Submittal Authorization

Approved By: [Signature]  November 1, 2011

I certify under penalty of law that I have examined and am familiar with the information submitted in this document and all attachments and that this document and its attachments were prepared under my direction or supervision in a manner designed to ensure that qualified and knowledgeable personnel properly gather and present the information contained therein. I further certify, based on my inquiry of those individuals immediately responsible for obtaining the information, that I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment.
Contents

Submittal Authorization .................................................................................................................. iii
Acronyms and Abbreviations ....................................................................................................... vii
Introduction ......................................................................................................................................... 1
Protocols ............................................................................................................................................... 3

- Influent Screening Protocol ...................................................................................................... 3
- Grit Removal Protocol ............................................................................................................... 3
- Primary Clarification Protocol .................................................................................................. 4
- Secondary Clarification Protocol ............................................................................................. 6
- Disinfection Protocol ................................................................................................................. 9
- Overall Stress Testing Schedule ............................................................................................... 9

Tables

1 Test Parameters and Sampling Schedule for Influent Screening ........................................ 3
2 Test Parameters and Sampling Schedule for Grit Removal ..................................................... 4
3 Controlled Flow Test Schedule for Grit Removal .................................................................... 4
4 Test Parameters and Sampling Schedule for Each Primary Clarifier .................................. 5
5 Controlled Flow Test Schedule for Primary Clarifier .............................................................. 5
6 Primary Clarification General Test Schedule ........................................................................ 6
7 Test Parameters and Sampling Schedule for Each Secondary Clarifier ............................... 7
8 Controlled Flow Test Schedule for Secondary Clarifier ......................................................... 8
9 Secondary Clarification General Test Schedule ..................................................................... 8

Appendix

A Sample Testing Protocol—Chlorine
Acronyms and Abbreviations

BOD  
BOD₅  5-day biochemical oxygen demand  
Cl  chlorine  
DOB  depth of blanket  
EWSU  Evansville Water and Sewer Utility  
fps  foot/feet per second  
ft²  square foot/feet  
gal  gallon(s)  
gpd  gallons per day  
lb  pound  
mg  milligram(s)  
mgd  million gallons per day  
mg/L  milligram(s) per liter  
ml  milliliter(s)  
MLSS  mixed liquor suspended solids  
RAS  return activated sludge  
SCADA  supervisory control and data acquisition  
SS  suspended solids  
SVI  sludge volume index  
TRC  total residual chlorine  
TS  total solids  
TSS  total suspended solids  
WWTP  Wastewater Treatment Plant
Introduction

Section E, Paragraph 19.d. of the Consent Decree (CD) states the following:

By no later than November 1, 2011, Defendants shall submit a stress test protocol for each treatment step (preliminary, primary, secondary and disinfection) at the East WWTP to determine the Maximum Treatable Flow Rates of each treatment step, following the Early Action Upgrades described above. Plaintiffs shall review the stress test protocol pursuant to Section XV of this Decree (Review and Approval Procedures). In accordance with that review and by no later than July 31, 2012, Defendants shall conduct the approved stress test. The stress test shall identify Maximum Treatable Flow Rates for each treatment step, and an overall Maximum Treatable Flow Rate for full treatment at the East WWTP while utilizing both the conventional secondary aeration basins (in step feed and/or contact stabilization modes).

The purpose of this report is to present the proposed stress testing protocols for determining maximum treatable flow rates through each treatment step at the East WWTP.
Protocols

Influent Screening Protocol

The East WWTP currently has one ¼-inch mechanical bar screen with a rated capacity of 20 million gallons per day (mgd). A second screen of the same type will be installed by March 1, 2012. Stress testing for this process will involve isolating the new mechanical bar screen and conducting a hydraulic analysis on it. Influent screening at the East WWTP is limited by the screen’s influent channel water level, the high-high water level alarm, and screen blinding. These three parameters will serve as definitions of screening failure in the stress test.

Flow will be increased incrementally through the new screen until the upstream water level reaches the predetermined maximum depth, the high-high alarm level sounds, or when blinding occurs. EWSU WWTP staff will manually adjust influent gates to control flow through the mechanical screen. It is anticipated that stress testing will be conducted over 5 hours. Testing and analysis will include the following parameters:

- Flow
- Depth of water in influent channel
- High-high alarm
- Screen status (blinded or no)

Table 1 summarizes the anticipated parameters and sampling requirements for the stress test. Stress testing staff will be onsite for the full duration of each test, and will communicate with the WWTP operator on times to adjust flows and terminate each run. The test will be repeated once.

**TABLE 1**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Parameter Analyzed</th>
<th>Sampling Method</th>
<th>Sampling Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influent</td>
<td>Flow</td>
<td>SCADA</td>
<td>Continuous</td>
</tr>
<tr>
<td></td>
<td>Channel Depth</td>
<td>Level Sensor</td>
<td>Continuous</td>
</tr>
<tr>
<td></td>
<td>High-high Alarm</td>
<td></td>
<td>Continuous</td>
</tr>
<tr>
<td></td>
<td>Screen Status</td>
<td></td>
<td>Continuous</td>
</tr>
</tbody>
</table>

SCADA = supervisory control and data acquisition

Grit Removal Protocol

The East WWTP contains two Pista vortex grit units with a rated capacity of 30 mgd each, for a total rated capacity of 60 mgd. According to the manufacturer, the 18-foot diameter units in place are designed to be operated at an influent velocity ranging from 2.0 to 3.5 feet per second (fps). Stress testing for this process will involve isolating a single unit and
conducting a hydraulic analysis on it. Due to the flow rate required, testing must be conducted during a wet weather event. EWSU WWTP staff will select the unit to be tested, and will manually adjust the appropriate gates will to deliver 30 mgd to the selected grit unit. It is anticipated that stress testing will be conducted over 5 hours. Testing and analysis will include the following parameters:

- Flow rate
- Influent and effluent total solids (TS)

Influent and effluent composite samples will be collected over the duration of the test. Analyses will be conducted on the samples in the EWSU Laboratory. Table 2 summarizes the anticipated parameters and sampling requirements for the stress test.

**TABLE 2**
Test Parameters and Sampling Schedule for Grit Removal

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Parameter Analyzed</th>
<th>Sampling Method</th>
<th>Sampling Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influent</td>
<td>Flow</td>
<td>SCADA</td>
<td>Continuous</td>
</tr>
<tr>
<td></td>
<td>TS</td>
<td>Composite</td>
<td>1 grab per hour</td>
</tr>
<tr>
<td>Effluent</td>
<td>TS</td>
<td>Composite</td>
<td>1 grab per hour</td>
</tr>
</tbody>
</table>

Stress test failure will be defined as zero TS removal efficiency. It is anticipated that the stress test will be conducted at an influent flow rate of 30 mgd, and will be kept constant for 5 hours. If the stress test fails, it will be repeated at an inlet flow rate corresponding to 3.0 fps. Table 3 summarizes the flow schedule for the test.

Stress testing staff will be onsite for the full duration of each test, and will communicate with the WWTP operator on times to adjust flows and terminate each run. Influent and effluent grab samples will be collected once every hour. Influent samples should be collected immediately downstream of the influent screens. This test will last 5 hours and will be repeated once.

**Primary Clarification Protocol**

The East WWTP contains seven primary clarifiers. Stress testing for this process will involve isolating two clarifiers and conducting a hydraulic analysis on them. EWSU WWTP staff will select the clarifiers to be tested. The appropriate clarifier influent gates will be manually adjusted to deliver the specified flow rates to that selected clarifiers. It is anticipated that several primary clarifiers will be taken out of service in order to achieve the desired flow rates through the two being tested. Testing and analysis is anticipated to be conducted over 4 days and will include the following parameters:

- Flow rate
- Influent total suspended solids (TSS) and biochemical oxygen demand (BOD)
- Effluent TSS and BOD
- Depth of sludge blanket (DOB)

TSS and DOBs will be monitored over the duration of each test using portable analyzers to determine when failure occurs. Influent and effluent composite samples will be also collected over the duration of each test. BOD and TSS analysis will be conducted on the samples. In addition to recoding these parameters, visual observations should also be recorded throughout the duration of each test. All laboratory testing will be conducted in the EWSU Laboratory. Table 4 summarizes the anticipated parameters and sampling requirements for the stress test.

### TABLE 4
Test Parameters and Sampling Schedule for Each Primary Clarifier

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Parameter Analyzed</th>
<th>Sampling Method</th>
<th>Sampling Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influent</td>
<td>Flow</td>
<td>Parshall Flume</td>
<td>Continuous</td>
</tr>
<tr>
<td></td>
<td>TSS</td>
<td>Portable Meter</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Effluent</td>
<td>TSS</td>
<td>Portable Meter</td>
<td>30 minutes</td>
</tr>
<tr>
<td></td>
<td>TSS and BOD$_5$</td>
<td>Composite</td>
<td>1 grab per hour</td>
</tr>
<tr>
<td>Sludge blanket</td>
<td>Depth</td>
<td>Portable Meter</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>

Stress testing failure will be defined as a predetermined unacceptable level of clarifier effluent TSS.

It is anticipated that the stress test will be conducted at 4 influent flow rates initially proposed to be 1,200, 1,500, 2,000, and 3,000 gallons per day (gpd) per square foot (ft$^2$), which correspond to 4.0, 4.9, 6.6, and 9.9 mgd per clarifier. The flow rate for each test will be kept constant for approximately 5 hours and monitored with the Parshall flumes located downstream of each clarifier. Each test will be repeated twice.

Table 5 summarizes the flow schedule for this test.

### TABLE 5
Controlled Flow Test Schedule for Primary Clarifier

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>Clarifier 1</th>
<th>Clarifier 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1 (3:00 p.m. to 8:30 p.m.)</td>
<td>Test No. 1—4.0 mgd</td>
<td>Test No. 2—9.9 mgd</td>
</tr>
<tr>
<td>Day 2 (6:30 a.m. to 12:00 p.m.)</td>
<td>Test No. 3—4.9 mgd</td>
<td>Test No. 4—6.6 mgd</td>
</tr>
<tr>
<td>Day 3 (3:00 p.m. to 8:30 p.m.)</td>
<td>Test No. 5—6.6 mgd</td>
<td>Test No. 6—4.9 mgd</td>
</tr>
<tr>
<td>Day 4 (6:30 a.m. to 12:00 p.m.)</td>
<td>Test No. 7—9.9 mgd</td>
<td>Test No. 8—4.0 mgd</td>
</tr>
</tbody>
</table>
Stress testing staff will be onsite for the full duration of each test, and will communicate with the WWTP operator on times to adjust flows and terminate each run. Table 6 provides a general schedule of testing activities per test run for the first hour. The testing sequence is repeated for the remaining 4 hours of the test run.

**TABLE 6**  
Primary Clarification General Test Schedule  
EWSU East WWTP Stress Testing Protocol

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Cleric Meter</th>
<th>HACH Meter</th>
<th>Manual Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clarifier 1</td>
<td>Clarifier 2</td>
<td>Clarifier 1</td>
</tr>
<tr>
<td>0</td>
<td>DOB</td>
<td>Inf/Eff TSS</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>DOB</td>
<td>Inf/Eff TSS</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>DOB</td>
<td>Inf/Eff TSS</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>DOB</td>
<td>Inf/Eff TSS</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
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<td>50</td>
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<td></td>
</tr>
<tr>
<td>55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>DOB</td>
<td>Inf/Eff TSS</td>
<td>Eff Composite</td>
</tr>
<tr>
<td>65</td>
<td>DOB</td>
<td>Inf/Eff TSS</td>
<td>Eff Composite</td>
</tr>
<tr>
<td>Repeat</td>
<td>Repeat</td>
<td>Repeat</td>
<td>Repeat</td>
</tr>
</tbody>
</table>

**Secondary Clarification Protocol**

The East WWTP’s secondary process is a traditional activated sludge process that features three aeration tanks and three secondary clarifiers. Stress testing for this process will involve isolating a single clarifier and conducting a hydraulic analysis on it. However, because each clarifier is directly paired with a dedicated aeration tank, isolating a clarifier requires isolating its paired aeration tank as well. Because of this aeration/clarification configuration, flow control must be managed at the two aeration tank splitter boxes.

EWSU WWTP staff will select the clarifier to be tested. The appropriate gates in the aeration splitter box will be adjusted to deliver the specified flow rates to that selected clarifier. While it is anticipated that the remaining two clarifiers will be taken fully out of service during the stress test, it will be necessary to continue aeration in all aeration tanks.
Testing and analysis is anticipated to be conducted over 5 days and will include:

- Influent flow rate
- Mixed liquor suspended solids (MLSS)
- Return activated sludge (RAS) flow rate and TSS
- Effluent BOD and TSS
- DOBs
- Sludge volume index (SVI) determination

MLSS, RAS TSS, effluent TSS, and DOBs, will be monitored over the duration of each test using a portable analyzer(s) to determine when failure occurs. In addition to this, a clarifier effluent composite sample will be collected at the completion of each test, from which an effluent TSS and BOD analyses will be conducted. In addition to recoding these parameters, visual observations should also be recorded throughout the duration of each test. All laboratory testing will be conducted in the EWSU Laboratory. Table 7 summarizes the anticipated parameters and sampling requirements for this test.

**TABLE 7**

Test Parameters and Sampling Schedule for Each Secondary Clarifier

<table>
<thead>
<tr>
<th>Parameter Analyzed</th>
<th>Sampling Method</th>
<th>Sampling Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influent Flow</td>
<td>Staff gage</td>
<td>30 minutes</td>
</tr>
<tr>
<td>SVI</td>
<td>Grab</td>
<td>30 minutes</td>
</tr>
<tr>
<td>MLSS</td>
<td>Portable Meter</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Effluent TSS</td>
<td>Portable Meter</td>
<td>15 minutes</td>
</tr>
<tr>
<td>TSS and BOD&lt;sub&gt;5&lt;/sub&gt;</td>
<td>Composite</td>
<td>1 grab per hour</td>
</tr>
<tr>
<td>RAS Flow</td>
<td>SCADA</td>
<td>Continuous</td>
</tr>
<tr>
<td>TSS</td>
<td>Portable Meter</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Sludge blanket Depth</td>
<td>Portable Meter</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>

BOD<sub>5</sub> = 5-day biochemical oxygen demand

Stress testing failure will be defined as a predetermined unacceptable level of clarifier effluent TSS.

It is anticipated that the stress test will be conducted at 3 influent flow rates initially proposed to be 7, 8.5, and 10 mgd. The flow rate for each test will be kept constant for approximately 5 hours. Influent flow will be monitored at the aeration tank splitter box by means of a staff gauge. RAS rate will be maintained through all tests. It is anticipated that the testing will be conducted at a RAS rate of approximately 40 percent of influent flow. Because RAS rate is not ratio controlled at the East WWTP, stress testing staff will be required to calculate the appropriate RAS rate and manually adjust RAS controls to generate the appropriate RAS flow.

Table 8 summarizes the flow schedule for the test.
If possible, stress testing for this process should be spread out over non-consecutive days, in order to identify sludge variability. Stress testing staff will be onsite for the full duration of each test, and will communicate with the WWTP operator on times to adjust flows and terminate each run. Each test will be repeated twice. Table 9 provides a general schedule of testing activities per test run for the first hour. The testing sequence is repeated for the remaining 4 hours of the test run.

### TABLE 9
Secondary Clarification General Test Schedule

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Cleric Meter</th>
<th>HACH Meter</th>
<th>Manual Sample</th>
<th>Staff Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>DOB</td>
<td>Eff TSS</td>
<td>Inf Flow</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>MLSS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>RAS SS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Eff TSS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>SVI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>DOB</td>
<td>Eff TSS</td>
<td>Inf Flow</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>MLSS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>RAS SS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Eff TSS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>SVI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>DOB</td>
<td>Eff TSS</td>
<td>Eff Composite</td>
<td>Inf Flow</td>
</tr>
<tr>
<td>Repeat</td>
<td>Repeat</td>
<td>Repeat</td>
<td>Repeat</td>
<td>Repeat</td>
</tr>
</tbody>
</table>

SS = suspended solids
Disinfection Protocol

Stress testing the East WWTP’s chlorine disinfection process will primarily involve jar tests. Fieldwork will include collecting approximately 5 gallons of secondary clarifier effluent during a wet weather event for laboratory analysis. Laboratory analysis will involve determining the total residual chlorine (TRC) required to achieve effluent permit levels for fecal coliform and *E. coli*. The level of disinfection at 12, 15, and 20 minutes of detention time at various levels of TRC are initially proposed to be examined.

Maximum flow rate will be determined at either 15 minutes of detention time in accordance with 10 State Standards or if the maximum flow rate at a detention time less than 15 minutes based on this testing protocol. See Appendix A for a sample laboratory testing protocol.

Overall Stress Testing Schedule

Stress testing is anticipated to commence in Spring of 2012 and will conclude by no later than July 31, 2012. The test results will be analyzed to identify the maximum treatable flow rates for preliminary, primary, secondary, and disinfection treatment steps, and the proposed overall maximum treatable flow rate for full treatment at the East WWTP. Stress testing results will be summarized in a report and submitted by no later than July 31, 2012.

On the day of scheduled testing, the stress test team will confirm with WWTP staff that current plant conditions are conducive to stress testing. The stress test team will arrive onsite for setup, calibration, and “dry runs” with portable test meters and sampling equipment. The stress test team will answer any remaining questions from WWTP staff prior to the start of testing. Prior to commencement of first test, the stress test team will ensure the following actions have been addressed:

- **Coordination with EWSU WWTP Laboratory** — The testing team will ensure that there are composite sample containers properly labeled for the test runs. The team will confirm anticipated schedule for sample delivery and analysis for TSS and BOD analysis.

- **Manual Sampler** — The testing team will ensure that manual samplers for the effluent composite sample and the influent sample for SVI analysis are available. Manual samplers consist of a 1000 mL collection bottle attached to an extension rod. The team will review sampling locations around unit processes being tested.

- **Portable HACH Solids Analyzer** — The testing team will acquire familiarity with portable solids analyzer, perform necessary calibrations, and perform a dry run using the HACH portable solids analyzer, which will be used to monitor TSS.

- **Portable Cerlic Blanket Monitor** — The testing team will acquire familiarity with portable blanket monitor, perform necessary calibrations, and perform a dry run to test for DOB, MLSS and RAS SS.

- **SVI Test (30-minute settleability test)** — The influent MLSS grab sample will be well mixed and poured into a 1,000-milliliter (ml) graduated cylinder. After 30 minutes, the volume of settled solids will be read in terms of ml. The SVI is calculated as follows:

\[
SVI = \frac{(\text{ml settled})}{(1,000)}/\text{MLSS mg/l}
\]
Appendix A
Sample Testing Protocol—Chlorine
Sample Testing Protocol—Chlorine

Objective

Determine the level of disinfection at 12, 15, and 20 minutes of detention time at various levels of total residual chlorine (TRC). TRC residuals to be evaluated are: 0.5, 1.0, 1.5, 2.0, and 2.5 milligrams per liter (mg/L). The objective is to determine the TRC required to achieve the following bacterial levels:

- Fecal Coliform Permit: <200/100 milliliter (ml)
- E. coli: <130/100 ml

Preliminary Actions

1. Sample Collection: During a storm event with secondary bypassing, collect 3 gallons (gal) of the secondary effluent from the middle of junction box prior to entering the east and west contact tanks.

2. Total suspended solids (TSS): Collect sufficient aliquot of sample and deliver to the laboratory for TSS analysis.

3. Hypochlorite solution: Prepare hypochlorite solution to achieve 1 milligram (mg) chlorine per milliliter (ml).

   Procedure:
   a. Collect one gallon of commercial grate sodium hypochlorite.
   b. One gallon of hypochlorite contains one pound (lb) of chlorine (Cl):
      Calculation: (1 lb Cl/gal)(454,000 mg/lb)/3,785 ml/gal = 120 mg/ml
   c. Prepare a 1.2-liter solution:
      Add 10 ml of hypochlorite solution to 1,190 ml of deionized (DI) water
      (10)(120 mg/ml)/1,200 water = 1 mg Cl/ml

4. Chlorine demand: Determine the chlorine demand.

   Procedure:
   a. Add one liter of sample to beaker and stir constantly.
   b. Add 4 ml of sodium hypochlorite solution. (4 mg/L hypochlorite solution—This is the approximate concentration dosage at the Morris Forman Water Quality Technology Conference).
   c. After 12 minutes, test for TRC.
d. Determine chlorine demand:

Initial chlorine dose - TRC = chlorine demand

Example: TRC = 1.0 = mg/L

Chlorine Demand = 4 mg/L - 1 mg/L = 3 mg/L

e. If the chlorine was completely consumed, repeat test with higher chlorine dosage until there is a TRC and the chlorine demand is determined.

5. Bacterial sample container preparation: Add 2 ml of sodium bisulfite to each sample container to dechlorinate each sample. Need 15 prepared sample containers.

Test

Set up three 1-liter aliquots per detention time per TRC objective, stirring constantly. Each aliquot is to be tested at the following TRC objective concentrations after 12, 15, and 20 minutes of detention time: 0.5, 1.0, 1.5, 2.0, and 2.5 mg/L.

For example: The first set is to be tested for a TRC objective of 0.5 mg/L at 12, 15, and 20 minutes of detention time. The second set is to be tested for TRC objective at 1.0 mg/L.

Procedure

1. Add hypochlorite solution to achieve the desired TRC.
2. The desired TRC = chlorine demand + TRC objective
3. Example: Using the example above to achieve a TRC of 0.5 mg/L, add 3.5 ml of hypochlorite solution to the sample.
4. Continue stirring.
5. After the specified detention time of 12 minutes, collect a sample in the prepared bacterial sample container). Then, immediately analyze the remaining aliquot for TRC and record on bench sheet.
6. Repeat for detention times of 15 and 20 minutes.
7. Have the laboratory test each sample for fecal coliform and *E. coli*.
8. Repeat procedure for the next TRC objective at the same detention times.