MEMORANDUM CH2MHILL

Citywide Illegal Connection Investigation, Phase 3 (CWI3)

Wet Weather Outfall Screening Protocols (Task 1)

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COPIES: Boston Water and Sewer Commission

FROM: CH2M HILL

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Introduction 1
Weather and Tide Monitoring 2
Screening and Sampling 2
Sampling Procedures 3
Quality Assurance/Quality Control 5
Public Notification 7
General Field Requirements 7
References 8
APPENDIX A - Locations Approved for Inspection 9
APPENDIX B - Outfall Screening Forms 10
APPENDIX C - Public Advisory 14

Introduction

The purpose of this document is to outline field procedures to perform wet weather screening and sampling of the Boston Water and Sewer Commission's (Commission's or BWSC's) storm drain outfalls (SDOs), combined sewer overflow outfalls (CSOs), and storm drain interconnections between the Commission and storm drains owned by other Municipal Separate Storm Sewer Systems (MS4s). The interconnection sampling locations will be storm drain manholes.

The goal of the wet weather field screening program is to collect a sample at all locations where flow was not observed during dry weather screening as well as locations where dry weather flow was below all Illicit Discharge Detection and Elimination (IDDE) thresholds as defined in paragraph 11 of Section VII Remedial Measures of Civil Action No. 10-10250-RGS, and determine if the wet weather flow is contaminated. Screening will consist of recording weather conditions, observing visual and olfactory characteristics of wet weather flow, and collecting samples to be analyzed for bacteria and other parameters.

Stacey DePasquale Engineering, Inc. (SDE), under contract to CH2M HILL, will perform outfall screening field work. The current list of approved storm drain outfalls (Table A-1) and interconnections (Table A-2) are included in Appendix A. CSO outfalls are currently on

hold, but they will be added to Appendix A once approved. Each outfall will be identified by its unique outfall number, and interconnections will be identified by their unique manhole Facility ID, as shown in Appendix A.

Pictures and forms from the 2012 CWI3 dry weather screening program will be used to guide the wet weather investigations. The Commission can provide additional plans and information about specific screening locations on an as-needed basis.

Weather and Tide Monitoring

SDE must continuously monitor (and keep records of) weather forecasts as a basis for determining when a period of acceptable wet weather exists in order to mobilize field crews to perform the wet weather screening. "Screening and Sampling" as described below may proceed under the following conditions, as stipulated in paragraph 13 of Section VII Remedial Measures of Civil Action No. 10-10250-RGS:

At least 0.25 inches of rainfall in the preceding 24 hours, or precipitation event sufficient to produce flow in an outfall

SDE will use the Commission's rain gauges to confirm that wet weather conditions have been met prior to mobilizing. For tidal locations, Screening and Sampling must be performed near low tide.

Screening and Sampling

Prior to or in conjunction with the dry weather screening, visual inspections consisting of recording the location and characterizing the condition of each SDO, CSO outfall, and interconnection were completed between July and November 2012. Therefore, a visual inspection will not be conducted during 2012 wet weather screening.

One day prior to screening and sampling visits, SDE will coordinate with CH2M HILL to notify the laboratory and the courier of the schedule for the sampling day.

A two-person field crew will conduct the screening and sampling by visiting the location of each outfall or interconnection manhole. Where possible, the same screening location visited during 2012 dry weather screening will be used for 2012 wet weather screening.

If the same location is not accessible, field crews will locate an alternate suitable screening site. The selected screening site will be as near the outfall as possible and free of standing water or back flow from the receiving water. It is anticipated that selected manholes in these cases will be no more than three manholes or 750 feet upstream outside of backflow or tidal influence. In any case where the sampling location for wet weather screening differs from the sampling location for dry weather screening the reason for the change must be noted in the field form.

If an upstream manhole is used for screening and sampling SDE should note if there is more than one inlet to the manhole as well as the flow characteristics from each pipe. It is important at CSO outfalls to collect a sample at a manhole downstream of the regulator. Sampling at CSO outfalls should be done prior to activation of the upstream CSO

regulator(s) or during a precipitation event that does not cause any upstream CSO regulator(s) to activate.

All observations and activities conducted at each screening location will be recorded on the screening and sampling form included in Appendix B. Forms will be completed on a portable data logger. Data will be exported to a spreadsheet and paper reports will also be generated and posted on the project SharePoint site on a weekly basis. The information recorded on the forms will include weather conditions during, and in the 24 hours prior to, each sampling event. At each location where flow is observed, record an observation of flow characteristics (odor, color, clarity, turbidity, deposits/stains). Collect a sample for laboratory analysis of the wet-weather flow for either *E. coli* bacteria or *Enterococcus* bacteria. Tables A-1 and A-2 designate each outfall location as discharging to fresh or marine waters. All interconnection manhole locations in Table A-3 are classified as discharging to fresh water bodies. Outfalls discharging to fresh water bodies shall be sampled for *E. coli* analysis, and those discharging to marine water bodies shall be sampled for *Enterococcus* analysis.

In addition to each analytical sample collected, the field crews will estimate the flow and collect a sample for on-site evaluation of the following parameters:

- pH – field measurement
- Temperature – field measurement
- Specific Conductivity – field measurement
- Surfactants – field measurement
- Ammonia – field measurement
- Total Residual Chlorine – field measurement
- Salinity – field measurement

Analytical samples collected will be labeled, sealed, and stored in ice-filled coolers. Samples will be transferred to G&L Laboratories of Quincy, MA for analysis within a six-hour maximum holding time. Completed chains of custody will accompany each shipment to the lab. All samples will be collected in accordance with the following further detailed instructions. It is estimated that between 6 and 12 samples will be collected per day, depending on distance among outfall locations.

Sampling Procedures

The following procedure outlines, in detail, the steps to be taken during the "Screening and Sampling" visit:

- Prior to the start of sampling, a trip blank sample must be prepared by filling a laboratory-provided sample container with clean bottled water (distilled or bottled drinking water is acceptable). This trip blank sample will be labeled and kept in a cooler with all samples collected that particular day.
- Upon arrival at the appropriate screening location, begin a new Screening and Sampling Form. Blank forms are included in Appendix B.
- Indicate whether the screening location is a storm drain outfall, combined sewer overflow outfall, or interconnection manhole.

- Record all pertinent observational information, including a general description of flow velocity, depth of water, appearance of water, etc.
- If outfall location is an actual manhole, complete information related to manhole appearance and condition.
- Record the time of sampling.
- Place a clean grab sampling container into the middle of the flow stream facing upstream. Retrieve the container after it has filled and swirl the contents to coat all inside surfaces with sample water. Dump the contents of the container away from or downstream of sampling location. Repeat this twice, so that sample container is fully rinsed with sample water three times.
- Using the same method, fill and retrieve the sample container a fourth time. Gently swirl container to maintain mixing of the grab sample.
- Open the sterile container for bacterial sampling. Use caution to handle only the outside of each sample container and to maintain sterile conditions during collection of bacterial samples. Fill sterile container with sample water and seal container. If duplicate samples are being collected at a particular location, they should be poured from the same container. The appropriate analysis will be conducted at sample locations as follows:
    - *E. coli* – freshwater discharge locations;
    - *Enterococcus* – marine discharge locations.
- Verify that the sample container is properly sealed and label each sample container with sample identifier, date, time, preservative type (ice only), and initials of sampling personnel. Duplicate samples shall be labeled with a "D" preceding the sample identifier. All information shall be also recorded on the field form.
- Place sample containers in ice-filled coolers until later transport to the lab takes place.
- Conduct on-site measurements of field parameters on remaining volume in sample container. If more volume is needed, a subsequent grab sample may be collected in the manner described for analytical sample collection. Cole Parmer® CHEMets colorimetric test kits will be used for field measurements of surfactants, ammonia, and total residual chlorine. Portable meters are used for measurements of pH, salinity, temperature, and specific conductivity. (Note that instrumentation shall be checked and calibrated in advance at the beginning of each day.)
- Gently swirl the container to maintain mixing.
- Use manufacture instructions to run the sample for the required field parameters.
- Record results and time of measurements on the field form.
- Clean and store meter during travel between sampling locations. Leave meter turned on to avoid the need for recalibration.

- For any reusable sampling equipment, decontamination shall be performed as follows:
    1. Rinse equipment with a 70% isopropyl alcohol solution. Rinsate shall be collected in a bucket and disposed of properly.
    2. Rinse equipment with deionized water.
- Note that samples must be transferred to and analyzed by G&L Laboratories within a **six-hour holding time**.
- Prior to transfer to the lab, a chain of custody shall be filled out and must accompany samples at all times. The person receiving samples at the lab must sign each chain of custody.

Quality Assurance/Quality Control

This Quality Assurance/Quality Control (QA/QC) section will establish the data quality objectives (DQOs) for the program, as follows:

- Data must be complete and of sufficient enough detail to assess water quality at each screening location.
- Data should represent actual conditions at the outfall outlet or interconnection manhole inlet.
- Data should be generated by accepted sampling methodologies.
- Data must be reproducible and accurate.

The screening and sampling program has been developed to encompass these DQOs as they pertain to characterizing the physical condition and water quality at each screening location. Sampling techniques selected were based upon past methods employed in the Boston Water and Sewer Commission's monitoring programs and upon standard industry practice. Field crew members from SDE have prior experience with sample methods and equipment usage. The methods proposed for field testing are standard methods, as stated in EPA guidance (EPA, 1986; 2002). In addition, G&L Laboratories is state and EPA certified to conduct the required analyses.

Table 1-1 lists the analytical methods to be used for each of the parameters to be tested.

Table 1-1: Analytical Methods to be used for Bacterial Analysis

Parameter	Analytical Method	Detection Limit
E. coli	EPA 1603	< 1cfu/100mL
Enterococcus	EPA1600	< 2cfu/100mL

Measures employed to ensure that QA/QC DQOs are met are described as follows.

Precision

Precision is the ability to obtain reproducible results when analyzing duplicate samples. The overall sampling precision will be determined by the collection and analysis of field

duplicate samples that are not identified as such to the analytical laboratory. Duplicate samples will be collected for the same analysis as the parent samples. They will be assigned an identical sample identifier, except for the addition of "D" preceding the identifier. Duplicate samples are to be collected at the frequency of one per twenty samples.

Because bacteria are living organisms that reproduce and die after sample collection, some degree of disparity between the duplicate sample and the original sample is expected and not necessarily reflective of sample collection or laboratory error.

Accuracy

Accuracy is the degree of difference between a reported value and its true value. As part of ensuring sufficient accuracy, minimization of false positive and false negative analytical data is attempted.

The potential for false positive data values will be assessed through the analysis of laboratory blanks, which must be less than the method detection limit (MDL) or instrument detection limit. Each batch of samples analyzed will be run with a laboratory blank.

Accuracy will also be assessed through the use of control samples of known composition. Laboratory control samples and calibration standards will be used by the laboratory, as needed.

Representativeness

Sample collection under this program is intended to provide data representative of actual conditions at particular screening locations. In order to ensure representativeness, outfall sample locations are selected as close to actual outfall outlets as possible. Where an outfall is unsuitable for sampling at its outlet due to inaccessibility, tidal inflows, or backwater effects, locations upstream may be selected with prior Commission approval only. However, since grab samples are only representative of a snapshot of water quality conditions at a given point in time, they may not be representative of long-term conditions. Data collected must be evaluated while recognizing this limitation.

In addition, samples collected must be representative of water quality at the location they were taken and not be influenced by cross-contamination from other samples collected the same day and stored in the same ice cooler. In order to ensure this, trip blank samples must be collected at the start of each day by filling a laboratory-provided container with clean bottled water. This filled container will be carried throughout the day in the same ice cooler with samples collected.

Sample Handling and Custody

All filled sample containers will be placed on ice immediately following sample collection. They shall then be transported to the lab, G&L Laboratories, within the minimum designated holding time of six hours. (Note that the holding time is applicable from time of sample collection to time of analysis.) A completed chain of custody must accompany each sample shipment to the lab, and sample custody will be tracked throughout the full analytical process in the lab. These forms will be included in the analytical report to CH2M HILL. Table 1-2 lists required types of container and preservation for each analysis to be performed.

Table 1-2: Requirements for Sample Holding

Parameter	Container Volume	Container Type	Preservative	Holding Time
E. coli	100 mL	Sterile plastic	Cooled to 4°C	6 hours
Enterococcus	100 mL	Sterile plastic	Cooled to 4°C	6 hours

Instrument/Equipment Testing, Inspection, and Maintenance

Testing, inspection, and maintenance will be performed for all instruments and equipment to be employed for the lab analyses to be conducted as part of this program, and such activities will be done in accordance with G&L Laboratories' quality procedures.

All field sampling equipment and instrumentation will be inspected on a regular basis, and preventative maintenance will be performed. Prior to mobilization to the field sites, equipment and instrumentation will be checked and calibrated in the office. Following each sampling event, all field equipment and instrumentation will be cleaned and stored properly.

Performance Audits and Corrective Actions

Periodic audits of the field program will be conducted by CH2M HILL at the start of the screening and sampling activities and on a random basis to evaluate adherence to and appropriateness of QA/QC requirements in the field. If unacceptable conditions are noted, CH2M HILL and SDE will initiate corrective actions together. These corrective actions may include:

- Re-analyzing samples (if holding times permit doing so);
- Re-sampling and subsequent analysis;
- Evaluating and amending sampling and analytical procedures;
- Accepting potentially flawed data with acknowledgement of uncertainty or inaccuracy by flagging of data and providing a qualifying explanation.

Public Notification

Boston Water and Sewer Commission has a general advisory that has been sent to City Councilors, City Hall, police departments and has been posted on the Commission's website. Field crews must bring copies of the advisory along with their BWSC identification cards in case of questions by interested individuals/parties while out in the field. The original advisory is included as Appendix C to this document.

General Field Requirements

Any major blockages, collapses, or defects to the storm drainage system or sanitary sewer system (that may pose a public health and safety threat) observed during any field operations will be reported to the Commission within 48 hours.

Field crews are authorized to request a police detail for personal safety reasons at any time. The Project Field Safety Instructions have been reviewed and signed by all CH2M HILL and SDE field staff and they will be followed at all times.

Safety vests do not have to be issued by the Commission, but crews must have them and they must be worn in the field.

References

US Environmental Protection Agency, 2002. Method 1600: enterococci in water by membrane filtration using membrane- Enterococcus indoxyl-D-glucoside agar (mEI), EPA 821/R-02/022, 2002. US Environmental Protection Agency, Office of Water (4303T), Washington DC.

U.S. Environmental Protection Agency. 2002. Method 1603: Escherichia coli (E. coli) in water by membrane filtration using modified membrane-thermotolerant Escherichia coli agar (modified mTEC). EPA-821-R-02-023. U.S. Environmental Protection Agency, Washington, DC.

EPA. 1986. Ambient Water Quality Criteria for Bacteria – 1986. January.

EPA. 2002. Urban Stormwater BMP Performance Monitoring, A Guidance Manual for Meeting the National Stormwater BMP Database Requirements. 2002.