CSO 018 Chlorine Disinfection Pilot Protocol

PREPARED FOR:	Onondaga County Department of Water Environment Protection
PREPARED BY:	CH2M
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The purpose of this technical memorandum (TM) is to provide a pilot test protocol for evaluating the effectiveness of using a sodium hypochlorite disinfection system for fecal coliform reduction at the Harbor Brook CSO 018 Constructed Wetlands Treatment System. Pilot testing sodium hypochlorite addition is desired to show proof of fecal coliform disinfection compliance as well as natural removal of chlorine residual through the wetland without the need for a dechlorination chemical like sodium bisulfite, which would increase the cost and complexity of the system.

Pilot Setup

The pilot system would consist of a sodium hypochlorite bulk storage tank, containment pad, chemical metering pump, piping/valves, and injection line. The bulk storage tank can consist of multiple 55-gallon drums or 275-gallon tote of 12.5% sodium hypochlorite and fed directly to the injection point. The injection point is proposed to be MH-4A after solids are removed at the grit and floatables facility. Box 2 is not recommended as the injection point because influent samples are required to be collected in this location, and we would not want the chlorine addition to affect those samples.

The chemical metering pump should be sufficiently sized to accommodate the full range of anticipated feed rates and be adjusted based on CSO flow rate and target dose. Power for the pump would be necessary, and can be obtained on-site from Panel A, or a temporary generator can be brought on-site. Refer to Table 1 for estimated sodium hypochlorite feed rates (for 12.5% concentration) and metering pump feed rate in gallons per hour (gph). Flows up to 25 cfs are shown for the purposes of the pilot test. It is assumed that for higher flows there will be insufficient staffing to manage the pilot hypochlorite system and sampling. The chemical metering pump should have a capacity up to 50 gph with turndown to 2 gph. A Watson Marlow Series 500 pump is recommended for this application which can be provided with manual or automatic controls. A photo of this style pump is shown below. This peristaltic hose pump is advantageous for sodium hypochlorite dosing applications since it will not become vapor locked and has a large turndown capability.

Table 1. Sodium Hypochlorite Target Feed Rates

Flow, cfs	Applied Hypo Dose, mg/L	Chlorine Use, PPD	12.5% Hypo Solution Feed Rate, gph
6	7.5	243	10
10	7.5	404	17
15	7.5	606	25
20	7.5	808	34
25	7.5	1011	42

Notes:

1) Applied hypo dose based on a target CT (conc. x time) of 50 mg/L-min through the influent pipe and cell 1 of the wetland. Assumed only half of applied hypo is available for disinfection and rest is consumed by other compounds.

2) cfs = cubic feet per second, ppd = pounds per day, gph = gallons per hour

3) Approximately 1 lb active chlorine per gallon hypo

A calibration column should be provided to verify pumping rate. Adjustment to these hypochlorite doses may be required based on initial disinfection results. The applied hypochlorite dose should not exceed 10 mg/L to prevent any adverse impact to the wetland plants and biota and should be maintained at 5 mg/L or less if possible. Table 2 provides a look up table for the estimated pump feed rate based on flowrate and target hypo dose.

Table 2. Estimated Pump Feed Rate (GPH) Based on Flow and Target Hypo Dose

Pump Feed Rate, Gallons Per Hour										
	Hypo Dose, mg/L									
Flow, cfs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
6	1.3	2.7	4.0	5.4	6.7	8.1	9.4	10.8	12.1	13.5
8	1.8	3.6	5.4	7.2	9.0	10.8	12.6	14.4	16.2	18.0
10	2.2	4.5	6.7	9.0	11.2	13.5	15.7	18.0	20.2	22.5
12	2.7	5.4	8.1	10.8	13.5	16.2	18.9	21.6	24.3	26.9
14	3.1	6.3	9.4	12.6	15.7	18.9	22.0	25.2	28.3	31.4
16	3.6	7.2	10.8	14.4	18.0	21.6	25.2	28.7	32.3	35.9
18	4.0	8.1	12.1	16.2	20.2	24.3	28.3	32.3	36.4	40.4
20	4.5	9.0	13.5	18.0	22.5	26.9	31.4	35.9	40.4	44.9
22	4.9	9.9	14.8	19.8	24.7	29.6	34.6	39.5	44.5	49.4
24	5.4	10.8	16.2	21.6	26.9	32.3	37.7	43.1	48.5	53.9
25	5.6	11.2	16.8	22.5	28.1	33.7	39.3	44.9	50.5	56.1

Note: Table assumes a maximum pumping rate of 50 gph and minimum rate of 2 gph.

To maximize storage volume, dechlorination, and natural treatment, the wetland cells should be placed into series mode for the pilot. It is recommended to run the pilot tests in the fall of 2016, spring of 2017, and summer of 2017 to obtain performance data over a number of different types of events and when the natural treatment within the wetland varies due to plant dormancy. This will ensure that the design of the chlorine disinfection system, if selected, considers the varying event types at the facility.

Test Parameters

The goal of the pilot test is to determine if chlorine addition upstream of the wetland, in addition to natural treatment within the wetland cells, can effectively reduce fecal coliform levels to less than 200 CFU/mL at the 018 outfall, while also completely removing any residual chlorine. During wet weather events above 6 cfs and up to 25 cfs, regardless of time of year, sampling for total chlorine, free chlorine, and total coliform should be completed in addition to the SPDES permit required parameters. Table 3 lists the pilot test parameters that should be collected in MH-4A before chlorine addition, wetland Cell 1 effluent, wetland Cell 2 effluent, and the effluent from the wetland (compliance point). This approach will allow for the tracking of chlorine residual and fecal coliform levels across the three wetland cells.

Table 3. Pilot Test Water Quality Sampling Parameters and Locations

Location	MH-4A	Wetland Cell 1 Effluent	Wetland Cell 2 Effluent	Wetland Discharge
Water Quality Parameters	SPDES permit parameters, plus Fecal Coliform, Total Chlorine, Free Chlorine	Fecal Coliform, Total Chlorine, Free Chlorine	Fecal Coliform, Total Chlorine, Free Chlorine	SPDES permit parameters, plus Fecal Coliform, Total Chlorine, Free Chlorine

A successful pilot test would demonstrate reduction of fecal coliform to less than 200 CFU/mL, no chlorine residual in the wetland effluent, and no adverse impacts on overall wetland treatment performance regardless of flow, temperature, pH, and influent coliform concentration.