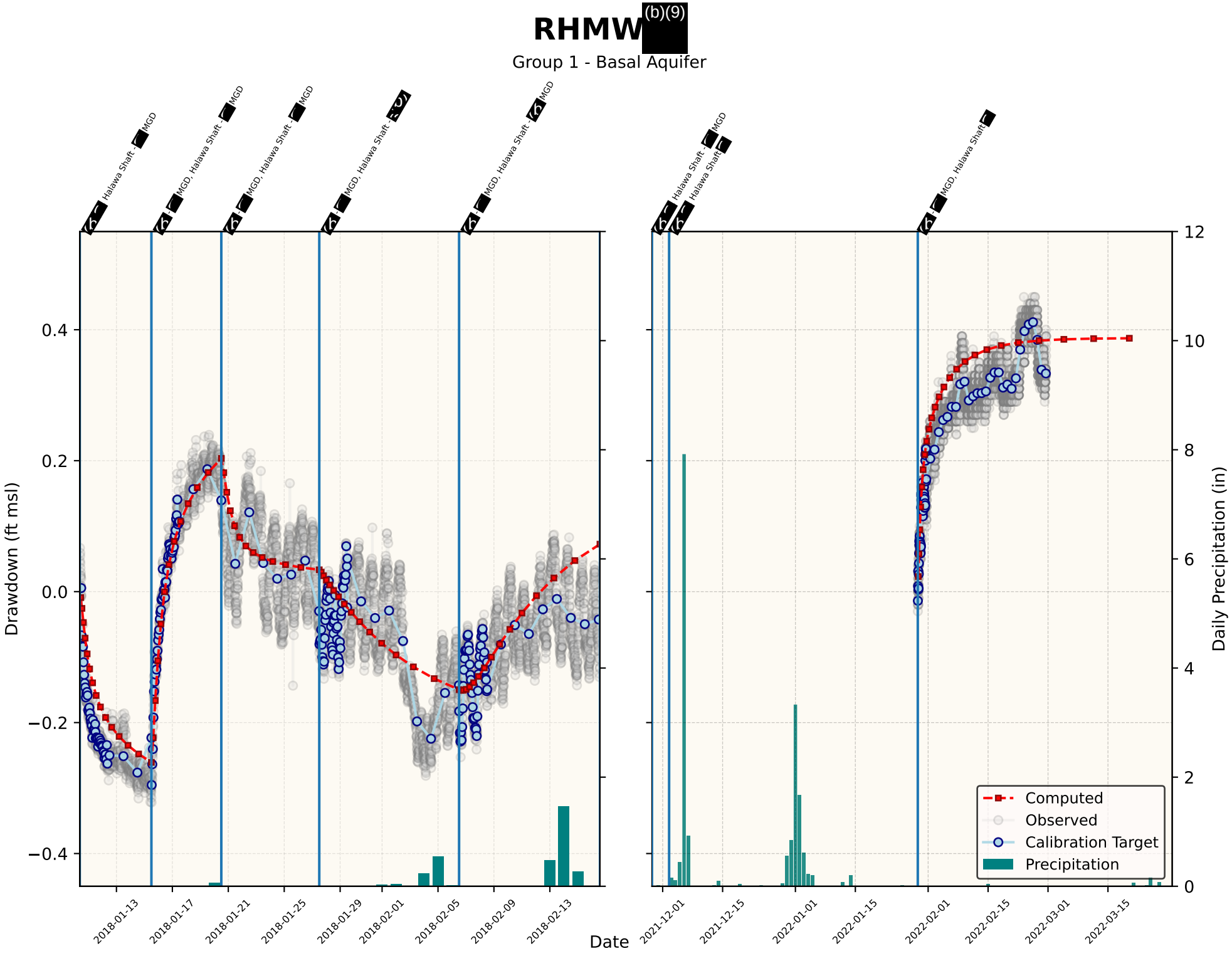

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

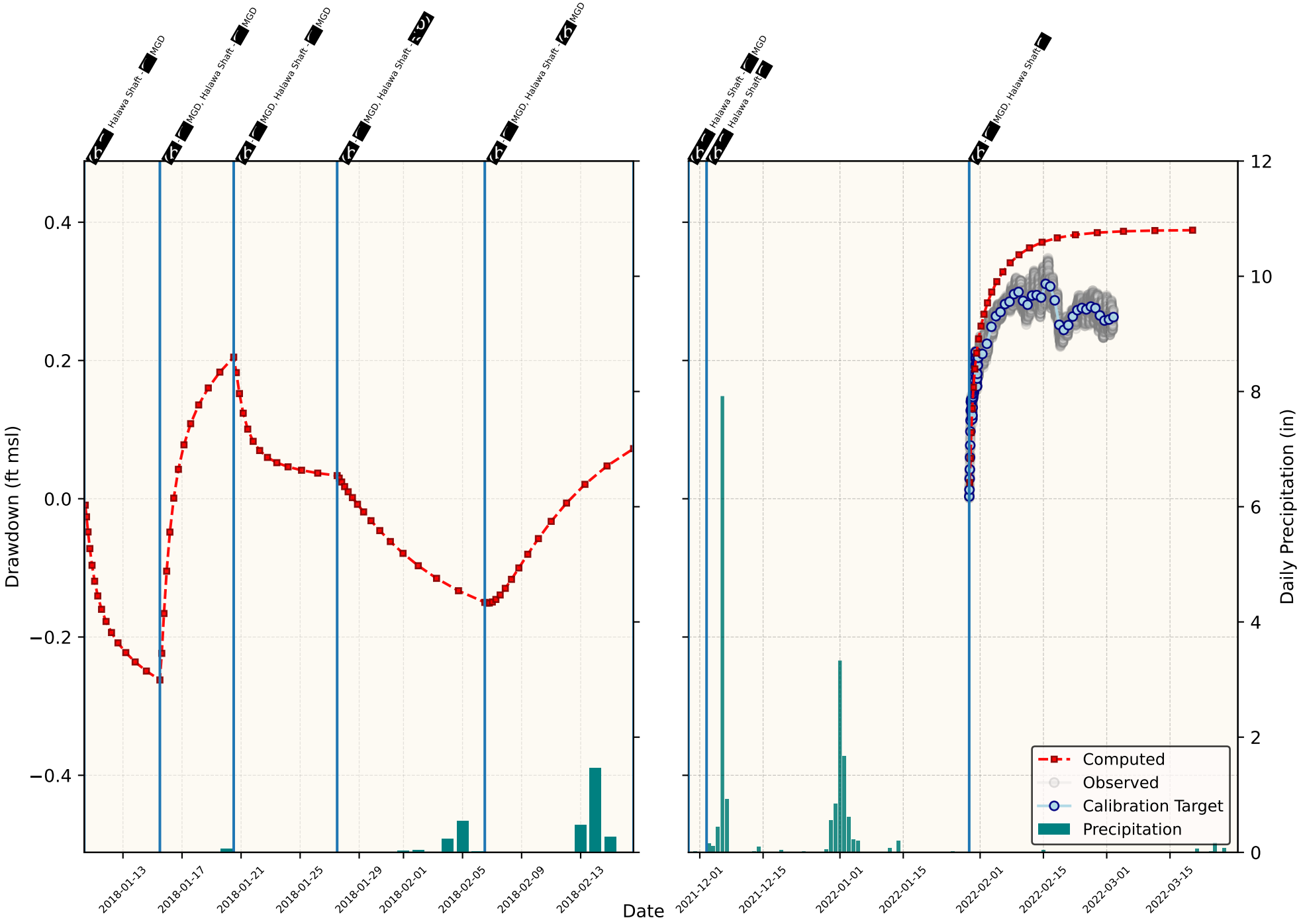

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation

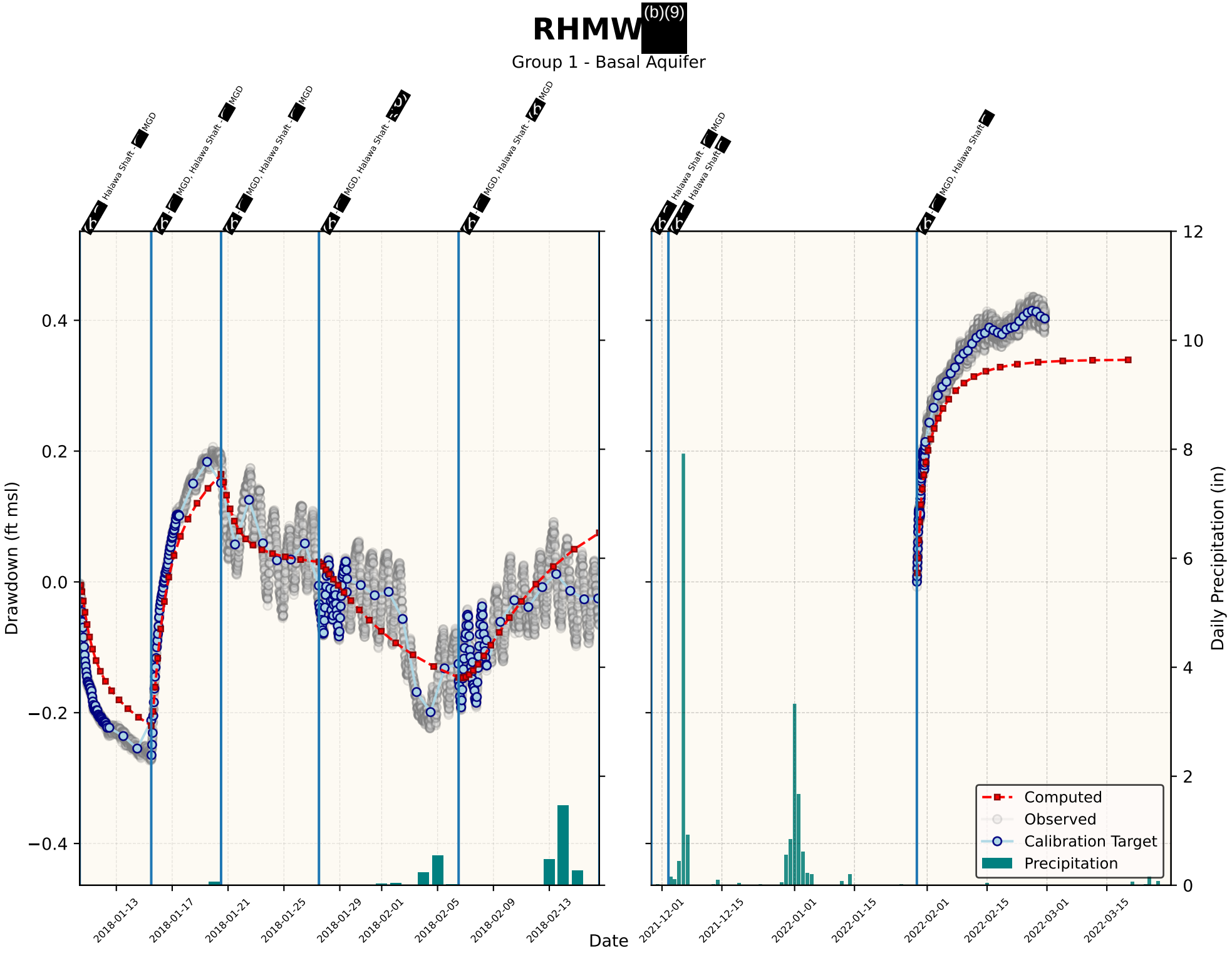

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

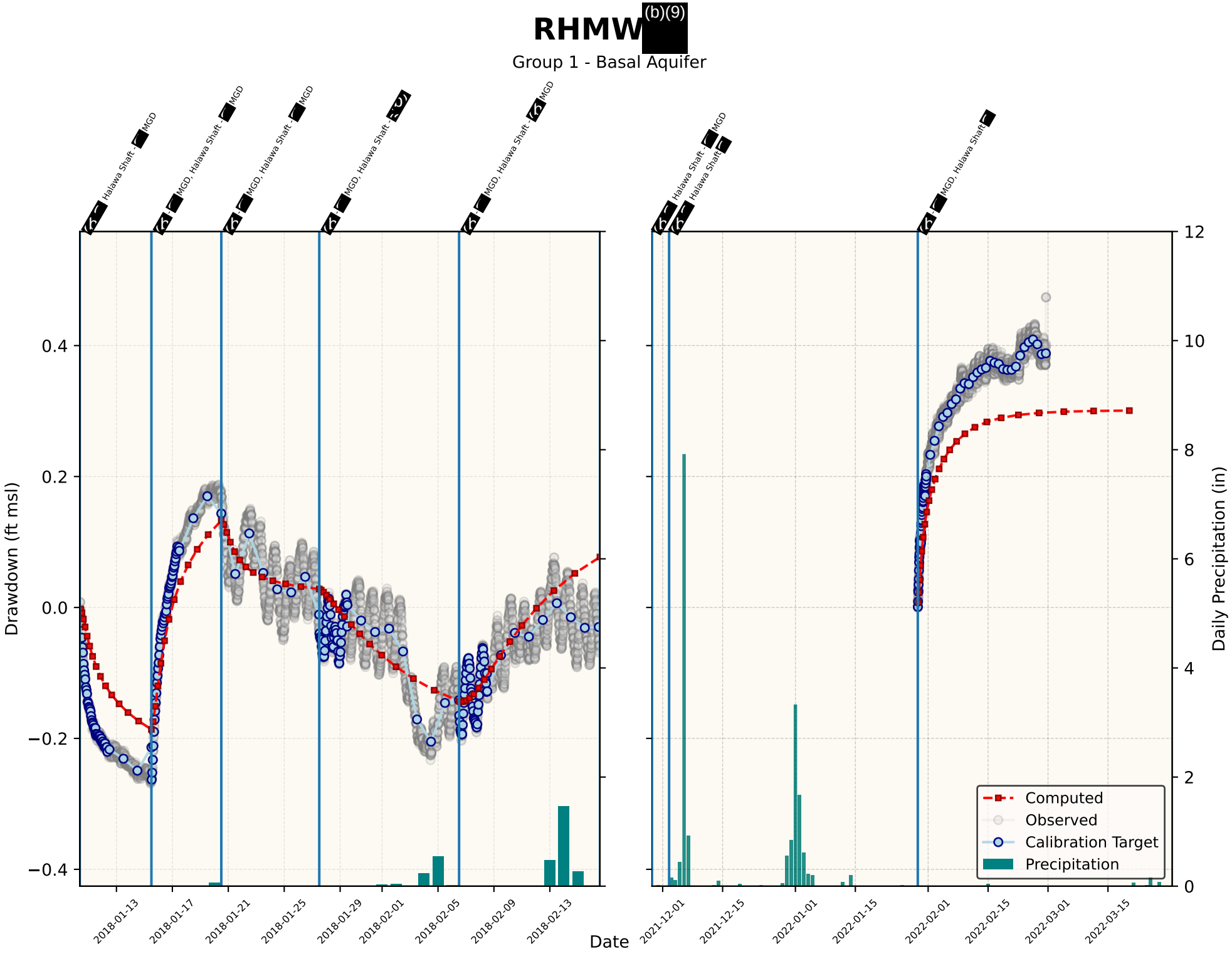

RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-01
2022-03-15
Date

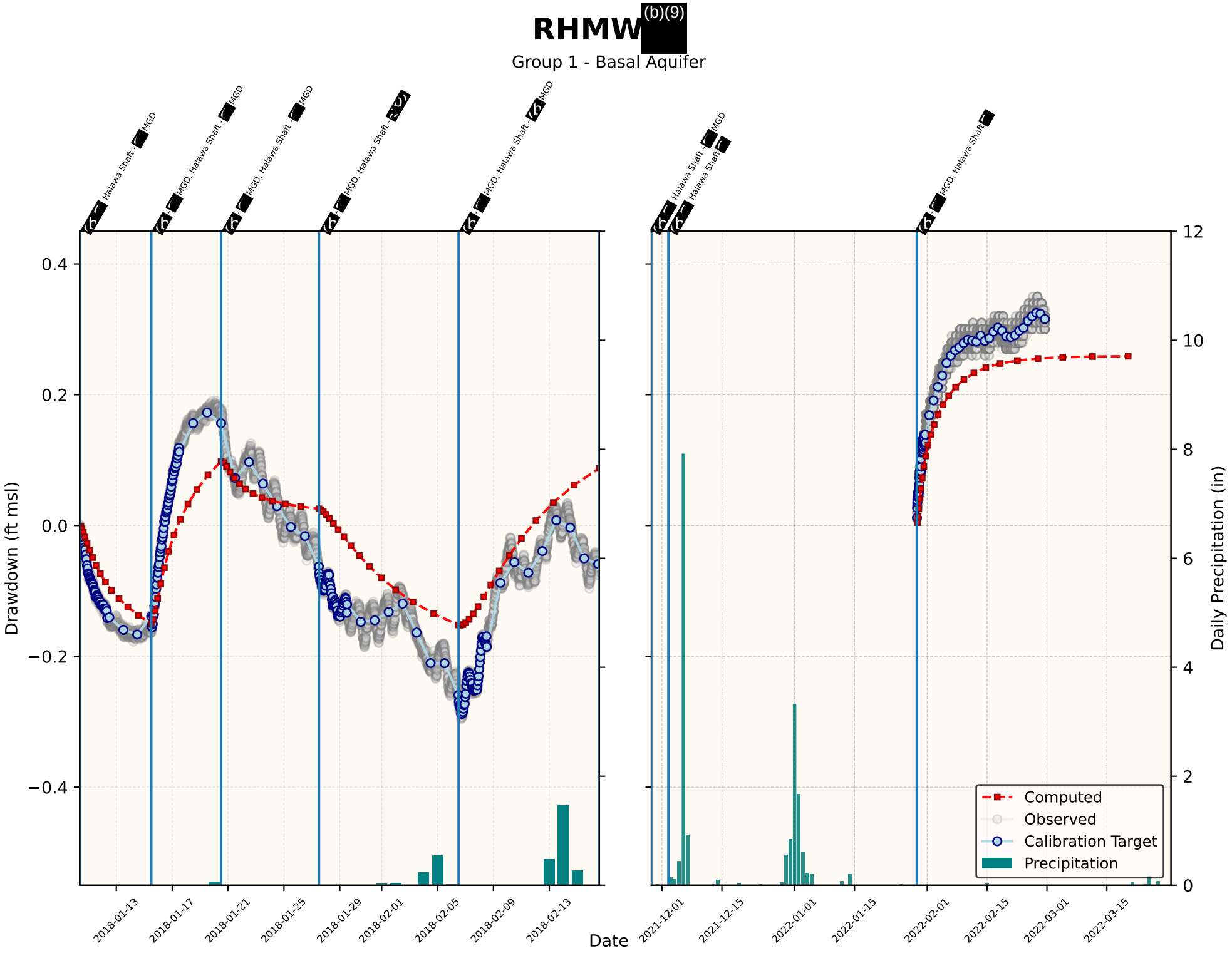
RHMW[redacted] (b)(9)

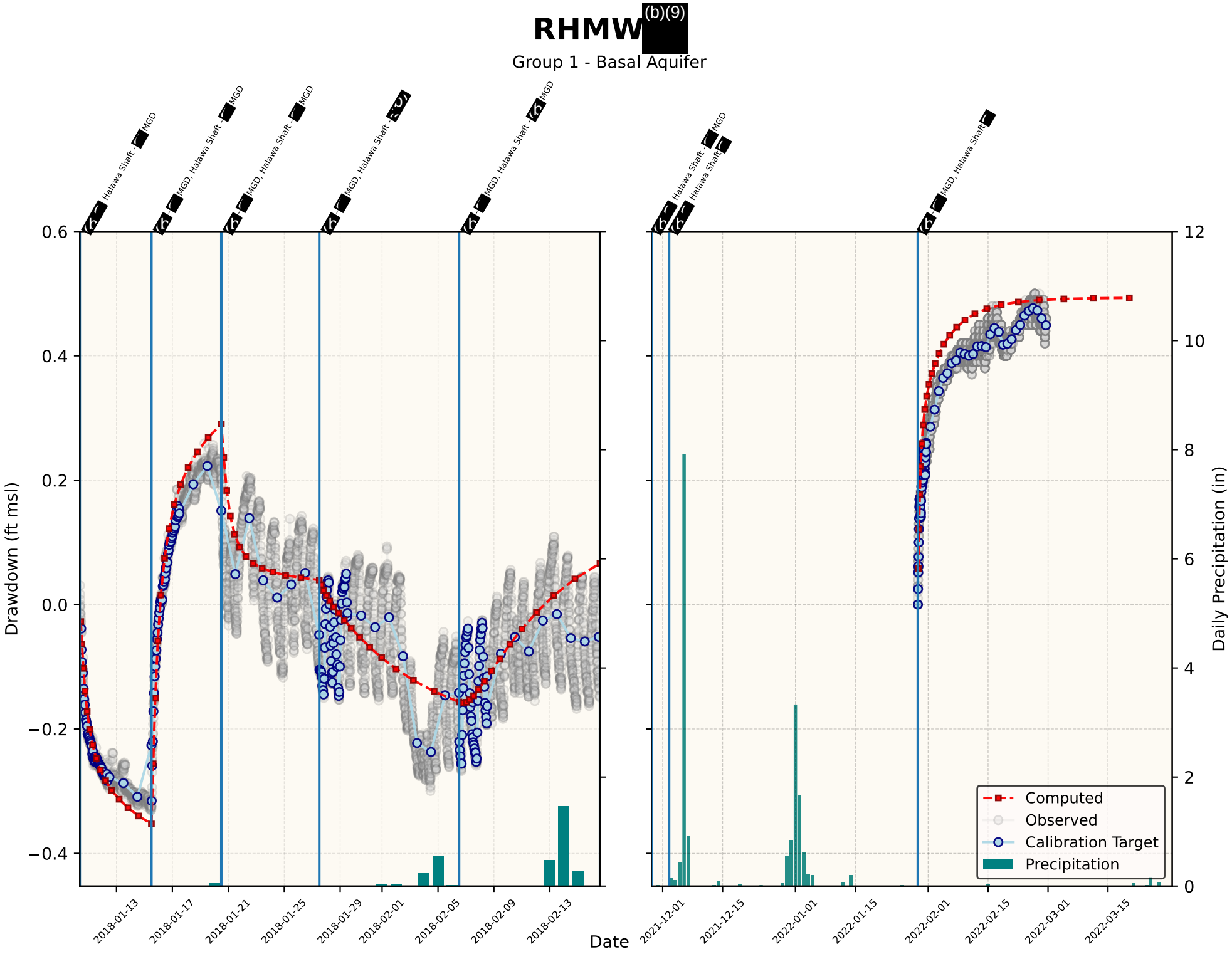
Group 1 - Basal Aquifer

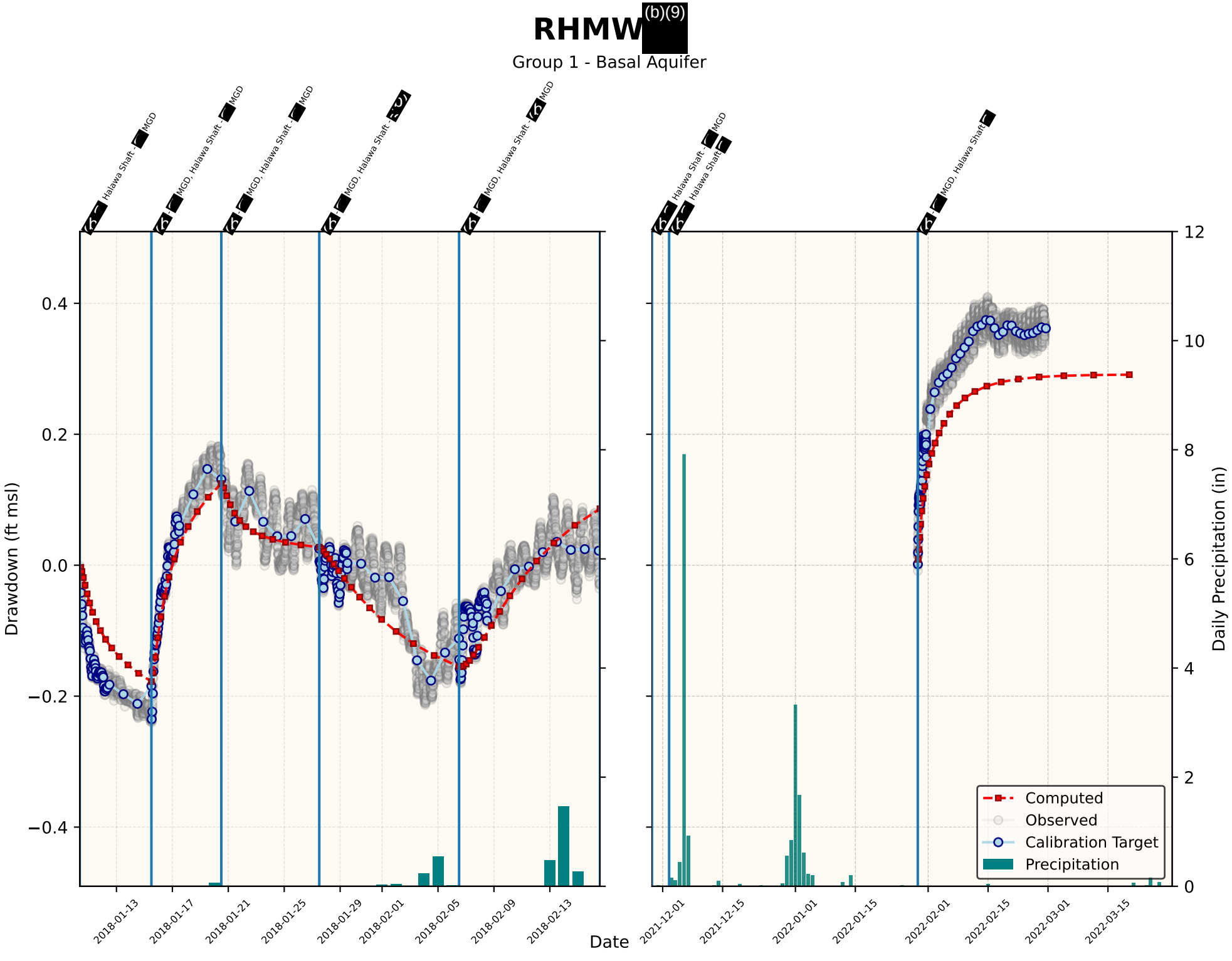


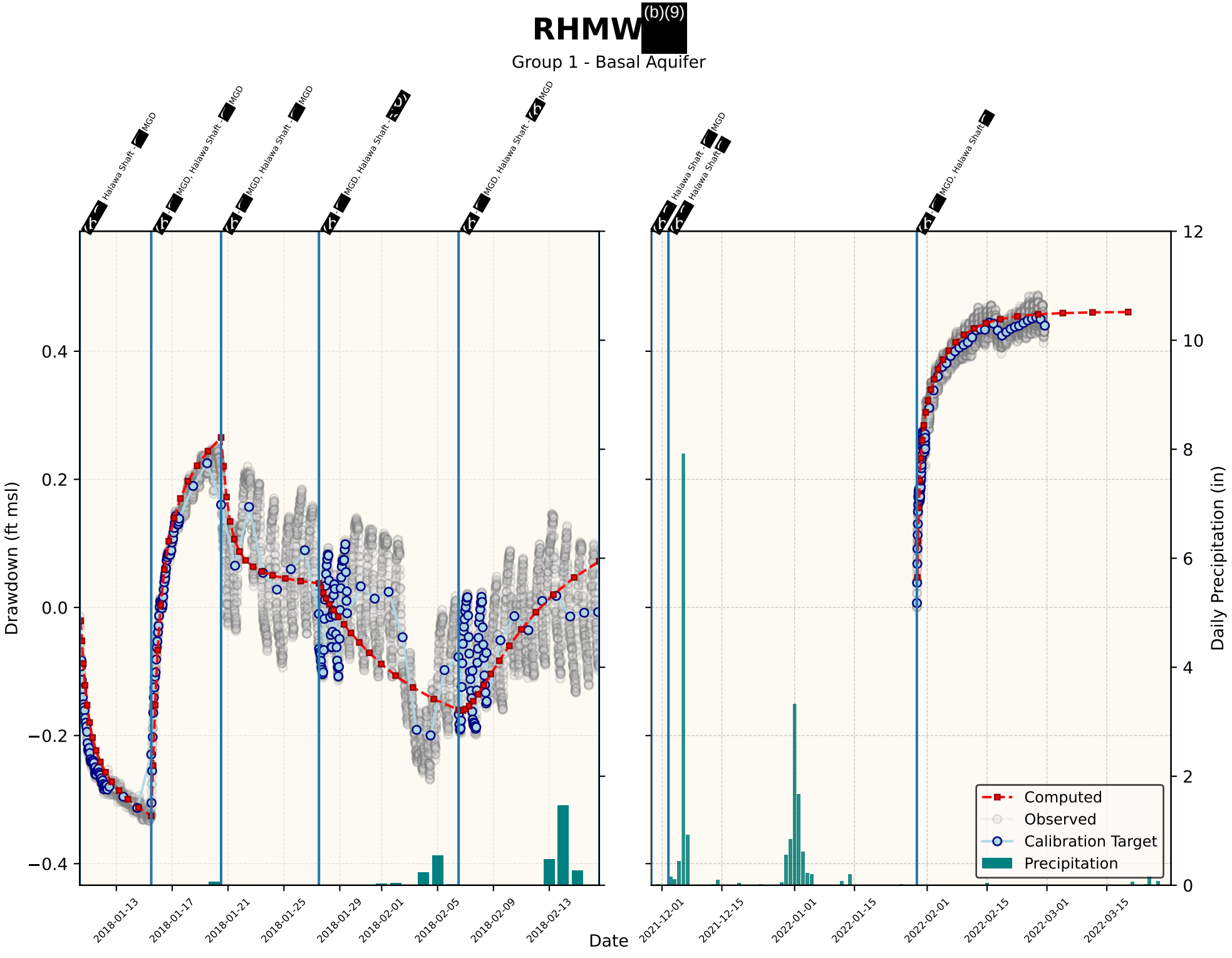

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date

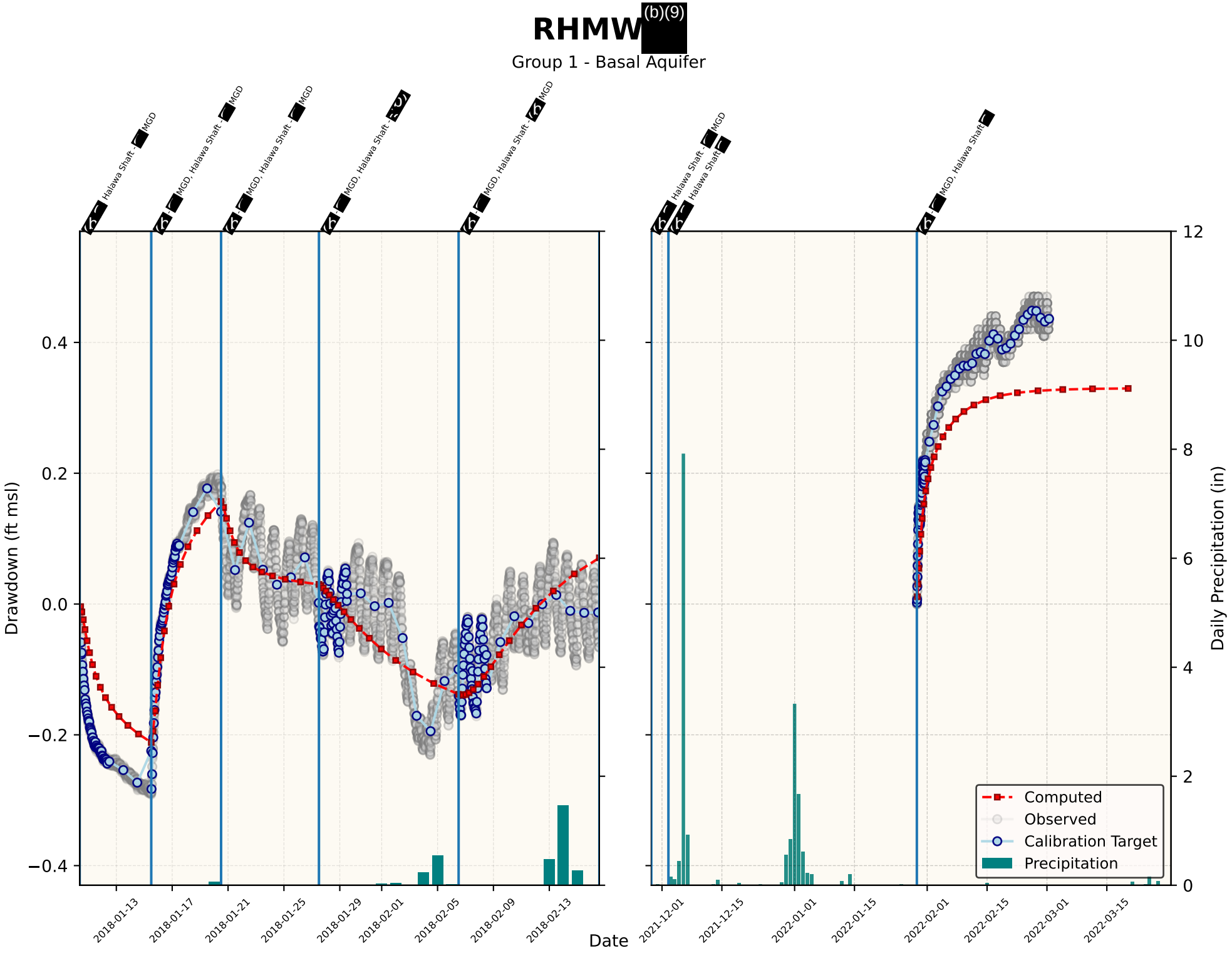

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

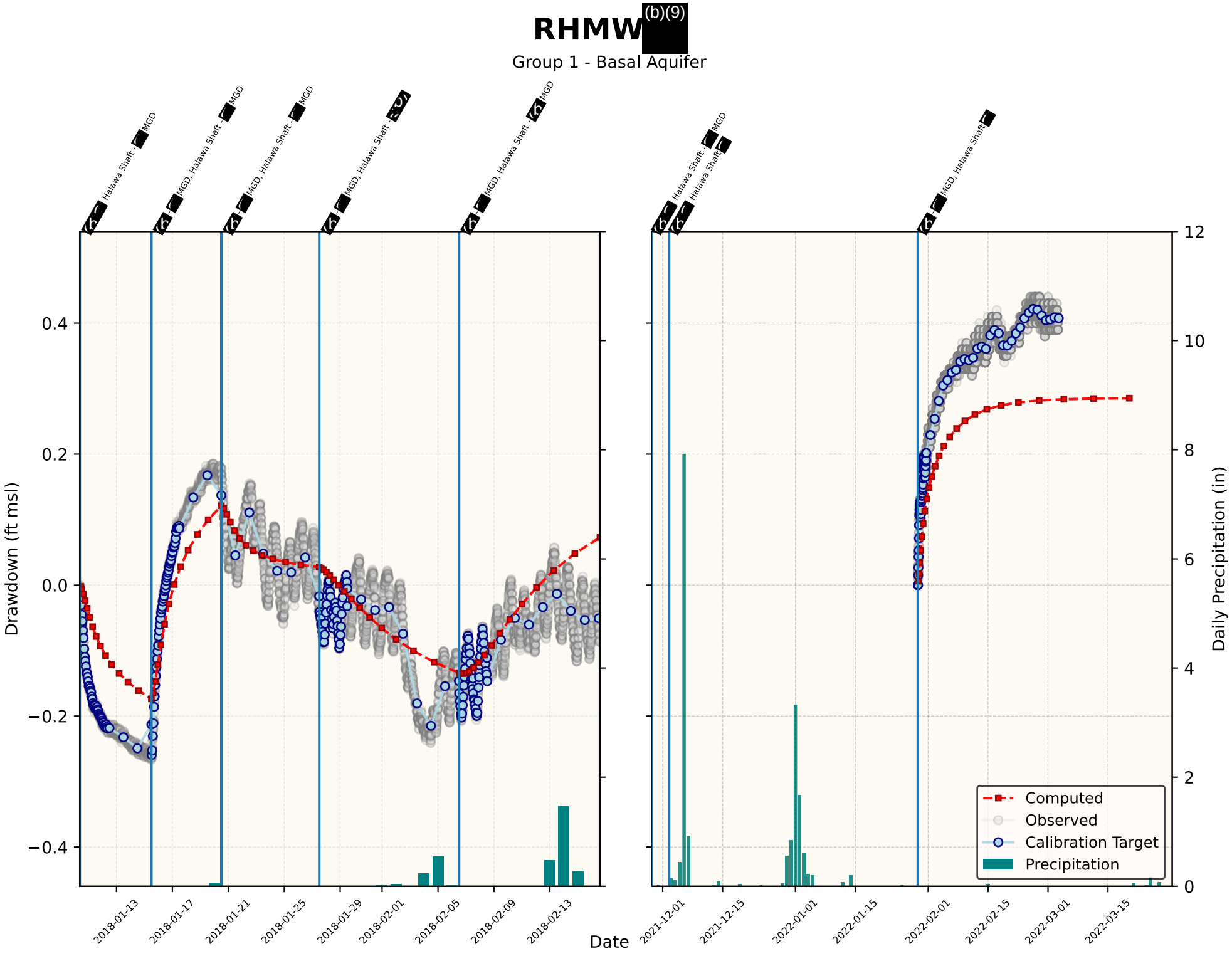

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

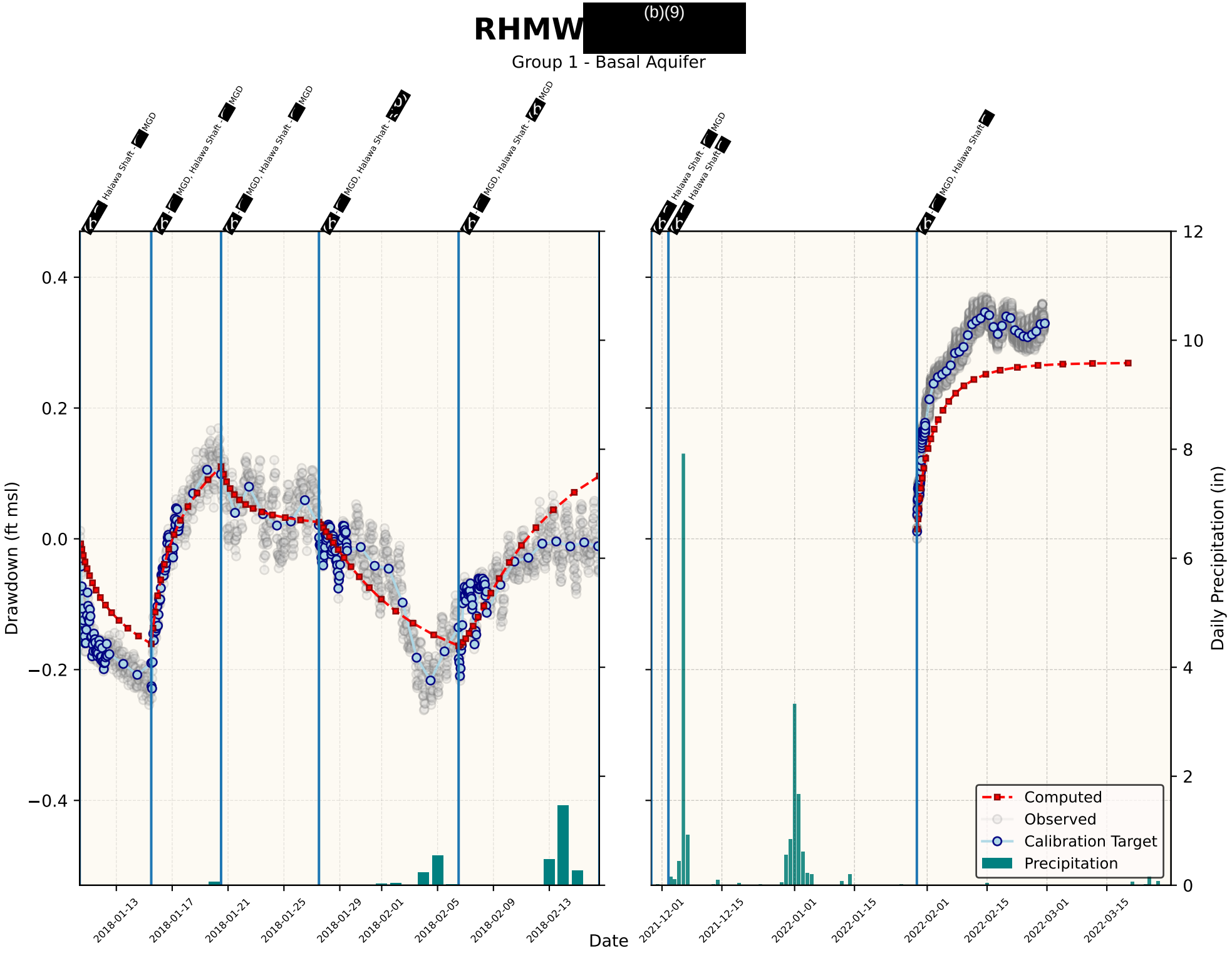

RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date


RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

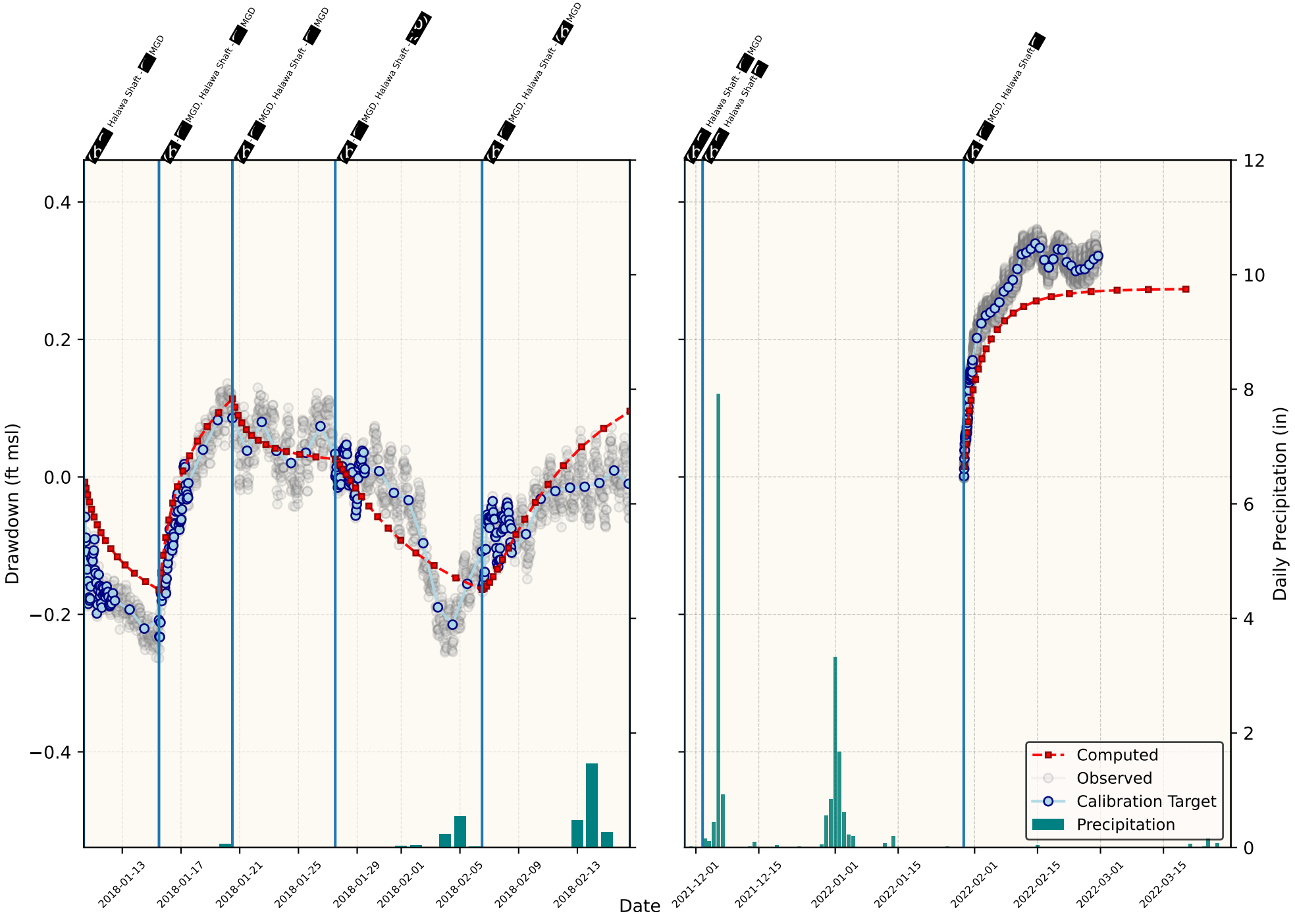

RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

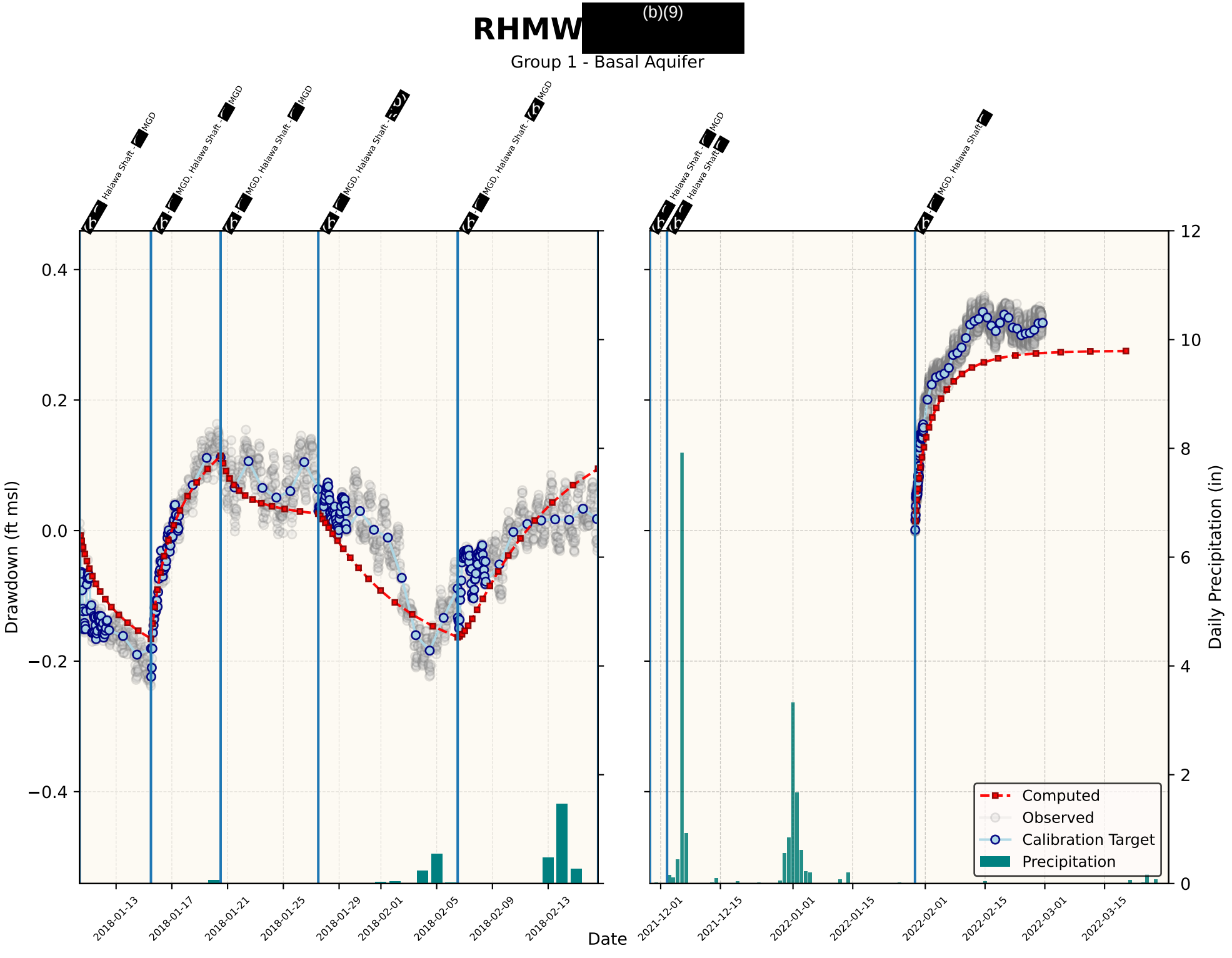

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

RHMW [redacted] (b)(9)

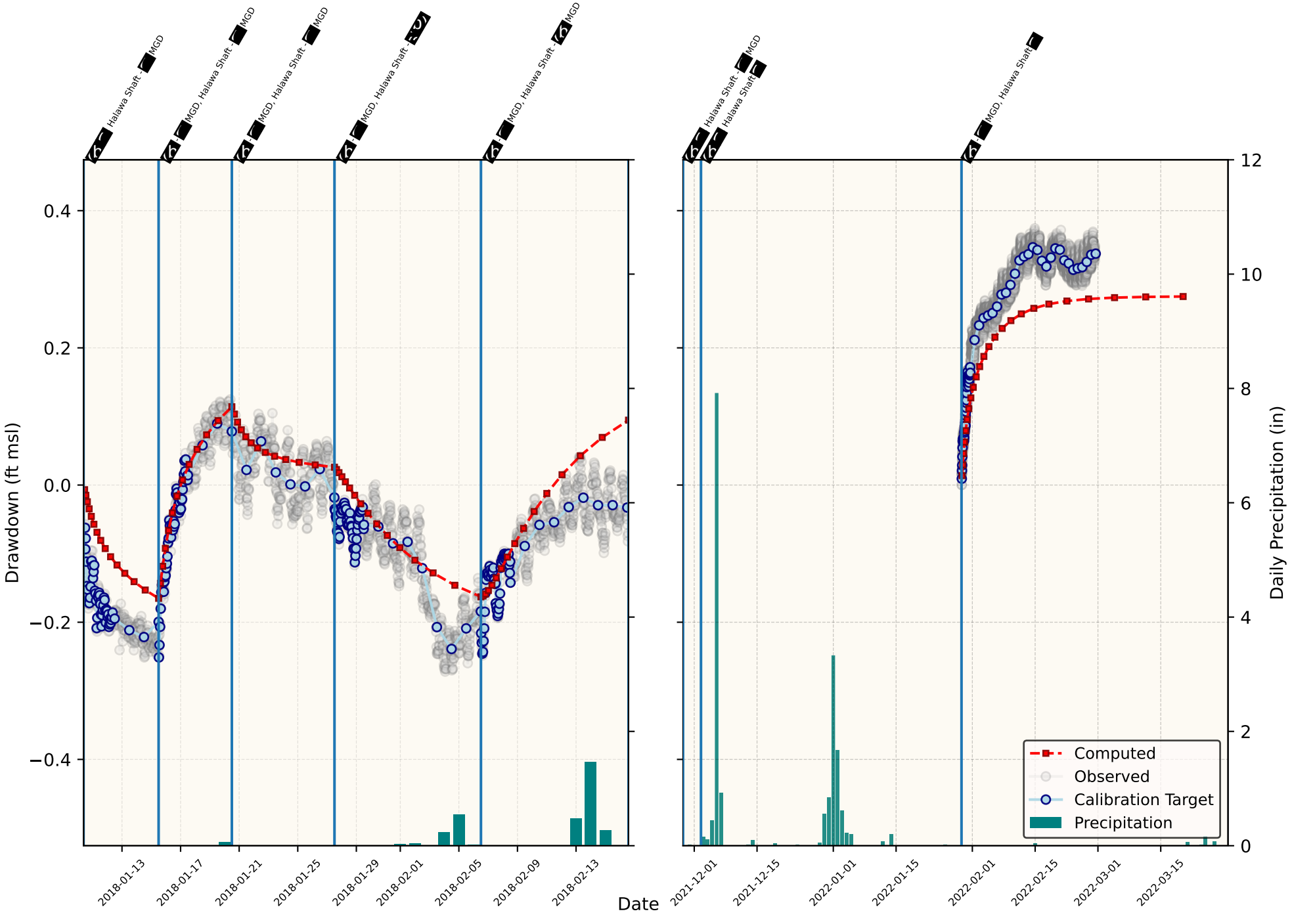
Group 1 - Basal Aquifer




RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

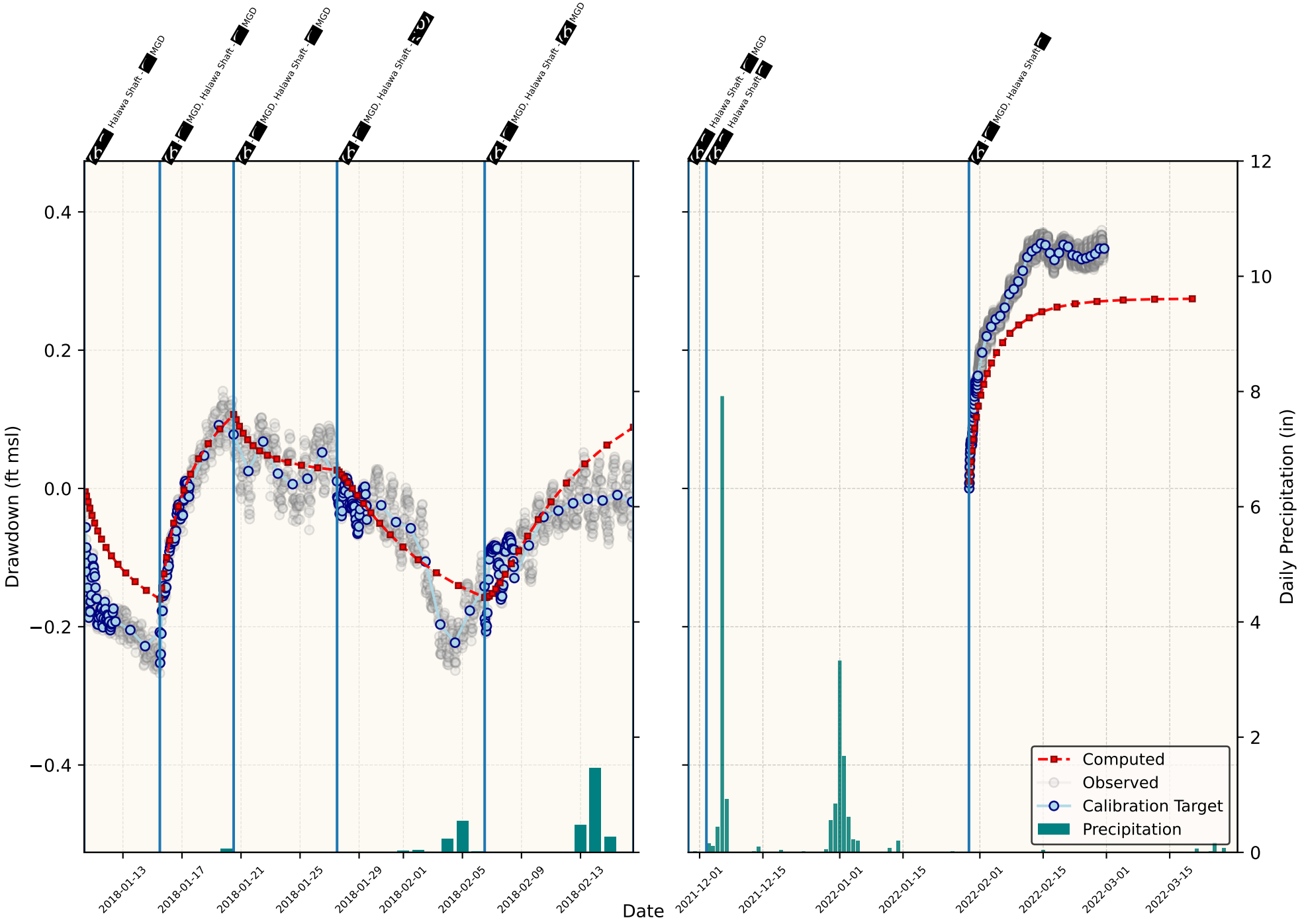
RHMW (b)(9)

Group 1 - Basal Aquifer



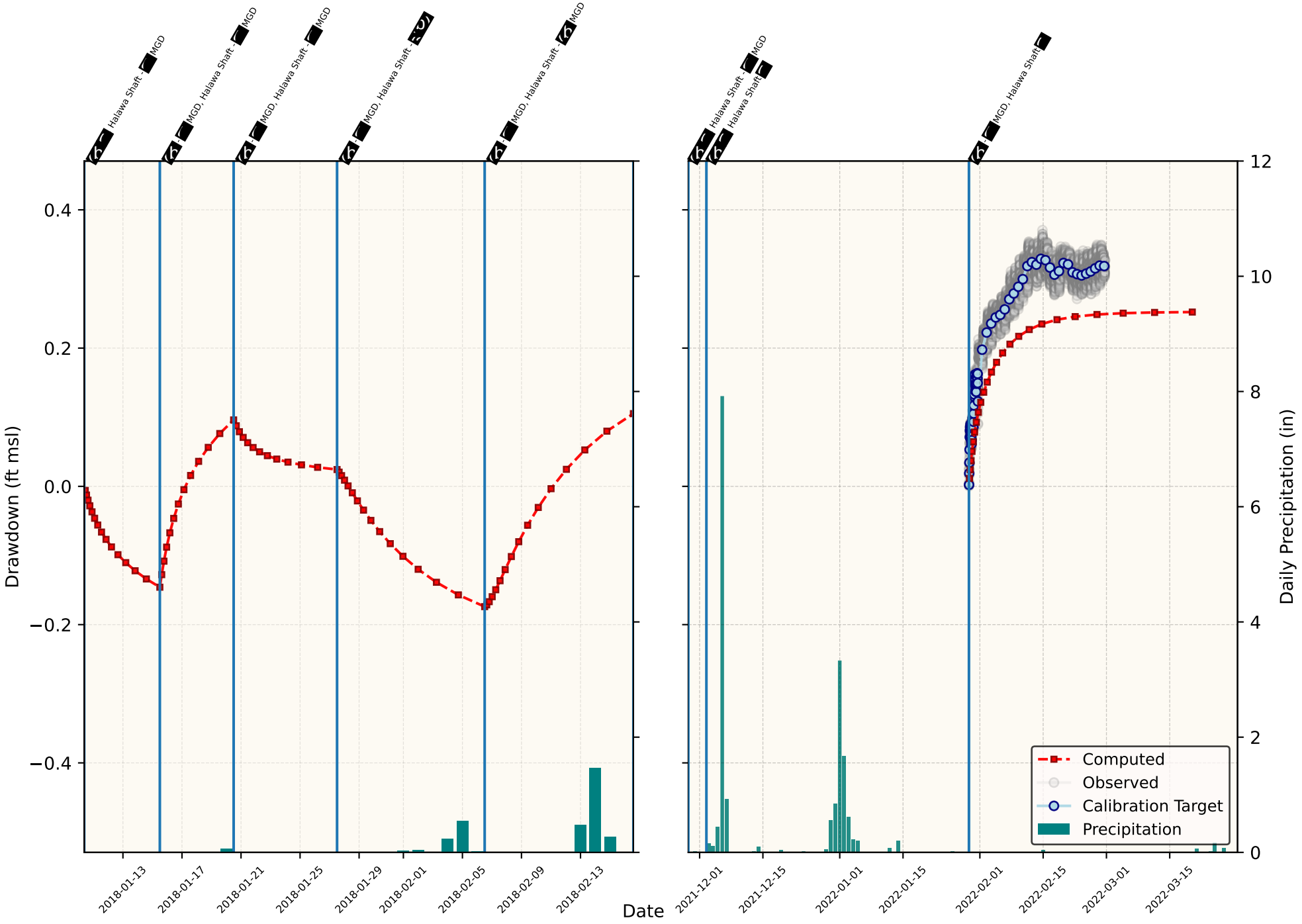
RHMW [redacted] (b)(9)

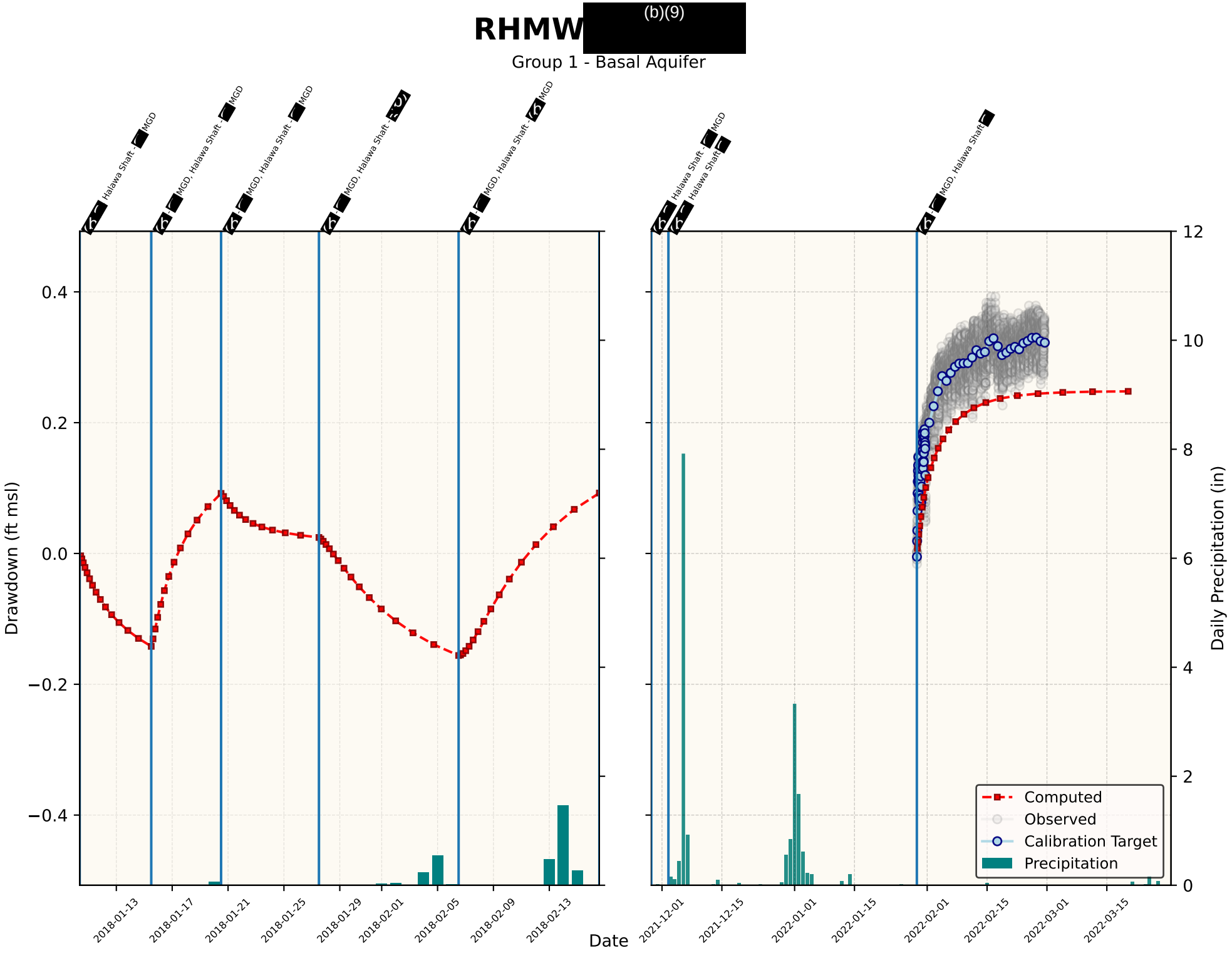
Group 1 - Basal Aquifer

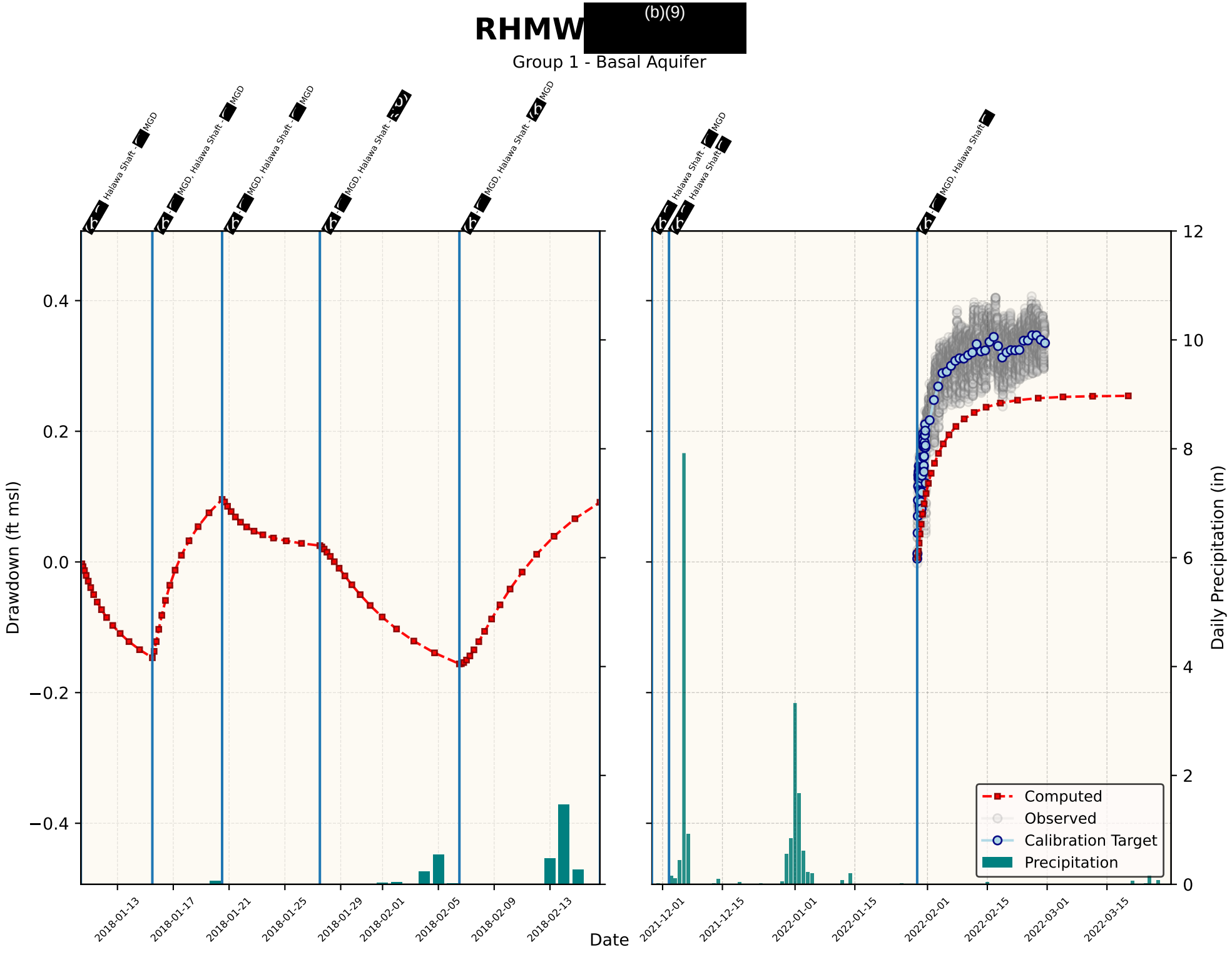


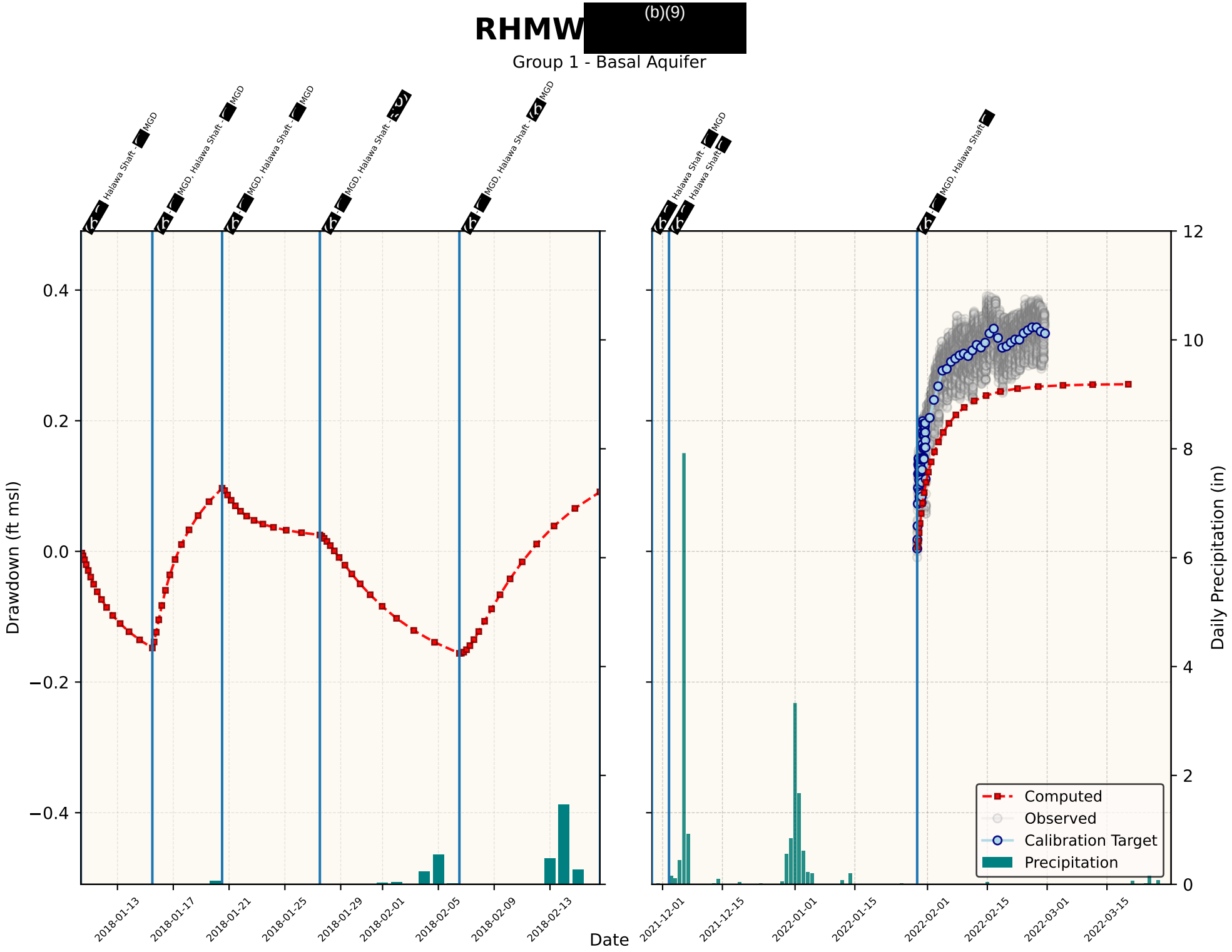
RHMW[redacted] (b)(9)

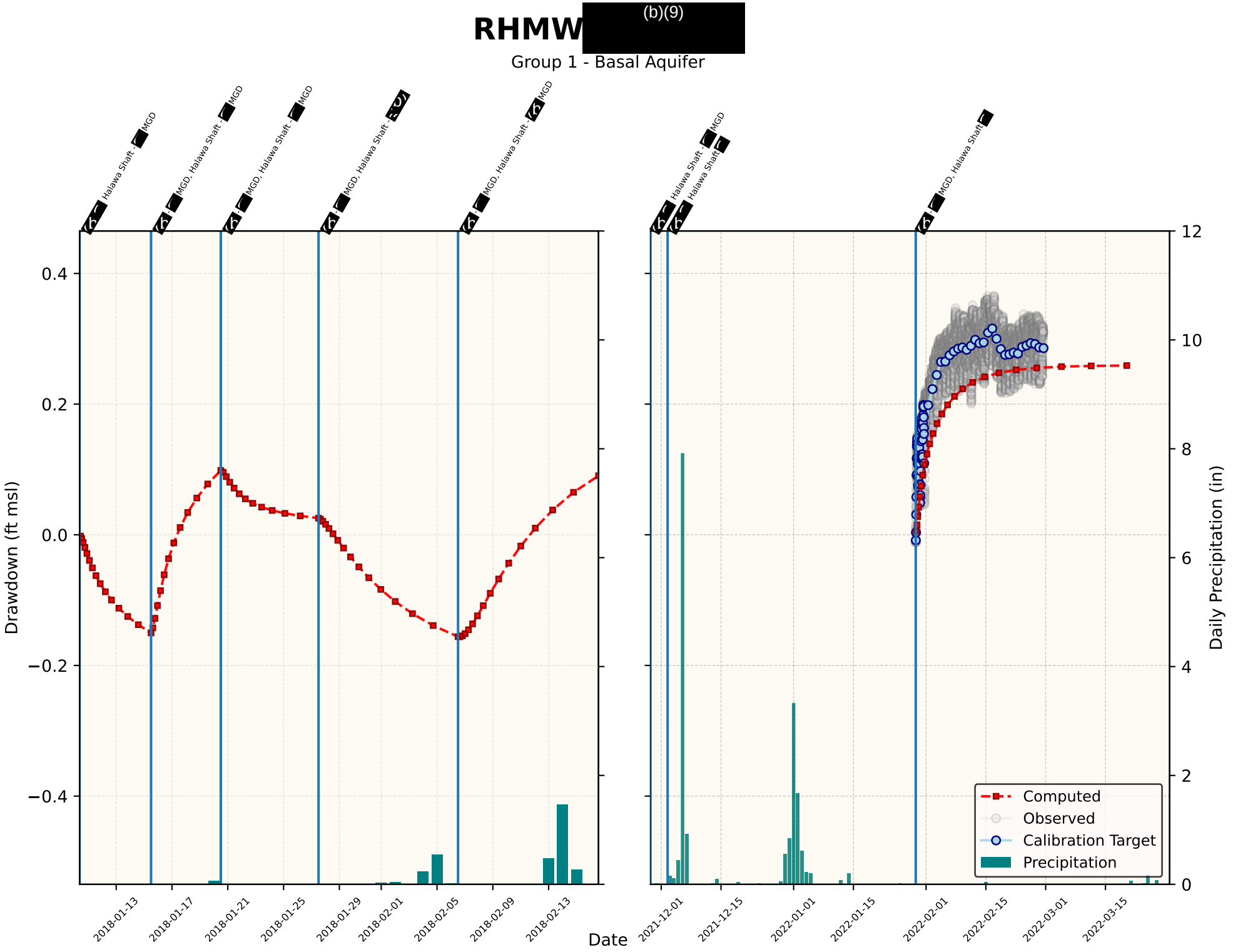
Group 1 - Basal Aquifer

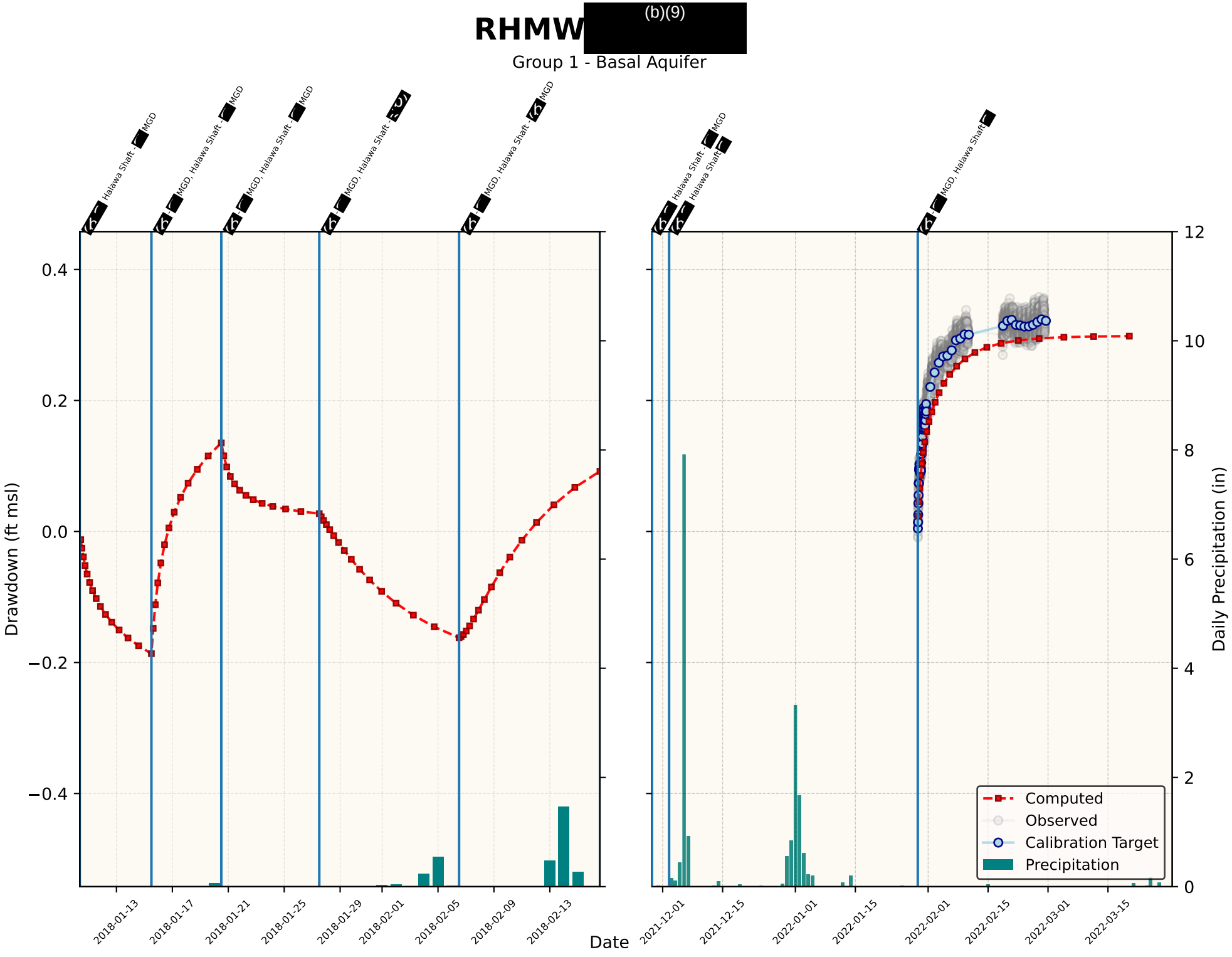


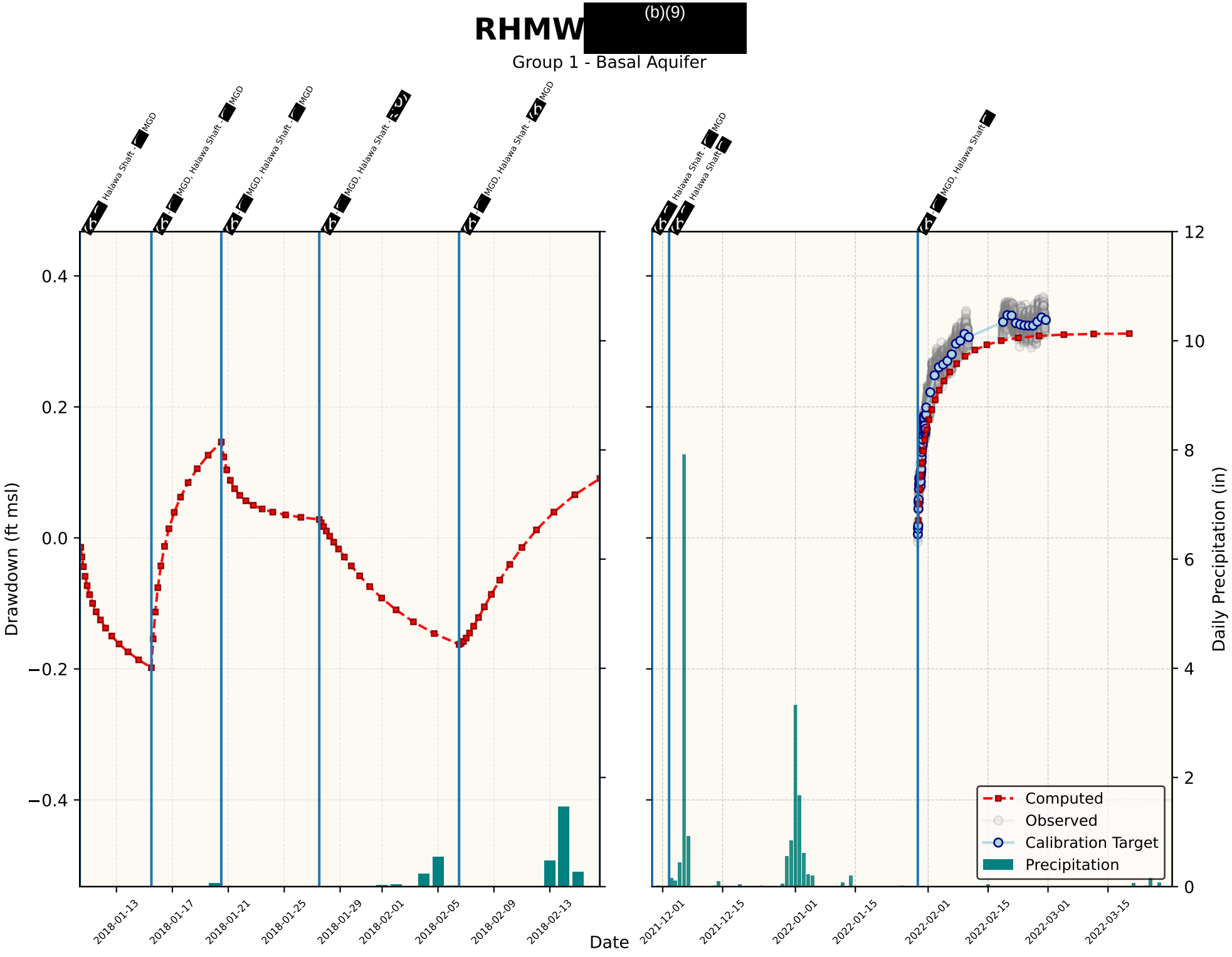

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

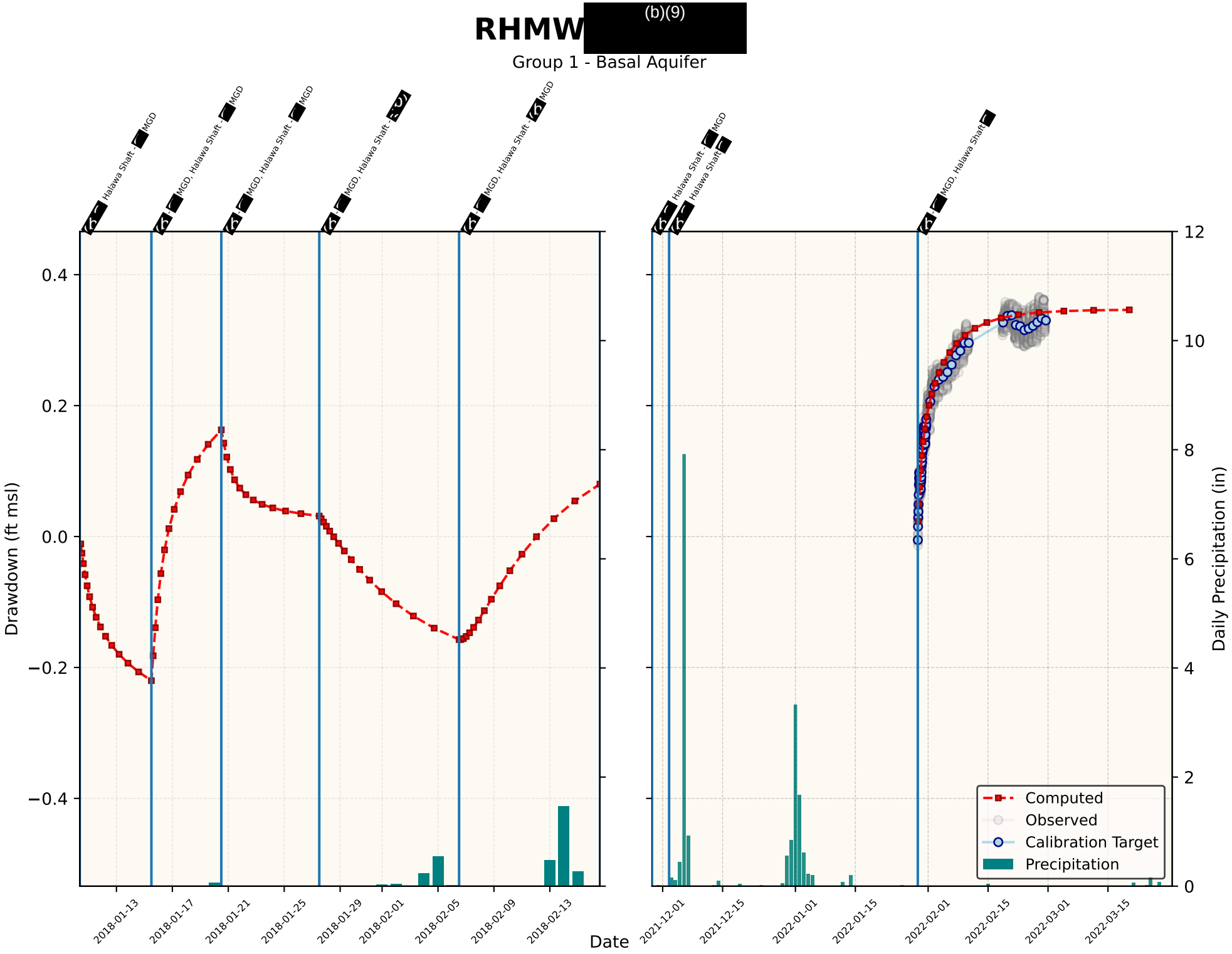

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

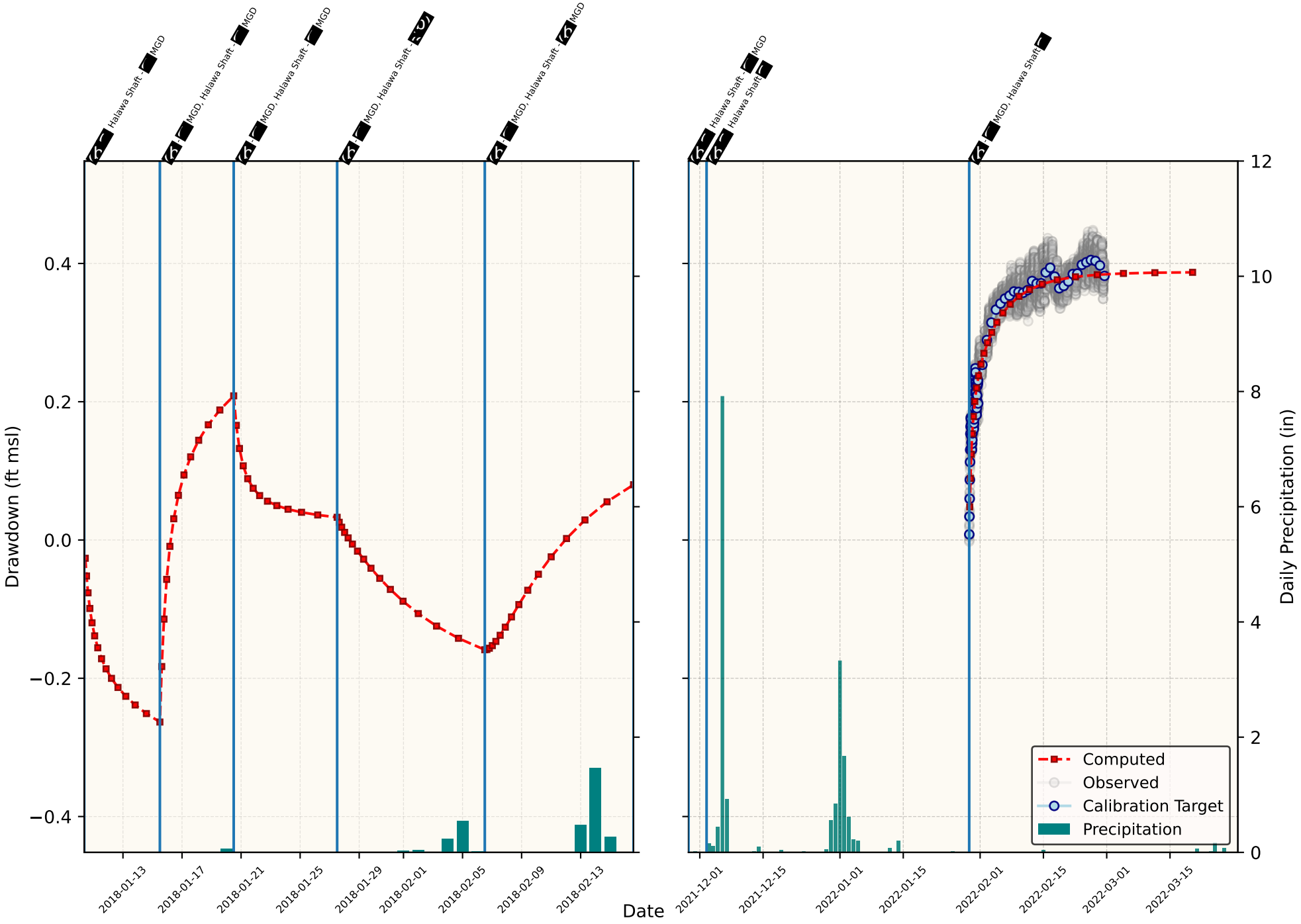

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
[redacted] Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] Halawa Shaft [redacted] MGD
[redacted] Halawa Shaft [redacted]
[redacted] MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

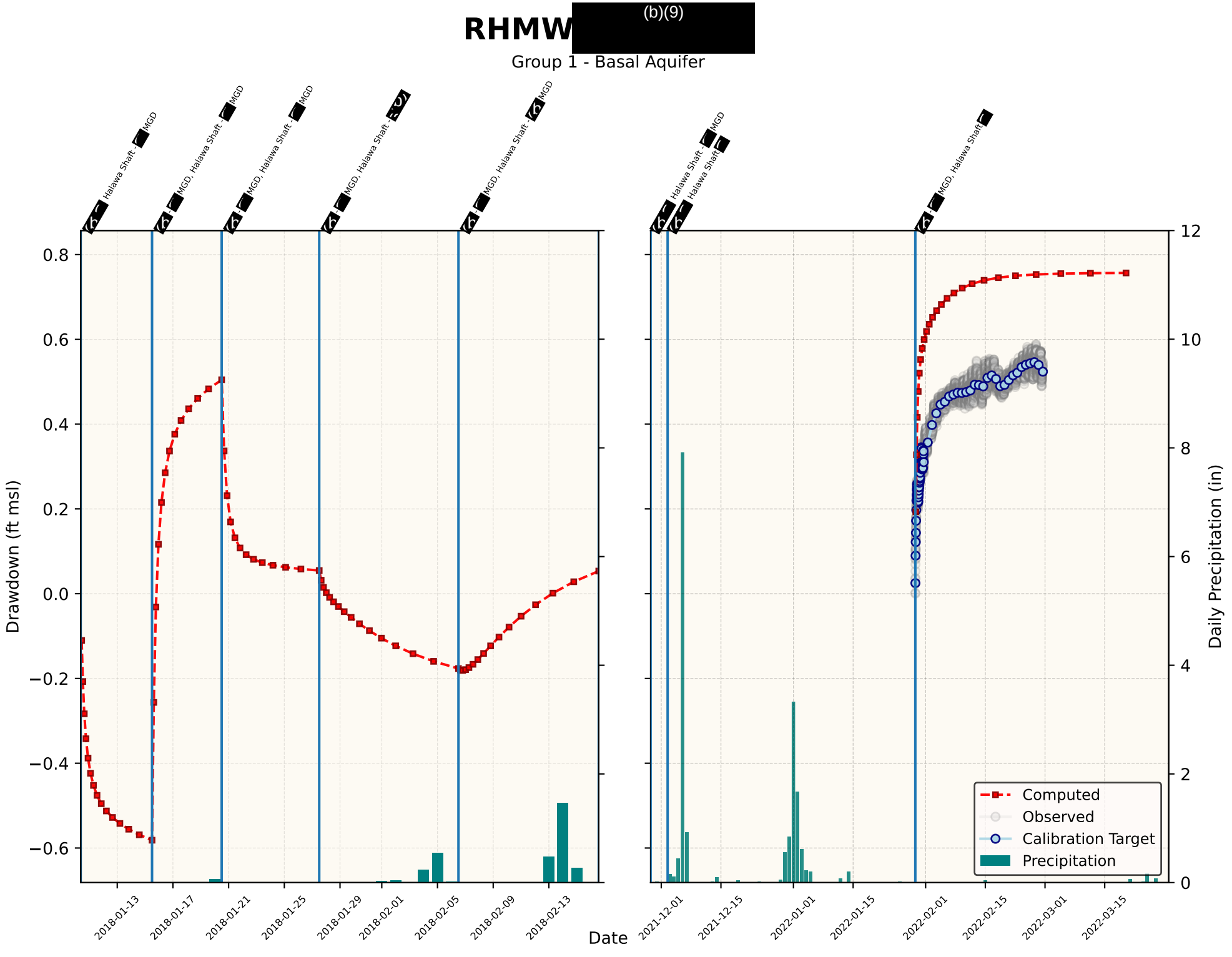

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

RHMW (b)(9)

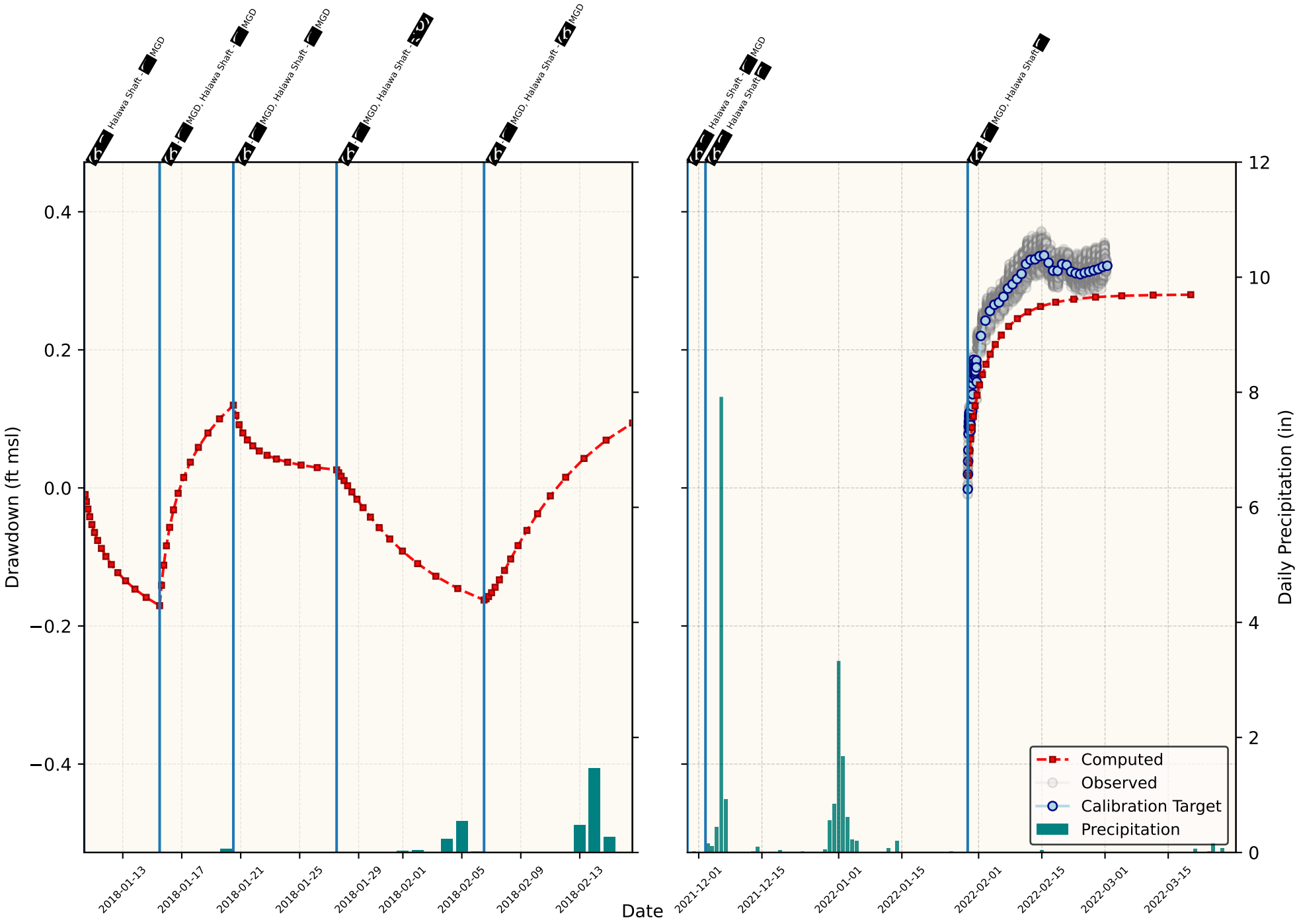
Group 1 - Basal Aquifer

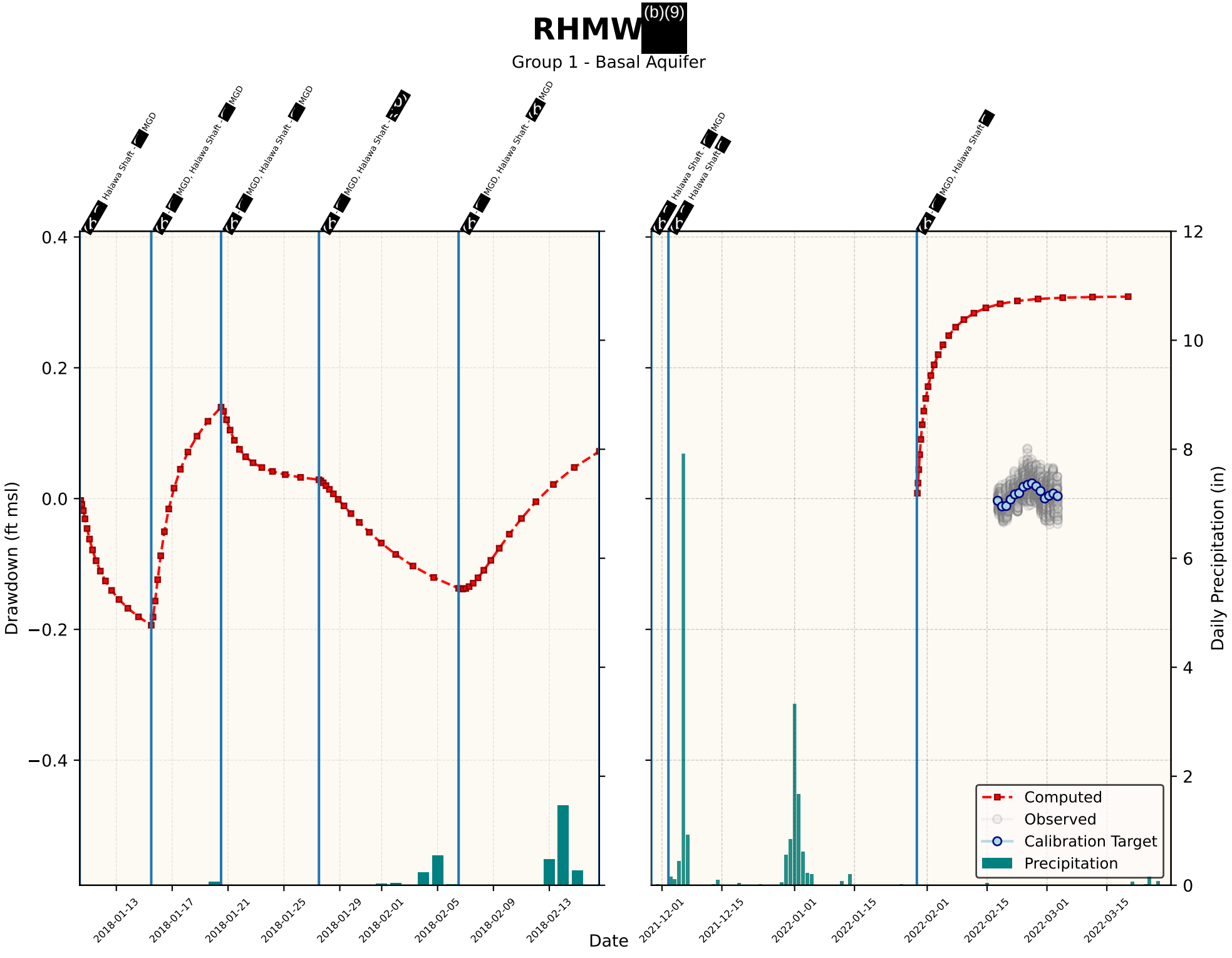


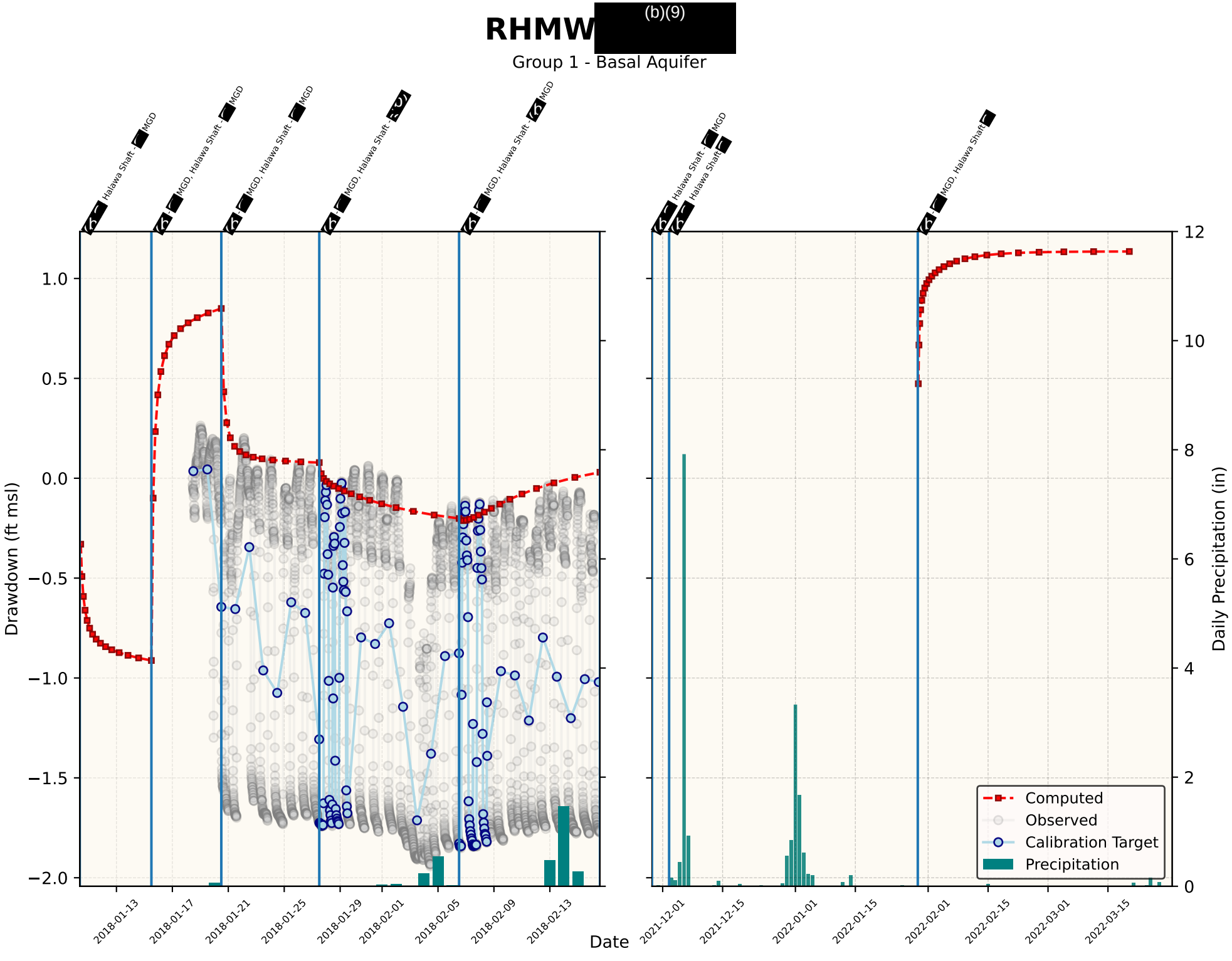

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

RHMW[redacted]

Group 1 - Basal Aquifer

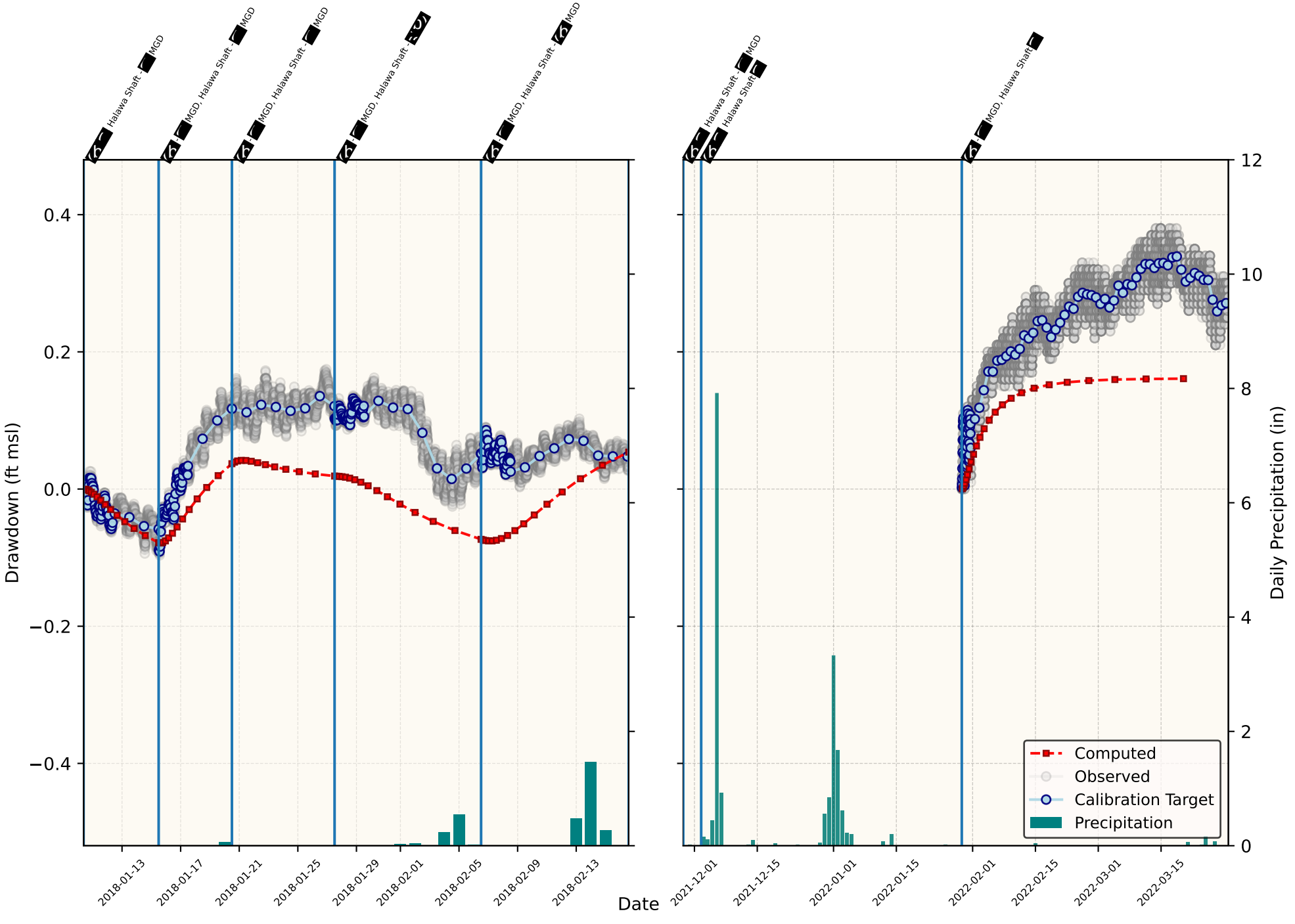


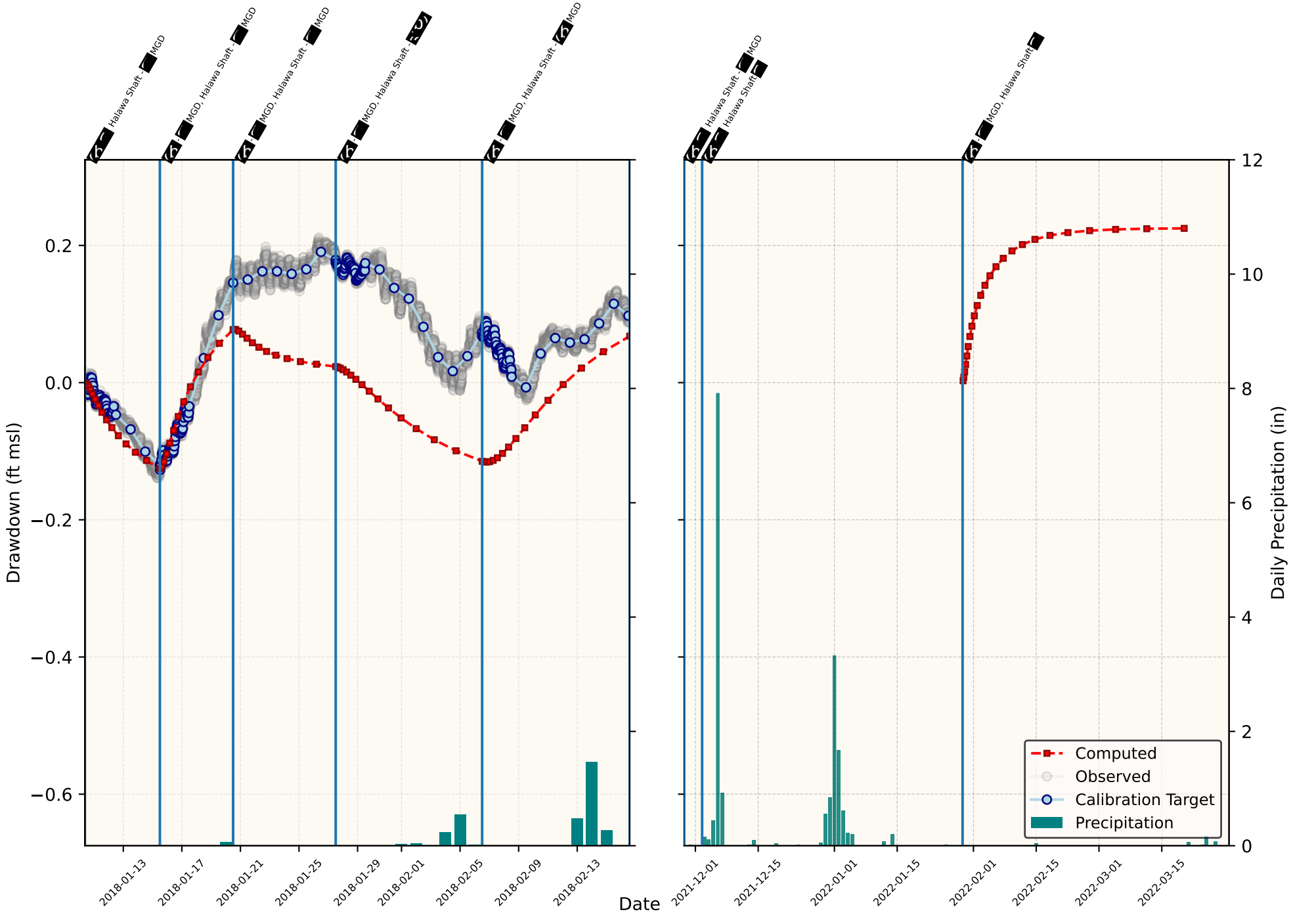

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

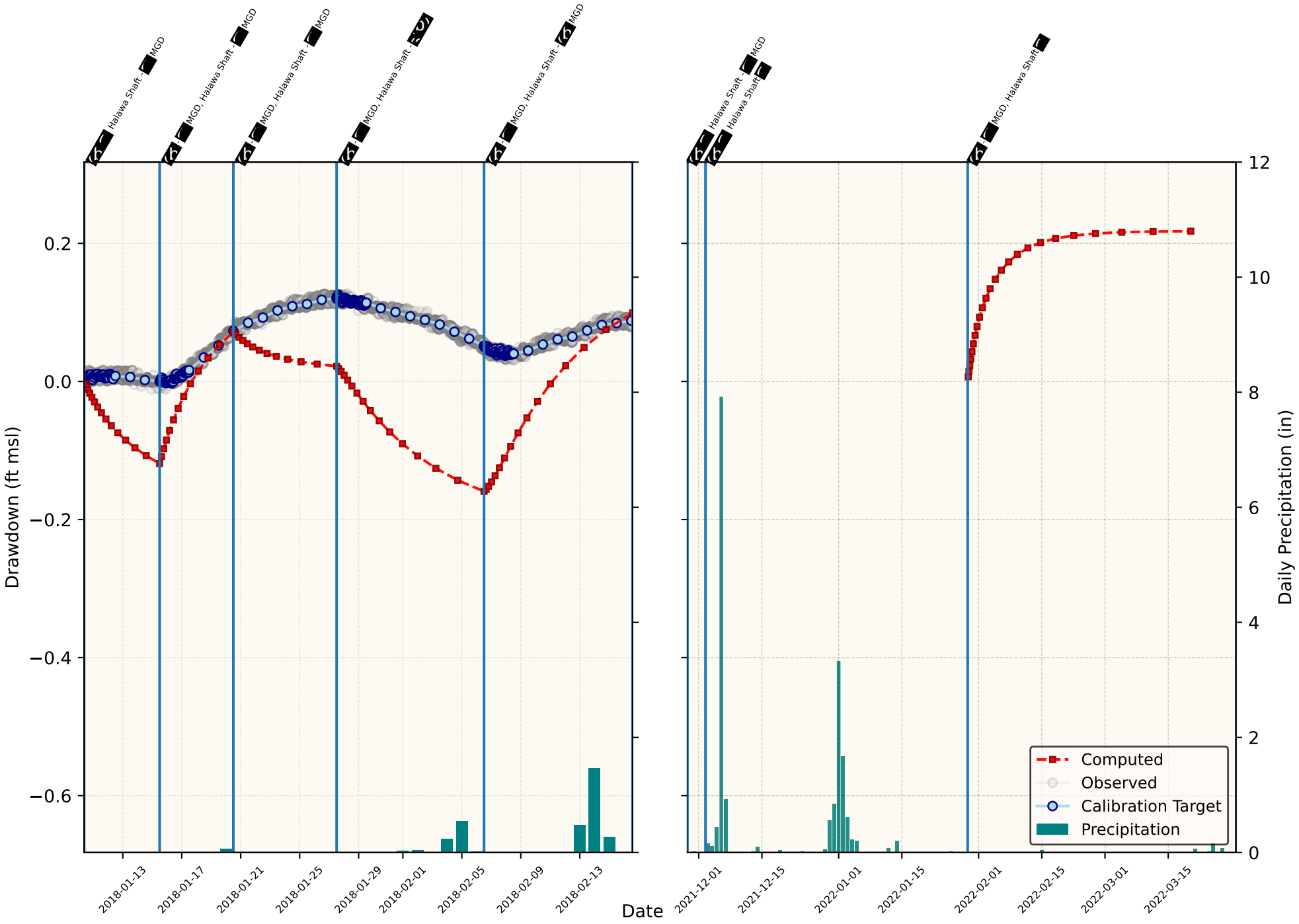

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

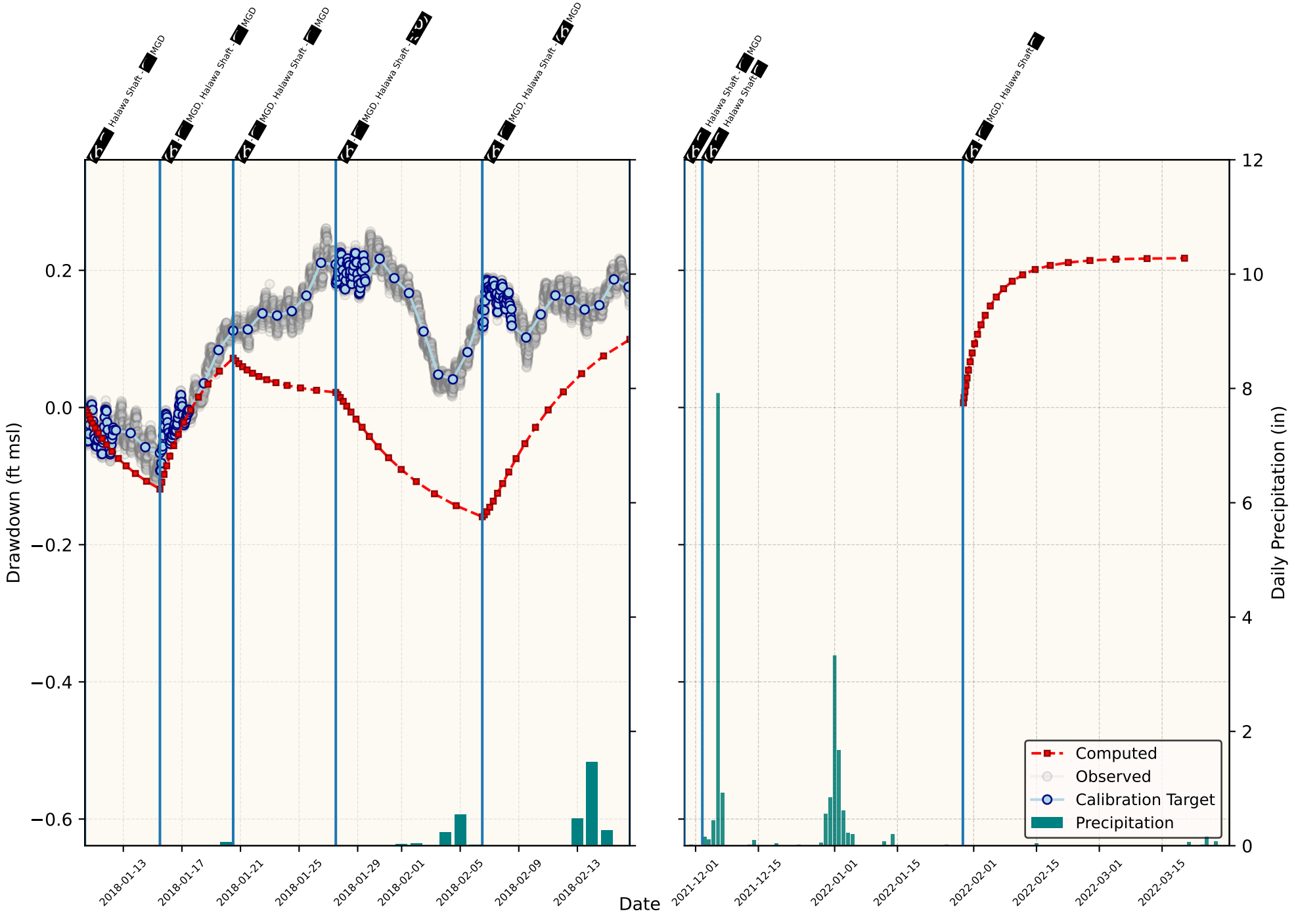
TAMC_[redacted]

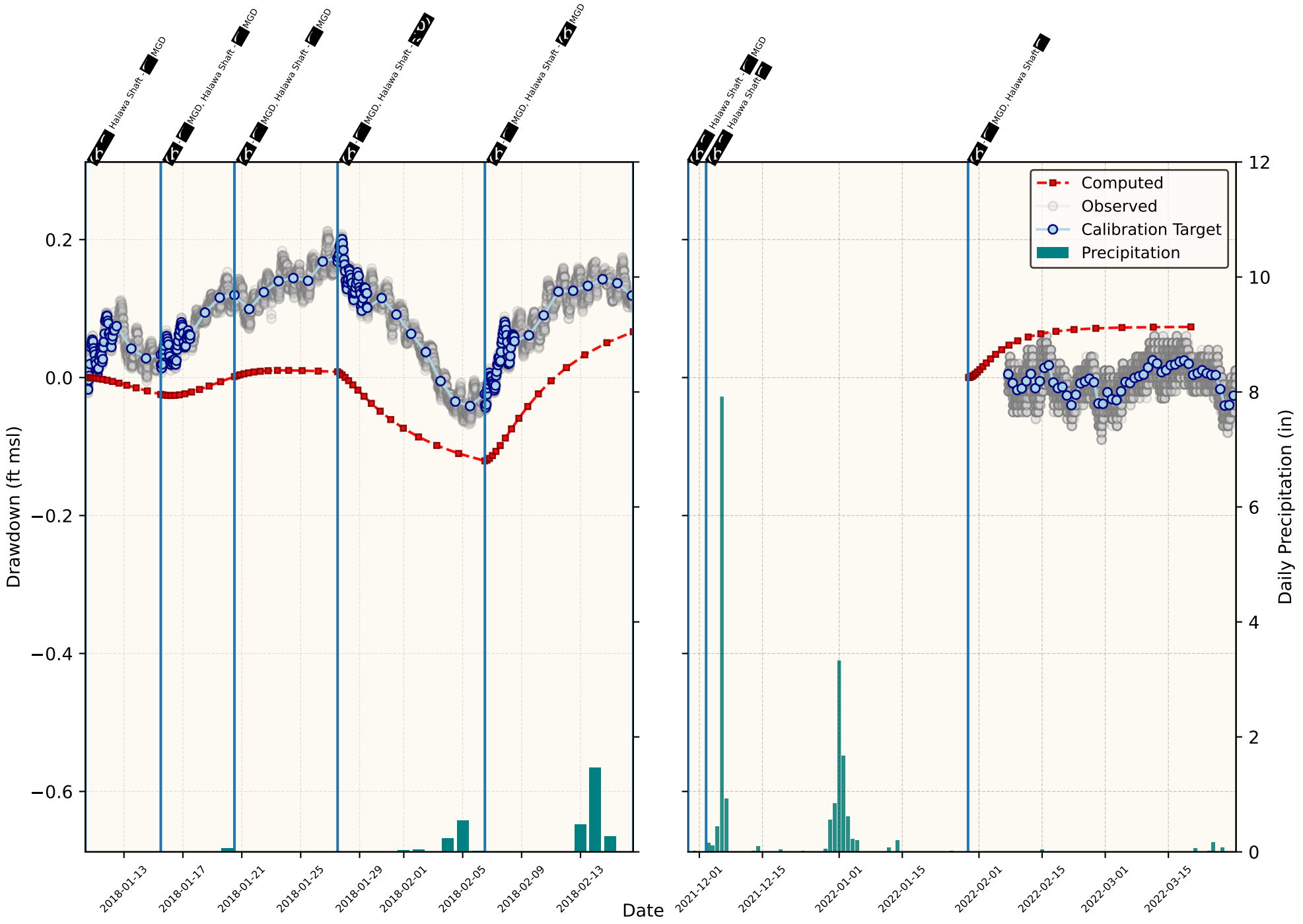
Group 1 - Basal Aquifer




DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

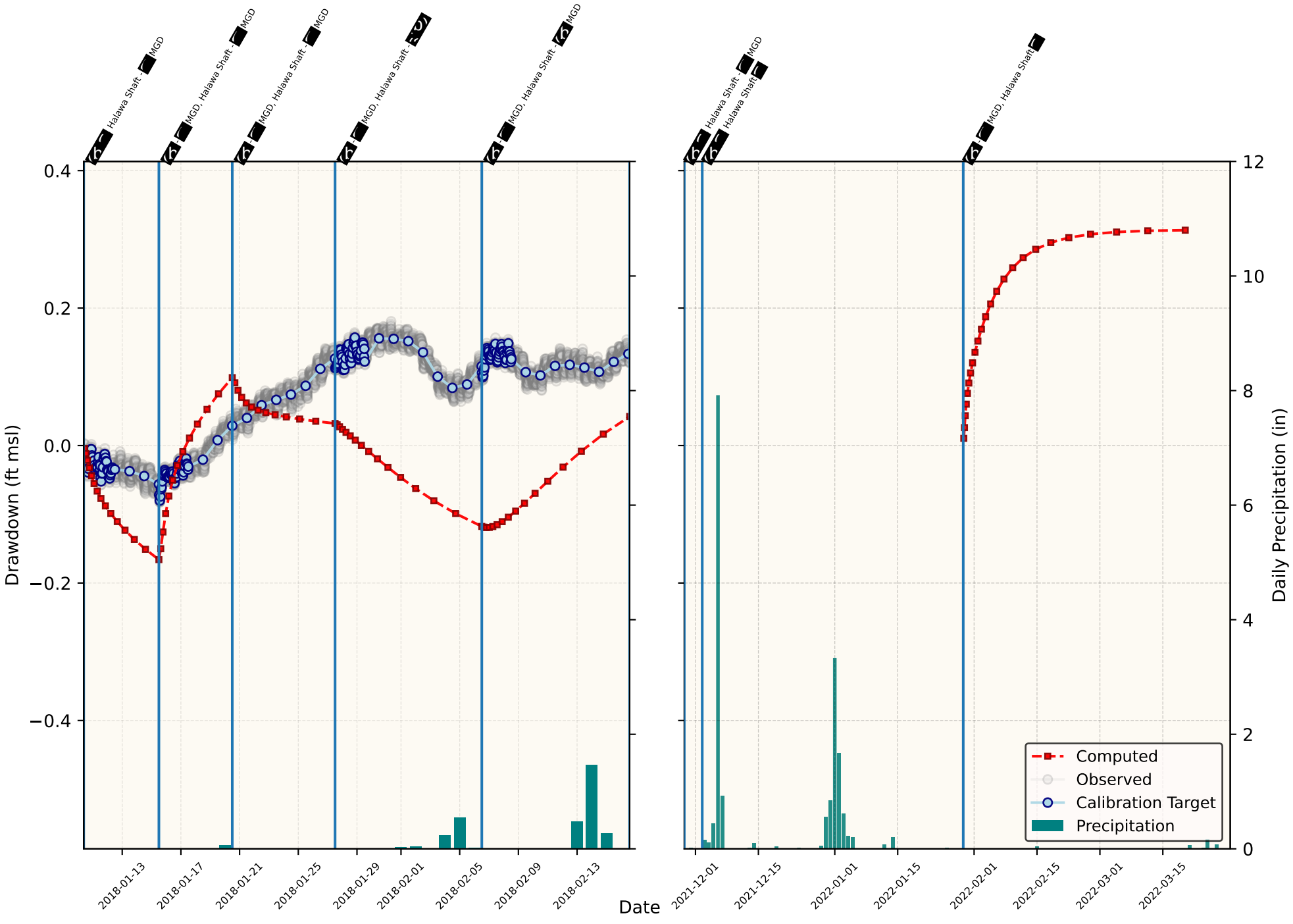

HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Halawa_Deep_Monitor_Well_HDMW2253-03
Group 2 - Deep Basal Wells
Halawa Shaft - MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

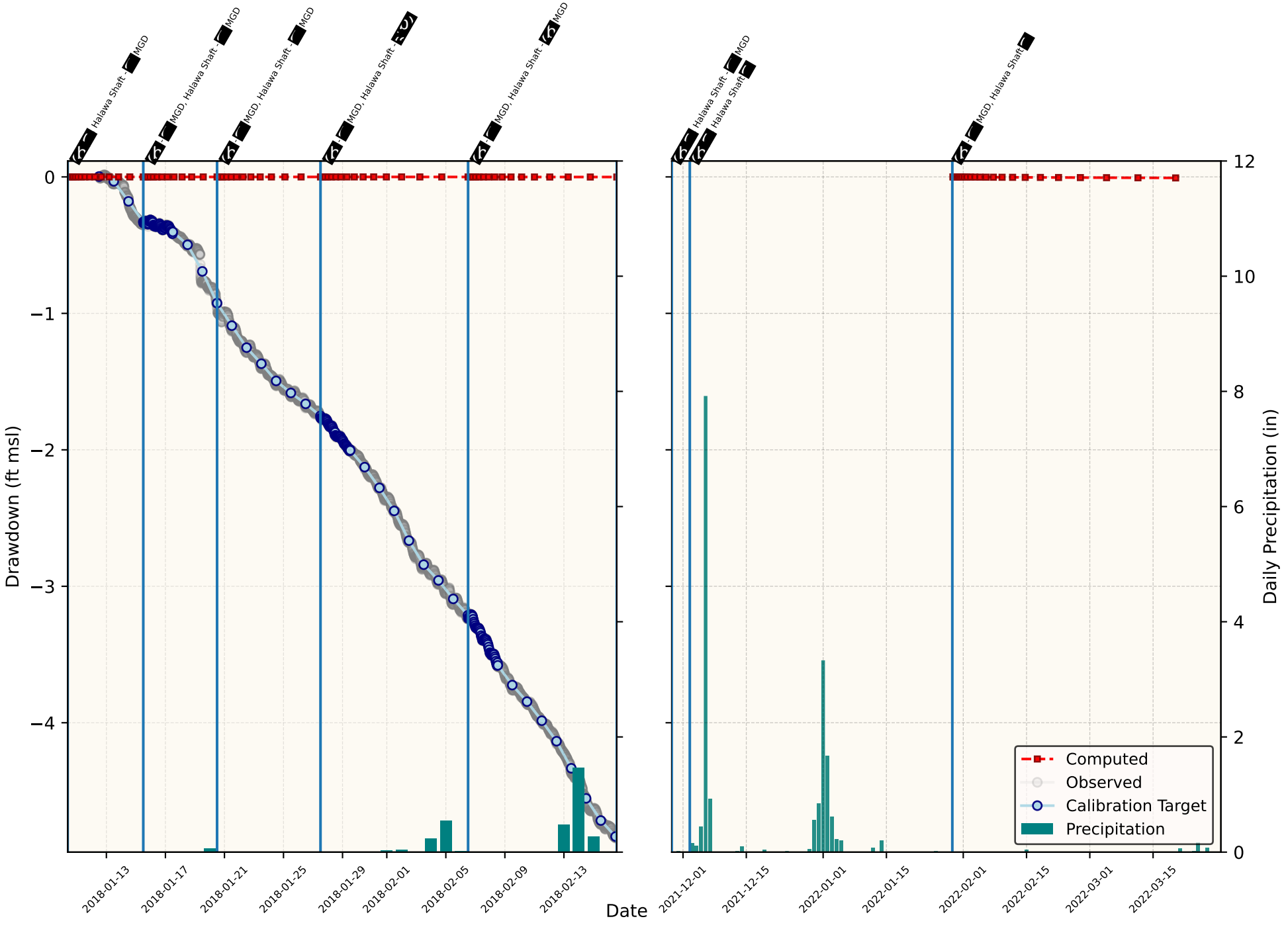
RHMW[redacted]

Group 3 - Saprolite/Confining Unit Well with Elevated Head



RHMW (b)(9) [redacted]

Group 3 - Saprolite/Confining Unit Well with Elevated Head



Groundwater Flow Model Calibration Evaluation Documents Sensitivity Scenario 6

Head Calibration Statistics

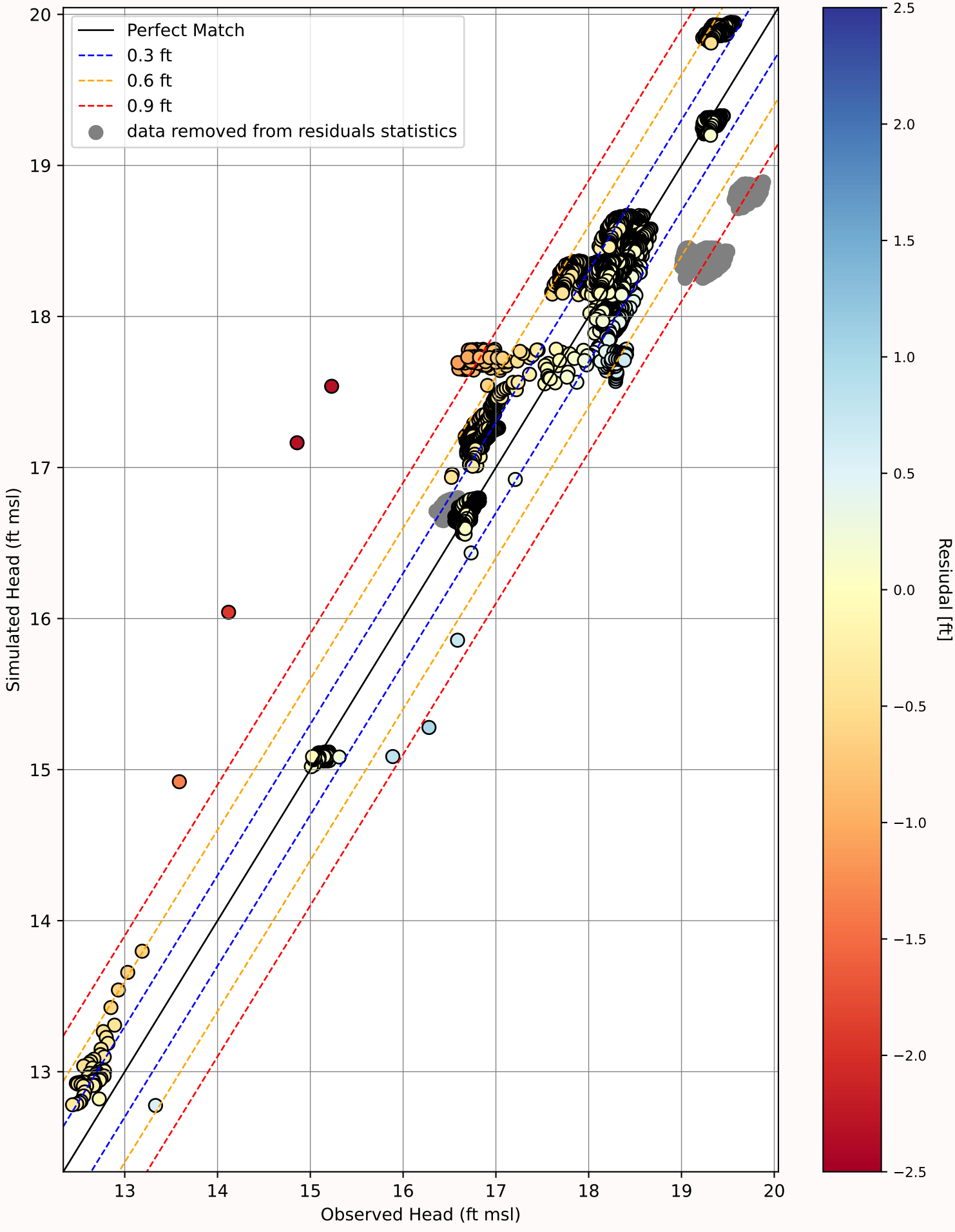
Wells	Basal Aquifer (Group 1)			Deep Wells (Group 2)	Confining Unit (Group 3)	Caprock (Group 4)	Cumulative
Time Period	2017/2018	2021/2022	All	All	All	All	All
Residual Mean (ft)	-0.12	0.11	-0.04	0.52	15.36	0.25	0.77
Absolute Residual Mean (ft)	0.20	0.26	0.23	0.65	17.14	1.46	1.11
Residual Standard Deviation (ft)	0.25	0.31	0.32	0.52	18.64	2.04	5.29
Sum of Squared Residuals (ft2)	424.68	426.60	1029.14	577.05	332019.62	555.44	334181.25
RMSE Error (ft)	0.28	0.33	0.32	0.73	24.13	2.04	5.34
Minimum Residual (ft)	-2.31	-0.74	-2.31	-1.08	-15.80	-4.30	-15.80
Maximum Residual (ft)	1.00	0.89	2.38	1.24	49.34	6.60	49.34
Number of Observations	5459	3915	9928	1075	570	133	11706
Range in Observations	7.14	3.26	7.19	4.26	97.94	6.85	116.87
Scaled Residual Standard Deviation (ft)	3.5%	9.6%	[redacted]%	12.2%	19.0%	29.7%	[redacted]%
Scaled Absolute Residual Mean (ft)	2.8%	7.9%	3.3%	15.3%	17.5%	21.3%	0.9%
Scaled RMSE Error (ft)	3.9%	10.1%	[redacted]%	17.2%	24.6%	29.8%	4.6%
Scaled Residual Mean (ft)	-1.7%	3.3%	-0.5%	[redacted]%	15.7%	[redacted]%	[redacted]%
Correlation Coefficient	0.97	0.91	0.94	0.99	0.93	-0.16	0.96

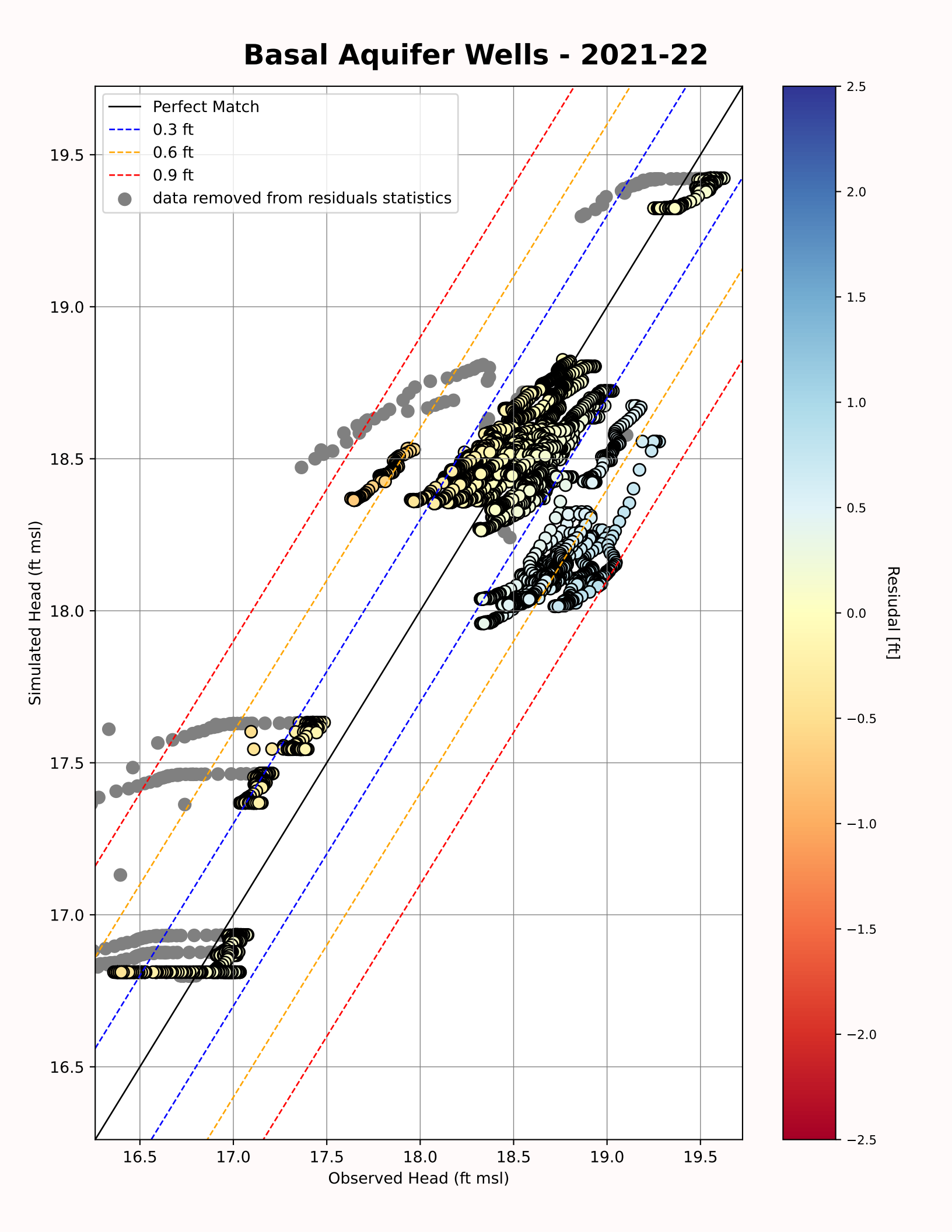
Drawdown Calibration Statistics

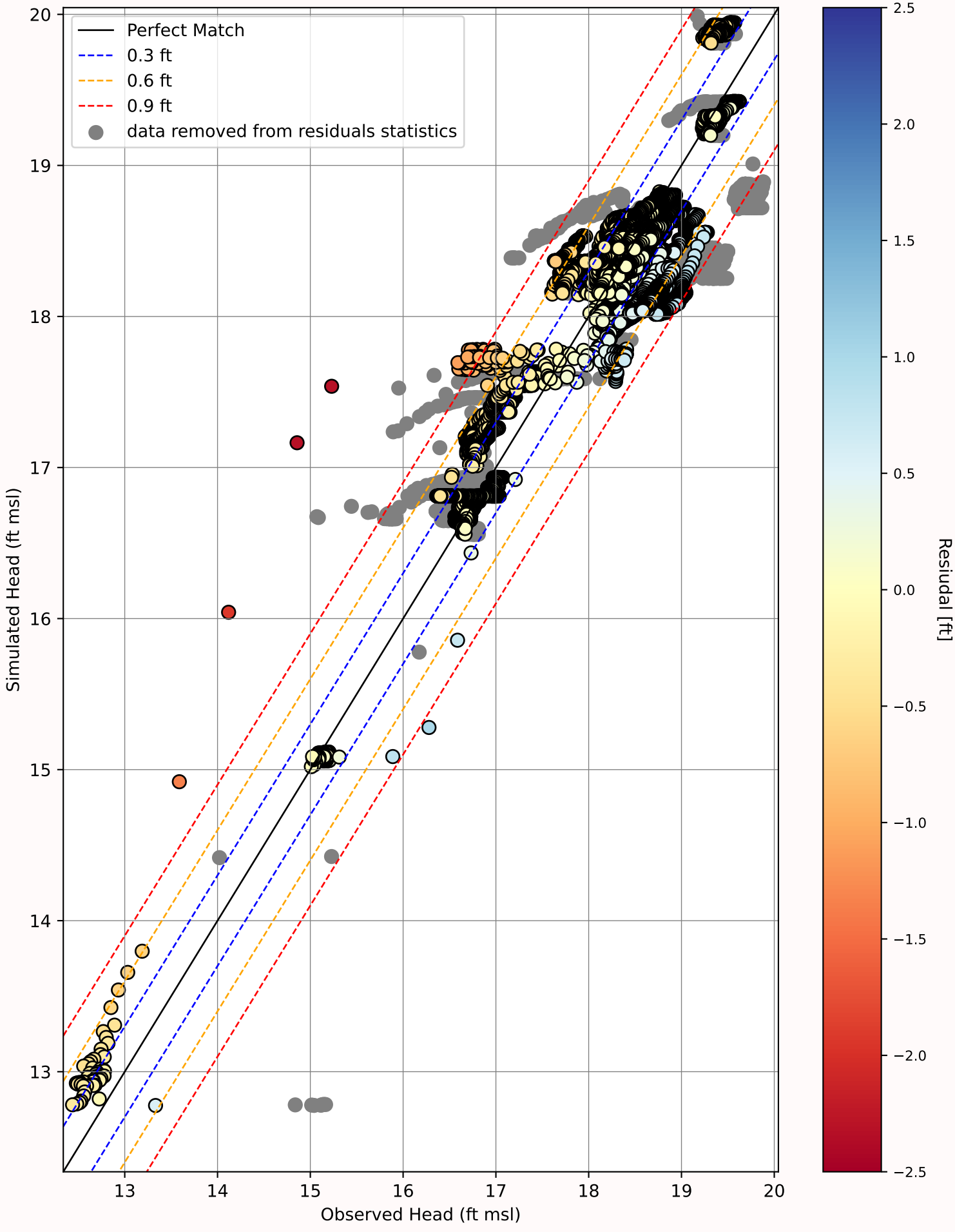
Wells	Basal Aquifer (Group 1)		
Time Period	**2017/2018**	**2021/2022**	**All**
Residual Mean (ft)	-0.02	0.07	0.02
Absolute Residual Mean (ft)	0.09	0.09	0.09
Residual Standard Deviation (ft)	0.21	0.11	0.18
Sum of Squared Residuals (ft2)	248.11	57.46	305.57
RMSE Error (ft)	0.21	0.13	0.19
Minimum Residual (ft)	-1.78	-0.21	-1.78
Maximum Residual (ft)	2.41	0.55	2.41
Number of Observations	5393	3533	8926
Range in Observations	4.76	0.68	4.76
Scaled Residual Standard Deviation (ft)	(b) %	16.0%	3.9%
Scaled Absolute Residual Mean (ft)	2.0%	12.8%	1.9%
Scaled RMSE Error (ft)	(b) %	18.9%	3.9%
Scaled Residual Mean (ft)	-0.4%	10.0%	0.3%
Correlation Coefficient	0.83	0.59	0.83

Conceptual Water Budget Comparison

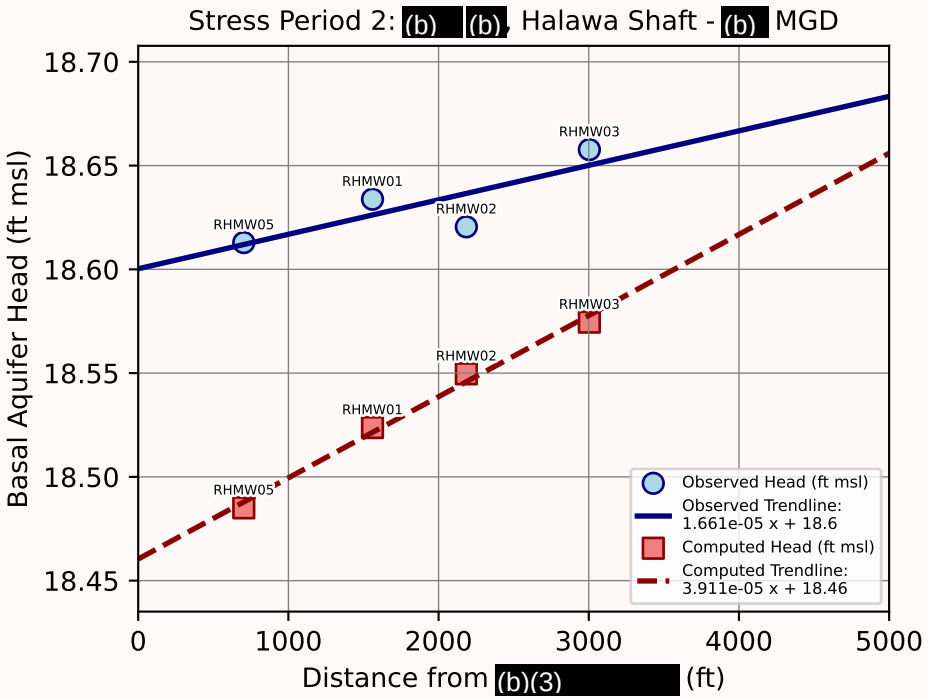
Type	Stress Period	Recharge (MGD)	Dike Region Inflow (MGD)	Well Discharge (MGD)	Spring Discharge (MGD)	Caprock Discharge (MGD)	Inflow from Adjacent Watershed (MGD)	Outflow to Adjacent Watershed (MGD)	Storage (MGD)	Total Inflows (MGD)	Total Outflows (MGD)
Conceptual	1	32.5	0.0	32.0	13.6	2.4	31.5	16.0	0.0	64.0	64.0
Simulated	1	32.5	0.0	32.3	12.8	4.0	42.5	25.9	0.0	75.0	75.0
Difference	1	0.0	0.0	0.3	-0.8	1.6	11.0	9.9	0.0	11.0	11.0
Conceptual	2	32.5	0.0	28.4	13.6	2.4	31.5	19.6	0.0	64.0	64.0
Simulated	2	32.5	0.0	28.4	13.0	4.0	41.1	27.0	-1.1	73.5	73.5
Difference	2	0.0	0.0	0.0	-0.6	1.6	9.6	7.4	-1.1	9.6	9.5
Conceptual	3	32.5	0.0	36.1	13.5	2.4	31.5	12.0	0.0	64.0	64.0
Simulated	3	32.5	0.0	36.1	12.7	4.0	43.4	25.2	2.0	77.9	78.0
Difference	3	0.0	0.0	0.0	-0.8	1.6	11.9	13.2	2.0	13.9	14.0
Conceptual	4	32.5	0.0	32.4	13.5	2.4	31.5	15.6	0.0	64.0	64.0
Simulated	4	32.5	0.0	32.5	12.8	4.0	42.8	25.4	0.0	75.3	74.7
Difference	4	0.0	0.0	0.0	-(b	1.6	11.3	9.8	0.0	11.4	10.7
Conceptual	5	32.5	0.0	25.7	13.7	2.4	33.4	24.1	0.0	65.9	65.9
Simulated	5	32.5	0.0	25.7	13.4	4.0	41.3	29.8	-0.1	73.8	73.0
Difference	5	0.0	0.0	0.0	-0.4	1.6	7.9	5.8	-0.1	7.9	7.1
Conceptual	6	32.5	0.0	37.7	13.6	2.4	33.4	12.2	0.0	65.9	65.9
Simulated	6	32.5	0.0	37.8	12.5	4.0	44.2	23.4	0.8	77.5	77.6
Difference	6	0.0	0.0	0.0	-1.1	1.6	10.8	11.3	0.8	11.6	11.7
Conceptual	7	32.5	0.0	32.0	13.4	2.4	32.8	17.4	0.0	65.3	65.3
Simulated	7	32.5	0.0	32.0	12.7	4.0	41.6	25.4	0.0	74.0	74.0
Difference	7	0.0	0.0	0.0	-0.6	1.5	8.8	7.9	0.0	8.8	8.8
Conceptual	8	32.5	0.0	30.1	12.6	2.4	31.5	18.8	0.0	63.9	63.9
Simulated	8	32.5	0.0	30.1	12.8	4.0	41.3	25.6	-1.2	73.8	73.7
Difference	8	0.0	0.0	0.0	0.2	1.5	9.8	6.8	-1.2	9.9	9.8
Conceptual	9	32.5	0.0	21.8	13.7	2.4	29.2	23.8	0.0	61.7	61.7
Simulated	9	32.5	0.0	21.8	13.6	4.0	38.6	31.7	0.0	71.1	71.1
Difference	9	0.0	0.0	0.0	-0.1	1.5	9.4	7.9	0.0	9.4	9.4
Conceptual	10	32.5	0.0	26.3	13.9	2.5	36.2	25.9	0.0	68.7	68.7
Simulated	10	32.5	0.0	26.3	13.3	4.0	40.7	29.7	0.0	73.2	73.3
Difference	10	0.0	0.0	0.0	-0.6	1.4	(b	3.8	0.0	(b	4.6

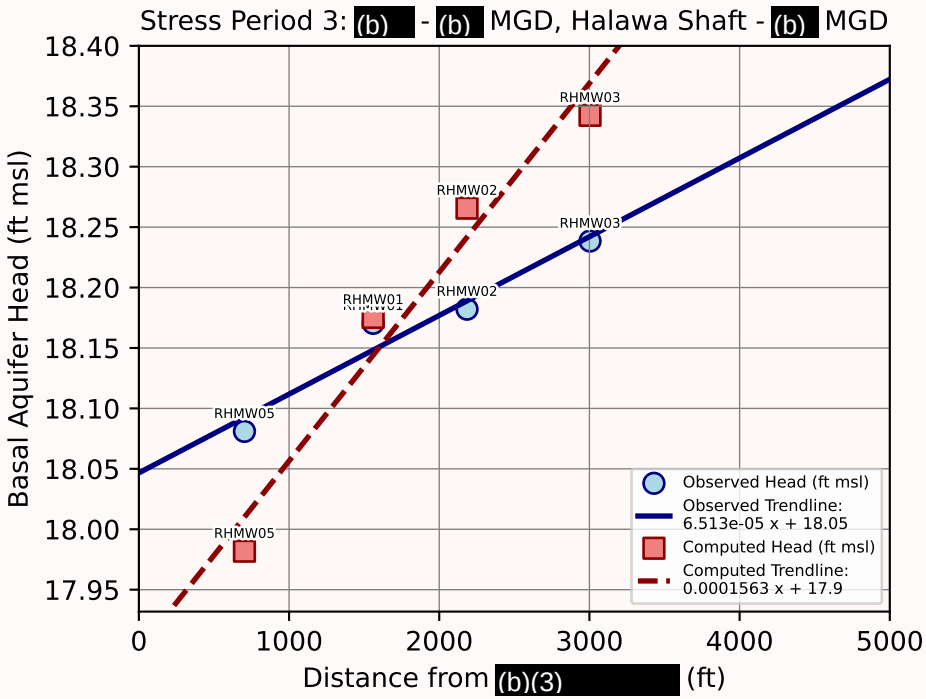

Basal Aquifer Wells - 2017-18
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
20
19
18
17
16
15
14
13
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

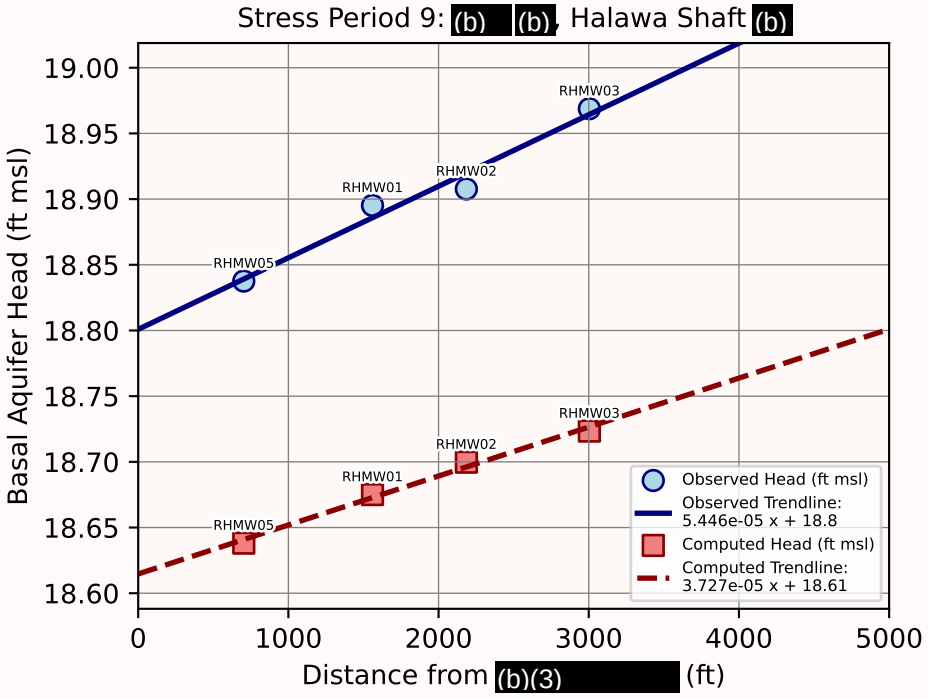

Basal Aquifer Wells - 2021-22
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
16.5
17.0
17.5
18.0
18.5
19.0
19.5
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

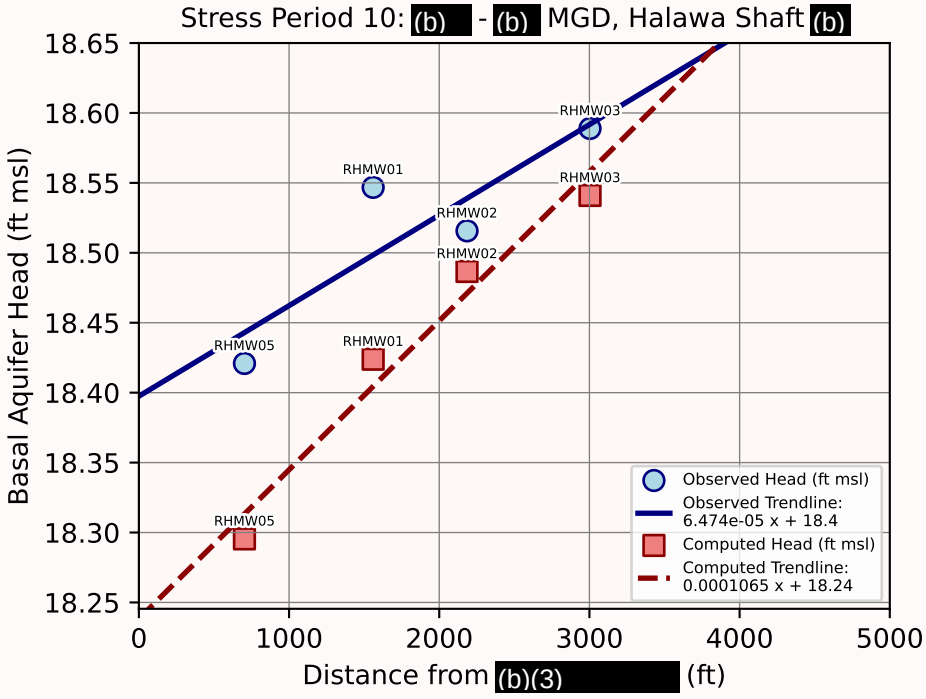

Basal Aquifer Wells - All
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
20
19
18
17
16
15
14
13
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

Gradients Along Red Hill Ridge

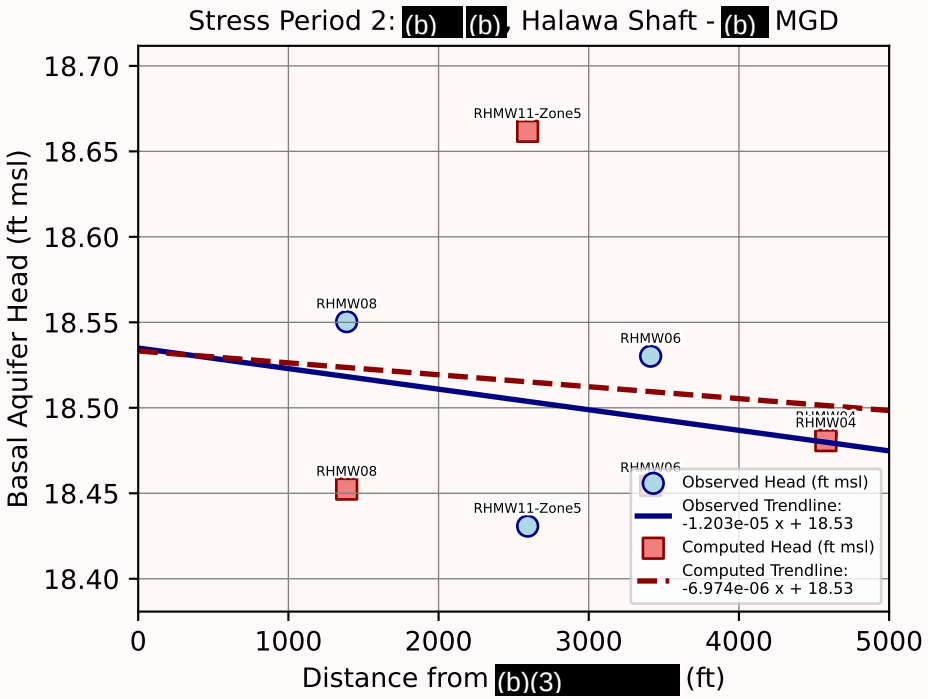


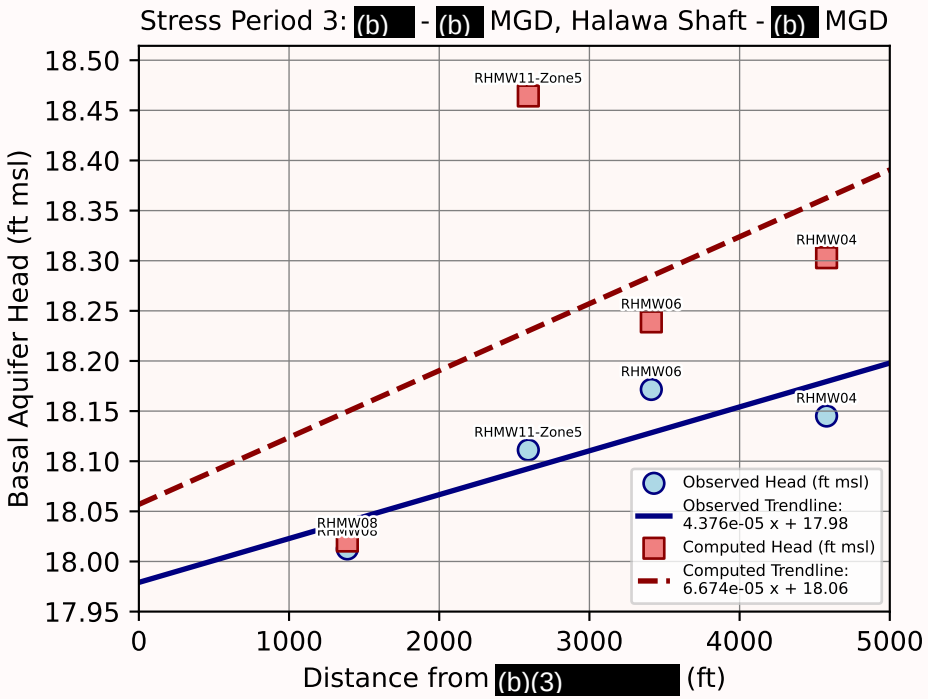


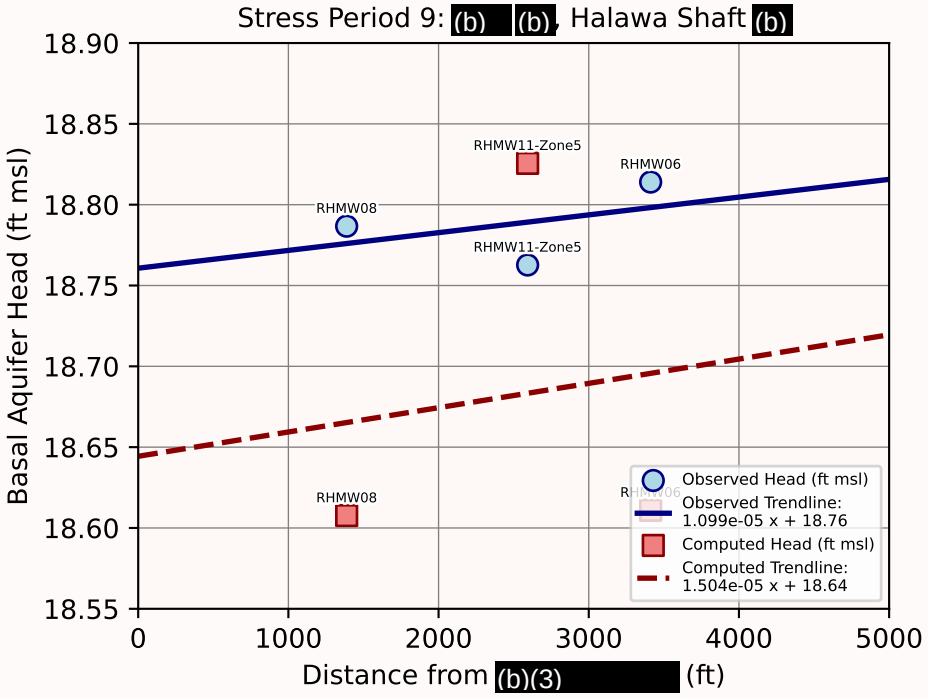


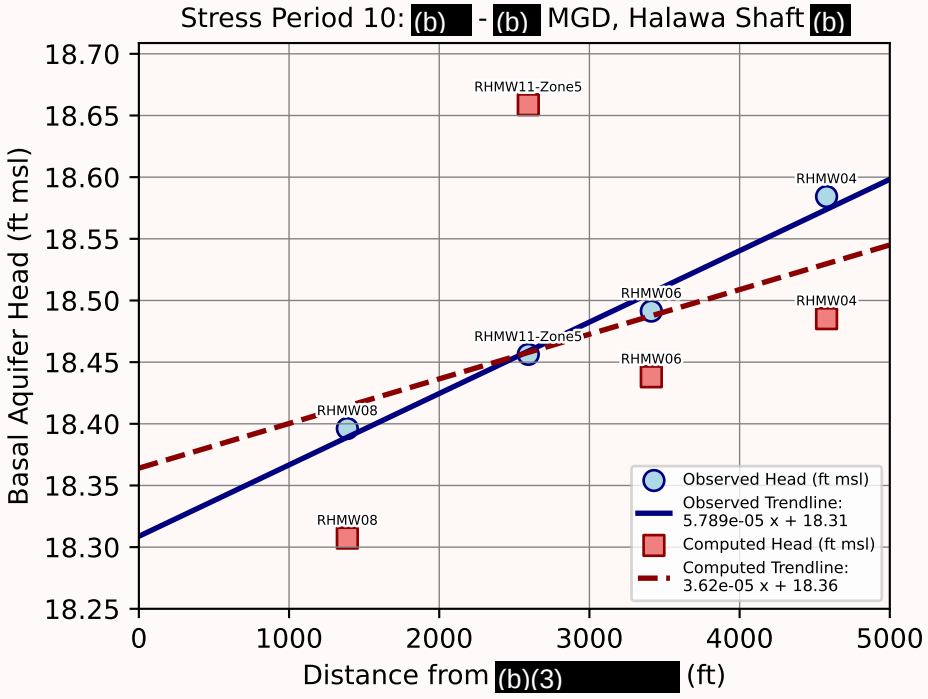


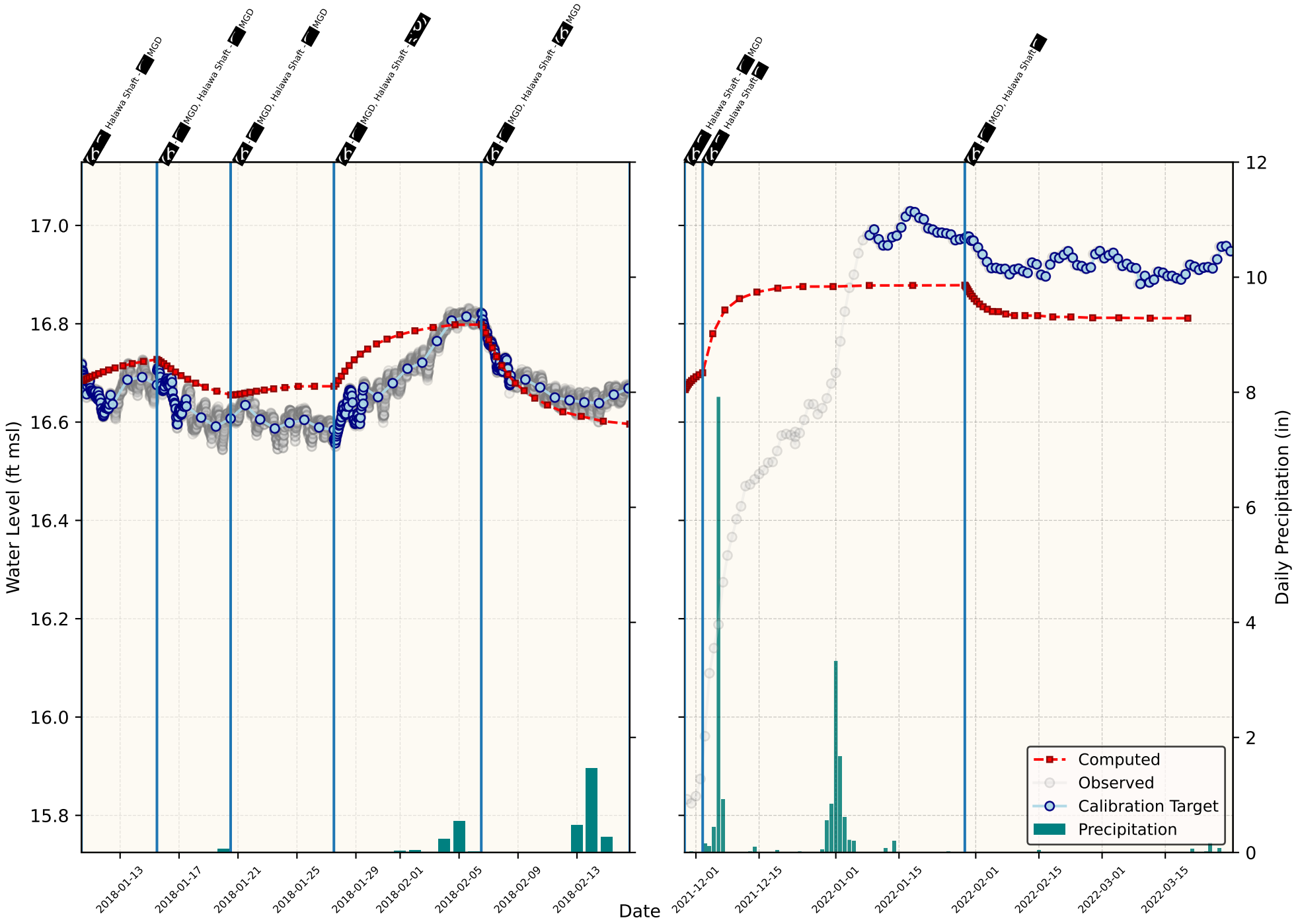
Gradients Northwest of Red Hill Ridge





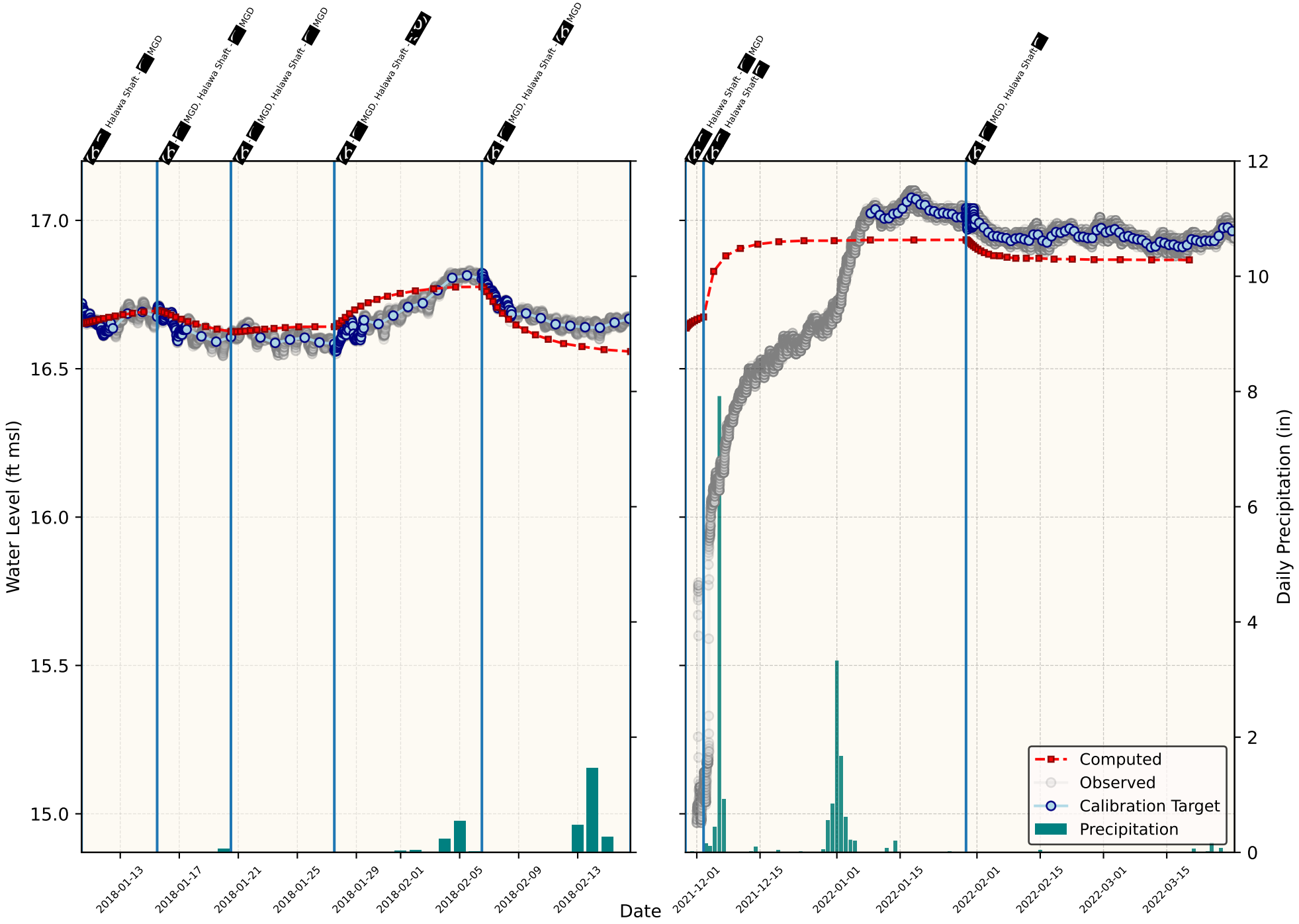


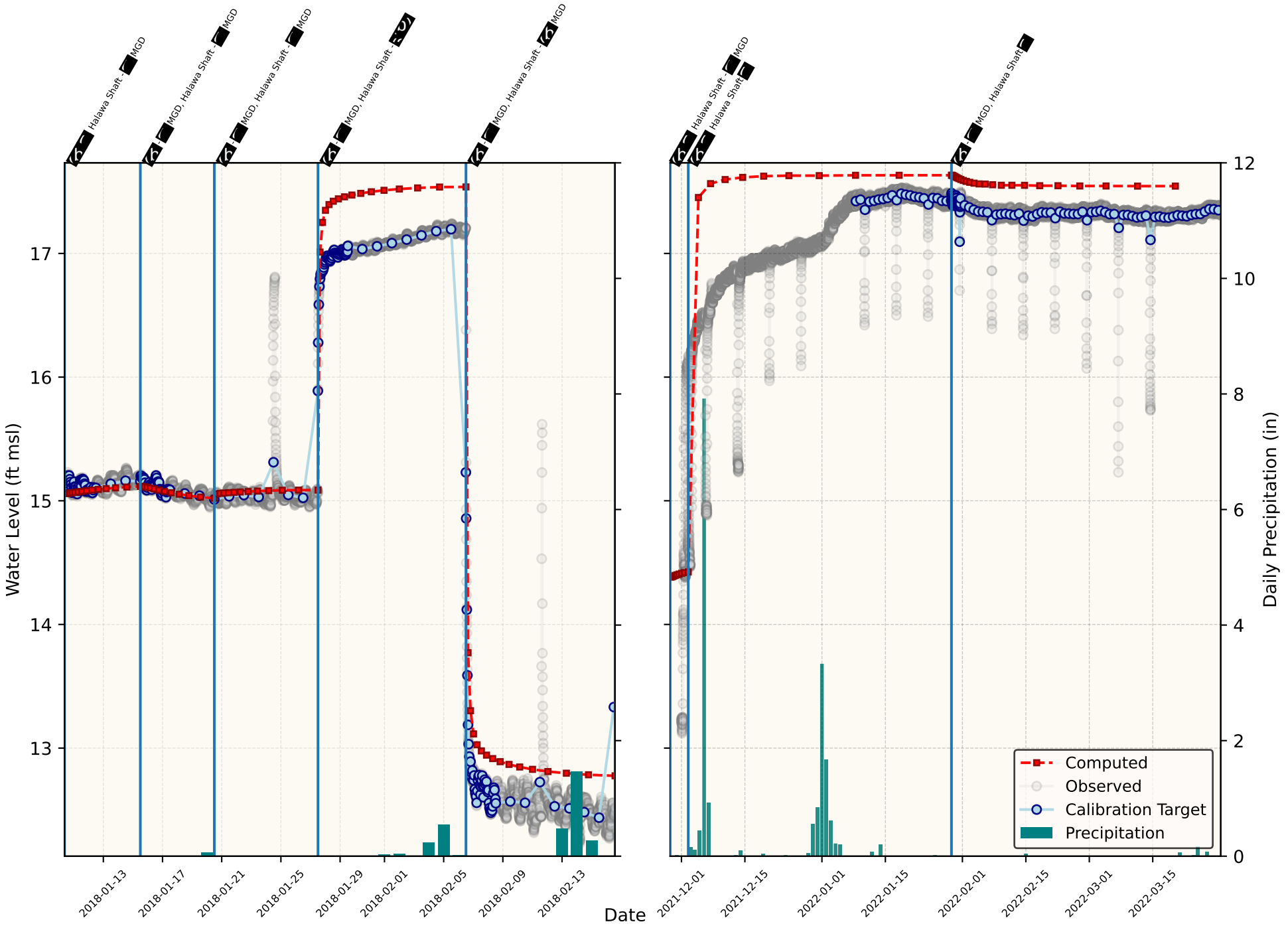


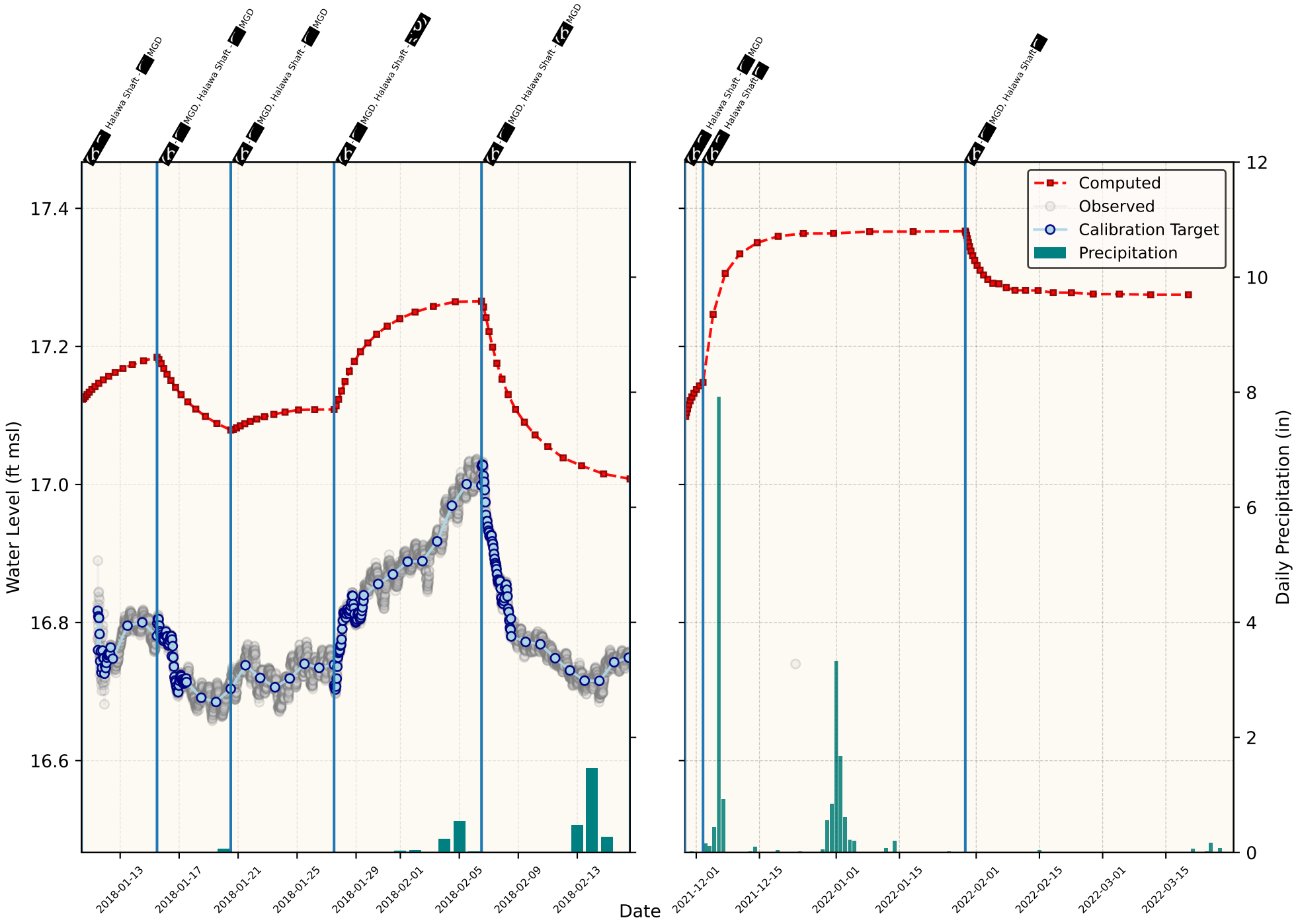

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

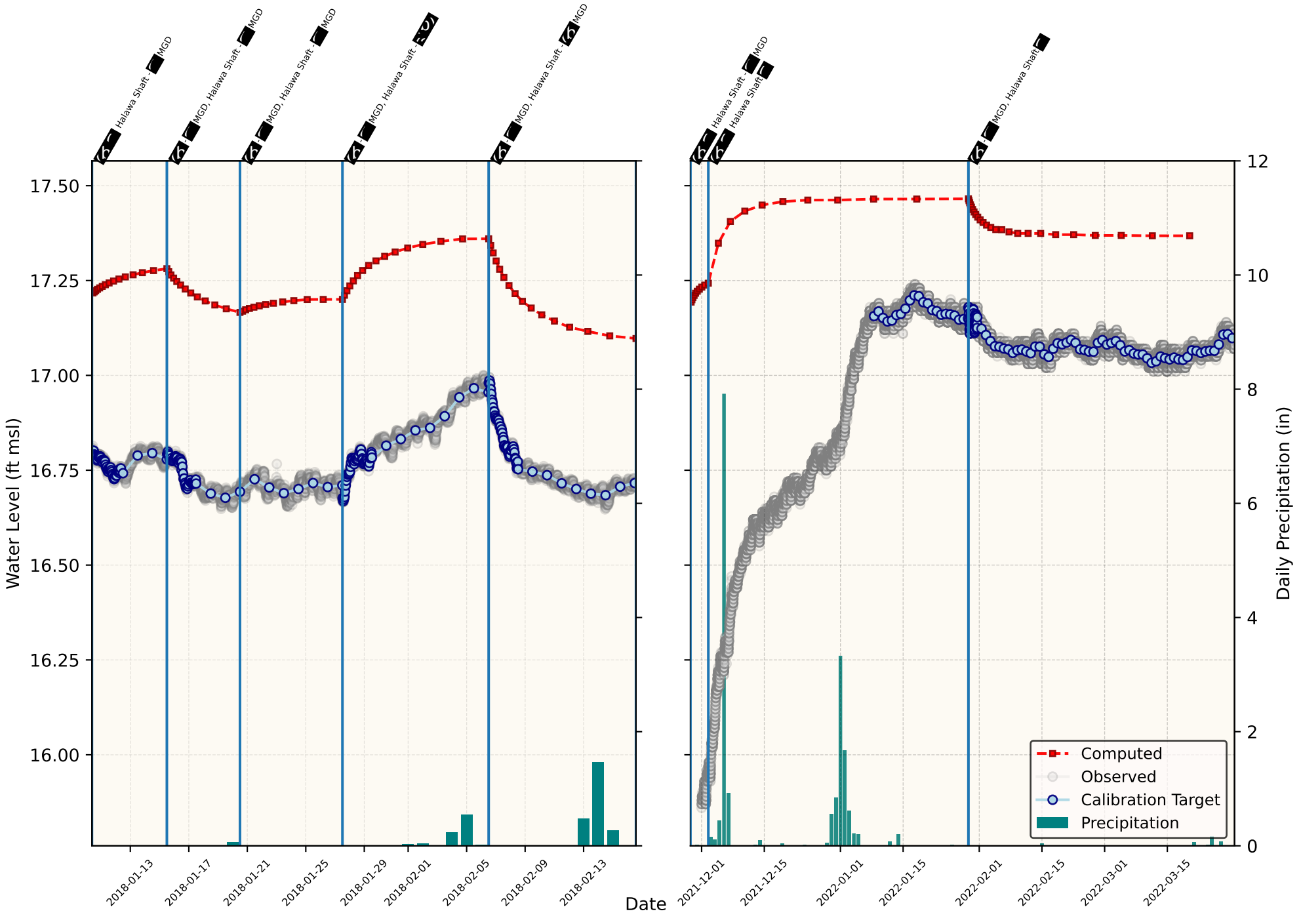
(b)(3) [redacted]

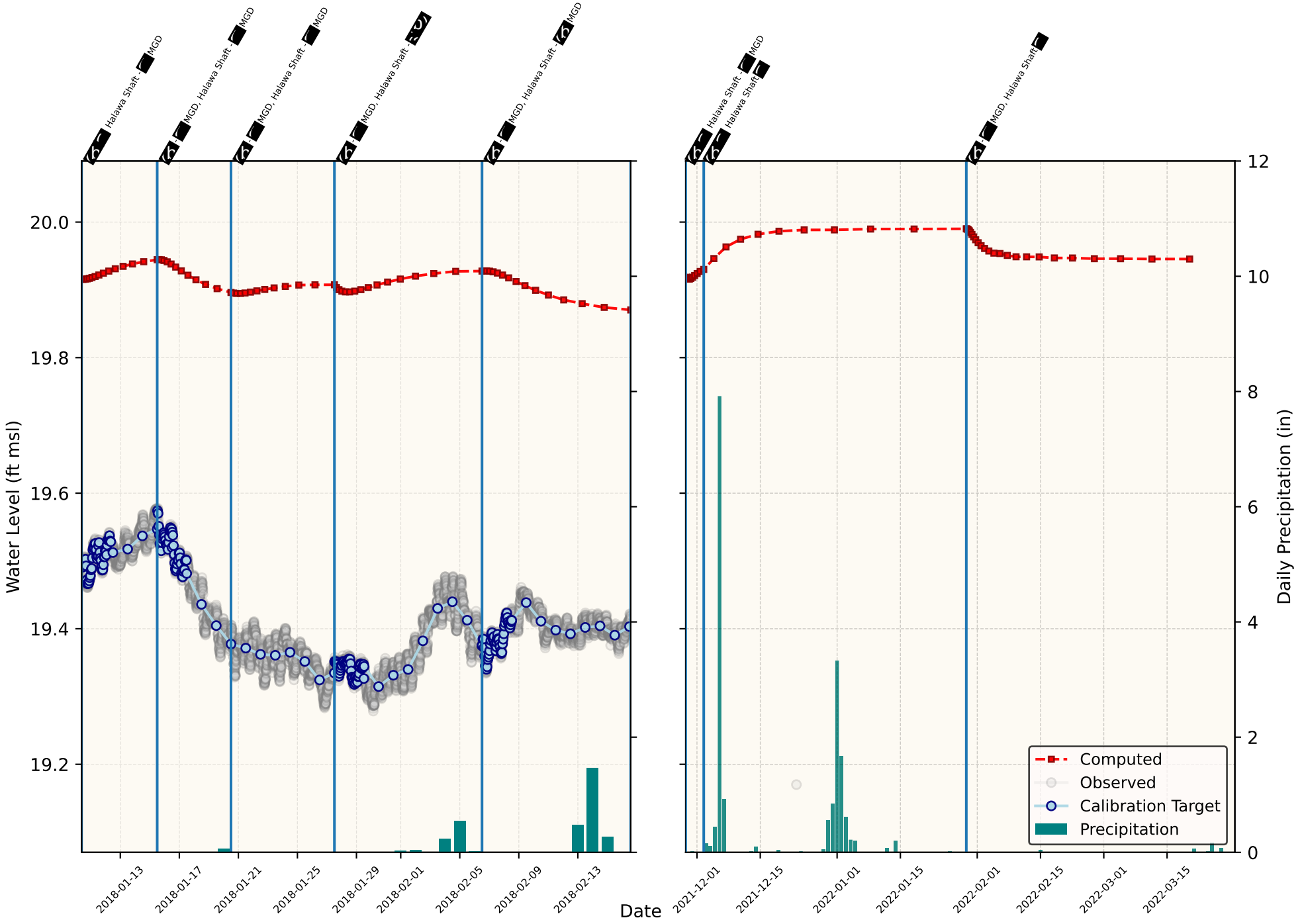
Group 1 - Basal Aquifer

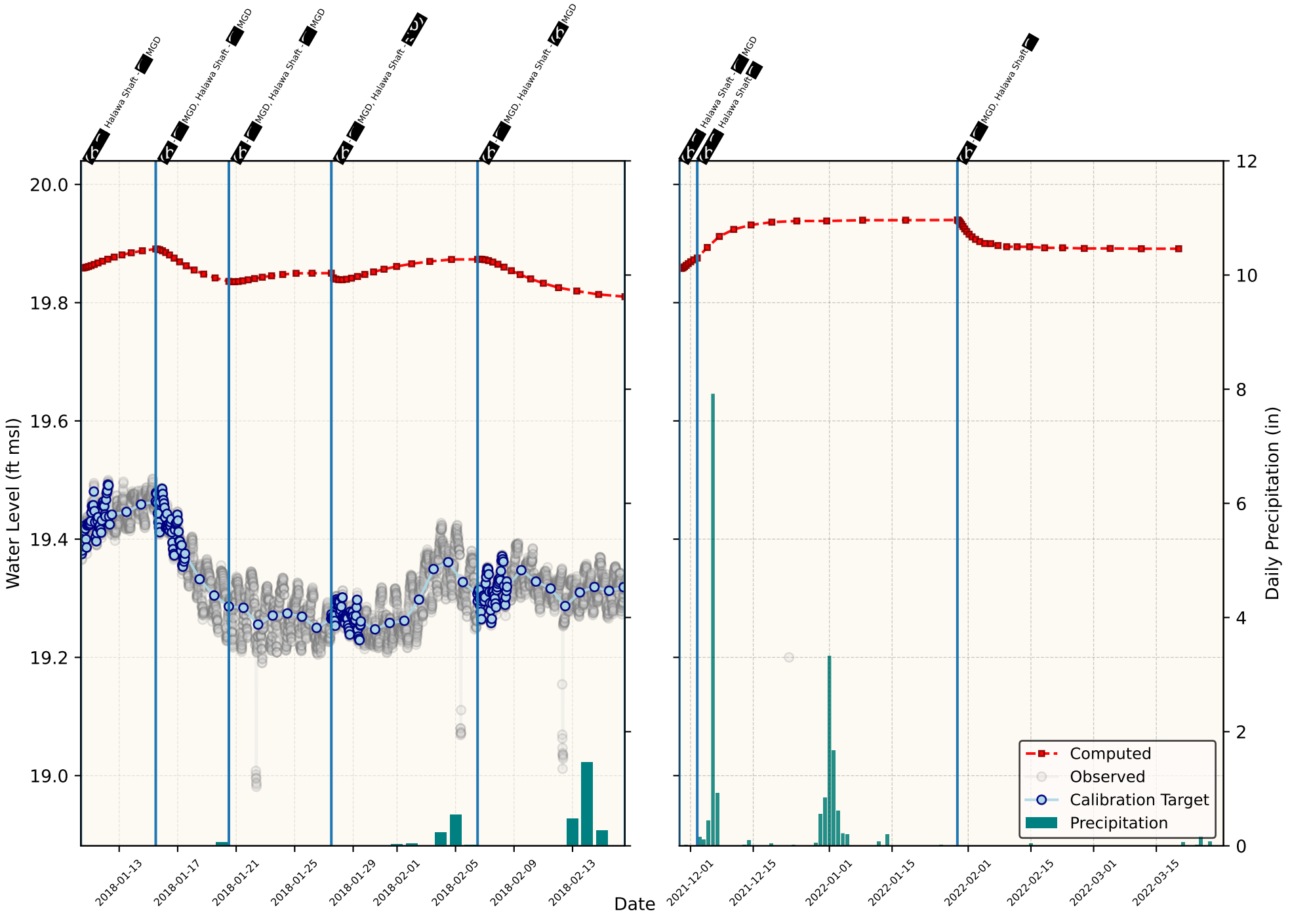


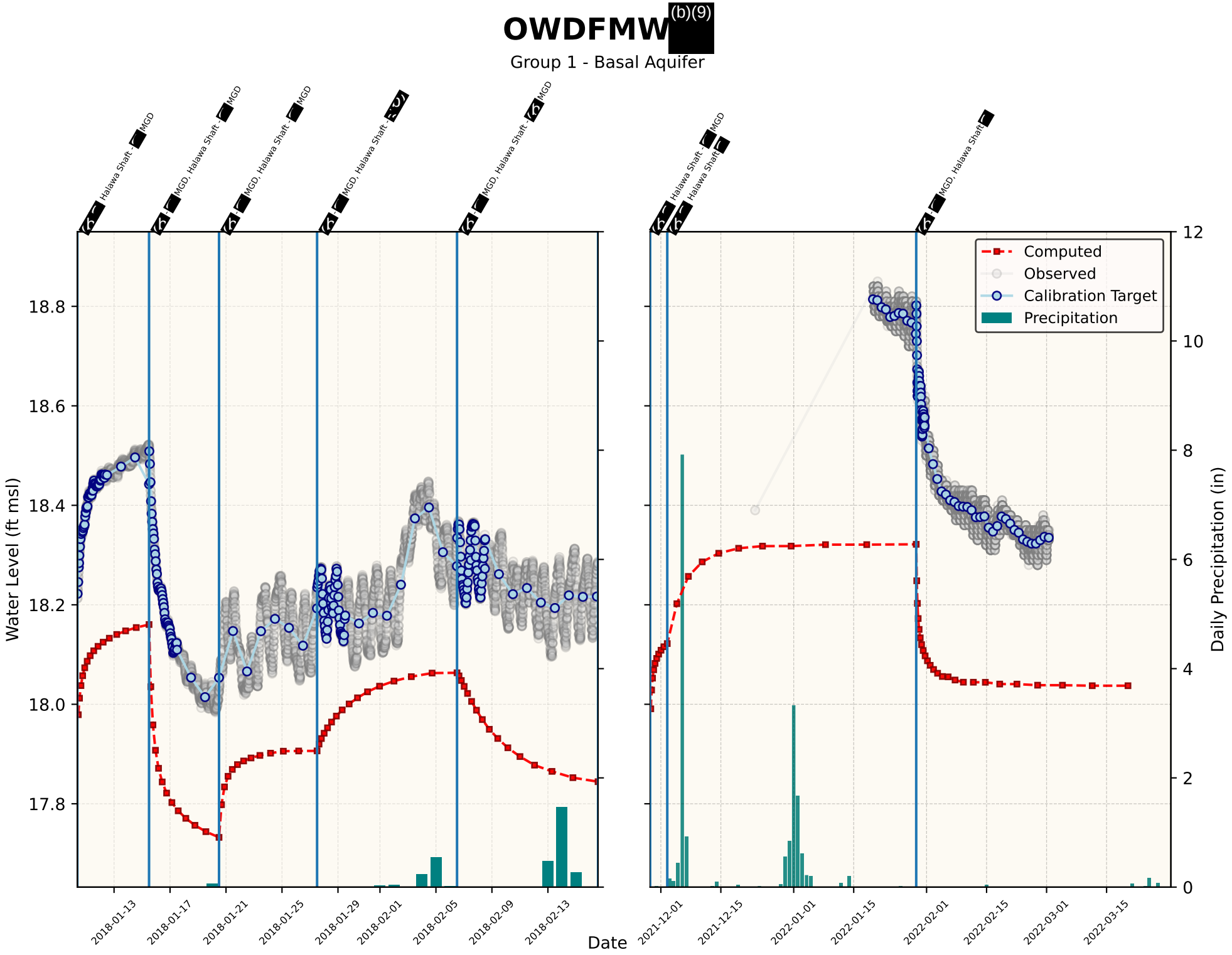

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

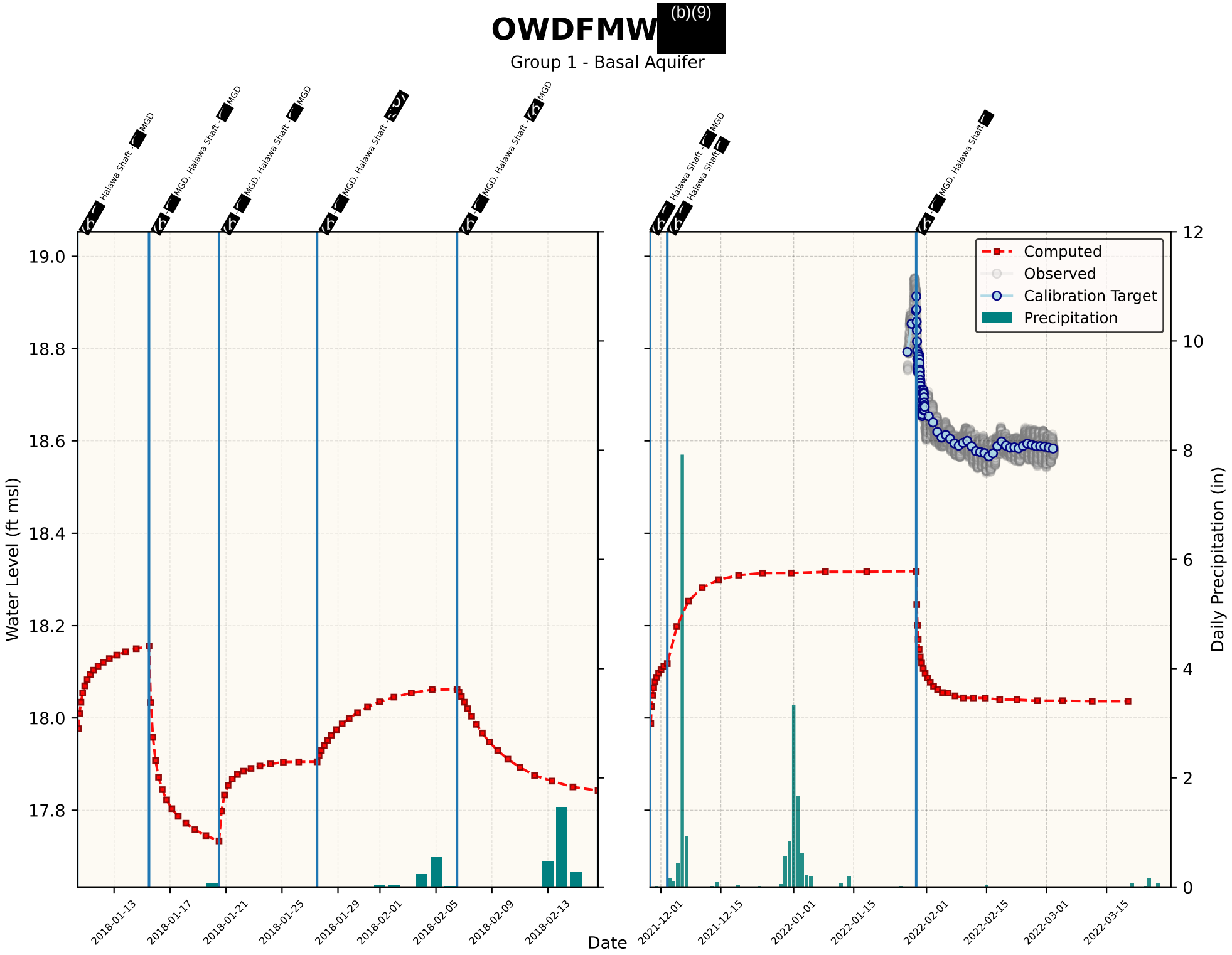

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
17.4
17.2
17.0
16.8
16.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

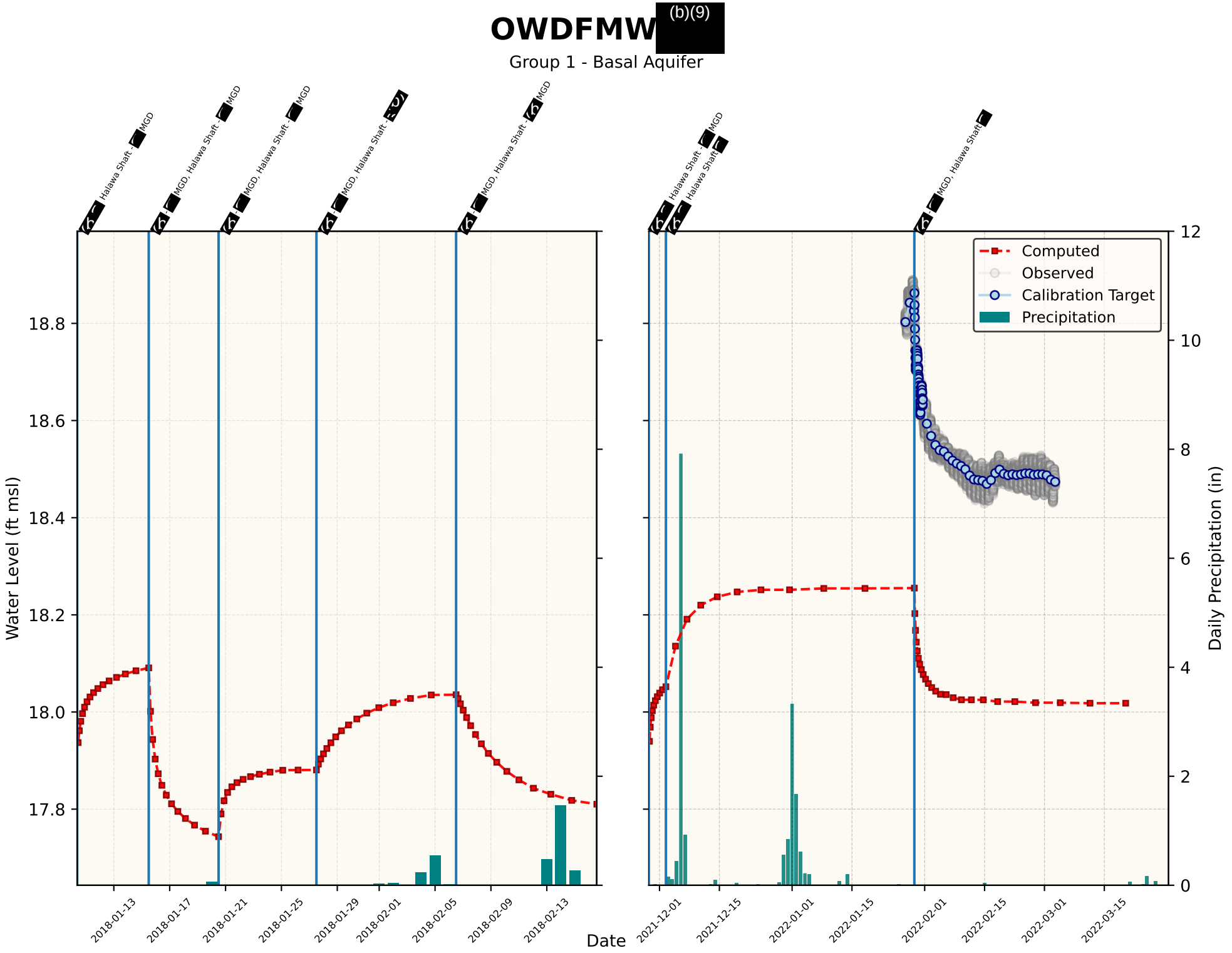

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

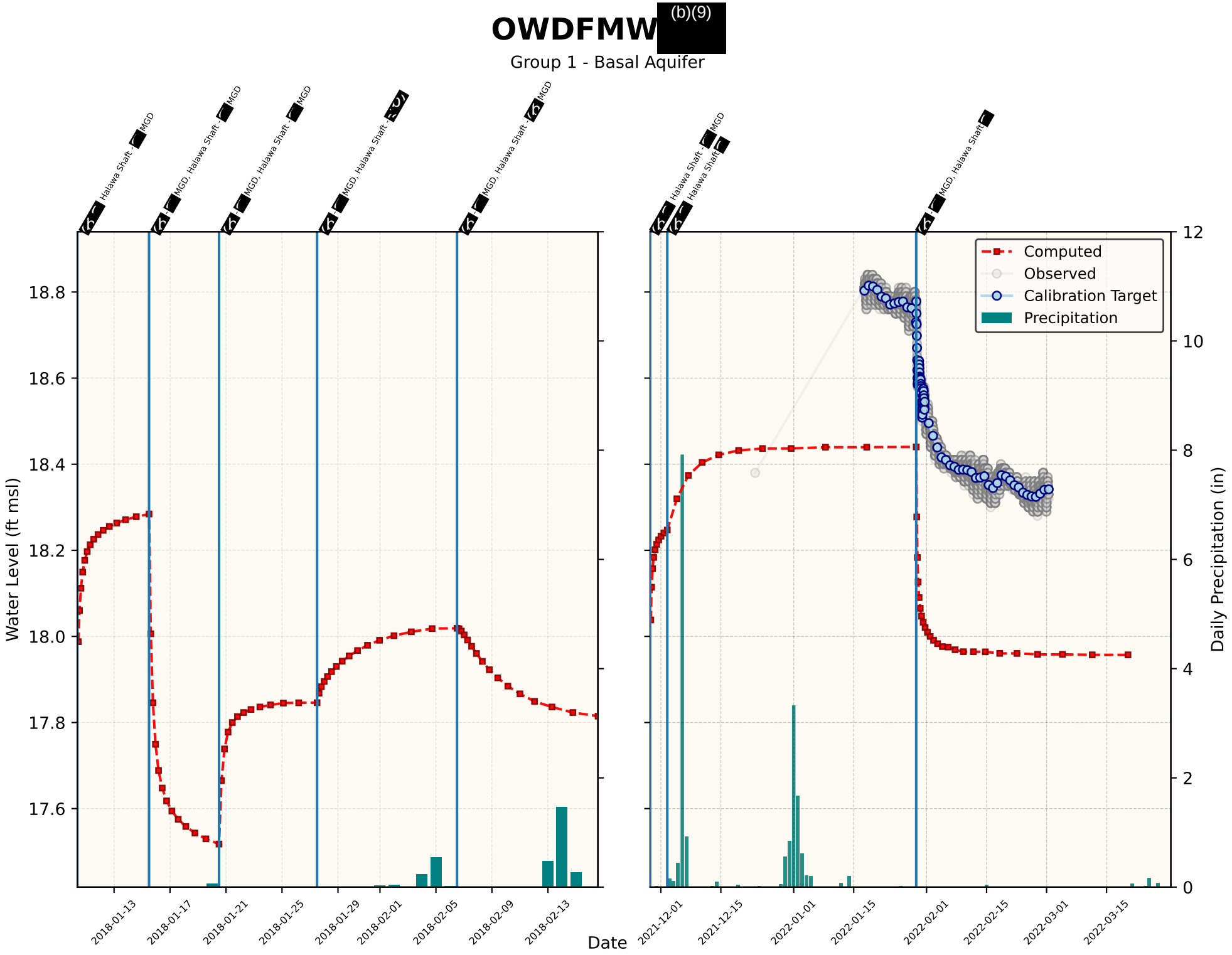

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

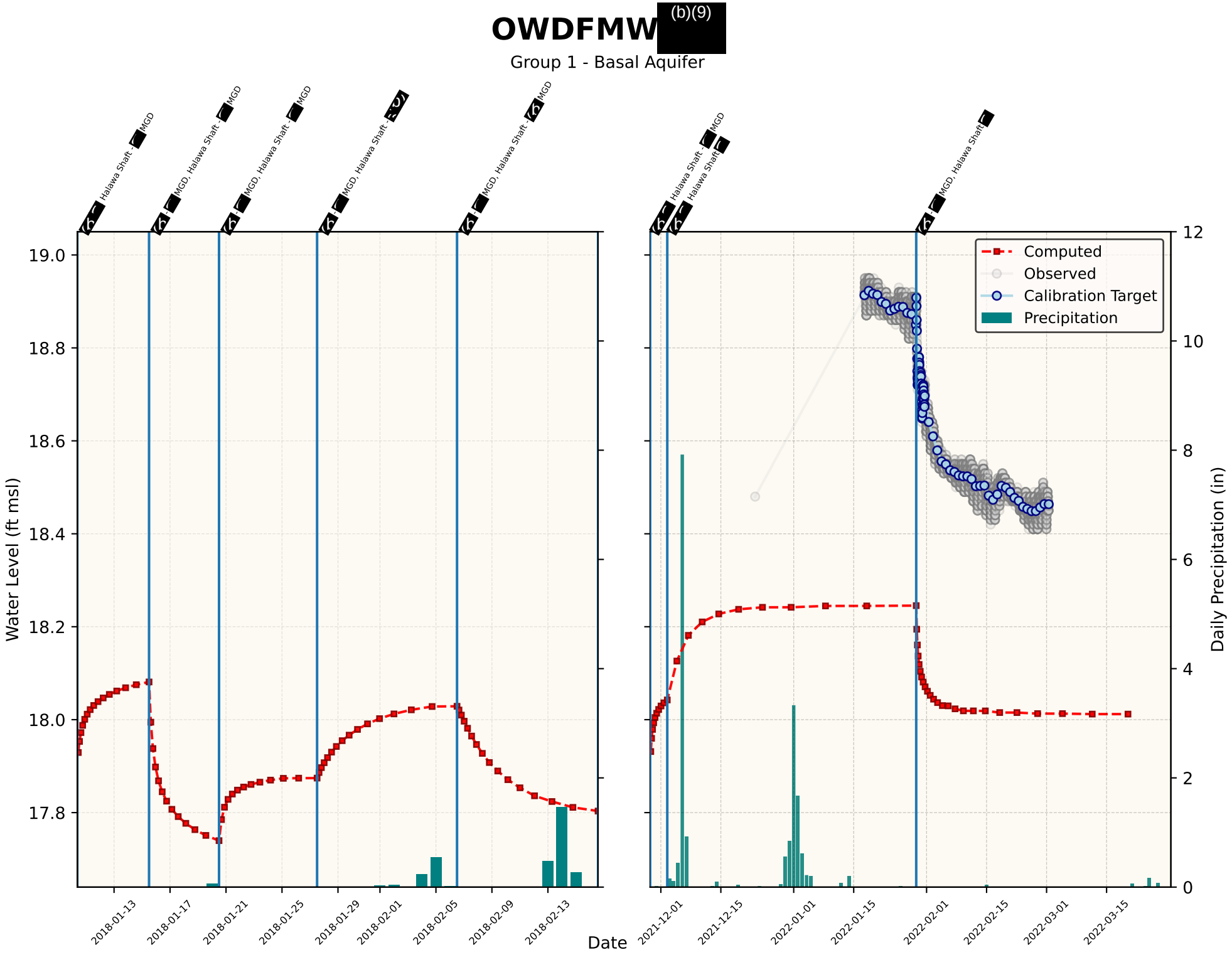

Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

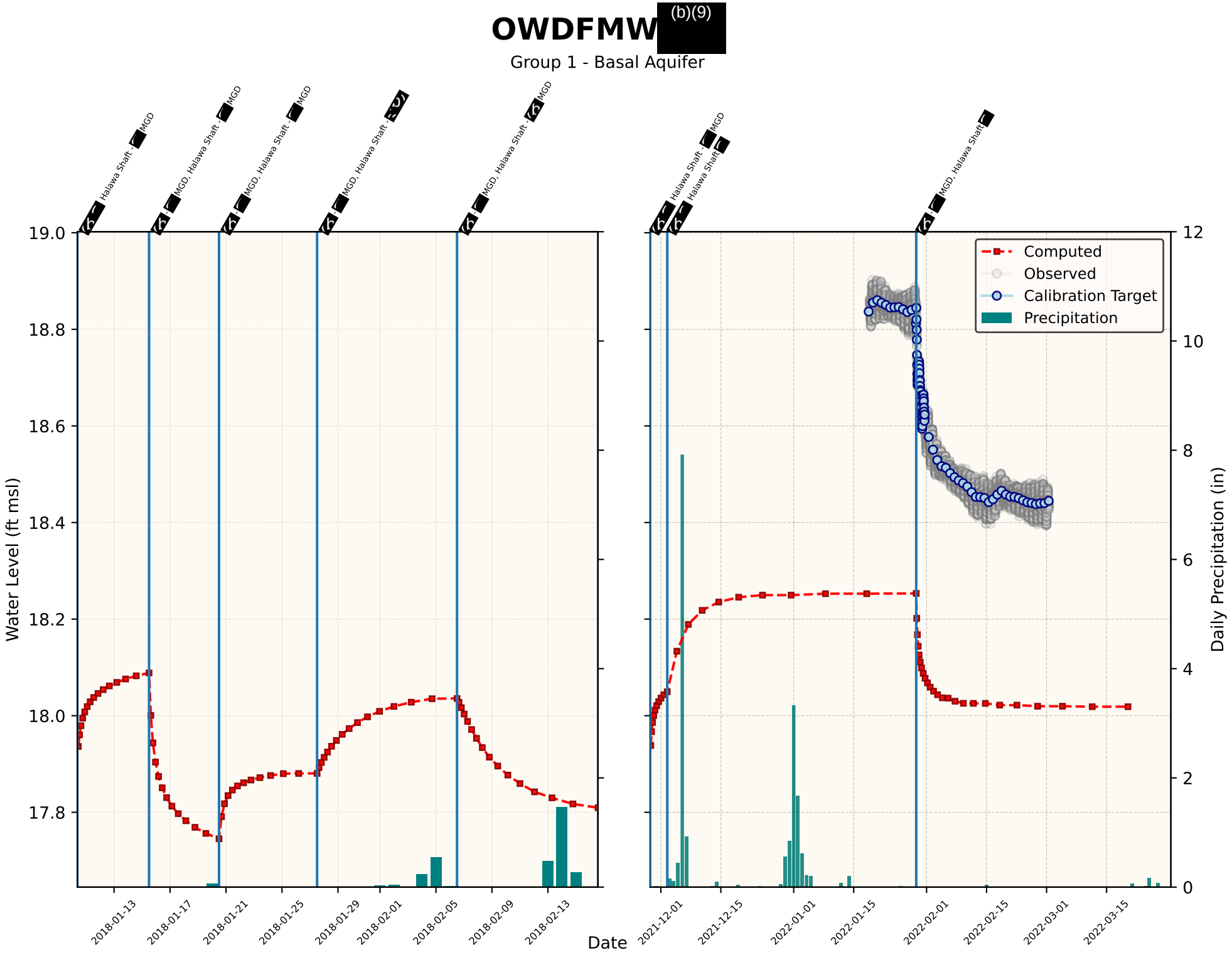

OWDFMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

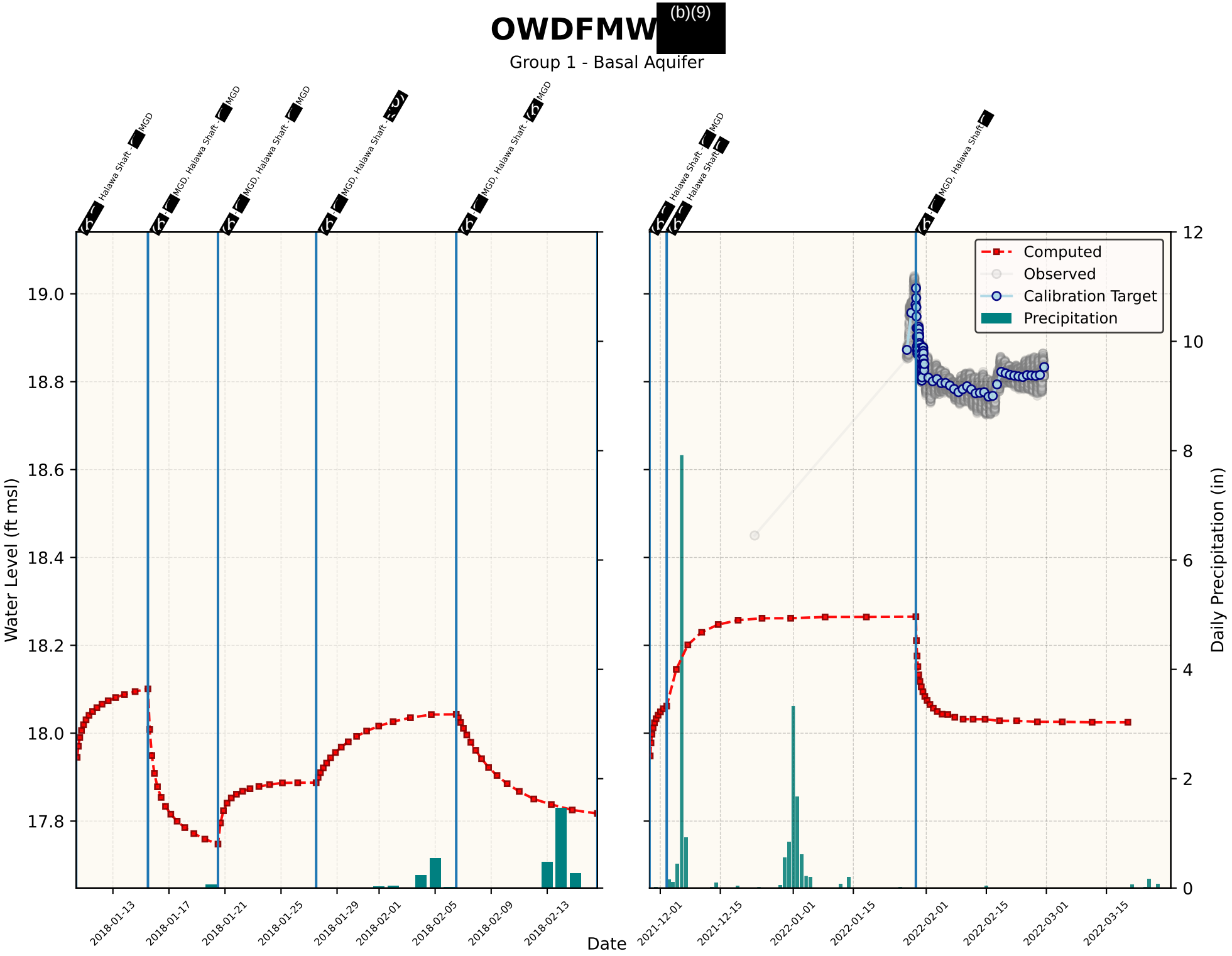

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

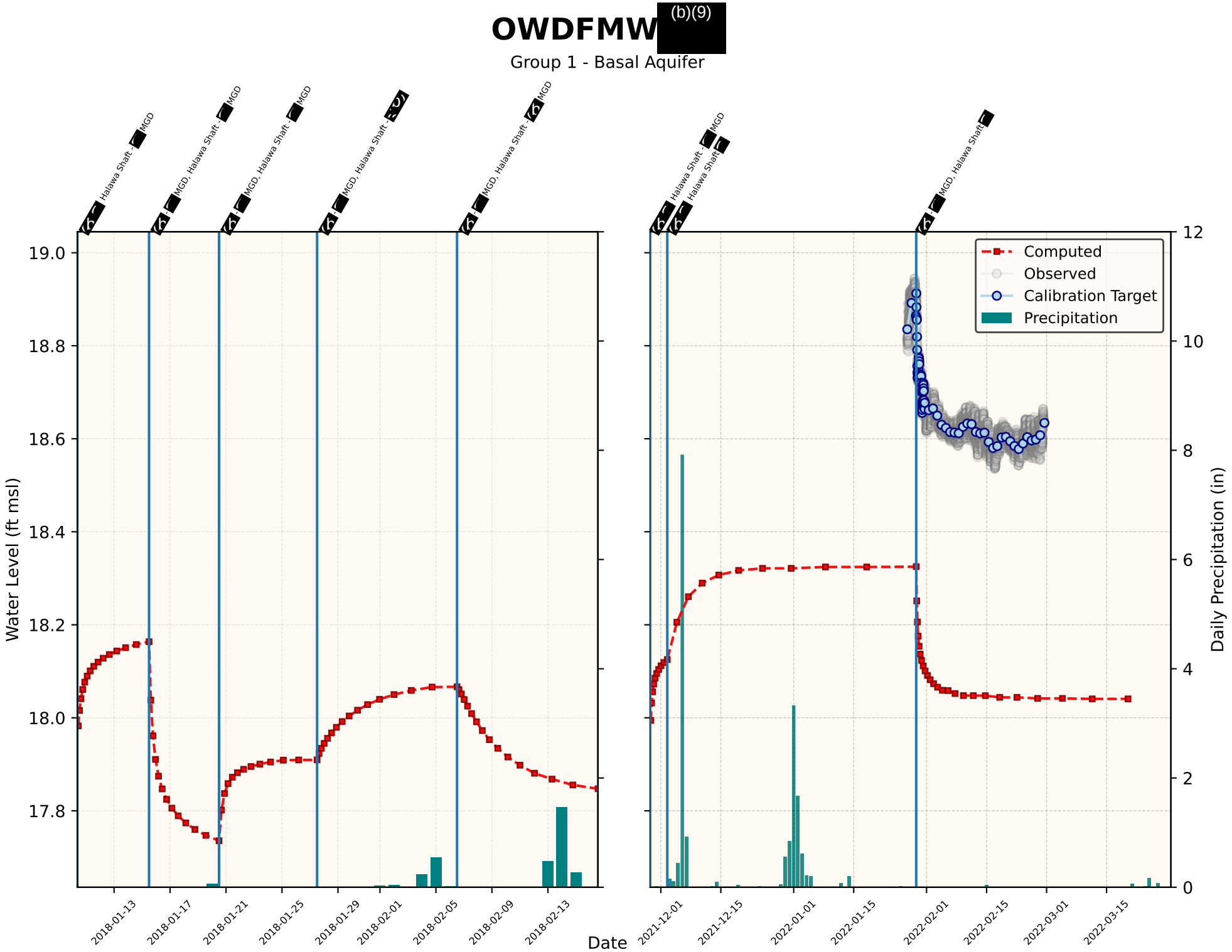

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

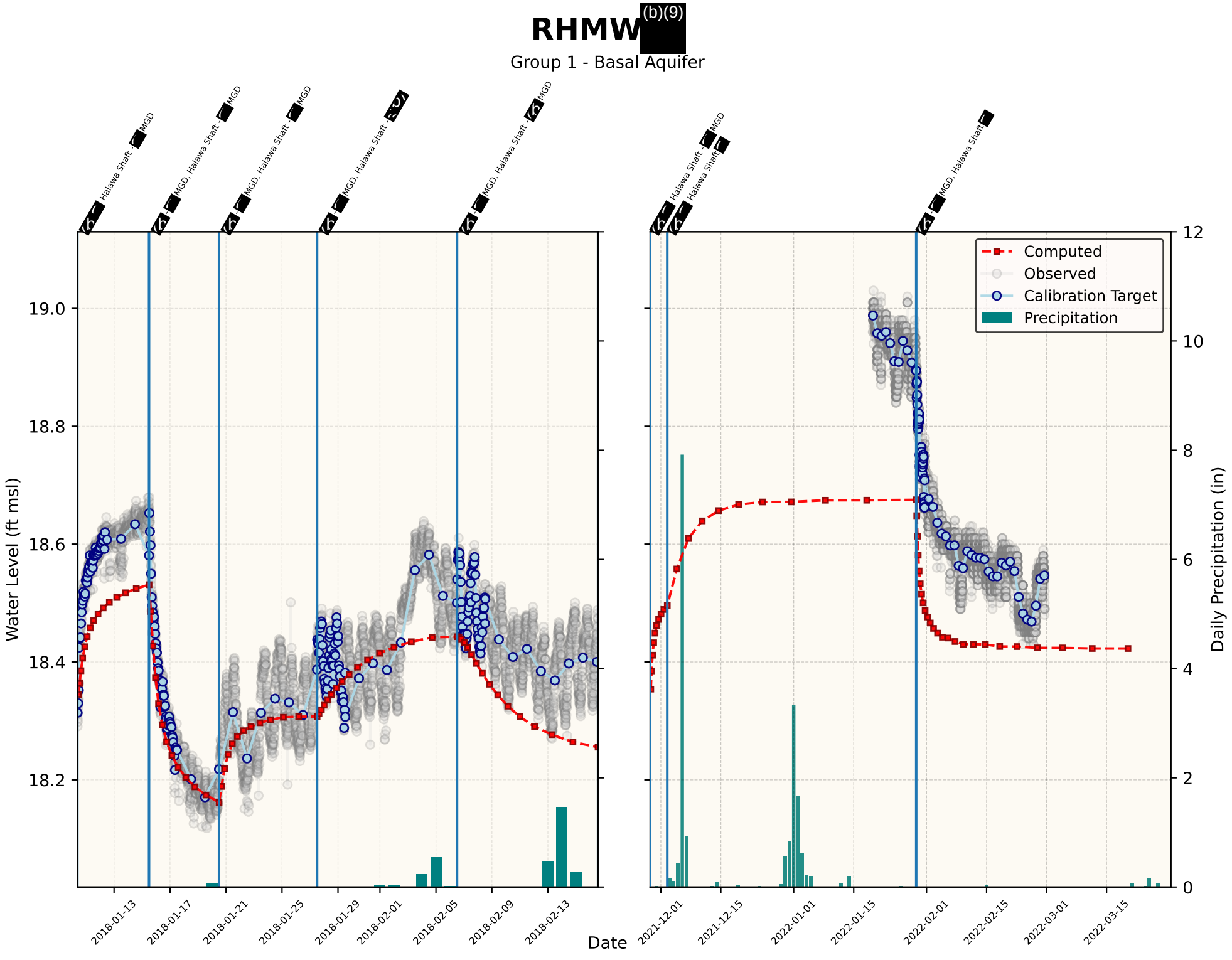

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
17.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
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2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
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2018-02-13
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2022-03-01
2022-03-15


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
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18.4
18.2
18.0
17.8
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2018-01-13
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2018-01-21
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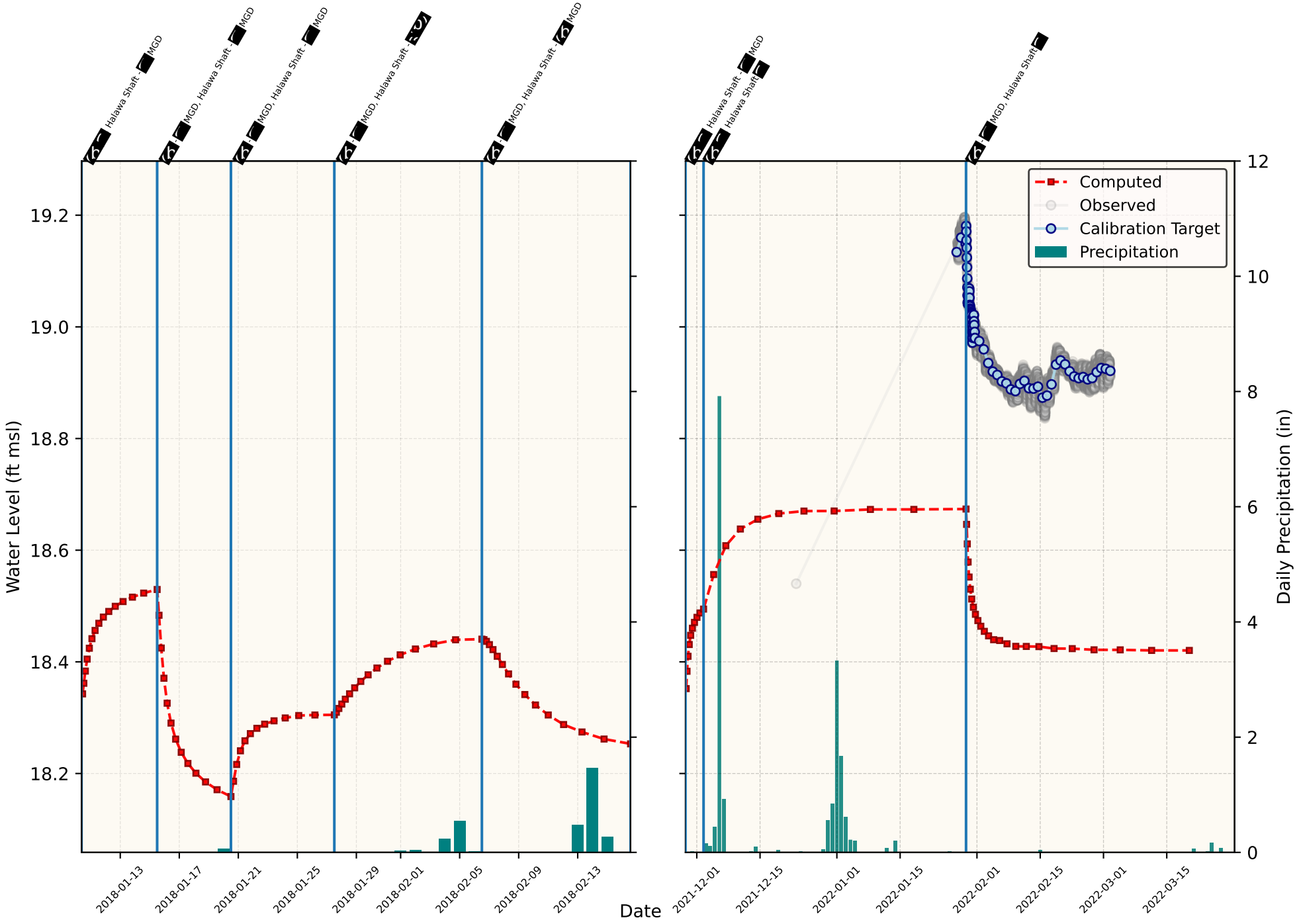

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
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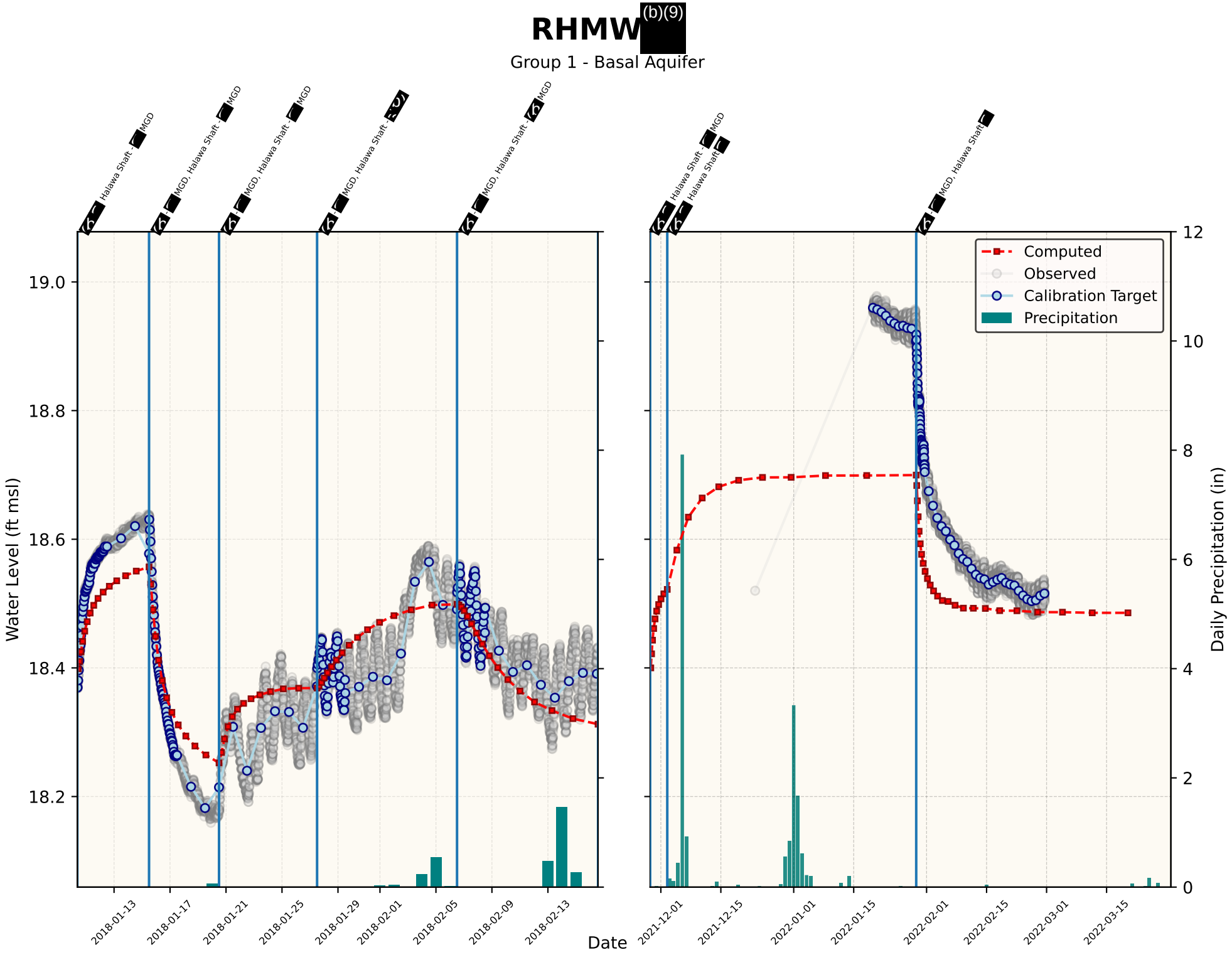

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
19.0
18.8
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18.4
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Daily Precipitation (in)
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Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
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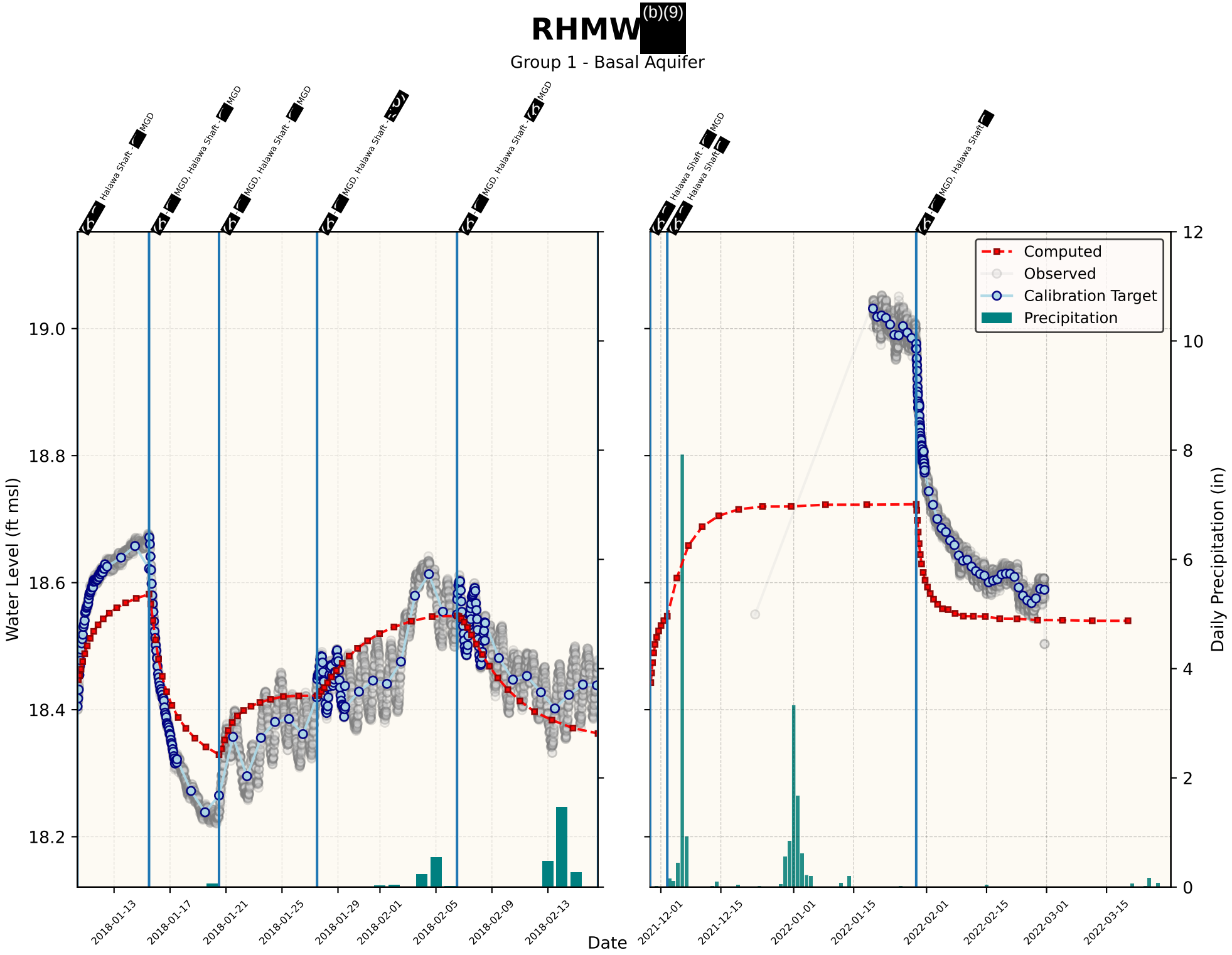

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
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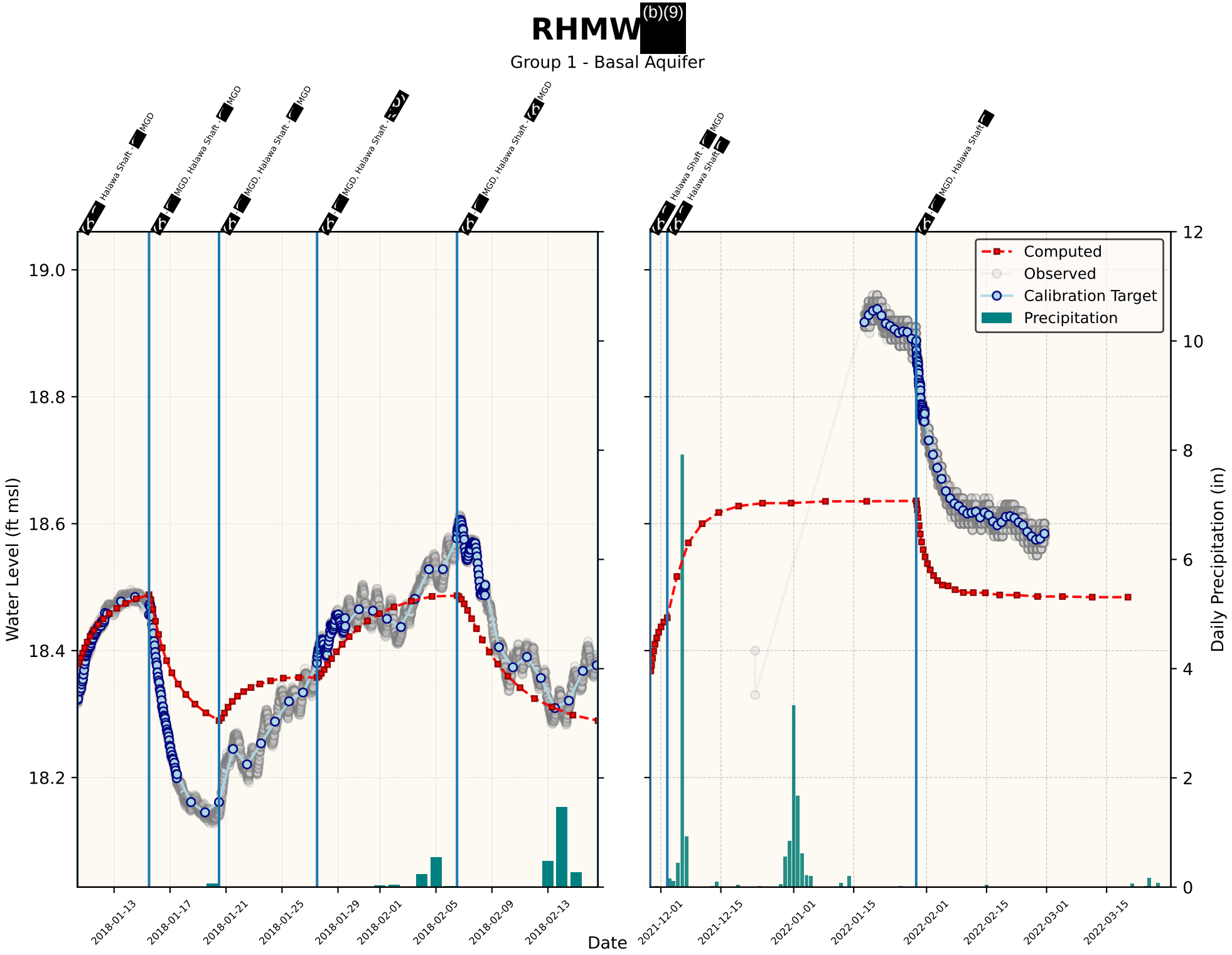
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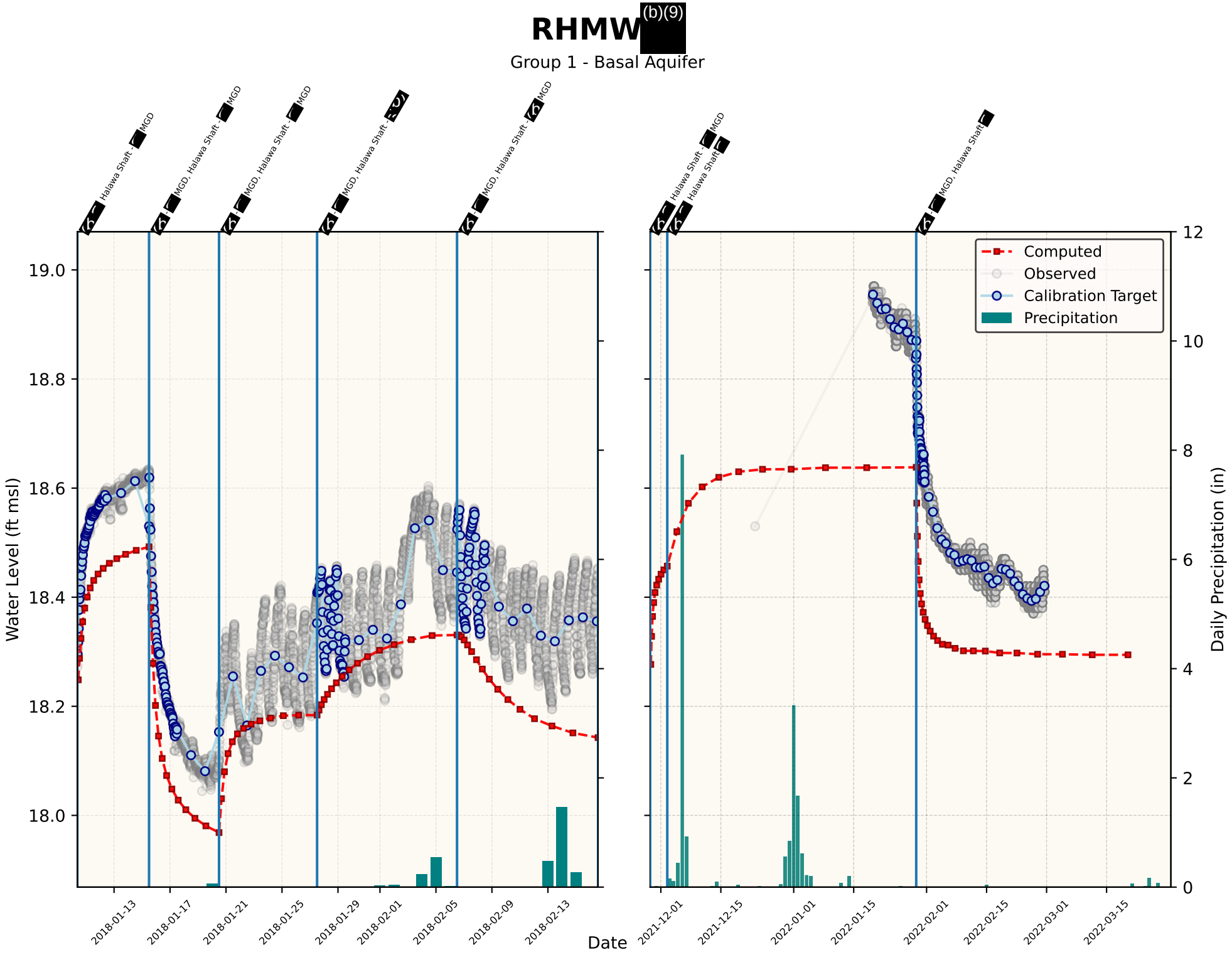
Group 1 - Basal Aquifer

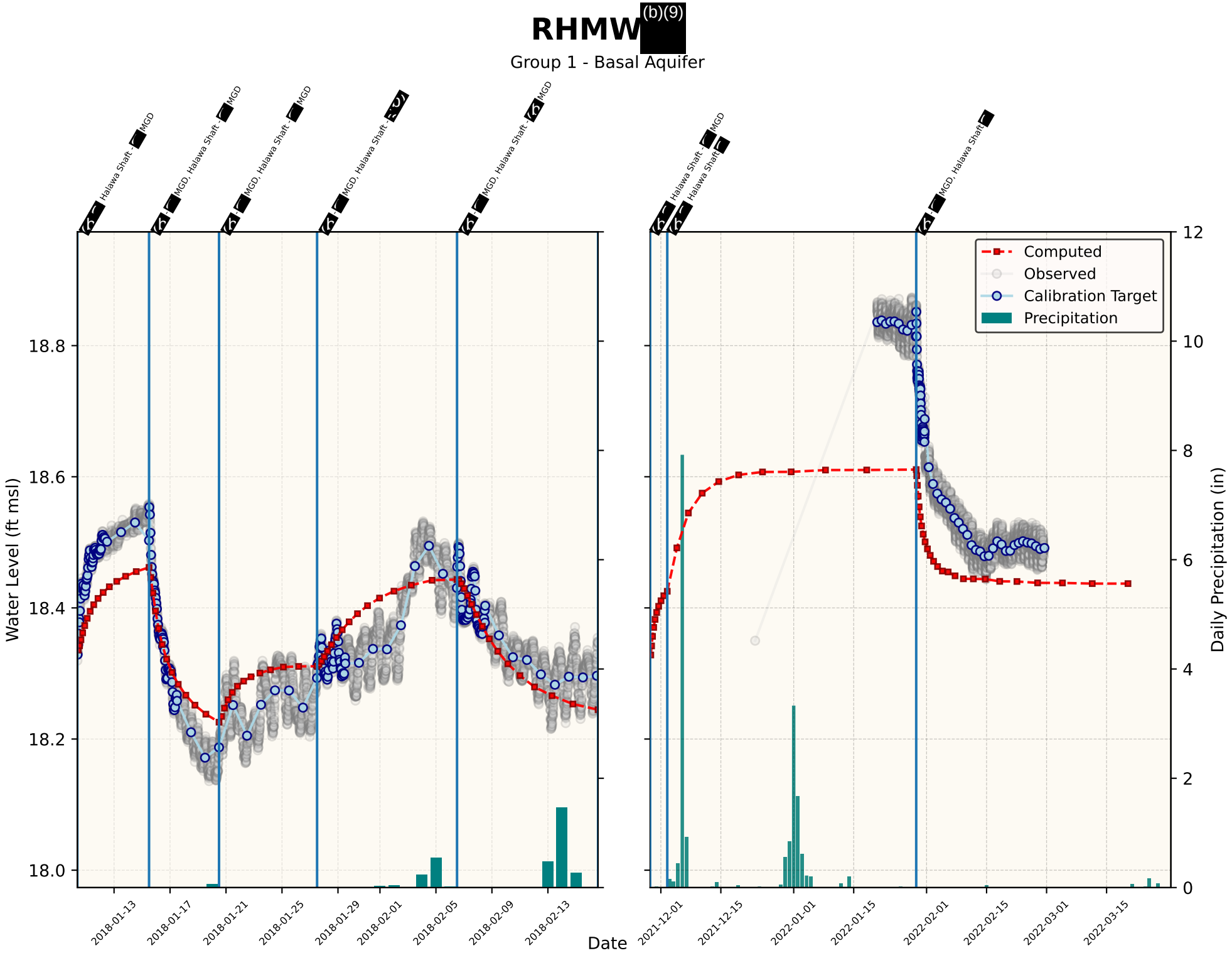


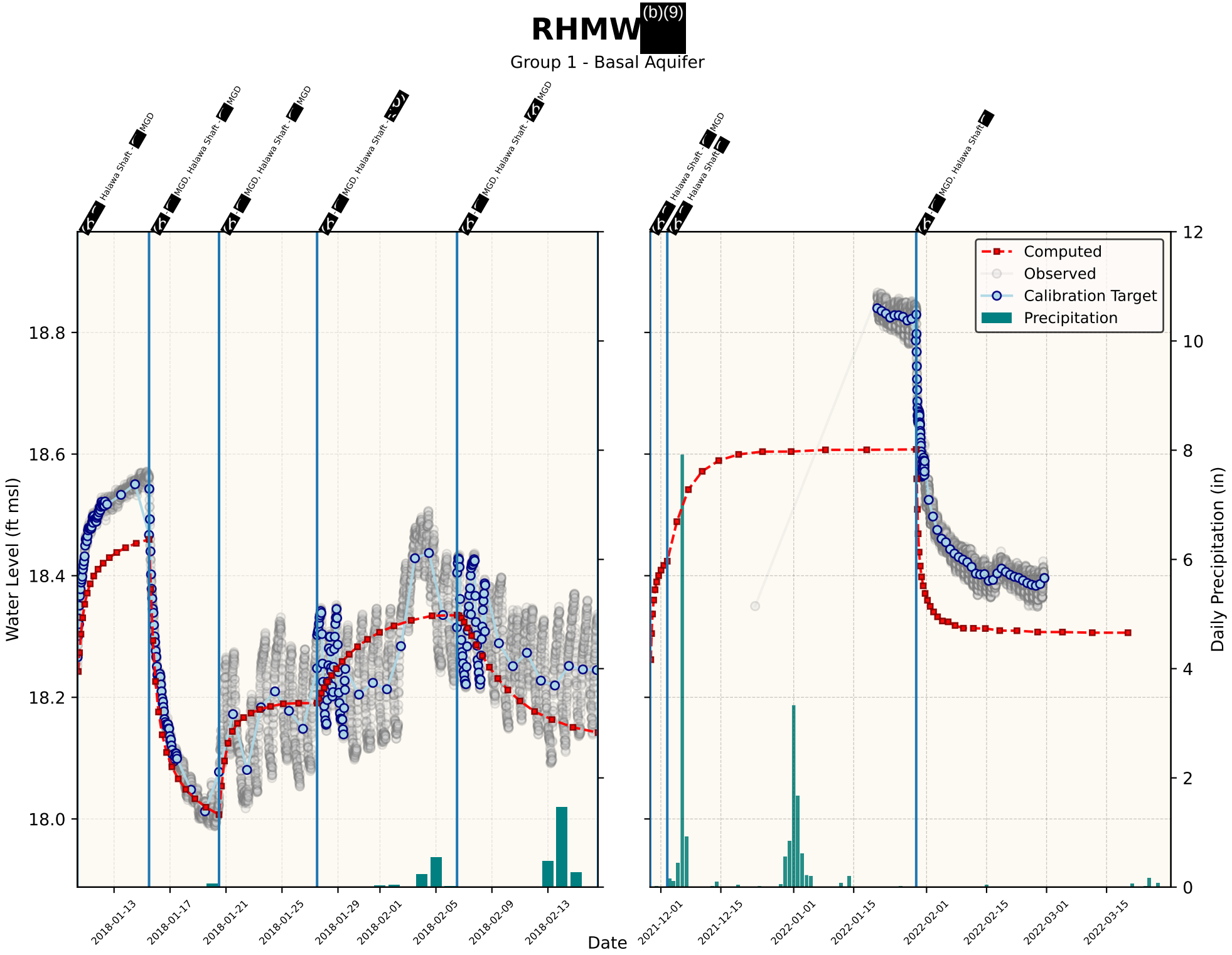

RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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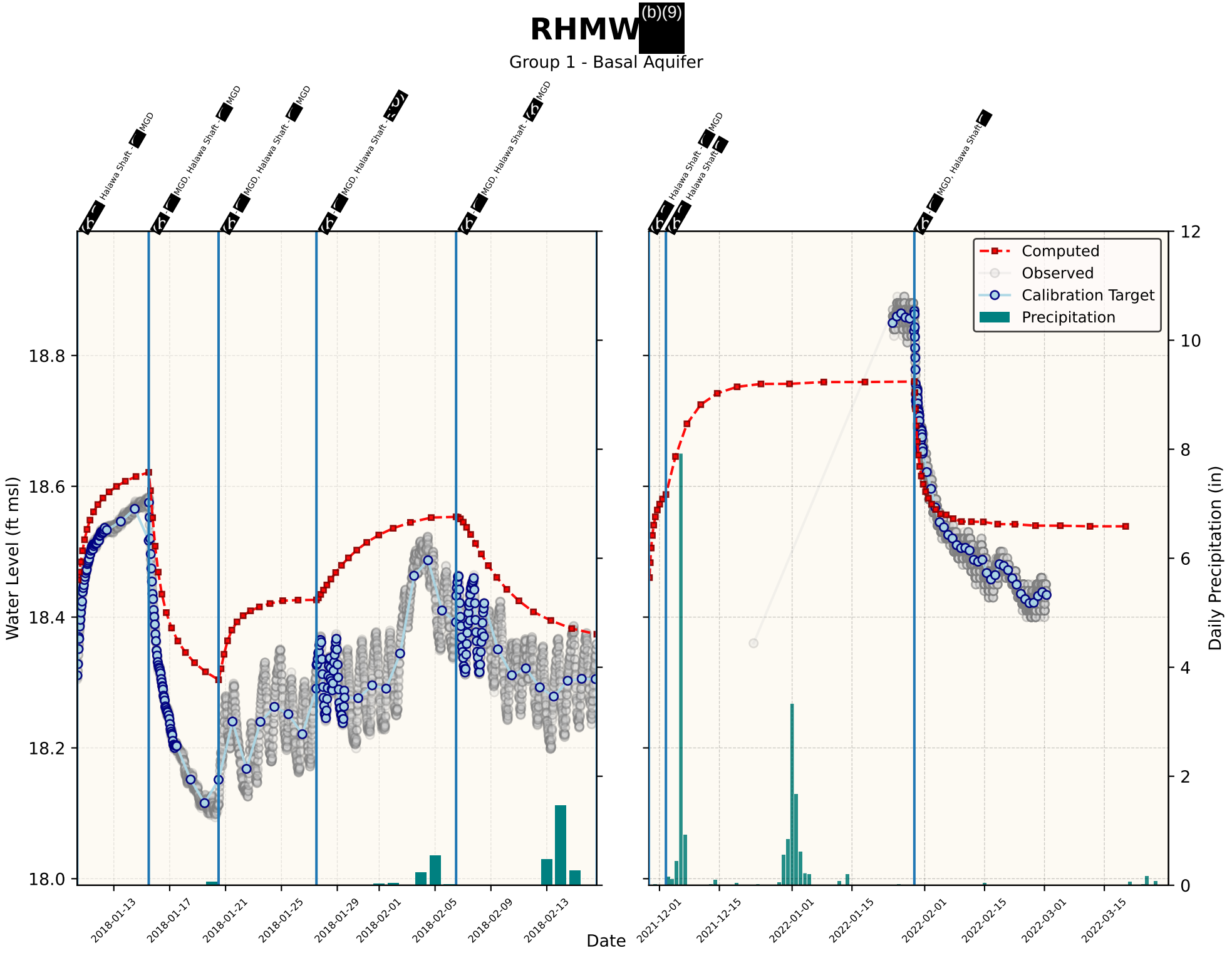

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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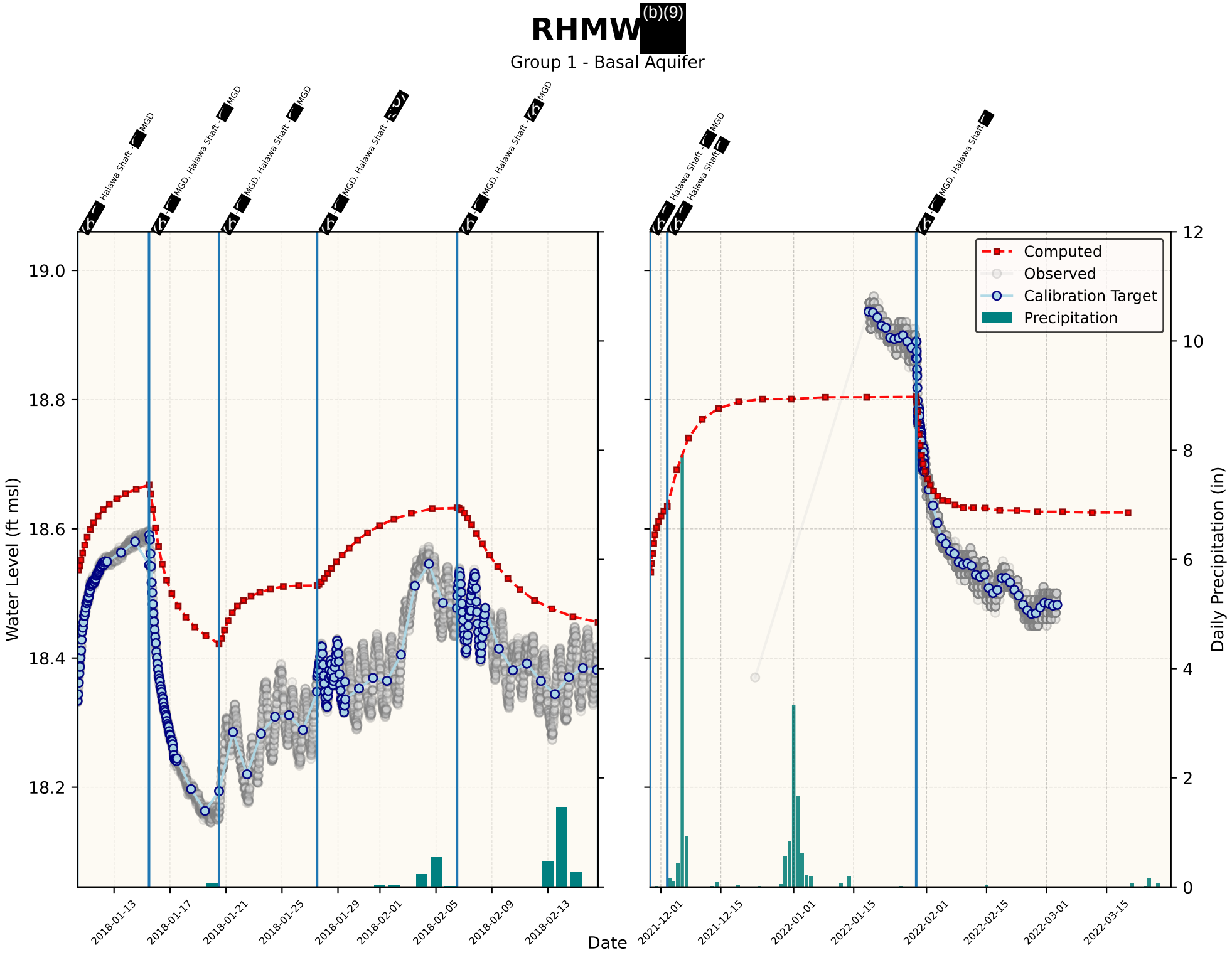

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
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Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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RHMW(b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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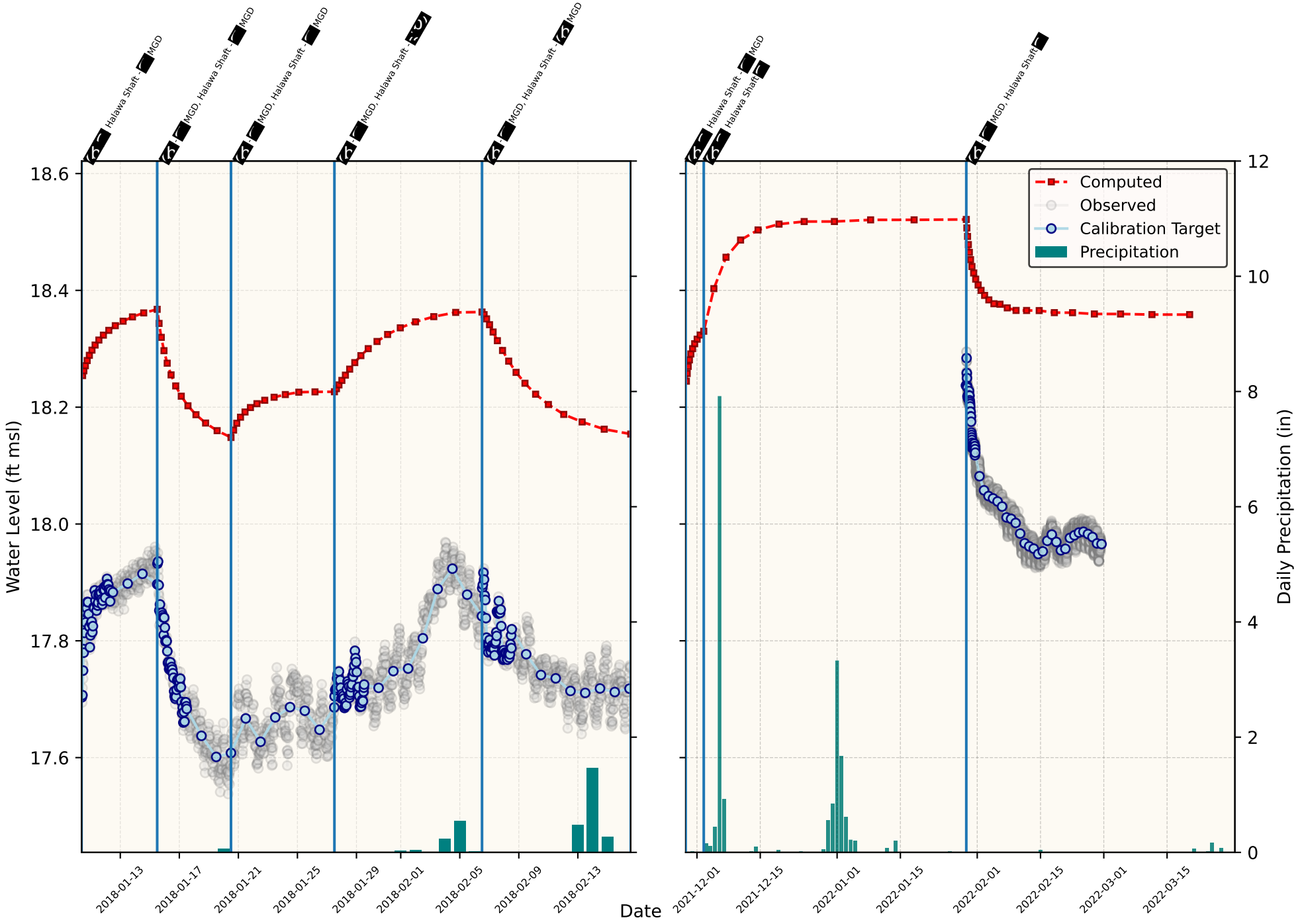

RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
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Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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2018-01-13
2018-01-17
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2022-03-15


RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.0
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2018-01-13
2018-01-17
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RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted] MGD
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Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
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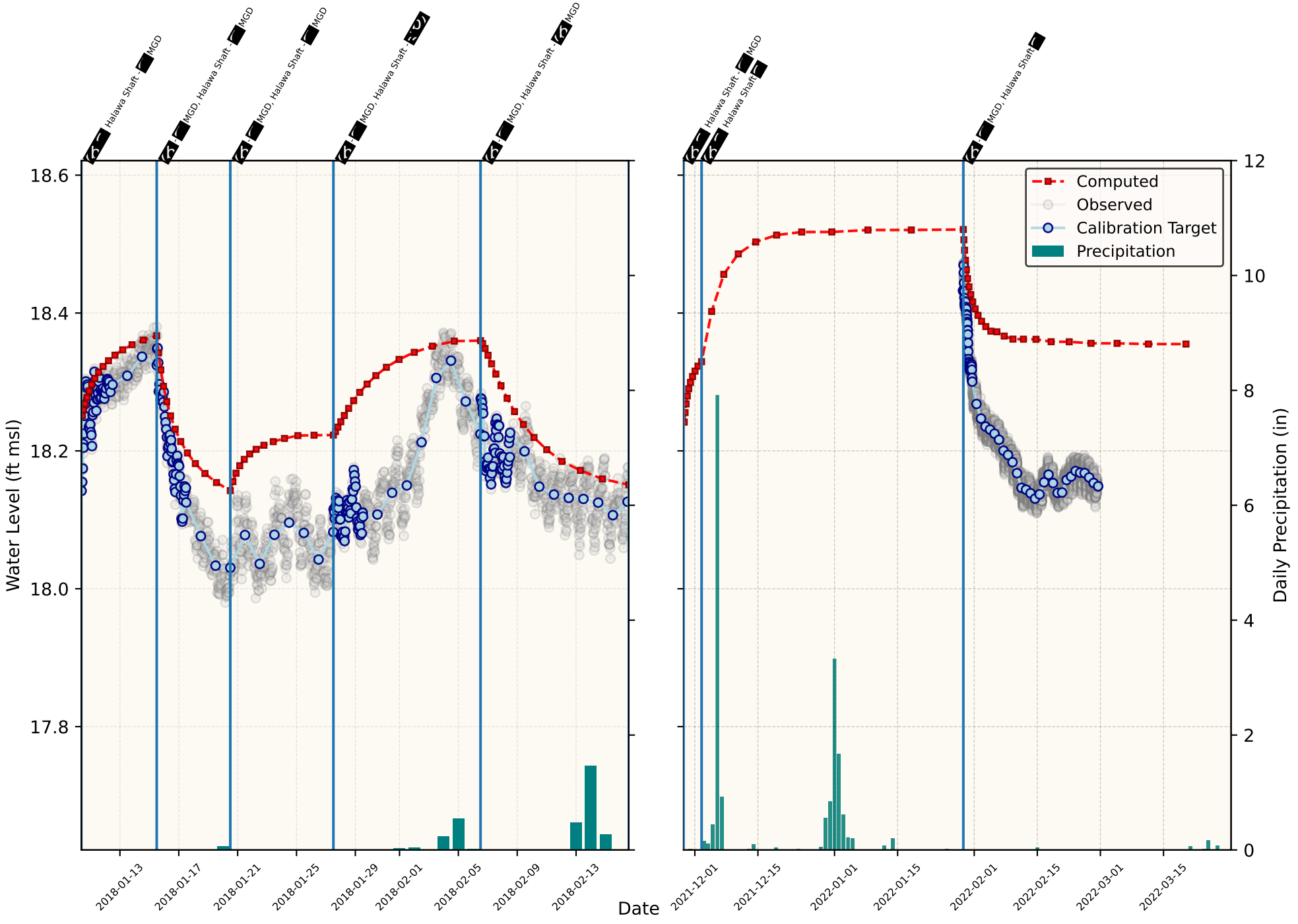
RHMW [redacted] (b)(9)

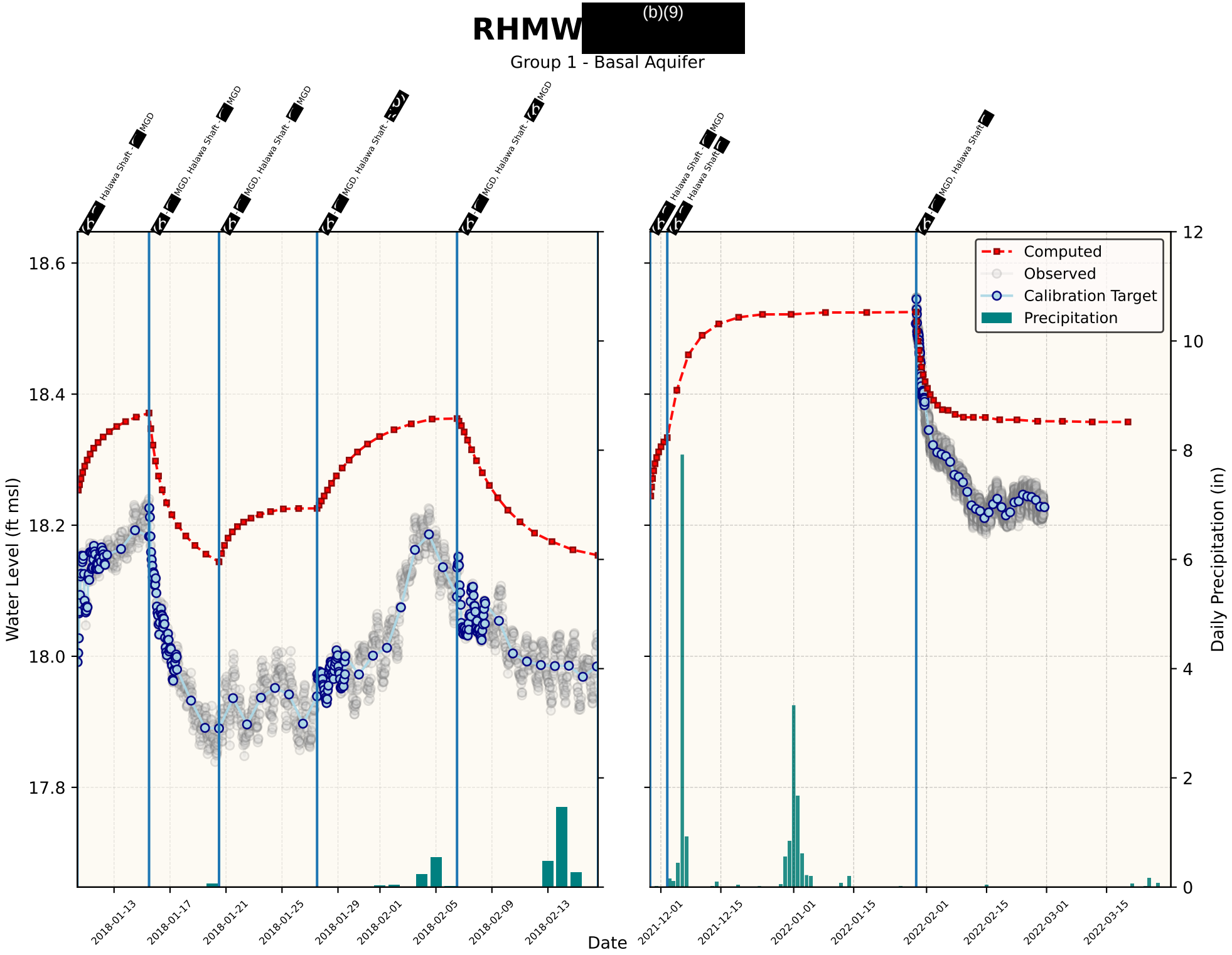
Group 1 - Basal Aquifer



RHMW [redacted] (b)(9)

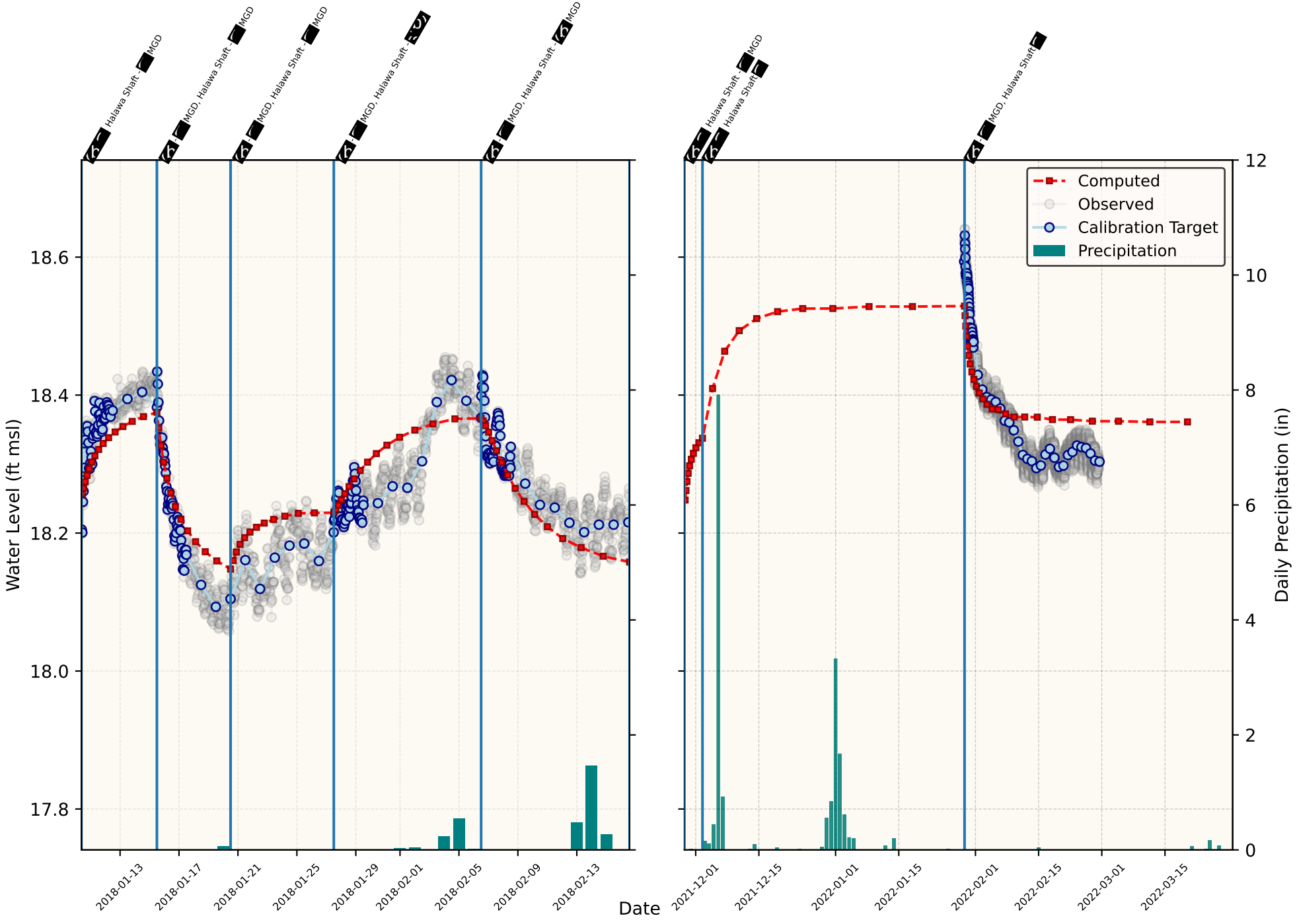
Group 1 - Basal Aquifer

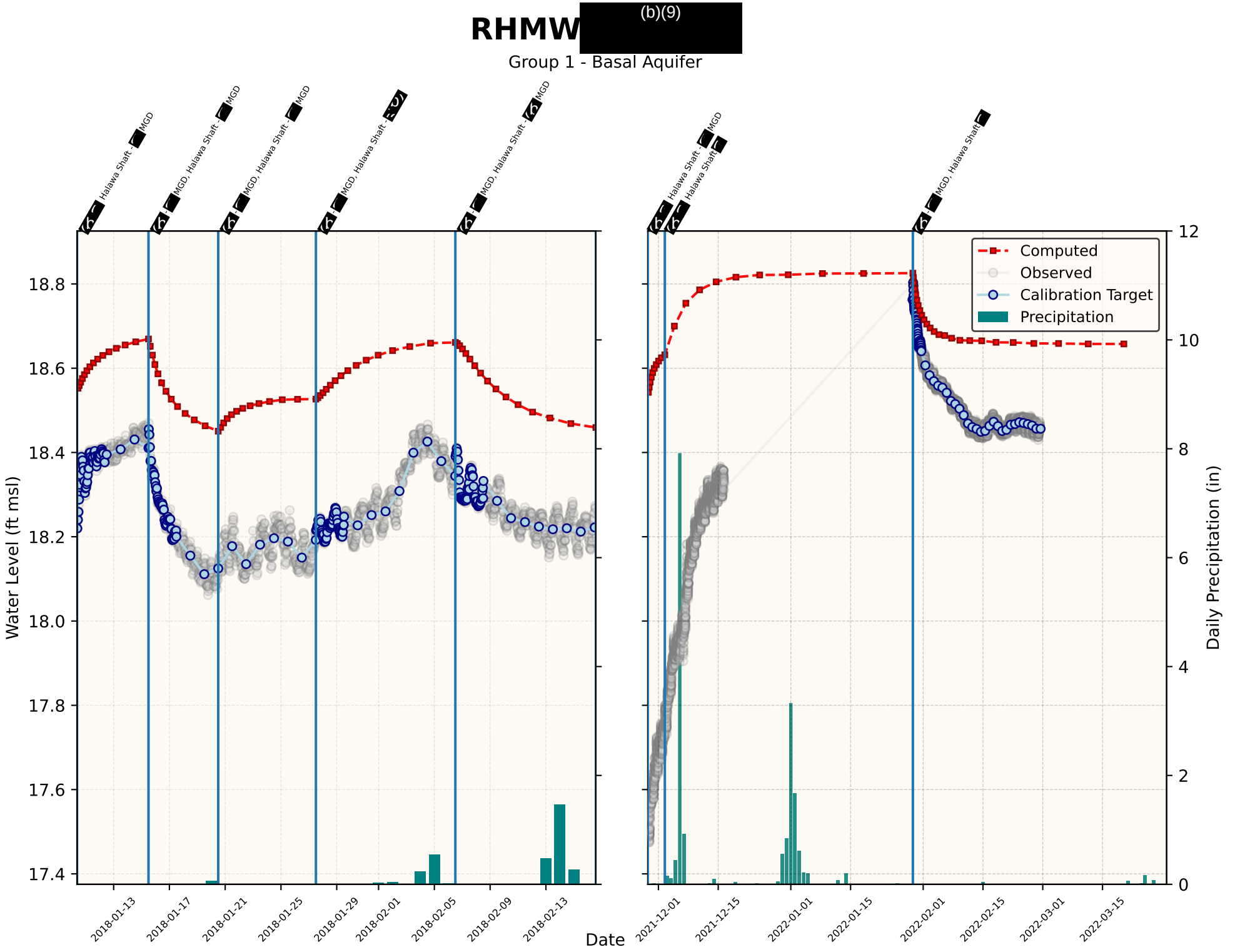


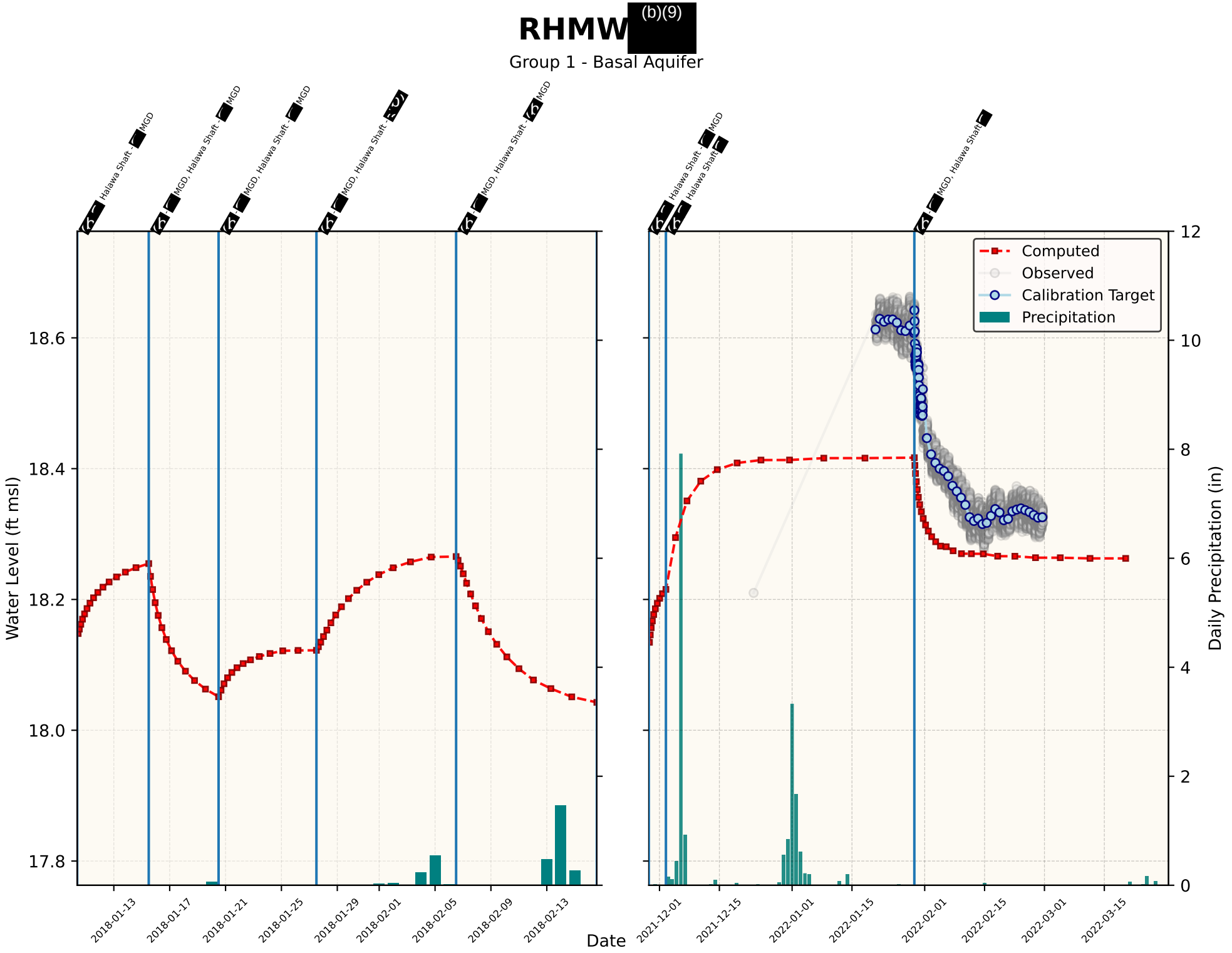

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.6
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RHMW[redacted] (b)(9)

Group 1 - Basal Aquifer

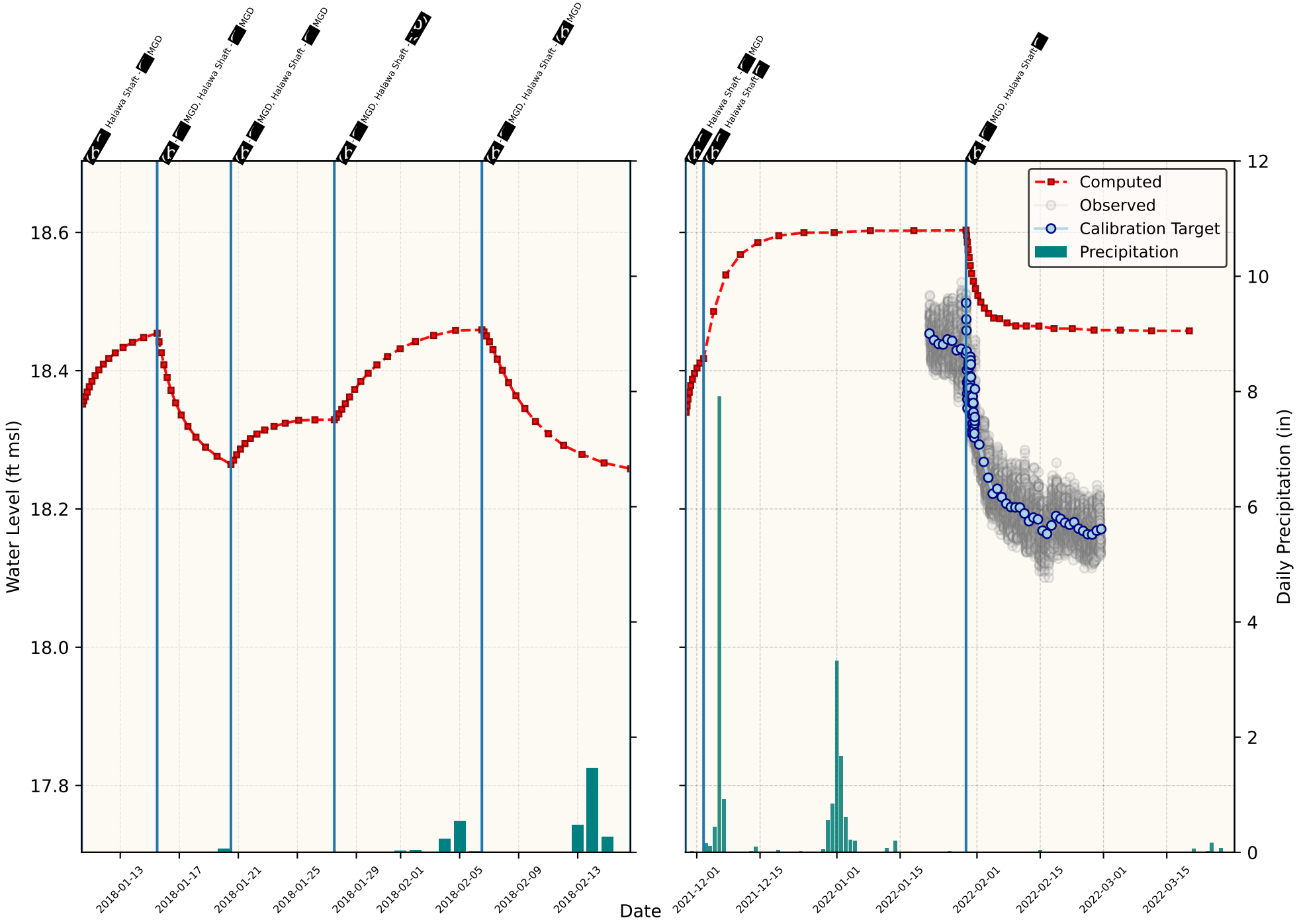


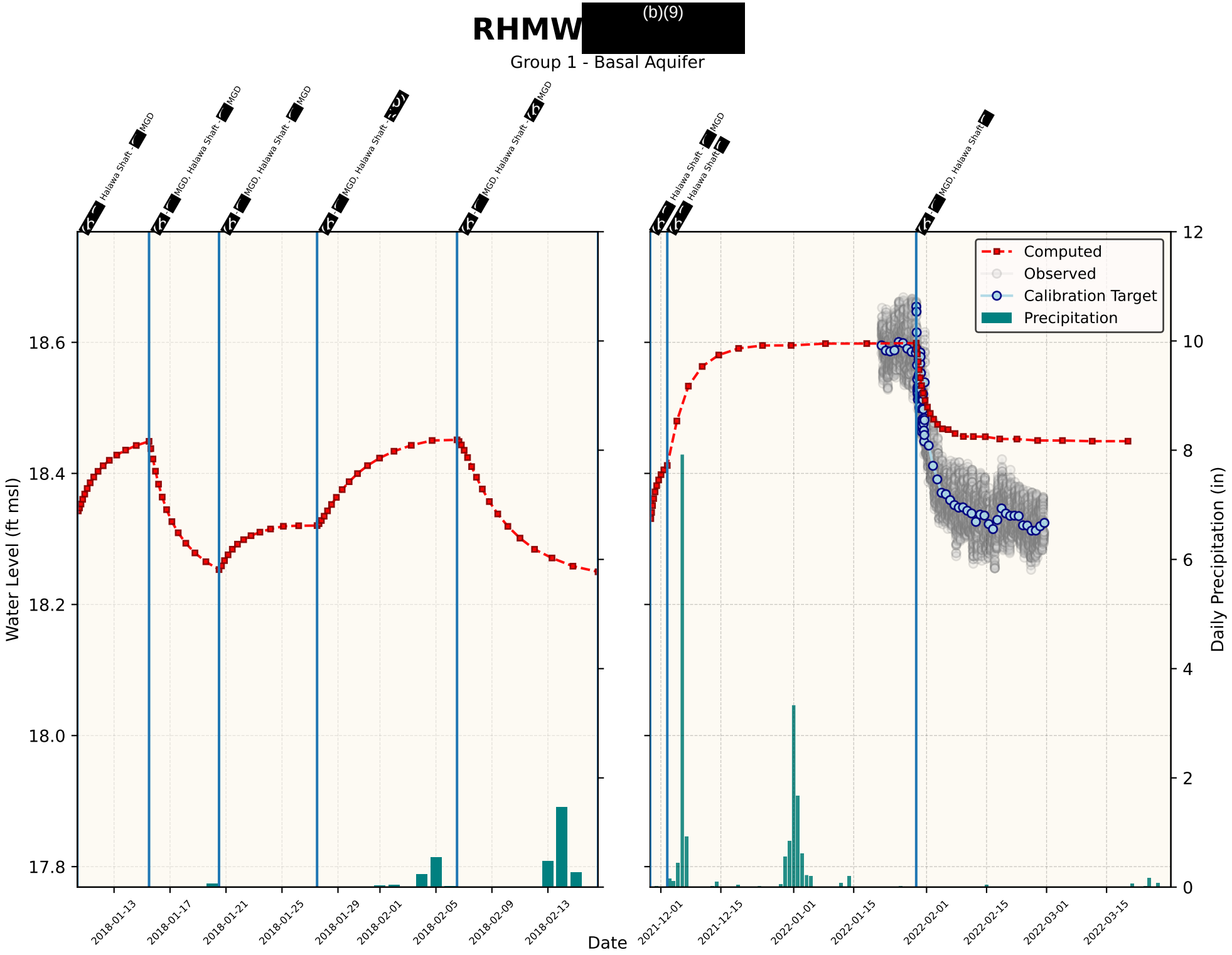

RHMW (b)(9)
Group 1 - Basal Aquifer
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Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
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RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
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Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.6
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2018-01-13
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RHMW (b)(9)

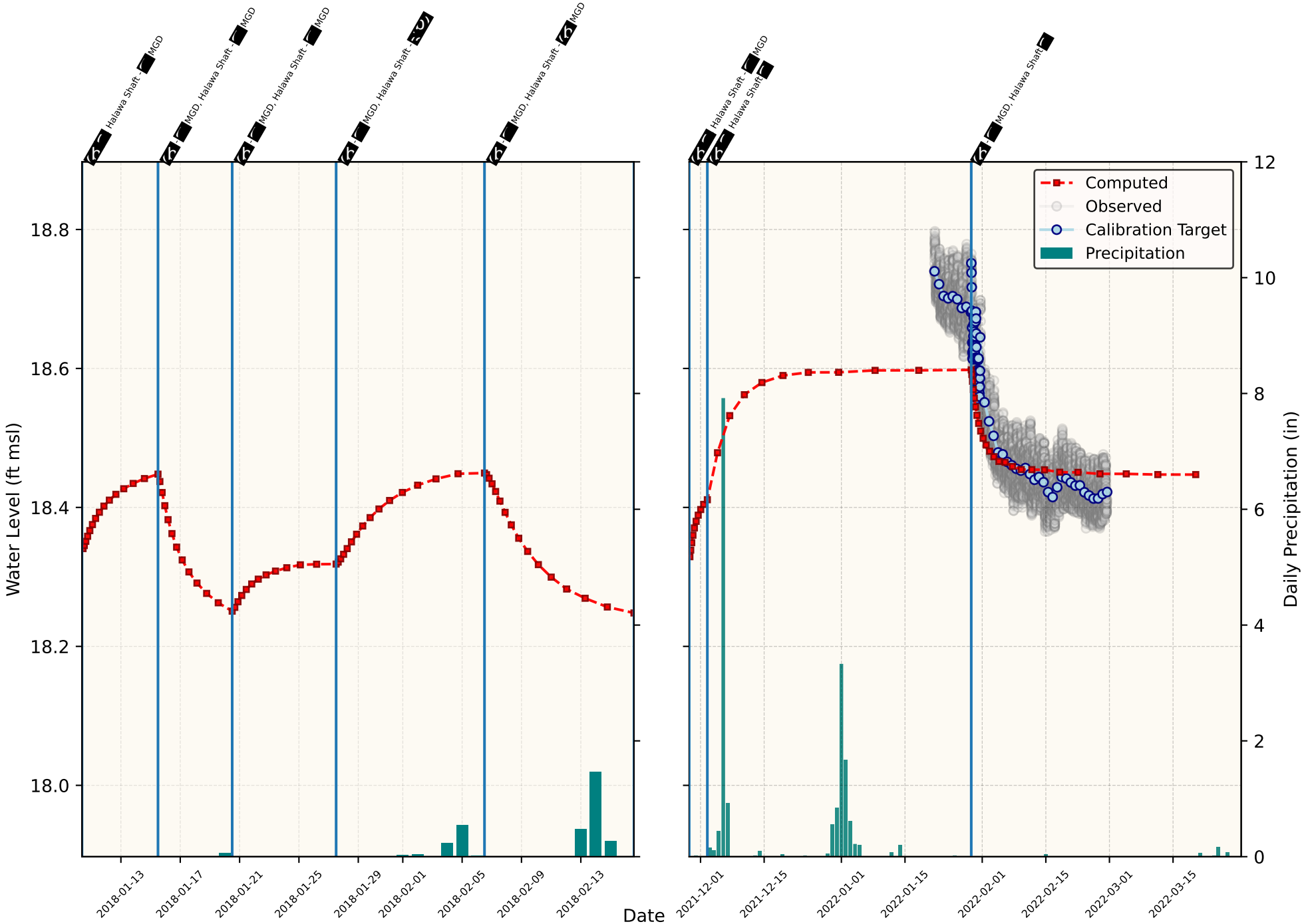
Group 1 - Basal Aquifer




RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
18.6
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Daily Precipitation (in)
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Computed
Observed
Calibration Target
Precipitation
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Date

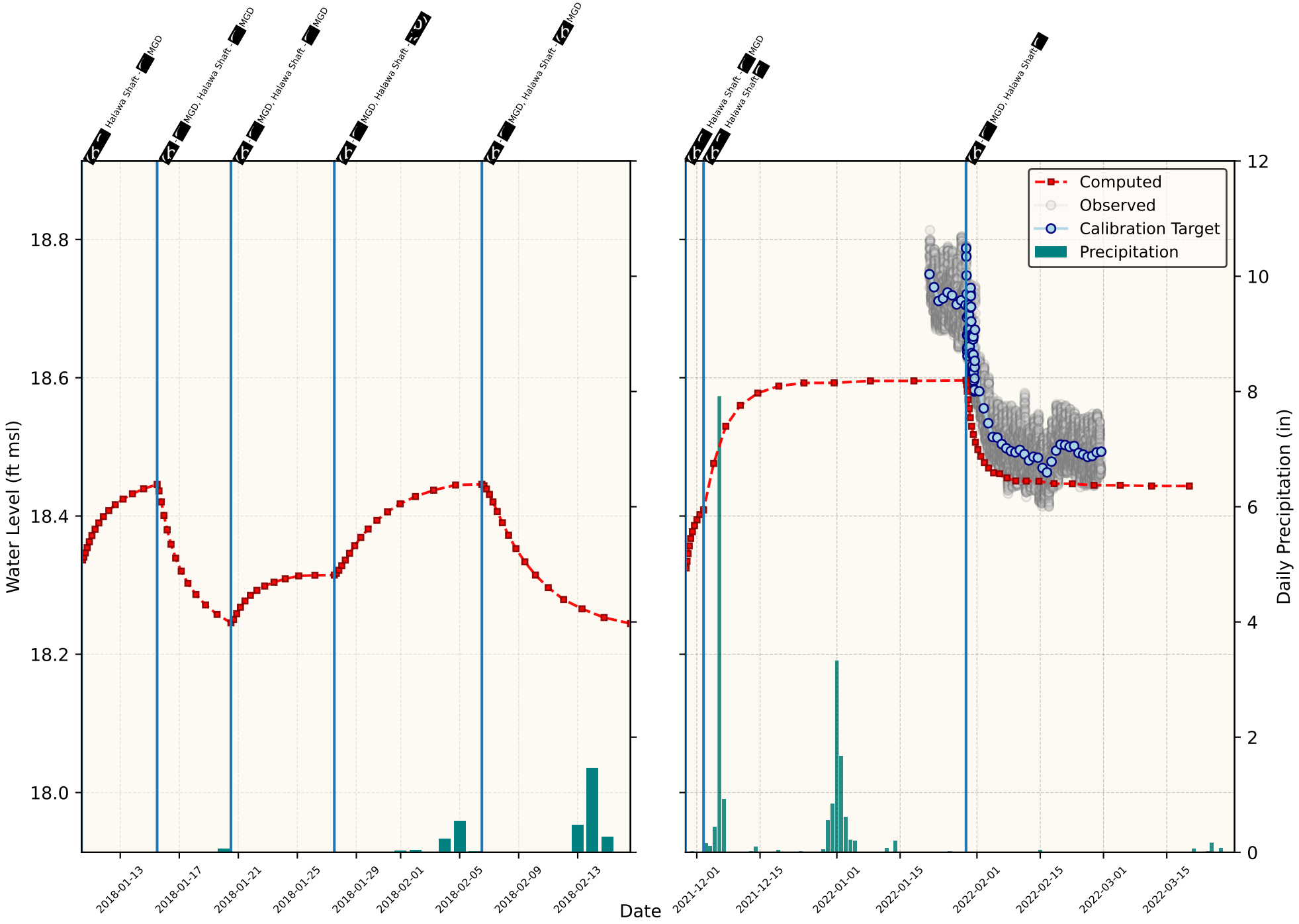
RHMW [redacted] (b)(9)

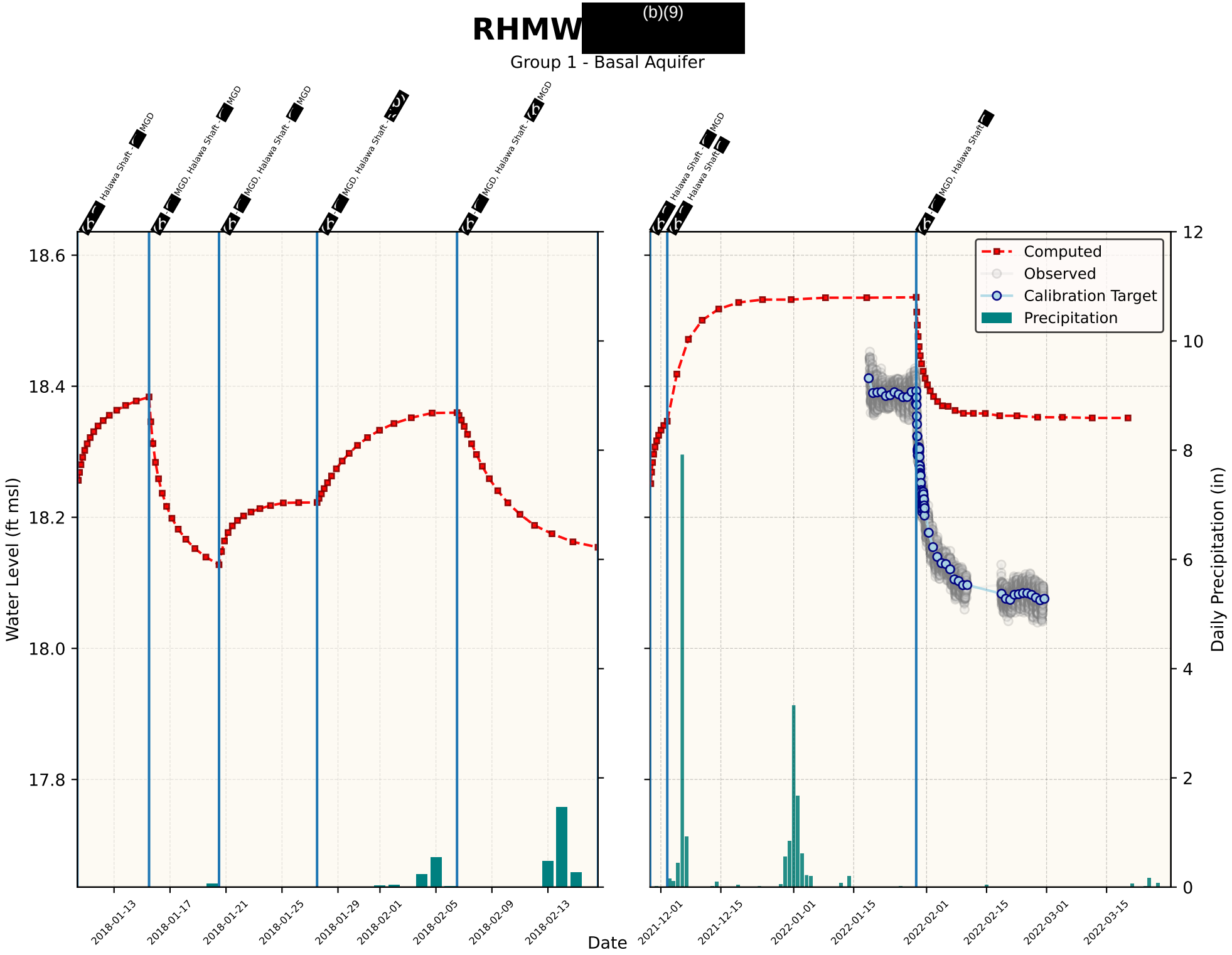
Group 1 - Basal Aquifer

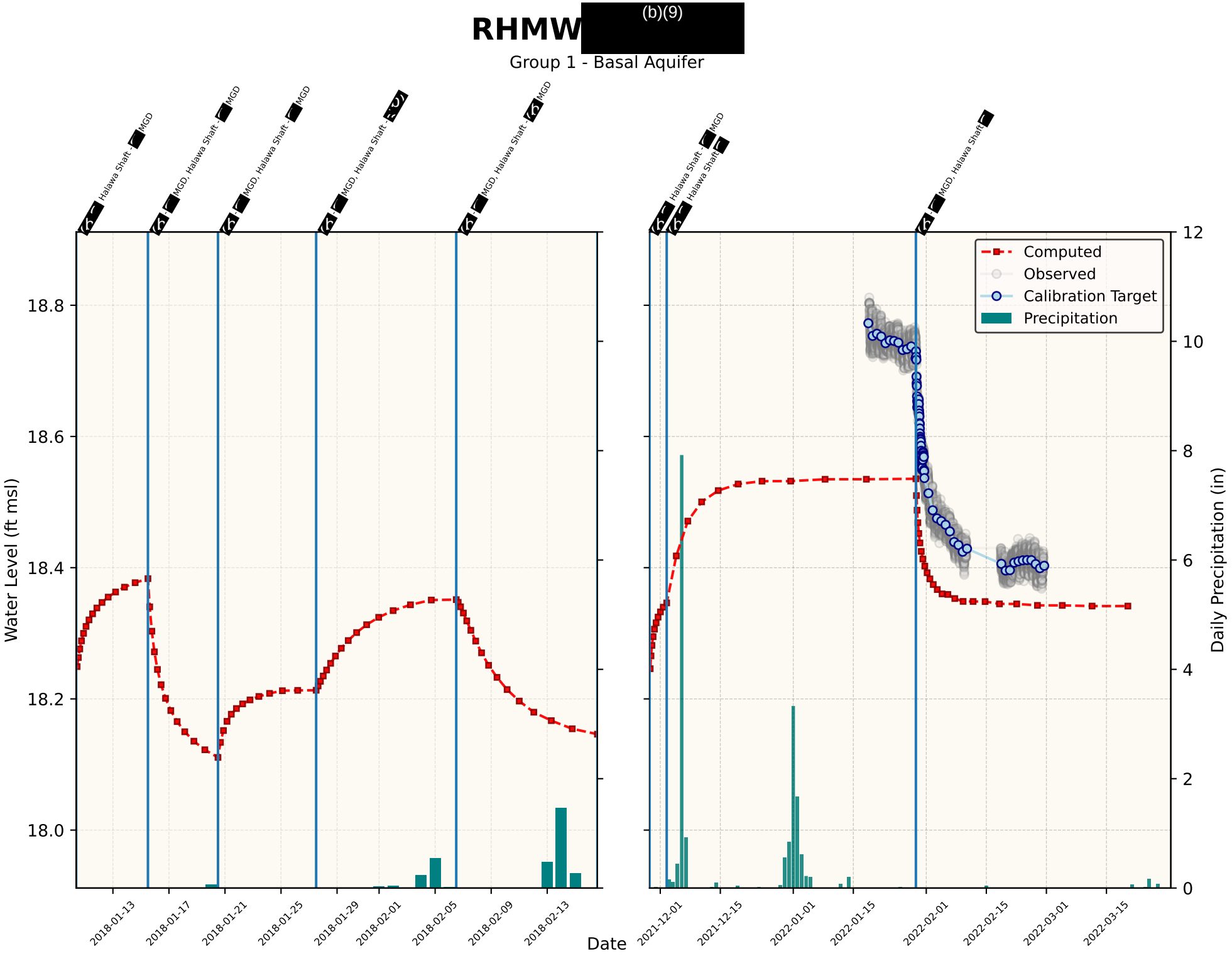


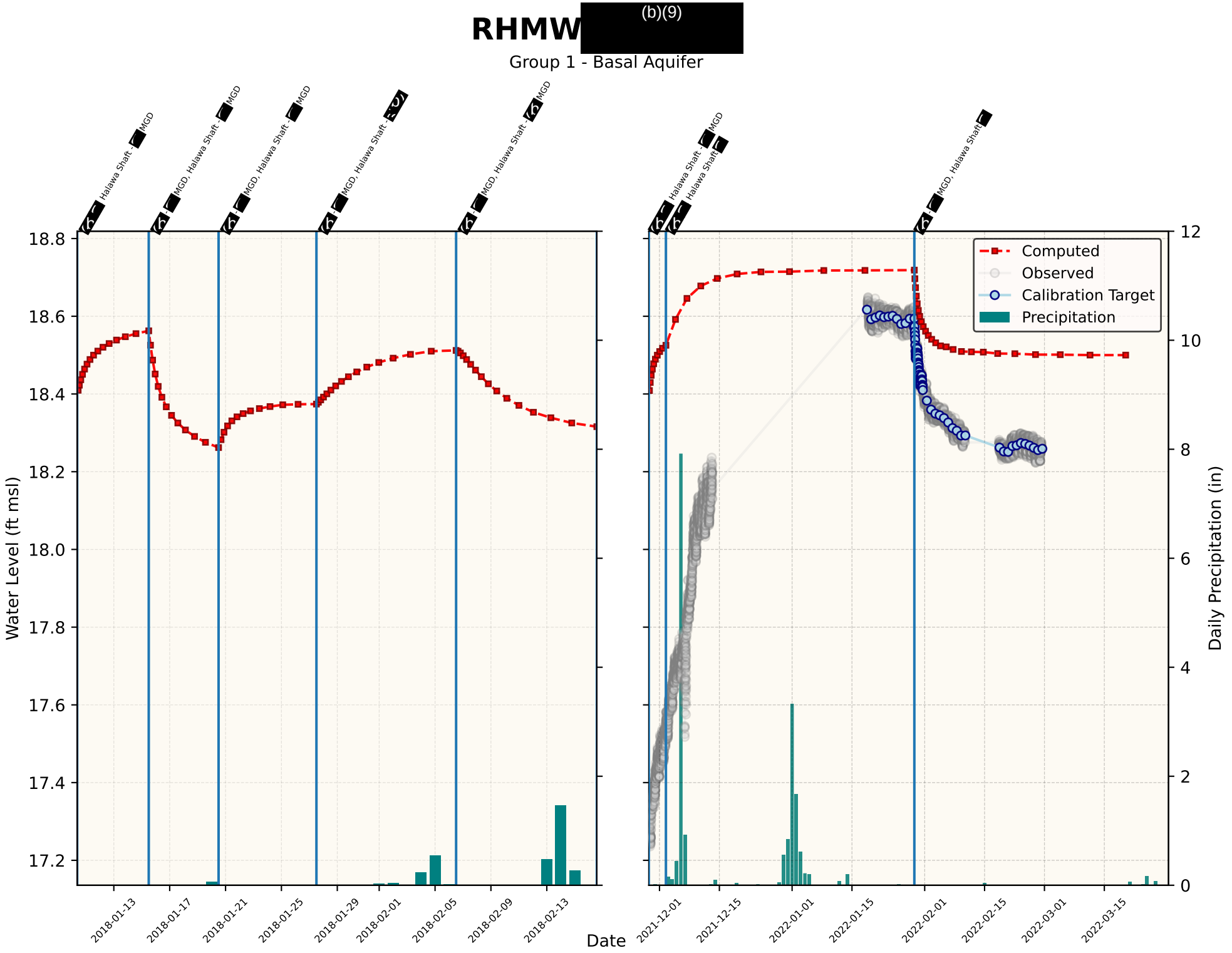
RHMW [redacted] (b)(9)

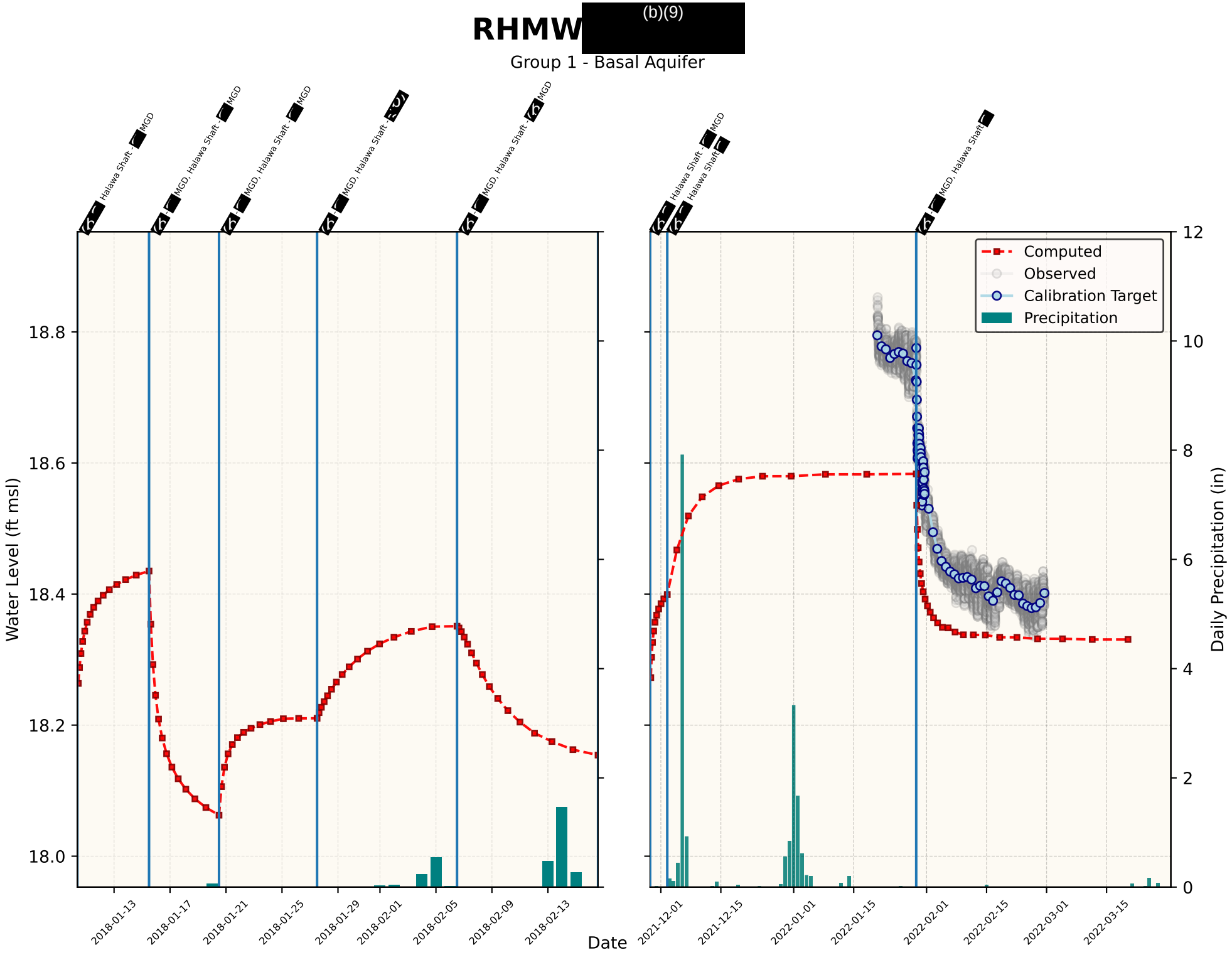
Group 1 - Basal Aquifer

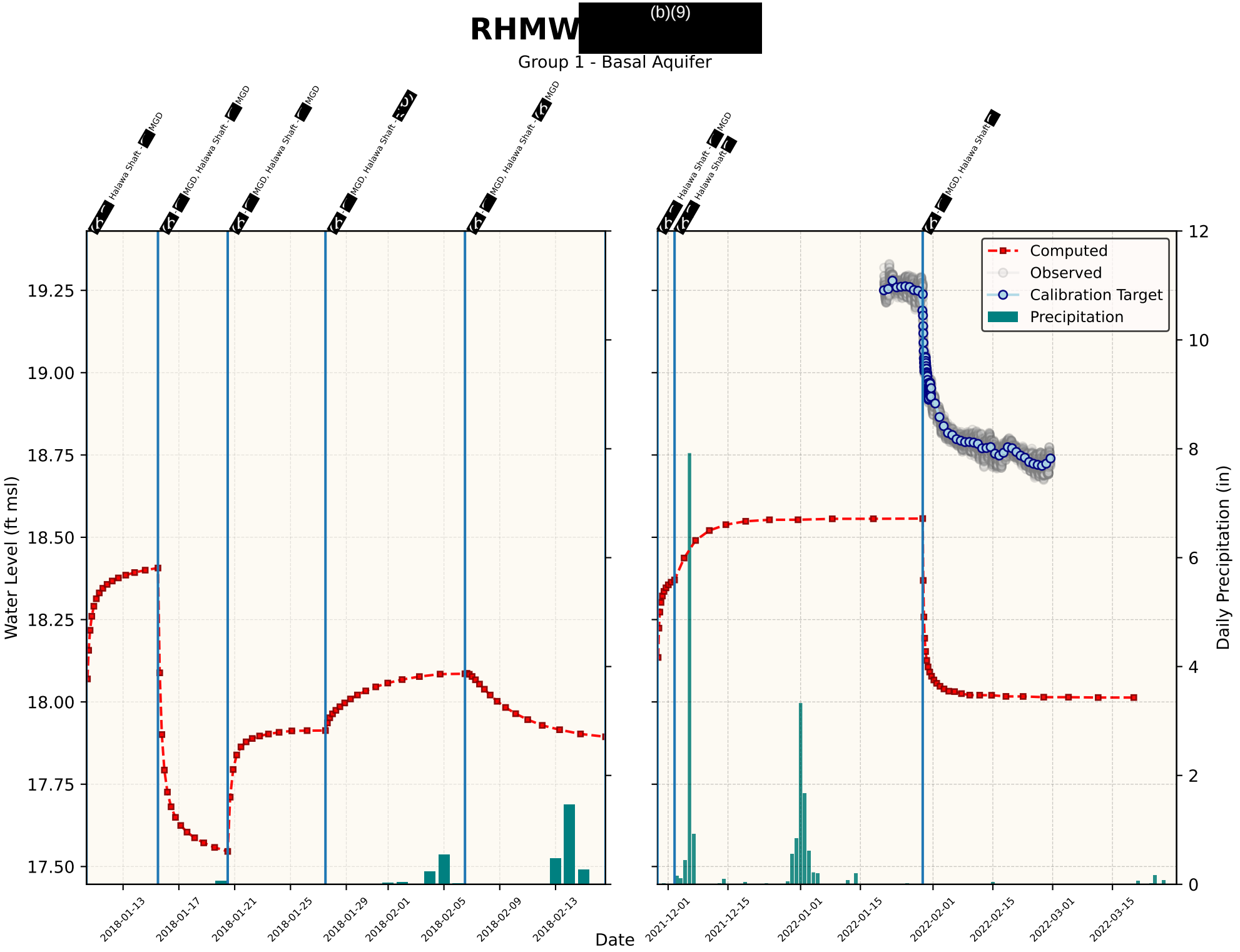


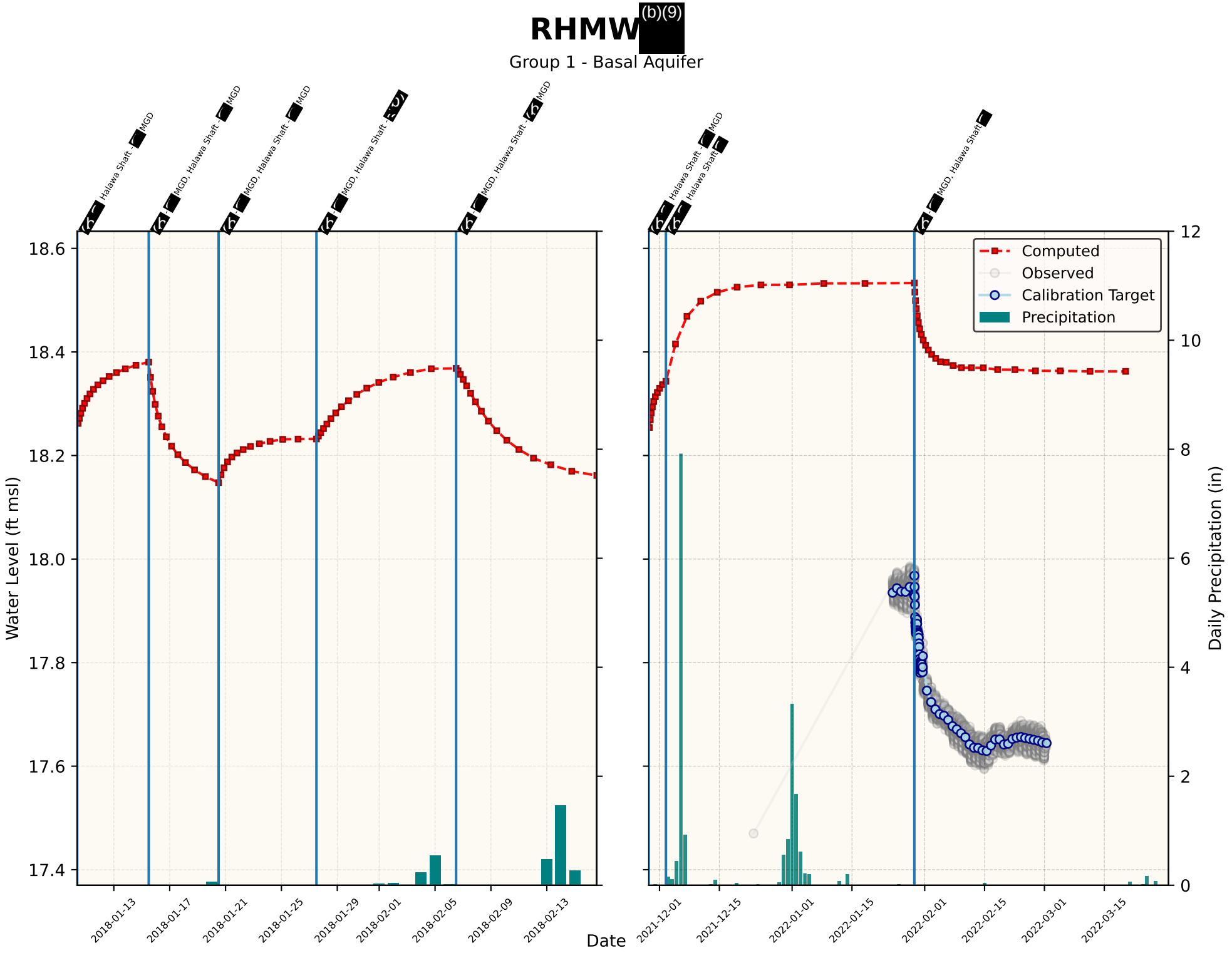

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Water Level (ft msl)
18.6
18.4
18.2
18.0
17.8
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation
Daily Precipitation (in)
12
10
8
6
4
2
0

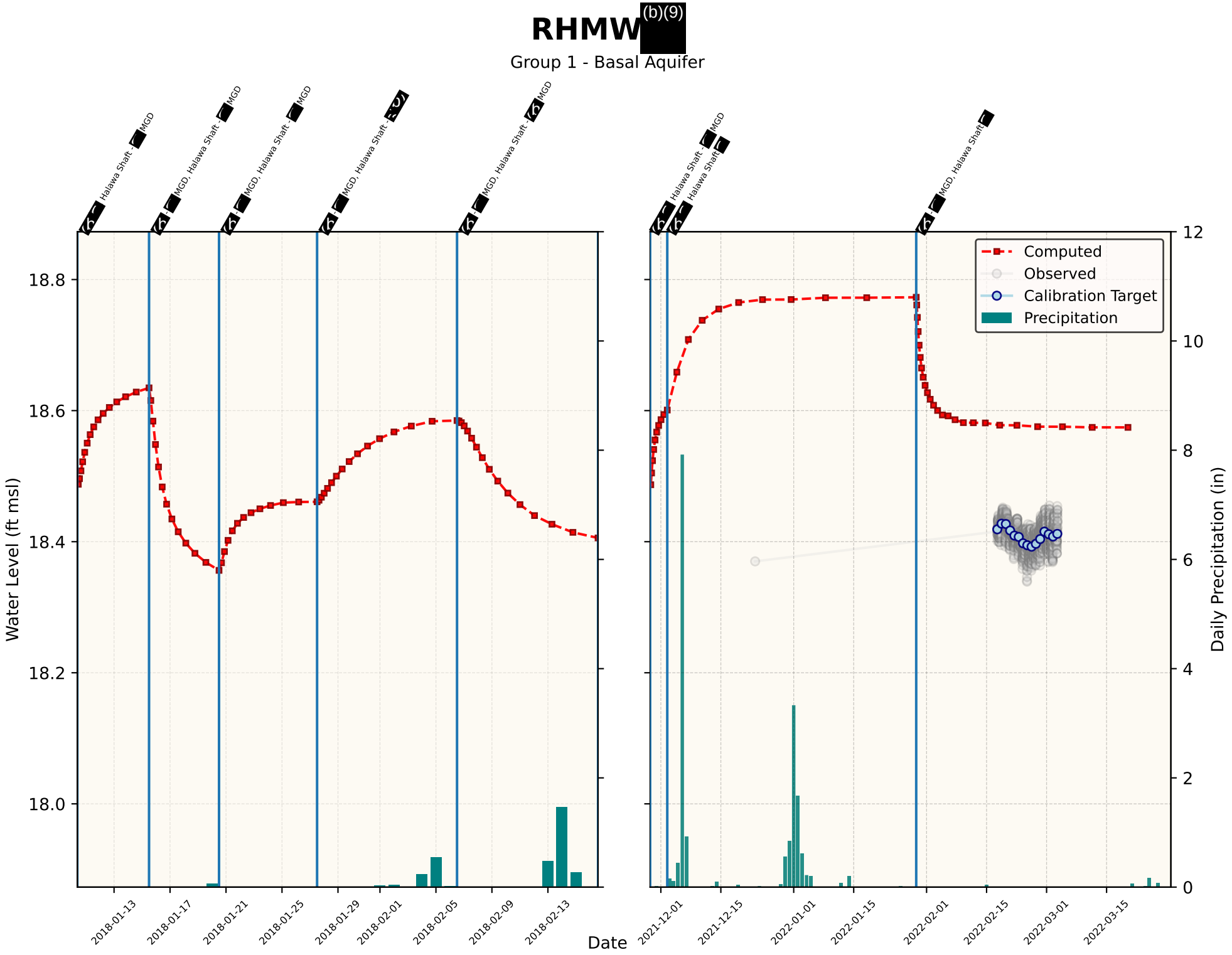

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-02-15
2022-03-01
2022-03-15

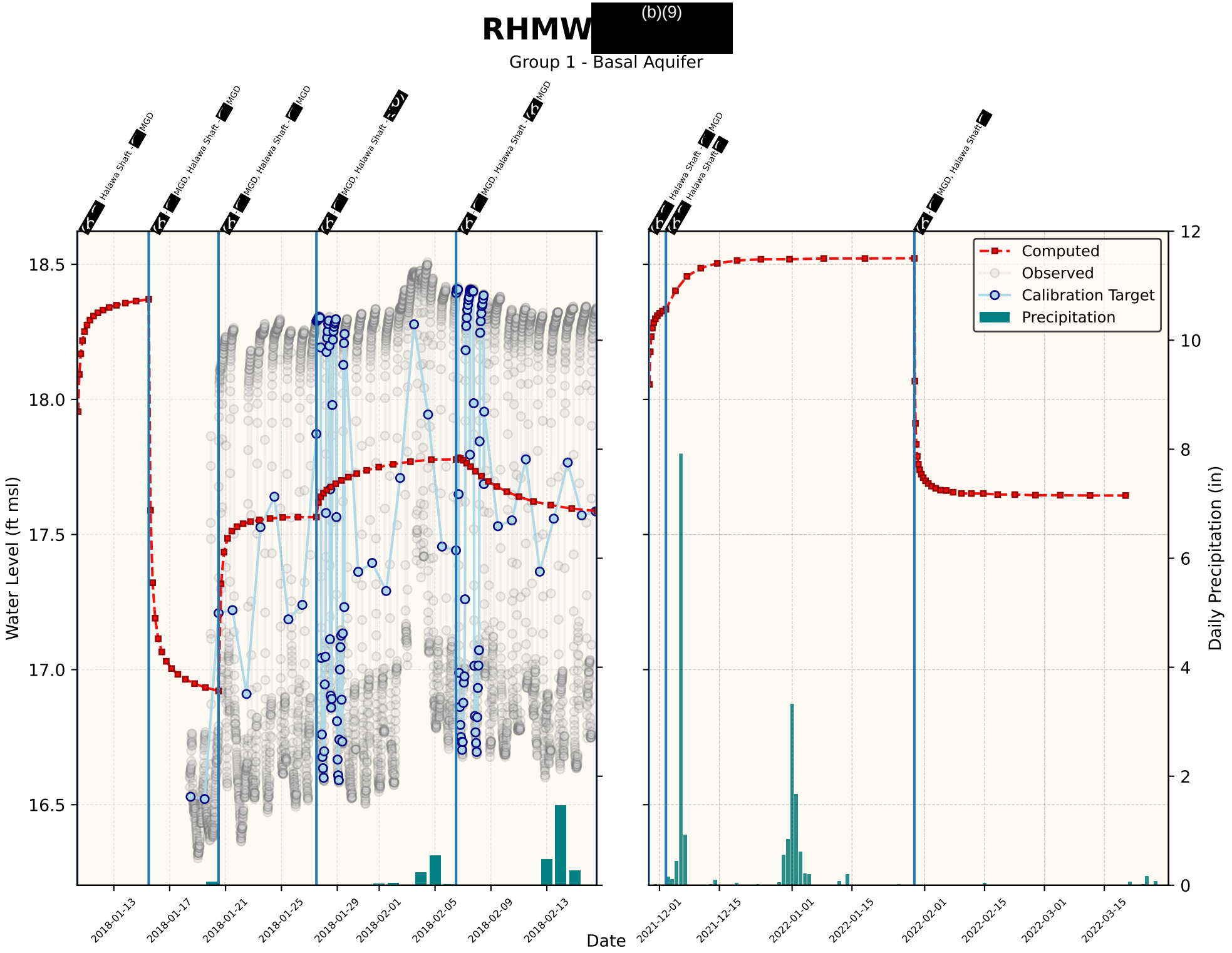

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
17.6
17.4
17.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.25
19.00
18.75
18.50
18.25
18.00
17.75
17.50
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.6
18.4
18.2
18.0
17.8
17.6
17.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

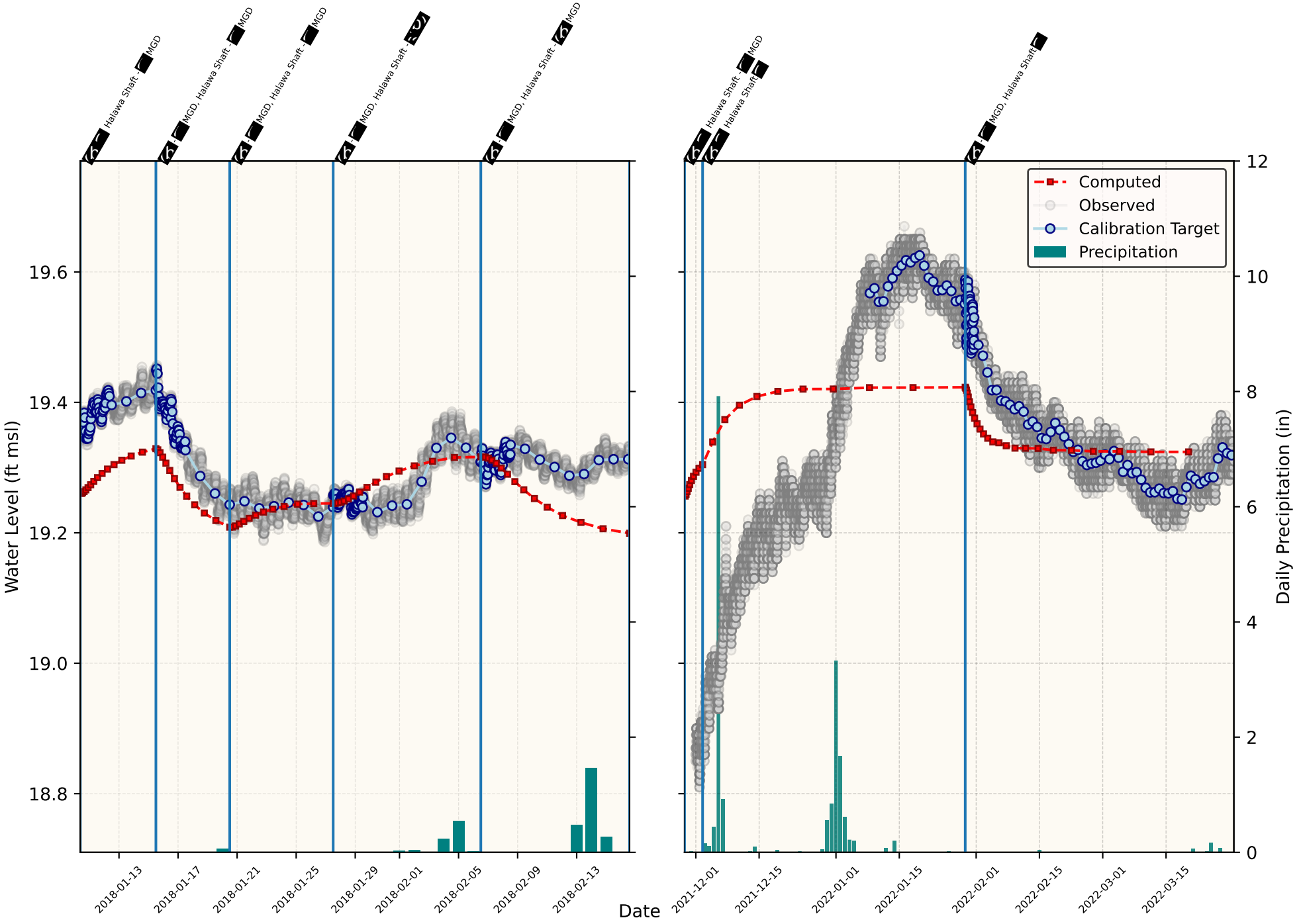

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

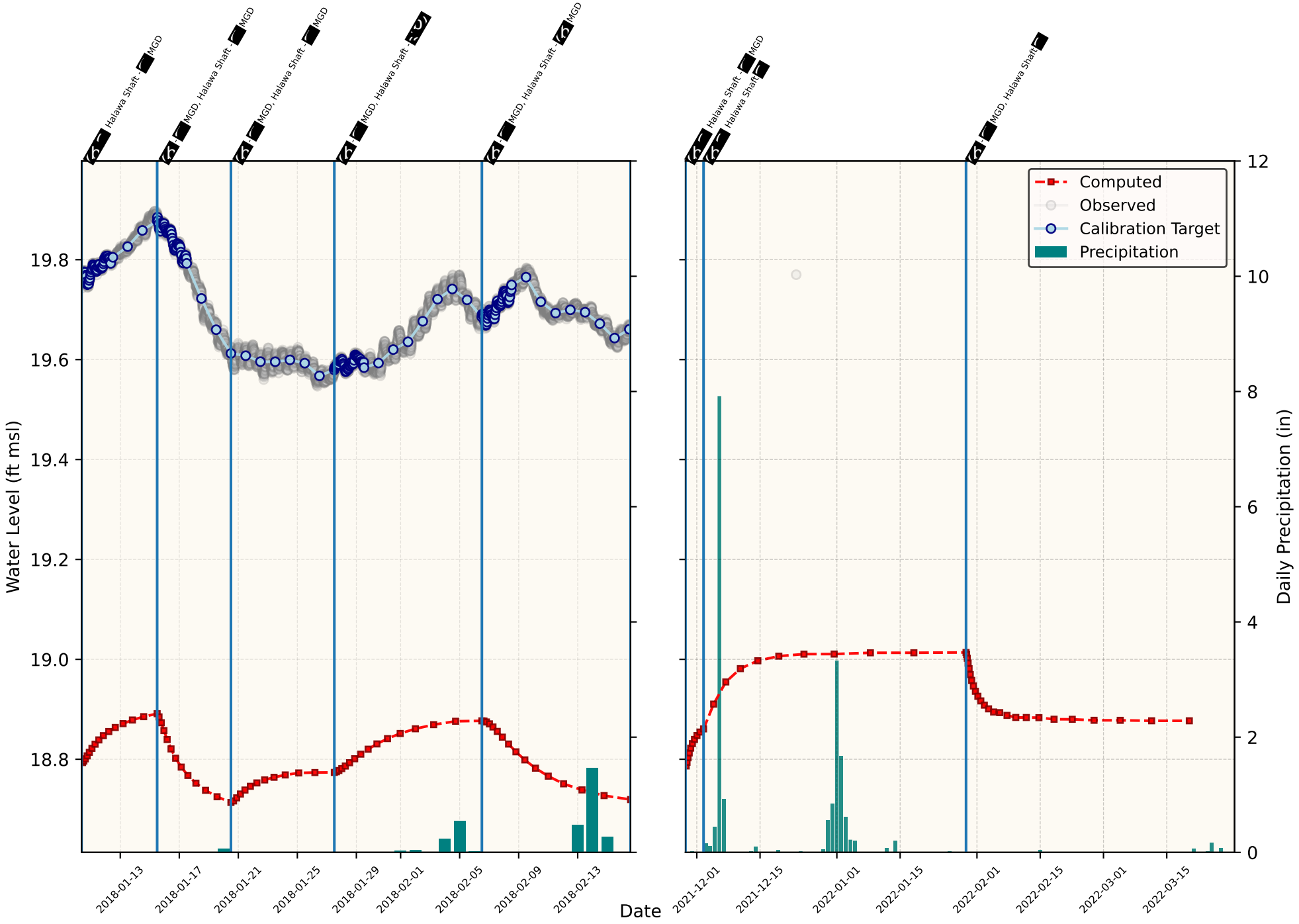

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.5
18.0
17.5
17.0
16.5
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

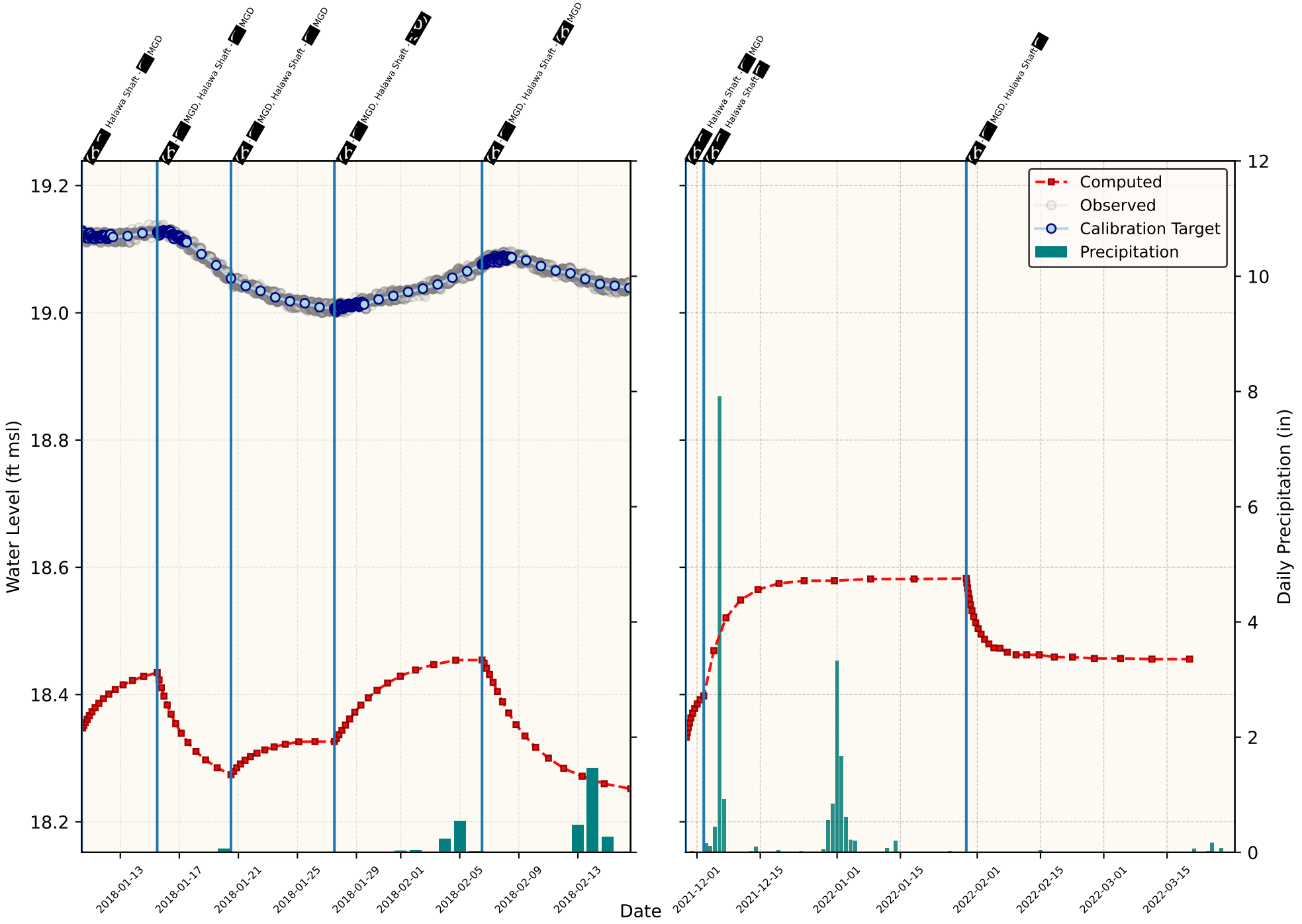
TAMC_[redacted]

(b)(9)

Group 1 - Basal Aquifer

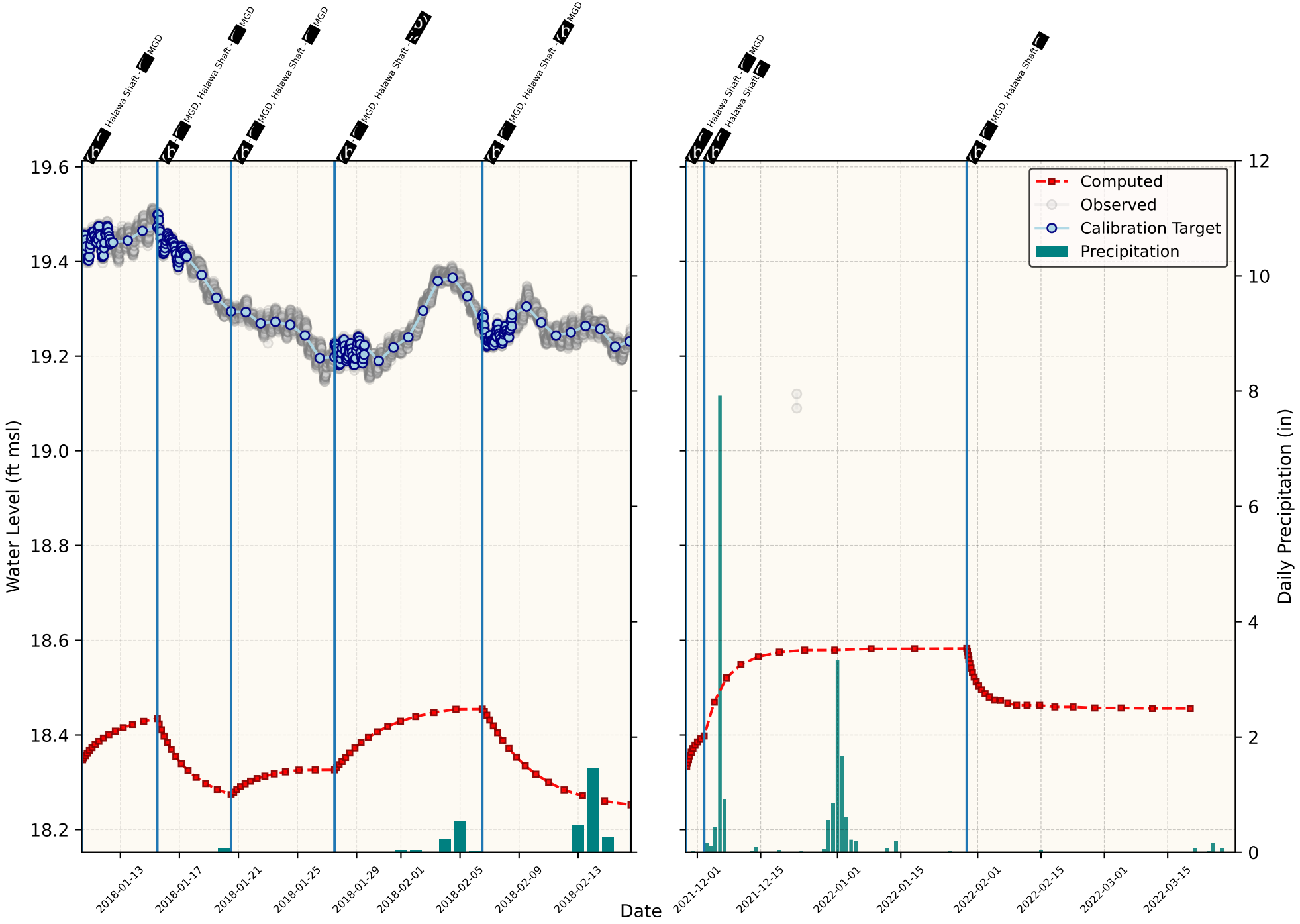


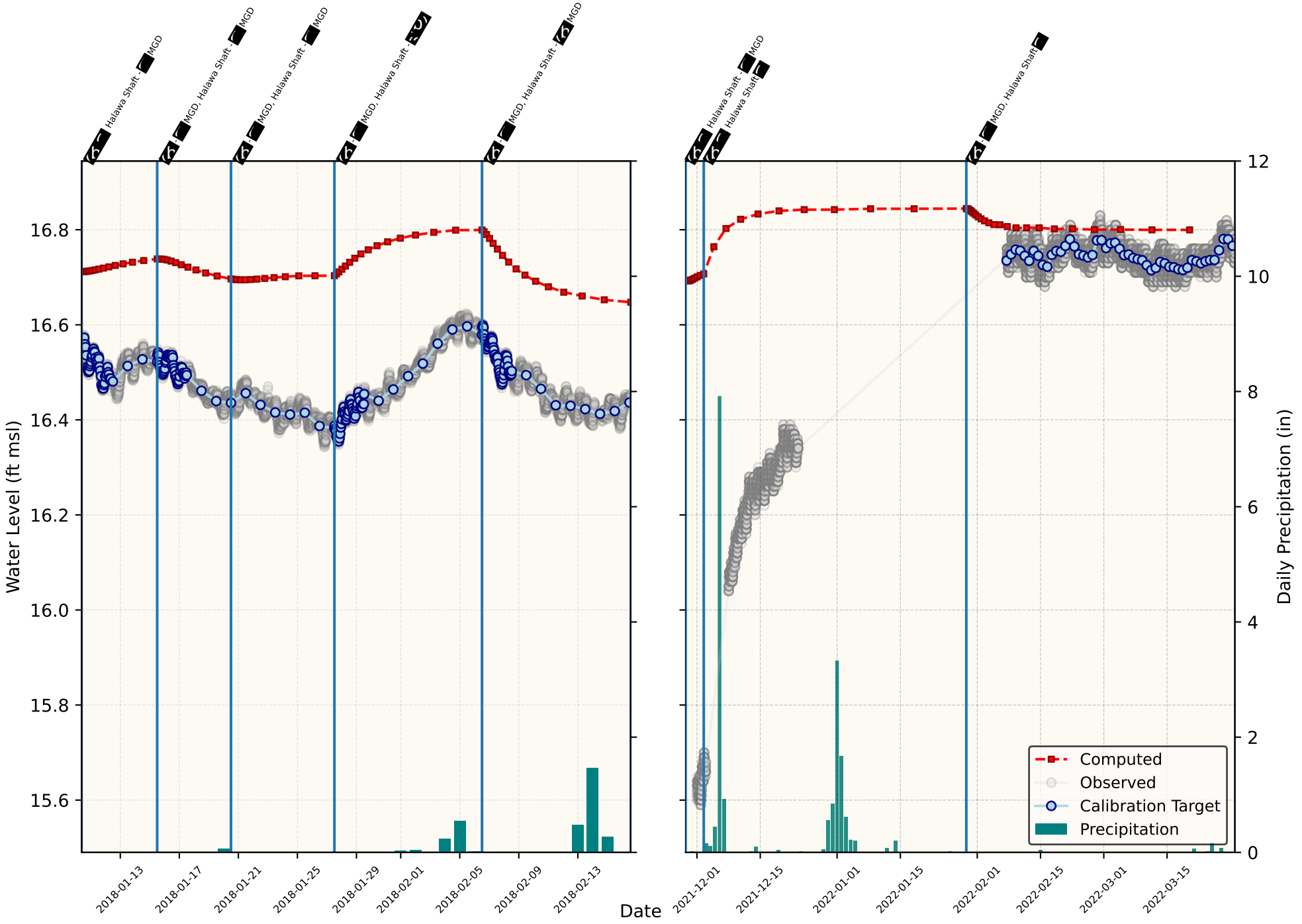

DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.8
19.6
19.4
19.2
19.0
18.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.2
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

Halawa_Deep_Monitor_Well_HDMW2253-03

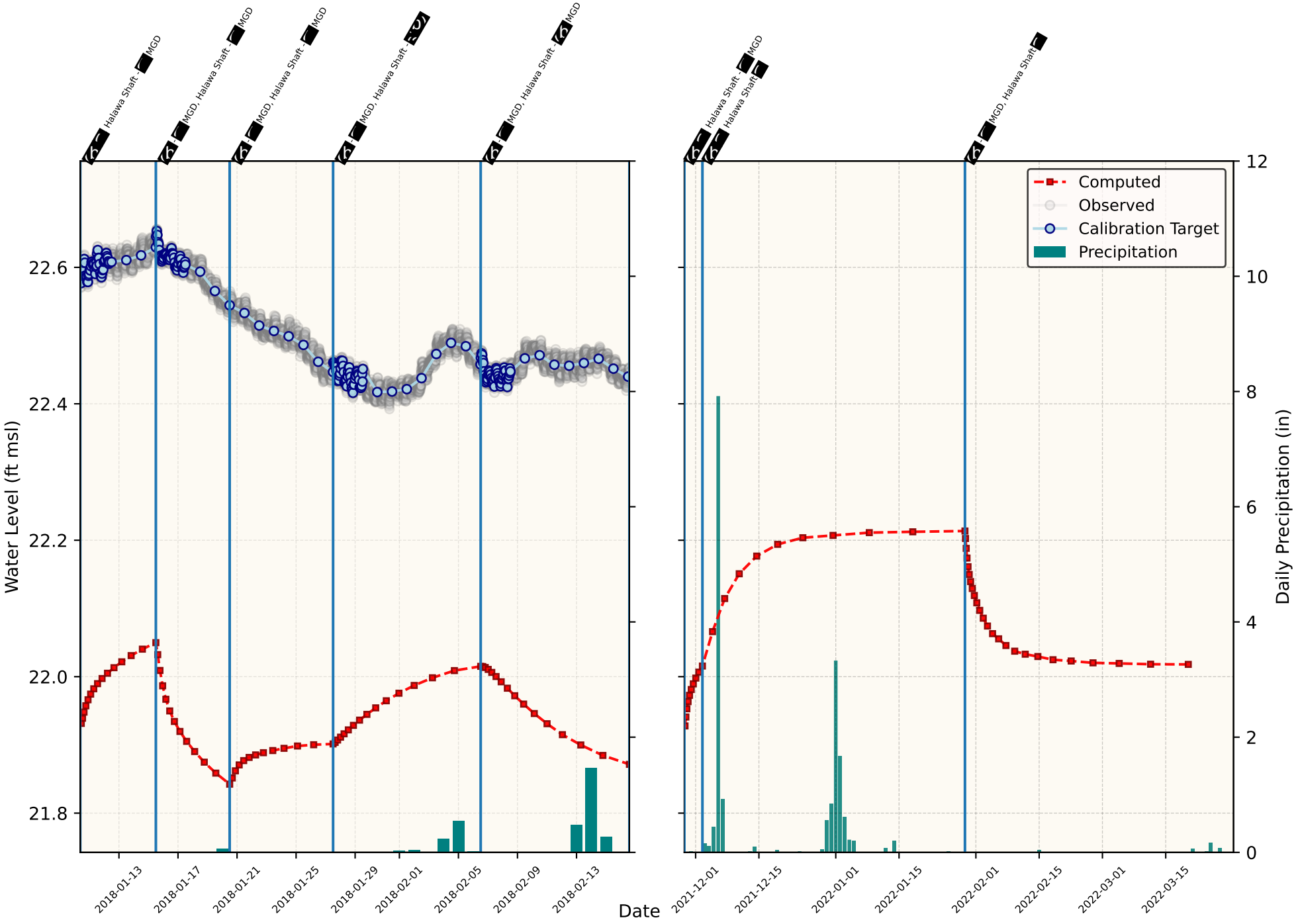
Group 2 - Deep Basal Wells




Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

RHMW[redacted]

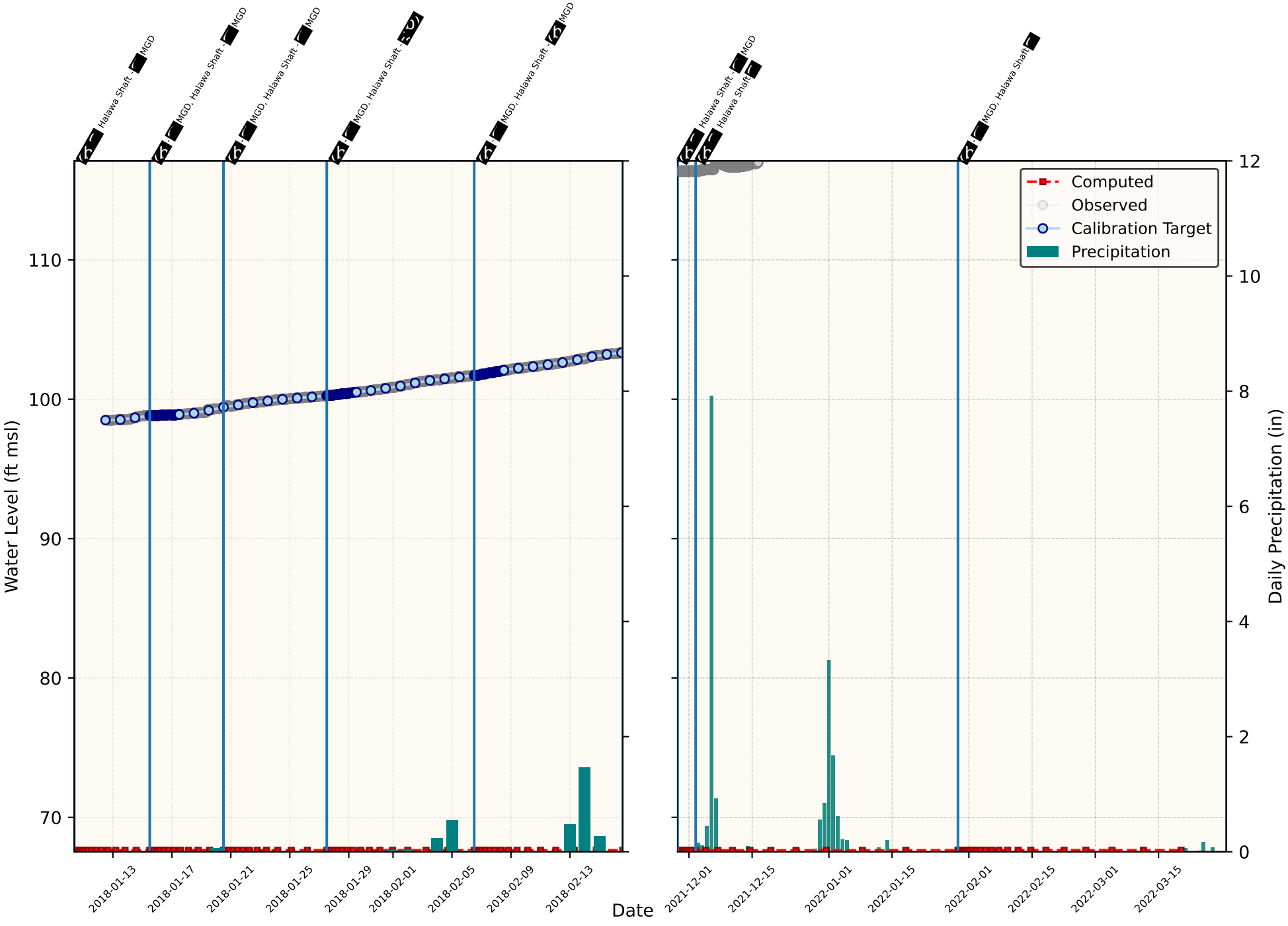
Group 3 - Saprolite/Confining Unit Well with Elevated Head

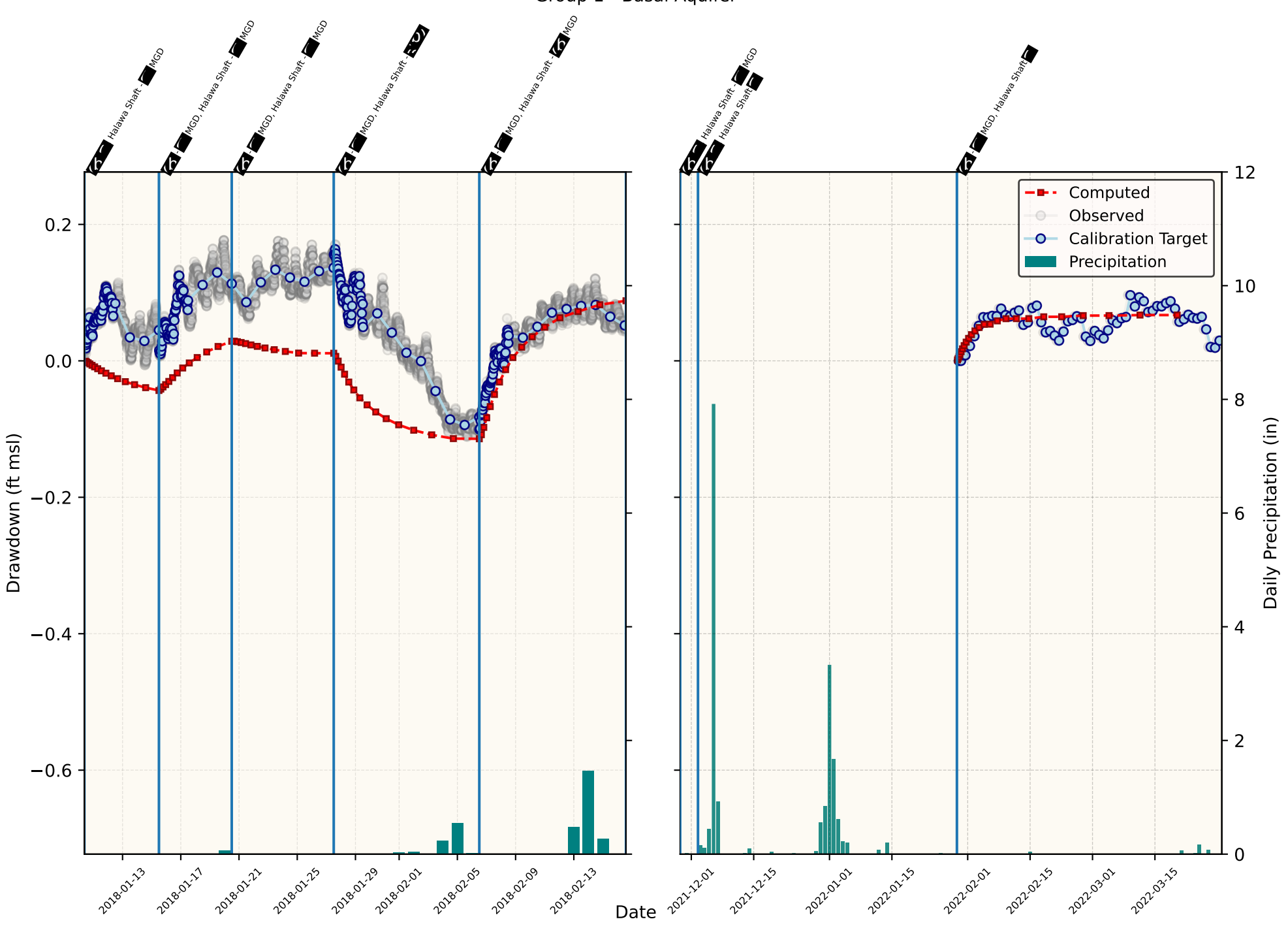


RHMW[redacted]

(b)(9)

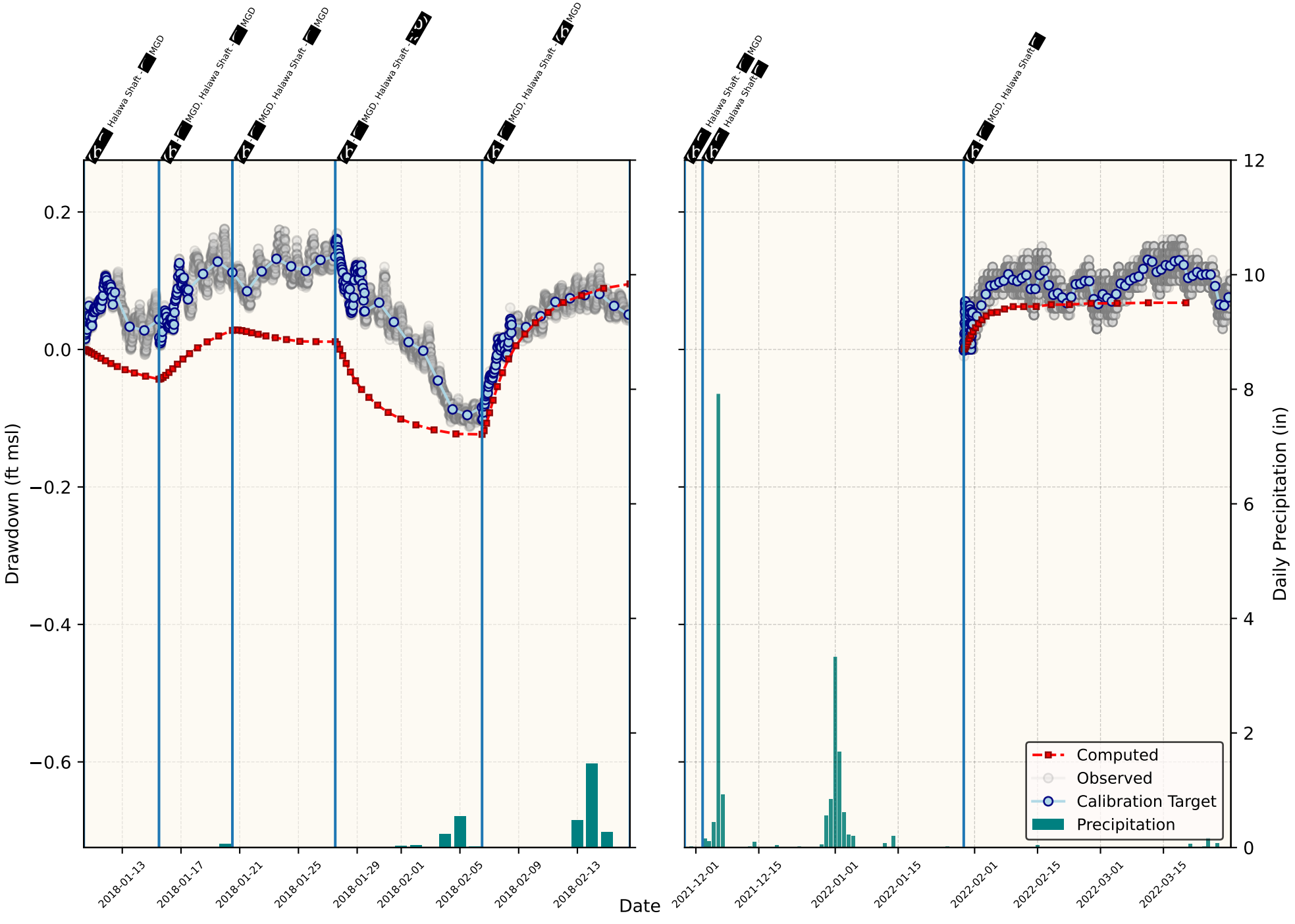
Group 3 - Saprolite/Confining Unit Well with Elevated Head

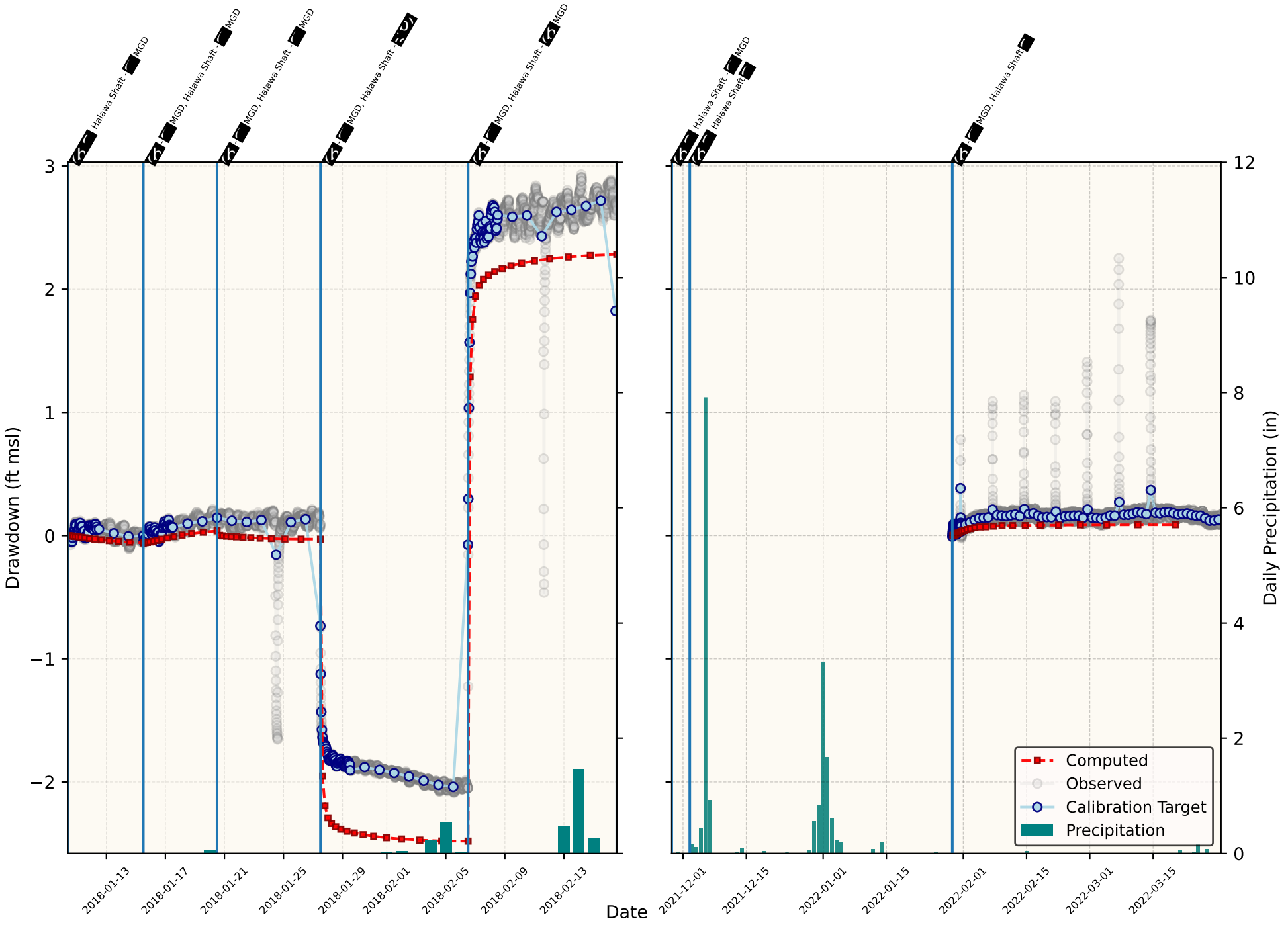


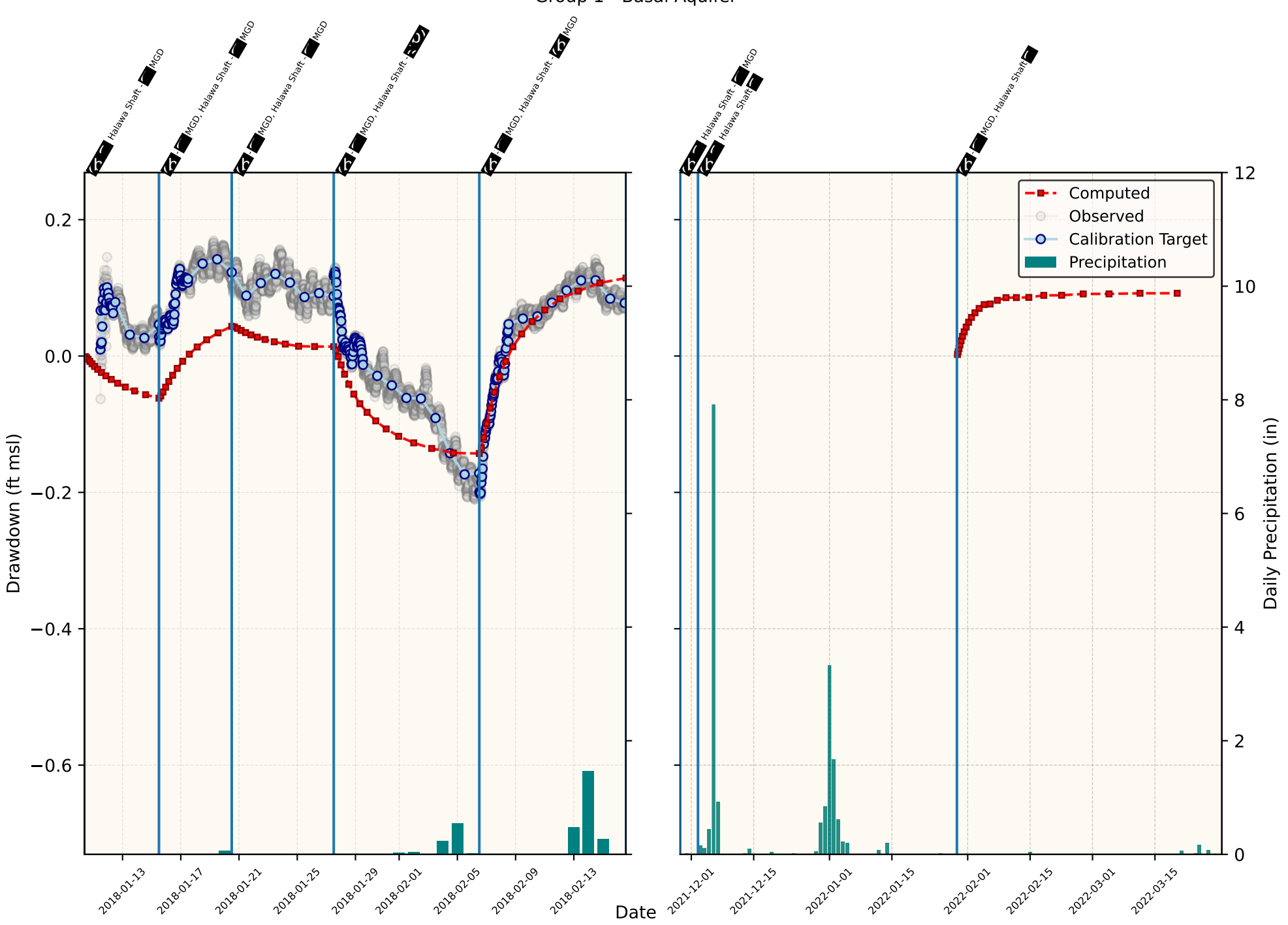

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

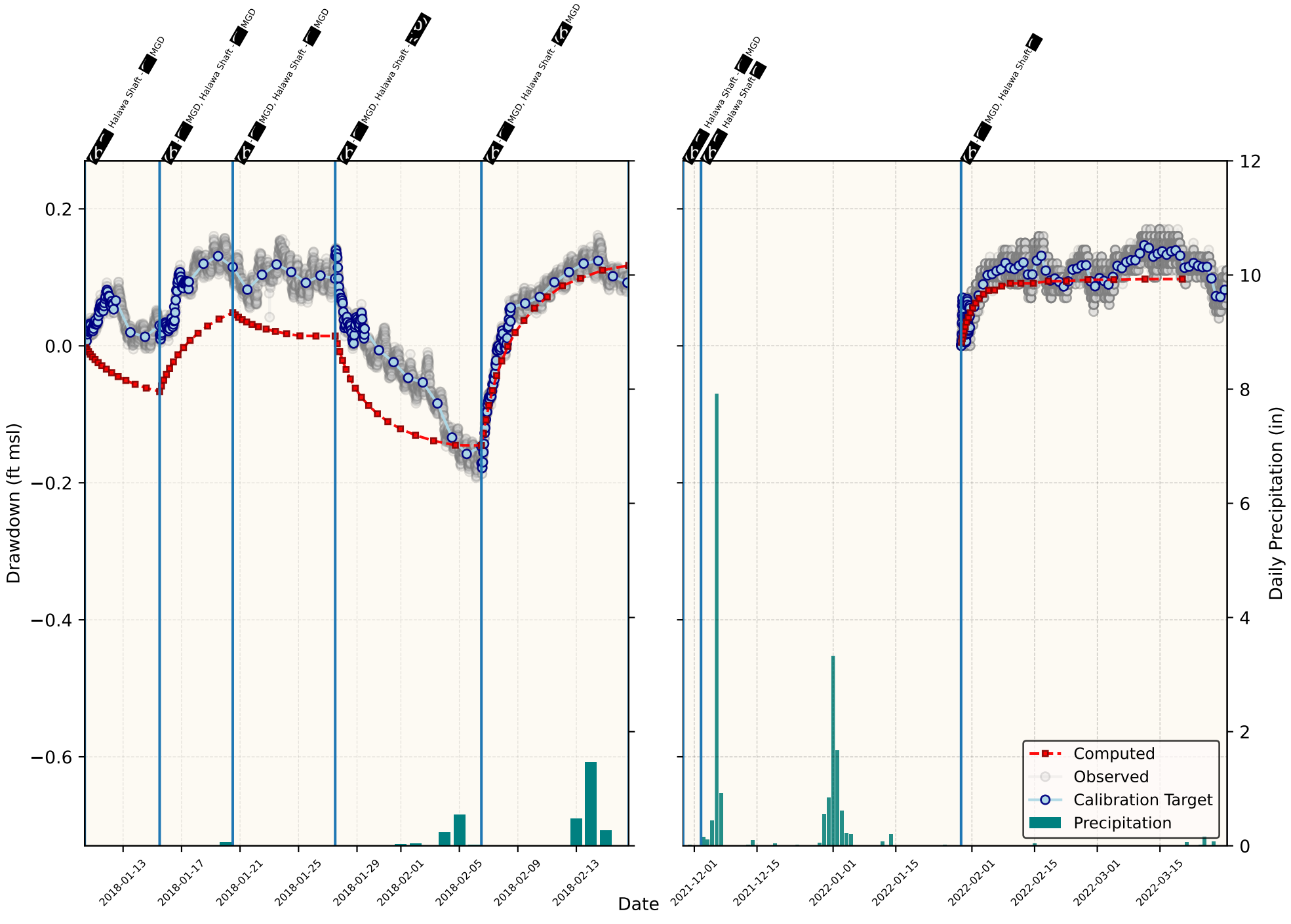
(b)(3) [redacted]

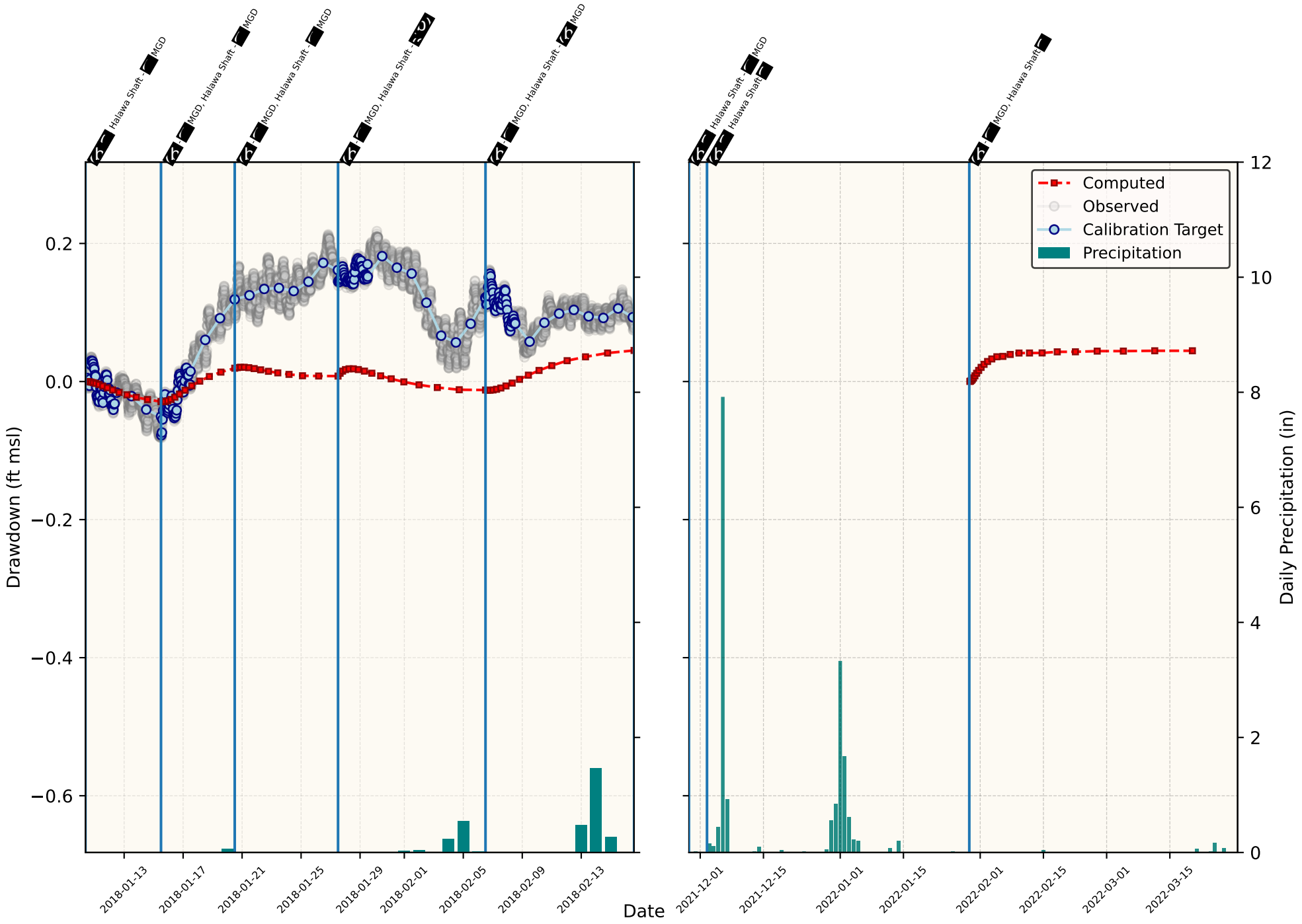
Group 1 - Basal Aquifer

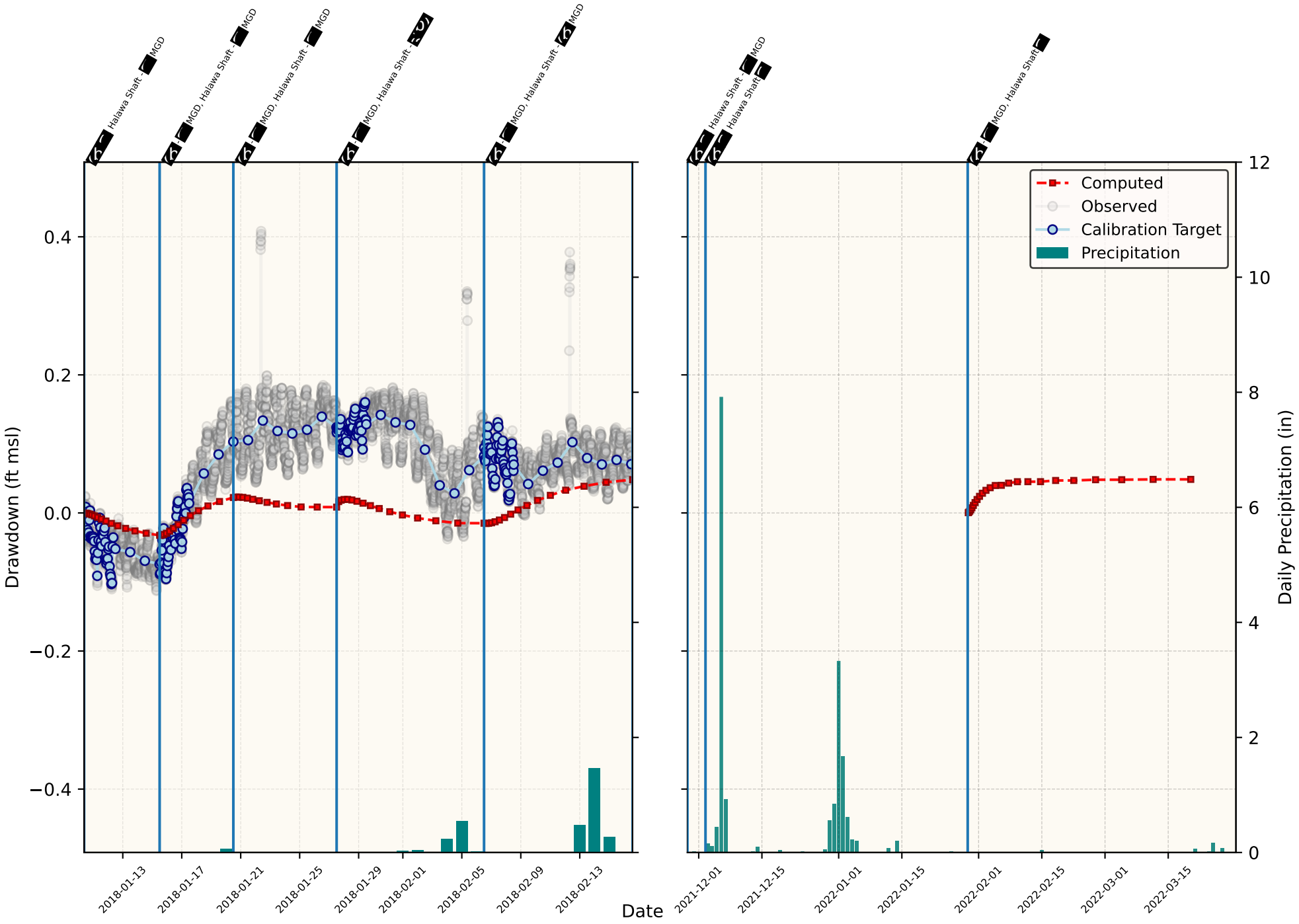


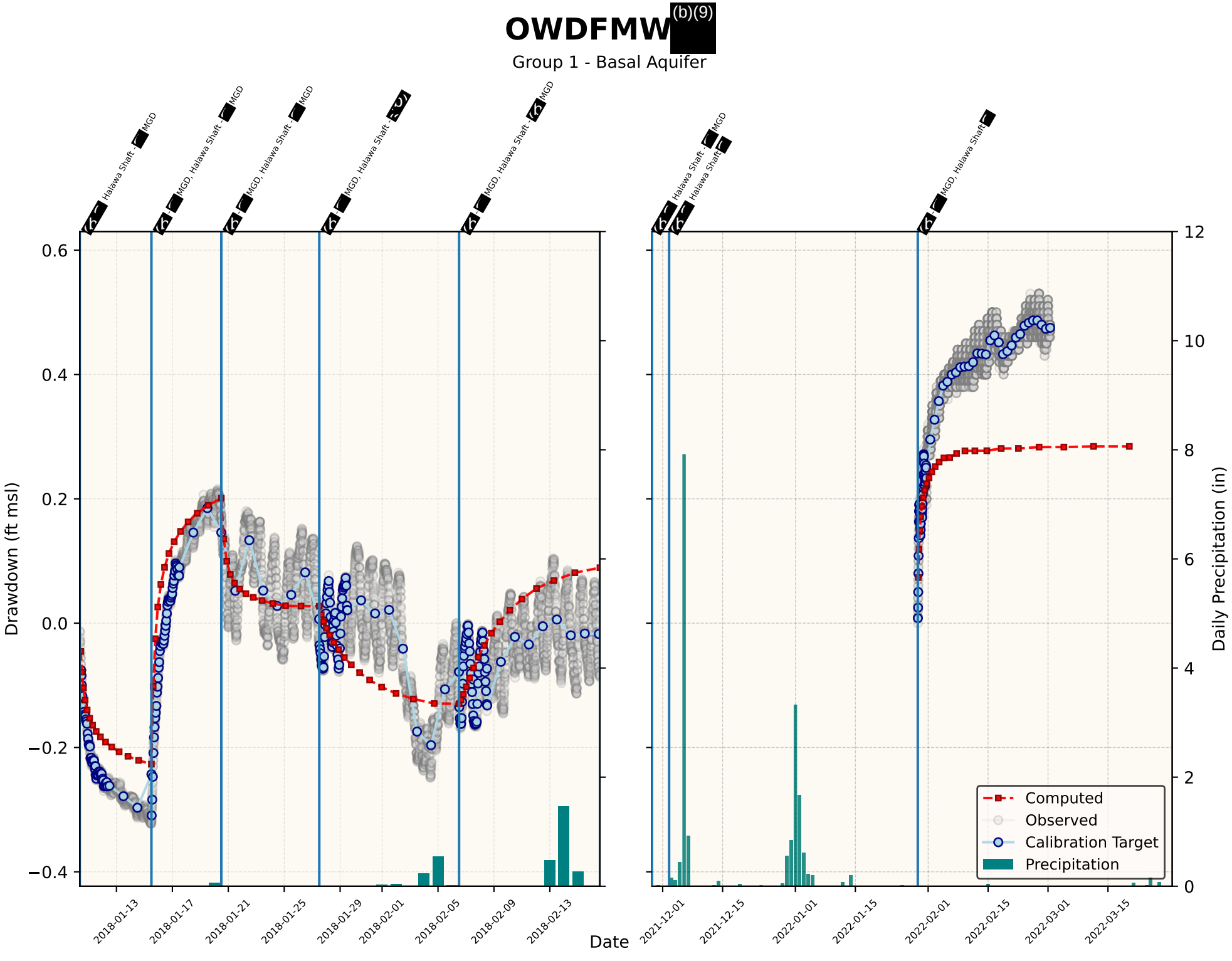

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
3
2
1
0
−1
−2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

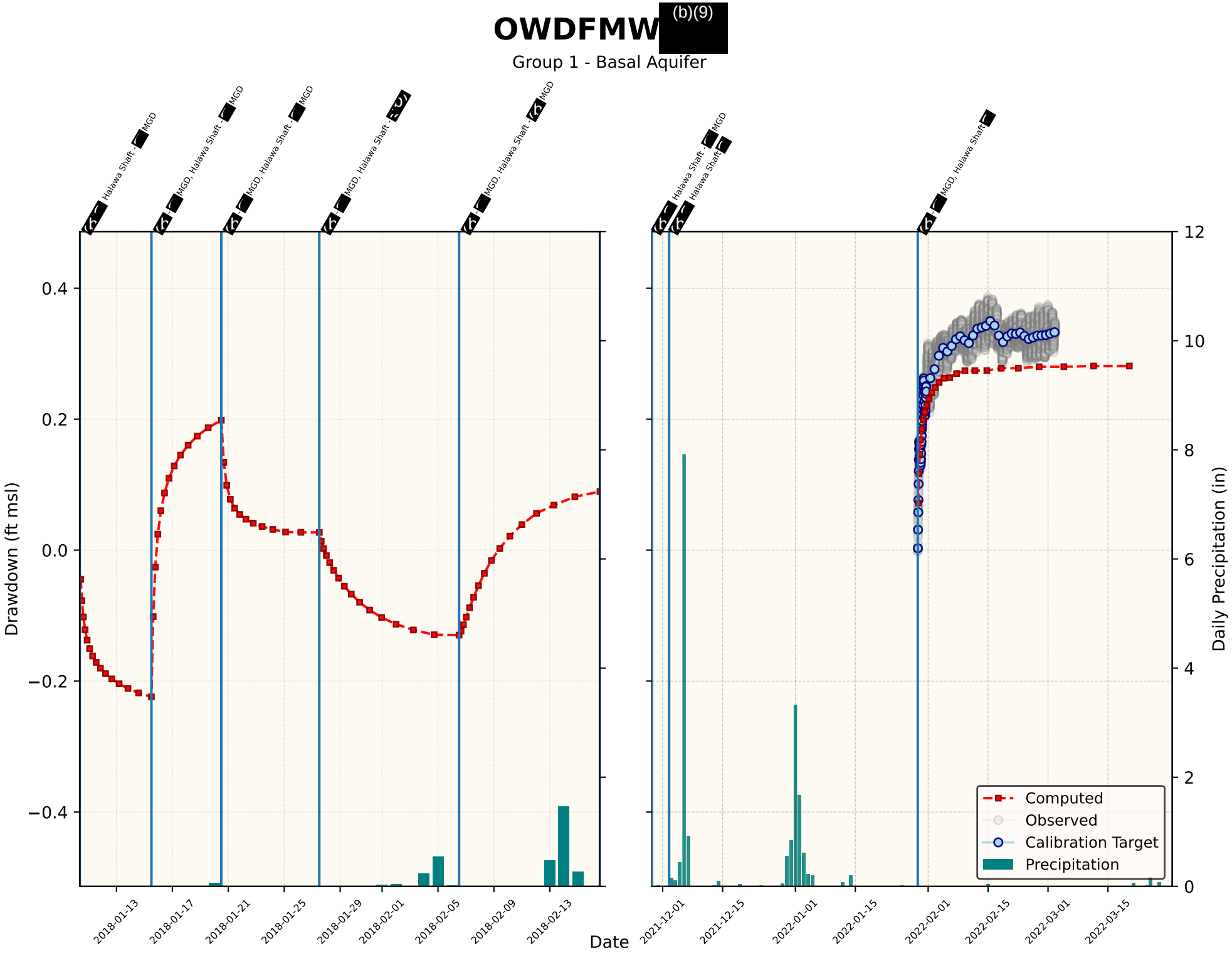

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

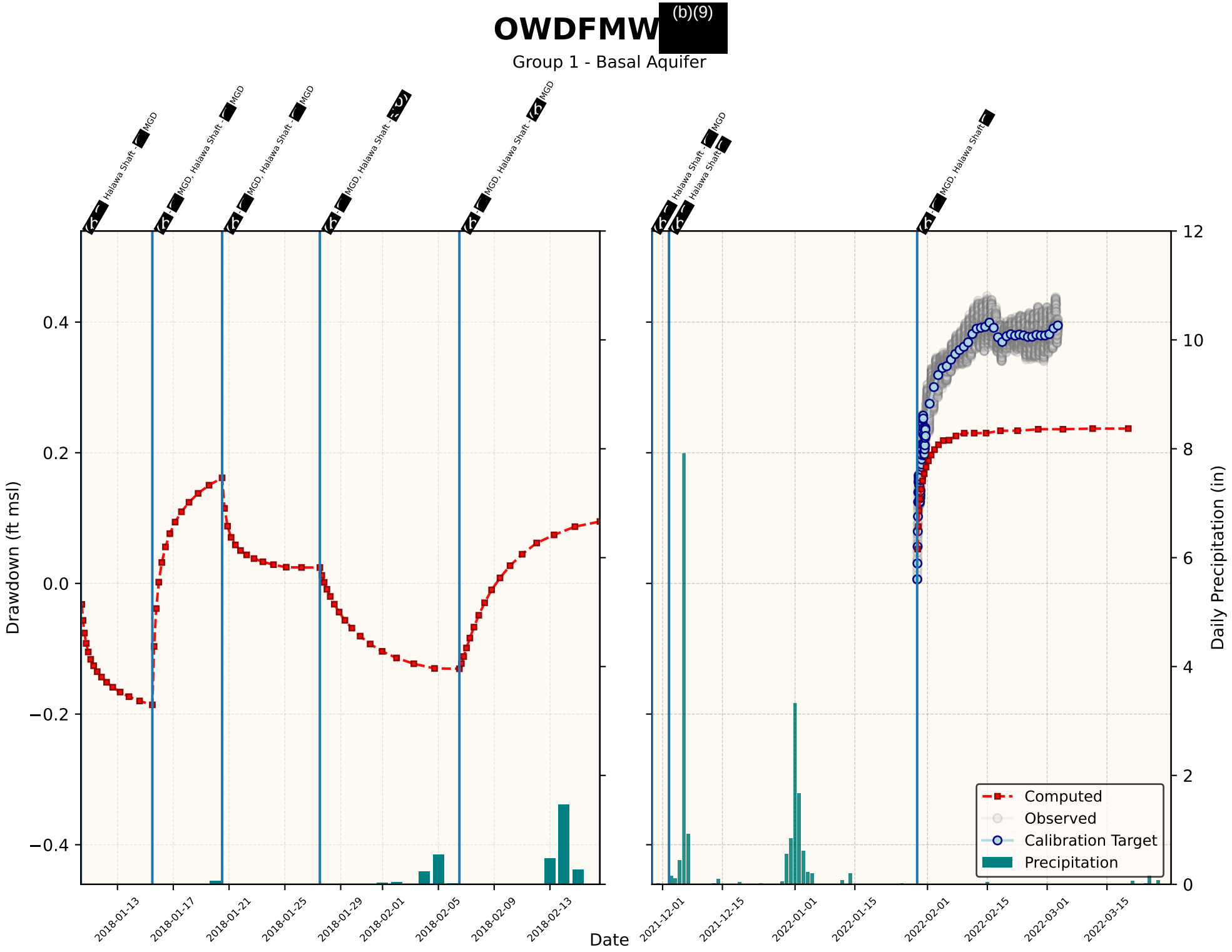

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

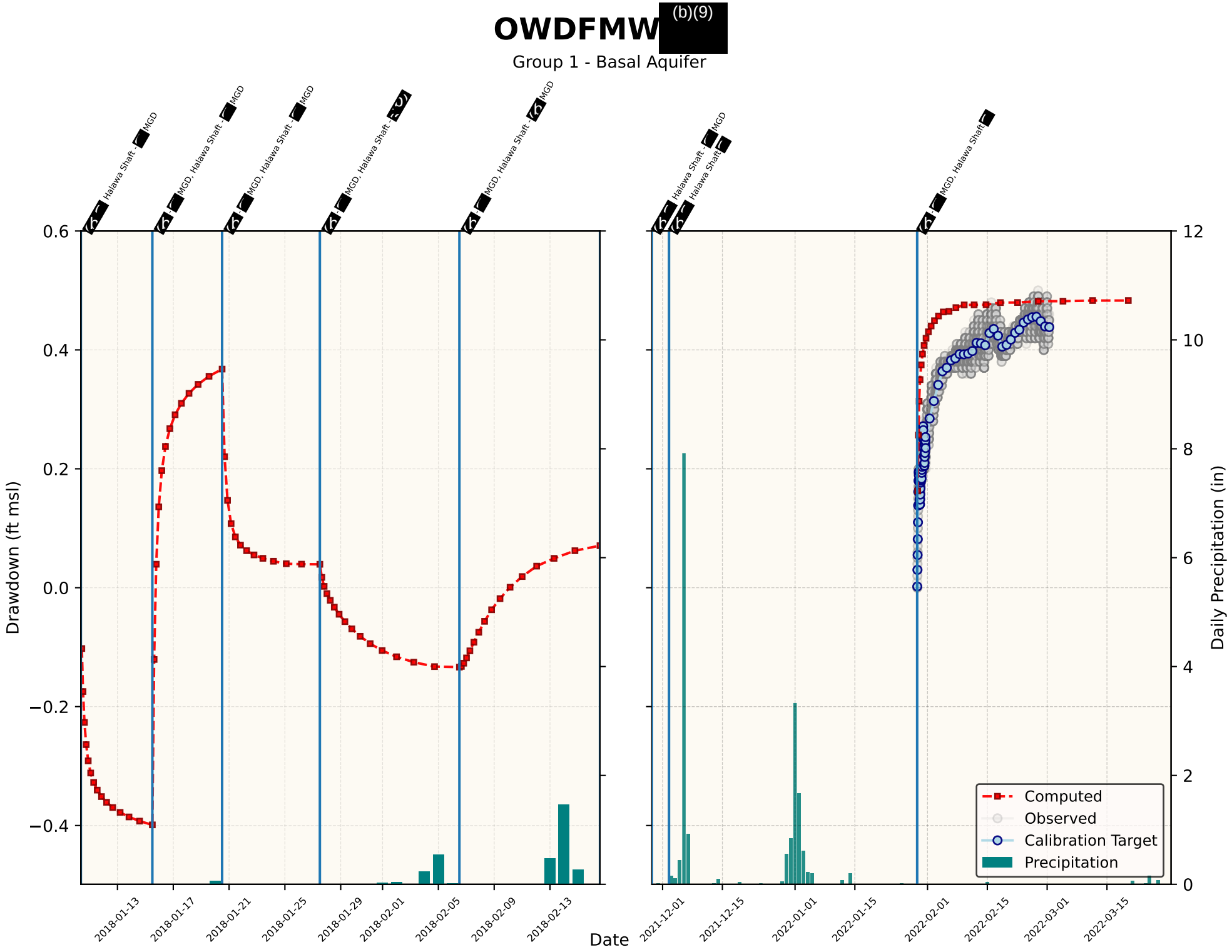

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


OWDFMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
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2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-15

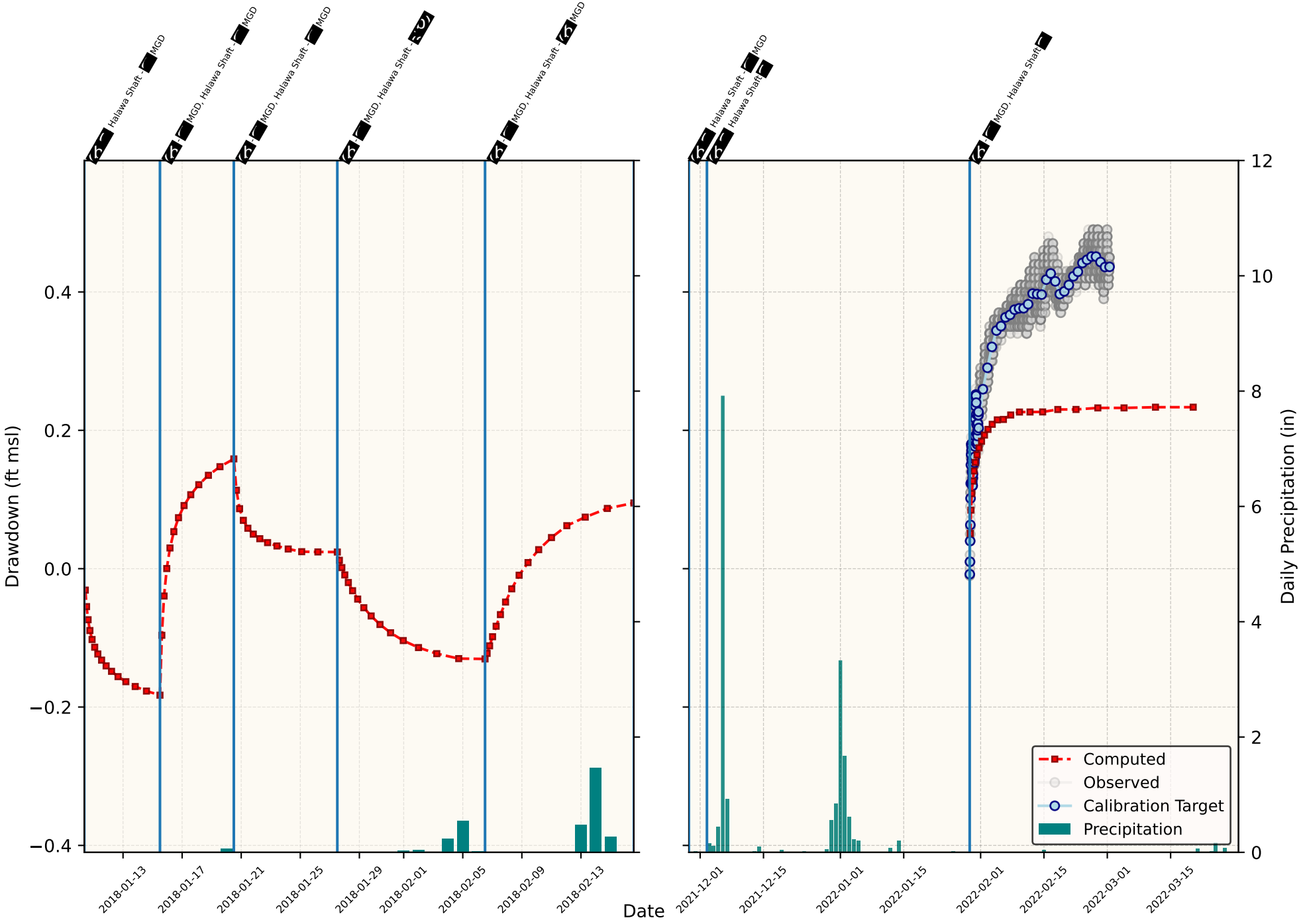

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
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2018-02-09
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2021-12-01
2021-12-15
2022-01-01
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2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation

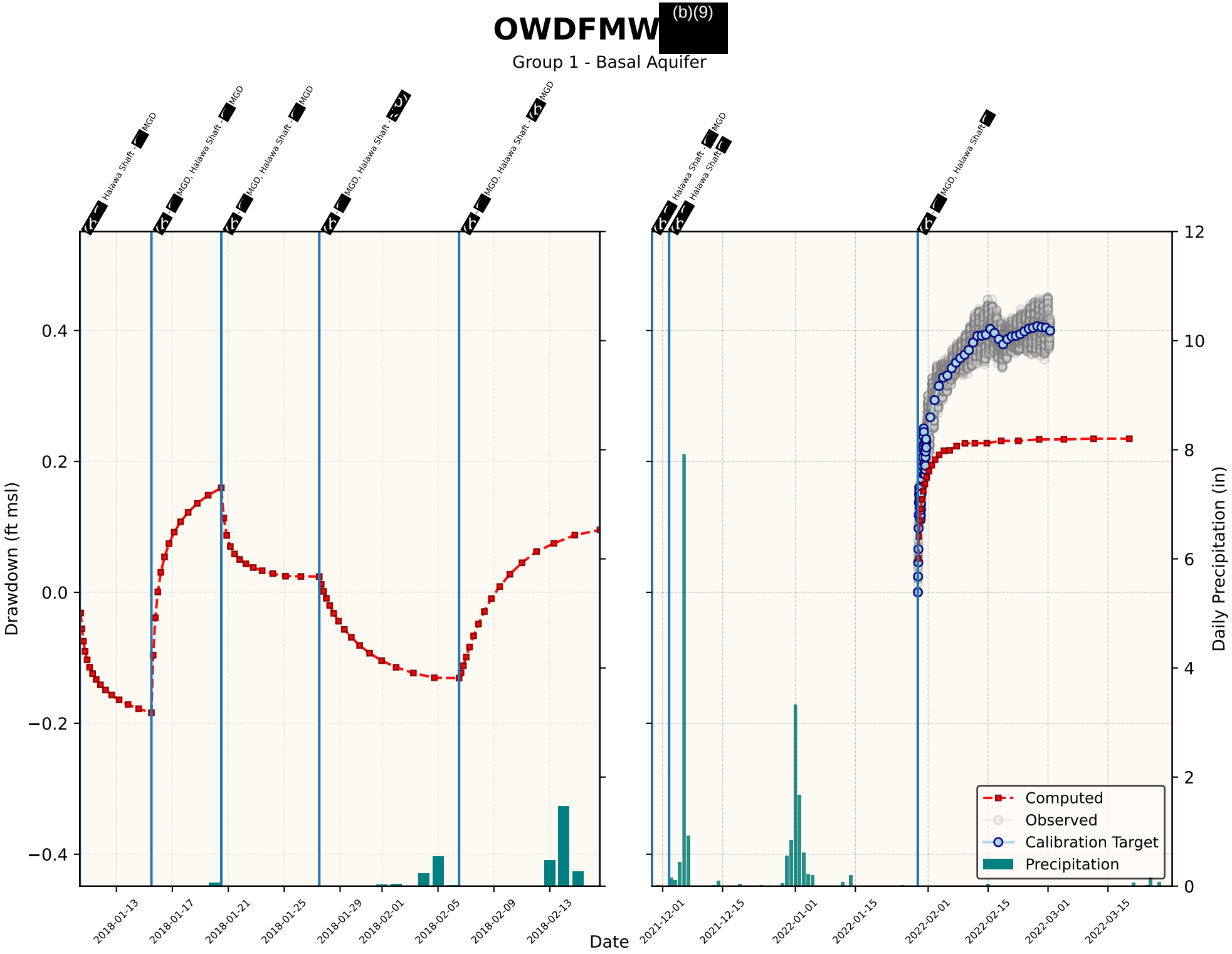

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
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2022-01-01
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2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

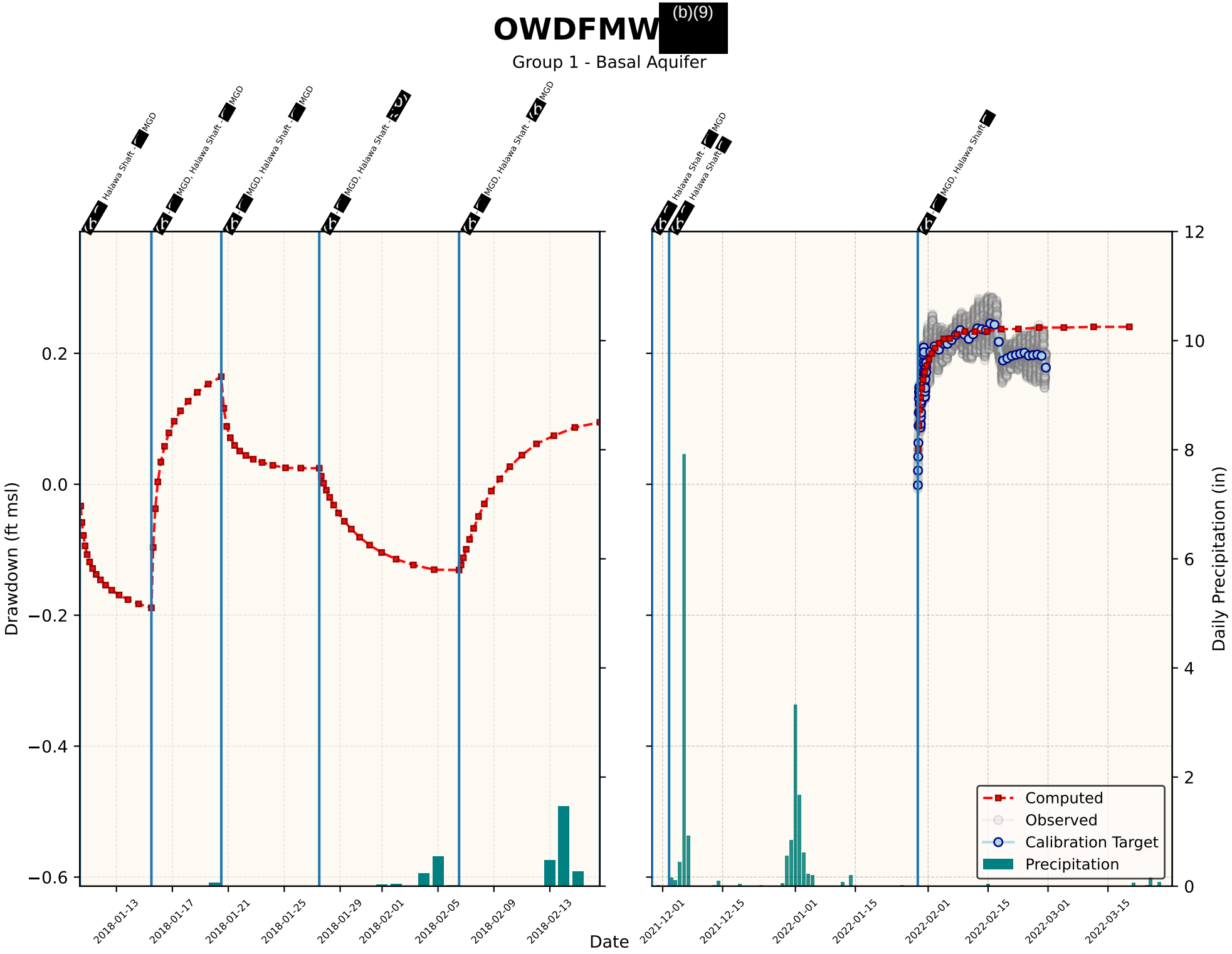

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
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2021-12-15
2022-01-01
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2022-03-15
Computed
Observed
Calibration Target
Precipitation

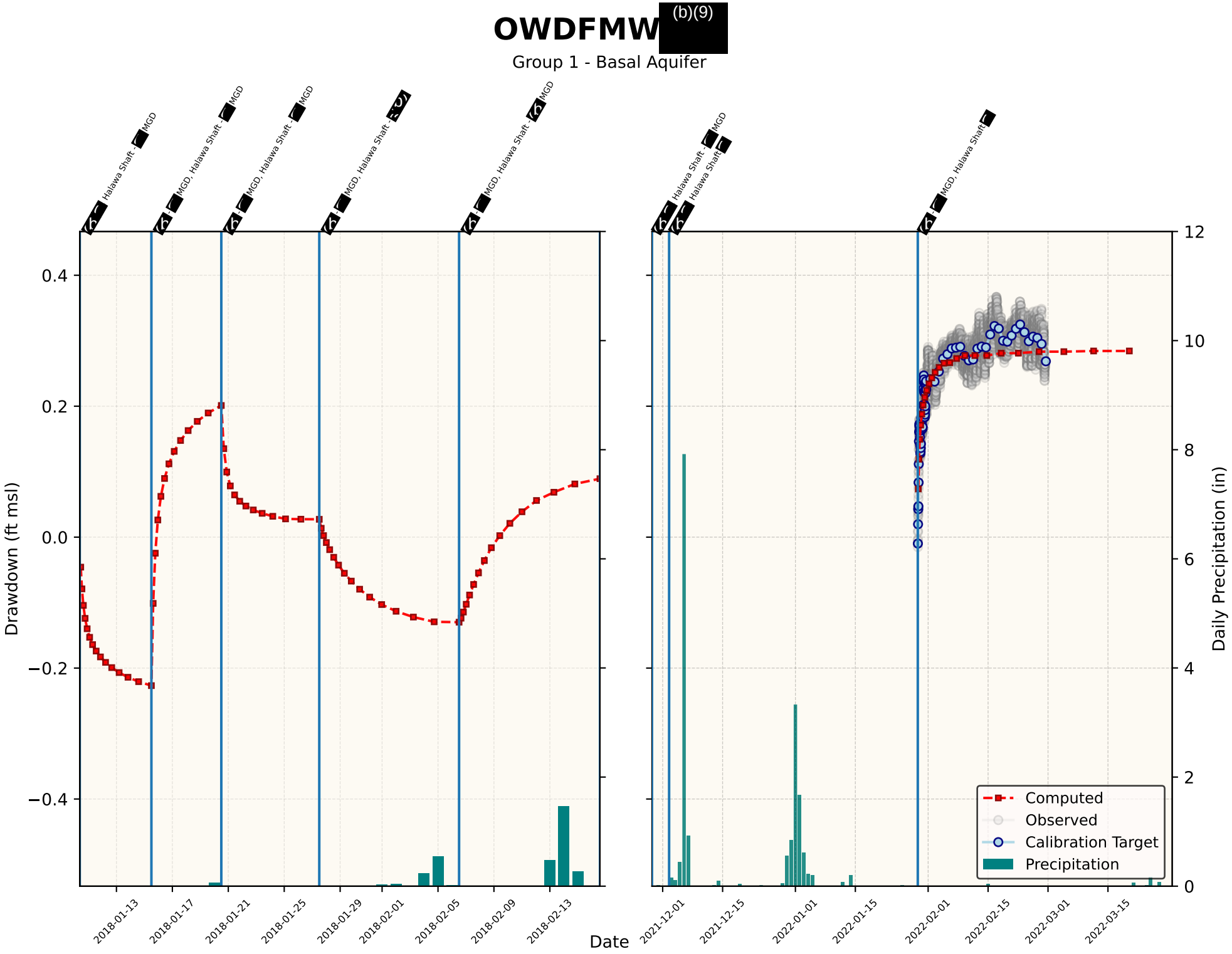
OWDFMW[redacted] (b)(9)

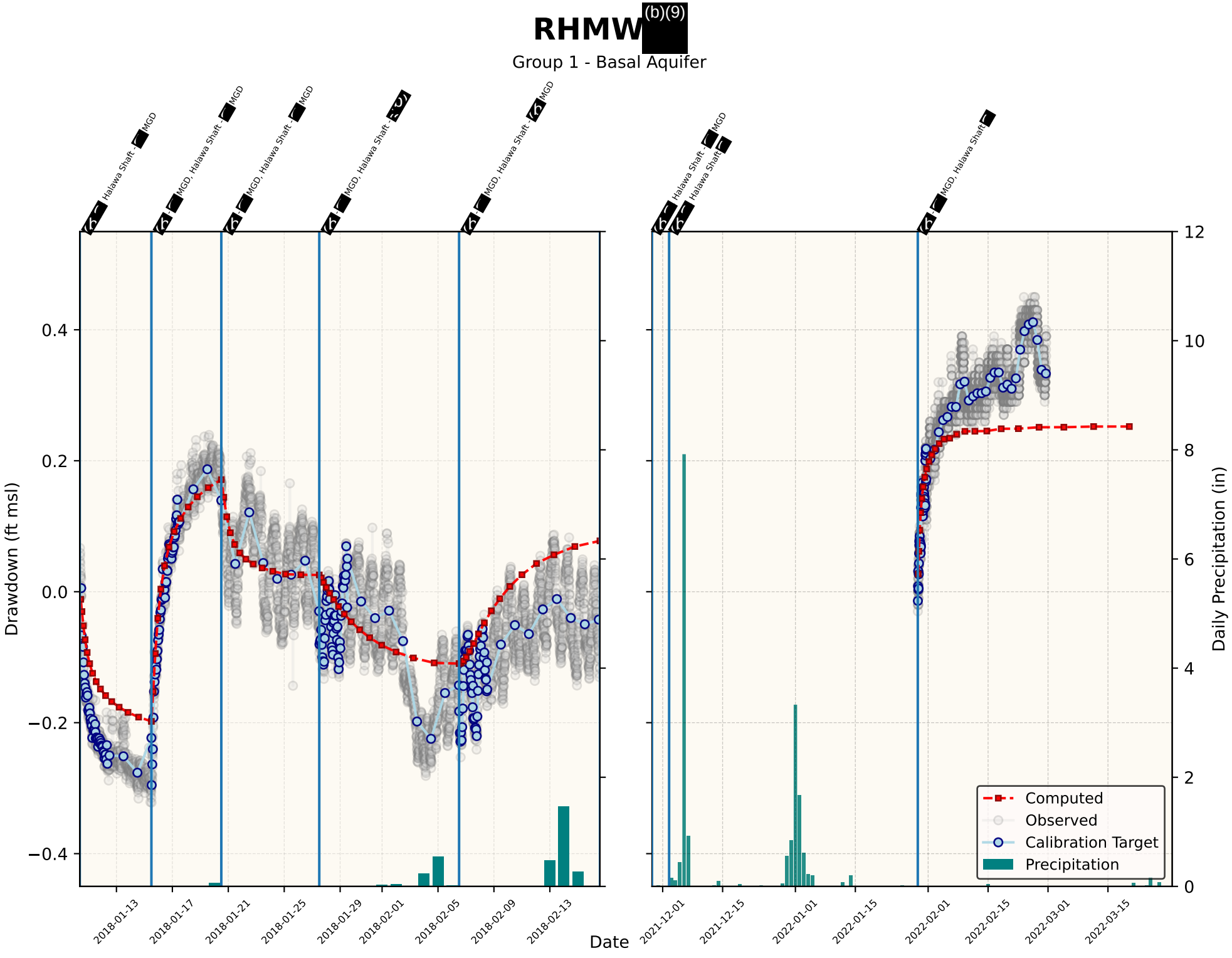
Group 1 - Basal Aquifer

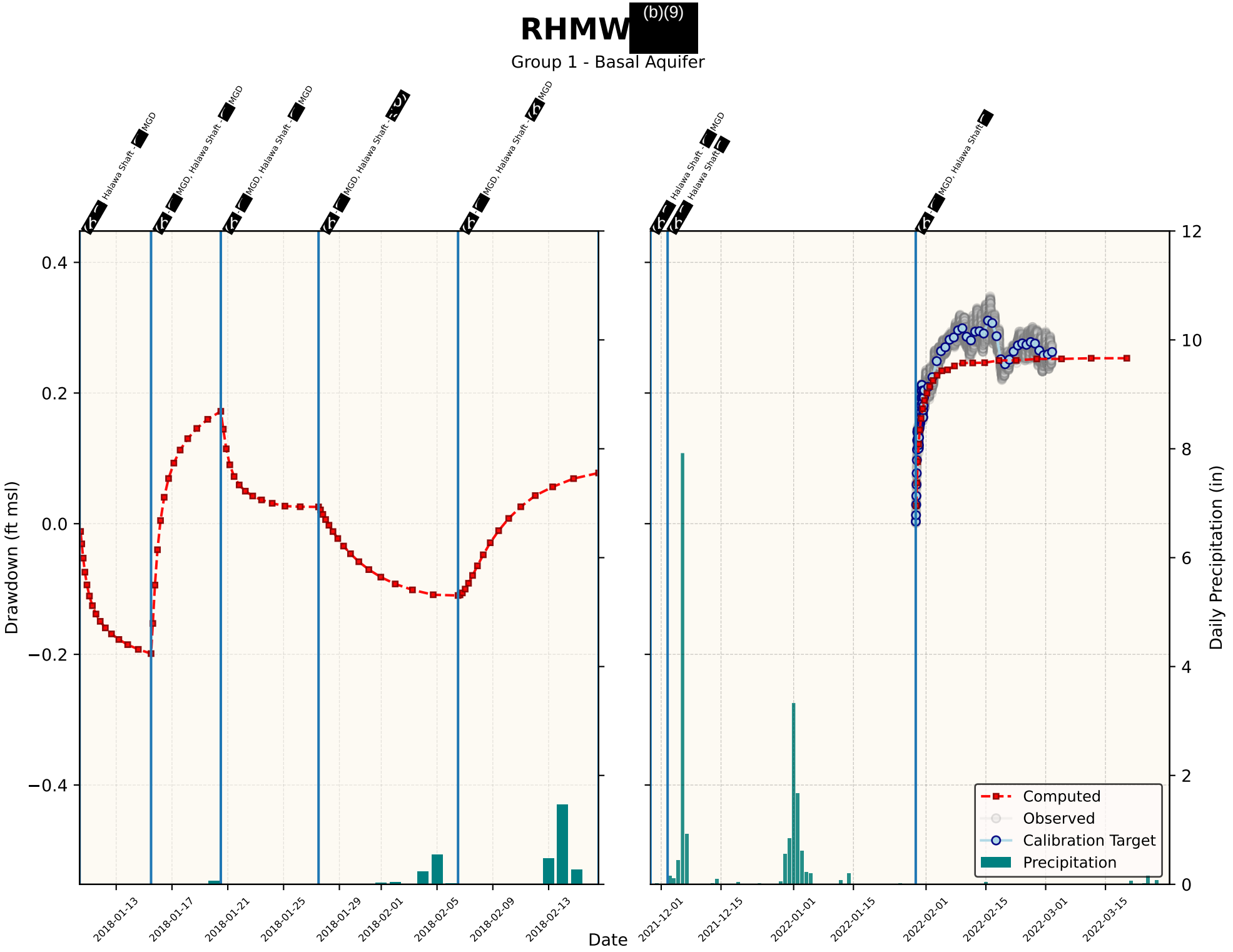


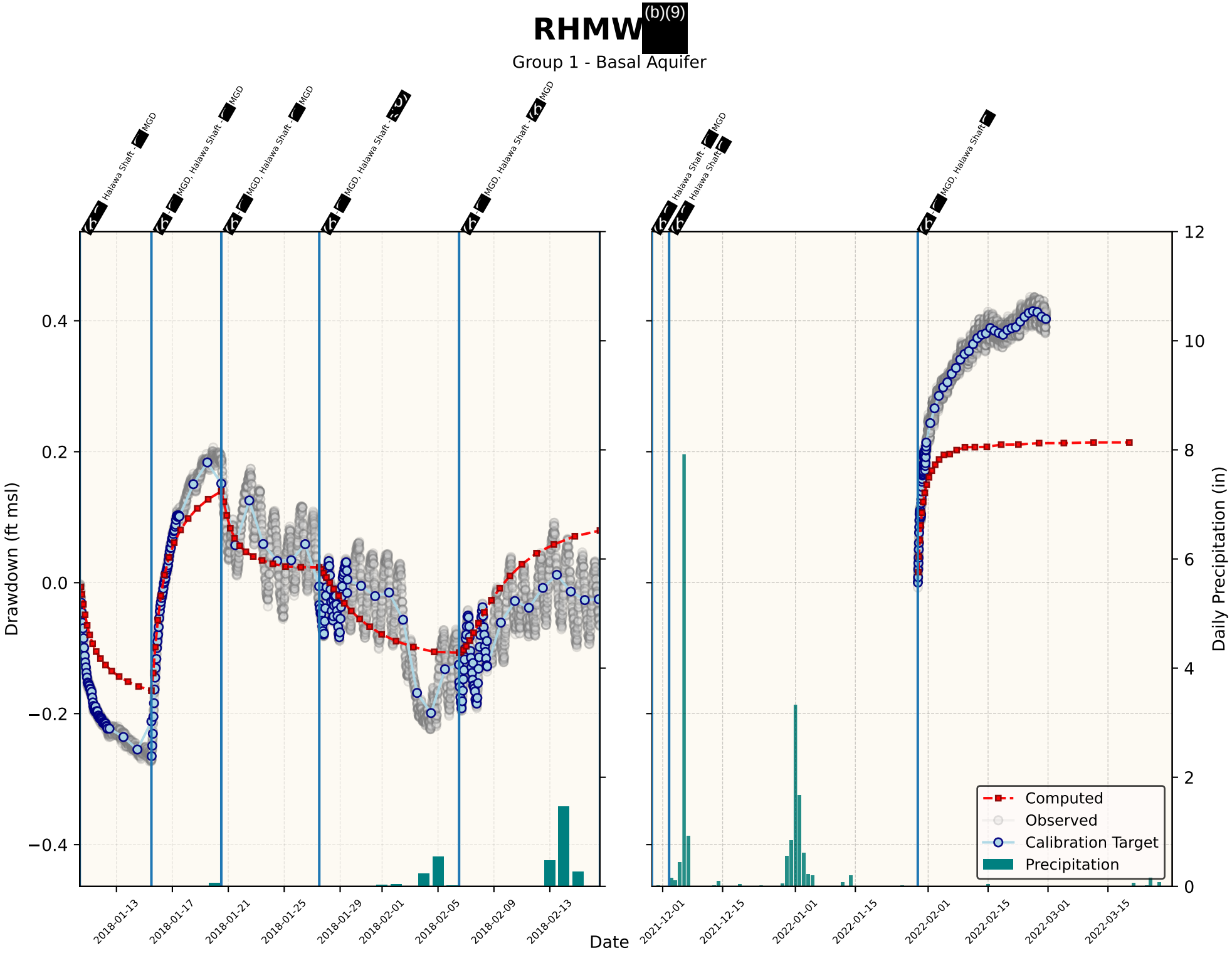

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

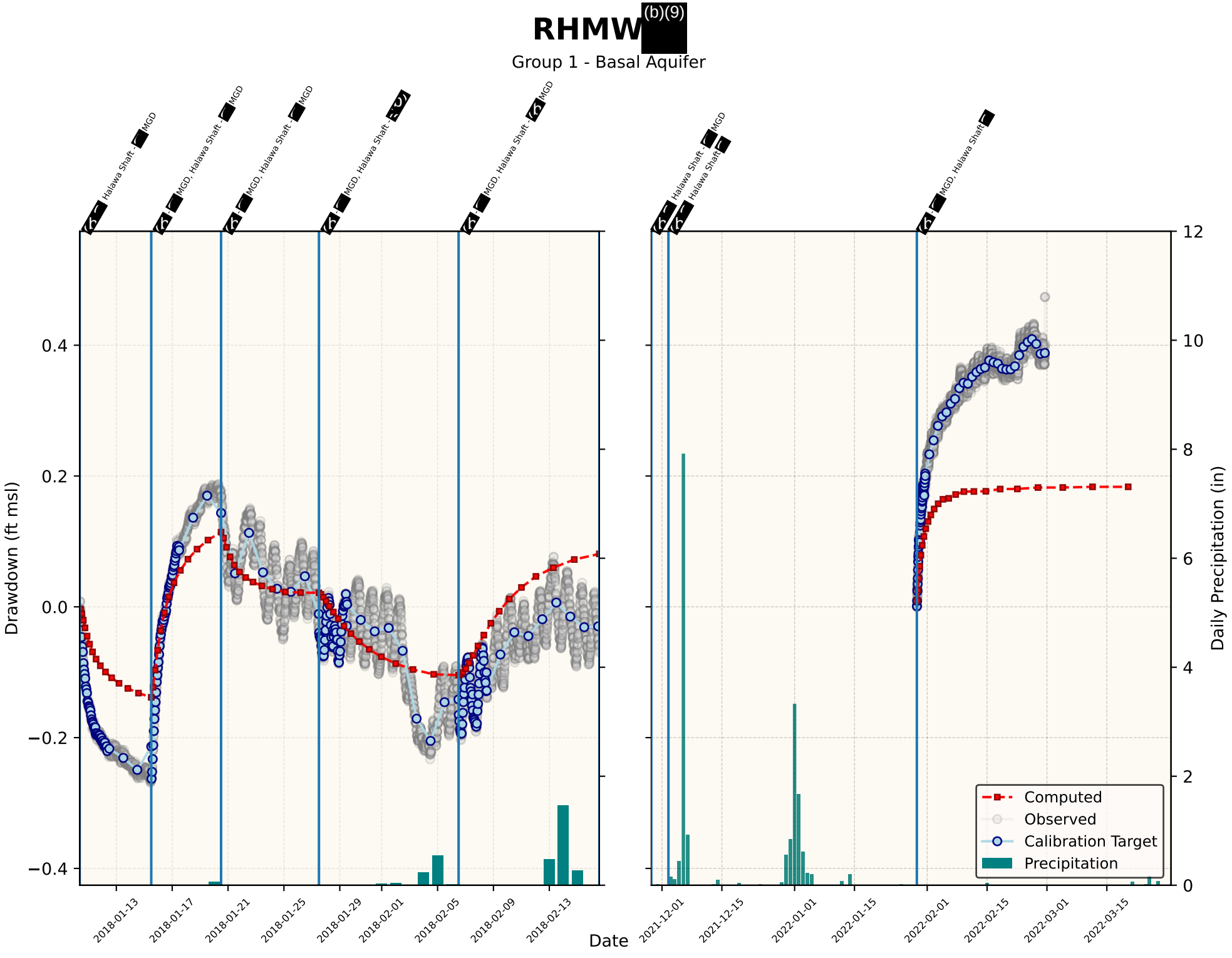

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
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−0.2
−0.4
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2018-01-13
2018-01-17
2018-01-21
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2021-12-15
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2022-01-15
2022-02-01
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2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
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4
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2018-01-13
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2018-01-21
2018-01-25
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2018-02-01
2018-02-05
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Date
Computed
Observed
Calibration Target
Precipitation

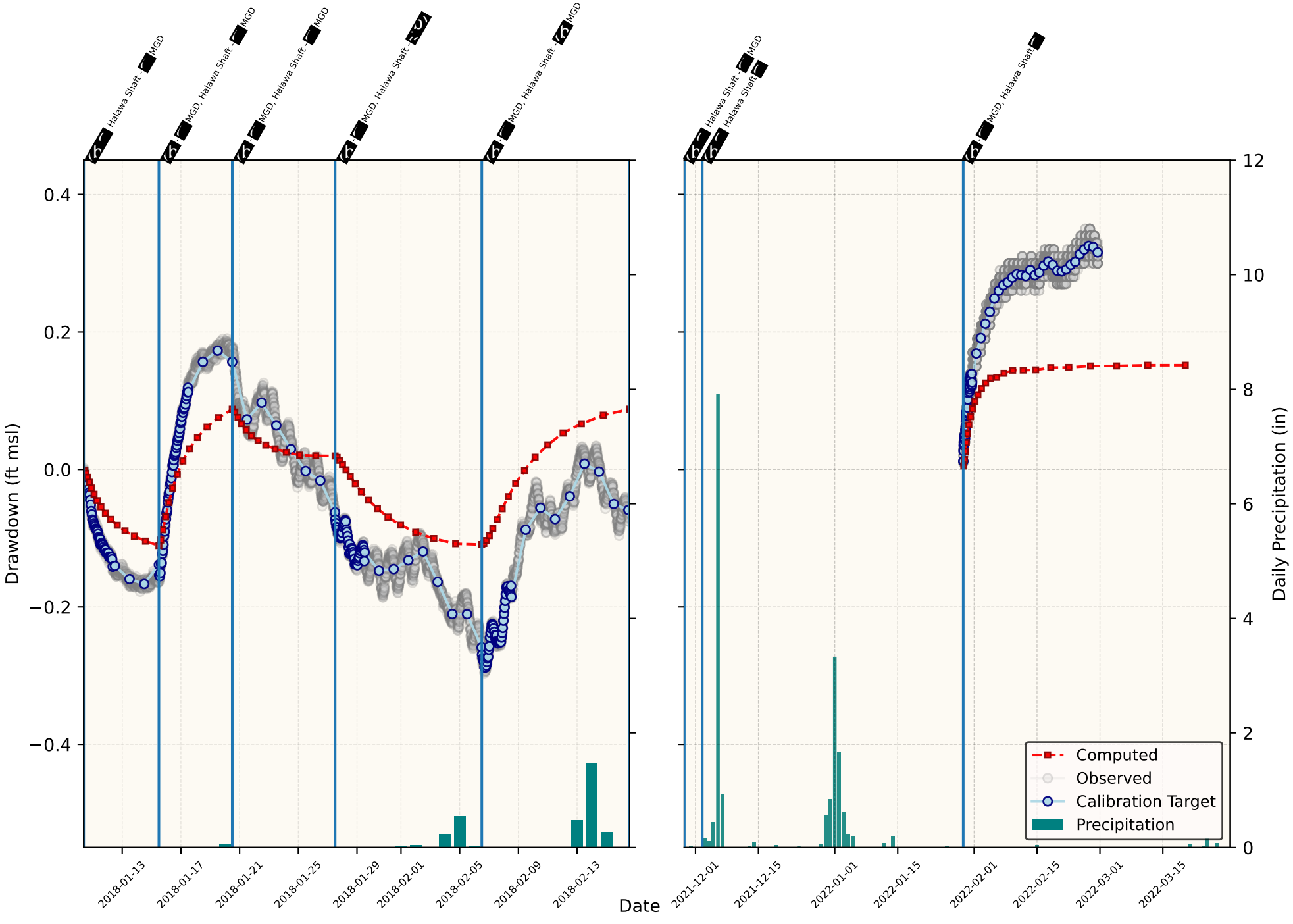

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
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MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
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2018-01-13
2018-01-17
2018-01-21
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2022-03-15

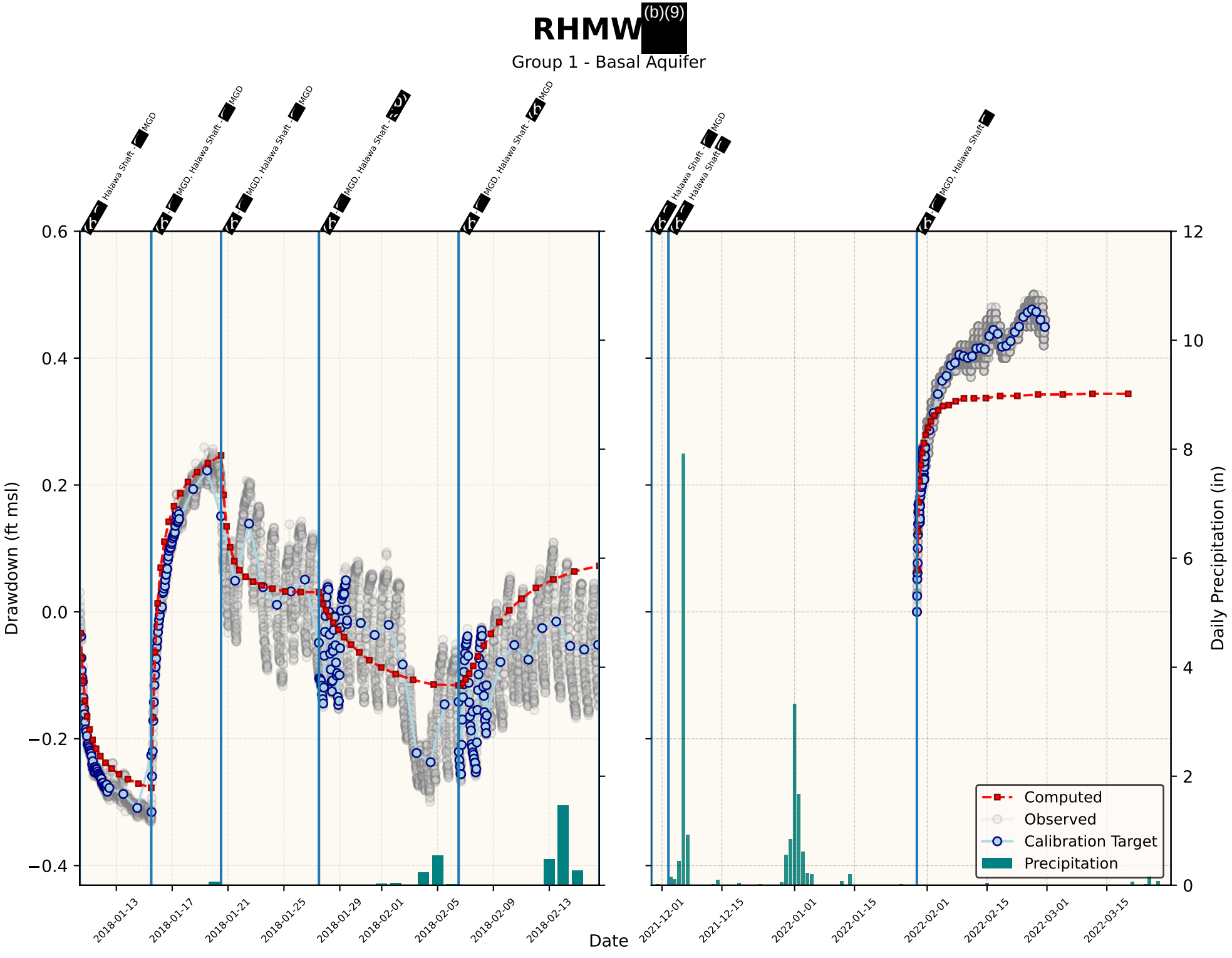

RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
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MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
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6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
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2018-02-13
2021-12-01
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2022-03-15

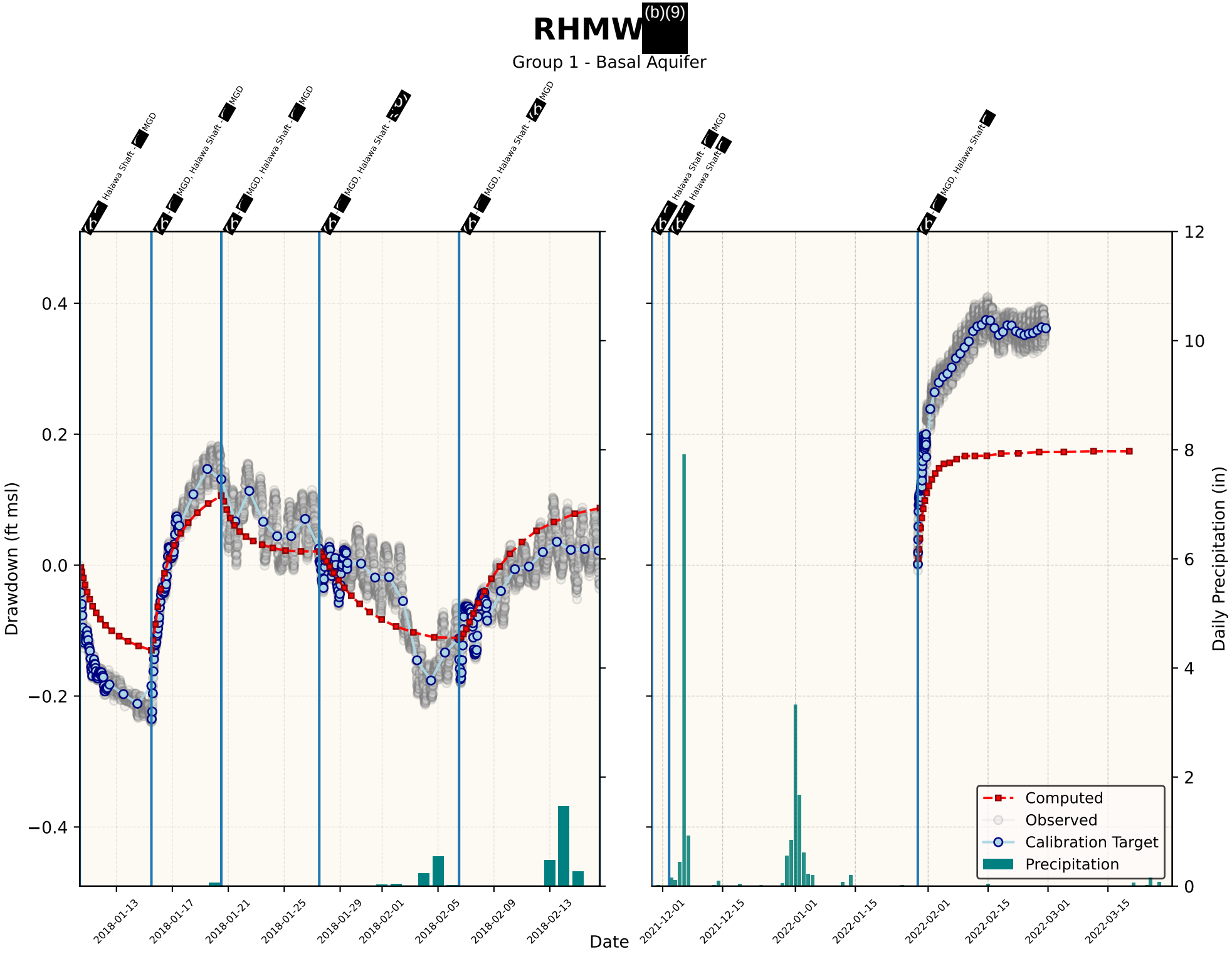

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
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2022-03-15
Date

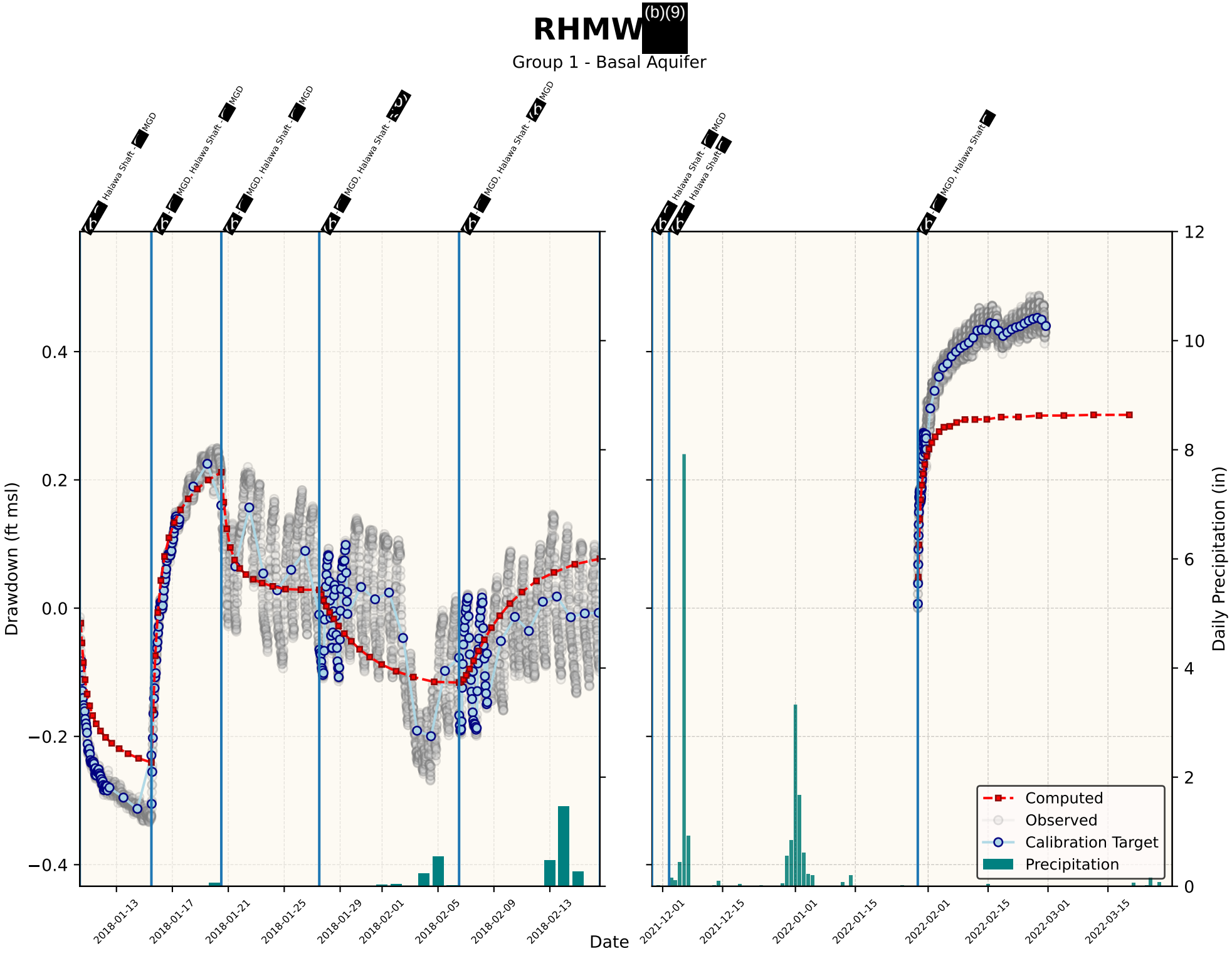
RHMW[redacted]

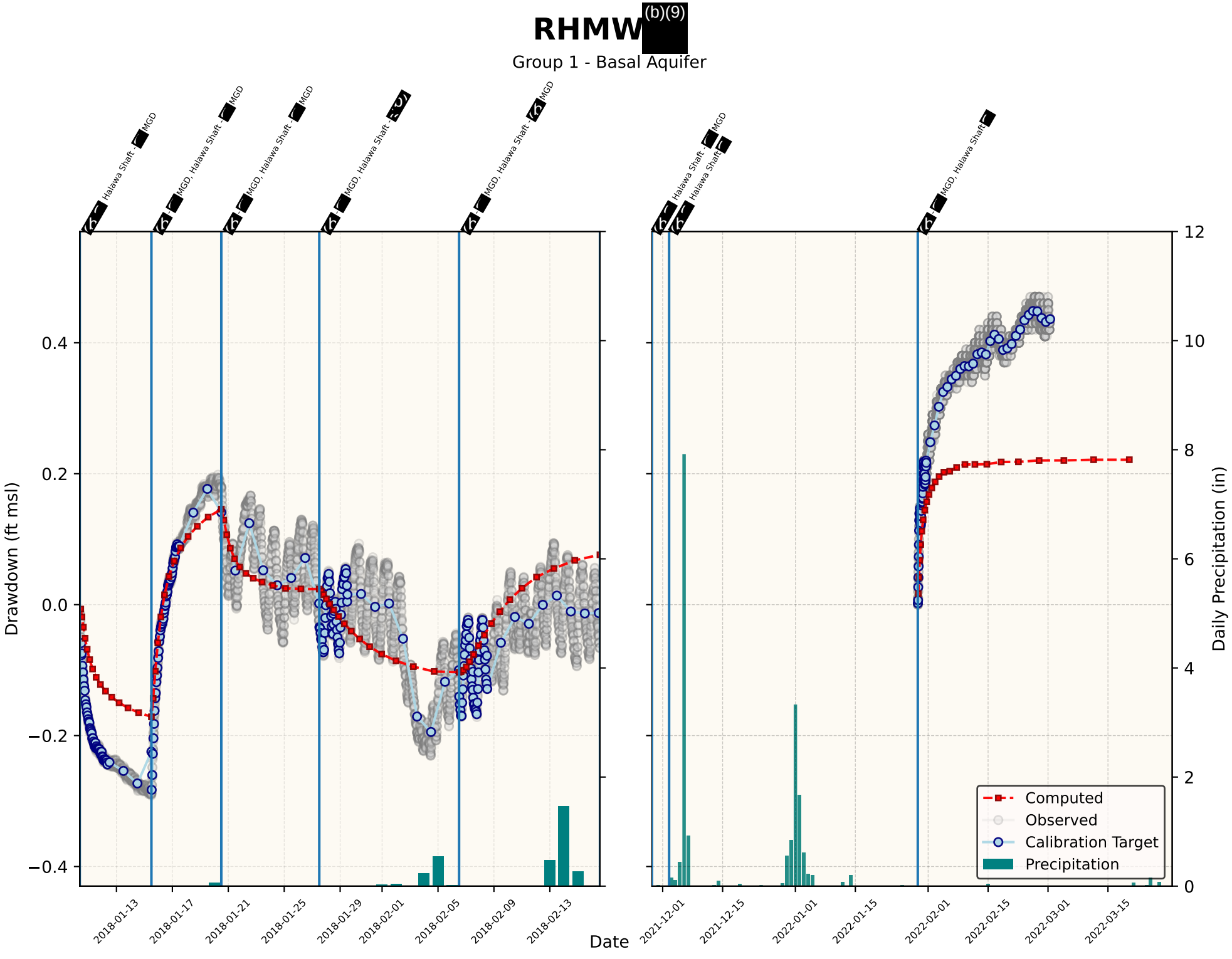
Group 1 - Basal Aquifer




RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.6
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
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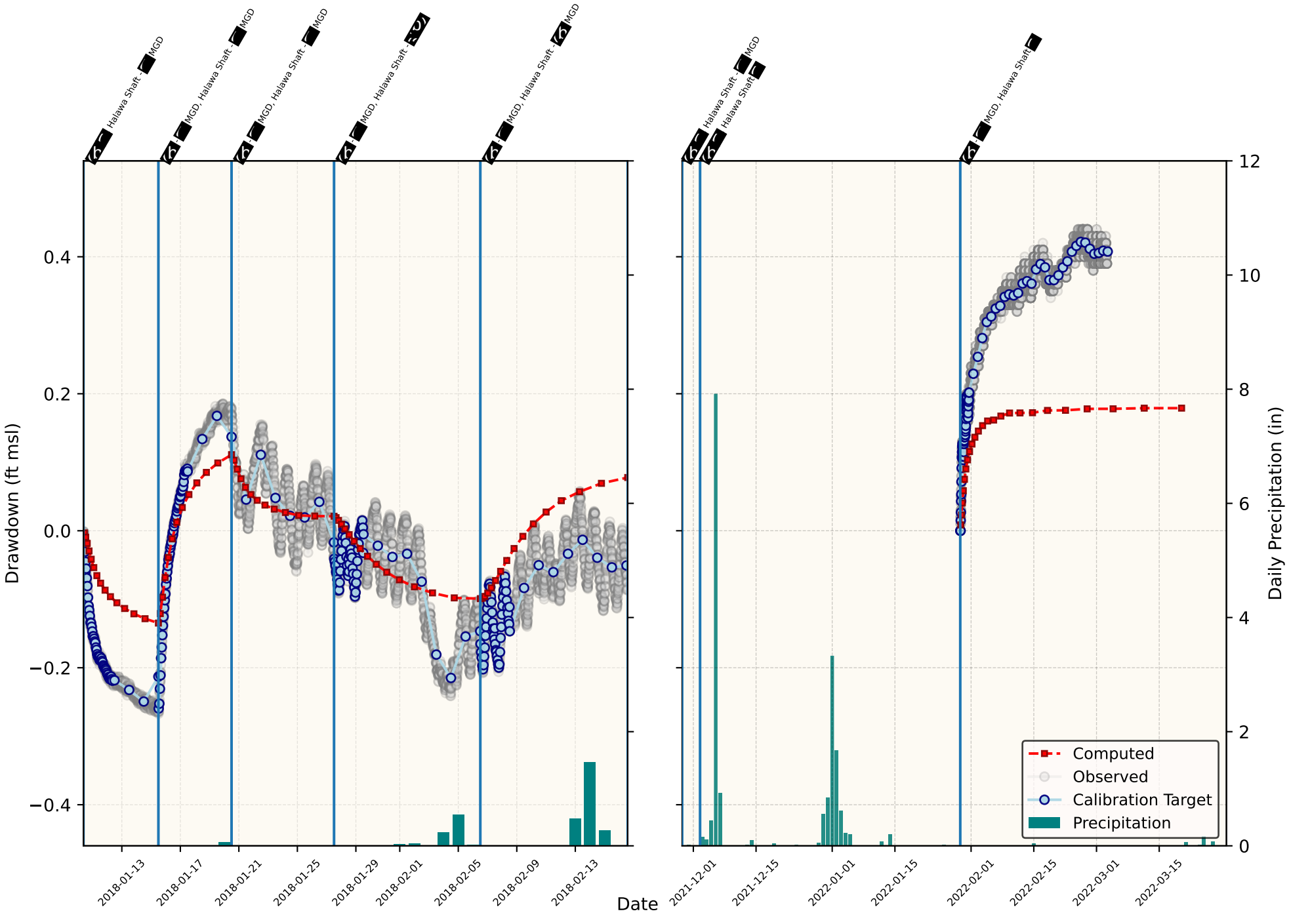

RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
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2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date


RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
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2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
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2018-01-25
2018-01-29
2018-02-01
2018-02-05
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Date
Computed
Observed
Calibration Target
Precipitation

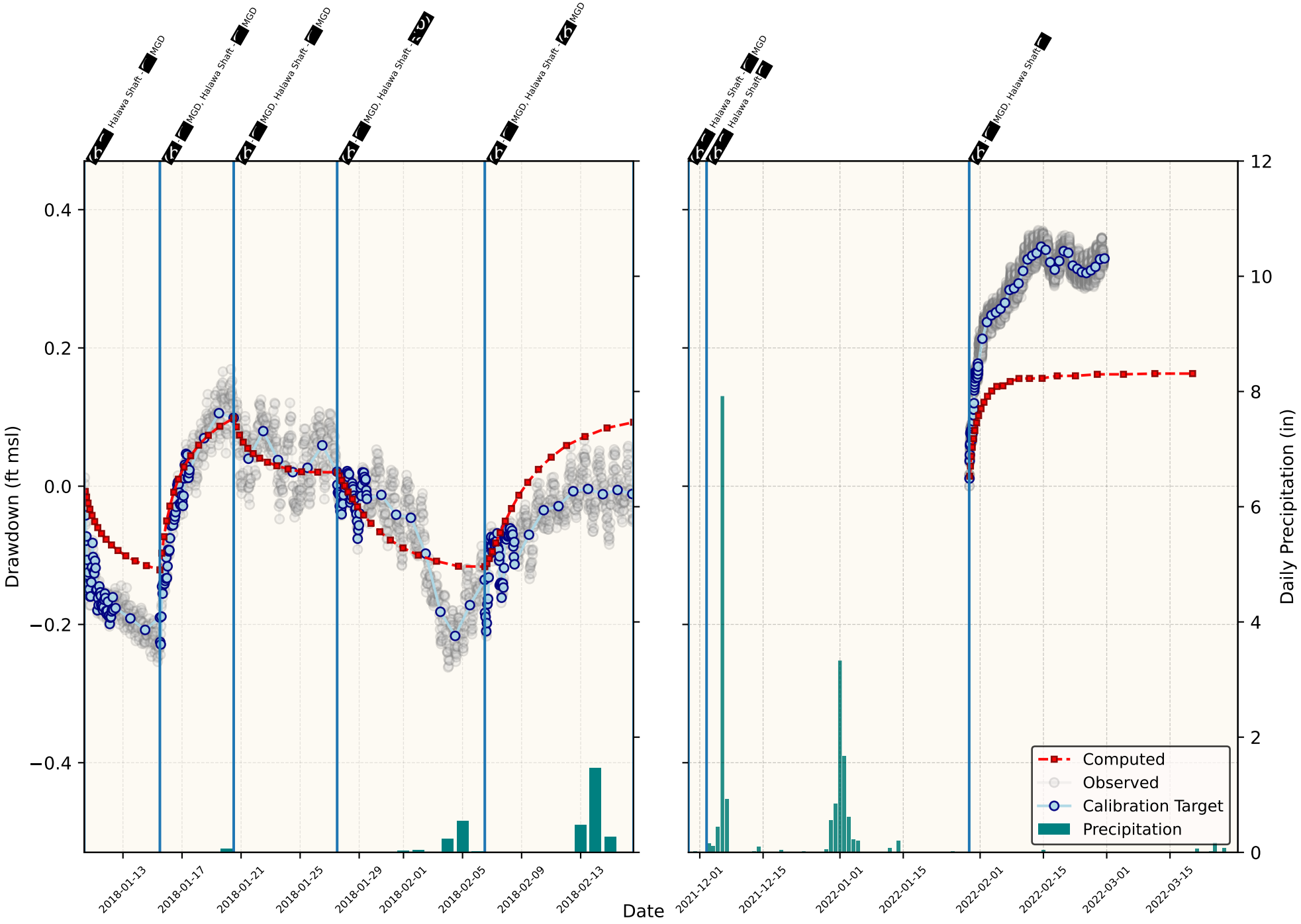
RHMW[redacted]

Group 1 - Basal Aquifer



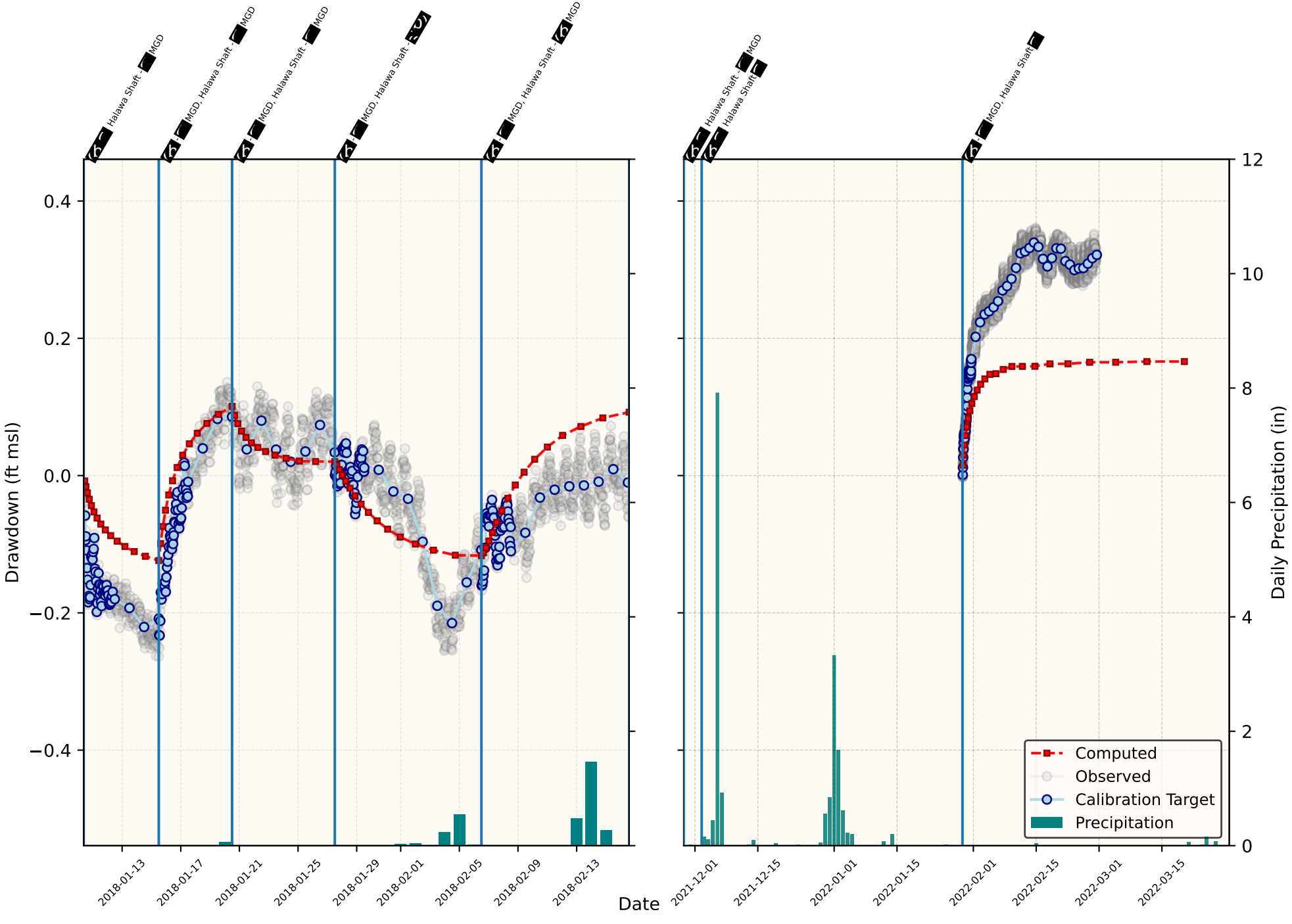
RHMW (b)(9)

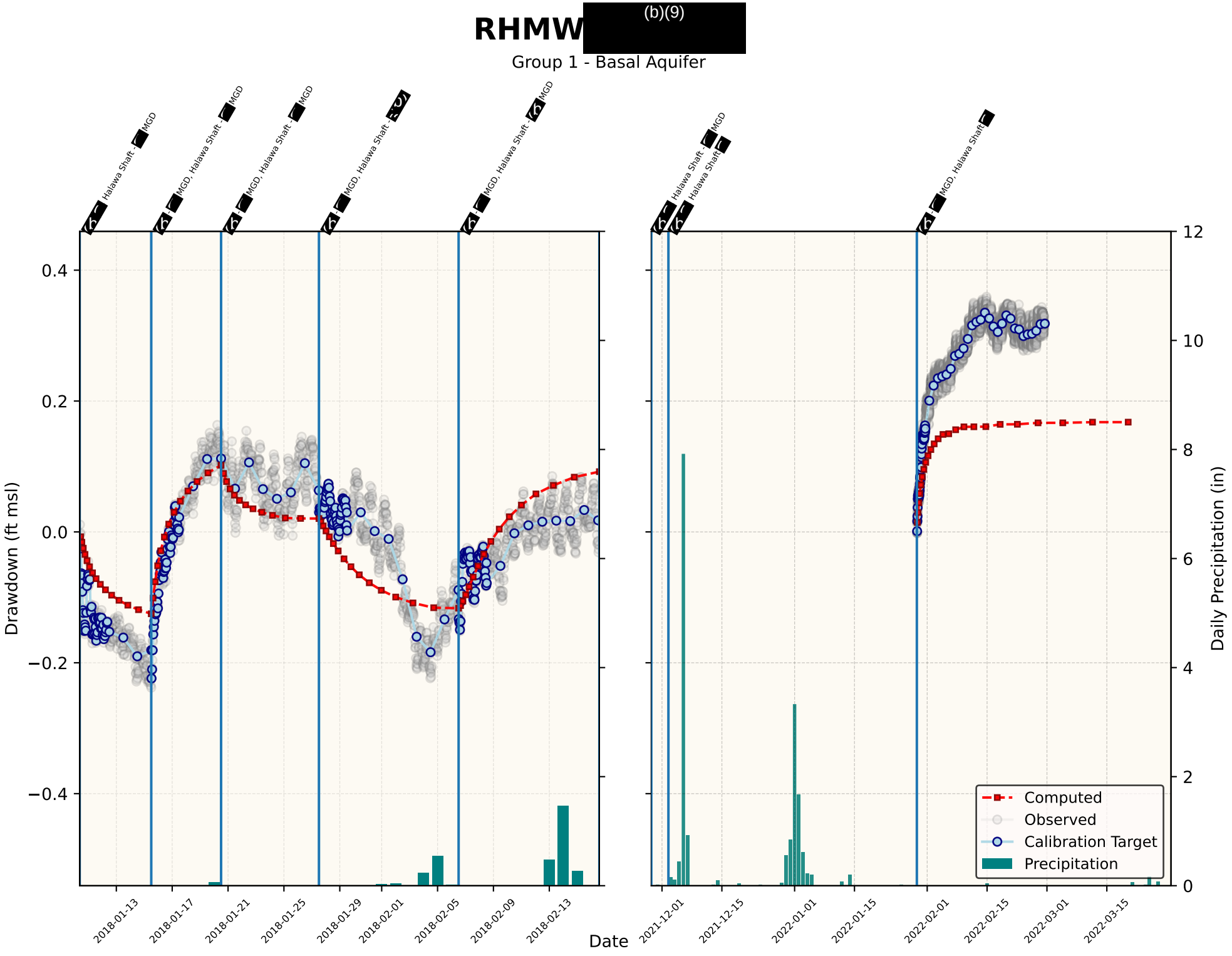
Group 1 - Basal Aquifer

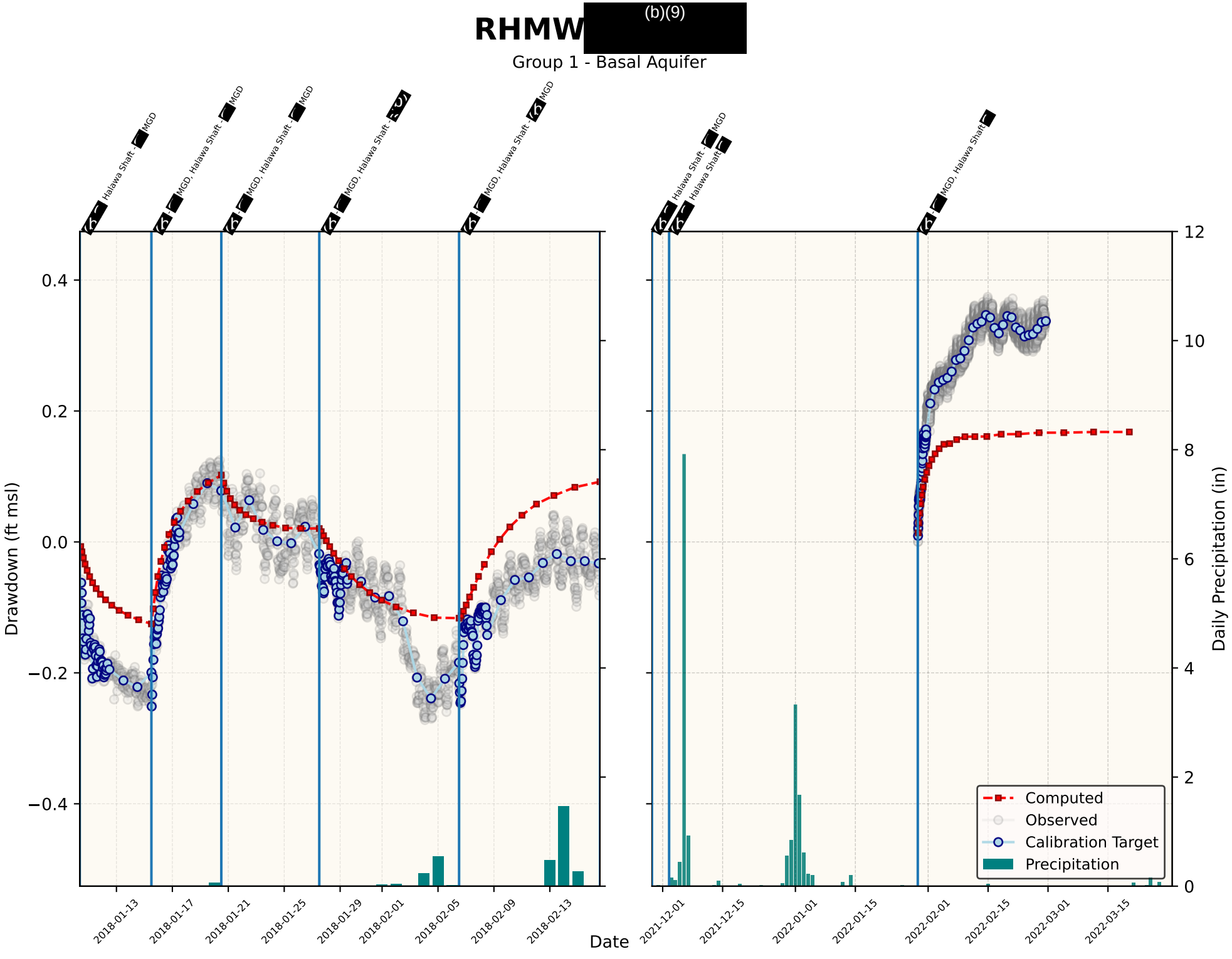


RHMW (b)(9)

Group 1 - Basal Aquifer

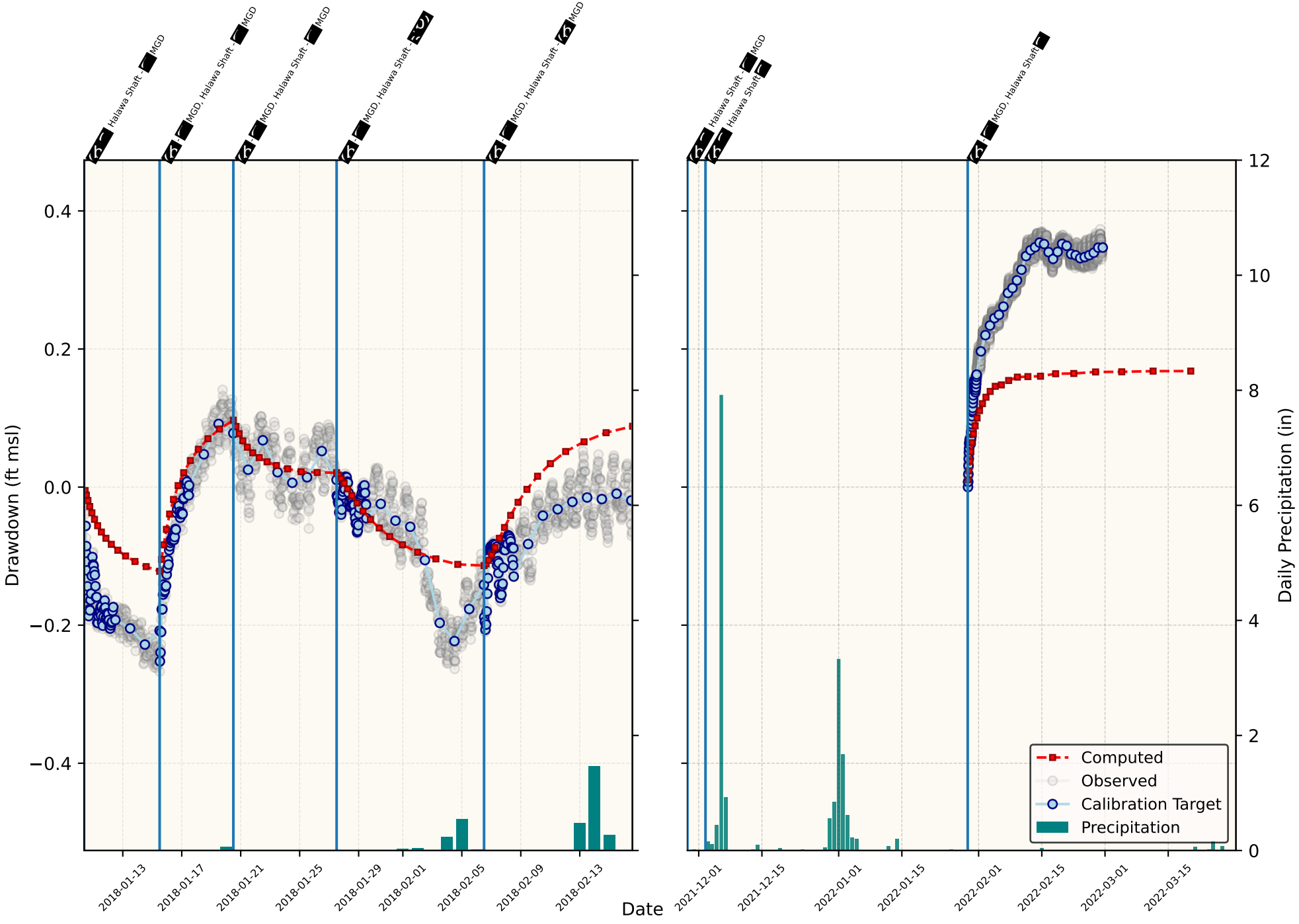



RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
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−0.2
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Daily Precipitation (in)
12
10
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2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
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2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

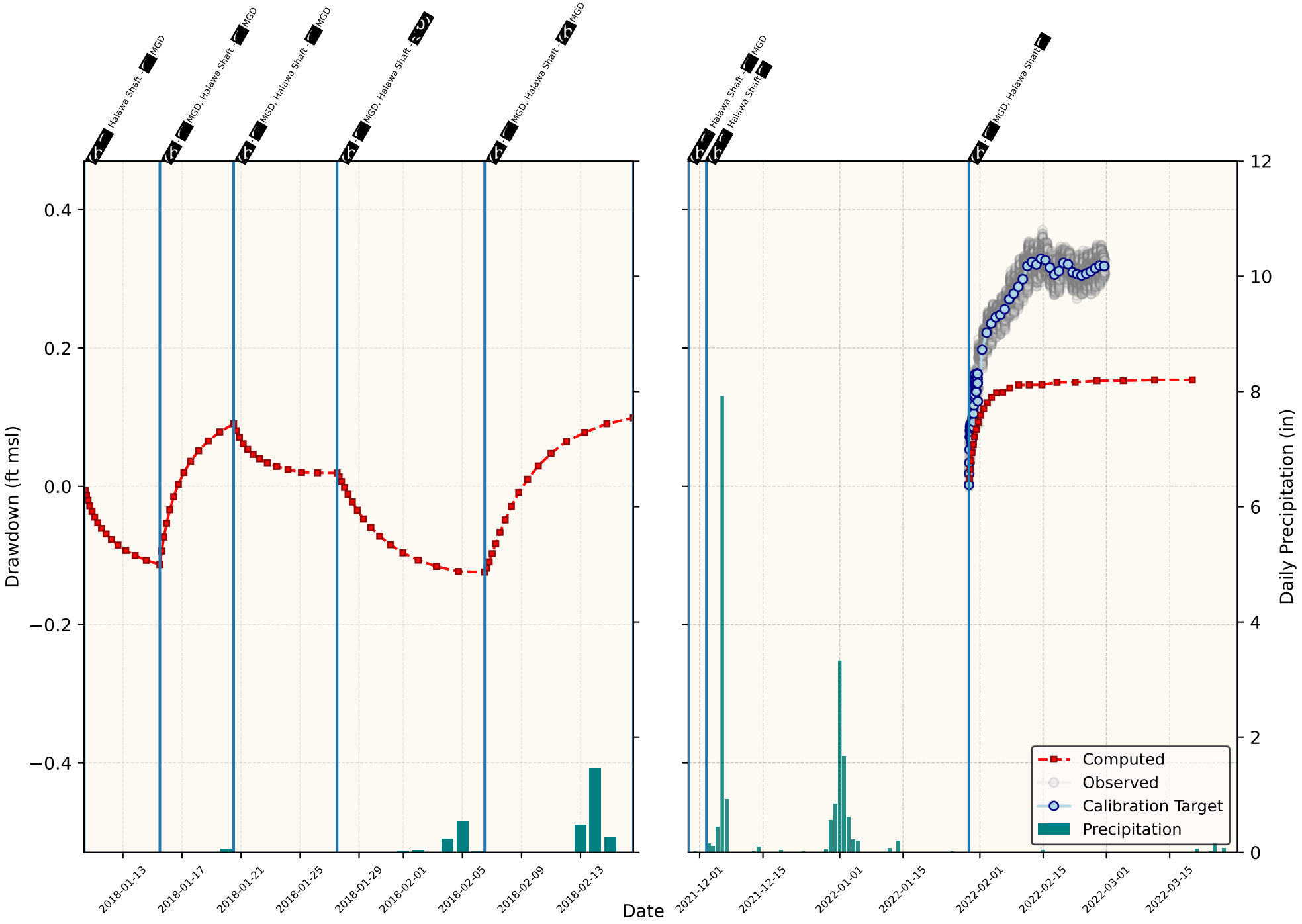
RHMW (b)(9)

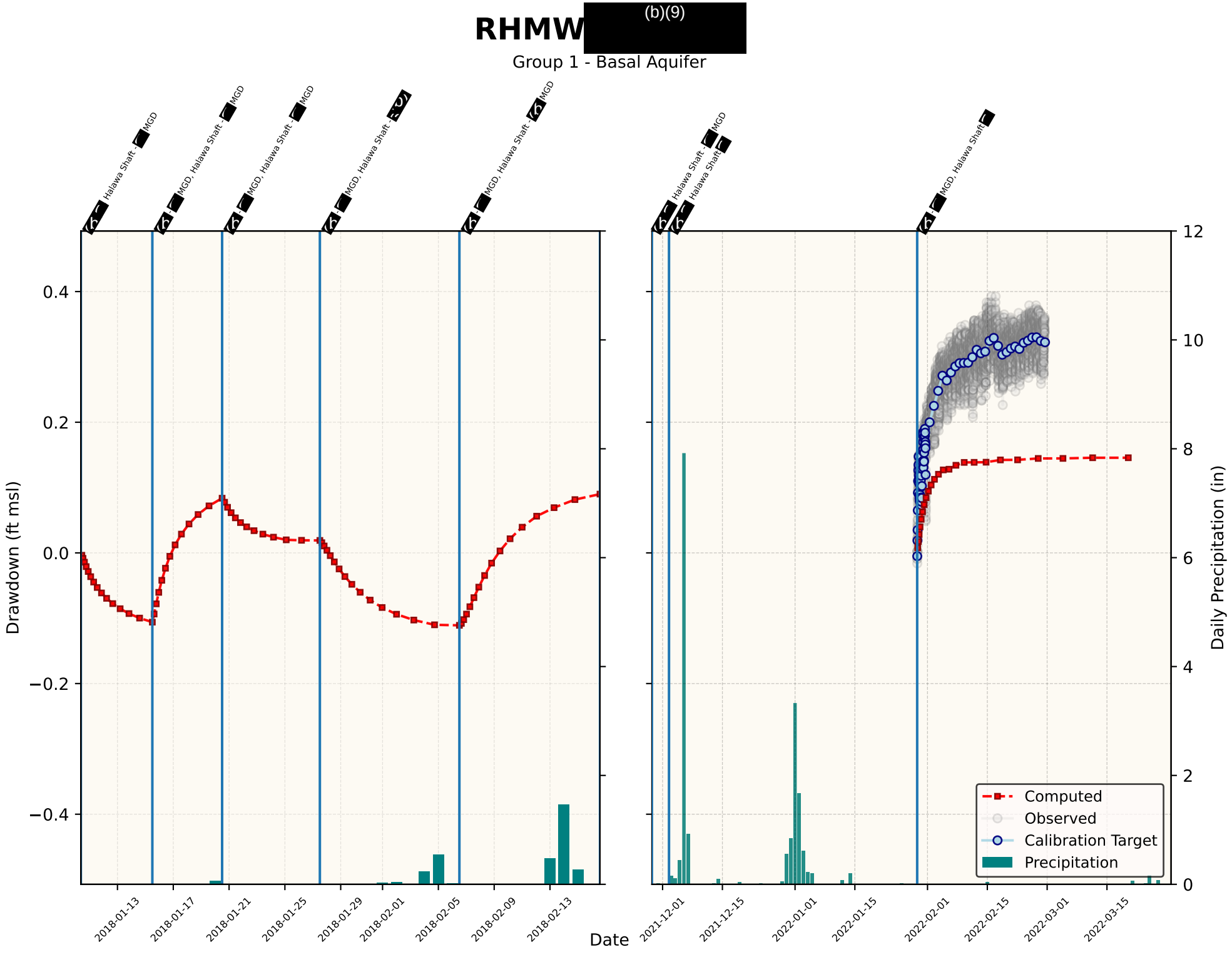
Group 1 - Basal Aquifer



RHMW[redacted] (b)(9)

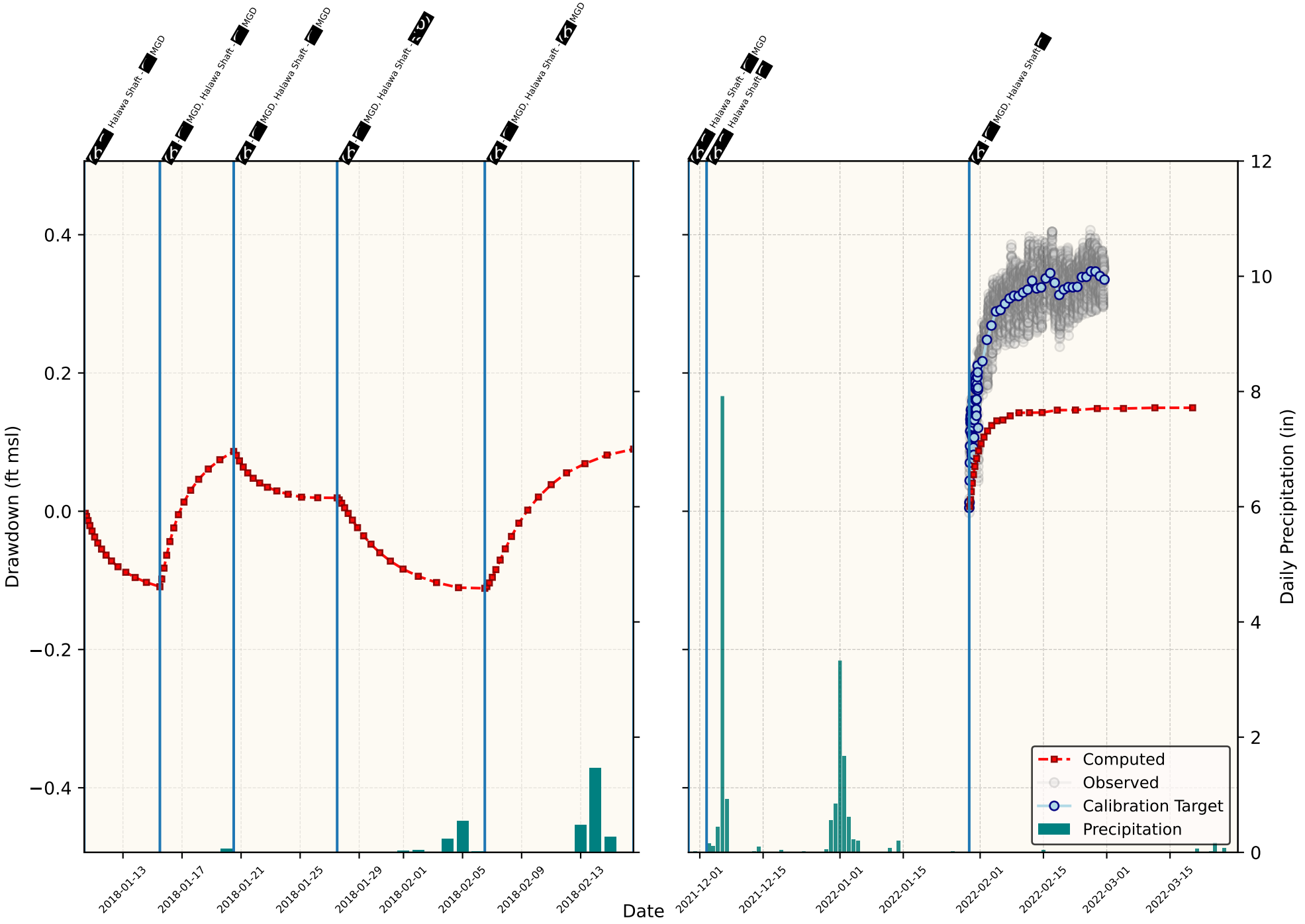
Group 1 - Basal Aquifer

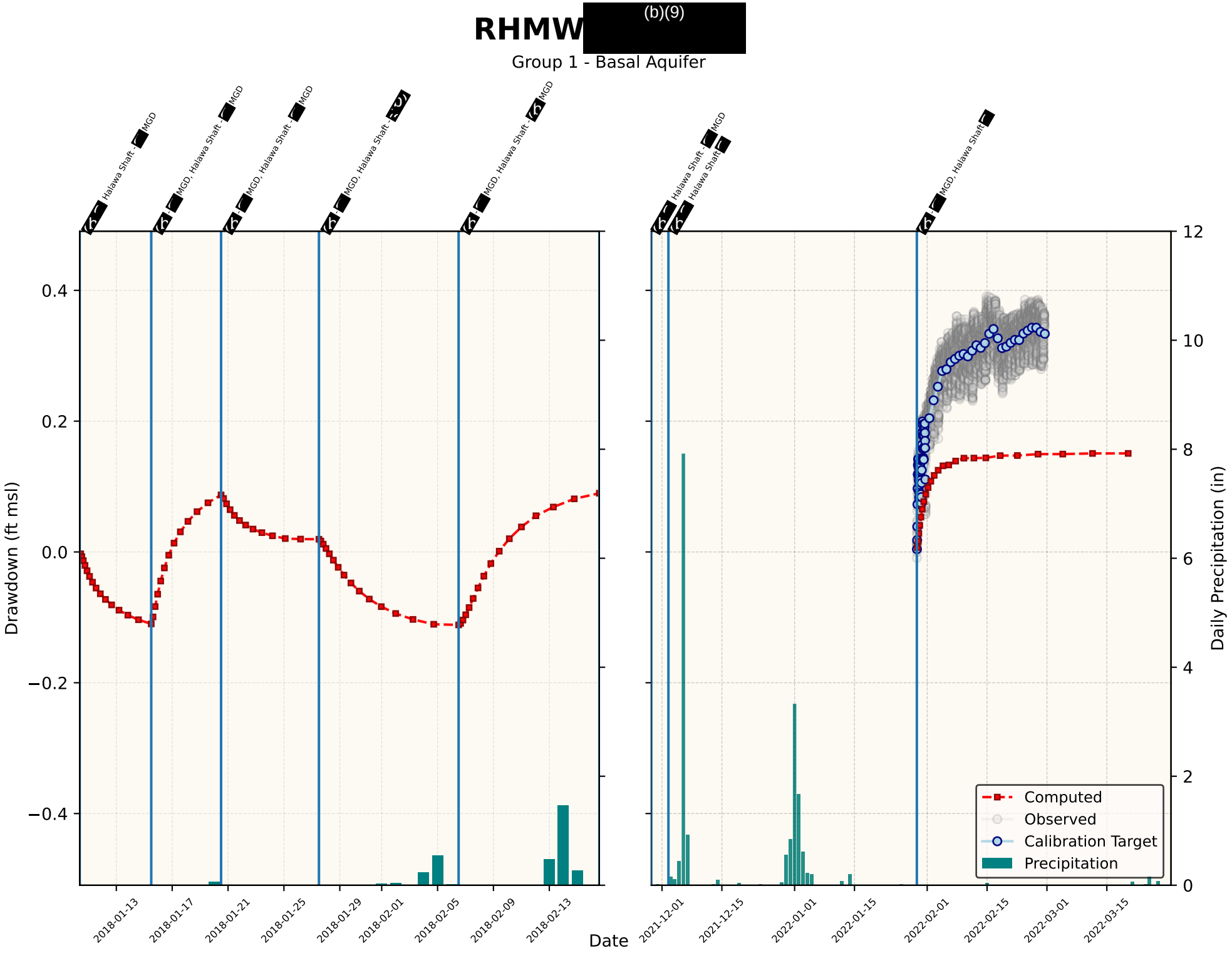


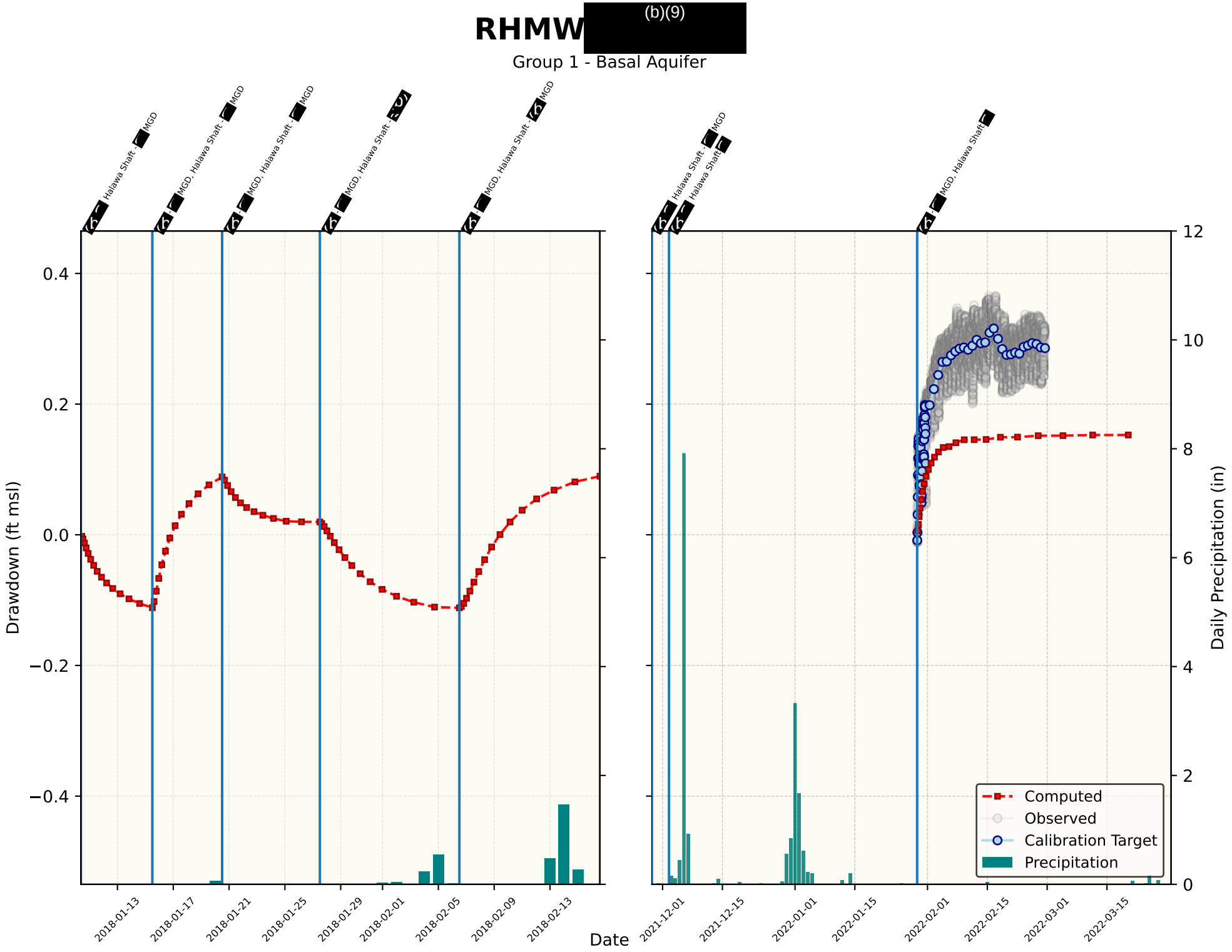

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

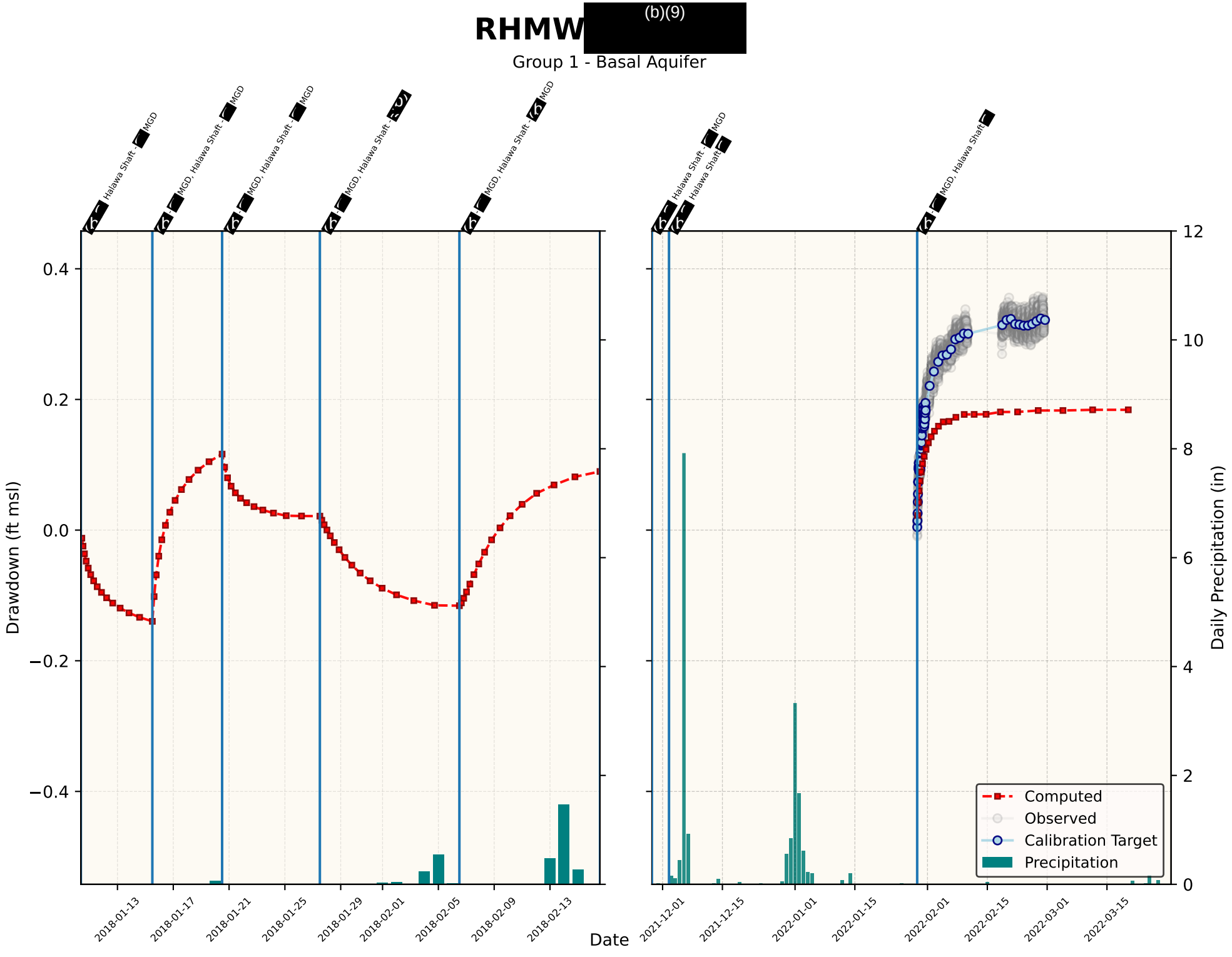
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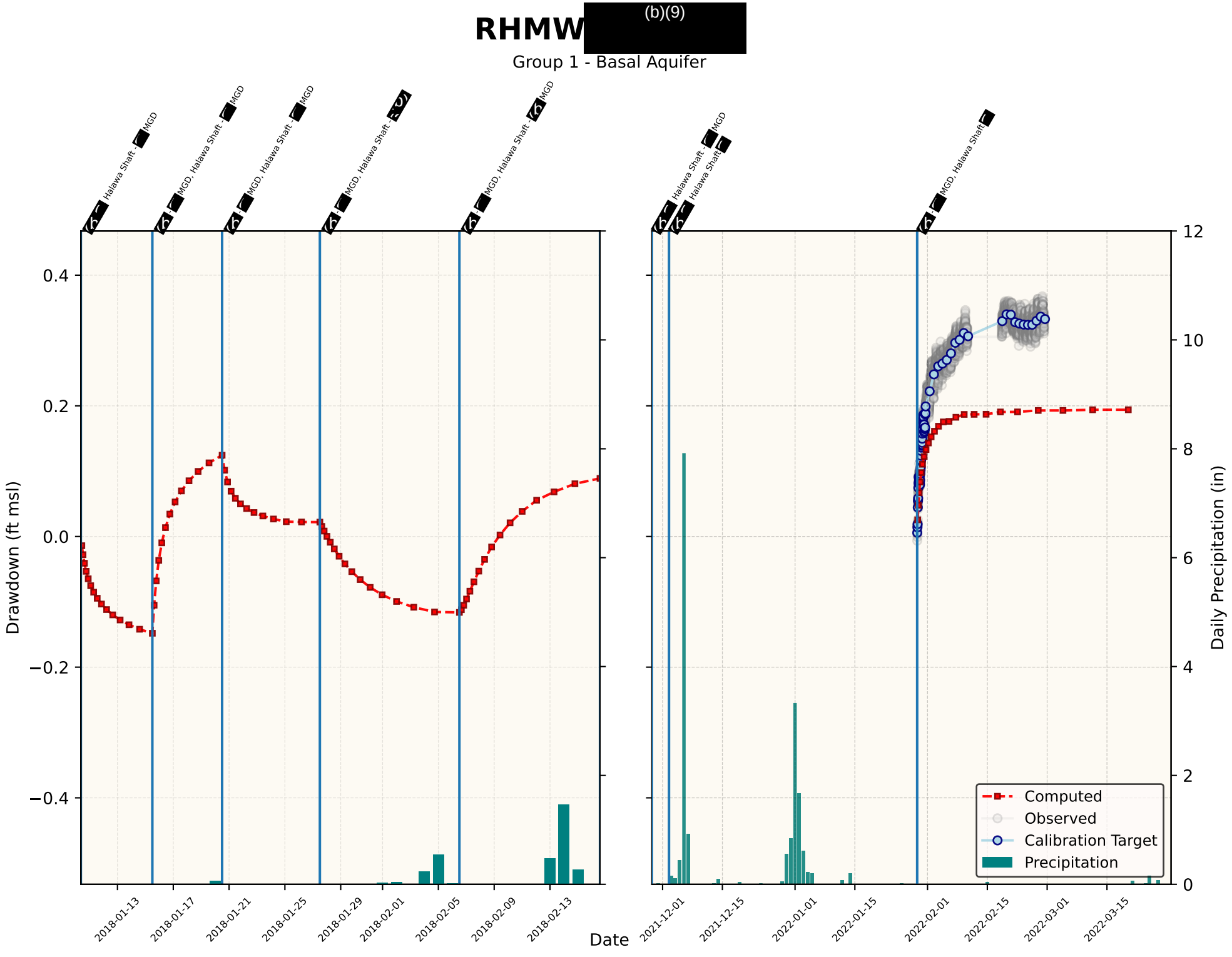
Group 1 - Basal Aquifer

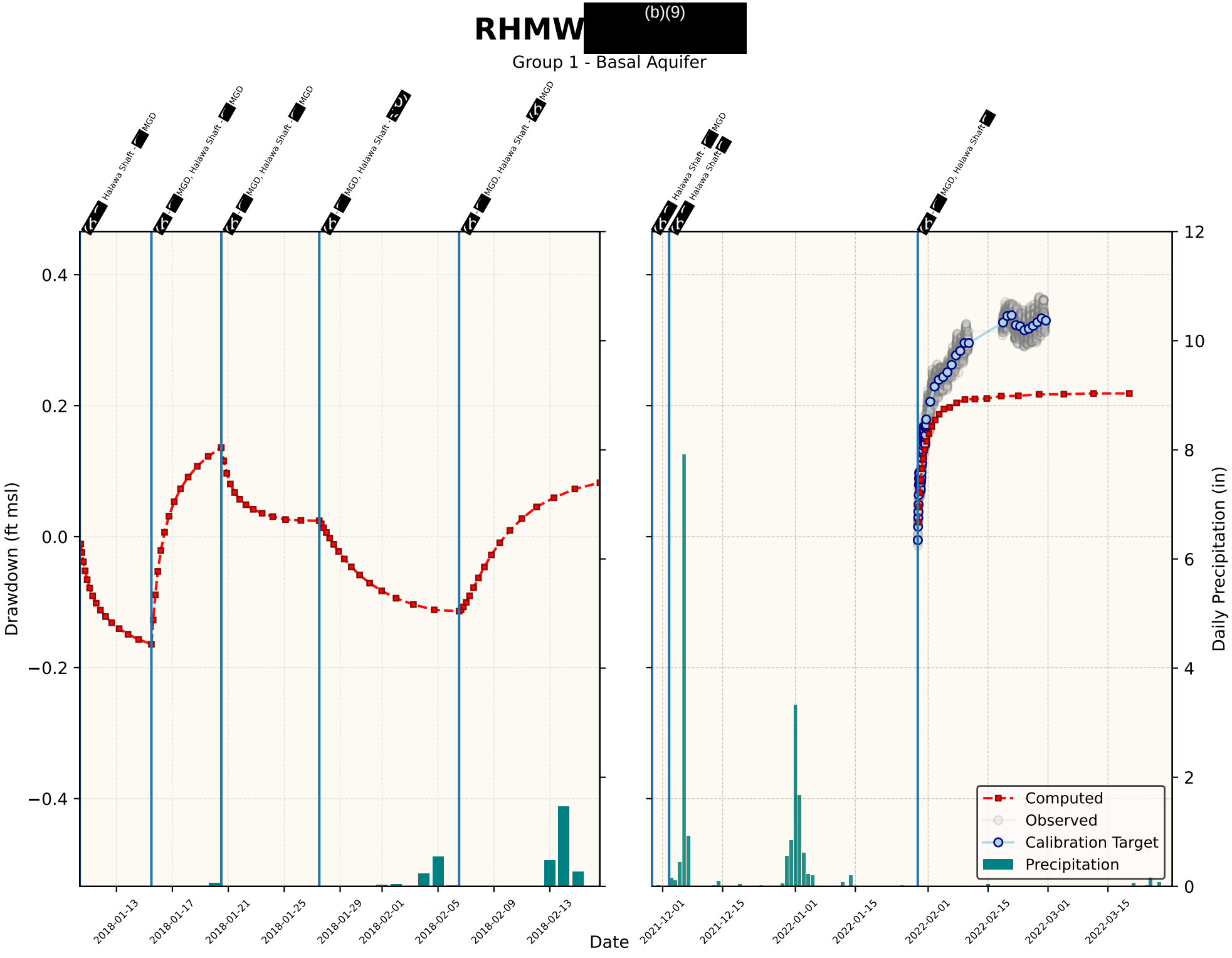



RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date


RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

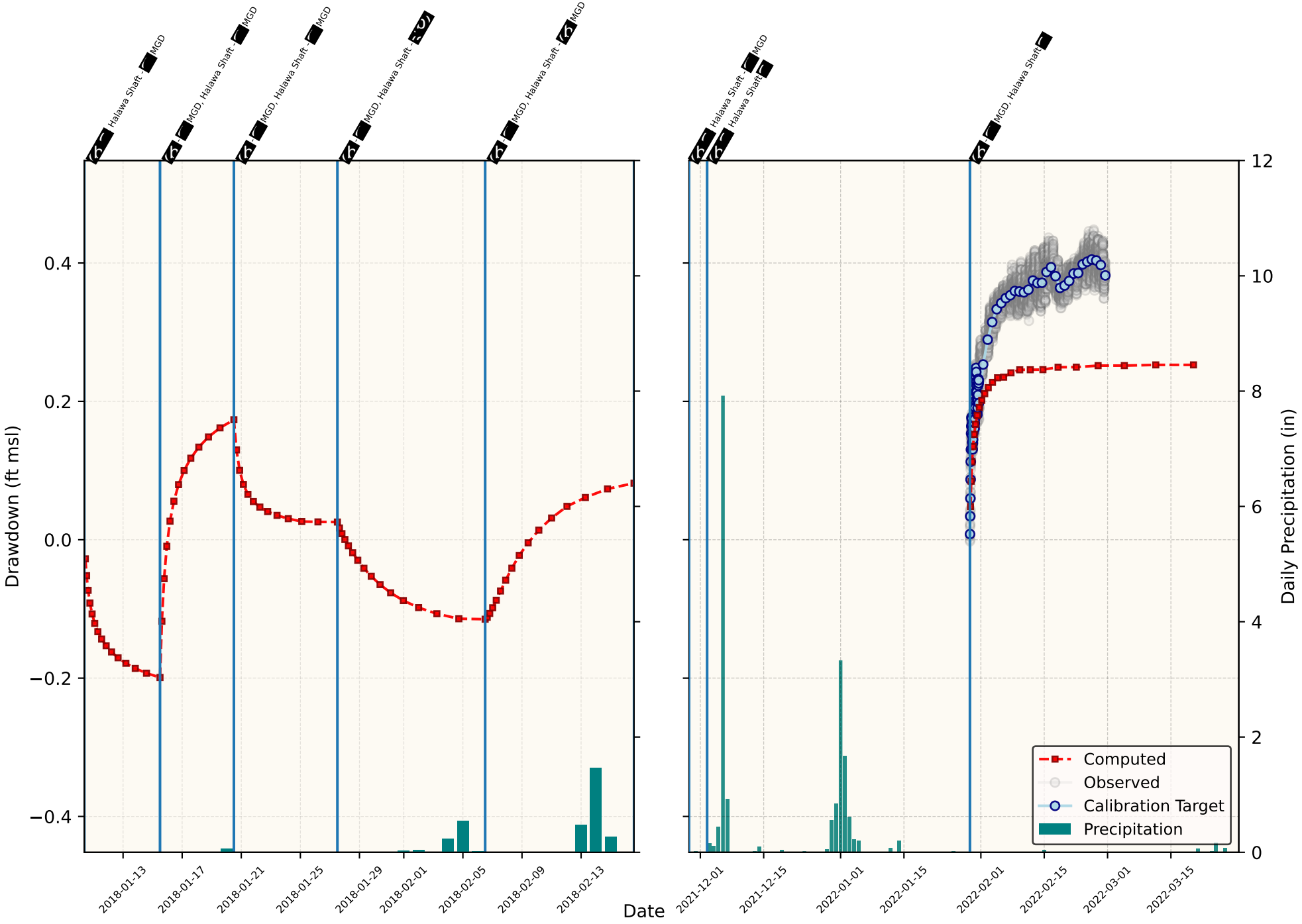

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

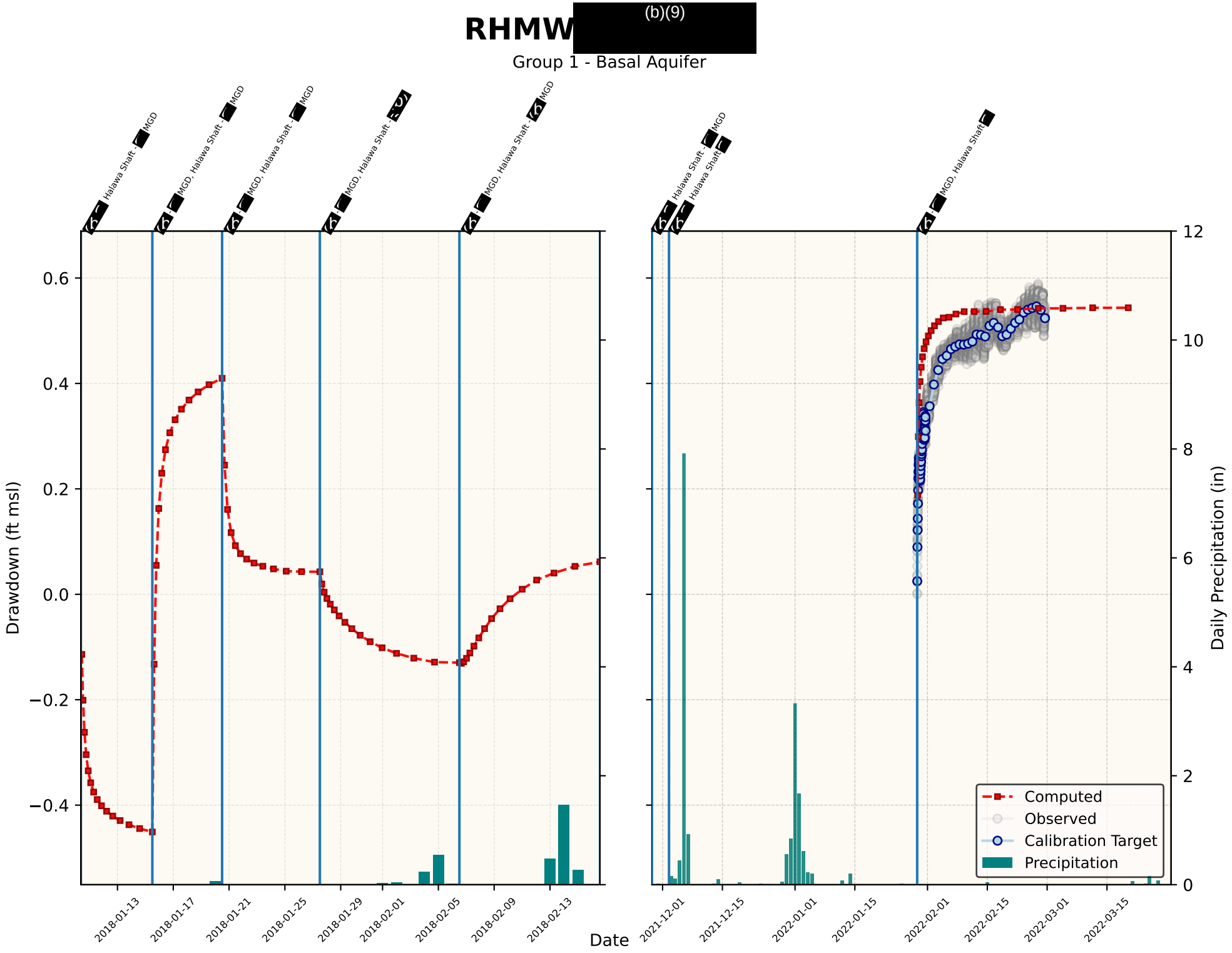

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation

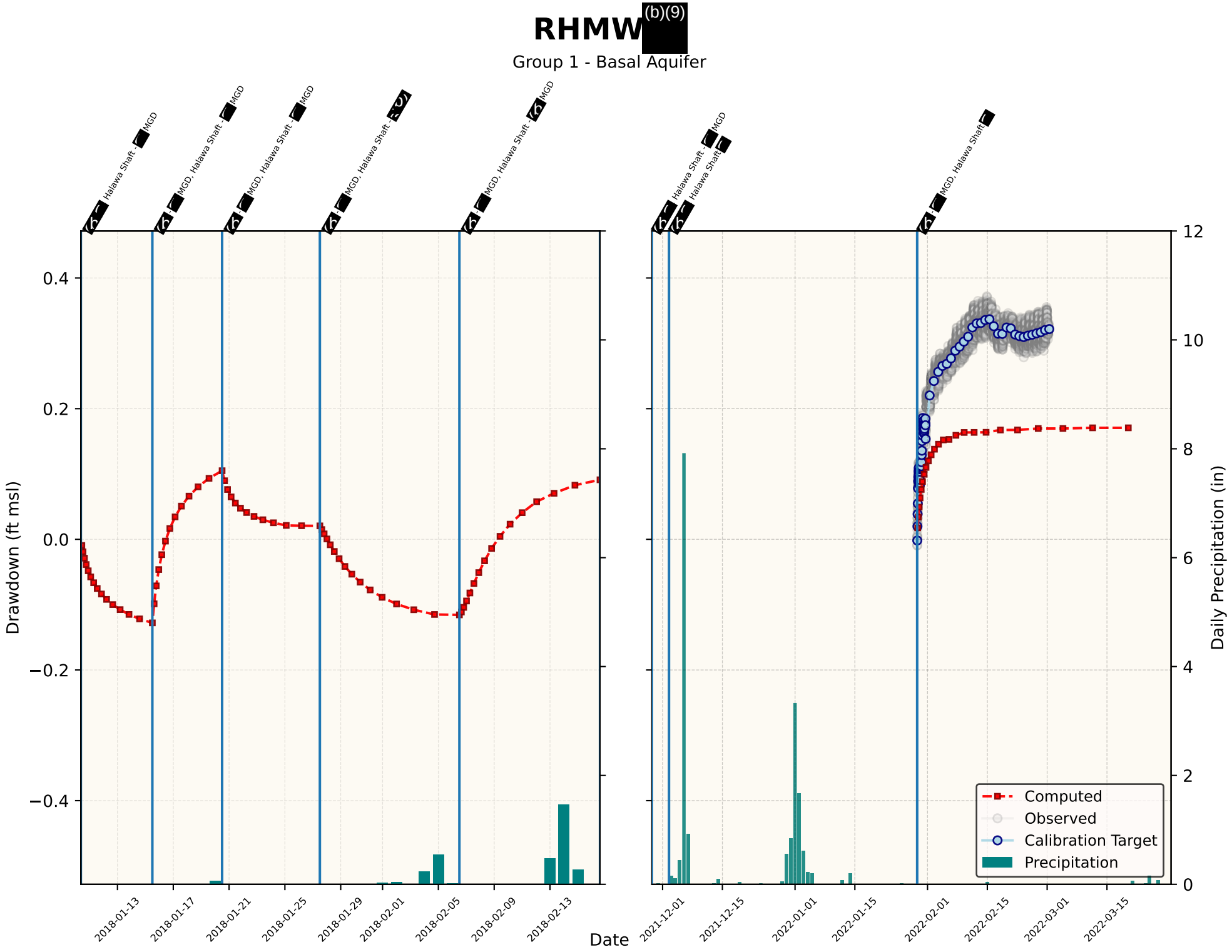

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

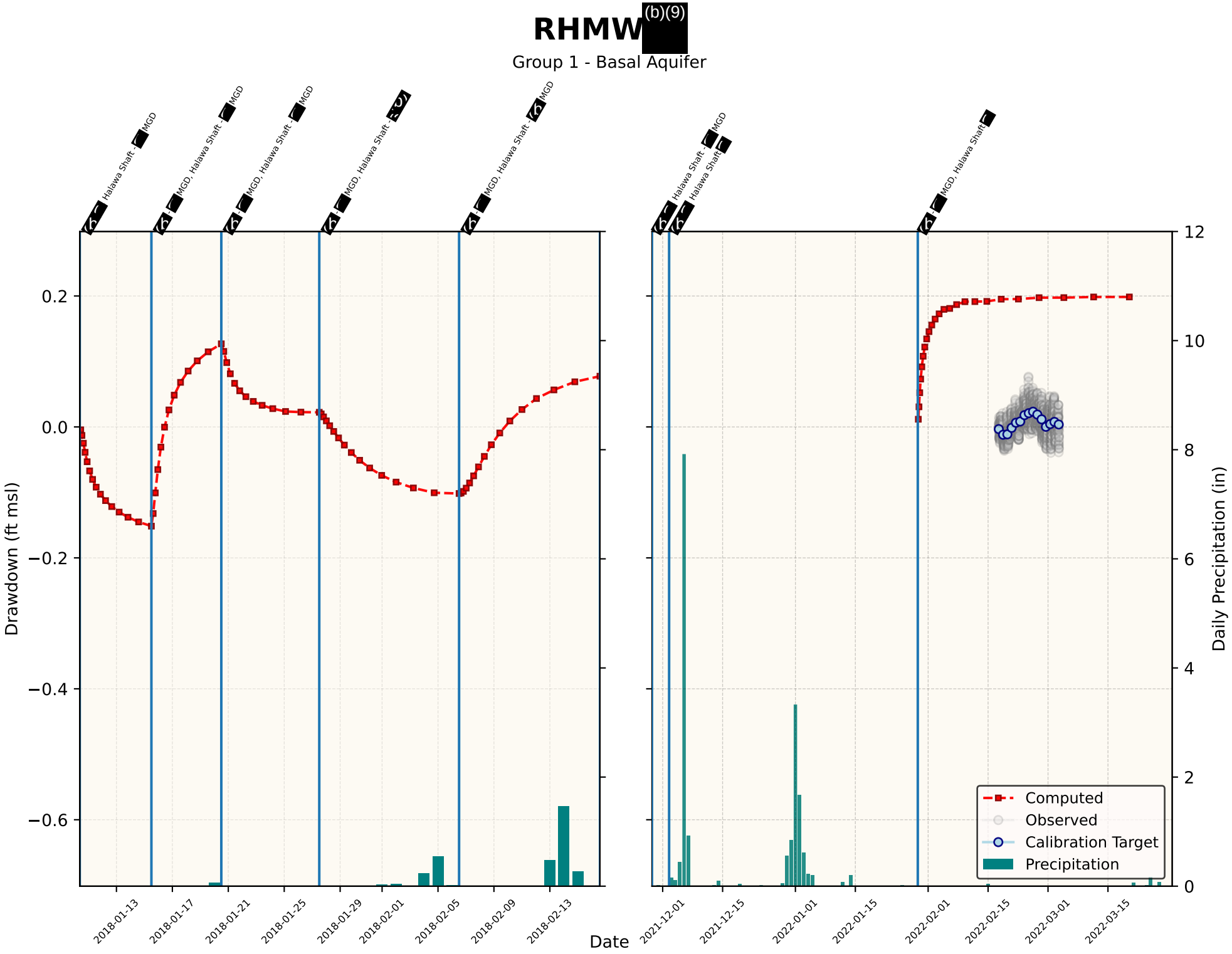
RHMW [redacted] (b)(9)

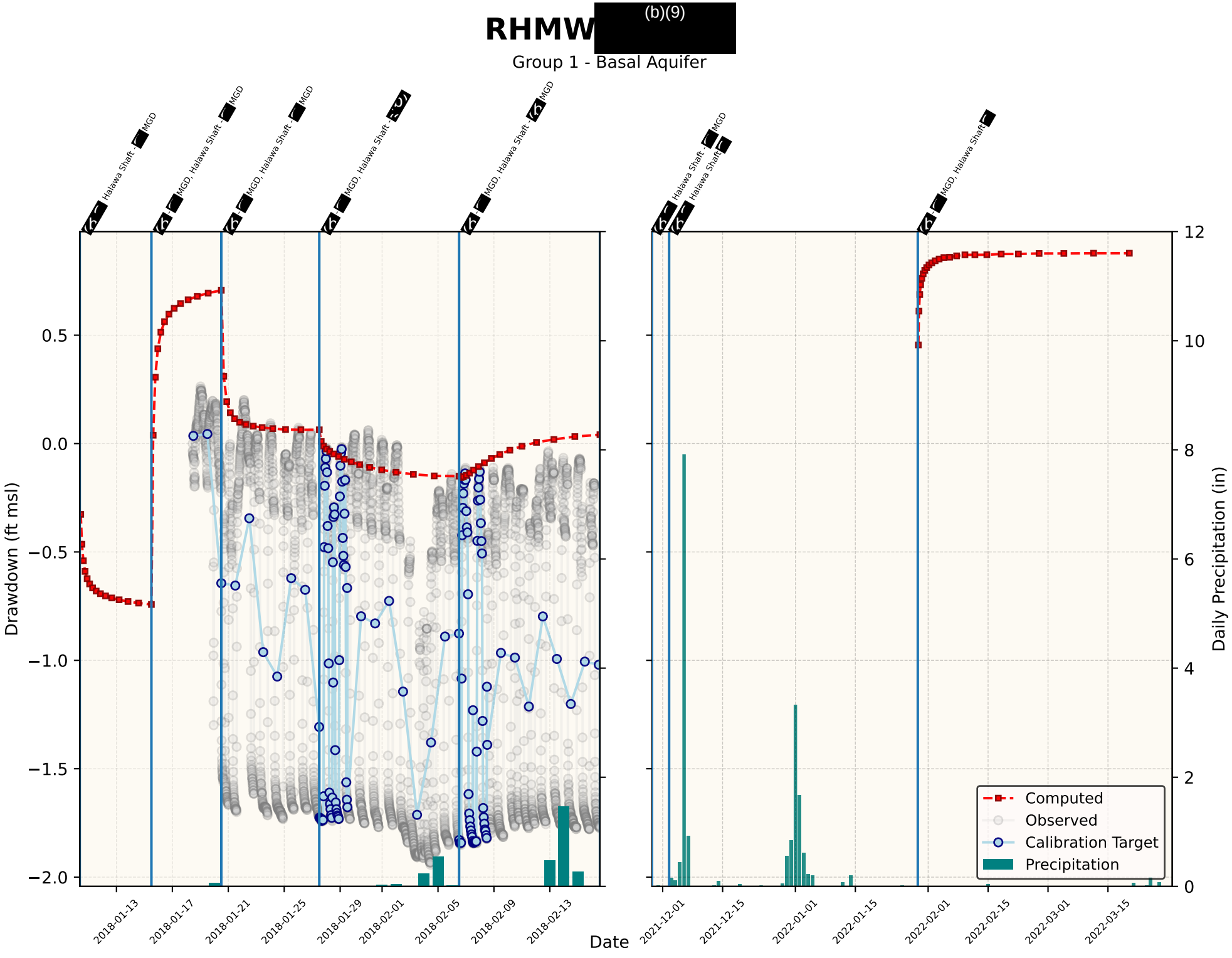
Group 1 - Basal Aquifer




RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

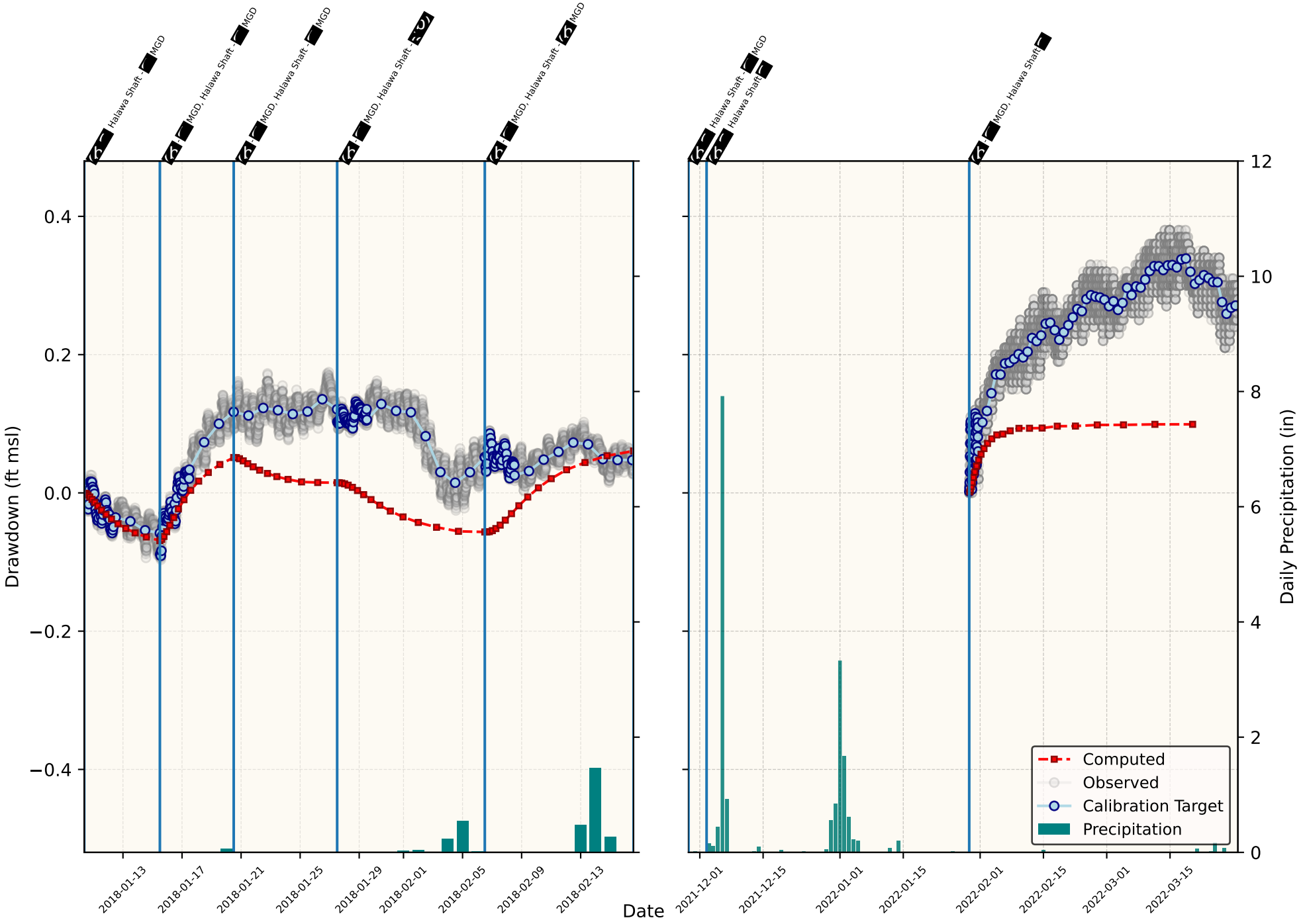

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

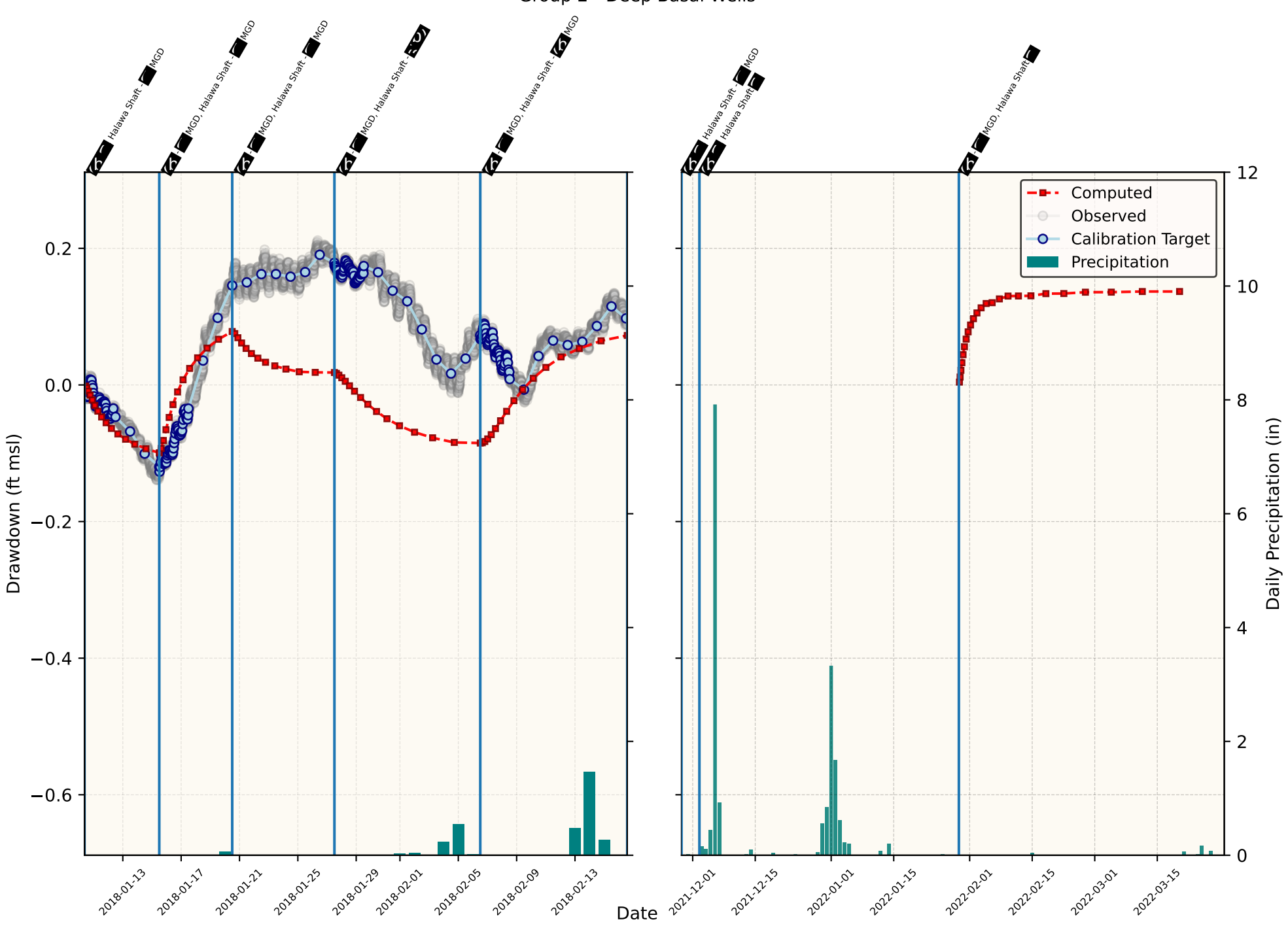

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation

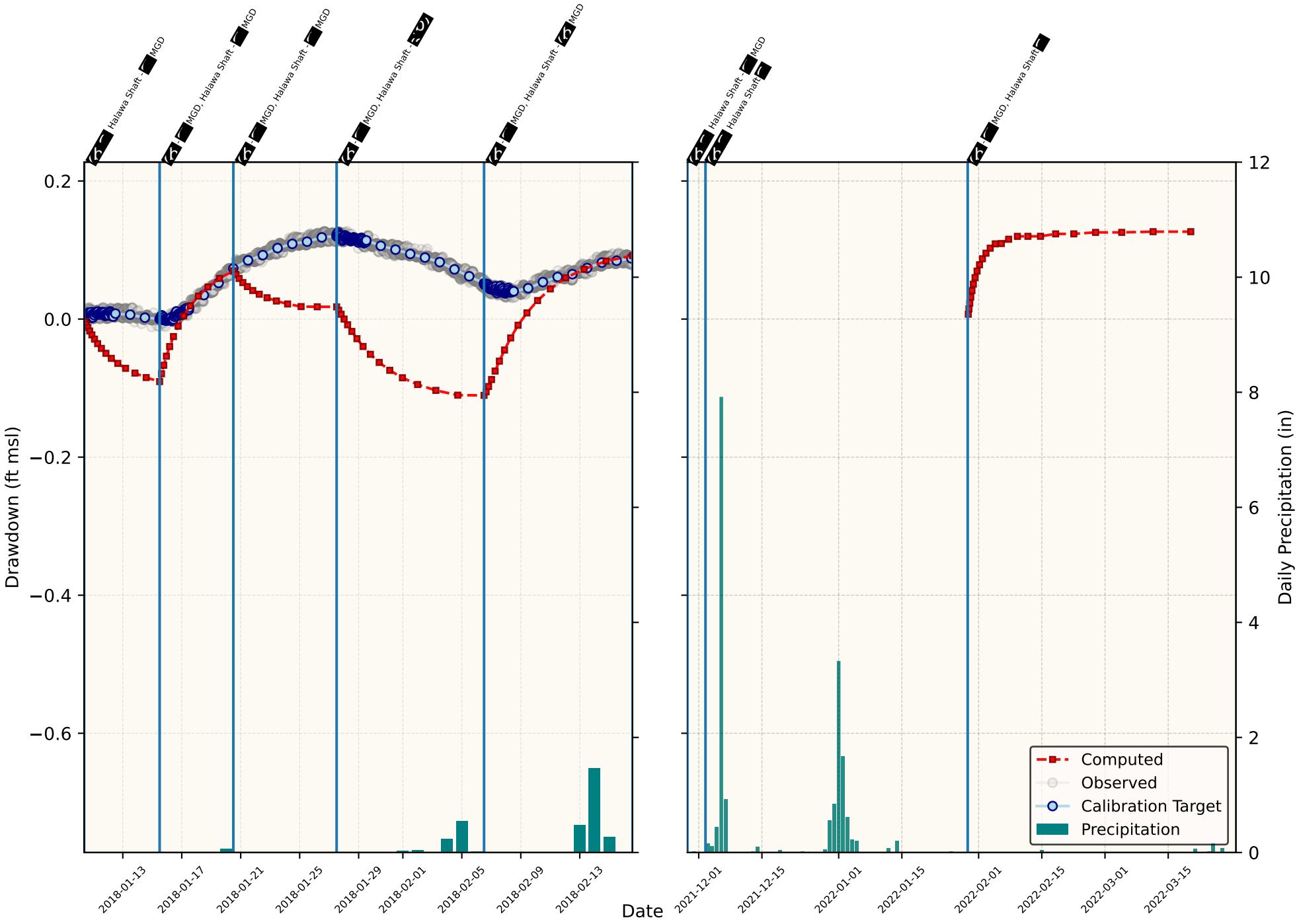

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.5
0.0
−0.5
−1.0
−1.5
−2.0
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

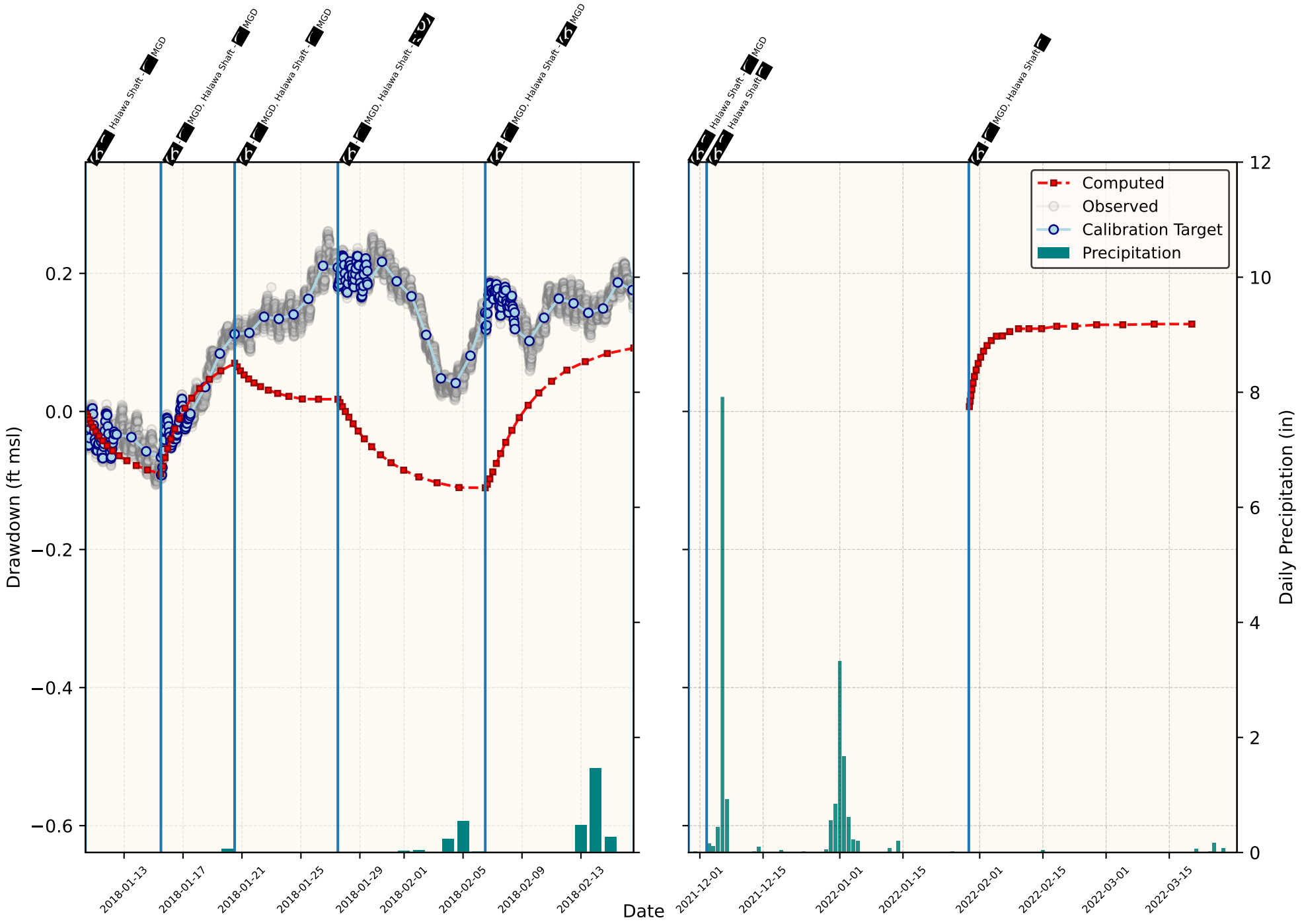
TAMC_[redacted] (b)(9)

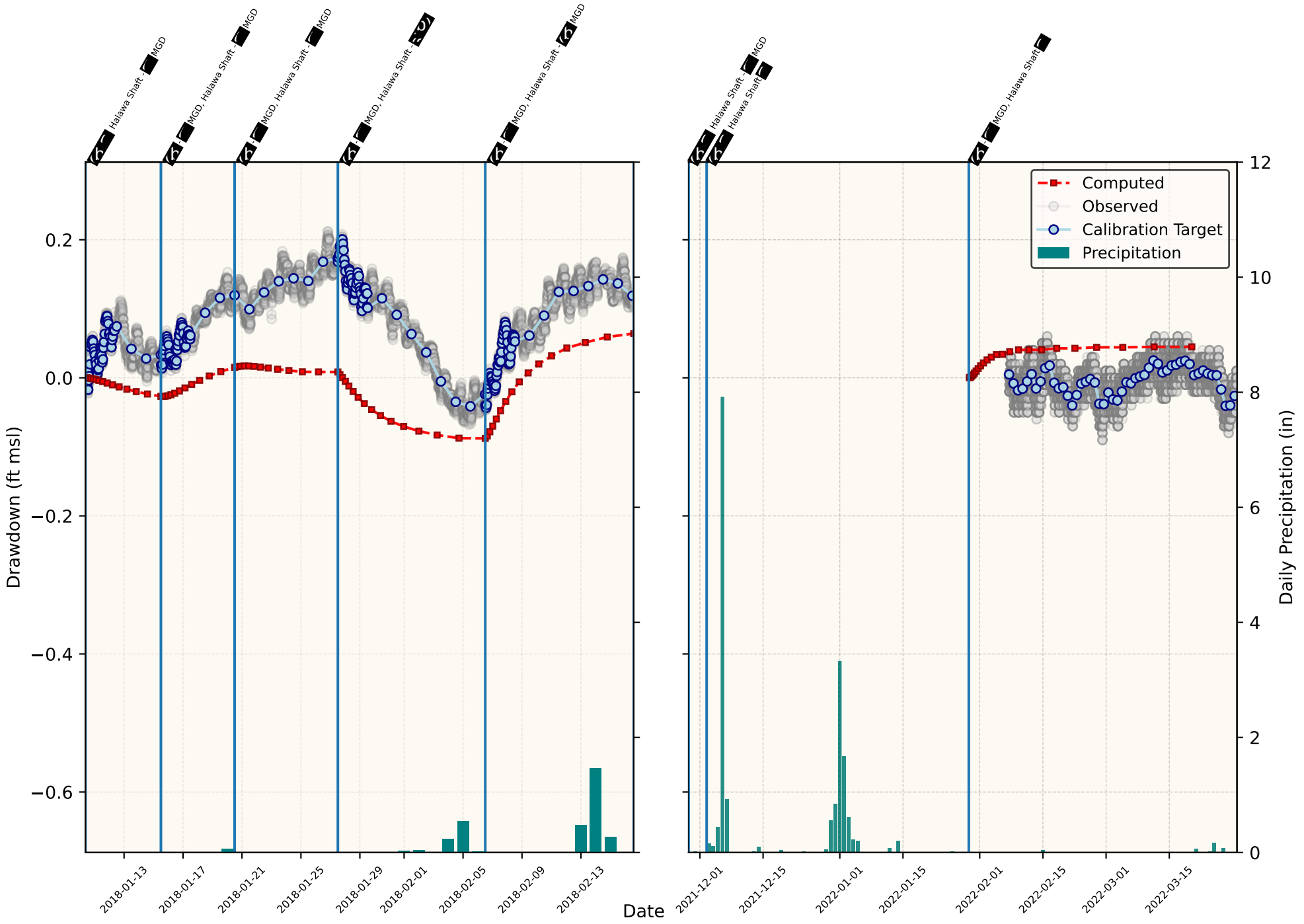
Group 1 - Basal Aquifer




DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

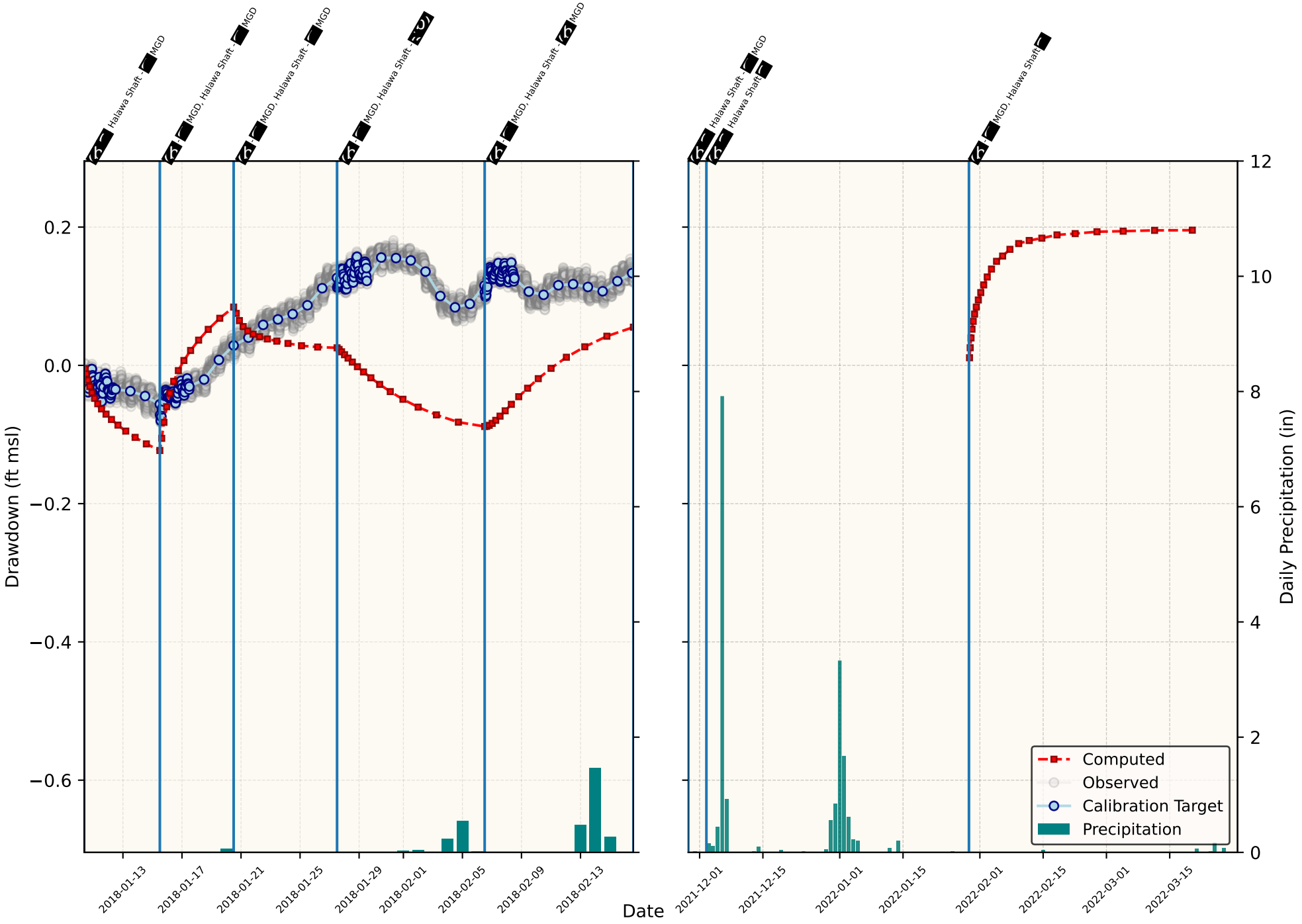

HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Halawa_Deep_Monitor_Well_HDMW2253-03
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-15

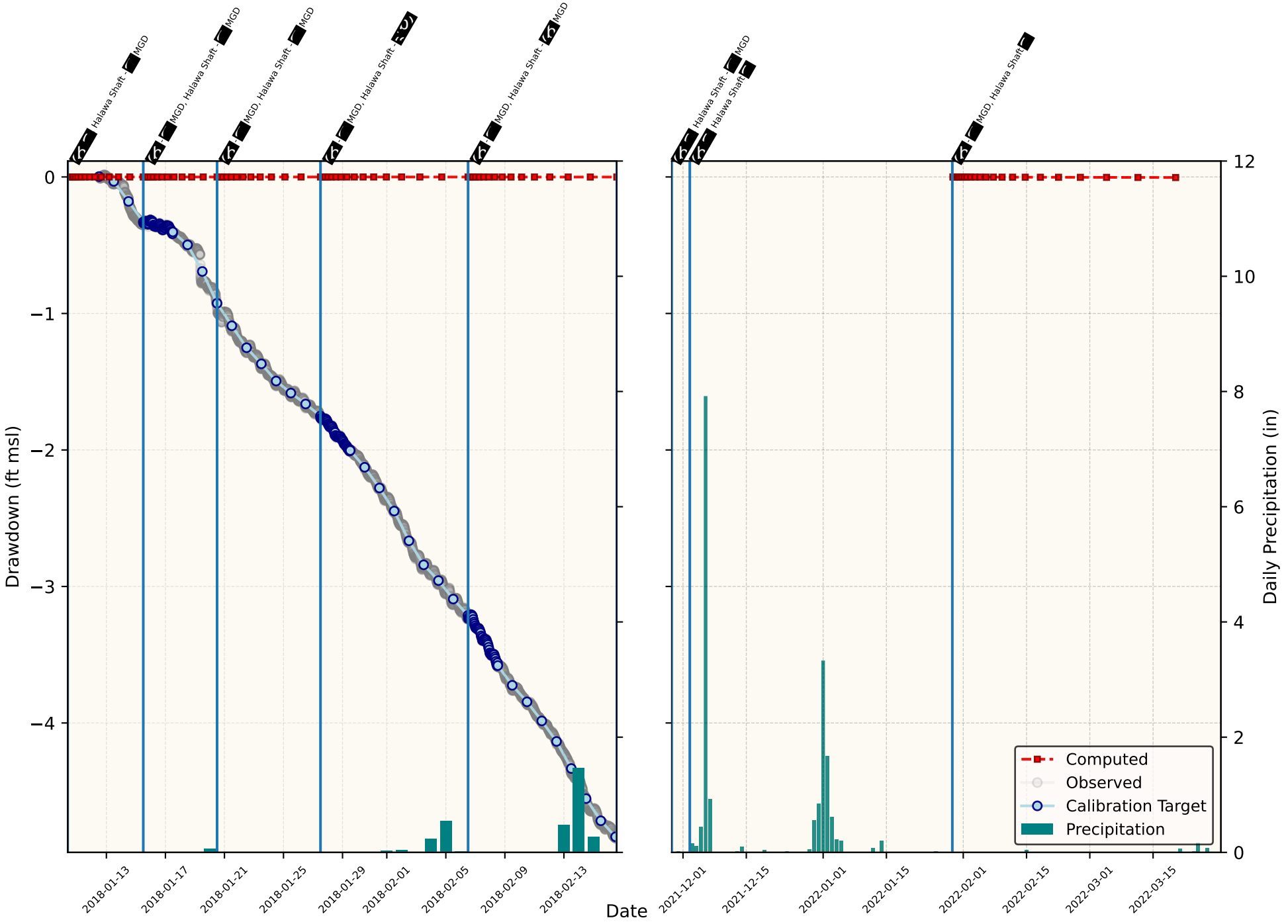
RHMW[redacted]

Group 3 - Saprolite/Confining Unit Well with Elevated Head



RHMW (b)(9) [redacted]

Group 3 - Saprolite/Confining Unit Well with Elevated Head



Groundwater Flow Model Calibration Evaluation Documents Sensitivity Scenario 7

Head Calibration Statistics

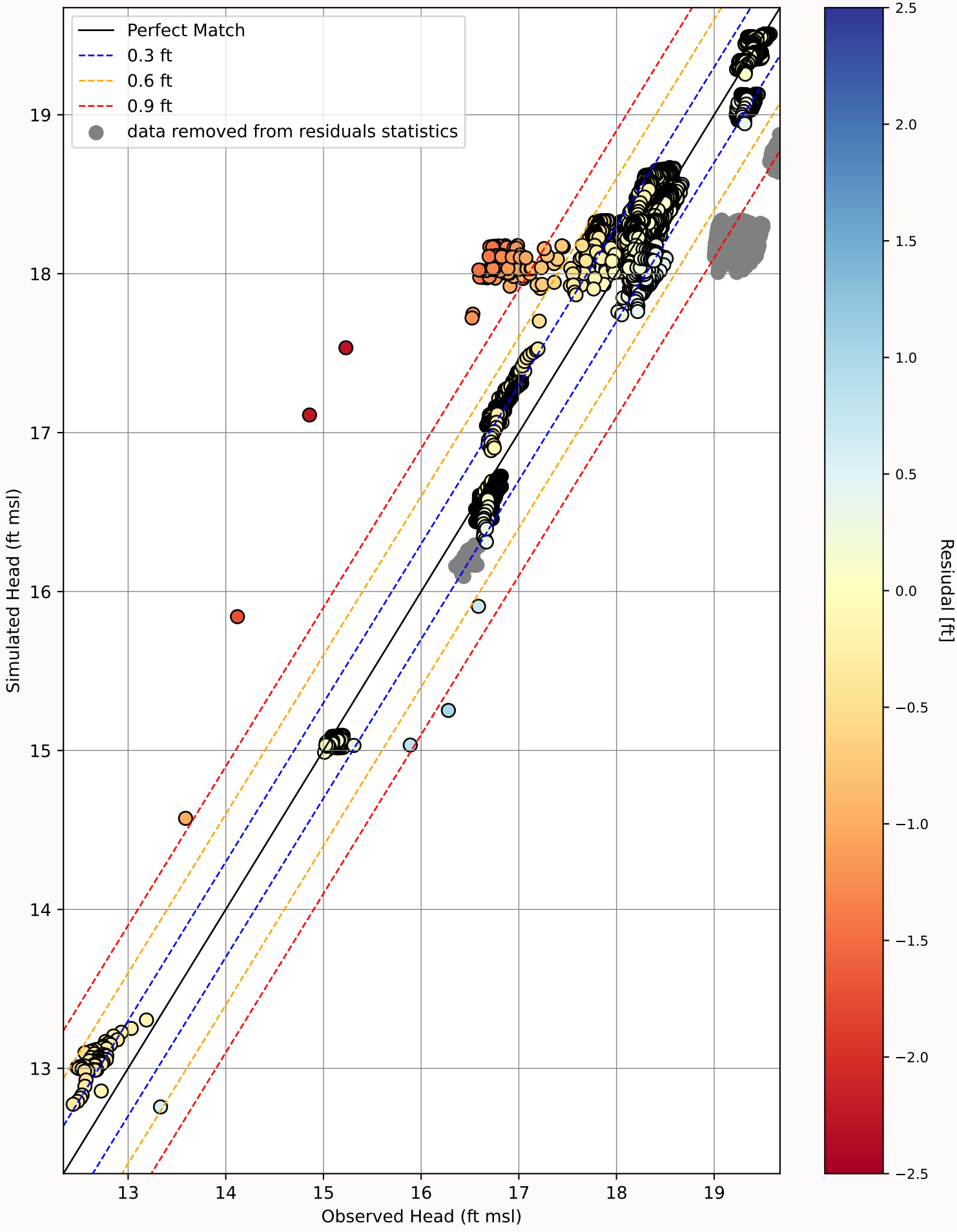
Wells	Basal Aquifer (Group 1)			Deep Wells (Group 2)	Confining Unit (Group 3)	Caprock (Group 4)	Cumulative
Time Period	**2017/2018**	**2021/2022**	**All**	**All**	**All**	**All**	**All**
Residual Mean (ft)	-0.04	0.00	-0.03	0.77	15.43	0.25	0.80
Absolute Residual Mean (ft)	0.16	0.22	0.20	0.78	17.19	1.46	1.09
Residual Standard Deviation (ft)	0.23	0.28	0.28	0.35	18.63	2.03	5.29
Sum of Squared Residuals (ft2)	297.81	297.94	767.02	771.17	333176.07	554.80	335269.05
RMSE Error (ft)	0.23	0.28	0.28	0.85	24.18	2.04	5.35
Minimum Residual (ft)	-2.30	-0.77	-2.30	-0.51	-15.73	-4.30	-15.73
Maximum Residual (ft)	1.03	0.72	2.40	1.48	49.43	6.60	49.43
Number of Observations	5459	3915	9928	1075	570	133	11706
Range in Observations	7.14	3.26	7.19	4.26	97.94	6.85	116.87
Scaled Residual Standard Deviation (ft)	3.2%	8.5%	3.8%	8.2%	19.0%	29.7%	(b)%
Scaled Absolute Residual Mean (ft)	2.3%	6.7%	2.8%	18.2%	17.6%	21.3%	0.9%
Scaled RMSE Error (ft)	3.3%	8.4%	3.9%	19.9%	24.7%	29.8%	4.6%
Scaled Residual Mean (ft)	-0.5%	0.1%	-0.4%	18.1%	15.8%	(b)%	(b)%
Correlation Coefficient	0.98	0.93	0.96	0.99	0.93	-0.16	0.96

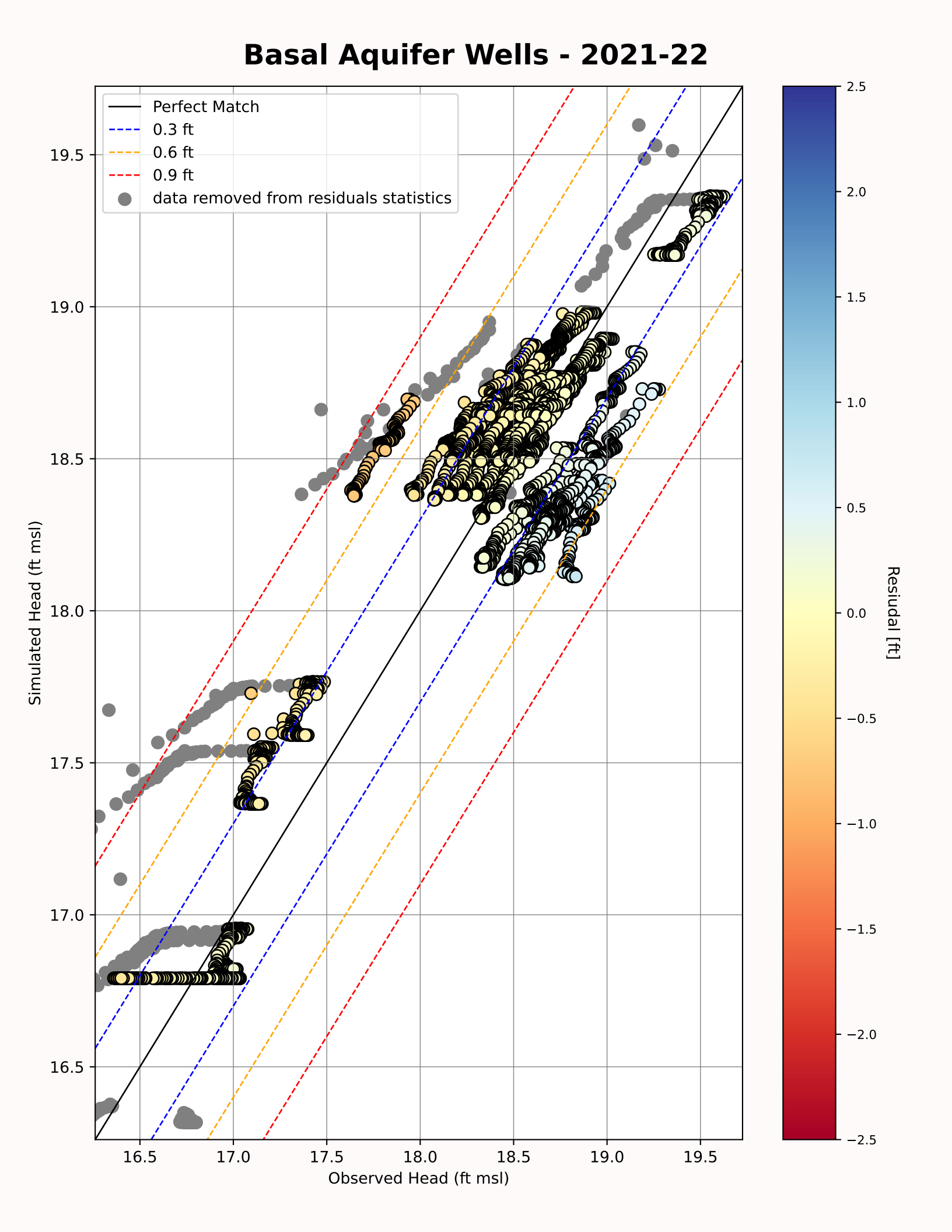
Drawdown Calibration Statistics

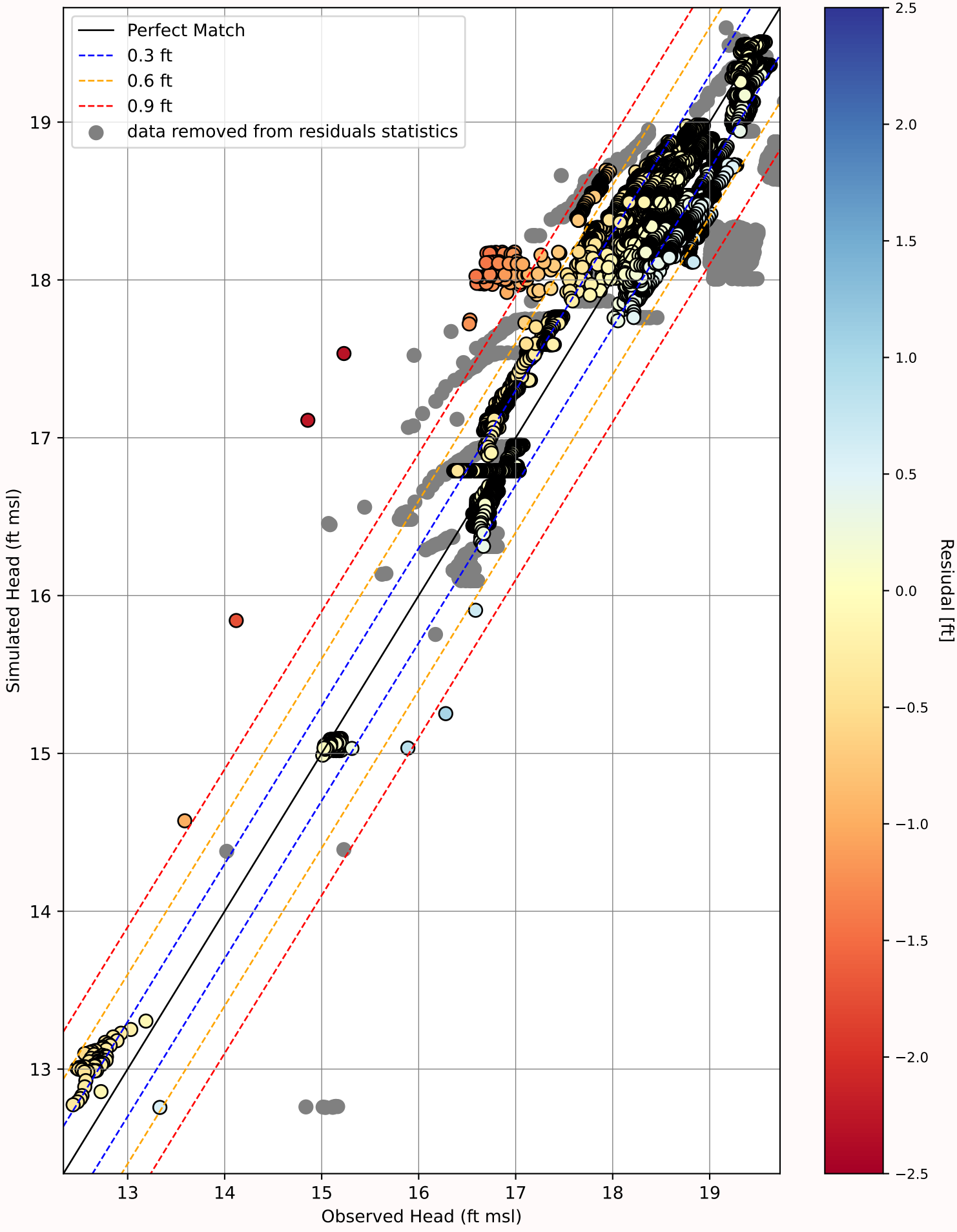
Wells	Basal Aquifer (Group 1)		
Time Period	**2017/2018**	**2021/2022**	**All**
Residual Mean (ft)	0.00	0.03	0.01
Absolute Residual Mean (ft)	0.09	0.06	0.08
Residual Standard Deviation (ft)	0.21	0.09	0.18
Sum of Squared Residuals (ft2)	247.38	33.00	280.37
RMSE Error (ft)	0.21	0.10	0.18
Minimum Residual (ft)	-1.77	-0.29	-1.77
Maximum Residual (ft)	2.44	0.48	2.44
Number of Observations	5393	3533	8926
Range in Observations	4.76	0.68	4.76
Scaled Residual Standard Deviation (ft)	(b) %	13.5%	(b) %
Scaled Absolute Residual Mean (ft)	2.0%	8.7%	1.7%
Scaled RMSE Error (ft)	(b) %	14.3%	(b) %
Scaled Residual Mean (ft)	0.0%	4.9%	0.3%
Correlation Coefficient	0.83	0.73	0.84

Conceptual Water Budget Comparison

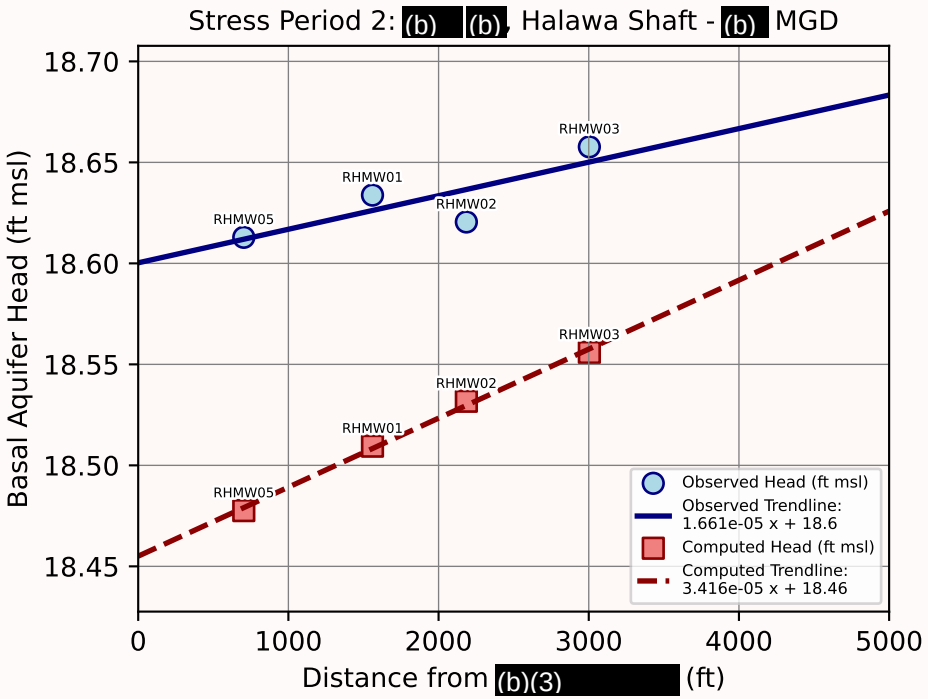
Type	Stress Period	Recharge (MGD)	Dike Region Inflow (MGD)	Well Discharge (MGD)	Spring Discharge (MGD)	Caprock Discharge (MGD)	Inflow from Adjacent Watershed (MGD)	Outflow to Adjacent Watershed (MGD)	Storage (MGD)	Total Inflows (MGD)	Total Outflows (MGD)
Conceptual	1	32.5	28.7	32.0	13.6	2.4	2.8	16.0	0.0	64.0	64.0
Simulated	1	32.5	28.7	32.3	13.2	3.9	10.5	22.3	0.0	71.7	71.7
Difference	1	0.0	0.0	0.3	-0.4	1.5	(b	(b	0.0	(b	(b
Conceptual	2	32.5	28.7	28.4	13.6	2.4	2.8	19.6	0.0	64.0	64.0
Simulated	2	32.5	28.7	28.4	13.4	3.9	9.6	22.7	-1.6	70.8	70.0
Difference	2	0.0	0.0	0.0	-0.2	1.5	6.8	3.1	-1.6	6.8	6.0
Conceptual	3	32.5	28.7	36.1	13.5	2.4	2.8	12.0	0.0	64.0	64.0
Simulated	3	32.5	28.7	36.1	13.2	3.9	10.8	22.4	2.5	74.5	75.6
Difference	3	0.0	0.0	0.0	-0.3	1.5	8.0	10.4	2.5	10.5	11.6
Conceptual	4	32.5	28.7	32.4	13.5	2.4	2.8	15.6	0.0	64.0	64.0
Simulated	4	32.5	28.7	32.5	13.1	3.9	10.9	22.0	-0.3	72.0	71.8
Difference	4	0.0	0.0	0.0	-0.5	1.5	8.0	6.4	-0.3	(b	7.8
Conceptual	5	32.5	28.7	25.7	13.7	2.4	4.7	24.1	0.0	65.9	65.9
Simulated	5	32.5	28.7	25.7	14.2	3.9	9.8	25.0	-1.1	71.0	70.0
Difference	5	0.0	0.0	0.0	0.5	1.5	5.1	0.9	-1.1	5.1	4.1
Conceptual	6	32.5	28.7	37.7	13.6	2.4	4.7	12.2	0.0	65.9	65.9
Simulated	6	32.5	28.7	37.8	12.6	3.9	11.6	21.1	2.6	75.4	75.4
Difference	6	0.0	0.0	0.0	-1.0	1.5	6.9	8.9	2.6	9.5	9.5
Conceptual	7	32.5	28.7	32.0	13.4	2.4	4.1	17.4	0.0	65.3	65.3
Simulated	7	32.5	28.7	32.0	12.9	3.9	9.5	21.9	0.0	70.7	70.7
Difference	7	0.0	0.0	0.0	-0.4	1.5	5.4	(b	0.0	5.4	5.4
Conceptual	8	32.5	28.7	30.1	12.6	2.4	2.8	18.8	0.0	63.9	63.9
Simulated	8	32.5	28.7	30.1	12.9	3.9	9.7	21.6	-1.6	70.9	70.2
Difference	8	0.0	0.0	0.0	0.4	1.5	7.0	2.8	-1.6	7.0	(b
Conceptual	9	32.5	28.7	21.8	13.7	2.4	0.5	23.8	0.0	61.7	61.7
Simulated	9	32.5	28.7	21.8	15.0	3.9	6.7	27.0	-0.1	67.8	67.8
Difference	9	0.0	0.0	0.0	1.4	1.5	6.1	3.2	-0.1	(b	(b
Conceptual	10	32.5	28.7	26.3	13.9	2.5	7.5	25.9	0.0	68.7	68.7
Simulated	10	32.5	28.7	26.3	14.4	3.9	8.6	25.5	0.0	69.8	70.1
Difference	10	0.0	0.0	0.0	0.4	1.4	1.1	-0.5	0.0	1.2	1.4

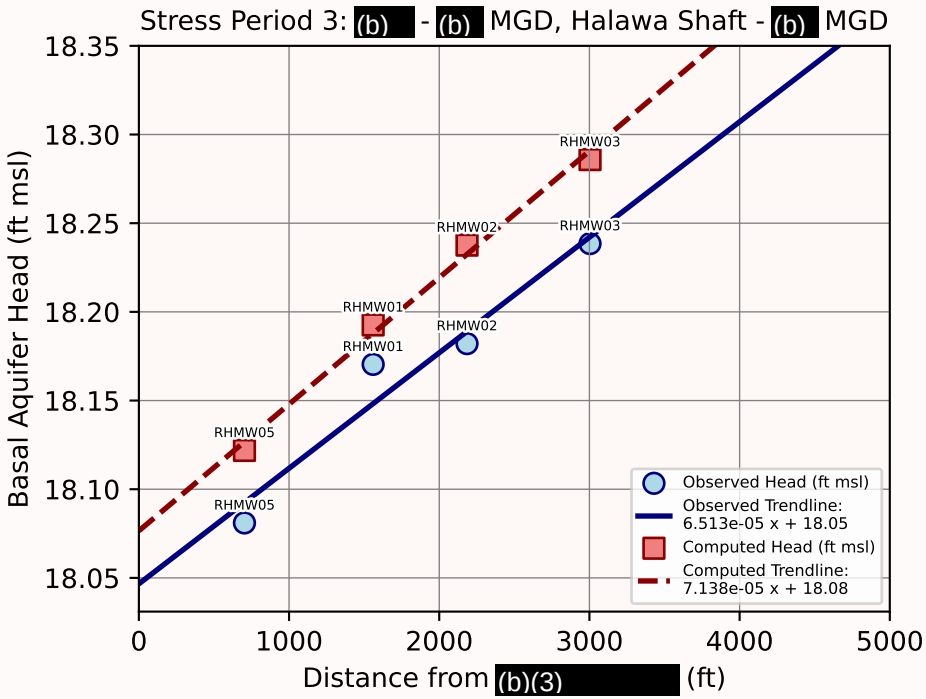

Basal Aquifer Wells - 2017-18
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

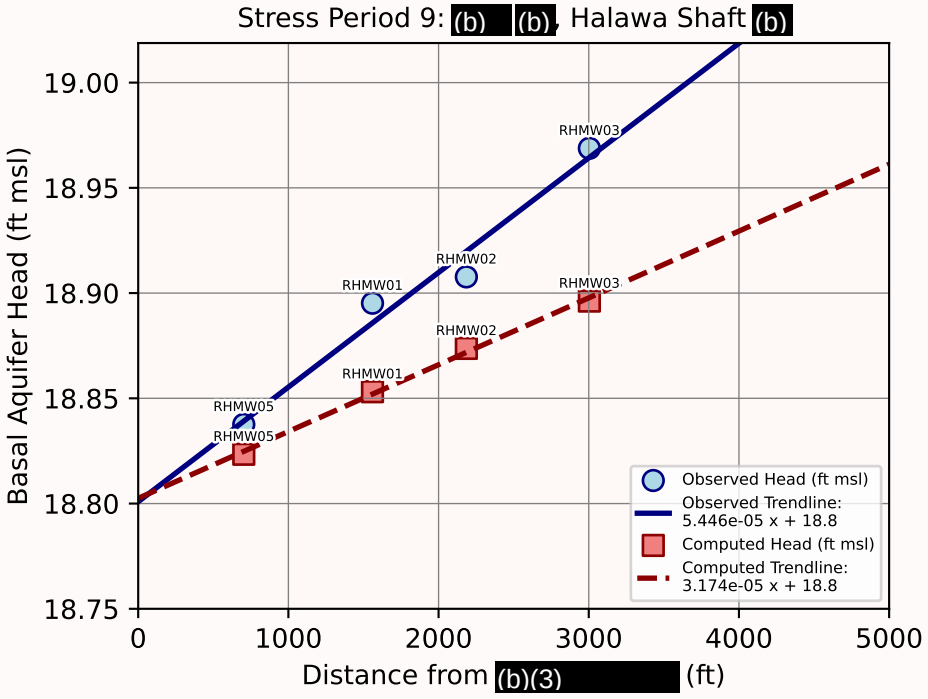

Basal Aquifer Wells - 2021-22
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
16.5
17.0
17.5
18.0
18.5
19.0
19.5
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

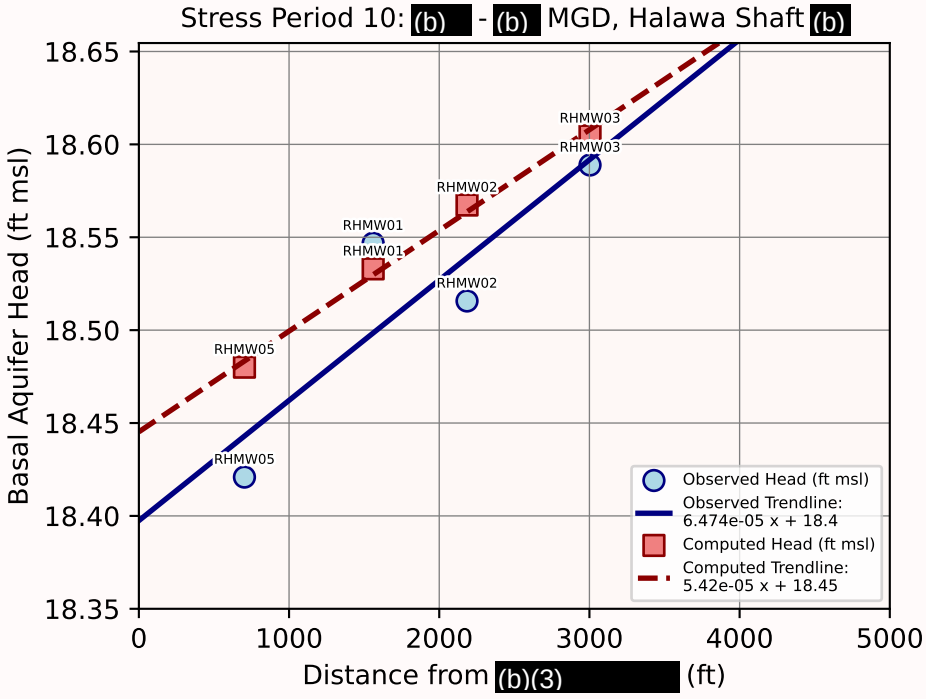

Basal Aquifer Wells - All
Perfect Match
0.3 ft
0.6 ft
0.9 ft
data removed from residuals statistics
Simulated Head (ft msl)
Observed Head (ft msl)
Residual [ft]
13
14
15
16
17
18
19
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5

Gradients Along Red Hill Ridge

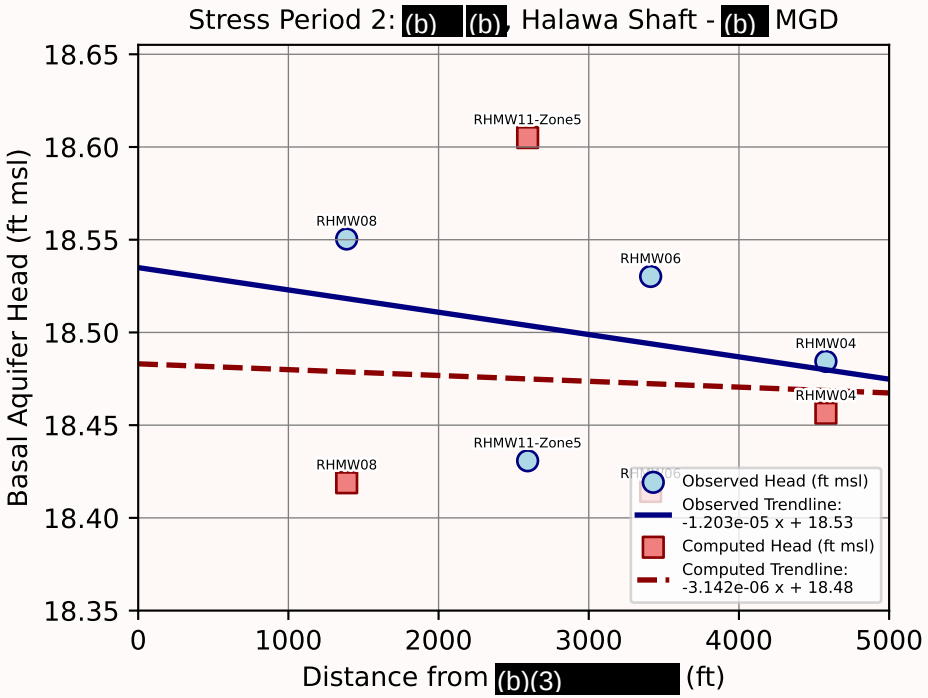


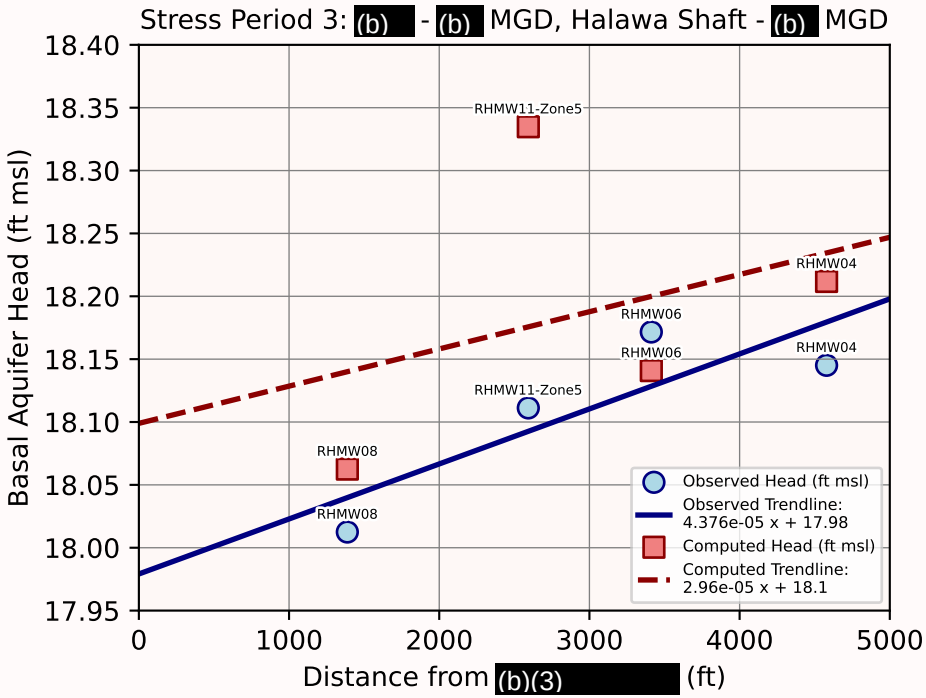


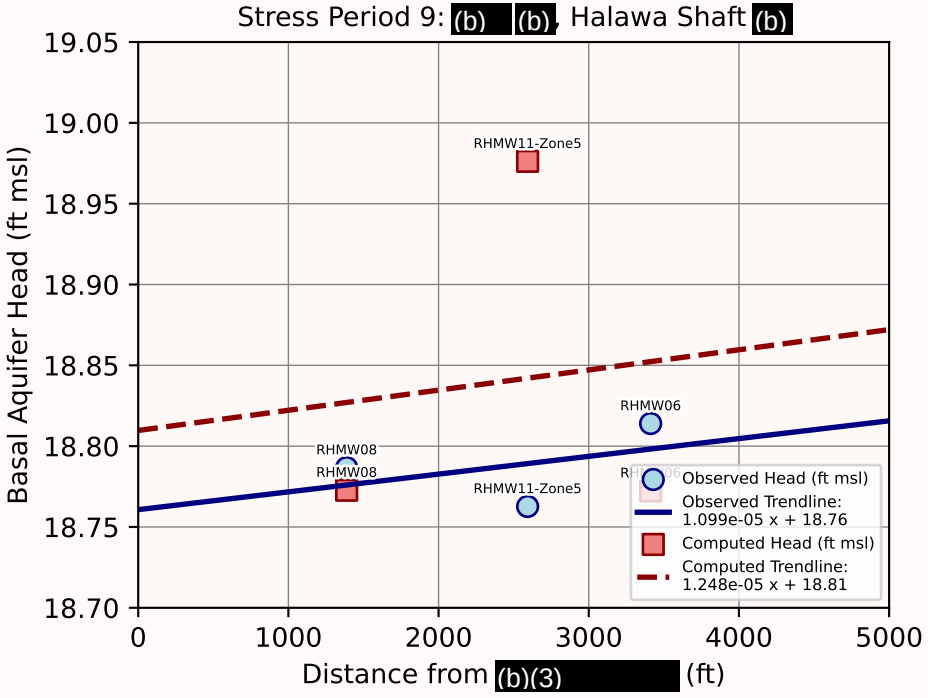


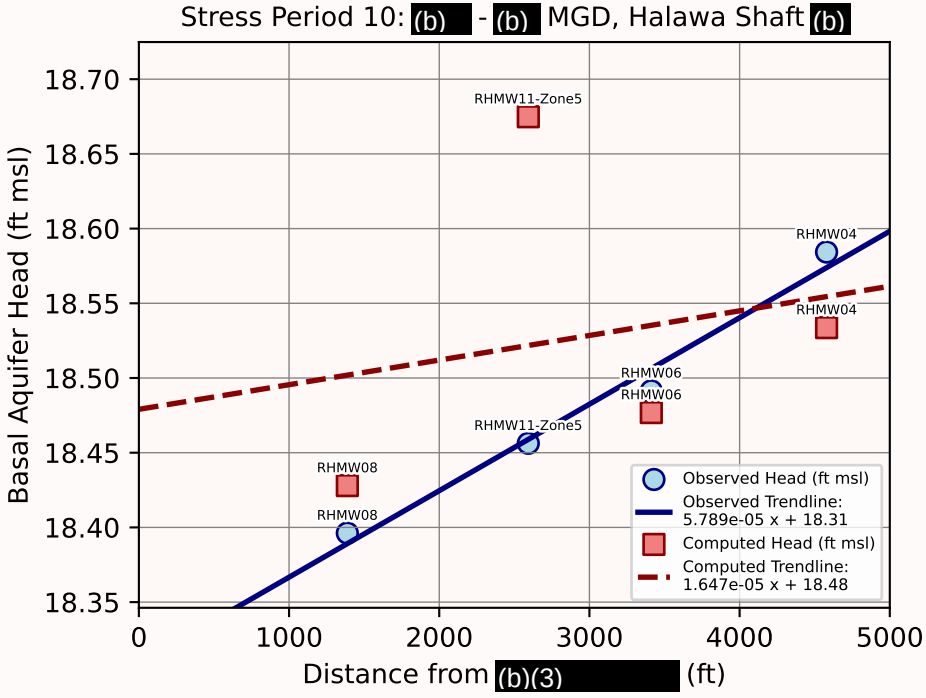


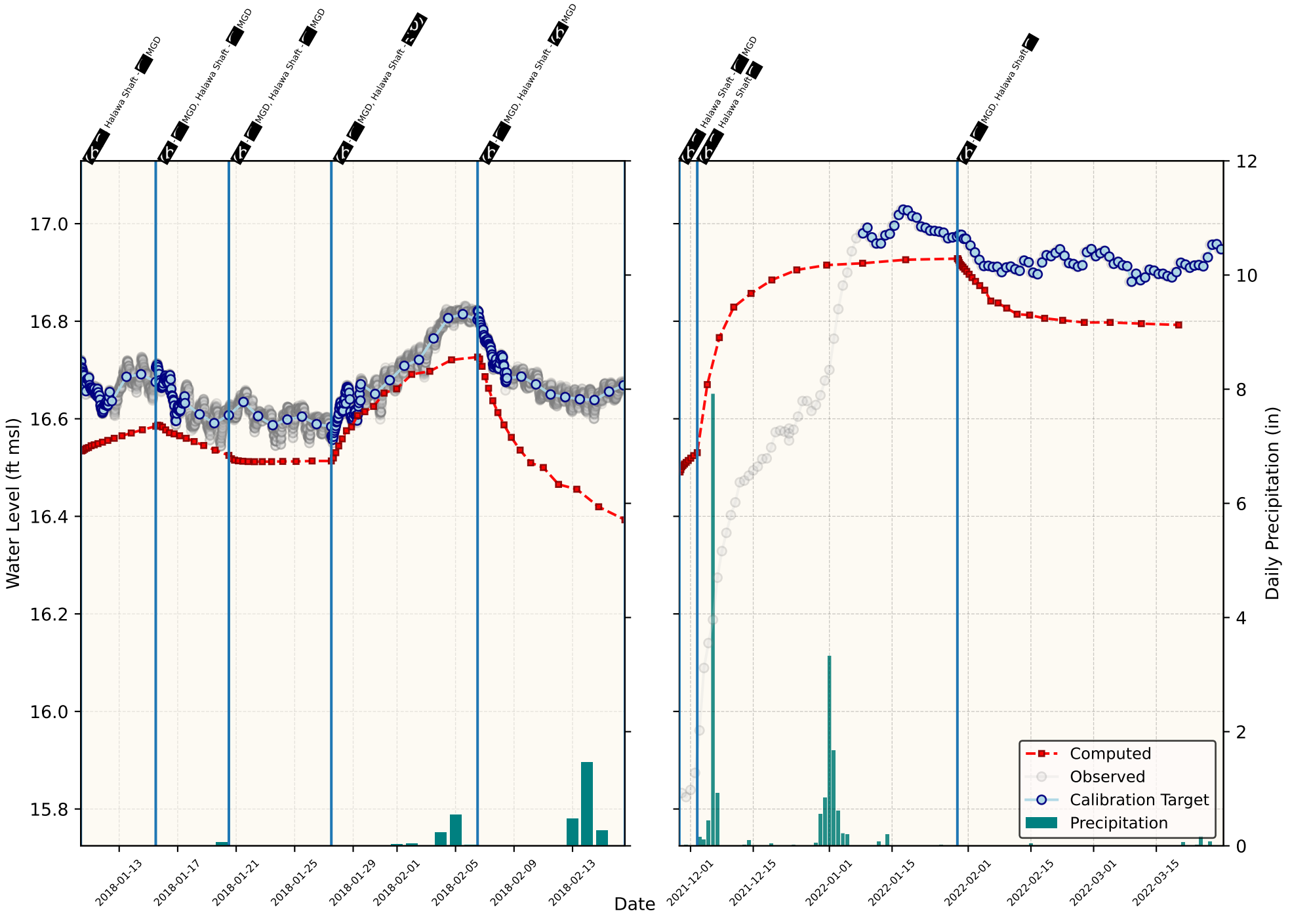
Gradients Northwest of Red Hill Ridge



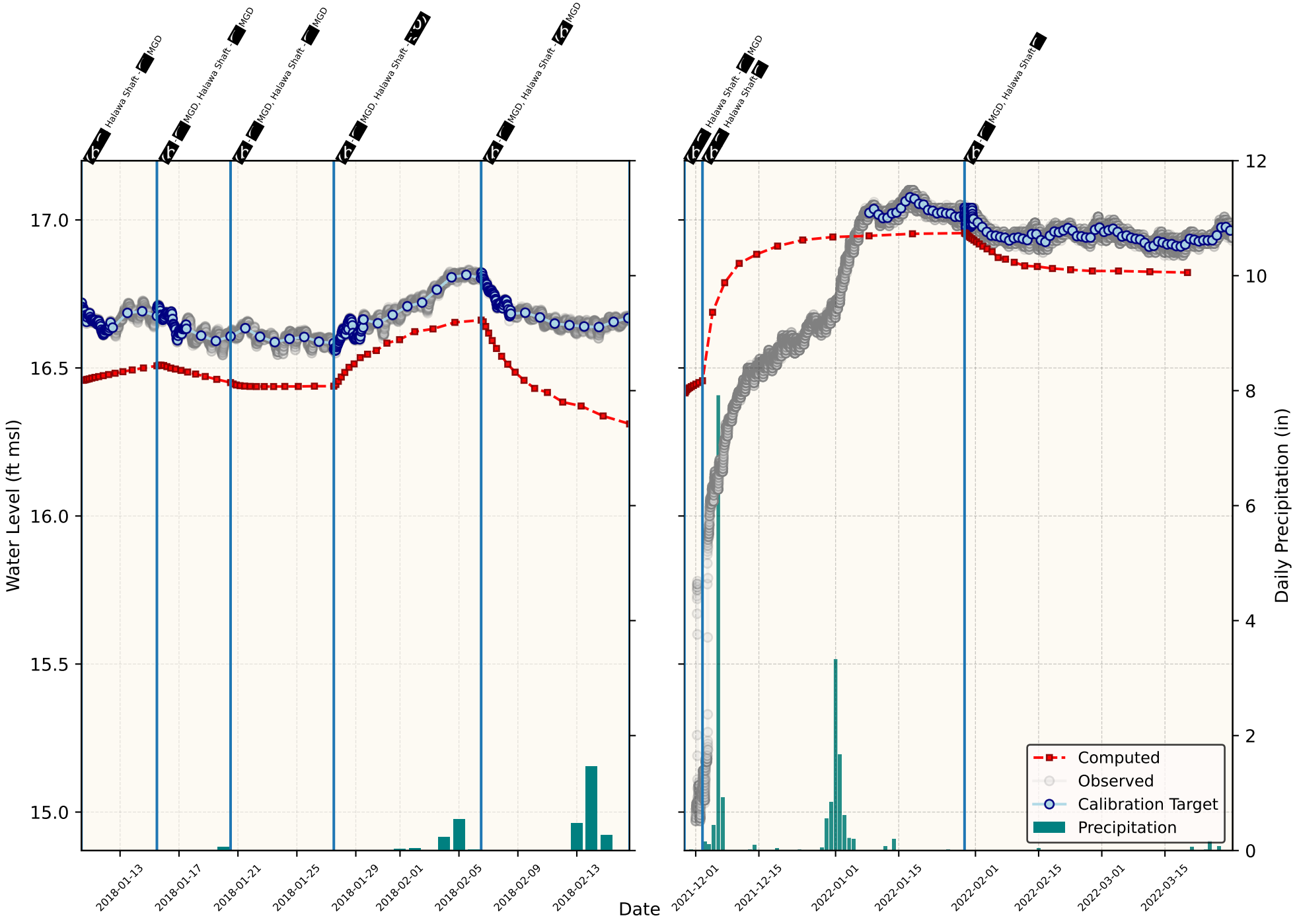


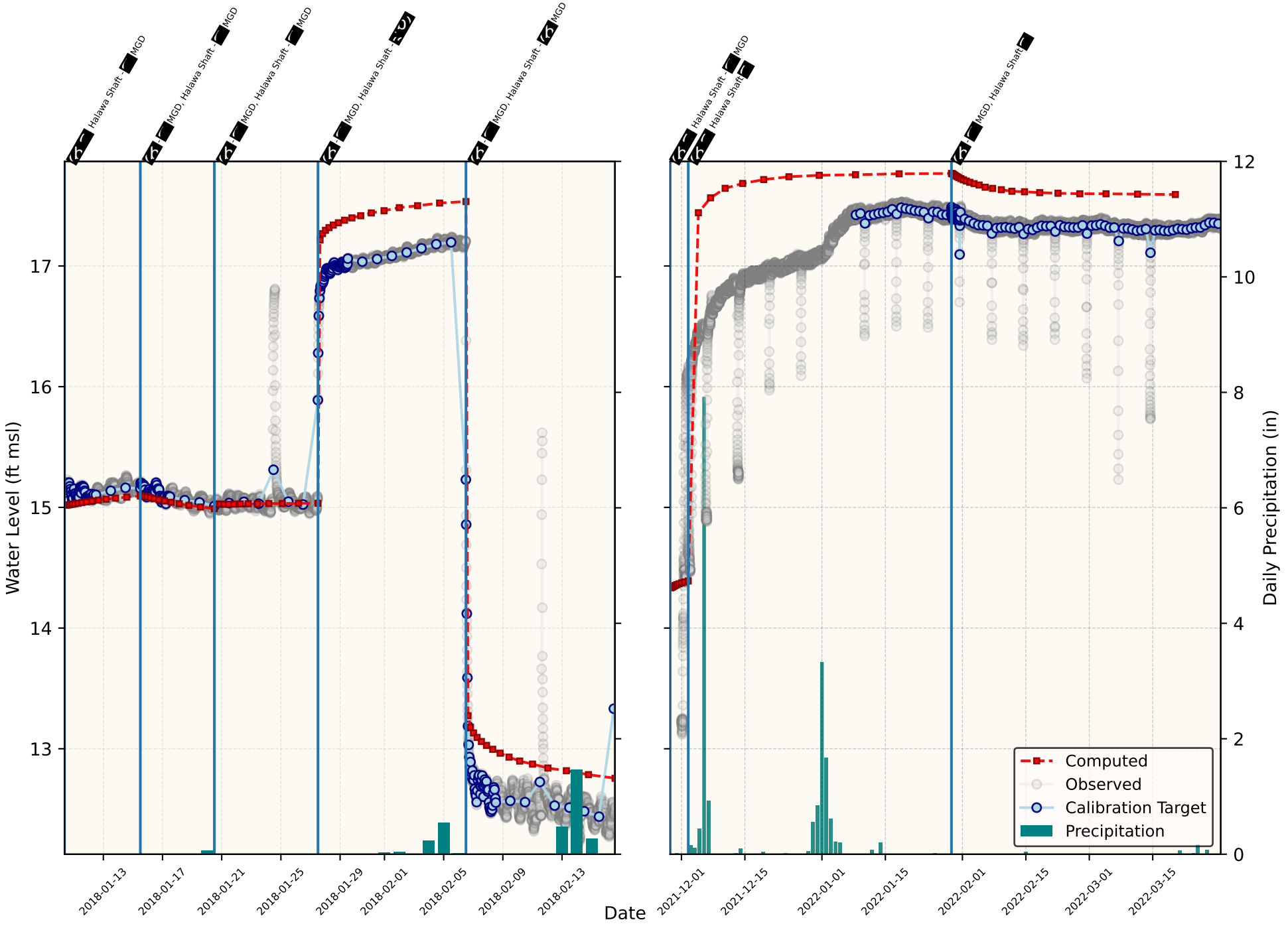


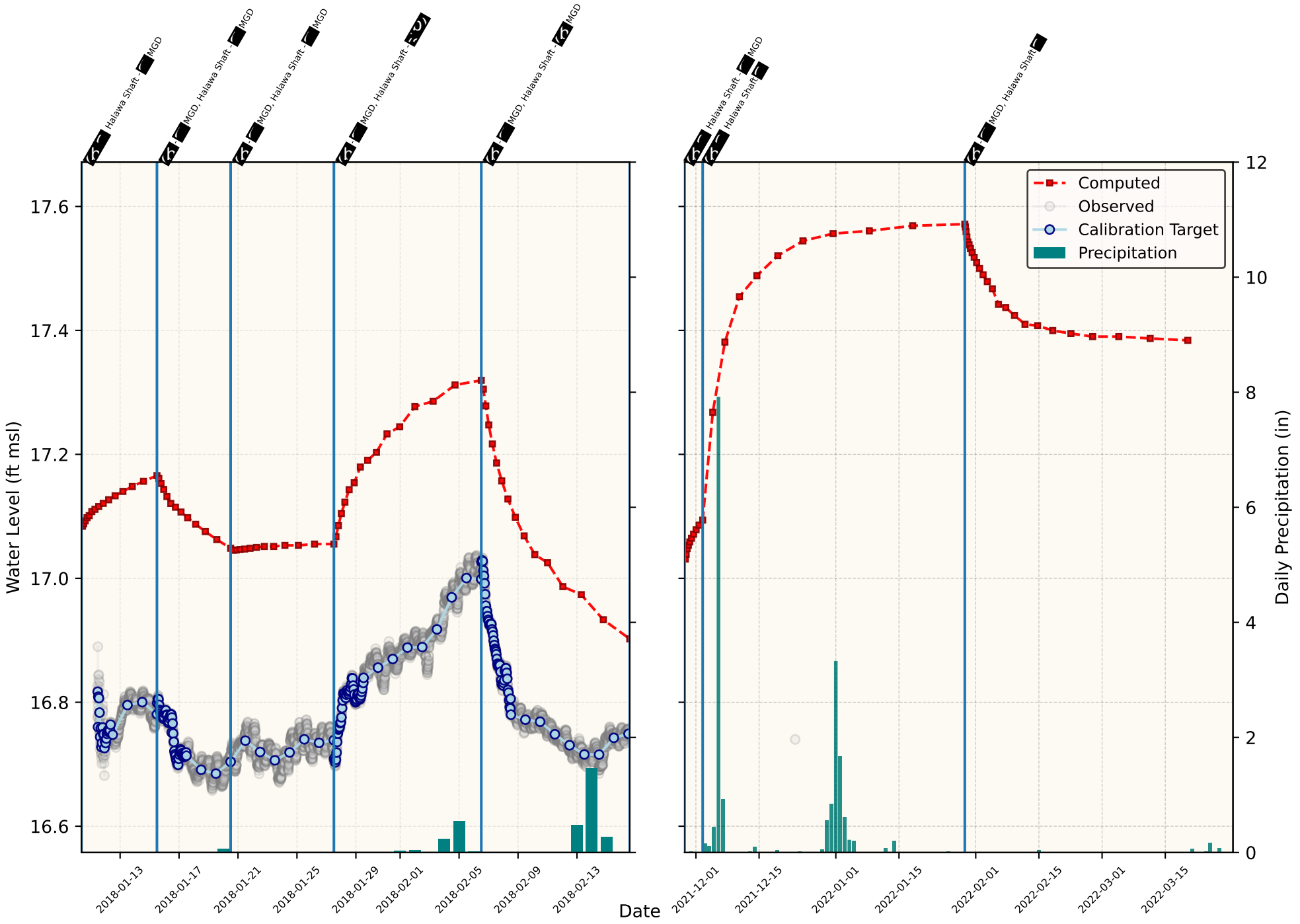


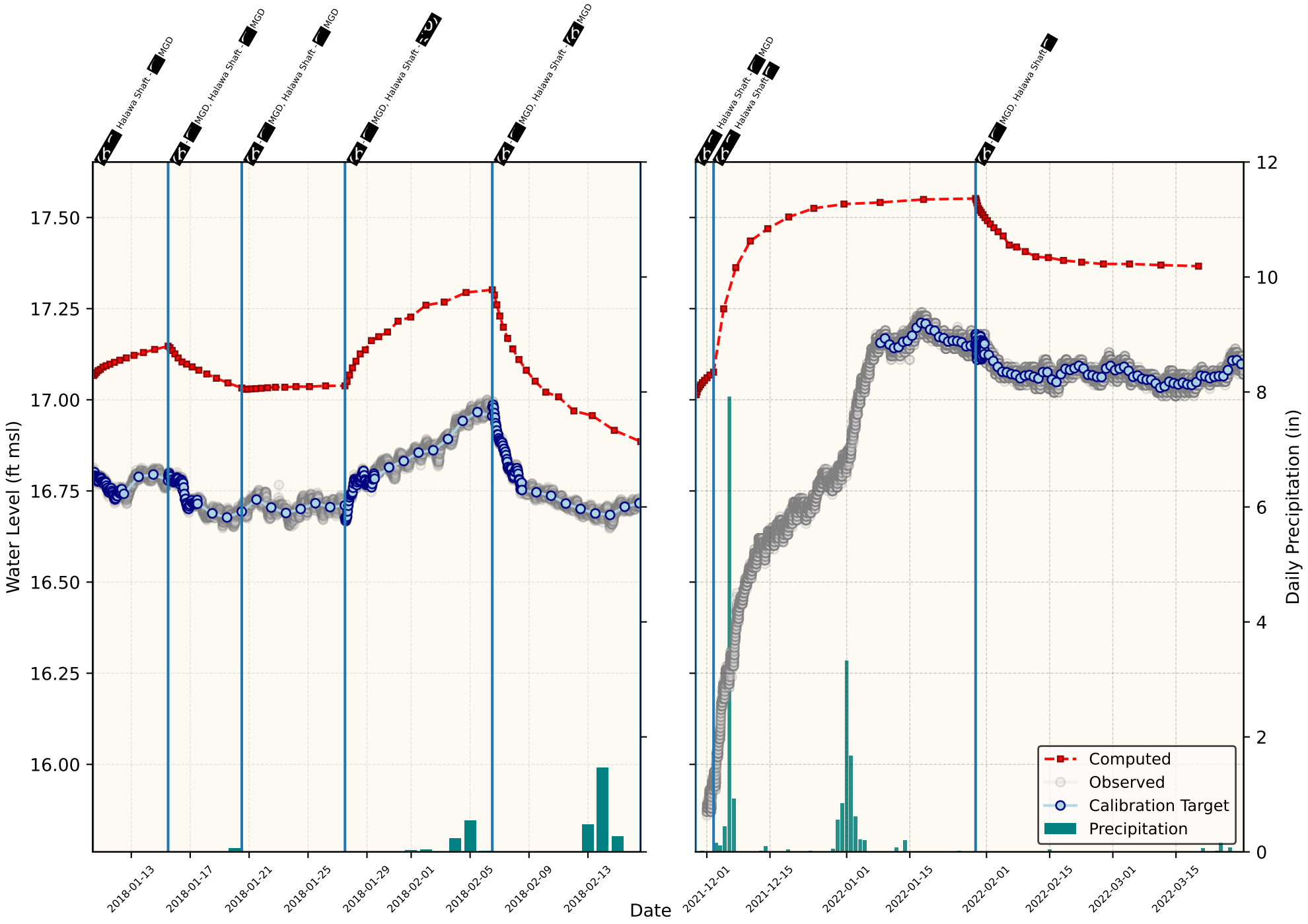

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
17.0
16.8
16.6
16.4
16.2
16.0
15.8
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

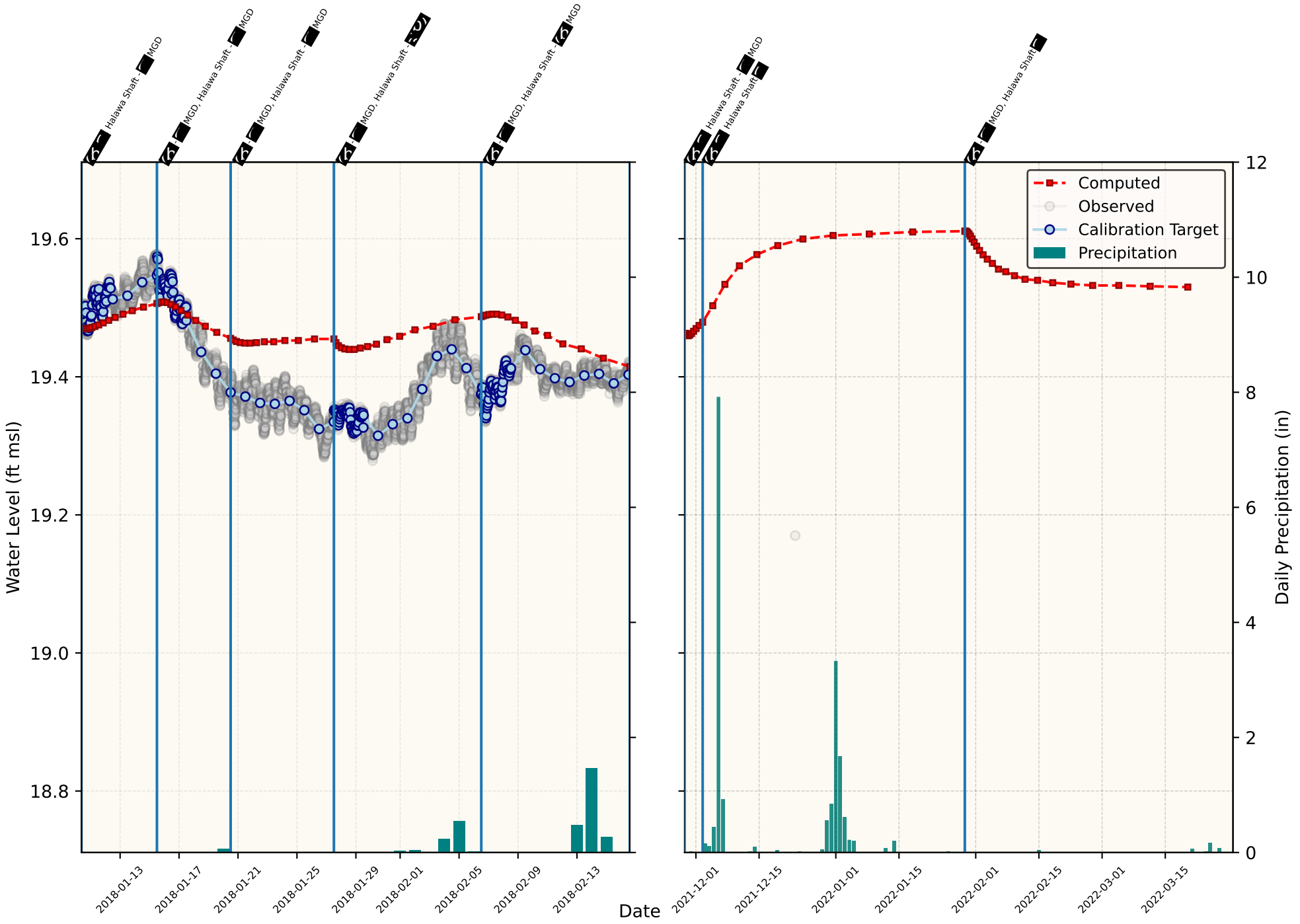
(b)(3)


Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

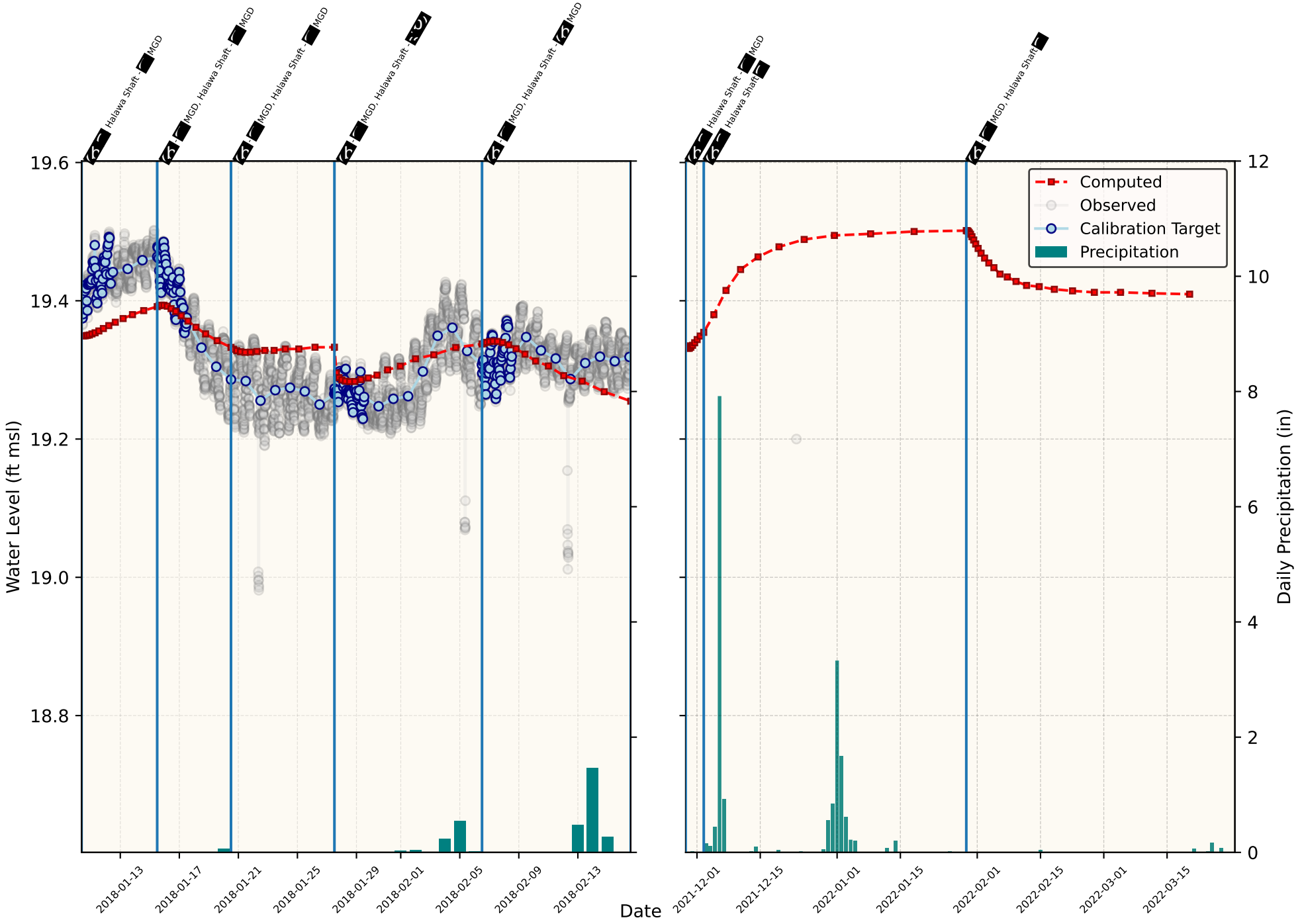

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
17.6
17.4
17.2
17.0
16.8
16.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

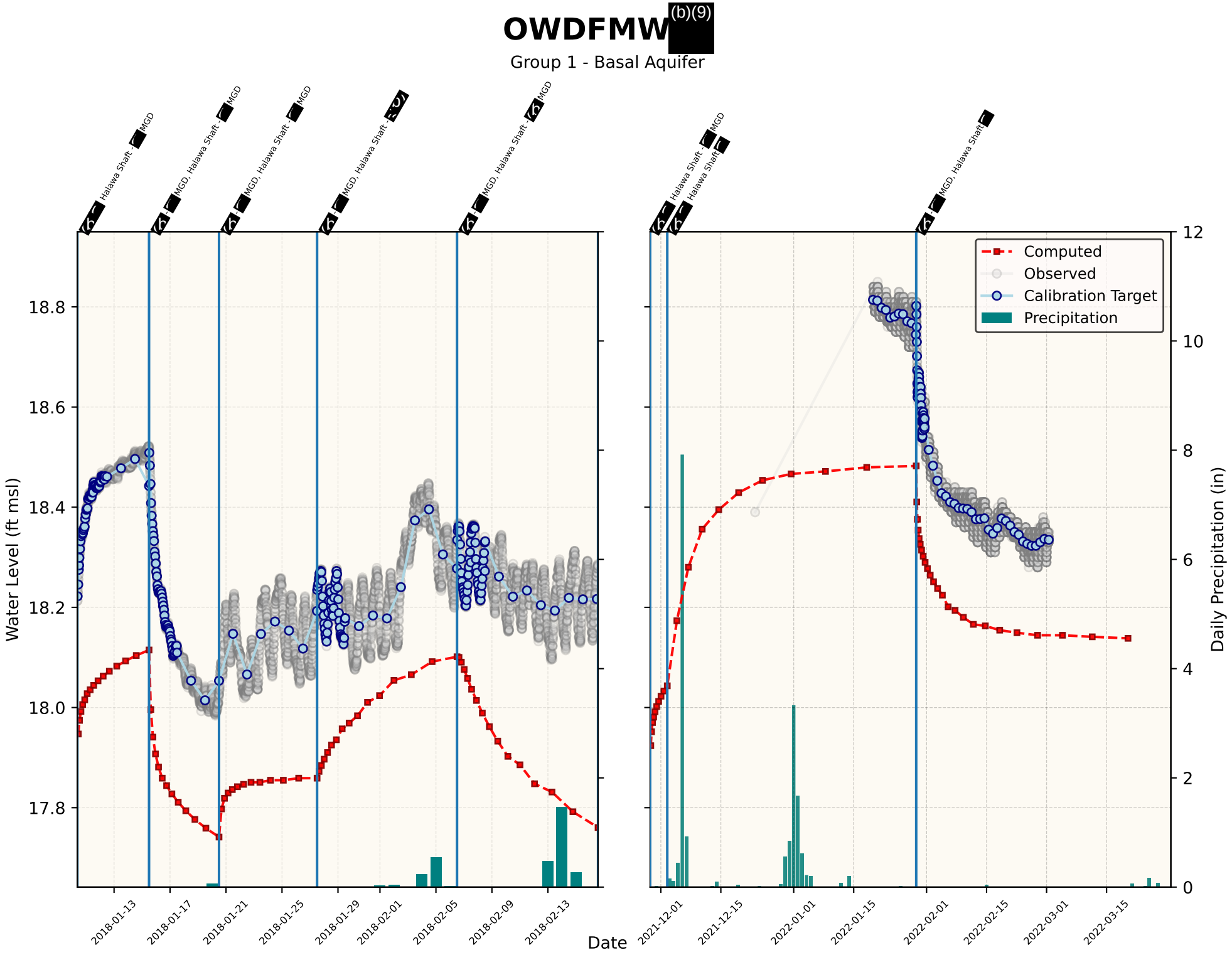

Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
17.50
17.25
17.00
16.75
16.50
16.25
16.00
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date

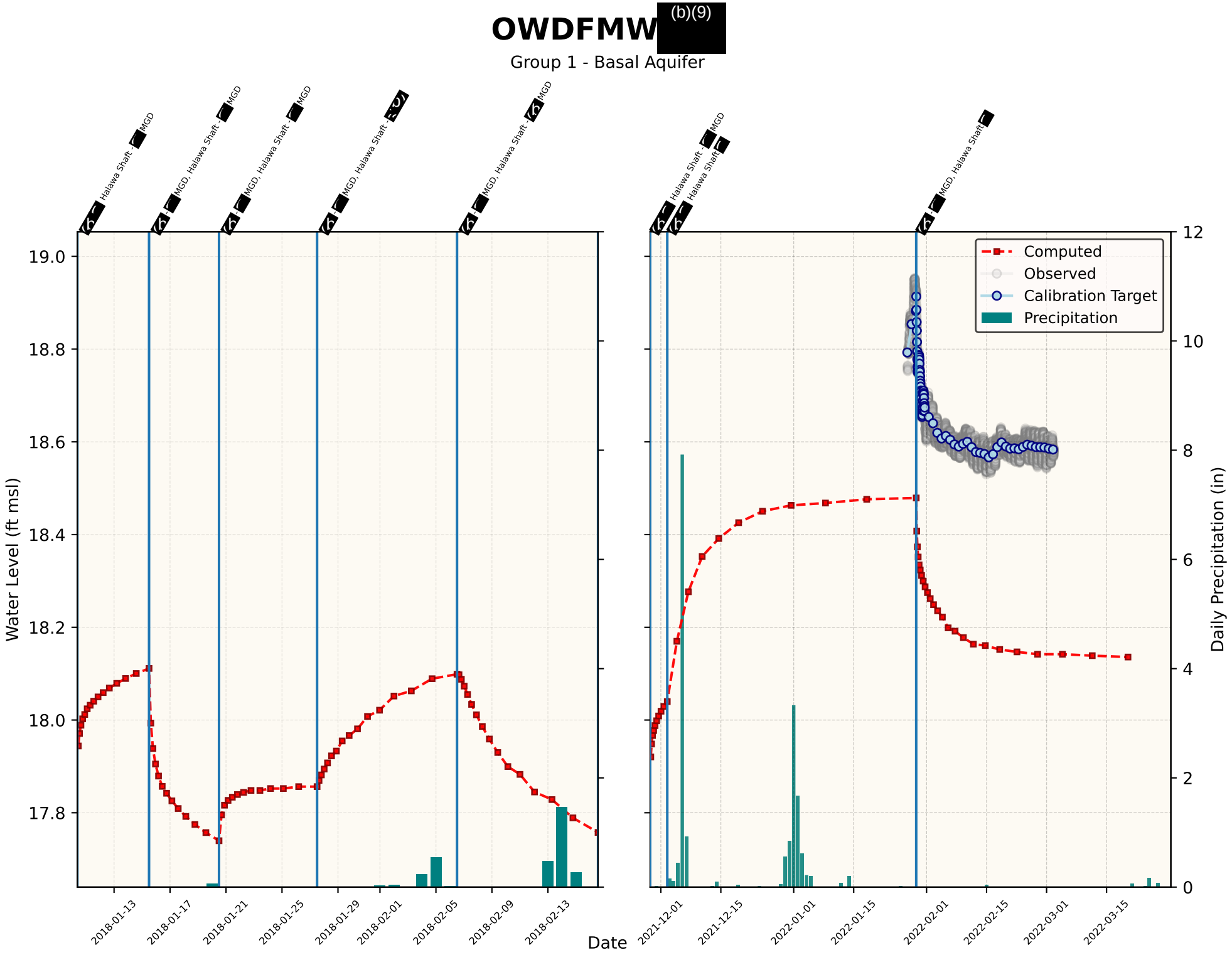

Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.6
19.4
19.2
19.0
18.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

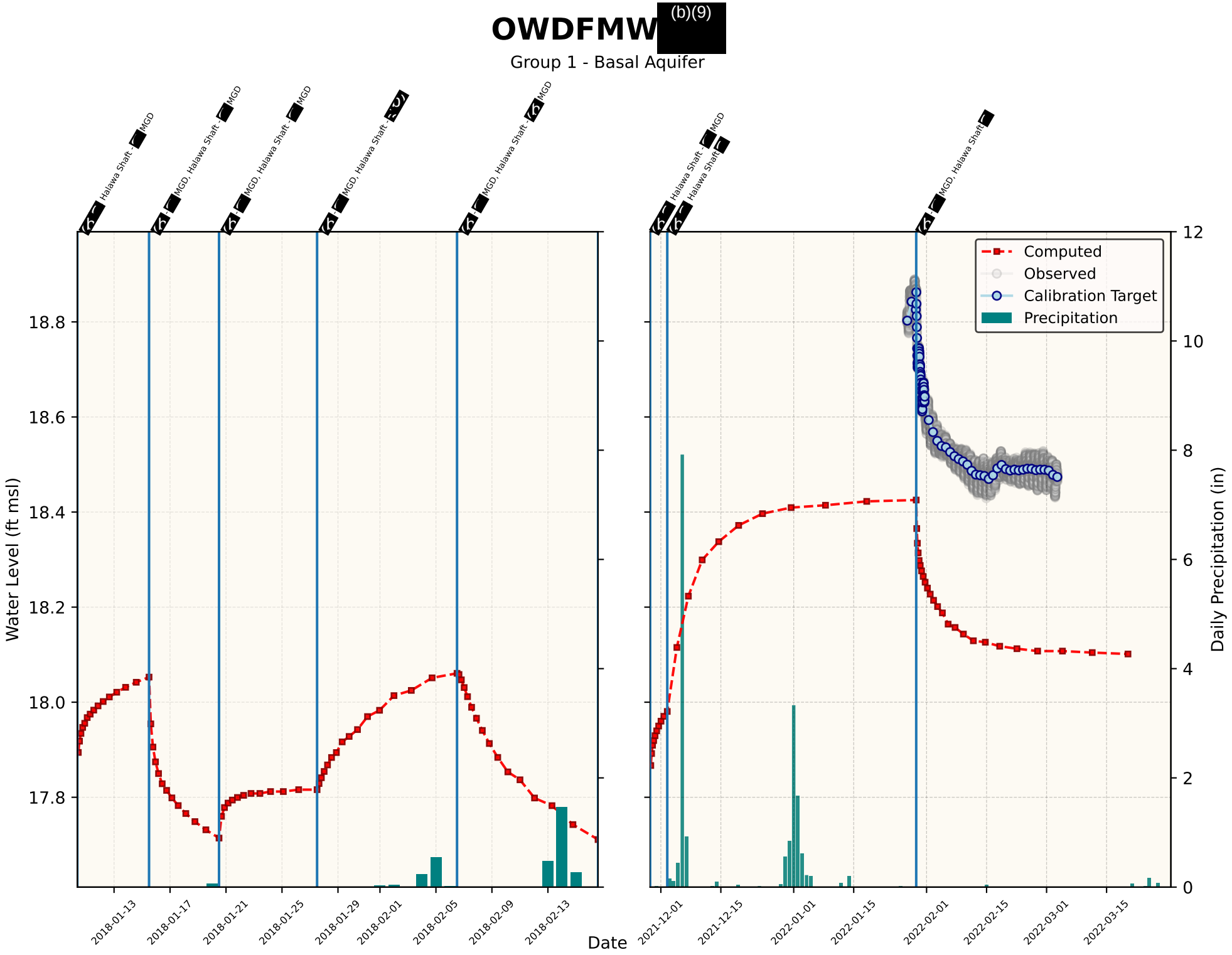
Moanalua_Deep

Group 1 - Basal Aquifer



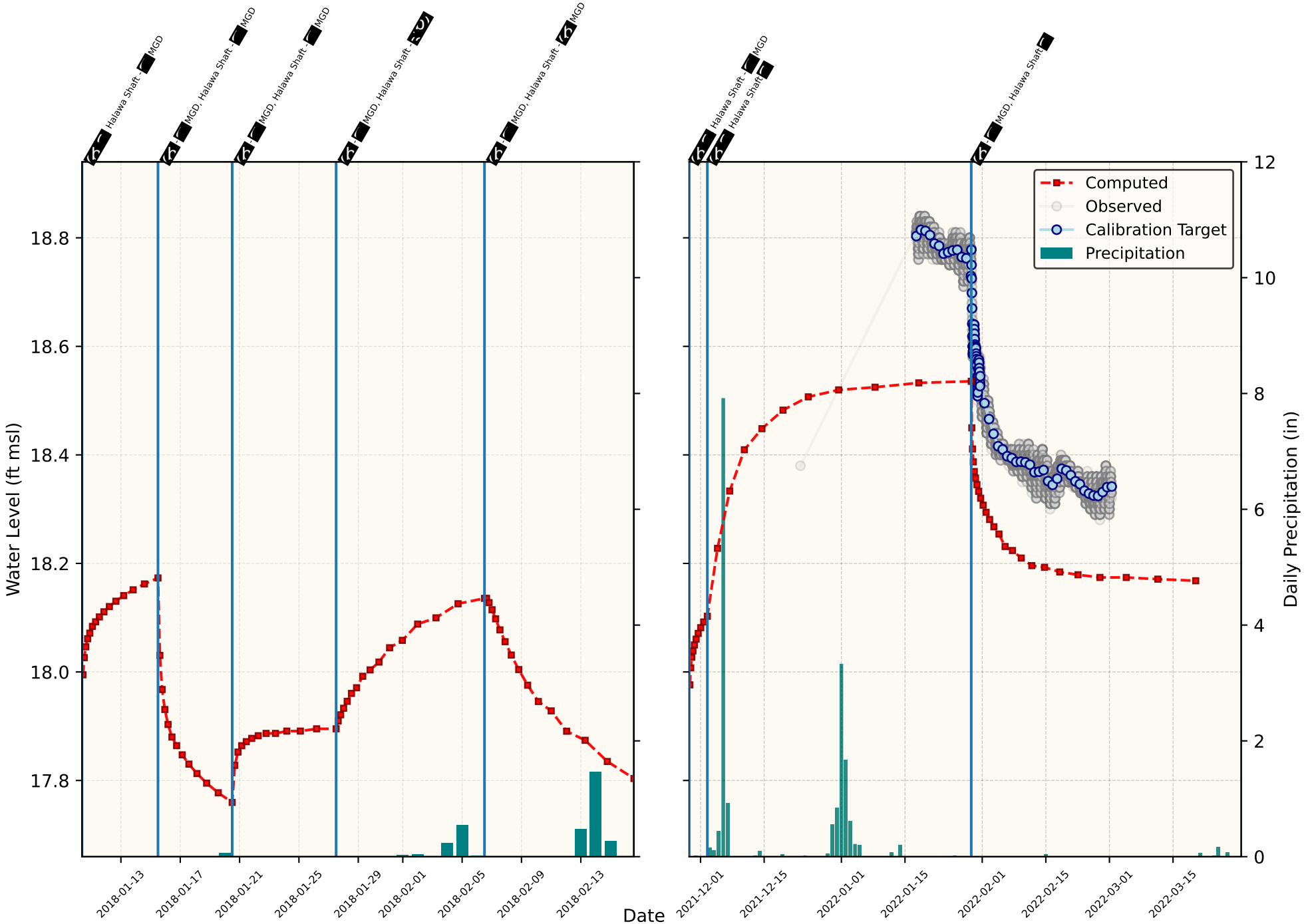

OWDFMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

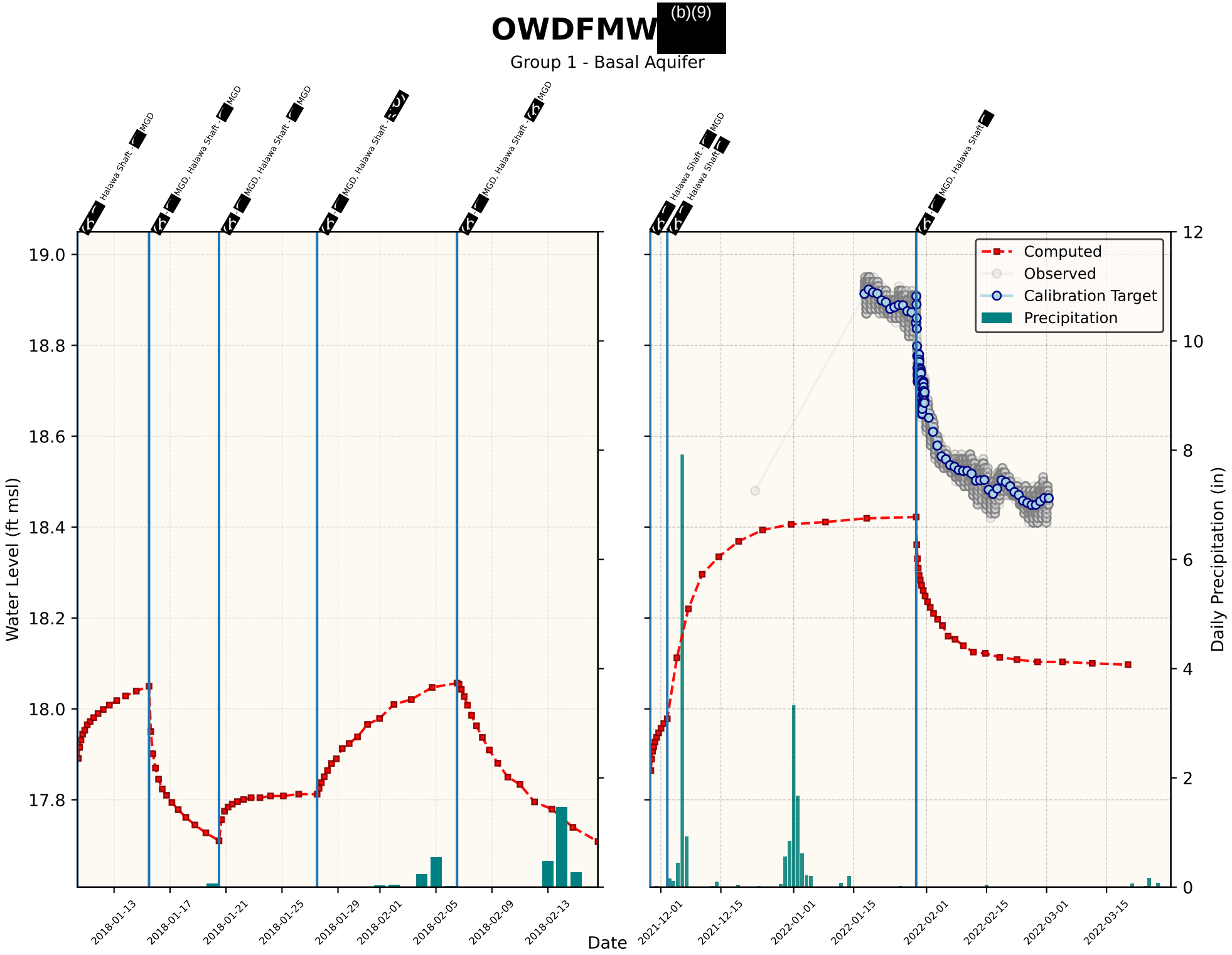

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

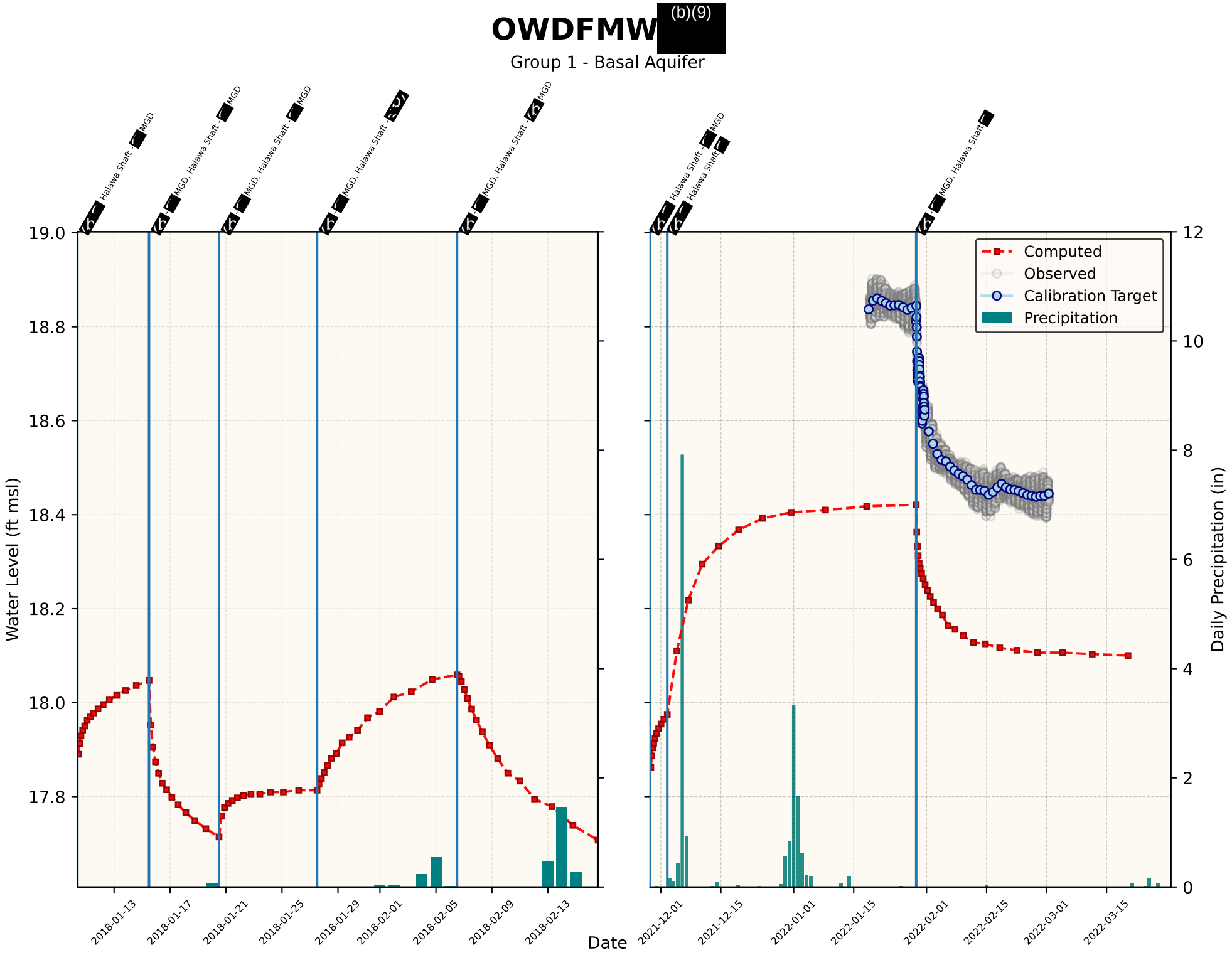

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-01-01
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2022-02-01
2022-02-15
2022-03-01
2022-03-15

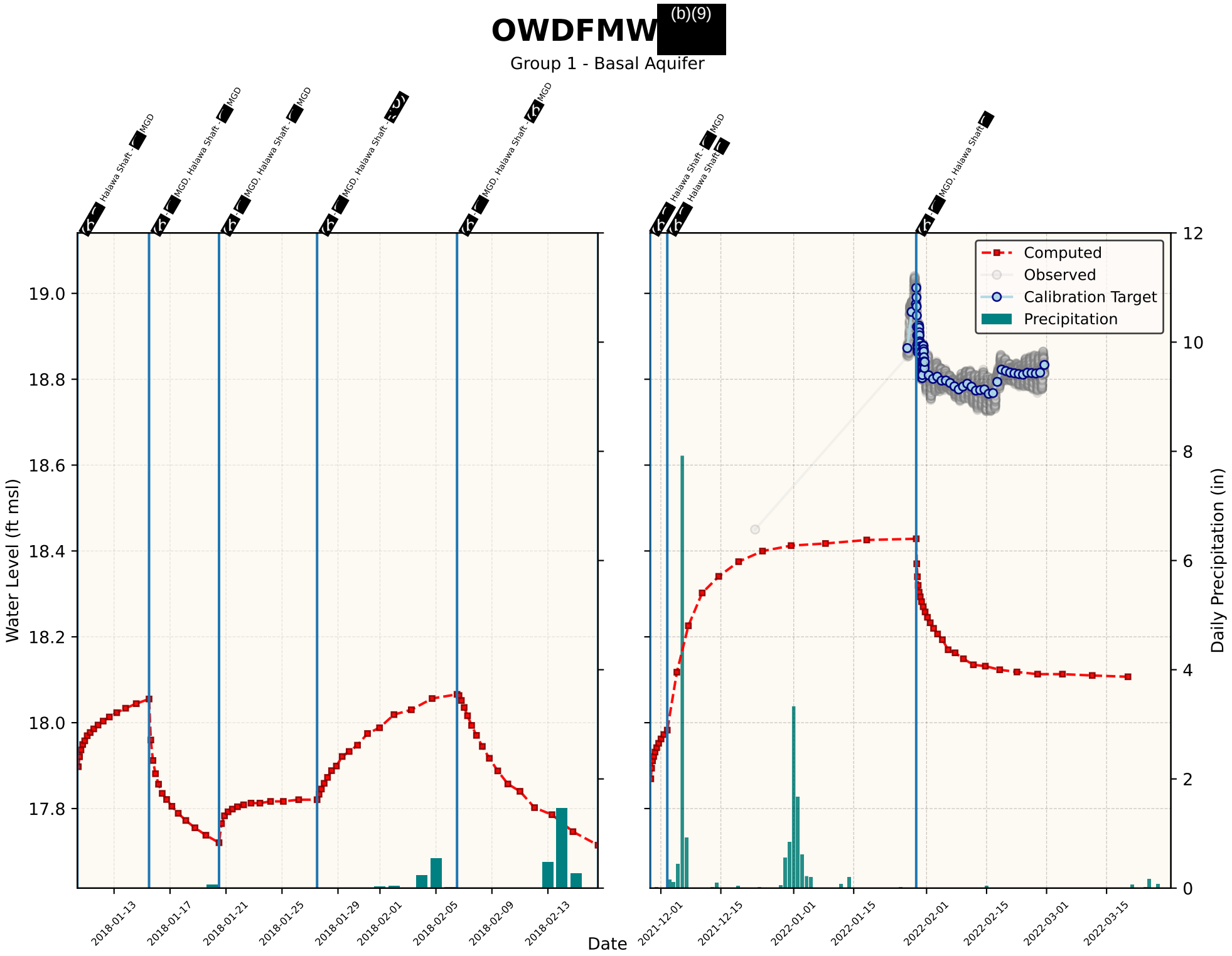
OWDFMW (b)(9)

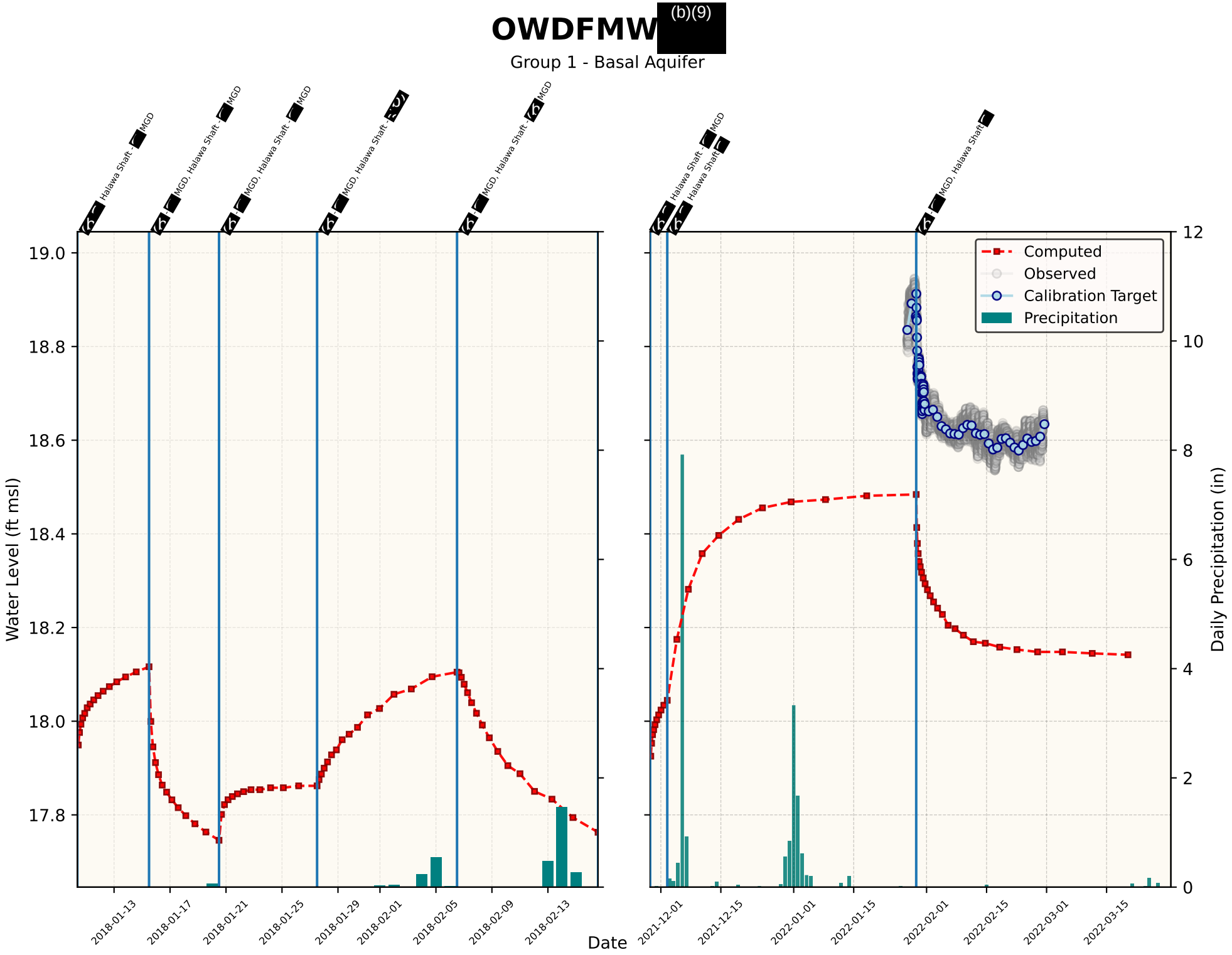
Group 1 - Basal Aquifer

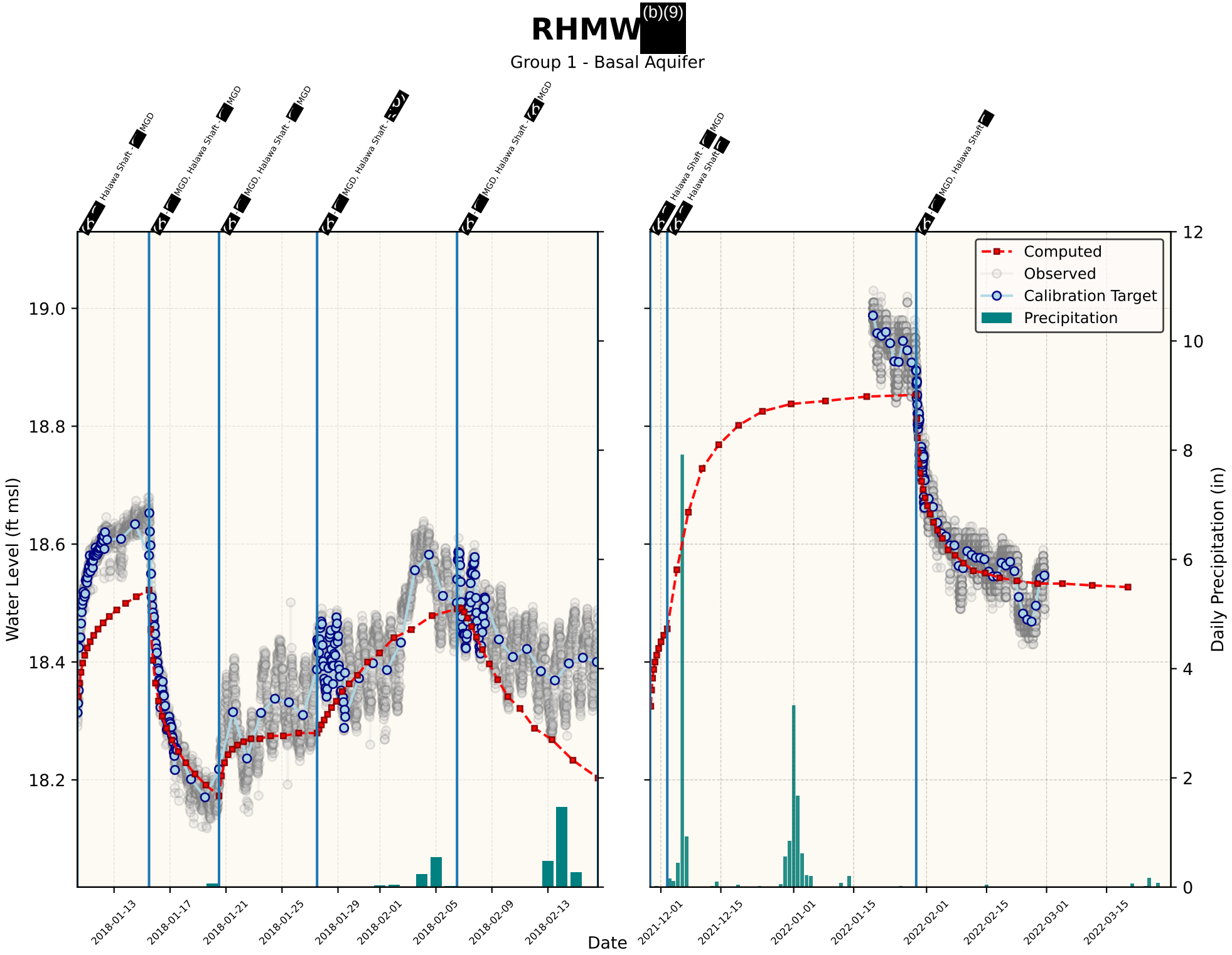



OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
19.0
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OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
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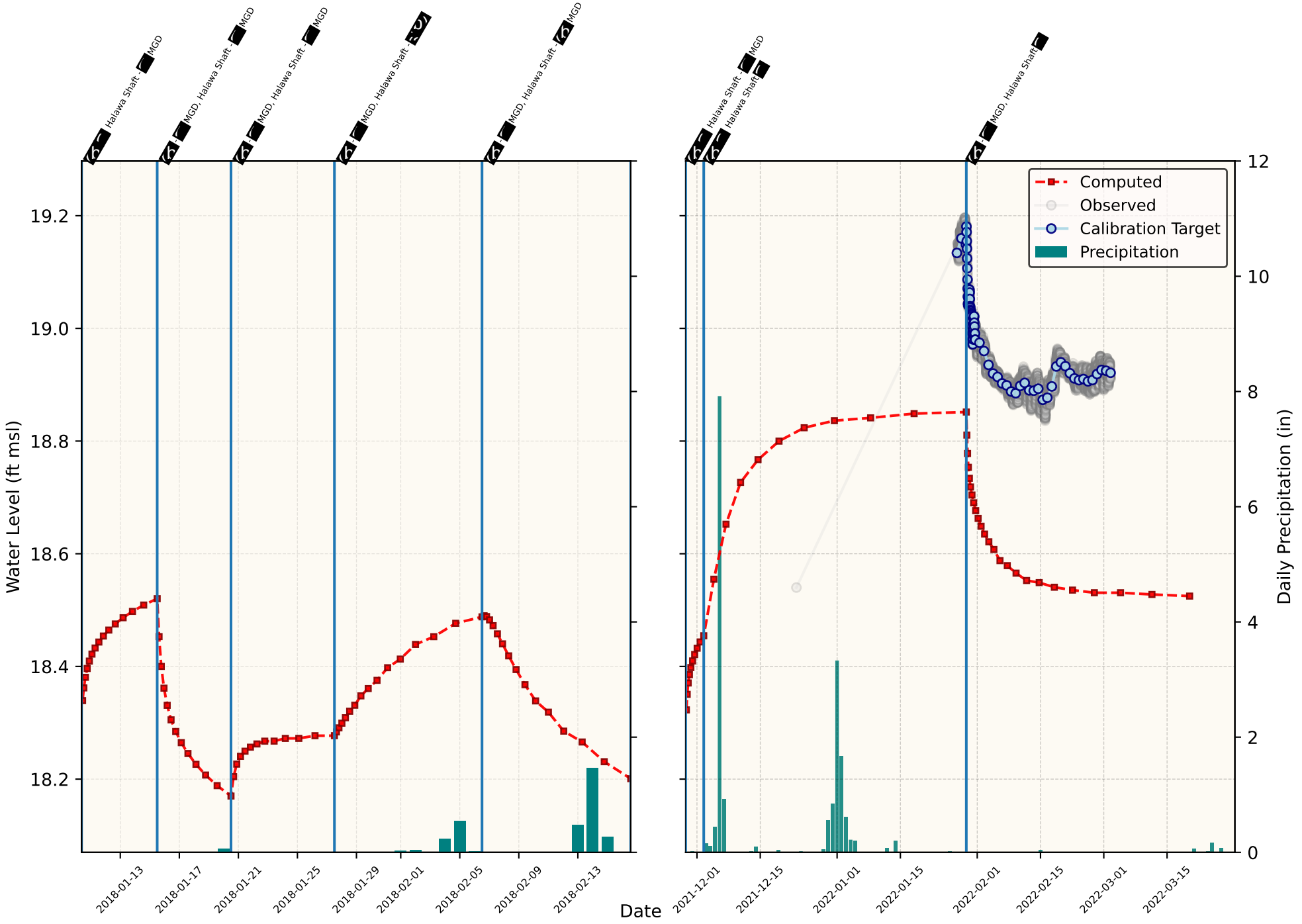

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
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Date
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Calibration Target
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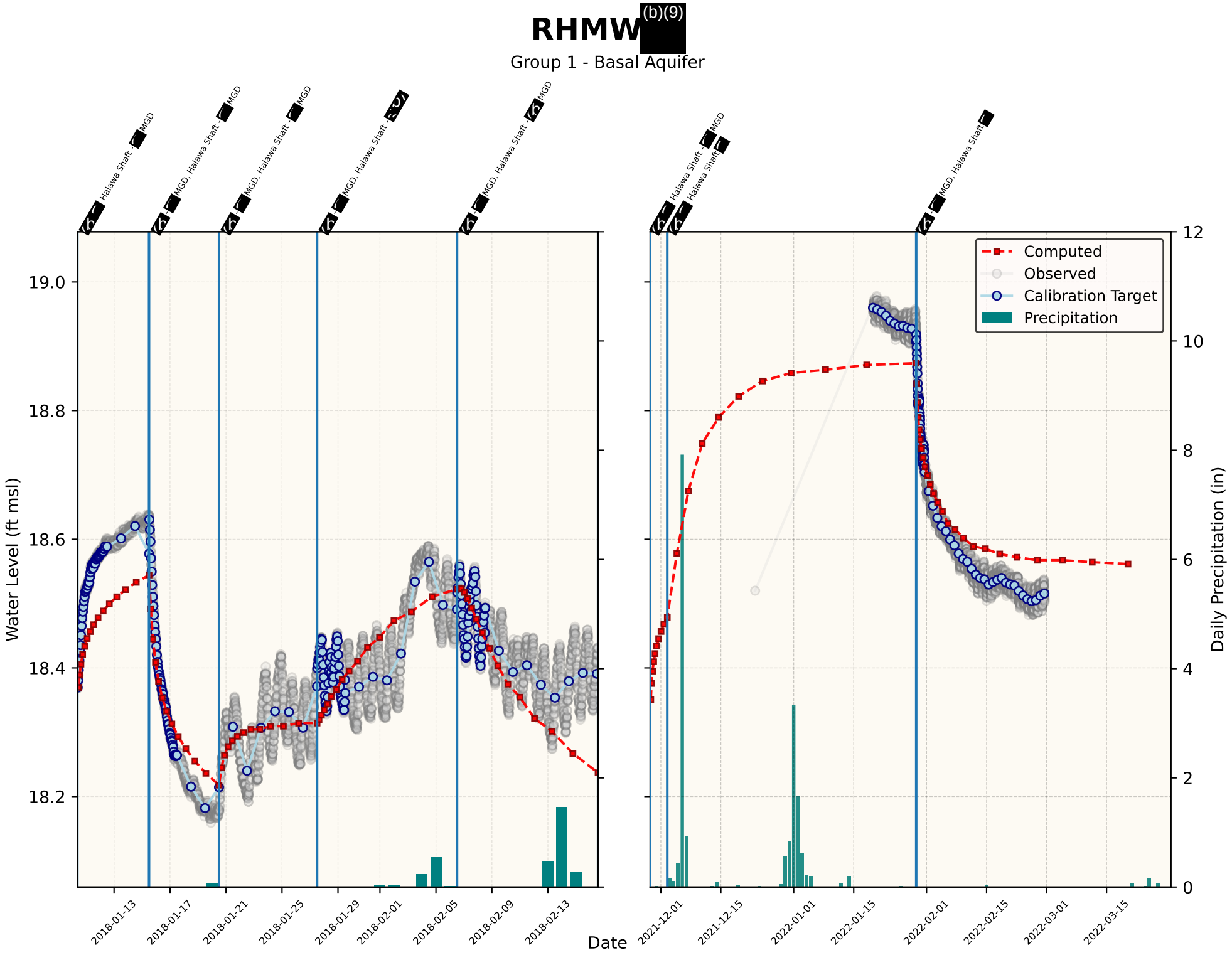

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
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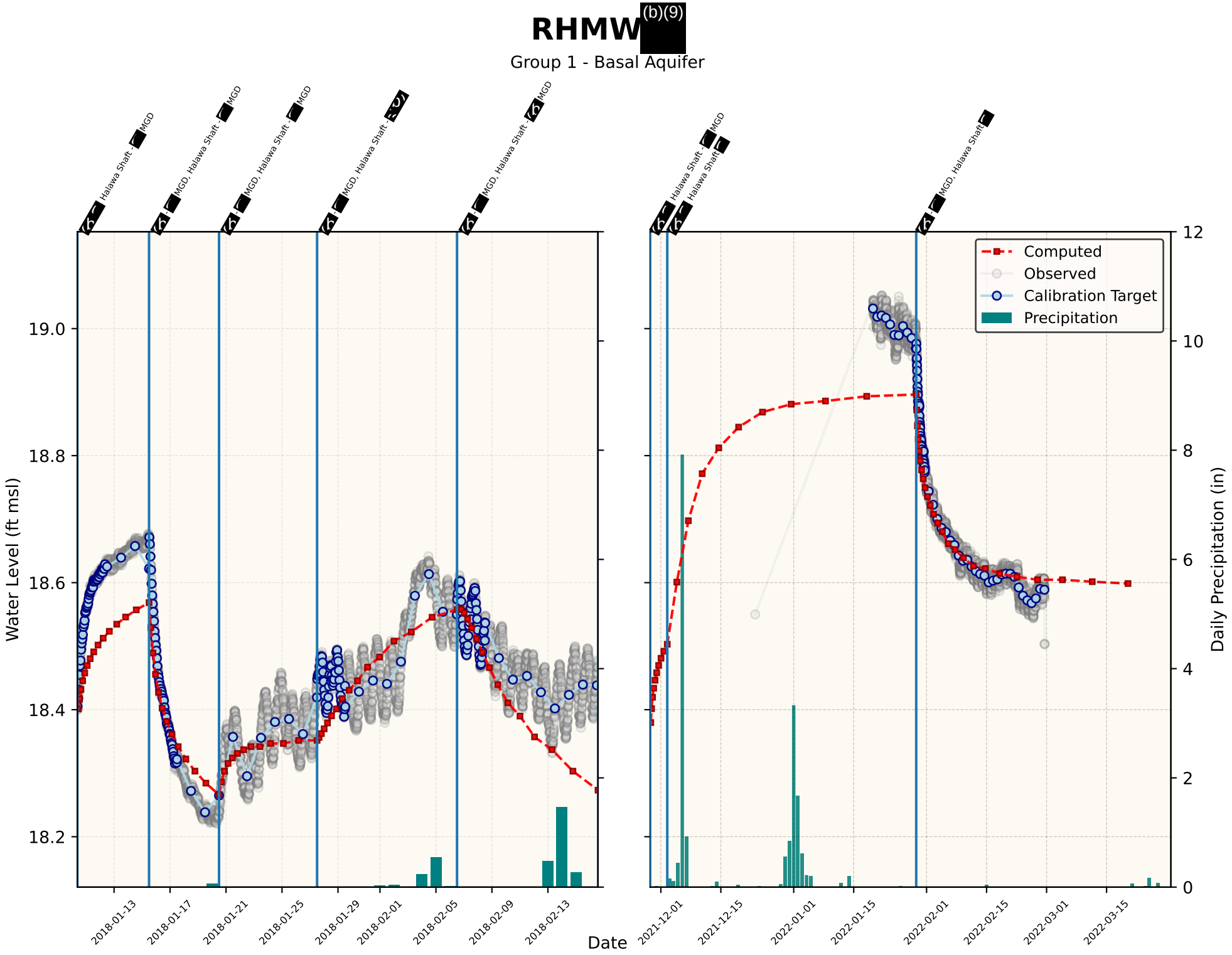

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MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
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Water Level (ft msl)
Daily Precipitation (in)
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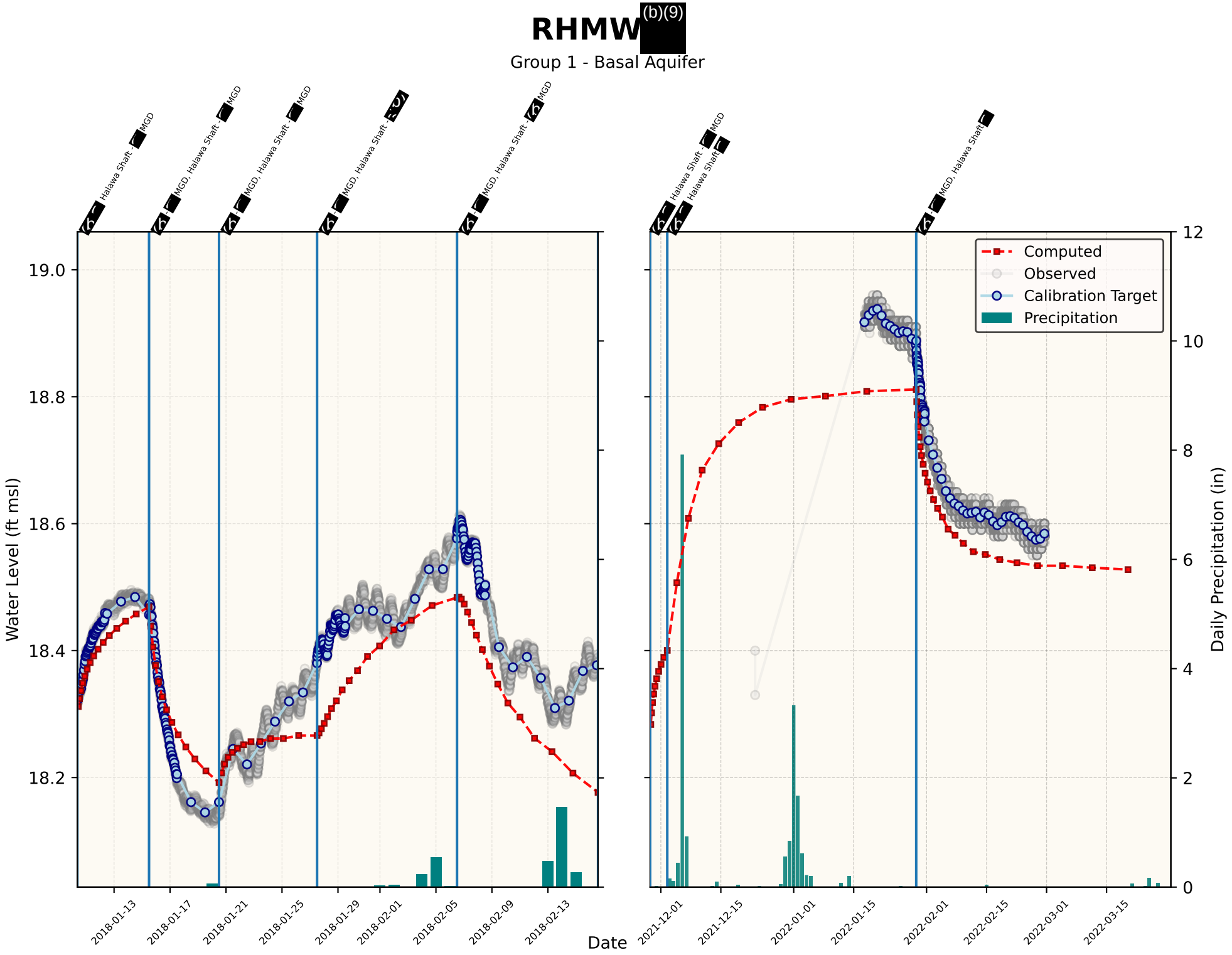
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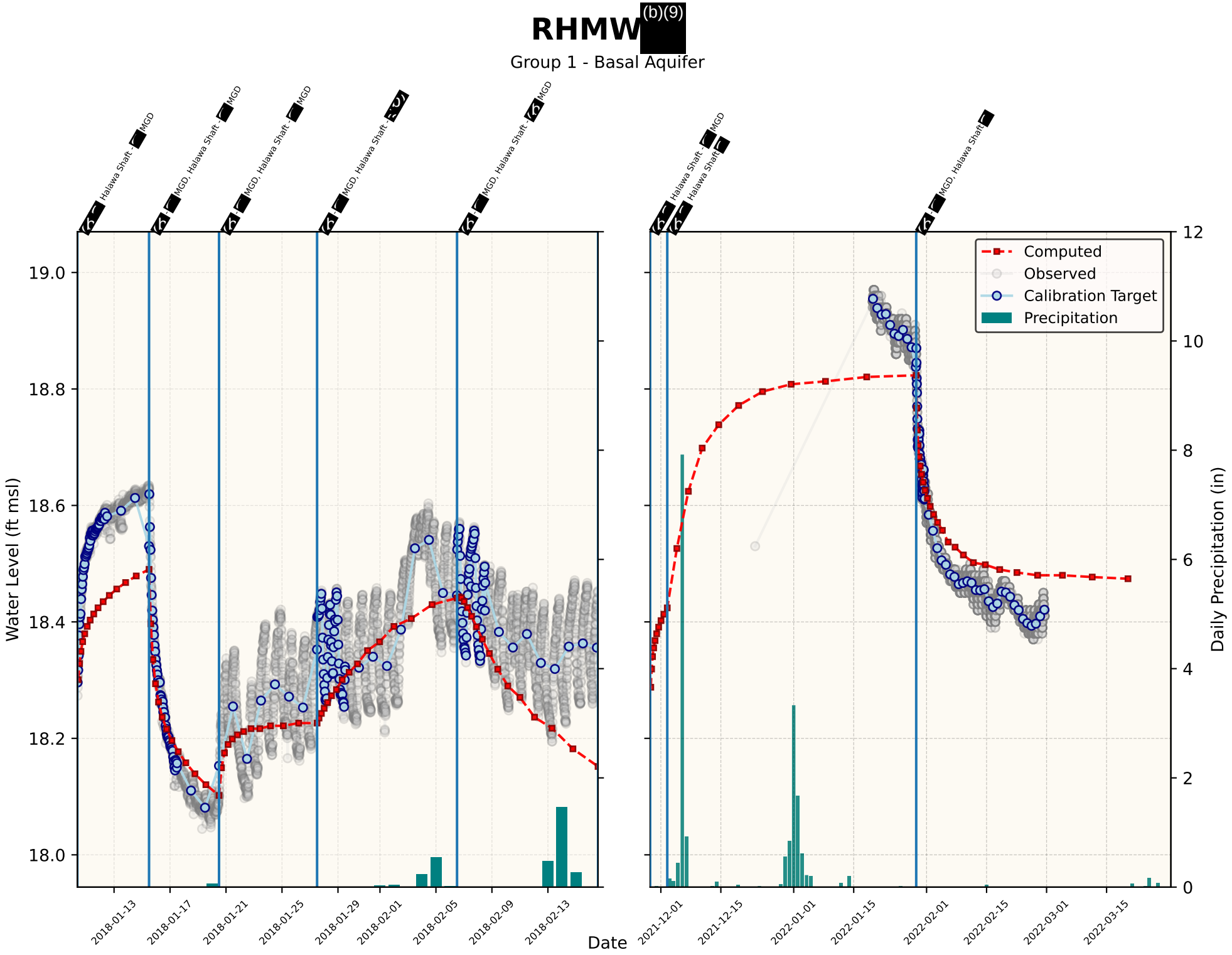
Group 1 - Basal Aquifer

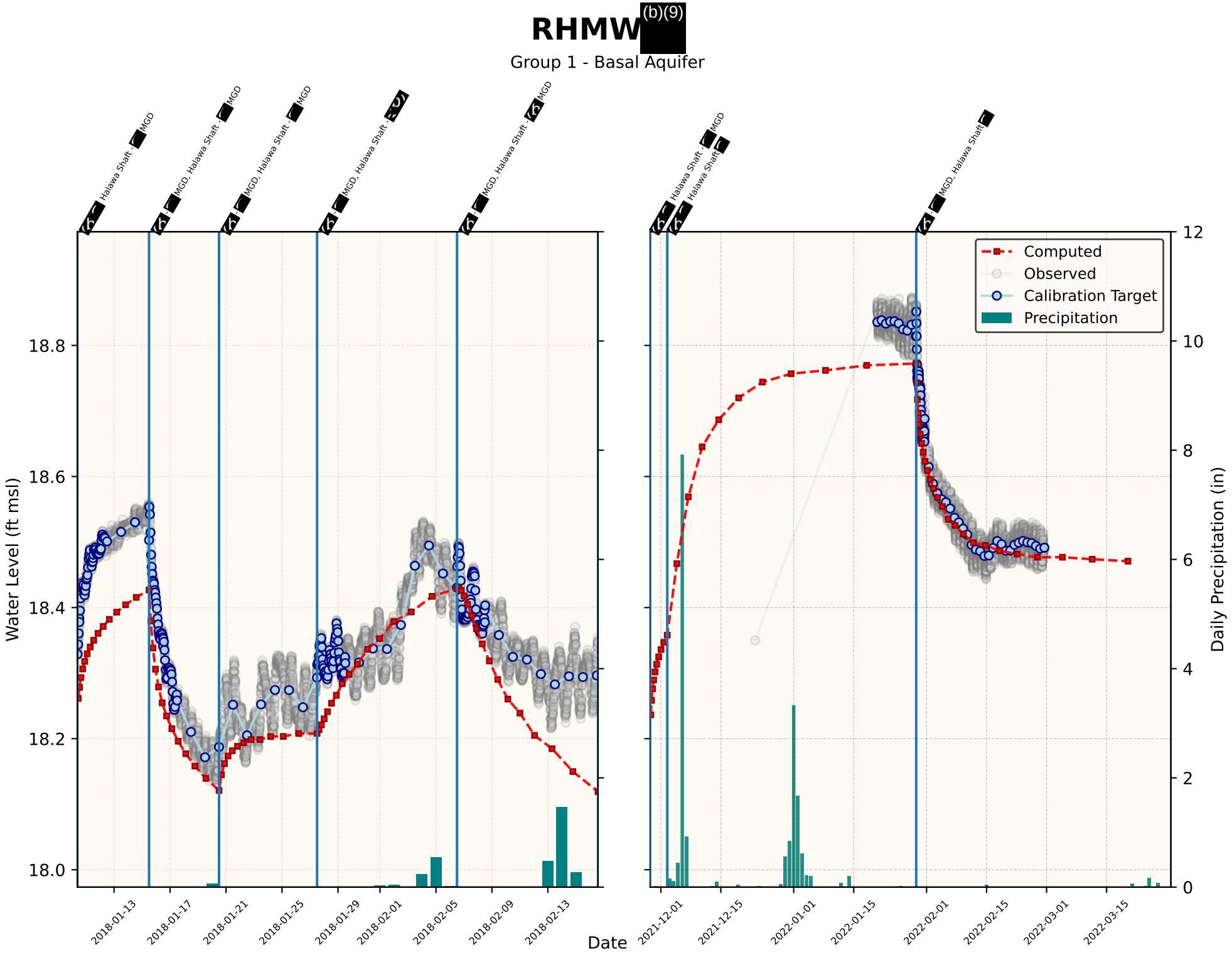


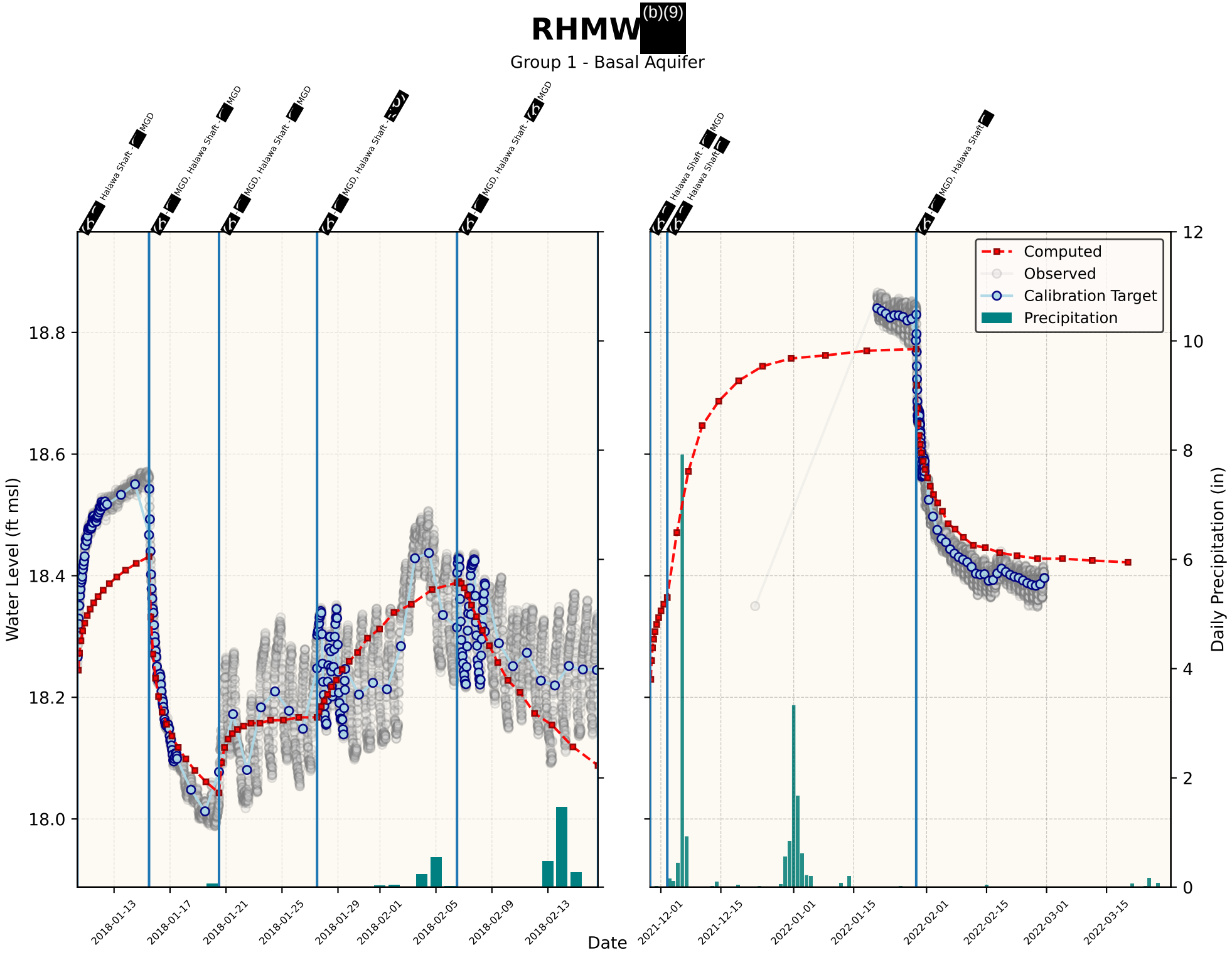

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Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
Computed
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Daily Precipitation (in)
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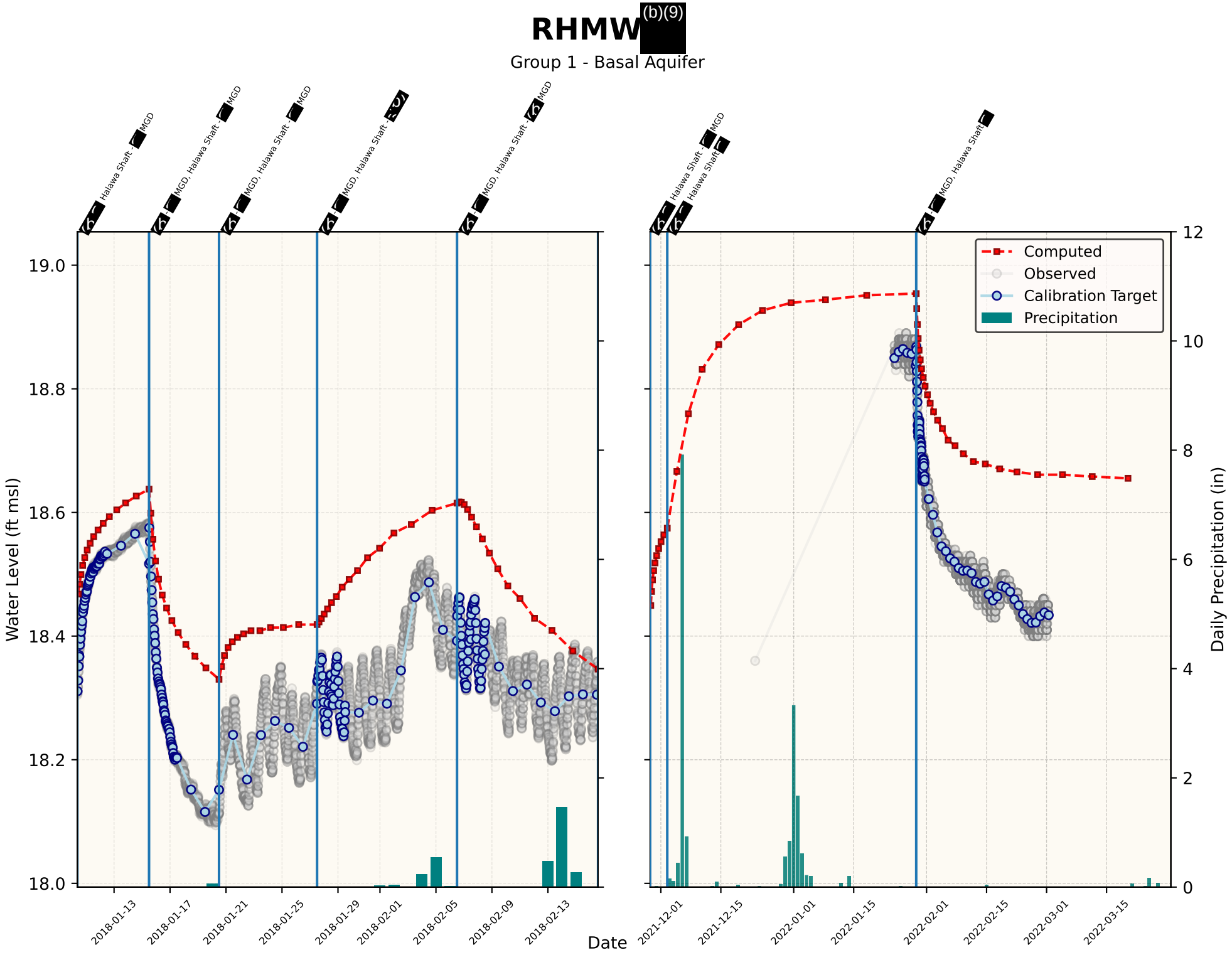

RHMW(b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
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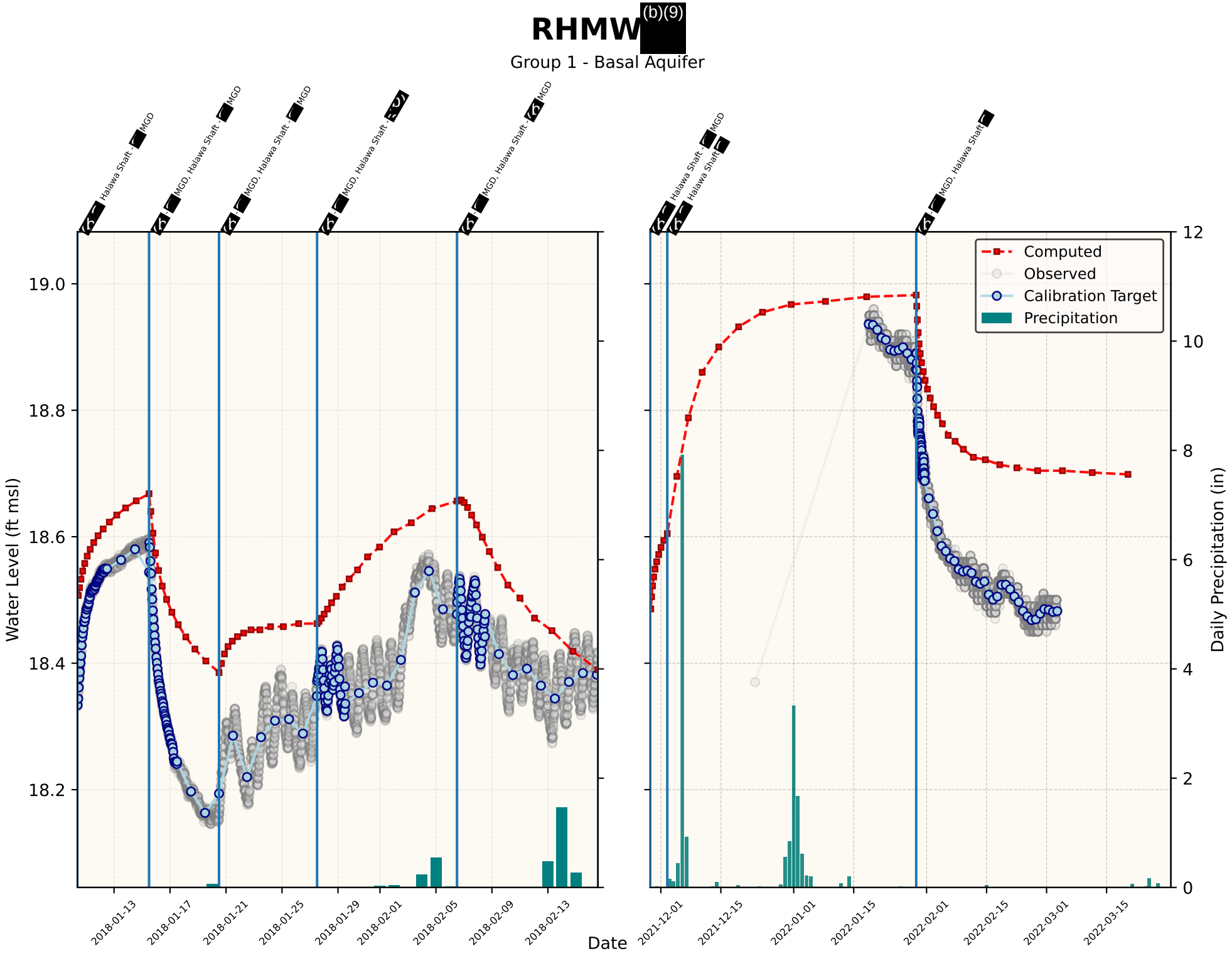

RHMW(b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
Computed
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Calibration Target
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Water Level (ft msl)
Daily Precipitation (in)
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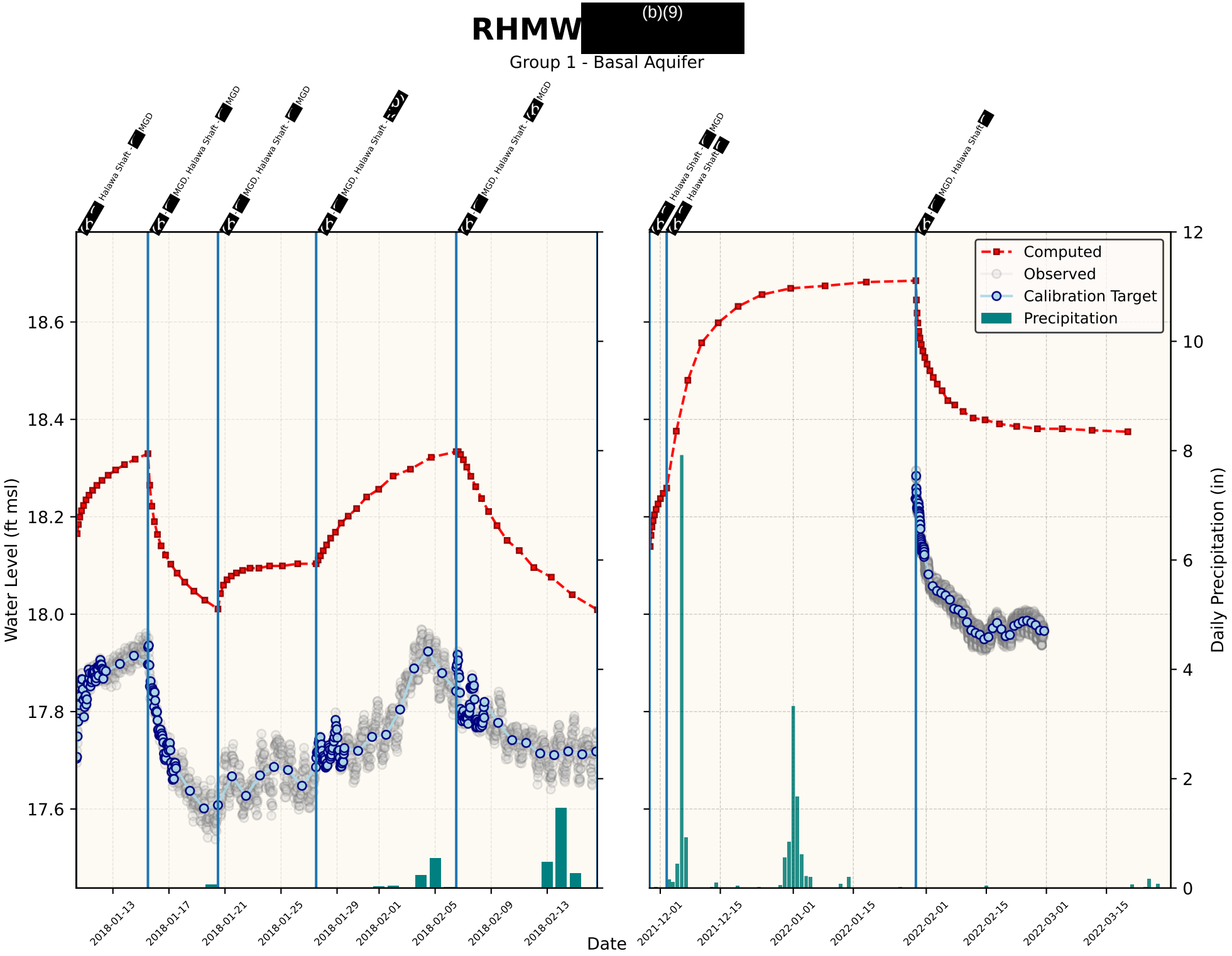

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
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Water Level (ft msl)
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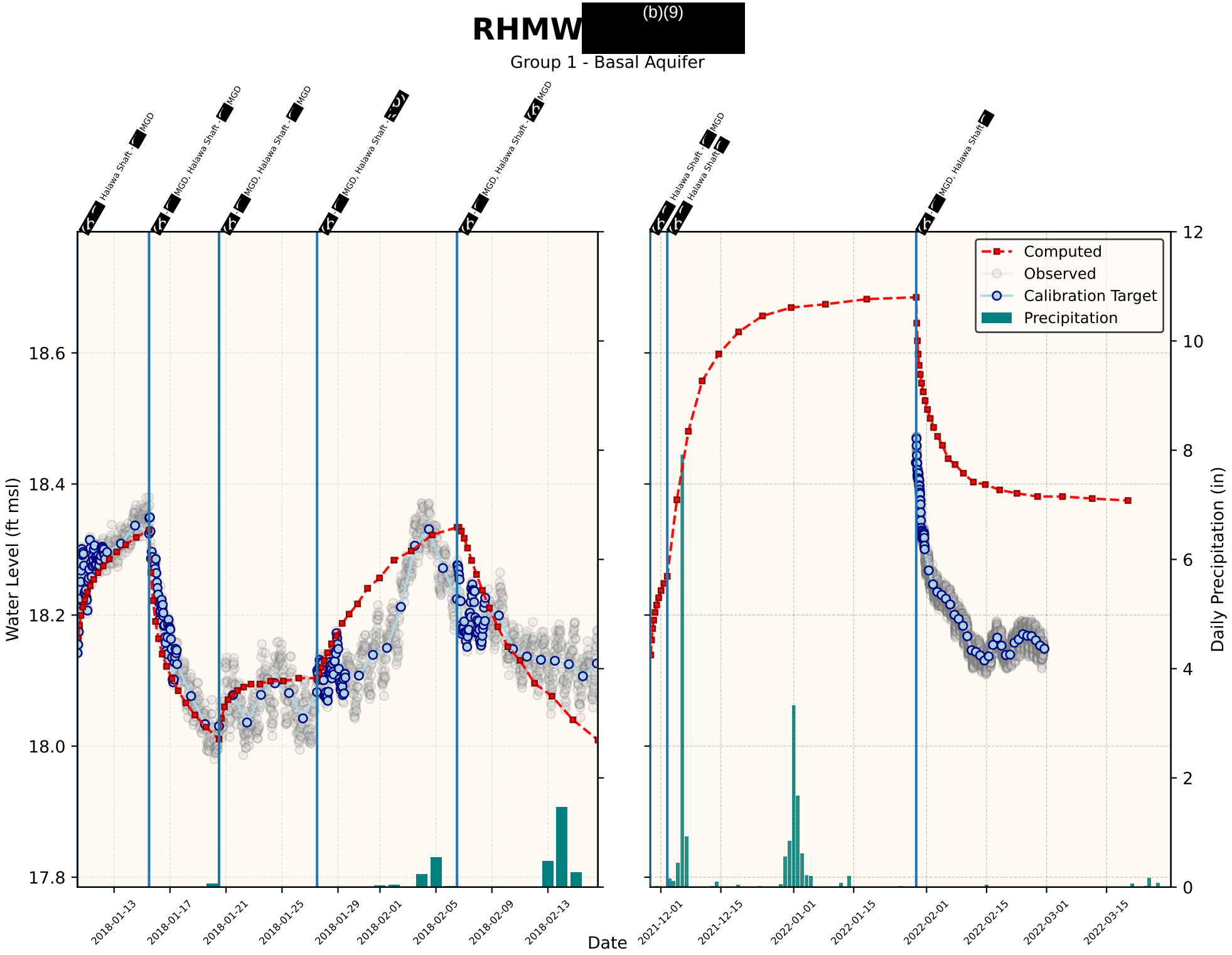

RHMW(b)(9)
Group 1 - Basal Aquifer
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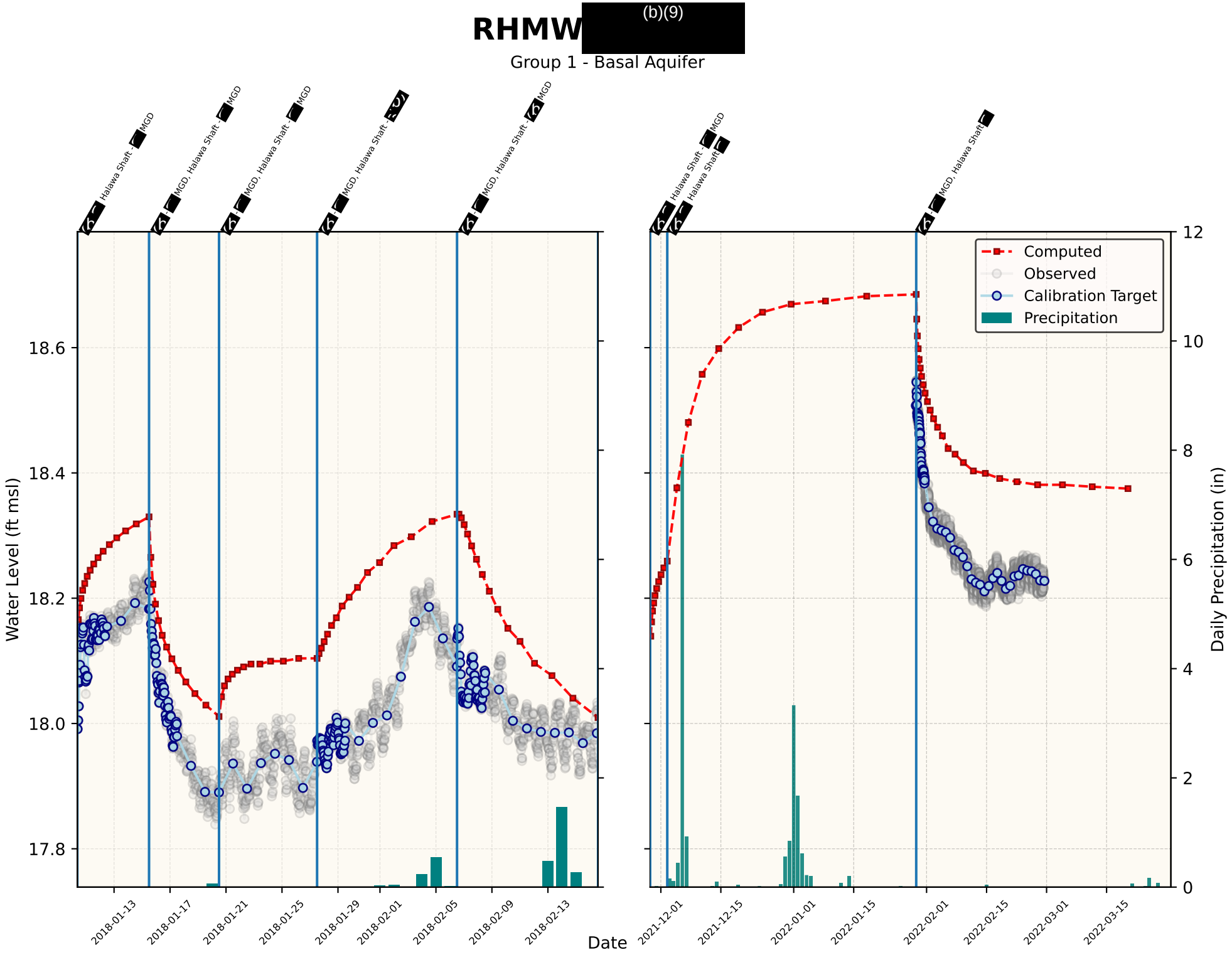

RHMW[redacted] (b)(9)
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RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
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Calibration Target
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Water Level (ft msl)
Daily Precipitation (in)
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RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
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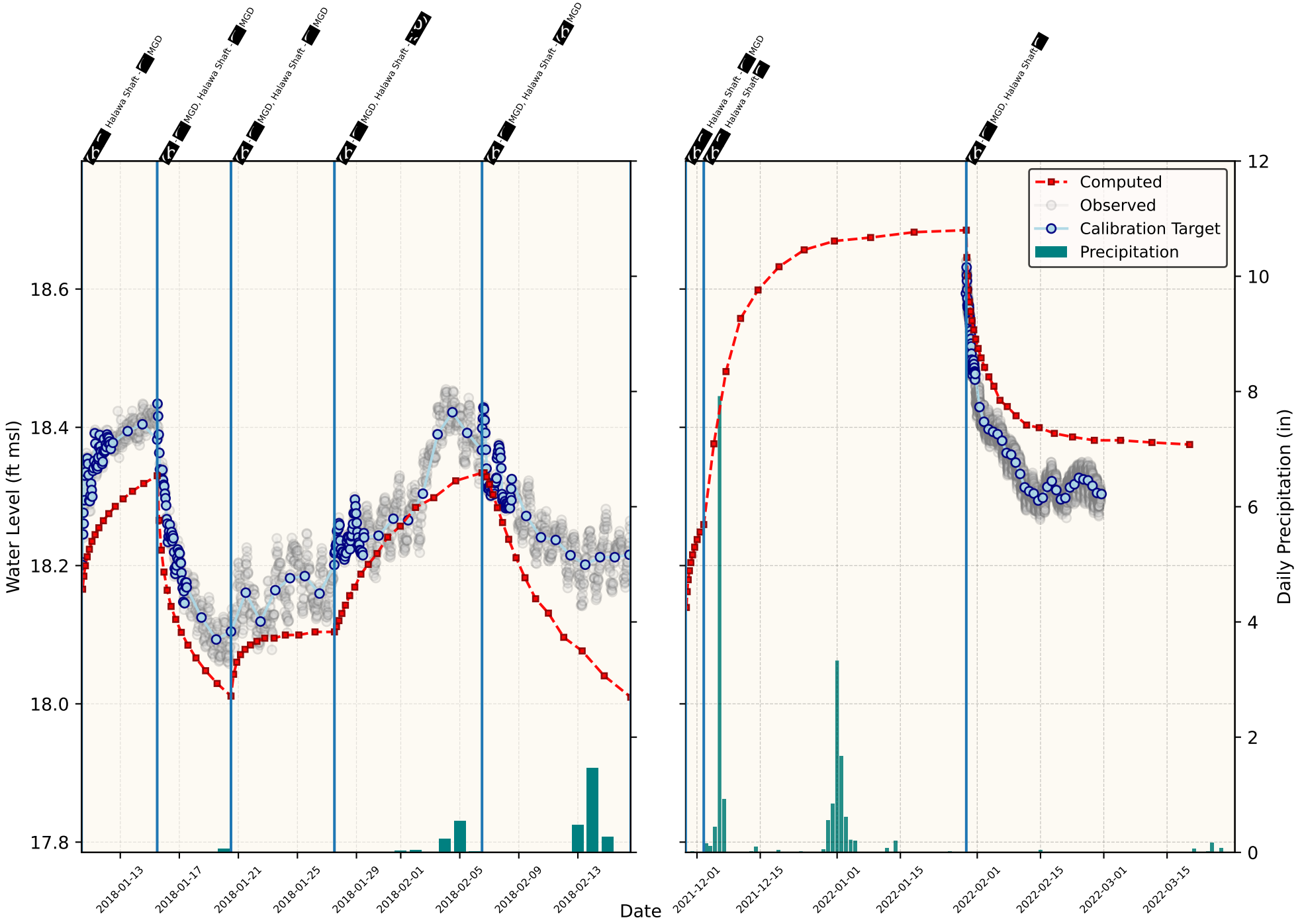

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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Water Level (ft msl)
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RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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Computed
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Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
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RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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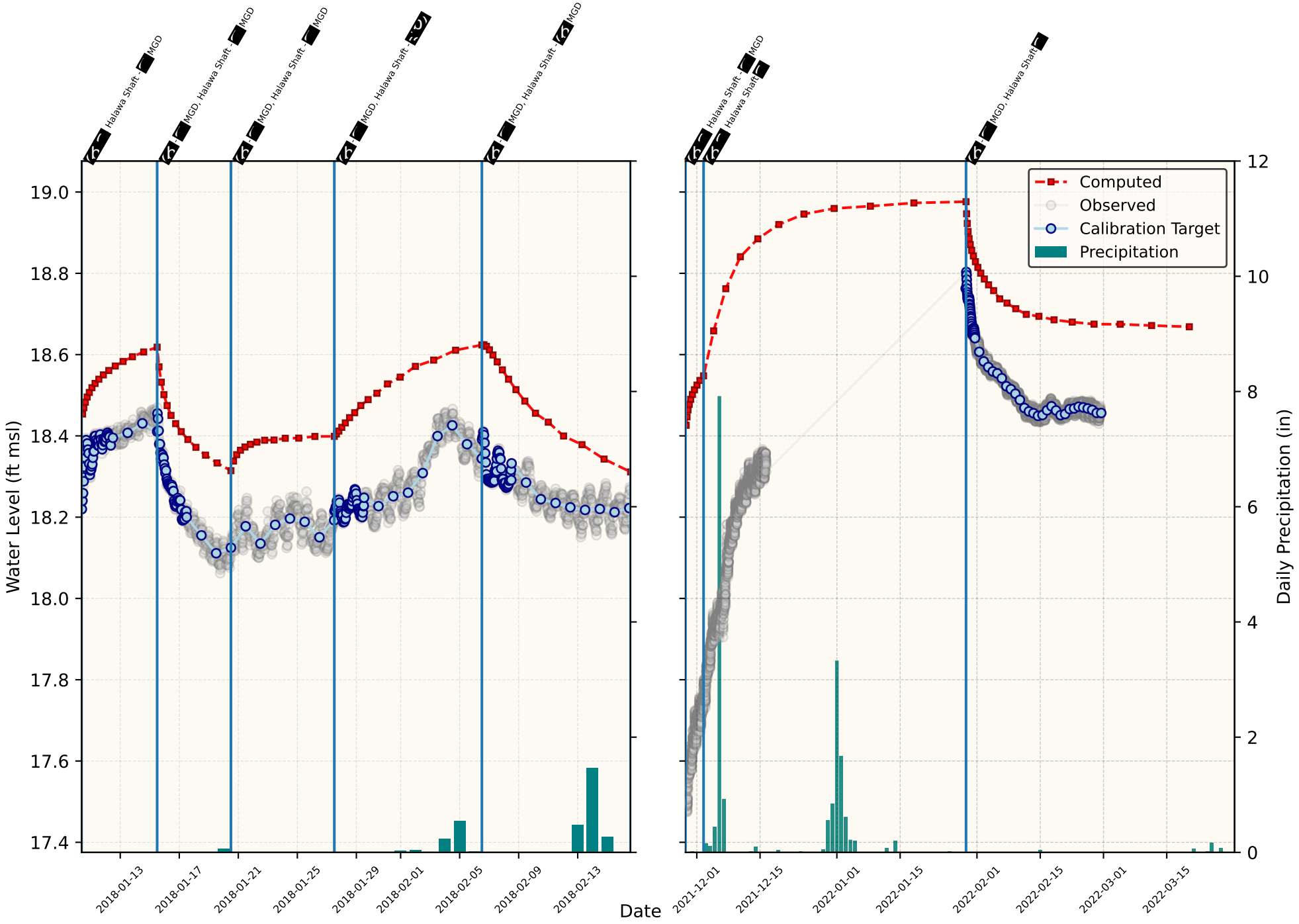
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Group 1 - Basal Aquifer



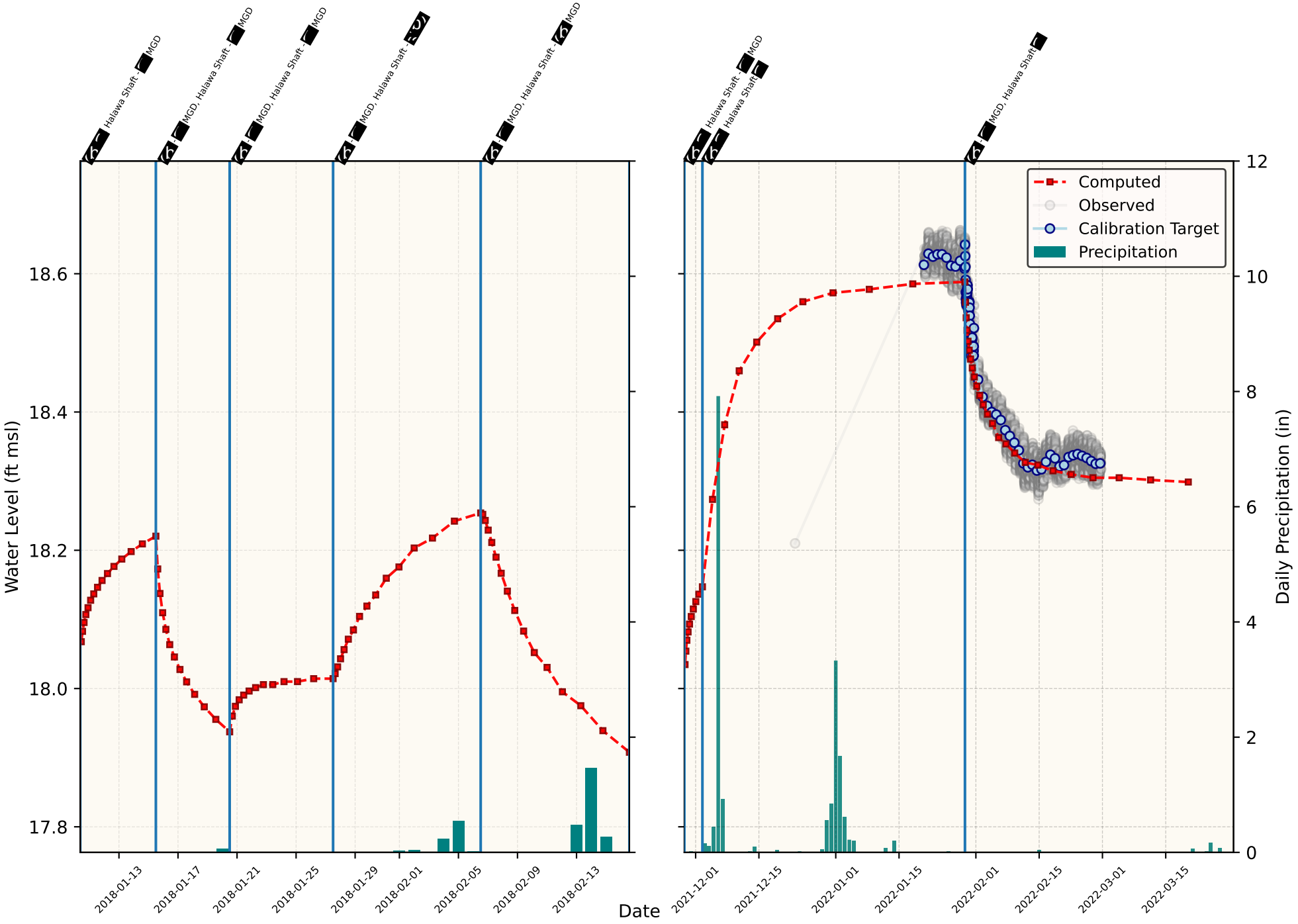
RHMW (b)(9)

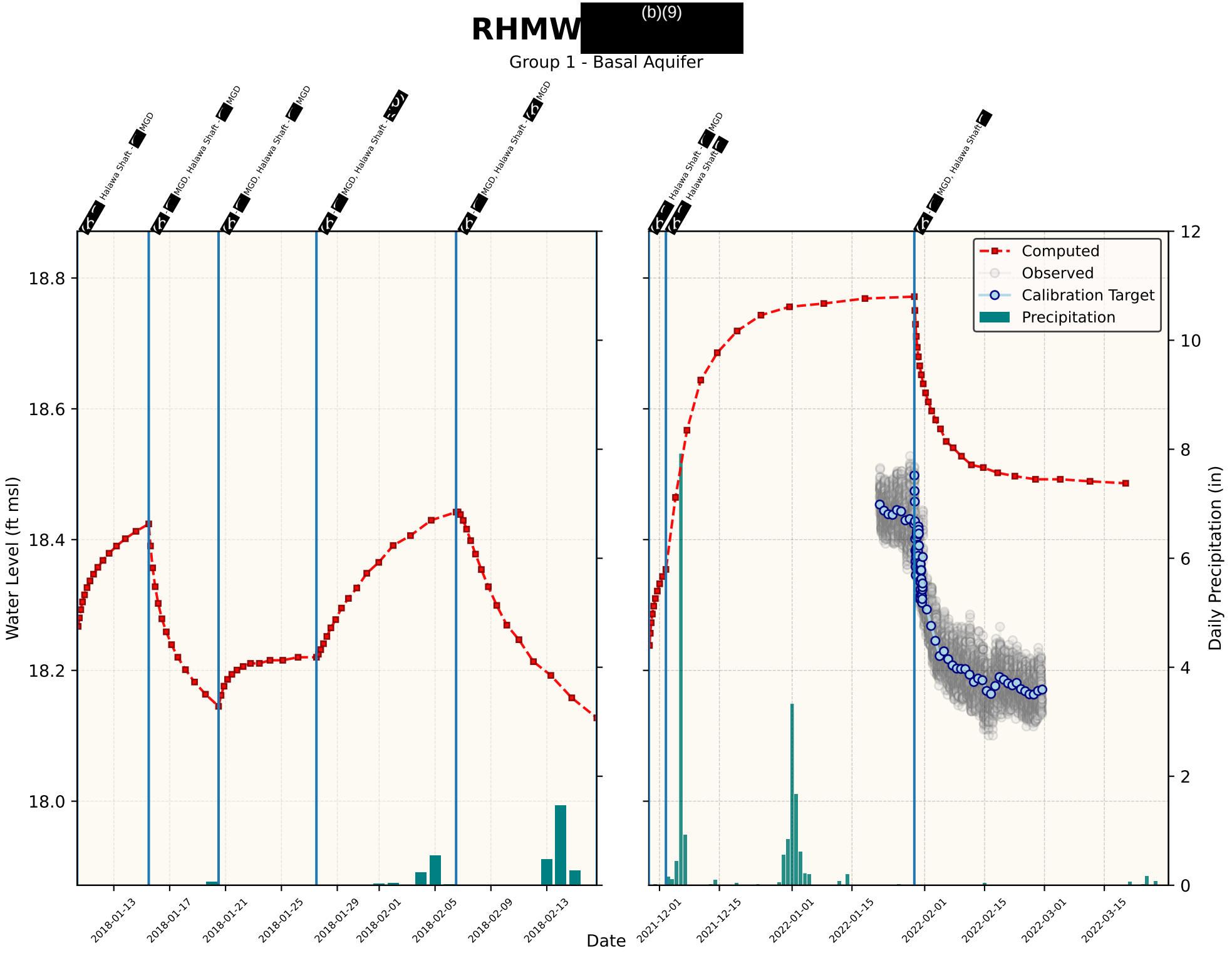
Group 1 - Basal Aquifer

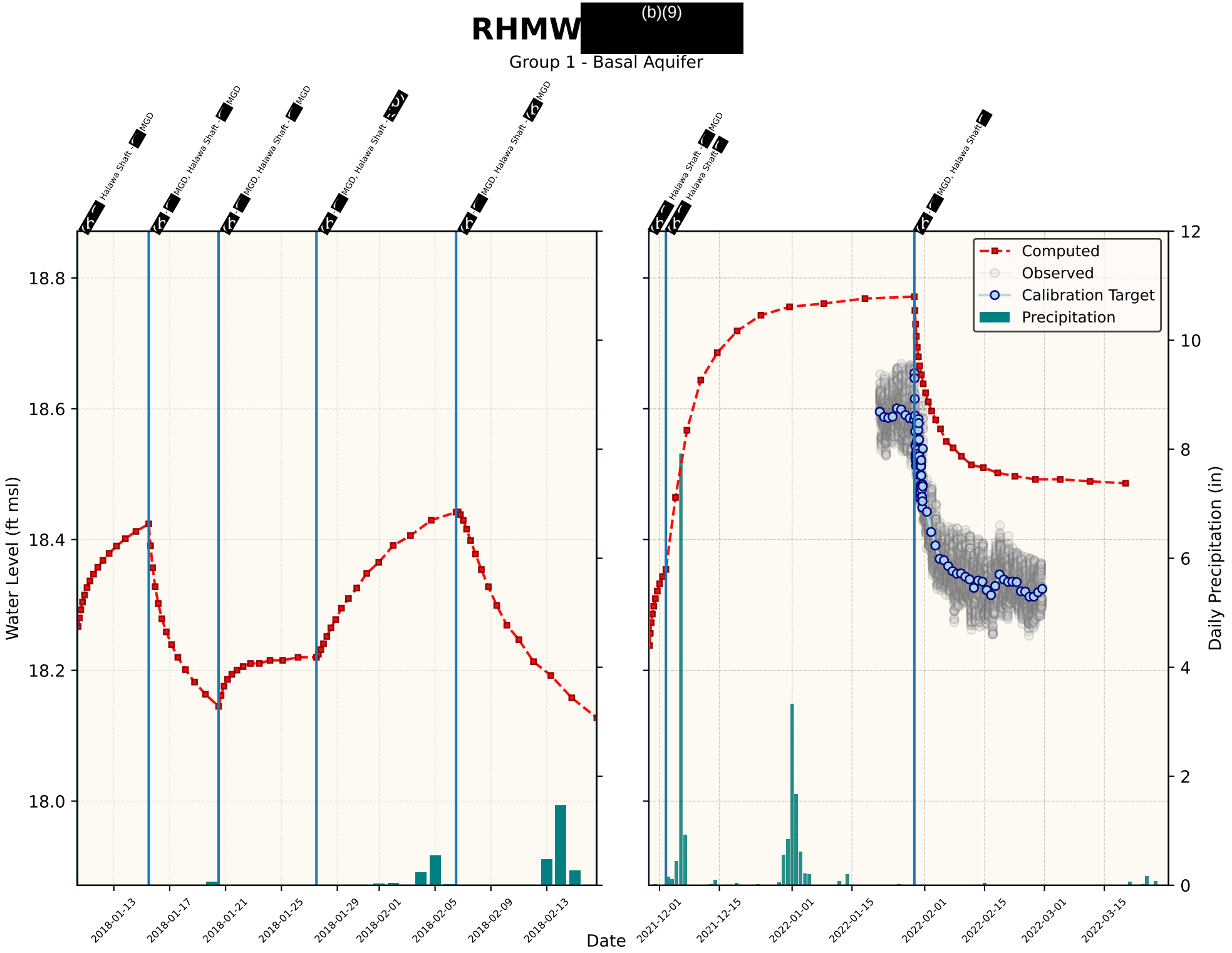


RHMW[(b)(9)]

Group 1 - Basal Aquifer

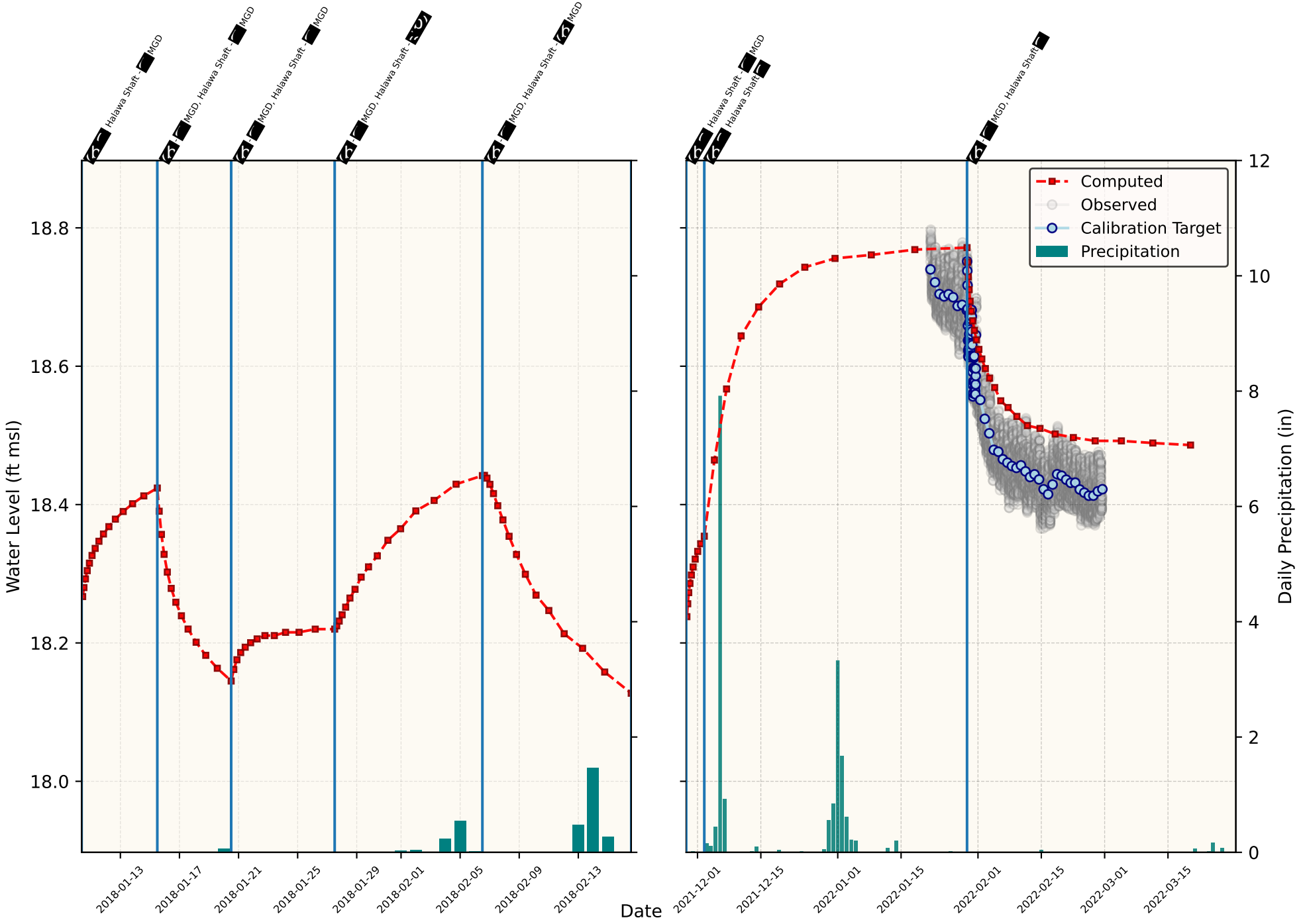


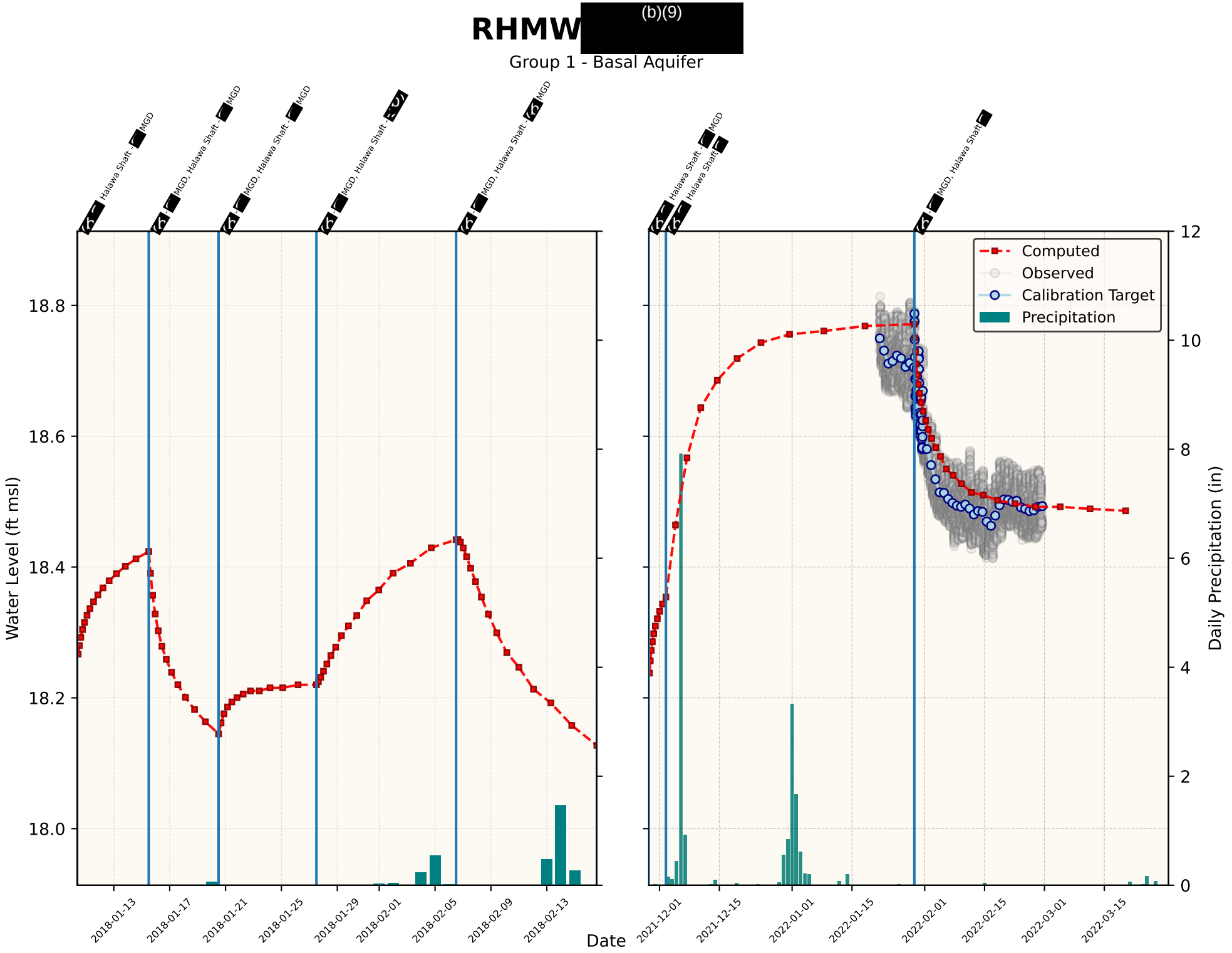

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
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MGD, Halawa Shaft [redacted]
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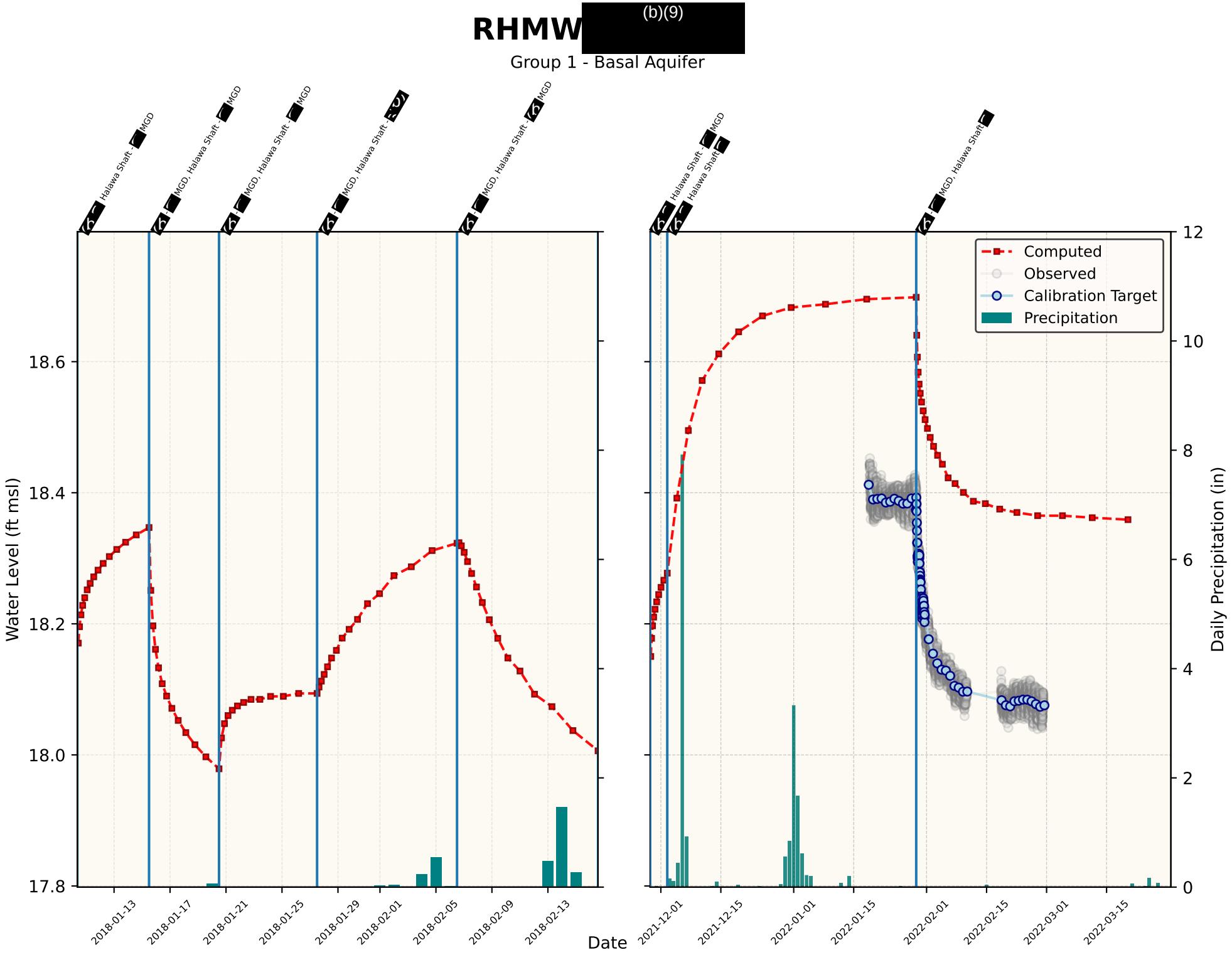

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer

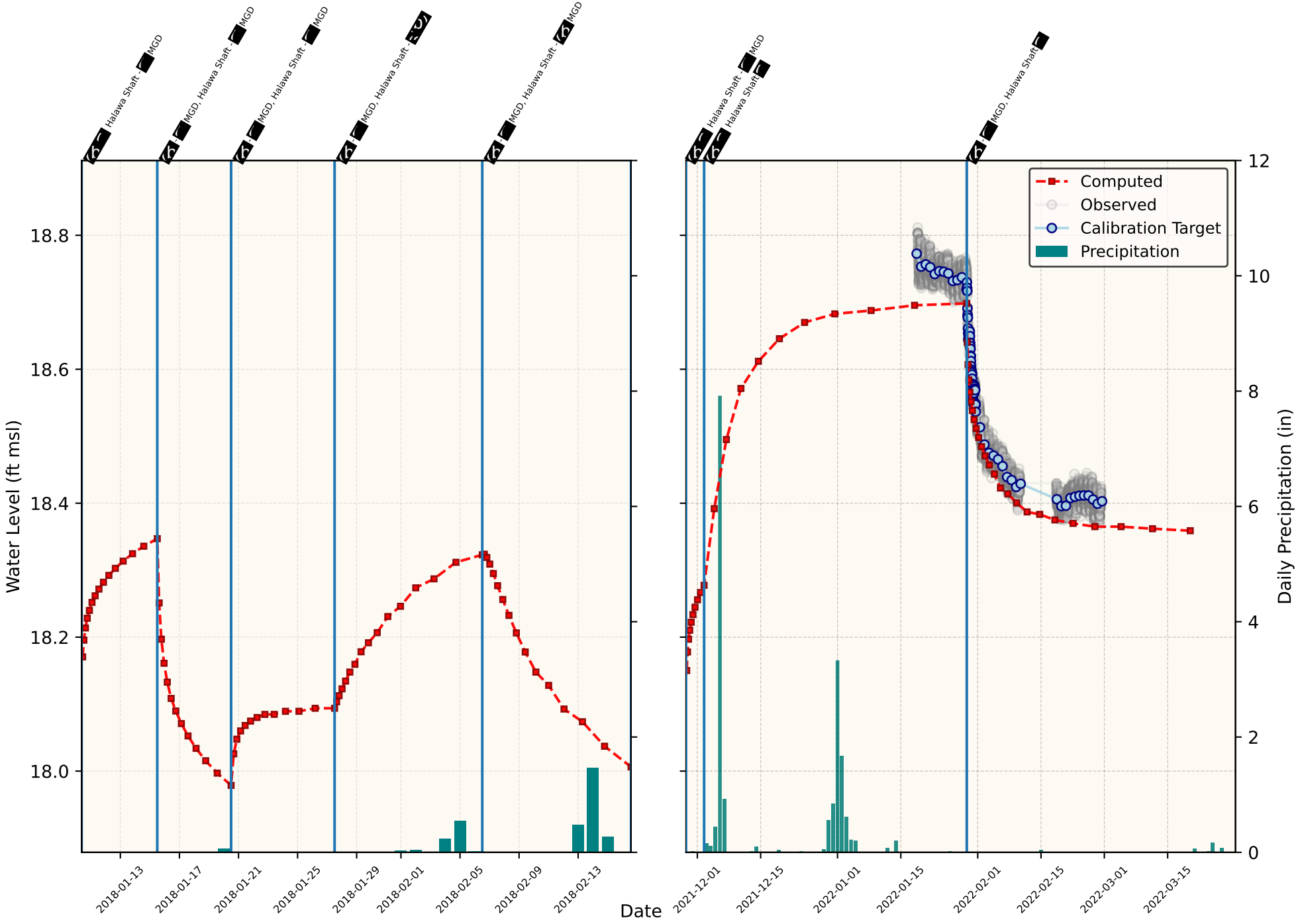


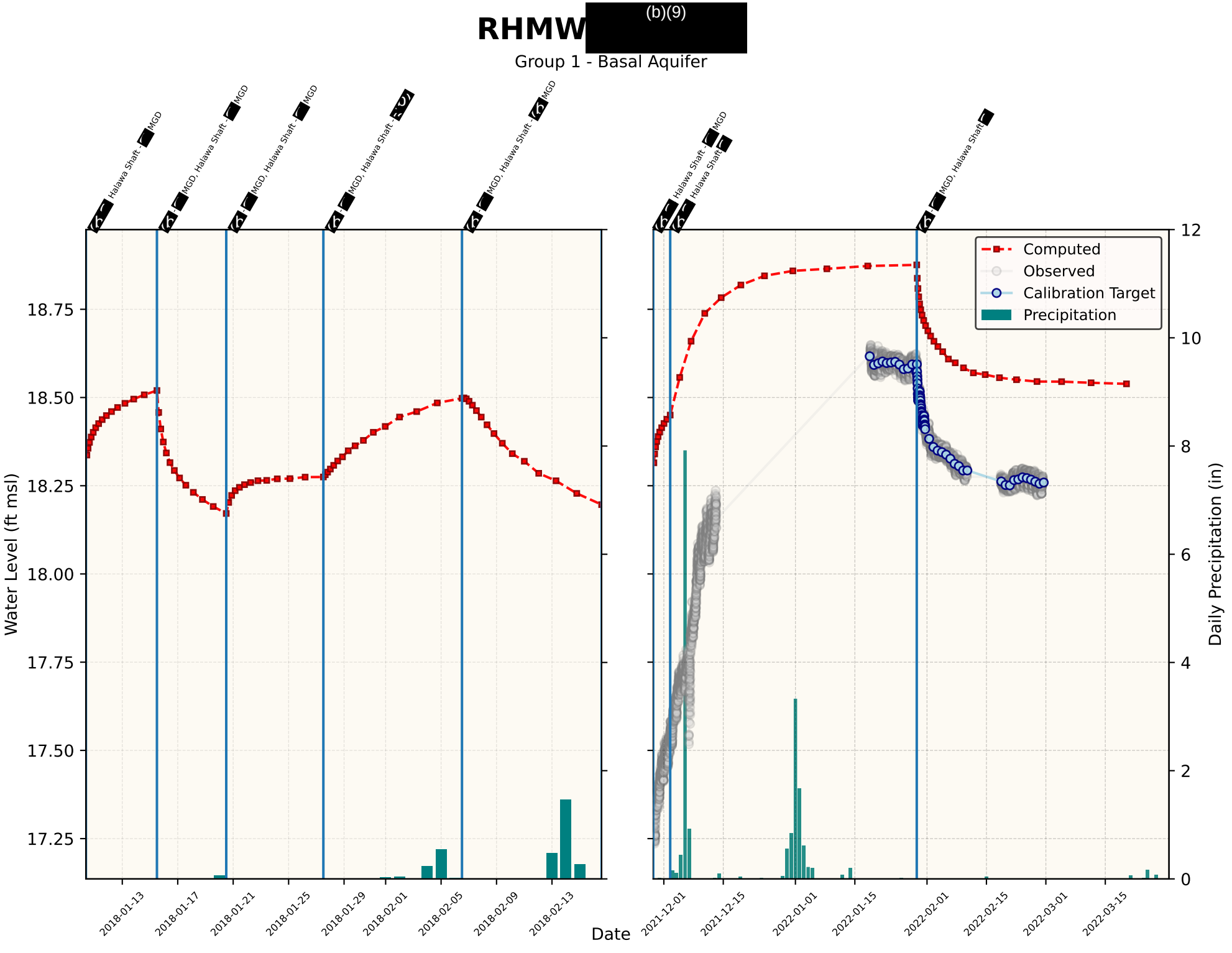

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

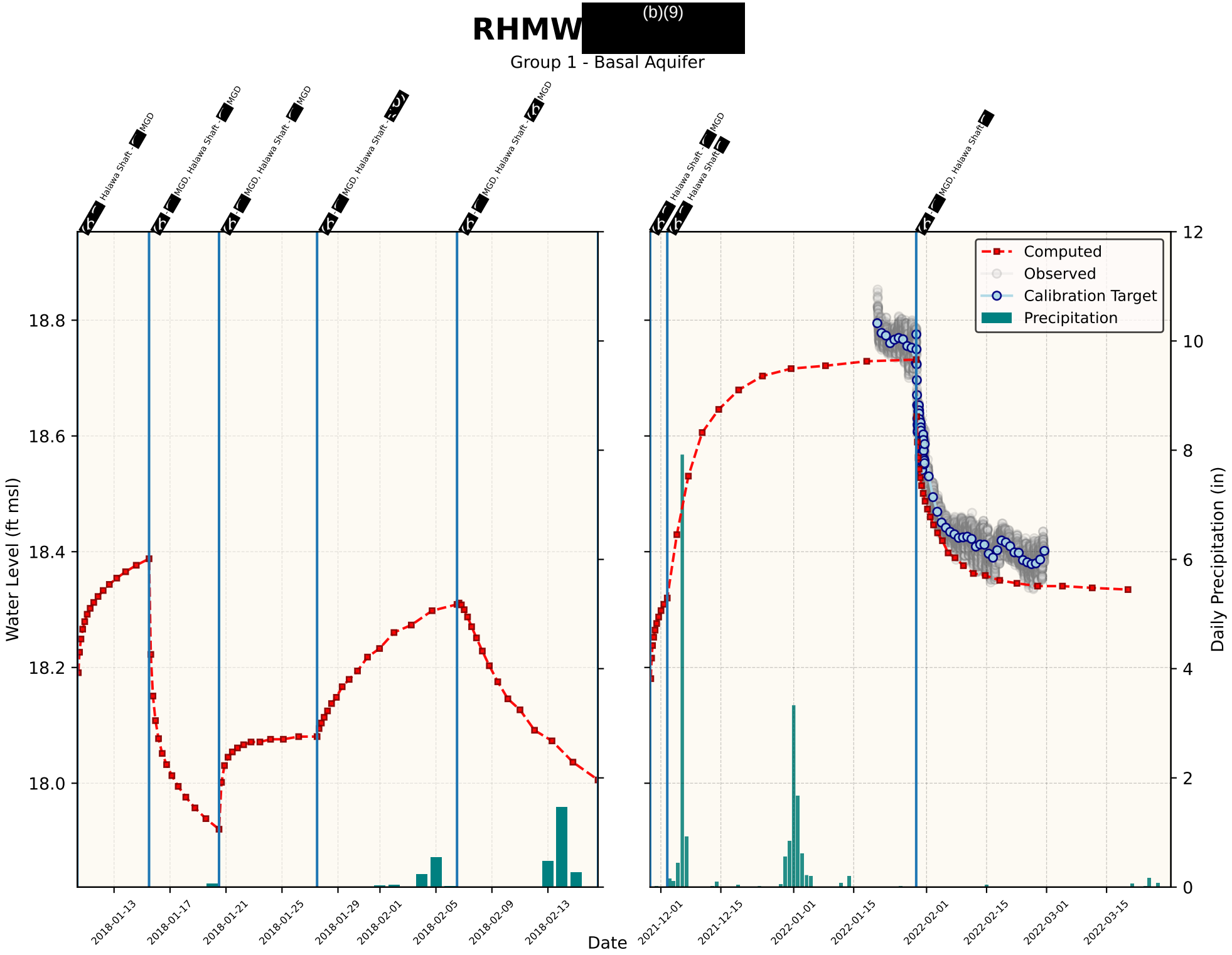

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.6
18.4
18.2
18.0
17.8
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer

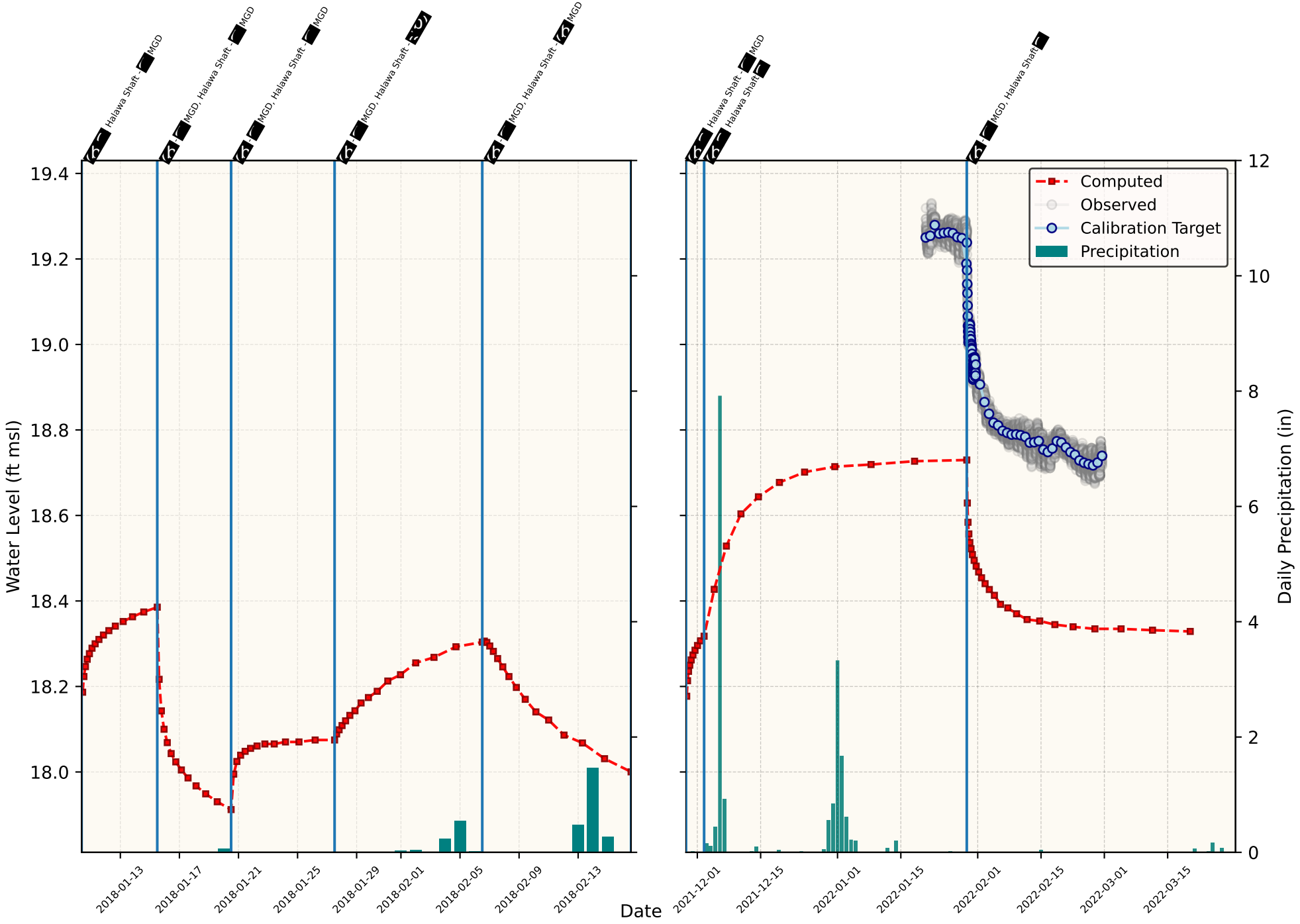


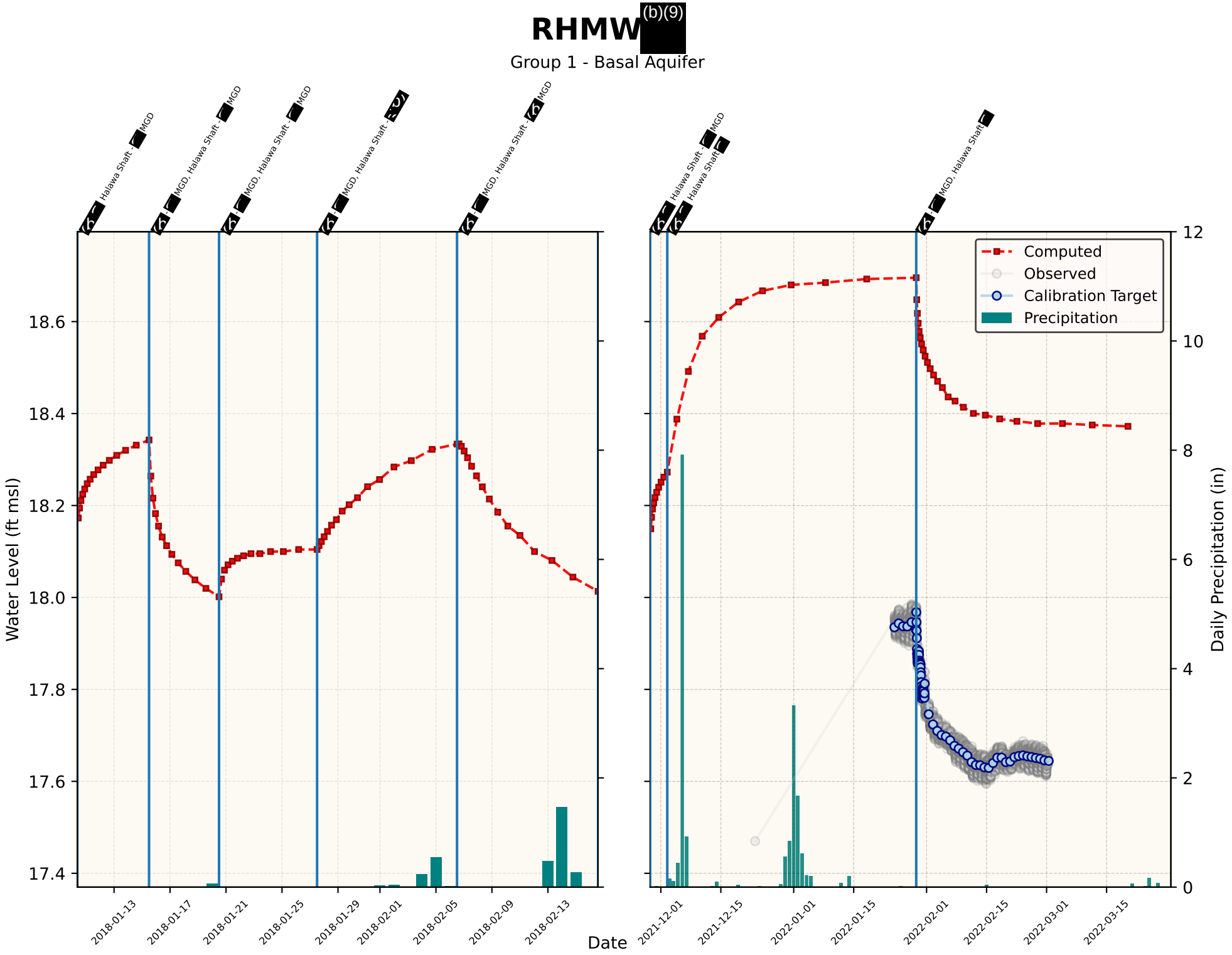

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
MGD, Halawa Shaft MGD
Halawa Shaft MGD
Halawa Shaft
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.75
18.50
18.25
18.00
17.75
17.50
17.25
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

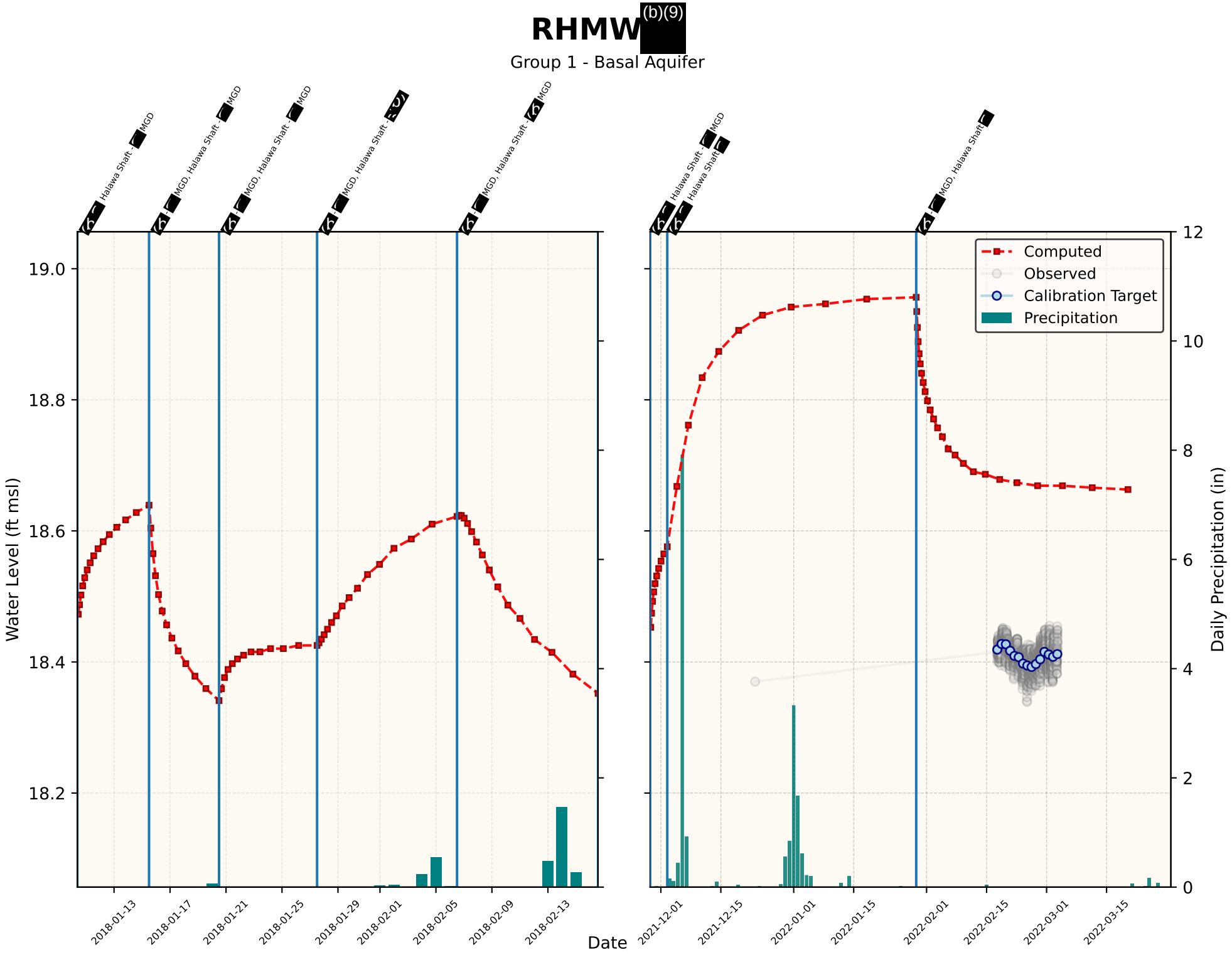

RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

RHMW (b)(9)

Group 1 - Basal Aquifer

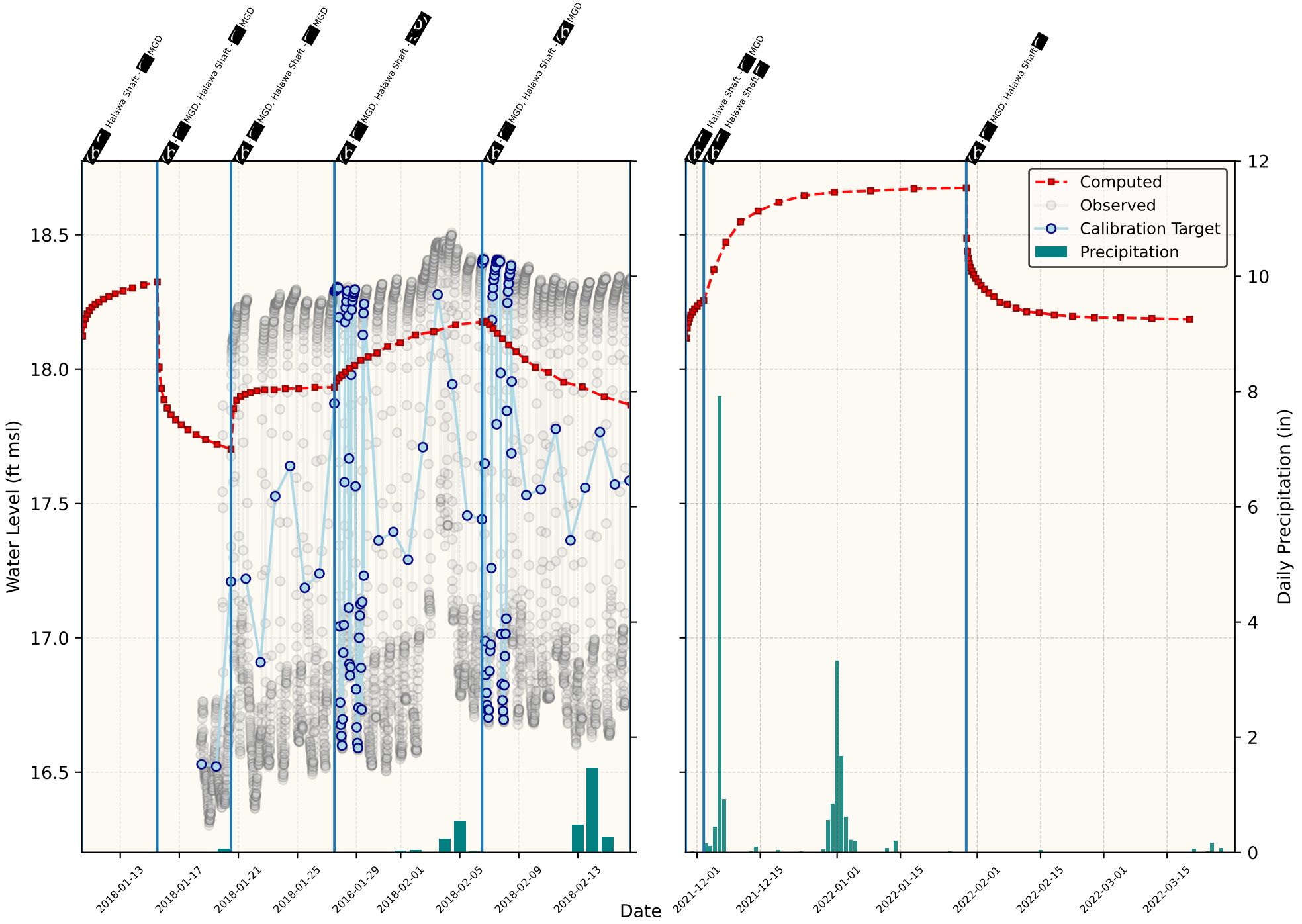



RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
18.6
18.4
18.2
18.0
17.8
17.6
17.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.0
18.8
18.6
18.4
18.2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

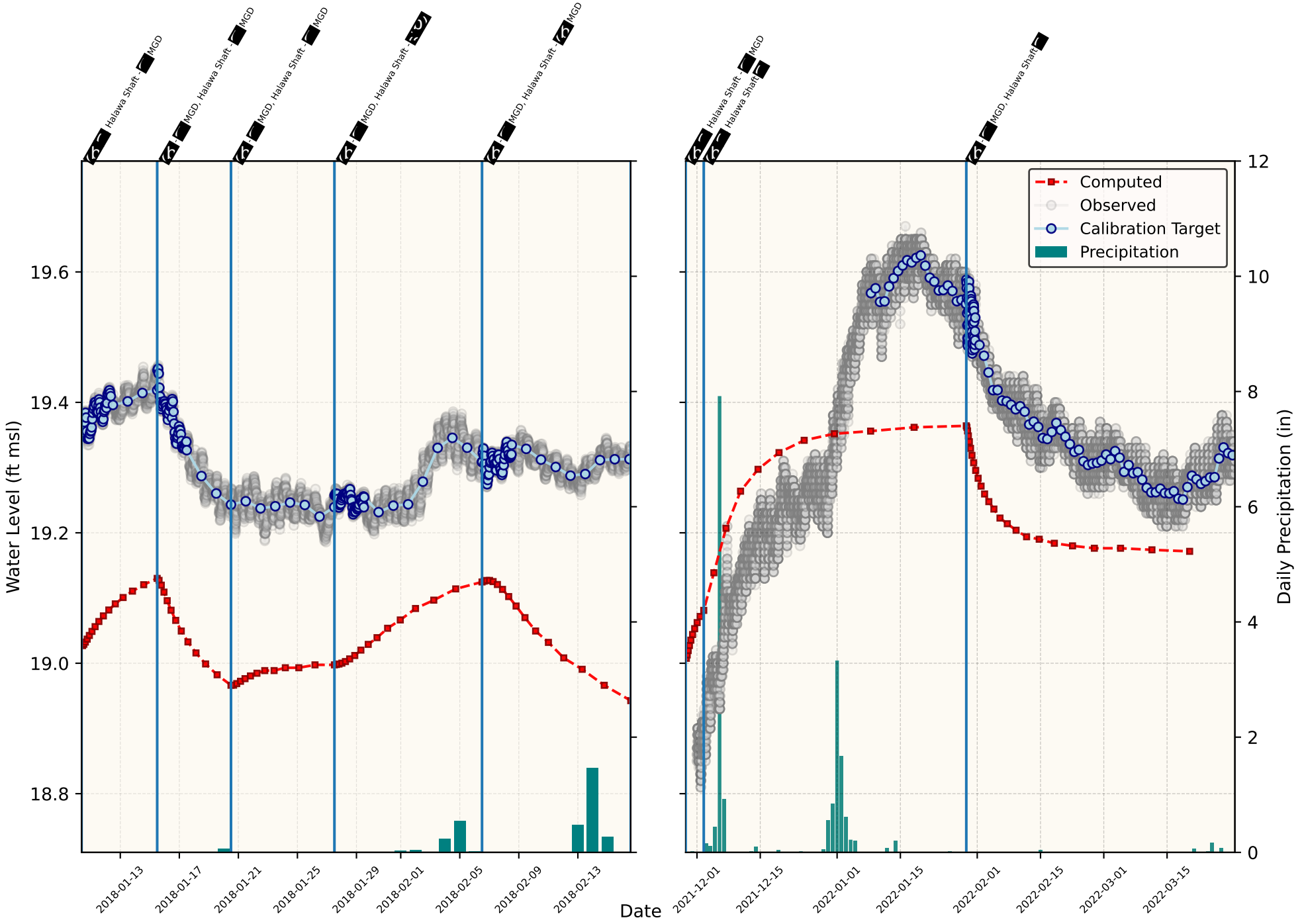
RHMW [redacted] (b)(9)

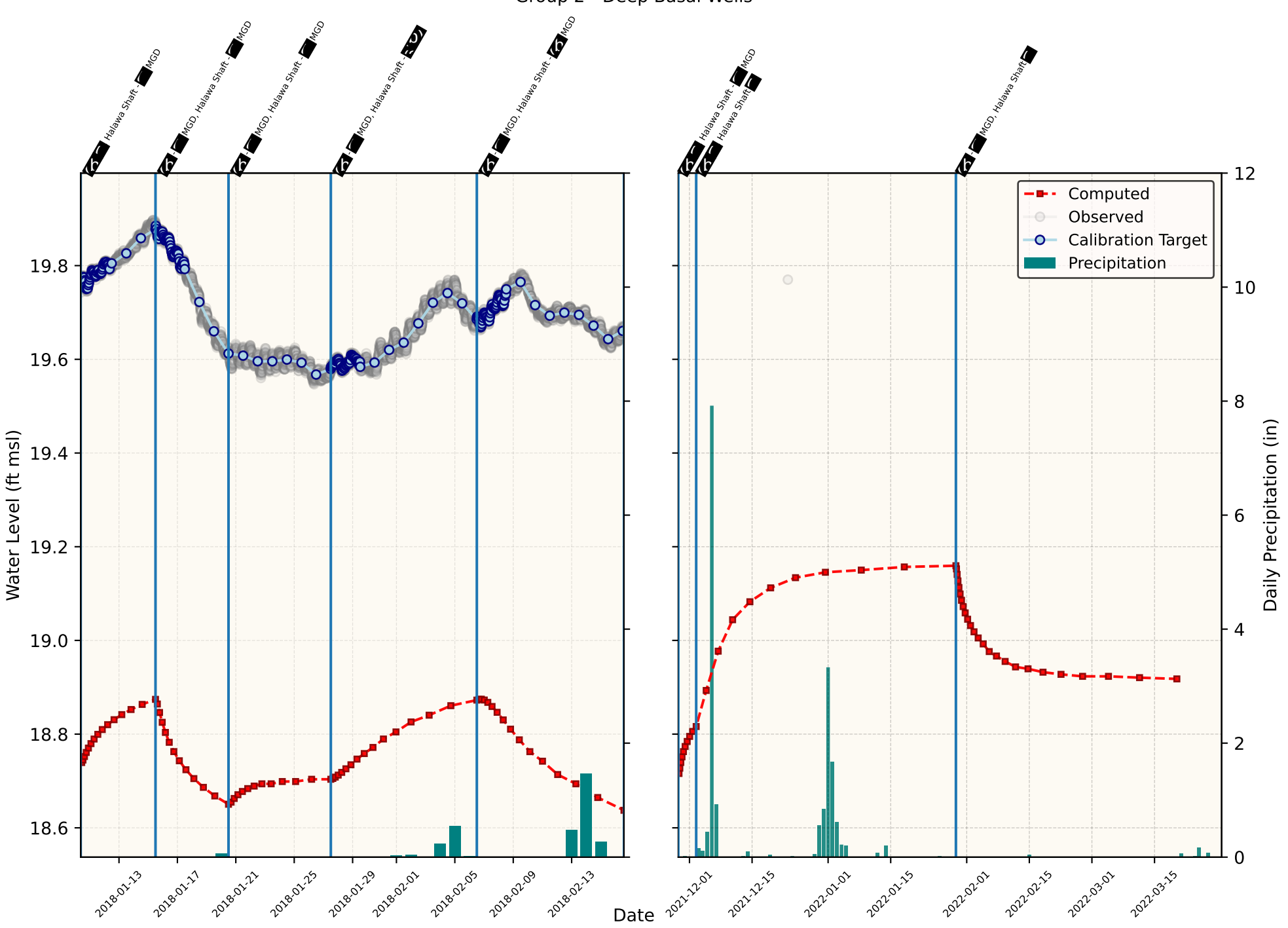
Group 1 - Basal Aquifer

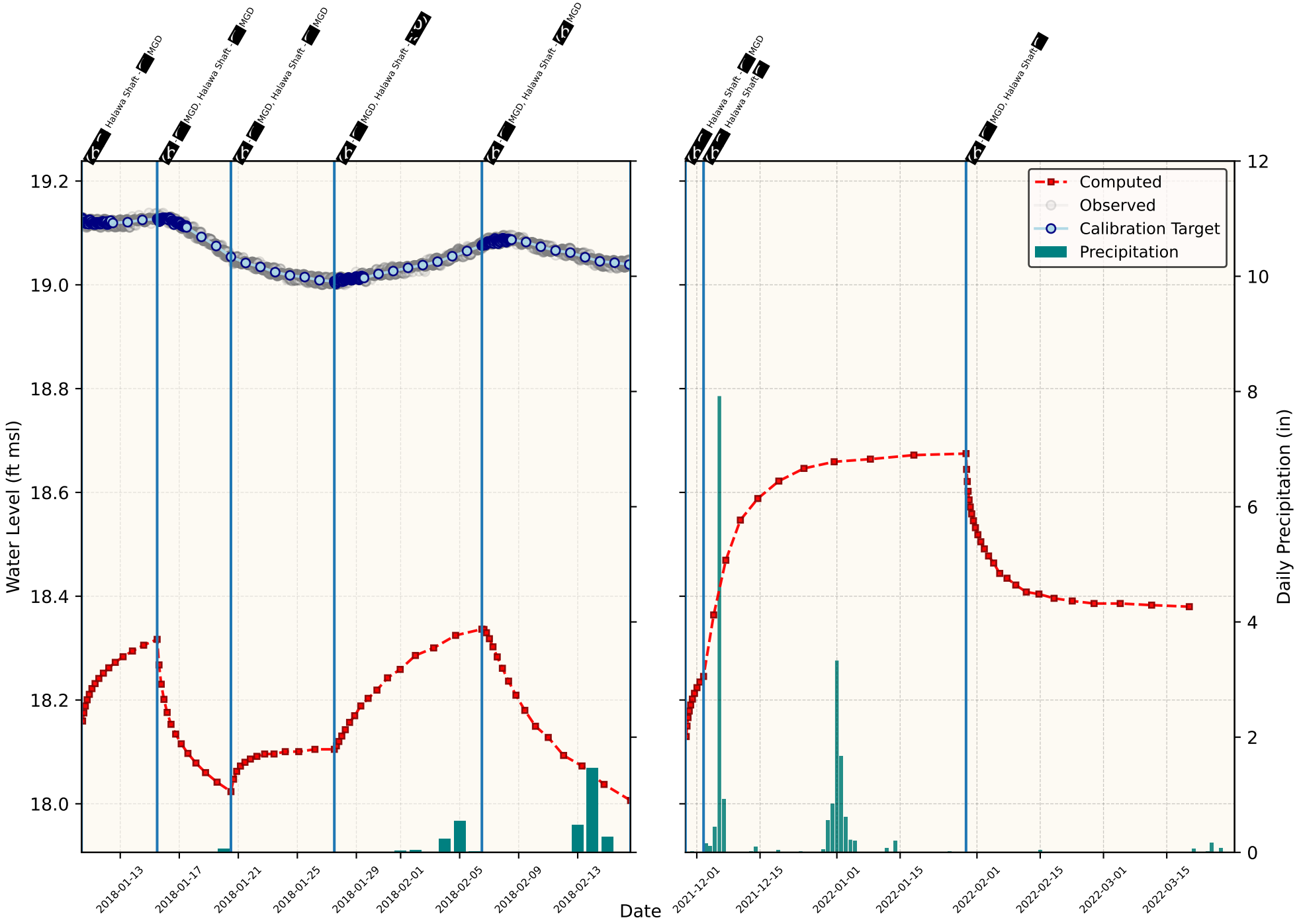


TAMC [redacted]

Group 1 - Basal Aquifer

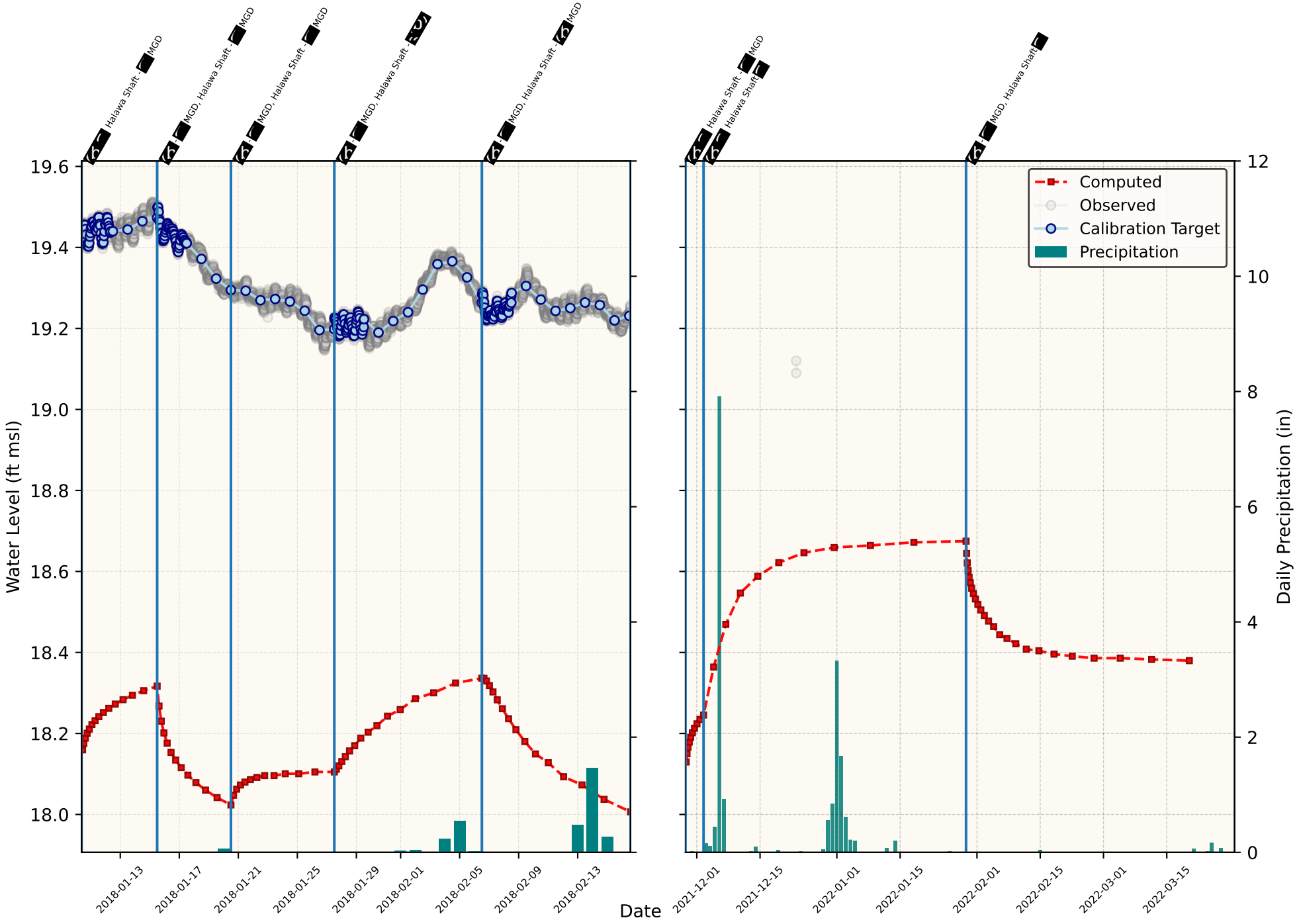


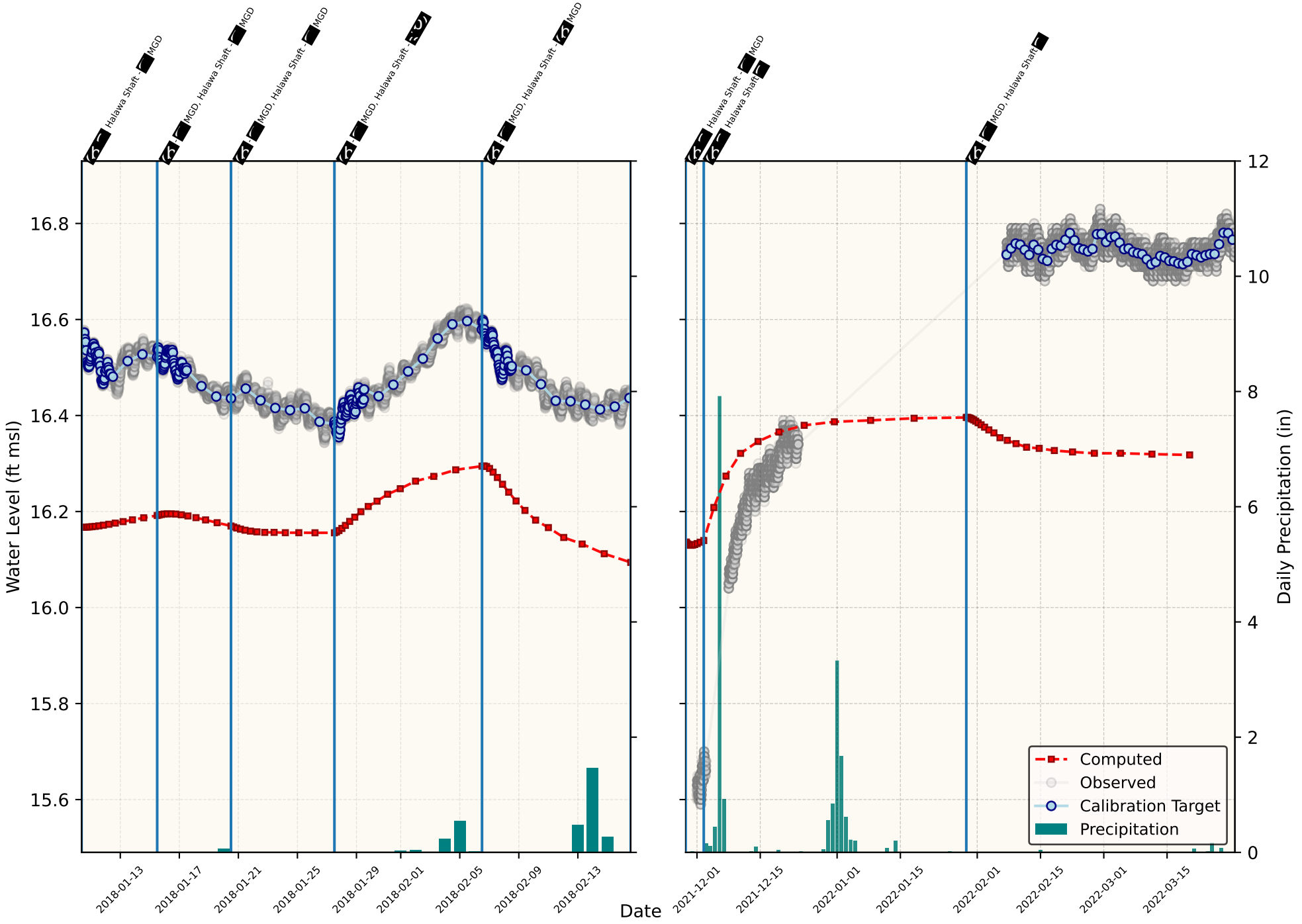

DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.8
19.6
19.4
19.2
19.0
18.8
18.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Water Level (ft msl)
Daily Precipitation (in)
Date
19.2
19.0
18.8
18.6
18.4
18.2
18.0
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

Halawa_Deep_Monitor_Well_HDMW2253-03

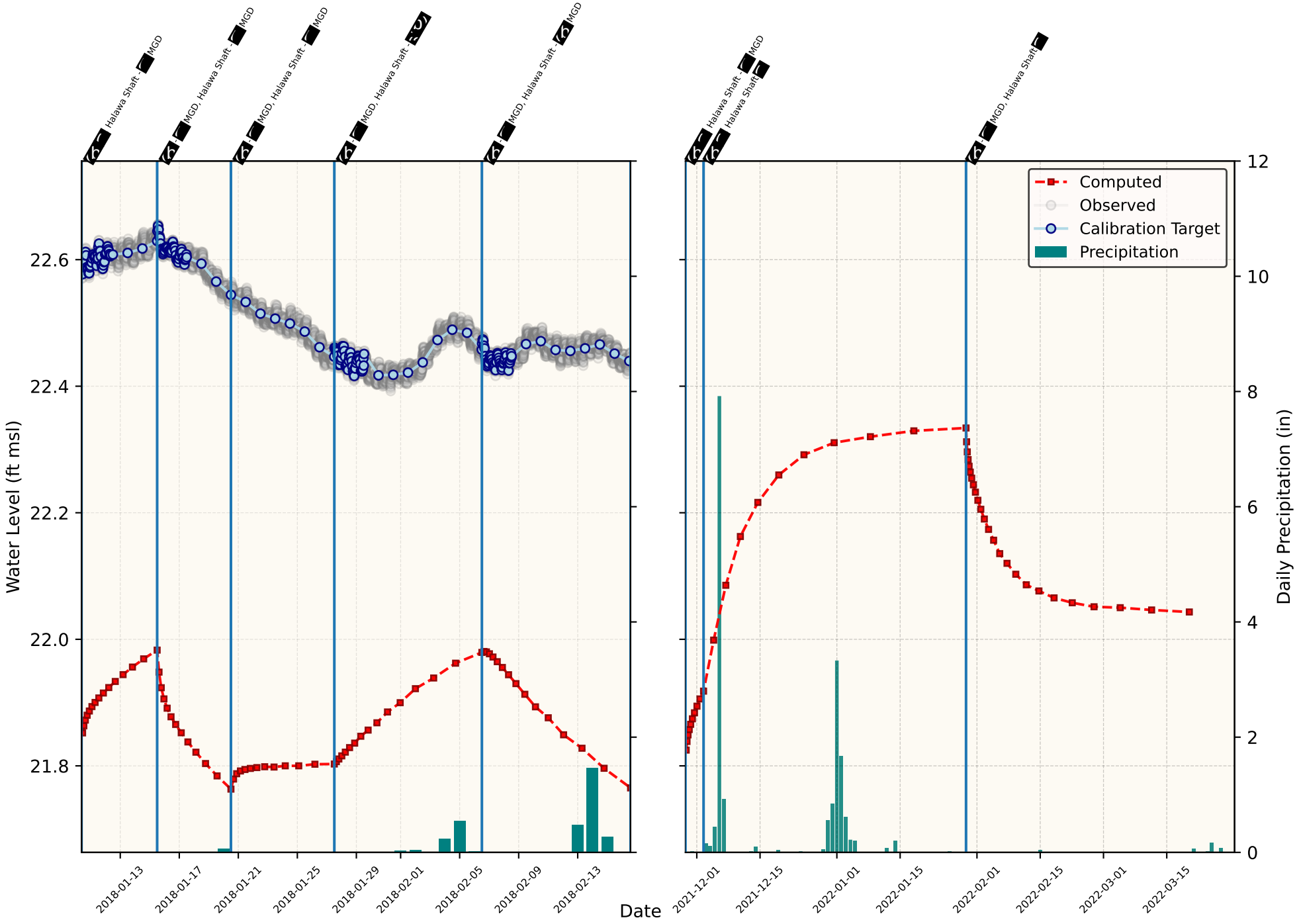
Group 2 - Deep Basal Wells




Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Water Level (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

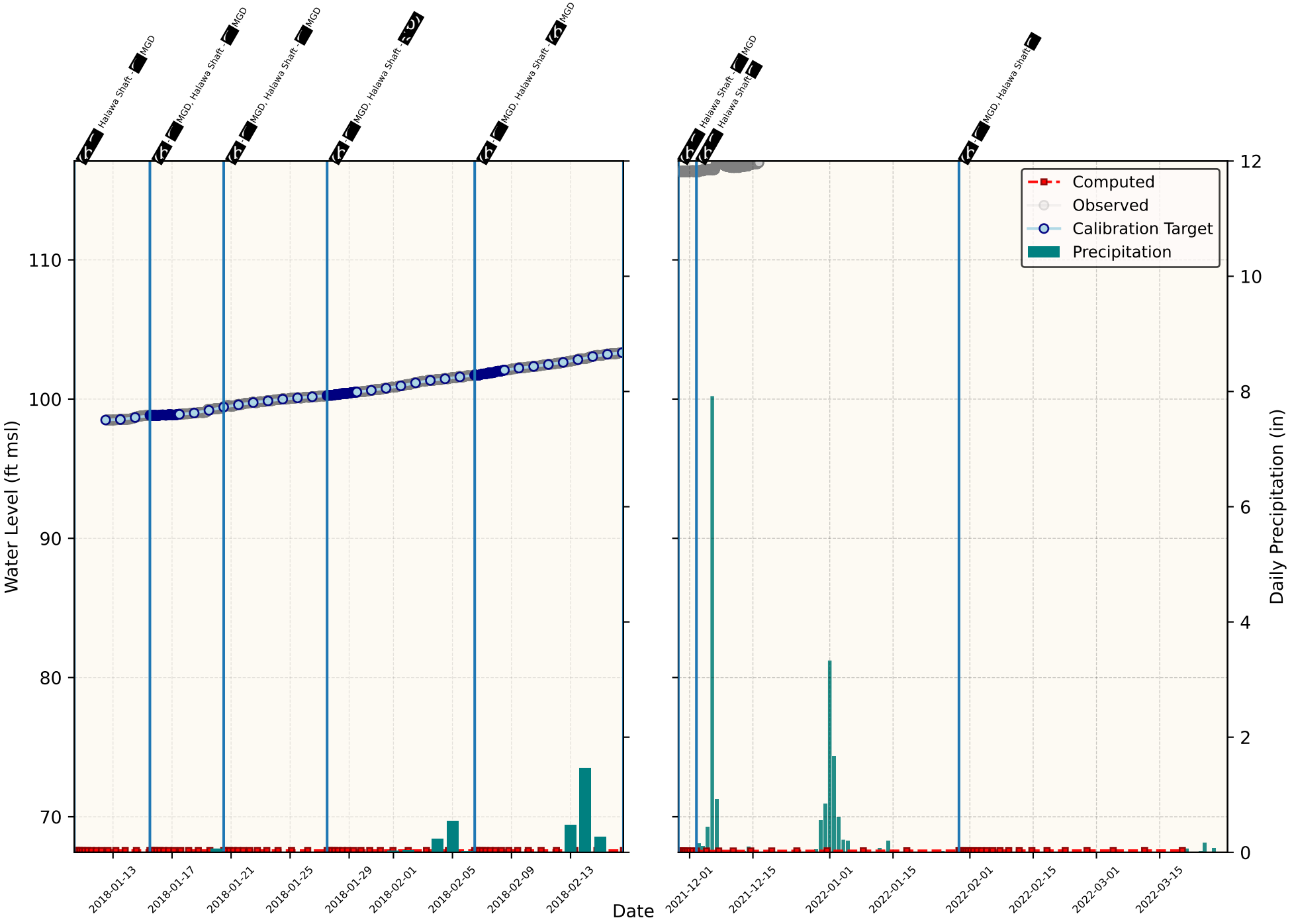
RHMW[redacted]

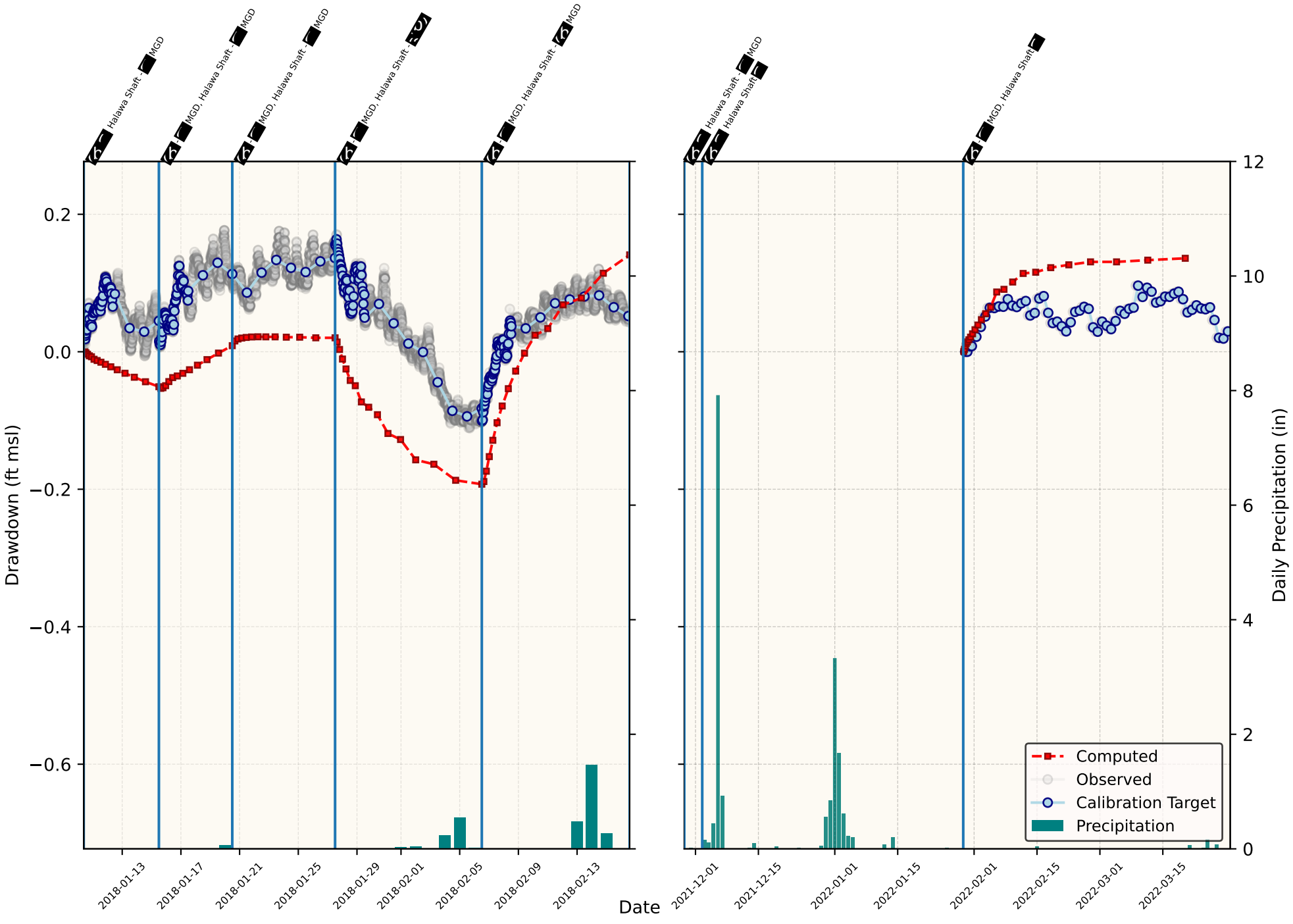
Group 3 - Saprolite/Confining Unit Well with Elevated Head



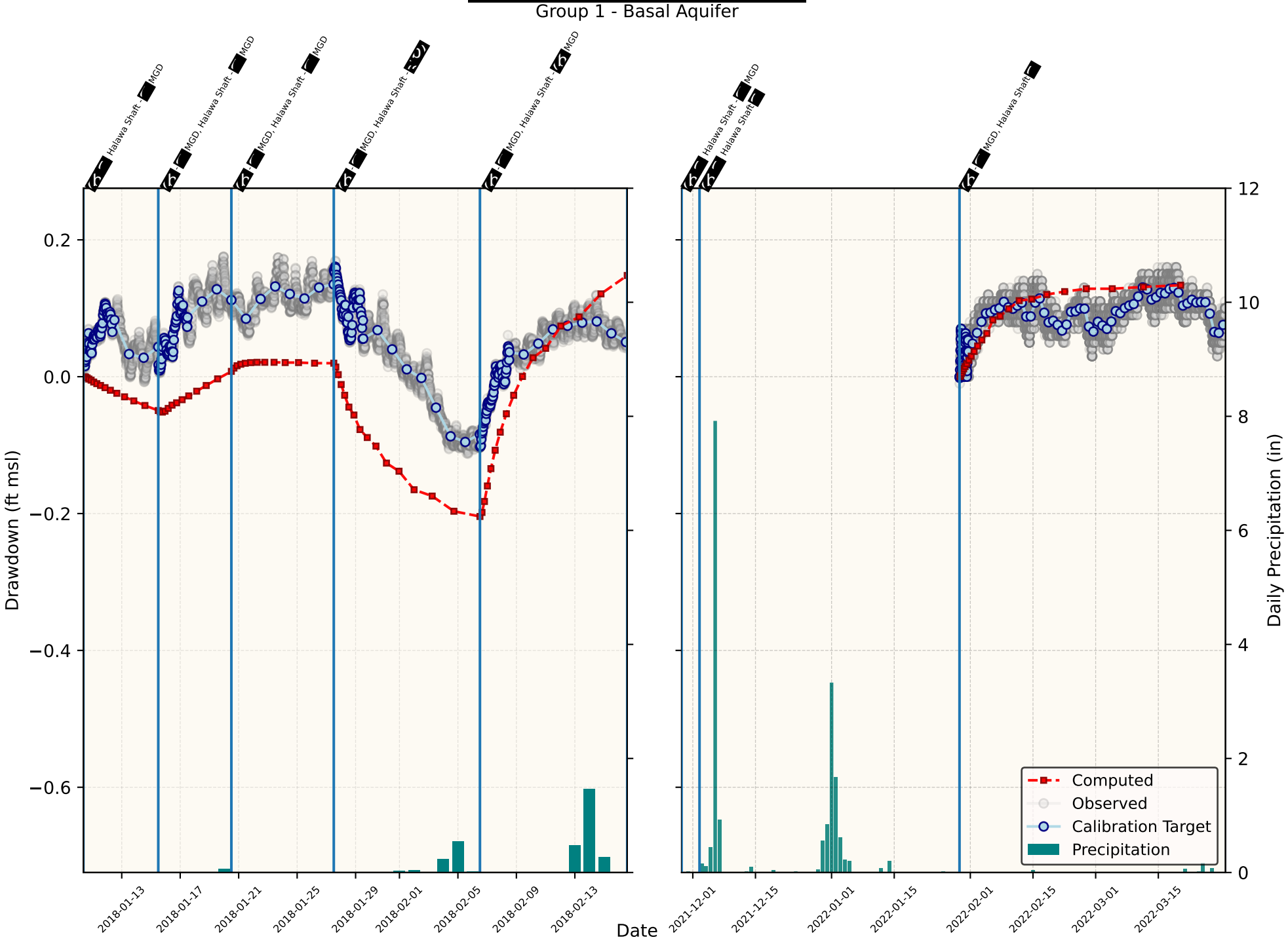
RHMW[redacted] (b)(9)

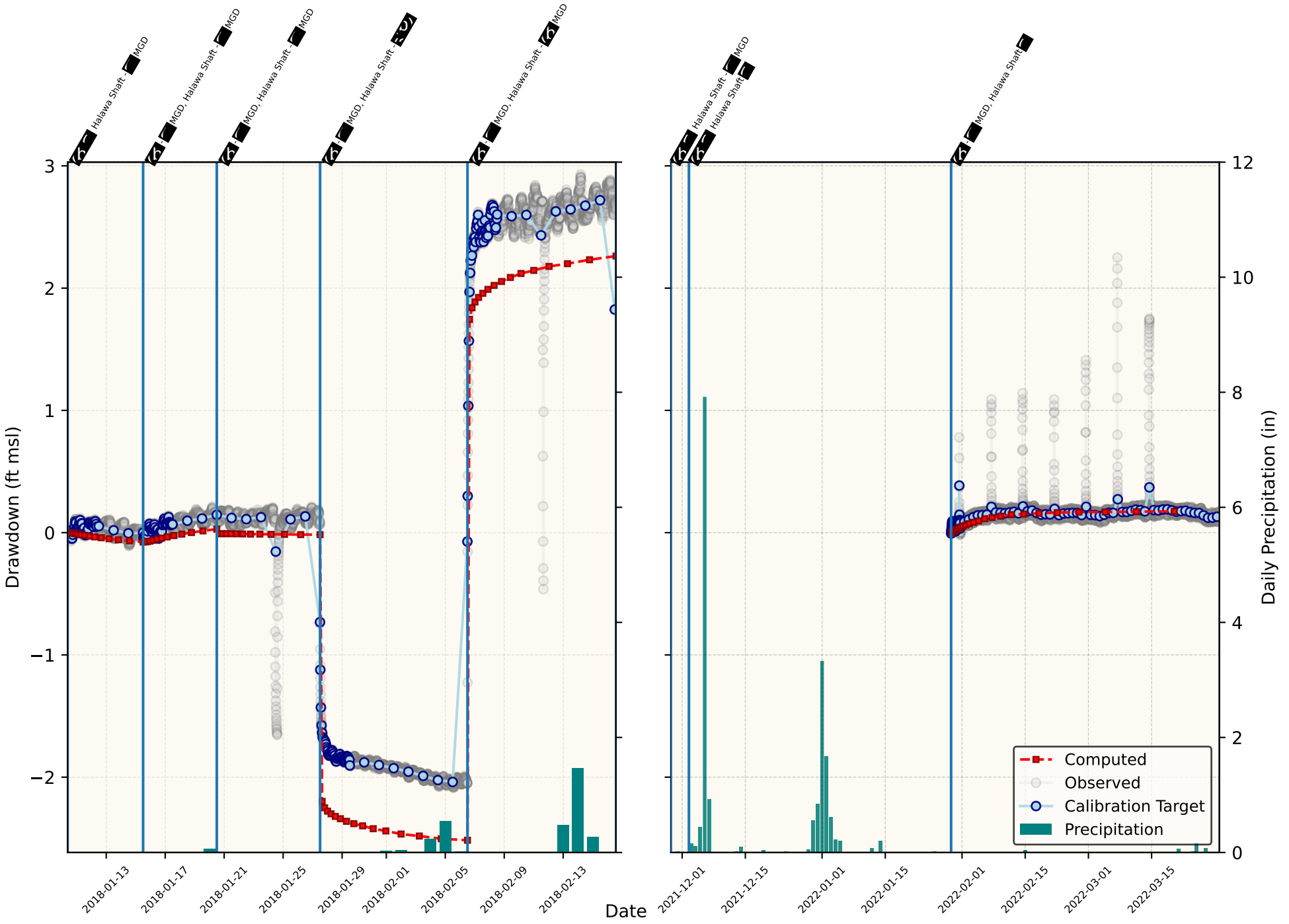
Group 3 - Saprolite/Confining Unit Well with Elevated Head

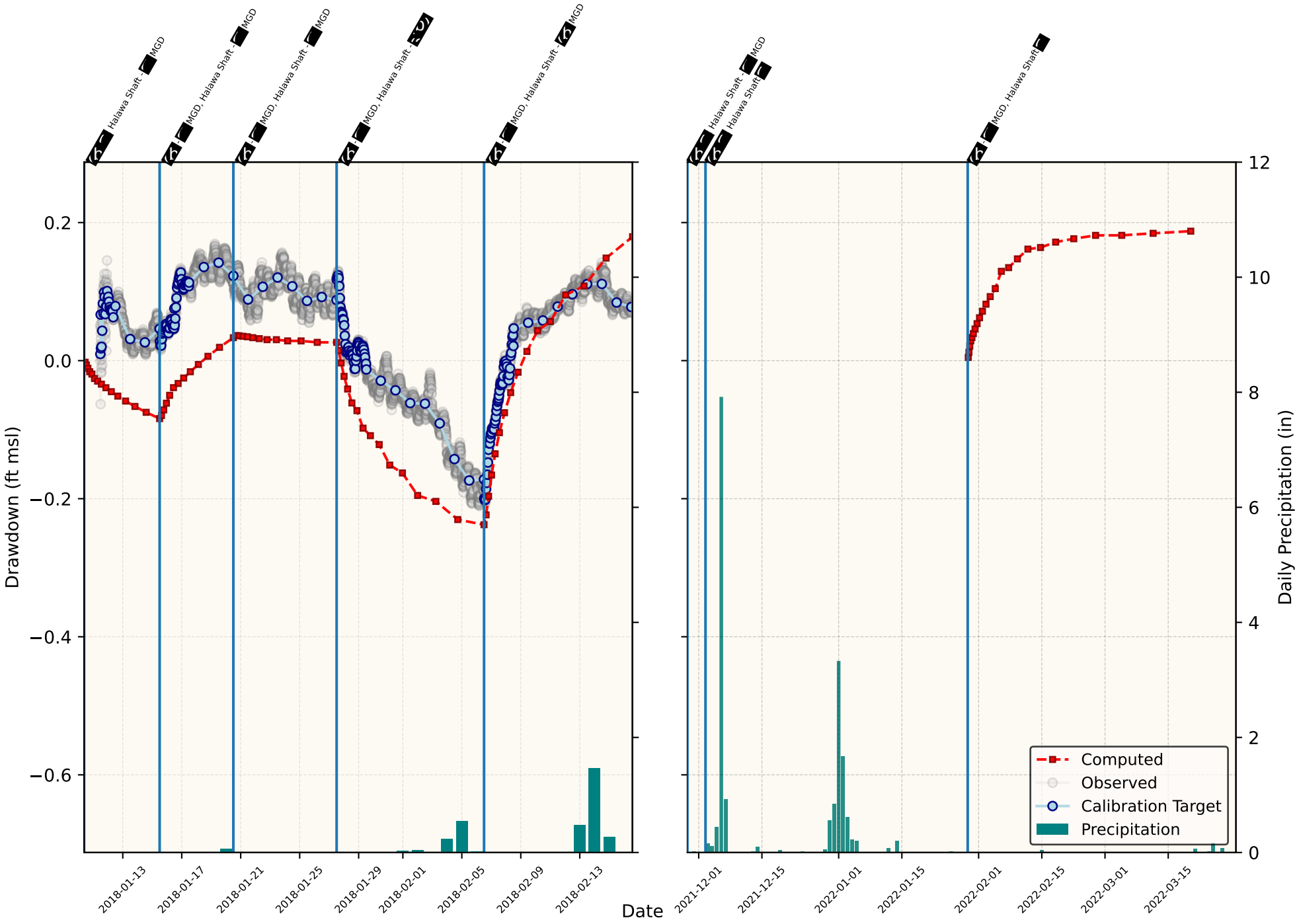


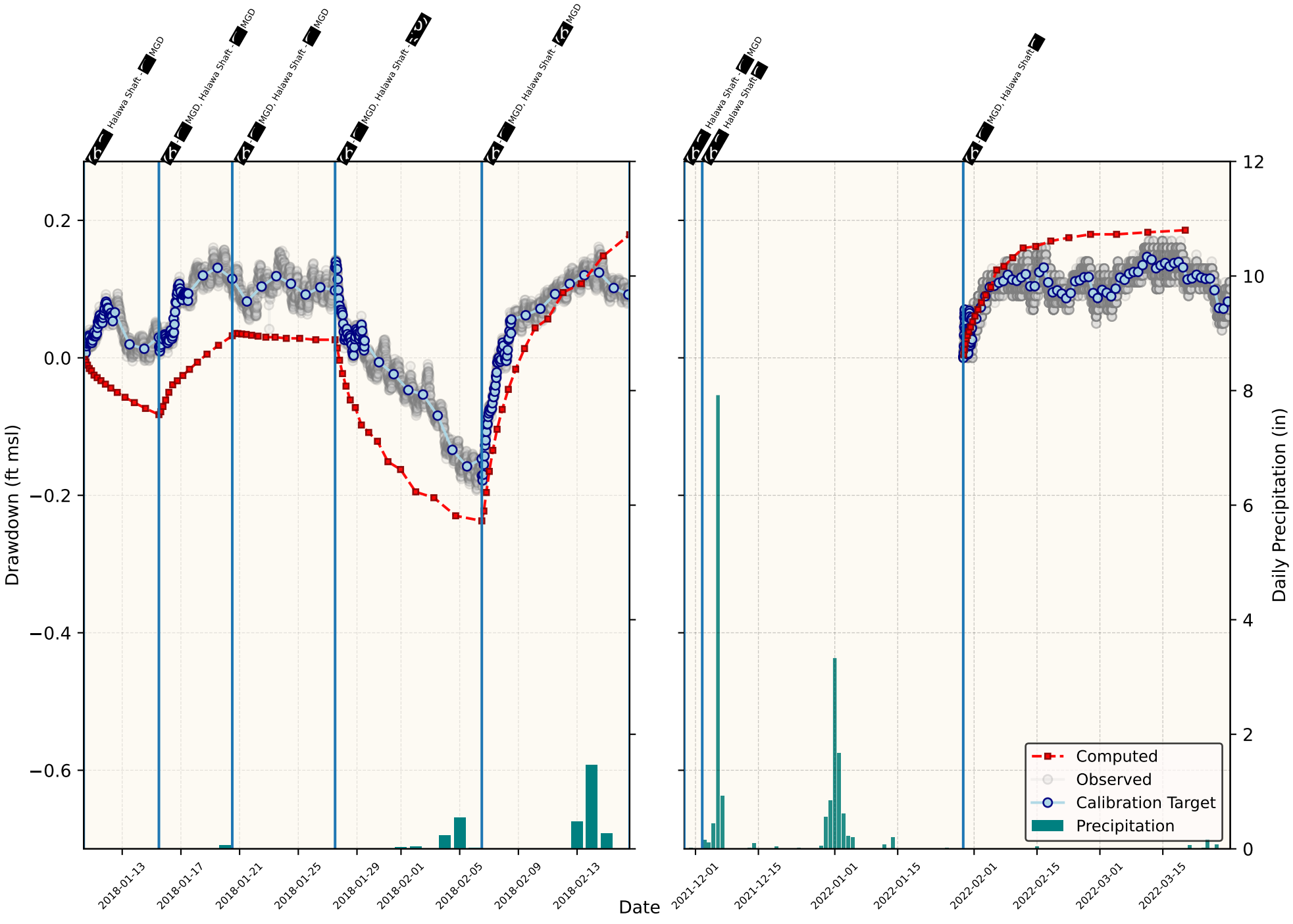

Aiea_Bay
Group 1 - Basal Aquifer
Halawa Shaft
MGD
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

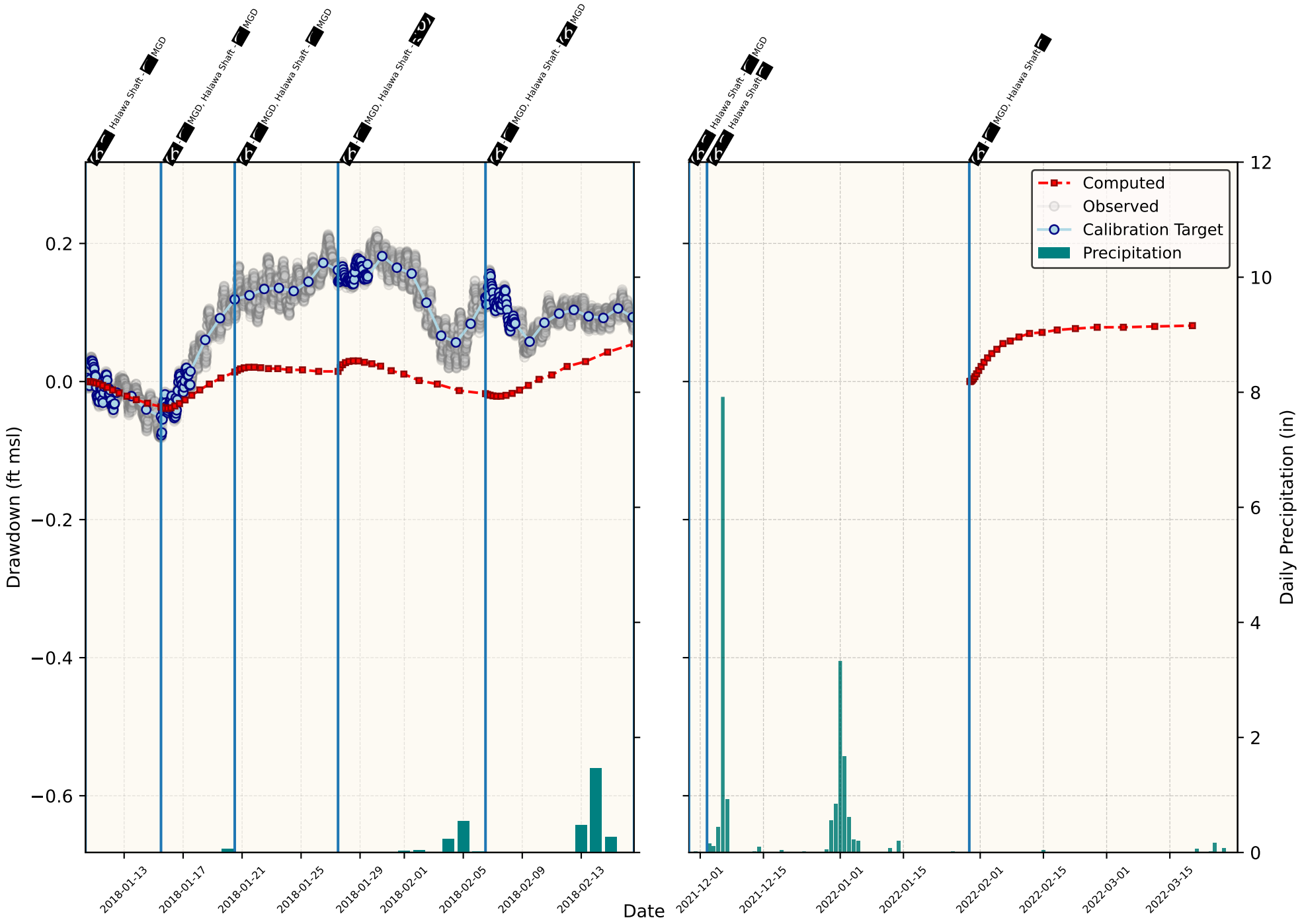
(b)(3) [redacted]

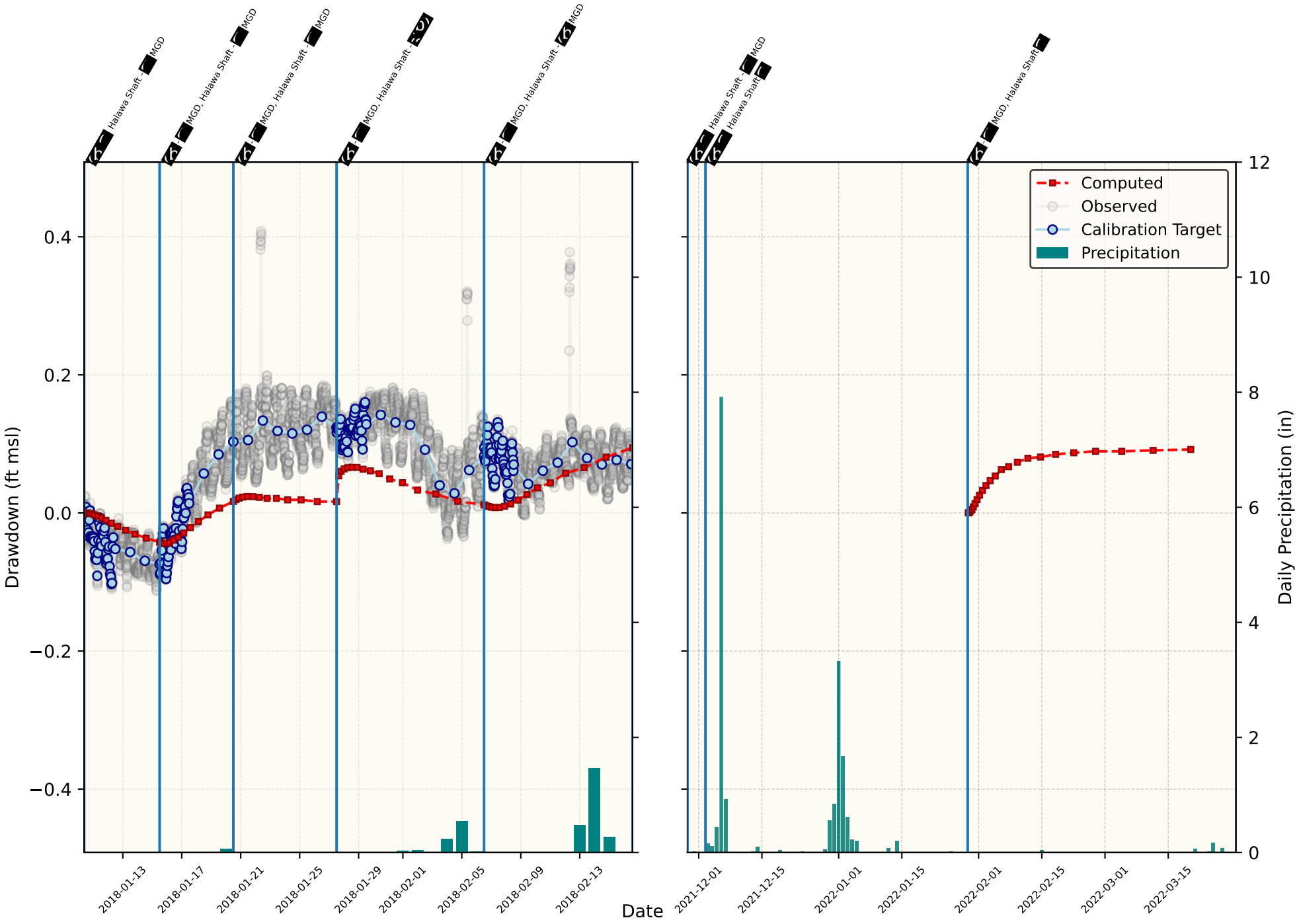

Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

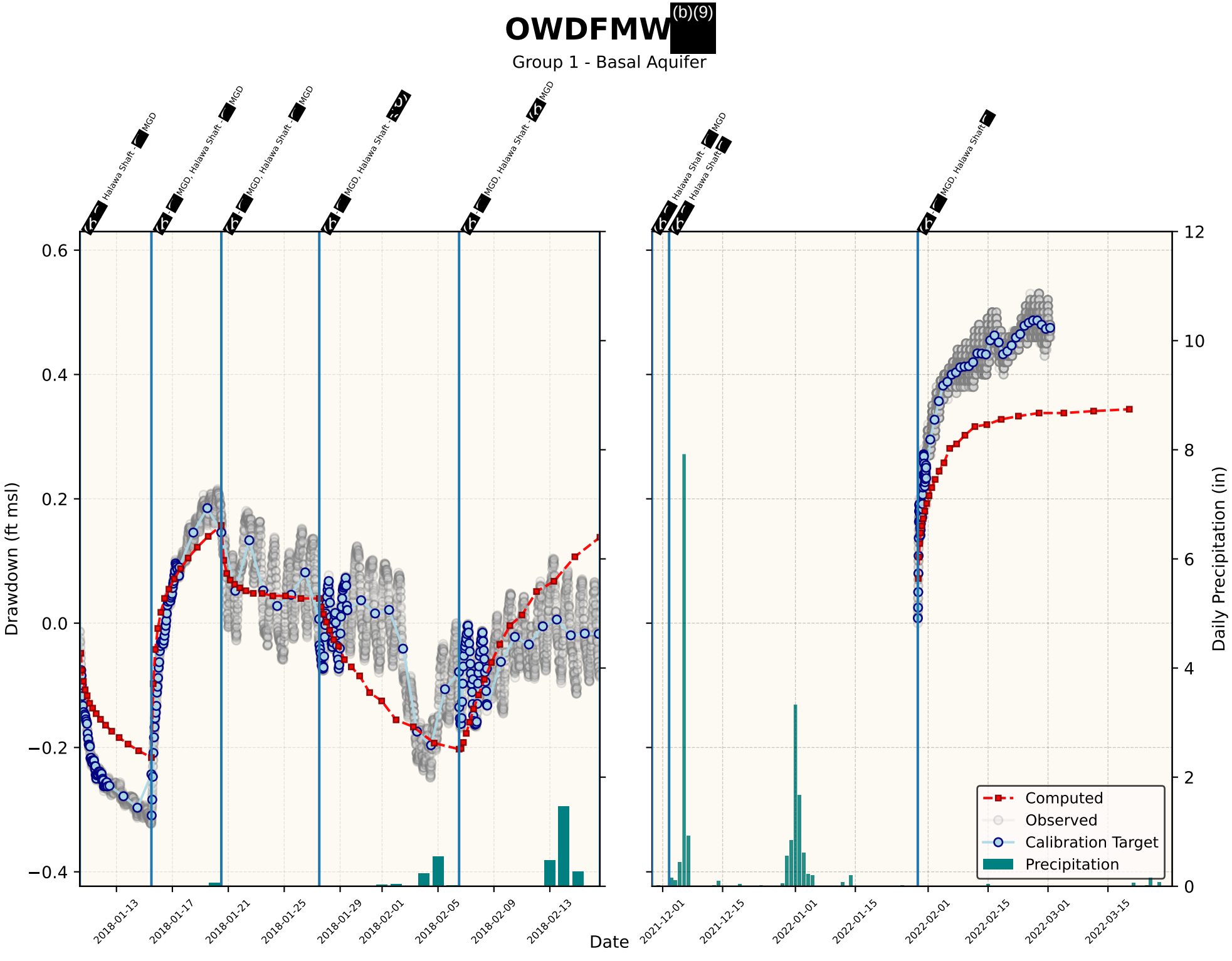

Halawa_Shaft
Group 1 - Basal Aquifer
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Halawa Shaft - MGD
Halawa Shaft - MGD
MGD, Halawa Shaft - MGD
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
3
2
1
0
−1
−2
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

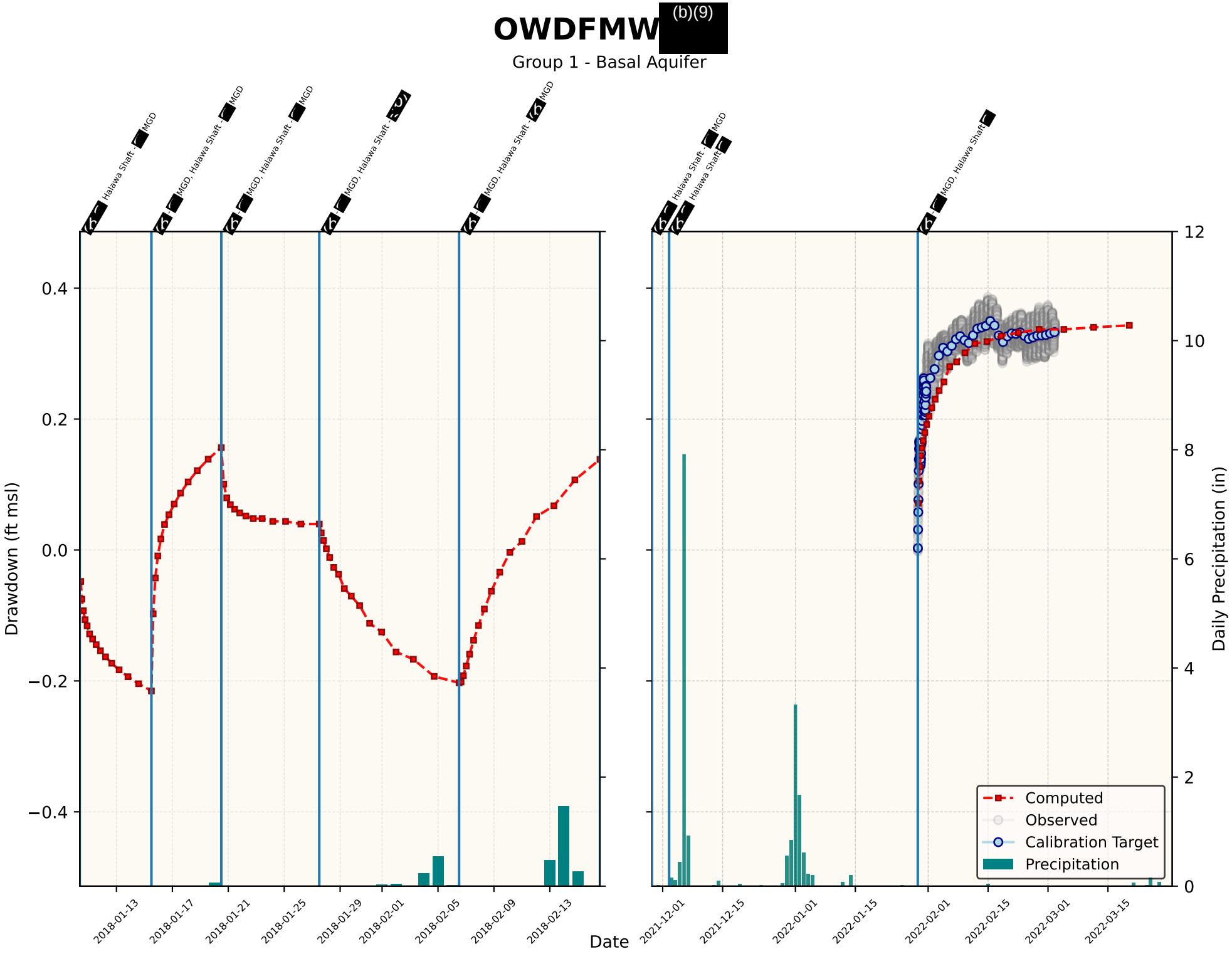

Halawa_T45
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Halawa_TZ
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


Manaiki_T24
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

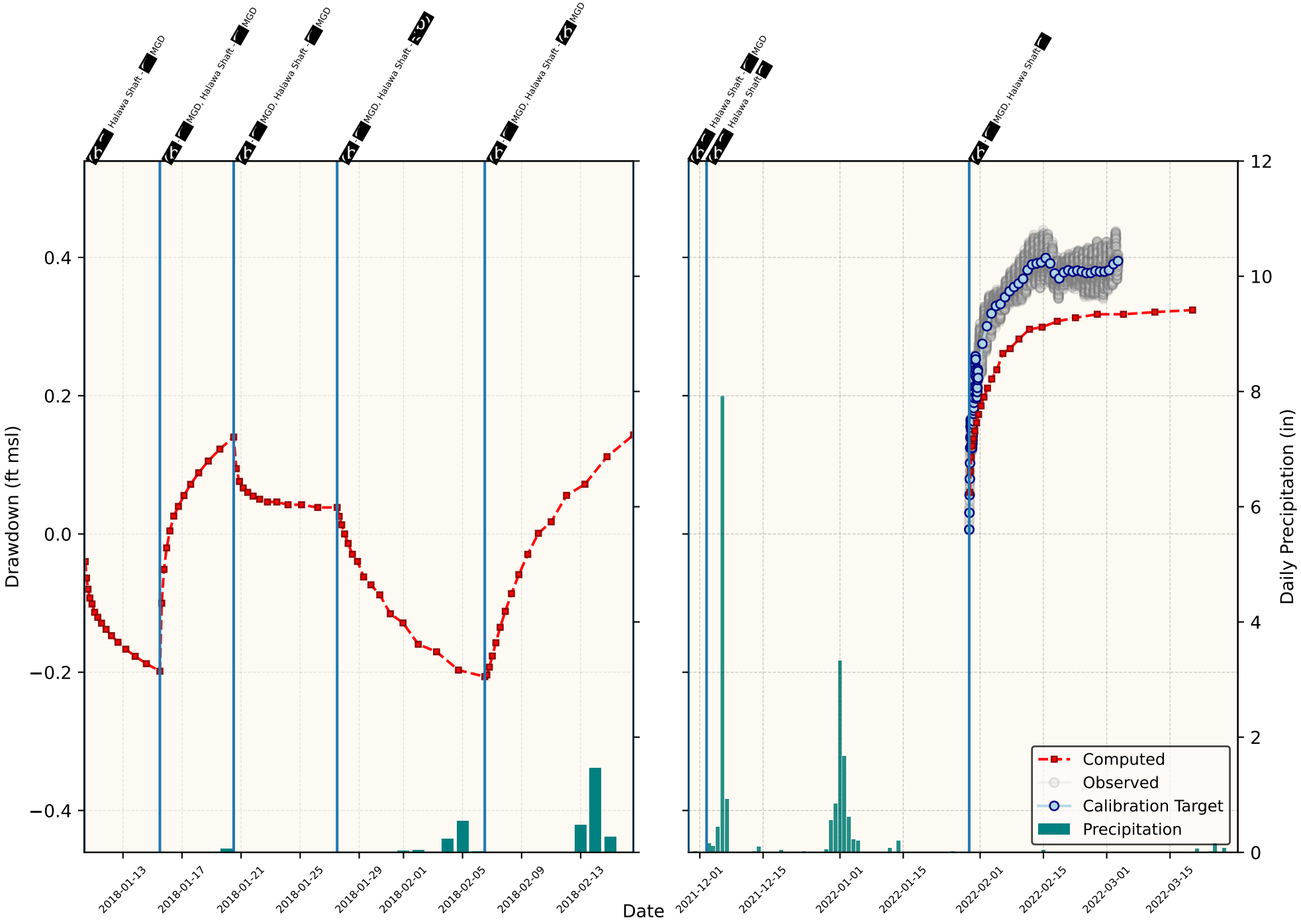

Moanalua_Deep
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

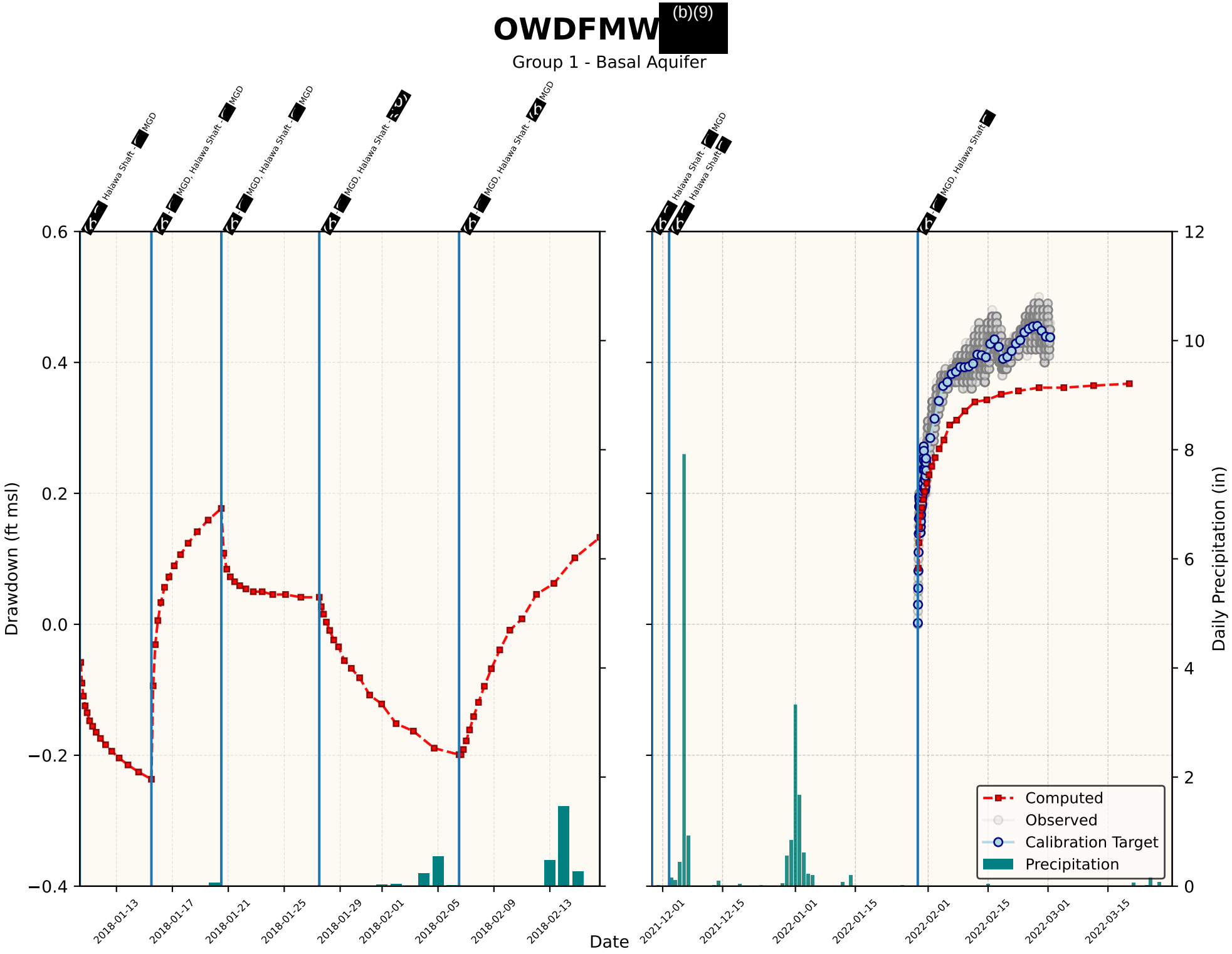

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

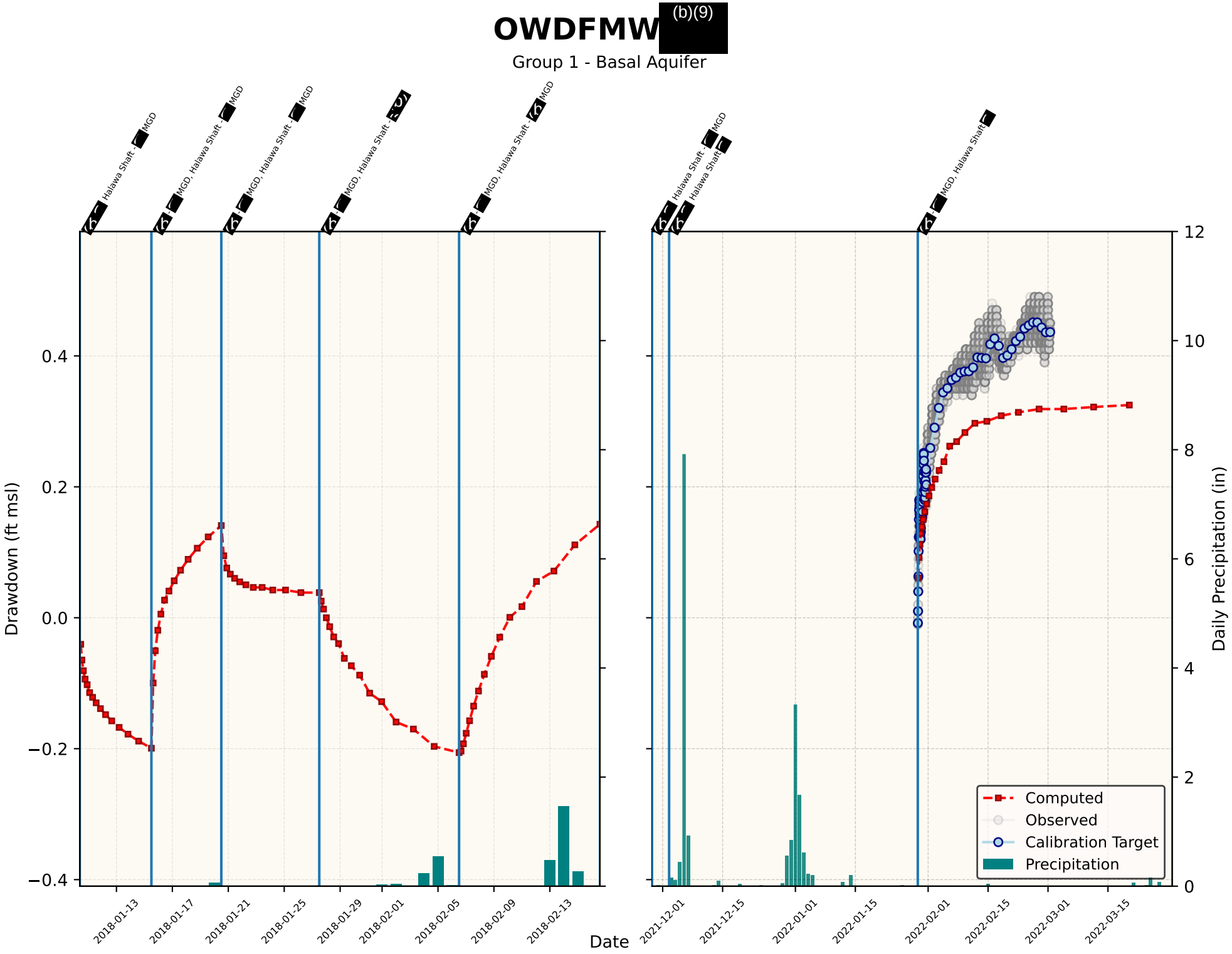

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

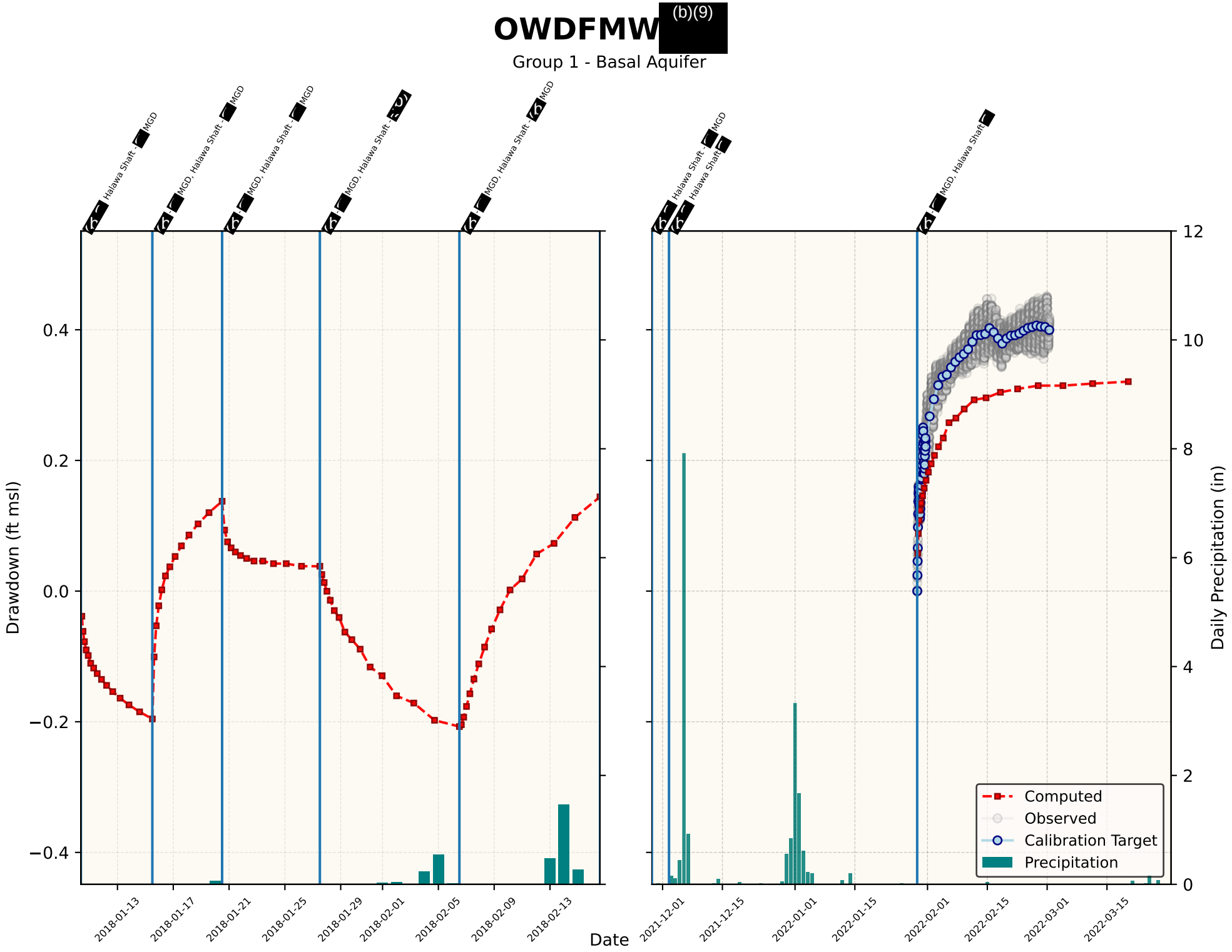
OWDFMW (b)(9)

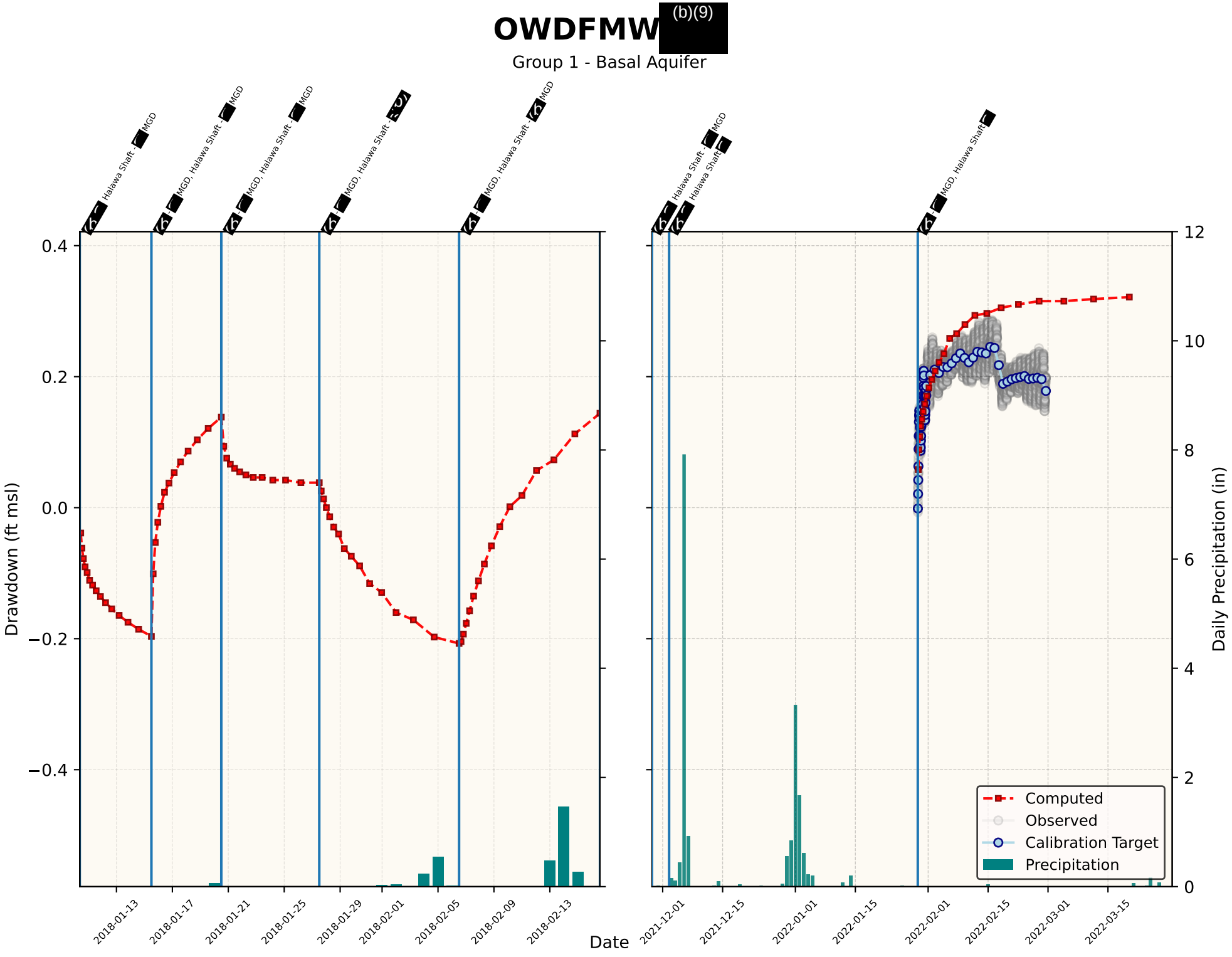
Group 1 - Basal Aquifer

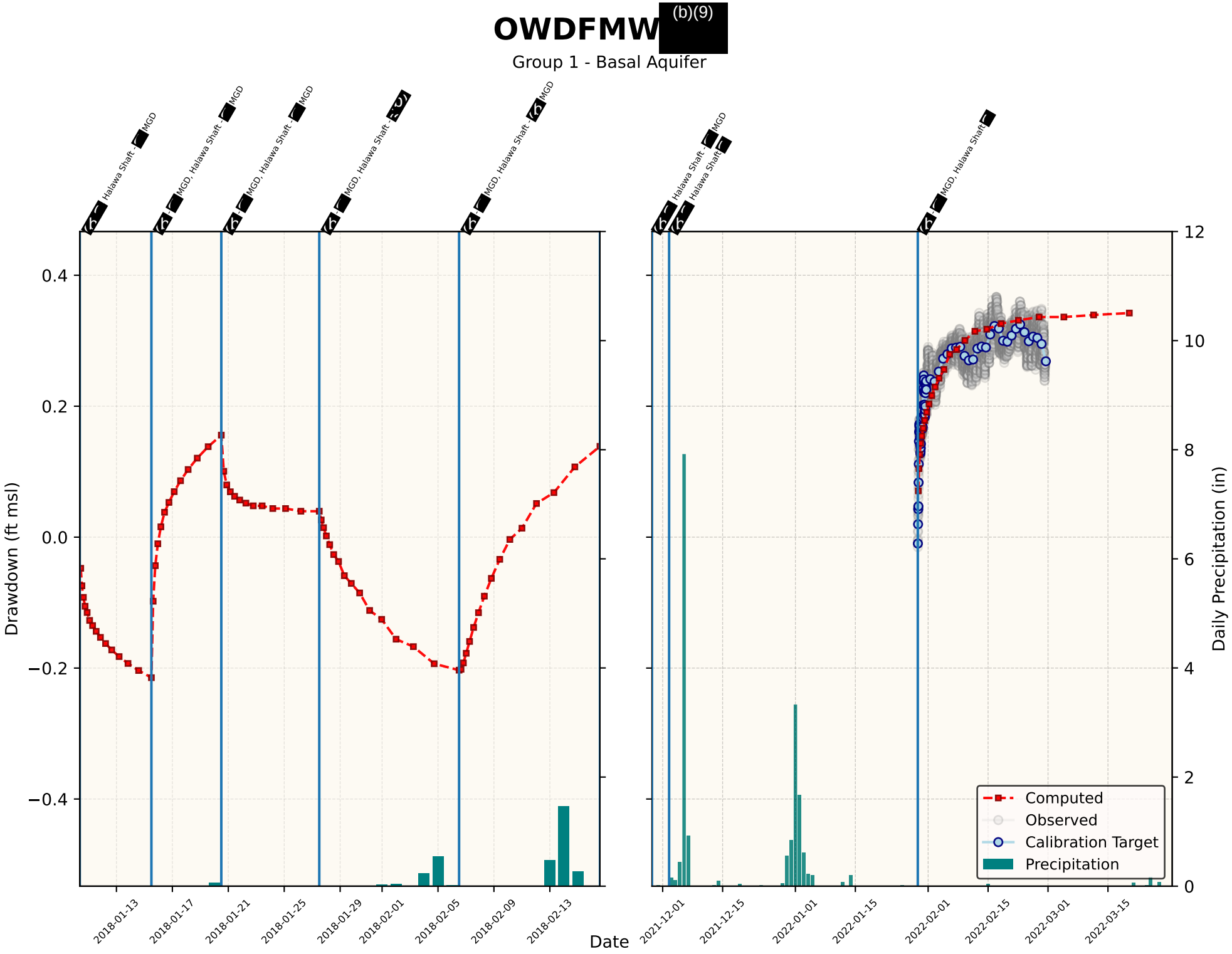


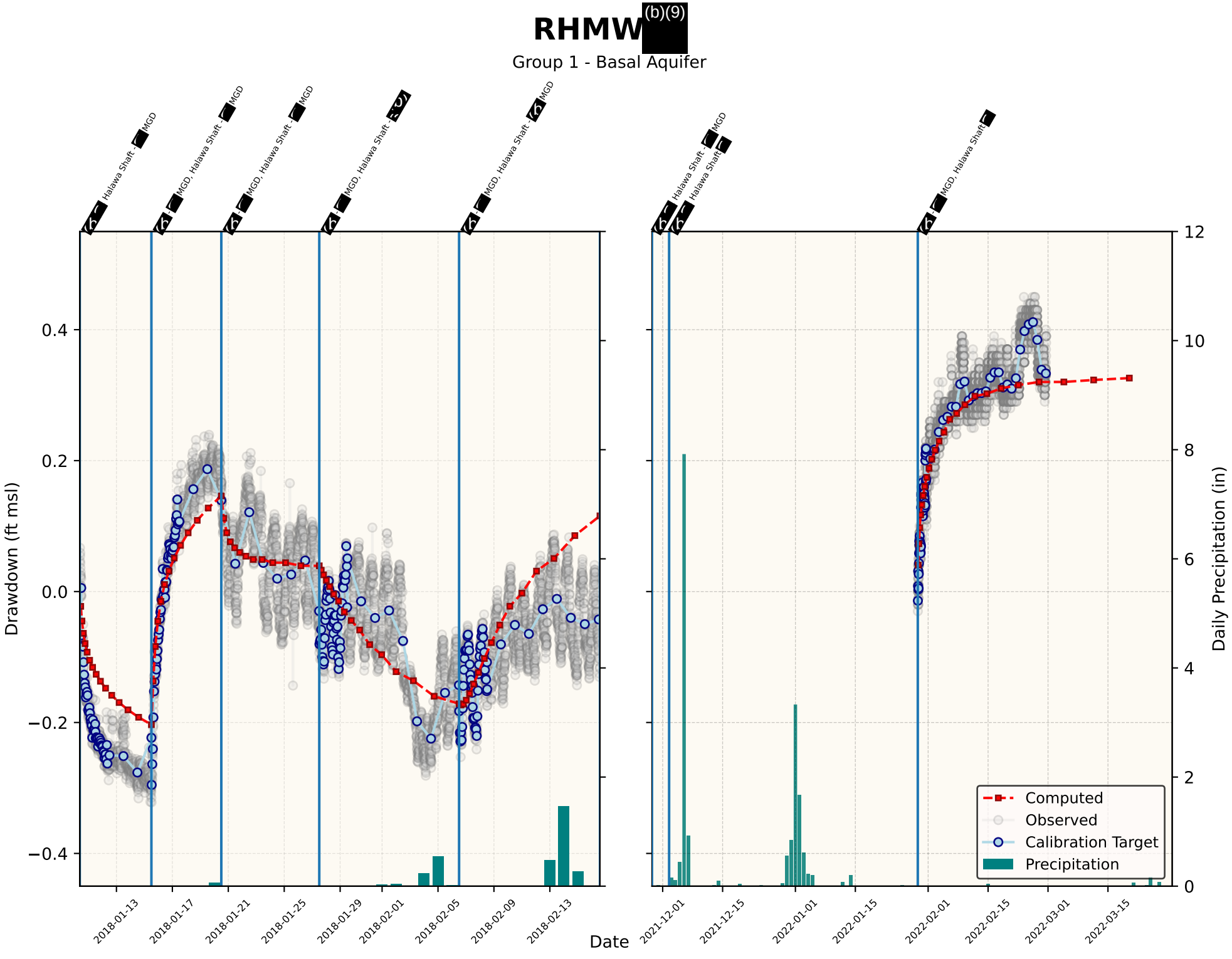

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
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2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

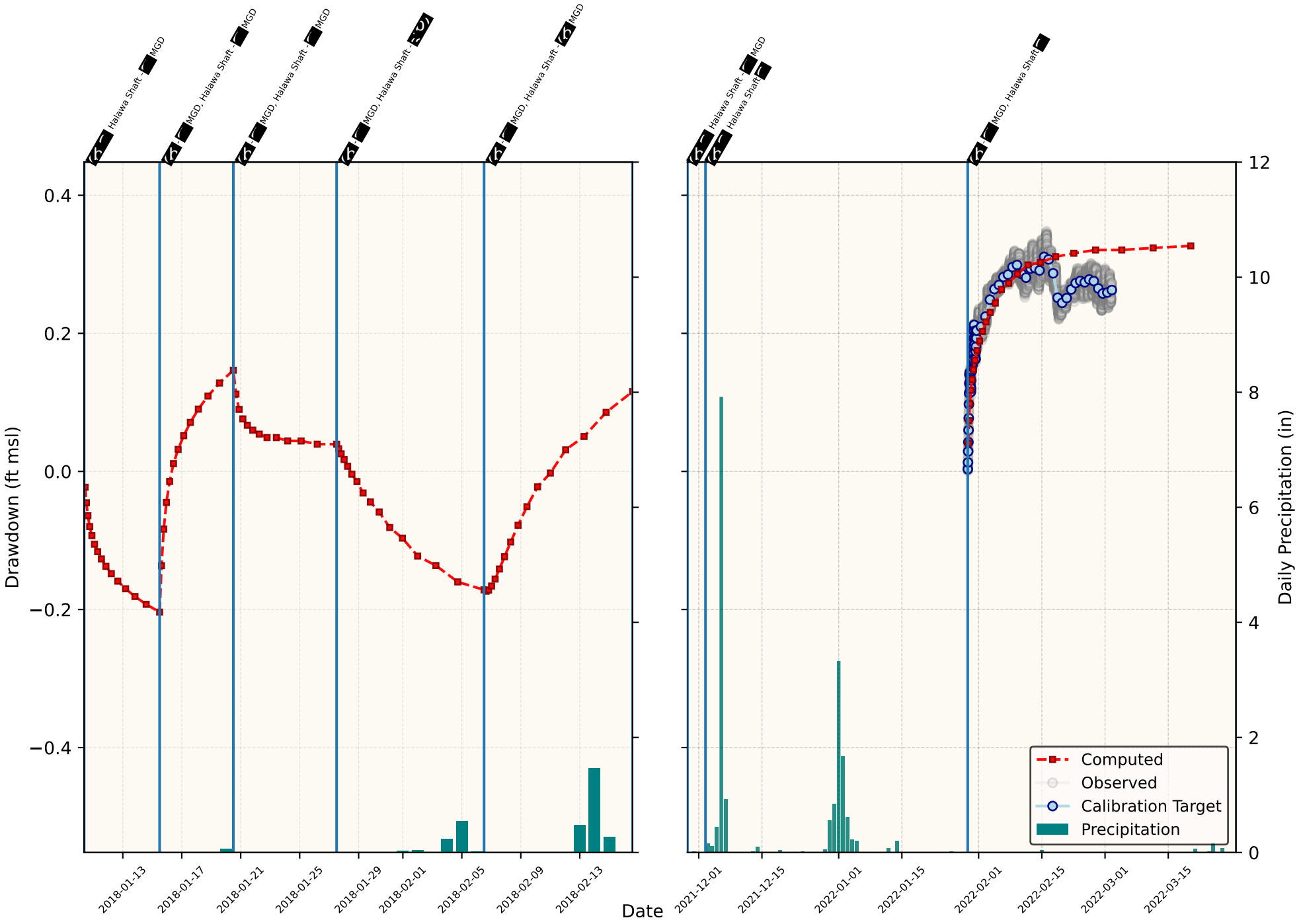

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
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2022-02-15
2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation

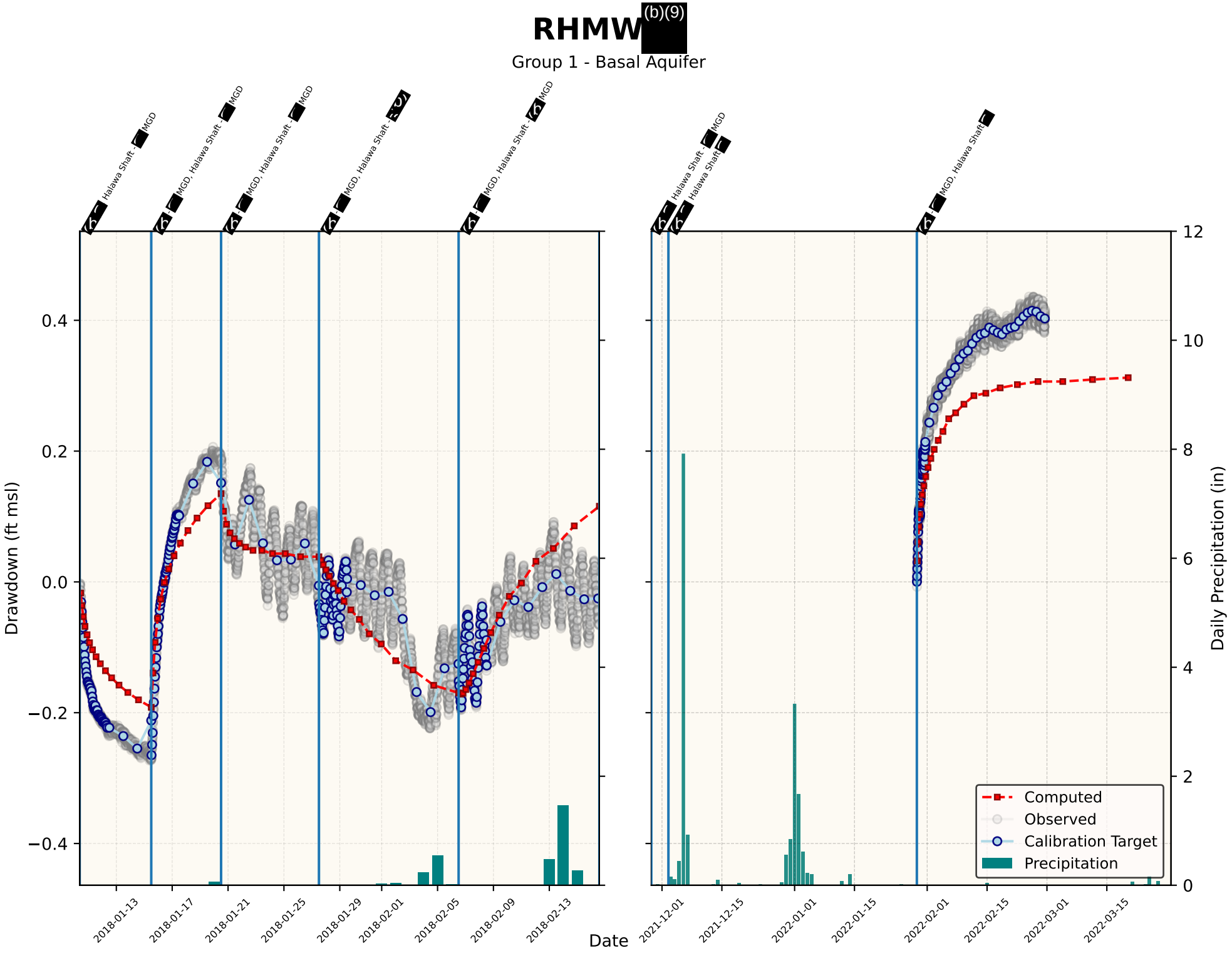

OWDFMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
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2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
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2022-02-15
2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation

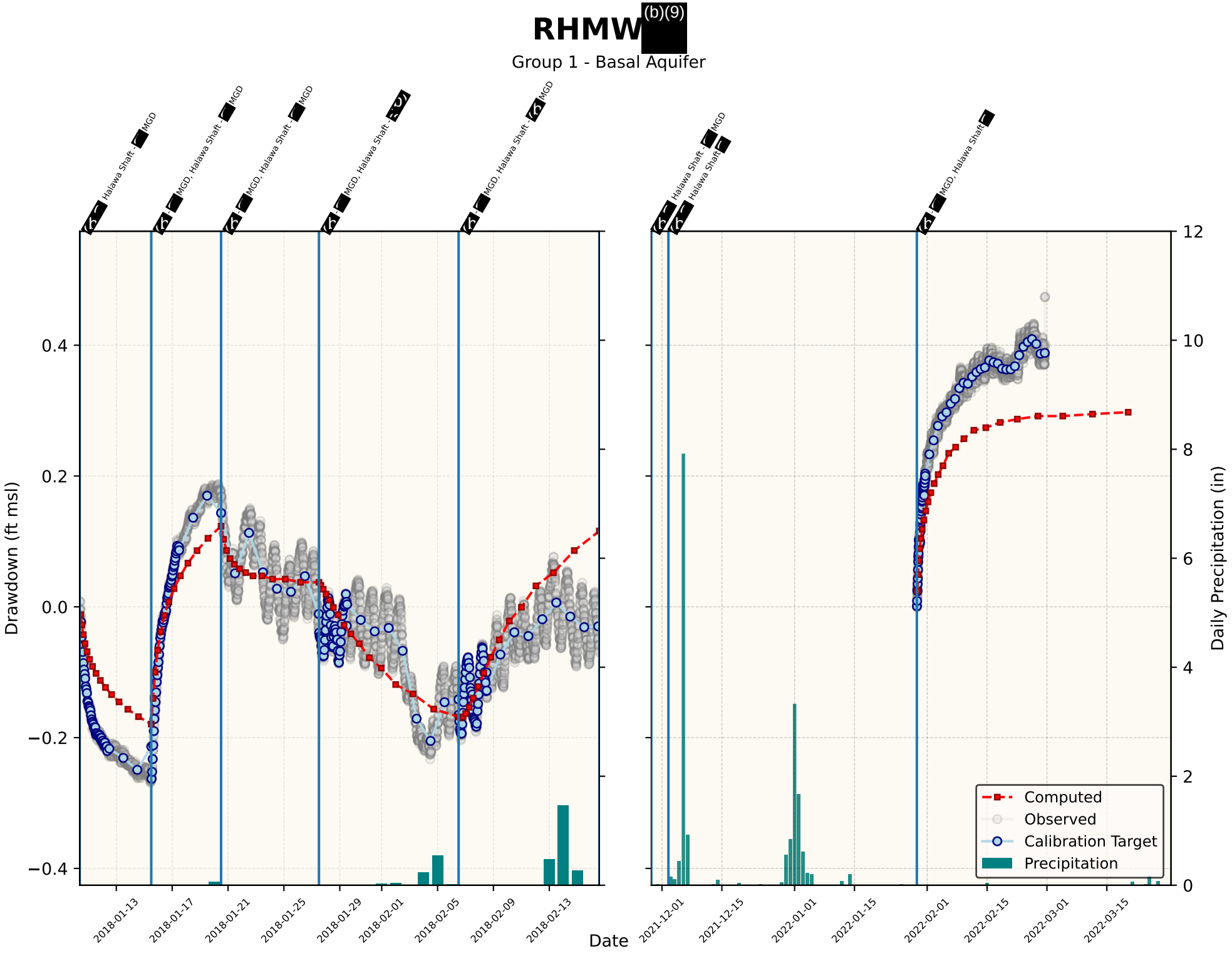

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-03-15
Date

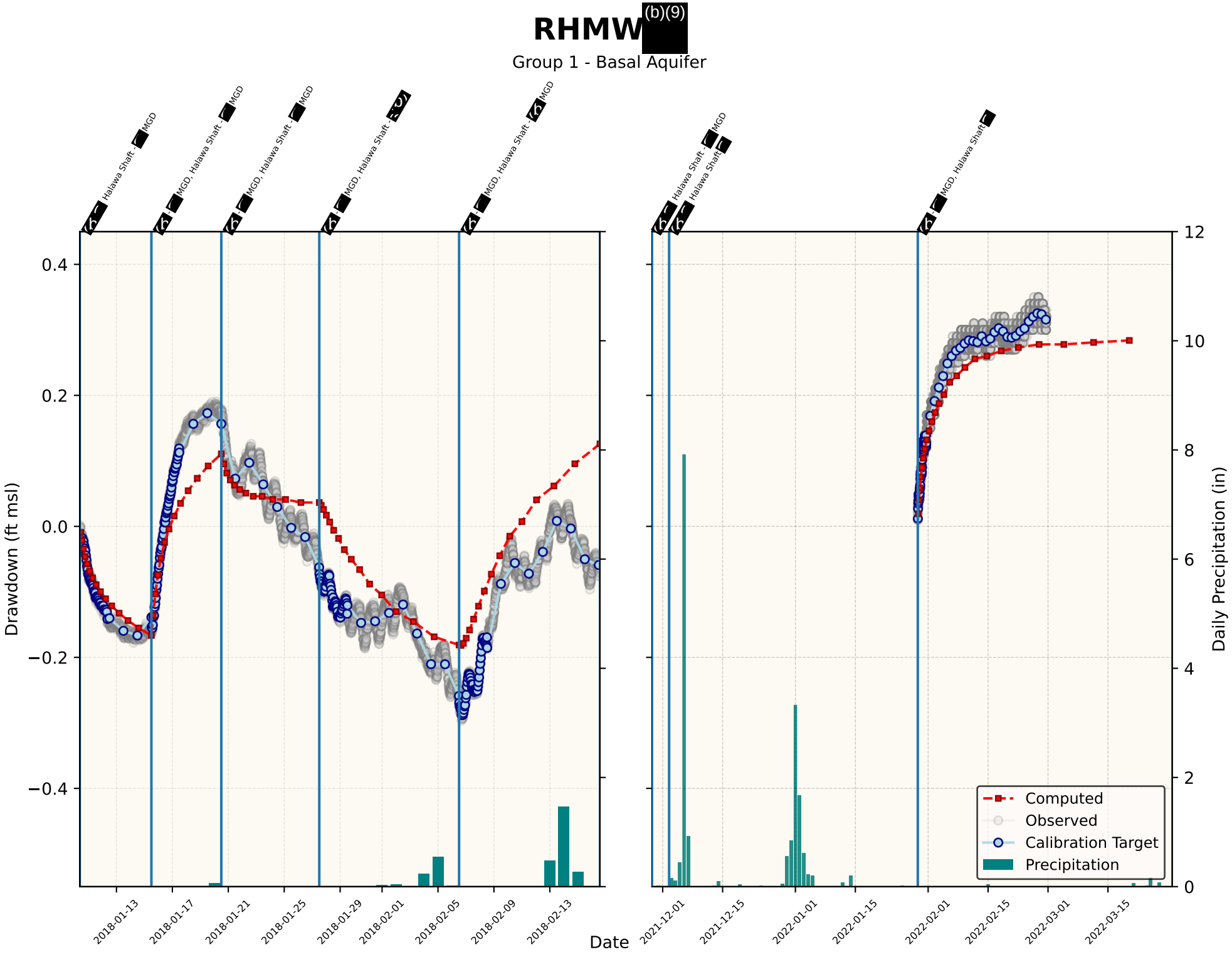
RHMW[redacted] (b)(9)

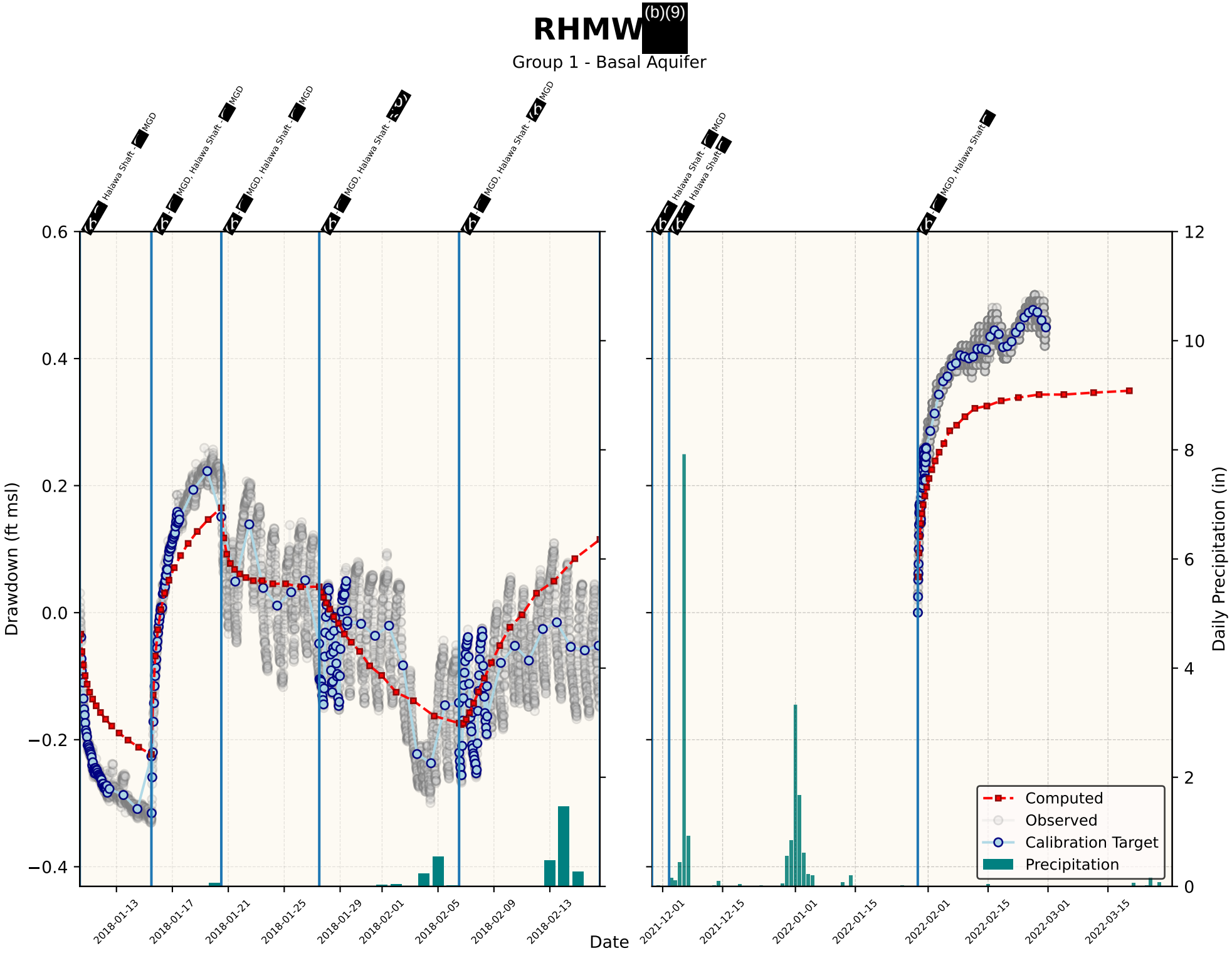
Group 1 - Basal Aquifer

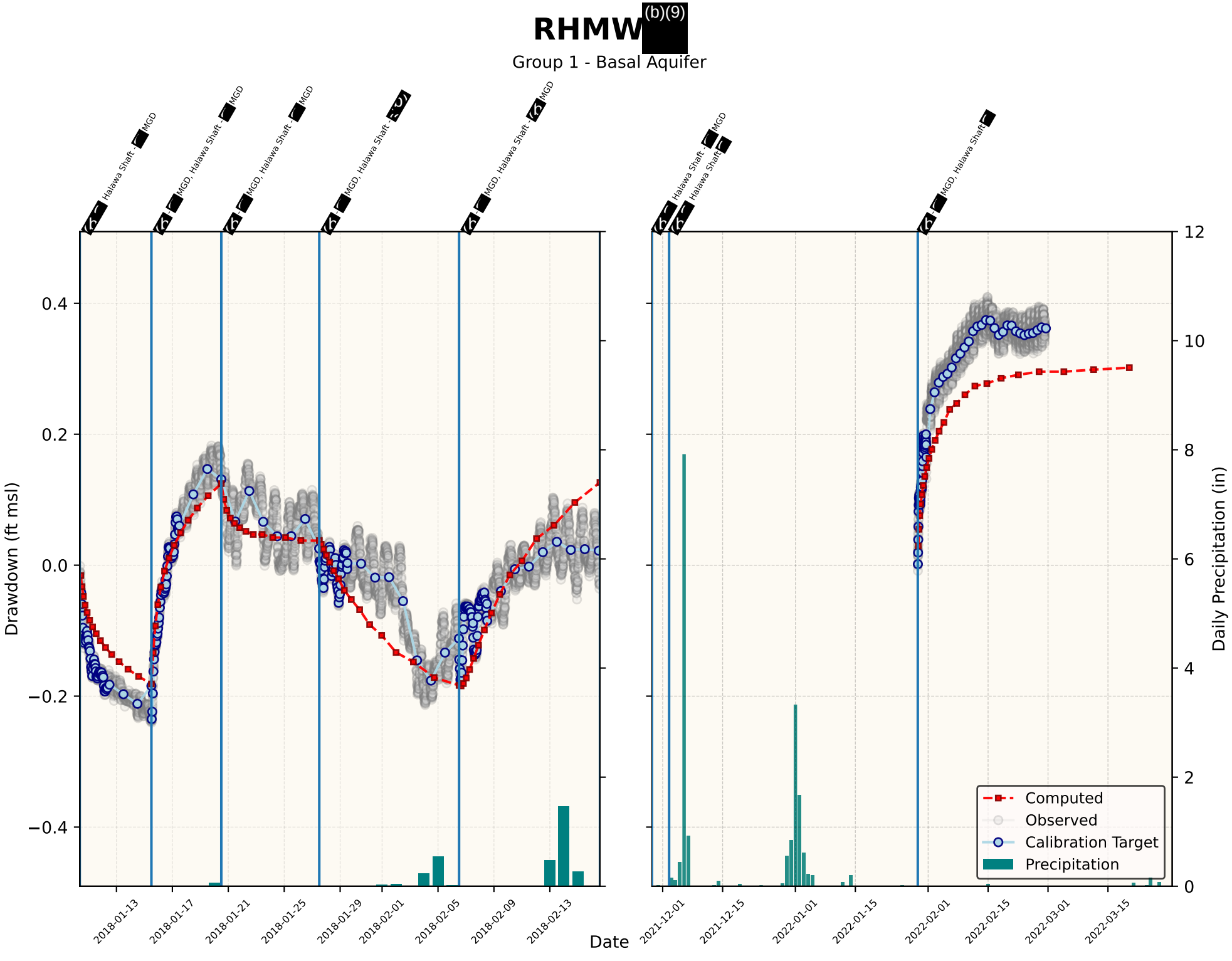


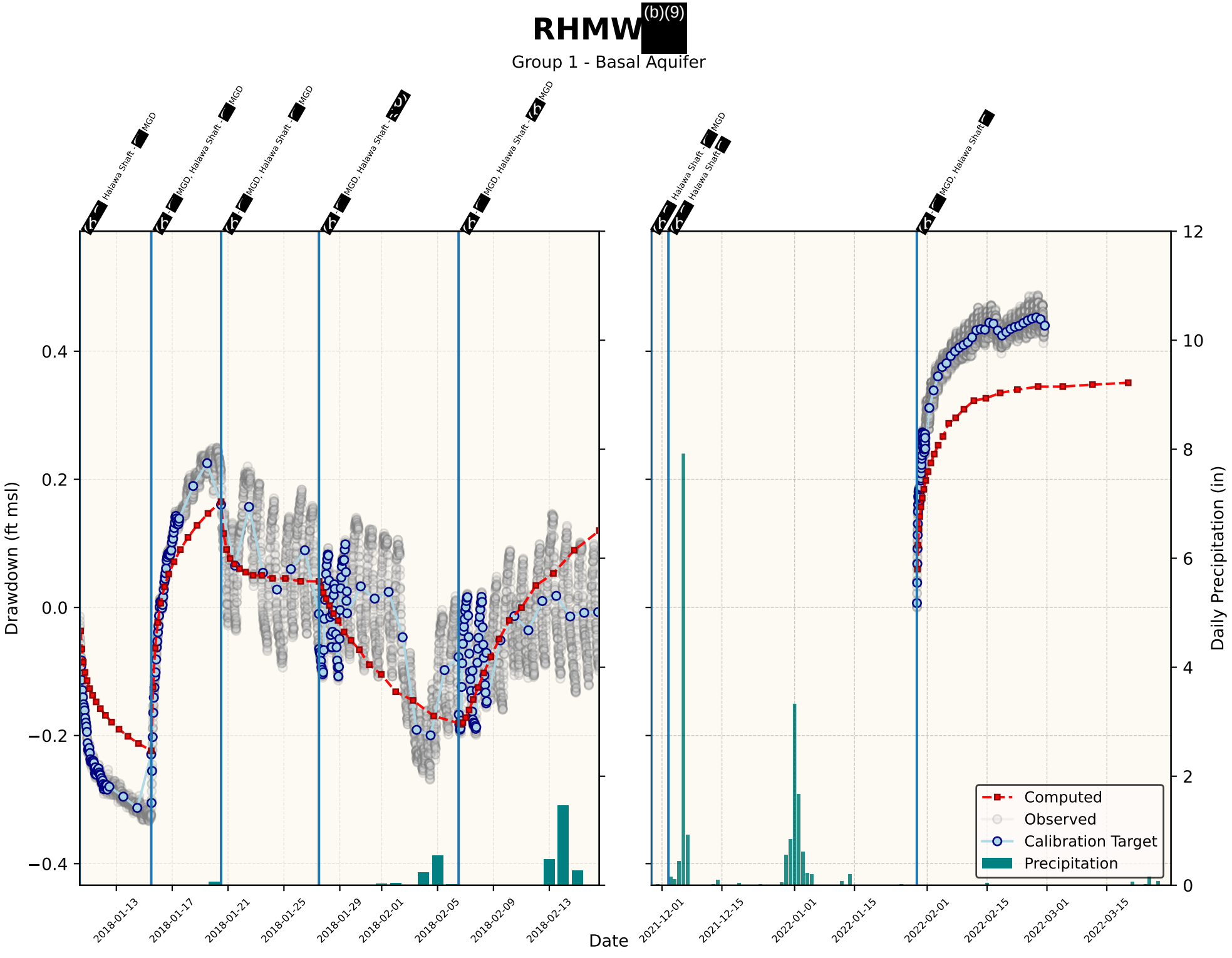

RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
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2018-02-13
2021-12-01
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2022-02-15
2022-03-01
2022-03-15

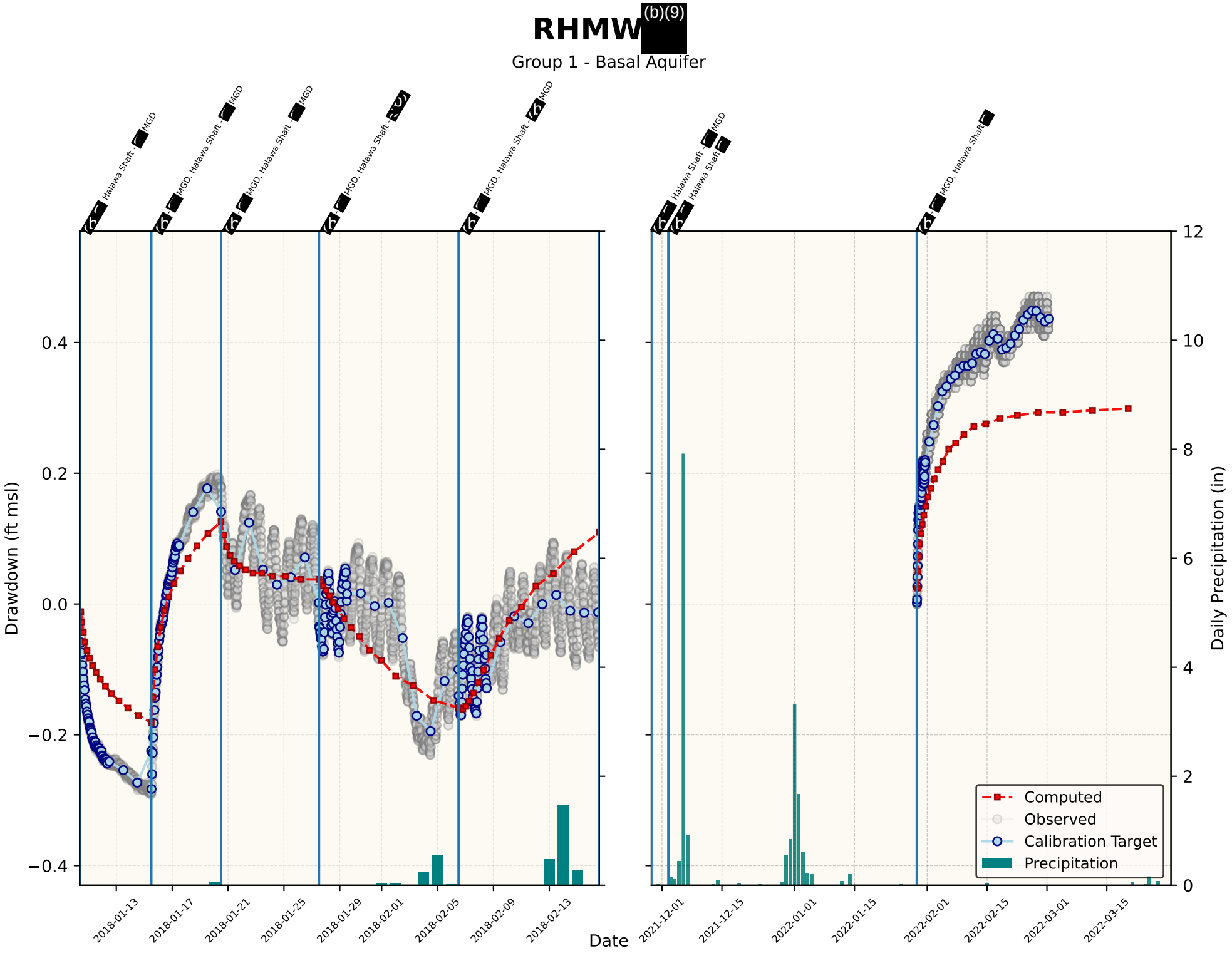

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

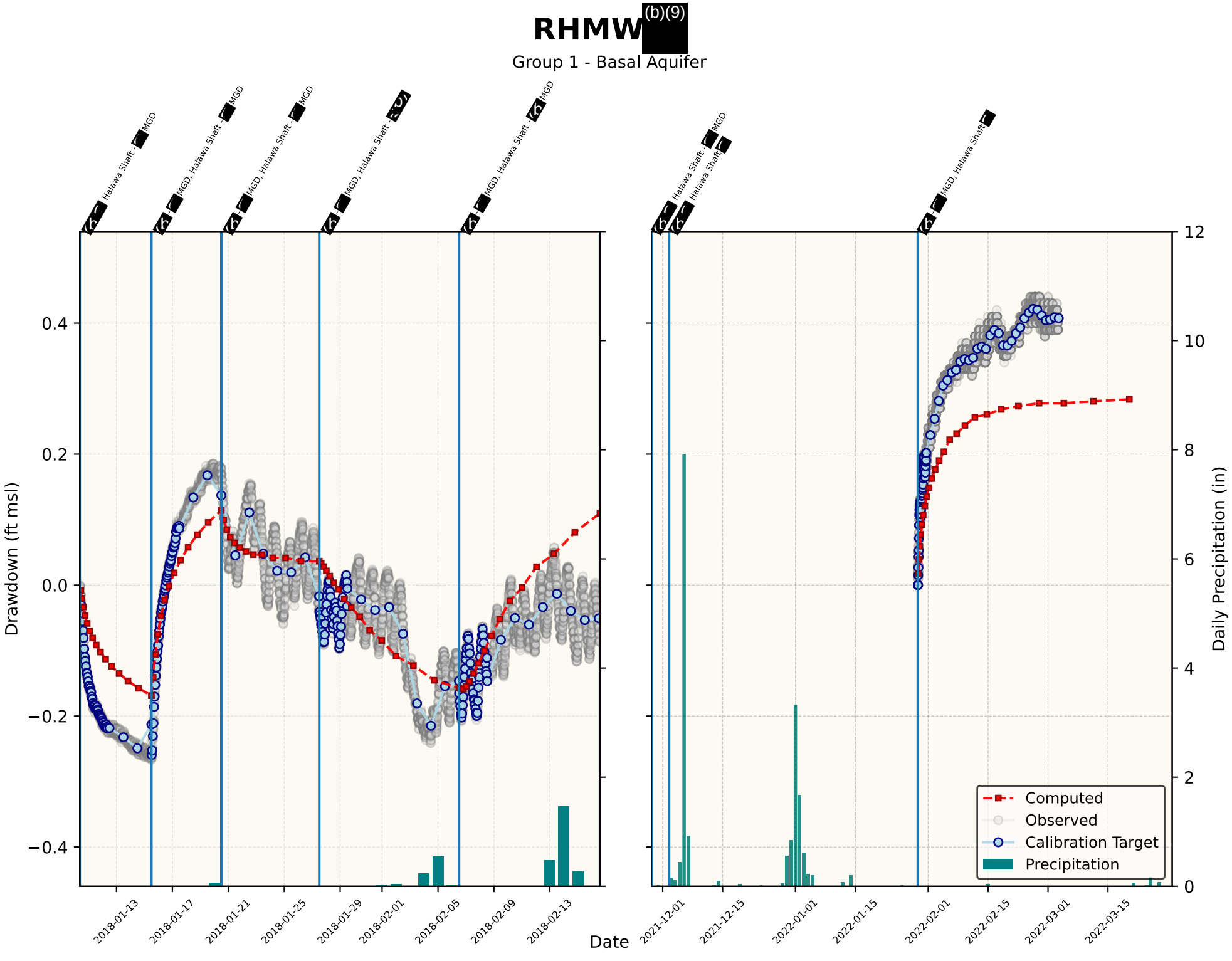

RHMW[redacted]
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
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2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


RHMW[redacted]
Group 1 - Basal Aquifer
[redacted] Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] Halawa Shaft [redacted] MGD
[redacted] Halawa Shaft [redacted]
[redacted] MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
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2022-01-01
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Date
Computed
Observed
Calibration Target
Precipitation

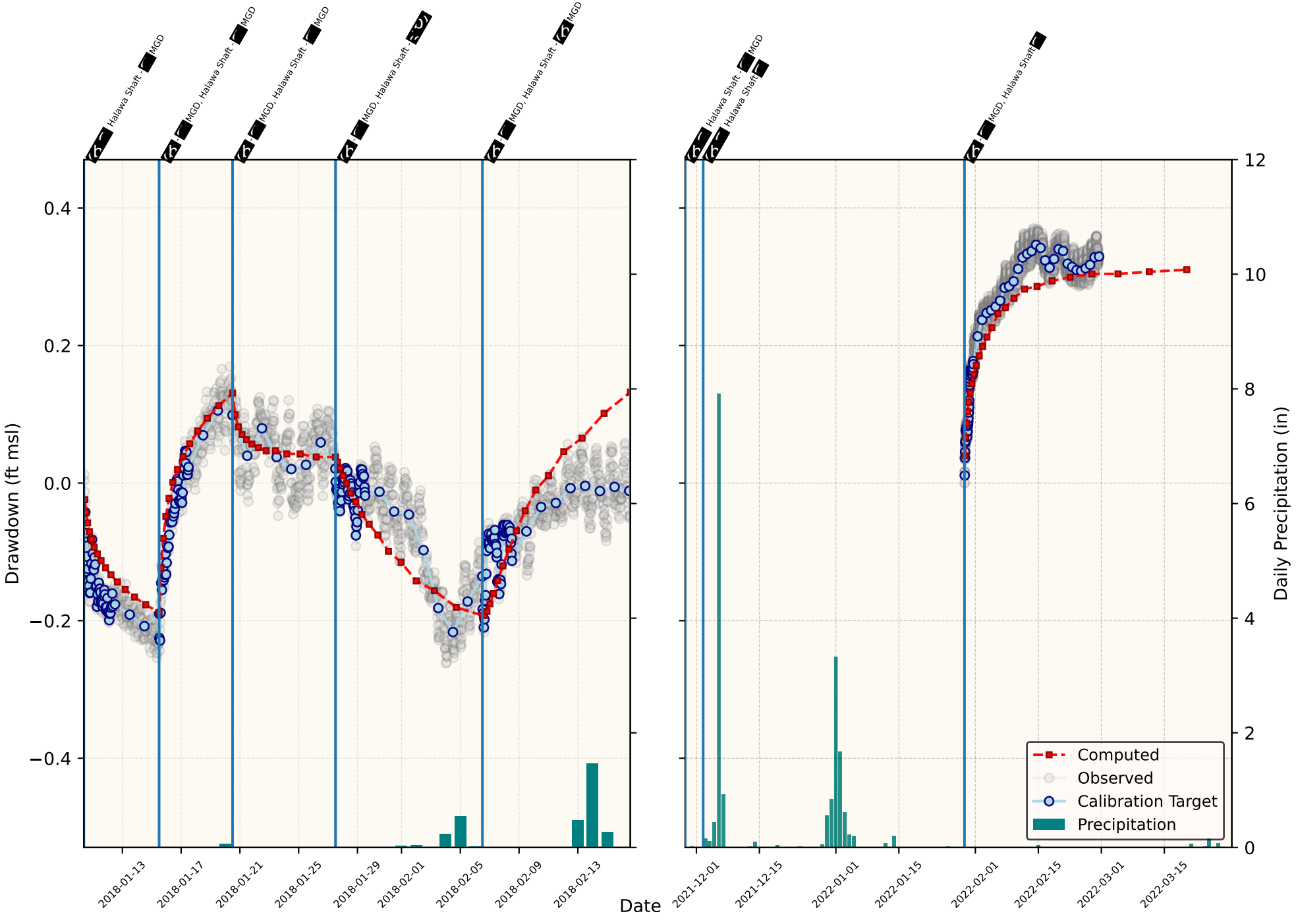

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
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2018-02-13
2021-12-01
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2022-03-15
Date

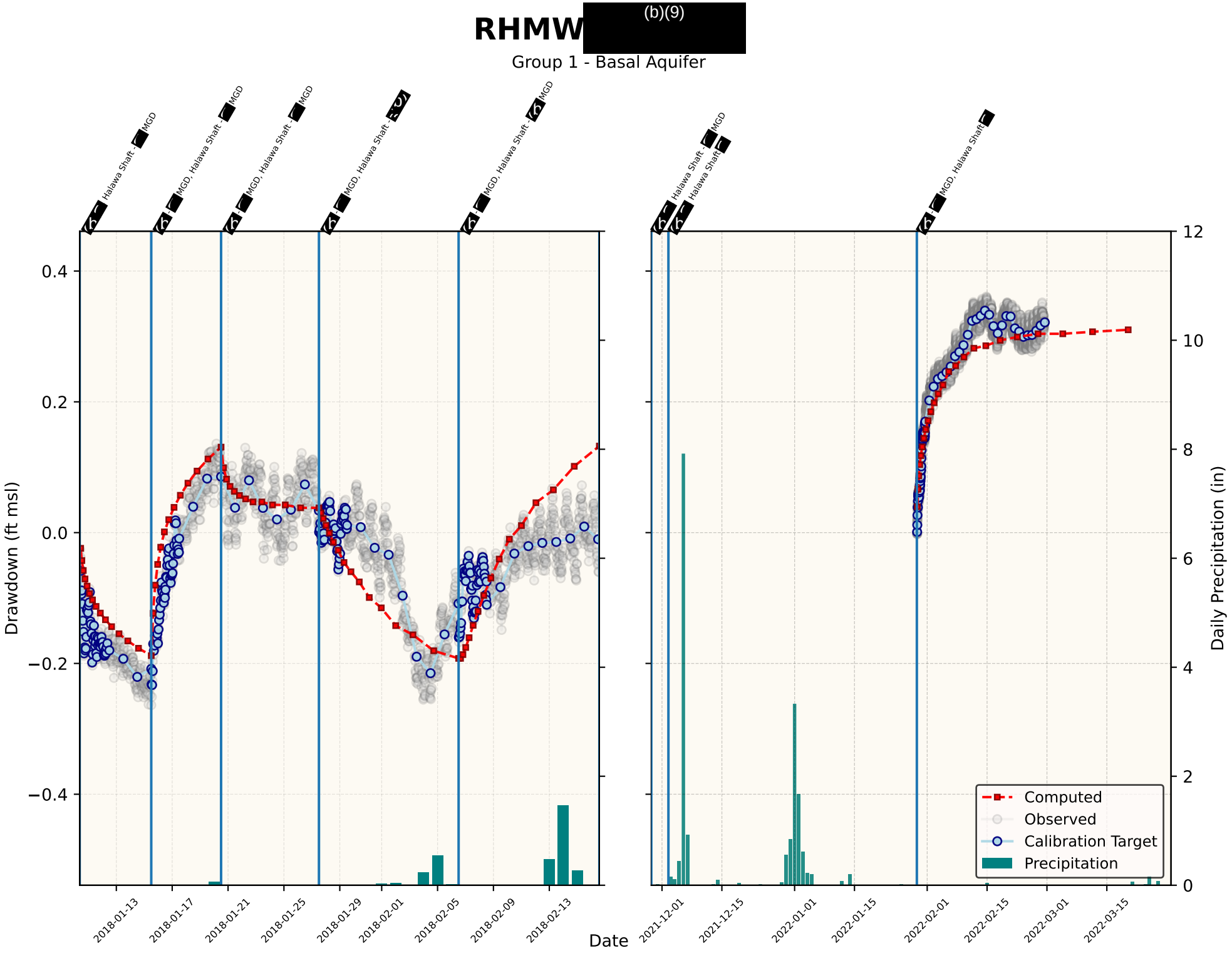

RHMW[redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
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2022-01-01
2022-01-15
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2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

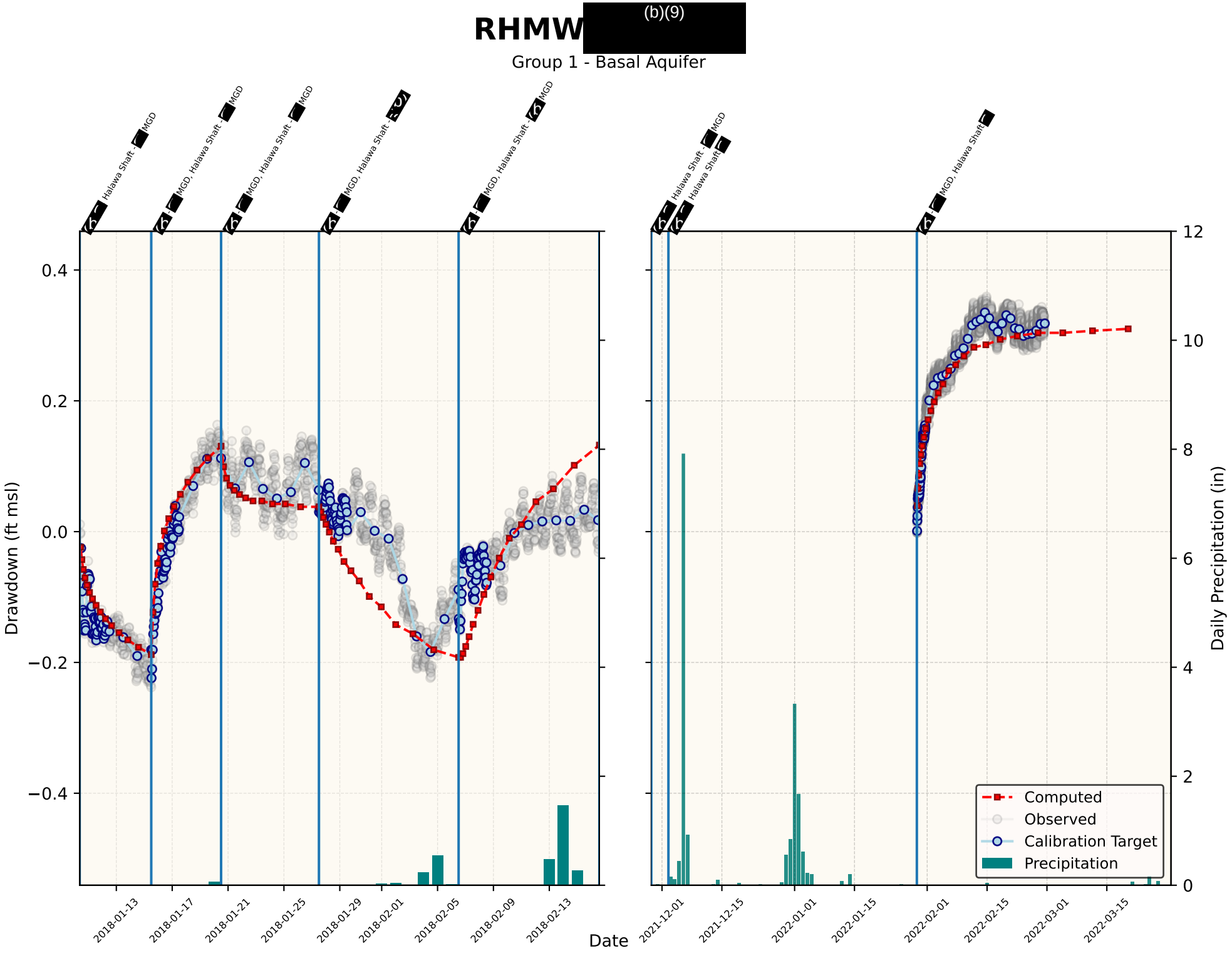

RHMW[redacted]
(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

RHMW (b)(9)

Group 1 - Basal Aquifer

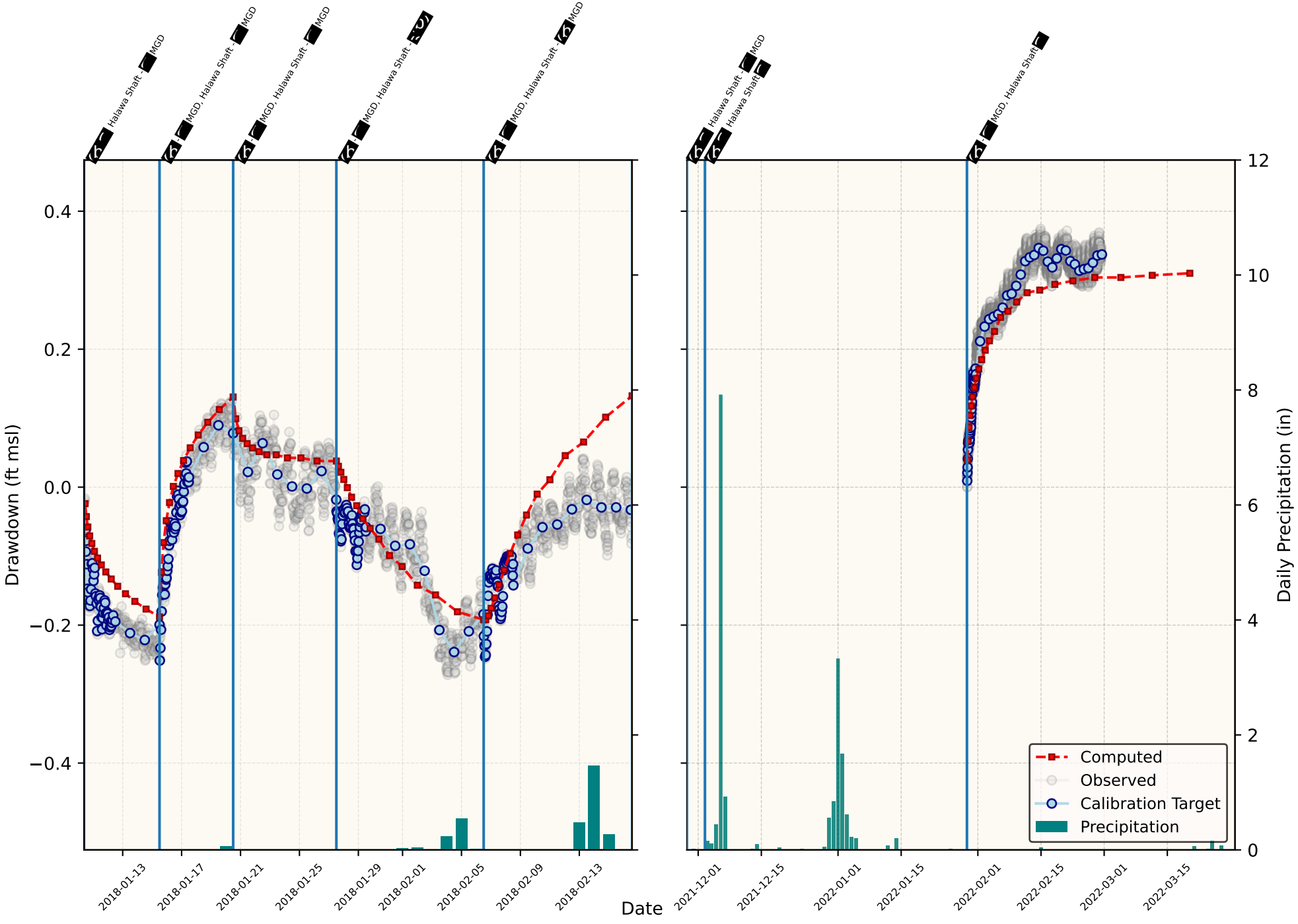



RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

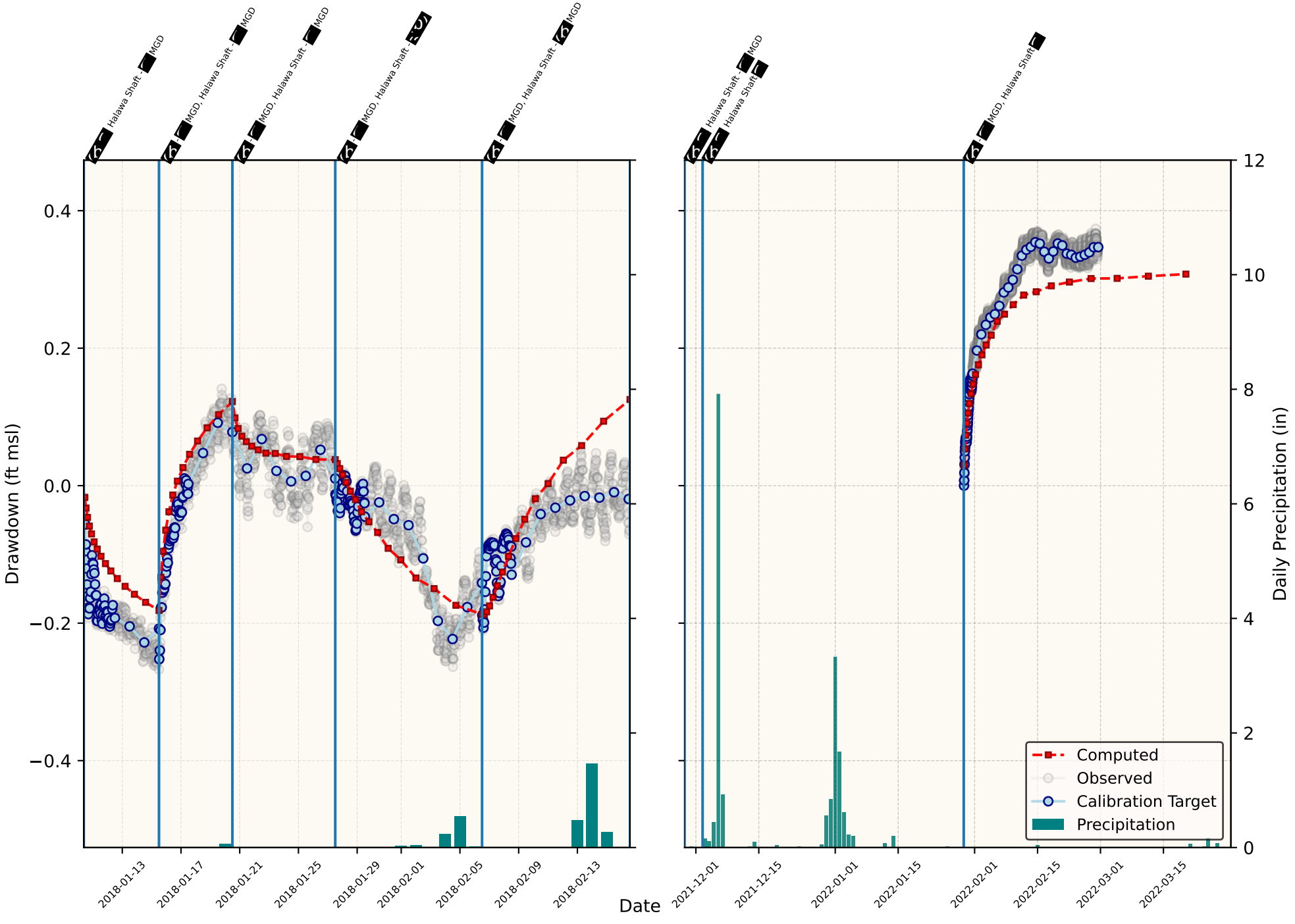
RHMW [redacted] (b)(9)

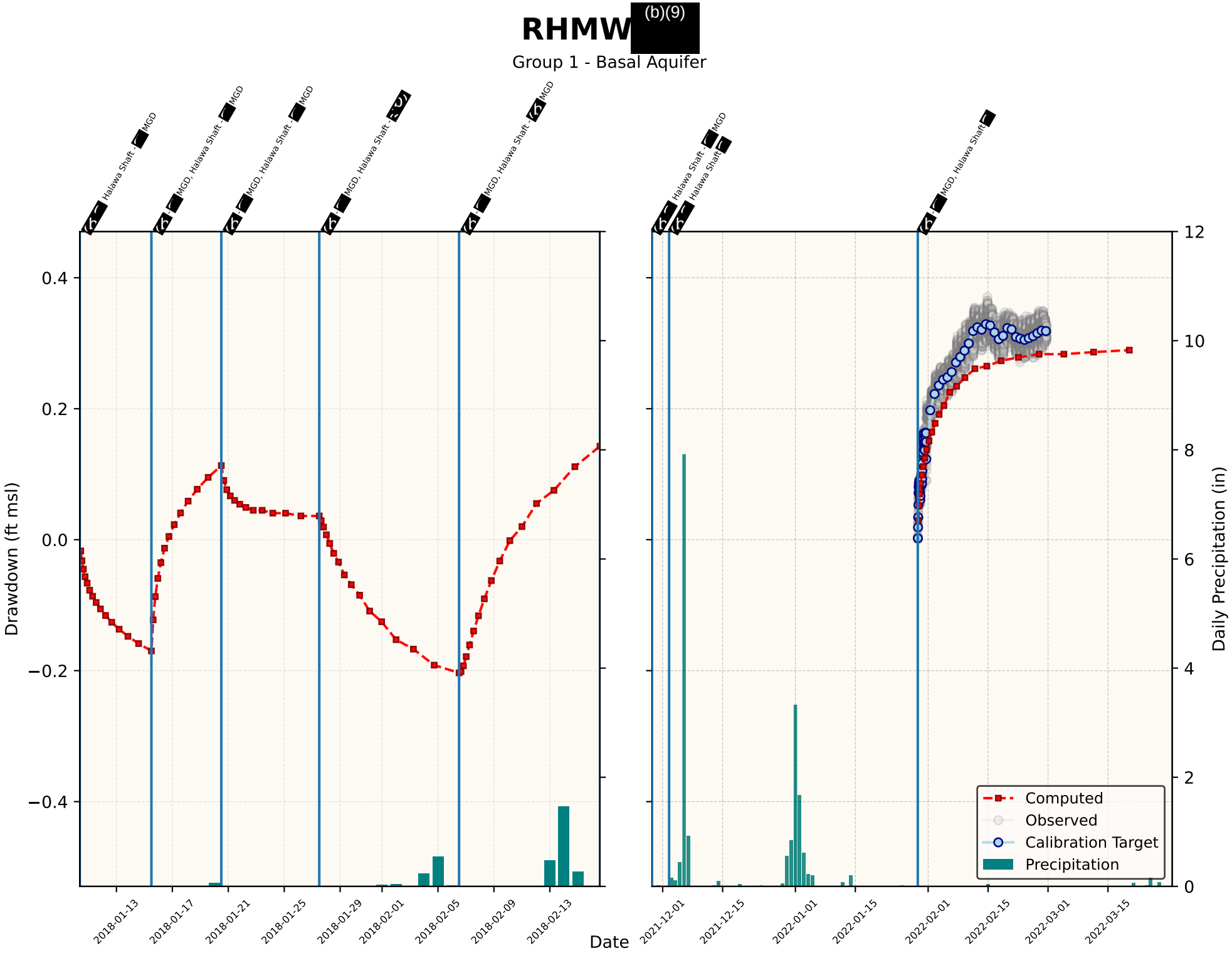
Group 1 - Basal Aquifer

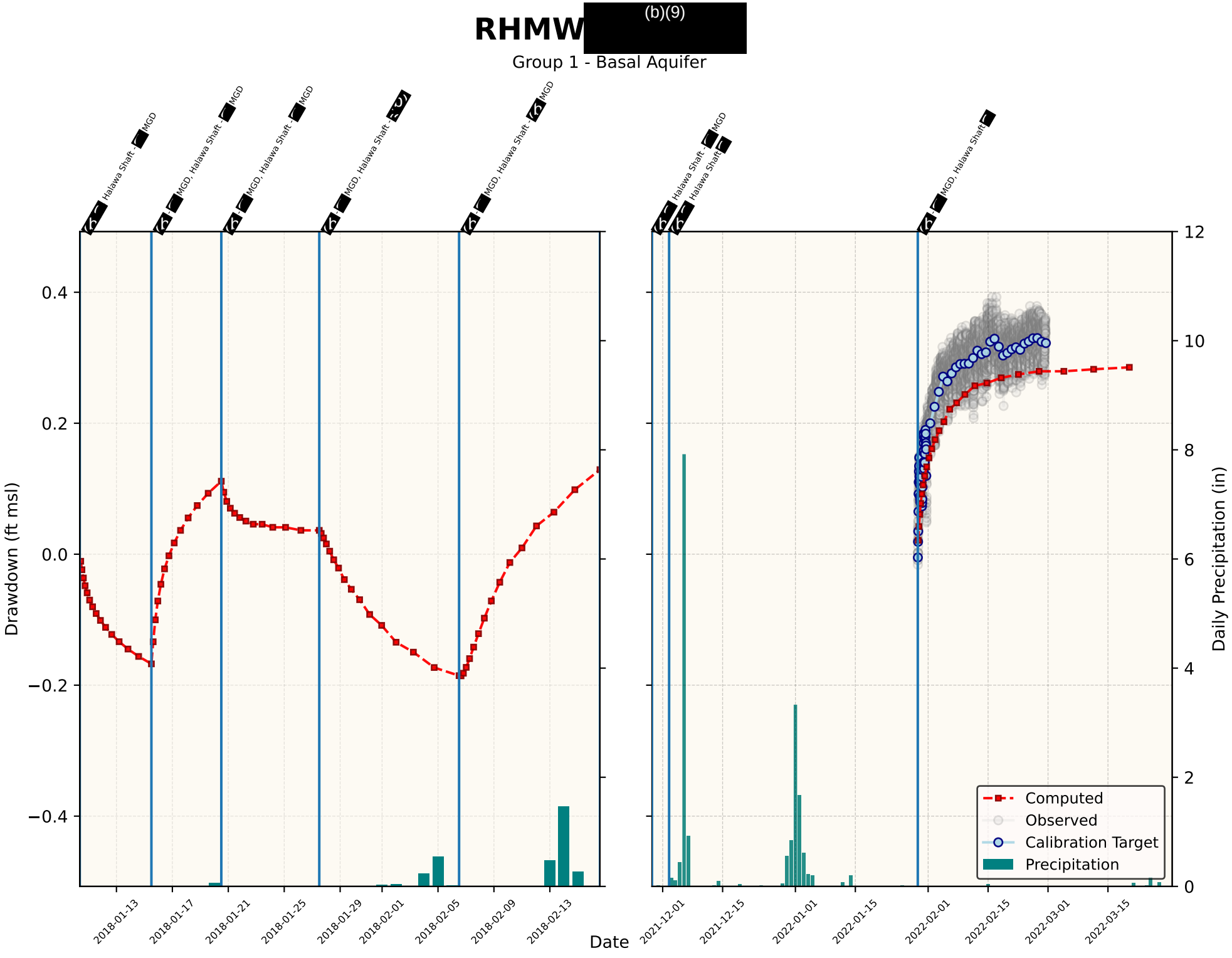


RHMW (b)(9)

Group 1 - Basal Aquifer

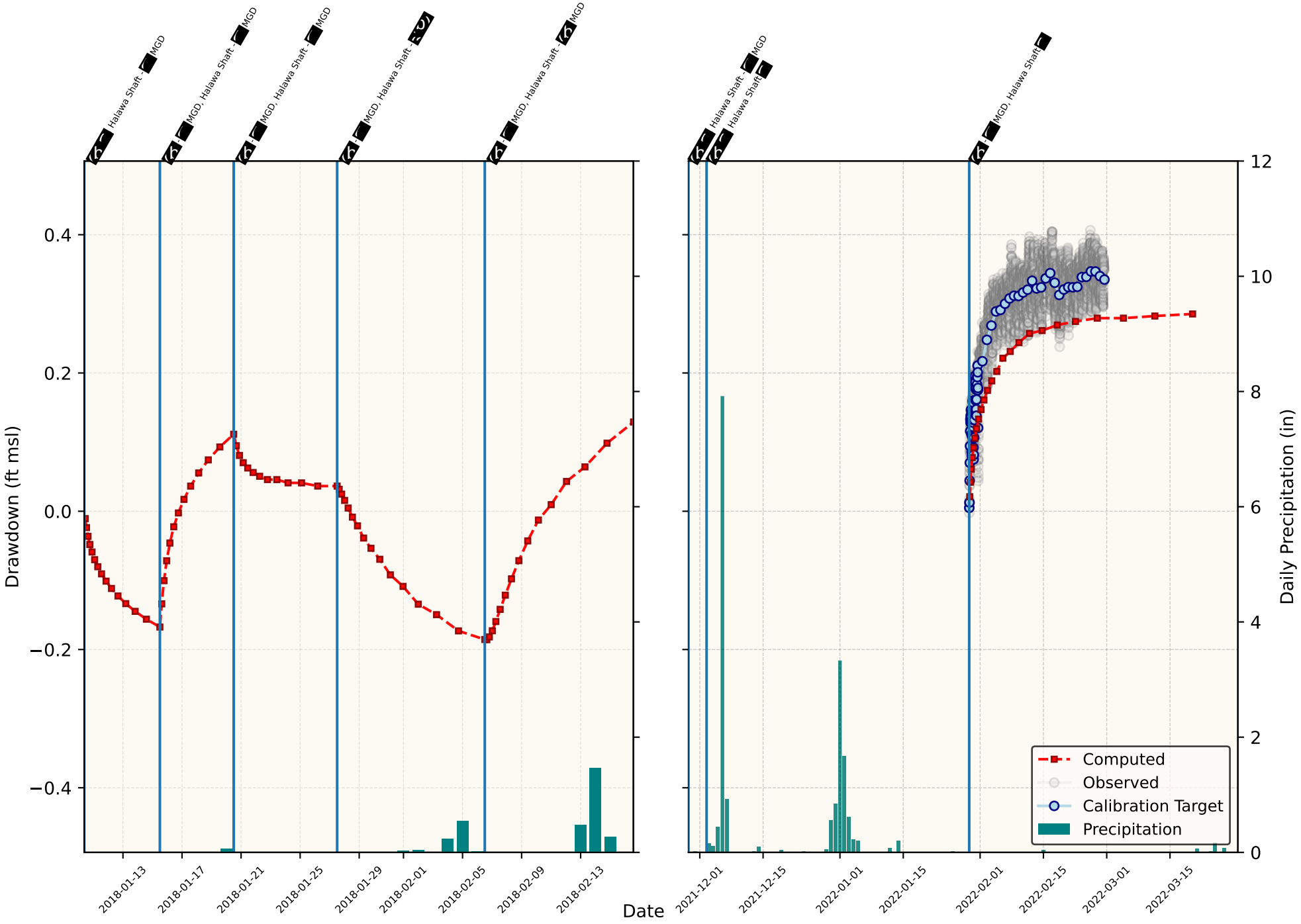


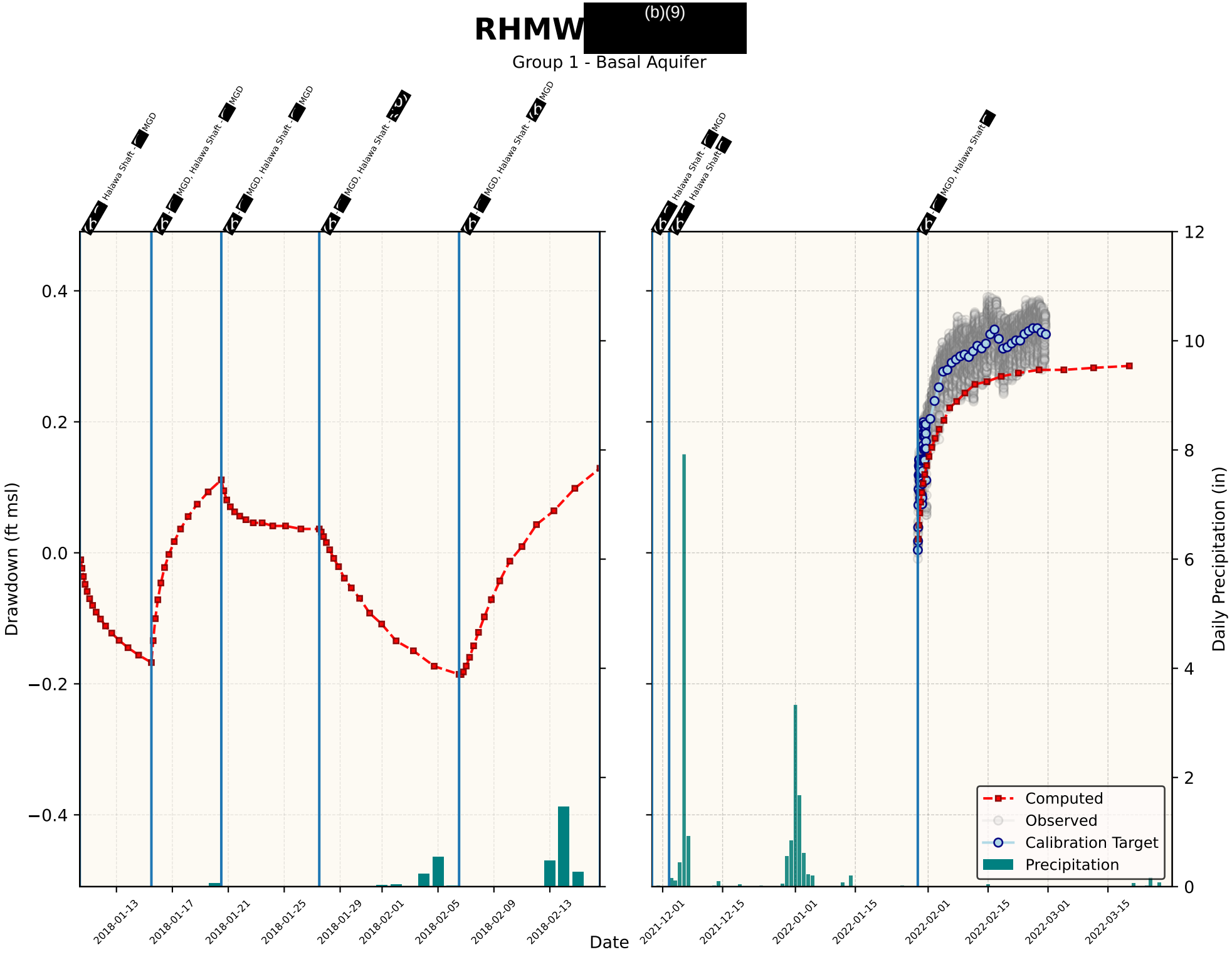

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Computed
Observed
Calibration Target
Precipitation

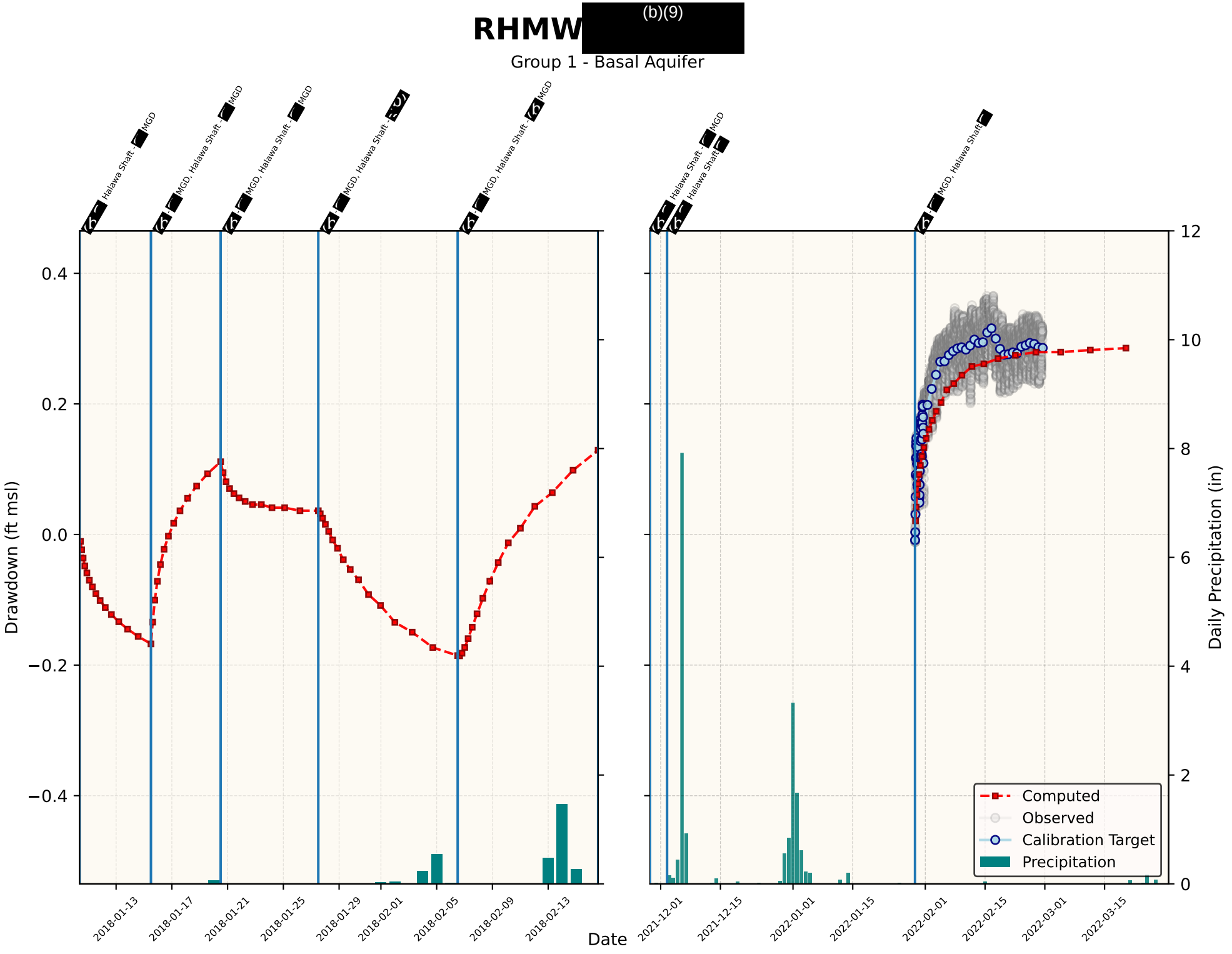

RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
Date
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Daily Precipitation (in)
12
10
8
6
4
2
0
Computed
Observed
Calibration Target
Precipitation

RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer

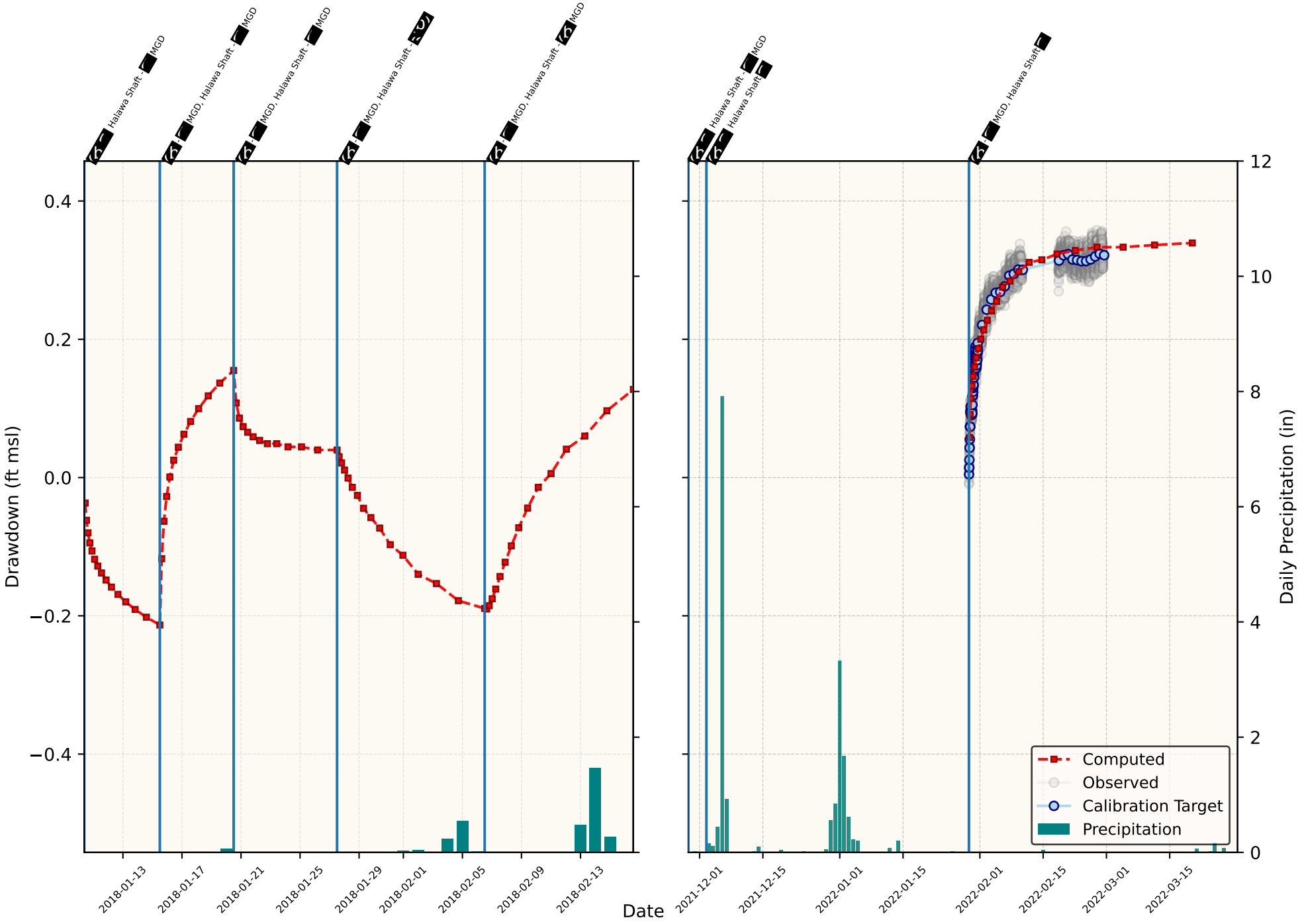



RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation


RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
[redacted] Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] MGD, Halawa Shaft [redacted] MGD
[redacted] Halawa Shaft [redacted] MGD
[redacted] Halawa Shaft [redacted]
[redacted] MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

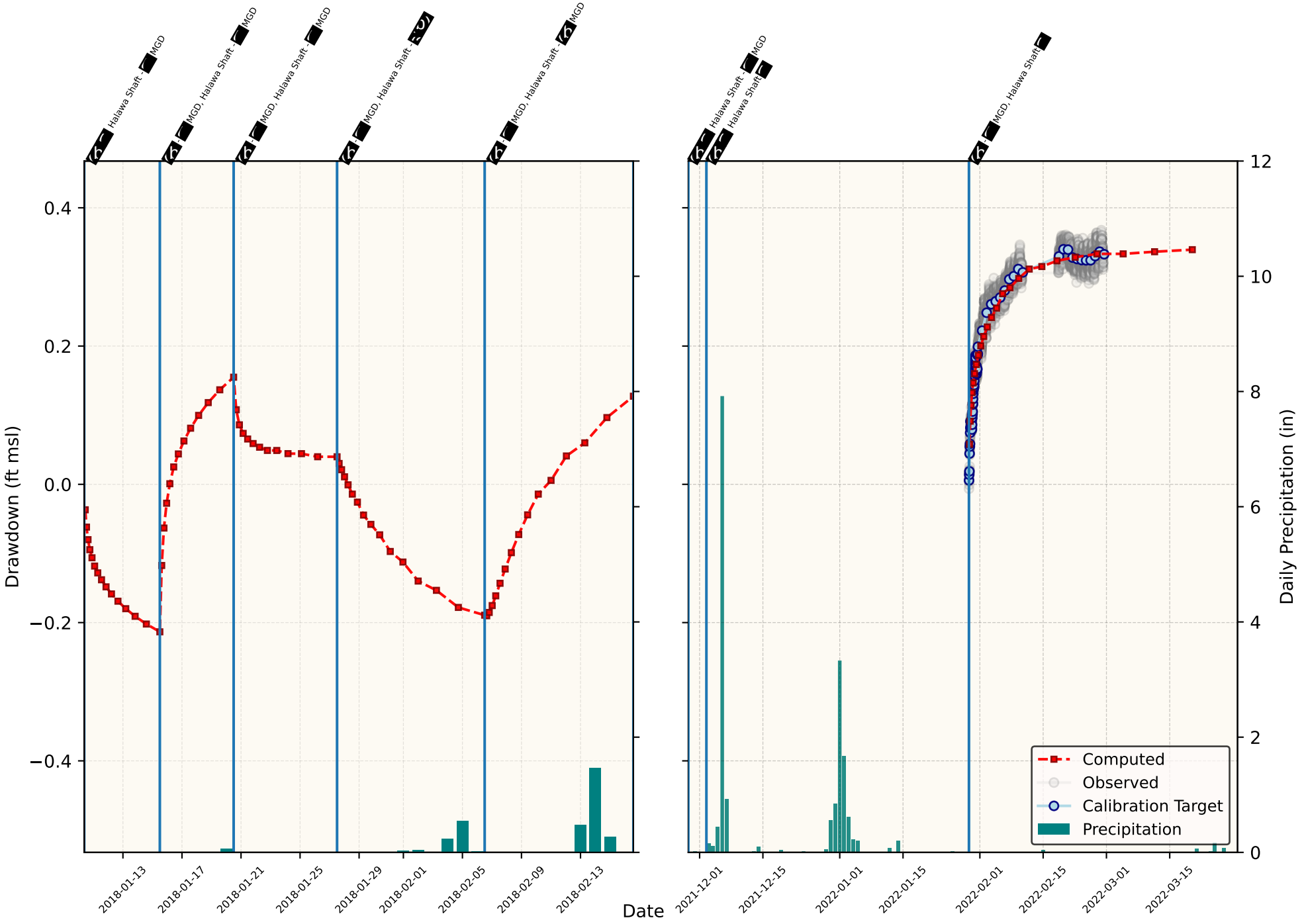
RHMW [redacted] (b)(9)

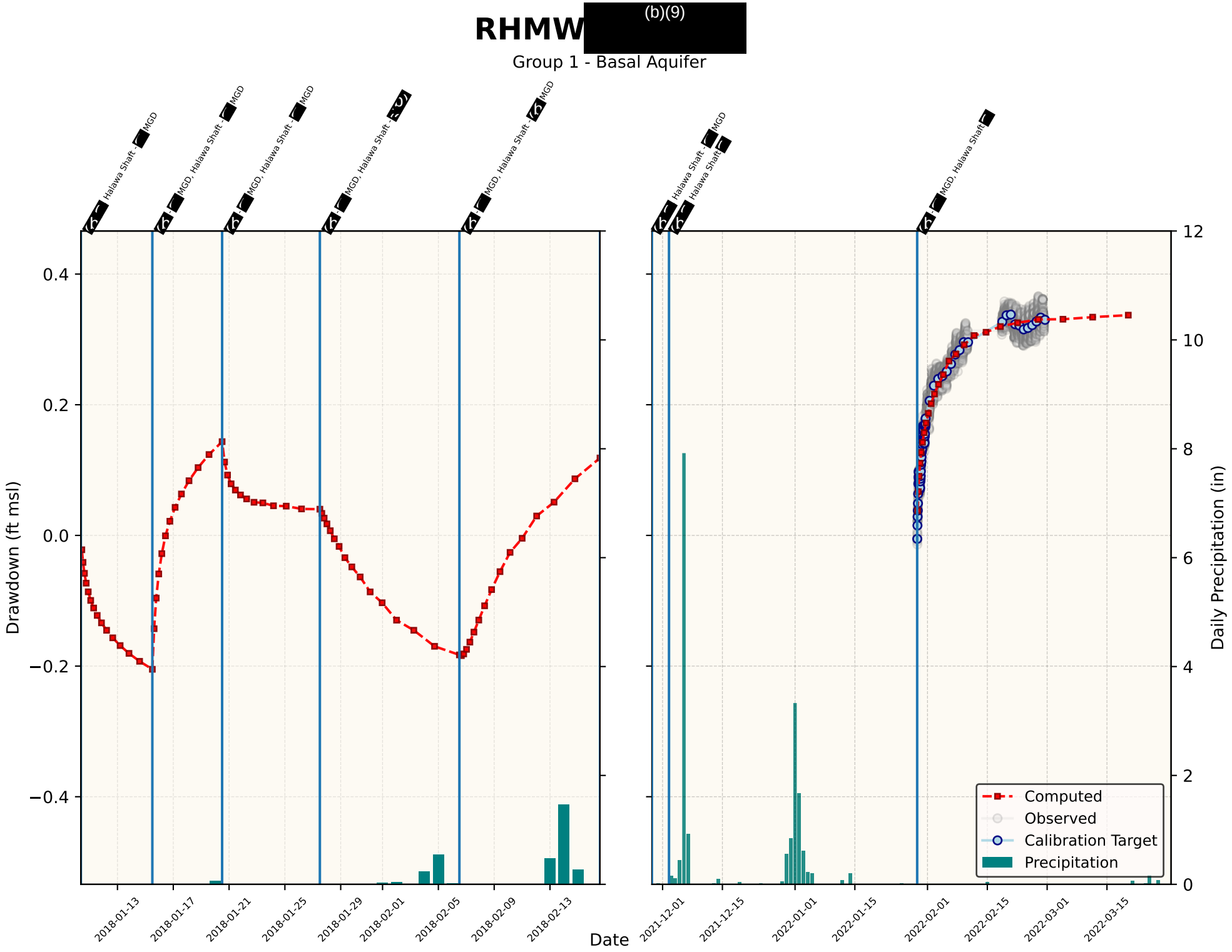
Group 1 - Basal Aquifer

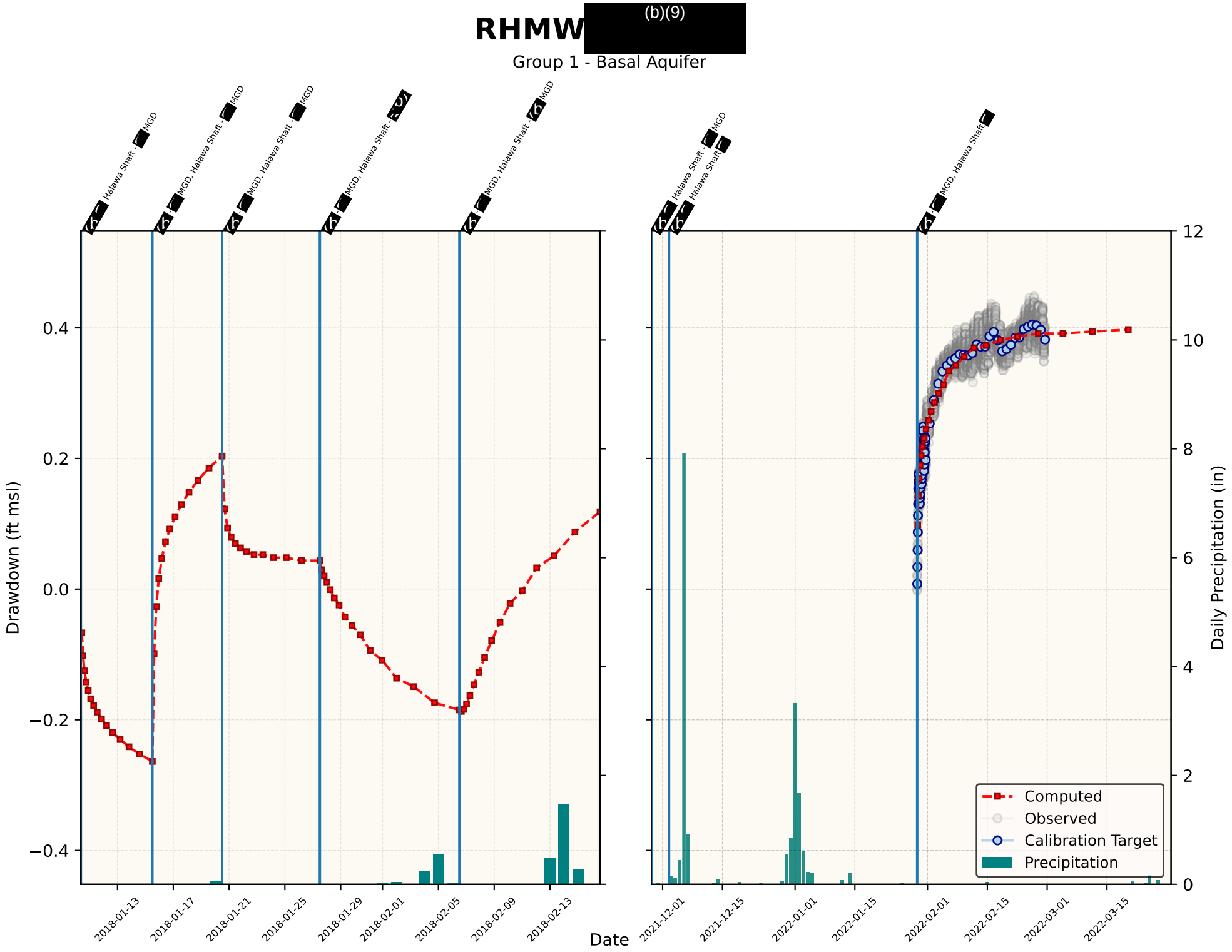


RHMW [redacted] (b)(9)

Group 1 - Basal Aquifer

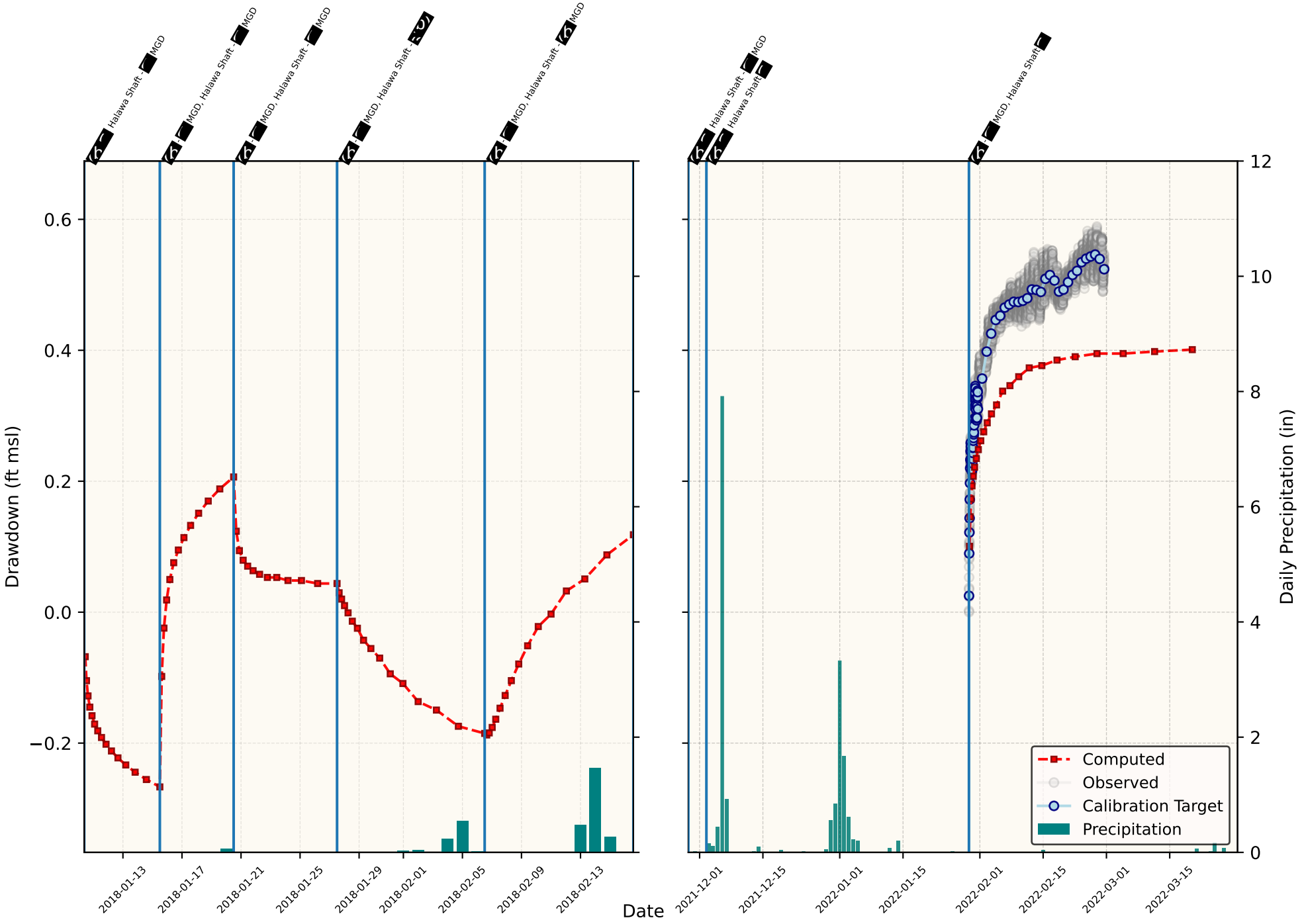



RHMW [redacted] (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation
0.4
0.2
0.0
−0.2
−0.4
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15


RHMW (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted] MGD
MGD, Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted] MGD
Halawa Shaft [redacted] MGD
Halawa Shaft [redacted]
MGD, Halawa Shaft [redacted]
Drawdown (ft msl)
0.4
0.2
0.0
−0.2
−0.4
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

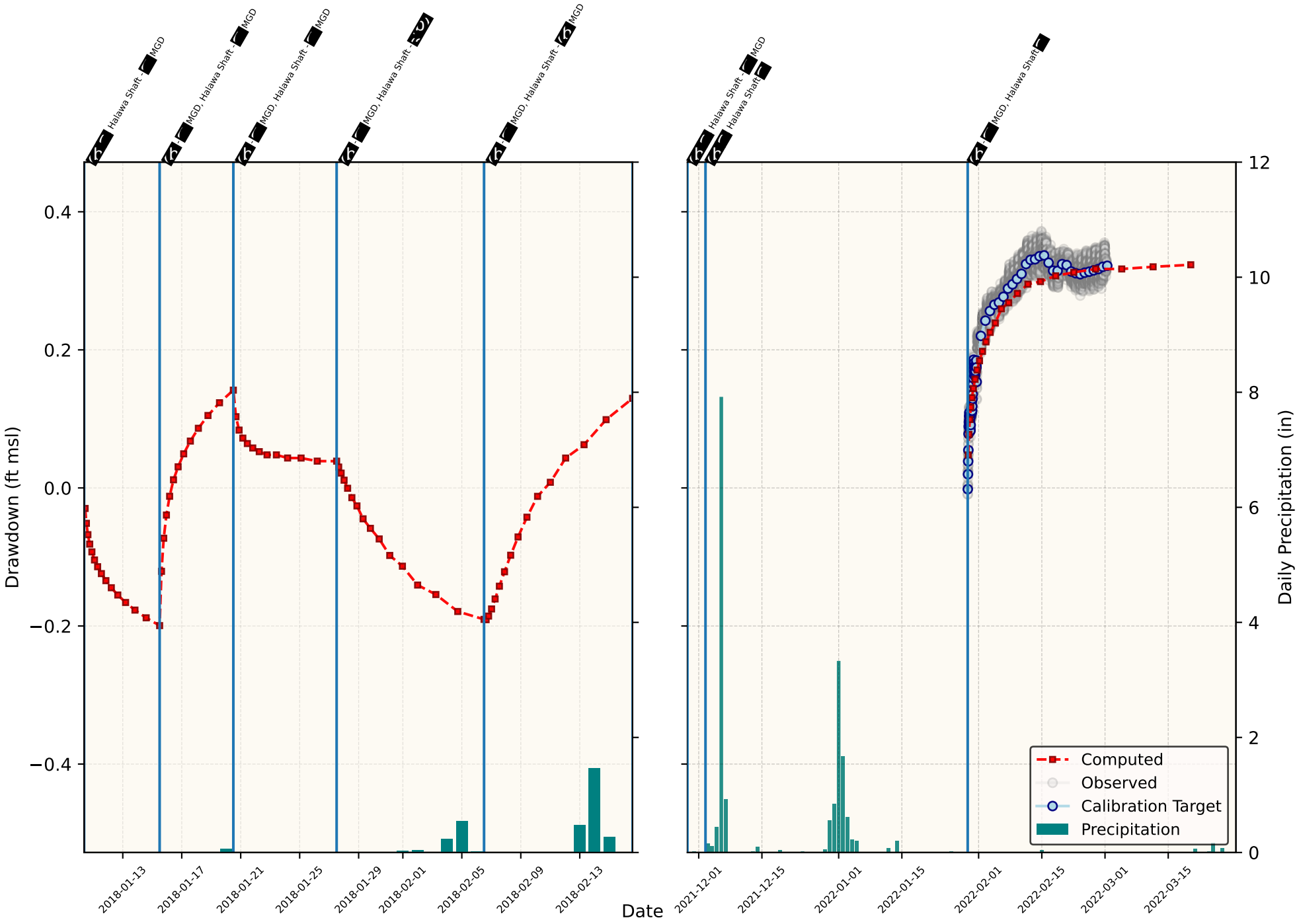
RHMW [redacted] (b)(9)

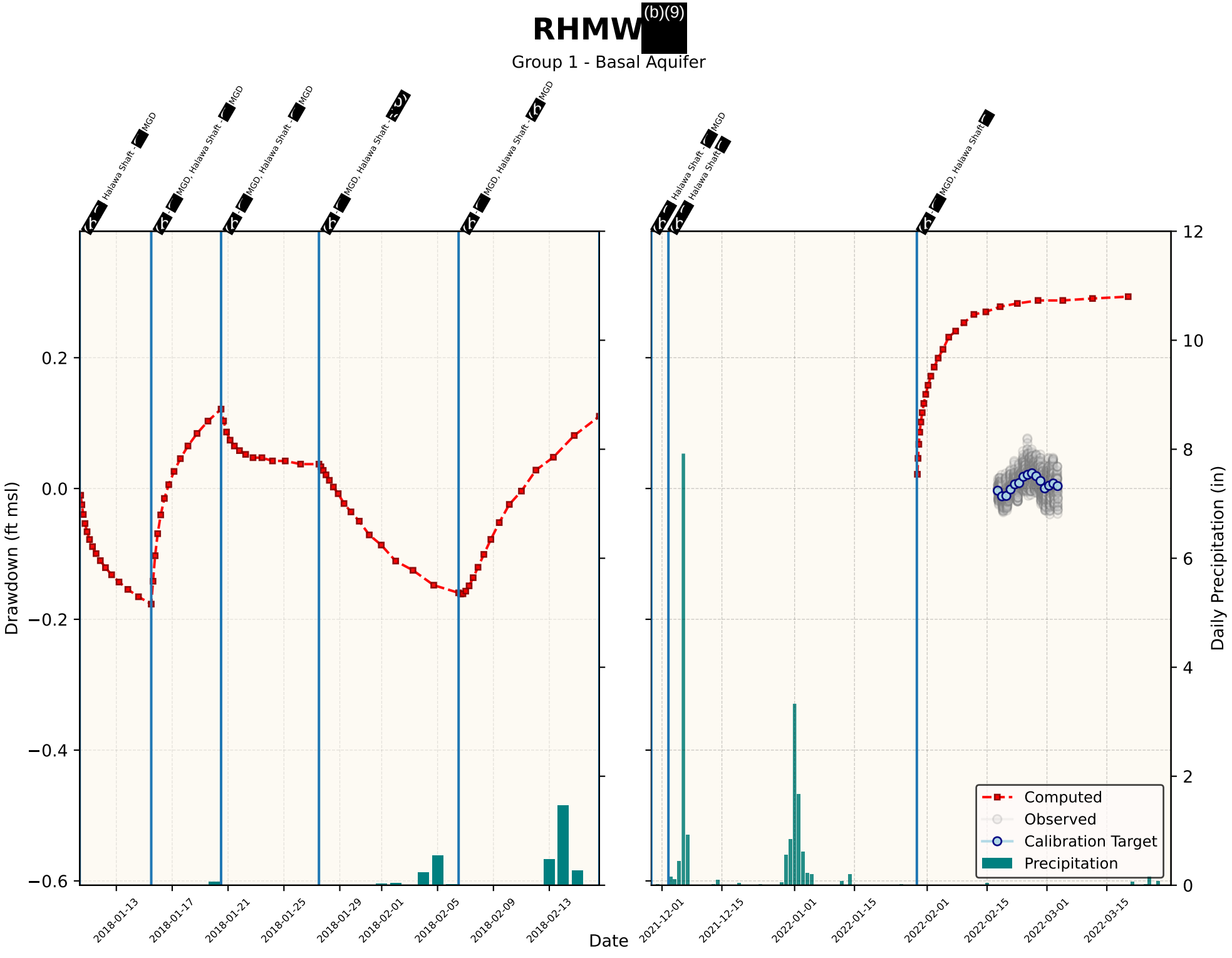
Group 1 - Basal Aquifer



RHMW(b)(9)

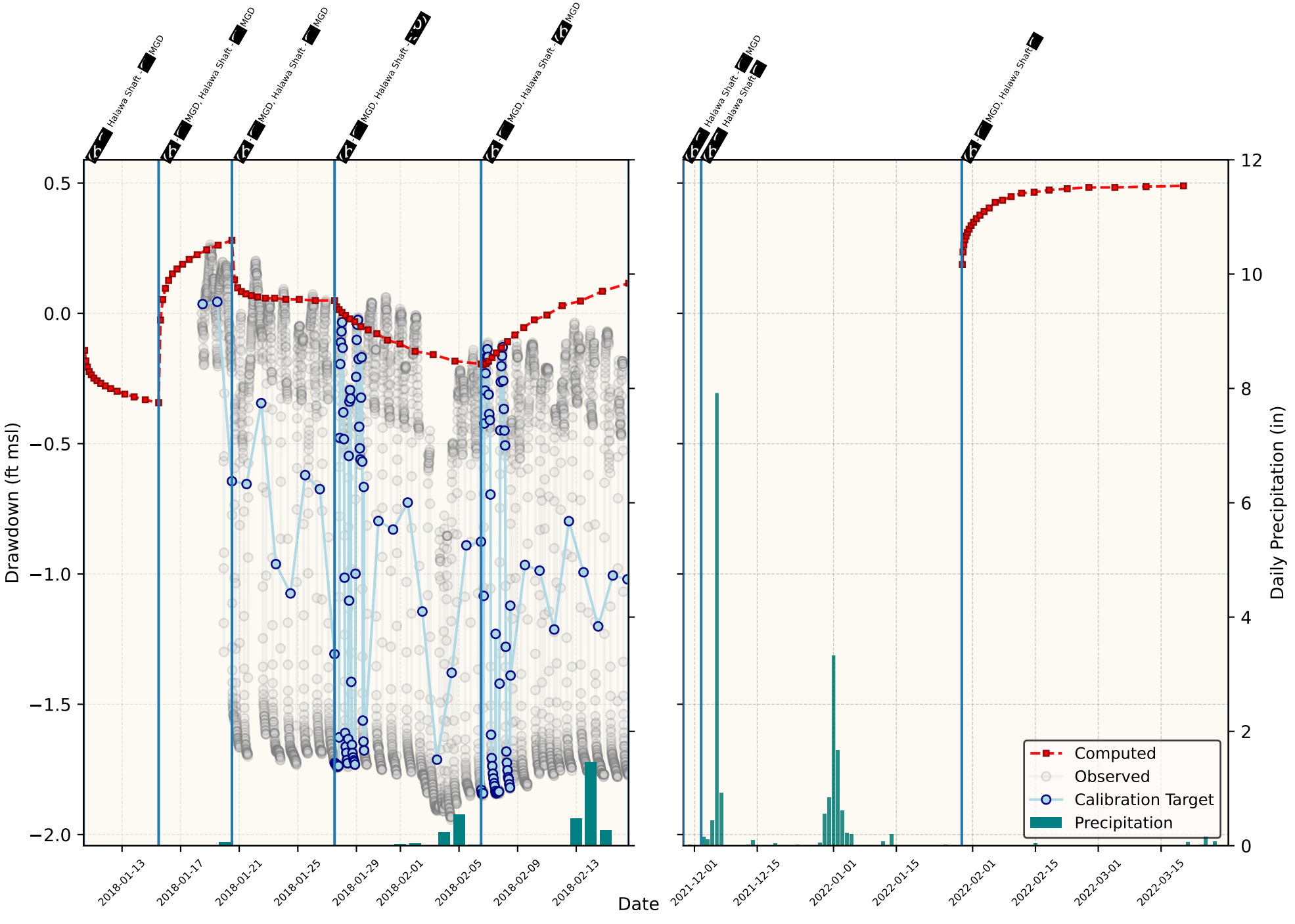
Group 1 - Basal Aquifer

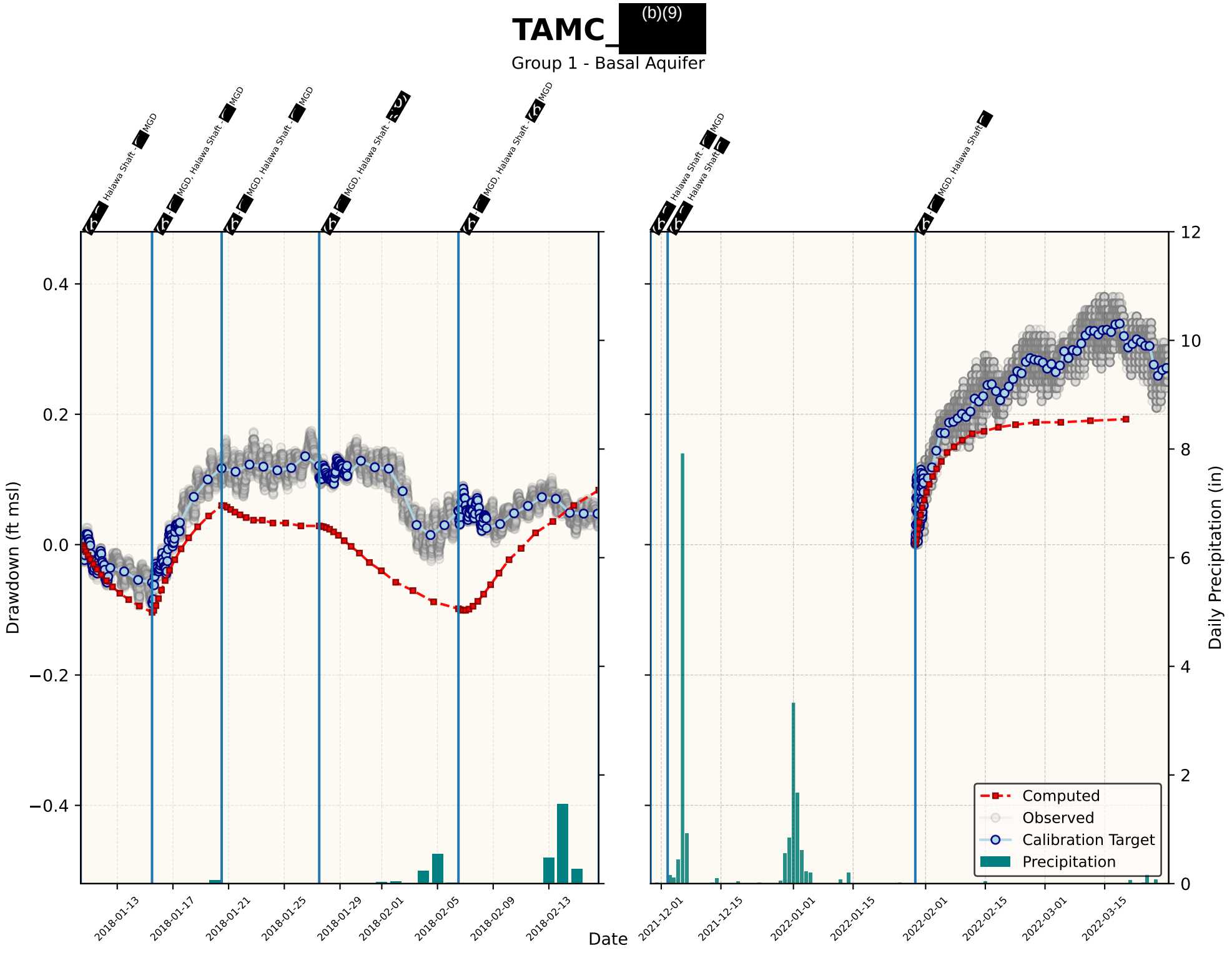


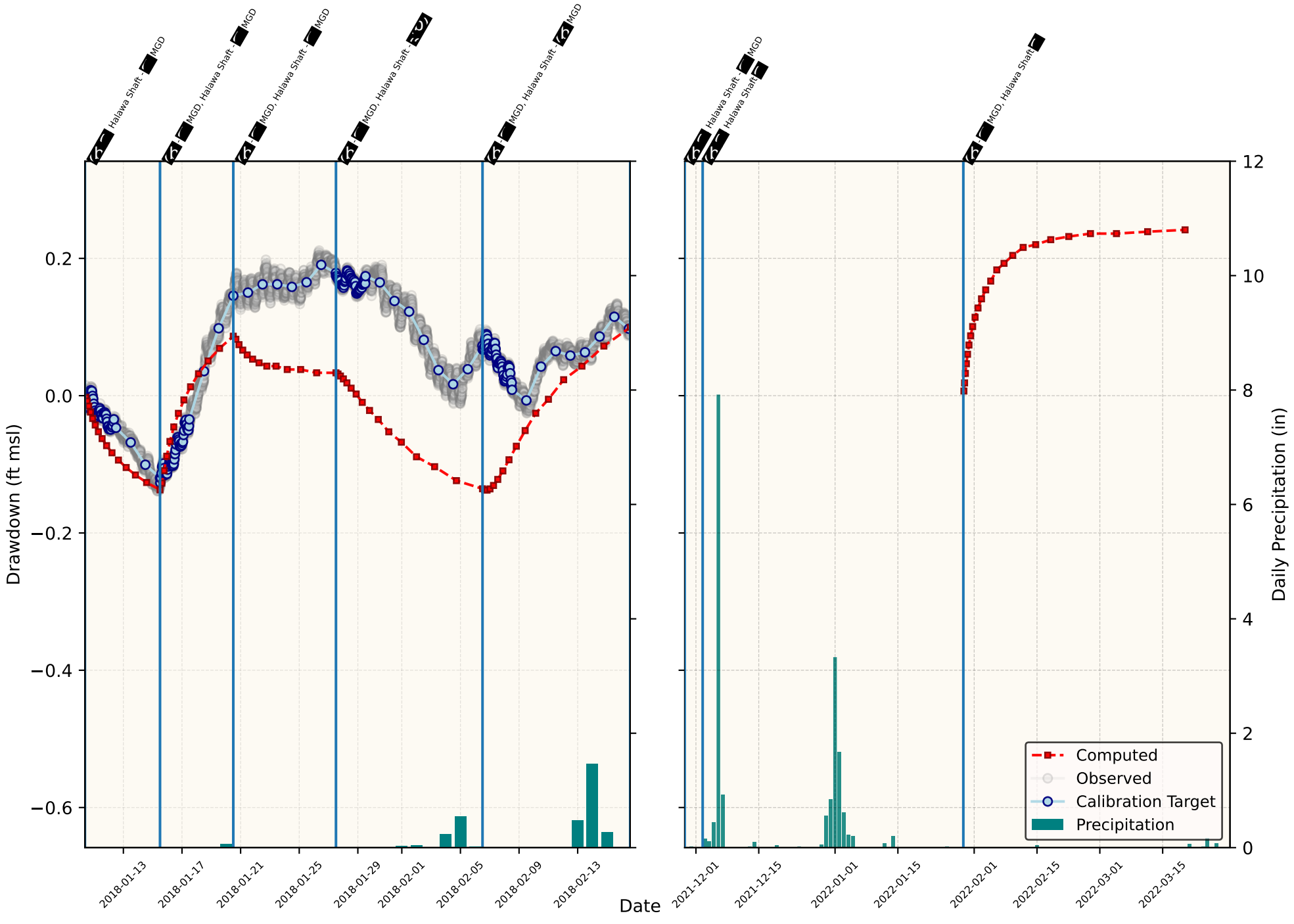

RHMW(b)(9)
Group 1 - Basal Aquifer
Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
MGD, Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9) MGD
Halawa Shaft (b)(9)
MGD, Halawa Shaft (b)(9)
Drawdown (ft msl)
0.2
0.0
−0.2
−0.4
−0.6
Daily Precipitation (in)
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15
Date
Computed
Observed
Calibration Target
Precipitation

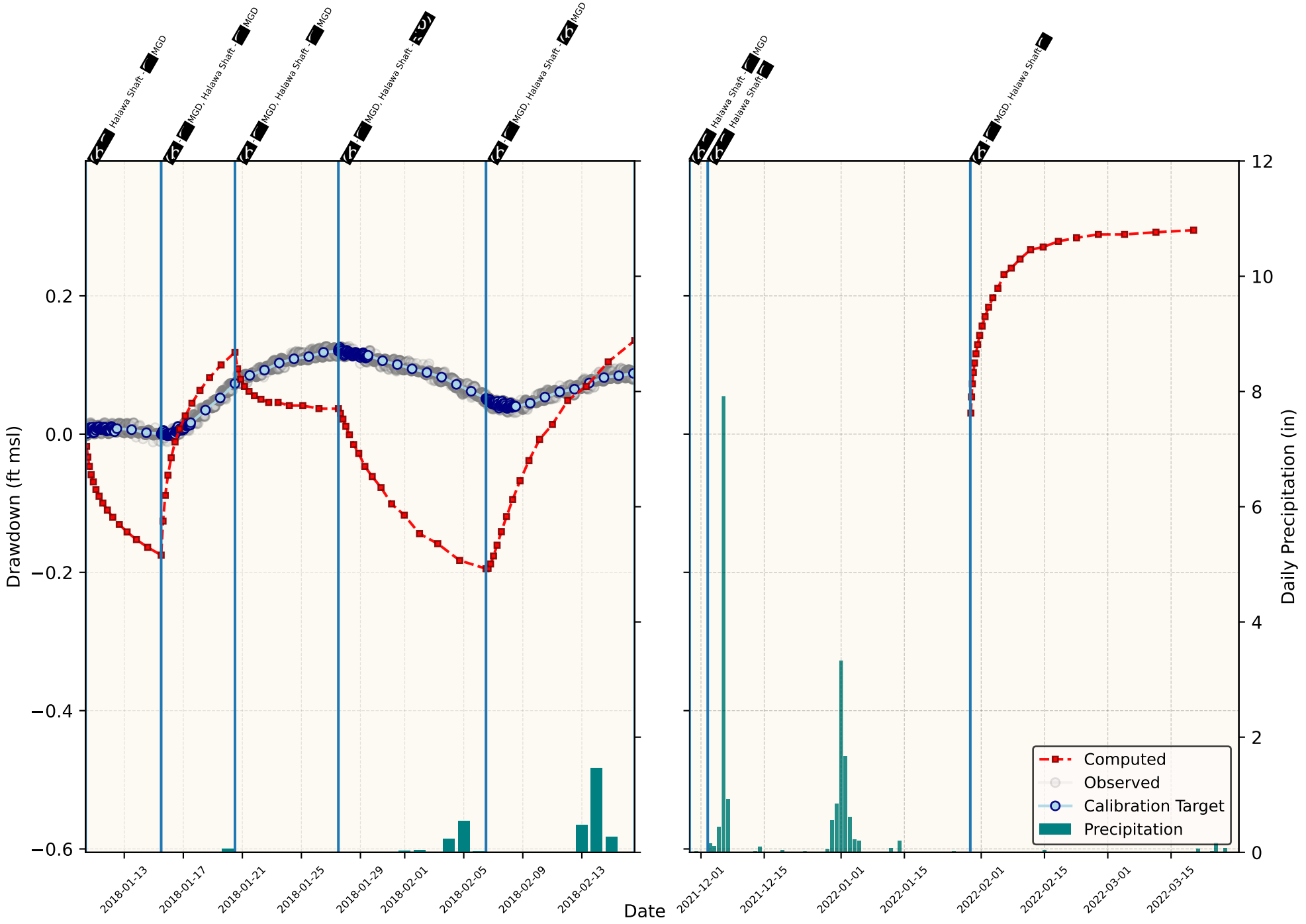
RHMW (b)(9)

Group 1 - Basal Aquifer



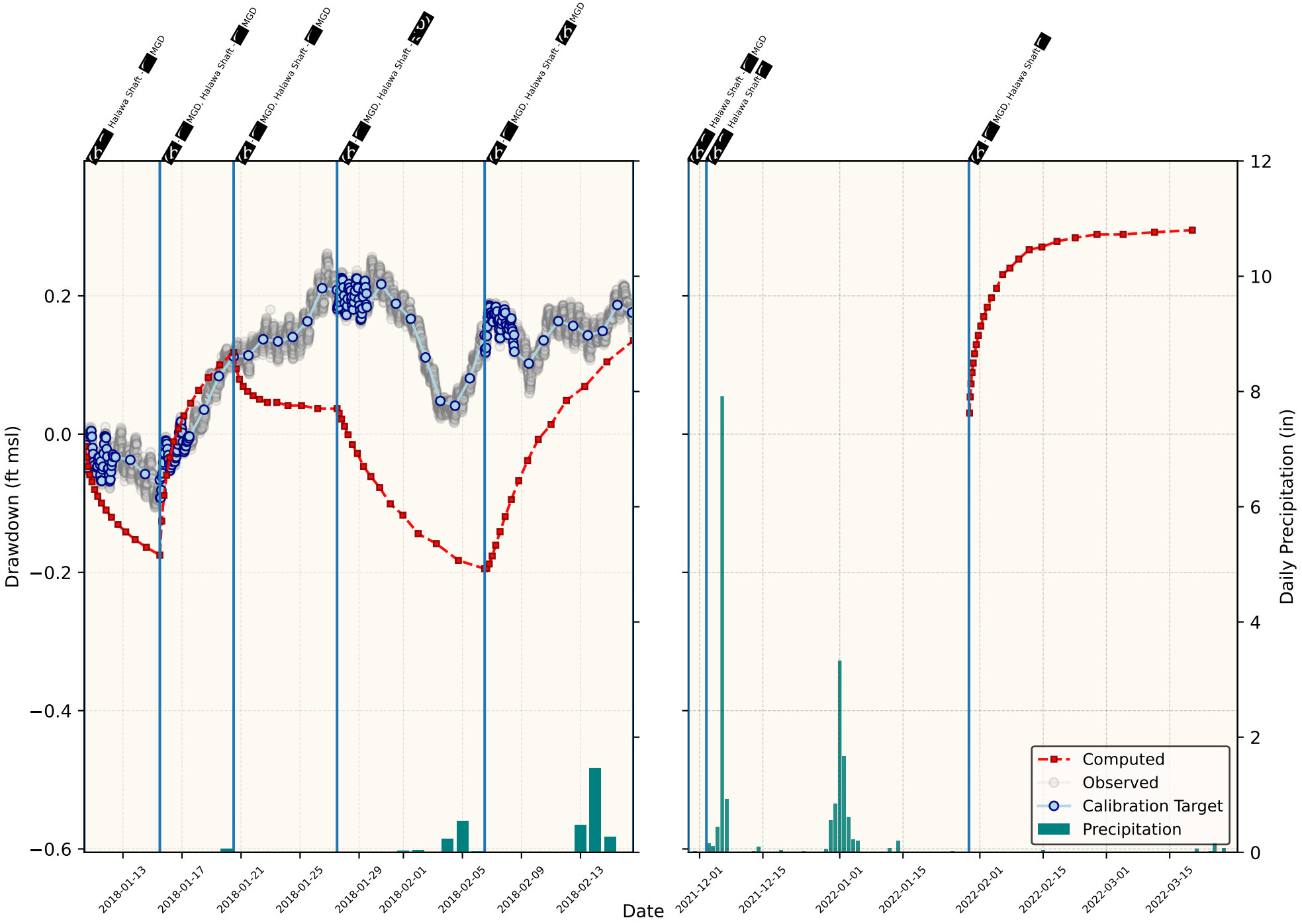

TAMC_ (b)(9)
Group 1 - Basal Aquifer
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

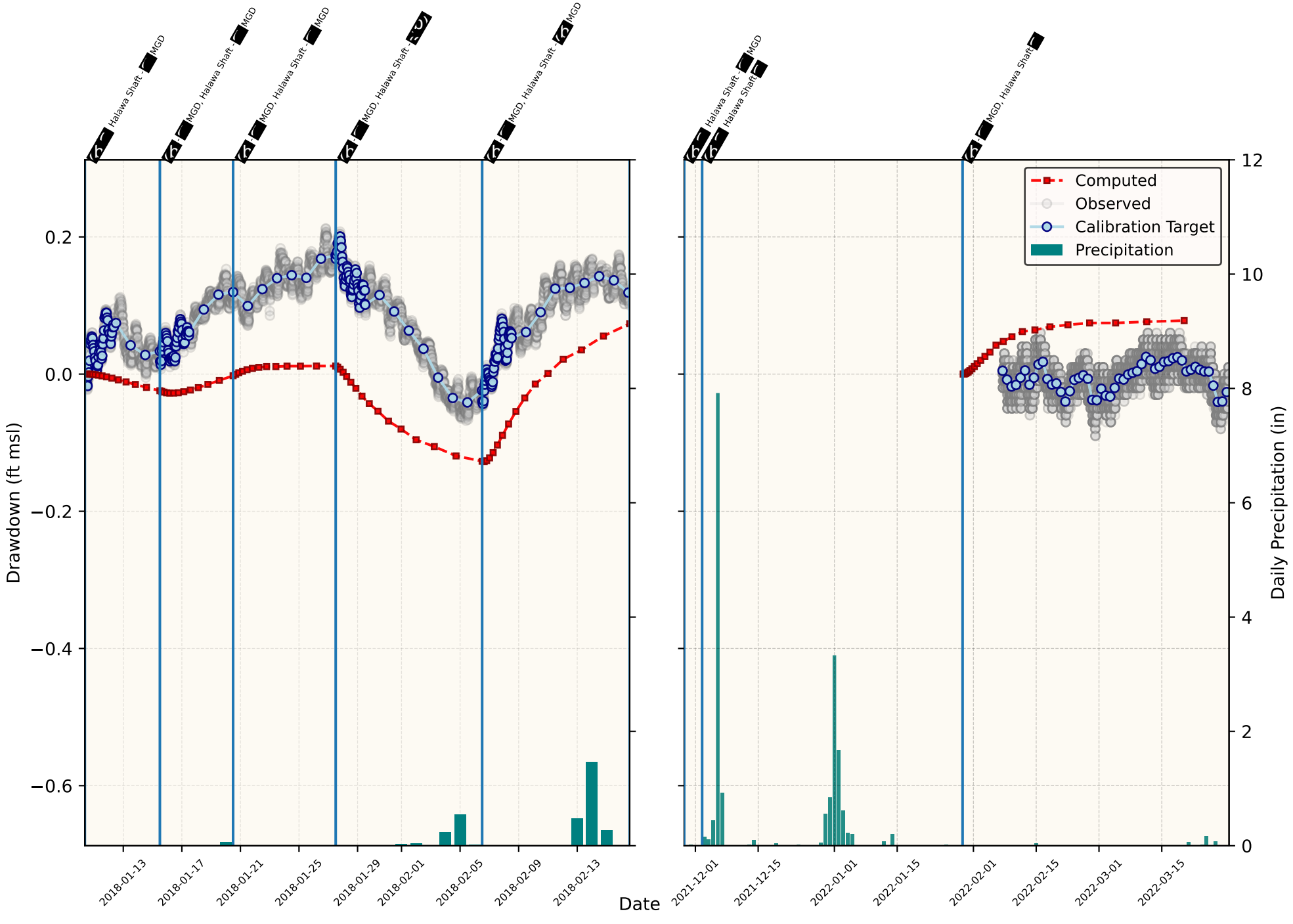

DH_43
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation


HDMW_Chase_Tube
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Drawdown (ft msl)
Daily Precipitation (in)
Date
Computed
Observed
Calibration Target
Precipitation

Halawa_Deep_Monitor_Well_HDMW2253-03

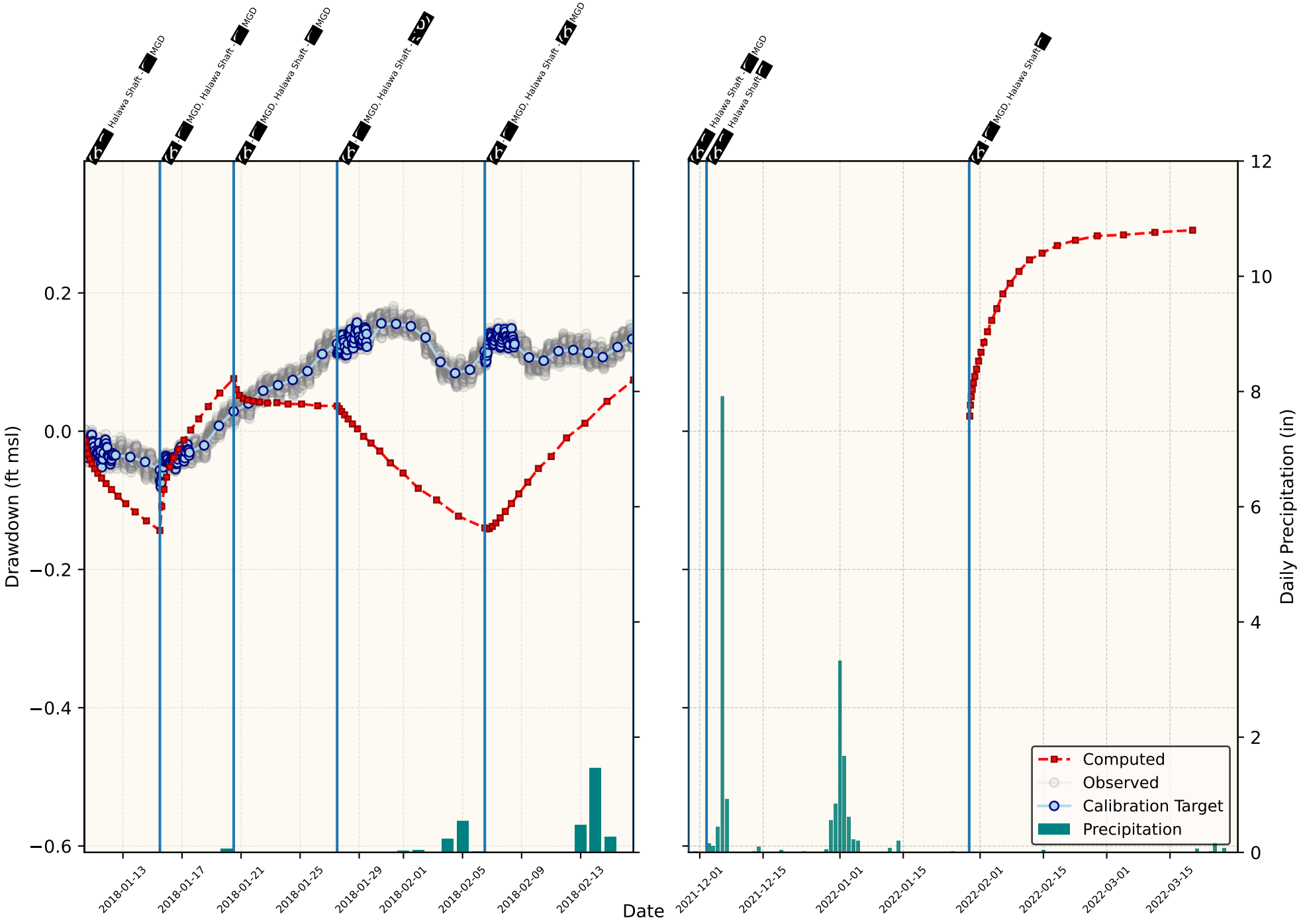
Group 2 - Deep Basal Wells




Kaamilo_Deep
Group 2 - Deep Basal Wells
Halawa Shaft
MGD
MGD, Halawa Shaft
Computed
Observed
Calibration Target
Precipitation
Drawdown (ft msl)
Daily Precipitation (in)
Date
0.2
0.0
−0.2
−0.4
−0.6
12
10
8
6
4
2
0
2018-01-13
2018-01-17
2018-01-21
2018-01-25
2018-01-29
2018-02-01
2018-02-05
2018-02-09
2018-02-13
2021-12-01
2021-12-15
2022-01-01
2022-01-15
2022-02-01
2022-02-15
2022-03-01
2022-03-15

RHMW[redacted]

Group 3 - Saprolite/Confining Unit Well with Elevated Head



RHMW (b)(9) [redacted]

Group 3 - Saprolite/Confining Unit Well with Elevated Head

