Metropolitan Water Reclamation District of Greater Chicago

MONITORING AND RESEARCH DEPARTMENT

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CHLORINE DISINFECTION PROCESS CONTROL EVALUATION AT THE JOHN E. EGAN WATER RECLAMATION PLANT

October 2014

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CHLORINE DISINFECTION PROCESS CONTROL EVALUATION AT THE JOHN E. EGAN WATER RECLAMATION PLANT

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DISCLAIMER

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Introduction

In a memorandum from the Maintenance and Operations (M&O) Department titled, "001 Fecal Coliform NPDES Permit Exceedance, May 30, 2011, John E. Egan WRP" dated June 24, 2011, the Monitoring and Research Department (M&R) was requested to study the 001 Outfall (001) disinfection process. The disinfection process operating procedures during high flow and suspended solids (SS) concentration conditions were of particular interest. The fecal coliform (FC) National Pollutant Discharge Elimination System (NPDES) permit limit at the John E. Egan (Egan) Water Reclamation Plant (WRP) 001 point is a daily maximum not to exceed 400 colony forming units per 100 milliliters (CFU/100 mL) during May through October. This limit was exceeded when a May 30, 2011, grab sample was found to have a FC concentration of 420 CFU/100 mL.

The operating conditions on May 30, 2011, during sampling were considered to be unsteady. The plant was in transition from 004 Excess Flow Discharge (004) operating conditions to 001 operating conditions. At the time of sample collection, a pair of filter cells were undergoing backwash, and the return activated sludge (RAS) flow was observed to be higher than normal. It was suggested that the current chlorine dosing control may have been unable to compensate for the operational changes that occurred. After reviewing M&O Department records, the secondary effluent turbidity was observed at greater than seven nephelometric turbidity units (NTU) when the May 30, 2011, grab sample was collected. The secondary effluent turbidity is generally about two NTU for that time of year. The high turbidity could indicate higher SS concentrations in the secondary effluent entering the disinfection process. Variable SS concentrations, transient filter effluent flows, RAS flow, and process changes related to 004 operating conditions may have contributed to the inadequate disinfection and FC concentration limit exceedance.

After reviewing the operating conditions, the M&R Department recommended investigation of a cascade control scheme for the 001 chlorination process in a memorandum to the M&O Department dated August 3, 2011. Cascade control utilizes a total residual chlorine (TRC) control parameter at the head of the chlorine contact tank (CCT), in this case before the filters, as well as a clear well (CW) TRC control parameter at the end of the CCT. Proper chlorine dosing control using TRC information before and after the filters may be able to compensate for variable flows and SS concentrations, because it takes into account the chlorine demand of the secondary effluent prior to entering the CCT. The cascade control scheme may be able to maintain a constant and effective CW TRC at the end of the CCT, eliminate potential NPDES permit violations, and reduce chemical costs due to overdosing.

The recommendation outlined in the August 3, 2011, M&R Department memorandum included a study to gather information that could lead to better disinfection control strategies during high flow events and transient conditions. The M&O Department responded in a memorandum dated October 1, 2011, concurring with the proposed M&R Department study and agreed to install an additional chlorine analyzer to monitor the pre-filter (PF) TRC. The project was

delayed and a finalized work plan was completed in September 2012, and fieldwork was executed from September 2012 through June 2013.

Background

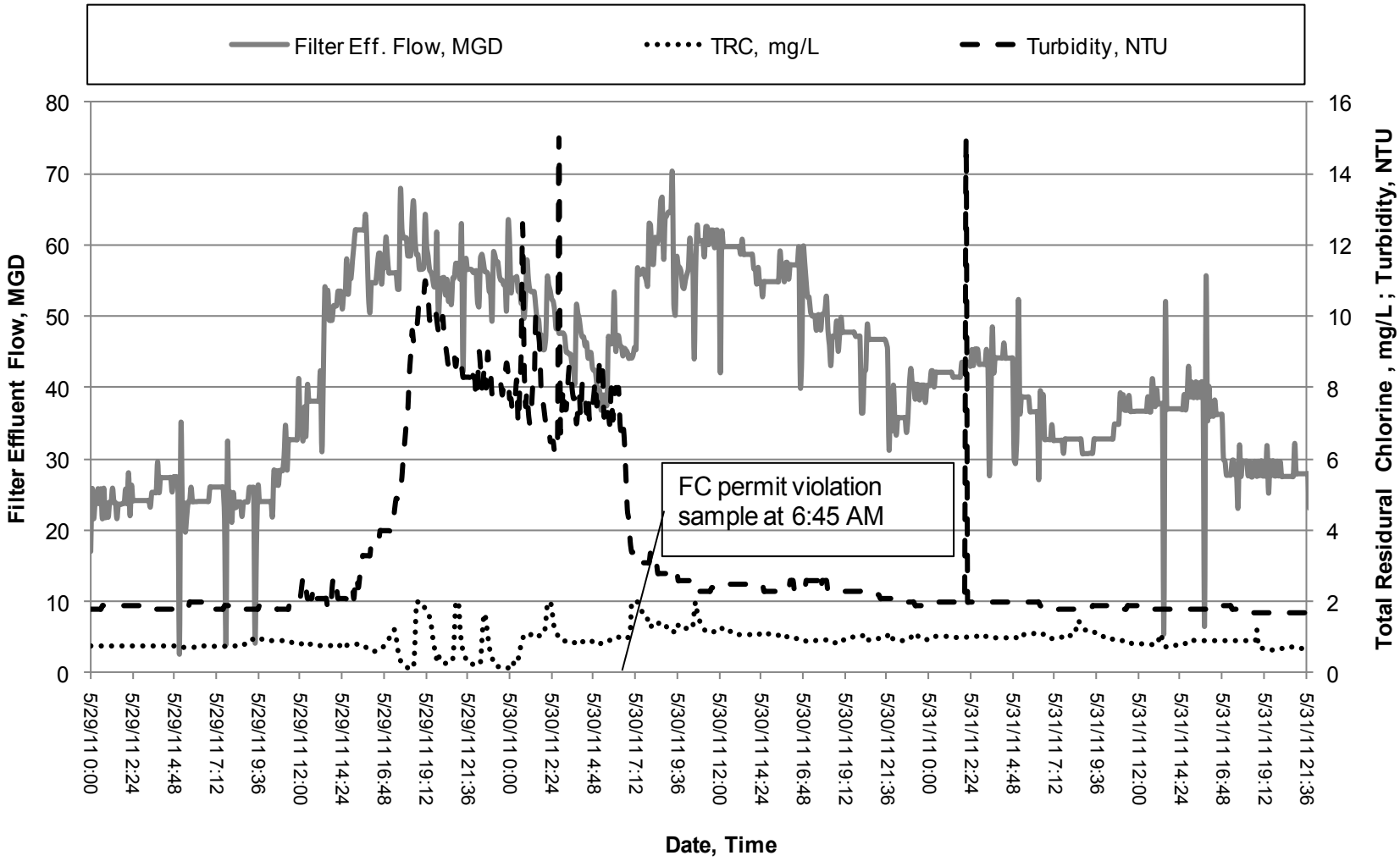
The Egan WRP is a tertiary wastewater treatment plant. Design average flow for the plant is 30 million gallons per day (MGD) with a design maximum flow of 50 MGD. The wastewater treatment process train consists of coarse screens, aerated grit, fine screens, primary clarifiers, aeration tanks, secondary clarifiers, chlorination, sand filtration, and dechlorination. The CCT includes conduit from the secondary clarifiers to the sand filters and the sand filters.

There are two NPDES permitted discharges, 001 and 004. The 001 is the dry weather plant discharge with flows up to the design maximum flow. During some wet weather events when flows exceed the maximum practical flow of 50 to 60 MGD, a portion of the flow is treated with only primary clarification, chlorination, and dechlorination. This is the 004 process train. At the same time that the 004 process is in use, the wastestream to the 001 bypasses the primary clarifiers and goes directly to the secondary process. The NPDES permit limit for FC concentration at both 001 and 004 is a daily maximum of 400 CFU/100 mL.

Current Chlorination Control for Disinfection at 001 Outfall. The 001 chlorination process is a manually controlled feedback/feed forward system. The feedback information is the CW TRC (instrument range of 0 to 2.0 milligrams per liter [mg/L]), and the feed forward information is the plant flow. The CW TRC has a set point of 0.85 to 0.95 mg/L, as reported by the M&O Department prior to beginning the study. As plant flow changes, operators anticipate the impact on the CW TRC and adjust the chlorine pump speed accordingly, i.e. increasing chlorine pump speed as the flow increases, and decreasing chlorine pump speed as the flow decreases. At the same time, the operators monitor the CW TRC and incorporate that information into the chlorine pump speed changes. Through experience, the operators have been able to maintain the CW TRC set point within the desired range during steady-state flows and most of the time during transient flows. A time-series graph of CW TRC, secondary effluent turbidity, and filter effluent flow for May 29 through 31, 2011, is shown in Figure 1. The CW TRC fluctuated from near zero to 2 mg/L when turbidity was generally above seven NTU, and flows periodically went above 50 MGD. It was hypothesized that under these high turbidity and flow conditions it was difficult for the operators to maintain the CW TRC set point at 0.85 to 0.95 mg/L, leading to the FC concentration NPDES permit violation.

Suspended solids concentrations are not monitored on-line; secondary effluent turbidity is monitored on-line but was not considered for chlorine dosing adjustments. SS concentration of the secondary effluent entering the chlorination process may affect the chlorine dose requirement for disinfection due to increased chlorine demand. Increased chlorine demand is attributed to oxidization reactions with substances entrained in the SS matrix. Examples of these oxidizable substances include: Fe^{+2}, Mn^{+2}, H_2S, and organic matter (Metcalf & Eddy, Inc., 1991). The initial chlorine demand reduces the amount of available chlorine when components in the wastewater quickly react with the chlorine, making less chlorine available for disinfection. After the initial chlorine demand was satisfied, higher SS concentrations may have continued to exert

FIGURE 1: JOHN E. EGAN WATER RECLAMATION PLANT FILTER EFFLUENT FLOW, TOTAL CHLORINE RESIDUAL, AND TURBIDITY (MAY 29 THROUGH MAY 31, 2011)



higher chlorine demand. Delayed chlorine demand was defined here as the chlorine needed to react with microorganisms and other materials that did not react with chlorine instantly. The delayed chlorine demand is the TRC difference between the beginning and end of the CCT (or sand filters in this case). A higher TRC at the beginning of the sand filters during higher than normal SS concentration periods may be required to consistently reduce FC concentrations safely below the 400 CFU/100 mL limit. SS concentrations may be related to turbidity (Packman et al., 1999). Therefore, there is a potential that the on-line turbidimeter may be used as an element in chlorine dose control decisions.

The Egan WRP recently installed a TRC on-line analyzer at the beginning of the CCT (ahead of the filters). This TRC analyzer provided real-time TRC concentrations soon after the chlorine was dosed. This installation provided an opportunity for understanding the potential correlation between TRC values before and after the CCT.

Cascade Control for Chlorination. Cascade control splits the process response into a primary and secondary control loop. Instead of adjusting the chlorine pump speed solely based on the primary loop (CW TRC control), the pump speed can also be determined by the secondary loop (PF TRC control). The set point of the secondary loop can be used to maintain the primary loop set point. The advantage is that the secondary loop can respond quickly to transient conditions, while operating the primary loop alone causes lags, fluctuations, and oscillations in the CW TRC, as seen in Figure 1. Conditions are considered transient when a significant change occurs in any parameter that affects disinfection, such as flow, sodium hypochlorite (NaOCl) pump speed, SS concentration, turbidity, PF TRC, or CW TRC. Any impact on the process other than steady state is considered transient.

The secondary loop uses the CW TRC value as a set point, and the PF TRC set point varies, depending on the CW TRC. The primary loop still controls the CW TRC, but the control responses are dampened if used in combination with the secondary loop. The benefit of using a cascade configuration is that any disturbance in the secondary loop can be corrected before a consequence is registered in the CW TRC; thus, stable CW TRC can be achieved. It has been documented that optimization of a chlorination system using an automated version of this control system was successful and reduced chemical costs at the Houston Beltway Wastewater Treatment Plant (Dieu et al., 1995). Full automation may not be a realistic option at this time at the Egan WRP, but the benefits of cascade control even in manual mode are promising.

Increased solids to the CCT may result in a decreased PF TRC. The change in PF TRC may be sufficient to program the control logic for an automated cascade control system. However, with the proposed cascade system under manual control, the influent turbidity could be of value to the treatment plant operators. The M&O Department may be able to use turbidity as an indication of higher solids entering the CCT. Hypothetically, they will see a decrease in PF TRC and adjust their dosing decisions to meet the CW TRC. The secondary effluent solids are removed and build up in the filters between backwash cycles. The dynamics of this increasing solids inventory in the CCT may also affect the chlorine demand. In summary, the variability of the incoming solids may be reflected in the PF TRC and the upstream turbidimeter, but will not register the changing solids in the filters.

Objectives

This study, with an ultimate goal of preventing NPDES FC permit violations at the Egan WRP 001 location and potentially implementing cascade control, had the following objectives:

1. Verify the TRC set point range in the CW that ensures consistent compliance with the NPDES FC permit, under various operating conditions, particularly under transient conditions (Phase I).

2. Investigate a potential correlation between secondary effluent turbidity with SS concentrations to determine whether turbidity can be used as an additional parameter for disinfection process control decisions (Phase II).

3. Evaluate a relationship between the PF and CW TRC concentrations in order to implement cascade control at the Egan WRP in the future (Phase III).

Materials and Methods: Phase I: Evaluation of Clear Well Total Residual Chlorine and Fecal Coliform Concentration

The methods and materials are shown separately for each of the three phases. Much of the operational data, samples collected, and analyses were used for all three phases. This phase of the study attempted to verify the TRC range in the CW that will ensure consistent compliance with the NPDES permit. The study design included a range of FC concentrations above and below the 400 CFU/100 mL FC concentration limit. During the chlorination season, normal operating controls were employed with a CW TRC set point target between 0.85 to 0.95 mg/L.

During the pre-chlorination season, April 17 through 30, 2013, the operators adjusted the chlorination process in order to obtain different conditions. The operators increased and decreased the chlorine feed rate with a CW TRC target range of 0.4 to 1.6 mg/L. The planned transition conditions are shown in Table 1. The operators also fed raw influent directly to the secondary process in an attempt to increase the SS concentration in the secondary effluent. The sample collection method was to collect samples once the target TRC was met, then collect samples 30 minutes apart to obtain two samples per TRC. The sample collection was modified to every 30 minutes, because the operators were not able to control the chlorine feed rate with the precision specified in the work plan.

During the pre-chlorination season, comparison of the CW and the collect-and-hold (C&H) sample FC concentrations were made in order to validate the C&H method as a proxy for CW FC concentration, since the CW cannot be sampled and analyzed for FC concentration during chlorination season.

Sample Locations. There were two sampling locations: (1) the CW sample line, which is located in the basement of the filter building; and (2) the PF sample line, which is located on the south wall on the main floor of the filter building.

TABLE 1: GUIDELINES FOR CHANGES IN TARGET CLEAR WELL TOTAL RESIDUAL CHLORINE FOR PRE-SEASON EXPERIMENTAL PERIOD, APRIL 17 THROUGH APRIL 30, 2013

Time (hhmm)	Target TRC (mg/L)
0700–0800	0.4
0800–0900	0.8
0900–1000	1.2
1000–1100	1.6
1100–1200	0.4

Note: The target TRCs were attempted during the noted time period but were not easily met.

Sampling Frequency.

Chlorination Season. The chlorination season samples were collected on September 18 and 25, 2012, October 2, 17, and 23, 2012, and June 12 and 26, 2013. A total of seven days of field sampling were conducted. Nine PF samples were collected per study day, approximately one sample every 30 minutes from 8:00 a.m. until 12:00 p.m.

Pre-Chlorination Season. The pre-season field sampling days were April 17, 22, 23, 24, 25, 29, and 30, 2013. Ten samples were collected on each of these seven days, approximately one sample every 30 minutes. Both PF and CW samples were collected from 7:00 a.m. to 12:00 p.m.

Sampling Procedure, Methodology, and Data Collection.

Clear Well Samples. The CW samples were collected directly into Bac-T bottles prepared with sodium thiosulfate ($Na_2S_2O_3$) and ethylenediaminetetraacetic acid (EDTA). The samples were delivered to the Analytical Microbiology and Biomonitoring Section (AM&B) before 1:00 p.m.

Pre-Filter and Collect-and-Hold Samples. The PF samples were collected into new one-gallon jars with a lid immediately screwed on. The samples were allowed to sit for the contact time that corresponded to the contact time in the CCT, which was based on the filter effluent flow. The plant currently monitors raw influent and filter effluent flow. Due to sludge wastage between the plant headworks and the head of the filters, variations in RAS flow, the exact flow entering filters is unknown. Filter backwash cycles also reduce the filter effluent flow as compared to the plant flow. After the elapsed contact time, an aliquot of the chlorine-contacted wastewater in the one-gallon jar was poured into Bac-T bottles prepared with $Na_2S_2O_3$ and EDTA.

To compare the CW samples and the C&H samples, CW samples were collected as close as possible to the end of the C&H contact time.

The remainder of the sample in the one-gallon jars was submitted to the Analytical Laboratories Division (ALD).

Sample Analysis. The samples collected from the PF and CW locations were analyzed for FC concentrations by AM&B. The PF samples were analyzed for SS concentrations by ALD.

Upon pouring off the Bac-T sample, the C&H samples were analyzed for TRC with a Hach AutoCAT 9000 at the end of the contact time. The procedure followed Method 4500-Cl D

in *Standard Methods for the Examination of Water and Wastewater* (18th Edition). In accordance with the procedure, an excess of potassium iodide was added to the water sample. The sample was adjusted to a pH of 4 with an acetate buffer. The sample was then titrated amperometrically with a standard phenylarsine oxide solution to determine the TRC concentration. The temperature was recorded.

Operational and Analytical Data. Operational data were retrieved from the decentralized control system (DCS) for each sampling day and for the time surrounding the May 31, 2011, and August 20, 2013, permit violations. The CW TRC, filter effluent and backwash, plant and RAS flows, turbidity, and temperature were retrieved in five to fifteen-minute increments for the study days. The FC and SS concentration data were retrieved from the Laboratory Information Management System (LIMS) database.

Data Evaluation. The data evaluation used the DCS data for all operational parameters evaluated. The filter effluent flow was used to estimate the CCT contact time. The TRC and this contact time were used to calculate the chlorine residual time (C_Rt) (C_Rt = contact time x TRC). The log FC versus TRC and the log FC versus C_Rt were used to evaluate the disinfection process. Transient conditions were evaluated with time-series plots, and the C&H method was evaluated.

The CCT contact time was verified using events that caused a sudden change in the PF and CW TRC values. The difference in time between PF and CW TRC spikes during these events was used to determine the time secondary effluent takes to pass through the CCT at a specific flow. The experimental CCT time measurements were compared to the calculated time provided by the M&O Department.

Scatter plots, based on the DCS and AM&B data, of the CW log FC concentration versus TRC and CW log FC versus C_Rt were used to evaluate disinfection performance. The geometric mean of the unchlorinated CW FC concentration data (January 2 through April 16, 2013, and November 6 through 26, 2013) was included in the linear regression analysis; the r^2 value was calculated. Reference points (not included in the regression) were also plotted which include: (1) the May 31, 2013, permit violation; (2) the August 20, 2013, FC concentration violation; and (3) the maximum unchlorinated CW FC concentration (January 2 through April 16, 2013, and November 6 through 26, 2013).

A scatter plot of CW log FC versus CRt excluding CW FC data less than or equal to 10 CFU/100 mL was also evaluated. Linear regressions, including the geometric mean of the unchlorinated FC concentration data, were established, and r^2 values were calculated. The reference points mentioned above were also included in the plots for reference, but were not included in the regression analysis. A conservative recommendation for a C_Rt target for process control was calculated for the conditions observed in this study.

Four time-series plots were prepared for each sample day in order to evaluate the effect of transient conditions. Each sample day was evaluated to determine if transient conditions affected the CW TRC and FC concentrations. The time-series plots are (A) turbidity, SS concentration, filter effluent and RAS flows; (B) turbidity, SS concentration, and backwash flow; (C)

turbidity, CW TRC, PF TRC, plant flow, and NaOCl pump stroke; and (D) CW TRC, C&H FC, and off-season CW FC concentrations. A time-series plot of the operational data during the August 20, 2013, violation and for the months of August 2013 was also examined.

The C&H and CW FC concentrations were compared using the Student's t-Test and time-series plots for each off-season sample day.

Materials and Methods: Phase II: Evaluation of Correlation of Secondary Effluent Turbidity and Suspended Solids Concentration

This objective attempted to correlate the secondary effluent turbidity with the secondary effluent SS concentration. The results may allow the on-line turbidity analyzer values to be used for making better chlorination process control decisions.

Sample Locations. The samples were collected from the PF sample line located on the main floor of the filter building as mentioned in Phase I.

Sampling Frequency. The sampling frequency during the chlorination and pre-chlorination season were the same as in Phase I.

Sampling Procedure, Methodology, and Data Collection.

Pre-Filter Samples. The PF samples collected in Phase I were used in this phase of the study.

Sample Analysis. The PF samples were analyzed for SS concentration as in Phase I.

Operational and Analytical Data. The operational and analytical parameters were retrieved as in Phase I.

Data Evaluation. The secondary effluent turbidity and SS concentrations were evaluated to determine if a relationship existed using a scatter plot, based on the DCS and ALD data, and a least-squares linear regression analysis. The interquartile method (Berk and Carey, 2010) was used to identify SS concentration outliers, which were not included in the linear regression.

The RAS flow, backwash and filter effluent flow, PF and CW TRC, turbidity, SS concentration, and the NaOCl pump stroke data were reviewed using time-series graphs to determine if operating conditions affect the secondary effluent SS concentration or turbidity. The relationship

between turbidity and the CW TRC was also evaluated as well as the effect of solids buildup in the filters.

SS and turbidity relationships were looked at collectively and grouped by quartile under similar operating conditions. The r^2 values were used to determine if there was an association between each parameter (and quartile within each parameter). An r^2 value ≥ 0.68 was considered to be a moderate correlation. The SS concentrations were determined from the difference between the dried solids with the crucible and the crucible only. The practical quantification limit was not used, because a more precise data point was desired. The relationships were also compared for three different flow ranges: 10–23 MGD, 24–49 MGD, and >50 MGD.

Materials and Methods: Phase III: Evaluation of Effectiveness of Using a Pre-Filter Total Residual Chlorine Process Control Parameter

This phase attempted to determine if a process control set point using the PF TRC analyzer could be used to reduce fluctuations in the CW TRC concentration. The relationship between the PF TRC and CW TRC concentration was evaluated using the DCS data.

Sample Locations. The bulk NaOCl solution used in the chlorination process was sampled from the storage tank located outside the filter building in order to evaluate the consistency of the NaOCl solution.

Sampling Frequency. The sampling frequency for the NaOCl bulk solution for the chlorination and pre-chlorination season included only one additional sample other than the bulk solution available chlorine analysis that was conducted with each delivery. The additional sample was collected and analyzed on October 1, 2012. The bulk solution was delivered approximately once every three days.

Sampling Procedure, Methodology, and Data Collection.

Sodium Hypochlorite Sample. M&O Department personnel were requested to collect the NaOCl sample and deliver it to ALD.

Sample Analysis. The NaOCl solution was analyzed for available chlorine by ALD.

Operational and Analytical Data. The operational data were retrieved as in Phase I. The M&O Department Monthly Operating Reports were also used.

Data Evaluation. The relationship between the PF and CW TRCs (based on the DCS) was evaluated as follows: (1) a comparison of the delayed chlorine demand during different flow ranges: 10–23 MGD, 24 MGD–49 MGD, and >50 MGD, (2) the stability of the NaOCl solution, (3) the effect of operational parameters and influent characteristics on CW TRC, and (4) a PF and CW TRC regression analysis.

The data evaluation focused on sampling days with different flows. The delayed chlorine demand (PF TRC minus CW TRC) was determined for each study day.

The monthly analyzed NaOCl bulk solution and pump flow were used to determine the chlorine decay in the 15 percent NaOCl solution.

The CW and PF TRC, filter effluent, plant, RAS flow and filter backwash flows, turbidity, and SS concentrations were plotted as time-series graphs. The time-series graphs were used to visually evaluate whether a change in one of the parameters influenced a change in PF TRC.

CW TRC relationships were looked at collectively and grouped by quartile under similar operating conditions. The r^2 values were used to determine if there was an association between each parameter (and quartile within each parameter). An r^2 value ≥ 0.68 was considered to be a moderate correlation. A PF and CW TRC least-squares regression analysis and r^2 value was used to evaluate the PF and CW TRC relationship.

Results and Discussion

Phase I: Evaluation of Clear Well Total Residual Chlorine and Fecal Coliform Concentration. The objective of Phase I was to verify the TRC set point range in the CW that ensures consistent compliance with the NPDES FC permit. The following data evaluations were conducted: (1) CCT contact time verification, (2) log FC versus TRC and log FC versus $C_R t$ modeling, (3) transient condition effect on TRC and FC concentration, and (4) verification of the C&H method.

On all of the pre-season study days, the operators, though experienced with chlorine feed systems, could not match the target CW TRC as specified in Table 1. The 0.4 mg/L CW TRC target at the beginning of the study was difficult to meet for the operators, because the trial start time conflicted with shift change duties. The 0.4 mg/L TRC at the end of the trial was difficult for the operators to meet because of the large change from 1.6 to 0.4 mg/L of TRC. The chlorine pump control had limits that restricted the pump rate of change. This was a challenge that was discovered after the study began. The result of these problems was that most of the study during the pre-season period was conducted at CW TRC values of 0.8 mg/L or greater. Considering that the typical chlorination season CW TRC is near 0.8 mg/L, most of the FC concentration results were less than 10 CFU/100 mL.

The filter effluent flow was used to estimate the CCT contact time based on information provided by the M&O Department, which included the volume of the conduit from the secondary clarifiers and the filters. The M&O Department-calculated contact times through the filters

at several different filter effluent flows were compared to the M&O Department estimates. The measured contact times only considered the time through the filters.

Time-series plots of the PF and CW TRCs at times of steady-state filter effluent flows were used to determine the contact time through the filters. Inflection points on the PF TRC curve were identified and the corresponding inflection point on the CW TRC curve was determined. The contact time at specific filter effluent flows through the filters were determined to be the time between the inflection points. For example, on April 24, 2013, 8:15 to 8:30 a.m. a steady flow of 42 MGD was found to have a 15 minute contact time through the filters, as illustrated in Figure 2. In a similar manner, inflection points were used to determine contact times at three other filter effluent flows, summarized in Table 2.

Figure 3 shows a comparison between the contact time calculated by the M&O Department and the contact time measured during this study. Generally, the calculated and measured contact times were in good agreement. An outlier of this agreement was observed at the 27 MGD filter effluent flow. Examples of time-series graphs at flows <30 MGD with inflection points that could be used to determine contact time were not available during the study times. In order to improve the correlation between the measured and the calculated contact times, it is recommended that the chlorine be used to cause a spike that could be tracked with this method at lower flows. However, given the good agreement between the measured and calculated contact time greater than 30 MGD, the C_Rt calculations in the remainder of the report were calculated with the contact time estimated by the M&O Department and the filter effluent flow.

The CW log FC versus TRC and C_Rt scatter plot are shown in Figures 4 and 5, respectively. The scatter plot did not indicate a strong linear relationship between the CW log FC and TRC or C_Rt. Also represented in Figures 4 and 5 are the violations that occurred on May 31, 2011, and August 20, 2013, and the maximum unchlorinated FC concentration. The TRC value does not take into consideration the contact time. The C_Rt term incorporates both time and concentration. The correlation between the log FC concentration and C_Rt was slightly improved compared to log FC versus TRC, but still very low.

The log FC concentration versus C_Rt plot, with the data less than 10 CFU/100 mL removed from the dataset, is shown in Figure 6. The correlation between log FC and C_Rt improved compared to the log FC versus TRC correlation. Visually, a linear trend was observed. However, additional data is required to verify this relationship for use as a decision-making tool since there was not a lot of FC concentration data in the 100 and 10,000 CFU/100 mL range.

The August 20, 2013, permit violation is plotted on Figures 4, 5 and 6. Visually this appears as an outlier on all three plots relative to the regression line, but the turbidity was not taken into consideration. The conditions at the time of the permit violation (9:45 a.m.) were: FC concentration = 810 CFU/100 mL, TRC = 1.77 mg/L, turbidity = 12.3 NTU, and plant flow = 22 MGD. The exact SS concentration during the time of sampling is not known. A time-series plot of operational data on August 20, 2013, is shown in Figure 7. Most notable was the series of backwash events and the high turbidity. This data is consistent with the hypothesis that the FC concentration permit violations are related to high turbidity. The high number of backwash events indicated the solids loading was higher than the conditions on the study days, which only had one or two backwashes. This establishes that there was higher SS on the day of this

FIGURE 2: TIME SERIES OF PRE-FILTER AND CLEAR WELL TOTAL RESIDUAL CHLORINE WITH STEADY FILTER EFFLUENT FLOW OF 42 MILLION GALLONS PER DAY BETWEEN 7:45 AND 9:55 A.M. ON APRIL 24, 2013

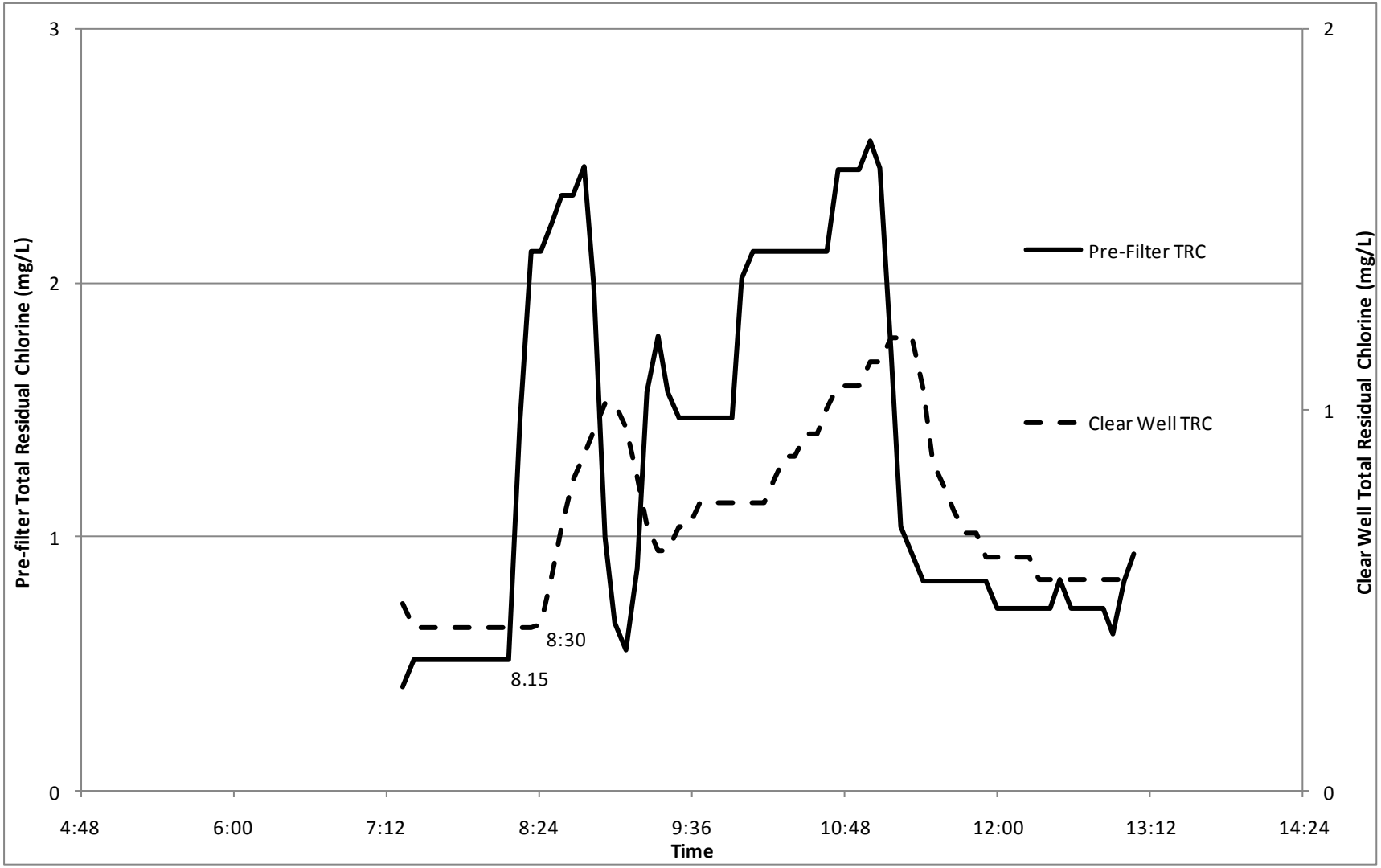


TABLE 2: MEASURED CONTACT TIME FOR THE 001 CHLORINATION PROCESS AT THE JOHN E. EGAN WATER RECLAMATION PLANT DURING THE PRE-SEASON STUDY PERIOD

Date	Time Period	Filter Effluent Flow (MGD)	Contact Time (minutes)
4/17/2013	10:05–10:15	50	10
4/24/2013	8:15–8:30	42	15
4/17/2013	7:50–8:10	30	20
4/30/2013	8:00–8:35	27	35

FIGURE 3: CHLORINE CONTACT TIME COMPARISON BETWEEN MONITORING AND RESEARCH DEPARTMENT MEASURED AND MAINTENANCE AND OPERATIONS DEPARTMENT ESTIMATES (MEASUREMENTS TAKEN APRIL 17, 24, AND 30, 2013)

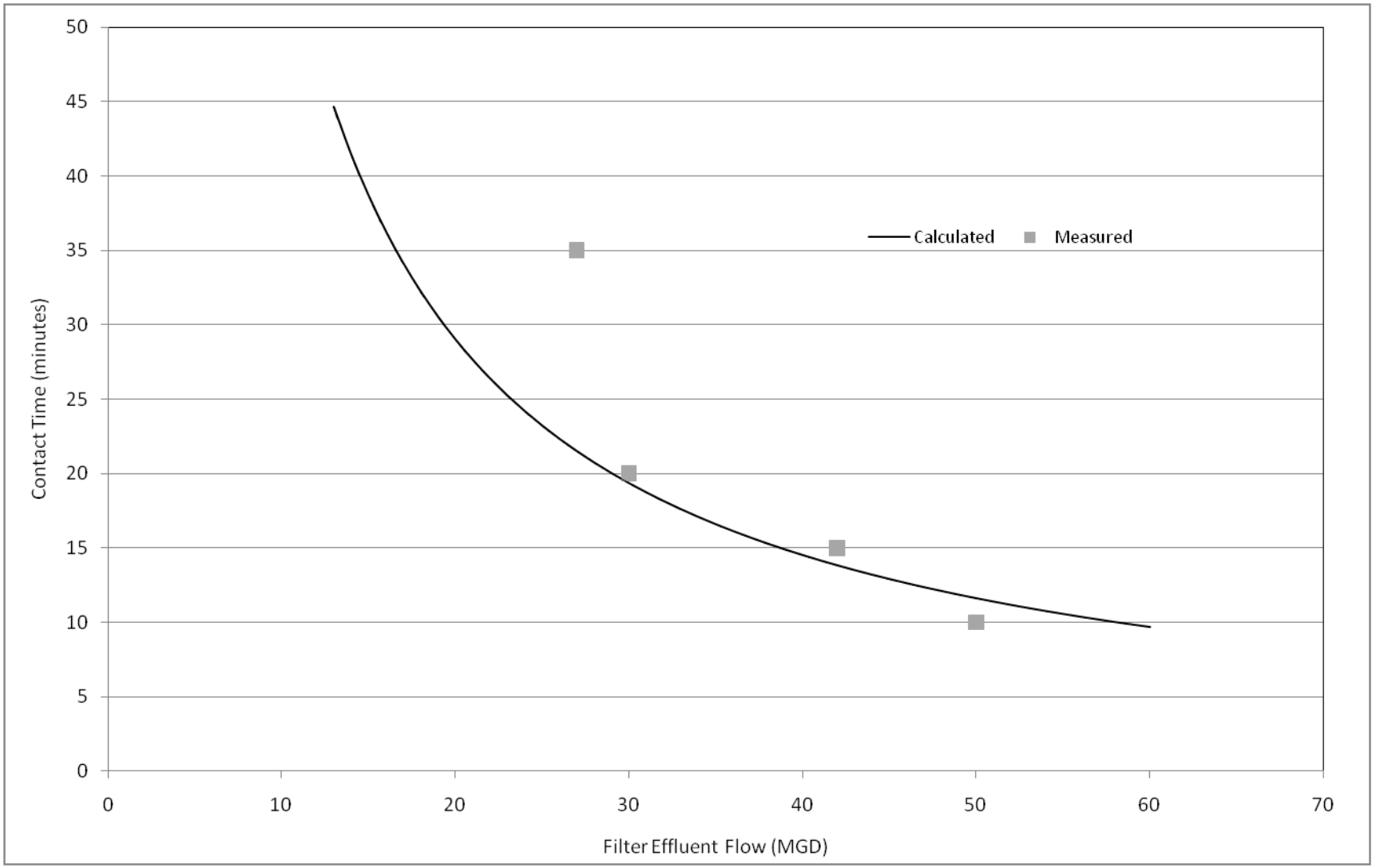
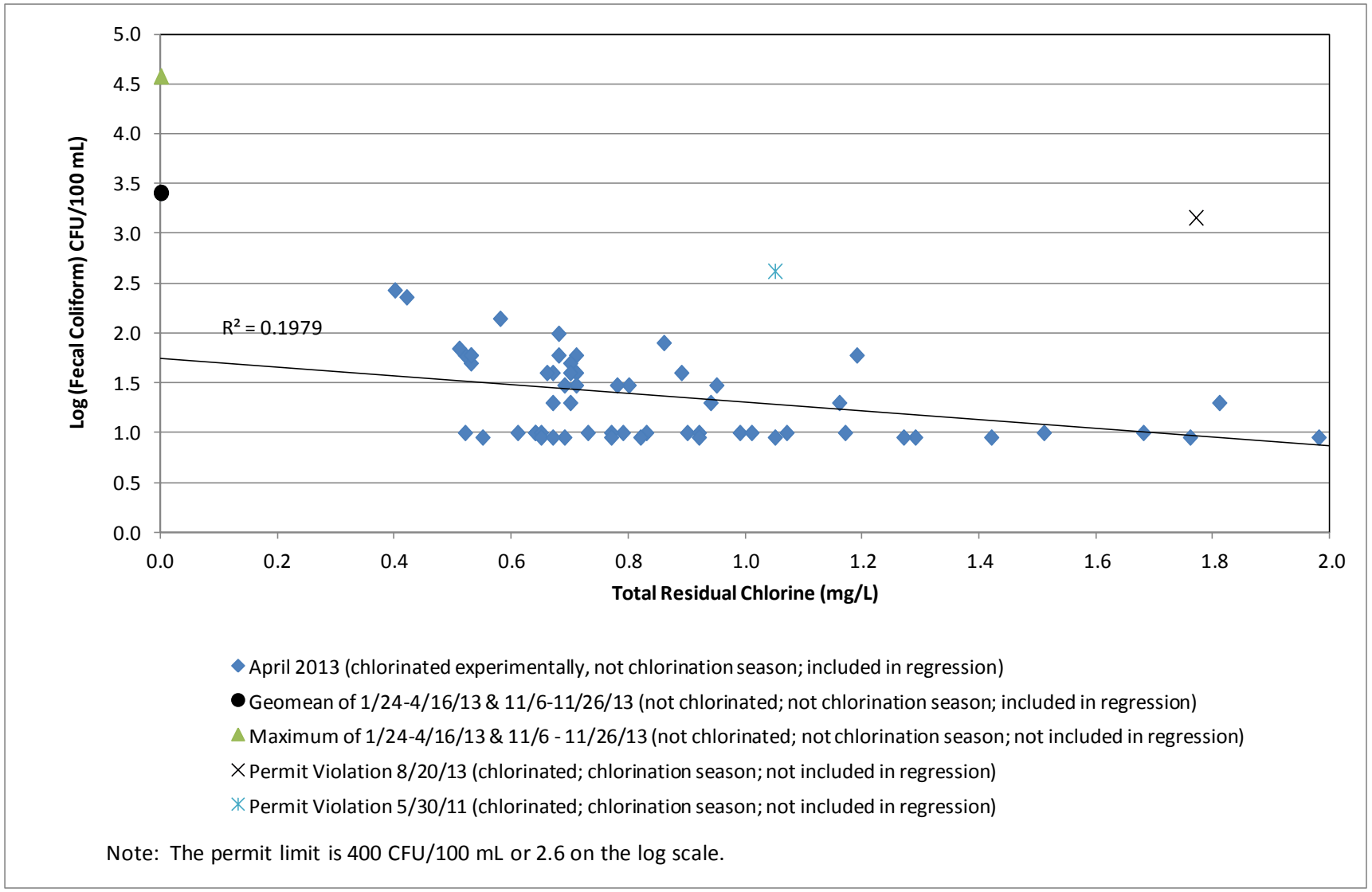
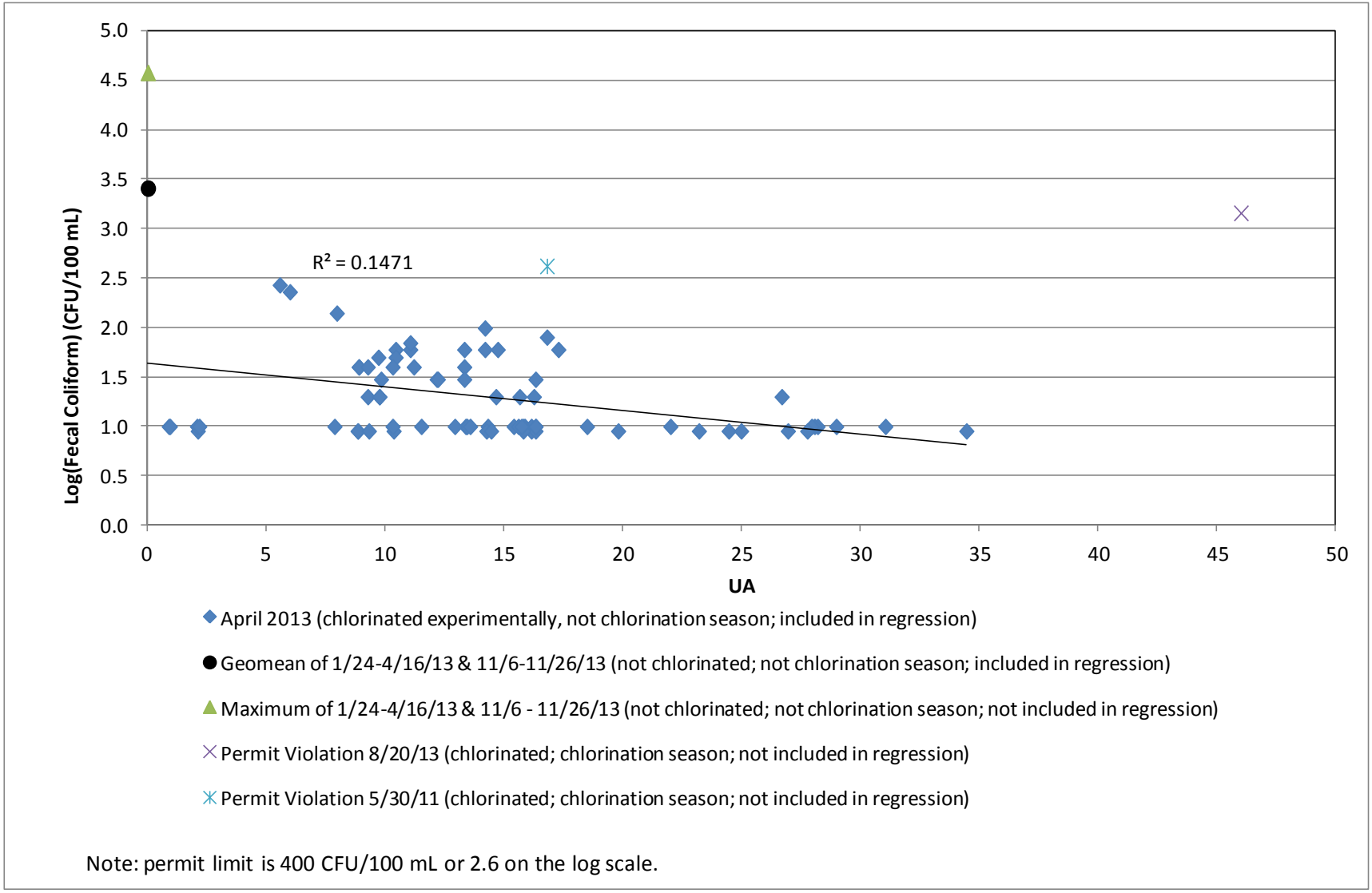


FIGURE 4: LOG CLEAR WELL FECAL COLIFORM VERSUS TOTAL RESIDUAL CHLORINE CONCENTRATIONS FOR STUDY DAYS



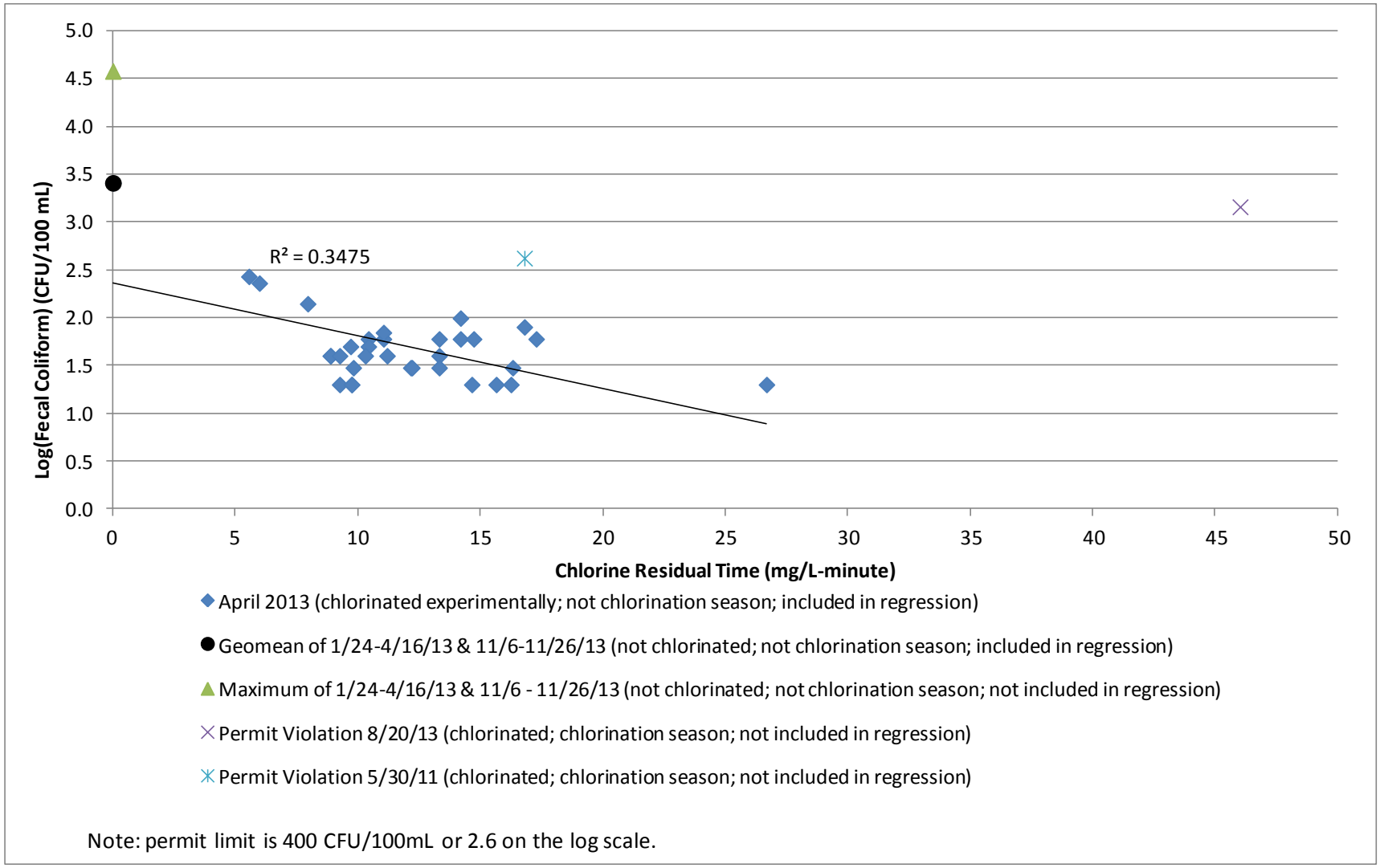
Note: The permit limit is 400 CFU/100 mL or 2.6 on the log scale.

FIGURE 5: LOG CLEAR WELL FECAL COLIFORM CONCENTRATION VERSUS CHLORINE RESIDUAL TIME FOR STUDY DAYS



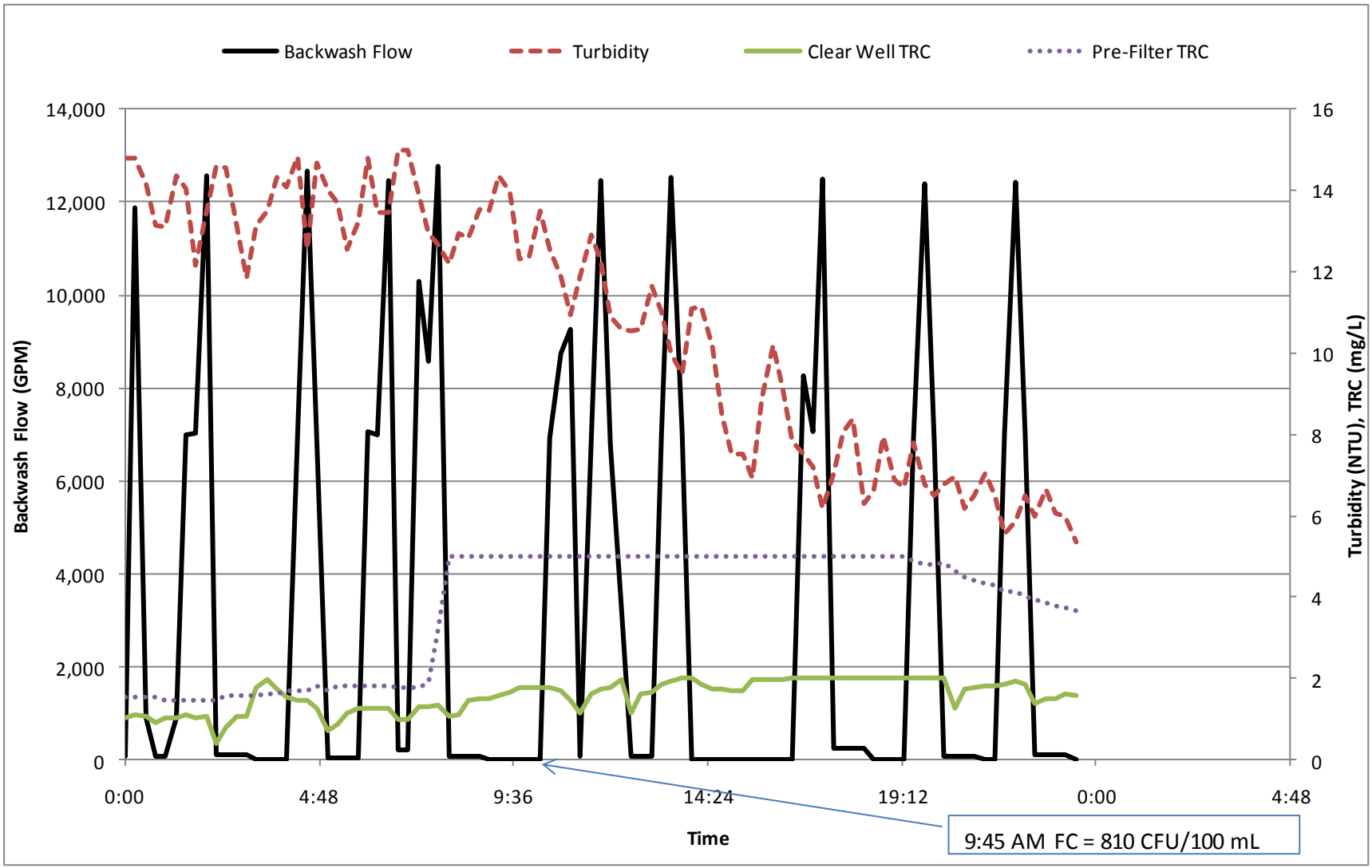
Note: permit limit is 400 CFU/100 mL or 2.6 on the log scale.

FIGURE 6: LOG CLEAR WELL FECAL COLIFORM CONCENTRATION VERSUS CHLORINE RESIDUAL TIME WITH FECAL COLIFORM CONCENTRATIONS LESS THAN 10 COLONY FORMING UNITS PER 100 MILLILITERS REMOVED FOR STUDY DAYS



Note: permit limit is 400 CFU/100mL or 2.6 on the log scale.

FIGURE 7: TURBIDITY, BACKWASH FLOW, AND TOTAL RESIDUAL CHLORINE CONDITIONS ON AUGUST 20, 2013, WHEN A FECAL COLIFORM PERMIT VIOLATION OCCURRED, PLANT FLOW RANGE OF 22 TO 26 MILLION GALLONS PER DAY



violation. High SS concentration may have led to shielding of the microorganisms, which led to the high FC concentration regardless of the high TRC. It has also been hypothesized that the particle size of the solids was larger during the permit violation than at times when there was not a FC permit violation. Even though a higher TRC was used, larger particles may have been in the FC grab sample, which caused a shielding effect.

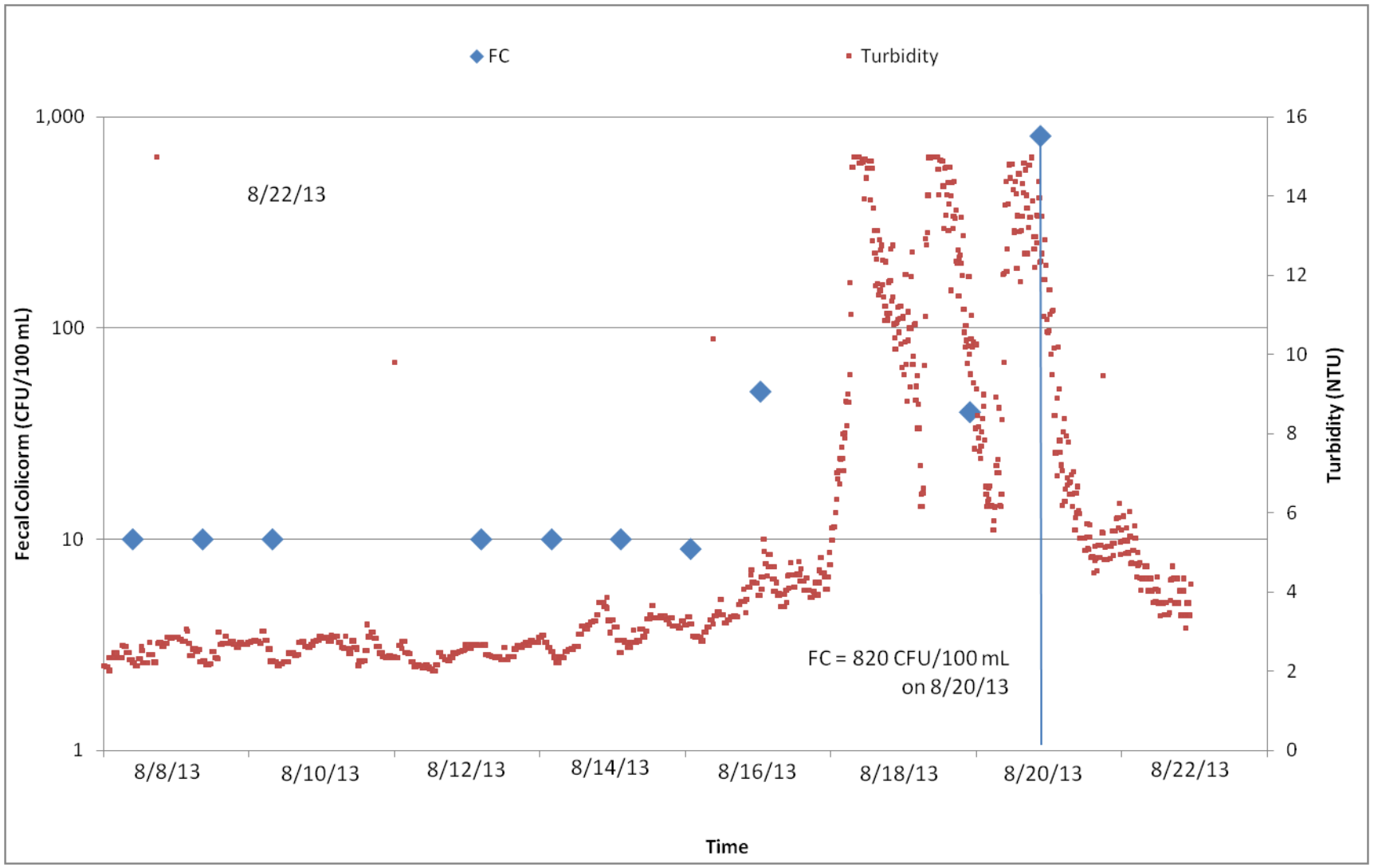
Figure 8 shows the turbidity and CW FC concentrations for the period of August 7 through 22, 2013. Secondary effluent turbidity started rising on August 16, 2013, which resulted in an increase of CW FC from less than 10 CFU/100 mL to detectable values around 50 CFU/100 mL. Higher turbidity is typically associated with relatively high suspended solids. In this case, the elevated turbidity as shown in Figure 8 resulted in the elevation of the filtered final effluent SS concentrations to 14, 10, and 12 mg/L on August 18, 19, and 20, 2013, respectively. The FC violation on August 20, 2013, was likely related to the unusually high secondary effluent turbidity and suspended solids. It appears that the elevated CW TRC to nearly 1.8 mg/L in response to this unusually high turbidity in the secondary effluent might not be sufficient. Otherwise, this was a rare incident, as referenced in Figure 4, in which the fecal bacteria detected in the final effluent might have been shielded by the solids in the effluent, and such occurrence could not be characterized by a typical study. Learning from this incident and taking a conservative approach to avoid potential exceedance of the 400 CFU/100 mL permit limit, we recommend that the CW TRC be increased to above 2 mg/L for the period that secondary effluent turbidity is 10 NTU or greater. However, M&O should use discretion to weigh the risks and benefits before making a decision on what level of CW TRC should be maintained under such unusual circumstances.

For process control, a large safety factor is often required, because a violation will occur with any FC concentrations above 400 CFU/100 mL. The practice has been to have a target FC concentration less than 100 CFU/100 mL; this will require a C_Rt of 6 mg/L-minute based on the regression curve in Figure 6. A more conservative target of 10 CFU/100 mL will require a C_Rt of approximately 25 mg/L-minute as calculated from the regression line determined in the study.

The 25 mg/L-minute operating target for C_Rt was used to develop a linear relationship showing the required CW TRC for different flow rates. Based on this study's limited data, the recommended CW TRC ranges proportionally from 0.86 to 2.2 mg/L for flows ranging from 20 to 50 MGD. All of the study data was collected with turbidity less than 7 NTU.

Some transient condition effects on CW FC concentrations were identified and evaluated using time-series plots (Appendix A, Figures A-1A through A-14D); for this study, transient conditions were considered to be a quick shift in operating conditions. An example that occurred during the pre-season study occurred on April 17, 2013, at approximately 11:30 a.m. A filter backwash (Figure A-6B) and filter effluent flow dip (Figure A-6C) corresponded to an increased CW FC concentration (Figure A-6D) and increased SS concentration (Figure A-6A). Evaluation of Figure A-6C shows that plant flow (47 MGD), NaOCl pump stroke, and turbidity (3.13 NTU) were stable at that time. The CW TRC analyzer was at the maximum (2 mg/L), indicating that the CW TRC was likely greater than 2 mg/L. At 11:30 a.m. the contact time corresponded to 12 minutes. A 25 mg/L-minute CRt operating target would require a CW TRC of 2.0 mg/L, which was met. This may indicate that the solids buildup in the filters contributes to increased FC concentration since the FC concentration increased at this point.

FIGURE 8: TURBIDITY VARIATIONS AND CORRESPONDING FECAL COLIFORM CONCENTRATIONS, AUGUST 7 THROUGH 22, 2013



Note: Permit violations occur when fecal coliform concentrations exceed 400 CFU/100 mL. Fecal coliform concentration values of <10 CFU/100mL were plotted as 10 CFU/100mL.

The CW and PF C&H FC concentrations were evaluated with the Microsoft Excel® spreadsheet formula for a paired Student's t-Test using a two-tailed distribution with unequal variance. The results showed the FC concentrations determined with the C&H method were not statistically the same as the CW FC concentrations (t-statistic = 0.002, degrees of freedom = 74, alpha = 0.05). All of the CW FC concentration data was below the 400 CFU/100 mL permit limit. The low correlation may be partly attributed to a lack of range in the data. The summary statistics are shown in Table 3.

Phase II: Evaluation of Correlation of Secondary Effluent Turbidity and Suspended Solids Concentration. The objective of Phase II was to investigate a potential correlation between secondary effluent turbidity with the SS concentration. The data evaluations included: (1) SS concentration versus turbidity regression analysis, (2) time-series evaluations of each study day, (3) the relationship between the turbidity and the CW TRC, and (4) overall and grouped evaluation of effect of operating parameters on SS concentration and turbidity.

The potential correlation between the secondary effluent turbidity and SS concentration was evaluated with scatter plots using the on-line turbidity measurements corresponding to the sample collection times. A least-squares linear regression was used to identify the relationship, as shown in Figure 9. The SS concentration outliers determined were less than 1.8 mg/L and greater than 6.4 mg/L, and they were not included in the linear regression. The scatter plot indicates there is a fair association, based on the r^2 value of 0.63. The association between turbidity and SS concentration indicated that there may be a benefit to considering secondary effluent turbidity for disinfection process control decisions based on the data collected. However, the collected data did not encompass the high turbidity conditions that were hypothesized to cause problems near 7 NTU. Additional data are needed in the higher ranges of turbidity in order to complete the model.

The relationships between filter effluent and backwash flows, and plant flows, turbidity, PF and CW TRC and SS concentrations were examined with time-series plots for each sampling day, Figures A-1A through A-14D.

The filter effluent flow increased and decreased with the plant flow, but with a lag and much more variability. This can be seen by comparing the filter effluent flow on Figures A-1A through A-14A and the plant flow on Figures A-1C through A-14C. The high variability is likely due to the summation of many individual flow meters, which resulted in a lot of noise. Some of the variability may be due to backwash flow events, but the high level of noise may have disguised these events.

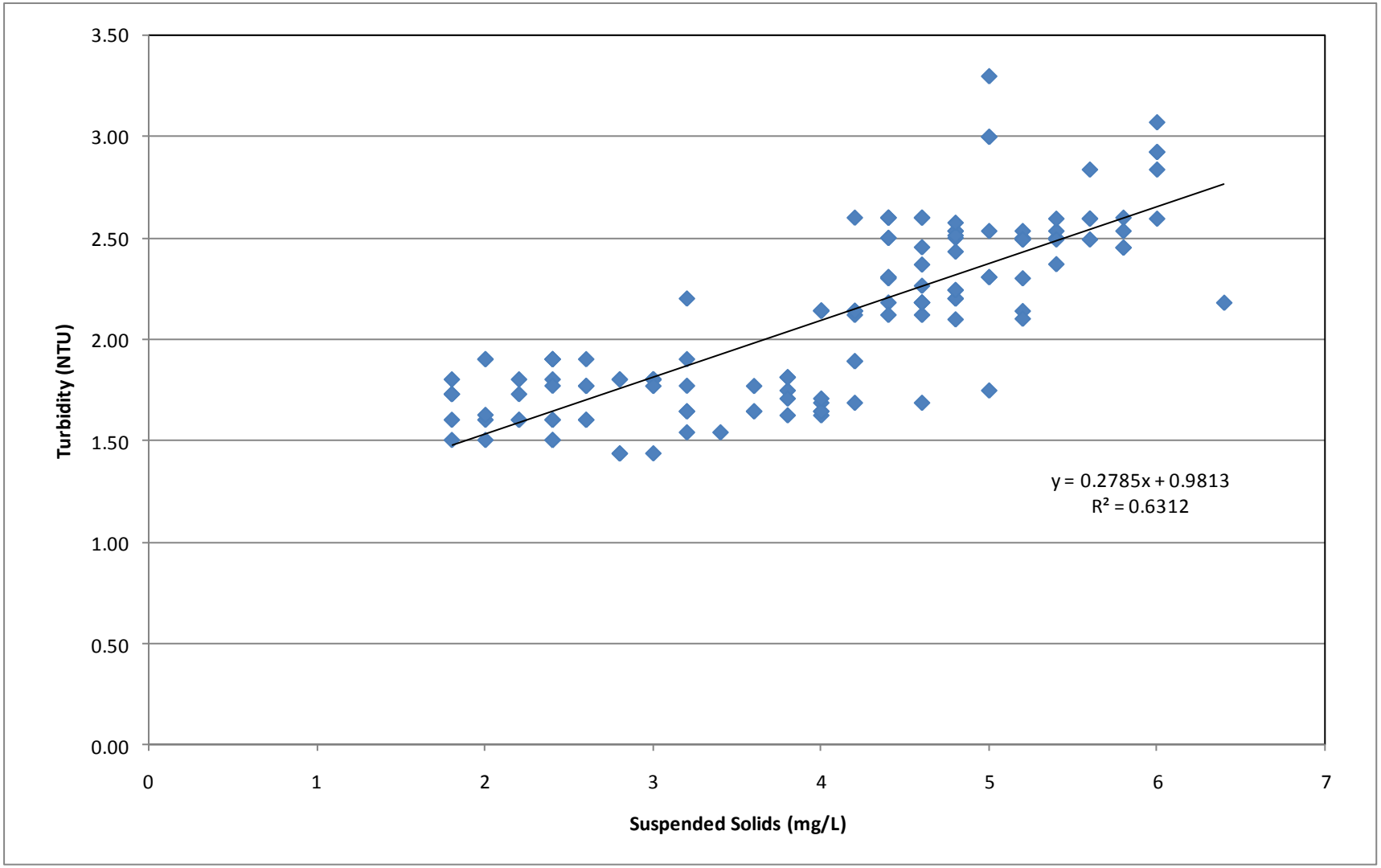
The June 26, 2013, study day had an excess flow 004 discharge. This can be seen on Figures A-14A through A-14D. The turbidity increased before the plant flow increased above 60 MGD at 8:35 a.m. (Figure A-14C). During this time the TRC values decreased, with the CW TRC minimum occurring about 8 a.m. even though NaOCl pump stroke was increasing. The C&H FC concentrations taken at 8:20 and 8:40 a.m. were higher than the others collected during the day. Based on the proposed hypotheses, the increased turbidity was caused by increased solids, which led to increased chlorine demand, which in turn resulted in a lower CW TRC.

TABLE 3: SUMMARY STATISTICS FOR THE CLEAR WELL AND PRE-FILTER COLLECT AND HOLD FECAL COLIFORM CONCENTRATIONS

	Fecal Coliform Concentrations (CFU/100mL)	
	Clear Well	Pre-Filter Collect and Hold
Mean	19	32
Maximum	270	1,300
Minimum	9	9
Standard Deviation	44	203
Kurtosis	16	24
Skewness	4	5
Count	75	77

Note: Samples were taken during experimental chlorination before the chlorination season started, April 17 through April 30, 2013.

FIGURE 9: TURBIDITY VERSUS SUSPENDED SOLIDS CONCENTRATION FOR THE JOHN E. EGAN WATER RECLAMATION PLANT CHLORINATED SECONDARY EFFLUENT (SEPTEMBER 18, 2012, THROUGH JUNE 26, 2013)



Also, the higher SS concentration could allow shielding of the microorganisms from the NaOCl. Both the reduced CW TRC and microorganism shielding can lead to higher FC concentrations.

Other examples of the CW TRC changing inversely with turbidity can be seen on June 12, 2013 (Figure A-13C, after 8:25 a.m.). The NaOCl pump speed was constant after 8:05 a.m., but there was a lag of about 25 minutes before the residual NaOCl reached the PF TRC analyzer. The turbidity decreased and the CW TRC increased. The impact of the chlorine delay caused by changing turbidity should be taken into consideration for chlorine dosing.

The SS concentration and turbidity relationships were looked at collectively and grouped by quartile under similar operating conditions. The overall r^2 value was determined through linear regression between the two parameters. Turbidity was compared against each operating parameter in order to determine r^2. A r^2 value greater than or equal to 0.68 was considered to indicate a moderate association between the two parameters in that quartile. The values for the quartiles for each parameter studied are shown in Table 4. The pairs that had an $r^2 \geq 0.68$ are shown in Table 5. The complete analyses are in Appendix A, Table A-1. The extreme values were not removed for these analyses. The turbidity showed a correlation with SS concentration in 10 out of 24 operating conditions cited in Table 5. Similar analyses were conducted for SS concentration with respect to other parameters, and the results with $r^2 \geq 0.68$ are shown in Table 6, with the full analysis results also in Table A-1. As expected, the same correlations were found in this analysis.

The plant flow was divided into influent flow categories: (1) 10–23 MGD, (2) 24–49 MGD, and (3) >50 MGD. The secondary effluent turbidity and SS concentration associations with operational parameters during these categorical flows are shown in Table 7. This evaluation indicated that during excess flow events (>50 MGD) there was a higher correlation between turbidity and SS concentrations than in other flow categories. The evaluation of the time-series plots did not definitively determine direct relationships. The evaluation of the r^2 values indicate there are moderate associations ($r^2 > 0.68$) with secondary effluent turbidity during excess flow conditions with respect to plant and RAS flow. Further evaluation consisted of a scatter plot of turbidity and SS concentration versus the RAS flow:plant flow ratio as shown in Figure 10. The scatter plot did not indicate that there was a relationship between the RAS flow:plant flow ratio and turbidity or SS concentration.

The number of backwashes ranged from zero to two on the study days. On October 17, 2012, there were no backwashes (Figures A-4B). An example of two backwashes occurred on June 26, 2013, beginning approximately at 10:30 a.m. (Figures A-14B). In this case the turbidity increased, then decreased; at about the time a second wave of high turbidity started to increase again and entered the filters, two backwashes were activated. This occurred about the time the excess flow discharge to 004 ended.

Phase III: Evaluation of Effectiveness of Using a Pre-Filter Total Residual Chlorine Process Control Parameter. The objective of Phase III was to evaluate a relationship between the PF and CW TRC. The evaluations consisted of: (1) a comparison of Cl_2 demand during flows: 23 MGD and below, 24 MGD to 49 MGD and greater than 50 MGD, (2) the stability of

TABLE 4: QUARTILE VALUES FOR ANALYTICAL AND OPERATING PARAMETERS ON STUDY DAYS, SEPTEMBER 18, 2012, THROUGH JUNE 26, 2013

	Pre-Filter SS (mg/L)	Pre-Filter Turbidity (NTU)	RAS Flow (MGD)	Filter Effluent Flow (MGD)	Filter Backwash (gpm)	Plant Flow (MGD)	RAS:Plant Flow Ratio	Outfall Temperature (°F)	Clear Well TRC (mg/L)
Minimum	1.6	1.43	9	11	1	10	0.27	30.89*	0.04
25%	3.0	1.73	16	18	10	23	0.60	43.61	0.70
50%	4.4	2.14	20	26	12	26	0.69	54.30	0.97
75%	5.2	2.50	29	36	13	35	0.78	60.59	1.20
Maximum	47.8	4.67	35	56	12,476	111	1.61	74.76	2.00

*The minimum temperature was found to be below 32°F, which is the freezing point of water at 1 atmosphere. Water can remain at liquid even below its freezing point, up to -25°C, if it is not disturbed and if the temperature does not drop further and no particle or ice crystal is added to it (<http://www.thewaterpage.com/waterbasics.htm>, accessed June 20, 2014). Additionally, effluent is not pure water and contains considerable dissolved solids or solutes. This is known to depress the freezing point (e.g. road deicing salt effect).

TABLE 5: TURBIDITY CORRELATION WITH ANALYTICAL AND OPERATING PARAMETERS, SEPTEMBER 18, 2012, THROUGH JUNE 26, 2013

	Pre-Filter SS (mg/L)	Pre-Filter Turbidity (NTU)	RAS Flow (MGD)	Filter Effluent Flow (MGD)	Filter Backwash (gpm)	Plant Flow (MGD)	RAS:Plant Flow Ratio	Outfall Temperature (°F)	Clear Well TRC (mg/L)
Overall Correlation Coefficients for Turbidity and Operating Parameters									
Turbidity	0.16	1.00	0.16	0.25	0.00	0.14	0.06	0.16	0.00
Correlation Coefficients for Turbidity and Analytical and Operating Parameters by Quartile									
Return Activated Sludge Quartiles									
25%	0.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
75%	0.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100%	0.68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Filter Effluent Flow Quartiles									
25%	0.80	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
75%	N/A	N/A	0.71	N/A	N/A	N/A	N/A	0.83	N/A
100%	0.68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Filter Backwash Flow Quartiles									
100%	0.80	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Temperature Quartiles									
100%	0.80	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 5 (Continued): TURBIDITY CORRELATION WITH ANALYTICAL AND OPERATING PARAMETERS, SEPTEMBER 18, 2012, THROUGH JUNE 26, 2013

	Pre-Filter SS (mg/L)	Pre-Filter Turbidity (NTU)	RAS Flow (MGD)	Filter Effluent Flow (MGD)	Filter Backwash (gpm)	Plant Flow (MGD)	RAS:Plant Flow Ratio	Outfall Temperature (°F)	Clear Well TRC (mg/L)
Clear Well Total Residual Chlorine									
25%	N/A	N/A	0.71	0.68	N/A	N/A	N/A	N/A	N/A
50%	0.78	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
75%	0.72	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pre-Filter Total Residual Chlorine Quartiles									
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes: SS = suspended solids, RAS = return activated sludge, TRC = total residual chlorine, N/A = not applicable.
Quartiles that had correlation coefficients of <0.68 were designated as not applicable. All rows of correlations that were all N/A were not included in the table. The full set of correlations is in Appendix A, Table A-6.

TABLE 6: SUSPENDED SOLIDS CONCENTRATION CORRELATION WITH ANALYTICAL AND OPERATING PARAMETERS, SEPTEMBER 18, 2012, THROUGH JUNE 26, 2013

	Pre-Filter SS (mg/L)	Pre-Filter Turbidity (NTU)	RAS Flow (MGD)	Filter Effluent Flow (MGD)	Filter Backwash (gpm)	Plant Flow (MGD)	RAS:Plant Flow Ratio	Outfall Temperature (°F)	Clear Well TRC (mg/L)
Overall Correlation Coefficients for SS Concentration and Operating Parameters									
	1.00	0.16	0.03	0.08	0.00	0.02	0.00	0.05	0.01
Correlation Coefficients for Suspended Solids Concentration and Operating Parameters by Quartile									
Return Activated Sludge Quartiles									
25%	N/A	0.74	N/A	N/A	N/A	N/A	N/A	N/A	N/A
75%	N/A	0.73	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100%	N/A	0.68	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Filter Effluent Flow Quartiles									
25%	N/A	0.80	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100%	N/A	0.68	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Filter Backwash Flow Quartiles									
100%	N/A	0.80	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Temperature Quartiles									
100%	N/A	0.80	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Clear Well Total Residual Chlorine Quartiles									
50%	N/A	0.78	N/A	N/A	N/A	N/A	N/A	N/A	N/A
75%	N/A	0.72	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pre-Filter Total Residual Chlorine Quartiles									
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes: SS = suspended solids, RAS = return activated sludge, TRC = total residual chlorine, N/A = not applicable.
Quartiles that had correlation coefficients of <0.68 were designated as not applicable. All rows of correlations that were all N/A were not included in the table. The full set of correlations is in the appendix.

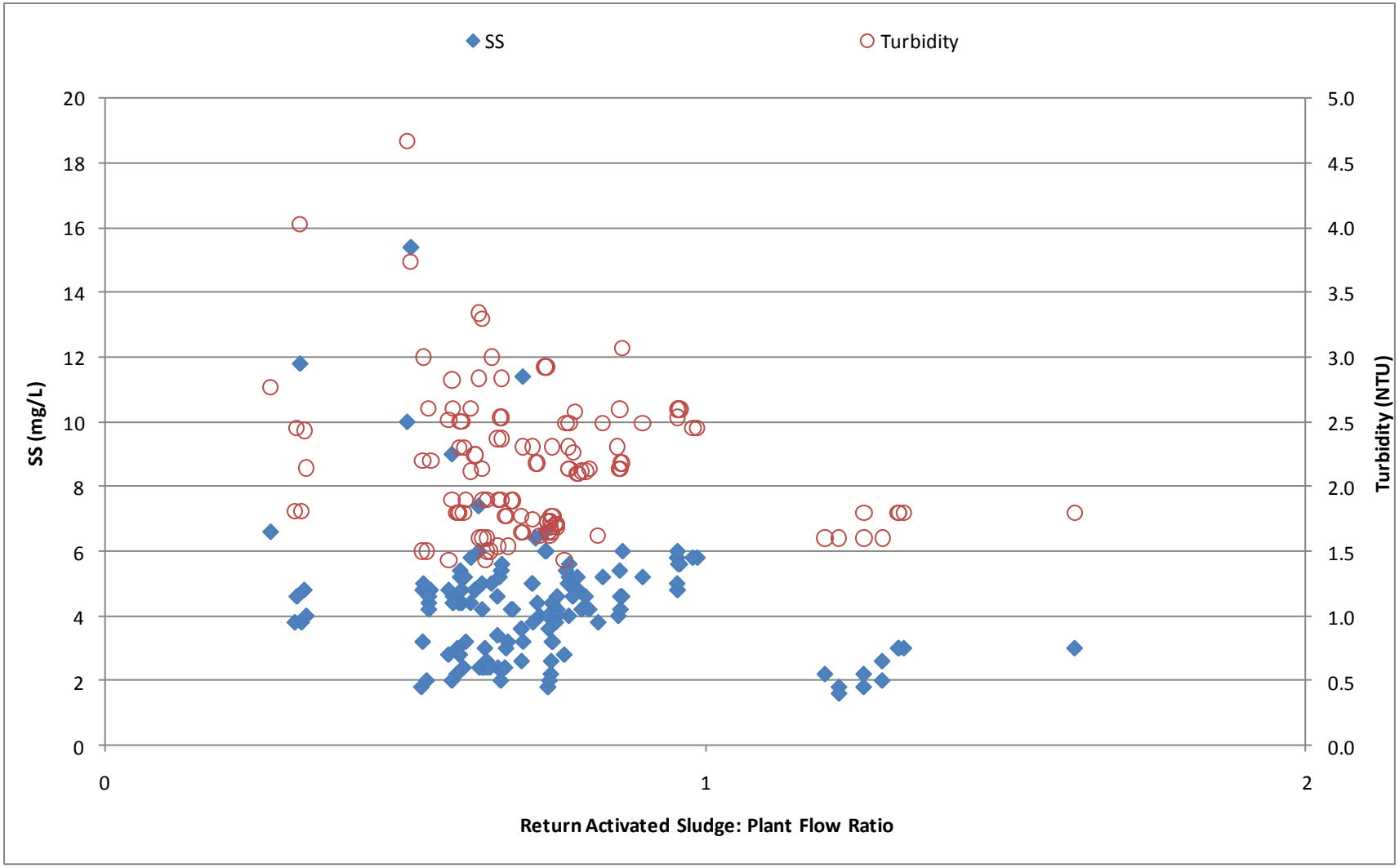
TABLE 7: CORRELATION COEFFICIENTS OF OPERATIONAL PARAMETERS WITH SECONDARY EFFLUENT TURBIDITY AND SUSPENDED SOLIDS CONCENTRATIONS UNDER DIFFERENT FLOW CONDITIONS, SEPTEMBER 18, 2012, THROUGH JUNE 26, 2013

	Parameter/Flow (MGD)				
	All	>24	>50	24–49	10–23
——————————Correlation Coefficients (r^2) for Association with the Secondary Effluent Turbidity——————————					
Pre-Filter Suspended Solids (mg/L)[1]	0.16	**0.70**[2]	**0.71**	0.64	0.08
Pre-Filter Turbidity (NTU)	1.00	1.00	1.00	1.00	1.00
Filter Effluent Flow (MGD)	0.25	0.37	0.01	0.43	0.02
Return Activated Sludge Flow (MGD)	0.16	0.34	**0.77**	0.52	0.21
Filter Backwash Flow (gpm)	0.00	0.00	0.03	0.01	0.01
Plant Flow (MGD)	0.14	0.13	**0.70**	0.40	0.01
Outfall Temperature (°F)	0.16	0.13	0.03	0.63	0.13
Clear Well TRC (mg/L)	0.00	0.01	0.66	0.02	0.06
Pre-Filter TRC (mg/L)	0.04	0.05	0.41	0.03	0.06
——————————Correlation Coefficients (r^2) for Association with the Secondary Effluent Suspended Solids Concentration——————————					
Pre-Filter Suspended Solids (mg/L)	1.00	1.00	1.00	1.00	1.00
Pre-Filter Turbidity (NTU)	0.16	**0.70**	**0.71**	0.64	0.08
Filter Effluent Flow (MGD)	0.08	0.35	0.03	0.52	0.15
Return Activated Sludge Flow (MGD)	0.03	0.28	**0.71**	0.57	0.00
Filter Backwash Flow (gpm)	0.00	0.00	0.04	0.01	0.02
Plant Flow (MGD)	0.02	0.12	**0.70**	0.38	0.02
Outfall Temperature (°F)	0.05	0.03	0.25	0.41	0.19
Clear Well TRC (mg/L)	0.01	0.00	**0.72**	0.00	0.05
Pre-Filter TRC (mg/L)	0.00	0.02	0.52	0.00	0.01

[1]The suspended solids concentration was determined without consideration of practical quantification limit.

[2]Bold font indicates the correlation coefficient is greater than 0.68 and there is at least moderate association between the two parameters.

FIGURE 10: RETURN ACTIVATED SLUDGE:PLANT FLOW RATIO RELATIONSHIP TO SECONDARY EFFLUENT TURBIDITY AND SUSPENDED SOLIDS CONCENTRATION



the NaOCl solution, (3) the effect of operational parameters and influent characteristics on TRC, and (4) a PF and CW TRC regression analysis.

The average delayed chlorine demand for each study day was grouped by flow for the study days during the chlorination season. A summary is shown in Table 8 and descriptive statistics for each sampling day are in Appendix A, Table A-2. The results showed that the difference between the CW and PF TRC was approximately 75 percent less when the flow was greater than 50 MGD compared to the lower-flow regimes.

One problem that occurred during the study was a high level of solids was observed in the filters at the beginning of the season. This may have resulted in a much larger delayed chlorine demand at the onset of the study.

An investigation into the NaOCl stability found that a fresh load of NaOCl was delivered approximately every three days. An evaluation of the September and October 2012 study days shows there were six truckloads delivered. The mean available chlorine in feed stock NaOCl solution analyzed by the ALD laboratory for each load was 160 grams (g) of chlorine per liter. The maximum, minimum, and standard deviation for available chlorine were 166, 153, and 4 g per liter, respectively. The results of this investigation indicated the NaOCl supply was consistent and not expected to cause under dosing due to low-strength NaOCl. The frequency of delivery minimized any dosing problems caused by low NaOCl concentrations in the feed stock.

The effect of operational parameters and influent characteristics were evaluated with the time-series plots during the chlorination season (Figures A-1A through A-14D). The pre-season plots were not relevant because the NaOCl dose was directly manipulated, leading to varying TRC levels. There was very little sign of the extreme oscillation of the CW TRC, which would be a major indicator of a need for cascade control during the chlorination season days studied. An extreme oscillation is considered to be approximately twice the target parameter value. There were a few instances of CW TRC oscillations, as seen in Figures A-1D, A-3D, A-4D, A-5D, and A-14D. Due to the minimal variability of CW TRC values from the target range (as reported by the M&O Department) of 0.8 to 0.9 mg/L, the percent of the time the CW TRC was either above or below the target range was not evaluated.

A scatter plot of the CW and PF TRC did not indicate a relationship, as shown in Figure A-15.

The quality control and quality assurance protocols are described in Appendix B. The raw data from the study is in Appendix C. Appendix C, Table C-1 presents operational data from the DCS, and Appendix C, Table C-2 has the analytical data from LIMS and field log records taken during the study.

TABLE 8: AVERAGE INITIAL AND DELAYED CHLORINE DEMAND EVALUATION MEASURED DURING THE CHLORINATION SEASON SAMPLING, SEPTEMBER 18, 2012, THROUGH JUNE 26, 2013 (SIX DAYS OF SAMPLING)

Parameter/Flow (MGD)	All	10–23	24–49	>50
Plant Flow (MGD)	31	19	26	96
NaOCl Pump Stroke (%)	39	36	37	56
Filter Effluent Flow (MGD)	23	17	21	53
PF TRC (mg/L)	1.88	2.03	1.73	1.23
CW TRC (mg/L)	1.11	1.15	0.86	1.00
Delayed Demand (mg/L) (PF TRC - CW TRC)	0.77	0.87	0.88	0.23
Pre-Filter SS (mg/L), Disregarding PQL	3.75	3.26	2.83	7.20

Notes:
PF TRC = pre-filter total residual chlorine.
CW TRC = clear well total residual chlorine.
PQL = practical quantitation limit.

Summary and Recommendations

Findings.

1. The M&O Department's current contact time determination was validated at flows greater than 30 MGD (Figure 3).

2. For both the May 30, 2011, and August 20, 2013, FC NPDES permit violations, outlier conditions, yet to be completely understood or confirmed, existed that rendered normally adequate clear well TRC concentrations and chlorine contact times to be insufficient.

3. High turbidity and possibly high SS concentrations were the most likely causes of the FC concentration violation on August 20, 2013 (Figure 7). Based on the data collected in this study, the conditions under which the FC violation occurred on August 20, 2013, were very unusual (Figures 4 and 5).

4. The FC concentration was elevated during the turbidity increase in August 2013 (Figure 8).

5. SS concentration was proportional to turbidity in the range of 2 to 6 mg/L (Figure 9).

6. Delayed demand was similar (0.77–0.88 mg/L) for flows below 50 MGD and much lower for flows greater than 50 MGD (0.23 mg/L) (Table 8).

7. The data collected from this study is not sufficient to determine if the C&H method for FC concentration analysis can be used as a proxy for the full-scale process.

8. NaOCl was stable based on supply and use.

Recommendations. In this study, the conditions under which the FC NPDES permit violation (exceeding 400 CFU/100 mL) of May 30, 2011, and August 20, 2013 occurred, could not be created. Increasing NaOCl dose when the turbidity of the secondary effluent is relatively elevated during the disinfection season has been practiced by the Egan WRP plant operators. The results from this study indicate that CW TRC as high as 1.78 mg/L, which is almost twice as high as the typical control target of 0.85 to 0.95 mg/L, would be sufficient to disinfect the secondary effluent under the transit conditions generated in this study, but appeared to be insufficient on August 20, 2013. Therefore, we recommend that CW TRC be increased to above 2 mg/L as a precautionary step when the secondary effluent turbidity is elevated to 10 NTU or greater.

The poor correlation between PF TRC and CW TRC indicates that the use of cascade control is not warranted at this time.

Potential Future Work.

1. Confirm the log FC versus C_Rt relationship during the chlorination off-season (TRC range 0 to 25 mg/L-minute) in order to get data with a larger range of FC concentrations. This relationship will be a baseline that can be used to estimate C_Rt for different turbidity levels.

2. The turbidity-SS concentration correlation should be verified at the higher ranges of turbidity greater than 7 NTU. This could be accomplished by waiting until turbidity increases and then collecting samples of the secondary effluent and having the sample analyzed for SS concentration, noting the collection time and turbidity. This study is currently being planned.

3. Verification of the C&H method may be worthwhile. If verified, the C&H method could be used at any time during the chlorination season to analyze the FC concentration without using a sample from the CW. The verification would involve dosing NaOCl (CW TRC range of 0.0 to 1.0 mg/L) during the off-season and collecting both C&H samples and CW samples for FC concentration analysis.

4. Develop a better understanding of the role of particle size distribution on shielding and TRC demand by determining particle size distribution in the secondary effluent under varying flow and operating conditions using microscopy and the Coulter Counter.

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APPENDIX A

AUXILIARY TABLES AND FIGURES FOR THE CHLORINE DISINFECTION PROCESS CONTROL EVALUATION AT THE JOHN E. EGAN WATER RECLAMATION PLANT REPORT

TABLE A-1: CORRELATIONS BETWEEN TURBIDITY AND SUSPENDED SOLIDS CONCENTRATION WITH OPERATING PARAMETERS FOR THE JOHN E EGAN WATER RECLAMATION PLANT, SEPTEMBER 18, 2012, THROUGH JUNE 26, 2013

	Quartile	Pre-Filter SS (mg/L)	Pre-Filter Turbidity (NTU)	RAS Flow (MGD)	Filter Effluent Flow (MGD)	Filter Backwash (GPM)	Plant Flow (MGD)	RAS:Plant Flow Ratio	Outfall Temperature (°F)	Clear Well TRC (mg/L)
Quartile Values										
Minimum		1.60	1.43	9	11	1	10	0.27	30.89	0.04
25%		3.00	1.73	16	18	10	23	0.60	43.61	0.70
50%		4.40	2.14	20	26	12	26	0.69	54.30	0.97
75%		5.20	2.50	29	36	13	35	0.78	60.59	1.20
100%		47.80	4.67	35	56	12,476	111	1.61	74.76	2.00
Return Activated Sludge										
Turbidity	25%	**0.74**	1.00	0.03	0.00	0.04	0.02	0.08	0.10	0.05
SS	25%	1.00	**0.74**	0.05	0.00	0.08	0.11	0.09	0.00	0.00
Turbidity	50%	0.28	1.00	0.00	0.08	0.00	0.06	0.04	0.41	0.00
SS	50%	1.00	0.28	0.03	0.02	0.22	0.01	0.01	0.17	0.01
Turbidity	75%	**0.73**	1.00	0.49	0.43	0.45	0.04	0.27	0.58	0.01
SS	75%	1.00	**0.73**	0.35	0.62	0.66	0.02	0.50	0.38	0.00
Turbidity	100%	**0.68**	1.00	0.09	0.00	0.05	0.00	0.01	0.04	0.08
SS	100%	1.00	**0.68**	0.07	0.00	0.10	0.01	0.03	0.09	0.03
Filter Effluent Flow										
Turbidity	25%	**0.80**	1.00	0.29	0.16	0.01	0.00	0.27	0.06	0.23
SS	25%	1.00	**0.80**	0.30	0.16	0.06	0.00	0.28	0.03	0.19
Turbidity	50%	0.25	1.00	0.05	0.01	0.17	0.00	0.02	0.16	0.11
SS	50%	1.00	0.25	0.01	0.18	0.59	0.00	0.00	0.18	0.05

TABLE A-1 (Continued): CORRELATIONS BETWEEN TURBIDITY AND SUSPENDED SOLIDS CONCENTRATION WITH OPERATING PARAMETERS FOR THE JOHN E EGAN WATER RECLAMATION PLANT, SEPTEMBER 18, 2012, THROUGH JUNE 26, 2013

	Quartile	Pre-Filter SS (mg/L)	Pre-Filter Turbidity (NTU)	RAS Flow (MGD)	Filter Effluent Flow (MGD)	Filter Backwash (GPM)	Plant Flow (MGD)	RAS:Plant Flow Ratio	Outfall Temperature (°F)	Clear Well TRC (mg/L)
Turbidity	75%	0.04	1.00	**0.71**	0.25	0.01	0.22	0.42	**0.83**	0.03
SS	75%	1.00	0.04	0.00	0.01	0.00	0.04	0.03	0.07	0.01
Turbidity	100%	**0.68**	1.00	0.00	0.11	0.00	0.00	0.00	0.01	0.14
SS	100%	1.00	**0.68**	0.01	0.12	0.01	0.00	0.03	0.05	0.07
Filter Backwash Flow										
Turbidity	25%	0.55	1.00	0.03	0.09	0.00	0.01	0.01	0.02	0.05
SS	25%	1.00	0.55	0.01	0.01	0.00	0.00	0.01	0.01	0.07
Turbidity	50%	0.01	1.00	0.66	0.29	0.11	0.28	0.14	0.91	0.06
SS	50%	1.00	0.01	0.04	0.00	0.02	0.05	0.01	0.06	0.03
Turbidity	75%	0.56	1.00	0.01	0.00	0.08	0.06	0.08	0.02	0.15
SS	75%	1.00	0.56	0.13	0.33	0.06	0.44	0.04	0.05	0.00
Turbidity	100%	**0.80**	1.00	0.28	0.51	0.06	0.29	0.13	0.50	0.01
SS	100%	1.00	**0.80**	0.31	0.57	0.08	0.30	0.14	0.47	0.06
Temperature										
Turbidity	25%	0.02	1.00	0.08	0.11	0.00	0.03	0.00	0.11	0.04
SS	25%	1.00	0.02	0.47	0.05	0.00	0.16	0.01	0.05	0.02
Turbidity	50%	0.59	1.00	0.14	0.02	0.01	0.00	0.18	0.04	0.02
SS	50%	1.00	0.59	0.03	0.07	0.06	0.09	0.04	0.00	0.03
Turbidity	75%	0.42	1.00	0.09	0.00	0.05	0.00	0.25	0.00	0.24
SS	75%	1.00	0.42	0.00	0.11	0.01	0.18	0.23	0.02	0.00

TABLE A-1 (Continued): CORRELATIONS BETWEEN TURBIDITY AND SUSPENDED SOLIDS CONCENTRATION WITH OPERATING PARAMETERS FOR THE JOHN E EGAN WATER RECLAMATION PLANT, SEPTEMBER 18, 2012, THROUGH JUNE 26, 2013

	Quartile	Pre-Filter SS (mg/L)	Pre-Filter Turbidity (NTU)	RAS Flow (MGD)	Filter Effluent Flow (MGD)	Filter Backwash (GPM)	Plant Flow (MGD)	RAS:Plant Flow Ratio	Outfall Temperature (°F)	Clear Well TRC (mg/L)
Turbidity	100%	**0.80**	1.00	0.37	0.49	0.01	0.28	0.21	0.00	0.00
SS	100%	1.00	**0.80**	0.30	0.47	0.00	0.22	0.21	0.02	0.01
Turbidity	50%	**0.75**	1.00	0.27	0.40	0.00	0.51	0.02	0.01	0.01
SS	50%	1.00	**0.75**	0.29	0.43	0.00	0.53	0.02	0.00	0.01
Turbidity	75%	0.05	1.00	0.45	0.45	0.01	0.31	0.13	0.14	0.09
SS	75%	1.00	0.05	0.00	0.00	0.00	0.00	0.00	0.05	0.03
Turbidity	100%	0.37	1.00	0.01	0.01	0.11	0.06	0.00	0.41	0.10
SS	100%	1.00	0.37	0.08	0.07	0.11	0.01	0.08	0.48	0.00
Clear Well Total Residual Chlorine										
Turbidity	25%	0.04	1.00	**0.71**	**0.68**	0.02	0.54	0.03	0.84	0.31
SS	25%	1.00	0.04	0.00	0.01	0.00	0.01	0.04	0.07	0.05
Turbidity	50%	**0.78**	1.00	0.36	0.55	0.00	0.41	0.12	0.00	0.24
SS	50%	1.00	**0.78**	0.39	0.59	0.00	0.45	0.12	0.00	0.21
Turbidity	75%	**0.72**	1.00	0.09	0.22	0.01	0.06	0.10	0.30	0.08
SS	75%	1.00	**0.72**	0.20	0.40	0.00	0.14	0.13	0.27	0.06
Turbidity	100%	0.55	1.00	0.01	0.00	0.00	0.02	0.01	0.30	0.04
SS	100%	1.00	0.55	0.14	0.07	0.00	0.05	0.02	0.23	0.07
Pre-Filter Total Residual Chlorine										
Turbidity	25%	**0.67**	1.00	0.15	0.32	0.03	0.19	0.16	0.02	0.01
SS	25%	1.00	**0.67**	0.18	0.36	0.01	0.27	0.17	0.01	0.03

TABLE A-1 (Continued): CORRELATIONS BETWEEN TURBIDITY AND SUSPENDED SOLIDS CONCENTRATION WITH OPERATING PARAMETERS FOR THE JOHN E EGAN WATER RECLAMATION PLANT, SEPTEMBER 18, 2012, THROUGH JUNE 26, 2013

	Quartile	Pre-Filter SS (mg/L)	Pre-Filter Turbidity (NTU)	RAS Flow (MGD)	Filter Effluent Flow (MGD)	Filter Backwash (GPM)	Plant Flow (MGD)	RAS:Plant Flow Ratio	Outfall Temperature (°F)	Clear Well TRC (mg/L)
Turbidity	50%	0.54	1.00	0.01	0.02	0.02	0.05	0.07	0.09	0.16
SS	50%	1.00	0.54	0.16	0.17	0.01	0.10	0.04	0.06	0.00
Turbidity	75%	0.10	1.00	0.06	0.35	0.07	0.32	0.21	0.36	0.07
SS	75%	1.00	0.10	0.00	0.05	0.00	0.00	0.00	0.12	0.08
Turbidity	100%	0.48	1.00	0.46	0.25	0.01	0.29	0.24	0.65	0.19
SS	100%	1.00	0.48	0.20	0.16	0.00	0.10	0.17	0.33	0.01

TABLE A-2: CHLORINE DEMAND SUMMARY FOR EACH STUDY PERIOD FOR THE JOHN E. EGAN WATER RECLAMATION PLANT 001 DISINFECTION STUDY

Date	Plant Flow (MGD)	NaOCl Pump Stroke (%)	Filter Effluent Flow (MGD)	NaOCl (gallons/day) M&O Daily Mean	NaOCl Dose (mg/L) M&O Daily Mean	Pre-Filter TRC (mg/L)	Clear Well TRC (mg/L)	Initial Demand (Dose - PF TRC)	Delayed Demand (PF TRC - CW TRC)	Pre-Filter SS (mg/L), Disregarding Minimum Detection Limit	Pre-Filter SS Load (lb/day)
9/18/12											
Mean	23	37	22	776	5.52	1.78	1.20	3.74	0.57	2.56	472
Stdev	6	2	6	0	0.00	0.47	0.54	0.47	0.59	0.46	144
Max	26	42	35	776	5.52	2.56	2.00	4.25	1.71	3.20	708
Min	10	36	14	776	5.52	1.27	0.84	2.96	N/C*	2.00	251
9/25/12											
Mean	18	34	16	758	6.23	2.02	1.04	4.21	0.99	2.24	295
Stdev	1	0	0	0	0.00	0.03	0.02	0.03	0.02	0.52	66
Max	18	34	16	758	6.23	2.06	1.06	4.23	1.01	3.00	401
Min	17	34	15	758	6.23	2.00	1.01	4.17	0.96	1.60	214
10/2/12											
Mean	18	36	16	791	6.57	2.63	1.05	3.94	1.58	2.33	301
Stdev	3	0	2	0	0.00	0.20	0.09	0.20	0.18	0.26	21
Max	23	36	19	791	6.57	3.01	1.27	4.12	2.02	2.60	330
Min	17	36	13	791	6.57	2.45	0.98	3.56	1.39	1.80	256

TABLE A-2 (Continued): CHLORINE DEMAND SUMMARY FOR EACH STUDY PERIOD FOR THE JOHN E. EGAN WATER RECLAMATION PLANT 001 DISINFECTION STUDY

Date	Plant Flow (MGD)	NaOCl Pump Stroke (%)	Filter Effluent Flow (MGD)	NaOCl (gallons/day) M&O Daily Mean	NaOCl Dose (mg/L) M&O Daily Mean	Pre-Filter TRC (mg/L)	Clear Well TRC (mg/L)	Initial Demand (Dose - PF TRC)	Delayed Demand (PF TRC - CW TRC)	Pre-Filter SS (mg/L), Disregarding Minimum Detection Limit	Pre-Filter SS Load (lb/day)
10/17/12											
Mean	20	36	16	777	6.19	2.20	1.23	3.99	0.97	4.69	621
Stdev	3	0	1	0	0.00	0.41	0.05	0.41	0.44	0.66	91
Max	23	36	18	777	6.19	2.64	1.27	4.77	1.44	5.40	762
Min	17	36	14	777	6.19	1.42	1.14	3.55	0.15	3.20	484
10/23/12											
Mean	19	36	17	1,014	6.05	1.28	1.30	4.77	N/C	4.71	672
Stdev	3	2	5	0	0.00	0.30	0.27	0.30	0.32	0.49	188
Max	23	40	24	1,014	6.05	1.72	1.61	5.18	0.54	5.80	906
Min	14	35	11	1,014	6.05	0.87	0.84	4.33	N/C	4.20	437
4/17/13											
Mean	34	43	32	747	2.69	2.79	1.08	N/C	1.71	5.82	1,615
Stdev	9	5	6	0	0.00	2.04	0.38	2.04	1.77	1.20	747
Max	51	48	49	747	2.69	4.99	1.65	2.55	3.64	9.00	3,712
Min	29	38	30	747	2.69	0.14	0.64	N/C	N/C	4.80	1,199

TABLE A-2 (Continued): CHLORINE DEMAND SUMMARY FOR EACH STUDY PERIOD FOR THE JOHN E. EGAN WATER RECLAMATION PLANT 001 DISINFECTION STUDY

Date	Plant Flow (MGD)	NaOCl Pump Stroke (%)	Filter Effluent Flow (MGD)	NaOCl (gallons/day) M&O Daily Mean	NaOCl Dose (mg/L) M&O Daily Mean	Pre-Filter TRC (mg/L)	Clear Well TRC (mg/L)	Initial Demand (Dose - PF TRC)	Delayed Demand (PF TRC - CW TRC)	Pre-Filter SS (mg/L), Disregarding Minimum Detection Limit	Pre-Filter SS Load (lb/day)
4/22/13											
Mean	31	21	33	778	3.39	3.37	1.05	0.02	2.32	9.58	2,497
Stdev	6	13	5	0	0.00	1.59	0.52	1.59	1.71	13.60	3,382
Max	40	45	40	778	3.39	4.99	2.00	2.38	4.33	47.80	12,061
Min	22	10	25	778	3.39	1.01	0.58	N/C	N/C	4.20	957
4/23/13											
Mean	26	13	26	667	2.97	1.58	0.72	1.39	0.86	4.64	1,006
Stdev	3	3	2	0	0.00	0.51	0.09	0.51	0.44	0.72	172
Max	29	18	29	667	2.97	2.30	0.90	1.93	1.49	6.40	1,419
Min	23	9	24	667	2.97	1.04	0.65	0.67	0.36	4.00	809
4/24/13											
Mean	47	17	44	797	2.79	1.33	0.75	1.46	0.58	5.36	1,972
Stdev	2	6	3	0	0.00	0.84	0.24	0.84	0.76	0.87	450
Max	49	25	52	797	2.79	2.56	1.13	2.38	1.67	7.40	3,178
Min	45	12	41	797	2.79	0.41	0.43	0.23	N/C	4.40	1,642

TABLE A-2 (Continued): CHLORINE DEMAND SUMMARY FOR EACH STUDY PERIOD FOR THE JOHN E. EGAN WATER RECLAMATION PLANT 001 DISINFECTION STUDY

Date	Plant Flow (MGD)	NaOCl Pump Stroke (%)	Filter Effluent Flow (MGD)	NaOCl (gallons/day) M&O Daily Mean	NaOCl Dose (mg/L) M&O Daily Mean	Pre-Filter TRC (mg/L)	Clear Well TRC (mg/L)	Initial Demand (Dose - PF TRC)	Delayed Demand (PF TRC - CW TRC)	Pre-Filter SS (mg/L), Disregarding Minimum Detection Limit	Pre-Filter SS Load (lb/day)
4/25/13											
Mean	39	38	41	737	3.16	2.08	0.99	1.08	1.10	5.48	1,868
Stdev	3	6	3	0	0.00	1.20	0.52	1.20	0.96	0.60	327
Max	42	46	47	737	3.16	3.67	1.98	2.61	2.56	6.60	2,463
Min	35	31	36	737	3.16	0.55	0.49	N/C	N/C	4.60	1,432
4/29/13											
Mean	25	34	25	484	2.75	2.35	0.37	0.40	1.98	3.54	752
Stdev	2	6	2	0	0.00	1.65	0.38	1.65	1.74	0.51	125
Max	28	42	28	484	2.75	4.91	1.24	2.24	4.38	4.40	979
Min	23	28	22	484	2.75	0.51	0.04	N/C	N/C	2.80	602
4/30/13											
Mean	26	35	26	630	3.67	2.42	0.89	1.25	1.53	3.90	859
Stdev	1	7	1	0	0.00	1.91	0.50	1.91	1.65	0.63	126
Max	28	46	28	630	3.67	4.99	1.64	3.01	3.99	5.00	1,056
Min	26	28	25	630	3.67	0.66	0.44	N/C	N/C	2.80	632

TABLE A-2 (Continued): CHLORINE DEMAND SUMMARY FOR EACH STUDY PERIOD FOR THE JOHN E. EGAN WATER RECLAMATION PLANT 001 DISINFECTION STUDY

Date	Plant Flow (MGD)	NaOCl Pump Stroke (%)	Filter Effluent Flow (MGD)	NaOCl (gallons/day) M&O Daily Mean	NaOCl Dose (mg/L) M&O Daily Mean	Pre-Filter TRC (mg/L)	Clear Well TRC (mg/L)	Initial Demand (Dose - PF TRC)	Delayed Demand (PF TRC - CW TRC)	Pre-Filter SS (mg/L), Disregarding Minimum Detection Limit	Pre-Filter SS Load (lb/day)
6/12/13											
Mean	24	37	20	747	4.18	2.02	0.93	2.16	1.09	2.51	431
Stdev	1	0	2	0	0.00	0.23	0.06	0.23	0.19	0.64	134
Max	26	37	22	747	4.18	2.33	1.05	2.47	1.40	3.60	659
Min	23	36	17	747	4.18	1.71	0.86	1.85	0.85	1.80	261
6/26/13											
Mean	96	56	53	1,248	4.12	1.23	1.00	2.89	0.23	7.20	3,199
Stdev	21	6	2	0	0.00	0.27	0.22	0.27	0.15	4.22	1,873
Max	111	60	56	1,248	4.12	1.64	1.30	3.21	0.51	15.40	6,895
Min	60	44	49	1,248	4.12	0.91	0.73	2.48	N/C	3.80	1,749

*N/C indicates a negative value was calculated using the arithmetic operations on the statistical values.

FIGURE A-1A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR SEPTEMBER 18, 2012

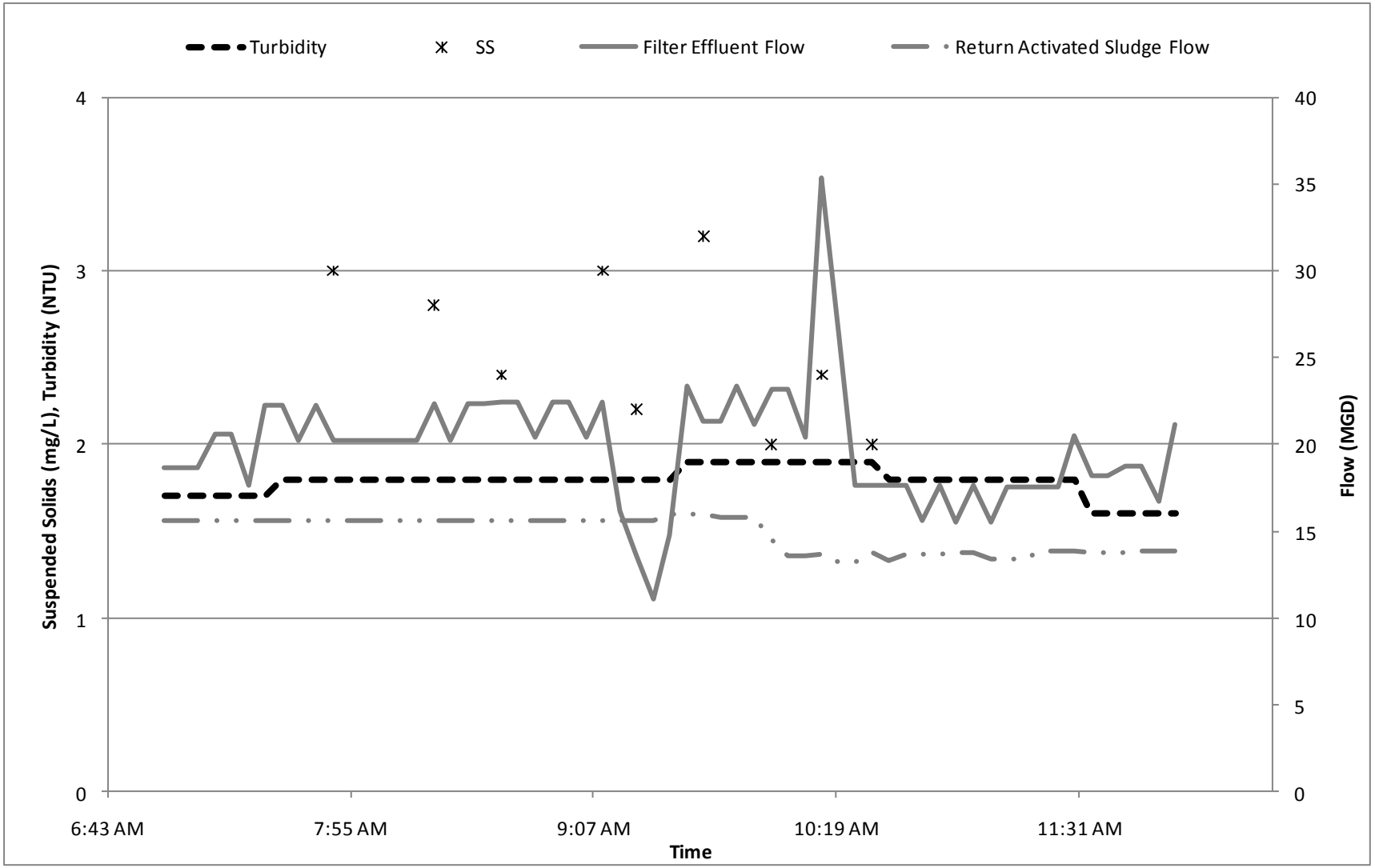


FIGURE A-1B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR SEPTEMBER 18, 2012

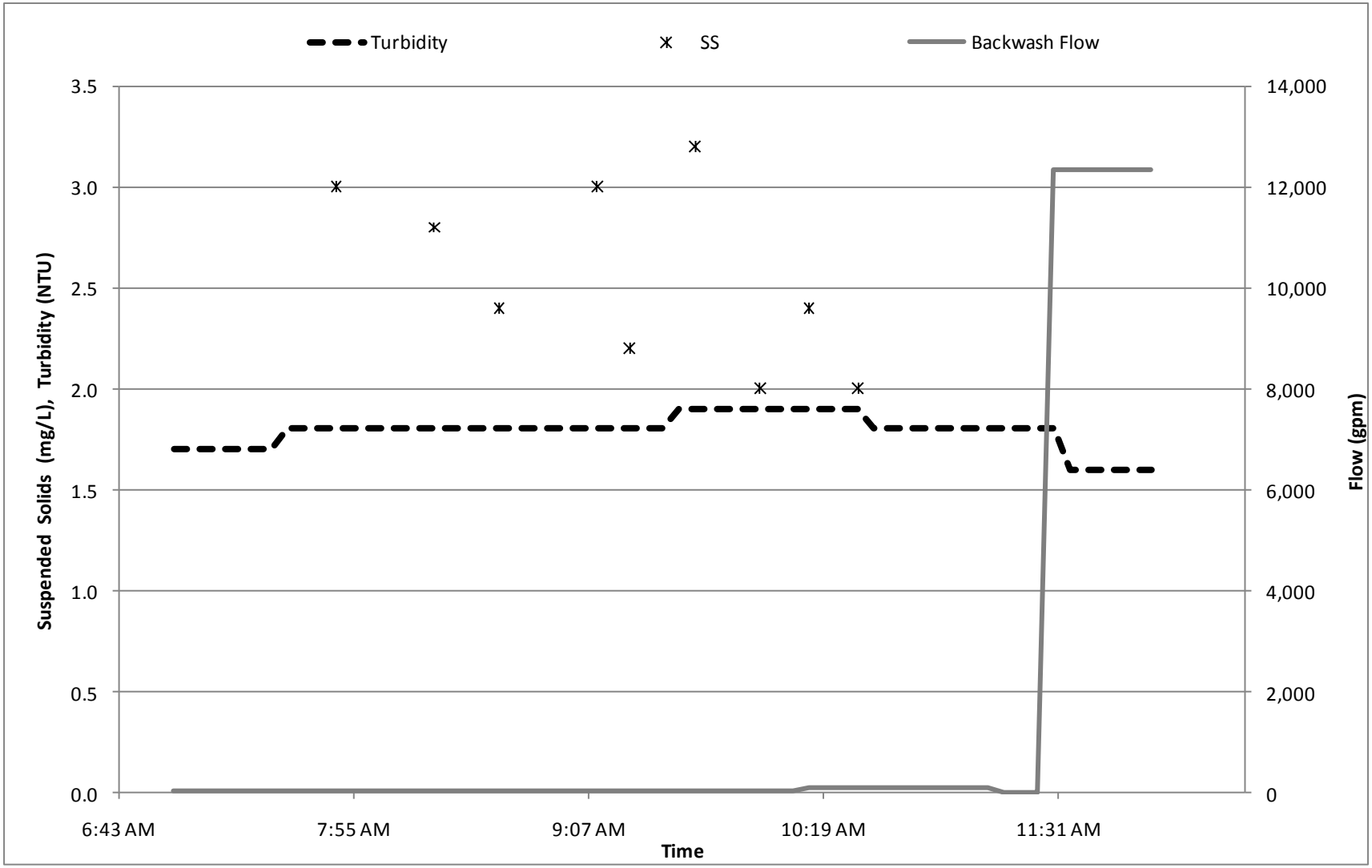


FIGURE A-1C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR SEPTEMBER 18, 2012

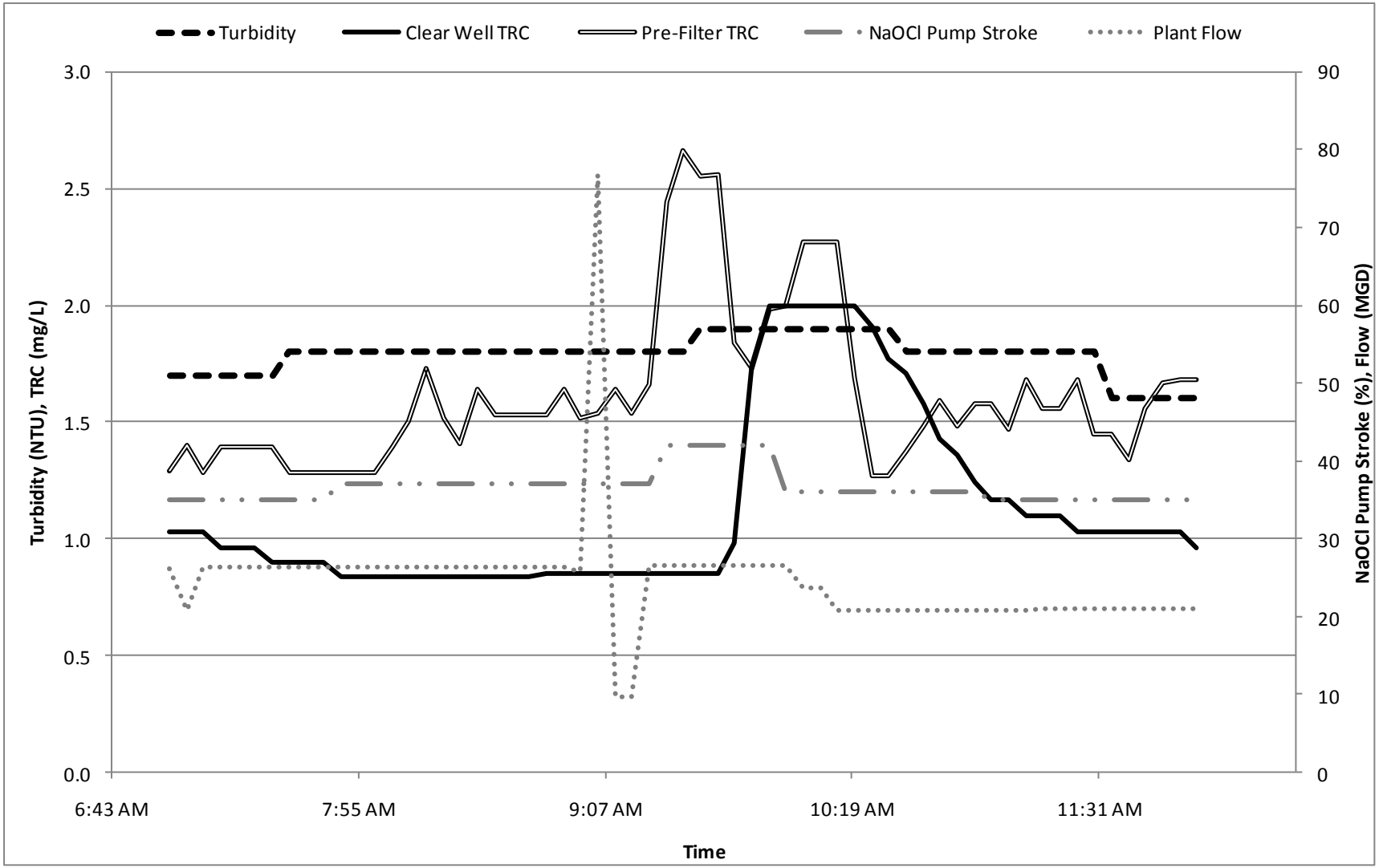
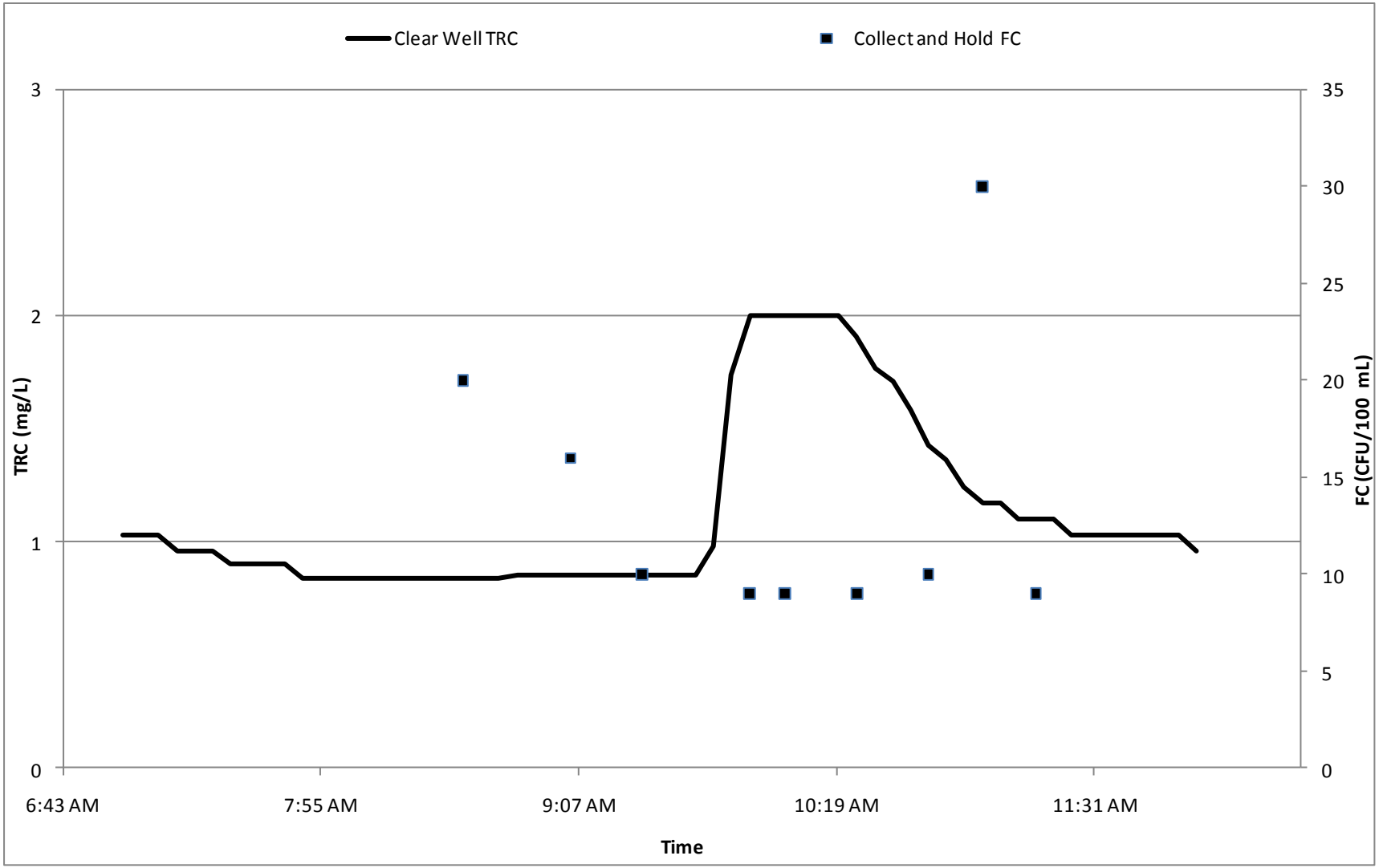


FIGURE A-1D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR SEPTEMBER 18, 2012



Note: All fecal coliform concentration values of <10 CFU/100 mL were plotted as 10 CFU/mL.

FIGURE A-2A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR SEPTEMBER 25, 2012

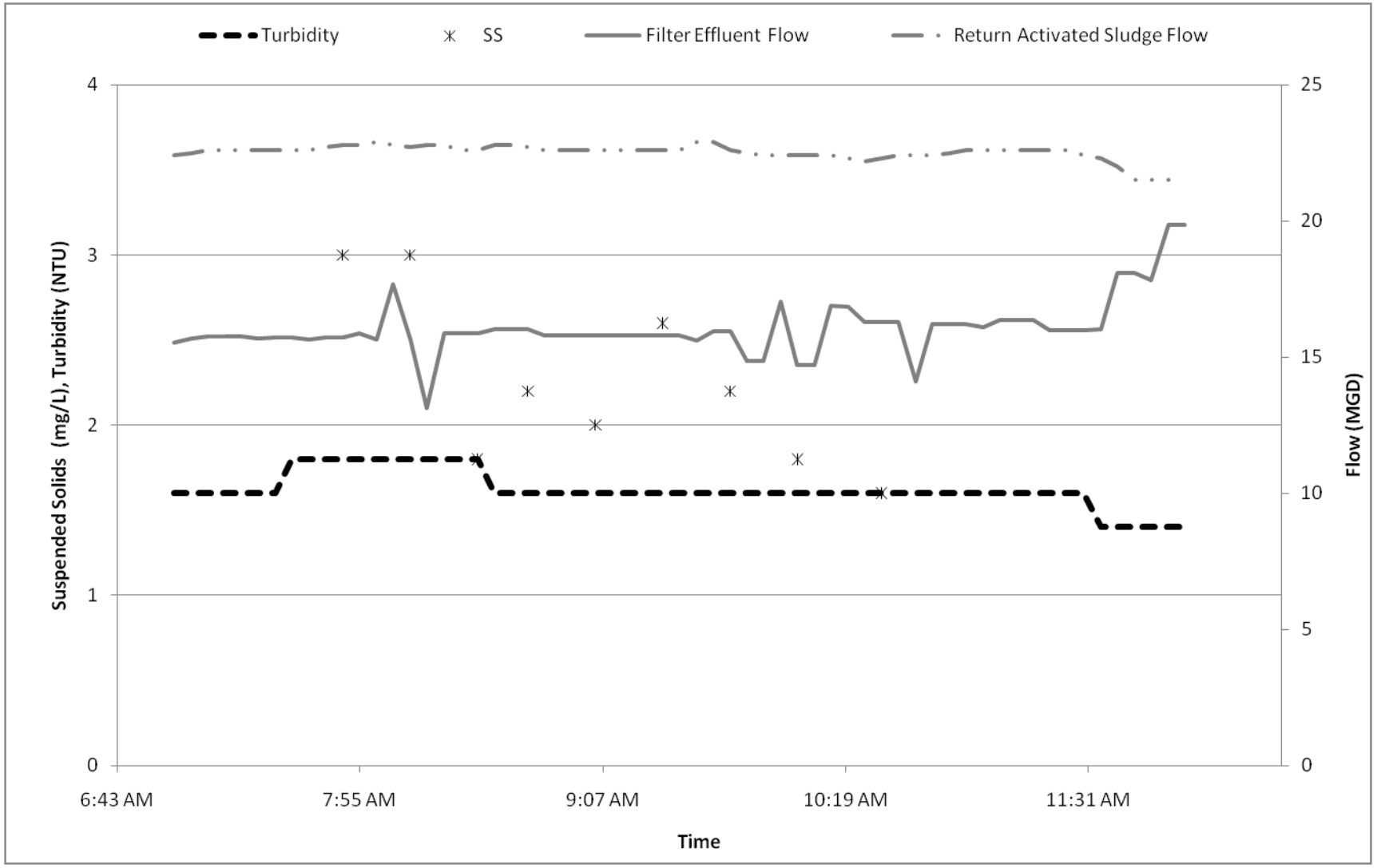


FIGURE A-2B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR SEPTEMBER 25, 2012

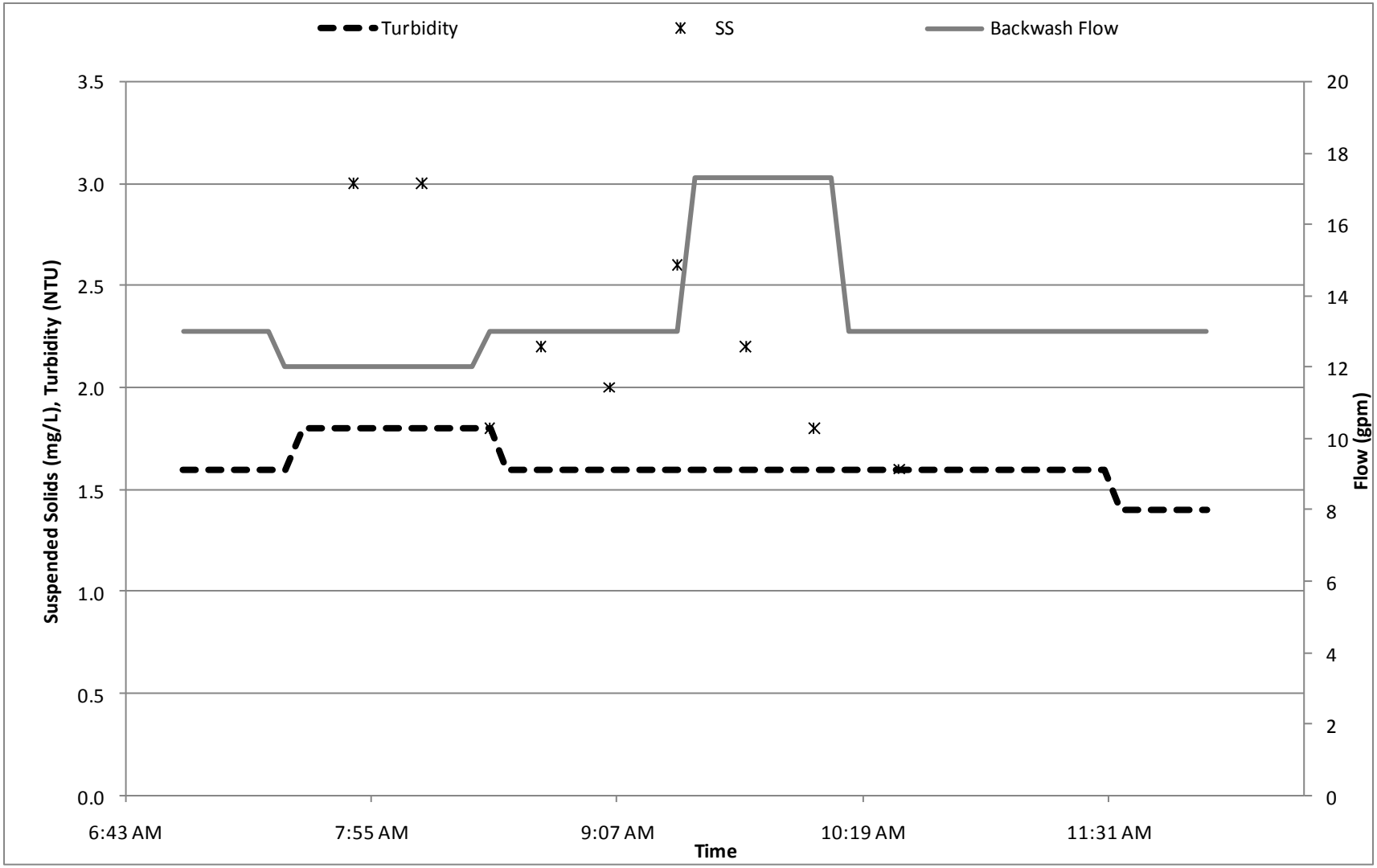


FIGURE A-2C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR SEPTEMBER 25, 2012

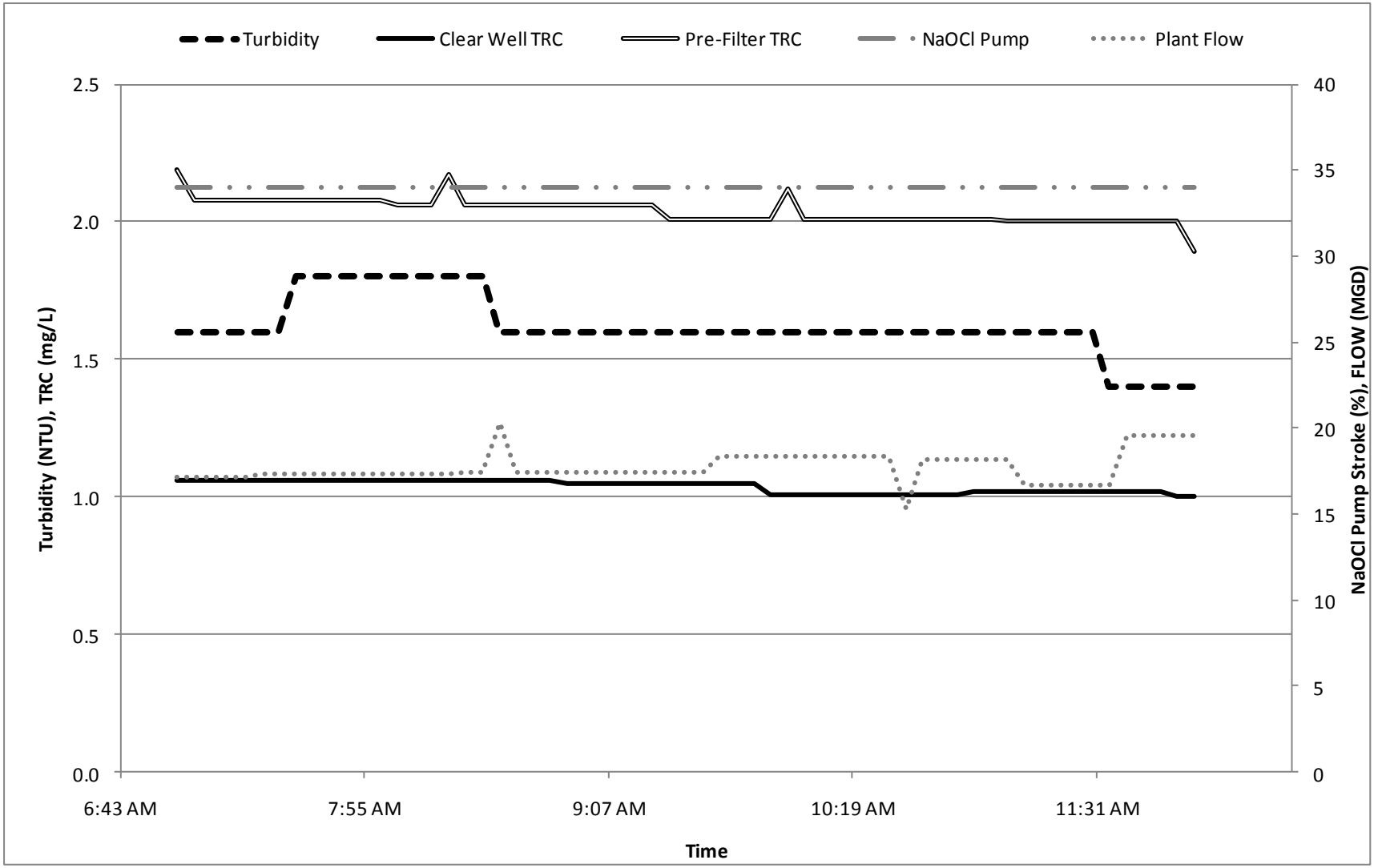
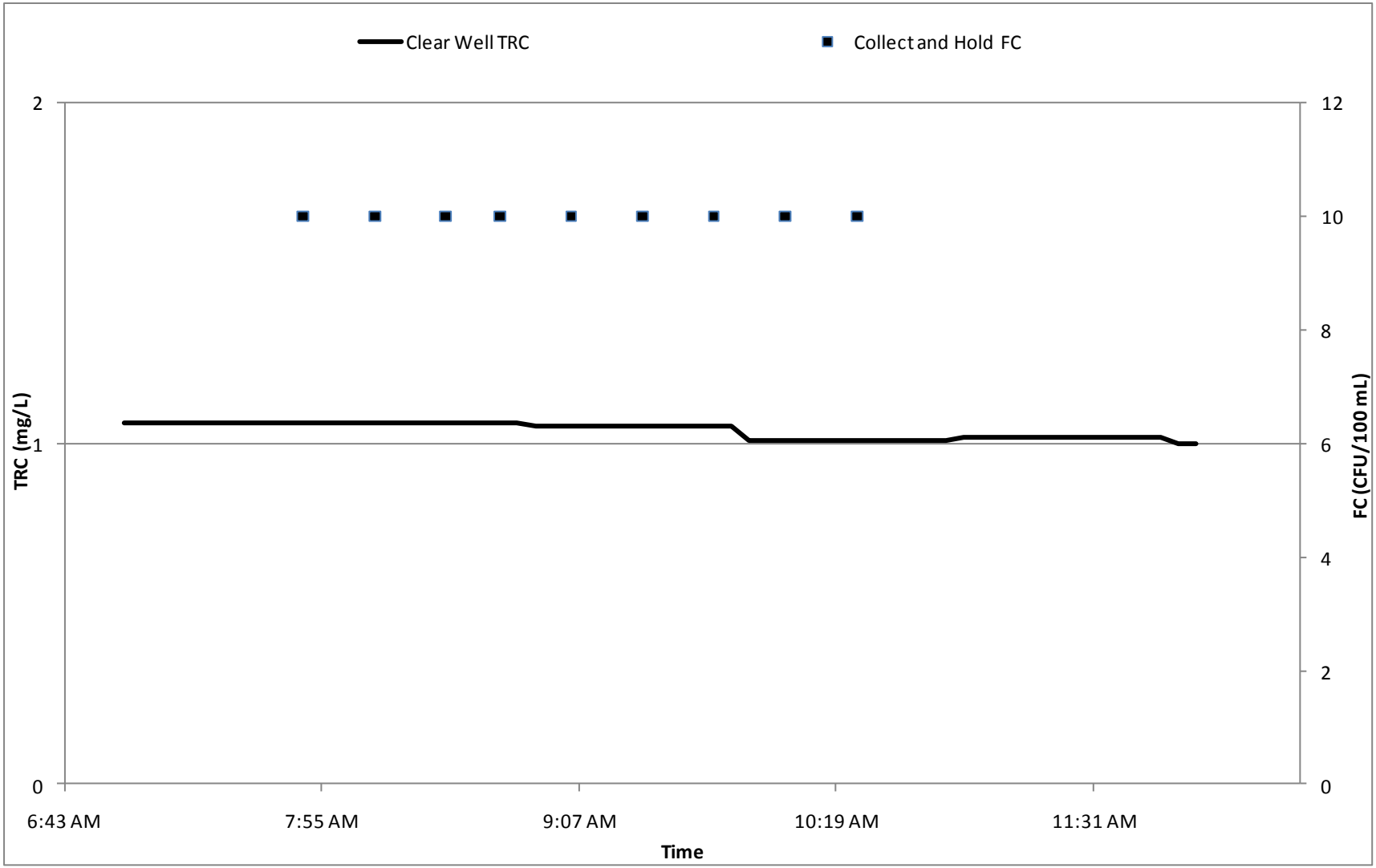


FIGURE A-2D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR SEPTEMBER 25, 2012



Note: All fecal coliform concentration values of <10 CFU/100 mL were plotted as 10 CFU/mL.

FIGURE A-3A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR OCTOBER 2, 2012

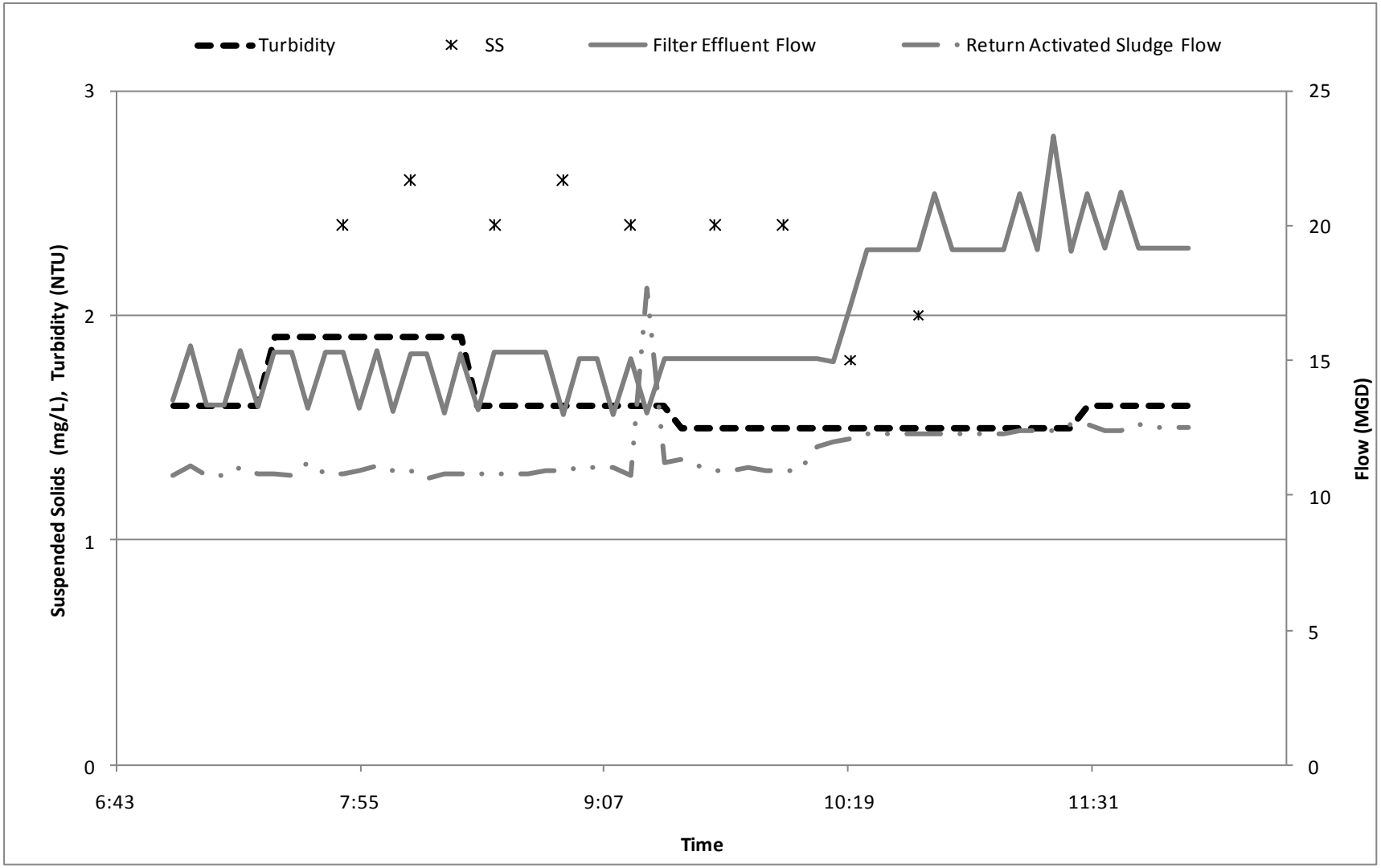


FIGURE A-3B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR OCTOBER 2, 2012

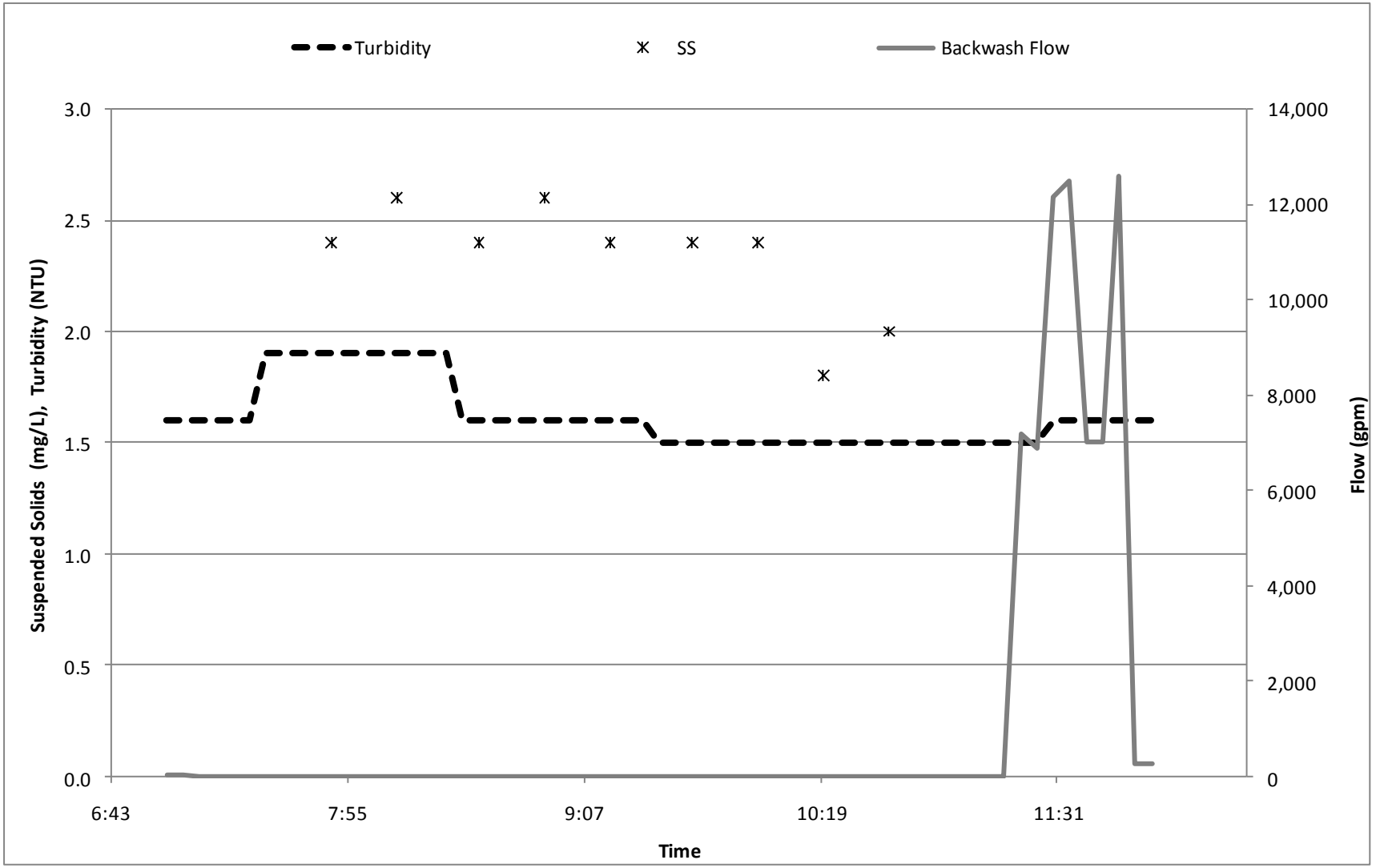


FIGURE A-3C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR OCTOBER 2, 2012

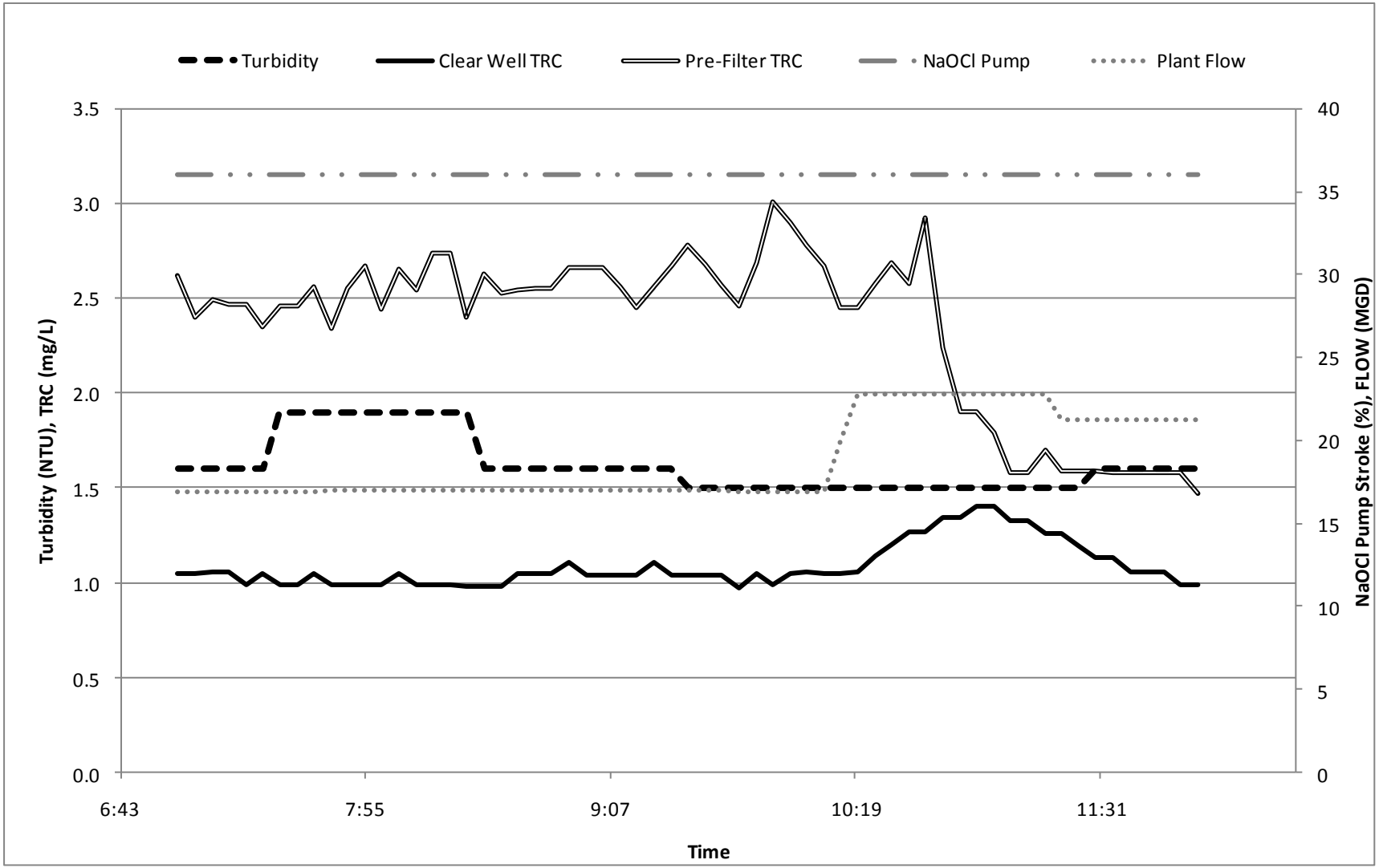
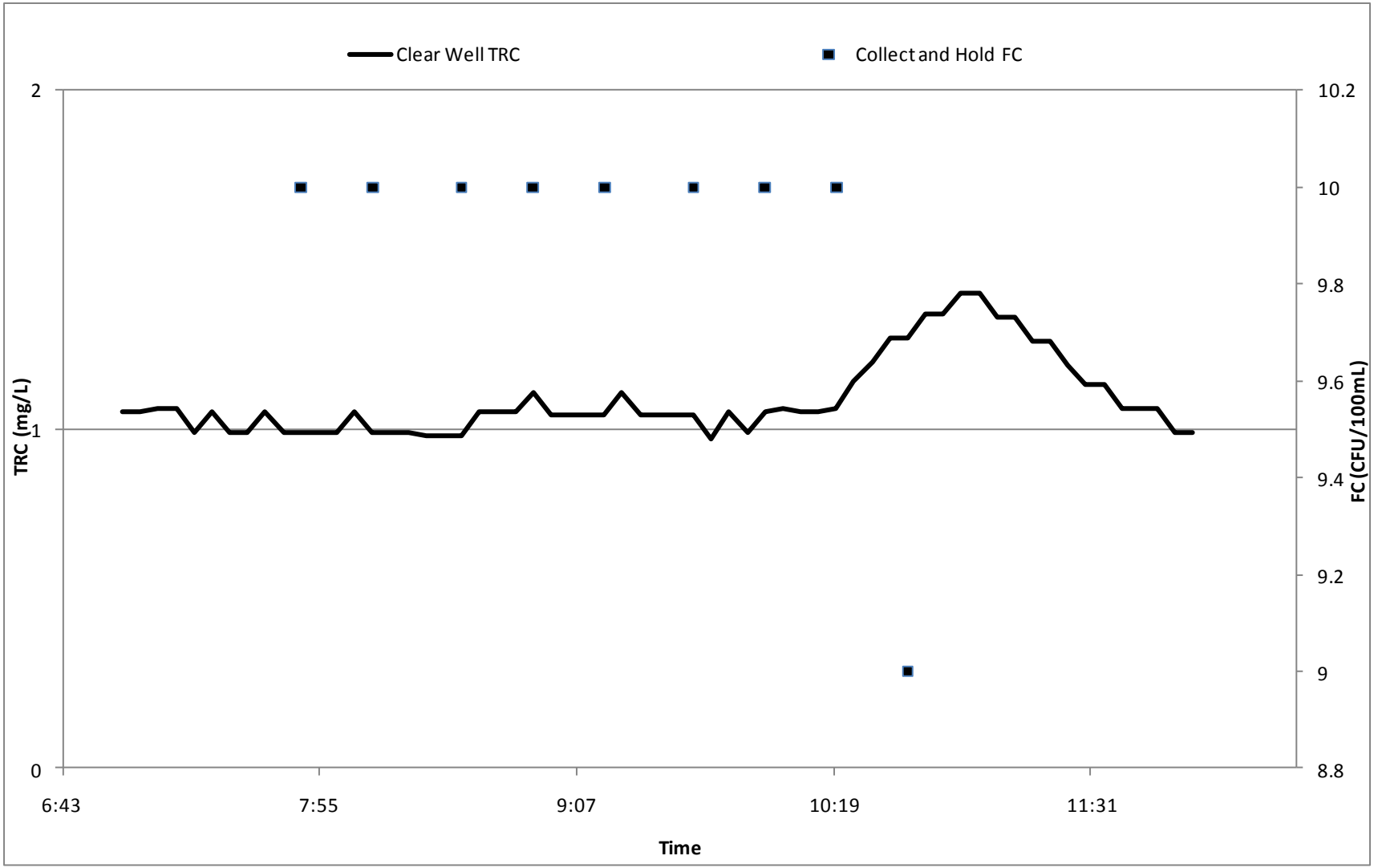


FIGURE A-3D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR OCTOBER 2, 2012



Note: All fecal coliform concentration values of <10 CFU/100 mL were plotted as 10 CFU/mL.

FIGURE A-4A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR OCTOBER 17, 2012

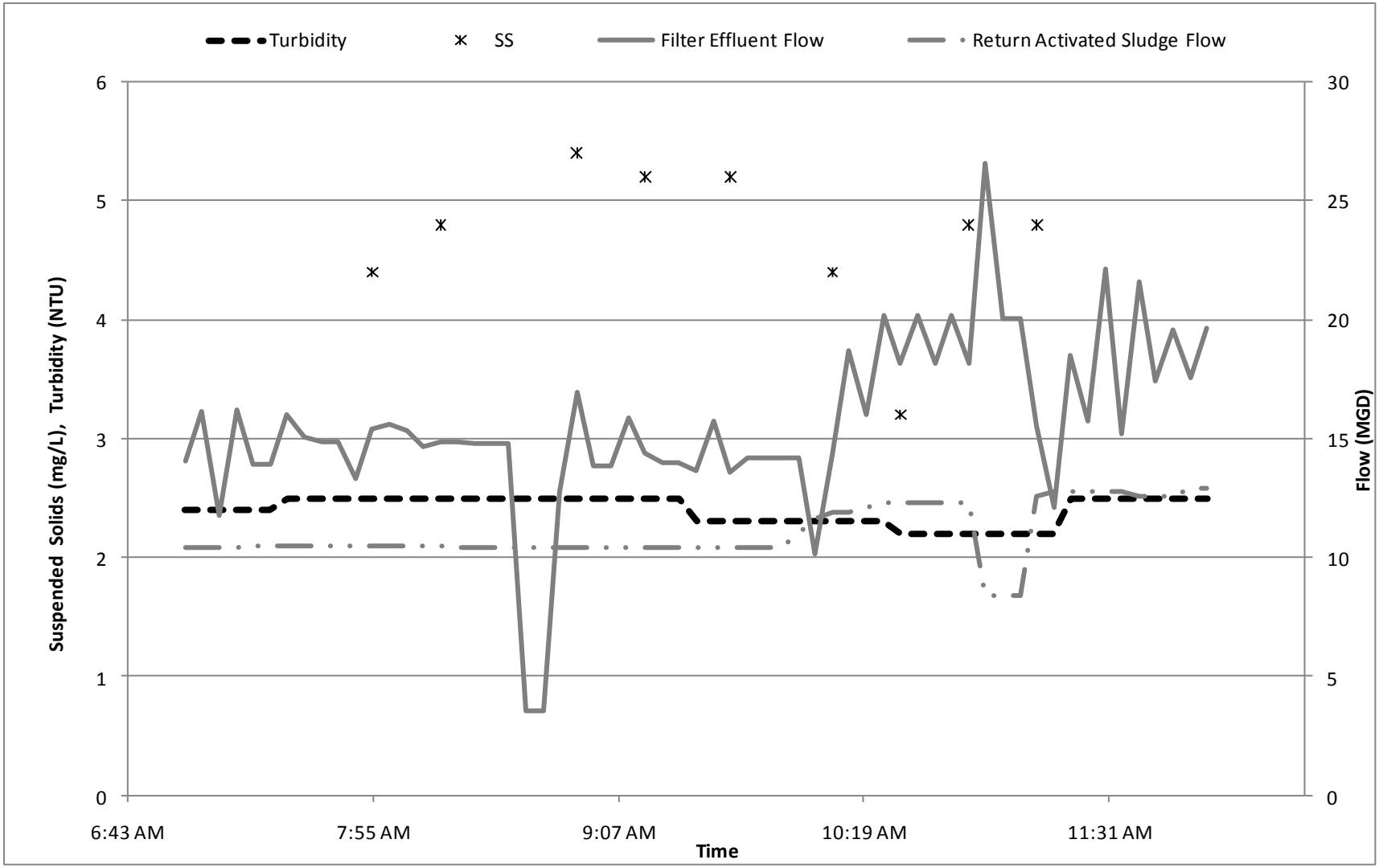


FIGURE A-4B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR OCTOBER 17, 2012

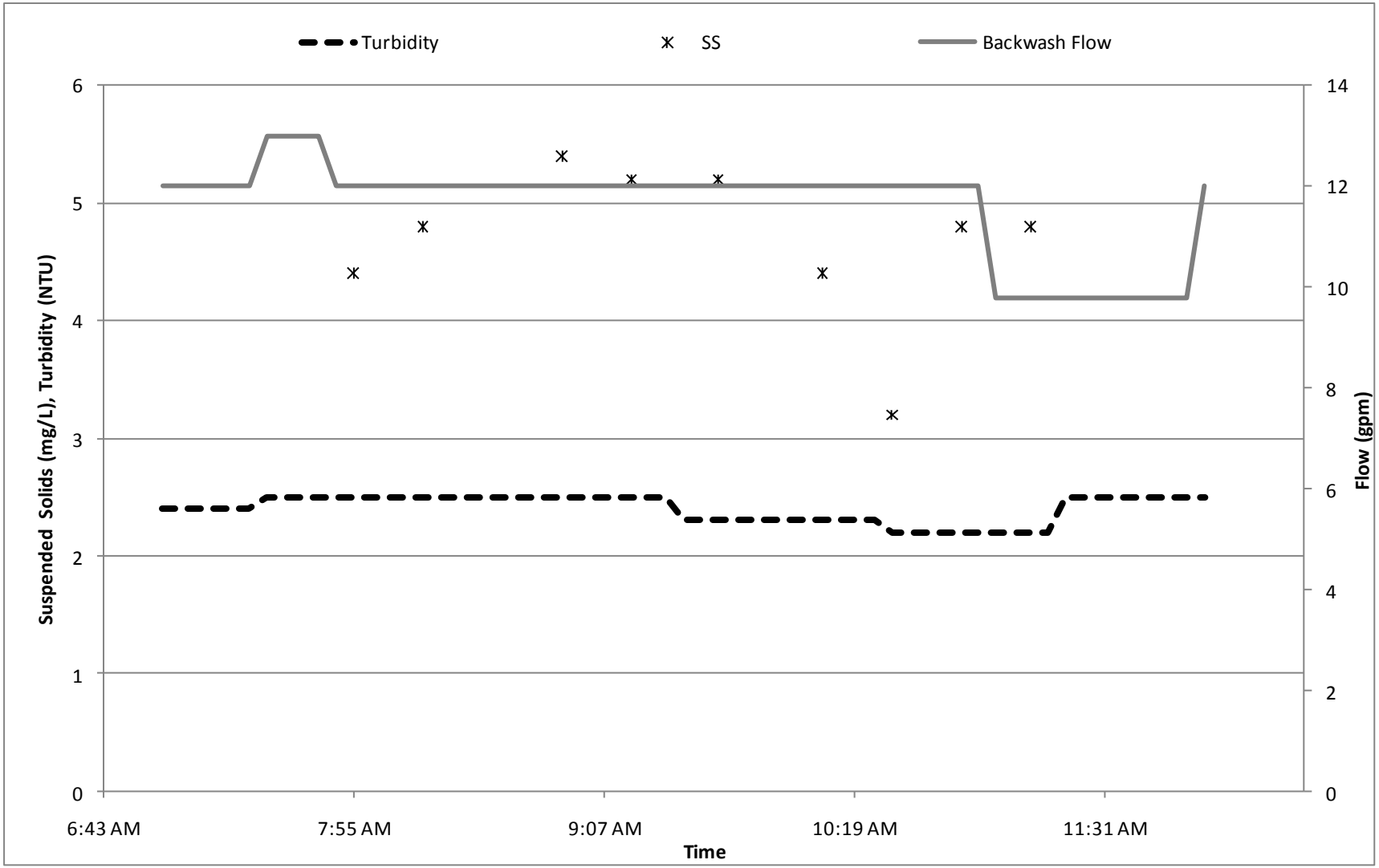


FIGURE A-4C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR OCTOBER 17, 2012

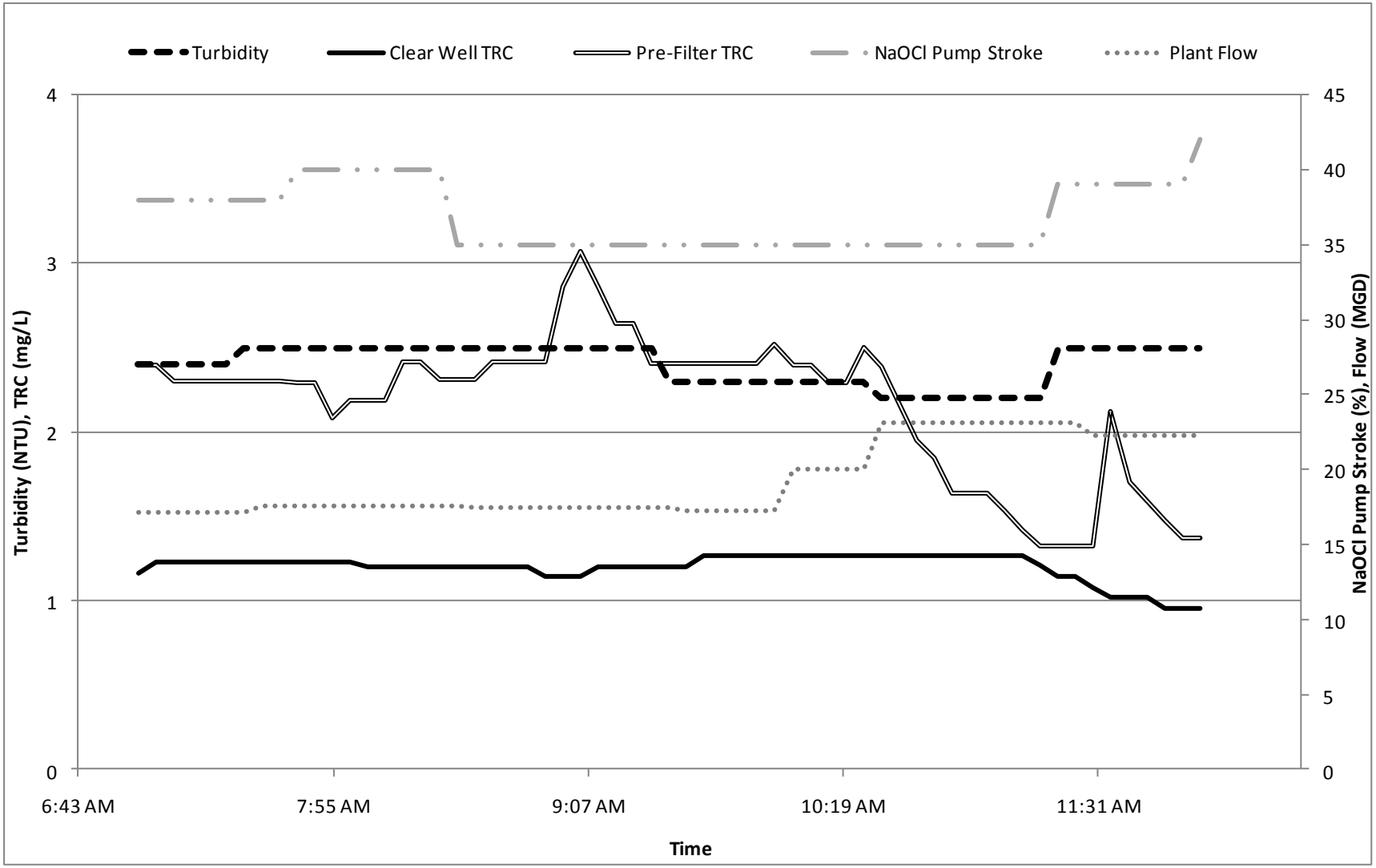
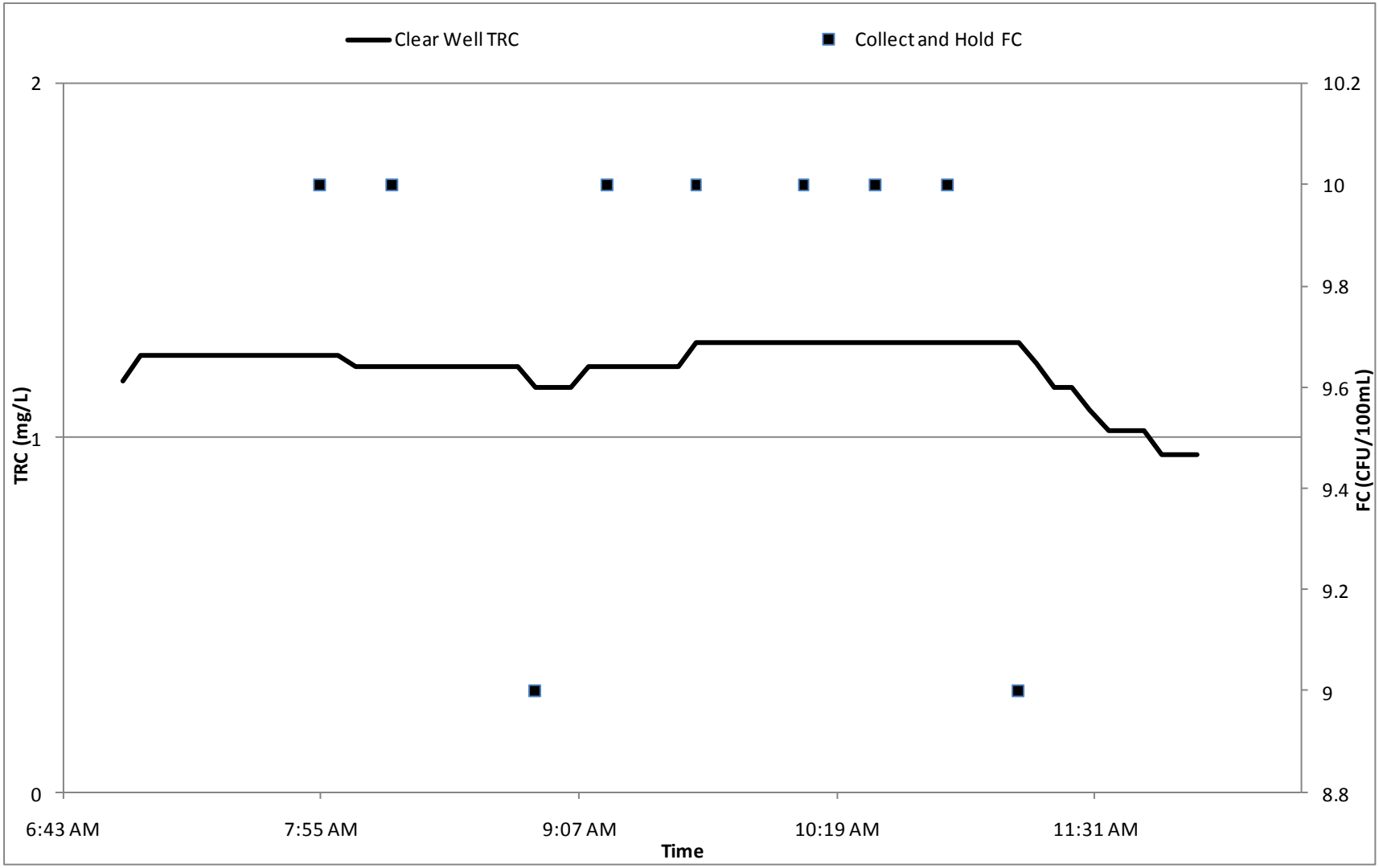


FIGURE A-4D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR OCTOBER 17, 2012



Note: All fecal coliform concentration values of <10 CFU/100 mL were plotted as 10 CFU/mL, respectively.

FIGURE A-5A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR OCTOBER 23, 2012

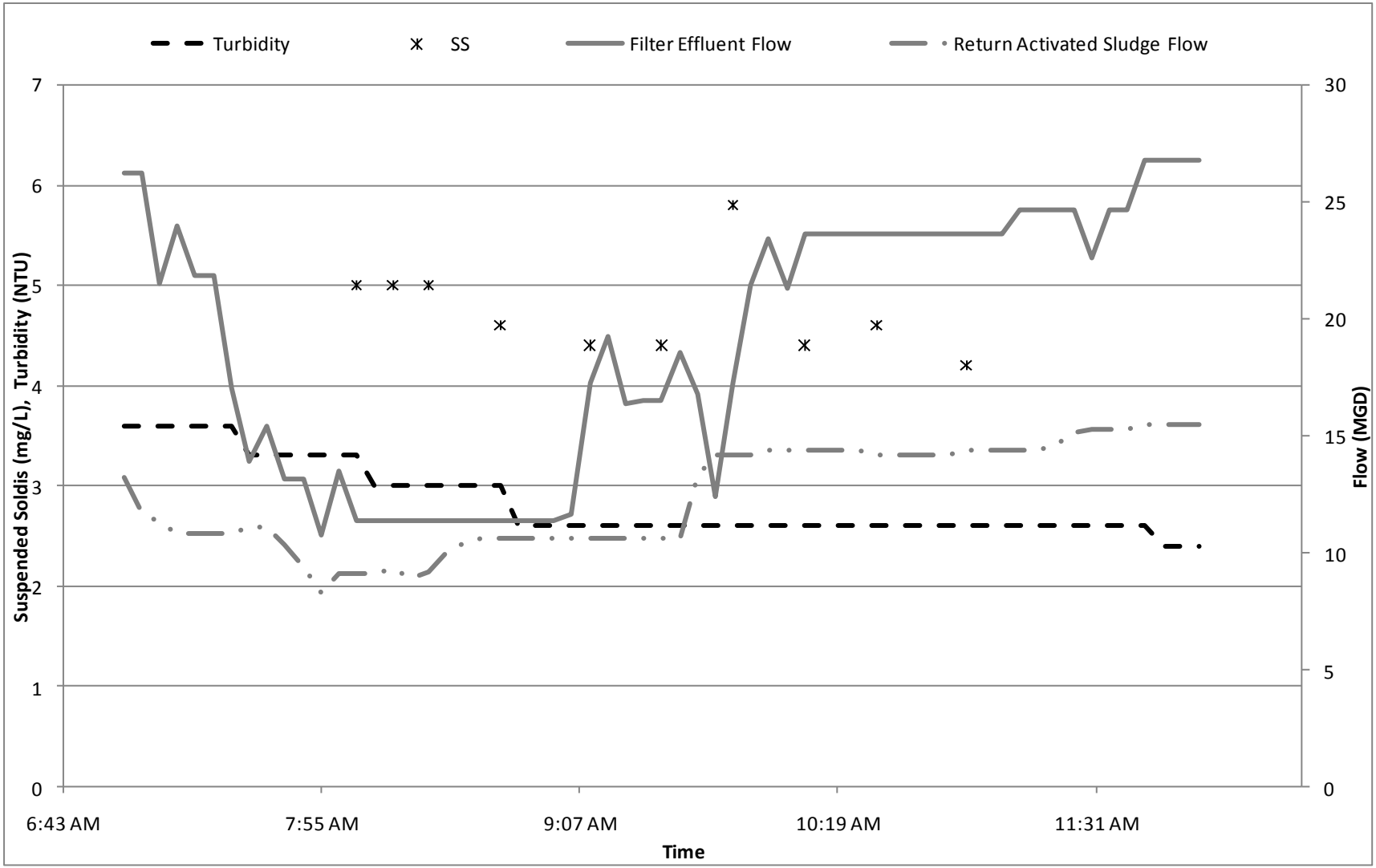


FIGURE A-5B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR OCTOBER 23, 2012

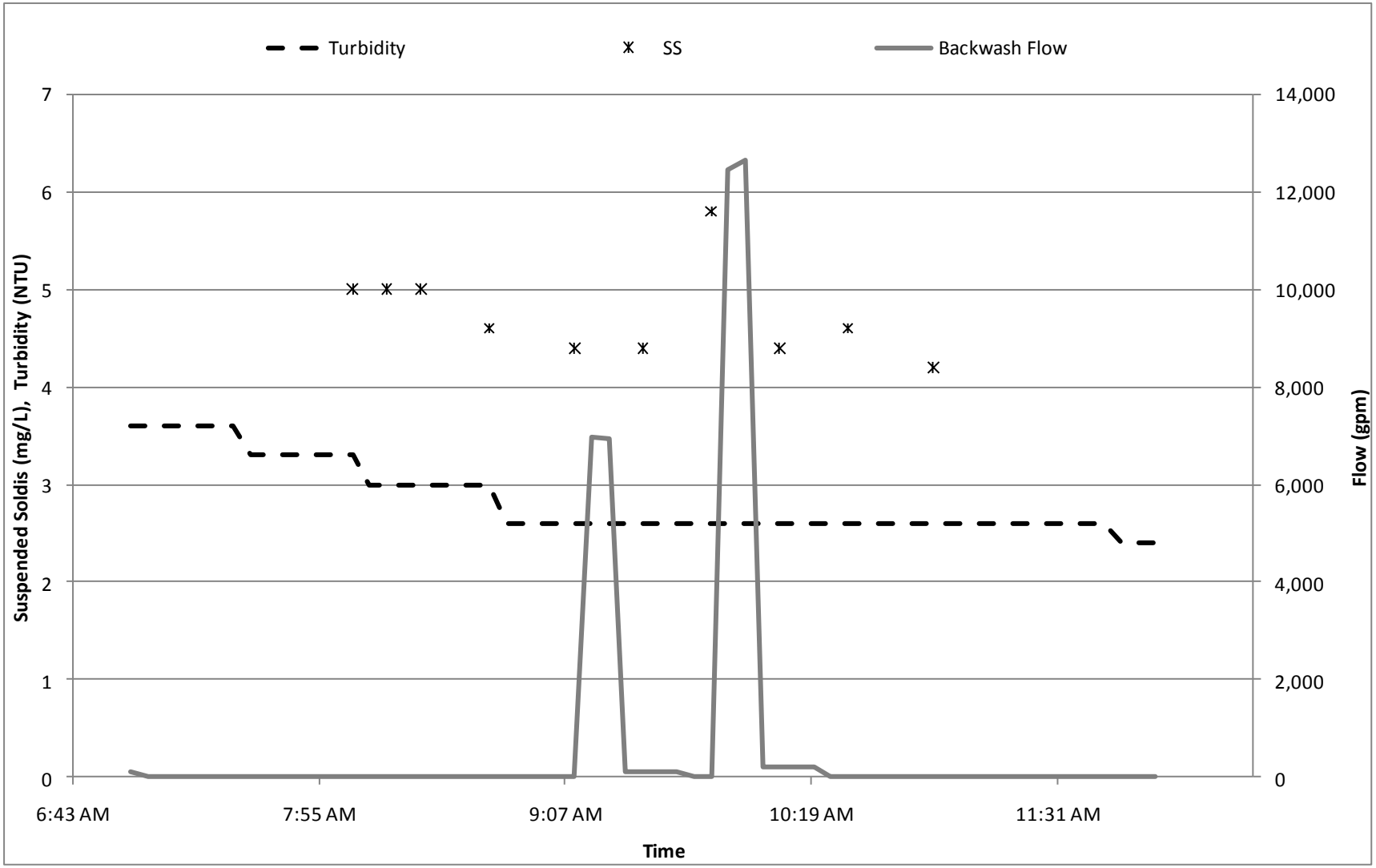


FIGURE A-5C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR OCTOBER 23, 2012

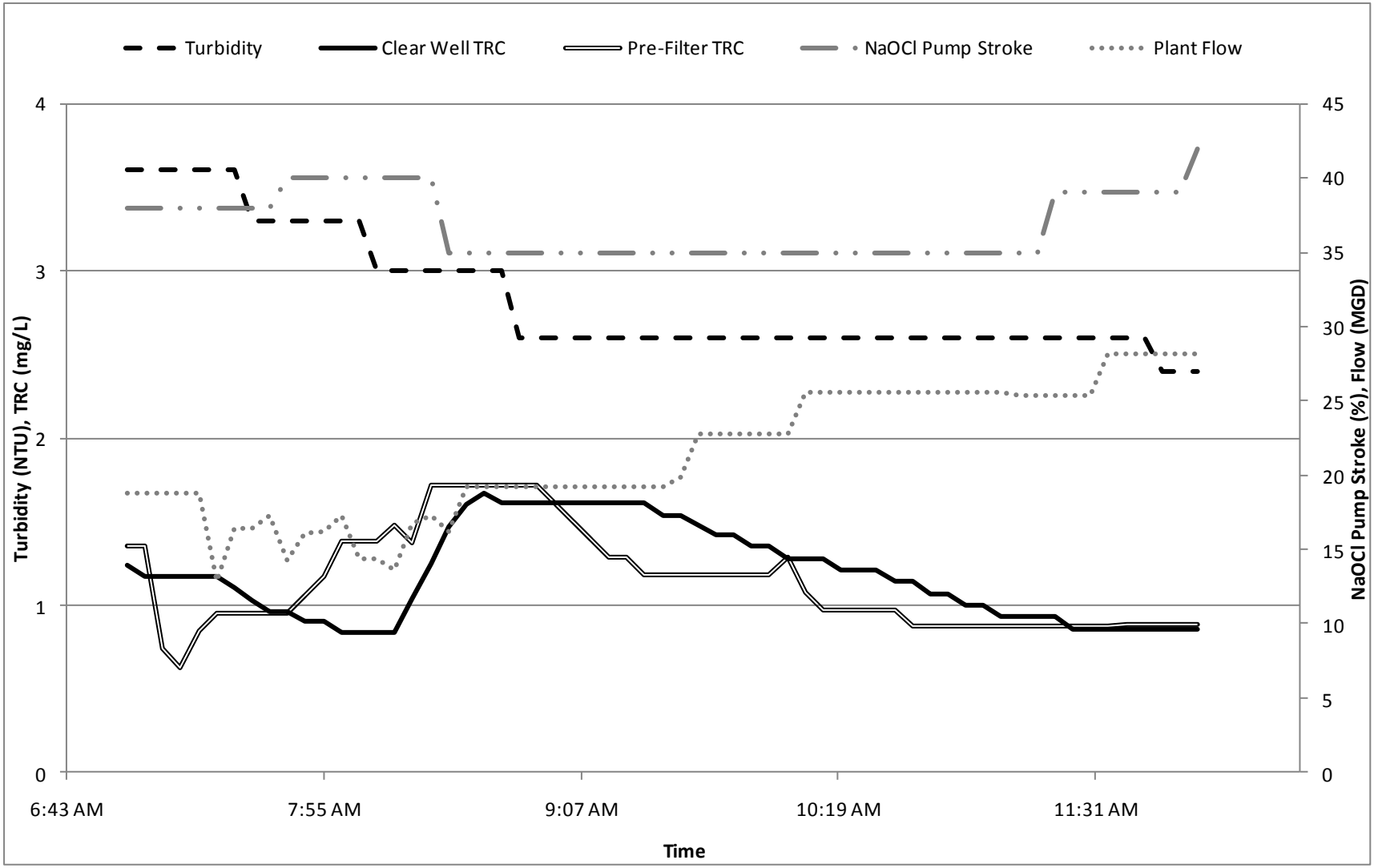
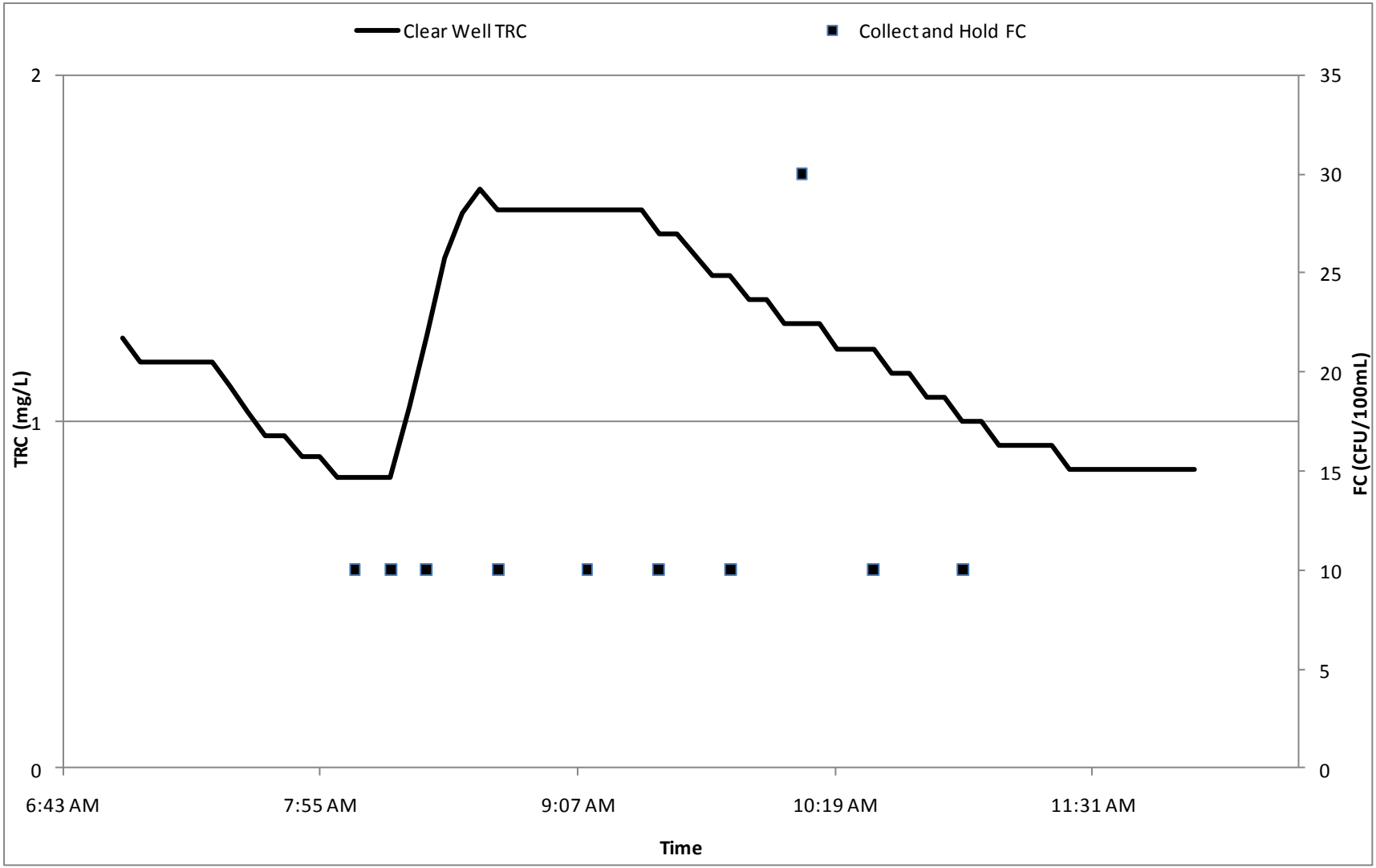


FIGURE A-5D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR OCTOBER 23, 2012



Note: All fecal coliform concentration values of <10 CFU/100 mL were plotted as 10 CFU/mL.

FIGURE A-6A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR APRIL 17, 2013

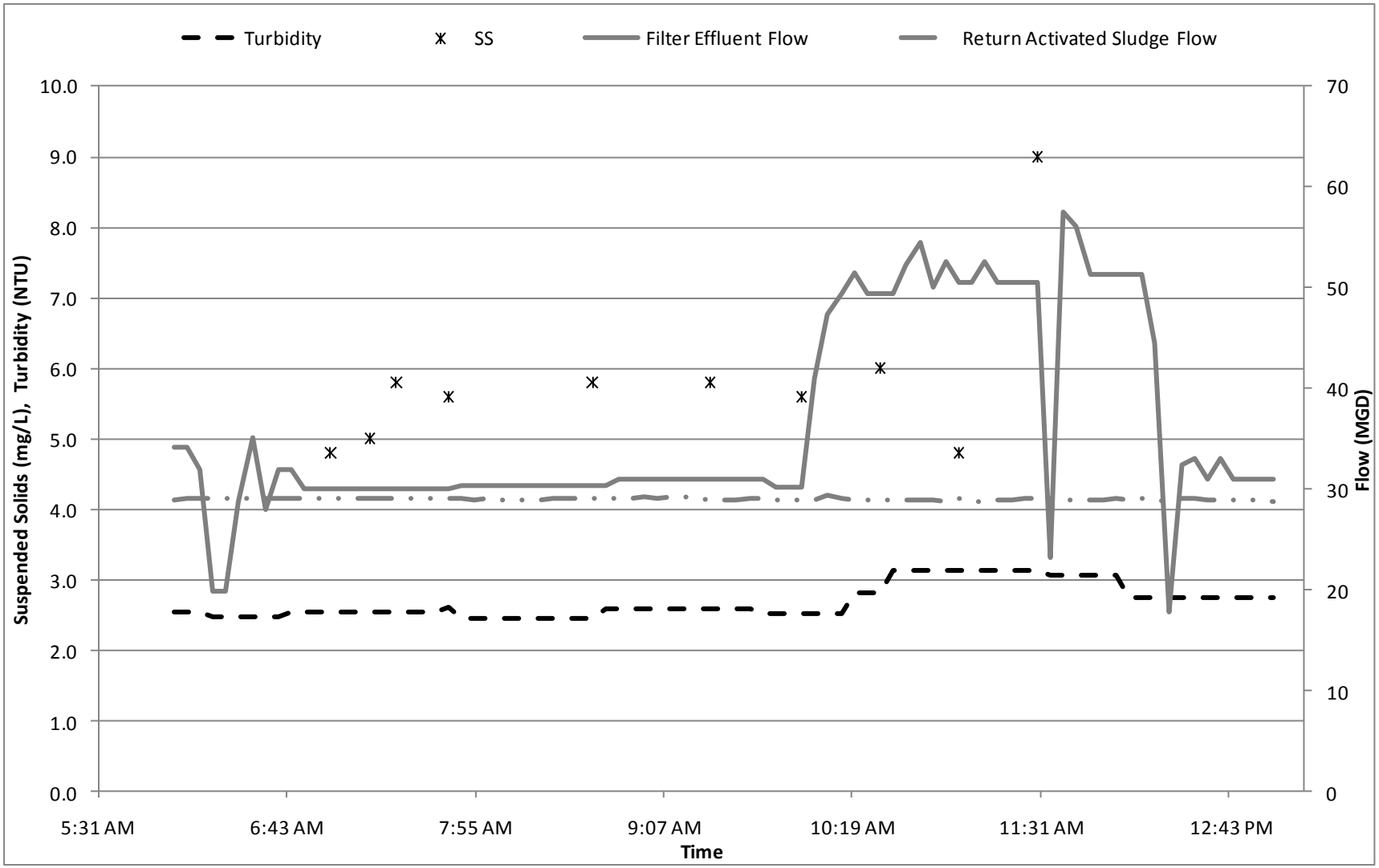


FIGURE A-6B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR APRIL 17, 2013

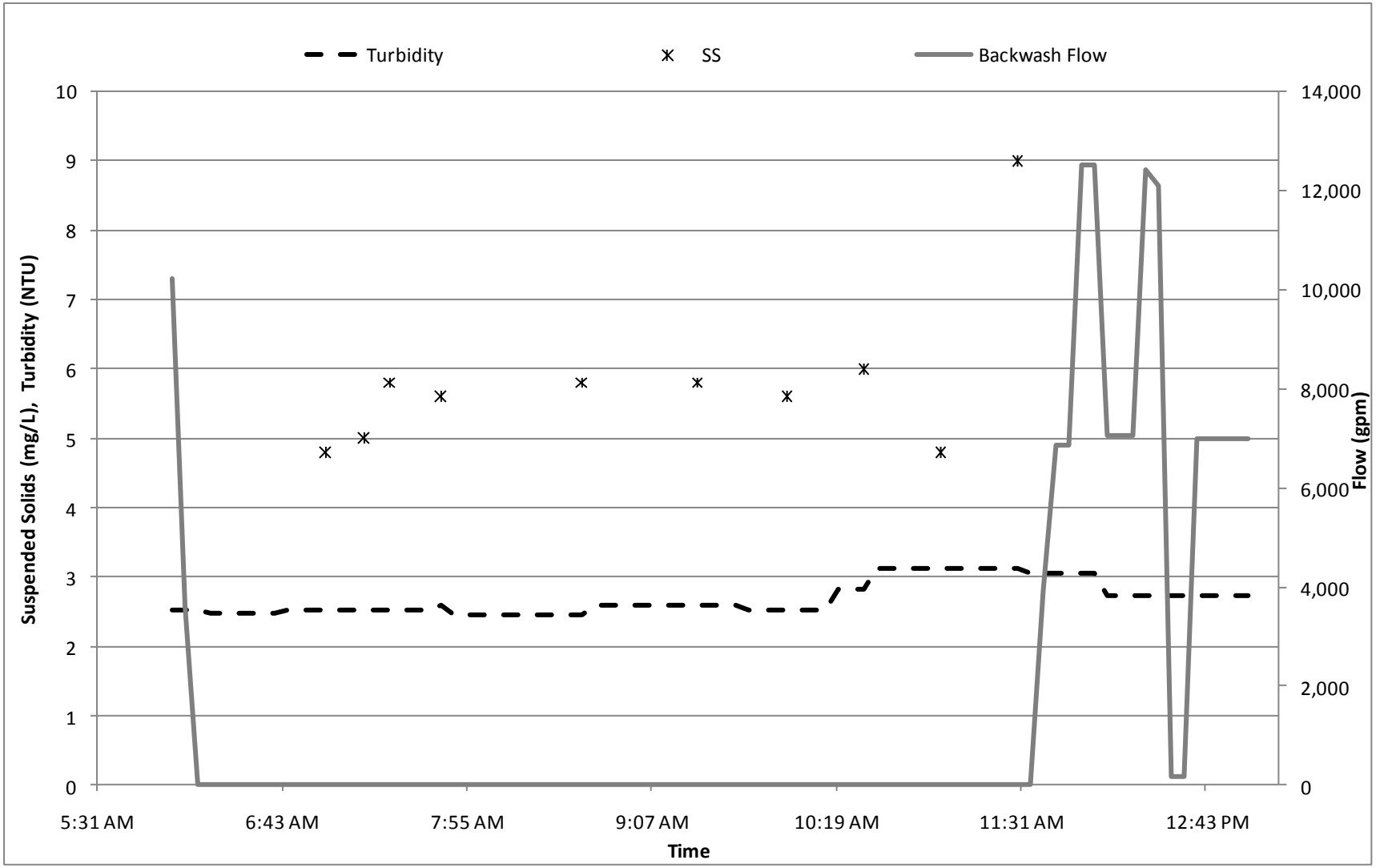


FIGURE A-6C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR APRIL 17, 2013

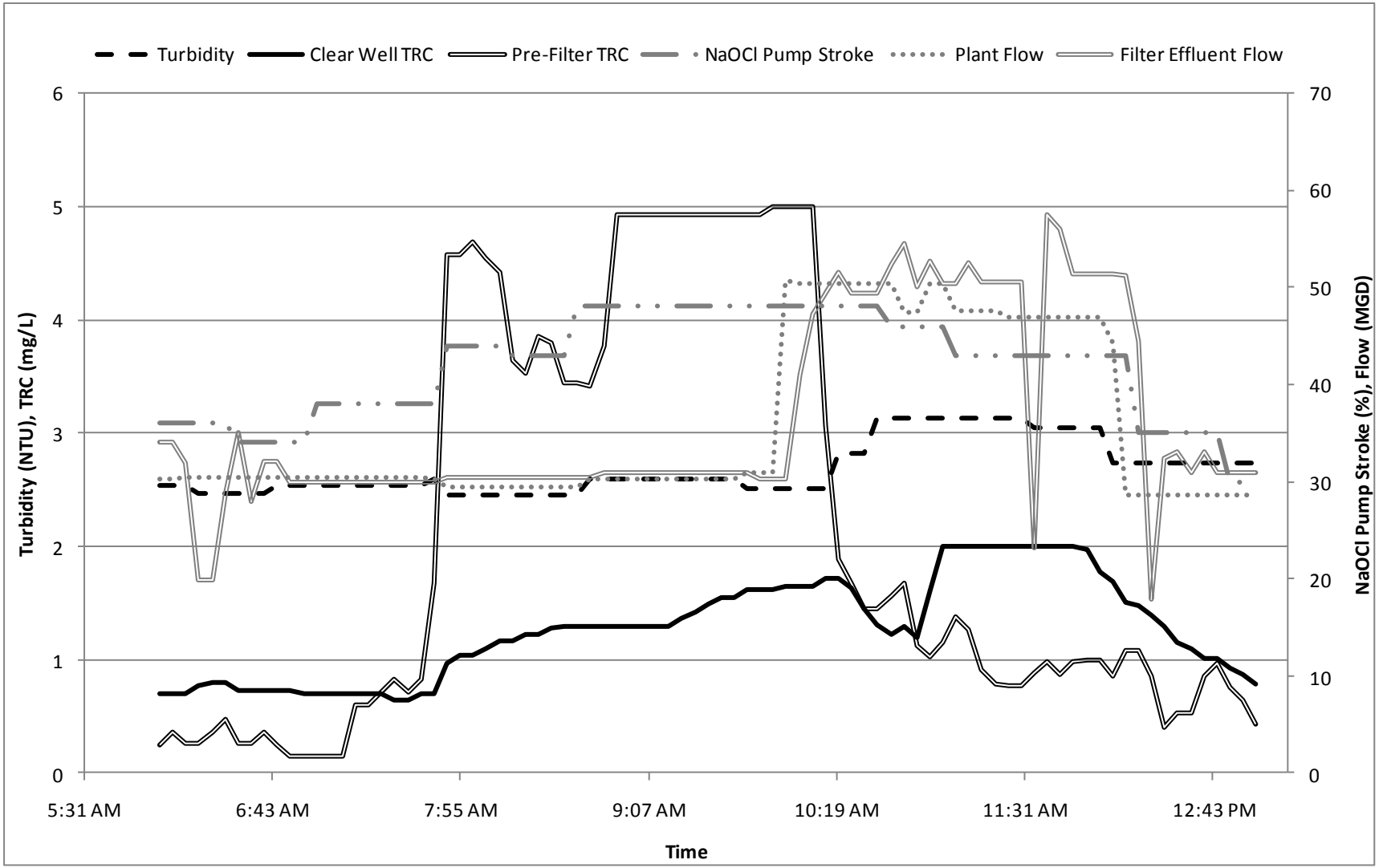
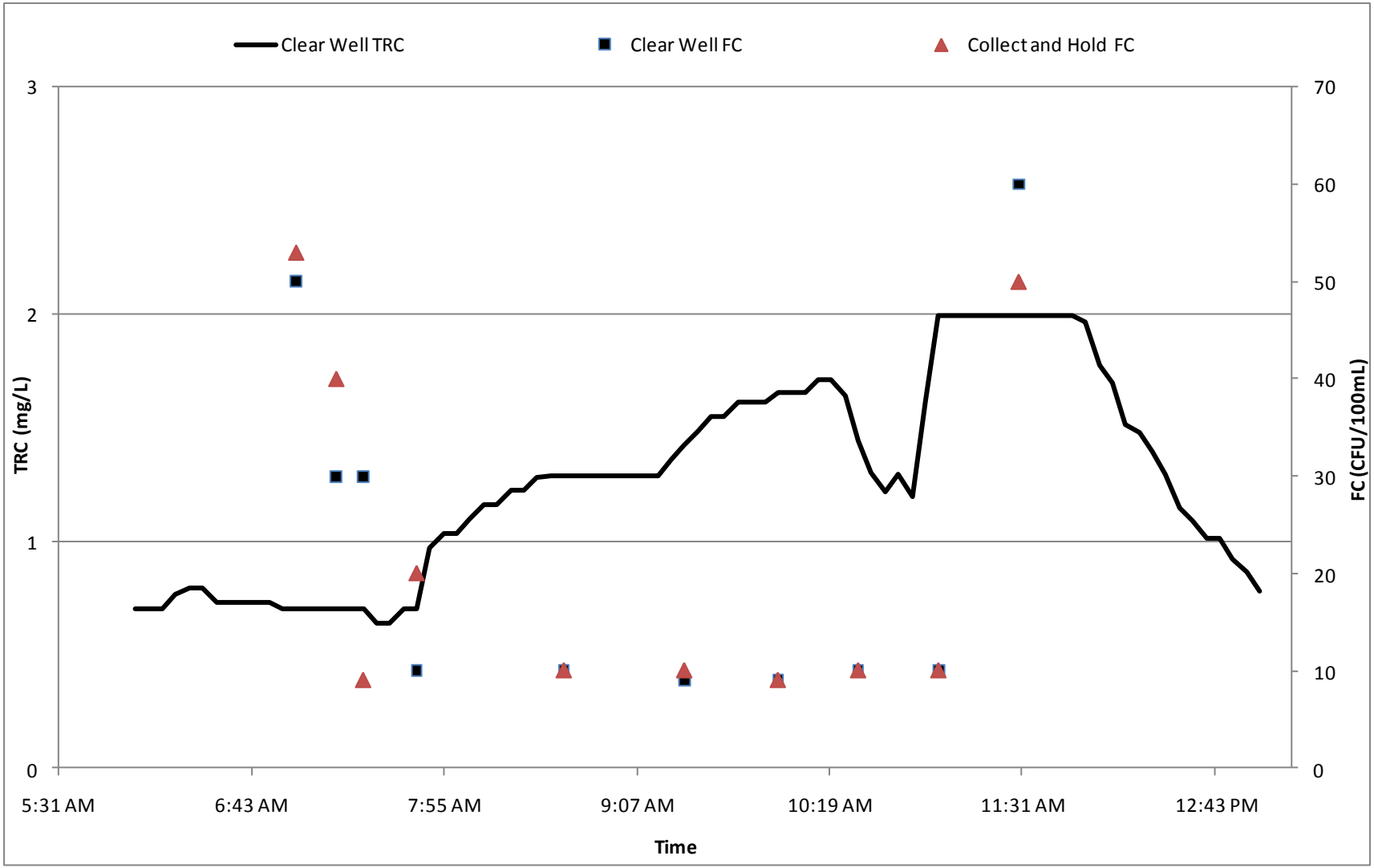


FIGURE A-6D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE, CLEAR WELL FECAL COLIFORM CONCENTRATION, AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR APRIL 17, 2013



Note: All fecal coliform concentration values of <10 CFU/100 mL were plotted as 10 CFU/mL.

FIGURE A-7A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR APRIL 22, 2013

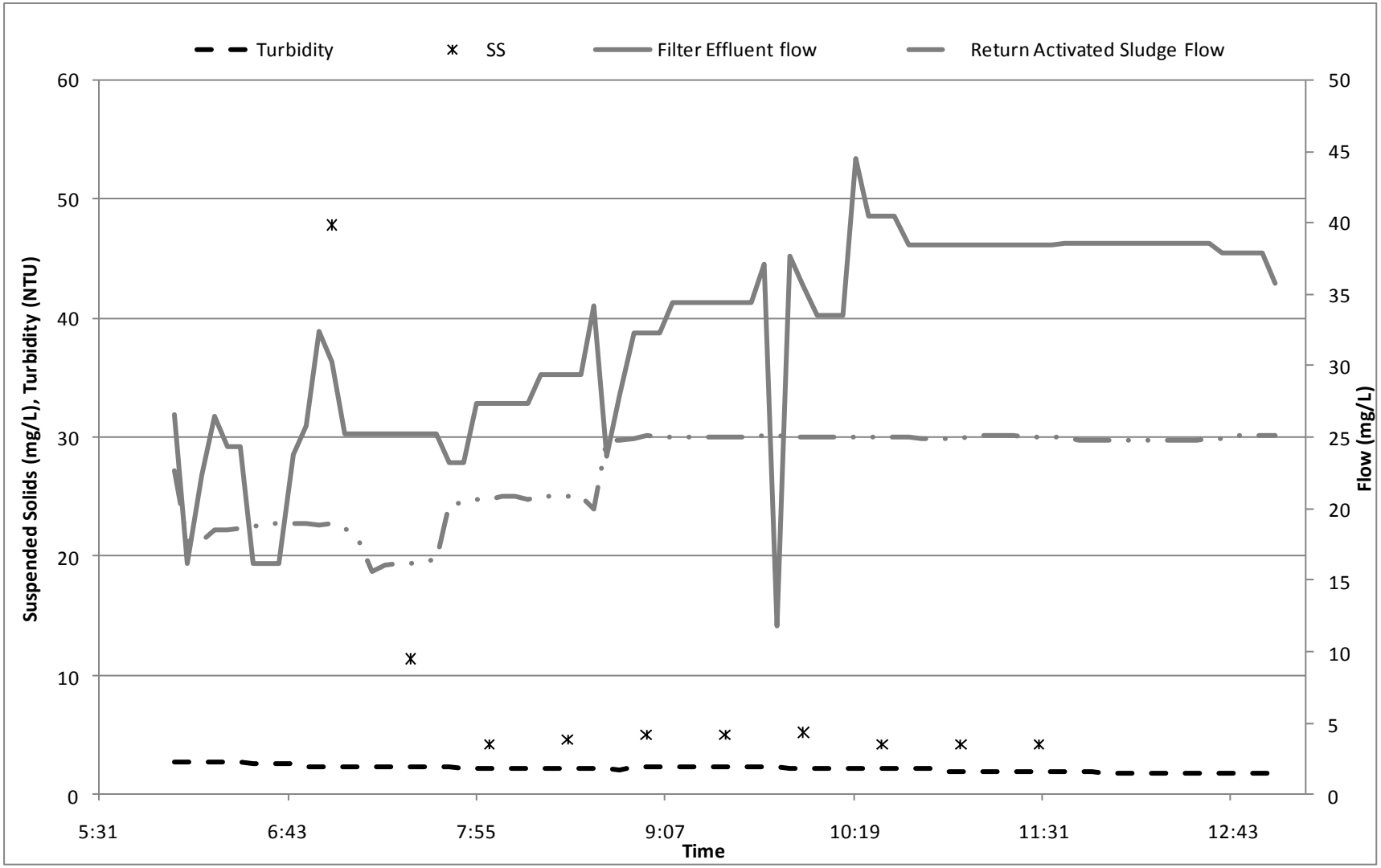


FIGURE A-7B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR APRIL 22, 2013

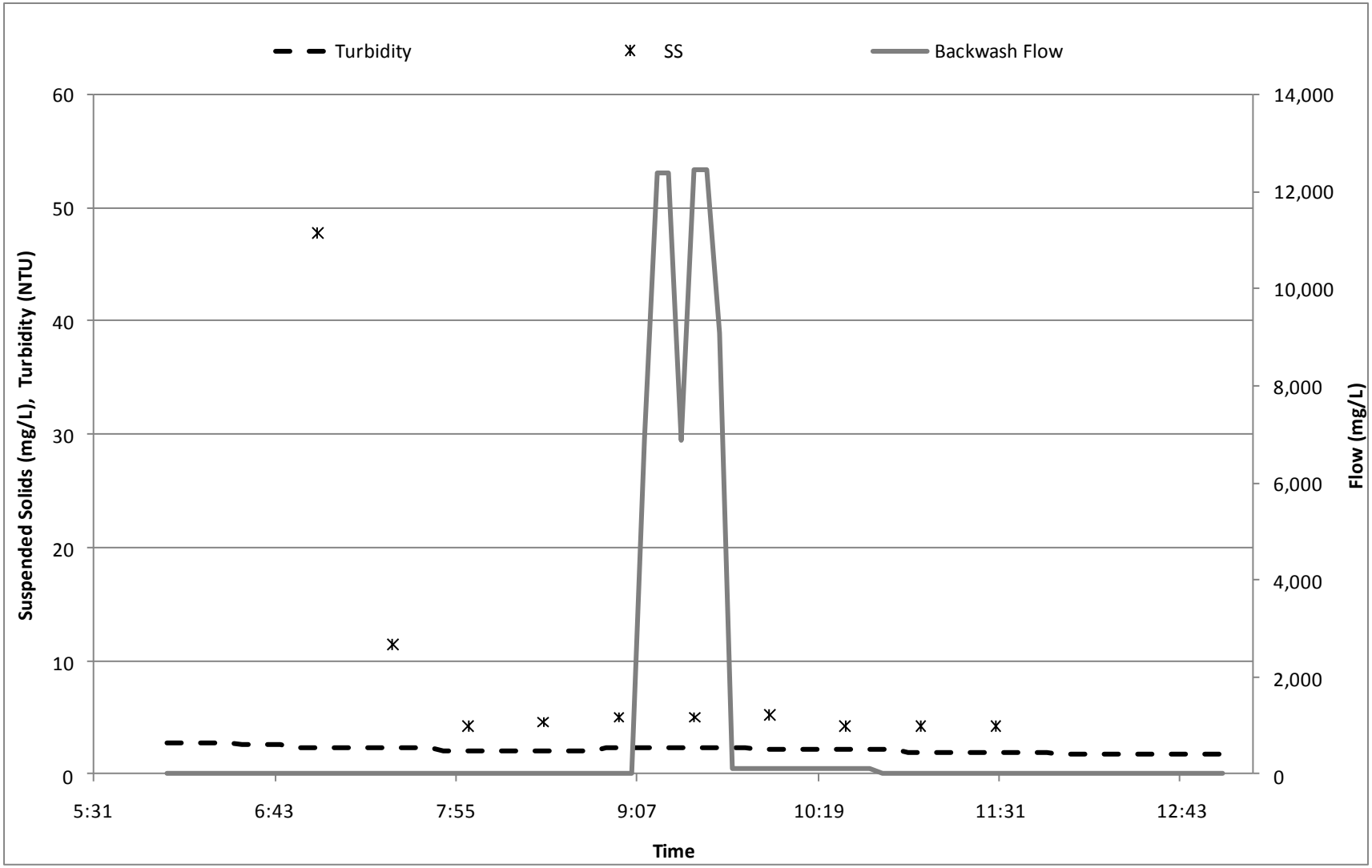


FIGURE A-7C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR APRIL 22, 2013

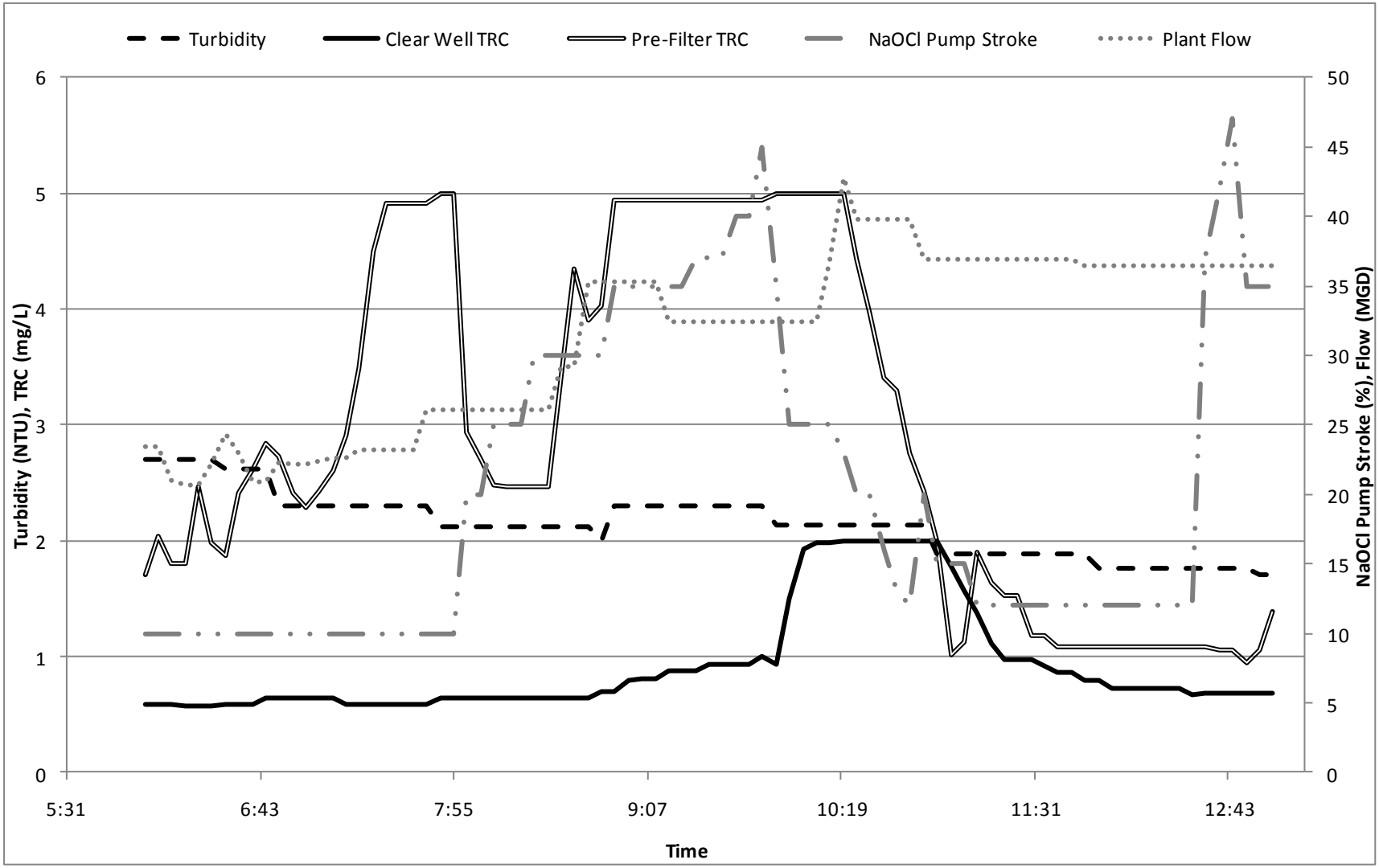
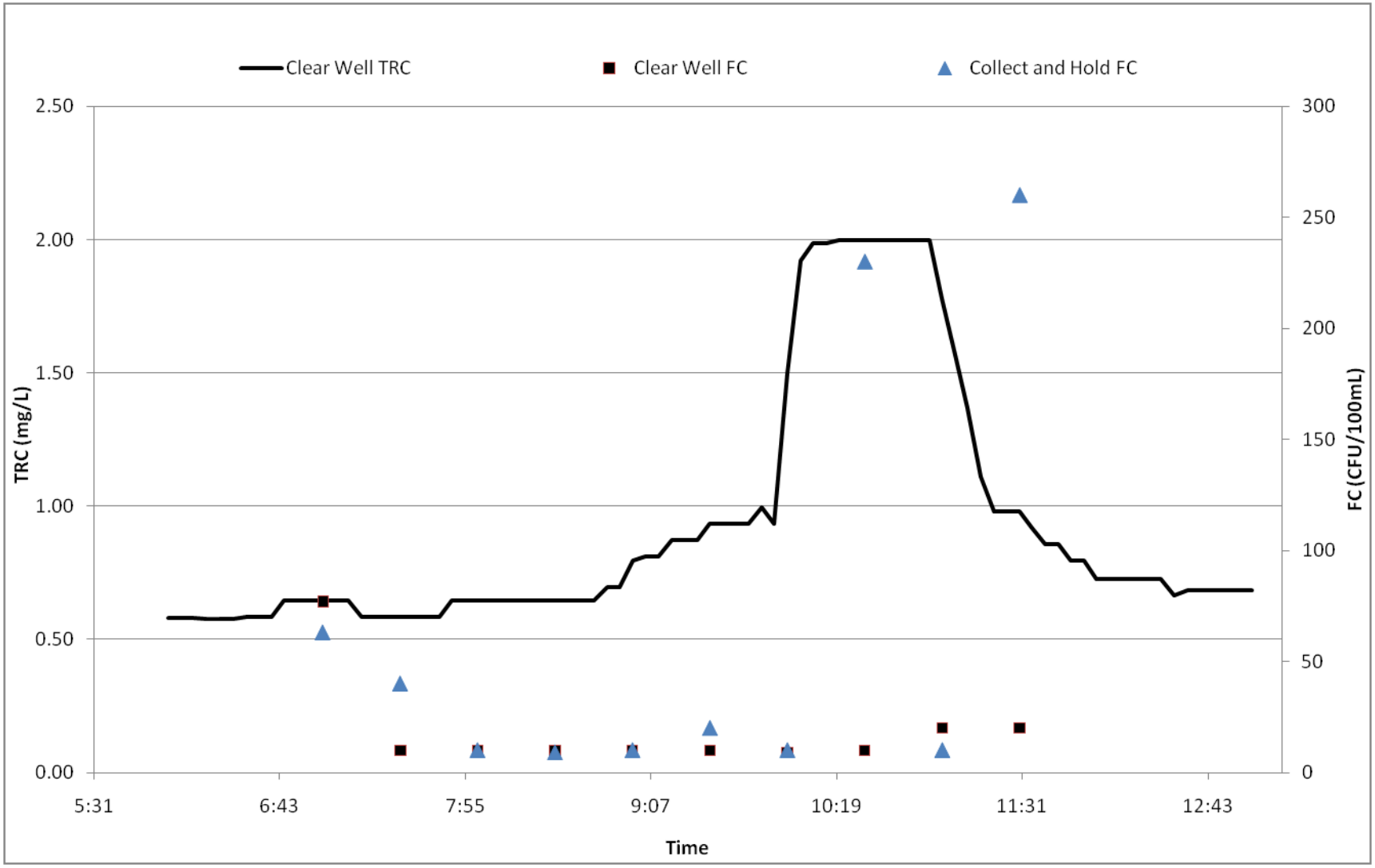


FIGURE A-7D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE, CLEAR WELL FECAL COLIFORM CONCENTRATION, AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR APRIL 22, 2013



Note: All fecal coliform concentration values of <10 CFU/100 mL were plotted as 10 CFU/mL.

FIGURE A-8A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR APRIL 23, 2013

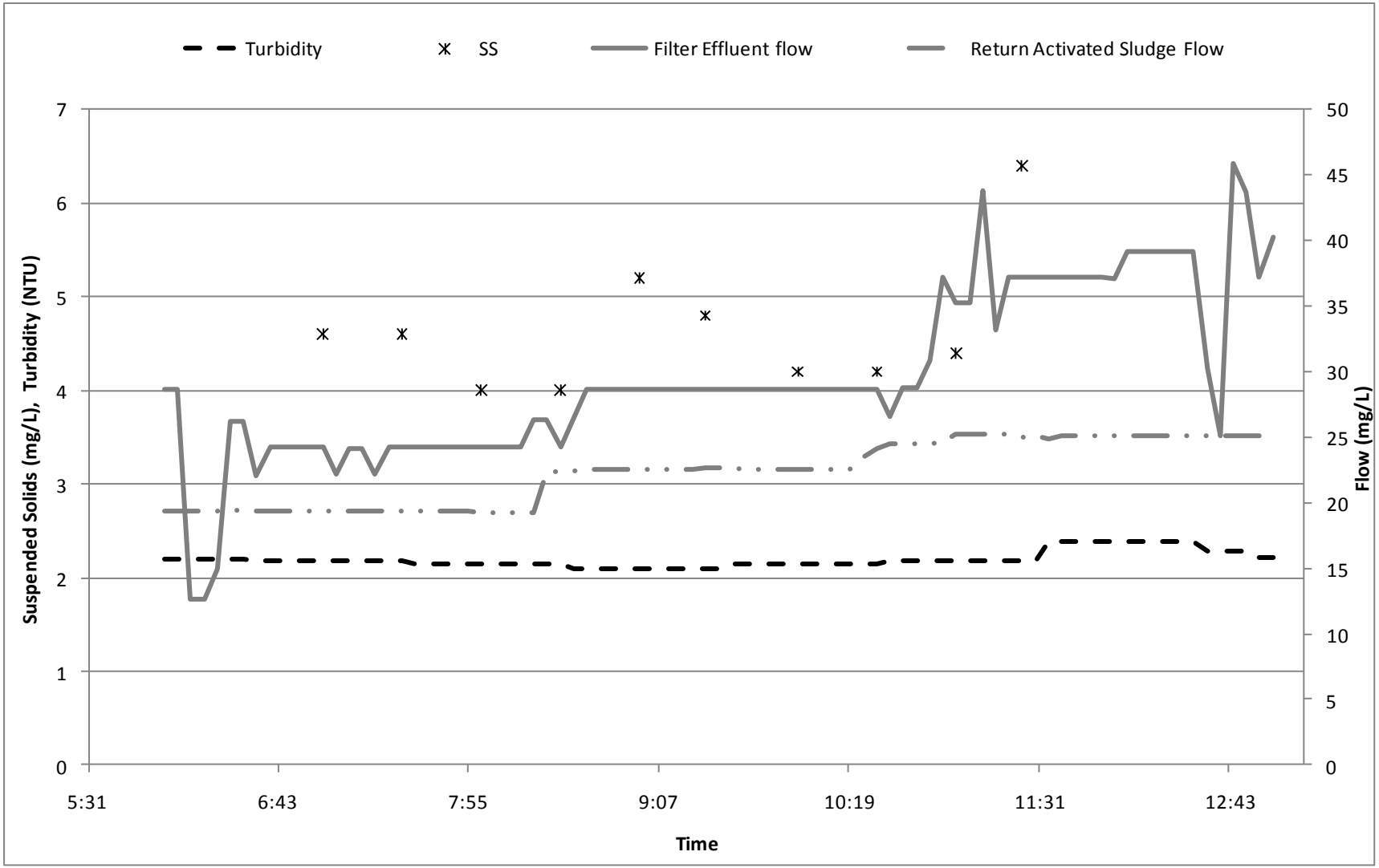


FIGURE A-8B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR APRIL 23, 2013

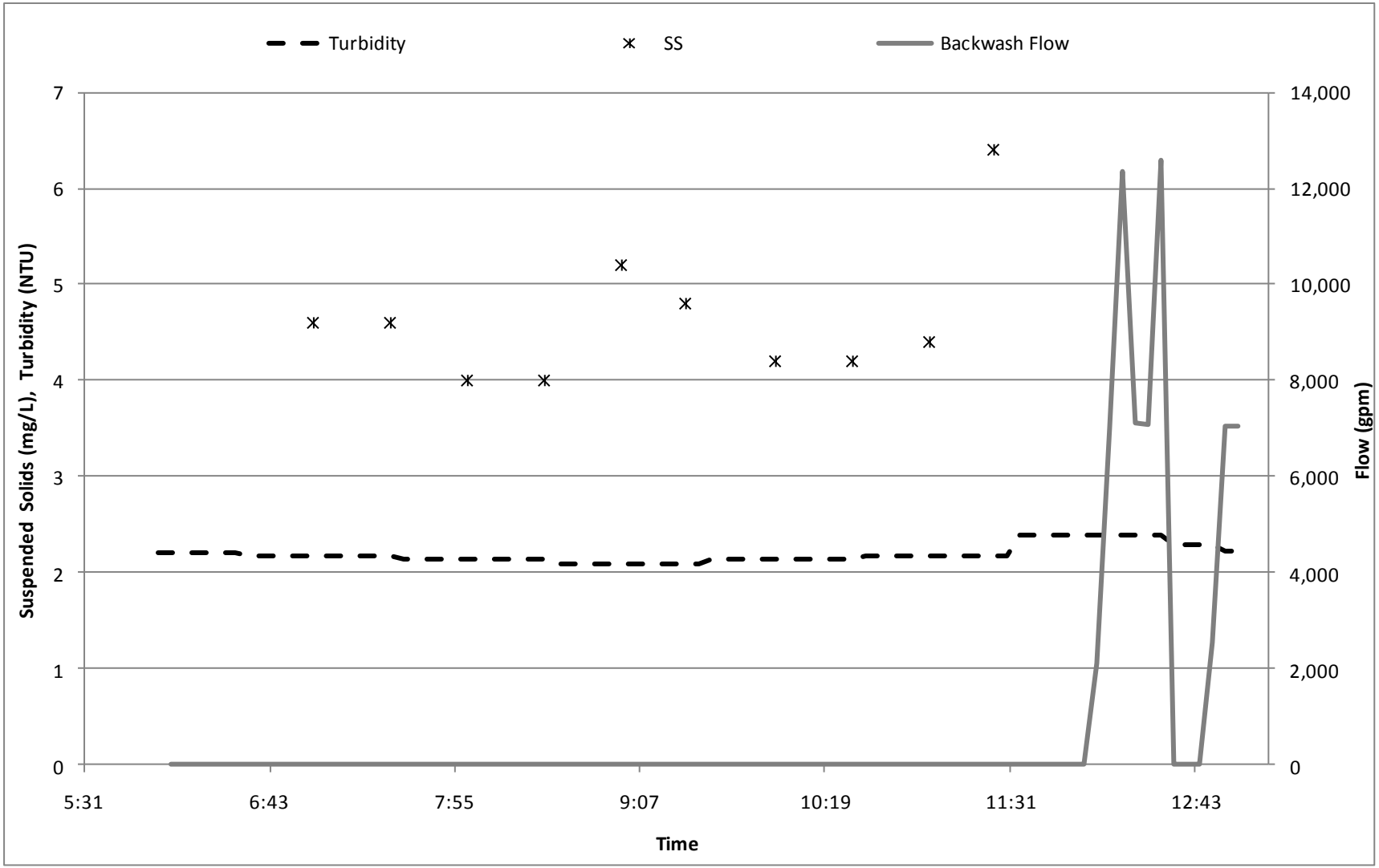


FIGURE A-8C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR APRIL 23, 2013

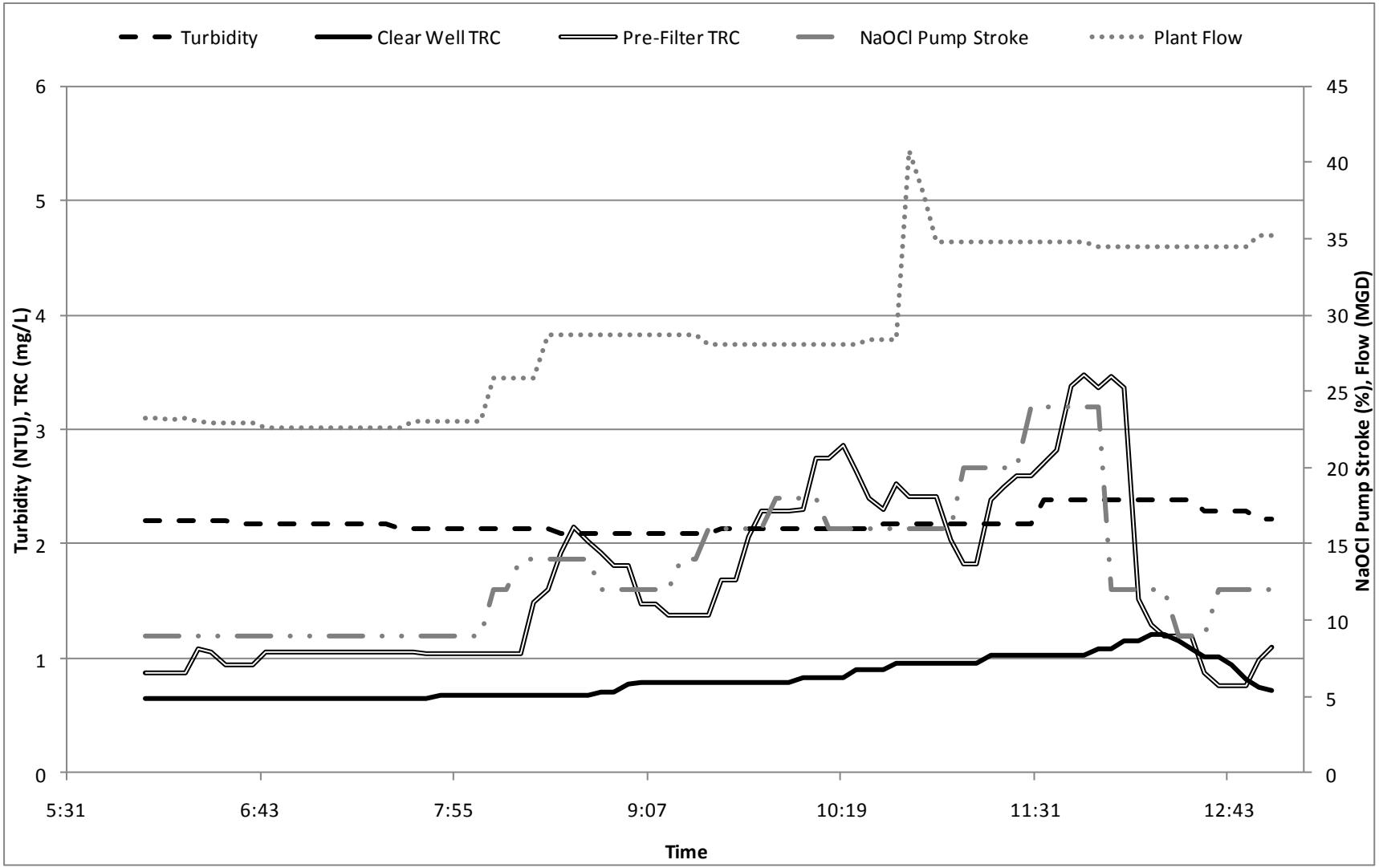
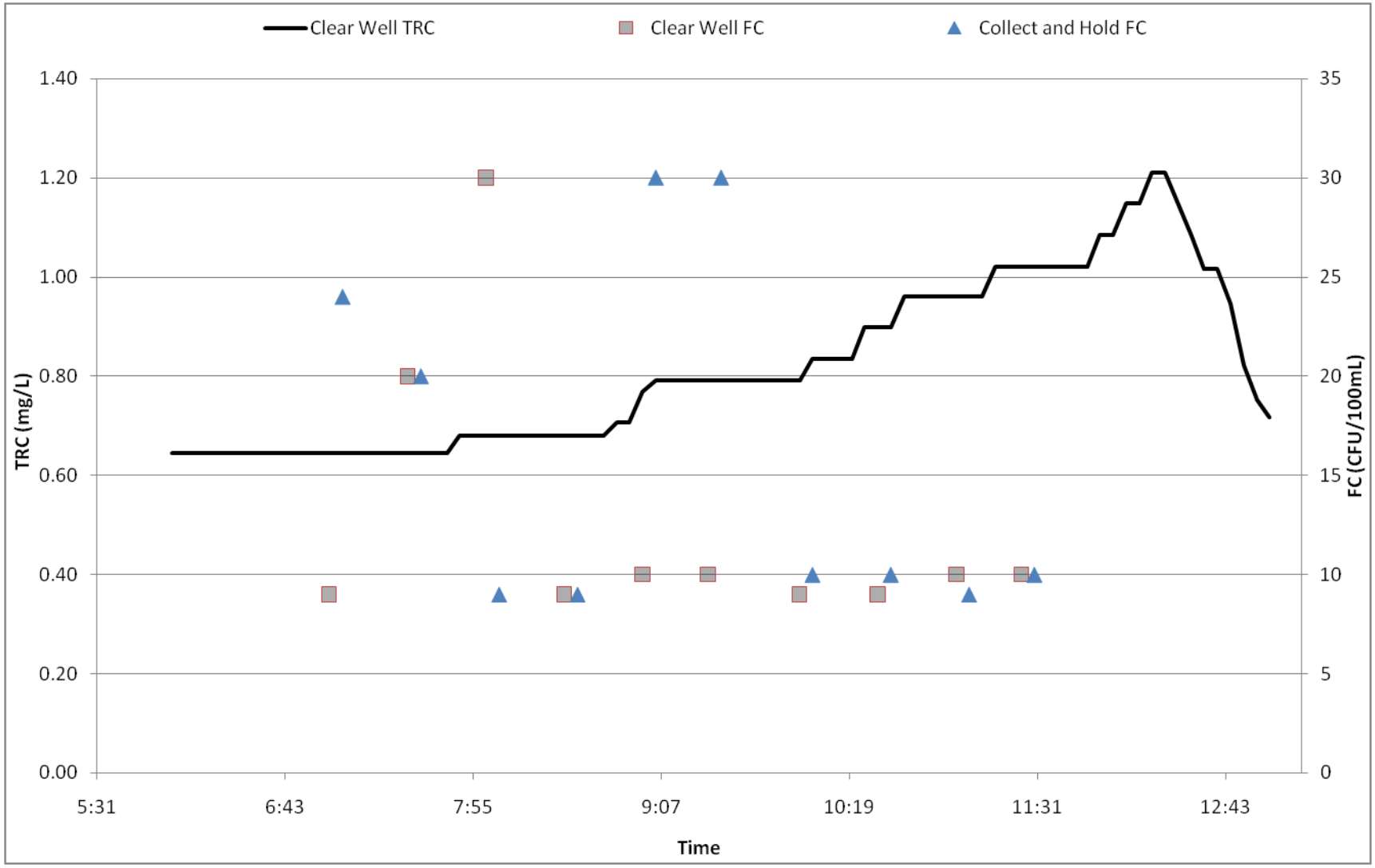


FIGURE A-8D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE, CLEAR WELL FECAL COLIFORM CONCENTRATION, AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR APRIL 23, 2013



Note: All fecal coliform concentration values of <10 were plotted as 10 CFU/mL.

FIGURE A-9A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR APRIL 24, 2013

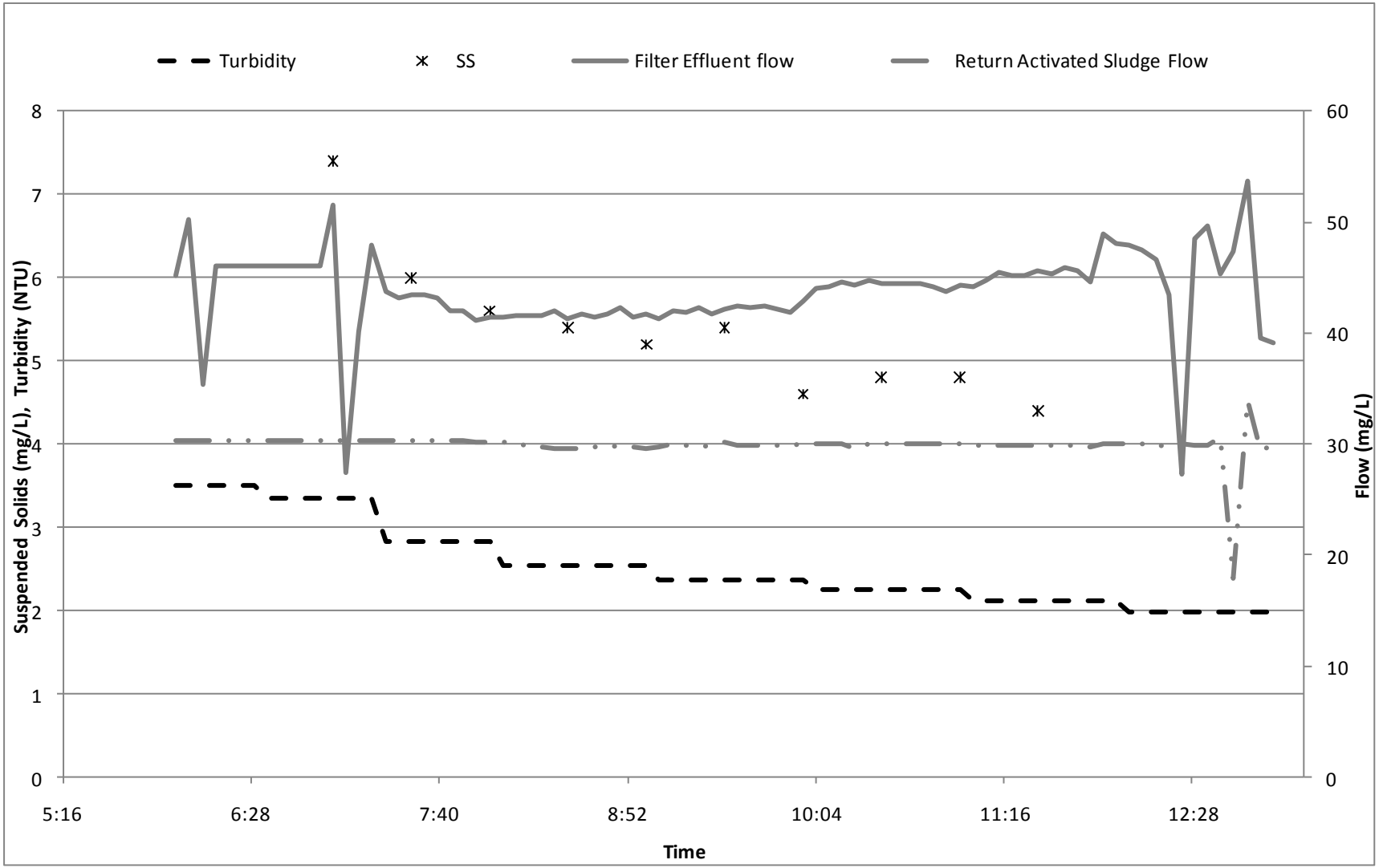


FIGURE A-9B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR APRIL 24, 2013

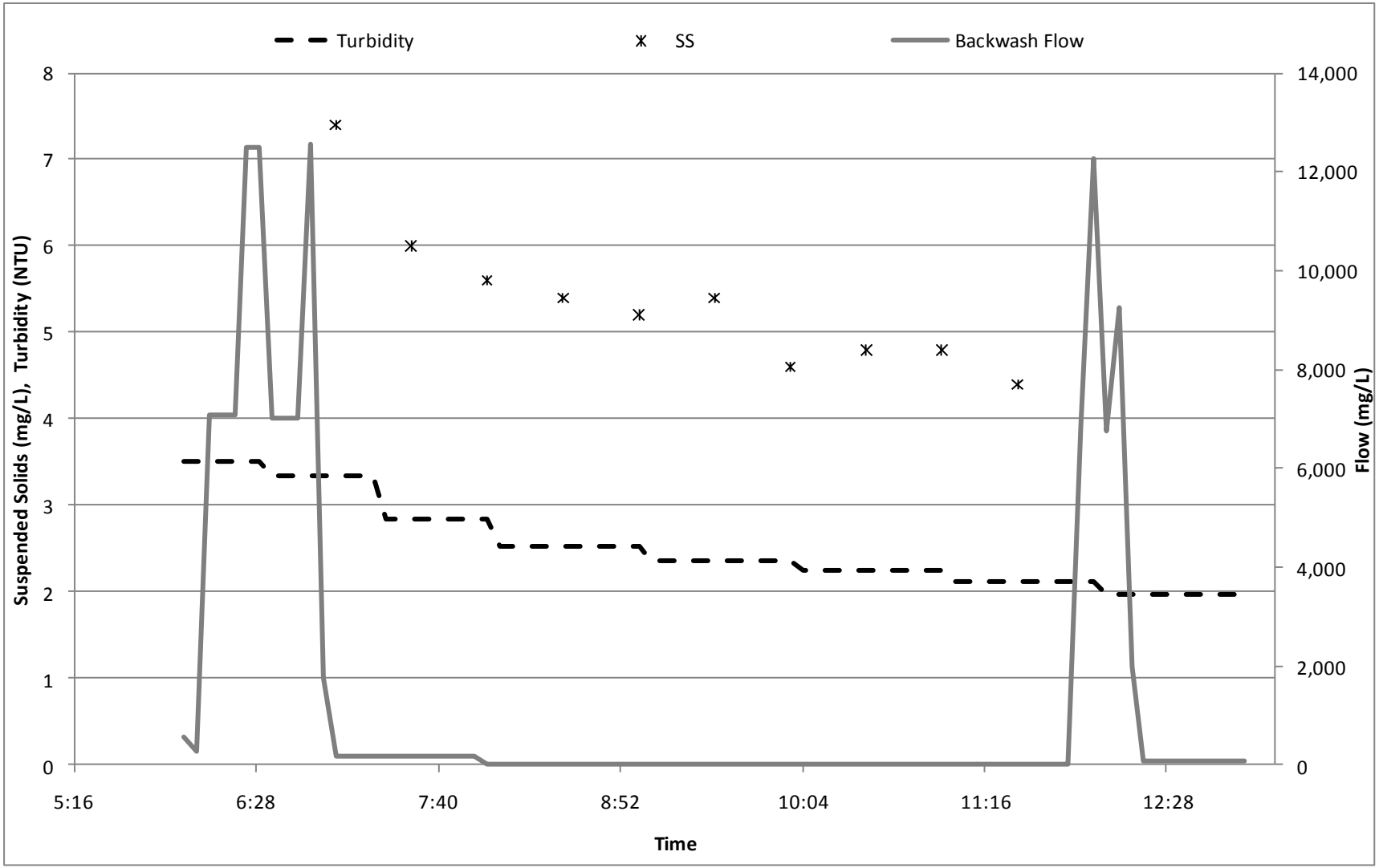


FIGURE A-9C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR APRIL 24, 2013

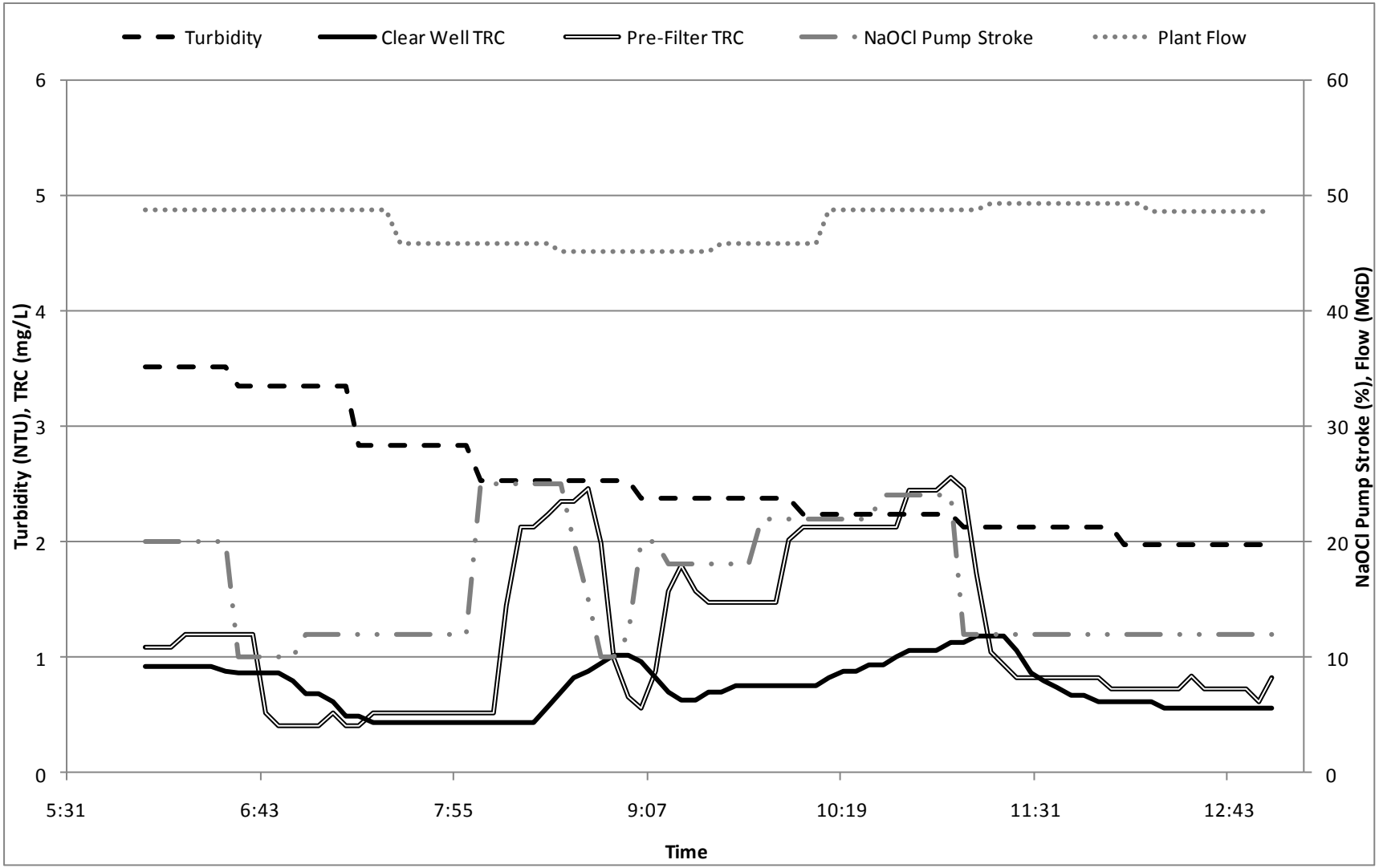
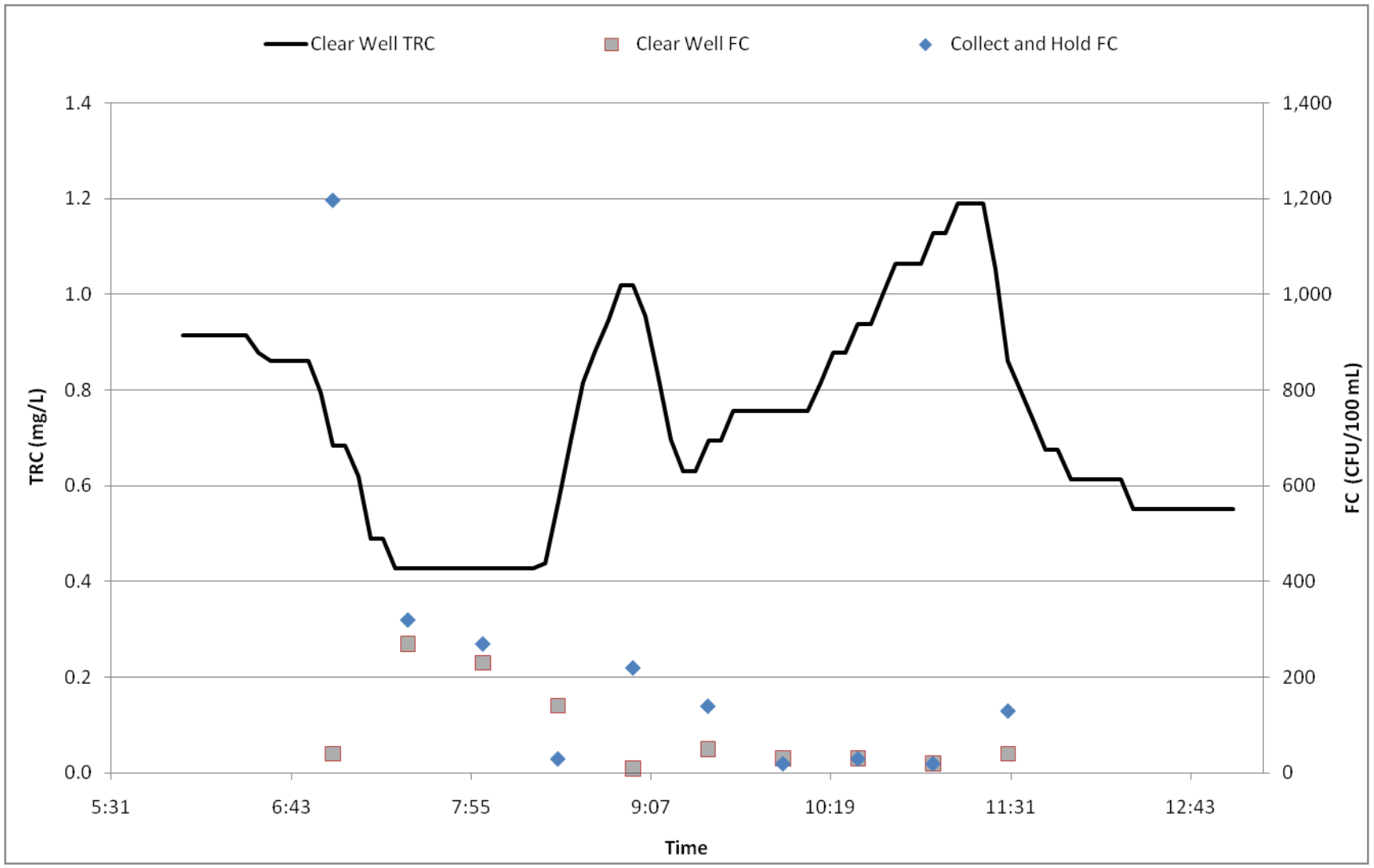


FIGURE A-9D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE, CLEAR WELL FECAL COLIFORM CONCENTRATION, AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR APRIL 24, 2013



Note: All fecal coliform concentration values of <10 and <100 CFU/100 mL were plotted as 10 and 100 CFU/mL, respectively.

FIGURE A-10A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR APRIL 25, 2013

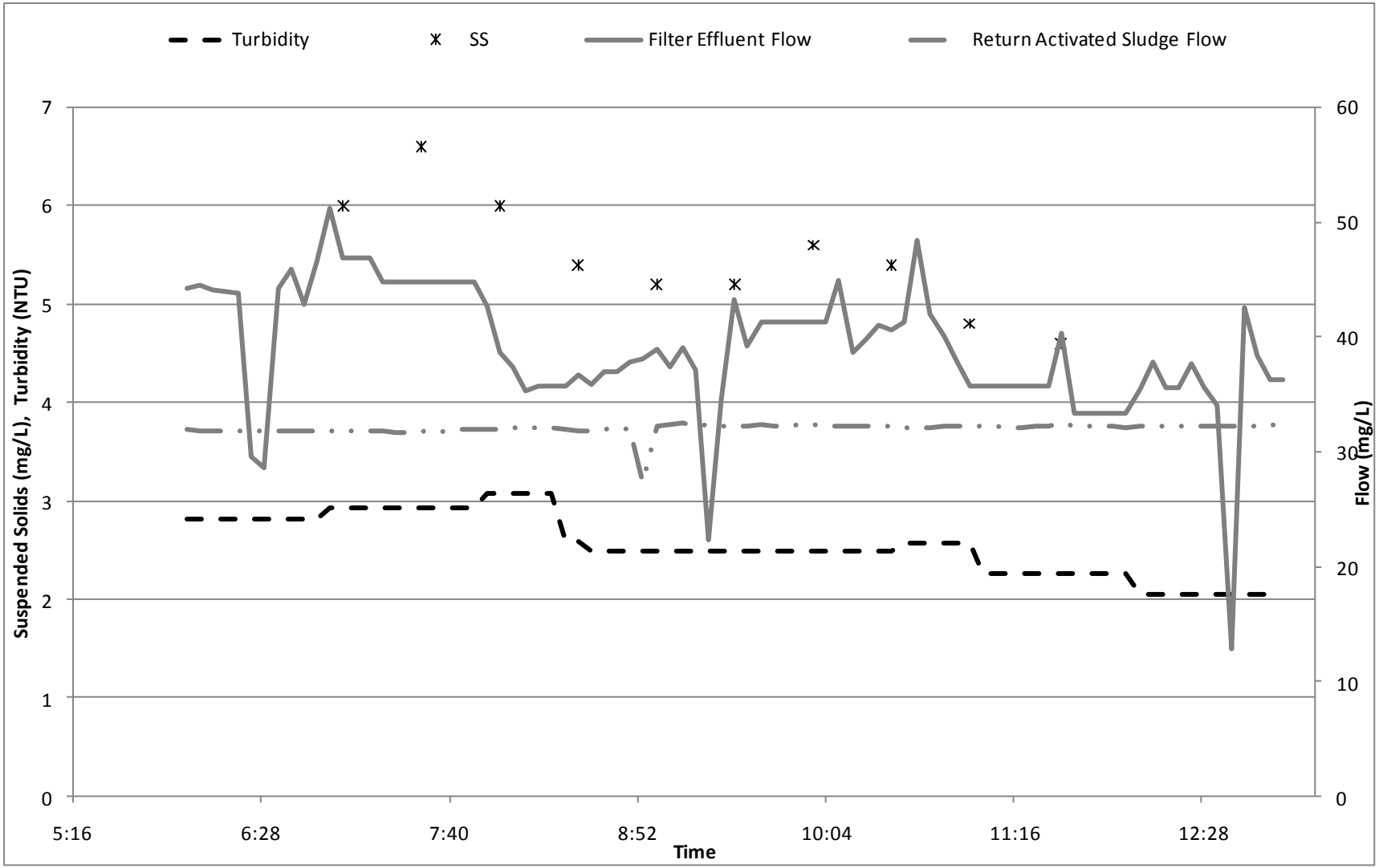


FIGURE A-10B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR APRIL 25, 2013

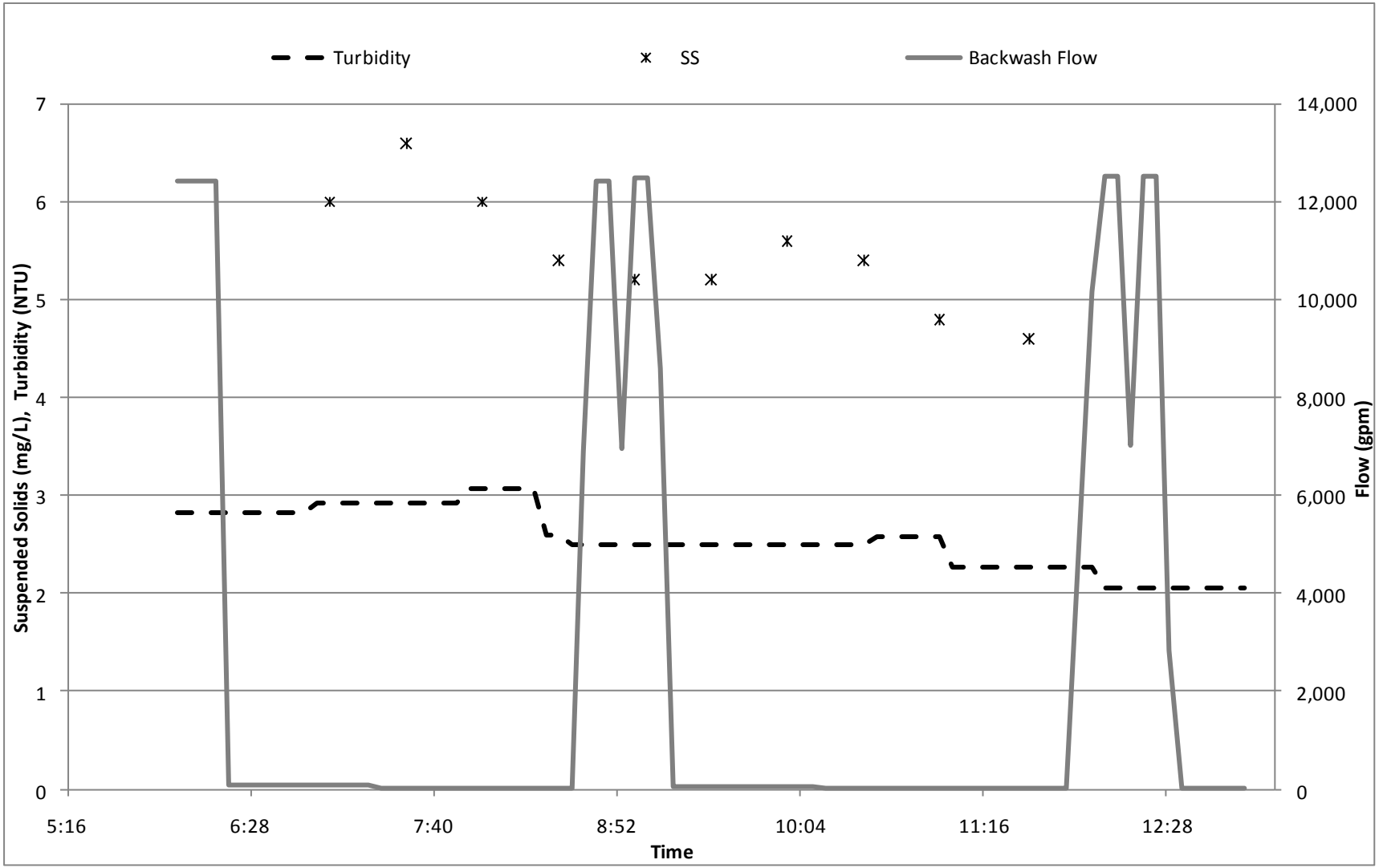


FIGURE A-10C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR APRIL 25, 2013

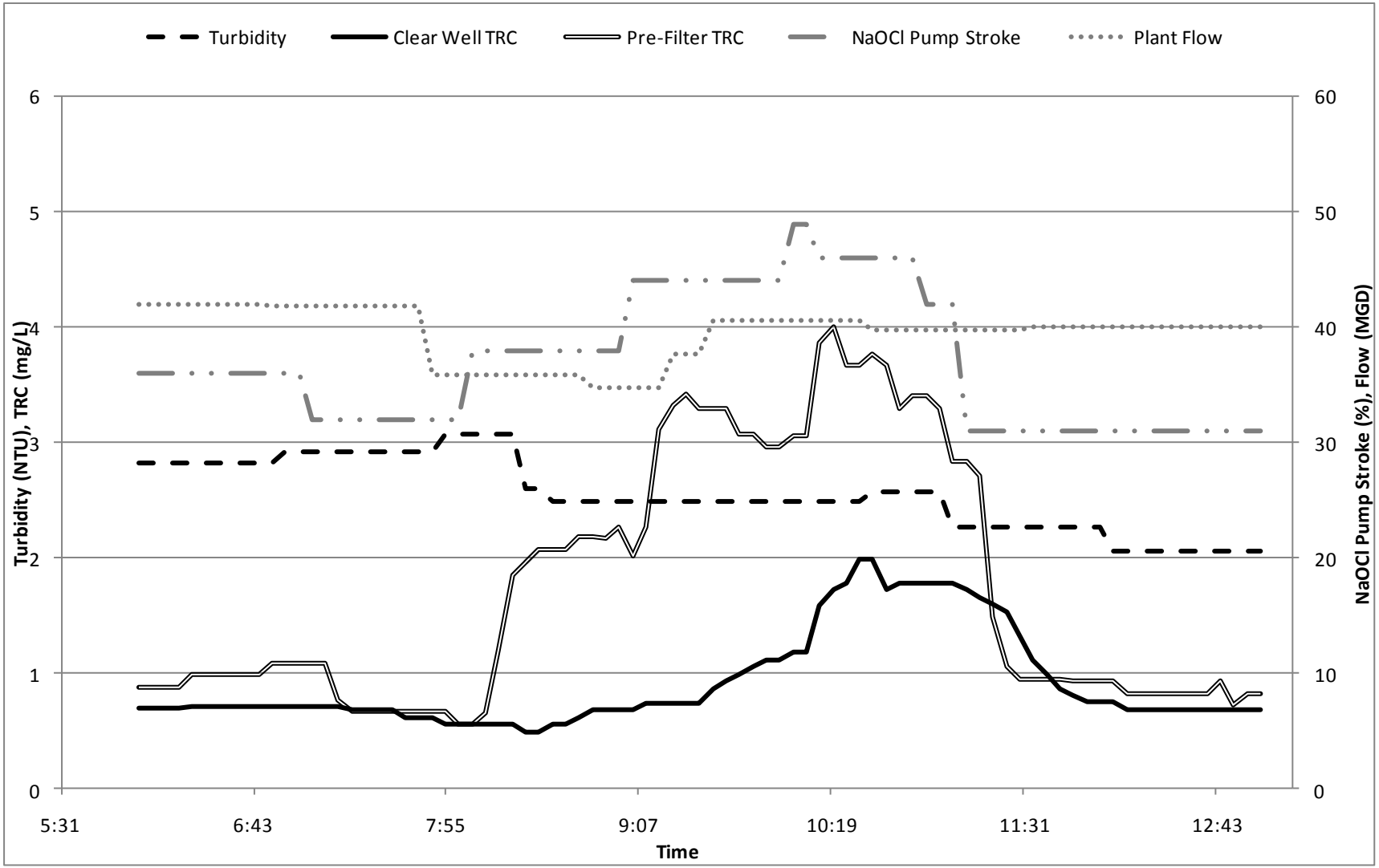
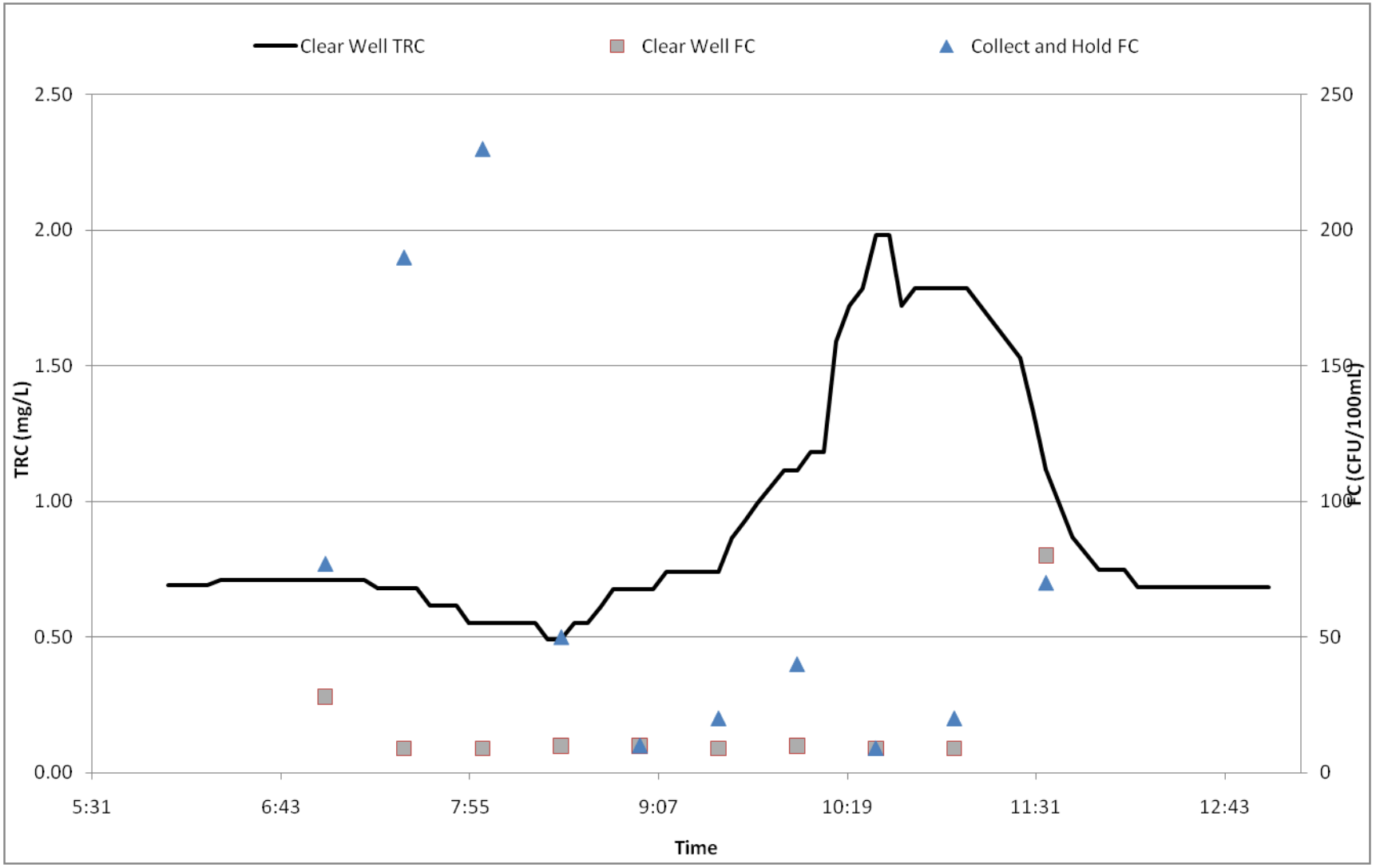


FIGURE A-10D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE, CLEAR WELL FECAL COLIFORM CONCENTRATION, AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR APRIL 25, 2013



Note: All fecal coliform concentration values of <10 CFU/100 mL were plotted as 10 CFU/mL.

FIGURE A-11A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR APRIL 29, 2013

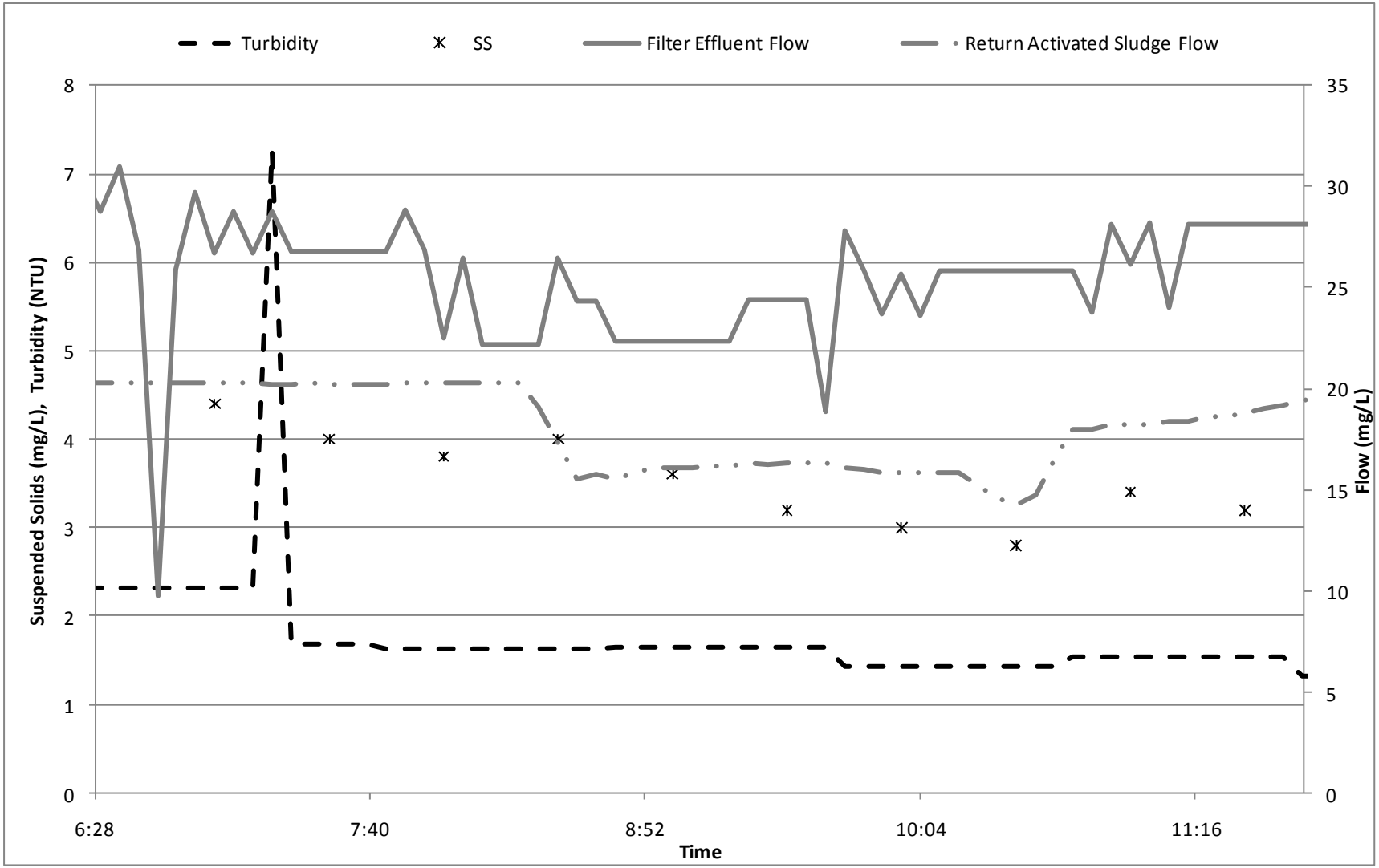


FIGURE A-11B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR APRIL 29, 2013

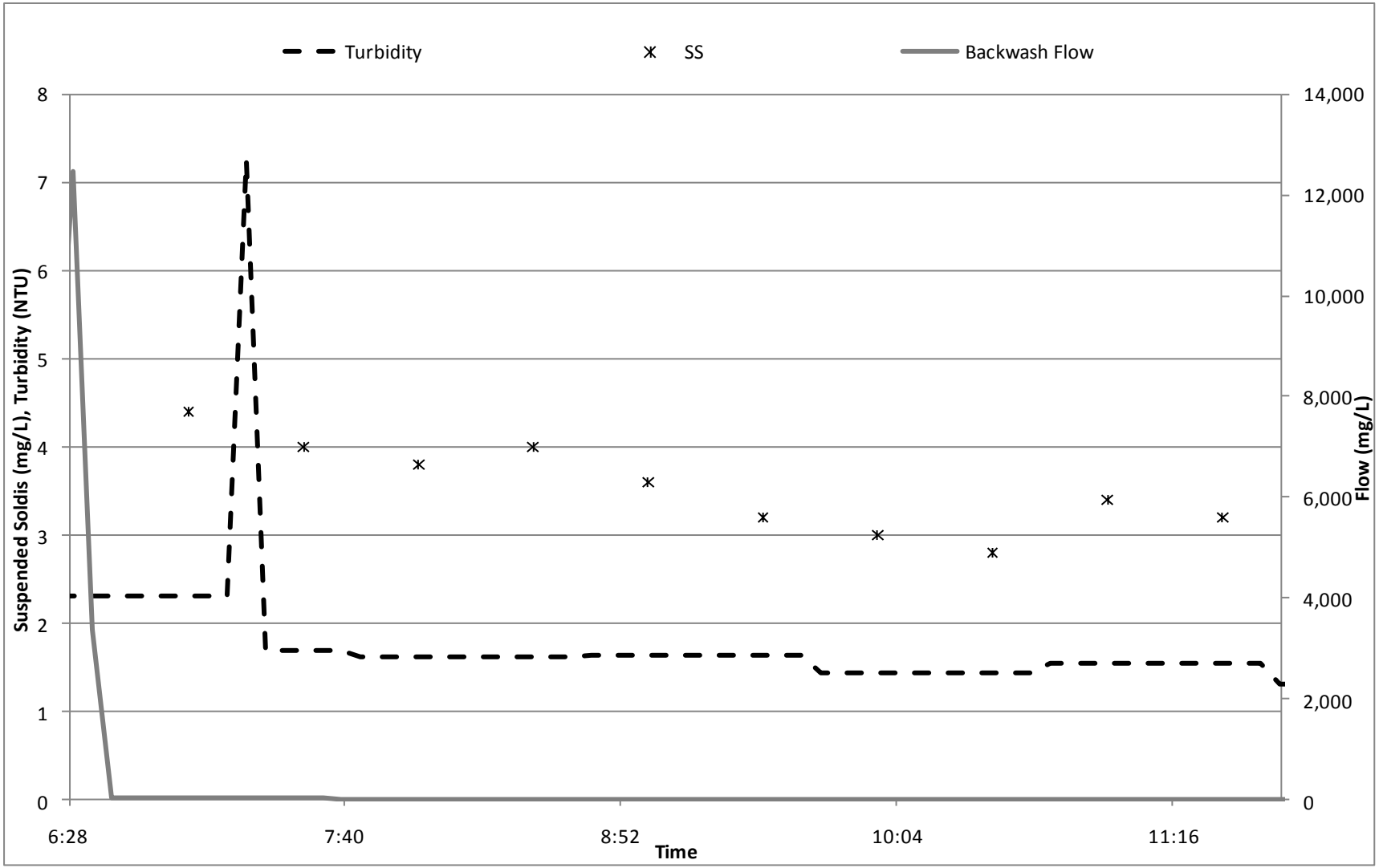


FIGURE A-11C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR APRIL 29, 2013

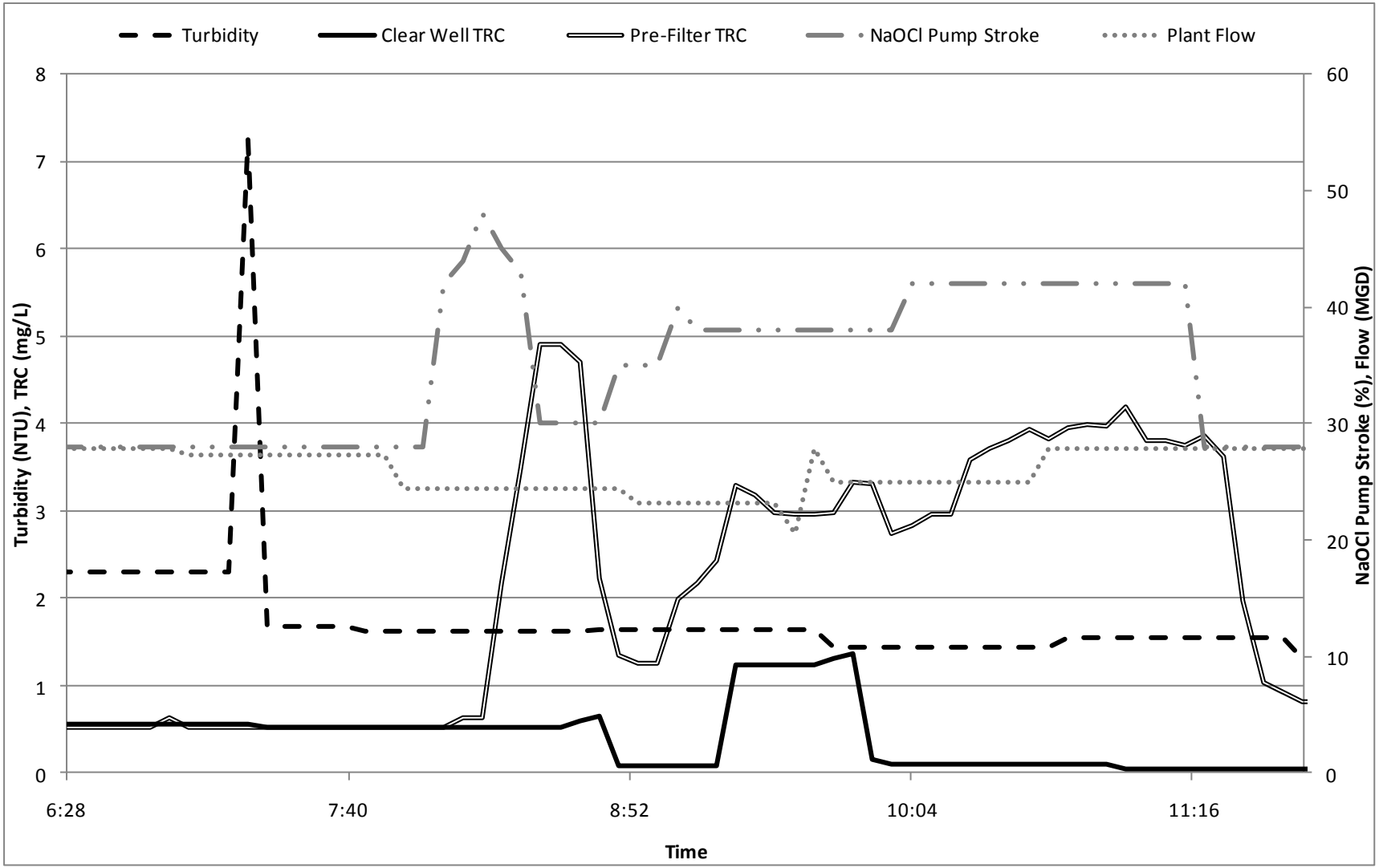
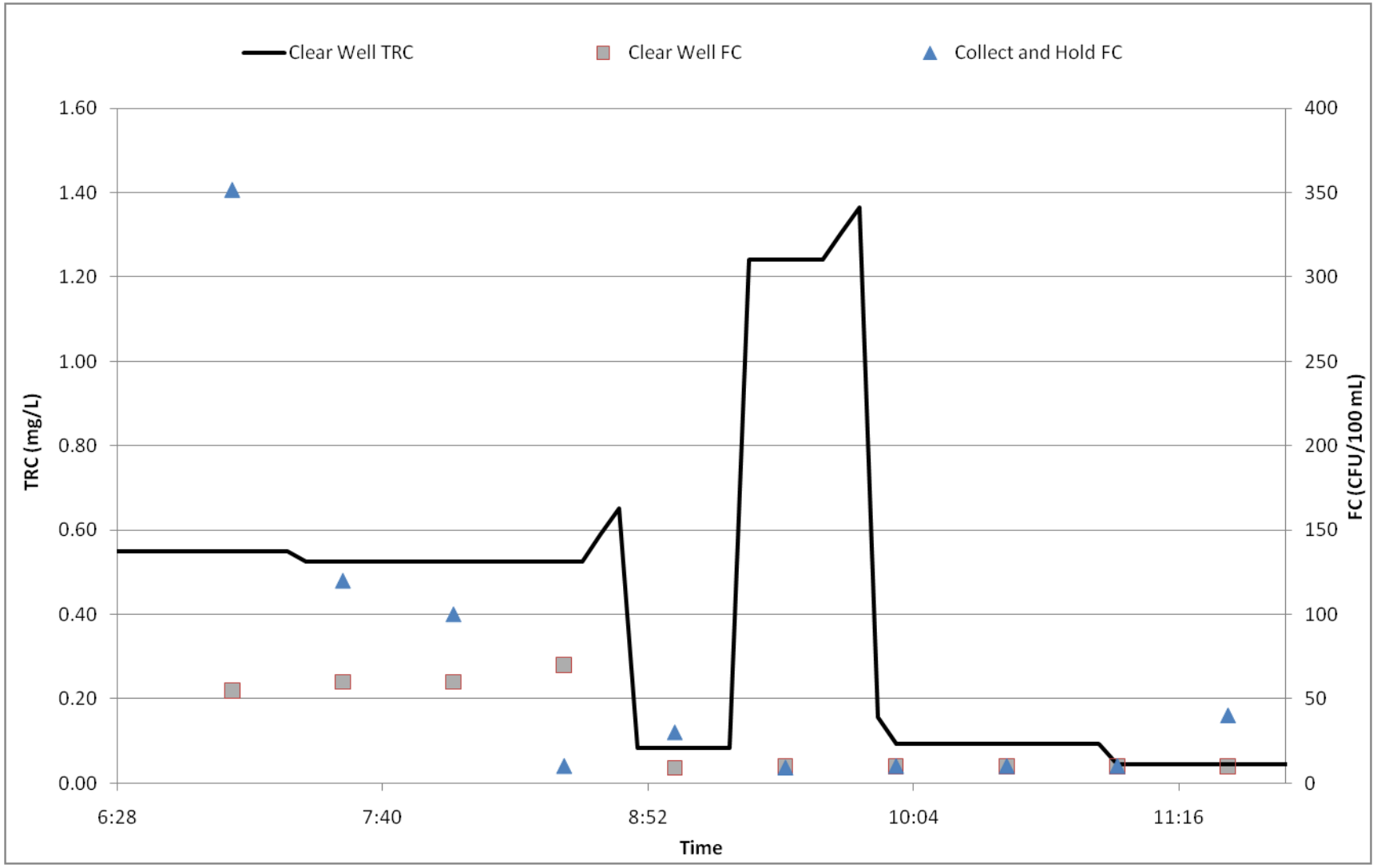


FIGURE A-11D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE, CLEAR WELL FECAL COLIFORM CONCENTRATION, AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR APRIL 29, 2013



Note: All fecal coliform concentration values of <10 and <100 CFU/100 mL were plotted as 10 and 100 CFU/mL, respectively.

FIGURE A-12A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR APRIL 30, 2013

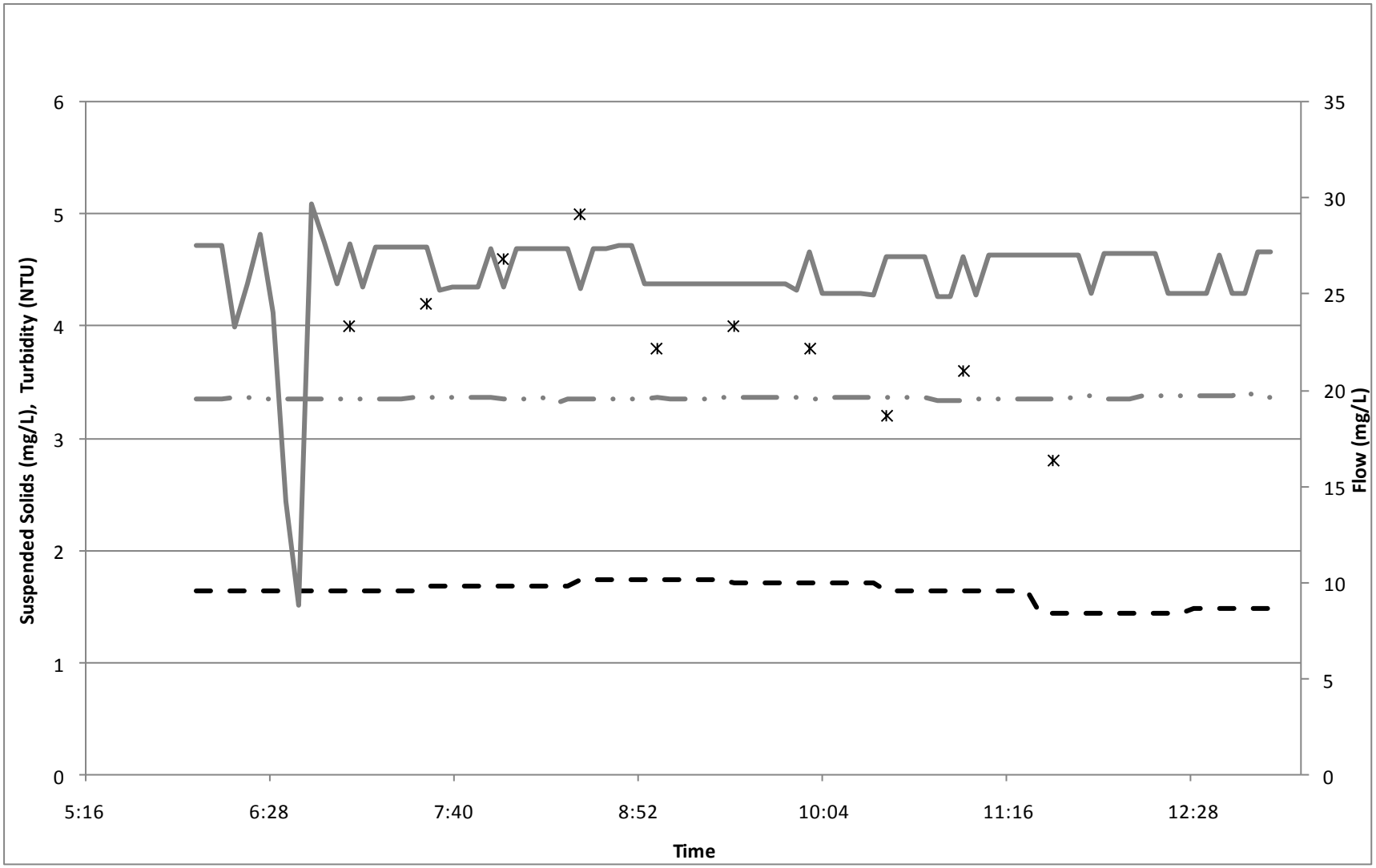


FIGURE A-12B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR APRIL 30, 2013

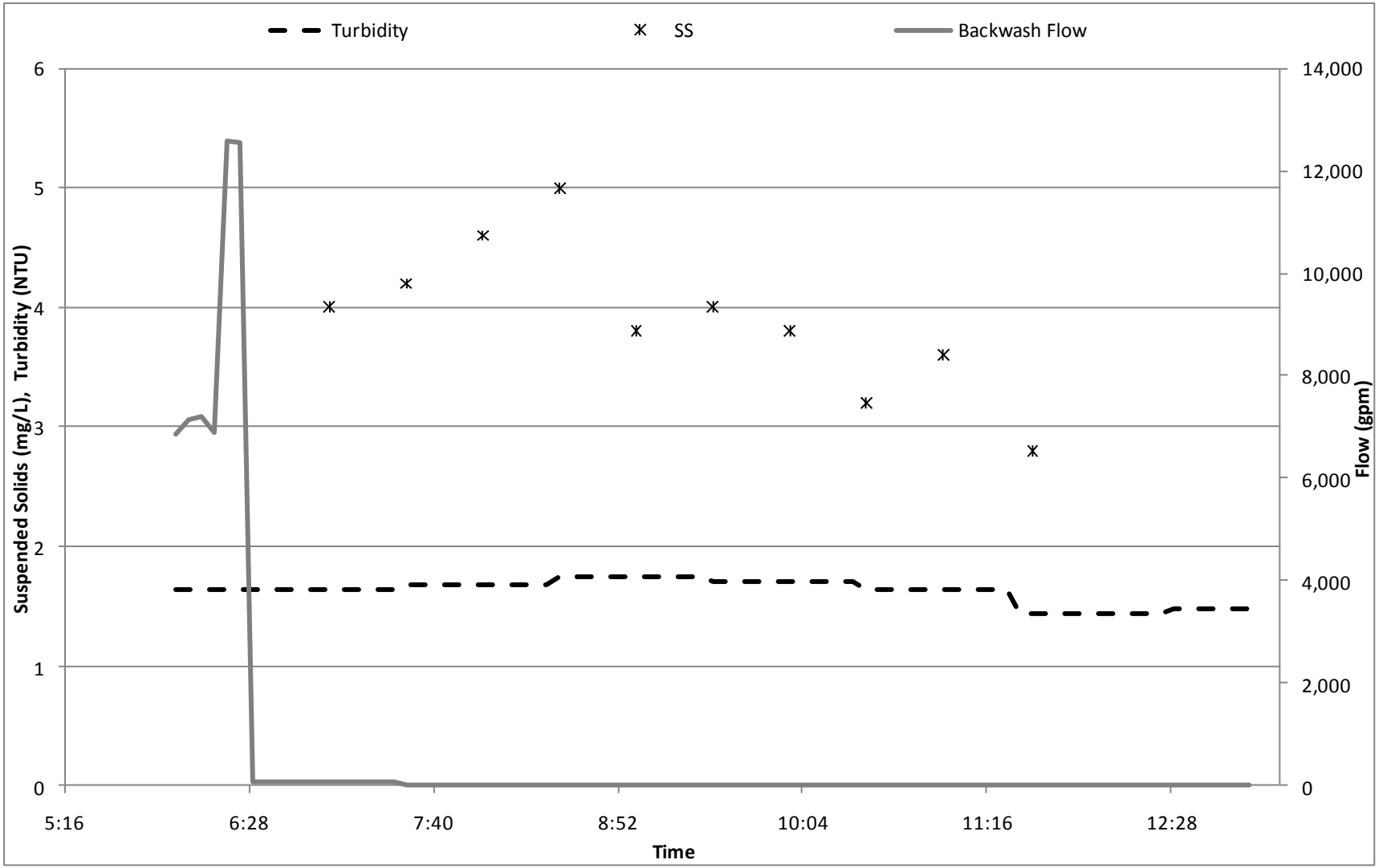


FIGURE A-12C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR APRIL 30, 2013

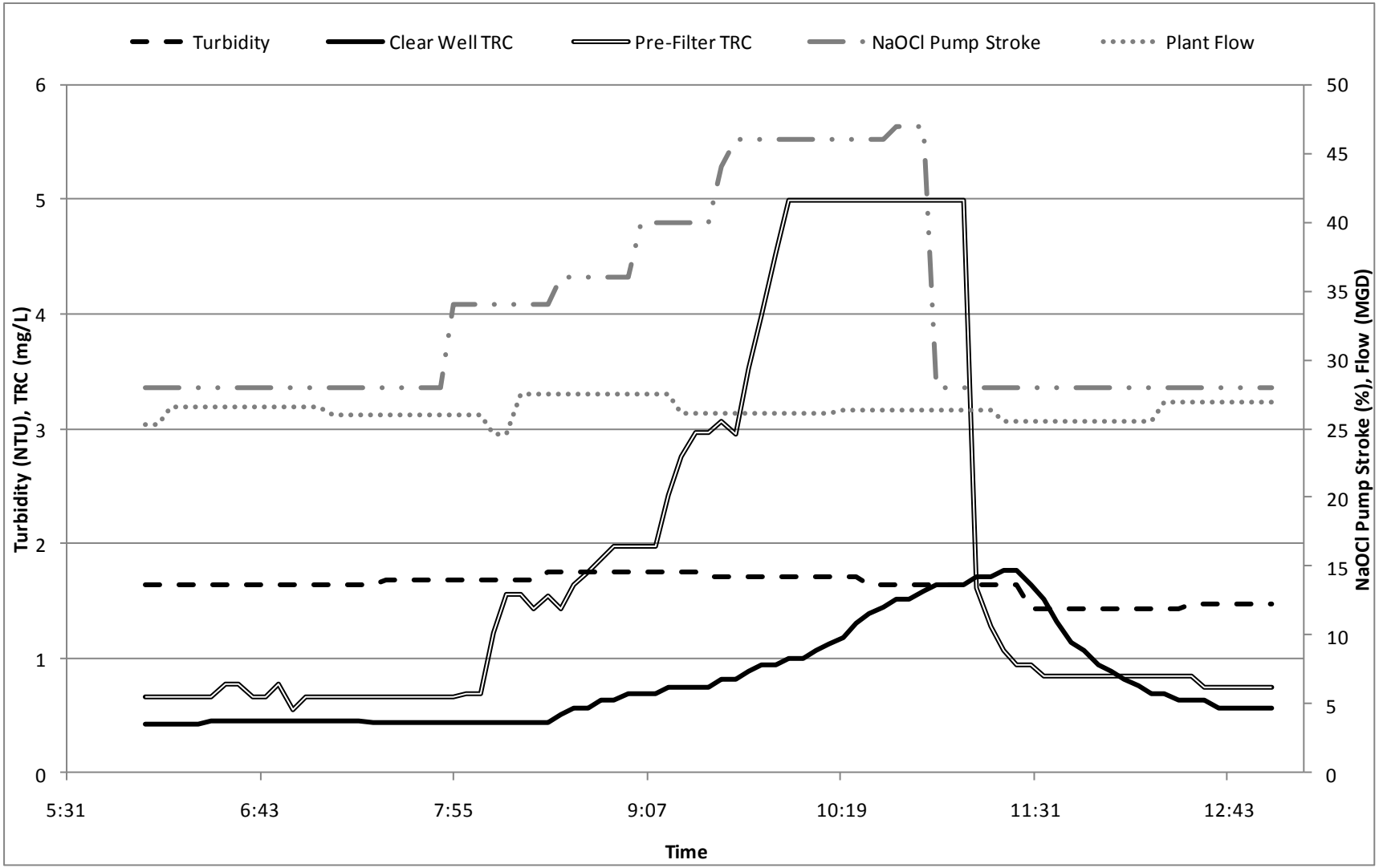
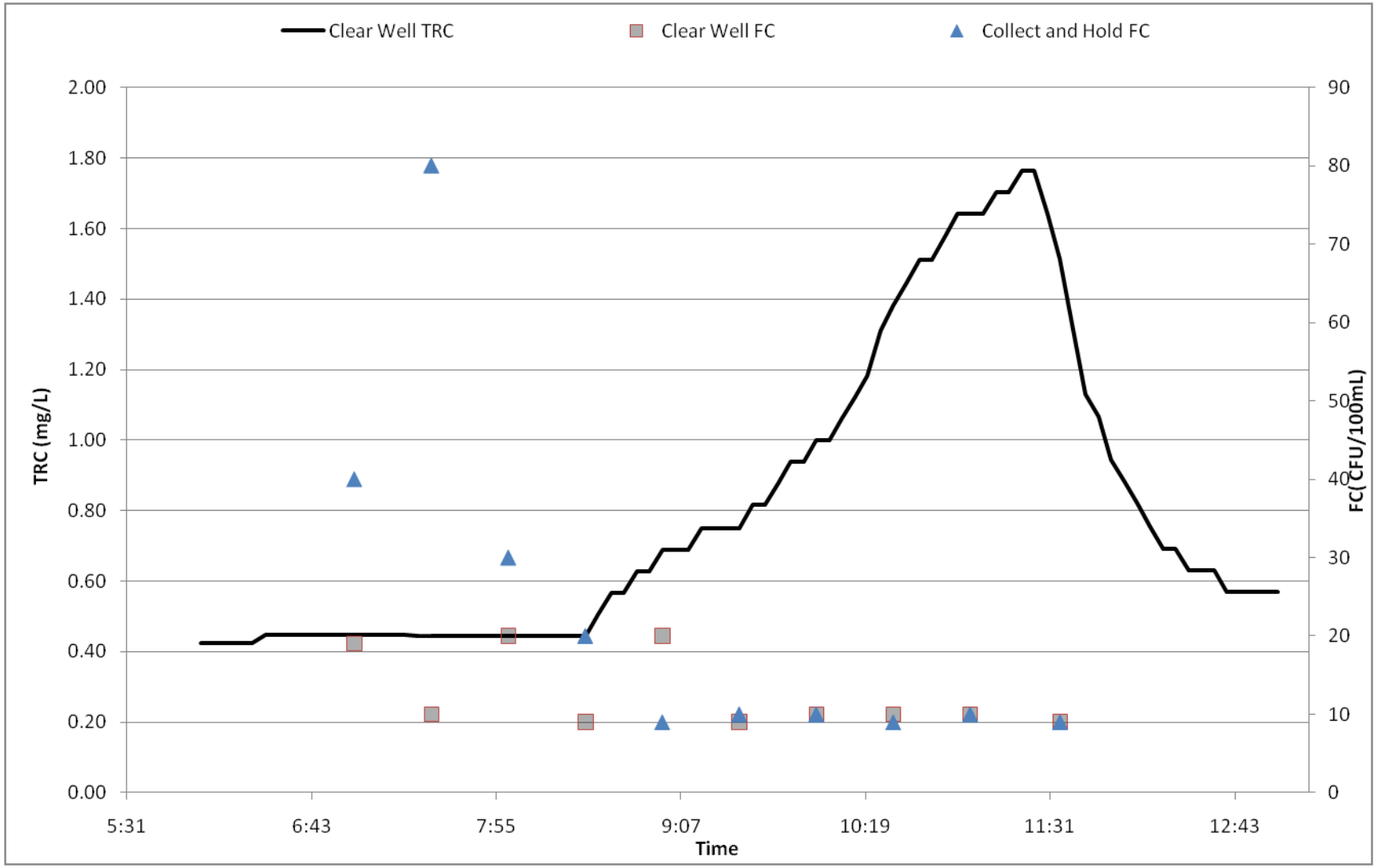


FIGURE A-12D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE, CLEAR WELL FECAL COLIFORM CONCENTRATION, AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR APRIL 30, 2013



Note: All fecal coliform concentration values of <10 CFU/100 mL were plotted as 10 CFU/mL.

FIGURE A-13A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR JUNE 12, 2013

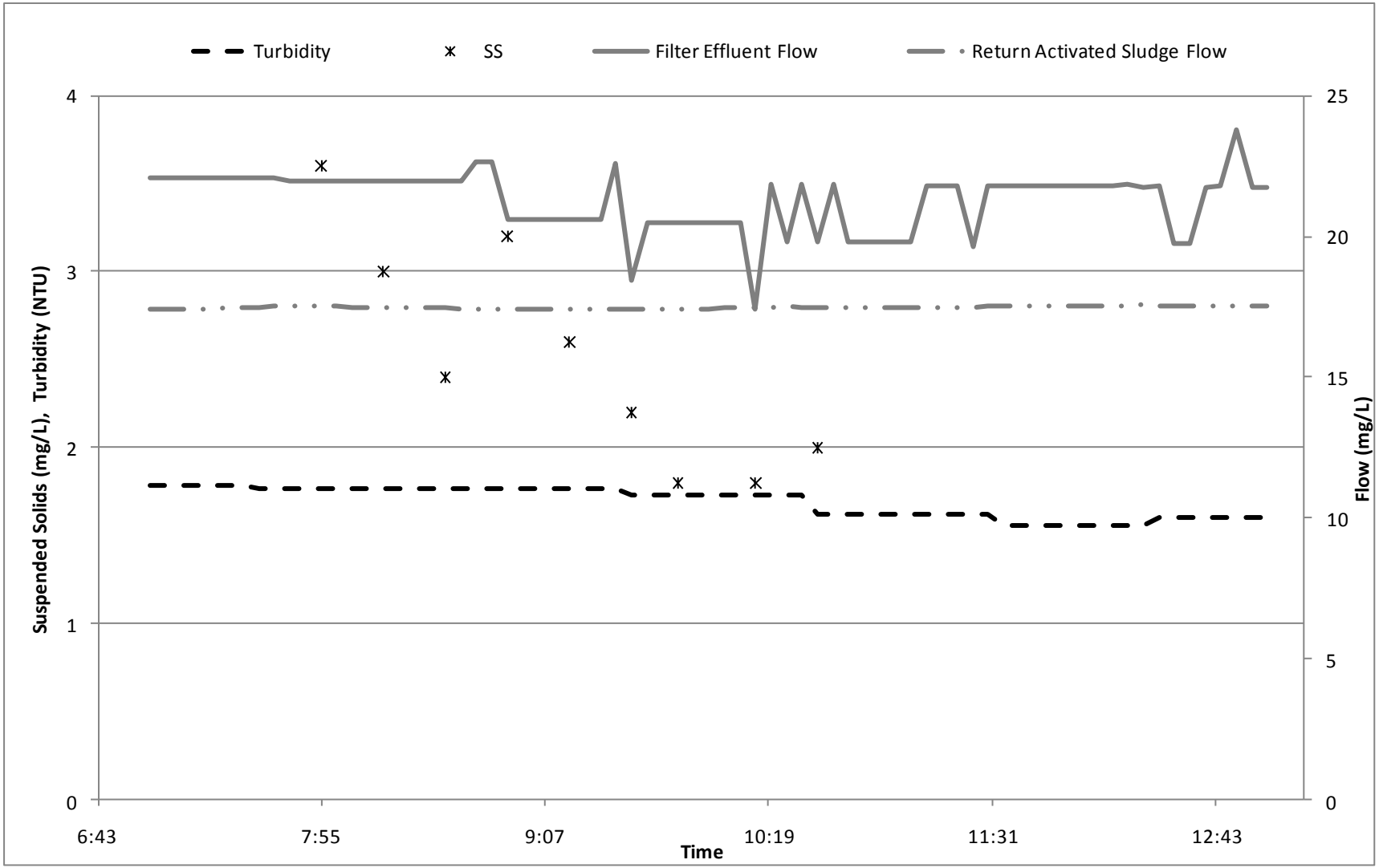


FIGURE A-13B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR JUNE 12, 2013

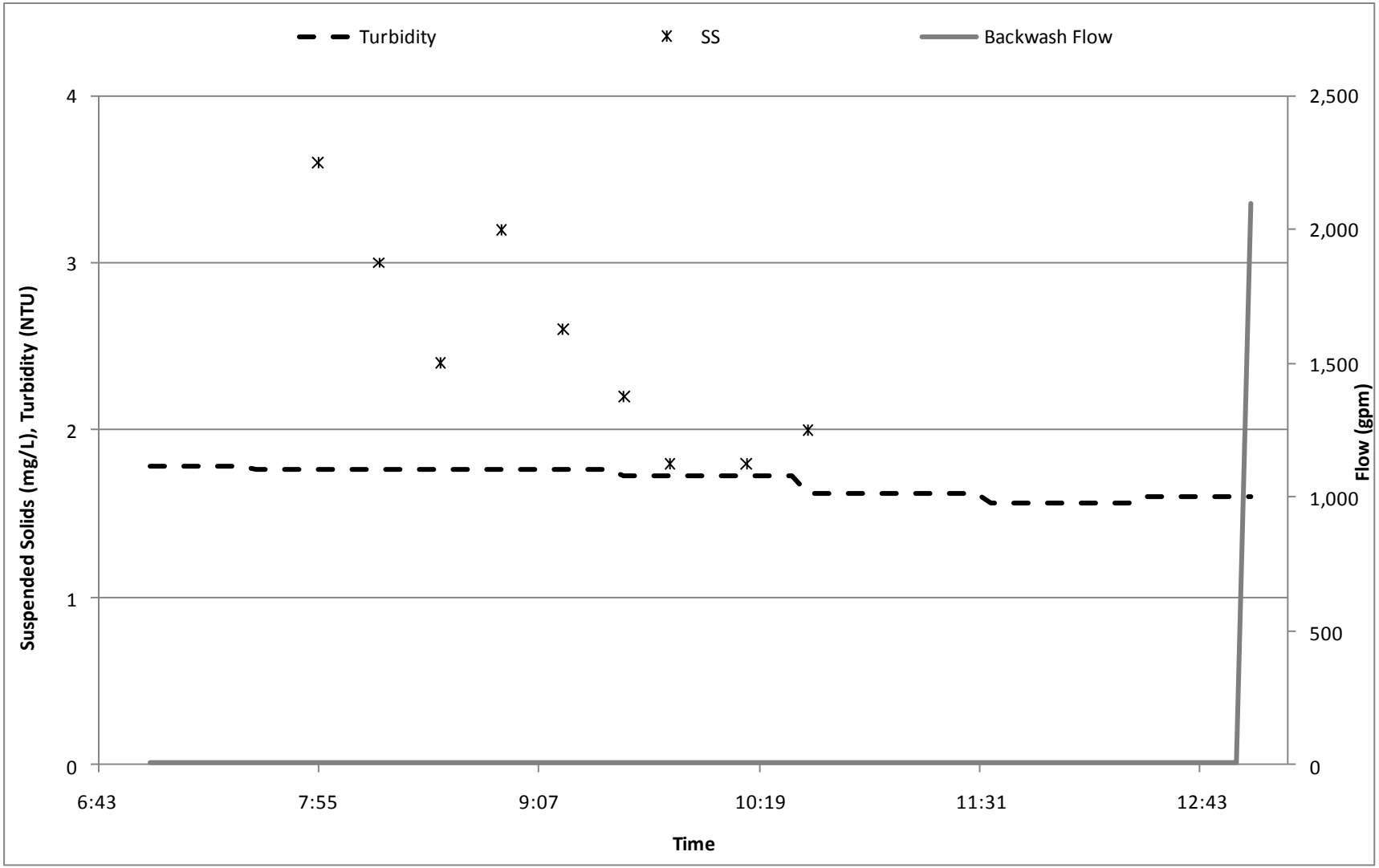


FIGURE A-13C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR JUNE 12, 2013

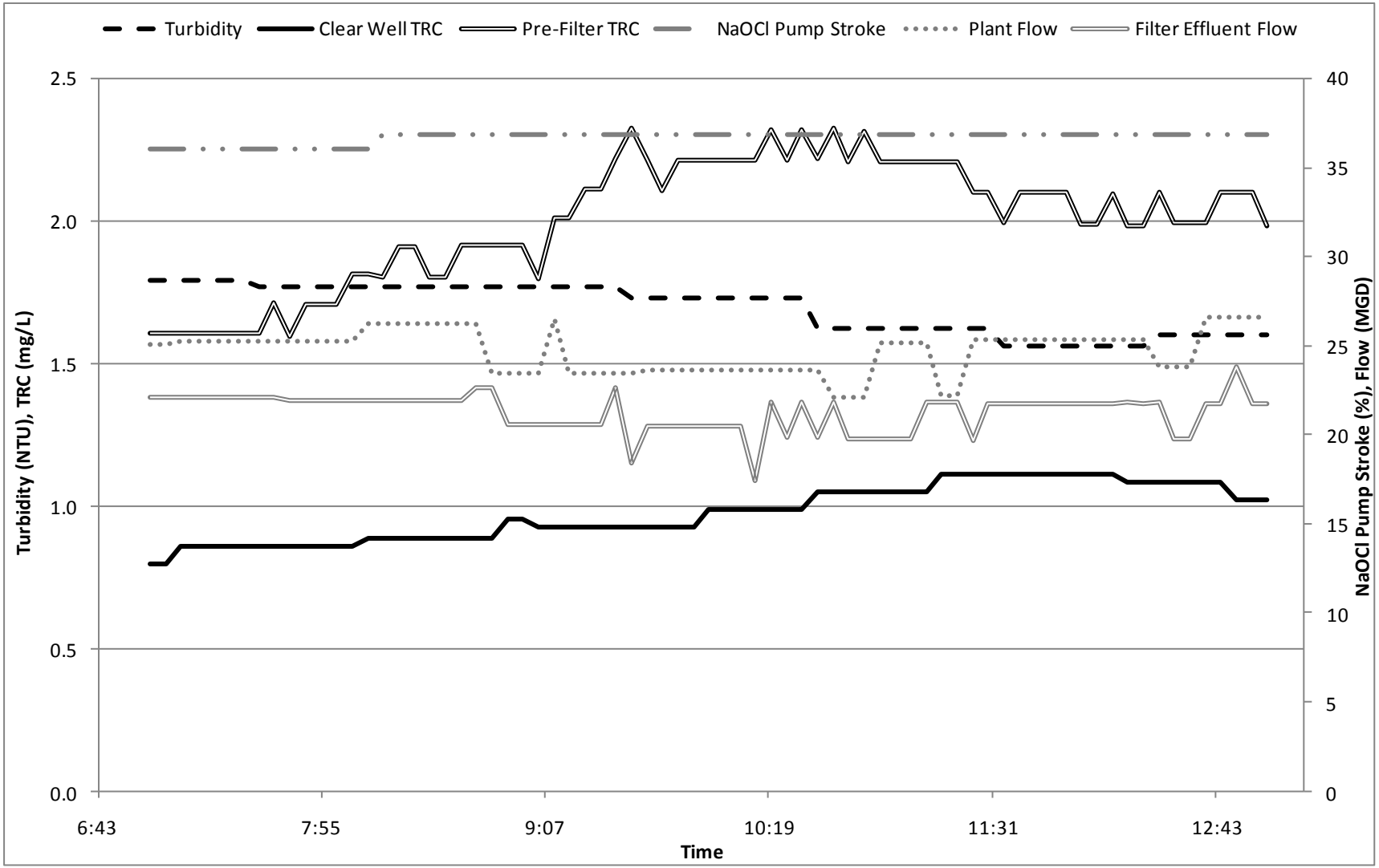
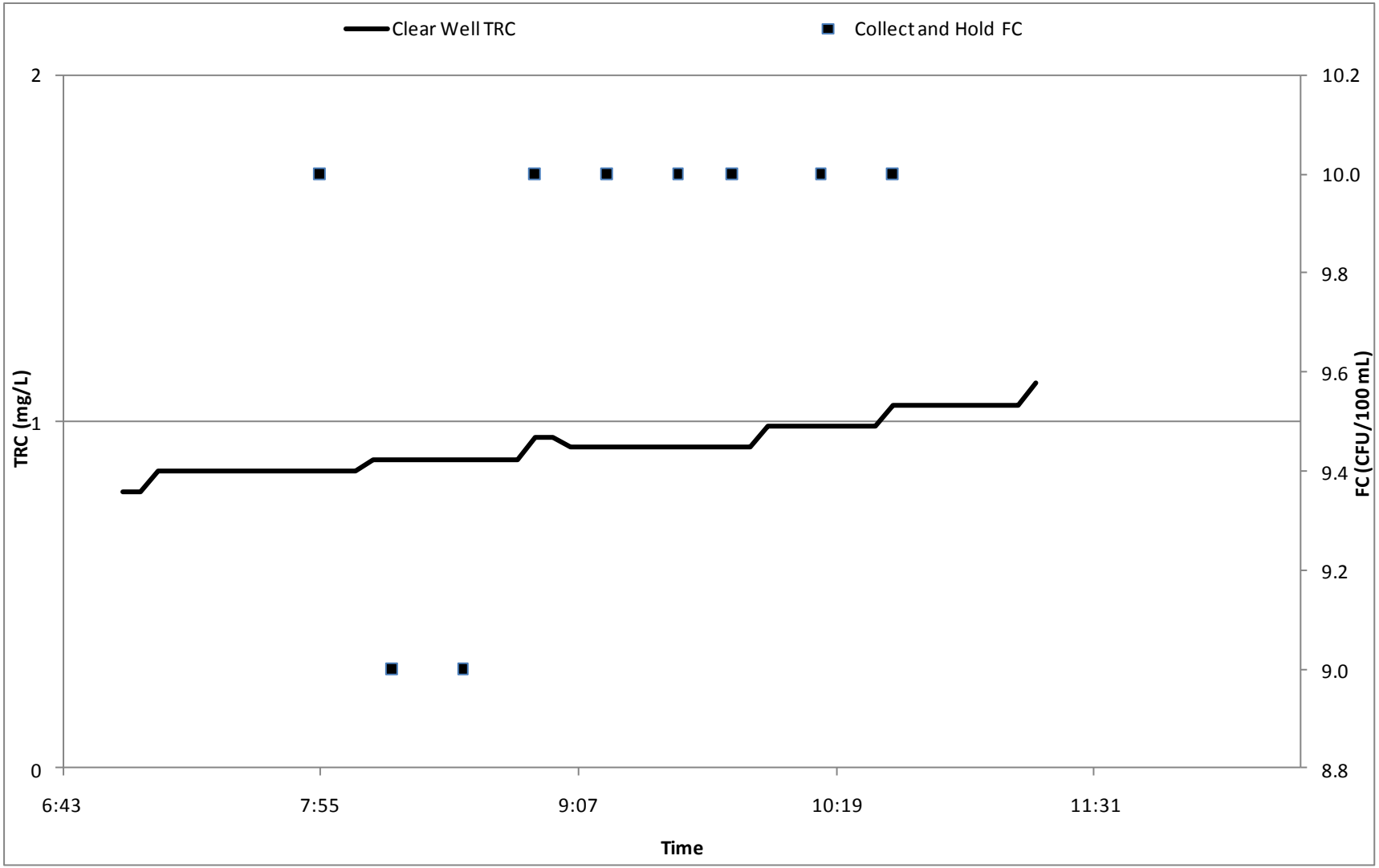


FIGURE A-13D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR JUNE 12, 2013



Note: All fecal coliform concentration values of <10 CFU/100 mL were plotted as 10 CFU/mL.

FIGURE A-14A: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, FILTER EFFLUENT FLOW AND RETURN ACTIVATED SLUDGE FLOW FOR JUNE 26, 2013

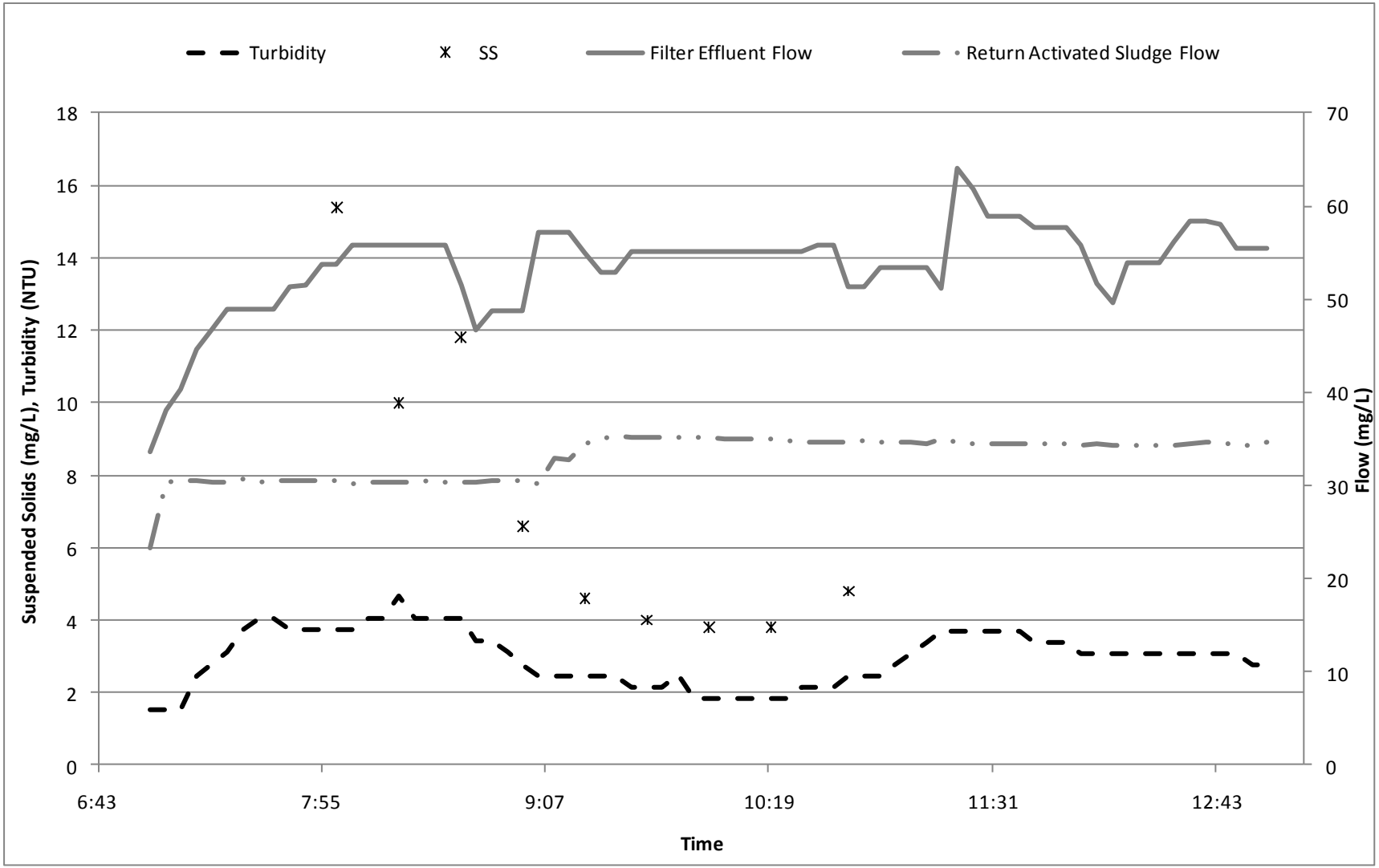


FIGURE A-14B: TIME SERIES PLOTS OF TURBIDITY, SUSPENDED SOLIDS CONCENTRATION, AND FILTER BACKWASH FLOW FOR JUNE 26, 2013

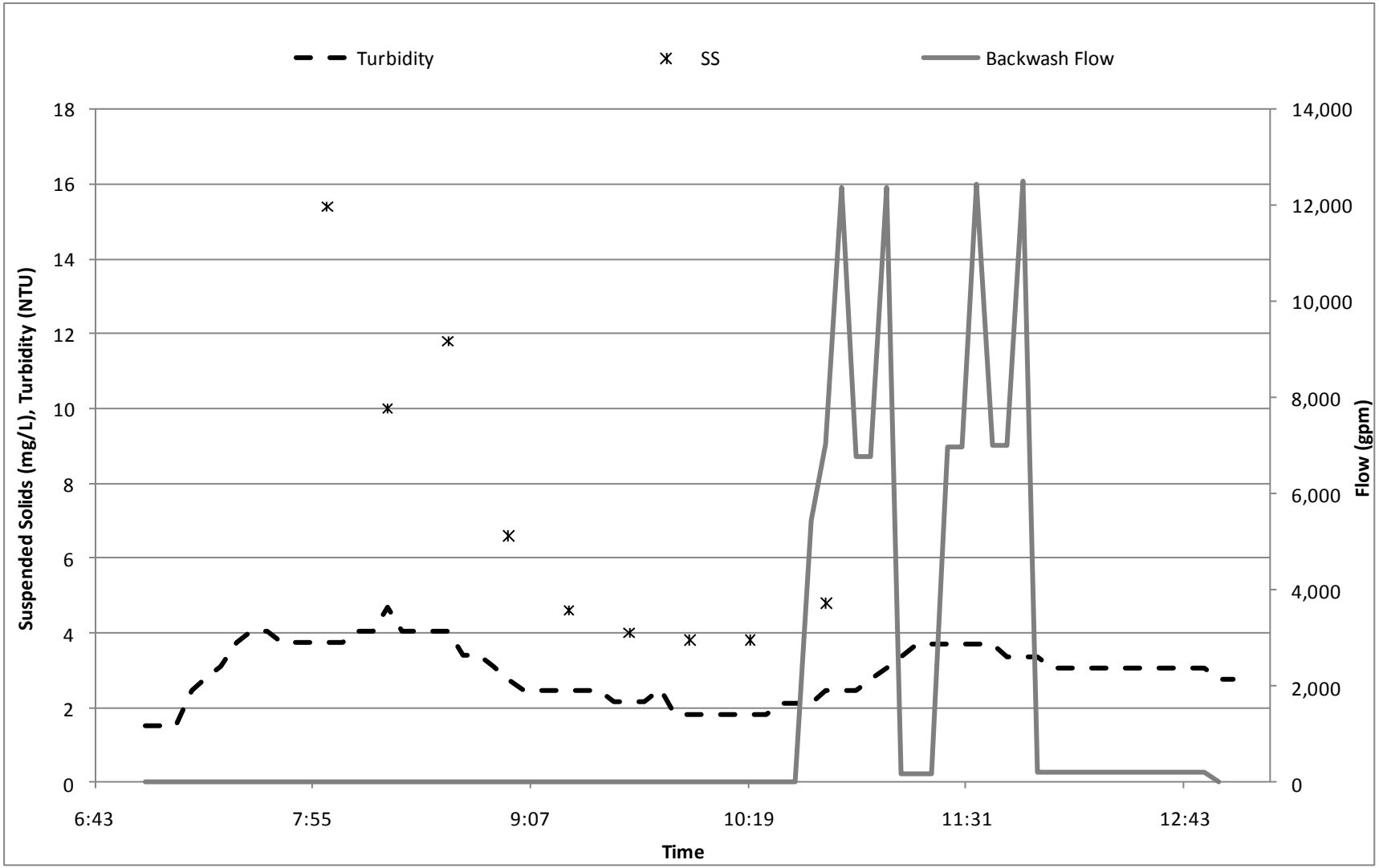


FIGURE A-14C: TIME SERIES PLOTS OF TURBIDITY, CLEAR WELL TOTAL RESIDUAL CHLORINE, PRE-FILTER TOTAL RESIDUAL CHLORINE, SODIUM HYPOCHLORITE PUMP STROKE, AND PLANT FLOW FOR JUNE 26, 2013

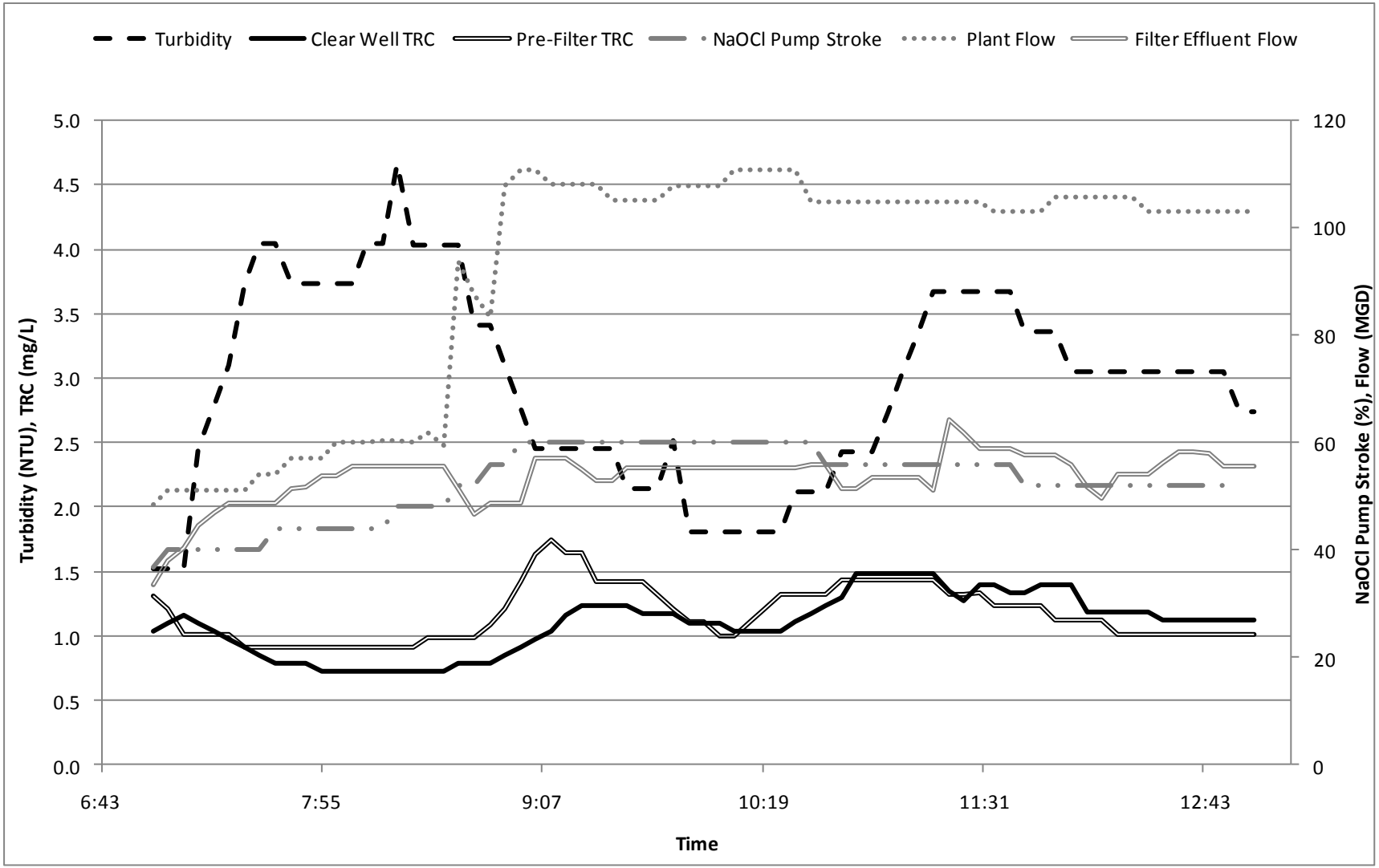
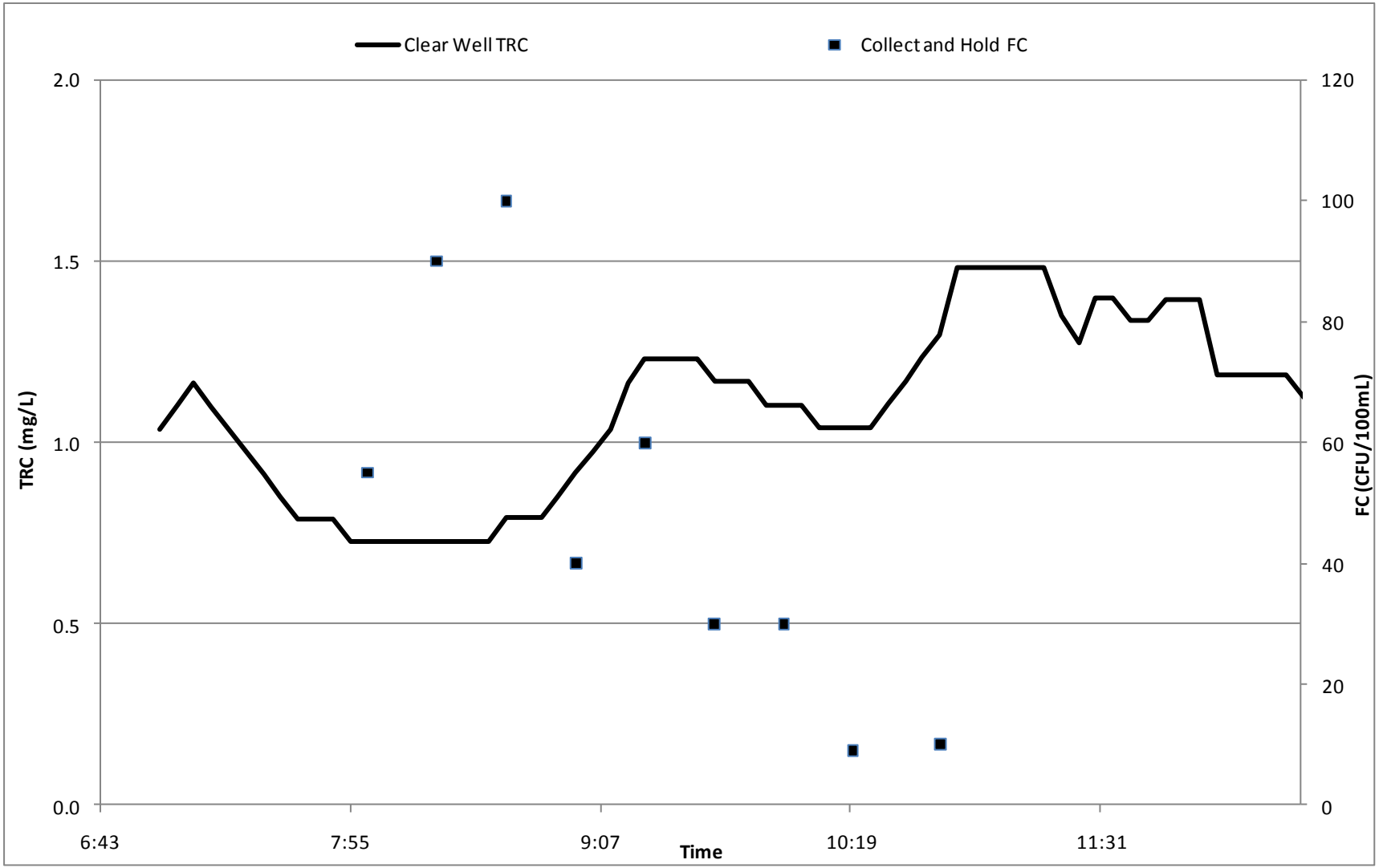
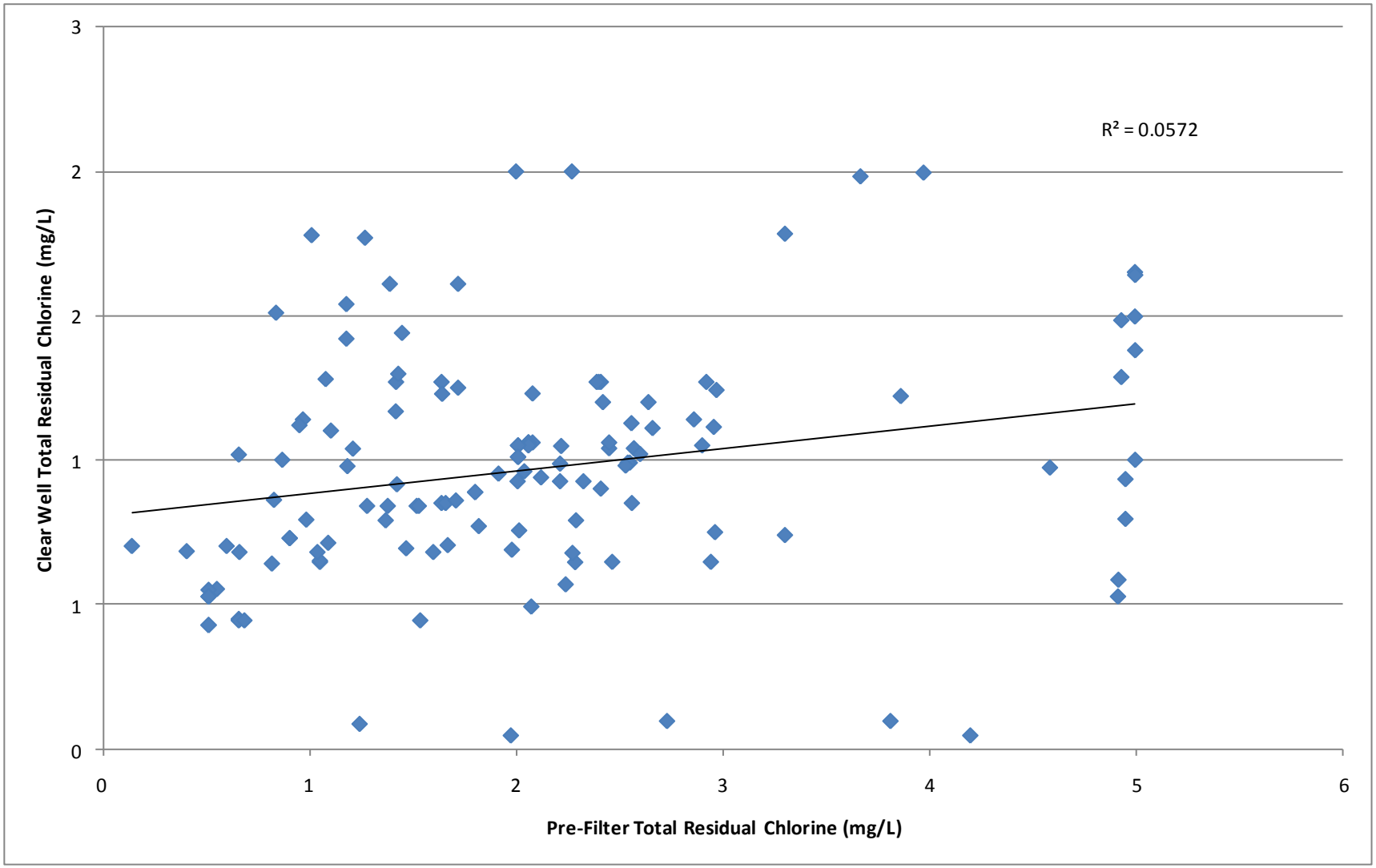


FIGURE A-14D: TIME SERIES PLOTS OF CLEAR WELL TOTAL RESIDUAL CHLORINE AND COLLECT-AND-HOLD FECAL COLIFORM CONCENTRATION FOR JUNE 26, 2013



Note: All fecal coliform concentration values of <10 and <100 CFU/100 mL were plotted as 10 and 100 CFU/mL, respectively.

FIGURE A-15: EVALUATION OF CLEAR WELL AND PRE-FILTER TOTAL RESIDUAL CHLORINE



APPENDIX B

QUALITY CONTROL AND QUALITY ASSURANCE METHODS FOR THE CHLORINE DISINFECTION PROCESS CONTROL EVALUATION AT THE JOHN E. EGAN WATER RECLAMATION PLANT STUDY

QUALITY ASSURANCE AND QUALITY CONTROL METHODS

A quality assurance and quality control (QA/QC) program was employed to ensure the evaluation was representative of the Egan WRP chlorination process. All field samples were collected in a manner that ensured analysis and evaluation provided an accurate representation of the disinfection process. This required that all on-line monitoring analyzers were calibrated by M&O prior to the study and as required during the study. Factors that can affect the quality of the samples are addressed in this section. These factors include preparation of sample containers, sample collection techniques, sample storage and delivery, and laboratory analysis. To aid in the detection and identification of errors, additional field samples, blanks, and duplicates were proposed for QA/QC. The analytical results were reviewed soon after they were available to ensure any necessary changes could be made in the sampling protocol before subsequent sampling.

Preparation

Prior to any sampling efforts, all parties involved in the study reviewed the project work plan. ALD and AM&B support requests were generated to ensure that the analytical needs of the project could be met, and a pre-job safety meeting was held.

The following materials were prepared prior to sampling: (1) field data log sheets; (2) a hard copy of the work plan including the sample location descriptions; (3) a copy of sampling and field procedures for the laboratory technicians performing the work; (4) blank chain of custody forms; (5) personal protective equipment such as latex gloves and hard hats; (6) writing instruments including pencils; (7) all new plastic and autoclaved glass containers; (8) chemicals used in the sampling methodology; (9) logged-in LIMS labels; and (10) a calibrated Hach AutoCat 9000.

Sampling and Measurements

Equipment. The M&O maintenance management system records were used to verify that each on-line instrument was calibrated and maintained as specified by the Maintenance Manager. The new Micro/2000 chlorine analyzer had the same calibration and maintenance schedule as similar instruments at the Egan WRP. The following instruments were relevant to this study: plant flow meters, filter effluent flow meters, RAS flow meters, backwash flow timers, and ammonia - nitrogen, turbidity, temperature, and TRC analyzers.

The Micro/2000 was installed to monitor the chlorinated secondary effluent as close to the dosing location as possible, i.e. the PF location. The analyzer was set up as follows: measure TRC in mg/L; TRC range: 0.0 to 10.0 mg/L; output signals wired into the Ovation system; and data points created in DCS. The TRC values were confirmed to agree between Micro/2000 and DCS; M&O verified the calibration with a titration.

The Hach AutoCat 9000 used in the C&H method was tested for operation periodically. The TRC analysis was verified via the standard addition method using a known chlorine standard. The Certificates of Analysis for the PAO reagent was obtained from the supplier.

Pre-Filter, Clear Well, and Hypochlorite Sampling. All samples collected by M&R from the PF and CW locations were collected after flushing of the sample lines to collect a representative sample. The PF samples collected for the C&H testing were collected in new one-gallon jars.

The hypochlorite sample collected by M&O was done using their normal protocol.

Field Blanks and Duplicates. A field blank for FC analysis was prepared in the field by the sampler. A sample of de-ionized water was collected using all equipment and procedures used for each sample collection method. One gallon of FC-free de-ionized water was brought to the sampling site. This blank was sampled as outlined above and was used to determine if FC contaminants may have been introduced through contact with sampling equipment and to verify the effectiveness of the sterilization process. One field blank was collected at the beginning of the study.

A duplicate sample is a second sample collected simultaneously with the sample. This sample was used to aid in the detection of variance within the laboratory procedures and analytical techniques. One duplicate sample during each sample day was collected for FC concentration samples.

Storage and Transport. The chain-of-custody form was filled in and the samples were stored in the ice cooler immediately after collection and during transport to either the Egan ALD or the AM&B. An example of a chain-of-custody is shown in Appendix B, Figure B-1. The SS concentration samples were delivered to the Egan WRP Login Room at the end of each sampling day. The chain of custody forms and the labeled containers were verified to be in agreement. The chain of custody was signed by the log-in technician, and a signed copy was retained. The FC concentration samples were delivered to AM&B within five hours of collection. The maximum holding time for FC analysis is six hours; one hour was needed for logging into AM&B.

Chain of Custody. A chain-of-custody plan, as described above, was necessary so that the possession and handling of individual samples could be tracked from the time of field collection through laboratory analysis. The chain-of-custody information included the name of collector, receiving laboratory, sample collection date, sample collection time, sample collection location, LIMS number, and parameters analyzed.

Sample Labels. Sample labels were generated in LIMS and included sample description, a unique LIMS number, date, and analysis requested. The FC concentration samples also had the

collection time. All sample labels were applied to the respective sample containers during the sampling procedure.

Data Integrity

Laboratory Information Management System. Data retrieved from the LIMS database were digitally converted and copied or transcribed into spreadsheets. A 100 percent check was performed, whereby 100 percent of the sample data were viewed individually in the LIMS platform to ensure the end document values agreed and that the sample results were authorized by the LIMS administrator.

Field Records. Field logs produced by laboratory technicians recording instantaneous operational data and information from the TRC evaluation using the Hach AutoCAT 9000 were filled out in the field and transcribed into spreadsheets. Each log was initialed by the technicians responsible and dated. A 100 percent check was performed, whereby 100 percent of the transcribed measurement data in the constructed spreadsheets were checked against the log sheets. A copy of the field log is shown in Appendix B, Figure B-2.

Analysis. The Egan ALD and AM&B used their internal QA/QC methods for SS, and hypochlorite concentrations and FC concentration analyses, respectively.

Data Analysis. The data quality was evaluated as soon as possible after each study period. Extreme data values were investigated to determine legitimacy. Simple statistical analysis was used to determine the mean, median, maximum, minimum, and standard deviation of each parameter. Outliers, when identified, were determined by the interquartile range method. For all plots within this report, only downloaded DCS data was used with respect to operational data. Field recordings of the DCS data were made, but occasional differences between the field and downloaded data were observed.

FIGURE B-1: SAMPLE CHAIN-OF-CUSTODY FORM

Custody Transfer Record for Environmental Monitoring and Research (EM&R) Division Samples

To: EGAN ANALYTICAL LABORATORY 2013 From: EM&R

Sample Date: 6/26/13 Sample Type (grab/composite): GRAB

Collected/Prepared By: R. Bodnar / A. Haizel Project Number: 47-13

			Container Type					
Collection Time	Sample Point I.D.	LIMS I.D.	SS		Lach Tri			
8:00	DAB_JE001	6902190	✓					
8:20	DAB_JE001	6902196	✓					
8:40	DAB_JE001	6902197	✓					
9:00	DAB_JE001	6902198	✓					
9:22	DAB_JE001	6902199	✓					
9:40	DAB_JE001	6902200	✓					
10:00	DAB_JE001	6902201	✓					
10:22	DAB_JE001	6902202	✓					
10:45	DAB_JE001	6902203	✓					

Transporter/Submitter: _____

RELINQUISHED BY	TIME	DATE	RECEIVED BY	TIME	DATE
A. Haizel	1:35	6/26/13	BRIAN McGINN	1:39	6.26

Sample disposition: (1) Returned to _____ by _____ on _____.

(2) Samples discarded following analysis on _____ by _____.

Note: Date/time collected are when the collection period ended.

STFORMEMR.XLS RMEMR.XLS
REV. 4/23/01 Rev. 4/18/01

FIGURE B-2: FIELD DATA LOG WORKSHEET

Field Data Log Date_____Sample Location___PRE-FILTER_____

Technicians_____

Sample #	LI MS #	Collect Time	Filter Eff. Flow, MGD **(ask TPO)**	Contact Time from chart , min	End contact time	KI time	Temp, °C	TRC, mg/L	Error, %
1									
1 dup									
2									
3									
4									
5									
6									
7									
8									
9									
10									
Check Pre Filt			Na	na					
Check Clear well									

APPENDIX C

RAW DATA FROM THE CHLORINE DISINFECTION PROCESS CONTROL EVALUATION AT THE JOHN E. EGAN WATER RECLAMATION PLANT STUDY

TABLE C-1: DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
9/18/12	7:00	19	12	35	1.03	1.29	1.70	44	26	16
9/18/12	7:05	19	12	35	1.03	1.40	1.70	44	21	16
9/18/12	7:10	19	12	35	1.03	1.28	1.70	44	26	16
9/18/12	7:15	21	12	35	0.96	1.39	1.70	44	26	16
9/18/12	7:20	21	12	35	0.96	1.39	1.70	44	26	16
9/18/12	7:25	18	12	35	0.96	1.39	1.70	44	26	16
9/18/12	7:30	22	12	35	0.90	1.39	1.70	44	26	16
9/18/12	7:35	22	12	35	0.90	1.28	1.80	44	26	16
9/18/12	7:40	20	12	35	0.90	1.28	1.80	44	26	16
9/18/12	7:45	22	12	35	0.90	1.28	1.80	44	26	16
9/18/12	7:50	20	12	37	0.84	1.28	1.80	44	26	16
9/18/12	7:55	20	12	37	0.84	1.28	1.80	46	26	16
9/18/12	8:00	20	12	37	0.84	1.28	1.80	46	26	16
9/18/12	8:05	20	12	37	0.84	1.39	1.80	46	26	16
9/18/12	8:10	20	12	37	0.84	1.50	1.80	46	26	16
9/18/12	8:15	20	12	37	0.84	1.73	1.80	46	26	16
9/18/12	8:20	22	12	37	0.84	1.52	1.80	46	26	16
9/18/12	8:25	20	12	37	0.84	1.41	1.80	46	26	16
9/18/12	8:30	22	12	37	0.84	1.64	1.80	46	26	16
9/18/12	8:35	22	12	37	0.84	1.53	1.80	46	26	16
9/18/12	8:40	22	12	37	0.84	1.53	1.80	46	26	16
9/18/12	8:45	22	12	37	0.84	1.53	1.80	46	26	16
9/18/12	8:50	20	12	37	0.85	1.53	1.80	46	26	16
9/18/12	8:55	22	12	37	0.85	1.64	1.80	48	26	16

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
9/18/12	9:00	22	12	37	0.85	1.52	1.80	48	26	16
9/18/12	9:05	20	12	37	0.85	1.54	1.80	48	77	16
9/18/12	9:10	22	12	37	0.85	1.64	1.80	48	10	16
9/18/12	9:15	16	12	37	0.85	1.54	1.80	48	10	16
9/18/12	9:20	14	12	37	0.85	1.66	1.80	48	26	16
9/18/12	9:25	11	12	42	0.85	2.44	1.80	48	26	16
9/18/12	9:30	15	12	42	0.85	2.66	1.80	48	26	16
9/18/12	9:35	23	12	42	0.85	2.55	1.90	48	26	16
9/18/12	9:40	21	12	42	0.85	2.56	1.90	48	26	16
9/18/12	9:45	21	12	42	0.98	1.84	1.90	48	26	16
9/18/12	9:50	23	12	42	1.74	1.73	1.90	48	26	16
9/18/12	9:55	21	12	42	2.00	1.98	1.90	50	26	16
9/18/12	10:00	23	12	36	2.00	2.00	1.90	50	26	15
9/18/12	10:05	23	12	36	2.00	2.27	1.90	50	24	14
9/18/12	10:10	20	12	36	2.00	2.27	1.90	50	24	14
9/18/12	10:15	35	77	36	2.00	2.27	1.90	50	21	14
9/18/12	10:20	26	77	36	2.00	1.69	1.90	50	21	13
9/18/12	10:25	18	77	36	1.91	1.27	1.90	50	21	13
9/18/12	10:30	18	77	36	1.77	1.27	1.90	50	21	14
9/18/12	10:35	18	77	36	1.71	1.37	1.80	50	21	13
9/18/12	10:40	18	77	36	1.58	1.48	1.80	50	21	14
9/18/12	10:45	16	77	36	1.43	1.59	1.80	50	21	14
9/18/12	10:50	18	77	36	1.36	1.48	1.80	50	21	14
9/18/12	10:55	16	77	36	1.24	1.58	1.80	53	21	14

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
9/18/12	11:00	18	77	35	1.17	1.58	1.80	53	21	14
9/18/12	11:05	15	77	35	1.17	1.47	1.80	53	21	13
9/18/12	11:10	18	77	35	1.10	1.68	1.80	53	21	13
9/18/12	11:15	18	7	35	1.10	1.56	1.80	53	21	13
9/18/12	11:20	18	7	35	1.10	1.56	1.80	53	21	14
9/18/12	11:25	18	7	35	1.03	1.68	1.80	53	21	14
9/18/12	11:30	21	12,342	35	1.03	1.45	1.80	53	21	14
9/18/12	11:35	18	12,342	35	1.03	1.45	1.60	53	21	14
9/18/12	11:40	18	12,342	35	1.03	1.34	1.60	53	21	14
9/18/12	11:45	19	12,342	35	1.03	1.56	1.60	53	21	14
9/18/12	11:50	19	12,342	35	1.03	1.67	1.60	53	21	14
9/18/12	11:55	17	12,342	35	1.03	1.68	1.60	56	21	14
9/18/12	12:00	21	12,342	35	0.96	1.68	1.60	56	21	14
9/25/12	7:00	16	13	34	1.06	2.19	1.60	51	17	22
9/25/12	7:05	16	13	34	1.06	2.08	1.60	51	17	23
9/25/12	7:10	16	13	34	1.06	2.08	1.60	51	17	23
9/25/12	7:15	16	13	34	1.06	2.08	1.60	53	17	23
9/25/12	7:20	16	13	34	1.06	2.08	1.60	53	17	23
9/25/12	7:25	16	13	34	1.06	2.08	1.60	53	17	23
9/25/12	7:30	16	12	34	1.06	2.08	1.60	53	17	23
9/25/12	7:35	16	12	34	1.06	2.08	1.80	53	17	23
9/25/12	7:40	16	12	34	1.06	2.08	1.80	53	17	23
9/25/12	7:45	16	12	34	1.06	2.08	1.80	53	17	23
9/25/12	7:50	16	12	34	1.06	2.08	1.80	53	17	23

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
9/25/12	7:55	16	12	34	1.06	2.08	1.80	53	17	23
9/25/12	8:00	16	12	34	1.06	2.08	1.80	53	17	23
9/25/12	8:05	18	12	34	1.06	2.06	1.80	53	17	23
9/25/12	8:10	16	12	34	1.06	2.06	1.80	53	17	23
9/25/12	8:15	13	12	34	1.06	2.06	1.80	54	17	23
9/25/12	8:20	16	12	34	1.06	2.17	1.80	54	17	23
9/25/12	8:25	16	12	34	1.06	2.06	1.80	54	17	23
9/25/12	8:30	16	13	34	1.06	2.06	1.80	54	17	23
9/25/12	8:35	16	13	34	1.06	2.06	1.60	54	20	23
9/25/12	8:40	16	13	34	1.06	2.06	1.60	54	17	23
9/25/12	8:45	16	13	34	1.06	2.06	1.60	54	17	23
9/25/12	8:50	16	13	34	1.06	2.06	1.60	54	17	23
9/25/12	8:55	16	13	34	1.05	2.06	1.60	54	17	23
9/25/12	9:00	16	13	34	1.05	2.06	1.60	54	17	23
9/25/12	9:05	16	13	34	1.05	2.06	1.60	54	17	23
9/25/12	9:10	16	13	34	1.05	2.06	1.60	54	17	23
9/25/12	9:15	16	13	34	1.05	2.06	1.60	57	17	23
9/25/12	9:20	16	13	34	1.05	2.06	1.60	57	17	23
9/25/12	9:25	16	13	34	1.05	2.01	1.60	57	17	23
9/25/12	9:30	16	17	34	1.05	2.01	1.60	57	17	23
9/25/12	9:35	16	17	34	1.05	2.01	1.60	57	17	23
9/25/12	9:40	16	17	34	1.05	2.01	1.60	57	18	23
9/25/12	9:45	16	17	34	1.05	2.01	1.60	57	18	23
9/25/12	9:50	15	17	34	1.05	2.01	1.60	57	18	23

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
9/25/12	9:55	15	17	34	1.01	2.01	1.60	61	18	22
9/25/12	10:00	17	17	34	1.01	2.12	1.60	61	18	22
9/25/12	10:05	15	17	34	1.01	2.01	1.60	61	18	22
9/25/12	10:10	15	17	34	1.01	2.01	1.60	61	18	22
9/25/12	10:15	17	13	34	1.01	2.01	1.60	61	18	22
9/25/12	10:20	17	13	34	1.01	2.01	1.60	61	18	22
9/25/12	10:25	16	13	34	1.01	2.01	1.60	65	18	22
9/25/12	10:30	16	13	34	1.01	2.01	1.60	65	18	22
9/25/12	10:35	16	13	34	1.01	2.01	1.60	65	15	22
9/25/12	10:40	14	13	34	1.01	2.01	1.60	65	18	22
9/25/12	10:45	16	13	34	1.01	2.01	1.60	65	18	22
9/25/12	10:50	16	13	34	1.01	2.01	1.60	65	18	23
9/25/12	10:55	16	13	34	1.02	2.01	1.60	65	18	23
9/25/12	11:00	16	13	34	1.02	2.01	1.60	65	18	23
9/25/12	11:05	16	13	34	1.02	2.00	1.60	65	18	23
9/25/12	11:10	16	13	34	1.02	2.00	1.60	69	17	23
9/25/12	11:15	16	13	34	1.02	2.00	1.60	69	17	23
9/25/12	11:20	16	13	34	1.02	2.00	1.60	69	17	23
9/25/12	11:25	16	13	34	1.02	2.00	1.60	69	17	23
9/25/12	11:30	16	13	34	1.02	2.00	1.60	69	17	22
9/25/12	11:35	16	13	34	1.02	2.00	1.40	69	17	22
9/25/12	11:40	18	13	34	1.02	2.00	1.40	69	20	22
9/25/12	11:45	18	13	34	1.02	2.00	1.40	73	20	22
9/25/12	11:50	18	13	34	1.02	2.00	1.40	73	20	22

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
9/25/12	11:55	20	13	34	1.00	2.00	1.40	73	20	22
9/25/12	12:00	20	13	34	1.00	1.89	1.40	73	20	11
10/2/12	7:00	13	15	36	1.05	2.62	1.60	51	17	11
10/2/12	7:05	16	15	36	1.05	2.40	1.60	51	17	11
10/2/12	7:10	13	13	36	1.06	2.49	1.60	51	17	11
10/2/12	7:15	13	13	36	1.06	2.47	1.60	51	17	11
10/2/12	7:20	15	13	36	0.99	2.47	1.60	51	17	11
10/2/12	7:25	13	13	36	1.05	2.35	1.60	51	17	11
10/2/12	7:30	15	12	36	0.99	2.46	1.90	51	17	11
10/2/12	7:35	15	12	36	0.99	2.46	1.90	51	17	11
10/2/12	7:40	13	12	36	1.05	2.56	1.90	51	17	11
10/2/12	7:45	15	12	36	0.99	2.34	1.90	51	17	11
10/2/12	7:50	15	13	36	0.99	2.55	1.90	51	17	11
10/2/12	7:55	13	13	36	0.99	2.67	1.90	51	17	11
10/2/12	8:00	15	13	36	0.99	2.44	1.90	51	17	11
10/2/12	8:05	13	13	36	1.05	2.65	1.90	51	17	11
10/2/12	8:10	15	12	36	0.99	2.54	1.90	51	17	11
10/2/12	8:15	15	12	36	0.99	2.74	1.90	55	17	11
10/2/12	8:20	13	12	36	0.99	2.74	1.90	55	17	11
10/2/12	8:25	15	12	36	0.98	2.40	1.90	55	17	11
10/2/12	8:30	13	12	36	0.98	2.63	1.60	55	17	11
10/2/12	8:35	15	12	36	0.98	2.53	1.60	55	17	11
10/2/12	8:40	15	12	36	1.05	2.54	1.60	55	17	11
10/2/12	8:45	15	12	36	1.05	2.55	1.60	55	17	11

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
10/2/12	8:50	15	13	36	1.05	2.55	1.60	55	17	11
10/2/12	8:55	13	13	36	1.11	2.66	1.60	55	17	11
10/2/12	9:00	15	13	36	1.04	2.66	1.60	55	17	11
10/2/12	9:05	15	13	36	1.04	2.66	1.60	55	17	11
10/2/12	9:10	13	12	36	1.04	2.56	1.60	55	17	11
10/2/12	9:15	15	12	36	1.04	2.45	1.60	58	17	11
10/2/12	9:20	13	12	36	1.11	2.56	1.60	58	17	18
10/2/12	9:25	15	12	36	1.04	2.67	1.60	58	17	11
10/2/12	9:30	15	13	36	1.04	2.78	1.50	58	17	11
10/2/12	9:35	15	13	36	1.04	2.68	1.50	58	17	11
10/2/12	9:40	15	13	36	1.04	2.57	1.50	58	17	11
10/2/12	9:45	15	13	36	0.97	2.46	1.50	58	17	11
10/2/12	9:50	15	12	36	1.05	2.69	1.50	58	17	11
10/2/12	9:55	15	12	36	0.99	3.01	1.50	58	17	11
10/2/12	10:00	15	12	36	1.05	2.90	1.50	63	17	11
10/2/12	10:05	15	12	36	1.06	2.78	1.50	63	17	11
10/2/12	10:10	15	12	36	1.05	2.67	1.50	63	17	12
10/2/12	10:15	15	12	36	1.05	2.45	1.50	63	20	12
10/2/12	10:20	17	12	36	1.06	2.45	1.50	63	23	12
10/2/12	10:25	19	12	36	1.14	2.58	1.50	63	23	12
10/2/12	10:30	19	12	36	1.20	2.69	1.50	63	23	12
10/2/12	10:35	19	12	36	1.27	2.58	1.50	63	23	12
10/2/12	10:40	19	12	36	1.27	2.92	1.50	63	23	12
10/2/12	10:45	21	12	36	1.34	2.24	1.50	63	23	12

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
10/2/12	10:50	19	10	36	1.34	1.90	1.50	63	23	12
10/2/12	10:55	19	10	36	1.40	1.90	1.50	63	23	12
10/2/12	11:00	19	10	36	1.40	1.79	1.50	65	23	12
10/2/12	11:05	19	10	36	1.33	1.58	1.50	65	23	12
10/2/12	11:10	21	12	36	1.33	1.58	1.50	65	23	12
10/2/12	11:15	19	12	36	1.26	1.70	1.50	65	23	12
10/2/12	11:20	23	7,171	36	1.26	1.59	1.50	65	21	12
10/2/12	11:25	19	6,883	36	1.19	1.59	1.50	65	21	13
10/2/12	11:30	21	12,149	36	1.13	1.59	1.60	65	21	13
10/2/12	11:35	19	12,483	36	1.13	1.58	1.60	65	21	12
10/2/12	11:40	21	7,010	36	1.06	1.58	1.60	65	21	12
10/2/12	11:45	19	7,010	36	1.06	1.58	1.60	65	21	13
10/2/12	11:50	19	12,603	36	1.06	1.58	1.60	65	21	13
10/2/12	11:55	19	282	36	0.99	1.58	1.60	65	21	13
10/2/12	12:00	19	282	36	0.99	1.47	1.60	66	21	13
10/17/12	7:00	14	12	38	1.16	2.40	2.40	56	17	10
10/17/12	7:05	16	12	38	1.23	2.40	2.40	56	17	10
10/17/12	7:10	12	12	38	1.23	2.30	2.40	56	17	10
10/17/12	7:15	16	12	38	1.23	2.30	2.40	56	17	10
10/17/12	7:20	14	12	38	1.23	2.30	2.40	56	17	11
10/17/12	7:25	14	12	38	1.23	2.30	2.40	56	17	11
10/17/12	7:30	16	13	38	1.23	2.30	2.50	56	17	11
10/17/12	7:35	15	13	38	1.23	2.30	2.50	56	18	11
10/17/12	7:40	15	13	38	1.23	2.30	2.50	56	18	11

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
10/17/12	7:45	15	13	40	1.23	2.29	2.50	56	18	11
10/17/12	7:50	13	12	40	1.23	2.29	2.50	58	18	11
10/17/12	7:55	15	12	40	1.23	2.08	2.50	58	18	11
10/17/12	8:00	16	12	40	1.23	2.19	2.50	58	18	11
10/17/12	8:05	15	12	40	1.20	2.19	2.50	58	18	11
10/17/12	8:10	15	12	40	1.20	2.19	2.50	58	18	11
10/17/12	8:15	15	12	40	1.20	2.42	2.50	58	18	11
10/17/12	8:20	15	12	40	1.20	2.42	2.50	58	18	10
10/17/12	8:25	15	12	40	1.20	2.31	2.50	58	18	10
10/17/12	8:30	15	12	35	1.20	2.31	2.50	58	18	10
10/17/12	8:35	15	12	35	1.20	2.31	2.50	58	17	10
10/17/12	8:40	4	12	35	1.20	2.42	2.50	58	17	10
10/17/12	8:45	4	12	35	1.20	2.42	2.50	58	17	10
10/17/12	8:50	13	12	35	1.20	2.42	2.50	60	17	10
10/17/12	8:55	17	12	35	1.14	2.42	2.50	60	17	10
10/17/12	9:00	14	12	35	1.14	2.86	2.50	60	17	10
10/17/12	9:05	14	12	35	1.14	3.07	2.50	60	17	10
10/17/12	9:10	16	12	35	1.20	2.86	2.50	60	17	10
10/17/12	9:15	14	12	35	1.20	2.64	2.50	60	17	10
10/17/12	9:20	14	12	35	1.20	2.64	2.50	60	17	10
10/17/12	9:25	14	12	35	1.20	2.41	2.50	60	17	10
10/17/12	9:30	14	12	35	1.20	2.41	2.30	60	17	10
10/17/12	9:35	16	12	35	1.20	2.41	2.30	60	17	10
10/17/12	9:40	14	12	35	1.27	2.41	2.30	60	17	10

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
10/17/12	9:45	14	12	35	1.27	2.41	2.30	60	17	10
10/17/12	9:50	14	12	35	1.27	2.41	2.30	60	17	10
10/17/12	9:55	14	12	35	1.27	2.41	2.30	60	17	10
10/17/12	10:00	14	12	35	1.27	2.52	2.30	60	17	11
10/17/12	10:05	10	12	35	1.27	2.40	2.30	60	20	12
10/17/12	10:10	14	12	35	1.27	2.40	2.30	60	20	12
10/17/12	10:15	19	12	35	1.27	2.29	2.30	60	20	12
10/17/12	10:20	16	12	35	1.27	2.29	2.30	60	20	12
10/17/12	10:25	20	12	35	1.27	2.50	2.30	60	20	12
10/17/12	10:30	18	12	35	1.27	2.39	2.20	60	23	12
10/17/12	10:35	20	12	35	1.27	2.17	2.20	60	23	12
10/17/12	10:40	18	12	35	1.27	1.95	2.20	60	23	12
10/17/12	10:45	20	12	35	1.27	1.85	2.20	60	23	12
10/17/12	10:50	18	12	35	1.27	1.64	2.20	60	23	12
10/17/12	10:55	27	12	35	1.27	1.64	2.20	60	23	8
10/17/12	11:00	20	10	35	1.27	1.64	2.20	60	23	8
10/17/12	11:05	20	10	35	1.27	1.53	2.20	60	23	8
10/17/12	11:10	16	10	35	1.27	1.42	2.20	60	23	13
10/17/12	11:15	12	10	35	1.21	1.32	2.20	60	23	13
10/17/12	11:20	18	10	39	1.14	1.32	2.50	60	23	13
10/17/12	11:25	16	10	39	1.14	1.32	2.50	60	23	13
10/17/12	11:30	22	10	39	1.08	1.32	2.50	60	22	13
10/17/12	11:35	15	10	39	1.02	2.12	2.50	60	22	13
10/17/12	11:40	22	10	39	1.02	1.70	2.50	60	22	13

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
10/17/12	11:45	17	10	39	1.02	1.59	2.50	60	22	13
10/17/12	11:50	20	10	39	0.95	1.48	2.50	63	22	13
10/17/12	11:55	18	10	39	0.95	1.37	2.50	63	22	13
10/17/12	12:00	20	12	42	0.95	1.37	2.50	63	22	13
10/23/12	7:00	26	95	38	1.24	1.35	3.60	53	19	13
10/23/12	7:05	26	10	38	1.17	1.35	3.60	53	19	12
10/23/12	7:10	21	10	38	1.17	0.74	3.60	53	19	11
10/23/12	7:15	24	10	38	1.17	0.63	3.60	53	19	11
10/23/12	7:20	22	10	38	1.17	0.85	3.60	53	19	11
10/23/12	7:25	22	12	38	1.17	0.95	3.60	53	13	11
10/23/12	7:30	17	12	38	1.10	0.95	3.60	53	16	11
10/23/12	7:35	14	12	38	1.03	0.95	3.30	53	16	11
10/23/12	7:40	15	12	38	0.96	0.95	3.30	53	17	11
10/23/12	7:45	13	12	40	0.96	0.95	3.30	53	14	10
10/23/12	7:50	13	12	40	0.90	1.06	3.30	53	16	9
10/23/12	7:55	11	12	40	0.90	1.17	3.30	53	16	8
10/23/12	8:00	14	12	40	0.84	1.38	3.30	53	17	9
10/23/12	8:05	11	12	40	0.84	1.38	3.30	53	14	9
10/23/12	8:10	11	12	40	0.84	1.38	3.00	53	14	9
10/23/12	8:15	11	12	40	0.84	1.48	3.00	53	14	9
10/23/12	8:20	11	12	40	1.04	1.37	3.00	53	17	9
10/23/12	8:25	11	10	40	1.25	1.72	3.00	53	17	9
10/23/12	8:30	11	10	35	1.47	1.72	3.00	53	16	10
10/23/12	8:35	11	10	35	1.60	1.72	3.00	53	19	10

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
10/23/12	8:40	11	10	35	1.67	1.72	3.00	53	19	11
10/23/12	8:45	11	10	35	1.61	1.72	3.00	54	19	11
10/23/12	8:50	11	10	35	1.61	1.72	2.60	54	19	11
10/23/12	8:55	11	10	35	1.61	1.72	2.60	54	19	11
10/23/12	9:00	11	10	35	1.61	1.60	2.60	54	19	11
10/23/12	9:05	12	10	35	1.61	1.50	2.60	54	19	11
10/23/12	9:10	17	10	35	1.61	1.39	2.60	54	19	11
10/23/12	9:15	19	6,975	35	1.61	1.29	2.60	54	19	11
10/23/12	9:20	16	6,923	35	1.61	1.29	2.60	54	19	11
10/23/12	9:25	17	96	35	1.61	1.18	2.60	54	19	11
10/23/12	9:30	17	96	35	1.54	1.18	2.60	54	19	11
10/23/12	9:35	19	96	35	1.54	1.18	2.60	54	20	11
10/23/12	9:40	17	96	35	1.48	1.18	2.60	54	23	13
10/23/12	9:45	12	13	35	1.42	1.18	2.60	54	23	14
10/23/12	9:50	17	13	35	1.42	1.18	2.60	54	23	14
10/23/12	9:55	21	12,465	35	1.35	1.18	2.60	54	23	14
10/23/12	10:00	23	12,638	35	1.35	1.18	2.60	54	23	14
10/23/12	10:05	21	214	35	1.28	1.29	2.60	54	23	14
10/23/12	10:10	24	214	35	1.28	1.08	2.60	54	26	14
10/23/12	10:15	24	214	35	1.28	0.97	2.60	54	26	14
10/23/12	10:20	24	214	35	1.21	0.97	2.60	54	26	14
10/23/12	10:25	24	13	35	1.21	0.97	2.60	54	26	14
10/23/12	10:30	24	13	35	1.21	0.97	2.60	54	26	14
10/23/12	10:35	24	13	35	1.14	0.97	2.60	54	26	14

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
10/23/12	10:40	24	13	35	1.14	0.87	2.60	54	26	14
10/23/12	10:45	24	15	35	1.07	0.87	2.60	58	26	14
10/23/12	10:50	24	15	35	1.07	0.87	2.60	58	26	14
10/23/12	10:55	24	15	35	1.00	0.87	2.60	58	26	14
10/23/12	11:00	24	15	35	1.00	0.87	2.60	58	26	14
10/23/12	11:05	24	13	35	0.93	0.87	2.60	58	26	14
10/23/12	11:10	25	13	35	0.93	0.87	2.60	58	25	14
10/23/12	11:15	25	13	35	0.93	0.87	2.60	58	25	14
10/23/12	11:20	25	13	39	0.93	0.87	2.60	58	25	15
10/23/12	11:25	25	12	39	0.86	0.87	2.60	58	25	15
10/23/12	11:30	23	12	39	0.86	0.87	2.60	58	25	15
10/23/12	11:35	25	12	39	0.86	0.87	2.60	58	28	15
10/23/12	11:40	25	12	39	0.86	0.88	2.60	58	28	15
10/23/12	11:45	27	10	39	0.86	0.88	2.60	60	28	16
10/23/12	11:50	27	10	39	0.86	0.88	2.40	60	28	16
10/23/12	11:55	27	10	39	0.86	0.88	2.40	60	28	16
10/23/12	12:00	27	10	42	0.86	0.88	2.40	60	28	16
4/17/13	6:00	34	10,230	36	0.70	0.25	2.53	37	30	29
4/17/13	6:05	34	3,613	36	0.70	0.36	2.53	37	30	29
4/17/13	6:10	32	24	36	0.70	0.26	2.53	37	30	29
4/17/13	6:15	20	24	36	0.76	0.26	2.47	37	30	29
4/17/13	6:20	20	24	36	0.79	0.36	2.47	37	30	29
4/17/13	6:25	29	24	36	0.79	0.47	2.47	37	30	29
4/17/13	6:30	35	24	34	0.73	0.26	2.47	37	30	29

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/17/13	6:35	28	24	34	0.73	0.26	2.47	37	30	29
4/17/13	6:40	32	24	34	0.73	0.36	2.47	37	30	29
4/17/13	6:45	32	24	34	0.73	0.25	2.53	37	30	29
4/17/13	6:50	30	24	34	0.73	0.14	2.53	37	30	29
4/17/13	6:55	30	24	34	0.70	0.14	2.53	37	30	29
4/17/13	7:00	30	24	38	0.70	0.14	2.53	37	30	29
4/17/13	7:05	30	24	38	0.70	0.14	2.53	38	30	29
4/17/13	7:10	30	10	38	0.70	0.14	2.53	38	30	29
4/17/13	7:15	30	10	38	0.70	0.60	2.53	38	30	29
4/17/13	7:20	30	10	38	0.70	0.60	2.53	38	30	29
4/17/13	7:25	30	10	38	0.70	0.71	2.53	38	30	29
4/17/13	7:30	30	10	38	0.64	0.82	2.53	38	30	29
4/17/13	7:35	30	10	38	0.64	0.71	2.53	38	30	29
4/17/13	7:40	30	10	38	0.70	0.82	2.53	38	30	29
4/17/13	7:45	30	10	38	0.70	1.67	2.60	38	30	29
4/17/13	7:50	30	10	44	0.97	4.58	2.45	39	29	29
4/17/13	7:55	30	10	44	1.03	4.57	2.45	39	29	29
4/17/13	8:00	30	10	44	1.03	4.68	2.45	39	29	29
4/17/13	8:05	30	10	44	1.10	4.54	2.45	38	29	29
4/17/13	8:10	30	10	44	1.16	4.42	2.45	38	29	29
4/17/13	8:15	30	10	43	1.16	3.64	2.45	38	29	29
4/17/13	8:20	30	10	43	1.22	3.53	2.45	38	29	29
4/17/13	8:25	30	10	43	1.22	3.86	2.45	38	29	29
4/17/13	8:30	30	10	43	1.28	3.79	2.45	38	29	29

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/17/13	8:35	30	10	43	1.29	3.45	2.45	38	29	29
4/17/13	8:40	30	10	48	1.29	3.45	2.45	38	29	29
4/17/13	8:45	30	10	48	1.29	3.42	2.59	38	30	29
4/17/13	8:50	31	10	48	1.29	3.77	2.59	38	30	29
4/17/13	8:55	31	10	48	1.29	4.93	2.59	38	30	29
4/17/13	9:00	31	10	48	1.29	4.93	2.59	38	30	29
4/17/13	9:05	31	10	48	1.29	4.93	2.59	37	30	29
4/17/13	9:10	31	10	48	1.29	4.93	2.59	37	30	29
4/17/13	9:15	31	10	48	1.29	4.93	2.59	37	30	29
4/17/13	9:20	31	10	48	1.36	4.93	2.59	37	30	29
4/17/13	9:25	31	10	48	1.42	4.93	2.59	37	30	29
4/17/13	9:30	31	10	48	1.48	4.93	2.59	37	30	29
4/17/13	9:35	31	10	48	1.55	4.93	2.59	37	30	29
4/17/13	9:40	31	10	48	1.55	4.93	2.59	37	30	29
4/17/13	9:45	31	10	48	1.61	4.93	2.51	37	31	29
4/17/13	9:50	30	10	48	1.61	4.93	2.51	37	31	29
4/17/13	9:55	30	10	48	1.61	4.99	2.51	37	31	29
4/17/13	10:00	30	10	48	1.65	4.99	2.51	37	51	29
4/17/13	10:05	41	10	48	1.65	4.99	2.51	38	50	29
4/17/13	10:10	47	10	48	1.65	4.99	2.51	38	50	29
4/17/13	10:15	49	10	48	1.71	3.05	2.51	38	50	29
4/17/13	10:20	52	10	48	1.71	1.89	2.82	38	50	29
4/17/13	10:25	49	10	48	1.64	1.68	2.82	38	50	29
4/17/13	10:30	49	10	48	1.44	1.45	2.82	38	50	29

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/17/13	10:35	49	10	48	1.30	1.45	3.13	38	50	29
4/17/13	10:40	52	10	46	1.22	1.56	3.13	38	50	29
4/17/13	10:45	54	10	46	1.30	1.68	3.13	38	47	29
4/17/13	10:50	50	10	46	1.19	1.13	3.13	38	47	29
4/17/13	10:55	53	10	46	1.61	1.02	3.13	38	50	29
4/17/13	11:00	50	10	46	2.00	1.14	3.13	38	50	29
4/17/13	11:05	50	10	43	2.00	1.37	3.13	37	48	29
4/17/13	11:10	53	7	43	2.00	1.26	3.13	37	48	29
4/17/13	11:15	51	7	43	2.00	0.91	3.13	37	48	29
4/17/13	11:20	51	7	43	2.00	0.79	3.13	37	48	29
4/17/13	11:25	51	7	43	2.00	0.77	3.13	37	47	29
4/17/13	11:30	51	7	43	2.00	0.77	3.13	37	47	29
4/17/13	11:35	23	7	43	2.00	0.88	3.05	37	47	29
4/17/13	11:40	58	3,908	43	2.00	0.99	3.05	37	47	29
4/17/13	11:45	56	6,846	43	2.00	0.87	3.05	37	47	29
4/17/13	11:50	51	6,846	43	2.00	0.98	3.05	37	47	29
4/17/13	11:55	51	12,525	43	1.97	0.99	3.05	37	47	29
4/17/13	12:00	51	12,525	43	1.77	0.99	3.05	37	47	29
4/17/13	12:05	51	7,049	43	1.69	0.86	2.74	38	44	29
4/17/13	12:10	51	7,049	43	1.51	1.08	2.74	38	29	29
4/17/13	12:15	44	7,049	35	1.48	1.08	2.74	38	29	29
4/17/13	12:20	18	12,433	35	1.39	0.86	2.74	38	29	29
4/17/13	12:25	32	12,097	35	1.30	0.40	2.74	38	29	29
4/17/13	12:30	33	175	35	1.15	0.52	2.74	38	29	29

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/17/13	12:35	31	175	35	1.09	0.52	2.74	38	29	29
4/17/13	12:40	33	6,996	35	1.01	0.85	2.74	38	29	29
4/17/13	12:45	31	6,996	35	1.02	0.96	2.74	38	29	29
4/17/13	12:50	31	6,996	30	0.92	0.75	2.74	38	29	29
4/17/13	12:55	31	6,996	30	0.87	0.64	2.74	38	29	29
4/17/13	13:00	31	6,996	30	0.78	0.43	2.74	38	29	29
4/22/13	6:00	27	10	10	0.58	1.70	2.70	38	23	23
4/22/13	6:05	16	10	10	0.58	2.04	2.70	38	23	18
4/22/13	6:10	22	10	10	0.58	1.80	2.70	38	21	18
4/22/13	6:15	26	10	10	0.58	1.80	2.70	38	21	18
4/22/13	6:20	24	10	10	0.58	2.47	2.70	38	21	18
4/22/13	6:25	24	10	10	0.58	1.98	2.70	38	22	19
4/22/13	6:30	16	10	10	0.58	1.87	2.62	38	24	19
4/22/13	6:35	16	10	10	0.58	2.41	2.62	38	23	19
4/22/13	6:40	16	10	10	0.58	2.62	2.62	38	21	19
4/22/13	6:45	24	10	10	0.65	2.84	2.62	38	21	19
4/22/13	6:50	26	10	10	0.65	2.73	2.31	38	22	19
4/22/13	6:55	32	10	10	0.65	2.40	2.31	38	22	19
4/22/13	7:00	30	10	10	0.65	2.29	2.31	40	22	19
4/22/13	7:05	25	10	10	0.65	2.42	2.31	40	22	19
4/22/13	7:10	25	10	10	0.65	2.60	2.31	40	23	18
4/22/13	7:15	25	4	10	0.58	2.90	2.31	40	23	16
4/22/13	7:20	25	4	10	0.58	3.49	2.31	40	23	16
4/22/13	7:25	25	4	10	0.58	4.50	2.31	40	23	16

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/22/13	7:30	25	4	10	0.58	4.91	2.31	40	23	16
4/22/13	7:35	25	4	10	0.58	4.91	2.31	40	23	16
4/22/13	7:40	25	4	10	0.58	4.91	2.31	40	23	16
4/22/13	7:45	23	4	10	0.58	4.91	2.31	40	26	20
4/22/13	7:50	23	4	10	0.65	4.99	2.12	40	26	20
4/22/13	7:55	27	4	10	0.65	4.99	2.12	40	26	21
4/22/13	8:00	27	4	20	0.65	2.94	2.12	44	26	21
4/22/13	8:05	27	4	20	0.65	2.70	2.12	44	26	21
4/22/13	8:10	27	4	25	0.65	2.48	2.12	44	26	21
4/22/13	8:15	27	4	25	0.65	2.47	2.12	44	26	21
4/22/13	8:20	29	4	25	0.65	2.47	2.12	44	26	21
4/22/13	8:25	29	4	30	0.65	2.47	2.12	44	26	21
4/22/13	8:30	29	4	30	0.65	2.47	2.12	44	26	21
4/22/13	8:35	29	4	30	0.65	3.43	2.12	44	29	21
4/22/13	8:40	34	4	30	0.65	4.35	2.12	44	29	20
4/22/13	8:45	24	4	30	0.65	3.90	2.12	44	35	25
4/22/13	8:50	28	4	30	0.70	4.03	1.99	48	35	25
4/22/13	8:55	32	4	35	0.70	4.95	2.31	48	35	25
4/22/13	9:00	32	4	35	0.79	4.95	2.31	48	35	25
4/22/13	9:05	32	4	35	0.81	4.95	2.31	48	35	25
4/22/13	9:10	34	6,922	35	0.81	4.95	2.31	48	35	25
4/22/13	9:15	34	12,368	35	0.87	4.95	2.31	48	32	25
4/22/13	9:20	34	12,372	35	0.87	4.95	2.31	48	32	25
4/22/13	9:25	34	6,891	37	0.87	4.95	2.31	48	32	25

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/22/13	9:30	34	12,448	37	0.93	4.95	2.31	48	32	25
4/22/13	9:35	34	12,448	37	0.93	4.95	2.31	52	32	25
4/22/13	9:40	34	9,081	40	0.93	4.95	2.31	52	32	25
4/22/13	9:45	37	110	40	0.93	4.95	2.31	52	32	25
4/22/13	9:50	12	110	45	1.00	4.95	2.31	52	32	25
4/22/13	9:55	38	110	35	0.93	4.99	2.14	52	32	25
4/22/13	10:00	36	110	25	1.50	4.99	2.14	52	32	25
4/22/13	10:05	33	110	25	1.92	4.99	2.14	52	32	25
4/22/13	10:10	33	110	25	1.99	4.99	2.14	52	32	25
4/22/13	10:15	33	110	25	1.99	4.99	2.14	52	37	25
4/22/13	10:20	45	110	23	2.00	4.99	2.14	52	43	25
4/22/13	10:25	40	110	20	2.00	4.43	2.14	52	40	25
4/22/13	10:30	40	110	20	2.00	3.97	2.14	52	40	25
4/22/13	10:35	40	110	16	2.00	3.40	2.14	56	40	25
4/22/13	10:40	38	110	13	2.00	3.29	2.14	56	40	25
4/22/13	10:45	38	7	12	2.00	2.76	2.14	56	40	25
4/22/13	10:50	38	7	20	2.00	2.42	2.14	56	37	25
4/22/13	10:55	38	7	15	2.00	1.99	1.89	56	37	25
4/22/13	11:00	38	7	15	1.78	1.01	1.89	56	37	25
4/22/13	11:05	38	7	15	1.57	1.12	1.89	56	37	25
4/22/13	11:10	38	7	12	1.37	1.90	1.89	56	37	25
4/22/13	11:15	38	7	12	1.11	1.64	1.89	56	37	25
4/22/13	11:20	38	7	12	0.98	1.53	1.89	56	37	25
4/22/13	11:25	38	7	12	0.98	1.53	1.89	56	37	25

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/22/13	11:30	38	7	12	0.98	1.18	1.89	56	37	25
4/22/13	11:35	38	7	12	0.92	1.18	1.89	60	37	25
4/22/13	11:40	39	7	12	0.86	1.08	1.89	60	37	25
4/22/13	11:45	39	7	12	0.86	1.08	1.89	60	37	25
4/22/13	11:50	39	7	12	0.79	1.08	1.89	60	36	25
4/22/13	11:55	39	7	12	0.79	1.08	1.76	60	36	25
4/22/13	12:00	39	7	12	0.73	1.08	1.76	60	36	25
4/22/13	12:05	39	7	12	0.73	1.08	1.76	60	36	25
4/22/13	12:10	39	7	12	0.73	1.08	1.76	60	36	25
4/22/13	12:15	39	7	12	0.73	1.08	1.76	60	36	25
4/22/13	12:20	39	7	12	0.73	1.08	1.76	60	36	25
4/22/13	12:25	39	7	12	0.73	1.08	1.76	60	36	25
4/22/13	12:30	39	7	12	0.66	1.08	1.76	60	36	25
4/22/13	12:35	39	7	37	0.68	1.08	1.76	63	36	25
4/22/13	12:40	38	7	42	0.68	1.06	1.76	63	36	25
4/22/13	12:45	38	7	47	0.68	1.06	1.76	63	36	25
4/22/13	12:50	38	7	35	0.68	0.95	1.76	63	36	25
4/22/13	12:55	38	7	35	0.68	1.06	1.70	63	36	25
4/22/13	13:00	36	7	35	0.68	1.39	1.70	63	36	25
4/22/13	13:05	44	7	35	0.68	2.71	1.70	63	36	25
4/22/13	13:10	42	7	35	0.92	1.52	1.70	63	36	25
4/22/13	13:15	38	7	35	1.11	1.42	1.70	63	36	25
4/22/13	13:20	35	7	35	1.14	1.52	1.70	63	36	25
4/22/13	13:25	35	7	35	1.01	1.52	1.70	63	36	25

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/22/13	13:30	33	7	35	0.95	1.42	1.70	63	36	25
4/22/13	13:35	33	7	35	0.95	1.42	1.70	63	36	25
4/22/13	13:40	33	7	35	0.89	1.42	1.70	63	36	25
4/22/13	13:45	33	4	35	0.89	1.42	1.70	63	36	25
4/22/13	13:50	33	4	35	0.82	1.42	1.70	63	37	25
4/22/13	13:55	33	4	35	0.82	1.42	1.87	63	37	25
4/22/13	14:00	33	4	35	0.82	1.53	1.87	63	37	25
4/23/13	6:00	29	10	9	0.65	0.87	2.20	50	23	19
4/23/13	6:05	29	10	9	0.65	0.87	2.20	50	23	19
4/23/13	6:10	13	10	9	0.65	0.87	2.20	50	23	19
4/23/13	6:15	13	10	9	0.65	0.87	2.20	50	23	19
4/23/13	6:20	15	10	9	0.65	1.08	2.20	50	23	19
4/23/13	6:25	26	10	9	0.65	1.06	2.20	50	23	20
4/23/13	6:30	26	10	9	0.65	0.95	2.20	50	23	19
4/23/13	6:35	22	10	9	0.65	0.95	2.18	50	23	19
4/23/13	6:40	24	10	9	0.65	0.95	2.18	50	23	19
4/23/13	6:45	24	10	9	0.65	1.05	2.18	50	23	19
4/23/13	6:50	24	10	9	0.65	1.05	2.18	50	23	19
4/23/13	6:55	24	10	9	0.65	1.05	2.18	50	23	19
4/23/13	7:00	24	10	9	0.65	1.05	2.18	50	23	19
4/23/13	7:05	22	10	9	0.65	1.05	2.18	50	23	19
4/23/13	7:10	24	10	9	0.65	1.05	2.18	50	23	19
4/23/13	7:15	24	10	9	0.65	1.05	2.18	50	23	19
4/23/13	7:20	22	10	9	0.65	1.05	2.18	51	23	19

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/23/13	7:25	24	10	9	0.65	1.05	2.18	51	23	19
4/23/13	7:30	24	10	9	0.65	1.05	2.18	51	23	19
4/23/13	7:35	24	10	9	0.65	1.05	2.14	51	23	19
4/23/13	7:40	24	10	9	0.65	1.05	2.14	51	23	19
4/23/13	7:45	24	10	9	0.65	1.04	2.14	51	23	19
4/23/13	7:50	24	10	9	0.68	1.04	2.14	51	23	19
4/23/13	7:55	24	10	9	0.68	1.04	2.14	51	23	19
4/23/13	8:00	24	10	9	0.68	1.04	2.14	51	23	19
4/23/13	8:05	24	10	9	0.68	1.04	2.14	51	23	19
4/23/13	8:10	24	10	12	0.68	1.04	2.14	51	26	19
4/23/13	8:15	24	10	12	0.68	1.04	2.14	55	26	19
4/23/13	8:20	26	10	14	0.68	1.04	2.14	55	26	19
4/23/13	8:25	26	10	14	0.68	1.48	2.14	55	26	22
4/23/13	8:30	24	10	14	0.68	1.60	2.14	55	29	22
4/23/13	8:35	26	10	14	0.68	1.92	2.10	55	29	22
4/23/13	8:40	29	10	14	0.68	2.14	2.10	55	29	23
4/23/13	8:45	29	10	14	0.68	2.03	2.10	55	29	23
4/23/13	8:50	29	10	12	0.71	1.92	2.10	55	29	23
4/23/13	8:55	29	10	12	0.71	1.82	2.10	55	29	23
4/23/13	9:00	29	10	12	0.77	1.82	2.10	55	29	23
4/23/13	9:05	29	10	12	0.79	1.48	2.10	55	29	23
4/23/13	9:10	29	10	12	0.79	1.48	2.10	55	29	23
4/23/13	9:15	29	10	12	0.79	1.37	2.10	55	29	23
4/23/13	9:20	29	10	14	0.79	1.37	2.10	55	29	23

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/23/13	9:25	29	10	14	0.79	1.37	2.10	55	29	23
4/23/13	9:30	29	10	16	0.79	1.37	2.10	55	28	23
4/23/13	9:35	29	10	16	0.79	1.69	2.14	55	28	23
4/23/13	9:40	29	10	16	0.79	1.69	2.14	55	28	23
4/23/13	9:45	29	10	16	0.79	2.06	2.14	55	28	23
4/23/13	9:50	29	10	16	0.79	2.29	2.14	55	28	23
4/23/13	9:55	29	10	18	0.79	2.29	2.14	55	28	23
4/23/13	10:00	29	10	18	0.79	2.29	2.14	55	28	23
4/23/13	10:05	29	10	18	0.83	2.30	2.14	55	28	23
4/23/13	10:10	29	10	18	0.83	2.75	2.14	55	28	23
4/23/13	10:15	29	10	16	0.83	2.75	2.14	55	28	23
4/23/13	10:20	29	10	16	0.83	2.86	2.14	55	28	23
4/23/13	10:25	29	10	16	0.90	2.63	2.14	55	28	24
4/23/13	10:30	29	10	16	0.90	2.40	2.14	55	28	24
4/23/13	10:35	27	10	16	0.90	2.30	2.18	55	28	24
4/23/13	10:40	29	10	16	0.96	2.52	2.18	55	28	24
4/23/13	10:45	29	10	16	0.96	2.41	2.18	55	41	24
4/23/13	10:50	31	10	16	0.96	2.41	2.18	55	38	24
4/23/13	10:55	37	10	16	0.96	2.42	2.18	55	35	25
4/23/13	11:00	35	10	16	0.96	2.04	2.18	55	35	25
4/23/13	11:05	35	10	20	0.96	1.82	2.18	55	35	25
4/23/13	11:10	44	10	20	0.96	1.82	2.18	55	35	25
4/23/13	11:15	33	10	20	1.02	2.39	2.18	54	35	25
4/23/13	11:20	37	10	20	1.02	2.49	2.18	54	35	25

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/23/13	11:25	37	10	20	1.02	2.60	2.18	54	35	25
4/23/13	11:30	37	10	24	1.02	2.60	2.18	54	35	25
4/23/13	11:35	37	10	24	1.02	2.71	2.39	54	35	25
4/23/13	11:40	37	10	24	1.02	2.82	2.39	54	35	25
4/23/13	11:45	37	10	24	1.02	3.38	2.39	54	35	25
4/23/13	11:50	37	10	24	1.02	3.47	2.39	54	35	25
4/23/13	11:55	37	10	24	1.08	3.37	2.39	50	35	25
4/23/13	12:00	37	2,098	12	1.08	3.47	2.39	50	35	25
4/23/13	12:05	39	7,019	12	1.15	3.36	2.39	50	35	25
4/23/13	12:10	39	12,356	12	1.15	1.51	2.39	50	35	25
4/23/13	12:15	39	7,102	12	1.21	1.30	2.39	50	35	25
4/23/13	12:20	39	7,096	12	1.21	1.19	2.39	50	35	25
4/23/13	12:25	39	12,585	9	1.15	1.19	2.39	50	35	25
4/23/13	12:30	39	28	9	1.08	1.19	2.39	50	35	25
4/23/13	12:35	30	28	9	1.02	0.87	2.29	50	35	25
4/23/13	12:40	25	28	12	1.02	0.76	2.29	50	35	25
4/23/13	12:45	46	2,550	12	0.95	0.76	2.29	50	35	25
4/23/13	12:50	44	7,060	12	0.82	0.76	2.29	50	35	25
4/23/13	12:55	37	7,060	12	0.75	0.98	2.22	48	35	25
4/23/13	13:00	40	12,227	12	0.72	1.09	2.22	48	35	25
4/23/13	13:05	40	12,559	15	0.72	1.09	2.22	48	35	25
4/23/13	13:10	40	6,973	15	0.66	1.09	2.22	48	35	25
4/23/13	13:15	40	6,973	15	0.66	1.20	2.22	48	35	25
4/23/13	13:20	40	6,973	15	0.66	1.53	2.22	48	35	25

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/23/13	13:25	40	12,549	15	0.66	1.53	2.22	48	35	25
4/23/13	13:30	40	12,549	15	0.66	1.53	2.22	48	35	25
4/23/13	13:35	40	150	15	0.72	1.64	2.22	48	35	25
4/23/13	13:40	21	150	15	0.72	1.52	2.22	48	35	25
4/23/13	13:45	30	150	15	0.72	1.52	2.22	48	35	25
4/23/13	13:50	44	150	15	0.72	1.54	2.22	48	35	25
4/23/13	13:55	37	150	15	0.79	1.43	2.20	45	35	25
4/23/13	14:00	37	150	13	0.79	1.54	2.20	45	35	25
4/24/13	6:00	45	566	20	0.91	1.09	3.51	30	49	30
4/24/13	6:05	50	255	20	0.91	1.09	3.51	30	49	30
4/24/13	6:10	35	7,078	20	0.91	1.09	3.51	30	49	30
4/24/13	6:15	46	7,078	20	0.91	1.19	3.51	30	49	30
4/24/13	6:20	46	7,078	20	0.91	1.19	3.51	30	49	30
4/24/13	6:25	46	12,479	20	0.91	1.19	3.51	30	49	30
4/24/13	6:30	46	12,479	20	0.88	1.19	3.51	30	49	30
4/24/13	6:35	46	7,015	10	0.86	1.19	3.34	30	49	30
4/24/13	6:40	46	7,015	10	0.86	1.19	3.34	30	49	30
4/24/13	6:45	46	7,015	10	0.86	0.51	3.34	30	49	30
4/24/13	6:50	46	12,547	10	0.86	0.41	3.34	31	49	30
4/24/13	6:55	46	1,767	10	0.79	0.41	3.34	31	49	30
4/24/13	7:00	52	176	12	0.68	0.41	3.34	31	49	30
4/24/13	7:05	27	176	12	0.68	0.41	3.34	31	49	30
4/24/13	7:10	40	176	12	0.62	0.51	3.34	31	49	30
4/24/13	7:15	48	176	12	0.49	0.41	3.34	31	49	30

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/24/13	7:20	44	176	12	0.49	0.41	2.84	31	49	30
4/24/13	7:25	43	176	12	0.43	0.51	2.84	31	49	30
4/24/13	7:30	44	176	12	0.43	0.51	2.84	31	49	30
4/24/13	7:35	43	176	12	0.43	0.51	2.84	31	46	30
4/24/13	7:40	43	176	12	0.43	0.51	2.84	31	46	30
4/24/13	7:45	42	176	12	0.43	0.51	2.84	31	46	30
4/24/13	7:50	42	176	12	0.43	0.51	2.84	32	46	30
4/24/13	7:55	41	176	12	0.43	0.51	2.84	32	46	30
4/24/13	8:00	41	10	12	0.43	0.51	2.84	32	46	30
4/24/13	8:05	41	10	25	0.43	0.51	2.53	32	46	30
4/24/13	8:10	42	10	25	0.43	0.51	2.53	32	46	30
4/24/13	8:15	42	10	25	0.43	1.45	2.53	32	46	30
4/24/13	8:20	42	10	25	0.43	2.13	2.53	32	46	30
4/24/13	8:25	42	10	25	0.44	2.13	2.53	32	46	30
4/24/13	8:30	41	10	25	0.57	2.24	2.53	32	46	30
4/24/13	8:35	42	10	25	0.69	2.35	2.53	32	45	30
4/24/13	8:40	41	10	20	0.82	2.35	2.53	32	45	30
4/24/13	8:45	42	10	15	0.88	2.46	2.53	32	45	30
4/24/13	8:50	42	10	10	0.95	1.99	2.53	32	45	30
4/24/13	8:55	41	10	10	1.02	0.99	2.53	32	45	30
4/24/13	9:00	42	7	12	1.02	0.66	2.53	32	45	30
4/24/13	9:05	41	7	20	0.95	0.55	2.37	32	45	30
4/24/13	9:10	42	7	20	0.82	0.87	2.37	32	45	30
4/24/13	9:15	42	7	18	0.70	1.57	2.37	32	45	30

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/24/13	9:20	42	7	18	0.63	1.79	2.37	32	45	30
4/24/13	9:25	42	7	18	0.63	1.57	2.37	32	45	30
4/24/13	9:30	42	7	18	0.69	1.47	2.37	32	45	30
4/24/13	9:35	42	7	18	0.69	1.47	2.37	32	46	30
4/24/13	9:40	42	7	18	0.76	1.47	2.37	32	46	30
4/24/13	9:45	42	7	18	0.76	1.47	2.37	32	46	30
4/24/13	9:50	42	7	22	0.76	1.47	2.37	34	46	30
4/24/13	9:55	42	7	22	0.76	1.47	2.37	34	46	30
4/24/13	10:00	43	7	22	0.76	2.01	2.37	34	46	30
4/24/13	10:05	44	7	22	0.76	2.12	2.24	34	46	30
4/24/13	10:10	44	7	22	0.76	2.12	2.24	34	46	30
4/24/13	10:15	45	7	22	0.82	2.12	2.24	34	49	30
4/24/13	10:20	44	7	22	0.88	2.12	2.24	34	49	30
4/24/13	10:25	45	7	22	0.88	2.12	2.24	34	49	30
4/24/13	10:30	44	7	22	0.94	2.12	2.24	34	49	30
4/24/13	10:35	44	7	24	0.94	2.12	2.24	34	49	30
4/24/13	10:40	44	7	24	1.00	2.12	2.24	34	49	30
4/24/13	10:45	45	7	24	1.06	2.44	2.24	34	49	30
4/24/13	10:50	44	7	24	1.06	2.44	2.24	36	49	30
4/24/13	10:55	44	7	24	1.06	2.44	2.24	36	49	30
4/24/13	11:00	44	7	24	1.13	2.56	2.24	36	49	30
4/24/13	11:05	44	7	12	1.13	2.45	2.12	36	49	30
4/24/13	11:10	45	7	12	1.19	1.73	2.12	36	49	30
4/24/13	11:15	45	7	12	1.19	1.04	2.12	36	49	30

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/24/13	11:20	45	7	12	1.19	0.93	2.12	36	49	30
4/24/13	11:25	45	7	12	1.05	0.83	2.12	36	49	30
4/24/13	11:30	46	7	12	0.86	0.83	2.12	36	49	30
4/24/13	11:35	45	7	12	0.80	0.83	2.12	36	49	30
4/24/13	11:40	46	7	12	0.74	0.83	2.12	36	49	30
4/24/13	11:45	46	7	12	0.67	0.83	2.12	36	49	30
4/24/13	11:50	45	7	12	0.67	0.83	2.12	39	49	30
4/24/13	11:55	49	6,818	12	0.61	0.83	2.12	39	49	30
4/24/13	12:00	48	12,269	12	0.61	0.72	2.12	39	49	30
4/24/13	12:05	48	6,761	12	0.61	0.72	1.97	39	49	30
4/24/13	12:10	47	9,255	12	0.61	0.72	1.97	39	49	30
4/24/13	12:15	47	1,987	12	0.61	0.72	1.97	39	49	30
4/24/13	12:20	43	81	12	0.55	0.72	1.97	39	49	30
4/24/13	12:25	27	81	12	0.55	0.72	1.97	39	49	30
4/24/13	12:30	49	81	12	0.55	0.83	1.97	39	49	30
4/24/13	12:35	50	81	12	0.55	0.72	1.97	39	49	30
4/24/13	12:40	45	81	12	0.55	0.72	1.97	39	49	31
4/24/13	12:45	47	81	12	0.55	0.72	1.97	39	49	18
4/24/13	12:50	54	81	12	0.55	0.72	1.97	42	49	34
4/24/13	12:55	39	81	12	0.55	0.61	1.97	42	49	29
4/24/13	13:00	39	81	12	0.55	0.83	1.97	42	49	30
4/24/13	13:05	45	81	12	0.55	0.93	2.08	42	46	30
4/24/13	13:10	43	81	12	0.55	0.83	2.08	42	46	30
4/24/13	13:15	42	81	12	0.55	0.83	2.08	42	46	30

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/24/13	13:20	42	7	12	0.54	0.72	2.08	42	46	30
4/24/13	13:25	42	7	12	0.54	0.72	2.08	42	46	30
4/24/13	13:30	45	7,046	12	0.54	0.72	2.08	42	46	30
4/24/13	13:35	44	11,408	12	0.54	0.72	2.08	42	46	30
4/24/13	13:40	43	8,384	12	0.54	0.72	2.08	42	46	30
4/24/13	13:45	43	6,966	12	0.54	0.72	2.08	42	46	30
4/24/13	13:50	44	12,396	12	0.54	0.72	2.08	46	46	30
4/24/13	13:55	42	1,820	12	0.54	0.72	2.08	46	46	30
4/24/13	14:00	35	30	12	0.54	0.72	2.08	46	46	30
4/25/13	6:00	44	12,427	36	0.69	0.88	2.82	34	42	32
4/25/13	6:05	45	12,427	36	0.69	0.88	2.82	34	42	32
4/25/13	6:10	44	12,427	36	0.69	0.88	2.82	34	42	32
4/25/13	6:15	44	12,427	36	0.69	0.88	2.82	35	42	32
4/25/13	6:20	44	76	36	0.71	0.99	2.82	35	42	32
4/25/13	6:25	30	76	36	0.71	0.99	2.82	35	42	32
4/25/13	6:30	29	76	36	0.71	0.99	2.82	35	42	32
4/25/13	6:35	44	76	36	0.71	0.99	2.82	35	42	32
4/25/13	6:40	46	76	36	0.71	0.99	2.82	35	42	32
4/25/13	6:45	43	76	36	0.71	0.99	2.82	35	42	32
4/25/13	6:50	47	76	36	0.71	1.09	2.82	35	42	32
4/25/13	6:55	51	76	36	0.71	1.09	2.93	35	42	32
4/25/13	7:00	47	76	36	0.71	1.09	2.93	35	42	32
4/25/13	7:05	47	76	32	0.71	1.09	2.93	35	42	32
4/25/13	7:10	47	76	32	0.71	1.09	2.93	35	42	32

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/25/13	7:15	45	76	32	0.71	0.77	2.93	37	42	32
4/25/13	7:20	45	4	32	0.68	0.66	2.93	37	42	32
4/25/13	7:25	45	4	32	0.68	0.66	2.93	37	42	32
4/25/13	7:30	45	4	32	0.68	0.66	2.93	37	42	32
4/25/13	7:35	45	4	32	0.68	0.66	2.93	37	42	32
4/25/13	7:40	45	4	32	0.62	0.66	2.93	37	42	32
4/25/13	7:45	45	4	32	0.62	0.66	2.93	37	42	32
4/25/13	7:50	45	4	32	0.62	0.66	2.93	37	36	32
4/25/13	7:55	43	4	32	0.55	0.66	3.07	37	36	32
4/25/13	8:00	39	4	32	0.55	0.55	3.07	37	36	32
4/25/13	8:05	37	4	38	0.55	0.55	3.07	37	36	32
4/25/13	8:10	35	4	38	0.55	0.66	3.07	37	36	32
4/25/13	8:15	36	4	38	0.55	1.20	3.07	38	36	32
4/25/13	8:20	36	4	38	0.55	1.86	3.07	38	36	32
4/25/13	8:25	36	4	38	0.49	1.96	2.59	38	36	32
4/25/13	8:30	37	4	38	0.49	2.07	2.59	38	36	32
4/25/13	8:35	36	4	38	0.55	2.07	2.49	38	36	32
4/25/13	8:40	37	6,879	38	0.55	2.07	2.49	38	36	32
4/25/13	8:45	37	12,405	38	0.61	2.18	2.49	38	36	32
4/25/13	8:50	38	12,405	38	0.68	2.18	2.49	38	35	32
4/25/13	8:55	38	6,944	38	0.68	2.17	2.49	38	35	27
4/25/13	9:00	39	12,476	38	0.68	2.27	2.49	38	35	32
4/25/13	9:05	37	12,476	44	0.68	2.02	2.49	38	35	32
4/25/13	9:10	39	8,595	44	0.74	2.27	2.49	38	35	32

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/25/13	9:15	37	55	44	0.74	3.11	2.49	38	35	32
4/25/13	9:20	22	55	44	0.74	3.32	2.49	38	38	32
4/25/13	9:25	35	55	44	0.74	3.43	2.49	38	38	32
4/25/13	9:30	43	55	44	0.74	3.30	2.49	38	38	32
4/25/13	9:35	39	55	44	0.87	3.30	2.49	38	41	32
4/25/13	9:40	41	55	44	0.93	3.30	2.49	38	41	32
4/25/13	9:45	41	55	44	0.99	3.07	2.49	38	41	32
4/25/13	9:50	41	55	44	1.05	3.07	2.49	38	41	32
4/25/13	9:55	41	55	44	1.11	2.96	2.49	38	41	32
4/25/13	10:00	41	55	44	1.11	2.96	2.49	38	41	32
4/25/13	10:05	41	55	49	1.18	3.06	2.49	38	41	32
4/25/13	10:10	45	55	49	1.18	3.06	2.49	38	41	32
4/25/13	10:15	39	7	46	1.59	3.86	2.49	40	41	32
4/25/13	10:20	40	7	46	1.72	4.00	2.49	40	41	32
4/25/13	10:25	41	7	46	1.79	3.66	2.49	40	41	32
4/25/13	10:30	41	7	46	1.98	3.66	2.49	40	41	32
4/25/13	10:35	41	7	46	1.98	3.77	2.58	40	40	32
4/25/13	10:40	48	7	46	1.72	3.67	2.58	40	40	32
4/25/13	10:45	42	7	46	1.78	3.29	2.58	40	40	32
4/25/13	10:50	40	7	46	1.78	3.41	2.58	40	40	32
4/25/13	10:55	38	7	42	1.78	3.41	2.58	40	40	32
4/25/13	11:00	36	7	42	1.78	3.30	2.58	40	40	32
4/25/13	11:05	36	7	42	1.78	2.84	2.26	40	40	32
4/25/13	11:10	36	7	31	1.72	2.84	2.26	40	40	32

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/25/13	11:15	36	4	31	1.66	2.72	2.26	41	40	32
4/25/13	11:20	36	4	31	1.59	1.49	2.26	41	40	32
4/25/13	11:25	36	4	31	1.53	1.06	2.26	41	40	32
4/25/13	11:30	36	4	31	1.32	0.95	2.26	41	40	32
4/25/13	11:35	40	4	31	1.12	0.95	2.26	41	40	33
4/25/13	11:40	33	4	31	0.99	0.95	2.26	41	40	32
4/25/13	11:45	33	4	31	0.87	0.95	2.26	41	40	32
4/25/13	11:50	33	4	31	0.81	0.93	2.26	41	40	32
4/25/13	11:55	33	5,090	31	0.75	0.93	2.26	41	40	32
4/25/13	12:00	33	10,162	31	0.75	0.93	2.26	41	40	32
4/25/13	12:05	35	12,533	31	0.75	0.93	2.06	41	40	32
4/25/13	12:10	38	12,533	31	0.69	0.82	2.06	41	40	32
4/25/13	12:15	36	7,027	31	0.69	0.82	2.06	42	40	32
4/25/13	12:20	36	12,526	31	0.69	0.82	2.06	42	40	32
4/25/13	12:25	38	12,526	31	0.69	0.82	2.06	42	40	32
4/25/13	12:30	36	2,831	31	0.69	0.82	2.06	42	40	32
4/25/13	12:35	34	10	31	0.69	0.82	2.06	42	40	32
4/25/13	12:40	13	10	31	0.69	0.82	2.06	42	40	32
4/25/13	12:45	43	10	31	0.69	0.93	2.06	42	40	32
4/25/13	12:50	38	10	31	0.69	0.72	2.06	42	40	32
4/25/13	12:55	36	10	31	0.69	0.82	2.06	42	40	32
4/25/13	13:00	36	10	31	0.69	0.82	2.06	42	40	32
4/25/13	13:05	36	10	31	0.69	0.82	2.01	42	40	32
4/25/13	13:10	41	10	31	0.63	0.82	2.01	42	40	32

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/25/13	13:15	37	10	31	0.63	0.82	2.01	44	40	32
4/25/13	13:20	39	10	31	0.63	0.82	2.01	44	40	32
4/25/13	13:25	41	10	31	0.63	0.82	2.01	44	40	32
4/25/13	13:30	41	10	31	0.63	0.82	2.01	44	40	32
4/25/13	13:35	41	10	31	0.63	0.82	2.01	44	39	32
4/25/13	13:40	41	10	31	0.63	0.82	2.01	44	39	32
4/25/13	13:45	41	10	31	0.63	0.82	2.01	44	39	32
4/25/13	13:50	41	10	31	0.63	0.82	2.01	44	39	32
4/25/13	13:55	41	10	31	0.63	0.80	2.01	44	39	32
4/25/13	14:00	41	10	31	0.63	0.80	2.01	48	39	32
4/29/13	6:00	31	6,856	28	0.49	0.63	2.33	49	28	20
4/29/13	6:05	29	12,458	28	0.49	0.51	2.33	49	28	20
4/29/13	6:10	31	12,458	28	0.49	0.51	2.35	49	28	20
4/29/13	6:15	31	6,829	28	0.49	0.51	2.35	49	28	20
4/29/13	6:20	29	7,118	28	0.55	0.51	2.35	49	28	20
4/29/13	6:25	31	7,118	28	0.55	0.51	2.31	49	28	20
4/29/13	6:30	29	12,454	28	0.55	0.51	2.31	49	28	20
4/29/13	6:35	31	3,386	28	0.55	0.51	2.31	49	28	20
4/29/13	6:40	27	24	28	0.55	0.51	2.31	49	28	20
4/29/13	6:45	10	24	28	0.55	0.51	2.31	49	28	20
4/29/13	6:50	26	24	28	0.55	0.51	2.31	49	28	20
4/29/13	6:55	30	24	28	0.55	0.62	2.31	49	28	20
4/29/13	7:00	27	24	28	0.55	0.51	2.31	49	27	20
4/29/13	7:05	29	24	28	0.55	0.51	2.31	49	27	20

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/29/13	7:10	27	24	28	0.55	0.51	2.31	49	27	20
4/29/13	7:15	29	24	28	0.55	0.51	7.26	52	27	20
4/29/13	7:20	27	24	28	0.53	0.51	1.68	52	27	20
4/29/13	7:25	27	24	28	0.53	0.51	1.68	52	27	20
4/29/13	7:30	27	24	28	0.53	0.51	1.68	52	27	20
4/29/13	7:35	27	24	28	0.53	0.51	1.68	52	27	20
4/29/13	7:40	27	12	28	0.53	0.51	1.68	52	27	20
4/29/13	7:45	27	12	28	0.53	0.51	1.62	52	27	20
4/29/13	7:50	29	12	28	0.53	0.51	1.62	52	27	20
4/29/13	7:55	27	12	28	0.53	0.51	1.62	56	24	20
4/29/13	8:00	22	12	28	0.53	0.51	1.62	56	24	20
4/29/13	8:05	27	12	42	0.53	0.51	1.62	56	24	20
4/29/13	8:10	22	12	44	0.53	0.62	1.62	56	24	20
4/29/13	8:15	22	12	48	0.53	0.62	1.62	56	24	20
4/29/13	8:20	22	12	45	0.53	2.17	1.62	56	24	20
4/29/13	8:25	22	12	43	0.53	3.49	1.62	56	24	19
4/29/13	8:30	26	12	30	0.53	4.91	1.62	56	24	17
4/29/13	8:35	24	12	30	0.53	4.91	1.62	56	24	16
4/29/13	8:40	24	13	30	0.59	4.71	1.62	56	24	16
4/29/13	8:45	22	13	30	0.65	2.23	1.64	61	24	16
4/29/13	8:50	22	13	35	0.08	1.35	1.64	61	24	16
4/29/13	8:55	22	13	35	0.08	1.24	1.64	61	23	16
4/29/13	9:00	22	13	35	0.08	1.24	1.64	61	23	16
4/29/13	9:05	22	13	40	0.08	1.99	1.64	61	23	16

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/29/13	9:10	22	13	38	0.08	2.17	1.64	61	23	16
4/29/13	9:15	22	13	38	0.08	2.42	1.64	61	23	16
4/29/13	9:20	24	13	38	1.24	3.29	1.64	61	23	16
4/29/13	9:25	24	13	38	1.24	3.18	1.64	61	23	16
4/29/13	9:30	24	13	38	1.24	2.97	1.64	61	23	16
4/29/13	9:35	24	13	38	1.24	2.96	1.64	61	21	16
4/29/13	9:40	19	12	38	1.24	2.96	1.64	61	28	16
4/29/13	9:45	28	12	38	1.30	2.97	1.43	63	25	16
4/29/13	9:50	26	12	38	1.36	3.32	1.43	63	25	16
4/29/13	9:55	24	12	38	0.16	3.31	1.43	63	25	16
4/29/13	10:00	26	12	38	0.09	2.73	1.43	63	25	16
4/29/13	10:05	24	12	42	0.09	2.84	1.43	63	25	16
4/29/13	10:10	26	12	42	0.09	2.96	1.43	63	25	16
4/29/13	10:15	26	12	42	0.09	2.96	1.43	63	25	16
4/29/13	10:20	26	12	42	0.09	3.59	1.43	63	25	15
4/29/13	10:25	26	12	42	0.09	3.72	1.43	63	25	15
4/29/13	10:30	26	12	42	0.09	3.81	1.43	63	25	14
4/29/13	10:35	26	12	42	0.09	3.93	1.43	63	25	15
4/29/13	10:40	26	12	42	0.09	3.83	1.43	63	28	16
4/29/13	10:45	26	12	42	0.09	3.95	1.54	65	28	18
4/29/13	10:50	24	12	42	0.09	3.98	1.54	65	28	18
4/29/13	10:55	28	12	42	0.09	3.97	1.54	65	28	18
4/29/13	11:00	26	12	42	0.04	4.20	1.54	65	28	18
4/29/13	11:05	28	12	42	0.04	3.80	1.54	65	28	18

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/29/13	11:10	24	12	42	0.04	3.80	1.54	65	28	18
4/29/13	11:15	28	12	42	0.04	3.75	1.54	65	28	18
4/29/13	11:20	28	12	28	0.04	3.86	1.54	65	28	19
4/29/13	11:25	28	12	28	0.04	3.62	1.54	65	28	19
4/29/13	11:30	28	12	28	0.04	1.97	1.54	65	28	19
4/29/13	11:35	28	12	28	0.04	1.03	1.54	65	28	19
4/29/13	11:40	28	10	28	0.04	0.93	1.54	69	28	19
4/29/13	11:45	28	10	28	0.04	0.82	1.31	69	28	19
4/29/13	11:50	28	10	28	0.04	0.82	1.31	69	28	20
4/29/13	11:55	26	10	28	0.04	0.82	1.31	69	28	20
4/29/13	12:00	26	10	28	0.03	0.82	1.31	69	29	20
4/29/13	12:05	26	10	28	0.03	0.82	1.31	69	29	20
4/29/13	12:10	26	10	28	0.03	0.71	1.31	69	29	20
4/29/13	12:15	26	10	28	0.03	0.71	1.31	69	29	20
4/29/13	12:20	26	10	28	0.03	0.71	1.31	69	29	20
4/29/13	12:25	28	10	28	0.03	0.71	1.31	69	29	20
4/29/13	12:30	26	10	28	0.03	0.71	1.31	69	29	20
4/29/13	12:35	28	10	28	0.03	0.71	1.31	69	29	21
4/29/13	12:40	26	10	28	0.03	0.71	1.31	70	29	21
4/29/13	12:45	28	10	28	0.03	0.71	1.27	70	29	21
4/29/13	12:50	26	10	28	0.03	0.71	1.27	70	29	21
4/29/13	12:55	26	10	28	0.03	0.71	1.27	70	29	21
4/29/13	13:00	26	10	28	0.03	0.71	1.27	70	27	21
4/29/13	13:05	22	10	28	0.03	0.71	1.27	70	27	21

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/29/13	13:10	28	10	28	0.03	0.69	1.27	70	27	21
4/29/13	13:15	28	10	28	0.03	0.80	1.27	70	27	21
4/29/13	13:20	28	10	28	0.03	0.80	1.27	70	27	21
4/29/13	13:25	28	10	28	0.03	0.80	1.27	70	27	21
4/29/13	13:30	28	10	28	0.03	0.70	1.27	70	30	22
4/29/13	13:35	28	10	28	0.03	0.70	1.27	70	46	22
4/29/13	13:40	38	10	28	0.03	0.70	1.27	73	43	22
4/29/13	13:45	40	10	28	0.03	0.70	1.35	73	43	22
4/29/13	13:50	40	10	28	0.03	0.49	1.35	73	43	22
4/29/13	13:55	40	10	28	0.03	0.49	1.35	73	21	22
4/29/13	14:00	34	10	28	0.02	0.49	1.35	73	24	22
4/30/13	6:00	27	6,848	28	0.42	0.67	1.64	59	25	20
4/30/13	6:05	27	7,149	28	0.42	0.67	1.64	59	25	20
4/30/13	6:10	27	7,191	28	0.42	0.67	1.64	59	27	20
4/30/13	6:15	23	6,901	28	0.42	0.67	1.64	59	27	20
4/30/13	6:20	26	12,569	28	0.42	0.67	1.64	59	27	20
4/30/13	6:25	28	12,551	28	0.45	0.67	1.64	59	27	20
4/30/13	6:30	24	63	28	0.45	0.77	1.64	59	27	20
4/30/13	6:35	14	63	28	0.45	0.77	1.64	59	27	20
4/30/13	6:40	9	63	28	0.45	0.67	1.64	59	27	20
4/30/13	6:45	30	63	28	0.45	0.67	1.64	59	27	20
4/30/13	6:50	28	63	28	0.45	0.77	1.64	59	27	20
4/30/13	6:55	26	63	28	0.45	0.55	1.64	59	27	20
4/30/13	7:00	28	63	28	0.45	0.66	1.64	59	27	20

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/30/13	7:05	25	63	28	0.45	0.66	1.64	59	27	20
4/30/13	7:10	27	63	28	0.45	0.66	1.64	59	26	20
4/30/13	7:15	27	63	28	0.45	0.66	1.64	59	26	20
4/30/13	7:20	27	63	28	0.45	0.66	1.64	59	26	20
4/30/13	7:25	27	63	28	0.44	0.66	1.64	59	26	20
4/30/13	7:30	27	12	28	0.44	0.66	1.68	59	26	20
4/30/13	7:35	25	12	28	0.44	0.66	1.68	59	26	20
4/30/13	7:40	25	12	28	0.44	0.66	1.68	60	26	20
4/30/13	7:45	25	12	28	0.44	0.66	1.68	60	26	20
4/30/13	7:50	25	12	28	0.44	0.66	1.68	60	26	20
4/30/13	7:55	27	12	34	0.44	0.66	1.68	60	26	20
4/30/13	8:00	25	12	34	0.44	0.69	1.68	60	26	20
4/30/13	8:05	27	12	34	0.44	0.69	1.68	60	26	20
4/30/13	8:10	27	12	34	0.44	1.22	1.68	60	25	20
4/30/13	8:15	27	12	34	0.44	1.55	1.68	60	25	20
4/30/13	8:20	27	12	34	0.44	1.55	1.68	60	28	19
4/30/13	8:25	27	12	34	0.44	1.43	1.68	60	28	20
4/30/13	8:30	25	12	34	0.44	1.54	1.75	60	28	20
4/30/13	8:35	27	12	36	0.50	1.43	1.75	60	28	20
4/30/13	8:40	27	12	36	0.57	1.64	1.75	61	28	20
4/30/13	8:45	28	12	36	0.57	1.76	1.75	61	28	20
4/30/13	8:50	28	12	36	0.63	1.86	1.75	61	28	20
4/30/13	8:55	25	12	36	0.63	1.97	1.75	61	28	20
4/30/13	9:00	25	12	36	0.69	1.97	1.75	61	28	20

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/30/13	9:05	25	12	40	0.69	1.97	1.75	61	28	20
4/30/13	9:10	25	12	40	0.69	1.97	1.75	61	28	20
4/30/13	9:15	25	12	40	0.75	2.42	1.75	61	28	20
4/30/13	9:20	25	12	40	0.75	2.76	1.75	61	26	20
4/30/13	9:25	25	12	40	0.75	2.97	1.75	61	26	20
4/30/13	9:30	25	10	40	0.75	2.96	1.71	61	26	20
4/30/13	9:35	25	10	44	0.82	3.07	1.71	61	26	20
4/30/13	9:40	25	10	46	0.82	2.96	1.71	64	26	20
4/30/13	9:45	25	10	46	0.88	3.52	1.71	64	26	20
4/30/13	9:50	25	10	46	0.94	3.98	1.71	64	26	20
4/30/13	9:55	25	10	46	0.94	4.53	1.71	64	26	20
4/30/13	10:00	27	10	46	1.00	4.99	1.71	64	26	20
4/30/13	10:05	25	10	46	1.00	4.99	1.71	68	26	20
4/30/13	10:10	25	10	46	1.06	4.99	1.71	68	26	20
4/30/13	10:15	25	10	46	1.12	4.99	1.71	68	26	20
4/30/13	10:20	25	10	46	1.18	4.99	1.71	68	26	20
4/30/13	10:25	25	10	46	1.31	4.99	1.71	68	26	20
4/30/13	10:30	27	12	46	1.38	4.99	1.64	68	26	20
4/30/13	10:35	27	12	46	1.44	4.99	1.64	68	26	20
4/30/13	10:40	27	12	47	1.51	4.99	1.64	68	26	20
4/30/13	10:45	27	12	47	1.51	4.99	1.64	68	26	20
4/30/13	10:50	25	12	47	1.58	4.99	1.64	73	26	19
4/30/13	10:55	25	12	28	1.64	4.99	1.64	73	26	19
4/30/13	11:00	27	12	28	1.64	4.99	1.64	73	26	19

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/30/13	11:05	25	12	28	1.64	4.99	1.64	73	26	20
4/30/13	11:10	27	12	28	1.70	1.61	1.64	73	26	20
4/30/13	11:15	27	12	28	1.70	1.27	1.64	73	26	20
4/30/13	11:20	27	12	28	1.77	1.06	1.64	73	26	20
4/30/13	11:25	27	12	28	1.77	0.95	1.64	73	26	20
4/30/13	11:30	27	10	28	1.64	0.95	1.43	73	26	20
4/30/13	11:35	27	10	28	1.51	0.84	1.43	73	26	20
4/30/13	11:40	27	10	28	1.31	0.84	1.43	73	26	20
4/30/13	11:45	27	10	28	1.13	0.84	1.43	73	26	20
4/30/13	11:50	25	10	28	1.07	0.84	1.43	75	26	20
4/30/13	11:55	27	10	28	0.94	0.84	1.43	75	26	20
4/30/13	12:00	27	10	28	0.88	0.84	1.43	75	26	20
4/30/13	12:05	27	10	28	0.82	0.84	1.43	75	26	20
4/30/13	12:10	27	10	28	0.75	0.84	1.43	75	26	20
4/30/13	12:15	27	10	28	0.69	0.84	1.43	75	26	20
4/30/13	12:20	25	10	28	0.69	0.84	1.43	75	27	20
4/30/13	12:25	25	10	28	0.63	0.84	1.43	75	27	20
4/30/13	12:30	25	12	28	0.63	0.84	1.48	75	27	20
4/30/13	12:35	25	12	28	0.63	0.74	1.48	79	27	20
4/30/13	12:40	27	12	28	0.57	0.74	1.48	79	27	20
4/30/13	12:45	25	12	28	0.57	0.74	1.48	79	27	20
4/30/13	12:50	25	12	28	0.57	0.74	1.48	79	27	20
4/30/13	12:55	27	12	28	0.57	0.74	1.48	79	27	20
4/30/13	13:00	27	12	28	0.57	0.74	1.48	79	27	20

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
4/30/13	13:05	27	12	28	0.57	0.74	1.48	79	27	20
4/30/13	13:10	27	12	28	0.57	0.74	1.48	79	27	20
4/30/13	13:15	23	12	28	0.57	0.74	1.48	79	27	20
4/30/13	13:20	13	12	28	0.51	0.74	1.48	79	27	20
4/30/13	13:25	26	12	28	0.51	0.74	1.48	83	27	20
4/30/13	13:30	24	10	28	0.51	0.85	1.48	83	27	20
4/30/13	13:35	26	10	28	0.51	0.95	1.48	83	27	20
4/30/13	13:40	26	10	28	0.51	0.85	1.48	83	27	20
4/30/13	13:45	26	10	28	0.51	0.85	1.48	83	27	20
4/30/13	13:50	28	10	30	0.51	0.74	1.48	83	27	20
4/30/13	13:55	26	10	26	0.51	0.74	1.48	83	27	20
4/30/13	14:00	26	10	26	0.51	0.74	1.48	83	27	20
6/12/13	7:00	22	10	36	0.80	1.60	1.79	67	25	17
6/12/13	7:05	22	10	36	0.80	1.60	1.79	68	25	17
6/12/13	7:10	22	10	36	0.86	1.60	1.79	68	25	17
6/12/13	7:15	22	10	36	0.86	1.60	1.79	68	25	17
6/12/13	7:20	22	10	36	0.86	1.60	1.79	68	25	17
6/12/13	7:25	22	10	36	0.86	1.60	1.79	68	25	17
6/12/13	7:30	22	10	36	0.86	1.60	1.79	68	25	17
6/12/13	7:35	22	10	36	0.86	1.60	1.77	68	25	17
6/12/13	7:40	22	10	36	0.86	1.71	1.77	68	25	18
6/12/13	7:45	22	10	36	0.86	1.60	1.77	68	25	18
6/12/13	7:50	22	10	36	0.86	1.71	1.77	68	25	18
6/12/13	7:55	22	10	36	0.86	1.71	1.77	68	25	18

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
6/12/13	8:00	22	10	36	0.86	1.71	1.77	68	25	18
6/12/13	8:05	22	10	36	0.86	1.82	1.77	72	25	17
6/12/13	8:10	22	10	36	0.89	1.82	1.77	72	26	17
6/12/13	8:15	22	10	37	0.89	1.80	1.77	72	26	17
6/12/13	8:20	22	10	37	0.89	1.91	1.77	72	26	17
6/12/13	8:25	22	10	37	0.89	1.91	1.77	72	26	17
6/12/13	8:30	22	10	37	0.89	1.80	1.77	72	26	17
6/12/13	8:35	22	10	37	0.89	1.80	1.77	72	26	17
6/12/13	8:40	22	10	37	0.89	1.92	1.77	72	26	17
6/12/13	8:45	23	10	37	0.89	1.92	1.77	72	26	17
6/12/13	8:50	23	10	37	0.89	1.92	1.77	72	23	17
6/12/13	8:55	21	10	37	0.95	1.92	1.77	72	23	17
6/12/13	9:00	21	10	37	0.95	1.92	1.77	72	23	17
6/12/13	9:05	21	10	37	0.93	1.80	1.77	71	23	17
6/12/13	9:10	21	10	37	0.93	2.01	1.77	71	27	17
6/12/13	9:15	21	10	37	0.93	2.01	1.77	71	23	17
6/12/13	9:20	21	10	37	0.93	2.11	1.77	71	23	17
6/12/13	9:25	21	10	37	0.93	2.11	1.77	71	23	17
6/12/13	9:30	23	10	37	0.93	2.22	1.77	71	23	17
6/12/13	9:35	18	10	37	0.93	2.33	1.73	71	23	17
6/12/13	9:40	20	10	37	0.93	2.21	1.73	71	24	17
6/12/13	9:45	20	10	37	0.93	2.11	1.73	71	24	17
6/12/13	9:50	20	10	37	0.93	2.21	1.73	71	24	17
6/12/13	9:55	20	10	37	0.93	2.21	1.73	71	24	17

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
6/12/13	10:00	20	10	37	0.99	2.21	1.73	71	24	17
6/12/13	10:05	20	10	37	0.99	2.21	1.73	75	24	17
6/12/13	10:10	20	10	37	0.99	2.21	1.73	75	24	17
6/12/13	10:15	17	10	37	0.99	2.21	1.73	75	24	17
6/12/13	10:20	22	10	37	0.99	2.32	1.73	75	24	17
6/12/13	10:25	20	10	37	0.99	2.21	1.73	75	24	17
6/12/13	10:30	22	10	37	0.99	2.32	1.73	75	24	17
6/12/13	10:35	20	10	37	1.05	2.22	1.62	75	24	17
6/12/13	10:40	22	10	37	1.05	2.33	1.62	75	22	17
6/12/13	10:45	20	10	37	1.05	2.21	1.62	75	22	17
6/12/13	10:50	20	10	37	1.05	2.31	1.62	75	22	17
6/12/13	10:55	20	10	37	1.05	2.21	1.62	75	25	17
6/12/13	11:00	20	10	37	1.05	2.21	1.62	75	25	17
6/12/13	11:05	20	10	37	1.05	2.21	1.62	76	25	17
6/12/13	11:10	22	10	37	1.05	2.21	1.62	76	25	17
6/12/13	11:15	22	10	37	1.11	2.21	1.62	76	22	17
6/12/13	11:20	22	10	37	1.11	2.21	1.62	76	22	17
6/12/13	11:25	20	10	37	1.11	2.10	1.62	76	25	17
6/12/13	11:30	22	10	37	1.11	2.10	1.62	76	25	18
6/12/13	11:35	22	10	37	1.11	1.99	1.56	76	25	18
6/12/13	11:40	22	10	37	1.11	2.10	1.56	76	25	18
6/12/13	11:45	22	10	37	1.11	2.10	1.56	76	25	18
6/12/13	11:50	22	10	37	1.11	2.10	1.56	76	25	18
6/12/13	11:55	22	10	37	1.11	2.10	1.56	76	25	18

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
6/12/13	12:00	22	10	37	1.11	1.99	1.56	80	25	18
6/12/13	12:05	22	10	37	1.11	1.99	1.56	80	25	18
6/12/13	12:10	22	10	37	1.11	2.09	1.56	80	25	18
6/12/13	12:15	22	10	37	1.09	1.98	1.56	80	25	18
6/12/13	12:20	22	10	37	1.09	1.98	1.56	80	25	18
6/12/13	12:25	22	10	37	1.09	2.10	1.60	80	24	18
6/12/13	12:30	20	10	37	1.09	1.99	1.60	80	24	18
6/12/13	12:35	20	10	37	1.09	1.99	1.60	80	24	18
6/12/13	12:40	22	10	37	1.09	1.99	1.60	84	27	18
6/12/13	12:45	22	10	37	1.09	2.10	1.60	84	27	18
6/12/13	12:50	24	10	37	1.02	2.10	1.60	89	27	18
6/12/13	12:55	22	10	37	1.02	2.10	1.60	89	27	18
6/12/13	13:00	22	2,098	37	1.02	1.98	1.60	89	27	18
6/26/13	7:00	34	127	37	1.03	1.31	1.52	66	48	23
6/26/13	7:05	38	12	40	1.10	1.21	1.52	66	51	30
6/26/13	7:10	40	12	40	1.17	1.01	1.52	66	51	30
6/26/13	7:15	45	12	40	1.10	1.01	2.45	66	51	31
6/26/13	7:20	47	12	40	1.03	1.01	2.78	64	51	30
6/26/13	7:25	49	12	40	0.97	1.01	3.10	64	51	30
6/26/13	7:30	49	12	40	0.91	0.91	3.74	64	51	31
6/26/13	7:35	49	12	40	0.85	0.91	4.05	64	54	30
6/26/13	7:40	49	12	44	0.79	0.91	4.05	64	54	31
6/26/13	7:45	51	12	44	0.79	0.91	3.74	64	57	31
6/26/13	7:50	52	12	44	0.79	0.91	3.74	64	57	31

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
6/26/13	7:55	54	12	44	0.73	0.91	3.74	64	57	30
6/26/13	8:00	54	12	44	0.73	0.91	3.74	64	60	30
6/26/13	8:05	56	4	44	0.73	0.91	3.74	64	60	30
6/26/13	8:10	56	4	44	0.73	0.91	4.05	64	60	30
6/26/13	8:15	56	4	44	0.73	0.91	4.05	64	60	30
6/26/13	8:20	56	4	48	0.73	0.91	4.67	67	60	30
6/26/13	8:25	56	4	48	0.73	0.91	4.03	67	60	30
6/26/13	8:30	56	4	48	0.73	0.99	4.03	67	62	30
6/26/13	8:35	56	4	48	0.73	0.99	4.03	67	59	30
6/26/13	8:40	51	4	52	0.79	0.99	4.03	67	94	30
6/26/13	8:45	47	4	52	0.79	0.99	3.40	67	87	30
6/26/13	8:50	49	4	56	0.79	1.09	3.40	67	83	30
6/26/13	8:55	49	4	56	0.85	1.21	3.10	67	108	30
6/26/13	9:00	49	4	60	0.91	1.42	2.76	67	111	30
6/26/13	9:05	57	1	60	0.98	1.64	2.45	67	111	30
6/26/13	9:10	57	1	60	1.04	1.75	2.45	67	108	33
6/26/13	9:15	57	1	60	1.16	1.64	2.45	67	108	33
6/26/13	9:20	55	1	60	1.23	1.64	2.45	66	108	34
6/26/13	9:25	53	1	60	1.23	1.42	2.45	66	108	35
6/26/13	9:30	53	1	60	1.23	1.42	2.45	66	105	35
6/26/13	9:35	55	1	60	1.23	1.42	2.14	66	105	35
6/26/13	9:40	55	1	60	1.17	1.42	2.14	66	105	35
6/26/13	9:45	55	1	60	1.17	1.32	2.14	66	105	35
6/26/13	9:50	55	1	60	1.17	1.21	2.51	66	108	35

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
6/26/13	9:55	55	1	60	1.10	1.11	1.81	66	108	35
6/26/13	10:00	55	1	60	1.10	1.11	1.81	66	108	35
6/26/13	10:05	55	1	60	1.10	1.00	1.81	66	108	35
6/26/13	10:10	55	1	60	1.04	1.00	1.81	66	111	35
6/26/13	10:15	55	1	60	1.04	1.11	1.81	66	111	35
6/26/13	10:20	55	1	60	1.04	1.21	1.81	67	111	35
6/26/13	10:25	55	1	60	1.04	1.32	1.81	67	111	35
6/26/13	10:30	55	1	60	1.11	1.32	2.12	67	111	35
6/26/13	10:35	56	1	60	1.17	1.32	2.12	67	105	35
6/26/13	10:40	56	1	56	1.24	1.32	2.12	67	105	35
6/26/13	10:45	51	5,428	56	1.30	1.43	2.43	67	105	35
6/26/13	10:50	51	7,028	56	1.48	1.43	2.43	67	105	35
6/26/13	10:55	53	12,387	56	1.48	1.43	2.43	67	105	35
6/26/13	11:00	53	6,786	56	1.48	1.43	2.74	67	105	35
6/26/13	11:05	53	6,786	56	1.48	1.43	3.05	67	105	35
6/26/13	11:10	53	12,372	56	1.48	1.43	3.36	67	105	34
6/26/13	11:15	51	175	56	1.48	1.43	3.68	67	105	35
6/26/13	11:20	64	175	56	1.35	1.32	3.68	70	105	35
6/26/13	11:25	62	175	56	1.27	1.32	3.68	70	105	35
6/26/13	11:30	59	6,960	56	1.40	1.34	3.68	70	105	34
6/26/13	11:35	59	6,960	56	1.40	1.23	3.68	70	103	35
6/26/13	11:40	59	12,425	56	1.34	1.23	3.68	70	103	35
6/26/13	11:45	58	6,997	52	1.34	1.23	3.36	70	103	35
6/26/13	11:50	58	6,997	52	1.40	1.23	3.36	70	103	35

TABLE C-1 (Continued): DECENTRALIZED CONTROL SYSTEM DATA FOR STUDY SAMPLE DAYS

Date	Collect Sample	Filter Effluent Flow (MGD)	Backwash Pump Flow (GPM)	NaOCl Pump (% Stroke)	Clear Well TRC (mg/L)	Pre-Filter TRC (mg/L)	Pre-Filter Turbidity (NTU)	Outfall Temp (°F)	Plant Flow (MGD)	RAS Flow Total (MGD)
6/26/13	11:55	58	12,497	52	1.40	1.12	3.36	70	106	34
6/26/13	12:00	56	212	52	1.40	1.12	3.05	70	106	34
6/26/13	12:05	52	212	52	1.19	1.12	3.05	70	106	34
6/26/13	12:10	50	212	52	1.19	1.12	3.05	70	106	34
6/26/13	12:15	54	212	52	1.19	1.01	3.05	70	106	34
6/26/13	12:20	54	212	52	1.19	1.01	3.05	71	106	34
6/26/13	12:25	54	212	52	1.19	1.01	3.05	71	103	34
6/26/13	12:30	56	212	52	1.13	1.01	3.05	71	103	34
6/26/13	12:35	58	212	52	1.13	1.01	3.05	71	103	34
6/26/13	12:40	58	212	52	1.13	1.01	3.05	71	103	35
6/26/13	12:45	58	212	52	1.13	1.01	3.05	71	103	35
6/26/13	12:50	56	212	52	1.13	1.01	3.05	71	103	34
6/26/13	12:55	56	212	52	1.13	1.01	2.74	71	103	34
6/26/13	13:00	56	4	52	1.13	1.01	2.74	71	103	35

Note: Water can remain a liquid even below its freezing point, up to -25°C, if it is not disturbed and if the temperature does not drop further and no particle or ice crystal is added to it (<http://www.thewaterpage.com/waterbasics.htm>, accessed July 20, 2014).

TABLE C-2: FIELD AND ANALYTICAL DATA

Date	Pre-Filter Collect Sample Time	Collect & Hold AutoCat 9000 TRC (mg/L)	Collect and Hold FC (CFU/100 mL)	Prefilter SS (mg/L)[1]	Clear Well Collect Sample Time	Clear Well TRC (mg/L)	Clear Well FC (CFU/100 mL)
9/18/12	7:51	0.96	20	3.0	N/A[2]	N/A	N/A
9/18/12	8:21	0.96	16	2.8	N/A	N/A	N/A
9/18/12	8:40	1.08	<10	2.4	N/A	N/A	N/A
9/18/12	9:09	1.09	9	3.0	N/A	N/A	N/A
9/18/12	9:21	1.57	9	2.2	N/A	N/A	N/A
9/18/12	9:42	1.12	9	3.2	N/A	N/A	N/A
9/18/12	10:03	1.62	<10	2.0	N/A	N/A	N/A
9/18/12	10:15	0.95	30	2.4	N/A	N/A	N/A
9/18/12	10:30	0.83	9	2.0	N/A	N/A	N/A
9/25/12	7:51	1.38	<10	3.0	N/A	N/A	N/A
9/25/12	8:10	1.52	<10	3.0	N/A	N/A	N/A
9/25/12	8:28	1.42	<10	1.8	N/A	N/A	N/A
9/25/12	8:47	1.39	<10	2.2	N/A	N/A	N/A
9/25/12	9:05	1.32	<10	2.0	N/A	N/A	N/A
9/25/12	9:26	1.33	<10	2.6	N/A	N/A	N/A
9/25/12	9:46	1.40	<10	2.2	N/A	N/A	N/A
9/25/12	10:06	1.28	<10	1.8	N/A	N/A	N/A
9/25/12	10:26	1.26	<10	1.6	N/A	N/A	N/A
10/2/12	7:52	1.81	<10	2.4	N/A	N/A	N/A
10/2/12	8:12	2.20	<10	2.6	N/A	N/A	N/A
10/2/12	8:35	1.75	<10	2.4	N/A	N/A	N/A
10/2/12	8:55	1.75	<10	2.6	N/A	N/A	N/A
10/2/12	9:16	1.68	<10	2.4	N/A	N/A	N/A
10/2/12	9:38	1.56	<10	2.4	N/A	N/A	N/A

TABLE C-2 (Continued): FIELD AND ANALYTICAL DATA

Date	Pre-Filter Collect Sample Time	Collect & Hold AutoCat 9000 TRC (mg/L)	Collect and Hold FC (CFU/100 mL)	Prefilter SS (mg/L)[1]	Clear Well Collect Sample Time	Clear Well TRC (mg/L)	Clear Well FC (CFU/100 mL)
10/2/12	9:57	2.04	<10	2.4	N/A	N/A	N/A
10/2/12	10:19	1.58	<10	1.8	N/A	N/A	N/A
10/2/12	10:39	2.03	9	2.0	N/A	N/A	N/A
10/17/12	7:54	1.52	<10	4.4	N/A	N/A	N/A
10/17/12	8:15	1.83	<10	4.8	N/A	N/A	N/A
10/17/12	8:56	1.88	9	5.4	N/A	N/A	N/A
10/17/12	9:16	1.69	<10	5.2	N/A	N/A	N/A
10/17/12	9:36	1.73	<10	5.2	N/A	N/A	N/A
10/17/12	10:09	1.59	<10	4.4	N/A	N/A	N/A
10/17/12	10:30	1.62	<10	3.2	N/A	N/A	N/A
10/17/12	10:50	1.18	<10	4.8	N/A	N/A	N/A
10/17/12	11:10	1.03	9	4.8	N/A	N/A	N/A
10/23/12	8:05	1.43	<10	5.0	N/A	N/A	N/A
10/23/12	8:08	1.43	<10	5.0	N/A	N/A	N/A
10/23/12	8:26	1.84	<10	5.0	N/A	N/A	N/A
10/23/12	8:47	1.83	<10	4.6	N/A	N/A	N/A
10/23/12	9:11	1.33	<10	4.4	N/A	N/A	N/A
10/23/12	9:31	1.11	<10	4.4	N/A	N/A	N/A
10/23/12	9:52	1.18	<10	5.8	N/A	N/A	N/A
10/23/12	10:12	0.97	30	4.4	N/A	N/A	N/A
10/23/12	10:33	0.87	<10	4.6	N/A	N/A	N/A
10/23/12	10:53	0.85	<10	4.2	N/A	N/A	N/A
4/17/13	7:00	0.82	53	4.8	7:00	0.71	49
4/17/13	7:13	1.35	40	5.0	7:30	0.71	30

TABLE C-2 (Continued): FIELD AND ANALYTICAL DATA

Date	Pre-Filter Collect Sample Time	Collect & Hold AutoCat 9000 TRC (mg/L)	Collect and Hold FC (CFU/100 mL)	Prefilter SS (mg/L)[1]	Clear Well Collect Sample Time	Clear Well TRC (mg/L)	Clear Well FC (CFU/100 mL)
4/17/13	7:26	1.52	9	5.8	8:00	0.80	30
4/17/13	7:43	1.44	20	5.6	8:30	0.90	<10
4/17/13	8:39	2.37	<10	5.8	9:00	1.07	<10
4/17/13	9:24	2.39	<10	5.8	9:30	1.29	9
4/17/13	10:00	3.35	9	5.6	10:00	1.27	9
4/17/13	10:32	3.27	<10	6.0	10:30	1.51	<10
4/17/13	11:02	3.48	<10	4.8	11:00	1.68	<10
4/17/13	11:32	1.51	50	9.0	11:57	1.19	60
4/22/13	7:02	0.99	63	47.8	7:00	0.68	77
4/22/13	7:30	0.74	40	11.4	7:30	0.61	<10
4/22/13	8:02	0.77	<10	4.2	8:00	0.64	<10
4/22/13	8:31	2.24	9	4.6	8:30	0.64	<10
4/22/13	9:02	4.59	<10	5.0	9:00	0.79	<10
4/22/13	9:30	5.38	20	5.0	9:30	0.92	<10
4/22/13	10:00	6.75	<10	5.2	10:00	1.42	9
4/22/13	10:30	2.36	230	4.2	10:30	2.00	<10
4/22/13	11:00	0.37	<10	4.2	11:00	1.81	20
4/22/13	11:30	0.58	260	4.2	11:30	0.94	20
4/23/13	7:00	0.74	24	4.6	7:00	0.65	9
4/23/13	7:31	0.75	20	4.6	7:30	0.67	20
4/23/13	8:00	0.72	9	4.0	8:00	0.69	30
4/23/13	8:30	0.96	9	4.0	8:30	0.69	9
4/23/13	9:00	1.17	30	5.2	9:00	0.77	<10
4/23/13	9:23	0.95	30	4.8	9:30	0.83	<10

TABLE C-2 (Continued): FIELD AND ANALYTICAL DATA

Date	Pre-Filter Collect Sample Time	Collect & Hold AutoCat 9000 TRC (mg/L)	Collect and Hold FC (CFU/100 mL)	Prefilter SS (mg/L)[1]	Clear Well Collect Sample Time	Clear Well TRC (mg/L)	Clear Well FC (CFU/100 mL)
4/23/13	10:00	1.60	<10	4.2	10:00	0.82	9
4/23/13	10:30	1.53	<10	4.2	10:30	0.92	9
4/23/13	11:00	1.22	9	4.4	11:00	0.99	<10
4/23/13	11:25	1.72	<10	6.4	11:30	1.01	<10
4/24/13	7:00	0.26	1,196	7.4	7:00	0.66	40
4/24/13	7:30	0.43	320	6.0	7:30	0.40	270
4/24/13	8:00	0.44	270	5.6	8:00	0.42	230
4/24/13	8:30	1.63	30	5.4	8:30	0.58	140
4/24/13	9:00	0.36	220	5.2	9:00	1.05	9
4/24/13	9:30	0.92	140	5.4	9:30	0.70	50
4/24/13	10:00	1.44	20	4.6	10:00	0.78	30
4/24/13	10:30	1.32	30	4.8	10:30	0.95	30
4/24/13	11:01	1.76	20	4.8	11:00	1.16	20
4/24/13	11:30	0.48	130	4.4	11:30	0.89	40
4/25/13	7:00	0.71	77	6.0	7:00	0.70	28
4/25/13	7:30	0.48	190	6.6	7:30	0.67	9
4/25/13	8:00	0.46	230	6.0	8:00	0.55	9
4/25/13	8:30	1.45	50	5.4	8:30	0.52	<10
4/25/13	9:00	1.45	<10	5.2	9:00	0.73	<10
4/25/13	9:30	2.52	20	5.2	9:30	0.77	9
4/25/13	10:00	2.10	40	5.6	10:00	1.17	<10
4/25/13	10:30	2.93	9	5.4	10:30	1.98	9
4/25/13	11:00	2.20	20	4.8	11:00	1.76	9
4/25/13	11:35	0.58	70	4.6	11:45	0.86	80

TABLE C-2 (Continued): FIELD AND ANALYTICAL DATA

Date	Pre-Filter Collect Sample Time	Collect & Hold AutoCat 9000 TRC (mg/L)	Collect and Hold FC (CFU/100 mL)	Prefilter SS (mg/L)[1]	Clear Well Collect Sample Time	Clear Well TRC (mg/L)	Clear Well FC (CFU/100 mL)
4/29/13	7:00	0.41	352	4.4	7:00	0.53	55
4/29/13	7:30	0.53	120	4.0	7:30	0.52	60
4/29/13	8:00	0.52	<100	3.8	8:00	0.53	60
4/29/13	8:31	5.73	<10	4.0	8:30	0.51	70
4/29/13	9:00	0.87	30	3.6	9:00	n/a	9
4/29/13	9:31	2.62	9	3.2	9:30	1.08	<10
4/29/13	10:00	2.26	<10	3.0	10:00	1.30	<10
4/29/13	10:33	3.30	<10	2.8	10:30	1.46	<10
4/29/13	10:59	3.46	<10	3.4	11:00	1.65	<10
4/29/13	11:32	0.55	40	3.2	11:32	1.68	<10
4/30/13	7:00	0.62	40	4.0	7:00	0.46	19
4/30/13	7:30	0.57	80	4.2	7:30	0.45	<10
4/30/13	8:00	0.57	30	4.6	8:00	0.44	20
4/30/13	8:30	1.05	20	5.0	8:30	0.49	9
4/30/13	9:00	1.38	9	3.8	9:00	0.69	20
4/30/13	9:30	2.25	<10	4.0	9:30	0.81	9
4/30/13	10:00	4.21	<10	3.8	10:00	1.00	<10
4/30/13	10:30	4.18	9	3.2	10:30	1.35	<10
4/30/13	11:01	4.31	<10	3.6	11:00	1.65	<10
4/30/13	11:50	0.61	9	2.8	11:50	1.02	9
6/12/13	7:55	1.39	<10	3.6	N/A	N/A	N/A
6/12/13	8:17	1.47	9	3.0	N/A	N/A	N/A
6/12/13	8:37	1.56	9	2.4	N/A	N/A	N/A
6/12/13	8:55	1.50	<10	3.2	N/A	N/A	N/A

TABLE C-2 (Continued): FIELD AND ANALYTICAL DATA

Date	Pre-Filter Collect Sample Time	Collect & Hold AutoCat 9000 TRC (mg/L)	Collect and Hold FC (CFU/100 mL)	Prefilter SS (mg/L)[1]	Clear Well Collect Sample Time	Clear Well TRC (mg/L)	Clear Well FC (CFU/100 mL)
6/12/13	9:14	1.60	<10	2.6	N/A	N/A	N/A
6/12/13	9:33	1.91	<10	2.2	N/A	N/A	N/A
6/12/13	9:52	1.90	<10	1.8	N/A	N/A	N/A
6/12/13	10:15	1.80	<10	1.8	N/A	N/A	N/A
6/12/13	10:35	1.78	<10	2.0	N/A	N/A	N/A
6/26/13	8:00	1.02	55	15.4	N/A	N/A	N/A
6/26/13	8:20	0.92	90	10.0	N/A	N/A	N/A
6/26/13	8:40	1.12	<100	11.8	N/A	N/A	N/A
6/26/13	9:00	1.53	40	6.6	N/A	N/A	N/A
6/26/13	9:22	1.63	60	4.6	N/A	N/A	N/A
6/26/13	9:40	1.41	30	4.0	N/A	N/A	N/A
6/26/13	10:00	1.26	30	3.8	N/A	N/A	N/A
6/26/13	10:22	1.69	9	3.8	N/A	N/A	N/A
6/26/13	10:45	1.90	<10	4.8	N/A	N/A	N/A

[1]SS concentration disregards the practical quantification limit.
[2]N/A = Not applicable.