APPENDIX G

WASTESTREAM TECHNOLOGIES PHASE IV ADDENDUM 6 SUMMARY REPORT

TREATABILITY REPORT

EVALUATION OF THE SETTLING CHARACTERISTICS OF FINE GRAIN SEDIMENT FROM ONONDAGA LAKE

Prepared For:

PARSONS

290 Elwood Davis Road, Suite 312
Liverpool, New York 13088

Prepared By:

Waste Stream Technology, Inc.
302 Grote Street
Buffalo, New York 14207

May 2009

1.0 Scope of Work

Sediment samples were obtained from Sediment Management Units (SMUs) 1 and 6 of Onondaga Lake, located in Onondaga County, NY. Sampling was performed in accordance with *the Onondaga Lake Pre-Design Investigation: Phase IV Work Plan-Addendum 6* (Parsons, 2008). Waste Stream Technology, Inc (WST) conducted pilot and bench scale testing on SMU 1A, SMU 1B, and SMU 6 to evaluate the effectiveness of removing sand-sized particles using a hydrocyclone and gravity thickening the fine grain sediment prior to geotextile dewatering.

2.0 Initial Characterization

Sediment from various locations within SMU 1 and two locations within SMU 6 were sampled in November 2008. A total of 5 fifty five-gallon drums of site water, and one fifty five-gallon drum and 9 five-gallon buckets of sediment were shipped to WST under chain-of-custody. Chain-of-custody documents are presented in Appendix A. Upon receipt, all samples were logged in, weighed, and stored in a cooler at 4^{o}C.

Sediment was passed through a quarter-inch screen to remove large debris. After the oversized material was removed, the buckets from SMU 1A and the buckets from SMU 6 were each composited into a 55-gallon drum. Sediment from SMU 1B did not need to be composited since the sample was contained in one drum as opposed to several buckets. After each sample was screened and composite, it was homogenized with a drill mixer. Subsamples were taken from each drum and initial analyses including percent solids (SM 2450G), specific gravity (SM 2710 F), and pH (SW-846 Method 9045 C) were performed. The results of these analyses are provided in Appendix B.

3.0 Hydrocyclone Testing

A hydrocyclone uses size and density separation to remove sand from dredged material for a variety of reasons. Sand is erosive to pump systems and can clog feed tubes. Sand sized particles tend to settle quickly and will settle in feed lines if flow is stopped or slowed. Large volumes of water are required to flush the lines and pumps when this happens. Also, sand can drop out fast when it is fed into a geotube, which

blocks additional feed from entering the tube. Testing to remove troublesome sand size particles was performed following the procedures set forth in the Standard Operating Procedure for Hydrocyclone Performance Testing and under observation and consultancy of Mike Wilkins, a technical engineer for the hydrocyclone supply company, Krebs Engineers.

A summary, of the hydrocyclone runs, is presented in Appendix C. The sediment was prescreened through a quarter inch sieve to remove the oversize material. After the sediment samples were screened they were diluted with site water to a 10% solids by weight slurry. The slurry was then pumped into the hydrocyclone. The target feed pressure was 20psi. Full feed pressure was not reached during the run of SMU 1A because of excess air caused by foaming of this sample.

The influent, overflow, and underflow material was sampled for percent solids and specific gravity analyses. Sieve analyses (Modified ASTM D-422) were also performed on the hydrocyclone overflow samples for SMU 1B and SMU 6 to confirm the removal of sand-size particles from the slurries. See Appendix C. The sieve analysis shows that 100% of the overflow sample from SMU 1B and 99% of the overflow from SMU 6 passed through a #200 sieve, demonstrating the high efficiency of the hydrocyclone to remove sand-size particles.

4.0 Jar Testing

An initial polymer screening was performed on 100 mL of the overflow slurries to evaluate the floc and water quality that various polymers produced. If a selected polymer produced a good floc that settled well, leaving fairly clear free water it underwent further testing. Polymer screening notes are listed in Appendix C.

Jar tests were performed according to procedures set forth in the Standard Operating Procedure for Jar Testing. Tests were performed on 1L slurries, using polymers that yielded good results during polymer screening. Various doses of a polymer were compared using the criteria of settling rate and water clarity, measured by turbidity, (SM 2130 B). The samples were rapidly mixed at 100rpm for two minutes after the addition of polymer. Typically samples are rapidly mixed for one minute after polymer is added. However, additional mixing improved the floc quality for the fine grain

slurries. After the rapid mix, the slurries were "slow mixed" at 20rpm for 20 minutes, and then settled for twenty minutes with no mixing. Each slurry was sampled for turbidity analysis at the end of the mixing and settling cycle. Jar testing results are presented in Appendix D.

The solids did not remain suspended during the slow mix and began to settle. This was most noticeable in the overflow slurries from SMU 1. This could be due to the high solids content and the fast settling rate of the slurries. Also, there was a significant foam layer at the top of the SMU 1A slurries that remained at the top of the slurry after settling (See Figure 1).

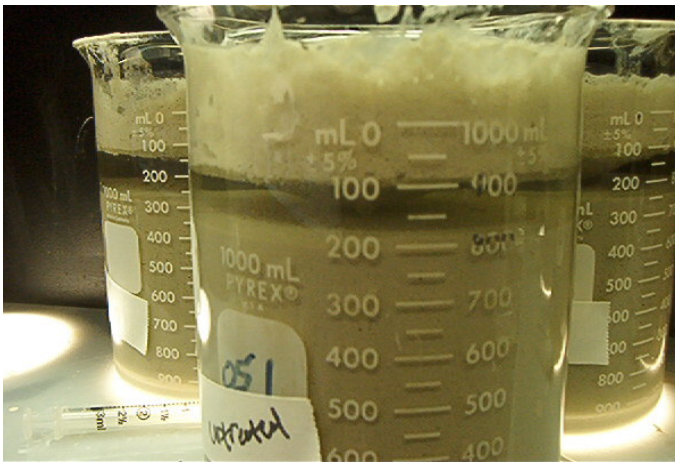


Figure 1:
Foam present in SMU 1A samples from Jar Test

A cationic solution coagulant, 7757 was selected for use in column testing based on jar testing results. Turbidity measurements from slurries treated with 7757 were generally lower in comparison to slurries treated with other polymers. Future dewatering applications were also taken into consideration during polymer selection. A cationic solution coagulant will interfere less and could enhance future polymer applications prior to dewatering. Also, coagulants are easier to use in field applications and have a wider acceptable dose range.

5.0 Column Testing

Column settling tests were performed, according to the Standard Operating Procedure for Column Settling Tests, on the fine grain slurries from SMU 1A, SMU 1B,

and SMU 6 using an 8'x 8" diameter plexiglass column. Using this column, the settling kinetics of each slurry can be evaluated by measuring the height of the interface between settled sediment and supernatant fluid over time. Sample ports are located every 6 inches along the column in order to extract samples of supernatant for total suspended solids. Settling tests were conducted on untreated and polymer treated slurries at various solids content.

Fifteen gallons of slurry were used for each test. Each slurry was thoroughly mixed and then poured into the column. Polymer was added and mixed in as necessary and prior to transferring the samples into the columns. Time was started as soon as the last bucket was completely emptied into the column. A sample for total suspended solids (SM 2540D) was taken through the ports at 5 feet, 2.5 feet and 0.5 feet when time was started. Every port was not sampled at the beginning of the test in order to ensure the samples were more representative of initial conditions. Sampling at every port would have consumed too much time and since the sediment settles at a fast rate, samples taken after a few minutes would not reflect the conditions at the start of the test.

The column tests were continuously monitored to observe formation of an interface. Time was noted when a noticeable interface had formed and the sediment line was recorded every 15 minutes for two hours, after the noted presence of an interface. The sediment line was also recorded at four and twenty four hours. The supernatant was sampled at one-hour, two hours and twenty-four hours after the start of the test. Column settling test results are in Appendix F.

6.0 Summary

The hydrocyclone was efficient at removing sand size particles from the 10% slurries of sediment from Onondaga Lake. Removing sand size particles will reduce the amount of sediment that goes through the dewatering process.

Polymer did not significantly enhance the settling rate of the test slurries, but were generally effective at reducing the total suspended solids, therefore making the supernatant clearer. This is most noticeable of column tests ran on SMU 6, as seen in Table 1. The TSS of the supernatant at 24 hours from SMU 6 at 3% solids was reduced 101% when treated with polymer and reduced 98% for tests ran at 6% solids.

While a cationic or anionic flocculant might have increased the settling rate, there are clear disadvantages to using these polymers. Flocculants have a lower acceptable dose range, making it easier to over treat this slurry. If the slurry is over treated, the water could become slimy and the floc can weaken. Over treatment should always be avoided by use of proper make down and feed equipment. Also, flocculants could interfere with future polymer application. The percent solids of the test slurry affected the settling rate. Slurries at lower percent solids appeared to settle faster than those at higher percent solids.

Table 1:

Total Suspended Solids from Column Settling Tests

	SMU 1A				SMU 1B							
	6%		9%		3%		6%		9%		12%	
Time (Hour)	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated	Untreated	Treated
0 @ 0.5 ft	64568	62564	58748	86064	50672	15832	68476	19643	81684	26637	121,914	23636
0 @ 2.5 ft	53556	60524	85496	76068	47904	19620	87196	18672	33980	23219	111340	22051
0 @ 5.0 ft	49416	52136	92792	82180	38696	30120	77356	3113	50412	23035	69604	20568
1	196	164	357	158	174	218	231	285	115	13	674	469
2	107	543	87	157	87	153	289	51	22	39	17	94
24	22	63	151	191	24	21	84	47	27	10	29	16

	SMU 6			
	3%		6%	
Time (Hour)	Untreated	Treated	Untreated	Treated
0 @ 0.5 ft	15208	6753	53932	25356
0 @ 2.5 ft	27000	5964	36688	24971
0 @ 5.0 ft	28736	5732	44176	22944
1	97	22	116	82
2	228	108	132	11
24	446	5	752	14

APPENDIX A

Chain of Custody Document

Onondaga Lake Treatability Study
Syracuse, New York
May 2009

0717

Submitted to: WasteStream Technologies
302 Grote St.
Buffalo, NY 14207
Attn: Nicole O'Sullivan 716-876-5290

Honeywell Chain Of Custody / Analysis Request

COC #: No ~~5991~~
Lab Use Only

Privileged & Confidential: Y
EDD To:
Sampler:
P O #
Analysis Turnaround Time:
Standard -
Rush Charges Authorized for -
2 weeks -
1 week -
Next Day -

Site Name: Onondaga Lake
Location of Site: Syracuse, NY
Lab Proj #
Lab ID

Client Contact: (name, co., address)

Parsons
290 Elwood Davis Road, Suite 312
Liverpool, NY 13088
315-451-9560

Hardcopy Report To:
Invoice To:

Preservative
Job No.

	Sample Identification: Location ID	Start Depth (ft)	End Depth (ft)	Field Sample ID	Sample Date	Sample Time	Sample Type	Sample Matrix	Sample Purpose	# of Cont.	Grab/Composite	Field Filtered Sample ?	Units	Lab Sample Numbers
1	OL-Water			OL-0717-01	3-27-09		REG	Water		5-~~55~~ 5 GAL Buckets				~~2~~ Buckets from 10119 2 Buckets from 10115 1 Bucket from 10116
2	OL-SED-SMU A			OL-0717-02	3-27-09		REG	Sed		5-5 GAL Buckets				
3	OL-SED-SMU B			OL-0717-03	3-27-09		REG	Sed		1-55 GAL Drum				Drum from location 10118
4	OL-SED-SMU 6			OL-0717-04	3-27-09		REG	Sed		4-5 GAL Buckets				2 Buckets from 60088 2 Buckets from 60100
5														
6														
7														
8														
9														
10														
11														
12														

Relinquished by: Signature on Original	Company: PARSONS	Relinquished by: Signature on Original	Frank Earl		Condition		Custody Seals Intact	
	Date/Time: 3/27/09 9:20			3/27/09 9:20	Cooler Temp.			
Relinquished by	Company	Received by	LST Company		Condition		Custody Seals Intact	
	Date/Time		3/27/09 12:20 Date/Time		Cooler Temp.			

Preservatives: 0 = None; [1 = HCL]; [2 = HNO3]; [3 = H2SO4]; [4 = NaOH]; [5 = Zn. Acetate]; [6 = MeOH]; [7 = NaHSO4]; 8 = Other (specify):

APPENDIX B

Initial Characterization

Onondaga Lake Treatability Study
Syracuse, New York
May 2009

Location	Sample ID	Volume Received (gallons)	% Solids	Specific Gravity	pH	Physical Description
OL-SED-SMU 1A	10114-1	5	38.46	1.33	11.79	Tan/gray liquid/ sludge and cement like solids with a chemical odor.
	10114-2	5	35.63	1.23	11.98	Tan/gray liquid/ sludge and cement like solids with a chemical odor.
	10115-1	5	35.64	1.25	11.49	Tan/gray liquid/ sludge and cement like solids with a chemical odor.
	10115-2	5	35.57	1.26	11.52	Tan/gray liquid/ sludge and cement like solids with a chemical odor.
	10116	5	38.22	1.26	11.65	Tan/gray liquid/ sludge and cement like solids with a chemical odor.
	<1/4" Composite	~20	35.56	1.22	11.89	~5 gallons of oversized material (>1/4") was removed during screening. Thick tan/ gray sludge. Significant chemical odor.
	<1/4" Composite Slurry (~10%)	~64	10.31	1.03	11.37	Tan/ gray slurry. Significant chemical odor.
OL-SED-SMU 1B	SMU B	55	36.79	1.25	12.09	Tan/gray liquid/ sludge and cement like solids with some organic matter and chemical odor.
	<1/4" Composite	~45	27.67	1.28	12.09	~10 gallons of oversized material (>1/4") was removed. Thick tan/ gray sludge. Significant chemical odor.
	<1/4" Composite Slurry (~10%)	~110	7.74	1.03	11.46	Tan/ gray slurry. Significant chemical odor.
OL-SED-SMU 6	60098-1	5	55.07	1.50	7.53	Sandy brown sludge
	60098-2	5	62.92	1.55	7.89	Sandy brown sludge
	60100-1	5	59.60	1.52	7.85	Black sandy/silty sludge.
	60100-2	5	55.81	1.34	8.10	Black sandy/silty sludge.
	<1/4" Composite	~20	58.93	1.51	7.92	Less than 1L of oversized material (>1/4") removed. Thick, black, sandy material.
	<1/4" Composite Slurry (~10%)	~110	5.17	1.00	8.30	Black sandy slurry. Settles extremely fast and is difficult to mix because of the fast settling rate.

APPENDIX C

Hydrocyclone Data

Onondaga Lake Treatability Study
Syracuse, New York
May 2009

Sieve Analysis of Overflow Material

Sample ID	Date	% Solids (w/w)	Cyclone	Vortex Finder	Cylinder	Apex	Vacuum	Feed Pressure (psi)		Influent Volume	Overflow Volume	Underflow Volume
								Target	Measured	(gal)	(gal)	(gal)
SMU 1A	4/8/2009	10.31	D6B-12	2.25"	Yes	1"	Partial	20	10*	~64	~30	<5
SMU 1B	4/7/2009	7.74	D6B-12	2.25"	Yes	1"	Partial	20	20	~110	~60	<5
			D6B-12	2.25"	Yes	1"	Full	20	20			
SMU 6	4/7/2009	5.17	D6B-12	2.25"	Yes	1"	Partial	20	20	~110	~60	~5

Sample ID	Influent		Overflow		Underflow	
	% Solids	SG	% Solids	SG	% Solids	SG
SMU 1A	11.41	1.04	10.29	1.02	28.37	1.13
SMU 1B	15.53	1.07	14.62	1.09	51.47	1.27
	15.53	1.07	14.27	1.06	48.64	1.21
SMU 6	9.85	1.02	4.66	1.01	63.59	1.56

Sample I.D. and Initial Dry Weight	Sieve #	Aperture (μm)	Tare Wt. (g)	Dry Weight (g)	Weight Retained (g)	% Weight Retained	% Weight Passed
SMU 1B Overflow 259.78 g wet/ 37.98 g dry (14.62% solids)	200	75	336.8	336.8	0.0	0.00	100.00
	325	45	339.8	339.8	0.0	0.00	100.00
	400	38	340.8	340.8	0.0	0.00	100.00
	< 400	< 38	--	--	38.0	100.00	---

Sample I.D. and Initial Dry Weight	Sieve #	Aperture (μm)	Tare Wt. (g)	Dry Weight (g)	Weight Retained (g)	% Weight Retained	% Weight Passed
SMU 6 Overflow 218.79 g wet/10.19 g dry (4.66% solids)	200	75	336.8	336.9	0.1	0.98	99.02
	325	45	339.8	340.1	0.3	2.94	96.07
	400	38	340.8	340.8	0.0	0.00	96.07
	< 400	< 38	--	--	9.8	96.07	---

APPENDIX D

Polymer Screening

Onondaga Lake Treatability Study
Syracuse, New York
May 2009

Sample ID	Polymer	Dose (ppm)	Observations
SMU 1A Overflow from the Hydrocyclone	7757	50	Slight floc with no free water
		Up to 600	No noticeable improvement
	7626	75	Floc begins to form, but is only slightly noticeable and does not settle.
		Up to 500	No noticeable improvement
	7626 + 7843	500 + 50	Floc improves and settles more.
		500 + 150	Thicker floc that settles more. Still some floating particles.
		500 + 200	Less floating particles, but water begins to get cloudy.
	7843	30	Slight floc with some free water
		40	Floc is slightly thicker and water is slightly more clear.
		50	Good floc that settles well leaving clear, free water with some floating particles.
		100	Floc starts to break apart and water begins to get cloudy.
	7824	10	Floc is very slightly noticeable.
		50	Good floc that settles well. Water is slightly cloudy.
		100	Floc is good and settles well, but is loose. Some floating particles.
	7823	Up to 500	Good floc, but is easily broken up with mixing. The water is cloudy with lots of floating particles.

Sample ID	Polymer	Dose (ppm)	Observations
SMU 1B Overflow from the Hydrocyclone	7626	Up to 600	No noticeable difference
	7843	20	Slight floc begins to form.
		40	Floc becomes thicker and settles slightly.
		100	Good floc, settles well leaving clear free water.
		200	Floc improves and there is more clear, free water.
		250	Water begins to get cloudy.
	7824	20	Slight floc begins to form.
		40	Floc becomes thicker and settles slightly.
		100	Good floc, settles well leaving clear free water.
		200	Floc is thick and settles well, but water is cloudy.

Sample ID	Polymer	Dose (ppm)	Observations
SMU 6 Overflow from the Hydrocyclone	7757	5	Good floc, settles well.
		20-100	Floc becomes larger and settles better leaving more free clear water as dose is increased.
		250	Floc appears to settle more slowly and water is slightly cloudy.
	7626	5	Noticeable floc.
		Up to 500	No noticeable improvement.
	7843	5	Slight floc that settles well leaving cloudy free water.
		10	Floc becomes larger and settles better leaving more free water that is clear.
		25	Floc becomes tighter and settles faster.
		50	Floc is thicker, but water becomes cloudy.
	7824	5	Slight floc that settles well leaving cloudy free water.
		10	Floc becomes larger and settles better leaving more free water that is clear.
		35	Floc is tighter and settles well leaving free clear water.
		75	Water starts to become cloudy.
	7823	5	Very fine floc, some free water.
		25	Floc improves and settles better leaving more free water.
		100	Water starts to become cloudy.

APPENDIX E

Jar Testing Data

Onondaga Lake Treatability Study
Syracuse, New York
May 2009

Sample ID	Jar #	Sample Volume (mL)	Polymer ID	Dosage (ppm)	Flash Mix (1 min. @ 100 rpm)	Slow Mix @ 20 rpm (observations)				Observations after settling	Settled NTU
						5 min	10 min	15 min	20 min	20 min	
SMU 1A	1	1000	--	--	No floc	Cloudy and very little free water.	~50mL of cloudy free water.	~75mL of cloudy free water.	~75mL of cloudy free water.	~150mL of cloudy free water.	423
	2		7824	10	Fine floc	Some clear free water.	~125mL of free water.	~150mL of free water.	~150mL of free water.	~250mL of free water.	223
	3			20	Fine floc	Some clear free water.	Loose floc, ~100mL of free water.	Loose floc, ~150mL of free water.	Loose floc, ~150mL of free water.	Loose floc, ~225mL of free water.	292
	4			30	Fine floc	Some clear free water.	Loose floc, ~100mL of free water.	Loose floc, ~150mL of free water.	Loose floc, ~200mL of free water.	Loose floc, ~250mL of free water.	294
	5			40	Good floc	~100mL of clear free water	Loose floc, ~300mL of free water.	Loose floc, ~350mL of free water some suspended particles.	Loose floc, ~400mL of free water some suspended particles.	Loose floc, ~450mL of free water some suspended particles.	161
	6			50	Fine floc	Some clear free water.	Loose floc, ~100mL of free water.	Loose floc, ~175mL of free water.	Loose floc, ~225mL of free water.	Loose floc, ~300mL of free water.	198
	7	1000	7843	15	Fine floc	~150mL clear, free water	~250mL clear, free water	~150mL clear, free water	~150mL clear, free water	~150mL clear, free water	43
	8			30	Fair floc	~175mL clear, free water	~275mL clear, free water	~350mL clear, free water	~400mL clear, free water	~475mL clear, free water	27.1
	9			40	Good floc	~225mL clear, free water	~350mL clear, free water	~4000mL clear, free water	~450mL clear, free water	~525mL clear, free water	54.6
	10			50	Good floc	~300mL free water, some suspended solids	~400mL free water, some suspended solids	~475mL free water, some suspended solids	~475mL free water, some suspended solids	~550mL free water, some suspended solids	33.3
	11			60	Good, fine floc	~425mL free water, some suspended solids	~500mL free water, some suspended solids	~525mL free water, some suspended solids	~550mL free water, some suspended solids	~600mL free water, some suspended solids	43.4
	12			70	Good, fine floc	~475mL free water, some suspended solids	~525mL free water, some suspended solids	~550mL free water, some suspended solids	~550mL free water, some suspended solids	~600mL free water, some suspended solids	65.3
	13	1000	7757	10	Very fine floc	~100mL of clear free water	~150mL of clear free water	~200mL of clear free water	~275mL of clear free water	~350mL of clear free water	19.2
	14			25	Very fine floc	~75mL of clear free water	~125mL of clear free water	~200mL of clear free water	~250mL of clear free water	~325mL of clear free water	18.8
	15			75	Very fine floc	~50mL of clear free water	~125mL of clear free water	~200mL of clear free water	~275mL of clear free water	~375mL of clear free water	6.3
	16			150	Very fine floc	~50mL of clear free water	~125mL of clear free water	~200mL of clear free water	~250mL of clear free water	~350mL of clear free water	28.3
	17			250	Very fine floc	~75mL of clear free water	~125mL of clear free water	~200mL of clear free water	~250mL of clear free water	~350mL of clear free water	20.3
	18			500	Very fine floc	~100mL of clear free water	~850mL of clear free water	~200mL of clear free water	~250mL of clear free water	~350mL of clear free water	11.3

Sample ID	Jar #	Sample Volume (mL)	Polymer ID	Dosage (ppm)	Flash Mix (1 min. @ 100 rpm)	Slow Mix @ 20 rpm (observations)				Observations after settling	Settled NTU
						5 min	10 min	15 min	20 min	20 min	
SMU 1B	1	1000	--	--	No floc	Slight layer of free water.	~50mL of cloudy free water.	~100mL of cloudy free water.	~125mL of cloudy free water.	~200mL of cloudy free water.	388
	2		7824	10	Fine floc	Slight layer of free water.	~150mL of free water with some floating particles.	~200mL of free water with some floating particles.	~225mL of free water with some floating particles.	~300mL of free water with some floating particles.	310
	3			20	Fair floc	Some clear free water.	~175mL of free water with some floating particles.	~225mL of free water with some floating particles.	~275mL of free water with some floating particles.	~325mL of free water with some floating particles.	79.8
	4			30	Fair floc	Some clear free water.	~100mL of free water with some floating particles.	~200mL of free water with some floating particles.	~250mL of free water with some floating particles.	~350mL of free water with some floating particles.	159
	5			40	Good floc	~150mL of clear free water with some floating particles	~225mL of clear free water with some floating particles	~300mL of clear free water with some floating particles	~325mL of clear free water with some floating particles	~375mL of clear free water with some floating particles	205
	6			50	Good floc	~200mL of clear free water with some floating particles	~275mL of clear free water with some floating particles	~350mL of clear free water with some floating particles	~375mL of clear free water with some floating particles	~450mL of clear free water with some floating particles	42.1
	7	1000	7843	15	No noticeable floc	Very fine floc, ~25mL free water.	~50mL free water	~100mL free water	~125mL free water	~175mL free water	143
	8			30	No noticeable floc	Very fine floc, ~50mL free water.	~100mL free water	~150mL free water	~175mL free water	~250mL free water	108
	9			40	No noticeable floc	Very fine floc, ~50mL free water.	~100mL free water	~150mL free water	~175mL free water	~250mL free water	75
	10			50	No noticeable floc	Very fine floc, ~50mL free water.	~100mL free water	~150mL free water	~200mL free water	~250mL free water	39.3
	11			60	No noticeable floc	Fine floc, ~100mL free water with some suspended particles.	~150mL free water with some suspended particles.	~200mL free water with some suspended particles.	~250mL free water with some suspended particles.	~325mL free water with some suspended particles.	43.3
	12			70	No noticeable floc	Fine floc, ~150mL free water with some suspended particles.	~200mL free water with some suspended particles.	~250mL free water with some suspended particles.	~300mL free water with some suspended particles.	~350mL free water with some suspended particles.	49.4
	13	1000	7757	10	Very slight floc. No free water.	Floc is slightly more noticeable, no free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	~200mL of clear free water	288
	14			25	Very fine floc. No free water.	Floc is slightly more noticeable, no free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	~150mL of clear free water	25.2
	15			75	Very fine floc. No free water.	Floc is slightly more noticeable, no free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	~275mL of clear free water	22.6
	16			150	Very fine floc. No free water.	Floc is slightly more noticeable, no free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	~150mL of clear free water	14.2
	17			250	Very fine floc. No free water.	Floc is slightly more noticeable, no free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	~175mL of clear free water	16.9
	18			500	Very fine floc. No free water.	Floc is slightly more noticeable, no free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	Some settling with a layer of clear, free water.	~200mL of clear free water	22.7

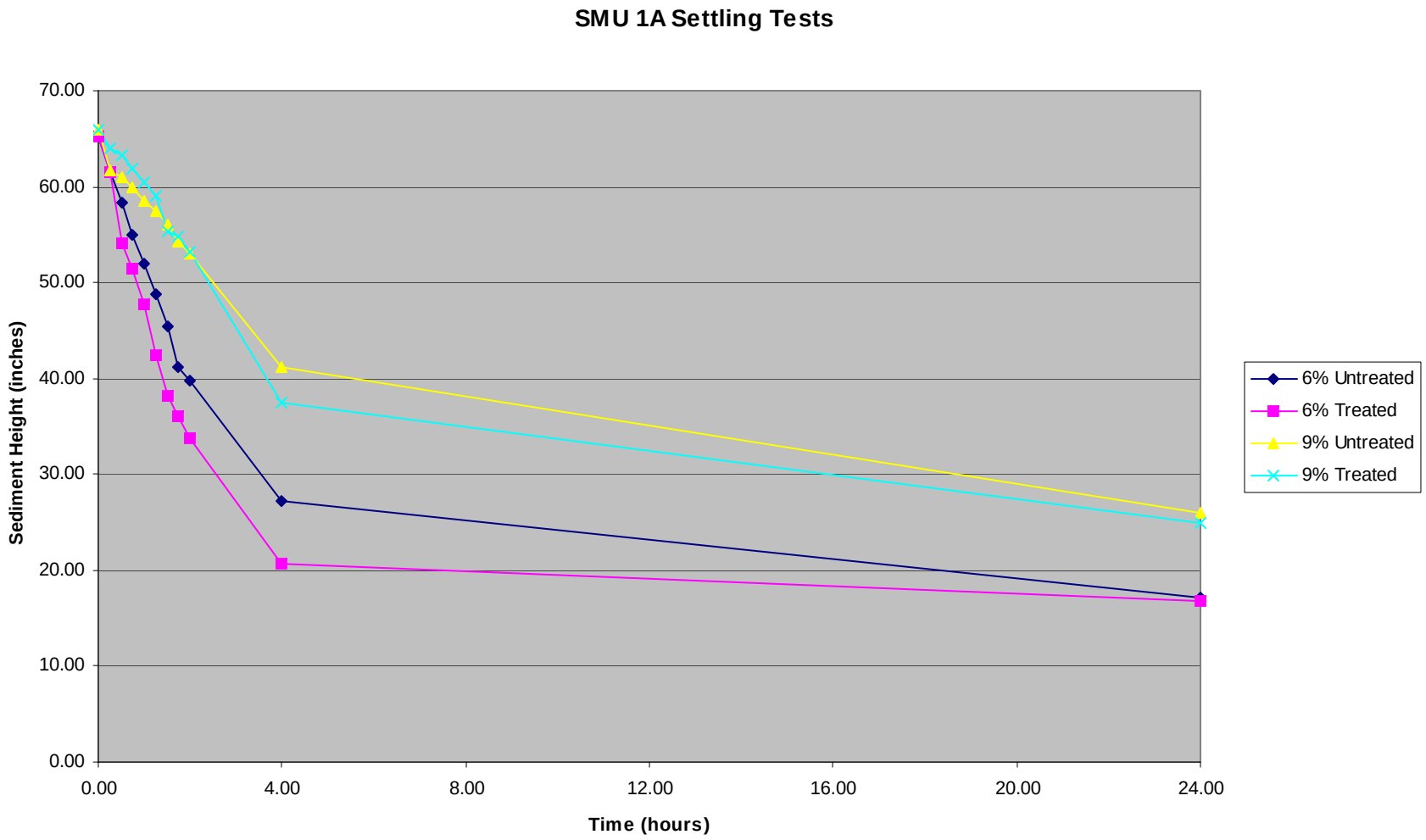
Sample ID	Jar #	Sample Volume (mL)	Polymer ID	Dosage (ppm)	Flash Mix (1 min. @ 100 rpm)	Slow Mix @ 20 rpm (observations)				Observations after settling	Settled NTU
						5 min	10 min	15 min	20 min	20 min	
SMU 6	1	1000	--	--	No floc	No noticeable difference	No noticeable difference.	~500mL of dark, cloudy water	~500mL of dark, cloudy water	~750mL of dark, cloudy, free water.	423
	2		7824	5	Good floc	~800mL of cloudy free water with some floating particles.	~850mL of cloudy free water with some floating particles.	~850mL of cloudy free water with some floating particles.	~850mL of cloudy free water with some floating particles.	~850mL of clear free water	116
	3			15	Good floc	~750mL of clear, free water, some floating particles.	~750mL of clear, free water, some floating particles.	~800mL of clear, free water, some floating particles.	~800mL of clear, free water, some floating particles.	~800mL of clear, free water, some floating particles.	21.5
	4			30	Good floc	~750mL of clear, free water, some floating particles.	~750mL of clear, free water, some floating particles.	~750mL of clear, free water, some floating particles.	~750mL of clear, free water, some floating particles.	~750mL of clear, free water, some floating particles.	12.4
	5			50	Good floc	~725mL of clear free water	~725mL of clear free water	~750mL of clear free water	~750mL of clear free water	~750mL of clear free water	17.3
	6			75	Good floc	~700mL of clear free water	~700mL of clear free water	~700mL of clear free water	~700mL of clear free water	~750mL of clear free water	7.87
	7	1000	7843	5	Fine floc	~800mL cloudy, free water	~800mL cloudy, free water	~800mL cloudy, free water	~800mL cloudy, free water	~850mL cloudy, free water	42.9
	8			10	Fine floc	~750mL cloudy, free water	~750mL cloudy, free water	~750mL cloudy, free water	~750mL cloudy, free water	~800mL cloudy, free water	51.2
	9			15	Fair floc	~700mL cloudy, free water	~750mL cloudy, free water	~750mL cloudy, free water	~750mL less cloudy, free water	~800mL clear, free water	48.3
	10			20	Fair floc	~750mL cloudy, free water	~800mL cloudy, free water	~800mL cloudy, free water	~800mL less cloudy, free water	~800mL clear, free water	42.3
	11			30	Good floc	~775mL cloudy, free water	~800mL cloudy, free water	~800mL cloudy, free water	~800mL less cloudy, free water	~900mL clear, free water	31.3
	12			50	Good floc	~850mL cloudy, free water	~850mL cloudy, free water	~850mL cloudy, free water	~850mL less cloudy, free water	~800mL clear, free water	34.2
	13	1000	7757	5	Fair floc	~450mL cloudy, free water	~600mL cloudy, free water	~675mL cloudy, free water	~325mL cloudy, free water	~325mL cloudy, free water	47.7
	14			10	Fair floc	~500mL cloudy, free water	~650mL cloudy, free water	~700mL cloudy, free water	~750mL cloudy, free water	~750mL cloudy, free water	41.5
	15			20	Good floc	~625mL of clear free water	~700mL of clear free water	~725mL of clear free water	~725mL of clear free water	~350mL of clear free water	13.7
	16			50	Good floc	~650mL of clear free water	~700mL of clear free water	~700mL of clear free water	~700mL of clear free water	~750mL of clear free water	7.29
	17			100	Very good floc	~700mL of clear free water	~725mL of clear free water	~750mL of clear free water	~750mL of clear free water	~775mL of clear free water	54.7
	18			200	Good floc	~700mL of clear free water	~725mL of clear free water	~750mL of clear free water	~750mL of clear free water	~775mL of clear free water	17.4

APPENDIX F

Column Settling Test Data

Onondaga Lake Treatability Study
Syracuse, New York
May 2009

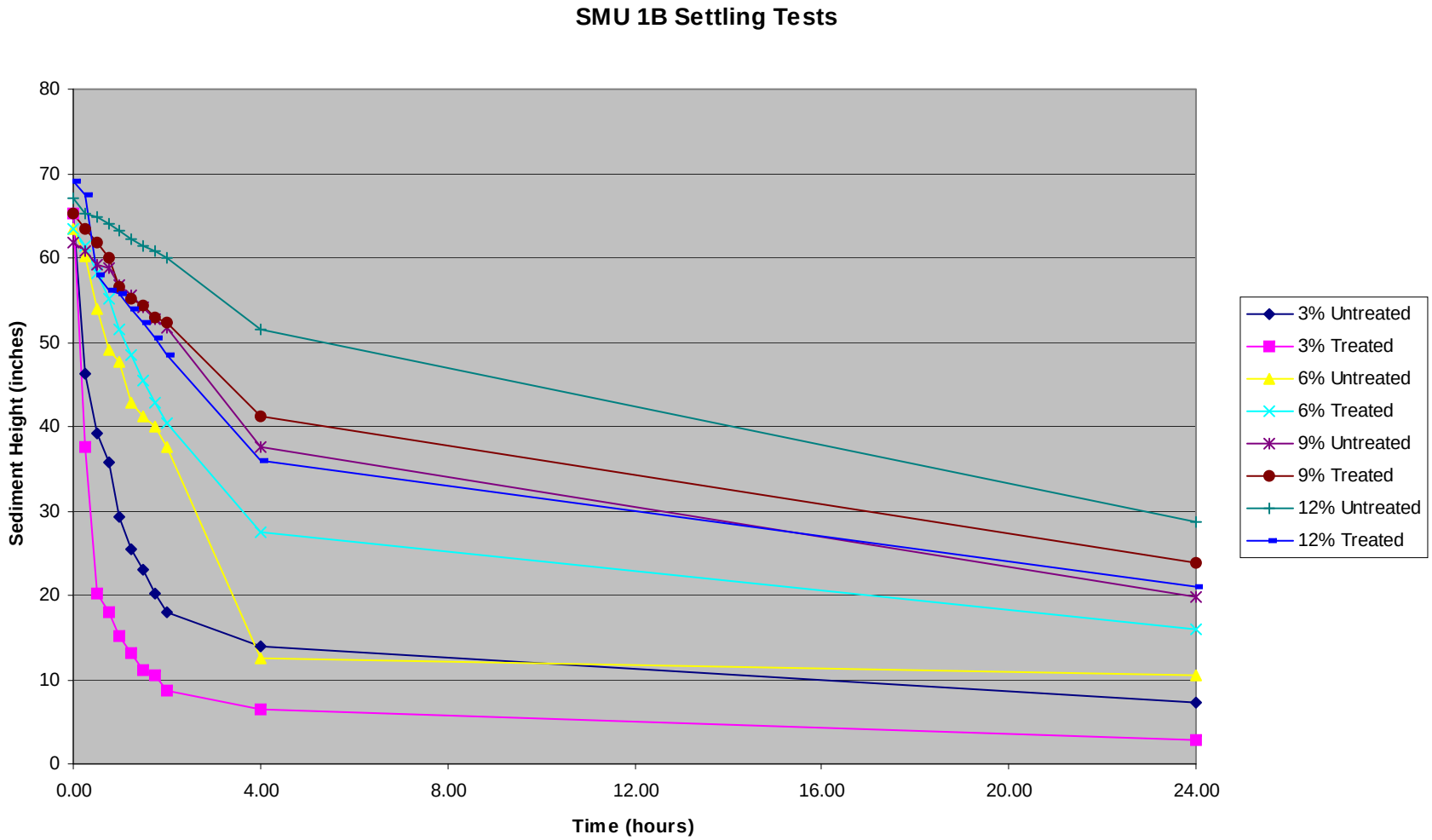
SMU 1A												
6% Solids						9% Solids					
Untreated			Treated with 250ppm 7757			Untreated			Treated with 250ppm 7757		
Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations
0:00	65.25		0:00	65.25		0:00	66.00		0:00	66.00	
0:02	--	Noticeable Interface	0:01	--	Noticeable Interface	0:05	--	Noticeable Interface	0:01	--	Noticeable Interface
0:17	61.50	Supernatant is slightly cloudy.	0:16	61.50	Good floc, settles well. Supernatant appears clear.	0:20	61.75	Supernatant is slightly cloudy.	0:16	64.00	Good floc, settles well. Supernatant appears clear.
0:32	58.25		0:31	54.13		0:35	61.00		0:31	63.25	
0:47	55.00		0:46	51.50		0:50	59.90		0:46	61.88	
1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled
1:02	52.00		1:01	47.75		1:05	58.50		1:01	60.50	
1:17	48.75		1:16	42.50		1:20	57.50		1:16	59.13	
1:32	45.50		1:31	38.25		1:35	56.00		1:31	55.25	
1:47	41.25		1:46	36.00		1:50	54.25		1:46	54.88	
2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled
2:02	39.75	Significant top layer of foam.	2:01	33.75	Significant top layer of foam.	2:05	53.00	Significant top layer of foam.	2:01	53.25	Significant top layer of foam.
4:00	27.25		4:00	20.75		4:00	41.25		4:00	37.50	
24:00	17.20	Supernatant sampled	24:00	16.75	Supernatant sampled	24:00	26.00	Supernatant sampled	24:00	25.00	Supernatant sampled


SMU 1A Settling Tests
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Sediment Height (inches)
0.00
4.00
8.00
12.00
16.00
20.00
24.00
Time (hours)
6% Untreated
6% Treated
9% Untreated
9% Treated

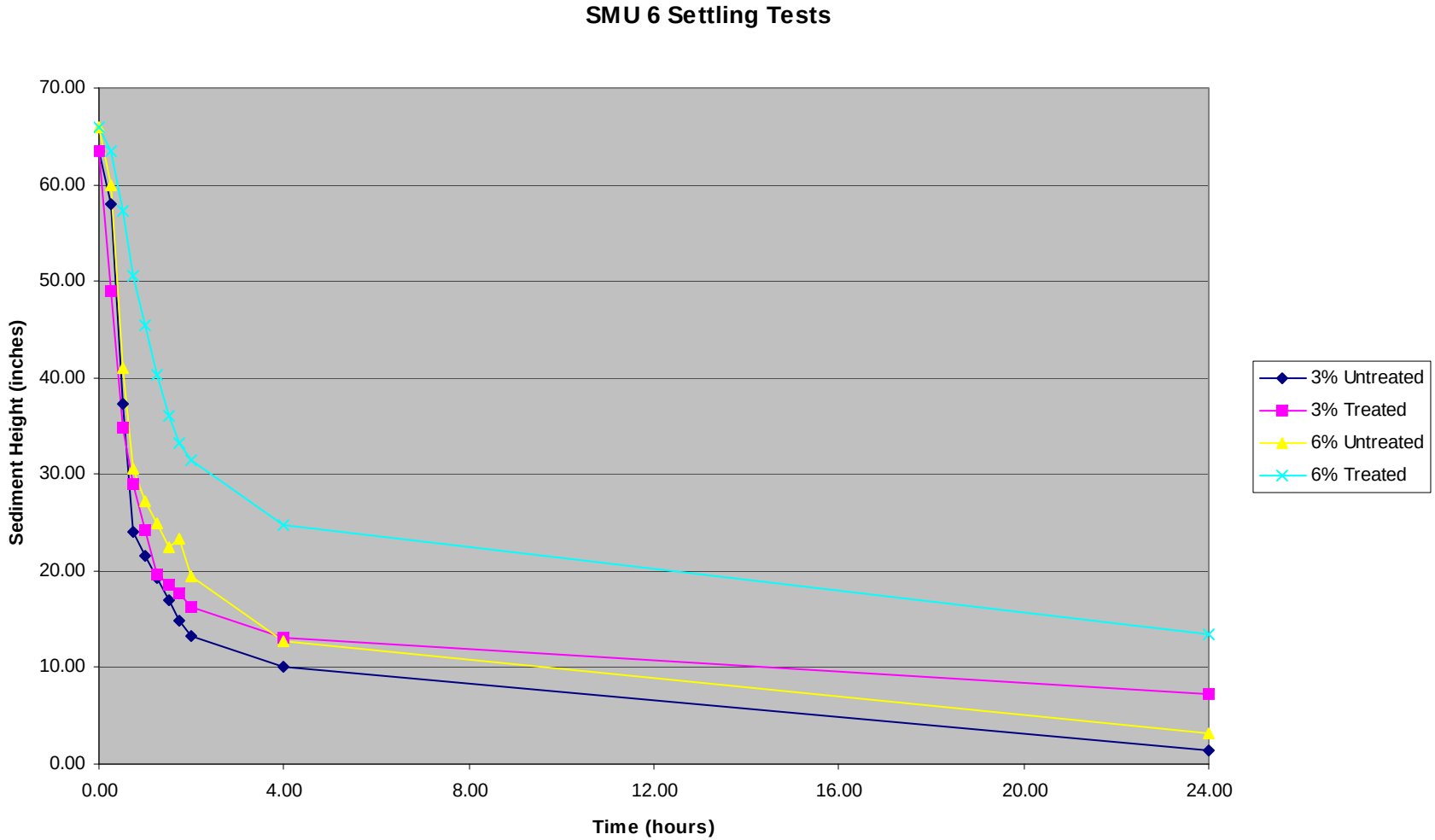
SMU 1B

3% Solids						6% Solids					
Untreated			Treated with 250ppm 7757			Untreated			Treated with 250ppm 7757		
Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations
0:00	65.25		0:00	65.25		0:00	63.50		0:00	63.50	
0:01	--	Noticeable Interface	0:01	--	Noticeable Interface	0:08	--	Noticeable Interface	0:01	--	Noticeable Interface
0:16	46.25	Supernatant is slightly cloudy.	0:16	37.50	Good floc, settles well. Supernatant appears clear.	0:23	60.13	Supernatant is slightly cloudy.	0:16	61.50	Good floc, settles well. Supernatant appears clear.
0:31	39.25		0:31	20.13		0:38	54.00		0:31	58.13	
0:46	35.75		0:46	18.00		0:53	49.00		0:46	55.13	
1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled
1:01	29.25		1:01	15.25		1:08	47.75		1:01	51.50	
1:16	25.50		1:16	13.13		1:23	42.88		1:16	48.50	
1:31	23.00		1:31	11.13		1:38	41.25		1:31	45.50	
1:46	20.25		1:46	10.50		1:53	40.00		1:46	42.75	
2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled
2:01	18.00		2:01	8.75		2:08	37.50		2:01	40.50	
4:00	14.00		4:00	6.50		4:00	12.50		4:00	27.50	
24:00	7.25	Supernatant sampled	24:00	2.75	Supernatant sampled	24:00	10.50	Supernatant sampled	24:00	16.00	Supernatant sampled

9% Solids						12% Solids					
Untreated			Treated with 250ppm 7757			Untreated			Treated with 250ppm 7757		
Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations
0:00	61.83		0:00	65.25		0:00	67.00		0:00	69.00	
0:14	--	Noticeable Interface	0:01	--	Noticeable Interface	0:07	--	Noticeable Interface	0:01	--	Noticeable Interface
0:29	60.75	Supernatant is slightly cloudy.	0:16	63.50	Good floc, settles well. Supernatant appears clear.	0:22	65.25	Supernatant is slightly cloudy.	0:16	67.50	Good floc, settles well. Supernatant appears clear.
0:44	59.25		0:31	61.75		0:37	64.75		0:31	57.94	
0:59	58.75		0:46	60.00		0:52	64.00		0:46	56.13	
1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled
1:14	56.75		1:01	56.50		1:07	63.20		1:01	55.75	
1:29	55.50		1:16	55.13		1:22	62.28		1:16	53.88	
1:44	54.13		1:31	54.25		1:37	61.50		1:31	52.25	
1:59	52.75		1:46	53.00		1:52	60.75		1:46	50.50	
2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled
2:14	51.75		2:01	52.25		2:07	60.00		2:01	48.50	
4:00	37.50		4:00	41.25		4:00	51.50		4:00	36.00	
24:00	19.75	Supernatant sampled	24:00	23.75	Supernatant sampled	24:00	28.63	Supernatant sampled	24:00	21.00	Supernatant sampled


SMU 1B Settling Tests
Sediment Height (inches)
80
70
60
50
40
30
20
10
0
0.00
4.00
8.00
12.00
16.00
20.00
24.00
Time (hours)
3% Untreated
3% Treated
6% Untreated
6% Treated
9% Untreated
9% Treated
12% Untreated
12% Treated

SMU 6												
3% Solids						6% Solids					
Untreated			Treated with 250ppm 7757			Untreated			Treated with 250ppm 7757		
Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations	Time	Mudline	Observations
0:00	63.50		0:00	63.50		0:00	66.00		0:00	66.00	
0:05	--	Noticeable Interface	0:01	--	Noticeable Interface	0:01	--	Noticeable Interface	0:00	--	Noticeable Interface at 5 seconds
0:20	58.00	Supernatant is extremely cloudy, difficult to see sediment line	0:16	49.00	Good floc, settles fast. Supernatant is clear.	0:16	60.00	Supernatant is extremely cloudy, difficult to see sediment line	0:15	63.50	Good floc, settles fast. Supernatant is clear.
0:35	37.25		0:31	34.75		0:31	41.00		0:30	57.25	
0:50	24.00		0:46	29.00		0:46	30.50		0:45	50.50	
1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	--	Supernatant sampled	1:00	45.50	Supernatant sampled
1:05	21.50		1:01	24.25		1:01	27.25				
1:20	19.25		1:16	19.67		1:16	25.00		1:15	40.25	
1:35	17.00		1:31	18.50		1:31	22.50		1:30	36.13	
1:50	14.88		1:46	17.75		1:46	23.25		1:45	33.25	
2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	--	Supernatant sampled	2:00	31.50	Supernatant sampled
2:05	13.25		2:01	16.25		2:01	19.50				
4:00	10.00		4:00	13.00		4:00	12.75		4:00	24.75	
24:00	1.50	Supernatant sampled	24:00	7.25	Supernatant sampled	24:00	3.25	Supernatant sampled	24:00	13.50	Supernatant sampled


SMU 6 Settling Tests
Sediment Height (inches)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
Time (hours)
3% Untreated
3% Treated
6% Untreated
6% Treated