SANTA ANA WATERSHED PROJECT AUTHORITY

Brine Line Water Quality Monitoring & Solids Formation Recovery Formula Report July 2019 – June 2025

DRAFT November 2025

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1 Introduction

The Inland Empire Brine Line is owned and operated by the Santa Ana Watershed Project Authority (SAWPA) and provides critical salinity management for the region by conveying primarily non-reclaimable wastes, including desalter concentrates and industrial wastewaters, from its upper reaches in Riverside and San Bernardino Counties to Orange County. Once the Brine Line crosses into Orange County (County Line), ownership of the wastewater is transferred from SAWPA to the Orange County Sanitation District (OC San). SAWPA pays OC San a monthly fee to dispose of the Brine Line wastewater, determined using the hydraulic flow and the level of total suspended solids (TSS) and biochemical oxygen demand (BOD_5) measured in the Brine Line at the County Line. Both agencies assess the County Line water quality using the Santa Ana Regional Interceptor (SARI) Monitoring Station (SMS), which is owned and maintained by OC San. Historically, the suspended solid load calculated from measurements at the SMS has exceeded the calculated cumulative suspended solids loads discharged to the Brine Line, suggesting solids formation through the system.

Trussell Technologies, Inc. (Trussell) was first retained by SAWPA in 2011 to characterize the suspended solids at the SMS and assess the nature of the suspended solids formed in the Brine Line (Trussell, 2011). SAWPA recovers costs paid to OC San by charging each discharger a fee using a billing formula that allocates the costs related to the solids formation. In response to an increase in Brine Line solids formation from 2014 through 2015, Trussell worked with SAWPA on a study aimed at characterizing solids from both discharger inputs and downstream water quality at SMS (Trussell, 2016a). The study focused on supplemental technical monitoring of select parameters related to solids formation. System-wide concurrent monitoring of the major dischargers, reach-by-reach locations, and SMS was completed between April 25 and 28, 2016. From the monitoring data, Trussell developed a revision of the billing formula to allocate the cost of suspended solids formation according to known formation mechanisms of the observed solids composition. Ongoing supplemental technical monitoring of these parameters was recommended to provide routine assessment of the suspended solids in the Brine Line and a mechanism for regularly updating the formula in response to system changes. This supplemental technical monitoring related to the assessment of solids formation in the Brine Line is separate from permit-required and compliance-based monitoring efforts. Subsequent evaluations of the Brine Line system solids were completed in a) 2017 for data collected from August 2016 through March 2017, b) 2018 for data collected from April 2017 through March 2018, and c) 2019 for data collected from April 2018 through March 2019.

Water quality and flow data from the SMS and from individual dischargers to the Brine Line collected from July 2019 through June 2024 were initially evaluated for the current Brine Line suspended solids assessment (see Appendix A). Supplemental technical monitoring was recommended to generate data that a) aligned all solids formation-related water quality parameters from representative samples collected from each discharger and b) characterized the solids present at SMS (see Appendix B). This supplemental sampling campaign was completed from April through June 2025. These two periods were used in conjunction with findings from the previous reporting period (April-December 2018) to develop an updated understanding of the Brine Line suspended solids. Table 1-1 summarizes the time periods used in this report.

Table 1-1. Timeframe Terminology

Terminology	Timeframe
Current Reporting Period	July 2019 – June 2025, excluding July 2024 – March 2025
Recent Sampling Period	April 2025 – June 2025
Previous Reporting Period	April 2018 – December 2018

This technical memorandum (TM) provides an updated summary and analysis of the water quality results based on system-wide monitoring and characterization of the suspended solids entering and leaving the Brine Line from July 2019 through June 2025. The TM includes recommendations for next steps, including updates to the solids characterization methodology, building on the water quality assessments from 2016 to present.

1.1 Project Objectives

Primary objectives for this TM include:

- Provide an SMS water quality review for the current reporting period.
- Characterize the organic and inorganic constituents present in the suspended solids at the SMS.
- Develop loading rates for all individual dischargers using water quality parameters from the billing formula (monitoring plan constituents).
- Assess suspended solids loading within the Brine Line system – including the combined dischargers and the downstream SMS.
- Assess solids formation in the Brine Line system for the recent sampling period and its impact to the current billing formula.
- Compare results from the recent monitoring period with data generated from past monitoring periods (April 2016, August 2016 – March 2017, April 2017 – March 2018, April 2018 – March 2019) to re-assess the recommended monitoring frequencies for the individual dischargers and update, as needed (Trussell, 2016e; 2017; 2018; 2019).

2 Methodology

In order to allocate costs associated with suspended solids and solids formation within the Brine Line, characterization of the upstream combined discharger inputs and downstream water quality at the SMS was required. The formed suspended solids through the system were determined using the mass balance shown in Figure 2-1. This methodology is consistent with Trussell's 2016 Proposed Solids Formation Recovery Formula for the Inland Empire Brine Line (Trussell, 2016e), with updates from subsequent reports from 2017, 2018, and 2019 (Trussell, 2017; 2018; 2019).

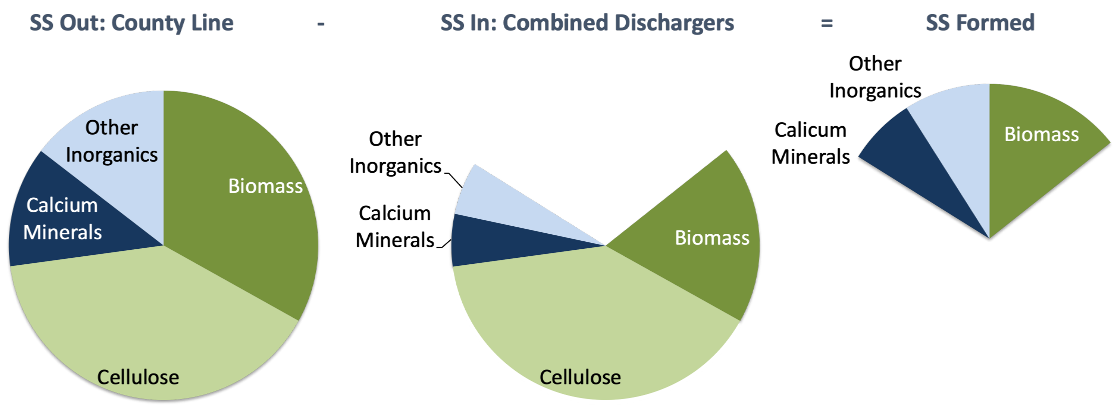

Figure 2-1. Characterization of solids formation through the Brine Line

The SMS monitoring data include results from weekly water quality samples and flow monitoring during the July 2019 through June 2025 period, as well as three solids characterization analyses that were performed on May 1, May 14, and May 29, 2025. Dischargers to the Brine Line were monitored for water quality parameters associated with solids formation mechanisms. The sampling frequencies for the period of July 2019 to June 2024 were determined based on loading values for each of the billing parameters determined from the 2019 Brine Line Study (Trussell, 2019). Then, from April 2025 to June 2025, dischargers were monitored for these water quality parameters at frequencies that were determined based on historical data and updated flow ranking.

3 Results and Discussion of Current Reporting Period (2019 – 2025)

The results of the water quality and flow data collection from the SMS and dischargers to the Brine Line of the current reporting period between July 2019 and June 2025 (excluding July 2024 through March 2025) are presented in the following section. The individual discharger flow and solids loading data are then summed for all dischargers and compared to the equivalent SMS data to understand long-term trends in the Brine Line.

3.1 SMS Data Review

To collect SMS water quality data, SAWPA collects weekly 24-hour composite samples from which triplicate analyses are completed for TSS, VSS, and total BOD_5, along with single replicate analysis of dissolved BOD_5, total and dissolved alkalinity, and total and dissolved calcium. OC San also performs monthly sampling and analysis of TSS and total BOD_5 at SMS to further characterize water quality at the SMS. The results of these SMS analyses are discussed in this section.

3.1.1 TSS Analysis

Figure 3-1 shows average TSS values from individual sampling events at the SMS from July 2016 through the current reporting period. The overall average of the individual average TSS values during this period was 103 mg/L. The linear trendline shown in Figure 3-1 (dotted blue line) indicates that TSS values at the SMS have decreased since July 2016.

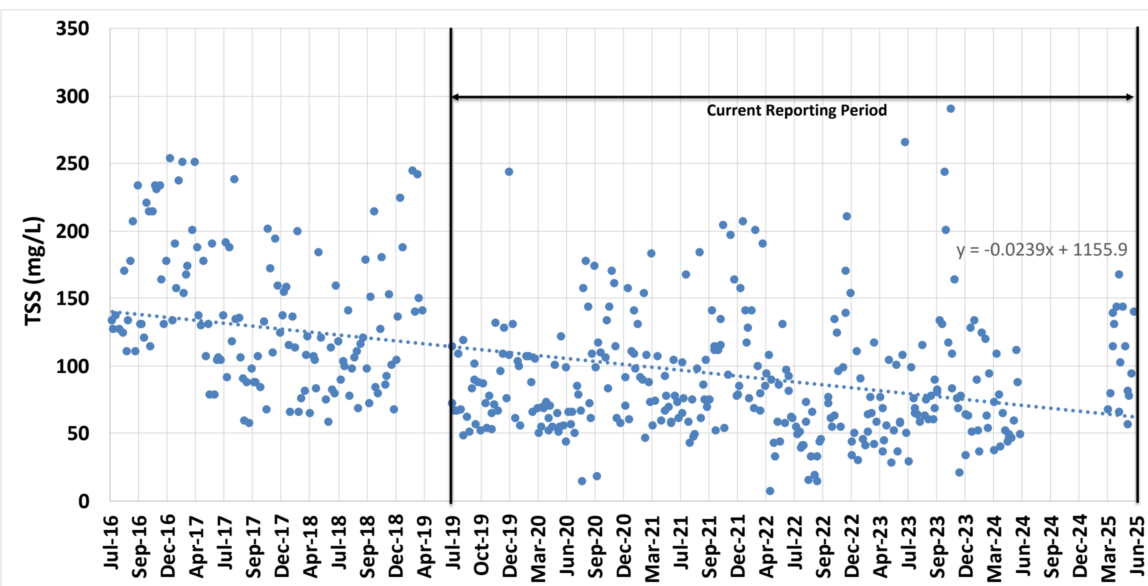

Figure 3-1. Average TSS results at the SMS from individual sampling events (July 2016 – June 2025)

Figure 3-2 shows the average TSS during only the current reporting period. As shown, the linear trendline of the current reporting period is much flatter than the trendline in Figure 3-2. The average TSS value at the SMS during the current reporting period was 86 mg/L.

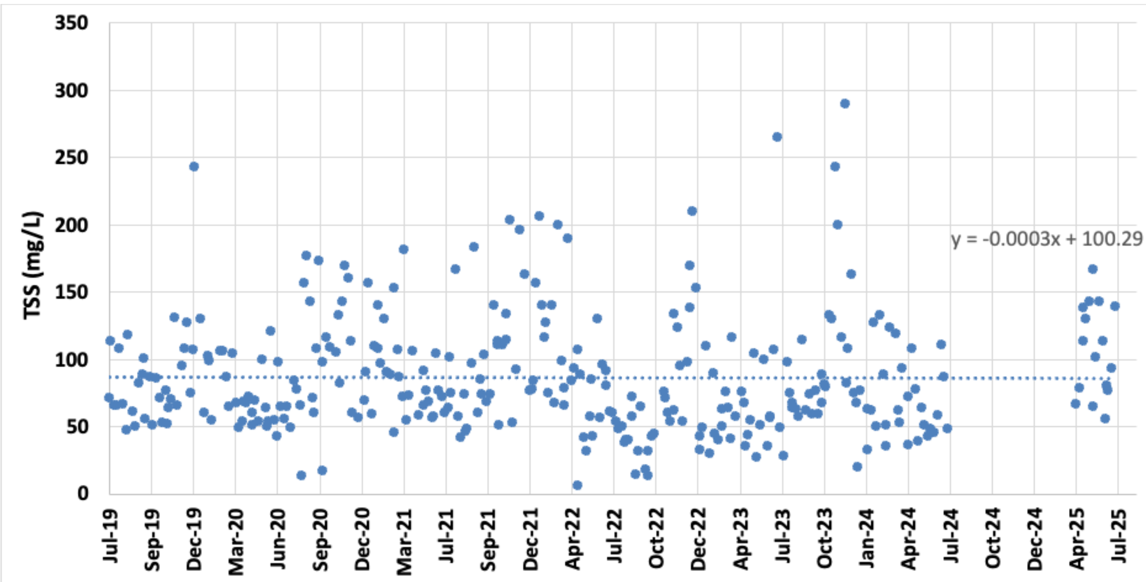

Figure 3-2. Average TSS results at the SMS from individual sampling events (July 2019 – June 2025).

As shown in both figures, the TSS sample results varied throughout the reporting periods. The high variability in TSS samples have historically been observed due to the heterogeneous mixture of wastewaters in the Brine Line. Triplicate analysis for each SAWPA TSS sample has been conducted to help correct for the variability.

3.1.2 VSS Analysis

Figure 3-3 shows average VSS values from individual sampling events at the SMS from July 2016 through June 2025. The overall average VSS value for this period was 78 mg/L.

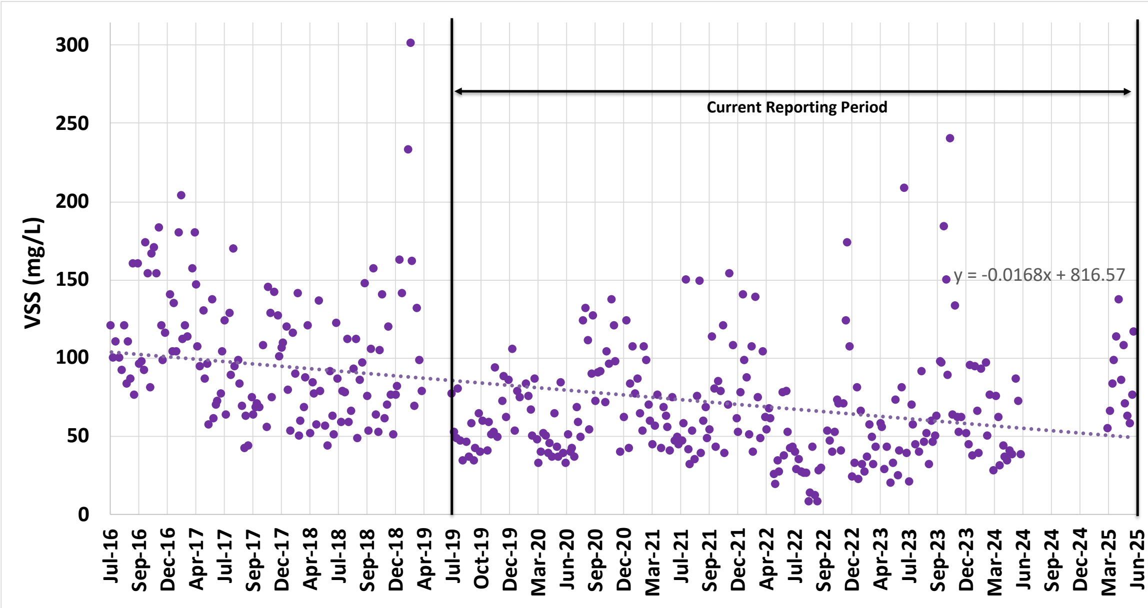

Figure 3-3. Average VSS results at the SMS from individual sampling events (July 2016 – June 2025)

Similar to the TSS trend over time, the VSS values decreased between July 2016 and June 2025, but as shown in Figure 3-4, stabilized during the current reporting period.

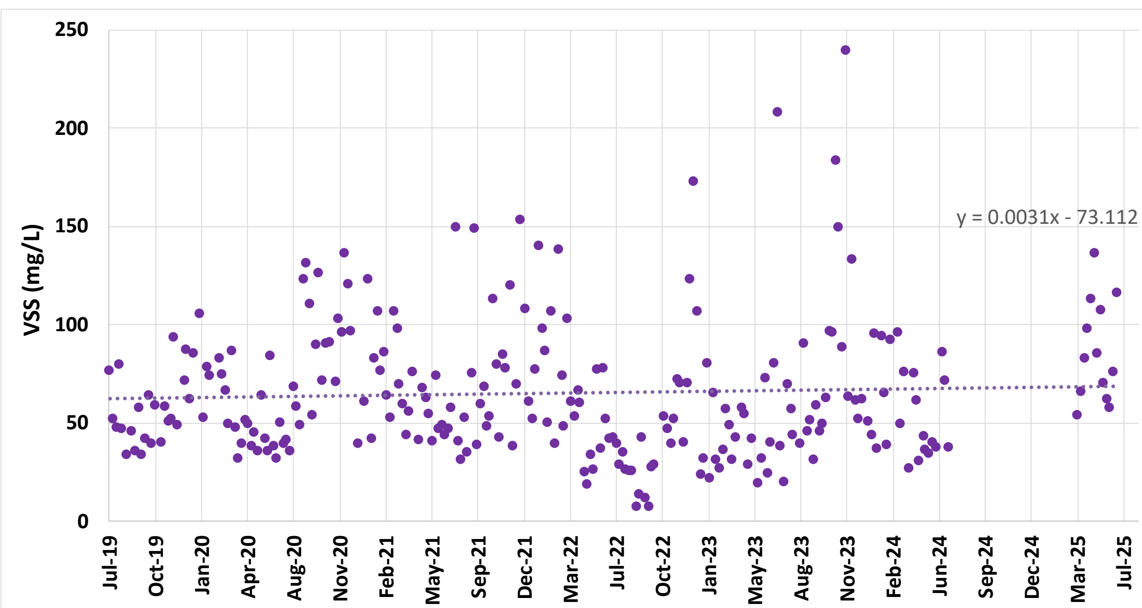

Figure 3-4. Average VSS results at the SMS from individual sampling events (July 2019 – June 2025)

With a flatter and more consistent trendline than the wider timeframe that included historical VSS data, the current reporting period between July 2019 and June 2025 yielded an overall average VSS of 65 mg/L. Similar to the trend observed for TSS, the VSS sample results varied throughout the reporting periods. To help correct for the variability, SAWPA performs analysis in triplicate for each VSS sample.

3.1.3 VSS/TSS Ratio

VSS represent the fraction of TSS of a given sample that volatilizes at 550°C and is used as a surrogate for the organic material. A small portion of non-organics can contribute to VSS, including waters of hydration, ammonia, and mass loss due to mineral transformation. VSS/TSS was calculated for each individual sampling event to represent the organic fraction of suspended solids. Table 3-1 shows the overall average TSS, VSS, and VSS/TSS ratio for each fiscal year within the current reporting period (19/20, 20/21, 21/22, 22/23, and 23/24), as well as the recent sampling period of April to June 2025.

Table 3-1. Average TSS, VSS, and VSS/TSS ratios from SMS

Timeframe	Average TSS[1] (mg/L)	Average VSS[2] (mg/L)	Average VSS/TSS Ratio[3]
July 2019 – June 2020	81	57	72%
July 2020 – June 2021	94	75	75%
July 2021 – June 2022	97	70	70%
July 2022 – June 2023	70	49	70%
July 2023 – June 2024	84	69	76%
April 2025 – June 2025	107	87	78%
Period Average:	**89**	**68**	**73%**

[1]Includes both SAWPA and OC San TSS data.
[2]Only includes SAWPA VSS data. OC San does not collect VSS data.
[3]Average of VSS/TSS of each individual SAWPA sampling event.

The average VSS/TSS ratio for the current reporting period was 73%, which is similar to the average value of 72% for the previous reporting period of April 2018 through December 2018 (Trussell, 2019). Variability in the average VSS/TSS ratio was observed among the fiscal years, as indicated in Table 3-1. However, the general trend of VSS/TSS ratios for weekly samples since July 2019 has been relatively consistent, as shown in Figure 3-5.

The estimated concentration of organic material present at the SMS was 75 mg/L, determined by multiplying the overall average TSS concentration (103 mg/L) by the average VSS/TSS ratio (73%). This value is slightly less than the organic concentration for the previous reporting period (April 2018 – December 2018) of 78 mg/L (Trussell, 2019).

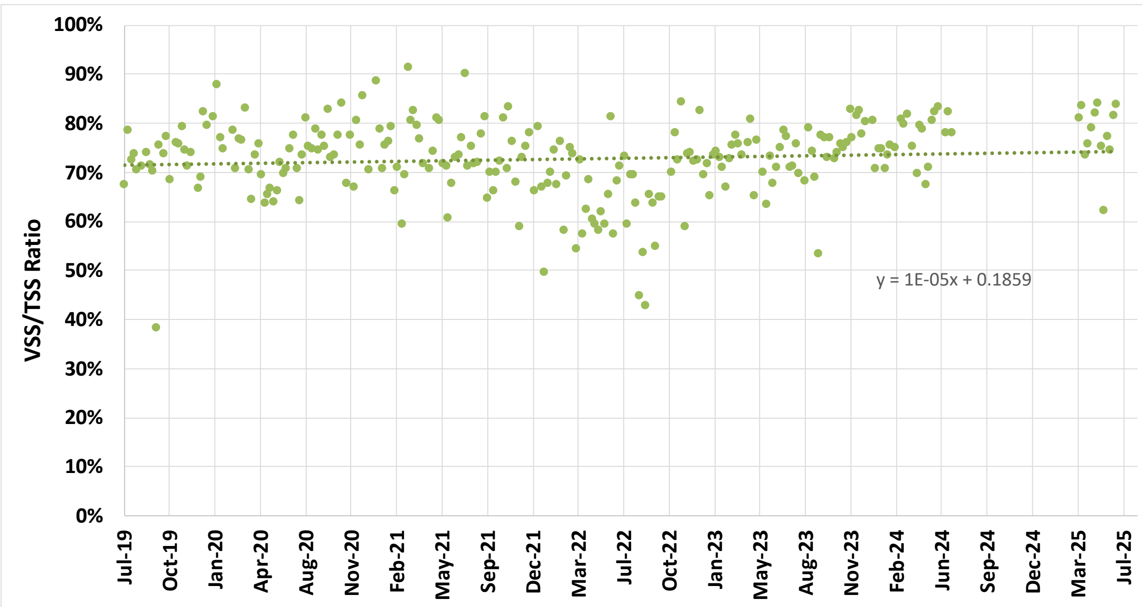

Figure 3-5. VSS/TSS ratio at the SMS from individual sampling events (July 2019 – June 2025)

3.2 Discharger Data Review

Since the 2016 Billing Formula Report (Trussell 2016e), SAWPA has implemented supplemental technical monitoring of solids formation-related parameters that was recommended to collect consistent, targeted data for characterization of the wastewater entering the Brine Line from each discharger. The recommended monitoring frequency for each discharger was determined based on their respective contribution to the solids formation in the previous reporting period. These discharger monitoring frequencies were re-evaluated using data from the current reporting period, which is discussed in Sections 3.2.2 and 6.2.

When data were unavailable for a specific discharger during a given month, data were extrapolated and averaged from surrounding months. While this is a reasonable approximation for months without data, it may not fully capture the variability in loading values. Additionally, total and dissolved parameters (i.e., calcium, alkalinity, BOD_5) were not always analyzed together from a single sample. This makes it difficult to establish a correlating relationship between total and dissolved measurements to determine a representative measurement of the particulate fraction. Considering the importance of the particulate measurements for understanding the solid fraction of the discharger loading, it is especially important to use correlating total and dissolved measurements for each of the billing parameters.

3.2.1 Changes within the Brine Line System and Dischargers

For the current reporting period (July 2019 – June 2025), data of 55 dischargers were included in the analysis. In comparison, 36 dischargers were analyzed for the previous reporting period (April 2018 – December 2018). Known changes to the Brine Line dischargers compared to the previous reporting period include:

- Six new direct dischargers came online after March 2019, including Rialto Bioenergy Solutions, Aramark, City of Beaumont, SCE Mira Loma Peaker Plant, In-N-Out, and Perris Desalter II.
- Six dischargers ceased discharge before July 2019, including Bonview, JCSD Harrison, JCSD Archibald, JCSD Scholar Way Metering Station, EMWD Railroad Canyon Pipeline, and Inland Bioenergy.
- The previous reporting period only analyzed direct dischargers (i.e., dischargers that pay their disposal fees directly to SAWPA); however, data from both indirect and direct dischargers were analyzed for this current reporting period. The data of 19 indirect dischargers were incorporated into the analysis of this current reporting period.

Five direct dischargers (Del Real, JCSD Wells 17 & 18, Magnolia Foods, Metal Container Corporation, and Roger Teagarden IX) are not within SAWPA's billing jurisdiction and are therefore not included in the current analysis. Their collective contributions are captured through monitoring at JCSD Etiwanda Metering Station.

Currently, the following changes are planned:

- Three dischargers (JCSD Hamner, Dart Container Corp and Decra Roofing) plan to cease their discharge to the Brine Line within the next 6 months.
- JCSD plans to eventually reroute the flows that currently enter the Brine Line at the Hamner and Wineville metering stations, and divert them to WRCRWA instead.

Water quality data were collected both by participating agencies and the dischargers, hereafter referred to as self-monitoring report (SMR) data in this report. Similar to previous reports, all agency and SMR data collected between July 2019 and June 2024 were provided to Trussell and incorporated in the analysis.

In comparison to July 2019 – June 2024, during the recent April – June 2025 sampling period, dischargers performed sampling according to the February 2025 sampling plan (see Appendix B). This provided monitoring results for all individual dischargers that had correlated water quality results for all parameters from a single sample. As such, the recent sampling period results only reflect the supplemental technical monitoring of dischargers; no SMR data were included, which differs from previous reports.

3.2.2 Discharger Loading Rates

For each discharger, data of each parameter were averaged on a monthly basis, converted to monthly loadings using monthly flow, then averaged over the reporting period. When data for a given parameter were unavailable for a particular month, the average of the two adjacent months were taken as an estimate and included in the calculation of averages. The monthly average loadings of dischargers were summed to determine the total average Brine Line discharger loading rate for each parameter.

Three categories of dischargers – brine, commercial, and domestic – have been established for the purposes of this technical report (unrelated to billing or legal terminologies) with the following definitions:

- **Brine dischargers** discharge high-TDS concentrate flow from water treatment processes.
- **Commercial dischargers** discharge wastewater from commercial operations, such as producing, manufacturing, processing, institutional, or governmental.
- **Domestic dischargers** discharge wastewater from private residences resulting from the use of water for personal washing, sanitary purposes, or discharging of human excrement and related matter.

Dischargers are categorized based on their primary category of flow (i.e., a discharger that discharges a small fraction of domestic flow to the Brine Line, but whose majority of flow is brine, is categorized as a brine discharger). A profile of monthly suspended solids loading to the Brine Line is subdivided between the three categories, as shown in Figure 3-6.

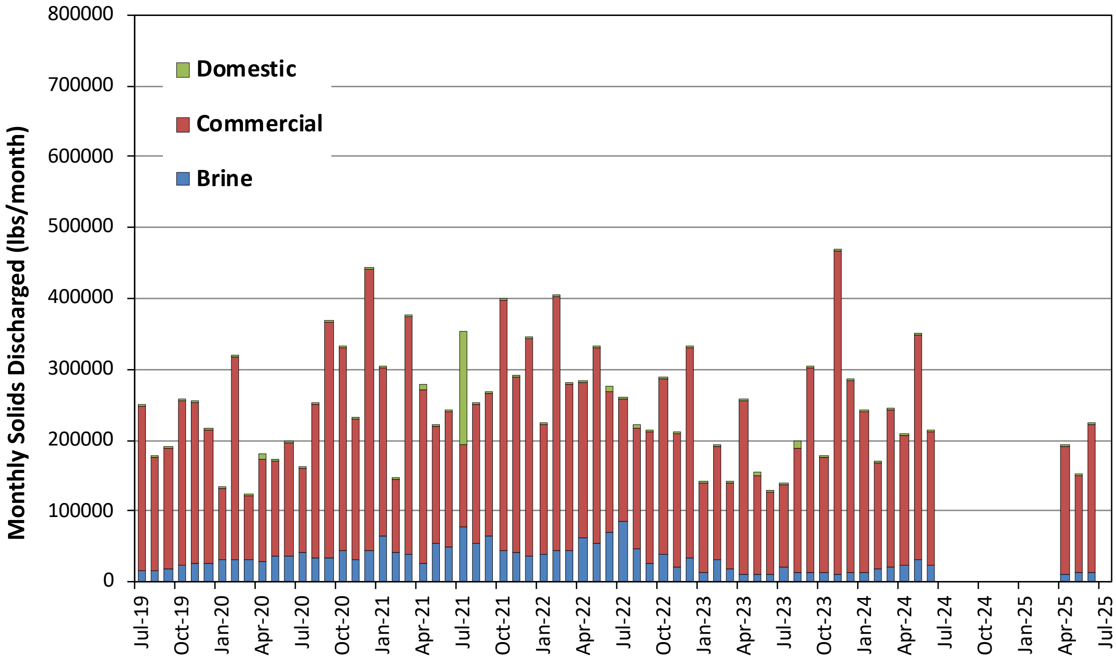

Figure 3-6. Brine Line discharger suspended solids loading by category (July 2019 – June 2025)

From Figure 3-6, commercial dischargers comprised most suspended solids loading. The solids loading by the brine dischargers increased from mid-2019 until reaching a peak in July 2022 and decreasing again. Domestic dischargers comprised the least of the suspended solids loading, which is consistent with SAWPA's efforts to remove primarily domestic flows from the Brine Line. However, there was a spike in domestic discharger output in July 2021, which corresponded to an emergency use of the Brine Line by WRCRWA.

A summary of average discharger loading into the Brine Line for each monitoring parameter is shown in Table 3-2. The table compares the average loading from the recent periods (July 2023-June 2024 and April-June 2025) with those from the preceding reporting period. Appendix C includes pie charts identifying the top dischargers representing at least 75% of the overall loading for each monitoring parameter for the combined period (July 2023-June 2024, plus April-June 2025).

Table 3-2. Summary of discharger loadings from recent data and comparison with last reporting period

Parameter	2019 Report* April – December 2018	Recent Fiscal Year July 2023 – June 2024	Recent Sampling Period April – June 2025
Flow (MG/mo)	314	379	385
TSS (lbs/mo)	202,100	248,600	200,200
VSS (lbs/mo)	170,000	199,500	168,500
BOD_5 (lbs/mo)	222,700	227,200	214,700
Dissolved BOD_5 (lbs/mo)	115,000	93,200	80,200
Total Alkalinity (lbs/mo)	2,192,000	3,099,600	2,919,600
Dissolved Alkalinity (lbs/mo)	1,336,600	2,964,900	2,804,200
Total Calcium (lbs/mo)	786,300	2,148,300	2,213,500
Dissolved Calcium (lbs/mo)	754,500	1,957,800	2,075,100

*Trussell, 2019.

Comparing the discharger loadings in July 2023 – June 2024 with the 2019 report values in Table 3-2, the flow to the Brine Line increased by 21%, which would be expected to result in a direct ~21% increase in all loading values if the corresponding concentrations remained stable. The loading values for most water quality parameters increased with increasing flows to the Brine Line, with the exception of dissolved BOD_5 (-19%). Dissolved alkalinity (+122%), total calcium (+173%), and dissolved calcium (+159%) doubled or nearly tripled, whereas TSS (+23%), VSS (+17%), and total alkalinity (+41%) saw smaller gains. Total BOD_5 rose slightly (2%).

In contrast, comparing the recent sampling period with July 2023 – June 2024, the combined discharger flow increased only 2%. Calcium (+3%) and dissolved calcium (+6%) increased, while TSS (-19%), VSS (-16%), total BOD_5 (-5%), dissolved BOD_5 (-14%), alkalinity (-6%), and dissolved alkalinity (-5%) declined slightly to moderately. The combined discharger VSS/TSS was relatively stable, with a ratio of 84% in the 2019 report, 80% in July 2023 – June 2024, and 84% during the recent sampling period.

The dischargers are ranked in Table 3-3 according to the average monthly flow for July 2023 – June 2025 (excluding July 2024 – March 2025). The table also lists the average monthly loading rates for the primary water quality parameters identified as surrogates for suspended solids formation mechanisms (*i.e.*, TSS, VSS, BOD_5, calcium, and alkalinity). For each parameter, dischargers are grouped as follows, as indicated in the legend:

1. Top 3 dischargers.
2. Contributing to 75% of overall dischargers' loading.
3. Contributing to 95% of overall dischargers' loading.
4. Other dischargers.

Three dischargers are located upstream of other dischargers, and their flows are merged into the flow sent to the downstream dischargers, including Chino II East (upstream of JCSD Etiwanda Metering Station), Chino II West (upstream of JCSD Wineville Metering Station), and SCE Mira Loma Peaker Plant (upstream of JCSD Hamner Metering Station). Both the upstream and downstream dischargers are listed separately in Table 3-3 to clarify their contributions to the Brine Line, but the contributions by the upstream dischargers were not factored into the overall loading ranking (i.e., top 3, 75%, and 95%).

Two dischargers – SCE Mira Loma Peaker Plant and JCSD Chandler Lift Station – lack certain water quality data due to infrequent discharge during the current reporting period. Their categories without data are marked with hyphens.

Table 3-3. Summary of discharger average flow (million gallons per month) and loading rates (kgs/month) from July 2023 through June 2025

Top 3	75% of loading	95% of loading

Flow Rank	Discharger Name	Monthly Flow	Total Solids	Volatile Solids	BOD (kg/month)		Alkalinity (kg/month)		Calcium (kg/month)	
		(MG/month)	(kg/month)	(kg/month)	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	Chino I Desalter	67.1	1278.5	738.7	1276	1230	373362	368920	276965	238068
2	Perris and Menifee Desalter MP001	67.0	756	605.6	1398	1182	181926	175229	220198	210277
3	JCSD Etiwanda Metering Station	57.9	62901	55013	43603	9441	157886	151234	69518	63224
4	Temescal Desalter	53.5	912.8	428.4	824	740	269008	244924	175085	156383
5	Perris and Menifee Desalter MP002	37.8	480	363	921	802	110375	106291	126653	125769
6	Chino Desalter II East	33.5	343	215	635	635	75002	71549	56696	52458
7	WMWD Arlington Desalter	19.4	1166	415	347	270	114937	112152	48378	46980
8	City of Beaumont Wastewater Treatment Plant	16.3	80	76	642	540	75488	72887	13496	13122
9	YVWD - Henry Wochholz Plant	13.0	152	144	375	348	13676	13409	9242	8778
10	Mountainview Generating Station	12.6	1005	329	284	254	7475	5645	9133	7943
11	JCSD Wineville Metering Station	6.1	9086	4769	3303	400	23031	21686	2141	1877
12	Aramark Uniform & Career Apparel, LLC	5.0	10833	7832	18540	7443	9766	9456	866	609
13	California Institution for Women (CIW)	4.7	8116	7615	3694	861	4433	3969	910	823
14	Mission Linen Supply	4.1	1404	1212	9417	7227	7932	7518	418	332
15	Chino Desalter II West	3.9	284	90.1	70.9	65.1	21620	20348	1220	1071
16	Stringfellow Pretreatment Facility	3.5	76.8	70.0	226.5	170.1	2279	2249	3688	3622
17	In-N-Out Burger, Chino Distribution Center	2.0	564	488	1658	947	3352	3236	801	770
18	JCSD Hamner Metering Station	1.7	3649	3310	1962	486	2832	2680	386	311
19	Niagara Bottling, LLC (IEUA)	1.5	259	113	277	95.0	7262	7262	5052	5052
20	Rialto Bioenergy Solutions	1.3	335	105	934	105.6	4233	4149	755.5	751.4
21	Californian Institution for Men (CIM)	1.0	42.5	13.0	13.8	6.54	6925	4501	5367	5199
22	Dart Containers	0.96	70.1	18.0	54.9	18.8	427	399	710	421
23	Niagara Bottling, LLC (SBMWD)	0.90	574	315	387	299	4432	4432	2252	2234
24	Repet, Inc.	0.87	3252	2622	7882	5577	3837	3650	211	128
25	Skorpios Technologies	0.53	168	55.6	40.0	30.2	252	252	1136	109
26	OLS Energy - Chino	0.46	12.71	9.12	5.34	4.90	400	155	189	171
27	Wellington Foods	0.37	187	147	2050	1448	678	529	93.3	70.7
28	Eastside Water Treatment Plant	0.36	34.9	9.5	5.29	3.36	1248	1206	1569	1244
29	Flavor Specialities	0.13	96.3	75.9	723	557	373	359	24.9	20.9
30	Inland Water Services	0.12	13.6	4.45	9.91	2.01	49.6	49.6	3224	2793
31	Green River Golf Course (GRGC)	0.12	158	139	156	18.9	92.9	91.5	35.1	29.2
32	RCSD	0.10	6.97	1.04	1.81	1.41	987	963	27.0	20.6
33	WRCRWA - South Regional Pumping Station	0.09	267	267	194	39.3	111	107	20.3	16.4
34	Saratoga Food, Inc.	0.08	406	369	710	519	428	428	19.6	13.1
35	Sierra Aluminum Company, Inc.	0.05	0.82	0.59	1.16	0.41	115	115	70.9	46.8
36	City of Colton - Agua Mensa Power Plant	0.05	1.13	0.60	0.11	0.11	48.9	48.9	20.4	18.5
37	Emerald Colton	0.049	1.60	0.71	1.13	0.89	27.5	27.5	804	734
38	Loma Linda University Power Plant	0.031	0.80	0.42	0.55	0.55	14.9	14.9	355	355
39	SCE Mira Loma Peaker Plant	0.020	0.15	0.15	0.35	0.35	-	-	-	-
40	Prudential Overall Supply	0.020	1.83	0.67	0.65	0.08	11.9	11.9	180	162
41	Loma Linda Veterans Affairs (VA) Medical Center	0.012	0.47	0.17	0.30	0.22	5.59	5.59	115	74.5
42	Decra Roofing Systems	0.010	2.64	2.49	9.69	9.09	12.4	12.4	17.9	12.8
43	Qualified Mobile, Inc.	0.009	3.38	0.36	0.21	0.21	8.04	8.04	21.4	17.0
44	Indian Oaks Campground	0.007	0.14	0.08	0.06	0.05	17.6	3.4	71.6	2.83
45	San Antonio Regional Hospital	0.005	0.45	0.18	1.78	0.08	2.57	2.35	92.8	79.9
46	La Sierra University	0.002	0.24	0.03	0.03	0.03	0.92	0.84	36.0	29.9
47	JCSD Chandler Lift Station	0.002	0.60	0.53	0.65	-	-	-	-	-

As seen in Table 3-3:

- The dischargers that contribute the most flow also generate the most alkalinity and calcium loading. These include Chino I Desalter, Perris and Menifee Desalter MP001, and Temescal Desalter – all three categorized as brine dischargers.
- The top TSS, VSS, and BOD_5 dischargers, including JCSD Wineville Metering Station, Aramark Uniform & Career Apparel, California Institution for Women, and Mission Linen Supply, are commercial dischargers. Despite their significant contributions to these loading categories, none rank in the top 10 of flow contribution.
- JCSD Etiwanda Metering Station, a commercial discharger, ranks third in flow contribution, while also leading in TSS, VSS, and BOD_5 loading, and contributing significantly to alkalinity and calcium loading. This discharge location represents the confluence of several diverse upstream flow types.

3.3 SMS and Discharger Loading Comparison

In this section, the SMS flow and solids loading are compared with those from the dischargers during the current reporting period.

The SMS flow and cumulative discharger flow are compared in Figure 3-7. The flow demonstrates a high degree of uniformity between the SMS and the combined dischargers. While flow from July 2016 through June 2025 was relatively stable, seasonal trends are observed (lower flows in the wintertime). Compared with July 2016 – March 2019 (average monthly flow of 316 MG/month at the SMS), an overall increase in Brine Line flows was observed for the current sampling period (average monthly flow of 353 MG/month at the SMS).

Note that SAWPA adjusts flows of direct dischargers to keep the flow imbalance between SAWPA's SMS flow reading and total discharger flow within 5%. The imbalance is calculated with the equation below. Indirect dischargers are not adjusted by SAWPA and are excluded in the % imbalance equation.

$$\%\ imbalance = \frac{SAWPA\ SMS\ Flow\ Value - Total\ Indirect\ Flows}{Total\ Direct\ Flows + SAWPA\ Adjustment} - 1$$

Figure 3-7 was developed using adjusted direct discharger flow values for the cumulative discharger flow calculation. In addition, the adjusted direct discharger flows were used for the loading calculation discussed in the next section.

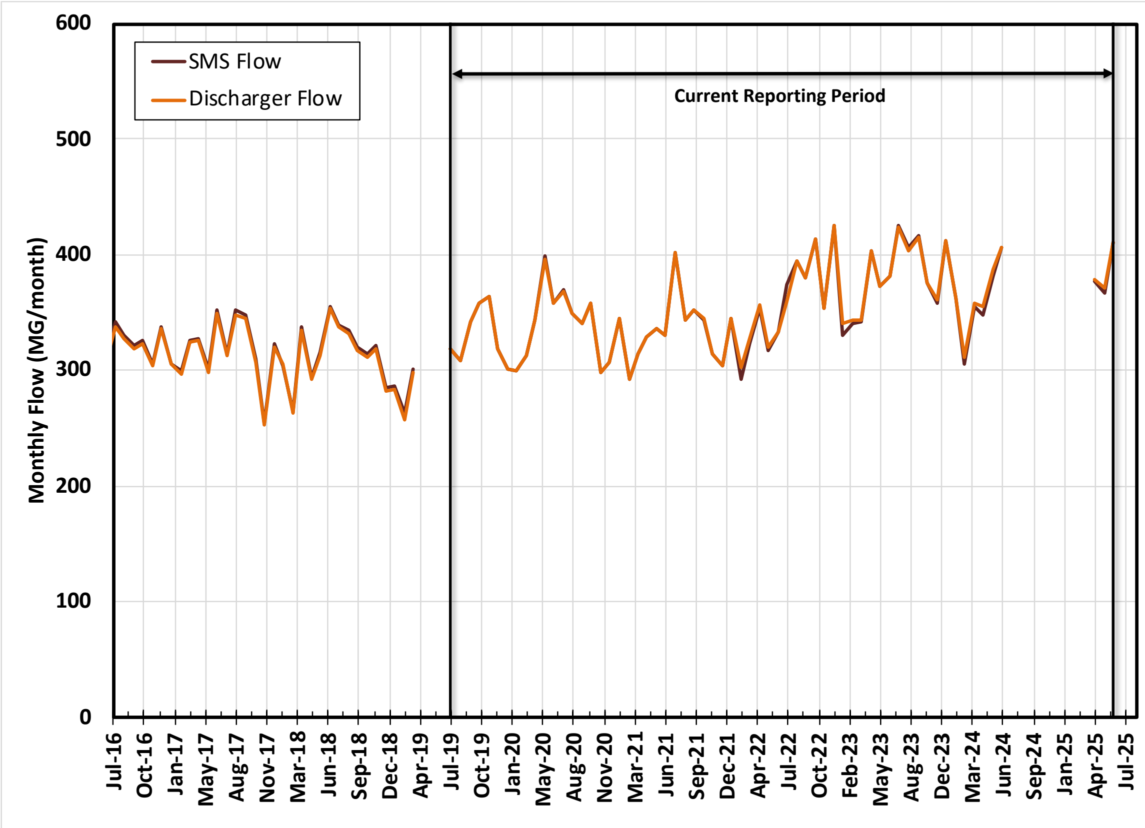

Figure 3-7. Cumulative flow from all dischargers compared with flow measured at SMS from July 2016 – June 2025.

Figure 3-8 shows the comparison of TSS load at the SMS versus the cumulative discharger loading on a monthly basis. TSS loading for an individual discharger is determined by multiplying the average TSS concentration for a particular month by their total measured flow for that month. If TSS concentration data is missing for a month when flow was contributed, it is estimated as the average concentration of surrounding months. Similarly, the SMS TSS load is determined by multiplying the monthly average TSS concentration by the monthly flow measured at the SMS.

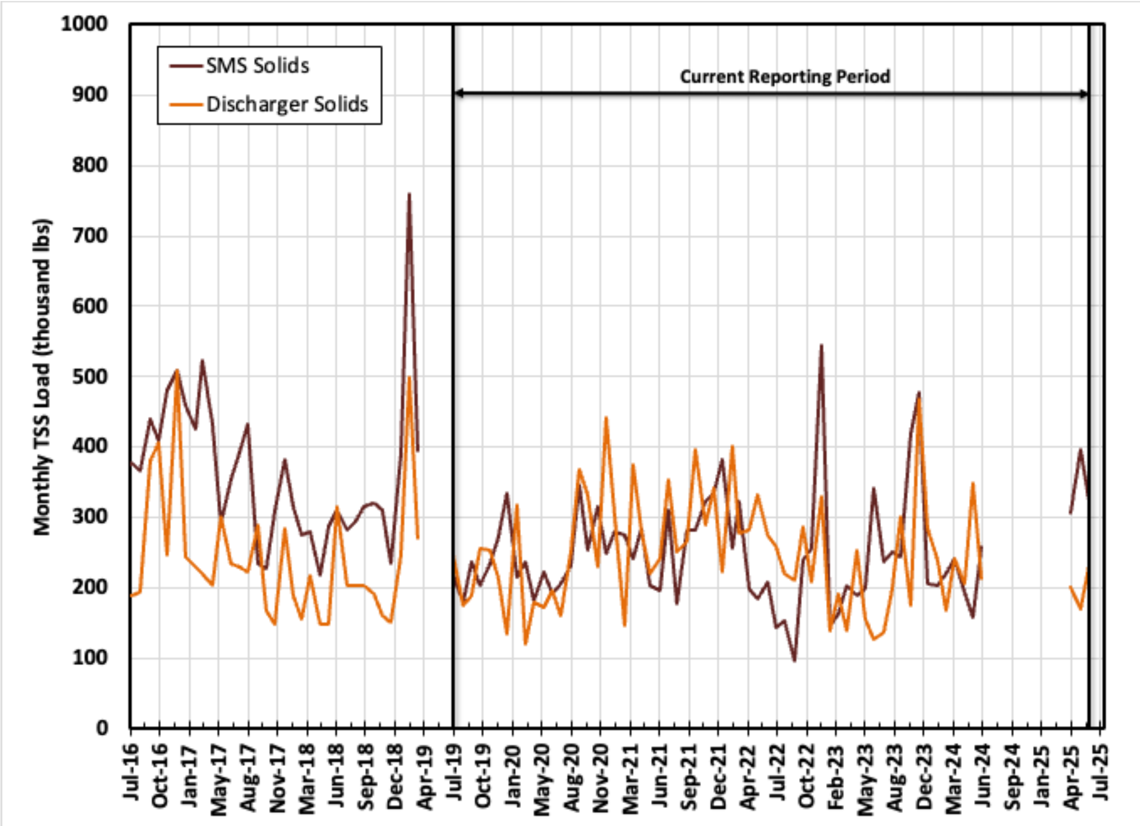

Figure 3-8. Total suspended solids from all dischargers compared with the SMS from July 2016 – June 2025.

Historically, the TSS load observed at the SMS exceeded the TSS load contributed by the combined dischargers. The recent trends between the TSS load observed at the SMS and the combined dischargers have exhibited a greater amount of month-to-month fluctuation since July 2019. Unlike the historical data, in which the SMS TSS load was generally higher than the combined discharger TSS load, the current reporting period from July 2019 to June 2025 yielded more mixed results. The combined discharger TSS load was higher than the SMS TSS load in December 2020, March and October 2021, February 2022, April – September 2022, and May 2024, and the SMS TSS load was higher than the combined discharger TSS load in December 2020, December 2022, June – July 2023 and April – June 2025.

On November 10, 2020, high TSS (6,800 mg/L) and VSS (5,000 mg/L) concentrations were reported at the JCSD Etiwanda Metering Station; upon further investigation by SAWPA, these high concentrations were reported to be linked to a specific production period by the upstream Del Real Foods. Another TSS concentration was reported for the same month that was considered more representative of the typical solids loading for that discharger (380 mg/L). The TSS and VSS results that were sampled at the SMS in November 2020 were typical values and did not seem to be significantly impacted by the high TSS and VSS discharge monitored at the JCSD Etiwanda Metering Station. For these reasons, the high TSS and VSS values were not incorporated in the data analysis and do not contribute to the discharger loading curve seen in Figure 3-8.

It is insightful to illustrate the difference in suspended solids loading in Figure 3-8 as a ratio, to visualize solids formation in the Brine Line independent of the overall magnitude. Averaged on a fiscal calendar basis, the solids observed at SMS divided by solids input from the dischargers is provided in Figure 3-9. A ratio of 1 means the solids loading observed at SMS equals that of the combined dischargers (*i.e.*, indicating no solids formation) whereas a ratio greater than 1 means that the solids loading at SMS exceeded the suspended solids discharged to the system (*i.e.*, suggesting solids formation). The suspended solids formation ratio in 2015/16 was 1.9 then a decrease in solids formation was observed in 2016/17 that coincided with increased monitoring frequency as part of the billing formula development (early 2016). The resolution of discharger solids loading was improved with increased monitoring, contributing to improved accounting for the solids within the Brine Line. The ratio remained approximately 1.5 for three consecutive years thereafter. Another stepwise change was observed between 2018/19 and 2019/20 (beginning of the current reporting period) after which the ratio remained at or around 1.0 for five fiscal years, suggesting a lack of solids formation. The ratio then increased to 1.3 during the 2024/2025 period, indicating solids formation; however, it is noted that this value only accounts for the recent 3-month supplemental technical monitoring data.

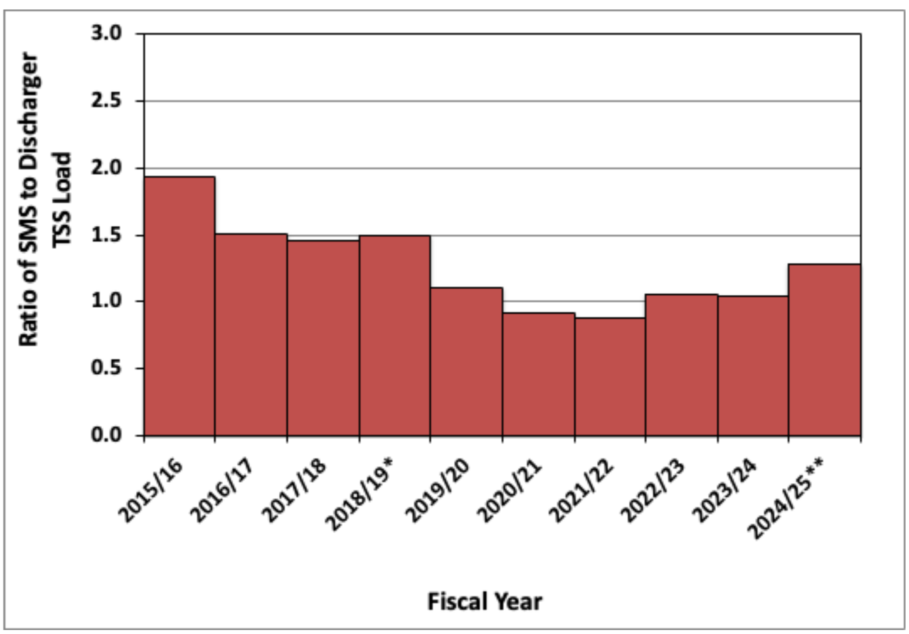

Figure 3-9. Relative increase in TSS in the Brine Line from the points of discharge to the SMS on a calendar year basis (July 2015 through June 2025).

*Based on 9 months (July 2018 – March 2019) of data.
**Based on 3 months (April 2025 – June 2025) of data.

4 Results and Discussion of Recent Sampling Period (April 2025 – June 2025)

4.1 Introduction

This section focuses on the results from the recent sampling campaign that occurred between April and June 2025. The campaign followed the Sampling Test Plan (Appendix B) that was developed to collect supplemental technical monitoring data to the 2019-2024 dataset, as identified by Trussell in the February 2025 communication to SAWPA (Appendix A). During this period, water quality and flow data were collected from dischargers to the Brine Line and the SMS, following new sampling frequencies recommended by Trussell in the Sampling Test Plan that were based on 2019-2024 flow and loading. In addition, solids characterization analyses were conducted at SMS to understand the solids fraction of the flows at the SMS.

Because the solids characterization analyses at SMS were only conducted during this 3-month period, and it is important to compare analogous data to each other, the SMS and discharger solids formation mass balance analysis was limited to the recent sampling period (April to June 2025). These recent sampling period data were used to update the billing formula and reflect ongoing conditions in the Brine Line.

4.2 SMS Assessment

During the recent sampling period, SAWPA continued to collect weekly 24-hour composite samples at the SMS, as was described in Section 3, for triplicate analyses of TSS, VSS, and total BOD_5; along with a single replicate analysis of dissolved BOD_5, total and dissolved alkalinity, as well as total and dissolved calcium. OC San also continued their typical monthly monitoring of TSS and total BOD_5 from composite samples at SMS.

Figure 4-1 shows the TSS results from SMS samples between April and June 2025. The average TSS at the SMS was 107 mg/L.

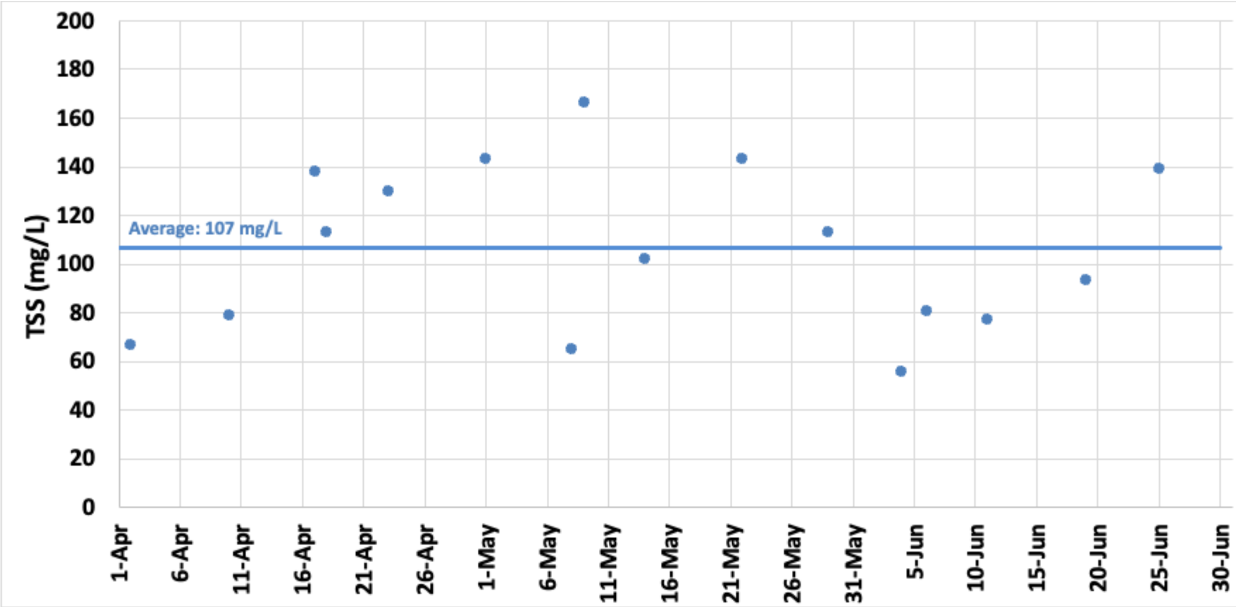

Figure 4-1. Average TSS results at the SMS from individual sampling events (April 2025 – June 2025)

The weekly averaged VSS data from the SMS are shown in Figure 4-2. The average VSS was 87 mg/L.

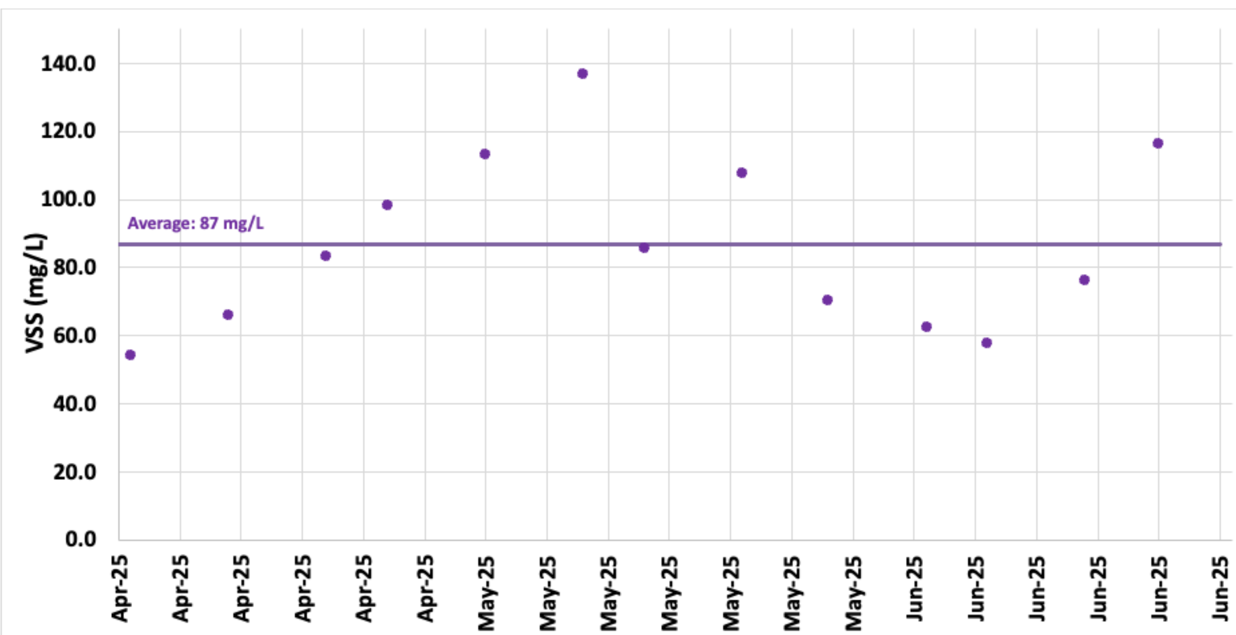

Figure 4-2. Average VSS results at the SMS from individual sampling events (April 2025 – June 2025)

During this same timeframe, solids characterization analyses were conducted by Camet Research on wet solids samples collected on May 1, May 14, and May 29, 2025. To accommodate the extra analyses, a larger volume (approximately 10 liters) was collected for the 24-hour composite sample from SMS on these days. Trussell took a split of the liquid sample and centrifuged it in the Trussell Laboratory to concentrate and separate the suspended solids from the liquid supernatant. The wet solids were then shipped to Camet to perform the following analyses: x-ray diffraction (XRD), wavelength dispersive x-ray fluorescence spectroscopy (WDXRF), and thermogravimetric analysis (TGA). The inorganic fraction of the solids can be understood from the XRD and WDXRF results, while TGA provides an assessment of the organics present in the solids. XRD results are semi-quantitative in nature but are used to identify the presence of different minerals. WDXRF is used to assess the elemental composition of the solids, which can then be used to quantify the minerals present. TGA evaluates the change in mass of the sample with temperature as it is heated to 950ºC, which is used to partition the organic fraction of the solids into cellulosic material (*e.g.*, paper and cloth fiber) and microbial biomass by evaluating the mass loss for the temperature ranges where these materials burn.

Using these testing methods on each of the three wet solids samples, Camet identified the relative composition of the solids based on the following categories:

- Calcium minerals – calcite and amorphous calcium phosphate (ACP)
- Cellulose
- Volatiles (organic matter and bound water) – this represents the microbial biomass
- Other inorganic constituents, such as silicon dioxide (SiO_2), iron (III) oxide (Fe_2O_3), sulfur trioxide (SO_3), and aluminum oxide (Al_2O_3)

The reports from Camet Research with results for the three solids characterization events can be found in Appendix D.

These solids composition categories were consistent with prior analyses of the Brine Line solids present at SMS. As with prior characterization events, the dominant minerals present were identified as ACP ($Ca_9(PO_4)_6$) and calcite (calcium carbonate, $CaCO_3$).

The understanding of the organic fraction of the solids present at SMS established by Camet (cellulose + volatiles) was then compared to the corresponding results produced by Babcock (see Appendix E) with the VSS-to-TSS ratio (VSS/TSS) from the same samples (May 1, 14, and 29). The Camet and Babcock VSS/TSS ratios were then averaged between the two datasets to establish the organic composition of the three sample dates, as seen in Table 4-1.

Table 4-1. Average VSS/TSS ratios of Babcock, Camet, and combined Babcock and Camet on the three solids characterization sample dates

Date	Babcock Average VSS/TSS	Camet Average VSS/TSS	Combined Average VSS/TSS
5/2/25	79%	76%	77%
5/15/25	79%	77%	78%
5/30/25	62%	76%	69%

Subsequently, the combined average VSS/TSS ratio of each sample day (Table 4-1) were used in conjunction with the identified solids composition breakdown of each sample day from the Camet analyses to generate three new characterizations of the solids composition of the SMS, including microbial biomass, cellulosic material, calcium minerals, and other inorganics. These three new characterizations can be found in Figure 4-3.

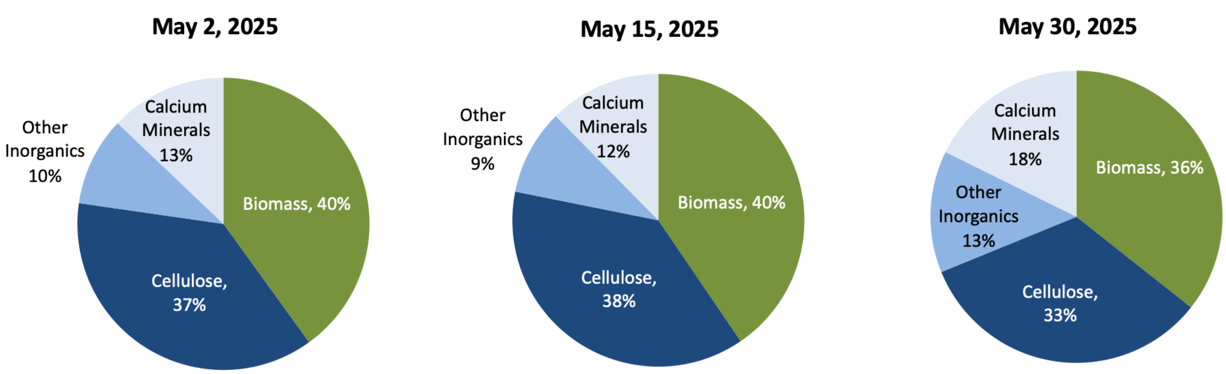

Figure 4-3. Three SMS solids characterizations performed in May 2025, using average VSS/TSS ratios determined from Camet and Babcock analyses

As seen in the figure, the three sampling events yielded proportionally similar compositions, particularly for the samples on May 2 and 15. The May 30 sample contained a higher proportion of inorganics than the prior two samples (31%, compared to 21-23%). In all three samples, the organic fraction (VSS) dominated, accounting for 69-78% of the total solids. Within the organic fraction, the proportions of biomass and cellulose were similar, but the biomass was slightly more in each sample. The inorganics were similarly evenly divided between calcium minerals and other inorganics; however, the proportion of calcium minerals were always greater.

The fractions from the three solids characterizations, expressed as a percent of the TSS at the SMS, were averaged to a single breakdown and multiplied by the average TSS from the liquid fraction of weekly composite samples for the recent period (April-June 2025) to obtain the breakdown by concentration (mg/L) shown in Table 4-2. The components were also expressed as a loading in pounds per month (lbs/month) by multiplying the concentrations by the average monthly flow rate measured at SMS from April through June 2025 (385 million gallons per month), as shown in Figure 4-4.

Table 4-2. SMS solids composition based on solids characterizations (April – June 2025)

SMS Results		
Component	%	Concentration (mg/L)
Microbial Biomass	39%	41.3
Cellulosic Material	36%	38.5
Calcium Minerals	14%	15.3
Other Inorganics	11%	11.7
Total	**100%**	**106.7**

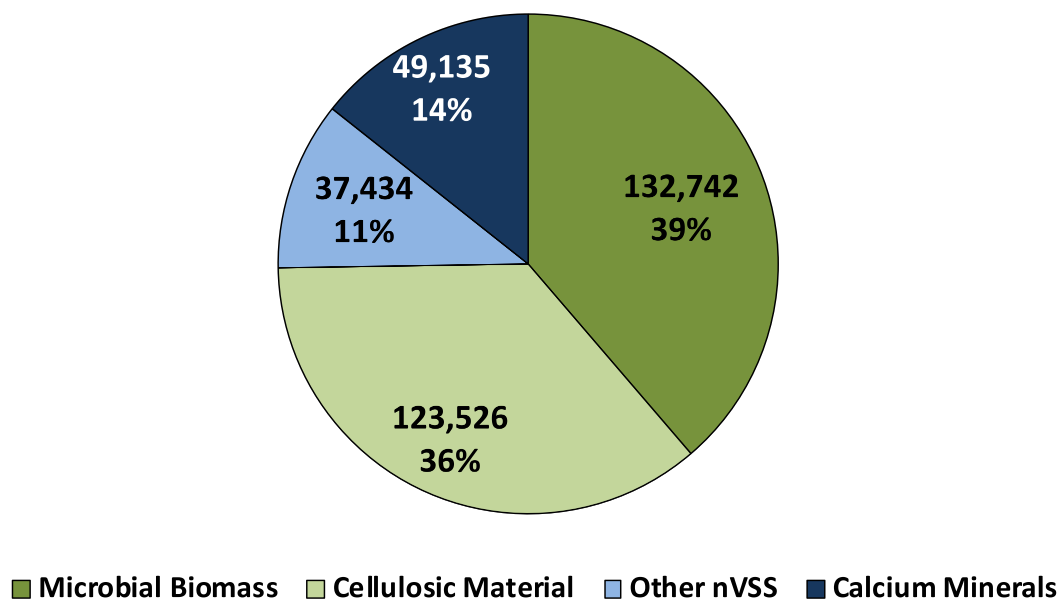

Figure 4-4. Overall composition of the Brine Line suspended solids at the SMS for April – June 2025 (loading represented as lbs/month)

The overall composition of suspended solids at SMS for the current reporting period (Figure 4-4) was compared to historical results since August 2016, as shown in Figure 4-5.

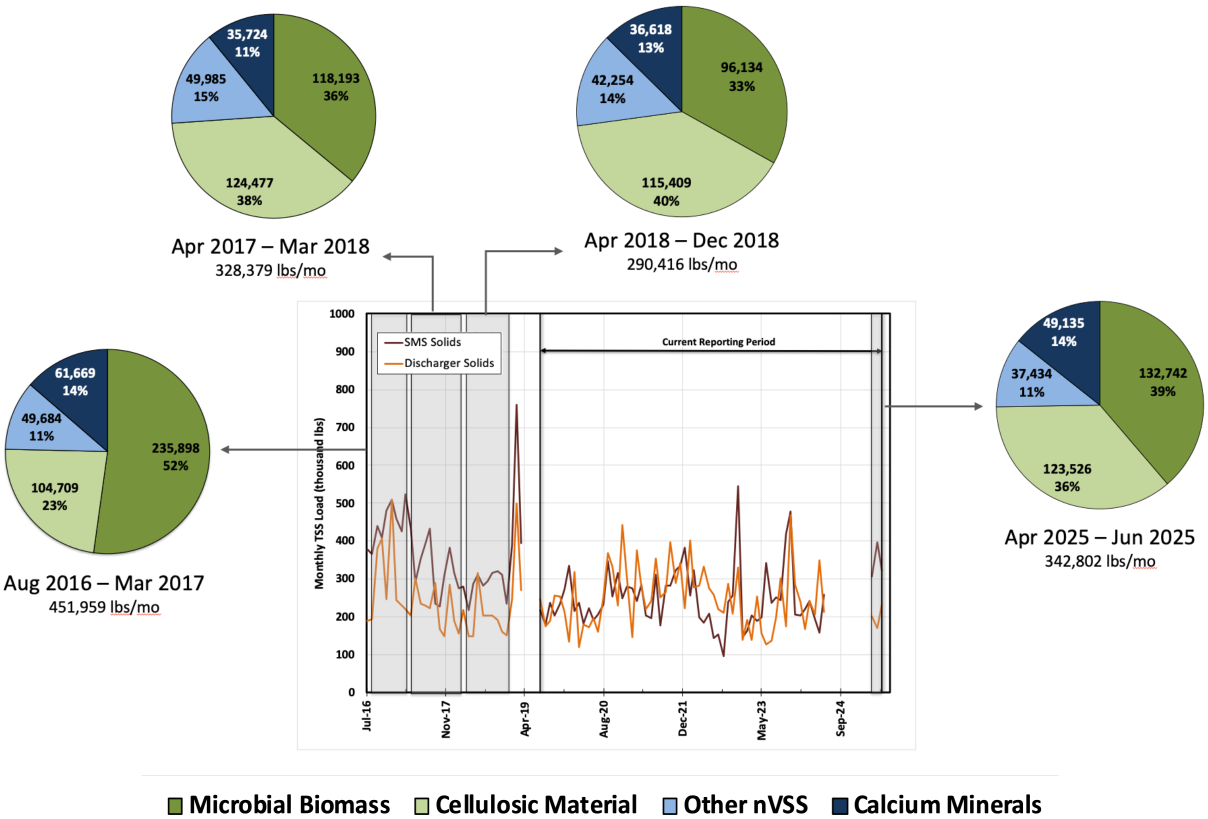

Figure 4-5. Suspended solids characterizations from samples collected at the SMS 2016 – 2025 (loading values in lbs/month)

As seen in the figure, the solids composition has remained consistent on a proportional basis across the different sampling periods, despite the relatively long gap in characterization analyses between December 2018 and April 2025. The solids from the recent sampling period were comprised of 75% organics (VSS, including microbial biomass and cellulosic material) and 25% inorganics (nVSS, including calcium minerals and “other” nVSS). This partitioning has been very stable across all four sampling periods shown in the figure, with the VSS accounting for 73-75%.

Within the organic fraction, the proportion of microbial biomass and cellulosic material has shifted over time. In August 2016 – March 2017, the microbial biomass encompassed the majority of the organic fraction while the cellulosic material encompassed the minority of the organic fraction. During the next two sampling periods (April 2017 – March 2018 and April – December 2018), the cellulosic material encompassed the majority of the organic fraction instead; however, the split was much more even. Then, from April – June 2025, the microbial biomass again encompassed a larger proportion of the organic fraction, albeit at a smaller relative fraction than from

August 2016 – March 2017. In terms of loading, cellulosic material increased from 115,000 lbs/month for the 2018 analysis to 123,000 lbs/month discharged for the recent analysis. The microbial biomass loading increased from 96,000 lbs/month in 2018 to 133,000 lbs/month for the recent period.

Within the inorganic fraction, the proportion of calcium minerals and "other" nVSS has also shifted over time. In August 2016 – March 2017, the calcium minerals encompassed the majority of the inorganic fraction while the "other" nVSS encompassed the minority of the inorganic fraction. During the next two sampling periods, the "other" nVSS surpassed the calcium minerals as the majority of the inorganic fraction. Then, from April – June 2025, the calcium minerals once again dominated as the larger proportion of the inorganic fraction. In terms of loading, "other" nVSS decreased from 42,000 lbs/month in 2018 to 37,000 lbs/month for the recent analysis. Conversely, calcium minerals increased from 37,000 lbs/month in 2018 to 49,000 lbs/month for the recent period.

It should be noted that the magnitude of solids loading at the SMS has varied over time. As indicated in Figure 4-5, the solids loading was elevated in the 2017 analysis (452,000 lbs/month), then dropped over the subsequent two periods, but have recently increased to approximately 343,000 lbs/month. Compared to 2018, the recent reporting period saw an increase in combined inorganic material and combined organic material of 8,000 lbs/month and 46,000 lbs/month, respectively.

4.3 Mass Balance Calculations

A mass balance of the suspended solids characterization between the discharger loading and the SMS is used to calculate the suspended solids formed through the Brine Line system. A summary of the full suspended solids mass balance is provided in Table 4-3.

Table 4-3. Brine Line system suspended solids composition based on mass balance (April 2025 – June 2025)

Component	SMS Results	Combined Discharger Results	Estimated Formed Solids
	Concentration mg/L	Concentration mg/L	Concentration mg/L
Microbial Biomass	41.3	14.0	27.4
Cellulosic Material	38.5	38.5	0.0
Calcium Minerals	15.3	6.4	8.9
Other Inorganics	11.7	3.5	8.2
Total	**106.7**	**62.3**	**44.4**

To find the combined discharger suspended solids composition for the April – June 2025 period, the combined discharger TSS loading was first partitioned into the organic (VSS) and inorganic (nVSS) fractions using the VSS/TSS ratio determined from the average discharger VSS and TSS loading during the period. Cellulose measured at the SMS was assumed to be consistent with combined discharged loads (not formed or accumulated). The remaining VSS is thus attributed to microbial biomass. Then, the remaining ~25% inorganic fraction of the combined discharger suspended solids composition was partitioned into calcium minerals and “other” nVSS. The particulate calcium loading of the dischargers determined during the period was converted to calcium minerals. During the SMS solids characterization, it was found that ACP and calcite are the dominant calcium minerals found in the calcium loading in the Brine Line. Using an element-to-mineral ratio of 0.4 (i.e., the molecular weight of calcium is about 0.4 in the total mineral molecular weights of ACP and calcite), the calcium mineral proportion was then determined for the inorganic fraction of the combined discharger suspended solids loading. The remaining suspended solids loading from the combined dischargers was attributed to “other” nVSS.

Once the SMS loading and combined discharger loading were determined, the suspended solids formation through the Brine Line was estimated as the difference between the loading measured at the SMS and the combined loading from all dischargers. Microbial biomass makes up a majority of the formed solids and can be attributed to biological growth. Calcium minerals and “other” nVSS encompass the remainder of formed solids through the Brine Line at almost equivalent amounts of growth.

Figure 4-6 consists of three pie charts representing the water quality characterization of the suspended solids loading at the SMS, of the cumulative dischargers and of the estimated formed suspended solids within the Brine Line.

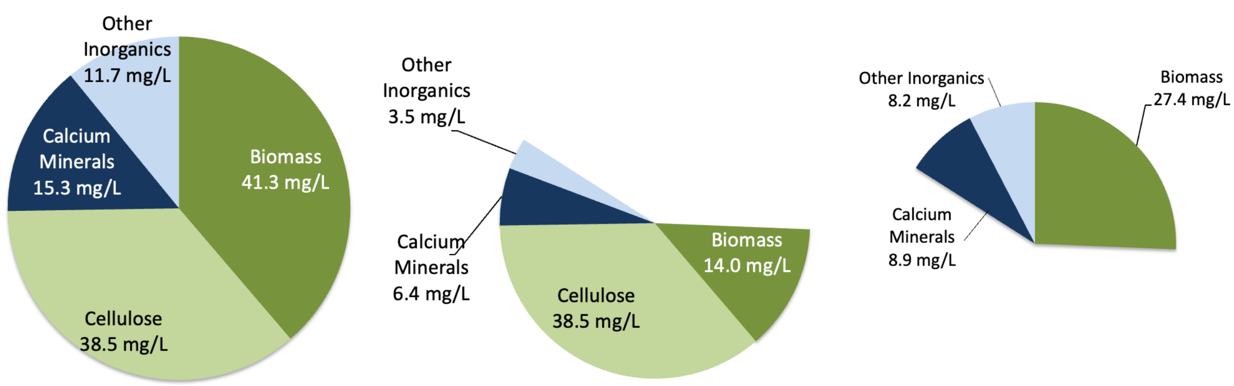

Figure 4-6. Characterization of solids at SMS, of cumulative dischargers, and formation in Brine Line for April – June 2025

Other inorganics make up 18% of the formed suspended solids. Camet Research provided a list of these inorganic constituents and the estimated fraction they contribute to the solids. The following four constituents, listed in order of their prevalence, comprise the majority of these remaining inorganics in the Brine Line solids:

- SiO_2 – also known as silica, this compound is the most common constituent in sand.
- Fe_2O_3 – also known as ferric oxide or rust.
- Sulfur trioxide (SO_3) – this compound is a byproduct of gypsum in cement and concrete.
- Aluminum oxide (Al_2O_3) – also known as alumina, this compound is found in corundum, which is used to line pipes to prevent abrasion and corrosion. Ceramic lined steel pipes typically contain an alumina ceramic layer.

It is expected that these four constituents are present in the Brine Line flow at the SMS based on wear and tear to the materials that make up the Brine Line collection system (e.g., iron-based pipes, ceramic lined steel pipes, etc.).

5 Billing Formula

Characterization of the total suspended solids formed in the Brine Line system are shown below in Table 5-1, Figure 5-1, and Figure 5-2 during the following reporting periods:

1) April – December 2018: values established in 2019 Billing Formula Report (Trussell, 2019)
2) April – June 2025: values established for the current reporting period, as discussed in Section 1

Figure 5-1 includes overall compositions of the formed suspended solids in the Brine Line from April – December 2018 and from April – June 2025. The pie chart for the recent sampling period includes the formed suspended solids composition that was shown in Figure 4-6.

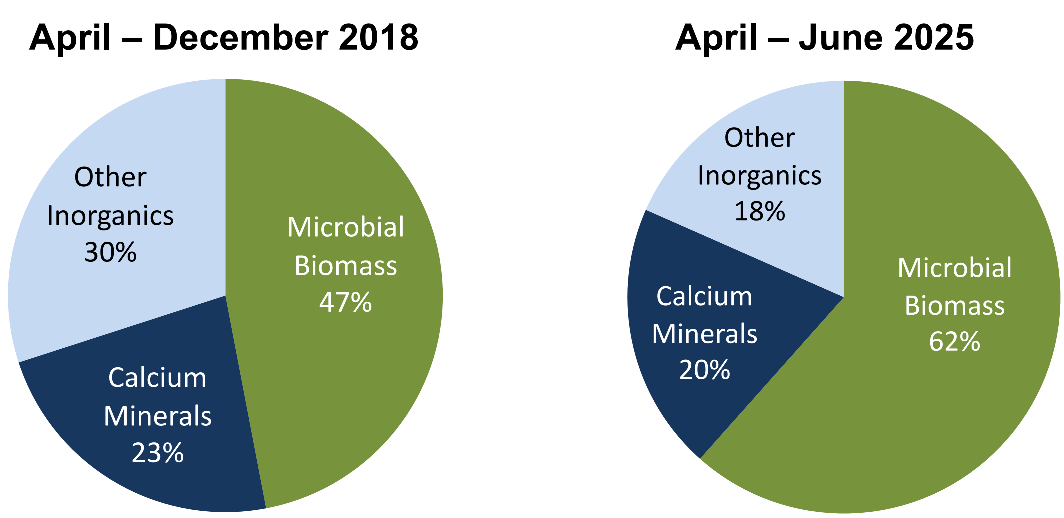

Figure 5-1. Overall composition of formed suspended solids for April – December 2018 and April – June 2025 estimates

5.1 Billing Formula Surrogates

Consistent with the previously established methodology, surrogates were determined to represent the different components of the formed suspended solids. Once established, these surrogates were used to build the billing formula.

- When calcium minerals are found to be formed through the Brine Line system, as they were in the current reporting period, two surrogates are used to allocate the contributing factors in the discharges that lead to precipitation of calcium carbonate and ACPs: 40% to dissolved calcium and 60% to dissolved alkalinity. The calcium minerals are allocated between the dissolved calcium and components of the dissolved alkalinity (carbonates and phosphates) contributing to the precipitation reactions.

- Dissolved BOD_5 measured from each discharger is used as a surrogate for microbial biomass formation (biological growth).
- A flow-based "service charge" parameter is used to apportion formed solids composed of non-calcium inorganics. As was discussed in a previous section, these "other inorganic" solids are expected to be present at the SMS due to wear and tear on the Brine Line collection system. As such, each discharger contributes to the formation or release of these "other" inorganics in proportion to their flow. Hence, a surrogate of flow is assigned for the "other inorganics".

Each solids component is shown with its respective formation surrogate in Table 5-1, along with the formed suspended solids breakdown for April – December 2018 and April – June 2025. The overall composition of the solids formed in the Brine Line is presented again in Figure 5-2 using these monitoring surrogates. The use of these surrogates for billing is discussed in Section 5.2.

Table 5-1. Composition of solids formed in the Brine Line for April – December 2018 and April – June 2025

Component	Percent of Formed Solids		Cost Allocation Parameter
	April 2018 - December 2018	April 2025 - June 2025	
Microbial Biomass	47%	62%	Dissolved BOD_5
Calcium Minerals	23%	20%	Dissolved calcium (40%) Dissolved alkalinity (60%)
Other Inorganics	30%	18%	Flow-based service charge
Total	**100%**	**100%**	

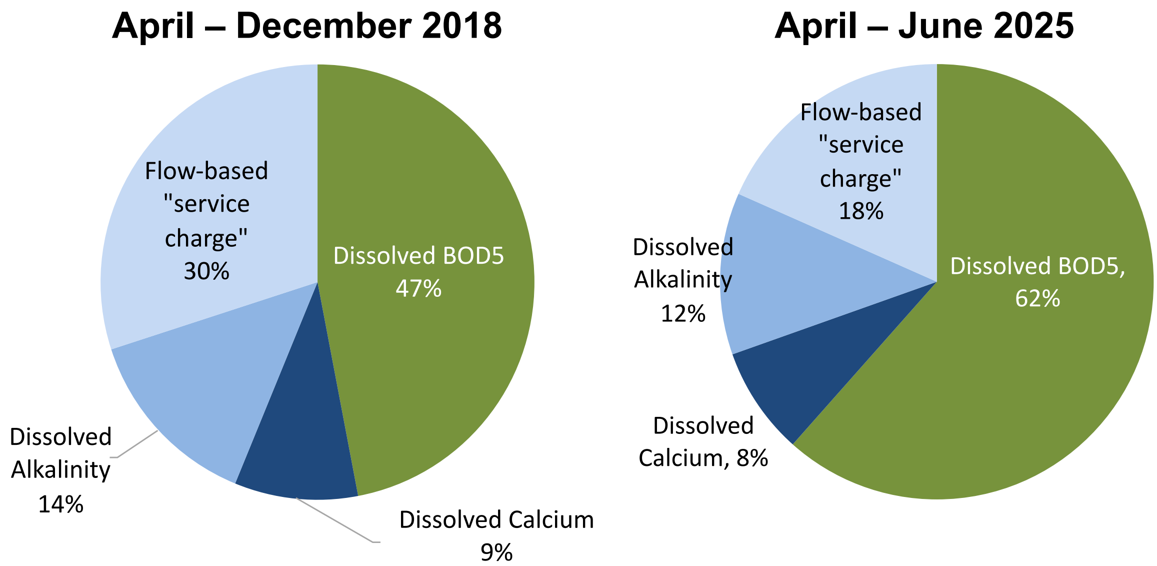

Figure 5-2. Overall composition of formed suspended solids for April – December 2018 and April – June 2025 estimates, by monitoring surrogate

5.2 Brine Line Billing Formula

A billing formula was previously established to equitably allocate the costs SAWPA incurs for OC San to treat and dispose of the solids formed or accumulated within the Brine Line system to the dischargers. The costs associated with the formed solids are allocated based on the formation mechanisms described in the prior subsection and identified in Figure 5-2 to determine the individual contribution of each discharger to the formed solids. The corresponding monitoring surrogates are used as the cost allocation parameters (Section 5.2). The formation factor (FF_i) defines the charge assigned to an individual discharger (*i*), based on their contributions to the overall loading of the identified surrogate parameters (e.g., dissolved BOD_5, dissolved calcium, dissolved alkalinity, and flow), discussed in the following section.

The billing formula from the 2019 assessment (Trussell, 2019) is provided for comparison. The proposed billing formula for the current reporting period is shown below as the 2025 Billing Formula.

2019 Billing Formula (April – December 2018)

$$FF_{TSS} = \left[\frac{Calcium_m}{Calcium_t} \times (0.094) + \frac{Alkalinity_m}{Alkalinity_t} \times (0.140) + \frac{dBOD_m}{dBOD_t} \times (0.471) + \frac{Flow_m}{Flow_t} \times (0.295)\right]$$

2025 Billing Formula (April – June 2025)

$$FF_{TSS} = \left[\frac{Calcium_m}{Calcium_t} \times (0.08) + \frac{Alkalinity_m}{Alkalinity_t} \times (0.12) + \frac{dBOD_m}{dBOD_t} \times (0.62) + \frac{Flow_m}{Flow_t} \times (0.18)\right]$$

Where:

FF_{TSS} = Formation factor for discharger's estimated share of the TSS formation load

$Calcium_m$ = The dissolved calcium load measured for the discharger

$Calcium_t$ = The sum of the dissolved calcium loads measured for all dischargers

$Alkalinity_m$ = The dissolved alkalinity load measured for the discharger

$Alkalinity_t$ = The sum of the dissolved alkalinity loads measured for all dischargers

$dBOD_m$ = The dissolved BOD_5 load measured for the discharger

$dBOD_t$ = The sum of the dissolved BOD_5 loads measured for all dischargers

$Flow_m$ = The individual flow contribution for the discharger

$Flow_t$ = The combined flow for all dischargers to the Brine Line

6 Monitoring Program

Consistent monitoring of the water quality at SMS and at each discharger, as well as periodic evaluation of the SMS solids characterization, are recommended for maintaining data that reflects real-time changes in the Brine Line system. The monitoring program has been updated to reflect the findings from the recent evaluation.

6.1 SMS Solids Characterization Sampling

The 2019 Annual Water Quality and Billing Formula Report recommended that SAWPA perform monthly solids characterization sampling at the SMS (Trussell, 2019). SAWPA currently does not perform regular solids characterization. After performing the analysis for this current reporting period and comparing the results to previous reporting periods, Trussell has concluded that the solids fraction breakdown between the different organic and inorganic categories has remained consistent over the last several reporting periods. As such, Trussell recommends completing future characterization events every two years with monthly assessment for a three-month period. Figure 6-1 shows an example of the monitoring schedule, and the actual sample timing is flexible.

# of Events	2026											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Weekly WQ Monitoring	4x	4x	4x	4x	4x	4x	4x	4x	4x	4x	4x	4x
Solids Characterization				1x	1x	1x						
# of Events	2027											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Weekly WQ Monitoring	4x	4x	4x	4x	4x	4x	4x	4x	4x	4x	4x	4x
Solids Characterization												
# of Events	2028											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Weekly WQ Monitoring	4x	4x	4x	4x	4x	4x	4x	4x	4x	4x	4x	4x
Solids Characterization								1x	1x	1x		

Figure 6-1. Example Schedule of SMS Weekly Monitoring Events and Solids Characterization Events

The three monthly sampling events are recommended to account for the inherent variability in this heterogenous and dynamic Brine Line system. The full scope of the monitoring plan at SMS is outlined in Table 6-1.

Table 6-1. Summary of monitoring plan at SMS

Constituent/Analysis	Test Method	Frequency	Notes
Field Measurements			
Flow	-	Online monitoring	Total per 24-hour sampling event
pH	-	Online monitoring, grab sample	Every sampling event
Temperature	-	Grab sample	Every sampling event
Liquid Analyses			
TSS	SM 2540D	Weekly	Expedited analysis (<24h hold); Analysis in triplicate
VSS	EPA 160.4	Weekly	Expedited analysis (<24h hold); Analysis in triplicate
BOD_5	SM 5210B	Weekly	Total and dissolved (TSS filter[1]); Total analysis in triplicate
Alkalinity	SM 2320B	Weekly	Total and dissolved (TSS filter[1])
Calcium	EPA 200.7	Weekly	Total and dissolved (TSS filter[1])
TDS	SM 2540C	During solids characterization event: once per month for 3 months, every 2 years	
Orthophosphate	SM 4500P E	During solids characterization event: once per month for 3 months, every 2 years	Total and dissolved (TSS filter[1])
Dissolved Organic Carbon (DOC)	SM 5310B	During solids characterization event: once per month for 3 months, every 2 years	Using TSS filter paper substitution[1]
Solids Characterization			
X-ray diffraction (XRD)	XRD	Once per month for 3 months, every 2 years	Provides mineral characterization
Wavelength Dispersive X-ray Fluorescence Spectroscopy (WDXRF)	WDXRF	Once per month for 3 months, every 2 years	Provides elemental characterization
Thermogravimetric analysis (TGA)	TGA	Once per month for 3 months, every 2 years	Provides cellulose identification and quantification

[1]All filtered measurements shall be filtered using a 1.5-micron glass fiber filter.

The current method for sample collection at the SMS is as follows. The 24-hour composite sample is mixed on-site, using a mechanical mixer, and then distributed into bottles for subsequent analysis per the monitoring plan defined in Table 6-1. The sample bottles are sent to both Babcock Laboratories and the Trussell lab. Babcock Laboratories performs liquid analyses listed in Table 6-1. Trussell takes the sample and separates the suspended solids from the liquid supernatant using centrifugation and then ships the resulting wet sludge to Camet Research for XRD, WDXRF, and TGA analyses.

6.2 Discharger Solids Characterization Sampling

In each discharger sampling event, it is recommended to collect a representative sample and complete single replicate analyses of TSS, VSS, total and dissolved BOD_5, total and dissolved alkalinity, and total and dissolved calcium, all from the same sample. When performing filtration for dissolved components, it is recommended to use a 1.5-micron glass fiber filter to be consistent with the definition of suspended solids from the TSS method. It is important to analyze all of the recommended water quality analyses from a single sample to ensure that the results are representative and can be correlated.

Each active discharger was grouped into one of five categories based on the loading values in Table 3-3: 1) the top three dischargers contributing to total loading for a given parameter, 2) dischargers contributing to the top 75% of the total loading for a given parameter, 3) dischargers contributing to the top 95% of the total loading for a given parameter, 4) intermittent dischargers, and 5) all remaining dischargers. A recommended sampling frequency was assigned to all dischargers within each category. The top three dischargers that contribute to total loading for a given parameter were assigned a monthly sampling frequency, at minimum. Dischargers that contribute to the top 75% of the total loading value for each of the billing parameters were assigned a quarterly sampling frequency, at minimum. Dischargers that contribute to the top 95% of the total loading value for each of the billing parameters were assigned a semiannual (twice per year) sampling frequency, at minimum. A few dischargers identified as having intermittent, seasonal, or emergency flow contributions (e.g., WRCRWA, SCE Mira Loma Peaker Plant, and JCSD Chandler Lift Station) are assigned an intermittent monitoring frequency, with the recommendation to collect a sample every time they discharge to the Brine Line. All remaining dischargers are assigned an annual sampling frequency at minimum. The monitoring frequencies are summarized in **Error! Reference source not found.**. Further refinement of these sampling frequency recommendations could be considered by evaluating the future variability in water quality results for these dischargers. If variability is low for a given discharger across all surrogate water quality parameters, it is expected to have less of an impact in evaluating the real-time cumulative solids loading to the Brine Line system.

The dissolved parameters are the priority for billing purposes. However, it is essential to monitor both total and dissolved species (BOD_5, calcium, and alkalinity) from the same representative sample. Total and dissolved species should not be measured from separate samples. This is a crucial aspect that provides representative correlation between total and dissolved species, allowing for calculation of the particulate or solid fraction present in the sample. Generating representative data on the solids present in the discharger samples allow for improved understanding of the inputs into the Brine Line system, which can then be used in combination with the assessment of solids from the SMS to evaluate solids formation within the Brine Line.

Table 6-2. Recommended ongoing sampling frequency for Brine Line dischargers

Top 3
Top 75%
Top 95%

M = Monthly
Q = Quarterly
SA = Semiannual
A = Annual
I = Intermittent

Flow Rank	Discharger Name	Total Solids	Volatile Solids	BOD (kg/month)		Alkalinity (kg/month)		Calcium (kg/month)	
		(kg/month)	*(kg/month)*	*Total*	*Dissolved*	*Total*	*Dissolved*	*Total*	*Dissolved*
1	Chino I Desalter	M	M	M	M	M	M	M	M
2	Perris and Menifee Desalter MP001	M	M	M	M	M	M	M	M
3	JCSD Etiwanda Metering Station	M	M	M	M	M	M	M	M
4	Temescal Desalter	M	M	M	M	M	M	M	M
5	Perris and Menifee Desalter MP002	Q	Q	Q	Q	Q	Q	Q	Q
6	Chino Desalter II East	Q	Q	Q	Q	Q	Q	Q	Q
7	WMWD Arlington Desalter	SA	SA	SA	SA	SA	SA	SA	SA
8	City of Beaumont Wastewater Treatment Plant	SA	SA	SA	SA	SA	SA	SA	SA
9	YVWD - Henry Wochholz Plant	SA	SA	SA	SA	SA	SA	SA	SA
10	Mountainview Generating Station	SA	SA	SA	SA	SA	SA	SA	SA
11	JCSD Wineville Metering Station	M	M	M	M	M	M	M	M
12	Aramark Uniform & Career Apparel, LLC	M	M	M	M	M	M	M	M
13	California Institution for Women (CIW)	M	M	M	M	M	M	M	M
14	Mission Linen Supply	M	M	M	M	M	M	M	M
15	Chino Desalter II West	SA	SA	SA	SA	SA	SA	SA	SA
16	Stringfellow Pretreatment Facility	A	A	A	A	A	A	A	A
17	In-N-Out Burger, Chino Distribution Center	SA	SA	SA	SA	SA	SA	SA	SA
18	JCSD Hamner Metering Station*	-	-	-	-	-	-	-	-
19	Niagara Bottling, LLC (IEUA)	A	A	A	A	A	A	A	A
20	Rialto Bioenergy Solutions	SA	SA	SA	SA	SA	SA	SA	SA
21	Californian Institution for Men (CIM)	A	A	A	A	A	A	A	A
22	Dart Containers	A	A	A	A	A	A	A	A
23	Niagara Bottling, LLC (SBMWD)	A	A	A	A	A	A	A	A
24	Repet, Inc.	Q	Q	Q	Q	Q	Q	Q	Q
25	Skorpios Technologies	A	A	A	A	A	A	A	A
26	OLS Energy - Chino	A	A	A	A	A	A	A	A
27	Wellington Foods	SA	SA	SA	SA	SA	SA	SA	SA
28	Eastside Water Treatment Plant	A	A	A	A	A	A	A	A
29	Frutarom USA, Inc.	SA	SA	SA	SA	SA	SA	SA	SA
30	Inland Water Services	A	A	A	A	A	A	A	A
31	Green River Golf Course (GRGC)	A	A	A	A	A	A	A	A
32	RCSD	A	A	A	A	A	A	A	A
33	WRCRWA - South Regional Pumping Station**	I	I	I	I	I	I	I	I
34	Saratoga Food, Inc.	SA	SA	SA	SA	SA	SA	SA	SA
35	Sierra Aluminum Company, Inc.	A	A	A	A	A	A	A	A
36	City of Colton - Agua Mensa Power Plant	A	A	A	A	A	A	A	A
37	Emerald Colton	A	A	A	A	A	A	A	A
38	Loma Linda University Power Plant	A	A	A	A	A	A	A	A
39	SCE Mira Loma Peaker Plant**	I	I	I	I	I	I	I	I
40	Prudential Overall Supply	A	A	A	A	A	A	A	A
41	Loma Linda Veterans Affairs (VA) Medical Center	A	A	A	A	A	A	A	A
42	Decra Roofing Systems	A	A	A	A	A	A	A	A
43	Qualified Mobile, Inc.	A	A	A	A	A	A	A	A
44	Indian Oaks Campground	A	A	A	A	A	A	A	A
45	San Antonio Regional Hospital	A	A	A	A	A	A	A	A
46	La Sierra University	A	A	A	A	A	A	A	A
47	JCSD Chandler Lift Station**	I	I	I	I	I	I	I	I

*Discharger has been taken offline, no sampling frequency recommendation required.
**Intermittent dischargers only need to sample every time they discharge.

7 Findings and Recommendations

Principal findings from this assessment include the following:

SMS

- **Brine Line flow has increased since 2019**: Compared to average monthly flow for the period of July 2016 – March 2019 of 316 MG/month, average monthly flow of the current reporting period has increased to 353 MG/month.
- **Brine Line suspended solids loading has decreased since 2019:** The monthly average suspended solids loading at the Brine Line has overall decreased since the historical period of July 2016 – March 2019. Compared with 286,000 lbs/month in the previous reporting period, solids loading at the SMS decreased to 260,000 lbs/month in 2023/24 fiscal year.
- **The composition of the solids has remained consistent:** The solids partitioning from the last reporting period and the current reporting period were both roughly 75% organic and 25% inorganic material. Of the organic fraction for this reporting period (75% of the TSS), approximately 39% was identified as microbial biomass and the remaining 36% was cellulosic material. On the inorganic side, the fraction of calcium minerals present is approximately 14% of the suspended solids, with “other inorganics” accounting for the remaining 11%.

Dischargers

- **Discharger flow and loading have increased since 2019:** Consistent with the Brine Line flow, the combined discharger flow has increased compared to the previous reporting period, which would result in an increase in all loadings if their concentrations remained unchanged. The combined discharger suspended solids loading has increased and continued to fluctuate month-to-month. The BOD_5 loading has been stable, dissolved BOD_5 loading has decreased, and total/dissolved alkalinity and total/dissolved calcium loading have significantly increased (doubled or nearly tripled).
- **Solids loading varied by discharger type**: Commercial dischargers comprise the majority of the solids loading; brine dischargers solid loading increased between July 2019 and July 2022 and have decreased since then; and domestic dischargers contributed the least to solids loading but experienced a spike in solids loading in July 2021 due to WRCRWA discharge.
- **Water quality monitoring can be improved:** As was mentioned in previous reports, the total and dissolved fractions of each monitoring parameter should both be analyzed from a single sample. This applies to the measurements of BOD_5, calcium, and alkalinity, as well as TSS and VSS. Additionally, the data collection frequency could be increased for some of the dischargers for certain parameters (e.g., dissolved calcium), as some month-to-month loading values of

impactful dischargers needed to be averaged between data points during the current analysis.

Suspended solids formation

- **The suspended solids formation has increased:** The net solids formation through the Brine Line has increased for the current period to 143,000 lbs/month, compared with an average 94,000 lbs/month for the last reporting period (2019). These average solids formation numbers are provided as a point of reference for comparing the changes over time. For billing purposes, SAWPA incorporates a 12-month rolling average of the suspended solids formation.
- **Increase in microbial biomass formation:** There were similar amounts of calcium mineral and other inorganics formation between the current reporting period and the previous reporting period, but there was about 62% microbial biomass formation during the current reporting period as compared with 47% microbial biomass formation during the previous reporting period. When the difference in formation magnitude between the two periods is considered, the current reporting period had nearly double the microbial biomass formation (88,000 lbs/month) as compared with the previous reporting period (44,000 lbs/month).
- **"Other" inorganic formed suspended solids were identified:** Per Camet Research's reports, the four constituents that contributed to the highest percentage of the "other" inorganic category were silica, ferric oxide, sulfur trioxide, and alumina. These four constituents are byproducts of wear and tear on the Brine Line collection system.

In light of these findings and known changes, the following recommendations are proposed:

- **Adopt a new billing formula:** It is recommended to adopt the proposed billing formula to reflect changes in the Brine Line solids composition observed since the previous reporting period over 5 years ago.

$$FF_{TSS} = \left[\frac{Calcium_m}{Calcium_t} \times (0.08) + \frac{Alkalinity_m}{Alkalinity_t} \times (0.12) + \frac{dBOD_m}{dBOD_t} \times (0.62) + \frac{Flow_m}{Flow_t} \times (0.18)\right]$$

- **Continue to implement monitoring program:** To continue tracking changes in the Brine Line water quality and suspended solids, it is recommended to continue implementing the monitoring program for both the SMS and individual dischargers to the Brine Line with the analyses and monitoring frequency discussed in Section 6. In addition, it is highly recommended to align the water quality analyses within the same representative samples, so that each water quality parameter from each discharger can be closely tracked and form indicative trends over time of the general conditions within the Brine Line.

- **Evaluate variability in the surrogate water quality parameters for top dischargers:** Assessment of the sample-to-sample variability for the surrogate water quality parameters for the top 3 discharger category (those with monthly frequency) is recommended to determine the impact on cumulative discharger loading values with different sampling frequencies.
- **Lower recommended solids characterization frequency at the SMS:** Monthly characterization of suspended solids is not necessary for the SMS because the solids fraction breakdown between the different organic and inorganic categories remains relatively consistent. Trussell recommends the solids characterization events to be performed once per month for three months, every 2 years.

8 References

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9 Appendix A – Trussell Communication with SAWPA, February 2025

COMMUNICATION

Santa Ana Watershed Project Authority

Draft Date: February 4, 2025

Authors: Aidan Hasegawa
Wen Cong, Ph.D.

Reviewers: Emily Owens-Bennett, P.E., BCEE

Subject: Inland Empire Brine Line Water Quality and Solids Formation Update

1 Background

Trussell Technologies, Inc. (Trussell) has been retained by the Santa Ana Watershed Project Authority (SAWPA) to conduct an updated study of the Inland Empire Brine Line (Brine Line) water quality and billing formula (Study). SAWPA owns and operates the Brine Line, which conveys a mixture of brine concentrate, domestic, and industrial wastewaters from its upper reaches in Riverside and San Bernardino Counties to Orange County. Ownership of the wastewater and conveyance is transferred from SAWPA to the Orange County Sanitation District (OC San) at the County Line, specifically at the Canyon RV Park monitoring station. The Study's objectives are twofold, (1) to assess recent water quality and evaluate changes through the Brine Line system and (2) to develop an updated scientifically-based formula for allocating costs associated with any identified solids formation. The first effort of the Study involved summarizing the water quality data of the Brine Line for the period covering July 2019 through June 2024; documenting an updated historical assessment of water quality in the Brine Line; and identifying findings and recommendations for supplemental monitoring to obtain sufficient data for assessing the solids formation and updating the Brine Line billing formula. This information is contained within this Communication and will ultimately be included in a final report on the Study.

The effort builds on Trussell's support of SAWPA since 2011 in characterizing suspended solids formation in the Brine Line. Since 2016, SAWPA has implemented a billing formula developed in collaboration with Trussell to allocate OC San solids treatment and disposal costs to SAWPA's dischargers for solids formed in the Brine Line. Trussell completed annual reviews of the billing formula and monitoring data for the years 2017, 2018, and 2019. It is important to note that the prior efforts to assess and allocate solids formed within the Brine Line system relied on characterization of the solids fraction of samples collected from the County Line monitoring location. This effort was discontinued in late 2021; thus, the data assessment for this current effort is limited to the water quality results (liquid samples) from both the County Line and individual Brine Line dischargers.

2 Methodology of Data Review

This section summarizes the methodology incorporated in the water quality data review, which builds on efforts from Trussell's prior Brine Line solids formation studies. Due to discontinuation of the solids monitoring at the County Line as of late 2021, this assessment does not include solids characterization.

2.1 Overview of Data Received

For the current reporting period (July 2019-June 2024), Trussell received water quality and flow data for sixty (60) direct and indirect Brine Line dischargers, and the downstream Canyon RV Park S-01 (S-01 or County Line) monitoring location. This water quality data was collected in conjunction with routine monitoring previously recommended to complement the solids formation billing formula.

The water quality data that were evaluated for the Study are listed in Table 1 below.

Table 1. Water quality parameters used in analysis.

Parameter	Unit
Total Suspended Solids (TSS)	mg/L
Volatile Suspended Solids (VSS)	mg/L
Biochemical Oxygen Demand (BOD_5), Total	mg/L
BOD_5, Dissolved	mg/L
Alkalinity, Total	mg/L as $CaCO_3$
Alkalinity, Dissolved	mg/L as $CaCO_3$
Calcium, Total	mg/L
Calcium, Dissolved	mg/L

Although water quality data was provided for each individual discharger during the monitoring period, there were discrepancies between the recommended monitoring frequency and the frequency of data for some dischargers, as well as missing data points for some water quality parameters. For several dischargers, the dissolved parameters were often not analyzed, which is a challenge for evaluating the particulate fraction of the sample for a given parameter (total – dissolved = particulate). Another data challenge was the occurrence of unpaired monitoring results, where the TSS and VSS were analyzed from different samples, making it difficult to establish representative data that can be correlated among parameters, as well as over time for a given discharger location.

2.2 Discharger Data Analysis

The water quality data from the sixty dischargers were averaged by month. Using the water quality parameters shown in Table 1, the following parameters were calculated:

- VSS/TSS ratio (unitless)
- Particulate BOD_5 (mg/L)
- Particulate Alkalinity (mg/L)

- Particulate Calcium (mg/L)

Solids loading values (in kilograms per month) associated with each of the water quality constituents that have historically been used to assess solids formation in the Brine Line were calculated using the product of monthly average flow data (in million gallons per month) and monthly average water quality data (in mg/L).

2.3 County Line Data Analysis

For the County Line, monthly flow data (in million gallons per month) and weekly water quality data (in mg/L) were provided. To calculate the VSS/TSS ratios, the average VSS of a given date was divided by the average TSS of that date. To calculate solids formation values for each of the contributing parameters, the monthly average water quality data from weekly sampling events and monthly average flow data were used.

2.4 Data Adjustments

The previous reporting periods contained some data adjustments, which were documented in past Trussell reports:

- The discharger Inland BioEnergy released an uncharacteristically high suspended solids load from late January into early March 2019, resulting in nonrepresentative suspended solids measurements from both discharger loading and from the County Line results from January to March of 2019 (Trussell, 2019). For this reason, data from January to March of 2019 were omitted in the 2019 report.
- In 2016, the frequency of data monitoring increased as part of the billing formula development (Trussell, 2019).

Key adjustments associated with the analysis of data from the current reporting period include:

- The JCSD Etiwanda Monitoring Station is located on a JCSD lateral, just upstream of the connection to the Brine Line. There are several upstream dischargers to the JCSD Etiwanda lateral, including Chino II East. In past analyses, the monitoring data from JCSD Etiwanda was adjusted to exclude the Chino II East flows and loading values, such that these two discharges could be evaluated separately. For the current reporting period, water quality and flow data were provided for five direct dischargers to the JSCD Etiwanda lateral, including Del Real Foods, JCSD Wells 17 & 18, Metal Container Corporation, JCSD Roger D. Teagarden IX Water Treatment Facility, and Magnolia Foods. The data from these 5 direct dischargers to the JCSD Etiwanda line were evaluated to assess relative solids loading values.
- In November 2020, high TSS (6,800 mg/L) and VSS (5,000 mg/L) concentrations were reported for the JCSD Etiwanda Monitoring Station. SAWPA confirmed that these values correspond with the Del Real Foods tamale production season and should be considered outliers as changes have been made to eliminate these high-solids loading wastewater events. Another TSS concentration was reported for the same month that was considered more representative of the company's typical solids

loading output (380 mg/L). For these reasons, the high value of 6,800 mg/L TSS was eliminated from this analysis.

3 Results

This section provides a summary of the water quality conditions within the Brine Line during the current reporting period. Flow and loading values are evaluated for the cumulative discharger contributions, the downstream County Line monitoring location, and comparison of these to reflect changes through the Brine Line system. After identifying trends, the data from each source were analyzed separately. This analysis also identified discrepancies and/or deficiencies in the monitoring data and associated solids loading assessment. These findings inform recommendations for additional monitoring to be completed in the subsequent phase of the Study.

3.1 Comparisons between County Line and Dischargers

Flow through the Brine Line is an indicator of changes through the system over time. As shown in Figure 1, flow demonstrates a high degree of uniformity between the County Line and the combined dischargers. Statistics of the monthly flow imbalance between the County Line flow and the total discharger flow during the selected historical period (January 2014 – March 2019) and the current reporting period (July 2019 – June 2024) are shown as tables in the figure. The average flow imbalances during the historical and current periods are similar and minimal (1.1% and 1.3%). Conversely, the current reporting period experienced more variation between its County Line flow and combined discharger flow than the historical period; the current period had larger 5th and 95th percentiles (-5.1% and 8.0%, respectively) than the historical period (-0.7% and 5.5%, respectively).

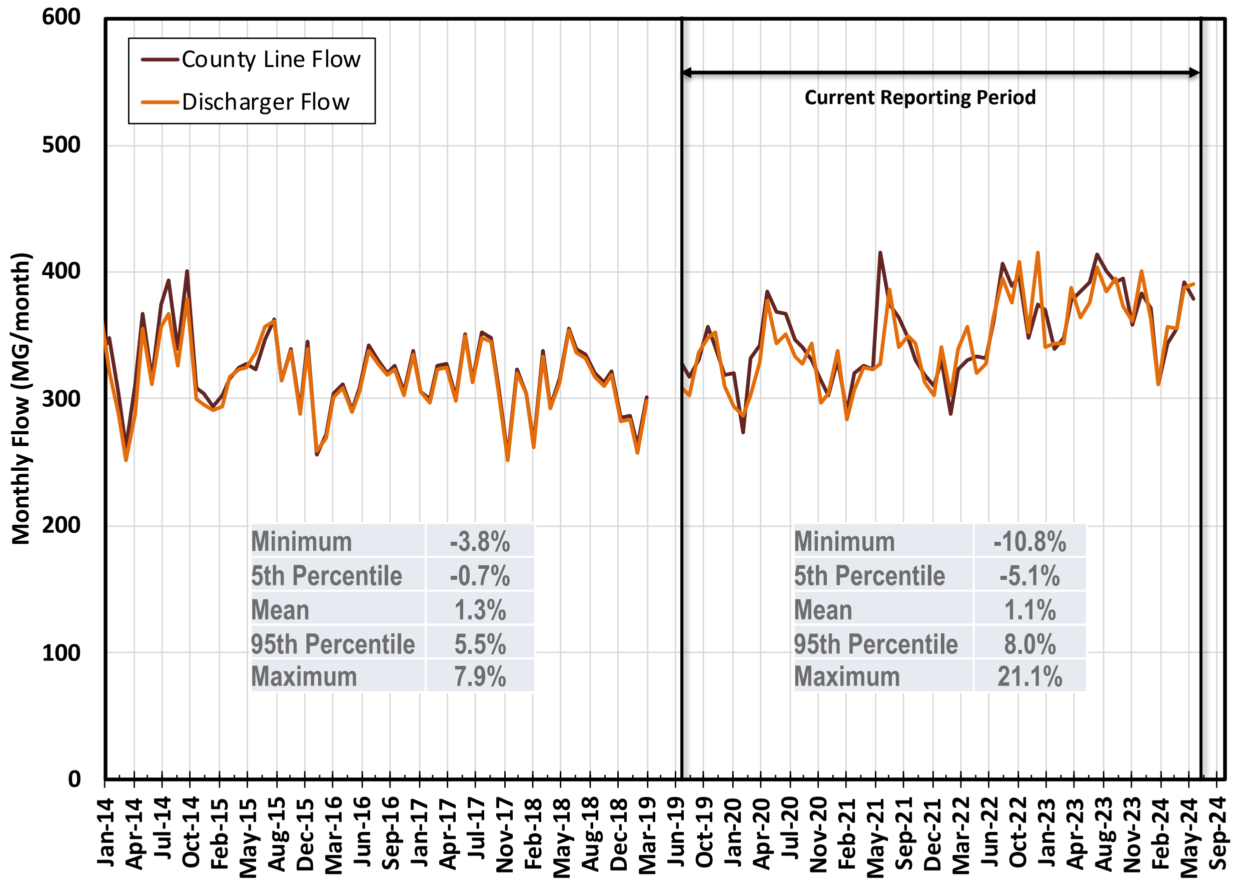

Figure 1. Cumulative flow from all dischargers compared with flow measured at S-01 from March 2014 – June 2024.

Then, the combined monthly TSS loading from all dischargers were graphed against the monthly TSS loads reported at the County Line monitoring location. Figure 2 shows the comparison from January 2016 to June 2024, with historical data through January 2016, as well.

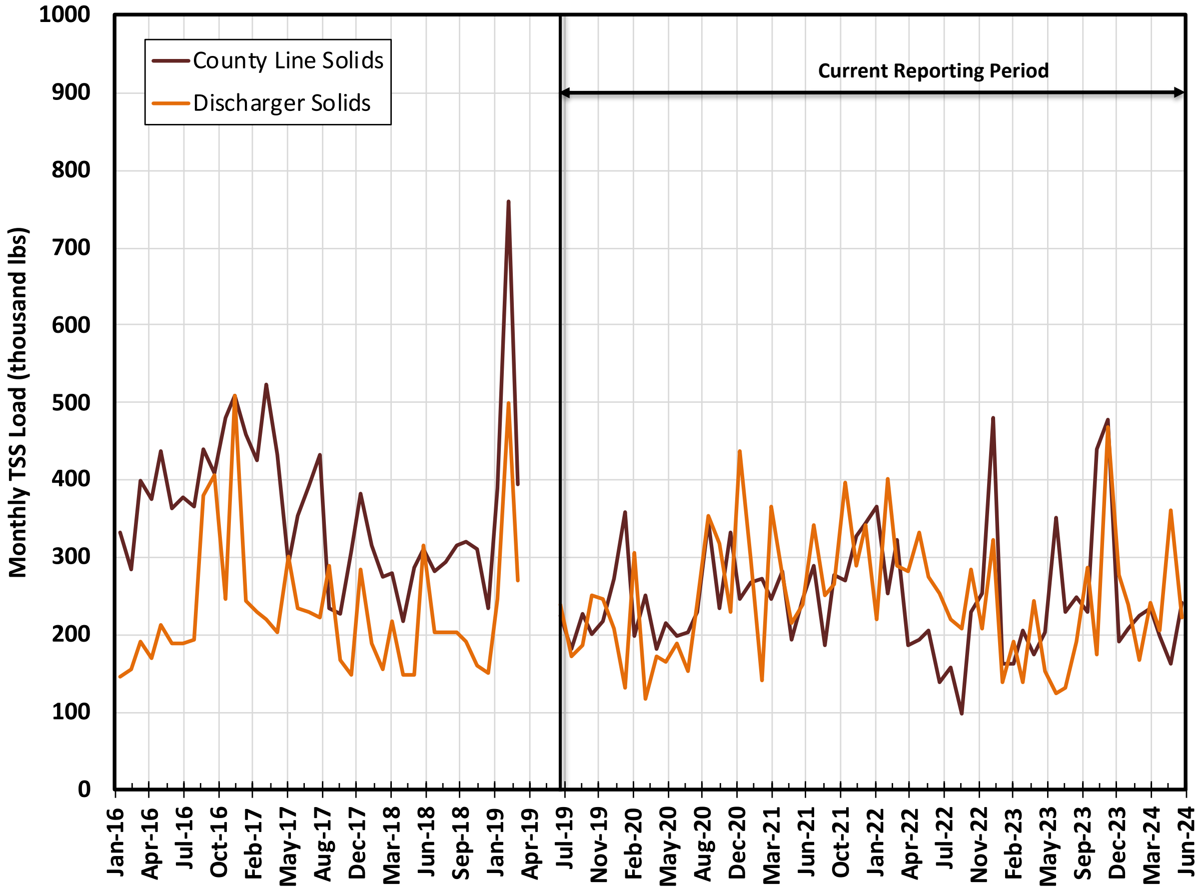

Figure 2. Total suspended solids from all dischargers compared with measured total suspended solids at S-01 from January 2016 – June 2024.

The trends between the TSS load observed at the County Line and the TSS load contributed by the combined dischargers have experienced a greater amount of fluctuation compared with trends from past reporting periods. Unlike the historical data, in which the County Line TSS load was generally higher in magnitude than the combined discharger TSS load, the current reporting period from July 2019 to June 2024 yielded more mixed results. For example, the combined discharger TSS load was higher than the County Line TSS load during the months of May and June 2022, but the County Line TSS load was higher than the combined discharger TSS load during the months of May and June 2023.

It is insightful to illustrate the difference in suspended solids loading in Figure 2 as a ratio, to visualize solids formation in the Brine Line independent of overall magnitude. Averaged on a fiscal calendar basis, the solids observed at Canyon RV Park S-01 station divided by solids input from the dischargers is provided in Figure 3. A ratio of 1 means the solids loading observed at the County Line equals that of the combined dischargers (*i.e.*, indicating no solids formation) whereas a ratio greater than 1 means that the solids loading at the County Line exceeded the suspended solids discharged to the system (*i.e.*, suggesting solids formation). The suspended solids formation ratios for the current reporting period were at or around 1.0.

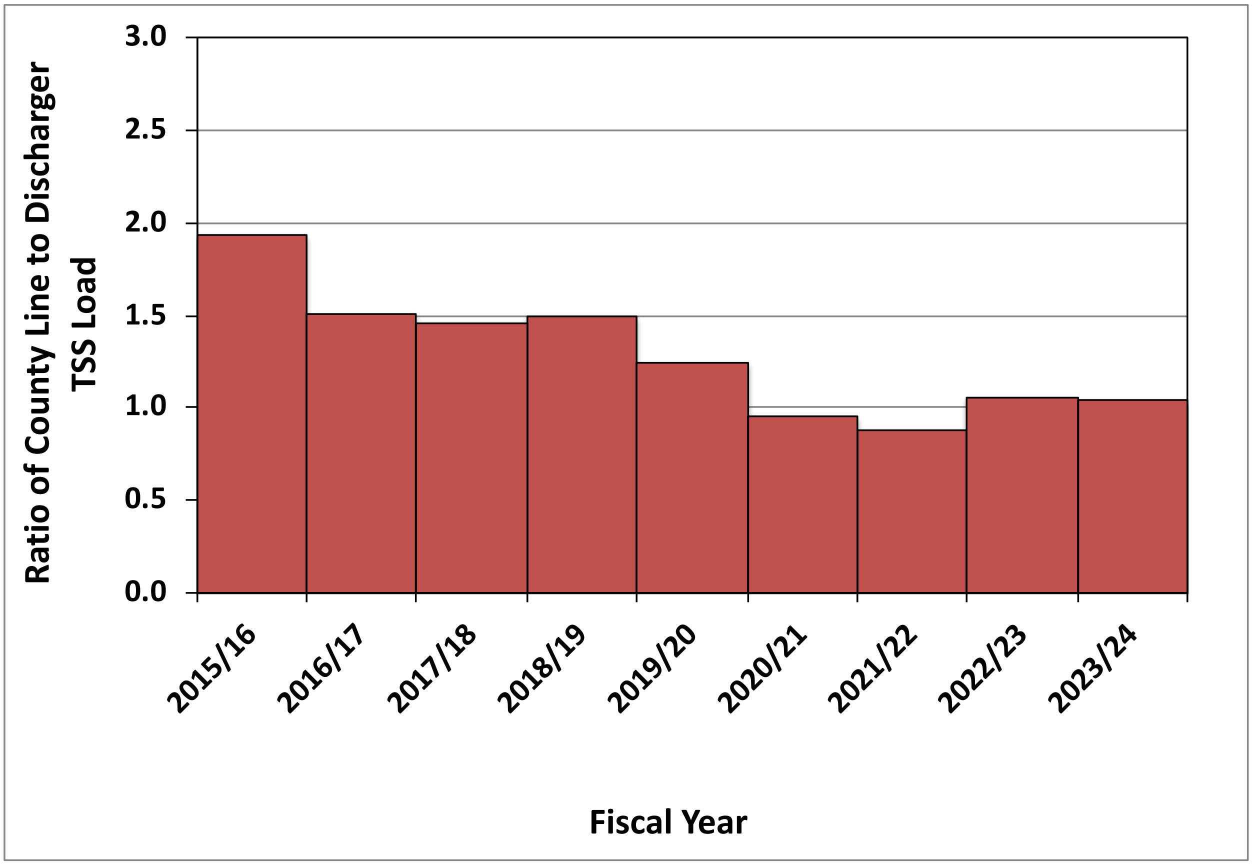

Figure 3. Relative increase in TSS in the Brine Line from the points of discharge to the County Line monitoring station on a calendar year basis (January 2015 – June 2024).

3.2 County Line

Figure 4 shows all weekly average TSS measurements from the S-01 monitoring station from January 2016 through June 2024. Figure 5 shows the weekly average TSS measurements from S-01 for the current reporting period only.

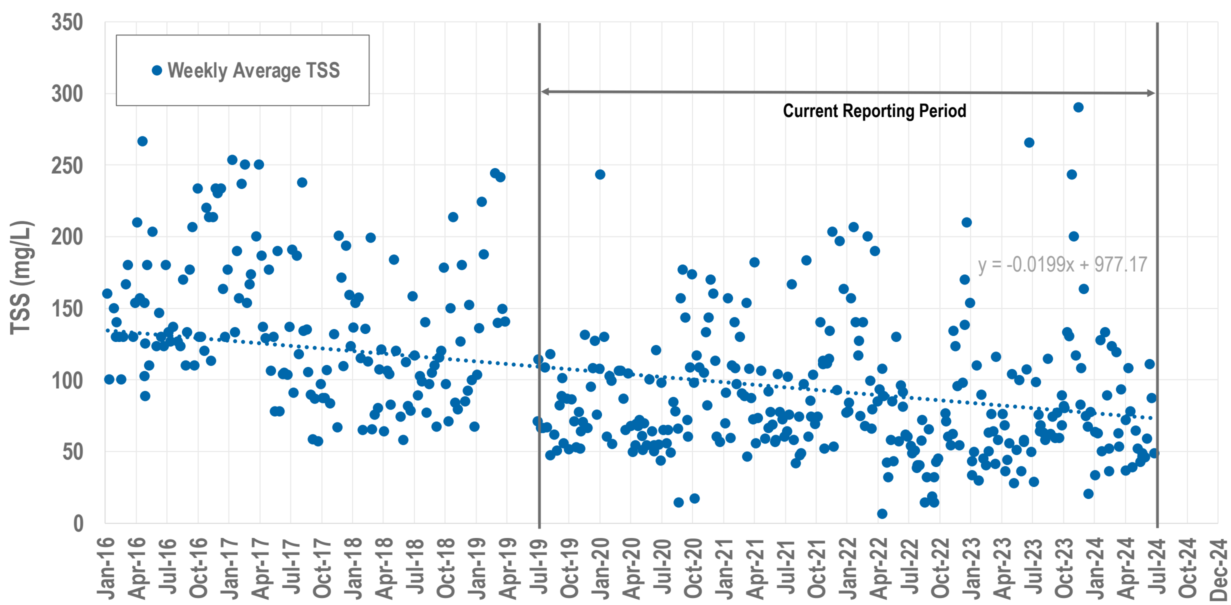

Figure 4. Weekly average TSS results at the S-01 station (January 2016 – June 2024).

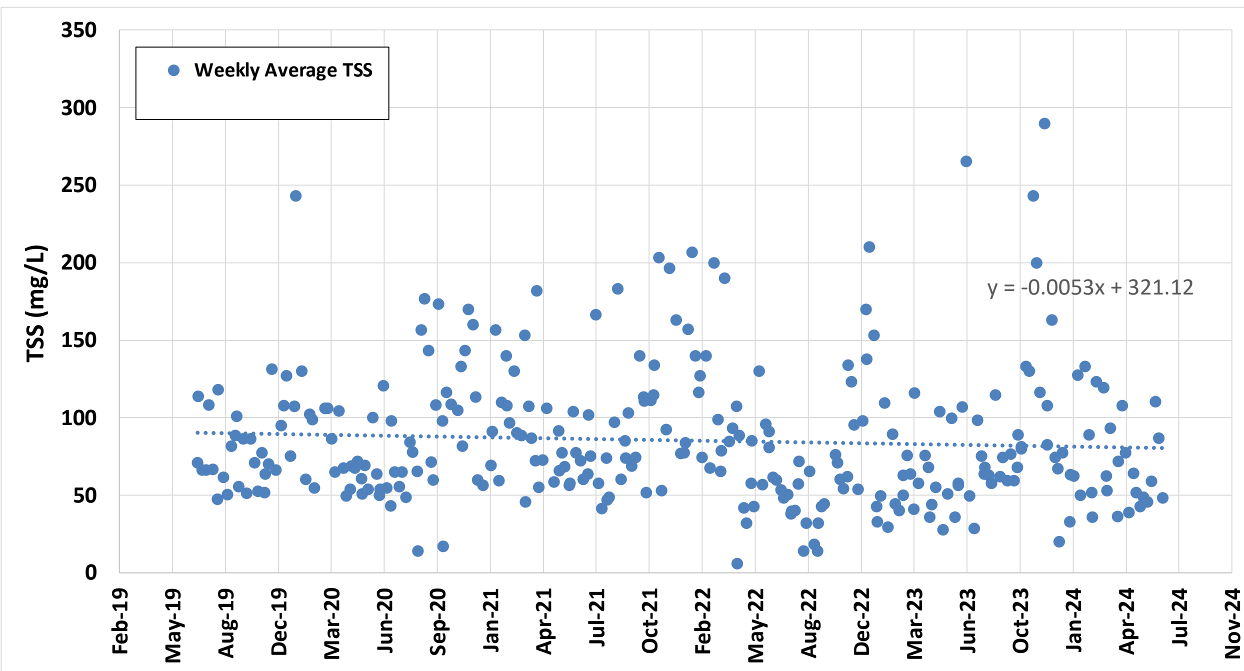

Figure 5. Weekly average TSS results at the S-01 station (July 2019 – June 2024).

As seen in Figure 5, the trendline of the current reporting period is much flatter and more consistent than the trendline in Figure 4. The overall average of the weekly average TSS measurements from S-01 during the current reporting period was 85 mg/L, as opposed to the average TSS of 106 mg/L during the wider timeframe that included historical data. Overall, weekly average TSS measurements from S-01 have been relatively stabilized over time, however the week-to-week variability in results was persistent throughout the reporting period.

TSS and VSS measurements were taken in triplicate from S-01 on a weekly basis and then averaged by week. These average weekly values were then averaged to generate a long-term understanding of the TSS, VSS, and VSS/TSS ratio trends. Table 2 shows the average of the average values for TSS, VSS, and the VSS/TSS ratio for the current reporting period, as well as each fiscal year within that period (19/20, 20/21, 21/22, 22/23, and 23/24).

Table 2. Average TSS, VSS, and VSS/TSS ratios from County Line.

Timeframe	Average TSS (mg/L)	Average VSS (mg/L)	Average VSS/TSS Ratio
July 2019 – June 2020	81	57	72%
July 2020 – June 2021	94	75	75%
July 2021 – June 2022	97	70	70%
July 2022 – June 2023	70	49	70%
July 2023 – June 2024	84	69	76%
Period Average:	**85**	**64**	**72%**

The average VSS/TSS ratio for the current reporting period was 72%, which is the same value as the average for the previous reporting period of April 2018 through December 2018 (Trussell, 2019). Notably, the average VSS/TSS ratio for each fiscal year differs from the overall average, as indicated in Table 2. However, the general trend of VSS/TSS ratios for weekly samples has been consistent since January 2016, as shown in Figure 6. This is important, as this ratio provides a surrogate measure of the organic fraction of the solids.

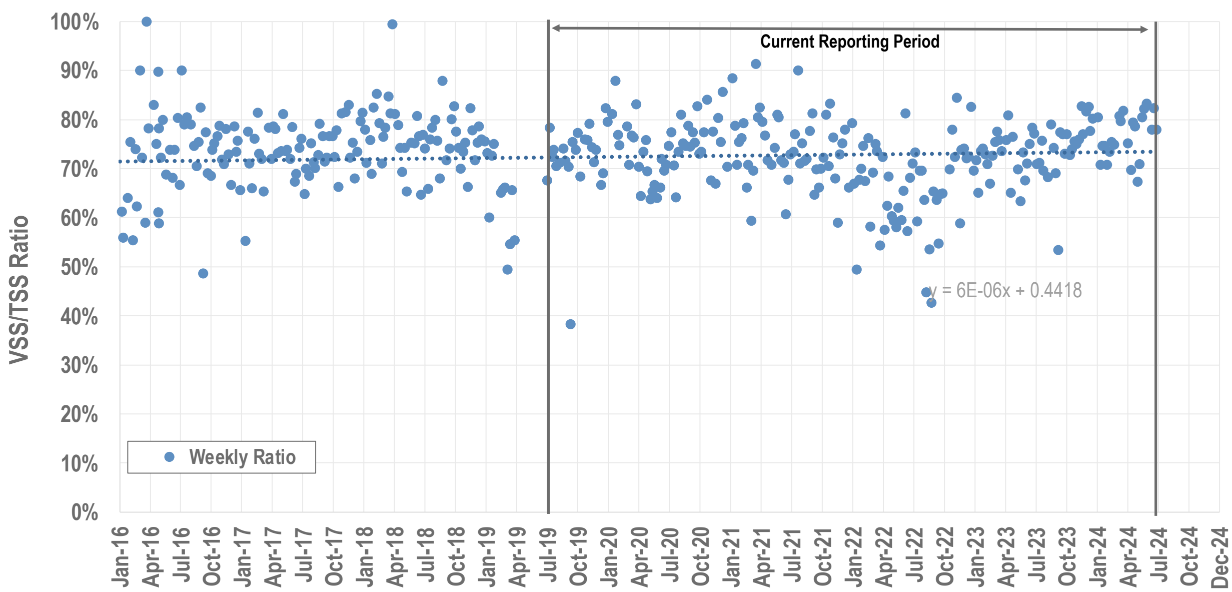

Figure 6. VSS/TSS ratio from weekly measurements at S-01 station (January 2016 – June 2024)

3.3 Dischargers

All sixty dischargers were categorized into three groups: brine, commercial, and domestic; and a profile of monthly suspended solids loading of dischargers through the Brine Line was created, as shown in Figure 7.

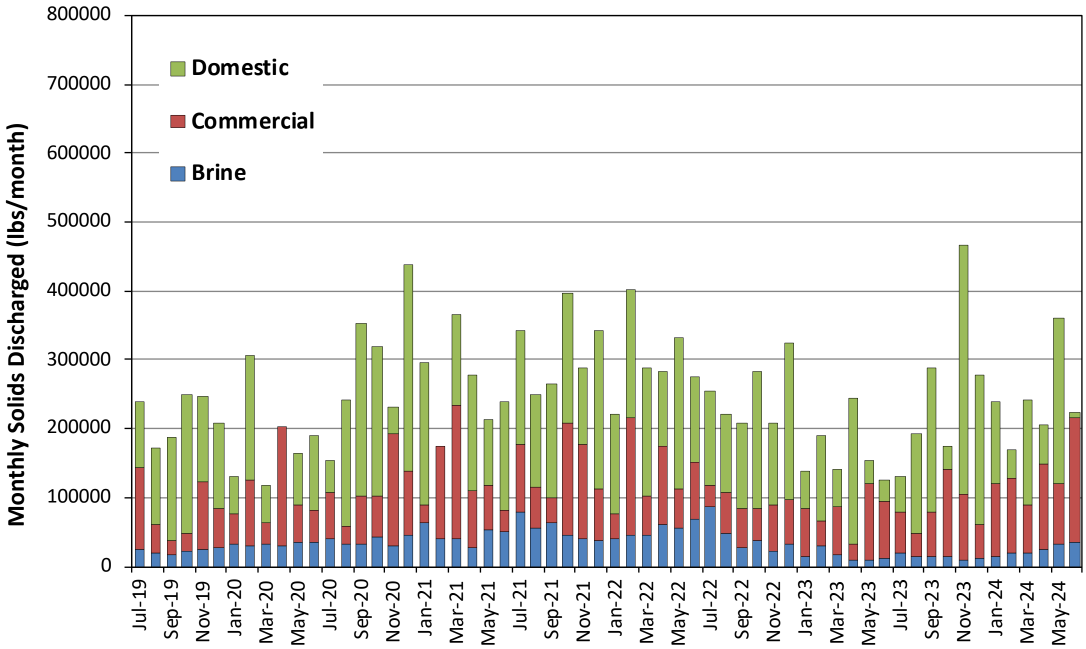

Figure 7. Brine Line discharger suspended solids loading by category (July 2019 – June 2024)

The figure illustrates how the magnitude of solids loading for the three categories of dischargers trend over time. Almost every month, the domestic dischargers comprised the majority of solids loading. The solids output by the brine dischargers grew over time and reached a peak in 2022 before decreasing again. Of the three categories, the domestic discharger loading experienced the highest amount of variability by month.

To directly compare the current dataset to the previous reporting periods, which only contained year-long datasets, the discharger data from the most recent fiscal year (2023-2024) were evaluated. The dischargers are ranked in Table 3 according to the average monthly flow for the 2023/24 fiscal period. The table also lists the average monthly loading rates for the primary water quality parameters identified as surrogates for suspended solids formation mechanisms (*i.e.*, TSS, VSS, BOD_5, calcium, and alkalinity). For each parameter, dischargers are grouped as (1) top 3 dischargers, (2) contributing to 75% of overall discharger loading, (3) contributing to 95% of overall discharger loading, and (4) other dischargers, as indicated in the legend. The data of indirect dischargers are in blue text, and the data of direct dischargers are in black text. When no data are available, the cell is marked with a hyphen. JCSD Etiwanda, JCSD Wineville, and JCSD Hamner are listed with flow and loading rates that were modified to exclude the flow and loading rates of dischargers located immediately upstream in the same lateral, including Chino II East, Chino II West, and SCE Mira Loma Peaker Plant, respectively.

The JCSD Etiwanda flow and loading values in Table 3 have not been adjusted to account for 5 additional upstream dischargers within the JCSD lateral. These include Del Real Foods, Metal Container Corporation, Magnolia Foods, JCSD Wells 17 & 18, as well as the JCSD Roger Teagarden Ion Exchange Treatment Plant. Unlike prior monitoring periods, flow and water quality data were provided for these 5 upstream dischargers for the current period. Although the relative loading values for these 5 dischargers have been summarized in Table 3, this represents a double-counting of the flow and loading contributed by the JCSD Etiwanda location. Preliminary analysis of the discrete loading values from these dischargers relative to the JCSD Etiwanda values indicates that there is some level of solids transformation (formation and/or scaling of the lateral) within the lateral based on the available monitoring data. Further assessment would be necessary to isolate the 5 individual discharger loads and their contribution to the Brine Line solids balance, rather than using the values from JCSD Etiwanda.

Table 3. Discharger average flow and suspended solids loading rates from July 2023 through June 2024.

Top 3	75% of loading	95% of loading

Flow Rank	Discharger Name	Monthly Flow (MG/month)	Total Solids (kg/month)	Volatile Solids (kg/month)	BOD (kg/month) Total	BOD (kg/month) Dissolved	Alkalinity (kg/month) Total	Alkalinity (kg/month) Dissolved	Calcium (kg/month) Total	Calcium (kg/month) Dissolved	Calcium (kg/month) Particulate
1	Chino I Desalter	66.8	1474.1	783.2	1402.1	1344.7	384824.6	379272.5	276368.1	225363.8	51004.3
2	Perris and Menifee Desalter MP001	64.2	814.5	556.6	1278.8	1147.3	176224.4	169168.4	212897.2	207677.3	12527.8
3	Temescal Desalter	52.7	1075.4	471.5	616.1	616.1	265630.0	247086.5	167799.6	149469.6	19996.4
4	Perris and Menifee Desalter MP002	37.3	617.1	410.7	936.2	846.4	108031.8	103594.8	126924.7	125974.7	11400.2
5	Chino Desalter II East	32.7	354.9	196.0	540.9	540.9	76019.6	71798.6	57562.5	52447.4	7672.6
6	JCSD Etiwanda Monitoring Station	23.7	67609.3	59343.7	45665.0	9924.0	82925.8	78942.2	9852.5	7784.2	2068.3
7	WMWD Arlington Desalter	19.5	1610.3	569.7	301.5	253.4	119047.5	116542.1	48702.1	47432.9	2175.8
8	City of Beaumont Wastewater Treatment Plant	16.0	69.1	64.7	466.5	434.2	74694.1	71442.9	13319.2	13016.7	605.0
9	YVWD - Henry Wochholz Plant	12.8	160.2	146.9	374.7	309.2	13667.4	13542.4	9122.8	8756.1	488.9
10	Mountainview Power Plant (Mountainview Gene	12.6	1132.0	367.0	298.4	262.4	-	5299.5	10107.7	8673.2	2459.1
11	Aramark Uniform & Career Apparel, LLC	4.6	9600.5	6590.6	17112.7	7468.7	9863.7	9512.1	710.9	513.6	236.7
12	California Institution for Women (CIW)	4.6	6480.4	6152.7	3411.2	768.7	4187.7	3783.5	898.7	825.9	79.5
13	Mission Linen Supply	4.1	1623.0	1393.6	10503.2	8060.5	8540.6	8050.8	368.1	272.6	104.2
14	Chino Desalter II West	3.9	333.3	98.8	69.5	69.5	22663.7	21211.9	1136.8	1034.5	153.3
15	Del Real Foods, LLC	3.6	12984.6	8277.3	28232.7	-	-	-	1394.9	-	-
16	Stringfellow Pretreatment Facility	3.5	74.2	66.1	162.0	107.1	2251.9	2235.7	3552.8	3488.0	388.3
17	Metal Container Corporation	3.3	13114.8	4852.1	3959.8	-	1214.7	-	5371.5	5371.5	0.0
18	JCSD Wineville Monitoring Station	2.5	9569.7	4566.1	3030.5	295.3	2446.9	2033.7	1126.9	954.2	213.1
19	In-N-Out Burger, Chino Distribution Center	2.0	457.4	388.2	1290.3	-	-	-	-	-	-
20	JCSD Hamner	1.6	4299.1	3897.8	1996.8	504.4	2662.2	2517.0	363.2	295.6	67.6
21	Niagara Bottling, LLC (IEUA)	1.5	265.4	119.7	289.2	-	-	-	-	-	-
22	Dart Containers	1.0	79.4	21.5	65.2	22.6	497.6	467.1	878.9	520.8	859.3
23	Californian Institution for Men (CIM)	0.97	46.9	15.3	14.3	4.3	6633.0	3705.2	5535.5	5447.1	353.5
24	Niagara Bottling, LLC (SBMWD)	0.90	340.3	215.0	351.6	-	-	-	2294.4	-	-
25	Rialto Bioenergy Solutions	0.86	40.7	29.1	42.5	-	-	-	507.7	-	-
26	Repet, Inc.	0.85	2618.9	2126.2	7091.2	5076.5	3593.7	3370.6	181.9	115.3	80.0
27	OLS Energy - Chino	0.49	9.5	9.5	4.4	3.8	476.1	174.0	199.1	184.2	19.9
28	Infineon Technologies Americas Corp.	0.44	202.3	66.1	43.8	43.8	-	-	122.3	44.6	77.6
29	Wellington Foods	0.35	185.7	140.3	2095.1	1316.0	697.3	514.1	81.3	51.8	39.3
30	Eastside Water Treatment Plant	0.32	40.3	11.0	4.5	1.8	1203.1	1152.0	1515.9	1118.2	530.3
31	JCSD Roger D. Teagarden IX Water Treatment Pla	0.28	24.6	1.7	5.3	5.3	608.7	588.4	57.0	20.3	36.7
32	Magnolia Foods	0.18	644.2	395.8	1797.8	-	954.6	-	208.2	208.2	0.0
33	JCSD Wells 17 * 18 Ion Exchange Treatment Faci	0.16	12.0	1.2	6.0	3.0	222.9	204.8	17.5	17.5	0.0
34	Flavor Specialities	0.14	98.3	78.5	697.7	548.3	397.0	382.2	24.0	20.9	5.4
35	Green River Golf Course (GRGC)	0.12	106.7	91.9	133.2	18.3	79.5	78.1	34.9	28.8	9.0
36	Inland Water Services	0.12	13.6	4.6	15.6	-	-	-	3221.4	-	-
37	WRCRWA - South Regional Pumping Station	0.11	469.6	469.6	303.9	-	-	-	-	-	-
38	RCSD	0.094	8.9	1.2	2.0	1.5	1179.0	1151.1	24.6	19.0	5.6
39	Saratoga Food, Inc.	0.082	390.4	359.7	701.2	-	-	-	19.1	-	-
40	City of Colton - Agua Mensa Power Plant	0.059	1.1	0.6	1.5	1.4	-	24.7	23.7	21.4	4.7
41	Sierra Aluminum Company, Inc.	0.059	0.9	0.6	1.1	-	-	-	79.4	-	-
42	Angelica Textile Services	0.049	2.0	0.9	1.2	-	-	-	805.9	-	-
43	Loma Linda University Power Plant	0.030	0.9	0.5	0.5	-	-	-	352.3	-	-
44	SCE Mira Loma Peaker Plant	0.025	0.2	0.2	0.4	0.4	-	-	-	-	-
45	Prudential Overall Supply	0.020	0.9	0.3	0.7	-	-	-	167.2	-	-
46	Decra Roofing Systems	0.010	2.3	2.2	6.8	-	-	-	12.3	-	-
47	Loma Linda Veterans Affairs (VA) Medical Cente	0.009	0.4	0.2	0.2	-	-	-	96.0	-	-
48	Qualified Mobile, Inc.	0.008	3.7	0.4	0.2	-	-	-	20.1	-	-
49	Indian Oaks Campground	0.007	0.2	0.1	0.0	-	-	-	-	-	-
50	San Antonio Regional Hospital	0.005	0.4	0.2	2.1	-	-	-	-	-	-
51	JCSD Chandler Lift Station	0.002	0.7	0.7	0.8	-	-	-	-	-	-
52	La Sierra University	0.002	0.0	0.0	0.0	-	-	-	-	-	-

As shown in Table 3, the dischargers that generated the most flow also produced the highest amount of alkalinity and calcium loading: Chino I Desalter and Chino Desalter II East, Perris and Menifee Desalter MP001 and 002, and Temescal Desalter. However, that was not true of the top TSS, VSS, and BOD_5 dischargers, who were lower in the flow ranking, including JCSD Etiwanda, Del Real Foods, Aramark Uniform & Career Apparel, and Metal Container Corporation.

A summary of average discharger loading into the Brine Line for each monitoring parameter is shown below in Table 4. The table compares the most recent fiscal year with the preceding three reporting periods.

Table 4. Summary of discharger loadings for the most recent fiscal year (July 2023 – June 2024) and the last three reporting periods.

Parameter	**2017 Report**	**2018 Report**	**2019 Report**	**Most Recent Fiscal Year**
	August 2016 – March 2017	April 2017 – March 2018	April 2018 – December 2018	July 2023 – June 2024
Flow (MG/mo)	317	313	314	374
TSS (lb/mo)	307,200	217,500	202,100	247,600
VSS (lb/mo)	189,600	177,800	170,000	187,100
BOD_5 (lb/mo)	249,500	261,000	222,700	223,400
Dissolved BOD_5 (lb/mo)	113,400	125,400	115,000	88,200
Alkalinity (lb/mo)	1,871,400	2,598,400	2,192,000	3,017,400
Dissolved Alkalinity (lb/mo)	2,418,700	2,363,700	1,336,600	2,904,100
Calcium (lb/mo)	1,759,800	1,631,300	786,300	2,110,200
Dissolved Calcium (lb/mo)	1,598,500	1,560,300	754,500	1,899,700

Comparing the results from the most recent fiscal year with the previous discharger loadings in Table 4, flow has increased from the historical data. Since the last reporting period (April 2018 through December 2018), all water quality parameters increased except for dissolved BOD_5 (-30%). Dissolved alkalinity (54%), calcium (63%), and dissolved calcium (60%) doubled or nearly tripled in value, whereas TSS (18%), VSS (9%), and alkalinity (27%) saw more modest increases. BOD_5 increased but remained mostly flat (0.3%).

4 Recommendations

This preliminary review of the Brine Line water quality data provides an initial understanding of the water quality and trends in the Brine Line from the past five years. Based on these findings, additional monitoring is needed to support the development of an updated billing formula to account for changes in solids loading through the Brine Line system. Trussell will develop a suggested supplemental monitoring plan that incorporates the following key recommendations:

- Further evaluation of the Brine Line flow data is needed, with the goal of aligning the values measured at the County Line with the combined discharger flow measurements.
- Supplemental monitoring of the dischargers that were determined to contribute to the top 75% of the loading for any of the water quality parameters historically used in the billing formula (TSS, VSS, BOD, alkalinity, calcium). In particular, this supplemental monitoring should provide the following:
    - Analysis of all monitoring parameters from a single sample, including the dissolved fractions. This will allow for correlation of all monitoring parameters among locations.
    - Three monitoring events for the dischargers that contribute to the top 75% of the loading for TSS, VSS, and BOD. The results for these parameters tend to be more variable from sample to sample, thus a single sample may not be representative.
- For dischargers that had no data from the 2023/2024 fiscal year period, it is recommended to collect one representative sample from which all of the monitoring parameters should be analyzed.
- Three monitoring events should be completed at the County Line from which all of the liquid fraction water quality parameters are analyzed. This same liquid sample should be processed to separate the solid fraction for solids characterization using the previously recommended analyses (Trussell 2019), including metals, particulate organic carbon, x-ray diffraction, scanning electron microscopy with energy dispersive x-ray spectroscopy, and thermogravimetric analysis.

5 References

Trussell (2011). "Understanding the Suspended Solids in the Inland Empire Brine Line." Workshop presentation to the *Santa Ana Watershed Project Authority*. Dec 20.

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10 Appendix B – Sampling Test Plan, February 2025

SAMPLING TEST PLAN

Santa Ana Watershed Project Authority

Draft Date: February 27, 2025

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Subject: Inland Empire Brine Line and Discharger Sampling Test Plan

1 Introduction

Trussell Technologies, Inc. (Trussell) was first retained by the Santa Ana Watershed Project Authority (SAWPA) in mid-2011 to assess the formation of suspended solids in the Inland Empire Brine Line (Brine Line). Since that time, Trussell has been involved in a series of investigations aimed at characterizing the suspended solids from the sampling point (SMS) closest to the Orange County Line (County Line), where the ownership of the wastewater within the Brine Line is transferred from SAWPA to the Orange County Sanitation District (OC San). In the first phase of the current Brine Line water quality and billing formula study (Study), Trussell determined that additional monitoring would be needed to complete the assessment of changes in solids loading through the Brine Line during the current reporting period from July 2019 through June 2024.

This document provides a sampling test plan aimed at monitoring for the Brine Line system to characterize the discharger inputs and downstream water quality, in order to evaluate the suspended solids formed within the Brine Line system. The first section describes recommended monitoring at the County Line SMS station, which includes field measurements and performing three sampling events for subsequent liquid fraction and solids characterization analyses. The second section describes recommended monitoring at the dischargers to the Brine Line, including field measurements and sampling events for subsequent liquid fraction analyses. Depending on the discharger's historically established solids loading rate, these sampling events will occur either once, monthly, or quarterly within the period of April through June 2025.

2 County Line Sampling Plan

Trussell recommends that SAWPA perform three special sampling events at the County Line SMS station to facilitate characterization of the solids fraction of the Brine Line flow. For each of these events, a large volume 24-hour composite sample will be needed. These sampling events will be performed biweekly (once every 2 weeks). In each event, the following activities will occur:

1. **(Trussell and SAWPA)** Coordinate sampling events with participating analytical labs. Trussell will work with Camet Research to confirm availability and sample preparation requirements. SAWPA will coordinate with Babcock Laboratories to arrange bottle orders, set up chain of custody forms, and schedule sampling events.
2. **(SAWPA)** Collect a 24-hour composite sample of at least 8 gallons from the SMS monitoring station. SAWPA previously used a 12-gallon container that was purchased for these solids characterization sampling events.
3. **(SAWPA and Trussell)** Once sampled, each 24-hour composite sample will be mixed on-site using a mechanical mixer and then distributed into labelled bottles for subsequent liquid fraction and solids characterization analyses. Trussell will support SAWPA with on-site sample processing.
    a. SAWPA to provide 4 clean one-gallon plastic jugs to hold Trussell's samples.
4. **(SAWPA)** Composite sample bottles will be loaded in coolers with ice packs and delivered to Babcock Laboratories with overnight shipping. Babcock Laboratories will use these bottles to perform liquid fraction water quality analyses.
5. **(Trussell)** At least 4 gallons of composite sample will be transported by Trussell on ice to the Trussell Lab for solids processing. Trussell will centrifuge the liquid sample to concentrate and separate the suspended solids (disposing the liquid supernatant).
6. **(Trussell)** Ship the wet solids to the Camet Research for analysis.
7. **(Trussell)** Help SAWPA coordinate with the labs to obtain test results for data analysis.

Table 1 shows a summary of the recommended liquid fraction water quality parameters and solids characterization analyses of the County Line samples. The liquid fraction sample analyses shall incorporate the use of total suspended solids (TSS) glass fiber filters (pore size of 1.5 microns) to separate the total and dissolved fractions of 5-day biochemical oxygen demand (BOD_5), alkalinity, calcium, and orthophosphate. This distinction is made because the 1.5-micron threshold will be used to define the suspended solids (via analysis of TSS), and the 'dissolved' constituents will represent the remainder of the sample. Flow through the County Line SMS monitoring station and pH will be continuously measured via online meters. Separately, pH and temperature will be measured via grab samples during every sampling event. Due to general variability in TSS, volatile suspended solids (VSS), and total BOD_5 measurements, it is recommended for SAWPA to collect three aliquots for analysis of these constituents, from which Babcock Laboratories will perform triplicate liquid fraction analyses (three total results for each parameter).

Table 1. Recommended County Line Sampling and Analyses.

Constituent/Analysis	Test Method	Responsible Party	Notes
Field Measurements			
Flow	--	SAWPA	Online monitoring; total per 24-hour sampling event.
pH	--	SAWPA	Online monitoring and grab sample analysis during every sampling event.
Temperature	--	SAWPA	Grab sample analysis during each sampling event.
Liquid Fraction Sampling			
Total Suspended Solids (TSS)	SM 2540D	Babcock Laboratories	Expedited analysis (< 24-hour hold); Analysis in triplicate
Volatile Suspended Solids (VSS)	EPA 160.4	Babcock Laboratories	Expedited analysis (< 24-hour hold); Analysis in triplicate
Biochemical Oxygen Demand (BOD_5)	SM 5210B	Babcock Laboratories	Total and dissolved[(a)]; Total analysis in triplicate
Alkalinity	SM 2320B	Babcock Laboratories	Total and dissolved[(a)]
Calcium	EPA 200.7	Babcock Laboratories	Total and dissolved[(a)]
Total Dissolved Solids (TDS)	SM 2540C	Babcock Laboratories	
Orthophosphate	SM 4500P E	Babcock Laboratories	Total and dissolved[(a)]
Dissolved Organic Carbon (DOC)	SM 5310B	Babcock Laboratories	Using TSS filter substitution[(a)]
Solids Characterization (Trussell to separate solids via centrifugation)			
X-ray diffraction (XRD)	XRD	Camet Research	Provides mineral characterization
Wavelength Dispersive X-ray Fluorescence Spectroscopy (WDXRF)	WDXRF	Camet Research	Provides elemental characterization
Thermogravimetric analysis (TGA)	TGA	Camet Research	Provides cellulose identification and organics quantification

[a]All filtered measurements shall be filtered using a 1.5-micron glass fiber filter

3 Discharger Sampling Plan

For dischargers, no solids characterization will be conducted. Instead, Trussell recommends sampling for the suite of water quality parameters listed in Table 2, following the sampling frequency recommended for each discharger in Table 3. The sampling frequencies in Table 3 were updated from the 2019 monitoring plan and based on the recent preliminary review of water quality from July 2019 through June 2024. Note that this sampling can be conducted in accordance with regular monthly/quarterly discharger sampling during the period of April through June 2025, which will result in between one and three sampling events for each discharger, based on the recommended monitoring frequency. The discharger sampling and analysis should use the following criteria:

1. Similar to the County Line sampling, each discharger sampling event shall produce 24-hour composite samples. SAWPA shall determine the composite sample volume required to meet the specified analyses in Table 2.
2. Each composite sample should be analyzed for all constituents listed in Table 2 to allow for correlation between the results from a representative sample. If the analysis of a single parameter must be repeated due to an error in monitoring or analysis, it is recommended to repeat the 24-hour composite sampling and re-analyze the entire suite of water quality parameters.
3. The water quality parameters in Table 2 shall be measured in a similar manner to the County Line sampling. Each composite sample will be mixed on-site with the mechanical mixer and distributed into bottles. All sample bottles will be sent to Babcock Laboratories for liquid fraction analyses. The ‘dissolved’ constituents will be filtered via the 1.5-micron glass fiber filter (consistent with the TSS measurement). Flow will be monitored using online flowmeters and the sum over the 24-hour sampling event will be recorded. pH and temperature will be monitored via grab samples. TSS, VSS, and total BOD_5 analyses will be performed in triplicate.
4. Table 3 lists the forty-seven active dischargers along with their recommended sampling frequencies based on Trussell’s preliminary assessment of their FY 2023 solids loading to the Brine Line. M represents monthly sampling, Q is for quarterly sampling, and dischargers listed with an asterisk (*) for their sampling frequency should be sampled at least once during April – June 2025 to characterize their recent solids loading rates. If a new discharger comes online during this period, it is recommended to assign quarterly sampling frequency to the discharger to establish water quality data.

Table 2. Recommended Discharger Sampling and Analyses.

Constituent/Analysis	Test Method	Responsible Party	Notes
Field Measurements			
Flow	--	SAWPA/Dischargers	Online monitoring; total per 24-hour sampling event
pH	--	SAWPA/Dischargers	Online monitoring or grab sample during each sampling event
Temperature	--	SAWPA/Dischargers	Online monitoring or grab sample during each sampling event
Liquid Fraction Sampling (derived from one composite sample)			
Total Suspended Solids (TSS)	SM 2540D	Babcock Laboratories	Expedited analysis (< 24-hour hold); Analysis in triplicate
Volatile Suspended Solids (VSS)	EPA 160.4	Babcock Laboratories	Expedited analysis (< 24-hour hold); Analysis in triplicate
Biochemical Oxygen Demand (BOD_5)	SM 5210B	Babcock Laboratories	Total and dissolved[(a)]; Total analysis in triplicate
Alkalinity	SM 2320B	Babcock Laboratories	Total and dissolved[(a)]
Calcium	EPA 200.7	Babcock Laboratories	Total and dissolved[(a)]

[(a)]All filtered measurements shall be filtered using a 1.5-micron glass fiber filter

Table 3. Recommended Discharger Sampling Frequency.

Discharger	Sampling Frequency
Angelica Textile Services	*
Aramark Uniform & Career Apparel, LLC	M
California Institution for Women (CIW)	M
Californian Institution for Men (CIM)	Q
Chino Desalter II East	M
Chino Desalter II West	Q
Chino I Desalter	M
City of Beaumont Wastewater Treatment Plant	M
City of Colton - Agua Mensa Power Plant	*
Dart Containers	Q
Decra Roofing Systems	*
Eastside Water Treatment Plant	Q

Discharger	Sampling Frequency
Flavor Specialties	M
Green River Golf Course (GRGC)	Q
In-N-Out Burger, Chino Distribution Center	M
Indian Oaks Campground	*
Infineon Technologies Americas Corp.	*
Inland Water Services	*
JCSD Chandler Lift Station	*
JCSD Etiwanda Monitoring Station	M
JCSD Hamner	M
JCSD Wineville Monitoring Station	M
La Sierra University	*
Loma Linda University Power Plant	*
Loma Linda Veterans Affairs (VA) Medical Center	*
Mission Linen Supply	M
Mountainview Power Plant (Mountainview Generating Station)	M
Niagara Bottling, LLC (IEUA)	*
Niagara Bottling, LLC (SBMWD)	*
OLS Energy – Chino	Q
Perris and Menifee Desalter MP001	M
Perris and Menifee Desalter MP002	M
Prudential Overall Supply	*
Qualified Mobile, Inc.	*
RCSD	Q
Repet, Inc.	M
Rialto Bioenergy Solutions	*
San Antonio Regional Hospital	*
Saratoga Food, Inc.	*
SCE Mira Loma Peaker Plant	*
Sierra Aluminum Company, Inc.	*
Stringfellow Pretreatment Facility	Q
Temescal Desalter	M
Wellington Foods	M
WMWD Arlington Desalter	M
WRCRWA - South Regional Pumping Station	*
YVWD - Henry Wochholz Plant	Q

The collection of these discharger samples, together with downstream sample collection at the County Line (SMS) described in Section 2, will provide the necessary data for establishing suspended solids loading values throughout the Brine Line system that are representative of current operations.

4 Logistics

The discharger and County Line sampling and water quality analyses presented in this plan are scheduled for April 2025 through June 2025. During this timeframe, SAWPA will sample at the dischargers with the associated sampling frequencies listed in Table 3. Any dischargers that have an asterisk (*) for their sampling frequency listed in Table 3 will be sampled at least once during this period. In addition, three sampling events will be conducted at the County Line (SMS) at a two-week interval. SAWPA will coordinate the sampling in cooperation with its member agencies.

5 References

Trussell (2019). "Inland Empire Brine Line Water Quality Monitoring & Solids Formation Recovery Formula Report April 2018 through March 2019." Report for the *Santa Ana Watershed Project Authority*. September 5.

11 Appendix C – Top Dischargers Representing Top 75% of Overall Loading for Each Monitoring Parameter

The following pie charts (Figure C 1 through Figure C 9) identify the top dischargers representing at least 75% of the overall loading for each monitoring parameter from the July 2023 – June 2025 (excluding July 2024 – March 2025) period, compared with the results from the previous reporting period (2019).

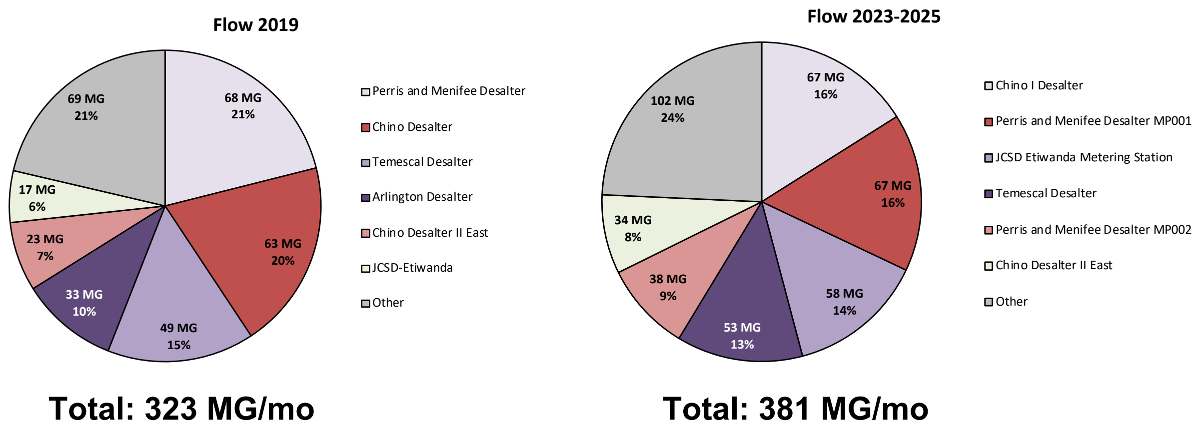


Figure C 1. Flow pie charts for 2019 and 2023-2025, including top dischargers contributing 75% or greater

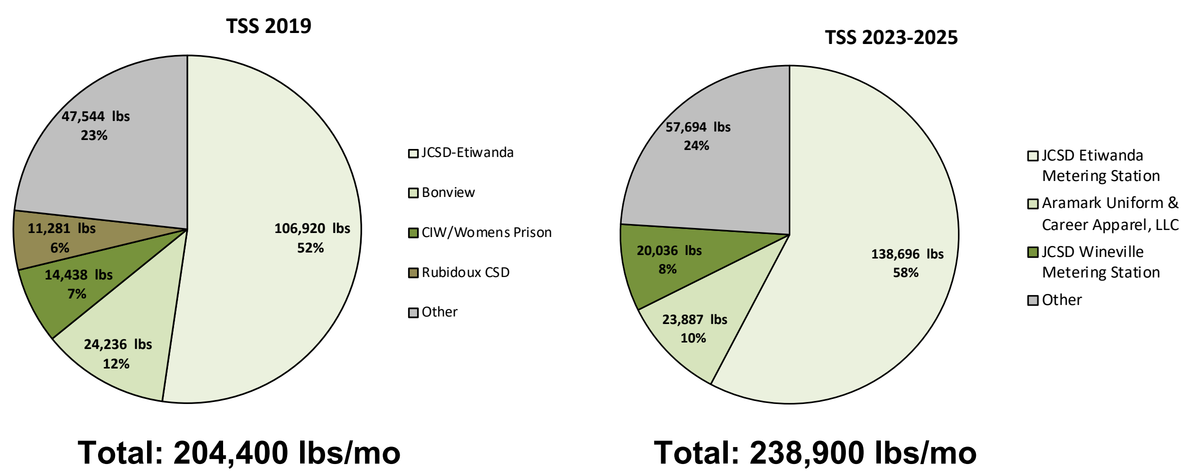
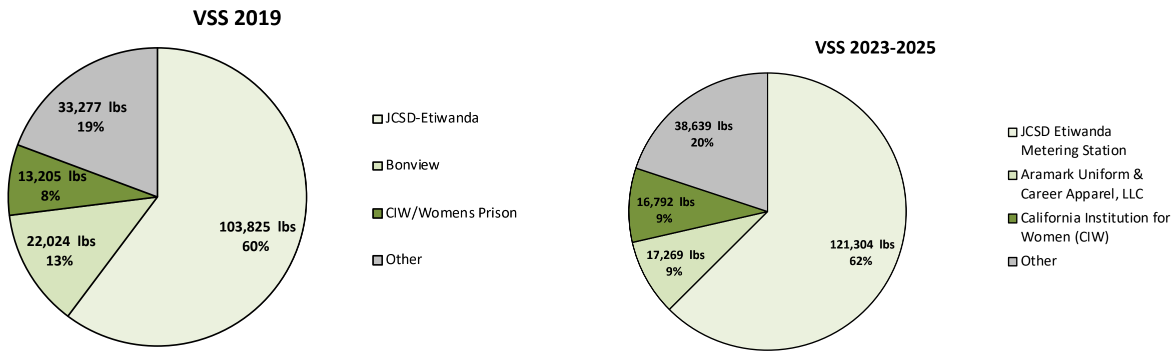
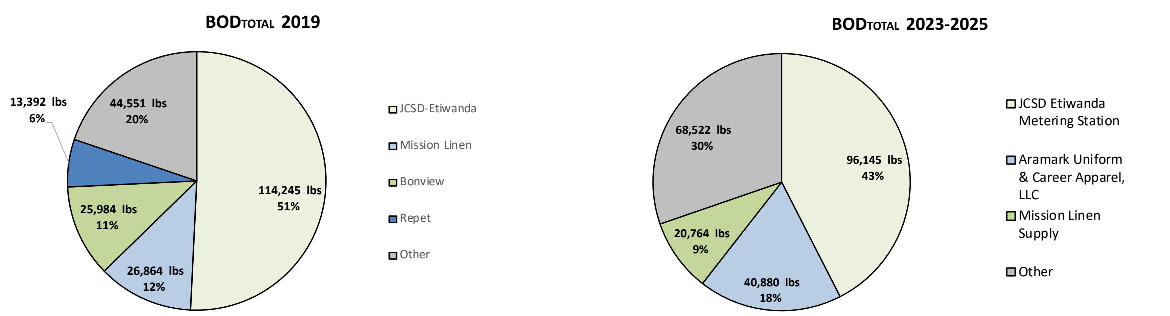


Figure C 2. TSS loading pie charts for 2019 and 2023-2025, including top dischargers contributing 75% or greater



Total: 172,300 lbs/mo **Total: 193,300 lbs/mo**

Figure C 3. VSS loading pie charts for 2019 and 2023-2025, including top dischargers contributing 75% or greater



Total: 269,600 lbs/mo **Total: 224,800 lbs/mo**

Figure C 4. Total BOD_5 loading pie charts for 2019 and 2023-2025, including top dischargers contributing 75% or greater

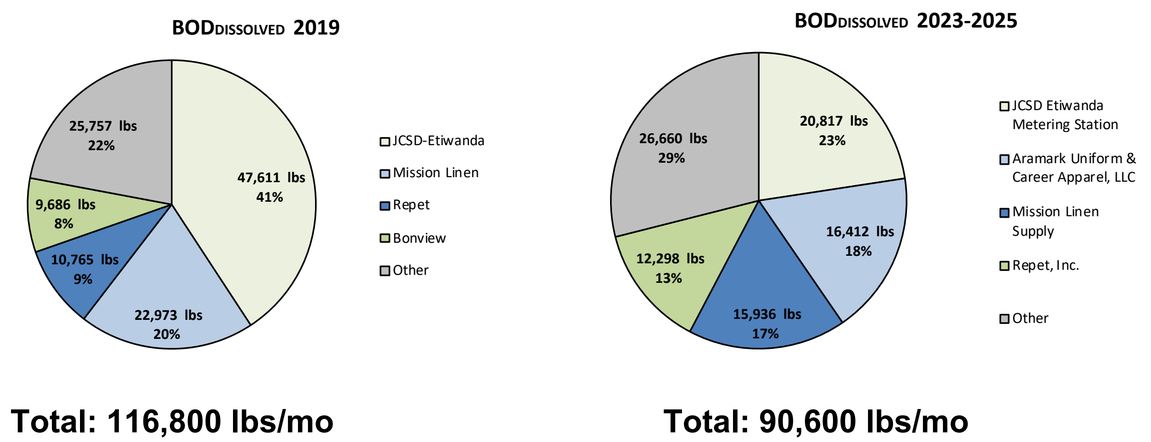


Figure C 5. Dissolved BOD_5 loading pie charts for 2019 and 2023-2025, including top dischargers contributing 75% or greater

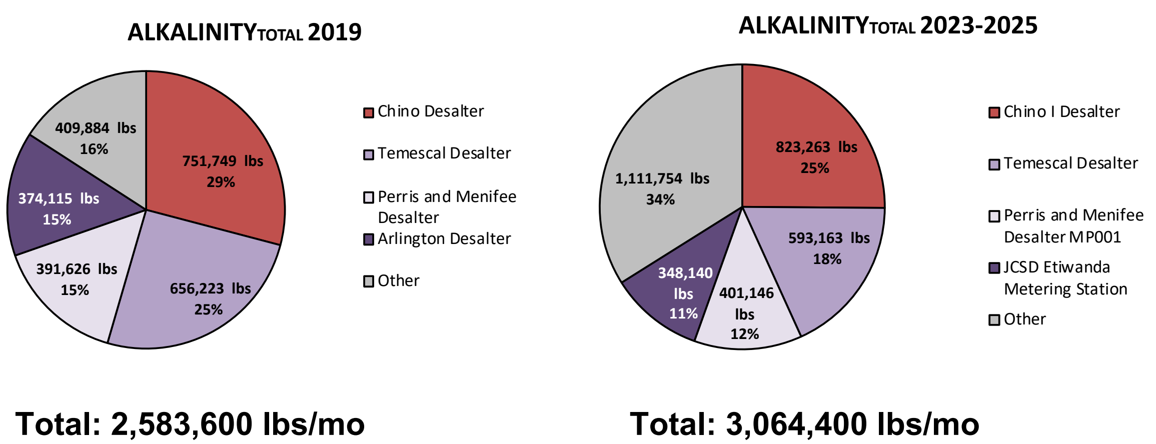
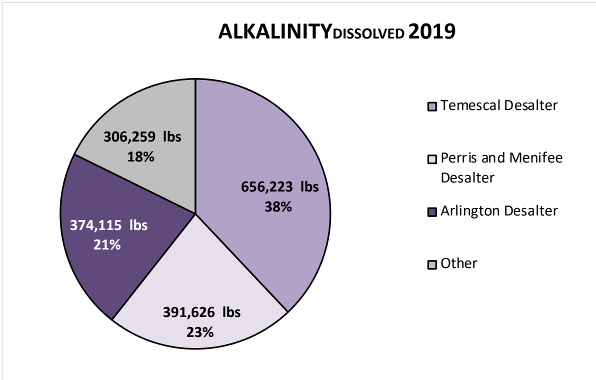
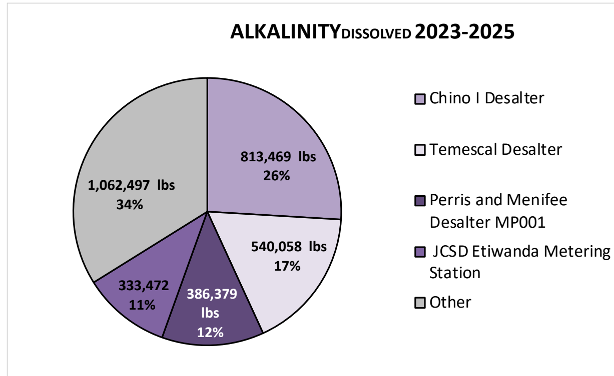


Figure C 6. Total alkalinity loading pie charts for 2019 and 2023-2025, including top dischargers contributing 75% or greater

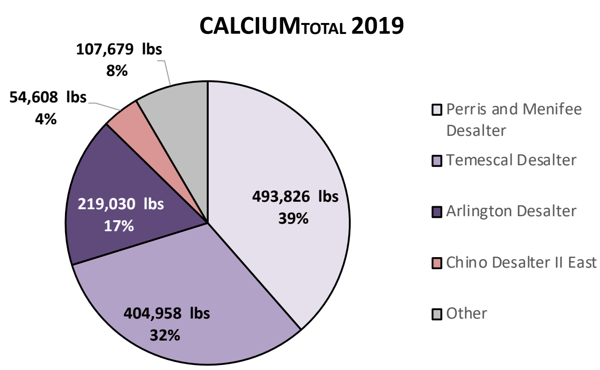


Total: 1,728,200 lbs/mo

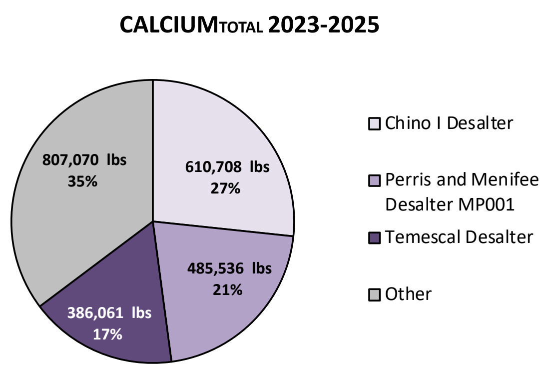


Total: 2,933,200 lbs/mo

Figure C 7. Dissolved alkalinity loading pie charts for 2019 and 2023-2025, including top dischargers contributing 75% or greater



Total: 1,280,100 lbs/mo



Total: 2,161,700 lbs/mo

Figure C 8. Total calcium loading pie charts for 2019 and 2023-2025, including top dischargers contributing 75% or greater

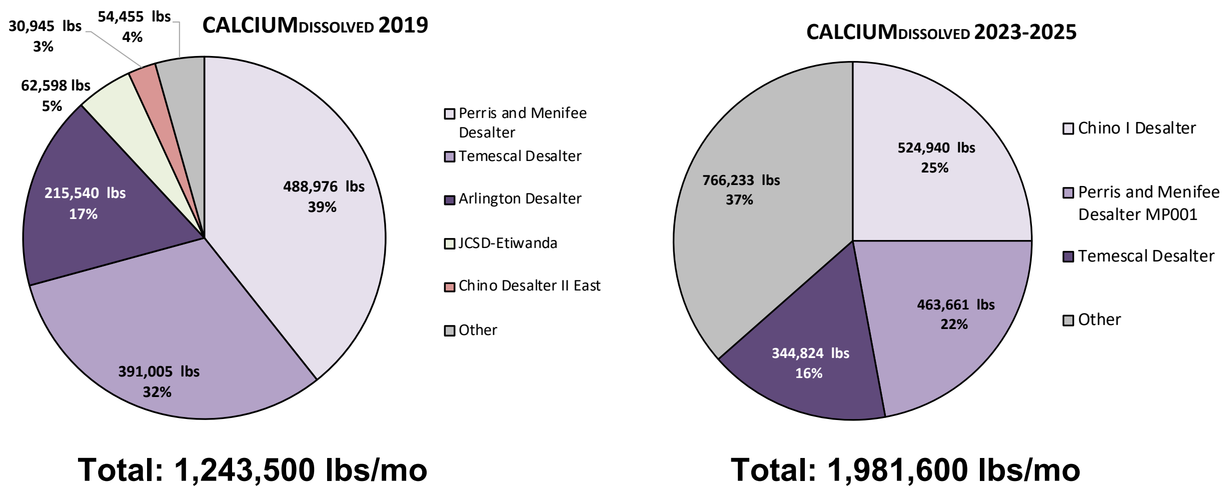


Figure C 9. Dissolved calcium loading pie charts for 2019 and 2023-2025, including top dischargers contributing 75% or greater

12 Appendix D – Camet Research Lab Results for the Three Solids Characterization Events

Aidan Hasegawa
Trussell Technologies Inc.
1904 Franklin Street, Suite 800
Oakland, CA 94612

May 8, 2025

RE: Analysis of Waste Water Sludge, Santa Ana Watershed Project Authority (SAWPA)
PO No.: 2025-49
Report No.: 80020225

INTRODUCTION

A wet sludge sample was characterized using X-ray powder diffraction (XRD), WDXRF and thermogravimetric methods. The sample was received on May 2, 2025 and identified as follows:

Item	Description	Sample Date
(1)	SAWPA, 001 / SO-1 (Canyon Park RV) Mag Meter – Line 2 Sample ID: 98154	05/01/25

SAMPLING AND TESTING METHODS

The as-received sludge was dried at 50°C in air and split into representative test portions. The crystalline phase compositions of dried (at 50°C) and calcined (at 950°C) aliquots were determined by X-ray powder diffraction. XRD data sets were collected on a Rigaku wide angle powder diffractometer using CuKα radiation (8.1keV) and a diffracted beam monochromator. The results are listed in Table 1 and illustrated in Figures 1 and 2.

Elemental compositions were estimated for test portions dried at 50°C and calcined at 450°C using a standard-less method and datasets collected on a Rigaku ZSX Priums IV WDXRF spectrometer. Elemental results are listed in Table 2 and illustrated in Figure4. The estimated composition of the dried sludge material is listed in Table 4.

Thermogravimetric analysis (TGA) was performed using a Perkin Elmer TGA 7 with a high temperature furnace in ambient air atmosphere The results are listed in Table 3 and illustrated in Figure 3.

Please let us know if you have any questions regarding these results,

TABLES

Table 1. Normalized mineral composition of sample #98154, May 1, 2025

Mineral Name / Chemical Formula	Calcined at 950°C	Dried at 50°C
	wt%	wt%
Hydroxyapatite, $Ca_{10}(PO_4)_6(OH)_2$	**38.5**	
Merillite, $Ca_9NaMg(PO_4)_7$	**15.0**	
Diopside, $CaMgSi_2O_6$	**25.0**	
Lime, CaO	**3.5**	
Anhydrite, $CaSO_4$	**2.5**	
Nepheline, $(Na,K)AlSiO_4$	**13.5**	
Not Identified	**< 5**	**<5**
Calcite, $CaCO_3$		**observed**
Quartz, SiO_2	**2.0**	**observed**

Table 2. Normalized and corrected oxide composition of the dried and calcined sludge material

Oxides / Elements	98154, dried at 50°C	98154, dried at 50°C corrected for LOI	98154, calcined at 450°C
	wt%	wt%	wt%
Na_2O	1.38	0.34	1.88
MgO	2.43	0.60	2.15
Al_2O_3	6.69	1.65	7.34
SiO_2	13.49	3.34	16.23
P_2O_5	13.21	3.27	12.71
SO_3	8.14	2.01	2.12
Cl	3.30	0.82	2.18
K_2O	1.89	0.47	1.95
CaO	37.45	9.27	41.96
TiO_2	1.29	0.32	1.40
Cr_2O_3	0.11	0.03	0.13
MnO	0.19	0.05	0.22
Fe_2O_3	9.35	2.31	8.81
NiO	0.05	0.01	
Co_2O_3			0.01
CuO	0.18	0.04	0.18
ZnO	0.60	0.15	0.53
As_2O_3	0.02	0.00	
Br	0.03	0.01	0.02
SrO	0.20	0.05	0.17
LOI at 450°C		75.25	
Total	100	100	100

Table 3. Weight loss data as determined by TGA.

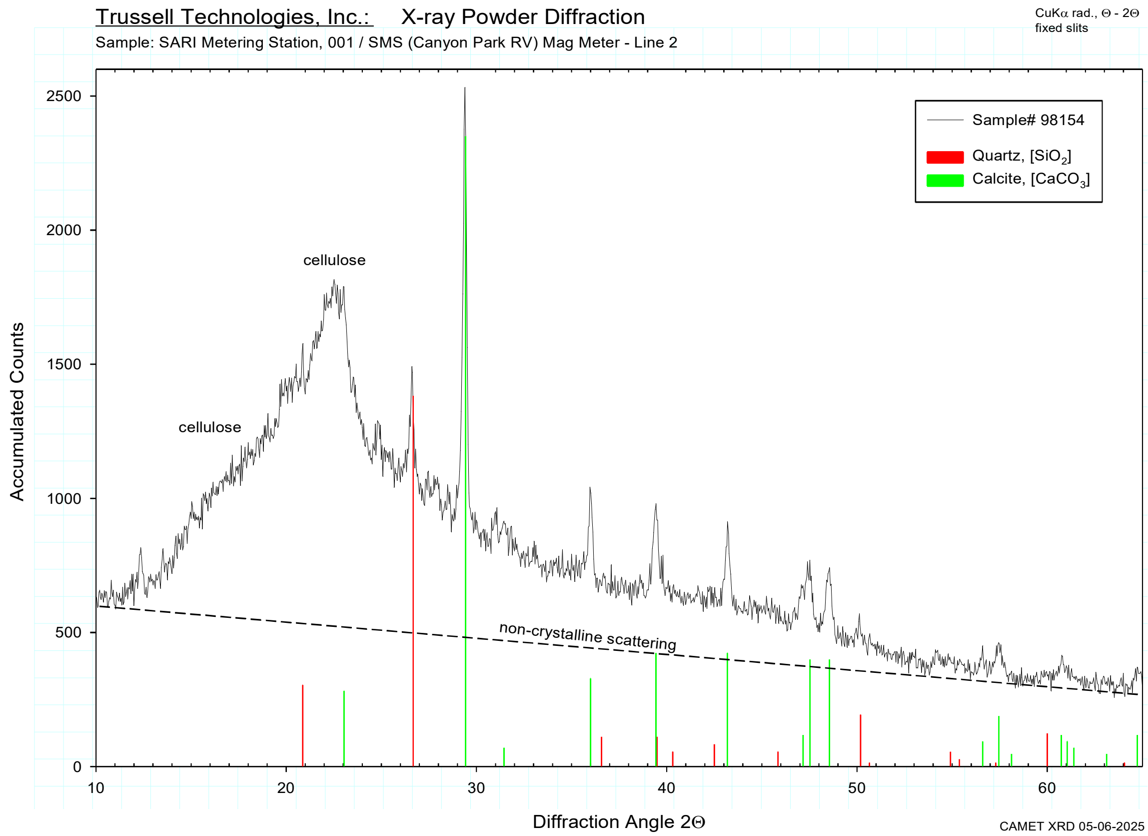
Temperature range, [ºC]	98154
	Weight loss, [%]
RT – 105	6.4
105 – 175	4.9
175 – 310	30.0
310 – 550	15.1
550 – 750	6.3
750 – 950	11.2
Total LOI (RT - 950°C)	73.9
Cellulose content[1]	34.9
Purge gas:	
Furnace	ambient air
Balance	ambient air

1 Combined weight loss between 105°C and 305ºC.

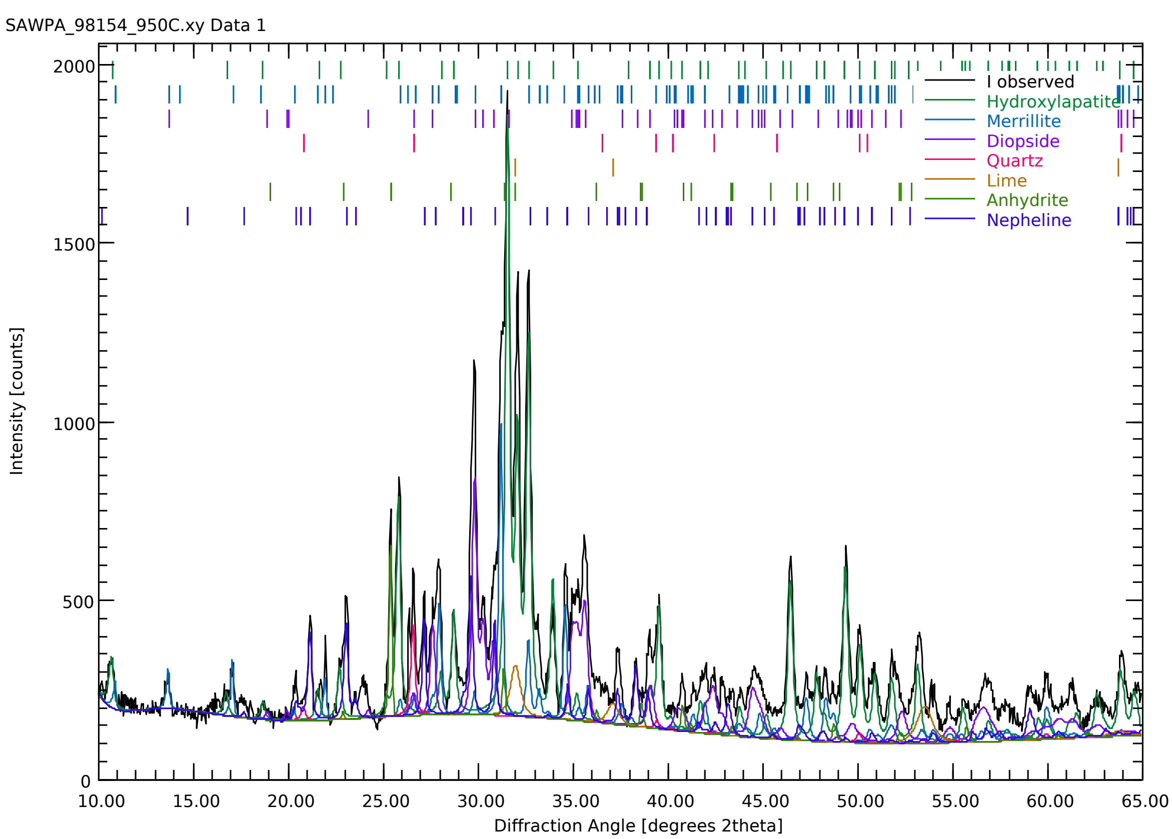
Table 4. Estimated composition of the as-received material dried at 50°C

	Sample 98154
	wt%
ACP [$Ca_9(PO_4)_6$]	**6.2**
$CaCO_3$	**8.0**
Cellulose, 105°C - 310°C	**34.9**
Volatiles (organic matter, bound water)	**40.6**
Na2O	0.29
MgO	0.51
Al2O3	1.40
SiO2	2.82
SO3	1.70
Cl	0.69
K2O	0.40
TiO2	0.27
Cr2O3	0.02
MnO	0.04
Fe2O3	1.95
NiO	0.01
CuO	0.04
ZnO	0.13
As2O3	0.00
Br	0.01
SrO	0.04

FIGURES



Trussell Technologies, Inc.: X-ray Powder Diffraction
Sample: SARI Metering Station, 001 / SMS (Canyon Park RV) Mag Meter - Line 2
CuKα rad., Θ - 2Θ
fixed slits
Sample# 98154
Quartz, [SiO2]
Calcite, [CaCO3]
cellulose
cellulose
non-crystalline scattering
Accumulated Counts
Diffraction Angle 2Θ
CAMET XRD 05-06-2025



SAWPA_98154_950C.xy Data 1
I observed
Hydroxylapatite
Merrillite
Diopside
Quartz
Lime
Anhydrite
Nepheline
Intensity [counts]
Diffraction Angle [degrees 2theta]

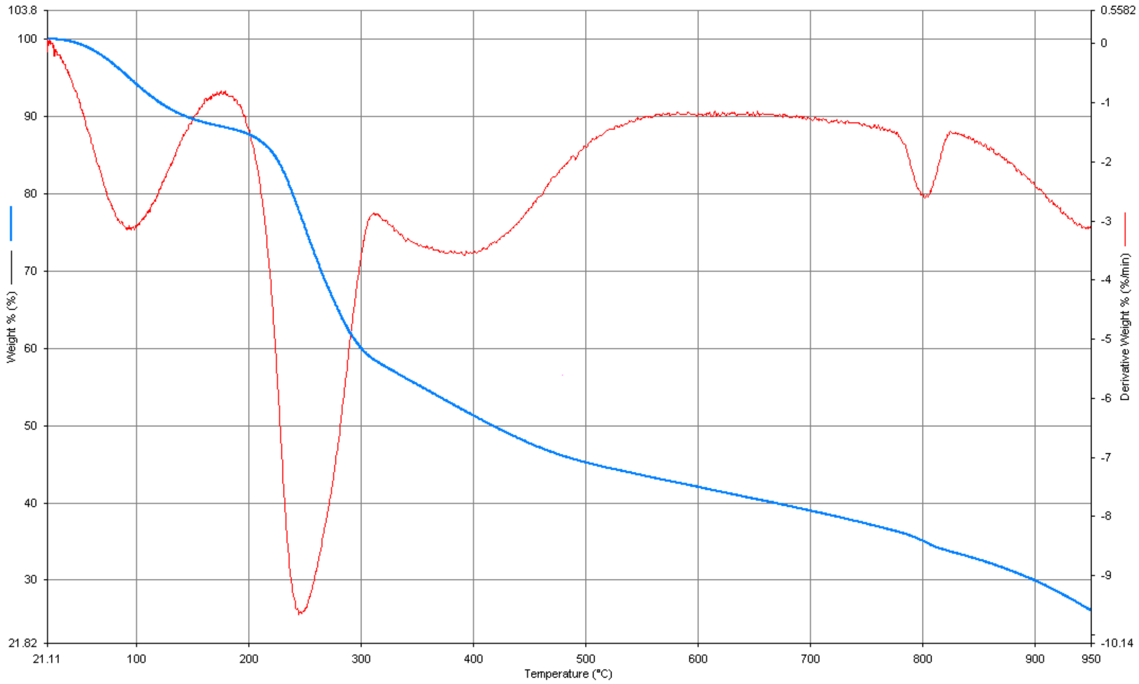


Figure 1. TGA graph of sample "SAWPA, 98154 - May 1, 2025". As received material, dried at 50ºC.
RT to 300ºC: 20ºC/min
300ºC to 950ºC: 40ºC/min
Balance: air Sample: air

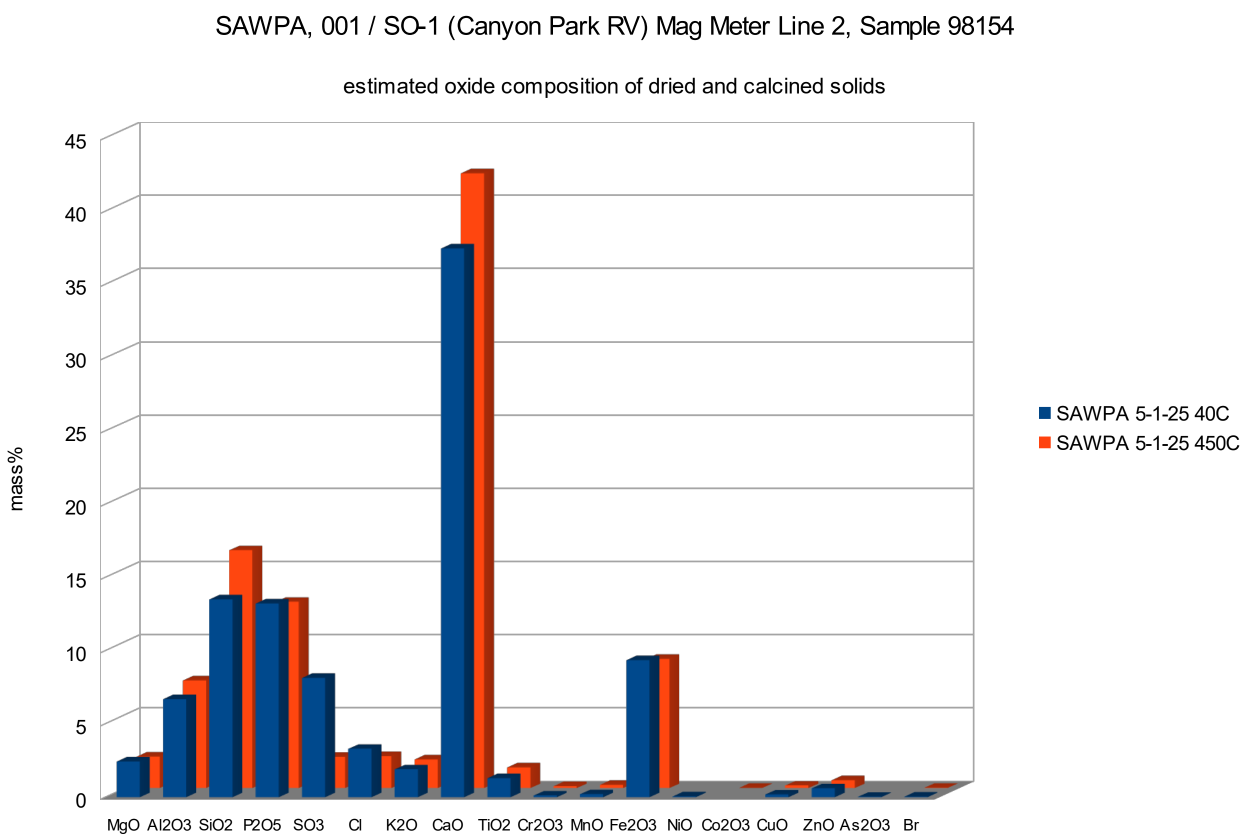


Figure 2. Estimated oxide composition of dried and calcined sample "SAWPA, 4-October-2021".

Wen Cong, Aidan Hasegawa
Trussell Technologies Inc.
1904 Franklin Street, Suite 800
Oakland, CA 94612

May 29, 2025

RE: Analysis of Waste Water Sludge, Santa Ana Watershed Project Authority (SAWPA)

PO No.: 2025-49

Report No.: 80020325

INTRODUCTION

A wet sludge sample was characterized using X-ray powder diffraction (XRD), WDXRF and thermogravimetric methods. The sample was received on May 15, 2025 and identified as follows:

Item	Description	Sample Date
(1)	SAWPA, 001 / SMS (Canyon Park RV) Mag Meter – Line 2 Sample ID: 98596	05/14/25

SAMPLING AND TESTING METHODS

The as-received sludge was dried at 50°C in air and split into representative test portions. The crystalline phase compositions of dried (at 50°C) and calcined (at 950°C) aliquots were determined by X-ray powder diffraction. XRD data sets were collected on a Rigaku wide angle powder diffractometer using CuKα radiation (8.1keV) and a diffracted beam monochromator. The results are listed in Table 1 and illustrated in Figures 1 and 2.

Elemental compositions were estimated for test portions dried at 50°C and calcined at 450°C using a standard-less method and datasets collected on a Rigaku ZSX Priums IV WDXRF spectrometer. Elemental results are listed in Table 2 and illustrated in Figure4. The estimated composition of the dried sludge material is listed in Table 4.

Thermogravimetric analysis (TGA) was performed using a Perkin Elmer TGA 7 with a high temperature furnace in ambient air atmosphere The results are listed in Table 3 and illustrated in Figure 3.

RESULTS

The sludge material consists of the cellulose portion, calcite and quartz, and non-crystalline phosphates, sulfates, silicates, alkalies and ferrous compounds. The non-crystalline fractions crystallize as various phosphate and silicate phases during calcination at 950°C

Please let us know if you have any questions regarding these results,

TABLES

Table 1. Normalized mineral composition of sample #98596, May 14, 2025

Mineral Name / Chemical Formula	Calcined at 950°C	Dried at 50°C
	wt%	wt%
Hydroxyapatite, $Ca_{10}(PO_4)_6(OH)_2$	**23.9**	
Merillite, $Ca_9NaMg(PO_4)_7$	**28.5**	
Diopside, $CaMgSi_2O_6$	**30.3**	
Lime, CaO	**1.1**	
Anhydrite, $CaSO_4$	**Not observed**	
Nepheline, $(Na,K)AlSiO_4$	**11.3**	
Archerite, $(K,NH_4)H_2PO_4$	**2.2**	
Not Identified	**< 5**	**<5**
Calcite, $CaCO_3$		**observed**
Quartz, SiO_2	**2.7**	**observed**

Table 2. Normalized and corrected oxide composition of the dried and calcined sludge material

Oxides / Elements	98596, dried at 50°C	98596, dried at 50°C corrected for LOI	98596, calcined at 450°C
	wt%	wt%	wt%
Na_2O	2.27	0.52	1.93
MgO	1.74	0.4	1.92
Al_2O_3	6.66	1.54	6.98
SiO_2	15.72	3.63	16.20
P_2O_5	12.95	2.99	12.75
SO_3	6.97	1.61	3.53
Cl	4.05	0.94	2.10
K_2O	2.77	0.64	2.44
CaO	32.77	7.57	35.64
TiO_2	2.2	0.51	2.48
Cr_2O_3	0.17	0.04	0.16
MnO	0.26	0.06	0.36
Fe_2O_3	10.15	2.34	11.91
NiO	0.04	0.01	
CuO	0.2	0.05	0.25
ZnO	0.52	0.12	0.53
As_2O_3	0.02	0	0.04
Br	0.04	0.01	
SrO	0.17	0.04	0.12
ZrO_2		0	0.00
BaO	0.33	0.08	0.65
LOI at 450°C		76.89	76.89
Total	100	100	100

Table 3. Weight loss data as determined by TGA.

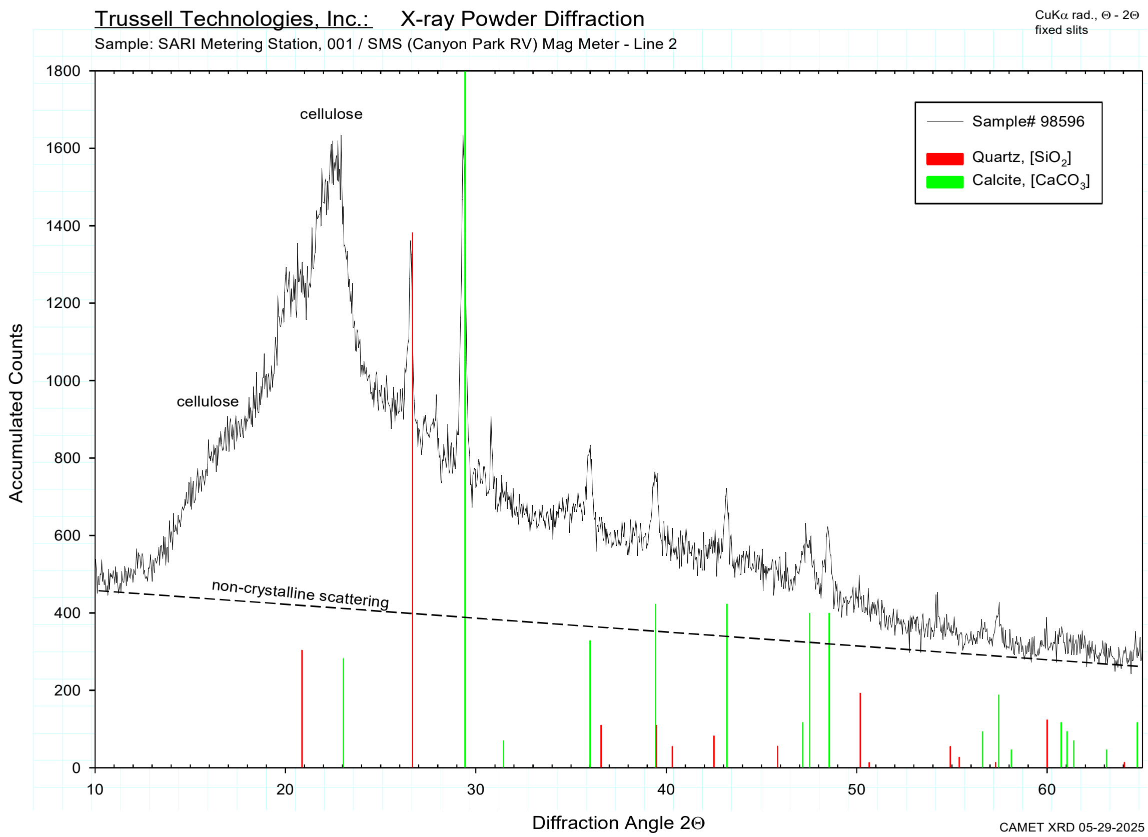
Temperature range, [ºC]	98596
	Weight loss, [%]
RT – 105	5.7
105 – 175	5.1
175 – 325	32.7
325 – 550	15.6
550 – 750	5.2
750 – 950	7.4
Total LOI (RT - 950°C)	71.8
Cellulose content[1]	37.9
Purge gas:	
Furnace	ambient air
Balance	ambient air

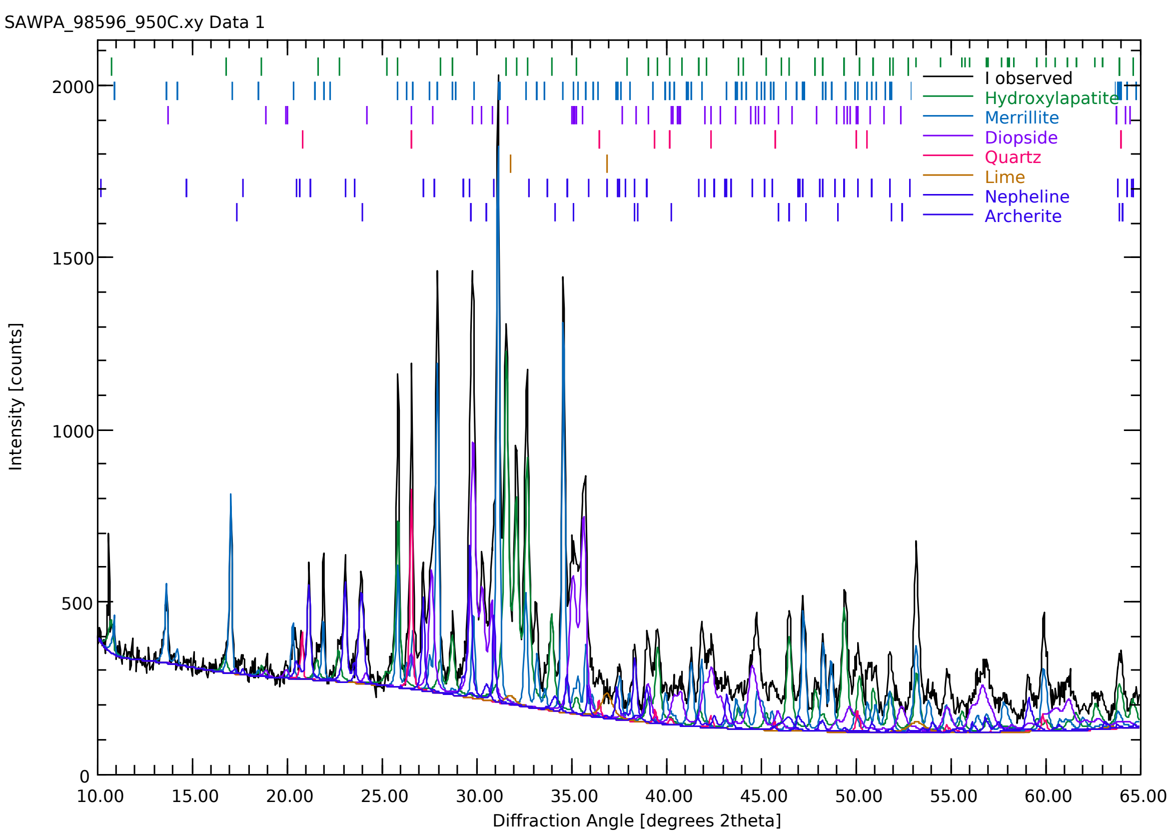
1 Combined weight loss between 105°C and 325ºC.

Table 4. Estimated composition of the as-received material dried at 50°C

	Sample 98596
	wt%
ACP [$Ca_9(PO_4)_6$]	**5.8**
$CaCO_3$	**6.3**
Cellulose, 105°C - 310°C	**37.9**
Volatiles (organic matter, bound water)	**39.0**
Na_2O	0.46
MgO	0.35
Al_2O_3	1.35
SiO_2	3.20
SO_3	1.42
Cl	0.82
K_2O	0.56
TiO_2	0.45
Cr_2O_3	0.03
MnO	0.05
Fe_2O_3	2.06
NiO	0.01
CuO	0.04
ZnO	0.11
As_2O_3	0.00
Br	0.01
SrO	0.04
ZrO_2	0.00
BaO	0.07

FIGURES


Trussell Technologies, Inc.: X-ray Powder Diffraction
CuKα rad., Θ - 2Θ
fixed slits
Sample: SARI Metering Station, 001 / SMS (Canyon Park RV) Mag Meter - Line 2
Sample# 98596
Quartz, [SiO2]
Calcite, [CaCO3]
cellulose
cellulose
non-crystalline scattering
Accumulated Counts
Diffraction Angle 2Θ
CAMET XRD 05-29-2025


SAWPA_98596_950C.xy Data 1
I observed
Hydroxylapatite
Merrillite
Diopside
Quartz
Lime
Nepheline
Archerite
Intensity [counts]
Diffraction Angle [degrees 2theta]

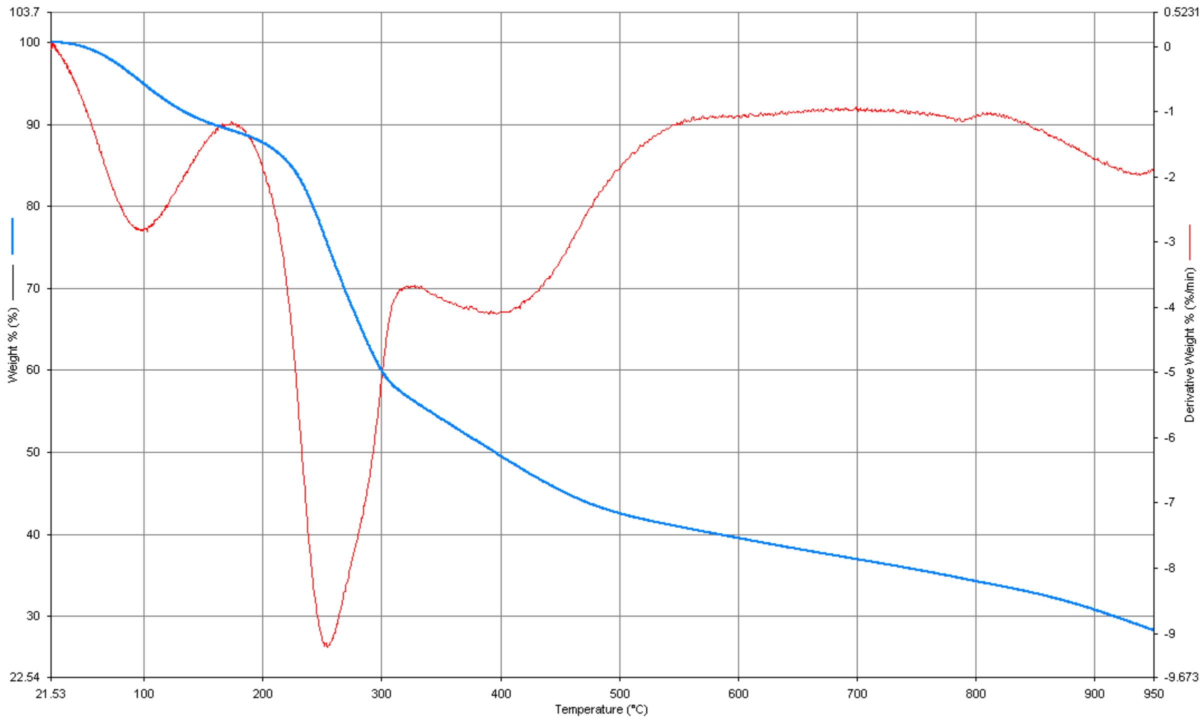


Figure 1. TGA graph of sample "SAWPA, 98596 - May 14, 2025". As received material, dried at 50ºC.
RT to 300ºC: 20ºC/min
300ºC to 950ºC: 40ºC/min
Balance: air Sample: air

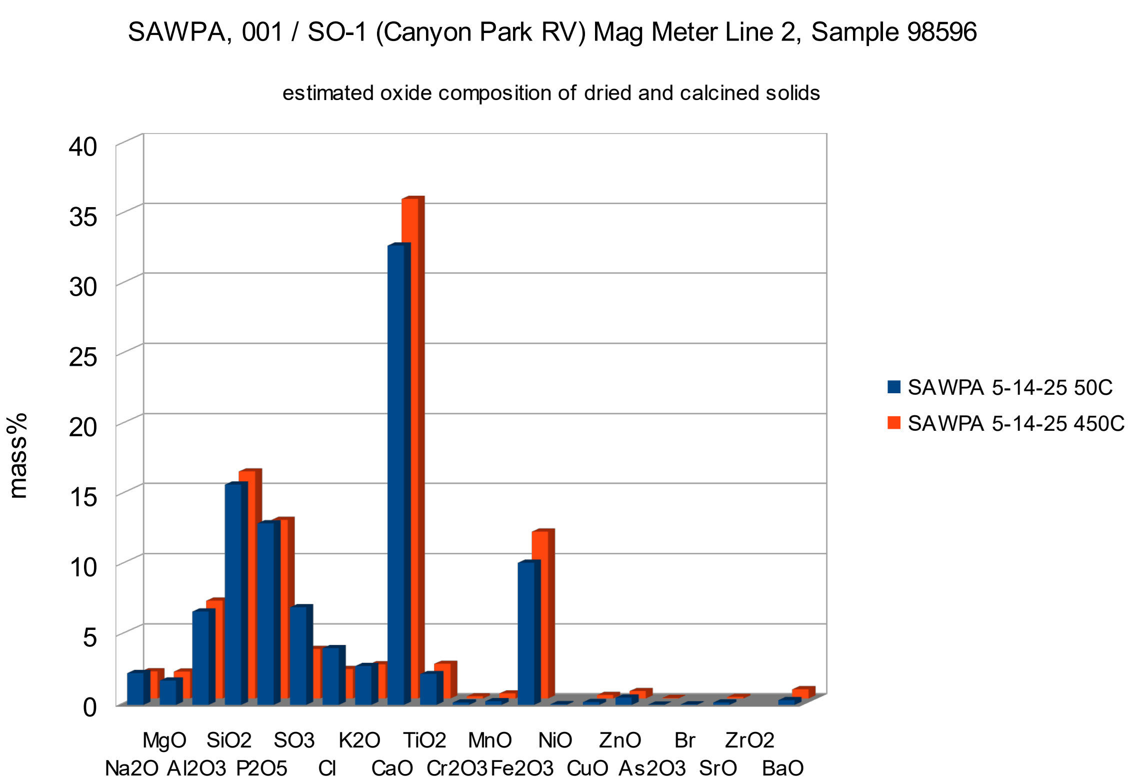


Figure 2. Estimated oxide composition of dried and calcined sample "SAWPA, 98596 - May 14, 2025".

Wen Cong, Aidan Hasegawa
Trussell Technologies Inc.
224 N Fair Oaks Ave
Pasadena, CA 91103

June 12, 2025

RE: Analysis of Waste Water Sludge, Santa Ana Watershed Project Authority (SAWPA)

PO No.: 2025-49

Report No.: 80020425

INTRODUCTION

A wet sludge sample was characterized using X-ray powder diffraction (XRD), WDXRF and thermogravimetric methods. The sample was received on May 30, 2025 and identified as follows:

Item	Description	Sample Date
(1)	SAWPA, 001 / SMS (Canyon Park RV) Mag Meter – Line 2 Sample ID: 98848	05/28/25

SAMPLING AND TESTING METHODS

The as-received sludge was dried at 50°C in air and split into representative test portions. The crystalline phase compositions of dried (at 50°C) and calcined (at 950°C) aliquots were determined by X-ray powder diffraction. XRD data sets were collected on a Rigaku wide angle powder diffractometer using CuKα radiation (8.1keV) and a diffracted beam monochromator. The results are listed in Table 1 and illustrated in Figures 1 and 2.

Elemental compositions were estimated for test portions dried at 50°C and calcined at 450°C using a standard-less method and datasets collected on a Rigaku ZSX Priums IV WDXRF spectrometer. Elemental results are listed in Table 2 and illustrated in Figure4. The estimated composition of the dried sludge material is listed in Table 4.

Thermogravimetric analysis (TGA) was performed using a Perkin Elmer TGA 7 with a high temperature furnace in ambient air atmosphere The results are listed in Table 3 and illustrated in Figure 3.

RESULTS

The sludge material consists of the cellulose portion, calcite and quartz, and non-crystalline phosphates, sulfates, silicates, alkalies and ferrous compounds. The non-crystalline fractions crystallize as various phosphate and silicate phases during calcination at 950°C

Please let us know if you have any questions regarding these results,

TABLES

Table 1. Normalized mineral composition of sample #98848, May 28, 2025

Mineral Name / Chemical Formula	Calcined at 950°C	Dried at 50°C
	wt%	wt%
Hydroxyapatite, $Ca_{10}(PO_4)_6(OH)_2$	**39.5**	
Merillite, $Ca_9NaMg(PO_4)_7$	**5.2**	
Diopside, $CaMgSi_2O_6$	**29.6**	
Lime, CaO	**1.6**	
Anhydrite, $CaSO_4$	**1.3**	
Nepheline, $(Na,K)AlSiO_4$	**13.3**	
Archerite, $(K,NH_4)H_2PO_4$	**4.5**	
Hematite, Fe_2O_3	**3.2**	
Not Identified		**<5**
Calcite, $CaCO_3$		**observed**
Quartz, SiO_2	**1.8**	**observed**

Table 2. Normalized and corrected oxide composition of the dried and calcined sludge material

Oxides / Elements	98848, dried at 50°C	98848, dried at 50°C corrected for LOI	98848, calcined at 450°C
	wt%	wt%	wt%
Na_2O	1.36	0.33	1.90
MgO	3.43	0.84	2.01
Al_2O_3	4.77	1.17	5.30
SiO_2	12.66	3.09	13.80
P_2O_5	11.34	2.77	9.88
SO_3	8.45	2.06	3.51
Cl	2.76	0.67	2.29
K_2O	1.55	0.38	2.19
CaO	40.12	9.80	41.43
TiO_2	4.17	1.02	5.29
Cr_2O_3	0.20	0.05	0.24
MnO	0.28	0.07	0.39
Fe_2O_3	8.16	1.99	10.77
NiO	0.04	0.01	0.06
CuO	0.21	0.05	0.28
ZnO	0.33	0.08	0.49
As_2O_3	0.02	0.01	
Br	0.03	0.01	
SrO	0.12	0.03	0.16
LOI at 450°C		75.57	75.57
Total	100.00	100.00	100.00

Table 3. Weight loss data as determined by TGA.

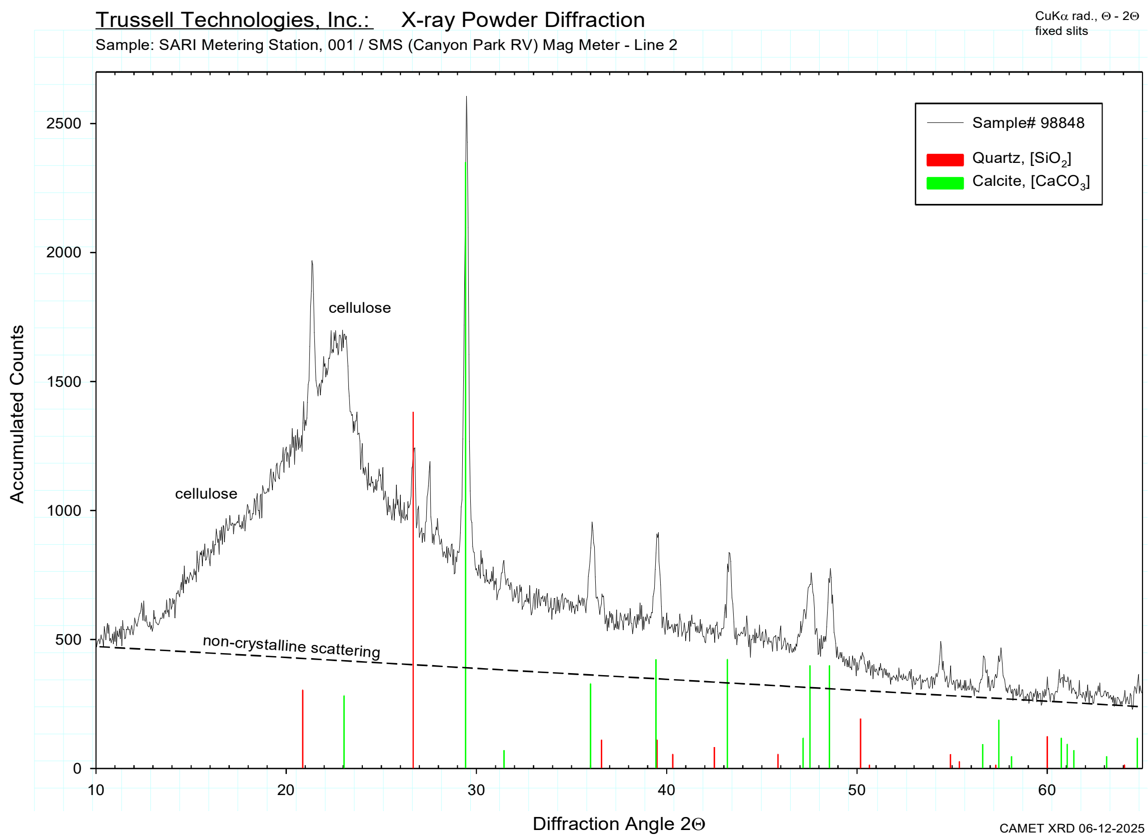
Temperature range, [ºC]	98848
	Weight loss, [%]
RT – 105	7.4
105 – 165	4.0
165 – 310	33.1
310 – 550	14.2
550 – 750	6.8
750 – 950	9.5
Total LOI (RT - 950°C)	75.0
Cellulose content[1]	37.1
Purge gas:	
Furnace	ambient air
Balance	ambient air

1 Combined weight loss between 105°C and 310ºC.

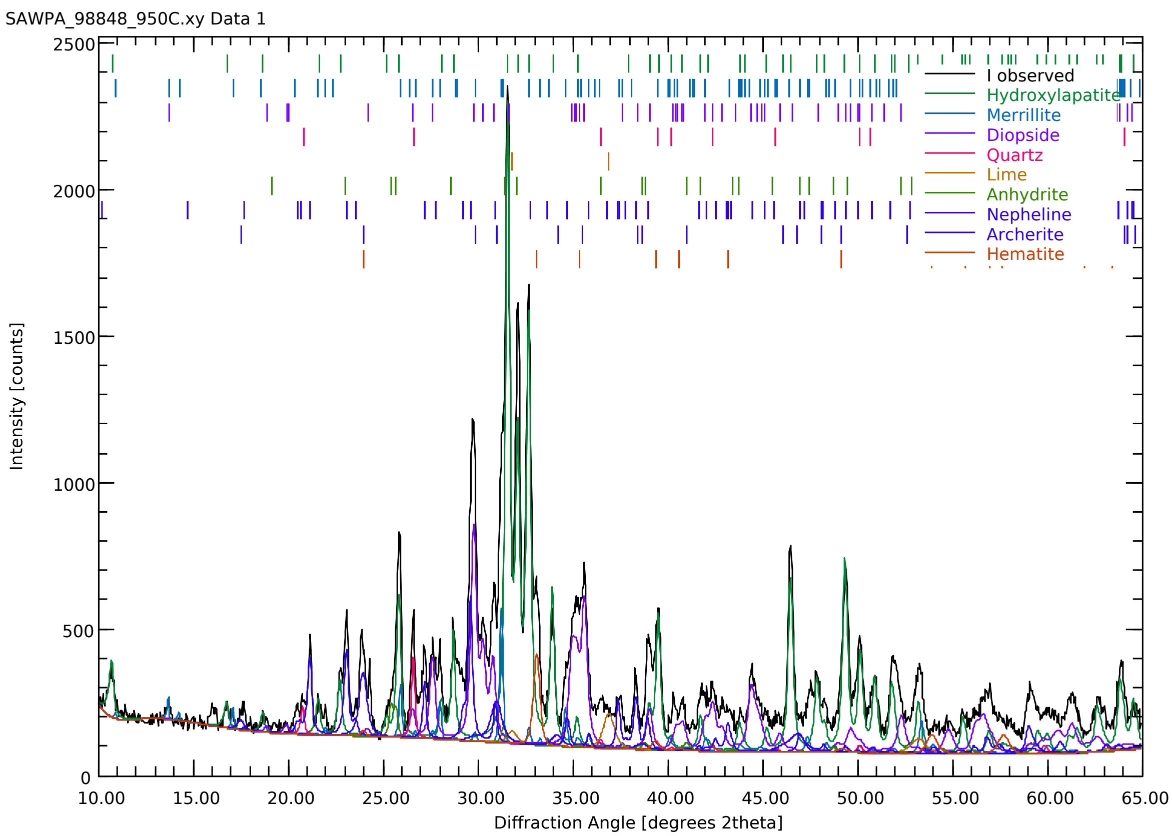
Table 4. Estimated composition of the as-received material dried at 50°C

	Sample 98848
	wt%
ACP [$Ca_9(PO_4)_6$]	**5.0**
$CaCO_3$	**9.6**
Cellulose, 105°C - 310°C	**37.1**
Volatiles (organic matter, bound water)	**38.5**
Na_2O	0.27
MgO	0.69
Al_2O_3	0.96
SiO_2	2.56
SO_3	1.71
Cl	0.56
K_2O	0.31
TiO_2	0.84
Cr_2O_3	0.04
MnO	0.06
Fe_2O_3	1.65
NiO	0.01
CuO	0.04
ZnO	0.07
As_2O_3	0.00
Br	0.01
SrO	0.03

FIGURES



Trussell Technologies, Inc.: X-ray Powder Diffraction
Sample: SARI Metering Station, 001 / SMS (Canyon Park RV) Mag Meter - Line 2
CuKα rad., Θ - 2Θ
fixed slits
Sample# 98848
Quartz, [SiO2]
Calcite, [CaCO3]
cellulose
cellulose
non-crystalline scattering
Accumulated Counts
Diffraction Angle 2Θ
CAMET XRD 06-12-2025



SAWPA_98848_950C.xy Data 1
I observed
Hydroxylapatite
Merrillite
Diopside
Quartz
Lime
Anhydrite
Nepheline
Archerite
Hematite
Intensity [counts]
Diffraction Angle [degrees 2theta]

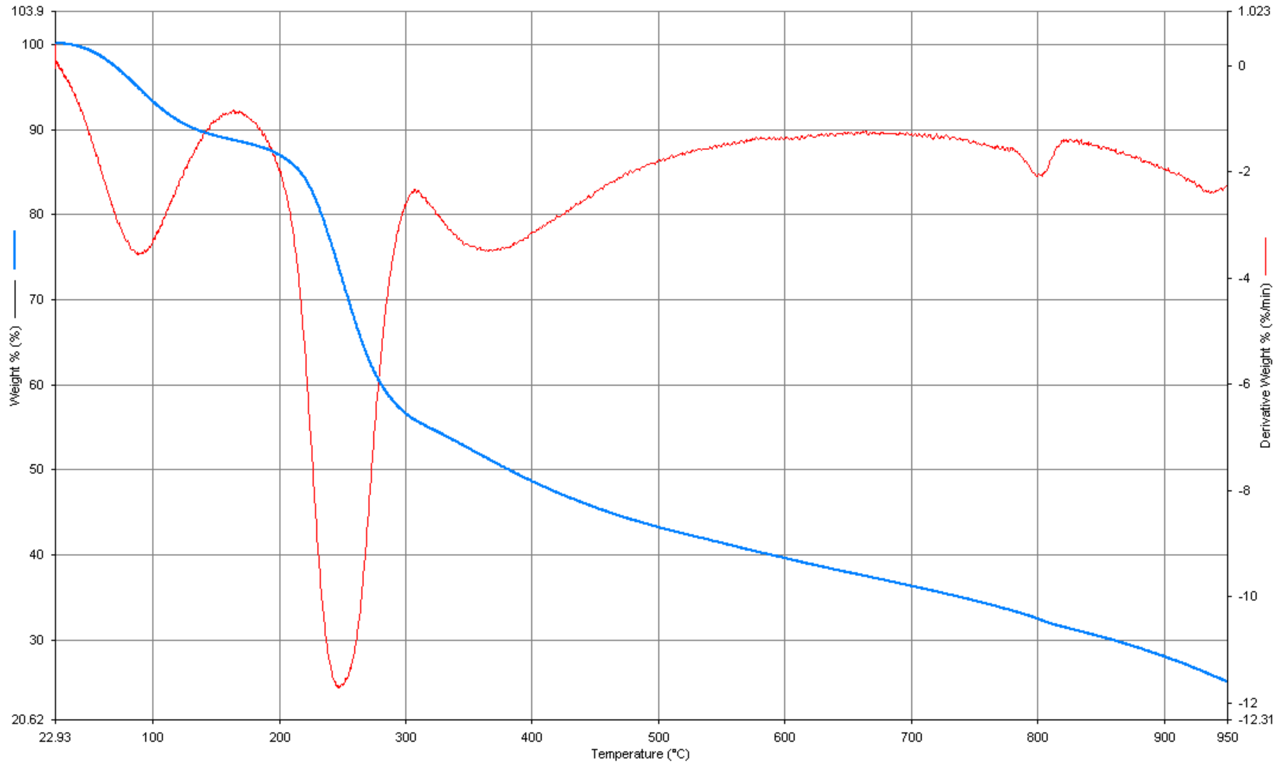


Figure 1. TGA graph of sample "SAWPA, 98848 - May 28, 2025". As received material, dried at 50ºC.
RT to 300ºC: 20ºC/min
300ºC to 950ºC: 40ºC/min
Balance: air Sample: air

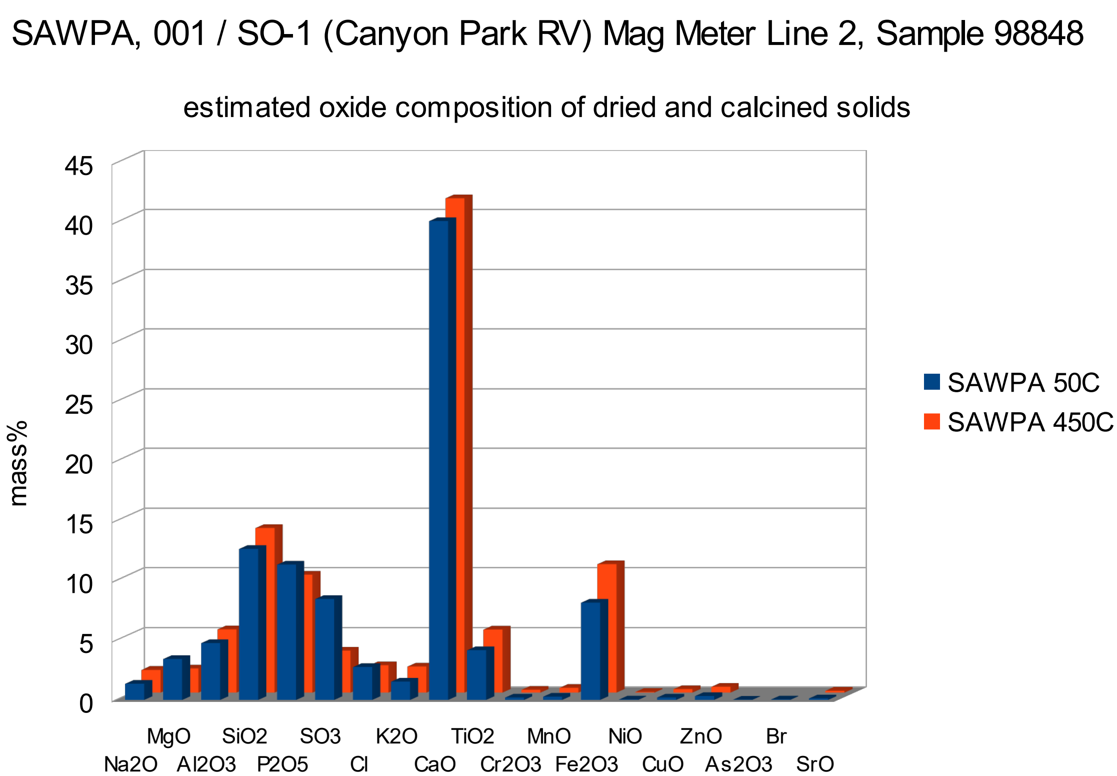


Figure 2. Estimated oxide composition of dried and calcined sample "SAWPA, 98848 - May 28, 2025".

13 Appendix E – Babcock Laboratories Results for the Three Solids Characterization Events

Parameter	Units	Sample Date		
		5/1/25	5/14/25	5/29/25
TSS	mg/L	140	96	110
TSS	mg/L	130	110	110
TSS	mg/L	160	100	120
VSS	mg/L	110	80	64
VSS	mg/L	100	94	69
VSS	mg/L	130	83	78
BOD_5	mg/L	42	48	26
BOD_5	mg/L	52	50	26
BOD_5	mg/L	45	59	28
Dissolved BOD_5	mg/L	ND	7	ND
Alkalinity	mg/L as $CaCO_3$	1,100	1,000	1,000
Dissolved Alkalinity	mg/L as $CaCO_3$	1,000	1,000	970
Bicarbonate	mg/L as $CaCO_3$	1,100	1,000	1,000
Dissolved Bicarbonate	mg/L as $CaCO_3$	1,000	1,000	970
Calcium	mg/L	650	710	660
Dissolved Calcium	mg/L	650	690	710
TDS	mg/L	5,000	5,400	5,000
Orthophosphate	mg/L	0.65	0.67	1.0
DOC	mg/L	11	12	10
pH	--	7.24	7.32	7.25
Temperature	°C	23.6	24.0	24.2
Electroconductivity	μS/cm	7.65	6.26	5.55