Suez Environment East Providence
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Riverside, RI 02915

Pilot Study Report:
Use of Protein Matrix at Suez Environment
Water Treatment Plant (East Providence, RI)

Executive Summary

The operations staff of the Suez Environment water treatment plant in East Providence, RI; Fay, Spofford & Thorndike LLC; and Protein Matrix LLC performed a collaborative study of the effects of Protein Matrix on treatment plant and collection system operations. Protein Matrix was applied to several different locations: the plant headworks – to allow treatment of all influent – and two lift stations, each of which had varying levels of historical FOG accumulation.

Results of the study were as follows:

- Observed reduction in the amount of FOG present within the facility
- Estimated 50% decrease in FOG-related operations and maintenance
- No adverse effects on plant processes
- No downstream resolidification of FOG
- Elimination of a historically-present "grease odor"
- Anticipated reduction in equipment wear/tear

Introduction

Protein Matrix products prevent fat, oil, and grease (FOG) buildup in pipes, lift stations, and grease traps and control odors through the prevention of hydrogen sulfide-producing scums. All Protein Matrix formulations contain neither bacteria nor enzymes and react with FOG molecules to produce a flowable non-foaming byproduct that will not re-solidify downstream and is digestible by wastewater treatment plant (WWTP) microorganisms. Certified under NSF/ANSI 60 for use in wastewater and potable water systems, Protein Matrix is a water-based biodegradable plant extract: non-toxic, non-flammable, non-volatile, and non-carcinogenic. Prior studies have shown that the use of Protein Matrix allows a WWTP to easily process the FOG that would otherwise accumulate in lift stations or downstream pipes, providing the following benefits:

- reduction of FOG-related maintenance
- odor control
- microbiological balance and efficiency
- cleaner effluent
- increased plant efficiency
- reduced hydrogen sulfide production

Measures of Success

The operations staff of the Suez Environment WWTP in East Providence, RI (EP); Fay, Spofford & Thorndike LLC (FST); and Protein Matrix LLC (PM) performed a collaborative study of the effects of Protein Matrix on treatment plant and collection system operations. The measures of success were as follows:

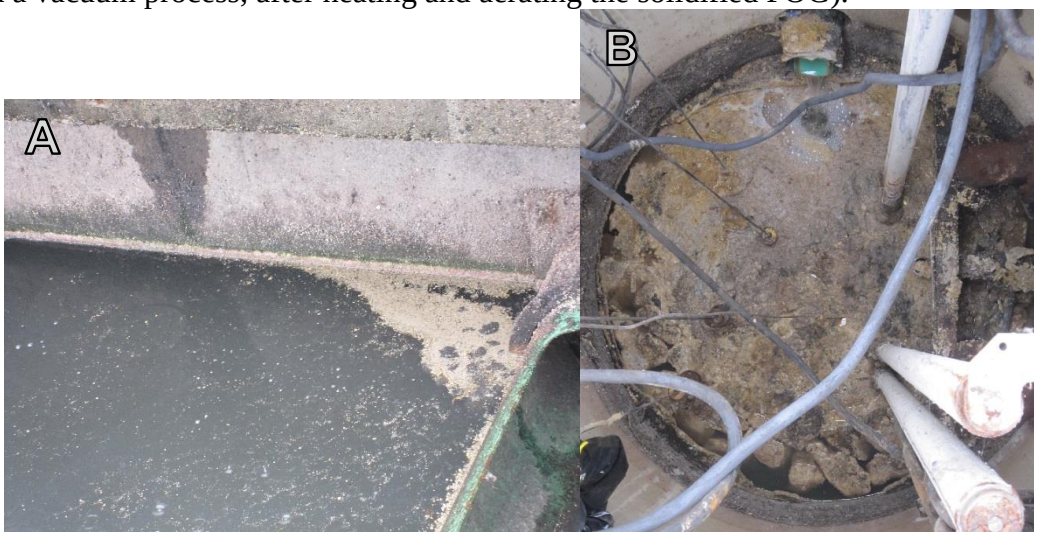
1. Reduction of operations and maintenance (O&M) effort and associated costs
2. No adverse changes in overall operations and/or performance

East Providence Water Treatment Facility

Located on the banks of the Providence River, the East Providence WWTP has been operated by United Water/Suez Environment since 2010. The facility, as designed, is rated for 14.1 MGD, and has a staff of 22. The treatment plant is connected to the community at large through a 140-mile collection system and 25 pump stations. The initial influent treatment process includes two grit chambers followed by four primary clarification tanks. The primary effluent then passes through aeration systems, secondary clarifiers, and chlorine contact tanks for disinfection. Once treated, it is released into the Providence River.

FOG-related Maintenance: As is the case in the vast majority of water treatment plants and outlying collection systems, the presence of FOG within the East Providence facility results in repetitive daily maintenance. Due to the rectangular geometry of the primary clarifiers (or "primaries"), FOG accumulates on the walls and in the corners, creating a "tide line" without regular raking of the surface (Figure 1A). This is a two-step process, in which mechanized rakes pull floating grease across the surface of the primaries, followed by manual raking of this FOG into rotating collection tubes. At this point, the grease flows from the collection tubes into a containment area (known as the stage 1 grease collection well – see Figure 1B). Flowable grease is diverted to the digesters on a biweekly basis, and the solids are pumped to a large grease pit (7000 gal, known as the

stage 2 grease pit) as needed. The stage 1 well requires regular cleaning to prevent grease buildup on the pumps, walls, and ladder, and the transfer line between this well and the digesters is frequently cleaned (via physical removal of solidified grease) to prevent clogs. Grease in the stage 2 pit is then removed by a waste recycling/biosolids company (via a vacuum process, after heating and aerating the solidified FOG).



Figures 1A and B. The effects of grease: a "tide line" on the primary clarifier and solidified FOG within the stage 1 grease collection well

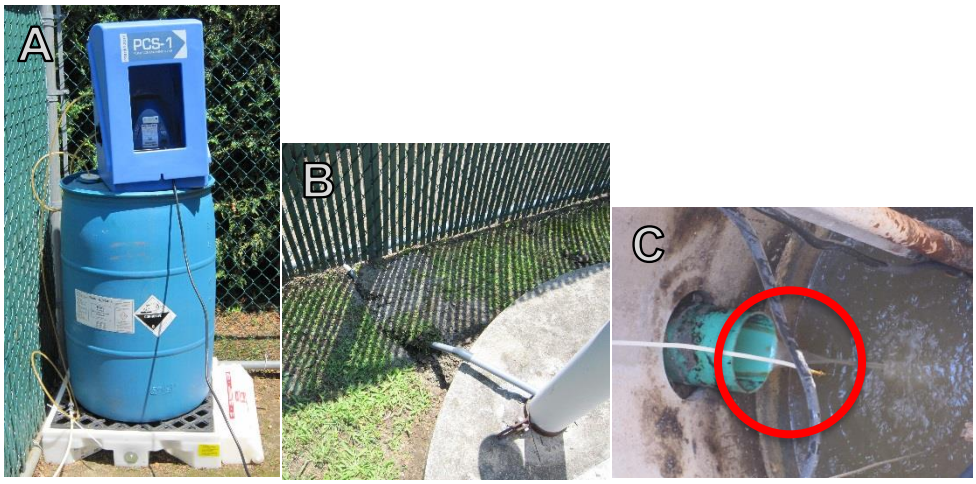
Pilot Methodology

The pilot study took place over the course of two months: six weeks of Protein Matrix treatment followed by two weeks without treatment that served as a negative control. Two different locations were selected for the application of Protein Matrix: 1) the plant headworks building, to allow treatment of all plant influent, and 2) a lift station, as these areas traditionally serve as areas of FOG accumulation.

For the headworks application, a Pulsafeeder XPV030 peristaltic metering pump was used to dose PM from a 275-gallon tote into the primary distribution box, to allow treatment of all influent as it entered the primary clarifiers (Figure 2). Throughout the study, metering pump flow at the headworks was adjusted on a weekly basis to determine the optimum dosage.

Figure 2. Installation at plant headworks allows for application of Protein Matrix immediately ahead of primary clarifiers

The lift station initially chosen for the pilot, known as the Sea View station, is one of the smaller lift stations within the collection system, handling less than 0.05 MGD. Prior to the installation, the lift station was cleaned to remove FOG buildup. A Pulsafeeder XPV008 peristaltic metering pump was used to dose Protein Matrix from a 55-gallon drum located in the fenced-in area adjacent to the lift station (Figure 3A). The feed line was run through PVC pipe buried under the fence and entered the lift station through the well's exterior vent (Figure 3B). The feed line was positioned to drip PM into the "waterfall" from the inlet gravity main (Figure 3C), so as to maximize agitation and, in turn, facilitate the PM-FOG reaction.



Figures 3A-C. Protein Matrix installation at Sea View: dosing line plumbed from fenced area (A), under fence (B), and aligned to deliver Protein Matrix into "waterfall" (C).

After one month of treatment, the system was moved to the Watchemoket pump station, so named due to its location on the shores of Watchemoket Cove. This station is designed for 10 MGD and must be flushed every week due to FOG accumulation. Prior to the pilot, when this station was flushed, large balls of grease were sent downstream and collected in the primary clarifier tanks. At this location, the Protein Matrix feed line was positioned immediately after the channel grinder.

Results

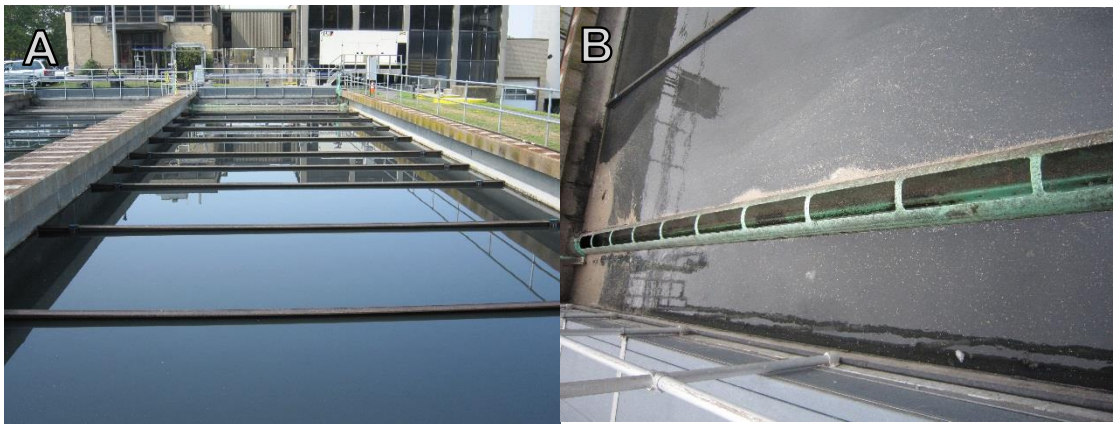
The most notable results of the pilot study can be summarized as follows:

- An observed reduction in the amount of FOG present within the plant
- An estimated 50% decrease in FOG-related O&M
- No adverse effects on plant processes
- Elimination of "grease odor"

Plant activity was monitored for two weeks after the cessation of Protein Matrix treatment. During this time, observed grease returned to pre-pilot levels, and with it, the O&M requirements of EP staff – that is, the benefits that occurred during the pilot were lost upon the conclusion of treatment.

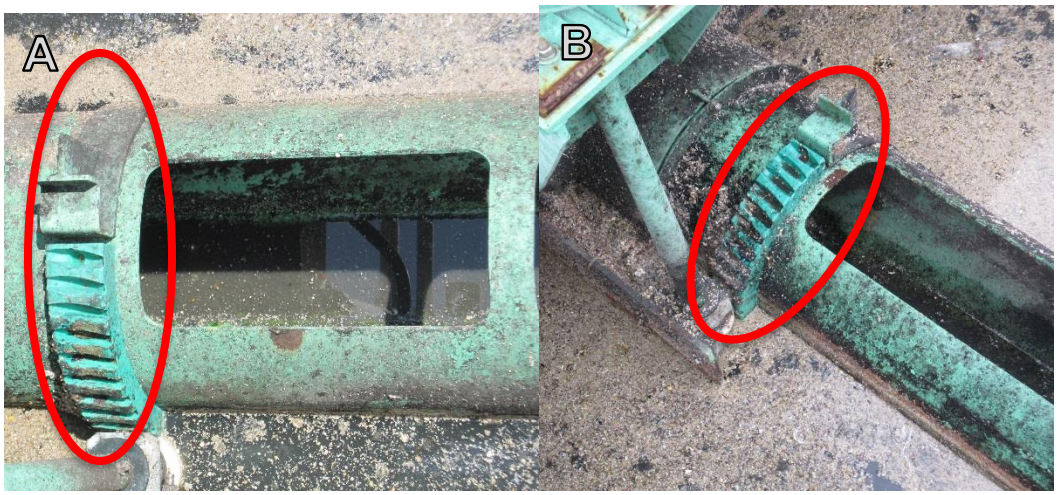
Headworks

During the pilot, EP staff observed a significant reduction in grease throughout the facility, which manifested itself in a number of ways. The first significant indicator was the absence of a tide line and oily sheen on the primary clarifiers (Figures 4A and B) – in fact, the EP assessment was that primaries were "the best they've ever looked".



Figures 4A and B. Lack of grease buildup within primary clarifiers during pilot study.

Secondly, thick FOG mats, normally present within three days of the cleaning process, did not form – instead, only small particles at an easy-to-manage level. This finding encapsulates the primary benefit of Protein Matrix usage – transformation of grease from a sticky, agglomerative semi-solid to a manageable byproduct, flowable and non-sticky. An additional example is seen in Figure 5, the gear mechanism used to rotate the collection tube. Whereas during the pilot, the mechanism is completely clean (Figure 5A), within a week after pilot closeout, the mechanism is already coated in sticky FOG (Figure 5B).

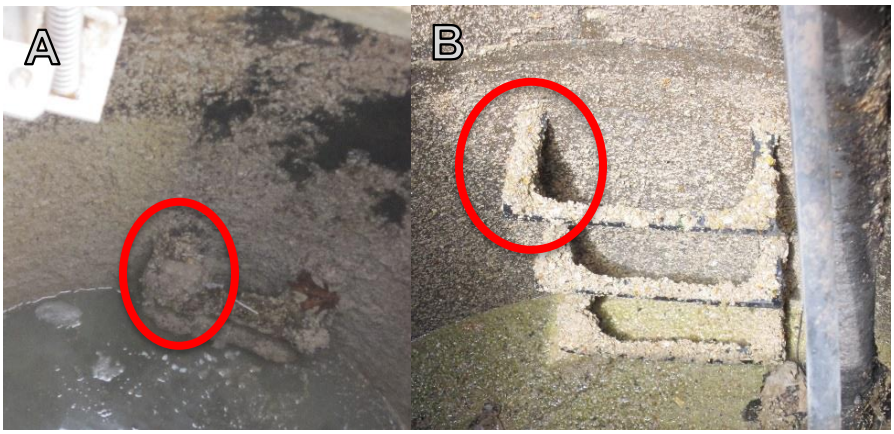


Figures 5A and 5B. Grease-free collection tube gears (A) throughout pilot, while only a few days after pilot closeout, grease has begun to stick

This reduction in grease has immediate effects on plant O&M. The maintenance staff reported that during the pilot period, their time spent dealing with FOG within the plant was reduced by 50%. Whereas before the pilot, grease was sent from the stage 1 collection area to either the stage 1 grease pit or the digesters biweekly, during the pilot, this frequency was decreased to every 7-10 days (an approximate two-to-threefold reduction). Furthermore, the flowable PM-FOG byproduct reduces the risk of transfer line clogs – throughout the pilot, neither the stage 1 collection area nor the transfer lines required cleaning (illustrated in Figure 6, as compared to Figure 1B above).

Figure 6. The stage 1 collection area exhibits minimal grease buildup during the pilot

This is also illustrated in Figures 7A and 7B – grease accumulation on a ladder within the stage 1 well, used as a marker of grease accumulation pre-cleanouts. Given that cleanouts of the grease pits and transfer line are often considered the worst work within a water treatment setting, this points to what PM has seen in other installations: not only direct financial savings, but also improved employee relations and worker efficiency as direct result of improvements in quality of work environment. To again quote plant staff, "My back isn't sore, and I can get a lot more done each day".



Figures 7A and B. Thick layer of FOG seen on ladder pre-pilot (A), whereas the thin layer of PM-Fog byproduct seen during the pilot (B) is easily washed off

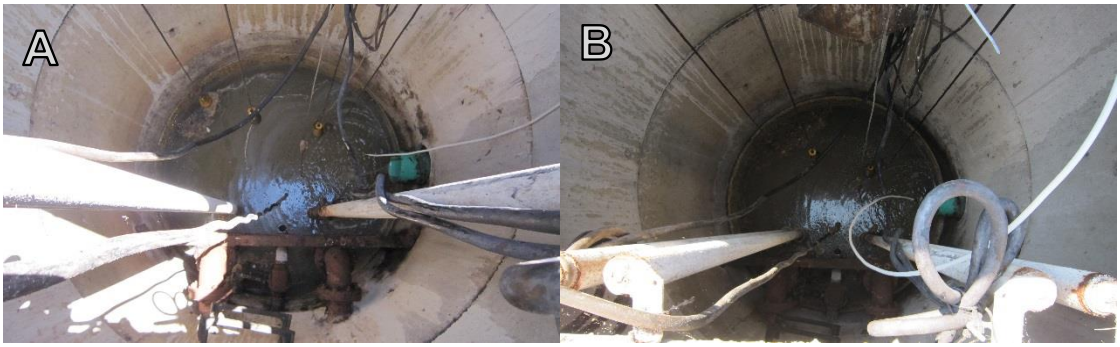
This reduction in maintenance to keep equipment clean also reduces the corresponding wear-and-tear, which, in the case of the aforementioned collection tube gear mechanism, has a history of engine burnouts due to overuse. This, in turn, leads to having to take the entire clarifier offline during repairs. Whereas before the pilot, the rakes and collection tubes were in use twice per week, during the pilot, that frequency was reduced to once per week – in this case, a significant reduction in capital equipment wear. In addition, East Providence staff believe that the reduced grease concentration will lead to greater pump efficiency and fewer repairs (Figure 8). This is consistent with previously-seen benefits of Protein Matrix usage, as cleaner primary effluent and reduced hydrogen sulfide production can reduce wear on infrastructure and capital equipment.

Figure 8. Clean water surrounding pumps in grease collection area is easier to pump

Finally, in addition to the observed reduction in grease, plant staff also noted elimination of a "grease odor" that had been present the summer before. Given the immediate and lasting impacts on community relations than can result from foul odors emanating from a plant or lift station, the importance of odor control should not be overlooked.

Lift Stations

Throughout one month of Protein Matrix treatment, the Sea View pump station remained clear of FOG (Figures 9A and B).



Figures 9A and B. No difference in FOG accumulation is seen in Sea View after one month of treatment (B).

Given the pump station's history of only moderate FOG accumulation, and the effects seen at the plant headworks, EP staff decided to move the system to the larger Watchemoket pump station. Protein Matrix was applied to this station for nearly a month, and despite several interruptions due to pump and power issues, plant staff indicated that flushing the station did not lead to golf ball-sized grease chunks in the downstream primaries, but rather the aforementioned small, non-sticky particles. As Watchemoket is several miles from the plant itself, this provides an additional piece of evidence that the PM-FOG byproduct will not re-solidify downstream. This is in stark contrast with competitive technologies (specifically, bacteria- or enzyme-based products), which have been shown to lead to downstream re-congealing of FOG that can lead to clogs, sanitary sewer overflows (SSOs), and, in turn, emergency O&M in confined spaces and difficult-to-access areas.

Effect on Plant Processes

All normal plant process data was monitored throughout the pilot study, and no harmful side effects were observed by any plant operators. Moreover, no effluent violations were noted. Select plant process data is graphed below, and all data can be found in Appendix A. As seen in Figures 10-12 (the biochemical oxygen demand (BOD) and total suspended solids (TSS) readings from both before (unshaded) and during the pilot (shaded in purple)), the rate of BOD and TSS removal remained consistent. Note that the influent BOD trends slightly upward, as drier weather during the pilot season reduced incoming flow (see black line in Fig. 10), which, in turn, increases BOD (a concentration-based metric); *i.e.*, the same level of incoming organics, without the benefit of being "diluted" by clean I&I rainwater. According to EP staff, this is a regular yearly trend. This had no effect on BOD and TSS removal efficiency, which, throughout the pilot study, was in line with historic norms, unaffected by use of Protein Matrix.

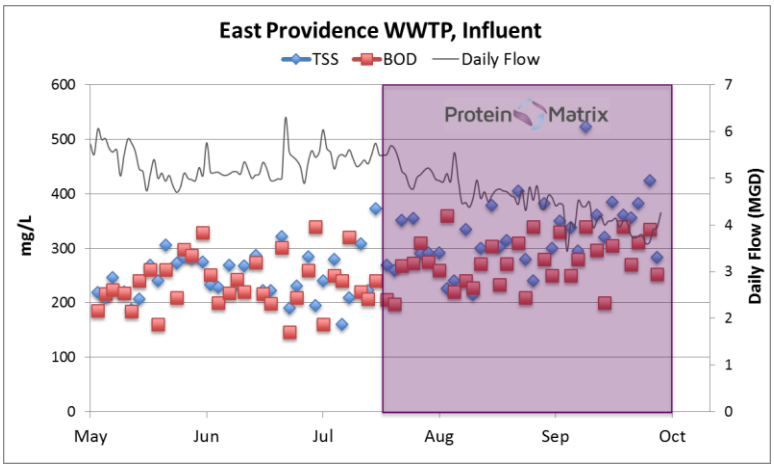


Figure 10. Influent TSS and BOD before (unshaded) and during (shaded) pilot study. The increase in influent BOD and TSS concentration is a result of the decrease in flow (black line).

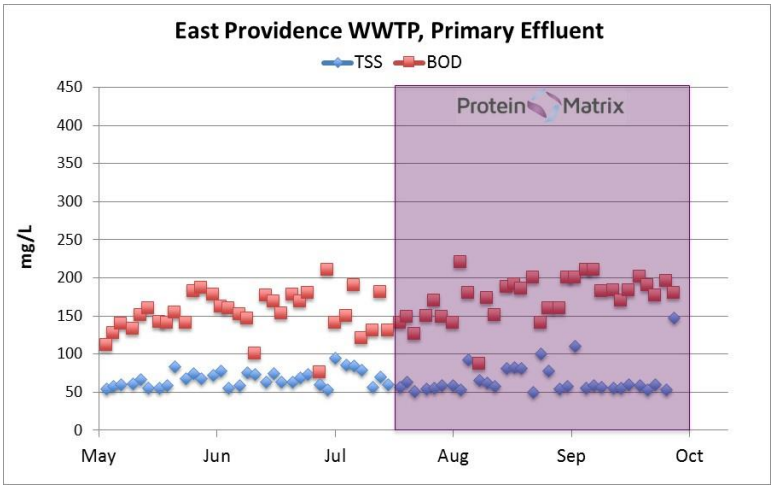


Figure 11. Primary effluent TSS and BOD before (unshaded) and during (shaded) pilot study. BOD and TSS removal ratios remained the same throughout.

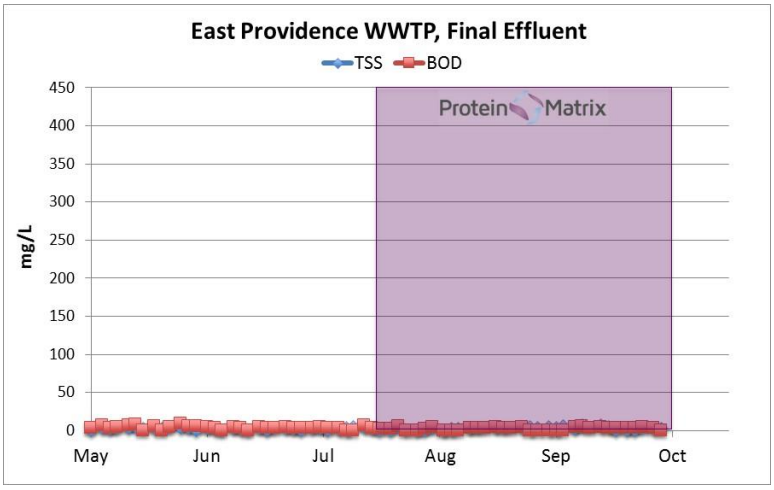


Figure 12. Final effluent TSS and BOD before (unshaded) and during (shaded) pilot study. During the pilot, final effluent BOD and TSS remained under 5 mg/L.

Conclusion and Recommendations

During this 60-day pilot study, Protein Matrix treatment has met the criteria defined at its outset: reduction in O&M effort and no harmful effects on plant processes. Based on these results, in addition to EP's qualitative observations and testimonials, both the PM and EP teams have classified the study as a success.

Appendix A. Plant Process Data

Date	Effluent Flow MGD	Effluent Minimum Daily Flow MGD	Effluent Maximum Daily Flow MGD	Inf BOD5, mg/L mg/L	Inf TSS, mg/L mg/L	Primary Eff BOD mg/L	Primary Eff Total Suspended Solids mg/L	Eff BOD5, mg/L mg/L	Eff TSS, mg/L mg/L	Eff Ammonia (as N), mg/L mg/L	Eff Nitrite (as N), mg/L mg/L	Eff Nitrate (as N), mg/L mg/L	Eff TKN (as N), mg/L mg/L
5/1/2015	5.73	3.42	6.36					3.3	0				
5/2/2015	5.51	3.39	7.46										
5/3/2015	6.06	3.60	7.87	186	219	111.3	53.8						
5/4/2015	5.83	3.38	7.15					6.1	2.9				
5/5/15	5.85	4.06	6.90	217	210	127.3	57.7						
5/6/2015	5.64	3.66	6.85					3.6	2.5	7.6	0.3	0.62	7.7
5/7/2015	5.56	3.01	6.85	224	247	138.8	60.2						
5/8/2015	5.61	3.37	7.03					4.6	2.8	8.7	0.29	0.39	9.3
5/9/2015	5.05	3.46	7.14										
5/10/2015	5.50	3.06	7.41	218	220	132.3	60.6						
5/11/2015	5.84	2.96	7.06					6.6	2.8				
5/12/2015	5.75	3.70	6.80	184	188	150.7	66.7						
5/13/2015	5.56	3.46	6.91					7.2	3.8	8.1	0.3	0.55	8.8
5/14/2015	5.20	2.54	6.62	240	207	160.0	55.7						
5/15/2015	5.14	3.43	5.89					0	2.9	6.1	0.38	1.3	8.1
5/16/2015	4.73	3.24	5.92										
5/17/2015	5.10	3.36	7.82	261	269	141.3	55.7						
5/18/2015	5.40	3.28	6.27					5.5	3.6				
5/19/2015	5.00	1.62	6.27	160	241	140.0	58.8						
5/20/2015	5.11	2.76	6.40					0	3.4	4.4	0.33	1.6	5.4
5/21/2015	4.94	2.75	6.00	261	306	154.4	83.3						
5/22/2015	5.06	3.10	6.58					4.7	4	5.4	0.35	1.400	6.5
5/23/2015	4.84	2.24	6.15										
5/24/2015	4.70	2.56	6.82	210	273	140.0	68.0						
5/25/2015	4.81	2.86	6.37					9	2.9				
5/26/2015	5.11	1.41	6.42	298	284	182.2	74.5						
5/27/2015	5.00	2.98	6.40					5.6	2.9	5.4	0.34	1.5	6
5/28/2015	4.97	2.80	6.29	287	281	186.6	67.3						
5/29/2015	4.95	2.72	6.31					5.4	0	3.4	0.31	2.4	4.8
5/30/2015	5.23	2.49	6.86										
5/31/2015	5.06	2.93	7.37	329	275	177.1	71.9						
6/1/2015	5.76	3.49	6.06					4.7	3.6				
6/2/2015	5.13	3.09	7.05	251	233	161.5	77.6						
6/3/2015	5.12	3.34	6.31					3	3	0.43	0	4.4	1.4
6/4/2015	5.13	3.17	6.51	200	228	160.0	55.1						
6/5/2015	5.08	2.50	6.33					0	0	0	0	5.7	1.2
6/6/2015	5.06	2.87	7.15										
6/7/2015	5.09	2.54	7.10	218	269	151.9	58.2						
6/8/2015	5.14	2.71	7.82					4.1	3.5				
6/9/2015	5.14	3.34	6.33	243	235	146.4	75.3						
6/10/2015	5.09	2.98	7.34					2.6	2.3	0.4	0	5.5	1.4
6/11/2015	5.35	3.24	6.48	220	268	100.0	73.4						
6/12/2015	5.19	2.92	6.52					0	0	1.2	0.14	4.7	2
6/13/2015	5.00	2.97	6.63										
6/14/2015	5.07	2.71	6.74	274	287	176.9	62.8						
6/15/2015	5.09	2.61	7.45					3.9	3				
6/16/2015	5.34	2.94	6.56	217	222	168.1	74.2						
6/17/2015	5.20	2.68	5.94					2.8	0	0.14	0	4.8	1.4
6/18/2015	4.96	2.69	6.11	199	222	152.5	62.9						
6/19/2015	4.95	2.94	6.81					3.1	2.8	0.12	0.24	5.1	1.4
6/20/2015	4.99	3.27	6.99										
6/21/2015	5.00	3.21	12.24	301	322	177.4	62.9						
6/22/2015	6.30	3.27	7.04					4.4	3				
6/23/2015	5.56	3.10	6.62	146	190	169.0	68.4						
6/24/2015	5.46	3.36	6.73					3.1	2.5	0.87	0.052	4.6	1.4
6/25/2015	5.38	2.62	6.41	210	231	180.0	73.2						
6/26/2015	5.24	3.05	6.17					3.6	0	0.17	0.08	5	1.1
6/27/2015	4.89	3.57	6.80										
6/28/2015	5.33	4.14	7.66	260	285	75.0	59.8						
6/29/2015	5.59	2.86	6.48					3.2	2.6				
6/30/2015	5.45	3.28	6.95	340	195	210.0	53.1						

Date	Effluent Flow MGD	Effluent Minimum Daily Flow MGD	Effluent Maximum Daily Flow MGD	Inf BOD5, mg/L mg/L	Inf TSS, mg/L mg/L	Primary Eff BOD mg/L	Primary Eff Total Suspended Solids mg/L	Eff BOD5, mg/L mg/L	Eff TSS, mg/L mg/L	Eff Ammonia (as N), mg/L mg/L	Eff Nitrite (as N), mg/L mg/L	Eff Nitrate (as N), mg/L mg/L	Eff TKN (as N), mg/L mg/L
7/1/2015	5.56	3.90	8.04					4.6	3.2	0	0	5.4	1.1
7/2/2015	6.04	3.48	7.08	160	240	140.0	94.0						
7/3/2015	5.64	3.21	7.86					3.4	0				
7/4/2015	5.55	3.31	7.40										
7/5/2015	5.20	3.47	7.08	250	280	150.0	86.0						
7/6/2015	5.45	3.42	7.09					3	2.2				
7/7/2015	5.51	3.30	6.45	240	160	190.0	84.0						
7/8/2015	5.47	3.20	7.33					0	4	0.13	0	5.2	1.3
7/9/2015	5.61	3.52	6.18	320	210	120.0	79.0						
7/10/2015	5.42	3.71	6.60					0	5.7				
7/11/2015	5.25	3.09	6.86										
7/12/2015	5.30	3.14	7.22	220	309	130.0	56.8						
7/13/2015	5.39	3.36	6.33					6.3	4				
7/14/2015	5.31	3.25	7.54	207	223	180.7	70.0						
7/15/2015	5.52	3.10	9.00					2.8	2.7	0.16	0	5	0.96
7/16/2015	5.75	3.42	6.78	240	373	130.5	59.4						
7/17/2015	5.50	3.59	6.72					2.4	0				
7/18/2015	5.50	3.43	7.27										
7/19/2015	5.51	3.15	7.48	206	269	140.0	56.2						
7/20/2015	5.69	3.42	6.81					2	0				
7/21/2015	5.64	3.84	6.31	198	260	147.9	62.6						
7/22/2015	5.44	3.50	6.36					5.7	4.5	0	0	3.6	0.99
7/23/2015	5.15	3.37	6.01	268	352	125.6	50.5						
7/24/2015	5.07	3.06	6.41					0	0				
7/25/2015	4.83	2.99	6.48										
7/26/2015	4.77	2.28	6.62	273	355	149.8	54.6						
7/27/2015	5.01	3.06	6.55					0	0				
7/28/2015	5.08	1.70	6.60	310	291	170.0	55.1						
7/29/2015	5.17	3.38	6.50					2.5	0	0.21	0	4.8	1
7/30/2015	5.22	3.34	6.52	275	292	148.5	58.9						
7/31/2015	5.14	3.07	6.17					4.4	2.9				
8/1/2015	4.98	2.87	7.11										
8/2/2015	4.95	3.14	7.15	260	292	140.0	58.6						
8/3/2015	4.92	3.33	6.38					0	0				
8/4/2015	5.10	3.92	7.54	360	226	220.0	52.6						
8/5/2015	4.93	2.66	7.15					0	3.1	0.4	0	3.5	1.5
8/6/2015	5.55	3.92	7.54	220	240	180.0	92.0						
8/7/2015	4.98	2.10	5.59					0	3.3				
8/8/2015	4.47	2.19	6.30										
8/9/2015	4.48	2.65	5.91	240	335	87.0	65.9						
8/10/2015	4.38	2.24	6.11					3.2	3.6				
8/11/2015	4.58	2.18	6.80	227	216	173.2	61.5						
8/12/2015	4.96	2.30	6.19					3.3	4.4	0.74	0	3.1	2.1
8/13/2015	4.57	2.39	5.40	272	300	150.3	57.1						
8/14/2015	4.71	2.94	5.93					3.5	3.8				
8/15/2015	4.50	2.52	6.44										
8/16/2015	4.63	2.24	6.29	304	379	187.1	81.4						
8/17/2015	4.74	2.78	6.11					4.3	4				
8/18/2015	4.77	2.19	5.84	233	302	191.2	82.7						
8/19/2015	4.73	2.78	5.96					3.3	3.8	0.28	0	4.6	0
8/20/2015	4.71	2.92	5.61	272	315	184.9	80.6						
8/21/2015	4.63	2.57	5.87					2.6	3.9				
8/22/2015	4.59	2.81	6.42										
8/23/2015	4.44	1.96	6.33	310	405	200.0	50.0						
8/24/2015	4.75	2.50	5.61					3.8	4.6	0.66	0	5.2	1.1
8/25/2015	4.31	2.22	5.88	210	280	140.0	100.0						
8/26/2015	4.81	2.62	5.72					0	5.3	0.39	0.07	4.8	0.85
8/27/2015	4.53	2.53	7.06	340	240	160.0	78.0						
8/28/2015	4.84	2.15	6.24					0	3.7				
8/29/2015	4.36	2.38	6.63										
8/30/2015	4.35	2.41	6.42	280	383	160.0	54.1						
8/31/2015	4.63	3.10	5.87					0	5	0	0.08	4.5	1.1

Date	Effluent Flow MGD	Effluent Minimum Daily Flow MGD	Effluent Maximum Daily Flow MGD	Inf BOD5, mg/L mg/L	Inf TSS, mg/L mg/L	Primary Eff BOD mg/L	Primary Eff Total Suspended Solids mg/L	Eff BOD5, mg/L mg/L	Eff TSS, mg/L mg/L	Eff Ammonia (as N), mg/L mg/L	Eff Nitrite (as N), mg/L mg/L	Eff Nitrate (as N), mg/L mg/L	Eff TKN (as N), mg/L mg/L
9/1/2015	4.59	2.62	5.50	250	300	200.0	57.6						
9/2/2015	4.41	1.67	5.87					0	4.8	0.47	0.07	4.4	1.2
9/3/2015	4.46	2.31	5.66	330	350	200.0	110.0						
9/4/2015	4.41	2.16	5.31					0	6.3				
9/5/2015	3.44	2.04	5.91										
9/6/2015	4.05	1.79	5.83	250	338	210.0	55.7						
9/7/2015	3.94	1.96	5.89					4.2	2.5				
9/8/2015	4.52	0.91	5.65	280	295	209.6	58.2						
9/9/2015	4.40	1.88	6.16					5.1	7.9	0.73	0	3.1	1.1
9/10/2015	4.40	1.95	6.20	339	523	181.6	56.4						
9/11/2015	4.49	2.75	5.24					2.9	4.1	1.8	0.14	3.4	2.6
9/12/2015	3.95	1.95	5.97										
9/13/2015	4.10	1.97	5.90	296	361	183.5	55.7						
9/14/2015	4.19	1.57	5.40					3.7	7.5				
9/15/2015	4.00	1.94	5.54	200	320	170.0	55.6						
9/16/2015	4.08	1.32	5.12					3.4	5.1	0.44	0.19	3.4	2.3
9/17/2015	4.09	1.70	5.00	305	385	182.8	59.4						
9/18/2015	4.14	1.48	5.64					2.6	0	0.87	0.35	3	1.9
9/19/2015	3.95	1.70	5.78										
9/20/2015	4.09	1.66	6.11	339	361	201.4	58.3						
9/21/2015	4.06	1.88	5.35					3.2	0				
9/22/2015	3.78	1.84	4.91	270	356	190.3	53.5						
9/23/2015	3.72	1.28	4.87					3.3	0	5.9	0.22	2.29	7.4
9/24/2015	3.76	1.51	5.22	311	382	176.2	59.4						
9/25/2015	3.79	1.74	5.09					3.9	2.6	1.7	0	4.8	3.3
9/26/2015	3.60	1.66	5.77										
9/27/2015	3.63	1.21	5.64	335	424	195.8	53.1						
9/28/2015	3.90	1.77	5.28					2.9	3				
9/29/2015	3.94	2.02	5.35	252	284	179.6	147.4						
9/30/2015	4.26	1.92	7.91					0	3.2	0.15	0	7	1.1

Date	Eff Nitrogen, Total (as N), mg/L mg/L	Eff Phosphorus Total, mg/L mg/L	Oil and Grease Total recoverable, mg/L mg/L	Copper Total, ug/L ug/L	Copper Total, ug/L ug/L	Coliform (fecal), number per 100 mL or n Number	Cyanide Total, ug/L ug/L	Cyanide Total, ug/L ug/L	Enterococci, number per 100 mL Number
5/1/2015									
5/2/2015									
5/3/2015						<2			
5/4/2015									
5/5/15						<2	0.00		5
5/6/2015	8.62	2.300		32.00	7.000			0.000	
5/7/2015			1.500			<2			
5/8/2015	9.98								
5/9/2015									
5/10/2015						<2			
5/11/2015									
5/12/2015						2			7
5/13/2015	9.65								
5/14/2015						<2			
5/15/2015	9.78								
5/16/2015									
5/17/2015						<2			
5/18/2015									
5/19/2015						<2			
5/20/2015	7.33								
5/21/2015						<2			7
5/22/2015	8.25								
5/23/2015									
5/24/2015						<2			
5/25/2015									
5/26/2015						<2			
5/27/2015	7.84								
5/28/2015						<2			4
5/29/2015	7.51								
5/30/2015									
5/31/2015						<2			
6/1/2015									
6/2/2015						<2			8
6/3/2015	5.8	1.200							
6/4/2015						<2			
6/5/2015	6.9								
6/6/2015									
6/7/2015						16,000			
6/8/2015						350			
6/9/2015						<2	0.00		5
6/10/2015	6.9			47.00	5.000			0.000	
6/11/2015			1.500			<2			
6/12/2015	6.84								
6/13/2015									
6/14/2015						<2			
6/15/2015									
6/16/2015						<2			
6/17/2015	6.2								
6/18/2015						<2			8
6/19/2015	6.74								
6/20/2015									
6/21/2015						<2			
6/22/2015									
6/23/2015						<2			7
6/24/2015	6.05								
6/25/2015						<2			
6/26/2015	6.18								
6/27/2015									
6/28/2015						<2			
6/29/2015									
6/30/2015						<2			18

Date	Eff Nitrogen, Total (as N), mg/L mg/L	Eff Phosphorus Total, mg/L mg/L	Oil and Grease Total recoverable, mg/L mg/L	Copper Total, ug/L ug/L	Copper Total, ug/L ug/L	Coliform (fecal), number per 100 mL or n Number	Cyanide Total, ug/L ug/L	Cyanide Total, ug/L ug/L	Enterococci, number per 100 mL Number
7/1/2015	6.5								
7/2/2015						2			
7/3/2015									
7/4/2015									
7/5/2015						2			
7/6/2015									
7/7/2015						0			1
7/8/2015	6.5	2.800							
7/9/2015						2			
7/10/2015									
7/11/2015									
7/12/2015						0			
7/13/2015									
7/14/2015						0			
7/15/2015	5.96			35.00	3.000				
7/16/2015			2.900			0			13
7/17/2015									
7/18/2015									
7/19/2015						0			
7/20/2015									
7/21/2015						0	0.00		1
7/22/2015	4.59							0.000	
7/23/2015						2			
7/24/2015									
7/25/2015									
7/26/2015						0			
7/27/2015									
7/28/2015						0			1
7/29/2015	5.8								
7/30/2015						0			
7/31/2015									
8/1/2015									
8/2/2015						0			
8/3/2015									
8/4/2015						0	0.00		1
8/5/2015	5	0.610		46.00	0.000			0.000	
8/6/2015									
8/7/2015						0			
8/8/2015									
8/9/2015						2			
8/10/2015									
8/11/2015						0			
8/12/2015	5.2								
8/13/2015			2.400			0			16
8/14/2015									
8/15/2015									
8/16/2015						5			
8/17/2015									
8/18/2015						0			1
8/19/2015	4.6								
8/20/2015						2			
8/21/2015									
8/22/2015									
8/23/2015						0			
8/24/2015	6.3								
8/25/2015						0			1
8/26/2015	5.72								
8/27/2015						0			
8/28/2015									
8/29/2015									
8/30/2015						2			
8/31/2015	5.68								

Date	Eff Nitrogen, Total (as N), mg/L mg/L	Eff Phosphorus Total, mg/L mg/L	Oil and Grease Total recoverable, mg/L mg/L	Copper Total, ug/L ug/L	Copper Total, ug/L ug/L	Coliform (fecal), number per 100 mL or n Number	Cyanide Total, ug/L ug/L	Cyanide Total, ug/L ug/L	Enterococci, number per 100 mL Number
9/1/2015						0			
9/2/2015	5.67	2.3							
9/3/2015			2			0			
9/4/2015									
9/5/2015									
9/6/2015						0			
9/7/2015									
9/8/2015						0	0.00		
9/9/2015	4.2			59.00	2			0	
9/10/2015						0			2
9/11/2015	6.14								
9/12/2015									
9/13/2015						0			
9/14/2015									
9/15/2015						5			6
9/16/2015	5.89								
9/17/2015						5			
9/18/2015	5.25								
9/19/2015									
9/20/2015						0			
9/21/2015									
9/22/2015						0			11
9/23/2015	9.91								
9/24/2015						0			
9/25/2015	8.1								
9/26/2015									
9/27/2015						2			
9/28/2015									
9/29/2015						2			1
9/30/2015	8.1								