MEMORANDUM CH2MHILL

Citywide Illegal Connection Investigation, Phase 3 (CWI3)

Dry Weather Outfall Screening Protocols (Task 1)

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Introduction....1
Weather and Tide Monitoring....2
Initial Visual Inspection....2
Screening and Sampling....3
Public Notification....6
General Field Requirements....9
APPENDIX A: Public Advisory....10
APPENDIX B: Outfall Screening Forms....11
APPENDIX C: Locations Approved for Inspection....15
APPENDIX D: Special Maps....16

7/25/2012: SDE is authorized to begin dry weather screening at storm drain outfalls only starting on Monday 7/30/2012.

7/27/2012: Protocols were revised July 27, 2012 to put Fort Point Channel Outfalls on hold until further notice. See Appendix C.

This document will be updated to include an approved list of interconnection manholes and combined sewer overflow outfalls (CSOs) as well as additional requirements for screening of CSOs prior to screening taking place at those locations.

Introduction

The purpose of this document is to outline field procedures to perform dry weather screening and sampling of the Commission'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.

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The goal of the dry weather field screening program is to identify locations with dry weather flow and determine if the flow is contaminated. Screening will consist of recording the actual location of Commission outfalls/interconnections, characterizing each location's current condition (size, material, flow, etc.), and collecting samples to be analyzed for bacteria and other parameters.

SDE, under contract to CH2M HILL, will base its investigations on information provided by the Commission. The current list of approved storm drain outfalls is included in Appendix C (Table 1-1). An approved list of interconnection screening locations and CSO screening locations will be added to Appendix C at a later date. Each outfall will be identified by its unique outfall number and interconnections will be identified by their unique manhole Facility ID, as shown in Tables 1-1.

Pictures and forms from the 2010 CWI2 dry weather screening program are available to CH2M HILL and SDE. 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 dry weather exists in order to mobilize field crews to perform the dry weather screening. "Screening and Sampling" may proceed under the following conditions:

Less than 0.1 inch of rainfall in the preceding 48 hours.

Work may in some cases proceed in less time than stipulated above, such as after extended dry periods with prior approval. SDE must contact the Commission's representative, Amy Schofield directly to obtain permission to proceed. If permission is granted, SDE shall provide documentation of the approval to CH2M HILL and the Commission.

For tidal locations, both "Visual Inspection and "Screening and Sampling" must be performed near low tide.

Visual Inspection

Visual inspections will be performed on all SDO and CSO outfalls in order to record the outfall location and condition and find a suitable screening location. A separate visit will be required to conduct the visual inspection for all outfalls that were **not** visited during the 2010 CWI2 dry weather screening program. For outfalls that were visited during the 2010 CWI2 program, the visual inspection and the screening and sampling activities may be performed during the same visit. All CSO outfalls will require a separate initial visual inspection because CSOs were not included in the 2010 dry weather screening program. Table 1-1 will indicate which SDO outfalls require a separate initial visual inspection and which do not.

Visual inspections will not be required for interconnection manholes.

A two-person field crew will conduct the visual inspection by visiting the location of each outfall and obtain GPS coordinates to an asset level accuracy of 5 – 10 meters. No supplemental survey or measurements will be employed. GPS location should be taken at the outfall or as close to the outfall as possible, and not necessarily at the sampling location if an upstream manhole is selected. SDE does not need to record GPS coordinates for outfalls that were screened during 2010 because the GPS coordinates were already recorded at that time. SDE must record GPS coordinates for interconnections.

Photos will include both close-up and locational shots where possible. The field crew will also record dimensions, shape, material (e.g., concrete, PVC), physical condition, and presence and location of an outfall sign. The Commission posted outfall signs wherever there was a place to post a sign, so field crews may have to look around a bit for the signs.

It is assumed that some outfalls will not be accessible or cannot be located after a 15 minute search. It is also assumed that some of these locations will be in areas subject to tidal inflows or will otherwise be subject to backwater effects. For these outfall locations field crews will locate a suitable screening site in an upstream manhole. The selected manhole 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. If the visual inspection is conducted prior to screening and sampling, the field crew will record its recommendation on the most promising sampling location based on current site conditions. This will be used for reference during the subsequent site visit. Note that in the cases of CSOs, these selected manhole locations should be downstream of CSO regulators, as indicated on figures provided by the Commission.

The Manhole Facility ID numbers of any likely unsuitable manholes downstream of the recommended manhole will be recorded in the comments section of the visual inspection screening form, along with the reason for unsuitability.

A one page form for the "Visual Inspection" is provided in the attachments as part of Appendix B. For the 2012 inspections, forms can be completed by hand and posted on the project SharePoint site on a weekly basis. CH2M HILL and SDE will develop a tool to record screening data on a portable data logger for use during 2013 screening.

Screening and Sampling

One day prior to screening and sampling visits, 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. In cases where the outfall is accessible and is not submerged, the outfall itself will be used for screening and sampling. If the screening and sampling is conducted on a subsequent site visit from the visual inspection, the field crew will re-assess the recommendation of sampling location to determine if the outfall is suitable. The Commission prefers to get the sample at the outfall if possible.

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 which pipes have flow and which do not. It is important for CSO outfalls to collect a sample at a manhole downstream of the regulator.

All observations and activities conducted at each screening location will be recorded on the screening and sampling form included in Appendix B. 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 dry-weather flow for either E. coli bacteria or Enterococcus bacteria. Tables 1-1 and 1-2 designate each outfall location as discharging to fresh or marine waters. All interconnection manhole locations in Table 1-3 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.

For locations with standing water present, inspect up to three manholes directly upgradient but no more than 750 feet from the outlet. Note which of these locations also has standing water and then, at the first upstream accessible manhole location from the outfall free of standing water, perform the same data recording and sampling as described above. If all manholes inspected upstream of the outfall contain standing water then a sample will not be collected.

Following 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 immediately 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.

There are several interconnection screening locations along the Boston/Brookline border for which sampling will require coordination with Brookline's Water and Sewer Department in order to collect samples simultaneously on both sides of the border. The comment field of Table 1-3 indicates which interconnections will require coordination with Brookline.

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 G&L Laboratories within a **six-hour holding time**. Samples will be dropped off at G&L at the end of the work day (at approximately 3:30pm).
- 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 & 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 1-4 lists the analytical methods to be used for each of the parameters to be tested.

Table 1-4: Sample Analyses

Parameter	Analytical Method	Detection Limit
E. Coli	SM9213D	< 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 1-5 lists required types of container and preservation for each analysis to be performed.

Table 1-5: Sample Requirements

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 identify those conditions together and initiate corrective actions. 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 & 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 attachment A 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 with 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

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.

APPENDIX A - Public Advisory

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SPECIAL ADVISORY

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FOR IMMEDIATE RELEASE
July 25, 2012

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Telephone: 617-989-7000

Storm Drain and CSO Outfall Inspections Citywide

Starting in July and continuing through the end of the year, the Boston Water and Sewer Commission, and its consultant Stacey DePasquale Engineering, will be inspecting and collecting water quality samples from the Commission's storm drain and combined sewer outfalls. The outfalls are located in neighborhoods throughout Boston in easements owned by the Commission. The locations are along the banks of Boston Harbor, Charles, Neponset, Mystic, and Muddy Rivers. Outfalls are also located adjacent to smaller brooks, such as Canterbury Brook and Bussey Brook, and near wetlands.

This work will be conducted Monday through Saturday, between the hours of 7:00 a.m. and 4:00 p.m. All field personnel will carry photo identification and wear proper safety gear. Vehicles used for the inspections will be marked with the name of the consulting firm, Stacey DePasquale Engineering.

Questions regarding the outfall inspections may be referred to Amy Schofield, BWSC Project Manager at (617) 989-7432.

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APPENDIX B - Outfall Screening Forms

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Boston Water and Sewer Commission

CITYWIDE ILLEGAL CONNECTION INVESTIGATION PROGRAM PHASE 3

OUTFALL NO.:_____

FEATURE ID: _____

STREET LOCATION: _____

RECEIVING WATER: _____

OUTFALL DRY WEATHER FIELD SCREENING PROGRAM

VISUAL INSPECTION

LOCATION TYPE: SDO____ CSO____

INSPECTION DATE / TIME:_____

INSPECTING COMPANY/INSPECTOR:_____ / _____

GPS COORDINATES: _____ _____

OUTFALL SIGN: Yes No

TIDAL IMPACT: Yes No

IF YES, TIME OF CLOSEST LOW TIDE: _____ A.M. P.M.

OUTFALL LOCATED? Yes No

OUTFALL ACCESSIBLE? Yes No

OUTFALL SUBMERGED? Yes_____ (%) No

APPROX OUTFALL DIAMETER (ft):_____

SHAPE: Round Oval Square Other: _____

MATERIAL: Metal Concrete PVC Other: _____

CONDITION: Normal Cracking Corrosion Other: _____

IS GRATE PRESENT? Yes No

CONDITION OF GRATE: Good Fair Poor

PHOTO # / LOCATION: _____ _____

If outfall not located, not accessible, or greater than 25% submerged, then select probable sampling location for screening and sampling (NOTE: Sampling for CSO outfalls must be conducted downstream of the regulator):

MANHOLE ID:_____ FEATURE ID: _____

COMMENTS:_____

Boston Water and Sewer Commission

CITYWIDE ILLEGAL CONNECTION INVESTIGATION PROGRAM PHASE 3

OUTFALL/MH NO.:_____

FEATURE ID: _____

STREET LOCATION: _____

RECEIVING WATER: _____

OUTFALL DRY WEATHER FIELD SCREENING PROGRAM

SCREENING AND SAMPLING

GENERAL INFORMATION:

LOCATION TYPE: SDO____ CSO____ INTERCONNECTION____

IF INTERCONNECTION, RECORD GPS COORDINATES: _____ _____

INSPECTION DATE / TIME:_____

INSPECTING COMPANY/INSPECTOR:_____ / _____

WEATHER: Cloudy Sunny

AIR TEMP: _____°F

TIME SINCE LAST RAIN: >48 Hours <48 Hours

QUANTITY OF RAIN LAST 24 HRS: ≥0.1 Inch <0.1 Inch

IF TIDAL, TIME OF CLOSEST LOW TIDE: _____ A.M. P.M.

VISUAL OBSERVATIONS AT OUTFALL: (Not Applicable for interconnections)

IS THERE FLOW? Flow Standing Water Dry

IF FLOW, VELOCITY: None Trickle Moderate Heavy Submerged:_____ %

APPROX SEDIMENT DEPTH:_____ %

APPROX DEPTH WATER AND SEDIMENT:_____ %

ODOR: None Musty Sewage Rotten Eggs Sour Milk Other:_____

COLOR: Clear Red Yellow Orange Brown Blue Green Gray Other:_____

CLARITY: Clear Cloudy Opaque Suspended Solids

TURBIDITY: None Oily Sheen Garbage Sewage Paper Other:_____

DEPOSITS/STAINS: None Sediments Oil Other:_____

SAMPLING LOCATION: Outfall Manhole

(Form Continues on Next Page)

OUTFALL/MH NO.:_____ (Continued)

IF SAMPLING LOCATION IS A MANHOLE:

MANHOLE FACILITY ID: _____ MANHOLE FEATURE ID:_____

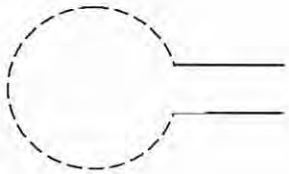
APPROX PIPE DIAMETER: _____Inches

PIPE SHAPE: Round Oval Square Other:_____

PIPE MATERIAL: Metal Concrete PVC Other:_____

CONDITION: Normal Cracking Corrosion Other:_____

INCLUDE SKETCH:
(include sampling location)



IS THERE FLOW? Yes No

APPROX FLOW VELOCITY: None Trickle Moderate Heavy Submerged:_____ %

APPROX SEDIMENT DEPTH:_____ %

APPROX DEPTH WATER AND SEDIMENT:_____ %

ODOR: None Musty Sewage Rotten Eggs Sour Milk Other:_____

COLOR: Clear Red Yellow Orange Brown Blue Green Gray Other:_____

CLARITY: Clear Cloudy Opaque Suspended Solids

TURBIDITY: None Oily Sheen Garbage Sewage Paper Other:_____

DEPOSITS/STAINS: None Sediments Oil Other:_____

FIELD ANALYSIS INFORMATION:

WERE SAMPLES COLLECTED? Yes No

IF NO, REASON: No Flow Insufficient Flow Standing Water Other: _____

RECORD FIELD SCREENING RESULTS:

Surfactants: _____ Ammonia: _____

pH: _____ Temperature: _____

Specific conductivity: _____ Salinity: _____

Total Residual Chlorine: _____

COMMENTS:_____