MEMORANDUM CH2MHILL

Citywide Illegal Connection Investigation, Phase 3 (CWI3)

Tributary Area Investigation Field Protocols (Task 2)

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The intent of this document is to outline standardized field procedures to systematically identify illegal sewer discharges into the Boston Water & Sewer Commission's (the Commission) separated storm drain system. Left uncorrected, these illegal flows ultimately discharge to local receiving waters without proper wastewater treatment.

Dry Weather Investigations

The manhole inspection program is the first step toward identifying specific pipe reaches where sanitary sewage is entering the storm drainage system. Before a series of manhole inspections may occur, a mandatory minimum period of acceptable field conditions must precede the investigative work. These prior conditions shall be referred to as dry weather conditions.

The Commission has a general notification letter that is sent to building owners and/or occupants in drainage areas where dry weather investigations will be performed.

Weather 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 manhole investigations. Sources for weather information may include the Commission's rain gauges in or close to areas where work is planned (link available on the project SharePoint site) as well as forecasts from one or more internet sources. Dry weather work may proceed under the following conditions:

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

Dry weather work may in some cases proceed in less time than stipulated above, such as after extended dry periods with prior approval. SDE must call the Commission's representative, Amy Schofield, directly to obtain permission to proceed. If permission is granted, SDE shall post documentation of the approval on the SharePoint site and send a notification to CH2M HILL and the Commission.

Drainage Area Network Investigation Procedures

The CWI3 program will use various procedures to make progress through the drainage area network. CH2M HILL will provide SDE with specific direction as to what procedures are approved for specific drainage areas.

Traditional (Top Down) Approach

For all drainage areas approved for work by the Commission:

- Investigation begins at upper reaches of new storm drainage areas (or where investigations are already in progress, starting downstream of the lower-most manhole determined to be void of contamination), and systematically progresses toward the outfall following standard manhole inspection procedures described below.
- Once contamination is identified within a drain segment, follow established dye test procedure to locate illegal connections for corrective action.
- Suspend all further investigation along the main trunkline located downstream of known contamination sources until corrective actions have been completed and follow-up investigations have cleared the contaminated segment(s).
- NOTE: Investigative work may commence downstream of the contaminated segment but is limited only to side drain branches tributary to the trunk.
- In order to advance progress, the Commission may approve dye testing of buildings downstream of know contamination prior to corrective action taking place.

Visual Inspections

A piloted protocol was used in the CWI1 South Dorchester Area (only) to facilitate progress in the drainage area. This method allowed work downstream of known anomalies and suspected leaking laterals. The premise is to perform visual inspections of consecutive manholes to look for signs of illegal connections. Look for such things as visual evidence not seen upstream, change in flow depth or speed, odor, or other signs that there may be a significant chance of there being an illegal connection between manholes. Written

permission by the Commission must be given prior to this method being implemented in any CWI3 study areas.

Sandbag Screening Approach

For small drainage areas (<50 acres or outfall diameter less than 18 inches), the top down approach may be implemented in such a way (consecutive concurrent sandbags) to quickly characterize the entire drainage area. This approach must be approved by CH2M HILL and the Commission prior to implementation.

For larger drainage areas that have been previously inspected, the Commission may approve a Sandbag Screening Approach:

- Select a week or several days of forecasted dry weather conditions
- Conduct manhole inspections throughout the drainage area (or a selected portion of an area), placing sandbags as needed. In this investigation approach, placement of sandbags is not limited to 3 consecutive junctures within 2,000 feet as it is with the top down approach. It will be determined by the sub-consultant in consultation with the project team how best to conduct the quick assessment.
- Report manhole inspection results for review.

The intent of this approach is to obtain a "snapshot" of the drainage area, i.e., updated data that can be used to determine re-investigation approaches.

Standard Manhole Inspections

Manhole inspection data will be collected electronically and results will be reported on an approved Manhole Inspection Form using a hand held device (a.k.a. tablet). The use of specialized field equipment will allow all manhole inspection work to be performed from the street surface - no confined space entry will be required. This field information shall be uploaded by SDE to the project SharePoint site on a weekly basis. CH2M HILL shall archive this information; use it to update progress maps, and to provide direction to SDE on how to proceed within drainage areas.

Structural manhole conditions will be noted during all manhole inspections. Field crews will report blockages, collapses or other major defects in the sanitary sewer and storm drain system to the Commission by telephone immediately and via email within 48 hours. Field crews will also notify CH2M HILL of any need for cleaning that is impeding progress.

All common manholes will be inspected to determine that there is no opportunity for intermixing of flows between the storm drainage and sanitary sewer systems. Field crews will record the common manhole type ("lovejoy" or "high outlet"). Lovejoy manholes will be inspected to determine whether the cover plate is in place and high outlet manholes will be inspected to determine whether the high outlet is blocked. All evidence of ***potential*** cross-connections between sanitary and storm drainage systems shall be noted on the Manhole Inspection Forms.

Manhole inspections procedures are broken down into two categories; dry weather flow, and no dry weather flow. Dry weather flow refers to flow from an unknown source that exists in the manhole even after the minimum required 48 hours of no rainfall preceded the

inspection. The flow may be groundwater infiltration or a source of inflow such as an illegal connection. No dry weather flow simply means that the manhole is dry or without flow passing through the structure. Step by step procedures for each observation type are given below.

No Dry Weather Flow

Contamination Observed

If no flow is observed in a manhole during inspection, but there is visual and/or olfactory evidence of contamination, open upstream storm drain manholes on applicable reaches of storm drain pipe to determine which direction contamination is suspected to be coming from. Select this suspect reach of storm drain to further investigate for illegal connections. (A reach is defined as the entire upstream length of storm drain entering the manhole.) After a reach has been selected, open every other manhole between juncture and upstream end of pipe or upstream juncture on selected storm drain to isolate section for investigation. (A section of pipe is defined as the portion of storm drain pipe where no contamination is identified in the upstream manhole, but contamination exists in the downstream manhole.) Results shall be recorded on Manhole Inspection Forms.

No Contamination Observed

If no flow is observed in a manhole during inspection, and no visual and/or olfactory evidence of contamination is present, place sandbags in the manhole inlet pipe(s) as well as upstream manhole inlet pipes to capture potential intermittent flows from upstream sources. Sandbags should only be placed when no rain is forecast over the next minimum 48 hours. In order to improve field crew efficiency during periods of dry weather, sandbags may be placed in up to 3 strategic consecutive junctures at a time. The combined length of the reach with multiple sandbags shall not exceed 2,000 feet.

After a minimum of 48 hours, re-inspect all sandbagged manholes for evidence of contamination as follows:

If flow was captured by the sandbag, with visual and/or olfactory evidence of contamination; record on the Manhole Inspection Form and open the next strategic upstream storm drain or common manhole on applicable reach(es) for additional investigation. Once reach(es) has/have been selected, systematically open every other manhole until the suspected section can be isolated for dye testing.

If captured flow is clear and odorless, field test kits will be used to determine temperature, pH and specific conductivity, and to detect the presence of surfactants or ammonia.

If field test kits indicate flow is contaminated, open the next strategic upstream storm drain or common manhole and select reach(es) for further investigation. For each reach selected, open every other manhole on selected storm drain until it is possible to isolate section with illegal connection(s) for further dye testing of buildings to identify source(s).

Using Sandbag Screening Approach: If no flow was captured by the sandbag, or flow was determined not to be contaminated, the upstream segments are assumed to be clear.

Using Traditional "Top Down" Approach: If no flow was captured by the sandbag, or flow was determined not to be contaminated, the upstream segments are assumed to be clear and field crews may proceed with manhole inspection at the next strategic manhole juncture downstream.

Dry Weather Flow

Contamination Observed

If dry weather flow is observed in a storm drain manhole during inspection, and evidence of contamination is observed, open next strategic upstream storm drain or common manhole and select reach(es) of storm drain to investigate for illegal connections. After a reach has been selected, open every other manhole on selected storm drain to isolate section for dye testing.

No Contamination Observed

If dry weather flow is observed in the storm drain and no evidence exists of contamination, field test kits shall be used to determine temperature, pH and specific conductivity, and to detect the presence of surfactants or ammonia.

If dry weather flow is contaminated, as indicated by detection of ammonia or surfactants using field equipment, open next upstream storm drain or common manhole to select reach(es) of storm drain for further investigation. For each reach selected, open every other manhole to isolate section(s) for further building dye testing.

Using Sandbag Screening Approach: If the field test kit determines flow not to be contaminated, the upstream segments are assumed to be clear.

Using Traditional "Top Down" Approach: If the field test kit does not detect contamination in dry weather flow collected from a storm drain manhole during inspection, upstream segments are assumed to be clear, and field crews may proceed with downstream manhole inspections.

Dye Testing

Please note that an owner or resident over the age of 18 MUST be present for a dye test to be performed.

As contaminated manholes are identified and contaminated storm drain sections are isolated, CH2M HILL will submit to the Commission dye test request lists containing buildings proposed for dye testing.

Public Notification and Door Hangers

Upon approval of dye test request lists, the Commission will provide contact information for building owner/resident, including address, owner's name and contact phone number, if available, to CH2M HILL using the SharePoint site. Once the field team informs the Commission they are ready to commence dye testing, the Commission will send out a dye test flyer to notify the building owner and resident at each address that a dye test will be conducted. Dye testing may begin three days after the flyers are sent out.

The first visit to the building must occur within two weeks of authorization (above). During the first visit, if nobody is present, a door hanger is left on the door knob or somewhere near the door or mailbox. The door hanger is not to be placed ***in*** a mailbox. The door hanger will explain the dye testing process and provide a toll free phone number of the field team so that a dye test can be scheduled. Additional door hangers may be left during follow up attempts. As phone calls are received, the field team will schedule appointments as appropriate.

After several unsuccessful visits have been made a particular building, an attempt to phone call the building owner will be made to set up an appointment for dye testing. If there is no answer, a message is left with a phone number to call back to schedule an appointment. The internet shall be used to find correct phone numbers for any numbers deemed to be inaccurate. Also, some larger apartment buildings have placards with management company's phone numbers. These can be helpful to access a building as residents may not answer the door. Police details can also be utilized for support to access buildings in which owners/occupants are suspicious. Field crews should use police details at any time it is necessary.

Dye Test Procedure

Dye testing of building sewer laterals will be performed in buildings along segments of storm drainage that have been isolated as having a source or sources contributing sewage and/or inappropriate discharges to it. Dye testing notifications and approvals are as described above. Dye tests must be completed within four weeks of the owner/resident being notified by the Commission.

Dye tests are typically performed within regular business hours. Occasionally it is necessary to perform dye tests outside of regular business hours or on a Saturday. Such tests will be scheduled in advance with the owner/resident.

Field crews will inspect the sewer and storm drain pipes of buildings selected for dye testing, preferably where the pipes exit the building. One fixture will be selected for a dye test per building, preferably located at the lowest level in the building where plumbing facilities exist. The fixture will be identified through a review of the plumbing of the building to ensure that the fixture represents the potential contamination source.

Additional dye tests may be performed at different fixtures within the same building if the building is large, the building sewer lateral(s) exiting the building are not accessible (cannot be seen), or partial (internal) illegal connections are suspected. In the event that more than one fixture is tested, the reason for the additional test will be noted and results of each dye test will be recorded on a separate Dye Test Form.

During each dye test, manholes on both the sanitary sewer and storm drain downstream of the building being tested will be opened and observed for dye. Additional manholes will be opened as necessary to determine the flow direction of dye from the fixture being tested. Manhole identification numbers of all manholes opened, along with results of dye observations at each manhole, will be recorded on the electronic dye test form on the tablet.

During each dye test SDE will inspect the internal plumbing exiting the building and answer each of the three questions below, to be recorded on the Dye Test Form. The

response to these questions may help identify buildings to return to if a source of contamination is not found during the first round of dye tests.

1. *Do all the basement plumbing fixtures connect to the same service connection?* This question is asking if the plumbing fixtures located in the basement connect to the same service connection. Possible answers include "yes", "no", "no basement fixtures", "no access to basement" and "no access to basement pipes". Even if the answer is "yes" there could still be another service connection exiting the building for which the basement fixtures are not connected (ex. storm piping).

2. *Do all the building pipes connect to the same service connection?* This question is asking if all of the internal plumbing (as accessible in the basement) discharges through one service connection. Possible answers include "yes", "no", and "no access to discharge pipes". If there is only one service connection and the answer is "yes", then presumably it should be sanitary. If the answer is "no" then there is either additional sanitary piping internal that goes to another service connection or there is internal storm piping (or both). If the answer is "no access to discharge piping" it typically indicates that some or all of the internal piping exits beneath the basement floor.

3. *Multiple service connections exiting the building?* This question is asking if there is more than one service connection for the building. Possible answers include "yes", "no", "no access to discharge piping", "no access to basement" and "unable to confirm – partial access to discharge piping".

Dye Test Results

A dye test will be deemed "Legal" if dye appears in the sewer only.

A dye test will be deemed "Not Legal" if dye appears in the storm drain only. The field crews will add a note to the comments section of the Dye Test Form to indicate if a Not Legal dye test is a partial (internal) illegal fixture (ex. washing machine tied into roof drain, all other building fixtures to sanitary sewer). If no comment is added to the Dye Test Form it is understood that the Not Legal result is representative of the entire building.

If dye is visible in both the sanitary sewer and the storm drain during a single dye test, it shall be noted in which structure the dye first appeared. This type of test is considered "Inconclusive – Dye In Both" and may be the result of a cross-connection. Noting the location of where the dye first appears may help provide insight as to where the problem exists.

If no dye is visible in the sanitary sewer or storm drain during a dye test, the dye test will be deemed "Inconclusive – No Dye Found". This may be due to a blockage in the building sewer lateral or it may indicate that the building is on a septic system.

Each positive dye test and inconclusive dye test will be reported to the Commission via the SharePoint site within 48 hours.

Post Correction Checks

Correction of illegal connections will be completed under a separate contract administered by the Commission. The Commission will notify the project team when an illegal connection has been corrected.

Following correction of all suspected illegal connection(s) in a section of storm drain, and after sufficient precipitation has occurred to flush the affected storm drain, field crews will place a sandbag at the downstream juncture of that reach of storm drain, following the procedures detailed in *Dry Weather Investigations, No Dry Weather Flow*. If flow containing detectable contamination is captured and/or evidence of contamination is found in the manhole, repeat steps to identify section of pipe for additional dye test investigation to locate the source of contamination. If no evidence of contamination is detected, downstream investigations will proceed.

In some cases transient sources may not be captured by post correction checks and those transient sources could affect downstream results during future manhole inspections. If this situation arises the Commission may request that SDE return to the original location of contamination to perform additional inspections.

General Field Requirements

Any observed blockages, collapses, or defects to the storm drainage system or sanitary sewer system observed during any field operations (manhole inspections, dye testing, etc.) will be reported to the Commission with 48 hours. This includes unblocked high outlets and plates missing on lovejoys.

Field crews are authorized to request a police detail for personal safety reasons at any time.

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

Field crews must wear Approved Contractor ID cards issued by the Commission at all times while in the field.

A Permit to Enter Commission Sewers and Storm Drains is required for each firm in order to perform tributary area investigations.

During field investigations, the field plans will be marked to note structures that are field-located but not on the Commissions maps, and piping configurations that differ from that shown on the maps. SDE will submit this information to CH2M HILL on an as-needed basis. CH2M HILL will submit these "map corrections" to the Commission's GIS department so that corrections can be made to the Commission's GIS data. The Commission will provide CH2M HILL with new pipe, manhole, and/or building Feature IDs so that field work completed at these locations can be added to the project database for mapping purposes.

In addition, if SDE will make a note on Manhole Inspection Forms and/or Dye Test Forms of any structures that are not present but are shown on the Commission's maps, newly constructed sanitary sewer or storms drains observed, or any misdirected flows or boundary lines observed.