

MEMORANDUM



TO: WLSD
FROM: Vonnie Reis & Paul Dombrowski
DATE: August 10, 2011
RE: WLSD I/I Investigations

As a follow up to the Monday, July 18 meeting held with the District, we have prepared the following summary of observations from the Infiltration/ Inflow (I/I) investigations conducted thus far and have prepared recommendations for work going forward under our current scope and budget. Typical dry weather plant flows are 80,000 to 100,000 gpd with higher flows occurring during high groundwater season and major rainfall events. Based upon metering data provided, average flows in January and March 2011 were 86,131 gpd and 167,163 gpd, respectively. Although these results are only over one season, this is a clear indication of seasonal high groundwater infiltration in combination with inflow associated with the substantial precipitation during the month of March.

Based on the length of pipe (approximately 20 miles) identification of 100,000 gpd of infiltration would not typically indicate a major problem. However, as a percentage of flow, that same amount indicates a significant increase in the WLSD system. During evaluation of the system, where possible, flows are converted to gpd per inch-mile of pipe (gpdim) to measure the severity of infiltration.

Work conducted by W&C to date includes:

- Review of historical flow data.
- Site visit of the entire system and inspection of the District's pump stations. A few wetwell chamber covers were observed to be located in areas where surface water might collect. (i.e., PS #1, PS #5, PS #7)
- Flow isolation of approximately 4.2 miles of sewer pipe in subareas 6, 7, and 8 during which 21,000 gpd of infiltration was identified.
- Review of manhole inspections conducted by the City (district wide) and W&C staff compiled that information. Recommended repairs to manholes are estimated to remove 30,000-50,000 gpd of infiltration from the system.
- CCTV inspections were conducted in approximately 2.5 miles of sewer pipe in segments of pipe identified with infiltration during the flow isolation program (Subareas 6, 7, and 8). Specific problems such as leaking service connections and cracked pipes were identified. The flow isolation estimate for infiltration was refined based on actual observed flows to 26,600 gpd.
- Building inspections were conducted at 193 locations in areas 6, 7, and 8 with an interior inspection success rate of approximately 54%. All building inspection information has been compiled into a database. Potential inflow sources identified during building inspections are roof leaders, sump pumps, grinder pump chambers, and service cleanouts.

Additional anecdotal information and observations include:

- Some grinder pumps are reported to run frequently. This may be an indication of groundwater infiltration to the pump chamber. The District is currently monitoring the run time of several grinder pumps to determine if grinder pump chambers are a significant inflow source.
- It is not believed that a significant number of roof leaders, driveway drains, or sump pumps are connected into to sewer system; however the discharge point for several roof leaders and drains was not identified during the inspections. No sump pumps with a direct connection to the sewer were observed, however there were three sump pumps where a discharge location was not identified.
- Yard cleanouts were observed with missing or broken caps. Evidence of uplift (frost heaves) was seen, potentially indicating a separated pipe. Some yard cleanouts were not located and are presumably buried. All of these locations may be inflow sources.
- It is questionable whether yard cleanouts or grinder pump chambers can be easily located without assistance from homeowners.



- Approximately 2/3 of the manholes in the District were inspected by District staff over the past couple years. Based on the reports generated by staff, leaking manholes appear to be a significant source of I/I.
- Rates of infiltration in excess of 4,000 gpdim are typically considered “excessive” and warrant remedial measures. In the WLS D System, Subareas 6 and 7 showed values of less than 2,000 gpdim and subarea 8 indicated I/I rates of over 4,000 gpdim; therefore Subarea 8 would be the first priority area to conduct pipe rehabilitation.

The table below presents potential I/I sources identified to date and presents recommendations for rehabilitation or additional investigation. Volumes of inflow for each source are estimated, based on a 1-inch rain event. Actual volumes may vary, based in the total rainfall and intensity of a given storm. It should be noted that this table represents only the sources identified thus far; additional investigation of “likely” sources in the remainder of the system is recommended.

| Potential Source | Flow type | Estimated I/I per defect | Number Identified ⁴ | Estimated I/I ⁵ | Rehabilitation or Additional Investigation |
|--|--------------|--------------------------|--------------------------------|----------------------------|---|
| Defective sewer pipe (Areas 6, 7, and 8) | Infiltration | Varies | 11,800 lf | 26,000 gpd | Seal or line pipe defects |
| Leaking sewer manholes (Approximately 70% inspected) | Infiltration | Varies | 55 | 30,000-50,000 gpd | Monolithic manhole lining and repairs |
| Leaking sewer manhole or wetwell covers | Inflow | 107 gal/event/location | 6 | 642 gal/event | Install watertight covers; raise to grade |
| Yard Cleanouts | Inflow | 214 gal/event/location | 15 | 3,210 gal/event | Locate cleanout and repair cap |
| Driveway drains (yard drains, etc.) | Inflow | 16 gal/event/location | 38 | 608 gal/event | Dye test or smoke test |
| Roof Leaders | Inflow | 16 gal/event/location | 101 | 1,616 gal/event | Dye test or smoke test |
| Pump covers/chambers | Inflow | 214 gal/event/location | 9 | 1,926 gal/event | Monitor runtimes for several weeks during high and low groundwater season |

Assumptions:

1. Driveway drains and roof leaders = 1,500 sf drainage area. 1” storm to yield 16 gallons per event.
2. Yard cleanouts and pump chambers = 20,000 sf drainage area. 1” storm to yield 214 gallons per event.
3. Leaking sewer manholes or wetwells = 10,000 sf drainage area. 1” storm to yield 107 gallons per event.
4. Number identified during house inspections. Only 104 of 193 houses were internally inspected (54%)
5. Estimated I/I identified is only for portions of the system inspected which is approximately 25% to 30% of the overall system. The expected accuracy of these estimates is 50% +/-

The estimates above demonstrate that in order to see the volume of inflow experienced at the plant during wet weather, the storm event would have to be 4-5” of rain and there would need to be multiple sources. The volume of flow increase during wet weather suggests a “large” source somewhere in the system. W&C recommends that inspections be conducted in cross-country areas where manholes are located, in the event that there are missing or broken manhole covers (i.e. a “large” source).



Recommendations for a Phased Plan

The District's sewer system experiences both seasonal infiltration and wet weather-related inflow. Preliminary manhole inspections of 2/3 of the system has resulted in the identification of a significant amount of infiltration due to leaking manholes. It is recommended that the **remainder of the manholes in the system be investigated**. This work should be conducted during high groundwater season.

Review of flow records at the plant indicate significant amounts of inflow during large storm events. Therefore, identification of the sources of inflow is imperative. From the results of the building inspections, it does not appear that sump pumps are a source of inflow; therefore, additional **internal building inspections are not recommended** at this time.

Roof drain, driveway drains, and cleanouts have not been fully ruled out as a major source; therefore a limited investigation to verify whether these are sources is recommended. Roof drains with an unidentified discharge point accounted for 69% of roof drains observed. Of the cleanouts observed, 32% were identified as potential inflow sources. Although these are "small" sources individually, cumulatively they may account for a significant amount of inflow. These sources can be easily identified by **smoke testing or dye testing**.

The recommendations below have been developed with the goal of staying within the budget of the existing contract. W&C recommends conducting only a portion of the smoke and dye testing originally proposed and evaluating the success rate of those activities before proceeding. Likewise, the results of the first 200 internal building inspections resulted in a recommendation to spend the budget for the next 200 building inspections elsewhere. The budget for those 200 building inspections is \$7,000. **The recommendations for work conducted by W&C below are all fundable under the current budget with WLSD.** However, once we finalize our plan we will notify DEP.

The following summarized the proposed next steps for the program and associated costs. Cost do not include follow-up actions.

| Task | Description | Source | Proposed cost |
|---|--|---|---------------|
| Additional Investigations by W&C | | | |
| 1. Inspect cross-country areas | Inspection of sewer manholes in off-road areas to identify any potential large inflow sources. 2 person crew for 2 days. Follow up action: Repair damaged manhole covers. (if any) Cost covered within existing contract budget. | Inflow Open/broken manhole covers | \$4,000 |
| 2. Smoke Test | Smoke test roof drains, driveway drains, and cleanouts. 10,000 lf at \$0.45/LF. Follow-up action: If a significant number of sources are identified, develop a program to redirect drains and conduct additional smoke testing on the entire system. Cost covered within existing contract budget. | Inflow Direct connections or broken/open cleanouts | \$4,500 |
| 3. Dye Test | Dye test roof drains or driveway drains. 10 at \$104/ea. Follow-up action: Same as for smoke testing. Cost covered within existing contract budget. | Inflow Direct connections | \$1,040 |



| Additional Inspections by WLSO staff | | | |
|---|---|--------------------------------------|-------------------|
| 1. Complete manhole inspections | Inspection of the remaining 125+ manholes in the system. Follow up action: Structural rehabilitation of leaking manholes. | Infiltration Leaking manholes | By District staff |
| 2. Pump chamber meters | Continue to monitor pump run times; get dry period and wet period data for comparison. If possible, get data when building is unoccupied. Follow-up action: Develop a protocol for replacement/repairs to privately owned tanks. | Inflow Leaking pump chambers | By District staff |
| Remedial Actions to be conducted by WLSO staff | | | |
| 1. Adjust "low" MH covers | Raise frame and cover and/or divert stormwater flow at PS locations where cover may be a source of inflow. Follow-up action: None. | Inflow Ponding stormwater | District Staff |
| 2. Repair cleanouts | Repair/raise cleanouts identified as potential inflow sources during building inspections. Follow-up action: Educate public on the importance of maintaining cleanouts.. | Inflow Broken cleanouts | By District Staff |

Notes:

1. Cost for W&C to complete investigations above is included in the existing Facilities Plan contract budget.
2. Budget remains for additional smoke testing and dye testing activities subject to the results of the initial phase.