Integrated Monitoring Report: Trash Receiving Water Monitoring Progress Report

Water Years 2024-2025 (October 2023 – September 2025)

Prepared on behalf of:

Alameda Countywide Clean Water Program
Contra Costa Clean Water Program
San Mateo Countywide Water Pollution Prevention Program
Santa Clara Valley Urban Runoff Pollution Prevention Program
Solano Stormwater Alliance

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
1. INTRODUCTION 3
2. BACKGROUND 4
2.1 Monitoring Approach 5
2.2 Technical Advisory Group 6
2.3 Receiving Water Trash Monitoring Plan and QAPP 7
2.4 Reporting Requirements 8
3. WY 2025 TRASH RECEIVING WATER MONITORING 9
3.1 Monitoring Site Locations 9
3.2 Sampling Methods 12
3.2.1 Sampling Equipment 12
3.2.2 Sampling Events 13
3.2.3 Sample/Data Collection 14
3.2.4 Trash Characterization 15
3.2.5 Flow Measurement/Calculations 15
3.3 Data Analysis Methods 19
3.4 Results 20
3.4.1 Sampling Events 20
3.4.2 Trash Characterization 23
3.4.3 Flow Conditions during Sampling 29
3.4.4 Trash Loading Estimates 35
3.5 Statement of Data Quality 38
3.5.1 Hydrologic Data 38
3.5.2 Trash Sample Collection Data 39
3.5.3 Trash Characterization Data 40
4. DISCUSSION 41
4.1 Investigation of Trash Generation Based on Monitoring Results 41
4.2 Lessons Learned 41
4.2.1 Storm Selection 41
4.2.2 Trash Sample Collection 42
5. CONCLUSIONS AND RECOMMENDATIONS 43
5.1 Conclusions 43
5.2 Refinements for the Next Water Year 43
5.3 Recommendations for MRP 4.0 44
6. REFERENCES 47

LIST OF FIGURES

Figure 1 Trash receiving water monitoring sites....11
Figure 2 Monitoring equipment modified box trawl (right) trawl deployed from a bridge crane (left) 12
Figure 3 AC-ALM trash receiving water sampling site and the two streamflow gages used to calculate flow 16
Figure 4 Types of trash collected at all 6 sampling sites during WY 2025....25
Figure 5 Types of trash collected at AC-ALM (Alamo Canal) and AC-CRA (Crandall Creek) during WY 2025....26
Figure 6 Types of trash collected at SC-ADO (Adobe Creek) and SC-LPA (Lower Penitencia Creek) during WY 2025....27
Figure 7 Types of trash collected at CC-ROD (Rodeo Creek) SM-COL (Colma Creek) during WY2025..28
Figure 8 WY 2025 annual hydrograph for Alamo Canal, Alameda County (AC-ALM)....29
Figure 9 WY 2025 annual hydrograph for Crandall Creek, Alameda County (AC-CRA)....30
Figure 10 WY 2025 annual hydrograph for Rodeo Creek, Contra Costa County (CC-ROD)....31
Figure 11 WY 2025 annual hydrograph for Lower Penitencia Creek, Santa Clara County (SC-LPA)....32
Figure 12 WY 2025 annual hydrograph for Adobe Creek, Santa Clara County (SC-ADO)....33
Figure 13 WY 2025 annual hydrograph for Colma Creek, San Mateo County (SM-COL)....34

LIST OF TABLES

Table 1 Number of MRP-required Trash Monitoring Sites for each Countywide Stormwater Program....5
Table 2 Trash receiving water monitoring locations. 10
Table 3 Full trash capture design standard storm size for each receiving water monitoring site....14
Table 4 Sampling locations and associated streamflow stations....19
Table 5 Trash receiving water monitoring events, WY 2025....21
Table 6 Sampling period and duration, rainfall and streamflow characteristics, and number of aliquots for each monitoring event 22
Table 7 Total trash volume per sampling event 23
Table 8 Low-flow screening thresholds, annual stormflow volumes and annual stormflow volumes normalized by watershed area. 35
Table 9 Annual trash loading rates for 6 receiving water sites monitored during WY 2025....37

APPENDICES

Attachment A. Trash Receiving Water Characterization Data

Attachment B. Sample Event Hydrographs and Trash Samples, WY 2025

Attachment C. Streamflow Versus Trash Rates

Attachment D. Quality Assurance Report for Trash Sampling Procedure

LIST OF ACRONYMS

ACCWP	Alameda Countywide Clean Water Program
BAMSC	Bay Area Municipal Stormwater Collaborative
CCCWP	Contra Costa Clean Water Program
EO	Executive Officer
MRP	Municipal Regional Permit
MS4	Municipal Separate Storm Sewer System
POP	Probability of Precipitation
QAPP	Quality Assurance Project Plan
QPF	Quantitative Precipitation Forecast
RMC	Regional Monitoring Coalition
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SSA	Solano Stormwater Alliance
SWRCB	State Water Resources Control Board
TAG	Technical Advisory Group
USEPA	United States Environmental Protection Agency
WOW	Watching Our Watersheds
WY	Water Year

EXECUTIVE SUMMARY

Provision C.8.e of the Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit (MRP 3.0) Order No. R2-2022-0018 issued by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB or Regional Water Board) directs Permittees to conduct trash monitoring at municipal separate storm sewer system (MS4) outfalls and in receiving waters. It prescribes specific criteria, methods, and frequencies for monitoring locations that must be met to address the management and monitoring questions listed in MRP 3.0. This Trash Receiving Water Integrated Monitoring Report, submitted in compliance with Provision C.8.h.v. of MRP 3.0, documents trash monitoring accomplishments from the planning year of water year (WY) 2024 through the first year of monitoring in WY 2025.

The MRP mandates that a pilot receiving water monitoring program to directly sample sections of receiving waters that receive runoff primarily from MS4 outfalls draining tributary areas controlled at the low trash generation level must begin on October 1, 2024.

During WY 2025, the Monitoring Team successfully sampled 3 storm events at 4 of the 6 monitoring locations and 2 storm events at the remaining 2 locations. A total of 19 samples and 117 aliquots (subsamples) were collected. Trash sampling at the 6 sites was conducted using Weighted Box trawls manufactured specifically for this project with 5 mm mesh size nets. The project used pre-existing streamflow stations operated by various water management agencies, and in one case, flow data were supplemented with on-site water-level monitoring.

Each trash aliquot (subsample) was characterized by measuring the total volume of collected trash and the volume of collected trash assigned to 13 categories.

The total trash volumes standardized by area across the 19 sample events ranged from 0.001 to 3.98 gallons per acre. The trash characterization data showed that plastic items made up the majority of the trash characterized in all samples (88%). The proportion of items characterized into the "*Single-use Plastic Food/Drink Ware*" and "EPS Foam Food Ware" categories were highest at Rodeo Creek (89%), followed by Crandall Creek (27%) and Lower Penitencia Creek (17%), with the remaining 3 sites ranging from 3% to 5%.

Annual trash loading rates were calculated using the mean trash concentration for all aliquots at each of the six sites. For each site, the mean trash concentration during stormflow was multiplied across the entire stormflow hydrograph for WY 2025. Using this simple method, trash loading rates for the 6 sites ranged from 0.01 to 2.17 gallons/acre/year. The values are below the low trash generation rate of 5 gallons/acre/year in MS4 drainage areas that municipalities have achieved through implementation of trash controls.

The BAMSC identified several refinements to receiving water sampling for WY 2026.
These modifications do not substantially impact receiving water monitoring and do not warrant revisions to the Receiving Water Monitoring Plan. First, because sampling data will be used to develop annual trash loads and loading rates at each of the 6 stations, a wide variety of storm types with varying antecedent dry conditions is desirable; the Monitoring Coordinator will use

professional judgment to select appropriate storms across a wide variety of storms and antecedent dry periods. Second, due to limitations in Weighted Box trawl performance, mid-water-column and channel-bed samples will be taken opportunistically, but not extensively. Third, additional training will be performed with field staff to more accurately address "active trash width." Lastly, the BAMSC Programs will evaluate factors that may influence trash loading rates and present data analysis approaches to the Trash TAG following WYs 2026 and/or 2027.

Trash-receiving water monitoring conducted by BAMSC during MRP 3.0 was explicitly structured as a pilot study and made possible through an external USEPA WQIF grant from the Watching Our Watersheds (WOW) project. While the data generated during WY 2025 and during the MRP 3.0 permit term are informative for advancing scientific understanding of trash transport in receiving waters and for testing the application of the Weighted Box trawl method, BAMSC strongly recommends that trash-receiving water monitoring not be included in MRP 4.0 because receiving water sampling has limited relevance to management questions, limited ability to answer monitoring questions, has high resource demand, and has a high degree of uncertainty.

1. INTRODUCTION

On behalf of all public agencies (i.e., Permittees) subject to the Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit (MRP; Order No. R2-2022-0018) issued by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB or Regional Water Board), this *Integrated Monitoring Report (IMR): Trash Receiving Water Monitoring Progress Report*, *Water Years*[1] *(WYs) 2024-2025* was prepared for the Bay Area Municipal Stormwater Collaborative (BAMSC) Regional Monitoring Coalition (RMC). Members of the BAMSC RMC include representatives from the following Countywide Stormwater Programs:

- Alameda Countywide Clean Water Program (ACCWP)
- Contra Costa Clean Water Program (CCCWP)
- Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)
- San Mateo Countywide Water Pollution Prevention Program (SMCWPPP)
- Solano Stormwater Alliance (SSA)

This report was prepared as a task defined under the Watching Our Watersheds (WOW) Regional Trash Monitoring Project, which is funded by grant number 98T61401 from the United States Environmental Protection Agency (USEPA) Water Quality Improvement Fund (WQIF). The WOW project addresses several MRP Provision C.8.e requirements for trash monitoring, including development of Regional Trash Monitoring Progress Reports.

This report was prepared by Balance Hydrologics, Inc., and EOA, Inc. (Technical Project Team) in coordination with BAMSC.

This report fulfills the requirements of Provision C.8.h.v of the MRP for describing receiving water trash monitoring accomplishments conducted in accordance with Provision C.8.e of the MRP from the planning year of WY 2024 through the first year of monitoring in WY 2025. The IMR for Trash *Receiving Water* Monitoring is presented herein; the IMR for Trash *Outfall* Monitoring will be sent to the Regional Water Board as a separate report.

[1] Most hydrologic monitoring occurs for a period defined as a Water Year, which begins on October 1 and ends on September 30 of the named year. For example, Water Year 2025 (WY 2025) began on October 1, 2024, and concluded on September 30, 2025.

2. BACKGROUND

The level of trash in California's receiving waters has increased substantially over the past few decades and is currently one of the state's most significant water quality issues (SWRCB 2015). Over the last decade, MRP Permittees have invested significant public resources to implement source controls and stormwater infrastructure improvements/upgrades to reduce the amount of trash discharged from their municipal separate storm sewer systems (MS4s) into receiving waters. Many of these actions are prescribed by Provision C.10 of the MRP, which mandates that Permittees achieve a 100% reduction of trash in stormwater discharges from baseline (2009) levels by June 2025. To date, most Permittees have achieved the 100% reduction goal, and a majority of municipalities that did not meet it have developed plans to reach 100% by the end of 2025.

With the adoption of the current MRP in 2022 (i.e., MRP 3.0), the Regional Water Board also added significant requirements for trash monitoring. Provision C.8.e requires Permittees to conduct trash monitoring at MS4 outfalls and in receiving waters, and prescribes specific monitoring location criteria, methods, and frequencies that must be achieved to address the management and monitoring questions identified in Provision C.8.e.v and listed below. Provision C.8.e.v required that Permittees submit a "collective" (i.e., regional) Trash Monitoring Plan that demonstrates how the requirements in Provision C.8.e will be met. The Trash Receiving Water Monitoring Plan was sent to the Regional Water Board Executive Officer (EO) for approval was July 31, 2024, in compliance with the MRP requirement to do so by July 31. The Trash Receiving Water Monitoring Plan (BAMSC 2024a) was designed to address Management Question 2 and Monitoring Question 2 from the MRP[2]:

Management Questions

1. Have the Permittees' trash management actions effectively prevented trash from their jurisdictions from discharging to receiving waters?
2. Are discharges of trash from areas within Trash Management Areas controlled to a low trash generation level, causing and/or contributing to adverse trash impacts in receiving water?

Monitoring Questions

1. What is the trash condition and approximate level of trash (volume, type, and size) within and discharging into receiving waters in areas that receive MS4 runoff controlled to a low trash generation via the installation of full trash capture devices, or the implementation of other trash management actions equivalent to full trash capture systems?
2. Does the level of trash in the receiving water correlate strongly with the conditions of the tributary drainage area of the MS4?

---

[2] The Trash *Receiving Water* Monitoring Plan was submitted to the Regional Water Board EO for approval on July 31, 2024, and trash receiving water monitoring began in WY 2025.

2.1 Monitoring Approach

Provisions C.8.e.ii – iii of the MRP prescribe trash monitoring methods, sites, events, frequency, and intervals.

The MRP mandates that a pilot receiving water monitoring program directly sample sections of receiving waters that receive runoff primarily from MS4 outfalls draining tributary areas controlled at the low trash generation level must begin on October 1, 2024. At least six receiving water sites regionwide must be monitored during at least three wet weather events per year. The required allocation among the Countywide Stormwater Programs is listed in **Table 1**. Targeted storm events are likely to result in trash discharges through the MS4 system, and targeted receiving water monitoring locations should not be downstream of direct discharge sites (e.g., homeless encampments, illegal dumping sites). Provision C.8.e.ii also requires direct measurement of streamflow at or near the monitoring station (to calculate loading) and collection of data on the type of material collected.

Table 1 Number of MRP-required Trash Monitoring Sites for each Countywide Stormwater Program

Countywide Program	# of Receiving Water Sites
ACCWP	2
CCCWP	1
SCVURPPP	2
SMCWPPP	1
Totals	**6**

2.2 Technical Advisory Group

To assist in the development and implementation of a scientifically-sound Trash Monitoring Plan, Provision C.8.e.iv requires Permittees to form and convene a Technical Advisory Group (TAG) composed of impartial science advisors and Regional Water Board staff. The Trash Monitoring TAG (Trash TAG) members include monitoring experts from throughout California:

- **Tony Hale, PhD** - Director of the Environmental Informatics Program at the San Francisco Estuary Institute (SFEI)
- **Shelly Moore** - Executive Director of the Moore Institute for Plastic Pollution Research
- **Tom Mumley, PhD**[3] - Assistant Executive Officer at the San Francisco Bay Regional Water Board
- **Dawn Petschauer**[4] - Stormwater Program Administrator at the City of Pasadena
- **Ted Von Bitner, PhD** - Assistant Vice President at WSP USA

To date, five Trash TAG meetings have been held, with a total of eight planned for the entire monitoring project. During WY 2023, meetings #1 and #2 were conducted in March and May 2023, respectively, with focus on obtaining Trash TAG guidance and feedback on the development of the Trash *Outfall* Monitoring Plan and Quality Assurance Project Plan (QAPP). In WY 2024, meetings #3 and #4 were conducted in March and May 2024, respectively, with focus on obtaining Trash TAG guidance and feedback on the development of the Trash *Receiving Water* Monitoring Plan and QAPP. Meeting #5 was conducted in February 2025 and focused on providing results and analyses from the first year of trash outfall monitoring (i.e., WY 2024) and TAG review of potential adaptations to future monitoring approaches. Subsequent meetings will be held at least annually to provide continued feedback regarding the implementation of both Trash Monitoring Plans (Outfall and Receiving Water).

Provision C.8.e.v also requires Permittees to provide opportunities for input on development of the Trash Monitoring Plan(s) by interested parties and scientific experts other than those participating in the TAG. As described in the trash outfall and receiving water monitoring plans, this requirement was satisfied by seeking input from stakeholders that participate in the BAMSC Trash Subcommittee (which include California Department of Transportation [Caltrans], local watershed groups, USEPA, university professors and academics, and Save the Bay) and other organizations, such as The Moore Institute.

[3] Dr. Mumley retired from his position at the Regional Water Board in June 2024. His replacement on the TAG is Rebecca Nordenholt, Senior Environmental Scientist, SF Bay Regional Water Board.

[4] As of January 2026, Dawn Petschauer is no longer on the TAG; a replacement member yet to be determined.

2.3 Receiving Water Trash Monitoring Plan and QAPP

A key element of any monitoring program is a comprehensive QAPP. The QAPP is a written document that describes the procedures that the monitoring project will use to ensure the data it collects and analyzes the project requirements. In this case, all data must be comparable to the California Surface Water Ambient Monitoring Program (SWAMP). This means that the project Measurement Quality Objectives (MQOs) (i.e., acceptance criteria for the data) must be equivalent to or exceed SWAMP MQOs which are described in the SWAMP Quality Assurance Program Plan (QAPrP)[5]. In the interest of achieving regional consistency among Trash Monitoring conducted by MRP Permittees, the WOW Technical Project Team developed a common QAPP for Trash Receiving Water Monitoring (BAMSC 2024b). The QAPP is SWAMP comparable to the extent practical, including requirements for QA/QC samples (e.g., replicates/duplicates), documentation, MQOs, and sampling and handling protocols.

[5] The current version of the SWAMP QAPrP is available here: *https://www.waterboards.ca.gov/water_issues/programs/swamp/docs/swamp-qaprp-2022.pdf*

2.4 Reporting Requirements

Along with each annual Urban Creeks Monitoring Report (UCMR), Provision C.8.h.iii. (2) of MRP 3.0 requires Permittees to submit a single collective regionwide trash monitoring annual progress report no later than March 31. In lieu of the WY 2025 UCMR, Permittees are required to submit a comprehensive Integrated Monitoring Report no later than March 31, 2026. For receiving water trash monitoring, this report covers planning actions conducted in WY 2024, data collected in WY 2025, and includes the information listed below (with associated sections of this report identified):

a) Narrative description of monitoring conducted, including the number of sites monitored and the number of monitoring events completed (**Sections 3.1** and **3.4.1**);

b) Description of storm events that were sampled, including the date(s) and times when sampling occurred, intensity and duration of the storm event, a description of where along the hydrograph the storm event was sampled, and justification used to determine the appropriate size to displace and/or mobilize the transport of trash through MS4 systems (**Section 3.4.1**);

c) Description and the results of data analysis methods, including statistical analyses (**Section 3.4**);

d) Results and lessons learned (**Sections 3.4** and **4.2**);

e) Data quality assurance procedures that were implemented for aliquots collected (**Section 3.5**);

f) Monitoring events (including locations and methods) planned for the subsequent fiscal year(s) (**Section 5.2**);

g) Updates of required Initial Trash Monitoring Plan elements (**Section 5.2**);

h) Summary of budget for each monitoring requirement;[6] and

i) With cause and justification, recommendations for changes to any of the elements of Provision C.8.e (**Section 5.3**).

By no later than March 31, 2026, permittees shall collectively submit a comprehensive Trash Monitoring Report coincident with the Integrated Monitoring Report, which, at a minimum, includes all items listed above, but for all prior water years since the previous Integrated Monitoring Report.

[6] Budget summaries for Trash Monitoring and other C.8 monitoring programs are reported separately by each of the participating BAMSC programs.

3. WY 2025 TRASH RECEIVING WATER MONITORING

During WY 2025, the Technical Project Team, at the direction of Member Programs from the BAMSC Regional Monitoring Coalition, conducted trash monitoring at all six regionwide receiving water monitoring locations. All three sample events occurred at four of the six sites. Due to delays in the manufacturing of monitoring equipment, unforeseen site hydrology issues, and the drier-than-normal water year, only two of the required three sampling events occurred at two of the sites, SM-COL and AC-CRA.

Key components of the receiving water monitoring program are summarized in the section below. These components include:

- Monitoring Site Locations
- Sampling Methods
- Data Analysis Methods
- Results
- Data Quality Assessment

3.1 Monitoring Site Locations

Six receiving water locations were selected for trash monitoring. Site locations are listed in **Table 2** and mapped in **Figure 1**. **Table 2** also presents the drainage area and percentage of urban land use associated with each site.

Table 2 Trash receiving water monitoring locations.

County	Station ID	Creek	Cross Street	Municipality	Latitude	Longitude	Drainage Area (acres)	Percent Urban Area
Santa Clara	SC-LPA	Lower Penitencia Cr.	Machado Ave	Milpitas	37.421761	-121.906768	2,748	100
Santa Clara	SC-ADO	Adobe Cr.	Middlefield Rd	Palo Alto	37.421769	-122.111659	6,752	59
Contra Costa	CC-ROD	Rodeo Cr.	Hawthorne Dr	Rodeo	38.024699	-122.263018	6,252	32
Alameda	AC-CRA	Crandall Cr.	Bonanza Drive/Siward Drive	Fremont	37.569432/ 37.567510	-122.059529/ -122.04716	2,769/ 1,800	95
Alameda	AC-ALM	Alamo Canal	Dublin Blvd	Dublin	37.705013	-121.918495	18,362	58
San Mateo	SM-COL	Colma Cr.	W Orange Ave	South San Francisco	37.653296	-122.425782	7,834	83

Note: AC-CRA was moved upstream to Siward Drive following February 13, 2025, sampling because it was discovered that the site backwaters from Alameda Creek during periods of extreme high flow in Alameda Creek. As a result, the site location metrics changed.

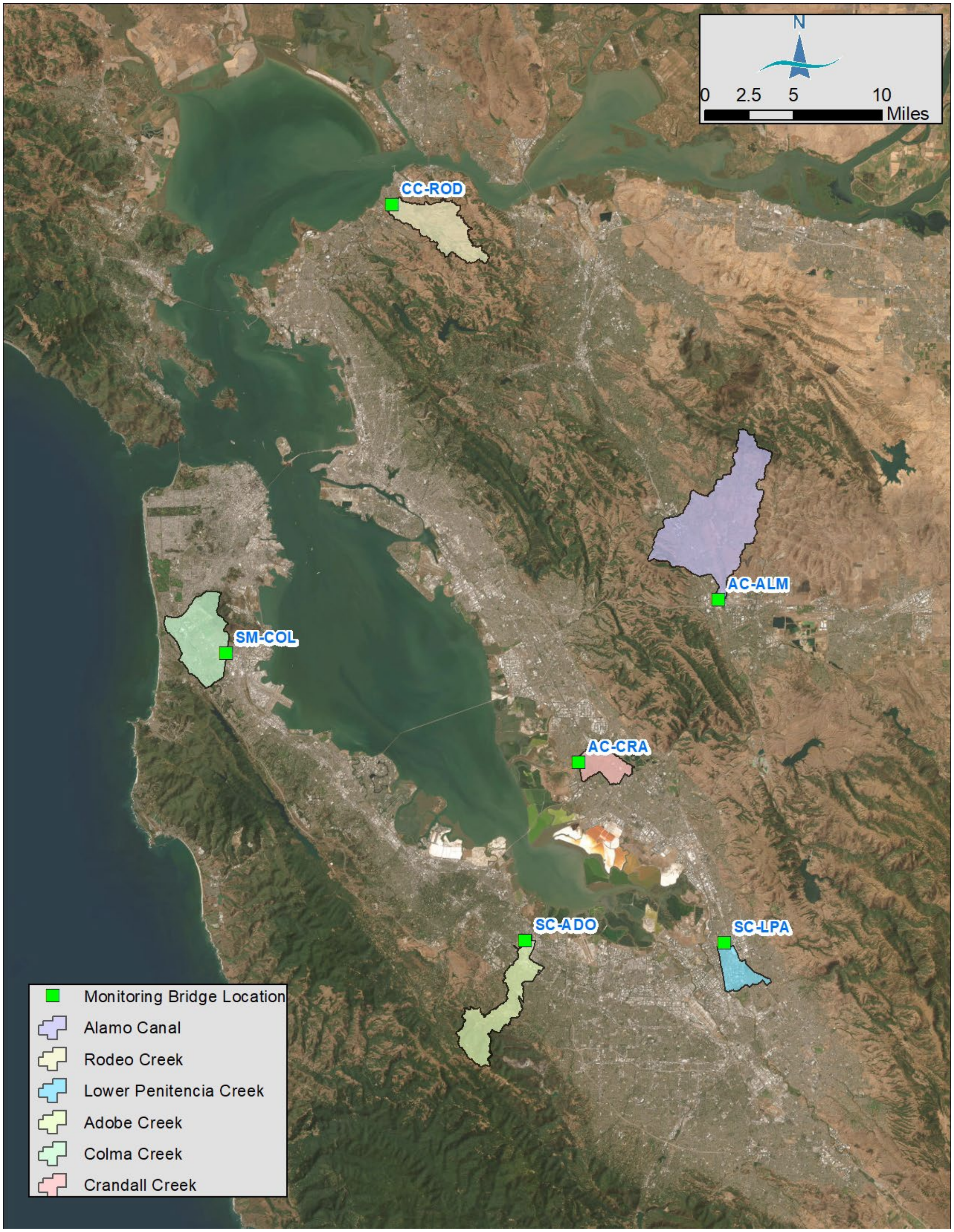


Figure 1 ***Trash receiving water monitoring sites. Note that the site location at AC-CRA was moved approximately 4,600 feet upstream to Siward Drive.*** *Thus, the watershed area for part of WY 2025 and subsequent monitoring years will be co-located with the pictured watershed, but smaller.*

3.2 Sampling Methods

The BAMSC RMC developed a regionally consistent approach for receiving water monitoring and data evaluation, informed by Trash TAG member recommendations.

3.2.1 Sampling Equipment

The primary piece of equipment used was a Modified Box trawl with a 5 mm mesh net, developed and manufactured by 5 Gyres (**Figure 2**). During most sampling events, the trawl was deployed using a USGS Type A bridge crane and A-55 reel (or similar). Trawls were also manually deployed (i.e., without a crane) when field crews could safely access the channel during low flows.

Figure 2 Monitoring equipment modified box trawl (right) trawl deployed from a bridge crane (left)

Flow data and/or stage data from streamflow gages operated by the City of South San Francisco (SM-COL), Valley Water (SC-ADO and SC-LPA), Alameda County Flood Control and Water Conservation District (AC-CRA), Alameda County Zone 7 Water Agency (AC-ALM), and Contra Costa County Flood Control District (CC-ROD) were downloaded for the entire water year, except the Adobe Creek station (SC-ADO), because the nearest streamflow gage, Adobe Creek at El Camino is 5,500 feet upstream of the sampling location at Middlefield Road. Additional water-level data were collected near the sampling location.

3.2.2 Sampling Events

Three trash monitoring storm events were targeted at each receiving water site during WY 2025. Over the course of the project, the type of storm that is targeted for a particular sampling event may vary based on the characteristics of the catchment, the prior storms monitored at a given location, information gained through previous monitoring, or other factors, but for Year-1 monitoring, the following guidelines were followed:

- Quantitative precipitation forecast (QPF) of approximately 0.25 inches or greater over a 6-hour period, even if the prior 6-hour contiguous period has precipitation, but less than 0.25 inches;
- Probability of precipitation (POP) of 70% or greater; and
- Antecedent dry period of approximately 48 hours or greater (defined as no separate event exceeding 0.1 inches of cumulative rainfall within a 24-hour period).

Using these guidelines, the WOW Technical Project Team attempted to meet the MRP requirements to monitor the following types of storms:

- Storms that trigger trash discharge and trash transport through the MS4 (0.25 inches of rain over a 6-hour period[7]); and
- The first significant storm event of each water year; and
- One storm per year that is forecasted to exceed the full capture design standard storm (i.e., the one-year, one-hour storm event). **Table 3** presents the one-year, one-hour storm for each of the six receiving water sites.

[7] The MRP suggests storms that discharge trash through MS4 are at least 0.25 inches over 24-hour period. However, the WOW Technical Project Team analyzed rainfall-streamflow relationships at the selected sites and found that the threshold in the MRP is likely too low to capture trash transport within receiving waters because the lower percentage of impervious surface. Therefore, a storm that is at least 0.25 inch over 6 hours will be used for trash monitoring. The receiving water QPF threshold value may be adjusted based on observations during WY 2025.

Table 3 Full trash capture design standard storm size for each receiving water monitoring site

County	Monitoring Location	1-yr, 1-hr magnitude (in.)[1]
Alameda	Crandall Creek, Fremont	0.34
Alameda	Alamo Canal, Dublin	0.41
Contra Costa	Rodeo Creek, Rodeo	0.37
Santa Clara	Lower Penitencia Creek, Milpitas	0.34
Santa Clara	Adobe Creek, Palo Alto/Mountain View	0.34
San Mateo	Colma Creek, South San Francisco	0.46

[1] Data from NOAA Precipitation Frequency Data Server *(https://hdsc.nws.noaa.gov/hdsc/pfds/)* Precipitation frequency estimates with 90% confidence intervals. Downloaded March 20, 2024.

At any given location, the design storm may not occur in a given year. In addition, if the design storm does occur, it may not occur during daylight hours and may not be well forecast (too high or too low). Thus, the design storm is more difficult to sample accurately than other storms, which don't have as specific rainfall targets.

Similarly, the first seasonal flush event may be poorly forecasted or occur when field staff are unavailable to mobilize (e.g., in the middle of the night).

3.2.3 Sample/Data Collection

The trawl was deployed in accordance with the Receiving Water Monitoring Plan to capture as much of a storm event hydrograph as feasible with the intent to capture near-complete hydrographs during each storm event. However, given the long duration of complete hydrographs at many sites and the inherent challenges associated with precipitation and streamflow forecasting, in some cases it was feasible to capture only the rising or falling limb of a storm. Sampling events that did not span an entire storm hydrograph still provide useful data and it was already planned to include collection of individual aliquots at different phases of the hydrograph; therefore, partial storms were included in the dataset. In some cases, additional storms were sampled (up to 4 per site in WY 2025) to provide additional data.

The receiving water sampling procedure is described in detail in the Trash Receiving Water Monitoring Plan (BAMSC 2024a). To summarize the procedure, sampling teams were mobilized and performed the following during each sample event:

- Target storms that allow for sampling to assess variability in trash transport across different phases of the storm hydrograph (e.g., the rising hydrograph, the peak, and the falling hydrograph).
- Collect individual aliquots during each sample event, varying in time from approximately 10 minutes to a few hours.

- Sample at the center of the channel. When streamflow was deep enough and as conditions allowed, aliquots were collected at the surface, midway through the water column, and on the channel bed. In many circumstances, streamflow was not deep enough to submerge the trawl, even when placed on the channel bed, and those aliquots represent the full water column.
- Transfer trash to mesh transport bags, which were labeled.
- Following each monitoring event, aliquots were transported to a storage facility.
- Following a dewatering/partial-drying period, the samples were removed from the transportation bags and placed on a large table to separate trash from organic debris (e.g., soil, sand, leaves, branches). Organic debris was disposed of appropriately.
- Trash was placed into labeled storage bags (e.g., garbage bags or mesh bags) and later characterized.

3.2.4 Trash Characterization

Each trash aliquot was characterized by measuring the volume of collected trash following protocols defined in the *Standard Operating Procedure for Trash Characterization* (Appendix E of BAMSC 2024a). Trash was sorted into 13 categories, then measured for volume (non-crushed, volumetric ounces) using a variety of containers ranging from a 50 mL graduated cylinder to a 5-gallon bucket. The total volume of trash items that did not fit into a 5-gallon bucket was estimated and noted on the data collection form.

3.2.5 Flow Measurement/Calculations

Flow data from streamflow gages operated by other public agencies were downloaded, time adjusted, and reviewed for the sampling periods and for the entire water year. **Table 4** presents a summary of the streamflow stations used to develop a record of flow for each of the six monitoring sites. **Figure 3** presents a map of the Alamo Canal sampling site (AC-ALM) along with the two streamflow gaging stations used to calculate flow for the site[8].

[8] A figure of the gaging sites is presented only for AC-ALM due to the complexity of stream gaging at the site.

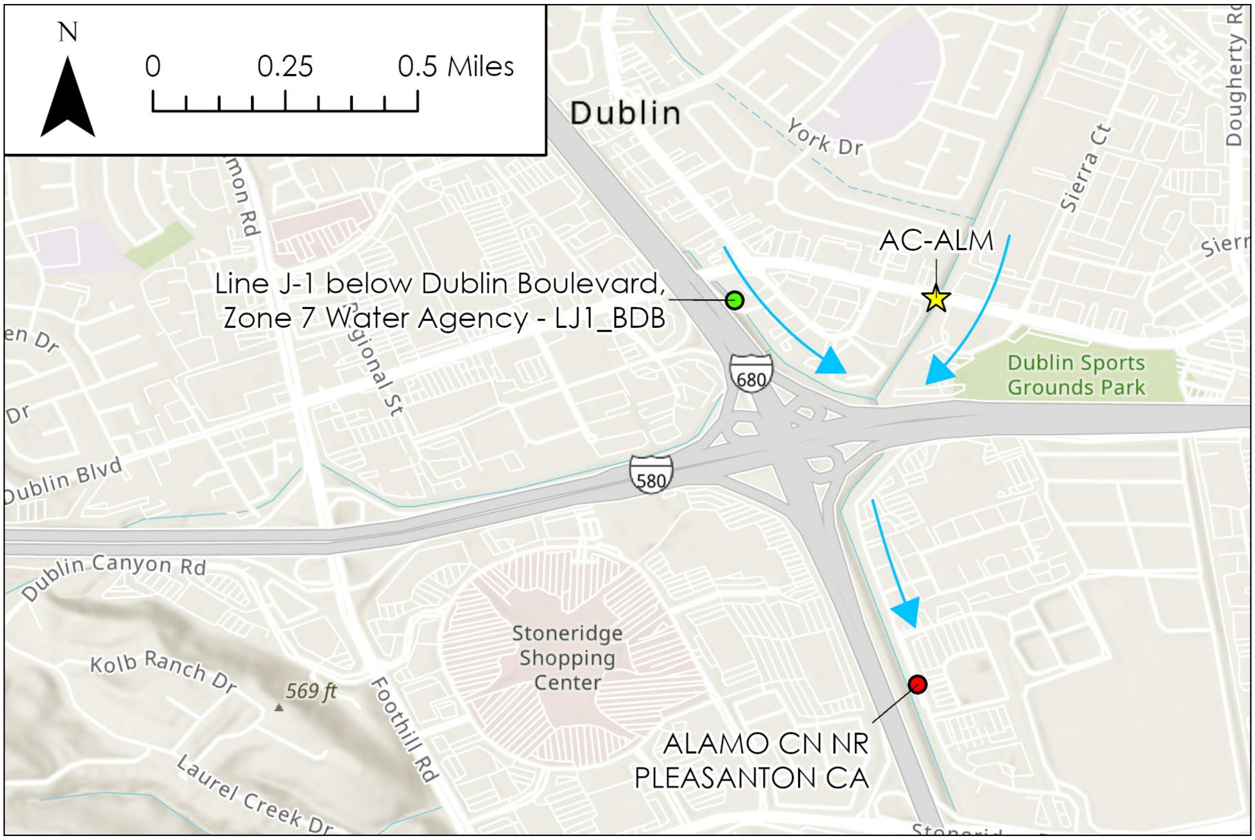


Figure 3 ***AC-ALM trash receiving water sampling site and the two streamflow gages used to calculate flow.*** *Flow was calculated by subtracting Line J-1 below Dublin Boulevard (Zone 7 Water Agency, LJ1_BDB) from Alamo Canal (USGS Alamo CN NR Pleasanton, California, 11174600).*

Additional analysis was required at four stations to develop a reasonable record of flow, Adobe Creek station (SC-ADO), the Rodeo Creek station (CC-ROD), the Alamo Canal station (AC-ALM), and the Colma Creek station (SM-COL). The process used to develop a record of flow for each of these four sites is presented below.

3.2.5.1 Lower Penitencia Creek (SC-LPA) and Crandall Creek (AC-CRA)

At Lower Penitencia Creek (SC-LPA) and Crandall Creek (AC-CRA), the record of flow was downloaded directly from the stations without modification.

3.2.5.2 Adobe Creek (SC-ADO)

At Adobe Creek (SC-ADO), the stream gage operated by Valley Water was recently moved approximately 5,500 feet upstream to El Camino Boulevard (Valley Water Alert Sensor 5135). To assess the correlation between the El Camino Valley Water station and the sampling site, two Solinst Levelogger® pressure transducers were installed at the former Valley Water streamflow gage location, which is located 340 feet downstream of the SC-ADO sampling location at Middlefield Road. The pressure transducers were installed on January 31, 2025, with the intent of collecting calibration data to use to improve the El Camino streamflow data. After the pressure transducers were installed at Middlefield Road, the water level record was compared with stage measurements taken during trash sampling events, and the calibrated stage record was then converted to streamflow using the Valley Water rating curve for the former Adobe Creek at Middlefield Road streamflow gaging station. The Valley Water rating curve extends down to 15 cfs and was extrapolated to 0 cfs using a linear interpolation to a zero-stage, zero-flow condition.

Streamflow response timing between the El Camino streamflow station and the Middlefield Road pressure transducers was evaluated and subsequently applied a 15-minute “lag” to the El Camino record of streamflow to account for the approximate streamflow travel time between the El Camino Station and Middlefield Road. Streamflow estimates collected during trash sampling events were used to calibrate a continuous record of streamflow for the “lagged” El Camino record using a multiplier, and for the Middlefield Road record of stage using a stage shift. Between October 1, 2024, and January 30, 2025, the lagged and calibrated El Camino streamflow record was used. Between January 31, 3025, and September 30, 2025, the calibrated record of streamflow at Middlefield Road was used for streamflow above 5 cfs, and the lagged and calibrated record of streamflow from the El Camino station was used for flows below 5 cfs.

3.2.5.3 Rodeo Creek (CC-ROD)

At Rodeo Creek (CC-ROD), only stage data are collected by Contra Costa County Flood Control. During WY 2025, the Technical Project Team collected topographic data at the site and created a 2-D HEC-RAS model, which was used to develop a stage-to-streamflow rating curve. The stage-to-streamflow rating curve was used to convert stage data into streamflow data. One streamflow measurement taken on October 13, 2025, was used to calibrate the record of streamflow. Additional streamflow measurements will be taken in WY 2026 and WY 2027 to help refine the stage-to-streamflow rating curve.

3.2.5.4 Alamo Canal (AC-ALM)

The Alamo Canal (AC-ALM) sampling site is not currently gaged directly; streamflow was estimated at the site by subtraction using two nearby gages **(Figure 3**):

(1) The USGS Alamo Canal near Pleasanton, CA gage (site number 11174600), which is located approximately 3,000 ft downstream of the confluence of the Alamo Canal, and Zone 7 Line J-1.

(2) Zone 7 gaging station Line J-1 below Dublin Boulevard (Line J-1 below Dublin Boulevard/LJ1_BDB/ Zone 7 Water Agency). This site is located approximately 1,500 ft upstream of the confluence with the Alamo Canal.

Streamflow was estimated in the Alamo Canal first by manually adjusting for time lag using stage data collected by the sampling team in the field during trash receiving water monitoring events. Streamflow data at that the USGS Alamo Canal data lagged approximately 30 minutes relative to the project site. The Line J-1 below Dublin Boulevard streamflow was subtracted from the time-adjusted Alamo Canal USGS streamflow to generate the record of flow for this site.

3.2.5.5 Colma Creek (SM-COL)

Upon requesting flow data from the City of South San Francisco, it became clear that the streamflow record from the City of South San Francisco Colma Creek streamflow gage at Orange Memorial Park, just upstream of the site, contained errors and was likely missing data. The Technical Project Team used a combination of methods to verify and calibrate the streamflow record, to the extent possible. This effort included converting the depth measurements recorded during WY 2025 sampling to streamflow estimates using the rating table for the City of South San Francisco streamflow gage (former USGS gaging station 11162720) and comparing those values to the record of streamflow transmitted directly from the City of South San Francisco streamflow gage[9]. Based on this comparison, the raw data shared with the Technical Project Team from the City of South San Francisco streamflow gage reported streamflows approximately 50% of the calibration streamflow estimates calculated from trash sampling data. As such, the streamflow record was multiplied by a factor of two prior to calculating loadings.

In addition, review of the streamflow data from the City of South San Francisco suggests that the streamflow gage may not accurately report low streamflow conditions and thus may miss low-flow portions of storm events. During the two sampling events, the streamflow estimates calculated during sampling were compared with trash transport rates and entered into the streamflow record. During the remaining storms in WY 2025, it is possible that the reported streamflow data underestimates baseflow and thus the total streamflow during WY 2025.

The streamflow gaging equipment at this station was upgraded in November 2025, and a more reliable record of streamflow for WY 2026 and WY 2027 will be available for these analyses.

[9] It should be noted that the channel geometry at the trash sampling station, where the depth measurements were taken, has a slightly different channel geometry, but it is likely negligible for the range of streamflows experienced during sampling events.

Table 4 Sampling locations and associated streamflow stations

Monitoring Location	Site ID	Streamflow station/Agency	Approx. distance up- or downstream
Crandall Creek at Bonanza Drive, Fremont Crandall Creek at Siward Road, Fremont	AC-CRA	Crandall Creek at Deep Creek Road – Alameda County Flood Control	2,900 ft upstream 250 downstream
Alamo Canal at Dublin Boulevard, Dublin	AC-ALA	Alamo Canal near Pleasanton -- USGS and Line J-1 below Dublin Boulevard – Zone 7 Water Agency	Alamo Canal near Pleasanton: 3,000 ft downstream
Rodeo Creek at Hawthorne, Rodeo	CC-ROD	Rodeo Creek at Hawthorne – Contra Costa County Flood Control District	0 ft
Lower Penitencia Creek at Machado Avenue, Milpitas	SC-LPA	Lower Penitencia Creek at Machado (Sensor 5000.1) – Valley Water	0 ft
Adobe Creek at Middlefield Road, Palo Alto/Mountain View	SC-ADO	1) Adobe Creek at El Camino Real (Sensor 5135) – Valley Water **and** 2) Pressure transducer installed at the old Middlefield Road Valley Water Station 340 downstream of the sampling location	5,500 ft upstream **and** 340 ft downstream
Colma Creek and West Orange Avenue, South San Francisco	SM-COL	Colma Creek at W. Orange Avenue -- City of South San Francisco (formerly USGS)	300 ft upstream

3.3 Data Analysis Methods

A combination of graphical and statistical methods were used to calculate and assess trash loading rates and trash types across sites and across time. The parameters evaluated included trash discharge rates during monitored storm events, streamflow rates, and the types of trash observed in receiving waters.

The annual trash loading rate (in gallons/acre/year) for each monitored catchment was estimated by calculating trash concentrations from volumes collected during single storm-event aliquots and dividing those volumes by the amount of water passing through the trawl during each aliquot. Trash concentrations for all storm-event aliquots were plotted for each receiving-water monitoring site, and the mean trash concentration was calculated following a similar method outlined in Cowger et al. (2022). The mean annual transport rate for each site was then applied to the complete storm-flow record through WY 2025, and site-specific loading estimates were calculated. Only storm flows were used to calculate the annual loading. Initially, this simple method appears most appropriate. As more data are collected in years 2 and 3, other methods of estimating trash loads will be evaluated. This is discussed in greater detail in **Section 4.1**.

3.4 Results

This section presents data results for all monitoring sites.

3.4.1 Sampling Events

All six sampling sites were prepared during the dry season of WY 2024. However, due to manufacturing delays, none of the bridge cranes and reels were delivered until January and February 2025. The Technical Project Team borrowed three cranes and reels[10]. As a result, not all sites could be sampled at the start of WY 2025. Despite the delay, trash monitoring was conducted during the first seasonal flush at three of the six sites. A total of 21 site visits were made for sampling: 19 for aliquot collection and 2 “dry runs”. **Table 5** presents a summary of sampling for WY 2025.

The Technical Project Team successfully sampled three storm events at four of the six monitoring locations, collecting data across 19 sample events. A total of 117 separate aliquots were collected across the six sample sites.

The storm characteristics for each sample event, including sample event start and end times, sampling duration, storm duration, antecedent dry period (days), total precipitation, rainfall intensity (inches/hour), peak streamflow rate (cfs), part of the hydrograph that was sampled, number of aliquots taken during each event, and total streamflow volume (cf) are summarized in **Table 6**. Total streamflow through trawl was estimated using field measurements of velocity and the depth of water entering the trawl orifice. The number of aliquots taken varies at each site, for each storm as a result of stream duration, flashiness, other streamflow and trash site conditions, and also as a result of compositing samples during the first event and two sites. The antecedent dry period for each storm was identified based on the number of days between the beginning of the storm of interest and the preceding period where rainfall was recorded in at least two consecutive 15-minute time intervals[11]. Note this definition of a storm is different than what was used to guide mobilization (i.e., 0.25 inches over a 6-hour period).

[10] Two were loaned to the Technical Project Team by SFEI, and a third was loaned to the project by Balance Hydrologics.

[11] Different agencies use different equipment with different thresholds for triggering a rainfall measurement, but typically for rainfall gages the minimum threshold is 0.04 inches.

Table 5 Trash receiving water monitoring events, WY 2025

	Year 1 (WY 2025)										
County	**Site**	**11/11/2024**	**11/20/2024**	**11/22/2024**	**12/12/2024**	**1/31/2025**	**2/1/2025**	**2/4/2025**	**2/13/2025**	**3/12/2025**	**Total visits WY 2025**
Alameda	AC-ALM			FF	P (↓)		P (↑)		Y/P (↑↓)		4
	AC-CRA								Y/R/P(↓)	C	2
Contra Costa	CC-ROD	FF	B	D			C			C	4
Santa Clara	SC-LPA			B/P(↑)				Y/P (↑)	Y/P(↓)	C	3
	SC-ADO			P(↑)			D	Y	C	C	4
San Mateo	SM-COL	FF				MF/L					2

Cranes and reels not delivered until 1/15/25: Using Balance's and SFEI's cranes and reels through 1/15/25

Notes:

FF= First Seasonal Flush

MF = Mid-season first flush

C = Complete or near-complete hydrograph sampled

L = Event was sampled but did not exceed the desired minimum rainfall threshold

B = Baseflow only

D = Dry run (mobilized but no sampling occurred)

Y = exceeded 1-yr 1-hr event, may or may not have sampled peak associated with 1-yr 1-hr event

P = Partial storm; (↑) indicates rising hydrograph; (↓) indicates falling hydrograph

R=Replicate collected

Table 6 Sampling period and duration, rainfall and streamflow characteristics, and number of aliquots for each monitoring event

Site	Event No.	Date | Time Start of Sampling Event	Date | Time End of Sampling Event	Sampling Duration (hours)	Storm Duration (hours)	Antecedent Dry (days)	Rainfall Total (in)	Rainfall Max Intensity (in/hr)	Part of Hydrograph Sampled[a]	Number of Aliquots	Peak Streamflow (cfs)	Total Streamflow Through Trawl During Sampling (cf)
AC-ALM	1	11/22/2024 | 14:40	11/22/2024 | 20:03	5.4	14	1.7	0.84	0.2	RPF	6	522	55,833
	2	12/12/2024 | 6:19	12/12/2024 | 13:06	6.8	20	16	0.73	0.16	RPF	10	257	41,932
	3	2/1/2025 | 12:58	2/1/2025 | 17:50	4.9	14	0.2	0.6	0.1	RPF	7	242	48,359
	4	2/13/2025 | 6:47	2/13/2025 | 9:57	3.2	34	6.1	2.55	0.43	PF	5	1823	46,505
AC-CRA	1	2/13/2025 | 6:37	2/13/2025 | 10:42	4.1	18	6.4	1.78	0.4	F	3	143	22,792
	2	3/12/2025 | 16:31	3/12/2025 | 20:48	4.3	16	10.4	0.87	0.23	RPF	5	27	26,904
CC-ROD	1	11/11/2024 | 9:52	11/11/2024 | 12:25	2.5	8	9.1	0.3	0.12	RPF	3	2	3,162
	2	2/1/2025 | 8:40	2/1/2025 | 14:56	6.3	17	0.4	0.59	0.1	RPF	4	7	15,669
	3	3/12/2025 | 14:00	3/12/2025 | 19:30	5.5	31	26	0.72	0.16	RP	4	28	21,459
SC-ADO	1	11/22/2024 | 12:45	11/22/2024 | 17:30	4.7	10	11	0.84	0.2	RPF	6	199	47,142
	2	2/4/2025 | 10:40	2/4/2025 | 18:00	7.3	14	39	1.12	0.36	RF	4	62	26,778
	3	2/13/2025 | 6:50	2/13/2025 | 15:40	8.8	34	6.4	1.96	0.32	PF	7	58	23,508
	4	3/12/2025 | 13:05	3/12/2025 | 18:45	5.7	3	27	0.32	0.12	RPF	4	17	13,940
SC-LPA	1	11/22/2024 | 8:30	11/22/2024 | 18:47	10.3	8	11	1.32	0.32	BR	9	201	21,409
	2	2/4/2025 | 9:45	2/4/2025 | 17:12	7.5	6	37.2	1	0.4	R	8	261	28,561
	3	2/13/2025 | 6:35	2/13/2025 | 10:50	4.3	34	5.9	2.04	0.4	F	5	212	33,206
	4	3/12/2025 | 12:03	3/12/2025 | 18:08	6.1	7	6.2	0.4	0.2	RPF	10	113	41,782
SM-COL	1	11/11/2024 | 9:22	11/11/2024 | 12:45	3.4	3	9.2	0.39	0.28	RF	8	458	34,436
	2	1/31/2025 | 10:15	1/31/2025 | 16:00	5.7	0	33	0.04	0.04	RPF	9	100	23,395

Notes:

[a] Part of Hydrograph: R=rising limb, P=peak, F=falling limb, B=baseflow

3.4.2 Trash Characterization

The measured volumes for each of the 13 trash categories, as well as the total volume of trash across the 19 sampling events collected at the 6 sites, are presented in **Appendix A**. The total trash volume per sampling event is summarized in **Table 7**.

Table 7 Total trash volume per sampling event

County	Site	Date	Total Gallons of Trash per Sampling Event
Santa Clara County	ADO	11/22/2024	0.18
	ADO	2/4/2025	0.22
	ADO	2/13/2025	0.05
	ADO	3/12/2025	0.17
	LPA	11/22/2024	0.13
	LPA	2/4/2025	0.58
	LPA	2/13/2025	0.00
	LPA	3/12/2025	2.65
San Mateo County	COL	11/11/2024	3.98
	COL	1/31/2025	1.14
Alameda County	ALM	11/22/2024	0.88
	ALM	12/12/2024	0.18
	ALM	2/1/2025	0.24
	ALM	2/13/2025	0.07
	CRA	2/13/2025	0.01
	CRA Replicate	2/13/2025	0.05
	CRA	3/12/2025	0.60
Contra Costa County	ROD	11/11/2024	0.00
	ROD	2/1/2025	0.00
	ROD	3/12/2025	0.15
Total Trash WY 2025 (Gallons)			**11.23**

Notes:
1) Total volume does not include replicate samples
2) Zero values are rounded. Very small amounts of trash were collected during those samples.

The total volume for the combined seven plastic trash categories accounted for 9.9 of the 11.2 gallons of trash (88%) collected and characterized during the 19 sample events (**Appendix A**). The total volume in the "Other Plastic Items/Pieces" trash category was 8.4 gallons, which accounted for 75% of the total trash.

Trash collected at all stations over all sampling events (*before scaling up to full creek width, full storm, or full year*)[12]:

- Total collected = 11.2 (gallons)
  - "Other Plastic Items/Pieces" = 74.8% of total
  - "Non-Plastic Trash Items" = 12.1% of total
  - "Single-Use Plastic Food/Drinkware" = 8.6% of total

These "*Other Plastic Items/Pieces*" were primarily comprised of plastic packaging for food and beverage goods purchased at convenience and grocery stores (but not plastic bags). "*Single-use Plastic Food/Drink Ware*" and "*Expanded Polystyrene* (*EPS) Foam Food Ware*" trash accounted for about 9% of the plastic trash volume. No "*Single-use Plastic Bags*" were collected during sampling. Many cities in the San Francisco Bay Area have adopted County ordinances that ban the distribution of some types of trash in these categories.

Additionally, the State of California recently adopted a ban on expanded polystyrene (foam) foodware, on January 1, 2025. Of the total trash volume, 2.3% was associated with "*EPS Foam Other"* trash. "*Smoking Products*" accounted for approximately 1.3% of the total trash volume.

A comparison of trash volumes observed for all six sites during WY 2025 is presented in **Figure 3**. **Figure 4** through **Figure 6** present comparisons of trash volumes observed at each of the six sites during WY 2025:

- The proportion of "*Other Plastic*" trash was highest in:
  - Colma Creek (85%) followed by
  - Alamo Canal (75%),
  - Lower Penitencia Creek (73%),
  - Adobe Creek (64%),
  - Crandall Creek (32%) and
  - Rodeo Creek (5%).

[12] Definitions for categories of trash are presented in **Appendix A**.

- "*Single-use Plastic Food/Drink Ware*" was the predominant trash type observed at Rodeo Creek.
- The combination of "*Single-use Plastic Food/Drink Ware*" and "*EPS Foam Food Ware*" (both being banned materials) was highest at:
  - Rodeo Creek (89%), followed by
  - Crandall Creek (27%),
  - Lower Penitencia Creek (17%), with the
  - The remaining three sites range between three and five percent.

Bottom-of-full-water-column aliquots will likely collect denser material. In contrast, surface or mid-column sampling will not collect denser material such as glass (1.8%) or metal (3%), except for hollow floating items such as glass bottles or aluminum cans. When more data has been collected following WY 2026 and WY 2027, this assumption will be investigated.

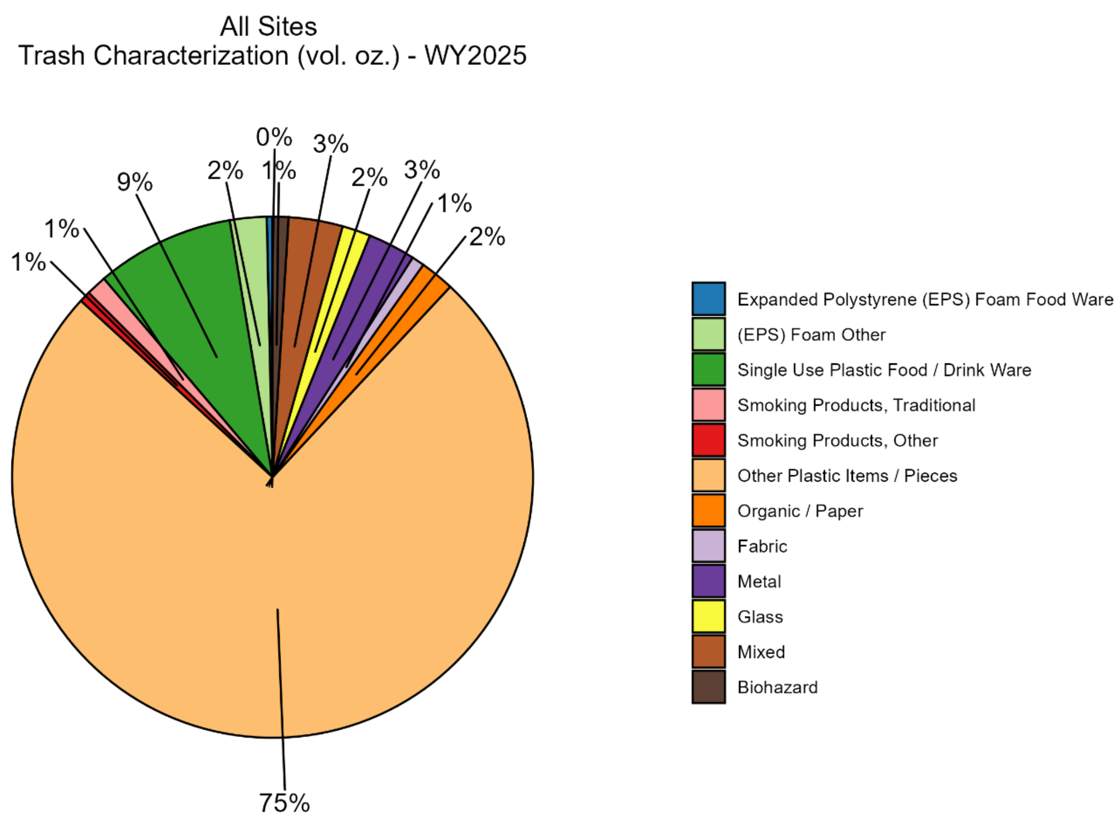


Figure 4 ***Types of trash collected at all 6 sampling sites during WY 2025***

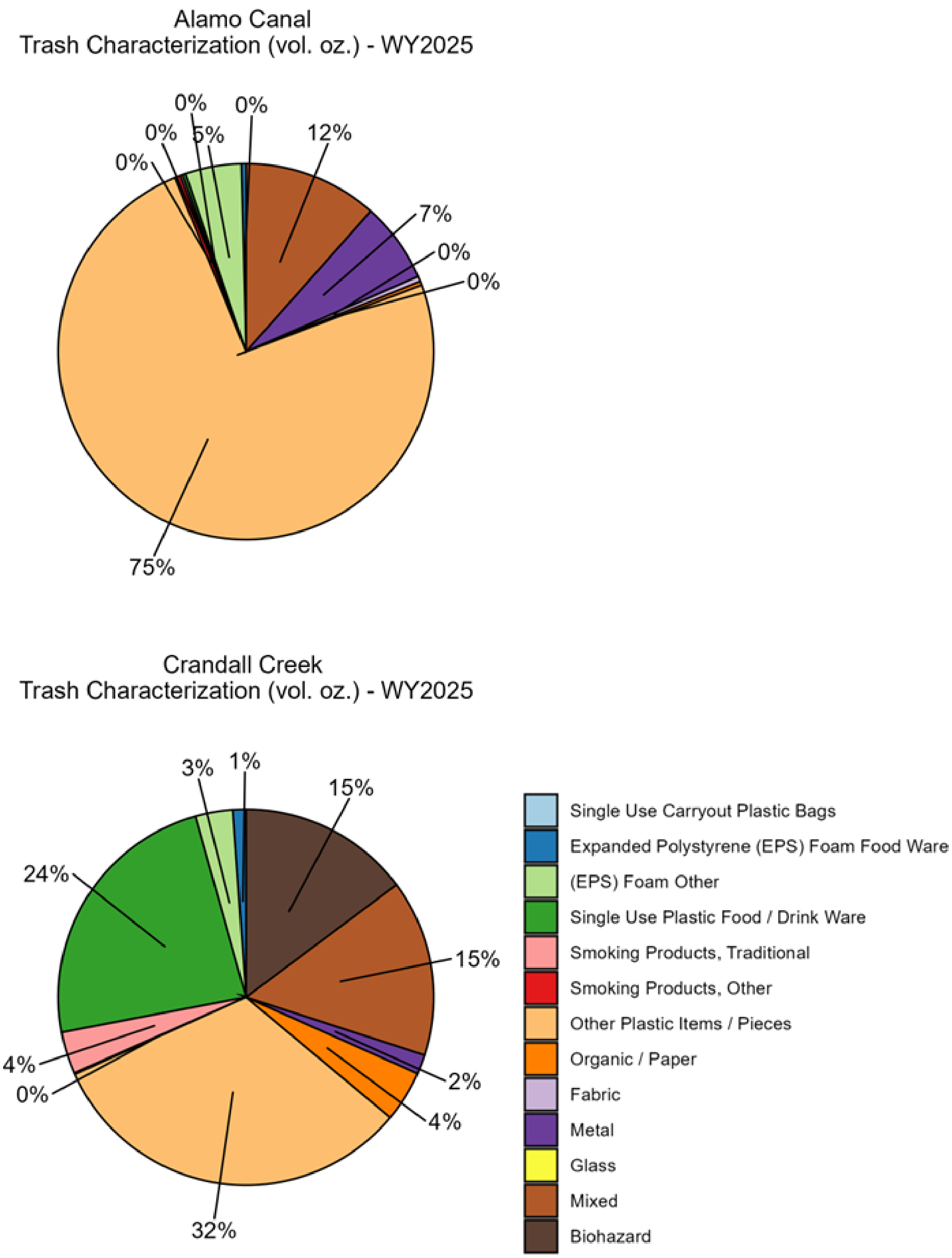


Figure 5 Types of trash collected at AC-ALM (Alamo Canal) and AC-CRA (Crandall Creek) during WY 2025

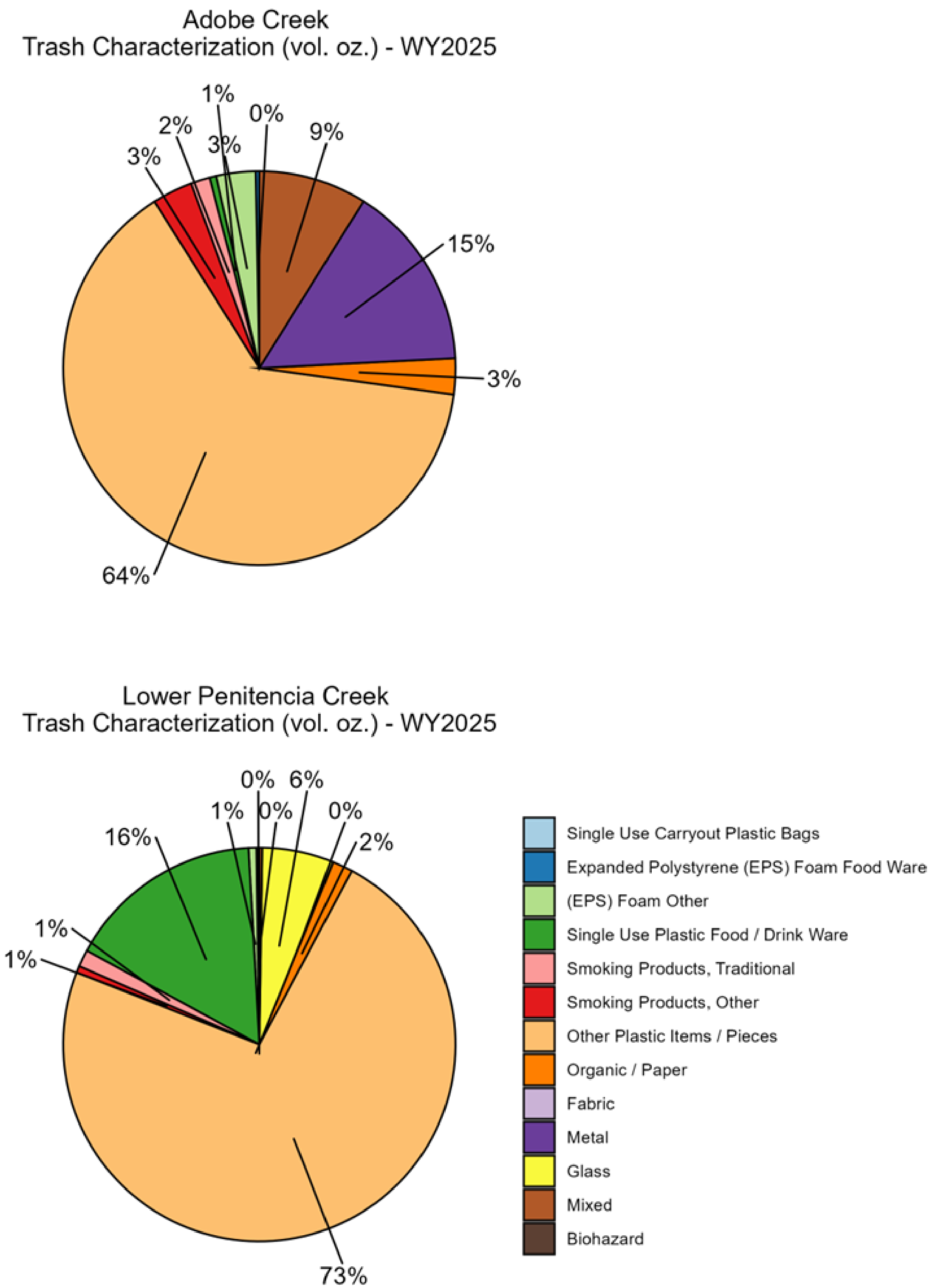


Figure 6 Types of trash collected at SC-ADO (Adobe Creek) and SC-LPA (Lower Penitencia Creek) during WY 2025

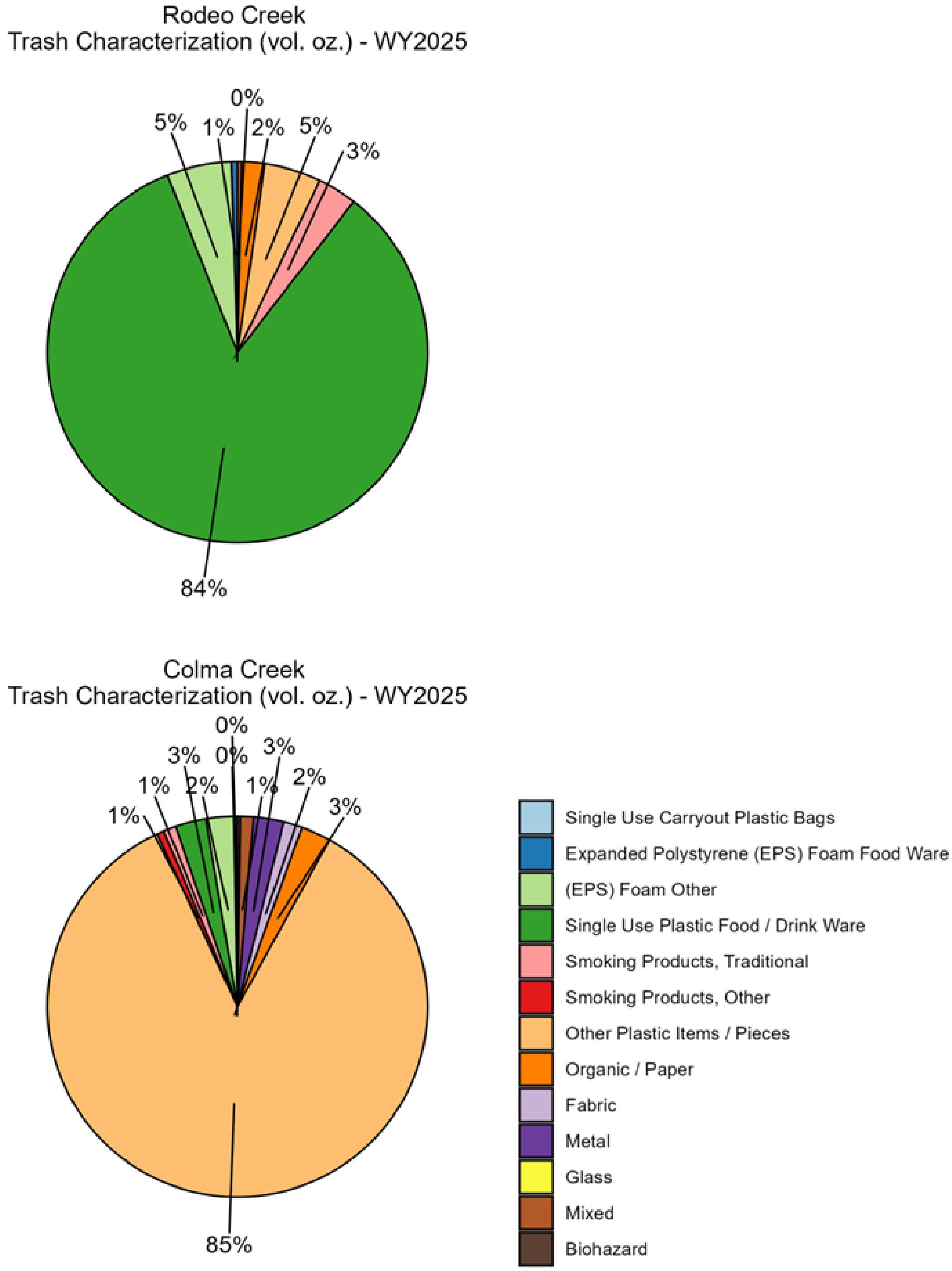


Figure 7 ***Types of trash collected at CC-ROD (Rodeo Creek) SM-COL (Colma Creek) during WY2025***

3.4.3 Flow Conditions during Sampling

Streamflow data were downloaded from the relevant stream gages and calibrated as presented in **Section 3.2.5**. **Figure 7** through **Figure 12** present the annual hydrographs for each of the six sampling stations for WY 2025: AC-ALM, AC-CRA, CC-ROD, SC-LPA, SC-ADO, SM-COL.

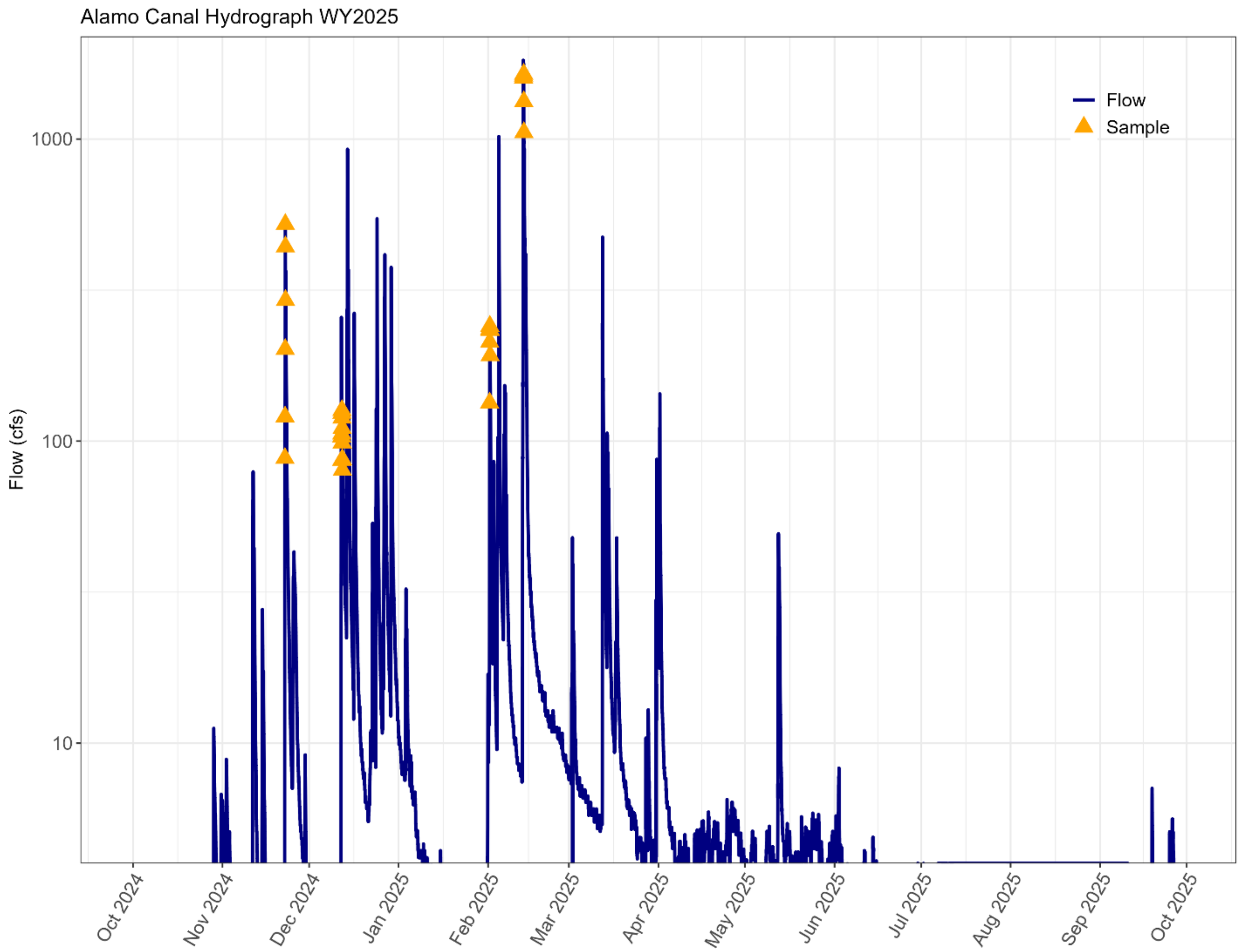


Figure 8 ***WY 2025 annual hydrograph for Alamo Canal, Alameda County (AC-ALM)***
"Sample" points indicate the flow at the centroid of each sampling aliquot

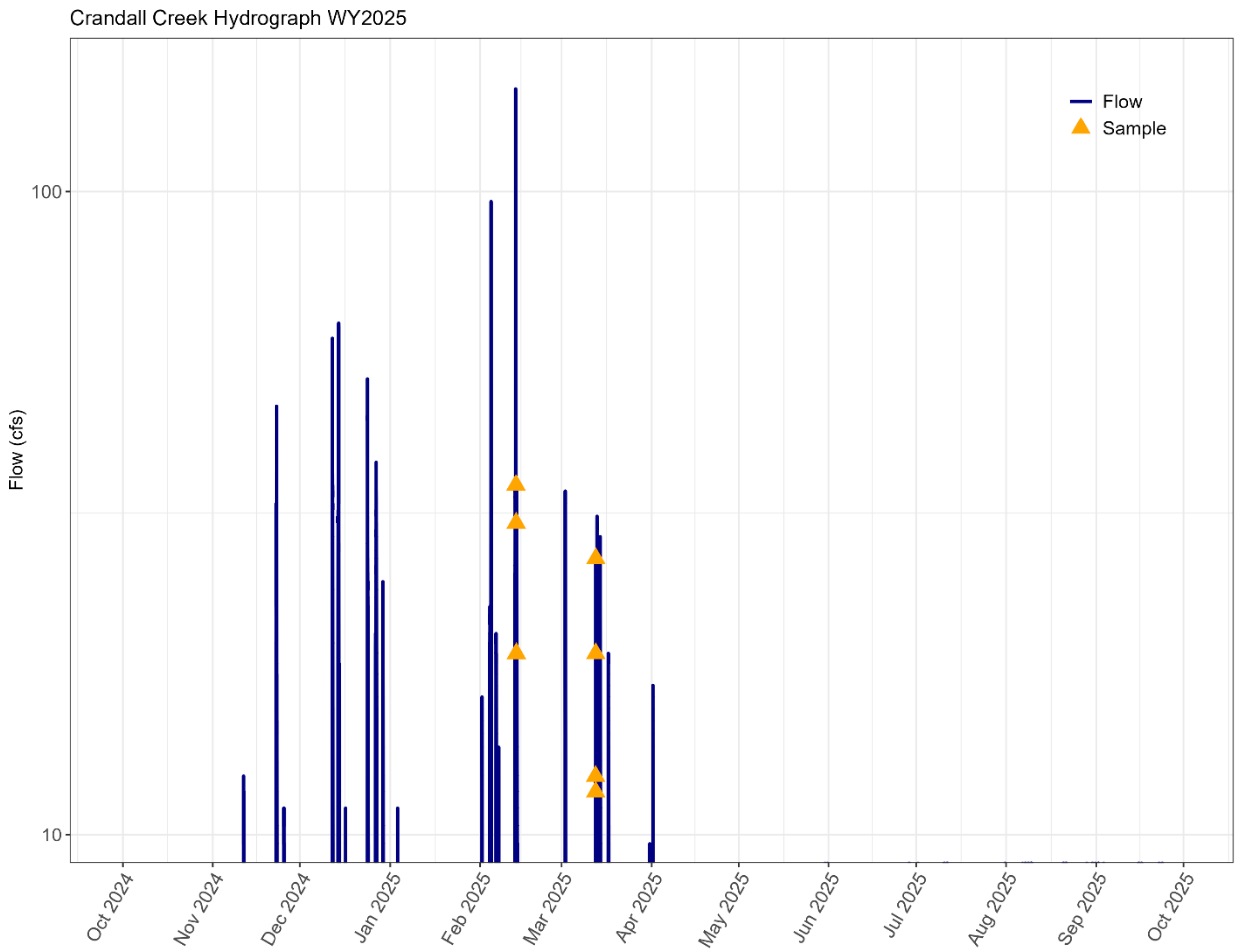


Figure 9 ***WY 2025 annual hydrograph for Crandall Creek, Alameda County (AC-CRA)***
"Sample" points indicate the flow at the centroid of each sampling aliquot

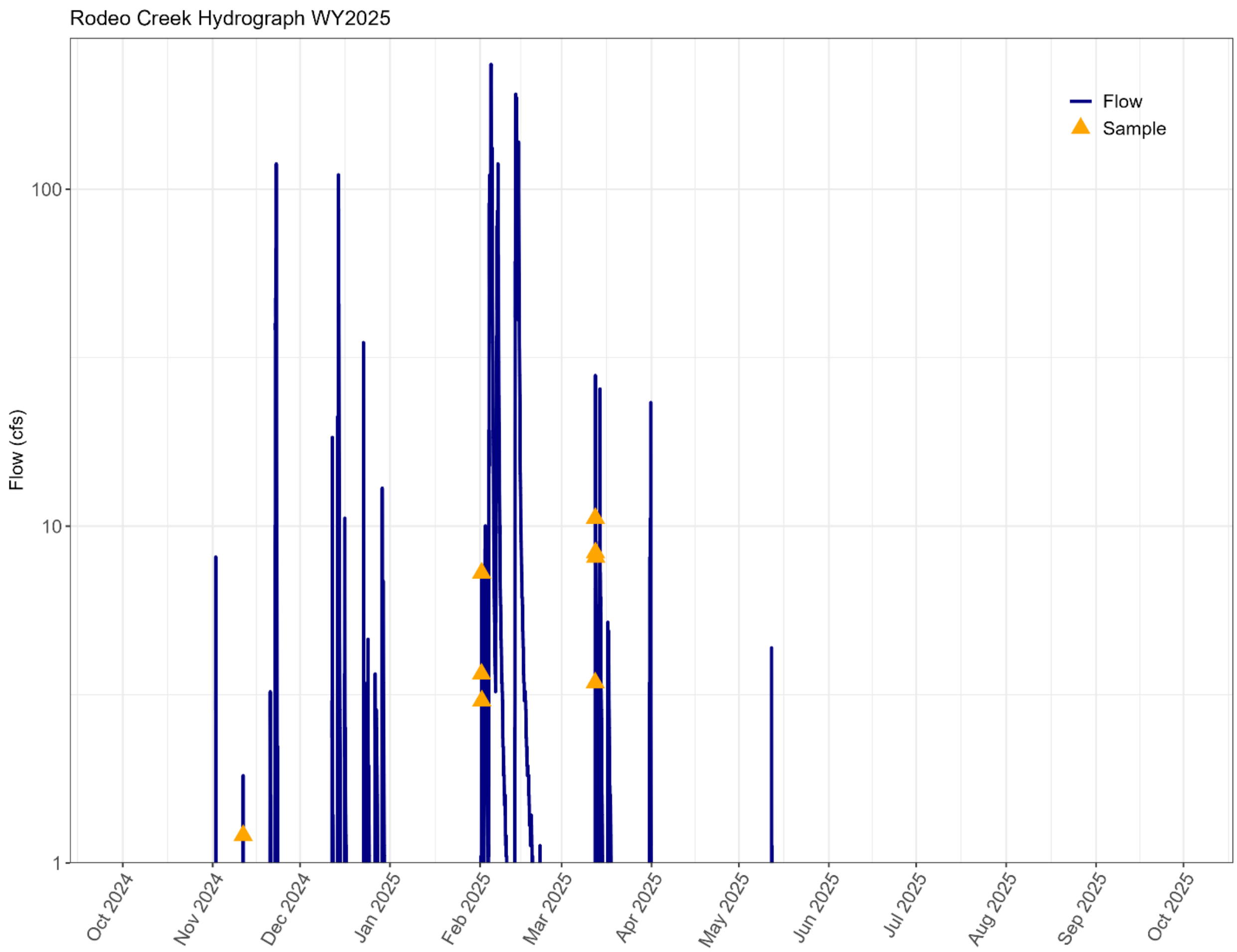


Figure 10 ***WY 2025 annual hydrograph for Rodeo Creek, Contra Costa County (CC-ROD)***
"Sample" points indicate the flow at the centroid of each sampling aliquot

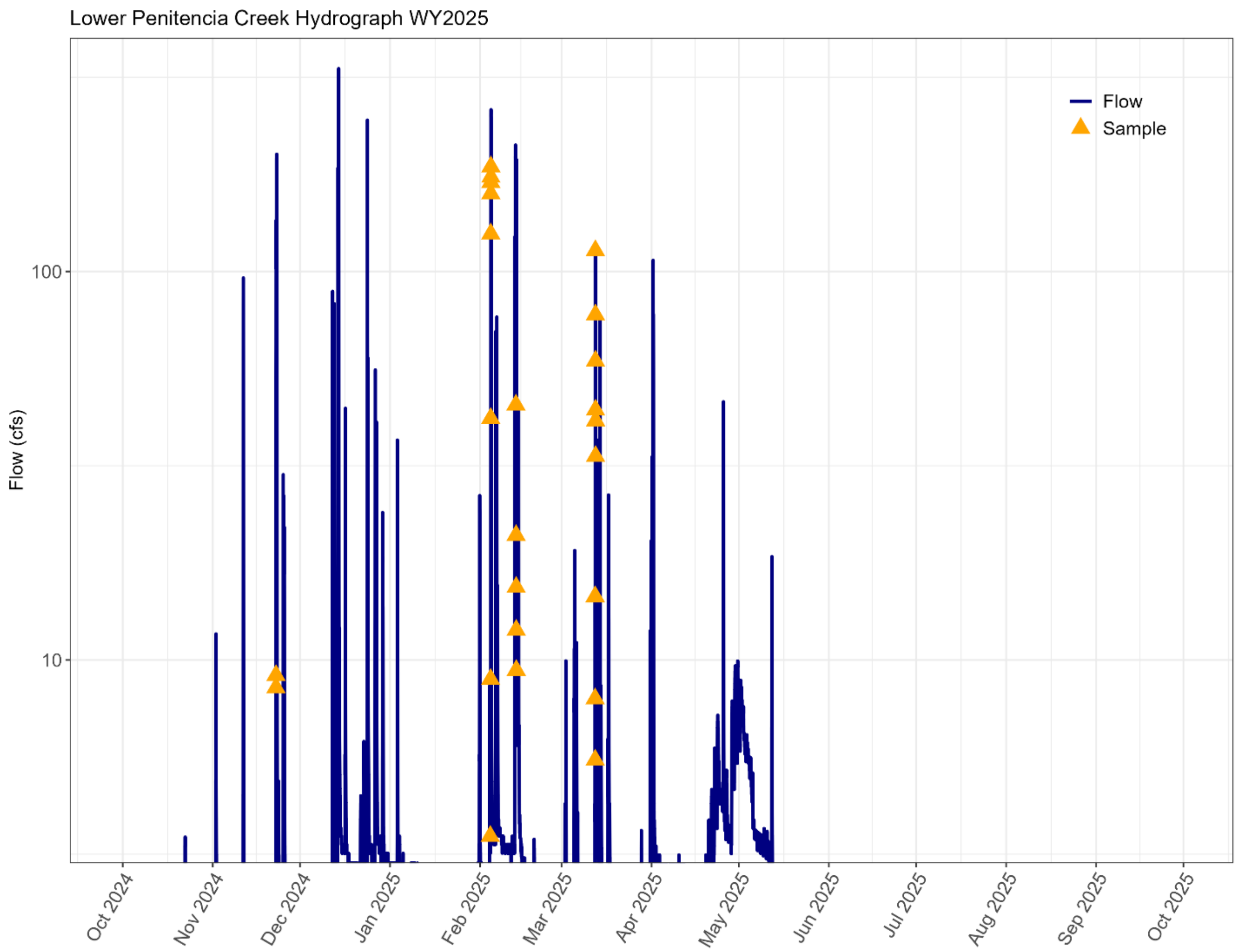


Figure 11 ***WY 2025 annual hydrograph for Lower Penitencia Creek, Santa Clara County (SC-LPA)***
"Sample" points indicate the flow at the centroid of each sampling aliquot

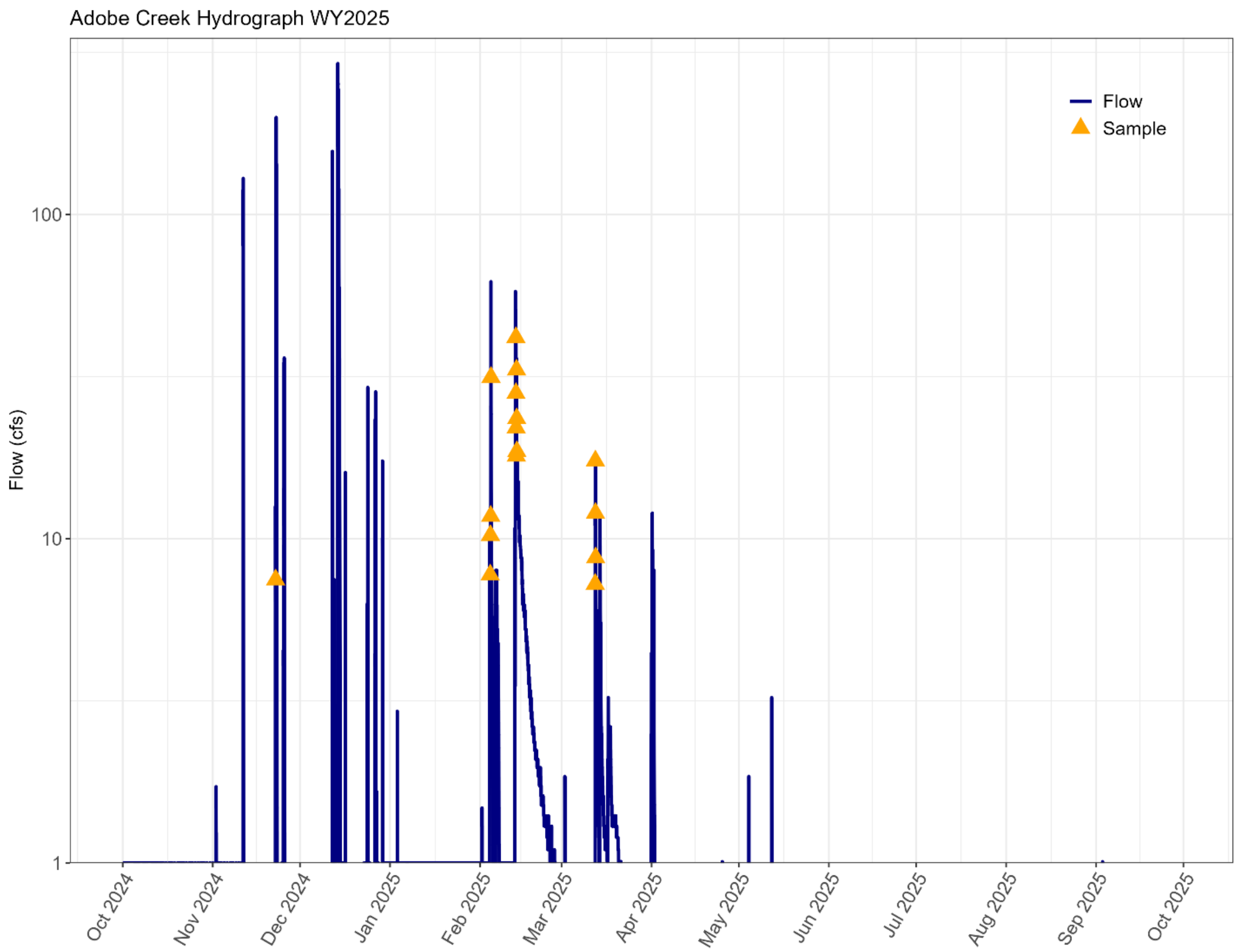


Figure 12 WY 2025 annual hydrograph for Adobe Creek, Santa Clara County (SC-ADO)
"Sample" points indicate the flow at the centroid of each sampling aliquot

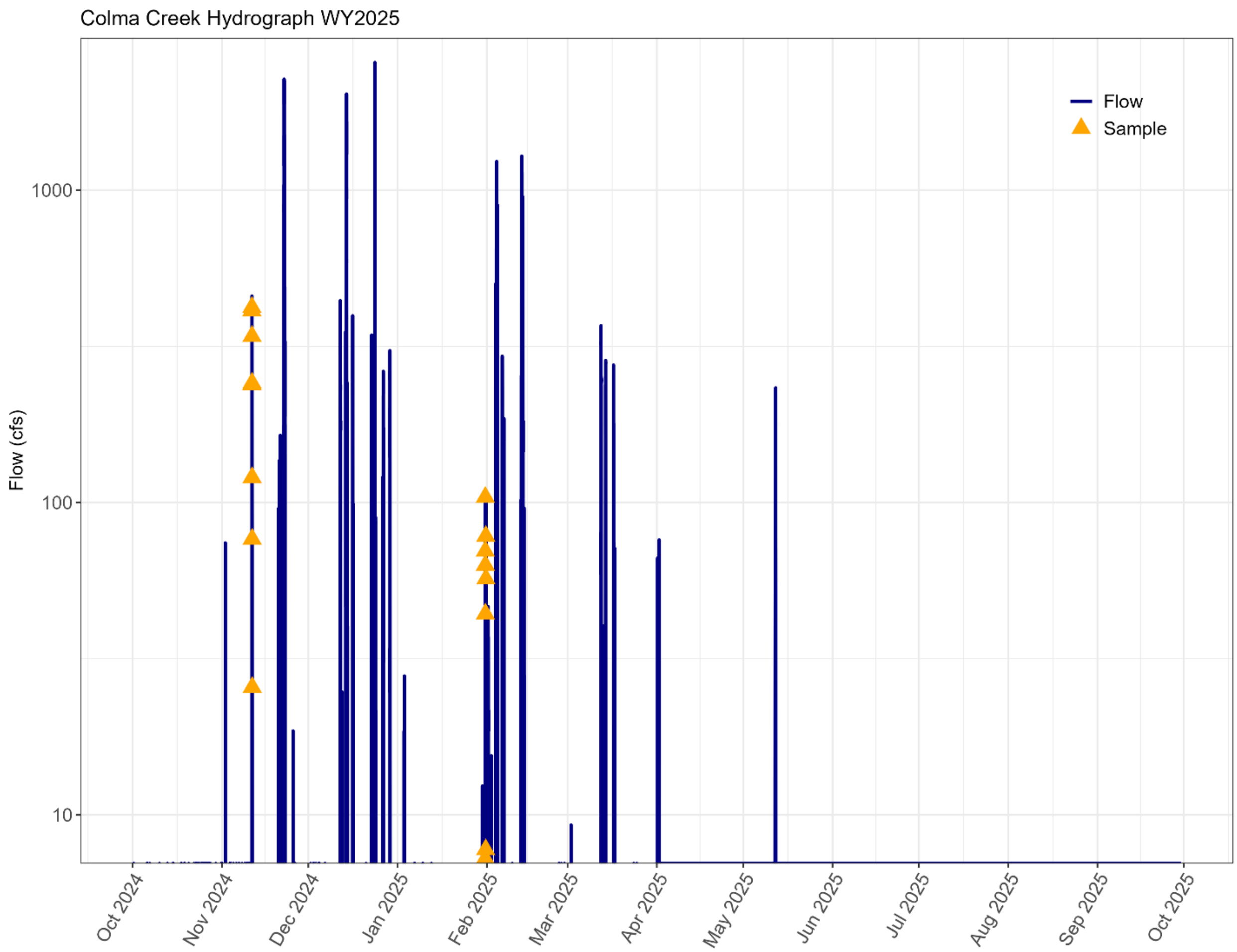


Figure 13 ***WY 2025 annual hydrograph for Colma Creek, San Mateo County (SM-COL)***
"Sample" points indicate the flow at the centroid of each sampling aliquot.

3.4.3.1 Baseflow

Three aliquots at SC-LPA were collected prior to a storm during baseflow conditions. No trash was collected in those aliquots, suggesting that pre-storm baseflow (and perhaps all baseflow) conditions do not transport significant volumes of trash.

3.4.3.2 Separating Stormflow from Baseflow

Based on the preliminary findings, trash is transported during stormflow and not transported during baseflow. In order to calculate annual loadings, stormflow hydrographs were separated from baseflow:

- Station-by-station and based on wet- and dry-season observations, a typical baseflow level was identified and assigned as the baseflow-screening threshold, which was applied to the annual flow record to separate stormflow from baseflow.

- A single baseflow-screening threshold value was used for the entire water year (as a simplification) for each site and optimized to include only stormflow rising and falling limbs, or persistently high inter-storm flow[13]. See **Table 8**.

- Using station-specific baseflow-screening thresholds, total stormflow volume was calculated for the water year for each station.

- Total stormflow volume was used to calculate trash loadings.

Table 8 presents the low-flow screening thresholds for each of the stream gages along with a comparison of the total annual stormflow for each station (acre-ft per year) and the total annual stormflow normalized by drainage area (acre-feet per acre per year).

Table 8 Low-flow screening thresholds, annual stormflow volumes and annual stormflow volumes normalized by watershed area.

Station	Baseflow-Screening Threshold (cfs)	Annual Stormflow Volume WY 2025 (ac-ft)	**Annual Stormflow Volume Normalized by Acres (inches)**
AC-ALM	4.00	7,662	**5.01**
AC-CRA	9.04	272	**1.43**
CC-ROD	0.10	862	**1.65**
SC-LPA	3.00	1,097	**4.79**
SC-ADO	1.00	478	**0.85**
SM-COL	6.99	2,000	**3.06**

3.4.3.3 Incomplete Streamflow Data Sets

The Rodeo Creek water level monitoring station operated by Contra Costa County Flood Control failed on August 1, 2025, and was repaired after the end of WY 2025, on November 4, 2025. Only two minor rainfall events occurred during that period, both were considered too small to mobilize trash.

3.4.4 Trash Loading Estimates

3.4.4.1 Portions of Hydrographs Sampled

To evaluate the timing of individual aliquots relative to stormflow, observed stage values at the sites were compared with hydrograph patterns, and sample events were plotted against the streamflow hydrograph. Plots for each sampled storm for all six Receiving Water sampling

[13] There are many different methods to separate stormflow from baseflow, this method is likely to be revised in the future.

locations for WY 2025 are presented in **Appendix B**. The secondary axes of the plots also display the trash transport rate (gallons/sec) for each aliquot.

3.4.4.2 Trash vs. Portion of Hydrograph

One question this data-collection campaign aims to address is whether more trash is transported on certain parts of the storm hydrograph and/or what other factors influence trash transport throughout a storm. Based on the initial year of data, there does not (yet) appear to be a simple or consistent correlation between trash volume and hydrograph timing (rising, peak or falling limb) (see **Appendix C**). Also, due to the inherent challenges of forecasting, sampling teams often missed the peaks of sampled storms.

3.4.4.3 Trash vs. Flow Rate

A comparison of streamflow and trash transport rates for all six sites with aliquots differentiated into baseflow, rising limb, peak flow, and falling limb aliquots are presented in **Appendix C**. For each site in **Appendix C**, plots of streamflow against trash transport rate data, by storm event, with arrows plotting the chronological order of each aliquot within an individual sampling event are also presented. Based on the initial year of data, there is wide variability in patterns. There are not enough data points to evaluate whether there is statistically significant variability between rising limb, peak, and falling limb aliquots. These analyses will be updated as appropriate following Year 2 and 3 monitoring to further evaluate the study questions.

3.4.4.4 Other Possible Factors

A similar lack of relationship was observed between trash volume and other factors evaluated, such as position of the sampler in the water column, instantaneous streamflow rate, and antecedent dry period. The potential influence of these factors on trash loading rates will be explored in the future as more data becomes available. Over time, there may be sufficient data to develop a rating curve of trash discharge (in gallons/acre) based on storm characteristics (e.g., intensity, duration, antecedent dry period) for each monitoring site. Rating curves may be useful for estimating trash loading for non-monitored storm events to recalculate annual trash loading rates for each site. There are numerous additional variables that may affect trash loading estimates. Below is a non-exhaustive list of potential variables:

- antecedent dry period;
- storm intensity (e.g. Is trash at receiving water monitoring stations coming from floodplain storage, or do directly from impervious areas when there is intense enough rainfall);
- watershed topology (connectedness and adjacency);
- storms larger than the design storm (1 year,1 hour storm event);
- street sweeping/trash removal schedules;
- full trash capture (FTC) device maintenance schedules;

- channel type proximal to the sampling site, and channel type distribution through the watershed (e.g. concrete vs vegetated, presence of a floodplain, which could impact thresholds for trash capture and release); and
- watershed-specific trash types.

3.4.4.5 First-Year Calculations of Annual Trash Loading

Until more data points are collected and analyzed, a simplified method was used to calculate annual trash loading rates for WY 2025, as proposed by Cowger et al. (2022). Annual trash loading rate (in gallons/acre/year) for each monitored catchment was calculated by:

1. Calculating the mean trash concentration of all aliquots collected at each station.
2. Multiplying the mean trash concentration by the stormflow volume for WY 2025 (see **Table 8**) at each respective station.
3. Aliquots taken during baseflow prior to the onset of stormflow were not used to calculate the average trash concentration for each site,
4. The replicate sample taken at AC-CRA was not used to estimate the mean trash concentration for that site.

The estimated annual trash loading rates for the 6 sites for WY 2025 ranged from 0.01 to 2.17 gallons/acre/year and are summarized in **Table 9**. Totals for all sites were below the low trash generation rate (5 gallons/acre/year) established in the MRP.

Table 9 Annual trash loading rates for 6 receiving water sites monitored during WY 2025

Station	Watershed size (ac)	Mean Trash Concentration (gal/cu. ft. of streamflow)	Annual Stormflow Volume (cu. ft.)	**Annual Trash Load (gal/ac/yr)**
AC-ALM	18,362	1.23E-05	3.34E+08	**0.22**
AC-CRA	2,769/1,800	2.21E-05	1.18E+07	**0.15**
CC-ROD	6,252	2.29E-06	3.75E+07	**0.01**
SC-LPA	2,748	3.62E-05	4.78E+07	**0.63**
SC-ADO	6,752	6.07E-06	2.09E+07	**0.02**
SM-COL	7,834	1.98E-04	8.59E+07	**2.17**

Data from two different locations on Crandall Creek (AC-CRA) were collected during WY 2025 and combined to estimate preliminary loadings because, while possible, backwatering during extreme flow conditions in Alameda Creek is unlikely to dramatically affect the amount of trash collected at that site. Data from the first sampling event at AC-CRA, which were collected at Bonanza Drive, will be removed from the calculations as more data are collected during WY 2026.

3.5 Statement of Data Quality

WY 2025 marked the initial year of trash receiving water monitoring being conducted by BAMSC Member Programs. Monitoring activities included the download and review, or collection of continuous streamflow data for streamflow gaging stations at or near each monitored site and the collection and characterization of trash collected during multiple sampling events at each site. All monitoring data were validated following procedures described in the QAPP (Version 1.0) (BAMSC 2024b). Review of monitoring data quality associated with each of these components is included below by data type.

3.5.1 Hydrologic Data

The Technical Project Team utilized publicly available calibrated streamflow gage data with existing stage-to-streamflow rating curves, when possible. The agencies responsible for maintaining the streamflow gages utilized for this project periodically check and calibrate streamflow data, however in most cases, because of the project reporting timeline, streamflow data was downloaded or requested prior to finalizing of the streamflow data for the water year. It is possible that changes in the quantity of streamflow may occur once the streamflow records for WY 2025 are finalized by the responsible agencies. Team hydrologists reviewed flow data for reasonableness by looking for anomalies (e.g. unexplained spikes in flow), comparing rainfall data, comparing to nearby stream gages, and comparing total annual streamflow per unit area. However, two issues were identified during monitoring activities and/or data processing steps that necessitated additional data calibration.

3.5.1.1 Colma Creek (SM-COL)

As described in **Section 3.2.5**, the Technical Project Team discovered potential unforeseen sources of error in the record of flow provided by the City of South San Francisco. The Technical Project Team used a combination of methods to verify and calibrate the streamflow record, to the extent possible.

The streamflow gaging equipment at this station was upgraded in November 2025, and a more reliable record of streamflow for WY 2026 and WY 2027 will be available.

3.5.1.2 Adobe Creek (SC-ADO)

As described in **Section 3.2.5** the Adobe Creek stream gage operated by Valley Water was recently moved approximately 5,500 feet upstream from Middlefield Road to El Camino Real (Valley Water Alert Sensor 5135). The Technical Project Team used a combination of methods to verify and calibrate the streamflow record, to the extent possible. This included installation of two Solinst Levelogger® pressure transducers for this project at the former Valley Water streamflow gage location which is located 340 feet downstream of the SC-ADO sampling location at Middlefield Road. Subsequent to the pressure transducers being installed at Middlefield Road, the water level record was compared to stage measurements taken during trash sampling events, then the calibrated record of stage was converted to streamflow using the Valley Water rating curve for the former Adobe Creek at Middlefield Road streamflow gaging station. Streamflow estimates taken during trash sampling events were used to calibrate a continuous record of streamflow.

Overall, the amount of flow measured at Adobe Creek appears to be low when normalized by watershed area. The Team will continue to monitor Adobe Creek streamflow and refine the streamflow calculations during WY 2026 and WY 2027, and update WY 2025 if those additional data suggest an update is needed.

3.5.2 Trash Sample Collection Data

3.5.2.1 Active Trash Width

"Active trash width" is a qualitative description of the width of streamflow where trash is visibly transported on the surface of the receiving water stream or canal. Numerically, the active trash width value would ideally be used to scale up from the sampler width (1.5 feet) to the total amount of surface transported trash calculated for that site. While qualitative and highly variable, active trash width may substantively impact the annual loading results; teams sampled at or near the channel thalweg where most of the streamflow occurs, and likely most of the trash is transported. It is therefore possible that trash concentration estimates are higher than the actual overall trash concentrations. Active trash width was not consistently assessed across all sample events during Year 1. As such, trash loading estimates assume trash concentrations are the same across the entire top width of streamflow, which likely results in an overestimate of trash concentrations over the entire channel width and an overestimated annual loading. The top wetted widths ranged from about 25 to 60 feet; thus, the width scaling factor varied from 17 to 40 for the sites. As more data is collected in Years 2 and 3, application of a multiplier to account for the perceived active trash width will be investigated.

3.5.2.2 Video Data Collection

Video recording equipment has functioned inconsistently, and video data are available only sporadically for WY 2025.

3.5.2.3 Sampler Capacity

Where video was available, aliquots were spot-checked. In two cases, nets that appear to be over-filled during a portion of the monitoring was observed. The nets were likely "rejecting" streamflow and trash during the period of time during which they were over-filled:

- SM-COL on November 11, 2024: SM-COL-11112024:0922-0
- SM-COL on November 11, 2024: SM-COL-11112024:0928-0

These aliquots were used in the initial calculations for mean annual trash concentration but should be considered as minimum values. It is unclear how much impact these aliquots have on trash concentrations, but it is likely that the trash concentrations measured during those aliquots underestimate actual trash concentrations while those aliquots were being collected. Training occurred ahead of Year-2 sampling to prevent over-filled nets during sampling (See **Section 4.2.2**).

3.5.2.4 Backwatering at Crandall Creek

During the February 13, 2025, sampling event at Crandall Creek, the Technical Project Team discovered that during high-flow events, Alameda Creek can cause backwatering at the Bonanza Drive sampling location that was originally selected for sampling. Backwatering may cause trash from Alameda Creek or Crandall Creek downstream of the site to be transported up above the sampling location and subsequently be sampled, even though the origin of some of that trash may not be from within the watershed. Aliquots from February 13, 2025, were used in the initial calculations for mean annual trash concentration, but may be excluded from calculations in subsequent years, when more data are available. It is unclear how much impact these aliquots have on trash concentrations.

Immediately after the February 13, 2025, sampling, the sampling team worked with the PMT to locate a new site upstream of the backwater zone to prevent sampling withing the backwater zone.

3.5.2.5 Sampling Events

Due to manufacturing delays and the inherent challenges associated with forecast-based sampling deployment, two of the Project sites (AC-CRA and SM-COL) were only able to be sampled twice during WY 2025. Additional sampling will be performed in WY 2026 (and WY 2027, if needed) so each site is sampled at least nine times over the course of the three-year monitoring period.

Replicate

One replicate sample event occurred on February 13, 2025, resulting in 5.3 percent of sample events with replicates. Therefore, the trash sample collection replicate criterion of 5 percent was met. **Appendix D** includes the Quality Assurance report for the replicate sample taken during WY 2025.

3.5.3 Trash Characterization Data

As part of the data quality review process, BAMSC Programs review all aspects of the data collection, analysis, and reporting process to identify any deviations from Project QAPP requirements (BAMSC 2024b). Minor deficiencies (e.g., incomplete datasheets, data entry errors) may be addressed at the local level. More significant deficiencies or those that may affect future data collection and reporting efforts are detailed in a Corrective and Preventative Action Report (CPAR), which describes the discrepancies identified, proposed response actions, and dispensation of affected data.

There were no issues identified during trash characterization data quality review that required development of a CPAR.

4. DISCUSSION

4.1 Investigation of Trash Generation Based on Monitoring Results

The preliminary annual trash loading results from WY 2025 (presented in **Section 3.4.4**) for all six receiving water sampling sites were below the "low" trash generation threshold of 5 gallons/acre/year included in the MRP. Although trash generation (i.e., the amount of trash available for transport to the MS4) is not synonymous with trash loading (i.e., the amount of trash flowing through a monitoring point), these results suggest that trash controls implemented in catchments draining to receiving water monitoring points are controlling trash discharges from contributing MS4s. Additional data collected over the next few WYs, along with data collected via stormwater outfall monitoring, will provide additional information on the efficacy of trash controls implemented to control trash discharges from MS4s.

4.2 Lessons Learned

Lessons learned from the first year of trash receiving water monitoring are summarized below.

4.2.1 Storm Selection

- The design storm (i.e., one-year, one-hour storm event) is difficult to predict from the information that is provided in the National Weather Service forecasts.
- During WY 2025, the Technical Project Team used a threshold for antecedent dry period criterion of no more than 0.1 inch of rain in the prior 24 hours. This criterion sometimes "ruled out" subsequent storms that could have provided useful data.
- Storms that may mobilize trash from MS4s may not be large enough to generate trash-transporting flows in receiving waters (0.25 inches of rain in 24 hours). Crandall Creek and Rodeo Creek, for example, appear to require substantially more rainfall (0.5-1.0 inches in less than 24 hours) to elevate flows and transport trash.
- Forecasting is an inexact science, and the Monitoring Coordinator endeavored to mobilize teams to meet the beginning of storms. As a result, the following has been observed:
- If the storm arrives earlier than forecasted, the sampling team may miss the rising limb or peak.
- Atmospheric rivers were repeatedly observed during WY 2025 stalling and/or progressing southward more slowly than forecasted. In a few cases, sampling teams were unable to remain on site long enough to sample a complete storm due to safety/darkness concerns.
- The lag between the onset of precipitation and increased baseflow varies across monitored watersheds and events.

4.2.2 Trash Sample Collection

- The Weighted Box trawls do not generally submerge when velocities increase above approximately four to five feet per second. As such, fewer mid-water-column and channel-bed aliquots were taken. Channels with concrete bottoms (such as Colma Creek) often exceed this velocity threshold, making higher flow sampling difficult and limiting the number of sampling opportunities.

- Originally, the Technical Project Team foresaw that too many aliquots would be collected for long-duration storms, and aliquots would need to be composited by the hour to reduce the labor associated with characterizing the trash within each sample. During WY 2025 the Technical Project Team found that compositing aliquots was not necessary so only one sample event (November 22, 2024, at SC-LPA, Lower Penitencia Creek) was composited. The Technical Project Team does not anticipate compositing aliquots during WY 2026 and WY 2027.

- Active trash width, or the width across the channel where a majority of trash transport takes place, is highly subjective and was not consistently assessed during WY 2025.

- Based on review of monitoring video, over-filling of the trawl nets was observed during a portion of the monitoring and were likely “rejecting” streamflow and trash during the period of time during which they were over-filled. During the Year -2 training, video was reviewed and monitoring staff were taught about the signs of overfilled nets.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Conclusions for the first year (WY 2025) of trash receiving water monitoring include:

- Trash sampling successfully occurred during at least three storm events at four of six sampling sites; and two storms were sampled at the remaining two sites.

- The first significant storm event was sampled at three of the six sites.

- An event greater than the predicted full trash capture "design" storm event "peak" was sampled at one site, SC-ADO. The design storms that were sampled missed the "peak" flow for the design storm events at SC-LPA, AC-ALM, and AC-CRA. Design storm events were not sampled at two sites, SM-COL and CC-ROD. It is anticipated that the design storm will not be sampleable at SM-COL due to the high velocities during high-flow events.

- Based on 117 trash aliquots collected regionally across 19 total storm sample events, plastic material comprised 88% of the trash collected (see **Appendix A**). "*Other Plastic Items/Pieces*" represented 75% of the total material. Other important plastic trash items include "*Single Use Food/Drink Ware*" and "*EPS Foam Food Ware"* which combined represented 9% of trash volume ("*EPS Foam Food Ware*" being less than 1%). Most cities in the San Francisco Bay Area have adopted bans on the distribution of all three types of trash. In addition, the State of California adopted a ban on polystyrene foam food ware on January 1, 2025.

- Based on first year of data and preliminary estimates using a simple method to calculate the annual trash load, it appears that trash controls implemented in the receiving water catchments, whether full trash capture devices or other types of controls, have controlled trash discharged from MS4s into receiving waters (see **Section 3.4.4/Table 9**). Trash discharged over the course of the first year of monitoring was well below the low trash generation level of 5 gallons/acre/year at all six sites.

5.2 Refinements for the Next Water Year

General refinements to the monitoring approach planned for WY 2026 are summarized below.

Because sampling data will be used to develop annual trash loadings at each of the six monitoring stations, sampling data from a wide variety of storm types will be useful for developing relationships between streamflow rate and trash concentration, and ultimately, annual trash loadings. During future monitoring, the Monitoring Coordinator will use professional judgment to optimize sampling to target data collection that could include a wide variety of antecedent dry conditions and storm conditions that could include categories of storms/conditions presented in the list below:

- Large events preceded by longer dry period (1 year-1hour storm, > 48 hour dry period)

- Large events preceded by shorter dry period (1 year-1hour storm, < 48 hour dry period)
- Large events preceded by a medium event (1 year-1 hour storm, preceded by an event with ~0.5-2 inches of rainfall)
- Medium events preceded by longer dry period (Event with ~0.5-2 inches of rainfall, > 48-hour period)
- Medium events preceded by shorter dry period (Event with ~0.5-2 inches of rainfall, < 48-hour period)
- Medium events preceded by a small event (Event with ~ 0.5-2 inches of rainfall following an event with ~0.25-0.50 inches of rainfall)
- Small events preceded by longer dry period (Event with ~0.25-0.5 inches of rainfall, > 48-hour period)
- Small events preceded by shorter dry period (Event with ~0.25-0.5 inches of rainfall, < 48-hour dry period)
- Base flow preceded by a medium event (including low flow prior to a storm event)
- During the lead-up to future storms, the Monitoring Coordinator will use professional judgment to optimize sampling to attempt to capture full or partial hydrographs during storm sample events in support of collecting data across categories of storms that represent a variety of conditions. Sampling teams will be available for up to four events annually.
- Due to limitations with the Weighted Box trawl performance in high velocity streamflow, mid-column and channel bed aliquots will be taken opportunistically moving forward. Adding additional weight is infeasible due to safety concerns.
- To improve consistency in assessing “active trash width”, a training on assessing active trash width was performed prior to WY 2026 and additional data collected during WY 2026 and WY 2027 will be used to assess a generalized multiplier that can be applied to data collected in the future and retroactively to data collected during WY 2025.
- As more data become available following trash receiving water monitoring during WY 2026, the BAMSC Programs will evaluate additional factors that may influence trash loading rates. BAMSC will present data analysis approaches to the Trash TAG in early 2026.

5.3 Recommendations for MRP 4.0

Trash receiving water monitoring conducted by BAMSC during MRP 3.0 was explicitly structured as a pilot study and made possible through an external USEPA WQIF grant from the WOW project. While the data generated during WY 2025 and through the MRP 3.0 permit term are informative for advancing scientific understanding of trash transport in receiving waters and for testing the application of the Weighted Box trawl method, **BAMSC strongly recommends that trash receiving water monitoring not be included in MRP 4.0**.

This recommendation is supported by the following considerations:

- **Limited relevance to Management Questions.** Trash receiving water monitoring does not directly address the primary Management Questions in the MRP, which focus on the effectiveness of trash management actions and on whether Trash Management Areas are achieving low-trash generation conditions. Early results from outfall monitoring indicate that trash controls are effectively controlling trash to low levels (see the Trash Outfall Monitoring IMR). As a result, receiving water monitoring is not necessary to evaluate whether discharges from areas with low trash generation are causing or contributing to adverse trash impacts in receiving waters.

- **Limited ability to answer Monitoring Questions.** Receiving water monitoring is only potentially relevant to the Monitoring Question regarding whether trash levels in receiving waters correlate with tributary MS4 drainage area conditions. However, the current monitoring design is ineffective at answering this question because receiving water and outfall monitoring locations cannot be co-located due to logistical and safety constraints. This limits the ability to establish a clear linkage between MS4 conditions and observed receiving water trash levels.

- **High resource demand and lack of sustainable funding.** Trash receiving water monitoring is resource-intensive, requiring storm monitoring, flow measurements, and detailed sample handling. The current program is supported by grant funding that will conclude at the end of the MRP 3.0 permit term, and similar external funding is unlikely to be available for MRP 4.0. As such, continuing this monitoring would not represent a sustainable compliance strategy.

- **Sampling representativeness and variability.** The sampling area of the Weighted Box trawl is small relative to the cross-sectional area of receiving waters, and floating trash has been observed to be highly variable and irregular in space and time. These factors limit the ability to accurately characterize trash concentrations or loads using the current approach.

- **Methodological challenges associated with Weighted Box trawls.** Deployment of Weighted Box trawls is technically challenging, particularly during high-flow conditions. Video review indicates that trawl submergence depth varies during sample collection, resulting in inconsistent sampling of the water column. Additionally, limitations in deploying trawls at mid-water and near-bed elevations constrain the ability to characterize vertical trash transport.

- **Persistent uncertainty despite dataset size.** Although completion of the pilot project will likely yield one of the largest receiving-water trash datasets currently available, the data are unlikely to sufficiently constrain the multiple sources of uncertainty associated with trash loading into receiving waters. Consequently, monitoring is unlikely to yield commensurate regulatory or management value relative to the effort required.

If the Water Board determines that trash receiving water monitoring must continue in MRP 4.0, BAMSC recommends modifying the program to substantially reduce the overall level of effort while preserving the most essential elements. Potential modifications include:

- **Reduce the number of monitoring sites** from six to four regionwide.
- **Reduce the number of monitored storm events** from three to two per year (targeting approximately ten storm events over the MRP 4.0 permit term).
- **Eliminate trash characterization requirements** as this data has not proven useful for evaluating the effectiveness of existing trash controls or identifying gaps. Measurement of overall trash volume per sample would be retained.

6. REFERENCES

BAMSC (Bay Area Municipal Stormwater Collaborative). 2024b. Receiving Water Trash Monitoring Quality Assurance Project Plan. Version 1.0. July 31, 2024.

Cowger, W., Gray, A., Brownlee, S., Hapich, H., Deshpande, A. and Waldschläger, K., 2022. Estimating Floating Macroplastic Flux in the Santa Ana River, California. Journal of Hydrology: Regional Studies, 44, p.101264.

BAMSC (Bay Area Municipal Stormwater Collaborative). 2024. Receiving Water Trash Monitoring Plan. Version 1.0. July 31, 2024.

SFBRWQCB (San Francisco Bay Regional Water Quality Control Board). 2022. San Francisco Region Water Quality Municipal Regional Stormwater NPDES Permit. Order R2-2022-0018, NPDES Permit No. CAS612008.

SWRCB (State Water Resources Control Board). 2015. Amendment to the Water Quality Control Plan for the Ocean Waters of California to Control Trash and Part 1 Trash Provisions of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California. Final Staff Report including the Substitute Environmental Documentation.

APPENDICES

APPENDIX A

Trash Receiving Water Characterization Data

Table A-1. WOW Trash Receiving Water Trash Characterization Data, WY2025

	Site	Date	Start Time	Plastic Trash Items (vol. oz.)							Non-plastic Trash Items (vol. oz.)						Volume	
				Single-Use Carryout Plastic Bags	Expanded Polystyrene (EPS) Foam Food Ware	(EPS) Foam Other	Single Use Plastic Food / Drink Ware	Smoking Products, Traditional	Smoking Products, Other	Other Plastic Items / Pieces	Organic / Paper	Fabric	Metal	Glass	Mixed	Biohazard	Total Ounces	Total Gallons
Santa Clara County	ADO	11/22/2024	13:15			0.34	0.17	0.07	2.54	20.23	0.17						23.52	0.1838
	ADO	2/4/2025	11:40			0.03				0.17			0.1				0.30	0.0023
			14:20			0.07				0.57			0.07				0.71	0.0055
			16:20		0.07	1.69	0.17	0.17	0.1	10.14	2.03		12				26.37	0.2060
			16:41			0.07	0.1	0.27									0.44	0.0034
	ADO	2/13/2025	7:25		0.17					1.69							1.86	0.0145
			8:20			0.07					0.14						0.21	0.0016
			10:05							0.03							0.03	0.0002
			11:30							0.17							0.17	0.0013
			13:15							1.01							1.01	0.0079
			14:14							0.85							0.85	0.0066
			15:25							2.54							2.54	0.0198
	ADO	3/12/2025	15:00			0.03		0.2		0.47							0.70	0.0055
			15:30					0.27		5.1							5.37	0.0420
			16:05					0.27		7.61					7.1		14.98	0.1170
			18:45			0.27				0.27							0.54	0.0042
	LPA	11/22/2024	17:15			0.68		0.27	0.1	16							17.05	0.1332
	LPA	2/4/2025	14:05								0.03						0.03	0.0002
			15:10							1.35					0.27		1.62	0.0127
			15:40		0.17		0.68	0.14		9.3							10.29	0.0804
			16:10				16	0.17	0.07	7.1	6.76						30.10	0.2352
			16:26			0.07	4.4			19.7							24.17	0.1888
			16:41			0.07	0.1	2.71		2.54							5.42	0.0423
			16:58					0.07	0.17	0.68							0.92	0.0072
			17:12					0.07		1.35							1.42	0.0111
	LPA	2/13/2025	8:30							0.34							0.34	0.0027
			9:10							0.07							0.07	0.0005
			9:44			0.03				0.03							0.06	0.0005
	LPA	3/12/2025	10:40				0.27	0.07	1.52	163.84					0.34		166.04	1.2972
			13:11			0.1		0.61		5.07	0.1						5.88	0.0459
			13:45					0.17		13.53							13.70	0.1070
			14:45			0.1				23.67					0.03		23.80	0.1859
			15:27				16	0.1									16.10	0.1258
			16:05			0.34		0.61		5.41				25.36			31.72	0.2478
			16:20		0.85	0.68		0.41	0.17	28	0.27				0.03		30.41	0.2376
			16:55		0.03	0.34	32.45	0.14		0.34					0.3		33.60	0.2625
			17:38			0.27		0.27		15.22					0.07		15.83	0.1237
			18:00					0.17	0.34	1.35			0.1				1.96	0.0153

Table A-1. WOW Trash Receiving Water Trash Characterization Data, WY2025, Continued

	Site	Date	Start Time	Plastic Trash Items (vol. oz.)							Non-plastic Trash Items (vol. oz.)						Volume	
				Single-Use Carryout Plastic Bags	Expanded Polystyrene (EPS) Foam Food Ware	(EPS) Foam Other	Single Use Plastic Food / Drink Ware	Smoking Products, Traditional	Smoking Products, Other	Other Plastic Items / Pieces	Organic / Paper	Fabric	Metal	Glass	Mixed	Biohazard	Total Ounces	Total Gallons
San Mateo County	COL	11/11/2024	9:22		0.68	0.85	2.03	0.2	0.14	179	5.92	4.23	0.1				193.15	1.5090
			9:28		0.1	6.76	2.03	2.03	1.69	208.8	1.69	1.01	0.2		0.41		224.72	1.7556
			9:42		0.34	0.51	0.34	1.01	0.17	66	1.18	0.34	0.14		0.14		70.17	0.5482
			10:16			3.38	0.51	0.27		1.01	0.1		0.2		0.2		5.67	0.0443
			10:47			0.07				1.01	0.17				0.34		1.59	0.0124
			11:08			0.85		0.68		2.54							4.07	0.0318
			11:43			0.68		0.61		1.69	0.2						3.18	0.0248
			12:15			0.03				6.76	0.1						6.89	0.0538
	COL	1/31/2025	10:15		0.68	0.17		0.85	0.68	37.28	0.34		0.1		0.17		40.27	0.3146
			10:36			0.34		0.17	0.17	5.34	1.69		16		0.17		23.88	0.1866
			10:48		0.14	0.57	0.34	0.81		10.14		2.7	0.07		5.07		19.84	0.1550
			10:58		0.07	0.61	11.83	0.1	0.1	15.22	4.23						32.16	0.2513
			11:15		0.07	0.1		0.07	0.68	9.47	0.07				0.27		10.73	0.0838
			11:48							0.34		0.51					0.85	0.0066
			13:19			0.1		0.03		0.17						1.69	1.99	0.0155
			14:28			0.07		0.14	0.34	10.14	0.85	1.69			0.34		13.57	0.1060
			15:00			0.3				1.69							1.99	0.0155

Table A-1. WOW Trash Receiving Water Trash Characterization Data, WY2025, Continued

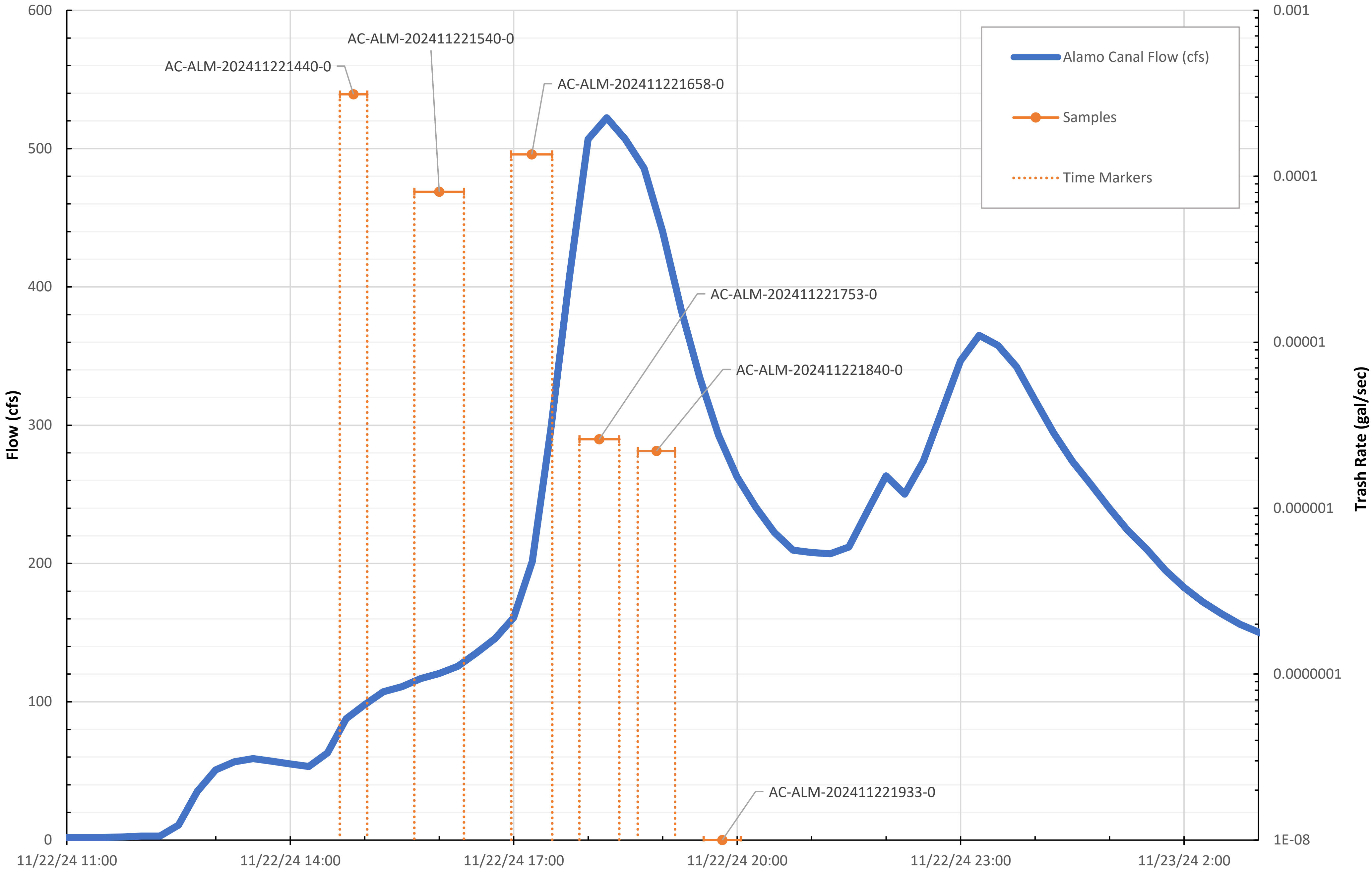
	Site	Date	Start Time	Plastic Trash Items (vol. oz.)							Non-plastic Trash Items (vol. oz.)						Volume	
				Single-Use Carryout Plastic Bags	Expanded Polystyrene (EPS) Foam Food Ware	(EPS) Foam Other	Single Use Plastic Food / Drink Ware	Smoking Products, Traditional	Smoking Products, Other	Other Plastic Items / Pieces	Organic / Paper	Fabric	Metal	Glass	Mixed	Biohazard	Total Ounces	Total Gallons
Alemeda County	ALM	11/22/2024	14:40			0.85				51.57	0.2						52.62	0.4111
			15:40			0.2				24.6							24.80	0.1938
			16:58			2.03		0.14	0.85	18.8	0.17	0.34	12				34.33	0.2682
			17:53			0.27	0.27			0.1							0.64	0.0050
			18:40							0.51							0.51	0.0040
	ALM	12/12/2024	6:19			0.07				0.34							0.41	0.0032
			7:08			0.03				0.03		0.03					0.09	0.0007
			7:46							20.03		0.03					20.06	0.1567
			8:25							0.68							0.68	0.0053
			9:04							1.02			0.03				1.05	0.0082
			9:41		0.03					0.17							0.20	0.0016
			10:36							0.17		0.27					0.44	0.0034
			11:16							0.14							0.14	0.0011
			11:59														0.00	0.0000
			12:36							0.03							0.03	0.0002
	ALM	2/1/2025	12:58			3.38		0.1		0.85							4.33	0.0338
			13:30		0.1	0.61				1.18							1.89	0.0148
			13:58		0.07	0.85		0.07		1.01					20.29		22.29	0.1741
			14:36							0.68							0.68	0.0053
			15:19					0.07		0.85							0.92	0.0072
			16:04							0.07	0.07						0.14	0.0011
			16:55				0.2			0.37							0.57	0.0045
	ALM	2/13/2025	6:47							0.51							0.51	0.0040
			7:07		0.51	0.17				0.1							0.78	0.0061
			8:01							0.34	0.14	0.14					0.62	0.0048
			8:36							3.38			0.07				3.45	0.0270
			9:26							3.38							3.38	0.0264
	CRA	2/13/2025	6:37			0.03											0.03	0.0002
			7:17					0.03		0.14	0.85						1.02	0.0080
			9:50			0.03				0.07							0.10	0.0008
	CRA Replicate	2/13/2025	6:37			0.03		0.07		1.79			0.07				1.96	0.0153
			7:17		0.17			0.07		4.4			0.07				4.71	0.0368
			9:50					0.03		0.03							0.06	0.0005
	CRA	3/12/2025	17:17					0.1		17							17.10	0.1336
			18:35		0.51	0.17	20	1.18		0.34					0.07	0.68	22.95	0.1793
			19:13			0.85		0.3		1.28			0.27		12		14.70	0.1148
			20:04		0.27	1.62		1.18	0.1	1.52	2.87		1.01		0.61	11.83	21.01	0.1641
			20:48					0.1		0.68					0.17		0.95	0.0074

Table A-1. WOW Trash Receiving Water Trash Characterization Data, WY2025, Continued

	Site	Date	Start Time	Plastic Trash Items (vol. oz.)							Non-plastic Trash Items (vol. oz.)						Volume	
				Single-Use Carryout Plastic Bags	Expanded Polystyrene (EPS) Foam Food Ware	(EPS) Foam Other	Single Use Plastic Food / Drink Ware	Smoking Products, Traditional	Smoking Products, Other	Other Plastic Items / Pieces	Organic / Paper	Fabric	Metal	Glass	Mixed	Biohazard	Total Ounces	Total Gallons
Contra Costa County	ROD	11/11/2024	9:52			0.17				0.07	0.03						0.27	0.0021
	ROD	2/1/2025	10:46			0.03				0.015							0.05	0.0004
			13:10			0.07				0.03							0.10	0.0008
	ROD	3/12/2025	0:00			0.03				0.07					0.07		0.17	0.0013
			14:00		0.07	0.68		0.17		0.68	0.34						1.94	0.0152
			15:07		0.03	0.07		0.17		0.03							0.30	0.0023
			15:27				16	0.1									16.10	0.1258
			16:11					0.2		0.03							0.23	0.0018
Total Volume, All Sites (oz)				**0.0**	**5.0**	**32.9**	**123.9**	**18.1**	**9.9**	**1075.2**	**30.7**	**11.3**	**42.5**	**25.4**	**48.5**	**14.2**	**1437.43**	**11.23**
Total Volume, All Sites (gallons)				**0.000**	**0.039**	**0.257**	**0.968**	**0.141**	**0.078**	**8.400**	**0.240**	**0.088**	**0.332**	**0.198**	**0.379**	**0.111**		
Percent of Total Volume				**0.000**	**0.345**	**2.285**	**8.619**	**1.260**	**0.691**	**74.801**	**2.136**	**0.785**	**2.954**	**1.764**	**3.371**	**0.988**		

APPENDIX B

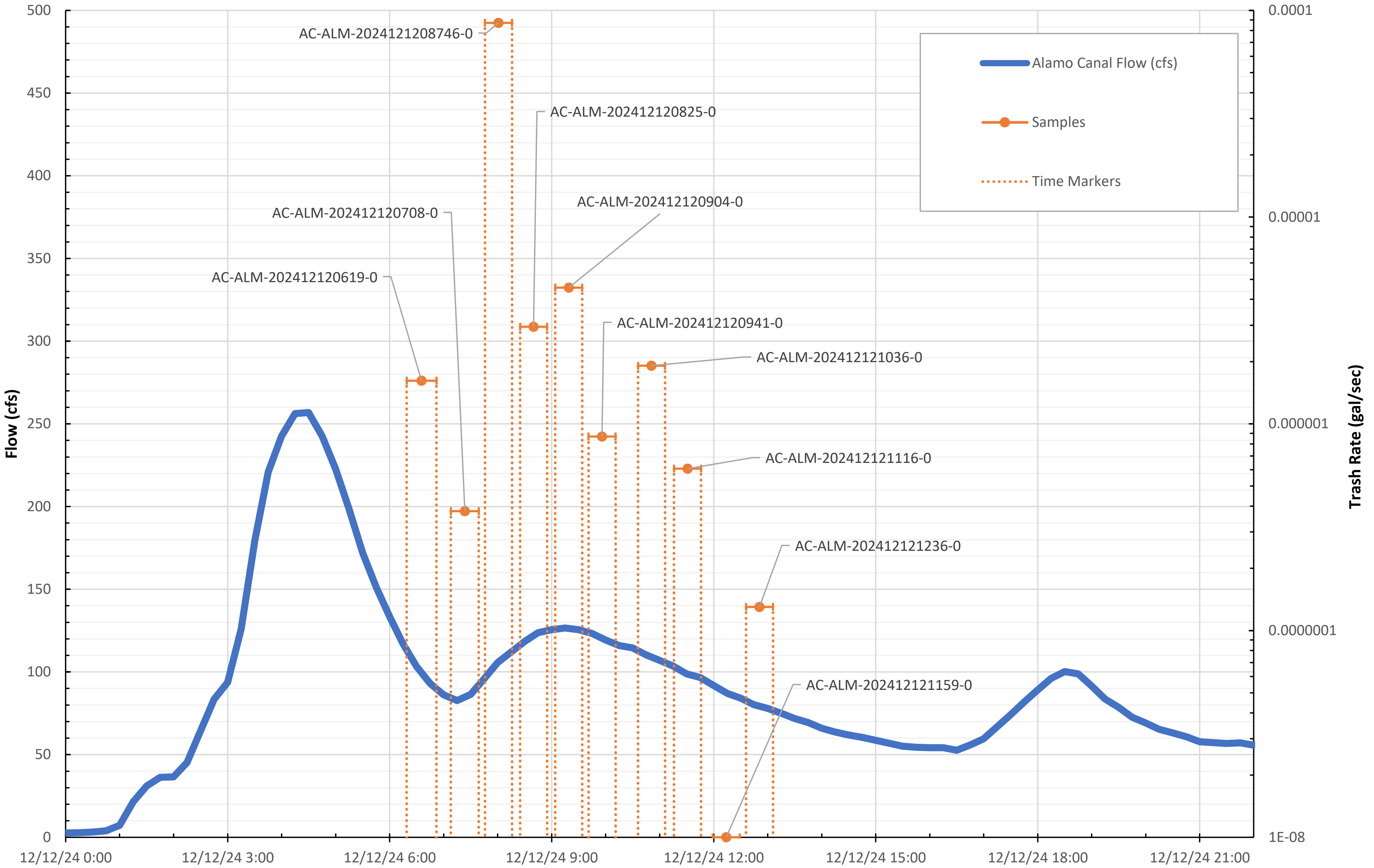
Sample Event Hydrographs and Trash Samples, WY2025



Balance Hydrologics

Figure B-1. **November 22, 2024 Sampling at Alamo Canal (AC-ALM), WOW Receiving Water Monitoring Project.**

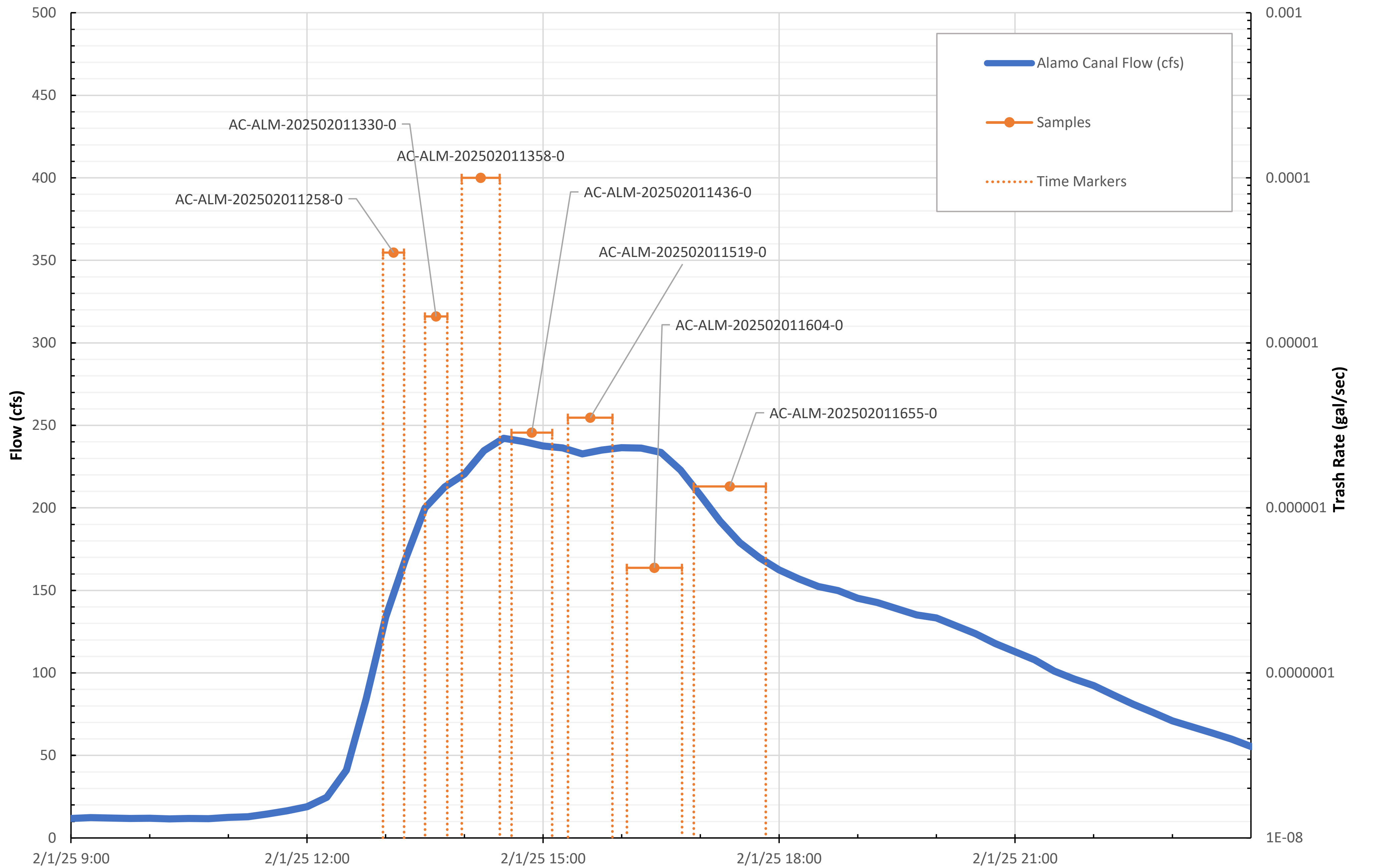
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-2. **December 12, 2024 Sampling at Alamo Canal (AC-ALM), WOW Receiving Water Monitoring Project.**

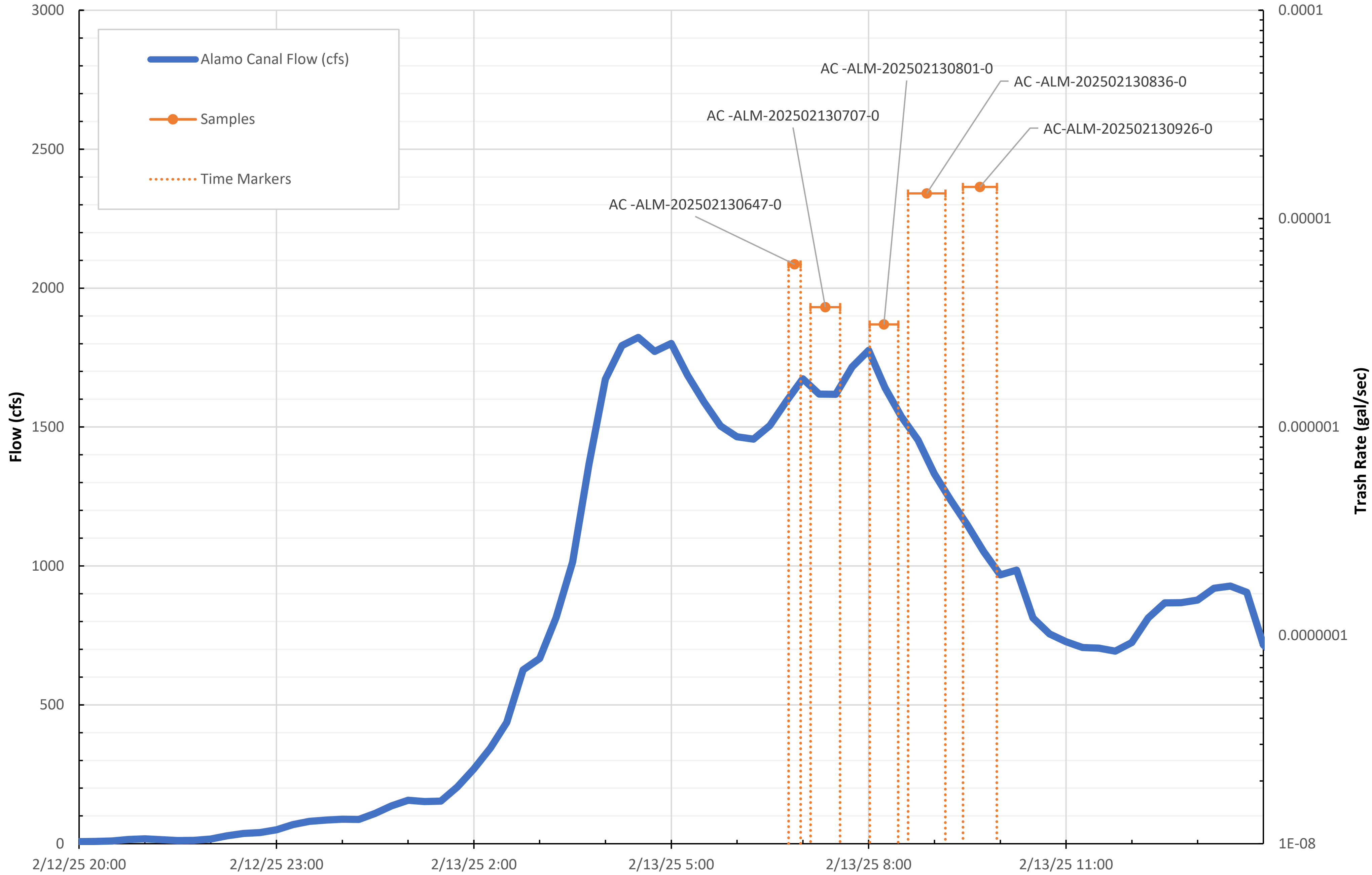
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-3. **February 1, 2025 Sampling at Alamo Canal (AC-ALM), WOW Receiving Water Monitoring Project.**

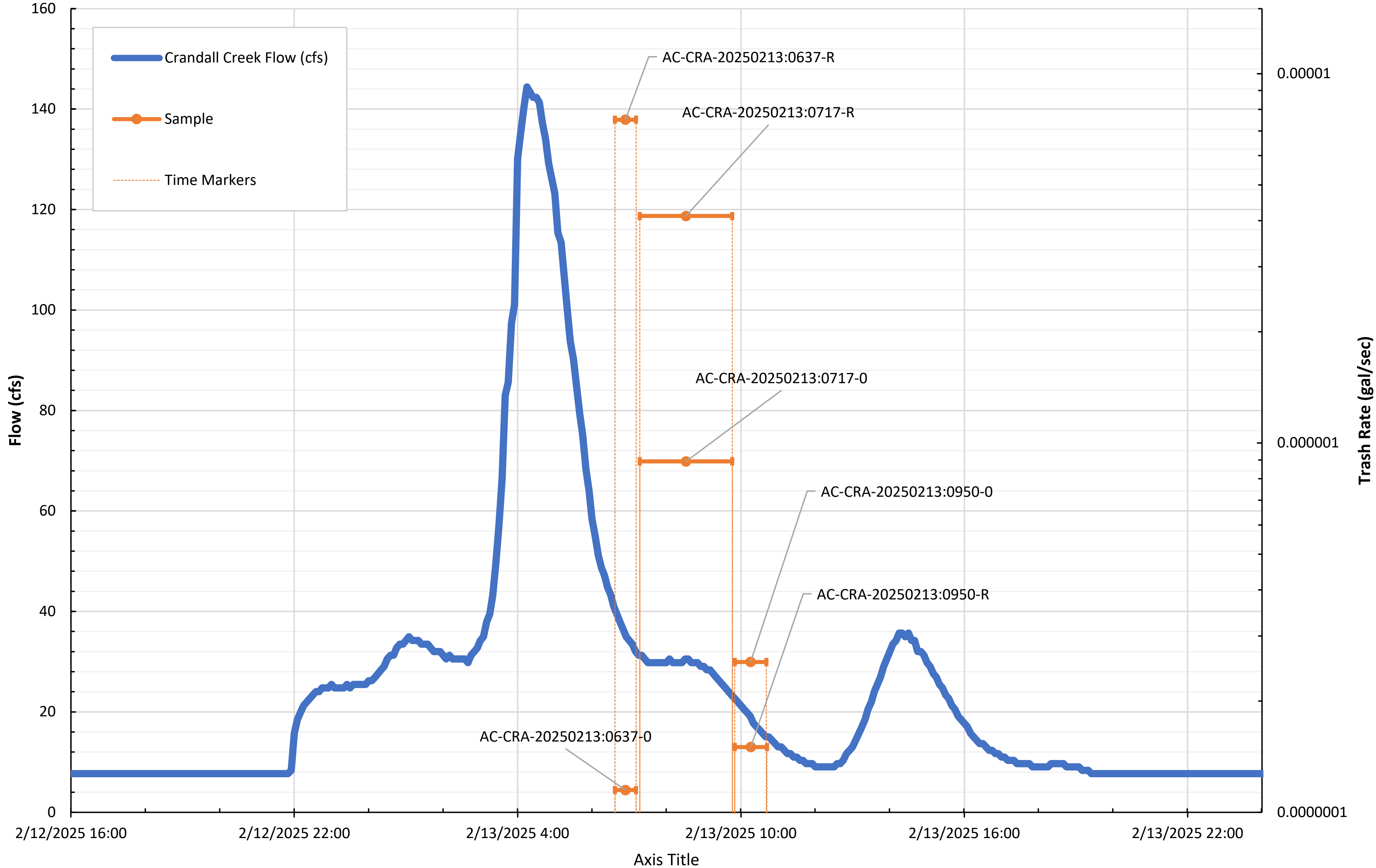
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-4. February 13, 2025 Sampling at Alamo Canal (AC-ALM), WOW Receiving Water Monitoring Project.

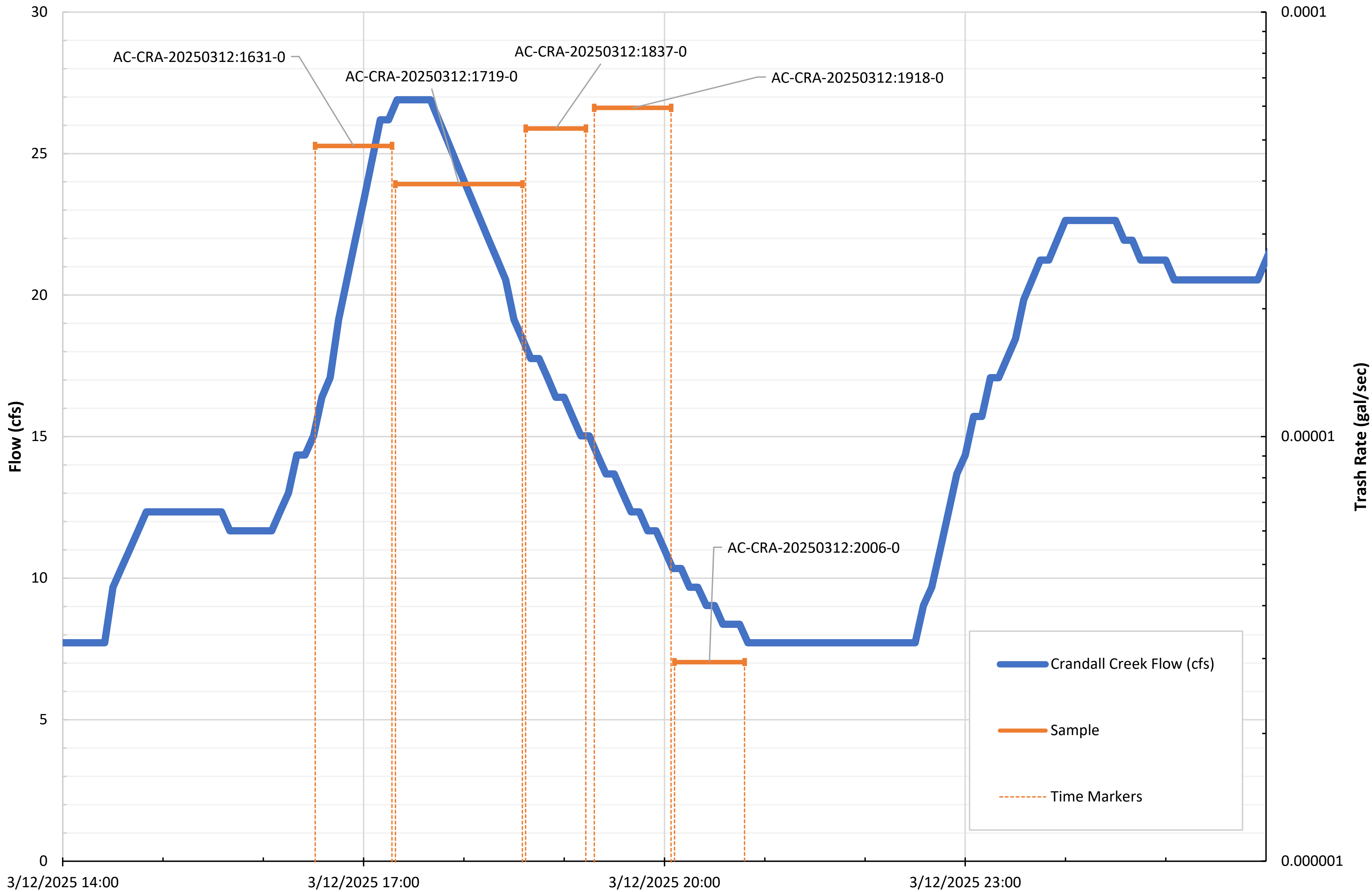
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-5. **February 13, 2025 Sampling at Crandall Creek (AC-CRA), WOW Receiving Water Monitoring Project.**

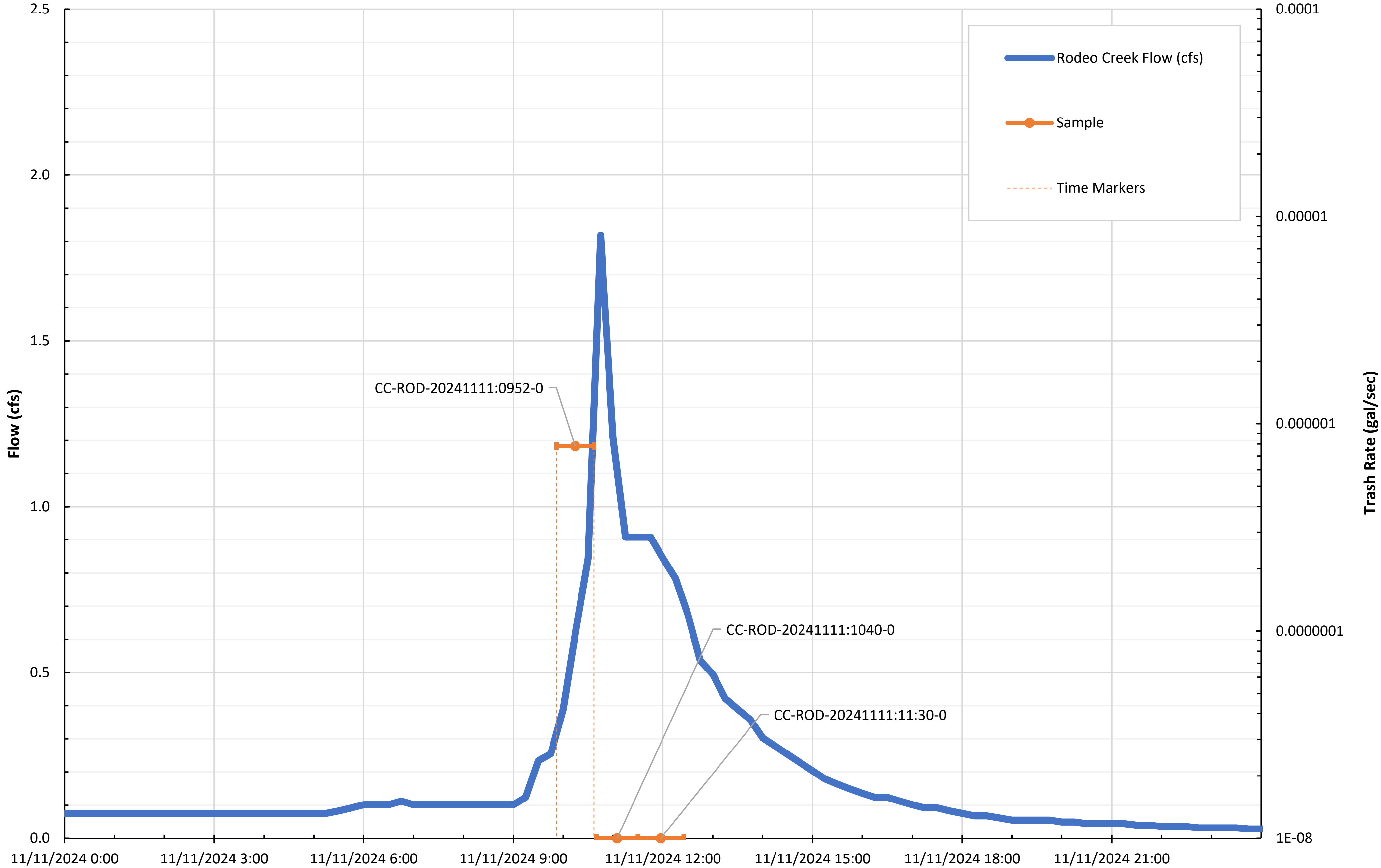
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-6. **March 12, 2025 Sampling at Crandall Creek (AC-CRA), WOW Receiving Water Monitoring Project.**

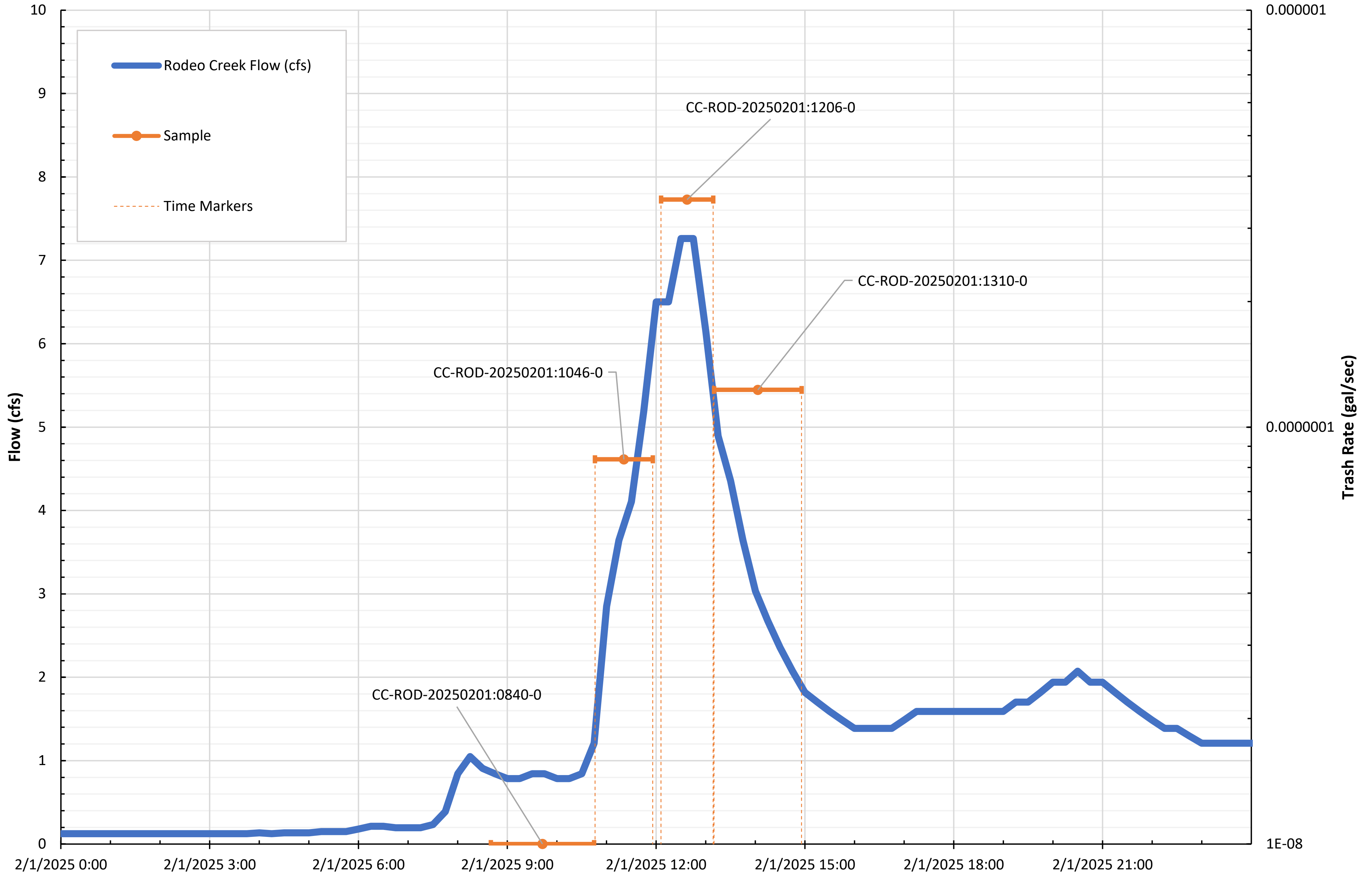
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-7. **November 11, 2024 Sampling at Rodeo Creek (CC-ROD), WOW Receiving Water Monitoring Project.**

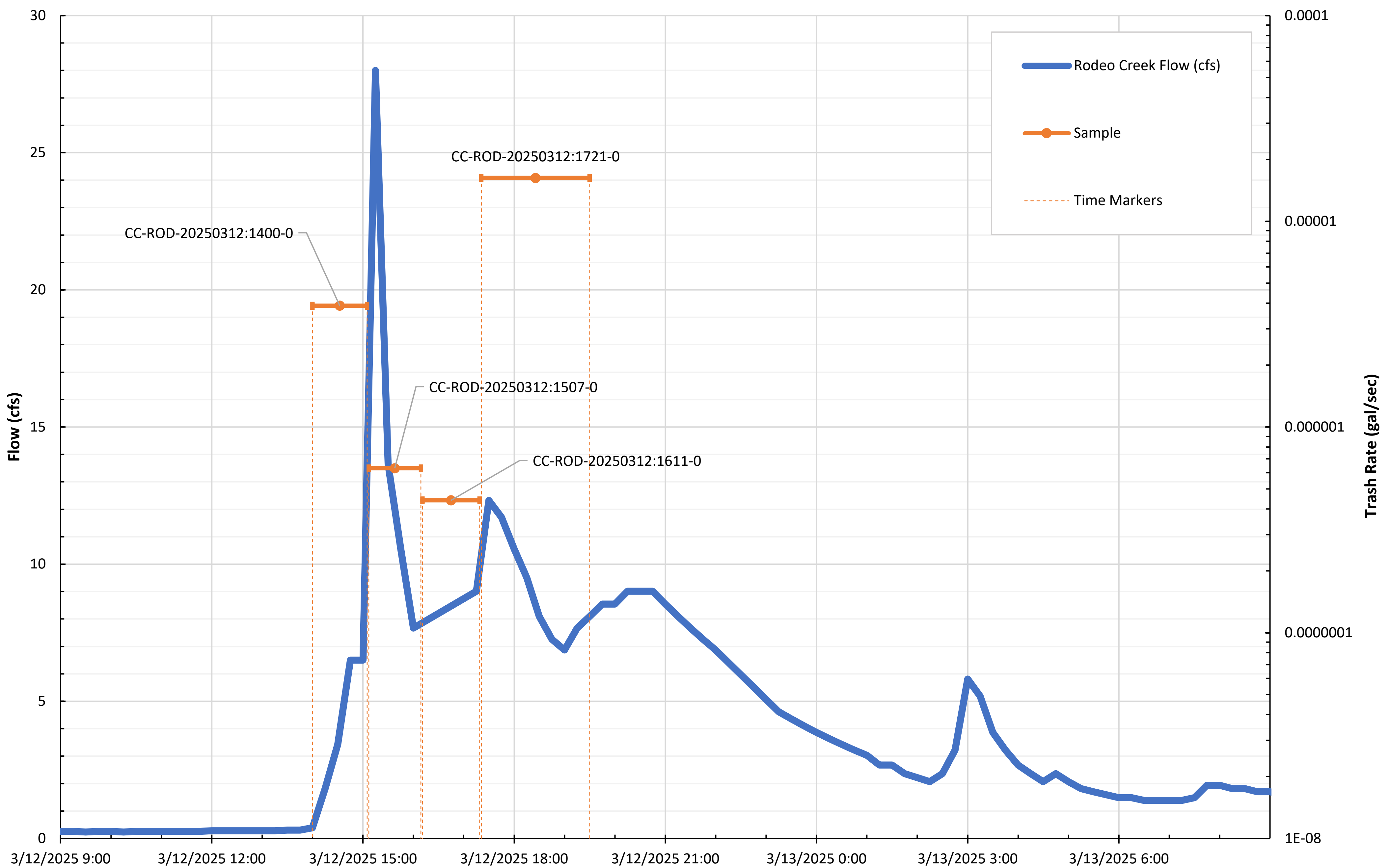
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-8. **February 1, 2025 Sampling at Rodeo Creek (CC-ROD), WOW Receiving Water Monitoring Project.**

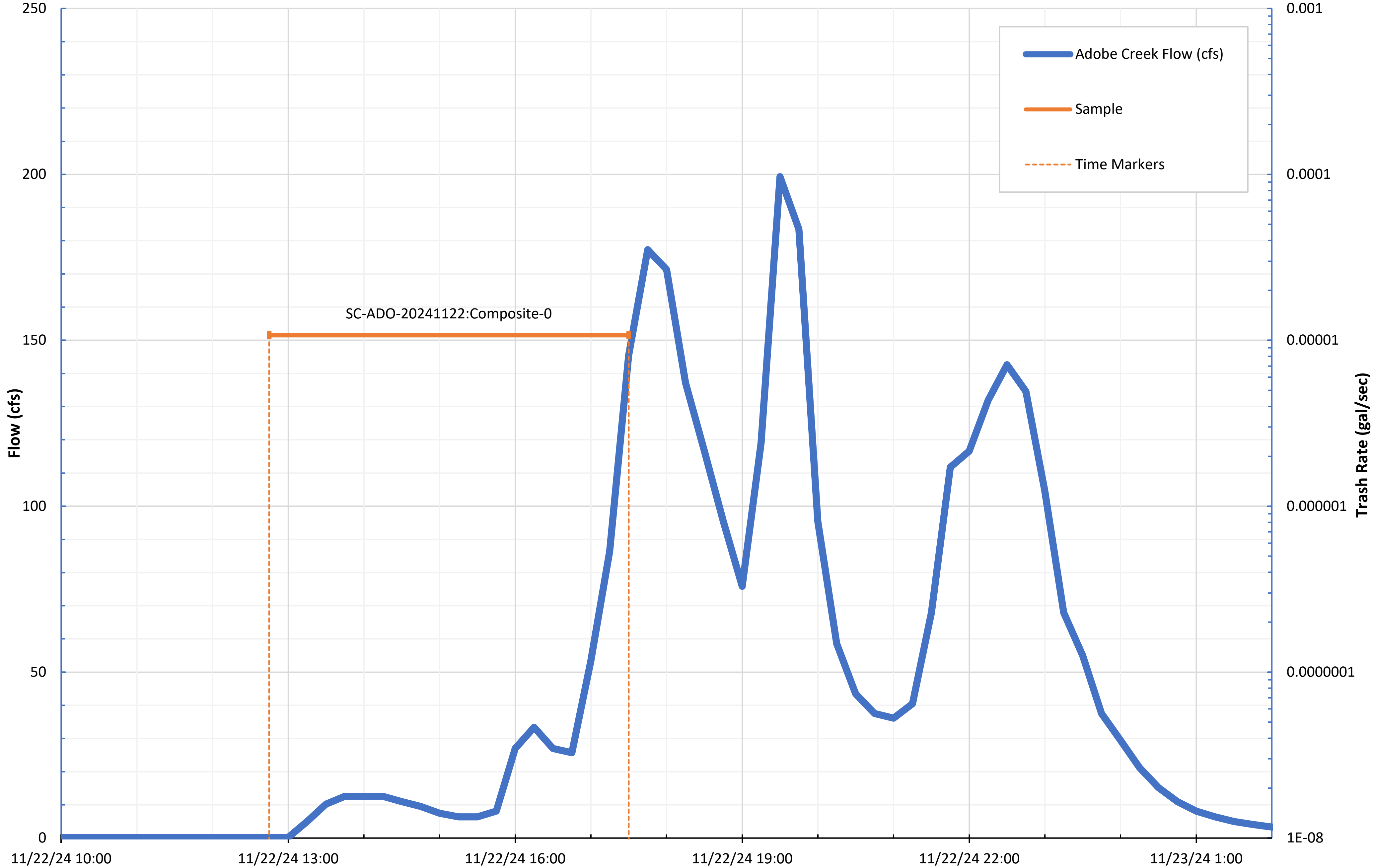
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-9. March 12, 2025 Sampling at Rodeo Creek (CC-ROD), WOW Receiving Water Monitoring Project.

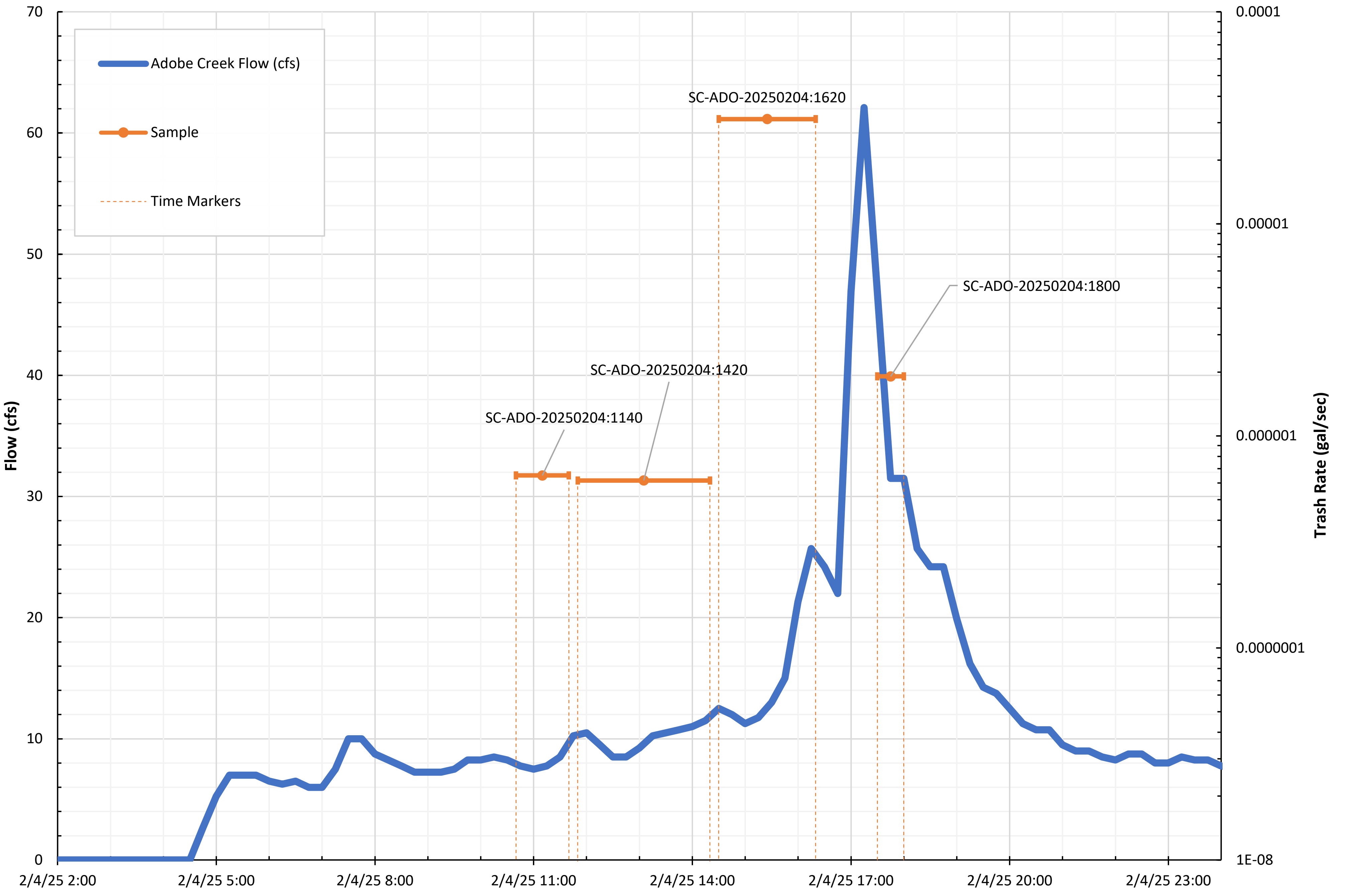
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-10. **November 22, 2024 Sampling at Adobe Creek (SC-ADO), WOW Receiving Water Monitoring Project.**

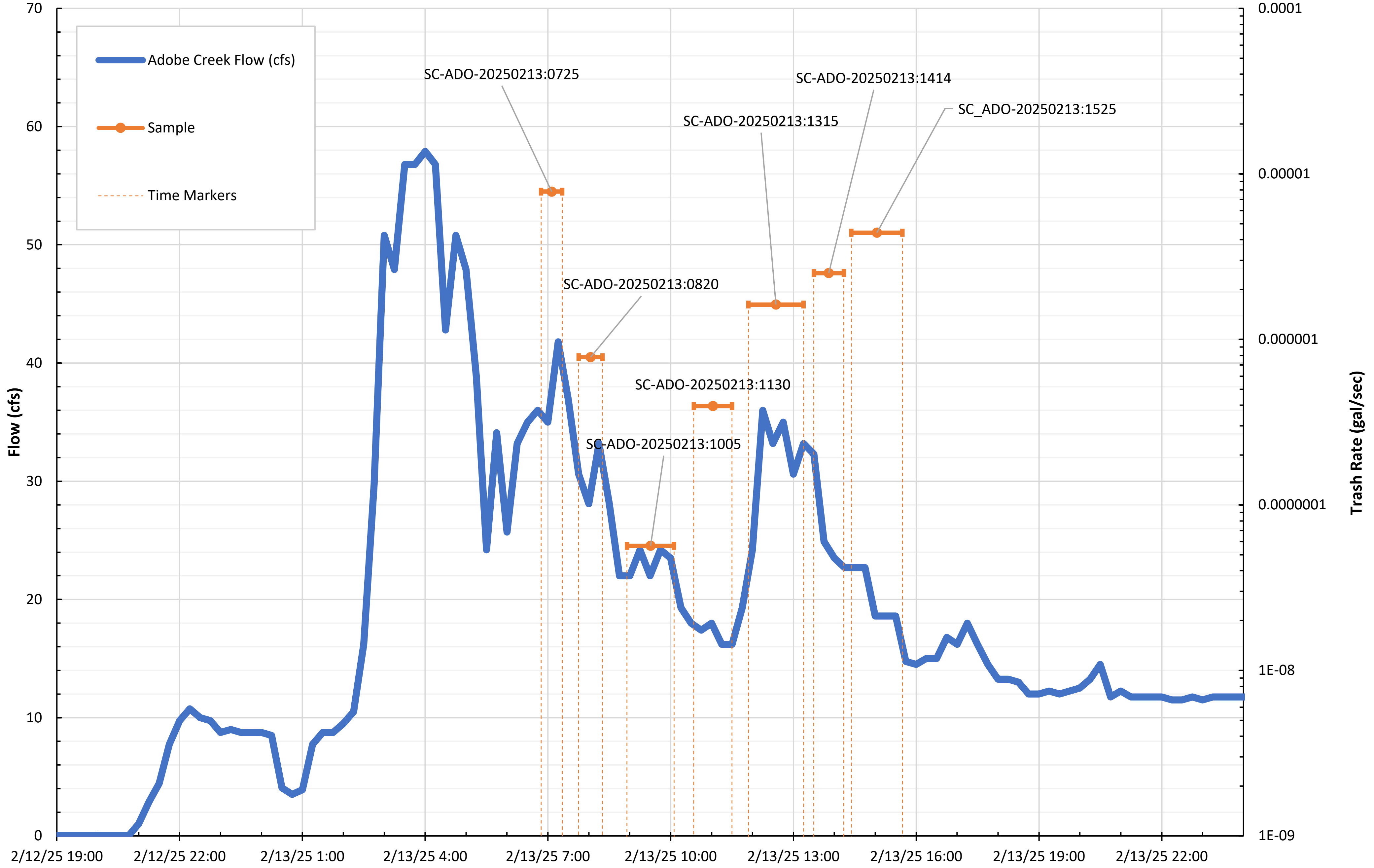
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-11. **February 4, 2025 Sampling at Adobe Creek (SC-ADO), WOW Receiving Water Monitoring Project.**

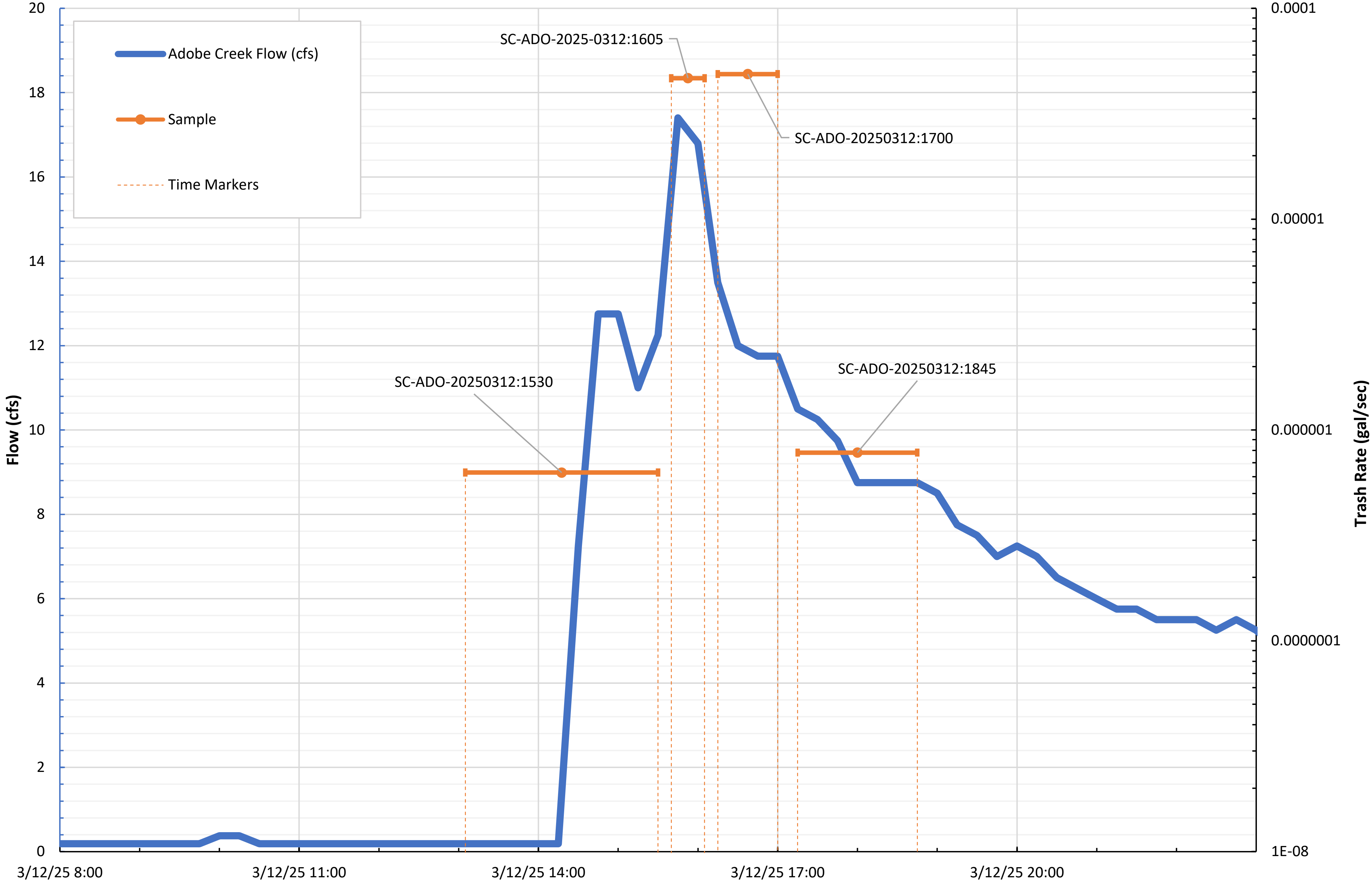
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-12. February 13, 2025 Sampling at Adobe Creek (SC-ADO), WOW Receiving Water Monitoring Project.

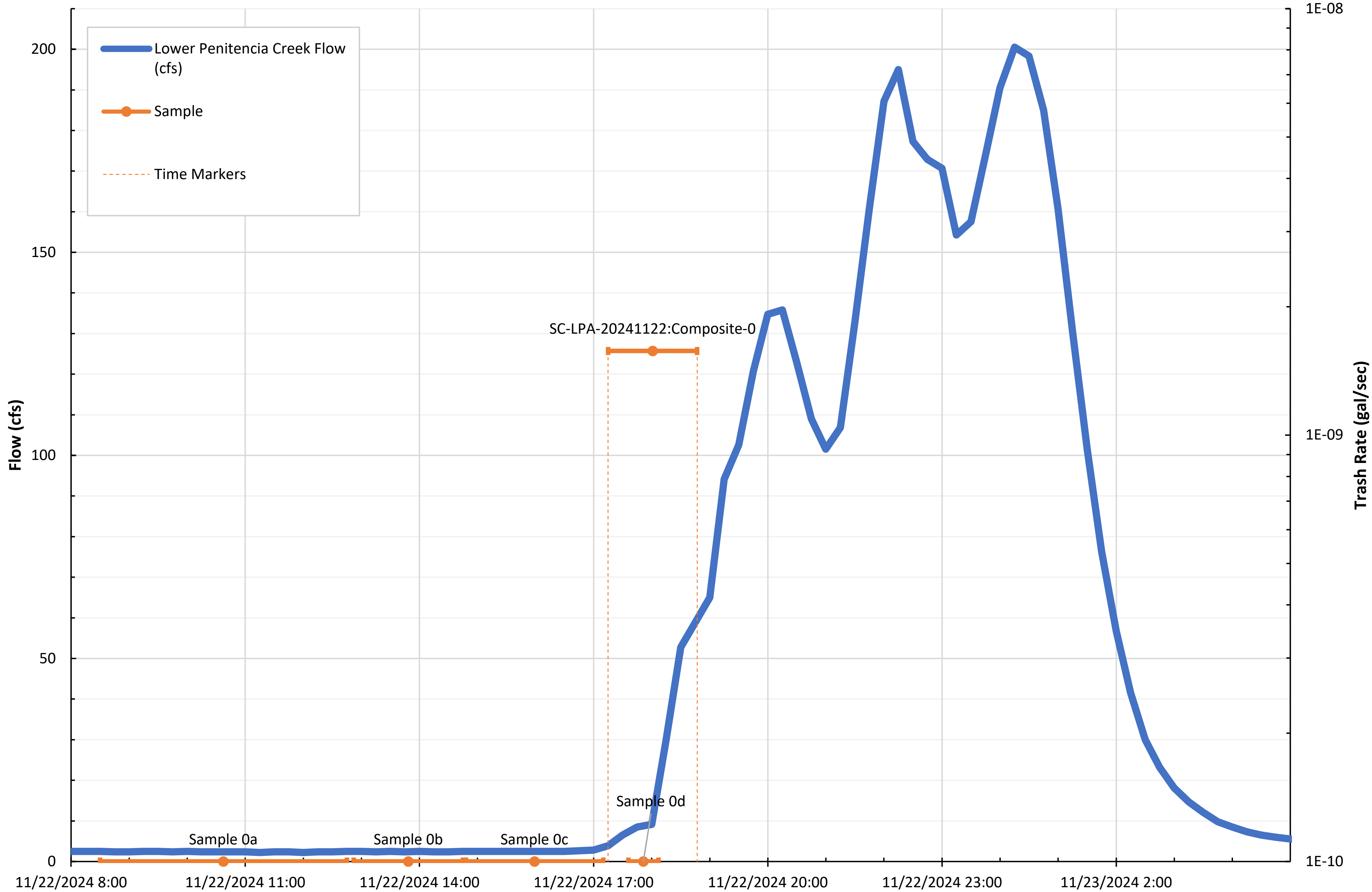
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-13. March 12, 2025 Sampling at Adobe Creek (SC-ADO), WOW Receiving Water Monitoring Project.

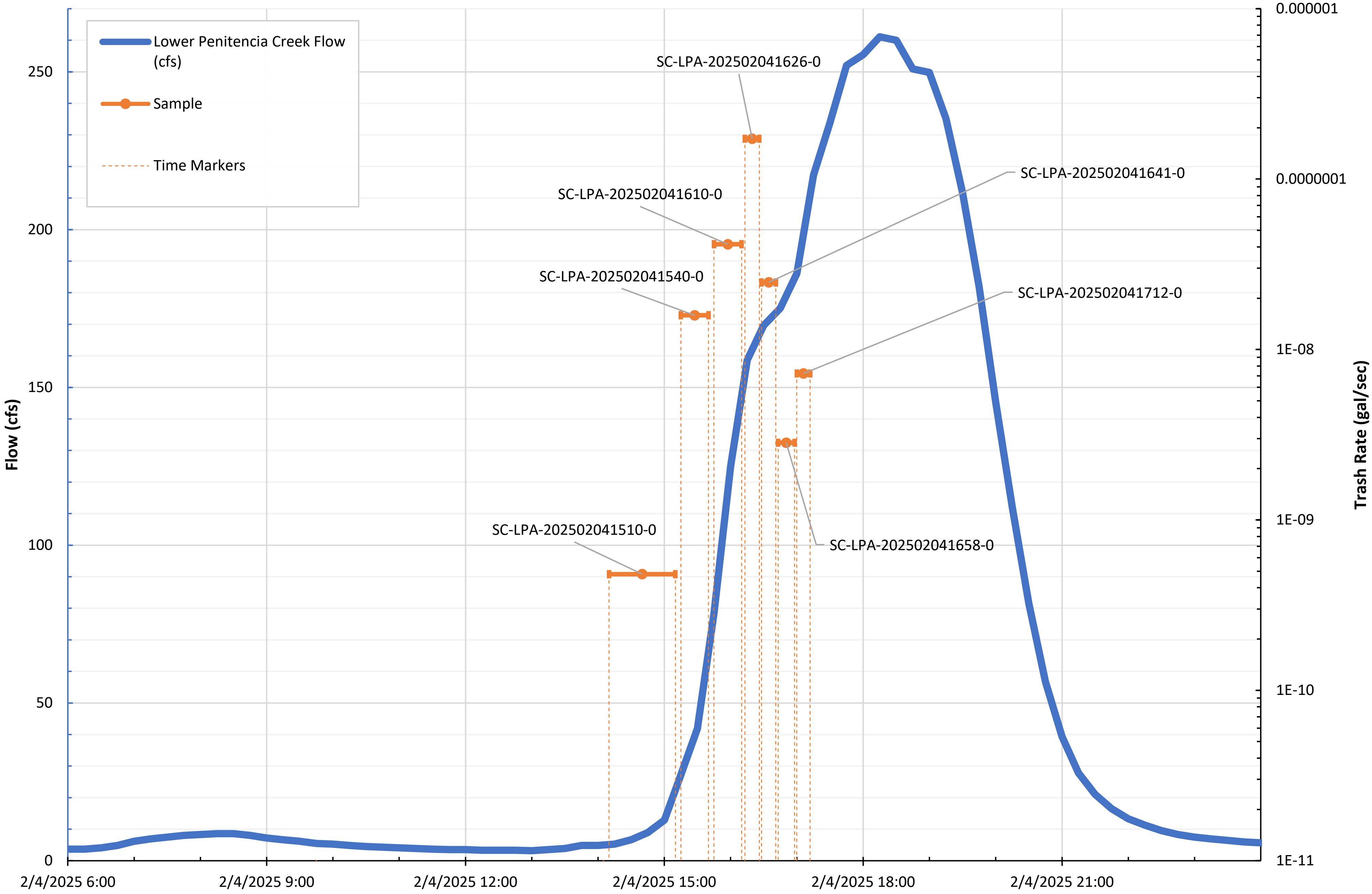
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-14. November 22, 2024 Sampling at Lower Penitencia Creek (SC-LPA), WOW Receiving Water Monitoring Project.

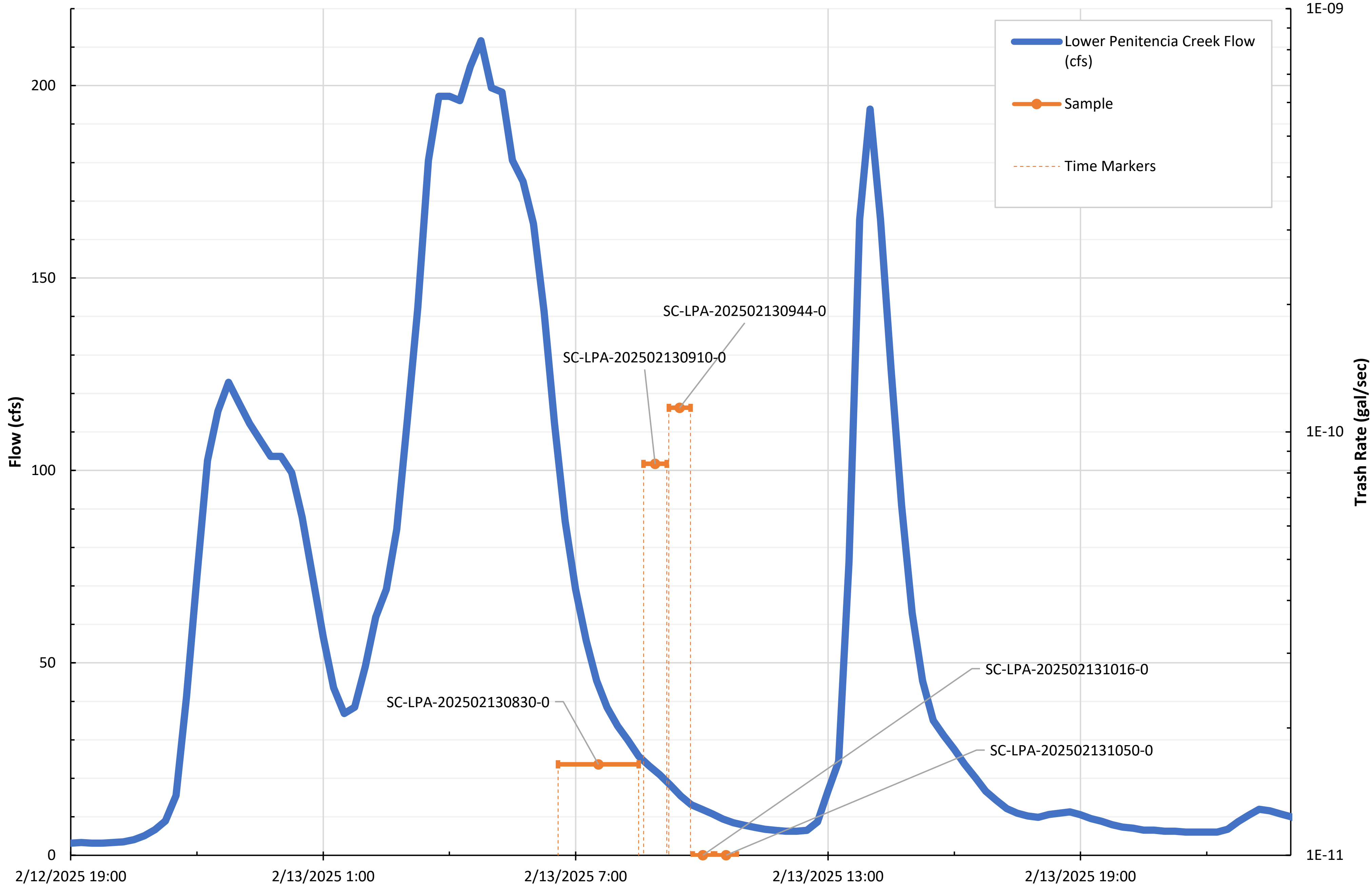
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-15. February 4, 2025 Sampling at Lower Penitencia Creek (SC-LPA), WOW Receiving Water Monitoring Project.

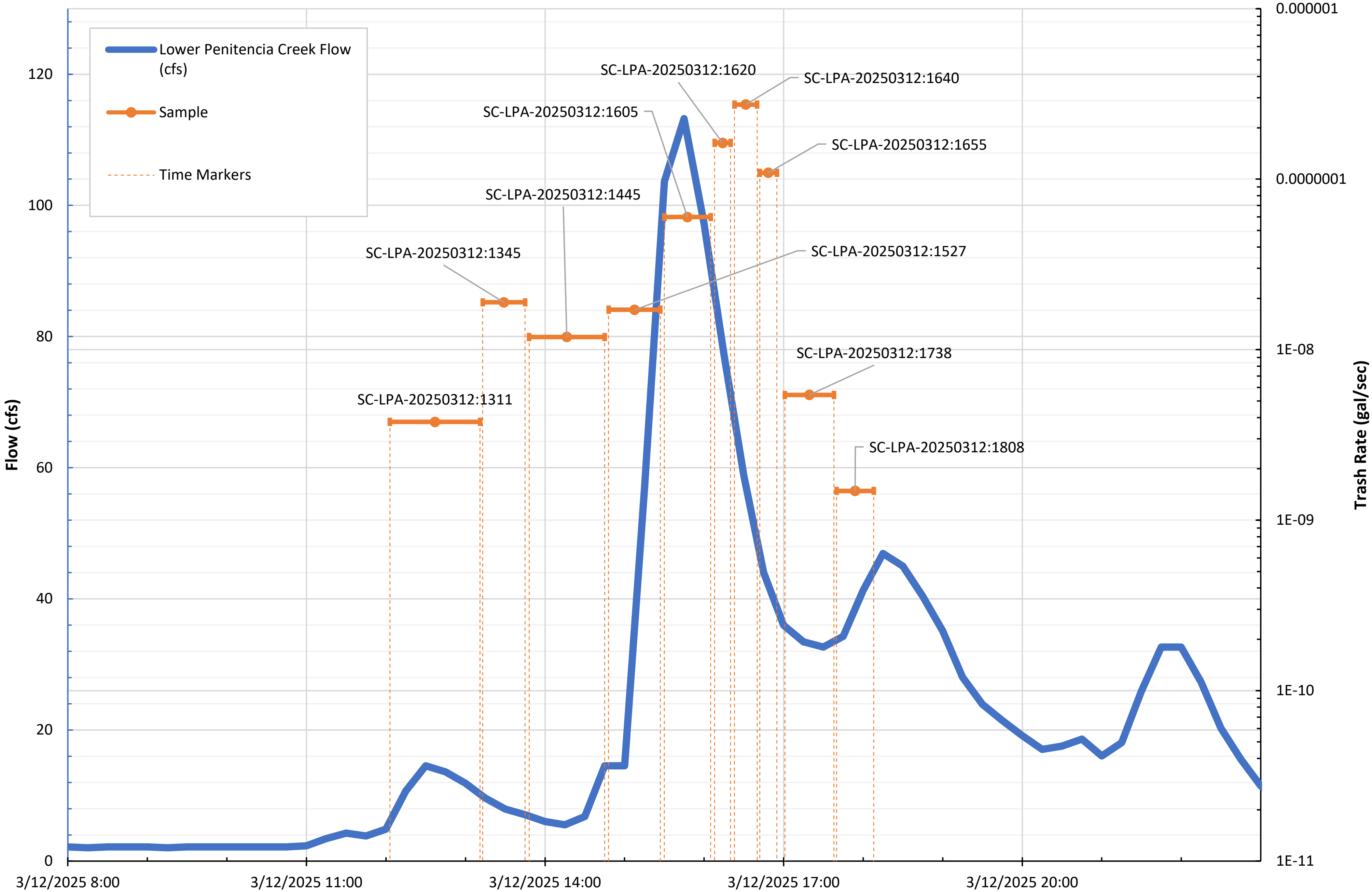
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-16. **February 13, 2025 Sampling at Lower Penitencia Creek (SC-LPA), WOW Receiving Water Monitoring Project.**

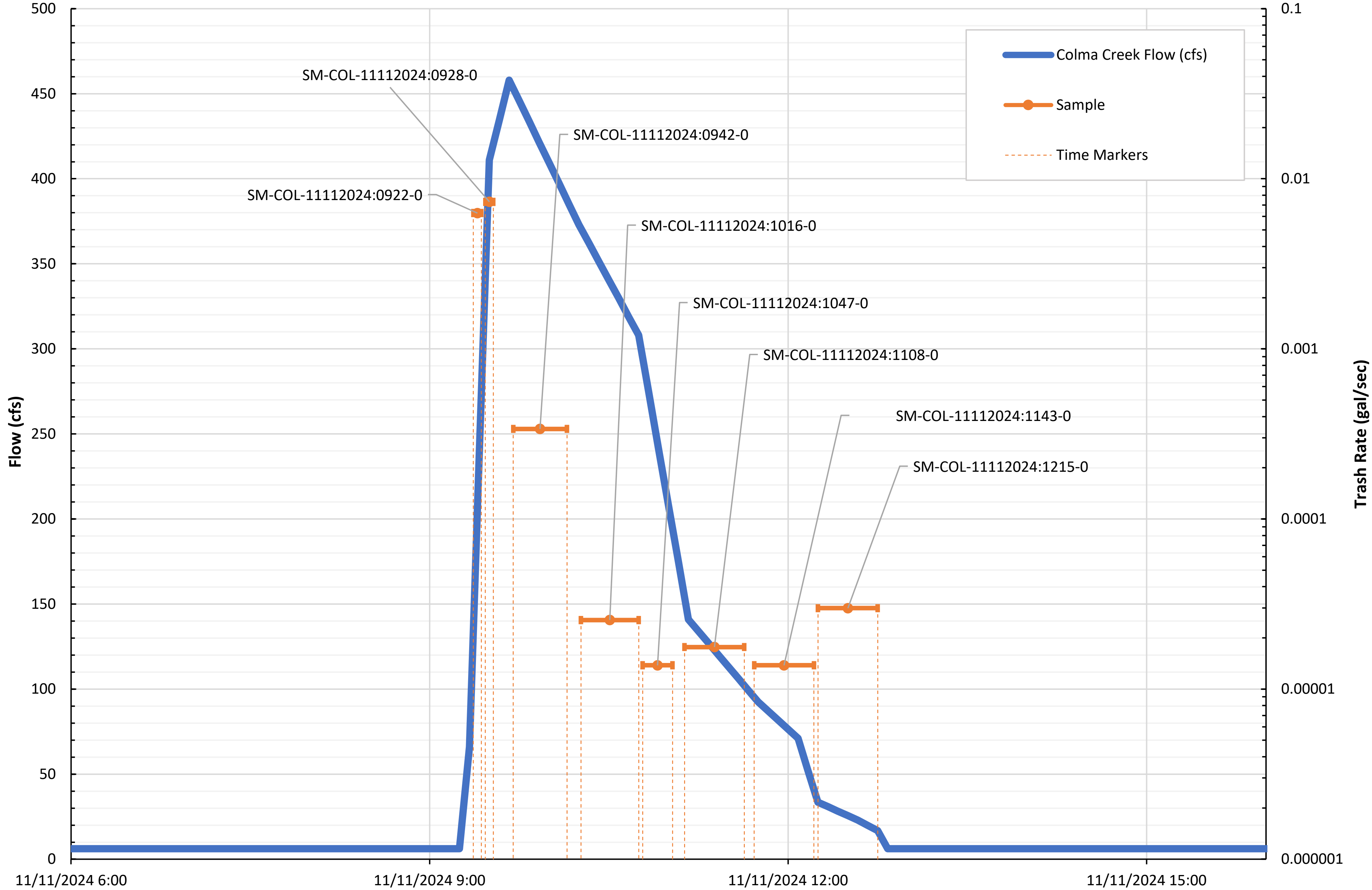
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-17. March 12, 2025 Sampling at Lower Penitencia Creek (SC-LPA), WOW Receiving Water Monitoring Project.

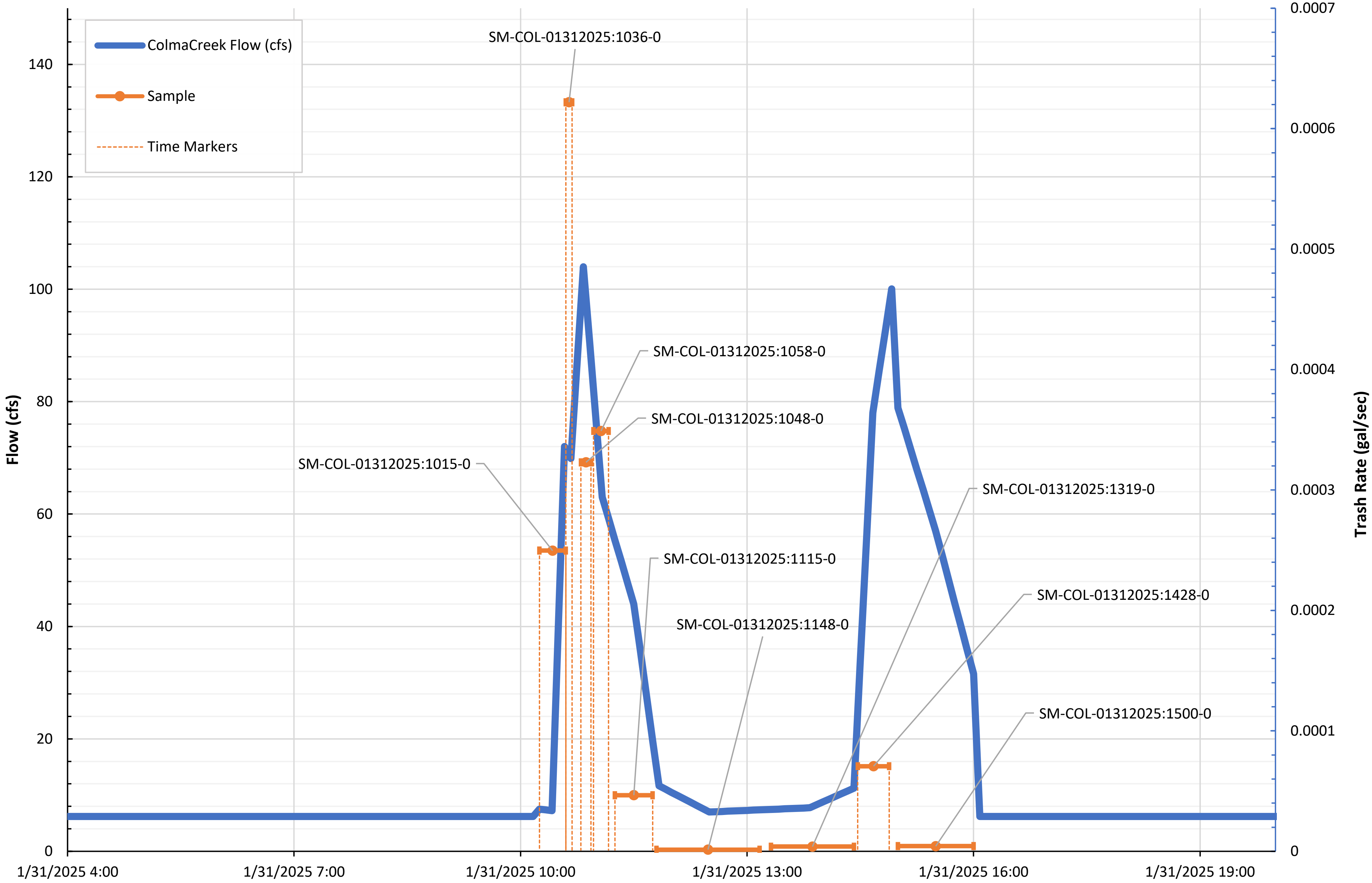
© 2026 Balance Hydrologics, Inc.



Balance Hydrologics

Figure B-18. **November 11, 2024 Sampling at Colma Creek (SM-COL), WOW Receiving Water Monitoring Project.**

© 2026 Balance Hydrologics, Inc.



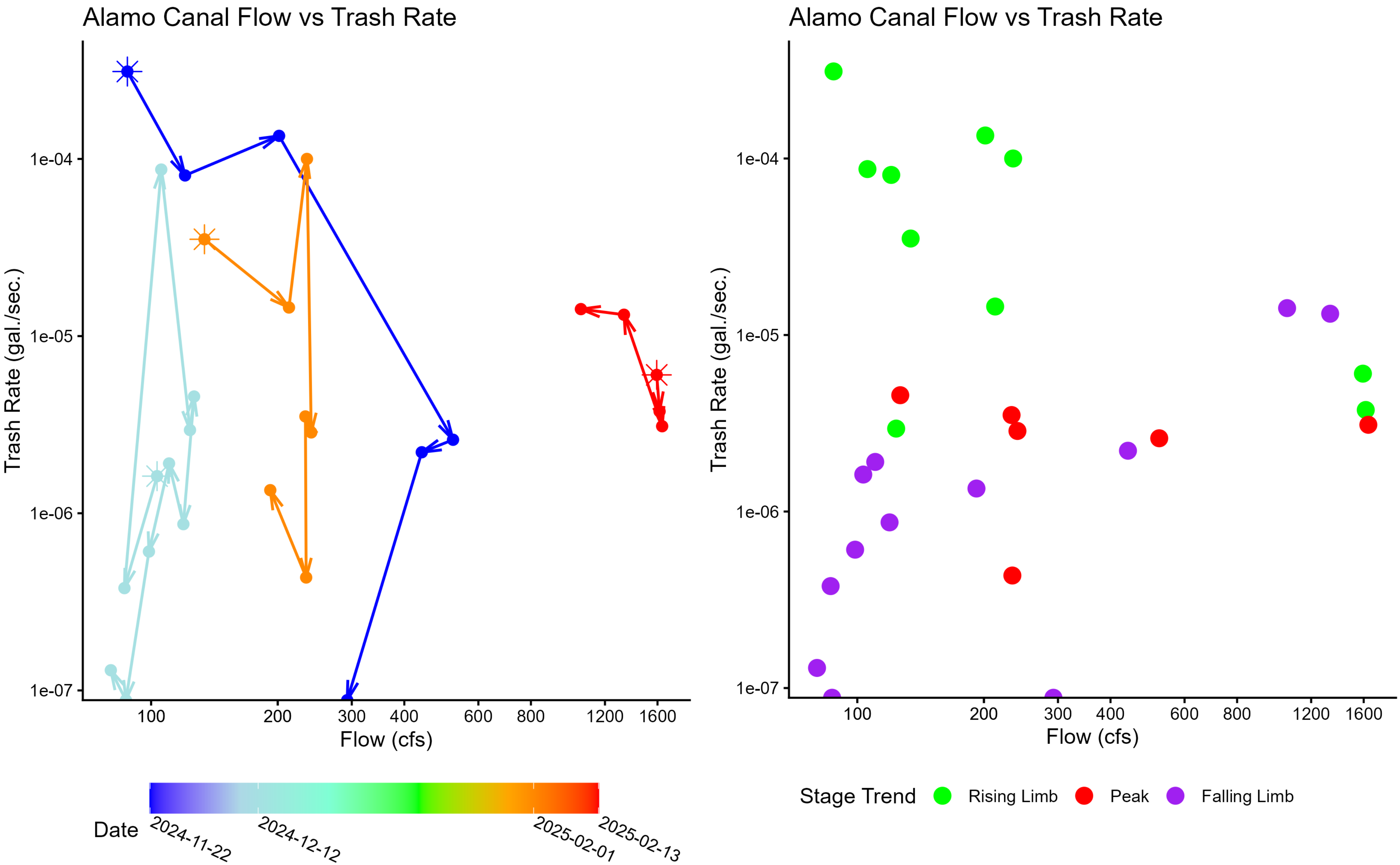
Balance Hydrologics

Figure B-19. January 31, 2025 Sampling at Colma Creek (SM-COL), WOW Receiving Water Monitoring Project.

© 2026 Balance Hydrologics, Inc.

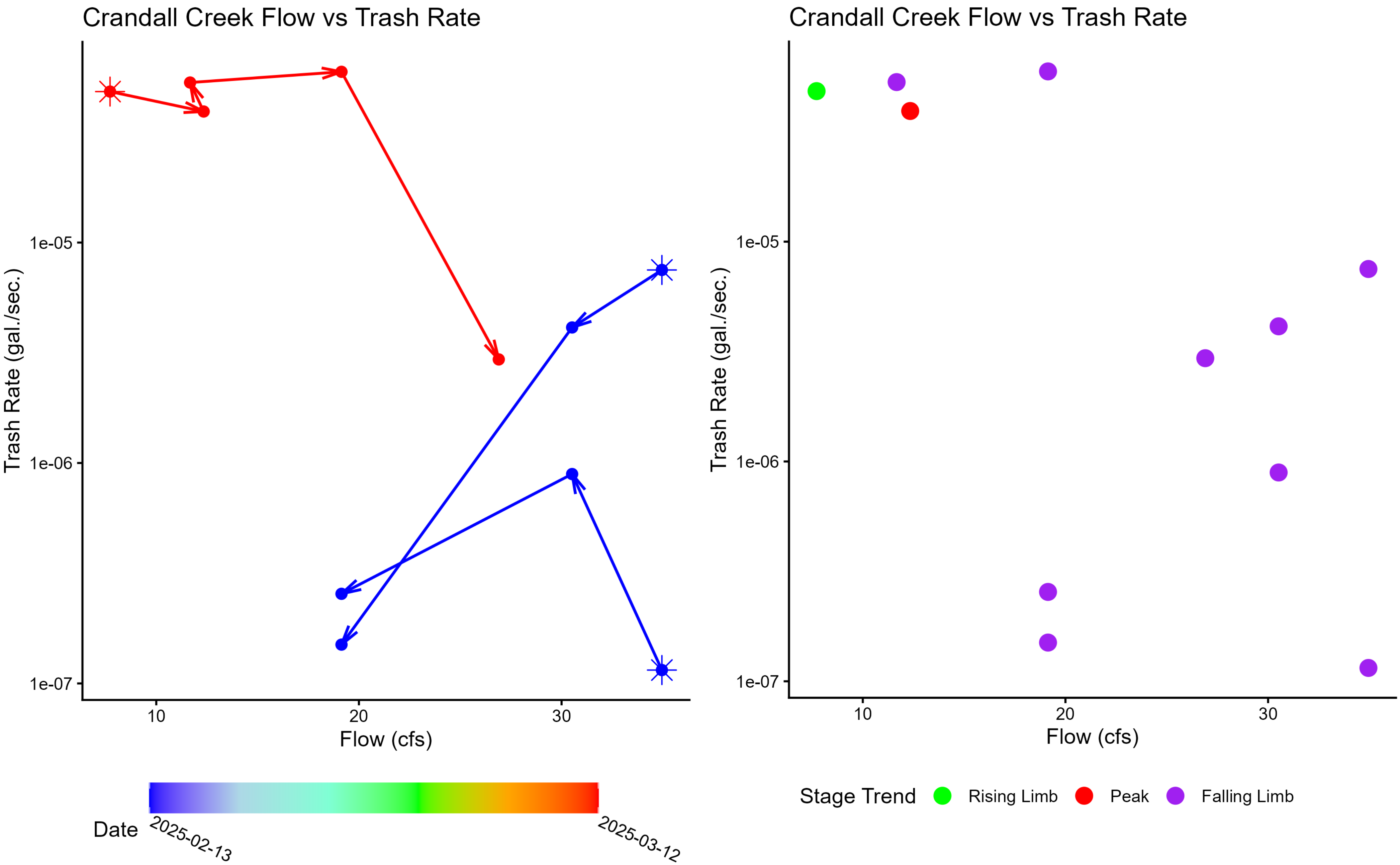
APPENDIX C

Streamflow Versus Trash Rates



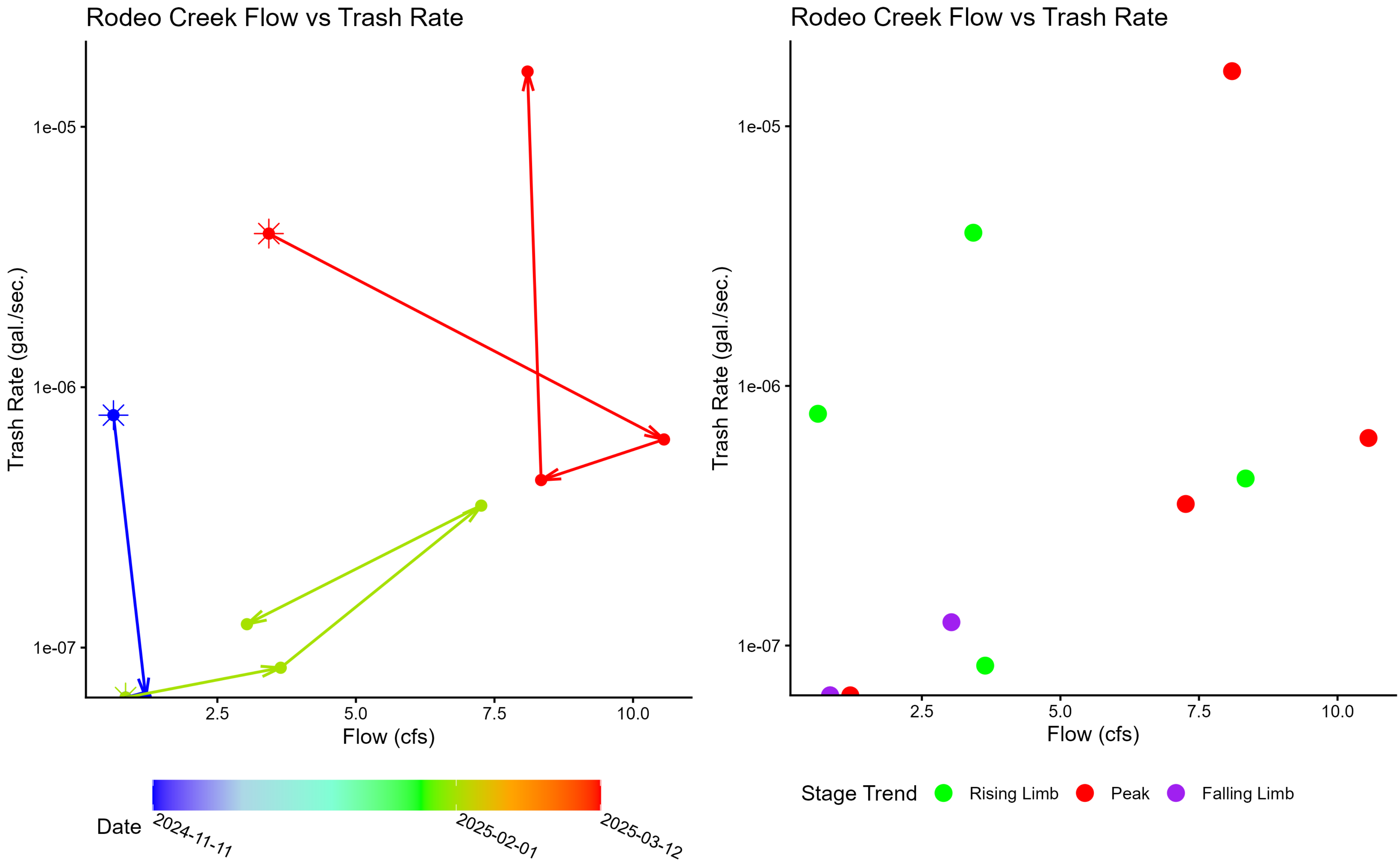
Balance Hydrologics

Figure C-1. **Flow compared to Trash Rate, Alamo Canal (AC-ALM), WOW Receiving Water Monitoring Project.** Plot on the left shows the chronological order of the sample using arrows, from first to last sample within each sample event. Plot on the right differentiates samples taken at base flow, on the rising hydrograph limb, at the storm peak, and on the receding limb.



Balance Hydrologics

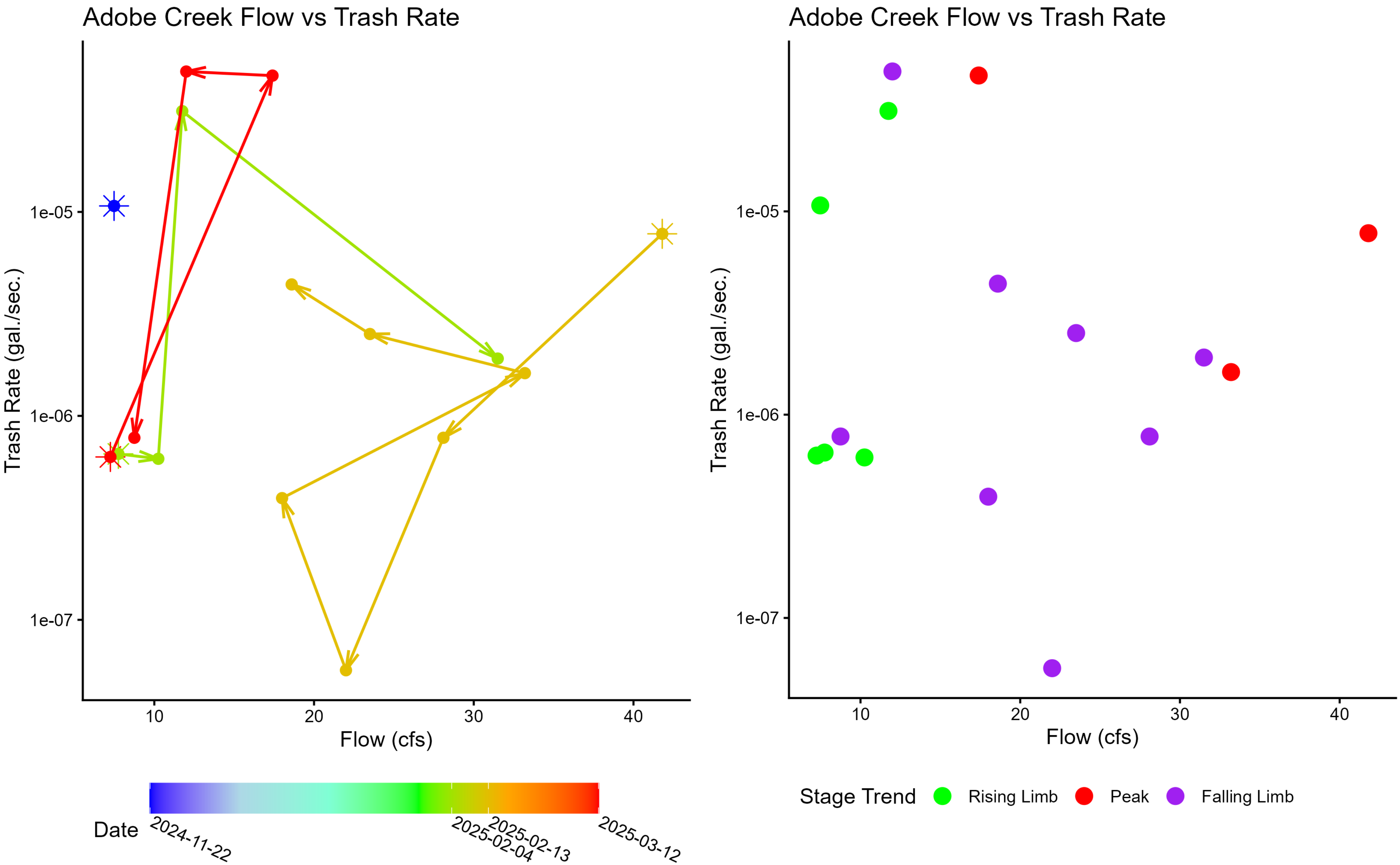
Figure C-2. **Flow compared to Trash Rate, Crandall Creek (AC-CRA), WOW Receiving Water Monitoring Project.** Plot on the left shows the chronological order of the sample using arrows, from first to last sample within each sample event. Plot on the right differentiates samples taken at base flow, on the rising hydrograph limb, at the storm peak, and on the receding limb.



Balance Hydrologics

Figure C-3. **Flow compared to Trash Rate, Rodeo Creek (CC-ROD), WOW Receiving Water Monitoring Project.** Plot on the left shows the chronological order of the sample using arrows, from first to last sample within each sample event. Plot on the right differentiates samples taken at base flow, on the rising hydrograph limb, at the storm peak, and on the receding limb.

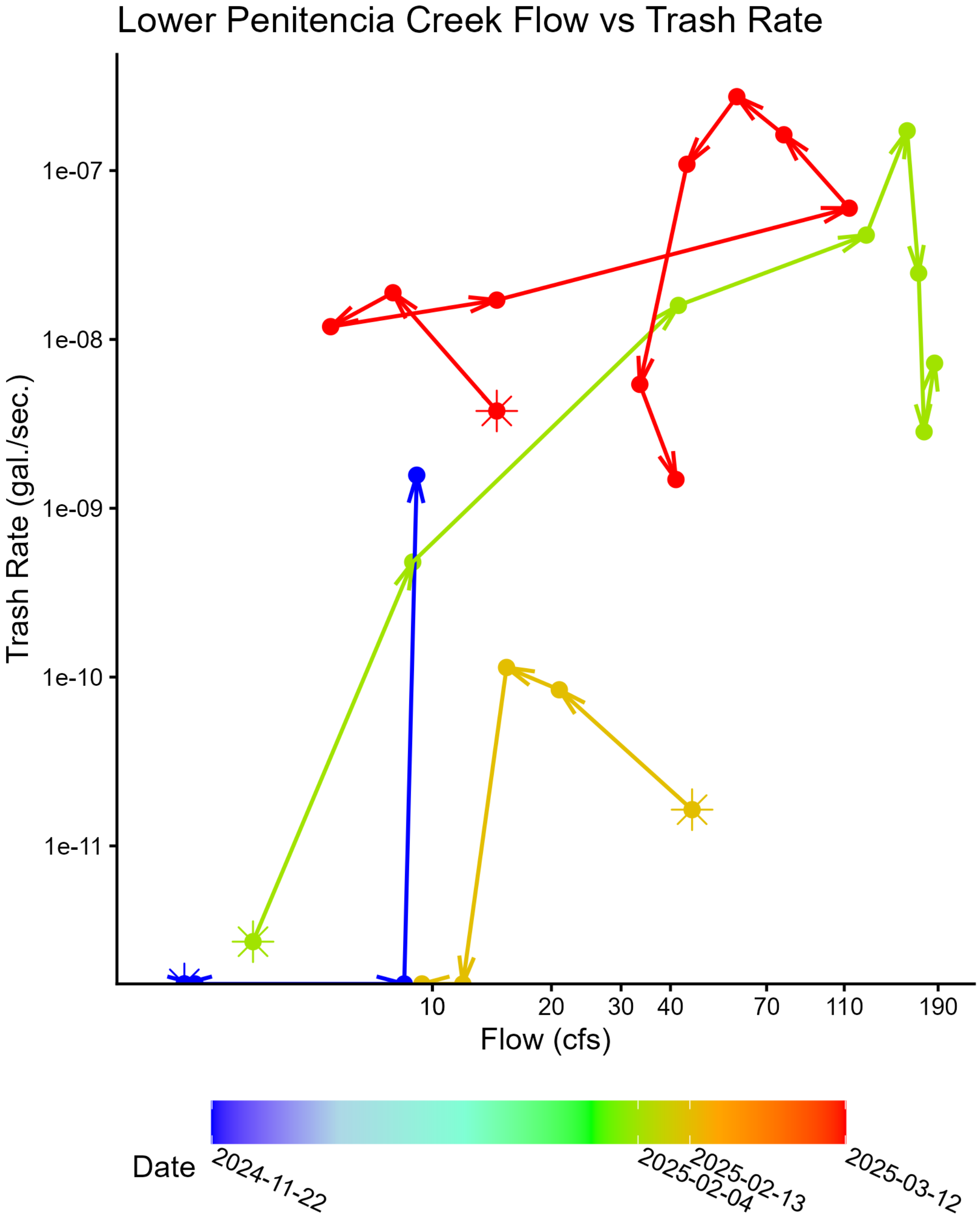
cs, Inc.

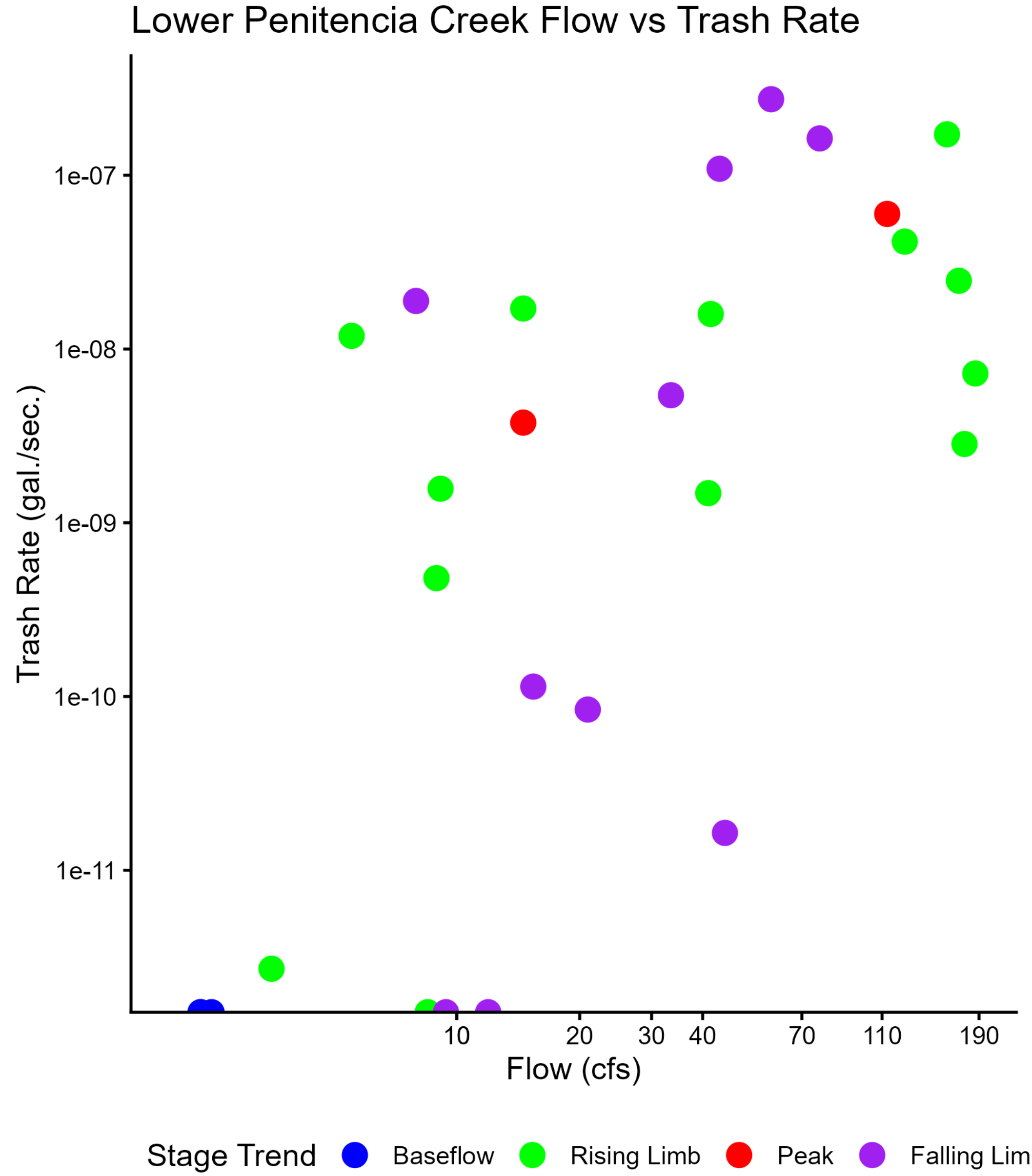


Balance Hydrologics

Figure C-4. **Flow compared to Trash Rate, Adobe Creek (SC-ADO), WOW Receiving Water Monitoring Project.** Plot on the left shows the chronological order of the sample using arrows, from first to last sample within each sample event. Plot on the right differentiates samples taken at base flow, on the rising hydrograph limb, at the storm peak, and on the receding limb.

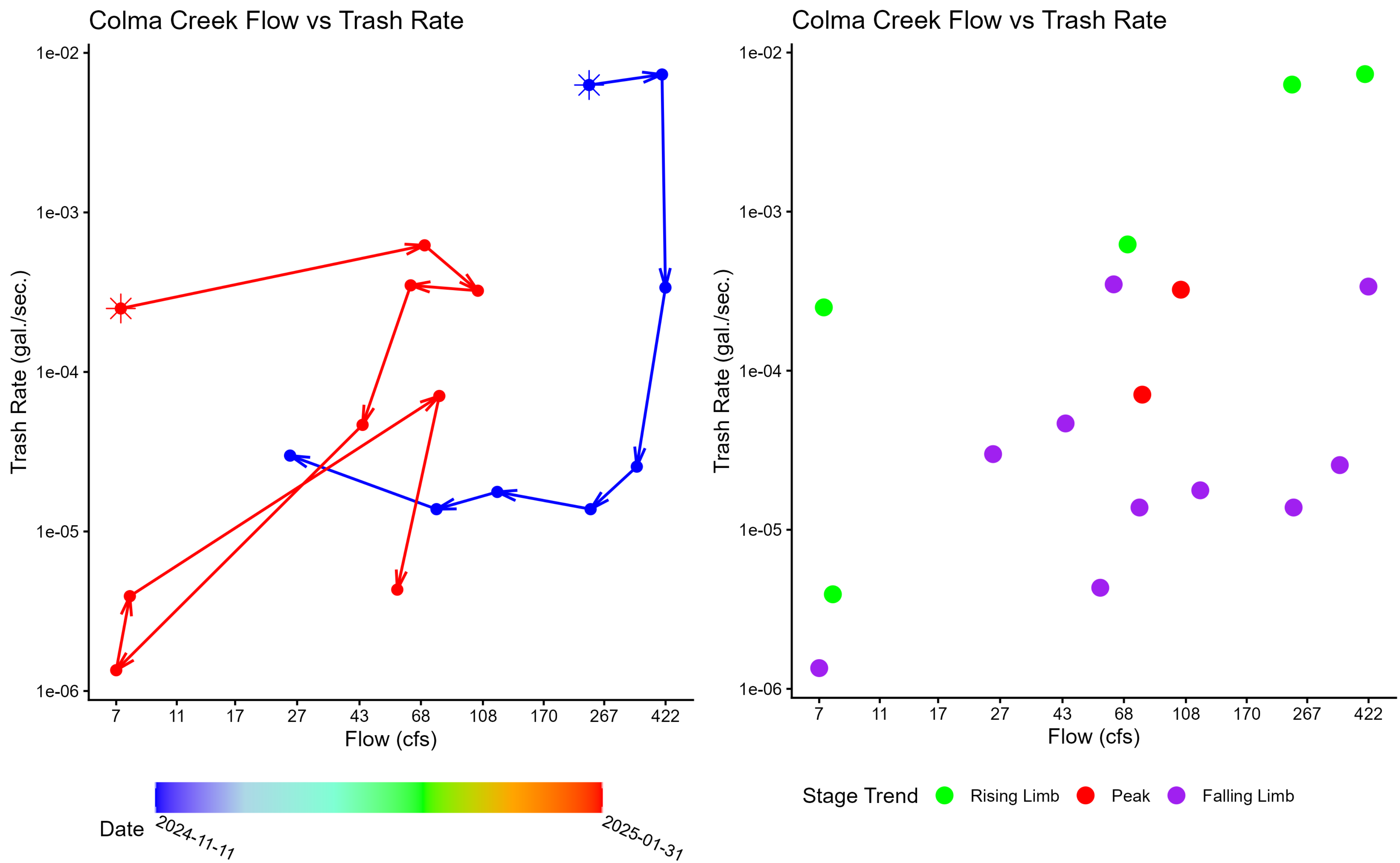
cs, Inc.





Balance Hydrologics

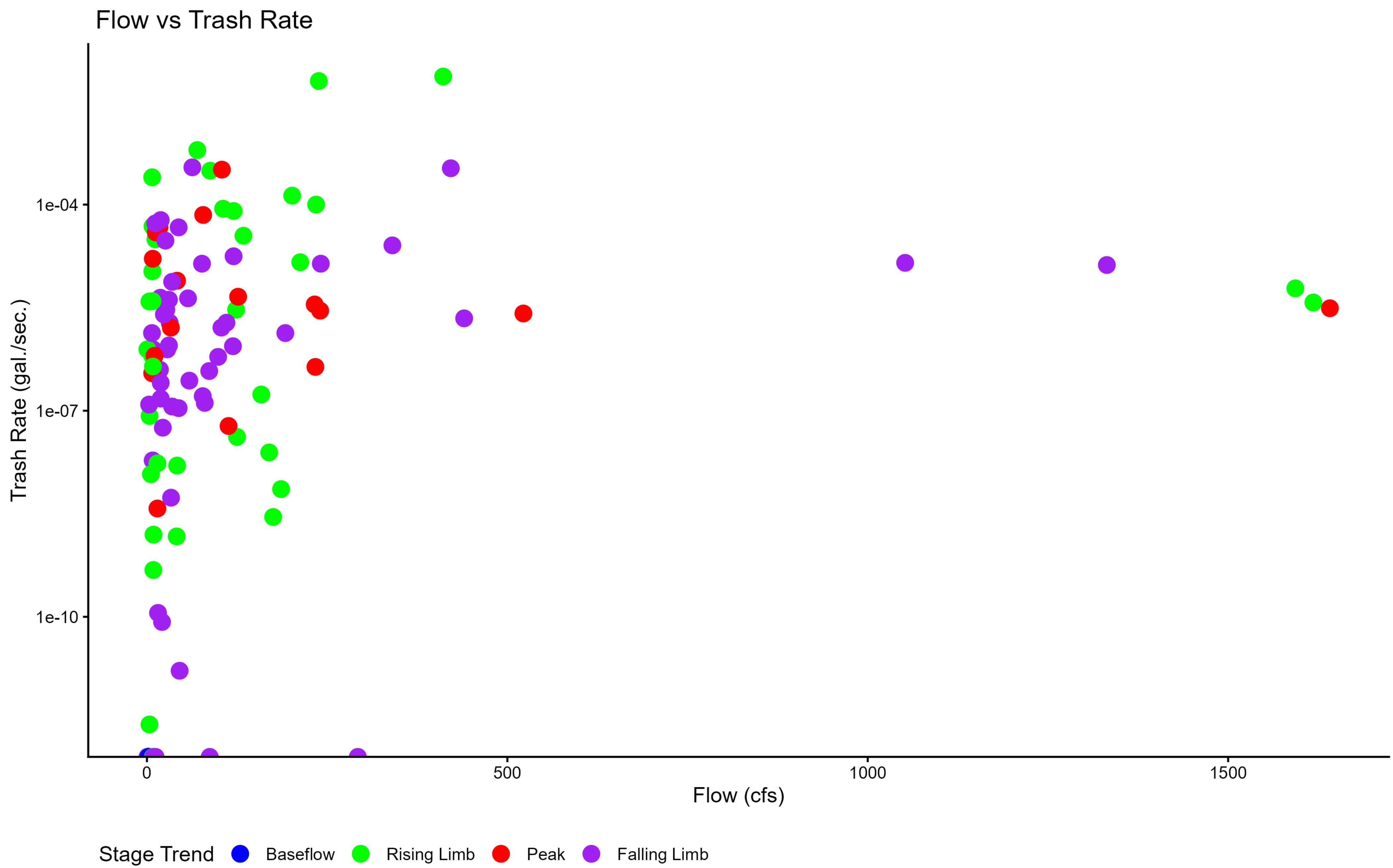
Figure C-5. **Flow compared to Trash Rate, Lower Penitencia Creek (SC-LPA), WOW Receiving Water Monitoring Project.** Plot on the left shows the chronological order of the sample using arrows, from first to last sample within each sample event. Plot on the right differentiates samples taken at base flow, on the rising hydrograph limb, at the storm peak, and on the receding limb.



Balance Hydrologics

Figure C-6. **Flow compared to Trash Rate, Colma Creek (SM-COL), WOW Receiving Water Monitoring Project.** Plot on the left shows the chronological order of the sample using arrows, from first to last sample within each sample event. Plot on the right differentiates samples taken at base flow, on the rising hydrograph limb, at the storm peak, and on the receding limb.

cs, Inc.



Balance Hydrologics

Figure C-7. **Flow compared to Trash Rate, all sites, WOW Receiving Water Monitoring Project.** Plot differentiates samples taken at base flow, on the rising hydrograph limb, at the storm peak, and on the receding limb.

APPENDIX D

Quality Assurance Report for Trash Sampling Procedure

APPLIED MARINE SCIENCES

December 29, 2025

Paul Randall
EOA, Inc.

Dear Paul

This memorandum summarizes results of the field audit performed as part of the WY 2025 receiving water trash monitoring component of the Watching Our Watersheds Project. The audit was conducted on February 13, 2025, at the Crandall Creek site in Fremont and generated the following findings:

- Peak flow occurred before daylight so was not part of the observations.
- One trawl was designated for collection of field sample, a second was designated for collection of field duplicate.
- Samples were collected side-by-side on either side of the projected thalweg (if no reps were to be collected, the field sample would be collected at a different point in the stream as indicated by a permanent mark placed on bridge).
- Duplicate sample appeared to be experiencing higher loadings of trash / vegetation.
- Sample aliquots were stored and labeled appropriately.

In general, sampling personnel appear to be operating in a safe manner consistent with monitoring plan and QAPP. There were no concerns identified and no follow up action required.

Paul Salop
Quality Assurance Officer