A. SANITARY SEWER WET WEATHER EVALUATION PROJECT

1. Introduction

Since 2002, the City of Ann Arbor has been implementing a footing drain disconnection (FDD) program to reduce rainfall dependent inflow and infiltration (RDII) and the subsequent risk of sanitary basement backups from their wastewater collection system. The City is responsible for operating and maintaining the public sanitary and stormwater infrastructure. Following numerous complaints and questions about the FDD program, the City suspended a large portion of the program in 2012. Following this suspension, the City initiated a Sanitary Sewer Wet Weather Evaluation (SSWWE) project specifically intended to address the following objectives:

a. Engage the public through the project, including the formation of a Citizens Advisory Committee (CAC) to make the final recommendations to Council.

b. Evaluate the flow removal effectiveness of the FDD program.

c. Evaluate the risks of future basement backup and sanitary sewer overflows from the sanitary sewer system.

d. Develop recommendations for the wet weather program for the City's sanitary sewer system.

In response to the FDD Survey performed, an additional objective was identified during the course of the study which was to examine issues with the FDD program to date and make recommendations to correct the issues. This is a new objective identified during the project and is covered in Section B.

The technical study consisted of sanitary flow metering, quantification of the flows removed from the sanitary system from the FDD program, hydrologic modeling to understand the frequency of sanitary wet weather peak flows, hydraulic modeling to support a sanitary capacity assessment, and the development of action plans to address identified sanitary sewer system deficiencies. Public engagement was performed throughout the project, including public meetings and the development of the CAC. The 2013 sanitary flow metering period experienced a number of significant rain events and provided suitable data to perform the study.

2. Major Findings

The most significant outcome from the study is the recommendation that additional **FDDs are no longer needed** in the original five (5) target areas. Other major findings from the study include:

a. The FDD program on average removed about 65% of the wet weather peak flow in the target districts from the sanitary system. Four (4) of the five (5) target districts (Orchard Hills, Bromley, Morehead and Dartmoor) have a 90% or greater statistical confidence of significant flow removals. A map of the five (5) target districts can be found in the Volume 2: Flow Evaluation Report, page 5, Figure 1. The Glen Leven district appears to be less effective, with a flow removal rate of about 36%, and the reason for this is still unknown.

b. The FDD program reduced the risk of basement backups in the target districts to the point where additional FDDs are not needed in these districts to achieve the desired level of protection for the system. For example, prior to the FDD program, a large storm event would result in widespread sanitary basement backups, especially in the target areas. After FDD, during the large storm event that occurred on June 27, 2013, there were no reports of basement backups attributed to the sanitary sewer system, in the five (5) target areas. Several high-risk homes in these areas had check valves installed prior to the study. However, the sanitary flow metering data shows that the sanitary sewer depths did not fill the pipes in these areas, so it is unlikely that the check valves were active and needed during this storm.

c. The hydraulic capacity assessment of the sanitary sewer system shows no issues in the target neighborhoods, except a section of pipe approximately 1,800 feet long in the Glen Leven district with a potential hydraulic restriction.

d. Five (5) potential hydraulic deficiencies (NOT the same as the five (5) original target areas) and one (1) potential operational improvement were identified in the downstream sanitary collector interceptors. These project areas are significantly less than what the City staff was expecting based on past studies. An action plan was prepared for each area. The Technical Oversight Advisory Committee (TOAG) reviewed these technical findings at their meeting on September 18 and concurred with the findings.

e. The Wastewater Treatment Plant (WWTP) has adequate capacity to handle existing and future peak flows, and with the completion of the plant overhaul project, will be upgraded to continue to provide this level of performance for the long-term.

f. A December 2013 survey of homeowners who had FDD performed in their home was conducted which led to follow-up inspections and a plan to alleviate issues with FDDs that were found to be out of compliance with the FDD project specifications. Findings and recommendations are in Section B.

3. Basis of System Evaluation

The design scenario that was selected for the evaluation of the sanitary system is described below:

a. Future growth in City based on planned development.

b. Future growth in township contract customers based on setting sanitary flows to contract limits.

c. 25-year recurrence interval peak sanitary flows plus 10% additional peak flow for:

i. Climate change (EPA National Stormwater Calculator "6-35 year high-wet" scenario is 10.4% increase in peak flows), or

ii. Increase in level of service from 25-year to 50-year (which is a 9% increase in peak flows), or

iii. Additional growth beyond that contained in the planned development.

Note that a larger scenario was also examined, which increased peak sanitary flows by 20% over the 25-year recurrence interval peak flow used in the design scenario described above. In OHM's evaluation of this larger scenario, the extent of the surcharging did not increase significantly. The increase in sanitary flow from the larger scenario could be addressed during project design through a small incremental upsizing of a system upgrade, such as building a slightly larger relief sanitary sewer, for example. This could potentially provide a large increase in the level of service provided by the sanitary sewer for a marginal increase in cost, and should be evaluated before sanitary upgrades are finalized.

4. Action Plans for the Six Project Areas

Five (5) potential hydraulic deficiencies and one (1) potential operational improvement were identified in the downstream sanitary collector interceptors. These can be found on a map shown in the Volume 4: Hydraulic Report, Appendix A. Many of the issues identified will require collecting and analyzing additional information from the specific location to further understand what improvements are required. An action plan was prepared for each area. The six (6) Action Plans are attached and are as follows:

a. Huron / West Park

b. High Level / 1st Street

c. High Level / State & Hoover

d. Pittsfield Valley

e. Glen Leven

f. Glen/Fuller Diversion (operational improvement item)

5. CAC Recommendations

During the October CAC meeting, in an attempt to identify where consensus existed regarding the recommendations, the facilitator polled the attending CAC members. All CAC attendees, ten (10), supported the recommendations below:

a. Perform the tasks outlined on the six (6) action plans for the project areas.

b. Should sanitary sewer system upgrades be required to address an issue in the six (6) project areas, utilize the larger design basis (50-year rain) as described in the Volume 4: Hydraulic Report, if doing so results in a marginal increase in the project cost and disturbance to the public.

c. Install a series of permanent meters in critical sanitary sewer system areas to provide a long-term record of sanitary system performance.

d. Formalize and perform a rotating maintenance program to proactively find high sanitary flows, blockages and collapses in the sanitary sewer system, including quickly establishing a baseline for the entire City. This would include rotating temporary sanitary sewer metering, sanitary manhole inspections and sanitary pipe video inspections. The frequency of the rotating program should follow industry standards for asset management and be planned to provide proactive identification of sanitary sewer issues. A higher frequency should be focused in those portions of the sanitary sewer system experiencing greater issues, such as those in the problem areas already identified. The program should include periodic evaluation of the original five (5) target FDD districts to verify they are still performing as desired.

B. FDD SURVEY / ISSUES RESOLUTION

1. FDD Survey Results - Dec 2013 to Jan 2014

a. 2350 surveys mailed to participants of both the City FDD program and the Developer Offset Mitigation (DOM) program, 850 responses – 133 completed online; 717 returned by mail, 36% response rate (Note: typical response rate for a municipal survey ranges from 20% to 40%).

b. Confidence level that the sample results represent responses from the entire set = 99%, with margin of error = 3.6% +/-.

c. 70% satisfied with sump pump installation.

d. 45% would recommend sump pump installation to a neighbor, twice as many as those who would not.

e. 100 of the 134 respondents that reported experiencing sanitary sewage backups PRIOR to FDD/sump pump installation did NOT experience them after FDD/sump pump installation.

f. 106 respondents who reported no flooding/seepage/dampness BEFORE FDD said they did experience flooding/seepage/dampness AFTER FDD.

g. Almost 40% reported some or significant increase in anxiety.

h. Received 131 comments of dissatisfaction; 71 comments of satisfaction.

2. FDD Survey Follow-Up Results

a. Objective: Collect information on prioritized list of survey respondents to document their problems, identify common issues, and develop improvement recommendations.

b. 150 homes identified, 101 homeowners contacted, 52 site visits performed, 25 phone interviews performed (all by OHM).

c. 77 homeowner reports completed, 10 homes identified where the FDD installations not according to specification appeared to cause water issues. At this rate of incidence, about 2% of 1,800 City FDD Program sites may not have been installed according to specification or somewhat less than 50 homes.

d. FDD Mitigation Subcommittee comprised of SSWWE and FDD CAC members formed to review OHM results and make go forward recommendations.

e. The subcommittee met three times during July and August. A set of recommendations emerged from the process. The sources of the recommendations were the City Staff, OHM, and the subcommittee.

f. This set of recommendations was reviewed extensively at the September 10, October 8 and November 12 SSWWE CAC meetings. During these reviews, the set of recommendations changed, as CAC suggestions were considered. In addition, the project team contributed changes to this set.

g. During the October CAC meeting, in an attempt to identify where consensus existed regarding the recommendations, the facilitator polled the attending CAC members. This polling was updated at the November CAC meeting. Many of the recommendations achieved consensus support from the CAC participants. Some of the polling tallies do not add up to the twelve CAC members on the committee due to absences or CAC members who abstained from voting on certain items. The results of the polling process for the recommendations that received consensus support are below. See Section III-E of this report for more detail on the polling results.

3. CAC Recommendations

a. FDD as a program tool (for City projects). **<u>The SSWWE project team recommended the discontinuation of mandatory FDDs in the target areas</u>** because the FDD program to date has significantly reduced the risk of basement backups in those areas and additional FDDs are not needed. The use of FDDs as a program tool for the City on future projects going forward was evaluated by the CAC with the following results:

    i. Do not retain the FDD program as is. (CAC polling results: All CAC members who voted, ten (10), supported this recommendation).

    ii. Eliminate mandatory FDDs as a program tool option. (CAC polling results: Seven (7) CAC members support/ four (4) CAC members did not support).

    iii. Modify the FDD program to be voluntary, incentivized and robust, with program changes that align with Best Practices (found on page B-92 of the FDD Survey Follow-Up Investigation Report found in section V-B of this report), and that gather input from candidate neighborhoods. (CAC polling results: ten (10) CAC members support/ one (1) CAC member did not support.)

b. Correct out-of-specification installations and conduct sump pump Outreach Program. Polling results: All CAC members, twelve (12), supported this recommendation.

    The City will initiate a program to correct FDD installations that were not completed according to specification or industry best practices, and were primarily responsible for water entering a basement. The City will retain a contractor to accomplish this program. Key elements of the program include:

    i. The correction process will start with the set of non-spec residences identified by the OHM investigation, ten (10), and will include any that emerge from the additional residences that OHM has not yet investigated (estimated to be somewhat less than 50 homes). The process will be done on a case-by-case basis.

ii. The City will send a mailing to all properties that have participated in the City FDD Program, which will provide them with the opportunity to come forward with potential FDD related problems to be investigated and corrected if warranted. A deadline will be given to ensure that this process does not continue indefinitely.

iii. Develop an outreach/education program, including how-to videos, to all Ann Arbor sump pump owners, to provide homeowners more complete information about their sump pump system.

iv. The City will attempt to fund this program by making responsible contractors and consultants pay for the applicable portion of program costs.

c. Implement OHM Best Practices. (CAC polling results: All CAC attendees, twelve (12), supported this recommendation). OHM outlined some of the best practices that it has observed from FDD programs over the years. Three categories of Best Practices were detailed:

i. Customer Service

ii. New Installations

iii. Retroactive Work

Specific recommendations for each of the three categories are described in Section V-B of this report.

d. Provide backup systems. (CAC polling results: Eight (8) CAC members support/ four (4) CAC members did not support.)

The recommendation is to provide a backup system to any resident desiring one who participated in the City's FDD Program. The estimated cost of providing the back-up systems to City FDD Program homeowners who do not currently have one is $810,000.

CAC members also suggested that residents who participated in the City's FDD Program receive discounts on back-up systems, that a back-up system be included in a revision to the City's FDD Installation Specification, and that the City benchmark other city FDD program regarding back-up systems.

The rationale for the CAC members in support of the back-up recommendation is as follows:

i. 1,800+ Homeowners were included in the City FDD Program, and the City did not fund backup systems despite the 2001 study recommendation to do so.

ii. Although many homeowners welcomed the FDD program, many other homeowners felt that they were forced into the FDD program due to the $100/month mandated increase in their sewer bill if they refused to have an FDD.

iii. The FDD program was originally announced/intended as a city-wide program, not a select neighborhood program.

iv. According to the 2013 Survey, 52% of the respondents expressed concern about a lack of a backup system.

v. Some DOM participants have been provided backup systems free of charge.

vi. Many target area residents were part of the City program for which a backup system was not offered; therefore, getting a backup system by participating in DOM was not an option for them.

vii. The FDD program replaced gravity systems with sump pumps. Sump pumps are not as reliable as gravity, which never wears out and continues to work during power outages. The backup systems will give the FDD participants a system that is more reliable (though not as good as what they had).

viii. Other municipalities in Michigan provide assistance in obtaining backup systems to FDD Program residents.

e. Pay damage claims to homeowners who experienced water damages due to out of specification installations. (CAC polling results: All CAC members who voted, eleven (11), supported this recommendation).

The recommendation is to pay damage claims residents who incurred water damages primarily due to out-of-specification FDD installations and the responsible contractors and/or consultants should pay the costs for these claims. The estimated cost for paying these damage claims (based on the rate of damage in the eleven (11) out-of-specification homes currently identified) is $160,000. The CAC's rationale for this recommendation is as follows:

i. 1,800+ Homeowners were included in the City FDD Program.

ii. Although many homeowners welcomed the FDD program, many other homeowners felt that they were forced into the FDD program due to the $100/month mandated increase in their sewer bill if they refused to have an FDD.

iii. The FDD program was originally announced/intended as a city-wide program, not a select neighborhood program.

iv. The OHM investigation revealed that perhaps 2% of FDD systems were not installed according to specifications and caused water damages.

v. Failing to pay for damage claims due to out-of-specification installation is not equitable, and not treating the FDD recipients in an equitable way will set a negative precedent for future programs that require broad public participation.

f. Pay Homeowner Compensation. (CAC polling results: Three (3) CAC members in support; nine (9) CAC members not in support).

This recommendation involved paying non-damage related costs that FDD homeowners have incurred as a result of FDD installation. Typical cost items include sump pump replacement, back-up battery replacement and sump pump insurance. As this recommendation was rejected by a majority of the CAC, it is not detailed in this summary. See Section V-C of this report for a more thorough description.

g. Provide Financial Support for Senior Citizens and Economically Disadvantaged Ann Arbor Residents with FDD Issues. (CAC polling results: Eight (8) CAC members in support; three (3) CAC members not in support).

   This recommendation is for the City to explore offering financial assistance to senior citizens and/or economically disadvantaged citizens who are having difficulties paying sump pump related expenses. The model for this program can be found in various Michigan utilities that help seniors and/or economically disadvantaged citizens with their electric/gas/water bills. These programs typically involve means testing.

h. Provide free radon inspection for all City program FDD residences. (CAC polling results: Three (3) CAC members in support; Seven (7) CAC members not in support).

   This basis of this recommendation is that the process of cutting a hole in the floor slab for has the potential to increase the seepage or radon gas into the basement. To address this risk, radon testing should be provided at all homes where FDD was performed to measure the radon levels. The CAC discussed the fact that radon is a general risk for homes in Washtenaw County, and that radon gas can enter from cracks and other openings in the basement besides the sump hole. The City's standard FDD installation specifications include sealing the sump hole so that gasses cannot escape.

i. Examine modifying rates for properties without footing drains connected to the sanitary system in a future rate study. (CAC polling results: Ten (10) CAC members in support; one (1) CAC member not in support).

   This recommendation involves studying whether or not properties that do not have footing drains connected to the sanitary sewer (and therefore do not drain footing water directly into the sanitary sewer system) receive a different level of service from the City. If the study validates that properties receive a different level of service, the methodology for allocating costs could be altered to reflect the differing level of service.   Presumably, properties that do not have footing drains connected to the sanitary sewer receive less service from the City because the City does not treat footing drain water that comes directly from these properties.

   In addition to studying differing levels of service, the CAC suggests that the study address whether or not it is feasible to give a water consumption or credit when a water backup pump activates due to a power shortage.

j. Developer Offset Mitigation (DOM) Program recommendations. (CAC polling results: All CAC members who voted, eleven (11) supported these recommendations).

   i. Continue a DOM program with revisions.

ii. Revisions to the DOM program allowing mitigation City-wide except for the developments where flows pass thru one of the five identified SSWWEP project areas.

iii. Re-examining the design flow rates (table A).

iv. Eliminate the 20% recovery factor.

v. Revisions to the DOM program to evaluate the ability of allowing developers to make a payment in lieu of offset mitigation.

vi. Revisions to the DOM program eliminating the 24-month requirement for using mitigation credits.

vii. Periodically revisit the program and identify other high-risk areas as they appear.

C. ADDITIONAL ITEMS

A number of comments and issues have surfaced during the course of the project as noted below. This information was prepared by the SSWWE project team to fully document all items that were raised, and summarize how they were addressed.

1. Innovative Option - The University of Michigan has received a grant to examine smart sanitary sewer network of distributed sensors connected to real-time control with algorithms to operate control points to store flow where the pipes are not full, and the City of Ann Arbor is one of the participating cities for the research. This is a potential innovative option that could provide further protection for rare events, particularly those with significant spatial variation in the rainfall.
2. WWTP Capacity - No recommendations are made for capacity improvements at the WWTP. The study found that the WWTP has adequate capacity to handle existing and future peak flows, even for the largest flows evaluated under Scenario C (50-year wet weather flow, with future growth plus climate change). The study found that during Scenario C, the City's wet weather equalization tank at the WWTP would not overtop. There is the possibility that a storm event larger than Scenario C could occur, or that the equalization basin would not be completely emptied from a previous large storm event before another large storm event occurs. The expected occurrence of events that exceed Scenario C, or of two back-to-back storms large enough to send flow to the wet weather equalization basin is very rare, and is not considered a significant risk.
3. Manhole Inflow – A suggestion was made that sealing pick holes on sanitary sewer manhole covers might address the remaining issues in the sanitary sewer system. Pick holes can result in stormwater inflow into the sanitary sewer system and should be addressed where relevant. This recommendation is included in the action plans. The City is also addressing this flow source as an operational practice. The City has a program to plug manhole pick-holes and is currently implementing a program to seal manholes with a gasket cover in low-lying areas that are prone to flooding to reduce inflow through manhole covers. The SSWWE project team does not expect that sealing manholes and pick holes will fully address the remaining issues in the sanitary sewer system.
4. Water Conservation Measures - A suggestion was made during the project to consider drinking water conservation measures through retrofitting houses and businesses with low-flow fixtures and appliances as a mechanism to address peak sanitary wet weather flow issues. Water conservation measures are appropriate for consideration for other important purposes, but they are not considered practical to address peak wet weather flows in the sanitary sewer. This is due to the magnitude of the wet weather flow in the sanitary system, which are much larger than the base sewage flow generated from water consumption. For example, the base flow in the sanitary sewer system from water consumption is approximately 18 cfs. The peak wet weather flow in the sanitary sewer system during large rains ranges from 90 to 120 cfs depending on the scenario. Even if water conservation measures reduced water consumption by 50% or 9 cfs, which would be very aggressive, the peak wet

weather flows would only decrease by 7-10% depending on the scenario. Compare this to 70-90% flow reductions from the FDD program that were needed to significantly reduce the risk of sanitary basement backup in the priority districts. Based on these flow components, we do not believe that water conservation measures is an effective mechanism to address peak wet weather flows in the sanitary sewer system. This conclusion was presented to the chair of the Technical Oversight and Advisor Group (TOAG), and he concurred. Other methods of addressing sanitary sewer issues will be more practical and cost effective, as outlined on the six (6) action plans.

5. Burial Depth of Curb Drain and Sump Pump Discharge Lines – During the course of the project, a concern was raised regarding the burial depth of curb drain and sump pump discharge lines above the frost line. Sometimes, due to the shallow depth of the receiving storm sewer inlet, it is not possible to bury the curb drains and sump leads below the frost line.

   Shallow storm sewer pipes buried above the frost line sometimes occur due to limitations with grading and slope available from the receiving surface waters. This is an inherent challenge with storm sewer pipes in general, and is not unique to the City of Ann Arbor. The common industry design basis for shallow storm pipes is to ensure that they are constructed with a positive slope and therefore will not have standing water within them, which minimizes the risk of freezing in winter. It is not uncommon for local drainage components, including storm sewers, to be built above the frost line, and these facilities do not typically have issues with freezing related blockages.

   We examined the temperatures of the water discharged through the sump discharge lines and curb drains. We found that there is limited data available on the temperature of sump pump discharge water. However, the EPA has published a map of shallow groundwater temperatures[1] that shows groundwater temperatures in the range of 47 to 52 degrees Fahrenheit in Southeast Michigan. We are also aware of a direct measurement of footing drain water temperatures that was performed in Ypsilanti, Michigan, which indicated that the water remained relatively constant throughout the seasons at 54 to 55 degrees Fahrenheit.

   The temperature of footing drain water is moderated by the ground, which provides a constant source of heat for groundwater, and reduces the variability of the groundwater temperatures, even in winter. The risk of winter freezing of curb drains and sump pump discharge lines is further reduced by the fact that they convey this relatively warm groundwater which would require additional cooling before freezing.

   The City's burial depth standards for curb drains and sump pump discharge lines are based on the following requirements and assumptions:

   i. The sump discharge lines in the ROW and on private property are required to be constructed with a positive slope, meeting the project specifications and the building code based on the size of the pipe (24-inch minimum cover for 2-

[1] http://www.epa.gov/athens/learn2model/part-two/onsite/ex/jne_henrys_map.html

inch pipes[2]). Each construction installation has been verified and approved by Planning & Development Services.

ii. With the required slope, the pipes will not have standing water in them.

iii. It is also assumed that the sump pump discharge water is relatively "warm" and will not have time to cool down and freeze in the sump lead or curb drain if positive slope is present.

These requirements and resulting conditions promote effective functioning of the sump discharge line and curb drain, even under extreme cold conditions like those experienced last winter. The specifications themselves are not indicative of any systematic defect in the City's system.

6. Use of Drilling Fluid in Curb Drain Installations - During the course of the project, a concern was raised regarding the use of bentonite drilling fluid in the installation of curb drains in the City's FDD Program and whether the material is toxic. Bentonite is a clay material that is mixed with water to form a slurry to assist in the installation of directionally drilled pipes. The material is required to be inert by the City's specifications, and is not toxic. The same material is widely used in the construction industry in the drilling of drinking water wells.

7. Gravity Back-Up for Sump Pumps – A suggestion was made during the project to examine the potential of a gravity back-up system for sump pumps, whereby if a sump pump failed, the footing water would be allowed to discharge to the sanitary sewer system by gravity before it backed up into the basement. The proposal included a check valve for back flow prevention and an automatic gravity overflow below the finished floor if the sump pump fails. The City's building department reviewed this option and found that it would not meet State building codes and the City's sewer ordinance. The SSWWE project team is not aware of any municipalities that have implemented such a gravity backup system.

   Some municipalities have adopted the practice of placing a floor drain near the sump pump to provide an outlet over the floor to a drain in the case of pump failure. The City's building department response to a question on this topic indicated that there is no minimum installation distance between a floor drain and the sump crock, however, the floor drain cannot be set up to act as a sump pit overflow drain, because sanitary and storm drainage systems of a structure shall be entirely separate (as a practical matter, if there is a significant overflow from the sump crock, it would drain via any existing floor drains). Also, it has been noted that the basement perimeter location typical for the sump crock is not typically the low point for the basement. Therefore, installing a floor drain adjacent to the crock may not effectively limit water from reaching other basement areas. Nonetheless, the CAC discussed that such an installation is a valid consideration for a homeowner contemplating the installation of a sump pump system, and as such requested that the City seek clarification from the State regarding whether such a system would meet State building codes.

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[2] http://www.a2gov.org/departments/engineering/Documents/project%20management%20fdd%20guidelines_2005-11-30.pdf

8. Air gaps - During the course of the project, a concern was raised regarding the purpose and function of the air gaps on the sump pump discharge lines. An informational sheet was prepared on the air gaps, and is included on page 46, section 1.129 of the Q&A Log.

D. CAC COMMENTS ON EXECUTIVE SUMMARY

This is a section where CAC comments on the executive summary will be included. We would like to include a citation for whose comment it is, and tabulate other CAC members who support each comment.

1. A question was raised about the potential impacts of stormwater surface flooding on the flows in the sanitary sewer system from footing drains (Jim Osborn). The City addressed this question in the Q&A log and posted the answer to Basecamp on August 29, 2014. That answer can be found in Section 6c of the report.

2. CAC member Peter Houk issued a statement explaining why fair treatment for FDD participants is important and invited other CAC members to join in on his statement. Here is Peter's statement:

   Through the FDD program, the city has substantially reduced the risk of basement backups in the target areas. The costs of the FDD program, however, were not equally distributed among sewer customers. Many FDD participants were not at risk themselves for basement backups, but their participation was nonetheless critical to the success of the program. FDD participants paid for the program through their sewer rates, as all sewer users did, but they are also paying for other ongoing costs: the loss of floor space in their basements, operation and maintenance, and extra insurance. Also, some residents who were the recipients of sub-standard FDD installations have had to pay to repair their homes after they were damaged by water and mold.

   The CAC has generated several options for ameliorating the cost and inconvenience that FDD recipients have incurred as a result of their participation in the program. These ideas are intended to ensure that residents who participated in the FDD program when it was mandatory and intended for city-wide implementation are treated fairly. CAC members are not necessarily experts in municipal law nor municipal administration nor sewer engineering, so some of the ideas that have been put forth may not be feasible. Even if the CAC's proposals cannot be executed, the effort that went into formulating them should be taken as evidence that CAC members expect the city to do more to ensure fair and equitable treatment of all FDD participants. This sentiment is also reflected in the CAC poll: 8 CAC members voted in favor of backup pumps for FDD participants and 10 CAC members voted in favor of paying for damage caused by out-of-spec installations.

   Fair treatment for FDD participants is important to CAC members for the following reasons:

   - *Their participation fixed the basement backup problem.*
   - *Because of their participation, additional residents in the target areas and throughout the city will not need to have FDD done to their homes.*
   - *Because of their participation, the city avoided a sewer system upgrade that would have cost millions and would have destroyed open space and natural areas in the city.*
   - *The city needs to demonstrate that those who participate in efforts to improve the community will be treated fairly. After all, this is not the last time the city will need resident participation to fix a big problem.*

   To achieve fairness and equity for FDD participants, we as CAC members propose these actions and urge council and staff to find ways to implement them:

- ***Backup pumps.*** *Many FDD participants were not at risk for basement backups, but in order to solve the basement backup problem they had to forfeit their very reliable gravity-based systems and replace them with sump pump systems that don't work during power outages and are susceptible to mechanical failures. Adding a backup to the sump pump will give FDD participants a system that is more reliable. While a sump pump with a backup pump will never be as simple or as reliable as the gravity-based systems these homes were built with, it will be much better than the system that the FDD program originally provided. Furthermore, other municipalities in Michigan included some support for backup systems in their own FDD programs.*
- ***Pay damage claims for sub-standard FDD installations.*** *City staff have proposed fixing sub-standard FDD installations, and this is a good start. But the damage that these installations caused needs to be fixed too. Even if the city doesn't have a legal responsibility to fix this damage, it needs to demonstrate that it will stand behind the residents who allowed their houses to be modified so as to fix the basement backup problem. The city needs to pay damage claims for problems caused by sub-standard FDD installations.*

Member Judy Hanway had an additional comment:

My first thought on hearing about the FDD Program was, "how can this be legal?" The FDDP program, the DOM, and other aspects of the program are currently under the scrutiny of a pending lawsuit and other lawsuits are likely to follow. The legality of the initial FDD Ordinance is in question and this will need to be settled in the courts. Any and all recommendations in the SSWWE final report regarding FDDs and the DOM program must be evaluated against the final resolution of the pending lawsuit(s).

No more mandatory FDDs!

Common sense says that water pipes above the frost line (42" in Michigan) will probably freeze. A thorough investigation (by an independent group of professionals) of the frozen pipe depths, especially in low-flow conditions, should be undertaken. The current specifications developed by CDM for the curb lines do not appear to comply with common sense building and engineering practices and codes. ***Something needs to be done to prevent these lines from freezing!***

Having the air gap next to the foundation wall is a bad idea. If and when water pours out of there, it could (and has) damaged the foundation wall and reentered the house through cracks in the foundation.

There should be pre- and post- radon testing if any more voluntary FDDs are to be done. A sump pump is a known entry point for radon. I think radon mitigation should be funded at all FDD/DOM locations. ***At the very least****, all FDD homeowners should be informed that they should have their radon levels checked. The current FDD website implies that there is nothing to worry about regarding radon from the sump.*

The FDDP saved the city of Ann Arbor a lot of money – ***because it passed many costs, as well as the responsibility of upkeep, onto the individual homeowner.*** *Homeowners who agreed to disconnect, did the city a big favor. They should be compensated for the expenses they've incurred.*

Backup systems should be provided to those homeowners who want one. There are newer systems available now that are better than the 8 hour battery backup.

The City Staff should pursue ***seeking a variance to the state plumbing code*** *in order to allow overflow of sump water to drain (via gravity) to the floor drain. This would help to alleviate basement flooding during power outages.*

Homeowners who have had problems since disconnecting their footing drains should be compensated (this includes making appropriate repairs and paying damages).

We should dispose of the "pre-qualified" contractor requirement for the FDDP. If someone volunteers to disconnect, they should be able to hire any licensed plumber to do the work.

The DOM program should allow developers to fund infrastructure improvements as part of their mitigation requirements.

The City needs to address storm and surface water to prevent this source of water from reaching the footing drains. The storm water budget needs to be enlarged so that more of the problem areas can be fixed.

The SSWWE CAC has been assured that there is adequate capacity at the Waste Water Treatment Plant. However, I remain unconvinced. I see all the high-density buildings going up (dorms, apartments etc), and can't help but wonder how accurate the projections are.

We need to stop paying for multiple studies and consultants and start using our funds to fix the infrastructure!

The city of Ann Arbor needs to do what is necessary to stop future sewage backups (including a more aggressive rotating maintenance program, permanent metering, video inspection of pipes, repair leaking sanitary sewer pipes, and install gasketed manhole covers, especially in low-lying or Target areas).

Member Joe Conen also had an additional comment:

Please note me as concurring with Peter's statement.

A back up pump should be provided and installed for any FDD participant who would want one.

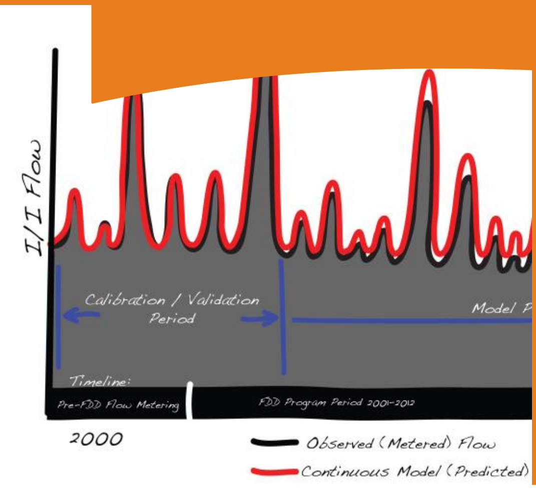
As a community we should treat the FDD participants with respect and fairness. This includes compensation for damage that resulted from to inadequate sump/pump installation.

Other members who concurred with Peter's statement include: Beverly Smith and Michelle Lovasz.

City of Ann Arbor
Sanitary Sewer Wet Weather Evaluation

Volume 1: Flow Monitoring Report

April 22, 2014



City of Ann Arbor

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City of Ann Arbor
Sanitary Sewer Wet Weather Evaluation Project

Flow Monitoring Report

April 22, 2014

A) Introduction

Following several large storm events in 1998, which resulted in numerous sanitary sewer backups throughout the City of Ann Arbor, the City formed a Citizen's Sanitary Sewer Overflow (SSO) Prevention Advisory Task Force (in 1999). In 2001, the Task Force recommended a City-wide footing drain disconnection (FDD) program. In 2003, the City entered into an Administrative Consent Order with the Michigan Department of Environmental Quality, requiring the disconnection of 799 footing drains from the City sanitary sewer system. This number of FDDs corresponds to the summation of the required 620 FDD in the Consent Agreement (signed on September 4, 2003) and the 179 FDD, which is based on the number of FDDs completed by the City since the initiation of the City's program on a pilot basis (on 10 homes) in October of 2000, the start of the FDD after the Task Force recommendation in 2001, and completed prior to June 30, 2003. Following numerous complaints and questions about the effectiveness of the FDD program, the City suspended a portion of the program in 2012. Subsequent to this suspension, the City initiated a Sanitary Sewer Wet Weather Evaluation (SSWWE) project specifically intended to address the following objectives:

- Evaluation of the effectiveness of the FDD program
- Assess the risk of future basement sanitary sewer backups
- Evaluate alternatives moving forward
- Assess potential hydraulic trunk sewer deficiencies

For this purpose, a flow metering plan was developed comprised of numerous flow meters, as well as peak stage recorders located strategically throughout the City. A peak stage recorder, in this context, refers to a mechanical cork device, which records the highest stage the sanitary sewer is reached in a manhole during a storm event. This level must be read on-site soon after a storm event and the cork re-set.

B) Flow Metering Plan

A comprehensive flow metering plan was developed including 30 flow meters, 20 peak stage recorders, and 5 rain gages, resulting in 55 monitoring sites. The specific purpose intended for each of the flow meters and peak stage recorders, their manhole locations in the City system (based on the existing City GIS coding), and original metering durations, are summarized in Table B-1. Figure B-1 provides a visual summary of the location of each of the metering and rain gage equipment in the City. Further detail on the flow meter and rain gage monitoring sites, e.g. installation and maintenance reports and a refined map of location in the City, is provided in the next section.

As can be seen from information contained in Table B-1 and Figure B-1, there were several critical objectives behind the flow metering plan:

1. Direct metering to evaluate the effectiveness of footing drain disconnections in the high priority areas identified in the 2001 flow metering study. As per Figure B-1, these areas include:

    a. Morehead
    b. Dartmoor
    c. Orchard Hills
    d. Glen Leven
    e. Bromley

2. Collection of rain gage data at each of the above-stated locations in order to correlate flow response to rain data

3. Metering to evaluate the regional impacts of footing drain disconnections

4. Metering to evaluate trunk line deficiencies

5. Metering to evaluate areas not impacted by FDD or other developments since 2003 for control districts

6. Metering to evaluate growth areas since 2003

7. Metering to evaluate magnitude of flows entering the City sanitary sewer system through Pittsfield Township

It should be noted that the wastewater treatment plant flow data was also utilized for the purposes of achieving the above-stated objectives. It should also be noted that several of the flow meters listed in Table B-1 were extended beyond the duration of the original metering schedule of 90 days and 180 days (meter MH 2D). These meters include

- 9C → extended to 8/27/2013
- 1A → extended to 8/28/2013
- A1 → extended to 8/27/2013
- C1 → extended to 8/27/2013
- C2 → extended to 8/27/2013
- F1 → extended to 8/27/2013
- MH 2D → extended to 10/30/2013

C) Meter Maintenance and Data Review

Monitoring equipment was maintained frequently in order to ensure reliable data collection and early diagnosis of any localized issues with the monitoring equipment. Data review itself went through a rigorous quality assurance and control procedure as detailed in this section.

Meter Maintenance
In an effort to ensure the collection of reliable data, the monitoring sites were frequently visited.

1. *Peak Stage Recorders*
   The peak stage recorders were generally visited immediately after a storm event with a rain volume in excess of approximately 1.5 inches. Some other sites where the dampness in the manhole resulted in the adherence of the movable cork to the measurement tube were visited on a more frequent basis depending on staff availability and occurrence of storm events. Table C-1 provides a summary of the site visits, level of surcharging observed, as well as stage recorder installation dates. Appendix A contains the installation sheets for the peak stage recorders preceded by the installation sheets for the flow meters.

2. *Rain Gages*
   Rain gage sites were generally visited twice a month to service and upload precipitation data.

3. *Flow Meters*
   Table C-2 provides a summary of the frequency of site visits for the flow meters as well as their installation and removal dates. Appendix A contains the installation sheets for the flow meters in addition to peak stage recorders.

Quality Assurance and Quality Control (QA/QC)
Quality control and assurance of data was important because only reliable data would produce reliable results. At the same time, it was important to not modify the raw data beyond what was reasonable in order to prevent any misinterpretation of the data. Edits were flagged and annotated in the source data files (e.g. spreadsheets) for archiving.

1. *Rain Gages*
   Rain data from each of the five gages was reviewed for any gaps or inconsistencies in relation to historic data, data trend, comparison to other gages nearby (either the five temporary project rain gages or five permanent City gages)

2. *Flow Meters*
   Flow meter data was reviewed in three parts:

a. Assessment of the data in terms of "level of noise" (i.e. an apparent random variation of data without a recognizable pattern) in relation to flow depth, flow rate, and meter drop-outs; if any inconsistencies were noted, the field crew was alerted. Such data was not used in the analysis if it could not be easily replicated by looking at historic variation, or simple data analysis. One simple data analysis was to utilize the metering data to develop a relationship between metered flow rate and metered flow depth. In cases where this relationship broke down due to faulty meter reading and it could easily be interpolated, it was done so (but, only for dry weather flow variations). Otherwise, faulty data was discarded from the analysis.
b. Assessment of the flow data in relation to depth data (also referred to as scatter plot analysis) in order to determine whether the scatter plot signal suggests meter malfunction, in which case, the field crew was notified.
c. For the five high priority areas (as shown in Figure B-1), comparison of dry weather flow patterns between year 2000 metering data and the data collected as part of this study.

D) Flow Metering and Peak Stage Recorder Results

Appendix B contains flow summary sheets for each of the flow meters utilized in this Study. The summary sheets contain the following information for each meter:

- Continuous flow series (flow versus time) throughout the metering period
- A scatter plot showing variation of flow with flow depth
- Meter location map
- Metering duration, start and end dates
- Purpose of meter as well as diameter of sewer meter was located in
- Simple meter statistics (average dry weather flow, peaking factor for storm events, etc.)
- Typical dry weather flow pattern
- Plot of storm events and associated flow response

As can be seen from the figures in Appendix B, the meters captured several storm events throughout the duration of the metering period. Some meters experienced dry weather drop outs, which could easily be interpolated with procedures described in the quality control and quality assurance section of this report. Some of the Pittsfield meters had drop outs mostly because the flows that these meters were measuring (and associated flow depths) were too small to provide less "noisy" data. However, information could still be gleamed from these meters; for example, whether the flow response measured from these district meters experienced inflow or infiltration, and if so, by how much.

In an effort to obtain a relatively easy sense for the level of wetness conditions in the areas tributary to the flow meters, Table D-1 was developed. This table is based on hourly averaged flow metering data (the raw data had a recording interval of 5 minutes) and the average flow column is based on an averaging of the hourly flow record for the entire duration of the metering period (including dry and wet weather periods). The peaking factor for each meter was determined by dividing the hourly averaged peak flow rate in the metering record to the average flow rate. As can be seen from Table D-1, nearly fifty percent of the meters showed peaking factors higher than 4. According to the Recommended Standards for Wastewater Facilities (2004 Edition of the 10 State Standards), sanitary sewer design peaking factors vary between approximately 2 to approximately 4 as a function of population served.

Table C-1 as referenced earlier in this report, summarizes the periods when the peak stage recorders indicated sanitary sewer flow surcharging. Out of the twenty peak stage recorders, one experienced consistent surcharging (71-67258). It was noted by the City that the cause of this surcharging was downstream root intrusion and the City addressed this issue. Other than the surcharging at this peak stage recorder, Table C-1 indicates that throughout the duration of the metering period, seven peak stage recorders indicated system surcharging.

E) Rainfall Results

Daily rainfalls for the temporary rain gages as well as permanent City gages (Barton, Jackson, and South Industrial, City Hall, and North Campus) are tabulated in Table E-1. As can be seen, there were several periods where data was not logged due to either a mal-function of the rain gage or the clogging of the equipment with debris. Figure E-1 shows a time series continuous plot of this rain data, as well as continuous, break-through cumulative totals over the duration of the metering period for this study.

In addition, Figure E-2 shows a bar chart of the rain data collected at the Barton Pond permanent city rain gage. The Barton Pond permanent rain gage was used to develop intensity-duration-frequency (IDF) curves in order to quantify the volume and intensity of the rain events during this monitoring period in relation to recurrence intervals. The recurrence interval data is based on the Washtenaw County Water Resources Commissioner rainfall statistics, which, the project team noted closely matches the National Oceanic and Atmospheric Administration published values for the State of Michigan (Atlas 14, published in 2013). The results of the IDF analysis are shown in Figure E-3.

Figure E-3 suggests that the largest storm event during the metering period was the June 27, 2013 event. At the Barton Pond gage, this event produced an average peak intensity equivalent to an approximately 10% chance of occurrence (or approximately a 10-year return period).

F) Conclusions

Both the rain data and the metering data generated valuable information in assessing the system response to a variety of storm events occurring in different time periods (April thru August of 2013). Figure F-1 summarizes this data for the five priority areas. Several additional conclusions, which are based on the analysis of the monitoring data, are summarized below:

- The temporary flow meters installed as part of this study recorded usable data

- These meters showed adequate performance for analysis of system response to storm events

The City is planning on keeping the peak stage recorders that were installed as part of this flow monitoring program.

Figures and Tables

Table B-1: Summary of Monitoring Site Statistics and Purpose

Meter No.	FACILITYID (from GIS)	ProposalMeterID	Metering Duration (days)	Pipe Diameter (in)	Description
1	71-66444	MH 47	180	10	Orchard Hills (Manhole 47 from Table E-1 in RFP)
2	71-65483	MH 2B	180	10	Bromley (Manhole 2 from Table E-1 in RFP; Meter also used to monitor project UT-SN-01-20)
3	71-70786	MH 2D	180	15	Dartmoor (Manhole 2 from Table E-1 in RFP)
4	71-63460	MH 11	180	15	Glen Leven 1 (Manhole 11 from Table E-1 in RFP)
5	71-63822	MH 102	180	18	Glen Leven 2 (Manhole 102 from Table E-1 in RFP)
6	71-63495	MH 49M	180	18	Morehead (Manhole 49 from Table E-1 in RFP)
7	71-67191	MH 49D	180	12	Liberty Washington (Manhole 49 from Table E-1 in RFP; Meter also used to monitor project UT-SN-01-20)
8	71-71420	12A	180	18	Meter 12A (Location from 2007 Study)
9	71-63293	11B	180	30	Meter 11B (Location from 2007 Study)
10	71-70091	5C	180	30	Meter 5C (Location from 2007 Study)
11	71-70852	A1	90	24	Meter A_1 (New meter location - monitors project UT-SN-01-20)
12	71-67390	B1	90	12	Meter B_1 (New meter location - monitors project UT-SN-91-15 & UT-SN-91-16)
13	71-71325	C1	90	20	Meter C_1 (New meter location - monitors project UT-SN-01-19)
14	71-71226	C2	90	24	Meter C_2 (New meter location - monitors project UT-SN-08-12)
15	71-67551	D1	90	15	Meter D_1 (New meter location - monitors project UT-SN-01-21)
16	71-68796	1A	90	15	Meter 1A (Location from 2007 Study; monitors project UT-SN-08-16)
17	71-68565	E1	90	15	Meter E_1 (New meter location - monitors project UT-SN-08-19)
18	71-63294	9B	90	24	Meter 9B (Location from 2007 study - monitors project UT-SN-01-25)
19	71-69691	9C	90	36	Meter 9C (Location from 2007 study - monitors project UT-SN-93-26)
20	71-62974	10A[1]	180	21	Meter 10A (Location from 2007 study - monitors Pittsfield Township flows)
21	71-71845	3B[2]	180	30	Meter 3B (Location from 2007 study)
22	71-71423	F1[3]	90	30	Meter F_1 (New meter location - monitors 30-inch outlet for Iroquois Ave Branch of Downtown)
23	71-61736	G1[4]	90	30	New Location
24	(Pittsfield Pipe)	Pitt-1	90	8	Meter Pitt-1 (New meter location - monitors direct connection to Swift Run Branch)
25	71-61503	Pitt-2	90	10	Meter Pitt-2 (New meter location - monitors direct connection to Swift Run Branch)
26	(Pittsfield Pipe)	Pitt-3	90	8	Meter Pitt-3 (New meter location - monitors direct connection to Swift Run Branch)
27	71-61514	Pitt-4	90	10	Meter Pitt-4 (New meter location - monitors direct connection to Swift Run Branch)
28	71-072861	Pitt-5	90	8	Meter Pitt-5 (New meter location - monitors direct connection to Swift Run Branch)
29	71-61232	Pitt-6	90	18	Meter Pitt-6 (New meter location - monitors Ellsworth Branch of Pittsfield system)
30	71-61268	Pitt-7	90	12	Meter Pitt-7 (New meter location - monitors Research Park Branch of Pittsfield system)

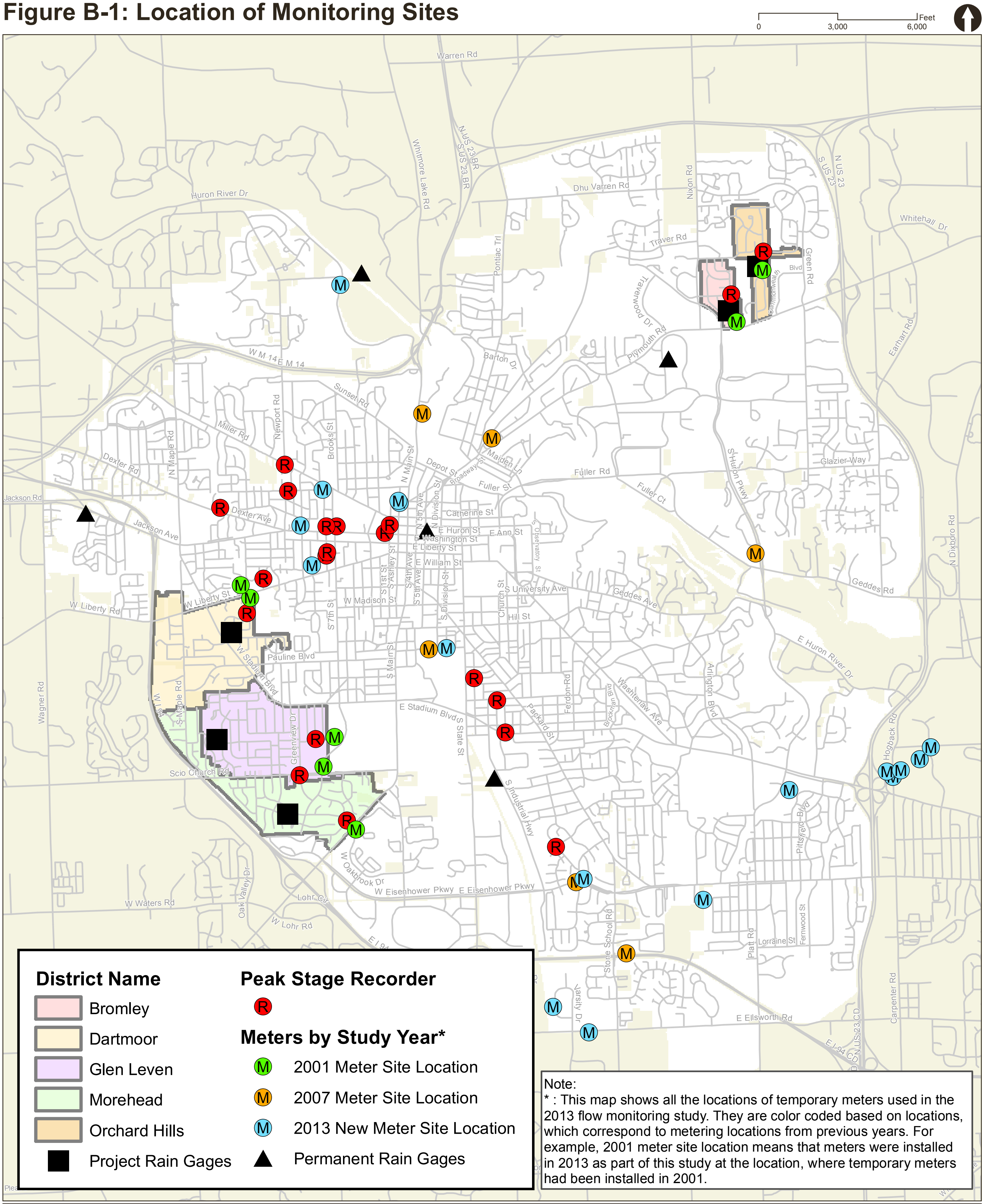
Meter Purposes:

Direct Metering to Evaluate Effectiveness of FDD's (2001 Study Replication)
Metering to Evaluate Regional Impacts of FDD's
Metering to Evaluate Ten (10) Trunk Line Deficiencies
Metering to evaluate Pittsfield flows

Other Meter Purposes:

[1]Metering to Evaluate Growth Areas Since 2003
[2]Metering to Evaluate Areas Unchanged Since 2003 for Control Districts
[3]Metering to Evaluate hydraulic deficiency in 30-inch Iroquois Branch
[4]Inserted due to observed flooding upstream (as per City request)

Figure B-1: Location of Monitoring Sites



November 27, 2013
CITY OF ANN ARBOR

Source: Data provided by Washtenaw County and the City of Ann Arbor. OHM does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 IntlFeet

Table C-1: Peak Stage Recorder Service Log

MARTIN CONTROL SERVICE DATES - STAGE RECORDERS																			
Stage Recorder Meter ID	Location	Installation Date	Diameter (inches)	March		April						June				August	
				3/21		*4/5*		*4/17*		*4/19*		*6/14*		*6/28*		*8/15*	
				Depth	*Notes*	*Depth*	*Notes*	*Depth*	*Notes*	*Depth*	*Notes*	*Depth*	*Notes*	*Depth*	*Notes*	*Depth*	*Notes*
71-073149	934 W Huron Street	2/28/2013	24	-	Dry	-	Dry	-	Dry	-	Dry	-	Wet Cork	-	Cork was wet and signs up to 4.5" from bottom, no true line though, replaced cork	-	Wet Cork
71-073151	116 N 7th Street	2/28/2013	21/24	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry
71-61320	640 Dartmoor	3/2/2013	15	-	Dry	-	Dry	-	Dry	-	Dry	-	Wet Cork	-	Dry	-	Dry
71-62111	1384 Pine Valley Court	3/13/2013	24	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry
71-63129	E Stadium / Westminster	3/15/2013	24	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	3.9"	7.5" from bottom of stick, replaced cork	-	Dry
71-63530	2385 Delaware	3/13/2013	18	-	Dry	-	Dry	-	Dry	-	Dry	-	Wet Cork	-	Wet Cork	-	Wet Cork
71-63809	Greenview, S of Scio Church	3/2/2013	15	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Wet Cork
71-64119	1205 Glen Leven	3/2/2013	10	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry
71-66014	Prairie / Aurora	2/28/2013	8	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Wet Cork
71-66546	Georgetown / Bluett	2/28/2013	10	-	Dry	-	Dry	-	Dry	-	Dry	-	Wet Cork	-	Wet Cork	-	Wet Cork
71-67258	2210 Dexter	3/15/2013	18	-	Dry	-	Dry	41"	41" of surcharge	46.25"	46.25" of surcharge	8"	8" of surcharge	93"	99" from bottom of the stick, replaced cork	-	Dry
71-67528	1409 Arborview	2/28/2013	15	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry
71-67697	725 Newport Place	3/13/2013	10	-	Dry	-	Dry	-	Dry	-	Dry	-	Wet Cork	-	Dry	-	Dry
71-70470	N 1st Street / W Ann Street	3/20/2013	10	N/A		-	Dry	-	Dry	-	Dry	-	Wet Cork	7.3"	Pieces of cork up to 8.5", no solid line to support surcharging though, replaced cork	-	Wet Cork
71-70886	Virginia / Bemidji	3/2/2013	15	-	Dry	-	Dry	-	Dry	-	Dry	-	7" water line from bottom, no cork displacement, replaced cork	6.8"	14" from the bottom of the stick, replaced cork	-	Dry
71-70918	234 8th Street	3/2/2013	21	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	7" from the bottom of the stick, replaced cork	-	Dry
71-71002	234 8th Street	2/28/2013	16	-	Dry	-	Dry	-	Dry	-	Dry	-	Wet Cork	4.9" (C) 7.4" (W)	8.5" from bottom of stick, 11" water line from bottom, replaced cork	-	Wet Cork
71-71482	1232 White Street	3/13/2013	30	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Wet Cork	-	Dry
71-71795	1401 Golden	2/28/2013	30	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	50.3"	57.5" from the bottom of the stick, replaced cork	-	Dry
71-73147	312 Huron Street	3/2/2013	15	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry	-	Dry

Definitions:

Dry = Peak Stage Dry, No Surcharge
Wet Cork = Replaced Wet Cork, No Signs of Surcharge
Depth = Surcharge above crown of pipe

(C) = Cork
(W) = Water Line

(shaded) Known downstream blockage, root intrusion, fixed by the City
N/A Stage recorder not serviced at this time because stage recorder was installed the day before

Table C-2: Flow Meter Service Log

MARTIN CONTROL SERVICE DATES

Meter	Installation Date	Removal Date	March			APRIL							MAY				JUNE				JULY				AUGUST			SEPTEMBER		OCTOBER		*TOTAL*
			3/18	*3/19*	*3/20*	*4/2*	*4/4*	*4/5*	*4/12*	*4/15*	*4/17*	*4/19*	*5/1*	*5/2*	*5/14*	*5/30*	*6/12*	*6/13*	*6/25*	*6/28*	*7/17*	*7/22*	*7/30*	*7/31*	*8/15*	*8/27*	*8/28*	*9/10*	*9/25*	*10/15*	*10/30*	*SERVICES*
1A	*2/22/2013*	*8/28/2013+*	X			X				X				X	X		X		X		X		X		X		X					*11*
3B	*2/21/2013*	*8/28/2013*	X			X				X				X	X	X	X		X		X		X		X		X					*12*
5C	*2/21/2013*	*8/27/2013*		X		X				X				X	X	X	X			X		X	X		X	X						*12*
9B	*2/27/2013*	*6/12/2013*		X			X				X			X	X		X															*6*
9C	*2/27/2013*	*8/27/2013+*		X			X				X			X	X		X			X		X		X	X	X						*11*
10A	*2/27/2013*	*8/27/2013*			X			X				X	X		X	X		X		X		X		X	X	X						*12*
11B	*2/21/2013*	*8/27/2013*		X			X				X			X	X	X	X			X		X		X	X	X						*12*
12A	*2/21/2013*	*8/27/2013*	X			X					X		X		X	X		X	X			X		X	X	X						*12*
A1	*2/22/2013*	*8/27/2013+*	X			X				X				X	X		X		X		X		X		X	X						*11*
B1	*2/22/2013*	*6/13/2013*	X					X				X	X		X			X														*6*
C1	*2/27/2013*	*8/27/2013+*	X			X				X			X		X			X	X		X		X		X	X						*11*
C2	*2/27/2013*	*8/27/2013+*	X					X				X	X		X			X	X		X			X	X	X						*11*
D1	*2/22/2013*	*6/12/2013*	X			X				X				X	X		X															*6*
E1	*2/22/2013*	*6/13/2013*			X			X				X	X		X			X														*6*
F1	*3/15/2013*	*8/27/2013+*			X			X				X	X		X			X	X			X		X	X	X						*11*
G1	*3/21/2013*	*6/13/2013*			X			X	X			X	X		X			X														*6*
MH 2B	*2/22/2013*	*8/28/2013*	X			X				X				X	X	X	X		X		X		X		X		X					*12*
MH 2D	*2/22/2013*	*10/30/2013*+*		X		X				X				X	X	X	X		X		X			X	X		X	X	X	X	X	*16*
MH 11	*2/21/2013*	*8/27/2013*		X			X				X			X	X	X	X		X			X		X	X	X						*12*
MH 47	*2/21/2013*	*8/28/2013*	X			X				X				X	X	X	X		X		X		X		X		X					*12*
MH 49D	*2/22/2013*	*8/27/2013**	X			X				X				X	X	X	X		X		X			X	X	X						*12*
MH 49M	*2/21/2013*	*8/27/2013*			X		X				X			X	X	X	X			X		X		X	X	X						*12*
MH 102	*2/21/2013*	*8/27/2013*		X			X				X			X	X	X	X		X			X		X	X	X						*12*
Pitt 1	*3/1/2013*	*6/13/2013*		X				X				X	X		X			X														*6*
Pitt 2	*3/1/2013*	*6/13/2013*			X			X				X	X		X			X														*6*
Pitt 3	*3/1/2013*	*6/13/2013*			X			X				X	X		X			X														*6*
Pitt 4	*3/1/2013*	*6/13/2013*			X		X					X	X		X			X														*6*
Pitt 5	*3/1/2013*	*6/13/2013*			X		X					X	X		X			X														*6*
Pitt 6	*3/1/2013*	*6/13/2013*		X			X					X	X		X			X														*6*
Pitt 7	*3/1/2013*	*6/13/2013*		X			X					X	X		X			X														*6*
TOTAL SERVICES	** Removal Date differs from Data End Date*	*+ Removal Date Extended*	*11*	*10*	*9*	*11*	*10*	*9*	*1*	*10*	*7*	*13*	*15*	*15*	*30*	*12*	*15*	*15*	*13*	*5*	*9*	*9*	*7*	*11*	*18*	*13*	*5*	*1*	*1*	*1*	*1*	***286***

Table D-1: Summary of Average Meter Flow Characteristics

Meter	Average Flow (cfs)	Peak Flow (cfs)	Peaking Factor
1A	0.307	2.359	7.683
3B	1.756	4.915	2.800
5C	1.727	7.053	4.085
9B	1.949	4.386	2.250
9C	5.989	14.072	2.350
10A	1.957	5.386	2.751
11B	1.308	3.482	2.662
12A	0.916	6.264	6.837
A1	1.268	4.947	3.900
B1	1.925	4.811	2.498
C1	2.275	10.083	4.433
C2	9.174	24.261	2.645
D1	0.532	1.586	2.984
E1	0.312	0.651	2.090
F1	1.501	7.301	4.863
G1	3.683	8.700	2.362
MH 2B	0.148	0.475	3.201
MH 2D	0.773	3.631	4.697
MH 11	0.143	1.208	8.464
MH 47	0.090	0.520	5.773
MH 49D	0.499	1.382	2.773
MH 49M	0.323	1.728	5.349
MH 102	0.369	2.112	5.728
Pitt-1	0.005	0.021	3.976
Pitt-2	0.218	0.905	4.142
Pitt-3	0.056	0.315	5.589
Pitt-4	0.441	2.978	6.750
Pitt-5	0.130	0.323	2.491
Pitt-6	0.736	2.112	2.872
Pitt-7	0.122	0.444	3.638

Table E-1: Summary of Daily Rainfall (in inches of rain) at Temporary Rain Gages and Permanent City Gages

date	Moorhead	Bromley	Glen Leven	Orchard Hills	Dartmoor	Barton Pond	Jackson Road	South Industrial	City Hall	North Campus
4/1	0	0	0		0	0	0	0		
4/2	0	0	0		0	0	0	0		
4/3	0	0	0		0	0	0	0		
4/4	0	0	0		0	0	0	0		
4/5	0	0	0		0	0	0	0		
4/6	0	0	0		0	0	0	0		
4/7	0	0	0		0	0	0	0		
4/8	0.17	0.17	0.17		0.16	0.15	0.16	0.17		
4/9	0	0.01	0		0	0	0.01	0		
4/10	0.69	0.59	0.71		0.79	0.59		0.47		
4/11	1.47	1.32	1.5		1.41	1.15		1.33		
4/12	0.34	0.3	0.36		0.29	0.26	0.42	0.25		
4/13	0	0.02	0		0	0.01	0	0		
4/14	0.02	0.02	0.02		0.02	0.01				
4/15	0.01	0.02	0.02		0.01	0.02	0.03	0.02		
4/16	0.31	0.28	0.31		0.26	0.17	0.25	0.32		
4/17	0.72	0.79	0.81			0.85	0.82	0.84		
4/18	0.79	0.58	0.75			0.69	0.69	0.78		
4/19	0.44	0.39	0.44			0.4	0.41	0.4		
4/20	0.03	0	0.04			0	0.01	0.02		
4/21	0	0	0			0	0	0		
4/22	0	0	0			0	0	0		
4/23	0.48	0.49	0.53			0.64	0.69	0.48		
4/24	0.35	0.35	0.35			0.17	0.29	0.21		
4/25	0.2	0.08	0.19			0.06	0.08	0.14		
4/26	0	0	0			0	0	0		
4/27	0	0	0			0	0	0		
4/28	0.25	0.3	0.24	0.26		0.26	0.24	0.27		
4/29	0.04	0.03	0.01	0.02		0.01	0.02	0.03		
4/30	0	0.01	0	0		0.01	0.01	0		
5/1	0	0	0.01	0		0	0	0		
5/2	0	0	0	0		0	0	0		
5/3	0	0	0	0		0	0	0		
5/4	0	0	0	0		0	0	0		
5/5	0	0	0	0		0	0	0		
5/6	0	0	0	0		0	0	0		
5/7	0	0	0	0		0	0	0		
5/8	0			0		0	0	0.45		
5/9	0			0.01		0	0	0		
5/10	0.26			0.19		0.25	0.28	0.29		
5/11	0.02			0.02		0.01	0.01	0.01		
5/12	0			0		0	0	0		
5/13	0			0		0	0	0.01		
5/14	0			0		0	0	0		
5/15	0			0		0	0	0		
5/16	0			0		0	0	0		
5/17	0			0		0	0	0.56		
5/18	0			0		0	0	0		
5/19	0			0		0	0	0		
5/20	0			0		0	0	0		
5/21	0.11			0	0.02	0.02	0	0.14		
5/22	0.1			0.5	0.16	0.18	0.07	0.08		
5/23	0.13			0.3	0.09	0.08	0.13	0.12		
5/24	0			0	0	0	0	0		
5/25	0			0	0	0	0	0		
5/26	0			0	0	0	0	0		
5/27	0.7				0.54	0.56	0.65	0.7		
5/28	0.19				0.24	0.25	0.17	0.15		
5/29	0				0	0	0	0.01		
5/30	0.16	0.16	0.28	0.1	0	0.31	0.37	0.17		
5/31	0.47	0.3	0.4		0.32	0.26	0.24	0.35		
6/1	0.16	0.2	0.16		0.17	0.17	0.18	0.19		
6/2	0	0	0	0	0	0	0	0		
6/3	0	0	0	0	0	0	0	0.03		
6/4	0	0	0	0	0	0	0	0		
6/5	0	0	0	0	0	0.76	0	0		0.76
6/6	0	0	0	0	0	0	0	0		0
6/7	0	0	0	0	0	0	0	0		0
6/8	0	0	0	0	0	0	0	0		0
6/9	0.32	0.68	0.3		0.29	0.01	0.02	0.03		0
6/10	0.98	0.91	0.86		0.92	1.25	0.94	1.36		1.61
6/11	0	0	0	0	0	0	0	0		0.01
6/12	1.2	0.93	1.04	0.86	1.13	0.1	0.06	0.08		0.23
6/13	0.35	0.45	0.31	0.39	0.28	1.37	0.79	1.46		1.23
6/14	0	0	0	0	0	0	0.01	0		0
6/15	0	0	0	0	0	0	0	0		0
6/16	0.47	0.4	0	0.37	0.5	0.4	0.38	0.47		0.44
6/17	0	0.05	0	0.07	0	0	0	0		0.06
6/18	0	0	0	0.01	0	0.04	0	0		0
6/19	0	0	0	0	0	0	0	0		0
6/20	0	0.47	0	0	0	0	0	0		0
6/21	0	0	0	0	0	0	0	0		0
6/22	0	0.01	0	0.04	0	0.13	0	0		0
6/23	0	0.33	0	0	0	0	0	0		0
6/24	0	0	0	0	0	0.03	0	0		0
6/25	0.78		0.57	0.69	0.8	0.65	0.63	0.57		0.94
6/26	0.38		0.31	0.12	0.24	0.19	0.4	0.45		0.15
6/27	0.97		1.21	2.62	2.16	2.54	1.8	2.39		2.26
6/28						0.3	0.55	1.46		0.31
6/29						0	0.05	0.17		0
6/30						0	0	0		0
7/1	0.17	0.23		0.22	0.15	0.12	0.13	0.19		0.2
7/2	0.02	0.02		0.01	0.01	0.02	0.02	0.03		0.01
7/3	0	0		0	0	0	0	0		0
7/4	0	0		0	0	0	0	0		0
7/5	0.02	0.01		0.01	0.02	0.02	0.01	0.02		0.01
7/6	0.13	0.04		0.04	0.18	0.18	0.19	0.1		0.07
7/7	0.07	0.07		0.03	0.08	0.11	0.13	0.1		0.04
7/8	0.25	0.14		0.23	0.17	0.12	0.08	0.24		0.14
7/9	0.06	1.16		1.05	0.37	0.92	1.89	0.08		1.22
7/10	0.03	0.01		0.01	0.01	0	0	0	0	0.01
7/11	0	0		0	0	0	0.01	0	0	0
7/12	0	0		0	0	0	0	0	0	0
7/13	0	0		0	0	0	0	0	0	0
7/14	0	0		0	0	0	0	0	0	0
7/15	0	0		0	0	0	0	0.14	0	0
7/16	0	0		0	0	0	0	0	0	0
7/17	0	0		0	0	0	0	0	0	0
7/18	0	0	0	0	0	0	0	0	0	0
7/19	0.47	0.54	0.55	0.52	0.33	0.04	0	0.02	0.15	0.43
7/20	0.01	0	0.05	0	0.01	0.25	0.25	0.34	0.03	0.05
7/21	0	0	0	0	0	0	0	0	0	0
7/22	0.02	0	0.02	0.01	0	0.01	0.01	0.02	0	0.01
7/23	0.03	0.09	0.04	0.07	0.18	0.08	0.36	0.06	0.45	0.2
7/24	0	0	0.03	0	0	0	0	0	0	0
7/25	0	0	0	0	0	0	0	0	0	0
7/26	0.04	0.29	0.03	0.04	0.03	0.02	0.02	0.01	0.02	0.02
7/27	0.29	0.2	0.24	0.14	0.35	0.22	0.47	0.41	0.22	0.24
7/28	0	0.03	0	0.02	0.01	0.01	0.03	0	0.04	0.04
7/29	0	0	0	0	0	0	0	0	0	0
7/30	0	0	0	0	0	0	0	0	0	0
7/31	0.22	0	0.25	0	0	0.33	0.27	0.18	0.23	0.31
8/1	0.05	0.01	0.03	0	0.01	0	0	0.1	0.05	0
8/2	0	0	0	0	0	0	0	0	0	0
8/3	0	0	0.01	0	0	0	0	0	0	0
8/4	0	0	0	0	0	0	0	0	0	0
8/5	0	0	0	0	0	0	0	0	0	0
8/6	0.14	0.08	0.12	0.06	0.02	0.01	0	0.2	0.02	0.08
8/7	0.17	0.23	0.21	0.23	0.19	0.23	0.21	0.17	0.15	0.23
8/8	0	0	0	0	0	0	0	0	0	0
8/9	0	0	0	0	0	0.05	0.04	0.06	0	0.07
8/10	0	0	0	0	0	0	0	0	0	0
8/11	0	0	0	0	0	0	0	0	0	0
8/12	2.8	3	2.73	1.91	2.2	2.3	2.46	2.61	2.77	3.2
8/13	0.01	0.01	0	0.01	0.01	0	0	0	0.01	0.01
8/14	0	0	0	0	0	0	0	0	0	0
8/15	0	0		0	0	0	0	0	0	0
8/16	0	0		0	0	0	0	0	0	0
8/17	0	0		0	0	0	0	0	0	0
8/18	0	0		0	0	0	0	0	0	0
8/19	0	0		0	0	0	0	0	0	0
8/20	0	0		0	0	0	0	0	0	0
8/21	0	0		0	0	0	0	0	0	0
8/22	0	0		0	0	0	0	0	0	0
8/23	0	0		0	0	0	0	0	0	0
8/24	0	0		0	0	0	0	0	0	0
8/25	0	0		0	0	0	0	0	0	0
8/26	0	0		0	0	0	0	0	0	0
8/27	0.43	0.37		0.35	0.49	0.43	0.26	0.46	0.37	0.34
8/28						0.08	0.08	0.1	0.04	0.09
8/29						0	0.09	0	0	0
8/30						0	0.22	0.38	0.12	0
8/31						0	0.01	0	0	0

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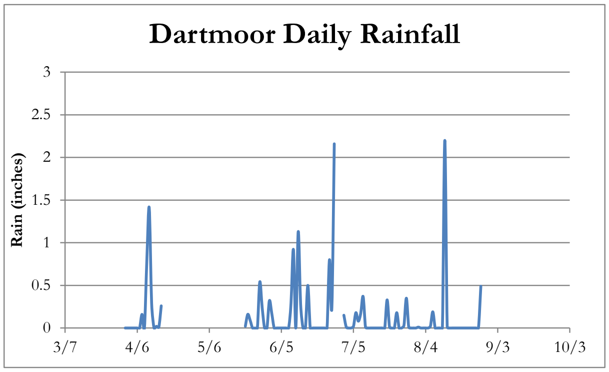
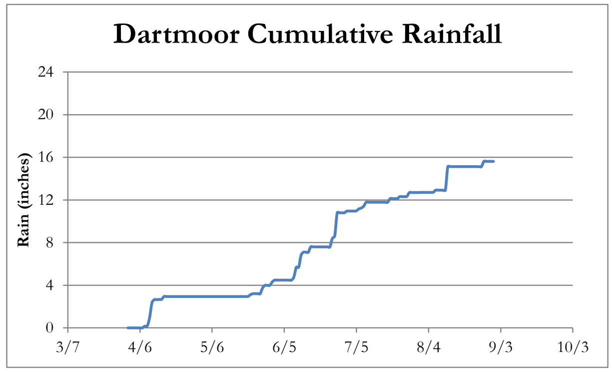
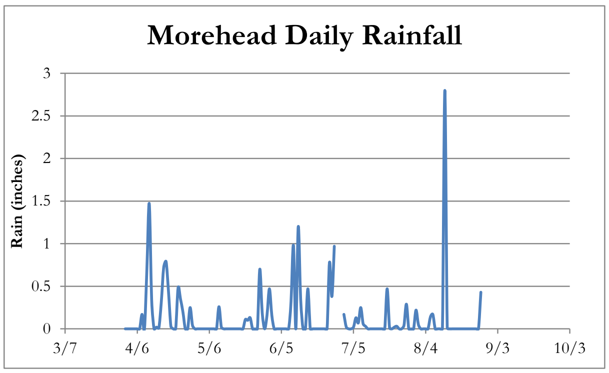
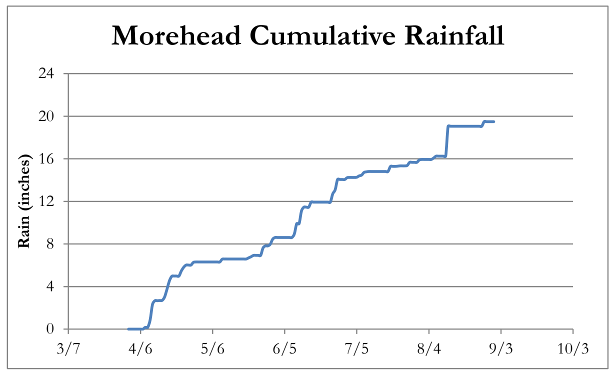
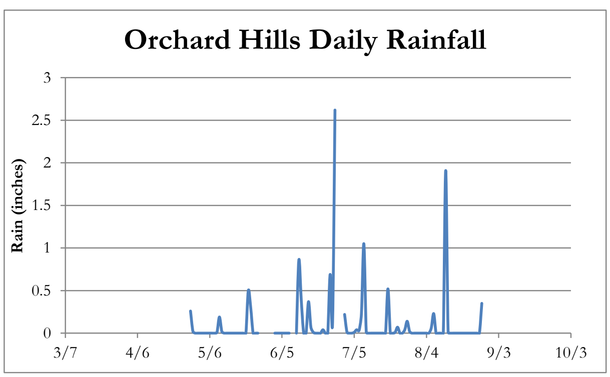
Figure E-1: Rain Data Charts

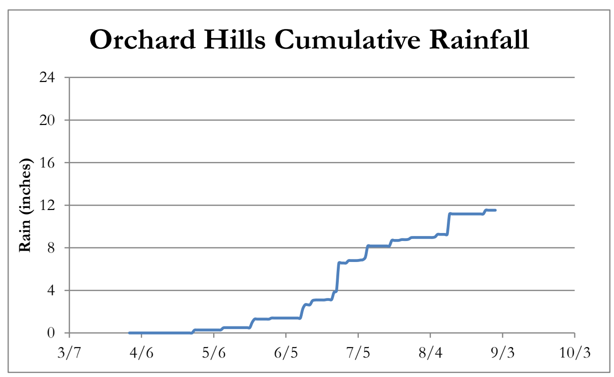


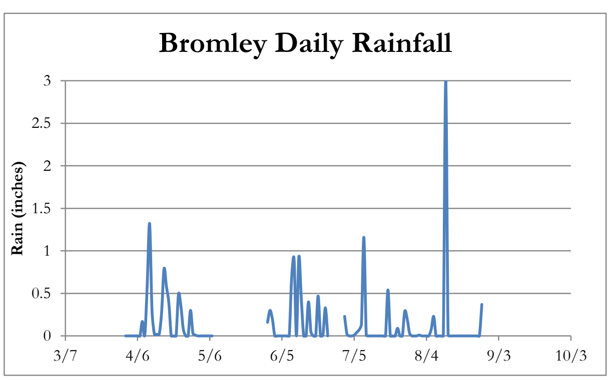












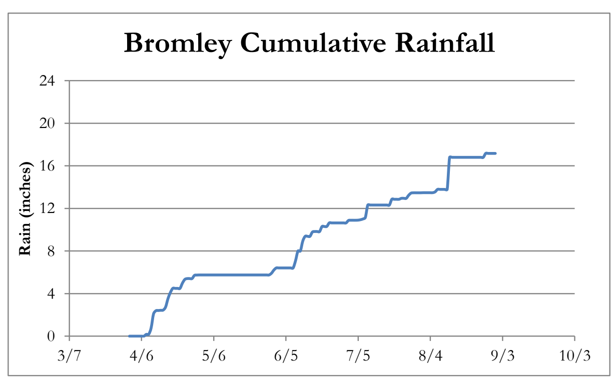
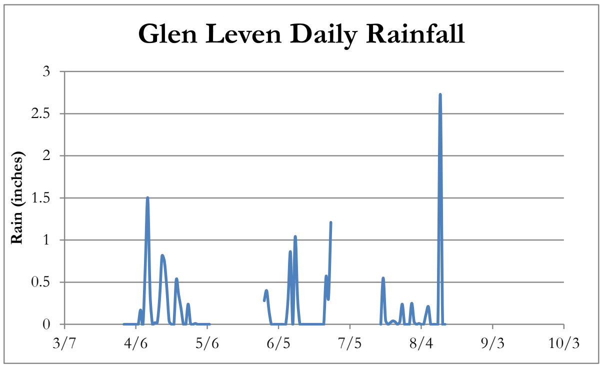
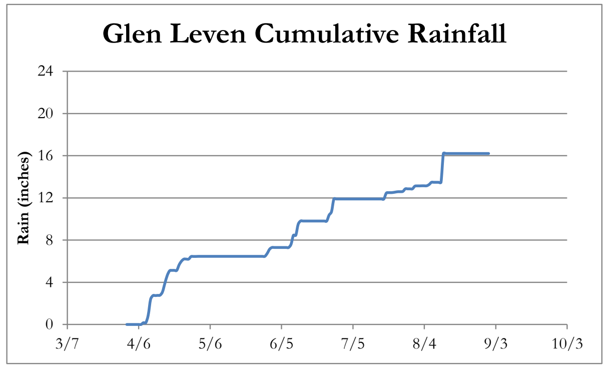
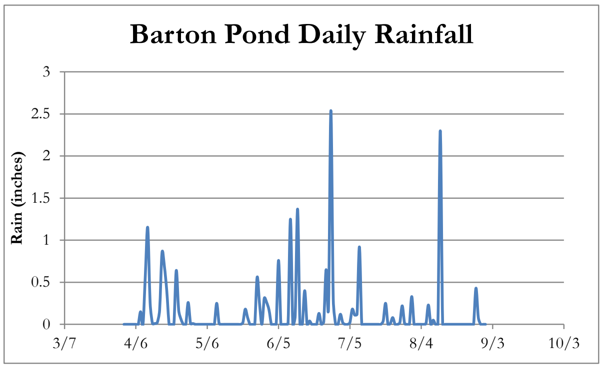
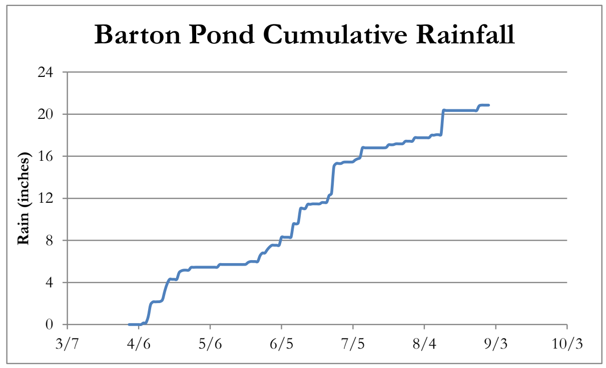


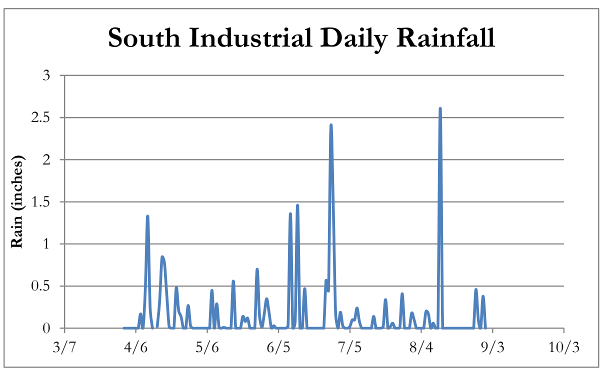
Figure E-1: Rain Data Charts – Continued from previous page

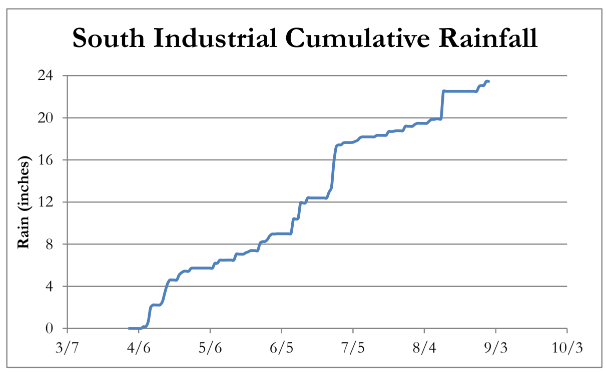


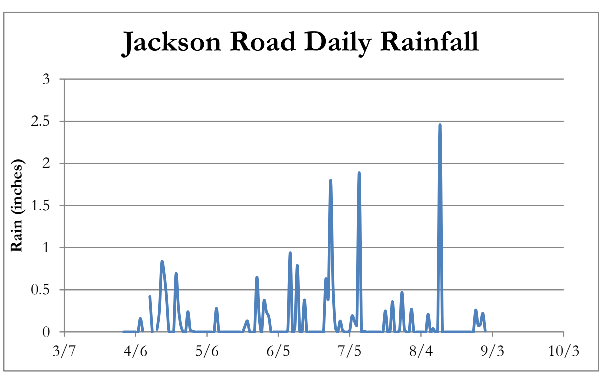












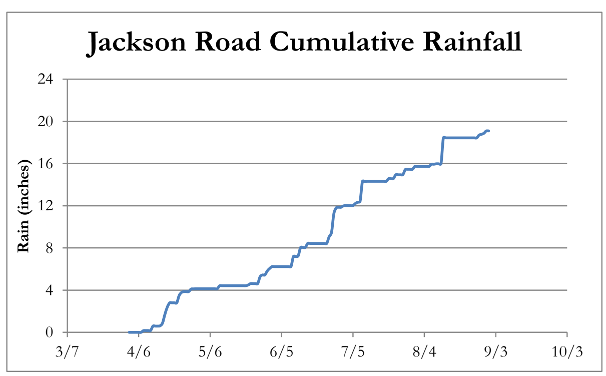
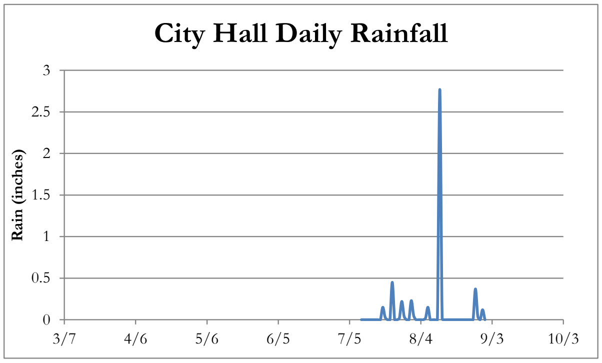
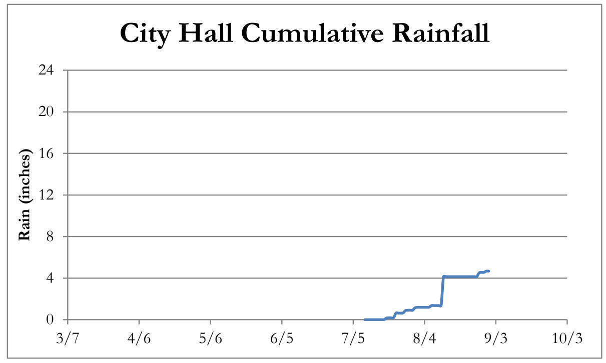
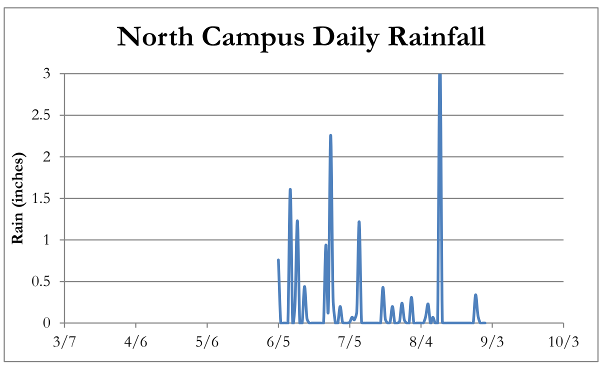


Figure E-1: Rain Data Charts – Continued from previous page







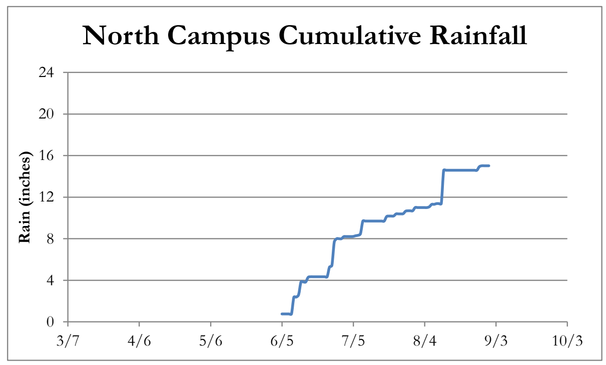
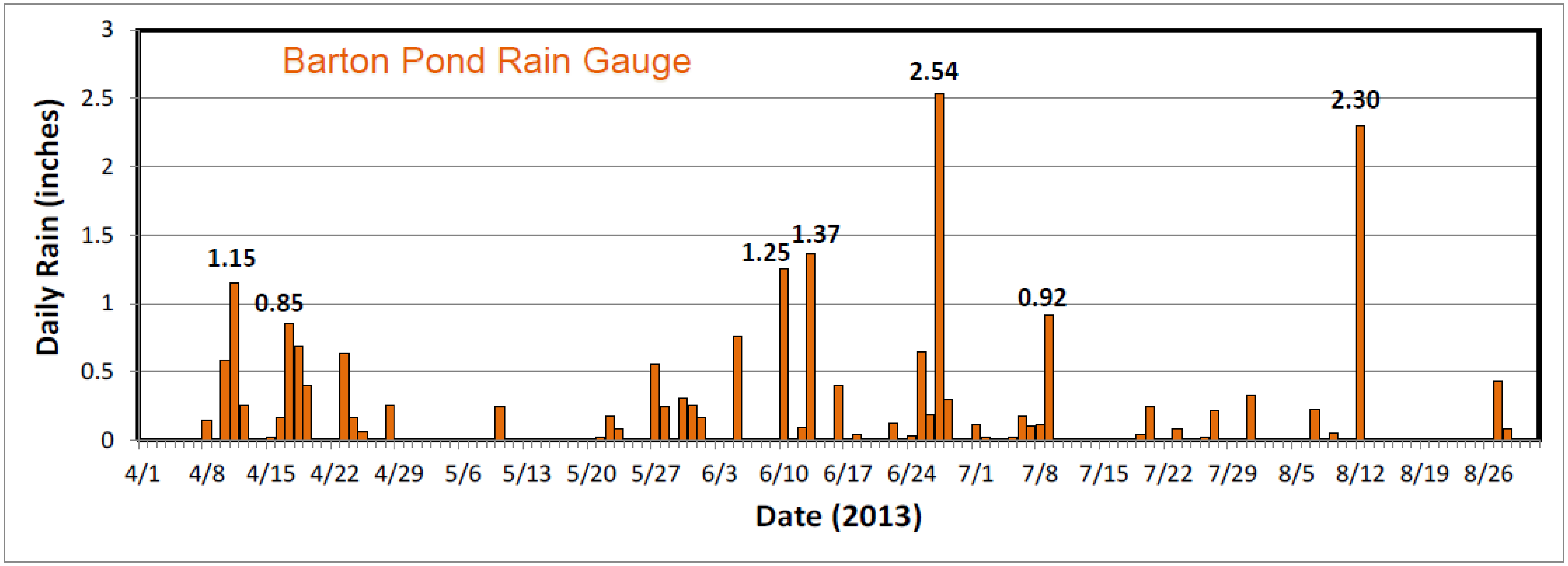


Figure E-2: Barton Pond Rain Data



Rainfall Period Summary

Apr – August 2013	= 20.9 inches
Typical	= 17.6 inches

Flow Meter Performance

- All meters in City recorded usable data
- Adequate meter performance for analysis

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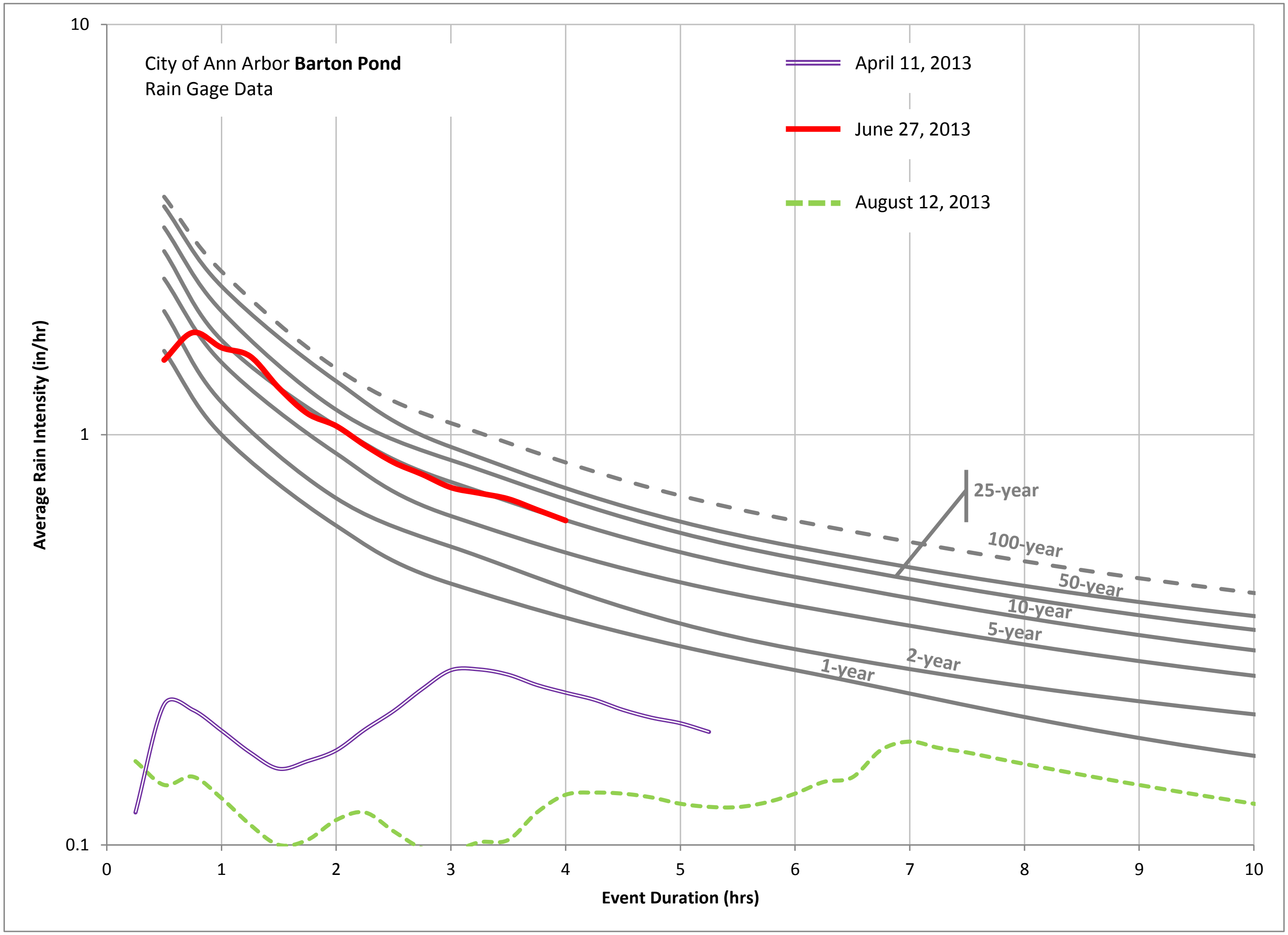
Figure E-3: Intensity-Duration-Frequency Charts for Observed Storm Events



NOTE: The recurrence interval data is based on the Washtenaw County Water Resources Commissioner rainfall statistics

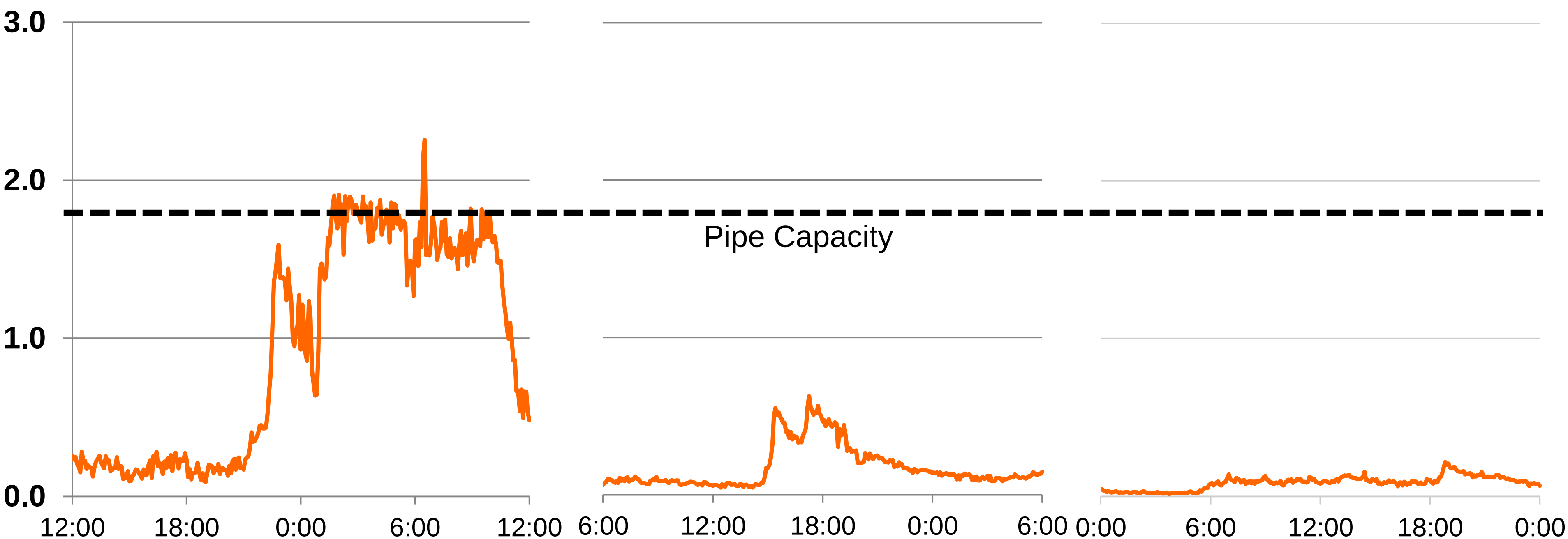
Figure F-1: Monitoring Results for the Five High Priority Areas

Sample Flow Comparison

Orchard Hills District – FDD 99% Complete

June 25, 2000	June 27, 2013	August 12, 2013
2.9-inches of rain	2.6-inches of rain	3.0-inches of rain
0.5-inch peak hour	1.7-inch peak hour	1.6-inch peak hour
peak flow of 2.3 cfs	peak flow of 0.63 cfs	peak flow of 0.22 cfs

(flow in cfs)



Sample Flow Comparison

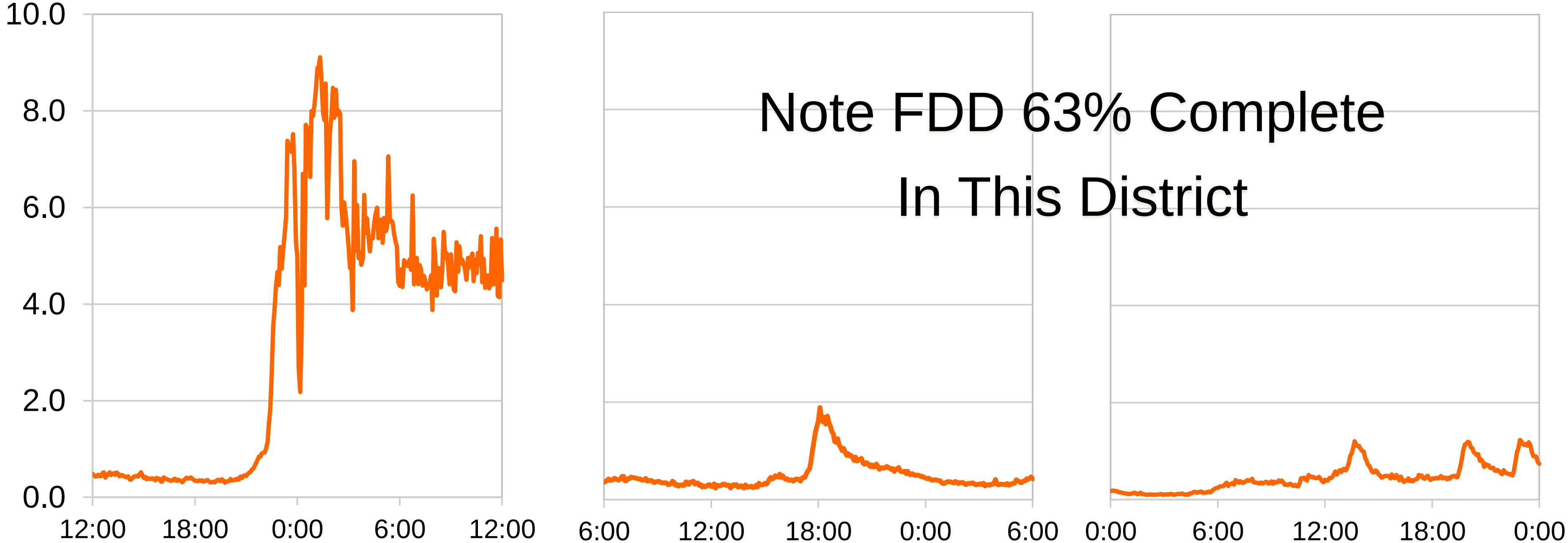
Morehead District – FDD 63% Complete

June 25, 2000
3.5-inches of rain
1.3-inch peak hour
peak flow of 9.1 cfs

June 27, 2013
0.96-inches of rain
0.75-inch peak hour
peak flow of 1.9 cfs

August 12, 2013
2.8-inches of rain
0.73-inch peak hour
peak flow of 1.2 cfs

(flow in cfs)



Sample Flow Comparison

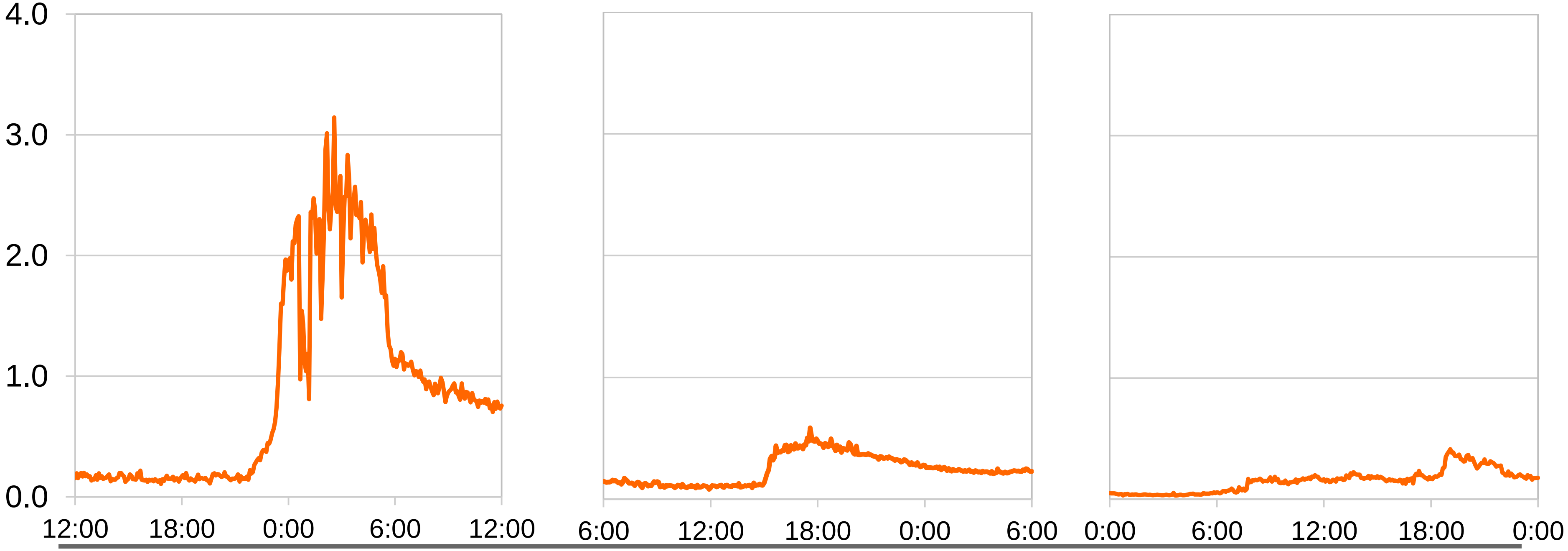
Bromley District – FDD 99% Complete

June 25, 2000
3.2-inches of rain
1.0-inch peak hour
peak flow of 3.1 cfs

June 27, 2013
2.6-inches of rain
1.7-inch peak hour
peak flow of 0.59 cfs

August 12, 2013
3.0-inches of rain
1.6-inch peak hour
peak flow of 0.41 cfs

(flow in cfs)



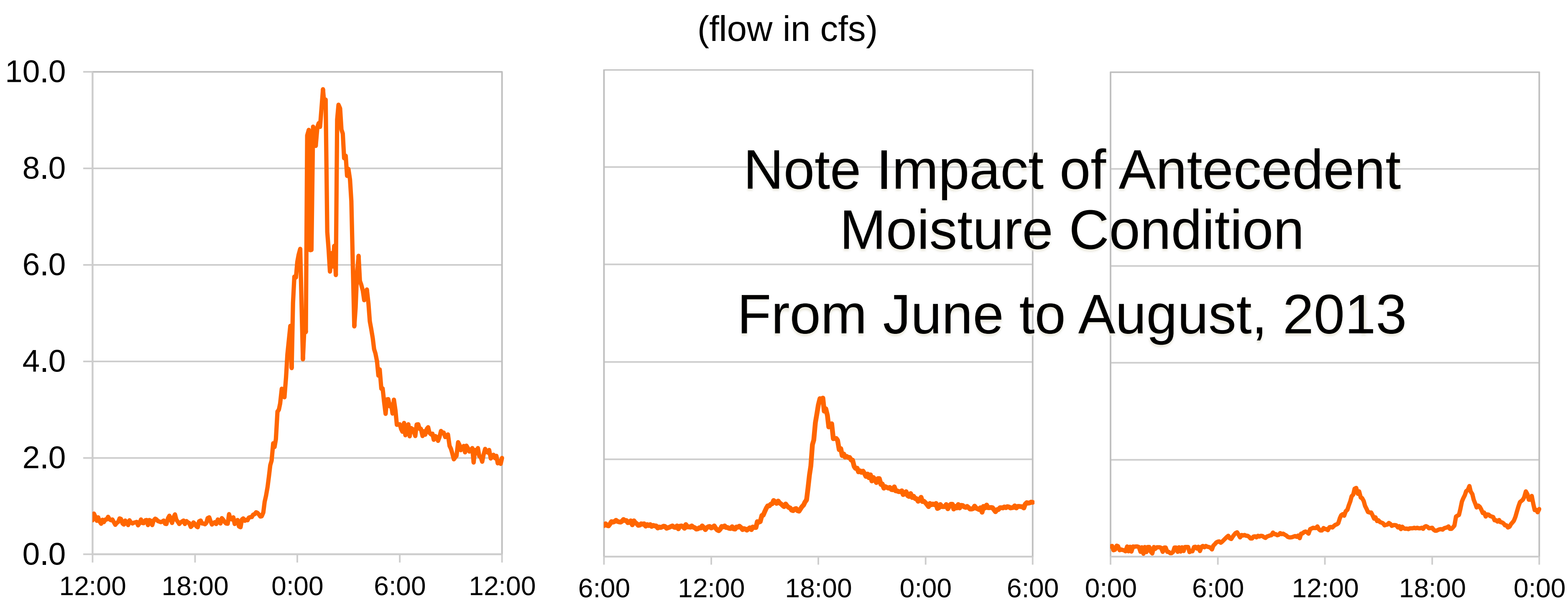
Sample Flow Comparison

Glen Leven District – FDD 56% Complete

<u>June 25, 2000</u>
4.0-inches of rain
1.7-inch peak hour
peak flow of 9.6 cfs

<u>June 27, 2013</u>
1.2-inches of rain
0.88-inch peak hour
peak flow of 3.3 cfs

<u>August 12, 2013</u>
2.7-inches of rain
0.69-inch peak hour
peak flow of 1.5 cfs



Sample Flow Comparison

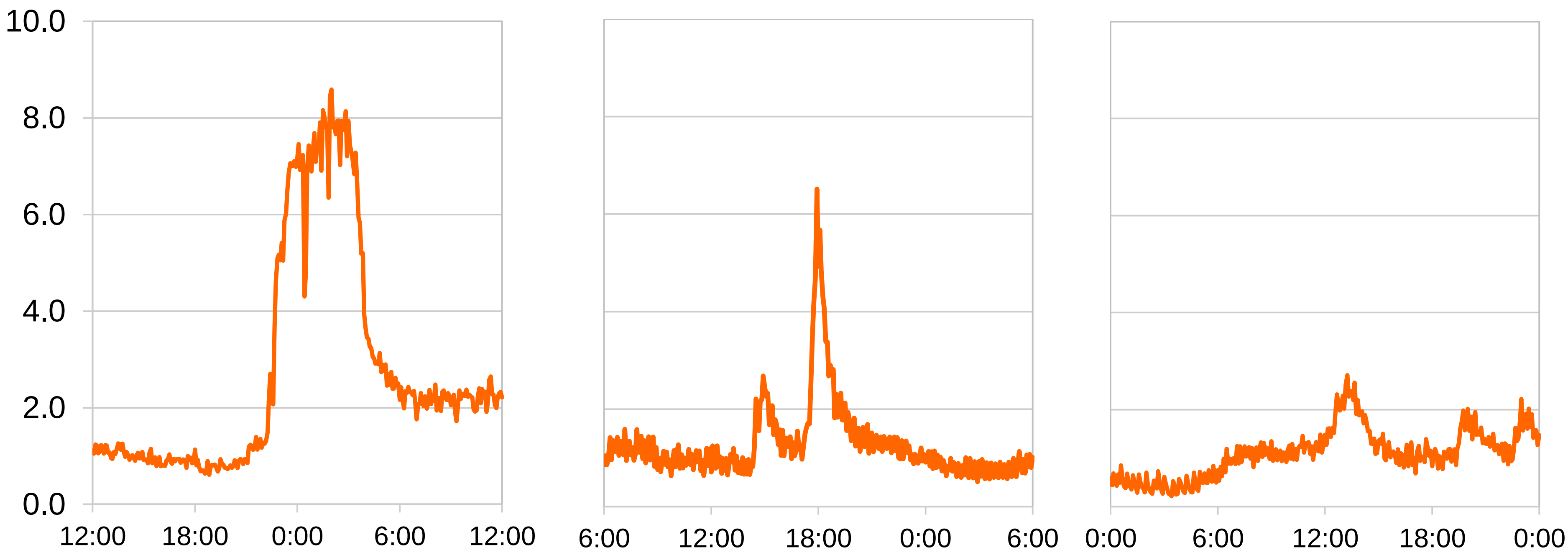
Dartmoor District – FDD 89% Complete

June 25, 2000
3.5-inches of rain
1.3-inch peak hour
peak flow of 8.6 cfs

June 27, 2013
2.1-inches of rain
1.1-inch peak hour
peak flow of 6.5 cfs

August 12, 2013
2.2-inches of rain
0.56-inch peak hour
peak flow of 2.7 cfs

(flow in cfs)



CITY OF ANN ARBOR

Sanitary Sewer Wet Weather Evaluation

VOLUME 2: FLOW EVALUATION REPORT

June 2014

OHM Advancing Communities®

ARCHITECTS. ENGINEERS. PLANNERS.

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Abbreviations

AMM: Antecedent Moisture Model

FDD: Footing Drain Disconnection

gpcd: gallons per capita per day

gpm: gallons per minute

I/I: Inflow and Infiltration

MDEQ: Michigan Department of Environmental Quality

RDII: Rainfall Dependent Inflow and Infiltration

SSO: Sanitary Sewer Overflow

TOAG: Technical Oversight and Advisory Group

WWTP: Wastewater Treatment Plant

Flow Evaluation Summary

Since 2001, the City of Ann Arbor has been implementing a footing drain disconnection (FDD) program to reduce rainfall dependent inflow and infiltration (RDII) and the subsequent risk of basement backups within their wastewater collection system. Following numerous complaints and questions about the FDD program, the City suspended a large portion of the program in 2012. Following this suspension, the City initiated a Sanitary Sewer Wet Weather Evaluation (SSWWE) project specifically intended to address the following objectives:

- Evaluate the effectiveness of the FDD program
- Assess the risk of future basement sanitary sewer backups
- Evaluate alternatives moving forward
- Engage the public throughout the process

Given the potential for significant capital expenditures to address hydraulic issues within the system, it is of the utmost importance to explore the effectiveness of the recent FDD program. Any measureable and meaningful differences in wet weather peak flows and total volumes could be translated into reductions in the risk of sewage backup into basements. This report will address the goal of assessing and quantifying the effectiveness of flow removal due to FDD as well as summarizing the current flow throughout the system and the expected future flows. The flow risk assessment at the meter locations will also be presented.

A comprehensive flow metering plan was developed including 30 flow meters, 20 peak stage recorders, and 5 rain gages, resulting in 55 monitoring sites. The data, collection process, and rigorous quality control procedures can be found in the 2014 Flow Metering Report. The majority of FDDs in the Ann Arbor sewer system have occurred in high priority areas identified in the City's Sanitary Sewer Overflow Prevention Study dated June 2001.

These areas, identified in Figure 1, include:

- Morehead
- Dartmoor
- Orchard Hills
- Glen Leven
- Bromley

Several analytical approaches were used in this study, including:

- Three independent, scientific, data-based methodologies to evaluate the flow removals attributed to FDD, including:
    1. Aggregation of meter data with scatter plots to evaluate rainfall/RDII correlation during pre-FDD versus the post-FDD flows in the priority districts and Wastewater Treatment Plant (WWTP).
    2. Development of meter correlations for the priority districts using the WWTP as a control.
    3. Use of a continuous hydrologic model that accounts for antecedent moisture effects to compare pre- vs. post-FDD flows in the priority districts and WWTP.
- Statistical regression analysis to determine whether there is a statistically-significant difference between pre- and post-FDD wet weather response in the priority districts for the three methods listed above.
- Application of two additional field measurements to further validate the FDD removal rates:
    1. Analysis of a curb drain during a small storm event and extrapolation to the Bromley district.
    2. Review of sump pump monitoring data collected since 2002.
- Comparison of flow removals to commonly accepted metrics of flow on a per-FDD basis.
- Evaluation of the components of the RDII flow (baseflow, inflow, and infiltration) during a large storm event in June in the priority districts to help identify sources of RDII and guide potential mitigation strategies.
- Creation of additional Antecedent Moisture Models (AMMs) for several key districts within Ann Arbor's system using data collected during the 2013 monitoring period for use in developing the system model.
- Analysis of long-term flows at the WWTP, including creation of an AMM and a mass balance of flows in the system with WWTP flows.
- A frequency analysis that routed 60 years of historic rainfall and temperature through the AMMs and performing a statistical analysis of the predicted 60 years of flow to develop a plot of the peak flow rate versus the annual probability of that flow occurring.
- A climate change frequency analysis with rainfall data scaled appropriately to account for these anticipated effects.
- Benchmarking the Ann Arbor system again other sewer systems across the Midwestern US to determine how "wet" or "dry" the Ann Arbor system is to guide wet weather strategies.

- Results of risk assessment at meters including a comparison to capacities of pipes at metered locations and comparison of the risk of basement back-up for pre- and post- FDD in the priority districts.

Findings show that the program has been successful at removing wet weather flow from the sanitary sewer system. There is a large degree of confidence that the FDD program has removed a significant amount of RDII flow from the system in 4 of the 5 priority districts. While there is less confidence in the results in Glen Leven, this may be attributed to several factors and will require further evaluation to draw meaningful conclusions. The results are summarized in Table 1.

**Table 1: Weighted Removal Results in the Priority Districts.
P-Values < 0.05 are considered statistically significant.**

Subdistrict	Volume Percent Removed	Volume Regression P-Value	Peak Percent Removed	Peak Flow Regression P-Value
Orchard Hills	78%	0.003	77%	0.000
Bromley	65%	0.029	72%	0.001
Morehead	72%	0.036	61%	0.014
Dartmoor	54%	0.079	38%	0.119
Glen Leven	25%	0.563	12%	0.676

I. Introduction

As evidenced in the 2014 Flow Monitoring Report, the monitoring period in 2013 provided above average rainfall and several large storms. The temporary flow meters installed as part of this study recorded data suitable for system evaluation. These meters showed adequate performance for analysis of system response to storm events. The majority of the FDDs performed to date have occurred in the five high priority areas identified in the city's Sanitary Sewer Overflow Prevention Study dated June 2001. To directly equate the 2000 flows to the 2013 flows in the priority districts, meters were placed in the exact same location and used similar metering technology. There is a varying percentage of total FDD completion within the priority districts. The total homes with disconnects are shown in Table 2. Equivalent units refer to the single family home equivalence for multi-family units. Figure 1 provides a map highlighting the location of the priority districts.

Table 2: Overview of Footing Drains Disconnected in the Priority Districts.

Subdistrict	Total Equivalent Units	Equivalent Footing Drains Disconnected	Percent Disconnected
Orchard Hills	258	255	99%
Bromley	231	229	99%
Morehead	561	352	63%
Dartmoor	333	297	89%
Glen Leven	958	536	56%

II. Meter Data Review

A mass flow balance was performed for all metered locations within the system. This procedure is designed to check metered flows, verify incremental flow calculations, and serve as a diagnostic tool for system performance. The cumulative flows along a branch show the actual metered flow and includes flow generated upstream of the meter. When calculating cumulative flow per capita, the population includes the populations of all upstream districts. The incremental flow in a district is only flow produced in that district and can be calculated by subtracting upstream metered flow from downstream metered flow. The incremental flow per capita utilizes the population within the meter district. The figures in Appendix A show average dry weather flow per capita for both cumulative and incremental flow in each meter district. These values are generally within typical ranges for sanitary sewer per capita flow of 60 to 150 gallons per person per day (gpcd) and balance cumulatively along branches in the system. Tables of these values are also available in Appendix A. This analysis concludes that system balances well with data suitable for use in developing the model and evaluating flows.

FIGURE 1 Priority District Map

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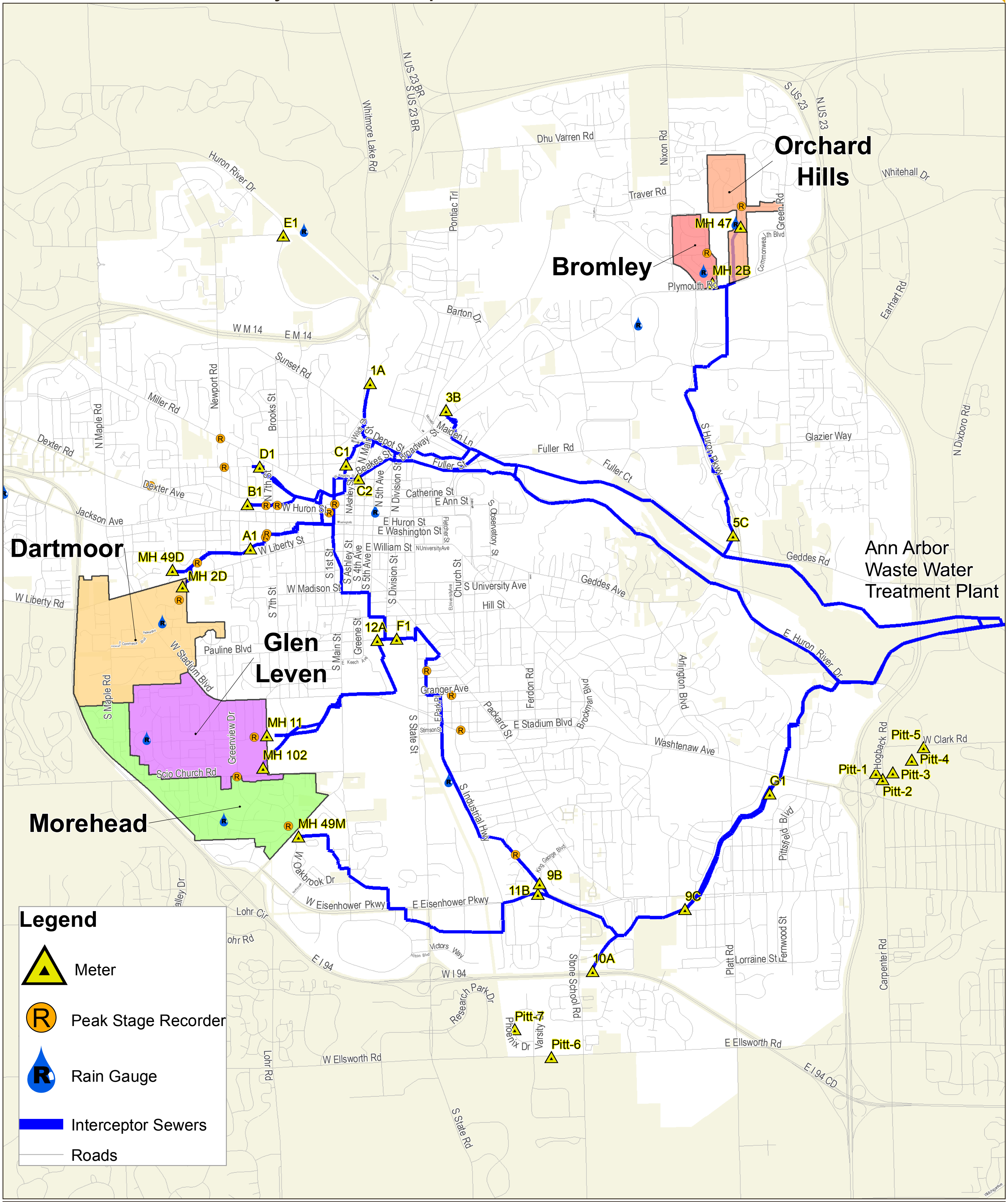


04.09.2014

CITY OF ANN ARBOR

Source: Data provided by Washtenaw County and the City of Ann Arbor. OHM does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 IntlFeet

Path: P:\0000_0100\0028130011_A2_Sanitary_Sewer_Evaluation\GIS\Maps\Subdistrict Maps\PriorityDistrctLocationMap.mxd

III. Flow Removal Evaluation Methodology

Several methods were used to investigate the effectiveness of FDD in the priority districts. The overall RDII volumes and peaks were evaluated and compared for the pre-FDD monitoring period in 2000 against the post-FDD monitoring period in 2013. Three independent, scientific methods were used to quantify the flow removal:

- Aggregation of meter data with scatter plots to evaluate rainfall/RDII correlation during pre-FDD versus the post-FDD flows.
- Development of meter correlations using the WWTP as a control.
- Use of a continuous hydrologic model that accounts for antecedent moisture effects to compare pre- vs. post-FDD flows in the priority districts and WWTP.

A multiple regression analysis was performed to compare the pre- and post-FDD monitoring periods. The multiple regression technique computes the statistical significance of a given hypothesis to test its scientific validity. In this case, the test hypothesis is that the difference in flows between 2000 and 2013 is due to the FDD program. The two independent variables, rainfall and pre- vs. post-rehabilitation period (represented by the Boolean value 0 or 1), were analyzed using this process against total event RDII volume and peak flow rate for each rain event. This process controls for the amount of rainfall to allow results to be directly attributed to the difference between 2000 and 2013. Two regression analyses were completed for each method:

- Total event rainfall vs. RDII volume
- Peak hourly rainfall vs. Peak RDII hourly flow rate

The process generates a 'p' value that indicates the probability that a hypothesis is invalid. Typically, the value of 'p' should be less than 5% (0.05) to draw statistically significant conclusions from the results of a multiple regression analysis. This means that there is less than a 5% chance that the hypothesis (pre- vs. post-rehabilitation time period has an impact on total observed RDII volumes or peak flows) is false, when controlling for rainfall depth. Results from the regression analysis will be presented with volume and peak removals associated with the priority district analysis methods: scatter plots, AMM, and meter correlations. These analyses ensure confidence in results and allow quantification of that level of confidence.

IV. Scatter Plots of Meter Data

Scatter plots aggregate meter data to illustrate the differences in the pre- vs post-FDD monitoring periods. They are a useful tool for screening the flow removals, but because of significant variation in the scatter plot due to variations like antecedent moisture effects, their accuracy is limited and other techniques should be relied upon for more conclusive results. The plots show RDII volume compared to total event rainfall, and show peak hourly flow rate compared to peak hourly rainfall. Each point on the plot represents an individual storm from directly measured data. The removals in

Table 3 are based on the difference between the pre- and post-FDD regression trendlines from the scatter plots for 3 inches of total rain volume and peak flow rate of 1 inch per hour. Figures of the scatter plots can be found in Appendix B. Statistically significant removals occurred for the Orchard Hills and Bromley areas for both peaks and volumes, as well as for peaks in Morehead. Although the results are not statistically significant for Dartmoor, they are close with p-values of 0.078 and 0.157 for volume and peak, respectively. Given the variability of scatter plots, other techniques can provide more conclusive results for this district.

Table 3: Results from Scatter Plot Analysis

Subdistrict	Volume Percent Removed	Volume Regression P-Value	Peak Percent Removed	Peak Flow Regression P-Value
Orchard Hills	77%	0.002	77%	0.000
Bromley	67%	0.035	85%	0.001
Morehead	78%	0.056	53%	0.020
Dartmoor	56%	0.078	9%	0.157
Glen Leven	13%	0.859	17%	0.837

V. Meter Correlation

Meter correlation is a useful tool in determining long-term changes in wet weather response for a metered sewershed by comparing the wet weather response of one metered area to an adjacent metered area. This tool allows for a comparison between one rehabilitated sewershed and an adjacent non-rehabilitated ("control") sewershed. In this case, the WWTP was used as a conservative control since less than 5% of the total flow would be affected by FDD. Because the comparison is to a control district that experienced similar wetness conditions, meter correlations can correct for variations in antecedent moisture conditions. However, their accuracy may be limited by spatial variation of rainfall. For this reason meter correlation performance was quantified for storms that were not significantly spatially varied.

Two correlations were developed and combined for each priority district. The first is used for dry weather to capture the diurnal nature of sewer flows and the second for wet weather to capture the effects of a large rain event. For each correlation, there are multiplicative and additive factors.

The factors are used as follows:

Flow at Meter 1 = [Flow at Meter 2] x CMF + CAF

Where:

Meter 1 is the meter of interest (in this case, priority districts)
Meter 2 is the control meter for the control sewershed (WWTP)
CMF = Correlation Multiplication Factor
CAF = Correlation Additive Factor (indicates changes in baseflow)

The districts were correlated to flows collected during the pre-FDD period in 2000. The correlation formula from 2000 was then used with the WWTP flow data in 2013. The reductions in peak flow or volume due to FDD were calculated based on the difference between these values and the observed flow rate in 2013. The removals and their statistical significance are summarized in Table 4. The differences between these flow series are illustrated in Appendix C. Statistically significant removals are present Orchard Hills, Bromley, and Morehead for both peaks and volumes. There is less confidence in the removals in Dartmoor and Glen Leven.

Table 4: Results from Meter Correlation Analysis

Subdistrict	Volume Percent Removed	Volume Regression P-Value	Peak Percent Removed	Peak Flow Regression P-Value
Orchard Hills	78%	0.003	76%	0.001
Bromley	65%	0.020	55%	0.003
Morehead	73%	0.017	56%	0.002
Dartmoor	45%	0.115	29%	0.086
Glen Leven	37%	0.262	6%	0.241

VI. Antecedent Moisture Model

The Antecedent Moisture Model (AMM) allows for development of a continuous hydrologic model of the system accounting for the variation in antecedent moisture conditions. Recent rainfall and soil moisture conditions significantly affect the system response to wet weather events. The AMM accounts for these variations, and because it uses rain gauges in each priority district, the impacts of spatially varied rainfall is minimal. These characteristics of AMM give us a high confidence in these results. Pre- and post- FDD models for the WWTP and priority districts were developed. Twelve additional models besides the priority districts were created for other districts to aid in analysis of the system, risk assessment, and calibration of the hydraulic model. A map of the system highlighting the modeled districts is available in Figure 2. A technical memorandum describing the AMM process is included in Appendix D.

A. Accuracy of Fits and Validation

An accuracy of fit analysis, which includes an evaluation of model errors, quantifies model performance to determine if the model is calibrated sufficiently. The accuracy of fit compares the peak flows and volumes between the actual observed values in the system to the model predictions for several large storm events. Net average error is the average of all the errors from several storms and allows positive and negative values to offset each other. The net average error is a measure of the model bias and should be as close to zero as possible. Total average error is the average of the absolute value of the errors from several storms and is a measure of the model's ability to predict volumes and flows for individual storm events. Table 5 summarizes the Accuracy of Fit analysis and indicates that the model is very accurately simulating the wet weather flows, with net errors of less than 1% (model bias) and total errors around 10% (predictive accuracy). It is therefore suitable for use in flow removal evaluation, long term simulation, and to determine system frequency flows. The accuracy of fit for each storm can be found in Appendix E.

Due to the brevity of the monitoring period, a validation process was developed for the model results. Intermediate storms were used in the calibration period to ensure that the overall model was not skewed toward a variation or particular type of storms. Validation tables are also available in Appendix E.

Table 5: Summary of Accuracy of Fit Analysis

Meter Subdistrict	Peak Flow		Volume	
	Net Average Error	Total Average Error	Net Average Error	Total Average Error
Orchard Hills	0.5%	18.7%	-0.1%	11.8%
Bromley	-0.2%	10.7%	-1.4%	10.9%
Dartmoor	-0.7%	12.0%	0.7%	14.6%
Glen Leven	2.8%	20.2%	-1.5%	21.5%
Morehead	0.6%	19.0%	-1.6%	13.8%
01A	0.0%	12.6%	0.3%	6.1%
10A	-0.2%	6.4%	0.7%	6.8%
11B	2.4%	10.5%	5.4%	12.1%
12A	1.0%	9.4%	0.6%	9.6%
3B	-0.5%	8.5%	0.8%	5.5%
5C	0.8%	14.0%	0.0%	8.4%
9B	1.0%	16.7%	1.9%	7.1%
9C	0.9%	8.9%	0.2%	15.6%
A1	0.2%	13.2%	-0.9%	8.0%
B1	-0.8%	7.1%	0.6%	6.8%
C1 + C2	0.5%	10.8%	0.2%	7.7%
F1	-0.8%	9.8%	0.9%	15.2%
G1	-0.2%	4.8%	-0.1%	5.3%
Average	**0.4%**	**11.9%**	**0.4%**	**10.4%**

B. Priority Districts Evaluation

To determine the flow removal, a model was calibrated to the pre-FDD period in 2000 and run forward to the post-FDD period in 2013. The reductions in flow or volume due to FDD were calculated based on the difference between these values and the observed flows in 2013 for each storm. Table 6 summarizes the results. Statistically significant removals are present in all districts except Glen Leven. The differences between these flow series are illustrated in Appendix F.

Table 6: Results from AMM Analysis in Priority Districts

Subdistrict	Volume Percent Removed	Volume Regression P-Value	Peak Percent Removed	Peak Flow Regression P-Value
Orchard Hills	80%	0.003	78%	0.001
Bromley	64%	0.032	69%	0.001
Morehead	68%	0.031	65%	0.000
Dartmoor	58%	0.043	44%	0.003
Glen Leven	16%	0.517	16%	0.461

C. Component Analysis in Priority Districts

AMM enables the breakdown of RDII into three components: inflow, infiltration, and baseflow. These can be useful in determining the type of wet weather flow present in the system to develop appropriate wet weather management strategies. Baseflow represents the contributions of seasonal groundwater intrusion into sewers. Inflow typically represents directly connected sources of storm water with large, quickly occurring peaks in the sanitary sewer. Infiltration represents the slow stormwater percolation into sanitary pipes.

The flow components were broken down using AMMs for the June 27, 2013 storm. The storm occurred after several exceptionally wet weeks that had saturated the soil. This large event provides an excellent insight into the absorption dynamics of the soil in the priority districts. In most systems, inflow dominates the peaks and overall percentage of flow. Figures displaying the relative proportion of each component in the pre- and post-FDD period are available in Appendix G. Table 7, below, summarizes the reductions by component for the model calibrated to 2000 compared to the model calibrated to 2013. This shows that FDDs have a large impact on inflow and infiltration, but a lessor impact on base flow, across all districts. This analysis is provided as an indication to show which components of flow experienced reductions in flow relative to others, to help guide any future flow removal or system rehabilitation that might be needed.

Table 7: Flow Removal Reductions by Component in June 27, 2013 Storm

Subdistrict	Inflow Percent Reduction	Infiltration Percent Reduction	Base Flow Percent Reduction	Total Flow Percent Reduction
Orchard Hills	91%	63%	13%	88%
Bromley	91%	3%	0%	85%
Morehead	78%	62%	0%	74%
Dartmoor	43%	64%	5%	45%
Glen Leven	23%	66%	0%	30%

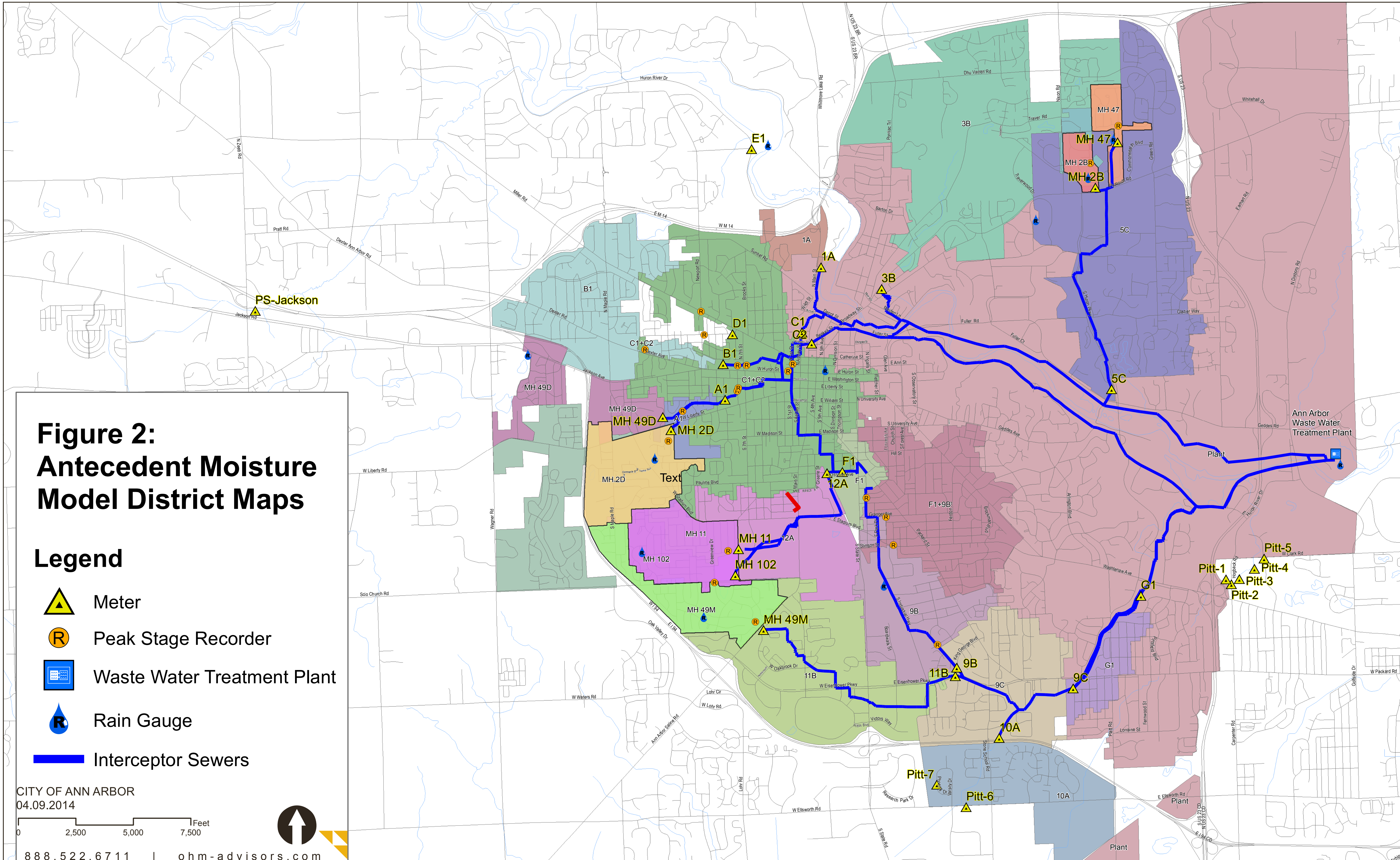


Figure 2: Antecedent Moisture Model District Maps

Path: P:\0000_0100\0028130011_A2_Sanitary_Sewer_Evaluation\GIS\Maps\Subdistrict Maps\AMM meter districts.mxd

VII. Flow Removal Summary

A. Comparison to Common Metrics

There are several commonly used rules of thumb for the flow removal due to FDD. Most commonly used is a flow rate per FDD of 3-5 gpm for large design storms, and for smaller storms, 1gpm per inch of rain. These metrics vary significantly depending on the rain pattern and antecedent moisture conditions. In most instances, these metrics were met which further validates the flow removal analysis. Table 8 summarizes percent removal for metered flow and design storms. The 25-year, 24-hour design storm of 3.9 inches was imposed in the 2013 AMM to determine the effects of a very large summer storm on the system. The design storm removals can be compared to projected removals of 70-90%. Table 9 presents flow removed calculated per FDD and can be compared to projections of 3-5 gpm per FDD, and typical values of 1 gpm per inch of rain per FDD.

Table 8: Percent Removal Results Averaged from 3 Methods

Subdistrict	Volume		Peak	
	2013 Storms Percent Removed	Design Storm Percent Removed	2013 Storms Percent Removed	Design Storms Percent Removed
Orchard Hills	78%	78%	77%	89%
Bromley	65%	66%	72%	85%
Morehead	72%	70%	61%	76%
Dartmoor	54%	66%	38%	45%
Glen Leven	25%	40%	12%	32%

Table 9: Flow per FDD Results Averaged from 3 Methods

Subdistrict	Flow per FDD (gpm)		Flow per FDD per inch of rain (gpm/in)	
	2013 Largest Storm	Design Storm	2013 Storms	Design Storm
Orchard Hills	2.53	4.75	0.71	1.22
Bromley	3.54	4.80	0.89	1.23
Morehead	3.92	6.31	1.66	1.62
Dartmoor	3.67	4.81	1.04	1.23
Glen Leven	1.07	1.21	0.38	0.31

B. Curb Drain Monitoring

The consistency with common metrics can be further corroborated by monitoring other components within the city's sanitary sewer system. On October 31, 2013, Martin Control Systems was enlisted to perform a manual measurement of flows from a stormwater curb drain for 30 minutes during a small storm in the Bromley district. This curb drain was connected to 5 houses with disconnected footing drains. They used buckets and stop watches to measure an average flow rate of 0.57 gpm per house with a disconnection. This value is reasonable given the small size of the storm. The flow per disconnection can be extrapolated to 0.29 cfs for the entire Bromley district with 229 disconnections. When compared to the actual metered sewer flow of 0.14 cfs for Bromley, approximately 66% of the total flow was generated by FDDs. This rate is consistent with other removals calculated for Bromley (85% for scatter plots, 55% from meter correlation, and 69% from AMM).

C. Sump Pump Monitoring

Many homeowners with completed FDDs and sump pump installations have volunteered to have a logging device placed on their sump pump system. These devices monitor the footing drain flows that are pumped out from these homes with the help of the sump pumps installed during the FDD work. Monitors were placed in homes in the priority districts and around the city where footing drains have been disconnected from the sanitary sewer system. The monitoring was completed by CDM Smith, Inc. The complete data set is shown in Figure 3. The figure shows that the flow from footing drains can vary significantly from house to house. When aggregated to a trendline, the data shows the average FDD production rate is around 5 gpm for large rains in the range of 3-4 inches of rain.

Figure 3: Sump Pump Monitoring Data from 2002-2013 for Single Family Homes.

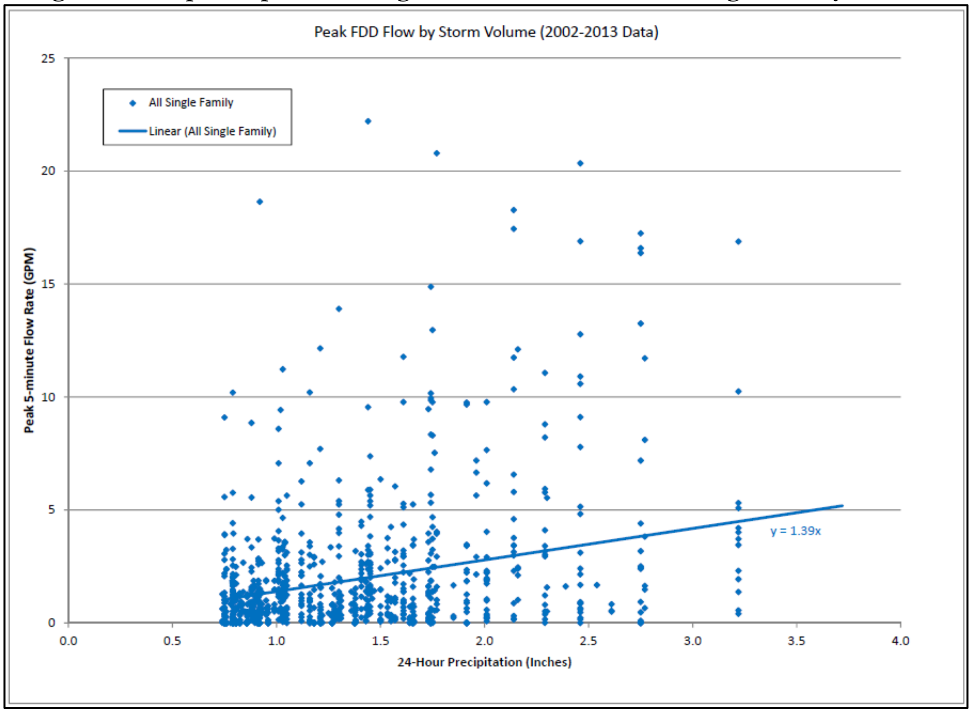
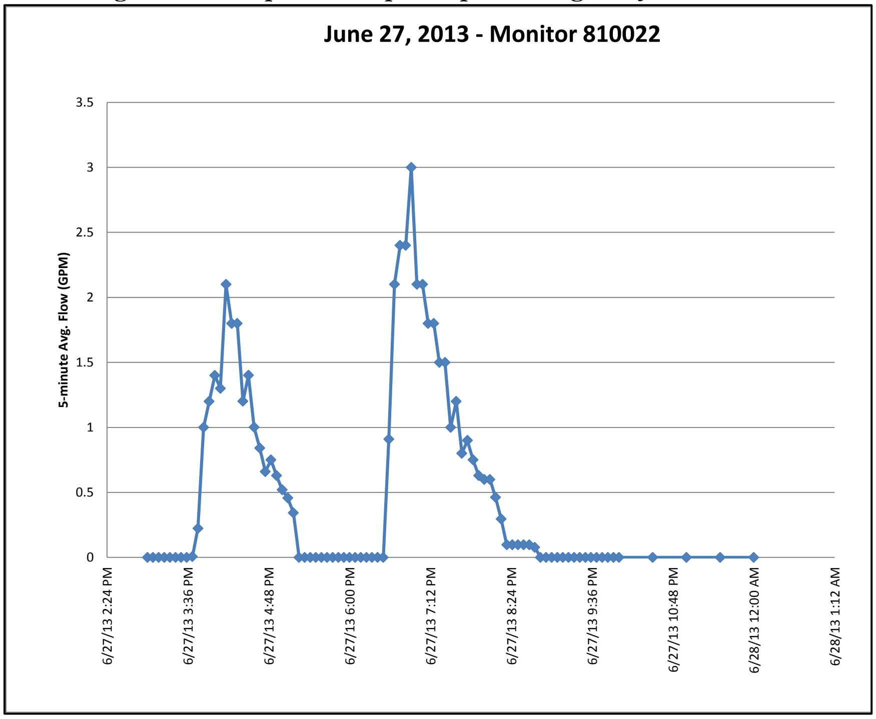


Figure 4 represents the flow recorded from a single sump pump during the June 27, 2013 storm. During this large summer storm, the sump pump generated peak flows of 2-3 gpm. This provides an illustration of the short duration, high intensity flow that can be generated from a footing drain.

Figure 4: Example of Sump Pump Discharge on June 27, 2013



VIII. Frequency Analysis

A frequency analysis is performed by routing 60 years of historic rainfall through the calibrated AMMs. Because the process uses the continuous AMM and the historic rainfall to generate a long-term flow record, the resulting output provides information on the likelihood of various flows occurring. It also accounts for variations in rainfall amounts, rainfall pattern and various wetness conditions. This results in 60 years of predicted flow that can be used in a statistical analysis of that flow to develop a plot of the peak flow rate versus the annual probability of that flow occurring. The historic rainfall and temperature data were obtained from the NOAA's National Climatic Data Center. The annual peak flow rates that occurred during the growth season (defined from April to October) were used to determine recurrence interval for flows in that sewer shed using a Log-Pearson Type III Distribution. The recurrence interval estimates the likeliness that a given flow rate will occur. The average recurrence interval can be related to frequency of occurrence. For example, over a long period of time, the 10-year flow can be expected to occur with an average interval of 10 years. This means there is a 10% probability of that flow being exceeded in a given year. This translates to yearly exceedence probabilities of 4% for 25 year, 2% for 50 year, and 1% for 100 year flows shown in Tables 10 and 11.

For the priority districts, the analysis was performed twice: once for the pre-FDD condition and once for the post-FDD condition. The results in the priority districts are summarized in Table 10, with figures available in Appendix H. These show a significant reduction in the design flow rates in the priority districts after FDD. The results for all the 2013 AMM districts are shown in Table 11 with supplemental figures in Appendix I.

Table 10: Recurrence Intervals of Pre- and Post-FDD Flow

Subdistrict	FDD status	Frequency Analysis Total Flow Rate (cfs)		
		10 year	25 year	100 year
Orchard Hills	Pre	2.89	3.60	4.67
	Post	0.44	0.51	0.62
Bromley	Pre	2.53	3.09	3.94
	Post	0.51	0.57	0.66
Dartmoor	Pre	6.83	8.21	10.29
	Post	4.06	4.78	5.85
Glen Leven	Pre	4.54	5.50	6.93
	Post	3.13	3.74	4.66
Morehead	Pre	6.11	7.42	9.37
	Post	1.78	2.06	2.46

IX. Climate Change Frequency Analysis

The frequency analysis process was repeated to incorporate the anticipated effects of climate change: The EPA's National Stormwater Calculator was recently updated to include climate variability based on Intergovernmental Panel on Climate Change protocols. The program has a low and high range, which varies from projecting less rainfall for the region to more rainfall for the region. The "high wet" range was used for this evaluation, which generally increased the rainfall amounts by about 10% - 20% depending on the season. Long term rainfall was scaled up or down proportionally each month to account for changes in rainfall patterns. This led to higher frequency flows rates for all meters and return periods. The results show that the changes in rainfall generally increase the peak flows by 10-20%and further indicate that a slight change in rainfall can have a fairly significant change in the risk assessment. Tables and figures summarizing these results are available in Appendix I.

Table 11: Summary of Frequency Flow Rates with Climate Change

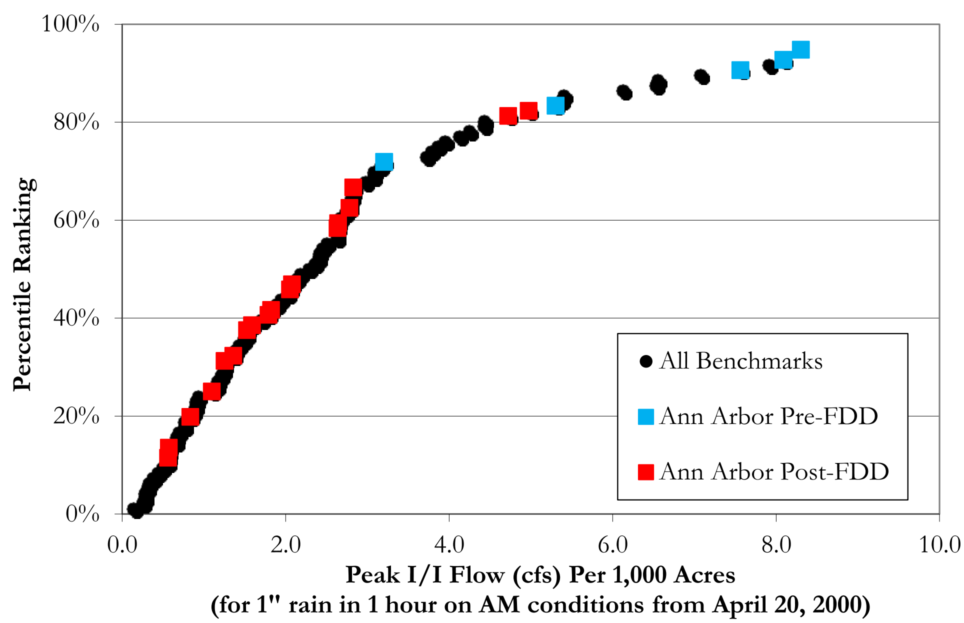
Subdistrict	Average Dry Weather Flow (cfs)	2013 Peak Metered Flow (cfs)	Historic Frequency Analysis Total Flow Rate (cfs)				Climate Projected Frequency Analysis Total Flow Rate (cfs)			
			10 year	25 year	50 year	100 year	10 year	25 year	50 year	100 year
Orchard Hills	0.10	0.63	0.44	0.51	0.56	0.62	0.50	0.58	0.65	0.71
Bromley	0.10	0.59	0.51	0.57	0.62	0.66	0.56	0.64	0.70	0.76
Dartmoor	0.50	6.51	4.06	4.78	5.31	5.85	4.76	5.70	6.42	7.14
Glen Leven	0.30	3.61	3.13	3.74	4.20	4.66	3.71	4.50	5.12	5.76
Morehead	0.30	2.03	1.78	2.06	2.26	2.46	2.06	2.42	2.69	2.97
01A	0.20	0.72	0.89	1.05	1.17	1.29	1.00	1.20	1.37	1.53
10A	2.00	5.79	5.14	5.74	6.17	6.61	5.76	6.51	7.08	7.64
11B	1.40	4.05	3.94	4.43	4.79	5.14	4.23	4.71	5.04	5.36
12A	0.60	7.40	5.03	6.11	6.91	7.70	6.16	7.61	8.69	9.77
3B	1.50	6.33	5.72	6.76	7.52	8.28	6.13	7.34	8.25	9.18
5C	1.70	8.76	7.53	8.69	9.56	10.42	7.81	9.30	10.44	11.62
9B	1.70	3.66	5.34	6.21	6.87	7.53	6.28	7.47	8.39	9.33
9C	5.90	15.26	14.20	15.64	16.67	17.67	15.67	17.42	18.68	19.90
A1	1.10	6.30	4.63	5.38	5.95	6.53	5.05	5.90	6.55	7.22
B1	2.20	4.89	6.60	7.68	8.47	9.25	7.88	9.38	10.51	11.66
C1+C2	11.20	38.94	31.82	34.89	37.06	39.16	35.01	38.76	41.45	44.08
F1	1.20	7.77	6.35	7.51	8.39	9.30	7.43	8.92	10.08	11.27
G1	3.80	12.33	13.52	15.49	16.98	18.51	16.95	19.91	22.19	24.55

X. Benchmarking Evaluation

This analysis provides a comparison between the modeled Ann Arbor sewer districts and 70 other sewer districts across the Midwestern US that have been simulated with AMMs. Because the model incorporates both rainfall and varying wetness conditions, the model can be used to control for these variables, and compare the performance of different systems under identical simulated rainfall and wetness conditions. To make this comparison to the existing benchmark meters a calibrated AMM was used with a standard rain event of 1" of rain in 1 hour. This allows a direct comparison between sewer systems to quantify how "tight" or "leaky" the Ann Arbor system is relative to other systems.

The results were tabulated for the priority districts for both pre- and post-FDD conditions to show how they have shifted in the benchmarking from FDD. The results show that on a peak flow basis, the City's districts are spread across the continuum of systems, with more sub districts in the lower "drier" half. This is shown in Figure 5. The peak flow drives system upgrades and is therefore the most relevant metric when evaluating these wet weather flows. On a wet weather volume basis, the City's districts are spread across the continuum of systems, with more sub districts in the upper "wetter" half. Both the peak I&I flow and capture coefficient decreased in all priority districts, with Glen Leven having the least amount of change. See Appendix J for figures and tables depicting Ann Arbor's sewer districts relative to other systems and their pre- or post-FDD status.

Figure 5: Peak I/I Flow Rankings for Unitized Storm, Acreage, and AM Conditions



Utilizing the benchmarking analysis and the number of FDDs throughout the city, a comparison can be made between the density of connected footing drains and flow. As the density of footing drains increase, the peak I/I flow and capture coefficients also increase. This provides further evidence that footing drains are a major driver of the I/I flow in Ann Arbor. Figures depicting these relationships are available in Appendix K.

XI. Wastewater Treatment Plant Evaluation

An AMM was created for the WWTP utilizing data from 1999-2013. This was used to perform a frequency analysis at the plant. The results are summarized in Table 12. The peak hour design capacity at the plant is 114 cfs. According the frequency analysis, the plant has the capacity to handle the 100 year flow. A review of historical data at the plant shows that there have been no flows exceeding 114 cfs from 1999-2013. Details are available in Appendix L.

Table 12: Results of Frequency Analysis at WWTP

Recurrence Interval	Flow Rate (cfs)
10	78.87
25	90.13
50	98.55
100	107.04

An evaluation of scatter plots and AMM calibrations for the pre- and post-FDD periods did not reveal any statistically significant flow removals at the plant. It is likely that the FDDs slightly reduced the peak and volume at the plant, but by the time this reduction reaches the plant, it is "washed out" by the flows from the rest of the system and the flow reductions are not discernible. The AMM developed of the WWTP flow showed a small change in the peaks and volumes. Although not statistically significant, this rate of reduction is consistent with the proportion of houses with FDDs performed throughout the entire city.

XII. Risk Evaluation

The Michigan Department of Environmental Quality (MDEQ) has a Sanitary Sewer Overflow (SSO) Policy that regulates the minimum threshold for untreated or partially treated overflow to natural waterways. The SSO policy statement defines the remedial design standard equivalent to the 25-year/24-hour storm, using growth conditions and normal soil moisture. The remedial design standard further can be defined as comparable to the extreme natural event. A MDEQ analysis of available data indicates that communities implementing corrective action programs to this remedial design standard will have on average less than one overflow per ten years. The MDEQ deems this standard to be appropriate, reasonable, cost effective and affordable and, based on past historical records, provides the measure of protection needed for public health and the environment.

The SSO requirements can be thought of as a minimum level of service. It should be noted that a regulatory SSO occurs only when untreated or partially treated sewage spills into a natural waterway and according the MDEQ, a basement back-up does not constitute an SSO. In order to model risk of overflows and subsequent basement backups, system capacity should be greater than design flows. The capacity of the pipe is dependent on the size of the pipe and its slope.
This analysis evaluates risk by comparing the pipe capacity and metered flow rates to the frequency analysis.

A. Flow Risk

A flow risk evaluation was completed at the metered points within the system. Tables are available in Appendix M. These show the results of the frequency analysis for various recurrence intervals (10-yr, 25-yr, 100-yr). The yellow highlighting depicts the recurrence interval that is closest to the given metric. For example, if the value on the pipe capacity table for a given meter is highlighted under the 25-year column, then it means that for that meter, the pipe has sufficient capacity to transport the 25-year flow. This analysis was done for several key metrics, including pipe capacity, the peak flow for several large storms in 2013, and the peak flow for the entire monitoring period in 2013. This analysis shows that all but one meter location has capacity for the 100-year flow for existing conditions.

B. Priority District Pre- and Post-FDD Risk Comparison

This analysis compares the risk evaluation for the priority districts for the pre- and post-FDD condition. This was done by tabulating the return period of the pipe capacity for both the pre- and post-FDD condition. In this case, the return period estimates the probability that the pipe will reach its full capacity. For example, in Orchard Hills during the pre-FDD period, the pipe would experience a flow rate that would completely fill it once in every 1.20 years. After the FDD were completed, the same pipe would be able to convey flow for a 200 year event. The summary table shows the results of the comparison and the supporting plots show the frequency analysis statistical plots with the derivation of each value. These plots are available in Appendix N. The results show that in the pre-FDD condition, four of the five priority districts had a level of service for the pipe capacity that were less than a 50-year recurrence interval, with two of the districts having less than a 2-year level of service. The results show that in the post-FDD condition, all five districts have greater than a 200-year level of service in the pipe capacity as shown in Table 13.

Table 13: Return Period in Priority Districts

Subdistrict	Pipe Capacity (cfs)	Pre-FDD Return Period (yrs)	Post-FDD Return Period (yrs)
Orchard Hills	1.2	1.20	> 200
Bromley	1.3	1.77	> 200
Dartmoor	9.1	43.71	> 200
Glen Leven	11.8	> 200	> 200
Morehead	7.5	26.09	> 200

XIII. Conclusions

Several conclusions can be drawn from the analyses presented in this report as follows:

1. The FDD programs removed a large amount of wet weather flow from the City's sanitary sewer system.
2. The magnitude of the FDD flow removal was consistent with the originally defined goals of the program.
3. There is a high degree of confidence in the flow removal results because:
    - The flow meters utilized for data collection were regularly maintained and serviced.
    - The data was rigorously quality controlled.
    - Three independent, scientific methods were used for the analyses.
    - The statistical significance quantified by a regression analysis for each method.
    - Flow removals were also consistent with curb-line monitoring, sump pump metering, and results from similar studies in other communities.

4. The Technical Oversight Advisory Group (TOAG) reviewed the flow evaluation methodology and findings and supported both the approaches used and conclusions.
5. The modeled risk of basement backups has been significantly reduced in the priority districts due to the FDD program. The June 27, 2013 storm supports this finding. The system response to this event produced large flow rates sometimes reaching the 100-year flow without sanitary backups in the study districts.
6. The WWTP has the capacity to handle the City's 100 year flow.
7. Climate change may impact the frequency of large flows and sensitivity to this will be examined with hydraulic modeling.

Appendix A
Mass Flow Balance

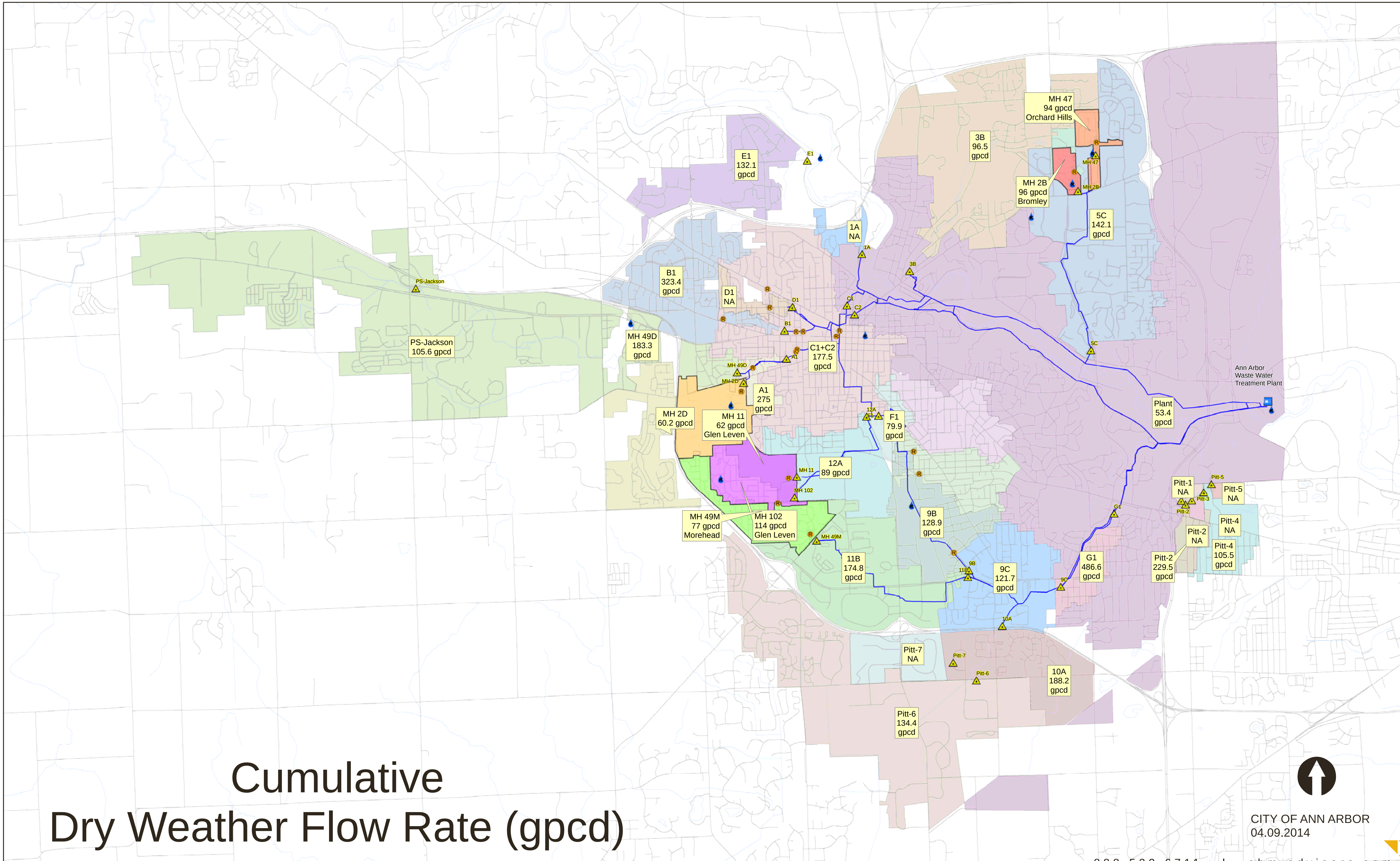
Figure: Cumulative Flow

Figure: Incremental Flow

Table: Cumulative Flow

Table: Incremental Flow

Cumulative Dry Weather Flow Rate (gpcd)



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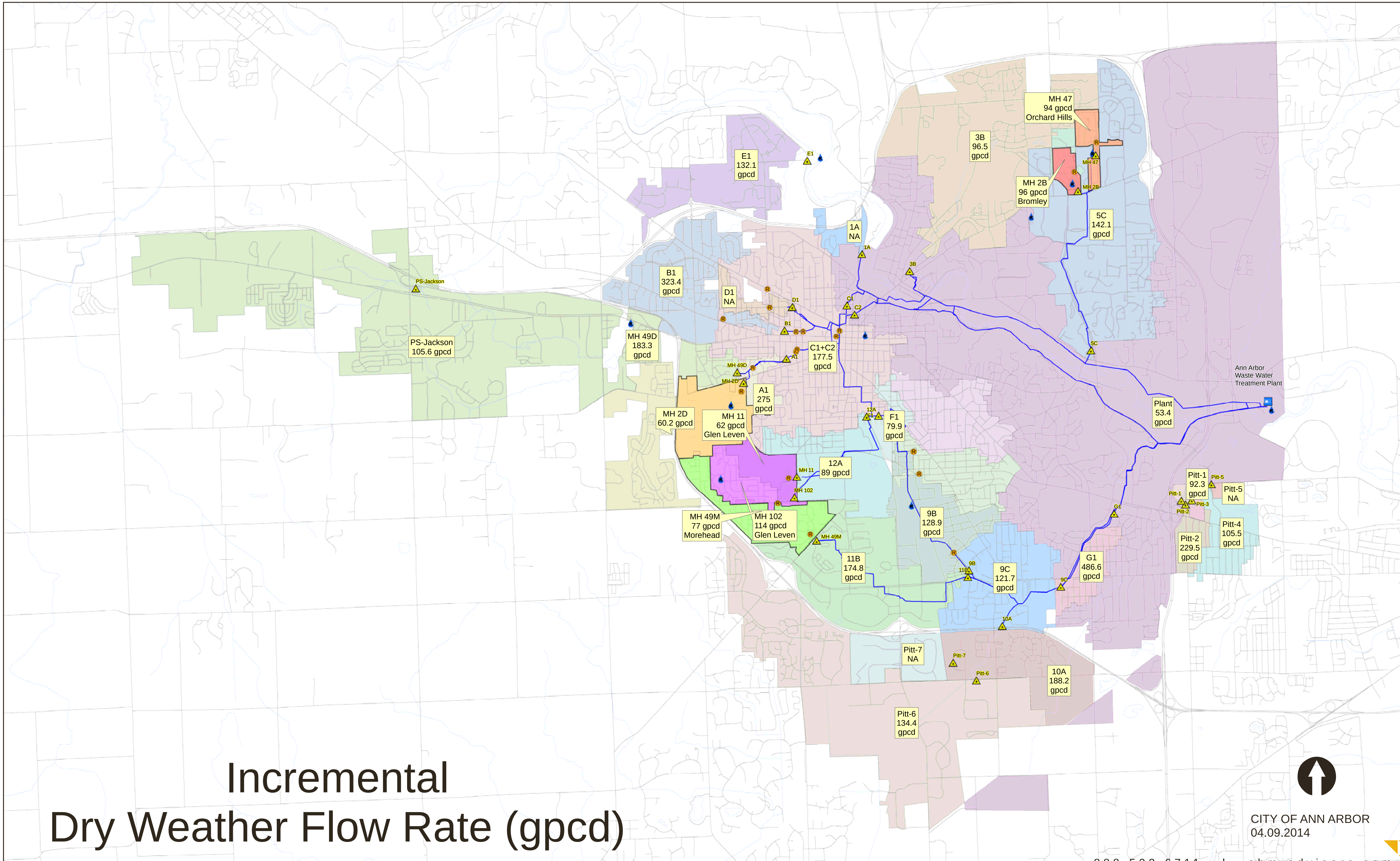
Incremental Dry Weather Flow Rate (gpcd)



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Ann Arbor Incremental Meter Districts Per Capita Flow Computions

Incremental Meter District	Upstream Meter Districts	Year 2010 Incremental Households	Year 2010 Incremental Population	Incremental Acerage	Average DWF		April 11, 2013			June 10, 2013		June 27, 2013		August 12, 2013	
					Incremental Dry Weather Flow Rate (cfs)	Incremental Sanitary Wastewater Flow Rate (gpcd)	Cummulative Peak Flow Rate (cfs)	Incremental Peak Flow Rate (cfs)	Incremental Sanitary Wastewater Flow Rate (gpcd)	Incremental Peak Flow Rate (cfs)	Incremental Sanitary Wastewater Flow Rate (gpcd)	Incremental Peak Flow Rate (cfs)	Incremental Sanitary Wastewater Flow Rate (gpcd)	Incremental Peak Flow Rate (cfs)	Incremental Sanitary Wastewater Flow Rate (gpcd)
MH 2B	[MH2B]	243	670	104.9	0.1	96.5	0.5	0.5	482.4	0.3	289.4	0.6	578.8	0.4	385.9
MH 47	[MH47]	257	684	74.0	0.1	94.5	0.4	0.4	378.0	0.3	283.5	0.6	567.0	0.2	189.0
5C	[5C]+[MH47]+[MH2B]	2941	6823	1608.4	1.5	142.1	7.1	6.2	587.3	3.4	322.1	7.6	720.0	6.4	606.3
3B	[3B]	4297	10049	1534.2	1.5	96.5	3.8	3.8	244.4	3.2	205.8	6.3	405.2	4.2	270.1
E1	[E1]	535	1468	624.0	0.3	132.1	0.6	0.6	264.2	0.7	308.2	-	-	-	-
1A	[1A]+[E1]	143	318	95.9	NA	NA	0.7	0.1	203.3	NA	NA	NA	NA	NA	NA
PS-Jackson	[PS-Jackson]	2345	5888	3144.4	1.0	105.6	2.5	2.5	269.0	2.4	267.9	2.4	267.9	3.0	332.6
D1	[D1]	399	881	96.4	NA	NA	1.7	1.7	1247.2	0.9	660.3	-	-	-	-
B1	[B1]	1944	4397	721.2	2.2	323.4	4.9	4.9	720.3	4.2	617.4	-	-	-	-
MH 49D	[MH 49D]	522	1058	303.4	0.3	183.3	1.6	1.6	977.5	1.6	977.5	2.7	1649.5	-	-
MH 2D	[MH 2D]	2427	5367	863.2	0.5	60.2	3.7	3.7	445.6	3.2	385.4	6.5	782.8	2.7	325.2
A1	[A1]+[MH 49D]+[MH 2D]	331	705	90.6	0.3	275.0	4.2	NA	NA	NA	NA	NA	NA	0.5	183.3
MH 11	[MH 11]	458	1035	131.1	0.1	62.5	1.1	1.1	687.0	0.6	374.7	1.6	999.2	0.5	312.3
MH 102	[MH 102]	500	1134	163.7	0.2	114.0	2.5	2.5	1425.0	1.2	684.0	1.9	1083.0	1.0	570.0
12A	[12A]+[MH102]+[MH11]	1141	2167	560.7	0.3	89.5	4.6	1.0	298.3	1.4	417.6	3.9	1163.3	0.6	179.0
F1+9B	[F1+9B]	3445	11162	795.8	-		-	-		-		-		-	
F1	[F1]+[F1+9B]50%	906	4123	122.7	1.2	79.9	4.2	4.2	279.8	4.2	279.8	7.8	519.5	3.8	253.1
C1+C2	[C1+C2]+[PS-Jackson]+[D1]+[B1]+[A1]+[12A]+[F1]	7463	16523	1557.6	4.5	177.5	30.3	8.3	322.7	5.5	213.6	15.1	446.5	3.9	114.7
MH 49M	[MH 49M]	1063	2515	327.4	0.3	77.1	2.0	2.0	514.0	1.5	385.5	1.9	302.0	1.2	308.4
11B	[11B]+[MH 49M]	2297	4067	931.4	1.1	174.8	3.7	1.7	270.2	1.7	270.2	2.2	349.6	1.7	270.2
Pitt-6	[Pitt-6]	1577	3366	2072.1	0.7	134.4	2.3	2.3	441.7	2.1	403.3	-	-	-	-
Pitt-7	[Pitt-7]	80	150	295.0	NA	NA	0.5	0.5	2154.5	0.8	3447.2	-	-	-	-
10A	[10A]+[Pitt-6]+[Pitt-7]	1646	4122	605.6	1.2	188.2	4.0	1.2	188.2	1.0	156.8	5.8	490.8	3.2	270.8
F1+9B	[F1+9B]	3445	11162	795.8	-		-	-		-		-		-	
9B	[9B]+[F1+9B]50%	1475	2944	522.5	1.7	128.9	3.6	3.6	272.9	3.7	280.5	-	-	-	-
9C	[9C]+[10A]+[11B]+[9B]	2032	4250	663.3	0.8	121.7	12.5	1.2	182.5	NA	NA	5.4	273.2	5.1	258.0
G1	[G1]+[9C]50%	538	1129	182.1	0.9	486.6	8.9	8.9	5095.3	12.3	7041.8	-	-	-	-
Pitt-1	[Pitt-1]	87	294	32.1	0.0	92.3	0.0	0.0	0.0	0.1	7.6	-	-	-	-
Pitt-2	[Pitt-2]	385	845	112.0	0.3	229.5	1.4	1.4	106.1	1.0	75.8	-	-	-	-
Pitt-3	[Pitt-3]	56	191	20.8	NA	NA	0.3	0.3	22.7	1.2	91.0	-	-	-	-
Pitt-4	[Pitt-4]	1166	2450	272.3	0.4	105.5	1.2	1.2	91.0	1.0	75.8	-	-	-	-
Pitt-5	[Pitt-5]	133	239	23.5	NA	NA	0.1	0.1	7.6	0.4	30.3	-	-	-	-
Plant	[Plant]+[Pitt-1]+[Pitt-2]+[Pitt-3]+[Pitt-4]+[Pitt-5]+[G1]+[9C]+[C1+C2]+[1A]+[3B]+[5C]	12050	31239	8936.0	2.6	53.4	64.1	0.8	16.6	NA	NA	8.2	130.4	31.4	527.0

	Priority District
	End of Branch
	Tributary to Plant Interceptor
NA	Flow Rates not Accurate
-	No Data

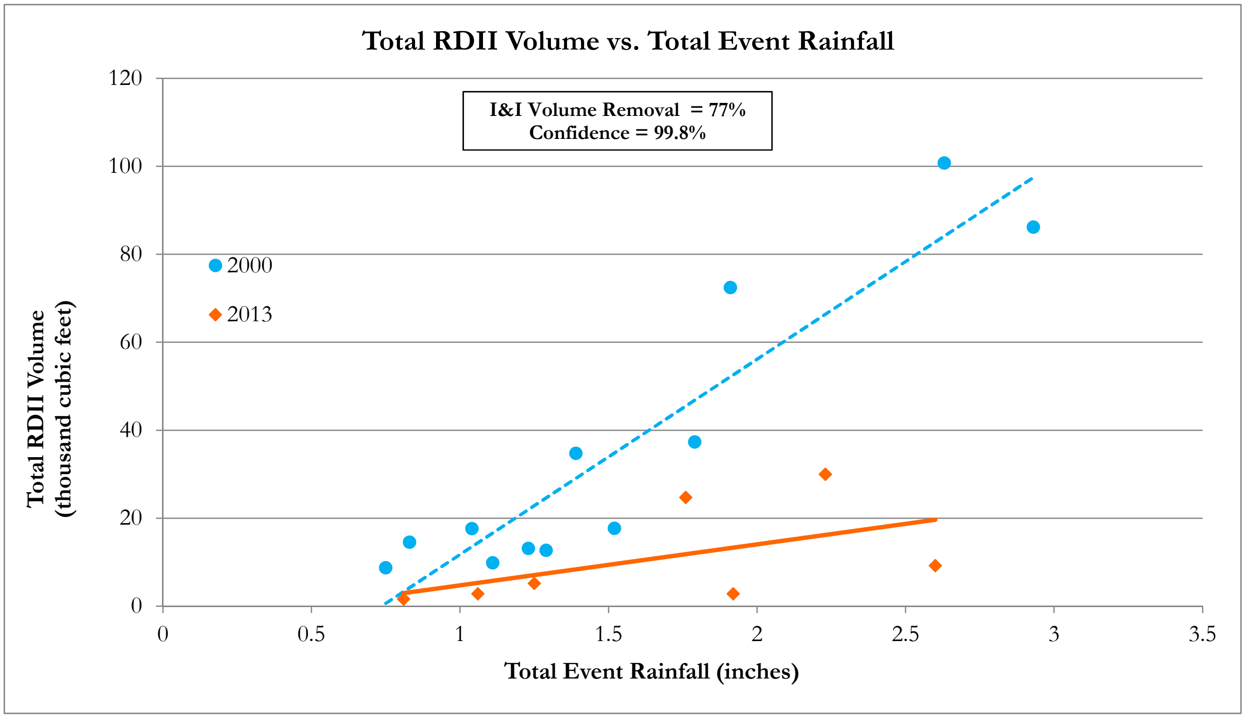
Ann Arbor Cumulative Meter Districts Per Capita Flow Computations

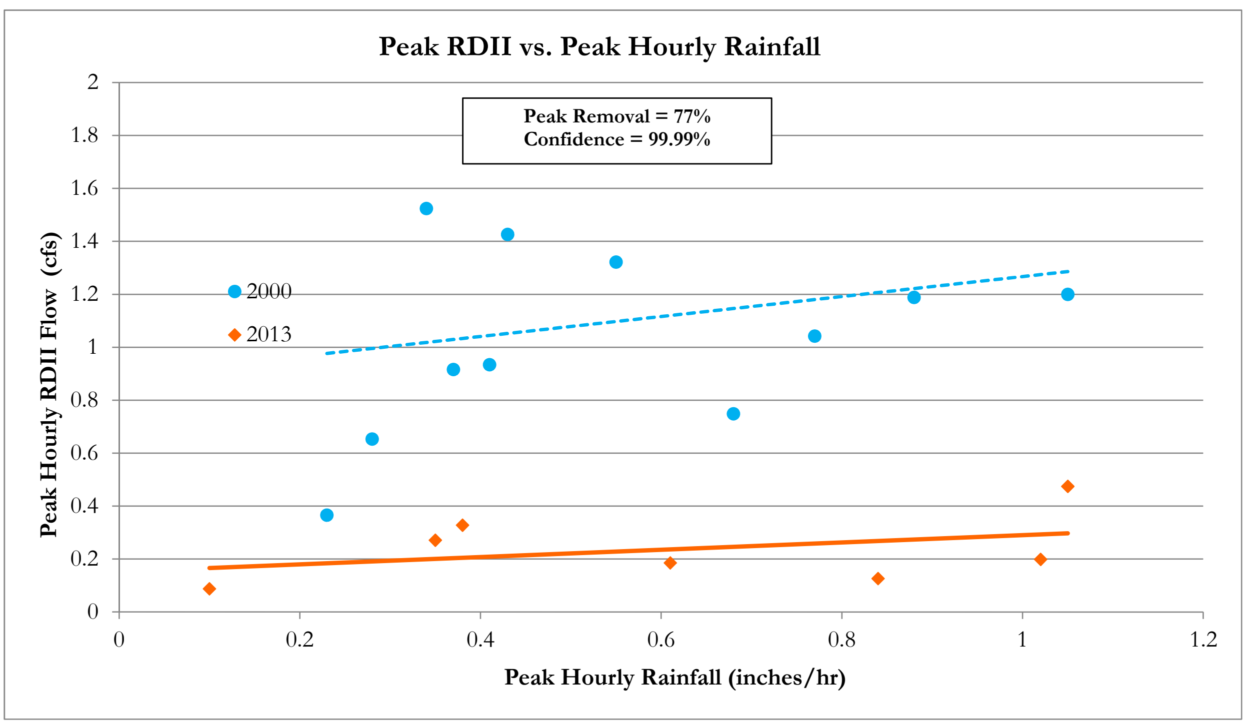
Incremental Meter District	Upstream Meter Districts	Year 2010 Incremental Households	Year 2010 Incremental Population	Incremental Acerage	Total Households	Year 2010 Population	Total Acerage	Average DWF		April 11, 2013		June 10, 2013		June 27, 2013		August 12, 2013	
								Average Dry Weather Flow Rate (cfs)	Sanitary Wastewater Flow Rate (gpcd)	Peak Flow Rate (cfs)	Sanitary Wastewater Flow Rate (gpcd)	Peak Flow Rate (cfs)	Sanitary Wastewater Flow Rate (gpcd)	Peak Flow Rate (cfs)	Sanitary Wastewater Flow Rate (gpcd)	Peak Flow Rate (cfs)	Sanitary Wastewater Flow Rate (gpcd)
MH 2B	[MH2B]	243	670	104.9	243	670	104.9	0.1	96.5	0.5	482.4	0.3	289.4	0.6	578.8	0.4	385.9
MH 47	[MH47]	257	684	74.0	257	684	74.0	0.1	94.5	0.4	378.0	0.3	283.5	0.6	567.0	0.2	189.0
5C	[5C]+[MH47]+[MH2B]	2941	6823	1608.4	3441	8177	1787.3	1.7	134.4	7.1	561.2	4.0	316.2	8.8	695.6	7.0	553.3
3B	[3B]	4297	10049	1534.2	4297	10049	1534.2	1.5	96.5	3.8	244.4	3.2	205.8	6.3	405.2	4.2	270.1
E1	[E1]	535	1468	624.0	535	1468	624.0	0.3	132.1	0.6	264.2	0.7	308.2	-	-	-	-
1A	[1A]+[E1]	143	318	95.9	678	1786	719.9	NA	NA	0.7	253.3	NA	NA	NA	NA	NA	NA
PS-Jackson	[PS-Jackson]	2345	5888	3144.4	2345	5888	3144.4	1.0	105.6	2.5	269.0	2.4	267.9	2.4	267.9	3.0	332.6
D1	[D1]	399	881	96.4	399	881	96.4	NA	NA	1.7	1247.2	0.9	660.3	-	-	-	-
B1	[B1]	1944	4397	721.2	1944	4397	721.2	2.2	323.4	4.9	720.3	4.2	617.4	-	-	-	-
MH 49D	[MH 49D]	522	1058	303.4	522	1058	303.4	0.3	183.3	1.6	977.5	1.6	977.5	2.7	1649.5	-	-
MH 2D	[MH 2D]	2427	5367	863.2	2427	5367	863.2	0.5	60.2	3.7	445.6	3.2	385.4	6.5	782.8	2.7	325.2
A1	[A1]+[MH 49D]+[MH 2D]	331	705	90.6	3280	7130	1257.2	1.1	99.7	4.2	380.7	3.7	335.4	6.3	571.1	3.2	290.1
MH 11	[MH 11]	458	1035	131.1	458	1035	131.1	0.1	62.5	1.1	687.0	0.6	374.7	1.6	999.2	0.5	312.3
MH 102	[MH 102]	500	1134	163.7	500	1134	163.7	0.2	114.0	2.5	1425.0	1.2	684.0	1.9	1083.0	1.0	570.0
12A	[12A]+[MH102]+[MH11]	1141	2167	560.7	2099	4336	855.4	0.6	89.4	4.6	685.7	3.2	477.0	7.4	1103.1	2.1	313.0
F1+9B	[F1+9B]	3445	11162	795.8	3445	11162	795.8	-	-	-	-	-	-	-	-	-	-
F1	[F1]+[F1+9B]50%	906	4123	122.7	2629	9704	520.6	1.2	107.0	4.2	279.8	4.2	279.8	7.8	519.5	3.8	253.1
C1+C2	[C1+C2]+[PS-Jackson]+[D1]+[B1]+[A1]+[12A]+[F1]	7463	16523	1557.6	20159	48859	8152.9	11.2	148.2	30.3	400.8	24.1	318.8	39.0	515.9	16.0	211.7
MH 49M	[MH 49M]	1063	2515	327.4	1063	2515	327.4	0.3	77.1	2.0	514.0	1.5	385.5	1.9	488.3	1.2	308.4
11B	[11B]+[MH 49M]	2297	4067	931.4	3360	6582	1258.9	1.4	137.5	3.7	363.3	3.2	314.2	4.1	402.6	2.9	284.8
Pitt-6	[Pitt-6]	1577	3366	2072.1	1577	3366	2072.1	0.7	134.4	2.3	441.7	2.1	403.3	-	-	-	-
Pitt-7	[Pitt-7]	80	150	295.0	80	150	295.0	NA	NA	NA	NA	NA	NA	-	-	-	-
10A	[10A]+[Pitt-6]+[Pitt-7]	1646	4122	605.6	3303	7638	2972.7	2.0	169.2	4.0	338.5	3.9	330.0	5.8	490.8	3.2	270.8
F1+9B	[F1+9B]	3445	11162	795.8	3445	11162	795.8	-	-	-	-	-	-	-	-	-	-
9B	[9B]+[F1+9B]50%	1475	2944	522.5	3198	8525	920.4	1.7	100.1	3.6	272.9	3.7	280.5	-	-	-	-
9C	[9C]+[10A]+[11B]+[9B]	2032	4250	663.3	11893	26995	5815	5.9	141.3	12.5	299.3	10.8	258.6	15.3	366.3	11.2	268.2
G1	[G1]+[9C]50%	538	1129	182.1	6484	14627	3090	3.8	190.3	8.9	393.3	12.3	543.5	-	-	-	-
Pitt-1	[Pitt-1]	87	294	32.1	87	294	32.1	NA	NA	NA	NA	NA	NA	-	-	-	-
Pitt-2	[Pitt-2]	385	845	112.0	385	845	112.0	NA	NA	NA	NA	NA	NA	-	-	-	-
Pitt-3	[Pitt-3]	56	191	20.8	56	191	20.8	NA	NA	NA	NA	NA	NA	-	-	-	-
Pitt-4	[Pitt-4]	1166	2450	272.3	1166	2450	272.3	NA	NA	NA	NA	NA	NA	-	-	-	-
Pitt-5	[Pitt-5]	133	239	23.5	133	239	23.5	NA	NA	NA	NA	NA	NA	-	-	-	-
Plant	[Plant]+[Pitt-1]+[Pitt-2]+[Pitt-3]+[Pitt-4]+[Pitt-5] +[G1]+[9C]+[C1+C2]+[1A]+[3B]+[5C]	12050	31239	8936.0	54882	132253	27588	24.9	121.6	64.1	313.3	50.7	247.8	80.3	392.4	48.8	238.5

	Priority District
	End of Branch
	Tributary to Plant Interceptor
NA	Flow Rates not Accurate
-	No Data

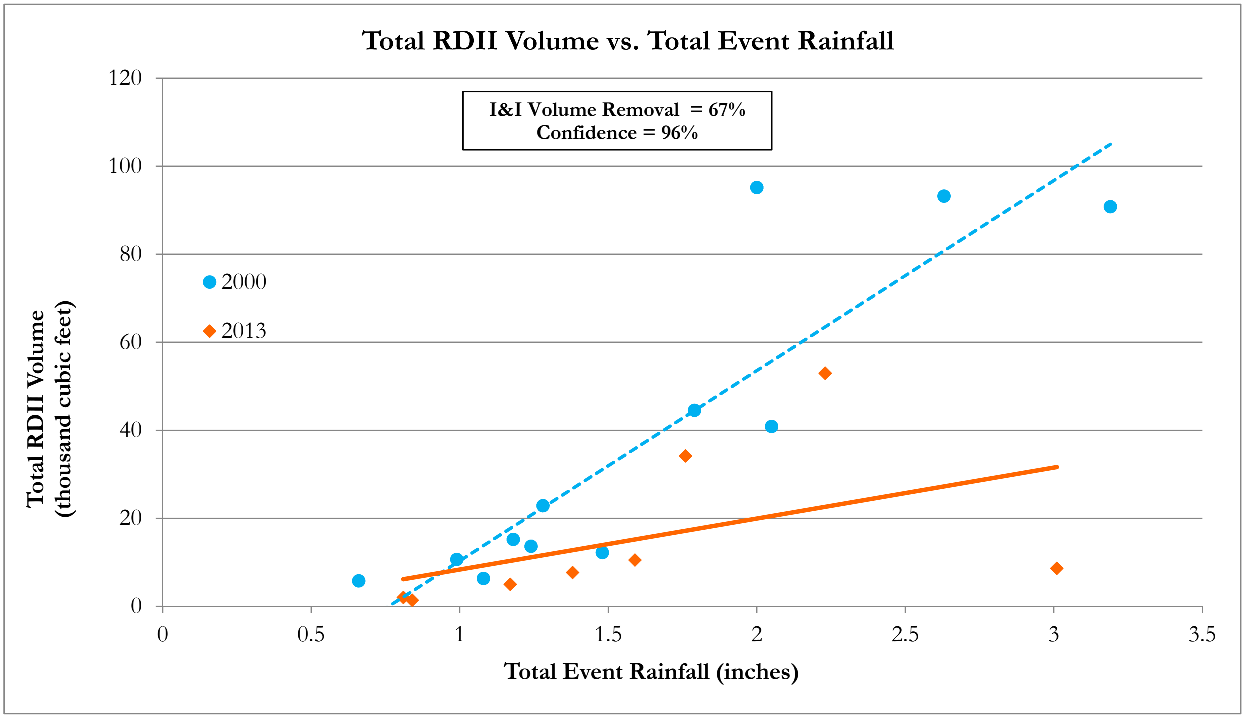
Appendix B
Scatter Plots

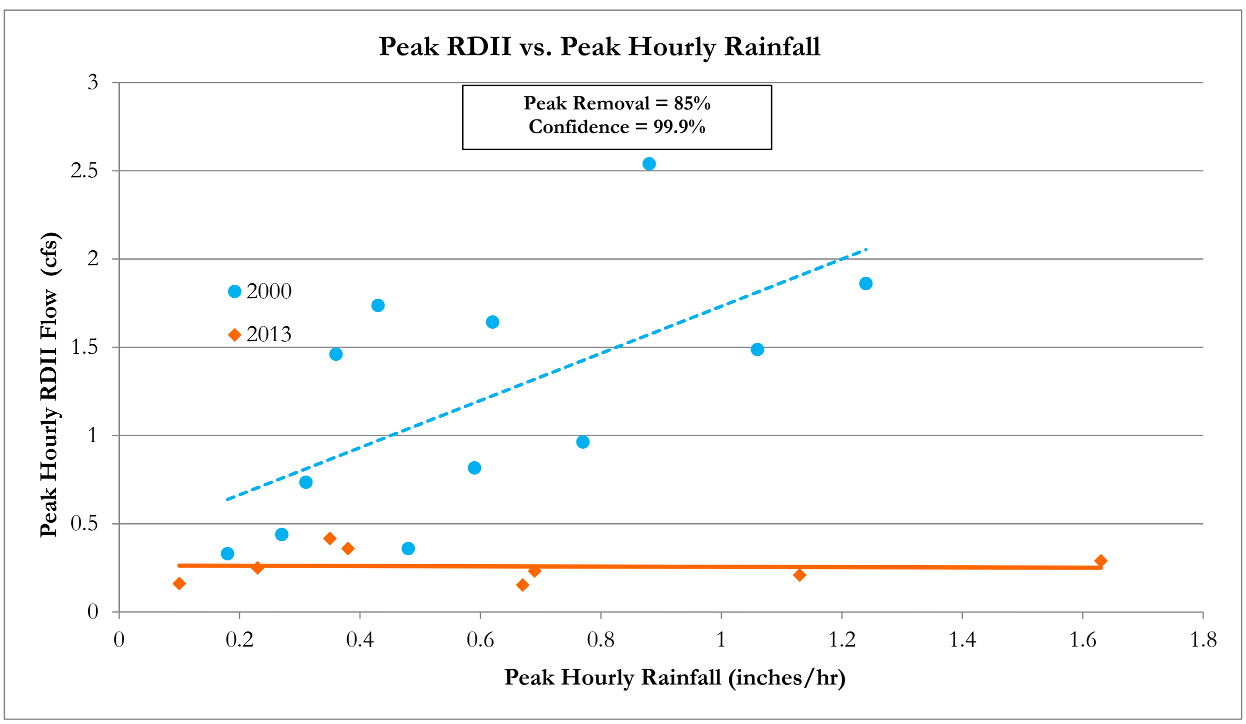
Orchard Hills District
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Summary of Results - Scatter Plots



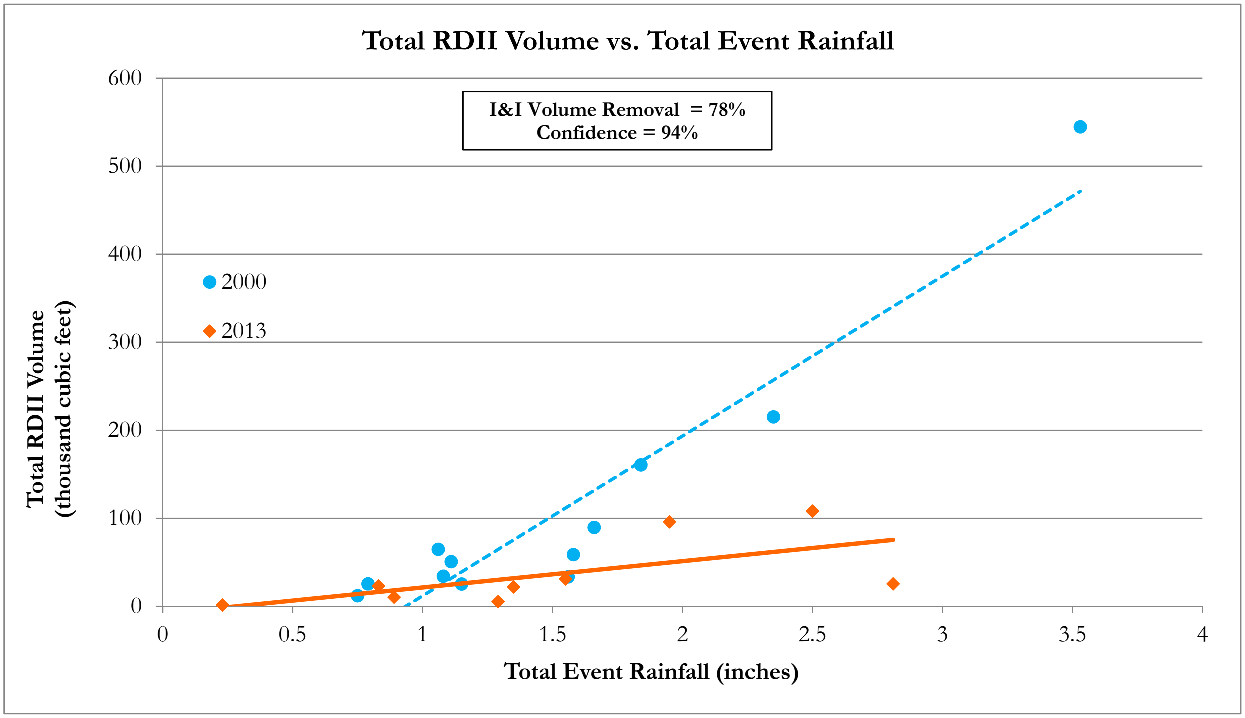


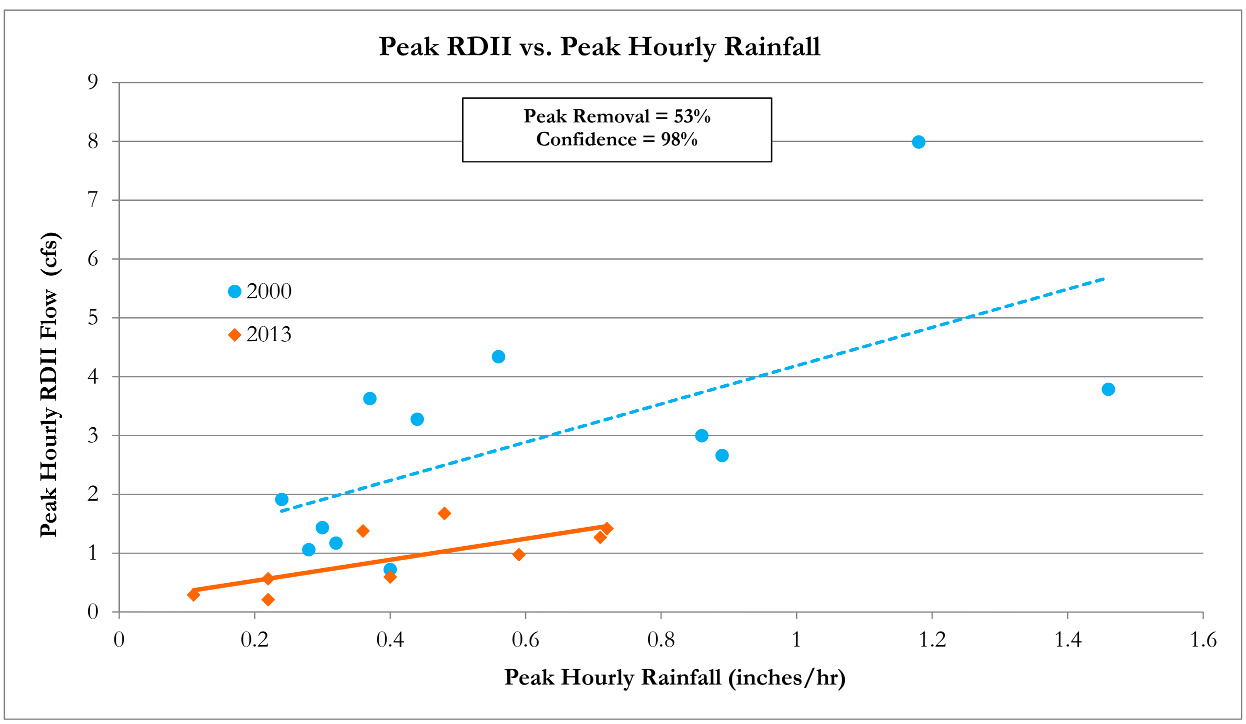
Bromley District
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Summary of Results - Scatter Plots



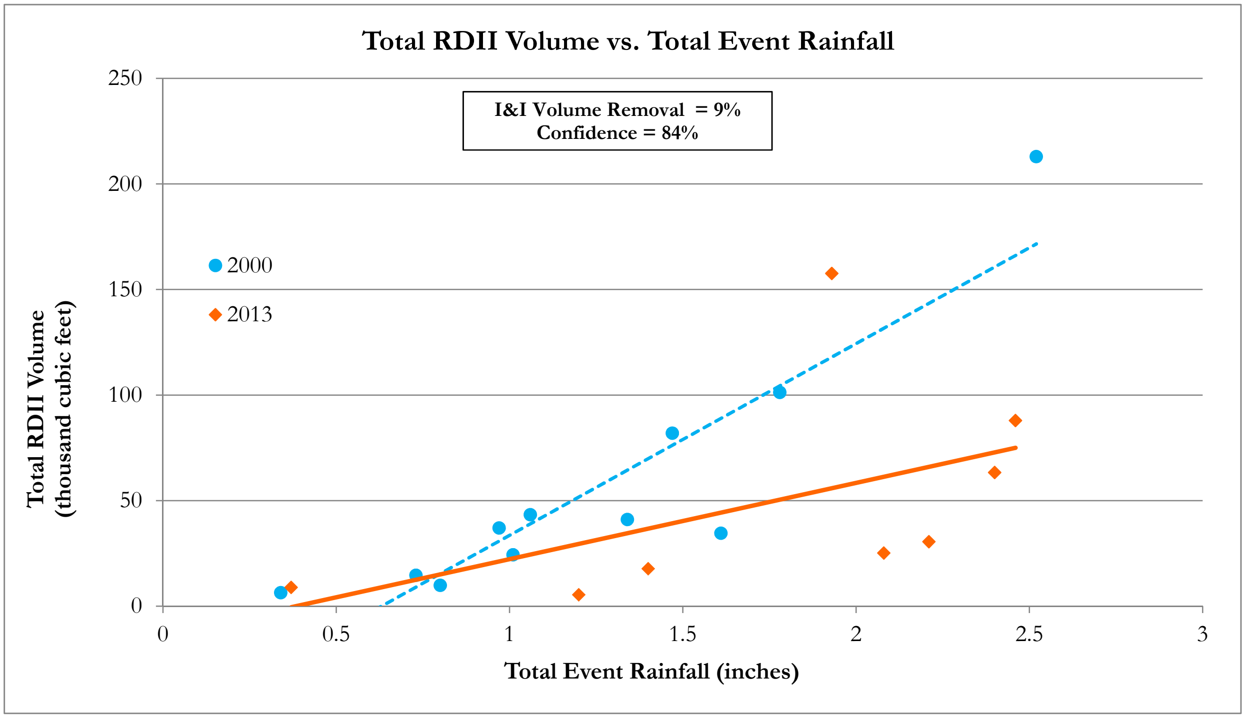


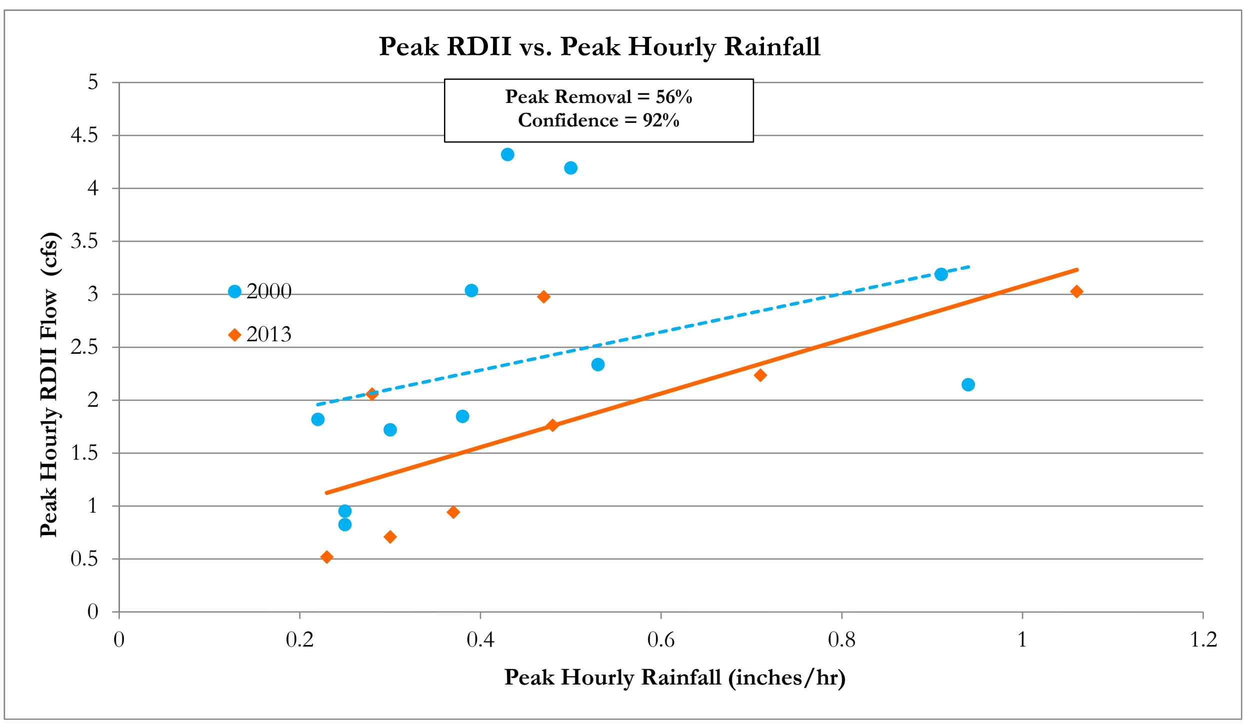
Morehead District
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Summary of Results - Scatter Plots



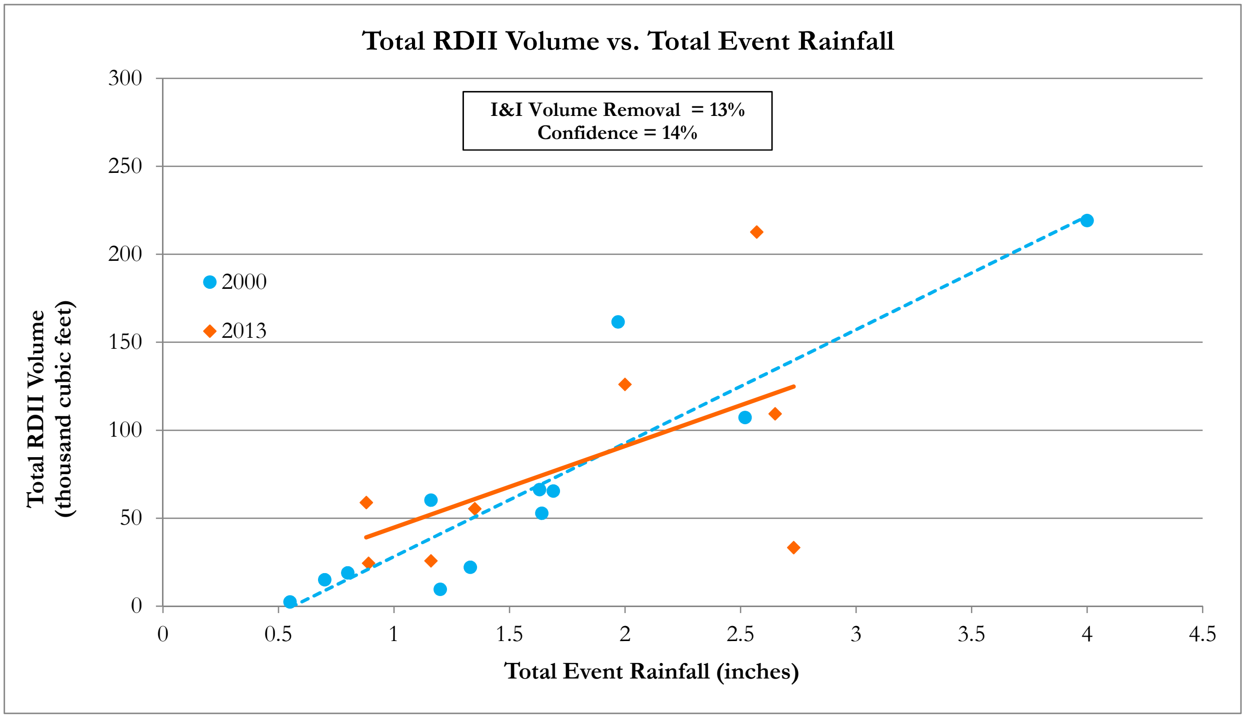


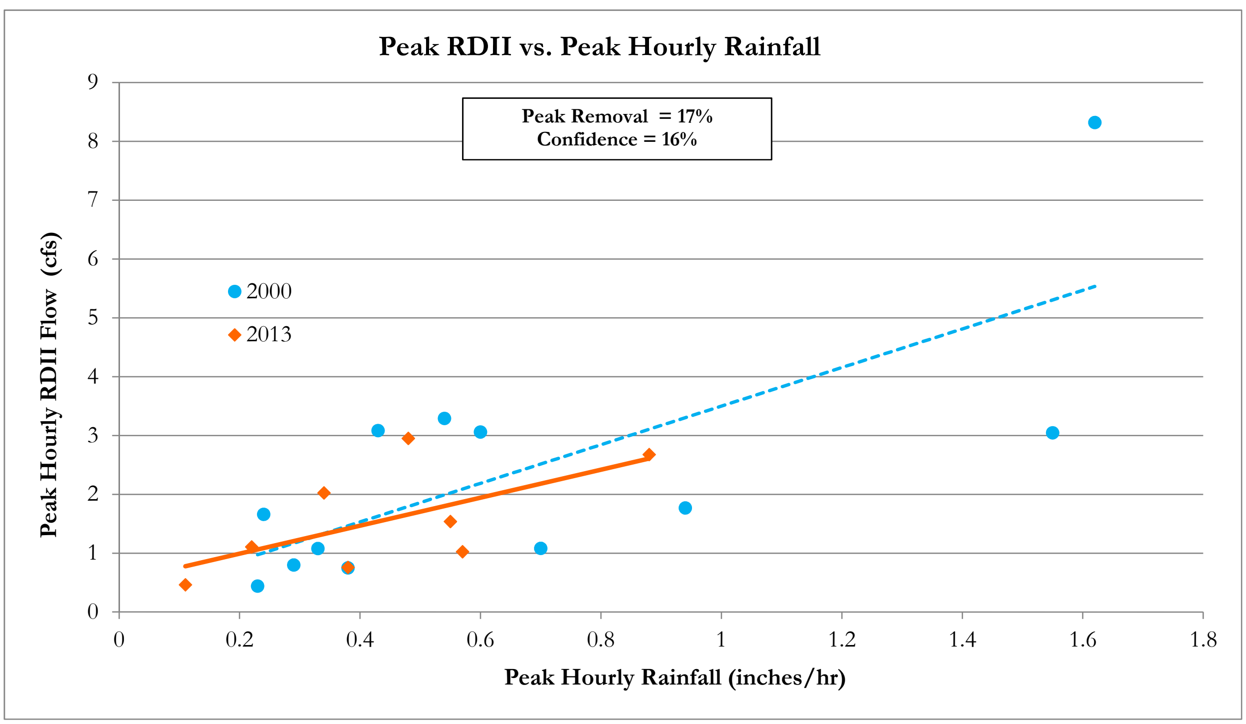
Dartmoor District
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Summary of Results - Scatter Plots





Glen Leven District
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Summary of Results - Scatter Plots

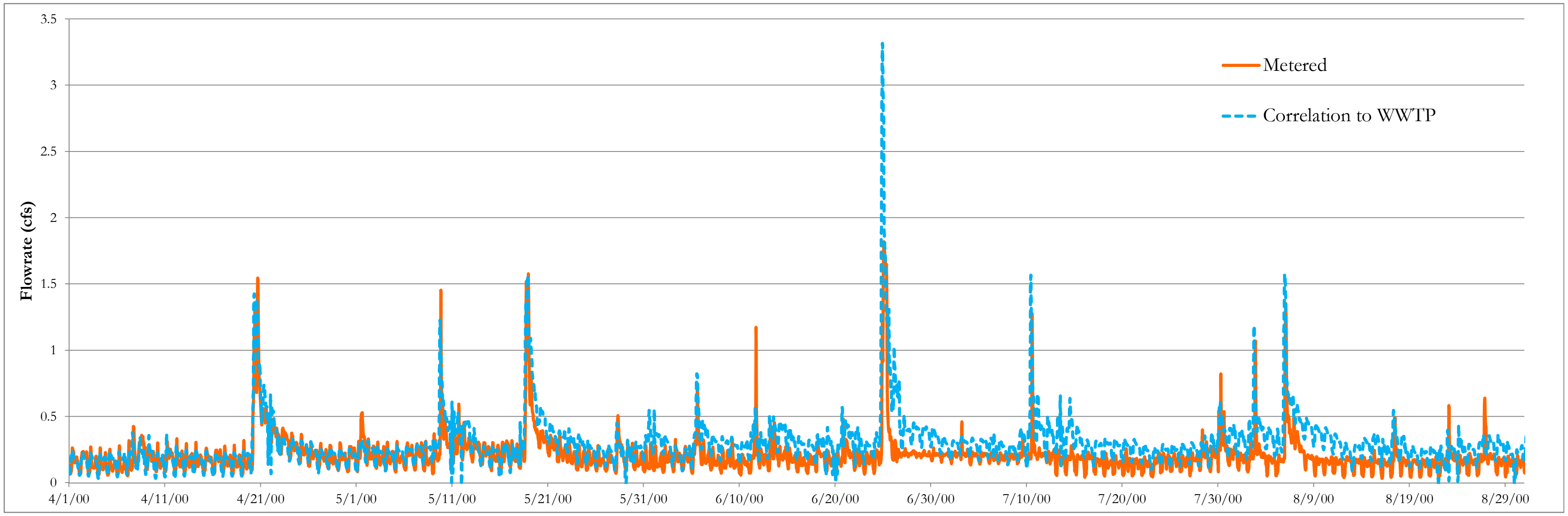




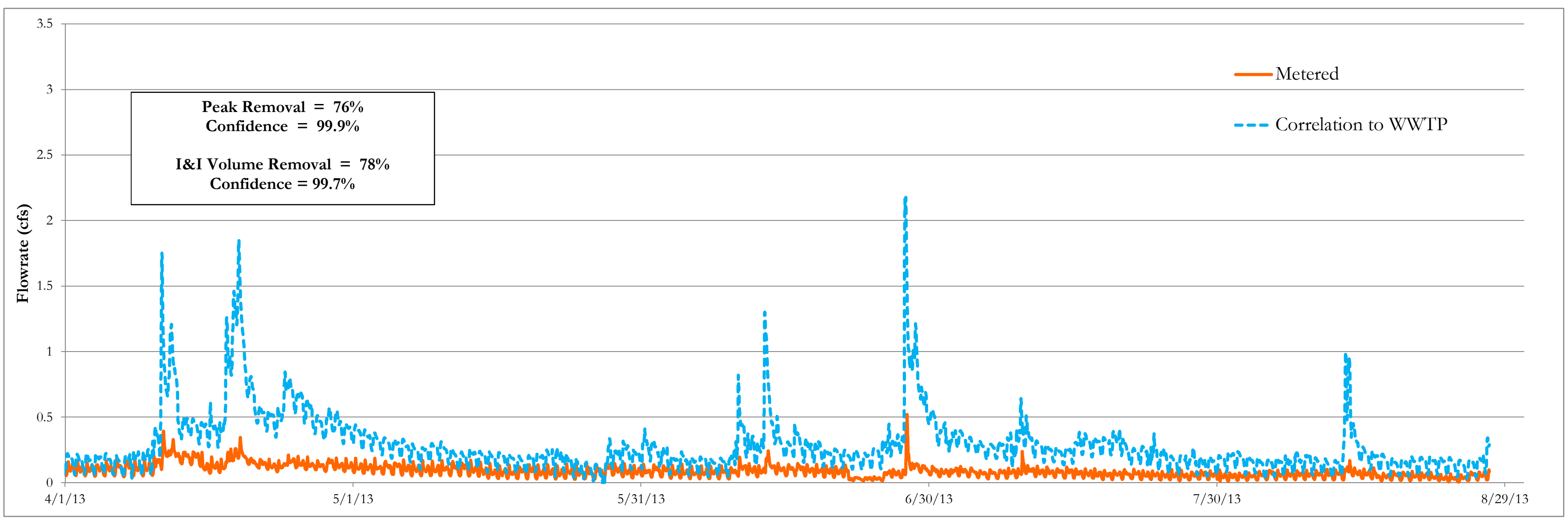
Appendix C
Meter Correlations

Orchard Hills District - Summary of Results - Meter Correlation

2000 Meter Data Correlated to 2000 Waste Water Treatment Plant Flow as Control District

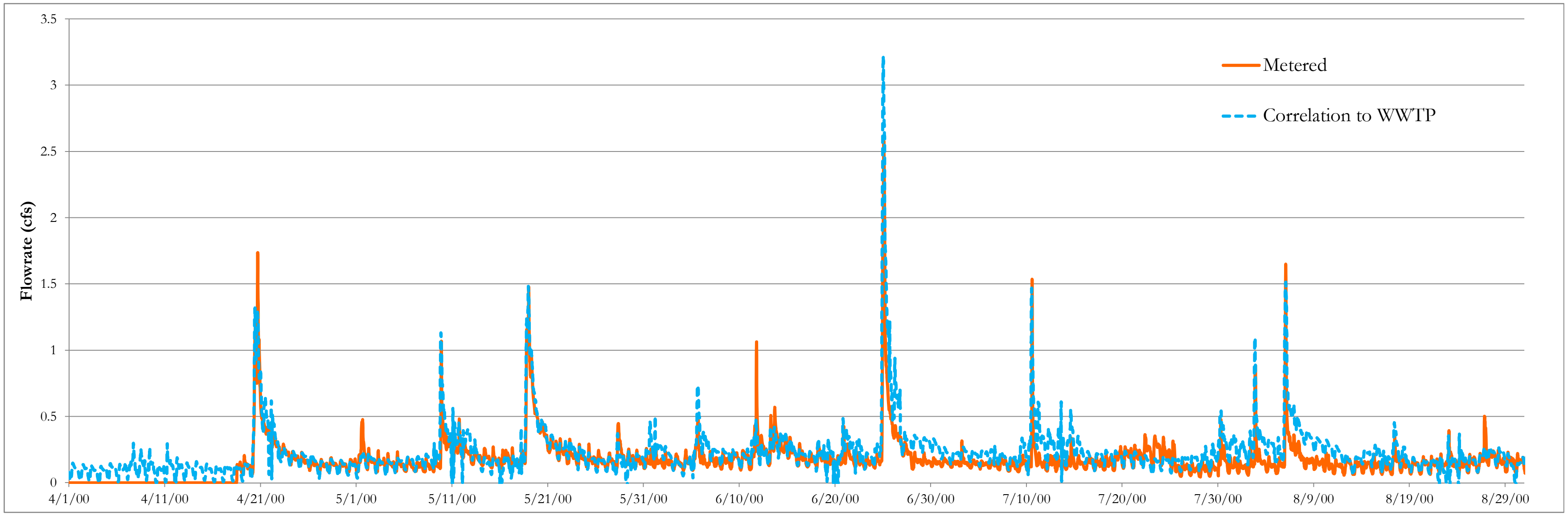


2013 Meter Data Correlated to 2000 Waste Water Treatment Plant Flow as Control District

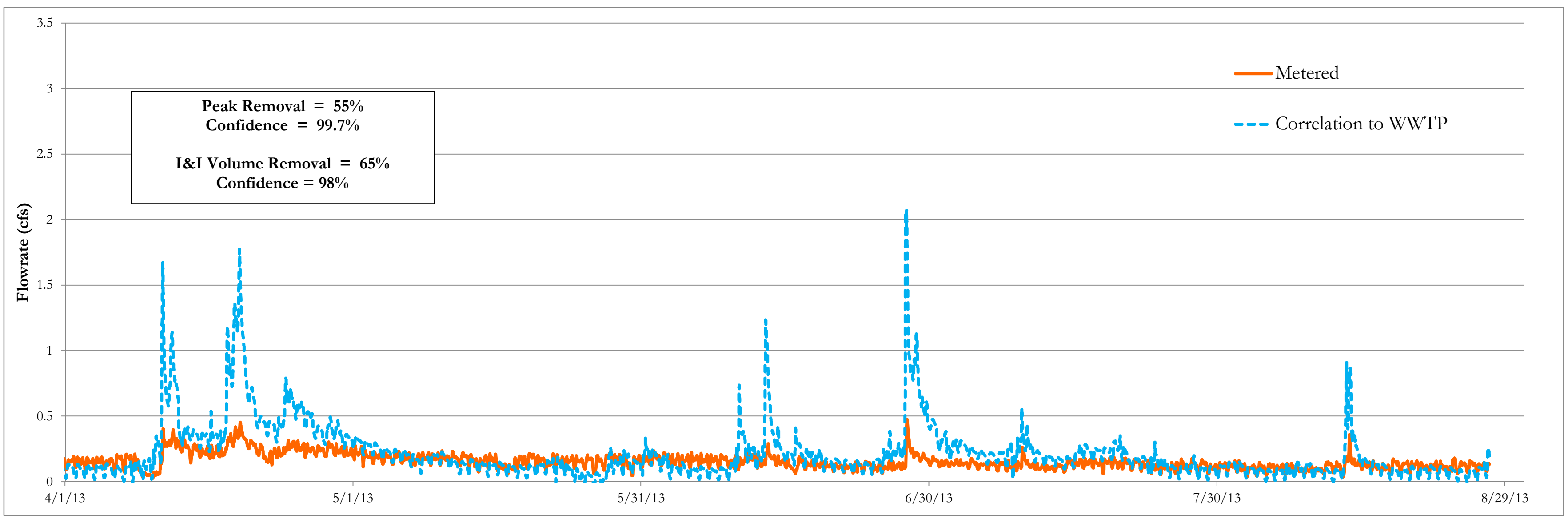


Bromley District - Summary of Results - Meter Correlation

2000 Meter Data Correlated to 2000 Waste Water Treatment Plant Flow as Control District

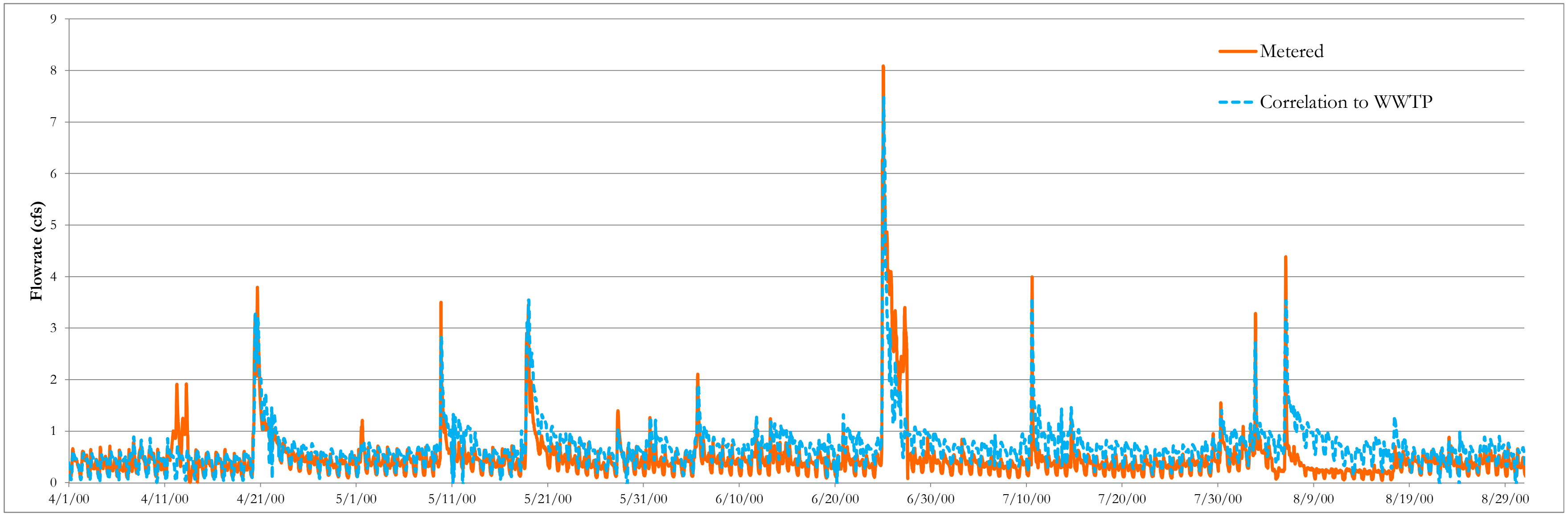


2013 Meter Data Correlated to 2000 Waste Water Treatment Plant Flow as Control District

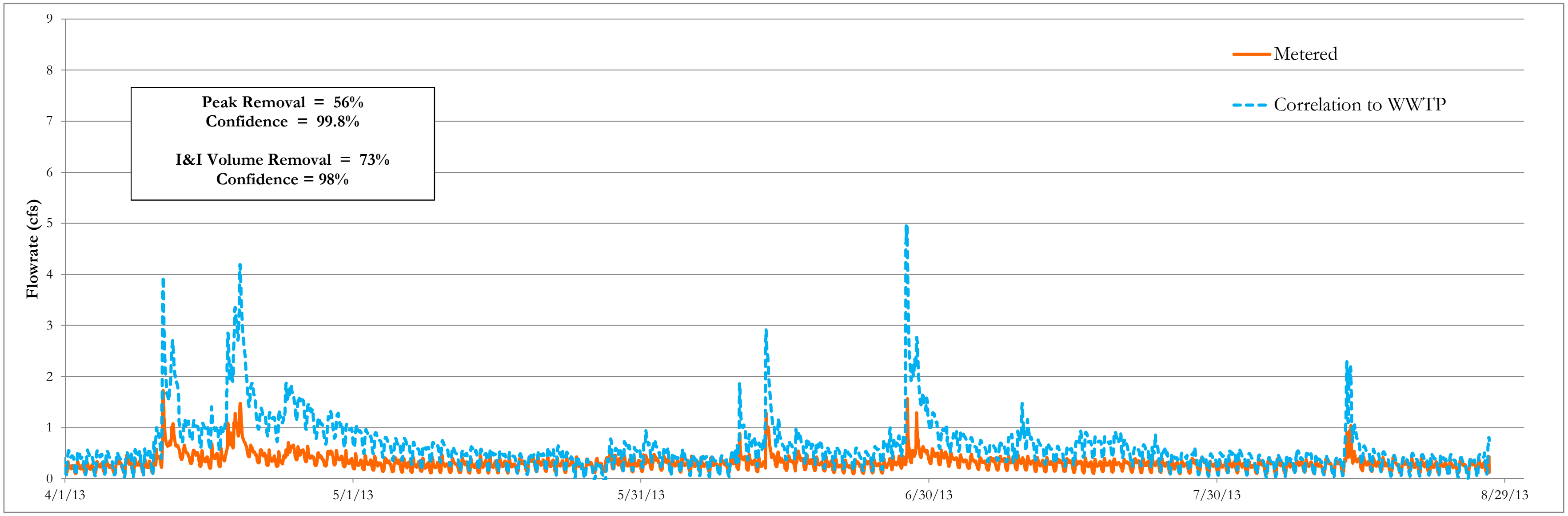


Morehead District - Summary of Results - Meter Correlation

2000 Meter Data Correlated to 2000 Waste Water Treatment Plant Flow as Control District

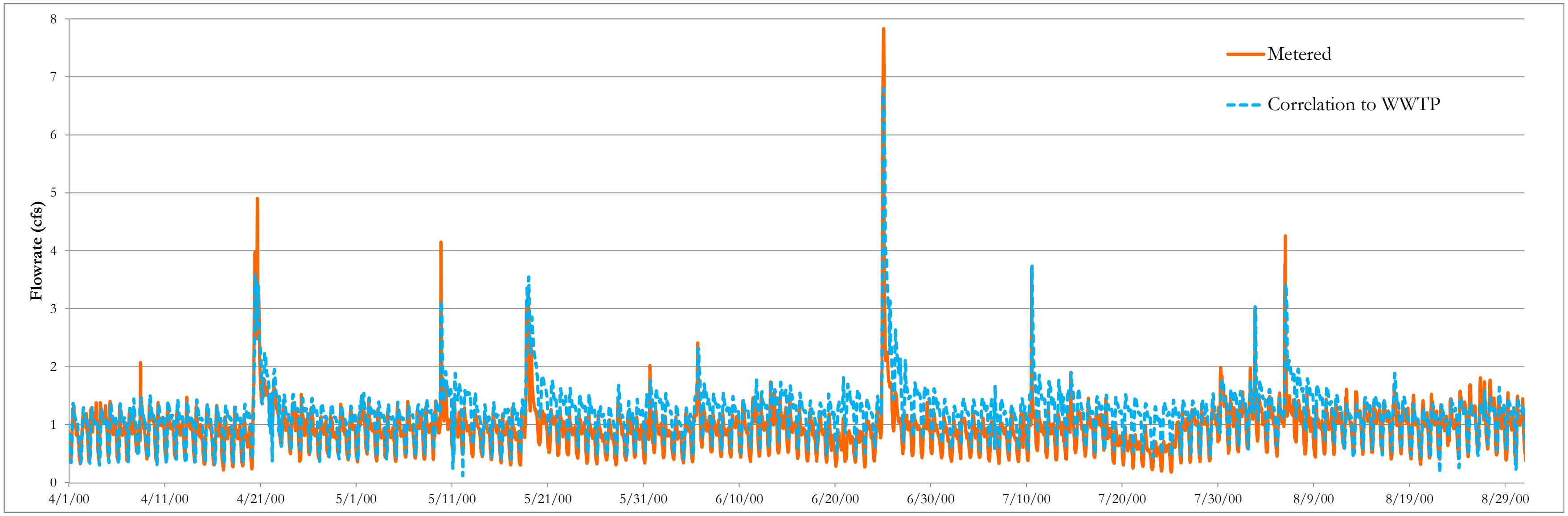


2013 Meter Data Correlated to 2000 Waste Water Treatment Plant Flow as Control District

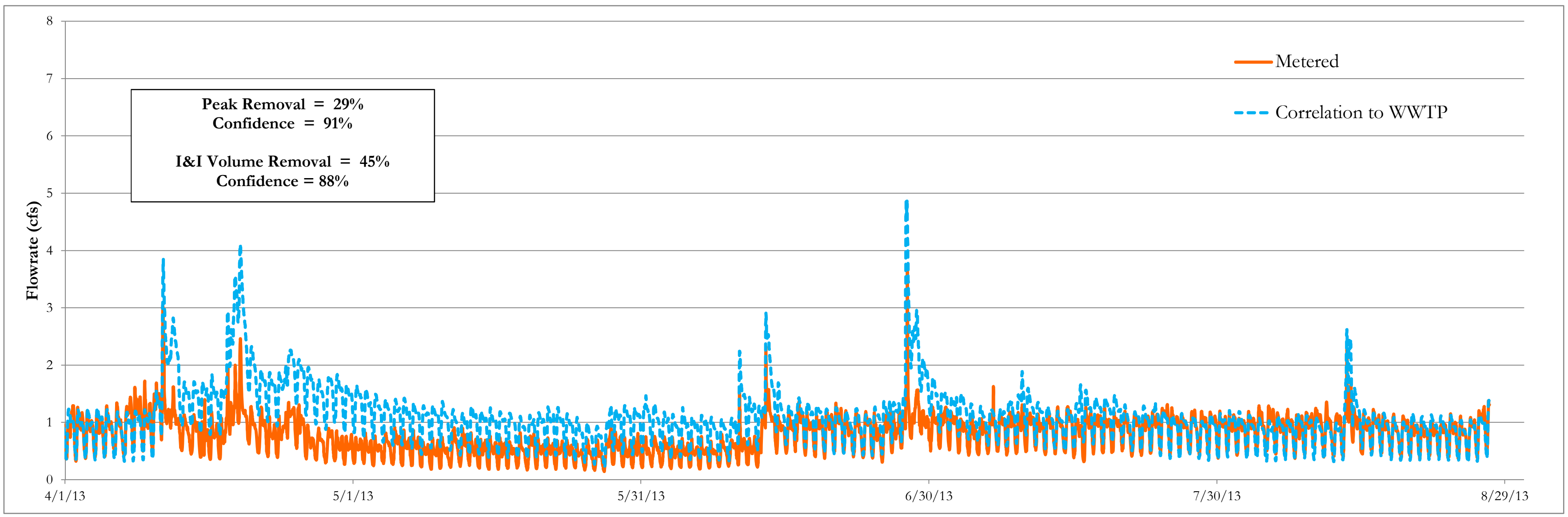


Dartmoor District - Summary of Results - Meter Correlation

2000 Meter Data Correlated to 2000 Waste Water Treatment Plant Flow as Control District

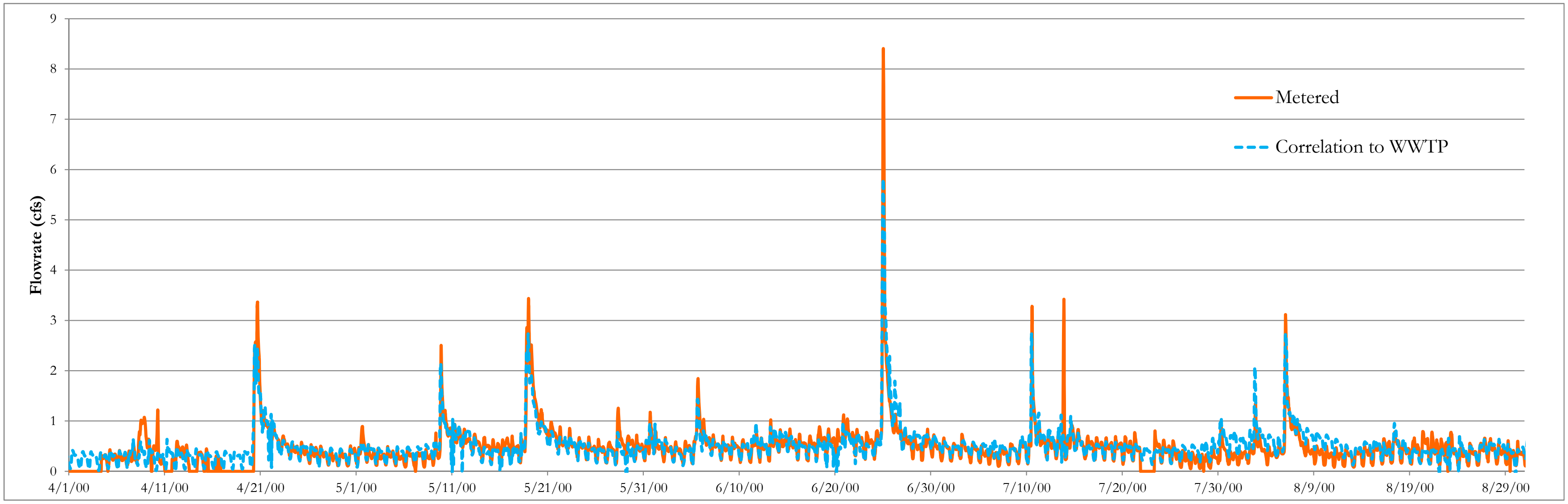


2013 Meter Data Correlated to 2000 Waste Water Treatment Plant Flow as Control District

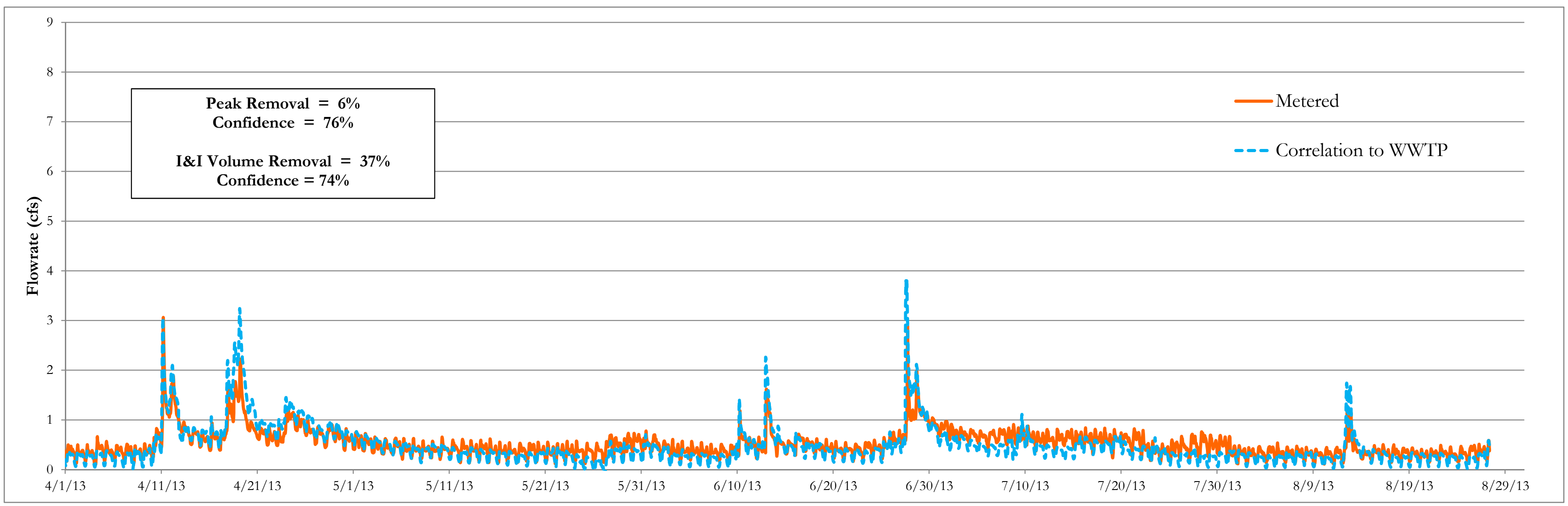


Glen Leven District - Summary of Results - Meter Correlation

2000 Meter Data Correlated to 2000 Waste Water Treatment Plant Flow as Control District



2013 Meter Data Correlated to 2000 Waste Water Treatment Plant Flow as Control District



Appendix D
i3d Technical Memorandum

Antecedent Moisture Model (AMM) Description

I/I into sanitary collection systems occurs through a complex series of mechanisms that include direct and indirect inflow, seepage into manholes, sewer defects, footing drains and numerous other sources. Because of the complex transport mechanisms of these flow sources, they are heavily dependent on variables that are not normally included in traditional stormwater-based models for I/I such as soil moisture conditions and ground water levels. These variables continuously change during storms and in between storms in response to antecedent moisture conditions. The AM model used for this study takes into account the overall antecedent moisture condition of the sewershed, resulting in a more accurate model based on the sewer system's response to wet weather.

In order to account for the effects of antecedent moisture, the AM modeling technique is based on system identification theory. The model utilizes tools from the fields of digital signal processing, control systems and time series analysis to model variable I/I using data-based models. System identification is the approach of identifying the most appropriate and simplest numerical model that accurately describes the observed data and then gaining insight into the physical characteristics of the system through interpretation of the resulting model structure. A block diagram of the resulting antecedent model structure is depicted in Figure 1. Note that the model structure contains an antecedent moisture block that is automatically modified based on the recent rainfall and temperature conditions. This approach allows the model to simulate the variation in capture coefficients that occur as a result of antecedent moisture conditions. The resulting numerical model structure identifies physical phenomenon from the data such as fast dynamics (inflow) and slow dynamics (infiltration), long term ground water flow variations, and responses to previous rainfall and temperature (antecedent moisture). In some cases, the system identification process also uncovers other phenomenon such as river inflow or system deterioration.

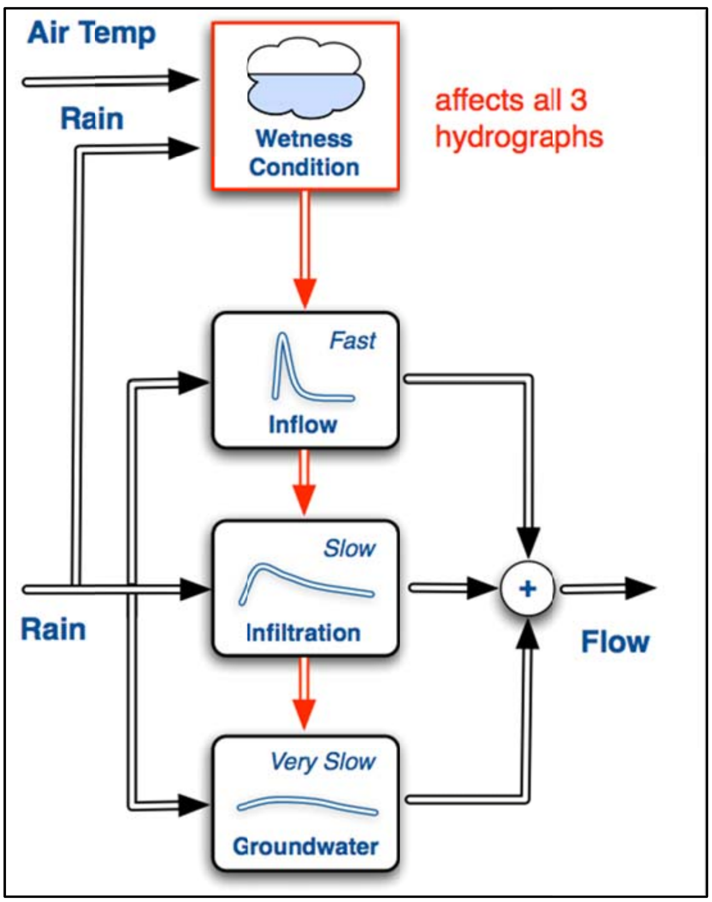


Figure 1: Antecedent Moisture Model Structure

Appendix E

Accuracy of Fit and Validation Tables

- Pre vs Post in Priority Districts
    - Additional Models, 2013

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Antecedent Moisture Model - Accuracy Fit Analysis

Meter	Peak Flow		Volume	
	Net Average Error	Total Average Error	Net Average Error	Total Average Error
Orchard Hills (MH47)	0.5%	18.7%	-0.1%	11.8%
Bromley (MH2B)	-0.2%	10.7%	-1.4%	10.9%
Dartmoor (MH2D)	-0.7%	12.0%	0.7%	14.6%
Glen Leven (MH11+MH102)	2.8%	20.2%	-1.5%	21.5%
Morehead (MH49M)	0.6%	19.0%	-1.6%	13.8%
01A	0.0%	12.6%	0.3%	6.1%
10A	-0.2%	6.4%	0.7%	6.8%
11B	2.4%	10.5%	5.4%	12.1%
12A	1.0%	9.4%	0.6%	9.6%
3B	-0.5%	8.5%	0.8%	5.5%
5C	0.8%	14.0%	0.0%	8.4%
9B	1.0%	16.7%	1.9%	7.1%
9C	0.9%	8.9%	0.2%	15.6%
A1	0.2%	13.2%	-0.9%	8.0%
B1	-0.8%	7.1%	0.6%	6.8%
C1 + C2	0.5%	10.8%	0.2%	7.7%
F1	-0.8%	9.8%	0.9%	15.2%
G1	-0.2%	4.8%	-0.1%	5.3%
Average	**0.4%**	**11.9%**	**0.4%**	**10.4%**

Net error is the average of all the errors and allows positive and negative values to offset each other. The net error is a measure of the model bias and should be as close to zero as possible.

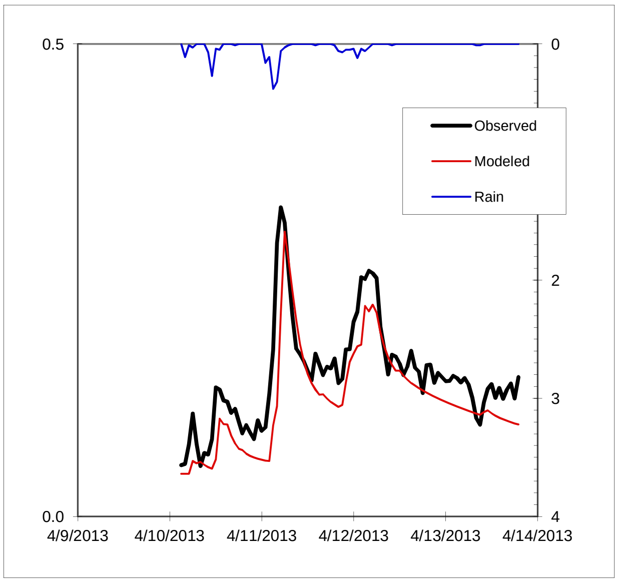
Total error is the average of the absolute value of the errors and is a measure of the model's ability to predict volumes and flows for individual storm events.

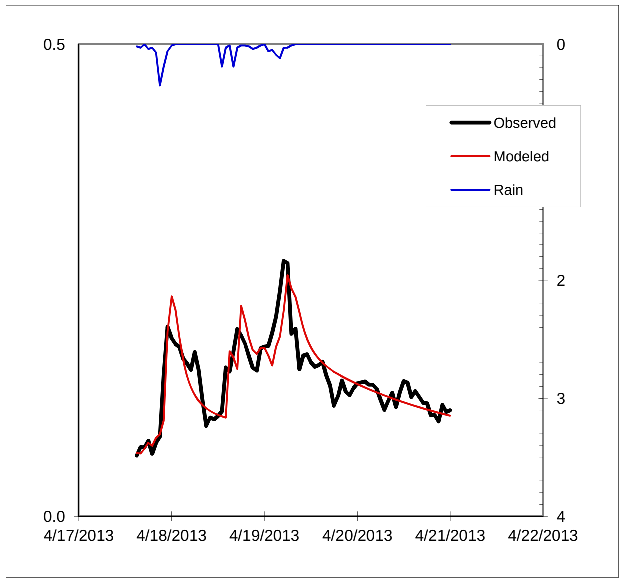
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Orchard Hills District - Meter MH-47 - 2013

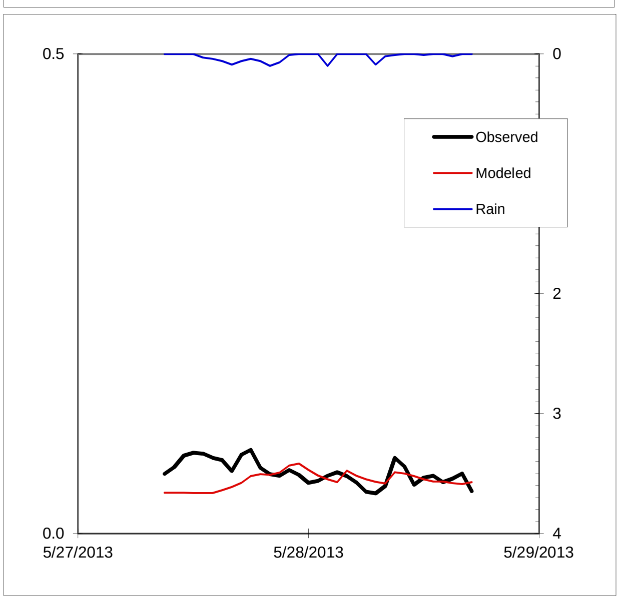
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.23	0.33	0.30	-7.9%	48	40	-17.2%	
04/17/13	1.76	0.27	0.26	-5.7%	43	43	0.5%	
05/27/13	0.81	0.09	0.07	-16.4%	8	7	-13.3%	
06/09/13	1.59	0.11	0.12	15.6%	10	11	5.6%	
06/12/13	1.25	0.18	0.17	-9.6%	14	13	-12.8%	
04/23/13	0.84	0.14	0.18	33.3%	16	17	5.5%	
06/27/13	2.6	0.47	0.33	-30.5%	10	9	-10.3%	
07/09/13	1.06	0.20	0.17	-11.9%	5	5	2.1%	
08/12/13	1.92	0.13	0.17	37.6%	4	6	39.2%	

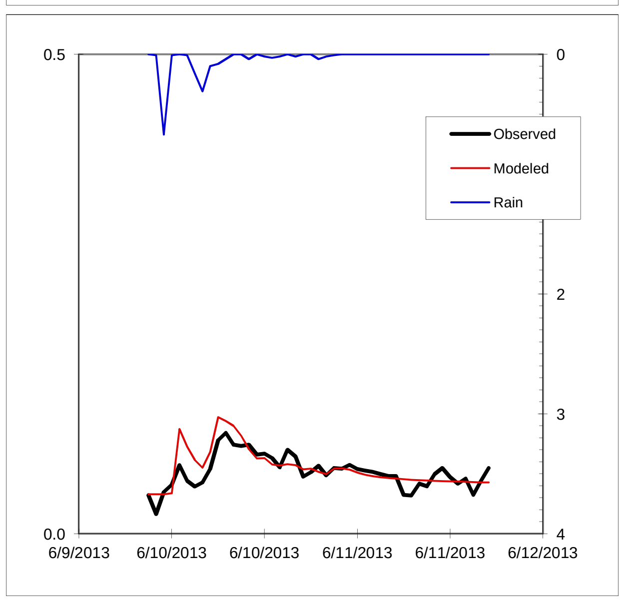
Net Average Error	0.5%		-0.1%
Total Average Error	18.7%		11.8%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

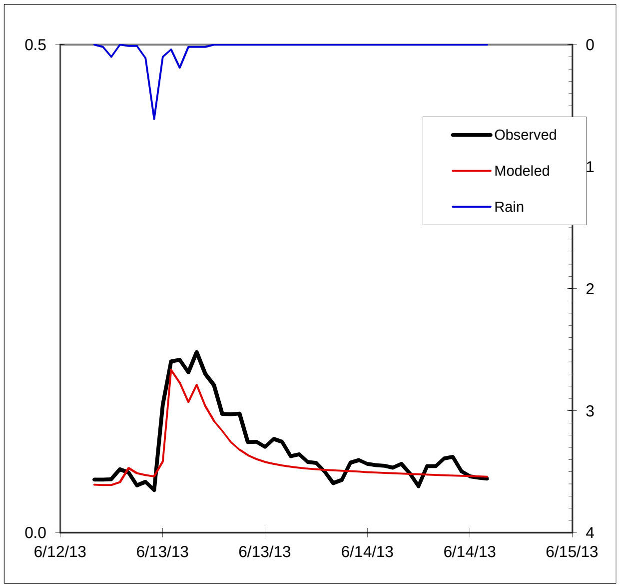


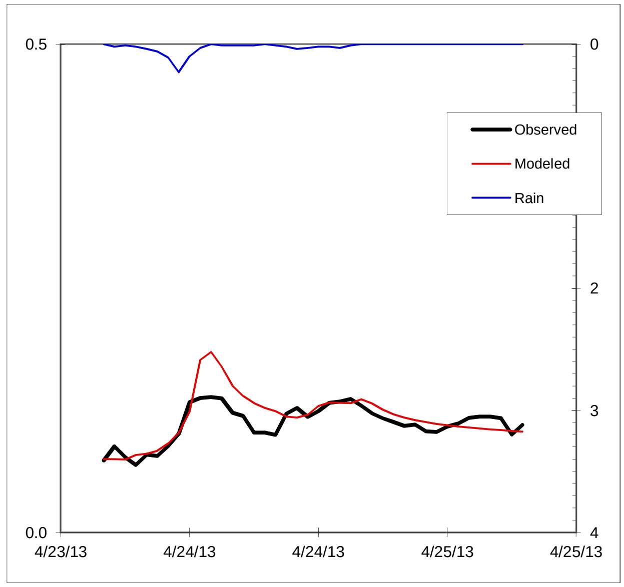


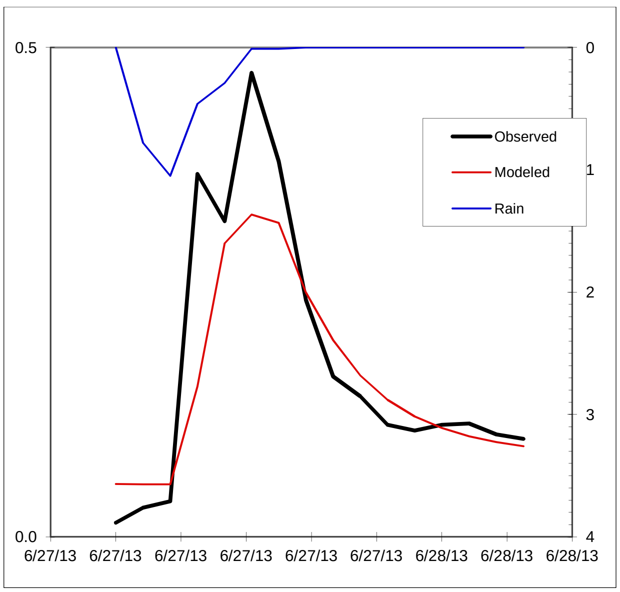


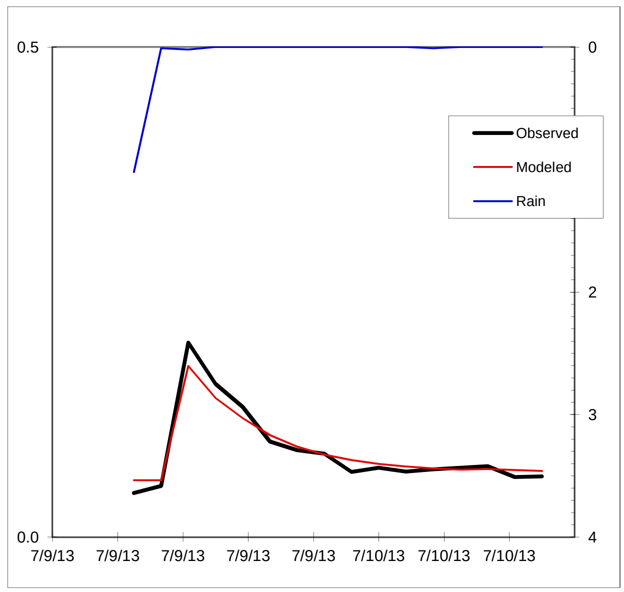


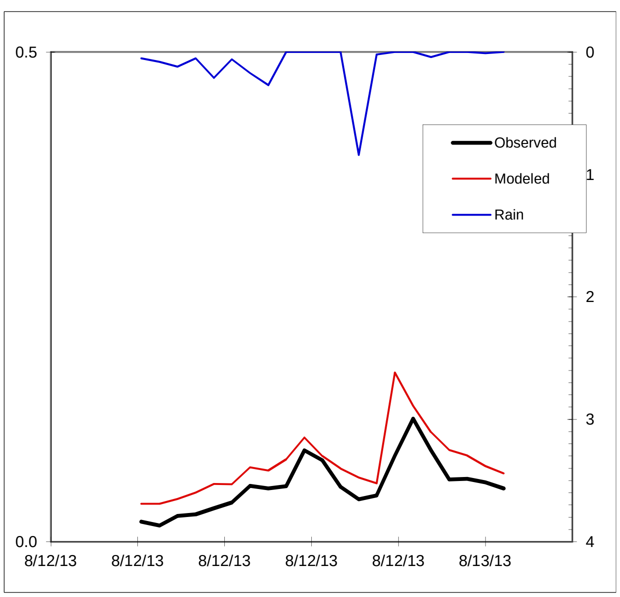
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Orchard Hills District - Meter MH-47 - 2013











Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Orchard Hills District - Meter MH-47 - 2013

Validation Group 1								
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.23	0.33	0.30	-7.9%	48	40	-17.2%	
05/27/13	0.81	0.09	0.07	-16.4%	8	7	-13.3%	
06/12/13	1.25	0.18	0.17	-9.6%	14	13	-12.8%	
06/27/13	2.6	0.47	0.33	-30.5%	10	9	-10.3%	
08/12/13	1.92	0.13	0.17	37.6%	4	6	39.2%	

Net Average Error	-5.4%		-2.9%
Total Average Error	20.4%		18.6%

Validation Group 2								
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/17/13	1.76	0.27	0.26	-5.7%	43	43	0.5%	
06/09/13	1.59	0.11	0.12	15.6%	10	11	5.6%	
04/23/13	0.84	0.14	0.18	33.3%	16	17	5.5%	
07/09/13	1.06	0.20	0.17	-11.9%	5	5	2.1%	

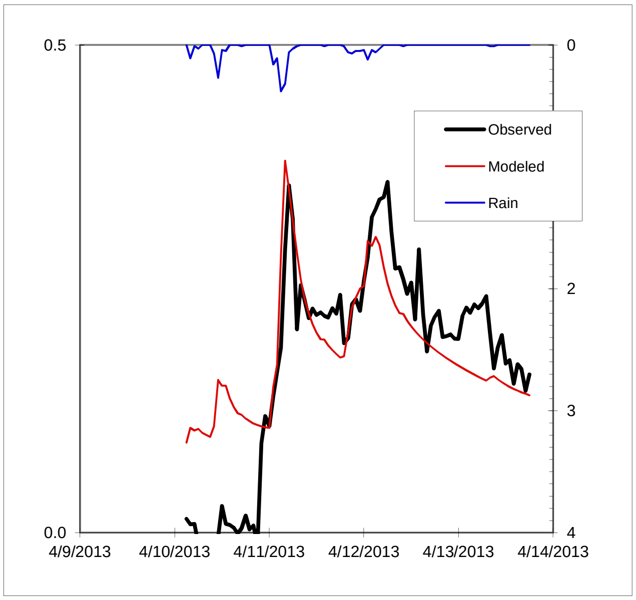
Net Average Error	7.8%		3.4%
Total Average Error	16.6%		3.4%

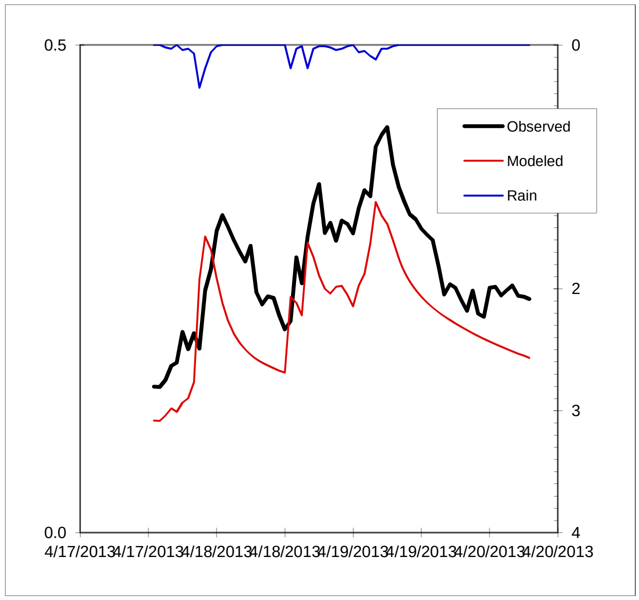
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Bromley District - Meter MH-2B - 2013

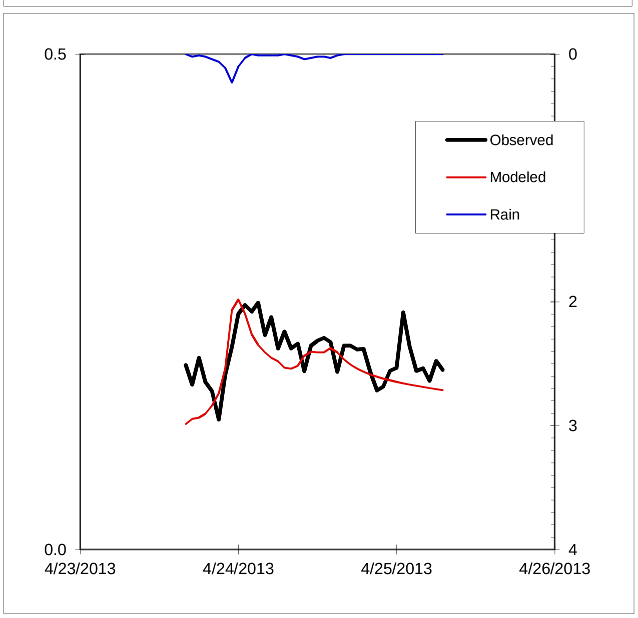
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.23	0.36	0.38	6.1%	56	59	4.8%	
04/17/13	1.76	0.42	0.34	-18.4%	66	53	-19.8%	
04/23/13	0.84	0.25	0.25	1.3%	29	27	-8.4%	
05/27/13	0.81	0.16	0.12	-24.9%	20	16	-20.4%	
06/09/13	1.59	0.16	0.17	5.6%	14	15	9.6%	
06/12/13	1.38	0.23	0.23	0.8%	17	18	5.9%	
06/27/13	2.9	0.43	0.41	-5.9%	34	32	-6.6%	
07/09/13	1.16	0.21	0.23	12.2%	6	6	4.4%	
08/12/13	3.01	0.29	0.35	21.0%	12	14	18.0%	

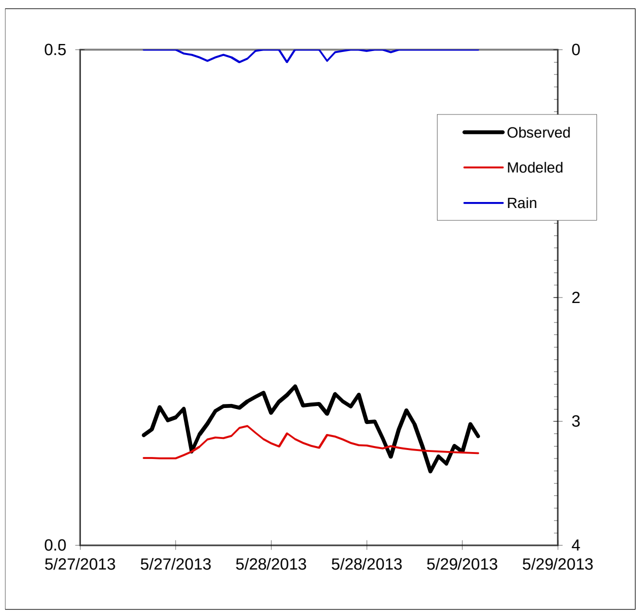
Net Average Error	-0.2%		-1.4%
Total Average Error	10.7%		10.9%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis

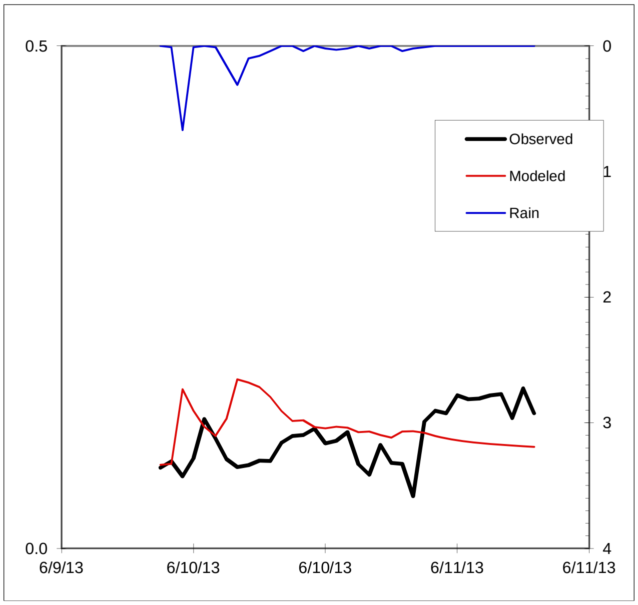


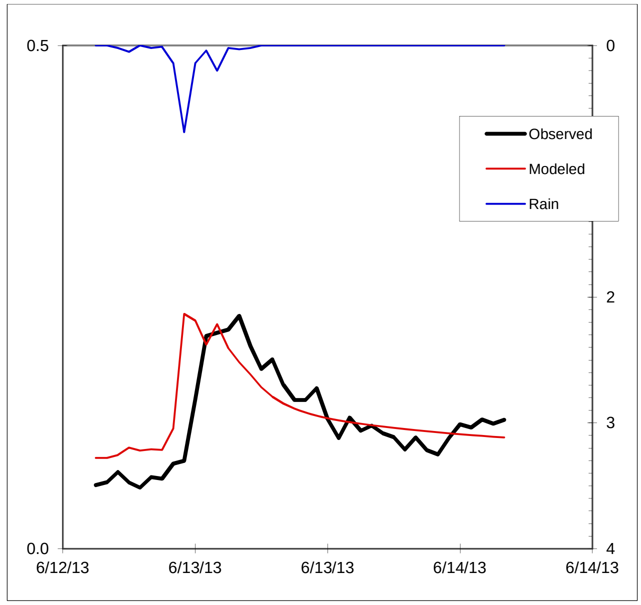


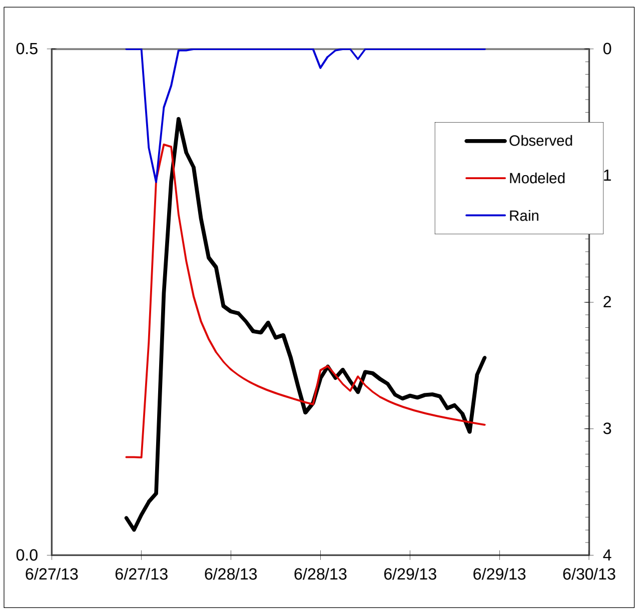


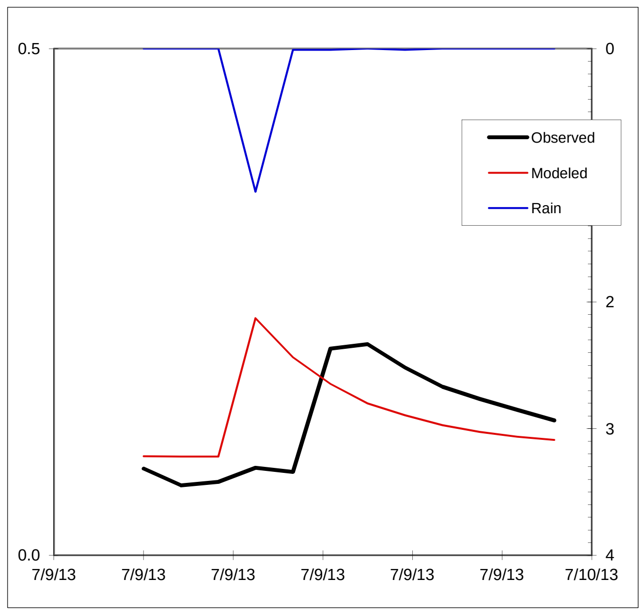


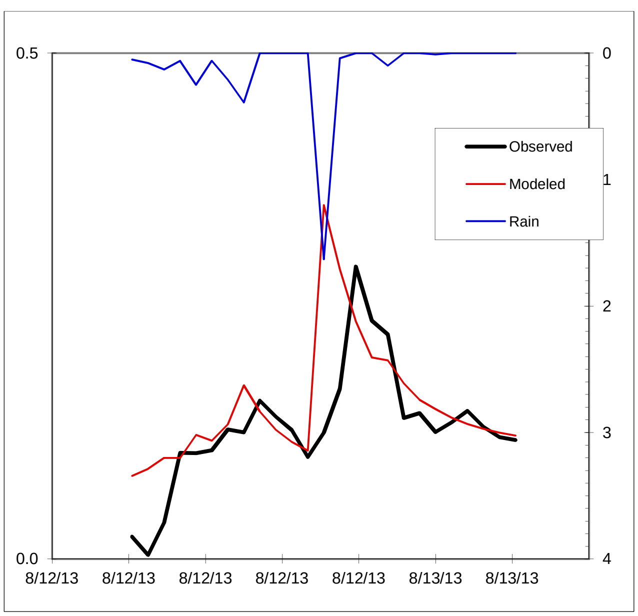
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Bromley District - Meter MH-2B - 2013











Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Bromley District - Meter MH-2B - 2013

Calibration Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.23	0.36	0.38	6.1%	56	59	4.8%	
04/23/13	0.84	0.25	0.25	1.3%	29	27	-8.4%	
06/09/13	1.59	0.16	0.17	5.6%	14	15	9.0%	
06/27/13	2.9	0.43	0.41	-5.9%	34	32	-6.6%	
08/12/13	3.01	0.29	0.35	21.6%	12	14	18.0%	

	Peak Flow Error		Volume Error
Net Average Error	5.6%		3.5%
Total Average Error	8.0%		9.5%

Validation Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/17/13	1.76	0.42	0.34	-18.4%	66	53	-19.8%	
05/27/13	0.81	0.16	0.12	-24.9%	20	16	-20.4%	
06/12/13	1.38	0.23	0.23	0.8%	17	18	5.9%	
07/09/13	1.16	0.21	0.23	12.2%	6	6	4.4%	

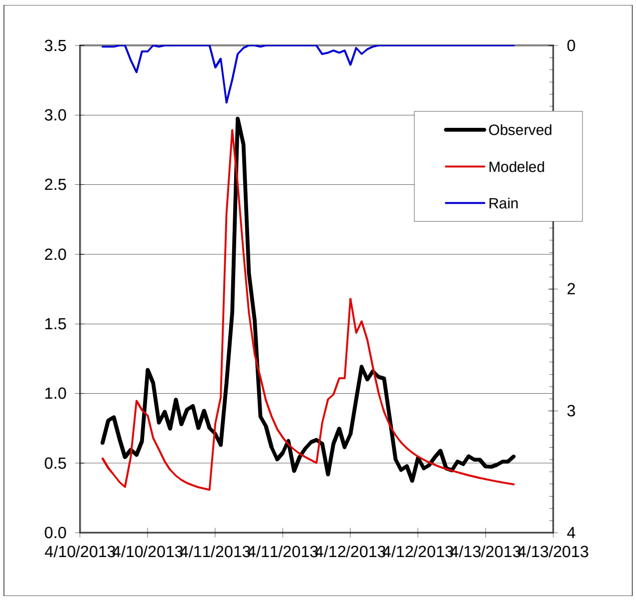
	Peak Flow Error		Volume Error
Net Average Error	-7.6%		-7.5%
Total Average Error	14.1%		12.6%

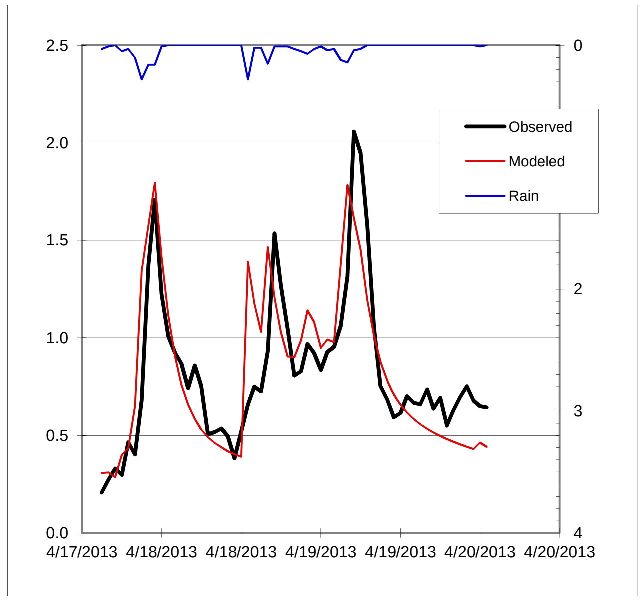
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Dartmoor District - Meter MH-2D - 2013

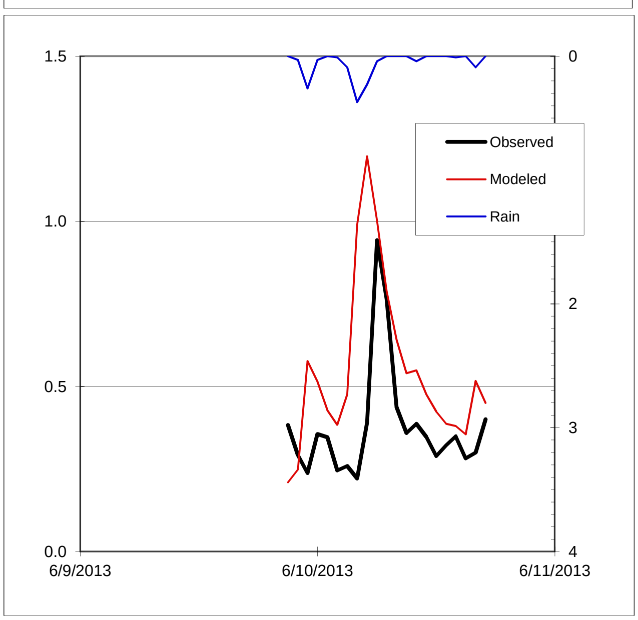
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.46	2.98	2.89	-2.8%	211	208	-1.5%	
04/17/13	1.93	2.06	1.80	-12.7%	175	177	0.9%	
06/09/13	1.2	0.94	1.20	26.9%	30	42	43.0%	
06/12/13	1.4	2.24	2.09	-6.5%	108	68	-36.8%	
06/26/13	2.4	3.03	3.40	12.5%	95	101	5.8%	
07/09/13	0.37	0.71	0.65	-7.7%	19	17	-10.4%	
08/12/13	2.21	1.76	1.50	-14.7%	75	77	3.3%	

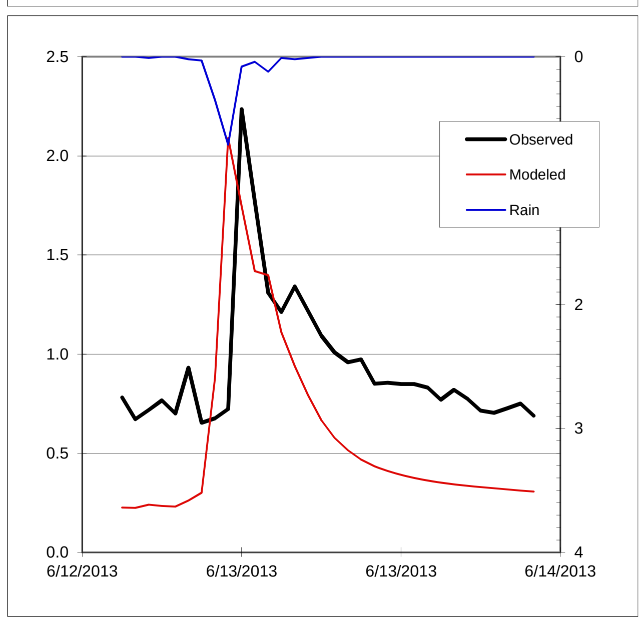
Net Average Error	-0.7%		0.7%
Total Average Error	12.0%		14.6%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis

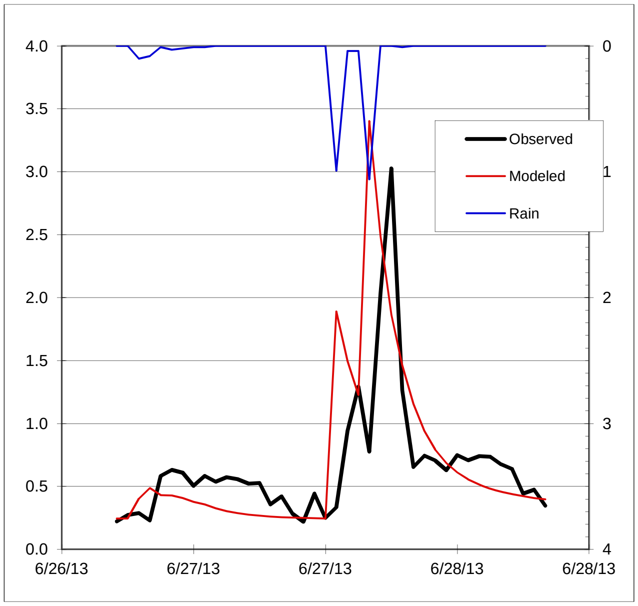


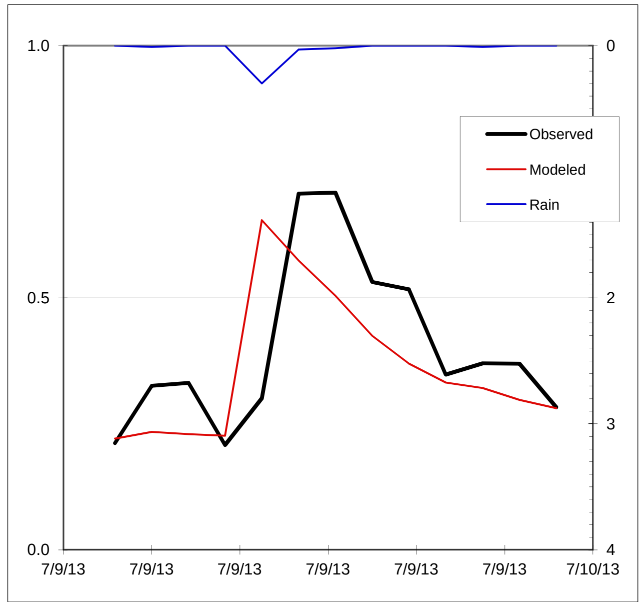


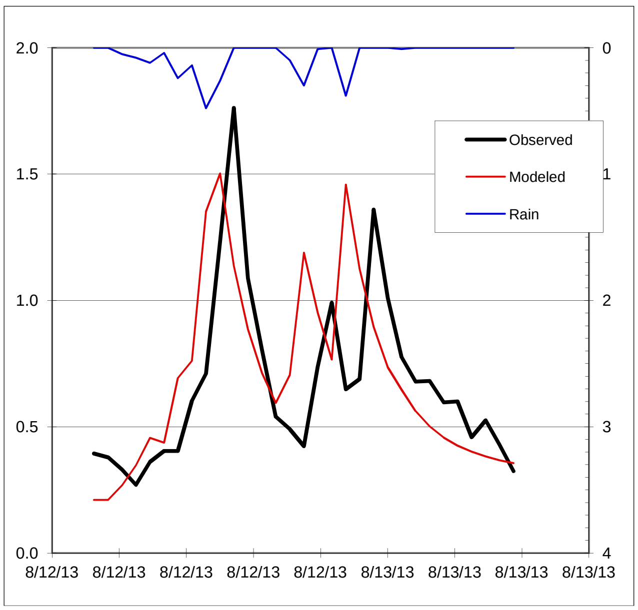




Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Dartmoor District - Meter MH-2D - 2013







Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Dartmoor District - Meter MH-2D - 2013

Calibration Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.46	2.98	2.89	-2.8%	211	208	-1.5%	
06/09/13	1.2	0.94	1.20	26.9%	30	42	43.0%	
06/26/13	2.4	3.03	3.40	12.5%	95	101	5.8%	
08/12/13	2.21	1.76	1.50	-14.7%	75	77	3.8%	

Net Average Error	5.5%		12.8%
Total Average Error	14.3%		13.5%

Validation Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/17/13	1.93	2.06	1.80	-12.7%	175	177	0.9%	
06/12/13	1.4	2.24	2.09	-6.5%	108	68	-36.8%	
07/09/13	0.37	0.71	0.65	-7.7%	19	17	-10.4%	

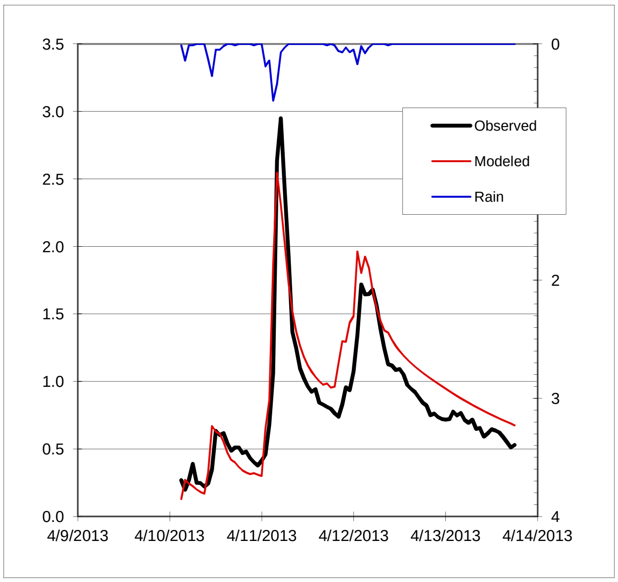
Net Average Error	-9.0%		-15.5%
Total Average Error	9.0%		16.0%

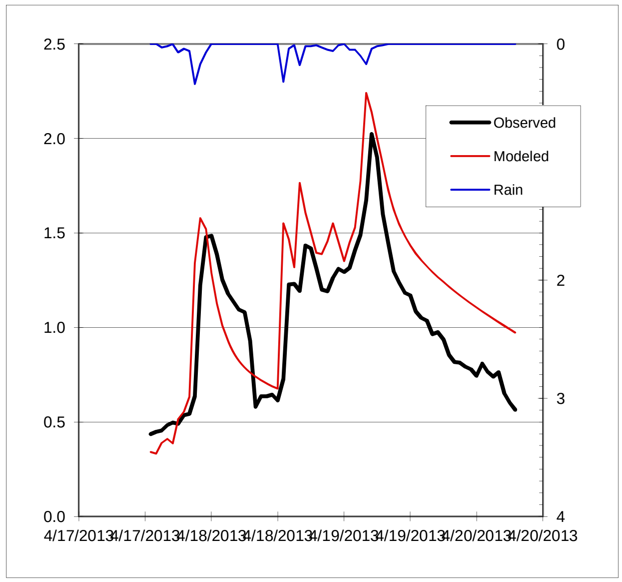
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Glen Leven District - Meters MH-11 & MH-102 - 2013

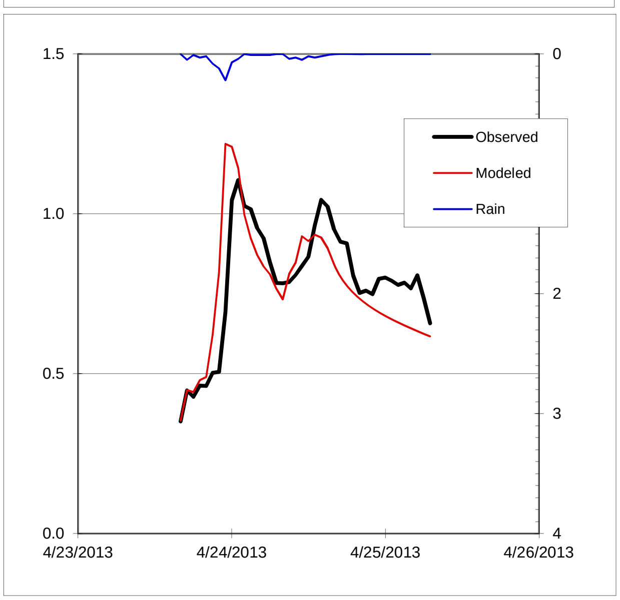
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.57	2.95	2.55	-13.6%	273	308	12.9%	
04/17/13	2	2.02	2.24	10.8%	247	288	16.7%	
04/23/13	0.88	1.11	1.22	10.2%	114	112	-2.6%	
05/27/13	0.89	0.46	0.48	4.9%	45	41	-9.4%	
06/09/13	1.16	0.76	0.87	15.2%	45	46	4.1%	
06/12/13	1.35	1.54	1.42	-7.8%	82	63	-23.3%	
06/27/13	2.65	2.68	1.63	-39.0%	183	117	-36.5%	
07/08/13	0.24	0.68	0.56	-17.9%	53	36	-31.7%	
08/12/13	2.73	1.02	1.66	62.5%	57	89	56.1%	

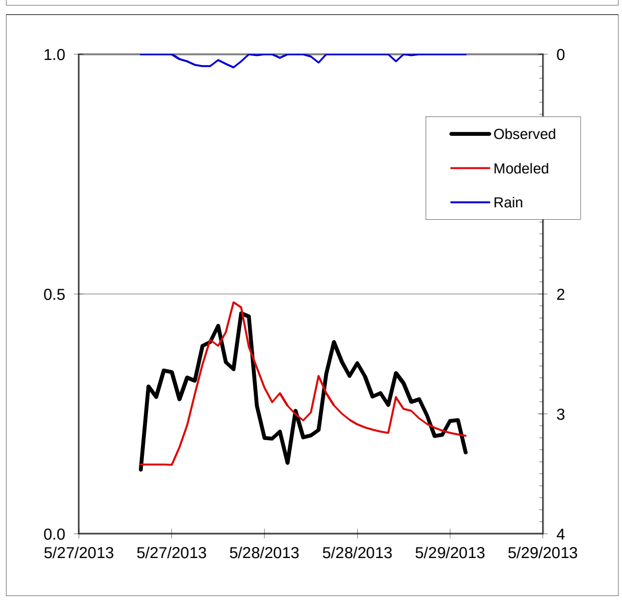
Net Average Error	2.8%		-1.5%
Total Average Error	20.2%		21.5%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

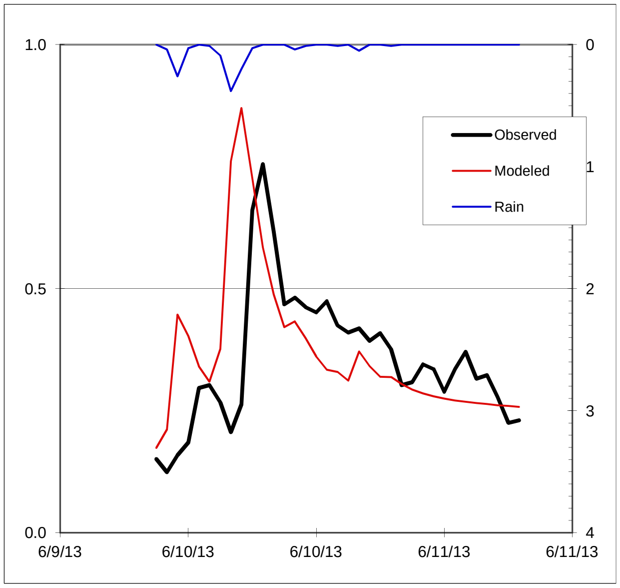


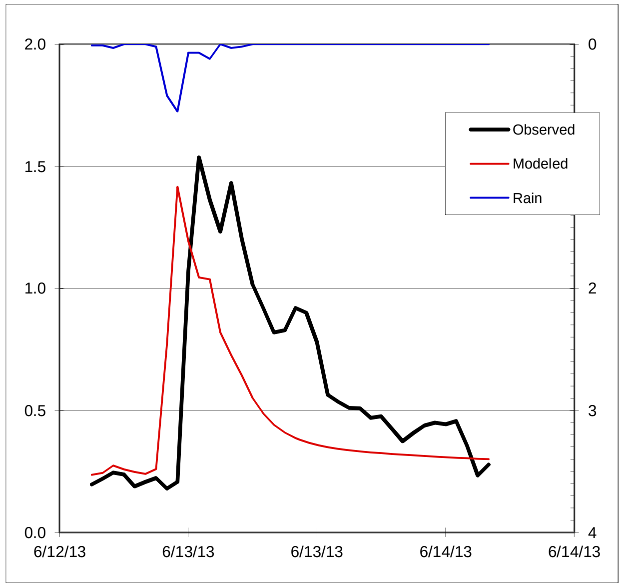


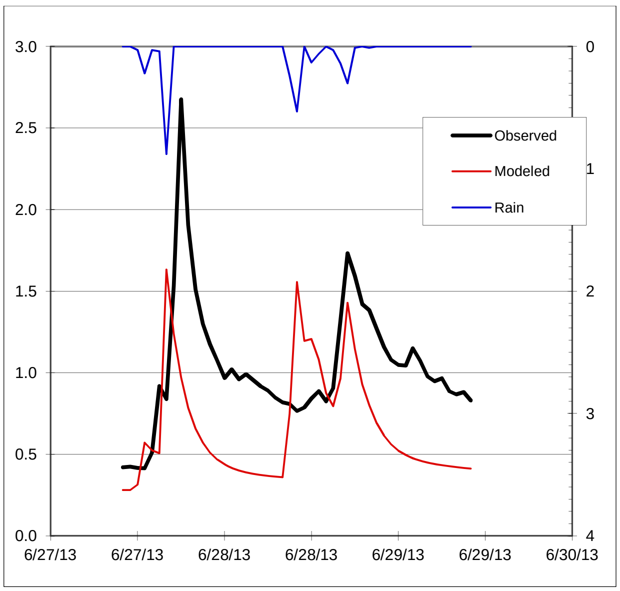


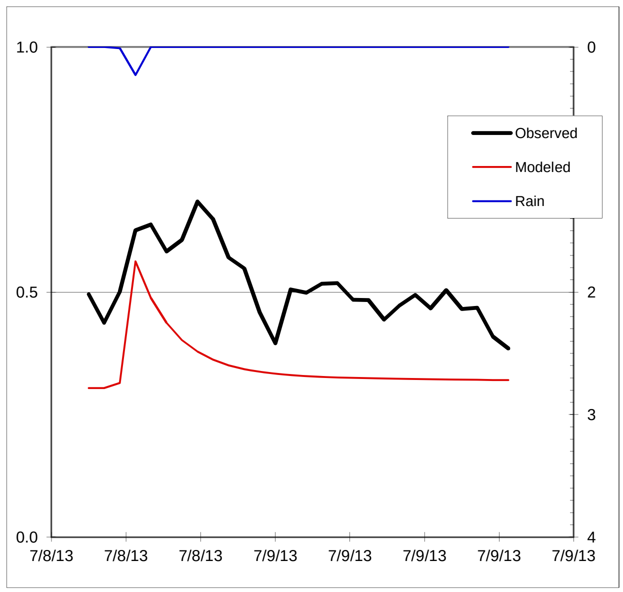


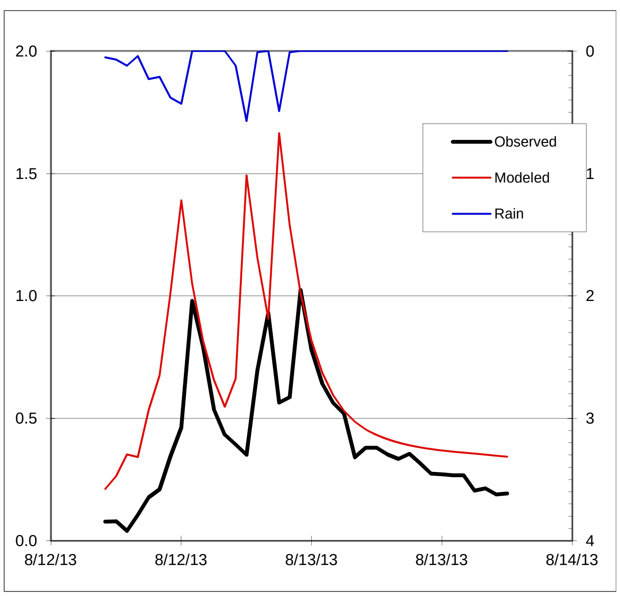
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Glen Leven District - Meters MH-11 & MH-102 - 2013











Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Glen Leven District - Meters MH-11 & MH-102 - 2013

Calibration Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.57	2.95	2.55	-13.6%	273	308	12.9%	
04/23/13	0.88	1.11	1.22	10.2%	114	112	-2.6%	
06/09/13	1.16	0.76	0.87	15.2%	45	46	4.1%	
06/27/13	2.65	2.68	1.63	-39.0%	183	117	-36.5%	
08/12/13	2.73	1.02	1.66	62.5%	57	89	56.1%	

Net Average Error	7.1%		6.8%
Total Average Error	28.1%		22.4%

Validation Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/17/13	2.00	2.02	2.24	10.8%	247	288	16.7%	
05/27/13	0.89	0.46	0.48	4.9%	45	41	-9.4%	
06/12/13	1.35	1.54	1.42	-7.8%	82	63	-23.3%	
07/08/13	0.24	0.68	0.56	-17.9%	53	36	-31.7%	

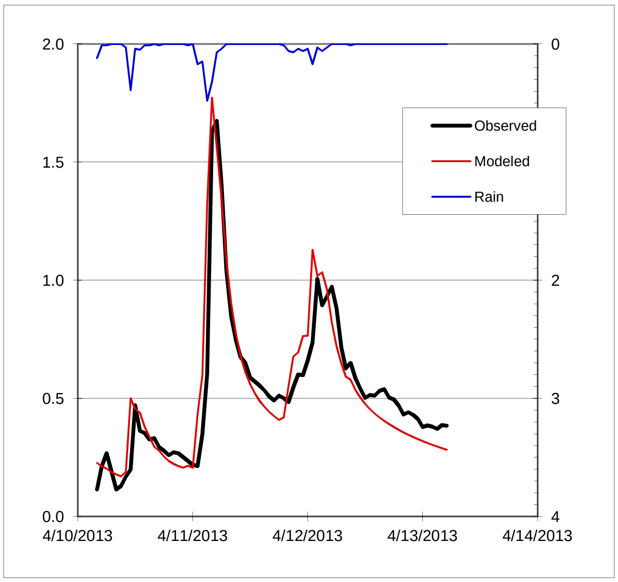
Net Average Error	-2.5%		-11.9%
Total Average Error	10.4%		20.3%

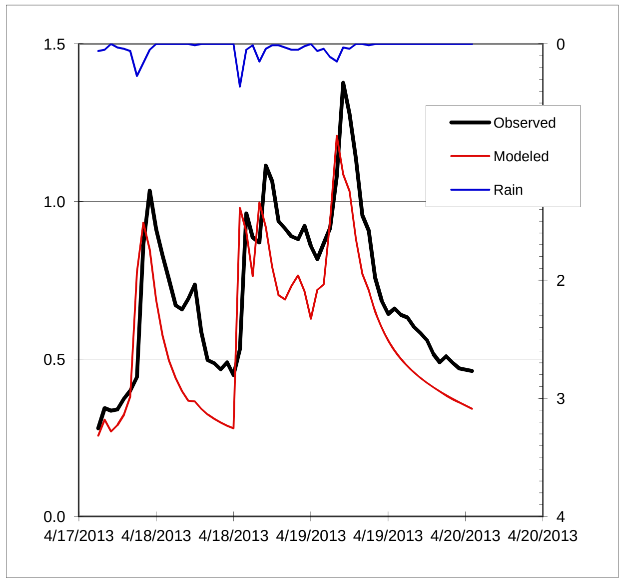
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Morehead District - Meter MH-49M - 2013

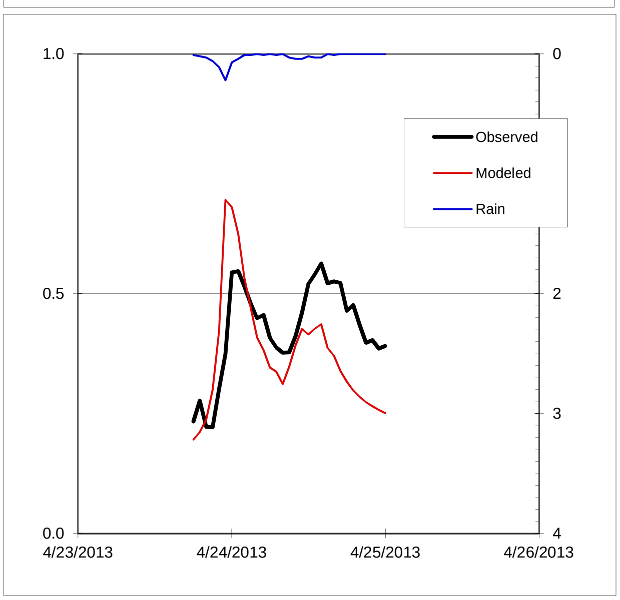
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.5	1.67	1.77	5.8%	140	141	0.1%	
04/17/13	1.95	1.38	1.21	-12.3%	152	125	-17.9%	
04/23/13	0.83	0.56	0.70	23.6%	48	43	-11.7%	
05/27/13	0.89	0.29	0.34	16.1%	28	29	3.1%	
06/09/13	1.29	0.59	0.64	8.3%	21	24	12.6%	
06/12/13	1.55	1.27	0.99	-21.8%	50	40	-21.4%	
06/26/13	1.35	1.42	0.79	-44.5%	45	36	-18.5%	
07/08/13	0.23	0.21	0.28	34.3%	6	7	21.6%	
08/12/13	2.81	0.97	0.94	-3.9%	38	45	17.6%	

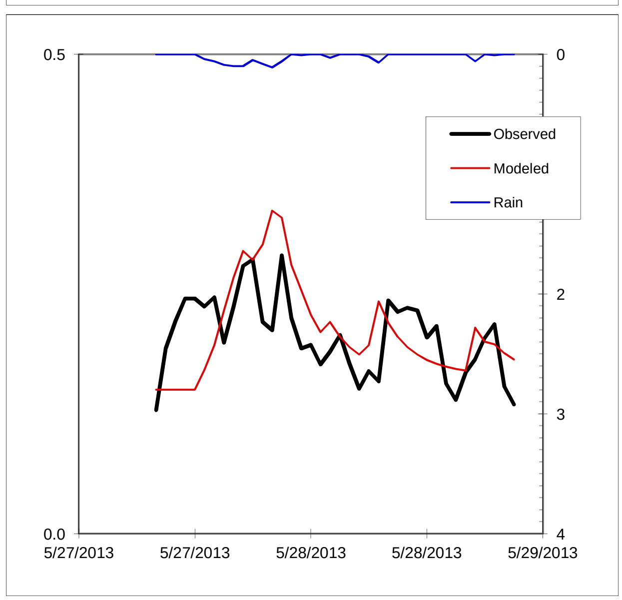
Net Average Error	0.6%		-1.6%
Total Average Error	19.0%		13.8%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

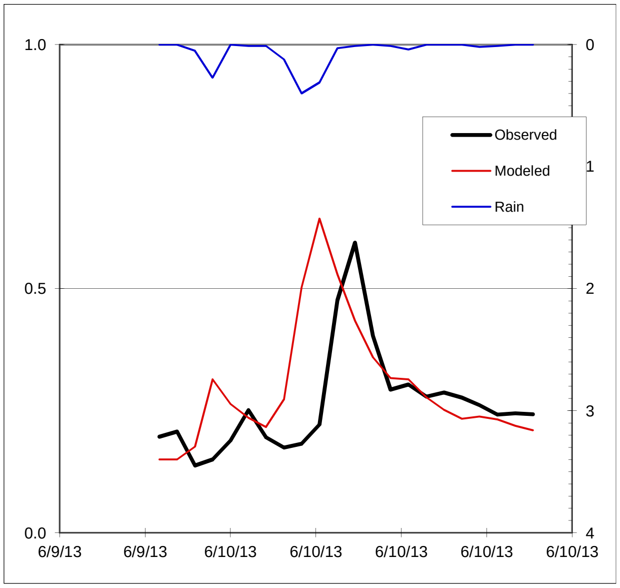


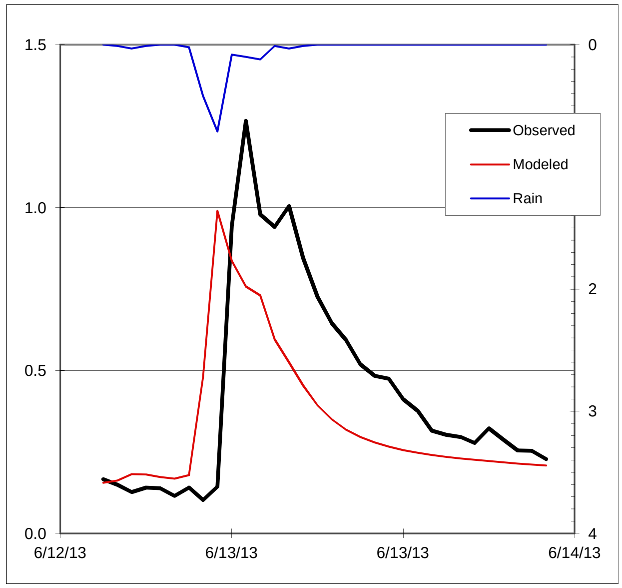


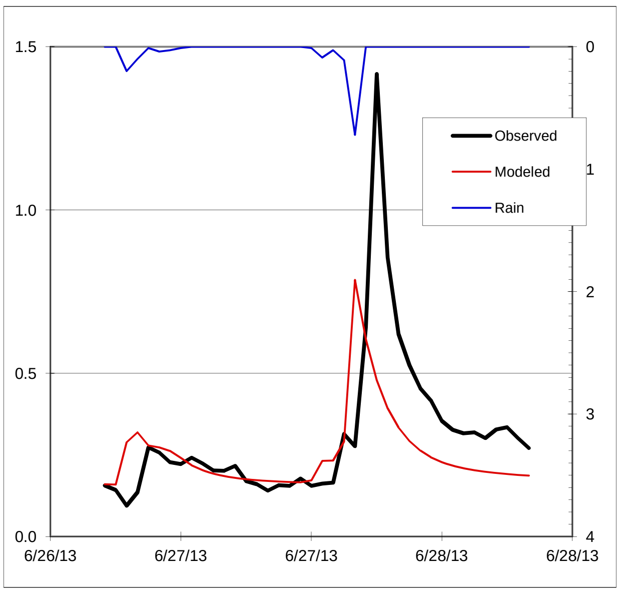


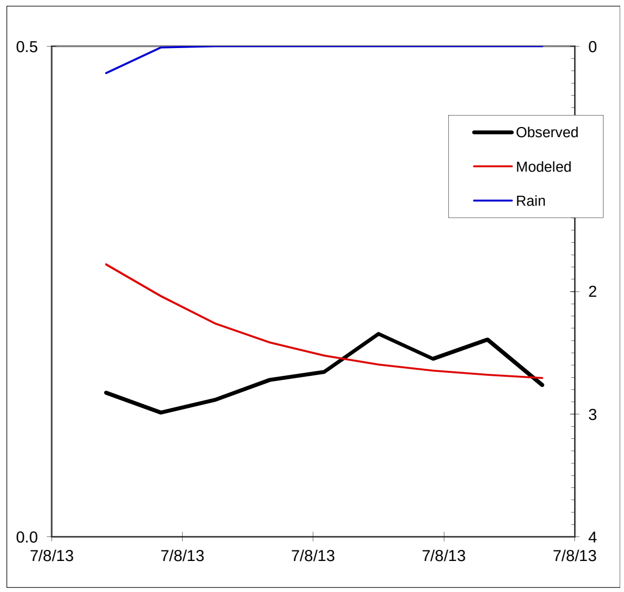


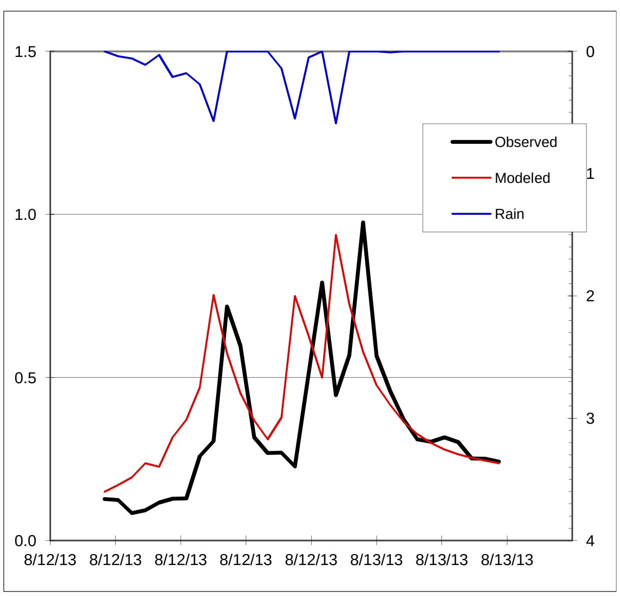
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Morehead District - Meter MH-49M - 2013











Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Morehead District - Meter MH-49M - 2013

Calibration Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/10/13	2.5	1.67	1.77	5.8%	140	141	0.1%	
04/23/13	0.83	0.56	0.70	23.6%	48	43	-11.7%	
06/09/13	1.29	0.59	0.64	8.3%	21	24	12.6%	
06/26/13	1.35	1.42	0.79	-44.5%	45	36	-18.5%	
08/12/13	2.81	0.97	0.94	-3.2%	38	45	17.6%	

Net Average Error	-2.2%		0.0%
Total Average Error	17.2%		12.1%

Validation Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/17/13	1.95	1.38	1.21	-12.5%	152	125	-17.9%	
05/27/13	0.89	0.29	0.34	16.1%	28	29	3.1%	
06/12/13	1.55	1.27	0.99	-21.8%	50	40	-21.4%	
07/08/13	0.23	0.21	0.28	34.3%	6	7	21.6%	

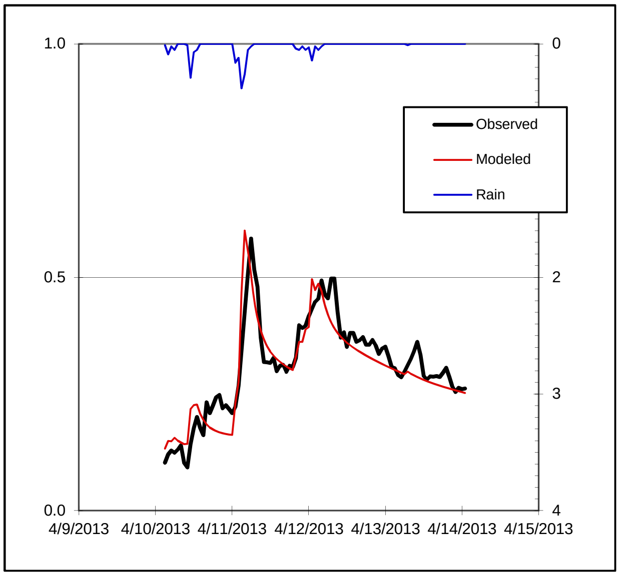
Net Average Error	4.1%		-3.7%
Total Average Error	21.1%		16.0%

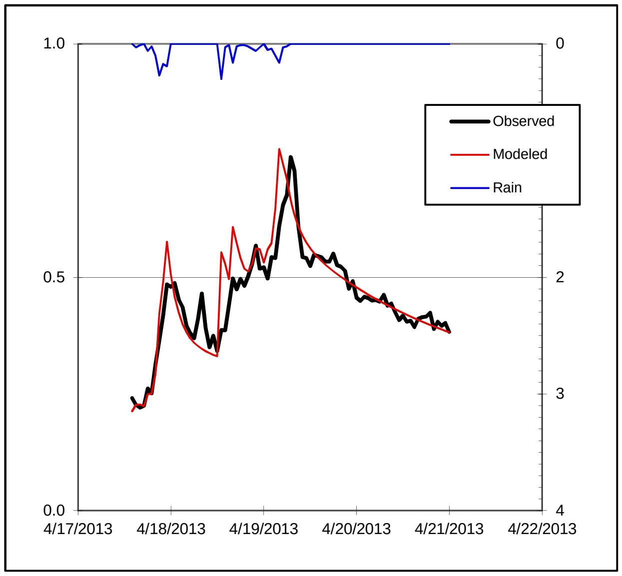
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 1A - 2013

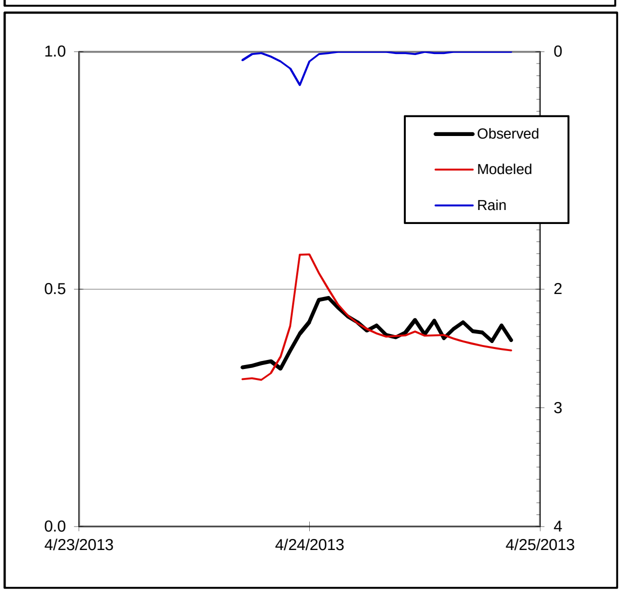
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.01	0.58	0.60	2.9%	107	104	-2.7%	
04/17/13	1.94	0.76	0.78	2.3%	137	140	2.1%	
04/23/13	0.81	0.48	0.57	19.0%	44	44	0.2%	
05/27/13	0.81	0.28	0.20	-27.8%	28	24	-14.8%	
06/10/13	1.25	0.31	0.36	13.5%	22	24	11.9%	
06/12/13	1.47	0.61	0.55	-10.0%	53	56	5.1%	

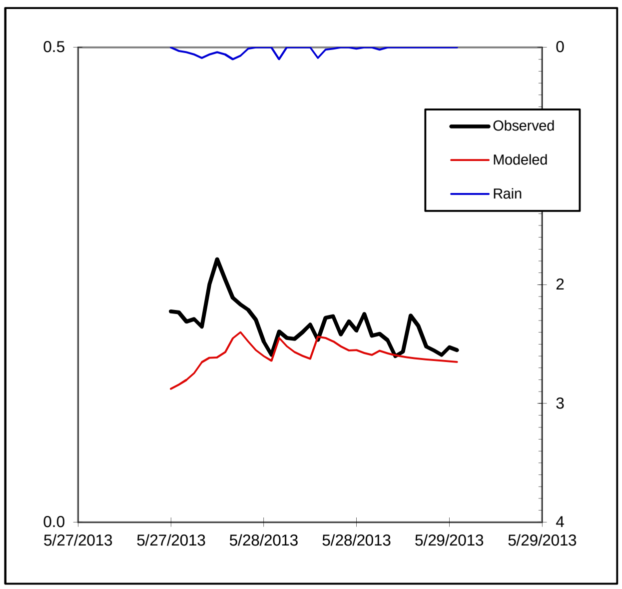
Net Average Error	0.0%		0.3%
Total Average Error	12.6%		6.1%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

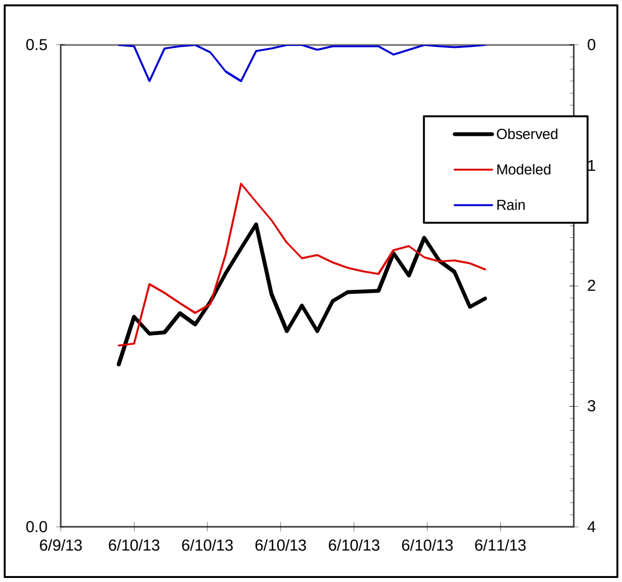


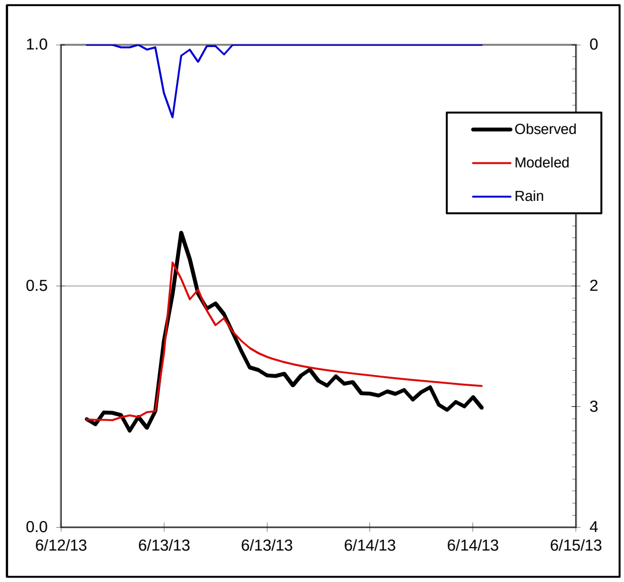






Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 1A - 2013





Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 1A - 2013

Calibration Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/10/13	2.01	0.58	0.60	2.9%	107	104	-2.7%	
04/23/13	0.81	0.48	0.57	19.0%	44	44	0.2%	
06/10/13	1.25	0.31	0.36	13.5%	22	24	11.9%	

Net Average Error	11.8%		3.1%
Total Average Error	11.8%		4.9%

Validation Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/17/13	1.94	0.76	0.78	2.3%	137	140	2.1%	
05/27/13	0.81	0.28	0.20	-27.8%	28	24	-14.8%	
06/12/13	1.47	0.61	0.55	-10.0%	53	56	5.1%	

Net Average Error	-11.8%		-2.5%
Total Average Error	13.4%		7.3%

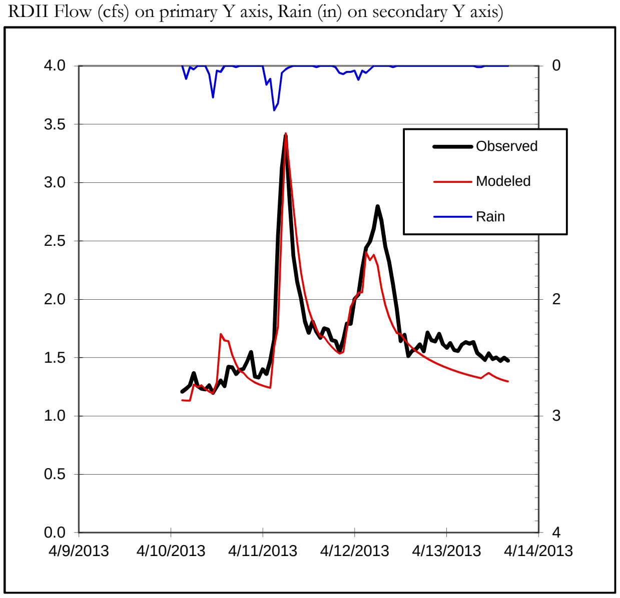
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis

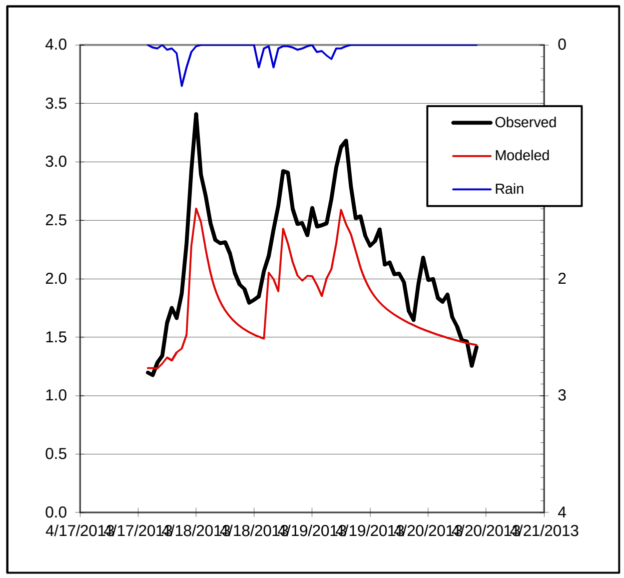
Meter 10A - 2013

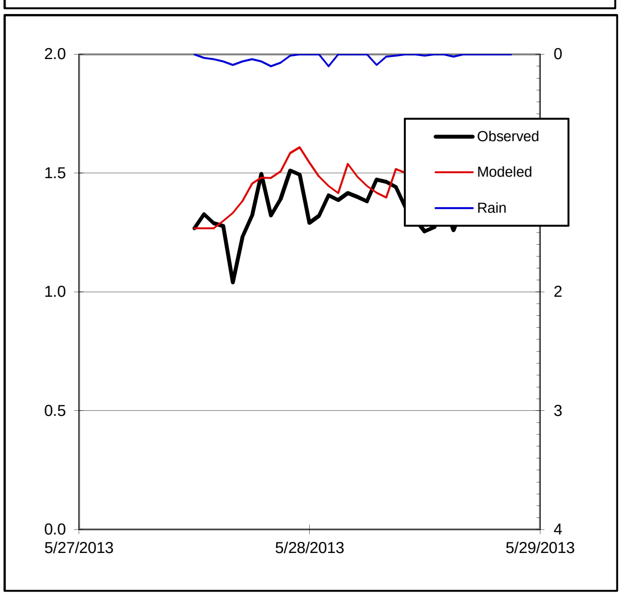
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.23	3.40	3.42	0.6%	538	510	-5.2%	
04/17/13	1.76	3.41	2.60	-23.7%	543	448	-17.5%	
05/27/13	0.81	1.51	1.61	6.6%	169	179	6.0%	
06/09/13	1.59	1.87	2.17	16.4%	154	174	12.7%	
06/12/13	1.25	3.51	2.50	-28.7%	341	304	-10.7%	
06/27/13	2.6	3.97	4.20	5.9%	140	153	10.0%	
08/12/13	1.92	2.30	2.83	22.8%	259	264	1.7%	
04/23/13	0.57	2.03	2.17	6.8%	68	70	3.4%	

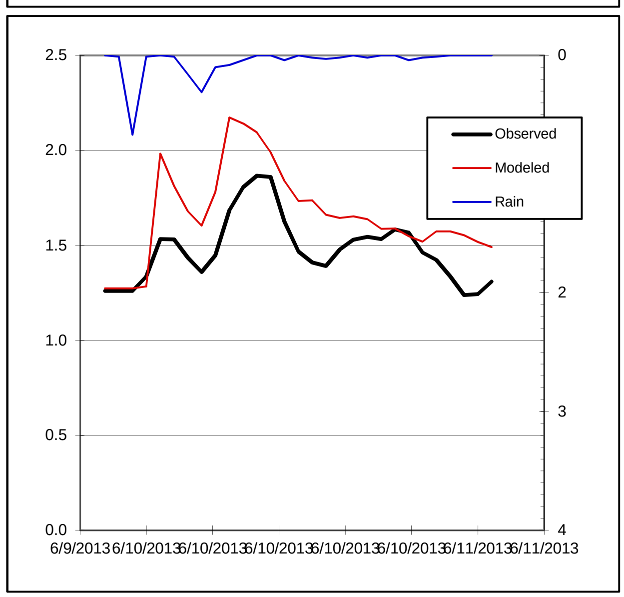
	Peak Flow Error (%)		Volume Error (%)
Net Average Error	0.8%		0.0%
Total Average Error	14.0%		8.4%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

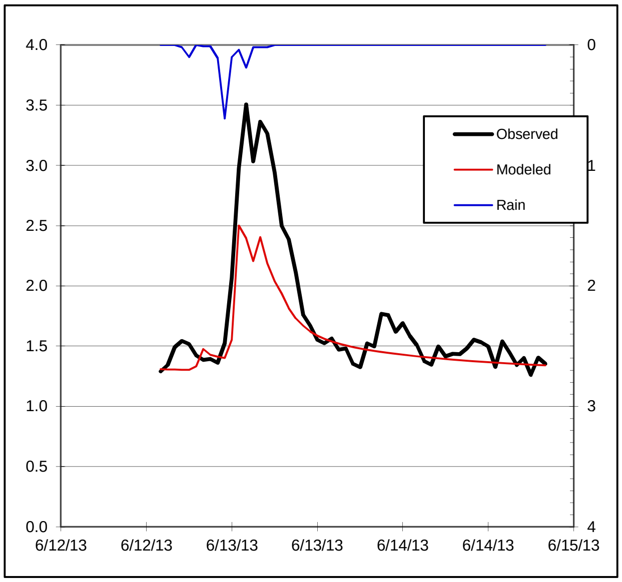


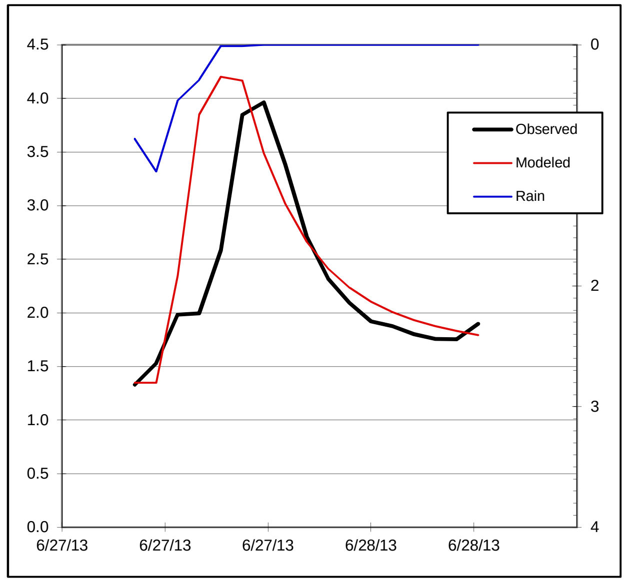


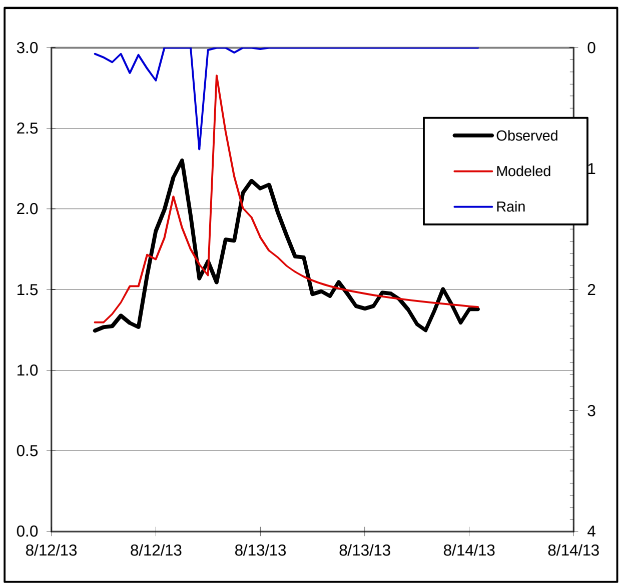


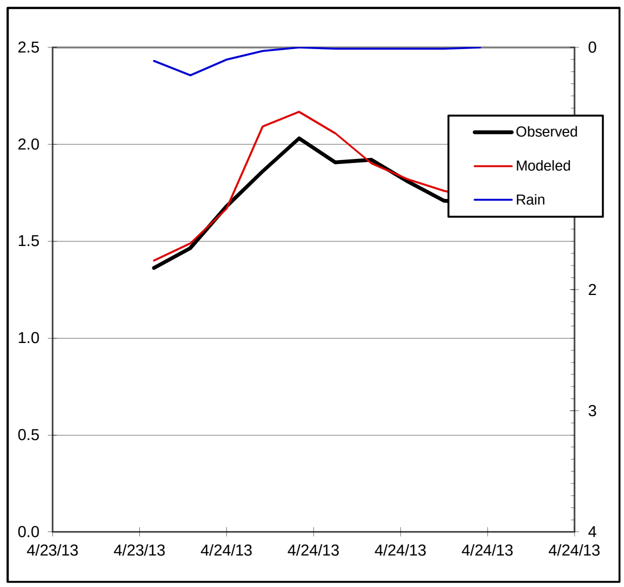


Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 10A - 2013









Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 10A - 2013

Calibration Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.23	3.40	3.42	0.6%	538	510	-5.2%	
05/27/13	0.81	1.51	1.61	6.6%	169	179	6.0%	
06/12/13	1.25	3.51	2.50	-28.7%	341	304	-10.7%	
08/12/13	1.92	2.30	2.83	22.8%	259	264	1.7%	

	Peak Flow Error (%)		Volume Error (%)
Net Average Error	0.3%		-2.1%
Total Average Error	14.7%		5.9%

Validation Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/17/13	1.76	3.41	2.60	-23.7%	543	448	-17.5%	
06/09/13	1.59	1.87	2.17	16.4%	154	174	12.7%	
06/27/13	2.6	3.97	4.20	5.9%	140	153	10.0%	
04/23/13	0.57	2.03	2.17	6.8%	68	70	3.4%	

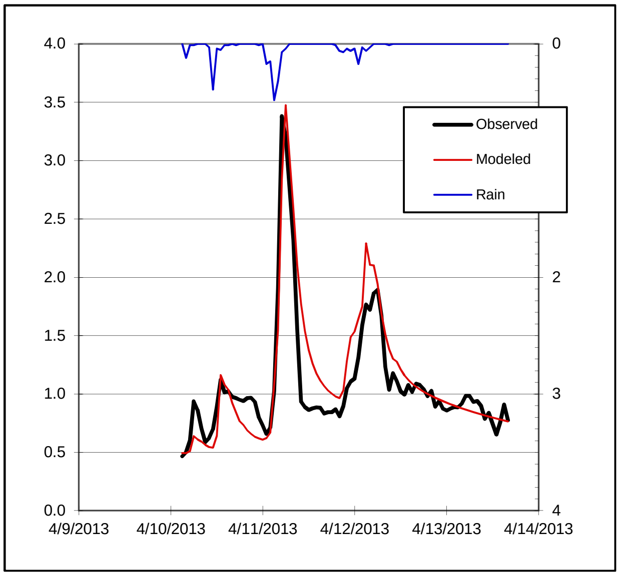
	Peak Flow Error (%)		Volume Error (%)
Net Average Error	1.4%		2.1%
Total Average Error	13.2%		10.9%

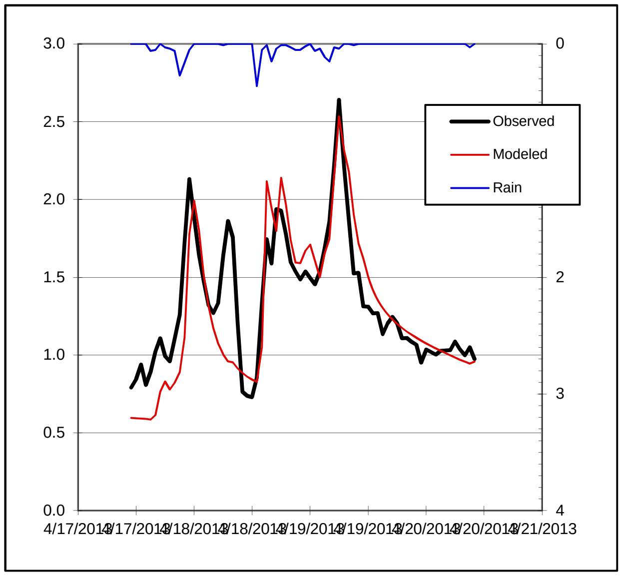
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 11B - 2013

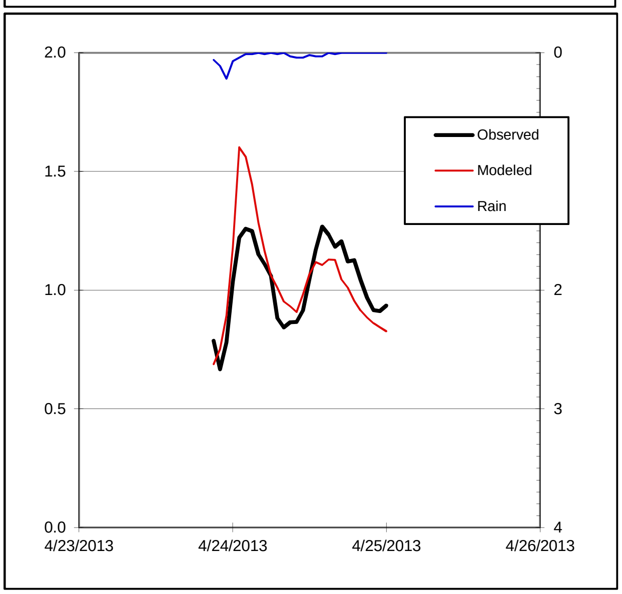
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.5	3.38	3.47	2.7%	335	354	5.7%	
04/17/13	1.98	2.64	2.53	-4.1%	349	337	-3.4%	
04/23/13	0.77	1.27	1.60	26.4%	106	108	1.5%	
05/27/13	0.89	0.72	0.87	21.7%	89	98	10.8%	
06/09/13	1.3	1.18	1.41	19.2%	96	101	4.9%	
06/12/13	1.55	2.60	1.99	-23.3%	129	119	-7.5%	
06/27/13	2.58	2.55	1.65	-35.3%	265	239	-9.8%	
08/12/13	2.77	1.83	1.84	0.6%	133	150	13.2%	

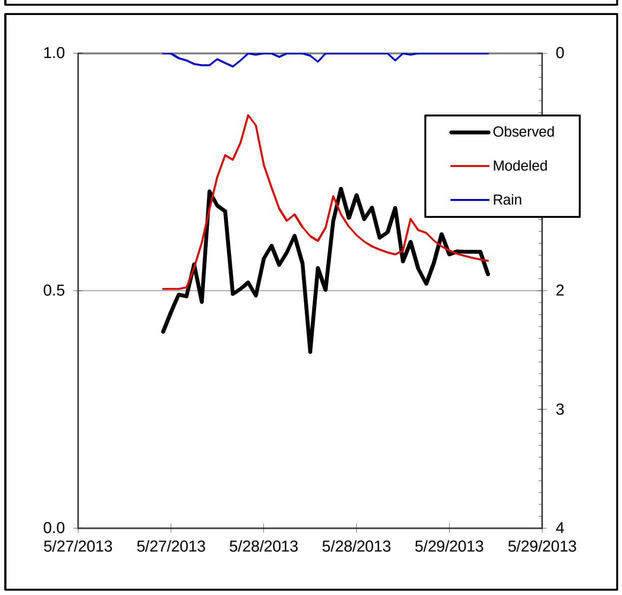
Net Average Error	1.0%		1.9%
Total Average Error	16.7%		7.1%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

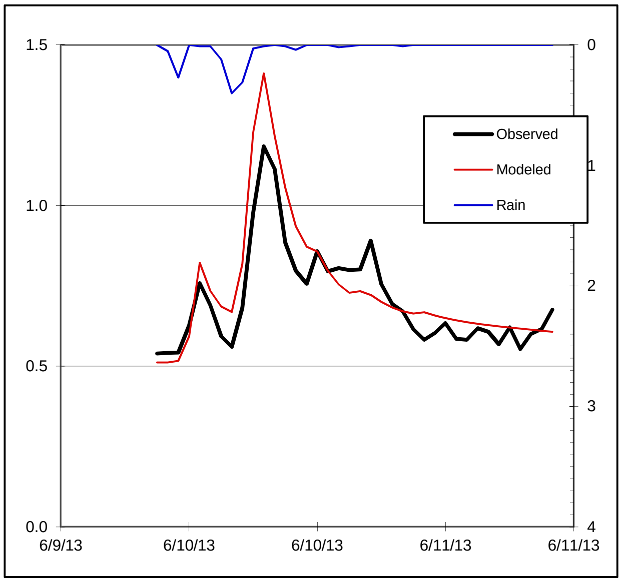


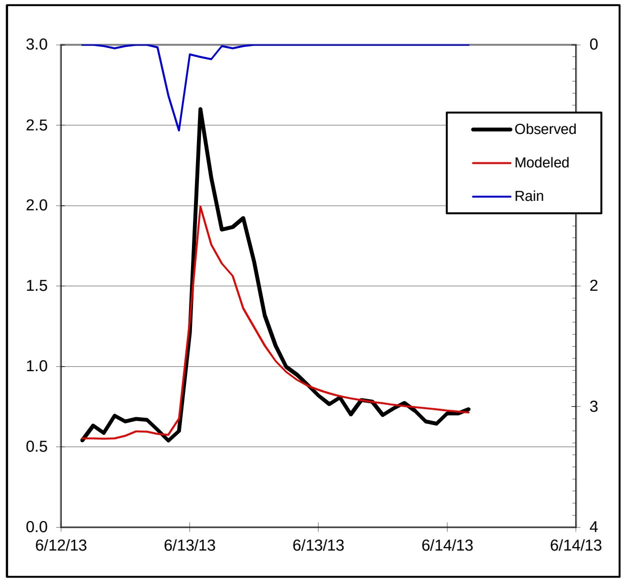


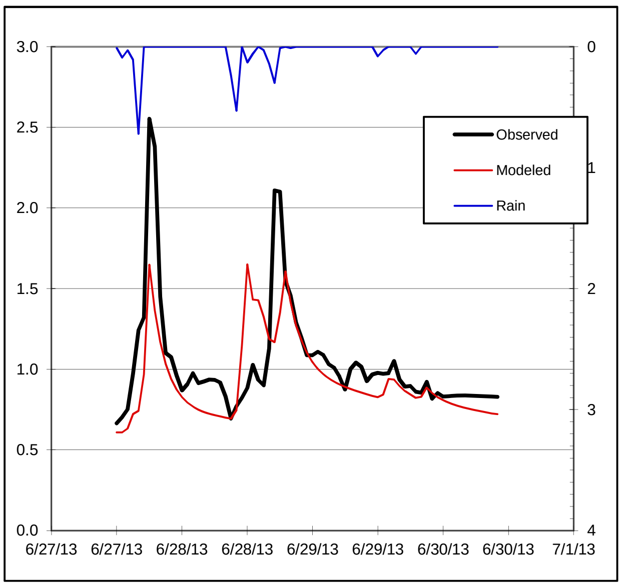


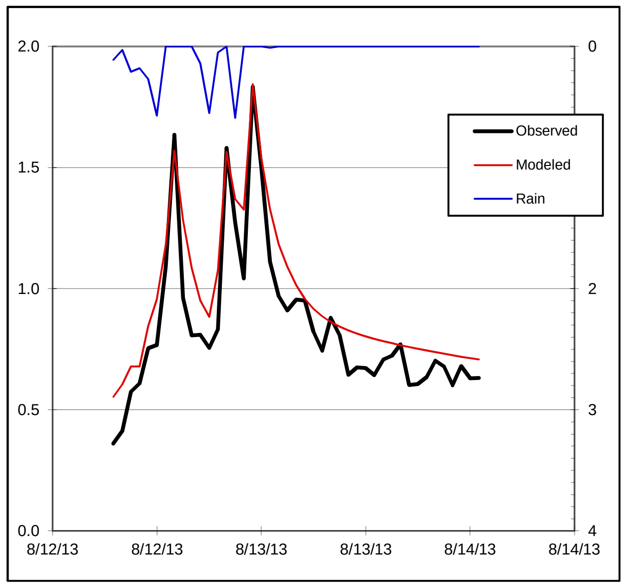


Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 11B - 2013









Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 11B - 2013

Calibration Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/10/13	2.5	3.38	3.47	2.7%	335	354	5.7%	
04/23/13	0.77	1.27	1.60	26.4%	106	108	1.5%	
06/09/13	1.3	1.18	1.41	19.2%	96	101	4.9%	
06/27/13	2.58	2.55	1.65	-35.3%	265	239	-9.8%	

Net Average Error	3.2%		0.6%
Total Average Error	20.9%		5.5%

Validation Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/17/13	1.98	2.64	2.53	-4.1%	349	337	-3.4%	
05/27/13	0.89	0.72	0.87	21.7%	89	98	10.8%	
06/12/13	1.55	2.60	1.99	-23.3%	129	119	-7.5%	
08/12/13	2.77	1.83	1.84	0.6%	133	150	13.2%	

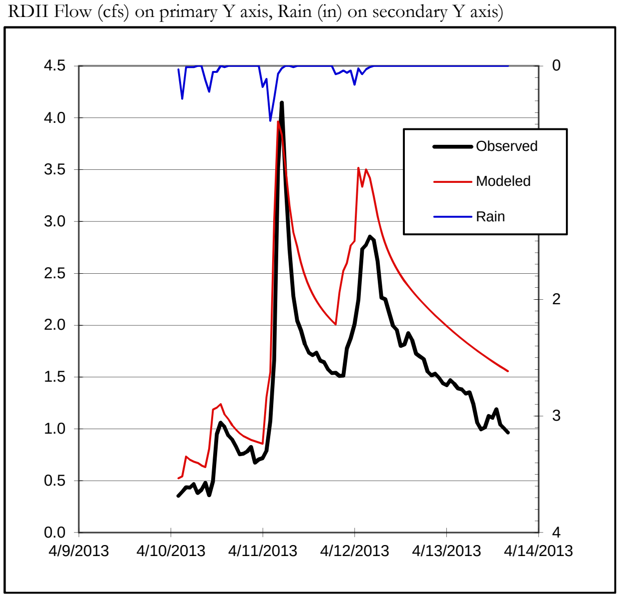
Net Average Error	-1.3%		3.3%
Total Average Error	12.4%		8.7%

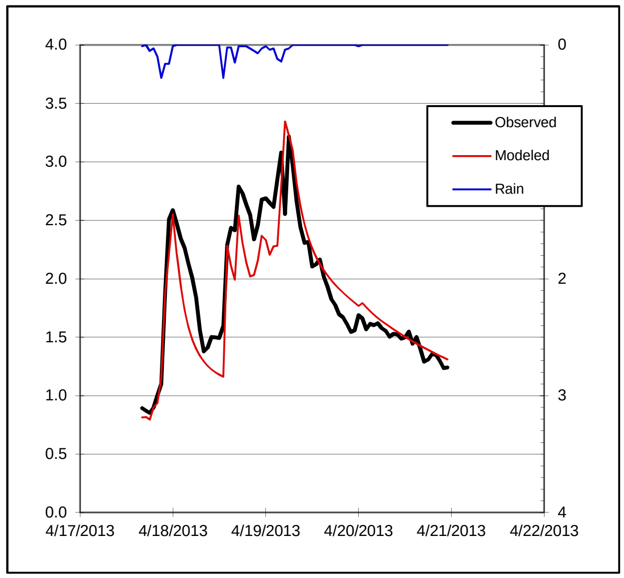
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 12A - 2013

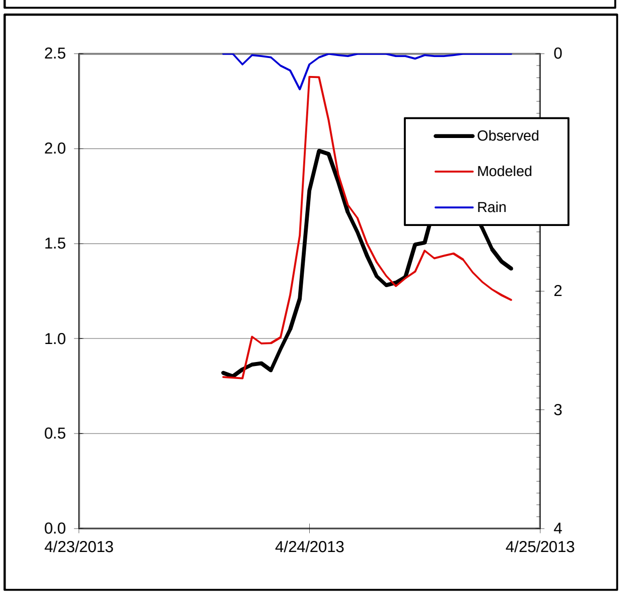
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.49	4.15	3.96	-4.4%	467	621	32.8%	
04/17/13	1.93	3.22	3.35	4.0%	547	526	-3.8%	
04/23/13	0.98	1.99	2.38	19.6%	158	157	-0.2%	
06/09/13	1.21	1.50	1.54	2.7%	106	119	12.2%	
06/12/13	1.4	2.90	2.80	-3.4%	212	180	-15.2%	
06/27/13	2.73	5.82	4.64	-20.2%	359	234	-34.7%	
08/12/13	2.21	1.78	1.92	7.9%	82	91	10.3%	

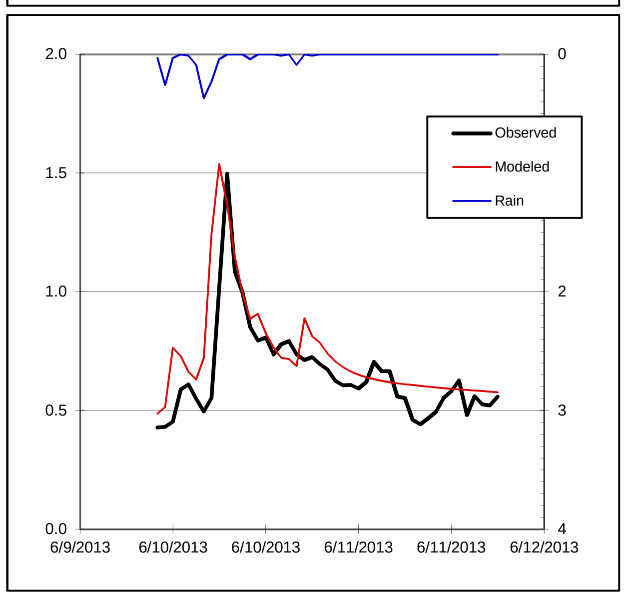
Net Average Error	0.9%		0.2%
Total Average Error	8.9%		15.6%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

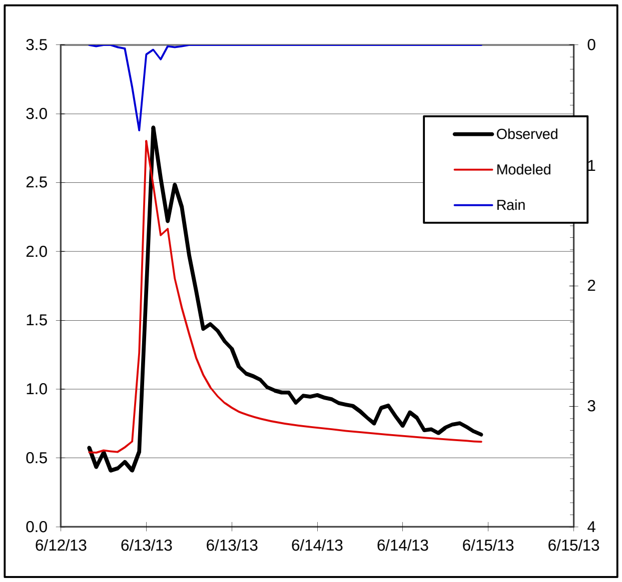


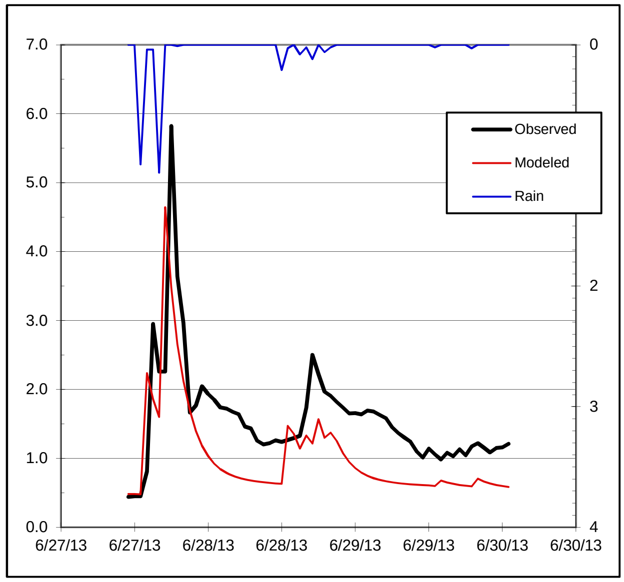


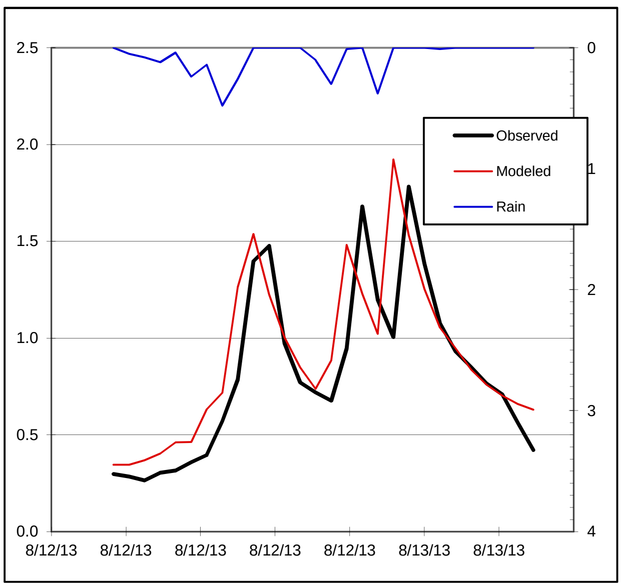




Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 12A - 2013







Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 12A - 2013

Calibration Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/10/13	2.49	4.15	3.96	-4.4%	467	621	32.8%	
04/23/13	0.98	1.99	2.38	19.6%	158	157	-0.2%	
06/12/13	1.4	2.90	2.80	-3.4%	212	180	-15.2%	
08/12/13	2.21	1.78	1.92	7.9%	82	91	10.5%	

Net Average Error	4.9%		6.9%
Total Average Error	8.8%		14.7%

Validation Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/17/13	1.93	3.22	3.35	4.0%	547	526	-3.8%	
06/09/13	1.21	1.50	1.54	2.7%	106	119	12.2%	
06/27/13	2.73	5.82	4.64	-20.2%	359	234	-34.7%	

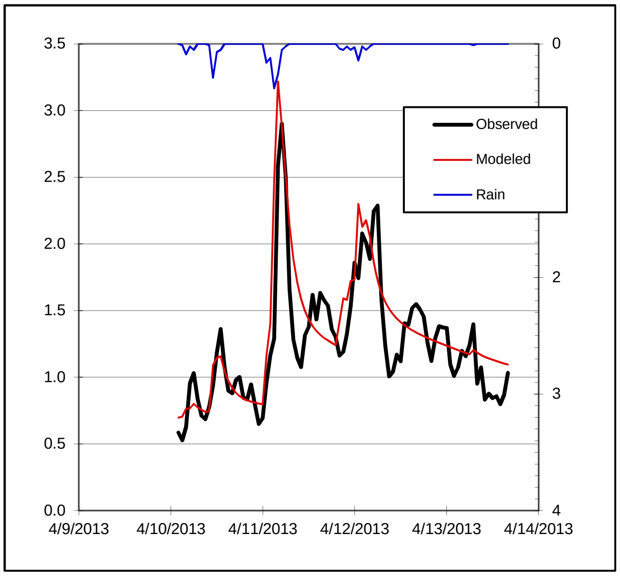
Net Average Error	-4.5%		-8.8%
Total Average Error	9.0%		16.9%

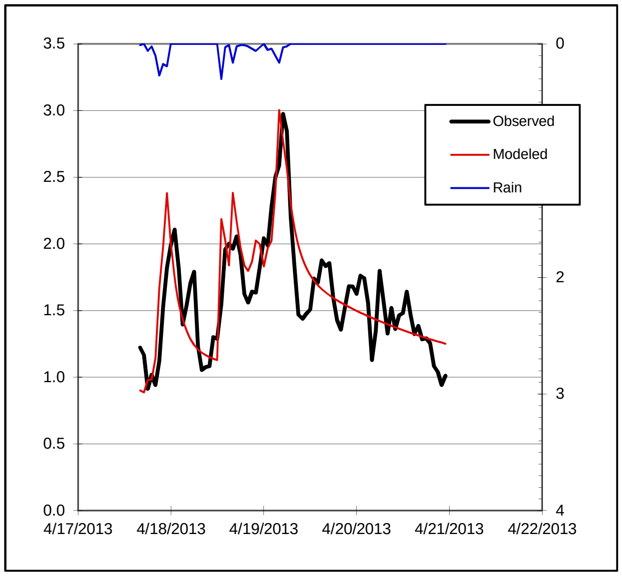
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 3B - 2013

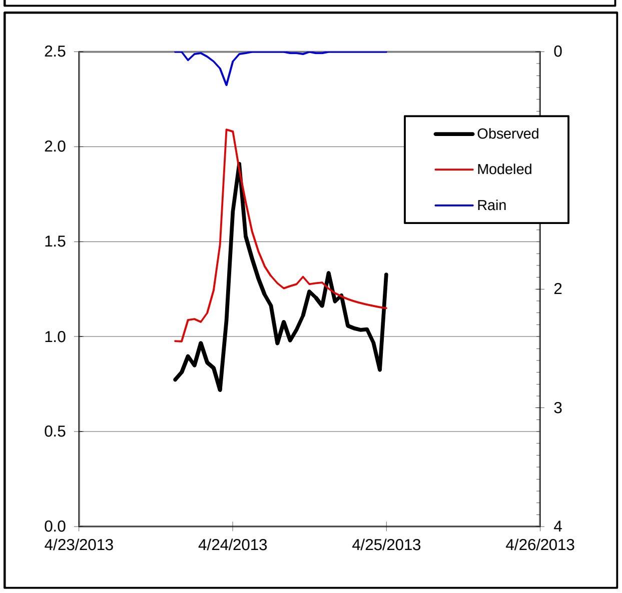
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.01	2.90	3.22	10.9%	395	421	6.8%	
04/17/13	1.94	2.97	3.01	1.0%	464	469	1.3%	
04/23/13	0.81	1.91	2.09	9.5%	139	164	18.2%	
06/09/13	1.25	1.71	1.47	-13.6%	151	148	-2.2%	
06/12/13	1.47	2.49	2.44	-2.1%	220	216	-2.0%	
06/27/13	2.77	4.13	3.99	-3.3%	307	298	-3.0%	
08/12/13	2.3	2.76	2.64	-4.1%	115	99	-14.1%	

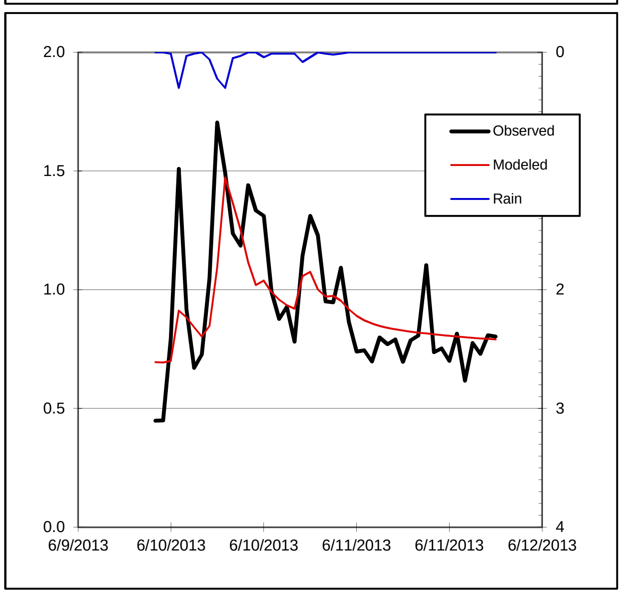
Net Average Error	-0.2%		0.7%
Total Average Error	6.4%		6.8%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

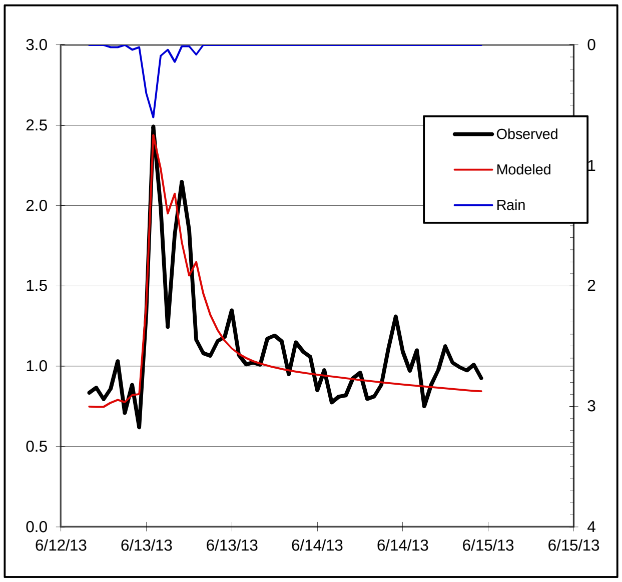


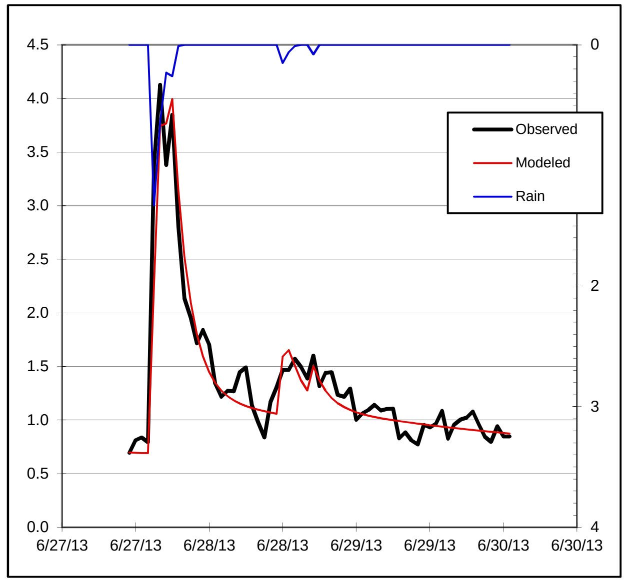


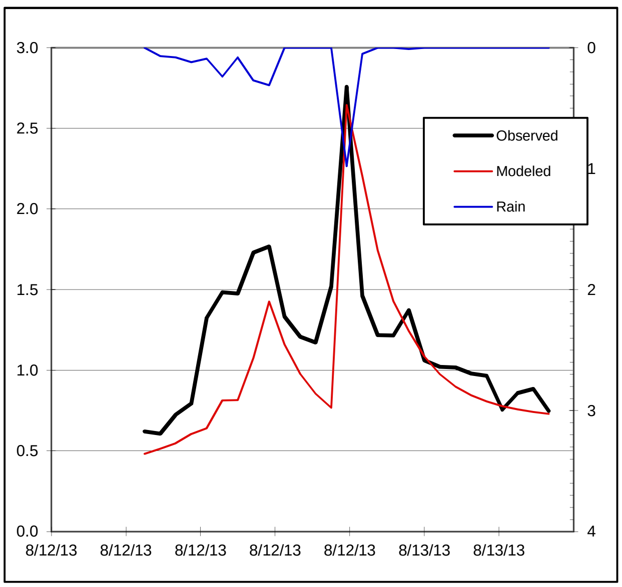




Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 3B - 2013







Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 3B - 2013

Calibration Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/10/13	2.01	2.90	3.22	10.9%	395	421	6.8%	
04/23/13	0.81	1.91	2.09	9.5%	139	164	18.2%	
06/12/13	1.47	2.49	2.44	-2.1%	220	216	-2.0%	
08/12/13	2.3	2.76	2.64	-4.1%	115	99	-14.1%	

Net Average Error	3.5%		2.2%
Total Average Error	6.7%		10.3%

Validation Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/17/13	1.94	2.97	3.01	1.0%	464	469	1.3%	
06/09/13	1.25	1.71	1.47	-13.6%	151	148	-2.2%	
06/27/13	2.77	4.13	3.99	-3.3%	307	298	-3.0%	

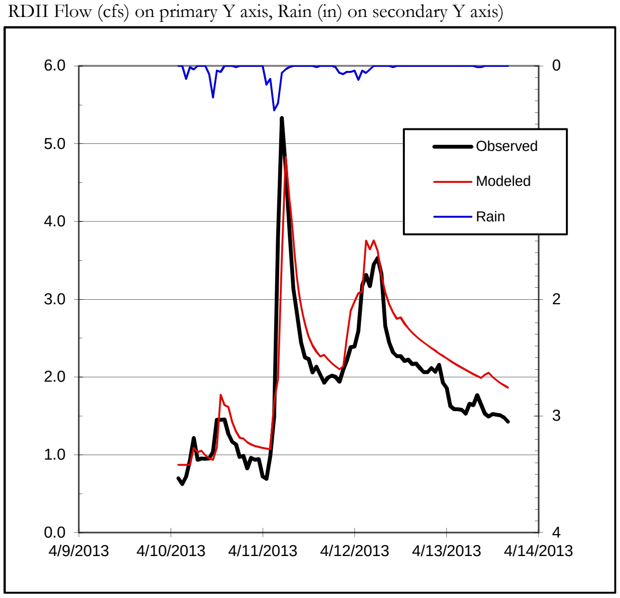
Net Average Error	-5.3%		-1.3%
Total Average Error	6.0%		2.1%

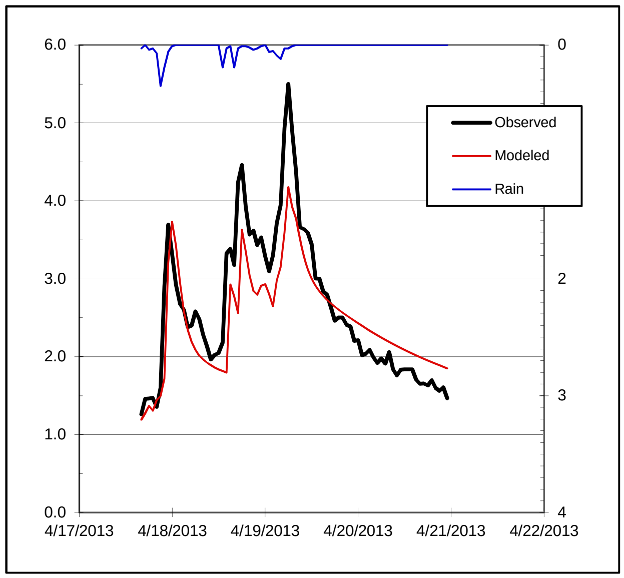
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 5C - 2013

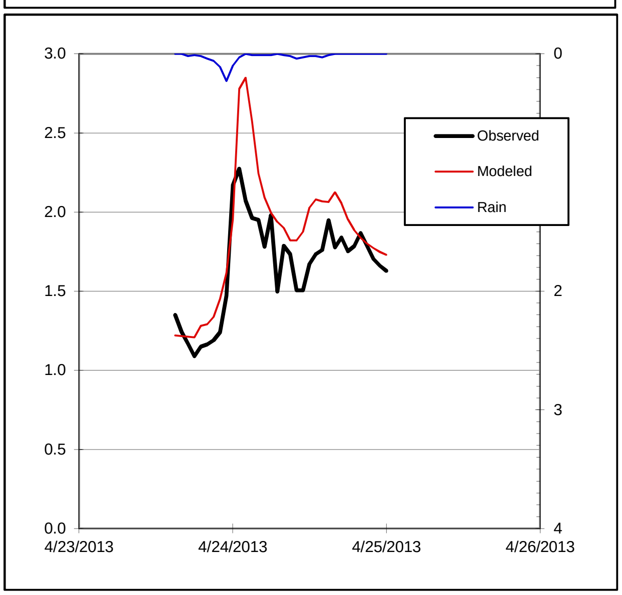
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.23	5.33	4.83	-9.4%	604	683	13.2%	
04/17/13	1.76	5.50	4.18	-24.1%	759	714	-5.9%	
04/23/13	0.84	2.27	2.85	25.3%	206	231	11.7%	
05/27/13	0.81	1.20	1.37	14.3%	106	136	27.7%	
06/09/13	1.59	2.15	2.16	0.6%	193	202	4.7%	
06/12/13	1.38	3.34	3.37	0.9%	274	275	0.5%	
06/27/13	2.9	6.46	6.26	-3.0%	449	397	-11.5%	
07/09/13	1.17	2.97	3.09	3.9%	117	102	-12.7%	
08/12/13	3.01	4.95	5.61	13.4%	193	233	20.9%	

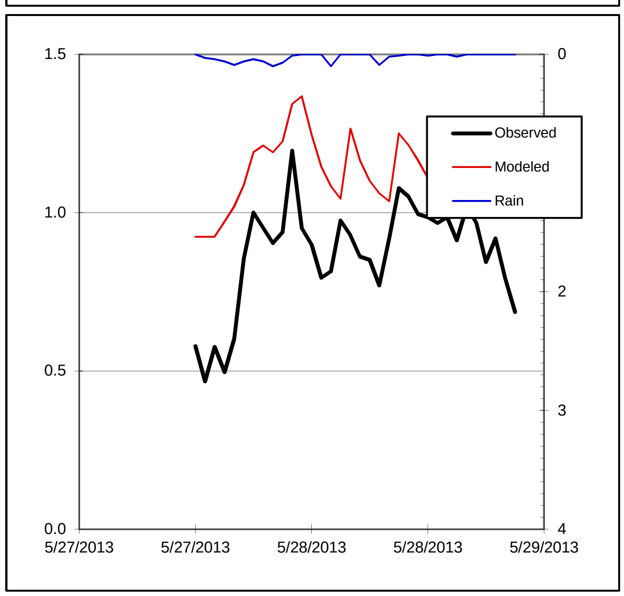
Net Average Error	2.4%		5.4%
Total Average Error	10.5%		12.1%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

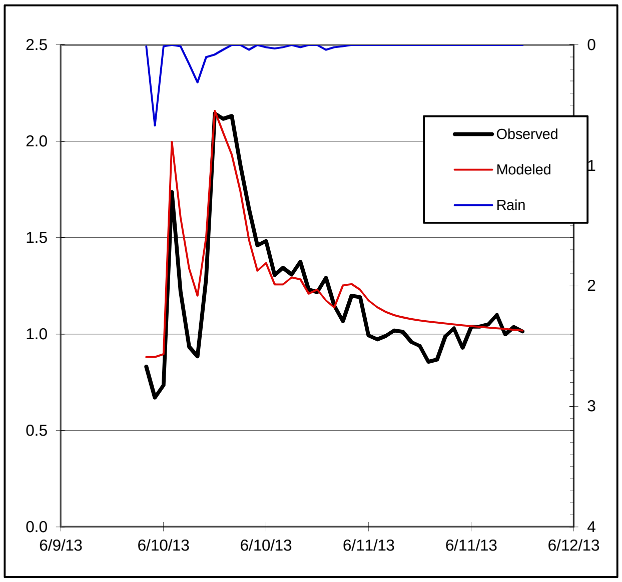


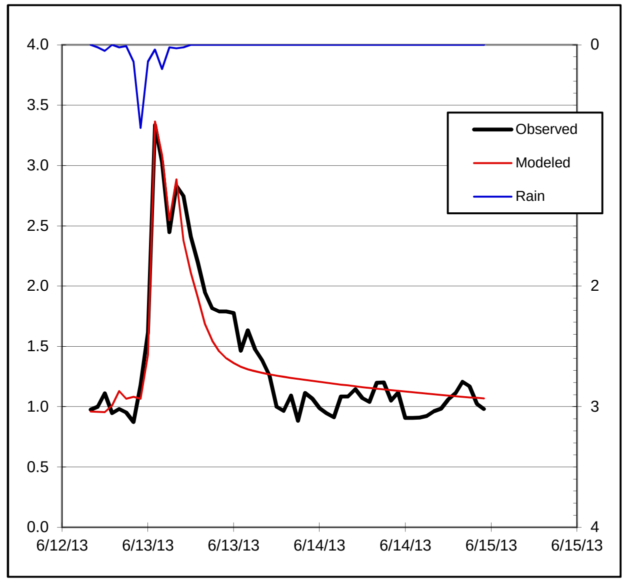


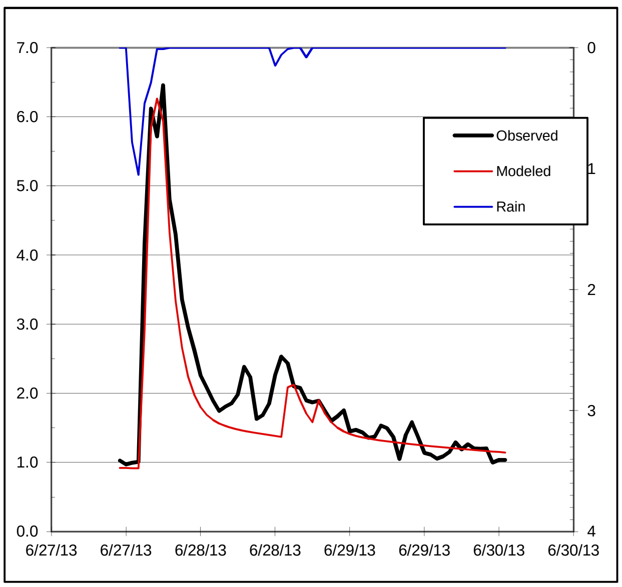


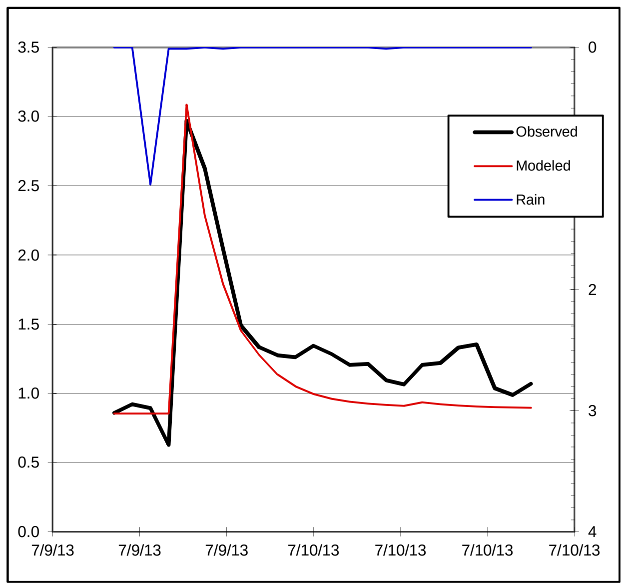


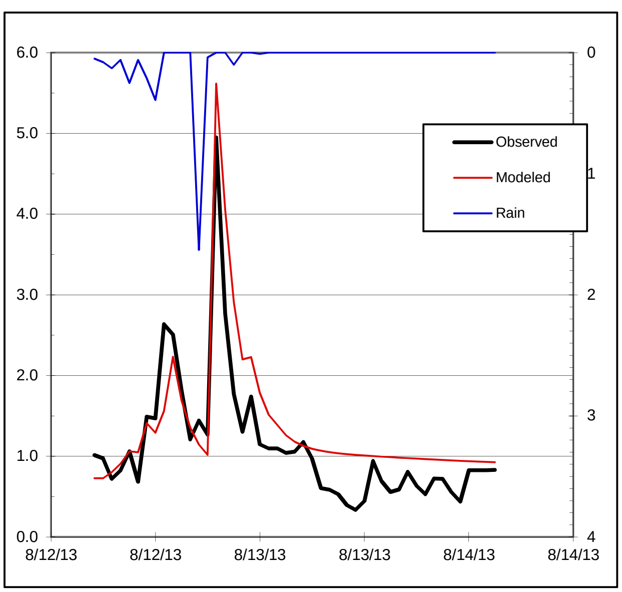
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 5C - 2013











Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 5C - 2013

Calibration Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.23	5.33	4.83	-9.4%	604	683	13.2%	
04/23/13	0.84	2.27	2.85	25.3%	206	231	11.7%	
06/09/13	1.59	2.15	2.16	0.5%	193	202	4.7%	
06/27/13	2.9	6.46	6.26	-3.0%	449	397	-11.5%	
08/12/13	3.01	4.95	5.61	13.4%	193	233	20.9%	

	Peak Flow Error (%)		Volume Error (%)
Net Average Error	5.4%		7.8%
Total Average Error	10.4%		12.4%

Validation Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/17/13	1.76	5.50	4.18	-24.1%	759	714	-5.9%	
05/27/13	0.81	1.20	1.37	14.3%	106	136	27.7%	
06/12/13	1.38	3.34	3.37	0.9%	274	275	0.5%	
07/09/13	1.17	2.97	3.09	3.9%	117	102	-12.7%	

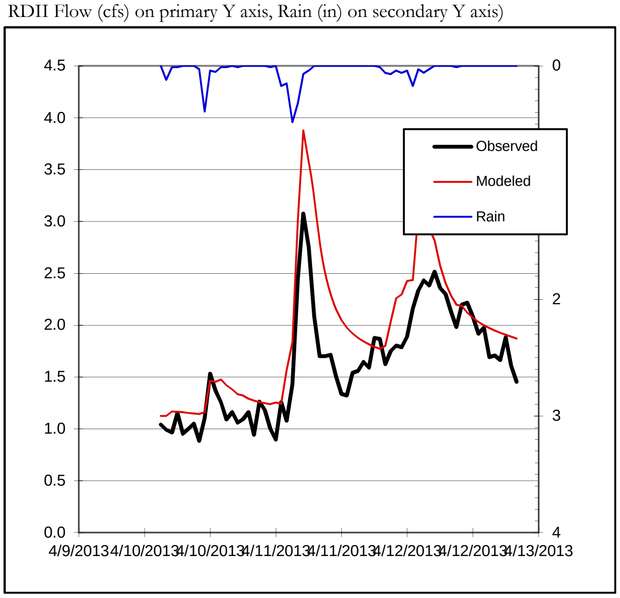
	Peak Flow Error (%)		Volume Error (%)
Net Average Error	-1.3%		2.4%
Total Average Error	10.8%		11.7%

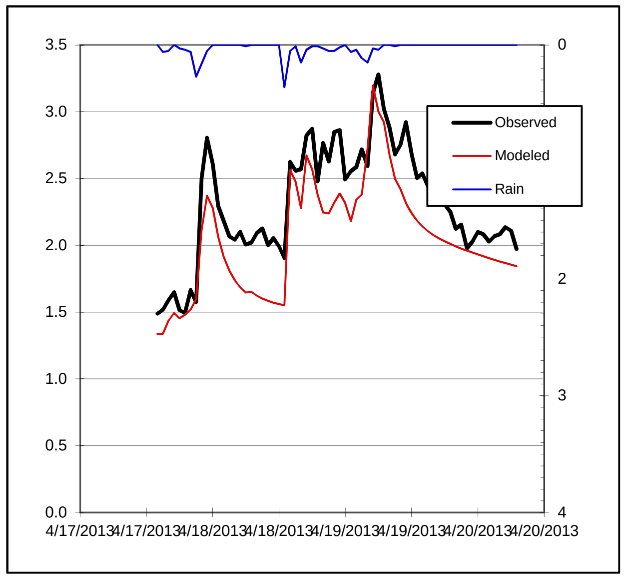
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 9B - 2013

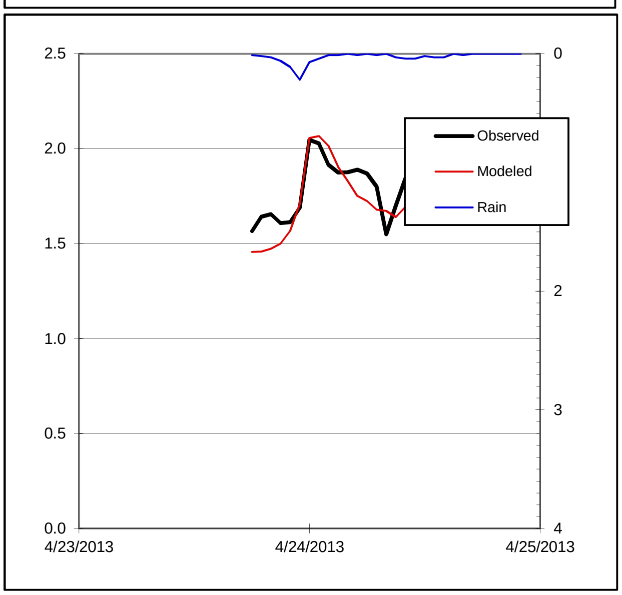
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.5	3.08	3.88	26.0%	390	462	18.5%	
04/17/13	1.95	3.28	3.20	-2.5%	554	492	-11.2%	
04/23/13	0.83	2.10	2.07	-1.5%	194	185	-4.3%	
05/27/13	0.89	1.44	1.44	-0.3%	172	184	7.1%	
06/09/13	1.3	2.38	1.98	-16.9%	142	132	-7.0%	

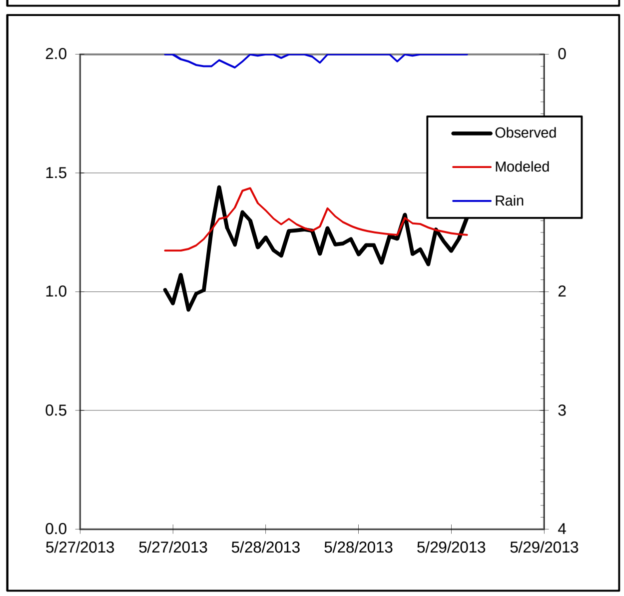
Net Average Error	1.0%		0.6%
Total Average Error	9.4%		9.6%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

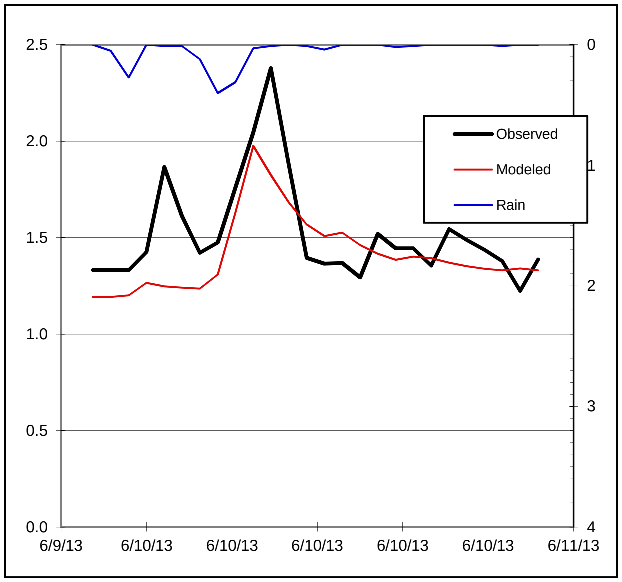








Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 9B - 2013



Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 9B - 2013

Calibration Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.5	3.08	3.88	26.0%	390	462	18.5%	
04/23/13	0.83	2.10	2.07	-1.5%	194	185	-4.3%	
06/09/13	1.3	2.38	1.98	-16.9%	142	132	-7.0%	

	Peak Flow Error		Volume Error
Net Average Error	2.5%		2.4%
Total Average Error	14.8%		9.9%

Validation Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/17/13	1.95	3.28	3.20	-2.5%	554	492	-11.2%	
05/27/13	0.89	1.44	1.44	-0.3%	172	184	7.1%	

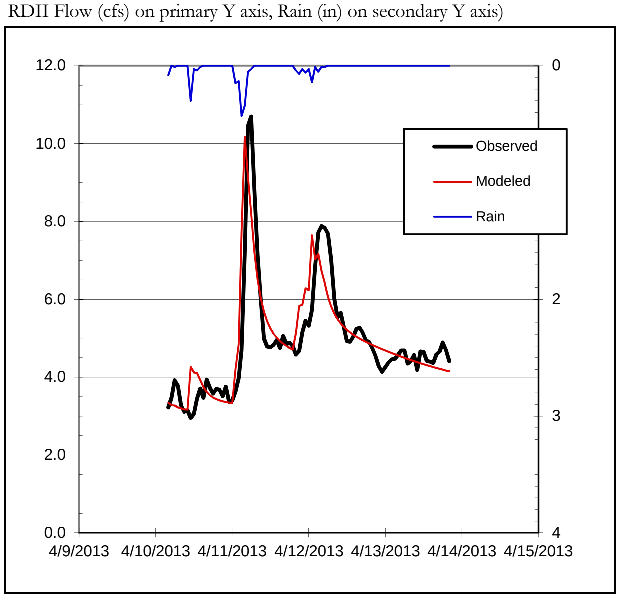
	Peak Flow Error		Volume Error
Net Average Error	-1.4%		-2.0%
Total Average Error	1.4%		9.1%

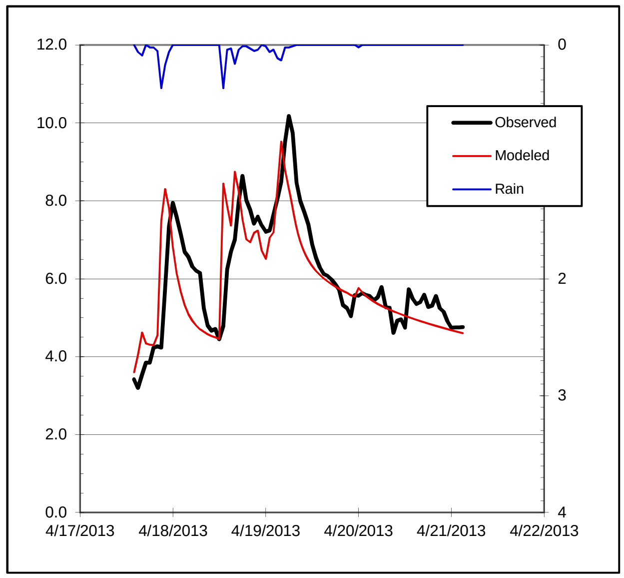
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 9C - 2013

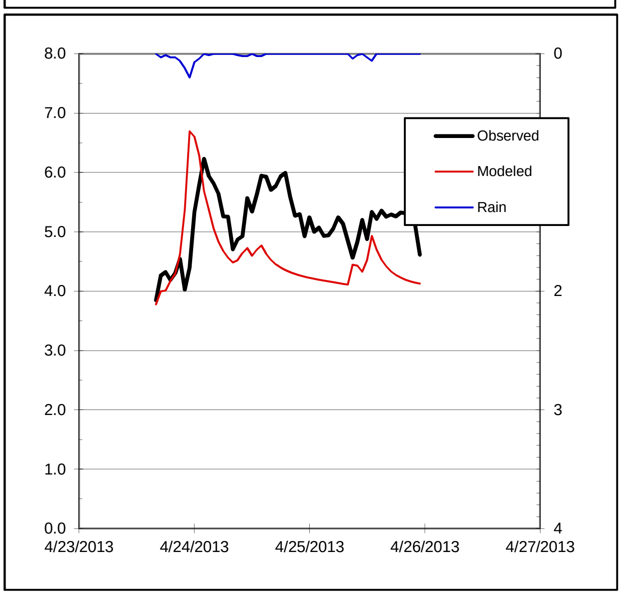
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.05	10.70	10.18	-4.9%	1,580	1,588	0.5%	
04/17/13	2.04	10.18	9.52	-6.5%	1,880	1,833	-2.5%	
04/23/13	0.83	6.23	6.69	7.4%	1,054	932	-11.6%	
05/27/13	0.86	4.06	4.69	15.5%	502	566	12.9%	
06/09/13	1.36	5.46	5.68	4.0%	659	661	0.3%	
06/12/13	1.54	9.24	8.58	-7.1%	892	855	-4.1%	
06/27/13	3.91	11.35	9.37	-17.5%	1,529	1,518	-0.8%	
08/12/13	2.61	7.26	7.64	5.3%	531	593	11.7%	

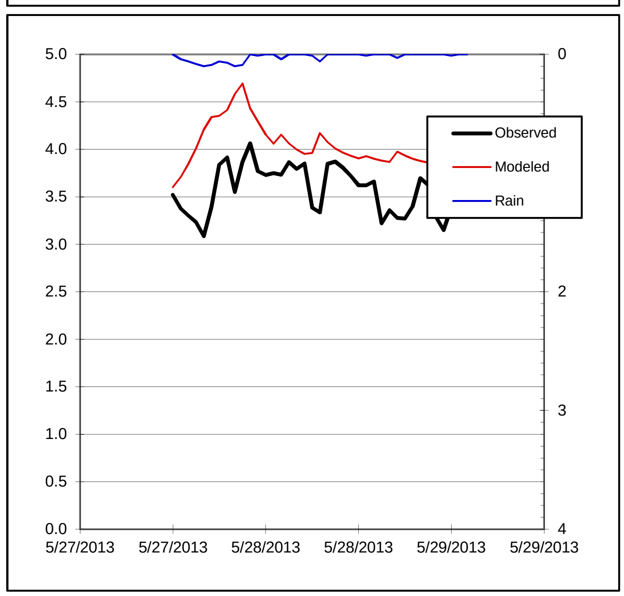
	Peak Flow Error (%)		Volume Error (%)
Net Average Error	-0.5%		0.8%
Total Average Error	8.5%		5.5%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

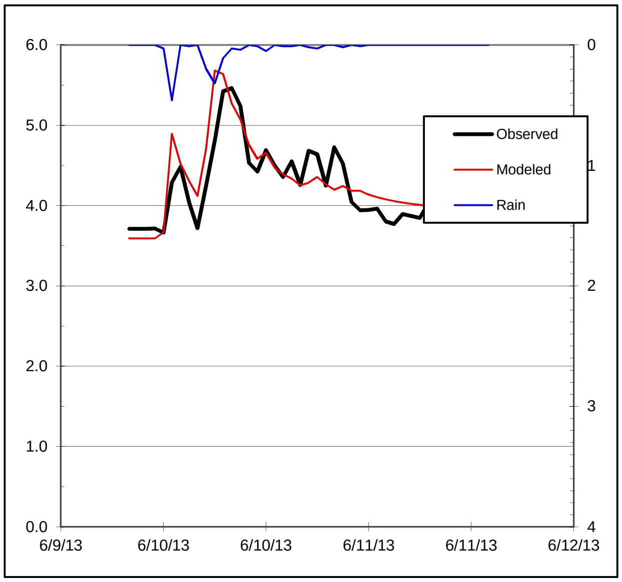


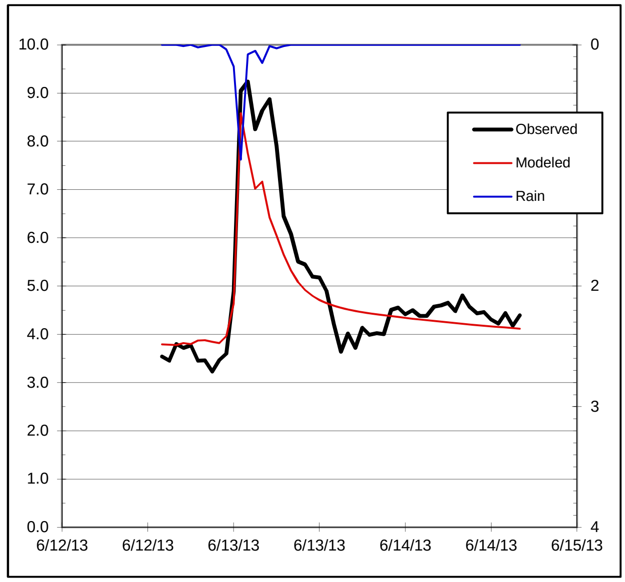


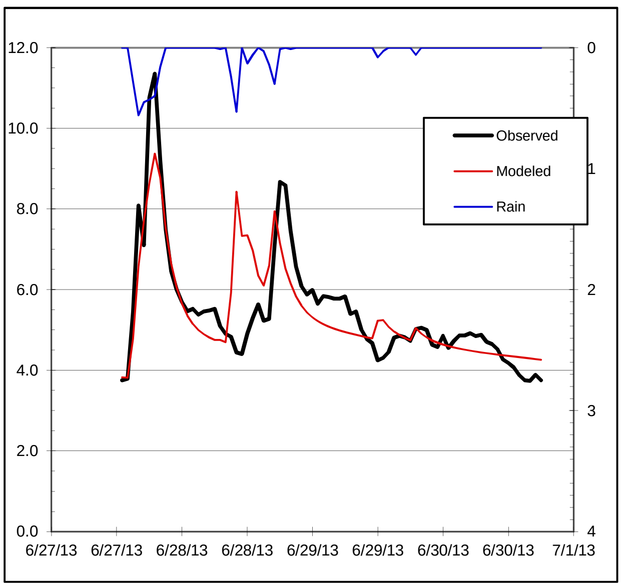


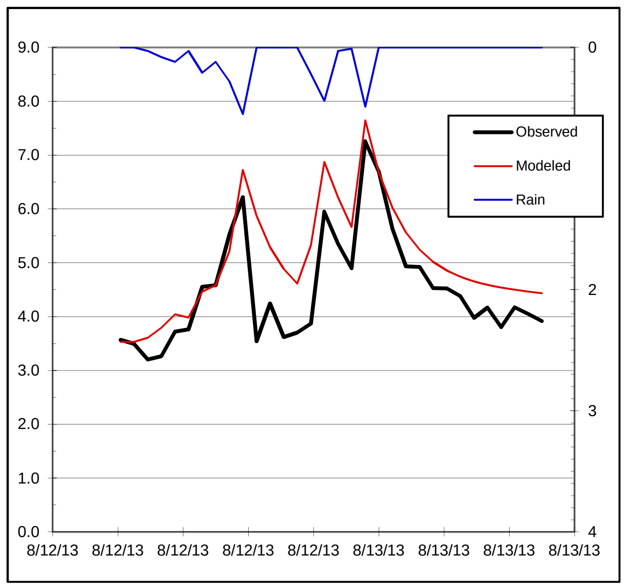


Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 9C - 2013









Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter 9C - 2013

Calibration Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.05	10.70	10.18	-4.9%	1,580	1,588	0.5%	
04/23/13	0.83	6.23	6.69	7.4%	1,054	932	-11.6%	
06/09/13	1.36	5.46	5.68	4.0%	659	661	0.3%	
06/27/13	3.91	11.35	9.37	-17.5%	1,529	1,518	-0.8%	

Net Average Error	-2.7%		-2.9%
Total Average Error	8.4%		3.3%

Validation Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/17/13	2.04	10.18	9.52	-6.5%	1,880	1,833	-2.5%	
05/27/13	0.86	4.06	4.69	15.5%	502	566	12.9%	
06/12/13	1.54	9.24	8.58	-7.1%	892	855	-4.1%	
08/12/13	2.61	7.26	7.64	5.3%	531	593	11.7%	

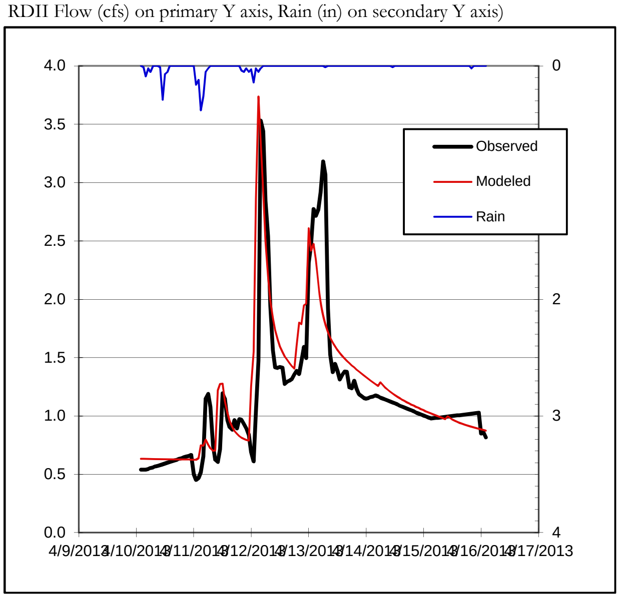
Net Average Error	1.8%		4.5%
Total Average Error	8.6%		7.8%

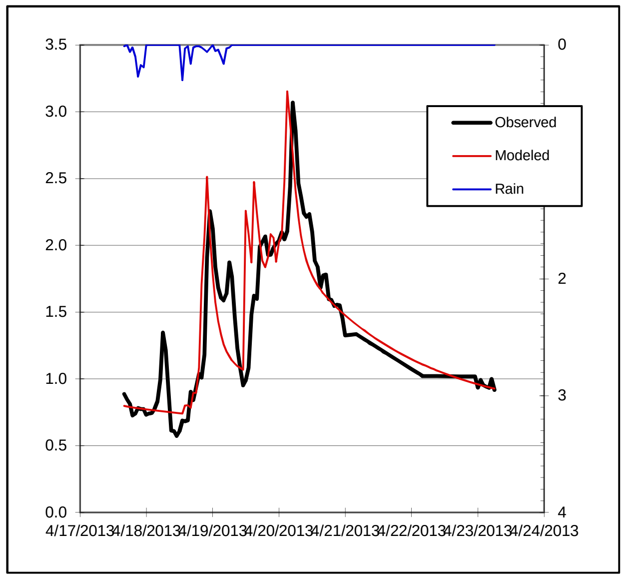
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter A1 - 2013

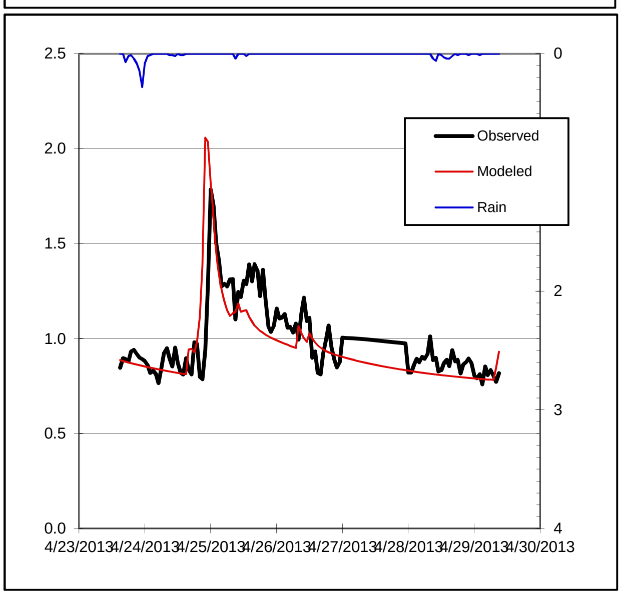
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.04	3.53	3.74	5.8%	612	641	4.8%	
04/17/13	1.94	3.07	3.15	2.8%	644	653	1.3%	
04/23/13	1.14	1.78	2.06	15.3%	500	476	-4.8%	
06/14/13	1.47	2.56	2.23	-13.0%	94	99	4.8%	
06/27/13	2.77	4.22	2.85	-32.5%	358	316	-11.7%	
07/09/13	0.92	1.45	1.53	5.0%	214	183	-14.6%	
08/12/13	2.3	2.01	2.38	18.3%	265	303	14.2%	

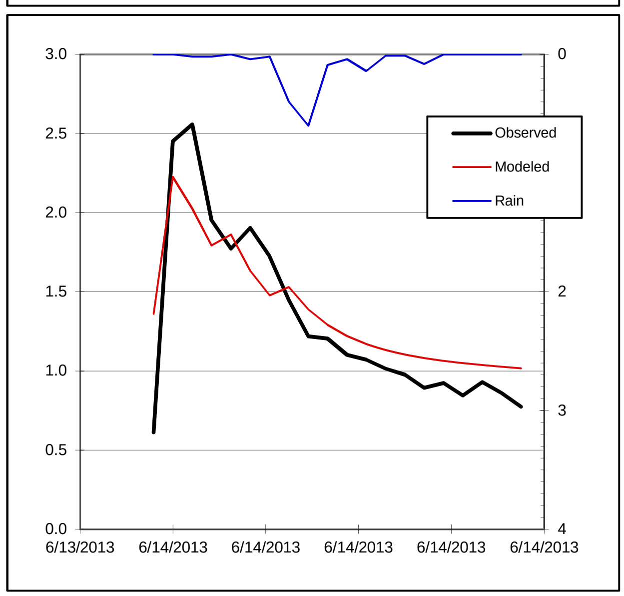
	Peak Flow Error		Volume Error
Net Average Error	0.2%		-0.9%
Total Average Error	13.2%		8.0%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

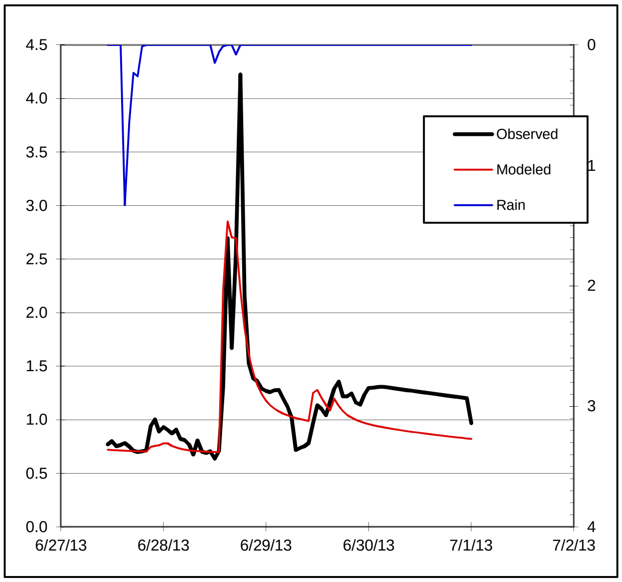


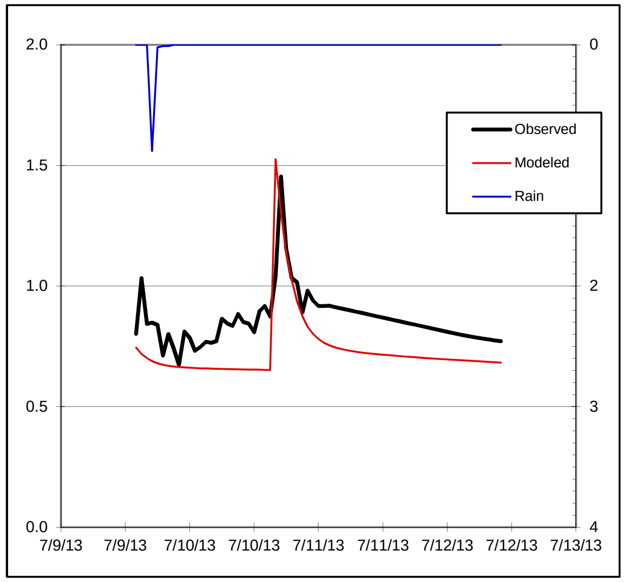


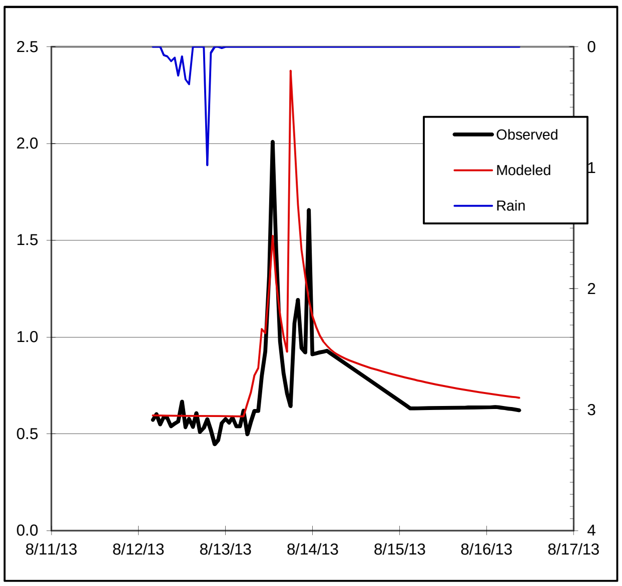




Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter A1 - 2013







Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter A1 - 2013

Calibration Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/10/13	2.04	3.53	3.74	5.8%	612	641	4.8%	
04/23/13	1.14	1.78	2.06	15.3%	500	476	-4.8%	
06/27/13	2.77	4.22	2.85	-32.5%	358	316	-11.7%	
08/12/13	2.3	2.01	2.38	18.3%	265	303	14.2%	

Net Average Error	1.7%		0.6%
Total Average Error	18.0%		8.8%

Validation Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/17/13	1.94	3.07	3.15	2.8%	644	653	1.3%	
06/14/13	1.47	2.56	2.23	-13.0%	94	99	4.8%	
07/09/13	0.92	1.45	1.53	5.0%	214	183	-14.6%	

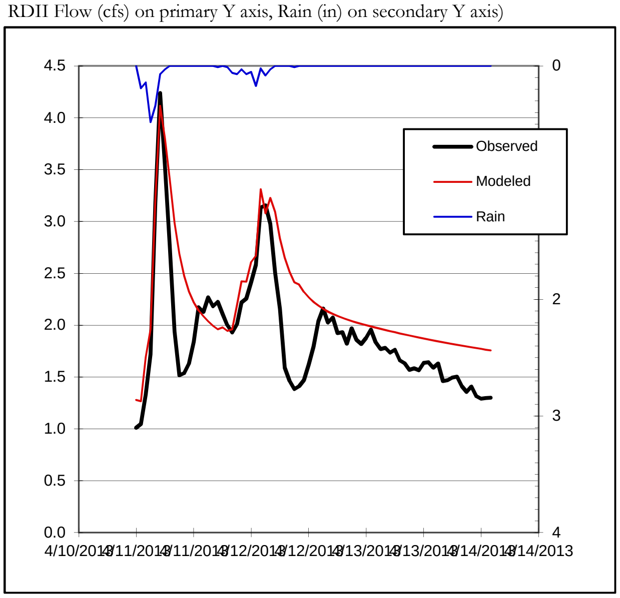
Net Average Error	-1.8%		-2.8%
Total Average Error	6.9%		6.9%

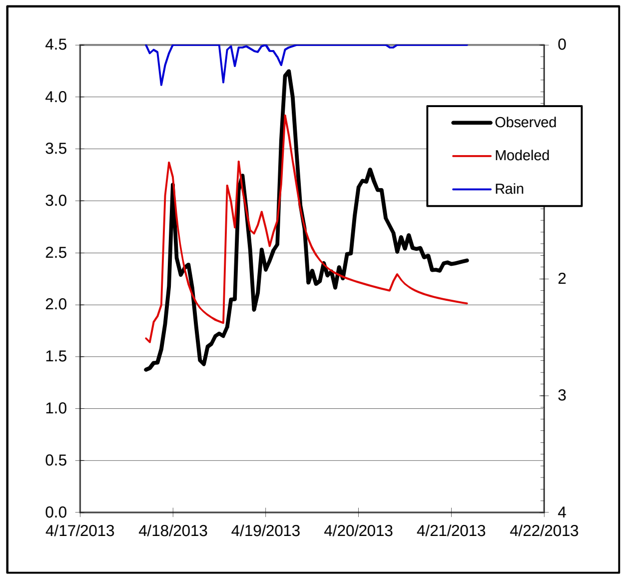
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter B1 - 2013

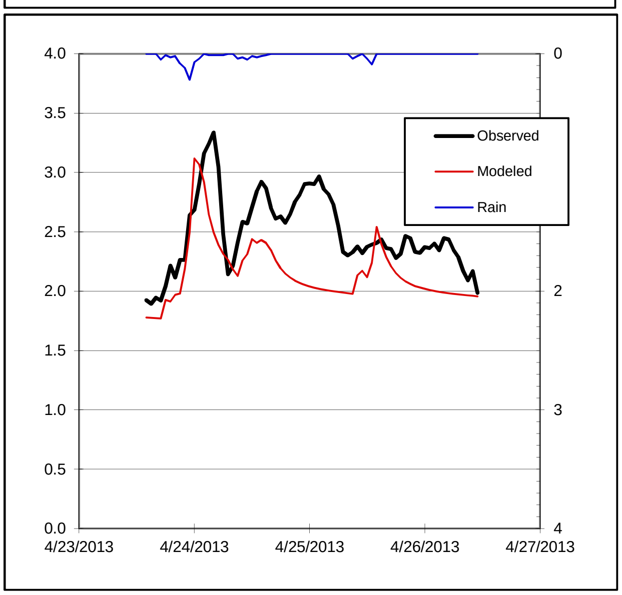
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	1.86	4.24	4.11	-2.9%	517	601	16.1%	
04/17/13	2	4.25	3.82	-10.0%	747	731	-2.2%	
04/23/13	1.07	3.34	3.12	-6.5%	634	550	-13.3%	
05/30/13	0.84	2.12	2.12	-0.2%	354	356	0.5%	
06/09/13	1.16	2.09	2.41	15.7%	250	255	2.0%	

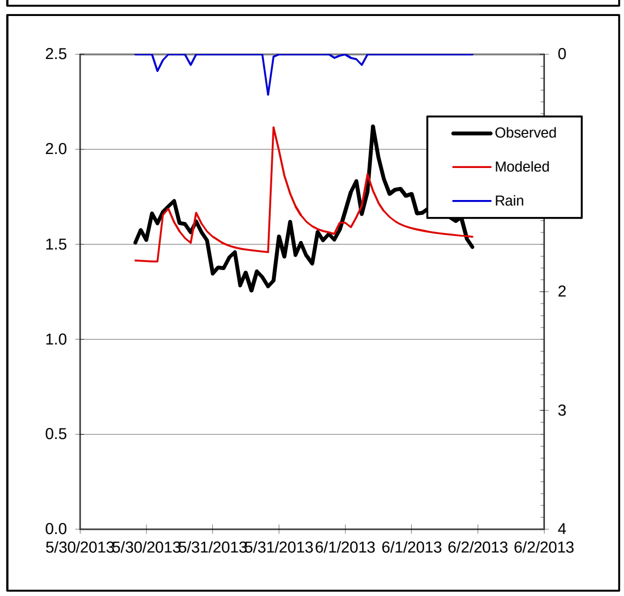
Net Average Error	-0.8%		0.6%
Total Average Error	7.1%		6.8%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

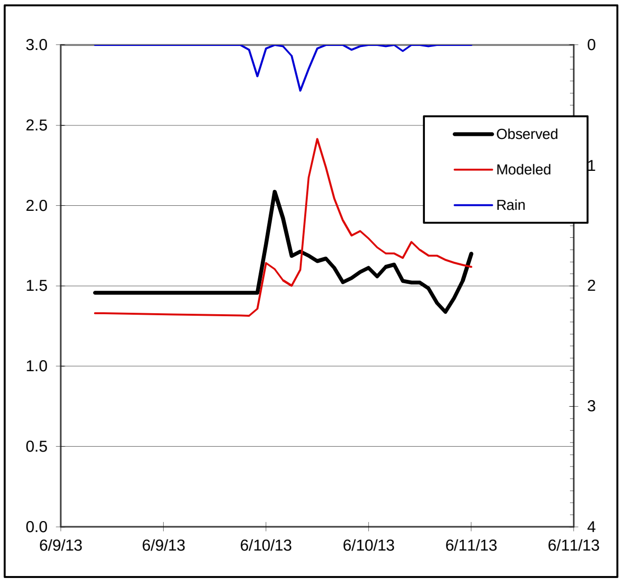








Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter B1 - 2013



Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis

Meter B1 - 2013

Calibration Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	1.86	4.24	4.11	-2.9%	517	601	16.1%	
04/23/13	1.07	3.34	3.12	-6.5%	634	550	-13.3%	
06/09/13	1.16	2.09	2.41	15.7%	250	255	2.0%	

	Peak Flow Error (%)	Volume Error (%)
Net Average Error	2.1%	1.6%
Total Average Error	8.4%	10.4%

Validation Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/17/13	2.00	4.25	3.82	-10.0%	747	731	-2.2%	
05/30/13	0.84	2.12	2.12	-0.2%	354	356	0.5%	

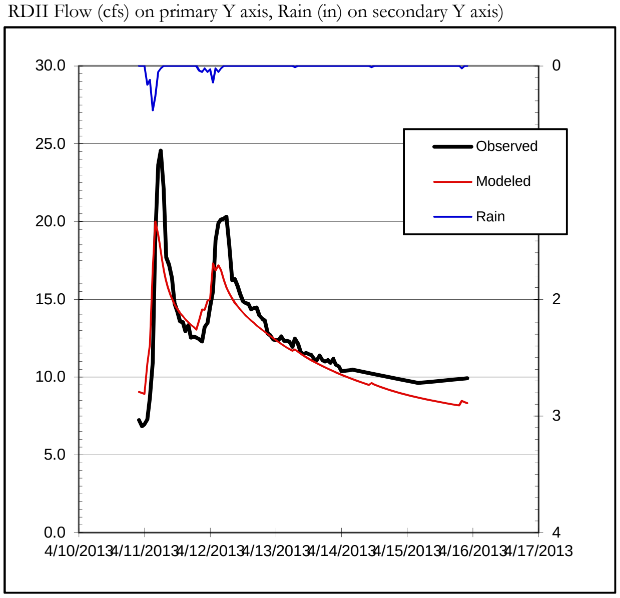
	Peak Flow Error (%)	Volume Error (%)
Net Average Error	-5.1%	-0.9%
Total Average Error	5.1%	1.3%

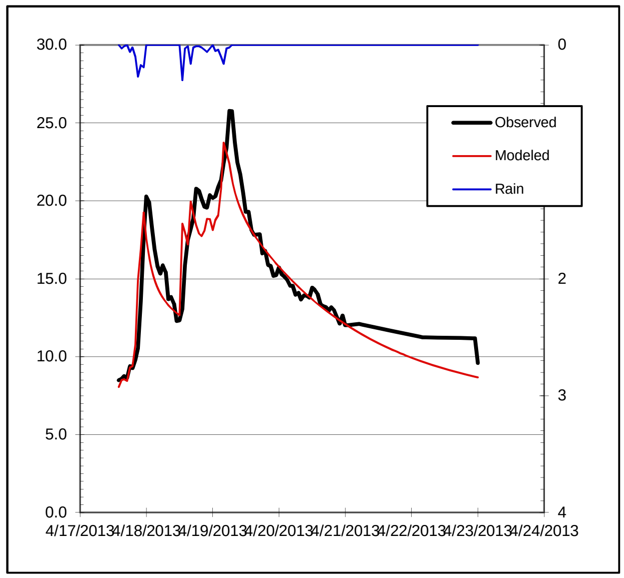
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter C1 and C2 - 2013

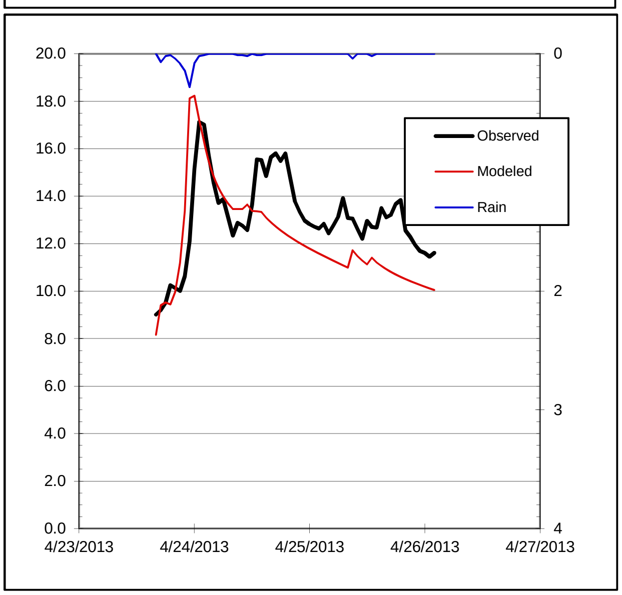
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	1.45	24.56	20.01	-18.5%	5,376	5,110	-5.0%	
04/17/13	1.94	25.77	23.74	-7.9%	6,806	6,445	-5.3%	
04/23/13	0.87	17.13	18.23	6.4%	2,811	2,607	-7.3%	
06/09/13	1.25	12.06	13.27	10.0%	1,676	1,868	11.4%	
06/12/13	1.47	19.76	17.97	-9.1%	2,289	2,304	0.7%	
06/25/13	3.52	23.76	23.65	-0.5%	6,390	5,829	-8.8%	
08/12/13	2.03	15.50	19.09	23.2%	1,535	1,773	15.5%	

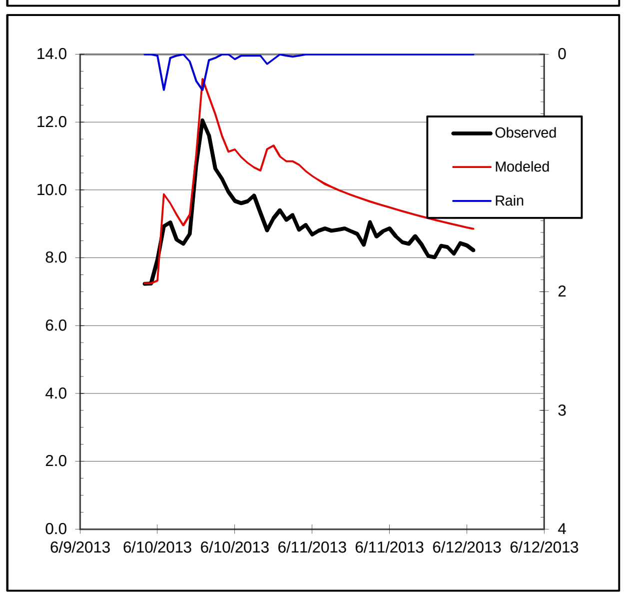
Net Average Error	0.5%		0.2%
Total Average Error	10.8%		7.7%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

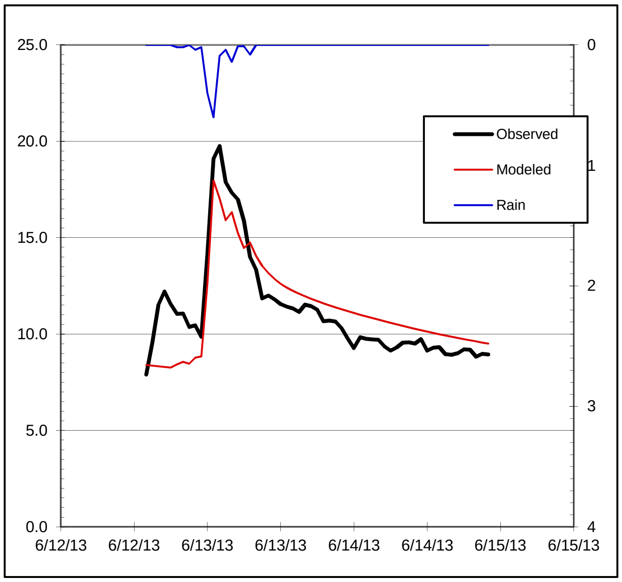


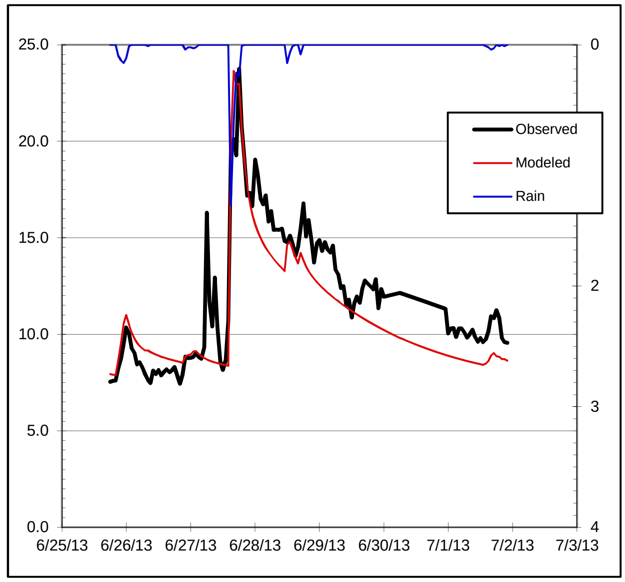


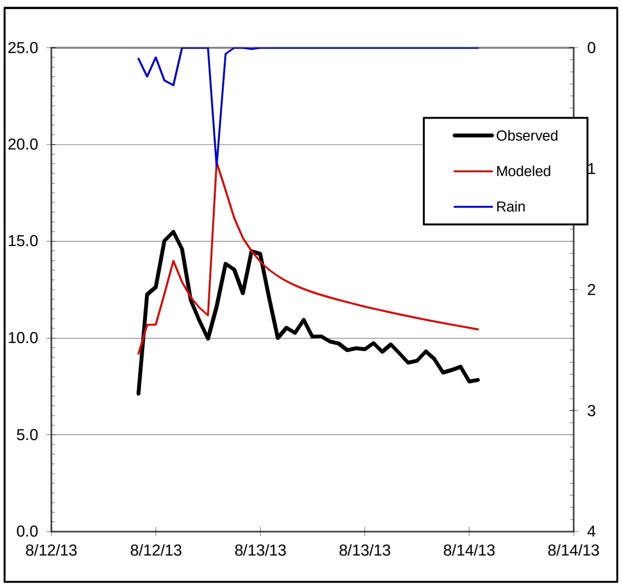




Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter C1 and C2 - 2013







Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter C1 and C2 - 2013

Calibration Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/10/13	1.45	24.56	20.01	-18.5%	5,376	5,110	-5.0%	
04/23/13	0.87	17.13	18.23	6.4%	2,811	2,607	-7.3%	
06/12/13	1.47	19.76	17.97	-9.1%	2,289	2,304	0.7%	
08/12/13	2.03	15.50	19.09	23.2%	1,535	1,773	15.5%	

Net Average Error	0.5%		1.0%
Total Average Error	14.3%		7.1%

Validation Group								
Storm	**Rain (in)**	**Observed Peak (cfs)**	**Model Peak (cfs)**	**Peak Flow Error (%)**	**Observed Vol (1000's cf)**	**Model Vol (1000's cf)**	**Volume Error (%)**	**Notes**
04/17/13	1.94	25.77	23.74	-7.9%	6,806	6,445	-5.3%	
06/09/13	1.25	12.06	13.27	10.0%	1,676	1,868	11.4%	
06/25/13	3.52	23.76	23.65	-0.5%	6,390	5,829	-8.8%	

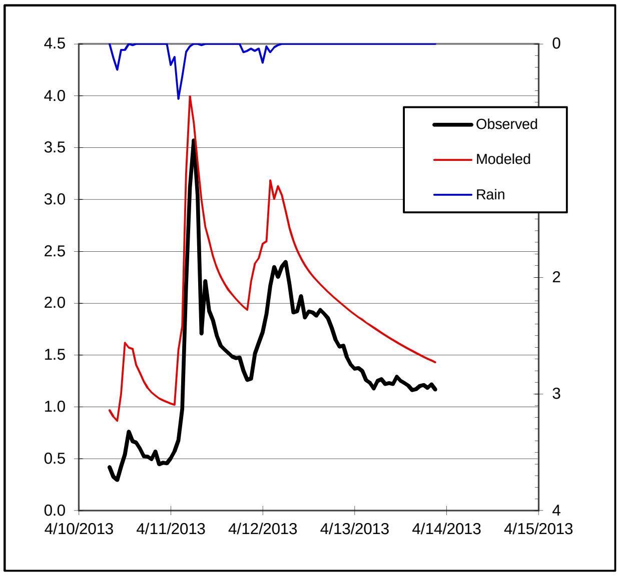
Net Average Error	0.6%		-0.9%
Total Average Error	6.1%		8.5%

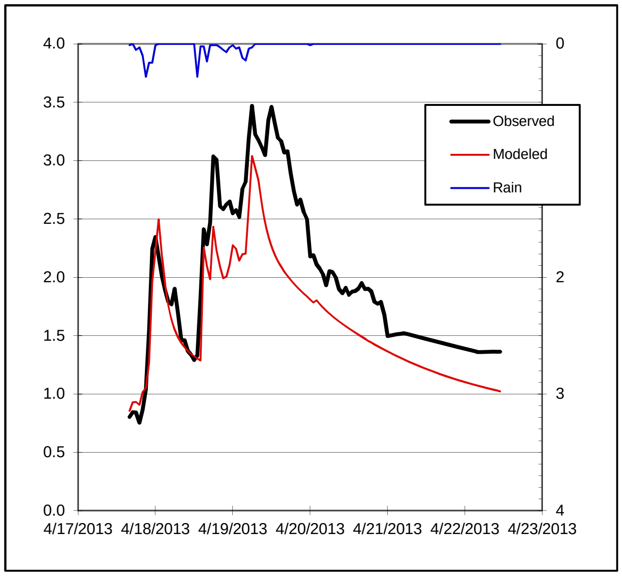
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter F1 - 2013

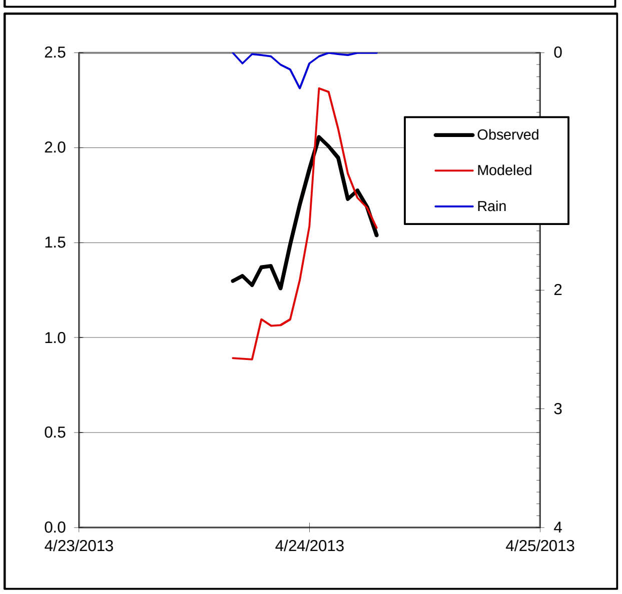
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.15	3.57	4.00	11.9%	439	616	40.5%	
04/17/13	1.93	3.47	3.04	-12.5%	822	677	-17.6%	
04/23/13	0.84	2.06	2.31	12.4%	97	88	-9.6%	
06/09/13	1.21	2.17	2.19	0.8%	223	231	3.5%	
06/12/13	1.4	3.67	3.38	-8.0%	411	378	-8.0%	
06/26/13	3.15	6.63	5.55	-16.4%	1,037	882	-14.9%	
08/12/13	2.21	2.87	3.06	6.4%	444	499	12.5%	

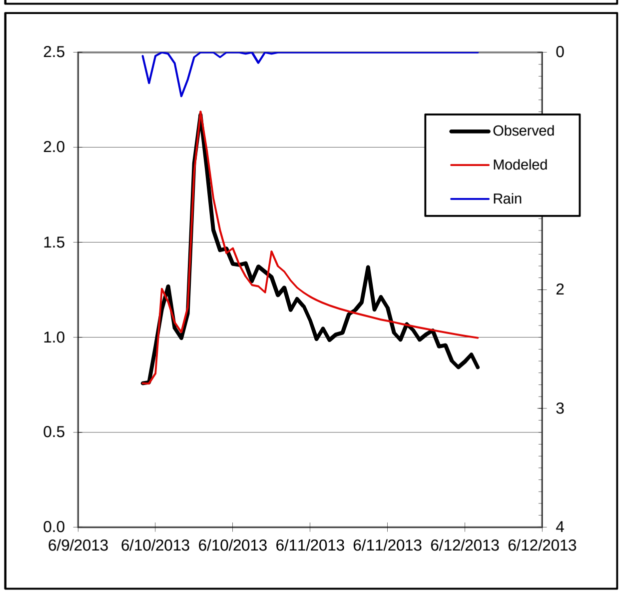
Net Average Error	-0.8%		0.9%
Total Average Error	9.8%		15.2%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)

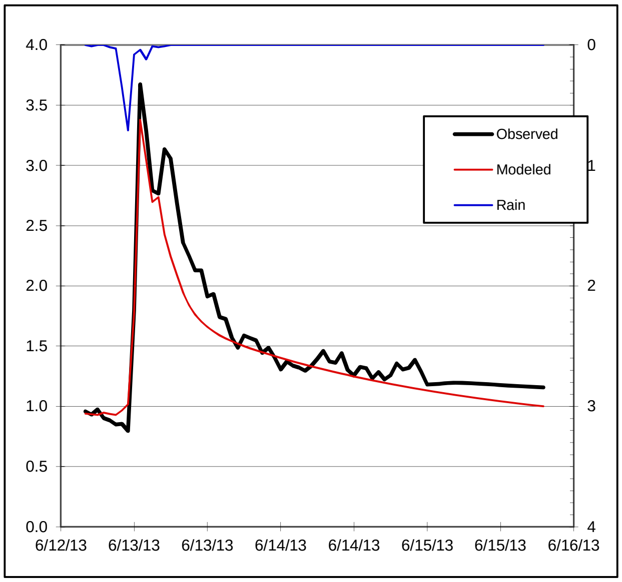


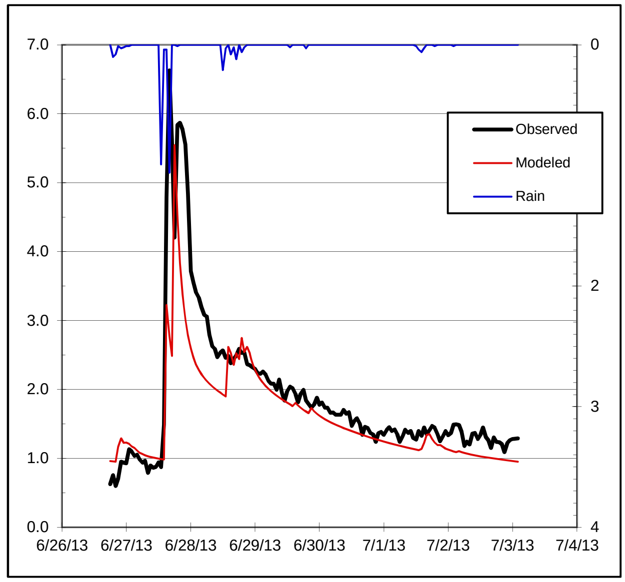


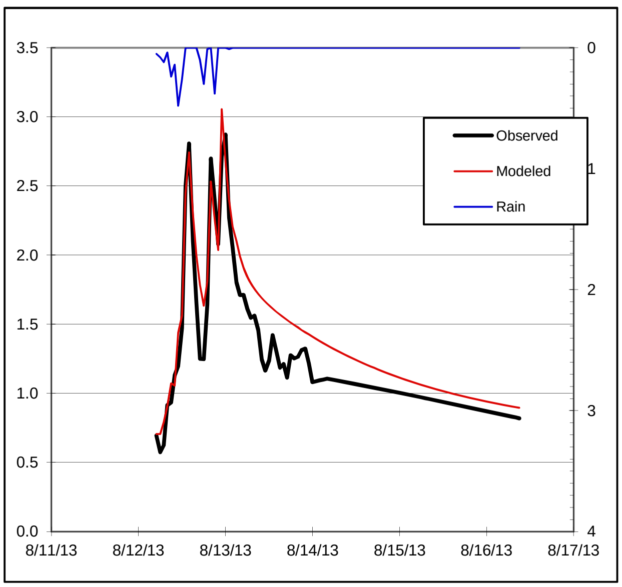




Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter F1 - 2013







Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter F1 - 2013

Calibration Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/10/13	2.15	3.57	4.00	11.9%	439	616	40.5%	
04/23/13	0.84	2.06	2.31	12.4%	97	88	-9.6%	
06/12/13	1.4	3.67	3.38	-8.0%	411	378	-8.0%	
08/12/13	2.21	2.87	3.06	6.4%	444	499	12.5%	

Net Average Error	5.7%		8.9%
Total Average Error	9.7%		17.6%

Validation Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/17/13	1.93	3.47	3.04	-12.5%	822	677	-17.6%	
06/09/13	1.21	2.17	2.19	0.8%	223	231	3.5%	
06/26/13	3.15	6.63	5.55	-16.4%	1,037	882	-14.9%	

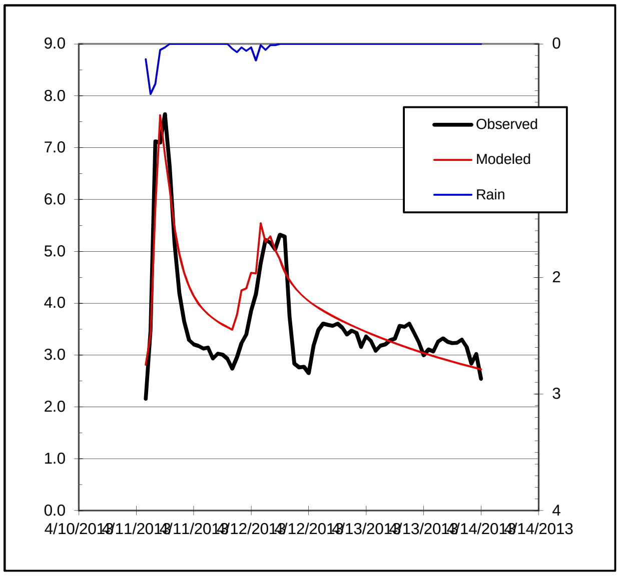
Net Average Error	-9.3%		-9.7%
Total Average Error	9.9%		12.0%

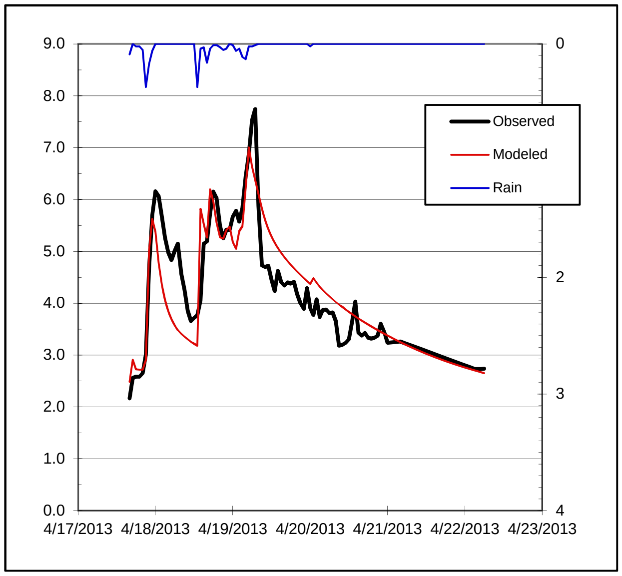
Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter G1 - 2013

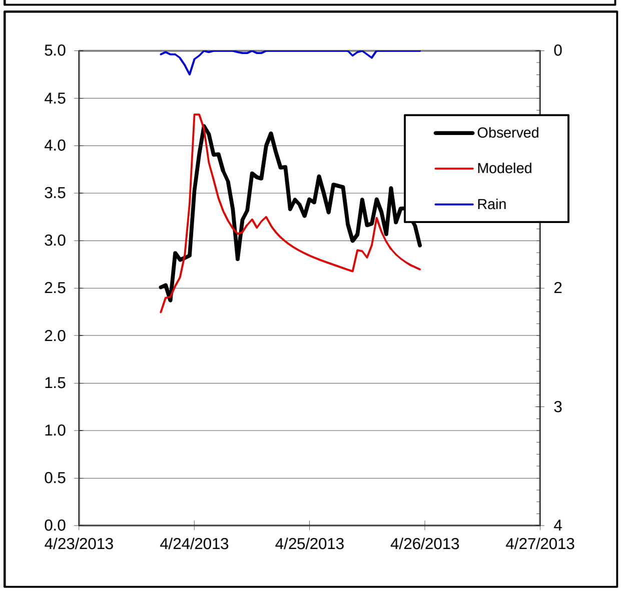
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/11/13	1.58	7.65	7.63	-0.2%	941	1,001	6.4%	
04/17/13	2.04	7.75	7.00	-9.6%	1,623	1,626	0.2%	
04/23/13	0.83	4.21	4.33	3.0%	678	605	-10.8%	
06/09/13	1.36	4.03	4.28	6.3%	336	349	3.9%	

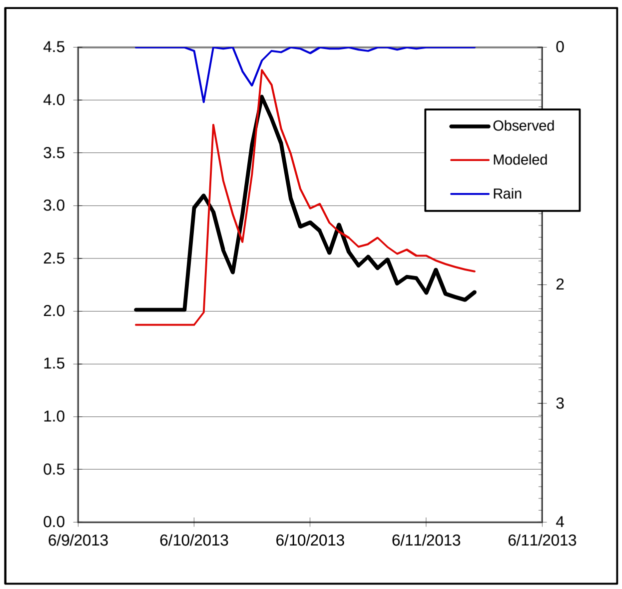
Net Average Error	-0.2%		-0.1%
Total Average Error	4.8%		5.3%

RDII Flow (cfs) on primary Y axis, Rain (in) on secondary Y axis)









Ann Arbor Sanitary Sewer Wet Weather Evaluation Project - Antecedent Moisture Model - Accuracy of Fit Analysis
Meter G1 - 2013

Meter G1 - 2013

Calibration Group

Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/11/13	1.58	7.65	7.63	-0.2%	941	1,001	6.4%	
04/23/13	0.83	4.21	4.33	3.0%	678	605	-10.8%	

Net Average Error	1.4%		-2.2%
Total Average Error	1.6%		8.6%

Validation Group

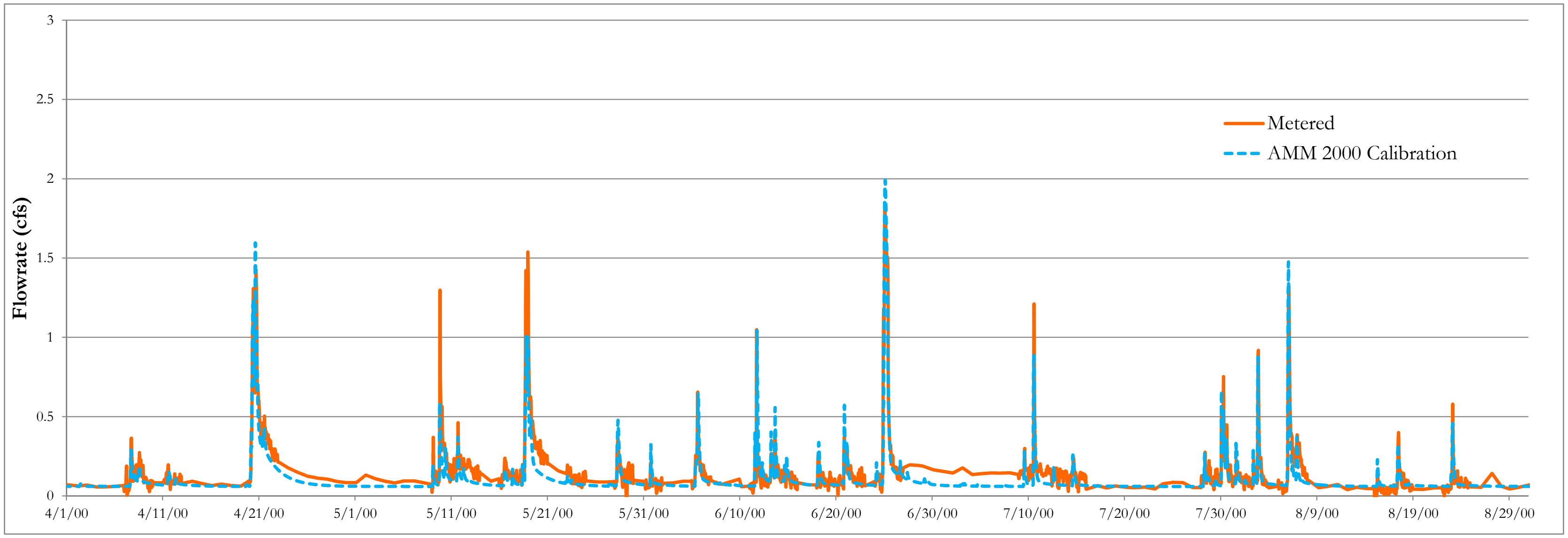
Storm	Rain (in)	Observed Peak (cfs)	Model Peak (cfs)	Peak Flow Error (%)	Observed Vol (1000's cf)	Model Vol (1000's cf)	Volume Error (%)	Notes
04/17/13	2.04	7.75	7.00	-9.6%	1,623	1,626	0.2%	
06/09/13	1.36	4.03	4.28	6.3%	336	349	3.9%	

Net Average Error	-1.7%		2.0%
Total Average Error	7.9%		2.0%

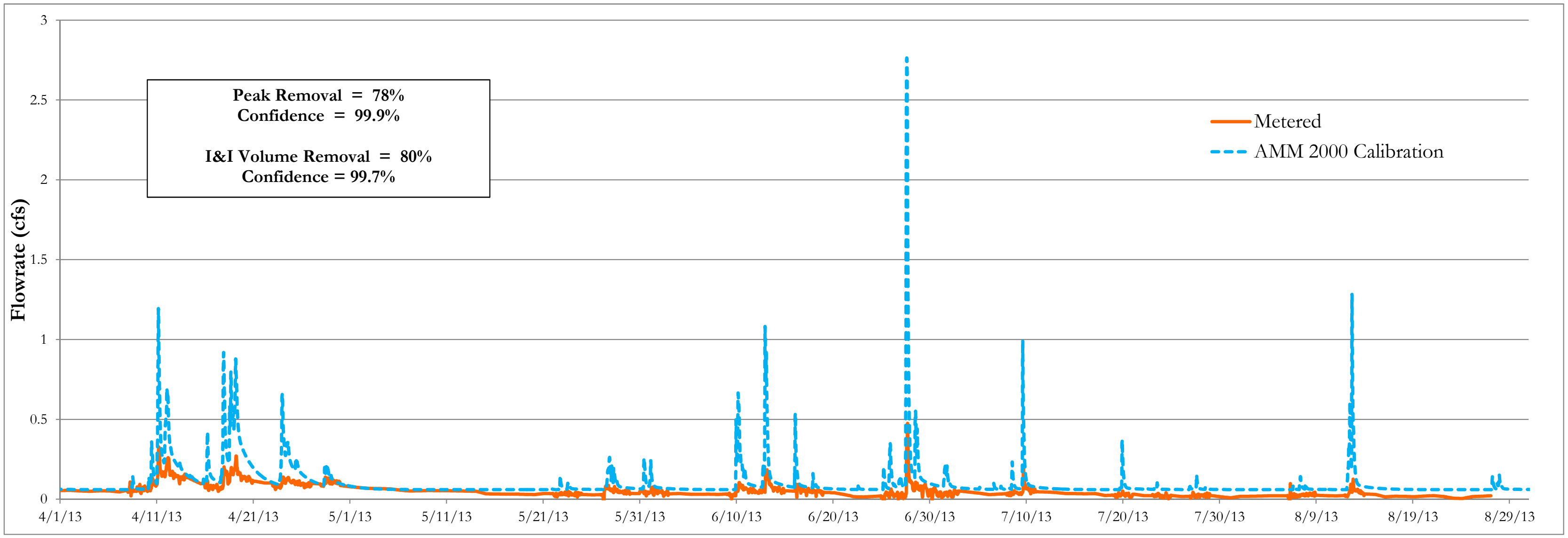
Appendix F
Antecedent Moisture Model
Figures for priority districts

Orchard Hills District - Summary of Results - Antecedent Moisture Modeling

2000 Meter Data with Model Calibrated to 2000 Meter Data

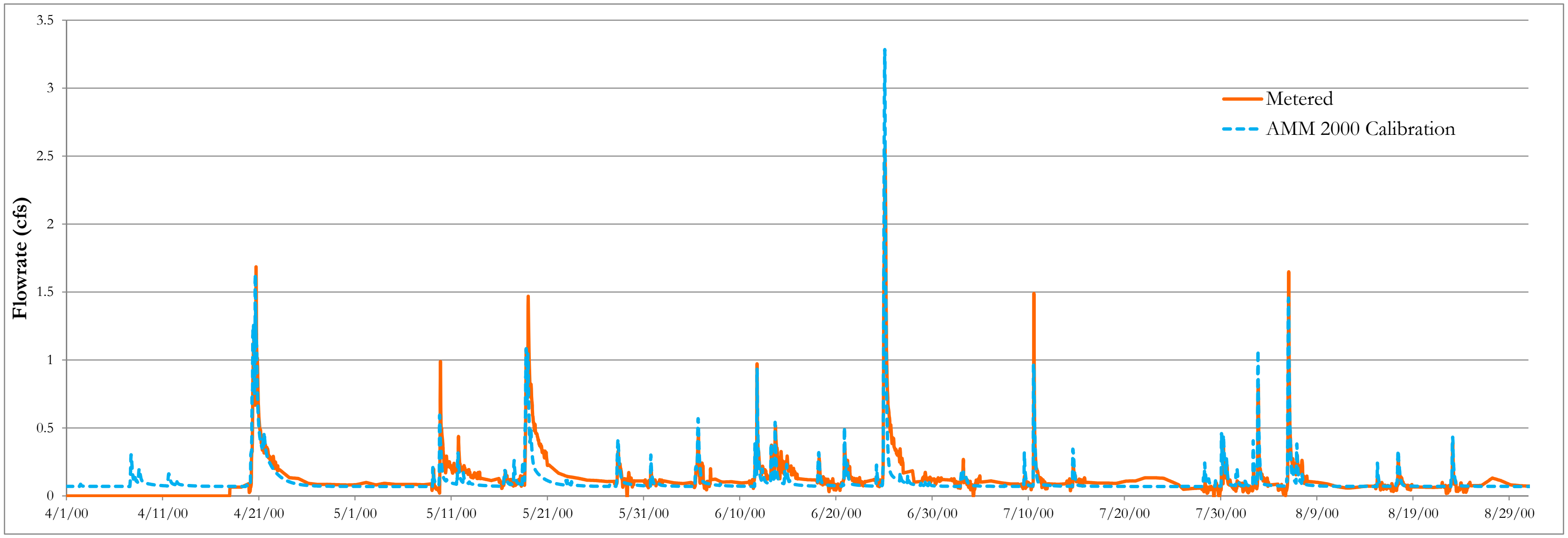


2013 Meter Data with Model Calibrated to 2000 Meter Data

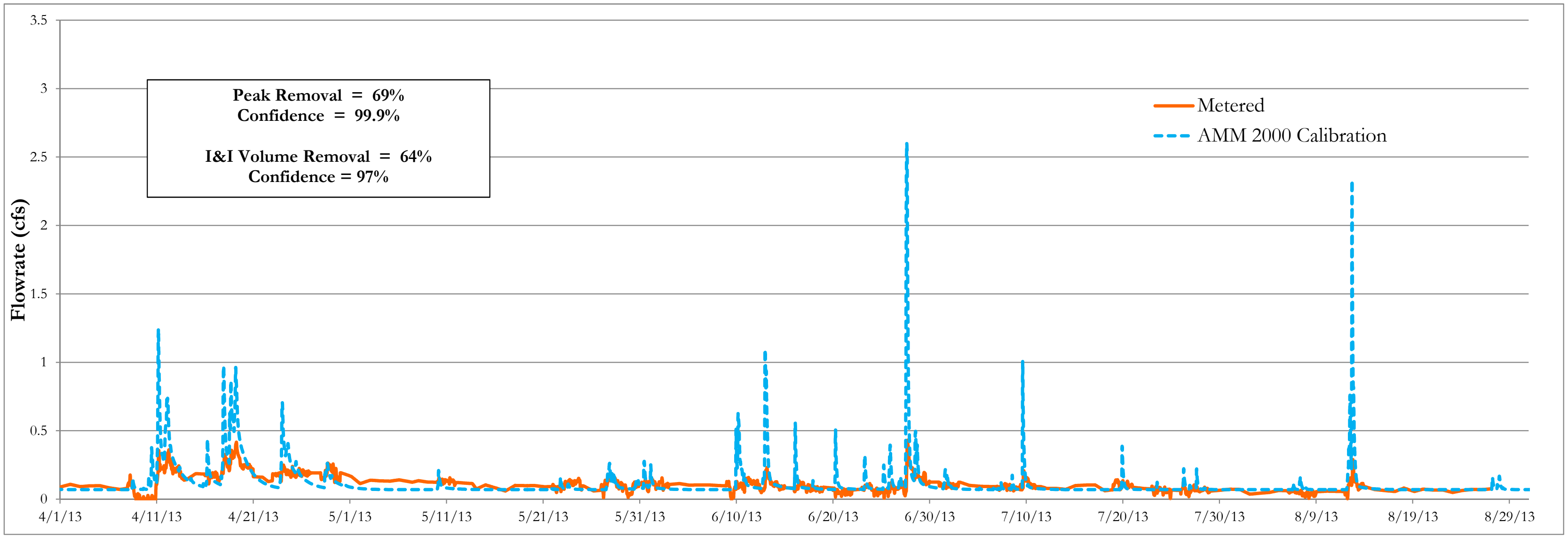


Bromley District - Summary of Results - Antecedent Moisture Modeling

2000 Meter Data with Model Calibrated to 2000 Meter Data

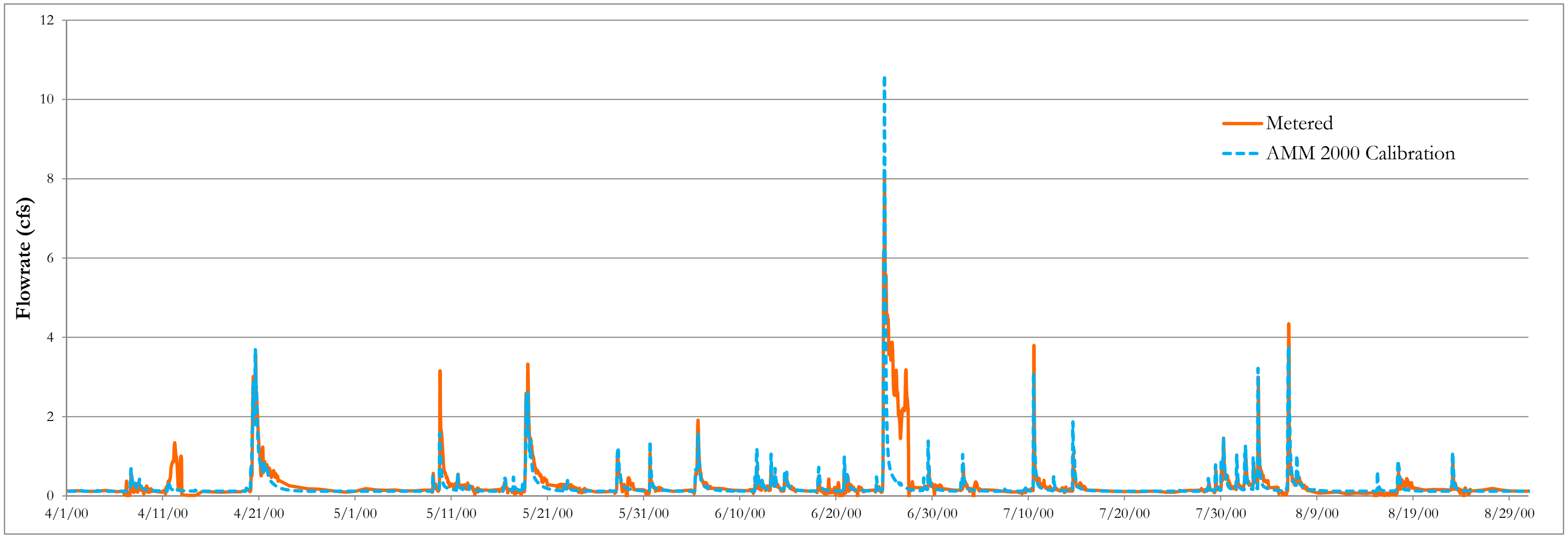


2013 Meter Data with Model Calibrated to 2000 Meter Data

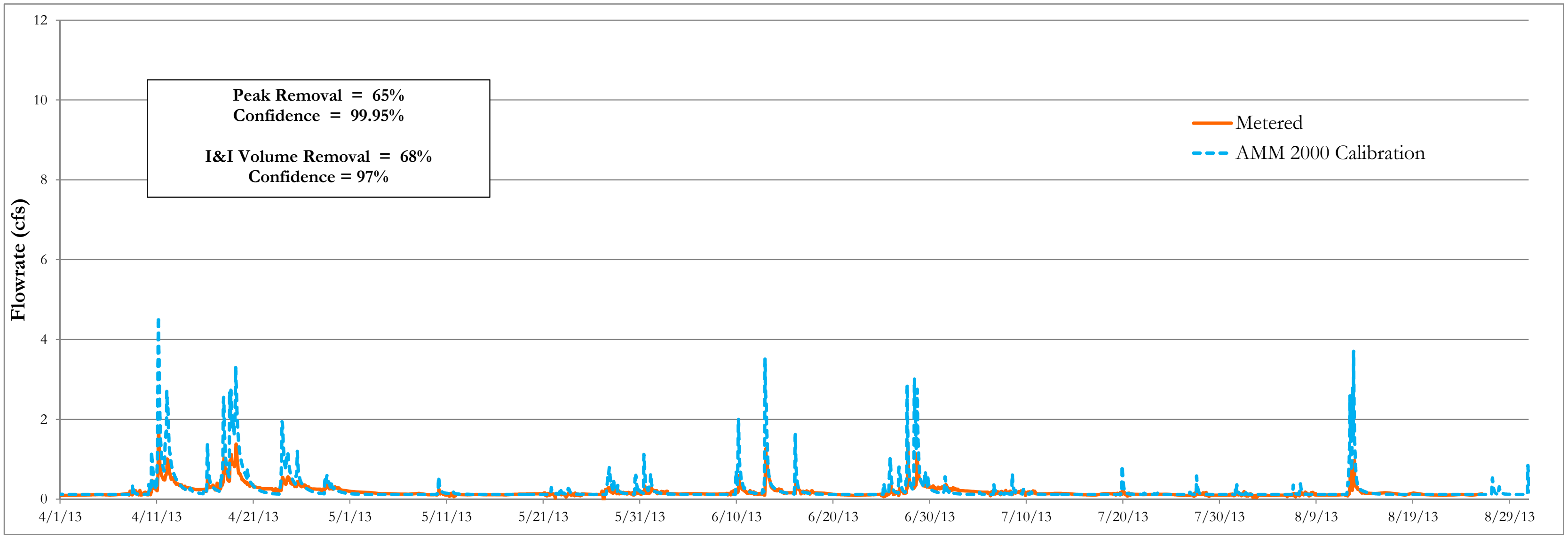


Morehead District - Summary of Results - Antecedent Moisture Modeling

2000 Meter Data with Model Calibrated to 2000 Meter Data

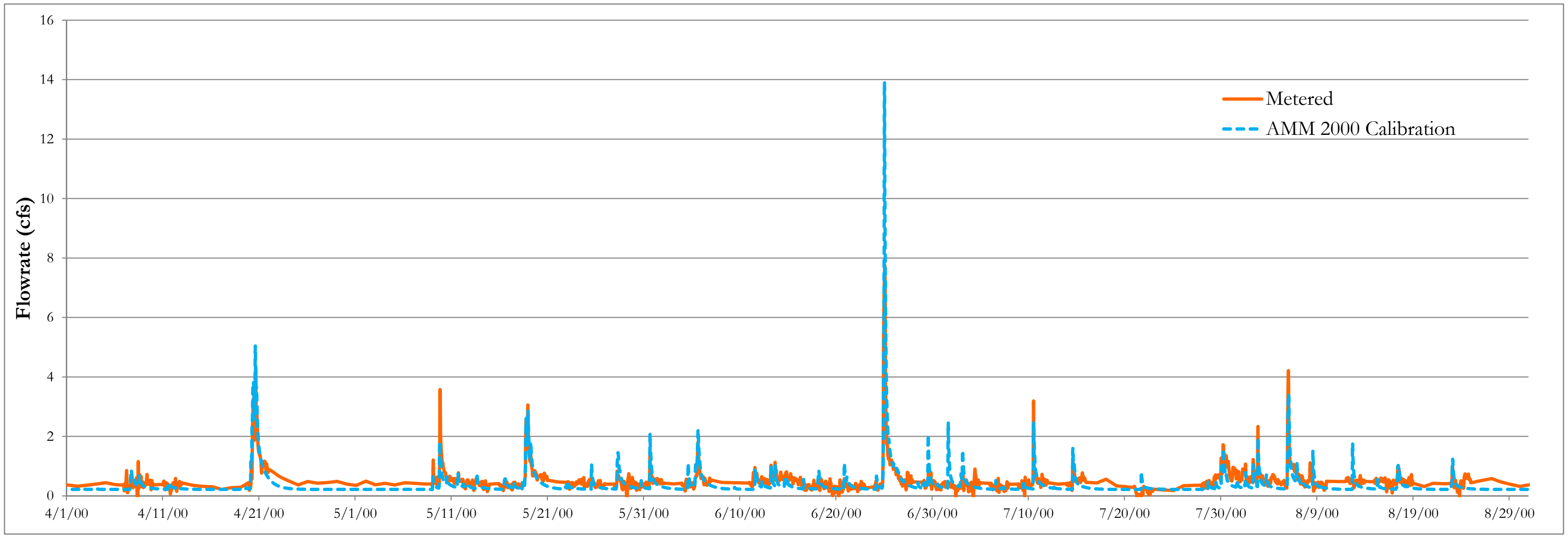


2013 Meter Data with Model Calibrated to 2000 Meter Data

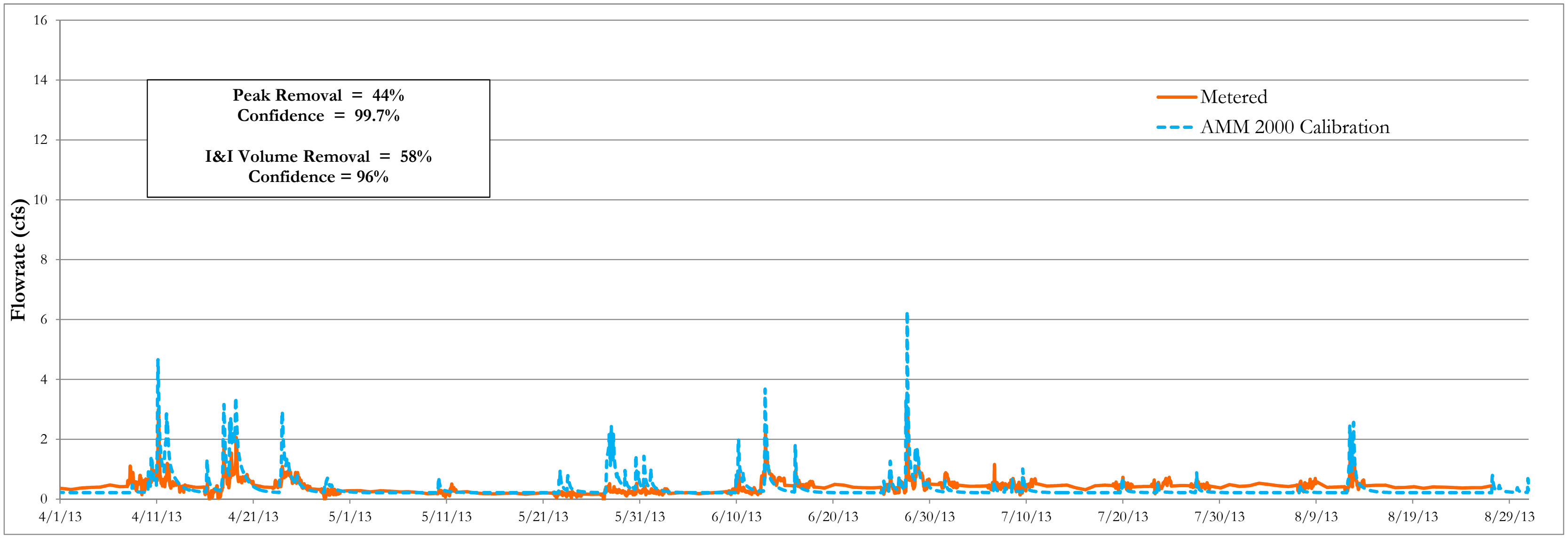


Dartmoor District - Summary of Results - Antecedent Moisture Modeling

2000 Meter Data with Model Calibrated to 2000 Meter Data

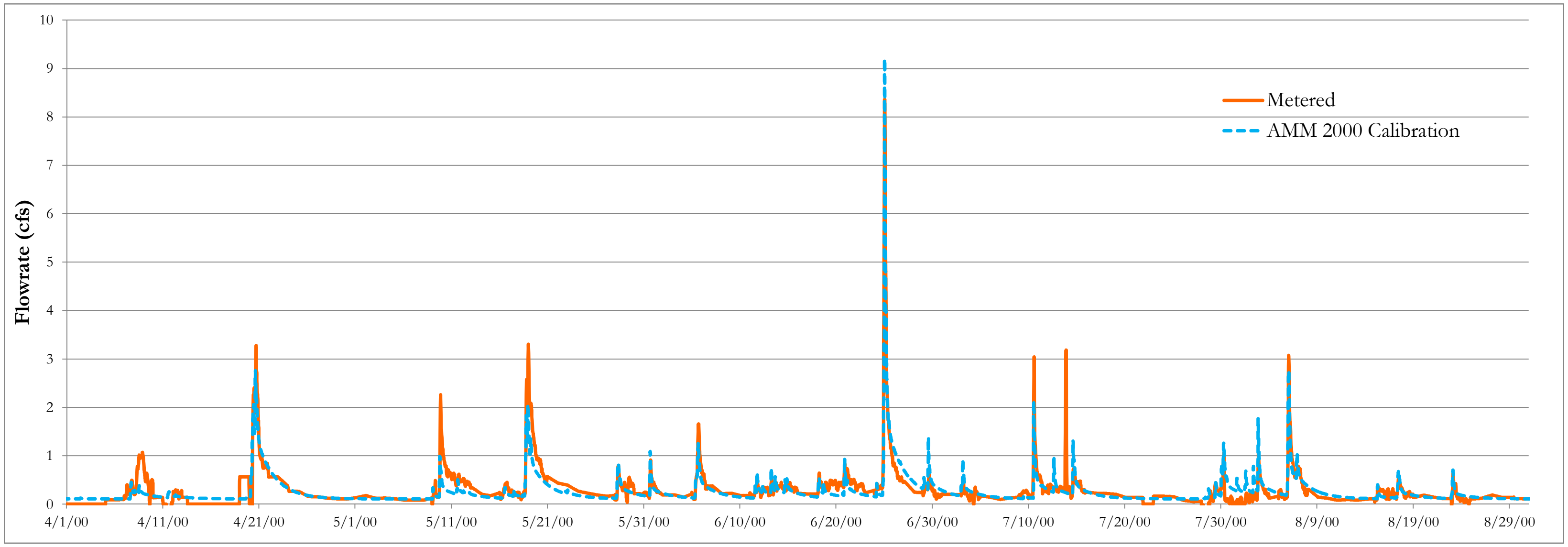


2013 Meter Data with Model Calibrated to 2000 Meter Data

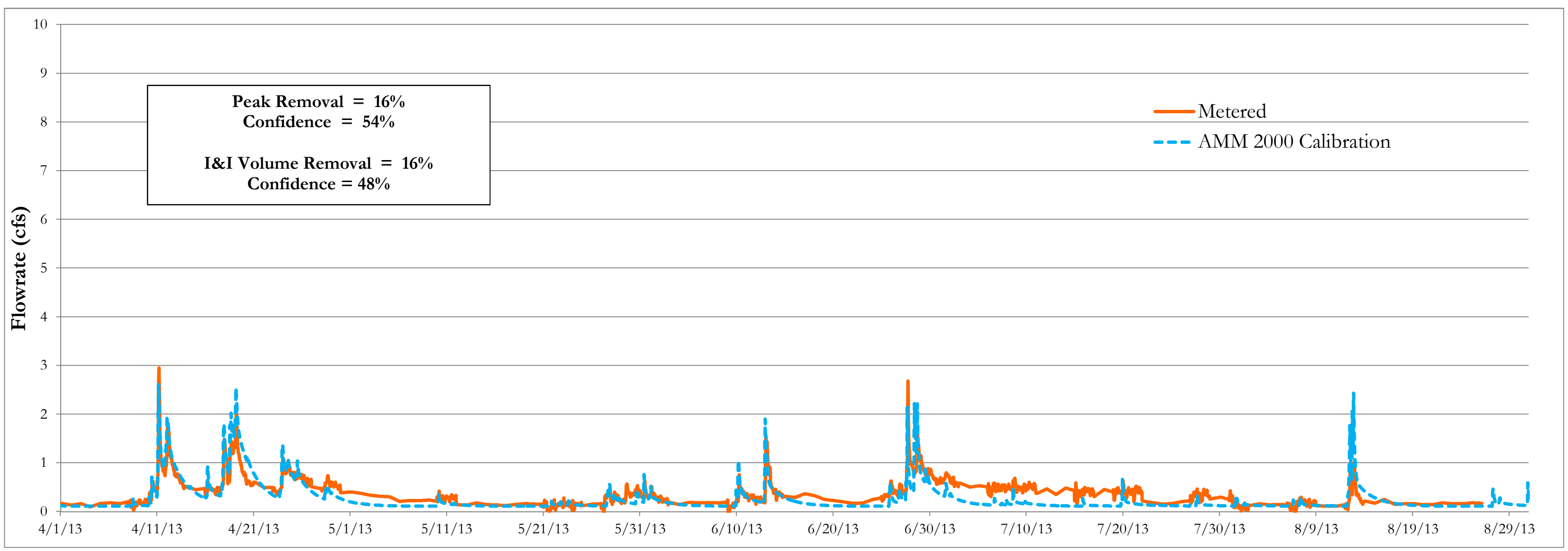


Glen Leven District - Summary of Results - Antecedent Moisture Modeling

2000 Meter Data with Model Calibrated to 2000 Meter Data



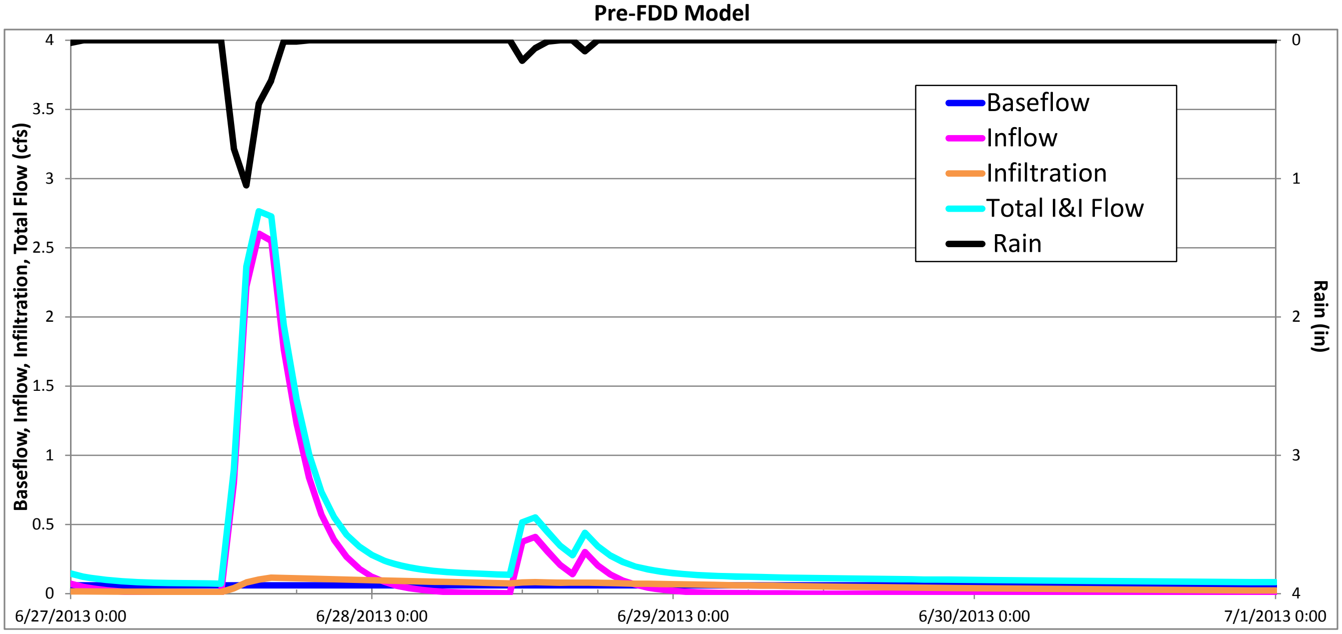
2013 Meter Data with Model Calibrated to 2000 Meter Data

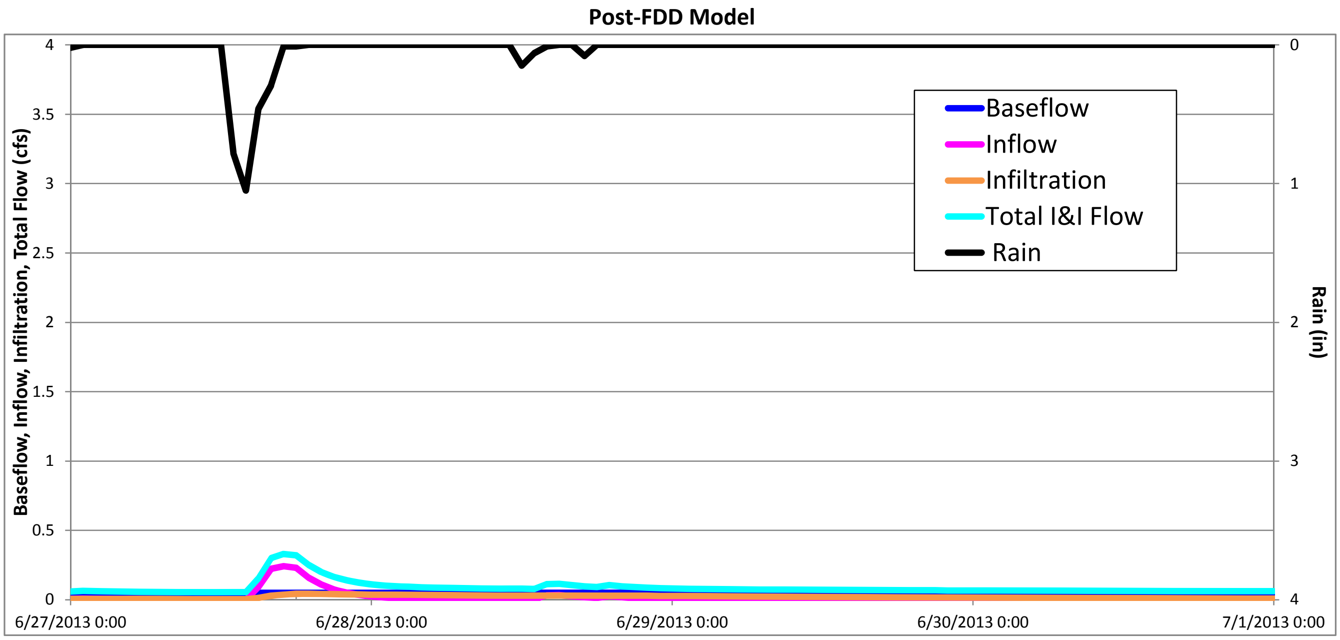


Appendix G

Flow components for June 27, 2013 storm

Orchard Hills District
June 27, 2013 Model Components





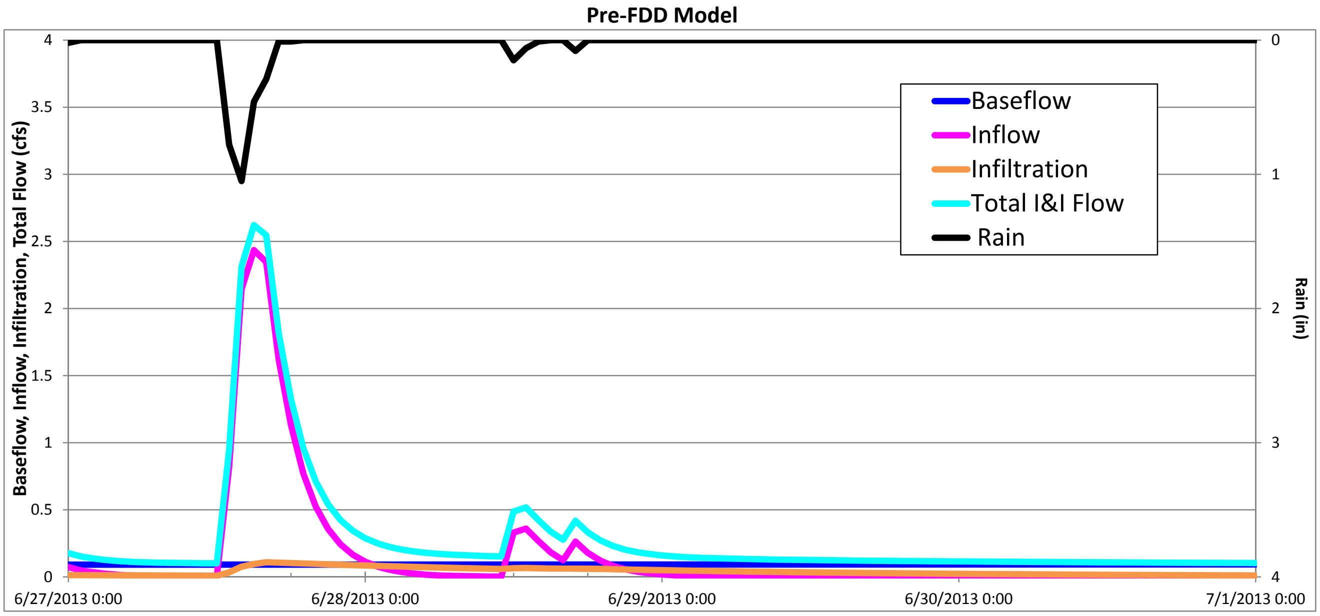
Volume

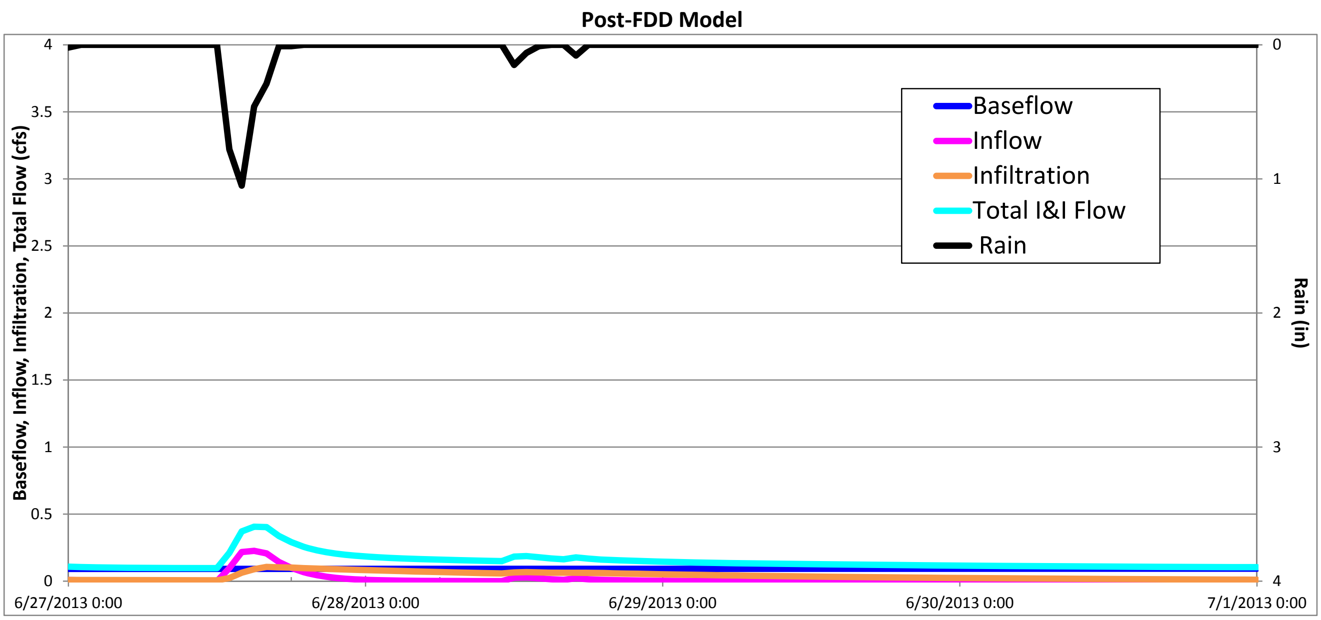
Component	2000 Calibrated AMM (Pre-FDD)	2013 Calibrated AMM (Post-FDD)	Percent Reduction
Inflow	59.0	5.5	90.7%
Infiltration	18.7	6.9	63.0%
Base Flow	21.0	17.8	15.2%
Total	98.6	30.1	69.5%

Peak Flow

Component	2000 Calibrated AMM (Pre-FDD)	2013 Calibrated AMM (Post-FDD)	Percent Reduction
Inflow	2.60	0.24	90.7%
Infiltration	0.12	0.04	62.6%
Base Flow	0.06	0.05	13.3%
Total	2.76	0.33	88.1%

Bromley District
June 27, 2013 Model Components





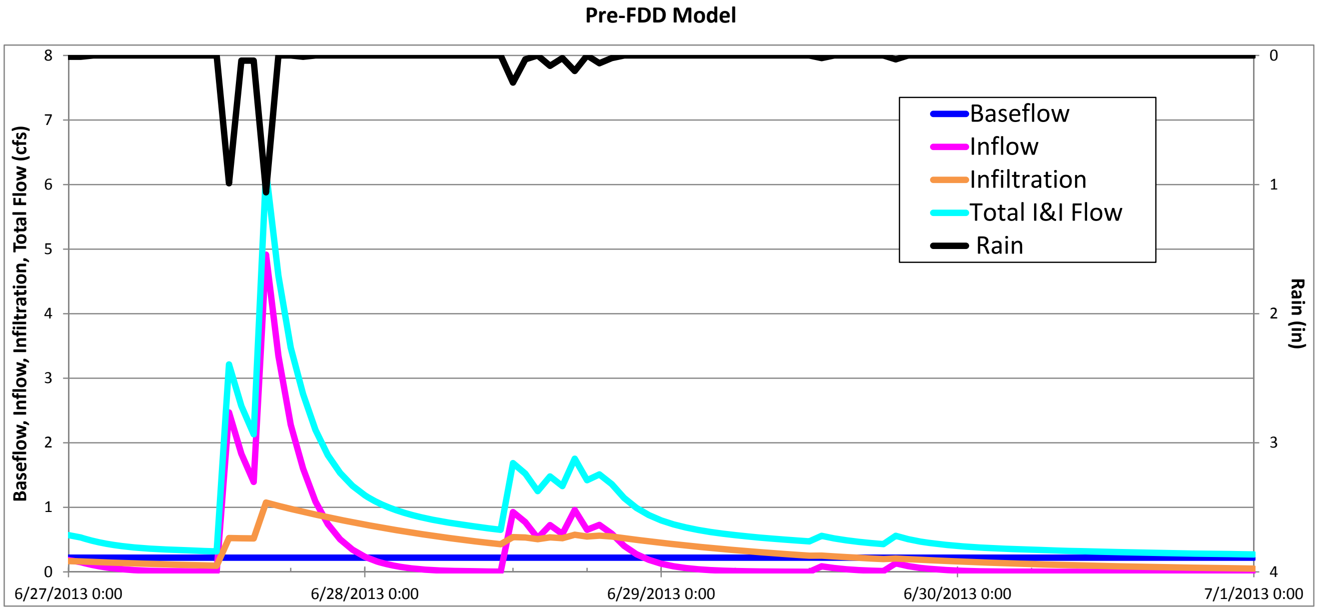
Volume

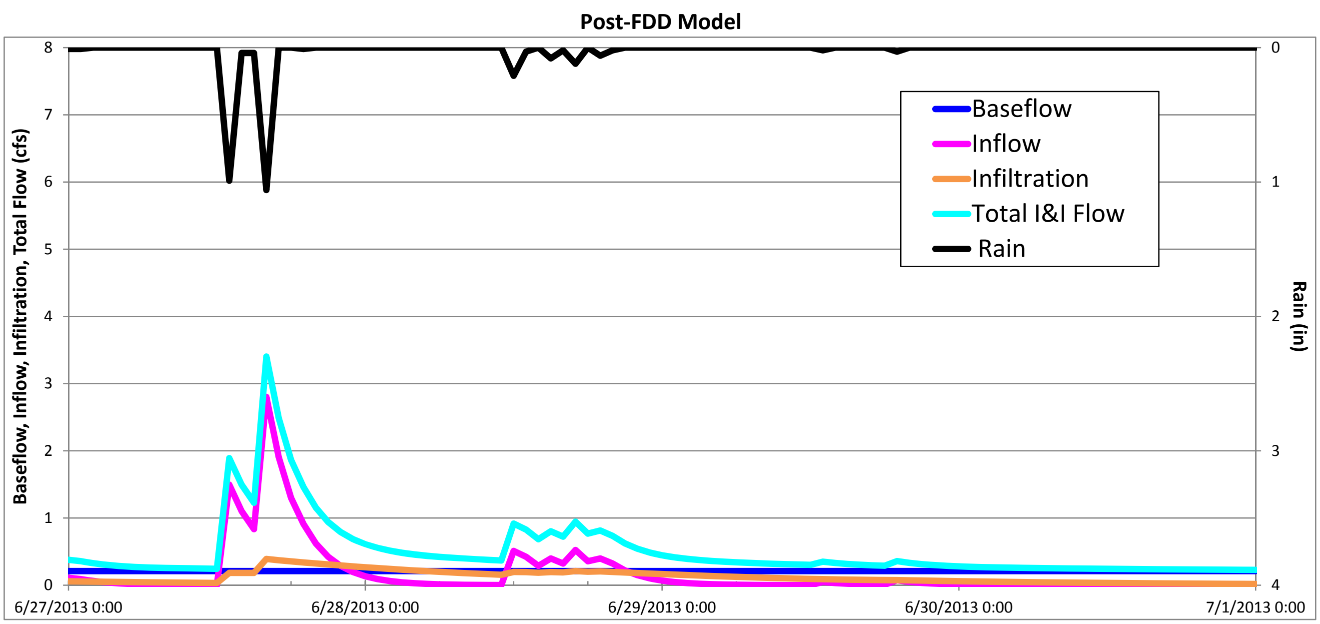
Component	2000 Calibrated AMM (Pre-FDD)	2013 Calibrated AMM (Post-FDD)	Percent Reduction
Inflow	54.8	5.0	90.9%
Infiltration	14.2	13.9	2.0%
Base Flow	32.1	32.1	0.0%
Total	101.1	51.0	49.6%

Peak Flow

Component	2000 Calibrated AMM (Pre-FDD)	2013 Calibrated AMM (Post-FDD)	Percent Reduction
Inflow	2.44	0.23	90.7%
Infiltration	0.11	0.11	2.8%
Base Flow	0.09	0.09	0.0%
Total	2.62	0.41	84.5%

Dartmoor District
June 27, 2013 Model Components





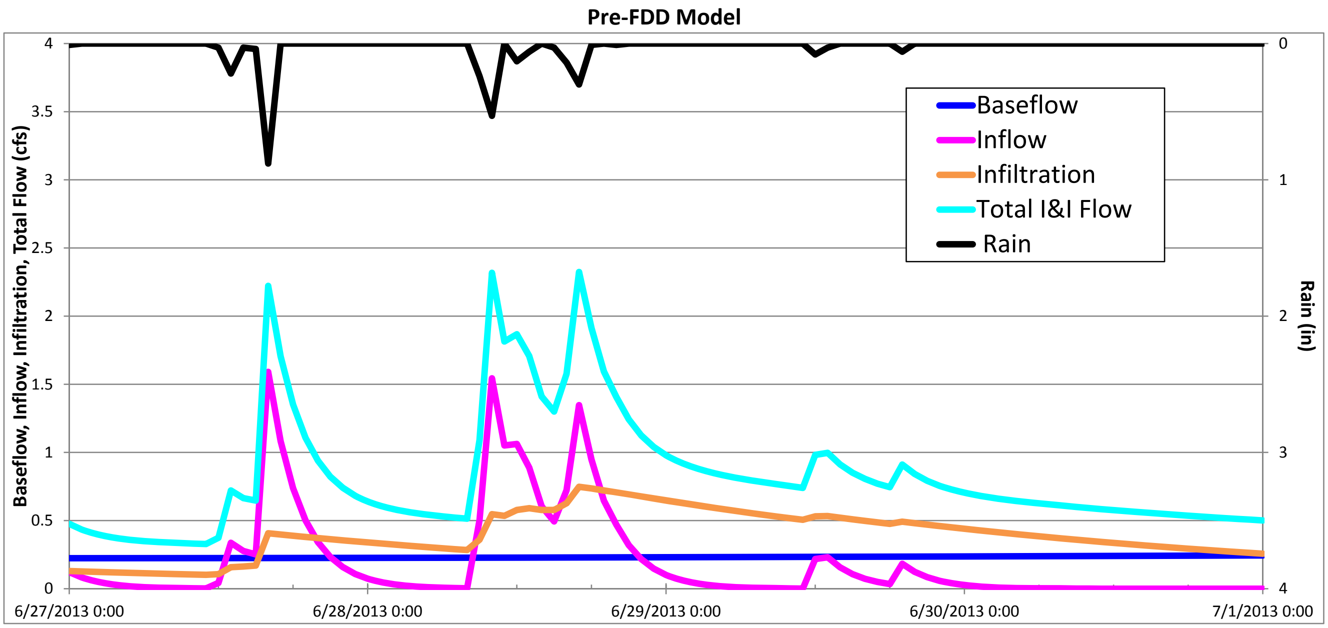
Volume

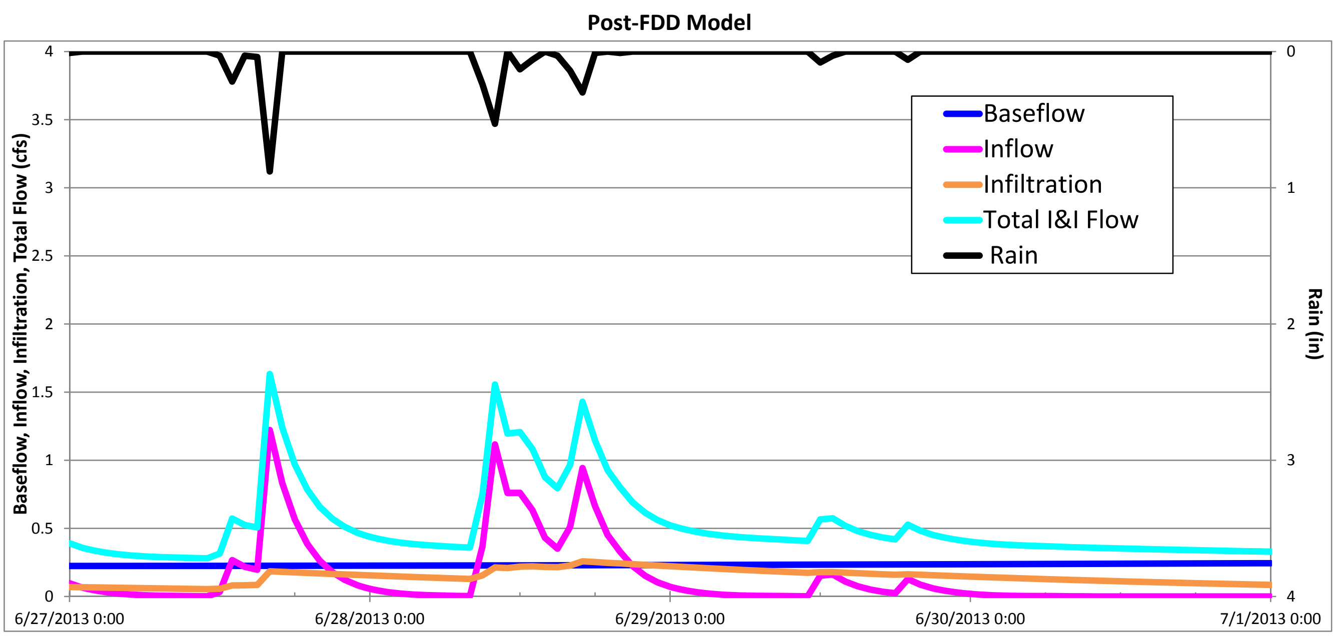
Component	2000 Calibrated AMM (Pre-FDD)	2013 Calibrated AMM (Post-FDD)	Percent Reduction
Inflow	109.0	62.2	42.9%
Infiltration	118.3	43.1	63.6%
Base Flow	76.8	73.3	4.5%
Total	304.1	178.6	41.3%

Peak flow

Component	2000 Calibrated AMM (Pre-FDD)	2013 Calibrated AMM (Post-FDD)	Percent Reduction
Inflow	4.91	2.80	43.0%
Infiltration	1.07	0.39	63.6%
Base Flow	0.22	0.21	4.5%
Total	6.21	3.40	45.2%

Glen Leven District
June 27, 2013 Model Components





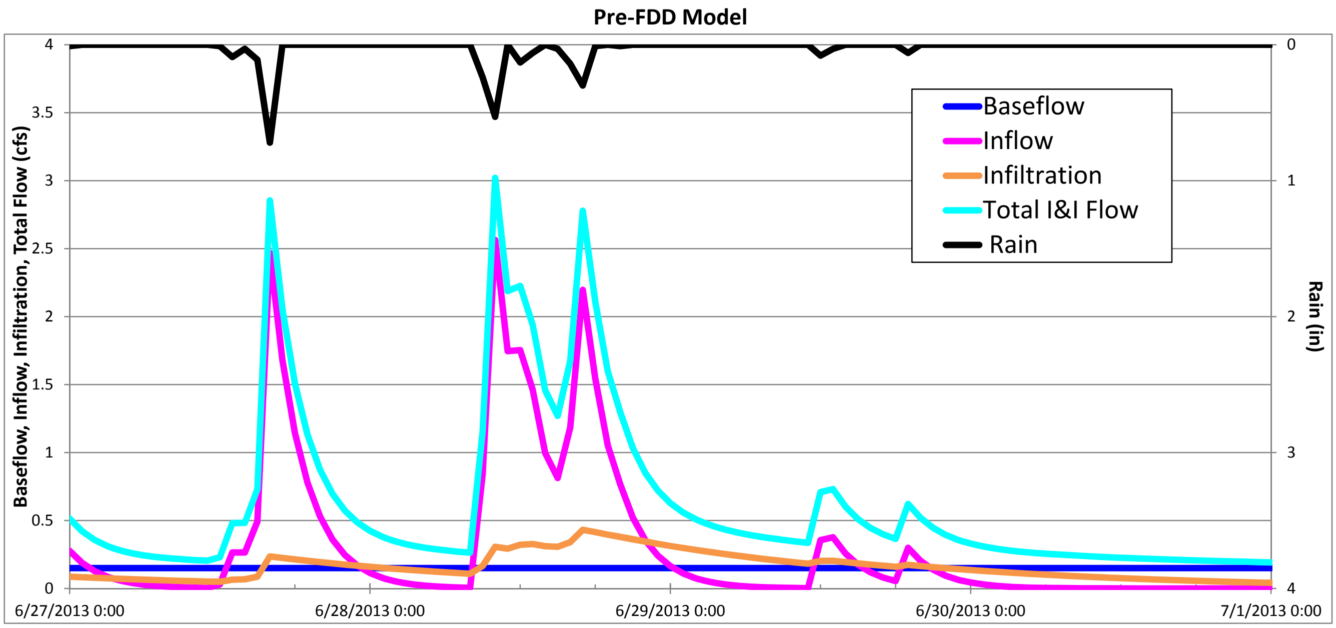
Volume

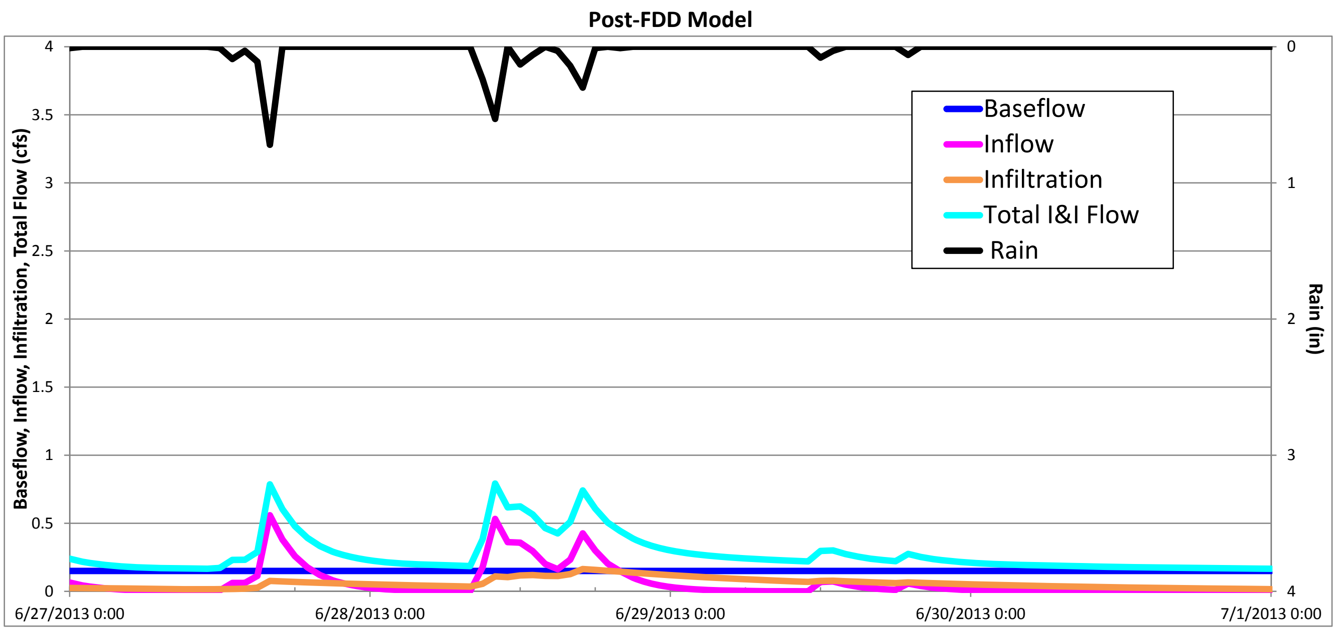
Component	2000 Calibrated AMM (Pre-FDD)	2013 Calibrated AMM (Post-FDD)	Percent Reduction
Inflow	68.4	49.9	27.0%
Infiltration	138.4	51.2	63.0%
Base Flow	81.0	81.0	0.0%
Total	287.7	182.1	36.7%

Peak flow

Component	2000 Calibrated AMM (Pre-FDD)	2013 Calibrated AMM (Post-FDD)	Percent Reduction
Inflow	1.59	1.22	23.2%
Infiltration	0.75	0.26	65.5%
Base Flow	0.24	0.24	0.0%
Total	2.32	1.63	29.7%

Morehead District
June 27, 2013 Model Components





Volume

Component	2000 Calibrated AMM (Pre-FDD)	2013 Calibrated AMM (Post-FDD)	Percent Reduction
Inflow	110.0	22.9	79.1%
Infiltration	57.3	20.8	63.7%
Base Flow	52.4	52.4	0.0%
Total	219.7	96.1	56.3%

Peak flow

Component	2000 Calibrated AMM (Pre-FDD)	2013 Calibrated AMM (Post-FDD)	Percent Reduction
Inflow	2.56	0.56	78.2%
Infiltration	0.43	0.16	62.0%
Base Flow	0.15	0.15	0.0%
Total	3.02	0.79	73.8%

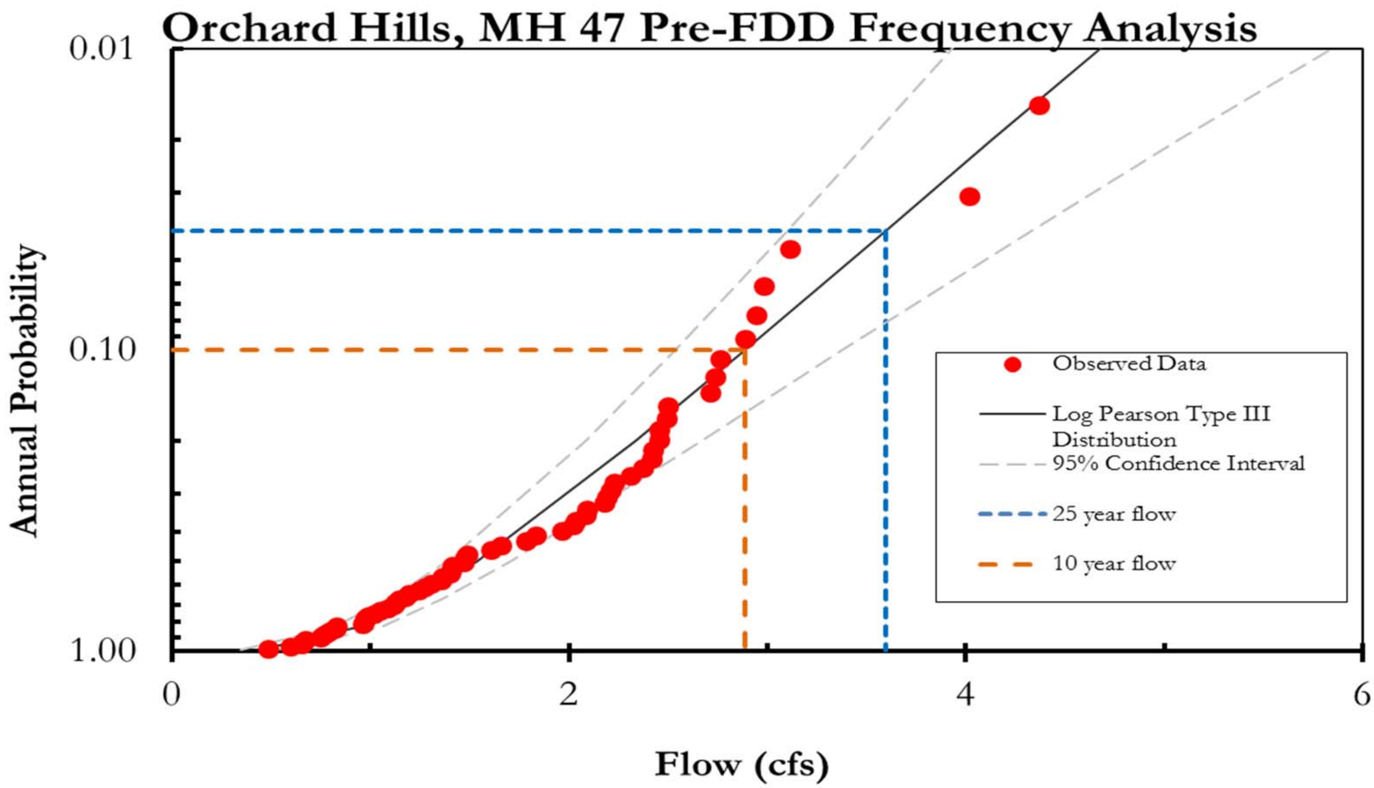
Appendix H

Frequency Analysis

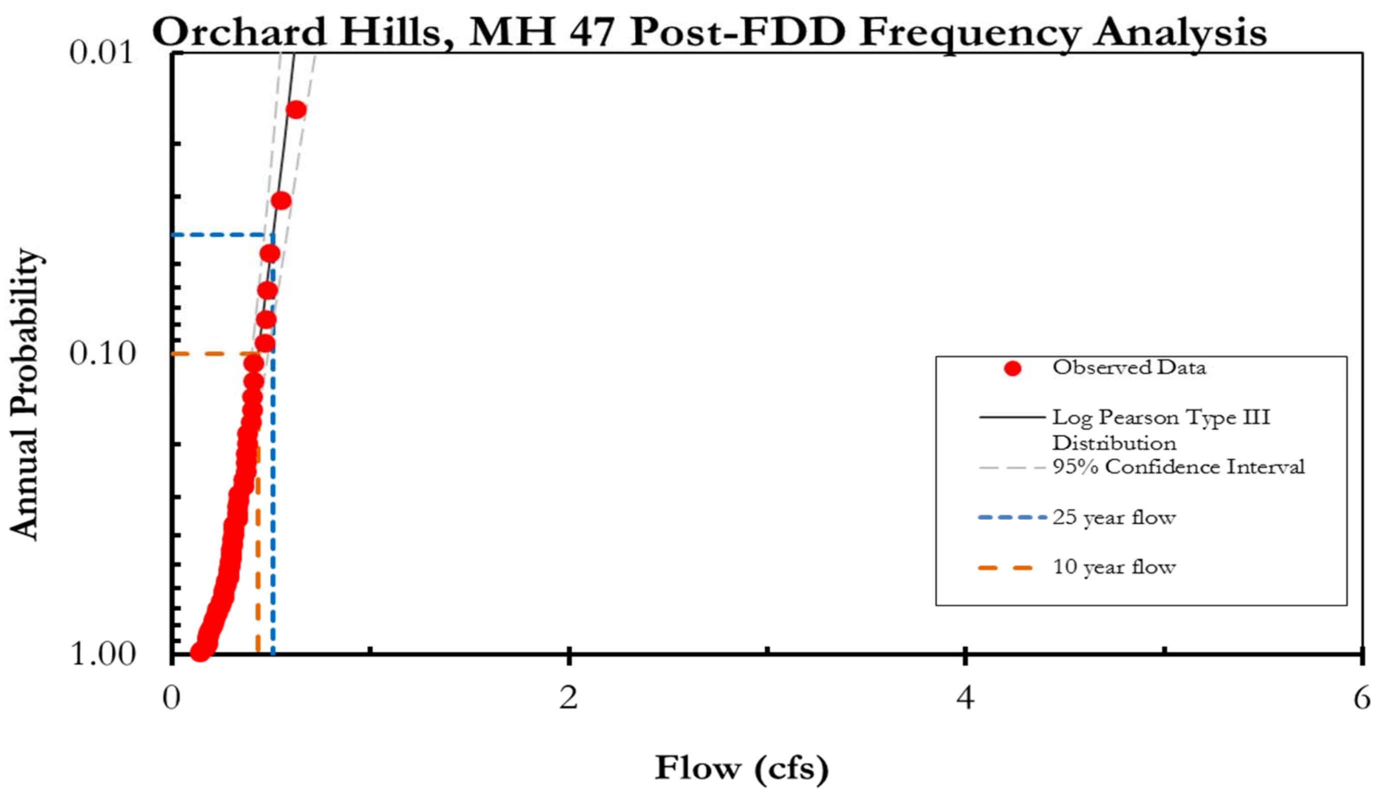
Pre vs Post-FDD in Priority Districts

Tables with Recurrence intervals

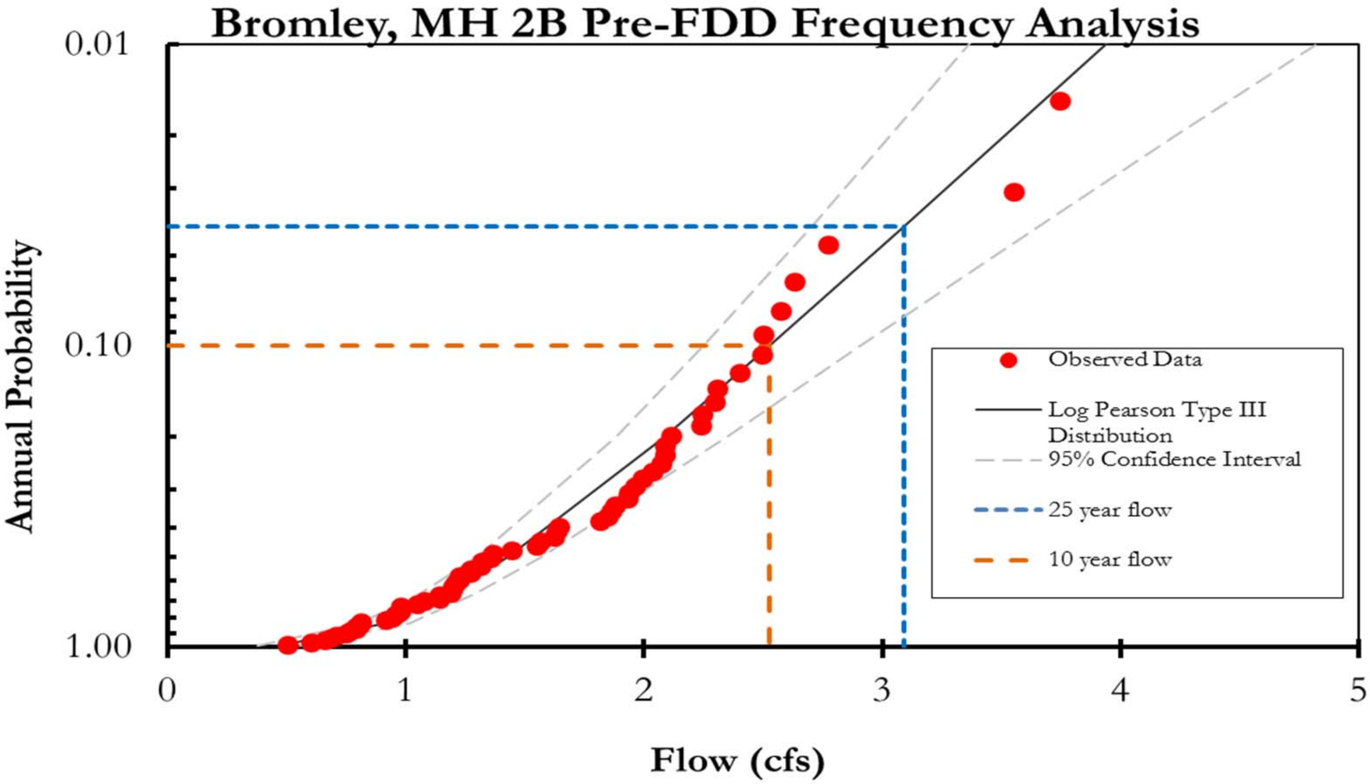
Log Pearson III Figures



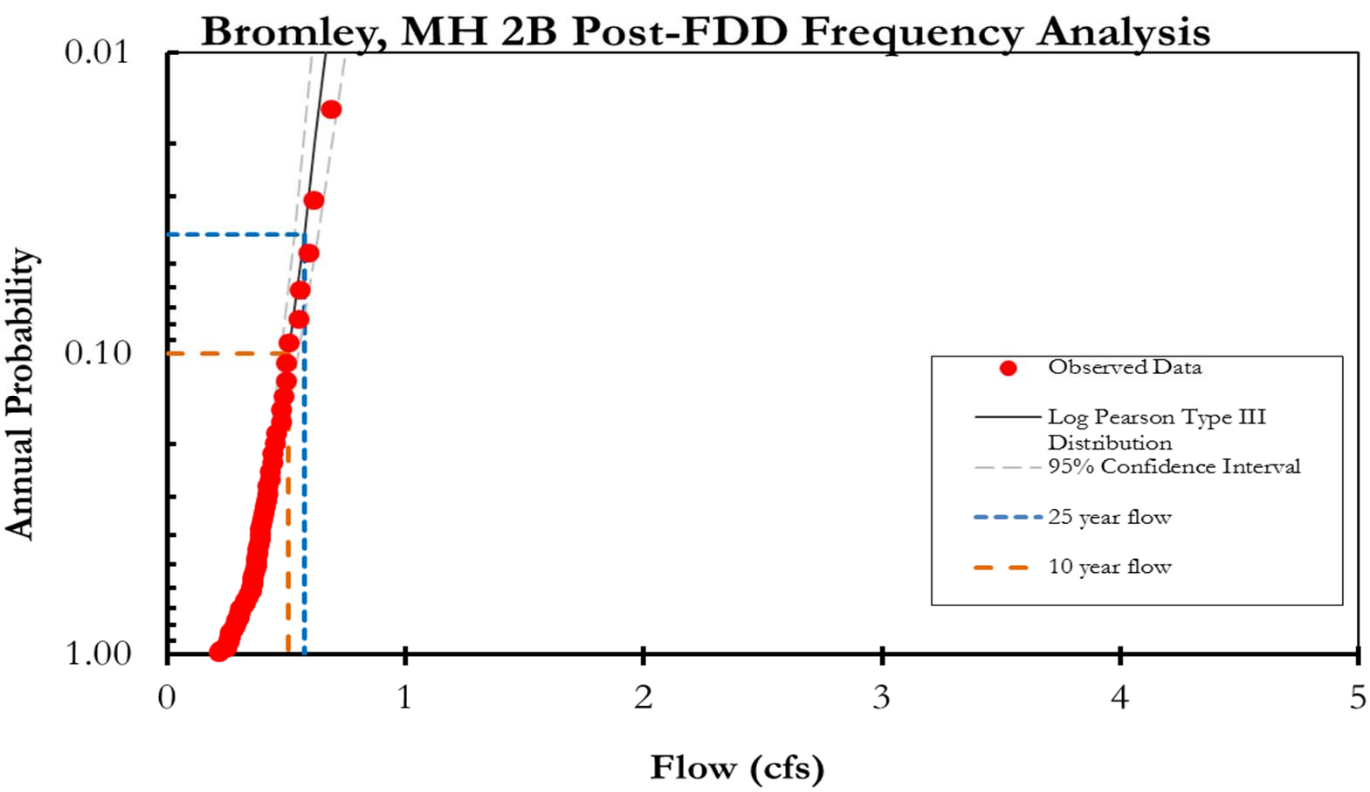
Orchard Hills, MH 47 Pre-FDD Frequency Analysis
0.01
0.10
1.00
Annual Probability
0
2
4
6
Flow (cfs)
Observed Data
Log Pearson Type III Distribution
95% Confidence Interval
25 year flow
10 year flow



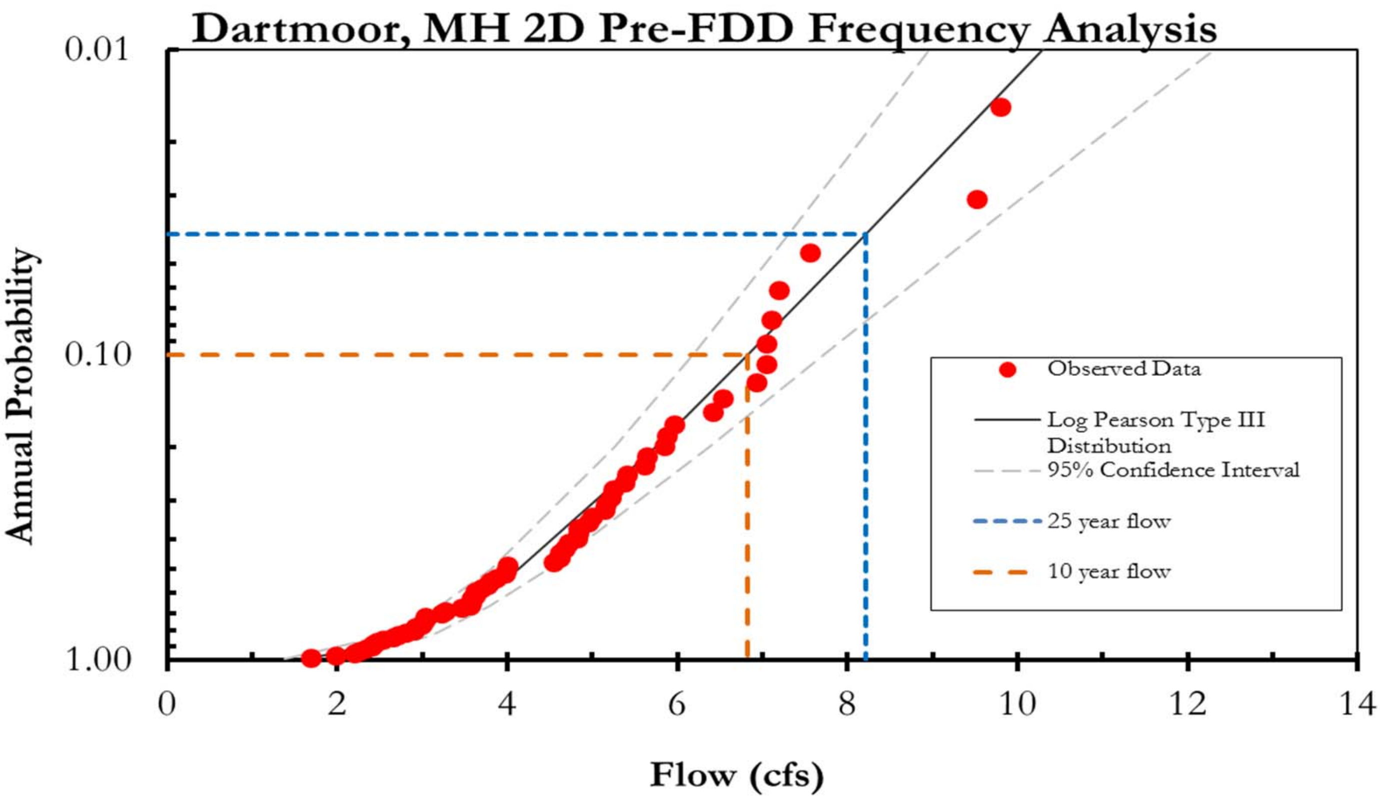
Orchard Hills, MH 47 Post-FDD Frequency Analysis
0.01
0.10
1.00
Annual Probability
0
2
4
6
Flow (cfs)
Observed Data
Log Pearson Type III Distribution
95% Confidence Interval
25 year flow
10 year flow



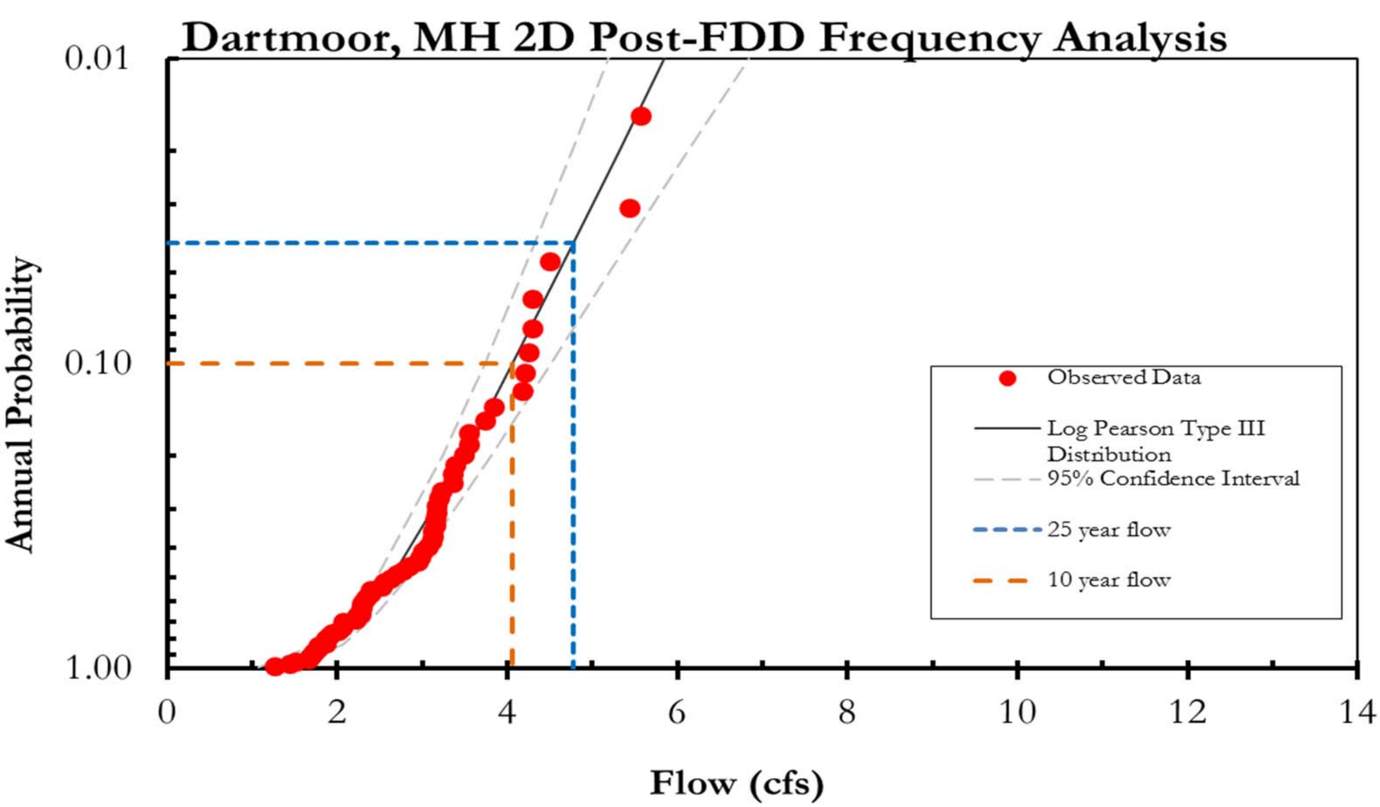
Bromley, MH 2B Pre-FDD Frequency Analysis
Annual Probability
0.01
0.10
1.00
Flow (cfs)
0
1
2
3
4
5
Observed Data
Log Pearson Type III Distribution
95% Confidence Interval
25 year flow
10 year flow



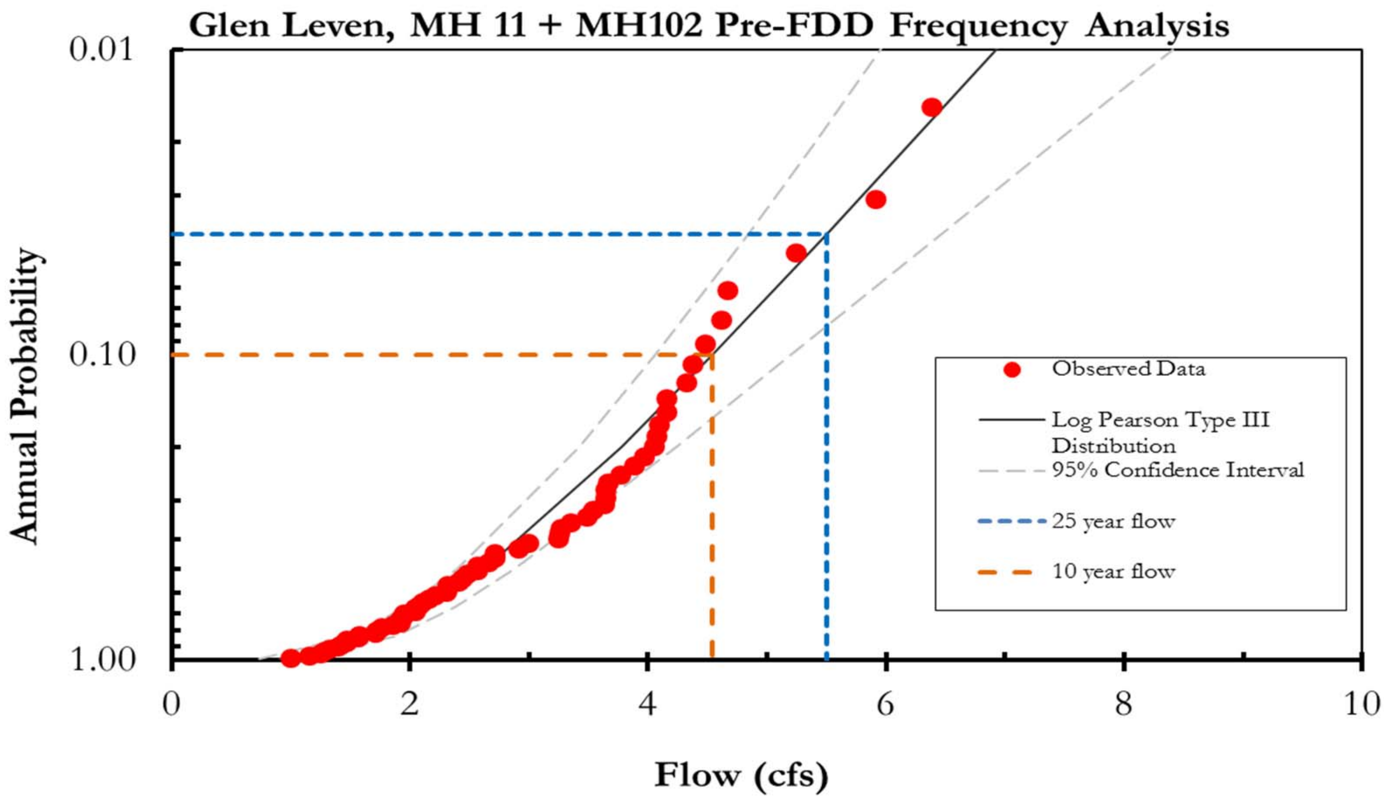
Bromley, MH 2B Post-FDD Frequency Analysis
Annual Probability
0.01
0.10
1.00
Flow (cfs)
0
1
2
3
4
5
Observed Data
Log Pearson Type III Distribution
95% Confidence Interval
25 year flow
10 year flow

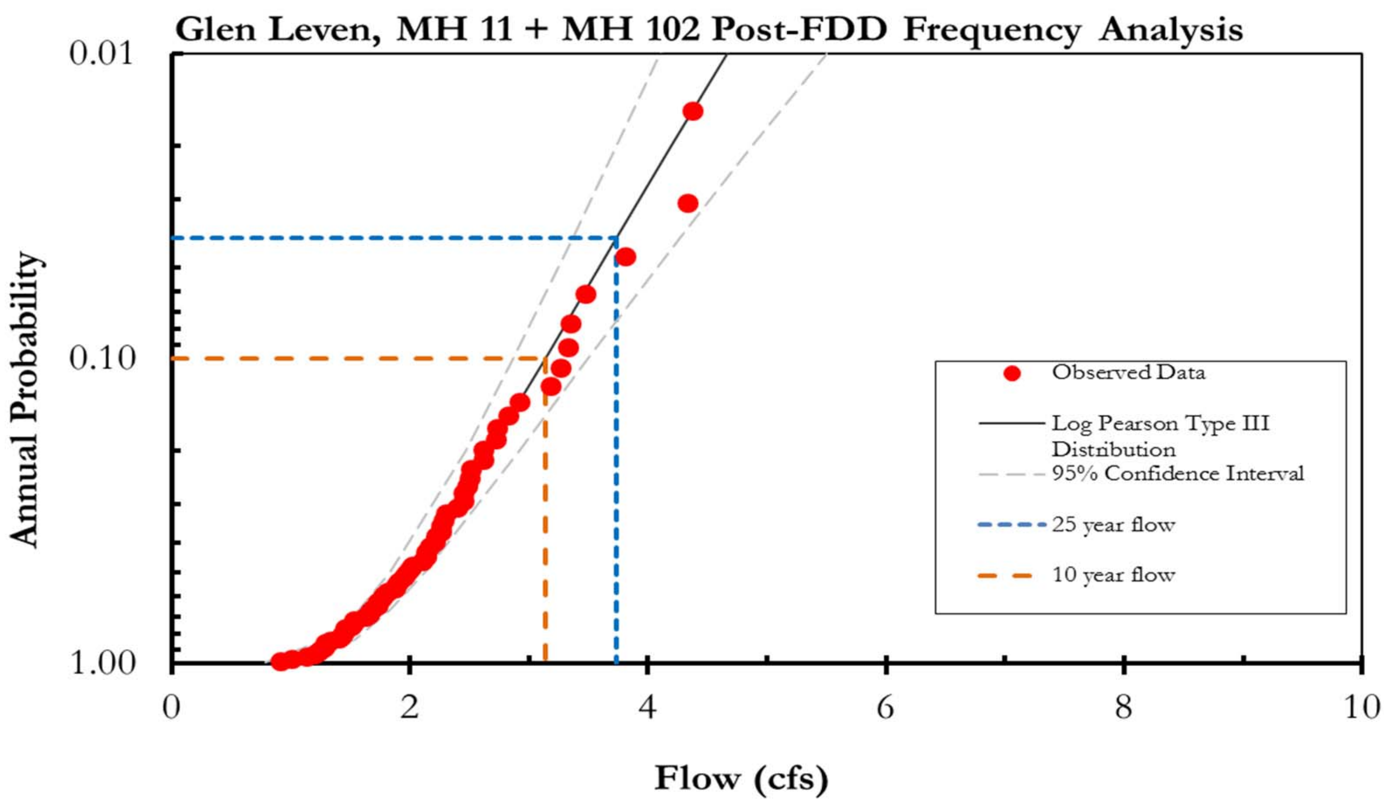


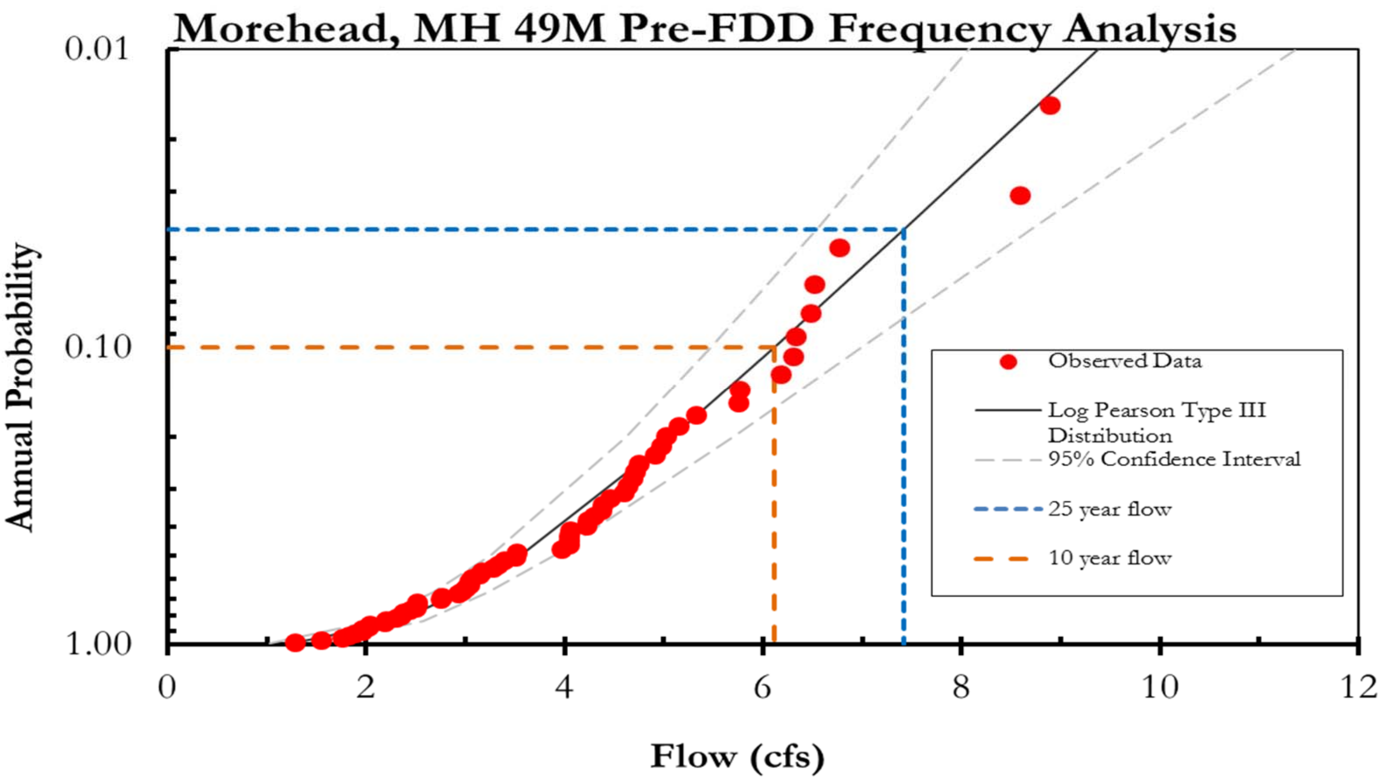
Dartmoor, MH 2D Pre-FDD Frequency Analysis
Annual Probability
0.01
0.10
1.00
0
2
4
6
8
10
12
14
Flow (cfs)
Observed Data
Log Pearson Type III Distribution
95% Confidence Interval
25 year flow
10 year flow

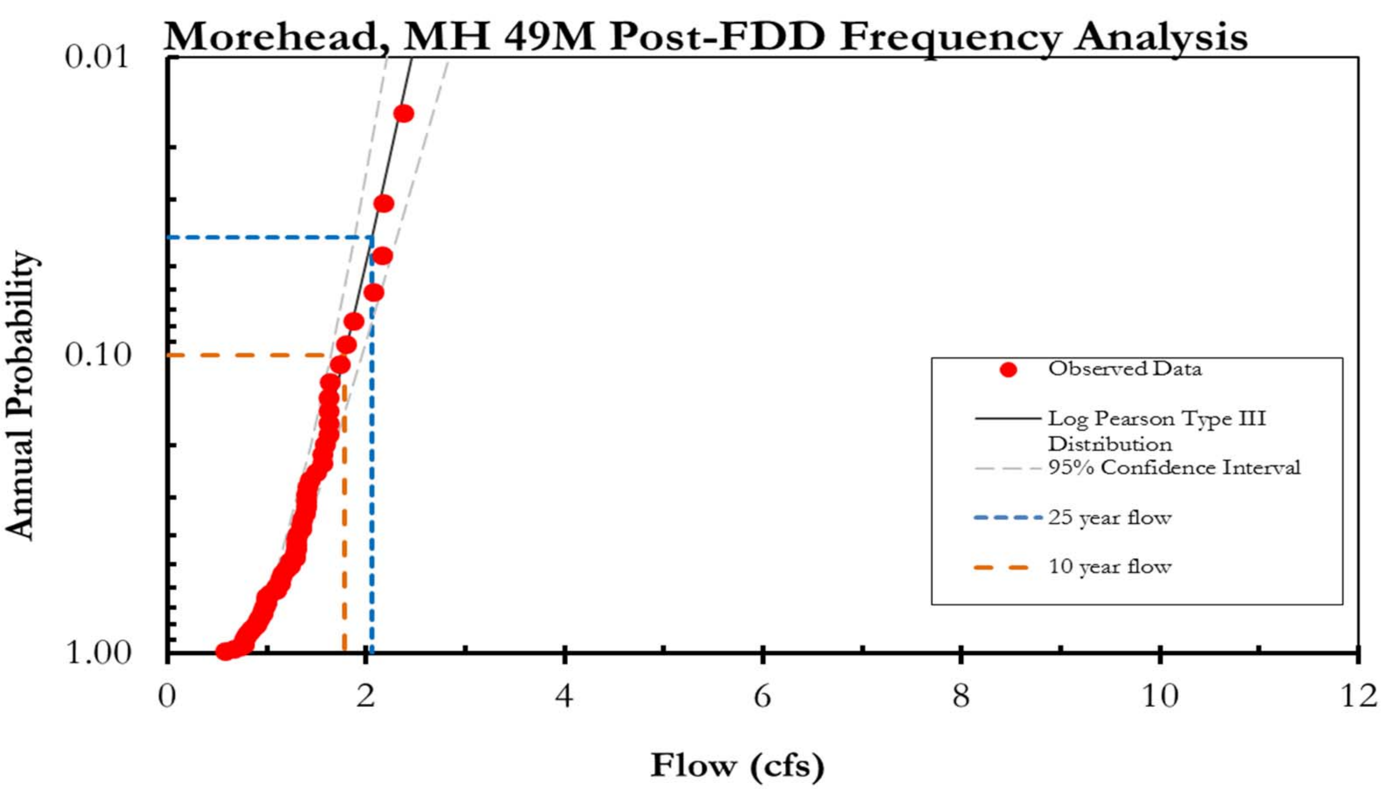


Dartmoor, MH 2D Post-FDD Frequency Analysis
Annual Probability
0.01
0.10
1.00
0
2
4
6
8
10
12
14
Flow (cfs)
Observed Data
Log Pearson Type III Distribution
95% Confidence Interval
25 year flow
10 year flow


Glen Leven, MH 11 + MH102 Pre-FDD Frequency Analysis
Annual Probability
0.01
0.10
1.00
Flow (cfs)
0
2
4
6
8
10
Observed Data
Log Pearson Type III Distribution
95% Confidence Interval
25 year flow
10 year flow


Glen Leven, MH 11 + MH 102 Post-FDD Frequency Analysis
Annual Probability
0.01
0.10
1.00
Flow (cfs)
0
2
4
6
8
10
Observed Data
Log Pearson Type III Distribution
95% Confidence Interval
25 year flow
10 year flow


Morehead, MH 49M Pre-FDD Frequency Analysis
0.01
0.10
1.00
Annual Probability
0
2
4
6
8
10
12
Flow (cfs)
Observed Data
Log Pearson Type III Distribution
95% Confidence Interval
25 year flow
10 year flow

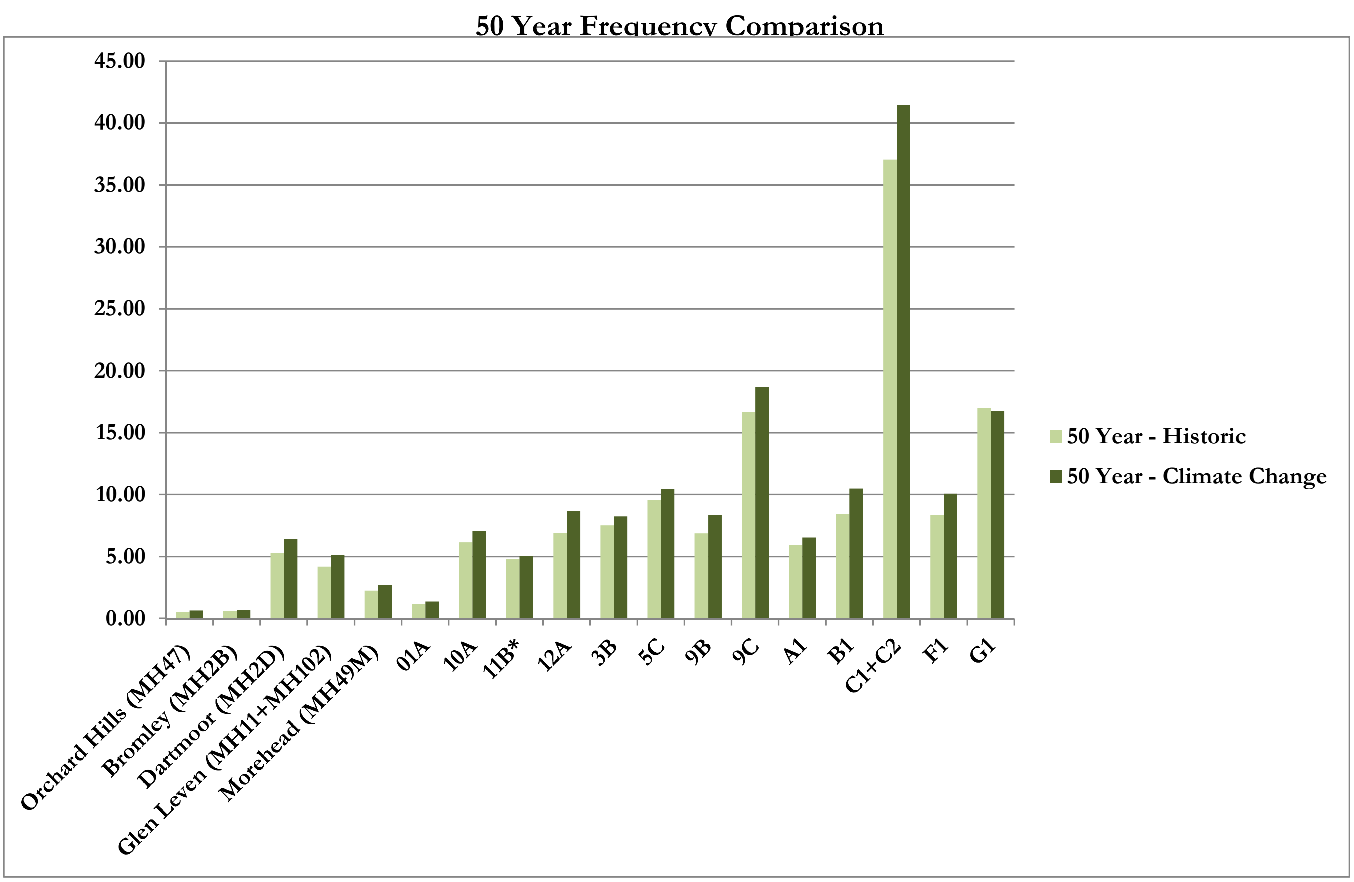

Morehead, MH 49M Post-FDD Frequency Analysis
0.01
0.10
1.00
Annual Probability
0
2
4
6
8
10
12
Flow (cfs)
Observed Data
Log Pearson Type III Distribution
95% Confidence Interval
25 year flow
10 year flow

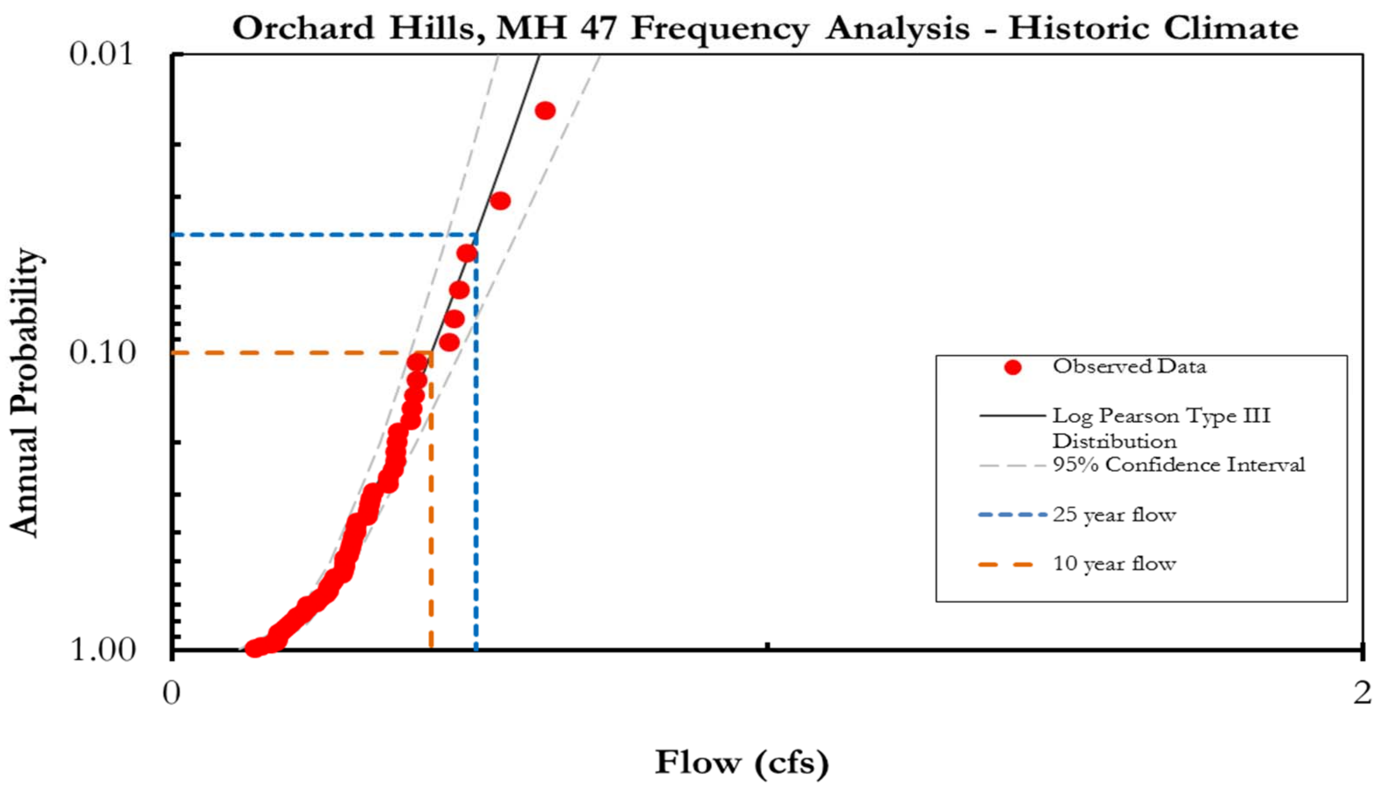
Appendix I
Historic vs Climate Change
Tables with Recurrence intervals
Log Pearson III Figures

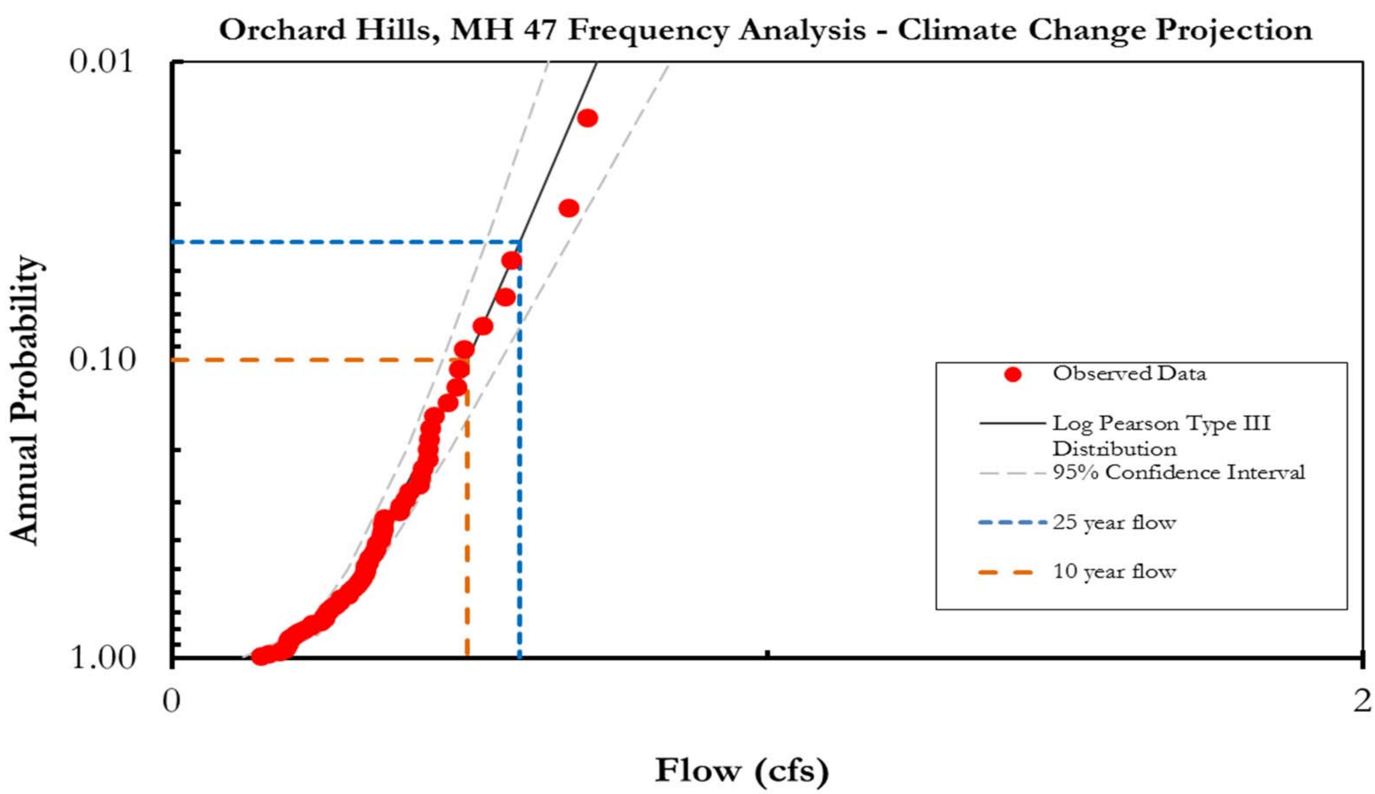
Ann Arbor Sanitary Sewer Wet Weather Evalution Project
Frequency Analysis - Historic Climate vs. Climate Change Summary

Meter ID	Historic Frequency Analysis Total Flow Rate (cfs)				Climate Projected Frequency Analysis Total Flow Rate (cfs)			
	10 year	25 year	50 year	100 year	10 year	25 year	50 year	100 year
Orchard Hills (MH47)	0.44	0.51	0.56	0.62	0.50	0.58	0.65	0.71
Bromley (MH2B)	0.51	0.57	0.62	0.66	0.56	0.64	0.70	0.76
Dartmoor (MH2D)	4.06	4.78	5.31	5.85	4.76	5.70	6.42	7.14
Glen Leven (MH11+MH102)	3.13	3.74	4.20	4.66	3.71	4.50	5.12	5.76
Morehead (MH49M)	1.78	2.06	2.26	2.46	2.06	2.42	2.69	2.97
01A	0.89	1.05	1.17	1.29	1.00	1.20	1.37	1.53
10A	5.14	5.74	6.17	6.61	5.76	6.51	7.08	7.64
11B*	3.94	4.43	4.79	5.14	4.23	4.71	5.04	5.36
12A	5.03	6.11	6.91	7.70	6.16	7.61	8.69	9.77
3B	5.72	6.76	7.52	8.28	6.13	7.34	8.25	9.18
5C	7.53	8.69	9.56	10.42	7.81	9.30	10.44	11.62
9B	5.34	6.21	6.87	7.53	6.28	7.47	8.39	9.33
9C	14.20	15.64	16.67	17.67	15.67	17.42	18.68	19.90
A1	4.63	5.38	5.95	6.53	5.05	5.90	6.55	7.22
B1	6.60	7.68	8.47	9.25	7.88	9.38	10.51	11.66
C1+C2	31.82	34.89	37.06	39.16	35.01	38.76	41.45	44.08
F1	6.35	7.51	8.39	9.30	7.43	8.92	10.08	11.27
G1	13.52	15.49	16.98	18.51	13.50	15.35	16.76	18.20

* Removed High Outlier from Climate Projected Frequency (4.41, 5.05, 5.52, 6.00)



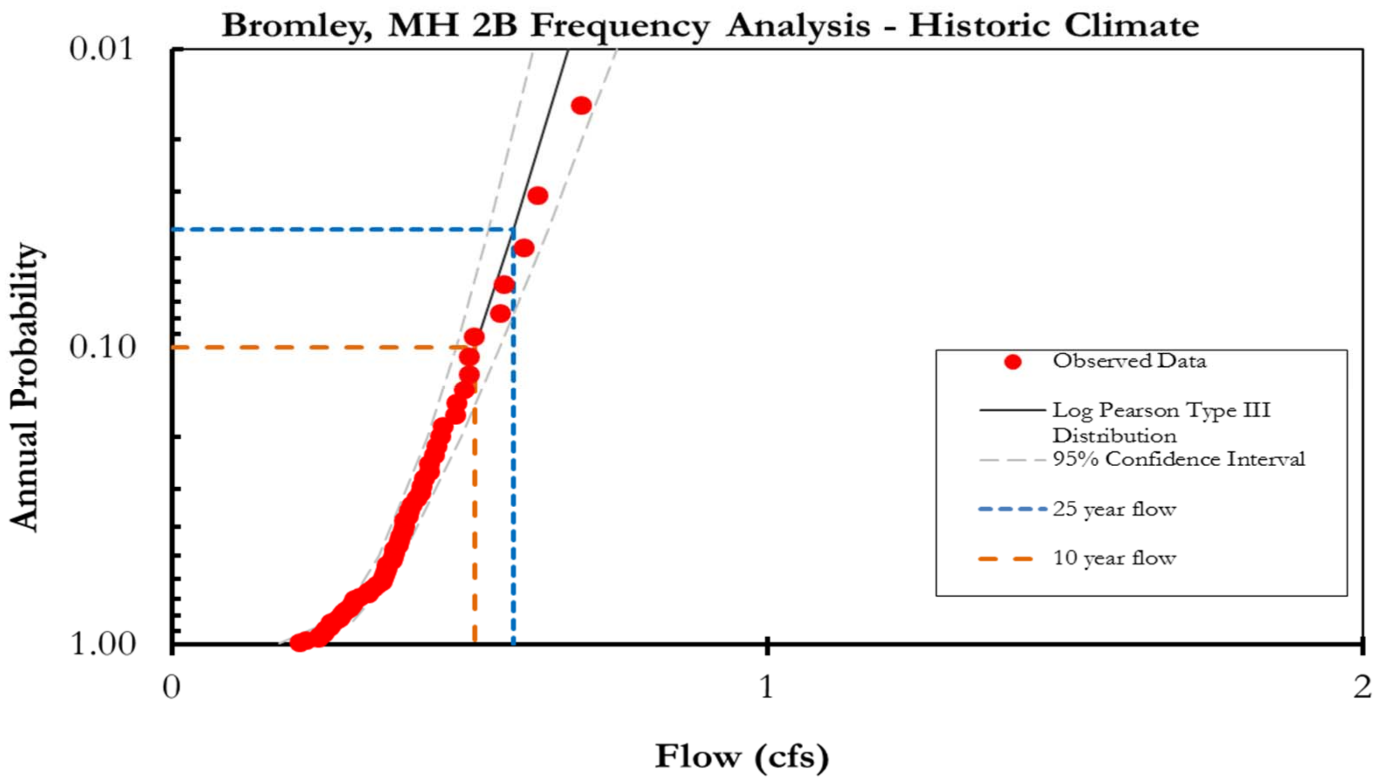


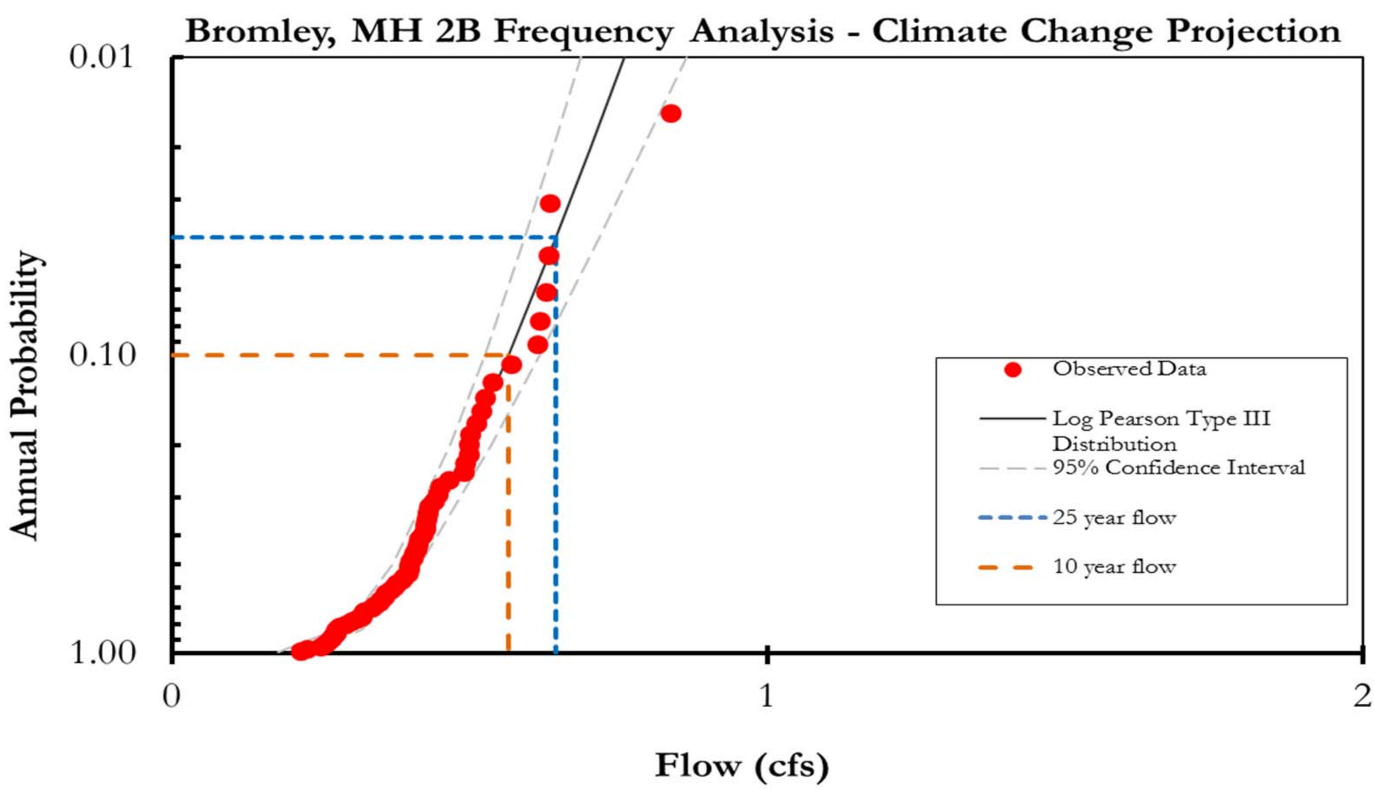


	10 year	25 year	50 year	100 year
Historic Climate	0.44	0.51	0.56	0.62
Climate Change	0.50	0.58	0.65	0.71

Pipe Capcity = 1.2 cfs

June 27, 2013 Storm Peak Flow = 0.63 cfs

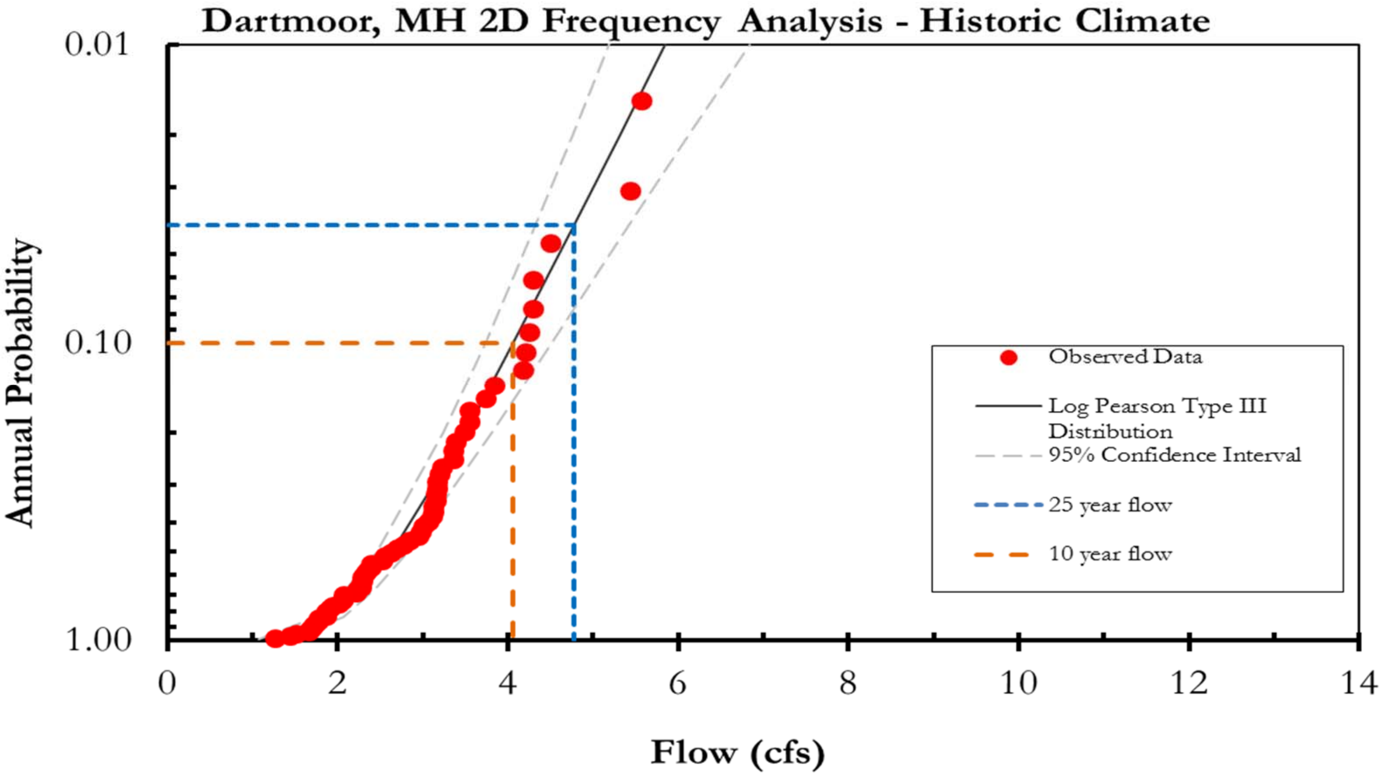


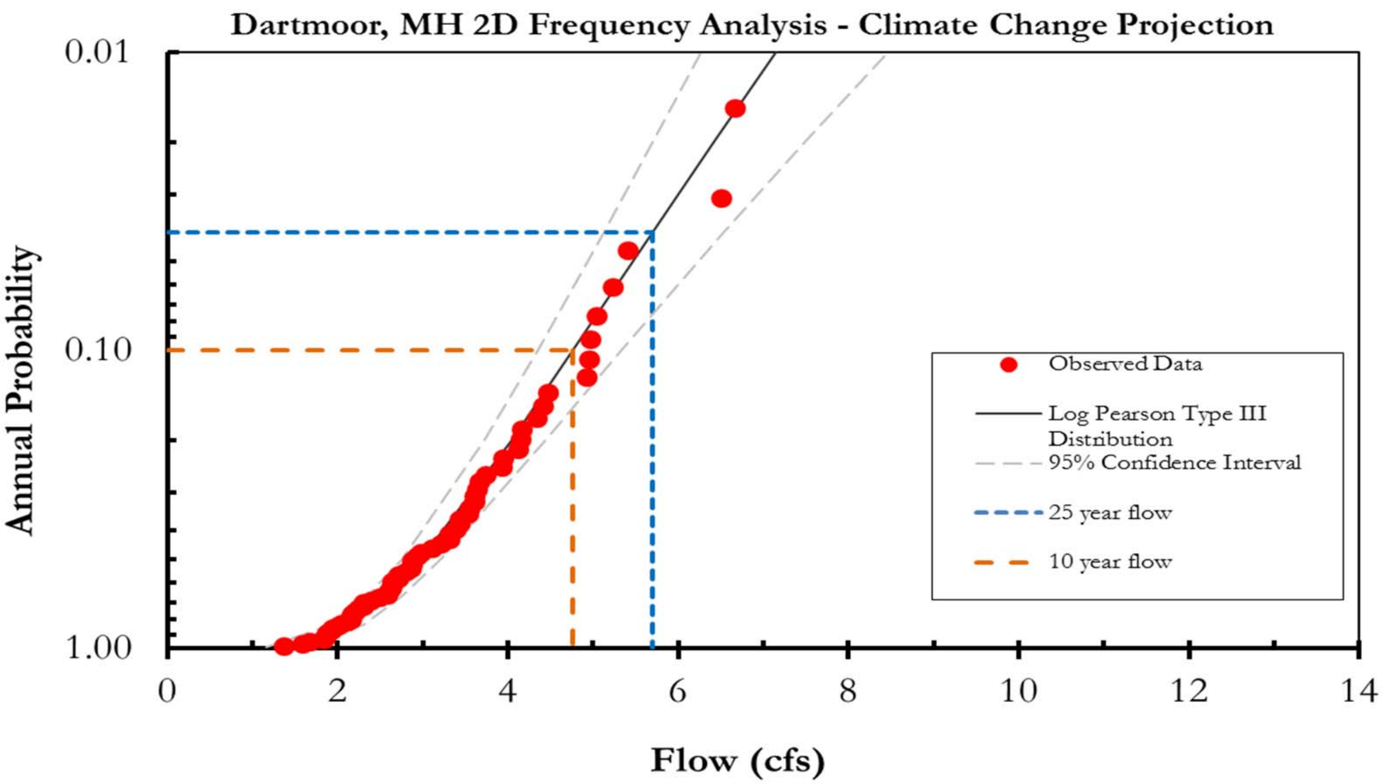


	10 year	25 year	50 year	100 year
Historic Climate	0.51	0.57	0.62	0.66
Climate Change	0.56	0.64	0.70	0.76

Pipe Capcity = 1.3 cfs

June 27, 2013 Storm Peak Flow = 0.59 cfs

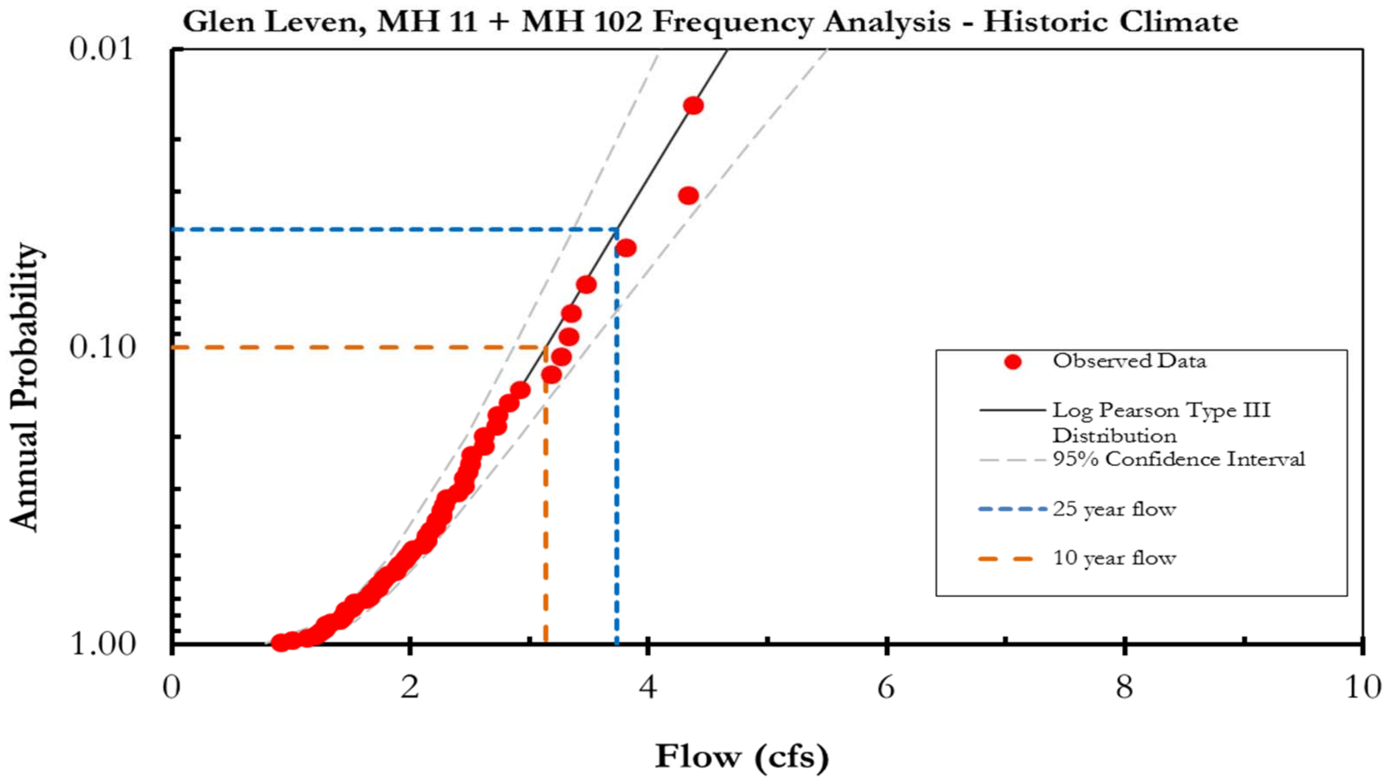


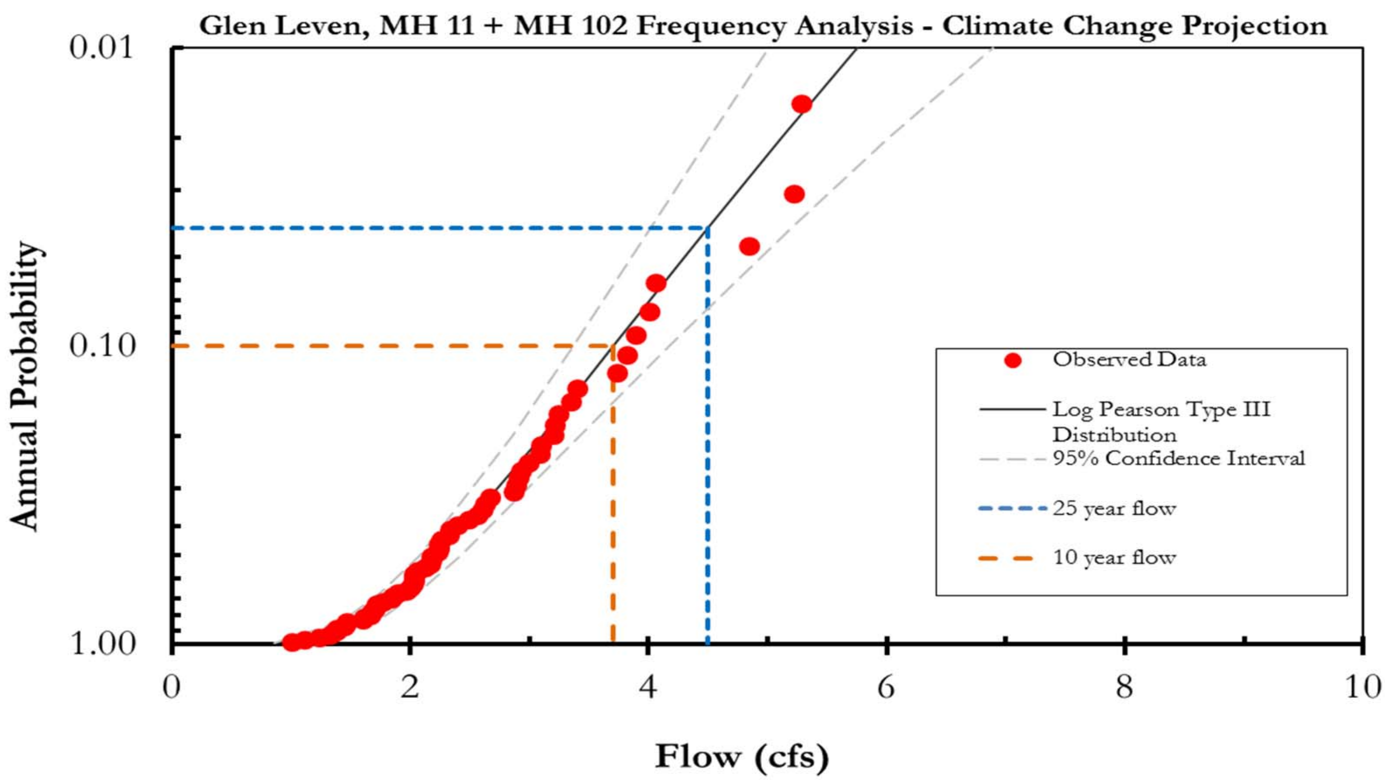


	10 year	25 year	50 year	100 year
Historic Climate	4.06	4.78	5.31	5.85
Climate Change	4.76	5.70	6.42	7.14

Pipe Capcity = 9.1 cfs

June 27, 2013 Storm Peak Flow = 6.51 cfs

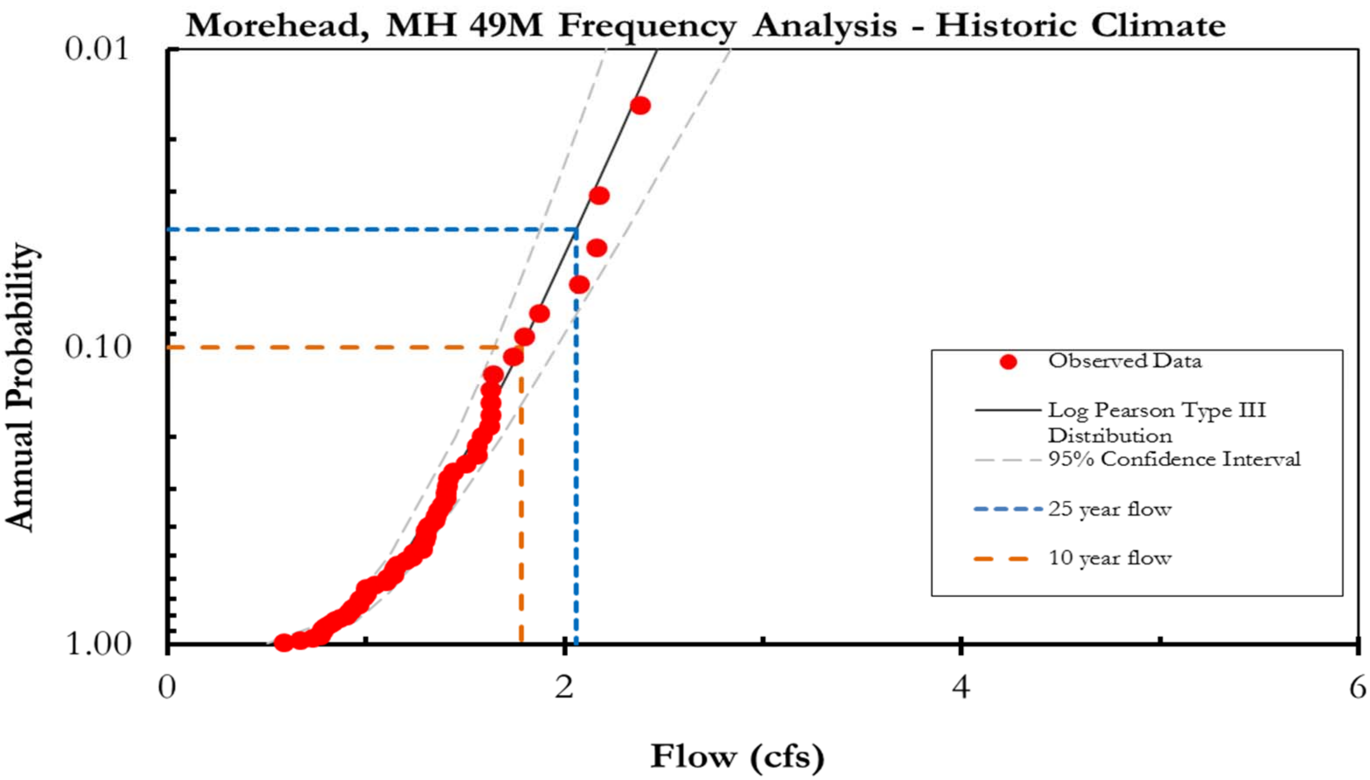


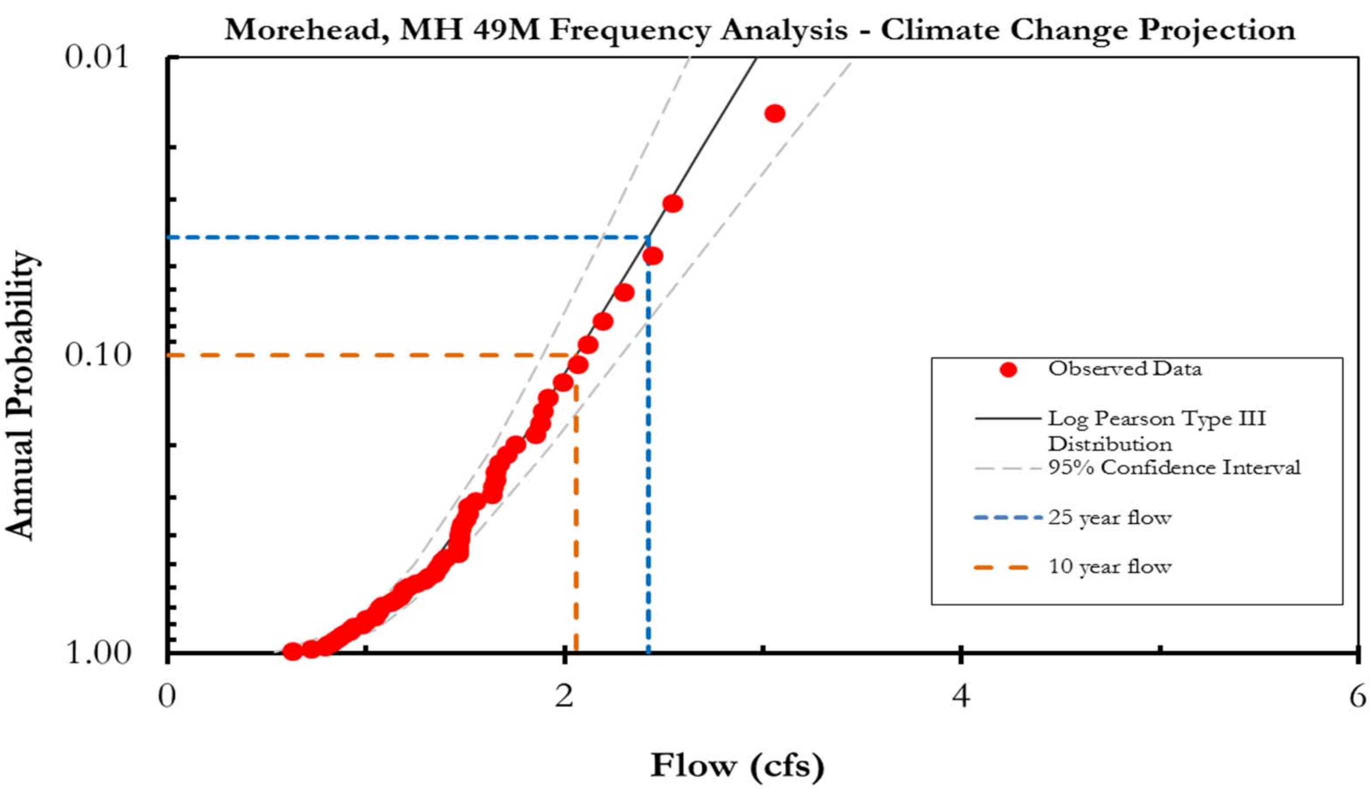


	10 year	25 year	50 year	100 year
Historic Climate	3.13	3.74	4.20	4.66
Climate Change	3.71	4.50	5.12	5.76

Pipe Capcity = 11.8 cfs

April 11, 2013 Storm Peak Flow = 3.61 cfs

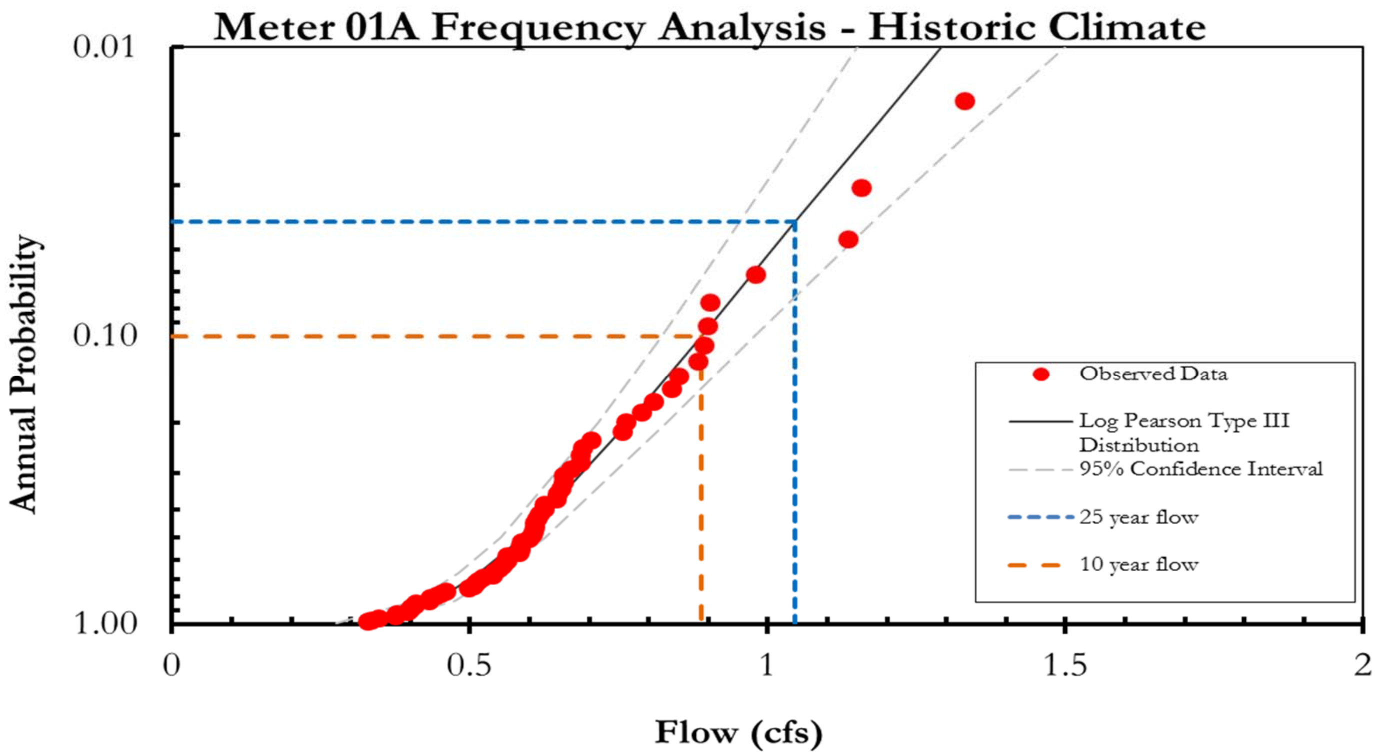


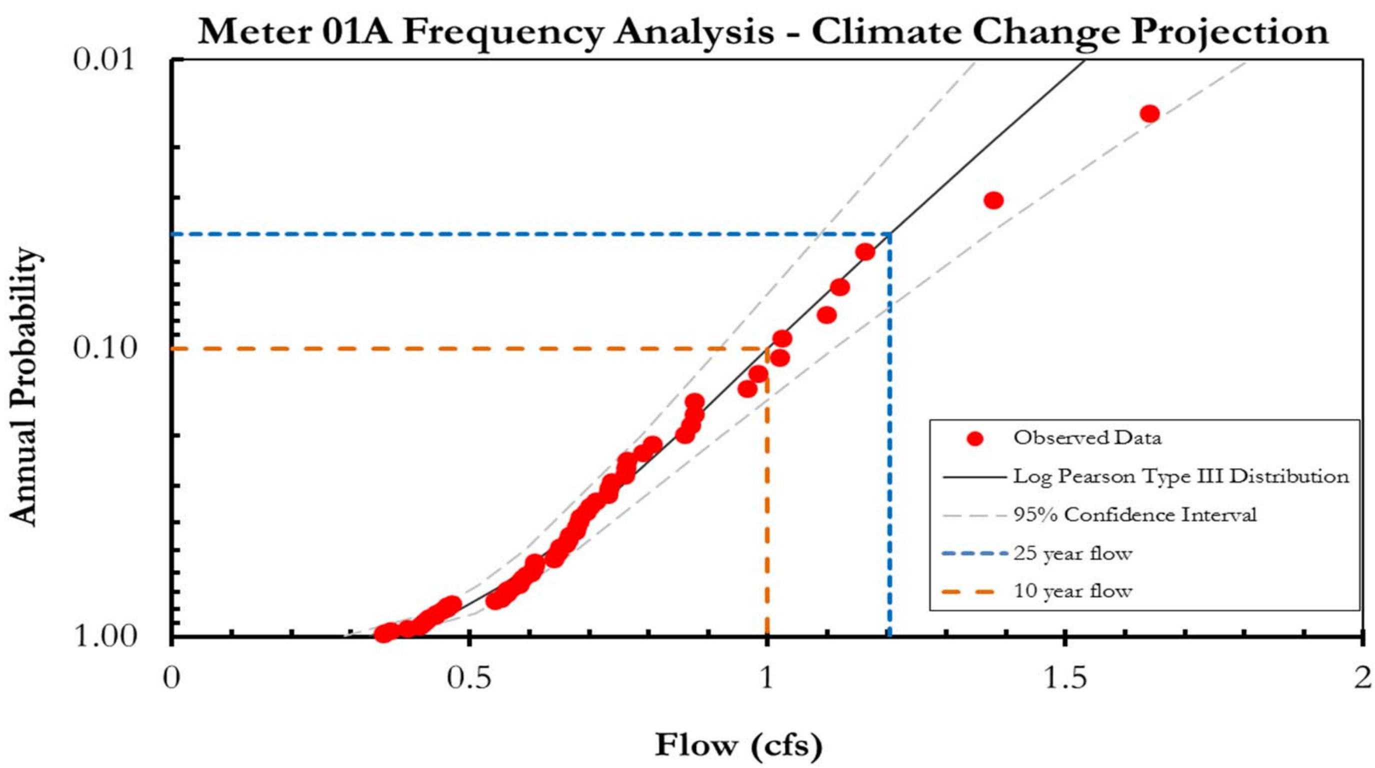


	10 year	25 year	50 year	100 year
Historic Climate	1.78	2.06	2.26	2.46
Climate Change	2.06	2.42	2.69	2.97

Pipe Capcity = 7.5 cfs

April 11, 2013 Storm Peak Flow = 2.03 cfs

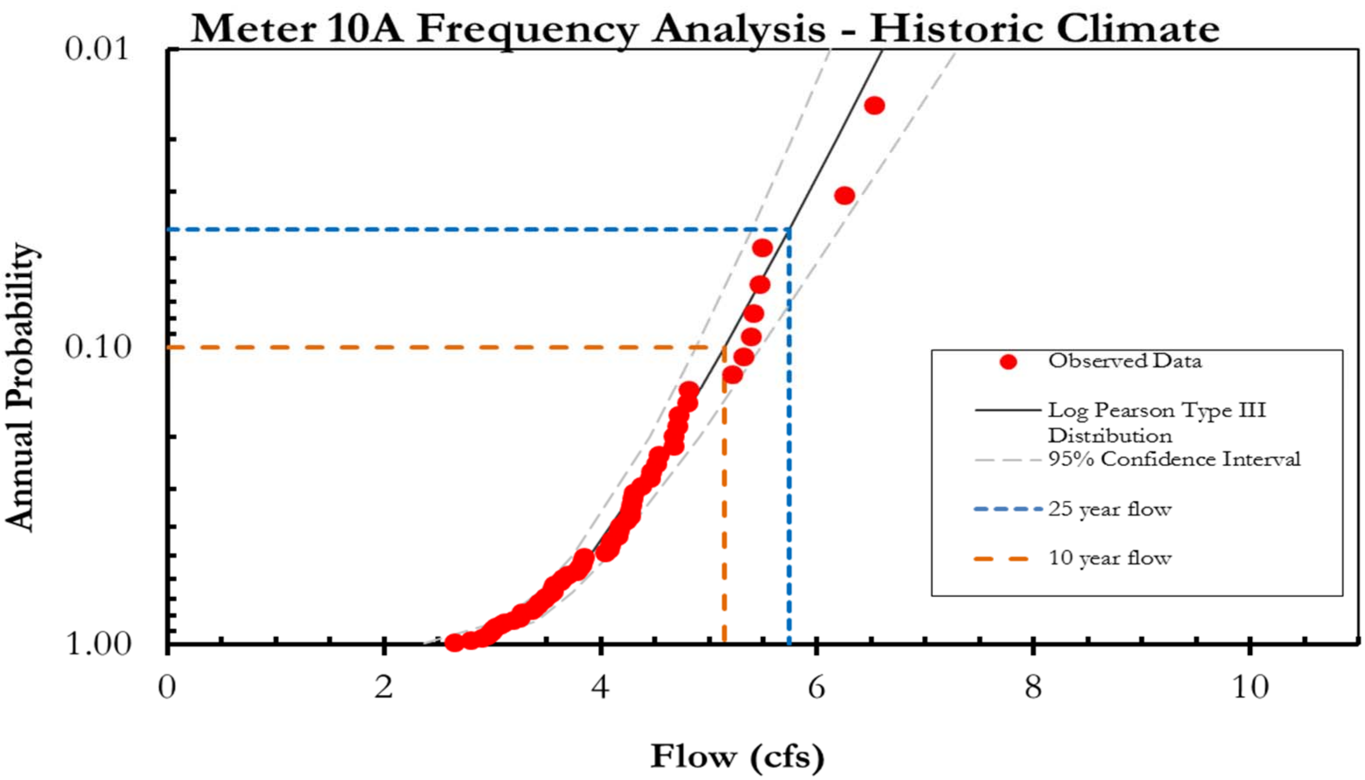


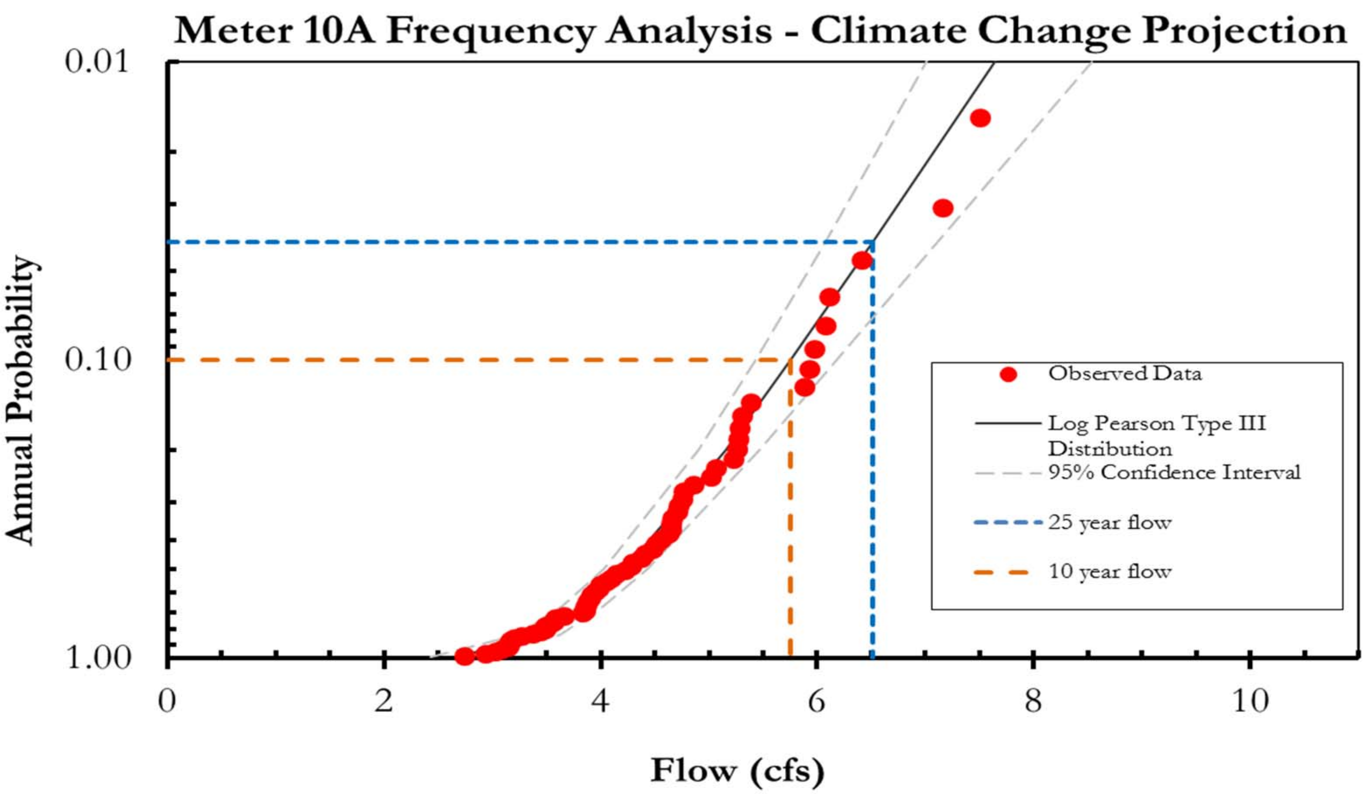


	10 year	25 year	50 year	100 year
Historic Climate	0.89	1.05	1.17	1.29
Climate Change	1.00	1.20	1.37	1.53

Pipe Capcity = 3.6 cfs

June 13, 2013 Storm Peak Flow = 2.03 cfs

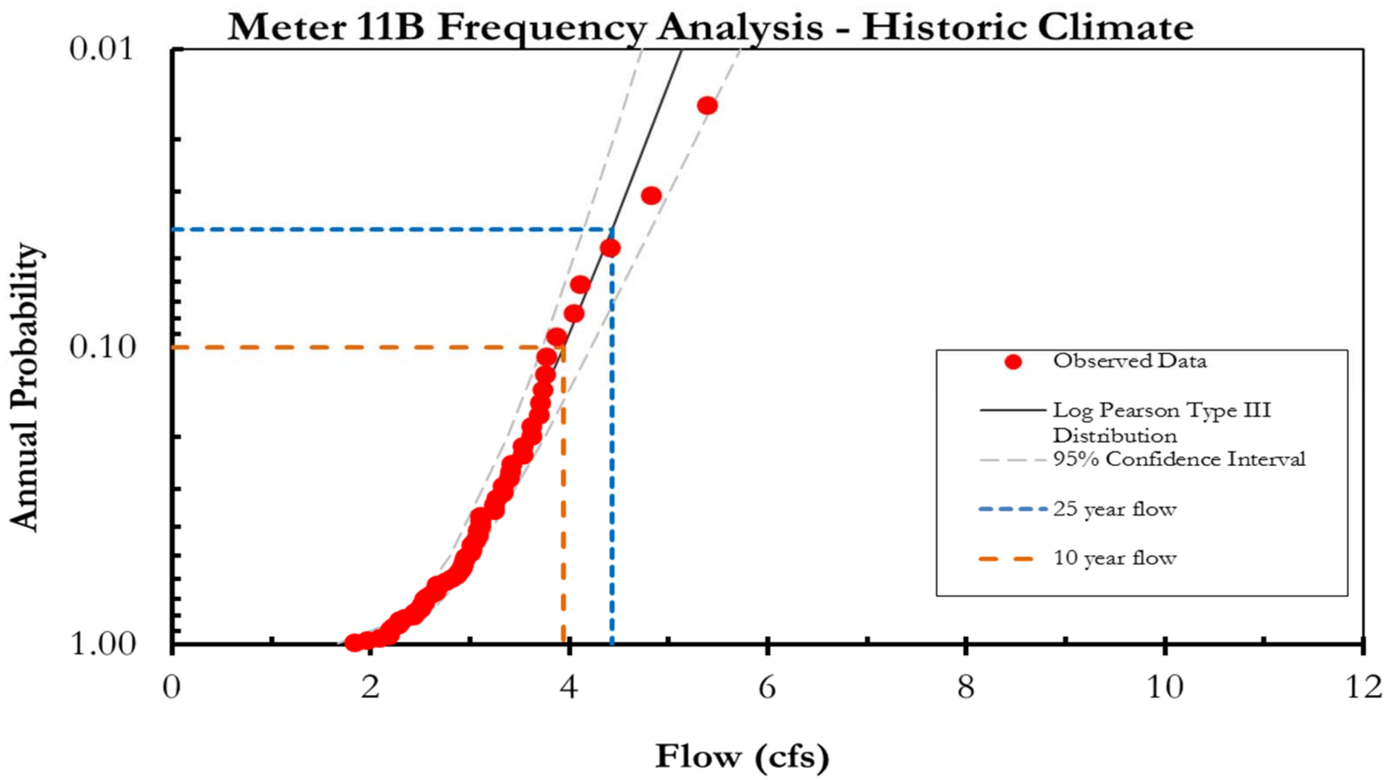


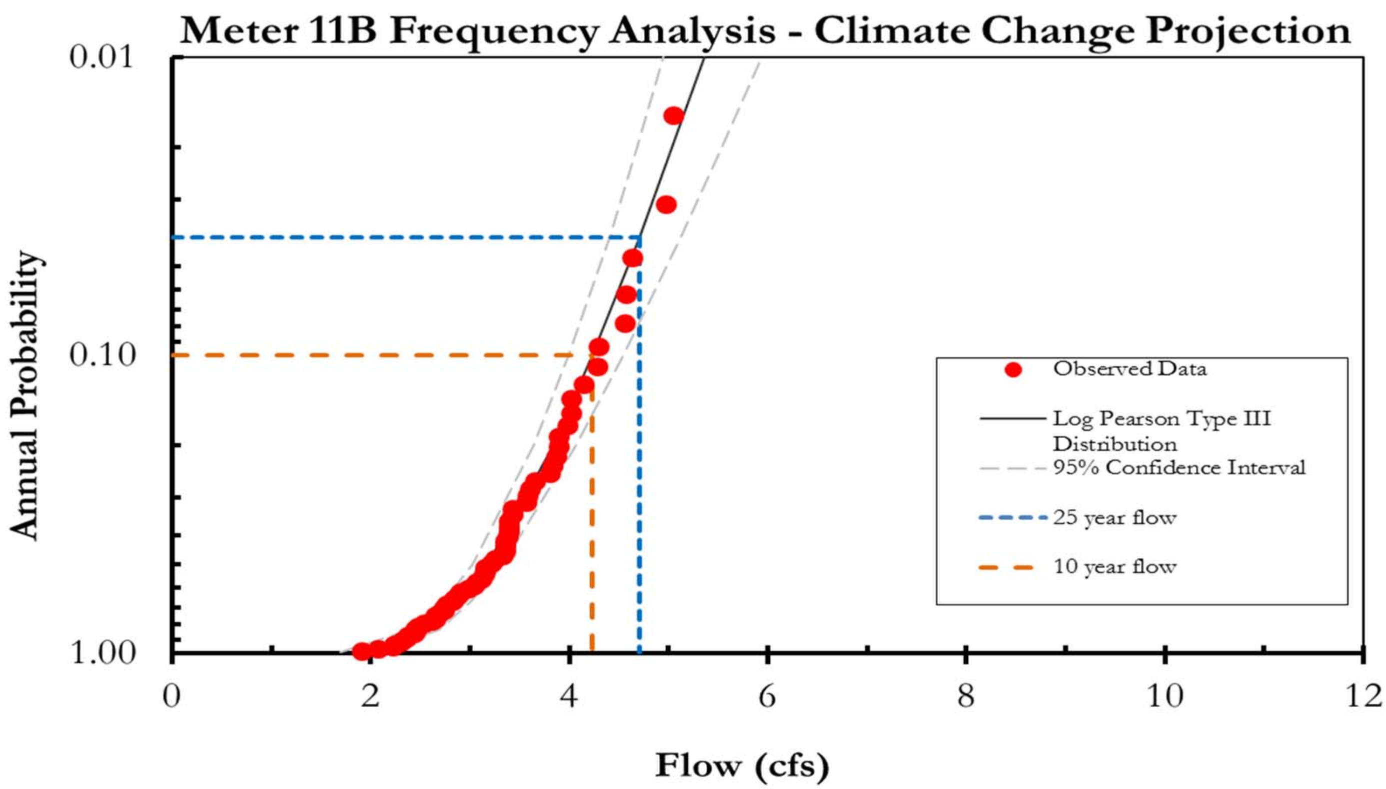


	10 year	25 year	50 year	100 year
Historic Climate	5.14	5.74	6.17	6.61
Climate Change	5.76	6.51	7.08	7.64

Pipe Capcity = 7.5 cfs

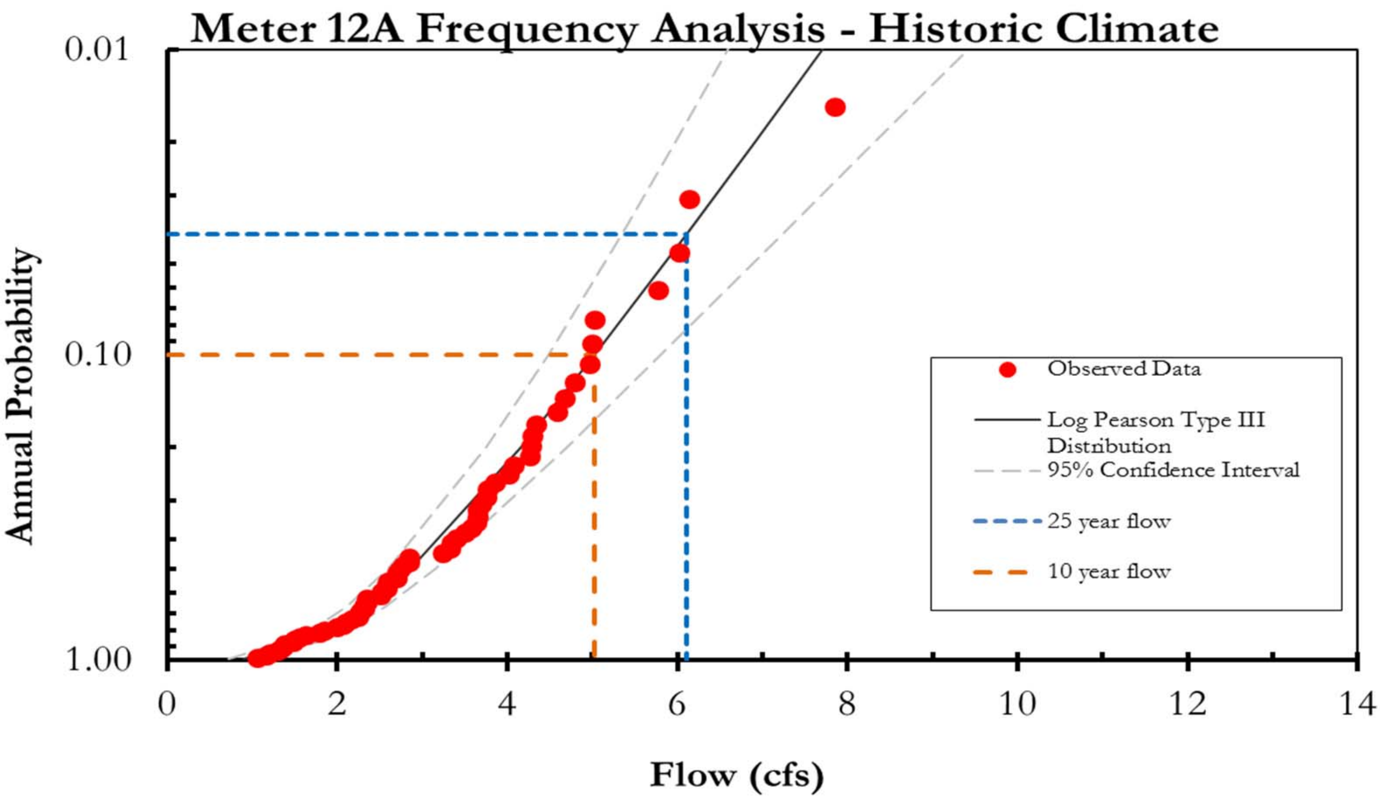
June 28, 2013 Storm Peak Flow = 5.79 cfs

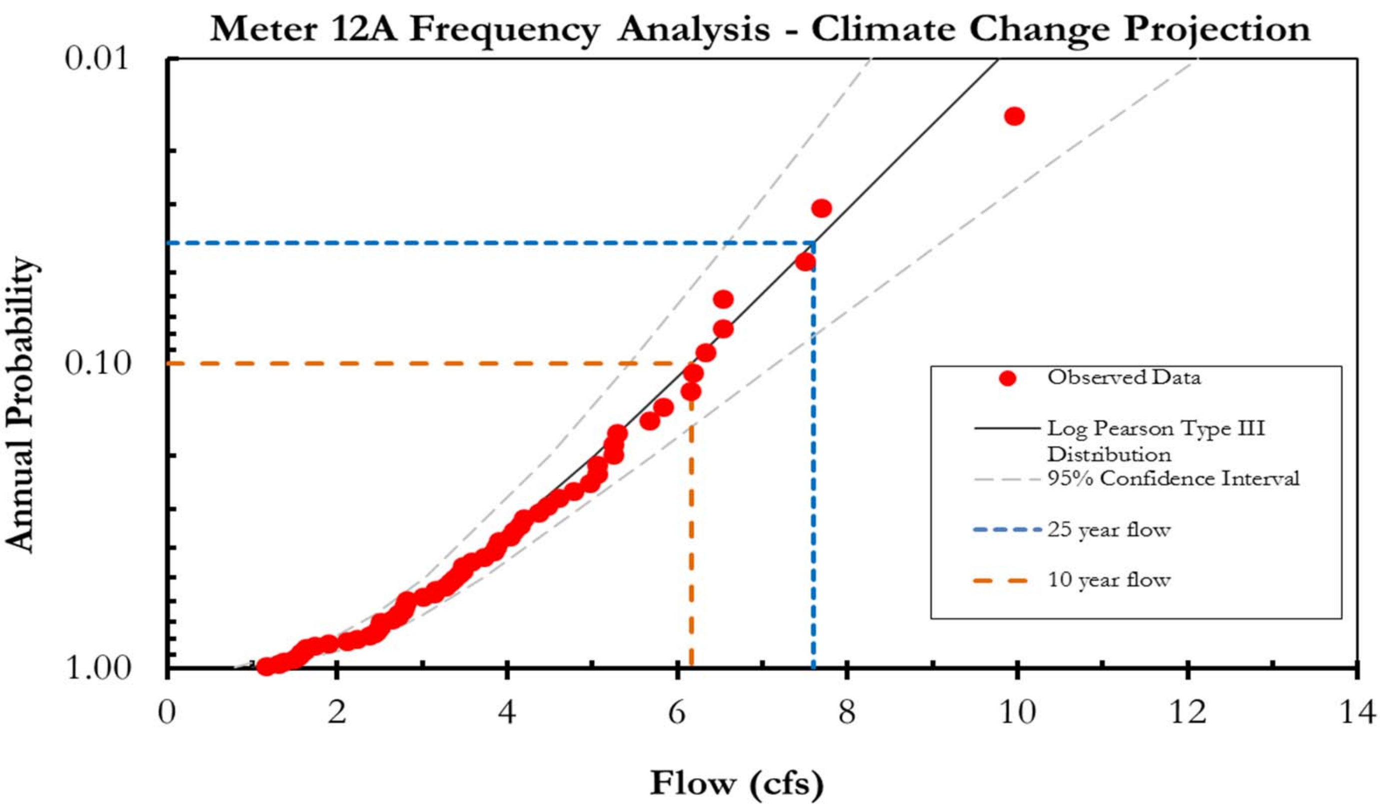




	10 year	25 year	50 year	100 year
Historic Climate	3.94	4.43	4.79	5.14
Climate Change	4.23	4.71	5.04	5.36

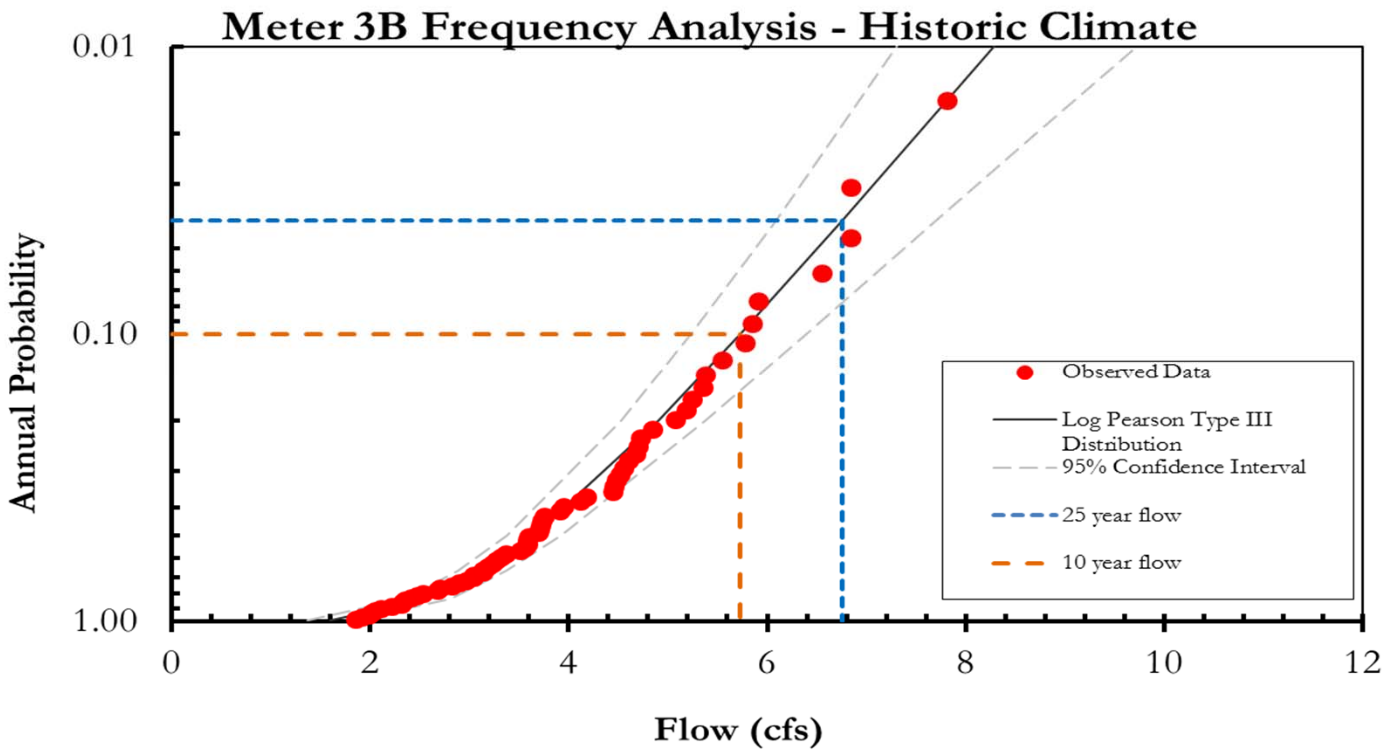
Pipe Capcity = 17.9 cfs
June 27, 2013 Storm Peak Flow = 4.05 cfs

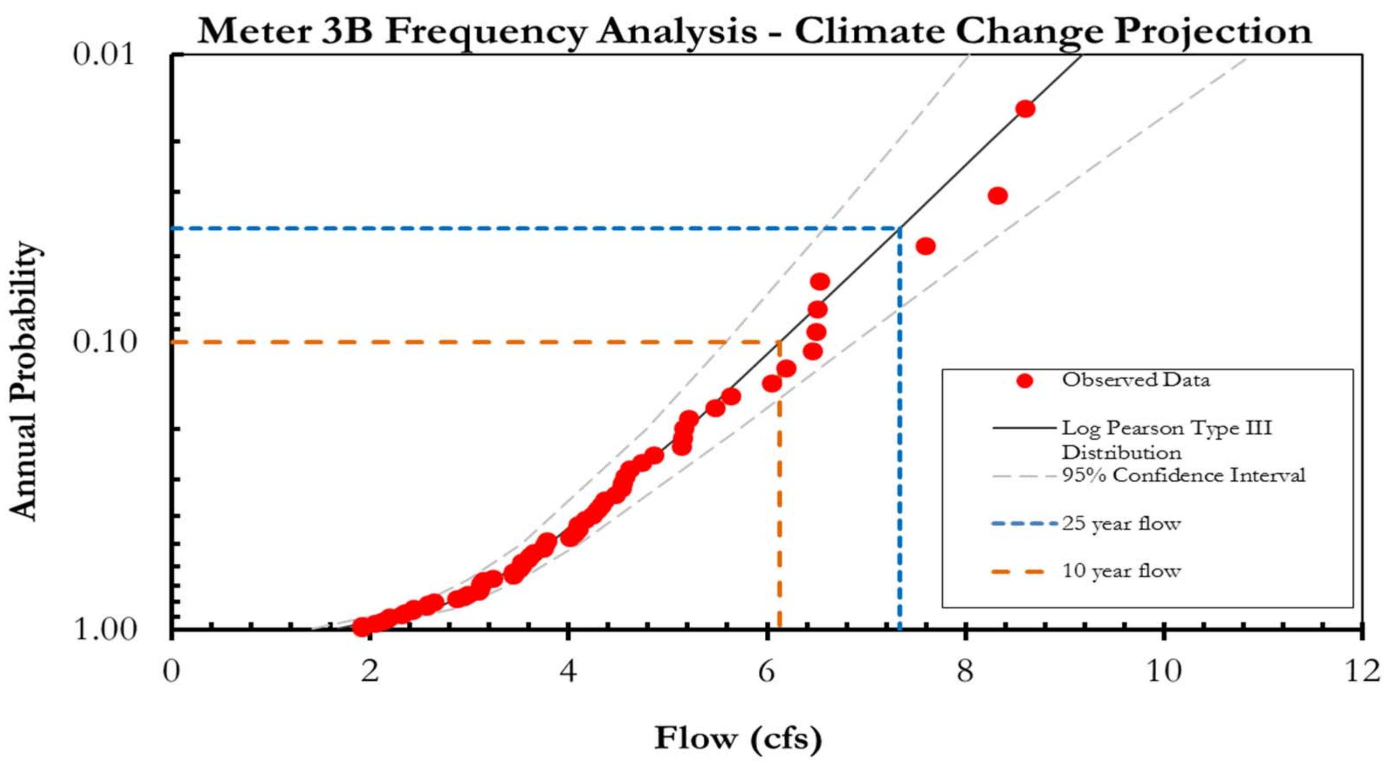




	10 year	25 year	50 year	100 year
Historic Climate	5.03	6.11	6.91	7.70
Climate Change	6.16	7.61	8.69	9.77

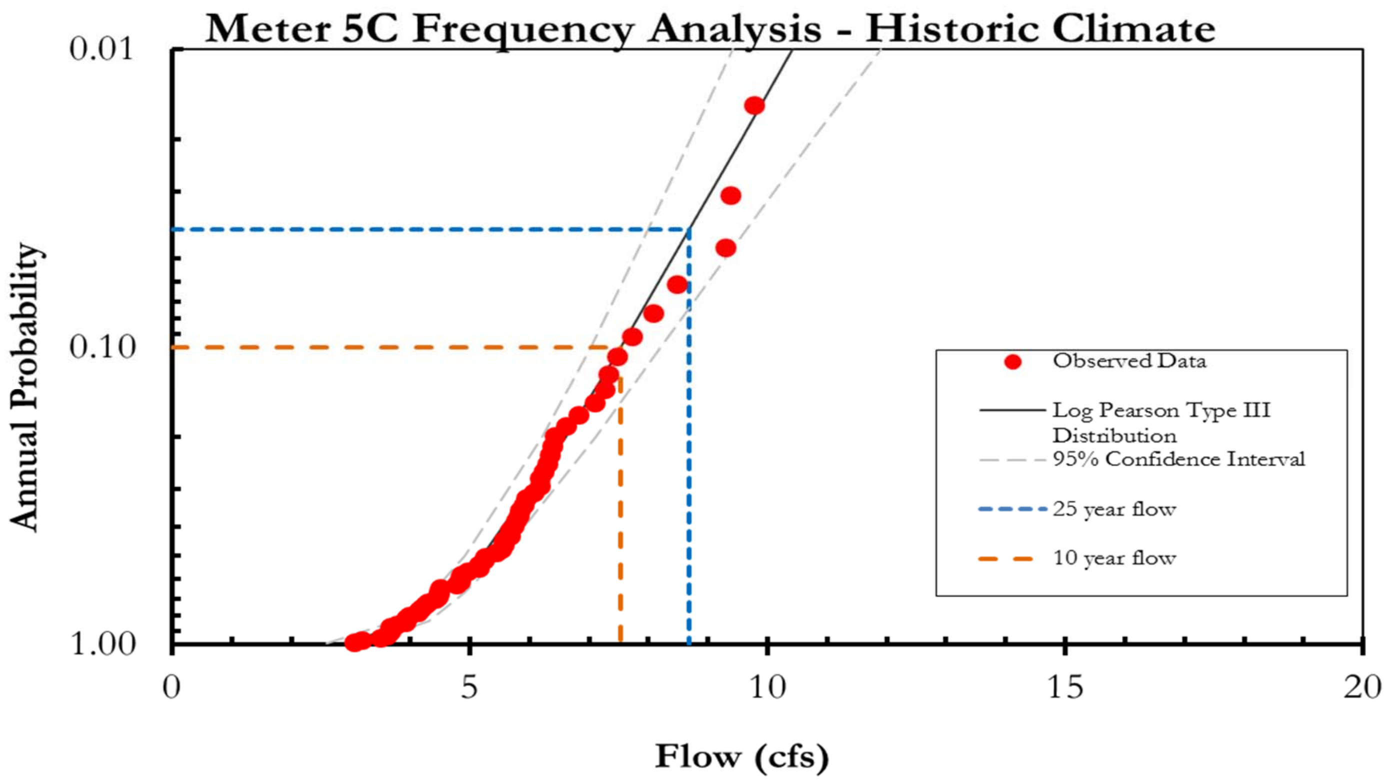
Pipe Capcity = 10.29 cfs
June 27, 2013 Storm Peak Flow = 7.4 cfs

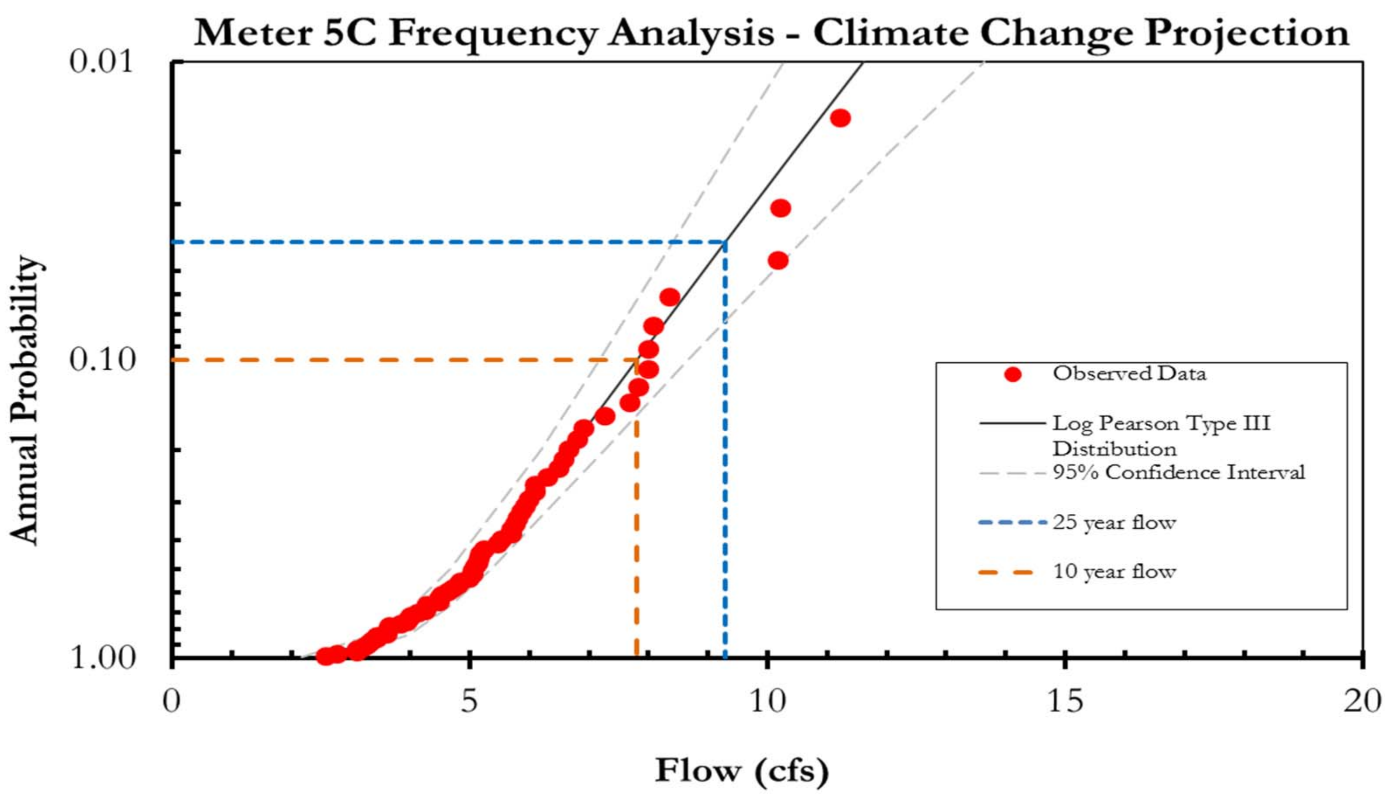




	10 year	25 year	50 year	100 year
Historic Climate	5.72	6.76	7.52	8.28
Climate Change	6.13	7.34	8.25	9.18

Pipe Capcity = 37.7 cfs
June 27, 2013 Storm Peak Flow = 6.33 cfs

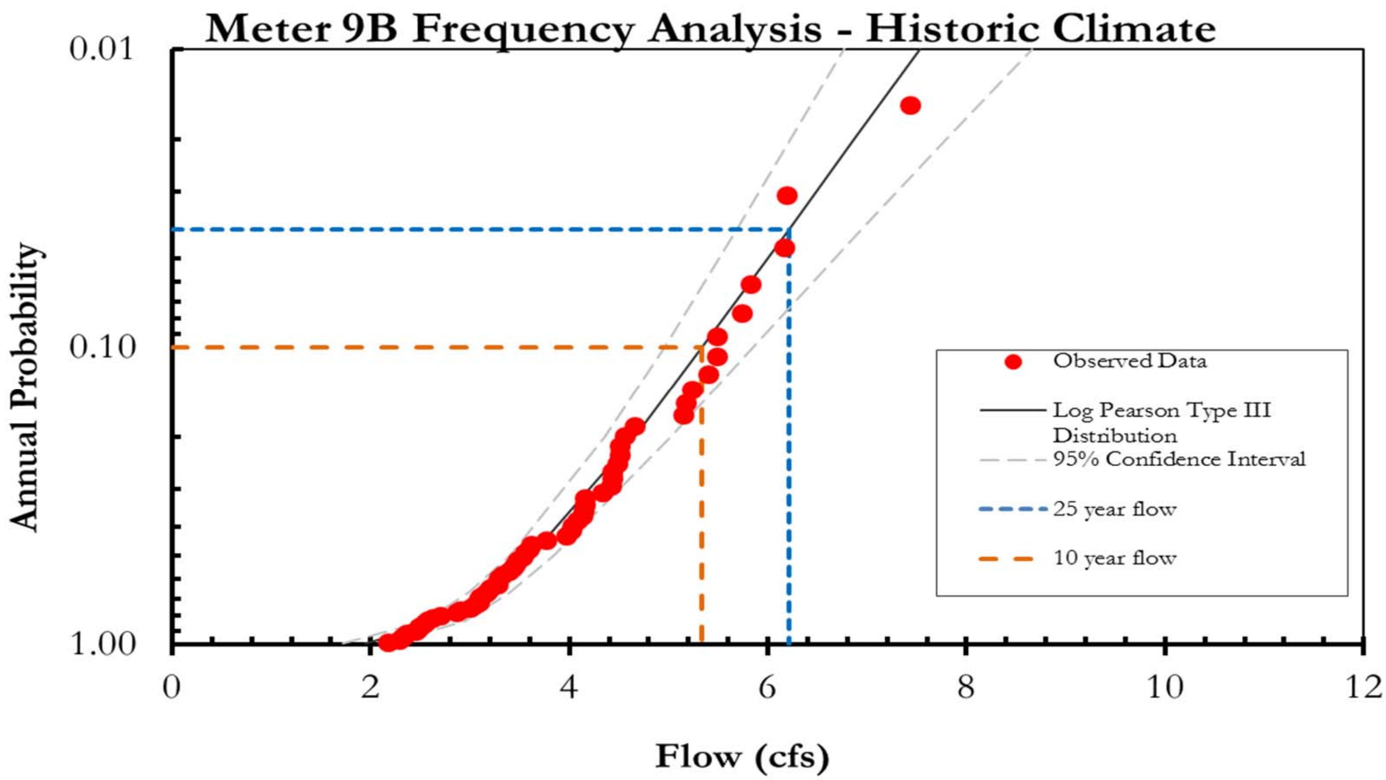


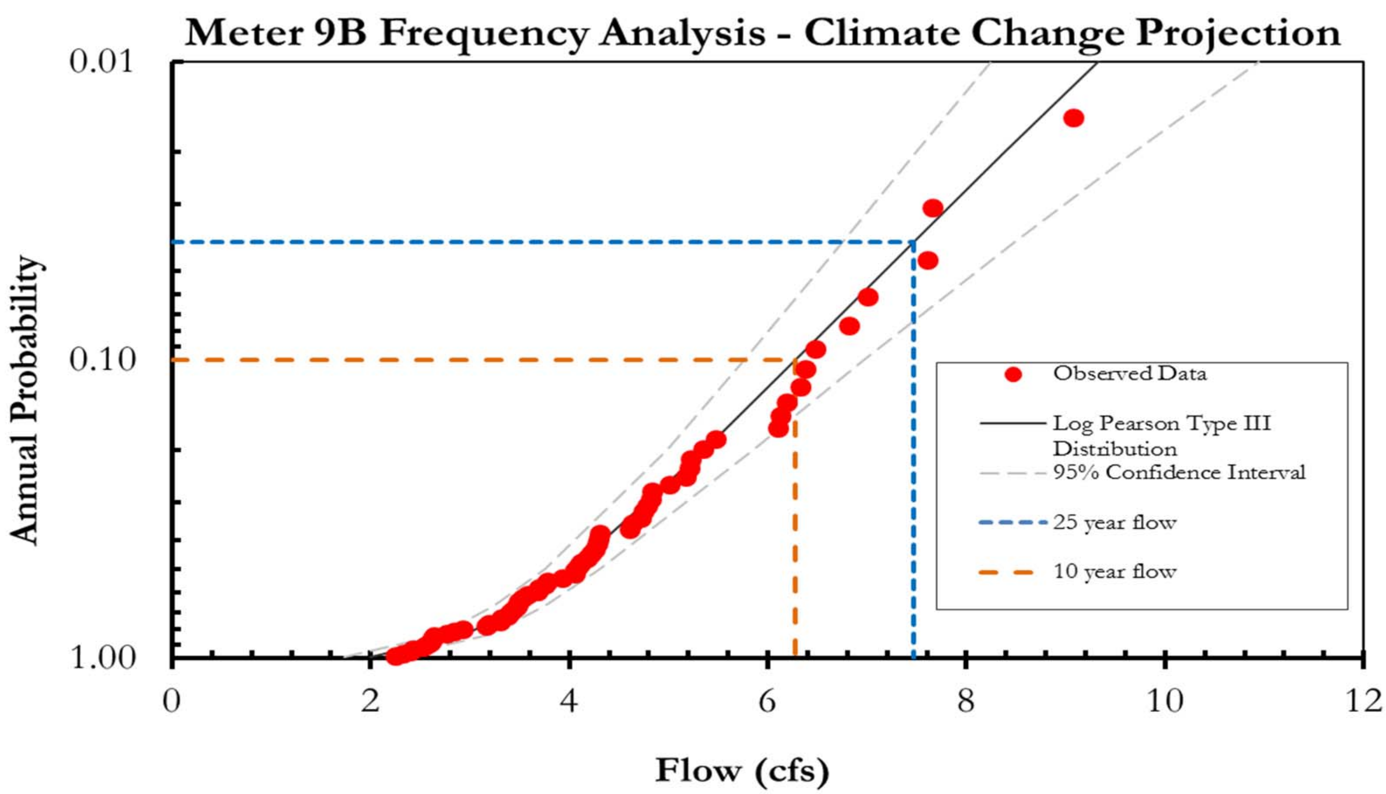


	10 year	25 year	50 year	100 year
Historic Climate	7.53	8.69	9.56	10.42
Climate Change	7.81	9.30	10.44	11.62

Pipe Capcity = 26.2 cfs

June 27, 2013 Storm Peak Flow = 8.76 cfs

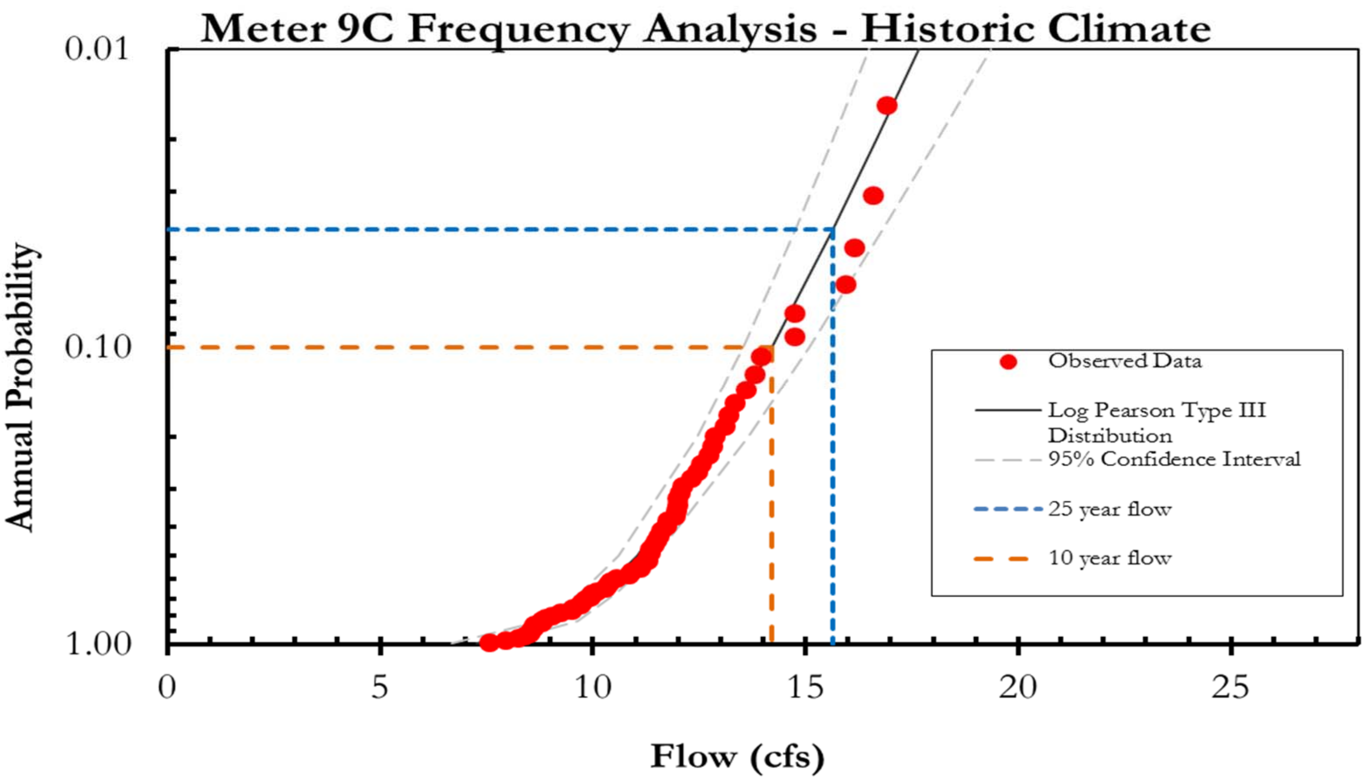


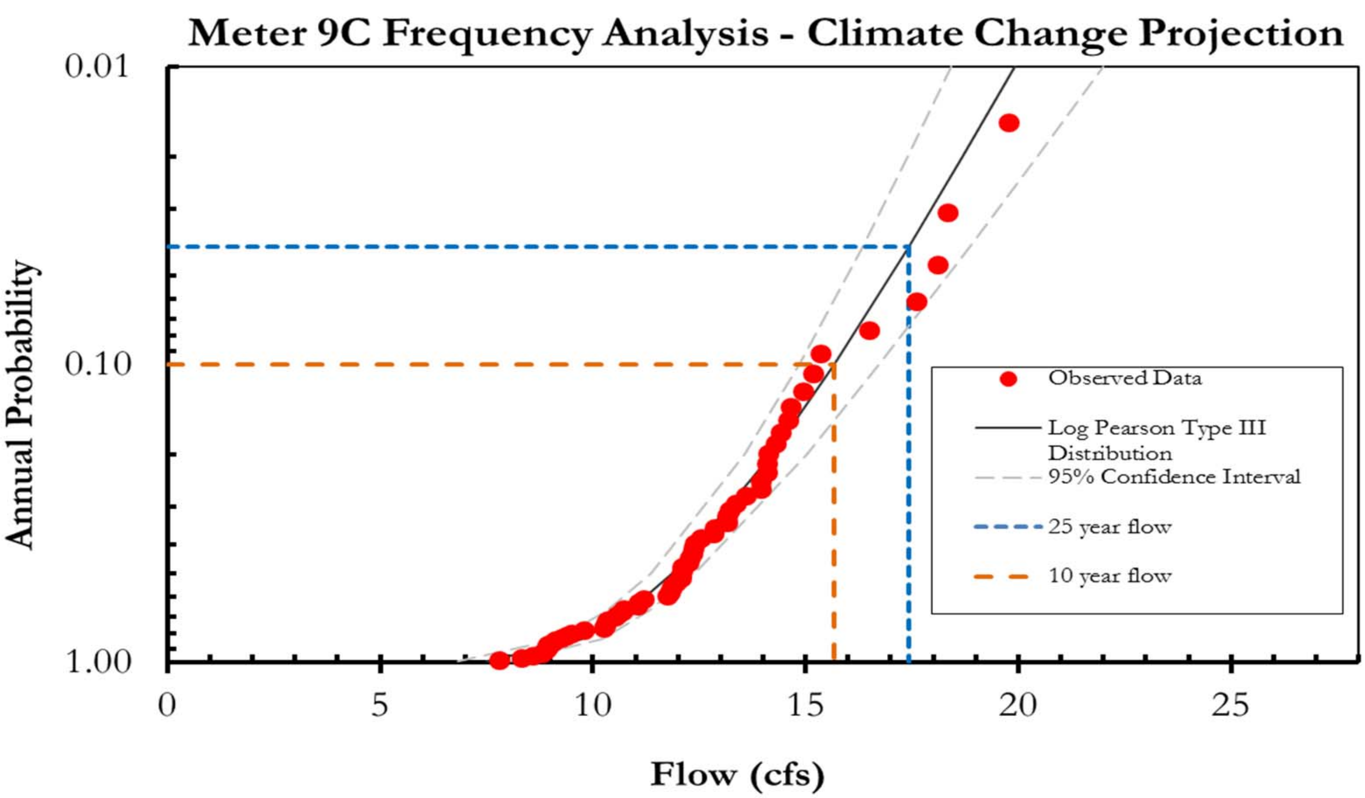


	10 year	25 year	50 year	100 year
Historic Climate	5.34	6.21	6.87	7.53
Climate Change	6.28	7.47	8.39	9.33

Pipe Capcity = 9.1 cfs

June 10, 2013 Storm Peak Flow = 3.66 cfs

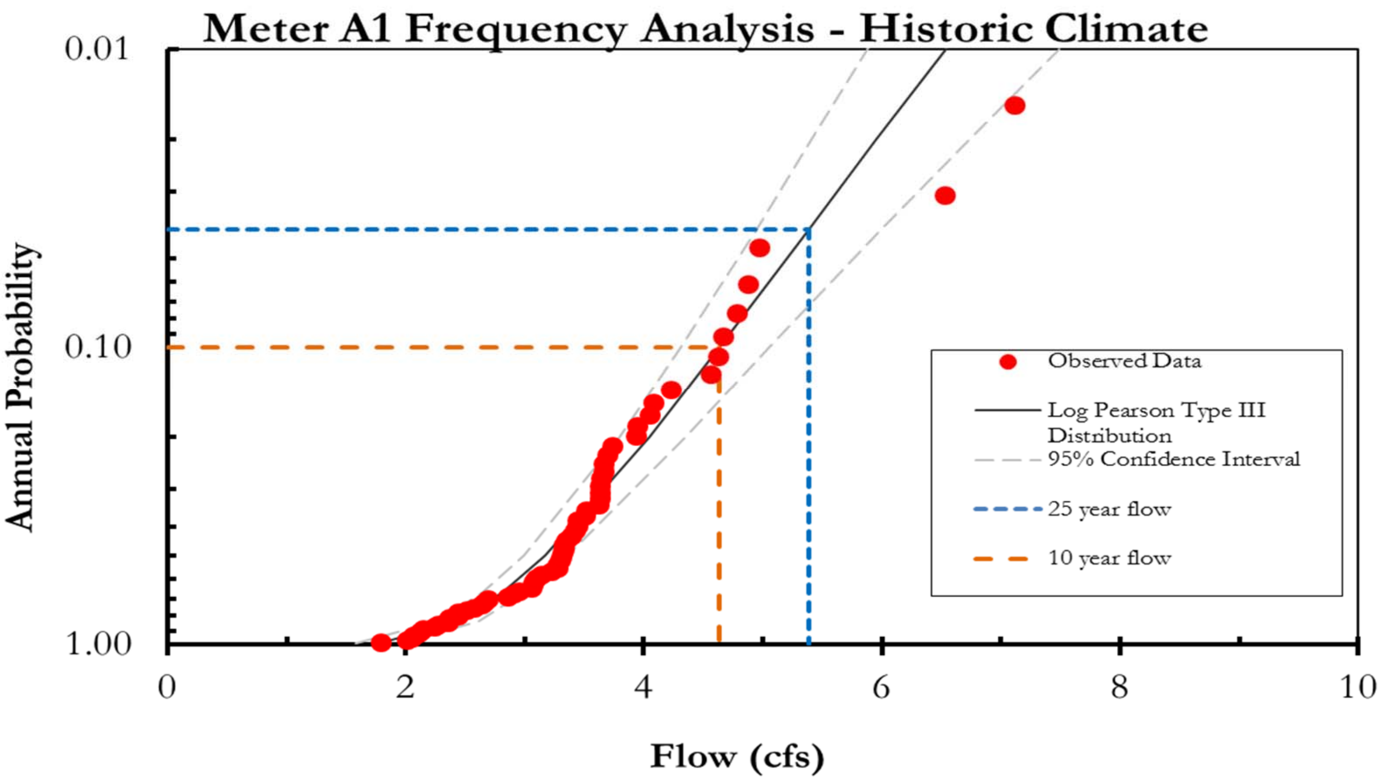


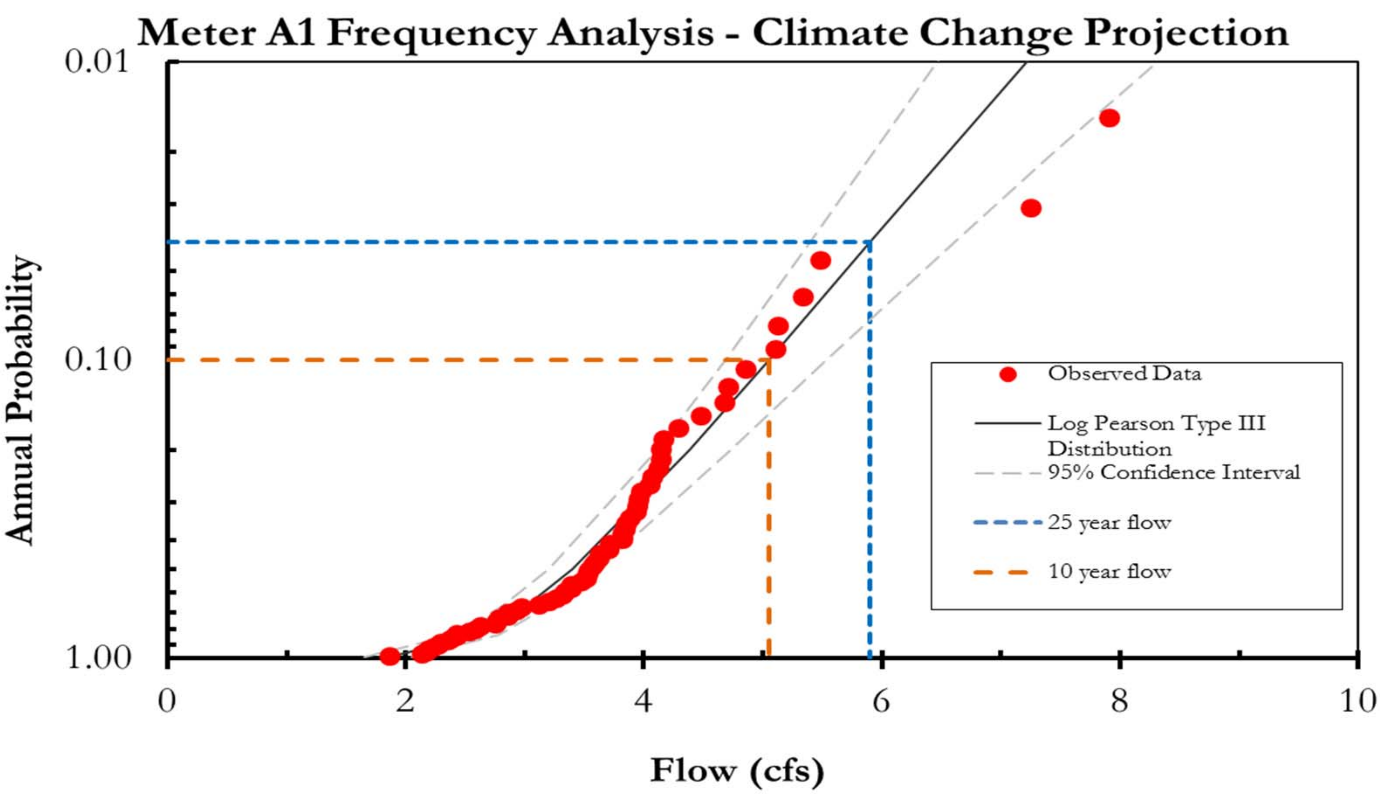


	10 year	25 year	50 year	100 year
Historic Climate	14.20	15.64	16.67	17.67
Climate Change	15.67	17.42	18.68	19.90

Pipe Capcity = 27.1 cfs

June 27, 2013 Storm Peak Flow = 15.26 cfs

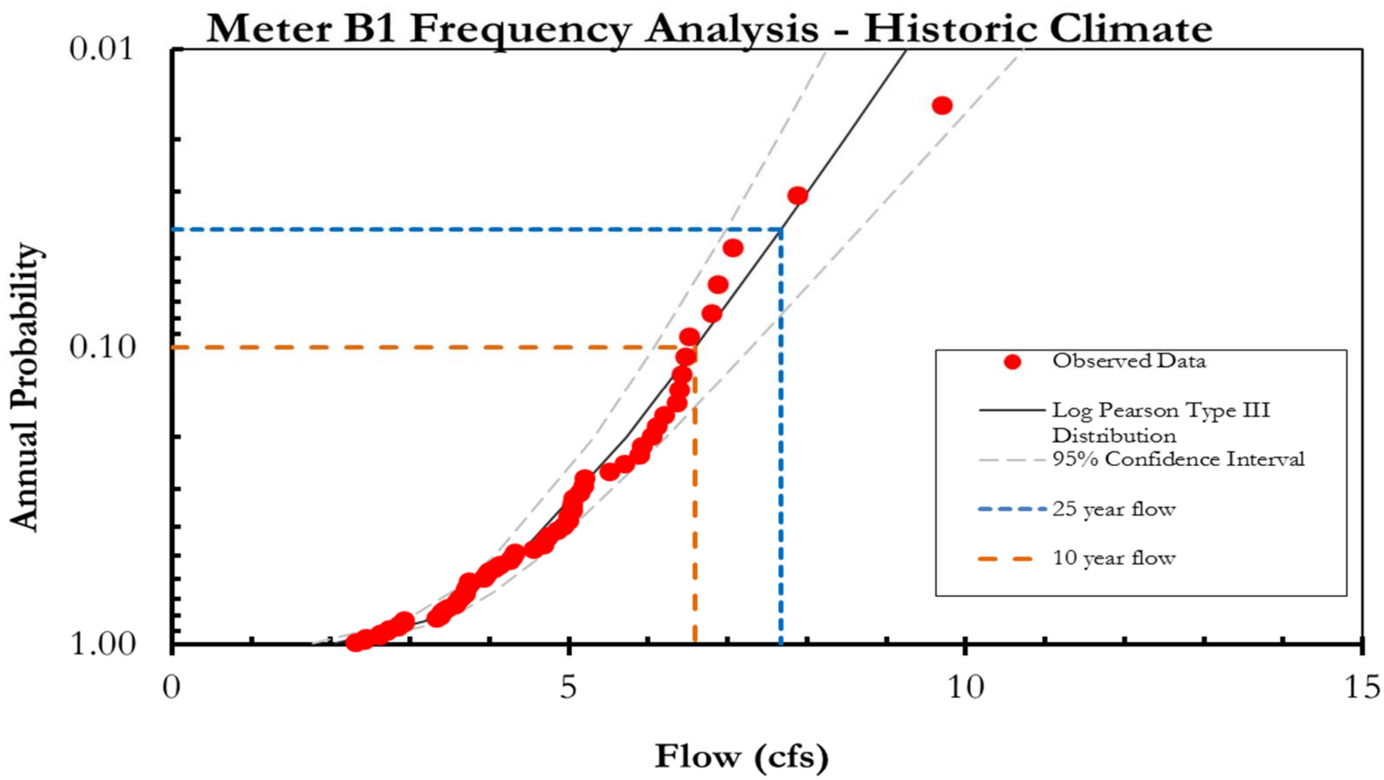


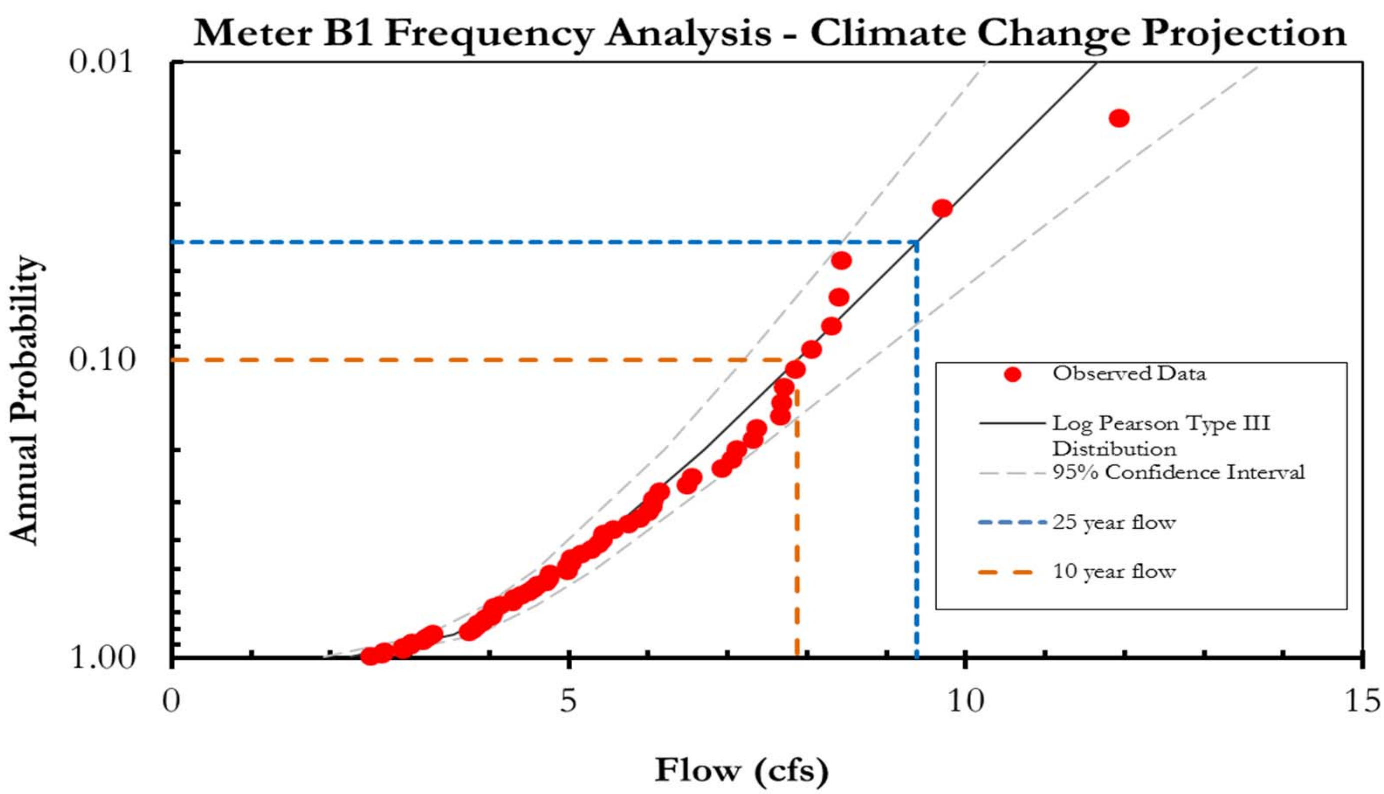


	10 year	25 year	50 year	100 year
Historic Climate	4.63	5.38	5.95	6.53
Climate Change	5.05	5.90	6.55	7.22

Pipe Capcity = 12.1 cfs

June 27, 2013 Storm Peak Flow = 6.3 cfs

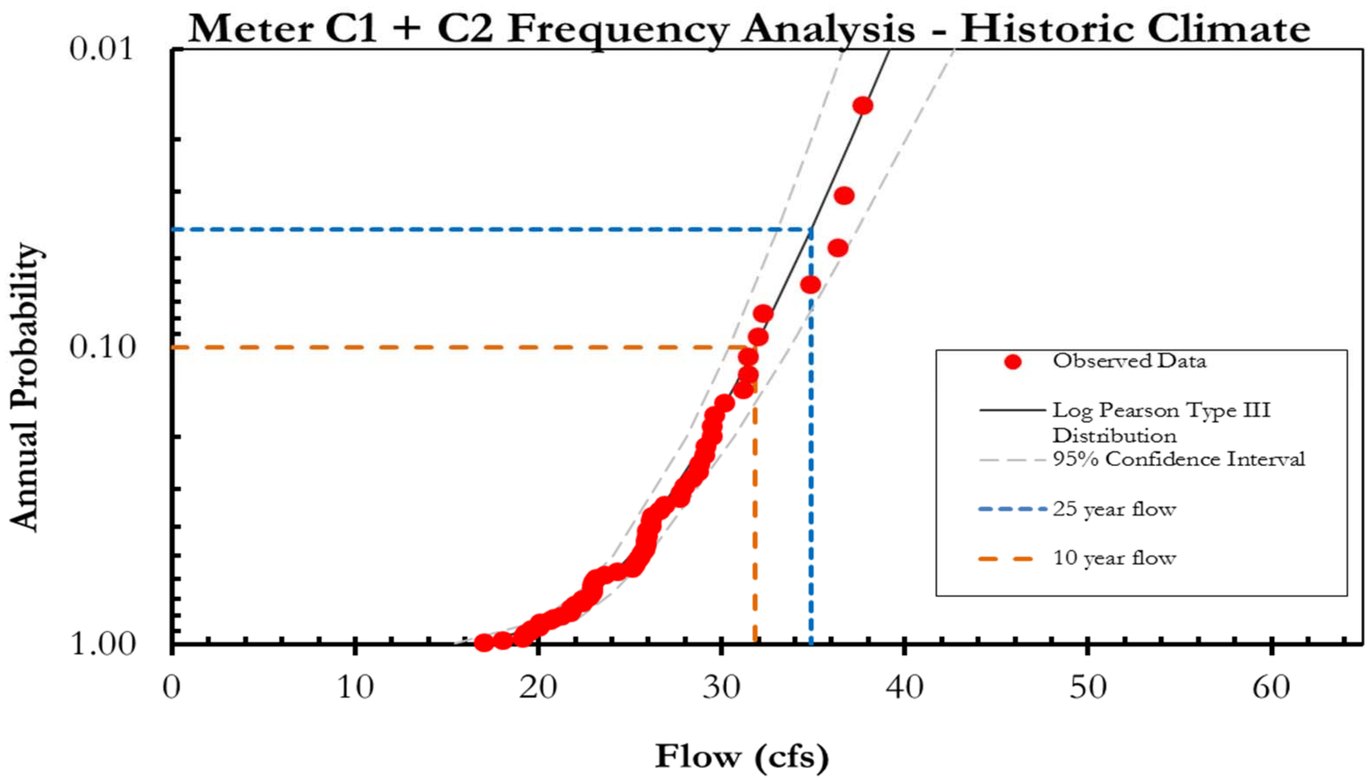


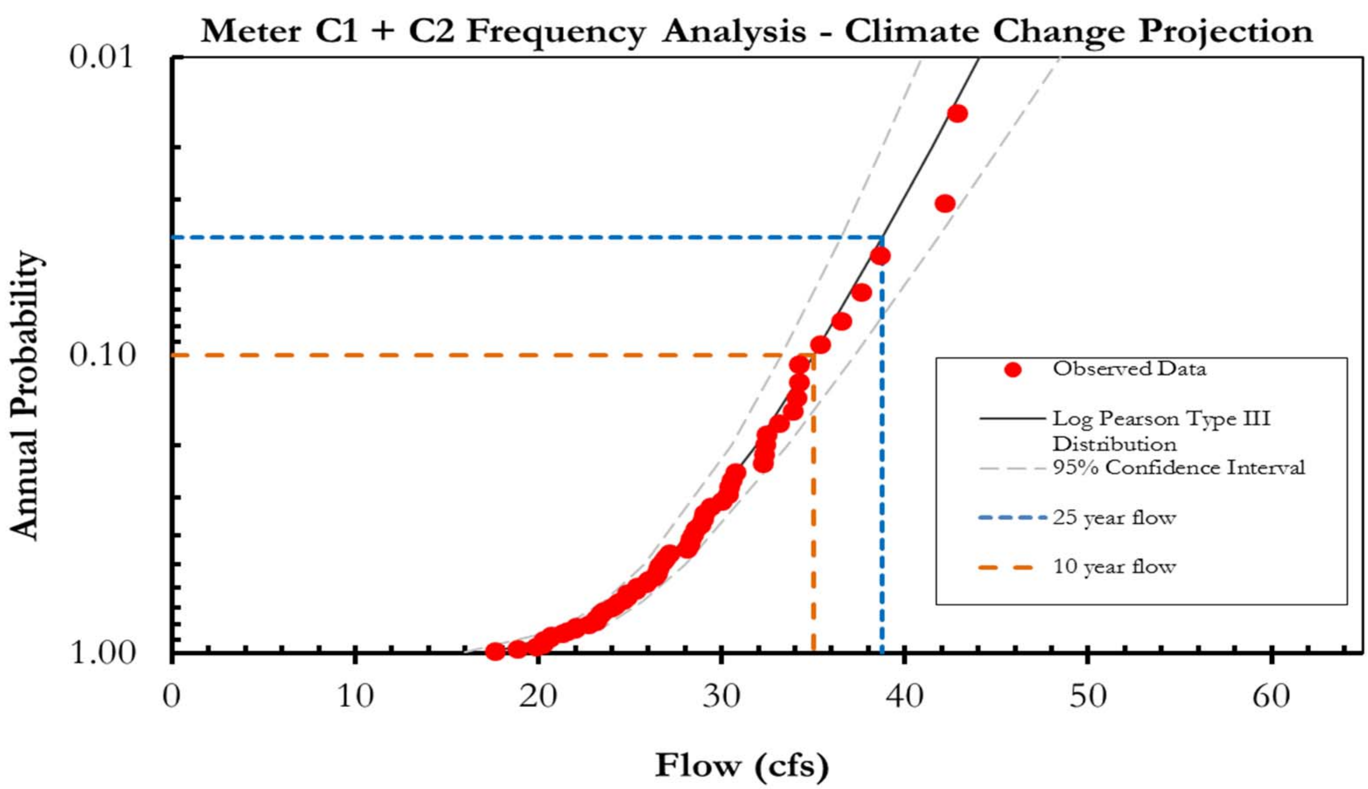


	10 year	25 year	50 year	100 year
Historic Climate	7.53	8.69	9.56	10.42
Climate Change	7.81	9.30	10.44	11.62

Pipe Capcity = 4.0 cfs

April 11, 2013 Storm Peak Flow = 4.89 cfs

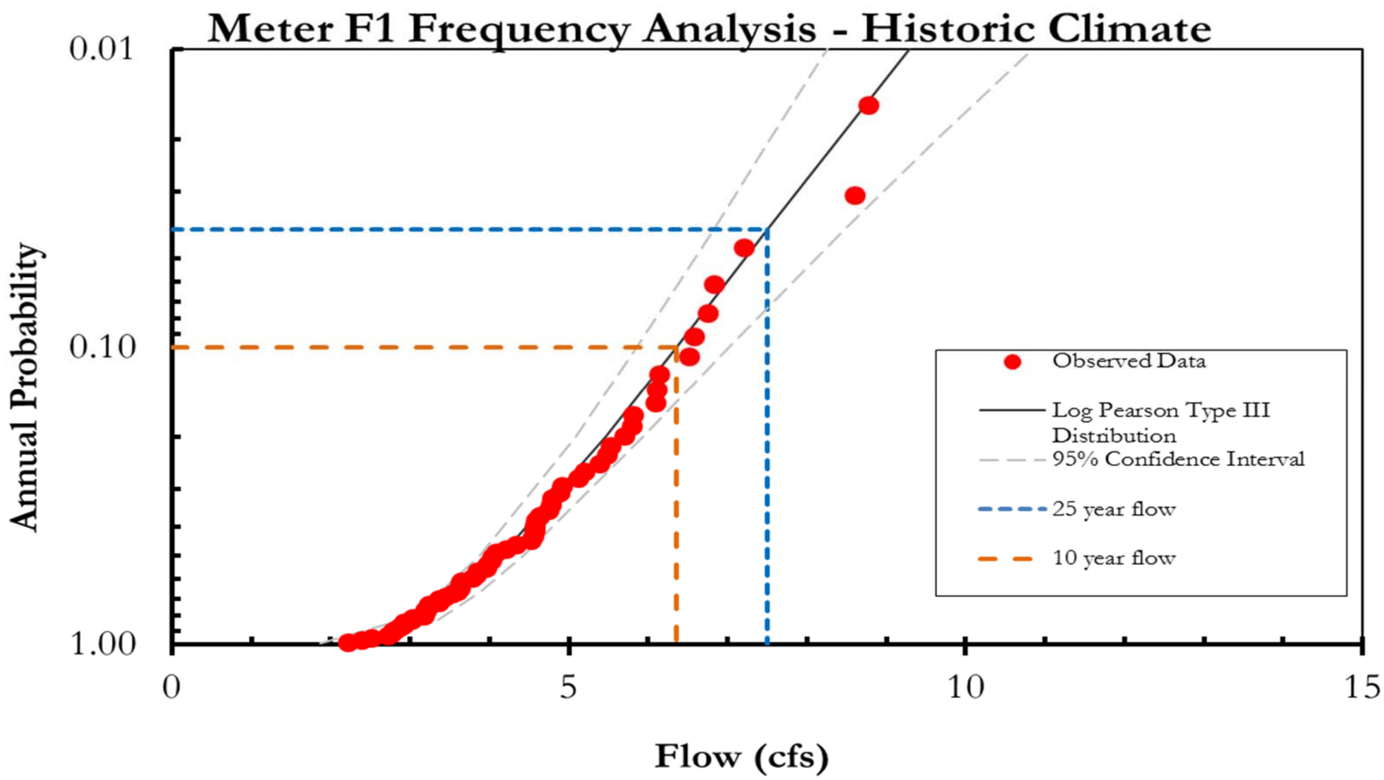


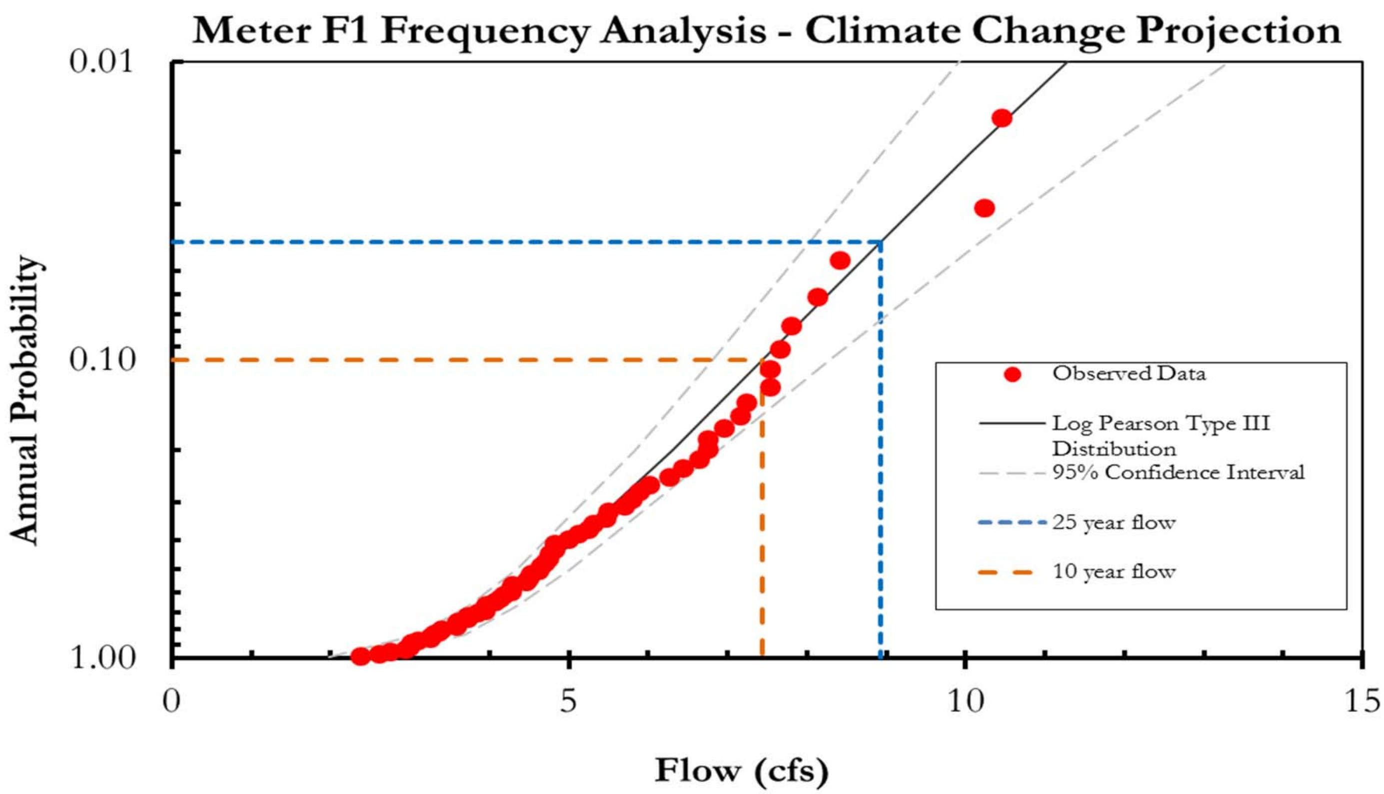


	10 year	25 year	50 year	100 year
Historic Climate	31.82	34.89	37.06	39.16
Climate Change	34.01	38.76	41.45	44.08

Pipe Capcity = 80.6 cfs

June 27, 2013 Storm Peak Flow = 38.94 cfs

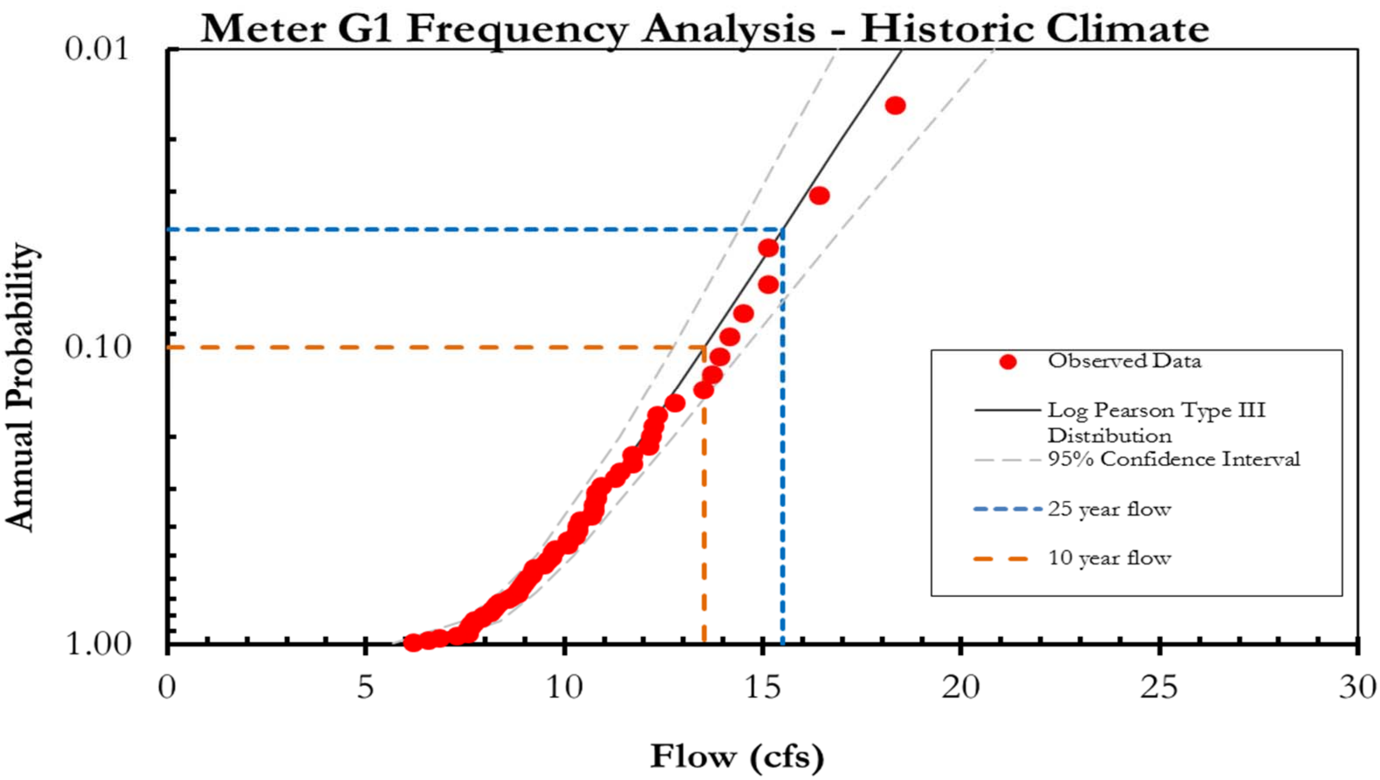


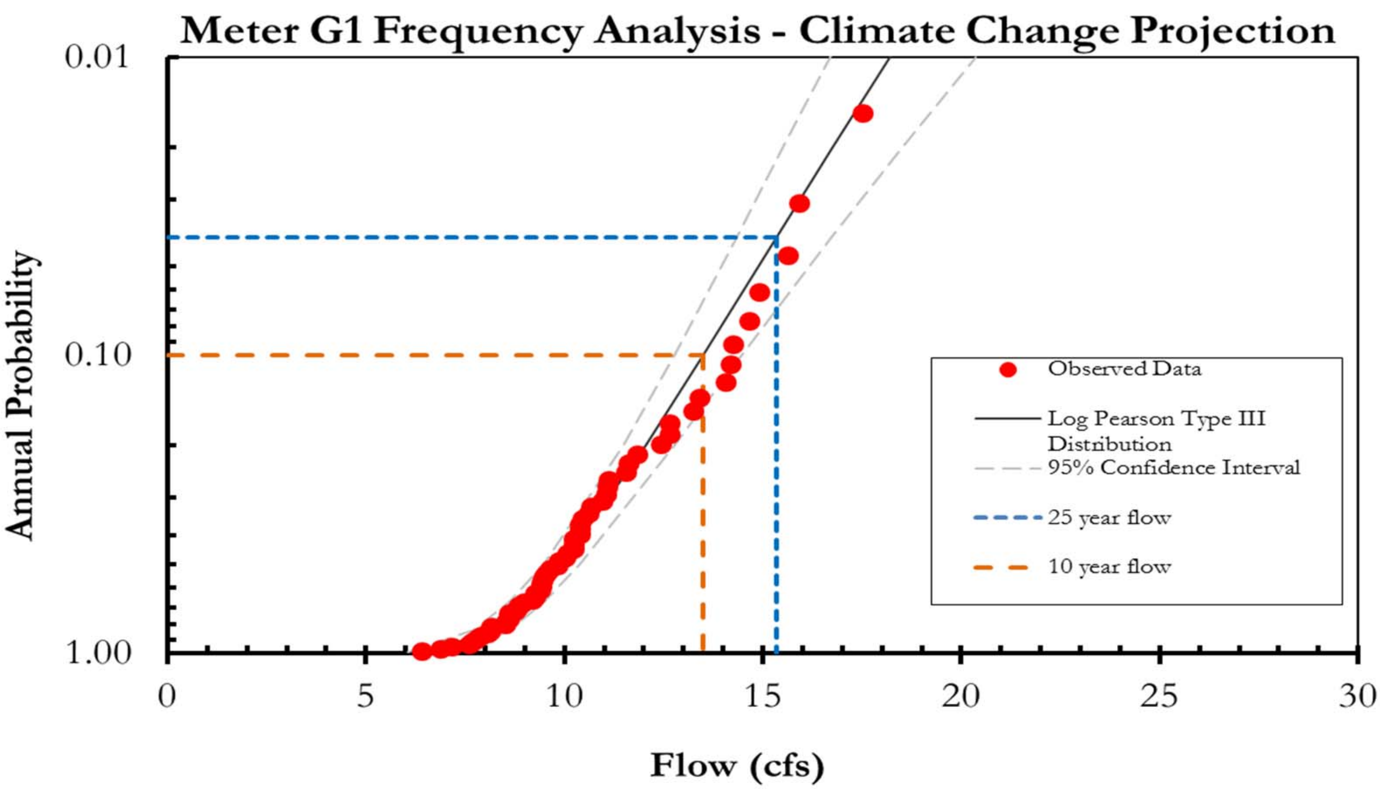


	10 year	25 year	50 year	100 year
Historic Climate	6.35	7.51	8.39	9.30
Climate Change	7.43	8.92	10.08	11.27

Pipe Capcity = 20.3 cfs

June 27, 2013 Storm Peak Flow = 7.77 cfs





	10 year	25 year	50 year	100 year
Historic Climate	13.52	15.49	16.98	18.51
Climate Change	13.50	15.35	16.76	18.20

Pipe Capcity = 21.0 cfs

June 13, 2013 Storm Peak Flow = 12.33 cfs

Appendix J
Benchmarking Evaluation

Benchmarking Evaluation
Table 1: Peak I / I Flow Rankings

Rank	Sub-Area	Peak Flow per 1000 ac	Percentile	Rank	Sub-Area	Peak Flow per 1000 ac	Percentile
1	11	58.5	99.0%	49	72	2.2	49.0%
2	4*	42.0	97.9%	50	26	2.1	47.9%
3	35	38.2	96.9%	51	Ann Arbor A1	2.1	46.9%
4	51	14.8	95.8%	52	Ann Arbor Bromley Post	2.1	45.8%
5	Ann Arbor Orchard Hills Pre	11.3	94.8%	53	8	2.0	44.8%
6	63	10.9	93.8%	54	59	1.9	43.8%
7	Ann Arbor Bromley Pre	8.1	92.7%	55	28	1.9	42.7%
8	33	7.9	91.7%	56	Ann Arbor Dartmoor Post	1.8	41.7%
9	Ann Arbor Morehead Pre	7.6	90.6%	57	Ann Arbor 9B	1.8	40.6%
10	29	7.1	89.6%	58	3	1.7	39.6%
11	60	6.5	88.5%	59	Ann Arbor 5C	1.6	38.5%
12	23	6.5	87.5%	60	Ann Arbor C1+C2	1.5	37.5%
13	58	6.1	86.5%	61	16	1.5	36.5%
14	45	5.4	85.4%	62	20	1.5	35.4%
15	34	5.4	84.4%	63	37	1.4	34.4%
16	Ann Arbor Glen Leven Pre	5.3	83.3%	64	70	1.4	33.3%
17	Ann Arbor Glen Leven Post	5.0	82.3%	65	Ann Arbor 3B	1.4	32.3%
18	Ann Arbor F1	4.7	81.3%	66	Ann Arbor 11B	1.3	31.3%
19	55	4.4	80.2%	67	18	1.2	30.2%
20	32	4.4	79.2%	68	25	1.2	29.2%
21	69	4.2	78.1%	69	48	1.2	28.1%
22	68	4.1	77.1%	70	1	1.2	27.1%
23	50	3.9	76.0%	71	24	1.2	26.0%
24	2	3.9	75.0%	72	Ann Arbor G1	1.1	25.0%
25	54	3.8	74.0%	73	9	0.9	24.0%
26	61	3.7	72.9%	74	12	0.9	22.9%
27	Ann Arbor Dartmoor Pre	3.2	71.9%	75	13	0.9	21.9%
28	71	3.2	70.8%	76	44	0.9	20.8%
29	65	3.1	69.8%	77	Ann Arbor 9C	0.8	19.8%
30	67	3.1	68.8%	78	19	0.8	18.8%
31	46	3.0	67.7%	79	5	0.8	17.7%
32	Ann Arbor 12A	2.8	66.7%	80	15	0.7	16.7%
33	21	2.8	65.6%	81	27	0.7	15.6%
34	62	2.8	64.6%	82	17	0.7	14.6%
35	31	2.8	63.5%	83	Ann Arbor 01A	0.6	13.5%
36	Ann Arbor Orchard Hills Post	2.8	62.5%	84	14	0.6	12.5%
37	22	2.7	61.5%	85	Ann Arbor 10A	0.6	11.5%
38	10	2.7	60.4%	86	47	0.6	10.4%
39	Ann Arbor Morehead Post	2.6	59.4%	87	7	0.5	9.4%
40	Ann Arbor B1	2.6	58.3%	88	43	0.4	8.3%
41	56	2.6	57.3%	89	40	0.4	7.3%
42	53	2.6	56.3%	90	6	0.3	6.3%
43	52	2.5	55.2%	91	38	0.3	5.2%
44	30	2.4	54.2%	92	41	0.3	4.2%
45	66	2.4	53.1%	93	39	0.3	3.1%
46	57	2.4	52.1%	94	36	0.2	2.1%
47	48	2.4	51.0%	95	42	0.1	1.0%
48	68	2.3	50.0%				

* Combined Sewer

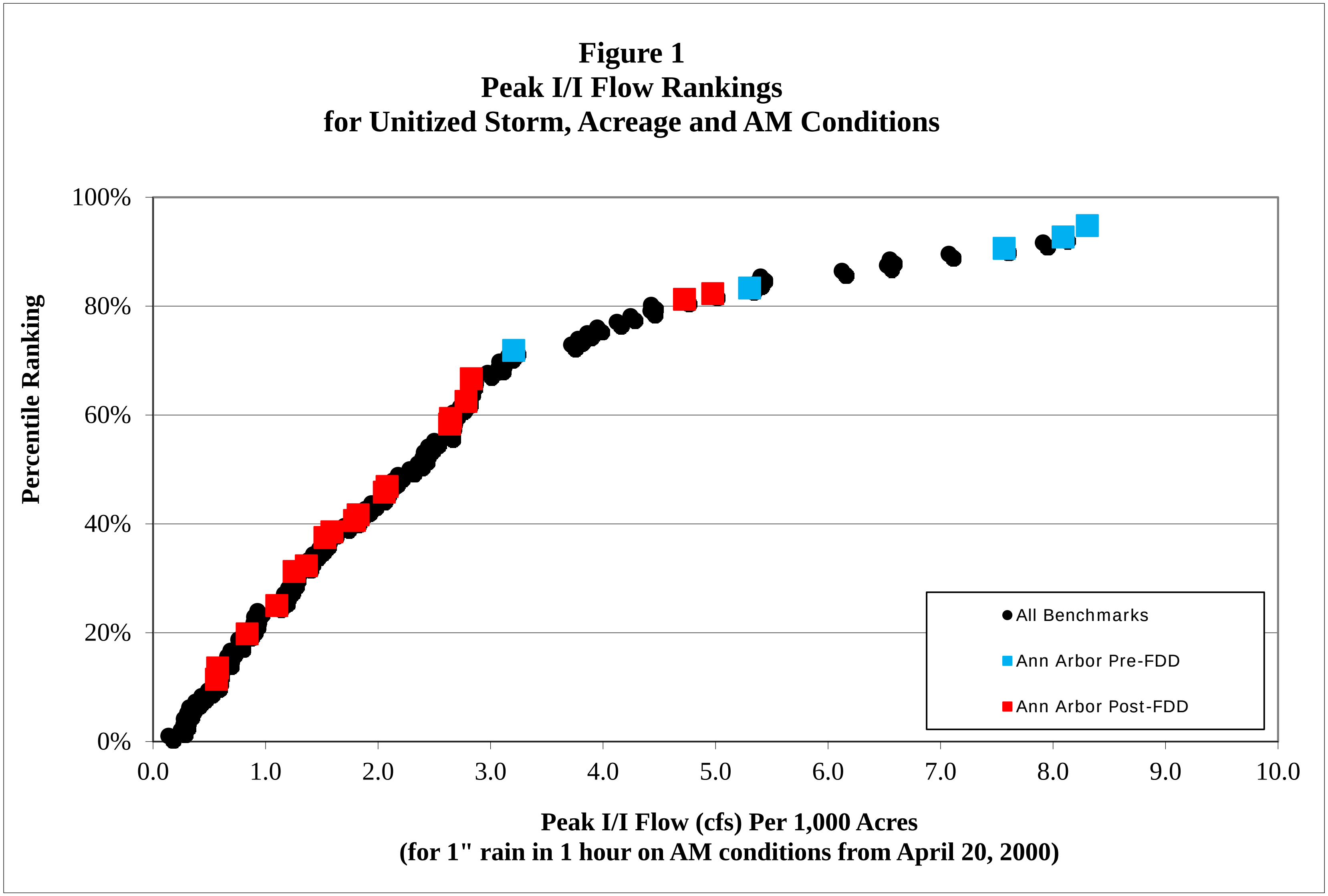


Figure 1
Peak I/I Flow Rankings
for Unitized Storm, Acreage and AM Conditions
Percentile Ranking
100%
80%
60%
40%
20%
0%
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
All Benchmarks
Ann Arbor Pre-FDD
Ann Arbor Post-FDD
Peak I/I Flow (cfs) Per 1,000 Acres
(for 1" rain in 1 hour on AM conditions from April 20, 2000)

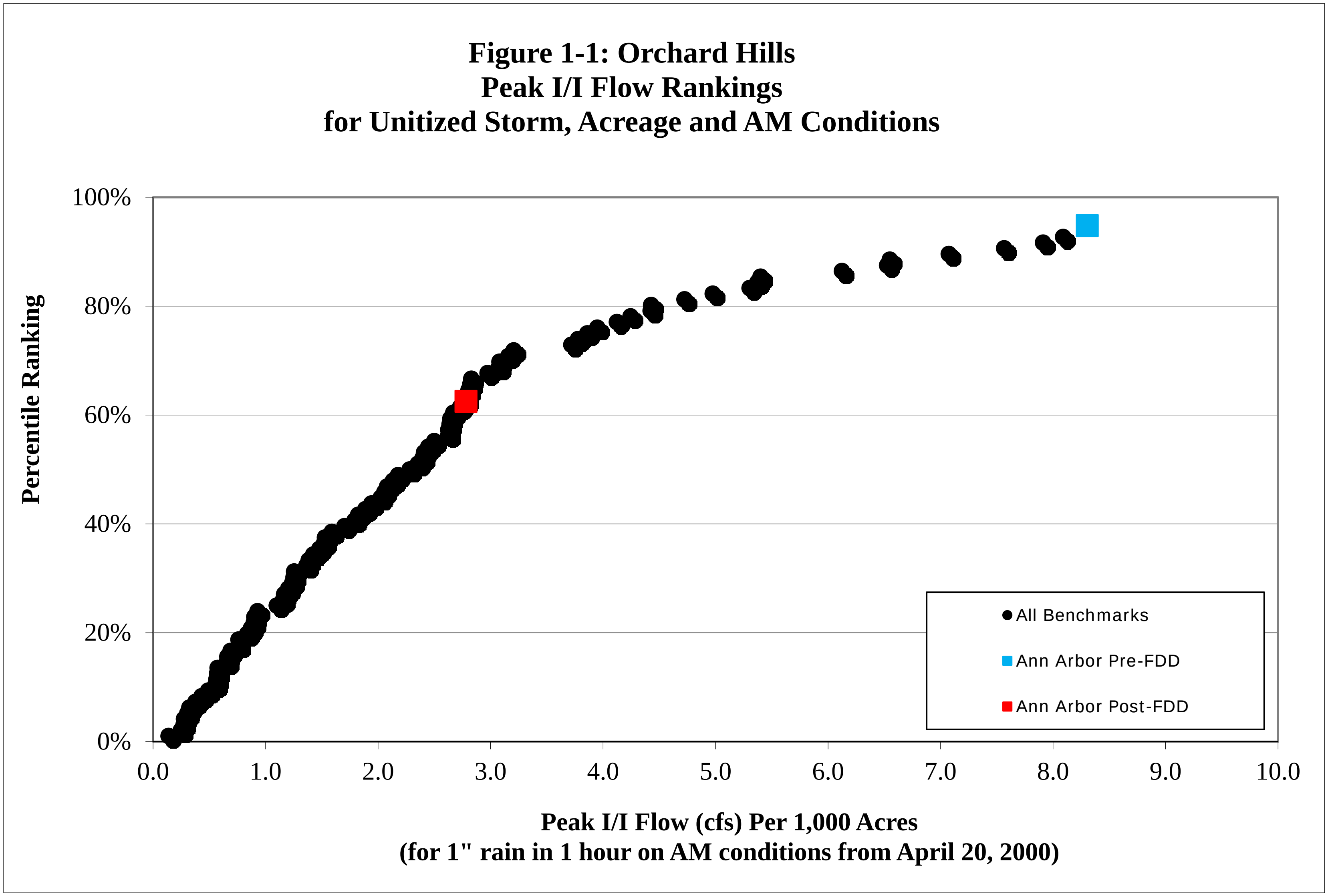


Figure 1-1: Orchard Hills
Peak I/I Flow Rankings
for Unitized Storm, Acreage and AM Conditions
Percentile Ranking
100%
80%
60%
40%
20%
0%
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
All Benchmarks
Ann Arbor Pre-FDD
Ann Arbor Post-FDD
Peak I/I Flow (cfs) Per 1,000 Acres
(for 1" rain in 1 hour on AM conditions from April 20, 2000)

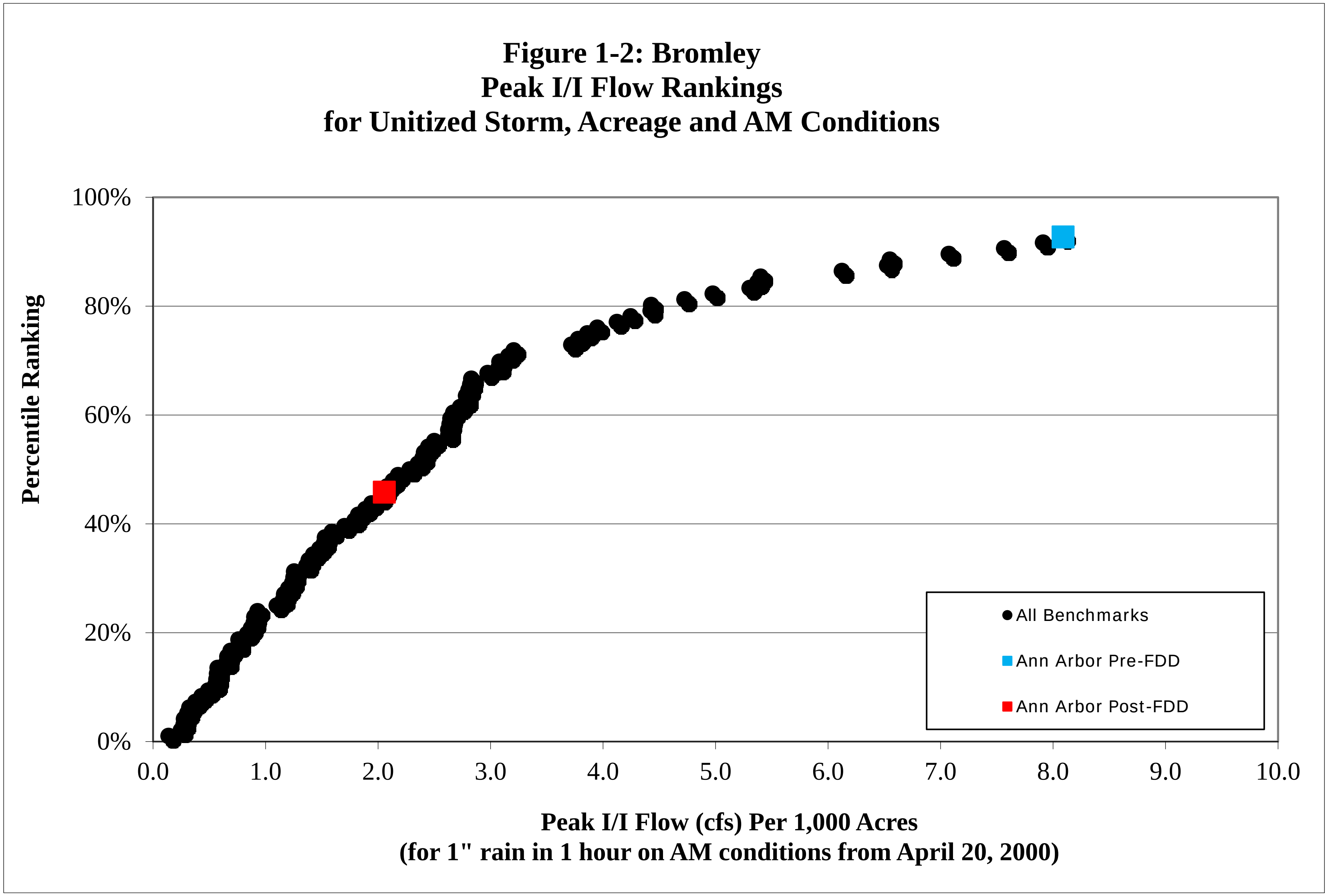


Figure 1-2: Bromley
Peak I/I Flow Rankings
for Unitized Storm, Acreage and AM Conditions
100%
80%
60%
40%
20%
0%
Percentile Ranking
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Peak I/I Flow (cfs) Per 1,000 Acres
(for 1" rain in 1 hour on AM conditions from April 20, 2000)
All Benchmarks
Ann Arbor Pre-FDD
Ann Arbor Post-FDD

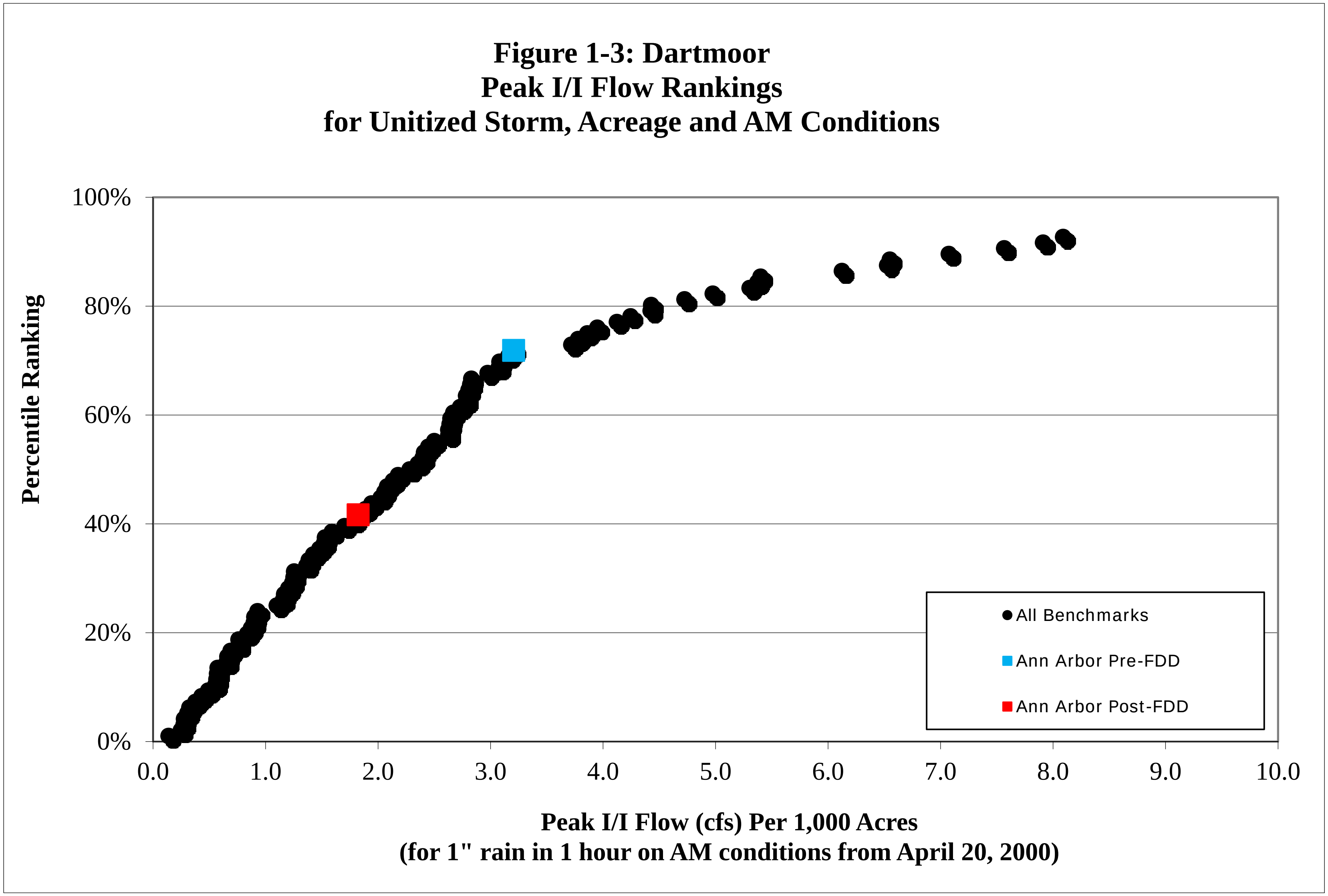


Figure 1-3: Dartmoor
Peak I/I Flow Rankings
for Unitized Storm, Acreage and AM Conditions
Percentile Ranking
100%
80%
60%
40%
20%
0%
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Peak I/I Flow (cfs) Per 1,000 Acres
(for 1" rain in 1 hour on AM conditions from April 20, 2000)
All Benchmarks
Ann Arbor Pre-FDD
Ann Arbor Post-FDD

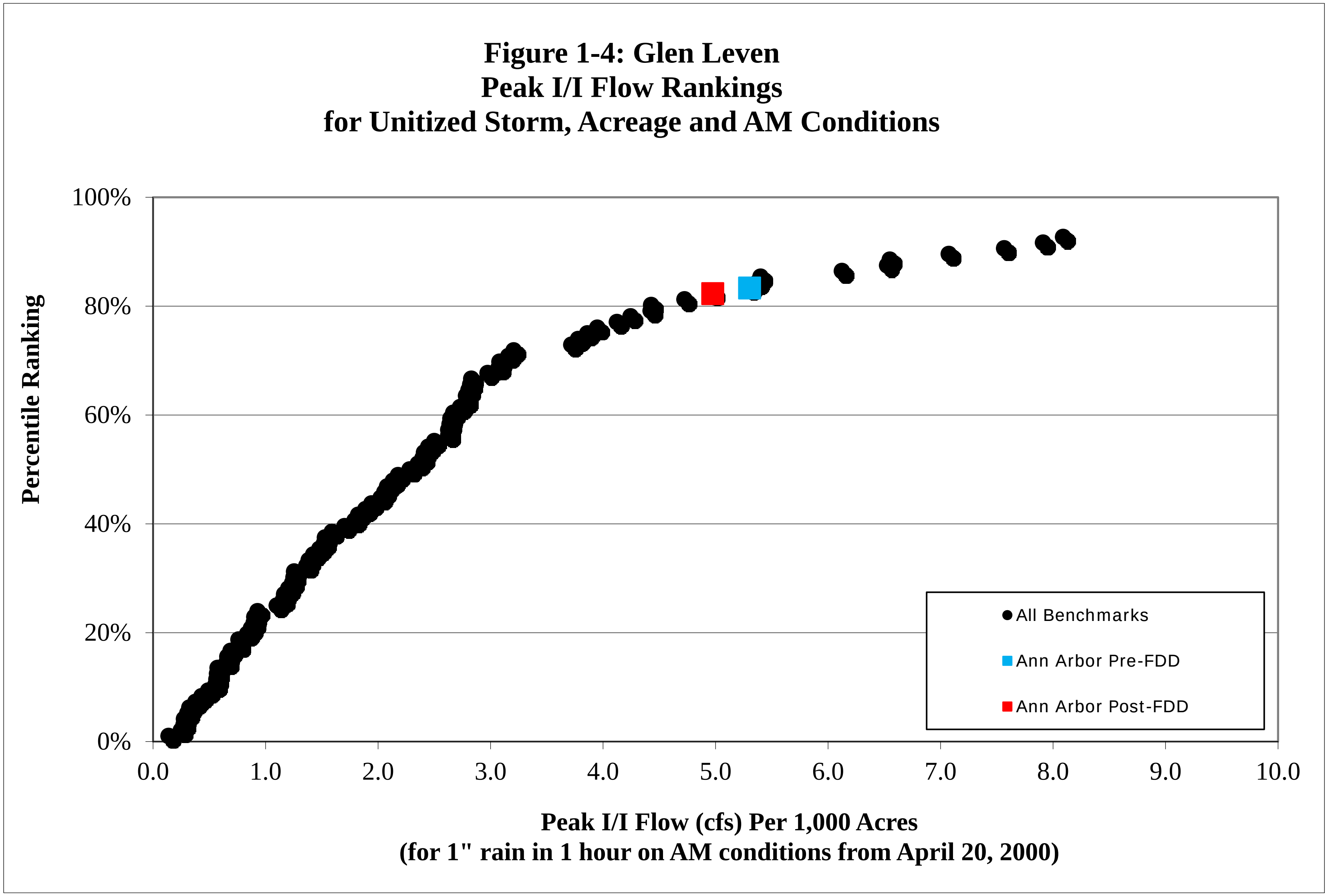


Figure 1-4: Glen Leven
Peak I/I Flow Rankings
for Unitized Storm, Acreage and AM Conditions
Percentile Ranking
100%
80%
60%
40%
20%
0%
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
All Benchmarks
Ann Arbor Pre-FDD
Ann Arbor Post-FDD
Peak I/I Flow (cfs) Per 1,000 Acres
(for 1" rain in 1 hour on AM conditions from April 20, 2000)

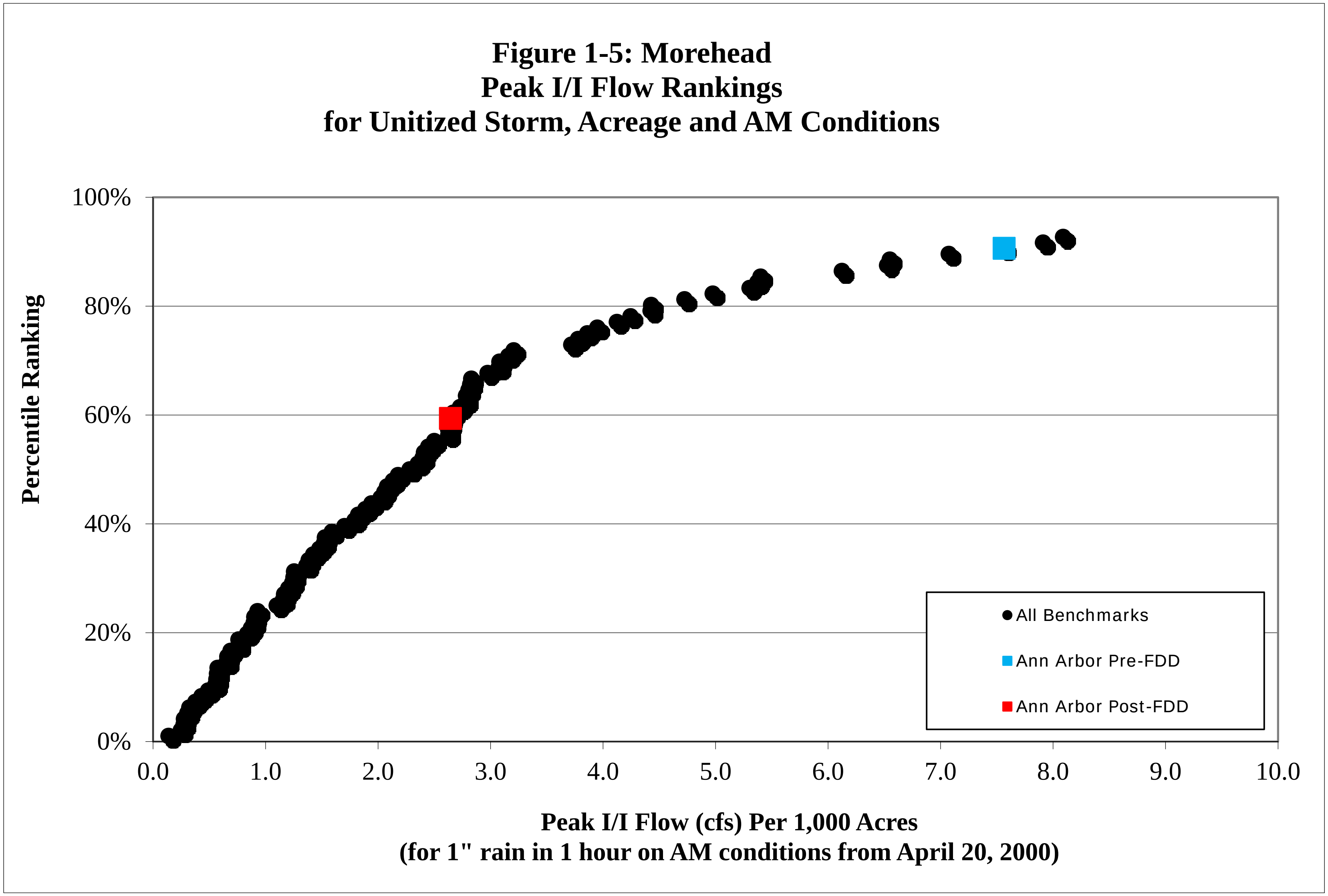


Figure 1-5: Morehead
Peak I/I Flow Rankings
for Unitized Storm, Acreage and AM Conditions
Percentile Ranking
100%
80%
60%
40%
20%
0%
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
All Benchmarks
Ann Arbor Pre-FDD
Ann Arbor Post-FDD
Peak I/I Flow (cfs) Per 1,000 Acres
(for 1" rain in 1 hour on AM conditions from April 20, 2000)

Benchmarking Evaluation
Table 2: Capture Percentage Rankings

Rank	Sub-Area	Capture Coefficient (C%)	Percentile	Rank	Sub-Area	Capture Coefficient (C%)	Percentile
1	11	46.7%	99.0%	49	44	2.6%	49.0%
2	35	40.2%	97.9%	50	26	2.5%	47.9%
3	Ann Arbor Orchard Hills Pre	30.3%	96.9%	51	32	2.5%	46.9%
4	Ann Arbor F1	22.2%	95.8%	52	28	2.4%	45.8%
5	Ann Arbor Glen Leven Pre	21.9%	94.8%	53	62	2.2%	44.8%
6	Ann Arbor Glen Leven Post	21.4%	93.8%	54	69	2.1%	43.8%
7	Ann Arbor Bromley Pre	20.9%	92.7%	55	50	2.0%	42.7%
8	45	19.8%	91.7%	56	37	1.9%	41.7%
9	Ann Arbor Morehead Pre	16.4%	90.6%	57	8	1.8%	40.6%
10	23	16.4%	89.6%	58	2	1.7%	39.6%
11	63	15.6%	88.5%	59	22	1.6%	38.5%
12	4*	15.5%	87.5%	60	3	1.6%	37.5%
13	60	13.4%	86.5%	61	16	1.6%	36.5%
14	Ann Arbor 12A	12.7%	85.4%	62	34	1.6%	35.4%
15	61	12.1%	84.4%	63	66	1.6%	34.4%
16	10	11.6%	83.3%	64	27	1.6%	33.3%
17	Ann Arbor Orchard Hills Post	9.4%	82.3%	65	59	1.5%	32.3%
18	58	8.9%	81.3%	66	21	1.5%	31.3%
19	Ann Arbor C1+C2	8.1%	80.2%	67	71	1.5%	30.2%
20	55	8.0%	79.2%	68	Ann Arbor 10A	1.3%	29.2%
21	31	8.0%	78.1%	69	20	1.3%	28.1%
22	54	7.8%	77.1%	70	24	1.3%	27.1%
23	51	7.5%	76.0%	71	68	1.2%	26.0%
24	Ann Arbor A1	7.5%	75.0%	72	72	1.1%	25.0%
25	Ann Arbor Dartmoor Pre	7.4%	74.0%	73	65	1.1%	24.0%
26	52	7.3%	72.9%	74	25	1.1%	22.9%
27	29	7.0%	71.9%	75	49	1.0%	21.9%
28	Ann Arbor Bromley Post	6.9%	70.8%	76	19	0.9%	20.8%
29	Ann Arbor B1	6.8%	69.8%	77	5	0.9%	19.8%
30	Ann Arbor 5C	6.6%	68.8%	78	70	0.6%	18.8%
31	1	6.3%	67.7%	79	41	0.6%	17.7%
32	Ann Arbor 9B	6.0%	66.7%	80	14	0.6%	16.7%
33	Ann Arbor Morehead Post	6.0%	65.6%	81	39	0.6%	15.6%
34	53	5.2%	64.6%	82	36	0.6%	14.6%
35	Ann Arbor G1	5.0%	63.5%	83	40	0.5%	13.5%
36	46	4.6%	62.5%	84	18	0.5%	12.5%
37	Ann Arbor 3B	4.6%	61.5%	85	42	0.5%	11.5%
38	30	4.2%	60.4%	86	43	0.4%	10.4%
39	33	3.8%	59.4%	87	38	0.4%	9.4%
40	56	3.8%	58.3%	88	48	0.4%	8.3%
41	Ann Arbor Dartmoor Post	3.7%	57.3%	89	12	0.4%	7.3%
42	Ann Arbor 11B	3.5%	56.3%	90	13	0.4%	6.3%
43	57	3.5%	55.2%	91	15	0.3%	5.2%
44	Ann Arbor 9C	3.3%	54.2%	92	17	0.3%	4.2%
45	9	3.1%	53.1%	93	7	0.2%	3.1%
46	67	2.8%	52.1%	94	47	0.2%	2.1%
47	64	2.7%	51.0%	95	6	0.1%	1.0%
48	Ann Arbor 01A	2.7%	50.0%				

* Combined Sewer

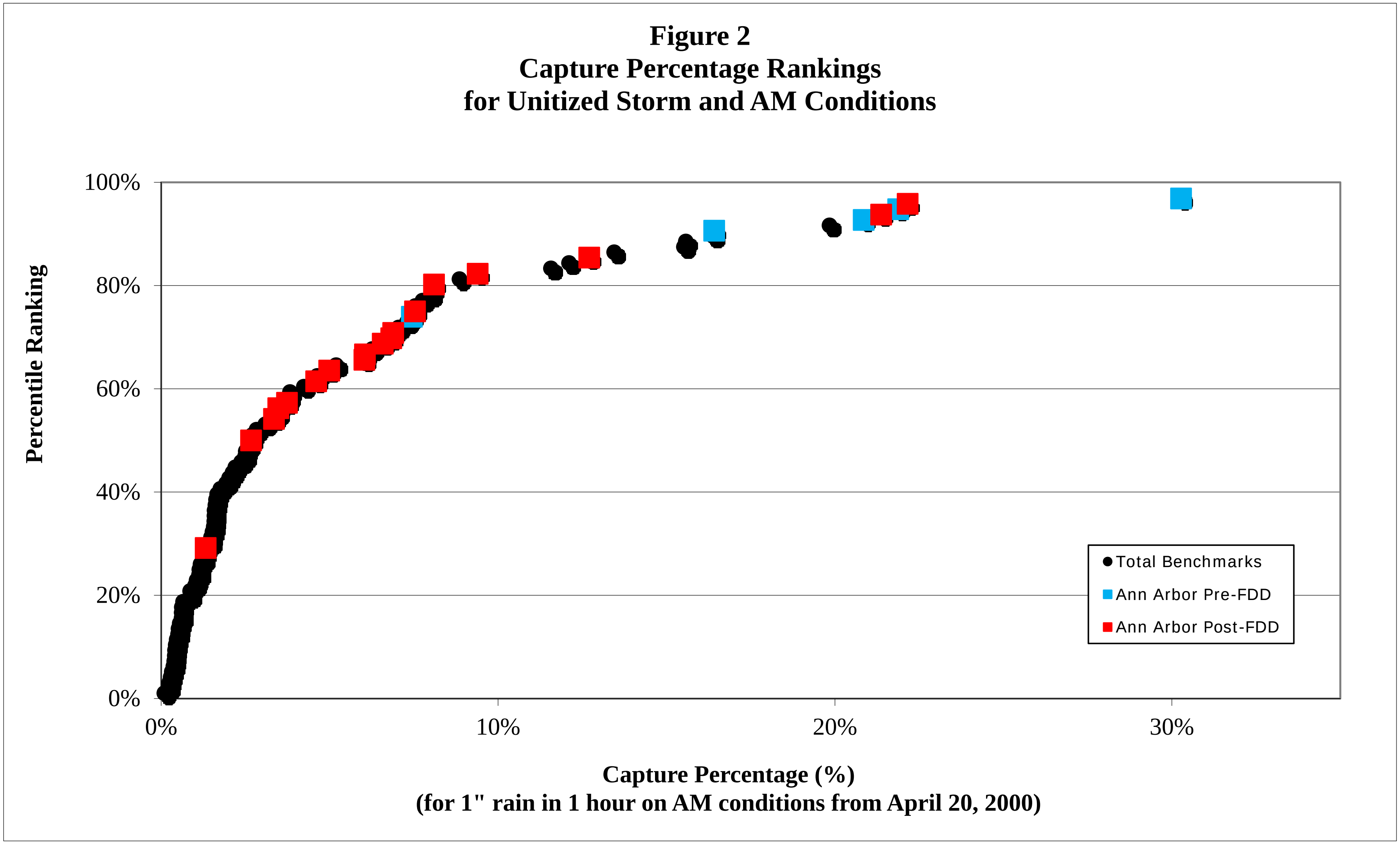


Figure 2
Capture Percentage Rankings
for Unitized Storm and AM Conditions
Percentile Ranking
100%
80%
60%
40%
20%
0%
0%
10%
20%
30%
Total Benchmarks
Ann Arbor Pre-FDD
Ann Arbor Post-FDD
Capture Percentage (%)
(for 1" rain in 1 hour on AM conditions from April 20, 2000)

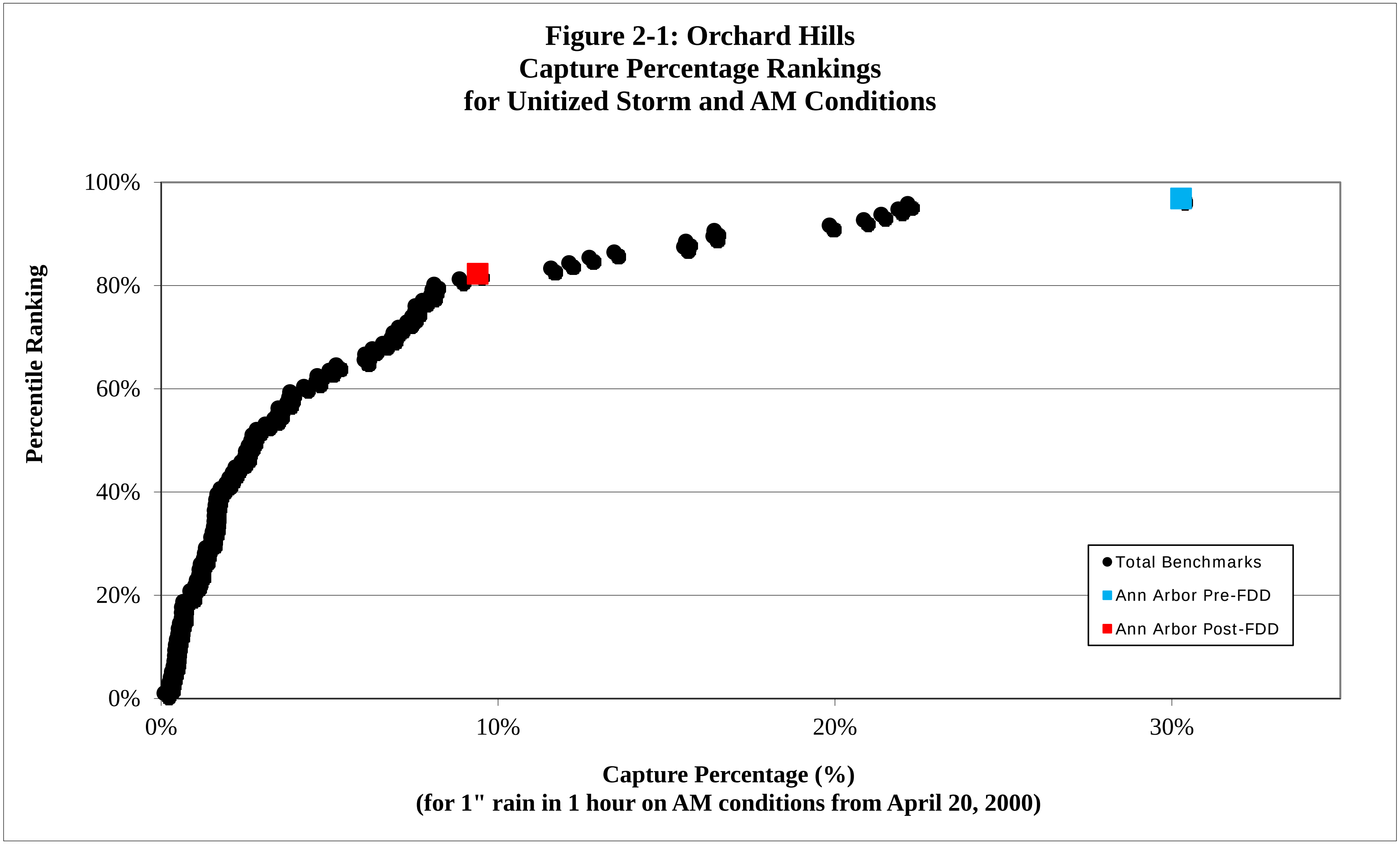


Figure 2-1: Orchard Hills
Capture Percentage Rankings
for Unitized Storm and AM Conditions
Percentile Ranking
100%
80%
60%
40%
20%
0%
0%
10%
20%
30%
Total Benchmarks
Ann Arbor Pre-FDD
Ann Arbor Post-FDD
Capture Percentage (%)
(for 1" rain in 1 hour on AM conditions from April 20, 2000)

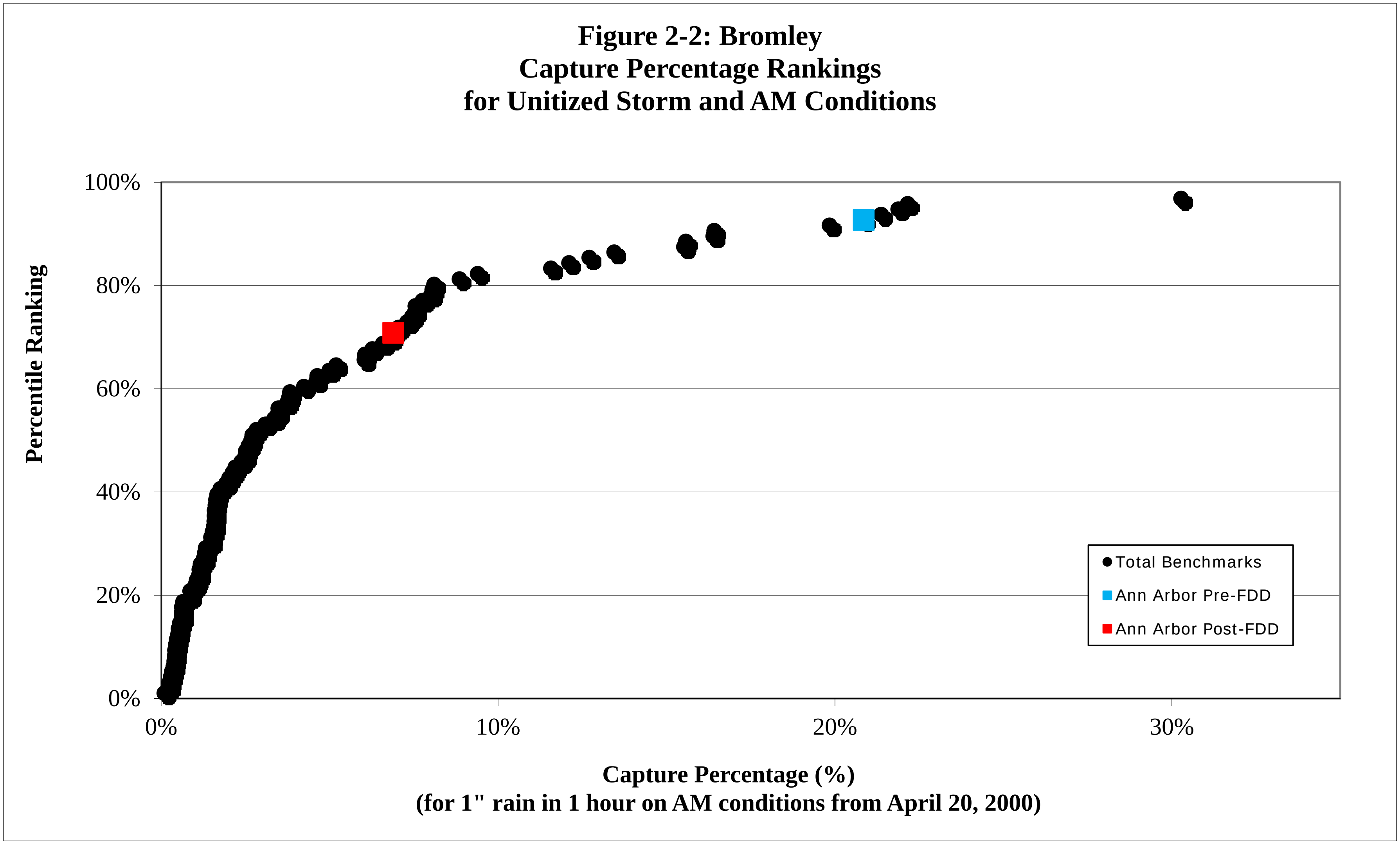


Figure 2-2: Bromley
Capture Percentage Rankings
for Unitized Storm and AM Conditions
100%
80%
60%
40%
20%
0%
Percentile Ranking
0%
10%
20%
30%
Total Benchmarks
Ann Arbor Pre-FDD
Ann Arbor Post-FDD
Capture Percentage (%)
(for 1" rain in 1 hour on AM conditions from April 20, 2000)

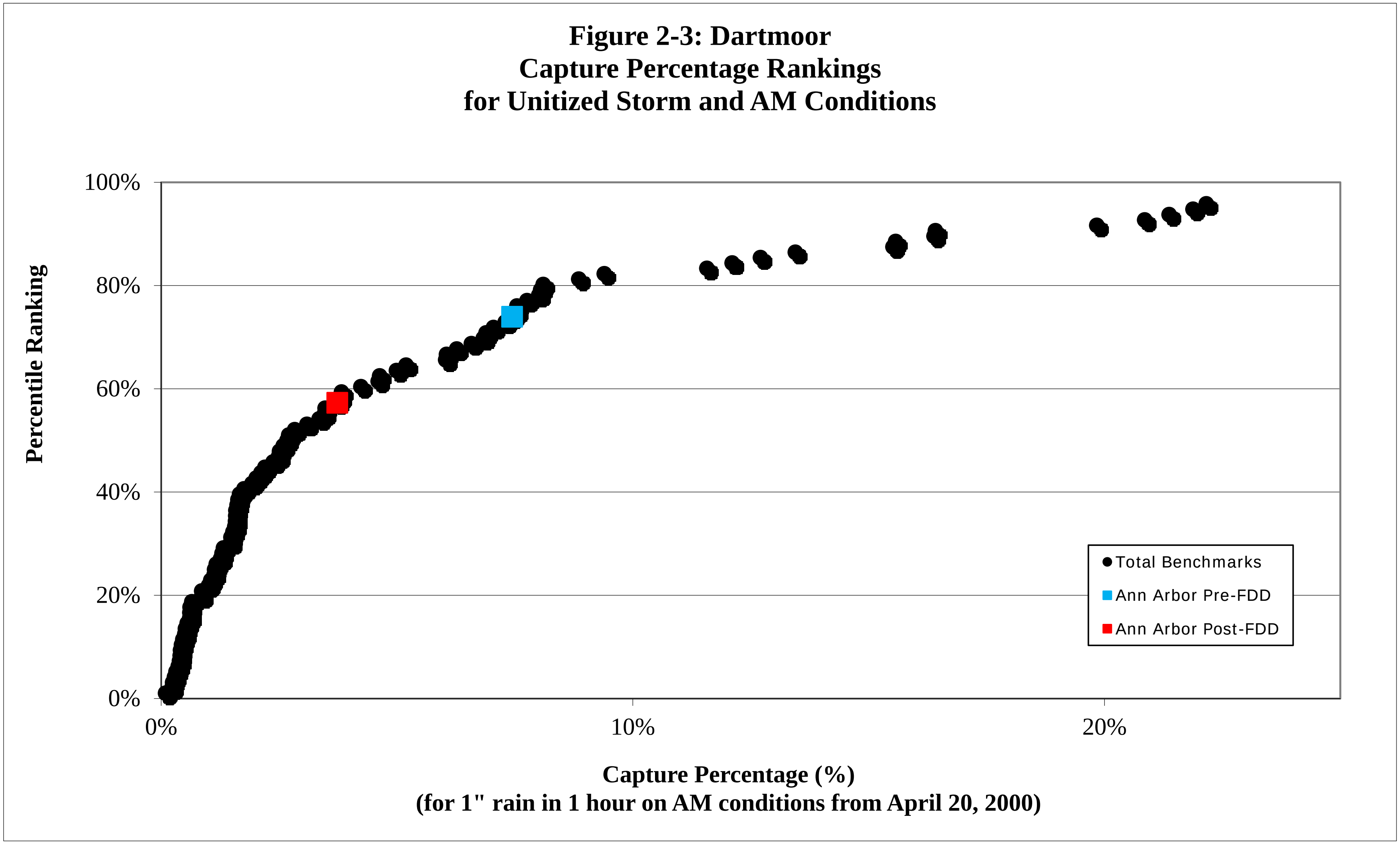


Figure 2-3: Dartmoor
Capture Percentage Rankings
for Unitized Storm and AM Conditions
Percentile Ranking
100%
80%
60%
40%
20%
0%
0%
10%
20%
Total Benchmarks
Ann Arbor Pre-FDD
Ann Arbor Post-FDD
Capture Percentage (%)
(for 1" rain in 1 hour on AM conditions from April 20, 2000)

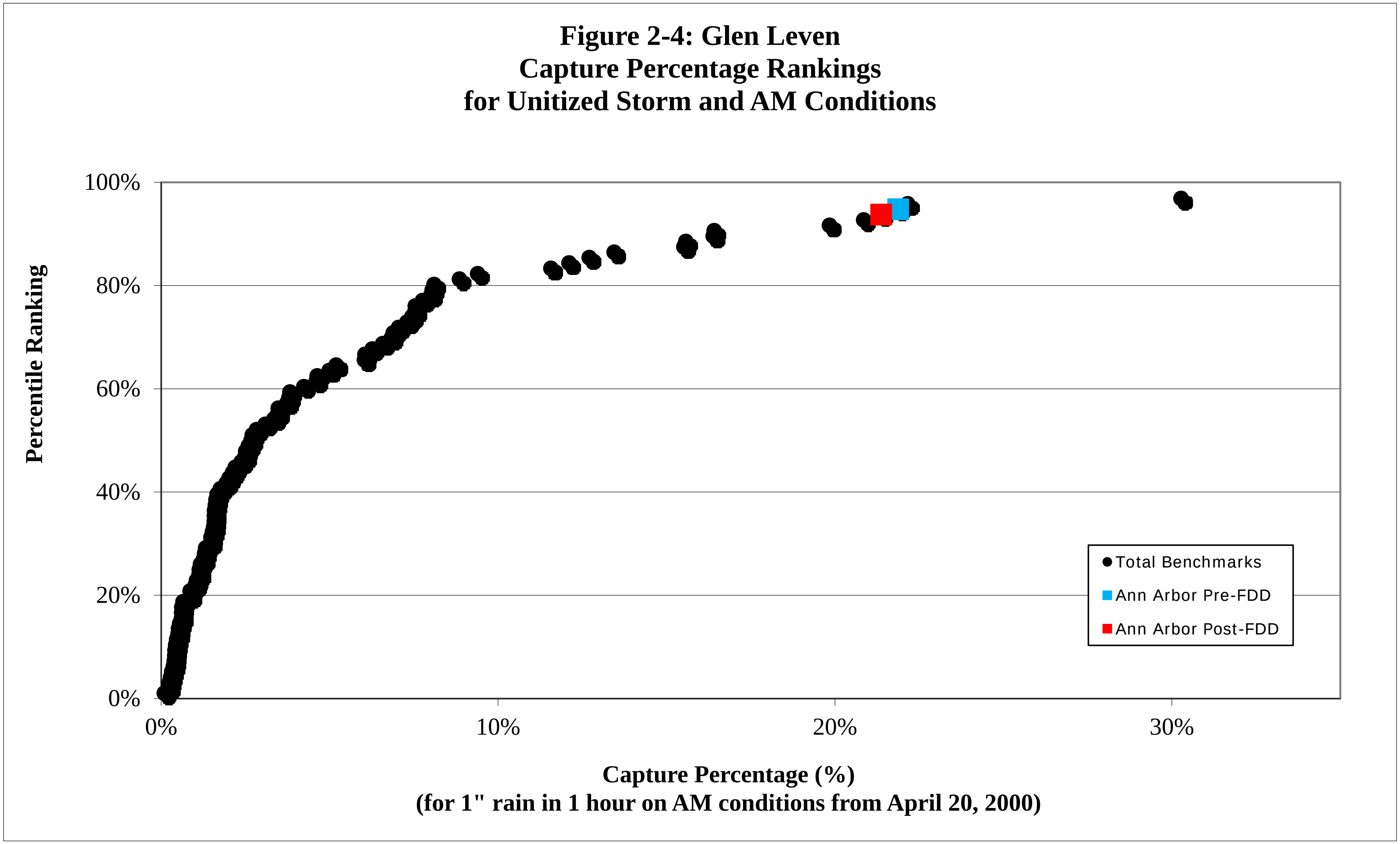


Figure 2-4: Glen Leven
Capture Percentage Rankings
for Unitized Storm and AM Conditions
Percentile Ranking
100%
80%
60%
40%
20%
0%
0%
10%
20%
30%
Total Benchmarks
Ann Arbor Pre-FDD
Ann Arbor Post-FDD
Capture Percentage (%)
(for 1" rain in 1 hour on AM conditions from April 20, 2000)

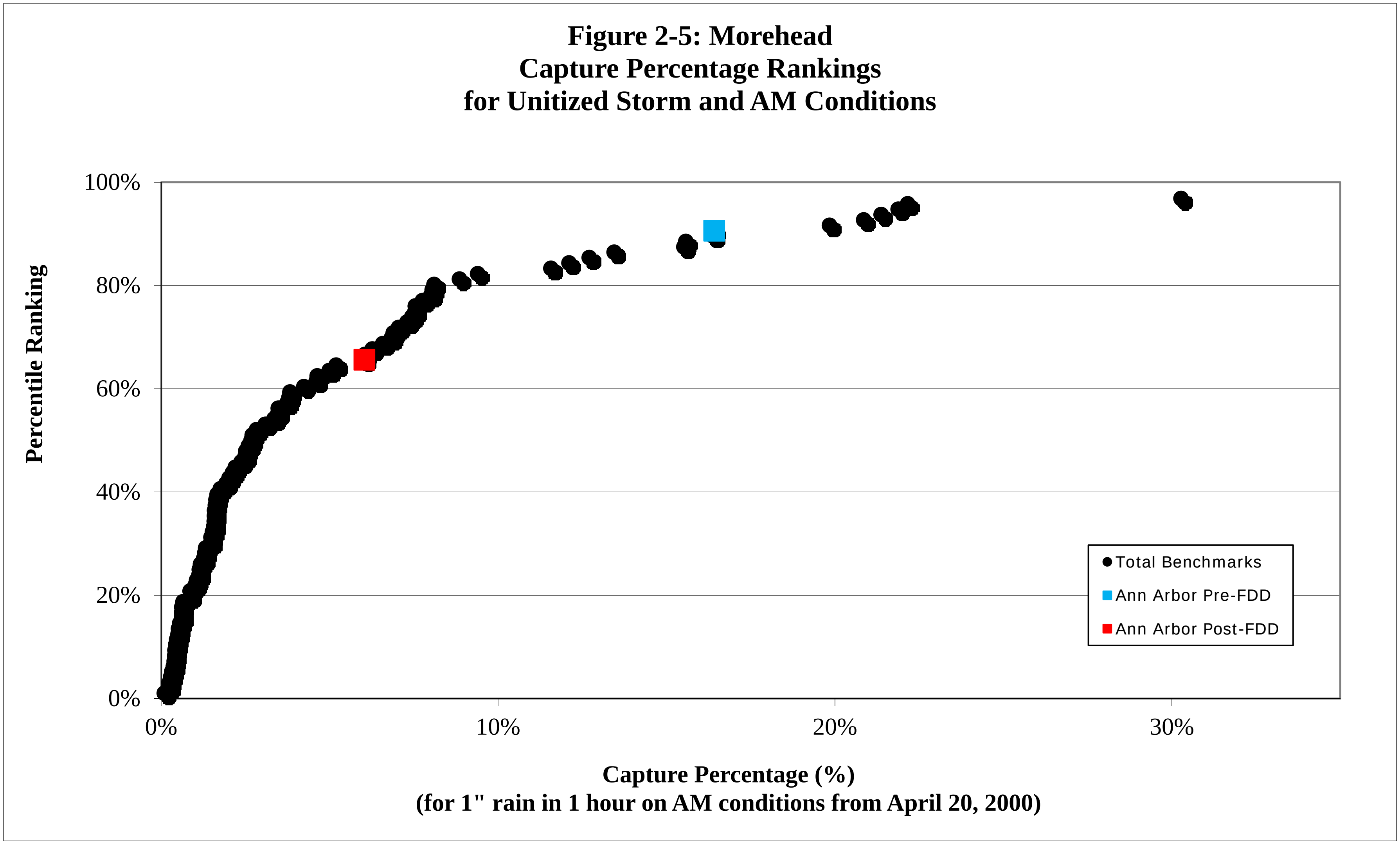
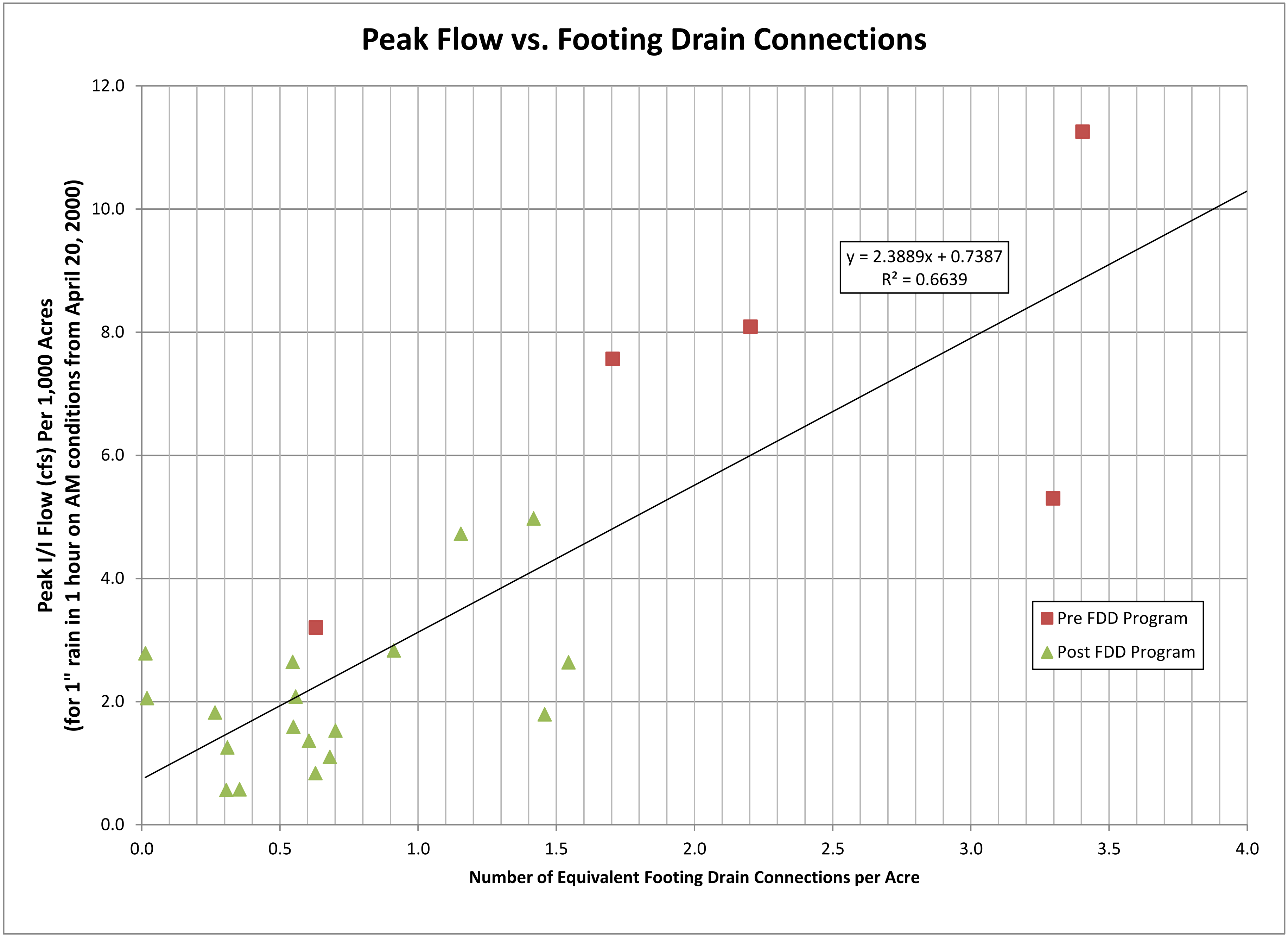


Figure 2-5: Morehead
Capture Percentage Rankings
for Unitized Storm and AM Conditions
Percentile Ranking
100%
80%
60%
40%
20%
0%
0%
10%
20%
30%
Total Benchmarks
Ann Arbor Pre-FDD
Ann Arbor Post-FDD
Capture Percentage (%)
(for 1" rain in 1 hour on AM conditions from April 20, 2000)

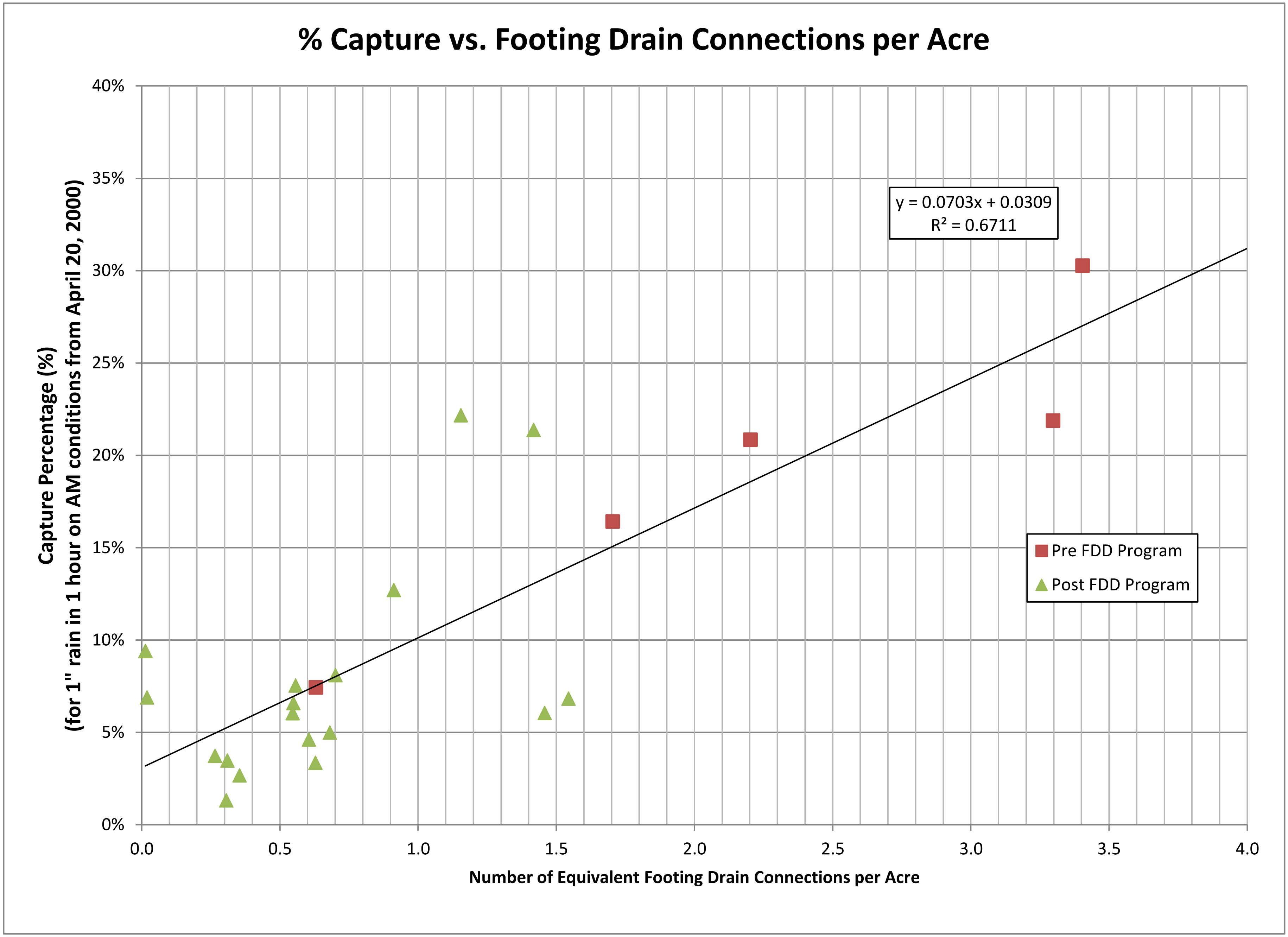
Appendix K
Density of Footing Drains

Ann Arbor Sanitary Sewer Wer Weather Evaluation Project
Footing Drain Connections Summary Table

Sub-Area Name	Connected Footing Drain/Acre	Peak Flow (cfs) per 1000 ac	Capture Coefficient (C%)
Ann Arbor Orchard Hills Pre	3.40	11.26	30.3%
Ann Arbor Orchard Hills Post	0.01	2.78	9.4%
Ann Arbor Bromley Pre	2.20	8.09	20.9%
Ann Arbor Bromley Post	0.02	2.06	6.9%
Ann Arbor Dartmoor Pre	0.63	3.21	7.4%
Ann Arbor Dartmoor Post	0.27	1.82	3.7%
Ann Arbor Glen Leven Pre	3.30	5.30	21.9%
Ann Arbor Glen Leven Post	1.42	4.97	21.4%
Ann Arbor Morehead Pre	1.70	7.57	16.4%
Ann Arbor Morehead Post	0.55	2.64	6.0%
Ann Arbor 01A	0.35	0.57	2.7%
Ann Arbor 10A	0.31	0.56	1.3%
Ann Arbor 11B	0.31	1.25	3.5%
Ann Arbor 12A	0.91	2.83	12.7%
Ann Arbor 3B	0.60	1.36	4.6%
Ann Arbor 5C	0.55	1.59	6.6%
Ann Arbor 9B	1.46	1.79	6.0%
Ann Arbor 9C	0.63	0.84	3.3%
Ann Arbor A1	0.56	2.08	7.5%
Ann Arbor B1	1.54	2.64	6.8%
Ann Arbor C1+C2	0.70	1.53	8.1%
Ann Arbor F1	1.15	4.72	22.2%
Ann Arbor G1	0.68	1.10	5.0%



Peak Flow vs. Footing Drain Connections
Peak I/I Flow (cfs) Per 1,000 Acres
(for 1" rain in 1 hour on AM conditions from April 20, 2000)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Number of Equivalent Footing Drain Connections per Acre
y = 2.3889x + 0.7387
R² = 0.6639
Pre FDD Program
Post FDD Program


% Capture vs. Footing Drain Connections per Acre
Capture Percentage (%)
(for 1" rain in 1 hour on AM conditions from April 20, 2000)
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Number of Equivalent Footing Drain Connections per Acre
y = 0.0703x + 0.0309
R² = 0.6711
Pre FDD Program
Post FDD Program

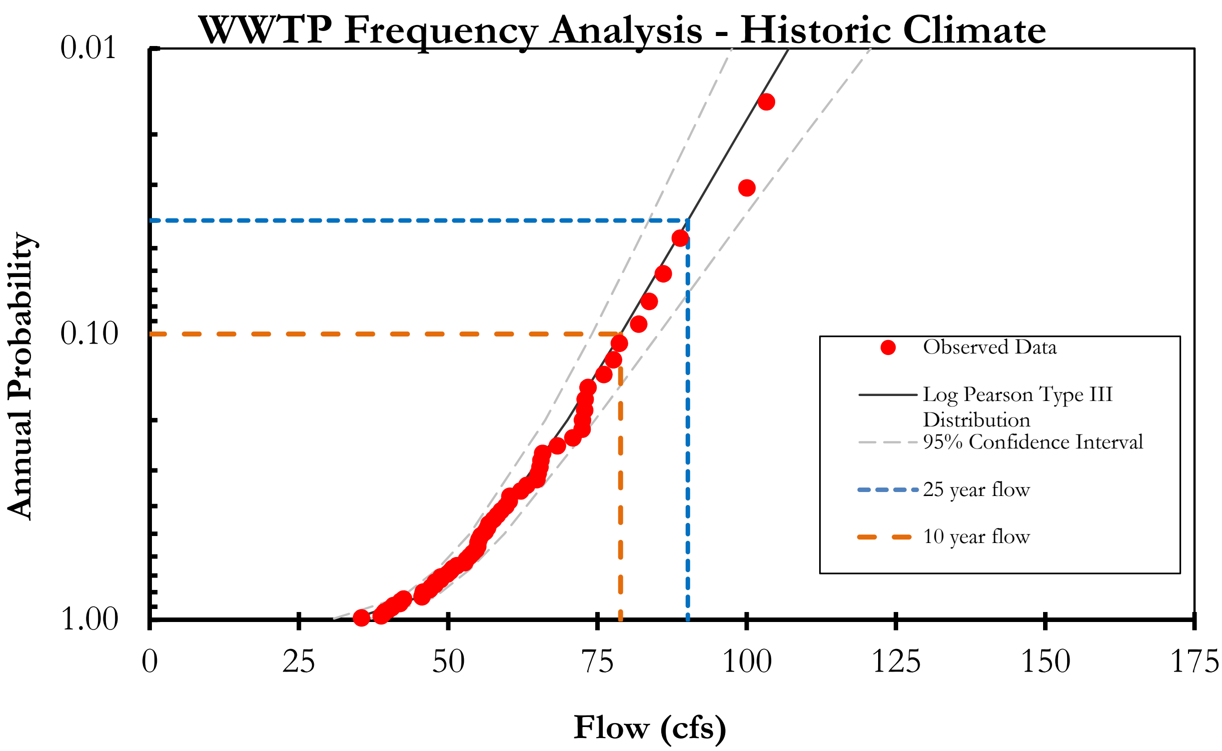
Appendix L

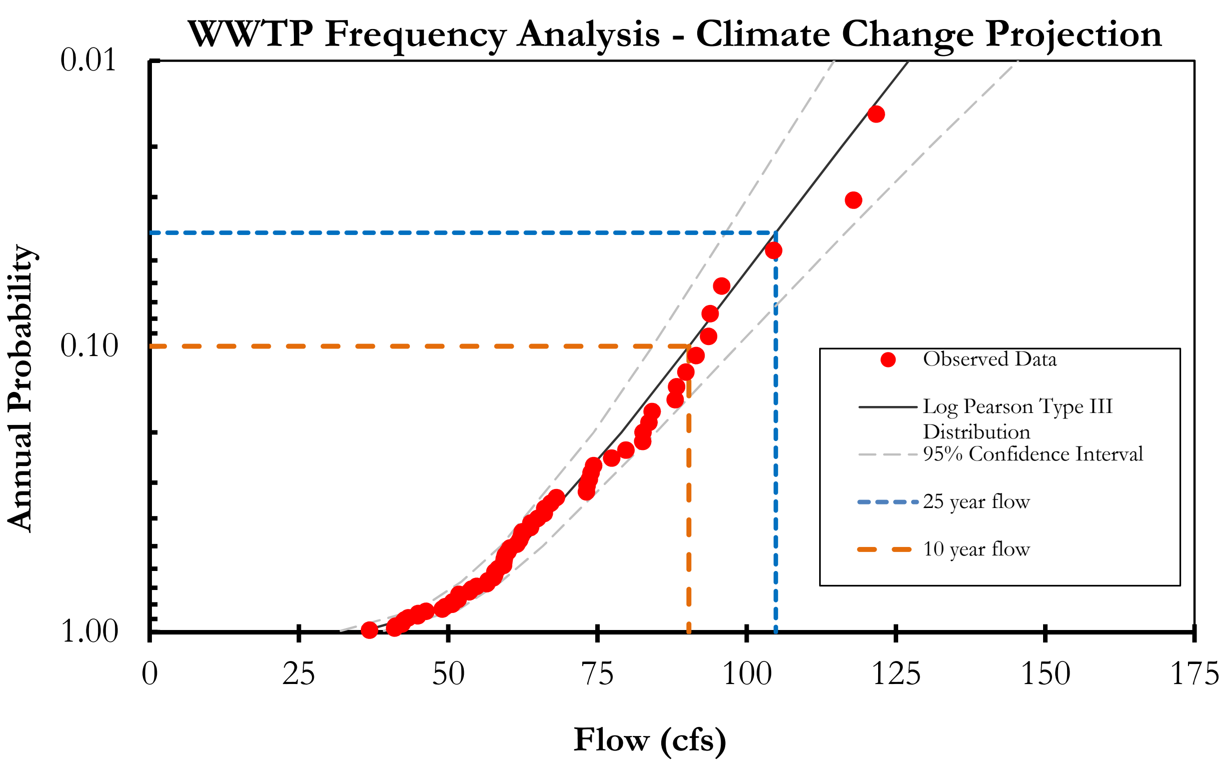
Wastewater Treatment Plant Evaluation

Flow Series

Storms

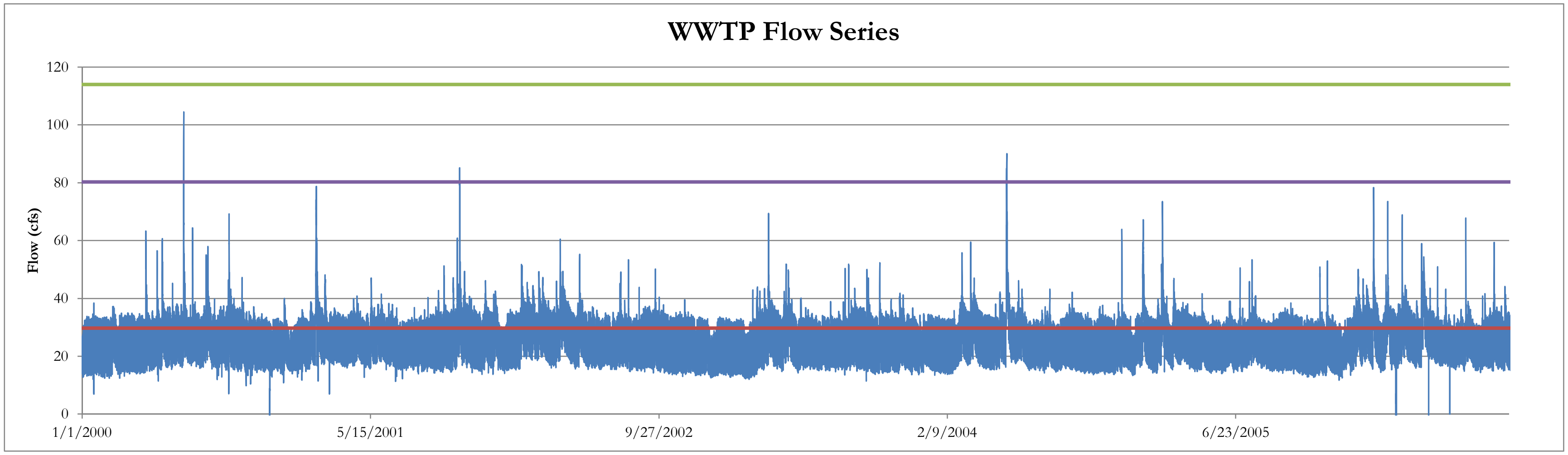
Log Pearson III Figure

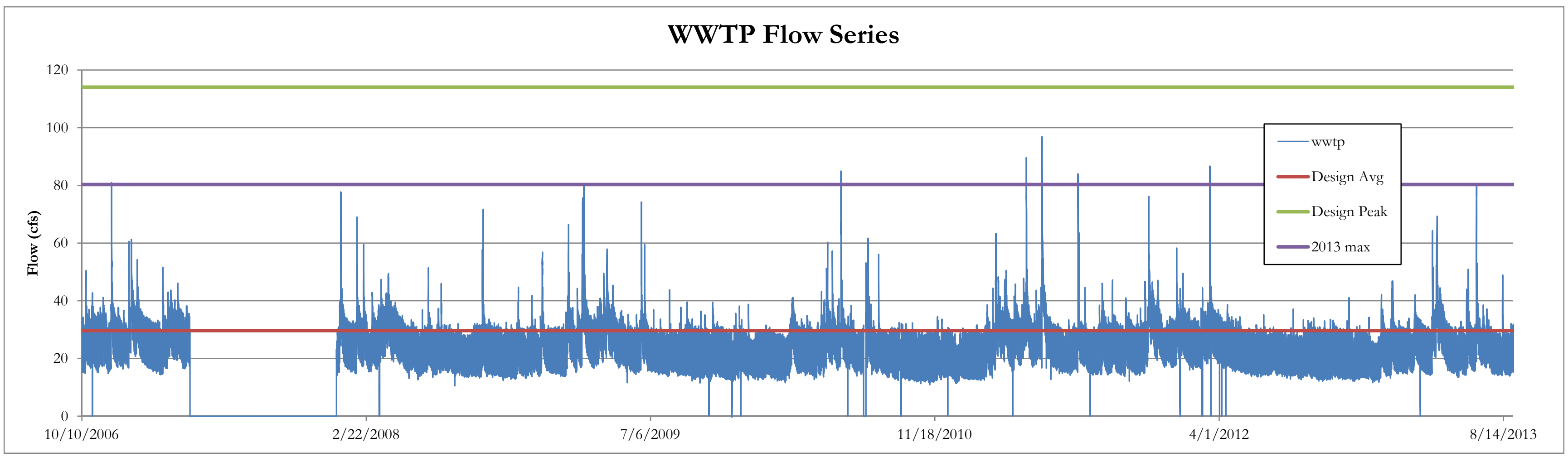


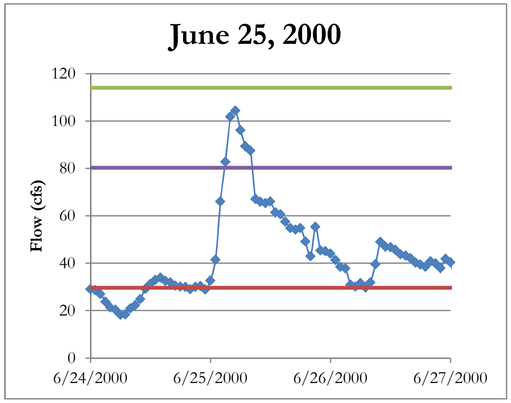


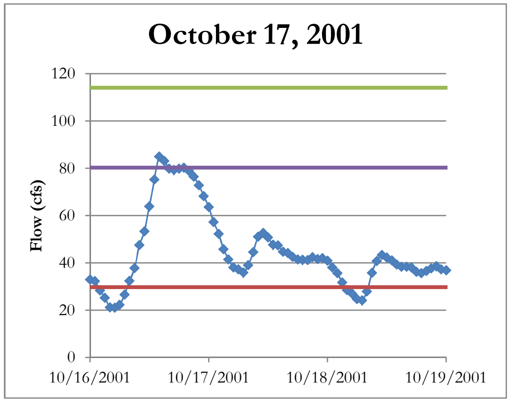
	10 year	25 year	50 year	100 year
Historic Climate	78.9	90.1	98.6	107.0
Climate Change	90.3	104.9	115.9	127.2

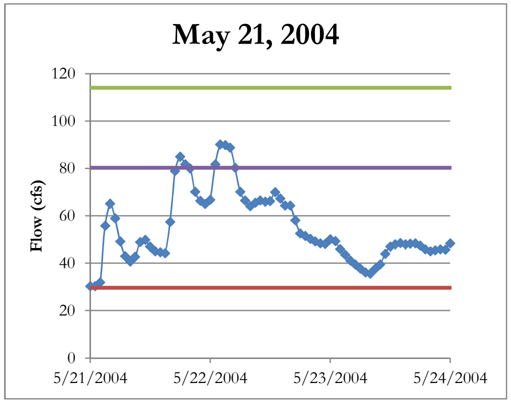
Plant Capacity = 114 cfs
June 27, 2013 Peak Flow = 80.2 cfs

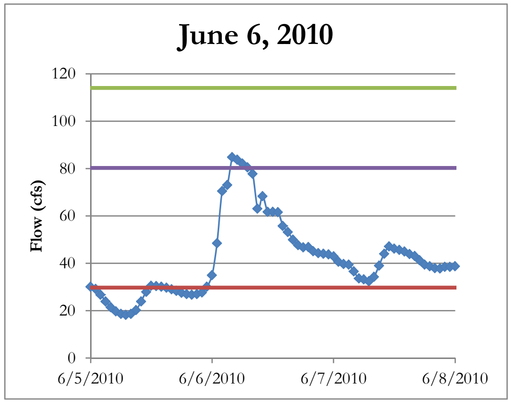

WWTP Flow Series
Flow (cfs)
0
20
40
60
80
100
120
1/1/2000
5/15/2001
9/27/2002
2/9/2004
6/23/2005

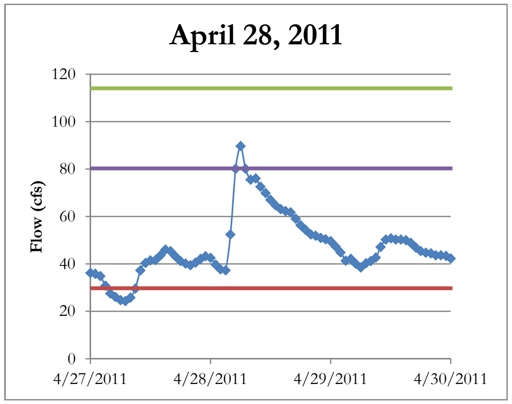

WWTP Flow Series
Flow (cfs)
0
20
40
60
80
100
120
10/10/2006
2/22/2008
7/6/2009
11/18/2010
4/1/2012
8/14/2013
wwtp
Design Avg
Design Peak
2013 max

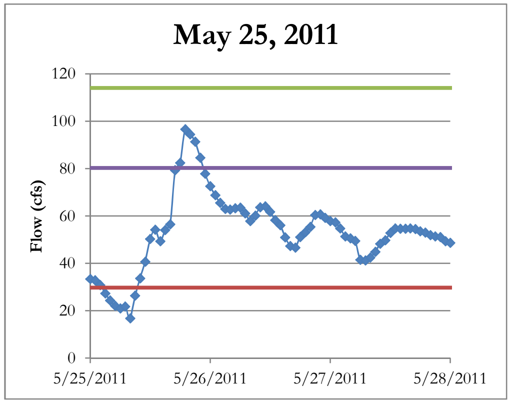

June 25, 2000
Flow (cfs)
120
100
80
60
40
20
0
6/24/2000
6/25/2000
6/26/2000
6/27/2000

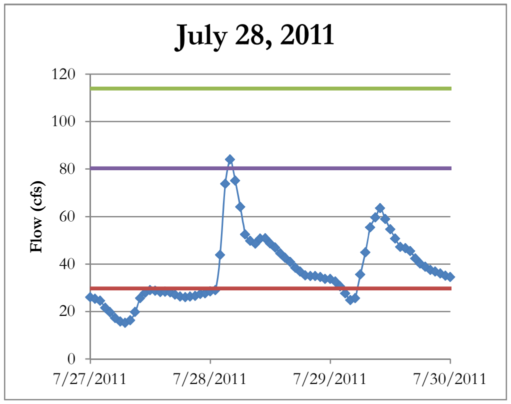

October 17, 2001
Flow (cfs)
120
100
80
60
40
20
0
10/16/2001
10/17/2001
10/18/2001
10/19/2001

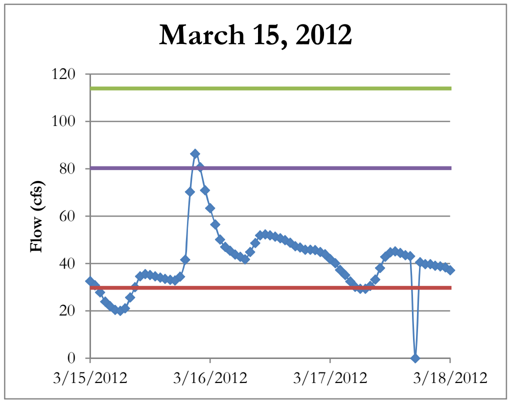

May 21, 2004
Flow (cfs)
120
100
80
60
40
20
0
5/21/2004
5/22/2004
5/23/2004
5/24/2004

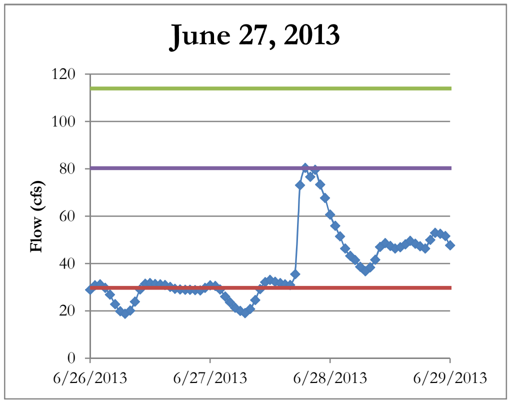

June 6, 2010
Flow (cfs)
120
100
80
60
40
20
0
6/5/2010
6/6/2010
6/7/2010
6/8/2010


April 28, 2011
Flow (cfs)
120
100
80
60
40
20
0
4/27/2011
4/28/2011
4/29/2011
4/30/2011


May 25, 2011
Flow (cfs)
120
100
80
60
40
20
0
5/25/2011
5/26/2011
5/27/2011
5/28/2011


July 28, 2011
Flow (cfs)
120
100
80
60
40
20
0
7/27/2011
7/28/2011
7/29/2011
7/30/2011


March 15, 2012
Flow (cfs)
120
100
80
60
40
20
0
3/15/2012
3/16/2012
3/17/2012
3/18/2012


June 27, 2013
Flow (cfs)
120
100
80
60
40
20
0
6/26/2013
6/27/2013
6/28/2013
6/29/2013

Appendix M
Frequency Risk Tables

City of Ann Arbor
Sanitary Sewer Wet Weather Evaluation Project
Recurrence Interval of the Pipe Capacity

Pre-FDD System (shading indicates the recurrence interval range of the pipe capacity)

Meter ID	Pipe Capacity (cfs)	< 10 yr	Frequency Analysis Total Flow Rate (cfs)			> 100 yr
			10 year	25 year	100 year	
Orchard Hills (47)	1.19		2.89	3.60	4.67	
Bromley (2B)	1.32		2.53	3.09	3.94	
Dartmoor (2D)	9.10		6.83	8.21	10.29	
Glen Leven (11+102)	11.80		4.54	5.50	6.93	
Morehead (49M)	7.49		6.11	7.42	9.37	
01A	3.58		0.89	1.05	1.29	
10A	7.52		5.14	5.74	6.61	
11B	17.86		6.27	7.15	8.48	
12A	10.29		5.03	6.11	7.70	
3B	37.68		5.72	6.76	8.28	
5C	26.17		10.15	11.84	14.41	
9B	9.11		5.34	6.21	7.53	
9C	27.13		14.20	15.64	17.67	
A1	12.11		4.63	5.38	6.53	
B1	3.96		6.60	7.68	9.25	
C1+C2	80.60		31.82	34.89	39.16	
F1	20.28		6.35	7.51	9.30	
G1	21.05		13.52	15.49	18.51	

Post-FDD System (shading indicates the recurrence interval range of the pipe capacity)

Meter ID	Pipe Capacity (cfs)	< 10 yr	Frequency Analysis Total Flow Rate (cfs)			> 100 yr
			10 year	25 year	100 year	
Orchard Hills (47)	1.19		0.44	0.51	0.62	
Bromley (2B)	1.32		0.51	0.57	0.66	
Dartmoor (2D)	9.10		4.06	4.78	5.85	
Glen Leven (11+102)	11.80		3.13	3.74	4.66	
Morehead (49M)	7.49		1.78	2.06	2.46	
01A	3.58		0.89	1.05	1.29	
10A	7.52		5.14	5.74	6.61	
11B	17.86		3.94	4.43	5.14	
12A	10.29		5.03	6.11	7.70	
3B	37.68		5.72	6.76	8.28	
5C	26.17		7.53	8.69	10.42	
9B	9.11		5.34	6.21	7.53	
9C	27.13		14.20	15.64	17.67	
A1	12.11		4.63	5.38	6.53	
B1	3.96		6.60	7.68	9.25	
C1+C2	80.60		31.82	34.89	39.16	
F1	20.28		6.35	7.51	9.30	
G1	21.05		13.52	15.49	18.51	

City of Ann Arbor
Sanitary Sewer Wet Weather Evaluation Project
Recurrence Interval of the Pipe Capacity

Post-FDD System (shading indicates the recurrence interval range of the pipe capacity)

Meter ID	Pipe Capacity (cfs)	< 10 yr	Frequency Analysis Total Flow Rate (cfs)			> 100 yr
			10 year	25 year	100 year	
Orchard Hills (47)	1.19		0.44	0.51	0.62	
Bromley (2B)	1.32		0.51	0.57	0.66	
Dartmoor (2D)	9.10		4.06	4.78	5.85	
Glen Leven (11+102)	11.80		3.13	3.74	4.66	
Morehead (49M)	7.49		1.78	2.06	2.46	
01A	3.58		0.89	1.05	1.29	
10A	7.52		5.14	5.74	6.61	
11B	17.86		3.94	4.43	5.14	
12A	10.29		5.03	6.11	7.70	
3B	37.68		5.72	6.76	8.28	
5C	26.17		7.53	8.69	10.42	
9B	9.11		5.34	6.21	7.53	
9C	27.13		14.20	15.64	17.67	
A1	12.11		4.63	5.38	6.53	
B1	3.96		6.60	7.68	9.25	
C1+C2	80.60		31.82	34.89	39.16	
F1	20.28		6.35	7.51	9.30	
G1	21.05		13.52	15.49	18.51	

Climate Change Projection (shading indicates the recurrence interval range of the pipe capacity)

Meter ID	Pipe Capacity (cfs)	< 10 yr	Frequency Analysis Total Flow Rate (cfs)			> 100 yr
			10 year	25 year	100 year	
Orchard Hills (47)	1.19		0.50	0.58	0.71	
Bromley (2B)	1.32		0.56	0.64	0.76	
Dartmoor (2D)	9.10		4.76	5.70	7.14	
Glen Leven (11+102)	11.80		3.71	4.50	5.76	
Morehead (49M)	7.49		2.06	2.42	2.97	
01A	3.58		1.00	1.20	1.53	
10A	7.52		5.76	6.51	7.64	
11B	17.86		4.23*	4.71*	5.36*	
12A	10.29		6.16	7.61	9.77	
3B	37.68		6.13	7.34	9.18	
5C	26.17		7.81	9.30	11.62	
9B	9.11		6.28	7.47	9.33	
9C	27.13		15.67	17.42	19.90	
A1	12.11		5.05	5.90	7.22	
B1	3.96		7.88	9.38	11.66	
C1+C2	80.60		35.01	38.76	44.08	
F1	20.28		7.43	8.92	11.27	
G1	21.05		13.50	15.35	18.20	

* Removed High Outlier (4.41, 5.05, 6.00)

City of Ann Arbor
Sanitary Sewer Wet Weather Evaluation Project
Recurrence Interval of the peak flow metering in 2013

Post-FDD System (shading indicates the recurrence interval range of the peak flow)

Meter ID	Pipe Capacity (cfs)	Avg Dry Flow (cfs)	2013 Peak Flow (cfs)	Date of Peak Flow	< 10 yr	Frequency Analysis Total Flow Rate (cfs)			> 100 yr
						10 year	25 year	100 year	
Orchard Hills (47)	1.19	0.10	0.63	6/27/2013		0.44	0.51	0.62	
Bromley (2B)	1.32	0.10	0.59	6/27/2013		0.51	0.57	0.66	
Dartmoor (2D)	9.10	0.50	6.51	6/27/2013		4.06	4.78	5.85	
Glen Leven (11+102)	11.80	0.30	3.61	4/11/2013		3.13	3.74	4.66	
Morehead (49M)	7.49	0.30	2.03	4/11/2013		1.78	2.06	2.46	
01A	3.58	0.20	0.72	4/11/2013		0.89	1.05	1.29	
10A	7.52	2.00	5.79	6/28/2013		5.14	5.74	6.61	
11B	17.86	1.40	4.05	6/27/2013		3.94	4.43	5.14	
12A	10.29	0.60	7.40	6/27/2013		5.03	6.11	7.70	
3B	37.68	1.50	6.33	6/27/2013		5.72	6.76	8.28	
5C	26.17	1.70	8.76	6/27/2013		7.53	8.69	10.42	
9B	9.11	1.70	3.66	6/10/2013		5.34	6.21	7.53	
9C	27.13	5.90	15.26	6/27/2013		14.20	15.64	17.67	
A1	12.11	1.10	6.30	6/27/2013		4.63	5.38	6.53	
B1	3.96	2.20	4.89	4/11/2013		6.60	7.68	9.25	
C1+C2	80.60	11.20	38.94	6/27/2013		31.82	34.89	39.16	
F1	20.28	1.20	7.77	6/27/2013		6.35	7.51	9.30	
G1	21.05	3.80	12.33	6/13/2013		13.52	15.49	18.51	

City of Ann Arbor
Sanitary Sewer Wet Weather Evaluation Project
Recurrence Interval of the April 11, 2013 Storm

Post-FDD System (shading indicates the recurrence interval range of the peak flow)

Meter ID	Pipe Capacity (cfs)	Avg Dry Flow (cfs)	Event Peak Flow (cfs)		Frequency Analysis Total Flow Rate (cfs)			
				< 10 yr	10 year	25 year	100 year	> 100 yr
Orchard Hills (47)	1.19	0.10	0.40		0.44	0.51	0.62	
Bromley (2B)	1.32	0.10	0.50		0.51	0.57	0.66	
Dartmoor (2D)	9.10	0.50	3.70		4.06	4.78	5.85	
Glen Leven (11+102)	11.80	0.30	3.60		3.13	3.74	4.66	
Morehead (49M)	7.49	0.30	2.00		1.78	2.06	2.46	
01A	3.58	0.20	0.70		0.89	1.05	1.29	
10A	7.52	2.00	4.00		5.14	5.74	6.61	
11B	17.86	1.40	3.70		3.94	4.43	5.14	
12A	10.29	0.60	4.60		5.03	6.11	7.70	
3B	37.68	1.50	3.80		5.72	6.76	8.28	
5C	26.17	1.70	7.10		7.53	8.69	10.42	
9B	9.11	1.70	3.60		5.34	6.21	7.53	
9C	27.13	5.90	12.50		14.20	15.64	17.67	
A1	12.11	1.10	4.20		4.63	5.38	6.53	
B1	3.96	2.20	4.90		6.60	7.68	9.25	
C1+C2	80.60	11.20	30.30		31.82	34.89	39.16	
F1	20.28	1.20	4.20		6.35	7.51	9.30	
G1	21.05	3.80	8.90		13.52	15.49	18.51	

City of Ann Arbor
Sanitary Sewer Wet Weather Evaluation Project
Recurrence Interval of the June 10, 2013 Storm

Post-FDD System (shading indicates the recurrence interval range of the peak flow)

Meter ID	Pipe Capacity (cfs)	Avg Dry Flow (cfs)	Event Peak Flow (cfs)	< 10 yr	Frequency Analysis Total Flow Rate (cfs)			> 100 yr
					10 year	25 year	100 year	
Orchard Hills (47)	1.19	0.10	0.30		0.44	0.51	0.62	
Bromley (2B)	1.32	0.10	0.30		0.51	0.57	0.66	
Dartmoor (2D)	9.10	0.50	3.20		4.06	4.78	5.85	
Glen Leven (11+102)	11.80	0.30	1.80		3.13	3.74	4.66	
Morehead (49M)	7.49	0.30	1.50		1.78	2.06	2.46	
01A	3.58	0.20	0.70		0.89	1.05	1.29	
10A	7.52	2.00	3.90		5.14	5.74	6.61	
11B	17.86	1.40	3.20		3.94	4.43	5.14	
12A	10.29	0.60	3.20		5.03	6.11	7.70	
3B	37.68	1.50	3.20		5.72	6.76	8.28	
5C	26.17	1.70	4.00		7.53	8.69	10.42	
9B	9.11	1.70	3.70		5.34	6.21	7.53	
9C	27.13	5.90	10.80		14.20	15.64	17.67	
A1	12.11	1.10	3.70		4.63	5.38	6.53	
B1	3.96	2.20	4.20		6.60	7.68	9.25	
C1+C2	80.60	11.20	24.10		31.82	34.89	39.16	
F1	20.28	1.20	4.20		6.35	7.51	9.30	
G1	21.05	3.80	12.30		13.52	15.49	18.51	

City of Ann Arbor
Sanitary Sewer Wet Weather Evaluation Project
Recurrence Interval of the June 27, 2013 Storm

Post-FDD System

(shading indicates the recurrence interval range of the peak flow)

Meter ID	Pipe Capacity (cfs)	Avg Dry Flow (cfs)	Event Peak Flow (cfs)	< 10 yr	Frequency Analysis Total Flow Rate (cfs)			> 100 yr
					10 year	25 year	100 year	
Orchard Hills (47)	1.19	0.10	0.60		0.44	0.51	0.62	
Bromley (2B)	1.32	0.10	0.60		0.51	0.57	0.66	
Dartmoor (2D)	9.10	0.50	6.50		4.06	4.78	5.85	
Glen Leven (11+102)	11.80	0.30	3.50		3.13	3.74	4.66	
Morehead (49M)	7.49	0.30	1.90		1.78	2.06	2.46	
01A	3.58	0.20	-		0.89	1.05	1.29	
10A	7.52	2.00	5.80		5.14	5.74	6.61	
11B	17.86	1.40	4.10		3.94	4.43	5.14	
12A	10.29	0.60	7.40		5.03	6.11	7.70	
3B	37.68	1.50	6.30		5.72	6.76	8.28	
5C	26.17	1.70	8.80		7.53	8.69	10.42	
9B	9.11	1.70	-		5.34	6.21	7.53	
9C	27.13	5.90	15.30		14.20	15.64	17.67	
A1	12.11	1.10	6.30		4.63	5.38	6.53	
B1	3.96	2.20	-		6.60	7.68	9.25	
C1+C2	80.60	11.20	39.00		31.82	34.89	39.16	
F1	20.28	1.20	7.80		6.35	7.51	9.30	
G1	21.05	3.80	-		13.52	15.49	18.51	

City of Ann Arbor
Sanitary Sewer Wet Weather Evaluation Project
Recurrence Interval of the August 12, 2013 Storm

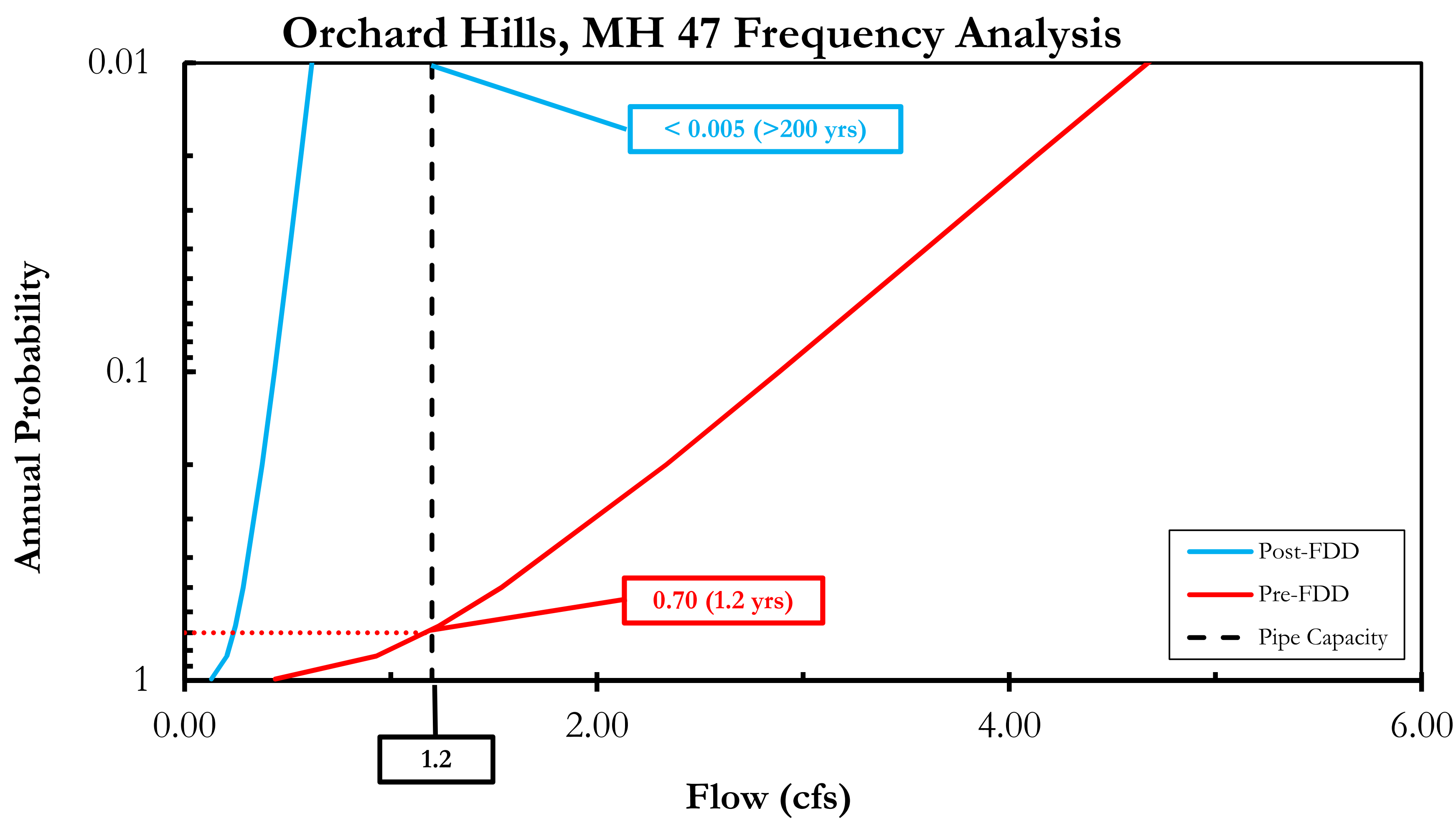
Post-FDD System (shading indicates the recurrence interval range of the peak flow)

Meter ID	Pipe Capacity (cfs)	Avg Dry Flow (cfs)	Event Peak Flow (cfs)		Frequency Analysis Total Flow Rate (cfs)			
				< 10 yr	10 year	25 year	100 year	> 100 yr
Orchard Hills (47)	1.19	0.10	0.20		0.44	0.51	0.62	
Bromley (2B)	1.32	0.10	0.40		0.51	0.57	0.66	
Dartmoor (2D)	9.10	0.50	2.70		4.06	4.78	5.85	
Glen Leven (11+102)	11.80	0.30	1.50		3.13	3.74	4.66	
Morehead (49M)	7.49	0.30	1.20		1.78	2.06	2.46	
01A	3.58	0.20	-		0.89	1.05	1.29	
10A	7.52	2.00	3.20		5.14	5.74	6.61	
11B	17.86	1.40	2.90		3.94	4.43	5.14	
12A	10.29	0.60	2.10		5.03	6.11	7.70	
3B	37.68	1.50	4.20		5.72	6.76	8.28	
5C	26.17	1.70	7.00		7.53	8.69	10.42	
9B	9.11	1.70	-		5.34	6.21	7.53	
9C	27.13	5.90	11.20		14.20	15.64	17.67	
A1	12.11	1.10	3.20		4.63	5.38	6.53	
B1	3.96	2.20	-		6.60	7.68	9.25	
C1+C2	80.60	11.20	16.00		31.82	34.89	39.16	
F1	20.28	1.20	3.80		6.35	7.51	9.30	
G1	21.05	3.80	-		13.52	15.49	18.51	

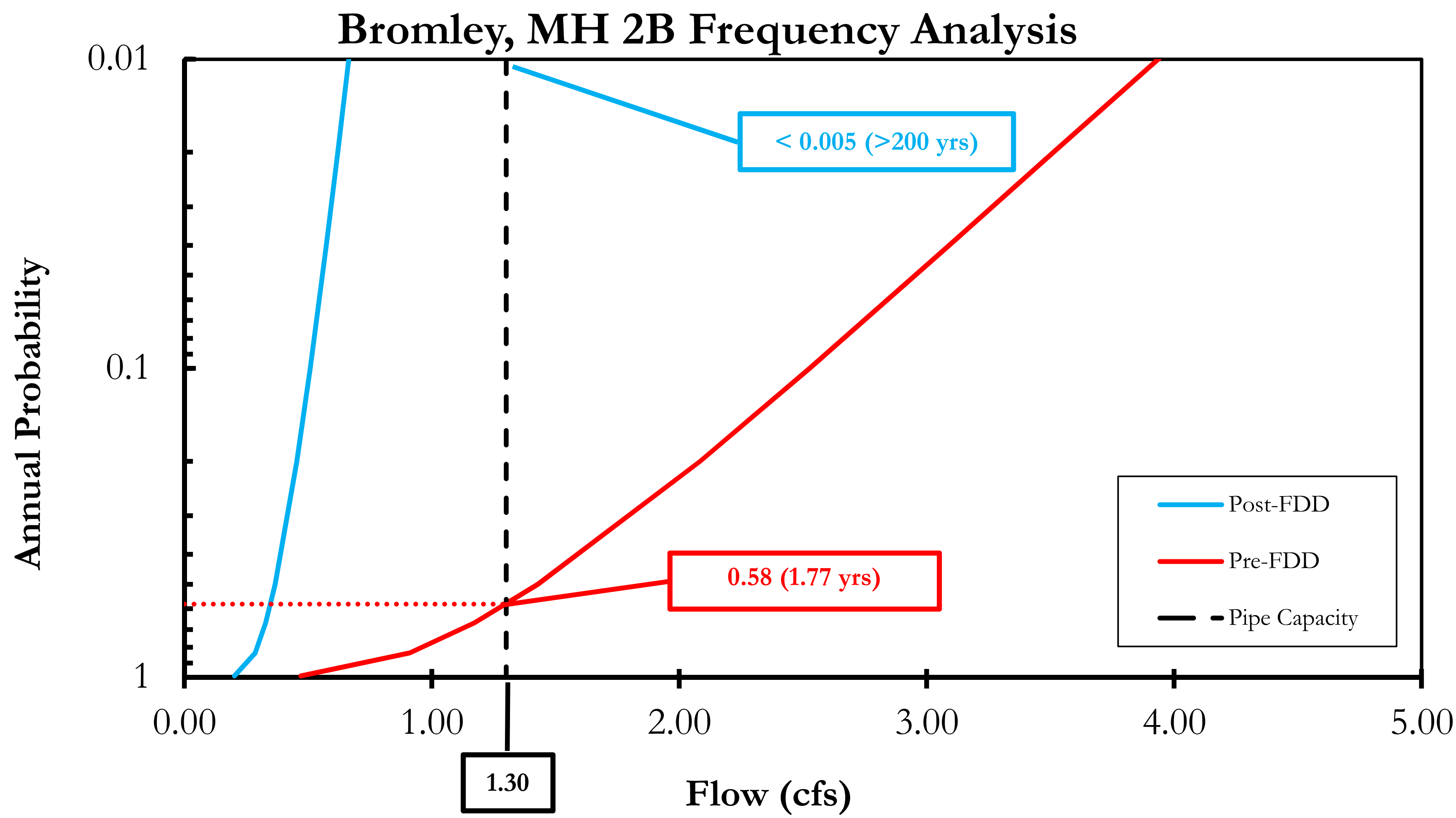
Appendix N
Return Period of Pipe Capacity in Priority Districts

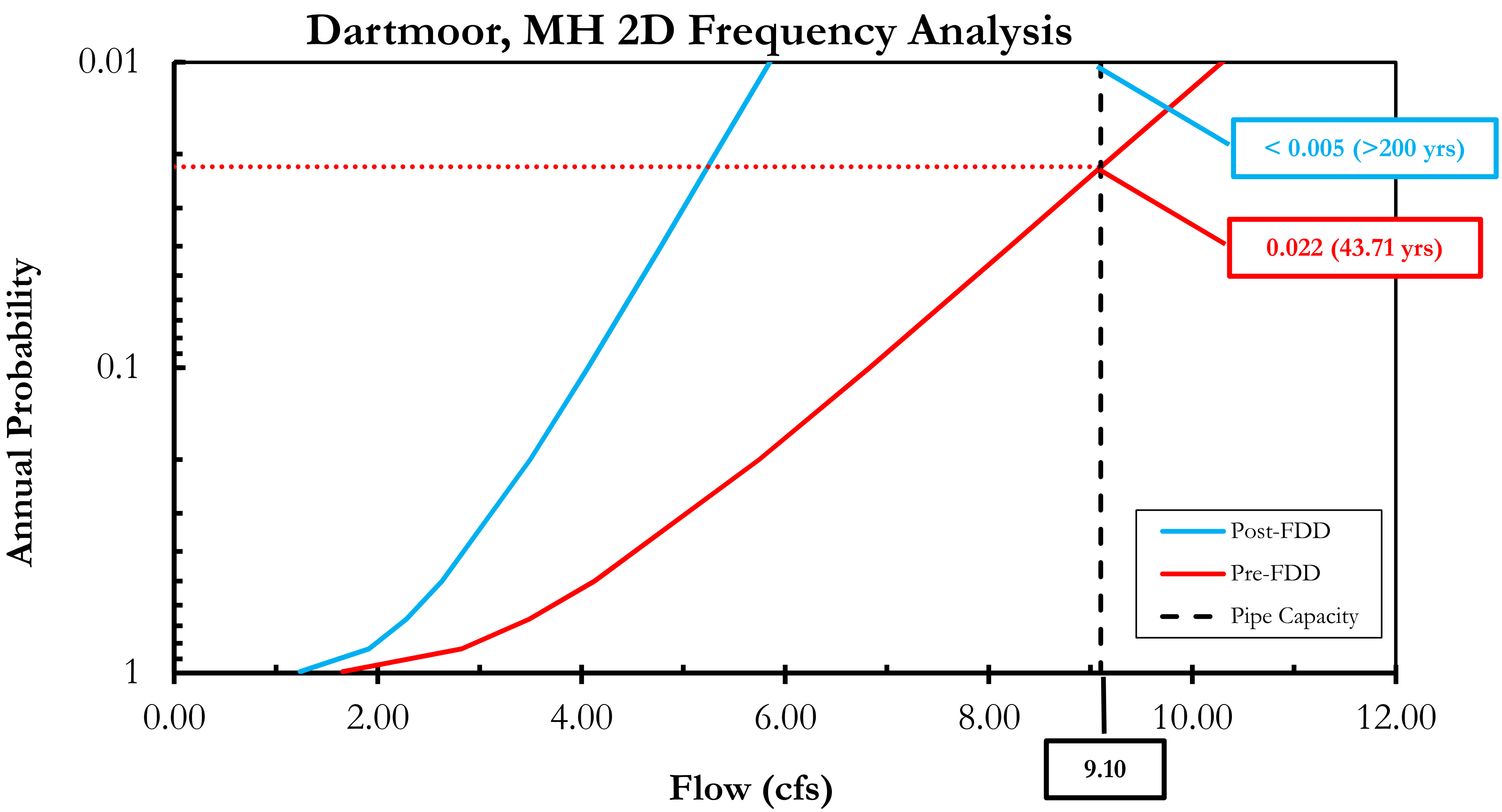
Frequency Analysis - Priority Districts Pre & Post FDD

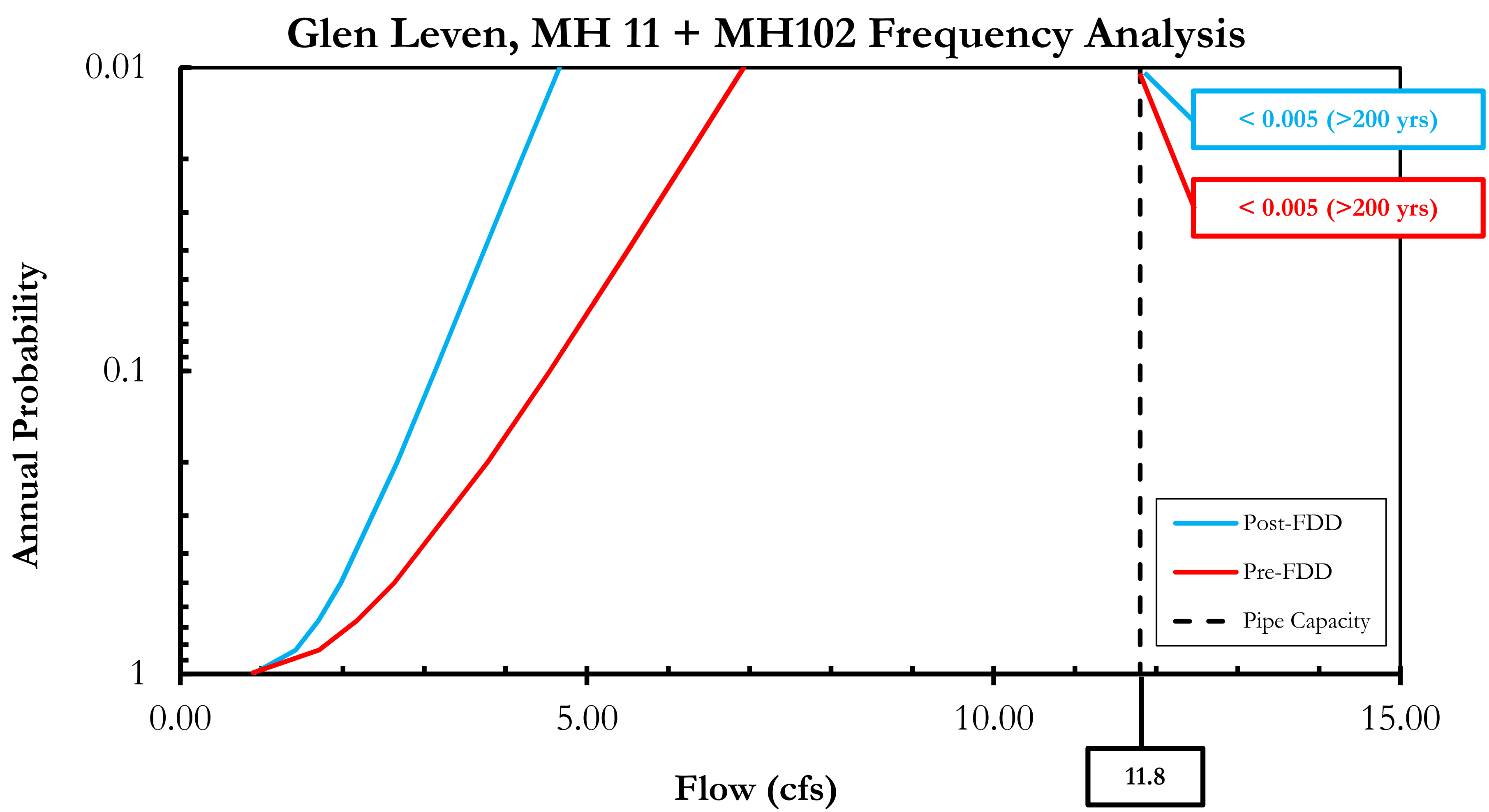
Meter	Pipe Capacity (cfs)	Pre-FDD Return Period (yrs)	Post-FDD Return Period (yrs)
Orchard Hills (MH47)	1.2	**1.20**	> 200
Bromley (MH2B)	1.3	**1.77**	> 200
Dartmoor (MH2D)	9.1	**43.71**	> 200
Glen Leven (MH11+MH102)	11.8	**> 200**	> 200
Moorhead (MH49M)	7.5	**26.09**	> 200



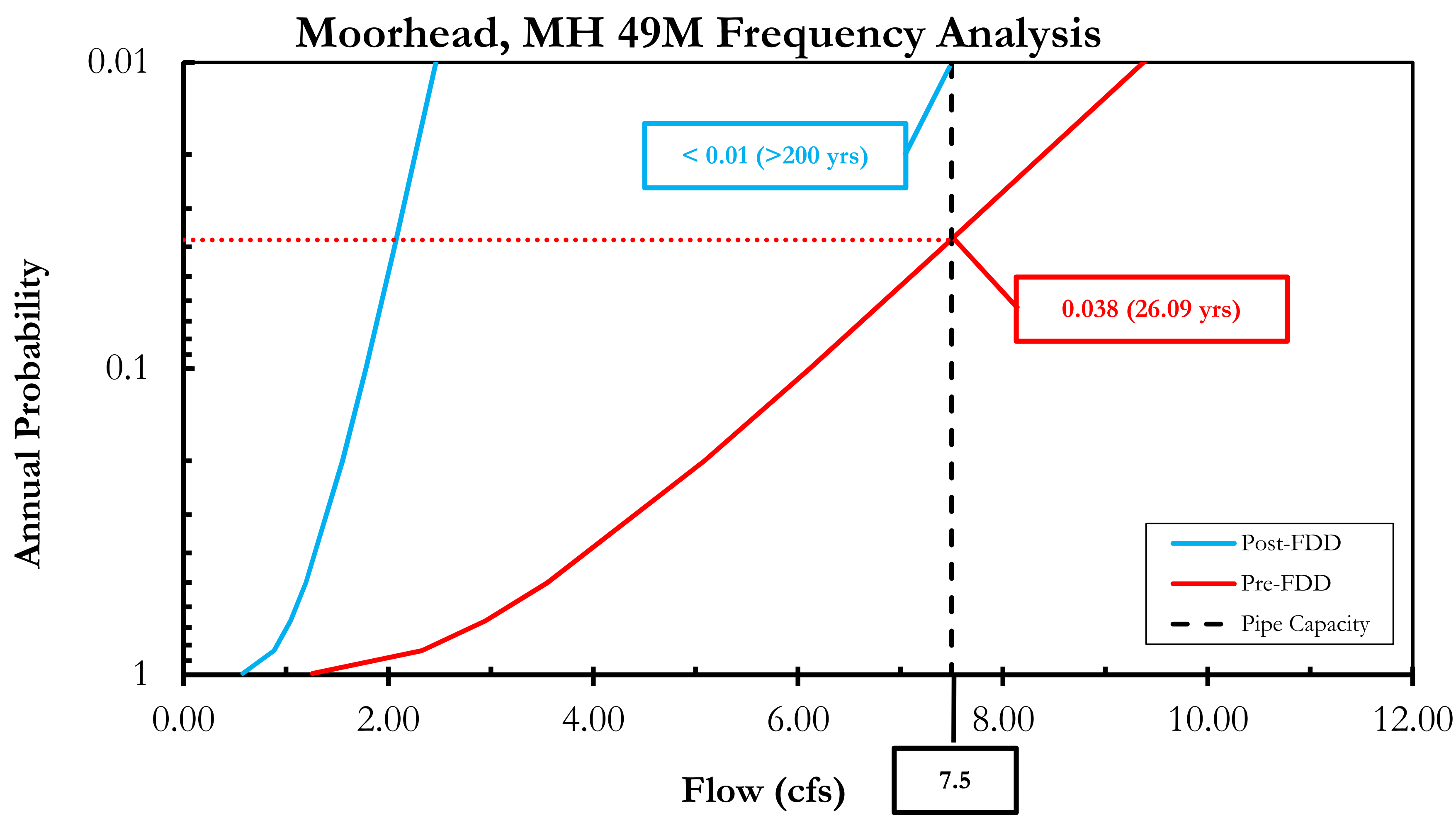
Orchard Hills, MH 47 Frequency Analysis
Annual Probability
0.01
0.1
1
0.00
2.00
4.00
6.00
Flow (cfs)
< 0.005 (>200 yrs)
0.70 (1.2 yrs)
1.2
Post-FDD
Pre-FDD
Pipe Capacity


Bromley, MH 2B Frequency Analysis
Annual Probability
0.01
0.1
1
0.00
1.00
2.00
3.00
4.00
5.00
Flow (cfs)
1.30
< 0.005 (>200 yrs)
0.58 (1.77 yrs)
Post-FDD
Pre-FDD
Pipe Capacity


Dartmoor, MH 2D Frequency Analysis
0.01
0.1
1
Annual Probability
0.00
2.00
4.00
6.00
8.00
10.00
12.00
Flow (cfs)
9.10
< 0.005 (>200 yrs)
0.022 (43.71 yrs)
Post-FDD
Pre-FDD
Pipe Capacity



Glen Leven, MH 11 + MH102 Frequency Analysis
Annual Probability
0.01
0.1
1
0.00
5.00
10.00
15.00
Flow (cfs)
11.8
< 0.005 (>200 yrs)
< 0.005 (>200 yrs)
Post-FDD
Pre-FDD
Pipe Capacity


Moorhead, MH 49M Frequency Analysis
Annual Probability
0.01
0.1
1
Flow (cfs)
0.00
2.00
4.00
6.00
8.00
10.00
12.00
< 0.01 (>200 yrs)
0.038 (26.09 yrs)
7.5
Post-FDD
Pre-FDD
Pipe Capacity

City of Ann Arbor
Sanitary Sewer Wet Weather Evaluation

Volume 3: Flow Component Report

October 2014

OHM Advisors is a firm of architects, engineers and planners committed to Advancing Communities. Leaders rely on our proven public and private sector expertise, insightful counsel and forward thinking to create thriving places for people.

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Abbreviations

AMM: Antecedent Moisture Model
cfs: cubic feet per second
DCI: Domestic, Commercial and Industrial Flow
DWF: Dry Weather Flow
FDD: Footing Drain Disconnection
GIS: Geographic Information Systems
gpcd: gallons per capita per day
gpm: gallons per minute
GWI: Ground Water Infiltration
I/I: Inflow and Infiltration
RDII: Rainfall Dependent Inflow and Infiltration
REU: Residential Equivalent Unit
SSWWE: Sanitary Sewer Wet Weather Evaluation
SWMM: Storm Water Management Model
WWTP: Wastewater Treatment Plant

Overview

In 2012 the City initiated a Sanitary Sewer Wet Weather Evaluation (SSWWE) project specifically intended to address the following objectives:

- Evaluate the effectiveness of the footing drain disconnection (FDD) program
- Assess the risk of future basement sanitary sewer backups
- Evaluate alternatives moving forward
- Engage the public throughout the process

A comprehensive flow metering plan was implemented in 2013. The flow metering task included 30 flow meters, 20 peak stage recorders, and 5 rain gages, resulting in 55 monitoring sites. The raw data, collection process, and rigorous quality control procedures can be found in the April 2014 Volume 1: Flow Metering Report.

The May 2014 Volume 2: Flow Evaluation Report addresses the goal of assessing and quantifying the effectiveness of flow removal due to footing drain disconnection (FDD), as well as summarizing the current flow and expected future flow rates throughout the system.

Report Objective

The objective of the report is to estimate the production rates from the remaining potentially connected footing drains in the City of Ann Arbor. To do this we need to divide the flow meter data into its flow components. An estimate of the non-footing drain I & I flows needs to come from an established relationship between the meter district physical components and the meter data. An outline of this methodology is included in Appendix A.

Given the potential for significant capital expenditures to address hydraulic issues within the system, it is important to have an understanding of all the flow components that contribute to the sewer system in order to manage the system, prevent overloading of the pipes and the wastewater treatment plant (WWTP) and evaluate alternatives moving forward. We anticipate the production rates of the FDD flows will be useful when considering FDD as a future alternative or for considering a developer offset mitigation.

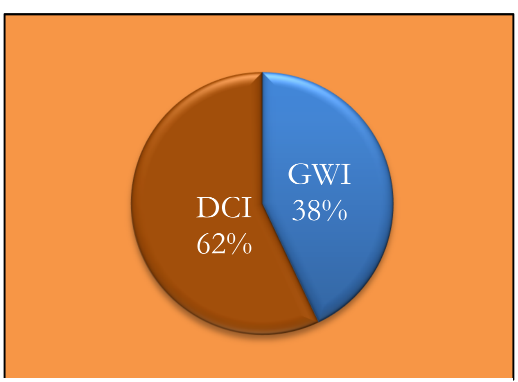


Figure 1: Dry Weather Flow Components

The dry weather flow (DWF) is the wastewater that is flowing in the sewer system when it is not raining. It is comprised of the domestic, commercial and industrial (DCI) sewage flow and the base flow ground water infiltration (GWI). The groundwater enters the sanitary system through damaged pipe sections, leaky joints, poor manhole connections or footing drain flows during dry weather. During dry weather, 38% of the wastewater treated at the Ann Arbor WWTP is from ground water infiltration. It is not uncommon for 25 – 50% of sanitary sewer system flows to come from GWI.

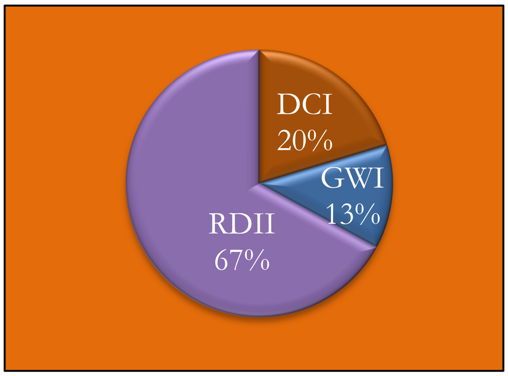


Figure 2: Wet Weather Flow Components

The wet weather flow is the increased sanitary flow rate from rainfall events. It is composed of the DWF and rainfall dependent infiltration and inflow (RDII), which enters the sanitary system through direct connection of downspouts, sump pumps, footing drains and illicit storm sewer connections.

During a storm event the RDII contributes, on average, 67% of the flow treated at the WWTP. The RDII components vary across the sewer system, and are dependent on many factors including number of footing drains connected; length, size and age of sewers; and soils, elevations, antecedent moisture soil conditions. The priority districts were originally selected for footing drain removal because the areas experienced frequent basement backups, and the meter data indicated that there was high RDII in these areas.

Going forward, the City of Ann Arbor will need to consider the benefit of removing the estimated remaining 18,000 footing drain connections versus other forms of RDII control. To assist the City in assessing the effectiveness of the RDII control alternatives, an evaluation of the footing drain peak flow production rates by metering district was prepared utilizing the 2013 flow metering data.

Meter District Characteristics

In order to evaluate the flow contribution components, it is necessary to define the characteristics of each meter subdistrict. The meter subdistrict boundaries were established by identifying the location of the meter from Martin Controls flow meter installation sheets. The incremental areas were then defined using the sanitary sewer geographic information system (GIS). These areas were compared and confirmed using the SWMM model areas. Differences between the GIS and SWMM model areas were reviewed with the City.

The new meter subdistrict shapefiles were intersected with the following data:

- 2010 Census population
- SEMCOG TAZ 2010 population projections
- SEMCOG land use

- Ann Arbor FDD shapefiles

These intersects provide the incremental meter district characteristics. Tables of these intersects are provided in Appendix B.

Dry Weather Flow Components

The typical dry weather flow rate for each meter was determined as part of the flow metering analysis. A 14-day dry period in 2013 was analyzed to determine the average flow rate, nightly minimum flow rate and the peak flow rate for each meter district. The minimum flow rate usually occurs at about 4:00 am. The peak flow rate usually occurs during the morning between 7:00 and 9:00 am. Figure 3 is a plot of Meter 9C; it illustrates a typical dry weather diurnal pattern.

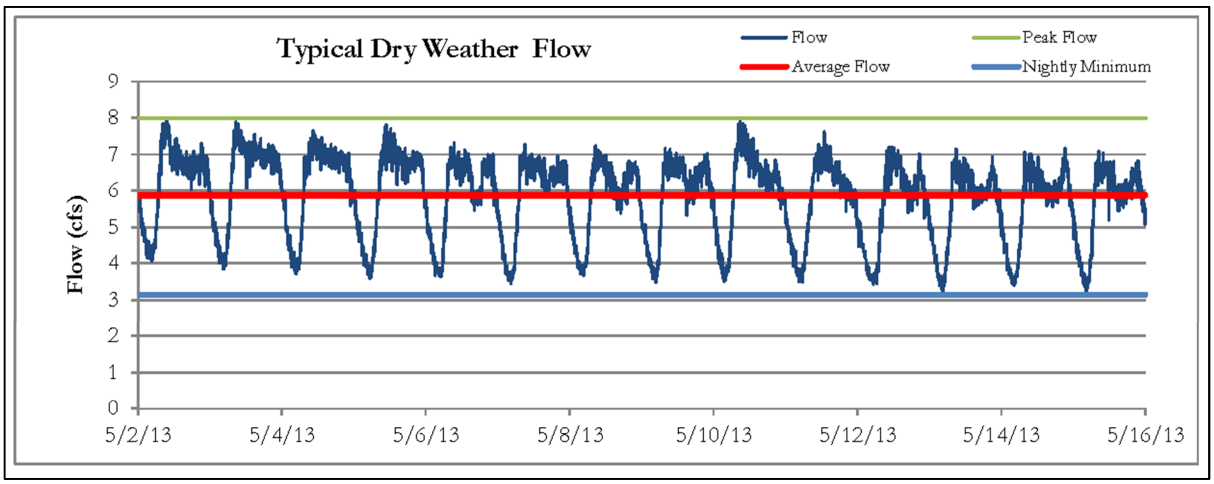


Figure 3: Typical Dry Weather Flow

The dry weather flow is comprised of the DCI sewage flow and the GWI. In residential areas the GWI is assumed to be 90% of the minimum nighttime flow rate to account for small rates of DCI flow in the middle of the night. In the plant area is a very large meter district that contains 31,239 residents, 17,116 employees and U of M Hospital and Veterans Hospital as well as U of M University Housing. For this area the DCI was estimated using the number of hospital beds, students, residential population and employment. The resulting GWI of 38% is consistent with the city average metered minimum nighttime flow rate. The DCI calculation is included in Appendix C

Table 1 is a summary of the average dry weather flow rates broken down into the DCI and GWI components for each meter district. The average GWI for all meter districts is 38% of the dry weather flow; however, it varies across the WWTP service area. This is due to variation in ground water conditions and sewer system age. Pump station connection minimum nightly flow is 0 due to pump cycles; therefore, it was estimated that the GWI to be equal to the minimum GWI in the system for these districts. The meter district boundaries are shown on Figure 5 for reference.

Table 1: Cumulative Dry Weather Flow Components

Meter District	Dry Weather Flow Rate DWF (cfs)	Domestic Commercial Industrial Flow Rate DCI (cfs)	Ground Water Infiltration GWI (cfs)	% DCI	% GWI
MH 2B (Bromley)	0.10	0.07	0.03	74%	26%
MH 47 (Orchard Hills)	0.10	0.08	0.02	82%	18%
5C	1.70	1.04	0.66	61%	39%
3B	1.50	1.19	0.31	79%	21%
E1	0.30	0.17	0.13	56%	44%
1A	0.36	0.25	0.11	70%	30%
PS-Jackson	0.96	0.94	0.03	97%	3%
D1	0.56	0.39	0.17	70%	30%
B1	2.20	1.01	1.19	46%	54%
MH 49D	0.30	0.24	0.06	79%	21%
MH 2D (Dartmoor)	0.50	0.39	0.11	79%	21%
A1	1.10	0.73	0.37	67%	33%
MH 11 (Glen Leven)	0.10	0.08	0.02	78%	23%
MH 102 (Glen Leven)	0.20	0.17	0.03	87%	13%
12A	0.60	0.38	0.22	63%	37%
F1+9B	2.43	1.30	1.13	54%	46%
F1	1.20	0.62	0.58	52%	48%
C1+C2	11.20	6.24	4.96	56%	44%
MH 49M (Morehead)	0.30	0.22	0.08	72%	28%
11B	1.40	0.95	0.45	68%	32%
Pitt-6	0.70	0.46	0.24	66%	34%
Pitt-7	0.12	0.08	0.04	70%	30%
10A	2.00	0.97	1.03	49%	51%
9B	1.70	0.91	0.79	54%	46%
9C	5.90	3.06	2.84	52%	48%
G1	3.80	2.56	1.24	67%	33%
Plant	29.70	17.98	11.72	61%	39%

Priority Meter Districts - Post FDD
Total of all districts metered at the water treatment plant

Wet Weather Flow Components

The total rate of RDII from the meter districts was established from the flow metering and subsequent modeling to develop design-event rates of RDII. This analysis is presented in the Flow Evaluation Report dated April 2014.

The 25-year return frequency was selected to further evaluate the wet weather components of the system. For the few meter districts not analyzed using the AMM model, the 25-year flow rate return frequency flow rates were estimated using a ratio of adjacent meters flow rates for the 2013 storm events.

The dry weather flow rate was subtracted from the 25-year return frequency flow rate to yield the wet weather RDII component of the wastewater. The next challenge was to develop a methodology divide the RDII into two components: 1) footing drain connections and 2) other non-footing drain I & I.

Flow evaluation of the FDD program focused on five priority districts where FDDs occurred and flow meter data was available for the period before and after the FDD. This analysis resulted in a RDII contribution for each footing drain in the priority districts. Table 2 is the flow removal per footing drain disconnection in these districts, from the Flow Evaluation Report.

Table 2: Flow Removal Results - Peak Flow per FDD

Subdistrict	2013 Largest Storm Flow per FDD (gpm)	25-Year Design Storm Flow per FDD (gpm)
Orchard Hills	2.53	4.75
Bromley	3.54	4.80
Moorhead	3.92	6.31
Dartmoor	3.67	4.81
Glen Leven	1.07	1.21
Average	2.94	4.38

Inch-Miles Correlation

To determine the footing drain flow contributions for the remaining meter districts, the 25-year RDII per inch mile of sewer was compared to the number of equivalent footing drain connections per acre. Sewer system GIS was used to determine the inch mile of sewer by multiplying the diameter of the pipe by its length in miles. The RDII was unitized using inch mile to incorporate development density and interceptor contributions into the analysis.

As shown in Figure 4, there is a good correlation between inch-miles of pipe and RDII. For meter districts with few footing drain connections the RDII does not go to zero because there are other I & I sources that remain after 100% of footing drains are disconnected. Therefore, for meter districts with a low number of footing drain connections, this correlation demonstrates a minimum I & I from non-footing drain sources of approximately 0.0079 cfs/inch mile for non-footing drain RDII sources.

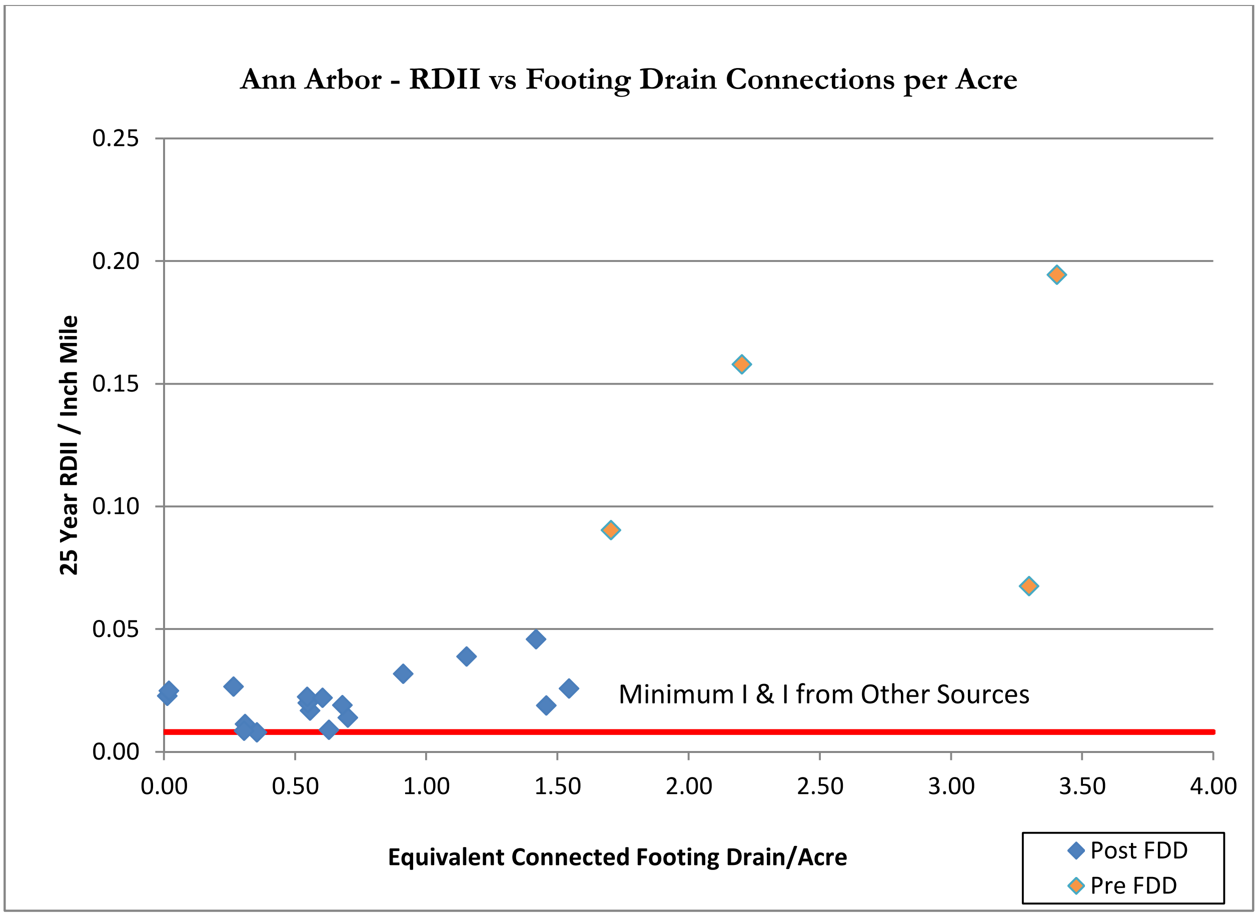


Figure 4: RDII vs. Equivalent Footing Drain Connections per Acre

This correlation, to estimate the non-footing drain I&I flow for the rest of the districts, was used as a basis for providing each district to split the total RDII between footing drain and non-footing drain sources. We can then use the portion generated from footing drain flows to compute the production rate per house and compare the district.

It is important to note that due to variation in I & I from other sources, the footing drain contributions per meter district may be less than provided in Table 3. The accuracy of the analysis is always going to be limited by the ability to estimate the split between footing drain and non-footing drain sources.

The inch mile of sewer and estimated count of potentially connected equivalent footing drains in each district was then used to determine the footing drain production rate range in each district. The satellite communities are included in the analysis as tributary areas to the meter districts. The detailed incremental and cumulative meter district characteristics and RDII determination are provided in Appendix B. Table 3 presents a summary of the range of footing drain flow rates for each meter district. The incremental footing drain flow rate calculations are provided in Appendix D.

Table 3: 25-Year Incremental Meter District RDII

Incremental Meter District	I & I Per Footing Drain (gpm)
MH 2B (Bromley)*	4.8
MH 47 (Orchard Hills)*	4.8
5C	1.7
3B	1.6
E1	0.1
1A	1.0
PS-Jackson	0.8
D1	0.9
B1	1.5
MH 49D	1.3
MH 2D (Dartmoor)*	4.8
A1	2.6
MH 11 & MH102* (Glen Leven)	1.2
12A	2.8
F1+9B	2.2
F1	2.0
C1+C2	1.5
MH 49M (Morehead)*	1.6
11B	0.5
Pitt-6	0.8
Pitt-7	0.8
10A	0.6
F1+9B	2.2
9B	0.1
9C	1.1
G1	2.4
Plant (Incremental)**	1.2
Whole System Average	1.7

Priority Meter Districts - Post FDD
Total of all districts metered at the water treatment plant

*Note: Priority district values taken from April 2014 Flow Evaluation Report. With the exception of Morehead where the remaining footing drain contribution was estimated.
**Note: Plant (Incremental) includes the flow that is metered at the WWTP that enters the system downstream of meters G1, 9C, C1, C2, 1A, 3B, 5C and the Pittsfield meters.

Results

Removal of RDII from the sewer system is an option to prevent sanitary sewer overflows and to make more efficient use of the WWTP. The percentage of each wet weather component is given in Table 4 for each meter. Evaluation of future FDDs should consider these estimated footing drain production rates in evaluating the effectiveness of future flow removals.

Table 4: Cumulative 25-Year Flow Components by Meter District

Meter District	25-Year (cfs)	DCI	GWI	Other I & I	Footing Drain Wet Weather
MH 2B (Bromley)*	0.57	13%	5%	79%	4%
MH 47 (Orchard Hills)*	0.51	16%	4%	78%	2%
5C	8.69	12%	8%	32%	49%
3B	6.76	18%	5%	28%	50%
E1	0.90	19%	15%	63%	4%
1A	1.05	24%	10%	66%	0%
PS-Jackson	3.26	29%	1%	69%	1%
D1	1.54	26%	11%	21%	43%
B1	7.68	13%	15%	22%	49%
MH 49D	2.06	11%	3%	27%	58%
MH 2D (Dartmoor)*	4.78	8%	2%	38%	51%
A1	5.38	14%	7%	38%	42%
MH 11 (Glen Leven)*	5.34	1%	0%	90%	9%
MH 102 (Glen Leven)*	1.60	11%	2%	45%	42%
12A	6.11	6%	4%	22%	68%
F1+9B	8.87	15%	13%	20%	53%
F1	7.51	8%	8%	17%	67%
C1+C2	34.89	18%	14%	39%	29%
MH 49M (Morehead)*	2.06	11%	4%	30%	55%
11B	4.43	22%	10%	48%	20%
Pitt-6	2.12	22%	11%	39%	28%
Pitt-7	0.37	23%	10%	56%	11%
10A	5.74	17%	18%	61%	4%
9B	6.21	15%	13%	30%	42%
9C	15.64	20%	18%	55%	7%
G1	15.49	17%	8%	31%	44%
Whole System	90.13	20%	13%	48%	19%

Priority Meter Districts - Post-FDD Percentage. Pre-FDD percentages ranged from 70-90% of peak flow.

Total of all districts metered at the water treatment plant

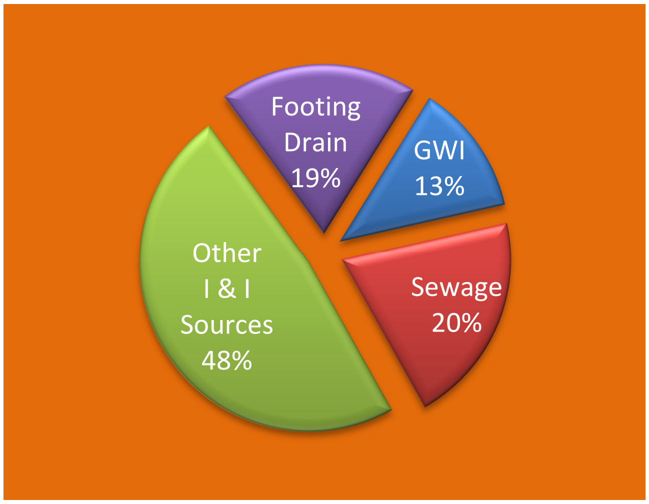


Figure 5: Ann Arbor Flow Component Summary

Figure 5 is a pie graph illustrating the flow component analysis results for the city of Ann Arbor. The RDII from footing drain flow contributions are 19% of the total peak flow, and RDII from non-footing drain sources are 48% of flow treated at the WWTP.

The flow components at each meter are shown in Figure 6 below. The stacked bar graph illustrates how the flow components distribution varies across the city. Certain meter districts have a much higher percentage of footing drain contribution than the city does as a whole.

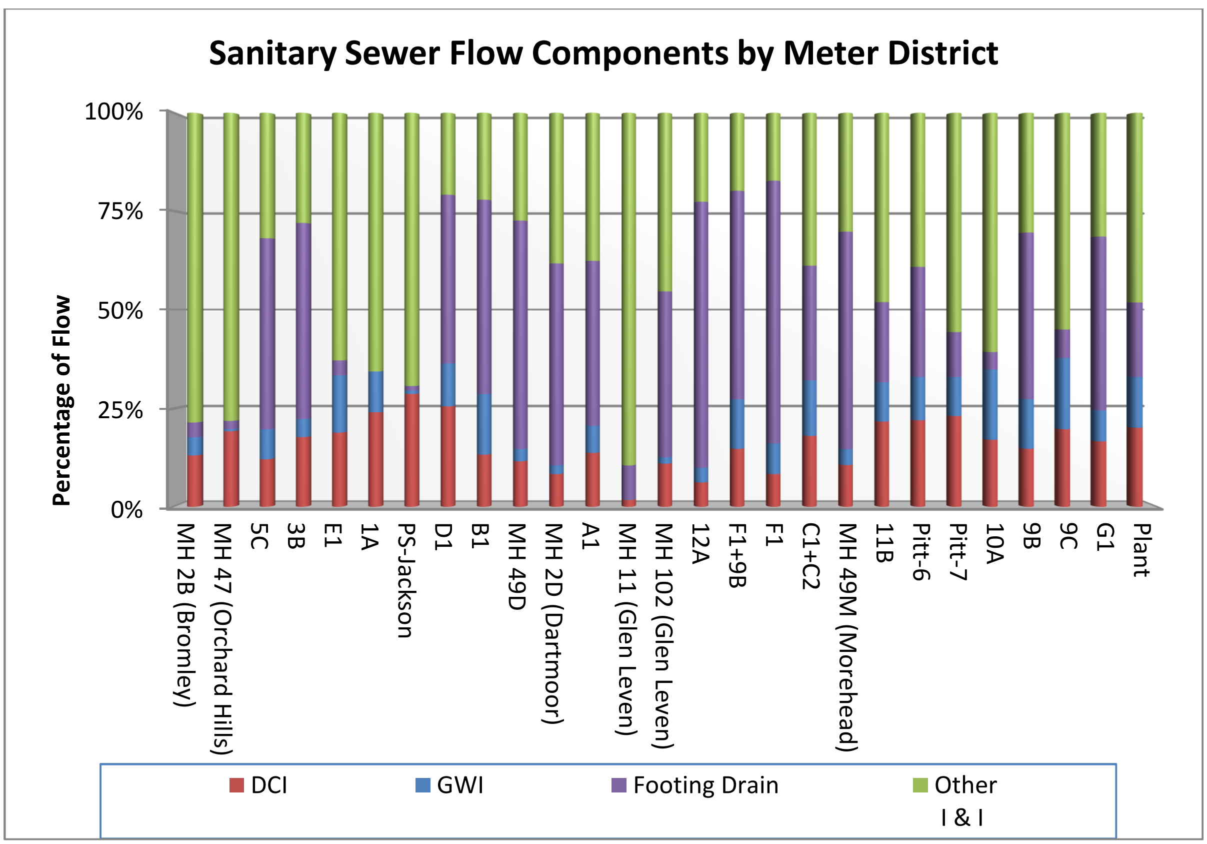


Figure 6: Flow Components by Cumulative Meter District

Figure 7 is the sanitary meter district map which illustrates the meter locations and the incremental tributary areas. There are large areas of the sewer system with relatively low production from footing drain connections. In these areas shown in green on Figure 8, the flow rate contribution is less than 1 gpm per footing drain for the 25-year recurrence interval flow. The areas with the highest production rates were in the target districts. There are several pockets in the city where there are medium (1-2 gpm) and high (2-3 gpm) production rates.

The parcels with potentially connected footing drains are shown in Figure 9. There are concentrated areas of footing drain connections in large meter districts. More discrete metering would be required to determine the footing drain flow rates for these areas.

Conclusions

The analyses performed showed that the remaining footing drains potentially connected to the City's sanitary sewer system comprise 19% of the total peak flow in the system. The remaining 81% is from domestic, commercial and industrial sewage (20%), ground water infiltration (13%) and other sources of I & I (48%). Although City-wide, only 19% of peak flows are from footing drains, the value in each district varies tremendously from 1% to 85% depending on the density of potentially connected footing drains present and the production rate of those foot drains.

As discussed in Volume 2: Flow Evaluation Report the footing drain disconnects reduced flow in several of the priority districts by 70 – 90%. This reduction in wet weather flow significantly reduced the risk of sanitary basement backups. For example, the percentage of flow attributed to footing drains in the Orchard Hills priority district was 90% Pre-FDD and is now 2% Post -FDD.

The analyses performed also estimated the peak production rate from footing drains for a 25-year frequency flow for each meter district. This analysis showed that the average production rates of the remaining footing drains is 1.7 gpm per footing drain. Although the City-wide average is only 1.7 gpm, the value in each district varies tremendously from 0.1 gpm to 6.3 gpm. Given that several of the priority district production rates were in the range of 4-6 gpm, this shows that the City did a good job of selecting the priority districts for footing drain disconnection. This conclusion is not surprising, given the high incidence of sanitary basement backup in these areas prior to footing drain disconnection.

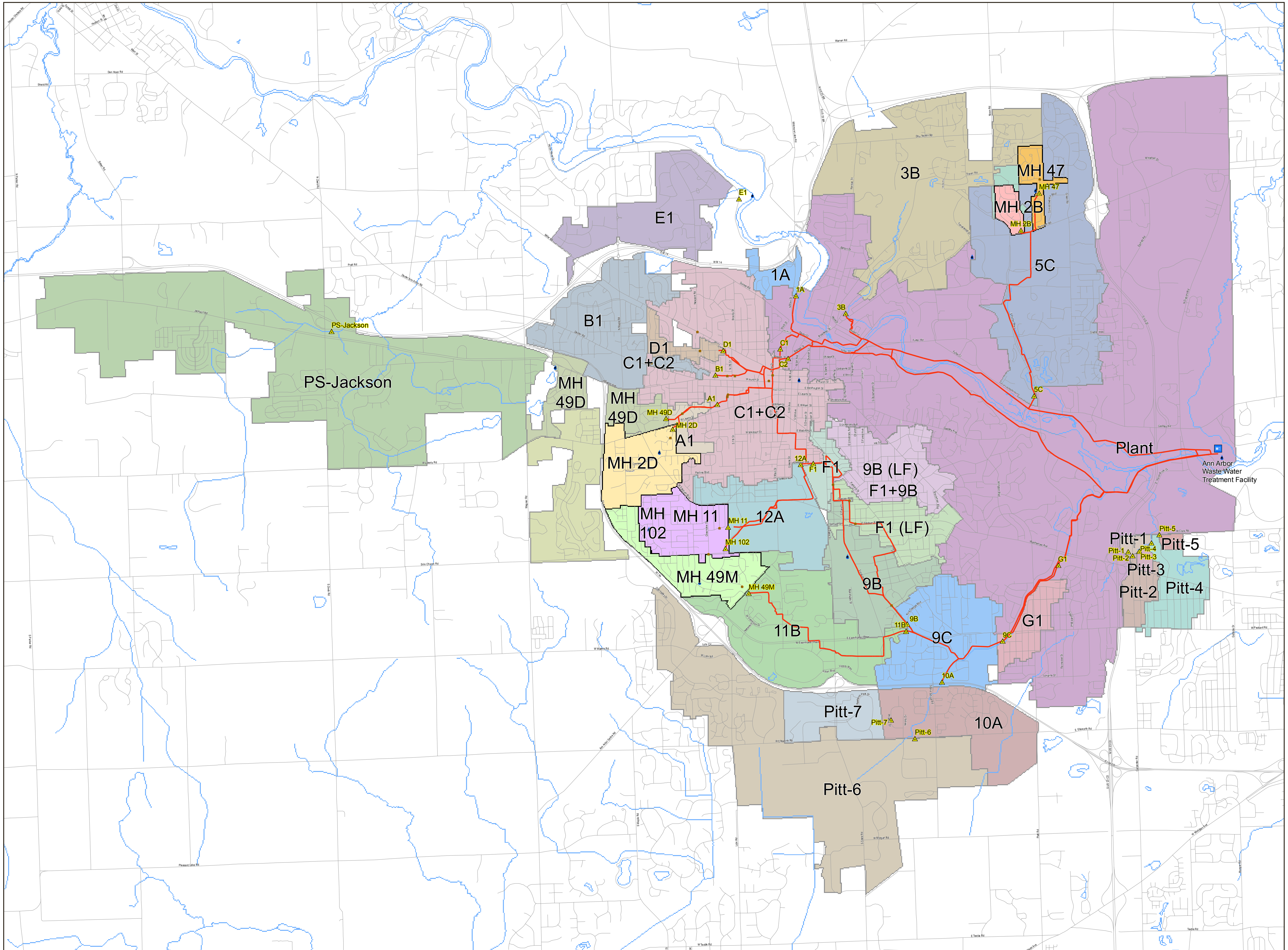
Based on these findings, we recommend the following:

1. Neighborhoods within large meter districts may have higher footing drain production rates than estimated due to being lumped together with multiple neighborhoods. If sewer system backups are occurring, discrete metering is recommended to determine if footing drain disconnect would provide the desired relief. This may be the case for the Pittsfield Valley area.
2. The City should consider the footing drain production rates within each district when evaluating alternatives or considering the impact of footing drain disconnections for developer offset mitigation.

FIGURE # 7

Ann Arbor Sanitary Meter District Map

CITY OF ANN ARBOR
06.23.2014



Legend

Meter

- 10A
- 11B
- 12A
- 1A
- 3B
- 5C
- 9B
- 9B (LF)
- 9C
- A1
- B1
- C1+C2
- D1
- E1
- F1
- F1 (LF)
- F1+9B
- G1
- MH 102
- MH 11
- MH 2B
- MH 2D
- MH 47
- MH 49D
- MH 49M
- PS-Jackson
- Pitt-1
- Pitt-2
- Pitt-3
- Pitt-4
- Pitt-5
- Pitt-6
- Pitt-7
- Plant

Rain Gauges

WWTP

Meter

PSR

Interceptor

0 2,000 4,000 6,000 8,000 Feet

Source: Data provided by Washtenaw County and the City of Ann Arbo. Orchard, Hiltz and McCliment does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 IntlFeet

Path: P:\0000_0100\0028130011_A2_Sanitary_Sewer_Evaluation\GIS\Maps\Subdistrict Maps\Meter District Map 11x17.mxd

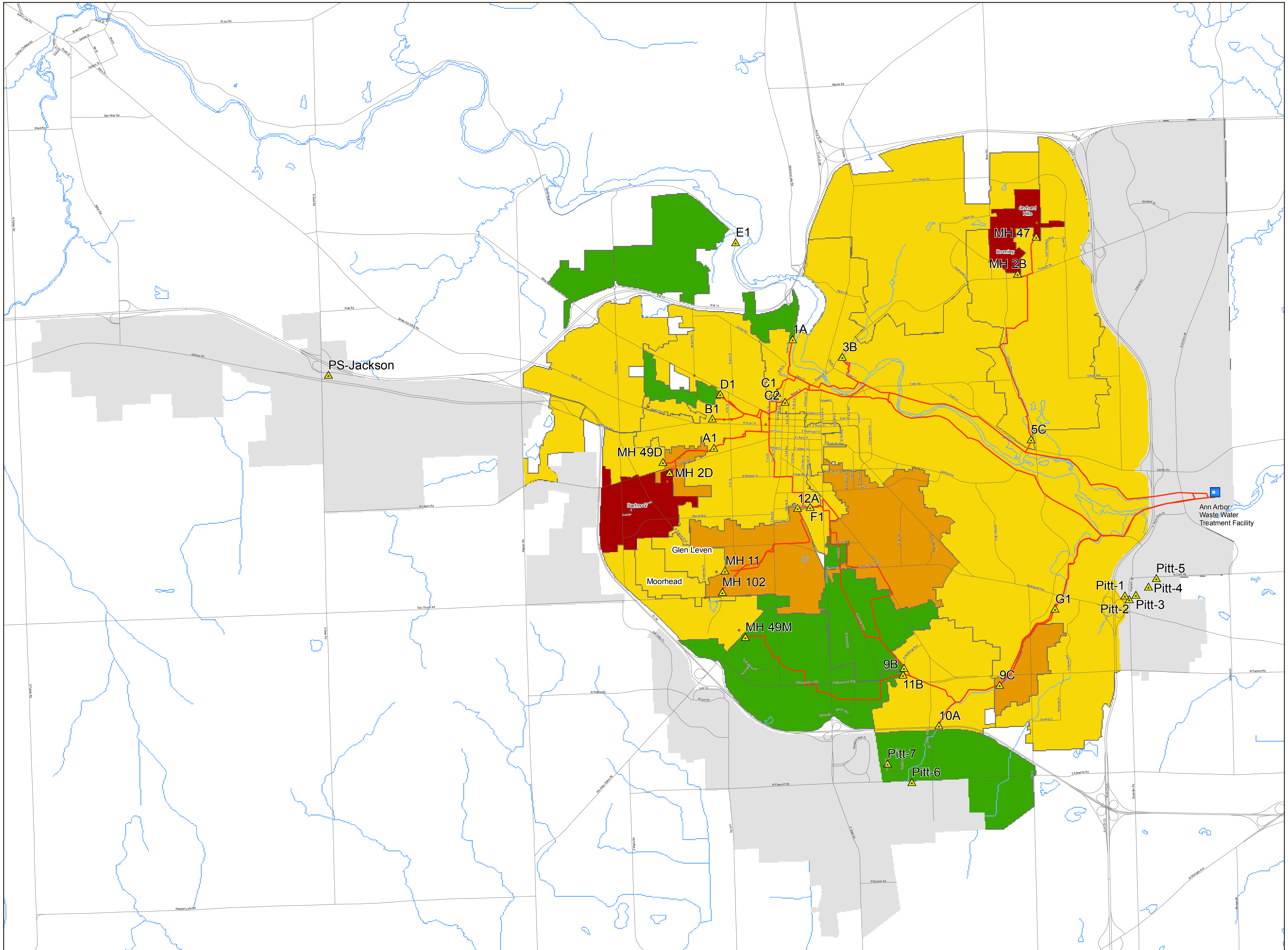


FIGURE # 8

Ann Arbor Footing Drain Flow Rate

CITY OF ANN ARBOR
09.26.2014

Legend

Meter

WWTP

Contract Customer

Footing Drain (gpm)

0.0 - 1.0

1.0 - 2.0

2.0 - 3.0

> 3.0

0 2,000 4,000 6,000 8,000 Feet

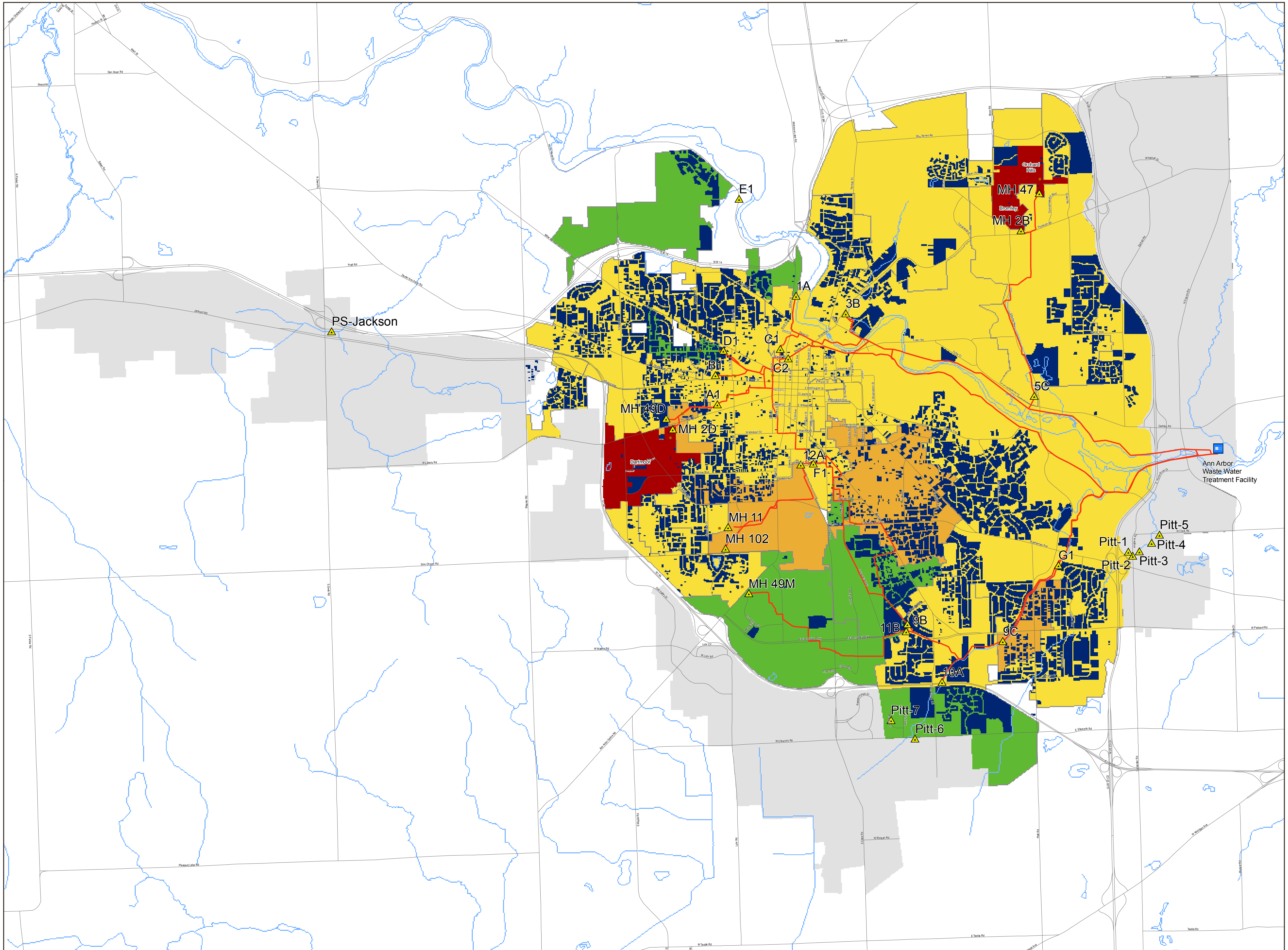
Source: Data provided by Washtenaw County and the City of Ann Arbro. Orchard, Hiltz and McCliment does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 IntlFeet

FIGURE # 9

Ann Arbor Connected Footing Drain

CITY OF ANN ARBOR
09.26.2014



Legend

- Meter
- WWTP
- Connected FD Parcel
- Contract Customer

Footing Drain (gpm)

- 0.0 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

0 2,000 4,000 6,000 8,000 Feet

Source: Data provided by Washtenaw County and the City of Ann Arbro. Orchard, Hiltz and McCliment does not warrant the accuracy of the data and/or the map. This document is intended to depict the approximate spatial location of the mapped features within the Community and all use is strictly at the user's own risk.

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 IntlFeet

Appendix A
Outline of Methodology

FOOTING DRAIN CONTRIBUTION TO RDII
ESTIMATION METHODOLOGY OUTLINE

ANALYSIS OBJECTIVE

- To estimate the production rates from the remaining footing drains.
    - o We anticipate this will be useful when considering FDD as a future alternative or for considering a developer offset mitigation program.

DESIRED OUTPOUT

- The production rates of FDD flows.
    - o An estimate of the non-footing drain flows needs to come from some other metric.

RAINFALL DEPENDENT INFLOW & INFILTRATION (RDII)

- Definition: Flow which enters the sanitary system through direct connection of downspouts sump pumps, footing drains and storm sewers.
- The total rate of RDII from the districts was established from the flow metering and subsequent modeling to develop design-event rates of RDII.
- The basis of RDII projections are the measurements in the field and not based on estimates from a population or inch-mile build-up.
- Because the total RDIIis known (from metering and modeling to establish design-event RDII rates as described above), a methodology is needed to split this total RDII between footing drain and non-footing drain (other I&I) sources.

INCH-MILES

- Definition: The inch mile of sewer is determined by multiplying the diameter of the pipe by its length in miles.
- Inch-miles are used to help split the total I&I flow into two components, not to make an estimate of the total I&I flow.
- <u>All</u> meter districts in Ann Arbor were looked at to determine I&I values based on inch-miles of pipe, as opposed to using standard published values.

FINDINGS/PROCESS

- Several of the districts have very few footing drains connected, thus providing typical I&I rates for non-footing drain sources.

- We unitized the RDII for each meter district by the inch-miles of pipe (to account for the different sizes of the district), and found that there is a pretty good correlation between inch-miles of pipe and non-footing drain I&I flows.

- This correlation, to estimate the non-footing drain I&I flow for the rest of the districts, was used as a basis for providing each district to split the total I&I between footing drain and non-footing drain sources. We can then use the portion generated from footing drain flows to compute the production rate per house and compare the district.

- However, this process is only going to provide an estimate of the footing drain production rates.

- The accuracy of the analysis is always going to be limited by the ability to estimate the split between footing drain and non-footing drain sources.

- There are many methods that could be used to do this, and they will provide some variability to the results.

- When evaluating footing drain disconnection alternatives, and DOM programs, the City should consider the production rates to have a range around these published numbers, and to consider the impacts that such a range may have on the decisions being made.

- If the impact is significant, then additional information should be collected before making a decision, such as doing an FDD pilot in the area, or additional metering, like what is recommended for the Pittsfield Valley area.

- One easy way to establish a range of production rates is to compute the high-end of the range, by assuming that 100% of the flows from a district are from footing drains. The report will have the necessary supporting information to do this.

Appendix B
Meter District Characteristics

Ann Arbor Cumulative Meter Districts Per Capita Flow Computations

Incremental Meter District	Upstream Meter Districts	Total Households	Year 2010 Population	Total Acerage	Footing Drains: Cumulative Completed Equivalent Footing Drain Disconnected	Footing Drains: Cumulative Connected Footing Drain Equivalent	Footing Drains: Cumulative (1930 -1980) Equivalent FDD	Footing Drains: % FDD Removed	Footing Drains: % of FDD Equivalent Still Connected	Land Use: Residential	Land Use: Developed	Land Use: Total	2010 Employment	2010 Equivalent Population	Inch-Mile Sewer	Flow Rates – Average DWF: Average Dry Weather Flow Rate (cfs)	Flow Rates – Average DWF: Sanitary Wastewater Flow Rate (gpcd)	Flow Rates – April 11, 2013: Peak Flow Rate (cfs)	Flow Rates – April 11, 2013: Sanitary Wastewater Flow Rate (gpcd)	Flow Rates – June 10, 2013: Peak Flow Rate (cfs)	Flow Rates – June 10, 2013: Sanitary Wastewater Flow Rate (gpcd)	Flow Rates – June 27, 2013: Peak Flow Rate (cfs)	Flow Rates – June 27, 2013: Sanitary Wastewater Flow Rate (gpcd)	Flow Rates – August 12, 2013: Peak Flow Rate (cfs)	Flow Rates – August 12, 2013: Sanitary Wastewater Flow Rate (gpcd)
MH 2B	[MH2B]	243	670	105	229	2	231	99%	1%	50	102	105	233	705	19	0.1	91.7	0.5	458.7	0.3	275.2	0.6	550.4	0.4	366.9
MH 47	[MH47]	257	684	74	251	1	252	100%	0%	57	74	74	15	686	18	0.1	94.3	0.4	377.0	0.3	282.8	0.6	565.5	0.2	188.5
5C	[5C]+[MH47]+[MH2B]	3441	8176	1787	594	981	1575	38%	62%	751	1741	1787	4433	8841	351	1.7	126.0	7.1	519.1	4.0	292.4	8.8	643.4	7.0	511.8
3B	[3B]	4297	10049	1534	186	928	1114	17%	83%	813	1209	1534	1630	10293	240	1.5	96.3	3.8	238.6	3.2	200.9	6.3	395.6	4.2	263.7
E1	[E1]	535	1468	624	1	195	196	1%	99%	406	620	624	1147	1640	72	0.3	124.9	0.6	236.5	0.7	275.9	-	NA	-	NA
1A	[1A]+[E1]	678	1786	720	1	255	256	0%	100%	444	696	720	1258	1974	87	0.2	NA	0.7	229.2	NA	NA	NA	NA	NA	NA
PS-Jackson	[PS-Jackson]	2345	5888	3144	0	20	20	0%	100%	898	2887	3144	5541	6719	350	1.0	92.5	2.5	235.7	2.4	234.7	2.4	234.7	3.0	291.5
D1	[D1]	399	881	96	27	345	372	7%	93%	69	95	96	21	884	40	0.6	NA	1.7	1242.8	0.9	657.9	-	NA	-	NA
B1	[B1]	1944	4397	721	179	1114	1293	14%	86%	442	661	721	596	4487	213	2.2	320.4	4.9	705.9	4.2	605.0	-	NA	-	NA
MH 49D	[MH 49D]	522	1058	303	13	413	426	3%	97%	124	300	303	609	1150	71	0.3	168.6	1.6	899.4	1.6	899.4	2.7	1517.8	-	NA
MH 2D	[MH 2D]	2427	5367	863	315	229	544	58%	42%	435	835	863	1478	5589	161	0.5	60.6	3.7	427.9	3.2	370.1	6.5	751.7	2.7	312.3
A1	[A1]+[MH 49D]+[MH 2D]	3280	7131	1257	333	700	1033	32%	68%	592	1221	1257	2416	7493	256	1.1	97.5	4.2	362.3	3.7	319.2	6.3	543.5	3.2	276.0
MH 11	[MH 11]	458	1035	131	299	169	468	64%	36%	98	129	131	27	1039	35	0.1	64.7	1.1	684.4	0.6	373.3	1.6	995.5	0.5	311.1
MH 102	[MH 102]	500	1134	164	255	249	504	51%	49%	108	163	164	154	1157	46	0.2	111.7	2.5	1396.6	1.2	670.4	1.9	1061.5	1.0	558.7
12A	[12A]+[MH102]+[MH11]	2099	4336	855	606	780	1386	44%	56%	287	704	855	2162	4660	174	0.6	80.6	4.6	638.0	3.2	443.8	7.4	1026.4	2.1	291.3
F1+9B	[F1+9B]	4352	15287	796	106	962	1068	10%	90%	479	776	796	897	15422	221	-	NA	-	NA	-	NA	-	NA	-	NA
F1	[F1]+[F1+9B]50%	3082	11767	521	54	601	655	8%	92%	281	510	521	863	11896	163	1.2	67.4	4.2	228.2	4.2	228.2	7.8	423.8	3.8	206.5
C1+C2	[C1+C2]+[PS-Jackson]+[D1]+[B1]+[A1]+[12A]+[F1]	20613	50922	8153	1413	5719	7132	20%	80%	3447	7584	8153	13462	52942	1714	11.2	137.2	30.3	369.9	24.1	294.2	39.0	476.1	16.0	195.3
MH 49M	[MH 49M]	1063	2515	327	379	179	558	68%	32%	235	313	327	158	2539	79	0.3	76.4	2.0	509.1	1.5	381.9	1.9	483.7	1.2	305.5
11B	[11B]+[MH 49M]	3359	6582	1259	380	390	770	49%	51%	548	1211	1259	2769	6997	269	1.4	125.4	3.7	341.8	3.2	295.6	4.1	378.7	2.9	267.9
Pitt-6	[Pitt-6]	1577	3366	2072	0	0	0		100%	399	1968	2072	4568	4051	288	0.7	111.7	2.3	367.0	2.1	335.1	-	NA	-	NA
Pitt-7	[Pitt-7]	80	150	295	0	22	22		100%	1	295	295	685	253	54	0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
10A	[10A]+[Pitt-6]+[Pitt-7]	3303	7638	2973	65	909	974	7%	93%	618	2832	2973	7187	8716	442	2.0	145.3	4.0	296.6	3.9	289.2	5.8	430.1	3.2	237.3
F1+9B	[F1+9B]	4352	15287	796	106	962	1068	10%	90%	479	776	796	897	15422	221	-	NA	-	NA	NA	NA	NA	NA	NA	NA
9B	[9B]+[F1+9B]50%	3651	10587	920	66	1342	1408	5%	95%	434	904	921	1578	10824	239	1.7	104.1	3.6	215.0	3.7	220.9	NA	NA	NA	NA
9C	[9C]+[10A]+[11B]+[9B]	12345	29057	5815	520	3658	4178	12%	88%	1924	5463	5815	12056	30865	1091	5.9	123.1	12.5	261.8	10.8	226.2	15.3	320.4	11.2	234.5
G1	[G1]+[9C]50%	6710	15658	3090	299	2104	2403	12%	88%	1082	2908	3090	6160	16582	617	3.8	146.8	8.9	346.9	12.3	479.5	-	NA	-	NA
Pitt-1	[Pitt-1]	87	294	32	0	0	0		100%	0	32	32	194	323	23	0.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pitt-2	[Pitt-2]	385	845	112	0	0	0		100%	44	112	112	280	887	29	0.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pitt-3	[Pitt-3]	56	191	21	0	0	0		100%	0	21	21	154	214	4	0.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pitt-4	[Pitt-4]	1166	2450	272	0	0	0		100%	165	258	272	353	2503	63	0.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pitt-5	[Pitt-5]	133	239	23	0	0	0		100%	23	23	23	6	240	5	0.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
Plant	[Plant]+[Pitt-1]+[Pitt-2]+[Pitt-3]+[Pitt-4]+[Pitt-5]+[G1]+[9C]+[C1+C2]+[1A]+[3B]+[5C]	55787	136376	27588	3212	16115	19327	17%	83%	10723	24058	27315	51073	144037	5491	29.7	133.3	64.1	287.6	50.7	227.5	80.3	360.3	48.8	219.0
	Total																								

Priority District
End of Branch
Tributary to Plant Interceptor
NA Flow Rates not Accurate
- No Data

OHM Advancing Communities

City of Ann Arbor Sanitary Sewer Meter District Population and Housing Intersect

Meter	Acreage	Census Intersect		TAZ Intersect													
		2010 Census Housing	2010 Census Population	2010 Housing	2010 Population	2015 Housing	2015 Population	2020 Housing	2020 Population	2025 Housing	2025 Population	2030 Housing	2030 Population	2035 Housing	2035 Population	2040 Housing	2040 Population
10A	605.6	1,743	4,137	1,646	4,122	1,815	4,163	1,839	4,025	1,846	3,871	1,846	3,797	1,850	3,779	1,849	3,877
11B	931.4	2,675	4,216	2,297	4,067	2,373	4,794	2,423	4,755	2,445	4,972	2,449	4,956	2,528	5,028	2,688	5,356
12A	560.7	861	1,594	1,141	2,167	1,272	2,589	1,322	2,682	1,358	2,855	1,373	2,892	1,381	2,871	1,380	2,893
1A	95.9	70	173	143	318	143	332	147	331	149	324	152	318	154	331	154	344
3B	1534.2	3,991	8,745	4,297	10,049	4,251	9,830	4,368	9,724	4,426	9,742	4,557	10,035	4,672	10,166	4,984	10,976
5C	1608.4	3,481	7,369	2,941	6,823	2,952	6,644	3,040	6,641	3,115	6,862	3,172	6,802	3,237	6,879	3,304	7,213
9B	522.5	1,705	3,068	1,475	2,944	1,521	3,289	1,555	3,271	1,580	3,380	1,605	3,383	1,622	3,478	1,620	3,517
9C	663.3	1,806	3,727	2,032	4,250	2,152	4,670	2,191	4,612	2,280	4,923	2,329	4,981	2,375	5,008	2,415	5,256
A1	90.6	386	665	331	705	348	753	357	770	369	797	374	818	383	827	385	863
B1	721.2	2,103	4,587	1,944	4,397	1,963	4,468	2,013	4,506	2,064	4,636	2,084	4,690	2,128	4,815	2,133	4,877
C1+C2	1557.6	8,513	17,567	7,463	16,523	7,506	17,443	7,678	17,471	7,815	17,798	7,888	18,003	7,965	18,059	7,994	18,468
D1	96.4	396	862	399	881	399	895	407	899	411	927	417	942	421	959	423	998
E1	624.0	503	1,502	535	1,468	551	1,413	583	1,402	623	1,528	635	1,514	673	1,582	676	1,628
F1	122.7	935	4,203	906	4,123	915	3,648	933	3,651	944	3,576	948	3,560	949	3,525	953	3,638
9B (LF)	458.6	2,407	8,471	2,508	8,810	2,544	7,909	2,622	7,953	2,659	7,895	2,675	7,846	2,690	7,808	2,697	7,976
F1 (LF)	337.2	1,770	6,228	1,844	6,478	1,871	5,815	1,928	5,848	1,955	5,805	1,967	5,769	1,978	5,741	1,983	5,864
F1+9B	795.8	4177.5	14699.2	4,352	15,287	4,415	13,724	4,549	13,800	4,614	13,701	4,642	13,615	4,668	13,550	4,680	13,840
G1	182.1	545	1,069	538	1,129	562	1,198	575	1,210	595	1,259	605	1,287	624	1,317	641	1,391
MH 102	163.7	448	1,010	500	1,134	512	1,135	519	1,145	523	1,174	536	1,215	541	1,239	542	1,251
MH 11	131.1	458	985	458	1,035	464	1,027	470	1,046	483	1,084	496	1,120	506	1,159	507	1,180
MH 2B	104.9	208	532	243	670	244	598	242	562	247	570	251	585	254	581	253	605
MH 2D	863.2	2,790	5,901	2,427	5,367	2,399	5,515	2,507	5,538	2,751	5,999	2,897	6,239	2,968	6,333	3,197	6,845
MH 47	74.0	257	728	257	684	256	625	255	592	258	601	261	605	264	601	263	627
MH 49D	303.4	445	886	522	1,058	569	1,229	573	1,213	587	1,274	590	1,279	599	1,272	600	1,326
MH 49M	327.4	825	1,995	1,063	2,515	1,060	2,395	1,077	2,378	1,078	2,413	1,093	2,390	1,111	2,398	1,123	2,457
Pitt-1	32.1	13	63	87	294	66	274	65	266	78	302	83	307	88	323	88	320
Pitt-2	112.0	302	641	385	845	356	815	368	847	361	833	367	844	375	879	375	869
Pitt-3	20.8	100	322	56	191	43	178	42	173	51	196	54	199	57	210	57	208
Pitt-4	272.3	827	1,979	1,166	2,450	1,146	2,608	1,178	2,650	1,154	2,587	1,175	2,636	1,218	2,730	1,233	2,793
Pitt-5	23.5	297	601	133	239	140	284	142	284	142	293	144	290	150	294	154	309
Pitt-6	2072.1	1,704	3,338	1,577	3,366	1,594	3,657	1,628	3,703	1,648	3,779	1,679	3,853	1,726	4,046	1,737	4,136
Pitt-7	295.0	0	0	80	150	48	93	57	122	57	105	57	106	57	107	57	108
Plant	8936.0	12,651	31,037	12,050	31,239	12,382	32,996	12,830	33,742	13,088	34,089	13,326	34,349	13,610	34,606	13,910	35,508
PS-Jackson	3144.4	2,490	5,959	2,345	5,888	2,577	6,136	2,750	6,303	3,143	7,095	3,552	8,005	3,662	8,244	3,676	8,295
Total	28384.2	57,707	134,160	55,787	136,376	56,993	139,416	58,684	140,314	60,282	143,547	61,639	145,615	62,815	147,197	64,055	151,973

	2010 Census Housing	2010 Census Population	2040 Census Population
Ann Arbor	48191	112670	123786
Ann Arbor Twp	2349	5013	5678
Pittsfield Twp	3362	7219	8743
Scio Twp	3805	9255	13765
Total	57707	134156	151973

Ann Arbor Sanitary Sewer Meter District Land Use

Meter	Acreage	Residential			Non Residential									Total In District
		Single-family residential	Multiple-family residential	Total Residential	Governmental / Institutional	Commercial	Industrial	Airport	TCU	Total Developed	Parks, Recreation, and Open Space	Agricultural	Water	
10A	605.6	91	126	217	218	38	37	0	58	569	36	1	0	606
11B	931.4	184	129	313	97	349	19	0	119	897	26	0	8	931
12A	560.7	76	4	80	231	40	0	0	61	412	146	0	2	561
1A	95.9	38	0	38	0	18	4	0	16	76	19	0	0	96
3B	1534.2	611	201	813	133	73	0	0	190	1,209	312	0	13	1,534
5C	1608.4	526	119	644	384	188	170	0	178	1,565	35	0	9	1,608
9B	522.5	147	47	194	58	116	48	0	100	516	7	0	0	522
9C	663.3	251	73	325	34	31	0	0	128	516	147	0	0	663
A1	90.6	32	2	34	43	0	0	0	9	86	5	0	0	91
B1	721.2	391	51	442	23	59	0	0	137	661	60	0	0	721
C1+C2	1557.6	830	48	878	155	89	2	0	383	1,507	50	0	1	1,558
D1	96.4	69	0	69	0	0	0	0	25	95	2	0	0	96
E1	624.0	406	0	406	135	9	0	0	70	620	3	0	1	624
F1	122.7	29	13	42	53	2	0	0	26	122	0	0	0	123
9B (LF)	458.6	256	20	276	56	8	0	0	102	442	16	0	0	459
F1 (LF)	337.2	199	4	203	30	16	0	0	84	333	4	0	0	337
F1+9B	795.8	455	24	479	86	24	0	0	187	776	20	0	0	796
G1	182.1	108	12	120	7	10	0	0	40	177	5	0	0	182
MH 102	163.7	108	0	108	17	0	0	0	38	163	1	0	0	164
MH 11	131.1	98	0	98	0	0	0	0	31	129	2	0	0	131
MH 2B	104.9	50	0	50	29	1	0	0	23	102	2	0	0	105
MH 2D	863.2	365	70	435	97	108	80	0	115	835	22	3	3	863
MH 47	74.0	57	0	57	0	0	0	0	17	74	0	0	0	74
MH 49D	303.4	108	16	124	8	101	4	0	64	300	3	0	1	303
MH 49M	327.4	220	15	235	13	0	0	0	65	313	10	0	4	327
Pitt-1	32.1	0	0	0	14	18	0	0	0	32	0	0	0	32
Pitt-2	112.0	32	12	44	8	41	0	0	19	112	0	0	0	112
Pitt-3	20.8	0	0	0	21	0	0	0	0	21	0	0	0	21
Pitt-4	272.3	131	35	165	10	47	0	0	36	258	2	0	12	272
Pitt-5	23.5	2	22	23	0	0	0	0	0	23	0	0	0	23
Pitt-6	2072.1	354	45	399	236	397	391	386	159	1,968	7	97	0	2,072
Pitt-7	295.0	0	1	1	6	91	154	0	43	295	0	0	0	295
Plant	8661.8	2,739	252	2,992	1,692	589	249	0	1,220	6,742	1,851	0	69	8,662
PS-Jackson	3144.4	868	30	898	81	750	759	0	399	2,887	151	97	9	3,144
Total	27314.2	9,375	1,349	10,723	3,887	3,187	1,918	386	3,957	24,058	2,925	198	133	27,315

OHM Advancing Communities

Meter	Footing Drain Disconnects																								
	Single Familiy FDD complete (1)	# ofMultiple Family FDD Complete	Multiple Family FDD Complete FDD EQ	FDD not complete or inspected (0)	FD not connected (-1)	Total FFD Completed EQ_FDD	Total Parcels In Districts	Parcels not given a year built (new, business or not connected to sewer)	Total Single Family Parcels	Total MultiFamily Parcels	Total MultiFamily FDD Equivalent	Total FDD Equivalent + Single Family	Count of Parcels Built_Year (1931 - 1980)	Count of Multifamily Parcels Built_Year (1931 - 1980)	FDD Equivalent Multifamily Parcels Built_Year (1931 - 1980)	FDD Parcels (1931 - 1980)	Equivalent FDD (1931 - 1980)	% of Parcels with footing drains	% of FDD_EQ Still Connected	FDD_EQ (1)	FDD=0 FDD_EQ=1	FDD_EQ (0)	MultiFamily SUM FDD_EQ (>1)	FDD=0 FDD_EQ>1	FDD=0 FDD_EQ >0
10A	1	3	63	302	1	65	333	26	286	21	672	958	301	21	672	297	952	99%	93%	264	263	22	672	609	872
11B	0	0	0	192	1	1	313	120	187	6	174	361	44	6	174	44	212	100%	100%	18	18	169	174	174	192
12A	52	0	0	406	0	52	493	35	455	3	27	482	390	3	27	338	414	87%	87%	381	329	74	27	27	356
1A	0	0	0	73	0	0	107	34	73	0	0	73	60	0	0	60	60	100%	100%	52	52	21	0	0	52
3B	1	1	185	812	0	186	1050	236	794	20	822	1616	310	18	822	308	1114	99%	83%	296	295	500	822	637	932
5C	111	0	0	899	3	114	1225	212	998	15	430	1428	676	14	430	565	1092	84%	90%	661	550	338	430	430	980
9B	11	0	0	639	2	13	745	93	631	21	502	1133	393	21	502	382	874	97%	99%	329	318	302	502	502	820
9C	8	0	0	834	1	9	1013	170	834	9	317	1151	716	7	317	708	1026	99%	99%	703	695	133	317	317	1012
A1	3	0	0	101	2	5	128	22	103	3	6	109	60	3	6	57	63	95%	92%	56	53	47	6	6	59
B1	152	2	19	1281	8	179	1667	224	1438	5	41	1479	1257	5	41	1103	1293	88%	86%	1244	1092	194	41	22	1114
C1+C2	162	3	6	4512	46	214	5174	451	4632	91	403	5035	2060	90	403	1895	2373	92%	91%	1881	1719	2754	403	397	2116
D1	27	0	0	375	0	27	413	11	402	0	0	402	372	0	0	345	372	93%	93%	373	346	29	0	0	346
E1	0	0	0	207	1	1	416	208	204	4	113	317	87	4	113	87	196	100%	99%	82	82	122	113	113	195
F1	1	0	0	317	0	1	340	22	280	38	111	391	48	38	111	47	121	98%	99%	5	4	276	111	111	115
9B (LF)	8	1	4	1067	0	12	1157	81	1031	45	217	1248	226	45	217	217	398	96%	97%	169	161	864	217	213	374
F1 (LF)	92	0	0	1023	2	94	1154	37	1109	8	20	1129	658	8	20	566	670	86%	86%	638	546	471	20	20	566
F1+9B	100	1	4	2090	2	106	2311	118	2140	53	237	2377	884	53	237	783	1068	89%	90%	807	707	1335	237	233	940
G1	33	0	0	381	6	39	448	28	419	1	0	419	314	0	0	281	314	89%	88%	303	270	117	0	0	270
MH 102	254	0	0	252	1	255	512	5	507	0	0	507	504	0	0	250	504	50%	49%	503	249	4	0	0	249
MH 11	283	0	0	177	16	299	479	3	476	0	0	476	468	0	0	185	468	40%	36%	454	171	22	0	0	171
MH 2B	228	0	0	6	1	229	259	24	235	0	0	235	231	0	0	3	231	1%	1%	230	2	5	0	0	2
MH 2D	228	3	66	228	21	315	547	67	474	6	249	723	302	5	247	71	544	24%	42%	234	6	240	249	183	189
MH 47	249	0	0	3	2	251	260	6	254	0	0	254	252	0	0	3	252	1%	0%	252	3	2	0	0	3
MH 49D	12	0	0	415	1	13	499	71	425	3	54	479	375	3	54	363	426	97%	97%	326	314	99	54	54	368
MH 49M	352	0	0	346	27	379	753	28	725	0	0	725	558	0	0	206	558	37%	32%	562	210	163	0	0	210
Pitt-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0	0	0
Pitt-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0	0	0
Pitt-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0	0	0
Pitt-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0	0	0
Pitt-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0	0	0	0	0	0
Pitt-6	0	0	0	0	0	0	48	48	0	0	0	0	0	0	0	0	0			0	0	0	0	0	0
Pitt-7	0	0	0	26	0	0	41	15	26	0	0	26	22	0	0	22	22	100%	100%	0	0	26	0	0	0
Plant	83	7	368	4521	8	459	5658	1039	4506	113	1813	6319	3058	113	1813	2968	4758	97%	90%	2784	2701	1724	1813	1445	4146
PS-Jackson	0	0	0	35	0	0	103	68	35	0	0	35	20	0	0	20	20	100%	100%	19	19	16	0	0	19
Total	2351	20	711	19430	150	3212	25335	3384	21539	412	5971	27510	13762	404	5969	11391	19327	83%	88%	12819		8734	5971		15728

Notes:
Some of the areas included in the FDD file were outside of the meter districts. Therefore the total (FDD=0 FDD_EQ >0) is less.
the area for MH47 changed because the meter is further north of Plymouth Road than original assumed
SEMCOG report shows 20,416 single family homes are in Ann Arbor for year 2010. This FDD file contains some areas outside of ANN Arbor and the total number of parcels = 24923
No spliting of parcels was done the meter district with the highest area % was given the footing drain
Meter MH 2D has a large area from scio township that is now tributary to this meter.

Source : P:\0000_0100\0028130011_A2_Sanitary_Sewer_Evaluation\MFB\Meter District Intersects.xlsx

Ann Arbor Employment by Meter District

Meter	2010 Employment	2040 Employment
10A	1,934	2,371
11B	2,612	3,052
12A	1,980	2,443
1A	111	128
3B	1,630	2,016
5C	4,185	5,061
9B	1,129	1,327
9C	522	642
A1	329	410
B1	596	726
C1+C2	1,863	2,297
D1	21	29
E1	1,147	1,440
F1	414	514
9B (LF)	535	671
F1 (LF)	362	449
F1+9B	897	1,120
G1	132	163
MH 102	154	196
MH 11	27	38
MH 2B	233	292
MH 2D	1,478	1,765
MH 47	15	21
MH 49D	609	703
MH 49M	158	206
Pitt-1	194	231
Pitt-2	280	327
Pitt-3	154	191
Pitt-4	353	418
Pitt-5	6	7
Pitt-6	4,568	5,291
Pitt-7	685	744
Plant	17,116	20,963
PS-Jackson	5,541	6,235
Total	51,073	61,369

Appendix C
Plant Meter District DCI Calculation

Table 5: Incremental DCI Calculation for Plant Metered Area

Institutional Flow Rate							
	Beds	**REU**	**People per REU**	**Equivalent Population**	**gpcd**	**gpm**	**cfs**
U of M Hospital	990	1.22	3	3,623	100	252	0.56
Veterans Hospital	145	1.22	3	531	100	37	0.08
U of M Housing	9,500	0.27	3	7,695	100	534	1.19
Population				31,239	100	2,169	4.83
Employment (15%)				2,567	100	178	0.40
Total				45,655		3,170	7.06

Appendix D
Flow Component Tables

Ann Arbor Cumulative Meter Districts Flow Rate Components

I & I from Other Sources = 0.0079 cfs/Inch Mile

Meter District	Upstream Meter Districts	Cumulative Total Households	Cumulative Year 2010 Population	Cumulative Year 2010 Employment	Cumulative Year 2010 Equivalent Population	Cumulative Total Acerage	Cumulative Connected Footing Drain Equivalent	Inch-Mile Sewer	Average DWF	GWI 90% of Minimum Nightly Flow	DCI Flow Rate	DCI Flow Rate	25 year	25 Year I & I	25 Year I & I Other Sources .0079 cfs/ Inch Mile		25 Year I & I Footing Drain Sources		25 Year I & I Footing Drain
									(cfs)	(cfs)	(cfs)	(gpcd)	(cfs)	(cfs)	(cfs)	% RDII	(cfs)	% RDII	(gpm/FD)
MH 2B (Bromley)	[MH2B]	243	670	233	705	105	2	19	0.10	0.03	0.07	61.87	0.57	0.47	0.45	95%	0.02	5%	4.80
MH 47 (Orchard Hills)	[MH47]	257	684	15	686	74	1	18	0.10	0.02	0.08	76.77	0.51	0.41	0.40	97%	0.01	3%	4.75
5C	[5C]+[MH47]+[MH2B]	3441	8176	4433	8841	1787	981	351	1.70	0.66	1.04	67.00	8.69	6.99	2.77	40%	4.22	60%	1.93
3B	[3B]	4297	10049	1630	10293	1534	928	240	1.50	0.31	1.19	71.55	6.76	5.26	1.89	36%	3.37	64%	1.63
E1	[E1]	535	1468	1147	1640	624	195	72	0.30	0.13	0.17	55.34	0.90	0.60	0.57	94%	0.03	6%	0.08
1A	[1A]+[E1]	678	1786	1258	1974	720	255	87	0.36	0.11	0.25	69.50	1.05	0.69	0.69	100%	0.00	0%	0.00
PS-Jackson	[PS-Jackson]	2345	5888	0	5888	3144	20	350	0.96	0.03	0.94	74.86	3.26	2.30	2.26	98%	0.04	2%	0.84
D1	[D1]	399	881	21	884	96	345	40	0.56	0.17	0.39	285.44	1.54	0.98	0.32	32%	0.66	68%	0.86
B1	[B1]	1944	4397	596	4487	721	1114	213	2.20	1.19	1.01	140.47	7.68	5.48	1.69	31%	3.79	69%	1.53
MH 49D	[MH 49D]	522	1058	609	1150	303	413	71	0.30	0.06	0.24	117.15	2.06	1.76	0.56	32%	1.19	68%	1.30
MH 2D (Dartmoor)	[MH 2D]	2427	5367	1478	5589	863	229	161	0.50	0.11	0.39	42.53	4.78	4.28	1.83	43%	2.45	57%	4.81
A1	[A1]+[MH 49D]+[MH 2D]	3280	7131	2416	7493	1257	700	256	1.10	0.37	0.73	58.21	5.38	4.28	2.02	47%	2.26	53%	1.45
MH 11 (Glen Leven)	[MH 11]	458	1035	27	1039	131	169	35	0.10	0.02	0.08	47.83	5.34	5.24	4.78	91%	0.46	9%	1.21
MH 102 (Glen Leven)	[MH 102]	500	1134	154	1157	164	249	46	0.20	0.03	0.17	93.50	1.60	1.40	0.72	52%	0.67	48%	
12A	[12A]+[MH102]+[MH11]	2099	4336	2162	4660	855	780	174	0.60	0.22	0.38	46.05	6.11	5.51	1.37	25%	4.14	75%	2.38
F1+9B	[F1+9B]	4352	15287	897	15422	796	962	221	2.43	1.13	1.30	53.49	8.87	6.44	1.75	27%	4.70	73%	2.19
F1	[F1]+[F1+9B]50%	3082	11767	863	11896	521	601	163	1.20	0.58	0.62	32.96	7.51	6.31	1.29	20%	5.02	80%	3.75
C1+C2	[C1+C2]+[PS-Jackson]+[D1]+[B1]+[A1]+[12A]+[F1]	20613	50922	7921	52110	8153	5719	1714	11.20	4.96	6.24	71.41	34.89	23.69	13.54	57%	10.15	43%	0.80
MH 49M (Morehead)	[MH 49M]	1063	2515	158	2539	327	179	79	0.30	0.08	0.22	54.28	2.06	1.76	0.62	35%	1.14	65%	2.85
11B	[11B]+[MH 49M]	3359	6582	2769	6997	1259	390	269	1.40	0.45	0.95	79.79	4.43	3.03	2.13	70%	0.90	30%	1.04
Pitt-6	[Pitt-6]	1577	3366	4568	4051	2072	315	288	0.70	0.24	0.46	57.93	2.12	1.42	0.83	58%	0.59	42%	0.84
Pitt-7	[Pitt-7]	80	150	685	253	295	22	54	0.12	0.04	0.08	131.30	0.37	0.25	0.20	83%	0.04	17%	0.84
10A	[10A]+[Pitt-6]+[Pitt-7]	3303	7638	7187	8716	2973	909	442	2.00	1.03	0.97	59.50	5.74	3.74	3.49	93%	0.25	7%	0.12
F1+9B	[F1+9B]	4352	15287	897	15422	796	962	221	2.43	1.13	1.30	53.49	8.87	6.44	1.75	27%	4.70	73%	2.19
9B	[9B]+[F1+9B]50%	3651	10587	1578	10824	920	1342	239	1.70	0.79	0.91	52.27	6.21	4.51	1.89	42%	2.62	58%	0.88
9C	[9C]+[10A]+[11B]+[9B]	12345	29057	12056	30865	5815	3658	1091	5.90	2.84	3.06	58.24	15.64	9.74	8.62	89%	1.12	11%	0.14
G1	[G1]+[9C]50%	6710	15658	6160	16582	3090	2104	617	3.80	1.24	2.56	90.86	15.49	11.69	4.88	42%	6.81	58%	1.45
Plant	[Plant]+[Pitt-1]+[Pitt-2]+[Pitt-3]+[Pitt-4]+[Pitt-5]+[G1]+[9C]+[C1+C2]+[1A]+[3B]+[5C]	55787	136376	194	323	27588	17944	5491	29.70	11.72	17.98	73.62	90.13	60.43	43.38	72%	17.05	28%	0.43
	Total															*		*	

	End of Branch
	Tributary to Plant Interceptor
NA	Flow Rates not Accurate
	Estimated Data
	Adjusted PS - Jackson and Pitt meters to use average per footing drain production rate
	Used calculation to determine the footing drain production rate for remaining connected footing drains in Moorhead priority district

* 72% - 28% Split between total system RDII. Footing drain flows are 19% of Total Wet weather flow rate when GWI and DCI are included.

Ann Arbor Incremental Meter Districts I & I Sources

I & I from Other Sources = 0.0079 cfs/Inch Mile

Incremental Meter District	Upstream Meter Districts	Incremental: Year 2010 Incremental Households	Incremental: Year 2010 Incremental Population	Incremental: Incremental Acerage	Incremental: Incremental Connected Footing Drain Equivalent	Incremental: Inch-Mile Sewer	Incremental Average DWF	Incremental 25 Year Flow Rate	25 Year I & I	Incremental 25 Year I & I Other Sources		25 Year I & I Footing Drain Sources		Incremental 25 Year I & I Footing Drain
							(cfs)	(cfs)	(cfs)	(cfs)	% RDII	(cfs)	% RDII	(gpm/FD)
MH 2B	[MH2B]	243	670	105	2	19	0.1	0.6	0.5	0.45	95%	0.02	5%	4.8
MH 47	[MH47]	257	684	74	1	18	0.1	0.5	0.4	0.40	97%	0.01	3%	4.8
5C	[5C]+[MH47]+[MH2B]	2941	6823	1608	978	314	1.5	7.6	6.1	2.48	41%	3.63	59%	1.7
3B	[3B]	4297	10049	1534	928	240	1.5	6.8	5.3	1.89	36%	3.37	64%	1.6
E1	[E1]	535	1468	624	195	72	0.3	0.9	0.6	0.57	94%	0.03	6%	0.1
1A	[1A]+[E1]	143	318	96	60	16	0.4	1.1	0.7	0.12	18%	0.57	82%	1.0
PS-Jackson	[PS-Jackson]	2345	5888	3144	20	350	1.0	3.3	2.3	2.26	98%	0.04	2%	0.8
D1	[D1]	399	881	96	345	40	0.6	1.5	1.0	0.32	32%	0.66	68%	0.9
B1	[B1]	1944	4397	721	1114	213	2.2	7.7	5.5	1.69	31%	3.79	69%	1.5
MH 49D	[MH 49D]	522	1058	303	413	71	0.3	2.1	1.8	0.56	32%	1.19	68%	1.3
MH 2D	[MH 2D]	2427	5367	863	229	161	0.5	4.8	4.3	1.83	43%	2.45	57%	4.8
A1	[A1]+[MH 49D]+[MH 2D]	331	705	91	58	23	1.1	5.4	4.3	0.19	4%	4.09	96%	2.6
MH 11	[MH 11]	458	1035	131	169	35	0.1	3.7	3.6	3.18	87%	0.46	13%	1.2
MH 102	[MH 102]	500	1134	164	249	46	0.2	1.6	1.4	0.72	52%	0.67	48%	
12A	[12A]+[MH102]+[MH11]	1141	2167	561	362	92	0.6	6.1	5.5	0.73	13%	4.78	87%	2.8
F1+9B	[F1+9B]	4352	15287	796	962	221	2.4	8.9	6.4	1.75	27%	4.70	73%	2.2
F1	[F1]+[F1+9B]50%	906	4123	123	120	52	0.0	3.1	3.1	0.41	13%	2.67	87%	2.0
C1+C2	[C1+C2]+[PS-Jackson]+[D1]+[B1]+[A1]+[12A]+[F1]	7463	16523	1558	2159	518	11.2	34.9	23.7	4.09	17%	19.60	83%	1.5
MH 49M	[MH 49M]	1063	2515	327	179	79	0.3	2.1	1.8	0.62	35%	1.14	65%	1.6
11B	[11B]+[MH 49M]	2297	4067	931	211	191	1.4	4.4	3.0	1.51	50%	1.52	50%	0.5
Pitt-6	[Pitt-6]	1577	3366	2072	315	288	0.7	2.1	1.4	0.83	58%	0.59	42%	0.8
Pitt-7	[Pitt-7]	80	150	295	22	54	0.1	0.4	0.2	0.43	174%	0.04	17%	0.8
10A	[10A]+[Pitt-6]+[Pitt-7]	1646	4122	606	887	99	1.2	3.2	2.1	0.78	38%	1.28	62%	0.6
F1+9B	[F1+9B]	4352	15287	796	962	221	2.4	8.9	6.4	1.75	27%	4.70	73%	2.2
9B	[9B]+[F1+9B]50%	1475	2944	522	861	129	0.5	1.8	1.3	1.02	79%	0.27	21%	0.1
9C	[9C]+[10A]+[11B]+[9B]	2032	4250	663	1017	141	5.9	15.6	9.7	1.11	11%	8.63	89%	1.1
G1	[G1]+[9C]50%	538	1129	182	275	71	3.8	15.5	11.7	0.56	5%	11.13	95%	2.4
Plant	[Plant]+[Pitt-1]+[Pitt-2]+[Pitt-3]+[Pitt-4]+[Pitt-5] +[G1]+[9C]+[C1+C2]+[1A]+[3B]+[5C]	12050	31239	8936	4299	1811	29.7	90.1	60.4	14.31	24%	46.12	76%	1.2

Priority District
End of Branch
Tributary to Plant Interceptor

Notes
Missing data was interpolated from other meters
Meter District 1A, 12A,11B and the Plant have two small of an area to accurately calculate and incremental footing drain contribution so the cumulative values are given.

CITY OF ANN ARBOR

Sanitary Sewer Wet Weather Evaluation

VOLUME 4: HYDRAULIC REPORT

November 2014

OHM
Advancing Communities℠

ARCHITECTS. ENGINEERS. PLANNERS.

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Hydraulic Summary

In an effort to evaluate the existing City of Ann Arbor sanitary sewer system for current and potential future hydraulic deficiencies, a hydrologic and hydraulic model has been utilized. The purpose of this document is to summarize the following:

- Capabilities of the existing City of Ann Arbor sanitary sewer system model as well as updates made to this existing model.
- Calibration process the model underwent as part of this study.
- Development of the design event hydrographs used for future system flow analyses.
- Recommendations resulting from the hydraulic modeling analysis of the system, including an assessment of the design event flows on the capacity of the wastewater treatment plant (WWTP).

Model Development and Calibration

The current City sanitary sewer model exists in the InfoSWMM platform and was developed as part of the June 2001 Sanitary Sewer Overflow Prevention Study. Model calibration is the process of checking the model performance against system measurements and adjusting model parameters, within reasonable ranges, to match the observations, if needed. The calibration process and results are outline below:

- Existing InfoSWMM model was updated predominantly with sanitary sewer upgrades that the City undertook since the last model update.
- Adjustments to the design event flow parameters were made in the model in order to reflect flow measurements performed as part of the current study.
- A null modeling type calibration was performed, which consists of inputting actual, measured flow rates into the numerical model and comparing the modeled depth values against actual observations to verify the hydraulic model performance.
- Modeled depth variations generally matched observed values to within less than 10%.
- Areas not matching these calibration standards were observed to display unusual hydraulic behavior such as hydraulic flow regime transitions or areas of unexplained hydraulic anomalies, which have been flagged for future, detailed investigation.

Basis of System Evaluation

In the context of this report, a design event is considered an event that is expected to occur at an agreed upon return frequency acceptable by the community stake holders as well as regulatory agencies. It should be noted that the Michigan Department of Environmental Quality (MDEQ) required that separate sanitary sewers have capacity for a 25-year, 24-hour storm on average summertime soil moisture, which is expected to limit sanitary sewer overflows (SSO) to an average recurrence interval of once in ten years. Below is a summary of the development of these design events.

- Three design event scenarios were evaluated.
- Scenario A included the following
    - Future growth in the City based on planned developments as reported by City staff.
    - Future growth in the Townships that the City provides sanitary sewer services to (Pittsfield, Ann Arbor, and Scio Townships) based on setting sanitary flows to contract limits in general.
    - 25-year recurrence interval peak wet weather sanitary wet weather flows.
- Scenario B, in addition to the elements in Scenario A, also included the following
    - An additional 10% increase of peak wet weather flows within the City (i.e. excluding increase in Township flows as they are set by contractual limits) to account for either one of these three possibilities:
        - Climate change (6 to 35-year "high wet" scenario, which corresponds to an approximately 10.4% increase in peak flows) or
        - increase in level of service from a 25-year to a 50-year wet weather response (which corresponds to an approximately 9% increase in peak flows), or
        - additional growth beyond that contained in the City's planned development list.
- Scenario C, which increases the peak sanitary flows by 20% over Scenario A, thereby accounting for all four flow increases simultaneously, which include contract customers at their contract limits, planned development in the City without a developer offset mitigation (DOM) program, climate change, and a 50-year recurrence interval wet weather flow.

Findings

- Scenario B was used as the design event for evaluation of system hydraulic improvement needs. Sanitary sewer surcharging was identified in Scenario B as is shown in Figure 5.
- The extent of surcharging in Scenario C, shown in Figure 6, did not increase significantly over Scenario B. Therefore, the increase in sanitary flows for Scenario C could be addressed during project design through small, incremental upsizing of system upgrades, which would provide a larger level of service.
- No hydraulic issues were found in high priority footing drain disconnection target areas with the exception of the Glen Leven district which contains an overloaded pipe section of approximately 1,800 ft.
- Six potential hydraulic deficiencies were identified in the downstream sanitary collector interceptors, requiring collection of additional information prior to the development of a specific improvement project. Action plans were prepared for each one of these areas which can be found in Appendix A. These six project areas are as follows:

    A. Huron/West Park
    B. High Level/1st Street
    C. High Level/State & Hoover
    D. Pittsfield Valley

E. Glen Leven
F. Glen/Fuller Diversion

- Currently, the wastewater treatment plant has been determined to have adequate capacity to handle existing and future peak flows as generated during Scenario C.

I. Introduction

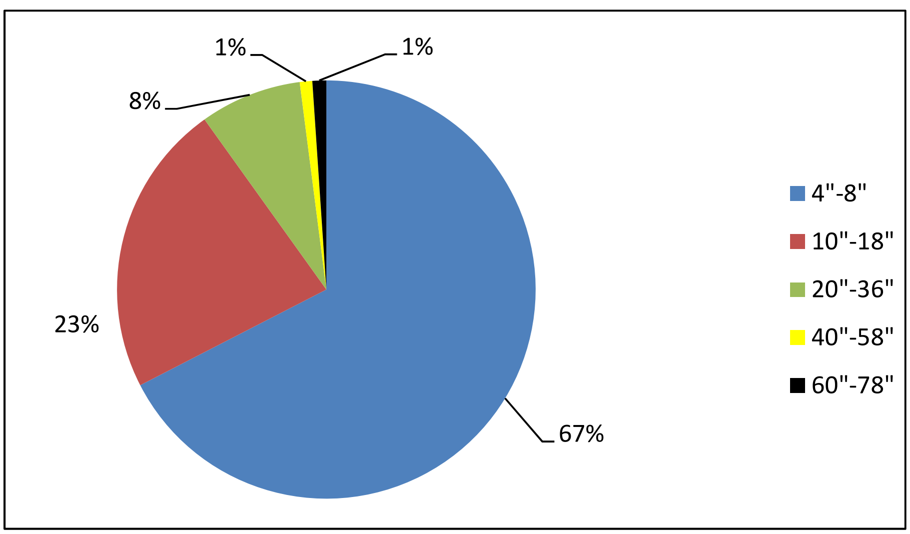
In an effort to evaluate the existing City of Ann Arbor sanitary sewer system for current and potential future hydraulic deficiencies, a hydrologic and hydraulic model has been utilized. Details of the flow metering and development, calibration, and analysis of the hydrologic model for this project can be found in both Volumes 1 and 2 of the overall documentation for this project. Volume 3 outlined the various components of the sanitary flow. This Volume provides details associated with the development, calibration, analysis, and conclusions related to the hydraulic evaluation of the City of Ann Arbor system.

II. System Model Development

The City of Ann Arbor sanitary sewer system provides sewer service to the City as well as Scio Township, Ann Arbor Township, and Pittsfield Township. The current City of Ann Arbor sanitary sewer model exists in the InfoSWMM platform and was developed as part of the 2001 Sanitary Sewer Overflow Prevention Study. Some of the features of the model are as follows:

- Approximately 400 miles of sanitary sewer is modeled.
- Sewer diameters in the model range from 4" to 78", and the model is predominantly comprised of sewers between 4" and 8" in diameter (approximately 67%, see Figure 1 below).

Figure 1: Percent of Sewers by Diameter



- Several pumping stations are in the model, including (named by their locations):
    - South Blvd.
    - Franklin
    - Sequoia Pkwy.
    - W. Liberty Rd.
    - Astor Av.
    - Kingwood St. / Barber Ave.
    - Jackson Rd. (Scio Twp.)
    - Park Lake Ave.

- Storage facilities, which were modeled include:
    - Georgetown Blvd. / Bluett Dr.
    - Salem Ct.
    - Park Lake Ave.

The current model sanitary sewer infrastructure was updated at locations where the City performed capital improvement projects. In addition, pump station firm capacity values were verified and updated as needed with more recently available pumping station information provided by the City. Finally, storage facility information was compared against as-built data and updated as needed.

III. Model Calibration

Model calibration is the process of checking the model performance against system measurements and adjusting model parameters, within reasonable ranges, to match the observations, if needed. The process ensures that the model matches the actual conditions in the system. The model calibration included a three step process:

A. Dry weather flow calibration – The model needed to be calibrated based on the flow rates measured from temporary flow meters utilized as part of this study.
B. Scatter plot review – consists of a plot of velocity versus depth of flow to diagnose system performance at each meter location and aid in the calibration process.
C. Friction factor calibration – Modeled sanitary sewer friction factors needed to be adjusted based on the same collected metering data, but this time focusing on the observed flow depths.

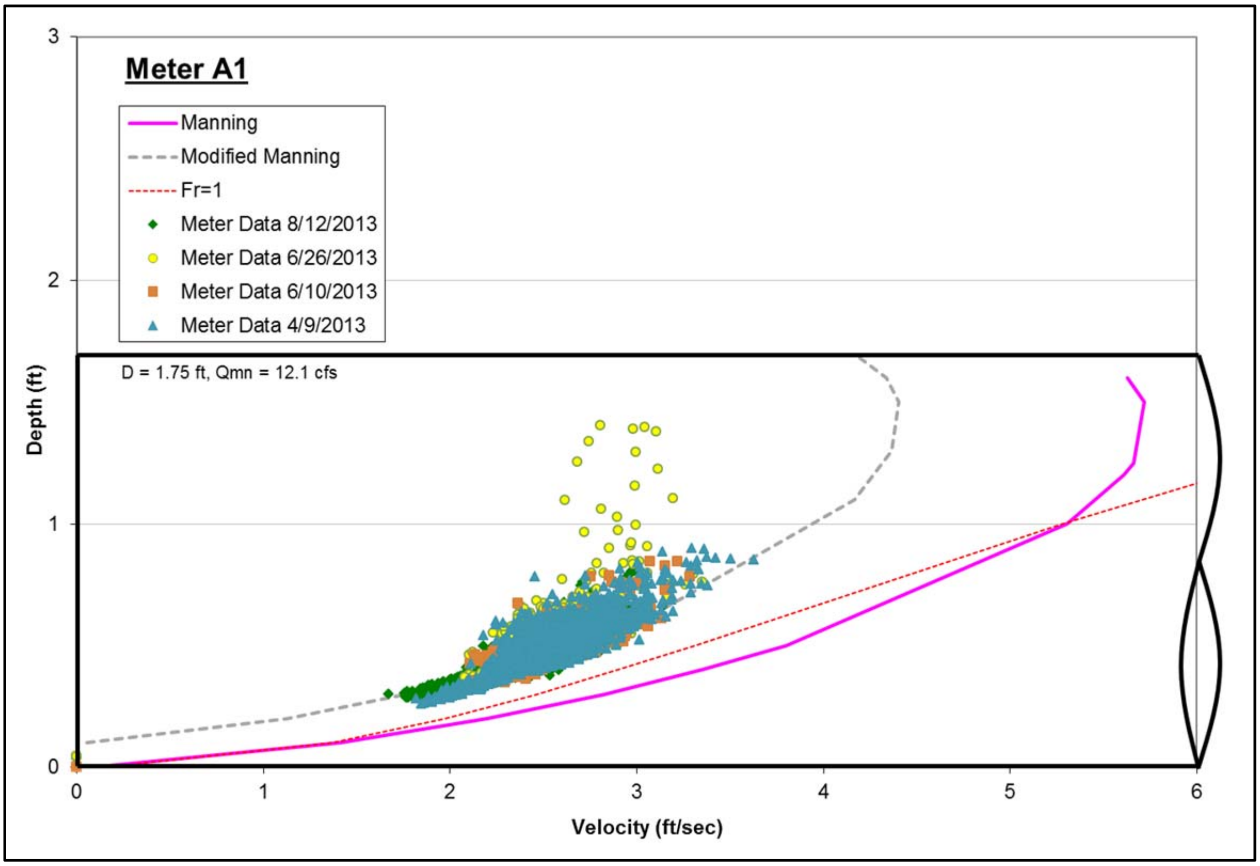
A. Dry Weather Calibration

Volume 2 of the documentation for this study summarizes the average dry weather flows measured at the temporary flow meters. The existing model dry weather flows were adjusted to match these values. Discussions about adjusting modeled wet weather flow response in order to match observed flow values is further discussed in the subsequent design event flow rate development section of this document.

B. Scatter Graph Review

Prior to null model calibration, flow metering data was evaluated in order to understand field conditions under which metering data was collected, which, in turn, assisted in the model calibration effort. This evaluation took place with the use of what is referred to as scatter graphs. A scatter graph is a plot of metered velocity and depth data, a sample of which is shown on the following Figure 2.

Figure 2: Sample Scatter Graph



Information presented in scatter graphs can be useful guides in calibrating numerical models. For example, they can inform the modeler about whether the flow is performing in a normal, surcharged, or backwater condition, and suggest phenomenon such as downstream blockages and sanitary sewer overflows. This information helps guide the calibration process, and identify which sections of the model are likely to calibrate within normal parameter ranges for friction factors and minor losses, as well as which might have unusual factors due to blockages or some other unusual hydraulic phenomenon.

C. Friction Factor Calibration

Model depth calibration was performed through a process referred to as null modeling. Null modeling consists of inputting actual, measured flows into the numerical model and comparing the modeled depth values with observed ones. Subsequently, model parameters were adjusted, within reasonable ranges, in order to match modeled depth values to within acceptable tolerance levels to the observations, usually to within less than 10% of the observed values. Areas where reasonable matches were not obtained with reasonable friction factors adjustments in the model were identified and recommendations were formulated, as discussed in the subsequent analysis results section of this document. The null modeling calibration process utilized three storms captured during the temporary flow monitoring period. These include the June 10th, June 27th, and April 11th 2013 storm events.

D. Calibration Results

Several areas were identified, which could not be calibrated within the desired 10% calibration criteria as outlined earlier, primarily due to local conditions in the field, some of which need further investigation (some of these areas formed the basis of future project areas discussed in the subsequent sections of the report). The locations needing further investigation (e.g. upstream of meter F1) required the use of friction loss modeling parameters outside the bounds of generally accepted engineering values, suggesting unusual hydraulic dynamics, the cause of which would need to be understood. Some other areas (e.g. upstream of meter MH2D) are likely the cause of steep-to-mild sewer pipe flow transitions, which, under field conditions would generate unusual hydraulic flow transition conditions but cannot be accurately modeled using SWMM modeling platforms. These areas include the following:

- Upstream of meter MH2D (steep-to-mild sewer pipe transition)
- Upstream of meter D1 (steep-to-mild sewer pipe transition)
- Upstream of meter F1 (used larger than standard engineering friction losses)
- Upstream of pressure stage recorder, which is placed upstream of meters C1&C2 (used larger than standard engineering friction losses)
- Upstream of B1 (was determined to be caused by root intrusion, which the City cleared)

The remainder of the meters calibrated within less than 10% of observed values by making simple friction factor adjustments to the numerical model.

IV. Development of Design Event Hydrograph

Volume 2 of the documentation for this study details the development of return frequency peak flow rates at select locations in the City system. These values were used in the development of the design event hydrographs for the hydraulic model. It should be noted that the means by which design event flow components were reflected in the City numerical model was through the scaling of the "R" component of the RTK inflow/infiltration (I/I) components in the existing City model to match frequency flow rates estimated at locations where temporary flow metering was conducted.

In the context of this report, a design event is considered an event that is expected to occur at an agreed upon return frequency acceptable by the community stake holders as well as regulatory agencies. It also includes appropriate flows to account for a variety of future conditions, which can be used in a hydraulic simulation model for capital improvement plan development purposes. For the City of Ann Arbor model, the development of the design event is impacted predominantly by these three factors:

- Return frequency of flow event
- Impact of climate change
- Anticipated growth in the system

Other parameters, such as I/I increases due to continual deterioration of the existing sanitary sewer infrastructure, are assumed to be small in scale compared to the above-mentioned factors, especially given the City's diligence in operation and maintenance activities to prevent these flow sources from increasing over time.

A. Return Frequency

As detailed in Volume 2, a frequency analysis was performed by generating an antecedent moisture model using long-term flows at the WWTP and temporary flow metering data, and subsequently routing 60 years of historic rainfall through this model. Because the process uses continuous antecedent moisture modeling and the historic rainfall to generate a long-term flow record, the resulting output provided information on the likelihood of various flows occurring. It also accounted for variations in rainfall amounts, rainfall pattern and various wetness conditions. As a result, 60 years of predicted flows were generated and used in a statistical analysis of flow to develop design flow rates for various recurrence intervals (i.e. 10-year, 25-year and 50-year). These flows formed the basis of the wet weather return event frequency flow component of the design event hydrograph.

B. Impact of Climate Change

Volume 2 also detailed the incorporation of climate change factors into the return frequency of flow rate estimates. These analyses indicated that a 10.4% increase in peak wet weather flows corresponds to the EPA's "high-wet" scenario for the future 6 to 35-year period which encompasses the planning period for this study.

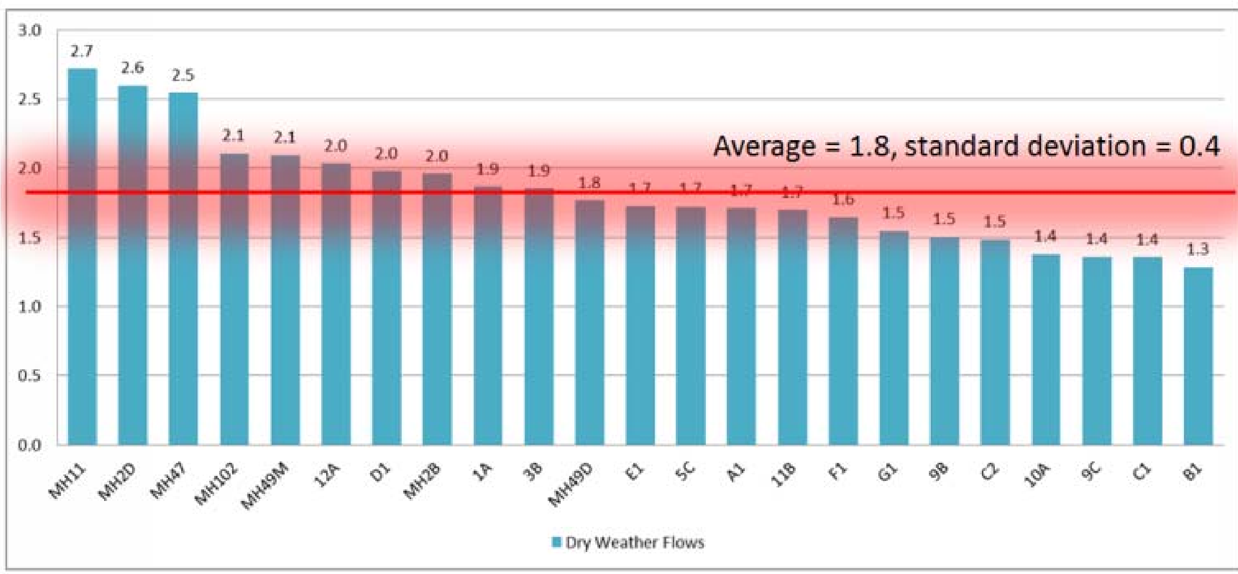
C. Anticipated Growth

It is estimated that future growth in the sanitary sewer system will occur from two potential sources:

- Development and re-development within the City of Ann Arbor.
- Growth in the contract customer communities of Scio Township, Pittsfield Township, and Ann Arbor Township.

City staff provided an estimate of the anticipated growth from planned as well as already approved developments in the City, which formed the basis of anticipated future base sanitary sewer flow increases within the City limits. These flows were subsequently increased by a peaking factor in order to estimate the peak dry weather flow from these developments. This peaking factor was determined by using flow data collected as part of this study. The Figure 3 below shows the variation of dry weather peaking factors at various meters along with the average and standard deviation. It is anticipated that new development would have less than the average peaking factor of 1.8. To be conservative, a peaking factor of 2.0 was used for peak dry weather flow from future growth.

Figure 3: Dry Weather Peaking Factors Variation



Overall growth in the customer contract communities was accounted for by increasing their flows to the peak contract limits. The Table 1 below shows the estimated total future growth in flow.

Table 1: Estimated Total Future Growth in Flow

Community	Anticipated Growth (CFS)
City of Ann Arbor	5.40[1]
Pittsfield Township	2.74[2]
Ann Arbor Township	8.67[3]
Scio Township	5.20[4]
Total	**22.01**

[1]Average, planned growth is 2.7 cfs and a peaking factor of 2.0 was used for maximum daily flow diurnals.
[2]Contract limit is 6.74 cfs and approximated, existing conditions 25-year storm flow contribution is 4.0 cfs.
[3]Contract limit is 8.67 cfs and no measurements were made regarding existing flow contributions, thus full contract limit was added to the model to be conservative.
[4]Current contract total design average allowable flow is approximately 3.2 cfs but maximum pumping capacity of 8.5 was used, excluding approximated, existing conditions 25-year storm flow.
contribution of 3.3 cfs.

V. Basis of System Evaluation

The hydraulic evaluation of the system necessitated the development of a design event scenario. The formulation of this scenario took shape during the course of evaluating three different flow scenarios as detailed in this section.

Scenario A was considered the base scenario and included the following characteristics:

- Future growth in the City is based on planned developments as reported by City staff and detailed in the previous section.
- Future growth in the Townships that the City provides sanitary sewer services to (Pittsfield, Ann Arbor, and Scio Townships) were based on setting sanitary flows to contract limits.
- 25-year recurrence interval peak wet weather sanitary flows.

Discussions with relevant stakeholders identified the need for consideration of conditions such as climate change, a basement backup protection level of service, which may be greater than a 25-year flow frequency, or the possibility of growth beyond what is planned by the City. In order to accommodate these requests, Scenario B was developed. This scenario includes flow components from Scenario A and an additional 10% increase of peak flows within the City (i.e. excluding increase in Township flows as they are set by contractual limits). The 10% increase is anticipated to accommodate the above stated possibilities as follows:

- Climate change (6 to 35-year “high wet” scenario, which corresponds to an approximately 10.4% increase in peak flows), or
- increase in level of service from a 25-year to a 50-year wet weather response (which corresponds to an approximately 9% increase in peak flows), or
- additional growth beyond that contained in the City’s planned development list.

Scenario B became the design event modeling scenario. The above stated flow components are summarized in Table 2 below. Contract customers are limited by their contract capacity and growth in the City may be offset by a Developer Offset Mitigation program.

Table 2: Flow Components

Components	Flow (cfs)
Existing Average Flow	29.7
25 yr., 24 hr. wet weather flow contribution	60.4
Anticipated Growth	22.01
10% additional increase[1] (for increased flexibility to account for unforeseen impacts)	8.74
Total Peak Flow	**120.85**

[1]Existing average flow is 29.7 cfs. Out of this, 27 cfs is approximated to be generated in the City of Ann Arbor, therefore, 10% of 27 + 10% of 60.4 wet weather contribution results in 8.74 cfs.

Finally, at the request of participating stakeholders in this project, one further analysis was performed, which increased the design event flow rate in Scenario B by an additional 10% (i.e. by an additional 8.74 cfs). This was referred to as Scenario C. Understanding the impacts of this scenario was desired because it accounts for several major flow increases simultaneously: 1) contract customers are at their contract limits, 2) increase in flows in the City from planned growth without offset mitigation from a Developer Offset Mitigation program, 3) flow increases from climate change, and 4) an increase in level of service from 25-year to 50-year recurrence interval.

VI. Results and Recommendations

The results from the hydraulic analysis of the City of Ann Arbor system as well as associated recommendations are summarized in this section.

A. Target Districts

The high priority footing drain disconnection target districts did not show flow surcharging with the exception of the Glen Leven area, indicating a potential hydraulic restriction of approximately 1,800 ft of sewer pipe. This finding shows the effectiveness of the City's footing drain disconnection program at reducing the risk of sanitary basement backups in the target districts.

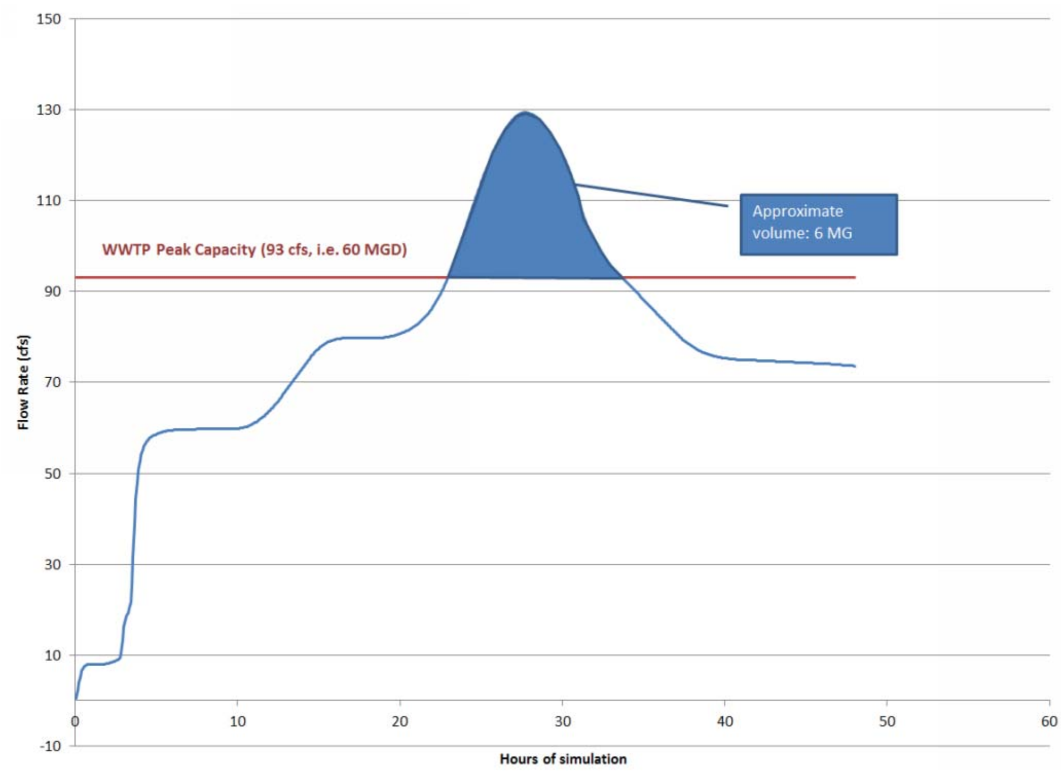
B. Wastewater Treatment Plant

Currently, the Wastewater Treatment Plant has adequate capacity to handle existing and future peak flows, and with the completion of the plant overhaul project, in progress during this study, is expected to continue to provide this level of performance.

The impact of the design event peak flow rate on the City's wastewater treatment plant was evaluated using Scenario C. As shown in the Figure 4 below, it was concluded that the plant can accommodate the flows from this alternative scenario without overflow from the equalization basin located at the plant. In the context of this Figure, it should be noted that according to City records, the sustained peak flow the plant is designed to treat is 60 million gallons per day (or 93 cubic feet per second) and the available retention and equalization volume is approximately 16 million gallons. Furthermore, a 50-year frequency event imposed on the entire system can be considered a fairly conservative simulation process with regard to the whole system because large rain events typically show spatial variation in rainfall volumes and intensities over an area as large as the Ann Arbor Sanitary Sewer System service area. For that reason, the total flow from the service area is likely to be lower than what the model predicted as part of Scenario C since some areas would be expected to receive less rainfall than others.

There is the possibility that a storm event larger than Scenario C could occur, or that the equalization basin would not be completely emptied from a previous large storm event before another large storm event occurs. The expected occurrence of events that exceed Scenario C, or of two back-to-back storms large enough to send flow to the wet weather equalization basin is very rare, and is not considered a significant risk.

Figure 4: WWTP Equalization Basin Performance During Scenario C



C. Collection System

Figures 5 and 6 show the modeled system hydraulic performance under scenarios B and C, respectively. These figures indicate that the extent of surcharging in Scenario C did not increase significantly over Scenario B. Therefore, the increase in sanitary flows for Scenario C could be addressed during project design to address capacity deficiency areas (summarized below) through small, incremental upsizing of system upgrades, which, in turn could potentially provide a larger level of service. In fact, the Citizen Advisory Committee recommended that if sanitary sewer system upgrades in hydraulically deficient areas are needed, Scenario C should be utilized in the design phase, if doing so results in a marginal increase in the project cost and disturbance to the public.

Figure 5: Preliminary Modeled Flow Analysis Scenario B

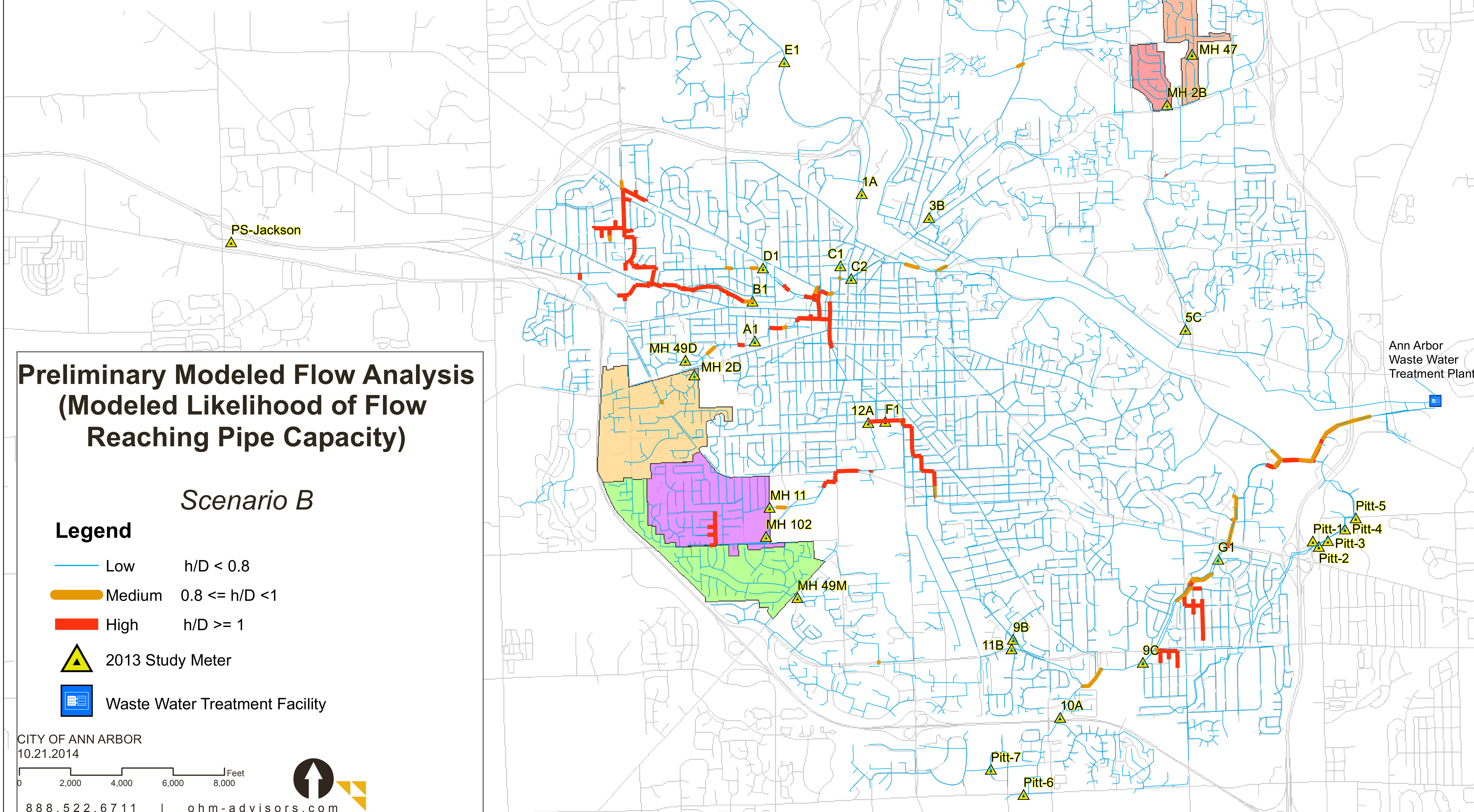
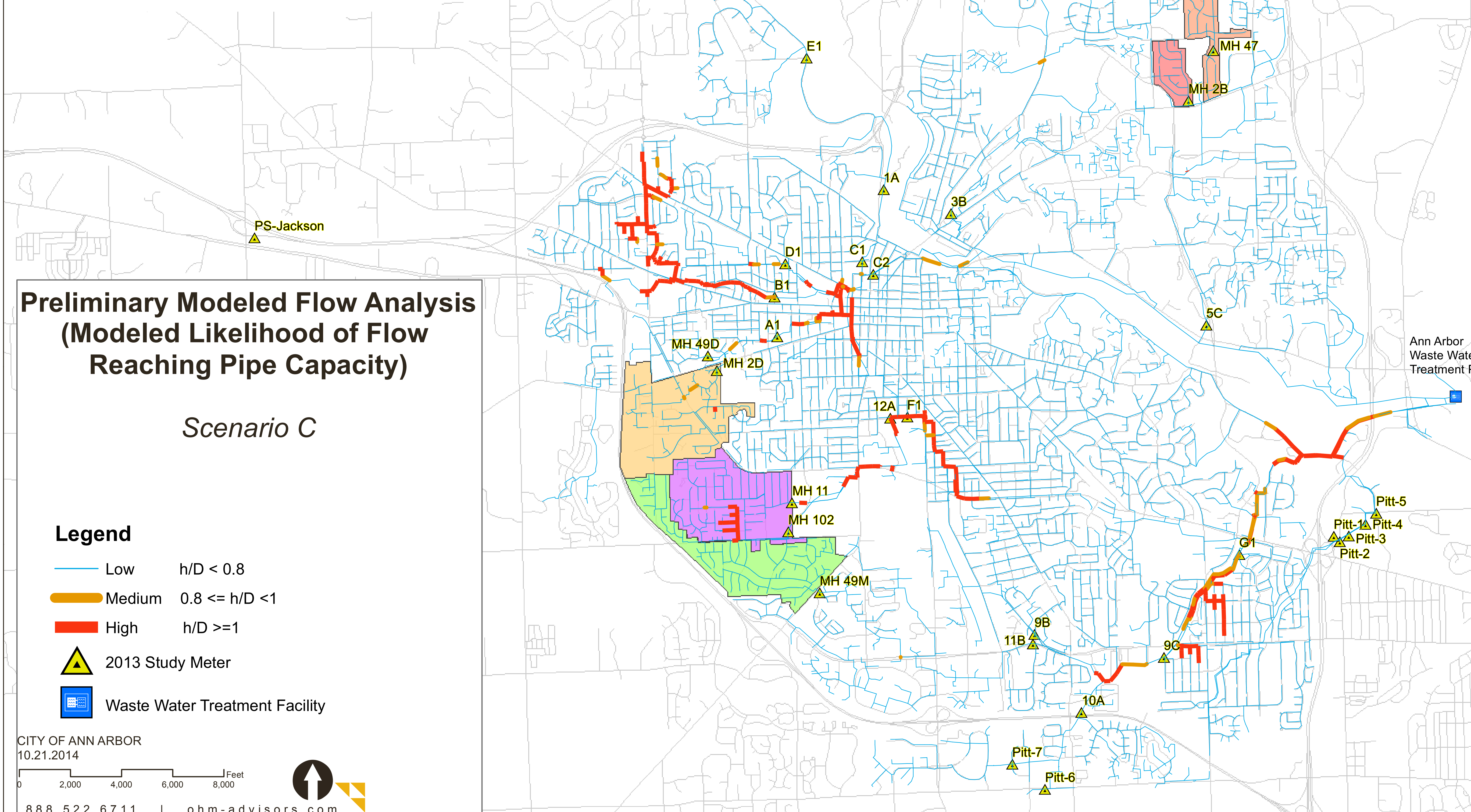


Figure 6: Preliminary Modeled Flow Analysis Scenario C



A total of six potential hydraulic deficiencies were identified in the downstream sanitary collector interceptors. These problem areas are significantly less than what the City staff was expecting based on past studies. An action plan was prepared for each area. The Technical Oversight and Advisory Committee reviewed these technical findings at their meeting on September 18, 2014 and concurred with the findings.

Many of the issues identified require collecting additional information from the specific locations to further understand and identify specific capital improvement projects. They may result in some small, focused projects. Action plans were prepared for each area and are summarized in Table 3 below. These six action plans can be found in Appendix A and are labeled as follows:

A. Project Area (A) Huron/West Park
B. Project Area (B) High Level/1st Street
C. Project Area (C) High Level/ State & Hoover
D. Project Area (D) Pittsfield Valley
E. Project Area (E) Glen Leven
F. Project Area (F) Glen/Fuller Diversion

Table 3: Action Plan Areas

No.	Project	Brief Description	Approx. Cost* ($)	Est Schedule*	Overview of Action Plan
A	Huron / West Park	Model indicates exceedance of sewer pipe capacity. However, City complaint data does not show reported sanitary backups in this area.	100,000	8 mos.	There is low confidence in the flow distribution in the model and this area is recommended for additional modeling and update of the model.
B	High Level / 1st Street	Model calibration to actual metering data shows the need to apply much higher hydraulic losses than commonly accepted engineering standards. This is a known deficiency area by the City and the reason for this unusually high loss is yet to be determined.	100,000	12 mos.	Investigate the cause of the high losses and correct it.
C	High Level / State & Hoover	Model calibration to actual metering data shows the need to apply much higher hydraulic losses than commonly accepted engineering standards. This is a known sanitary sewer overflow area. The cause of the problem is currently under investigation by the City.	100,000	12 mos.	Investigate the cause of the high losses and correct it.
D	Pittsfield Valley	Model indicates sanitary pipe capacity exceedance in this region. This area is suspected of having high footing drain flows. This area was not directly metered as part of the current study.	100,000	8 mos.	Directly meter the area and then evaluate options to reduce the risk of basement backups.

E	Glen Leven	Model indicates surcharging of approximately 1,800 ft of sanitary sewer in this previous FDD target area. High flows from inflow and infiltration still exist in this area.	20,000	3 mos.	Evaluate whether pipe surcharging is acceptable, and if not, remove flow or construct a relief sewer.
F	Glen/Fuller Diversion	There is a concern that the existing sanitary diversion structure configuration may not be adequately diverting sanitary flow during wet weather and improvements may be needed.	30,000	4 mos.	Monitor flows and correct the diversion if flows not splitting as desired during wet weather.

*The approximate cost and estimated schedule to perform additional analysis to **determine** extent of problem, not to **correct** the problem.

VII. Additional Items

A number of comments and issues have surfaced during the course of the project as noted below. This information was prepared by the SSWWE project team to fully document all items that were raised, and summarize how they were addressed.

A. Innovative Option

The University of Michigan has received a grant to examine smart sanitary sewer network of distributed sensors connected to real-time control with algorithms to operate control points to store flow where the pipes are not full. The City of Ann Arbor is one of the participating cities for the research. This is a potential innovative option that could provide further protection for rare events, particularly those with significant spatial variation in the rainfall.

B. Manhole Inflow

A comment was raised to consider the installation of the gasketed manhole cover and sealing manhole pick holes in the Citizen Advisory Committee's final recommendation. It was thought that these should at least be installed in low-lying areas, in all targeted neighborhoods, and at manholes affected by new road construction.

At this time, the City has begun to implement the gasketed manhole covers in the city. In addition, additional funding is being programmed into the City's Capital Improvement Program for the implementation of a citywide program for sealing lids and other manhole repairs/rehabilitation in flood prone and high risk areas. The potential of hydrogen sulfide gas accumulation is an issue that will need to be evaluated as part of the program.

Pick holes can result in stormwater inflow into the sanitary sewer system and should be addressed where relevant. This recommendation is included in the action plans. The City is also addressing this flow source as an operational practice. The City has a program to plug manhole pick-holes and is currently implementing a program to seal manholes with a gasket cover in low-lying areas that are prone to flooding to reduce inflow through manhole covers. We do not expect that sealing manholes and pick holes will fully address the remaining issues in the sanitary sewer system.

C. Water Conservation Measures

A suggestion was made during the project to consider drinking water conservation measures through retrofitting houses and businesses with low-flow fixtures and appliances as a mechanism to address peak sanitary wet weather flow issues. This approach is not considered practical because the magnitude of the wet weather flow in the sanitary system is much larger than the base sewage flow generated from water consumption. For example, the base flow in the sanitary sewer system from water consumption is approximately 18 cfs. The peak wet weather flow in the sanitary sewer system during large rains ranges from 90 to 120 cfs depending on the scenario. Even if water conservation measures reduced water consumption by 50% or 9 cfs, which would be very aggressive, the peak wet weather flows would only decrease by 7-10% depending on the scenario. Compare this to 70-90% flow reductions from the FDD program that were needed to significantly reduce the risk of sanitary basement backup in the priority districts. Based on these flow components, we do not believe that water conservation measures is an effective mechanism to address peak wet weather flows in the sanitary sewer system. This conclusion was presented to the chair of the Technical Oversight and Advisor Group (TOAG), and he concurred. Other methods of addressing sanitary sewer issues will be more practical and cost effective, as outlined on the six action plans. It should be noted that water conservation measures are appropriate for consideration for other important purposes.

D. Abandoned Lansdowne Pump Station

A concern was raised regarding a pump station that was originally shown on plans for the Lansdowne area, which was subsequently abandoned. City record drawings indicate that a sanitary lift station was constructed as part of the Lansdowne Subdivision (platted in 1963) at the northwesterly corner of the Lans Way/Ascot Road intersection. One run of sanitary sewer was constructed immediately downstream of the lift station which had a "temporary plug" installed in it, indicating that the gravity sanitary sewer would be extended in the future. Then in 1966 when Lansdowne No. 2 was platted and developed, this temporary plug was removed and this area received a gravity outlet. At this point, the lift station and force main were abandoned as Lansdowne was now serviced by gravity sewer through Lansdowne No. 2, and the lift station and force main were no longer needed to service the subdivision. The capacity evaluation of the sanitary sewer system in this area did not show any deficiencies with these gravity pipes.

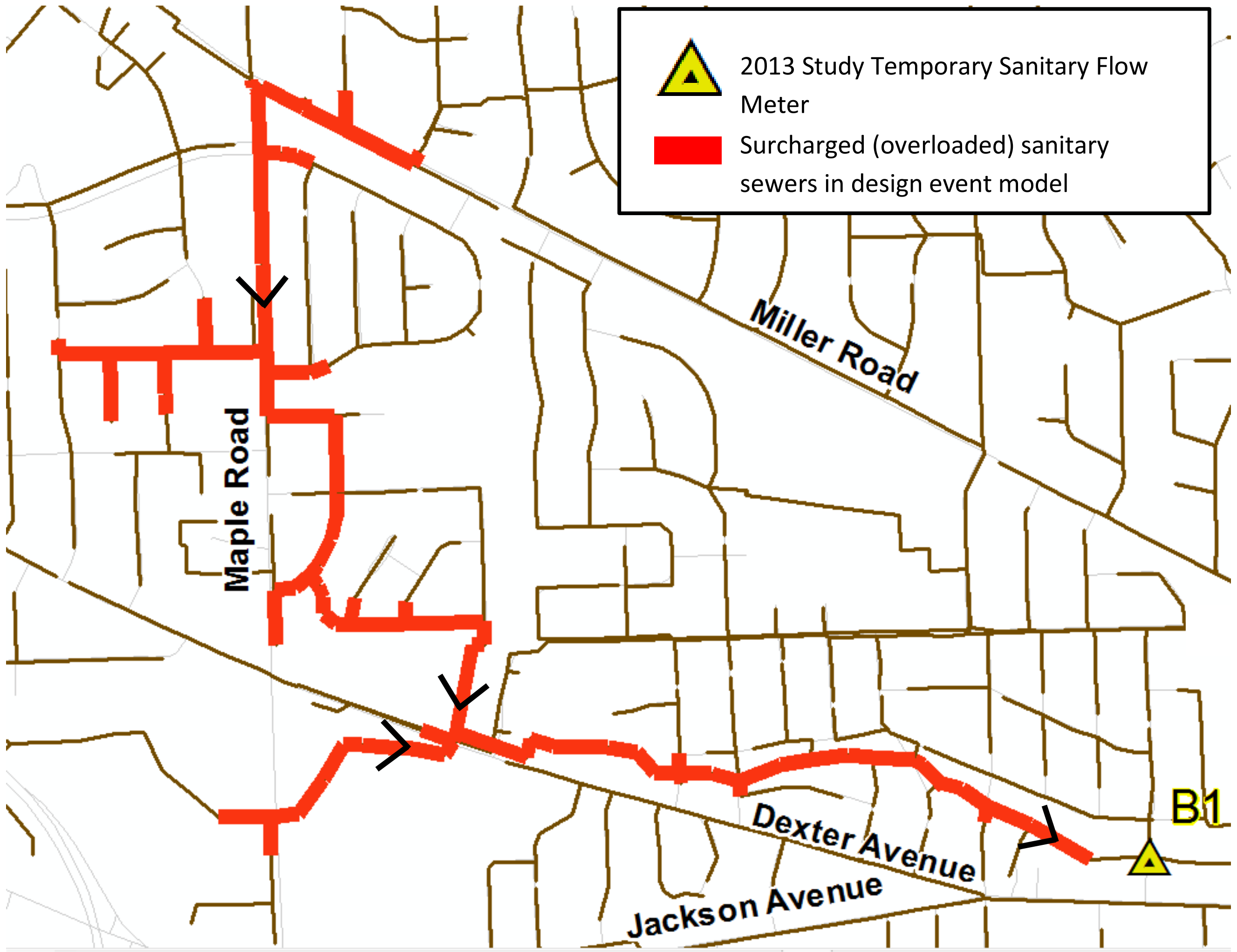
E. Linear Storage on South Seventh

A suggestion was made to consider storage in South Seventh and to coordinate the construction with the road improvements scheduled in this area. The capacity evaluation of the sanitary sewer system in this area did not show any deficiencies that would necessitate an improvement in this area, so this option was not explored further.

Appendix A

Collection System Action Plans

Project Area (A)
Huron / West Park



Sanitary Model Background

1. Existing sanitary sewer model was calibrated to downstream sanitary meter (B1) using metering data. Sanitary flow distribution upstream of this meter in the current model is as identified in previous (2002) model.
2. Sanitary model includes sanitary sewer infrastructure updates performed by the City since the development of the original sanitary model (2002).

Observations

1- Sanitary sewer model shows sanitary flows that exceed the sanitary sewer pipe capacities as identified in the adjacent figure, resulting in modeled surcharging as high as ~15 ft. above the sanitary sewer bottom.

2- The City had previously recognized this as a problem area and constructed a relief sanitary sewer downstream of meter B1. Further work was planned but extent of improvements needed was yet to be identified.

3- The City complaint data (sanitary sewer backup report) does not show reported sanitary backups in this area.

Therefore, we do not have high confidence in the surcharging identified by the sanitary sewer model and recommend action items listed below before making significant capital investments.

Suggested Action Plan for Further Investigation

Tasks Associated with Project

1. Identify locations for additional temporary sanitary metering and other data collection (e.g. video inspection) in order to better understand actual sanitary system performance.
2. Perform temporary sanitary flow metering and data collection.
3. Revise sanitary model based on findings.
4. Re-run sanitary model for design event to identify deficiencies.

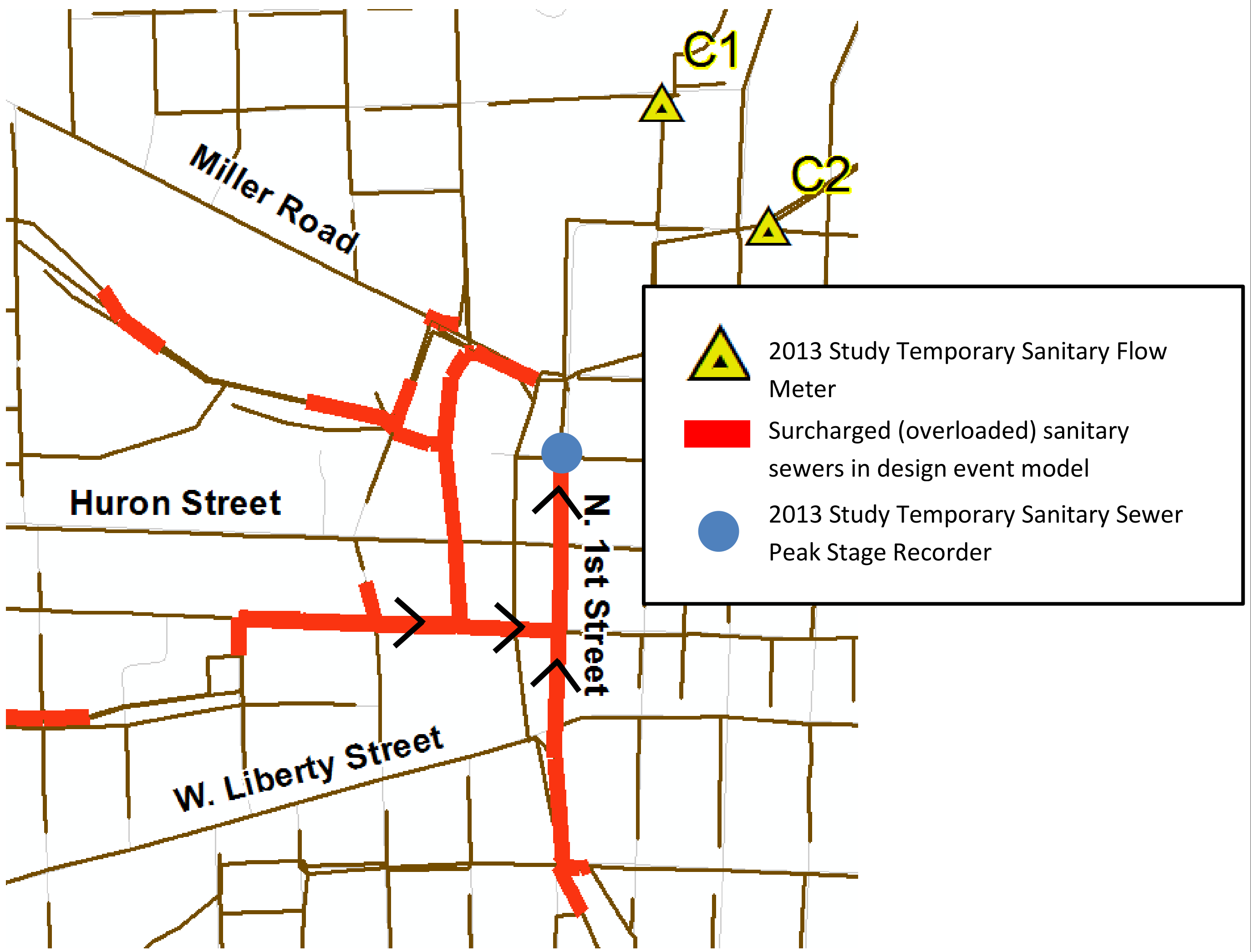
Expected Outcome

1. Sanitary flow metering and data collection report.
2. Revised sanitary sewer model.
3. Proposed plan to address sanitary sewer deficiencies, including capital improvements to be included in the City's capital improvement plan.

- **Estimated investigation cost**: less than $100,000
- **Estimated timeline to complete**: approximately 8 months

CAC COMMENTS:

Project Area (B)
High Level / 1st Street



Sanitary Model Background

1. Existing sanitary model was calibrated to downstream sanitary flow meter (C1/C2) as well as peak stage recorder (shown in figure). Sanitary flow distribution upstream of these meters in the current model is as identified in previous (2002) model.
2. Model includes sanitary sewer infrastructure updates performed by the City since the development of the original sanitary model (2002).

Observations

1- Sanitary model calibration efforts show that very high hydraulic losses, i.e. blockages, needed to be applied in order to make the sanitary model match peak stage recorder (PSR) data (location of PSR is shown on map). These losses, i.e. blockages, are much higher than suggested by engineering standards.

2- Design event sanitary sewer model calibrated to the PSR shows flows that exceed the sanitary pipe capacities, resulting in modeled surcharging as high as ~8 ft. above sanitary sewer bottom.

3- The City had previously recognized this as a problem area. Further work was planned but extent of improvements needed was yet to be identified.

Therefore, it is believed that further investigations are needed to resolve the unusual hydraulic losses before making significant capital investments.

Suggested Action Plan for Further Investigation

Tasks Associated with Project

1. Install branch flow meters to verify the flows in this area.
2. Televise and physically inspect sanitary pipes and manholes.
3. Perform field sanitary flow testing if feasible by directing water from a hydrant into the sanitary sewer.
4. Organize a wet weather mobilization team to measure sanitary depths during storm events.
5. Perform continuous sanitary depth and flow meter monitoring at key locations, if needed.

Expected Outcome

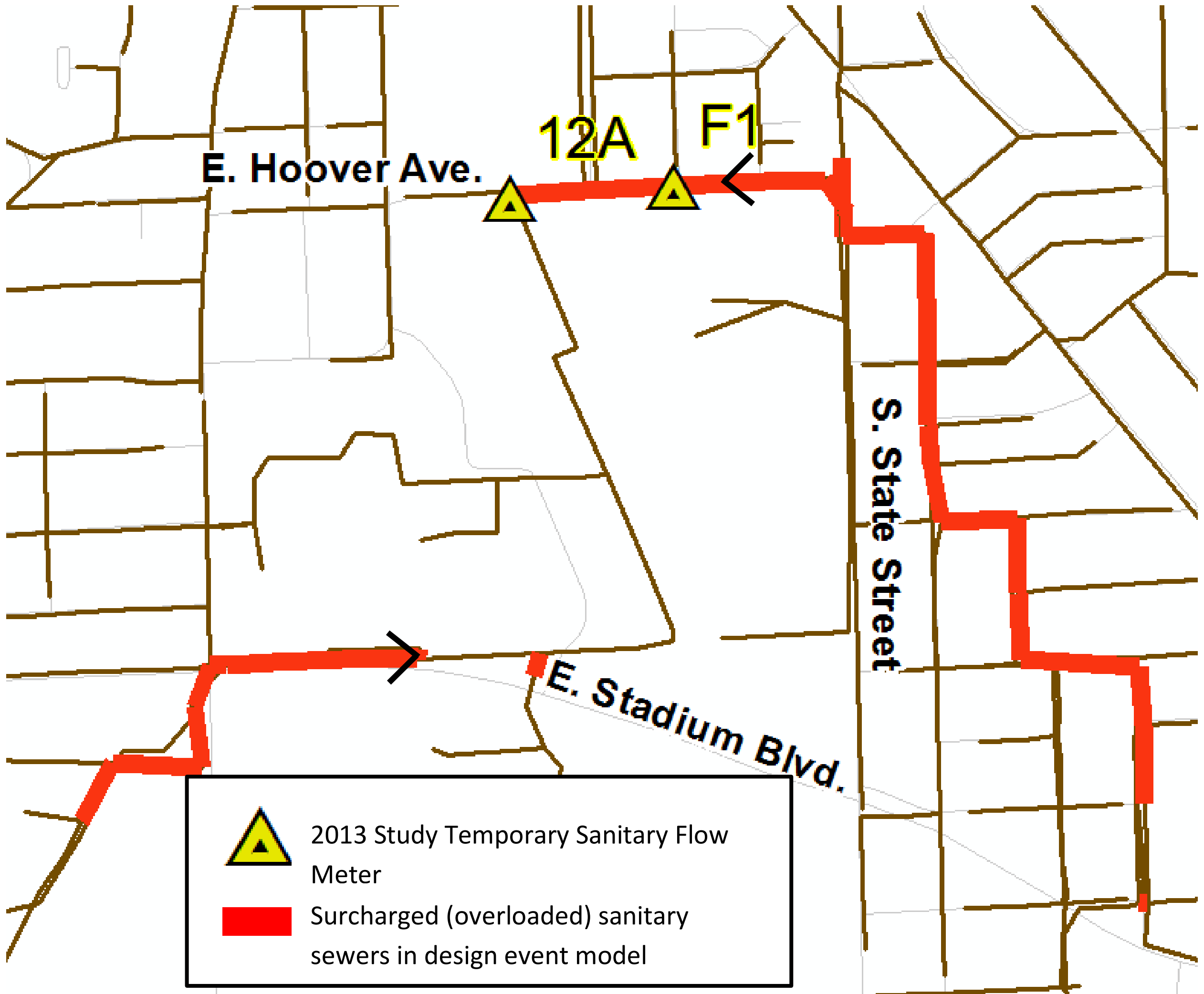
1. Identification of obvious physical obstructions (e.g. root blockages) or, if not present, in the sanitary sewer.
2. Perform further field investigation in order to identify sanitary structures and conditions resulting in unexpectedly high sanitary depths in this area.

- **Estimated investigation cost**: Less than $100,000
- **Estimated timeline to complete**: 12 months

CAC COMMENTS:

1. The 18" sanitary sewer, set west of First St., runs north from Washington St directly under what is known as the Atrium Office building (315 W Huron).
2. Examine the results of the stormwater model calibration study to determine if stormwater flooding might be contributing to issues in this area.

Project Area (C)
High Level / State & Hoover



Sanitary Model Background

1. Existing sanitary sewer model was calibrated to downstream sanitary meter (F1/12A) using metering data. Sanitary flow distribution upstream of this meter in the current model is as identified in previous (2002) model.
2. Model includes sanitary sewer infrastructure updates performed by the City since the development of the original sanitary model (2002).

Observations

1- Sanitary sewer model calibration efforts show that very high hydraulic losses needed to be applied in order to make the model match sanitary flow meter data. These losses are much higher than suggested by engineering standards.
2- Design event sanitary sewer model calibrated to the downstream sanitary flow meter shows flows that exceed the sanitary pipe capacities, resulting in modeled surcharging as high as ~8 ft. above sewer bottom.
3- The City had previously recognized this as a problem area. Further work was planned but extent of improvements needed was yet to be identified.
4- This is a known Sanitary Sewer Overflow (SSO) area - upstream of meter F1.

Therefore, it is believed that further investigations are needed to resolve the unusual hydraulic losses before making significant capital investments.

Suggested Action Plan for Further Investigation

Tasks Associated with Project

1. Televise and physical inspect sanitary pipes and manholes.
2. Perform field sanitary flow testing if feasible by directing water from a hydrant into the sanitary sewer.
3. Organize a wet weather mobilization team to measure sanitary depths during storm events.
4. Perform continuous sanitary depth and flow meter monitoring at key locations, if needed.

Expected Outcome

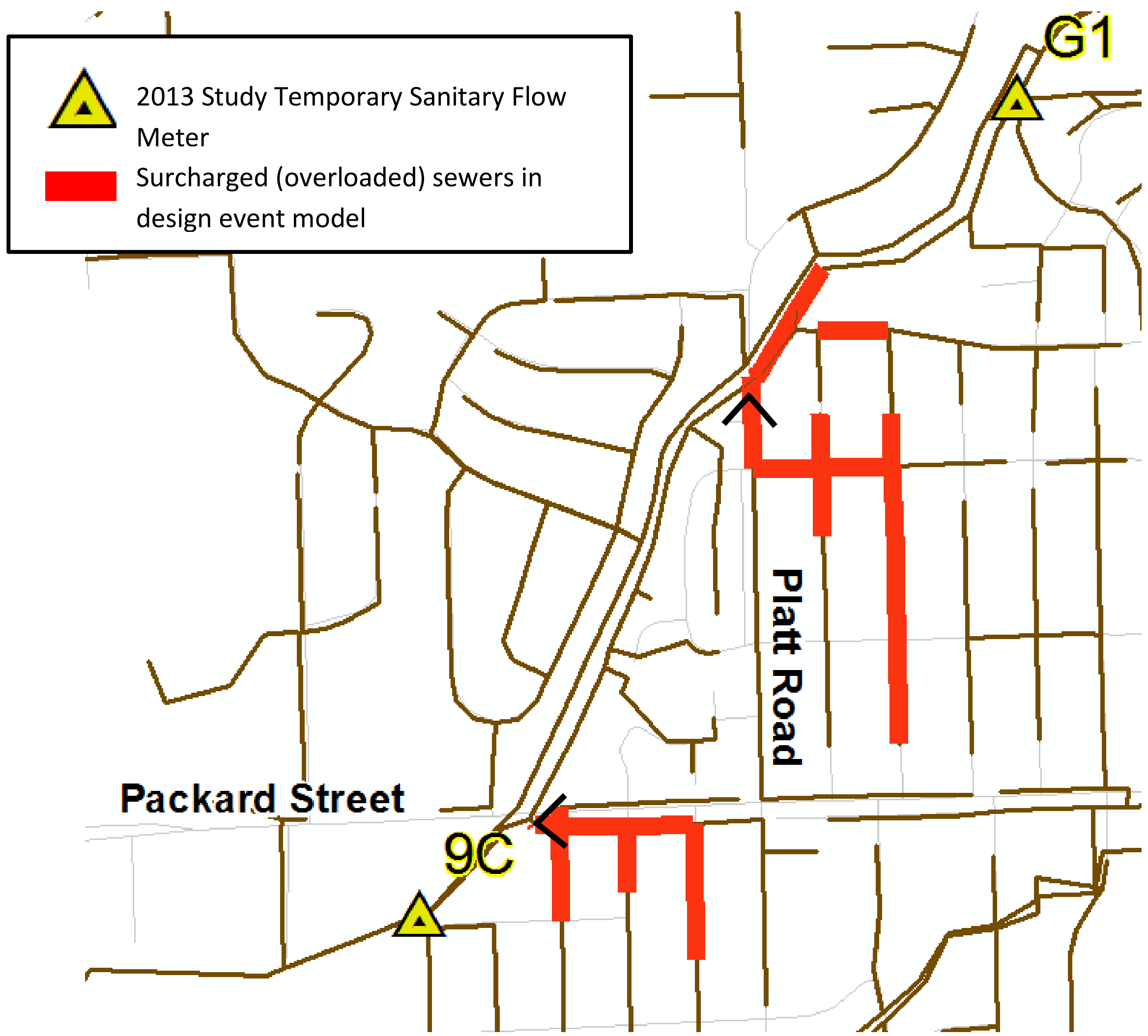
1. Identification of obvious physical obstructions (e.g. root blockages) or, if not present, in the sanitary sewer.
2. Perform further field investigation in order to identify sanitary structures and conditions resulting in unexpectedly high sanitary depths in this area.

- **Estimated investigation cost**: Less than $100,000
- **Estimated timeline to complete**: 12 months

CAC COMMENTS:

1. Consider monitoring the sanitary depth downstream to understand where the sanitary back-ups begin.

Project Area (D)
Pittsfield Valley



Sanitary Model Background

1. Existing sanitary sewer model was calibrated to downstream sanitary meter (G1) using metering data. Sanitary flow distribution upstream of this meter in the current model is as identified in previous (2002) model.
2. Sanitary model includes sanitary sewer infrastructure updates performed by the City since the development of the original sanitary model (2002).

Observations

1- Sanitary model shows sanitary flows that exceed the sanitary pipe capacities as identified in the adjacent figure, resulting in modeled surcharging as high as ~11 ft. above sanitary sewer bottom.

2- The City had previously recognized this as a problem area as this area includes sanitary backup complaints.

3- This area is suspected of having high footing drain flows that maybe overloading the sanitary system. The area was not directly metered and so actual sanitary flows are not known. Sanitary model results are based on assumed sanitary flow distribution.

Therefore, it is believed that further investigations are needed before making significant capital investments (i.e., storage, relief sewer, sanitary flow source removal, including FDD).

Suggested Action Plan for Further Investigation

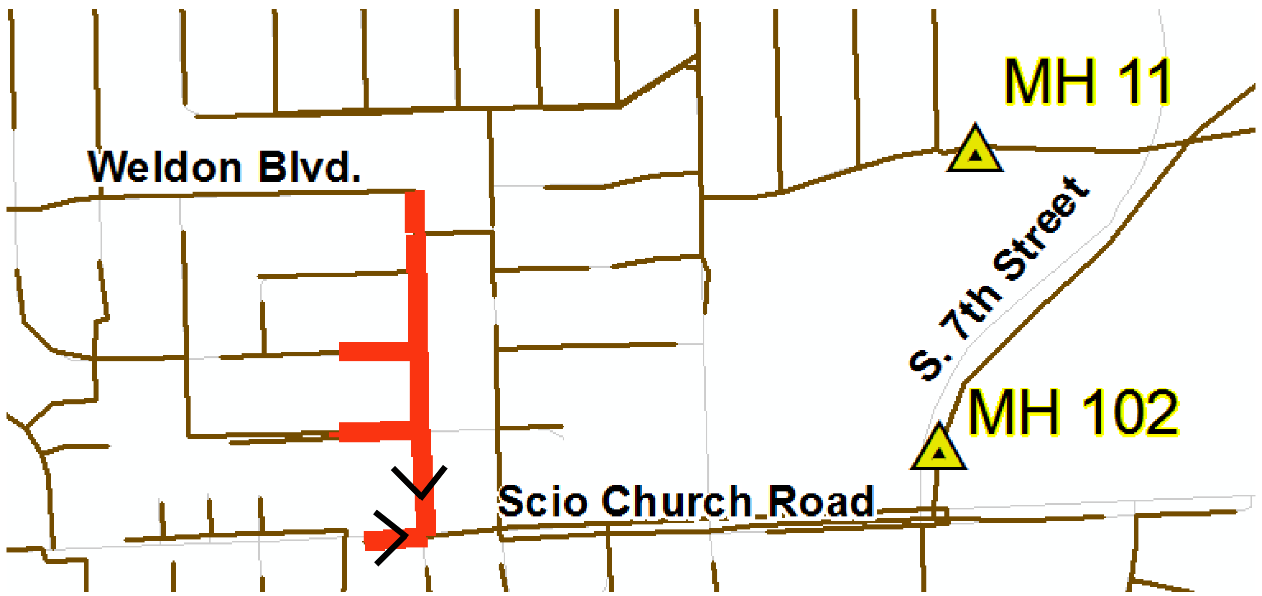
Tasks Associated with Project	**Expected Outcome**
1. Ensure that all sanitary manhole pick holes are plugged before flow metering 2. Perform sanitary metering to understand sanitary flow magnitude and source. 3. Survey home owners to understand extent and cause of sanitary sewer basement backups. 4. Determination of cause of sanitary backups (i.e. is it high sanitary flows, system capacity constraints, or local, homeowner system issues).	1. Sanitary flow metering, data collection, and survey results report. 2. Revised sanitary sewer model. 3. Proposed plan to address sanitary deficiencies, including capital improvements to be included in the City's capital improvement plan to address identified sanitary sewer deficiencies.

- **Estimated inspection cost**: less than $100,000
- **Estimated timeline to complete**: approximately 8 months

CAC COMMENTS:

1. Consider sealed and gasketed sanitary manhole lids.

Project Area (E)
Glen Leven



2013 Study Temporary Sanitary Flow Meter
Surcharged (overloaded) sanitary sewers in design event model

Sanitary Model Background

1. Existing sanitary sewer model was calibrated to downstream sanitary meter (MH11/MH102) using metering data. Sanitary flow distribution upstream of this meter in the current model is as identified in previous (2002) model.
2. Sanitary model includes sanitary sewer infrastructure updates performed by the City since the development of the original sanitary model (2002).

Observations

1- Sanitary model shows sanitary flows that exceed the sanitary pipe capacities for approximately 1,800 ft., resulting in modeled surcharging as high as ~3 ft. above sanitary sewer bottom.
2- This is one of the high-priority footing drain disconnection areas (Glen Leven).
3- Sanitary metering data analysis indicated that footing drain disconnection was less effective in this area than in the other high-priority areas.
4- High flows from inflow & infiltration into the sanitary system still exist in this district, either from remaining footing drains or other inflow & infiltration sources.

Therefore, it is believed that further investigations are needed before making significant capital investments.

Suggested Action Plan for Further Investigation

Tasks Associated with Project

1. Determine sanitary surcharge level that impacts basements.
2. Develop a scope and cost for sanitary sewer evaluation survey (SSES), inclusive of televising, sanitary manhole inspection, smoke testing, and temporary sanitary flow monitoring.
3. Prepare a preliminary cost estimate for a sanitary relief sewer.
4. Perform cost effectiveness evaluation between construction of relief vs further I/I removal.

Expected Outcome

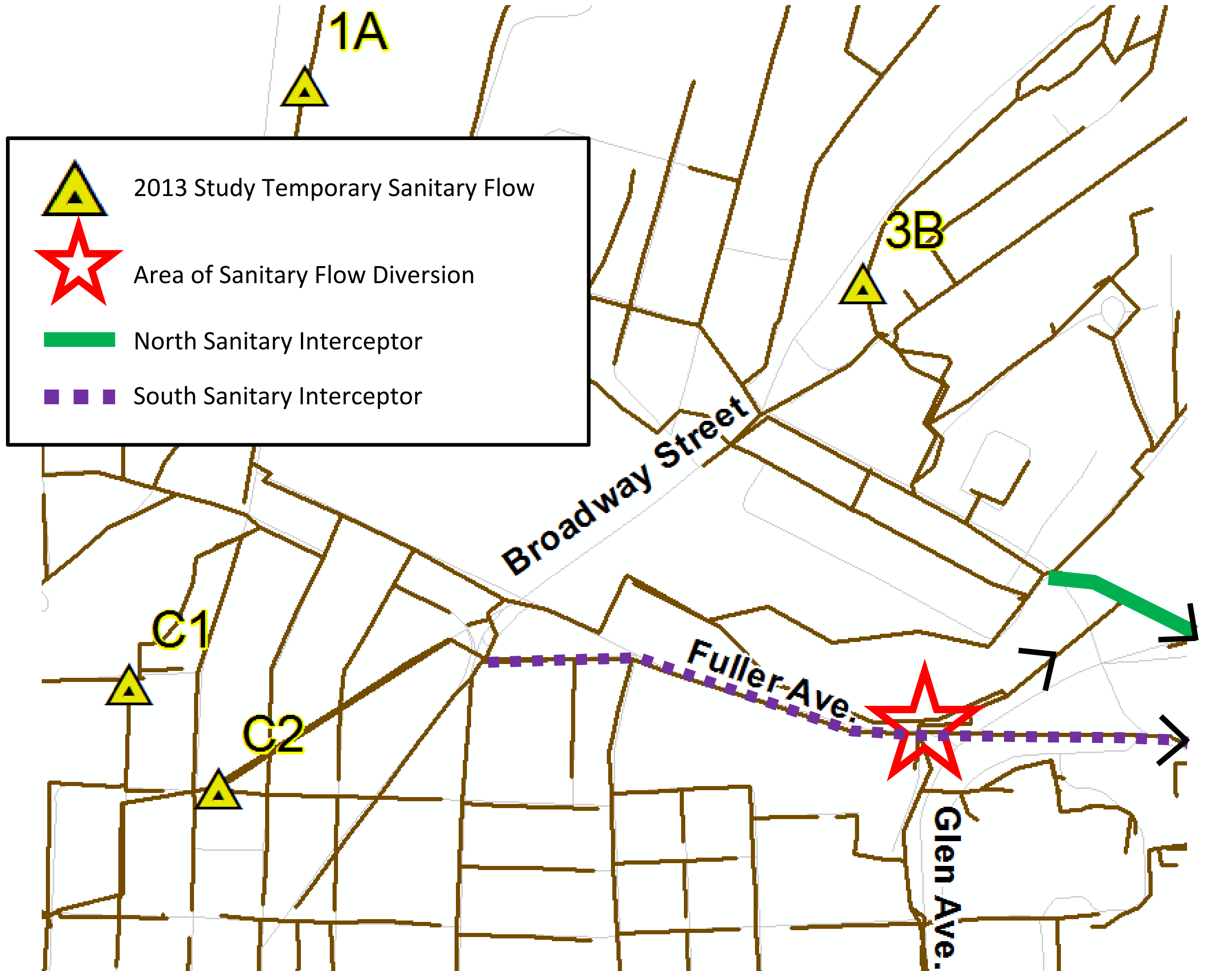
1. Evaluation results of whether sanitary surcharge is acceptable.
2. Cost estimates for SSES, I&I removal, and construction of relief sanitary sewer.
3. Recommendation for how to proceed based on cost estimates and community values.

- **Estimated investigation cost**: Less than $20,000
- **Estimated timeline to complete**: 3 months

CAC COMMENTS:

1. What is our level of confidence in the model in this area, and the prediction of 3-feet of surcharge? *OHM indicated high confidence.*
2. There were some concerns expressed by OHM about the flow split between the two meters on this area. Does that affect the confidence? *No. The meter data was used to distribute the sanitary flow in the model.*
3. Should the City consider some "free board" above the three feet of surcharge to provide some cushion before basements are impacted? *CAC recommends two feet.*

Project Area (F)
Glen/Fuller Diversion



Sanitary Model Background

1. The sanitary diversion shown in the map helps move sanitary flow from the south sanitary interceptor to the north sanitary interceptor during high sanitary flows, thereby improving the performance of the south sanitary interceptor by making use of available capacity in the north sanitary interceptor.
2. Sanitary flow diversion is achieved in the sanitary sewer via a sanitary pipe with the top cut off. When the sanitary flow reaches the level of the cutoff top, it spills over into the diversion pipe to the north sanitary interceptor.
3. This sanitary diversion is currently modeled as a basic sanitary flow diversion.

Observations

1- There is concern that the sanitary diversion structure configuration in the field (sanitary sewer pipe with the top cut off) may not be adequately diverting sanitary flow during wet weather (high flow conditions) and improvements may be needed in order to make it operate as desired during wet weather. The flow split during dry weather conditions is not a concern.
2- The City is considering temporary metering sanitary flows in the vicinity of this sanitary diversion structure in order to understand its current performance.

Therefore, before any further capital improvements are initiated in this area to improve structure efficiency, further evaluation is warranted.

Suggested Action Plan for Further Investigation

Tasks Associated with Project

1. Identify level of operational flexibility and control in the existing sanitary diversion structure.
2. Perform temporary sanitary flow metering and data collection
3. Implement proposed sanitary diversion structure design changes as necessary.

Expected Outcome

1. Sanitary flow metering and data collection report.
2. Determination of whether sanitary diversion needs modifications to function as intended.
3. Ann Arbor City staff to review findings and implement operational changes as needed.

- **Estimated investigation cost**: Tasks 1 & 2, less than $30,000
- **Estimated timeline to complete**: 4 months

CAC COMMENTS:

1. A noticeable odor can be smelled in the area when this sanitary diversion is active.
2. This project is not driven by potential sanitary basement backups, and is a sanitary sewer operations issue. As such, it is not really within the focus of the CAC, and should be a City focus as part of their operations of the sanitary system.

CITY OF ANN ARBOR

Sanitary Sewer Wet Weather Evaluation

VOLUME 5: PUBLIC ENGAGEMENT REPORT

January 2015

OHM
Advancing Communities℠

ARCHITECTS. ENGINEERS. PLANNERS.

Table of Contents

I. Introduction

A. Project Objectives

Since 2002, the City of Ann Arbor has been implementing a Footing Drain Disconnection (FDD) Program to reduce rainfall dependent inflow and infiltration (RDII) and the subsequent risk of sanitary basement backups from their wastewater collection system. Following numerous complaints and questions about the FDD Program, the City suspended a large portion of the program in 2012. Following this suspension, the City initiated a Sanitary Sewer Wet Weather Evaluation (SSWWE) Project specifically intended to address the following objectives:

1. Engage the public through the project, including the formation of a Citizens Advisory Committee (CAC) to make the final recommendations to Council.
2. Evaluate the flow removal effectiveness of the FDD Program.
3. Examine issues with the FDD Program to date and make recommendations to correct the issues. This is a new objective identified during the project.
4. Evaluate the risks of future basement backup and sanitary sewer overflows from the sanitary sewer system.
5. Develop recommendations for the wet weather program for the City's sanitary sewer system.

B. Overview of City's Wet Weather Projects

The SSWWE Project is one (1) of four (4) wet weather projects that the City has been conducting. A brief description of each project and component of the overall wet weather program is contained below. Additional details for each project are available through the project team and subsequent documentation prepared for each project. Figure 1 contains an overview of the overall wet weather program.

- **Stormwater Model Calibration & Analysis Project** - Citywide project to create a calibrated model of the City's stormwater system to accurately represent real world stormwater behavior. This model will help identify aspects of the City's stormwater system that would benefit from improvement.
- **Upper Malletts Stormwater Conveyance Study** - Washtenaw County worked in partnership with the City of Ann Arbor and with help from the local community to evaluate the stormwater problems in the Malletts Creek area. The study identified, analyzed and proposed a set of options to decrease the risk of flooding for Upper Malletts Creek neighborhoods. This study was completed in the spring of 2014.
- **Sanitary Sewer Wet Weather Evaluation Project** – Topic of this report, with objectives outlined above. Focused on the effectiveness of the FDD program at reducing sanitary backups into basements.

- **Footing Drain Disconnection (FDD) Program** - The City of Ann Arbor's project initiated in 2002 at the recommendation of the Sanitary Sewer Overflow Citizens Advisory Committee to reduce the incidents of sewage backups in basements in the City. The FDD Program was partially suspended as of September 2012 pending the outcome of the SSWWE Project.

The Over-Arching Technical Oversight & Advisory Group (TOAG) is a group of industry and technical experts formed to review and comment on the technical aspects of the City's wet weather projects. Findings from each of the wet weather studies were presented to the TOAG for review and comment. The Technical Working Group is comprised of the City's Project Managers for each of the wet weather studies, and staff leadership to coordinate project efforts and milestones amongst the various projects. Each project formed a citizens advisory group and conducted public meetings and resident meetings during the duration of each project to solicit input from the public on community values and recommendations.

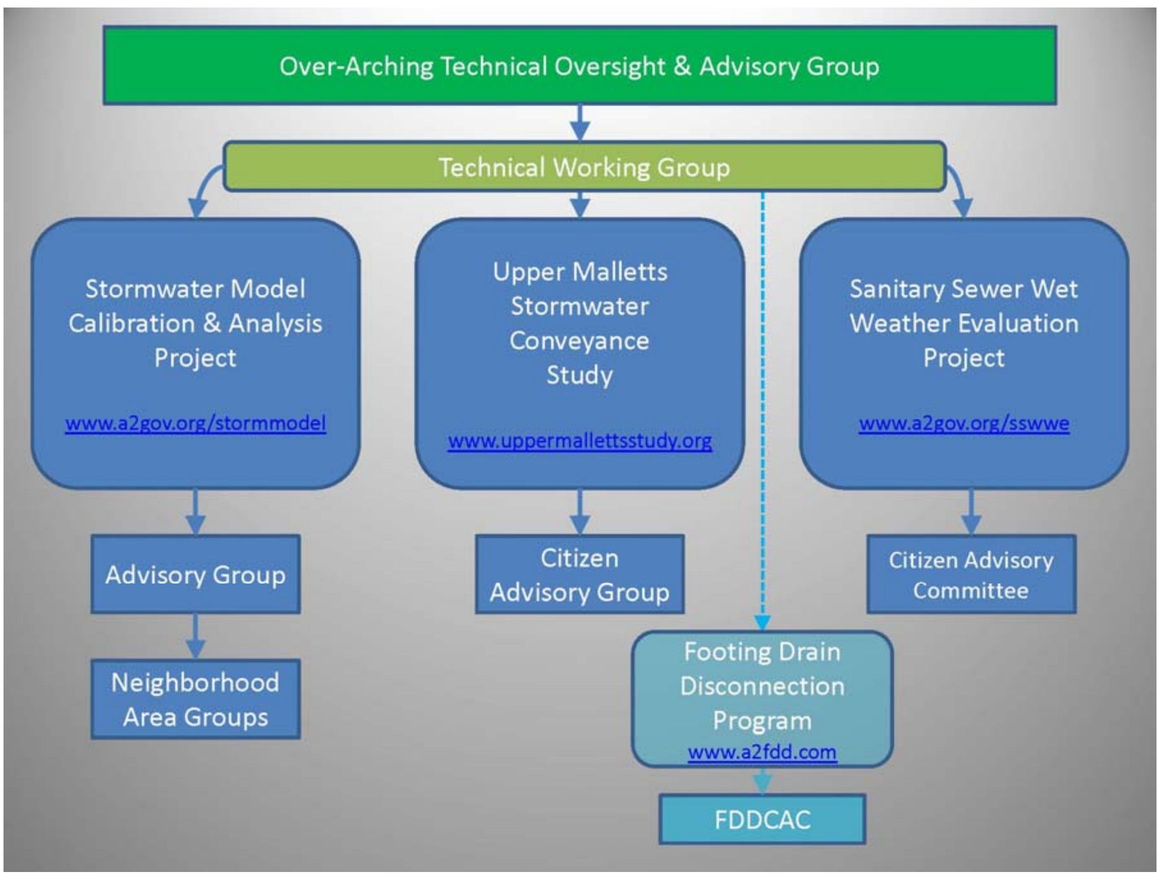


Figure 1: Overview of City's Wet Weather Projects

C. Report Outline

This report was preceded by several technical reports that documented the technical analyses and findings conducted as part of the study. These report volumes were prepared as each component of work was performed and were previously submitted and accepted by the City. The final reports on the SSWWE Project consists of the following five (5) volumes:

- **Volume 1 – Flow Metering Report** – Documented the 2013 flow metering locations, methods and results.
- **Volume 2 – Flow Evaluation Report** – Quantified the magnitude of flow removed from the sanitary sewer system as a result of FDD.
- **Volume 3 – Flow Components Report** – Provided a split of the flow in the sanitary sewer system into components (sewage, ground water infiltration, wet weather flow) and estimated the production rates from FDDs for the metering districts across the City.
- **Volume 4 – Hydraulic Report** – Outlines the findings and recommendations from the hydraulic modeling and capacity assessment of the sanitary sewer system.
- **Volume 5 – Public Engagement Report (this report)** – Documents the public engagement activities performed as part of the SSWWE Project.

D. Purpose of this Report

This Public Engagement Report documents the public engagement activities performed as part of the SSWWE Project. The major components of the public engagement included:

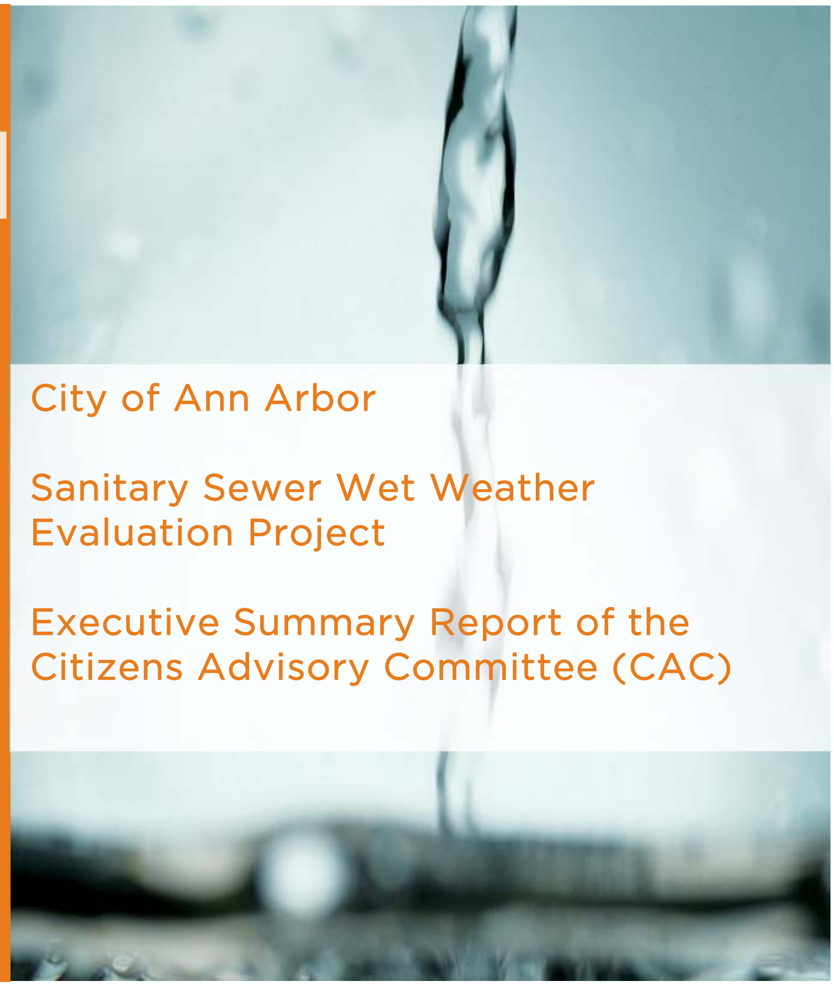
1. Broadcasted meetings and information via:
    a. City website public calendars
    b. Press releases for all public meetings
    c. City email list
    d. Direct mail to FDD homes for surveys and meeting notices
2. Formed a Citizens Advisory Committee (CAC) and conducted sixteen (16) CAC meetings.
3. Conducted an extensive survey of residents who had FDD performed. 2,350 surveys sent and 850 responses, which were used to guide an investigation into several FDD installations.
4. Conducted numerous public meetings including:
    a. Two (2) public meetings on the SSWWEP
    b. Two (2) public meetings on FDD
    c. Three (3) FDD subcommittee meetings
    d. Numerous individual and small group technical briefings and phone interviews
5. Developed and maintained project library web site on the City's web page.
6. Developed and maintained CAC calendar and document management site (Basecamp), including download of all CAC digital discussions to City web site.
7. Videotaped all CAC and public meetings and provided on City web site.
8. Created four (4) informational videos and numerous infographics.
9. Submitted materials to the TOAG and incorporated their comments into our work.

Documentation of these activities is contained in the subsequent sections of this report.

II. Executive Summary

On the following pages you will find the Sanitary Sewer Wet Weather Evaluation Project Executive Summary Report.

December 11, 2014



City of Ann Arbor

Sanitary Sewer Wet Weather Evaluation Project

Executive Summary Report of the Citizens Advisory Committee (CAC)

OHM
Advancing Communities®

Prepared by OHM Advisors

CONTENTS

3. Introduction

Since 2002, the City of Ann Arbor has been implementing a footing drain disconnection (FDD) program to reduce rainfall dependent inflow and infiltration (RDII) and the subsequent risk of sanitary basement backups from their wastewater collection system. The City is responsible for operating and maintaining the public sanitary and stormwater infrastructure. Following numerous complaints and questions about the FDD program, the City suspended a large portion of the program in 2012. Following this suspension, the City initiated a Sanitary Sewer Wet Weather Evaluation (SSWWE) project specifically intended to address the following objectives:

a. Engage the public through the project, including the formation of a Citizens Advisory Committee (CAC) to make the final recommendations to Council.

b. Evaluate the flow removal effectiveness of the FDD program.

c. Evaluate the risks of future basement backup and sanitary sewer overflows from the sanitary sewer system.

d. Develop recommendations for the wet weather program for the City's sanitary sewer system.

In response to the FDD Survey performed, an additional objective was identified during the course of the study which was to examine issues with the FDD program to date and make recommendations to correct the issues. This is a new objective identified during the project and is covered in Section B.

The technical study consisted of sanitary flow metering, quantification of the flows removed from the sanitary system from the FDD program, hydrologic modeling to understand the frequency of sanitary wet weather peak flows, hydraulic modeling to support a sanitary capacity assessment, and the development of action plans to address identified sanitary sewer system deficiencies. Public engagement was performed throughout the project, including public meetings and the development of the CAC. The 2013 sanitary flow metering period experienced a number of significant rain events and provided suitable data to perform the study.

4. Major Findings

The most significant outcome from the study is the recommendation that additional **<u>FDDs are no longer needed</u>** in the original five (5) target areas. Other major findings from the study include:

a. The FDD program on average removed about 65% of the wet weather peak flow in the target districts from the sanitary system. Four (4) of the five (5) target districts (Orchard Hills, Bromley, Morehead and Dartmoor) have a 90% or greater statistical confidence of significant flow removals. A map of the five (5) target districts can be found in the Volume 2: Flow Evaluation Report, page 5, Figure 1. The Glen Leven district appears to be less effective, with a flow removal rate of about 36%, and the reason for this is still unknown.

b. The FDD program reduced the risk of basement backups in the target districts to the point where additional FDDs are not needed in these districts to achieve the desired level of protection for the system. For example, prior to the FDD program, a large storm event would result in widespread sanitary basement backups, especially in the target areas. After FDD, during the large storm event that occurred on June 27, 2013, there were no reports of basement backups attributed to the sanitary sewer system, in the five (5) target areas. Several high-risk homes in these areas had check valves installed prior to the study. However, the sanitary flow metering data shows that the sanitary sewer depths did not fill the pipes in these areas, so it is unlikely that the check valves were active and needed during this storm.

c. The hydraulic capacity assessment of the sanitary sewer system shows no issues in the target neighborhoods, except a section of pipe approximately 1,800 feet long in the Glen Leven district with a potential hydraulic restriction.

d. Five (5) potential hydraulic deficiencies (NOT the same as the five (5) original target areas) and one (1) potential operational improvement were identified in the downstream sanitary collector interceptors. These project areas are significantly less than what the City staff was expecting based on past studies. An action plan was prepared for each area. The Technical Oversight Advisory Committee (TOAG) reviewed these technical findings at their meeting on September 18 and concurred with the findings.

e. The Wastewater Treatment Plant (WWTP) has adequate capacity to handle existing and future peak flows, and with the completion of the plant overhaul project, will be upgraded to continue to provide this level of performance for the long-term.

f. A December 2013 survey of homeowners who had FDD performed in their home was conducted which led to follow-up inspections and a plan to alleviate issues with FDDs that were found to be out of compliance with the FDD project specifications. Findings and recommendations are in Section B.

5. Basis of System Evaluation

The design scenario that was selected for the evaluation of the sanitary system is described below:

a. Future growth in City based on planned development.

b. Future growth in township contract customers based on setting sanitary flows to contract limits.

c. 25-year recurrence interval peak sanitary flows plus 10% additional peak flow for:

i. Climate change (EPA National Stormwater Calculator "6-35 year high-wet" scenario is 10.4% increase in peak flows), or

ii. Increase in level of service from 25-year to 50-year (which is a 9% increase in peak flows), or

iii. Additional growth beyond that contained in the planned development.

Note that a larger scenario was also examined, which increased peak sanitary flows by 20% over the 25-year recurrence interval peak flow used in the design scenario described above. In OHM's evaluation of this larger scenario, the extent of the surcharging did not increase significantly. The increase in sanitary flow from the larger scenario could be addressed during project design through a small incremental upsizing of a system upgrade, such as building a slightly larger relief sanitary sewer, for example. This could potentially provide a large increase in the level of service provided by the sanitary sewer for a marginal increase in cost, and should be evaluated before sanitary upgrades are finalized.

6. Action Plans for the Six Project Areas

Five (5) potential hydraulic deficiencies and one (1) potential operational improvement were identified in the downstream sanitary collector interceptors. These can be found on a map shown in the Volume 4: Hydraulic Report, Appendix A. Many of the issues identified will require collecting and analyzing additional information from the specific location to further understand what improvements are required. An action plan was prepared for each area. The six (6) Action Plans are attached and are as follows:

a. Huron / West Park

b. High Level / 1st Street

c. High Level / State & Hoover

d. Pittsfield Valley

e. Glen Leven

f. Glen/Fuller Diversion (operational improvement item)

7. CAC Recommendations

During the October CAC meeting, in an attempt to identify where consensus existed regarding the recommendations, the facilitator polled the attending CAC members. All CAC attendees, ten (10), supported the recommendations below:

a. Perform the tasks outlined on the six (6) action plans for the project areas.

b. Should sanitary sewer system upgrades be required to address an issue in the six (6) project areas, utilize the larger design basis (50-year rain) as described in the Volume 4: Hydraulic Report, if doing so results in a marginal increase in the project cost and disturbance to the public.

c. Install a series of permanent meters in critical sanitary sewer system areas to provide a long-term record of sanitary system performance.

d. Formalize and perform a rotating maintenance program to proactively find high sanitary flows, blockages and collapses in the sanitary sewer system, including quickly establishing a baseline for the entire City. This would include rotating temporary sanitary sewer metering, sanitary manhole inspections and sanitary pipe video inspections. The frequency of the rotating program should follow industry standards for asset management and be planned to provide proactive identification of sanitary sewer issues. A higher frequency should be focused in those portions of the sanitary sewer system experiencing greater issues, such as those in the problem areas already identified. The program should include periodic evaluation of the original five (5) target FDD districts to verify they are still performing as desired.

B. FDD SURVEY / ISSUES RESOLUTION

1. FDD Survey Results - Dec 2013 to Jan 2014

a. 2350 surveys mailed to participants of both the City FDD program and the Developer Offset Mitigation (DOM) program, 850 responses – 133 completed online; 717 returned by mail, 36% response rate (Note: typical response rate for a municipal survey ranges from 20% to 40%).

b. Confidence level that the sample results represent responses from the entire set = 99%, with margin of error = 3.6% +/-.

c. 70% satisfied with sump pump installation.

d. 45% would recommend sump pump installation to a neighbor, twice as many as those who would not.

e. 100 of the 134 respondents that reported experiencing sanitary sewage backups PRIOR to FDD/sump pump installation did NOT experience them after FDD/sump pump installation.

f. 106 respondents who reported no flooding/seepage/dampness BEFORE FDD said they did experience flooding/seepage/dampness AFTER FDD.

g. Almost 40% reported some or significant increase in anxiety.

h. Received 131 comments of dissatisfaction; 71 comments of satisfaction.

2. FDD Survey Follow-Up Results

a. Objective: Collect information on prioritized list of survey respondents to document their problems, identify common issues, and develop improvement recommendations.

b. 150 homes identified, 101 homeowners contacted, 52 site visits performed, 25 phone interviews performed (all by OHM).

c. 77 homeowner reports completed, 10 homes identified where the FDD installations not according to specification appeared to cause water issues. At this rate of incidence, about 2% of 1,800 City FDD Program sites may not have been installed according to specification or somewhat less than 50 homes.

d. FDD Mitigation Subcommittee comprised of SSWWE and FDD CAC members formed to review OHM results and make go forward recommendations.

e. The subcommittee met three times during July and August. A set of recommendations emerged from the process. The sources of the recommendations were the City Staff, OHM, and the subcommittee.

f. This set of recommendations was reviewed extensively at the September 10, October 8 and November 12 SSWWE CAC meetings. During these reviews, the set of recommendations changed, as CAC suggestions were considered. In addition, the project team contributed changes to this set.

g. During the October CAC meeting, in an attempt to identify where consensus existed regarding the recommendations, the facilitator polled the attending CAC members. This polling was updated at the November CAC meeting. Many of the recommendations achieved consensus support from the CAC participants. Some of the polling tallies do not add up to the twelve CAC members on the committee due to absences or CAC members who abstained from voting on certain items. The results of the polling process for the recommendations that received consensus support are below. See Section III-E of this report for more detail on the polling results.

3. CAC Recommendations

a. FDD as a program tool (for City projects). **<u>The SSWWE project team recommended the discontinuation of mandatory FDDs in the target areas</u>** because the FDD program to date has significantly reduced the risk of basement backups in those areas and additional FDDs are not needed. The use of FDDs as a program tool for the City on future projects going forward was evaluated by the CAC with the following results:

    i. Do not retain the FDD program as is. (CAC polling results: All CAC members who voted, ten (10), supported this recommendation).

    ii. Eliminate mandatory FDDs as a program tool option. (CAC polling results: Seven (7) CAC members support/ four (4) CAC members did not support).

    iii. Modify the FDD program to be voluntary, incentivized and robust, with program changes that align with Best Practices (found on page B-92 of the FDD Survey Follow-Up Investigation Report found in section V-B of this report), and that gather input from candidate neighborhoods. (CAC polling results: ten (10) CAC members support/ one (1) CAC member did not support.)

b. Correct out-of-specification installations and conduct sump pump Outreach Program. Polling results: All CAC members, twelve (12), supported this recommendation.

    The City will initiate a program to correct FDD installations that were not completed according to specification or industry best practices, and were primarily responsible for water entering a basement. The City will retain a contractor to accomplish this program. Key elements of the program include:

    i. The correction process will start with the set of non-spec residences identified by the OHM investigation, ten (10), and will include any that emerge from the additional residences that OHM has not yet investigated (estimated to be somewhat less than 50 homes). The process will be done on a case-by-case basis.

ii. The City will send a mailing to all properties that have participated in the City FDD Program, which will provide them with the opportunity to come forward with potential FDD related problems to be investigated and corrected if warranted. A deadline will be given to ensure that this process does not continue indefinitely.

iii. Develop an outreach/education program, including how-to videos, to all Ann Arbor sump pump owners, to provide homeowners more complete information about their sump pump system.

iv. The City will attempt to fund this program by making responsible contractors and consultants pay for the applicable portion of program costs.

c. Implement OHM Best Practices. (CAC polling results: All CAC attendees, twelve (12), supported this recommendation). OHM outlined some of the best practices that it has observed from FDD programs over the years. Three categories of Best Practices were detailed:

i. Customer Service

ii. New Installations

iii. Retroactive Work

Specific recommendations for each of the three categories are described in Section V-B of this report.

d. Provide backup systems. (CAC polling results: Eight (8) CAC members support/ four (4) CAC members did not support.)

The recommendation is to provide a backup system to any resident desiring one who participated in the City's FDD Program. The estimated cost of providing the back-up systems to City FDD Program homeowners who do not currently have one is $810,000.

CAC members also suggested that residents who participated in the City's FDD Program receive discounts on back-up systems, that a back-up system be included in a revision to the City's FDD Installation Specification, and that the City benchmark other city FDD program regarding back-up systems.

The rationale for the CAC members in support of the back-up recommendation is as follows:

i. 1,800+ Homeowners were included in the City FDD Program, and the City did not fund backup systems despite the 2001 study recommendation to do so.

ii. Although many homeowners welcomed the FDD program, many other homeowners felt that they were forced into the FDD program due to the $100/month mandated increase in their sewer bill if they refused to have an FDD.

iii. The FDD program was originally announced/intended as a city-wide program, not a select neighborhood program.

iv. According to the 2013 Survey, 52% of the respondents expressed concern about a lack of a backup system.

v. Some DOM participants have been provided backup systems free of charge.

vi. Many target area residents were part of the City program for which a backup system was not offered; therefore, getting a backup system by participating in DOM was not an option for them.

vii. The FDD program replaced gravity systems with sump pumps. Sump pumps are not as reliable as gravity, which never wears out and continues to work during power outages. The backup systems will give the FDD participants a system that is more reliable (though not as good as what they had).

viii. Other municipalities in Michigan provide assistance in obtaining backup systems to FDD Program residents.

e. Pay damage claims to homeowners who experienced water damages due to out of specification installations. (CAC polling results: All CAC members who voted, eleven (11), supported this recommendation).

The recommendation is to pay damage claims residents who incurred water damages primarily due to out-of-specification FDD installations and the responsible contractors and/or consultants should pay the costs for these claims. The estimated cost for paying these damage claims (based on the rate of damage in the eleven (11) out-of-specification homes currently identified) is $160,000. The CAC's rationale for this recommendation is as follows:

i. 1,800+ Homeowners were included in the City FDD Program.

ii. Although many homeowners welcomed the FDD program, many other homeowners felt that they were forced into the FDD program due to the $100/month mandated increase in their sewer bill if they refused to have an FDD.

iii. The FDD program was originally announced/intended as a city-wide program, not a select neighborhood program.

iv. The OHM investigation revealed that perhaps 2% of FDD systems were not installed according to specifications and caused water damages.

v. Failing to pay for damage claims due to out-of-specification installation is not equitable, and not treating the FDD recipients in an equitable way will set a negative precedent for future programs that require broad public participation.

f. Pay Homeowner Compensation. (CAC polling results: Three (3) CAC members in support; nine (9) CAC members not in support).

This recommendation involved paying non-damage related costs that FDD homeowners have incurred as a result of FDD installation. Typical cost items include sump pump replacement, back-up battery replacement and sump pump insurance. As this recommendation was rejected by a majority of the CAC, it is not detailed in this summary. See Section V-C of this report for a more thorough description.

g. Provide Financial Support for Senior Citizens and Economically Disadvantaged Ann Arbor Residents with FDD Issues. (CAC polling results: Eight (8) CAC members in support; three (3) CAC members not in support).

   This recommendation is for the City to explore offering financial assistance to senior citizens and/or economically disadvantaged citizens who are having difficulties paying sump pump related expenses. The model for this program can be found in various Michigan utilities that help seniors and/or economically disadvantaged citizens with their electric/gas/water bills. These programs typically involve means testing.

h. Provide free radon inspection for all City program FDD residences. (CAC polling results: Three (3) CAC members in support; Seven (7) CAC members not in support).

   This basis of this recommendation is that the process of cutting a hole in the floor slab for has the potential to increase the seepage or radon gas into the basement. To address this risk, radon testing should be provided at all homes where FDD was performed to measure the radon levels. The CAC discussed the fact that radon is a general risk for homes in Washtenaw County, and that radon gas can enter from cracks and other openings in the basement besides the sump hole. The City's standard FDD installation specifications include sealing the sump hole so that gasses cannot escape.

i. Examine modifying rates for properties without footing drains connected to the sanitary system in a future rate study. (CAC polling results: Ten (10) CAC members in support; one (1) CAC member not in support).

   This recommendation involves studying whether or not properties that do not have footing drains connected to the sanitary sewer (and therefore do not drain footing water directly into the sanitary sewer system) receive a different level of service from the City. If the study validates that properties receive a different level of service, the methodology for allocating costs could be altered to reflect the differing level of service. Presumably, properties that do not have footing drains connected to the sanitary sewer receive less service from the City because the City does not treat footing drain water that comes directly from these properties.

   In addition to studying differing levels of service, the CAC suggests that the study address whether or not it is feasible to give a water consumption or credit when a water backup pump activates due to a power shortage.

j. Developer Offset Mitigation (DOM) Program recommendations. (CAC polling results: All CAC members who voted, eleven (11) supported these recommendations).

   i. Continue a DOM program with revisions.

ii. Revisions to the DOM program allowing mitigation City-wide except for the developments where flows pass thru one of the five identified SSWWEP project areas.

iii. Re-examining the design flow rates (table A).

iv. Eliminate the 20% recovery factor.

v. Revisions to the DOM program to evaluate the ability of allowing developers to make a payment in lieu of offset mitigation.

vi. Revisions to the DOM program eliminating the 24-month requirement for using mitigation credits.

vii. Periodically revisit the program and identify other high-risk areas as they appear.

C. ADDITIONAL ITEMS

A number of comments and issues have surfaced during the course of the project as noted below. This information was prepared by the SSWWE project team to fully document all items that were raised, and summarize how they were addressed.

1. Innovative Option - The University of Michigan has received a grant to examine smart sanitary sewer network of distributed sensors connected to real-time control with algorithms to operate control points to store flow where the pipes are not full, and the City of Ann Arbor is one of the participating cities for the research. This is a potential innovative option that could provide further protection for rare events, particularly those with significant spatial variation in the rainfall.
2. WWTP Capacity - No recommendations are made for capacity improvements at the WWTP. The study found that the WWTP has adequate capacity to handle existing and future peak flows, even for the largest flows evaluated under Scenario C (50-year wet weather flow, with future growth plus climate change). The study found that during Scenario C, the City's wet weather equalization tank at the WWTP would not overtop. There is the possibility that a storm event larger than Scenario C could occur, or that the equalization basin would not be completely emptied from a previous large storm event before another large storm event occurs. The expected occurrence of events that exceed Scenario C, or of two back-to-back storms large enough to send flow to the wet weather equalization basin is very rare, and is not considered a significant risk.
3. Manhole Inflow – A suggestion was made that sealing pick holes on sanitary sewer manhole covers might address the remaining issues in the sanitary sewer system. Pick holes can result in stormwater inflow into the sanitary sewer system and should be addressed where relevant. This recommendation is included in the action plans. The City is also addressing this flow source as an operational practice. The City has a program to plug manhole pick-holes and is currently implementing a program to seal manholes with a gasket cover in low-lying areas that are prone to flooding to reduce inflow through manhole covers. The SSWWE project team does not expect that sealing manholes and pick holes will fully address the remaining issues in the sanitary sewer system.
4. Water Conservation Measures - A suggestion was made during the project to consider drinking water conservation measures through retrofitting houses and businesses with low-flow fixtures and appliances as a mechanism to address peak sanitary wet weather flow issues. Water conservation measures are appropriate for consideration for other important purposes, but they are not considered practical to address peak wet weather flows in the sanitary sewer. This is due to the magnitude of the wet weather flow in the sanitary system, which are much larger than the base sewage flow generated from water consumption. For example, the base flow in the sanitary sewer system from water consumption is approximately 18 cfs. The peak wet weather flow in the sanitary sewer system during large rains ranges from 90 to 120 cfs depending on the scenario. Even if water conservation measures reduced water consumption by 50% or 9 cfs, which would be very aggressive, the peak wet

weather flows would only decrease by 7-10% depending on the scenario. Compare this to 70-90% flow reductions from the FDD program that were needed to significantly reduce the risk of sanitary basement backup in the priority districts. Based on these flow components, we do not believe that water conservation measures is an effective mechanism to address peak wet weather flows in the sanitary sewer system. This conclusion was presented to the chair of the Technical Oversight and Advisor Group (TOAG), and he concurred. Other methods of addressing sanitary sewer issues will be more practical and cost effective, as outlined on the six (6) action plans.

5. Burial Depth of Curb Drain and Sump Pump Discharge Lines – During the course of the project, a concern was raised regarding the burial depth of curb drain and sump pump discharge lines above the frost line. Sometimes, due to the shallow depth of the receiving storm sewer inlet, it is not possible to bury the curb drains and sump leads below the frost line.

   Shallow storm sewer pipes buried above the frost line sometimes occur due to limitations with grading and slope available from the receiving surface waters. This is an inherent challenge with storm sewer pipes in general, and is not unique to the City of Ann Arbor. The common industry design basis for shallow storm pipes is to ensure that they are constructed with a positive slope and therefore will not have standing water within them, which minimizes the risk of freezing in winter. It is not uncommon for local drainage components, including storm sewers, to be built above the frost line, and these facilities do not typically have issues with freezing related blockages.

   We examined the temperatures of the water discharged through the sump discharge lines and curb drains. We found that there is limited data available on the temperature of sump pump discharge water. However, the EPA has published a map of shallow groundwater temperatures[1] that shows groundwater temperatures in the range of 47 to 52 degrees Fahrenheit in Southeast Michigan. We are also aware of a direct measurement of footing drain water temperatures that was performed in Ypsilanti, Michigan, which indicated that the water remained relatively constant throughout the seasons at 54 to 55 degrees Fahrenheit.

   The temperature of footing drain water is moderated by the ground, which provides a constant source of heat for groundwater, and reduces the variability of the groundwater temperatures, even in winter. The risk of winter freezing of curb drains and sump pump discharge lines is further reduced by the fact that they convey this relatively warm groundwater which would require additional cooling before freezing.

   The City's burial depth standards for curb drains and sump pump discharge lines are based on the following requirements and assumptions:

   i. The sump discharge lines in the ROW and on private property are required to be constructed with a positive slope, meeting the project specifications and the building code based on the size of the pipe (24-inch minimum cover for 2-

[1] http://www.epa.gov/athens/learn2model/part-two/onsite/ex/jne_henrys_map.html

inch pipes[2]). Each construction installation has been verified and approved by Planning & Development Services.

ii. With the required slope, the pipes will not have standing water in them.

iii. It is also assumed that the sump pump discharge water is relatively "warm" and will not have time to cool down and freeze in the sump lead or curb drain if positive slope is present.

These requirements and resulting conditions promote effective functioning of the sump discharge line and curb drain, even under extreme cold conditions like those experienced last winter. The specifications themselves are not indicative of any systematic defect in the City's system.

6. Use of Drilling Fluid in Curb Drain Installations - During the course of the project, a concern was raised regarding the use of bentonite drilling fluid in the installation of curb drains in the City's FDD Program and whether the material is toxic. Bentonite is a clay material that is mixed with water to form a slurry to assist in the installation of directionally drilled pipes. The material is required to be inert by the City's specifications, and is not toxic. The same material is widely used in the construction industry in the drilling of drinking water wells.

7. Gravity Back-Up for Sump Pumps – A suggestion was made during the project to examine the potential of a gravity back-up system for sump pumps, whereby if a sump pump failed, the footing water would be allowed to discharge to the sanitary sewer system by gravity before it backed up into the basement. The proposal included a check valve for back flow prevention and an automatic gravity overflow below the finished floor if the sump pump fails. The City's building department reviewed this option and found that it would not meet State building codes and the City's sewer ordinance. The SSWWE project team is not aware of any municipalities that have implemented such a gravity backup system.

   Some municipalities have adopted the practice of placing a floor drain near the sump pump to provide an outlet over the floor to a drain in the case of pump failure. The City's building department response to a question on this topic indicated that there is no minimum installation distance between a floor drain and the sump crock, however, the floor drain cannot be set up to act as a sump pit overflow drain, because sanitary and storm drainage systems of a structure shall be entirely separate (as a practical matter, if there is a significant overflow from the sump crock, it would drain via any existing floor drains). Also, it has been noted that the basement perimeter location typical for the sump crock is not typically the low point for the basement. Therefore, installing a floor drain adjacent to the crock may not effectively limit water from reaching other basement areas. Nonetheless, the CAC discussed that such an installation is a valid consideration for a homeowner contemplating the installation of a sump pump system, and as such requested that the City seek clarification from the State regarding whether such a system would meet State building codes.

[2] http://www.a2gov.org/departments/engineering/Documents/project%20management%20fdd%20guidelines_2005-11-30.pdf

8. Air gaps - During the course of the project, a concern was raised regarding the purpose and function of the air gaps on the sump pump discharge lines. An informational sheet was prepared on the air gaps, and is included on page 46, section 1.129 of the Q&A Log.

D. CAC COMMENTS ON EXECUTIVE SUMMARY

1. A question was raised about the potential impacts of stormwater surface flooding on the flows in the sanitary sewer system from footing drains (Jim Osborn). The City addressed this question in the Q&A log and posted the answer to Basecamp on August 29, 2014. That answer can be found in Section 6c of the report.

2. CAC member Peter Houk issued a statement explaining why fair treatment for FDD participants is important and invited other CAC members to join in on his statement. Here is Peter's statement:

   Through the FDD program, the city has substantially reduced the risk of basement backups in the target areas. The costs of the FDD program, however, were not equally distributed among sewer customers. Many FDD participants were not at risk themselves for basement backups, but their participation was nonetheless critical to the success of the program. FDD participants paid for the program through their sewer rates, as all sewer users did, but they are also paying for other ongoing costs: the loss of floor space in their basements, operation and maintenance, and extra insurance. Also, some residents who were the recipients of sub-standard FDD installations have had to pay to repair their homes after they were damaged by water and mold.

   The CAC has generated several options for ameliorating the cost and inconvenience that FDD recipients have incurred as a result of their participation in the program. These ideas are intended to ensure that residents who participated in the FDD program when it was mandatory and intended for city-wide implementation are treated fairly. CAC members are not necessarily experts in municipal law nor municipal administration nor sewer engineering, so some of the ideas that have been put forth may not be feasible. Even if the CAC's proposals cannot be executed, the effort that went into formulating them should be taken as evidence that CAC members expect the city to do more to ensure fair and equitable treatment of all FDD participants. This sentiment is also reflected in the CAC poll: 8 CAC members voted in favor of backup pumps for FDD participants and 10 CAC members voted in favor of paying for damage caused by out-of-spec installations.

   Fair treatment for FDD participants is important to CAC members for the following reasons:

   - *Their participation fixed the basement backup problem.*
   - *Because of their participation, additional residents in the target areas and throughout the city will not need to have FDD done to their homes.*
   - *Because of their participation, the city avoided a sewer system upgrade that would have cost millions and would have destroyed open space and natural areas in the city.*
   - *The city needs to demonstrate that those who participate in efforts to improve the community will be treated fairly. After all, this is not the last time the city will need resident participation to fix a big problem.*

   To achieve fairness and equity for FDD participants, we as CAC members propose these actions and urge council and staff to find ways to implement them:

   - ***Backup pumps.*** *Many FDD participants were not at risk for basement backups, but in order to solve the basement backup problem they had to forfeit their very reliable gravity-based systems and replace them with sump pump systems that don't work during power outages and are susceptible to mechanical failures. Adding a backup to the sump pump will* *give FDD participants a system that is more reliable. While a sump pump with a backup pump will never be as simple or as reliable as the gravity-based systems these homes were built with, it will be much better than the system that the FDD program originally provided. Furthermore, other municipalities in Michigan included some support for backup systems in their own FDD programs.*

- ***Pay damage claims for sub-standard FDD installations.*** *City staff have proposed fixing sub-standard FDD installations, and this is a good start. But the damage that these installations caused needs to be fixed too. Even if the city doesn't have a legal responsibility to fix this damage, it needs to demonstrate that it will stand behind the residents who allowed their houses to be modified so as to fix the basement backup problem. The city needs to pay damage claims for problems caused by sub-standard FDD installations.*

Member Judy Hanway had an additional comment:

My first thought on hearing about the FDD Program was, "how can this be legal?" The FDDP program, the DOM, and other aspects of the program are currently under the scrutiny of a pending lawsuit and other lawsuits are likely to follow. The legality of the initial FDD Ordinance is in question and this will need to be settled in the courts. Any and all recommendations in the SSWWE final report regarding FDDs and the DOM program must be evaluated against the final resolution of the pending lawsuit(s).

No more mandatory FDDs!

Common sense says that water pipes above the frost line (42" in Michigan) will probably freeze. A thorough investigation (by an independent group of professionals) of the frozen pipe depths, especially in low-flow conditions, should be undertaken. The current specifications developed by CDM for the curb lines do not appear to comply with common sense building and engineering practices and codes. ***Something needs to be done to prevent these lines from freezing!***

Having the air gap next to the foundation wall is a bad idea. If and when water pours out of there, it could (and has) damaged the foundation wall and reentered the house through cracks in the foundation.

There should be pre- and post- radon testing if any more voluntary FDDs are to be done. A sump pump is a known entry point for radon. I think radon mitigation should be funded at all FDD/DOM locations. ***At the very least****, all FDD homeowners should be informed that they should have their radon levels checked. The current FDD website implies that there is nothing to worry about regarding radon from the sump.*

The FDDP saved the city of Ann Arbor a lot of money – ***because it passed many costs, as well as the responsibility of upkeep, onto the individual homeowner.*** *Homeowners who agreed to disconnect, did the city a big favor. They should be compensated for the expenses they've incurred.*

Backup systems should be provided to those homeowners who want one. There are newer systems available now that are better than the 8 hour battery backup.

The City Staff should pursue ***seeking a variance to the state plumbing code*** *in order to allow overflow of sump water to drain (via gravity) to the floor drain. This would help to alleviate basement flooding during power outages.*

Homeowners who have had problems since disconnecting their footing drains should be compensated (this includes making appropriate repairs and paying damages).

We should dispose of the "pre-qualified" contractor requirement for the FDDP. If someone volunteers to disconnect, they should be able to hire any licensed plumber to do the work.

The DOM program should allow developers to fund infrastructure improvements as part of their mitigation requirements.

The City needs to address storm and surface water to prevent this source of water from reaching the footing drains. The storm water budget needs to be enlarged so that more of the problem areas can be fixed.

The SSWWE CAC has been assured that there is adequate capacity at the Waste Water Treatment Plant. However, I remain unconvinced. I see all the high-density buildings going up (dorms, apartments etc), and can't help but wonder how accurate the projections are.

We need to stop paying for multiple studies and consultants and start using our funds to fix the infrastructure!

The city of Ann Arbor needs to do what is necessary to stop future sewage backups (including a more aggressive rotating maintenance program, permanent metering, video inspection of pipes, repair leaking sanitary sewer pipes, and install gasketed manhole covers, especially in low-lying or Target areas).

Member Joe Conen also had an additional comment:

Please note me as concurring with Peter's statement.

A back up pump should be provided and installed for any FDD participant who would want one.

As a community we should treat the FDD participants with respect and fairness. This includes compensation for damage that resulted from to inadequate sump/pump installation.

Other members who concurred with Peter's statement include: Beverly Smith and Michelle Lovasz.

3. CAC member Joe Conen issued a statement on the potential for obstruction of the curb drain or sump pump discharge line due to freezing.

Investigation by OHM into freezing of curb drain lines concluded that freezing occurred in curb lines due to "bellies" (low spots) in the sump discharge lines that allowed some of the discharged water to pool and cool in these lines. This allowed the water to subsequently freeze when it moved through the curb line. These low spots could reasonably increase the likelihood of freezing in the area of the low spot in the sump discharge line. However, I am skeptical that low spots in the sump discharge lines would be a significant contributor to freezing in the curb lines.

It is my view that freezing in the curb line results from the configuration of the curb line (i.e. how it slopes, absence or presence of dips, and its length), the temperature of the soil around the curb line (dependent on burial depth and soil conditions above the line), and the volume of water flowing through the line. While the temperature of the water discharging from the sump is a factor in whether ice will form, sump water will cool significantly as it travels through the sump discharge line regardless of the absence or presence of dips in the line. The water will continue to cool (faster due to *larger contact area) once it enters the curb line. Ice will build up in the curb line if the ground temperature surrounding the pipe is significantly below freezing and the frequency and volume of flow is too low to warm the pipe. Curb lines that experience the lowest surrounding temperatures are vulnerable to icing, and, among those, longer pipes with lower flows are most vulnerable.*

Section C.5 of the executive summary indicates that it is not always possible to bury the curb line below the frost line due to the shallow depth of the receiving storm drain inlet. While this may be true in some cases, where the receiving drain is deep enough, more effort could have been made to bury these lines deeper than the 2 feet minimum required by the specification. This could have been accomplished by specifying a depth below the frost line, where practical, and requiring specific approval for lesser depth. This would have reduced the likelihood of freezing in these lines.

Member Judy Hanway commented:

Thank you Joe for a very detailed explanation of the possible causes for freezing in the curb lines.

CAC member Michelle Lovasz also concurred with Joe's statement.

III. Citizen's Advisory Committee (CAC)

A. CAC Member Roster

Name	Street of Residence
Colin Breed	Pittsfield Blvd
Vince Caruso	Glendale
Joe Conen	Lans Way
Judy Hanway	Ascot Road
Peter Houk	Yeoman Court
Michelle Lovasz	Miller Avenue
Patricia Marten	Scio Church Road
Darren McKinnon PE (for First Martin Corp)	Depot Street
Jim Osborn	Brandywine
Frank Pelosi	Chaucer Drive
Frank Richardson	Ardmoor
Beverly Smith	Henry Street

B. CAC Meetings Matrix

A matrix showing CAC Meetings and attendees can be found on the following page.

SSWWEP - CAC Meetings

ATTENDEES	08/21/13	10/29/13	12/12/13	01/09/14	02/13/14	03/20/14	04/17/14	05/14/14	06/18/14	07/09/14	08/13/14	09/10/14	10/08/14	11/12/14
SSWWEE & FDD CAC														
Beverly Smith	X	X	X	X	X	X	X	X	X	X	X		X	X
Bruce Geffen	X	X	X	X										
Colin Breed	X	X	X	X	X	X	X	X	X		X	X	X	X
Darren McKinnon									X	X	X	X	X	X
Frank Burdick	X	X	X	X	X									
Frank Caruso			X											
Frank Pelosi	X	X			X	X				X				X
Frank Richardson	X	X	X	X	X	X	X		X		X	X	X	
George Johnston (FDD CAC)									X			X		X
Jim Osborn	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Joe Conen	X	X	X	X	X	X	X			X		X	X	X
Judy Hanway				X	X	X	X	X	X	X	X	X	X	X
Kathy Boris	X	X	X	X	X	X	X	X						
Mark Wagner	X	X			X		X	X	X	X				
Matt Wherry	X	X												
Michelle Lovasz			X		X			X						
Patricia Marten		X	X	X	X	X	X	X		X			X	X
Peter Houk	X	X		X	X	X	X	X	X	X	X	X	X	X
Sonia Manchek (FDD CAC)									X					
Ted Dorr	X													
Vince Caruso	X	X		X	X	X	X	X	X	X		X	X	X
SSWWEE Project Team Members														
Ann Arbor														
Abigail Elias				X										X
Craig Hupy				X										X
Deb Gosselin								X						
Troy Baughman						X			X	X	X	X	X	X
Cresson Slotten	X			X	X			X		X	X	X	X	X
Nick Hutchinson	X	X	X	X		X	X	X	X	X	X	X	X	X
Anne Warrow									X			X		
Munrovia Pictures														
Greg DeLiso		X	X	X	X	X	X	X	X	X	X	X	X	X
OHM Advisors														
Greg Marker					X		X	X	X	X		X	X	X
Lindsey Kerkez			X				X							
Murat Ulasir	X		X		X	X	X	X		X				
Robert Czachorski	X	X	X	X	X	X	X	X		X	X	X	X	X
Famous in Your Field														
Lori Byron		X	X	X	X	X	X	X	X	X		X	X	X
Project Innovations														
Charlie Fleetham	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CDM														
Mark TenBrock									X					
Hinshon Environmental														
Dick Hinshon										X				
Public Observers														
Aram Kalousdian		X	X	X	X									
Cy Hufano				X										

ATTENDEES	08/21/13	10/29/13	12/12/13	01/09/14	02/13/14	03/20/14	04/17/14	05/14/14	06/18/14	07/09/14	08/13/14	09/10/14	10/08/14	11/12/14
Dan Ketelaar													X	
Dave Askins (Ann Arbor Chronicle)		X		X	X									
Darren McKinnon								X	X					
Ethel Potts				X			X			X	X	X		
Frank Burdick						X	X	X	X	X	X	X	X	X
Jack Eaton (City Council)		X		X	X	X	X	X	X		X	X		X
Jane Lumm (City Council)							X							
Judy Hanway			X											
Kristin Lovelace					X									
Leon Bryson							X	X						
Margie Teall (City Council)						X								
Mike Anglin (City Council)						X								
Mike Martin												X	X	
Nancy Kaplan								X						
Public Safety Officers						X							X	
Ryan Stanton (Ann Arbor News)				X										
Sonia Manchek (FDD CAC)		X												
Terry Holman							X	X						
William Higgins		X	X	X	X							X	X	X

C. CAC Meeting Agendas and Meeting Summaries

Meeting Agendas and Summaries are included on the following pages for meetings that took place on:

October 29, 2013
December 12, 2013
January 9, 2014
February 13, 2014
March 20, 2014
April 17, 2014
May 14, 2014
June 18, 2014
July 9, 2014
August 13, 2014
August 21, 2014
September 10, 2014
October 8, 2014
November 12, 2014
November 19, 2014

October 29, 2013
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Citizens Advisory Committee (CAC) Agenda
Slauson Middle School – Media Center
Tuesday, October 29, 2013 - 6:30 p.m. to 9:00 p.m.

1. **Welcome** - Charlie Fleetham (CAC Facilitator) 6:30 p.m. (5 min.)

2. **Desired Outcomes** – Charlie Fleetham 6:35 p.m. (5 min.)

   - Update CAC on project status and the plan for the next 60 days
   - Organize the CAC and subcommittees as needed
   - Conduct subcommittee breakout sessions

3. **CAC Introductions/Icebreaker** – All 6:40 p.m. (10 min.)

   Charlie Fleetham will also introduce videographer and his expected role in the project.

4. **Review of August 21 Meeting Summary and Q&A Responses** - Charlie Fleetham 6:50 p.m. (15 min.)

   Charlie will review the meeting summary and revise as needed with CAC input.

5. **SSWWE Project Update** - Robert Czachorski 7:05 p.m. (30 min.)

   Robert will provide a view of the analysis to date and plans for the next 60 days.

6. **CAC Organization Exercise** - Charlie Fleetham 7:35 p.m. (20 min.)

   Charlie will facilitate a group exercise to confirm the group's purpose, identify group roles and responsibilities, discuss participation expectations, discuss the CAC decision making process, set and confirm the schedule of meetings, and discuss formation of subcommittees to work outside of regular CAC meetings.

7. **Subcommittee Breakout Groups (Discussion and Report Out)** 7:55 p.m. (30 min)

   The CAC will breakout into Survey, Best Practice Research and Reliable Discharge Subcommittees.

8. **Summary, Thank You, and Next Steps** – Charlie Fleetham 8:25 p.m. (10 min.)

   Charlie will send a follow-up meeting summary and other materials to all CAC members. Materials will also be available on line at www.a2gov.org/sswwe.

9. **Public Comments (3 minute limitation)**

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Sanitary Sewer Wet Weather Evaluation Study
Citizens Advisory Committee
Responses to Remaining Questions from August 21, 2013 Meeting

1. **How many sewer backups were reported in the June 5/6, 2000 storm event?**

   Response: Approximately 200 homes reported basement flooding.

2. **How many sewer backups were reported during the June 27, 2013 event?**

   Response: 4 backups were reported. Following investigation by City Field Operations, 9 of the 34 were determined to have possibly been caused by an issue with the city's sanitary system.

3. **How many homes have reported sewer backups since FDD work was completed in their homes?**

   a. As of 2012, approximately 2500 single family homes have been disconnected as part of the FDD program.

   b. From 2001-2012, 70 homes have reported a suspected sewer backup since they had FDD work completed in the home. It is not clear whether these reported incidents were a result of the city's sanitary sewer being overwhelmed during a storm event or if the incident was caused by something different (blockage, tree roots, issue with private lead, etc.).

4. **How does the City learn about sewer back-ups?**

   Response: Sewer back-ups are reported to our Field Services Unit at 734-794-6350 or www.a2gov.org/crs during normal business hours. For after hours, weekends and holidays, back-ups are reported to our Water Treatment Plant at 734-994-2840.

5. **Why was the FDD program suspended?**

   Response: See attached City Council resolution R-12-435

6. **How many homeowners have opted out of FDD?**

   Response: Three homeowners have opted out.

7. **How do all five districts compare in before FDD/after FDD storm response?**

   Response: This question will be addressed with the comparative graphs that OHM has developed for the five districts for the June 2000 storm, the June 27, 2013 storm and the August 12, 2013 storm.

8. **How much does it cost to treat stormwater vs. sanitary sewage?**

Response: There is no cost to treat stormwater at the pipe outlet, as this water is collected by a separate storm sewer pipe system, which ultimately discharges to the Huron River without an end-of-pipe treatment plant. Treatment and management of stormwater is handled through other mechanisms such as source control, street sweeping, public education programs and stormwater collection system maintenance. Stormwater does not make its way to the wastewater treatment plant, unless it enters the sanitary sewer system through defects, in the sanitary sewer system or private property sources like footing drains. The cost for treating sewage at the wastewater treatment is approximately $1400 per million gallons. Therefore, when any stormwater enters into the sanitary sewer system, unnecessary cost is incurred because all the flow which enters into the sanitary sewer pipes goes to the wastewater treatment plant.

9. **What is the legal justification (ordinance) behind the FDD program?**

The Michigan Home Rule City Act was amended in2002 to add Section 5j:

"A city, in order to protect the public health, may adopt an ordinance to provide for the separation of storm water drainage and footing drains from sanitary sewers on privately owned property. The legislative body of a city may determine that the sewer separation authorized by this section is for a public purpose and is a public improvement and may also determine that the whole or any part of the expense of these public improvements may be defrayed by special assessment upon lands benefited by the public improvement or by any other lawful charge. A special assessment authorized by this section shall be considered to benefit only lands where the separation of storm water drainage and footing drains from sanitary sewers occurs." MCL 117.5j (emphasis added).

Although the City Council adopted Section 2:51.1 of the Ann Arbor City Code, which governs the current footing drain disconnect program, in 2001, the amendment to the Home Rule City Act in 2002 makes clear that the ordinance and footing drain program are authorized under Michigan law.

Amendments in 1987 to the federal Clean Water Act require municipalities to take steps to prevent sanitary sewer overflows. Such overflows, resulting in the discharge of pollutants into the rivers and streams, would violate the City's National Pollution Discharge Elimination System (NPDES) permit. Since the early 1980s the state construction code, which the City is obligated to follow, has prohibited connections of downspouts and footing or foundation drains to the sanitary sewer system. The City's footing drain disconnects are consistent with those obligations. The sump pumps that are installed with the connections to the storm sewer system are no different than the sump pumps builders or contractors install - and have installed - in properties constructed since the construction code change in the early 1980s.

A quick search has found that other states and municipalities have adopted similar statutes and ordinances requiring properties to disconnect historic connections to sanitary systems and connect with storm sewer systems. Some ordinances impose criminal penalties if a property owner does not disconnect stormwater discharge to a sanitary sewer; others provide that the municipality can shut off the water supply to the property if the property owner does not disconnect.

We have not found any administrative agency or court decision that has found a footing drain disconnect program to be illegal.

10. What is the legal justification of the developer mitigation program?

The interface between the Developer Offset Mitigation Program and property owners who may take advantage of the program to fund their footing drain disconnect is simply a funding mechanism. It is purely voluntary for any property owner who is offered funding by a developer. The property owner is free to accept or refuse the offer. The ability of a property owner to accept or reject a developer's offer is distinct from an obligation to disconnect that the City might impose under Sec. 2:51.1 of the City Code.

While there might be disagreement as to the best way to minimize or limit the impact of a new development on the sanitary sewer system, the City is not legally required to pick the best option. This choice also has the benefit of reducing risks of storm water overflows from combined sanitary and storm flows in the sanitary sewer system. In addition, property owners who take advantage of a developer's offer are not subject to the same subsidy limits as property owners whose footing drain disconnects are funded by the City.

City of Ann Arbor

301 E. Huron St.
Ann Arbor, MI 48104
http://a2gov.legistar.com/Calendar.aspx

Council Action

Resolution: R-12-435

File Number: 12-1240 **Enactment Number: R-12-435**

Resolution Directing Staff to Temporarily Suspend the City's Footing Drain Disconnection (FDD) Program Efforts within the Glen Leven and Morehead (Lansdowne Neighborhood) Areas

Whereas, in August, 1998 and June, 2000, large rain events resulted in many, multiple basement backups in various parts of the City;

Whereas, In response to these basement backups City Council established the Sanitary Sewer Overflow (SSO) Study Task Force comprised of homeowners, city staff and experts to investigate the causes and bring a recommendation to resolve the basement flooding to City Council;

Whereas, The Sanitary Sewer Overflow Study Task Force identified five priority areas across the city;

Whereas, The Sanitary Sewer Overflow Study Task Force held community meetings across the city to receive public input and direction on various solutions and;

Whereas, Based on community direction the Sanitary Sewer Overflow Study Task Force recommended that a comprehensive city-wide footing drain program be implemented;

Whereas, On August 6, 2001, City Council passed an ordinance to implement a comprehensive City-wide footing drain disconnection (FDD) program to eliminate or reduce instances of surcharged sanitary sewers and SSOs;

Whereas, The current program focus priority area of Glen Leven and Lansdowne has encountered unique, historical creek bed patterns and overland storm water drainage issues, which have impacted the implementation of the FDD program; and

Whereas, The communication between this area and the city needs improvement;

RESOLVED, That City staff is directed to temporarily suspend the City's Footing Drain Disconnection Program efforts within the Glen Leven and Morehead (Lansdowne Neighborhood) areas for the following action items to occur:

- Analyze and/or address existing issues in the local stormwater system to improve stormwater drainage/conveyance and address the existing surface flooding that residents are experiencing in this area
- Clarify the methods and consequences of opting -out of the program

RESOLVED, That during the temporary suspension, City staff are directed engage the necessary consulting firms to review and adjust certain aspects of the Footing Drain Program detailed below;

- Consider other means for achieving removal of footing drain flows from the sanitary sewers (recognizing that it is essential to remove these flows)
- Review the technical issues related to the equipment quality and configuration associated with the Footing Drain Disconnect program
- Investigate subsidizing the cost of equipment associated with improving homeowner confidence in the level of protection afforded by the program
- Provide more review and analysis on the air gap feature provided for the sump pumps
- Conduct a robust survey of Footing Drain Disconnect participants that would yield statistically significant data on homeowner satisfaction and program efficacy;

RESOLVED, That a meeting be scheduled for this area on October 11 at 7:00 p.m. at Lawton Elementary School to continue with discussion on aspects of the Footing Drain Disconnect program and neighborhood stormwater issues;

RESOLVED, That a weekly posting will be made to the city's Footing Drain Disconnect website;

RESOLVED, Staff be directed to continue the Developer Mitigation Program; and

RESOLVED, Staff be directed to allow and continue facilitating citizen initiated footing drain disconnection efforts.

As Amended by Ann Arbor City Council on September 17, 2012

At a meeting of the City Council on 9/17/2012, a motion was made by Marcia Higgins, seconded by Margie Teall, that this Resolution R-12-435 be Approved. The motion passed.

Sanitary Sewer Wet Weather Evaluation (SSWWE) Study
Citizens Advisory Committee Meeting Summary
October 29, 2013

Attendees:

▪ Kathy Boris	▪ Bruce Guffin	▪ Frank Richardson
▪ Colin Breed	▪ Peter Houk	▪ Beverly Smith
▪ Frank Burdick	▪ Pat Martin	▪ Mark Wagner
▪ Vince Caruso	▪ Jim Osborn	▪ Matt Wherry
▪ Joe Conen	▪ Frank Pelosi	

Project Team Attendees:

▪ Lori Byron	▪ Robert Czachorski	▪ Greg DeLiso	▪ Charlie Fleetham	▪ Nick Hutchinson

Observers:

▪ Dave Askins	▪ Jack Eaton	▪ William Higgins	▪ Aram Kalousdian	▪ Sonia Manchek

1. **Welcome – Charlie Fleetham**

Charlie Fleetham reviewed the meeting materials; committee Q & A from the last meeting, and an email sent by Irv Mermelstein regarding the legal foundation of the FDD program in Ann Arbor (see Attachment #1). Charlie said that the email had been received too late to address it in its entirety, but he summarized a brief consultation with Ann Arbor legal counsel:

a. The City puts the highest priority on the comfort level of the CAC members. The City has/will take legal responsibility for any decisions that it makes from the recommendations that emerge from the CAC process.

b. The City is very confident that a legal foundation has and continues to exist for the FDD program.

c. The Loretto case referenced in Mr. Mermelstein's email is not a relevant analogy because Loretto concerns installation of private property owned by a public utility in a residence. Sump pumps are not private property owned by a utility. They belong to the owner of the residence.

Charlie then suggested addressing Mr. Mermelstein's email at the next meeting, and he asked for CAC member input. All members agreed with this recommendation. Comments are shown below:

- I like the way that the meetings are being run. I believe that the legal concerns should be addressed, but at a future meeting.
- The CAC needs to understand the causes of the overflow at the WWTP from the August storm.
- I want an explanation of the expansion of the WWTP. Why is it needed? Where is the significant increase coming from if we have developer mitigation program, etc.? I am concerned about putting the expansion of the plant at the expense of homeowners.
- I wants to know the sources & percentages of inflow into the sanitary system.
- I would like to determine whether sump pump installations have caused any water in basements.

- Is climate change being addressed in this project? I believe that climate change is causing larger storms and should be dealt with.
- I agree with addressing legal concerns at a future meeting.
- What is the impact of Ann Arbor's Leaf Policy on overflows?
- I'm watching for an adequate response from the City to Irv's email.
- I would like to hear the City's legal staff comment on Mermelstein's email.
- I don't have footing drains but have had flooding and would like the project/CAC to investigate the reasons.
- I agree with deferring legal discussion.
- Without Irv, we would all have footing drains by now, so there must be something in his argument worth paying attention to.
- Irv is not the only one with concerns. The City doesn't have good answers to residents' questions.
- I am interested in the innovative alternatives to FDDs. Are we absolutely committed to FDDs or is there something else?
- Let's postpone talking about the legal issues, but reserve time to address at the next meeting.
- It's nice to get meeting material in advance. The explanation of the resolution suspending the program was a little vague – I'd like to get deeper into that.
- The previous survey seemed to show problems that homeowners had with sump pumps failing after two years - is that indicative of a known widespread problem?

2. **Review of 8/21 meeting summary** – Charlie reviewed the meeting summary and noted that this and future CAC meetings would be videotaped for loading on the City website. He also noted that the videotaping was prompted by a comment from a citizen observer at the 8/21 CAC meeting. There were no comments on the meeting summary, although Vince Caruso noted that he had submitted a request for evaluation of complaints regarding water emerging from the sump pump hole in the floor, i.e. that the hole becomes an egress point for a high water table. Charlie said that this issue would be covered in the survey.

3. **Project Update – Robert Czachorski, (OHM Project Manager)** – Robert reviewed the SSWWE study objectives:
   - Did the FDD program reduce stormwater flows to the sanitary system
   - What is the risk of basement backup
   - How to effectively communicate technical methods and results to the community

   He said that FDD evaluation uses three scientific techniques:
   - Scatter plots
   - Control district
   - Continuous model

He then reviewed flow metering data results for the five priority districts. The presentation compared flows to the sanitary sewer system during three major storms:

- June 25, 2000 (pre-FDD)
- June 27, 2013 (post-FDD, percentages complete vary by district)
- August 12, 2013 (post FDD post-FDD, percentages complete vary by district)

All districts showed lower flows in 2013 compared to 2000. Robert encouraged the CAC to stay open minded about the cause of the lower flows. Although the casual observer might conclude that the FDD program was responsible, Robert emphasized that presentation was only showing data at this point, not a causal analysis. Regarding the data, he said that it had been a great flow monitoring period, with lots of rain and consistent data from 7 rain gauges. During the presentation, the CAC members asked many questions. These are presented with responses at the close of this summary. After the presentation, the CAC split into small groups and discussed the presentation. Charlie asked the small groups to reflect on what they had heard and what questions they had. This feedback is summarized below:

- What did you hear in this presentation?
    - We heard there appears to be a footing drain success story, but it appears that other factors may be causing flow reductions.
    - It appears that 100% disconnecting in some neighborhoods doesn't necessarily lead to better outcomes than those with 50% footing drains disconnected.
    - FDD is reducing flow in some neighborhoods.

- What questions do you have about the presentation? (See the Question and Answer section for responses per the # noted after the question.)
    - Can we have maps with number of houses in each neighborhood, along with pipe dimensions? (1.a/1.b)
    - Why was a 10" pipe in one of the subdivisions? (1.b)
    - How old are the pipes in each of these neighborhoods and could infiltration, roots, etc. be causing the flows? (1.c)
    - How often does the plant get at capacity during these events? (1.d)
    - How much more FDDs are needed (what's the goal) when we're getting such good results? (2.a)
    - What is the impact of wetlands on FDD? (2.b)
    - What is the distribution of FDDs throughout the city? Color map, heat map? (2.c)
    - Do we have a control site from 2000 to compare to these neighborhoods? (3.a)
    - Can the Malletts Creek surface water study address the sanitary flows? (3.b)
    - What kind of impact does personal use have on storms and flows? (Showers, laundry, etc.) (3.c)
    - Can you correlate of all this water data with actual basement flooding? (3.f)
    - Have we discussed any other alternatives yet, such as increasing sewer storage? (4a)
    - What's the benefit of doing FDDs, if you can get the same result from fixing the pipes? (4b)
    - What about the strategy of doing FDDs throughout the City, rather than just in certain neighborhoods? Would that give you a better outcome? (4.c)

4. **CAC Organization -** Charlie Fleetham commented that a CAC member had shared the CAC email addresses outside the group. He said he was disappointed as he hoped that by sharing the CAC roster with CAC members and the project team that CAC members could communicate with each other (which had already happened). He said he felt the sharing the email addresses outside the CAC was inappropriate because CAC members had not given their permission. He encouraged CAC members to provide new emails if desired and said that heretofore that his communication with the CAC would be blind carbon copy only. He then proceeded to ask the CAC questions regarding norms:

   - Question: Should new members be allowed to join after this meeting?

     Response: CAC members agreed that if someone has particular expertise, they would be welcome to join, but should be able to get themselves up to speed, not slow the process.

   - Question: Does that CAC wish to designate leaders within the group?

     Response: No, this would be premature.

   - Question: What is the CAC's overarching goal?

     Response: The CAC will review the data regarding flows to the sanitary sewer system, analysis regarding future risks of basement backups, and evaluation of alternatives and make a recommendation(s) to City Council. Minority report(s) will be accepted, as long as they are based on data. Charlie will submit a report development and review process at a future meeting.

   - Question: When should we conduct the next public meeting?

     Response: The CAC recommended scheduling next **Public Meeting** in January to show all data results and the City's response to any CAC legal concerns.

5. **Survey Breakout Group:** At the previous meeting, the CAC members recommended conducting a survey of FDD residences to ascertain level of satisfaction about the FDD installation, basement back up and water flooding incidents, ancillary issues and any extra costs connected with an FDD installation. The City agreed with this recommendation, and Charlie facilitated a breakout group to discuss survey questions and potential scope of work. The break out group consisted of Kathy Boris, Bruce Geffen, Frank Richardson, and Matt Wherry. They made the following suggestions:

   - Add an incentive for completing the survey, including a drawing for a local eatery or a virtual reward (Internet coupon package).

   - Add a definitive statement where the survey participants will be able to see results.

6. **Research Best Practices Breakout Group:** Following a CAC suggestion for a focused discussion on best practices, this breakout group set the following goals: research and review what other communities have done and create and evaluate a family of options that are available to address sanitary sewer issues. Robert Czachorski described the three categories of approaches to sanitary sewer system issues:

   - Source removal – FDDs, other surface water connections, infiltration into pipe cracks, pipe lining, manhole freeze/thaw

- Transport and Treat – bigger pipes, new pipes, relief sewers, etc.
- Storage – larger pipes, tanks. Storage can be local and distributed.

Vince Caruso commented that the original SSO committee's first recommendation was storage; however, the Committee was concerned about disturbing parks and nature areas. There was discussion that the CAC may establish a principle that any FDD solution be paired with a stormwater solution. Robert suggested that Levels of Service ideas needed to be balanced with cost. As an example, the group may look at the possibility of linear storage, and know that it's more complex to design and construct in a developed area, and therefore more costly.

Frank Pelosi commented that the committee should evaluate what other cities are doing. Robert emphasized that cities are addressing the storm water issue in many different approaches, but that solutions are highly dependent on the system (is there room in the municipality for storage, where, how much it will cost to construct.) Beverly Smith asked about building another treatment plant to help with capacity and future development. Robert commented that it is unlikely that the MDEQ would permit construction of another treatment plant before other measures had been exhausted. Robert gave the group OHM's research on other communities with large scale FDD programs, including a paper on a large project in Duluth, MN that addresses engineering, legal and policy issues. There are many similarities between Duluth's sanitary sewer system issues and those of the Ann Arbor.

Action Item: Robert will research alternative solutions implemented in other cities and provide the subgroup a list of communities to contact and interview.

7. **Reliable Discharge Breakout Group** – This group discussed the Frank Burdick's sketch (distributed in the previous meeting summary) that was aimed at creating a backup for sump pump failure. Nick Hutchinson facilitated the group, which discussed issues of backflow related to sump pumps and Frank Burdick's gravity design. Pros and cons were identified:

   a. Pros: simple, reliable gravity-based system
   b. Cons: City's building department responded that the City's current code would not allow the design. Note – the group discussed whether or not Frank's design was legally impermissible or if there was room for negotiation with design modifications.

   The group challenged the City's position on backups as betterments, as compared to current gravity drains, and discussed alternatives to sump pumps:

   - Exterior sumps and pumps installed in a covered pit:
     - Pros: reduces potential basement flooding from sump pump concerns
     - Cons: maintenance, may not solve pump reliability concern

   - Install a primary and backup (potentially battery backed) pump with independent level switches
     - Pros: more reliable (multiple points of failure)
     - Cons: more expensive, (backup systems considered a "betterment" and creates additional tax issues)

   Action items:
   - Nick to get clarification from City's Building Department on gravity design – is there a win-win possible?
   - Project team to follow up on backup pumps as betterment issue – is this clear and definitive?

8. **Next Meeting: Thursday, December 12, 6:30 p.m. to 9:00 p.m. at Clague Middle School, 2616 Nixon Road**

9. **Public Comment -** In the Upper Malletts area, the goal is to perform projects to enable the stormwater system to accommodate a storm the size of the March 15, 2012 event. In the initial public meeting and in comments made by Evan Pratt, 40% of content of flow in pipes are stormwater infiltration. New homes are being approved in areas served by Ann Arbor and yet, Scio Township will be plugging manholes. There seems to be a disconnect between what's actually being done in and around the City and the goals stated for these projects. (William Higgins)

Question and Answer Section

1. **Infrastructure Information**

   a. **What are the approximate ages of the houses in the target neighborhoods?**

Study Area	Average Age of Home
Bromley	50
Dartmoor	42 (52 if not counting the newer development on W Liberty west of I-94)
Glen Leven	56
Morehead	42
Orchard Hills	47

   b. **Can the committee see maps with the number of houses in each neighborhood, along with pipe dimensions in each neighborhood?**

   The City is working on assembling these maps and they will be ready by the next CAC meeting.

   c. **How old are the pipes in each of these neighborhoods and could infiltration via cracks, roots, etc. be causing stormwater to enter the sanitary sewer system? (Meaning that footing drains do not comprise as much of the flow as estimated.)**

   We are preparing plots for the next CAC meeting that includes flow components, e.g. inflow, infiltration, base flow, etc., which will help assess how much stormwater is coming from other sources, and what these sources look like in the flow data. We will have this information at the next CAC meeting. The decade of installation for the sanitary pipes in the 5 study areas are shown below:

   Orchard Hills & Bromley – 1960's
   Dartmoor – 1950's to 2000's
   Morehead – 1960's to 1990's
   Glen Leven – 1950's to 1980's

   d. **How often does the plant reach capacity during these large rain events?**
   Reports of overflows at the plant can be viewed at: http://www.deq.state.mi.us/csosso/

2. **FDD Program**

   a. **How much more FDDs are needed when we're getting such good results from these 2600? What's the goal?**
   One aspect of the current study is the evaluation of system hydraulic deficiencies during a design rain event. The results of this analysis are anticipated to include an identification of additional capacity needs, if any.

   b. **What's the impact of wetlands on FDD?**
   Wetlands, if they function properly, tend to store surface runoff and gradually infiltrate the stored flow into the soil. Therefore, such flows would manifest themselves in the infiltration or groundwater component of flow metering flow data. The next CAC meeting will include a presentation on flow data and the inflow, infiltration, and baseflow components of flow data.

   c. **What is the distribution of FDDs throughout the city? Can we see a color map, a heat map?**
   {Additional map – backups in 2000 vs. 2013 comparison}
   The City is working on assembling these maps and they will be ready by the next CAC meeting.

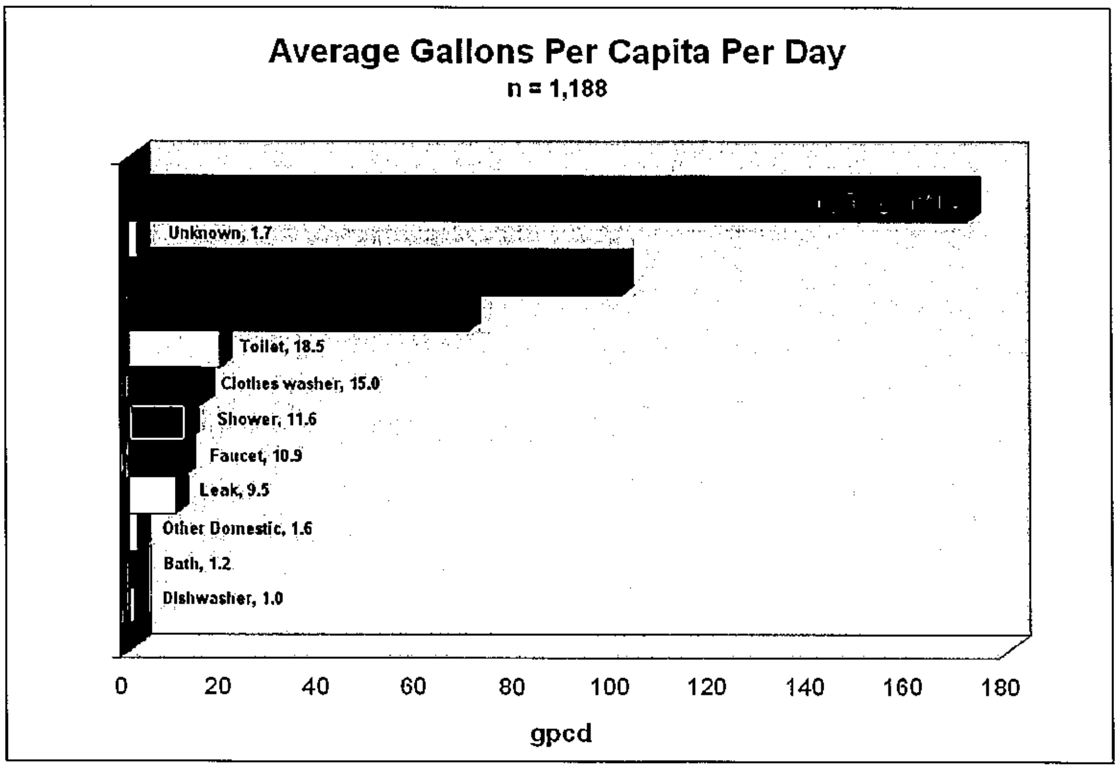
3. **SSWWEP Data and Analysis**

   a. **Do we have a control to other neighborhoods for the 2000 storm?**
   There is not an "ideal" control meter on a small upstream neighborhood without FDDs. However, the wastewater treatment plant (WWTP) is working as a suitable control district with some limitations. The limitations include changes in the system over the last 13 years such as new development (baseflow), and the fact that the flows at the WWTP may have decreased slightly themselves as a result of FDD. Because houses with FDD comprise only about 5% of the total houses in the City, the WWTP is functioning as a suitable control, despite these limitations. It should be noted that a decrease in flows at the WWTP as a result of FDD would tend to result in the underestimation of FDD flow removals in the priority neighborhoods, when the WWTP is used as a control.

   b. **The Malletts Creek surface water study is happening simultaneously, could it address the sanitary flows in those neighborhoods?**
   The Malletts Creek Stormwater Conveyance Study is being administered by the Washtenaw County Water Resources Commissioner who does not have jurisdication with the city's sanitary sewer system. However, the study is aware of the City's Footing Drain Disconnection Program and is taking into account the impacts the FDD program has on the existing stormwater system within the study area.

   c. **What kind of impact does personal use have on storms and flows? (Showers, laundry, etc.) Could it be skewing the data?**
   The chart below shows typical water demand in a household. Note that this figure tabulates household water use, and it is reasonable to assume that this water use would be discharged to the sanitary sewer, except the "outdoor" component. The "outdoor" use component in the table below is for lawn sprinkling and other irrigation, and this water use generally does not make its way to the sanitary sewer.

For reference, the peak flow rates from the year 2000 metering (pre-FDD conditions) ranged from 1,900 to 7,600 gallon per capital per day for the five priority districts. Other studies and FDD programs have estimated that the peak flow generation of a footing drain from a rain event is in the range of 3 – 5 gallons per minute per footing drain, which equates to approximately 1,950 to 3,300 gallons per capita per day.



source: Residential End Uses of Water, AWWA Research Foundation, 1999
http://www.allianceforwaterefficiency.org/residential-end-uses-of-water-study-1999.aspx

d. **We want to make sure that what appears to be a footing drain success story also includes mention of what else could be causing those reductions.**
Variations from different rainfall amounts, rainfall patterns and antecedent moisture conditions can "mask" the underlying changes in flows due to FDD. A scientific "control" for these items will be done with the FDD flow evaluation using three independent techniques that include scatter plots, meter correlations to a control, and continuous hydrologic modeling.

e. **It appears that 100% disconnecting in some neighborhoods doesn't necessarily lead to better outcomes than those with 50% FDDs. Is that true?**
It is very possible that the findings will show different effectiveness for flow removals from FDDs for the different districts, due to variations in the sub-surface, ground water conditions, and other differences between the districts. It is premature to draw those conclusions at this point, because the flow data presented has not yet been controlled for different rainfall amounts, rainfall patterns and antecedent moisture conditions. Those results will be ready at the next CAC meeting.

f. **Correlation of all this water data with actual basement flooding?**
Maps of basement backup locations will be ready at the next CAC meeting.

g. Is there a meter in 2013 that was on a control district that you can show us?
Yes, there are two. Although these meters were not installed in 2000, so we cannot use them for control comparisons, we can examine the 2013 flows and compare them to the post-FDD flows of the other districts. This information will be presented at the next CAC meeting.

4. SSWWEP Optimal Solution(s)

a. **Have we discussed any other alternatives yet, such as increasing sanitary sewer storage?**
The study includes an alternatives evaluation to begin in 2014, which will evaluate several alternatives to alleviate potential hydraulic system deficiencies, including storage.

b. **What's the benefit of doing FDDs if you can get the same stormwater reduction result from fixing the pipes? Or if pipes are deteriorating at a rate to offset any reductions from FDDs?**
It is not clear that the same flow removals can be achieved by rehabilitation of the pipes. The analysis of effectiveness of the FDD program on flow removals will identify how much flow was removed from FDD's and how much remains from other sewer defects in the five priority areas. This information can then be used to answer this question, and assess the feasibility of non-FDD flow removal in the future.

c. **What about the strategy of doing FDDs throughout the City, rather than just in certain neighborhoods? Would that give you a better outcome?**
Recall that the objective of the FDD program in the five priority districts was to address basement backups within those neighborhoods. To be effective in this objective, the FDDs had to target the neighborhoods with the basement backups. Evaluation of future FDDs as an alternative must consider the location of the FDDs relative to the capacity of the sanitary collection system and the risk of future basement backups. This evaluation, together with the evaluation of other options such as storage, will be evaluated in the next phase of the study.

5. Additional Questions from Post-Meeting Comments from Residents

- **Have you considered measuring flow directly on the curb line to determine the flows from FDDs?**
(the "curb line" is the small PVC pipe that is installed to collect the FDD flow from several houses and connect it to a storm inlet)
Subsequent to this comment, we contacted Martin Control Services (MCS), the City's flow metering contractor, to inquire about metering these connections. The best way to meter the flow from a pipe like this is a direct measurement with a bucket and stop watch during a rain event, because the flow and pipe size are too small for traditional continuous metering. MCS mobilized on the morning of October 31, 2013 during a moderate rainfall event (approximately 1-inch of rain over 12 hours) to make a direct measurement of the flow in a sample curb line in the Orchard Hills subdivision. The curb line they metered collects sump pump flow from 5 houses. MCS also made a measurement of the flow in the 10-inch pipe that was metered during the flow-metering program. These measurements, and subsequent analysis, show that approximately 66% of the total flow generated (i.e. the total of the flow in the 10-inch sanitary pipe and the footing drain flow in the curb line) is from footing drains. Additional information on this measurement will be presented at the next CAC.

- **I also need a source for the 70-90% figure for total volume in the sanitary sewer system supposedly from connected footing drains. I'd like to see what CDM has to say about the basis for that number, which has been stated to be studies. I need a study to back up the figures. The SSO Report has no source for those numbers, as far as I know. Others documents have said 'studies have shown.' Are there studies?**

  This question was posed to CDM (who did the 2001 study), and their response is pasted below in italics. The key take away is that they were estimates – very soon we will have the actual values computed.

  Tables 6 & 7 and Figures 6-8 in the Duluth paper "Was it Worth the Price" were presented to the "Best Practices" sub-group (see Attachments #2 for the entire paper). This study showed fairly significant flow removal rates from FDD. There is not much dispute in the industry that FDD can be very effective at removing flows.

  The key questions for Ann Arbor is how much did their FDD program remove, and then given that knowledge, the current state of the system, and the desire of the public, what is the best way to move forward from here? Those items will be our focus for the next several months of the study. The first piece (how much flow was removed) will be ready very soon, and tabulated using multiple techniques and multiple measurements. The second piece (where to go from here) will be performed over the winter and spring. All options are on the table and will be explored, and the City has made it clear that they hope and expect that the CAC will make a recommendation.

  Message from Mark TenBroek, CDM dated 11-7-13

  The SSO report presented an estimate that 70%-90% of the observed I/I during wet weather was likely from connected footing drains in the study areas. This estimate was largely based on the following data sources:

  - ***Direct Storm Measurements** – CDM Smith identified 20 house leads in Ann Arbor during the SSO project that discharged directly to manholes. During two rain events, 14 of these locations in 4 of the study areas were measured using a bucket and stopwatch method while flow metering was concurrently taking place in sanitary sewers. A comparison of these measurements led to the conclusion that 70% to 90% of the I/I flows were sourced from connected footing drains.*

  - ***Pilot FDD Monitoring** – Pilot FDD work was performed after the flow metering was completed to establish the range of expected flows generated by disconnected footing drains. These monitored sump pump flows were consistent with the directly monitored house leads, which estimated peak flows in the range of 3-5 gpm/home for large storm events.*

  - ***Peer Community Observations** – Footing drain disconnection work had been performed in West Lafayette Indiana, Canton Township, and Auburn Hills prior to the Ann Arbor SSO study. These peer communities had observed reductions in I/I after the disconnection of these footing drain sources, but the percentage of I/I flow from these sources had not been quantified at the time of the SSO study.*

After the SSO project was completed, additional data was collected as the FDD program proceeded to develop additional evidence of the source of I/I that was observed in the sanitary sewers, as described below:

- ***Southeast Michigan Sump Pump Monitoring*** *– After the SSO project was completed, CDM Smith deployed a number of sump pump monitors in homes around SE Michigan that were of a similar vintage as the Ann Arbor homes, but where sump pumps had been installed. This was done as part of the DWSD Wastewater Master plan. The monitored sump pump flows were similar to that observed in the pilot FDD installations in Ann Arbor.*

- ***Continuing Ann Arbor FDD Sump Pump Monitoring*** *– CDM Smith installed a large number of sump pump monitors that were moved to new sump pumps as the FDD work was performed in Ann Arbor. This data collection was performed from 2001 until present. The results of that work show that while the peak footing drain flows are voriable for individual homes, the average of the peak flows generated by footing drains was typically in the range of 3-5 gpm/home during large storm events.*

Charlie Fleetham

From: Irvin Mermelstein <nrglaw@gmail.com>
Sent: Tuesday, October 29, 2013 3:25 AM
To: Charlie Fleetham
Cc: JUDITH HANWAY; Aram Kalousdian; Jack Eaton; glynnb; amsyme; villagekt; Kathy Boris; Frank Burdick; (jecnmpc@sbcglobal.net); ted; geffenb; tombeth40; (petehouk@gmail.com); michelomayo; (marten@umich.edu); (jimosborn7@cs.com); (frankpelosi@gmail.com); (evaack@yahoo.com); caesersmith; (mwag@aol.com); (wherrymatt@gmail.com); kea2000; michellomayo; vrcaruso; Nicholas (NHutchinson@a2gov.org) (NHutchinson@a2gov.org); Robert Czachorski (robert.czachorski@ohm-advisors.com); Murat Ulasir (murat.ulasir@ohm-advisors.com); Jennifer (JLawson@a2gov.org) (JLawson@a2gov.org); (cpulcipher@a2gov.org); Lori Byron (lori@famousinyourfield.com); cslotten; Greg DeLiso (gregdeliso@mac.com); rkellar; Troy; stanhbaker; Postema, Stephen; dave.askins; Ryan Stanton; Ellen Fisher; Evan Pratt; Harry Sheehan; hedgerc@ewashtenaw.org; David Wilkinson
Subject: Sanitary Sewer Wet Weather Evaluation Study--Brief Rebuttal of City Position Concerning Legality of FDDs

Dear Charlie and Members of the Citizens' Advisory Committee,

Judy Hanway joins me in this email.

Charlie Fleetham recently provided the CAC with a write-up of the City's legal arguments to support its claim of authority to perform FDD work on private property. Charlie didn't invite a contrary view from a lawyer outside of the City, so this email is intended to provide a brief rebuttal, primarily for the CAC, of the City's position. Judy, Aram Kalousdian and I may take the liberty of providing additional relevant details in further communications.

This email addresses two discreet issues. The first section addresses the City's lack of legal "power" to implement the FDDP, as admitted in 2001 by the City **in the SSO Report**. I raised this with Charlie in a detailed email to him on September 5.

The second section is a necessary and quick debunking of the City's sudden notion that its power and authority to complete involuntary permanent FDD installations and construction on private property does not come from the City's **own** FDD Ordinance, passed **in 2001**, but rather from a completely different state statute (Section 5j of the State's Home Rule Law) that was not enacted **until 2002**. That law was **not effective until May 14, 2002,** and the City **never implemented the state statute** with a City Ordinance (as required right in the state statute itself). Section 5j is irrelevant and I don't see even a good faith basis for the argument.

Attachment #1, 102913 CAC Meeting, SSWWE Project

1. <u>Final SSO Report: No "Power" or "Legal Framework" to Perform FDDs Legally on Private Property</u>

Involuntary construction and permanent physical installations on private property are at the heart of the design of the FDDP. That design was the work product of the Sanitary Sewer Overflow Task Force in 2001. Work and construction on private property was the route advocated by CDMI and its president, Mark Tenbroek, the contractor who conceived of and wrote the SSO Report. This approach was accepted by the City apparently until sometime very late (after April 2001) in the Task Force's program design work.

The Report was issued in June 2001 and made a final recommendation of the FDDP for enactmen by a City Council Ordinance, but there was an immediate legal problem described as such in the SSO Report itself.

It's unclear why, but right in the text of the SSO Report, on Pages L2 and L3, the Task Force added a big caveat to its recommendation: in plain English, the Task Force concluded that **there was no way legally to implement the FDDP** they had just recommended because **the City had no "power" (and therefore no authority) to do the work involved in FDDs on private property.**

On Page L2, the SSO Report asked this basic question, which should perhaps have been answered much earlier:

> **Legal Authority--**Can and will the City of Ann Arbor have the **legal framework** to accomplish the work required on private property?

The answer went even further than the question:

> **A first step is to develop a legal framework** that would allow access and work on private property. To be effective, the City of Ann Arbor **would need to have the power to accomplish the disconnection work on private property.**

The City had therefore just paid CDMI (and its public relations subcontractors) a lot of money to help the City develop a program for which the City lacked "power" (in the legal and constitutional sense) to enact or implement. It is a very damning admission in the City's own report that, as of June 2001, no one had yet figured out (or thought about) how to do the recommended and highly intrusive Ann Arbor-style FDDs **within the law and within the City's powers**. The SSO Report recommendations were a legal mistake and CDMI wanted a legal fix.

There was, however, no legal fix to be had in City Hall. The City had already said in its own report that it had no "legal authority," "power" or "legal framework" for the FDDs prescribed in the same report. The central problem for the City Attorney in June 2001 was that municipalities **exercise** power, they don't **create** it. The lawful legal and political "powers" of municipal governments are created by the Michigan State Constitution and the United States Constitution, and conferred on local governments (or not) under State and federal laws like the Home Rule Act. Neither the City Council nor the City Attorney could create legal or political power for the City itself **of any kind** just by passing an ordinance. Most especially, they could not create "power" to deal with the private property rights of citizens in the very manner that the **Federal and State courts had already powerfully condemned as unconstitutional.**

That is just what the state of the law already was in June 2001 concerning work on private property. By **1982,** both the US Supreme Court (in the *Loretto* case) and the Michigan courts had established that there were clear and simple constitutional limits on **involuntary permanent physical installations** (like FDDs) on private real property. These limitations came into play if, **before the involuntary installation,** the owners had been neither accorded "due process" about taking their property nor paid "just compensation" for the real property rights to be taken. Those are required by both the federal and state constitutions, including the US Fifth Amendment Takings Clause. **It is a fact that FDD Ordinance, however, was implemented entirely without any due process or just compensation for homeowners.**

These landmark decisions of the courts meant **before the SSO Task Force was formed in 2000,** that if a permanent physical installation had occurred because of an **"enforced consent"** under an enactment (like the FDD Ordinance), and the installation created **more than a "trivial" burden** on the property owner, **then that installation would be held to be an unconstitutional "taking" of private property for which the owner would have to be paid.**

Such takings were held to be of a particularly disfavored type called "*per se* takings," because the Supreme Court views physical takings as **crossing constitutional red lines** concerning real property rights.

The next obvious important question is: Even if a court agreed with a plaintiff that her FDD "consent" was enforced, **what does a "trivial" burden mean?** In the 1982 *Loretto* case, the US Supreme Court examined a simple "enforced consent" permanent physical installation (under a NY State law) of **static cable wires** in a non-living utility space within a privately-owned apartment building in New York City. The City argued that the cable wires were not burdensome to the owner—they were out of the sight of tenants and were maintenance and operation-free—and that cable access **was a civic benefit.**

But Justice Thurgood Marshall rejected New York City's arguments in the strongest terms and ruled that the cable wires installation was an "enforced consent" ***per se* physical taking** and thus illegal. The City couldn't leave a permanent installation behind when it left. The Court said that even cable wires installed by enforced consent created a **"more than trivial"** burden on the owner's "right to exclude." The Court stated that the "right to exclude" is the core right of private property ownership and **that the City's civic purpose for the taking—good, bad or simply lacking—was irrelevant.**

There are some things that American governments cannot do, and it was no secret in 2001 that involuntary permanent physical installations on private real property, like the FDDs described in the SSO Report, had for all intents and purposes been prohibited by the courts long before then. I have told the City this for over a year. The City would have to explain whether this problem was missed in 2001 before the final SSO Report or simply ignored. Either is possible.

As for "enforced consent," it is a fiction that there is an opt-out in the FDD Ordinance. What is in fact there is a $1200/per year fine or tax, with no due process, on the exercise of a resident's right to exclude, which is so carefully protected by the Loretto case. It's not surprising that only three people "opted out. FDDs under the FDD Ordinance are "enforced consent" installations, just as they were designed to be. The *Loretto* rule, by the way, was just affirmed by the US Supreme Court in December 2012 in the *Arkansas Game* case.

Concerning "just compensation," the Loretto installations were legally **far less burdensome** than **any** FDD, **even without any flooding out of the sump**. Cable wires don't flood basements, but FDDs often do and **every** FDDs requires mandatory operation, maintenance, repair, replacement, physical labor, etc. Those are not "trivial" burdens in comparison to cable wires. These are all **parts** of the burden on the homeowner (including the installation itself) and are all compensable in a lawsuit filed by any resident with an FDD, past or future. The relevant statute of limitations is 15 years.

The apartment house owner in NY received $1 in compensation from New York City, but she established a national legal standard. FDDs under the Ann Arbor Ordinance are **all** takings and **none** are $1 takings. These takings are going to be very expensive and going ahead with such takings by the City, which was known to be beyond the powers of the City, was taking an enormous risk with the City's finances and future. That risk is now preparing to mature while the City is considering doing further FDDs. Those will be expensive too.

The part of the SSO Report, in fact, is little noted by the City, as is the fact the legal problem in 2001 was so clearly recognized as an actual lack of municipal "power" from any constitutional source. **That was an insurmountable problem** and the verdict from the City Attorney in 2001 should have been, without doubt, that (i) the built-in "no power" problem of the FDDP design (admittedly a mistake by CDMI and the Task Force) could not be fixed and (ii) that FDDs could **never** be done Constitutionally without condemnation proceedings and just compensation **for each house.**

Further, Michigan condemnations go at the very high costs established by Article X, Sec 2 of Michigan Constitution. FDDs should **never** have been understood by the City and the City Attorney as anything other than very expensive and slow to do, not a quick, cheap alternative to upgrading the sanitary sewer infrastructure. If that had been understood, the City would have had to go back to the drawing board, but it would have avoided doing the expensive involuntary FDDs that will now have to be paid for in court.

Instead, for reasons that are not apparent, the City determinedly walked itself right into **1,821 per se physical takings** under the FDD Ordinance. The Ordinance is simply a virtual cookbook for doing the admittedly unlawful FDDs designed by the Task Force and recommended in the SSO Report. Those FDDs, as predicted by the SSO Report, were all unlawful and I don't think the City's current priority should be figuring out whether to do more FDDs under the FDD Ordinance. The problem for the City is figuring out how the City is going to cope with the costs of paying for the almost 2,000 FDDs already done. Effectiveness of FDDs is legally and practically irrelevant.

Section 5j: Not Self-Executing, Not Retroactive and Not Relevant

I reviewed Section 5j of the Home Rule Law months ago and dismissed it for a number of reasons discussed here. The City's reliance on Section 5j, in fact, appears to be a shift in its position on its authority to do FDDs on private property. The City's apparent position now is that **the FDD Ordinance cannot stand on its own feet** (with which I agree), and instead suddenly needs to be propped up by a later-enacted statute **and** suggestions of retroactivity. I don't see any good faith basis for this argument. The problems discussed above are on top of that.

Section 5j would have had to solve, in 2002, the power/no power issue from the SSO Report in 2001 **and** it would have had to be retroactive. Section 5j does not create a "power," and when the State wants to confer "power" on a City, not just an authorization, it says so specifically. Section 5a of the Home Rule Act, for example, states that cities shall "have power" to maintain their own record keeping systems. Section 5j just doesn't do that.

The second major defect in the City's argument is that Section 5j **was not self-executing** in Ann Arbor or anywhere else. In any Michigan city, Section 5j just sat on a shelf **unless an ordinance was passed after May 14, 2002 to implement it.** That is its effective date, as stated in the law itself. **No such ordinance was ever introduced or passed.** I doubt that it was even considered, because Ann Arbor had already passed its own custom-made FDD Ordinance, which went way beyond any sort of program that a Section 5j ordinance would have allowed.

Section 5j is also only prospective (forward-looking only) and **not retroactive.** It did not authorize or validate or affect in any way any ordinance **passed before May 14, 2002,** including an ordinance about footing drains. The authorization to cities was only to pass future Section 5j ordinances after its effective date and not before. There is no basis for arguing to the contrary.

No Michigan court would interpret Section 5j to, in effect, authorize unconstitutional per se physical takings under the FDD Ordinance. For example, there is **nothing** in Section 5j that would have authorized the City to impose mandatory operation and maintenance obligations **only** on City residents with FDD installations **and** at their own cost and expense. It's the cable wires problem—combined with the machinery, it's way too great a burden under the hair-trigger Loretto rule.

A final indication that the City has done nothing under Section 5j is that the statute specifically authorized funding of projects under a Section 5j ordinance **by Special Assessments.** Special Assessment procedures could have killed the FDDP, because the affected owners would have had due process rights to be heard and to challenge FDDs as "benefits" or as a "benefit" to their specific properties. A variety of votes and approvals would have been required for the Special Assessment. None of this ever happened relating to footing drain "separations" under Section 5j.

The FDD Ordinance is the only authority (valid or invalid) the City ever created and the only one the City or its contractors have ever relied for involuntary residential FDDs. The FDD Ordinance doesn't get any help from the irrelevant Section 5j.

I'll address the City's "retroactive building code" theory and your other points in an email later today or tomorrow.

Irv Mermelstein

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Was It Worth the Price? I/I Reduction Effectiveness of a Foundation Drain Disconnection Program in Duluth, Minnesota

Andy Lukas, P.E., Brown and Caldwell;
Steve Lipinski, City of Duluth

ABSTRACT

As the C in the emerging CMOM regulations refers to Capacity Assurance of a collection system, many communities are taking necessary steps to make decisions on how to better operate their collection system facilities. In particular, USEPA recommends the use of continuous infiltration and inflow (I/I) models, coupled with hydraulic models to perform capacity analyses of critical facilities. Implementing such tools was key to understanding the I/I reduction evaluation achieved by a foundation drain disconnection program conducted by the City of Duluth, Minnesota. The study of I/I reduction effectiveness evaluation was conducted by Brown and Caldwell through a contract with the Western Lake Superior Sanitary District (WLSSD), the regional wastewater wholesaler for the City.

The intent of the disconnection program was to reduce the amount of wet weather infiltration and inflow to eliminate the overflow at the Dodge St. Pump Station. The removal project consists of redirecting residential footing drains into a new sump pump pit installed in the house. The sump pump is required to discharge to a satisfactory area to minimize the likelihood that clear water recycles back to the foundation. From concept to reality took a great deal of effort from City staff. This work included changing state law to allow public funds to be spent on private assets in order to reduce clear water in the system. The work began in 1996 and was declared complete in 2002.

The effectiveness evaluation of the removal project was based on modeling before and after construction conditions. The key to the analysis was use of a calibrated continuous RDII simulation model, coupled with a dynamic hydraulic model of the collection system. In summary, the RDII removal effectiveness took place in the following steps:

- Model calibration
- Long-term simulation
- Statistical Comparison

The paper will present details of the techniques used to simulate I/I and hydraulic conditions before and after program completion. Details of the City's foundation drain disconnection program are also provided.

KEYWORDS

Collection system, foundation drain disconnection, pump station, infiltration, inflow, sanitary sewer overflow, modeling, hydraulics.

Attachment #2, 102913 CAC Meeting, SSWWE Project

INTRODUCTION

The Western Lake Superior Sanitary District (WLSSD) and the City of Duluth have combined efforts to reduce overflows and clear water inflow and infiltration into the sewer system during the past 20-years. The purpose of their efforts is to reduce peak flows to avoid overflows in the conveyance system. Even though much action has been taken and significant improvements have been noted, overflows still continue at unacceptable intervals. Future elimination of overflows will continue to focus on clear water removal. The clear water removals will focus on the house footing drain disconnection program by the City of Duluth.

PROJECT SETTING

Duluth, Minnesota is unique in having at its front door one to the greatest and highest quality water resources in the world. Duluth is located at the Western tip of Lake Superior. Lake Superior holds 10% of the world's fresh water. The City extends along approximately 26 miles of steep river and lake edge. Above the escarpment is a high concentration of wetlands. Soils are heavy clay on a basalt base. Forty two above ground streams and numerous underground streams cross the City. Winter frost can go as deep as 72 inches. Annual precipitation is 30 inches, much of which occurs as an average of 80 inches of snowfall resulting in dramatic spring runnoff.

Much of the housing stock is 50 to 100 years old and built prior to modern planning and housing requirements. The City has 420 miles of pipe, some of which is over 100 years old. However an intensive maintenance program including cleaning and televising has allowed the City to determine condition and maintain the public infrastructure.

CITY OF DULUTH INFLOW & INFILTRATION REDUCTION PROGRAM HISTORY

Recognizing the importance of protecting Lake Superior the City has been active in seeking solutions to Inflow & Infiltration (I/I) problems since the 1970's. The program began in the mid-70's at the time the Western Lake Superior Sanitary District (WLSSD) was formed and Federal funds were used to construct the treatment plant. Conditions of funding required a Sanitary Sewer Evaluation Study (SSES) to determine the condition of the collection system.

The City of Duluth is the largest municipal customer of WLSSD. WLSSD provides regional planning, pollution control, wastewater management and bio-solids disposal within its 500 square mile area. This includes treatment plant operations, water quality monitoring and water quality regulation. Although there has almost always been some on-going I/I reduction work within the district, WLSSD instituted a district wide I/I reduction program in 1992. The program included quarterly meetings of all communities in the jurisdiction of WLSSD. The communities were required to develop individual I/I reduction programs.

I/I activities prior to 1992 included, replacing vented manhole covers with solid covers, sealing manholes, rehabilitating or replacing pipes, and plugging cross connections. Other activities included providing free dirt to homeowners to landscape slopes away from basements, inspection and disconnection from the sanitary sewer sump pumps on Park Point (a low sand pensinula in the harbor), and a roof drain removal program.

By 1994, WLSSD recognized that the I/I program was not progressing as rapidly as desired. WLSSD placed a moritorium on any new sanitary connections in Duluth until the City adopted an acceptable plan to reduce I/I.

At this time the City of Duluth was negotiating the construction of a new Ominmax Theater and the Northwest Airbus Maintenance Facility. The City Administration and the City Council held several meetings to address the issue. Representatives from WLSSD and the Minnesota Pollution Control Agency (MPCA) attended the meetings and provided information on what makes up an acceptable I/I reduction plan. The suggested approach was to pass an ordinance that made clear water connections to the sanitary collection system illegal and to provide a method of inspection and enforcement. The City of Duluth's I/I reduction plan would require approval of the WLSSD Board prior to implementation.

On August 22, 1994, the Duluth City Council passed Ordinance 9201, which stated: "*...every person that owns a building which has roof drains, areaway drains, other roof runoff, subsurface drainage, foundation drains, unpolluted industrial water of cooling water connected to a building sewer or building sanitary sewer shall disconnect and remove such roof drains, areaway drains, sump pumps, foundation drains or other sources of unpolluted water in an effective, workmanlike manner..*"

The public outcry against this ordinance was tremendous and "sump pump" became a nasty word. At the September 12, 1994, City Council Meeting the chambers were filled with citizens overflowing into the halls to address the council with their disapproval of Ordinance 9201. The result was that the City Council rescinded the Ordinance. However, the City was faced with the moratorium on new sanitary sewer connections due to the lack of an acceptable I/I reduction plan. As a result, the City Council appointed a Citizen I/I Task Force, which was charged with reviewing the I/I issues and bringing recommendations back to the Council by December 31, 1994. The Task Force had to come up with a solution to a problem the City had been working on for 2 ½ years in a little more than 3 months.

The I/I Task Force met with City Staff, WLSSD personnel, and MPCA representatives. These discussions gave the Task Force the technical background of the I/I issues. The Task Force also held public hearings throughout the community. At these meetings the Task Force heard concerns of the community and in turn provided education back related to I/I. On December 15, 1994 the Task Force presented its report and recommendations to the City Council. The Task Force conclusions and recommendations were:

<u>The following sources of Inflow & Infiltration were identified:</u>

- Roof drains from downtown and other flat roofed buildings.
- Deteriorating and poorly maintained sanitary sewer lines.
- Lateral lines (which connect private building sewers to City mains).
- A neglected and inadequate storm sewer system.
- Residential foundation drains.
- Former City sanitary sewer lines now the property of WLSSD.

Task Force recommendations for immediate and short-term action:

- "No exceptions" enforcement or the 1977 ordinance requiring disconnection of roof drains form the sanitary sewers.
- A program of accelerated cleaning and inspection of City sanitary and storm sewer lines.
- Detailed analysis of entire City sewer system with highest priority on sub-basins in Lakeside and Morgan Park which currently produce most sewage overflows. Other priority areas for early study include Denfeld, Endion and Woodland.
- A program of voluntary citizens actions supported by technical assistance and information provided by City staff.
- Development of funding support for voluntary improvements by homeowners.

Task Force recommendations for long-term action and improvements:

- Reconstruction of the sanitary sewer system and extension and rehabilitation of the storm sewer system.
- Protection of wetlands and other undeveloped areas which provide natural retention of stormwater and runoff, and help prevent surges in sewer systems.
- A program of continuing enforcement of I & I regulations.
- Development of a water conservation program.

The City Council accepted the recommendations of the I/I Task Force. City staff was directed to create an long-term I/I reduction plan based upon the Task Force recommendations. When the staff brought the comprehensive plan and budget back to the Council, staff was redirected to look at a less ambitious program because of the unknowns regarding the effectiveness the proposed I/I remedial solutions. Staff developed a short-term plan that would become a demonstration program to lay the ground work for the long-term plan. One of the first steps was to develop a public information program which included overhead presentations, an information video created with assistance of a local television station and neighborhood meetings.

The short term plan had to be presented to the WLSSD Board for approval. During the presentation it was pointed out that to develop a long-term plan the City would increase sewer rates 5% to cover the cost of a short term program to determine what corrective actions would be the most cost effective. The WLSSD Board approved the short-term plan with the stipulation that the sanitary sewer connection moratorium would not be removed until a long-term plan was approved. The Board further added that connection requests would be reviewed on a case by case basis.

In 1995 the City of Duluth developed and implemented a short term I/I Reduction Plan. The City Council by resolution agreed to support a long term plan based upon the findings of the 1995 short term program. The short term plan included:

1. Roof drain removal from sanitary collection system.
2. Accelerated sewer cleaning and inspection program.
3. Sanitary sewer system analysis.
4. A public education/information program.
5. A voluntary I/I removal demonstration project
6. Continued enforcement of current I/I regulations.

To perform the demonstration program the City needed to request authority to spend public funds on private property from the Minnesota Legislature. The Demonstration Program required remedial activities on private property and one of the I/I Task Force Recommendations was to create a funding source to pay for private property work. Minnesota statues prohibited (as most state statues) the spending of public funds on private property. The City of Duluth was informed that if the City were to request funding from the state the request would have a very difficult chance of approval, but if the request was the ability to spend public funds on private property without state funding it would have a good chance to be approved.

The City requested the State Legislature to pass legislation allowing the City to use sewer utility (public) funds to perform work on private property to remove I/I from the sanitary sewer system. The Legislature approved the request on a one time basis for the City to spend up to $400,000 on private property to perform a demonstration program. The stipulation was that no State funding was to be requested for this project.

The Demonstration Program would be performed in two sewer basins that were experiencing the majority of the overflows due to I/I. City staff began with a cleaning and televising program, both basins were televised in dry weather and again during wet weather conditions. The City hired a local consultant (RREM) to help direct the I/I reduction program. A flow monitoring program was instituted along with the cleaning program. The consultant identified the locations for flow meter installation, the City staff installed, maintained and complied the data from the meters. The consultant performed the analysis of the data. Community meetings were held to inform the customers on the activities taking place in their neighborhoods along with soliciting volunteers to have the I/I corrective work in their homes.

Once property owners volunteered to participate, the City performed inspections to determine if the property was contributing I/I. If the property was contributing I/I, the inspector and property owner would determine what corrective action would be used, then the property owner would have to obtain 3 bids for each type of work. The City would provide a grant to the property owner to pay the lowest responsible bidders. The check would then be made out to the property owner and the contractor.

The Demonstration Program's activities led to many accomplishments. One hundred percent of all roof drains in the City of Duluth were inspected and 95% of them were removed. The work was accomplished with the assistance of the Water & Gas Department meter readers, who were performing inspections of homes during their monthly meter readings. There was a 55% increase in cleaning footage of the sanitary collection system along with a 250% increase in the CCTV footage. Under the I/I program additional Collection System Maintenance Workers were hired and a second CCTV truck was purchased. A total of 4 Wastewater Compliance Officers were hired to perform the I/I inspections and for the enforcement of current sanitary sewer regulations. But the most important factor was the "buy-in" by the public. Property owners, within the Demonstration Program, embraced the program with enthusiasm, which was a far cry from the public response in August of 1994.

Using the results of the Demonstration Program the City staff hired RREM (engineering consultant) to assist in the development a long term plan in late 1995. The plan would extend the same activities of the Demonstration Program for 6 additional years. The budget for the grant program was based upon costs for I/I reduction work during 1995. The long term plan will provide grants to 350 homes per year, averaging of $2,500 per home. The assumptions made were that over the next 6 years the City would remove enough I/I to meet the goals set forth by the WLSSD and MPCA. The long term program would require the City Council to increase sewer rates another 14.9% , and the City would have to get approval from the State Legislature to continue spending public funds on private property to remove I/I from sanitary sewers.

The City Council unanimously approved the long term plan including the rate increase. At that point the plan was presented to WLSSD for approval, the WLSSD Board also unanimously approved the long term plan. Finally, the State Legislature had to be approached again. This time the City was requesting permanent permission to use public funds for private property corrective work to remove I/I. The State Legislature reviewed the results of the Demonstration Program and determined that I/I was a state wide issue. Based on the City of Duluth program the state adopted legislation that would allow any municipality in the state of Minnesota the authority to use public funds for I/I remediation on private property. This legislation is Chapter 471 Section 471.342 in the State of Minnesota Statutes.

The legislation required the City to develop program guidelines that govern the program and prior to the adoption of the program guidelines, the City Council must conduct a public hearing after giving at least ten days' published notice of the hearing.

The legislation allowed communities to establish a program that would provide loans and grants to property owners to assist in financing the cost of abating I/I on their property. Due to the cost to administer a loan program the City elected to provide grants to remove I/I related to underground sources and a loan program for roof drain disconnections. As it turned out only one request was made for a roof drain loan and the City developed guidelines that local banking institutions would provide a loan with the City guarentee for payment if the property owner defaulted on the loan.

Near the end of 2001 WLSSD again had concerns that the City of Duluth was not removing I/I rapidly enough to eliminate overflows in basins listed in the WLSSD NPDES permit. Again, WLSSD required the City to modify the I/I Reduction Program to increase the number of disconnections each year from 350 to 500.

To accomplish the additional disconnections the City had to modify the program to reduce the amount of time the process takes to hire a contractor and get the work completed. The City developed a scope of work and requested bids from contractors for the following work:

Many lessons have been learned as the program has grown. The first assumption that the City could eliminate overflows and reduce wet weather flows to an acceptable level in 6 years was flawed. The program has evolved over time and today it has made many changes.

The I/I reduction grant program has been refined and now the only corrective actions funded through the grant are disconnection of foundation drains which includes installing sump pumps or gravity discharge. The program has focused on the most cost effective work to remove I/I, while roof drains, rain barrels and landscaping help reduce the I/I entering the sewer system the disconnection of foundation drains has proven to be the most cost effective.

Basin 2 Project Background
Construction in one basin, Basin 2, in the City of Duluth offered the opportunity to determine the relative effectiveness of the house foundation drain disconnection program. Disconnection of the foundation drains was planned to be completed in 2002 in this basin. Wet weather flow in this basin contributes to a sanitary sewer overflow at the Dodge Street Pump Station. The project basin, shown in Figure 1, is located in northeast Duluth. Basin 2 has a total area of 560 acres with 1194 homes that are served by the separate sanitary and storm system. Basin 2 discharges into the WLSSD's Dodge Street Pump Station. Currently, flows delivered to the Dodge Street Pump Station by the City of Duluth sanitary system are strongly influenced by rainfall. As a result, during intense storms, flows reaching the pump station are in excess of the capacity of the station, and overflows occur to the storm sewer located next to the station. The storm sewer eventually discharges to Lake Superior. The area was selected because the area is known to have frequent sanitary sewer overflows. Characteristics of the basin are given in Table 1.

Table 1. Basin Characteristics

Parameter	Units	Value
Sewer Basin Area	Acres	560
Population	People	2731
Sewered Population	People	2731
Total Pipe	Feet	74,296
	Inch Diameter Mile (IDM)	125
Basin Area per IDM	Acres/IDM	4.48
Sewered Population per Acre	Population/Acre	4.88
Sewered Population per IDM	Population/IDM	21.85

The City of Duluth began identification and disconnection of foundation drains from the Basin 2 sanitary sewer system in 1996. Disconnection of the foundation drains was accomplished by redirecting them into a new sump pump pit that is installed in the homeowner's basement. The discharge from sump pumps was directed away from the house to minimize the recycling of water back into the sewer system. In some cases the discharge was connected to the storm sewer. Table 2 summarizes the disconnection program through 2002. Of the 1194 homes in Basin 2, 1141 have been inspected. Of the 1141 homes, inspectors identified 761 for foundation drain disconnection and sump pump installation. By July 15, 2002, 725 sumps pumps had been installed to disconnect the foundation drain connections.

Table 2. Disconnections/Sump Pump Installations

	1995	1996	1997	1998	1999	2000	1/1/2001 - 11/30/2001	12/1/01 - 6/1/2002	6/1/2002 - 7/15/2002	Total
Sump pumps installed Basin 2	0	3	86	218	76	40	141	132	29	725
Cumulative for Program	0	3	89	307	383	423	564	696	725	

The Dodge Street Pump Station was constructed in 1930. There are two pumps at the pump station with a maximum pumping capacity of 1.94 mgd. Pump 1, 25 horsepower Chicago pump, is original to the pump station. Pump 2, 30 horsepower Smith & Loveless pump, was installed in 1987. The pump station force main is 12-inches in diameter and 3293 feet long. Wet weather flows reaching the Dodge Street Pump Station that are in excess of the capacity of the station overflow through a pipe to the storm sewer located next to the station.

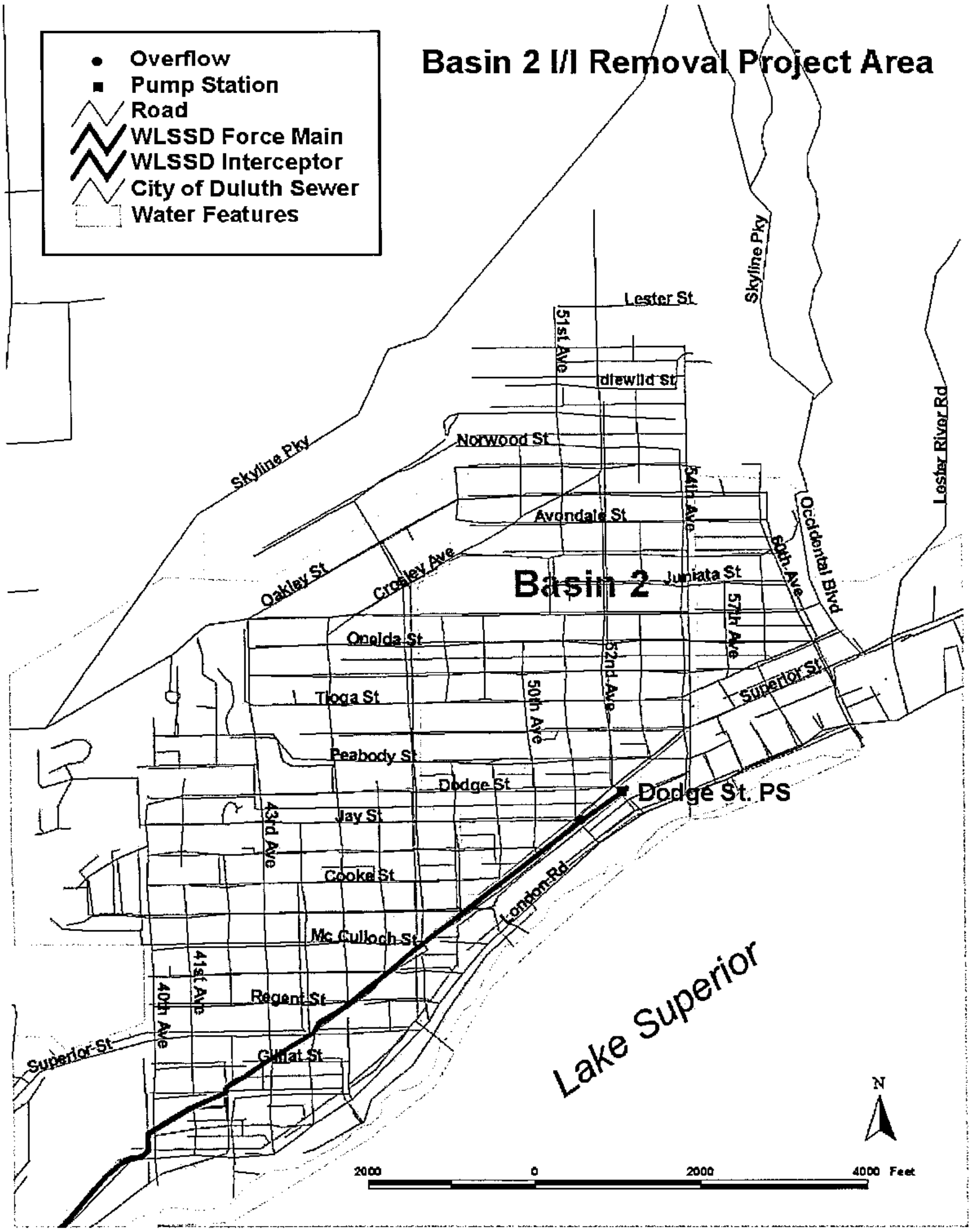

Figure 1. Basin 2 Project Area

MONITORING DATA

This section describes the flow and rainfall data collected as part of this construction project.

Flow Monitoring Data

There is a long term magnetic flow meter (Bailey-Fischer and Porter mag meter) installed on the Dodge Street Pump Station discharge piping. A mag meter records volume of flow by measuring the velocity of water in the meter and multiplying by the cross sectional area of the meter tube flow. This flow meter remained in place throughout the construction program. WLSSD currently calibrates and performs preventative maintenance on this meter at a 90-day frequency .

An area velocity flow meter placed in the overflow pipe at the Dodge Street Pump Station measures overflow data. This meter was installed in 1999. Due to hydraulic conditions in the overflow pipe near the overflow meter, there are concerns for the ability of the meter to measure overflow rates accurately at low flow depths. Regardless, the meter provides a good indication of overflow occurrence.

Rainfall Data
The WLSSD has maintained a tipping-bucket type rainfall gauge at the Dodge Street Pump Station since 1999. Rainfall data for this site was acquired from 1999 to 2002. Long-term rainfall records were acquired from the *National Weather Service Duluth Airport Rain Gauge* from 1948 through 2001. The Duluth Airport is approximately 8 miles west from the project site and, over the long term, experiences similar weather patterns to those experienced in the project basin.

Basin 2 SSES Information
Activities performed during the sanitary sewer evaluation survey (SSES) investigations performed by the City of Duluth for this study area included flow and rainfall monitoring, sewer line cleaning and televising, smoke testing, elimination of roof drain connections, replacement of vented manhole covers with solid covers and private system inspections. The RDII reduction from these measures is unknown. Anecdotally, the City has provided some indication of the success. Prior to aggressive work to reducing RDII sources, many homes in Basin 2 experienced basement backups. According to discussions with City staff involved during the Basin 2 disconnections, several manholes were known to have "floating" covers during storm events, suggesting significant sewer system surcharging.

BASIN 2 PROJECT DETAILS

This section provides details on the work performed during the foundation drain disconnection project, including a discussion of project costs.

Construction Details
The intent of the disconnection program was to reduce the amount of wet weather infiltration and inflow to eliminate the overflow at the Dodge St. Pump Station. The removal project consists of redirecting residential footing drains into a new sump pump pit installed in the house. The sump pump is required to discharge to a satisfactory area so that recycling of clear water back into the sanitary sewer is minimized. From 1996 through 2000 residents were required to receive three quotes from a contractor to perform the work required for sump installation. When the number of homeowners that were willing to get quotes began to taper off, the City began to bid the work out. The bid packages were set up for the contractors to bid the work in increments of fifty installations. Contracts were awarded to the low bidders.

Construction Costs
The average cost for sump pump installation from 1996 – 2000 was $2,500. This was the time period when the homeowners were receiving quotes from the contractor. From 2001

– 2002 the average cost to install a pump was $1,500-$2,000. Table 3 summarizes the average unit costs for sump pump installation after the City began to bid the work out. The average bid unit cost is based on seven bids that were received by the City.

Table 3. Average Cost for Sump Pump Installation

Bid Item	Description	Average Bid Unit Price
Base Bid Sump Pump		$1,269.29
Additional Items if Required		
Electrical Upgrade	Upgrade electrical service to code	$871.43
Re-Plumb & Vent	Re-plumb and vent plumbing fixtures flowing directly into sump pit or house trap	$385.71
House Trap	Remove house trap	$347.14
PVC Discharge (per Foot)	Discharge pipe if more than 20 feet are required	$3.37
Underground Discharge (per Foot)	Underground discharge greater than 30 feet	$4.14
Floor Drain (Additional) each	Additional floor drains if necessary	$135.57
Discharge to storm	Attach discharge to storm sewer	$789.29
Underground to discharge	Run underground discharge pipe to curb	$206.43
Addition al Discharge	Additional discharge protection to prevent recycling	$128.86
Larger Sump Pump (1/2 HP)	Larger sump pump if necessary	$130.71

The overall estimated construction cost of the sump pump installation project is $1,586,000. This estimate is based on installing 423 sump pumps prior to 2000 for $2,500 each and installing 302 sump pumps after 2000 for $1,750 each. The total City's cost for administration and foundation drain inspection for Basin 2 was $685,000.

POST-CONSTRUCTION DATA EVALUATION

The following section discusses the analysis performed for before- and after-construction conditions. The effectiveness evaluation of the removal project was based on the use of a calibrated continuous RDII simulation model. In summary, the RDII removal effectiveness took place in the following steps:

- Model calibration – Calibrated models were developed for each basin using data from before and after the removal projects.
- Long-term simulation – The before and after construction models were each used to simulate a continuous series of hourly flows resulting from the local 53 year historical rainfall record. Total flows including sanitary and RDII flows were computed.
- Statistical analysis – Peak RDII flows corresponding to specific return periods were determined for both of the before and after construction models. A Log-Pearson Type III distribution was applied to the annual maximum data in order to derive the return period flows. The performance of the RDII removal project was estimated by determining the flow reduction achieved at specific return periods.

Calibration

Brown and Caldwell's experience in modeling similar situations indicates that the analysis is best served by constructing and calibrating using a continuous, dynamic model. In this context, our method relies upon three elements. Base sanitary flows were projected using population and employment data and unit generation rates. Wet weather flows are developed using rainfall data and collected flow data. Brown and Caldwell's hydrologic RDII model was used to estimate the amount of extraneous water entering the sewer system. The RDII model is calibrated against historical measured flows. Finally, because of conditions present for this project, it was necessary to construct a dynamic hydraulic model. The dynamic hydraulic modeling software used is called SewerCAT. SewerCAT was developed as a public domain program for analyzing sewer hydraulics.

For this project, model calibration took place in three steps. First, the wastewater flow model was calibrated to measured dry weather flow data. Second, the RDII model was calibrated to measured pump station discharge. Third, The hydrographs generated by the RDII model were used as inputs to the hydraulic model, and the results of the hydraulic simulation were compared to measured flow discharge at the Dodge St. Pump Station, measured wet well elevations, and reported overflow volumes.

Calibrated models have been developed for Basin 2 before and after the foundation drain removal project. The calibration results are presented in Table 4.

Table 4. Calibration Results

Period	Average Event Flow Volume Error	Maximum Event Flow Rate Error
June20-29 1999	13%	-11%
July 2-12,1999	-1%	-19%
August 10-17, 1999	17%	1%
June20-29 2002	1%	3%
July 6-12 2002	2%	3%
July 23-26 2002	32%	8%
August 9-13, 2002	24%	4%

The “before” condition represents 1999 conditions, not 1996 when the program actually began. This is partly because WLSSD began metering rain and overflow data at the pump station in 1999. This is also partly because much of the early gains achieved by the disconnection program were realized upstream of the pump station. Not until basement backups and manhole overflows were remedied did flows at the pump station begin to decline during storm events. For these reasons, 1999 was selected as the before-construction condition for this analysis.

Long-Term Simulation

Long-term simulations were performed with the before and after-construction, calibrated Basin 2 models. Long-term simulations used 53 years of hourly rainfall data (1948 – 2001) from the *National Weather Service Duluth Airport Rain Gauge* and produced over 53 years of simulated flows from Basin 2 before and after the removal project.

As part of the long-term simulation runs, the number of simulated overflow events for before- and after- construction conditions was compared. This is shown in Figure 2. Prior to sump pump installation 393 overflows (7.4 per year) were simulated during the 53 years compared to 63 overflows (1.2 per year) that were simulated after the RDII removal. The number of simulated overflow occurrences was reduced by 83%. Table 5 provides further details of the simulated overflow reductions.

Figure 3 is a comparison of the overflow volume simulated at the Dodge Street Pump Station based on the 53-year continuous simulation. The graph represents the number of overflow events versus the volume of the event. For example there were 55 overflow events greater than 1 MG using the before-construction parameters and only seven overflow events greater than 1 MG using the after-construction parameters.

Table 5. Before- and After-Construction Simulated Overflow Occurrences

Period	Total Number of Simulated Overflows	Number of Simulated Overflows per Year	Number of Overflows greater than 1 Million Gallons
Before-Construction	393	7.4	55
After-Construction	62	1.2	7

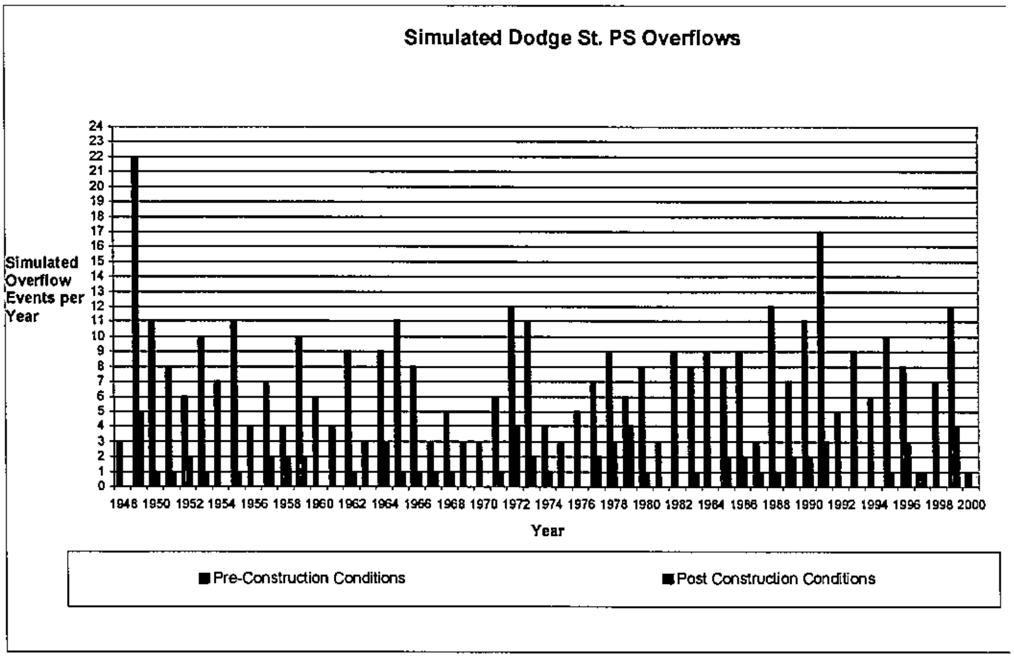

Figure 2. Numbers of Overflows before and after Improvements

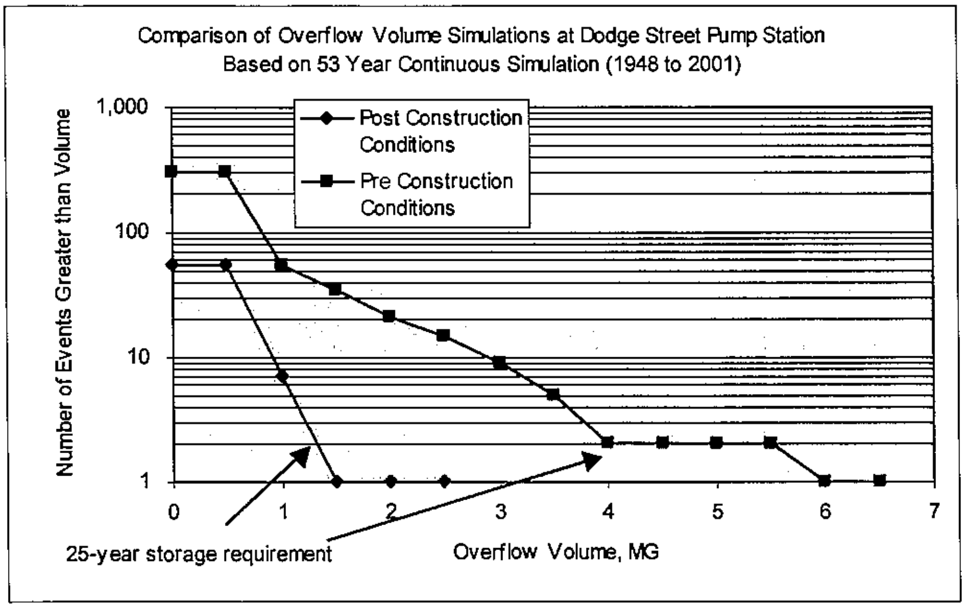

Figure 3. Simulated Overflow Volume Before and After Construction

Statistical Analysis

To define the differences between the periods of analysis, the models were used to compute hourly flows for each hour of the 53 year rainfall record at the Duluth Airport gauge. The annual maximum peak hourly RDII flows as well as the maximum annual calendar day RDII flows (24-hour average) were extracted from the resulting databases and statistically analyzed. The recurrence relationships are developed by fitting a Log Pearson Type 3 curve to the annual RDII maximum data. In this way, it is possible to compare peak RDII flows with defined return periods for both the before- and after-construction periods, providing an estimate of the reduction in RDII and peak flows. Figures 4 and 5 show the results for peak hourly and peak daily RDII. When considering these values, it is important to note that Dodge Street Pump Station receives and average daily wastewater flow of approximately 0.21 mgd in addition to the RDII flow.

Percentage reductions in peak RDII flows for defined return periods are shown in Tables 6 and 7 for peak hour and peak day, respectively.

Table 6. Before- and After-Construction Peak Hour RDII Conditions for Basin 2

Condition	5-year peak hour RDII			10-year peak hour RDII			20-year peak hour RDII		
	mgd	Gpad	gpd/idm	mgd	gpad	gpd/idm	mgd	gpad	gpd/idm
Before-construction	8.6	15,400	69,100	10.6	19,000	85,300	12.7	22,700	102,000
After-construction	4.4	7,800	35,100	5.4	9,700	43,400	6.5	11,600	52,000
Flow Removal Effectiveness	4.2	7,600	34,000	5.2	9,300	41,900	6.2	11,100	50,000
Percent Removal Effectiveness	49			49			49		

Table 7. Before- and After-Construction Peak Day RDII Conditions for Basin 2

Condition	5-year peak day RDII			10-year peak day RDII			20-year peak day RDII		
	mgd	gpad	gpd/idm	mgd	gpad	gpd/idm	mgd	gpad	gpd/idm
Before-construction	3.0	5,300	24,000	3.5	6,300	28,500	4.0	7,300	32,700
After-construction	1.6	2,900	13,000	1.9	3,400	15,500	2.2	4,000	17,800
Flow Removal Effectiveness	1.4	2,500	11,000	1.6	3,000	13,000	1.9	3,300	15,000
Percent Removal Effectiveness	46			46			46		

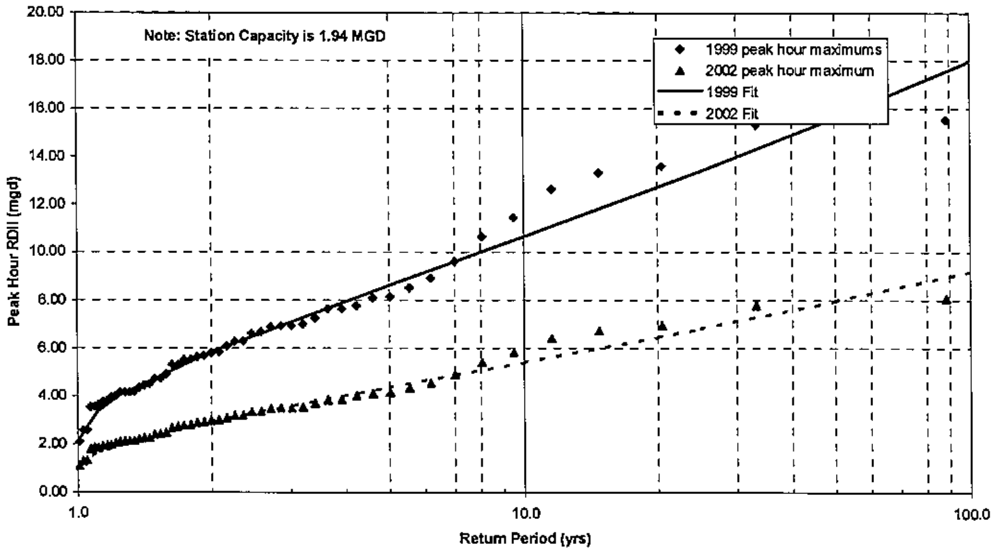

Figure 4. Return Period for Annual Maximum Peak Hourly Flows

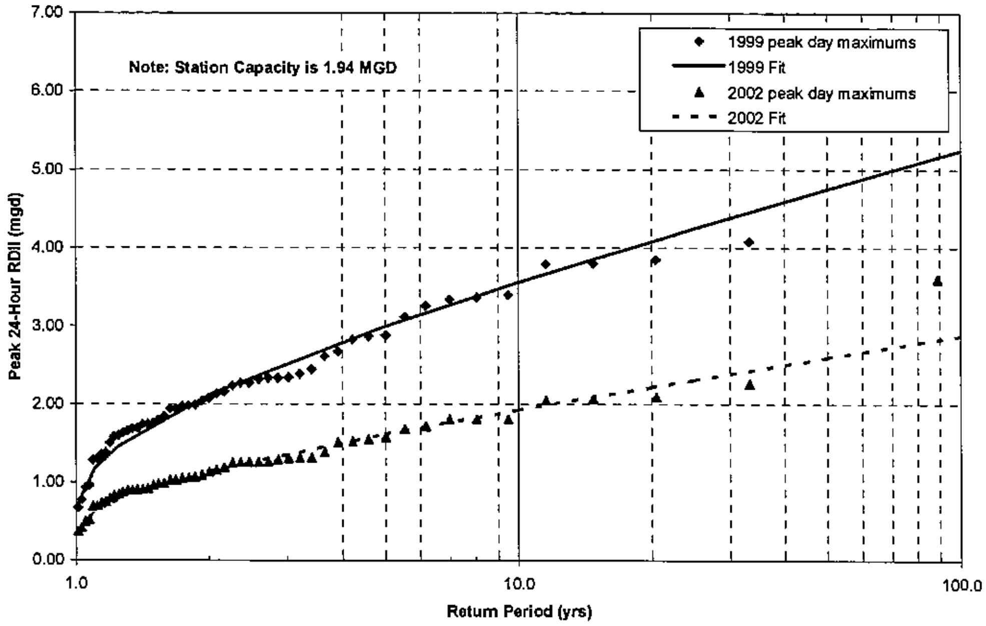

Figure 5. Return Period for Annual Maximum Peak Day (24-hour average) Flows

RDII Reduction

The results of the analysis discussed above indicate that the foundation drain disconnection program in Basin 2 was effective in reducing rainfall-related flows to the pump station. This significantly reduced the estimated volume of flow to the Dodge Street Pump Station and correspondingly, reduced the overflow amount and frequency to Lake Superior.

The effectiveness in reducing the peak hour RDII flows suggests that the rapidly responding RDII was reduced. A plausible explanation for this conclusion is that by disconnecting foundation drains, rain water that was finding a quick pathway along the foundation walls is no longer getting into the sanitary system.

The above concepts are illustrated in Figures 6, 7 and 8. Figure 6 shows the simulated total flows upstream of the Dodge Street pump station before and after completion of the foundation drain disconnection project. The first event, from late June 1999, can be considered a major event. This rain event lasted over a duration of three days producing approximately 3.5 inches of rain with a peak intensity of 1.2 in/hr. As can be seen in Figure 6 the simulated wet weather flow recedes more slowly in the "before construction" condition, suggesting that the disconnections have reduced the flow of groundwater into the sewer system. The peak flow has also been significantly reduced indicating the rapidly responding RDII has also been reduced.

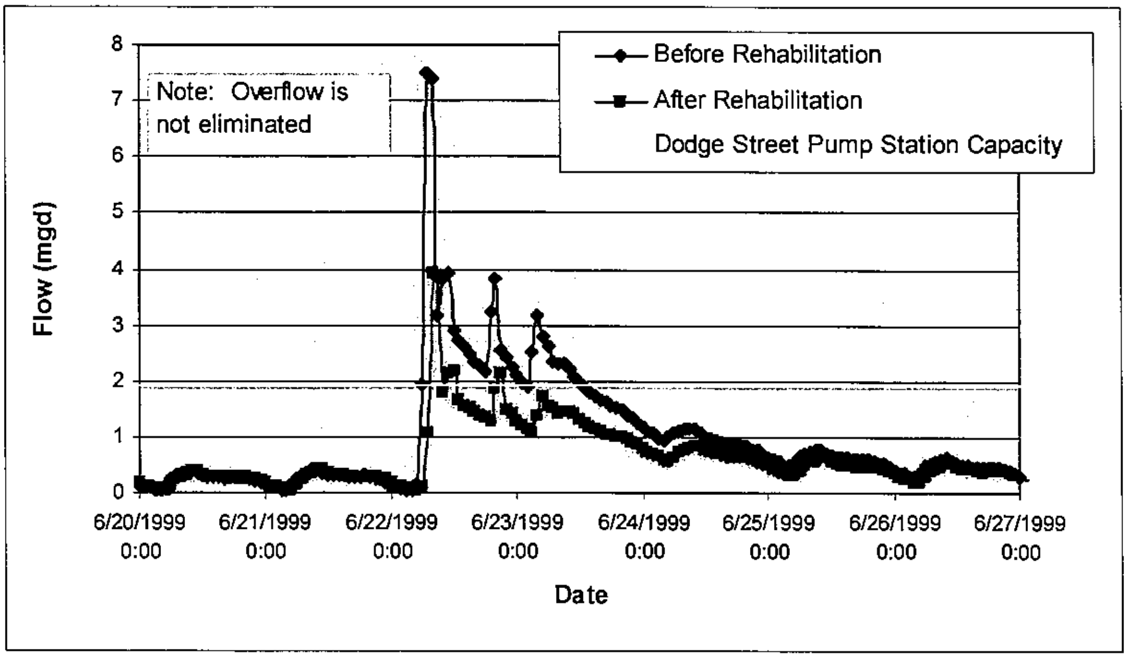

Figure 6. Major Event Before and After Construction Simulated Conditions

The same concepts are also illustrated in Figure 7. This event, from early July 2002, is considered a relatively large event. This rain event lasted two days, producing approximately 2.5 inches of rain with a peak intensity of 0.5 in/hr.

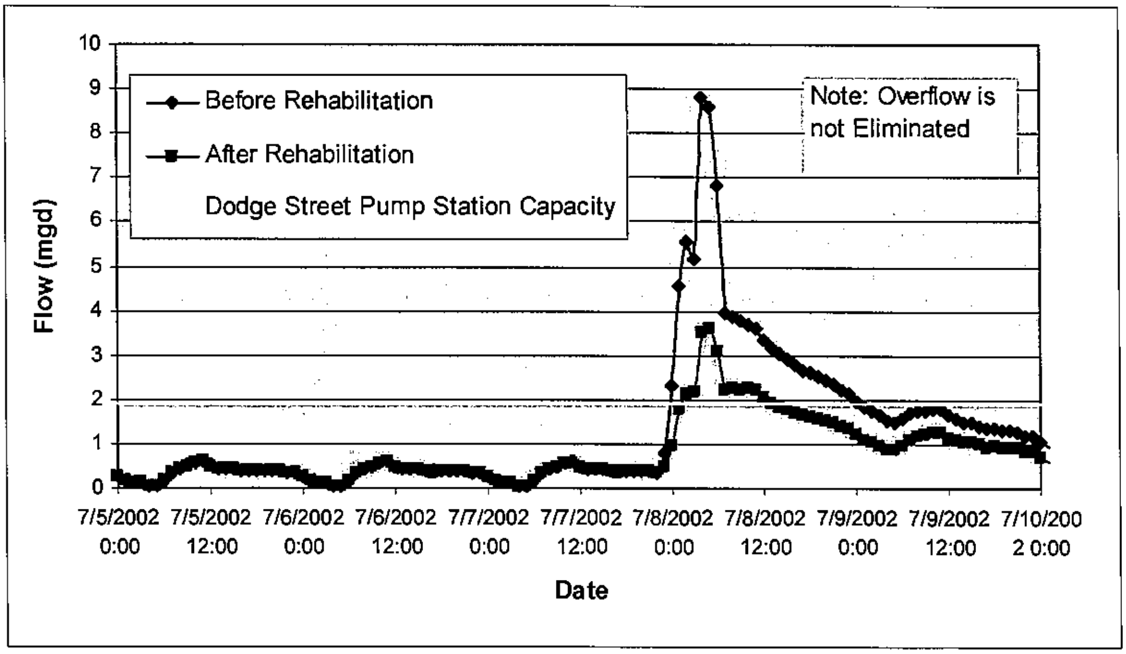

Figure 7. Simulated Total Flows Before and After Construction - Significant Event

The same concepts are also illustrated in Figure 8. This event, from early August 2002, can be considered a medium event. This rain event lasted one day, producing approximately 1 inch of rain with a peak intensity of 0.5 in/hr. As this event occurred after the program was substantially complete, no overflow was observed or simulated at the Dodge Street Pump Station. However, simulating the event with the before-construction model suggests that the station would have overflowed if the disconnections had not occurred.

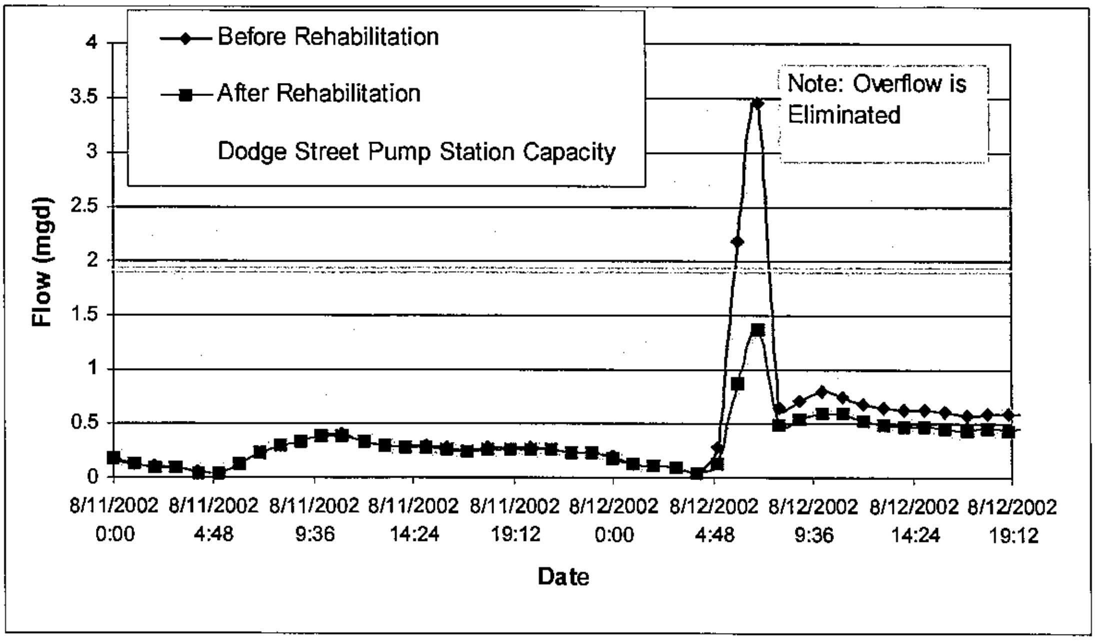

Figure 8. Simulated Total Flows Before and After Construction in a Medium Event

The simulated July 8 and August 12, 2002 events were confirmed with actual metering data. WLSSD recorded overflow on July 8 but not on August 12, 2002. The August 12, 2002 storm event is a good indication that the numbers of overflow occurrences have been reduced.

As a final step of determining the apparent improvement in RDII conditions, we performed an event RDII volume analysis. The actual rainfall data recorded during events in 1999 and 2002 along with the simulated RDII volumes during those years were compared. Once the RDII volume and total rainfall were determined for each event, they could be plotted as pairs of data. Linear regression was performed on before and after data separately, as shown on Figure 9. The slope reduction suggests a 48% reduction in event RDII volume between the two conditions.

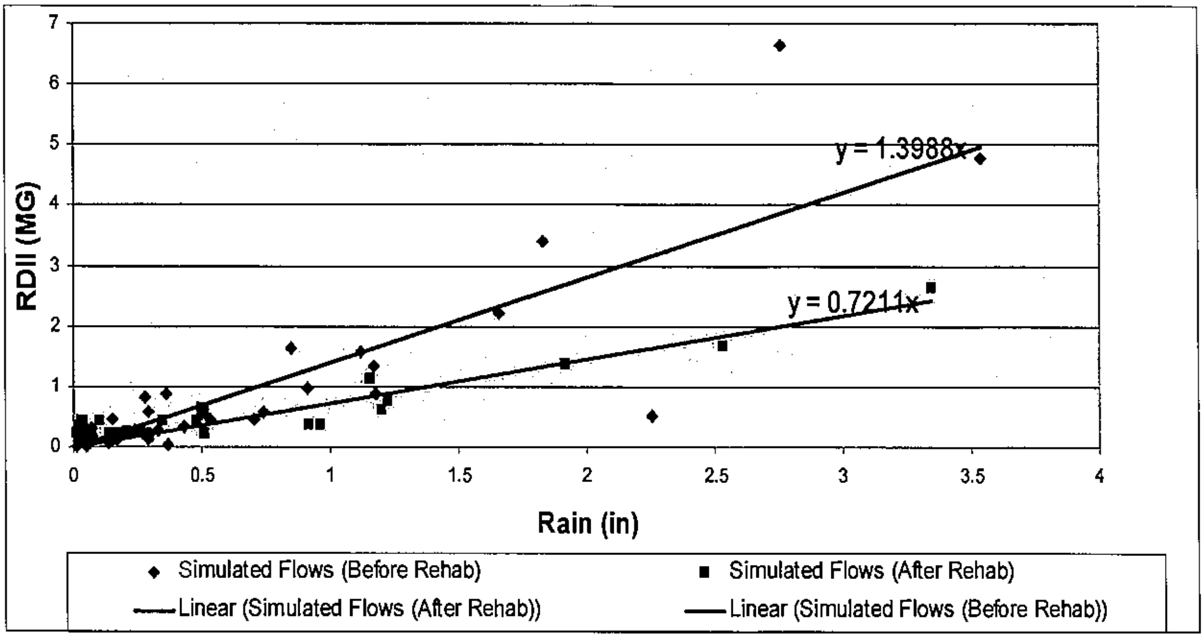

Figure 9. Rainfall versus RDII Volume

Cost-Effectiveness Evaluation
The cost-effectiveness evaluation of this project combines the cost data gathered with the estimated RDII reductions achieved. Two considerations of cost-effectiveness are avoided storage cost associated with preventing overflows and unit cost of RDII removal. The approach and results for the cost-effectiveness evaluation are provided below.

Storage is one alternative to eliminate overflows at the pump station. The cost benefit of the disconnection program was evaluated by comparing the cost of the disconnection program with the estimated cost of storage facilities avoided as a result of the reduction in RDII. This is not the only way to measure cost effectiveness but it gives a good perspective of the cost benefit. Storage was sized to contain a 25-year recurrence interval volume. The return periods for overflow volume were calculated using the log-Pearson Type III distribution. Figure 10 shows the storage requirements at the Dodge Street Pump Station to eliminate overflows for the 25-year event for before-and after-construction conditions. The estimated storage volume required has been reduced from 4.1 million gallons to 1.1 million gallons, resulting in a cost-avoidance of approximately $10.3 million. The cost-avoidance figure is based on a $16.0 million capital cost for constructing a 4.1 million gallon storage tank and a $5.7 million capital cost for constructing a 1.1 million gallon storage tank . Table 8 includes storage basin unit costs used in determining the estimated costs of the storage volume required before and after foundation drain removal. These unit costs are average unit costs for underground concrete storage tanks, assuming pumping for dewatering, no odor control facilities, and no rock excavation. They were compiled from cost models developed for other projects, adjusted to estimated, current construction costs for the Duluth area (based on Engineering News Record Construction Cost Index for Minneapolis = 7348). The cost-savings must be compared to the $2.3 million spent by the City to administer and perform the foundation drain disconnection program, which suggests an overall cost-savings of $8.0 million.

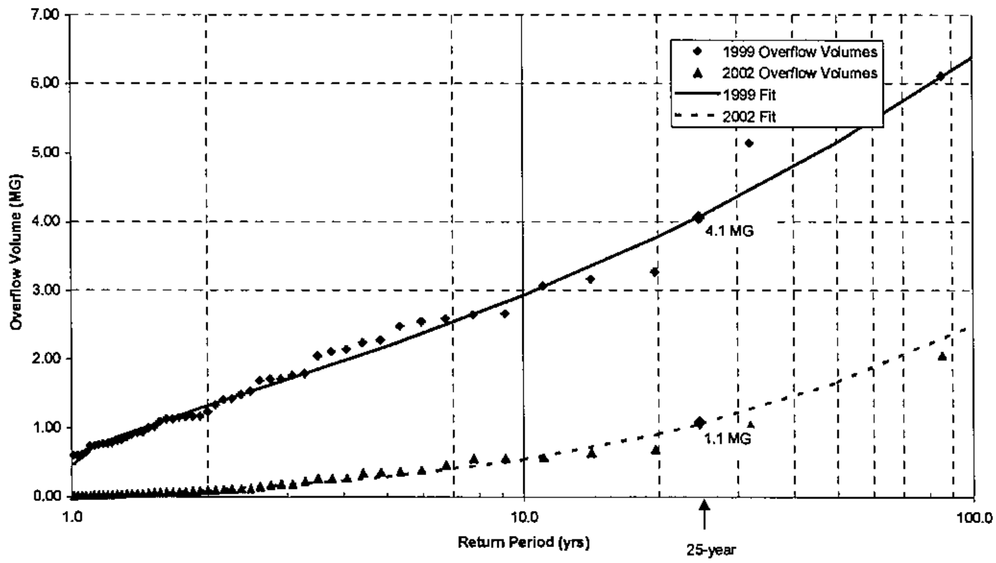

Figure 10. Overflow Volume Versus Return Period

Table 8. Storage Basin Unit Costs

Size (MG)	Construction Unit Cost ($/gal)	Capital[1] Unit Cost ($/gal)
1	4.00	5.20
2	3.00	3.90
5	2.50	3.25
10	2.00	2.60
15	2.00	2.60

[1]Includes 30% factor for design, construction management, and administration.

Table 9 summarizes the estimated unit costs for RDII removal for the Basin 2 project in terms of peak flow frequency and duration. These flow RDII removal unit costs would be valuable for comparing to conveyance capacity costs, such as those related to upgrading Dodge St. Pump Station, the Dodge St. Pump Station forcemains, and the Lakeside Interceptor. As additional capacity at Dodge Street would only worsen downstream overflow conditions, cost-benefit analysis based on conveyance upgrades was not performed.

Table 9. RDII Flow Removal Unit Costs

Flow Condition	Flow Removal Cost, $/gpd	
	Peak Hour	Peak Day
5-year	$0.38	$1.13
10-year	$0.31	$0.99
20-year	$0.26	$0.83

CONCLUSIONS

The foundation drain removal project in Basin 2 shows a significant reduction in RDII. The results show that disconnecting foundation drains will reduce RDII, as seen in the peak flow analysis. Reducing the RDII from quickly entering the system will limit the number of overflows that occur at the Dodge Street Pump Station. On average, the number of simulated overflows were reduced from 7.4 occurrences per year to 1.2 occurrences per year after the foundation drain disconnection program. Reducing peak day and peak month flows reduces the storage volume required to eliminate these overflows. The 25-year recurrence interval storage volume estimated before the foundation drain disconnection program occurred was 4.1 MG. After the foundation drain disconnection program, the estimated 25-year recurrence interval storage volume is reduced to 1.1 MG.

This project was also cost effective. While the foundation drain disconnection program has not eliminated all overflows at the Dodge Street Pump Station, it appears that overflow volumes have been significantly reduced. By investing $2.3 million in administering and performing the disconnections, the City has potentially avoided $10.3 million in storage basin costs required to contain a 25-year recurrence volume at the Dodge St. Pump Station. This comparison translates to an estimated $8.0 million cost-savings.

The City disconnection program has effectively eliminated all connected foundation drains that could be removed through this voluntary program. Any additional overflow reductions would require either mandatory disconnections, other private property-based RDII reduction measures, City sewer system RDII reduction measures, or construction of storage upstream of the Dodge Street Pump Station.

December 12, 2013
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Citizens Advisory Committee (CAC) Agenda
Slauson Middle School – Media Center
Thursday, December 12, 2013 - 6:30 p.m. to 9:00 p.m.

1.	**Welcome** - Charlie Fleetham (CAC Facilitator)	6:30 p.m. (5 min.)
2.	**Desired Outcomes** – Charlie Fleetham	6:35 p.m. (5 min.)

- Update CAC on project status and the plan for the next 60 days
- Identify desired outcomes for 12/17 CAC meeting re. legal issues

3. **Discuss CAC Communications and Process** – Charlie Fleetham — 6:40 p.m. (20 min.)

- Review 10/29 CAC meeting summary
- Review of F. Burdick Log submittal and discussion on accessing the Log
- Discuss email list – protocol for distributing and sharing emails

4. **Update on FDD Survey** - Charlie Fleetham — 7:00 p.m. (10 min.)

5. **Update on Technical Oversight and Advisory Group** – Nick Hutchinson — 7:10 p.m. (10 min)

Nick will discuss the recent activities of this overarching group providing overview and guidance on the City of Ann Arbor's four wet weather projects/programs.

6. **SSWWE Flow Analysis** - Robert Czachorski — 7:20 p.m. (45 min.)

- Evaluation of Flow Metering Results
- Curb Drain Study Results, including video on flow
- Sump Pump On-Off Monitor Updates

7. **CAC Breakout Discussion on Evaluation of Flow Analysis** - All — 8:05 p.m. (20 min.)

8. **Report Outs on Breakout Discussions** – All — 8:25 p.m. (15 min)

9. **Decision on Tentative December 17th Meeting re. Legal Issues** – All — 8:40 p.m. (10 min.)

10. **Summary, Thank You, and Upcoming Meeting** – Charlie Fleetham — 8:50 p.m. (10 min.)

Charlie will send a follow-up meeting summary and other materials to all CAC members. Materials will also be available on line at www.a2gov.org/sswwe.

11. **Public Comments (3 minute limitation)** — **9:00 p.m**

Web: **a2gov.org/SSWWE**
Email: **SSWWE@a2gov.org**

Sanitary Sewer Wet Weather Evaluation Project - Progress Report
December 5, 2013

1. **Public Engagement Activities** - the City has sponsored an extensive public engagement effort which included the engagement of a firm specializing in public engagement (Project Innovations, Inc., www.projectinnovations.com). Significant activities include:

   - Planning and facilitating a public meeting (attended by 38 citizens) on April 23rd to introduce the SSWWE project and extend an invitation to participate in a Citizens Advisory Committee.

   - We are planning another public meeting on Thursday, January 16th at Clauge Middle School from 6:30 to 8:30 pm.

   - Organized a city-wide Citizens Advisory Committee (CAC), now consisting of 13 active members.

   - Planning and conducting two CAC meetings – August 21st and October 29th. We have also planned and prepared for two additional CAC meetings on December 12 and 17.

   - Producing extensive summaries for the CAC meetings and beginning with the October 29 meeting, videotaping the meetings.

   - Maintaining and extensive project library, including engineering and public engagement information on http://www.a2gov.org/government/publicservices/systems_planning/waterresources/sanitary-sewer-project/Pages/default.aspx

   - Developing an extensive frequently asked question and answer list, which is currently forming the base of a log that will be available to the CAC members for information and comment.

   - Developing and administering a survey to 2,400 plus residences and multi-family sites that have had footing drain disconnection and sump pump installation.

   - Developing an information video on footing drain disconnection and associated flow concepts.

2. **Technical activities** – The City has retained OHM Advisors (http://www.ohm-advisors.com/) to perform an evaluation of the effectiveness of the Footing Drain Disconnection (FDD) program, assess the risk of future basement backups, and evaluate alternatives to address wet weather flows in the City. Significant activities that have been completed include:

- Developed technical information and technical presentations for the public engagement meetings described above.

- Flow metering was performed from March through August of 2013. The metering included 30 continuous flow meters, 5 rain gauges and 20 peak stage level recorders. The metering was performed by Martin Control Services, who performed installation, meter maintenance and downloads.

- Flow data was collected, compiled, quality control reviewed and summarized in a Flow Metering Report. The Flow Metering Report will be distributed to the CAC in December 2013.

- Comparison of flows from storms before the inception of the FDD program (year 2000) and the present (summer of 2013) were prepared and presented to the CAC. This included comparison plots of rainfall, flow and depth for the five (5) priority districts.

- Prepared a comprehensive evaluation of the effectiveness of the FDD program at removing flows from the sanitary sewer system. This included three independent, scientific methods of scatter plots, control districts, and continuous hydrologic modeling.

- A break-out meeting was held with the "Best Practices" sub-group at the October 29, 2013 CAC meeting, and per the sub-groups request, a detailed compilation of how other communities have addressed wet weather flows was compiled. The compilation includes several examples of all three fundamental alternatives, including a) source removal, b) transport and treat, and c) storage. This information will be distributed to the CAC for the Dec 12 meeting.

3. **Next steps** – below is an outline of the next steps of the project:

   - The results of the FDD evaluation will be presented at the December 12 CAC meeting. Please note that the flow evaluation for FDD will not draw conclusions about the future of the FDD program. A recommendation for continuing the FDD program will not be made from this evaluation. There is a lot more work to do to establish cost effectiveness, social acceptance and environmental considerations for all options before a recommendation is made by the CAC.

   - The FDD flow evaluation report will be prepared and distributed in April of 2014.

   - The technical team will prepare the hydraulic model, basement back-up risk evaluation and alternative evaluation. The alternatives examined will be performed in close conjunction with the CAC for direction. The results of this work will be presented in May of 2014 and the final report will be prepared in July of 2014.

- The CAC will make recommendations based on the results of the study that reflect community values to balance risk, cost, environmental considerations and social acceptance.

TECHNICAL OVERSIGHT ADVISORY GROUP (TOAG)

Purpose:

The City of Ann Arbor Technical Oversight Advisory Group (TOAG) is intended to provide technical expertise and guidance to the City of Ann Arbor and the Washtenaw County Water Resource Commissioner on issues relating to the four technical studies listed below:

- Sanitary Sewer System Flow Monitoring and Wet Weather Evaluation;
- Upper Malletts Stormwater conveyance Study;
- Stormwater Modeling and Calibration;
- Footing Drain Disconnection Program (FDD).

The purpose of the group will be to oversee the projects and provide input on overlapping technical issues, ensure consistency in the project approaches, focus on quality assurance by independently assessing work products and examining project assumptions, identify gaps, conflicts, and/or deficiencies on topics relevant to multiple projects, and to also provide feedback and comments from a community perspective to the work being undertaken.

Membership and Leadership:

The TOAG is comprised of 10 individuals with varied backgrounds and expertise regarding wet weather issues as they affect Ann Arbor and its residents. Invitations to participate on the TOAG were extended by the City to selected persons knowledgeable about stormwater management, water quality, climate changes, hydraulics, hydrology, drainage and infrastructure, planning, design, public involvement, and other related issues. Some of the TOAG members are affiliated with organizations whose activities relate to wet weather issues and problems. However, the people who are participating on the TOAG are serving as private individuals rather than as a representative of their organization. The City's intent is to create a group which has the capability to effectively provide comments and feedback on complex technical issues relating to wet weather problems.

Consultant support is being provided by Richard Hinshon, P.E. and President of Hinshon Environmental Consulting, who is serving as the Manger/Facilitator of TOAG. Cresson Slotten, Manager of the Systems Planning Unit of the Department of Public Services for the City of Ann Arbor, is serving as the Group Leader who will provide leadership and direction to the TOAG Manager/Facilitator.

TOAG Authority and Responsibility:

The TOAG will be responsible for providing an independent review of the work being performed as part of the four projects listed above. The TOAG will be expected to identify items where additional data or other information needs to be prepared, and to provide recommendations to the City and the project managers of the three studies and the FDD program on matters that require follow up or action. The TOAG will serve in an advisory capacity and will not have independent authority to address problems or issues

Next Steps

- Proceed with bi-monthly meetings, with first meeting scheduled for December 10
- Identify and collect appropriate project information and identify overlapping issues
- Begin monitoring project progress on the four technical studies

TECHNICAL OVERSIGHT & ADVISORY GROUP:

NAME	AFFILIATION
Dick Hinshon, (Chair)	President, Hinshon Environmental Consulting hinshonr@aol.com
Dan Brown	Great Lakes Integrated Sciences and Assessments
Jonathan Bulkley	University of Michigan (retired); Allen Creek
Aline Cotel	University of Michigan Dept. of Civil and Environmental Engineering
Scott Dierks	Cardno JFNew
Arnie Geldermans	Midwestern Consulting
Alicia Ritzenthaler	Cooperative Institute for Limnology and Ecosystem Research (University of Michigan).
Laura Rubin	Huron River Watershed Council
Don Tilton	Environmental Consulting & Technology (ECT)
Scott Wade	LimnoTech
Jennifer Wolf	Public Information and Education Expert

City of Ann Arbor staff contact for TOAG: Cresson Slotten (cslotten@A2gov.org)

NOTE: The individuals serving on the TOAG are contributing their experience and knowledge on wet weather issues, and are NOT serving as representatives of their respective employers or providing input to the process on behalf of any firm or agency. Furthermore, the TOAG members are not directly involved in the work that is being done under the individual wet weather projects.

Sanitary Sewer Wet Weather Evaluation Project (SSWWE)
Citizens Advisory Committee Meeting Summary
December 12, 2013

Attendees:

▪ Joe Conen	▪ Frank Burdick	▪ Colin Breed	▪ Michelle Lovasz
▪ Jim Osborn	▪ Bruce Geffen	▪ Beverly Smith	▪ Frank Richardson
▪ Frank Caruso	▪ Kathy Boris	▪ Patricia Martin	

Project team attendees:

▪ Nick Hutchinson	▪ Robert Czachorski	▪ Murat Ulasir	▪ Lindsey Kerkez
▪ Charlie Fleetham	▪ Lori Byron	▪ Greg DeLiso	

Observers:

▪ Aram Kalousdian	▪ William Higgins	▪ Judy Hanway

1. Welcome, Agenda and Meeting Materials Review

Charlie Fleetham welcomed CAC members and community residents, reviewed the agenda and desired outcomes for the meeting.

Mr. Fleetham reviewed packet materials:

- Agenda
- Project update
- Presentation slides – flow data
- Presentation slides – Q & A online tool
- FDD Survey
- Wet weather management Best Practices

2. Project team and organization

Next, Mr. Fleetham introduced Project Team members and their respective areas of responsibility within the project.

3. CAC Member Check In

Mr. Fleetham asked CAC members to share their comments and questions regarding the project. Following are their comments, categorized for convenience.

a. Requests:

- Provide electronic materials as searchable PDFs, not scanned images.
- CAC needs to have a mission statement to clarify its purpose.
- Would like to see additional City staffers who are relevant to the discussion at the meetings.
- Tell me why the CAC was formed?

b. Project Progress/End Product

- Would like to find the best solution – one that's economical and keeps sewage out of the Huron River and Ford Lake.
- Glad that Dartmoor neighborhood is no longer having flooding issue.
- Climate change will bring more intense rains; we'll need a margin of error to deal with this.
- Are we doing footing drain disconnects to stop surcharging in my neighborhood or are we doing it to stop overflows at the plant? Not convinced the data supports the latter.
- Don't want a sump pump in my basement.
- Also on the Upper Malletts Creek Study, interested in flooding and management issues citywide.

c. Process

- Overwhelmed by the amount of communications.
- Everyone is a citizen volunteer. I would like respect and courtesy in communications.
- Wants citizens to be more concerned about punching holes in basements
- I've become more of a student of the flow.
- Blindsided by the volume and tone of emails, does not want any part of any law suit.
- Concerned about legal actions against CAC members.
- Email correspondence has become unmanageable.
- Not pleased with email address being shared with non-CAC members and the lengthy emails
- Wants the CAC to not be involved in the legal question.
- Hopes that CAC can come up with a solution that solves the sewage backup and flooding issues.
- What is the Committee's concern or responsibility regarding Mermelstein's allegations?
- Has not had a chance to read all the emails, too many.

Following the CAC members sharing comments and questions, Nick Hutchinson explained the history of the FDD project, the impetus of a Citizens Advisory Committee, as well as the selection of OHM Advisors (engineering consultant) in a qualifications-based selection process, and Project Innovations' (Charlie Fleetham) role for public engagement. He reiterated the CAC's charge: review all the engineering data and analysis and making a recommendation to City Council on the approach going forward to mitigate wet weather issues.

4. Footing Drain Video

CAC members viewed a short video created to explain footing drains and the history of the FDD project and the next steps associated with the SSWWE project. Following the video, Charlie asked CAC members to share comments or questions:

- What is the sanitary pipe size/capacity in specific target neighborhoods? Note: maps of sewer system were on display during the meeting that contained answers to these and that the next phase of the project (hydraulic analysis) will focus on conditions affecting the system's capacity.

- All CAC members should read the review 2001 SSO Report to see the recommendations made by that body. (Note: the report is available at -http://www.a2fdd.com/Documents/AA_SSO_Report.PDF

5. **Flow Analysis Presentation**

Robert Czachorski, Project Manager with OHM Advisors presented the flow data and analysis for the five target districts. Robert also offered to talk one-on-one with any CAC members who have questions about flows, data, or calculations.
(Presentation slides available at this url: http://bit.ly/1cCvTap). The presentation showed results of flow monitoring and analysis, across all five districts and used the wastewater treatment plant as a control district. The flow data was analyzed used three different scientific techniques:

- Scatter plots
- Meter correlation
- Continuous antecedent moisture model

Robert noted that there were 52 basement backups reported in 2000 in the Target Areas. In 2013, there was 1 reported basement backup in the Target Areas. The 1 backup in 2013 was investigated and found to not be caused by the City's sanitary sewer. He also noted that the project team had collected additional data from curb line metering on 10/31/13, and he reviewed sump pump data from the CDM project team. (CDM monitored 50 to 60 sump pumps across FDD houses.)

6. **CAC's Questions, Comments about the Flow Data and Analysis**

Charlie asked CAC members to form groups of three to discuss what they saw and heard during the presentation and to share questions they had about the data, the analysis and the results. See section #10 for responses to CAC member questions.

7. **Technical Oversight & Advisory Group**

Nick Hutchinson reviewed information about the Technical Oversight Advisory Group (TOAG) and the other studies going on in and around the City.

- Stormwater Model Calibration & Analysis
- Upper Malletts Creek
- SSWWEP

The TOAG's charge is to review the data and results of all three projects, for technical expertise and cohesiveness between the projects. The City will arrange for Dick Hinshon, the TOAG Facilitator, to attend a future meeting to discuss the TOAG's activities.

8. **CAC Communications Protocol, Tools and Question & Answer Log**

Mr. Fleetham reviewed the public engagement desired outcomes for the project and a proposal to reorganize the Q & A log, to make it more useful to CAC members in fulfilling their objectives. With the CAC's approval, the Q & A will be reorganized into three categories:

- Category 1 - questions about the project data, presentations and results.
- Category 2 – questions that may be relevant to the CAC's future recommendations to Council (storage, expansion, FDD installations).
- Category 3 – questions related to other City projects and functions

Based on CAC members' comments regarding the number of email messages, tone of messages and email addresses being shared outside the CAC, Charlie proposed that the CAC use a web-based project management tool called Basecamp to communicate and house CAC-related files. CAC members voted to use Basecamp, on the condition that all members agreed to not to share email addresses and passwords with non-members. All members agreed.

Charlie asked that any members who wished to provide an alternate email address, specifically for CAC communications, to send it to him.

9. Next CAC meeting – Thursday, January 9, 2014, at Slauson Media Center, 6:30pm – 9pm.

10. Public Comment (paraphrased/summarized)

I am currently serving on the Upper Malletts Creek CAC. I am presenting binders from the 1997 Surface Water Study and the 2001 Disconnect Study; $145M in sanitary sewer treatment plant upgrade which does not increase capacity. I believe this City is in a catastrophic situation, concerning its sanitary sewage capacity. I recommend that CAC members review the three studies. They are available at the Pittsfield Township Library. (Mr. William Higgins)

11. Question and Answer Section

Following are the questions generated by CAC members regarding Mr. Czachorski's presentation of the flow monitoring data and analysis performed in the five target neighborhoods.

Q. What else in the last 13 years might have affected the results observed from FDD? System maintenance and repairs, etc.?

A. The City will respond to this question, reviewing its internal records of projects and maintenance performed on the system.

Q. How relevant are the various detention and retention projects being done to the results observed? When were the water clearances in the Pioneer/Allens Creek/Malletts Creek area done and could those have an impact?

A. City to respond.

Q. Was account taken of the differences in soil conditions in saturation?

A. Yes, the project team members used a model designed specifically to account for differences in soil saturation (antecedent moisture.)

Q. Could fixing bad manholes and sewer pipes in some areas account for the flow removal results?

A. It is possible that sewer and manhole repairs could impact system flows. Typically a substantial program is needed to make a significant impact on wet weather flows, and the City did not conduct a substantial program. The City keeps records of the locations of these types of repairs, and those records will be reviewed to verify whether any repairs were done in these areas.

Q. In Morehead, there's hard packed clay, which creates a bathtub effect around each house. It's the same when you disturb the earth to install sewer pipes. How does that impact the differences in flows, pre and post FDD?

A. Prior to FDD, this "bathtub" effect can drive a lot of flow to the sanitary sewer through the footing drain. This flow is removed from the sanitary sewer by FDD.

Q. Houses are close in some neighborhoods; are there things that individual residents might have done, like install drains that could account for the lower flows?

A. The flows were measured at the neighborhood level, at the sanitary outlet from each neighborhood, so small changes in drainage between houses are unlikely to impact the results.

Q. Is the CAC responsible for recommending solutions to reduce sanitary sewer basement backups or for also recommending solutions to reduce sanitary sewer overflows?

A. The City will clarify this charge at the January 9th meeting during a discussion on mission/goals.

Q. StormCorp looked for storms and noted flooding, as part of the Upper Malletts Study. The Chaucer Court neighborhood flooded badly during the 2012 storm, but had none this year. More catch basins were added this year, along with two manholes for sewer systems. In very high storm rate events, manholes can make a big difference. Morehead and Glen Leven both raise questions about phenomenology.

A. Regarding the Chaucer Court ponding differences in 2012 vs. 2013: we didn't just look at large storms, we also measured and analyzed for small storms, every single storm, large and small. Taken together, with the multiple scientific methods of analysis, and the high level of statistical confidence, the results are correct in this neighborhood.

Q. On Page 8 of the presentation slides handout, confidence levels on the slide for the summary results are lower than the confidence levels of single methods. Why is Glen Leven so low?

A. There are differences in results in Morehead and Glen Leven. From both analysis and experience, we know that results are not linear; completing 50% of the FDDs in a neighborhood doesn't necessarily mean a 50% reduction in flow. Glen Leven homes are older, closer together. Each house has a smaller drainage area, which makes for smaller flows. The next phase of the project, the hydraulic analysis of the sanitary sewer system in these neighborhoods may reveal other factors that have impacted the results in the Glen Leven area.

Q. What are the basic number of houses/sump pumps per neighborhood?

A. This information was tabulated in the hand-out tables presents at the CAC meeting.

Q. If it's all working so well, why are people still experiencing wetness in their basement?

A. Wetness in basement could be caused by a multitude of issues ranging from stormwater, groundwater seepage through the walls, sanitary sewage backing up into the basement, or other causes. The next phase of the study will evaluate the risk of sanitary sewer backups.

January 9, 2014
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Citizens Advisory Committee (CAC) Agenda
Slauson Middle School
Thursday, January 9, 2014 - 6:30 p.m. to 9:00 p.m.

1. **Welcome -** Nick Hutchinson — 6:30 p.m. (5 min.)

2. **Desired Outcomes –** Nick Hutchinson — 6:35 p.m. (5 min.)

   - Resolve questions regarding FDD legality and committee member legal liability
   - Confirm committee mission and plan for next phase of work, in particular CAC analysis of the FDD Survey results
   - Confirm public meeting agenda for January 16

3. **Discussion on FDD Legality and CAC Liability –** Abigail Elias — 6:40 p.m. (45 min.)

   Abigail Elias, Chief Assistant City Attorney, will discuss her recent memorandums to the CAC and respond to questions from the CAC about liability/immunity, etc.

4. **CAC Mission and Go Forward Plan –** Craig Hupy — 7:45 p.m. (15 min)

   Craig Hupy, Public Area Services Administrator, will confirm the CAC mission and discuss the CAC role in analyzing FDD survey results.

5. **Summary of FDD Survey Results** - Charlie Fleetham — 8:00 p.m. (30 min.)

   Charlie will summarize the results of the FDD survey and facilitate the CAC in organizing an analysis of the results.

6. **Introduction to BaseCamp –** Lori Byron — 8:30 p.m. (20 min)

   Lori will make a presentation on the BaseCamp software and how it will be used to maintain the question and answer log for the SSWWE project.

7. **Upcoming Meetings** – All — 8:50 p.m. (10 min.)

   - January 16th Public Meeting at Clague - confirm agenda
   - Next CAC Meetings - confirm proposed dates and determine topics

8. **Public Comments (3 minute limitation per speaker)** — 9:00 p.m. until finish

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Sanitary Sewer Wet Weather Evaluation Project (SSWWE)
Citizens Advisory Committee Meeting Summary
Slauson Middle School
January 9, 2014

Attendees:

▪ Kathy Boris	▪ Vince Caruso	▪ Peter Houk	▪ Frank Richardson
▪ Colin Breed	▪ Joe Conen	▪ Patricia Martin	Beverly Smith
▪ Frank Burdick	▪ Bruce Geffen	▪ Jim Osborn	

Project team attendees:

▪ Nick Hutchinson	▪ Robert Czachorski	▪ Cresson Slotten	▪ Abigail Elias
▪ Charlie Fleetham	▪ Lori Byron	▪ Greg DeLiso	▪ Craig Hupy

Observers (as indicated on sign-in sheet)

▪ Dave Askins (Reporter, Ann Arbor Chronicle)	▪ Judy Hanway	▪ Cy Hufano	▪ Ethel Potts
▪ Jack Eaton (Councilman)	▪ Bill Higgins	▪ Aram Kalousdian	▪ Ryan Stanton (Reporter, Ann Arbor News)

1. **Welcome** – Nick Hutchinson, City of Ann Arbor

   Mr. Hutchinson welcomed the CAC members and the public, then introduced project team members present, reviewed the meeting agenda and thanked the CAC members for the time they've devoted to this project.

2. **Discussion on FDD Legality and CAC Liability** – Abigail Elias, Chief Assistant City Attorney discussed her recent memorandum and email communication to the CAC (see Attachment #1) and responded to CAC questions about liability/immunity/etc. Discussion highlights included:

   a) Concern about liability resulting from CAC recommendations:
   What is the personal liability of the CAC members regarding CAC recommendations, in the event that the City is sued? Ms. Elias stated that as the CAC is, in a sense, a part of the City process; therefore, its members would be defended by the City. Governments in Michigan have very broad immunity against liability. There are some exceptions to this broad immunity regarding personal conduct; however, sitting on a committee does not fall into those exceptions.

   b) Attorney's fees covered for CAC members:
   If the City is sued and loses the case, will the City, while representing a CAC member also pay attorney fees? Ms. Elias said it's the City's policy to indemnify the employee or citizen being sued as long as the person is acting within their duties and cooperates with the defense. This does not require the citizen to agree with the City's recommendation; however, it does require that the citizen cooperate in his or her own defense by speaking with attorneys, appearing at meetings, etc.

   c) Legality of the Footing Drain Disconnection Program:
   A blogger at Ann Arbor Underwater (http://a2underwater.com/) has written that the City's footing drain disconnection program is illegal, citing the Loretto case as a precedent (see Attachment #2). Ms. Elias explained that the Loretto case is not close to or relevant to the FDD ordinance or program. The Supreme Court ruling regarding Loretto (a New York case which struck down a law that required a landlord to permit a cable television company to install its cable facilities upon the landlord's property, resulting in a physical occupation of the

landlord's building) has no impact on the City's FDD program. The home improvements – sump pump and line connecting to storm sewer – are not owned by the city. The City is not placing City facilities within any homes or on any private properties and is not taking any space in those homes or properties for City facilities.

Ms. Elias explained that the courts distinguish police powers (those for the health, safety and welfare of the citizens) from takings by third parties. Much of the Loretto case did discuss how the government courts look at whether there is a public health, safety and welfare reason to require a homeowner to undertake the change, and when there is not an undue burden on the homeowner to undertake the change. She stated that a city can require the homeowner to pay for the FDD; however, Ann Arbor felt that asking the residents to pay for the FDD costs was not in agreement with community values. The only case Elias found that ruled that the homeowner's burden to comply was excessive occurred when it would have cost around $30,000 for the homeowner to connect to the public system.

When asked if she was aware of any cases where an order to disconnect a footing drain and installation of a sump pump was overturned or upheld, Ms. Elias said her research had not found any, with the exception of one Ohio trial court decision that generally upheld the municipality's footing drain disconnection program against challenges, but overturned the disconnection requirement for one property based on the cost (see Attachment #3).

Note: Regarding the aforementioned Ohio case, here is a post-meeting comment submitted by Frank Burdick:

I think it is important to correct the record from the 9Jan CAC meeting to the the CAC members as presented by the City Attorney's office ie, re: Legal Presentation and a previous court case. Please forward this message to the CAC so that the FACTS of case referenced by A.Elias, can be properly reviewed and interpreted by the CAC.

Since 1916, legislation has reflected a desire to separate storm sewer and sanitary sewer systems in the city of Shaker Heights. In 1949, the Director of Public Service was authorized to abate any condition in which the systems were combined. The 1976 ordinance repeated the idea of independent sewer lines. Plaintiffs' house was built in 1927. Plaintiffs purchased the home in 1977, and committed themselves to correct any violations pointed out to them. [redacted] *The plaintiffs had the right to rely on the fact that plumbing permits were issued in 1927 for their home. Furthermore, it was reasonable for them to feel secure when no point-of-sale violations were noted in 1977. The plaintiffs had the right reasonably to rely upon the city's tacit representations that all was well with their house and its appurtenances. They will suffer significant damage now if they are charged for the repairs necessary to comply with the ordinance.*
It is therefore ordered, adjudged and decreed that the defendant is estopped from enforcing Shaker Heights Ordinance No. 76-66 against the plaintiffs, and that the city of Shaker Heights cannot retroactively and unlawfully apply said ordinance to plaintiffs' property by requiring that certain of their house's storm lines be disconnected from the city's sanitary sewer and reconnected to the city's storm sewer.

d) <u>MDEQ requirements regarding footing drain disconnections and SSO Task Force Recommendations:</u>
The MDEQ required the City to undertake substantial measures to prevent sanitary sewer overflows. Other regulatory bodies have made similar orders to municipalities. Ann Arbor has fulfilled its Consent Order requirement to disconnect 799 footing drains. Ms. Elias noted that the MDEQ Consent Order and the SSO Task Force's recommendation, which led to the FDD ordinance are two different things; the MDEQ is concerned with SSOs to the river, the SSO Task Force was formed to solve the problem of backups in basements (300 had occurred during a single storm prior to task force formation.)

e) <u>FDDs mandatory:</u>
Mr. Hupy (Public Area Services Administrator) and Ms. Elias both addressed a question as to whether FDDs are mandatory, stating that there is not a blanket requirement for every home in the City to disconnect. Homes have been prioritized to achieve the most impact (reduced basement backups) and where the infrastructure is in

place to divert stormwater flows to the storm water system. Mr. Hupy noted that homeowners do have an option to refuse FDD, but it brings a financial penalty to pay for the increased flows in the sewer system.

A CAC member who also served on the 2001 SSO Task Force said that the Task Force and citizens at public meetings initially considered recommending that the City increase its sanitary sewer storage. However, after learning that several parks and green spaces would be disrupted, the Task Force subsequently recommended FDDs. Ms. Elias and Mr. Hupy both emphasized that the CAC's charge is to make what it feels is the best decision for the community regarding managing the current and future risks of sanitary sewage overflows, which may or may not include FDDs or other options.

f) <u>References to legal concerns of SSO Task Force mentioned in the SSO Report and original intended duration of the FDD program:</u>
A CAC member said that there were references to legal concerns in the SSO Report and asked what they were and how they were resolved. Ms. Elias responded that it's typical for a recommendation to be reviewed by City legal counsel as to how it will be enacted from a legal standpoint. Even before Ann Arbor began its footing drain disconnection program there were other communities that had done so earlier. City attorneys looked at what other communities did to create ordinances.

As to the original intended duration of the FDD program, Mr. Hupy said the intended goal was to solve the problem city-wide, but knowing that funds were limited, the program initially targeted those five target areas that reported 50% of all the basement backups. (Note: target areas are Orchard Hills, Bromley, Morehead, Dartmoor, and Glen Leven.) It was intended to be a long-term program, to deal with the City in its entirety.

g) <u>Offset Mitigation Program:</u>
Mr. Hupy explained that developers in the City are required to mitigate 1.2 times the sanitary sewer flow the new development is expected to contribute. Typically, the developers choose FDDs because it's the easiest way to mitigate the additional flows. The developer negotiates with homeowners, who are free to accept or refuse the offer. The city does not require any individual homeowner to disconnect on behalf of a developer.

CAC member asked if developments in outlying townships are approved, will additional FDDs in the City of Ann Arbor be required? Mr. Hupy said that when the City does its planning, it does look at its contract obligations from other communities and sizes capacities for maximum flow (which they don't typically send.) Because Scio Township, for example, has a contract with the City, the City is obligated to provide service. Developers in school districts have done local retrofits to offset some minor additions.

When asked about the new Munger graduate dorm, Mr. Hupy said that the University has been implementing a rigorous retrofit program to reduce its own flow.

h) <u>Battery backups and other backup items for FDD-mandated homes:</u>
A CAC member asked about battery backups and other backup items for FDD-mandated homes. Ms. Elias said that those items are not required by code, so there is some concern about "improvements" and whether they would be allowed legally. The City is researching whether it would be able to provide equipment beyond what is required by the Building Code, in the event that the CAC considers FDDs as a viable approach, going forward.

i) <u>Potential loss of property value due to flooding, post FDD:</u>
A CAC member commented that the City contends that the sump pump is a benefit to the property, but if it doesn't work and floods the basement, the occurrence must be disclosed in the sales process and it potentially reduces property values. How is that a benefit to the homeowner? Ms. Elias responded that preventing sanitary sewer overflows in basements is a benefit to the homeowner; sewage is less desirable than stormwater, even though neither is a positive situation.

j) Upgrades to older homes:
A CAC member asked why residents who bought homes with footing drains connected to the sanitary sewer system should be forced to upgrade to current code? Ms. Elias stated that building codes have changed and other ordinances have been typically enacted since a typical home was purchased. Residents are required to comply, particularly with those enacted to protect the health, safety and welfare of citizens.

Another CAC member said that homeowners have the right to have their basements not flooded with sewage and the right to demand that the City resolve the problem. Other homes upstream don't have the right to refuse to disconnect just because they want to continue sending their stormwater downstream to other's homes. Sewage is a serious issue and an equitable solution needs to be found. Another CAC member agreed that people should not have sewage in basements, but believed the solutions should be in the right of way, not in homes. Ms. Elias cautioned that we should be aware that storm patterns may have changed in the last decade and may be contributing to water in basements that wasn't there before.

Conclusion: Mr. Fleetham, CAC Facilitator, wrapped up the discussion on FDD legality and CAC member immunity, by making a proposal to the CAC members regarding future activities:

1. Deliberations about FDD legality are outside the scope of the CAC, not part of the CAC mission, and should not be pursued in the future.
2. Assume that FDD is legal, until it is deemed otherwise in a court of law.
3. The CAC should consider continuing FDD as part of its recommendation process.
4. If CAC members are pestered or harassed by parties outside the CAC during the rest of their service to the City, they should notify the City Project Manager – Nick Hutchinson.

Mr. Fleetham asked if the CAC agreed with the above statements and no objections were raised.

3. CAC Mission and Go Forward Plan

Mr. Hupy thanked the committee for its work and said it is a valuable service provided to the City and helps it greatly. He then reviewed the CAC's initial goals:

1. Review the consultant's data. This includes flow data, analysis, hydraulic analysis, risk of future backups, as well as survey data.
2. Select economically viable and community-acceptable approaches.
3. Recommend alternatives to Council.
4. Review and synthesize public engagement program.
5. Communicate with community and other stakeholders.

Mr. Hupy described the City's treatment plant, its capacity and what plans are underway. Engineers design redundancy into systems, to account for failures. The City actually has two plants – an East plant and a West plant Responding to a question about expanding the plant, he noted it was very difficult to add capacity to the primary WWTP: it's landlocked. Sending flow to the Ypsilanti plant is not viable, it's too far away and would require pumping because of the elevation difference.

A CAC member asked for clarification on the committee's mission and goals - are we trying to solve sanitary backups in basements in the target areas, across the entire city or overflows into the river or backups from manholes? Mr. Hupy responded that the CAC's charge is to evaluate and make recommendations regarding wet weather capacity within the sanitary sewer system – City-wide. He explained that the upcoming hydraulic analysis will reveal what current/future impacts on the sanitary sewer system and the CAC will review those and, together with the flow analysis, alternatives, and community values, will make a recommendation to City Council.

Mr. Hupy then reviewed other stormwater and sanitary sewer projects in and around the City and assured CAC members that data is being shared between projects so that teams can make the best decisions for the community.

In response to a question about a 1997 Black & Veatch report, Mr. Hupy explained that since the 90's the approach to reroute stormwater has changed to source control. A CAC member asked if the new source control philosophy is impacting the City's sewer capacity? Mr. Hupy said that the City's data analysis has not shown a negative impact on sewer capacity. Monitoring data on sump pump usage is factored into the analysis.

4. **Summary of FDD Survey Results**
Mr. Hupy stated that he was pleased with the large number of survey responses (+800 out of 2350 distributed), as the large number of returns assures statistically valid results. He said the survey results would receive quick attention from the City to:
- Address the heightened anxiety mentioned by almost 40% of respondents, whether or not FDD is selected as a response going forward.
- Investigate the cases where homeowners reported having water/sewage in basements that were previously dry.
- Engage CAC members who have an interest in reviewing the survey results and developing a follow up plan.

Mr. Fleetham reviewed the draft survey report and said that all of the responses had not been entered and the data was still being classified/scrubbed. Highlights include:
- Received 819 responses of 2350 sent, a much higher number of responses than expected. Results are statistically valid, with 99% confidence and 3.6% +- margin of error.
- Results are bifurcated: almost 70% were satisfied with their sump pump installation; just over 20% expressed dissatisfaction. However, +200 comments were received detailing reasons for dissatisfaction.
- Of respondents who experienced sanitary backups prior to FDD, 70% are no longer having backups.
- 103 respondents reported water in basements, post FDD.
- Increase in anxiety reported by about 40% of respondents.
- Have received more than 300 comments and have classifying them for easier review.

5. **Introduction to BaseCamp** - CAC members have been signed up for BaseCamp, which contains a log of CAC questions and answers. Lori Byron will support CAC members with one-on-one training as needed.

6. **Additional Topics: Gravity Backup System Proposed by CAC** Member
CAC members expressed dissatisfaction with the City Building Department's response regarding a proposed gravity backup system design and requested a more detailed discussion to learn if the design could be altered to be compliant. The CAC agreed that this topic needed to be included on a future agenda.

7. **Next Meetings** – Charlie Fleetham will send a Doodle poll to the CAC for Feb/Mar/April dates.

8. **Public Comment**
A resident commented that the SWWEE website contained no notice of tonight's meeting or the upcoming Public Meeting on the 22nd. (Judy Hanway) [Public Meeting was rescheduled for Thursday, February 6.]

There have been a number of threatened lawsuits in the Lansdowne area but that they have been settled. Feels that the City has transferred a lot of cost from the sump pump. (William Higgins)

CAC members must be clear and understand specifically how FDD relates to developer agreements. It is confusing regarding who mandates that the developers have to mitigate. Is it true that the developers have to negotiate with homeowners? The committee should get clear about the developer mitigation program; is it for the benefit of developers or not? It is perplexing that nine months into the program, the CAC members are still asking about the mission. (Cy Bufano)

MEMORANDUM

TO: Citizen Advisory Commission, SSWWE Project

FROM: Abigail Elias, Chief Assistant City Attorney

SUBJECT: Responses to Concerns Raised about FDD Programs

DATE: November 25, 2013

I. **Citizen Advisory Committee (CAC) Question of Concern:** Is Mr. Mermelstein's argument that Ann Arbor did not and does not have the legal right to enact an FDD program valid?

Answer: No.

II. **Mr. Mermelstein's First Argument:**

- The City passed an FDD Ordinance in 2001, which is Section 2:51.1 of the City Code
- Implementation of 2002 Home Rule (5j) (Section 5j, added to the Michigan Home Rule City Act) is required to empower the City to enact its FDD ordinance.
- Since the City didn't implement 2002 Home Rule (5j), the FDD ordinance is invalid.

Answer:

1. The timing of the Michigan legislature's enactment of Section 5j of the Michigan Home Rule City Act (MCL 117.5j) relative to the City's enactment of Section 2:51.1 of the Ann Arbor City Code does not invalidate Section 2:51.1.

MCL 117.5j provides:

> *A city, in order to protect the public health, may adopt an ordinance to provide for the separation of storm water drainage and footing drains from sanitary sewers on privately owned property. The legislative body of a city may determine that the sewer separation authorized by this section is for a public purpose and is a public improvement and may also determine that the whole or any part of the expense of these public improvements may be defrayed by special assessment upon lands benefited by the public improvement or by any other lawful charge. A special assessment authorized by this section shall be considered to benefit only lands where the separation of storm water drainage and footing drains from sanitary sewers occurs.*

- Mr. Mermelstein is correct that Ann Arbor enacted Section 2:51.1 of the City Code in 2001 and that the Michigan legislature enacted MCL 117.5j in 2002.
- The addition of Section 5j to the Michigan Home Rule City Act provides additional authority for Section 2:51.1 of the Ann Arbor City Code, but the City's enactment of Section 2:51.1 in advance of the legislature's enactment of MCL 117.5j does not invalidate the enactment of Section 2:51.1.
- It is unclear what Mr. Mermelstein thinks the City needed to do to "implement" MCL 117.5j. The state legislature enacted it, and it did not require further action by any municipality to take effect.
- Finally, the City did not need MCL 117.5j for authority to implement an FDD program. As discussed below, MCL 117.5j is not the sole authority for the City's FDD program.

Attachment #1

2. The federal Clean Water Act also provides authority for the City's FDD program as follows:

   - The federal Water Quality Act amendments in 1987 to the federal Clean Water Act require municipalities to take steps to prevent sanitary sewer overflows. Such overflows, resulting in the discharge of pollutants into rivers and streams violate a municipality's National Pollution Discharge Elimination System (NPDES) permit.
   - Even before 1987, Michigan's construction code prohibited connections of downspouts and footing or foundation drains to the sanitary sewer system. The City of Ann Arbor, like many other municipalities, implemented a program to require disconnection of downspout discharges to the sanitary sewer system. Although footing drains also were supposed to be disconnected from the sanitary sewer system, that requirement was not actively pursued or enforced.
   - Because the flow of storm water into a sanitary sewer system is one of the primary causes for sanitary sewer overflows, Ann Arbor, like many other municipalities, subsequently implemented its FDD program.
   - In addition, by Administrative Consent Order entered into with the Michigan Department of Environmental Quality as a result of some sanitary sewer overflow events from the City's sanitary sewer system (ACO-SW03-003, September 4, 2003), the City agreed to undertake a program to disconnect footing drains as a way to try to eliminate future sanitary sewer overflow events. As noted above, such overflows violated the City's NPDES permit.

3. Ann Arbor's FDD program is not unique. An Internet search for "foundation drain disconnect sanitary sewer storm" brings up numerous examples, including ordinances and other public documents published by the municipality or agency requiring the disconnections. Because of the absence of any easily available database with all or even multiple municipal codes in it, we have not compiled a list of all such ordinances and programs. <u>Nevertheless, searches in legal databases for court and administrative decisions that have addressed one or another aspect of a footing drain disconnect program has found no case or decision that has found any aspect of any such program to be unconstitutional or otherwise legally invalid.</u>[1] Following are brief summaries of pertinent points in some of those cases and decisions:

   (1) <u>Magnuson v City of Hickory Hills</u>, 933 F2d 562 (7th Cir. 1991).

   Hickory Hills, Illinois, had a program to eliminate illicit sewer connections due to the requirements of the federal Clean Water Act. Because of some procedural snafus and because they had been threatened with a water shut off for failure to comply with the disconnect requirements of the sewer rehabilitation ordinance, the Magnusons, who were homeowners subject to the Hickory Hills ordinance, brought a lawsuit in federal court. The case was dismissed by the trial court and the Magnusons appealed. This decision of the federal court of appeals describes the Hickory Hills' program including the legal basis for its implementation:

   > *It didn't matter much to Noah, but Hickory Hills, Illinois, cares very much where the water goes. The Chicago suburb maintains two separate sewer systems, one for storm water and the other for sanitary waste. Residents having homes with basements, half-basements, crawl spaces, and overhead sewers are required to install two sump pumps: one to handle sanitary waste and another to collect and divert storm water coming from gutters, window wells, floor drains, and drain tiles. Without the additional pump, storm water from these parts of the house flows into the sanitary waste sewer system, causing back-ups and flooding. Despite an ordinance banning the connection of "storm water" sump pumps to the sanitary sewer system, the City still had a problem with property owners whose illegal hook-ups posed a potential flooding hazard.*

[1] We found one Ohio trial court decision that upheld a footing drain disconnect ordinance against various challenges, but held it invalid as applied to one property because of the enormous cost imposed on that property owner.

> *In addition to flood prevention, Hickory Hills had another reason for wanting to pull the plug on sump pump violators. Pursuant to The Clean Water Act of 1972, 33 U.S.C. §§ 1251-1387, the Metropolitan Sanitary District of Great Chicago ("MSD") (now called the Metropolitan Water Reclamation District of Greater Chicago) enacted comprehensive legislation requiring all municipalities under its jurisdiction (including Hickory Hills) to make deliberate efforts to eradicate the overloading of local sanitary sewer systems. To effectuate this goal, the MSD sued towns who failed to undertake or complete a sewer repair program. In an effort to comply with the MSD's mandate, Hickory Hills adopted a sewer rehabilitation program to abate the hazards caused by the infiltration of storm and ground water into the sanitary sewer system. Part of the City's strategy was to institute house-to-house inspections to "flush out" potential sources of illegal discharge into the sanitary sewer system. 933 F2d at 693.*

The Magnusons' lawsuit challenged Hickory Hills' threat to shut off their water if they failed to disconnect, arguing there wasn't a rational relationship to the problem the City wished to remedy. The court rejected that argument:

> *The Magnusons may be right in theorizing that there exist better ways to shore up the flooding problem in Hickory Hills. A perfect "fit" between the problem and the remedy, however, is not required. When rights of a fundamental nature are involved, regulation limiting these rights may be justified only by a compelling state interest. See <u>Roe v. Wade</u>, 410 U.S. 113, 155, 93 S.Ct. 705, 728, 35 L.Ed.2d 147 (1972). We do not consider the right to continued municipal water service such a fundamental right; therefore, all that is required is that there be a reasonable relationship between the continued water service and the conditions imposed by the City. We will strike down the conduct in question only if it is "arbitrary and unreasonable bearing no substantial relationship to the public health, safety or welfare." <u>Euclid v. Ambler Realty Co.</u>, 272 U.S. 365, 395, 47 S.Ct. 114, 121, 71 L.Ed. 303 (1926). See also <u>Coniston Corp. v. Village of Hoffman Estates</u>, 844 F,2d 461, 467 (7th Cir. 1988); Burrell v. City of Kankakee, 815 F.2d 1127, 1129 (7th Cir. 1987).*
>
> *Here, the conduct complained of is neither arbitrary nor unreasonable. It was directed toward a legitimate goal related to public health and safety. The City could use the threat of water service termination in order to insure the success of the sewer rehabilitation program, a program aimed at complying with legislation requiring all municipalities under MSD jurisdiction to make deliberate efforts to eradicate the overloading of local sanitary sewer systems. . . . The case for cutting off water service for failure to comply with a sewer rehabilitation program is even more compelling [than a case upholding the shut off of water for failure to pay for garbage disposal], because the two services are fundamentally interdependent. Common sense informs us that any decrease in the flow of tap water necessarily would diminish the amount of water entering the sewer system. Because the Magnusons have failed to come forward with any credible evidence showing that the City's program is arbitrary or unreasonable, their substantive due process claim fails. 933 F2d at 567.*

Although the <u>Magnuson</u> case did not address any "takings" claims as outlined by Mr. Mermelstein (see Section III, below), the court did address and support the legitimacy of Hickory Hills' disconnect program. <u>The court did not did not even hint at any possible unconstitutionality of the program.</u>

(2) Board of City Commissioners of Johnson County v Grant, 264 Kan 58 (1998)

Johnson County, Kansas, implemented a program to disconnect from the sanitary sewer system, sources of storm water and/or groundwater such as foundation drains on private residential properties. The County implemented this "Private I & I Removal Program" after "exhaustive engineering surveys and studies of the sanitary sewer system" that had identified infiltration and inflow from such sources as a major factor contributing to sewer backups and bypasses. The lawsuit arose when defendant Grant and eigbt other homeowners refused to allow inspection of their homes to determine if they had a connection to the sanitary sewer system that had to be disconnected under the Private I & I Removal Program.

The trial court had held that the program served a legitimate governmental interest in preventing, "to the extent feasible, sewer backups and bypasses that threaten the public health and environment," and that the ability to enforce the Program's provisions, including inspections, was necessary. The Kansas Supreme Court upheld the trial court's decision.

Although the Grant decision does not explicitly address the issues raised by Mr. Mermelstein, the courts' decision was premised on and implicitly approved the legitimacy of the Private I & I Removal Program.

(3) Pure Waters, Inc. v Michigan Dept. of Natural Resources, 873 F Supp 41 (ED Mich, 1994)

The facts and issues in Pure Waters, which was a challenge to a plan to build a large retention for control of combined sewer overflows (CSO), generally are not relevant to the situation in the City of Ann Arbor. However, in its discussion of options to control CSO the court commented that,

> *The removal of storm water inflow sources that originate on private property such as foundation drains and sump pumps can be very expensive to remove. It also may be difficult to enforce their permanent removal from the sanitary system. 873 F Supp at 47.*

The court raised only the issue of cost as an obstacle and did not raise as a possible obstacle the legal invalidity of an FDD program.

(4) Village of Bourbonnais v Illinois Environmental Protection Agency, PCB 83-71 (Illinois Pollution Control Board) (1983) (1983 WL 25566).

The disconnect program described in this administrative decision is similar to Ann Arbor's. In this matter, the Village of Bourbonnais and Kankakee Water Co. petitioned for a temporary variance to allow bypass and discharge of untreated flows to the river due to excess infiltration and inflow of storm water into the sanitary sewer system. A "major problem" was "the difficulty in reducing inflow from sources such as sump pumps, downspouts and footing drains."

The variance was granted for a limited period of time, with conditions that included a requirement that an existing "house-to-house inspection program for detection and removal of downspouts, footing drains and sump pump connections to the sanitary sewer system" be continued, along with a requirement that all residents be given 90 days to disconnect all such connections to the sanitary sewer system and, if not done, that property owners be fined and then disconnected by the Village/Water Company within 90 days. In addition, water would be shut off to any property that had not disconnected.

(5) Town of Highland v Lieberman, 944 NE2d 994 (Ct. of Appeals, Indiana, Unreported) (2011).

This case was decided under Indiana law and is not reported; it is relevant here only for its description of the separation programs. This lawsuit was brought for damages due to a sewer back up following a heavy rainfall event, even though the Highland Sanitary District had implemented "Separation Programs" to remove storm water flow from the sanitary sewer system, including disconnection of storm water flow into the sanitary sewer system from private properties. The validity of the separation program was not questioned by the court.

III. Mr. Mermelstein's Second Argument:

- Ann Arbor's FDD program was/is unconstitutional because it violates private property rights as established in a Supreme Court case (Loretto). The Loretto ruling implies that Ann Arbor's FDD program was/is an unconstitutional taking of private property by the City and therefore illegal.

Answer:

1. The facts and circumstances and decision in Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419 (1982), are not close or relevant to the situation at hand and the decision has no bearing on the FDD ordinance or program.

   - Loretto involved a New York law that required a landlord to permit a cable television company to install its (the cable company's) cable facilities upon the landlord's property, resulting in a physical occupation of the landlord's building by the cable facilities. The Supreme Court ruled that the law was unconstitutional.
   - In contrast, a footing drain disconnection and installation of sump pump facilities brings a property into compliance with the City's 1982 construction code. No physical occupation by City equipment or the equipment of a third party is involved.
   - The home improvements – sump pump and line connecting to storm sewer – become and are part of the property where they are installed. They are owned by the property owner, not by the City. The City is not placing City facilities within any homes or on any private properties and is not taking any space in those homes or properties for City facilities or facilities of a party other than the property owner.
   - The facilities that the property owner installs under the FDD program are no different than the facilities built into a home that was built originally with a footing drain that discharges to the storm sewer system; both of those property owners have the same maintenance and operation responsibilities relative to those facilities.
   - The sump pump facilities benefit the property, its owner and its occupants because they help prevent sanitary sewage backups into the property's basement, which is a known health hazard.

2. The installation of a sump pump provides direct and indirect benefits to the property owner.

   - Storm water flow from footing drains that are connected to the City's sanitary sewer system contribute to the surcharging of the sanitary sewage system in heavy rain events, with the result that the sanitary sewer flow may back up through basement floor drains. This impacts both properties with footing drains connected to the sanitary sewer system and to properties in their neighborhood, even if those properties have footing drains that discharge to the storm sewer system. A property owner benefits in a similar manner when other properties in the neighborhood disconnect footing drains from the sanitary sewer system.

- The prevention of sanitary sewage backups through basement floor drains benefits not only the property owner but also the surrounding neighborhood and the entire community. This program and its objective are for the health and safety of the community, including the property owners who undertake the disconnections.

IV. What exposure do CAC members have if a legal action is brought against the CAC or individual members for recommendations that emerge from the CAC?

Although we can never guarantee that nobody will sue the CAC or its members for their recommendations, we think a case brought against the CAC or its members would be without merit and would be quickly thrown out by a court. Following are some general principles that should apply.

- The CAC and its members should not be subject to any lawsuits for the recommendations they make. The CAC will only make recommendations; it will be the City, acting through the City Council and staff, that will make the decision how to proceed. There shouldn't be a factual basis for any claims against the CAC and its members.
- The CAC, as a body established to advise the City of Ann Arbor, is not a body that can be sued separate from the City; if a lawsuit were brought, it would have to be against the City.
- The CAC and its members are exercising quintessential government functions that do not fall into any of the exceptions to governmental immunity under Michigan law. In other words, even if the CAC were negligent in making its recommendations, governmental immunity would shield the CAC and its members from liability.
- Although the immunity analysis under federal law is different than under Michigan law, there also should be no grounds for any claims against the CAC and its members for providing their views and advice to the City decision makers.

There are always some exceptions to one or more applicable principles of law, and there is never a guarantee or 100% certainty when questions are asked about lawsuits and probable outcomes. However, we are not aware at this time of any exceptions that would apply. We think it highly unlikely any exceptions would apply, and we are reasonably confident as to how courts would view such a lawsuit.

Finally, the City has never had to respond to a lawsuit against volunteer members of a citizen advisory committee - or any similar committee or task force - for doing what the committee or task force was formed to do. In the event that were to happen with the CAC and/or its members, the City would represent the CAC and its members. As with the representation of City employees, representation of individual CAC members would require them to assist with and be cooperative relative to the defense of the case.

Charlie Fleetham

From: Charlie Fleetham
Sent: Wednesday, November 27, 2013 5:40 PM
To: Charlie Fleetham (charlie@projectinnovations.com)
Cc: Hutchinson, Nicholas (NHutchinson@a2gov.org); Robert Czachorski (robert.czachorski@ohm-advisors.com); Murat Ulasir (murat.ulasir@ohm-advisors.com); Lawson, Jennifer (JLawson@a2gov.org); (cpulcipher@a2gov.org); Lori Byron (lori@famousinyourfield.com); 'cslotten@a2gov.org'; Greg DeLiso (gregdeliso@mac.com); 'rkellar@a2gov.org'; 'Baughman, Troy'; Elias, Abigail (AElias@a2gov.org)
Subject: FW: Response from Ms. Abigail Elias re: November 25th Memorandum
Attachments: 121713 CAC Meeting Prep Material.pdf

Greetings CAC Members,

Please find below a response from Ms. Abigail Elias, Chief Assistant City Attorney, regarding questions that have been raised regarding her November 25th, 2013 memorandum – "Responses to Concerns Raised about the FDD Program." I am forwarding this response in hopes that it may answer similar questions held by other CAC members. I have also attached the November 25th memorandum.

Thanks for effort you are putting into reading these many emails. I certainly appreciate the energy!

Have a great Thanksgiving!!

Attachment #1, continued

Charlie Fleetham
CAC Facilitator

From: Elias, Abigail [mailto:AElias@a2gov.org]
Sent: Wednesday, November 27, 2013 5:27 PM
To: Charlie Fleetham; Hutchinson, Nicholas; robert.czachorski@ohm-advisors.com
Subject: RE: URGENT> Fwd: Meeting Material for December 17 CAC Meeting on FDD Legal Questions

Charlie – please forward to the CAC my responses to the questions you forwarded to me. Thank you.

A CAC member has asked a couple of critical questions about my November 25 memorandum "Response to Concerns Raised about the FDD Program." Following are the questions and my responses:

1. Does the memorandum mean that the City legal staff now represents CAC members?
2. If the above is true, am I now prohibited from talking to other lawyers?
3. If the City is sued regarding this project, will I be required to support the City's position even if I do not agree with it?

My responses:

The CAC and its members HAVE to be independent to do what the CAC is tasked to do. Whether other members of the CAC agree with another member or not does not matter; whether members are inclined to support the FDD concept, inclined to oppose the FDD concept or neutral does not matter; each member needs to reach his or her own conclusions during the process of the CAC developing a recommendation or recommendations. The City Attorney's office does not represent any CAC member or the committee entire in any matter at this time. More important, our office does not tell any members of the CAC what to think.

CAC members are free to talk to anyone they want and my memorandum did not say otherwise.

The only time representation MIGHT come into the picture is if someone were to file a lawsuit that named CAC member individually in his or her role as a member of the CAC – as opposed to being a lawsuit against the City. That should not happen if the lawsuit were brought by a knowledgeable attorney, given the role of the CAC and its members. However, if that were to happen and if the CAC member wanted the City Attorney's office representation, IN THAT CASE, we think it appropriate to consider members of the CAC eligible for representation. Members of the community who have chosen to put in the time and effort to volunteer on the CAC should not have to bear the cost of representation if they become subject to a lawsuit based on that participation. If CAC members wants that representation, they need to help/cooperate with the attorney representing them. If they don't want the City Attorney's office to represent them, that is their choice. In any event, no member of the CAC ever would be asked to make anything other than truthful statements; the facts will be the facts. Being intentionally untruthful would be considered non-cooperative. Whether a CAC member agreed or disagreed with this office's view of the legal issues relative to the FDD program likely would not be an issue in the representation.

Abigail Elias, Chief Assistant City Attorney | City of Ann Arbor, Michigan | mailto:aelias@a2gov.org | Telephone numbers: Office: (734) 794-6170 ext. 41888 | Direct: (734) 794-6188 | Internal extension: 41888 | Fax: (734) 994-4954 | Cell: (734) 320-7953 | address: 301 E. Huron Street, Ann Arbor, MI 48104 | mail address: P.O. Box 8647, Ann Arbor, MI 48107-8647.

A mind once expanded by a new idea never returns to its original dimensions. OLIVER WENDELL HOLMES

Charlie Fleetham

From:	Irvin Mermelstein <nrglaw@gmail.com>
Sent:	Tuesday, October 29, 2013 3:25 AM
To:	Charlie Fleetham
Cc:	JUDITH HANWAY; Aram Kalousdian; Jack Eaton; glynnb; amsyme; villagekt; Kathy Boris; Frank Burdick; (jecnmpc@sbcglobal.net); ted; geffenb; tombeth40; (petehouk@gmail.com); michelomayo; (marten@umich.edu); (jimosborn7@cs.com); (frankpelosi@gmail.com); (evaack@yahoo.com); caesersmith; (mwag@aol.com); (wherrymatt@gmail.com); kea2000; michellomayo; vrcaruso; Nicholas (NHutchinson@a2gov.org) (NHutchinson@a2gov.org); Robert Czachorski (robert.czachorski@ohm-advisors.com); Murat Ulasir (murat.ulasir@ohm-advisors.com); Jennifer (JLawson@a2gov.org) (JLawson@a2gov.org); (cpulcipher@a2gov.org); Lori Byron (lori@famousinyourfield.com); cslotten; Greg DeLiso (gregdeliso@mac.com); rkellar; Troy; stanhbaker; Postema, Stephen; dave.askins; Ryan Stanton; Ellen Fisher; Evan Pratt; Harry Sheehan; hedgerc@ewashtenaw.org; David Wilkinson
Subject:	Sanitary Sewer Wet Weather Evaluation Study--Brief Rebuttal of City Position Concerning Legality of FDDs

Dear Charlie and Members of the Citizens' Advisory Committee,

Judy Hanway joins me in this email.

Charlie Fleetham recently provided the CAC with a write-up of the City's legal arguments to support its claim of authority to perform FDD work on private property. Charlie didn't invite a contrary view from a lawyer outside of the City, so this email is intended to provide a brief rebuttal, primarily for the CAC, of the City's position. Judy, Aram Kalousdian and I may take the liberty of providing additional relevant details in further communications.

This email addresses two discreet issues. The first section addresses the City's lack of legal "power" to implement the FDDP, as admitted in 2001 by the City **in the SSO Report.** I raised this with Charlie in a detailed email to him on September 5.

The second section is a necessary and quick debunking of the City's sudden notion that its power and authority to complete involuntary permanent FDD installations and construction on private property does not come from the City's own FDD Ordinance, passed **in 2001,** but rather from a completely different state statute (Section 5j of the State's Home Rule Law) that was not enacted **until 2002.** That law was **not effective until** May 14, 2002, and the City **never implemented the state statute** with a City Ordinance (as required right in the state statute itself). Section 5j is irrelevant and I don't see even a good faith basis for the argument.

Attachment #2, [redacted]

1. Final SSO Report: No "Power" or "Legal Framework" to Perform FDDs Legally on Private Property

Involuntary construction and permanent physical installations on private property are at the heart of the design of the FDDP. That design was the work product of the Sanitary Sewer Overflow Task Force in 2001. Work and construction on private property was the route advocated by CDMI and its president, Mark Tenbroek, the contractor who conceived of and wrote the SSO Report. This approach was accepted by the City apparently until sometime very late (after April 2001) in the Task Force's program design work.

The Report was issued in June 2001 and made a final recommendation of the FDDP for enactmen by a City Council Ordinance, but there was an immediate legal problem described as such in the SSO Report itself.

It's unclear why, but right in the text of the SSO Report, on Pages L2 and L3, the Task Force added a big caveat to its recommendation: in plain English, the Task Force concluded that **there was no way legally to implement the FDDP** they had just recommended because **the City had no "power" (and therefore no authority) to do the work involved in FDDs on private property.**

On Page L2, the SSO Report asked this basic question, which should perhaps have been answered much earlier:

> **Legal Authority**--Can and will the City of Ann Arbor have the **legal framework** to accomplish the work required on private property?

The answer went even further than the question:

> **A first step is to develop a legal framework** that would allow access and work on private property. To be effective, the City of Ann Arbor **would need to have the power to accomplish the disconnection work on private property.**

The City had therefore just paid CDMI (and its public relations subcontractors) a lot of money to help the City develop a program for which the City lacked "power" (in the legal and constitutional sense) to enact or implement. It is a very damning admission in the City's own report that, as of June 2001, no one had yet figured out (or thought about) how to do the recommended and highly intrusive Ann Arbor-style FDDs **within the law and within the City's powers.** The SSO Report recommendations were a legal mistake and CDMI wanted a legal fix.

There was, however, no legal fix to be had in City Hall. The City had already said in its own report that it had no "legal authority," "power" or "legal framework" for the FDDs prescribed in the same report. The central problem for the City Attorney in June 2001 was that municipalities **exercise** power, they don't **create** it. The lawful legal and political "powers" of municipal governments are created by the Michigan State Constitution and the United States Constitution, and conferred on local governments (or not) under State and federal laws like the Home Rule Act. Neither the City Council nor the City Attorney could create legal or political power for the City itself **of any kind** just by passing an ordinance. Most especially, they could not create "power" to deal with the private property rights of citizens in the very manner that the **Federal and State courts had already powerfully condemned as unconstitutional.**

That is just what the state of the law already was in June 2001 concerning work on private property. By **1982**, both the US Supreme Court (in the *Loretto* case) and the Michigan courts had established that there were clear and simple constitutional limits on **involuntary permanent physical installations** (like FDDs) on private real property. These limitations came into play if, **before the involuntary installation,** the owners had been neither accorded "due process" about taking their property nor paid "just compensation" for the real property rights to be taken. Those are required by both the federal and state constitutions, <u>including the US Fifth Amendment Takings Clause</u>. **It is a fact that FDD Ordinance, however, was implemented entirely without any due process or just compensation for homeowners.**

These landmark decisions of the courts meant **before the SSO Task Force was formed in 2000,** that if a permanent physical installation had occurred because of an **"enforced consent"** under an enactment (like the FDD Ordinance), and the installation created **more than a "trivial" burden** on the property owner, **then that installation would be held to be an unconstitutional "taking" of private property for which the owner would have to be paid.**

Such takings were held to be of a particularly disfavored type called "*per se* takings," because the Supreme Court views physical takings as **crossing constitutional red lines** concerning real property rights.

The next obvious important question is: Even if a court agreed with a plaintiff that her FDD "consent" was enforced, **what does a "trivial" burden mean?** In the 1982 <u>*Loretto* case</u>, the US Supreme Court examined a simple "enforced consent" permanent physical installation (under a NY State law) of **static cable wires** in a non-living utility space within a privately-owned apartment building in New York City. The City argued that the cable wires were not burdensome to the owner—they were out of the sight of tenants and were maintenance and operation-free—and that cable access **was a civic benefit.**

But Justice Thurgood Marshall rejected New York City's arguments in the strongest terms and ruled that the cable wires installation was an "enforced consent" ***per se* physical taking** and thus illegal. The City couldn't leave a permanent installation behind when it left. The Court said that even cable wires installed by enforced consent created a **"more than trivial"** burden on the owner's "right to exclude." The Court stated that the "right to exclude" is the core right of private property ownership and that the City's **civic purpose for the taking—good, bad or simply lacking—was irrelevant.**

There are some things that American governments cannot do, and it was no secret in 2001 that involuntary permanent physical installations on private real property, like the FDDs described in the SSO Report, had for all intents and purposes been prohibited by the courts long before then. I have told the City this for over a year. The City would have to explain whether this problem was missed in 2001 before the final SSO Report or simply ignored. Either is possible.

As for "enforced consent," it is a fiction that there is an opt-out in the FDD Ordinance. What is in fact there is a $1200/per year fine or tax, with no due process, on the exercise of a resident's right to exclude, which is so carefully protected by the Loretto case. It's not surprising that only three people "opted out. FDDs under the FDD Ordinance are "enforced consent" installations, just as they were designed to be. The *Loretto* rule, by the way, was just affirmed by the US Supreme Court in December 2012 in the *Arkansas Game* case.

Concerning "just compensation," the Loretto installations were legally **far less burdensome** than any FDD, **even without any flooding out of the sump.** Cable wires don't flood basements, but FDDs often do and every FDDs requires mandatory operation, maintenance, repair, replacement, physical labor, etc. Those are not "trivial" burdens in comparison to cable wires. These are all parts of the burden on the homeowner (including the installation itself) and are all compensable in a lawsuit filed by any resident with an FDD, past or future. The relevant statute of limitations is 15 years.

The apartment house owner in NY received $1 in compensation from New York City, but she established a national legal standard. FDDs under the Ann Arbor Ordinance are **all** takings and **none** are $1 takings. These takings are going to be very expensive and going ahead with such takings by the City, which was known to be beyond the powers of the City, was taking an enormous risk with the City's finances and future. That risk is now preparing to mature while the City is considering doing further FDDs. Those will be expensive too.

The part of the SSO Report, in fact, is little noted by the City, as is the fact the legal problem in 2001 was so clearly recognized as an actual lack of municipal "power" from any constitutional source. **That was an insurmountable problem** and the verdict from the City Attorney in 2001 should have been, without doubt, that (i) the built-in "no power" problem of the FDDP design (admittedly a mistake by CDMI and the Task Force) could not be fixed and (ii) that FDDs could never be done Constitutionally without condemnation proceedings and just compensation **for each house.**

Further, Michigan condemnations go at the very high costs established by Article X, Sec 2 of Michigan Constitution. FDDs should never have been understood by the City and the City Attorney as anything other than very expensive and slow to do, not a quick, cheap alternative to upgrading the sanitary sewer infrastructure. If that had been understood, the City would have had to go back to the drawing board, but it would have avoided doing the expensive involuntary FDDs that will now have to be paid for in court.

Instead, for reasons that are not apparent, the City determinedly walked itself right into 1,821 **per se physical takings** under the FDD Ordinance. The Ordinance is simply a virtual cookbook for doing the admittedly unlawful FDDs designed by the Task Force and recommended in the SSO Report. Those FDDs, as predicted by the SSO Report, were all unlawful and I don't think the City's current priority should be figuring out whether to do more FDDs under the FDD Ordinance. The problem for the City is figuring out how the City is going to cope with the costs of paying for the almost 2,000 FDDs already done. Effectiveness of FDDs is legally and practically irrelevant.

Section 5j: Not Self-Executing, Not Retroactive and Not Relevant

I reviewed Section 5j of the Home Rule Law months ago and dismissed it for a number of reasons discussed here. The City's reliance on Section 5j, in fact, appears to be a shift in its position on its authority to do FDDs on private property. The City's apparent position now is that **the FDD Ordinance cannot stand on its own feet** (with which I agree), and instead suddenly needs to be propped up by a later-enacted statute **and** suggestions of retroactivity. I don't see any good faith basis for this argument. The problems discussed above are on top of that.

Section 5j would have had to solve, in 2002, the power/no power issue from the SSO Report in 2001 **and** it would have had to be retroactive. Section 5j does not create a "power," and when the State wants to confer "power" on a City, not just an authorization, it says so specifically. Section 5a of the Home Rule Act, for example, states that cities shall "have power" to maintain their own record keeping systems. Section 5j just doesn't do that.

The second major defect in the City's argument is that Section 5j **was not self-executing** in Ann Arbor or anywhere else. In any Michigan city, Section 5j just sat on a shelf **unless an ordinance was passed after May 14, 2002 to implement it.** That is its effective date, as stated in the law itself. **No such ordinance** was ever **introduced** or **passed.** I doubt that it was even considered, because Ann Arbor had already passed its own custom-made FDD Ordinance, which went way beyond any sort of program that a Section 5j ordinance would have allowed.

Section 5j is also only prospective (forward-looking only) and **not retroactive.** It did not authorize or validate or affect in any way any ordinance **passed before May 14, 2002,** including an ordinance about footing drains. The authorization to cities was only to pass future Section 5j ordinances after its effective date and not before. There is no basis for arguing to the contrary.

No Michigan court would interpret Section 5j to, in effect, authorize unconstitutional per se physical takings under the FDD Ordinance. For example, there is **nothing** in Section 5j that would have authorized the City to impose mandatory operation and maintenance obligations **only** on City residents with FDD installations and at their own cost and expense. It's the cable wires problem—combined with the machinery, it's way too great a burden under the hair-trigger Loretto rule.

A final indication that the City has done nothing under Section 5j is that the statute specifically authorized funding of projects under a Section 5j ordinance by **Special Assessments.** Special Assessment procedures could have killed the FDDP, because the affected owners would have had due process rights to be heard and to challenge FDDs as "benefits" or as a "benefit" to their specific properties. A variety of votes and approvals would have been required for the Special Assessment. None of this ever happened relating to footing drain "separations" under Section 5j.

The FDD Ordinance is the only authority (valid or invalid) the City ever created and the only one the City or its contractors have ever relied for involuntary residential FDDs. The FDD Ordinance doesn't get any help from the irrelevant Section 5j.

I'll address the City's "retroactive building code" theory and your other points in an email later today or tomorrow.

Irv Mermelstein

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February 13, 2014
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Citizens Advisory Committee (CAC) Agenda
Forsythe Middle School
Thursday, February 13, 2014 - 6:00 p.m. to 8:30 p.m.

1. **Welcome -** Cresson Slotten Cresson, Systems Planning Unit Manager will welcome the CAC.	6:00 p.m. (5 min.)
2. Desired Outcomes – Cresson Slotten ▪ Discuss/edit/approve committee behavioral norms ▪ Debrief Feb 6 public meeting results ▪ Review results of tech briefings with CAC members ▪ Update progress on addressing issues raised in FDD survey ▪ Update on hydraulic analysis ▪ Discuss/brainstorm alternatives ▪ Update on BaseCamp Q&A Log ▪ Update on Tech Oversight and Advisory Group (TOAG)	6:05 p.m. (5 min.)
3. **Discuss/Edit/Approve CAC Behavioral Norms –** Charlie Fleetham Charlie, CAC Facilitator, will review a set of recommended CAC behavioral norms and discuss with the CAC for their approval.	6:10 p.m. (15 min)
4. Report on Feb 6 Public Meeting Results - Charlie Fleetham	6:25 p.m. (10 min)
5. Update Progress on Addressing FDD Survey Issues - Robert Czachorski Robert, OHM Project Manager for the SSWWE, will provide update.	6:35 p.m. (5 min)
6. Update on CAC Tech Briefings – Robert Czachorski	6:40 p.m. (5 min)
7. Update Progress on Hydraulic Analysis – Robert Czachorski	6:45 p.m. (5 min)
8. Brainstorm Non-FDD Alternatives – Robert Czachorski Robert will lead the CAC in a brainstorming session on non-FDD alternatives for mitigating the risk of basement backups. Session will include review of implementation alternatives applied in other communities.	6:50 p.m. (80 min)
9. Plan Agenda for March 20 CAC meeting – All	8:10 p.m. (10 min)
10. BaseCamp/Log update – Lori Byron	8: 20 p.m. (5 min)
11. Update on TOAG Activities – Cresson Slotten	8:25 p.m. (5 min)
12. Public Comment (three minute limitation per speaker)	8:30 p.m. until finish

Web: **a2gov.org/SSWWE**
Email: **SSWWE@a2gov.org**

Sanitary Sewer Wet Weather Evaluation Project (SSWWE)
Citizens Advisory Committee Meeting Summary
Forsythe Middle School
February 13, 2014

Citizens Advisory Committee Attendees:

▪ Kathy Boris	▪ Joe Conen	▪ Patricia Marten	▪ Beverly Smith
▪ Colin Breed	▪ Judy Hanway	▪ Jim Osborn	▪ Mark Wagner
▪ Frank Burdick	▪ Peter Houk	▪ Frank Pelosi	
▪ Vince Caruso	▪ Michelle Lovasz	▪ Frank Richardson	

Project team attendees:

▪ Lori Byron (Famous in Your Field)	▪ Robert Czachorski (OHM)	▪ Greg DeLiso (Munrovia Pictures)	▪ Charlie Fleetham (Project Innovations)
▪ Greg Marker (OHM)	▪ Cresson Slotten (Ann Arbor)	▪ Murat Ulasir (OHM)	

Observers:

▪ Dave Askins (Ann Arbor Chronicle)	▪ Jack Eaton (City Council)	▪ William Higgins	▪ Aram Kalousdian	▪ Kristin Lovelace

1. **Cresson Slotten, City of Ann Arbor, welcomed CAC members and the public and reviewed the meeting agenda.**

2. **Cresson reviewed the desired outcomes for the meeting:**
   - Discuss/edit/approve committee behavioral norms
   - Debrief Feb 6 Public Meeting results
   - Review results of tech briefings with CAC members
   - Update progress on addressing issues raised in FDD survey
   - Update on hydraulic analysis
   - Update on Basecamp / Q & A log
   - Update on Tech Oversight and Advisory Group (TOAG)

3. **Discuss/Edit/Approve CAC Behavioral Norms – Charlie Fleetham, Project Innovations**

   Discussed role of the facilitator in the process:
   - To make it easier for the CAC and the City of Ann Arbor to come to a recommendation. Maintain order in the conversation and make sure that everyone gets involved.

   - Get everyone involved, where everyone is the CAC and the public.

   - Get everyone involved by identifying desired outcomes and getting them met. Approaches used in this project:
     - FDD Survey
     - Tech briefings
     - Q & A log in Basecamp
     - Postcards/emails to survey respondents
     - Specific agenda topics
     - October sub-committee work
     - Questions & answers slides
     - FDD Survey follow up

- Individual follow up with CAC members between meetings
- Recommendations for developing CAC report:
  - Agree/select community values
  - Agree, select the voice of community
  - Agree/select tech data
  - Agree/select solutions

- Maintain order in conversations
  - Agenda development
  - Managing the agenda time and topics
  - Ensuring adherence to norms (sometimes implicit, sometimes explicit)
  - The City has empowered the facilitator to maintain norms by:
  - Identifying breach (online/meeting)
  - Asking for a retraction/apology/ceasing the violations
  - Repeated breaches bring request to leave

Fleetham shared his personal experience and point of view:
1. I have no position on FDD. I had a sump pump in a house I owned. That's it.
2. My singular position as a facilitator is to maintain dignity of CAC and team members
3. Been through the fire before in controversial projects like school closings, company startups, multimillion dollar settlements.
4. Believes that we can succeed together. The CAC is on schedule to complete an informed recommendation.

Fleetham read proposed CAC norms and asked anyone with objections to comment. No objections were made. Highlighted norms were suggested, discussed, and also approved. The final CAC norms are:

- Treat each other with dignity and respect.
- Listen first to understand, and don't be dismissive of input received when we listen.
- Support each other - don't throw each other under the bus to external parties
- Avoid territoriality – try to think about both what's good for neighbors, as well as the entire City.
- Come prepared to meetings...showing value and respect for the time and convenience of others.
- It's okay to be the messenger with bad news...we will greet it with a problem solving approach.
- The discussion of issues, ideas and direction will not bring about a personal attack and return to haunt someone in the future.
- Project team members (consultant and City staff) will be accountable and responsible to the CAC.
- Don't use bold or CAPS in Basecamp postings – perceived as screaming and disrespectful.
- When asking for information, describe relevance to project objectives.

Next, CAC members separated into small groups to discuss how the process is going so far. Following the small group conversations, CAC members shared their comments about the process to date and CAC norms:

- Fine with what we have.

- Want a balanced approach to what's being disseminated and discussed.

- Be more respectful in communications. When writing emails and postings, suggest that using bold and caps is perceived as disrespectful.

- Glad that the CAC is made up of a cross-section of the City, not only experts in one topic.

- Need to focus on the objectives that need to be addressed.

- Sees that there are two objectives: 1) Are we reducing flows in the targeted areas and 2) Are we reducing the flows to the Huron River?

- Believes that we should give everyone a chance to speak and to be heard.

- Group should spend some time to prioritize the questions being asked.

- The CAC does need a lot of information to make a decision, perhaps there is a way to better organize all the information, so that members can find information easily.

- Would like Basecamp to be open to the public.

- Related to 2001 Study, found it informative to see the information and the recommendation. Err on the side of offering more information, rather than less.

- Does not believe that there is too much information; it's needed. However, there have been questions requesting information that are very detailed and may not be directly relevant to the CAC's mission. Suggests that requestors of information determine whether the request is aligned with one of the objectives.

- The questions that are being asked do not require the consultants to spend time, only the City.

- When a member asks questions, have them add a sentence or two about how it's relevant to the outcomes. Whether its City personnel or consultants, time is not unlimited.

- Would like those who have not joined the CAC to not be included in the CAC Basecamp discussions … they seem to be ghost CAC members.

Fleetham said that project team will create a proposal for organizing information on alternatives to make it easier for CAC members to review and analyze concepts and data.

4. Report on February 6 Public Meeting results – Charlie Fleetham, Project Innovations

Outreach Process
- 850 FDD Survey respondents invited through post card/emails.
- Press coverage in Ann Arbor Chronicle/Ann Arbor News
- A2 Underwater distributed 100 flyers (per Judy Hanway)

Participation
- 38 participants total
- 3 council members
- 22 citizens
- 13 CAC members
- 27 discernible questions and/or comments (12 from CAC members)

Fleetham's Takeaways
- Outstanding participation from CAC members
- Participants were patient and thoughtful in their questions/comments
- City made positive impact with plan to address issues raised in survey . . . Greg Marker added value as potential problem solver.

5. **Progress update on addressing FDD issues found in survey – OHM Advisors**

Greg Marker, the OHM Engineer assigned to the task, updated the CAC the on initial FDD triage:

- Met and collected data from City and CDM to get data and background on the houses that had the most serious issues with their FDD, sump pump installations.
- Will review all the data, then conduct phone conversations with homeowners who reported the most significant problems.
- Will report on FDD findings at April CAC meeting.
- Marker will determine detailed issues and together with OHM, City and the CAC (as desired) will determine any trends and the go forward plan.

6. **Update on CAC Tech Briefings – Robert Czachorski, OHM Advisors**

Most CAC members attended or are scheduled to attend tech briefings where they can discuss flows, capacity, various methods of dealing with wet weather impacts, and ask any questions in a small group environment.

The tech briefing on Feb 17 will be held at Panera Bread, as the City's offices are closed for President's Day.

7. **Update Progress on Hydraulic Analysis – Murat Ulasir, OHM Advisors**

Background: hydrology deals with the flow component of a sewer or stormwater system, hydraulics deals with the pipes and the infrastructure.

The City has a model of its sanitary sewer system; OHM is making sure the model matches the existing infrastructure and that the model reflects what actually happens to flows within the system.

Question: From a purely hydraulics standpoint, could you make a recommendation of where storage could be placed?

OHM: Yes, that is typically the first outcome after hydraulic analysis is to determine where storage is most needed ideally. After that, the field investigations determine whether locations are available or feasible.

8. **Discussion on non-FDD alternatives – Robert Czachorski, OHM Advisors (see attached flip chart images). (Note: responses to questions are from Czachorski unless otherwise noted.)**

Image 1: Start by defining the problem we are solving: wet weather issues in the sanitary system. The sanitary sewer is only supposed to carry sewage from the houses and buildings, but it doesn't. It leaks. Czachorski plotted a normal flow (known as the diurnal flow) to represent how flows move through the system. The picture of flow over time is called a hydrograph.

Image 1.5: Next, Czachorski drew an image of pipe to illustrate how flows make their way through the pipe. If the flow becomes too great in the area of the system outside the house, the pipes are filled and the flow backs up from the pipe and into a basement. There are three categories of solutions:
1. Source removal
2. Storage
3. Transport & treat

Image 2: Sample Town - high storm peaks/basement backups concentrated in some neighborhoods.

Image 3: Source Removal examples:

- FDD
- Water conservation – Frank Burdick's low flow and water saving device alternative proposal

- Manhole/pipe rehab – if you have cracks in the pipes and manholes, rainwater can leak into the sanitary sewer system
- Line the service lead
- Remove D.C.I.A – Directly Connected Impervious Area

Question: How effective it can be to rehabilitate sanitary leads or line a pipe?

Response: Rehab results are very dependent on the system. It depends on the age, condition of the system. Also, some communities do spot repairs. Those communities that are most successful with rehab take a holistic approach, fixing the pipes, the leads, and the whole gamut.

Question: How tight is Ann Arbor's system?

Response: Cresson Slotten said that public works officials in other communities have told him that Ann Arbor's system is "tight." Czachorski said it's common for 30-50% of the flow in a sanitary sewer system to be groundwater inflow or infiltration.

Question: We would like a review of the budget and associated issues affecting storm and sewer system.

Response: We will review the budget at a later date.

Question: How much stormwater can flow into manholes with pick holes?

Response: Sometime, a significant amount.

Image 4: Sample Town #2: High storm peak found in select pipes. Storage may be best solution. If the problem is confined to a particular neighborhood, expanding capacity at the plant will not solve it; you'd need storage in the neighborhood itself.

Image 5: Storage solutions include:
- Tanks
- Linear storage
- Shafts
- In-system storage

Storage refers to temporarily storing excess flow in a tank, tunnel or large pipe (also called linear storage) until flows leave the system. Consideration for the CAC: tunneling for a storage pipe is expensive. Because you need a lot of storage capacity, you will need long lengths of pipe. Shafts – a vertical pipe, approximately 100' wide and hundreds of feet deep. Used in Dearborn, where 3 of 4 shafts failed. City of Dearborn is currently in litigation. In system storage – not used very often. Regarding tanks:

1. Tanks need to be maintained and sometimes this can be problematic.
2. Tanks have a "stink" factor; gases need to be treated before emitting.
3. Linear storage can go under a road. Judy Hanway

Question: Regarding the Miller Ave area, did the work included stormwater upgrades?

Response: Cresson Slotten – yes, although the approach to stormwater is more typically to use infiltration on site.

Question: Please identify storage specific to Bluett/Georgetown and Yost Blvd.

Response: Cresson Slotten brought maps for the CAC to review.

Question: If the CAC is looking at overflows to the river or capacity in specific neighborhoods, we should look storage area that is available near the WWTP?

Response: We will study this idea in the alternatives analysis.

Image 6: Sample Town #3 - high storm peaks found in transmission main leading into the WWTP. If the problem is the pipe going to the WWTP and the plant itself, best solution is to put storage near the plant. Also, if problems are some distance from each other, relief sewers (transport and treat) could be a solution.

Image 7: Transport and Treat - Czachorski outlined five approaches in the transport & treat category:

- Replace current pipes in problem areas with larger pipes
- Relief sewers
- Pump stations, where sewage is lifted from a low point to a higher point
- WWTP expansion
- Outlet to a neighbor plant (YCUA)
- Outlet to a new plant – Judy Hanway

Question: If there is an isolated problem in a small area, could you put a grade protection station in the right of way?

Response: Yes, cost is roughly $200,000 for six houses.

Question: What about future increased flows; can the capacity be exceeded?

Response: Yes, one of the disadvantages of storage is that it is finite.

Question: What is the difference between a relief sewer and linear storage?

Response: The size of the pipe.

Question: Is linear storage preferred over tanks?

Response: Not necessarily, however, tunneling tends to be much more expensive than using tanks. $10/gallon vs. $3 to $5/gallon just as a rough guideline.

Question: How much interface will Murat Ulasir have with the Upper Malletts Study to focus on the areas where infrastructure projects are already planned?

Response: Yes, this is the point where the two study teams start to interact.

9. **Discuss agenda for March 20 CAC meeting - Charlie Fleetham outlined some suggested topics.**
   a. Preliminary results of the hydraulic analysis will be presented.
   b. Solution and library to organize information on various approaches to deal with wet weather.
   c. Discuss the community values

CAC members made the following requests in preparation for the March meeting:

- Someone from the City attend the March meeting to discuss the budget.

- Information on the relative costs of the various approaches.
- Tell us how many FDDs have been done since the summer of 2012?
- Please share the effectiveness evaluation of the City's stormwater tank project at Pioneer High School.
- Spend in the CAC meeting reviewing the questions log to have the group decide on the relevancy of the questions and the completeness of the responses – Frank Burdick
- Provide better description of minority report … provide samples of majority and minority reports – Frank Burdick

10. Basecamp Update – Lori Byron, Famous in Your Field

Highlighted the current process for answering the volume of questions:

- Questions are posted on Basecamp by members of the CAC.
- Byron collects the questions from Basecamp, as well as those asked during public meetings, CAC meetings and via email, submitting them to the City for responses.
- City staff members meet and provide responses to the questions.
- Byron then posts the responses to Basecamp and adds them to the ongoing SSWWE Q & A document. The updated SSWWE Q & A document is posted to the City's project website bimonthly.
- Responses provided by City staff are labeled [CITY] in Basecamp.
  - 243 questions to date
  - 224 responses to date
  - 19 awaiting response

11. TOAG update – Cresson Slotten

The Technical Oversight and Advisory Group (TOAG) is a group of subject matter experts who provide technical expertise, coordination, review, guidance, process overview, and quality assurance on all of the Wet Weather Projects.

The TOAG met with the SSWWE Project Team earlier in the day for a presentation on the results of the first phase of the SSWWE project; flow monitoring and analysis.

12. Public Comment:

Currently serving on the Upper Malletts committee. Feels that the general public should know what is happening on Basecamp. It's a secret site and it should be opened up. (William Higgins)

March 20, 2014
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Citizens Advisory Committee (CAC) Agenda
Slauson Middle School
Thursday, March 20, 2014 - 6:30 p.m. to 9:00 p.m.

1. **Welcome –** Nick Hutchison	6:30 p.m. (5 min.)
2. **Desired Outcomes –** Nick Hutchison ▪ Update on DOMP – FAQ/Video review ▪ Findings on Risk Assessment and Hydraulic Capacity Evaluation ▪ Community Values – Forced Ranking Exercise ▪ Update on FDD Survey – Triage and Assessment Efforts	6:35 p.m. (5 min.)
3. **Provide Update on DOMP –** Project Team Members ▪ Review DOMP Video – Charlie Fleetham ▪ Review DOMP FAQ – Lori Byron / Troy Baughman ▪ Q & A – All	6:40 p.m. (25 min)
4. **Preliminary Findings on Risk Assessment and Hydraulic Capacity Evaluation –** Murat Ulasir ▪ Setting the stage by reviewing project progress – Robert Czachorski ▪ Presentation on Risk Assessment/Hydraulic Capacity – Murat Ulasir ▪ Small Group Breakout sessions – All ▪ Facilitated Discussion and Q&A – Charlie Fleetham	7:05 p.m. (80 min)
5. **Community Values – Forced Ranking Exercise -** Charlie Fleetham	8:25 p.m. (15 min)
6. **Update Progress on Addressing FDD Survey Issues –** Greg Marker	8:40 p.m. (10 min)
7. **Plan Agenda for April 17 CAC meeting**	8:50 p.m. (10 min
8. **Public Comment (three minute limitation per speaker)**	9:00 p.m. (till completed)

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

City of Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Citizens Advisory Committee (CAC) Meeting Summary
Thursday, March 20, 2014

Citizens Advisory Committee Members:

▪ Kathy Boris	▪ Judy Hanway	▪ Frank Pelosi
▪ Colin Breed	▪ Peter Houk	▪ Frank Richardson
▪ Vince Caruso	▪ Patricia Marten	▪ Beverly Smith
▪ Joe Conen	▪ Jim Osborn	

Project team members:

▪ Troy Baughman (Ann Arbor)	▪ Greg DeLiso (Munrovia Pictures)	▪ Nick Hutchinson (Ann Arbor)
▪ Lori Byron (Famous in your Field)	▪ Charlie Fleetham (Project Innovations	▪ Murat Ulasir (OHM)
▪ Robert Czachorski (OHM)		

Meeting observers:

▪ Mike Anglin (City Council)	▪ Jack Eaton (City Council)	▪ Margie Teall (City Council)
▪ Frank Burdick	▪ Public Safety Officers (2)	

1. **Nick Hutchinson, City of Ann Arbor, welcomed CAC members and the public and reviewed the meeting agenda.**

   Re-introduced the team members and roles:

   - Nick Hutchinson, *City of Ann Arbor* – project manager on the Sanitary Sewer Wet Weather Evaluation project
   - Troy Baughman, *City of Ann Arbor* – modeler with the City
   - Robert Czachorski, *OHM Advisors* - project manager for the consultant team
   - Murat Ulasir, *OHM Advisors* – performing hydraulic modeling and analysis
   - Greg DeLiso, *Munrovia Pictures* – videographer
   - Greg Marker, *OHM Advisors* – construction engineer, performing follow up on the 2013 FDD Survey
   - Charlie Fleetham, *Project Innovation* – managing public engagement
   - Lori Byron, *Famous in Your Field* – assisting in public engagement

   Welcomed three Council members:
   - Mike Anglin, 5th Ward
   - Jack Eaton, 4th Ward
   - Margie Teall, 4th Ward

2. **Nick Hutchinson reviewed the desired outcomes for the meeting:**

- Update on Developer Offset Mitigation Program (DOMP) – FAQ & Video review.
- Findings on Risk Assessment and Hydraulic Capacity Evaluation.
- Community values – Forced Ranking Exercise.
- Update on FDD Survey Follow Up.

3. **Update on Developer Offset Mitigation Program (DOMP) – Project team**

Charlie Fleetham asked CAC members to introduce themselves and indicate any additions they would like to make to the agenda.

A CAC member asked why the group did not participate in creating Community Values for Forced Ranking. Also asked that when a subgroup meets, could someone please provide a brief summary of discussion.

Charlie discussed the development of the forced ranking exercise; the list of items were intended as a starting point, to spur discussion. The CAC is free to use this list and to modify it as they wish.

A CAC member asked if the SSO Task Force developed its list of values or if they got it from another source. Nick Hutchinson responded that he did not know, but can research if needed.

Fleetham played the Developer Offset Mitigation Program video for the CAC. The CAC members then discussed the DOMP video and FAQ in small groups and shared reactions and questions with the entire group:

- Found the tone of the two programs very different, DOM seems to be better resourced, battery backups mentioned.

- Wonders who is responsible if the job isn't done right, in the City's program vs. the developer's program?

- Sounds like the developer contractors are more responsive than City's contractors.

- Question: Are all the developers providing backups?
  Response: *Don't know, the developers negotiate with homeowners, we don't know what they negotiate.*

- Question: Are most DOM FDDs performed by the prequalified contractors?
  Response: *They don't have to be, any licensed plumber can do the work.*

- Question: Is CDM involved in the DOMP?
  Response: *Yes, CDM makes an inspection, verifying that the disconnection has been performed. This cost is paid by the FDD program.*

- Question: Homeowners in the DOMP videos mentioned that the sump pump dried up flooding in their basements, how does that work?
  Response: *A sump pump usually stands in a sump pit -- a hole with a gravel base about 2 feet deep and 18 inches wide -- dug in the lowest part of your basement or crawlspace. As the pit fills with water, the pump turns on. It moves the liquid out of the pit through pipes that run away from your home to the storm sewer or to a spot where the water can drain away from your foundation. Digging down under the floor will draw the water level down.*

- Video says that DOM is completely voluntary; notes that the program is mandatory for developers. Modify video accordingly (done).

- Payment made for stadium expansion; believes that should not be repeated. Made things more complicated than it should be and is a gray area with respect to fairness.

- Backup pumps were mentioned in the video; contrast that with the City FDD program. Homes in the target areas did not have the option of a backup.

- When I built our house, we built a walkout. We were required by code to buy a sump pump, maintain a sump pump, and provide our own backup. This is the situation for most homeowners. Unfortunately, early on, the developers got the City to allow direct connection to sewer system.

- Question: Would like to know what complaints are about the DOM program? What are the major issues that people have with that?
  Response: We can use the survey data to parse out the respondents who had developer-sponsored disconnections.

- Question: Were the DOM homes surveyed in the FDD survey? Response: *Yes.*

- Question: Regarding the DOM FDDs paid for by the University of Michigan for its Stadium expansion project, did the City then conduct mandated FDDS?
  Response: *Yes, in Glen Leven area.*

- Question: Feels that the City made a profit on the DOMP installations.
  Response: *Baughman notes that the $4,200 covered under the City's FDD program does not include the costs to design and construction the curb drains needed to reroute stormwater flows to the storm sewer system.*

- Understands that roughly a 1/3 of the DOMs were from installing low flow fixtures, disconnecting swimming pools. Doesn't believe that is in the best interest of community to only reduce usage flows, when it's peak flows during wet weather that are the issue.

- Question: have any homeowners been turned down for the DOM? Say, if they wanted too much?
  Response*: While the City staff is not involved in developer/homeowner negotiations and cannot say if this is true, Marker says that two contractors have told him that they've declined homes where it was too costly (difficult) to pipe to the storm drain.

4. Preliminary Findings on Risk Assessment and Hydraulic Capacity – Robert Czachorski & Murat Ulasir

Setting the stage by reviewing project progress – Robert Czachorski

- Building blocks of the program: public engagement, flow metering, FDD flow removal evaluation, flow risk evaluation, hydraulic capacity assessment, alternatives evaluation, recommendations.

- Project team is actually a month ahead of schedule in the deliverables.

- Terminology Primer:
  - Hydrology – flows generated by rainfall
  - Hydraulics – depth and flow in the pipes
  - Risks are described as annual probabilities

- Level of Service Primer:
  - State of MI regulates sanitary overflows to surface waters.
  - We picked up on the CAC's potential desire to set a level of service higher than what's required by the DEQ.

- Reviewed design flow plot to demonstrate how modelers model design flow (statistical analysis).

- How do we model risk?
  - One way is to compare design flow to pipe capacity.
  - Reviews flow risk assessment example from Morehead as an example (meter 49m).
  - Pipe capacity at meter location 7.49 cfs.
  - 4% chance in any given year that the pipe would exceed capacity.
  - Post FDD, less than .5% chance of exceeding capacity.
  - Glen Leven is an outlier. It has two outlets. Additional capacity was installed in the 80s.
  - Post-FDD, all priority districts have a recurrence interval of reaching pipe capacity up to 200 years. The June 27, 2013 storm supports this finding.
  - Points out an outlier, B1, which is the only meter area post-FDD that does not have a 100+ year capacity. Pipe capacity at the meter does not represent system capacity in this area. Needs to be checked with the hydraulic model.

- WWTP – Peak hour design capacity at the WWTP is 114 cfs.
  - Post FDD, the 100-year probability is 107 cfs.
  - May 22, 2004 is the last time that the plant experienced an SSO from flows. This instance was a combination of a high flow and an operational issue.

- Flow Risk Assessment Climate Change Methodology
  - EPA's National Stormwater Calculator Program now contains IPCC protocols for climate change.
  - In the High/Wet scenario increases by 10-20%.
  - Shows a Climate Change Example for meter 12a. Pipe capacity is > 100 year flow for historic climate and high/wet scenario.

- What's next for the SSWWE Project:
  - Finish climate change evaluation.
  - Run scenarios that account for future growth.
  - CAC evaluation of desired level of service.
  - FDD survey analysis.

Preliminary Hydraulic Capacity Assessment Results – Murat Ulasir

- Why do we use models?
  - To simulate the system at locations where we don't have observations.
    - Meters provide information at points around system.
    - Hydraulic model fills in the gaps.
  - To simulate potential changes to the system.

  - What does a modeler do?
    - Murat used EPA SWMM, a regulatory-approved modeling software package to perform the hydraulic analysis.

  - Showed 3 simulation results:
    - Base system, pre-FDD conditions.
    - Pipes are assumed to be flowing free without blockages or obstructions.

  - Distributed maps of City's sewer system pipes, 12" or larger. In the modeling, Murat pulled in a record of all depths of the pipe.

  - In this model, the pipes are cut off at the ends. As the hydraulic modeling analysis continues, he will model neighborhood pipes in the system.

  - Shows a map of modeling results post-FDD, behaving as the meters reported (depths in pipes) and the City still shows ample capacity in nearly all areas, except for one metered area (near Elbel Field.) The City has begun televising the pipes in that area to determine the issue.

Summary OHM Observations:

- Most of the system can convey the 50-year post FDD flows.
- The WWTP plant can handle the flow.
- There is no longer a significant risk of basement backups in the target areas.
- Based on this data, we would not recommend continuing the mandatory FDD in the target areas.
- We would recommend continuing with the DOMP program with process improvements as identified in the Survey Mitigation effort.
- Given the above, we would not recommend continuing with FDD “as is" in other areas of the city.

Following the data presentations, the CAC members broke into groups to discuss their major takeaways from the presentation then reconvened to share comments and questions:

- Data was interesting and compelling. Thought that the data gave a lot of evidence that the mandatory program does not need to continue. It also shows that we no longer need to have concerns about WWTP overflows.

- Is concerned about fairness; homeowners who were mandated for FDDs are left with problems, doesn’t seem fair.

- Agrees that it does seem that the mandatory FDD won’t have the bang for the buck in the future. Still concerned about problems with overflows in specific areas of the City. Looked up reports of manhole overflows in the areas of Hoover Street (Elbel Field area.) How does the City investigate those situations? Thinks that the CAC should recommend that any sewer manhole overflows be investigated as to cause.

- It appears to be clear that the FDDs have solved the problem in the target areas. However the City continues to have backups in some areas, so there must be some issues in the local pipes. Those still need to be uncovered and addressed.

- FDD was successful in its mission, but there are still five objectives as he sees it:
  1) No sanitary sewer backups in basements.
  2) No SSOs.
  3) The City of Ann Arbor should rectify any deficiencies in any FDDs previously mandated by the city.
  4) 1-3 should be done as cost effectively as possible.
  5) Use developer offset mitigation FDDs that are voluntary as a method of providing for future growth.

- Murat and Robert noted that there is still more investigation to be done to know the magnitude and locations of risks of sanitary sewer backups.

- A CAC member commented that when a developer in his area (Glendale) wanted to build, a neighbor did a door-to-door survey to find out issues that homeowners have. Found that many – half it seemed – have flooding and sanitary backups. These problems were reported to the City, which did send maintenance teams to clean out some pipes.

- Believes that the federal EPA has a 0% tolerance for SSOs. Robert commented that regulatory issues are complex. The EPA has legislation that prohibits SSOs; however, the states are left to enforce those. The challenge is that communities cannot be burdened with infinite design capacity.

- Question: Did the hydraulic model include climate change?
  Response: *No, this version did not take climate change into account, but we will in future models.*

- Question: Hydraulic model was showing 50 year frequency; what about 100 year frequency?
  Response: *Robert suggests that the project team will create a matrix of model runs to be developed.*

- Would like to see different models, still learning terminology and knows that understanding increases with exposure.

- Robert emphasized that project team is not talking about rain events (inches of rain) but instead of probabilities of recurrence of flows exceeding pipe capacity; 1%, 4%, 10%, etc.

- Question: Regarding potential CAC recommendations, continuing DOM. Asks if homeowners are still volunteering for disconnects?
  Response: *yes, they are.*

- Perhaps CAC should consider continuing DOM, just to allow for growth. Murat noted that a future model will be run showing results with townships that have purchased capacity at full contract capacity.

- Question: Is there a standard frequency for the City's maintenance of pipes in its sewer system?
  Response: *the City's goal is to televise every pipe in the system every seven years. He notes that while it's a goal that does not always happen.*

5. Community Values – Forced Ranking Exercise

Due to time constraints, Charlie proposed that the CAC members participate in a web conference to discuss community values. Asked that all CAC members complete the ranking exercise to share their opinions.

6. **Update on progress addressing FDD Survey issues - Greg Marker**

- 150 homes on list.
- Data collected, collated for 91.
- Did 46 phone interviews, 22 don't require site visits and are done (homeowner resolved issue, does not require assistance.)
- 4 had site visits and are completed.
- 24 scheduled for on site visits, based on phone calls.
- 25 have not responded to phone, email and/or letter.
- 4 in correspondence with Greg.
- Performed on site investigation of 4 homes on Avondale – frozen curb drain.

- CAC members asked: what is the standard for an overflow? Is the air gap how other communities deal with water? Doesn't seem like a good design to have overflows drain onto basement wall.

7. **Next meeting April 17, 6:30p.m. – 9:00p.m., Slauson Media Center**

A CAC member asked that future meetings not be scheduled on the third Thursday of the month, as it conflicts with a long standing watershed group meeting.

8. **Public comment**

No comments were made.

April 17, 2014

CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Citizens Advisory Committee (CAC) Agenda
Slauson Middle School
Thursday, April 17, 2014 - 6:30 p.m. to 9:00 p.m.

1. **Welcome –** Nick Hutchinson	6:30 p.m. (5 min.)
2. **Desired Outcomes –** Nick Hutchinson ▪ Review Revised Timing Schedule ▪ Update on WWTP – FAQ/Video review ▪ System Scenarios and Neighborhood Capacity Evaluation ▪ Community Values – Forced Ranking Exercise ▪ Update on FDD Survey – Triage and Assessment Efforts	6:35 p.m. (5 min.)
3. **Review Revised Timing Schedule –** Robert Czachorski	6:40 p.m. (10 min)
4. **Provide Update on WWTP –** Project Team Members ▪ Review WWTP Video – Charlie Fleetham ▪ Review WWTP FAQ – Lori Byron / Jennifer Lawson ▪ Q & A – All	6:55 p.m. (20 min)
5. **System Scenarios and Neighborhood Findings- Hydraulic Capacity Evaluation –** Murat Ulasir ▪ Scenario Selection and Review – Robert Czachorski ▪ Presentation on Neighborhood Risk Assessment/Hydraulic Capacity – Murat Ulasir ▪ Small Group Breakout sessions – All ▪ Facilitated Discussion and Q&A – Charlie Fleetham	7:15 p.m. (80 min)
6. **Community Values – Forced Ranking Exercise -** Charlie Fleetham	8:15 p.m. (15 min)
7. **Update Progress on Addressing FDD Survey Issues –** Greg Marker	8:45 p.m. (5 min)
8. **Plan Agenda for Wednesday, May 15 CAC meeting**	8:50 p.m. (10 min)
9. **Public Comment (three minute limitation per speaker)**	9:00 p.m. (till completed)

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Sanitary Sewer Wet Weather Evaluation Project (SSWWE)
Citizens Advisory Committee Meeting Summary
Slauson Middle School
Thursday, April 17, 2014

Citizens Advisory Committee Attendees:

▪ Kathy Boris	▪ Joe Conen	▪ Patricia Marten	▪ Beverly Smith
▪ Colin Breed	▪ Judy Hanway	▪ Jim Osborn	▪ Mark Wagner
▪ Vince Caruso	▪ Peter Houk	▪ Frank Richardson	

Project Team Members:

▪ Lori Byron (Famous in Your Field)	▪ Greg DeLiso (Munrovia Pictures)	▪ Nick Hutchinson (Ann Arbor)	▪ Greg Marker (OHM)
▪ Robert Czachorski (OHM)	▪ Charlie Fleetham (Project Innovations)	▪ Lindsey Kerkez (OHM)	▪ Murat Ulasir (OHM)

Public Observers:

▪ Leon Bryson	▪ Jack Eaton (City Council)	▪ Jane Lumm (City Council)
▪ Frank Burdick	▪ Terry Holman	▪ Ethel Potts

1. **Nick Hutchinson, City of Ann Arbor, welcomed the CAC and public observers and reviewed the desired outcomes for the meeting:**
   - Review revised timing schedule
   - Update on WWTP – FAQ/Video review
   - Review system scenarios and neighborhood capacity evaluation
   - Community values – forced ranking exercise
   - Update on FDD Survey – triage and assessment efforts

2. **Facilitator Charlie Fleetham reviewed the agenda and handout packet:**
   - Meeting agenda
   - Previous meeting summary
   - Disorderly conduct notice (attachment #1)
   - Project integrated timeline schedule (attachment #2)

   He also asked for additional topics from CAC members, and a CAC member asked that Basecamp be made public.

   Charlie polled the CAC members on the request:
   - 5 voted to publish data outputs from Basecamp at interval periods during the project.
   - 6 voted to publish data outputs from Basecamp at the end of the project.
   - 1 voted for no publication.

[Note that all project documents, presentations and meeting materials are posted to the City's project website at www.a2gov.org/SSWWE. Additionally, all questions and answers asked by CAC members, as well as by members of the public are logged and posted to the City's project website every two weeks. What is not currently posted to the public are the individual CAC member opinions, brainstorming, etc.]

3. **Review project's revised timing schedule – Robert Czachorski, OHM**
   Robert gave the background on the proposed SSWWE & FDD Projects Integrated Timeline, included in the meeting packet:
   - There are two major and separate efforts: the SSWWE project and the FDD Survey Issue Mitigation.
   - In the process of conducting the FDD Survey, the SSWWE CAC assumed a role in the FDD effort. It is now time to begin transition of all FDD responsibility back to the FDD CAC.
   - The FDD CAC has always been charged with interfacing and representing the public for the FDD project. The SSWWE CAC is charged with reviewing engineering study results and evaluating alternatives and making a recommendation to Council, a forward looking mission.

Follow up on timeline proposal

A CAC member expressed concern that community values discussion was being given short shrift. He was concerned about fairness to those residents who've been forced to have an FDD and now have issues. We need a fair solution for those conditions. It may be necessary to include FDD redress recommendations for City Council to be able to implement the CAC's recommendation. We need to set up a time to give serious time and discussion.

Charlie shared that he received requests from several CAC members to minimize the community values discussion and devote as much time as possible to the results of the hydraulic analysis.

Another CAC member agreed that addressing fairness was important for the 2,600+ people who've had footing drains disconnected. Is the project deliverable a survey of community values or a recommendation to Council of what remedies should be made?

Charlie said that an extended discussion on community values would occur at a future meeting. He agreed that the CAC's decision on values would be a major driver for a set of recommendations to City Council. He also clarified that recommending a plan for addressing FDD homeowner issues will likely be a joint FDD CAC/SSWWE CAC effort, which will take place at the June 18 "Super CAC" meeting. However, after this plan is developed, the implementation would shift to the FDD CAC.

Impacts of other studies

- A CAC member asked that the group get an overview of the stormwater efforts and how those might impact the SSWWE project. Robert agreed that coordinating with the concurrent stormwater projects is important and an update on all related projects will be provided. He also said that the SSWWE project team does have a task in the project to coordinate with other ongoing community projects.
- A CAC member mentioned that the Stormwater Calibration Study will have a public meeting on May 20.

- A CAC member requested a posting of the Upper Malletts Creek 3-page recommendations.

Q. A CAC member expressed concern that with so many projects and CACs and the TOAG group that the SSWWE recommendations could be overridden by recommendations from other projects and CACs.

A. Nick shared that the TOAG's role is to provide professional expert overview of the techniques used, the engineering analysis, not to make recommendations or critique recommendations made by the SSWWE CAC. Robert explained that the TOAG is reviewing all the concurrent projects, as well.

Q. Is the FDD CAC ongoing or does it have a project end date like the SSWWE CAC?

A. The FDD CAC is open ended and its work depends somewhat on the recommendations of the SSWWE CAC. If FDDs are not recommended to go forward, then the FDD CAC's role will be to oversee the follow up on the results of the survey, but might not continue beyond that.

Q. When does the Stormwater Modeling Study end?

A. November 2014.

Q. Is the Malletts Creek project complete?

A. Yes, the project is complete and the City just received the final report.

4. **Update on City's Wastewater Treatment Plant (WWTP)**
   - The CAC reviewed WWTP video and reviewed WWTP FAQ handout

   - A CAC member reported that a WWTP staff member commented at an Environmental Commission meeting that the FDDs performed were not removing as much stormwater as is coming into the pipes through infiltration. People should understand this. Jennifer Lawson said that the City has a lining program to line older and/or problem areas.

   - A CAC member commented that the Supervisor of Ann Arbor Township stated there would be no way that the WWTP will be expanded (it's located in Ann Arbor Twp.) City staff agreed that there is little room for a plant expansion.

Jennifer fielded a set of questions about the WWTP video.

Q. Why wasn't the SSO consent agreement with the EPA mentioned in the WWTP video?

A. The City is no longer under the consent agreement.

Q. How is plant capacity is affected by the West plant being out of commission?

A. The 29.5 MGD capacity number mentioned in the video and FAQ doesn't take into account the storage capacity of the equalization basin, which is not impacted by the construction.

Q. Will the West plant be rebuilt?

A. Yes, rebuilding the West plant is the purpose of the $120M capital improvement project discussed in the video and FAQ.

Q. What is current capacity at the WWTP while the West plant is out of commission? And what will it be when the reconstruction of the West plant is complete?

A. It's 20.0 MGD currently and will be 29.5 MGD once construction is complete.

Q. So, the plant has capacity to handle the flows?

A. Yes, the plant has capacity to handle the flows. As was stated in the video, Ann Arbor's flows have not increased substantially in the last five years and aren't expected to do so in the next few years.

Q. Is it correct that even with future growth, the City will be using less water?

A. Yes, water usage is and has been decreasing in recent years.

Q. Are lift stations and pump stations the same thing?

A. Yes, they are devices used to raise sewage over low lying areas.

Q. How does the City's future plan predict 2025 WWTP daily flows of 24.5 MGD reconcile with SEMCOG's population growth forecast of 4%?

A. The 2025 predicted flow of 24.5 MGD came from a 2004 Black & Veatch WWTP Facility Master Plan. However, since that master plan was developed, the economic and population situation in Michigan has changed significantly, and we no longer expect to reach those projections.

Q. A CAC member looked up a report of a May 2011 SSO that caused sewage to come from several manholes. What caused it? Was there any follow up?

A. The May 2011 SSO was investigated and no defects in the pipe were found at that time. It's the City's practice to jet clean and TV after an SSO.

Q. The 10,000 gallon SSO reported in 2013 – was that an operational issue or a capacity issue?

A. It was an operational issue. In addition to the large, sudden amount of rain that fell, there was a lot of flooding around the plant itself. An amount of sewage discharged from the plant's headworks during about a 10-minute period; operators noticed it and followed SSO reporting and clean up procedures.

5. **System Scenarios and Neighborhood Findings – Hydraulic Capacity**

Robert provided a brief overview. The modeling scenarios presented during this meeting are starting points, not all the modeling that will be done for the project. The CAC will be able to request models that reflect the conditions they want to see.

- After tonight's hydraulic presentation, the CAC's focus will slowly shift to the community values/level of service discussions guiding all alternatives evaluation.

- There are two different models: backbone and neighborhood. The backbone model is made of the interceptor pipes in the sanitary sewer network. Modeling the backbone of the system is faster and can uncover issues to be examined further. This is the triage level.

- Neighborhood models include all the pipes in the system and are intensive to create, so they are typically reserved for problems areas revealed by the backbone/triage model.

- Here is the most important conversion formula: 1.54 cfs per MGD

Murat Ulasir reviewed conditions that were simulated:
- Flow frequencies – desired level of protection beyond MDEQ-required 10 year frequency.
- Climate Impacts –15% increase in wetness, frequency.
- Growth Projections – added 10% of the system's current flow, plus contributing townships at their contractual limits.

Color-coding on the map legend could be thought of as the percentage of the pipe that's full.

Murat first displayed maps that showed the backbone sanitary sewer system at 25-year, 50-year and 100-year frequencies:
- System appears to be able to handle the flows for a 25-year frequency, with a few exceptions. Hoover area does show up as having pipe issues.
- Model of existing conditions / 50 year frequency shows a few more issues.
- Model of the 100-year conditions show a number of issues.

Murat showed a model of this system at the neighborhood level (all the pipes in the system) with existing conditions, 50-year frequency, with climate change and growth.
- The system handles the priority neighborhoods well, except for areas in the Glen Leven/Dartmoor neighborhoods.
- Shows a problem in the Hoover area.

Q. Can you say that any of these neighborhoods will have surcharging or flooding?

A. The model shows that the interceptor is full in certain areas, but does not show beyond-capacity flow in the neighborhood pipe. Without meters in all the pipes, there's no way to know whether an individual pipe might have a root intrusion or other obstruction.

At a future meeting, the project team will show maps of the system model with SSOs and historic basement backups overlaid.

- SSOs (Sanitary Sewer Overflows) are not always connected with a rain event. Tree roots, clogs from trash or grease can also cause an SSO.
- SSO is a legal term that indicates that sewage has been released to the waters of the state. Those are required to be reported to the MDEQ and the county health department. Basement backups are not.

Project next step: determine the conditions to use for the final neighborhood level models and alternatives.

Q. Can you find out when a sewer pipe was cleaned in a particular neighborhood?

A. Yes, the City keeps records of the cleaning and televising.

Q. How many flow meters are there in the City?

A. Currently, there are no flow meters, except for the one at the WWTP. As part of the project, the team had about 34 flow meters installed in the same areas as were installed in the 2001 SSO Study. While the City does not have flow meters, they do have about 21 pressure recorders that measure the maximum amount of surcharging that the pipe experienced at the event. If the CAC felt that it were important, they could recommend that the City buy and install permanent flow meters.

Q. How much would a flow meter cost if the City were to install one permanently?

A. About $1000/month. That includes monitoring, maintenance, and periodic data recording and processing.

Q. Looking at the map, can we say whether homes in the red areas will have basement backups?

A. Murat opened the model and zeroed in on a particular red area, which showed that the sewer flows extended beyond the pipe (surcharging.) Any areas where flows extend beyond the pipe are problems for which the CAC could make recommendations to resolve. Robert said that basically there's two ways to fix these areas: take the flow out upstream or put in storage. The project team and the CAC will determine what types of projects can be done, the costs and how they mesh with community values. A CAC member said that the model may not show every problem. In an informal survey in a neighborhood, almost 50% of homeowners said that they'd had basement backups.

Q. How large are the pipes?

A. The pipes in the neighborhoods are typically 8" or 12", which make up about 80% of the pipes in the system. The transmission mains; however are about 48" or larger.

Q. Regarding OHM's experience with projects in other community – do other communities typically account for growth, or climate change?

A. Robert said that most communities perform a study of their system as a result of an enforcement action. They then design the solution to meet MDEQ's 10-year standard. If the community is undertaking a study as a result of basement backups, it may design a solution that's more robust than the 10-year standard. To date, few or no communities have included climate change as factors in their design, probably because the EPA only recently released it modeling protocols for climate change rainfall data. A CAC member said that the EPA published a report requesting that communities expand wastewater treatment plants or reduce flows to accommodate climate change. The University of Michigan has adjusted its models because they believe climate change is happening. Other CAC members asked for a posting of the report on Basecamp and the project website.

Q. How was growth factored into the model? Why was 10% selected?

A. There were many complex ways to predict impacts of growth; population change, water consumption change, employment change. The 10% factor was selected to give the CAC a baseline to judge impacts.

Q. If townships exceed contract capacity, does the City have to accept it? Are the contracts open ended?

A. Charlie said that typically the acceptor of the flow can require that the community adding flows to build storage or mitigate flows exceeding the contract limit.

Q. If all the choke points in the neighborhoods were removed, could that have a negative impact on the WWTP?

A. Yes, it could allow the flows to rush to the plant, with the possibility of overwhelming it.

Q. Are the township contracts open ended or perpetual?

A. Robert said that in general these municipal contracts are long-term and require multiple years notice before either party can terminate the contract.

Q. Is a 50-year rain the same at a 50-year flow frequency?

A. No, the 50-year flow frequency refers to a chance of recurrence. The antecedent moisture can have a big impact on how much flow is generated by the same rain event.

Q. CAC member said that the backbone model shows few problems, but looking at the neighborhood scenarios may not give enough information to accurately evaluate the issues.

A. Yes, the modeler may be able to extend the backbone model to include all the red pipes.

A. Can we determine whether the areas with red pipes shown on the maps are having a problem for only a minute or for hours?

A. The maps are showing the peak hour, the highest one-hour of flow in the system, running over two days.

Q. Are we possibly spinning our wheels here? Is City Council going to say, "We don't care about a 50-year plan, we want a 25-year plan"?

A. We can't predict what City Council will do with recommendations; however, we can give the CAC mitigation options and related costs, which will help to understand the costs, the level of protections that projects may afford and help create the case for making any particular decision.

Q. Can we get a copy of the model maps for a longer review?

A. Because of Homeland Security concerns, the City may not be able to distribute the model maps as they were shown during the meeting, but the project team will explore ways to convey the modeling results to the CAC without violating security restrictions.

Modeling for future CAC meetings:

- Robert suggested that at the next meeting OHM will present the simulation with a small range of potential mitigation projects and a rough estimate of costs.
- CAC members should expect a significant communication from Robert within a week or so.

6. **FDD Survey Follow Up Update – Greg Marker, OHM**

The late snows in April have slowed the post-survey site visits; Greg needed to wait until the snow melted to examine the exterior installation. He gathered data for all the homes that reported significant issues or concerns on the 2013 FDD Survey. Data packets include:

- FDD Survey results for that homeowner
- CDM installation information
- Photos
- Any previous communication with the City

Post survey follow up progress:

- Greg has been in touch with 88 households.
- Of those 88, the investigation is now complete for 54 households.

- For 21 households, phone interviews resolved any outstanding issues. Those tended to be situations where the homeowner was comfortable with the operation of a sump pump and was able to replace aged equipment, if needed.
- In phone tag with 26 households.
- Phone interviews last approximately 30 minutes.
- Conducted 33 home inspections, spending roughly one hour at each home, talking with the homeowner, inspecting the basement installation, cycling the pump and examining the exterior of the home. Takes 10-20 pictures per home to document the situation.

Q. Why would homes where the homeowner was handy and did not experience significant problems be on the list for follow up?

A. Any homeowners who reported sump pump failures, significant water or sewage in the basement or requested a visit were put on the Survey triage list.

7. **Public Comment**

Frank Burdick - I want you to make sure that you guys realize that this group is just a focus group; it's not a Citizens Advisory Group even if they can call it that. City Council hasn't acknowledged it. I've talked to City Council. I've talked to Council reps. They say that this is just something that the consultant is doing. Keep that in mind. The letter that I got that kicked me off Basecamp was from OHM. The letter that I got that kicked me off this focus group was from OHM. This is important for the following reasons: Whatever recommendations you come up with may not go into the report because it's only OHM's report. All they have to do is say they involved the community. That's what they said they were going to do. Keep that in mind. Here's another point. Greg is aggressive. I want to make sure that you people know this. You think I'm aggressive? He's very aggressive. There's people in this room that didn't know it. And I think that he makes phone calls that I think could possibly dissuade people who want to participate.

Ethel Potts - I was a little shocked at the beginning of your meeting when you had a discussion as to whether the public was going to have access to this Basecamp information available to the group. Apparently half of you say "No", and I think it's going to backfire. You are exchanging information; staff is asking questions; you are responding; you are probably responding to each other and on that you are going to be basing some decisions. When those decisions hit the public, the public and the City officials are going to want you to rehearse all over again all this information that was backup for your decisions so you might just as well have just let us know what you were talking about to begin with. Let Basecamp be opened up. It will probably have to be opened up at some point, very awkwardly.

[Note that all project documents, presentations and meeting materials are posted to the City's project website at www.a2gov.org/SSWWE. Additionally, all questions and answers asked by CAC members, as well as by members of the public are logged and posted to the City's project website every two weeks. What is not posted to the public are the individual CAC member opinions, brainstorming, etc.]

May 14, 2014
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Citizens Advisory Committee (CAC) Agenda
Slauson Middle School
Wednesday, May 14, 2014 - 6:30 p.m. to 9:00 p.m.

1. **Welcome –** Nick Hutchinson	6:30 p.m. (5 min.)
2. **Desired Outcomes –** Nick Hutchinson ▪ CAC Decision on Posting Basecamp Entries on SSWWE Library Site ▪ Confirm Revised Timing Schedule ▪ Deeper Understanding of AA Utility Capital Funding Process ▪ Review Next Version of System Scenarios and Neighborhood Models	6:35 p.m. (5 min.)
3. **Options for Posting Basecamp Entries -** Charlie Fleetham	6:40 p.m. (10 min)
4. **Review Revised Timing Schedule –** Robert Czachorski	6:55 p.m. (10 min)
5. **Next Version: System Scenarios and Neighborhood Models –** Murat Ulasir ▪ Scenario Selection and Review – Robert Czachorski ▪ Presentation on Neighborhood Risk Assessment/Hydraulic Capacity – Murat Ulasir ▪ Review of 2013 Basement Backup Data- Murat Ulasir ▪ All Group Discussion	7:05 p.m. (80 min)
6. **Intro to City Utility Capital Funding** – Deb Gosselin, P.E., Ann Arbor Systems Planning Engineer	8:15 p.m. (30 min)
7. **Plan Agenda for Wednesday, June 18 SSWWE/FDD Combined CAC meeting –** Charlie Fleetham	8:50 p.m. (10 min)
8. **Public Comment (three minute limitation per speaker)**	9:00 p.m. (till completed)

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Sanitary Sewer Wet Weather Evaluation Project (SSWWE)
Citizens Advisory Committee Summary
Slauson Middle School
Wednesday, May 14, 2014

Citizen Advisory Committee Attendees:

▪ Kathy Boris	▪ Judy Hanway	▪ Patricia Marten	▪ Mark Wagner
▪ Colin Breed	▪ Peter Houk	▪ Jim Osborn	
▪ Vince Caruso	▪ Michelle Lovasz	▪ Beverly Smith	

Project Team Members:

▪ Lori Byron (Famous in Your Field)	▪ Charlie Fleetham (Project Innovations)	▪ Greg Marker (OHM)
▪ Robert Czachorski (OHM)	▪ Deb Gosselin (Ann Arbor)	▪ Cresson Slotten (Ann Arbor)
▪ Greg DeLiso (Munrovia Pictures)	▪ Nick Hutchinson (Ann Arbor)	▪ Murat Ulasir (OHM)

Public Observers:

• Frank Burdick	• Jack Eaton (City Council)	• Nancy Kaplan
• Leon Bryson	• Terry Holman	• Drew McKinnon

1. **Nick Hutchinson, City of Ann Arbor, welcomed the CAC and public observers and reviewed the desired outcomes for the meeting.**
   - CAC decision on posting Basecamp entries on SSWWE Library Site
   - Confirm revised timing schedule
   - Deeper understanding of AA Utility Capital Funding Process
   - Review next version of system scenarios and neighborhood models

2. **Facilitator Charlie Fleetham reviewed discussion and options for posting Basecamp (BC) entries on City's SSWWE website.**

   - Reviewed the previous CAC meeting's discussion on publishing Basecamp contents. Six CAC members had voted to publish outputs from Basecamp at the end of the project, five to publish at intervals during the project and one voted for no publication. Fleetham asked the CAC to share comments on desired interval for publishing.

   - Comments by CAC Members:
     - That there was some benefit to having BC private to facilitate brainstorming and discussions, but that value has been overshadowed by the perception that the CAC could be hiding something, which it is not. Indifferent to intervals.

     - Wishes to err on the side of openness. Doesn't believe the public should engage in BC itself, but public should see the discussions.

- Leaving BC closed until the close of the project would allow for the most information to be shared with the public ultimately, because it would allow open and wacky ideas to be shared among the CAC. Raises the concern that if a members might be reluctant to offer creative ideas if they know that they will be shared publicly across the City. That concern could lead CAC members to share ideas only via email, which would not expose them to the public or to not share ideas at all, which could diminish the number of creative solutions. That's why he believes that BC should be made public at the end of the project.

- Publishing BC at the end of the project is important, but publishing during the project could allow comments to be taken out of context and would stifle discussions.

- Supports transparency, but understands concerns about comments being taken out of context.

- Wishes to err on the side of transparency. Would prefer that it never be made public, but keeping it private creates a controversy or suspicion where none is warranted. Would also prefer that it be published at the end.

- Wants BC to be made public all the way along, and for anyone who has a good idea to share it. Not fair to leave the public out until all recommendations have been made. Welcomes the public to express their ideas.

- Wants BC to be made public and for the public to be able to offer ideas, too.

- Agrees that BC should be open, but that the conversation be kept among the CAC members. Public has the ability to offer ideas and commentary via email and at meetings.

- Wants it to be made public at periods throughout the project.

▪ Outcome: Basecamp outputs will be published on the City's project website, beginning June 1 and will be updated every two weeks.

Q. Member asks how the public will know that its available, will there be a link on the project homepage?

A. Yes, the City can include the link on the project's homepage.

3. Review Revised Project Timing Schedule – Robert Czachorski

Robert recapped discussion from the April meeting: the CAC wishes to review a range of relevant topics and information, such as impacts of the stormwater study, community values, CIP, TOAG interaction, FDD evaluation. To do this and absorb the considerable technical data, the CAC needs more time.

▪ The CAC also agreed that pushing the FDD public meeting deeper into the summer so that recommendations could be presented (versus investigation results).

▪ Additional meetings extend the project by four months from its original 18-19 month schedule, to end in November.

Robert walked through the timeline and also suggested that some of the SSWWE CAC members might wish to join the FDD CAC. Upcoming meetings and topics:

- June 18 – FDD CAC and SSWWE CAC joint meeting.
- July 9 – Additional details on model scenarios, costs and alternatives. Dick Hinshon, facilitator of the TOAG, will talk with the SSWWE CAC.
- August 13 – Review storm study findings and how those will impact the SSWWE project. First pass of set of alternatives.
- September 10 – Community values and second pass on alternatives and recommendations.
- October 8 – Draft conclusions and TOAG review.
- November 12 – Final recommendations.

Q. What is TOAG?

A. TOAG stands for Technical Oversight Advisory Group, a team of subject matter experts who are reviewing all three of the City's wet weather projects, evaluating the methodology.

Q. How did City Council's recent postponed vote on funding affect this project?

A. The vote was on a contract with CDM for some portions of the FDD program and doesn't affect the SSWWE project.

Robert noted that the project extension fits within the project budget approved by Council. Charlie thanked the CAC for devoting additional time to provide a thorough and thoughtful evaluation and recommendation.

4. System Scenarios and Neighborhood Models – Murat Ulasir

Murat reviewed the project progress to date and the current stage - hydraulic capacity assessments and alternatives. He emphasized that the analysis is preliminary.

Next, he reviewed information discussed at April CAC meeting: the sanitary sewer district for the collection system, WWTP capacity and various flow frequency scenarios: 25-year, 50-year, 100-year frequency flow recurrence intervals.

He explained flow components at the WWTP for 25-year flow frequency scenario. There are two components that make up the flow:

1. Base flow (average daily amount sent to the WWTP) = 29.7cfs
2. Wet weather flow (stormwater) = ~60 cfs

Total ~90 cfs flow.

Following are conditions to simulate - 3 things impact conditions:
- Flow frequencies
- Climate impacts
- Growth projections

Murat describes the recommended potential scenarios to simulate:

Scenario A
- Existing climate
- 25-year flow frequency
- Planned growth within the City peaked by a factor of 2.0
- Contract customers at contractual limits

Scenario B
- Add 10% flow (to flows *within* the City)

The 10% flow increase could represent:
- An increase from a 25-year to a 50-year flow (which is 9%)

  -or-
- Growth within the City of 10%

  -or-
- A medium range increase in rainfall due to climate change

Scenario A modeling results:
Using base flow, 25-year frequency wet weather flow, township amounts at their contract limits and the planned growth within the City limits peaked by a factor of 2, adds 22.02 cfs to the base flow of 29 cfs and wet weather inflow of 60 cfs. Total is 112.cfs Murat noted that the townships will add 3x the amount that planned City growth will add.

Scenario B modeling results:
Uses all the elements from above and adds 10% to flows with the City (*another* 8.74 cfs) for a total of 120.86 cfs.

Murat showed the preliminary modeled flow analysis (a visual representation of the likelihood of flow reaching pipe capacity in a given area of the system.) He emphasized that map shows flow analysis (likelihood of pipe reaching overflow conditions,) not risk conditions.

Murat explains the hydraulic modeling process, which includes the construction as-builts (pipe size and inversion), the conditions of the pipes, metering data. Direct measurement of flow in the pipes are collected from 50 sites throughout the system: 30 flow meters, 20 peak stage recorders.

With 50 measuring devices, the model represents the system well, with about 90% accuracy. Note: There could always be root balls collecting after the measurements or occurring in areas without meters.

Comparison to historic basement backups:

Murat showed a map of reported sewer backups overlaid with the hydraulic analysis for Scenario B, which shows several areas with high likelihood of flow reaching pipe capacity. He cautioned that the data includes all reported issues (surface water, private lead, and City sewer backups), starting from 2000.

He showed a map of reported wet weather issues since 2000 and another map with the major 2000 rain event removed. Including the major 2000 rain event shows many wetness issues in the FDD priority areas, but few when the 2000 storm is removed.

Issues were evident on the west side of downtown, Ashley area, Ravine north of Huron & Dexter, Iroquois, and in Maple/Miller area.

The Glendale neighborhood has had a few backups during the 2013 storm; CAC member living in the neighborhood comments that the few backups showing on the map do not reflect the number of flooding issues reported in a neighborhood survey. Charlie asks the CAC member who lives in Glendale neighborhood to provide results from the informal poll conducted to the project team, so that they can follow up on these issues.

Preliminary scale of improvement needs:

Murat emphasized that improvement options were being given only to provide a basis for comparison, no recommendations are being made. Results are very preliminary and a numeric representation of scale of problem only.

Scenario A example
Qpeak: 26 cfs
4 storage tanks
Volume: 8 MGD x $2-$10+/gallon

Scenario B
Opeak: 32 cfs
5 storage tanks
Volume: 11 MGD x $2-$10+/gallon

Robert explained that based on the CAC's recommendation, the engineers will produce a detailed hydraulic analysis of future flows, together with rough estimates of different potential construction projects and costs.

Outcome: CAC debated whether 10% increase is enough, or if the engineers should analyze a higher level of increase. The CAC selected Scenario B for further modeling and review of potential alternatives and cost information.

Following are questions asked and answered during the scenario modeling presentation:

Q. Do return flow frequencies correlate with rainfall frequency?

A. No, they do not correlate because the same amount of rainfall can have vastly different impacts on the sewer system, depending on the amount of antecedent moisture (wetness conditions) at the time of the rainfall. A return flow frequency of 25 years means that, in any given year, there is a 4% chance of that level of flow occurring within the system.

Q. Does flow refer to what we flush or run down the drain?

A. Flow refers to personal and commercial use (what we flush, etc.) as well as the water that enters the sewer system through infiltration.

Q. Does the base flow in the model include wet weather?

A. The base flow component includes the daily use, plus the groundwater infiltration that occurs year round. The wet weather component refers to the amount of inflow that enters the system after a rain event through footing drains, manhole covers, etc.

Q. The April presentation showed 50-year flows, why the change to 25-year flows?

A. When the contract limits from townships were added, growth and climate change were added, the 50-year system assessment showed many problems. The 25-year flows, with the added flows from growth and climate change are similar to 50-year flows without those conditions. If, after reviewing the results from the two proposed scenarios, the CAC wishes to evaluate a 50-year return flow frequency, the project team will do so.

Q. Given that water usage in the City is decreasing even though the population has increased, it may make sense to use lower growth numbers in the scenarios.

A. Yes, by using a 10% flow increase, you can allow for a range of impacts, whether those are from growth or climate change or some other factor.

Q. Scenario A shows a base of 29 cfs, with a wet weather inflow of 60 cfs, but you do not account for where it's coming from. Can you account for the sources of infiltration as well as how difficult the different sources might be to remove?

A. Yes, the project team expects to be able to show that analysis to the CAC in July. At this meeting, Murat can show the geographic areas contributing the additional wet weather flow, but not the component sources.

Q. Is Scenario B the same as a 50-year return frequency?

A. Yes, it's similar. Scenario B covers several different conditions: a certain amount of climate change or growth in the City.

Q. CAC member suggested that the stadium was lowered to be below the flood plain; it may be constantly pumping water. Could that contribute to problems in Iroquois area?

A. The issues in the Iroquois area are very complex; the situations do not match the metering data, which do not show flow exceeding the capacity of the pipe.

Q. How might the stormwater impacts affect flows in particular neighborhoods?

A. At the August meeting, the CAC will have a presentation on the results of the stormwater study.

Q. Who is responsible for uncovering the anomalies that were shown in the model?

A. The City. Field crews are investigating now, based on the model results, but the City cannot predict what it will find or when. Sometimes there is no obvious cause, such as a large obstruction.

Q. Is the reason the Scenario B does not include any increase from the townships that City Council would have to vote to approve any increases to contract limits and would not, without townships funding improvements?

A. Correct.

Q. How does the 8 MGD storage volume compare with that of Michigan Stadium?

A. If you assume that Michigan Stadium was a rectangle with dimensions of 300 feet by 500 feet and was 100 feet tall, that would be 112.2 MG. For comparison purposes, a 10 MG storage tank that was 20 feet deep would be a square with an edge length of 260 feet.

Q. Can the townships' contractual limits be increased arbitrarily, or must they be negotiated and voted on by Council?

A. Correct, these types of contracts typically require approval from the elected officials and involve lengthy negotiations for any changes, or to require improvements.

Q. How much can the City grow? You've used 10% in your model, but is it built out?

A. Ann Arbor has little greenfield development areas, some in the northeast Nixon Road area. In Cresson's 27 years with the City, there has been very little population growth. What has grown is Ann Arbor's employment base; however that has a small impact on water/sewer usage compared to residents.

Q. If a developer in a neighboring township wants to build a development and incorporate into the City of Ann Arbor, is the City obligated to accept the flow?

A. No, unless the development is in the contracted service area. The geographic boundaries for which the City is contracted to service with municipal utilities have already been determined and in the modeling, the project team has assumed all those areas to be contributing their full contracted daily amounts.

5. Ann Arbor Utility Capital Funding – Deb Gosselin

Please refer to the PDF presentation, Ann Arbor Utility Capital Funding on the City's project website: www.A2gov.org/SSWWE > Library.

CIP Process recap:

- All needs identified in the process are included in the CIP.
- The number and size of projects to address these needs are limited by the available resources:
  - Funding
  - Staff
- To do more projects each year, more resources are needed.
- At present, the CIP has allocated a $2.5M "pot" annually for wet weather mitigation projects. The City also has another pot for lining of sanitary sewer pipes and funds designated for manhole rehabilitation.

Following are questions and responses regarding Ann Arbor's Utility Capital Funding:

Q. What about SRF loans, were all or a portion of any loans forgiven?

A. Yes, that's true, the City has obtained some SRF loans, of which a portion was forgiven. Typically those forgiven were involved improvements to water quality. Those were funded by the U.S. government's Stimulus Program and at some point, that program will no longer be available. The City cannot count on any portion of a loan being forgiven in the future.

Q. Are there SRF loans available for sanitary also?

A. Yes, and the City mainly uses them for the water treatment plant. Each source of funding has different rules that govern how it can be used. As an aside, the State's sanitary SRF program is much larger than the State's stormwater program.

Q. Are different capital improvement projects competing for the same funds? Say roads vs. sewers?

A. No, road funding and revenue sources can only be used for transportation projects and sewer revenue for sewer system projects.

Q. What's the size of the pot for road funding?

A. There isn't time to respond to that during this meeting, as there is a great deal of material to cover that is directly related to the SSWWE project, but anyone who wishes to discuss it with City staff outside the meeting is welcome to do so.

Q. If a project is on the CIP, does that mean it will be performed?

A. Often they are, but occasionally there are other influences at a higher decision making level that impact whether the project is performed when programmed.

Q. Can funds be "stockpiled" in order to fund larger projects than what is allocated each year?

A. Yes, in fact, the City stockpiled annual revenues to fund the work at the WWTP.

Q. Because FDDs were put on hold for the last two years, were the funds stockpiled?

A. A portion of the FDD program continued, some of the funds went to pay for the studies, and some were diverted to other projects within the same asset.

Q. Will there be a point where studies are no longer included on CIP, but instead used to pay for infrastructure projects?

A. Studies are included on the CIP list, just as construction projects. But yes, the asset teams could determine that they want to stockpile funds for construction. There's a balancing act between building new and funding studies to determine how to solve a particular issue. The three related wet weather studies can be thought of as similar to a master plan, developing a global solution to wet weather problems.

Q. Would the City think about bonding this [recommendations that might come out of the SSWWE project]?

A. Yes, it could happen. For example, the City's current WWTP upgrades ($120M) were 7 or 8 years in the decision-making process.

6. **Wednesday, June 18, SSWWE/FDD will be a combined CAC meeting.**

Location: Malletts Creek Library, 3090 E. Eisenhower Pkwy
Time: 6:30 p.m.

7. Public Comment

(Frank Burdick) When this thing began, we all talked about two main goals. One was to solve SSOs at the plant and the other one was to prevent surcharging with the pipes and backups in the basements. At the meeting last month, Robert concluded that the plant could handle the flow. That the plant could handle the flow was also stated at the public meeting. And Robert came up to us after the meeting and said he thought he deserved a round of applause. He thought that was quite admirable. Now why is it you suppose that all that hoorah didn't get included in the meeting summary? I'll let you think on that question. Why is that not in the summary? At the last meeting we talked about people using less domestic water and that the flow is being reduced by demographics. Gee that sounds familiar. The report that I put together showed that we could save 160,000 gallons per day just with 2700 homes. Where is that in the study? Why aren't we talking about that? Why can't that be in Murat's modeling? I talked to Robert about it originally and he said: "Oh that won't make a difference." It's too miniscule according to Robert. I think it's important for you to see it. The City engineers have failed to properly recognize and acknowledge the frozen pipe and the improper pipe burial depth that I sent you the email about. Their response to that has been totally lacking in engineering logic and common sense and anything having to do with the frost line and constructability and everything else. So we're supposed to now believe the City and all these engineers with all the datas and all the flow charts and all the stuff when we can't even get common sense response to what really has happened with the frozen pipes, burial depths and the toxins involved in the installation of those. Question 18 on the survey indicates that 289 of the 814 respondents still have air gaps. Why is that? Where is the City? Where's the consultants? Where's Greg Marker? Where's the resolution to make sure that we have the supposed air gap solution? On all the houses when 289 of them didn't even respond? $20 to $100 million are needed now to finish this job, er to fix the project. You can spend $2600 for a three bedroom, three bathroom house and you reduce the flow of 160,000 gallons a day. That's all I have.

June 18, 2014
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
SSWWE/FDD Citizens Advisory Committees Meeting
Mallets Creek Library
Wednesday, June 18, 2014 - 6:30 p.m. to 9:00 p.m.

1. **Welcome –** Nick Hutchinson	6:30 p.m. (5 min.)
2. **Desired Outcomes –** Nick Hutchinson ▪ Share results of FDD Survey Mitigation effort ▪ Get CAC feedback on results and on OHM's go forward recommendations	6:35 p.m. (5 min.)
3. **CAC Member Introductions and Desired Outcomes –** All	6:40 p.m. (20 min)
4. **FDD Mitigation – Background, Purpose and Proposed Follow Up –** Nick Hutchinson	7:00 p.m. (10 min)
5. **FDD Mitigation Results** ▪ **Review of Survey Results – Charlie Fleetham** ▪ **Prioritization Process – Charlie Fleetham** ▪ **Mitigation Results – Greg Marker** ▪ **Next Steps - Charlie Fleetham**	7:10 p.m. (90 min)
6. **Plan Agenda for Fall FDD Public Meeting –** Charlie Fleetham	8:40 p.m. (10 min)
7. **Feedback on Meeting – All**	8:50 p.m. (10 min)
8. **Public Comment (three minute limitation per speaker)**	9:00 p.m. (till completed)

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Sanitary Sewer Wet Weather Evaluation Project (SSWWE)
SSWWE/FDD Joint Citizens Advisory Committees Meeting Summary Rev 3.0
Changes highlighted
Malletts Creek Library
Wednesday, June 18, 2014

Citizens Advisory Committee Attendees:

Colin Breed	Judy Hanway	George Johnston (FDD CAC)	Jim Osborn	Beverly Smith
Vince Caruso	Peter Houk	Sonia Manchek (FDD CAC)	Frank Richardson	Mark Wagner

Project Team Members (SSWWE & FDD)

Troy Baughman (Ann Arbor)	Greg DeLiso (Munrovia Pictures)	Nick Hutchinson (Ann Arbor)	Mark TenBroeck (CDM)
Lori Byron (Famous in Your Field)	Charlie Fleetham (Project Innovations)	Greg Marker (OHM Advisors)	Anne Warrow (Ann Arbor)

Public Observers:

Frank Burdick	Jack Eaton (City Council)	Darren McKinnon

1. **Nick Hutchinson, City of Ann Arbor, welcomed members of both CACs and reviewed the desired outcomes for the meeting:**

   - Share results of FDD Survey Mitigation effort.
   - Get CAC feedback on results and on the go forward recommendations.

2. **CAC Member Introductions and Desired Outcomes**

   Members of the SSWWE CAC and FDD CAC introduced themselves and shared their desired outcomes:

   - I want to know why FDDs were originally installed as a one-size fits all solution, rather than having a larger pump if the house was a prolific source of stormwater infiltration? Should the City provide backup pumps for continuity of service? There are questions about how the contractors were selected, and I have heard of issues with landscaping. Even if majority of installations were done correctly, the few that weren't will generate a lot of attention, as they should. Also, I am concerned about redress for issues that people have experienced.

   - Very interested to know if anyone has had continued water or sanitary issues post FDD, and if so, do we know the cause?

- Interested in the decision to not include a backup pump in the original installation.

- Curious about large events with stormwater flows and FDDs - how those interact and whether those were unforeseen, or whether FDDs are overwhelming the stormwater system?

- Wants to hear what Greg Marker has found so far.

3. FDD Mitigation – Background, Purpose and Proposed Follow Up

Nick Hutchinson re-emphasized that the City is committed to addressing the issues that resulted from the FDD survey and follow up investigation. The City invested time/resources for an experienced OHM construction engineer to investigate FDD issues reported on the 2013 Survey.

The post-survey investigation is part of a continuous effort to measure and solicit homeowner experiences and adjust the program. The City knows that not all the issues have been addressed, but the survey investigation follow up and the joint CAC meeting is part of the effort to resolve additional issues and improve the program.

At the close of the presentation, we'll make a recommendation on how to move forward. Ultimately the recommendation of how to deal with these issues falls to the two CACs – retroactively with input from the SSWWE CAC and FDD CAC and potentially going forward based on SSWWE recommendations.

4. FDD Mitigation Results

Charlie Fleetham reviewed the 2013 FDD Survey results. Review the Survey Summary Report.

Charlie reviewed survey statistics:
- 2350 surveys mailed
- 36% response rate
- 99% confidence level
- 3.6% margin of error +/-

Charlie reviewed key findings:
- 70% of respondents were satisfied with their sump pump installation. Note – this finding does not imply that 70% of the respondents are satisfied with having a sump pump in their basement. We assume that many of the respondents focused their response solely on the installation experience. (Request for clarification from Judy Hanway.)
- 45% would recommend a sump pump to a neighbor, twice as many as those who would not.
- 100 of the 134 respondents that reported experiencing sanitary sewer backups PRIOR to FDD/sump pump installation did NOT experience them after FDD/sump pump installation.
- 106 respondents who reported no flooding/seepage/dampness BEFORE FDD said they did experience flooding/seepage/dampness AFTER FDD.

- Almost 40% reported some or significant increase in anxiety – a major factor in the City's commitment to investigate survey issues.

Survey comments were prioritized, with a focus on those who reported water and/or sanitary backup in the basement. Objectives of the follow up investigation include:

1. Document problems.
2. Identify common issues.
3. Develop recommendations.

The FDD investigation process went as follows:

1. Identify FDD houses for follow up.
2. Include issues identified in Feb public meeting.
3. Collect background information from City files, CDM.
4. Conduct investigations.
5. Document results.

150 FDD homes identified for initial investigation, across three categories of issues:
- Water/sanitary issues.
- Installation issues.
- Requested assistance.

After Charlie's review, Greg Marker made a presentation on the results of his investigation efforts.
- Spatial analysis of the issues mentioned in the FDD Survey responses did not reveal any common themes.
- Collected background information on each installation and communication from City, CDM and contractor staff.

Results to date:
- Contacted 101 homeowners.
- Performed 52 site visits.
- Conducted 25 phone interviews.
- 24 homeowners have not responded to phone messages, emails or letters.
- Talked with 77 homeowners who reported water in the basement.
- Found that 18 of 77 did have water in the basement caused by an FDD, which extrapolates to 3-4% of the total FDD installations.

He reviewed reasons for complaints of water of basement that were not caused by FDDs:
- Failed footing drains (interior or exterior).
- External grading directed large amounts of water to house.
- Stormwater leaked through crack in wall, egress window, or window.
- Failed sanitary lead.
- Existing sump had issues unrelated to FDD.

Top five issues found after investigating 52 houses:

- No hole in discharge between check valve and pump (causes pumps to wear out more quickly).
- External grading.
- Landscape repairs.
- Air gap modification.
- Interior restoration (carpet, tiles, paint, etc.).

The following questions were asked by CAC members:

Q: Was there an effort to look at other communities with FDD programs?

A. Yes, Greg has personally acted as the Field Engineer for FDD programs in five communities (Farmington's Chatham Hills Subdivision, Auburn Hills' Bloomfield Orchards Subdivision, Westland, Romulus, Livonia.) Additionally, he researched two others and previously provided a report to the CAC.

Q. Did Chatham subdivision meter every home? And what was the cost? Did Ann Arbor meter homes?

A. In the Chatham Hills subdivision every home was inspected to determine if footing drains were connected to the sanitary sewer system. 75 of the 550 homes were connected to the sanitary. Those 75 homes' footing drains were then disconnected from the sanitary and a sump pump installed. Following the FDDs, all 75 of the homes were metered. The estimated cost to meter a home is about $400 per home, and the metering period should be at least 8-10 months in order to capture multiple significant rain events. The metering results at the individual homes were verified by meters in the system and showed a 3 cfs (or 1346 gpm) reduction in flow to the sanitary system. As for the homes in Ann Arbor's FDD Program, Anne Warrow and Mark TenBroek said that the City metered about 40 homes for about a ten-month period, on a rotating basis resulting in about 150 homes being metered. (Expanded response submitted by Greg Marker in response to following Mark Wagner comments.)

Q. Does the hilliness of a community affect the stormwater flows?

A. Greg believes that soil types have more impact on stormwater flows than elevation. He said that Michigan has the most widely varied soils in the country.

Q. In other communities, have you discovered problems similar to what Ann Arbor has experienced?

A. ~~In Greg's experience, about 1% of homeowners have a problem that he cannot resolve.~~

In Greg's experience, about 1% of homeowners have a problem that he cannot resolve due to a problem like noise or a surface restoration that cannot be resolved to the satisfaction of the owner. (Expanded response contributed by Greg Marker.)

Q. Does Ann Arbor have more problems than other communities?

A. In his experience, yes. He notes that the programs he's been involved in have had a field engineer on site for each installation and every contact between the homeowner and the contractor, which is a significant investment. Ann Arbor's program was larger in scale than the other communities and has been in place for more than a decade.

Q. Is it common for homes to have issues with a sanitary backup after a disconnection?

A. In all the cases Greg has investigated so far, he has not found a sanitary backup caused by an FDD. All have been related to non-City sanitary issues.

Q. Does the City keep a record of homes that were metered?

A. Yes, the City metered about 40 homes for about a ten-month period, on a rotating basis about 150 homes have been metered.

Q. If a home's footing drains are not connected to an external collection system, what are the options?

A. The owner can pipe the stormwater collected in the footing drains to a rain garden, to the yard, a cistern or to the public system (with a right of way permit.)

Q. What is the purpose of the hole in the sump pump discharge line between check valve and pump?

A. It's a 3/16 hole above the water line to drain the line to prevent vapor lock and strain on the pump. The hole is recommended on the manufacturer's instructions.

Q. To prevent mineral buildup, should homeowners be instructed to clean their pumps?

A. Pumps can be disassembled and cleaned, but it's unlikely that homeowners would remove, disassemble and clean their pumps. Instead, there should be a small hole in the discharge line.

Q. Are homes with external grading issues related to FDDs?

A. ~~Not to the installation process in the current FDD program, but if the CAC wishes to consider FDDs in any form going forward, external grading should be part of the program.~~

Not to the installation process in the current FDD program, however external grading issues increase the volume of water to a given sump, increasing the number of cycles, and decreasing the life of the pump. If the CAC wishes to consider FDDs in any form going forward, external grading should be part of the program. (Expanded response contributed by Greg Marker.)

Q. Could a home with grading issues be fitted with a larger pump?

A. That may not solve the problem long term, because even though larger pump pumps faster, the problem of large amounts of water running along the basement walls remains.

Q. What is the purpose of the air gap?

A. ~~If there is an issue in the external discharge or the curb collection system or the stormwater system not letting water out, the footing drain does not have an outlet and the sump pump will continue to run and burn out the pump. The air gap provides this outlet in extreme conditions.~~

If there is an issue in the external discharge or the curb collection system or the stormwater system not letting water out, the footing drain does not have an outlet and the sump pump will continue to run and burn out the pump. The air gap provides an outlet in extreme conditions. Anne and Nick stated the City is putting together a short memo on the purpose of an air gap as it also is present to stop a siphon effect if the storm system surcharges and the check valve fails. (Expanded response contributed by Greg Marker.)

Q. Regarding air gap issues, what are the indications of a problem?

A. If the pump is running frequently 8-24 hours after a rain event, and water is splashing out of the air gap, the FDD installation has a problem.

Q. Say the ~~footing drain lead~~ storm lead (correction submitted by Troy Baughman) fails between the house and the sidewalk; who is responsible, homeowner or City?

A. Homeowner.

Q. Prior to 2000, when people had a footing drain failure and replaced the footing drain, were they required to put a sump pump in?

A. The City will follow up with a response, but Greg commented that in his experience in other communities, if the homeowner pulled a permit for any internal plumbing project, a sump pump would have been required.

Greg reviewed 3 example results from his investigation:

1. Alternate sump location.
2. Internal discharge piping.
3. Water issue unrelated to FDD.

<u>Example #1 – Alternate sump location, sump pump was installed in crawl space.</u>

Q. When was this installed?

A. Greg believes it was 2008.

Q. Did the homeowner report the issues?

A. Yes, according to the homeowner.

Q. Was the alternate location the cause of the problem?

A. ~~Yes, installing it the low point causes only the high end of the footing drains to drain to the sump.~~

Yes, disconnecting the footing drains at the low point and installing it at the high end of the footing drains caused the problem in the basement. (Clarification submitted by Greg Marker.)

Example #2 - Undersize discharge piping from 1.5” to 2”. House had two sumps that went to sanitary, the FDD program upgraded pumps and rerouted with new piping and discharge to the storm.

Q. What is the GPM of these sump pumps?

A. A half-horsepower pump will pump 60 GPM.

Q. What is a Fernco?

A. It’s the fitting that holds the check valve in place.

Q. Was new piping put on for this FDD installation?

A. Yes.

Q. Define *head loss.*

A. It’s the amount of pressure that water or the pumping system exerts on the system. Every 2.31’ of water = 1lb of pressure.

Q. Is the head is determined by the head of the sump?

A. The head is increased by each bend because each bend increases the friction.

Example #3 – Not related to FDD – sanitary pipe broken under basement floor

Homeowner complained that landscaping was not repaired and reported a sanitary backup after the FDD installation. Greg’s investigation found that the problem causing the sanitary backup was under the floor of the home and not related to the FDD installation.

FDD Survey Investigation Next Steps:

- Recommendation to create small FDD/SSWWE sub-committee to complete root cause analysis and develop alternative solutions.
- Present recommendations at the Fall 2014 Public Meeting.

Volunteers for FDD/SSWWE subcommittee: Jim, George, Colin, Peter, Vince, and Judy. Meetings will be in the evening at City Hall and Charlie will schedule/facilitate.

Q. Are these homeowner situations too different or are there common themes that can be addressed?

A. Every home is unique. The challenge has been to find the common themes in this set of unique circumstances. (Correction from Judy Hanway) ~~Yes, there are some common themes. Greg wants to make sure that we do the full analysis of what went wrong to find~~

Q. It seems like the better use of our time would be to address issues with those who've had FDD installations.

A. Agreed, the major focus of the group would be devoted to resolving problems.

Q. When will the SSWWE CAC look forward?

A. Looking forward is the focus of the SSWWE project, evaluating the sanitary sewer conditions and function and recommending the solutions for the wet weather issues.

Q. SSWWE members have seen the risk analysis. What is your opinion of that?

A. One SSWWE CAC member says that he is reserving judgment until the entire picture is presented. Another says that the data is clear from the flow analysis that the FDD project removed significant flows in the five study neighborhoods; however, there are still a few areas across the City that show problems. Analysis is still being done to uncover the issues. A couple of members comment that they feel the high ground water in Lawton/Churchill neighborhood contributes to the surface water issues.

A FDD CAC member comments that he is impressed to the results of the risk analysis and that there's been a vast improvement in the reduction of the risk. He is looking forward to see the final report.

5. **Next CAC meeting July 9, to be held in Council Chambers.**

6. **Public Comment:**

(Frank Burdick) "I'm Frank Burdick. Before I give my comments, I want to read something. You talked about significance, the twelve most significant. You have 33 pages of comments that you didn't show in the survey. Let me just read a beginning and end line: 'I begged not to have to do this and I feel that my personal rights were violated because I was forced into it. I hate what the City has done to my house and to my life.' You have 33 pages of examples that you didn't put in your survey. You put in your pie charts, pie charts are great for pie charts but even if you have a pie chart that shows 20% failure, it's a failed program. I'm sure there were 20% of Corvairs that failed too, we don't have Corvairs around either. The survey that Charlie keeps touting as something that the SSWWE came up with. It's something that was in OHM's contract. Page 25 of their contract clearly reads evaluate effectiveness of current footing drain disconnect program. Develop online survey to collect the latest information on basement backups and overall system performance and Geocode results. It's all in the contract. Charlie got paid a change order so he could do the survey when OHM got paid to do it twice. Joe Conen, and I and Bill Higgins developed a program or a design to be able to pretest a home before they put an FDD in. It got summarily disregarded. Not looked at, just ignored. I could go on but I'm not going to waste your time."

July 9, 2014
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
SSWWE Citizens Advisory Committees Meeting Agenda – Rev 2.0
City Council Chambers
Wednesday, July 9, 2014 - 6:30 p.m. to 9:00 p.m.

1. **Welcome –** Nick Hutchinson	6:30 p.m. (5 min.)
2. **Desired Outcomes –** Nick Hutchinson ▪ Review of Scenario B model results ▪ Presentation/review of potential alternatives and associated costs ▪ Increase understanding TOAG's role and activities	6:35 p.m. (5 min.)
3. **Review of Project Timing and Progress –** Robert Czachorski	6:40 p.m. (10 min)
4. **TOAG Presentation -** Dick Hinshon	6:50 p.m. (40 min)
5. **Scenario B Modeling Results -** Murat Ulasir ▪ Review of May 14 CAC Meeting results ▪ Review of progress since May 14	7:30 p.m. (30 min)
6. **Review of Potential Alternatives and Costs –** Robert Czachorski/Murat Ulasir	7:40 p.m. (80 min)
7. **Brainstorm Agenda for Aug 13 CAC Meeting -** All	8:50 p.m. (10 min)
8. **Public Comment (three minute limitation per speaker)**	9:00 p.m. (till completed)

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Sanitary Sewer Wet Weather Evaluation Project (SSWWE)
Wednesday, July 9, 2014 - Citizens Advisory Committee Meeting Summary
City Council Chambers

Citizens Advisory Committee Attendees:

▪ Colin Breed	▪ Joe Conen	▪ Peter Houk	▪ Jim Osborn	▪ Beverly Smith
▪ Vince Caruso	▪ Judy Hanway	▪ Pat Marten	▪ Frank Pelosi	▪ Mark Wagner

Project Team Members/Consultants:

▪ Troy Baughman (Ann Arbor)	▪ Greg DeLiso (Munrovia Pictures)	▪ Greg Marker (OHM Advisors)
▪ Lori Byron (Famous in Your Field)	▪ Charlie Fleetham (Project Innovations)	▪ Cresson Slotten (Ann Arbor)
▪ Robert Czachorski (OHM Advisors)	▪ Nick Hutchinson (Ann Arbor)	▪ Murat Ulasir (OHM Advisors)
▪ Dick Hinshon (Hinshon Environmental)	▪	▪

Public Observers:

▪ Frank Burdick	▪ Ethel Potts

1. **Nick Hutchinson, City of Ann Arbor, welcomed the participants and reviewed the desired outcomes for the meeting:**

   - Presentation from Dick Hinshon on the role of the Technical Oversight Advisory Group (TOAG).
   - Review of Scenario B model results.
   - Presentation of team assessment of risk.

2. **Robert Czachorski, OHM Advisors, reviewed project timing and progress:**

   Click here to view the project timeline on the SSWWE Project Website.

   - FDD Survey Mitigation Results Public meeting has been scheduled for September 3, 2014.
   - SSWWE August meeting will focus on the impacts of the Stormwater Calibration Project.
   - September meeting will focus on community values and will discuss additional recommendations.
   - October meeting will focus on draft conclusions and TOAG report.
   - November meeting will finalize recommendations.
   - Charlie noted that the FDD Mitigation Subcommittee will receive a packet of materials to study for the 7/14/14 meeting.

   Q. Will all the recommendations be posted on Basecamp for the public to review?

   A. Yes, all the recommendations and presentation documents are posted on the project website.

3. **Dick Hinshon, TOAG facilitator, presented TOAG (Technical Overarching Group) makeup and purpose:** Charlie front ended the presentation by asking the CAC members to identify questions for Dick. These included:

    1. When will the decisions be made?
    2. Do we have to wait for all the studies to be complete before a decision is made?
    3. How do the studies influence on another?
    4. How will FDDs impact stormwater flooding?
    5. How will climate change be incorporated into the project?
    6. OHM modeling in Glendale neighborhood does not show backups, but house-to-house survey shows a 5-block area where 50% have reported experiencing flooding or sanitary backups. How will those be reconciled?
    7. Would like to see the TOAG explain how the three wet weather projects are integrated.

Presentation Highlights:
The TOAG is a new concept for the City, formed because of the confluence of three wet weather projects: Upper Mallets, SSWWE, and the Storm Modeling projects. The TOAG is a panel of volunteers, experts in their field, chaired by Dick Hinshon, an environmental consultant, who is the only TOAG member who is compensated. Dick works on the policy, finance, regulatory and public engagement aspect of engineering. TOAG interfaces with the City's technical workgroup staff. Its purpose is to advise and provide technical expertise to City on the three wet weather projects. The group does not have a political or project agenda or a vested interest and is not afraid to tackle controversial subjects. It does not make decisions about the three projects (response to Q1/Q2 above). Its tasks include:

- Ensure consistency in project approaches;
- Identify overlapping issues affecting multiple projects;
- Independently assess work products;
- Examine project assumptions;
- Identify gaps, conflicts, deficiencies;
- Provide feedback from a community perspective (these bullets respond to Q3/Q7 above)

TOAG Roster:
- Dick Hinshon, TOAG chair, Hinshon Environmental Consulting
- Dan Brown, Great Lakes Integrated Sciences + Assessments, climate change expert
- Jonathan Bulkley, University of Michigan retired Professor
- Aline Cotel, University of Michigan Dept. of Civil and Environmental Engineering
- Scott Dierks, Senior Engineer, Cardno JFNew
- Arnie Geldermans, Midwestern Consulting
- Alicia Ritzenthaler, University of Michigan Cooperative Institute for Limnology and Ecosystem Research
- Laura Rubin, Huron River Watershed Council
- Don Tilton, Environmental Consulting & Technology, wetlands expert

- Scott Wade, Limnotech, GIS expert
- Jennifer Wolf, public information & education expert

TOAG IS:
- Independent body with technical knowledge and expertise.
- Obtains and reviews information and data generated by the projects.
- Identifies issues and concerns.
- Suggests consideration of subjects that warrant attention or study.
- Interacts with City staff who manage the project.

TOAG ISN'T:
- A manager of the 3 wet weather projects.
- A forum for citizen complaints or objections.
- Involved in the political process or interfacing directly with elected officials.
- Making decisions to approve or reject proposed capital improvement studies.

TOAG Activities in First Eight Months:
- Reviewed/commented on Upper Malletts Creek Draft Report.
- Reviewed/commented on SSWWE flow monitoring.
- Reviewed/commented on Stormwater Model Calibration.
- Reviewed/commented on "Design Storm" and methodology for assessing Climate Change impacts.
- Reviewed/commented on City's CIP program.
- Reviewed City's current Public Education/Outreach activities.

Q. Do TOAG member have veto powers?

A. No, they are an advisory body.

Q. Are the TOAG findings posted for the public?

A. Yes, the TOAG reviews and recommendations are shared with the project managers, who then post them on the project websites. (This applies to the City's projects; Dick does not know if the Washtenaw Drain office posted TOAG comments on Malletts Creek.)

Q. How often does the TOAG post its Basecamp content to the public?

A. It does not. The TOAG shares its findings with the project managers, who may do with it as they wish.

Q. Does the TOAG have a consensus on climate change?

A. The TOAG asked its climate change expert, Dan Brown, for comments on climate change and Dick shared highlights from a Dan Brown memo on the SSWWE project's appropriate consideration of climate change.

Q. The model used in SSWWE project uses a 10% increase for climate change; does the TOAG feel that is appropriate?

A. The TOAG agrees that the range used is appropriate; however, the level of service design storm has not yet been evaluated. It will be reviewed and evaluated later in the project. Whether or not the Stormwater Calibration Model project incorporates climate change is likely an overarching issue that the TOAG will address (responds to Q5 on previous page).

Q. What about coordination between the Stormwater Calibration Project and the SSWWE project? If the stormwater system does not work properly, then more water collects around the house, and is collected by the footing drains and then enters the system. If the stormwater system were tackled, it might take care of sanitary sewer issues.

A. The TOAG has looked at the impact of the disconnected footing drains and their impact on the storm system as part of the Stormwater Modeling Calibration project, and found that amount of stormwater contributed by footing drains is a relatively small percentage of the overall flows in the stormwater system. (responds to Q4 on previous page). However the TOAG has not looked at the impact of connected footing drains on the sanitary sewer system, or whether flooding from an overwhelmed stormwater system is overburdening the sanitary. Troy Baughman will ask CDM to respond to that question during next month's meeting. Regarding flooding in the Glendale district, we would expect the SSWWE team to address this issue (responds to Q6 on previous page).

4. Scenario B Modeling Results – Murat Ulasir & Robert Czachorski:

Click to view the presentation online.
Robert recapped the high level results of hydraulic capacity assessment:
- Most of the upstream neighborhoods, including the five study areas, show no problems. The problems that exist now are interceptor problems.
- Potential risks in six areas.
- These problems are of a smaller scale than many cities are experiencing.
- Two of the problem areas, A & D, may be numerical issues because the meters were located downstream of the flow. More metering may determine whether there are real issues.
- Areas B & C, model shows that there is ample capacity in the pipe; however, there have been backups in the area, so the problem may be a blockage, or a structure (manhole, for example) that's not operating properly.
- In Glen Leven, Area E, the problem is a couple hundred feet of pipe. There may be another source of stormwater entering the system there.
- Area F may be resolved with an operational change.

Reviewed CAC decision points:
1. Recommendations regarding problem area solutions.
2. City-wide items:
    a. Consensus achieved on no more mandatory FDDs.
    b. Continue DOM for growth? If yes, what changes?
3. Weigh in on recommendation of FDD mitigation work group.
4. CAC executive summary report.

CAC members shared their current opinions on whether a consensus existed in the CAC for recommending mandatory FDDs in the future:

- Doesn't agree that there is a consensus on no mandatory FDDs. Wants to know the facts before making a decision.
- I don't have a lot of confidence in the model because it doesn't show any problems, when I know from surveys that there are many problems.
- Believes that most of the CAC agreed that the FDD program should not continue in its present form.
- Wonders if CAC is imposing basement flooding on other neighborhoods by not using mandatory FDDs.
- Agrees that CAC cannot leave a homeowner with the risk of basement backup; however, does not believe that a mandatory program will be needed. 20,000 footing drains are still connected, disconnecting all would be prohibitively expensive. A voluntary robust incentivized FDD program may offer a margin of error for sewer capacity.
- Based on what survey respondents shared about their terrible problems, I don't believe that we can recommend a mandatory FDD program.
- We're also dancing around a major issue: do we go back and reconnect all these footing drains?
- Robert said the OHM engineering team believes it is unlikely that additional mandatory FDDs would be needed in the five target areas.
- Robert suggested revised language regarding FDD consensus: if any future mandatory FDD program is recommended in any part of the City, the recommendation will include significant modifications from the current program. A majority of the CAC seemed to agree with this suggestion.

Murat then recapped June's presentation of preliminary hydraulic analysis:

- Hydraulic analysis of Scenario A and Scenario B.
- Scenario A - base flow, 25 year wet weather impact, plus growth.
- Scenario B - base flow, 25 year wet weather impact, plus growth, plus an additional 10% flow. Additional 10% could represent growth within the City, climate change or an increase in level of service protection.

Murat showed a map of reported flooding and basement backups since 2000. Note: Only after 2013 were sanitary backups reported separately from stormwater flooding. Comments included:

- The map doesn't reflect backups and flooding in Glendale, because neighbors are reluctant to report issues through lack of awareness that the City could do anything about it and fear of lowering home's resale value.
- I have experienced flooding and sewer backups and did not report to the City.
- Don't rely on a transport and treat option because the City's treatment plant likely cannot be expanded.

Murat cautioned that the preliminary evaluation of alternatives in the six problems areas include capital costs only (not lifecycle costs) and are based on generic unit costs for traditional alternatives:

- Storage: $5 per gallon
- Transport/treat: $500 / foot
- Source removal: $12,000 / FDD

Under Scenario B, modeling shows red pipes in six areas and description of the below areas follow:

A: Huron/West Park
B: High Level – First Street
C: High Level – State & Hoover
D: Pittsfield Valley
E: Glen Leven
F: Diversion

Project area A – Huron West Park

- Area impacted 252 acres
- Probability of surcharge each year: ~50%
- Traditional options:

Options	Size	Capital Cost
Transport and treat	9,403 ft	$4.7 mil
Storage	0.5 MG	$2.5 mil
Source removal	1,892 footing drains	$22.7 mil

OHM suggested alternative:
- Targeted, temporary flow metering
- Re-distribution of metered flow
- Re-analysis of this area

Project area B – High Level/First Street

- Area impacted 49 acres
- Probability of surcharge each year: ~100%
- Pipe is buried 15 feet deep, and the pipe is backing up 5ft. It could impact basements, but it depends on the home and its elevation. Project team had a depth sensor and saw an anomaly of one area throttling the flow and causing a backup.
- Traditional options:

Options	Size	Capital Cost
Transport and treat	6,972 ft	$3.5 mil
Storage	9.8 MG	$49 mil
Source removal	8,211 footing drains	$98.5 mil

OHM suggested alternative:
- Targeted field reconnaissance
- Potential re-design of manhole structures
- Re-analysis of this area

Project area C – High Level/State & Hoover

- Area impacted: 130 acres
- Probability of surcharge each year: ~100%
- Traditional options:

Options	Size	Capital Cost
Transport and treat	3,759 ft	$1.9 mil
Storage	1.2 MG	$6 mil
Source removal	4,195 footing drains	$50.3 mil

OHM suggested alternative:
- Targeted field reconnaissance
- Potential re-design of manhole structures
- Re-analysis of this area

Project area D – Pittsfield Valley

- Area impacted: 148 ac
- Probability of surcharge each year: ~100%
- Traditional options:

Options	Size	Capital Cost
Transport and treat	5,956 ft	$3 mil
Storage	1.6 MG	$8 mil
Source removal	3,054 footing drains	$36.6 mil

OHM suggested alternative:
- Targeted field reconnaissance
- Targeted temporary flow metering
- Re-analysis of this area

Project area E – Glen Leven

- Area impacted: 26 acres
- Probability of surcharge each year: ~25%
- Traditional options:

Options	Size	Capital Cost
Transport and treat	1,848 ft	$0.9 mil
Storage	0.02 MG	$0.1 mil
Source removal	146 footing drains	$1.7 mil

OHM suggested alternative:

- Targeted field reconnaissance
- Targeted temporary flow metering
- Re-analysis of this area

Project area F – Diversion

Area F may be resolved with an operational change, to reconfigure the connection to redirect flow from the southern interceptor into the northern interceptor, which has capacity. The City has started metering flows to evaluate this change.

Scenario C

Murat briefly reviewed an additional scenario (Scenario C) devised by OHM that would add a higher level of service. Scenario C accounts for two of three items that increase flow: growth, climate change or 50-year protection, and adds an additional 10% flow. Moving from Scenario B to Scenario C increases capital improvement expenditures by about 20% for each Project area.

Questions and answers during the presentation:

Q. What would happen if Scio Township wanted to send more flow? Would Scio or Ann Arbor have to pay to build a bigger pipe?

A. The model already assumes all the townships are at their contract capacity; however, in the event of a renegotiated contract, Scio would typically pay to upgrade infrastructure.

Q. When you list a cost for storage, what kind of storage is it? A tank, a large pipe?

A. The estimates were based on the total volume to be stored, not a particular type. They are intended to provide reference points only.

Q. When you monitor, do you monitor only flow or also depths in manholes?

A. Both.

Q. What does it mean to re-distribute metered flow in an area?

A. In Area A, for example, the metering shows that there's a significant flow coming from the area; however, it's unknown whether it originates from the north or the south. Additional meters located in upstream in the problem areas are needed to determine where the flows originate.

Q. Where will the additional funding for the reconnaissance and targeted metering come from?

A. From the sanitary sewer fund that is designated for repair and upgrades.

Q. In looking at the analysis for Area B, it looks like there's something significant blocking and backing up the flow.

A. Yes, we have depth sensors that prove that the flow reached a certain height in the pipes; however, according to the model, it should not have. Rather than spending millions of dollars to build a storage tank, the problem might be solved by reconstructing a couple of manholes. The same is true of Area C.

Q. How would anecdotal flooding data be entered into the model?

A. The best data to collect for a particular area that's having issues, like Glendale, would be to put depth sensors in the sanitary pipe. Troy Baughman believes the City does still have some peak flow recorders in place.

Q. A member of the public has requested to be notified via email of these meetings. Isn't this happening?

A. The project team hasn't been provided a list of people to contact. The City posts the meetings on the project website and on the City's calendar. The project team will send email announcements if the City wishes.

Comments:

- We want to consider the cost impacts of allowing for a 20% size increase.
- Globally I think it's good, but it really needs to be strongly tested with overflows. The model is only as good as the data. When the model doesn't match the observed conditions, you need to dig deeper.
- Will be interested in the TOAG's review of the modeling results.
- I think we're doing our public duty by not recommending multimillion expenditures when we don't know yet if they are warranted.
- Would like to see the treatment plant capacity aligned with each project. Was surprised that the cost of FDDs was so much higher than other options.
- I'm glad the City is doing the modeling; I think it's a good thing. I'd like to know the cost of permanent gages. Very inexpensive, from what I understand. We'd have the data continuously flowing into City Hall, updating the models. Other cities are doing it.
- I'm frustrated that we've gone through all this information quickly and we haven't had the opportunity to discuss it.
- Regarding whether or not CAC members trust the model: If it's happening in a neighborhood like Glendale, it's probably happening in other neighborhoods. There is possibly a lack of data.
- Regarding whether or not the CAC wants to hear the presentation again:
    - The Stormwater Calibration project is encouraging citizens to provide anecdotal data on stormwater flooding. Perhaps that would help.
    - If the problem areas all require more data collection and that's it; then no, we don't need to continue to review the modeling results.
    - The end result of all this study is good thing. It shows that the pipes across the City, with the exception those six areas, are good.

5. Public Comment

(Frank Burdick) This podium is very familiar to me as I have stood here and addressed City Council multiple times concerning the flawed FDD and DOM Programs and the lack of City sanctioning of this focus group. Tonight you debated the mandatory program without considering the legal ramifications. This focus group continues to bury your heads in the sand regarding the legal issues. You should be aware that the City Attorney has used your work product and your names in the legal proceedings in federal court and district court. Your work is being used to support the City's case. You should also be aware that the data, the flow rates, and the partial survey results are being used in the City's pleadings, prior to your final acceptance of this same data. The City Attorney has submitted only the few pro-FDD survey responses and none of the 32 pages of the anti- FDD comments in their pleadings. Tonight you discussed plant capacity as a concern, well two months ago OHM and the City said that the plant can handle the flow. So what is the truth on the capacity, now or 10 years from now? Pipes are good now you say but they're all balanced on the backs of the citizens who have been forced into the program. Where is the equity in that? Tonight you talked about alternatives but you failed to mention the half dozen or so non-FDD suggestions that I have included in this cut to the chase memo. I was glad to hear Robert borrow the phrase. They've all been summarily ignored as you continue to ignore me now. I wish you luck in your efforts as I will continue to address City Council, the ultimate decision makers . . . other than the courts that will soon have their say. Thanks.

(Ethel Potts) My name is Ethel Potts. When I moved to the west side of town some years ago the first new word I learned was surcharge, because I ran into that immediately. The second new word I learned was metering, gages. And I belong to the Allens Creek Water Shed group which was forming about that time and we wanted data. We wanted some baseline data so we could tell if things were getting better or worse. If there is baseline data, please get it for us. We still don't have it. That was about 35 years ago. If the City had been collecting data when we first asked for it, we'd have about 25 years of data by now. So if there is any, please get if for us and please let us have it, so as more data gets collected we would know where we are. At present, we don't know. We just have anecdotal evidence of what goes on in the West Side. Thank you.

August 13, 2014
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
SSWWE Citizens Advisory Committees Meeting Agenda
City Council Chambers
Wednesday, August 13, 2014 - 6:30 p.m. to 9:00 p.m.

1. **Welcome –** Nick Hutchinson	6:30 p.m. (5 min.)
2. **Desired Outcomes –** Nick Hutchinson ▪ Review of Current Status of Storm Study ▪ Begin decision making process re. OHM recommendations ▪ Prep for Sept 17th FDD Public Meeting	6:35 p.m. (5 min.)
3. **Review of Project Timing and Progress –** Robert Czachorski	6:40 p.m. (10 min)
4. **Storm Study Presentation -** Troy Baughman	6:50 p.m. (40 min)
5. **Executive Summary Outlines** - Robert Czachorski/Charlie Fleetham a. OHM SSWWE Study b. FDD Survey/Mitigation/Recommendations	7:30 p.m. (20 min)
6. **Review of Project Cut Sheets –** Robert Czachorski	7:50 p.m. (40 min)
7. **Review of Glendale Flooding Issue –** Troy Baughman	8:30 p.m. (20 min)
8. **Prep for Upcoming Meetings –** 9/10 SSWWE Meeting on Community Values, 9/17 FDD Public Meeting	8:50 p.m. (10 min)
9. **Public Comment:** (three minute limitation per speaker)	9:00 p.m. (till completed)

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
SSWWE Citizens Advisory Committee Meeting Summary
City Council Chambers
Wednesday, August 13, 2014 - 6:30 p.m.

Citizens Advisory Committee Attendees:

▪ Colin Breed	▪ Peter Houk	▪ Jim Osborn	▪ Beverly Smith
▪ Judy Hanway	▪ Darren McKinnon	▪ Frank Richardson	

Project Team Members/Consultants:

▪ Troy Baughman (Ann Arbor)	▪ Greg DeLiso (Munrovia Pictures)	▪ Nick Hutchinson (Ann Arbor)	▪ Cresson Slotten (Ann Arbor)
▪ Robert Czachorski (OHM Advisors)	▪ Charlie Fleetham (Project Innovations)		

Public Observers: Frank Burdick, Jack Eaton, Ethel Potts

1. Nick Hutchinson, City of Ann Arbor

Nick asked for a moment of silence in honor of former CAC member, Mark Wagner, who passed away suddenly on July 19, 2014. Mark will be missed.

Nick then welcomed new CAC member Darren McKinnon, Ann Arbor resident, employed by First Martin Corporation.

Q. A CAC member commented that the DOM seemed to be a better program because the voluntary nature requires negotiation with homeowners, and asked about the extent of the negotiations, and inspections from the developer's side.

A. Mr. McKinnon shared that he was one of the first DOM volunteers, undergoing the disconnection and sump pump installation to mitigate dampness in his basement. As for the DOM program, he felt that because the program has been in place for ten plus years, the low-hanging fruit (homeowners who want an FDD and sump pump) had been harvested, making it challenging to find homeowners with connected footing drains who wished to disconnect. Expressed concern that if the plaintiffs were to prevail in their FDD lawsuit filed against the City, developers, who do not have municipal immunity, could incur significant long-term risk for any flooding that occurs after a DOM FDD. He personally had not negotiated with homeowners for the DOM program, but understands that typically the contractors take care of negotiations for the developers.

2. Nick reviewed the desired outcomes for the meeting:

- Review of Current Status of Storm Study
- Begin decision-making process regarding OHM's recommendations
- Prep for Sept. 17 FDD Public Meeting

3. Robert reviewed the project timing and progress:

- View the project timeline on SSWWE Project Website.
- Note that the FDD Public Meeting will be held Sept. 17.

4. Overview of the Stormwater Calibration Project – Troy Baughman

The Stormwater Calibration Project Presentation is posted on the SSWWE project's Library page.

- 2006-2009 project, First Phase
    - Stormwater GIS and base model
    - Flow monitoring
- 2012-2015 project, Second Phase
    - Public engagement
    - Preliminary model calibration
    - 2013 data collection
        - Flow and rainfall monitoring
        - LEDG program
    - Final calibration
    - Model analysis
- Uses InfoSWMM 2D model
- FDD Flow evaluation
    - Used 4 gpm peak flow per FDD
    - Stormwater system pipe design capacities
    - March 15, 2012 peak flow rates
    - Modeled two scenarios: no FDDs and 100% FDD
- Maps visually illustrating the FDD Flow impact on stormwater system are on the project website.
    - For majority of the pipes, FDD flows contribute less than 2% of peak flows
    - Less than 2% of pipe capacity
- Next steps in Stormwater Calibration Project
    - Design storm simulations
    - Level of service analysis
    - Future conditions analysis
    - Stormwater management impacts (City's Green Streets policy, etc.)
    - FEMA flood map verification

- Recommend improvements to the City's stormwater system

Questions and comments during the Stormwater Calibration project overview:

Q. What about homes where the footing drains outlet to the yard? How do those impact the model results?

A. The model result is more conservative (worst case scenario), because modelers assumed that each FDD home contributed 4gpm to the stormwater system. In reality, some of the stormwater being outlet to yards would infiltrate the ground before reaching the stormwater system.

Q. The model is based on 4gpm. The ACO report uses 10 gpm. What would happen if your model used 10 gpm?

A. We don't know the impacts of a 10 gpm flow, but we do know that from the flow monitoring and direct sump pump measurements that some homes contribute less than 4 gpm, others contribute more. Because of these measurements, the City and the technical consultants are comfortable using the 4gpm figure.

Q. Do the modeling results validate the estimates that were made of the flows from footing drains when the program began?

A. Yes, in footing drain disconnection programs across the country, a flow of 3 to 5 gpm from each home is standard and our analysis supports similar findings.

Q. There are homes where, during the March 2012 storm, the curb drains were full and the sump pumps could not pump the FDD flows into them.

A. Yes, that is why the air gap is important. The purpose of the air gap is to provide an outlet for the footing drain flows, in the event that the curb drain is blocked or full.

Q. If the neighborhoods that have flooding problems and connected footing drains had better drainage, would that eliminate some of the sanitary sewer capacity issues? It seems that there's a gap between the two studies [SSWWE and Stormwater Calibration.]

A. As part of the Stormwater Calibration project, the team will closely review the sanitary model and the surface water (stormwater) model, looking for any areas that may be both surcharging the sanitary and overland flooding. If any of those areas exist, they would be prioritized in the plan to improve the stormwater system.

Q. What about FDD homes that are high producers of storm water flows, where those flows can't enter the stormwater system because it's overwhelmed. Those high producing homes may have graded their property and done everything possible to mitigate stormwater impacts but can still potentially cause sanitary backups in homes downstream, requiring FDDs in other homes. However, if the stormwater system were able to handle the larger rain events, the FDDs would not be required. Isn't the City failing its responsibility to ensure that the stormwater system has adequate capacity?

A. There's an important difference in level of service results between the sanitary sewer system and the stormwater system that may not be widely understood. In general, the level of service for the sanitary sewer system is expected to be higher (greater capacity, less frequent surcharging) because of the health, safety and regulatory issues related to sewage. It's different for the stormwater system; a community cannot economically or physically build a stormwater system that absorbs every drop of water from every inch of the City and prevents it from settling into homeowners' yards or the street. The capacity of a street to temporarily hold rain water is factored into the level of service for storm systems. When people complain about water in the streets, they don't realize that the streets function as a temporary storage device. Much of the stormwater system was designed to handle a storm of a size that recurs about once every five years, while some of the newer sections were designed to handle larger storms that have a 10% chance of occurring each year.

Q. The Malletts Creek Study developed several recommendations to address flooding in certain neighborhoods, like Lansdowne. If those projects were constructed, it could solve some of the stormwater issues in those areas.

A. Yes, the Malletts Creek Study developed its project recommendations based on the March 15, 2012 storm, an event that has a 10% chance of occurring every ten rains. That's a level of service that the stormwater system was not designed to meet, because of the relative infrequency of those storms, combined with the large capital costs. The Stormwater Calibration project includes modeling several different storms, to develop a standard for the stormwater system that meets community values for both level of service and economics.

Q. Will development in outlying townships (like Scio Township) that will increase impervious surfaces, increase flooding in Ann Arbor?

A. Developments throughout Washtenaw County must follow the County's stormwater management mandates, which require developers to use stormwater management best practices so as to not negatively impact the stormwater flows in the area.

Conclusion: We can conclude from this model and analysis that the FDD flows are NOT overwhelming the stormwater system; it's actually contributing very little flow.

5. Glendale Neighborhood Sanitary Sewer System – Troy Baughman

Background: The sanitary sewer model does not show capacity issues in the Glendale neighborhood; however, a CAC member shared an informal survey showing that about 17% of homeowners in a five block area experienced sanitary sewer backups. He's concerned that proposed development in that area could increase problems.

Troy noted that the system in this area is aging and displayed a map (slide 17 of the Stormwater Calibration Presentation) that showed the City's sanitary sewer system maintenance and improvements in the Glendale neighborhood over the last 12 years. Routine televising found collapsed sanitary pipes, which were then repaired and lined. Several other sanitary sewer segments in the neighborhood are programmed for lining.

The sanitary sewer model also serves as a troubleshooting tool. In cases where the model shows adequate capacity and yet backups are reported, it's typically a problem that can be solved through maintenance, such as jetting and rodding pipes or lining pipes.

When a resident reports a backup, a number of questions are asked that help to determine the best approach to mitigate any future problems. Questions asked include the date of the backup, whether it was raining, whether neighbors also had backups. City staff then investigates the pipes in the area of the reported backup, checking manholes and when warranted, televising pipes. Without knowing those specifics from the Glendale survey, it's challenging to determine what could be causing problems until field crews have performed investigations.

The Glendale neighborhood is at the top of the sewer shed and during the June 27, 2013 storm, the City did not receive any reports of basement backups in this area.

Troy believes that this area does have some connected footing drains. Pipe televising shows a number of tree root intrusions, which could also be impacting homeowners who may have tree roots blocking their sanitary leads.

Fleetham commented that Ann Arbor has separate sanitary sewer and stormwater systems, unlike many other metro Detroit area cities, like Hamtramck, Royal Oak, Oak Park, Ferndale, which have combined systems and experience basement backups every year. These communities were particularly impacted by the August 11, 2014 storm, which caused thousands of basement backups.

6. **Introduction of Executive Summary outlines and project cut sheets -** Robert Czachorski/Charlie Fleetham

Robert suggested that the CAC review the format, structure and high-level content of the Executive Summary outline. Subsequent meetings will focus on the content of the Executive Summary, particularly the recommendations.

The summary is divided into two parts:

- Section A: OHM SSWWE Study
- Section B: FDD Survey/Mitigation/Recommendations

Robert walked through the major headings of the Executive Summary, Section A, SSWWE Study:

- Major Findings
  - 2013 flow metering results.
  - FDD program removed about 65% of wet weather peak flow in the target districts.
  - FDD greatly reduced the risk of basement backups in the target districts and additional FDDs in the target areas are not needed to achieve the desired level of protection. OHM is not recommending any further FDDs in the target areas.
  - Six potential hydraulic deficiencies were identified in the downstream collector interceptors, less than what City staff expected based on past work.

- The Wastewater Treatment Plant has adequate capacity to handle peak flows, and when plant renovations are complete, will have capacity to handle expected future flows.
- Project team conducted a survey of residents with FDDs, which led to follow up inspections and a plan to address issues with those found to be out of compliance with project specifications.

- Action Plans for the Six Project Areas (cut sheets)
  - Project A - Huron/West Park
  - Project B - High Level/1st Street
  - Project C - High Level/State & Hoover
  - Project D - Pittsfield Valley
  - Project E - Glen Leven
  - Project F - Diversion
- CAC Comments on the Action Plan
- Potential CAC Recommendations
- Other Potential Considerations

Questions and comments:

- High Level refers to the name of the sewer trunkline in projects B and C (1st Street and State & Hoover.) Coincidentally, these are also areas which show high levels of flows in the model.
- The pipe that runs north of Washington Street and Huron also runs under the Atrium office building. City may want to look for possible anomalies there.
- Projects B & C are not the same area; they are several miles apart.
- Project D (Pittsfield Valley) requires metering to narrow the problem; could be excessive footing drain flows causing red pipes in the model and the basement backups reported.
- Project E (Glen Leven) likely does have surcharging; however, the depth may not back up into basements. Will recommend that the City interview/survey residents in the area.
- Project F (Diversion) is an area where one sewer section has ample capacity and the other does not. The top was cut off the pipe to allow the full pipe to flow into the pipe with capacity. Team recommends analyzing the effectiveness of the diversion. CAC member comments that there's sometimes odor in the Fuller & Glen area during rain events.
- Potential CAC recommendations could include continuing with developer offset mitigation to reserve capacity for future needs. In Project Area D, if it were determined that footing drains were contributing to the excess peak flows, would the CAC wish to recommend footing drain disconnections, either on a voluntary or a mandatory basis? And if so, with any program changes?
- Other potential CAC recommendations could include best management practices that have been proposed, as well as innovative storm/sewer concepts in development with University of Michigan.

7. **Charlie walked through the major areas of the Executive Summary, Section B, FDD Survey/Issues Resolution:**
   - FDD Survey Stats (see project website for full presentation)
   - FDD Survey Follow-Up Results
   - City Staff Proposal to Address FDD Investigation Findings

- Develop and implement process to address FDD investigations not done according to specification.
- Develop an outreach/education program for sump pump maintenance and operation.
- If FDD installations are recommended going forward, design process improvements to reduce installation errors and increase citizen awareness of O & M.

- Potential FDD Mitigation Subcommittee Recommendations for CAC Consideration such as back up systems, compensation for tangible/intangible expenses, and special claims process for FDD residents. Each of the items proposed will have a description, cost estimate, and status. FDD Mitigation Subcommittee will review and revise these sheets at August 25, 2014 meetings.

Comments on FDD Survey Follow-Up Recommendations:

- Wants to pursue the rate reduction proposal for those who've had an FDD to know the amounts and feasibility.
- Not sure that it's appropriate to include the *City Staff Proposal to Address FDD Investigation Findings* in the SSWWE report from OHM. City Staff has other means to communicate with Council.
- Suggests that the section be presented as issues, City staff's position, and CAC's recommendations for each item under *Address FDD Investigation Findings*.
- Concerned that the City is taking specific actions based on the FDD Survey results. Those actions were not publicized as part of the survey and now residents may have out-of-spec installations that are not corrected, because they did not respond to the survey. Fleetham notes that there will be a Public Meeting on the topic of FDDs, which will be posted in various areas. Another CAC member comments that while the City Staff's position is that there will not be an extensive search for additional out of spec homes, the CAC can recommend additional actions. Robert explains that the estimated 50 homes that are out of spec include 11 that have already been found and assumes that, based on the metrics, there could be as many as 50 of the 1800+ FDD installations.

8. Next SSWWE CAC Meeting:

September 10, 2014; Slauson Media Center

9. There were no public comments.

August 21, 2014
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Citizens Advisory Committee (CAC) Agenda
City Hall – Basement Conference Room
Wednesday, August 21, 2013 - 6:30 p.m. to 8:30 p.m.

1. **Welcome -** Charlie Fleetham (CAC Facilitator) 6:30 p.m. (5 min.)

2. **Desired Outcomes –** Charlie Fleetham 6:35 p.m. (5 min.)

   - Introduce the Sanitary Sewer Wet Weather Evaluation (SSWWE) Project
   - Update CAC on project status and the plan for the next 60 days
   - Organize the CAC
   - Respond to information requests about the Footing Drain Disconnection (FDD) Program

3. **CAC Introductions/Icebreaker –** All 6:40 p.m. (10 min.)

4. **SSWWE Background/Project Introduction** – Nick Hutchinson 6:50 p.m. (15 min.)

   Nick (Ann Arbor Project Manager) will describe the background and purpose of this project and the project objectives. He will identify project materials, including the description and the FAQ documents. Also, he will summarize other ongoing projects related to this wet weather study.

5. **SSWWE Project Update** - Robert Czachorski 7:05 p.m. (30 min.)

   Robert (Consultant Team Project Manager) will discuss the wet weather metering task and provide a view of the analysis to date and plans for the next 60 days.

6. **FDD Program Status –** Cresson Slotten 7:35 p.m. (15 min.)

   A status of the FDD program will be provided.

7. **CAC Organization Exercise -** Charlie Fleetham 7:50 p.m. (30 min.)

   Charlie will facilitate a group exercise to confirm the group's purpose, identify group roles and responsibilities, discuss participation expectations, discuss the CAC decision making process, set and confirm the schedule of meetings, identify CAC information needs, and the most important topics to discuss at the next meeting.

8. **Summary, Thank You, and Next Steps –** Charlie Fleetham 8:20 p.m. (10 min.)

   Charlie will send a follow-up meeting summary and other materials to all CAC members. Materials will also be available on line at www.a2gov.org/sswwe.

9. **Public Comments (3 minute limitation)**

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Sanitary Sewer Wet Weather Evaluation (SSWWE) Study
Citizens Advisory Committee Meeting Summary
August 21, 2013
Submitted by Charlie Fleetham, Meeting Facilitator

CAC Attendees:

▪ Kathy Boris	▪ Peter Houk
▪ Colin Breed	▪ Jim Osborn
▪ Frank Burdick	▪ Frank Pelosi
▪ Vince Caruso	▪ Frank Richardson
▪ Joe Conen	▪ Beverly Smith
▪ Ted Dorr	▪ Mark Wagner
▪ Bruce Geffen	▪ Matt Wherry

Project Team Attendees:

▪ Nick Hutchinson (AA)	▪ Robert Czachorski (OHM)
▪ Cresson Slotten (AA)	▪ Murat Ulasir (OHM)
▪ Charlie Fleetham (Project Innovations)	

Presentation Materials:

1. **Welcome:** To begin the meeting, Charlie Fleetham, the meeting facilitator, reviewed the goals that the City Council had asked the committee to pursue:

   - Review materials and data presented by the consultant.
   - Select economically viable and community acceptable alternative(s).
   - Recommend alternative(s) to City Council.
   - Review public engagement strategy and synthesize public comment.
   - Communicate to neighbors and other stakeholders.

2. **Desired Outcomes:** Charlie asked the participants to introduce themselves in small groups and to share what they liked about Ann Arbor. He asked them to identify an outcome of the committee work that would "delight" them. Responses included:

   - To know more about storm sewers, sanitary sewers and flood abatement . . . get a much deeper understanding of how our system works.
   - To design a win-win solution to the FDD problem (like the Argo Ponds solution).
   - To design a solution that stops flooding homes and reduces the flow to the treatment plant.
   - To design a solution that responds to the needs of the citizens.
   - We need to give homeowners some relief.

- The solution should stop flooding into the river, but we can't have homeowners living in fear about a sump pump failure.
- The proposals should be equitable – for current and future residents.
- There should be no flooding for anybody.
- Create a triple win-win solution for these classes: environment, homeowners, and city.
- The city should not force a solution on our citizens.
- Don't make the city's problem into the homeowner's problem.
- Create a solution that gives homeowners an incentive.
- I want to know why my basement was dry for so many years and suddenly start getting wet two years ago.
- The solution should provide comfort to our neighbors.
- The solution must be superior to what we have now.
- Let's find a voluntary solution that eliminates sanitary backups and sanitary overflows due to stormwater infiltration that does not result in potential for new stormwater flooding in basements.

3. **SSWWE Background** – Nick Hutchinson, City Project Manager, described the background and purpose of this project and summarized other ongoing projects related to this wet weather study.

4. **SSWWE Update:** Robert Czachorski (OHM Project Manager) discussed the wet weather metering task and provided a view of the analysis to date and plans for the next 60 days.

5. **Footing Drain Disconnection (FDD) Program Status:** Cresson Slotten, City Systems Planning Unit Manager, provided a status on the FDD program.

6. **Committee Information Needs**: Charlie asked the committee to discuss future information needs in small groups. Identified needs included:

   - Why was the FDD program suspended?
   - How many homeowners have opted out of FDD?
   - Survey the homeowners with FDD. How many back-ups have occurred? How many have experienced water in their basements? What is the before and after picture?
   - Why are there backups in homes without footing drains?
   - Where did the backups occur on June 27?
   - What is the percentage flow into the sanitary system from roof drains and other non-footing drain paths?
   - What has been the experience of other cities with FDD programs?
   - What innovative non-FDD solutions have other cities tried to reduce storm flows into the sanitary system?
   - What is the legal justification (ordinance) behind the FDD program?
   - What is the legal justification of the developer mitigation program?
   - Is sewer capacity an issue in the backups?
   - The root cause of citizen unhappiness is the lack of a reliable backup if the sump pump fails. Have you considered allowing a backup connection into the sewer system in case of sump pump failure (see attached sketch)?

- How many communities have limited development to constrain flows into their sewer/storm system? What have been the results?

7. **Question and Answer Section:** During the meeting, the CAC members asked many questions. Although many of the questions were answered during the meeting, some required post-meeting study. Preparing the responses required different levels of effort, and the project team divided them into two sets. Please find below answers to the first set of questions. Responses to the second set – which required more information gathering – will be provided before the next meeting (now scheduled for Tuesday, October 29, 6:30 pm to 9:00 pm at the Tappan Middle School).

   - **Do most sanitary sewers work by gravity?**
     Gravity sewers serve nearly all of the houses and businesses in Ann Arbor. Most sanitary sewers work by gravity, and the sanitary sewer pipes usually follow existing land contours to reduce pumping. Sometimes, we have to pump sewage from a low area or over a hill via a pump station. Because of the topography of Ann Arbor, the City has very few pump stations.

   - **What is the capacity of our sanitary system (minus the plant)?**
     The capacity of the sanitary sewer system (minus the plant) varies depending on location. Upstream pipes serving individual neighborhoods (typically 8-inch diameter sewers) have a capacity large enough to meet the needs of a smaller area, and downstream interceptors serving large portions of the City have a higher capacity. The key item is the capacity of the pipe compared to the expected design flow under wet weather conditions. These values will be developed for the trunk sewers and interceptors in our project.

   - **What is the capacity of our storm system?**
     For a given area served, the storm sewers generally have a much larger capacity than the sanitary sewers. This is because the flow generated from a property from stormwater runoff is significantly larger than the sanitary sewage generated, and the range of flows within a storm sewer system are much higher than that of a sanitary sewer system. Please note: storm systems are not designed to handle all storm events! In large events, surcharging into streets is expected. The streets hold the water until it can enter back into the storm water system. The Stormwater Model Calibration and Analysis Project will determine the capacity and effectiveness of our storm sewer system.

   - **Can the city make storm sewers overflow into sanitary sewers?**
     No. Discharge of stormwater sources into the sanitary sewer system is prohibited by local ordinance. Why? Flows from the storm sewer system would quickly overwhelm the sanitary sewer system and lead to sewer overflows and backups into basements.

   - **How does stormwater get into the sanitary sewer system?**
     The role of sanitary sewers is to transport wastewater from homes and businesses to the treatment plant. Along the way, some stormwater enters the sewer pipes. Some common sources of stormwater include - cracks in pipes or manholes, cross connections to storm sewers or drains, and pick holes or vent holes on manhole covers. The 2001 Task Force identified that 70 to 90% of the total sewer flow - in some portions of the system - was coming from footing drains during storm events.

- **What is the total estimated project costs of the three studies – Upper Mallets, Storm, and Sanitary Sewer Wet Weather Evaluation?**
  Upper Malletts Drainage Study - $215,000
  Stormwater Hydraulic Model Calibration & Analysis Project - $900,000
  Sanitary Sewer Wet Weather Evaluation Project - $1,250,000

- **Have you put monitors in homes that have participated in the Footing Drain Disconnection Program?**
  Yes, sump pump monitoring has been occurring since 2002. Over 75 homes have been monitored to date.

- **Did you make a prediction in advance about the results?**
  Yes. We estimated peak flows of 3-5 gallons per minute per house – the same estimate made at the outset of the Footing Drain Disconnection program. This value is consistent with generally accepted industry standards for peak flows from footing drains. It should be noted that this is an expected peak flow rate averaged over many houses. For any individual house, the actual peak flow from the footing drain can vary significantly.

- **Are you studying how the flow from the recently installed sump pumps increases surface flooding?**
  Yes, this will be studied as part of the Stormwater Hydraulic Model Calibration & Analysis Project.

- **Are you taking into account long term weather forecasts (climate change)?**
  Quantifying the impacts of climate change on long-term weather is a very complex technical issue. This item can be addressed by the CAC during alternative evaluation phase. For example, the CAC can consider the cost versus the risk of failure (i.e. a larger storm overwhelming the system), where the risk includes an allowance for larger rainfalls as a result of climate change. We are reviewing the most up-to-date rainfall statistics and will consider these when making recommendations.

- **During the June 27 storm, the treatment plant had an overflow. How many gallons?**
  Estimated 10,000 gallons. Note: the plant treats on average 19.2 million gallons per day (mgd).

- **Has the EPA contacted the city about the June 27 overflow?**
  The City notified Michigan Department of Environmental Quality (MDEQ) of the incident.

- **What are the current and planned normal and peak capacities?**
  As previously stated, the current present day average flow into the treatment plant is 19.2 mgd. The projected need in 2025 is 24.3 mgd. The annual average daily design capacity of the City's current wastewater treatment facility is 29.5 mgd.

- **What is the per cent usage of the capacity?**
  See previous response for inputs – on an average day about 66% of the plant's capacity is used.

- **What is the expected growth in capacity usage (as well as growth in usage since the initial studies in 2000)?**
  In 2025, we expect about 27% more flow on average between today's average flow and the forecasted flow.

- **What are the sources for this estimated growth in flows?**
  Ann Arbor Waste Water Treatment Plant Facilities Master Plan conducted in 2004 forecasted continuing population growth.

- **Can the treatment plant be expanded?**
  No. The wastewater treatment plant size is constrained by its physical location. It is surrounded by railroad tracks, a creek, and the river.

- **In what era were homes constructed where their foundation footing drains were connected to the sanitary sewer system?**
  Most homes constructed between 1935 and 1980 have footing drains connected to the sanitary sewer system.

- **Was FDD adopted by the state?**
  The State of Michigan does not have a specific requirement that communities must perform FDDs. FDD removals have been accepted by the State as a means of source control for sanitary sewer overflows. Ann Arbor's Administrative Consent Order (ACO) with the State of Michigan required that the City perform 775 FDDs to control sanitary sewer overflows.
  The State requires that participants in the State Revolving Fund (SRF) low-interest loan program implement the most cost-effective alternatives. Cost-effectiveness varies by systems and depends on the feasibility of all options including source removal, storage or transport and treatment.

- **How many FDD's have been done in Ann Arbor?**
  Approximately 2,700 FDDs have been completed since the start of the program in 2001.

- **Has the operating cost of a sump pump for an individual homeowner been evaluated?**
  Yes, power costs were estimated at less than $2/yr for the average homeowner (these would vary) and that the sump pump would need to be replaced from time to time. It was estimated that the life of a sump pump was 7 years with a replacement cost of approximately $300.

- **How do you determine if a house has footing drains connected to the sanitary sewer?**
  An on-site assessment of each home is performed by the FDD Construction Manager to determine if the footing drains are connected to the sanitary sewer system.

- **If significant structural work is done on a home, does the footing drain have to be disconnected?**
  Disconnection is required for any work done on a home that involves replacing or altering the existing footing drains such as foundation and/or basement wall replacement work.

- **Did the 2001 Sanitary Sewer Overflow Study consider what the impact to the stormwater system would be as a result of the flows being added by the sump pumps?**
  The analysis performed in 2001 estimated footing drain disconnection could increase the volume of flow discharging to the storm drainage system by up to 3-5%. However, during the largest storms that cause basement flooding, the storm drainage system is not designed to convey these peak flows downstream, but instead temporarily stores some of this stormwater in the streets. It was determined the increased stormwater volume from the sump pumps would not be noticeable because it would only increase the depth of the water in the streets by a few percent.

- **Why are there backups in homes without footing drains?**
  A house without a footing drain may experience a sanitary sewage backup when the sanitary sewer backs up to a level above an adjacent basement floor elevation. One potential cause occurs when the sanitary sewer system is overwhelmed with infiltration and inflow during a large storm event and cannot keep up with the flows discharged to the sanitary sewer. In that case, the sewer flow becomes pressurized and sewage will leave the sewer system at the low points in the system. If the low point in the system is a basement (or several basements), the sewage will back up into those basements. Another cause of a backup could simply be due to blockage in the sanitary sewer or the sanitary lead to the house.

8. **Questions Currently Being Studied (the second set):**

- How many sewer backups were reported in 2000?
- How many sewer backups have been reported this year?
- How many sewer backups have been reported in homes with FDD?
- How does the City learn about sewer back-ups?
- Why was the FDD program suspended?
- How many homeowners have opted out of FDD?
- What is the legal justification (ordinance) behind the FDD program?
- What is the legal justification of the developer mitigation program?
- How do all five districts compare in before FDD/after FDD storm response?

9. **Next Meeting**: Tuesday, October 29, 6:30 pm to 9:00 pm, Tappan Middle School, Media Center

10. **Public Comments:** Four observers' comments on the proceedings. Key points are noted below:

- **Comment #1:** These meetings should be held in the council room and televised. More efforts should be made to publicize them.

- **Comment #2:** The committee should look at the city's growth plans. What will growth do to the system capacity?

- **Comment #3:** What is the emotional cost to the homeowners? Anxieties have increased in homes with sump pumps. Have you surveyed on this topic? What are the implications of the developer offset mitigation program for growth?

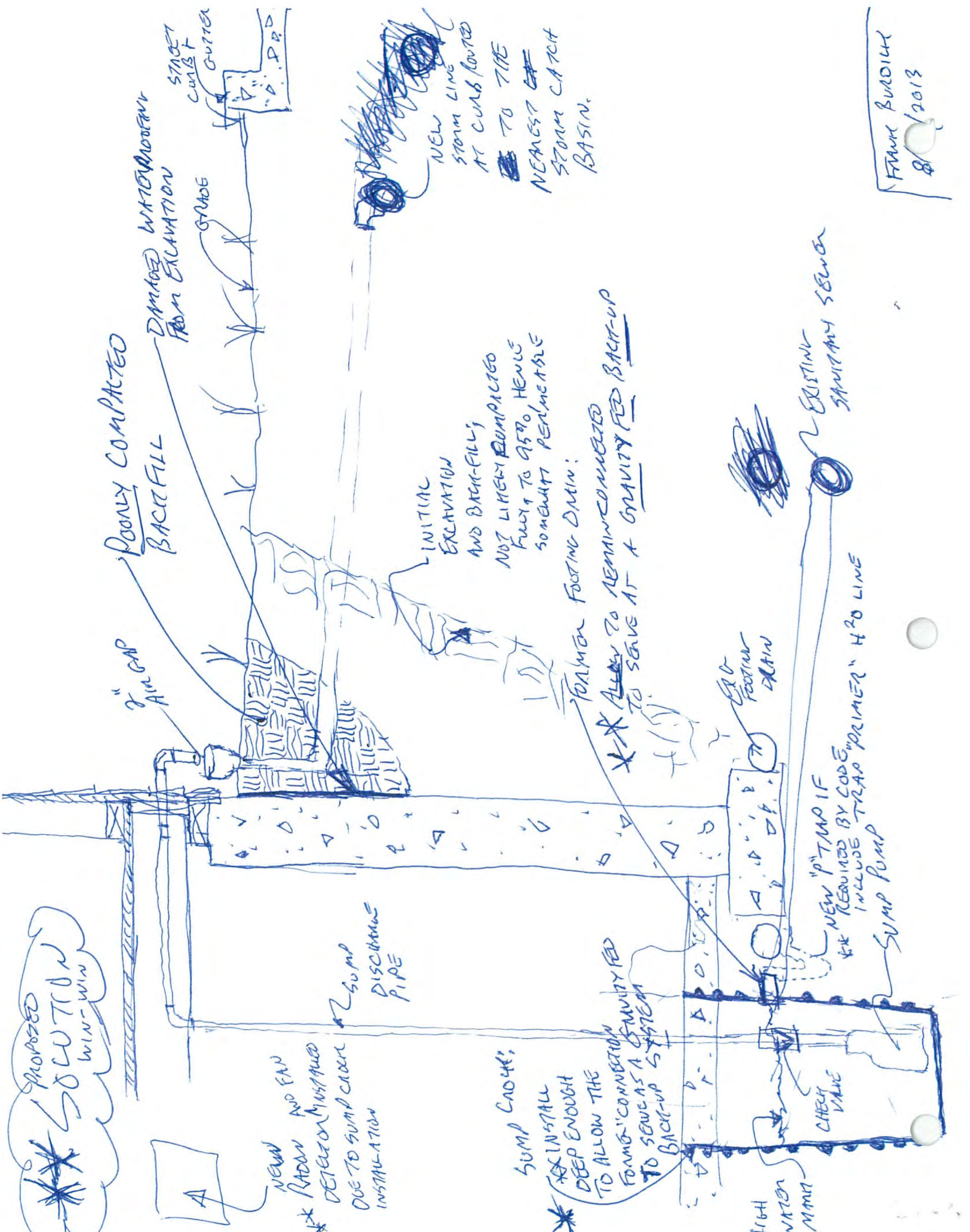
- **Comment #4:** This study should obviously include a survey of homeowners with FDD. How many floods and what types have occurred? Before and after FDD? What other problems have occurred for the homeowners? If this study doesn't address the homeowner's problems, what study will?

- **Comment #5 (Post meeting email):** Why not list in-house sources of sanitary water, major item by item, e.g. 1 toilet x say 10 flushes per day x toilet capacity 1.6- 3.0 x 365 days = 10,000 +\- gallons per year, etc. Then total that against total sanitary plant flow. What is left is dilution, which high level officials have stated in public and in print to be 1-7% footing drain and 40% surface water leakage.

  Unless you have concrete evidence of your numbers on page three of your Advisory Meeting handout, you at least need to qualify the numbers as "pending studies underway". Naturally, if heavy rain spiking exceeds Sanitary Plant Capacity, the City has to act now to provide temporary storage or face EPA fines if you don't.

  Other locations have sanitary impounds. Possibly put together and decide the correctness of the 2001 Impound numbers and take another stab at it, including the true costs of the disconnects. (And what does the City do when it runs out of places to disconnect....?) The City of Ypsilanti has more capacity AND has storage (albeit free from Willow Run) and Dearborn area has 1-1/2 huge storages (maybe they can show that to be a bad idea...)

  Bottom line, very good meeting. The CAC members were stacked AGAINST sump pumps. Liked meeting pace and control. (It is not believable that $120,000,000 Treatment Plant rebuild does NOT increase capacity or "no space to increase Plant size" or provide retention.....)


PROPOSED SOLUTION WIN-WIN
NEW RADON AND FAN DETECTOR INSTALLED DUE TO SUMP CROCK INSTALLATION
SUMP DISCHARGE PIPE
SUMP CROCK; INSTALL DEEP ENOUGH TO ALLOW THE FORMER "CONNECTION" GRAVITY FED TO SEWER AS A BACK-UP SYSTEM
HIGH WATER MARK
CHECK VALVE
2" AIR GAP
POORLY COMPACTED BACKFILL
DAMAGED WATERPROOFING FROM EXCAVATION
GRADE
STREET CURB & GUTTER
NEW STORM LINE AT CURB ROUTED TO THE NEAREST STORM CATCH BASIN.
INITIAL EXCAVATION AND BACK-FILL; NOT LIKELY COMPACTED FULLY, TO 95%, HENCE SOMEWHAT PERMEABLE
FORMER FOOTING DRAIN: ALLOW TO REMAIN CONNECTED TO SERVE AS A GRAVITY FED BACK-UP
EXT. FOOTING DRAIN
EXISTING SANITARY SEWER
NEW "P" TRAP IF REQUIRED BY CODE INCLUDE TRAP "PRIMER" H2O LINE
SUMP PUMP
FRANK BURDICK 8/ /2013

September 10, 2014
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
SSWWE Citizens Advisory Committee Meeting Agenda
City Council Chambers
Wednesday, September 10, 2014 - 6:30 p.m. to 9:00 p.m.

1. **Welcome –** Nick Hutchinson	6:30 p.m. (5 min.)
2. **Desired Outcomes –** Nick Hutchinson ▪ Review/decide on OHM SSWWE Recommendations ▪ Review/discuss FDD Subcommittee Recommendations ▪ Present City's Strategies/Options for the DOM Program ▪ Review for Sept 17th FDD Public Meeting Agenda	6:35 p.m. (5 min.)
3. **Review of Project Timing and Progress –** Robert Czachorski	6:40 p.m. (10 min)
4. **OHM SSWWE Study – Review and Decide -** Robert Czachorski	6:50 p.m. (40 min)
5. **FDD Survey Mitigation Recommendations** – **Review and Discuss** – Charlie Fleetham	7:30 p.m. (40 min)
6. **Present DOM Continuation Issues –** Cresson Slotten	8:10 p.m. (30 min)
7. **Agenda Review for 9/17 FDD Public Meeting –** Charlie Fleetham	8:40 p.m. (20 min)
9. **Public Comment:** (three minute limitation per speaker)	9:00 p.m. (till completed)

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project

SSWWE Citizens Advisory Committee Meeting Summary
Slauson Media Center
September 10, 2014 – 6:30p.m.

SSWWE & FDD Citizen Advisory Committee attendees:

▪ Colin Breed	▪ Judy Hanway	▪ Darren McKinnon
▪ Vince Caruso	▪ Peter Houk	▪ Jim Osborn
▪ Joe Conen	▪ George Johnson	▪ Frank Richardson

SSWWE & FDD Project Team members:

▪ Troy Baughman (Ann Arbor)	▪ Greg DeLiso (Munrovia Picures)	▪ Greg Marker (OHM Advisors)
▪ Lori Byron (Famous in Your Field)	▪ Charlie Fleetham (Project Innovations)	▪ Cresson Slotten (Ann Arbor)
▪ Robert Czachorski (OHM Advisors)	▪ Nick Hutchinson (Ann Arbor)	▪ Anne Warrow (Ann Arbor)

Public Observers:

Frank Burdick	William Higgins	Ethel Potts
Jack Eaton (Council Member)	Mike Martin	

1. **Nick Hutchinson, City of Ann Arbor, welcomed participants.**

2. **Nick reviewed the desired outcomes for the meeting:**

   - Review/decide on OHM SSWWE Recommendations
   - Review/discuss FDD Subcommittee Recommendations
   - Present City's strategies/options for the DOM Program
   - Review for September 17th FDD Public Meeting Agenda

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3. Robert Czachorski, OHM Advisors, reviewed the project timing and process:

- View the project timeline on SSWWE Project Website.
- The FDD Public Meeting will be held Wednesday, September 17 at Slauson Middle School Auditorium. The focus of the meeting is on the FDD Survey Investigation results and mitigation recommendations.

4. SSWWE Study Review of Proposed Projects – Robert Czachorski

Reviewed the six projects proposed, based on specific locations with potential issues. View the descriptions on the SSWWE project website.

Not recommending any major construction projects at this point. The problem areas found all require location-specific investigation and data collection.

The six projects were reviewed at August CAC meeting. Robert points out the new information: more description of the modeling scenario used; more precise cost estimates.

All six projects include recommendations for Best Management Practices, including permanent flow monitoring and rotating maintenance.

Questions and comments during the SSWWE Study proposed projects review:

- Recommend permanent gauging for the City for full-time monitoring. Believes that gauges are $500-$800 each and can be controlled remotely. Thinks that it would find pipe blockages before they cause backups and wetness. Prefers permanent gauges to storm teams.
- Rotating maintenance program should include the original 5 target areas. Do not assume that the FDD Program solved all sanitary sewer issues.
- Remove subjective terms from the report, like "excellent" to describe the monitoring period.
- Suggest that the CAC see some of the early results from the Stormwater Calibration Project, too.
- Be clear in the Final Report to differentiate between water and sewer flows.
- Add "the reason is still unknown" that FDD program was less effective [in the Glen Leven district]
- Suggests that the Project Cut Sheets have dates to differentiate the versions.
- Suggests arrowheads on pipes to show flow direction.
- Opposed to any more FDDs as a solution anywhere.
- Support FDDs if they are reasonable and voluntary.

Q. What's the cost per gauge?

A. Depends on the technology. In the SSWWE project thirty meters were installed for 5 months with a cost of about $250K. Those measured depth and flow velocity in the sanitary sewer system.

Q: Is the problem observed in Project B caused by a collapsed pipe under the Atrium office building?

A: We did check that, and a collapsed pipe could not cause all of the red pipes in the model.

Q: Is Project B in a high confluence area? If you don't have meters upstream, how do you know that you understand the flows?

A: It's one of the most complex areas of the City's system. I have high confidence that we do understand the flows, but we should do some branch flow metering to verify our understanding of the branch split for the flows.

Q: For Project C, would you want to meter further downstream to see if flows are normal down there?

A: Yes, that might work. An easy solution is to mobilize a team to pop manholes during storms to physically observe the depths.

Q: Has the City filled pickholes in manhole covers?

A: The City has done some pickhole plugs but those are lost whenever the manhole is lifted. Would like to install more gasketed covers.

Q: Because Project E shows that pipes do fill with sewage about 3 feet above the top of the pipe, how confident are you in the model? If basements are at 3 feet depth, you might want some free space.

A. The modeler is pretty confident in the model results in this area, but we agree that if on-site metering and basement elevation investigation determines that 3 feet of surcharging won't impact basements, there should be some additional space as a failsafe.

Q. If there are problems with this diversion [Project F], could it cause backups? It should be part of preventative maintenance program, rather than waiting until there are backups.

A: Yes, if it's not working, it could cause backups downstream by the treatment plant. The City wanted to have the project team look at this area to determine if the split [the amount being diverted] is correct.

Next step: Robert will modify the Project Cut Sheets with the suggestions received, and post on Basecamp for CAC to review and comment prior to the October 8 CAC meeting.

Robert reviews Section 4 of the Executive Summary outline draft

Review the Executive Summary outline draft on the SSWWE project website.

Notes that Section 4B will be reviewed from the Executive Summary.
Sections 5 & 6 will be discussed under another agenda item.

Questions and comments during the Executive Summary draft review:

Q: If a street floods to the extent that stormwater overruns the curb, entering the envelope of the house and captured by footing drains connected to the sanitary sewer, might decreasing the storm flooding help with minimize flows to the sanitary? Has this been studied?

A: No, this specific question has not been studied. While reducing stormwater flooding could have an incremental impact on the sanitary sewer system, fixing these problems is not necessary to reduce the risk of sanitary sewer backups in basements.

Q: In storms where there were basement backups, were there instances without extensive surface flooding?

A: Yes, we have observed storms with basement backups, but little surface flooding.

Q: A lot of the homes in the original five target areas had check valves, so that could be the reason that homes were not flooded during the June 2013 storm?

A: No, the meter data from 2013 shows that the sanitary sewer flows in the system did not reach the levels to activate the check valves. Meter data shows that the flows only reached the lower half of the pipe. The City also explains that check valves were installed in early in the program in homes that had experienced basement backups to provide relief until enough footing drains could be disconnected to significantly reduce the critical mass of stormwater flow from the sanitary sewer system in a neighborhood.

Q. Should the study also make recommendations to upsize the sanitary system outside the six identified problem areas to accommodate future growth where it's most likely to occur, especially the downtown area?

A. The modeling performed did include current and future development and found just these six problem areas across the entire City.

Q. City said that stormwater system is designed to have six inches of water in the street, but that depth would flood homes in some neighborhoods, because they are at a lower grade than the streets. Believes that it's not acceptable.

A. That's important input for the Stormwater Calibration Project and the Troy Baughman, the Project Manager will make note of it.

5. FDD Survey Mitigation Recommendations – Review and Discuss

Charlie reviews 11 page document created with FDD Subcommittee & City staff. View the draft FDD Subcommittee recommendations report out on the SSWWE project website. It consists of three components:

- City Staff Draft Go Forward Process regarding FDD Mitigation
- Best Practices
- FDD Subcommittee Mitigation Recommendations

City Staff Draft Go Forward Process regarding FDD Mitigation, items 1-5:

- Includes the FDD Mitigation Subcommittee comments and polling results
- Charlie tried to pull out the implied community values from the subcommittee's discussions.
- City is planning to address out of spec investigations, understands that there may be more than what were investigated as part of the follow up to the FDD Survey.

Best Practices:

- Drafted by OHM team, reviewed by the City.
- The City already practiced many of the recommendations during its FDD Program.
- Major point of discussion among the FDD subcommittee was a 2-year warranty.

FDD Subcommittee Mitigation Recommendations:

- Backup or compensation for all program participants
- Compensation for damage claims
- Compensation for non-tangible sump pump ownership costs

The document includes City staff position on subcommittee's recommendations – the staff does not support those recommendations.

Notes the difference between damage claims and homeowner compensation. Damage claims refer to damages reported by homeowners resulting from a sump pump installation and homeowner compensation refers to the added costs of having a sump pump (batteries, maintenance, etc.)

Questions and comments during the FDD Survey Mitigation Recommendations review:

- The City's listed objections to providing backups are not insurmountable. Believes homeowner with technical knowledge would opt to have a backup system in a finished basement.
- All ratepayers are realizing the benefits of a properly functioning sanitary sewer basements, no longer have to pay to clean up basement backups. The only people who are now exposed to risk of sump pump malfunction are those who had them installed. Owners of older homes did not voluntary agree to have an FDD. Wants to hear from City staff how providing backups would provide an inequitable situation.
- Could see how agreeing to some of these charges could lead to an endless stream of costs. Could see City funding a backup, but believes the other expenses (ongoing maintenance and replacement) are untenable.
- Rather than what the City does not support, wants to see a response from the City what we can do, how we can solve the problem
- Agrees with the point about inequity, that some people got FDDs and others did not, that's not equitable.
- The FDD program was chosen because it was the least expensive and that was because much of the cost was transferred to homeowners.
- Believe that the City's comments are negative and are rejecting the subcommittee's work.
- Disagrees with the City's objection that FDD damage claims should not be treated differently; they should be treated differently, simply because the program was mandatory.
- Fixing the out of spec installations is a half measure; they agree to fix the out of spec installations but not the damages caused by those installations.

- 1800 homeowners underwent FDDs, not necessarily voluntarily, for the benefit of all City homeowners. It's right that the entire City should now pay for those homeowner's problems.
- The amount allocated for backups could be done as rate reductions. Can understand that the City would be reluctant to comment or agree on these recommendations with the FDD lawsuit in the courts.
- If we have to wait until the FDD lawsuit is determined, that's fine, but I don't want to lose sight of the homeowners with issues.
- City Council makes the ultimate decision, not City Staff; a Council Member is in attendance, hearing this discussion.

Q. Who from the City was involved in the decision to not support the recommendations?

A. Staffers from the Public Services area reviewed the recommendations, along with other members, including legal staff.

Charlie asks whether those homeowners who no longer have backups accrued value as a result of the FDD. Asks from a ratepayer perspective, whether ratepayers should fund backup systems on top of providing relief from sanitary sewer backups?

CAC member responds that education and outreach can explain to ratepayers that they all benefit from funding the FDDs.

Charlie comments that the subcommittee's recommendations can go to City Council, regardless of City staff's support. The City Staff has not rejected these recommendations outright, however Council will likely ask Staff's opinion on the recommendations.

Next action: Charlie asks that City Staff respond more extensively at the next meeting and also for CAC members to comment or offer alternative suggestions in Basecamp.

6. Discuss Developer Offset Mitigation decision factors – Cresson Slotten

Cresson shares several key points relating to the sanitary sewer system and development:

- City code requires that connections for new developments be provided, if there is adequate capacity to handle the new flow.
- Before a new sanitary sewer is constructed, an MDEQ Part 41 permit is required and the City must show that it has capacity in the system to be approved.
- DOM program was enacted by Council resolution in 2003 with a goal of no net impact on sewer capacity.

- DOM required that mitigation take place upstream of the area of the sewer that the development would affect.

Following the results of the SSWWE study, it's an appropriate time to review the DOM program and understand the community's views. Now that we have a clearer picture of the City's sanitary sewer system capacity, there are decisions to be made: should the DOM continue? And if so, as it exists currently or with changes?

Discussion points:

- Continue with DOM to reserve capacity as a "cushion"?
- Continue to require offset mitigation (removing 120% of estimated flows the development will add)?
- Keep or do away with the 80/20 rule that requires that 80% of flow removal occur in the same sewer district as the new development?
- FDDs are not the only option for mitigation, but have been, by far, the most prevalent.
- Should FDDs be allowed at all in the future?
- With diminished flow removal from remaining FDDs, should the calculation be changed?
- Is payment in lieu of mitigation an option? Depending on the approach, may not be legal, would have to be determined.

CAC member Darren McKinnon reviewed a white paper he provided to the City and the CAC with alternate approaches and recommendations. Read the Proposed Alternate DOMP Highlights on the SSWWE project website.

Highlights of recommendations:

- Table A calculations are based on outdated fixture water usage amounts.
- Allow developer contributions to the sanitary sewer fund equal to the amount of increased flow that the development will add.
- Allow developer's engineers to design sanitary sewer system upgrades to fix any capacity problems.
- Wants to expand the mitigation options to developers; FDDs, plus other methods
- Developers are not allowed to view sanitary sewer maps due to Homeland Security issues, which makes it more difficult for developers to understand the sewer situation on a site under purchase consideration.
- FDD credits expire within 24 months. This discourages widespread disconnections. Eliminate expiration of FDD credits.
- Remove the developer as the solicitor for FDD volunteers. The City could maintain a database of those willing to be disconnected.
- End 80/20 rule. Allow mitigation across all three sewer districts.

- No net increase in sanitary sewer flow is not a reasonable policy. Plan for some growth and size the system accordingly.
- Per the Administrative Consent Agreement, DOM was supposed to end years ago.
- First Martin Corporation has a vested interest in a well functioning sanitary sewer system and is willing to do its share in building and maintaining the system.

7. **Public Comment:**

(Ethel Potts) I would like to take you all back to Project Area B in the map. There's one thing about the wording the way it's written. The word storm is used once on the entire page. This is an example of how when they talk about pipes or whatever it should always be sanitary system or storm system. You could look at this page forever and never know if you're looking at sanitary sewers or storm sewers. There's no way to tell. I happen to know this area quite well. I cut my teeth on learning about surcharging on this area. This area is…it gives the impression of being very simple, but what doesn't show up is Murray and Mulholland between Liberty and Washington in which the manhole cover's low, in which the creek runs right through the basements and right over here on 8th Street right next to this property the creek runs right through the basements. And this has historically been true. So, the magnitude of the problem, the age, this has been going on forever. These are old houses. This is not a new problem in a new subdivision. But I think I would like that reflected here. For instance, the gauges, yes, I can see why they are there; those are two very crucial places that have an extreme amount of collection of water. However what about the residential areas up Liberty, up Washington, up Huron, where people are having major stormwater problems? Sanitary I don't know and this doesn't tell me. But are there sanitary problems also? I would surely like them to show up on here if they do, but the stormwater problems are major and long-range and this does not reflect this.

(Mike Martin) I want to thank everyone on the committee for their time and input and passion and also City staff for their as well. Darren expressed very well our concerns with the program. The only thing I'd want to add is that there's precedence within the Developer Offset Mitigation Program for City Council to make adjustments. That program has already been amended once in 2005 or 2006, so I think at this point it's time for another adjustment to the program and appreciate your consideration. There are a lot of smart people in here that are passionate about the FDD program and we share a similar passion for the DOM program. It would have been nice to hear some other people weigh in on it because I'm sure you're familiar with it, but we just ran out of time, so again, I appreciate everyone's time. Thank you.

(Frank Burdick) First, greetings to the remaining members of the original CAC/Focus Group. I see that there are six of the original members of the original 23. Two additional people and one gentleman sitting here who's not on the CAC and who was allowed to talk. I'd like to make a point that the public meeting scheduled for next week is not being properly handled regarding FDD invitations to all those homeowners that have FDDs. Not all of them are receiving them. There was some talk about some postcards but people aren't receiving the postcards. Um, I want to talk about the fact that you're real proud of or OHM seems to be real proud of the fact that there's no new basement backups but fail to acknowledge the check valves. Robert wants you to believe his flow data to argue this point. That the check valves did not kick in. However we have people like Vince who question the validity of the flow data. So do you want to believe common sense, that backflow preventers prevent flow from a basement or do you want to believe flow data? Something to think about. The City says they will address out of spec installations. Unfortunately the specs they are attempting to comply with do not comply with building codes or standard residential building construction practices and designs especially when it comes to the burial depths. The City inspectors, the pre-approved contractors all voiced their concerns to the public services divisions. Their concerns were ignored and the inspectors and CDM have turned a blind eye to these code violations. The courts are saying that the case under litigation is not concerned if the FDD program or the DOM program is a good or effective idea, it is whether or not it is a lawful idea. Hence all the intentions of the City regarding the effectiveness are all moot points. OHM has already shown you that they will modify their documents at will without your input. They did it tonight. You saw it tonight. Do you believe that OHM will include your concerns in their final report? That's for you to decide. Tonight you touched on lawsuits but you failed to recognize that your work, your names, the OHM flow data, have all been included in the City's arguments to the state and federal courts. All this before you have blessed the report. Finally the number one thing you should be doing is similar to what this gentlemen just said, is you should be helping the City rewrite the FDD ordinance. That's the only thing that going to last. City Councils are going to come and go. You had one City Council adopt this based on the task force of 2001, you have another City Council that's going to have to bless this thing whenever you get done. But ultimately the ordinance is the only thing that will stay. You want to have effectiveness, long term effectiveness, help them rewrite the ordinance. Thank you.

October 8, 2014
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
SSWWE Citizens Advisory Committees Meeting Agenda
Tappan Middle School
Wednesday, October 8, 2014 - 6:30 p.m. to 9:00 p.m.

1. **Welcome –** Nick Hutchinson	6:30 p.m. (5 min.)
2. **Desired Outcomes –** Nick Hutchinson ▪ CAC Support of OHM SSWWE Recommendations ▪ CAC Support of City's DOM Proposal ▪ Achieve Win-Win Solution on FDD Mitigation Recommendations	6:35 p.m. (5 min.)
3. **Review of Project Timing and Progress –** Robert Czachorski	6:40 p.m. (5 min)
4. **OHM SSWWE Six Projects – Review and Finalize -** Robert Czachorski - TOAG Review - CAC Feedback Received to Date - Minority Reports and CAC Comments - Executive Summary Consensus	6:45 p.m. (20 min)
5. **Present City DOM Proposal –** Cresson Slotten	7:05 p.m. (40 min)
6. **FDD Mitigation Recommendation – Driving to Win/Win Solution –** Charlie Fleetham	7:45 p.m. (60 min)
7. **Process Review for Final Public Meeting –** Charlie Fleetham	8:45 p.m. (15 min)
9. **Public Comment:** (three minute limitation per speaker)	9:00 p.m. (till completed)

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
SSWWE Citizens Advisory Committee Meeting Summary
Tappan Middle School Media Center
October 8, 2014 - 6:30 p.m.

SSWWE & FDD Citizen Advisory Committee attendees:

▪ Colin Breed	▪ Judy Hanway	▪ Pat Marten	▪ Beverly Smith
▪ Vince Caruso	▪ Peter Houk	▪ Jim Osborn	
▪ Joe Conen	▪ Darren McKinnon	▪ Frank Richardson	

SSWWE Project Team members:

▪ Troy Baughman (Ann Arbor)	▪ Greg DeLiso (Munrovia Picures)	▪ Greg Marker (OHM Advisors)
▪ Lori Byron (Famous in Your Field)	▪ Charlie Fleetham (Project Innovations)	▪ Cresson Slotten (Ann Arbor)
▪ Robert Czachorski (OHM Advisors)	▪ Nick Hutchinson (Ann Arbor)	

Public Observers:

▪ Frank Burdick	▪ Dan Ketelaar
▪ William Higgins	▪ Mike Martin

1. **Nick welcomed and reviewed the meeting's desired outcomes:**
   - CAC Support of OHM SSWWE Recommendations
   - CAC Support of City's DOM Proposal
   - Achieve Win-Win Solution on FDD Mitigation Recommendations

2. **Project timing and progress** – Robert Czachorski
   - Robert reviewed the project timeline and items accomplished since last CAC meeting, including the Sept 19 FDD Public Meeting. He thanked the CAC members who participated in the public meeting for their dedication to the process.

3. **Final Recommendation Worksheet Review** – Charlie Fleetham distributed a worksheet and said it would function as an individual tally sheet for CAC members to express their preferences and ideas/comments. He asked the CAC members to put their names on the sheets for turn in after the meeting so he could document/summarize the ideas/comments.

4. SSWWE Study Recommendations: The Six Projects – Review and Finalize - Robert Czachorski

- Robert reviewed the updates since the last meeting:
  - TOAG review and comments on SSWWE Sanitary Sewer System presentation
  - CAC feedback received to date
  - Disposition of minority reports and CAC comments
  - Executive Summary consensus

  Study recommendations cover three main points:

  - Action plans for six project areas
  - Recommendation for permanent metering
  - Recommendation for rotating maintenance program

Robert reviewed permanent meter and rotating maintenance program recommendations. Action plans for 6 project areas have been discussed at length at previous meetings.

CAC members vote:

1A. Action plans for 6 project areas	1B. Install permanent meters	1C. Rotating maintenance program
Yes – all	Yes – all	Yes – all

Comments/Questions:

Q. Is there an industry standard that recommends how often the pipes in a sanitary sewer system should be inspected?

A. There is no single recommendation for the frequency of pipe recommendations. However, a number of municipalities are adopting an asset management approach to maintaining infrastructure. An asset management best practice is to inspect every pipe in the system and assigning each one a rating, based on its condition, that designates how frequently it should be re-inspected and maintained.

Q. Does the City have enough staff to inspect, clean and repair all the sanitary sewer system every few years?

A. When City staff mentions resources used in inspecting and maintaining our infrastructure that includes a wide range of resources that factor into system maintenance – staff, contractors, and specialized equipment like vactor trucks. The City is moving toward more strategic and proactive sanitary sewer maintenance and repair program, an asset management approach. Staff has a request for funding for an asset management program on the upcoming CIP (capital improvement plan.)

Q. Should metering downstream of the Hoover/Hill area be added to the project plan in order to determine whether there are problems downstream?

A. If there is metering study in that area, it would be simple to add one more meter downstream and this is noted in the project recommendation.

- Request to update citizens via email when maintenance will be performed on the sanitary sewer system. Cresson will share that recommendation with the City's communications staff.
- Final report should include a recommendation to perform a comprehensive inventory of the sanitary sewer system condition. This would establish a "baseline."
- CAC member points out that preventing backups is an important endeavor and wants strong language urging the City to install permanent meters as a proactive measure to find pipe blockages. Hire additional staff if necessary.

5. FDD/Developer Offset Mitigation Program Recommendations

- Cresson Slotten walked through City's recommendations regarding DOM:
  - As long as there continue to be any issues in the sanitary sewer system, some form of mitigation should continue to be required; however, the specifics of the program could change.
  - City feels that system's conditions and functioning has changed since the DOM program was first implemented; therefore, it's appropriate to change the program.
  - If a project will add flow upstream of one of the problem areas, the mitigation should take place in that same flow area of the system. If the project is not located in an area that would add flow to an existing problem area, the developer could mitigate anywhere in the system.
  - We should reexamine how the flows are actually calculated (Table A) and revise.
  - Current offset mitigation requires a 20% recovery factor; new recommendation would eliminate the additional 20%, and make the requirement 'no net increase' in flows.
  - Allow developers to make contributions to improve the sanitary sewer system in the area the development would impact.

- Cresson reviewed changes suggested by CAC:
  - Additional flows that would contribute to the problem areas would have to be offset in advance.
  - Review DOM program every 5-7 years.
  - Involve developer community in the program specifics (Table A calculation changes).
  - In addition to in lieu payment, allow in lieu system improvements.
  - When the six wet weather sanitary sewer issues are resolved, reexamine the DOM requirement.

CAC members vote:

2A. Continue Developer Offset Mitigation Program	2B. Potential DOM Changes
Yes – all	B1. Mitigation city wide – yes, all B2. Re-examine design flow rates (Table A) – yes, all B3. Eliminate additional 20% recovery factor – yes, all B4. Allow "in lieu" developer payments – yes, 7; no, 3

Comments/Questions:

Q. Is there enough mitigation opportunity left? Are there enough flows to offset or will a DOM mandate throttle development?

A. Developers are free to choose other mitigation methods than disconnecting footing drains. For example, some institutional developers, such as Ann Arbor Public Schools, chose to disconnect swimming pools from the sanitary sewer system. Flow metering has shown that certain pockets of the city still have wet weather flow that could be removed. Additionally, if the DOM program is revised to allow payments in lieu of performing mitigation, a developer could opt to fund one of the SSWWE study's six recommended projects.

Q. How many homes in Ann Arbor still have connected footing drains?

A. Based on the assumption that houses built between 1941 and 1980 have footing drains connected to sanitary sewer, the remaining potential FDD equivalents is approximately 15,000. Note: this includes both single family and multi-family properties.

The City discovered during our investigation work throughout the course of the program, that although some houses built prior to 1941 have connected footing drains, the majority of them do not. Therefore, these homes are excluded from the above estimate.

Q. Is it true that the WWTP has ample capacity during dry periods; the only concern is during wet weather?

A. Yes, the WWTP has capacity to handle the average daily flows. Any concerns are largely operational.

Q. If developers could continue to solicit homeowners for FDDs, would the City still use the 4GPM figure in the calculation?

A. That would be re-evaluated as part of modifying the DOM program.

Q. Is there a way for developers to know whether parcels being considered for purchase are located upstream of one of the five sanitary sewer problem areas identified in the SSWWE study?

A. While the City cannot publicly distribute or publish detailed maps of the sanitary sewer system, staff members are happy to meet with developers who wish to learn more about specific parcels and share sewer system specifics for a site.

Additional CAC Member Comments:

- Wants to see more details about in lieu payments.
- Wants to see the DOM program changes in writing.
- Developer investments must be timely between the funding and the project. Timely work on the system should be defined based on whether a new development would compromise an area of the system.
- The DOM program should be reviewed on a periodic basis for effectiveness.

- Believes that DOM benefits the city because it removes wet weather flow (through mitigation.)
- The TOAG report cautions that the treatment plant capacity is not endless. Unlimited development could diminish it.
- There should be no time limit on FDD mitigation credits. Current program gives a 24 month period.
- Do not want to see DOM program end when the six projects are complete.
- Developer options should include contributing funds or actually building a project (hiring the contractor and managing the construction.)

6. Mandatory FDDs as a Program Tool

The project team posed the question, using Project D (Pittsfield Valley) in Executive Summary as an example. This area has suspected high weather flows, similar to five FDD target neighborhoods. Assuming that one of the six wet weather issues could be resolved via FDDs, are mandatory FDDs acceptable to the CAC as a program tool?

After discussion, group opted to change the item to *incentivized, robust, voluntary* FDDs.

CAC members vote:

2Ci. Eliminate mandatory FDDs as a program tool for City projects.	2Cii. When modified to voluntary, incentivized and robust program tool?	2Ciii. Retain mandatory FDD program as is.
Yes – 6; No – 4	Yes – 9; No – 1	Yes – 0; No - 10

Comments/Questions:

Q. If an area has high flows, could a numerical estimate be made of the number of footing drains to be disconnected and the neighborhoods be canvassed to determine the number of potential volunteers and cost per installation, in order to know if FDDs would be cost effective solution?

A. Yes, the City would perform initial flow monitoring to verify flows volume and then City staff would meet with neighbors to understand basement backup issues and present options.

- City should describe what a voluntary program should look like (will it include back-ups?)
- Need clarification on what "ruggedized" would mean.
- FDDs should be a last resort, not a first.
- It's not fair to incentivize going forward when those who were in the mandatory program don't get the same equipment, features, etc. What if the houses in the new program had a botched job like Avondale? It's just not right to go into people's basements.

7. FDD Mitigation Recommendations (Looking Back)

Charlie recapped FDD Survey results, City's proposal and FDD subcommittee recommendations. The CAC felt the City's initial proposal was inadequate. City then suggested a need-based assistance program for seniors and rate study to evaluate impacts of FDD on homeowner's sanitary and water usage.

Cresson explained that the City's last sanitary sewer and water usage rate study was done about 10-12 years ago. A rate study evaluates the entire system, all its infrastructure and service delivery costs, its future needs and rate philosophy. City is currently undergoing a limited scope study of its water and sewer connection fees. Rough estimate is that a rate study would take about one year, and cost around $400K to $600K including rate consultants and staff time.

In response to a request for more information about rates and cost of service, Charlie described a Michigan Municipal League summary of the Bolt decision, which prohibits charging a user for improvements that do not benefit all ratepayers.

Several CAC members discussed that while many homeowners who purchase a home have the burden of a sump pump as part of normal ownership duties, those homeowners who bought homes connected to the sanitary sewer system had an expectation of continuing to have footing drains connected to sanitary sewer system.

CAC members vote:

Item 3A. City to correct out-of-spec installations/conduct outreach program	3B. Implement OHM best practices	3C. Provide back-ups for all FDD homeowners
Yes – all	Yes – all	Yes – 7; No – 3

3D. Pay damage claims resulting from out of spec FDD installations	3E. Homeowner compensation
Yes – all	Yes – 2; No – 8

3F. Support for Seniors and Economically Disadvantaged (City helping to fund sump pump replacements, inspections, batteries, etc. on a means-tested basis.)	3G. Address modifying rates for properties without footing drains in a rate study
Yes – 7; No – 3	Yes – 8; No – 1; On the fence - 1

Comments/Questions:

Q. In OHM's experience, have other communities provided backup pumps to homeowners undergoing a City funded FDD?

A. Yes, in some instances. Project team members will talk with other municipal staff to learn how other communities addressed providing backups.

Q. Is it feasible that a rate study would actually create a separate class of ratepayers (FDD homeowners in this case)?

A. The project team will contact rate consultants to determine this and will report back to the CAC before the November meeting.

Q. How was the $100 penalty for not having an FDD calculated? And how is it allowable when rates are supposed to be based on service costs?

A. The $100 charge is for the cost of processing footing drain flows, now and in the future. Other cities that have footing drain disconnection programs also charge a penalty to homes that opt not to disconnect.

- Everyone who was in the FDD program should get operations and maintenance assistance, or no one.
- Correcting out of spec installations and paying damage resulting from those out of spec installations should be costs should be borne by the FDD program contractors and consultants, not ratepayers.
- Suggest that FDD homeowners with a water backup have a reduction of their water usage bill during power outages.
- In order to cast a final vote on item E Homeowner Compensation, we want to know whether item G. Rate Study is likely to create a separate class of ratepayers for those who still have footing drains attached to the sanitary sewer system.
- Request that the City bring some innovative ideas to compensate FDD homeowners for inconvenience, damage, etc. For example, the City could use its bulk buying power to purchase backup pumps at a discount and provide them to FDD homeowner at cost.

Charlie requested that the CAC review, edit and add to the FDD subcommittee recommendations to share their community values rationale for providing backups and compensation to FDD homeowners. This will be included in the final report.

7. Final meetings

Final CAC meeting - November 12 at Tappan Middle School

Final SSWWE Public Meeting – November 19 at Slauson Middle School

8. Public Comment:

(William Higgins) It seems to me that all of this wrap up needs to include surface water. We have surcharged surface water pipes in Lansdowne. And all this talk about compensation for backups and so forth is strictly sanitary as I see it. We at least need to make some mention of the pending report that supposedly will correct surface water, the impounds. It's been sitting there since November. A couple, ten twelve million bucks of impounds to fix the surface water piping which gets surcharged in some areas. Until that's addressed or at least mentioned, the audience is going to wonder, what the hell happened to surface water. It's just a suggestion. I know that you're talking sanitary, but you've got this additional water from the sump pumps going out into a system that's surcharged in some cases and there's a proposal that supposedly will fix that but it's been sitting there unaddressed since November 13.

(Frank Burdick) Okay, welcome to the 8 of the original 23 members. Let me start by saying that I have spoken to Council Members. One thing that they all agree on is that they are expecting written input from the citizens from this citizen advisory committee. They acknowledge that city staff will have their chance to provide input and OHM certainly will provide input so that they can get paid. Council needs written input from the citizens. Tonight you discussed action plans to maintain the existing sanitary sewer conveyance piping and manholes. A few months ago we asked for and received a report from the City that gave us the history of this work over the past few years. It indicated a blatant disregard for the troublesome target areas. The City's response was that they expected the homeowners in these areas to remedy the I/I flow with FDDs while the city spent their few dollars on a few pipes and manholes outside of these areas. You may recall the Basecamp posting with the analogy of the "leaking fluids from the old used car." Tonight you discussed mandatory FDD programs. Unfortunately you all appear like ostriches with your head in the sand by not considering the current lawsuits and further lawsuits that are likely soon to follow. Tonight you discussed rate studies. Perhaps you may recall that these were suggested in my cut to the chase memo dated 28 May 2014. I even suggested, at that time, that sump pumps could be directed to rain barrels in warmer seasons to provide storm water rate reductions, as well. As I said last month, this focus group should include in the recommendations a long lasting modification to the ordinance. The ordinance will outlive this group and many more City Councils. Tonight you spoke about the Bolt Act and other community's legal solutions. Greg, I mean Greg Marker, and Robert told us on 12 February 2014 that Dearborn allows a floor drain next to the sump pump. Our city refuses to consider a similar gravity supported FDD back up system. Tonight you spoke of a minority report, however Fleetham expects you to write it. He spends hours with city staff and the City Attorney. Perhaps he should spend an equal amount of time to truly facilitate and meet with you to develop this minority report. Thank you.

November 12, 2014
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
SSWWE Citizens Advisory Committees Meeting Agenda
Tappan Middle School
Wednesday, November 12, 2014 - 6:30 p.m. to 9:00 p.m.

1. **Welcome –** Nick Hutchinson	6:30 p.m. (5 min.)
2. **Desired Outcomes –** Nick Hutchinson ▪ CAC Support of Final Recommendations ▪ Agenda development for Public Meeting on Nov 19 ▪ Feedback and Evaluation	6:35 p.m. (5 min.)
3. **Review of Executive Summary Changes/Completion Plan –** Robert Czachorski	6:40 p.m. (15 min)
4. **Review of Project Worksheet -** Charlie Fleetham	6:55 p.m. (10 min)
5. **Revised City DOM Proposal –** Cresson Slotten	7:05 p.m. (20 min)
6. **Follow Up to FDD Mitigation Recommendation – Cresson Slotten**	7:25 p.m. (20 min)
7. **Process for Public Meeting (Wed. Nov 19) –** Charlie Fleetham	8:15 p.m. (15 min)
8. **Feedback and Evaluation of Process** – Charlie Fleetham	8:30 p.m. (30 min)
9. **Public Comment:** (three minute limitation per speaker)	9:00 p.m. (till completed)

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
SSWWE Citizens Advisory Committees Meeting Summary
Tappan Middle School
Wednesday, November 12, 2014 - 6:30 p.m.

SSWWE & FDD Citizen Advisory Committee attendees:

▪ Colin Breed	▪ Judy Hanway	▪ Darren McKinnon	▪ Frank Pelosi
▪ Vince Caruso	▪ Peter Houk	▪ Pat Marten	▪ Beverly Smith
▪ Joe Conen	▪ George Johnston	▪ Jim Osborn	

SSWWE Project Team members:

▪ Troy Baughman (Ann Arbor)	▪ Greg DeLiso (Munrovia Picures)	▪ Nick Hutchinson (Ann Arbor)	▪ Cresson Slotten (Ann Arbor)
▪ Lori Byron (Famous in Your Field)	▪ Abigail Elias (Ann Arbor)	▪ Craig Hupy (Ann Arbor)	
▪ Robert Czachorski (OHM Advisors)	▪ Charlie Fleetham (Project Innovations)	▪ Greg Marker (OHM Advisors)	

Public Observers:

▪ Frank Burdick	▪ Jack Eaton (City Council)	▪ William Higgins

1. **Nick Hutchinson, City of Ann Arbor Project Manager, welcomed the group and reviewed desired outcomes.**
   - CAC Support of Final Recommendations
   - Agenda development for Public Meeting on Nov 19
   - Feedback and Evaluation

2. **Charlie Fleetham, CAC Facilitator reviewed City's orderly conduct policy and the meeting agenda.**

3. **Robert Czachorski, OHM Advisors Project Manager, reviewed the Executive Summary Changes/Completion Plan – Robert Czachorski**

CAC reviewed Executive Summary version dated November 4. Team has received additional comments since the version was drafted. Those will be incorporated.

Addition of Item 5., a Section D to include CAC comments on Executive Summary. Requests CAC member comments to be made by December 1st.

For Item 6D, strengthened language regarding routine maintenance.

Section B, Items F & G added to reflect wrap up of process.

Page 7, section was completely rewritten to include complete CAC recommendations regarding FDDs going forward and mitigation.

Page 11, section C Additional Items was modified to include other significant topics of discussion, including U of M's innovative sensor system, as well as FDD alternate options such as floor drains as emergency overflow tools.

Page 13, item 7, Gravity backup suggestion.

CAC discusses the ambiguity of determining intent in installing a floor drain as emergency overflow.

Charlie asks how the CAC wishes to handle the issue on the CAC's recommendation.

Comments and questions regarding sump pumps and floor drains:

Q: Is installing a floor drain with a sump pump in an attempt to have sump water discharge to the sanitary system?

A. The team understood the City's building official to say that installing a floor drain with an FDD would be viewed as an attempt to have sump water discharge to the sanitary system and would not pass inspection State Plumbing Code.

- Request that the City get clarification from the State Building Department: can you move your floor drain next to the sump pump?
- If the drain already exists in the basement and drains to the sanitary, what's the difference?
- Recommend that we ask the State to interpret the Building Code to determine whether it was allowable.
- CAC requests a copy of Livonia's program to see how they allowed it.
- Greg Marker raises a constructability issue because the new drains are installed at a higher elevation than the existing floor drains, which results in water seepage or flooding in the basement.
- Hesitate to call this a backup system, because it's really an emergency measure.

Robert will make all the changes noted and will post a final draft version, along with a red-line version to show what's changed, to Basecamp. The CAC is asked to review and approve the final version, which will be delivered to Council.

Robert reviews the volumes of technical reports that will be included in the final project report.

Additional questions/comments on the Executive Summary:

Q. Can you put a link to all the reports in one post.

A. Yes, Robert will create a single post on Basecamp with all reports and attachments in one location.

Q. Will the Final Report include the CAC's recommendations on FDDs and mitigation? Concerned that Council is so overwhelmed with material, that the Executive Summary should be as brief as possible.

A. Yes, the team will create a 1-page overview of the recommendations and include in the front.

Q. Be sure to include information in the report about stormwater as well as installing permanent meters. Make it a more robust effort, City-wide, not just in target areas. Will be important in the Lawton and possible Glendale areas.

A. Yes, the recommendations are prominently included in the Executive Summary.

Q. Is it true that City-wide, stormwater flows play a small role in overall flooding, but in areas with high water tables, removing excess stormwater may relieve localized flooding problems?

A. It may be the case, but that issue has not been studied. The Comment section is a great place for CAC members to emphasize their opinion of the high importance of the issue.

Q. An earlier response about the composition of flows in the sanitary sewer system is that 48% of the flow in the system comes from inflow and infiltration. Should we be trying to find out what is causing it?

A. Yes, in areas that are experiencing problems it makes sense to find out what's causing those high flows. In other areas, where there are no capacity issues, it's not as pressing an issue to remove the flow. In most systems, 25% to 60% of the sanitary sewer flows are from I & I (inflow and infiltration.) It's also a matter of weighing the cost of finding and removing the source of the infiltration against the benefits doing so would bring. Keep in mind that the rotating maintenance program is intended to find some of those sources and remove them.

4. Charlie Fleetham reviews Project Worksheet.

Crossed out sections indicate those topics that were discussed and voted on at previous CAC meetings.

CAC member adds another 'yes' vote on Section 1. Go Forward Sanitary Sewer Wet Weather Mitigation.

Clarified CAC's recommendations on FDD as Program Tool (for City Projects); added a section for recommendations for DOM program changes.

Added section G, under 3. FDD Mitigation with information about rate study examining creating a separate class of ratepayers for those who have footing drains discharging to the sanitary sewer system.

Questions on a rate study:

Q. CAC member questions the intent of a rate study.

A. Craig Hupy clarifies that City staff would recommend to Council that a rate study be conducted. When a rate study occurs the rate consultant would be asked to examine creating a separate class of ratepayers.

Q. Will the rate study incentivize homeowners to get FDDs?

A. That's not the intent of the rate study and because there's no recommendation to continue FDDs as a tool for City programs.

Q. Would the rate study cover sanitary and storm?

A. No, the rate study would cover sanitary and water.

Q. Will we discuss radon tonight?

A. Cresson responds that between the time the SSO Study was conducted and the FDD program was launched, the City consulted with radon mitigation experts, which resulted in the spec including a sealed cover on the sump pump. Notes that radon enters a home from many locations. Also notes that Washtenaw County is a pocket of high radon levels, with as many 40% of homes having radon issues.

Comments on radon:

- CAC member recommends testing for radon before an installation and after an FDD installation. If there is an increase in radon, it's the right thing for the City to help with mitigation.
- Another member comments that having a sealed sump pump tied into the footing drains actually benefits the homeowner because the infrastructure for mitigation is already in place, and costs less than a home without the sump pump connection.
- I think there's confusion about the whole radon issue, the A2FDD website says that radon is not a concern for FDD homeowners. Those sealed covers don't remain sealed, some homeowners don't know how to reseal the lid after maintenance. Wants the City to clean up the answers on the FDD website and that the City should pay for radon tests for FDD homeowners.
- Also recommends that the City pay for radon tests for FDD homeowners.
- If you have a home in Washtenaw County, you have a higher chance than others of having radon in your basement. Having a sump pump installed is unlikely to make any difference in radon levels. Believes that anyone who lives in Washtenaw County should have a radon test, regardless of whether the home has a sump pump. Does not believe that the City should pay for all those radon tests.

Charlie polls CAC on whether to recommend that the City provide radon testing for all FDD homeowners:

7 – No
3 – Yes
1 – Not sure

5. Cresson Slotten reviews revised City DOM program proposal:

Cresson reviews the changes in the document from the October meeting:

- Clarifies that DOM requirements would apply to developments that would add flow contributing to one of the five project areas identified in the SSWWE project.
- Provide a map to developers identifying properties that fall upstream from the 5 identified SSWWE project locations.
- Added "case-by-case basis" to make an appropriate payment.
- Added "development in some areas may require immediate, specific, mitigation prior to the development adding flow to the sanitary system to avoid potentially impacting high risk downstream areas."

Additional questions/comments on the DOM program proposal:

Q. Regarding in lieu payments, would the City staff determine which projects would be required to perform immediate, specific mitigation?

A. Yes, largely. City staff reviews the developer's plans, negotiates with the developer regarding the specifics of the development and then makes recommendations, which are then sent to Council for final approval.

Q. What is Table A?

A. Table A is a table of flow values used to calculate the flows that a development will generate. Table A is now a dated document, and the City and the development community both believe that it should be updated. The development community will be engaged in modifying the flow rates used in Table A.

Charlie polls the group on the following items from the Final Recommendations worksheet:

- Continue developer offset mitigation requirement? Yes, all.
- 2B, Recommend potential DOM changes as outlined by Cresson? Yes, all
- Eliminate mandatory FDD program? CAC member who was absent during the October polling adds a "yes" vote.
- Item C3. Modify to "Voluntary, incentivized, robust" program with changes that align with best practices and that gathers input from candidate neighborhoods. Another "yes" vote.
- Provide backup pumps for all future FDD homeowners? CAC members who were absent during the October polling add one "yes" and one "no" vote.
- Pay for damages from out of spec installations? Two "yes" votes.
- Pay for operations and maintenance for FDD homeowners? One "yes" vote, one "no" vote.
- Support for seniors and economically disadvantages. One "yes", one pass.

Item 3G. Address modifying rates for properties without footing drains in a rate study

Cresson recaps the CIP process from the presentation that Deb Gosselin made at a previous CAC meeting to describe how the CAC's recommendations for project programming would fit into the CIP process.

- A typical rate study takes 6 months or so to complete and costs around $300,000 - $400,000. CAC members who were absent during the October add two "yes" votes.

Charlie verifies that the Executive Summary, Page 7, Item 3, IV, includes the CAC's desire to make contractors responsible for FDD repairs.

Questions/comments:

Q. What does "robust, incentivized" solution mean?

A. Robust means a high quality pump, a back up pump.

Q. Will these comments be included in the document? They are creating confusion about which items were voted on and which were individual's notes.

A. All comments on the worksheets were catalogued and included on the worksheet under CAC Concerns section. For the sake of clarity, Charlie agrees to remove all comments from the worksheet and asks that CAC members post their comments on Basecamp to be included in the new Section D of the Executive Summary.

Q. Will the City correct all FDD installations that are out of spec, or only those that caused water damage?

A. The City's mitigation program will address homes who believe their FDD installation may be out of spec.

- Concerned about the language on the payment in lieu section in the document requiring immediate, specific mitigation, rather than pooling developer funds to solve one of the big five SSWWE project areas. Believes that it would be in the City's best interest to get the payment in lieu for those developer projects in the SSWWE areas.
- Homeowners who bought houses in Ann Arbor with footing drains connected to the sanitary sewer system had an expectation of NOT having the burden of operating and maintain a sump pump.

6. **Process for Public Meeting (Wed. Nov 19) –** Charlie Fleetham

- Postcards were sent to all FDD homeowners.
- Public Meeting posted on City's website.
- Press release sent to the media.

Asks if CAC members have any specific requests for material to be covered during the meeting.

Comments:

- Believes that FDD participants had an expectation to not have a sump pump and should be given special consideration because unlike homeowners who purchased a home with an existing sump pump.
- Believes that all out of spec FDD installations should be fixed, regardless of whether the home had had water in the basement.
- Homeowners who are concerned that they have out of spec, but have not had water damage can request an inspection.
- Wants it emphasized at the Public Meeting that the CAC unanimously recommended that FDD program not continue as it was implemented.

7. Craig Hupy recognizes and thanks the CAC for their dedicated service in serving on the Committee.

8. Feedback and Evaluation of Process – Charlie Fleetham

Charlie gives CAC members an evaluation form to share their opinions and comments on how the project was conducted, as well as the project team members.

Comments from CAC members:

- Probably did as well as could be managed, considering how complex this project is, and how much information was involved. Felt the team listened to opinions, while keeping the project on track. Believes that the committee members did a great job in keeping homeowners concerns at the forefront.
- Thanks for letting me join late in the process.
- A difficult issue to tackle, but did a good job. Appreciate all your efforts, staff included.
- Thought it was very difficult to be on this committee, there was a lot of material.
- I know more about sanitary sewer than I ever expected to. It was a good group of people and I think we came to some good conclusions.
- Been great to meet everyone on the CAC, the project, the staff, the facilitation.
- Great experience, learned things from other CAC members, Executive Summary was well written.

Nick extends his thanks to all the CAC members for their time, especially because it was a difficult project based on the volume of material involved. Notes that for the staff, the project is just beginning.

Cresson appreciates that CAC members volunteered so much of their time and knows that it created a much stronger end project.

Robert Czachorski enjoyed meeting each of the CAC members and getting to know each of them and their perspectives. Offered that any CAC member with questions could contact him, he's happy to answer them on his own time.

9. Public Comment

(William Higgins) This is a little anticlimactic, but I'm disturbed by this problem of the 24-inch curbside pipe. I know there's an explanation for it. This is a picture of a frozen leaf guard. And behind it is a pattern of spray. This picture was taken 8 days after 10 degrees of ambient when it hit 46 degrees and the sun is hitting the bricks and it's melting ice. So where did the ice come from? I have 500 feet roughly of 6-inch curbside pipe at 24 inches. There's maybe two possibly three connections to sump pumps. Mine runs once a week for 3 seconds and a gallon and a half. Even after 8 hours of rain and a half-inch from 4 in the morning until 8 o'clock at night it ran once for two seconds. I have 42 feet of 2-inch pipe from this thing to the 6-inch pipe and another hundred feet to the curb basin. Now, if we are dealing with prolonged 10 degrees which we did and there's no water in that pipe, there's nobody pumping it, mine doesn't pump. The temperature of that 500 feet of pipe is below freezing, we don't know what it is. We know you can go down 42 feet and put a pipe in and it's supposed to not freeze, so somewhere between ground level and 42 feet is the temperature of that pipe. If I take a bucket of water and dump a gallon of water in that pipe, it'll never see the end. It'll never get there. And it didn't. This is not just one house. So this program may be over with, but it seems to me that it would be a good idea to measure this winter the temperature of depths and be able to handle this problem when it reoccurs. And it's going to. It's been quite a long run but it's not over with. Thanks.

(Frank Burdick) Well, you guys can all start ignoring me now. You know I wrote a lot of bullets during the course of the meeting and a lot of technical issues and rebuttals and things to talk about. But I want to just hit on a couple of them because what's the point, you don't listen anyways. I guess one is why does George Johnston get a vote all of a sudden? He's been here for two or three meetings, I've been here for all 16. That kinda concerns me a little bit. And it seems that someone could be perceive that it's another ringer for the city, so they could get their count up the way they want. The bottom line here is the City adopted this FDD program as the cheap way out. In 2001, other things were on the table, everything was different. The program is wrong, it's illegal and the city can't own up to the harm they've caused without risking a huge cost to fix what they broke. Your six-figure city paid city staff all are marching to the same drummer. They're keeping their mouth shut per the direction of certain players at City Hall. Bottom line, I've said it over and over, til I'm blue in the face, gravity backup system is the win-win solution and you all just want to tune me out right here, but I really want you to think about this. All that's really needed it to seek a variance from the state code. That's all that's needed. If the city can choose to make up their own ordinance, make up their own code more or less. And Ralph Welton told us on Feb 12, I'm hired to enforce the code and the local ordinance in the jurisdiction where I work. It's a simple matter of getting a variance to the code. And that's your win win solution. For your existing installations for the people are being harmed by this. That it's the win-win solution for the people who want to volunteer for one. I started with this on August 25, 2013 or whatever it was and I'll end with it now. Thanks for nothing.

(Greg Marker) I just wanted to say that I've enjoyed working with every one of you, it's was a fun project so far. I reiterate wheat Robert said, I am available after project, you can call me with questions. I love this topic and I enjoy talking about it. My service to you does not end here. You know, we've built relationships; feel free to use me if you have a question at a future date. I do enjoy what I do and if you have a problem or a question, I would love talking about it later. So, I thank everybody for your time here today and for the last year because there's a lot of work you guys put in, and I had fun doing it with you. So, thank you.

November 19, 2014
CAC Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project [SSWWEP]
Public Engagement Meeting Agenda
Slauson Middle School
Wednesday, November 19, 2014 - 6:30 p.m. to 8:30 p.m.

1. Welcome - Nick Hutchinson	6:30 p.m. (5 min)
2. Desired Outcomes – Nick Hutchinson ▪ Present SSWWE Project Objectives and Results ▪ Present Project Recommendations and CAC Preferences ▪ Feedback	6:35 p.m. (2 min)
3. Introduction to Facilitator and Facilitation Process – Charlie Fleetham	6:37 p.m. (3 min)
4. Project Background/Starting Objectives/Summary Results – Nick Hutchinson Nick, the City Project Manager, will review the origins of the project, the starting objectives, and summary results.	6:40 p.m. (15 min)
5. Project Methodology and Results – Robert Czarchorski Robert, the OHM project manager will describe how wet weather flow was measured and the results. He will also describe how future risks of basement backups were modeled and provide more detail on the major findings and recommendations that emerged from the modeling process.	6:55 p.m. (20 min)
6. The Footing Drain Disconnection Investigation Results - Robert Czarchorski Robert will present the results of the FDD survey, the results of the follow up investigation, and the go forward recommendations.	7:15 p.m. (30 min)
7. Public Engagement Process – Charlie Fleetham Charlie, Public Engagement Task Leader, will review the public engagement process deployed in the project and will highlight the accomplishments of the Citizens Advisory Committee.	7:45 p.m. (25 min)
8. Summary, Thank You, and Next Steps – Nick Hutchinson Please make sure we have your contact information. We will send a follow-up message with the meeting summary and other materials to everyone who provides an email address this evening. Materials will also be available on line at www.a2gov.org/SSWWE.	8:10 p.m. (5 min)
9. Public Comments (3 minute limitation per speaker)	8:15 p.m. until finish

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project [SSWWEP]
Public Engagement Meeting Summary
Slauson Middle School
Wednesday, November 19, 2014 - 6:30 p.m.

1. Welcome and Desired Outcomes – Nick Hutchinson

Nick Hutchinson, City of Ann Arbor Project Manager introduced the project team members and reviewed the desired outcomes for the meeting:

- Present the SSWWE Project objectives and results
- Present the SSWWE Project recommendations and CAC preferences
- Hear feedback from public

2. Project Background/Starting Objectives/Summary Results – Nick Hutchinson

The City of Ann Arbor experienced sanitary sewer basement backups for decades. This problem became even more significant in the late 1990s when hundreds of homes had sewage in their basements during heavy rainstorms. An SSO Task Force formed in 2000, made of citizens and technical experts, and evaluated various alternatives, such as storage, upsizing pipes and FDDs. After collecting input from citizens during a series of public meetings, the Task Force recommended implementing a Footing Drain Disconnection Program to remove stormwater flows from the sanitary sewer system.

The Sanitary Sewer Wet Weather Evaluation (SSWWE) Project was initiated in early 2013. The study's purpose is to evaluate the effectiveness of the FDD program in reducing sanitary sewer backups, the future risk of basement backups and evaluates methods of mitigating wet weather impacts.

Nick showed a short video that explains the SSWWE project's history and purpose.

You can view the presentation on the project website at A2gov.org/SSWWE.

Summary results – SSWWE

1. FDD program significantly reduced the risk of basement backup in the target areas.
2. No more mandatory FDDs in target areas.
3. Five potential future problems discovered outside the original five target districts.
4. These five potential problem areas will be studied for correction.
5. WWTP has capacity to serve existing and future systems needs.

Summary results – FDD

1. Broad level of satisfaction with FDD program, but with many reports of dissatisfaction.
2. Water issues investigated. Most resulted from non-FDD issues. (Most frequent causes - grading, failed footing drains, stormwater entering through cracks, windows, etc.) Ten were found to be caused by installations that do not meet specification. At that rate, there may be a total of 36 or more out of spec installations.
3. City will initiate programs to correct out-of-spec installations.
4. City to implement program to inform and educate citizens on operating and maintaining their sump pumps.

CAC made nine recommendations to correct/improve the FDD Program, which included a task to explore different rate classes in future rate study, support for seniors and economically disadvantaged residents to assist with operations and maintenance activities and expenses, and paying for damages caused by out of spec installations.

Questions and comments:

Q. Are you expecting any action by Council regarding the FDD ordinance?
A. Yes, we think it's likely that the ordinance would have to be modified, based on the results of the SSWWE Study, but we don't yet know the specifics.

Q. In 2000, if you had measured flow in the five problem areas identified, would you have found those same areas? Wouldn't it have been better to save the money spent on the FDD Program and instead fix those issues?
A. In 2000, the flow was measured. There were many more problems across the sanitary sewer system in 2000 than there are today. The City's sanitary sewer system has fewer problems and more capacity as a result of the FDD program.

Q. Is it anyone's intention to evaluate the FDD spec to see if they comply with code?
A. The FDD spec was developed with the input of building officials and other specialists, to be code compliant.

Q. By a show of hands, how many engineers here think that burying curb lines at 24" have no chance of freezing?
A. The specification has been reviewed when it was created and has been reviewed several times since it was developed. The specific issue about burial depths has been reviewed and a pipe with a positive slope, carrying sump pump water, which is typically about 50 degrees should not freeze. However, if there is a belly, or a small dip in the line, that can trap a small amount of water that could freeze; that is what happened on Avondale.

Q. How do I know if I have an out of spec installation?
A. If you have a concern, such as water in the basement, you can let the City know and when the mitigation project begins, your home can be investigated.

Q. I'm new to the area, my home is on Weldon. Did my home have an FDD?
A. Based on where you live, it's likely that your home had an FDD. Please give your address to one of the project team members and that individual will check the records and let you know.

Q. How do you know who the FDD homeowners are?
A. The City has a record of each address that underwent an FDD.

Q. I'd like to think that the City should review the specifications.
A. Thank you for your suggestion. The specifications have been reviewed multiple times. If there were to be an FDD program going forward, the specification would be reviewed again for continued code compliance and to incorporate the most recent best practice suggestions.

Q. Do you have a prediction as to how many people who have had FDDs will have problems in the future?
A. No, we don't have a prediction, however, when out of spec installations are corrected, there will be a notification for homeowners who have concerns.

Comment: Some of the citizens have solved the problem for all of the citizens.

3. Public Engagement Process – Charlie Fleetham

You can view the presentation on the project website at A2gov.org/SSWWE.

Summary results – Public Engagement

Very robust public engagement program, including an active and engaged citizen advisory committee, video recording of each public meeting, detailed meeting summaries, videos explaining aspects of the project and infographics, among other engagement tools. A Citizens Advisory Committee was formed and met 16 times to review data, ask questions and make recommendations.

Questions and comments:

Q. Can you speak to the fact that you integrated a developer into the committee and that you removed a member?
A. Early in the process, the Committee set the standard that any resident would be able to join the committee at any time, as long as they were able to bring themselves up to speed. A resident who happens to work for a developer asked to join the CAC and did so. And yes, one member was removed the committee. This occurred after the committee established norms and that member violated the norms of conduct. There was a clear process for removal, which was communicated to that member.

4. Project Methodology and Results – Robert Czachorski

Consultant Project Manager, Robert Czachorski of OHM Advisors, reviewed the results of the SSWWE Study. You can view the presentation on the project website at A2gov.org/SSWWE.

The TOAG (Technical Overarching Advisory Group) is an independent, technical body comprised of subject matter experts who reviewed the SSWWE study methodology and results.

FDD Program was effective in removing stormwater flows from the sanitary sewer system during wet weather events. During a large rainstorm in June 2013, there were no reported basement backups caused by the City's system. That's a sharp contrast from 2000, when there were widespread basement backups.

Flow analysis findings:

- The FDD program significantly reduced stormwater flows to the sanitary sewer system.
- The FDD program greatly reduced the risk of basement backups in the target areas.
- Mandatory FDDs are no longer recommended in the target areas.

The hydraulic capacity assessment shows that there are five areas that could be considered "bottlenecks" in the system, or places where the capacity is less than expected. This is much, much less than before the FDD program. OHM Advisors has done approximately 100 of these studies and the issues in Ann Arbor's system are much less severe than most other cities. Another change is that these capacity issues are not in the neighborhoods, but are upstream, in the interceptors. The team developed a plan of action for each of the five problem areas.

Questions and comments:

Q. What percent of the flow removal can be attributed to manhole repairs and other maintenance?
A. The City did not have major repair or maintenance programs in the target areas, so the flow removals cannot be attributed to those things.

Q. It appears that the FDD Program didn't work in Glen Leven.
A. Yes, the FDD program was less effective in the Glen Leven target area.

Q. Can the results in Dartmoor be attributed to the higher percentage of multi-family homes?
A. That could contribute to the results.

Q. What's the capacity of the plant before the upgrade and what will it be in the future?
A. The plant's capacity is a more complex concept than a single number because the plant has capacity to accept and treat flows, as well as store flows for a period of time for treatment later. The current WWTP has a design capacity of 29.5 million gallons per day (MGD. Additionally, the plant has storage that can handle short peaks in flow rate that, if extrapolated to a daily rate, would be the equivalent of about 70 million gallons in a day. On average, the plant treats about 18.5 MGD, or about 60% of its capacity. The treatment capacity will not change with the plant upgrades; the upgrades are renovating old buildings and equipment, not increasing capacity. On the project website (www.a2gov.org/SSWWE) you can see a short video that explains the plant's functions and capacity.

Q. With all the development in the last ten years, how can you know that the treatment plant has capacity in the future?
A. Ten years ago, the plant was not operating at capacity and over the last decade, the City has required that developers offset any flow they expect to add to the sanitary sewer system. This practice, as well an overall reduction in water consumption mean that the plant has adequate capacity now and in the future. The CAC recommended continuation of the Developer Offset Mitigation program, with a few modifications.

- Note that the City was under a consent order by the EPA to avoid sanitary sewer overflows into the Huron River. Welcome to City Council members in attendance.

5. The Footing Drain Disconnection Investigation Results - Robert Czachorski

Robert Czachorski reviewed the 2013 FDD survey results, which prompted the FDD investigation. You can view the presentation on the project website at A2gov.org/SSWWE.

Objectives of the survey and follow-up investigation:

- Document problems
- Identify common issues
- Develop recommendations

Based on survey results, City initiated an investigation of those homes where the owner reported water in the basement after an FDD installation. Of 101 incidents on the survey, 77 were investigated via phone or site visit. The engineer found ten homes where an FDD that was not installed properly caused water in the basement. In about 50 homes, there was another cause of water in the basement.

Some of the reasons for complaints of water in the basement "not related to FDD:"

- Grading that directs water toward the house
- Failed footing drains
- Stormwater leaking through a crack or a window.

Process – the team worked with Subcommittee to create recommendations for future actions. CAC recommendations regarding FDD:

1. Do not retain FDD program as is.
2. Any future FDDs must be voluntary, robust and incentivized.
3. Correct out of spec installations.
4. Conduct outreach program.
5. Implement best practices.
6. Provide backups systems.
7. Pay damage claims due to out of spec installations.
8. Support seniors / economically disadvantaged.
9. Include task to explore different rate classes in future rate study.

Recommendations that did not achieve consensus:

1. Homeowner compensation for sump pump operations and maintenance.
2. Free radon inspection program.

CAC members who had a strong feeling about radon (as well as other issues) can add their comments to the Executive Summary, in order to make their opinions known to City Council.

Questions and comments:

Q. Wasn't doing a survey in your scope of work?
A. Doing a survey of this level was not; detailed paper surveys were mailed to 2300 homes and then data entered manually.

Q. Do you have an estimation of the expected lifetime of a pump is?
A. Each home has its own rate of flow that determines the life expectancy of the pump. Manufacturers offer general guidelines that pumps last ten years on average.

Q. Regarding the 10 homes that had problems because they were out of spec, did you find any patterns? Any particular contractors> How soon after the installation was made did you discover the failures?
A. We could not find any geographic patterns to the problems, nor any concentrations among particular contractors. Of the 100+ homes investigated, most had had footing drains disconnected and sump pumps installed between 2004 and 2008. The investigation was conducted in 2014.

Q. Did you find problems with any particular contractors?
A. Three ways that an installation can be out of spec: out of compliance with building code, out of the manufacturer's installation instructions or out of industry standard best practices. None of the ten instances were out of building code, which is what the City inspector staff evaluates. These ten did not follow manufacturer's installation instructions or industry standard best practices.

Q. What is a good, reliable backup system?
A. The most common backup system is battery backup. The second most popular is water-powered backup pump. The third type is a generator, to replace power sources. Each of these is progressively more expensive.

Q. You need to let people know about the radon issue. If you don't want to pay for the test, it's $10, but you need to let people know. I had to pay $800 for a mitigation system. Let people know.
A. Some of the CAC discussions on radon were that Washtenaw County has a naturally high level of radon. Anyone who lives in Washtenaw County should be aware of that risk and determine whether they wish to have a radon test. Another aspect the CAC discussed related to radon was that the City's spec required that the sump pump lid be sealed. There are also many other sources in a basement where radon can enter the home, such as cracks in the walls or around windows.

Q. Can you tell us the cost of the FDD Program to date?
A. I don't have the exact figures, but in recent years, the Capital Improvement Program has had about $2.5M per year allocated to the FDD program.

Q. How much would it have cost to enlarge the sanitary sewer pipes rather than intruding into the integrity of our homes? Why wasn't that option more seriously considered? Even if the cost was double, it might have been better than to expose citizens to pump replacements forever.
A. SSO Task Force weighed those issues and examined enlarging pipes and because the locations would have disrupted large swathes of green space and would have only pushed the problem further down the system, the Task Force ultimately recommended the FDD Program.

Q. How many people on the CAC had sump pumps?
A. I think about half of the citizens on the committee had sump pumps. Others were interested because they had had basement backups or water in their basement.

Q. Do you know how many people put in gas generators?
A. We did ask that question in the survey, however we don't know the number on the spot.

Q. My basement is flooded and I reported it to the City, but they said that they don't know why. I've got about a $6000 bill.
A. Please give me your information after the meeting and someone from the City will look into it.

Q. Air gaps don't comply with code. Your specs are not code. What's your intention to remedy the problem with the air gaps not up to code?
A. We are not aware of any air gaps that do not comply with code.

Comments:

- I live in Orchard Hills and had an FDD in 2008. Recently, my pump began to run often. The repair services recommended replacing the entire unit, which cost about $300. I think that everybody who has these sump pumps is exposed to these risks and expenses.
- We have a lady on Delaware who has replaced her sump pump 9 times.
- I think this program is a terrible disservice to the homeowners in the target area. It exposes the homeowner to ongoing risk from sump pump failures and loss of electricity.

- I also had to install a battery backup, because of fear of failure or loss of power, which cost about $700. Also, as a senior on my own, I cannot perform the maintenance that's recommended.

- I'd just like to say that those of us who enjoy the river and who had feces in our basements appreciate those who up the hill or in the middle who went through the FDD program to help keep feces out of our basement.

- I had flooding in my basement when my curb drain froze and it caused flooding in my basement, so even if I don't have an out of spec installation, I still had flooding caused by an FDD.

- My sump pump is installed in a crawl space. I bought a radon detector and it showed high levels of radon, so everyone should get their radon tested. Also, after a heavy rain, I hear a rattling water flow going up the side of the house. I never had problems before the FDD program.

- A backup also requires an additional battery, etc. That's why it's so expensive.

- I don't understand why 7 people decided not to recommend radon testing. Sealing the cover is not a solution; most installations I've seen are no longer sealed.

- The 2001 SSO Report recommended that the City test before installing a sump pump and test radon levels after. If you're supposed to open the crock to clean it out, why is sealing the lid thought to be a solution?

- It seems to me that it would have been better for the City to level these houses than to install these FDDs.

6. Public Comment

My name is Frank Burdick and I was on the CAC, I was the one kicked off the CAC. You can see why, because I don't really like the answers I get from the City or I should say the lack of answers. They're not forthcoming. My perception is they're always hiding behind something. Now my perception is that they're hiding behind the direction of the City attorney, so now they can't tell the truth. Tonight's the opportunity for the City to check the box to say that they've had public outreach. There's two other meetings going on, a stormwater calibration meeting and a pedestrian task force so people who wanted to come to this but they also went to another meeting. They like to talk about this FDD Study that I helped create and the results of that study they say that there's a certain percentage of people that are satisfied with it. Well if Ford Motor Company had 20% of their buyers dissatisfied with their car, would Ford Motor Company still be in business? I don't think so. The other thing about that survey is, it was put out in a non-descript envelope right during the Christmas holiday season and most of them got thrown away. And the ones that didn't even got opened, if you were a dissatisfied homeowner and it was during the Christmas season, would you want to sit down and berate the City for what they did to you? Or would you want to throw it away and have a happy holiday? Some people believe in sugar plums, but that's what I think. So this study is flawed. The CAC members were, they worked hard and but what ended up happening, I was there every meeting, I saw it, what ended up happening is some people started and were motivated by it, but the remaining people that continued to sit on the CAC, most of them were people that the City put on the system. They weren't people that were advocates for the general public they were there to help the City reach desired outcomes. Thanks.

D. CAC Recommendations

CAC final preferences regarding project recommendations can be found on the following page.

SSWWE CAC Final Preferences Regarding Project Recommendations

1. Go Forward Sanitary Sewer Wet Weather Mitigation

A. Action Plans for 6 Project Areas

a. Huron / West Park
b. High Level / 1st Street
c. High Level / State & Hoover
d. Pittsfield Valley
e. Glen Leven
f. Glen/ Fuller Diversion
g. Use "Scenario C" if sanitary sewer upgrades needed in any above

	YES	NO
Support:	11	0

B. Install Permanent Meters

	YES	NO
Support:	11	0

C. Rotating Maintenance Program

	YES	NO
Support:	11	0

2. Go Forward FDD

A. Proposed DOM Changes (11/12/14)

	YES	NO
1. Do not continue with DOM as is	11	0
2. Mitigation City-Wide w/provisions for five SSWWEP Project Areas	11	0
3. Revise design flow rates (Table A)	11	0
4. Eliminate 20% Recovery Factor	11	0
5. In lieu develop payments	11	0
6. Eliminate 24 month requirement for developer to use DOM credits	11	0
7. Re-evaluate periodically, and identify other high risk areas as they appear	11	0

B. FDD as Program Tool (for City projects)

	YES	NO
1. Retain as is	0	10
2. Eliminate Mandatory FDD	**7**	**4**
3. Modify to "Voluntarily, Incentivized, Robust" program with Changes that Align with Best Practices and that gathers input from candidate neighborhoods.	10	1

3. FDD Mitigation

	YES	NO
A. Correct Out-of-Spec Installations / Conduct Outreach Program	12	0
B. Implement OHM Best Practices	12	0
C. Provide Back-ups	8	4
D. Pay Damage Claims (due to out of spec)	11	0
E. Homeowner Compensation for O & M	3	9
F. Support for Seniors / Economically Disadvantaged	8	3
G. City initiates free radon inspection program for all City Program FDD residences	3	7
H. Examine Modifying Rates for Properties without Footing Drain in Rate Study	10	1

Nov. 12, 2014

IV. Public Meeting Agendas and Meeting Summaries

Meeting Agendas and Summaries are included on the following pages for meetings that took place on:

April 23, 2013
February 6, 2014
September 17, 2014
November 19, 2014

April 23, 2013
Public Engagement Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
Public Engagement Meeting Agenda
Tappan Middle School
Tuesday, April 23, 2013 - 6:30 pm to 8:30 pm

1. **Welcome -** Nick Hutchinson — 6:30 pm (5 min)

2. **Desired Outcomes –** Nick Hutchinson — 6:35 pm (5 min)

   - Why is the City doing a Sanitary Sewer Wet Weather Evaluation Project?
   - Who is on the project team?
   - Describe what is happening on the project, including the schedule and deliverables, in easy to understand terms.
   - Get your feedback!

3. **Project Introduction** – Ann Arbor Staff — 6:40 pm (15 min)
   City of Ann Arbor staff will describe the background and purpose of this project and the project objectives. They will identify project materials, including the description and the FAQ documents. Also, they will summarize other ongoing projects related to this wet weather study.

4. **Team Introduction –** OHM Team Members — 6:55 pm (5 min)
   The OHM team members (consultants) will introduce themselves and their roles.

5. **Project Description** - Robert Czachorski — 7:05 pm (20 min)
   The OHM project manager will describe how the team plans to measure wet weather flows and to study them in order to produce a city-wide recommendation for managing the risk of sanitary system overflows.

6. **The Citizens Advisory Committee –** Nick Hutchinson — 7:25 pm (10 min)
   City staff will call out for interest in participating on a Citizens Advisory Committee – a vehicle for you to get involved as an advisor and a decision maker on the project recommendations.

7. **Facilitated Discussion -** Charlie Fleetham — 7:35 pm (45 min)
   We will conduct small breakout discussions followed by report out to all participants. Discussion topics will include footing drain disconnection concerns, flood prevention, engineering approach, and city oversight/decision making. Comments to the group at large will be welcomed!

8. **Summary, Thank You, and Next Steps –** Nick Hutchinson — 8:20 pm (5 min)
   Please make sure we have your contact information. We will send a follow-up message with the meeting summary and other materials to everyone who provides an email address this evening. Materials will also be available on line at www.a2gov.org/storm

9. **Adjourn** — 8:30 pm (5 min)
   Please help yourself to an information packet! It contains more details on the project, contact information for the key team members and a summary of the Citizens Advisory Committee.

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

City of Ann Arbor
Sanitary Sewer Wet Weather Evaluation Project Public Meeting
Meeting Summary April 23, 2013
Tappan Middle School Media Center

1. Nick Hutchinson, Project Manager for the City of Ann Arbor's Sanitary Sewer Wet Weather Evaluation Project kicked off the meeting, outlining its purpose:

- Explain why the City is performing a Sanitary Sewer Wet Weather Evaluation Project.
- Introduce the project team members.
- Describe the project, including the schedule and deliverables, in easy-to-understand terms.
- Get community feedback.

2. Small group introduction and discussion.

Participants at tables introduced themselves to each other and discussed their interest in the project.

Each table held a map, depicting the location of the 30 flow meters installed to measure wet weather flows and the five high priority neighborhoods that were the focus of the Footing Drain Disconnection program.

3. Project Background and Other Wet Weather Projects

Nick Hutchinson introduced the City of Ann Arbor staff members working on the SSWWE project. Hutchinson described the background and purpose of the SSWWE project.

The project – focusing on prevention, inclusive public engagement, scientific analysis, and environmental concerns – is designed to do four things:

- Measure how much the FDD program reduced stormwater flow into the sanitary system.
- Assess the current risk of sewer backups in the City.
- Research and evaluate new ways to control the impacts of stormwater on the system.
- Develop a plan to manage the risk of sanitary system overflows going forward.

Jen Lawson, City of Ann Arbor's Water Quality Manager gave an overview of the three other related wet weather projects:

- **Upper Mallet's Creek Stormwater Conveyance Study -** Washtenaw County Water Resources Commissioner's Office, in cooperation with the City of Ann Arbor. The purpose of this project is to evaluate stormwater behavior in the Upper Malletts Creek area. It is an engineering and landscape analysis of what happens to water on the surface of the land if the stormwater pipes are full.

- **Stormwater Calibration and Analysis Project -** to help the City of Ann Arbor identify aspects of the City's stormwater system that would benefit from improvement – and then to make data-driven, citizen-informed decisions about the best way to make these improvements.

- **Footing Drain Disconnection Program (FDD) –** The City of Ann Arbor's project initiated in 2002 at the recommendation of the Sanitary Sewer Overflow Citizens Advisory Committee to reduce the incidents of sewage backups in basements in the City.

  The FDD program is partially suspended as of September 2012, however the City's Project Management team and the project consultant, CDM Smith continue to respond to any reported issues related to FDDs performed.

Additional materials available on the project website:

- Diagram of the four projects and the webpage for each

- Map of flow meter locations

-Project overview flier

4. Project Manager from consultant OHM Advisors, Robert Czachorski introduced the consultant team and their roles.

5. Project Description

The OHM project manager Czachorski described how the team plans to measure wet weather flows and to study them in order to produce a city-wide recommendation for managing the risk of sanitary system overflows.

(See the presentation slides and project timeline, on the project website.)

6. Questions and Answers

During the presentation, participants were invited to share questions, comments and concerns. The questions and answers will be posted separately on the project website, to give community members broad access.

7. Call for Citizens Advisory Committee members

City staff requested volunteers to serve on a Citizens Advisory Committee, kicking off summer 2013.

Citizens Advisory Committee Charge:

- Review materials and data presented by the consultant
- Select economically viable and community acceptable alternative(s)
- Recommend alternative(s) to City Council
- Review public engagement strategy and synthesize public comment
- Communicate to neighbors and other stakeholders

If you are interested in being a part of the Citizens Advisory Committee, please contact Nick Hutchinson at nhutchinson@a2gov.org.

8. Summary, thank you and next steps

City of Ann Arbor staff thanked attendees for their participation.

The next public meeting is planned for November 2013, after flow monitoring is complete.

Individuals who expressed interest in serving on the Citizens Advisory Committee will be contacted in June.

February 6, 2014

Public Engagement Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project [SSWWEP]
Public Engagement Meeting Agenda
Slauson Middle School
Thursday, Feb. 6, 2014 - 6:30 pm to 8:30 pm

1. **Welcome -** Nick Hutchinson — 6:30 pm (5 min)

2. **Desired Outcomes –** Nick Hutchinson — 6:35 pm (5 min)
   - Overview SSWWEP
   - Update on Study Findings
   - Review FDD survey results

3. **Project Introduction** – Nick Hutchinson — 6:40 pm (15 min)
   Nick Hutchinson, the City Project Manager, will describe the origination of the project, the City's objectives for the project, and how the City has organized the project team, including the Citizen Advisory Committee. He will identify the project website, key documents available on the website and summarize other ongoing projects related to this wet weather study.

4. **Introduction to Footing Drain Disconnection** - Robert Czachorski — 6:55 pm (20 min)
   Robert Czachorski, the OHM project manager will provide an update on the study progress and show a video about Footing Drain Disconnection (FDD). The video showing will be followed by a short facilitated question and answer session on results of the study to date.

5. **The Footing Drain Disconnection Survey -** Charlie Fleetham / Nick Hutchinson — 7:15 pm (65 min)
   Charlie Fleetham, facilitator of the Citizens Advisory Committee, will present the results of the FDD survey followed by a presentation by Nick Hutchinson of Ann Arbor's plan to evaluate and address issues reported in survey comments.

6. **Summary, Thank You, and Next Steps –** Nick Hutchinson — 8:20 pm (10 min)
   Please make sure we have your contact information. We will send a follow-up message with the meeting summary and other materials to everyone who provides an email address this evening. Materials will also be available on line at www.a2gov.org/SSWWE.

7. **Public Comments (3 minute limitation per speaker)** — 8:30 p.m until finish

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

SSWWE Public Meeting Summary
Feb 6, 2014
Submitted by Charlie Fleetham, Feb. 13, 2014

Outreach Process

- 850 FDD Survey respondents invited through post card/emails.
- Press coverage in Ann Arbor Chronicle/Ann Arbor News
- A2 Underwater distributed 700 flyers (per Judy Hanway)

Participation

- 38 participants
  - 3 council members
  - 22 citizens
  - 13 CAC members
  - 27 discernible questions and/or comments (12 from CAC members)

Takeaways (Charlie Fleetham, CAC Facilitator)

- Outstanding participation from CAC members
- Participants were patient and thoughtful in their questions/comments
- City made positive impact with plan to address issues raised in survey . . . Greg Marker added value as potential problem solver.
- City reiterated position that it has NOT determined to continue mandatory FDD

Video Questions/Comments (paraphrased)

Comment	Name	Timestamp
▪ *What is the range of confidence interval in the flow results?* ▪ Statistics confidence levels were averaged for the 3 methods used to determine the flow removals. Those average confidence ranges varied from 38.1% to 99.8. Values above 95% are considered statistically significant. This was the base for 3 of the 5 priority districts – Orchard Hills, Bromely and Moorhead. While not statistically significant, Dartmoor was close at 90.1%. Glen level had the lowest value at 38.1%, and also had the lowest computed rate of flow removals.	Frank Pelosi	42:57
▪ I was involved in the 2000 storage effort. Then, the City rejected storage because footing drain disconnection was cheaper. Much more rain is expected in the future and we need to pay attention to it.	Vince Caruso	44:22
▪ *What is the City's view on a flow preventer or check valve? How many houses in 2000 that had backups didn't have check valves? How many check valves have been installed?* ▪ The City does not have any knowledge of check valves existing on homes prior to the start of the FDD Program. Of the 52 homes located in one of the 5 priority areas who reported a basement backup during June 2000, 44 of these homes have had check valves installed as part of the FDD Program.	Frank Burdick	49:00
▪ *If you hook up a back flow preventer to a basement and sewage can't now backup to the basement; as the sewage pipe fills up; there no place for sewage to go. What happens in this case?* ▪ When the check valve is closed preventing sewer backup, but also sewage flow from the house cannot drain out to the city's sewer system. The homeowner will not be able to flush toilets, use sinks, etc.	Jim Osborn	50:22

▪ *How often would storage pipes fill up with a sustained rain?* ▪ The MDEQ requires that storage designed to address sanitary sewer overflows be designed to have overflows not more than once in ten (10) years. The City may elect to provide a higher level of service than this.	Jim Osborn	53:11
▪ *130 people are in the first triage, but 353 people had water issues. Why only 130?* ▪ The most significant issues reported are being investigated first.	Pat Marten	1:03
▪ I didn't have water before FDD; we have replaced sump pump 5 times.	Pat Cook	1:04
▪ *I am concerned about mandates. Remember the sidewalks? I am frustrated. There is a $100 a month fee if you decided not to do an FDD. Is there a maintenance schedule for sump pump; you only find out they are not working when there is water in the basement.* ▪ Pumps manufacturers have recommended maintenance practices. The contractor installing the sump pump should provide this information to the property owner. Additionally, a general maintenance guide can be found on www.a2fdd.com.	Jim Birch	1:05
▪ Greg Marker should use the SSO report as a guideline for inspections.	Frank Burdick	1:09:28
▪ *Did surveys indicate if the flooding was caused by disconnect or is it something we don't know?* ▪ Respondents were asked about flooding, dampness or seepage. The causes of those instances aren't known unless the person reported more details in the comments section.	unknown	1:10:17
▪ *Regarding flooding in basement – did the surveys collect details on the cause of the flooding?* ▪ Again, respondents were asked about flooding, dampness or seepage. The causes of those instances aren't known unless the person reported more details in the comments section.	Jim Osborn	1:11:35
▪ *Were there flooding issues identified to or related to changes regarding impervious surfaces surrounding the homes over time and whether there could be backups anticipated and prevented by sump pumps?* ▪ Unclear on the question, however the Citywide Stormwater Modeling Calibration & Analysis project will be studying the city's stormwater system and possible improvements.	unknown	1:12:46
▪ *Is there explanation on why there is flooding after disconnection?* ▪ A number of factors can cause flooding after disconnection. For sanitary backups, the number of houses in the area that have had footing drains disconnected is important, because it can take many houses in an area to reduce the risk of basement backups from the sanitary sewer. The size and patterns of rainfall and the preceding wetness of the soils also plays a factor. Water seepage or stormwater issues can occur after footing drain disconnection depending on the extent of surface flooding or ground water levels. There is also the potential of a mechanical failure or power failure that can cause the sump pump not to operate.	Frank Pelosi	1:15:47
▪ *Why is there not an explanation on sanitary flooding after sump pump installation? What does the sump pump installation have to do with these issues? Why are people having to have multiple sump pumps installed? The people that have never had flooding before are the most concerned.* ▪ A critical mass of disconnections is necessary in an area before the risk of sanitary basement backup is significantly reduced. Once a critical mass has	Frank Burdick	1:17:12

been achieved, it is likely that the frequency of sanitary backups will be greatly reduced. That appears to be the case in Ann Arbor, and will be verified with the risk evaluation. Some potential explanations for why someone who has never had flooding problems before might be experience flooding after FDD was contained in the previous answer. It is difficult to determine why some people need multiple pumps installed without examining the specifics of each case. Doing that is part of the work that OHM is performing with the follow up to the survey.		
▪ There is an increased risk of problems after having sump pumps installed.	Frank Burdick	1:19:34
▪ I am one of the 12 original pilot homes from 2000-2001. We were identified as a flood area - Saxon, corner of South Maple and Scio Church, coming down from Pauline and South Maple. There were supposed to be 20,000 homes disconnected; some homes were just done last year. South Maple has a dip in the road just before it meets Scio Church; it flooded last year because there was no place for the water to drain. The City needs to go back to the initial study and find out why they disconnected only some homes and never followed thru. They need to check Waltham near Saxon. Even in dry times, the water table is really high, and in those homes the sump pumps are running all the time. They are going thru multiple sump pump and battery backups due to the high water table. The soil is very very wet. These things have to be looked at. As a whole on our street the homeowners and neighborhoods around are not satisfied with the way the FDD program has worked.	Marian Williams	1:21:12
▪ *When the FDD program was first started, could you have done a smaller study first or testing to make sure it would work before going into a HUGE program that was going to cover a large part of the city?* ▪ Prior to the implementation of the FDD program, a pilot test with 11 homes was performed to evaluate the installation methods and expected effectiveness of the FDD work which lead to developing standards for the FDD Program.	Leon Bryson	1:24:41
▪ *What type of study was done to get the desired results? What I'm hearing is that we did not get the desired results; some people that didn't have sanitary sewage backups before now have sanitary backups as a result of the footing drain disconnection and sump pump installed. That is not what we expected to happen; so why would we do that if we couldn't interpret that before we spend a lot of money?* ▪ The City conducted a sanitary sewer study in 2000 and 2001 and conducted a pilot footing drain disconnection program before embarking on the current program. For 4 out of 5 districts, the flow removal rates from the sanitary sewer system are meeting the goals of the program. However, there have been a significant number of issues identified after the program. The City is working to understand and correct those issues.	Leon Bryson	1:26:10
▪ I never had a problem, but 4 years after having sump pump installed, the sump pump was not running when it was raining . . . concerned about not being home the next time. We have had sump pump issues and replaced parts, etc.	Unidentified woman	1:29:24
▪ There should be some type of reimbursement for homeowners that didn't have a problem before FDD.	Jim Birch	1:32:45
▪ How is the $100 charge calculated? ▪ This is being researched by the City.	Unidentified woman	1:33:51

▪ If the FDD is something we are going forward with, it needs to be rolled out a lot better than in the past; as far as backups and how it's installed. I will be looking closely at this issue.	Jim Osborn	1:36:22
▪ I live in the Northeast side of Ann Arbor and I thank the officials that are here tonight for their work and the citizens on the committee. I am very gratified with the results.	Rod Sorge	1:37:45
▪ I think that OHM and the materials and the details they have provided show they are actually paying attention to this group and are 1000 times better than the original sanitary sewer advisory group. Back then, things were just thrown together. There was no continuity; we didn't understand things, and no explanation as to how we were supposed maintain the sump pumps. Based on all the information, I give OHM and the people here a lot of credit. This group is much more involved and serious about trying to do something for all of us. I appreciate that.	unknown woman	1:38:41

Comments from cards

Eric Machs, 2155 Ascot, 734-998-3507

- *Wouldn't installation of low flow fixtures (aerators, shower heads, toilets, and clothes washer) which in my house over last 5 years reduced on average daily water usage to approximately 100 gallons/day, be a significant factor in reducing peak flow in sanitary sewer and factor into whether a home should be forced to participant in FDD in that neighborhood?*
- Any reductions to base flows from low flow fixtures would be helpful in addressing the peak flows in the sanitary sewer system. However, this solution alone is probably not sufficient to fully address the issue. For example, some of the peak wet weather flows in the sanitary sewer in the priority districts prior to FDD were 30 times the levels of the sewage base flows. That means that even if the water consumption and resulting sewage base flows were reduced to zero during wet weather events, the remaining wet weather flow that is 30 times the level of the base flow would still have to be dealt with.

- Would like to see a design, including cost and tradeoffs, be developed for an exterior outside the home FDD sump installation. An exterior approach/design would reduce possibility of a FDD sump "back up" causing water to enter homes basement.

Joe Walls, 2228 Delaware, 734-747-8837

- We have had basement water problems ever since FDD but not before.

No Name

- Presenters allowed questions that was good. The test of the meeting will be the follow-up on the questions.

No Name

1. Water tables, flood plains and flows change over the years and flooding will get worse (likely.) How do we determine what's a climate issue and what's an issue of an improper sump pump installation? We will bankrupt the city if we're on the hook for changing weather.

2. Any information on best practices from other communities? It's always good to know if other communities are struggling with this.

3. And please correct some of the misinformation about commercial neighborhood developments making the situation worse. Most of these vastly improve storm drainage because they come up to modern detention standards.

Participant List

Name	Address	EMAIL
Vivienne Armentrout	920 Vesper Rd., 48103	vnarmentrout@sbcglobal.net
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Jim Birch	2460 Mershon	jamesbirch@live.com
Leon Bryson	636 Center Dr.	Lbryson106224mi@comcast.net
Andrew Culey	WEMU 89.1	acluley@emich.edu
Patricia Cook	2323 Miller	N/A
Jack Eaton (council member)	1606 Dicken Dr.	jeaton@a2gov.org
William Higgins	2131 Chaucer Dr.	Whiggins27@gmail.com
Terry Holmon	636 Center Dr.	Holman12003@yahoo.com
Steve Igrisan	1430 Greenview	N/A
_____ Kaplan	N/A	Can't decipher on sign in list
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Jan Wolfe		janwolfe@umich.edu

September 17, 2014
Public Engagement Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project [SSWWEP]
Public Engagement Meeting Agenda
Slauson Middle School
Wednesday, Sept 17, 2014 - 6:30 p.m. to 8:30 p.m.

1. **Welcome -** Nick Hutchinson — 6:30 p.m. (5 min)

2. **Desired Outcomes –** Nick Hutchinson — 6:35 p.m. (2 min)
   - Update on FDD Investigation Findings
   - Update on Recommendations for Next Steps
   - Feedback

3. **Introduction to Facilitator and Facilitation Process –** Charlie Fleetham — 6:37 p.m. (3 min)

4. **Project Introduction** – Nick Hutchinson — 6:40 p.m. (5 min)
   Nick Hutchinson, he ity roject anager, will review the results of the SSWWE Project, the origination of the FDD Investigation effort and the City's objectives.

5. **Introduction to Footing Drain Disconnection Survey** – Charlie Fleetham — 6:45 p.m. (15 min)
   Charlie Fleetham, the Project Innovations, Inc. Public Engagement Task Manager, will review the results of the 2013 FDD Survey.

6. **The Footing Drain Disconnection Investigation Results -** Greg Marker — 7:15 p.m. (30 min)
   Greg Marker, OHM Engineer, will present the results of an investigation of most critical homeowner issues raised in the survey.

7. **Go Forward Recommendations –** Charlie Fleetham — 7:45 p.m. (30 min)
   The following recommendations will be reviewed: City Staff Proposal to correct out of spec FDD Installations, OHM Proposal for Best Practices, and SSWWE CAC proposals for Backup Systems, Addressing Damage Claims and for Compensating Homeowners for FDD Related Costs

8. **Public Comments** (3 minute limitation per speaker) — 8:15 p.m. until finish

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

FDD Public Meeting Summary
September 17, 2014
Slauson Middle School Auditorium
6:30pm

1. Welcome and Desired Outcomes – Nick Hutchinson

Nick gives background, describing what led to the Footing Drain Disconnection Program. For years, a number of residents experienced sanitary sewer backups in basements. In early 2000s, an SSO Task Force studied the issue and ultimately, recommended a Footing Drain Disconnection program be implemented in 5 neighborhoods.

In 2013, the Sanitary Sewer Wet Weather Evaluation (SSWWE) project began. The SSWWE project has three major goals:

- Evaluate the effectiveness of the FDD program
- Assess the risk of future backups
- Set a direction for handling wet weather impacts on the sanitary sewer system going forward

The final SSWWE study results will be presented in detail at a future Public Meeting, likely sometime in November 2014.

Reviews project's major findings to date:

- FDD was effective in reducing the amount of stormwater in the sanitary sewer system.
- Risk of sanitary sewer backups in five target neighborhoods is very low. Further FDDs in those neighborhoods are not recommended.
- Six areas (across the City) that still have some sanitary sewer issues.

2. FDD Survey Results – Charlie Fleetham

Charlie reviewed the FDD Survey Results presentation, which is posted on the SSWWE project website.

Following the survey results, the City contracted with a civil engineer experienced in FDD programs and construction to investigate reports of water in the basement.

Comments/questions on FDD Survey Results:

Q. How were homeowners with an FDD notified about the meeting?

A. Postcards and emails were sent to all survey respondents, depending on which was provided with the survey. The City posted notices of the meeting on the usual City and community sites.

Q. How many of the homes that experienced a sanitary sewer backup before the FDD program and haven't since, had a backflow preventer installed?

A. City does not have those numbers now. Will review records and respond.

- Believes that survey results might be different if conducted after 2013-2014 winter, that more homeowners would report problems, as they have had with a frozen curb drain.
- Wants to clarify the reason that the FDD program began. EPA and City entered into a consent agreement after sanitary sewer overflows at the plant and sewage backups in basements. Concerns about capacity issues caused by excessive stormwater in the sanitary system and future impacts like climate change led to a study and recommendation to put large storage tanks in parks and woodland areas. The Task Force and public protested that plan, preferring an FDD program.

3. FDD Survey Investigation Findings – Greg Marker

Greg reviewed the FDD Survey Investigation Findings presentation, which is posted on the SSWWE project website.

Objectives of the FDD follow up investigation:

1. Document problems
2. Identify common issues
3. Develop recommendations

Comments/questions on FDD Survey Investigation Results presentation:

Q. So you have a consultant CDM design the program, CDM inspect the program, building inspector inspected, how did these out of spec installations happen?

A. The goal of the investigation was to determine the types of issues that homeowners have and how many might have been caused by the FDD, not to determine who was responsible at this point. As an example of how an installation could pass inspection, a couple of the homes Greg investigated had extremely long pipes with many bends in line. The original installation might have met the specification at the time; however later modifications to the spec might have required a larger pipe diameter. If FDDs were performed in the future, the CAC may wish to recommend a larger diameter pipe based on the number of bends.

Q. Concern about the alternate location issue. A number of the homes were older, with finished basements, where installing the sump at the lowest point would destroy the use of the basement.

A. Yes, it can be very challenging to locate the sump pump in a finished basement. If the sump pump needs to be located in an area that's not near the footing drain connection, then the floor should be trenched to the alternate location.

Q. When you started, you said that the problems were all over the place, were they all over the City?

A. No, they were fairly evenly dispersed across the five target neighborhoods.

Q. This program was mandated. If these were not required, how many of these problems [FDD investigations] would not have occurred? I believe that the percentage of problems related to FDDs is much larger than 2% because some homeowners would not have had any issues if installing sump pumps hadn't been mandated.

A. These numbers are based on the initial investigation. Some of the homes that were identified as "inconclusive" had elements that were out of spec but also had other issues that can cause water intrusion, such as poor drainage. The SSWWE CAC will make recommendations to address these issues and ultimately, City Council will take action to support those recommendations or not.

Q. Wants to know about the depth of the pipe for the curb drain collection pipes. The storm sewer is only 3' deep. How can the pipe be deep enough if its less than 48"? It seems to be higher than the depth of the storm sewer system. What if the pipe freezes, how will water get out of the home?

A. The specification for the curb drain system is 18" to 24" inches. It's more important that the pipe have positive fall than be deep. Warm sump pump water exits the house, typically at about 58 degrees. At that temperature, as long as the pipe has positive fall, it will flow to the stormwater system.

Q. What if the external discharge freezes? How can water get out?

A. That's why the air gap is important. It provides an emergency outlet, in the event that the discharge pipe is not working.

- I think the pie chart on your slide is mislabeled; totals should be 32% Not Clear and 55% Not FDD. [Yes. The slide has been corrected on the presentation PDF posted on the website.]
- Were the problems caused by ice in the air gap included in the totals presented? We're still looking for the exterior pipes specification. In my case I'm convinced that there was ice in air gap and pipes were not installed according to spec, but much shallower.
- 2% sounds good until it's your home, then it's a financial disaster.
- One frozen curb drain in 60 years is too many. This should not happen.
- Trenching across a finished basement could be prohibitively expensive for a homeowner. The City should pay those costs because they're requiring the disconnection.
- The air gap discharges water near the foundation of the home. If you're out of town, or don't notice a problem immediately, it can cause major damage.
- I want to talk about this frozen pipe thing. I've heard about this 58 degree thing. If the temperature is below zero, and there's pipe 40 or 50 feet long, freezing heaves the pipe, creates a belly at every driveway.
- I don't think most homeowners decided to have the sump pump installed in an alternate location because they preferred another location, but because the disconnection point was impractical, such as directly at the bottom of the stairs.

4. FDD Subcommittee and City Go Forward Recommendations – Charlie Fleetham

Charlie reviewed the FDD Survey Investigation recommendations, which is included in the presentation posted on the SSWWE project website.

Recommendations fall into these major categories:

City - Out of spec installations and educational outreach

OHM – Best practices for any future installations

FDD Subcommittee:

- Sump pump backup system
- Homeowner damage claims
- Homeowner compensation

Comments/questions on FDD Subcommittee survey investigation presentation:

Q. I also had multiple pump failures. I know I have a groundwater problem. There are a hundred houses on a higher elevation from me. Paid $10K to have footing drains rebuilt, then had to install a sump pump. Why can't I have a gravity backup?

A. Current plumbing code does not allow a gravity backup. It would require a change of state plumbing code to make it possible; current plumbing code prohibits connection between sanitary and storm systems.

Q. Did the survey find any differences between those homeowners who were required to install a sump pump through the City's FDD program and those who volunteered for an FDD through the Developer Offset Mitigation program?

A. No, we did not delineate the responses based on which program the respondents participated in. We could do that in the future with the GIS data, but initially felt it was more important to investigate the kinds of problems homeowners were having and the potential causes, so that we can alleviate them as much as possible.

Q. What is the remedy for those of us with frozen pipes to make sure this doesn't happen in future?

A. Nick will check on the televising to make sure that it happens this fall.

Q. What about the development, when will we say enough of the FDDs and ask developers to pay to improve the sanitary sewer system, rather than doing more disconnects?

A. The Developer Offset Mitigation program does require the developer to take steps to remove the flow that the new development will be adding to the system (plus extra.) Developers can do this in ways other than performing FDDs, however nearly all have chosen FDDs. Going forward, the Committee is looking at whether there should be changes to the current Developer Offset Mitigation program and what those changes should be.

Q. It sounds expensive to pay for ongoing insurance, backups, replacements, etc. Will the City consider reconnecting them to the sanitary sewer system?

A. No, we believe there are regulatory issues that prohibit reconnecting the footing drain to the sanitary sewer system. The Citizens Advisory Committee could recommend that the City investigate the legality of reconnecting footing drains, if the members wish.

Q: In the presentation, there was mention that there was a problem compensating the homeowners for damage caused by FDDs. I know of claims that were paid then, back in the 80s, I wonder if the law has changed since then?

A. Governmental immunity is in place because the cost of providing services would be so prohibitive that to do so would bankrupt the municipality if it were held to the same liability standards as private individuals or businesses.

- We never had a problem in our basement before the FDD, getting ready to get 3rd sump pump, got a battery backup, which failed, then a water backup, ran all weekend while out of town, caused big water bills, which the City said that it would help with one time only. We eventually got a generator. What about a program where, if you followed certain best practices, such as regular inspections, the City would them pay for problems. It's not fair to comply with the City's FDD mandate and then also to pay for problems caused by those sump pumps.
- This feels like the sidewalk program. The City required homeowners to pay for sidewalks to be put in, some homeowners didn't do it and later the City paid for theirs. Don't do that again.
- CDM has been involved since the 2001 Task Force, inspected the curb drains and FDDs, now you have OHM investigating their work and Project Innovations conducting another survey and now you want to hire another consultant to fix the out of spec installations. Where does the City take responsibility and fix the problem instead of hiring consultants?
- Gravity supported backups systems; you say that those are against building code, but I believe that it's just a City ordinance, which the City can change. The City has constantly found ways to not do what could be done.
- It seems as though there are extenuating circumstances that might make reconnecting footing drains an exception to the Code requirements.
- I'm Peter Houk and I wanted to join the CAC because I wanted to represent my neighbors who underwent mandatory FDDs and wants to see that those homeowners are treated equitably. I also had a mandatory FDD and this issue is important to me. Glad to hear the support for the subcommittee's recommendations to provide relieve to homeowners. Because the final decision will be made by City Council, I suggest that concerned homeowners contact their Council members and make your opinions know.
- The original SSO Task Force recommended backups and they were not provided. There were several other options under consideration and I wonder if the Task Force would have recommended storage and upsizing had they known that back ups would not be provided.
- I think its CDM's responsibility to pay to have these things fixed, not for the taxpayers to fund it, because CDM inspected and approved the installations. We have leverage with them because they have ongoing contracts.

- I also agree that it's fair that CDM and contractors pay to fix the problems, not the taxpayers. I also strongly believes that homeowners who had to participate in the FDD program should be treated differently, simply because they were required to participate in the program.
- The City has preselected plumbing contractors, one formed by ex-City employees. There's out of spec installations performed by preselected contractors, it's time to dip into the errors and omissions for CDM and get this paid for.

5. Public Comment

My name is Frank Burdick. I've been voicing my dissent to this program since 2012 after hearing comments at meetings like this. If you're opposed to the sump pump program you can consider standing up during my presentation. As a point of disclosure, I was an active member of the CAC until March of 2014 when the consultant OHM kicked me off there because they didn't like, they couldn't handle the dissent to their desired outcomes. Their desired outcomes include continuing the sump pump program and refusing to take any responsibility for the poorly designed and failing installations. I suspect there's too much toothpaste out of the tube and the City doesn't or can't expose the liability about those installations. I want to make three major points. First and most important those who've voiced opposition to this sump pump program aren't the bad guys. We're just the messengers. The City's the one who created this mess. And we're the ones trying to oppose it and voice our concerns. Secondly the point about equity you've heard a lot about it. You've got all of Orchard Hills about 97% disconnected and the other neighborhoods aren't. Well thank you Orchard Hills for doing it. I have people on one side of the street that have them and hate them. The other side of the street doesn't have them and don't want them. How is that fair? What's wrong with that picture? The third major point is those who voice opposition to sump pumps, we support methods and design that will prevent sanitary sewage backups in homes. That's the whole point. Nobody wants to see sewage backup into basements. The problem should have been fixed in the right of way. There were recommendations to do that in 2001 and they took the cheap way out, Council took the cheap way out. And now it's not going to be cheap anymore. This is going to be more costly going forward. Regarding specifications, they are trying to bring them up to current specs. Well there's plenty wrong with current specs, the specs are not up to code. There's a code about air gaps, there's a code about frost codes that's related to air gaps, there's a code about burial depth from pipes and they've created a system that does not protect the pipes from frost or freeze ups. The City's people's response to the failed sump pump program includes spending more tax payers money on a third consultant. They want to pay for an improved training program to show you how to maintain the equipment. The city refused to take full responsibility for the harm and anxiety they have caused. It's time to stop this program and not continue to apply lipstick on this pig.

November 19, 2014
Public Engagement Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project [SSWWEP]
Public Engagement Meeting Agenda
Slauson Middle School
Wednesday, November 19, 2014 - 6:30 p.m. to 8:30 p.m.

1. **Welcome -** Nick Hutchinson	6:30 p.m. (5 min)
2. **Desired Outcomes –** Nick Hutchinson ▪ Present SSWWE Project Objectives and Results ▪ Present Project Recommendations and CAC Preferences ▪ Feedback	6:35 p.m. (2 min)
3. **Introduction to Facilitator and Facilitation Process –** Charlie Fleetham	6:37 p.m. (3 min)
4. **Project Background/Starting Objectives/Summary Results** – Nick Hutchinson Nick, the City Project Manager, will review the origins of the project, the starting objectives, and summary results.	6:40 p.m. (15 min)
5. **Project Methodology and Results** – Robert Czarchorski Robert, the OHM project manager will describe how wet weather flow was measured and the results. He will also describe how future risks of basement backups were modeled and provide more detail on the major findings and recommendations that emerged from the modeling process.	6:55 p.m. (20 min)
6. **The Footing Drain Disconnection Investigation Results -** Robert Czarchorski Robert will present the results of the FDD survey, the results of the follow up investigation, and the go forward recommendations.	7:15 p.m. (30 min)
7. **Public Engagement Process –** Charlie Fleetham Charlie, Public Engagement Task Leader, will review the public engagement process deployed in the project and will highlight the accomplishments of the Citizens Advisory Committee.	7:45 p.m. (25 min)
8. **Summary, Thank You, and Next Steps – Nick Hutchinson** Please make sure we have your contact information. We will send a follow-up message with the meeting summary and other materials to everyone who provides an email address this evening. Materials will also be available on line at www.a2gov.org/SSWWE.	8:10 p.m. (5 min)
9. **Public Comments** (3 minute limitation per speaker)	8:15 p.m. until finish

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project [SSWWEP]
Public Engagement Meeting Summary
Slauson Middle School
Wednesday, November 19, 2014 - 6:30 p.m.

1. Welcome and Desired Outcomes – Nick Hutchinson

Nick Hutchinson, City of Ann Arbor Project Manager introduced the project team members and reviewed the desired outcomes for the meeting:

- Present the SSWWE Project objectives and results
- Present the SSWWE Project recommendations and CAC preferences
- Hear feedback from public

2. Project Background/Starting Objectives/Summary Results – Nick Hutchinson

The City of Ann Arbor experienced sanitary sewer basement backups for decades. This problem became even more significant in the late 1990s when hundreds of homes had sewage in their basements during heavy rainstorms. An SSO Task Force formed in 2000, made of citizens and technical experts, and evaluated various alternatives, such as storage, upsizing pipes and FDDs. After collecting input from citizens during a series of public meetings, the Task Force recommended implementing a Footing Drain Disconnection Program to remove stormwater flows from the sanitary sewer system.

The Sanitary Sewer Wet Weather Evaluation (SSWWE) Project was initiated in early 2013. The study's purpose is to evaluate the effectiveness of the FDD program in reducing sanitary sewer backups, the future risk of basement backups and evaluates methods of mitigating wet weather impacts.

Nick showed a short video that explains the SSWWE project's history and purpose.

You can view the presentation on the project website at A2gov.org/SSWWE.

Summary results – SSWWE

1. FDD program significantly reduced the risk of basement backup in the target areas.
2. No more mandatory FDDs in target areas.
3. Five potential future problems discovered outside the original five target districts.
4. These five potential problem areas will be studied for correction.
5. WWTP has capacity to serve existing and future systems needs.

Summary results – FDD

1. Broad level of satisfaction with FDD program, but with many reports of dissatisfaction.
2. Water issues investigated. Most resulted from non-FDD issues. (Most frequent causes - grading, failed footing drains, stormwater entering through cracks, windows, etc.) Ten were found to be caused by installations that do not meet specification. At that rate, there may be a total of 36 or more out of spec installations.
3. City will initiate programs to correct out-of-spec installations.
4. City to implement program to inform and educate citizens on operating and maintaining their sump pumps.

CAC made nine recommendations to correct/improve the FDD Program, which included a task to explore different rate classes in future rate study, support for seniors and economically disadvantaged residents to assist with operations and maintenance activities and expenses, and paying for damages caused by out of spec installations.

Questions and comments:

Q. Are you expecting any action by Council regarding the FDD ordinance?
A. Yes, we think it's likely that the ordinance would have to be modified, based on the results of the SSWWE Study, but we don't yet know the specifics.

Q. In 2000, if you had measured flow in the five problem areas identified, would you have found those same areas? Wouldn't it have been better to save the money spent on the FDD Program and instead fix those issues?
A. In 2000, the flow was measured. There were many more problems across the sanitary sewer system in 2000 than there are today. The City's sanitary sewer system has fewer problems and more capacity as a result of the FDD program.

Q. Is it anyone's intention to evaluate the FDD spec to see if they comply with code?
A. The FDD spec was developed with the input of building officials and other specialists, to be code compliant.

Q. By a show of hands, how many engineers here think that burying curb lines at 24" have no chance of freezing?
A. The specification has been reviewed when it was created and has been reviewed several times since it was developed. The specific issue about burial depths has been reviewed and a pipe with a positive slope, carrying sump pump water, which is typically about 50 degrees should not freeze. However, if there is a belly, or a small dip in the line, that can trap a small amount of water that could freeze; that is what happened on Avondale.

Q. How do I know if I have an out of spec installation?
A. If you have a concern, such as water in the basement, you can let the City know and when the mitigation project begins, your home can be investigated.

Q. I'm new to the area, my home is on Weldon. Did my home have an FDD?
A. Based on where you live, it's likely that your home had an FDD. Please give your address to one of the project team members and that individual will check the records and let you know.

Q. How do you know who the FDD homeowners are?
A. The City has a record of each address that underwent an FDD.

Q. I'd like to think that the City should review the specifications.
A. Thank you for your suggestion. The specifications have been reviewed multiple times. If there were to be an FDD program going forward, the specification would be reviewed again for continued code compliance and to incorporate the most recent best practice suggestions.

Q. Do you have a prediction as to how many people who have had FDDs will have problems in the future?
A. No, we don't have a prediction, however, when out of spec installations are corrected, there will be a notification for homeowners who have concerns.

Comment: Some of the citizens have solved the problem for all of the citizens.

3. Public Engagement Process – Charlie Fleetham

You can view the presentation on the project website at A2gov.org/SSWWE.

Summary results – Public Engagement

Very robust public engagement program, including an active and engaged citizen advisory committee, video recording of each public meeting, detailed meeting summaries, videos explaining aspects of the project and infographics, among other engagement tools. A Citizens Advisory Committee was formed and met 16 times to review data, ask questions and make recommendations.

Questions and comments:

Q. Can you speak to the fact that you integrated a developer into the committee and that you removed a member?
A. Early in the process, the Committee set the standard that any resident would be able to join the committee at any time, as long as they were able to bring themselves up to speed. A resident who happens to work for a developer asked to join the CAC and did so. And yes, one member was removed the committee. This occurred after the committee established norms and that member violated the norms of conduct. There was a clear process for removal, which was communicated to that member.

4. Project Methodology and Results – Robert Czachorski

Consultant Project Manager, Robert Czachorski of OHM Advisors, reviewed the results of the SSWWE Study. You can view the presentation on the project website at A2gov.org/SSWWE.

The TOAG (Technical Overarching Advisory Group) is an independent, technical body comprised of subject matter experts who reviewed the SSWWE study methodology and results.

FDD Program was effective in removing stormwater flows from the sanitary sewer system during wet weather events. During a large rainstorm in June 2013, there were no reported basement backups caused by the City's system. That's a sharp contrast from 2000, when there were widespread basement backups.

Flow analysis findings:

- The FDD program significantly reduced stormwater flows to the sanitary sewer system.
- The FDD program greatly reduced the risk of basement backups in the target areas.
- Mandatory FDDs are no longer recommended in the target areas.

The hydraulic capacity assessment shows that there are five areas that could be considered "bottlenecks" in the system, or places where the capacity is less than expected. This is much, much less than before the FDD program. OHM Advisors has done approximately 100 of these studies and the issues in Ann Arbor's system are much less severe than most other cities. Another change is that these capacity issues are not in the neighborhoods, but are upstream, in the interceptors. The team developed a plan of action for each of the five problem areas.

Questions and comments:

Q. What percent of the flow removal can be attributed to manhole repairs and other maintenance?
A. The City did not have major repair or maintenance programs in the target areas, so the flow removals cannot be attributed to those things.

Q. It appears that the FDD Program didn't work in Glen Leven.
A. Yes, the FDD program was less effective in the Glen Leven target area.

Q. Can the results in Dartmoor be attributed to the higher percentage of multi-family homes?
A. That could contribute to the results.

Q. What's the capacity of the plant before the upgrade and what will it be in the future?
A. The plant's capacity is a more complex concept than a single number because the plant has capacity to accept and treat flows, as well as store flows for a period of time for treatment later. The current WWTP has a design capacity of 29.5 million gallons per day (MGD. Additionally, the plant has storage that can handle short peaks in flow rate that, if extrapolated to a daily rate, would be the equivalent of about 70 million gallons in a day. On average, the plant treats about 18.5 MGD, or about 60% of its capacity. The treatment capacity will not change with the plant upgrades; the upgrades are renovating old buildings and equipment, not increasing capacity. On the project website (www.a2gov.org/SSWWE) you can see a short video that explains the plant's functions and capacity.

Q. With all the development in the last ten years, how can you know that the treatment plant has capacity in the future?
A. Ten years ago, the plant was not operating at capacity and over the last decade, the City has required that developers offset any flow they expect to add to the sanitary sewer system. This practice, as well an overall reduction in water consumption mean that the plant has adequate capacity now and in the future. The CAC recommended continuation of the Developer Offset Mitigation program, with a few modifications.

- Note that the City was under a consent order by the EPA to avoid sanitary sewer overflows into the Huron River. Welcome to City Council members in attendance.

5. The Footing Drain Disconnection Investigation Results - Robert Czachorski

Robert Czachorski reviewed the 2013 FDD survey results, which prompted the FDD investigation. You can view the presentation on the project website at A2gov.org/SSWWE.

Objectives of the survey and follow-up investigation:

- Document problems
- Identify common issues
- Develop recommendations

Based on survey results, City initiated an investigation of those homes where the owner reported water in the basement after an FDD installation. Of 101 incidents on the survey, 77 were investigated via phone or site visit. The engineer found ten homes where an FDD that was not installed properly caused water in the basement. In about 50 homes, there was another cause of water in the basement.

Some of the reasons for complaints of water in the basement “not related to FDD:”

- Grading that directs water toward the house
- Failed footing drains
- Stormwater leaking through a crack or a window.

Process – the team worked with Subcommittee to create recommendations for future actions. CAC recommendations regarding FDD:

1. Do not retain FDD program as is.
2. Any future FDDs must be voluntary, robust and incentivized.
3. Correct out of spec installations.
4. Conduct outreach program.
5. Implement best practices.
6. Provide backups systems.
7. Pay damage claims due to out of spec installations.
8. Support seniors / economically disadvantaged.
9. Include task to explore different rate classes in future rate study.

Recommendations that did not achieve consensus:

1. Homeowner compensation for sump pump operations and maintenance.
2. Free radon inspection program.

CAC members who had a strong feeling about radon (as well as other issues) can add their comments to the Executive Summary, in order to make their opinions known to City Council.

Questions and comments:

Q. Wasn’t doing a survey in your scope of work?
A. Doing a survey of this level was not; detailed paper surveys were mailed to 2300 homes and then data entered manually.

Q. Do you have an estimation of the expected lifetime of a pump is?
A. Each home has its own rate of flow that determines the life expectancy of the pump. Manufacturers offer general guidelines that pumps last ten years on average.

Q. Regarding the 10 homes that had problems because they were out of spec, did you find any patterns? Any particular contractors> How soon after the installation was made did you discover the failures?
A. We could not find any geographic patterns to the problems, nor any concentrations among particular contractors. Of the 100+ homes investigated, most had had footing drains disconnected and sump pumps installed between 2004 and 2008. The investigation was conducted in 2014.

Q. Did you find problems with any particular contractors?
A. Three ways that an installation can be out of spec: out of compliance with building code, out of the manufacturer’s installation instructions or out of industry standard best practices. None of the ten instances were out of building code, which is what the City inspector staff evaluates. These ten did not follow manufacturer’s installation instructions or industry standard best practices.

Q. What is a good, reliable backup system?
A. The most common backup system is battery backup. The second most popular is water-powered backup pump. The third type is a generator, to replace power sources. Each of these is progressively more expensive.

Q. You need to let people know about the radon issue. If you don't want to pay for the test, it's $10, but you need to let people know. I had to pay $800 for a mitigation system. Let people know.
A. Some of the CAC discussions on radon were that Washtenaw County has a naturally high level of radon. Anyone who lives in Washtenaw County should be aware of that risk and determine whether they wish to have a radon test. Another aspect the CAC discussed related to radon was that the City's spec required that the sump pump lid be sealed. There are also many other sources in a basement where radon can enter the home, such as cracks in the walls or around windows.

Q. Can you tell us the cost of the FDD Program to date?
A. I don't have the exact figures, but in recent years, the Capital Improvement Program has had about $2.5M per year allocated to the FDD program.

Q. How much would it have cost to enlarge the sanitary sewer pipes rather than intruding into the integrity of our homes? Why wasn't that option more seriously considered? Even if the cost was double, it might have been better than to expose citizens to pump replacements forever.
A. SSO Task Force weighed those issues and examined enlarging pipes and because the locations would have disrupted large swathes of green space and would have only pushed the problem further down the system, the Task Force ultimately recommended the FDD Program.

Q. How many people on the CAC had sump pumps?
A. I think about half of the citizens on the committee had sump pumps. Others were interested because they had had basement backups or water in their basement.

Q. Do you know how many people put in gas generators?
A. We did ask that question in the survey, however we don't know the number on the spot.

Q. My basement is flooded and I reported it to the City, but they said that they don't know why. I've got about a $6000 bill.
A. Please give me your information after the meeting and someone from the City will look into it.

Q. Air gaps don't comply with code. Your specs are not code. What's your intention to remedy the problem with the air gaps not up to code?
A. We are not aware of any air gaps that do not comply with code.

Comments:

- I live in Orchard Hills and had an FDD in 2008. Recently, my pump began to run often. The repair services recommended replacing the entire unit, which cost about $300. I think that everybody who has these sump pumps is exposed to these risks and expenses.
- We have a lady on Delaware who has replaced her sump pump 9 times.
- I think this program is a terrible disservice to the homeowners in the target area. It exposes the homeowner to ongoing risk from sump pump failures and loss of electricity.

- I also had to install a battery backup, because of fear of failure or loss of power, which cost about $700. Also, as a senior on my own, I cannot perform the maintenance that's recommended.

- I'd just like to say that those of us who enjoy the river and who had feces in our basements appreciate those who up the hill or in the middle who went through the FDD program to help keep feces out of our basement.

- I had flooding in my basement when my curb drain froze and it caused flooding in my basement, so even if I don't have an out of spec installation, I still had flooding caused by an FDD.

- My sump pump is installed in a crawl space. I bought a radon detector and it showed high levels of radon, so everyone should get their radon tested. Also, after a heavy rain, I hear a rattling water flow going up the side of the house. I never had problems before the FDD program.

- A backup also requires an additional battery, etc. That's why it's so expensive.

- I don't understand why 7 people decided not to recommend radon testing. Sealing the cover is not a solution; most installations I've seen are no longer sealed.

- The 2001 SSO Report recommended that the City test before installing a sump pump and test radon levels after. If you're supposed to open the crock to clean it out, why is sealing the lid thought to be a solution?

- It seems to me that it would have been better for the City to level these houses than to install these FDDs.

6. Public Comment

My name is Frank Burdick and I was on the CAC, I was the one kicked off the CAC. You can see why, because I don't really like the answers I get from the City or I should say the lack of answers. They're not forthcoming. My perception is they're always hiding behind something. Now my perception is that they're hiding behind the direction of the City attorney, so now they can't tell the truth. Tonight's the opportunity for the City to check the box to say that they've had public outreach. There's two other meetings going on, a stormwater calibration meeting and a pedestrian task force so people who wanted to come to this but they also went to another meeting. They like to talk about this FDD Study that I helped create and the results of that study they say that there's a certain percentage of people that are satisfied with it. Well if Ford Motor Company had 20% of their buyers dissatisfied with their car, would Ford Motor Company still be in business? I don't think so. The other thing about that survey is, it was put out in a non-descript envelope right during the Christmas holiday season and most of them got thrown away. And the ones that didn't even got opened, if you were a dissatisfied homeowner and it was during the Christmas season, would you want to sit down and berate the City for what they did to you? Or would you want to throw it away and have a happy holiday? Some people believe in sugar plums, but that's what I think. So this study is flawed. The CAC members were, they worked hard and but what ended up happening, I was there every meeting, I saw it, what ended up happening is some people started and were motivated by it, but the remaining people that continued to sit on the CAC, most of them were people that the City put on the system. They weren't people that were advocates for the general public they were there to help the City reach desired outcomes. Thanks.

V. Footing Drain Disconnection (FDD) Investigations

A. Survey

1. Survey Form – see following pages.
2. Survey Summary – see following pages.

PROJECT INNOVATIONS INCORPORATED

Footing Drain Disconnection (FDD) Survey

The City of Ann Arbor is evaluating its Footing Drain Disconnection (FDD) Program. We have been informed that the footing drain has been disconnected at your residence and that a sump pump has been installed. The City has formed a Citizens Advisory Committee to work with the City and its consultant to evaluate the effectiveness of the FDD program, to assess the future risk of basement backups, and to evaluate alternatives and set direction for addressing basement backup risks. To support these objectives, the Citizens Advisory Committee is sponsoring a survey of all Ann Arbor residences and multi-family dwellings that have undergone an FDD installation. Our company, Project Innovations, Inc., (a Michigan based firm specializing in public engagement) has been contracted to perform this survey.

How to Complete the Survey:

There are three ways you can complete the Footing Drain Disconnection Survey:

1. **Complete a web-based survey.** Type the following url into your internet browser. You will be guided through the survey **[https://www.surveymonkey.com/s/FootingDrain].**

2. **Complete a paper survey.** Enclosed is a printed survey. Complete it and return it in the postage-paid envelope.

3. **Complete the survey in person.** We will hosting focus groups in Ann Arbor. At the focus group, we will have laptop stations where you can take the survey. Assistance will be available for those who need it. Look for focus group meeting dates to be announced on AnnArborNews.com, AnnArborChronicle.com, Treetown Log and in your neighborhood newsletters.

Sharing your experience gives the Citizens Advisory Committee valuable information to make recommendations about the FDD program. To learn more about the FDD Program visit the project website at http://www.a2gov.org/sswwe. All responders who return the survey with their contact information by **DECEMBER 20** will be entered into a random drawing to win one of six $50 gift certificates to Ann Arbor businesses, like Main Street Ventures restaurant group, Downtown Home & Garden, Zingerman's Deli and Great Harvest Bread Co.

Once available, survey results will be shared with the community on the City of Ann Arbor Sanitary Sewage Wet Weather Evaluation website noted above. If you have questions about this survey, please email, charlie@projectinnovations.com or call me at 248-476-7577.

Thanks for your help with this important process!

Sincerely,

Charles Fleetham

Charles Fleetham, President
Project Innovations, Inc.
22000 Springbrook Ave., Suite 106
Farmington Hills, MI 48336

PROJECT INNOVATIONS INCORPORATED

Sanitary Sewer Wet Weather Evaluation Project
Footing Drain Disconnection [FDD] Survey

Instructions

- **Please verify that footing drain disconnection has occurred, and that a sump pump has been installed. If not, do NOT take this survey.**
- **Please indicate your address. Surveys without addresses will NOT be tallied.**
- **Please complete the survey in black or blue ink. (A Word version of this survey can be obtained by emailing charlie@projectinnovations.com)**
- **Please mail the survey to Project Innovations in the self-addressed stamped envelope by DECEMBER 20, 2013.**

Important Definitions

- **Sanitary sewage backups occur when sewage or sewage tainted water backs up into your basement through your basement drain.**
- **Water flooding occurs when rain water pools or seeps into your basement through basement windows, the sump pump hole or cracks in the basement.**

Survey Questions

1. **What is the address of your residence: ______________________________**

2. **Did you live in this residence PRIOR to the sump pump installation?**

Yes	No
☐	☐

3. **What is your overall level of satisfaction with your sump pump installation?**

Very Satisfied	Satisfied	Don't Know	Dissatisfied	Very Dissatisfied
☐	☐	☐	☐	☐

4. **Would you recommend a sump pump installation to a neighbor?**

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

5. **Did this residence experience sanitary sewage backups in the basement PRIOR to footing drain disconnection?**

Yes	No	Don't Know
☐	☐	☐

6. **If the answer to #5 is YES, please indicate the incident dates and restoration costs (if applicable).**

Date/Time Frame:	Costs:
Date/Time Frame:	Costs:
Date/Time Frame:	Costs:

7. Has this residence experienced sanitary sewage backups in the basement AFTER footing drain disconnection?

Yes ☐ No ☐ Don't Know ☐

8. If the answer to #7 is YES, please indicate the incident dates and restoration costs (if applicable).

Date/Time Frame:	Costs:
Date/Time Frame:	Costs:

9. Did this residence experience water flooding/seepage/dampness in the basement PRIOR to footing drain disconnection? Check all that apply.

Water Flooding ☐ Seepage ☐ Dampness ☐

10. If you checked any boxes above, please indicate if your basement was damaged.

Yes ☐ No ☐

11. Did this residence experience water flooding/seepage/dampness in the basement AFTER footing drain disconnection? Check all that apply.

Water Flooding ☐ Seepage ☐ Dampness ☐

12. If applicable, please indicate any restoration costs due to the above occurrences and whether or not your neighbors experienced the same conditions.

Date/Time Frame:	Costs:	Neighborhood:	YES	NO	DON'T KNOW
Date/Time Frame:	Costs:	Neighborhood:	YES	NO	DON'T KNOW
Date/Time Frame:	Costs:	Neighborhood:	YES	NO	DON'T KNOW

13. Please indicate any non-restoration costs that you have incurred since sump pump installation:

Item	Costs
a. Replacing sump pump(s)	
b. Replacing sump pump check valve	
c. Adding battery and/or water siphon backup	
d. Relocating sump pump	
e. Interior modifications to conceal sump pump, etc.	
f. Landscaping repair	
g. Additional power generator	
h. Other costs related to the sump pump installation	

14. How has the installation of a sump pump affected your peace of mind?

Significant reduction in anxiety ☐ Some reduction in anxiety ☐ No impact ☐ Some increase in anxiety ☐ Significant increase in anxiety ☐

15. Please indicate your concerns, if any, about the sump pump in your residence.

	NOT Concerned	Concerned	VERY Concerned
Noise from the pump			
Water flooding from sump pump hole.			
Sump pump malfunction.			
Lack of a backup system.			
Replacing sump pump.			
Reduction in property value due to sump pump.			
Going up and down stairs to check on sump pump.			
Disrupted my basement design/style.			

16. Does your sump pump have a backup system?

Battery ☐ Water Siphon ☐ No ☐ Other (specify) ______________________________

17. Please estimate frequency at which your sump pump operates by circling your best estimate below.

Wet Periods	Dry Periods
Very often	Very often
Often	Often
Not very often	Not very often

18. Where the pipe exits the house, the discharge pipe is currently tied directly to the pipe coming up from the ground. (See illustration, enter "yes" if it IS connected or "no" if there is an air gap between the two pipes.)

Yes ☐ No ☐ Don't Know ☐

19. Other Comments: (please use another sheet of paper if necessary)

OPTIONAL: FOR ENTRY INTO DRAWING FOR GIFT CERTIFICATES

Name: ______________________________

Email: ______________________________

Phone: ______________________________

City of Ann Arbor
2013 Sanitary Sewage Wet Weather Evaluation Project
Footing Drain Disconnection (FDD) Survey Results
January 24, 2014

I. Introduction

This report contains the results of the FDD survey conducted under the auspices of the Sanitary Sewer Wet Weather Evaluation Project (SSWWEP). The results include survey statistics, quantitative results, key findings, and an appendix of respondent comments. A video summarizing the project is available at: http://www.a2gov.org/government/publicservices/systems_planning/waterresources/sanitary-sewer-project/Pages/default.aspx.

iPhone Users Only:

The tag below connects to the website. To use it, download the app from iTunes or use the web browser on your phone at http://gettag.mobi

In 2013, under the direction of City Council, Ann Arbor launched the SSWWEP to evaluate its FDD Program. The project objectives include measuring whether the Footing Drain Disconnection program reduced stormwater flow to the sanitary system, assessing the risk of sewer backups in the City, researching and evaluating new ways to control the impacts of stormwater on the sanitary system, and recommending the method(s) to further reduce wet weather impacts to the sanitary system. The City engaged OHM Advisors to provide engineering consulting and public engagement facilitation services. With OHM support, the City formed a Citizens Advisory Committee (CAC) to review project data and to provide a recommendation on the go-forward direction for addressing basement backup risks.

A key element of the CAC's recommendation may address the future of the FDD program. To support the evaluation of the FDD program, CAC sponsored a survey of all Ann Arbor residences and multi-family dwellings that have undergone an FDD installation. With support from OHM, the CAC developed a survey and OHM administered it. The survey process consisted of a postcard alert to all FDD sites (homeowners + multi-family dwellings), followed a week later by a survey package containing an introductory letter, a survey and a stamped return envelope. The letter introduced the project, the survey purpose, and also identified an online URL for people who wanted to complete the survey on a digital device. 2350 surveys were mailed by Dec. 4, 2013 with a response deadline of Dec. 20. By Dec. 20, 764 surveys had been received via mail and online. Since Dec. 21 an additional 86 surveys were received via mail and entered into the survey database.

On Jan. 9, 2014, the OHM team distributed a draft summary of the survey highlights to the CAC and the public in attendance. Craig Hupy, Public Area Service Administrator congratulated the CAC on the positive role they had played in sponsoring the designing of the survey. He invited the CAC to help the City identify retroactive and future improvements in the FDD program and pledged that City staff would carefully analyze the survey and develop a go-forward corrective action plan.

II: Survey Statistics

A. Total surveys completed

- 2350 surveys mailed
- 850 responses – 133 completed online; 717 returned by mail
- 36% response rate (Note: typical response rate for a municipal survey ranges from 20% to 40%.)

B. Validity of survey results

- Confidence level that the sample results represent responses from the entire set = 99%
- Margin of error = 3.6% +/-

C. Geographic dispersion of responses. TBD. Respondent addresses are being correlated.

II. Results from the FDD Survey

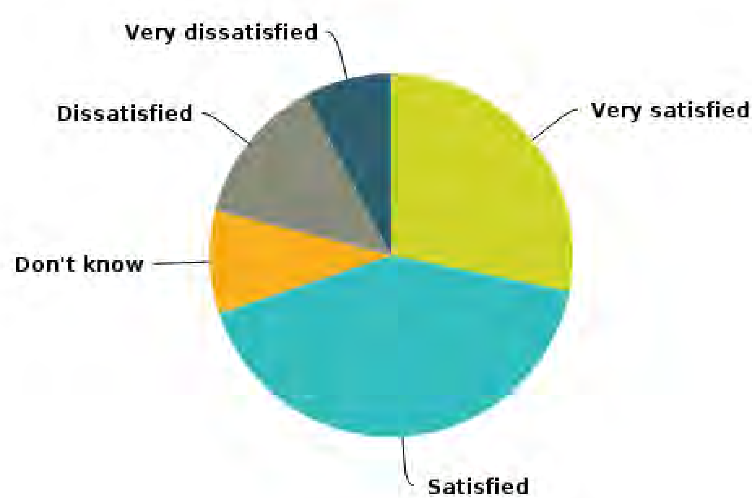
__Question #1:__ **Address of residence -** entered into the database for analysis along with names and emails as provided.

__Question #2:__ **Did you live in the residence PRIOR to the sump pump installation.**

Yes = 715 respondents or 84%   No = 133 respondents or 16%

__Question #3:__ **Overall level of satisfaction regarding sump pump installation.**

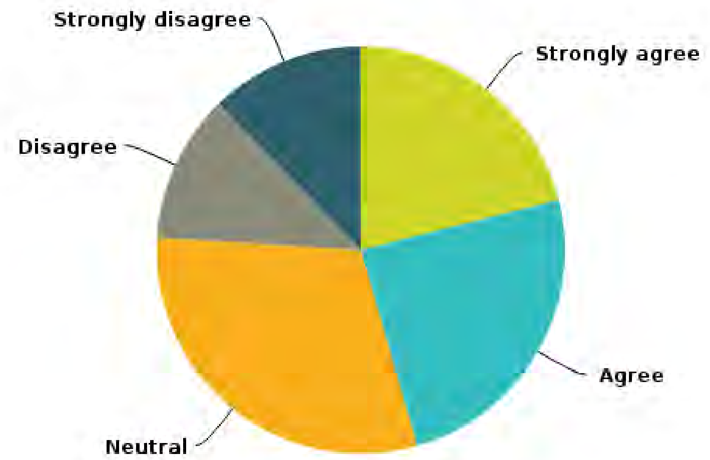
- Very Satisfied = 28%
- Satisfied = 42%
- Dissatisfied = 13%
- Very Dissatisfied = 8%
- Don't know = 9%



Key Finding:
While the majority of survey respondents report satisfaction or neutral feelings regarding their sump pump installation, about 21% of respondents report feeling degrees of dissatisfaction with the installation.

Question #4: I would recommend a sump pump installation to a neighbor:

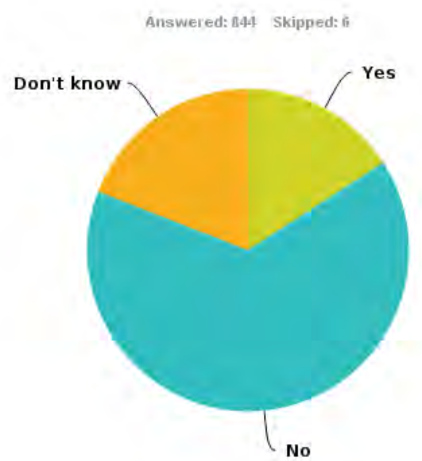
- Strongly Agree = 21%
- Agree = 24%
- Neutral = 31%
- Disagree = 12%
- Strongly Disagree = 12%



Key Finding:
45% would recommend a sump installation to a neighbor. This is almost twice as many as those that would not.

Question #5: Did the residence experience sanitary sewage backups in the basement PRIOR to footing drain disconnection?

Yes = 16%
No = 65%
Don't Know = 19%



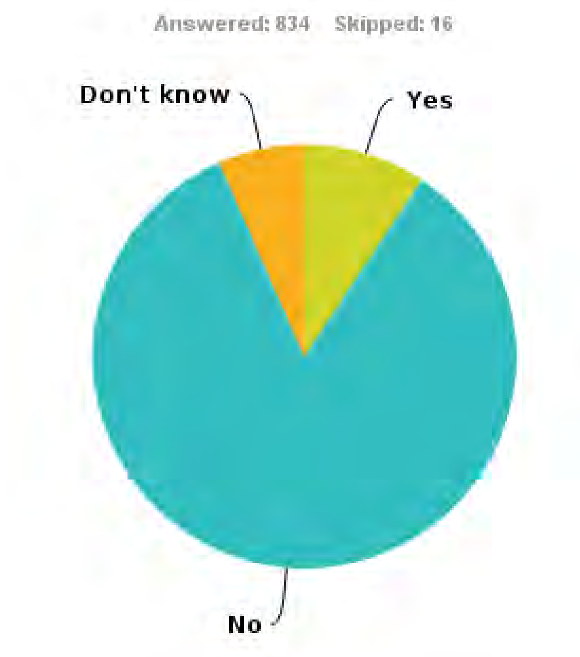
Key Finding:
134 of 850 or 16% of respondents reported experiencing sanitary sewage backups PRIOR to FDD/sump pump installation.

Question #6: If the answer to #5 was YES, the total restoration costs listed by those who experienced sanitary sewage backups.

Total costs = $310,150 for 90 respondents

<u>Question #7:</u> Has the residence experienced sanitary sewage backups in the basement AFTER footing drain disconnection?

Yes = 9%
No = 84%
Don't Know = 7%



Key Findings:
100 of the 134 respondents that reported experiencing sanitary sewage backups PRIOR to FDD/sump pump installation did NOT experience them after FDD/sump pump installation.

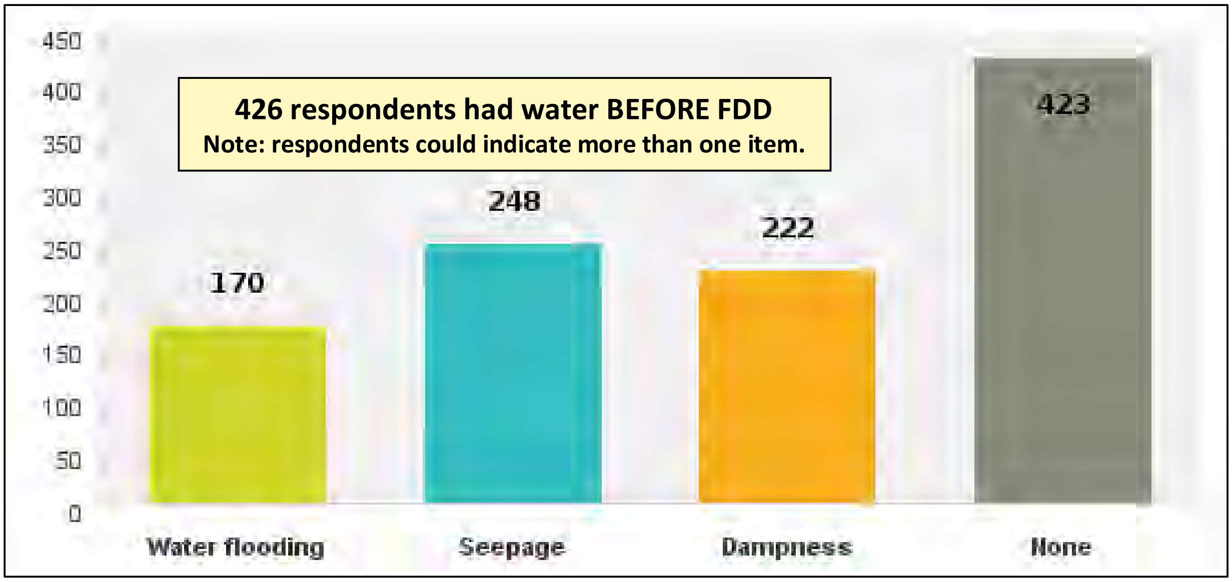
34 of the 134 continue to have sanitary sewage backups.

42 respondents that did not have sanitary backups BEFORE FDD experienced them AFTER FDD.

<u>Question #8:</u> If answer to #7 is YES, indicate dates / costs

Total costs = $66,470 for 67 respondents

Question #9: Did the residence experience water flooding/seepage/dampness in the basement PRIOR to footing drain disconnection?



Question #10: If boxes were checked in Question #9, was your basement damaged PRIOR to the FDD?

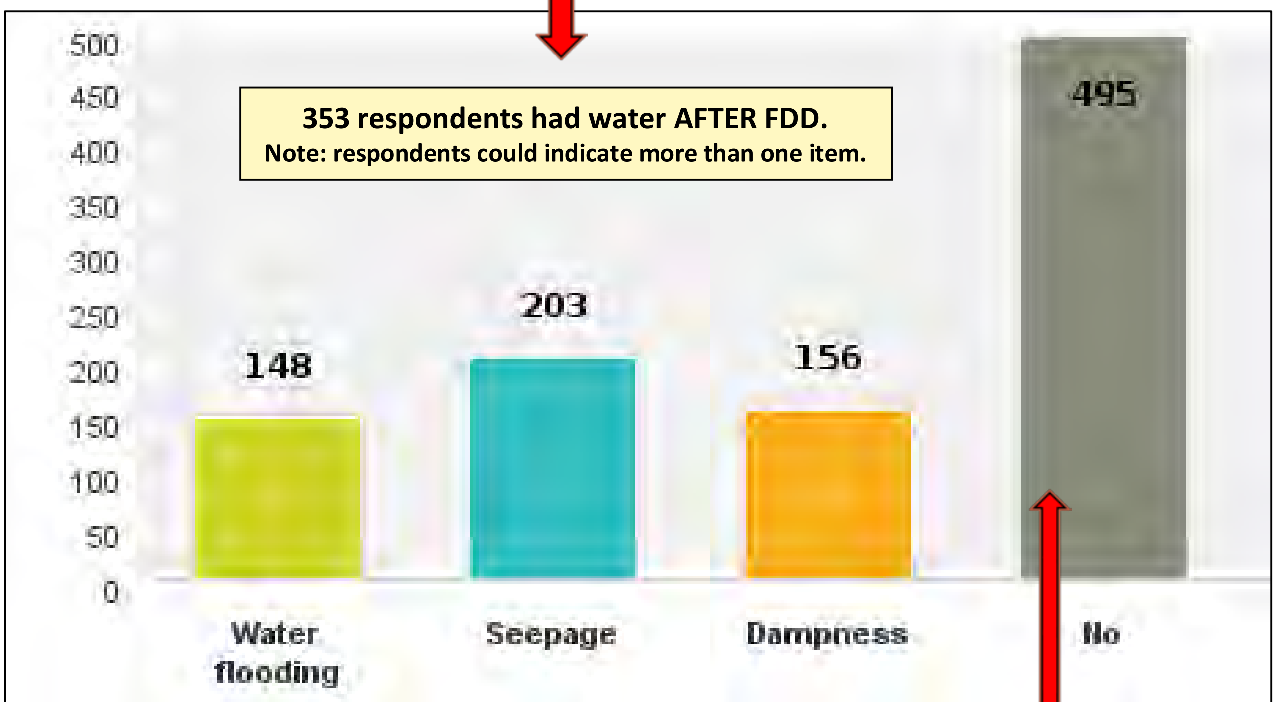
Key Finding:
Yes = 154 respondents or 36%
No = 274 respondents or 63%

Key Finding:
426 respondents, 50% of the total sample, reported experiencing water flooding/seepage/dampness BEFORE FDD.

<u>Question #11:</u> Did the residence experience water flooding/seepage/dampness in the basement AFTER footing drain disconnection?

Key Findings:
106 respondents who reported no flooding/seepage/dampness BEFORE FDD said they did experience flooding/seepage/dampness AFTER FDD.

247 respondents who had experienced flooding/seepage/dampness BEFORE FDD CONTINUED to experience flooding/seepage/dampness AFTER FDD.



Of the 495 respondents who reported NO water flooding/seepage/dampness AFTER FDD, 178 respondents HAD reported water flooding/seepage, dampness BEFORE FDD.

Totals:
278 respondents reported RELIEF from sanitary and/or water issues after FDD.

148 respondents reported NEW sanitary and/or water issues after FDD.

<u>Question 12:</u> Total restoration costs for water flooding/seepage/dampness AFTER footing drain disconnection.

Total restoration costs = $456,000 (158 respondents reporting)

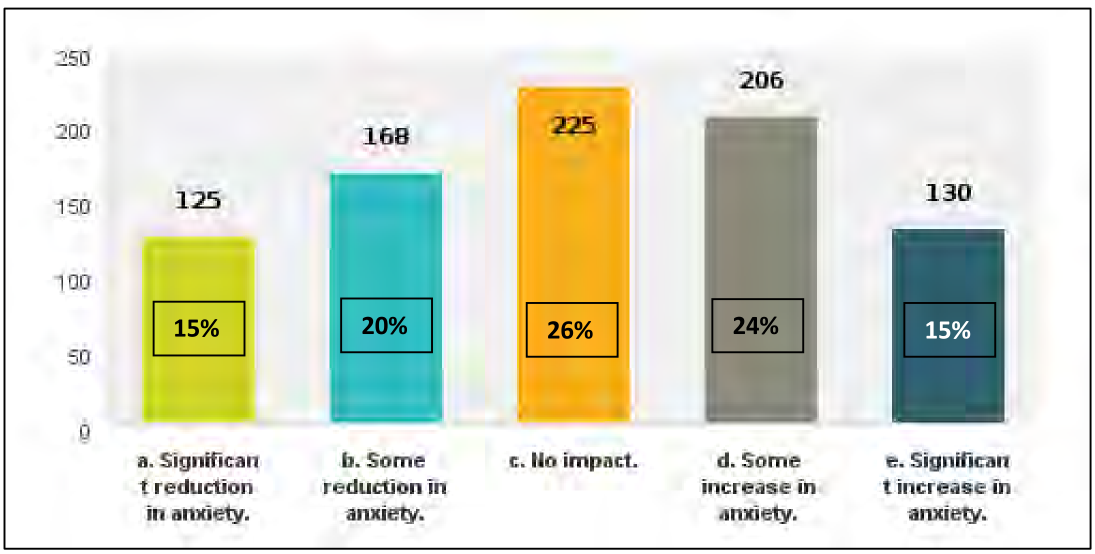
Key Finding: The average restoration cost was $3,297.

<u>Question #13:</u> Any non-restoration costs incurred since sump pump installation?

346 Respondents out of 850

Replacing sump pump(s)	$67,680
Replacing sump pump check valve	$2,913
Adding battery and/or water siphon backup	$92,494
Relocating sump pump	$1,750
Interior modifications to conceal sump pump, etc.	$24,646
Landscaping repair	$52,809
Additional power generator	$107,997
Other costs related to the sump pump installation	$195,064
Total:	**$545,353**

<u>Question #14:</u> How has the installation of a sump pump affected your peace of mind?



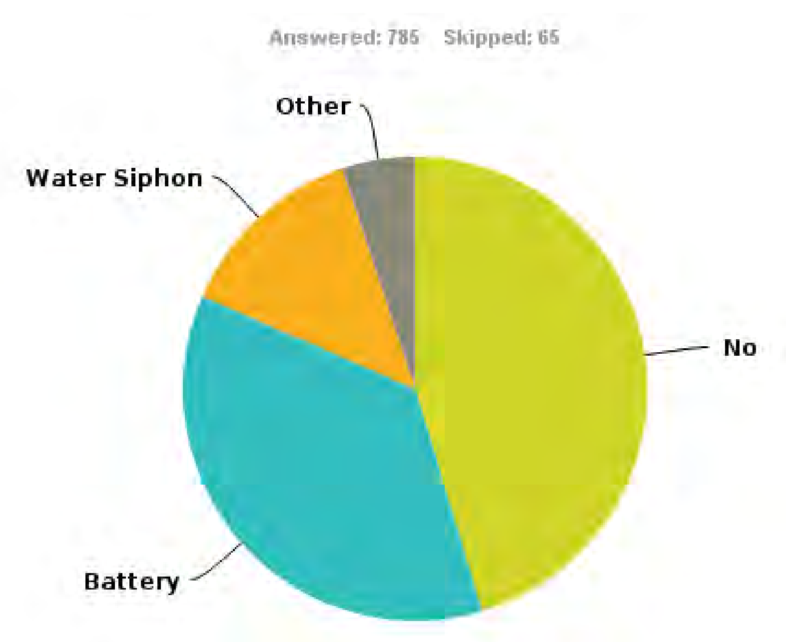
Key Finding:
Almost 40% reported some or significant increase in anxiety.

Question #15: **Distribution of concerns about sump pumps.**

Answer Options	Not concerned	Concerned	Very concerned
Sump pump malfunction.	31% - 229	43% - 323	26% - 193
Lack of a backup system.	47% - 323	33% - 227	19% - 131
Replacing sump pump.	41% - 293	41% - 293	18% - 127
Water flooding from sump pump hole.	53% - 367	31% - 213	17% - 118
Disrupted my basement design/style.	72% - 502	16% - 110	13% - 90
Reduction in property value due to sump pump.	67% - 464	22% - 151	11% - 76
Noise from the pump.	73% - 521	19% - 134	8% - 60
Going up and down stairs to check on sump pump.	73% - 501	18% - 124	9% - 60

Question #16: **Does your sump pump have a backup system?**

No = 41%
Battery = 36%
Water Siphon = 13%
Other = 5%

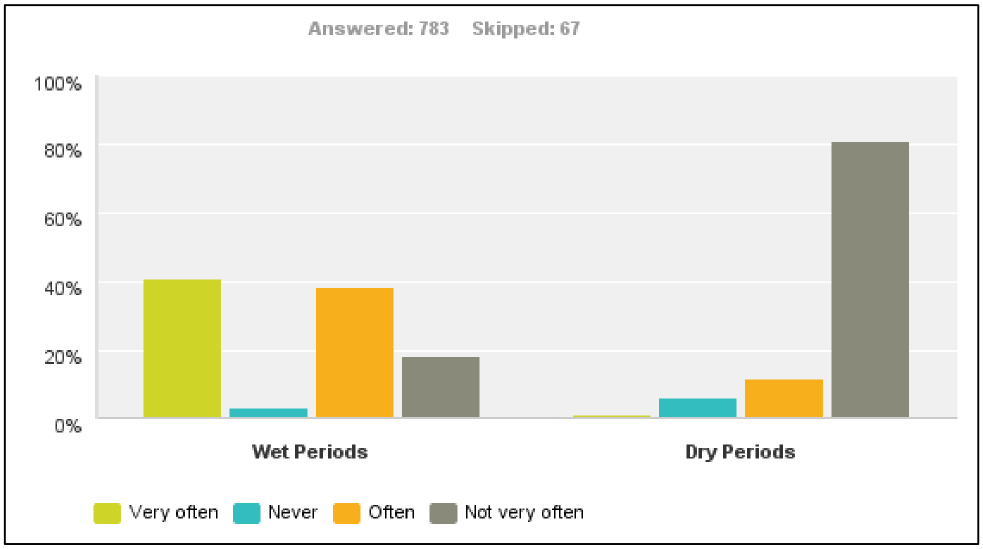


Key Finding:
Almost half of survey respondents don't have a backup system.

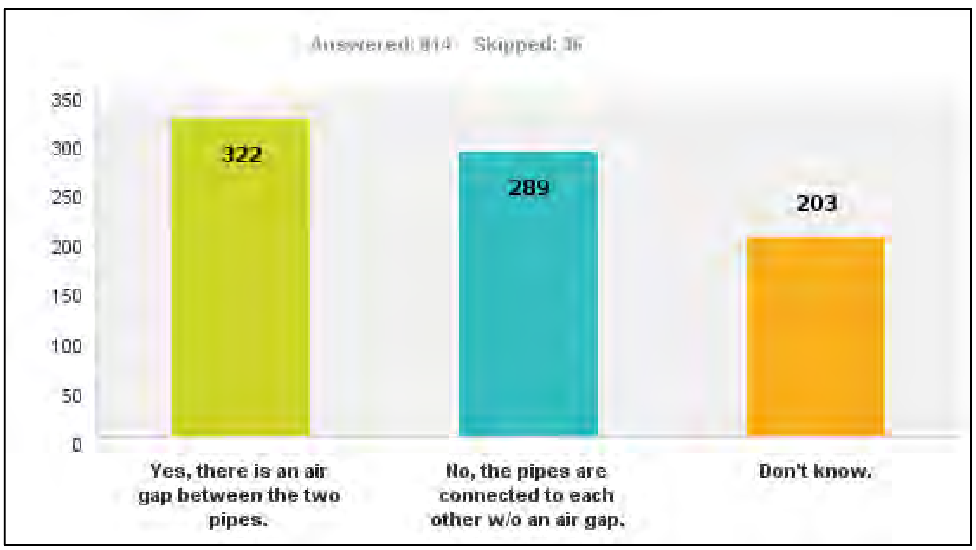
<u>Question #17:</u> Frequency at which sump pump operates?

Wet Periods
Very Often/Often = 79%
Not Very Often/Never = 21%

Dry Periods
Very Often/Often = 13%
Not Very Often/Never = 87%



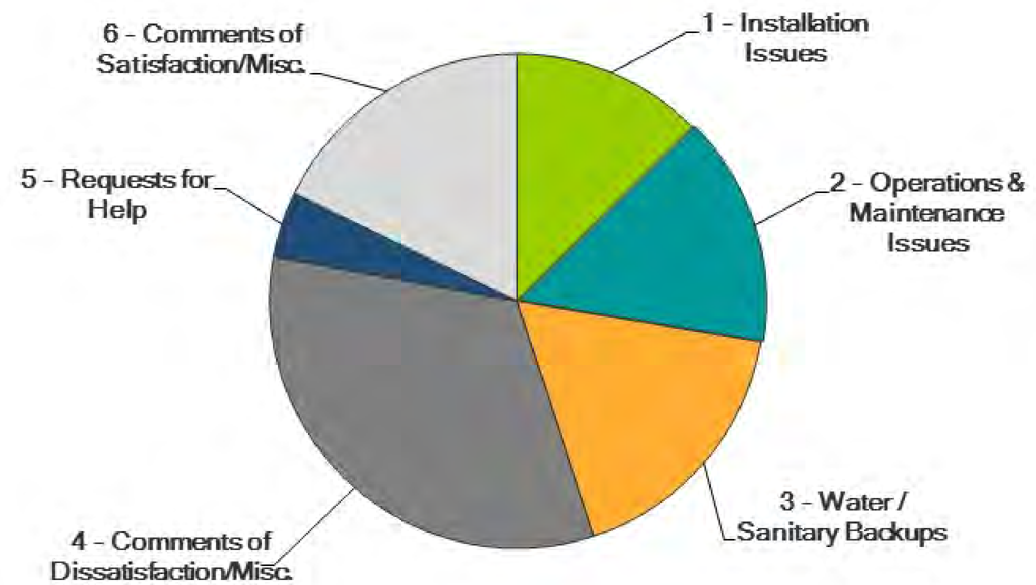
<u>Question #18:</u> Is there an air gap between the two pipes?



In addition to these results, there are five mentions of an "air gap" in the 307 comments, with the majority of those stating that they are not sure whether their home has one and would like someone to check their connection.

Distribution of Survey Comments:

398 Survey respondents provided comments - Total includes comments for Questions 14 and 19
Comments* were categorized as follows:



Comment Categories:

1. **Installation Issues** = 50 (13%)
2. **Operations & Maintenance Issues** = 60 (15%)
3. **Water/Sanitary Backups** = 69 (17%)*
4. **Comments of Dissatisfaction/Misc.** = 131 (33%)
5. **Requests for Help** = 17 (4%)
6. **Comments of Satisfaction/Misc.** = 71 (18%)

* Any comment mentioning water/sanitary backup in the basement was put in Category #3.

Appendix 1 –

City of Ann Arbor Footing Drain Disconnection Survey Comments

Category #1: Installation Issues – comments from questions #19 & #14 – total of 53

Comments from Question #19

1. The installer damaged the paint in numerous places on our basement stairs.

2. A trench was dug very near a tree. Shortly after, the tree began to decline significantly. We believe this was a result of the work near the tree. We need to have it removed.

3. There is an obstruction 8 feet in from the sanitary clean out that snags debris and clogs the sewer. Perhaps roots entering from the pipe that used to drain the footing?

4. Air gap is present but no leaf guard was installed as shown. Debris must be removed by hand.

5. Perimeter footing drains replaced concurrent with sump pump install (combination of interior and exterior).

6. Recommend that any homeowner strongly consider upgrading sump pump and having a back-up system added at installation.

7. Hutzel did a horrible job from the house to the street!

8. I begged not to have to do this and I feel that my personal rights were violated because I was forced into it. Now there is moisture around the sump pump to the extent that the tiles are loose, less storage space, worry about performance and maintenance, moisture outside perhaps? The garage floor area seems to have been affected, effort and time needed to investigate further and make repairs, financial loss for repairs and if our home is devalued, and emotional stress. I HATE what the city has done to my house and to my life.

9. Sump pump wire rested in spot that prevented pump from operating. Called plumber, quickly found problem, fixed for $110; Pump operation should be checked by installer so that wire cannot prevent from coming on.

10. We were one of the first repairs as we had so many instances of sewage backup and floor was jack hammered up in 5 places to install check valves . . . these are problematic as i have already had to clear two of them including one from Mr. Rooter.

11. Basement floor cracks due to jack hammer use. Unsure if west-front footing drain is connected to sump. Seepage along west front of basement.

12. Having sump pump installed has ruined floor in utility room because installers had to drill and patch numerous holes. Cement is falling apart around pump rim. I hate the sump pump and think it was a waste of money to be installed. Never had an issue prior to installation, now it's another piece of equipment to clean and maintain.

13. Had to replace vinyl tile in room with sump pump, due to installation at my expense and labor.

14. City never did final inspection to verify completion. Floor tiles left undone and ceiling was not restored. Trench settled and no filling by city. The sump has air hammer every time it operates and no reply from city about what to do. No follow through!

15. Trench area is low - needs raising also some seed did not take.

16. This was required by the city and the added cost was a burden. Had to pay extra to tap into the storm drain because the city wouldn't allow any other type of drainage system. It delayed placement of the drainage system due to inspections that were needed and it tore up my yard and driveway.

17. Left big trench in my yard from install.

18. This has destroyed my downstairs family area. It has ruined antique furniture. It used to be a place for my grandchildren to sleep. No more. It's a pit down there. I have been here 41 years. Thanks for your input and response. Basement flooded AFTER disconnect.

19. When the floor drain in the laundry room was installed, the drain is NOT the lowest point in the floor. The lowest point is the check valve next to it.

20. Currently we are experiencing a "sink hole" in the lawn where the discharge tube connects to the street connection. This is also undermining the sidewalk and three sections of side walk are caving in.

21. Should have been placed at back of house.

22. Re the above: The discharge pipe nests into the drain pipe with about 1/4" gap all around. The ends of the pipes are not separated as shown above, and there is no green leaf guard.

23. Landscaping has never recovered. Damage still visible.

24. We wanted (and still want to) do what is right for the drainage/sewer/water system. So we were and aren't necessarily upset by the disconnect program. However, we were not pleased with the cost and also are not happy with where the pump is in the basement . . . it is in a bad location and takes away from the appeal of the basement . . . and to have placed it in another area would have been cost prohibitive. As a result our home value has likely decreased. FYI - after FDD, we had matter come up through floor drain when city was flushing/cleaning lines in neighborhood. This hadn't happened before FDD in the 15 years we had been at this house, but don't know if this is related in anyway. We never had water in our basement until we got the sump pump.

25. Pipes are directly under my bedroom. Disturbing sleep.

26. This was unnecessary and has made my home environment less desirable due to the noise and appearance of floor that was never repainted as promised.

27. I wasn't here, but it was as if they tried to find the most inconvenient spot in the middle of the basement to put the sump.

28. Very poor work performed by a landscape company after sump pump placement.

29. 2009-2012: failed concrete in Lansdowne widespread. Inadequate grading, poor drainage, standing water, basement wall cave-ins, curb cuts nonfunctional due to improper street resurfacing. Asphalt foundation water proofing poorly applied, dampness at wire tie's thru walls.

30. The location of the sump pump is EXTREMELY bad.

31. It was a significant cost, was railroaded through by the city without regard for the elevation of my property or the history (none) of issues at this location, and has caused real and potential degradation of my property, and potential degradation of my health (from radon). I am more concerned about radon since the floor integrity was breached, and the basement floor now has 2 different tile types and a thickness difference.

32. We have had extensive problems that have cost us over $10,000 that are directly attributable to the Footing Drain Disconnection program. We are very unhappy and have considered taking legal action. Spent $7,000 on digging new drains to redirect water from backyard to front yard due to improper sump pump installation. In addition, we had to excavate and reseal the basement foundation due to leaks caused by the drainage problems caused by the improper sump pump installation.

33. The installation of a sump pump just about assures those never having trouble with water in the basement will have the problem at some time in the future. When power is lost for a protracted period, flooding is apt to occur. Because I am unable to remove the cover (repairmen have great difficulty trying too), I once had to siphon water through the cover hole with a pop bottle. Neighbor with backup system says that doesn't really work very well. Installation did make a mess of utility area arrangement. I understand the problem and agree with the necessity, but lament I just the same. Suggest some indication on outside of envelope as to contents. Looks like an ad to sell something - addressed to Homeowner from an unknown addressee. It almost went straight into the wastebasket.

34. Lawn was torn up, damage was never repaired. Sump pump coupling burst - flooding basement. Sump pump seems inoperable.

35. I can't get to my crawl space anymore - danger - power outages are very scary without footing drainage.

36. Very loud and cheaply done. Cracked sidewalk and killed yard. Also placed under master bedroom and ruined wall and carpet putting it in!

37. My front yard grass is not as good as used to be (dry quicker than before)

38. Landscaping - where dug to street has permanent dip in lawn; seeded with mostly weeds.

39. Good idea getting pump but entire process messed up by basement walls and bookcases.

40. Repeated sound of water "rattling" through pipe after a rain; danger of flooding basement if rainstorm knocks out power. This would flood more houses than before disconnect program! They should have enlarged sanitary drain pipes instead of destroying integrity of basements!

41. Was not pleased with the landscape/ground restoration. Poor grass seed placement and little/no mulch. Also some setting of the trench backfill.

42. An unnecessary inconvenience for us, still need to repair basement floor and have sump camouflaged as it is in the middle of living area in basement.

43. Never had a problem before. They didn't do it right the first time. The second time they had to dig up the basement floor again to connect it. Ended up with a cracked basement wall, we carpet, paneling, and another big mess.

44. Do I need the air gap for my connection outside?

45. Regarding #12 & #13, haven't incurred costs YET because we haven't dealt with it yet but will need to - sump pump was located in finished area of basement instead of unfinished area - we were not consulted. Will need to have backup system (did research when first installed - no good options and all costly!) Will need to somehow "box out" sump pump area or relocate because it's an eyesore and in carpeted area not near a drain - a big problem if leaks or backs up - will need to replace carpet and repair damaged landscaping. Caused problems that take effort and money to deal with when we never had problems in the first place!

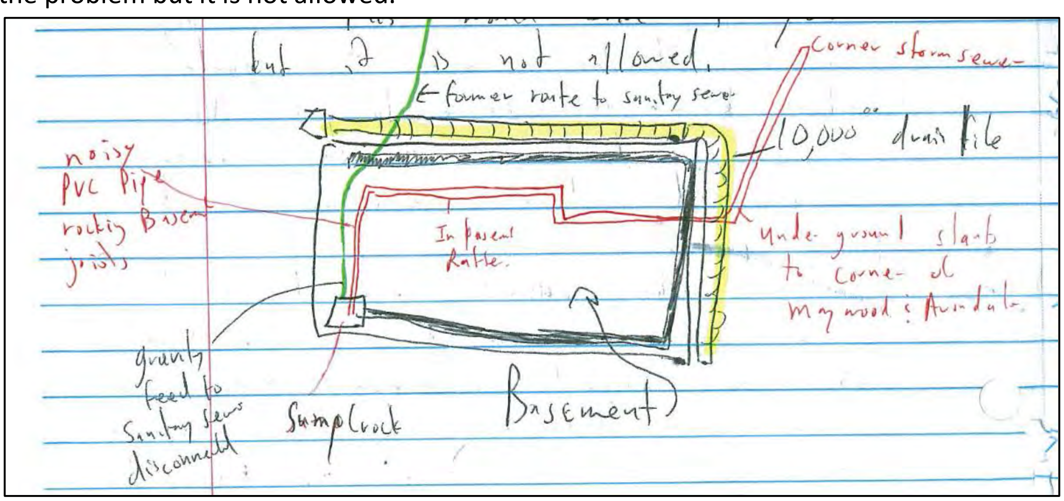
46. Gravity drainage, which is what used to be in our house, is always best. The sump pump basin is not large enough and was not installed low enough in the ground to prevent water pooling in the crawl space - a major problem.

47. Should I be concerned that there is no air gap where the pipes connect?

48. I have an air gap question, please contact me.

49. Unfortunately, this is a program that was necessitated by poor, unconscionable choices by the city decades ago. Who in their right mind would have allowed drained storm water into the sanitary sewers? Now people have to use sump pumps, which so prone to failure, either mechanical or loss of power (which typically happens during big storms. Backup systems are not reliable, and they make the sump covers even less radon tight which may cost lives from radon caused lung cancer. Poor quality work seen. Covers are not radon tight in addition. Cannot see through opaque cover simply.

50. Prior to having the disconnect and sump pump installation, we paid to have all the footing drains dug up and replaced on the south and east side of the house. These were tied to an internal drain tile that drained by gravity from sump crock (ceramic) into the sanitary sewer. Everything was dry after that. No one else on the street was disconnected. My neighbor, therefore discharges into my side yard and the whole neighborhood drains downhill into my basement. So the gravity discharge to the sewer was disconnected and replaced by a sump pump and it runs constantly in the spring. My neighbor discharges into a “garden” also known as a mosquito pit. Also, a sump discharges at our property line and drains eventually into my basement. Why wasn’t she disconnected? So whenever the power goes out which has happened numerous times, more than 10 times (several times for 24-72 hours) without power! When power goes off we use a water hydraulic pump backup. This recently dislodged and stuck inside the float of the electric pump which then flooded the basement. So we can’t have carpet in the basement and the peeling paint on the concrete floor is a mess. Here is the question: why can’t we have a gravity system for backup during emergency power outage then use the electric sump for normal operation? This would solve the problem but it is not allowed.



51. Thanks for the encouragement we received after having communication with your Survey Company. We purchased this home in January 1968. In April 1968 after returning from a Gospel concert in Detroit, we were advised by one of our neighbors to check our basement for water. We were heartbroken; because upon purchasing this house, we were not informed of sewage backup in the neighborhood. Sequoia Parkway island was an open ditch but we had no idea that problems existed. That night we had three (3) feet of sewage in the basement. Since that time, we have had problems after problems.

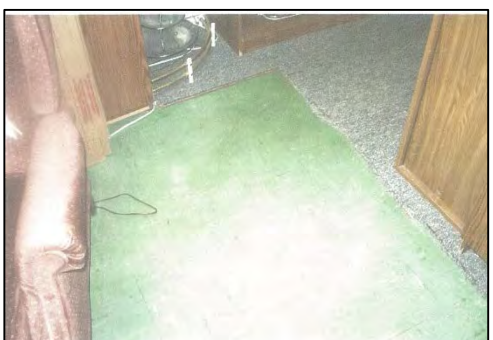
    After work was done on Sequoia Parkway (the ditch was enclosed and the pump installed) and after a few years had passed, we decided to redecorate our recreation room for the family – our mistake.

    Finally, the City of Ann Arbor contracted the Perimeter Company - owned by one of the city's former employees - to install a sump pump in our recreation room (it was left in a very unprofessional condition as indicated by the photographs). We have had one malfunction of the sump pump since installation and water overflowed over most of basement. The city employee came out but we had to clean the basement.

    Our wall-to-wall carpet was removed - except where certain heavy items were - by contractors hired by the city in one of the earlier episodes. In that case, the contractors cut around those heavy items and disconnected our gas fireplace. We have called Perimeter several times and the City of Ann Arbor - Susan McCormick's office before she left Ann Arbor - and complained about the condition that was left. To this day, we have not received a call from either the City or Perimeter. There have not been any repairs or communications since this occurred. The gas fireplace is still disconnected, the carpet has not been reinstalled and the deplorable finish on the sump pump is the same.

    We could have sold this house, but we cannot with a good and honest conscience. We have added a carport, a shower in the basement, a family room and extended the master bedroom since we purchased this house.
    We are grateful for your giving us this opportunity to let someone know the problems we have endured.

Rec. Room
Recreation Room



Cut Out Carpet

Disconnected Fireplace
Gas

Comments from Question #14

1. No problems prior to installation. With a 5 year warranty on the pump, potential for failure exists. Loss of power during a storm when the pump will be needed, but won't function. Also, concern about radon with a hole in my basement floor. No radon testing was included in the pump installation. The contractors (Perimeter) who did the job were excellent.

2. A defective part was installed and I had to pay $122 for a repair. This convinced me that I was given a poor quality pump and expect more problems down the road.

Category #2: Operations & Maintenance Issues - from questions #19 & #14 – total of 60

Comments from Question #19

1. I would never have a sump pump without a backup system, since stormy weather that knocks out power is the time when you most likely need a sump pump!

2. Cost of replacing battery pretty high; unclear what maintenance needs to be done to sump pump; tore up yard and street. Also neighbor's yard.

3. This past year we had to have our pipe to the street fixed because it had become filled with mineral deposits. I was told that this is not common, but it caused flooding around my house on the outside, because the water had no place to go once it discharged into the pipe. It just cascaded like a fountain until someone came out to fix it. This whole project has been a disaster for me and my family. Our pump runs often and we have worn out six of them since the first installation about 10 years ago. Fortunately I am handy and have been able to replace the pumps by myself. Otherwise I would have spent over $4000 on pumps. Thank goodness for the backup pumps which have saved our butts (and our basement) many, many times when the power goes out or when the main pump fails. This fiasco has cost me a fortune and I would like to be reimbursed for all of my expenses. I don't think I should have to sue the city to recover my costs, but I have complained many times and have had no satisfaction. Telling me that I am one of the few that has these kinds of problems does not make me feel any better. Before the installation I had no flooding or sewage backup or any water problems at all. Now every thunderstorm or heavy rain we have to worry. If you only knew how many nights I had to spend down the basement watching over the pump! We have had to use bilge pumps from my boat to keep the water level down in heavy rain situations.

4. We are concerned at the increase in radon levels in our basement since the installation of the sump pump.

5. I am considering having a natural gas generator to turn on when electrical power goes off.

6. Battery backup has an alarm that sounds when recharging is slow. This happens somewhat frequently, so we have typically silenced the alarm.

7. The backup battery is quite heavy. When I wanted to have the battery checked for possible replacement, I had to find someone who could bring the 30lb battery upstairs and put it in my car and then ask him again to take it back downstairs. This is difficult and before sump pumps I didn't have to deal with this.

8. We have never experienced sewage backup and/or water dampness in our basement but our next door neighbors have. I am concerned about the electric consumption when the battery is constantly being recharged.

9. I am uneasy during power outages since the batter backup system is not working. New battery and possibly the charger needed. Added expense.

10. The little cage is already chewed and has gaps. Are there replacement cages for the gap or perhaps a metal one?

11. As far as I know, the sump pump has not run since it was installed.

12. Sanitary sewage backups were caused by sewer pipe blockage. Once activated, the backup pump seems to run continuously. This seems to be wasteful of water and would be particularly bad if it occurred while we were on a vacation. Also, because of the backup pump, I can no longer turn off the water at the meter when leaving for an extended period of time.

13. Have already had to replace sump pump battery ($580) - battery fumes triggered CO detector, causing extreme anxiety for 2 days until repair! Serviceman refused to perform service outside business hours. Feel free to call if you would like more details.

14. Even during huge storms with vast amounts of rain, I very rarely hear our sump pump come on (no hearing loss). This is the most concerning and have no way to be sure it's actually working properly so we go and check for water very frequently. Installer told us we could now get flooding when we never had it before.

15. I was unaware of the necessity of checking/replacing my backup battery with any frequency.

16. At times where the sump pump operates water squirts out where the air gap is shown in your picture, although my connection does not have an air gap.

17. It has never kicked on - we're on top of a hill. I know one should "never say never" but I can say "up to now, never".

18. Currently considering battery backup system.

19. Question 17, small amount of water spills out from here whenever the pump pumps out water.

20. It involves more additional expense than anticipated. It is noisy in the family room. We have already had to replace it once. It has caused more anxiety due to the issues if it fails or we have a power outage. We had to stay up into the early morning hours manually emptying the sump pump during a power outage. I have questions about the project.

21. The installer returned to drill air hole somewhere near pump so that the pump wouldn't stop working so often. This helped initially however the drain noise increased dramatically and the fix no longer appears to work as I need to frequently open the cover and jostle the pipe to make the pump work.

22. Pipe hammers loudly when pump turns off. Mechanical pump switch has failed frequently. A solid state switch would have been preferable.

23. The original battery exploded (literally) about a year or so after installation and threw acid and acidic smoke throughout my office, which is located in the basement in the same room as the sump pump.

24. Sump pump installed in January 2003, malfunctioned in January 2007 and was replaced at that time.

25. There is an odor coming from the sump pump in hot muggy weather.

26. The noise of the sump pump is much louder than we expected.

27. Sometimes there is an odor, very noticeable!

28. Part of issue . . . pumps don't have on/off light to know it is engaged.

29. Have battery backup but unreliable. Power goes out, it starts beeping and has to be reset over and over - problematic!

30. I have unplugged my sump pump because there is an electrical malfunction in the unit. I refuse to pay to fix this city made problem.

31. Had a Watchdog battery installed with the sump pump. Found that system to be more problem then the pump. Sometimes there was a constant beeping from the battery which was impossible to turn off. Distilled water had to be added many times. When the battery had to be replaced, I decided not to. So now I worry about the basement flooding with no backup system.

32. DTE's electricity is obsolete and poor. Sump pump motors aren't very good. If the motor is running and there is a "stuttering" surge (off-on rapid succession), the motor goes out, so the battery backup is useless. Hence the expense of a water siphon backup.

33. I have come to the conclusion that I have to replace the sump pump every 2 years. Since Aug. 2011 last sump that went bad had new pump put in Aug. 2013. I wish I never had this done.

34. The sump motor had to be replaced because it "froze up" due to disuse - i.e. not enough water flowing into sump.

35. Backflow malfunctioned. City, insurance co, all didn't want to touch it! "Out of warranty".

36. The only reason we did this was to avoid fines from the city of Ann Arbor. The costs to us have been over $5,000 so far!!!

37. This whole concept is a disaster for homeowners, we spend a significant amount of time way from Ann Arbor and have zero confidence in system, even with the water backup in place. It takes up a lot of space, is noisy, unreliable and creates many problems for us, without providing any benefits. I will be very upset if this program is canceled without restoring our basement to its original state. We will be screwed in the same way we were when we paid to replace our sidewalks and then the city decided to pay for everyone else!

38. My concerns are: continuing maintenance of whole system - replacement of backup battery; replacement of sump pump; electrical outages when gone on trips. I am very concerned.

39. The initial pump installation used two pumps that went out of production in a couple of years, forcing us to replace them with new ones. Repair parts were not available.

40. I was very unhappy about the sump pump noise - not mentioned by owner. City wouldn't do anything since I hadn't signed the contract which was done by previous owner. It seems that Hutzel put the sump pump in then I had to pay them to do it right. I did not like that.

41. Very concerned about backup due to power outage of system failure.

42. Sump pump has malfunctioned setting off alarm repeatedly. It is currently disconnected from power supply. Trying to decide how to proceed.

43. They put the pump in the basement which is only 3 feet high and every time the backup starts beeping, it is hard to fix and have replaced battery twice and we never had a problem.

44. Way too much noise!

45. Pump failed and had to be replaced at my expense.

46. Cost a lot of money because we go to Florida in the winter, I had to purchase a generator to make sure it runs when power is out.

47. Would have been and still helpful to receive instructions on maintenance backup.

48. PVC pipe from sump pump to outside began to shutter when sump pump runs. This occurred AFTER warranty period, and estimated costs to repair (cut through dry wall, re-run pipes, patch, paint, etc.) are in the thousands of dollars. Very dissatisfied with program. Lawn was never adequately repaired - cost $750 to repair. City contractor unresponsive.

49. We are not sure if the sump pump is operating correctly. One week of very heavy rain resulted in seepage.

50. What maintenance is needed?

51. I have a question about the outside drain.

Comments from Question #14

1. Was installed incorrectly first time had to reinstall. Had small leak in backup, small leak in PVC pipes, fixed. Pipes run the length of house and is very loud under our bed room. I am a light sleeper. During rain it runs every minute. Our back yard is flat and the water pools like a swamp, so it runs a lot.

2. Didn't purchase the back-up sump pump. Short life of sump-pump.

3. None of these yet but I can't find anyone including plumbers who will check it. I have no one to maintain it so it’s a problem waiting to happen that I would not have had to deal with prior.

4. We do not know what is expected in maintenance, what type, what contract, what is the back-up method if anything goes wrong. Do not have the cash to change for a system that we know and the pump is next to the only windows that could be transform in egress windows in our basement.

5. 1) Power outages occur monthly, duration varies, up to 36 hours (so far). 2) At time of installation no roots in system; now have roots and will be excavating, etc. pump clogs, 3) line along street barely 2' below grade; fear freezing or clogging of catch-basin outlet of pipe, 4) exchanged reliable passive system for headaches; anxiety; maintenance; and $$$ + energy cost, 5) wet season finds duty cycle of 10 seconds on, 30 seconds off annoying (accompanied by check valve thud)

6. Pump requires frequent adjustment.

7. We had no issues prior to the requirement to have this installed. I know that at some point the motor will go bad so regardless if I have a backup generator or not the only way we will know the motor is bad is when we have water in the basement and there will be damage to the carpeting and furniture.

8. Occasional high pitched whine of unknown origin. Battery recharging??? Just having a large hole in the basement floor is disconcerting.

9. Battery is too expensive and we are not convinced of the reliability. We are in our 70's and would not be able to maintain the battery.

Category #3: Water / Sanitary Backups - comments from questions #19 & #14 – total 66

Comments from Question #19

1. Originally we had 2 sump pumps installed before the program of footing drain disconnection. When we had an addition added to our house (1973) the contractor destroyed some of our footing drains. After considerable expense we had 2 sumps installed that took the water that was seeping into our basement and connected them to the storm sewer. This fixed the problem of flooding and seepage from the outside to the inside. Then in 2005 Richard Conners, one of your "pre-qualified" installers replaced our old pumps and sold us a battery (marine) backup system at considerable expense. On Aug. 4, 2009 on one of the 2 pumps, the clamps came loose and water was being ejected all over the basement. Conners came and replaced the clamps for $145. However the battery backup system didn't help nor alert me to the malfunction. On Feb. 5, 2010, I discovered a huge electric bill and checked that the pumps had been running continuously in quite some time and our lower basement under the new addition had 3 inches of water on the floor. Conners didn't want to come but we insisted and he came and replaced the rubber fitting with a stronger plastic arrangement with the check valve inside. The battery was weak and the warning system did not work and within a week the battery completely failed. The control system was underwater and must have been damaged. Conners told me I was supposed to add water to the battery once a year but that was the first time he told me that. The manual never mentioned that! Anyways, I no longer have any backup or warning system, so I routinely go and check that all is working. Fortunately, this year I checked and found that other clamps that Conners had installed had come loose and broke. I purchased new clamps and installed them. This lasted a few weeks and then the rubber connectors came out. My daughter bought new connectors and new clamps and we reinstalled them. We did not experience such problems before 2005 but we did replace the sump pumps several times. I think that Conners installed a higher quality pump since these pump themselves have not failed. Our problem seems to have been faulty installation and our expensive warning and backup system that did not work when it was needed. It was my impression that Conners was not an experienced plumber or installer. I did not like the way he connected our floor drain to the pump system. We had 2 floor drains. He cemented one over and so the water under the house was forced to go the other floor drain while was connected to the old pump system, so eventually it all is tied in with the new system. But it makes me uneasy as I think it is a makeshift system. I do believe you do need to help the people whose sewage system backup because the city's sewage system can't handle excess rainfall but there must be a better way than messing up footing drain that were working before the disconnection. Also, you should have done a better job of vetting the installers. One of my neighbors also used Conners and another used Hutzel. Neither to my knowledge had any subsequent difficulties. I hope you pay attention to the things I have written here rather than just doing a statistical analysis of the short question and answer.

2. Before installation we had no problem; after we had 3 times wet basement, now we always worry it will happen again.

3. Q2: Sump pump installed May 2010; I was very stressed about the $700 cost of the battery backup. Q3: Working so far, but didn't really need/want one – makes noise, uses power. Q5: I'm had one MAJOR, then 2 minor sewage backups due to the City's tree roots growing into the pipe! Q7/8: Sept. 2010: Entire basement flooded; Sept. 2011, Aug. 2012, & Aug. 16, 2013: minor, just around drain. I moved here in Jan. 2008 and there were NO sewer backups until 4-1/2 month AFTER the sump pump was installed! Q13: I also worry about cost of battery replacement – I am a retired senor! Now I worry about a power failure and flooding in the sump area, whereas none before. Q15: Concerned about replacing the battery backup. I always check the lights on the sump pump. Unsightly! Q19: I was VERY satisfied with the company that installed the sump: Perimeter – punctual, efficient, courteous, and competent) Now I worry about a power failure and flooding in the sump area, whereas none before. Also, I worry about cost of battery replacement - I am a retired senior.

4. Our neighbor reported that he was unaware of flooding problems in our house when we had our first flooding incident in Nov. 2010. He has been in his house approximately 20 years and his opinion indicates to me that the system before the FDD seemed to work well. I understand the reasoning for the disconnection, but based on my experience, I don't think the initial sump pumps were installed or load tested properly (especially our battery-based backup pump). We have spent significant money to reduce the amount of water flowing towards our house (landscape drainage, new downspouts), but our sump pump still runs very often probably due to high groundwater levels and water coming up into the sump from the ground. During very wet periods (heavy rain or spring thaw), our main pump can trigger as quickly as every 30 seconds, running for 10 seconds at a time. It was also a professional plumber's opinion that the footing drain tile entrance into our pit was placed too low to allow a decent amount of water to collect in the pit before it flowed back into the drain tile. This necessitates running the pump more often. First basement flooding ("incident #1") occurred 5 months after we purchased the house due to main sump pump failure and battery-powered backup system not working (I think the backup system float switch caught on the wall of the pit and never activated, probably due to poor installation). I think this was roughly 5 years after the footing drain disconnection and sump pump installation. Neighbor reported to us that he was unaware of any flooding problems in our house and has lived on street approximately 20 years.

5. Flooding during power outage. City funding did not provide for a robust system.

6. City installed pump did not have backup and flooded basement when power went out during heavy rains this past June. Would not have had that problem if no sump pump. $10,000 in damages - most but not all covered by insurance. Not happy at all with sump pump program.

7. We had a very complicated situation - already had one sump and we installed a second pump and redirected the initial sump and routed it out to the yard. We have concerns (based on the color of the grass) that the water is not going all the way to the storm drain . . . this whole process and the subsequent flooding have been a real pain.

8. The sump pump installed by city backed up because the float got stuck. I had to replace sump pump and paneling in basement.

9. The sump pump has vibrated and moved in the hole and the float has pushed against the wall and stopped floating when full of water, so the pump didn't turn on and water overflowed the hole and made the floor and carpet wet, twice. Also concerned that power outage will have the same problem - overflow of water. I have extended the protective metal ring, as it wasn't wide enough before. The backup battery or water injection pump would be something we will eventually get, though a little pricy when we first considered it.

10. Being a good citizen, when we got the letter telling us we needed to have our storm sewer disconnected, everyone in town would be, we thought, the city had thought things through and it would be fine. The installation process was frustrating, having many workman carrying buckets from our basement, certainly what are they doing and how would our home be changed forever? I bought this house in 1970 and wanted to live in town, with services and no well, no sump pump, no septic tank. Police, street lights and garbage pickup. Services, for which the additional tax dollars, compared to living in the country would be worth it.30 large containers of soil was removed from our back yard so that where the long drain went, the grass would be ground would be flat. Certainly these folks, understand the ground settles and we have a permanent impression in our lawn a constant reminder of what had allowed. The first summer we had the sump, in July the power went out, not a storm, but a substation fire and we were out for many hours. In the evening we went to my mother's to watch TV and returned home to still no power, dark as all can imagine, and this constant water is running noise. We had installed a water backup system and it was working and working and working. We had 6 inches of water in our basement, yes, the water was being dumped right back around our house, the open pipe was right outside our kitchen window. We were drowning ourselves! We had no idea how to stop the water. Midnight we called the person in our neighborhood that was the Ombudsman, and called every person we could think of. Yes, Hutzel who installed it. Dark and flashlights and finally one neighbor came over and he knew how to stop any more water from running. Another neighbor on the street had the same thing occurring. My husband got the city engineers out on Monday and we lost a lot in our basement and yes, Coaches cleaned it up and yes, we paid our $1,000 deductible. And, yes the engineering error on this backup system was corrected. But, we still have a sump, and we have a second one and we had more trouble, when the float failed and when we had a couple other large storms. And, it is terrible! Costly, worrisome, permanent damage to our home and yard. And, why? And, where is our compensation? Why do we have these expenses and worries and the same taxes? Our next door neighbor waited to get his installed until I guess he decided he had no choice, but they installed his to run to the curb and not through the whole back yard. They have sold and are gone from town and now we have a new neighbor. A couple weeks ago I got a call from a friend who wanted to come and stay. We have a full house, but a nice finished basement, yes?! My first thought is, what is the weather forecast? No rain I hope. The March when the tornado hit in Dexter, we had water up to our front door. Another mess, but no one cares. My husband had the city engineers here again that time too, but no help and why should we suffer? We also own a rental at 1720 Tudor; we had to have a sump put in there too. No disasters yet, but it will need to be replaced, and inspected, and so on and so on. We own some other AA properties and will not just get the things installed, again, because the city says so. Such trust we placed in our government and City!

11. Due to exterior basement wall excavation to install the discharge pipe, my basement now leaks every time there's a moderate rain event. The cinder block walls have cracked where mortar used to be. Prior to sump pump installation this was never a problem. City should pay to have this fixed as problem will only get worse.

12. It isn't the pump that was the problem. It works fine, the installation in a formally dry basement caused all sorts of ground water to enter the basement. Ruining carpet, wall board, and furniture. The subsequent silence from the city was particularly galling. I would now rather I had opted to pay the $100/month extortion instead of this miss.

13. We are in a quad-level with less than a full basement, sump pump took valuable storage space away. I don't believe the sump pump itself took away home value, but being in the now-designated "problem area" may have. The "program" may have created a new wall seepage issue that was not there previously, or it could be a coincidence. Program seemed to create a new seepage issue where we didn't have before.

14. Dislike whole project. No one could ever sleep in bedroom above sump; noise level; 2 additional holes dug, grass didn't grow where they seeded. This is the worst band-aid fix for a problem that goes back to when sub was built. Yes, many floods lost everything. City saying not responsible.

15. We bought our house because it did not flood and did not have a sump pump. Now we have the pump's constant noise and the backup is a constant problem. We cannot lift the full battery and carry it upstairs. The sump pump is installed under our unlit staircase which is pretty inaccessible. We have never checked to see if it works because we can't really get in the tight space and figure it out while holding a flashlight. The battery backup has to be continually repaired and/or replaced - at GREAT inconvenience and expense! It also needs constant maintenance. The sump took one of our few fuses in our house. It's extremely noisy because it's under our staircase and our house has an open floor plan and is small. It runs constantly during wet times. Our basement is now damp whereas it never was before (we've been here since 1991). We would not have bought here if we knew we would have to have this sump pump retrofit like this. We know of several people who've had to replace the pumps. We dread this expense. We do not know how to do this work ourselves so must hire it out. This pump is a constant source of irritation.

16. I think this program was a disaster for our family. In February 2008, your team installed the system and left the exhaust pipe extending about 8ft from the house as the ground was frozen and they couldn't connect to the sewer. So the water kept running back toward my house and eventually broke through the foundation and flooded my basement for a week. I had to install a B-Dry system at my expense for over $2500. I contacted the FDD program and I was told, too bad. I appealed to the city and they rejected my request to cover the costs out of hand without even hearing me out. It still leaves a bad taste in my mouth and bank account.

17. We did not have water problems prior to installation; though previous residents may have (pre-1993). We had a backup shortly after FDD installation due to faulty check valve. We replaced orangeberg and have had no further problems.

18. This is the worst thing possible. The drain disconnect has cost me thousands of dollars. The installation destroyed my basement floor, holes dug, tiles not replaced, check valve at toe stubbing level. I've had 2 major floods, both happened during summer storms when the power went out. Both times I was traveling and did not know until I came home. Coach's Catastrophe Carpet Care came both times; $2,200 the first time - all furniture, carpet, everything had to be thrown out, the second cost was $1,800, the same thing, everything had to be thrown away. I bought a generator at a cost of $7,000, then the pump stopped working - another flood. Replaced the pump for a few hundred dollars. I am a 73 year old widow on a fixed income, living alone. This program has cost me thousands of dollars, destroyed my peace of mind and had a negative impact on the value of my home. Also, I would be interested in knowing whether anyone has paid the onerous fines we were threatened with.

19. We had a sump pump previously and so Perimeter did not replace our pump at the time and left us with a pump. We recently had that pump installed by Perimeter (November 2013) because the backup was running and not stopping. Our sanitary backups and dampness in the basement do not seem to have any relationship to the FDD.

20. Around May 31, 2011, a storm passed thru Ann Arbor, I was traveling and arrived home to find our sump pump was running and found the original check valve used in the installation had failed resulting in the sump pump pulling in the water from outside of the house and depositing that water in the basement due to the check valve failure. I immediately pulled the plug for the pump but there was a water spill in the basement that covered almost all of the basement floor and as we had wall to wall carpeting on the floor that was now soaked from the pump location all the way across to the stairwell. I saved the rug by using our carpet cleaner to get rid of all the water it had absorbed taking 2 days to complete that job. There were lots of others in our neighborhood with similar problems that day and as a result I couldn't get anyone to come to look at our house. I replaced the check valve with a much more robust one that is still in the system. We have never had any problems with the system since that incident.

21. I never had any problems until I had the footing drain disconnect. This summer the City came out due to multiple floods and installed a bigger sump pump and replaced my battery backup. I have not had any more problems since but I am waiting until the spring before I say everything is ok.

22. There definitely has been more water in my basement since the sump pump came in heavy rain. It is in the area of the pump, but I don't know whether it came from the pump. Also, the installer had agreed to leave the lid easy to open so I could check on things and he did not. I need the original information that came from the city to better manage this situation and don't know where to obtain that. I need to be able to get into the area below the floor - to see or make modifications.

23. We never had water problems in our basement until after the footing drain disconnect. Now we have seepage through one wall whenever the ground is saturated with water. All spring and much of the fall.

24. I wish I had not gotten it installed. The house was functioning well for about 40 years. In the last 5 years since the pump was installed, we have had dampness and a couple of sewage backups.

25. I had very rare water infiltration prior to the installation of the FDD. Since I have had multiple instances which required me to pay for landscaping to help mitigate. I have had water soak my basement carpet many times but did not list the cost to replace as I am reluctant to do so. Overall I wonder why this needed to be done.

26. In our yard and with crawl space, we've had intermittent dampness, etc. and have waterproofed crawl space and spent a lot of money for water drainage in yard.

27. I would like to remove the sump pump. Since installation we have had flooding (none in the 10+ years prior to the installation), had to pay to get it fixed, lost items due to flooding and have lost storage space due to pump. Plus we worry about additional flooding and pump failure. It prevents us from remodeling our basement.

28. I was very concerned about the sump pump being unable to handle the extreme amount of water during the storm with the Dexter tornado. There was some seepage through the basement floor during that storm.

29. Before installation we had zero problem in the front of the basement since - we have had water twice. Fortunately we try to keep anything of value off the floor.

30. Never had any backup problems before sump pump installation. Now am totally dependent on it to prevent basement flooding in wet weather and spring melt - if there is power outage for example. In 2008, the main pump motor had seized up and the batter backup pump meter also seized up - flooded and ruined the finished basement. Also, the only tie-in to the footing drain meant the sump had to go in my finished media room, very disruptive.

31. We have lived in our house for the past 42 years and never had any water in our basement until after the sump pump was installed and malfunctioned twice!

32. Do not hear pump. Basement is damper than before pump. We are absent 6 months of the year. Stated purpose of this was to stop sewer backups. Did it?

33. Very unhappy about disruptive installation and the fact that the mostly dry basement became wet AFTER the sump pump was installed--with little government concern about our complaints.

34. The flooding experienced before sump pump was originally put in - this was due to rain water coming in under basement door. I have a walk up and out basement. The flood in June was due to a power outage. The battery life is 4hrs. The outage was at least 8hrs. on a very rainy day. Therefore the flood. Since then I have purchased sump pump insurance.

35. The sump pump that was installed did not last. Flooding has been a significant concern since I bought the house in 2009. The previous owners claimed they never had water damage, but I have had 3 major floods and 3 or 4 minor floods since 2009. I just got a backup sump pump system installed last month, and I am hoping I can sleep better now whenever it rains.

36. We were not pleased with the program from the beginning and the fact that we were required to participate. In all the time my wife and I have lived here we never had storm water or sewage water come into the basement until this year. Now we are worried whenever we go on vacation and we are on watch whenever we get a heavy rain storm. It's very disappointing. What will happen with our house (and all the other homes) that have undergone the disconnect should the city decide to discontinue the program? That's an expensive miscalculation!

37. We used Richard Connors/RDC for our digging and sump pump replacement. He was NOT pleased with us when he had to come back and fix the trench he had to re-dig that caused a problem going from the pipe to the street. I'm just sorry Sue McCormick didn't have to endure what we residents went through. We had $8,000-$10,000 of damage from the malfunctioning sump pump. We had a sewer backup with another $2,000 clean up. We never had a drop of water in our basement before the sump pump fiasco. We had to endure the digging up of a trench in our finished basement. This process/program was costly and infuriating from start to finish.

38. We are convinced that the water flooding in our basement was due to reconstruction of Stadium Blvd. We are on the corner lot and never had this amount before or ever in the last 25 years. The flow had to be changed with construction.

39. Sump pump (and backup) failed, flooding basement, lost stuff, replaced carpet, painted. Worry now about repeat. Lawn has long trench - not filled properly - needs soil. New driveway segment not sealed to street need asphalt. Can we ask the program to come back and fix lawn and asphalt or is it way too late? (Annoying, we had no water problem before.)

40. We indicated we did NOT want a sump pump in our basement. Our basement was DRY following the interior perimeter drain work done by the company. Since the disconnect sump pump installation we have had one serious flooding and one serious seepage. Since we were not given a choice in this matter (and we were told all of Ann Arbor would be required to have a disconnect pump, apparently no longer true) this has turned out to be a very unpleasant experience. We were told if we wanted a backup system, generator, etc. we would have to pay for it.

41. We never had water in our basement until we got the sump pump!

42. Water (storm) came up through the floor drains, but the sump pump never turned on.

43. Per Hutzels, the sewage backup that occurred in March 2012 was due to the flapper/seal between the sump line and sewage line becoming stiff over the 10 years it was there, so it did not work properly. They replaced it. I suggest that the city replace these about every 8 years to prevent seal failure in a lot of homes.

44. The installation did absolutely nothing to prevent sewer backups.

45. Concerned about: power outages, having to install backup pump and pump failure when there is no power outage. We have new water issues due to the installation.

46. Our basement had not flooded for 34 years until after sump pump installation.

47. We NEVER had damp basement walls or seepage prior to the disconnection of the footing drains. We are NOT happy with this having been forced on us.

48. Sewer backup was due to collapsed sewer pipe, not drainage. Several flooding events since sump pump installation, none before, flooding events caused property damage and personal injury - very unhappy and anxious about sump pump each time it rains heavily.

49. Water damage to home office / basement from malfunctioning water siphon backup (twice).

50. Putting in the sump pump has caused more water problems in the basement. Also I had to install a new battery after some flooding. Water now comes up from the drainpipe when it rains and causes a pool of water on the basement floor. The seepage has not decreased since the pump was installed.

51. I want to be re-connected to the footing drain. After the failure of the pump I am very anxious that my basement will flood again. I hate the sound and the upkeep. I was never afraid of flooding before the pump was installed. Now, I am consistently afraid the pump will fail and cause damage and cost me $$. I hear it when I try to sleep. It's like someone flushing a toilet every few minutes.

52. When the drain from the neighborhood collects the rain our creek floods and so does our yard. My largest concern is that when there is rain the creek rises and so does the level of the sump pump in the basement. Our house the next house right after the drain outlet. We have had flooding in our yard, almost into the basement.

53. Our basement flooded when the pump wires loosened somehow. Only an accidental brush restored power.

54. We CAN NOT have flooding in the neighborhood like we did in 2011/2012. Not only did my basement get wet but flooding also occurred in the garage from very high water levels (at least 3" standing water), high enough to flow into my garage.

55. Before the footing drain disconnection project, the basement never flooded. Since then, we've had multiple incidences of flooding after strong rain. Coincidence?

56. Why don't I have an air gap on exit pipe?

57. My 50-year old VCT tile was removed last spring and new VCT installed. The old tile was still attached nicely. The new tile is already lifting from all the water down there. I did not realize until now that the new appearance of large amounts of water could have been from the disconnection of footing drain.

58. Regarding questions 5,6,7,9 - the pipe damage, which resulted in basement flooding would still have happened with the sump pump, so don't conclude that since no damage has occurred in the 5 months since the pump was installed that it's the reason for the lack of problems, 60-yr. old rusty pipes caused our flooding.

59. I have water in egress window.

60. The blue container in the picture is what I placed to keep the water from going all over the area. Here are pictures of our defective pump on two occasions. Then the pump went out after repairs and water seeped into basement from under floors flooding with nowhere else to go. Replaced new sump pump. Never had a problem until you installed this thing. Would never recommend doing this. We never had water or leakage in basement before. We built and have lived in this house for 40+ years!!!

61. Since the sump pump was installed I haven't had any major backups like the ones from 1998 & 2000. I've had 1 or 2 times where I had stinky black water come up from the basement drain, but it wasn't clear to me if the mess came from just the section between the drain and the whole house check valve or if it came from further out. I don't think it was a sanitary sewer backup (or maybe just minimal). I also had an instance where clear water filled up the pipe/space between the check valve and the basement floor. The plumber thought it was ground water leaking in there but had no idea why. It reached the level of the basement floor by the time it was discovered. I don't remember having trouble with rainwater coming in the basement windows until the past 5 years. It seeps through the concrete at the base of the windows and also at the base of the wall where it meets the floor. I had a drain installed parallel to the driveway, out to the street, which has resolved the problem on that side, but water still seeps in along the south wall. Frankly, I don't pay attention to how often the sump pump comes on. I'll never trust the basement EVER, so I have water alarms everywhere.

62. The radon fan they installed at the same time was very noisy at first, but now I can barely hear it, and it lowered our radon number 80%. Two neighbors sump pump battery backup systems have failed and caused alarms and were difficult to get fixed. We've hadn't heard the pump run, so, a year or so ago I poured water into the sump until it ran just to make sure it worked. Our neighbor (higher than us) did some work that changed the surface drainage and caused significant seepage into our basement through the south wall and window wells, but the sump never ran.

63. The sump pump that was installed in our home must have been a poor quality item. I called the city when it failed and asked about a warranty. I was told it had a 1 year warranty. When we went to replace it there were no pumps available with less than 5-yr. warranty. That fact leads me to believe the pump the city installed was of poor quality. Our basement flooded as we were out of town when this occurred. Our finished basement was ruined. We have no peace of mind!

64. I was part of the pilot installation. A battery backup would have been useful. Have some issues with overflow around air gap, as mine discharges into a 20 foot long underground pipe and thence into a rain garden -would guess some animal(s) have built a nest in the discharge line. Leaks do not seep back around foundation. Installer never finished the tile around floor drain and sump - would have been nice to have that done. Otherwise have same pump, runs fine, while I can suppress the noise and transmitted vibration, I like to hear that the pump is running vs. not. I still cannot understand my neighbor's issues - while on the Task Force (Morehead rep.) I dealt with three poor installations, but never heard of anyone thereafter having issues with backups and only one incident of the pump causing a clear water problem (discharged into a gravel bed next to the foundation ... short circuited into footing drains and pump could not keep up). Seems to me that a lot of my neighbors expect sumps to handle serious water seepage issues that have nothing to do with sewer backups and that they were and are part of the stormwater and sanitary sewer overflow problems, no sump pump should run more than a few minutes an hour due to rainfall - any that do need further investigation to see why. The idea that a water pooling in backyards and flowing up against casement windows has anything to do with FDD or can be resolved with FDD is almost like a witch hunt! Maybe the stormwater program will wake people up, especially if they look at the scope and magnitude planned - but should be sobering to think that w/o the FDD the previous floods would not be mitigated for another few years with large public works that have yet to be approved and funded - the FDD was always intended as a low cost stop gap solution that avoided digging up streets and making major system changes - too bad that message did not get out before groups like a2underwater started disseminating misinformation and council did their squeaky wheel response. At this point someone in authority needs to make a public statement backed by real data not anecdotes that establishes what, if any, connection there is between the FDD and recent flooding. Good engineers and engineering efforts have been disparaged and maligned. CDM may have problems getting future work with the city." I would like to know how to clear the FDD and getting it restarted; also "homemade" battery backup solutions. After first backup, could not sleep during storms - installed water alarms. Second backup occurred with son and wife in hospital, very traumatic.

65. I don't think there's an air gap. I'm not home to check. This project has been awful for me and my property. I've invested thousands of dollars and still can't count on a dry basement. Worse, I'm always afraid during heavy rains and whenever the power fails (which is fairly often in my neighborhood). I lost my investment in the basement remodel and am not confident that I could do it again without risking my investment. I'm really concerned about resale value when I finally sell my home. I certainly can no longer say that I have a dry basement and I would need to disclose the hassles of maintaining the sump pump. I spent $10,000 when I first moved in to seal basement and drain to sanitary sewer footing drains. I was completely dry for 10 years and remodeled downstairs. After the disconnect and sump pump, I had a huge flood which ruined it all. I have had numerous small floods, water flows, leaks and dampness ever since. So have neighbors on both sides of me. The pump is often insufficient to keep up with the water and the battery backup is not enough to last through power failures. I'm very anxious whenever the power fails and very worried when I go away for work or vacation. My neighbor has hooked my pump up to his generator through my basement window several times but this is not a great thing to have to rely on. I am not comfortable dealing with a generator myself. The sump pump and the battery have also died and been replaced twice.

Comments from Question #14

1. We opted not to include battery back-up when we installed the sump pump, and we should have. We have gotten water when the power has done off in storms.

Category #4: Comments of Dissatisfaction/Misc.- comments from questions #19 & 14 – total 125

Comments from Question #19

1. We never wanted or needed this and felt we were forced into installing this. Plus, we had to pay quite a bit so we did not trip over it while coming down the stairs. It is ugly and noisy. Very unhappy! Thanks A2 city.

2. I am very unhappy due to the water in my basement and the cost to me to get it fixed.

3. We have always had a dry basement. My primary concern now is a malfunctioning pump and a flooded basement.

4. I wish that this survey had been sent to us sooner. I don't remember a lot of details.

5. Next time you send out an important survey, don't do it around the holidays when folks are busy, just getting to this now. (Jan. 3)

6. A footing drain disconnect only works if the footing drains are working . . . otherwise the water still finds a way in.

7. Never had a problem before. Complete waste of time and money. During damp periods it goes off every 45 seconds to 1 minute. The pipes are in the floor and the master bedroom. We hear it all the time.

8. Since we lived in an area where someone downhill had gotten flooding, we were one of the first to go through the FDD program. Our footing drains were no longer functioning at that time. It seems wasteful to have had this done as the equipment is all BRAND NEW looking. It never has run. If there were some way to monitor flow from footing drains to sanitary sewer prior to the FDD that might have been a good first step, and might have saved the expense of the program in our case.

9. We had to get one per the city of Ann Arbor. Everyone was supposed to. We feel mislead.

10. I wish we were not forced to have it put in (penalty if we didn't). Never had problems before forced to put it in.

11. The city and contractors where very professional during the experience. Brigadere contractor were very clean and did a great job with landscaping and tried to insulate to keep noise down, it didn't work, but at least they offered to help by adding the insulation. Although there were many problems with the installation, which had to be redone several times and passed it even passed inspection. Overall, I don't agree with the program! With all the building going on in the city (high rises) and new subdivisions and apartments being built, I don't see how this will help. Our neighborhood was built before they graded, so our lot is flat and collects water in the back yard, therefore making the pump run continuously when wet. The water that is pumped must run the length of our ranch basement therefore putting more pressure on the pump to get water out. New home were built with sump in mind and generally pump up and out, our is retrofitted for an older home design so the city had a limited budget to work with and had to do it the cheapest way, not the correct way in my opinion. They gave us options to place it in different places but each of the options had its negatives (asbestos tiles in basement, placement under bedrooms, or pumping out to yard but signing a release due to water going to neighbor's yard).

12. We were dissatisfied with the city's role in the installation (inspector not available, no communication). The installer (Bidagare) was excellent.

13. I was so upset when I was forced to add a sump pump to my nice dry basement. I still don't understand why. Others in Ann Arbor have never been approached at all to do this. I found out neighbors on Maple Rd. were given a choice, I was forced. If I didn't do it, I'd be charged an additional $250 more a month. The first estimate was going to totally destroy my finished basement to add your unnecessary sump pump. Thank goodness my 2nd estimate - Richard worked creatively to help preserve most of my basement space.

14. After researching this topic and having numerous contractor bids to stop water seeping ($5,000-$7,800 estimated to replace tiles) and spending several hundred dollars to seal obvious cracks in the driveway and basement window wells above grade basement walls, I cannot see that this project was any benefit to homeowners. On top of this mandatory project, the financial burden associated with the sidewalk repair, which fell to some Arbor residents, is financially stressful.

15. Hard to believe that disconnecting a half dozen houses in this neighborhood of several hundred old homes are worth the anguish I suffer. Is it a coincidence of roots and standing pool of water?

16. Limited area was selected because one neighbor with broken orange-board pipe complained to city -- not very scientific or engineered fact based; others in area (across street) were not required. I believe one person with order did it without penalty. Apply policy evenly, and base it on engineering data, not misinformed complaints.

17. We never had basement flooding issues prior to sump pump installation. Our greatest disappointment with the program was that while battery backups were strongly recommended, they were NOT paid for by the city. We feel the addition of the sump pump has added a potential liability to our household. I hope the sanitation system is no longer overwhelmed but I wish we didn't need a pump and I'd like to know if this program has been effective.

18. I'm going to be very unhappy if people are allowed to avoid putting in sump pumps as a result of changes made after this survey or if improvements are made that I don't get to take advantage of because mine has already been done.

19. The gravity drain system works with or without power, it boggles my engineering mind that anyone would want to switch to a system that requires power in order to prevent basement flooding! After all when is your power most likely to fail? All together "during a storm". And since Ann Arbor has not buried the power lines, our power fails fairly often. Adding insult to injury is the fact that the sump is located in the middle of the primary basement area, making any options for finishing more difficult.

20. I felt threatened by the City of Ann Arbor to have this installed or else we were going to be fined $100/mo. for not complying. I learned that my next door neighbor refused to sign the Liability Agreement for the city and there were no repercussions and they do not have a sump pump in their home. This is consistent with the city's policies in similar situations such as sidewalk repairs. I paid for mine under threat of the city. Now the city is paying for the people’s sidewalks who didn't comply. I think people will learn their lessons with this cities government to not comply. It cost you every time.

21. I understand the reasons for the project and support the intended outcomes, but really question whether this was a cost-effective solution. From my immediate perspective we had no problem. I wonder if the flooding of the sewage treatment facility might not have been averted by a centralized, systemic correction rather than a distributive one.

22. Will probably not own another home with a sump pump.

23. I wouldn't recommend this, there was no problem to begin with, concerned for more basements floods.

24. I resented being required to have FDD done. I would be happy if it were undone so I didn't have this sump pump in my cellar.

25. I think the whole project is a bunch of malarkey initiated by the complaints of a few vocal residents. It has cost an inordinate amount of time and money by the city and residents. It seems just stupid to me.

26. I want my old footing drain to be re-connected. I want to get rid of this sump pump.

27. I'm sorry I ever let this happen!

28. Having lived at this home for over 40 years and NOT experienced any drainage/water problems, it is our hope that the sump pump hole in our basement floor will not flood our lower level in the future.

29. At least in our case, there seemed to be no reason, no benefit, and significant expense, for this change.

30. When power is out, you must reset the battery. We are gone 3 months per year and this is a concern. Refill battery with water every 2-3 months.

31. Battery backup is only a short term solution if power fails. Purchased portable generator for longer solution. Still an issues if not at home for extended period of time.

32. I don't like it, I hate it. I liked it better the other way.

33. Sump pump is another burden of home-ownership. Failure can happen anytime. Also, they are noisy. A sump pump could keep me from purchasing a house.

34. I believe that this is not a good solution. More unclean water is being dumped into the storm drains. The drain capacity is being exceeded. There is no maintenance of the pipes from the homes to the storm drains. Critters in the storm drains and blockages cause backups. Sewage capacity should be expanded instead.

35. Houses on Iroquois are built on very sandy soils. Newly installed sump pumps on the east end of the street have never cycled. Homes on the west have had sewage backups before and after sump installation. This costly installation was unnecessary for half the street and did not stop sewage backup on the other half. Is this a good use of tax money?

36. We would never have done this if it was not mandatory.

37. We had no flooding problems prior - now we have to worry about power failure and continually adding water to battery.

38. Installation seems a waste of money in areas where flooding has not been a problem. The new system introduces a potential malfunction problem that did not exist before.

39. I am a renter and this is NOT a basement but my home!! I am now very anxious about this system in general but especially because all my possessions are at risk (especially if the power goes out). Duplexes should have been exempt from this repair!! You changed a system that worked perfectly.

40. I saw no need to have the sump pump installed. I've lived in this house for 40 plus years and never had a water or sewer problem.

41. As an alternate backup system, I propose ensuring that a floor drain is within 5' of the sump pump installation. Some homes already have a floor drain near the pump while other homes have drains across the basement. There would be minimal additional cost and keep basements dryer in cases of total pump failure.

42. If I leave the house I hope the sump pump works - I did not have to think about it before - I think the cost and the extra cost and worry to me - sump pump and flooding now - pump not working - no trouble before, dumbest the city of Ann Arbor has done. I am 87 years old.

43. I would like to go back to the way it was before it was installed.

44. I consider this project a boondoggle. I suspect that 90% of Ann Arbor homes do not require a sump pump for their own needs. Its validity, if any, lies solely in a possibly reduced load on the water treatment system. This project does nothing to address sewer overflow problems due to sewer designs subject to surge or gravity loads.

45. We have lived here for 45 years and have never had a problem in our basement until this thing.

46. Really believe this was not required for my house

47. We don't feel we needed the sump pump.

48. Basement NEVER had any issues and never have seen the need to do this so that we now have to worry about it not working.

49. This survey comes off as quite biased against the FDD program (as opposed to an objective evaluation, especially Q's 13, 14, 15). Also, questions #9 & #11 should have had a "don't know" option for homeowners like us who purchased this home after the pump was installed.

50. We have lived in this house and have had a dry basement for over 47 years. I question that any of this was necessary!!

51. This house has had at least 5 basement floods. The first flood occurred shortly after the house was built in the 1960s and the residents then (my parents) had moved in. Since they had just moved in, many boxed possessions were stored in the basement and were a total loss. I don't have money figures for that initial loss, but it was considerable. A check valve was installed after the 1998 flood and prevented subsequent flooding. The sump pump was installed when the city was facing lawsuits from residents around the city. The history of the city's response to flooding has been: 1) it was a rare 100-yr. flood; 2) it was a rare 50-yr. flood; 3) it was a rare 25-yr. flood; 4) we're being sued so we'll disconnect drains and install sump pumps; 5) let's send out a survey.

52. I particularly worry about long term power outages when the battery would no longer be working.

53. In our situation I feel the whole project was a waste. We sit on high ground. Sump pump well has been dry since the day of installation.

54. The city of Ann Arbor was aware of this problem for many years and did nothing to install proper drainage for this entire area.

55. We did not need this stupid sump pump. We have incurred many costs because of it including increase in electric bills.

56. I never had any problem in my basement and I was very angry that I had to pay for the installation of this ugly thing that will probably cause problems I never had.

57. In my opinion, the footing drain disconnect program and required sump pumps are a horrible idea. When we are away from the house for several days, we cannot turn off the main water in the house because the sump backup system operates off of water. Therefore, we are exposed to potential water damage. We will not buy another house that has a sump pump because there are so many negative ramifications.

58. Don't forget the expense and aggravation of checking/cleaning floor drain check valves and laundry sink check valves. Also the mental stress leaving house unattended while on vacation.

59. Have lived at this location 30+ years and have never had water/sewage in basement - now worry every time it rains that pump will fail and we'll have a wet basement.

60. The sump pump has given me many headaches, and costly!

61. The city should pay to restore my basement to its prior condition.

62. We live on the top of a hill and never had any problems with flooding. We now are dependent on the sump pump during the spring especially. We went along with the disconnect because we were told it was mandatory and would prevent flooding for some of our neighbors. I resent the fact that Ann Arbor government is now questioning the footing disconnect program. This is typical of the indecision of this town. We are now stuck with the sump pump and others are now going to get away with keeping footing drains. If this is the town's plan, I anticipate a major outcry from those of us who are already stuck with sump pumps.

63. The city has caused sewer backups when they "jet clean" the sanitary sewer. Twice this has happened to us. Two neighbors also had waste material packed around floor drains in their basements. What benefit has the footing drain disconnect resulted in? Sanitary sewer overflows are still occurring. Millions of dollars are being spent at the wastewater plant. Having no sanitary sewer backups since the sump pump (except for the jetting backups) was put in has nothing to do with the disconnect program. Monitoring alarms and redundant backup systems helps prevent sanitary sewer backups.

64. Lack of equity and fairness in treating all homeowners equally is a big dissatisfaction. I am aware of homes that did not have the installation because the city would have had to pay very substantial sums to refinish a finished basement. So the notion of this being a mandated solution to a problem only apparently applies if it is convenient or cheap for the city.

65. Thanks for adding something that I didn't need. Way to add to my furniture expense. City should have stayed out of my basement. You should come and take it out or give me a backup at no cost. I never had a problem with long term power out, now I will have a problem thanks for that!

66. Do not like the whole idea - if my power goes my basement will flood. Battery backups only last a few hours. Plus, the pump makes a loud "thump" when the valves shut. I would take it out if I could. And no doubt it was so Ann Arbor did not have to expand its own sewage system!

67. Never had any problems with drainage prior to installation of sump pump. Now I have the risk of a power outage or sump pump malfunction resulting in a flooded basement. So I am now worse off and dissatisfied with the footing drain program.

68. Flooding was not a concern for us but now we have to worry about what will happen when the sump pump grows old and fails. We bought this house to raise a family in, but this whole mess of a system/project makes us reconsider whether we'll stay for the long term in the neighborhood.

69. We are unhappy because selected early on for this project at an expense (now and future maintenance) to us. Perhaps the city should have had a "test" neighborhood and provided homeowners with backup systems.

70. Annual check of back water valve $100/per year.

71. I know why the program was put in place and it makes economic sense for the city. But any failure of the pump system and you will get a flooded basement. I wanted an emergency overflow that ran to the floor drain, but the inspector would not allow it!!! This is crazy as that would solve my concerns for when I am away for extended periods.

72. I understand the need to change the flow of rain water but the sump pump is now a point of entry for flood water in the event of a pump failure, power outage or backup system failure. I strongly dislike the footing drain disconnect.

73. I cannot tell you how angry I was and still am that the city of Ann Arbor forced this on me. I feel it devalued my property and made my previously perfectly fine house vulnerable to the elements. Who wants to destroy their house's secure infrastructure?

74. We are very UNHAPPY we were forced to install something that caused flooding in our basement and we can't fix it up until city of Ann Arbor fixes the disconnect problems!

75. I wish we hadn't hurried to have it done. We thought we were being environmentally correct and responsible citizens.

76. I wasn't having problems with flooding before the sump pump was installed. I haven't noticed a change. I just have something to monitor now. I'm concerned about the lack of air space in the way sump pump exits the house.

77. All of this brought on by poor city planning!

78. Do not like water-powered backup pump and recommend against it. City is ridiculous in requiring back-flow testing on this backup.

79. This was a totally unnecessary imposition by the city and I'm not happy I was forced to do it.

80. I am pleased with the flood mitigation ideas that have been proposed. Until they are implemented, I live in fear of our next flood. I don't plan to replace flood damaged furniture until that time.

81. This project should NEVER have gotten as far as it did and adversely affecting so many homeowners. Very infuriating. We should be reimbursed for damage and defective pumps and batteries and everyone who bothered with this survey should get a gift certificate.

82. Don't see the point of poking a hole in my dry basement.

83. Foundation Systems of Michigan repaired my drainage system because the original drain tile was broken.

84. I saw no valid reason for this installation.

85. I have never been happy about being forced into this installation. WE have never had backup problems prior to the pump. Although it works now, I worry about flooding should the pump fail or the electricity goes out for an extended period.

86. I wish I did not have a sump pump so that I would not have to worry about power outages. My basement never had storm water problems. Now I have to hope my expensive backup system works.

Comments from Question #14

1. Sump pump was needed here because p-joint in drain pipe would fill with sand and we'd get flooding with normal rain when that caused a clog. Pump eliminates that problem but it runs often and cannot handle the major area floods.

2. Especially when power goes out.

3. Now I have to worry about the pump whenever I go on vacation. We lose our power all of the time and have lost it for multiple days on a number of occasions. The battery back-up works well for a couple of days, but I never had any problems before the pump installation and it has cost me many thousands of dollars to maintain.

4. Concerned about power outages. No battery or generator on sump pump.

5. It never has run once. Sump well is bone dry. This was not a needed installation.

6. I begged not to have to do this because our basement floor was perfect. My worst fears have been realized.

7. Whenever it rains, we worry, whenever we lose power with rain, we worry.

8. Just a slight increase. I don't think the sump pump has ever even gone off.

9. Always a worry when power goes out. It is a concern when we are out of town.

10. Sump is good, but now there is potential of Sump backing up!

11. I had another house in Ann Arbor without sump pump and slept great, now with a sump pump I am kept awake every time it rains listening for the pump to cycle.

12. One more thing to worry about - especially when we have heavy rains.

13. We already had a sump pump in a lower area of the basement. Why were we forced to put in an additional sump pump? This sump pump has NEVER run.

14. Basement still damp, worried if sump pump stops.

15. With every severe storm there is concern that we could/will lose power and we will again have flooding in the basement.

16. We never know if the flood will happen again.

17. Since there has never been a sewer backup as long as I've lived here (1972), the sump pump has not improved anything for me, though I certainly understand about not wanting to overload the sanitary sewer system with rainwater runoff during storms, and see the need for a sump pump to remedy that. But of course now if the sump pump fails I *will* have a leakage problem that I never would have had back in the "bad old days"!

18. I had no problems before with a gravity, fail safe system. Now I must rely on a mechanical system that can fail.

19. Failure of sump pump a possibility.

20. Need allow a bypass to the sanitary (like the original system) for when pump goes out. This would solve the peace of mind issue. I have a full backup, but long outages overwhelm the battery. Also pump went out and needed replacement. Plumbers say that is common after 5 years or so. The concept makes sense, but dry basements can become wet if sump fails.

21. City should pay to fix these problems!!!

22. Every time we are away from the house for more than a day or so, we now have to worry about electrical outages, which often occur with heavy rain storms, and also sump pump malfunction. We never had this worry before. We had a sound, poured cement basement that was trouble free aside from occasional dampness if the dehumidifier failed to operate.

23. Before, gravity took the water away. Now, if the battery and power go out, I could have flooding.

24. My largest concern is that when there is rain the creek rises and so does the level of the sump pump in the basement. Our house the next house right after the drain outlet. We have had flooding in our yard, almost into the basement.

25. Now I worry about the sump pump working or the water back up functioning. Very, very upsetting and expensive.

26. A sump pump has not prevented basement flooding in heavy rains. I'm always worried.

27. Worried about power outages.

28. This caused mold in our basement we had never seen before! We're figuring out now what we should try to fix this problem.

29. Concerns about long-term power outages and primary pump malfunction.

30. Still worry if electricity goes down.

31. If we lose power and generator fails, our basement may flood.

32. If we have a power outage during a wet season and we are not at home, there could be serious flooding in our basement.

33. Additional cost of replacing batteries for battery backup and noise of the sump pump.

34. I never worried about flooding in my basement. Now I have to worry about it. Sump pump overflow should've been allowed to flow into the sanitary sewer to prevent flooding in case of pump failure.

35. If electricity is out for any length of time and the batter runs out of juice, we're screwed.

36. It's very loud and unnecessary.

37. Never had a problem previously, yet city mandated FDD program forced channeling of all footer drain runoff (previously fully external to house system) into a new sump hole within our finished basement and water removal is now dependent upon an electric sump pump (and additional battery back-up sump pump installed at our cost).

38. I would prefer to not have to wonder if it will go on, or if it can handle the volume, or that if the power goes out that the backup battery will work.

39. Slight increase in anxiety originates from dependence on sump to remove water collected through the drain tile. If pump malfunctions or power is lost for extended period, basement floods. Previously water would just drain out, and there was no need for a sump pump. I also understand, however, civic need to reduce burden on sanitary system.

Category #5: Requests for Help - comments from questions #19 total of 18 & 14: no comments

Comments from Question #19

1. This house was purchased in 2005. The inspector missed water logged carpet in partially finished basement. Two sides of my house was excavated and a drain/gravel was installed at parameter of home. Two sump pumps were installed. The finished basement was demolished because of mold (still unfinished). Protech did the mold remediation. The work cost $12,000 and the basement remains unfinished. Would like someone to check pipe, I feel I was taken advantage of regarding install of 2 sump pumps.

2. We still have damage from the sewage backup. The pump hangs up on sticks from time to time and spills out water. We put in a battery but it makes a whining noise when in use. It took years for the grass to grow back where the ground was dug up to connect the sump line directly to the sewer. Why doesn't my discharge pipe attach to anything?

3. City didn't make recommendation on battery backup or siphon system is better. Battery backup lasts less than 3 hours. What good is that? If it rains there is potential for basement flooding. Can siphon system be added now? Please let us know. Siphon does not require electricity.

4. Installer was very good, but I am concerned that I do not know how to operate or maintain the sump pump.

5. What contract, what is the back-up method if anything goes wrong? Do not have the cash to change for a system that we know and the pump is next to the only windows that could be transform in egress windows in our basement. Knowing what type of sump pump would be nice, it goes less often recently and we have no idea of what is going on.

6. Originally very disruptive as many items had to be removed from the crawl space, then installation was delayed, so I had a basement full of "stuff." Worry about sump pump failure during a power outage now, but don't know if battery back-up is particularly reliable. New worry now that I realize I don't have an air gap. Is this bad? I never had flooding/sanitary back-up problems before, so for me, the sump pump wasn't a great advantage, just another thing to worry about and maintain.

7. We have no confidence in backup system. During power outages, alarm sounds, but cannot be reset. Fortunately, any outages have been short in duration. What will happen if not home during an outage?

8. I don't know how to check things for proper function. I don't think I should have had to replace the pump so soon.

9. This is a tri-level house and a backup could damage the family room. Can only get (have) $10,000 of insurance for backup from outside. Two backup batteries have burned out in spite of maintenance. Need more initial options such as double or triple pump, better float switch, etc. If the pump fails, there is a flood in spite of the backup battery.

10. We checked the pump after 4-1/2 years, after the dry hot summer and before predicted heavy rain. It was not working! What if this happened when we were gone on a trip?

11. What is the average life span of the sump pumps installed by the city and how will I know it needs to be replaced? Who pays for the replacement of a sump pump put in by the city?

12. Should I have an air gap? Please respond.

13. I'm not sure if I have a backup system or not, plumber told me I didn't but installer said he put one in - non-battery. HELP!!

14. Do not hear sump pump coming on or off during rains. No way of checking if pump is operating or not.

15. Concerned with increased radon levels since installation. We do yearly checking but no mitigation was recommended yet.

16. The sump pump failure was due to power outage in my area. The pump began working again once power was restored. I am seeking/researching backup solutions to avoid future problems.

17. Basically I have no idea how to maintain the pump - nothing was left or mailed after repeated calls - game up. Tile removed and utility closet door off and cannot put back because pipes run outside of closet through closet door opening. Door is still leaning against wall. Pump is so loud it shakes at times.

18. My backyard floods terribly since the footing drain was disconnected. It literally is a swamp--I have ducks floating in my backyard after a heavy rain. The massive amounts of water have killed off a lot of the landscaping plants in the back of property. I don't even bother to plant anything back there anymore. I have drains all over my yard that used to work, and the water just sits over the top of them now. I want to know what is causing the flooding in my backyard and what can be done about it.

Category #6: Comments of Satisfaction/Misc. - comments from questions #19 & #14 – total 68

Comments from Question #19

1. Our basement is in clay soil and was built without proper drainage around the outside of the basement walls. This led to entrapment of water outside the basement walls and resulted in bowing and cracking of the walls, and flooding of basement. Repair of cracks, installing proper drainage and sump pump fixed all these problems and cost about $50,000.

2. We sometimes get a puddle in the basement after a heavy rain and the pump does not seem to have changed that other than that the installation was very neat and not disruptive.

3. Our house seems to be at a low point so water movement seems a continuing issue here. The pump helps, but it gets overwhelmed with the major flooding events. Power outages are always a concern although we have yet to exceed the battery life of our backup pump. Our new replacement pump is quieter than the old one but the noise and the fact that area flooding still occurs limits our usage of our basement. Still, I have to say the disconnect improved things for us although at considerable expense (referring to pump replacements every 5 - 7 years into an indefinite future). I would like to know how to improve drainage and water control around our house and long term implications of water flow for our house.

4. The city was initially reluctant to help but then were persuaded and I was grateful.

5. We know there was moisture in the basement prior to our living here, however we don't know the exact nature of the problem nor when it occurred (eg before or after sump pump installation). As such, I have left several questions blank.

6. I would be happy to answer any questions as I am appreciator of corrections made through the efforts of Everdry and the diversion program of the Ann Arbor contractor.

7. Our experience was excellent: Courteous personnel, prompt job, good clean up, no bill to me.

8. Also received radon abatement which was extremely beneficial and resulted in the greatest peace of mind.

9. This is so new to me. I'm not sure what to say or expect. Presently, to the best of my knowledge, everything is working OK.

10. I'm satisfied, there have been no problems of any kind.

11. It was completed before we purchased the home. I don't think it has ever even flipped on to run. No problems at all. I forget it is even there.

12. VERY happy with the sump pump. Our old system used to discharge onto the street, so the street was always flooded as well as the basement. Now, hardly any flooding or water anywhere.

13. My home is on high ground so it did not need to connect to a buried pipe to send rain water to the Huron River. Before the FDD project, gravity without pipes sent my footing water to the River.

14. City and Hutzels did a GREAT job. There was a water main break in the street on Prairie St. at noon and in front of 3 houses down. The city came immediately and had it fixed by nightfall. GREAT JOB!

15. Very pleased overall with the FDD. My basement has been very dry and more pleasant since the FDD was done. My only problem was that I had to replace the sump pump.

16. The only water coming into the basement is from surface water through a high crack - none from my tile; sewer pipe problem is unrelated to the disconnect.

17. Continue disconnect program; those who object aren't thinking rationally! Bidigare did a great job!

18. Perimeter did a great job inside and out (yard).

19. The main difference after installation is: there is no damp or moldy smell when I go down the basement steps NOW! It was evident after the several week installation process. I'm pleased!

20. We were part of the Pilot program when the FDD program was started. We have had separate installations of the sealed caps and the discharge air gap since the original installation. We have been very satisfied with the results so far.

21. Work men did a very good job.

22. Perimeter did a great job. I had to replace pump and battery.

23. I am much less concerned about sewage backups since the sump pump was installed.

24. Pump worked very well for 2 yrs.; 5 or so months ago it malfunctioned and water came thru cracks above drain lines. Perimeter fixed it, but water was significant - though much better than before.

25. Excellent work!

26. I have lived in this neighborhood (Ivywood previously) since 1970. With the sump pump installation in the entire neighborhood I finally have peace of mind.

27. So happy with this new system!! Greatly relieved, thank you so much!

28. Pump was installed free - company was installing a pump in a house across the street.

29. We were very glad to have the pump installed. We had heard about flooding in this basement before we had the house. It provides peace of mind and has worked well for years ago.

30. The company "Bidigare" was very pleasant to work with and provided some extra work on other home plumbing issues in exchange for the permission to perform the diversion. Work was performed professionally and efficiently.

31. No worse than before / possibly a little better.

32. Moved in in May and have not ever heard by sump pump running. Doesn't mean that it has, however.

33. Replaced sump pump and get basement waterproofed within 2 years of footing drain disconnection. New pump is much more reliable and much quieter. Original was loud and stopped working very quickly.

34. We had minor issues, but no problems like most of our block.

35. I wish I had it from the very beginning. Water does serious damage.

36. Shortly after drain disconnection, we had Everdry waterproof our basement because of leakage from the floor and walls. They hooked up their drain to the sump pump and took over the warranty. We have not had any problems since both of these procedures were completed.

37. I was/am pleased it isn't as noisy as I had feared. I hardly notice it. "Perimeter" company was highly recommended to me and they did very good work!

38. Since it was installed there have been no problems. Eventual replacement would be a concern.

39. We're happy with the work.

40. Before sump pump was installed I had B-DRY SYSTEM put in the basement and no problems since. If the pump runs, I never hear it. The discharge if any goes in the backyard, not hooked up to the street drain.

41. Since we've owned the house (8 years), we never had any issues.

42. With installation of Everdry tile system, our basement flooding has ceased.

43. In Nov. 1988 we had water shooting into the basement between the cement blocks. We called three companies. I am not sure which one we hired, except that they could do the job in a few days - the other two could not do it for weeks or months. The system has worked fine ever since and there has been no water in the basement. The general opinion was that the leakage happened because it had been a very dry summer and fall.

44. We had the orangeberg tile replaced at the same time as the footing drain disconnect and also had the footing drains cleaned out. All this has made a big difference for us.

45. Very professionally done.

46. We had our sump installed by a construction company when they waterproofed our basement walls. We have a very wet area and this has made a huge difference in the basement. Had to install more drain tile in basement as well. We spent much more than the city reimbursed, but it's working.

47. Thank you for doing this, there is a misperception of how many citizens dislike this solution to sanitary overflow and basement backups.

48. Lived here less than 1 year. No obvious water problems yet.

49. Thanks you to the city for installing initial sump pump.

50. I cannot tell when, if or how sump pump is working! No problems before sump pump installation.

51. I have never heard the sump pump come on!

52. Basement does not flood since the sump pump was installed.

53. Sump pump installation made me feel more comfortable purchasing the home.

54. We live on the top of the hill and had no problems before installation. Neighbors on bottom of hill had many wetness problems.

55. Seepage was corrected years ago with B-Dry system.

56. Dampness in basement largely due to old footer drain (also tied into gutter). Sump adds peace of mind.

57. I had the B-Dry system installed several years ago. I haven't worried since.

58. I'm glad the house already had a sump pump when we bought it.

Comments from Question #14

1. We've only been in the residence since March 22, 2010. Haven't had any problems as such since.

2. Never had to worry about basement flooding before--however, we agree that it's a good idea to disconnect from the sanitary sewer & know that our neighbors DID have sanitary sewer flooding before the sump pumps.

3. Our previous sewer backups were the result of tree roots infiltrating the line and a previous owner (pre 1998) installed a b-dry system and sump pump due to moisture, so we have not really experienced any changes due to the FDD. I am very concerned that my neighbors who did NOT allow sump pump installation are being selfish. Houses that allowed pumps are no longer contributing to downstream back-ups. That makes me feel good.

4. The only time my yard flooded on 20 years was the summer before last when we had the really wet season with a particularly heavy rain storm. We bought a portable pump to move water from the yard before it reached basement windows, but no water came in, and the drains did not flood or back-up into the house. All before the project installation.

5. Since we moved in after I don't know any difference.

6. Good, except we worry when the power goes out. We have no backup.

7. I only marked answers that I felt were relevant in my case. A sump pump was installed in this residence prior to the footing drain disconnection. This sump pump was used to connect to the new drain system. The footing drains around the house had stopped working years before. I think this is an excellent program. I have had no problems. In addition to the footing drain disconnect, the placement of a backup valve in the main sewage pipe was an important step."

8. It was an important consideration when we were purchasing the house to know that since installation of sump with backup battery there had been no further flooding.

9. Because of footing disconnection and sump pump installation we can move forward with basement improvement options to reduce dampness.

10. I was glad that I purchased a house that had a sump pump installed already.

B. OHM Report on FDD Issues

On the following pages is the Sanitary Sewer Wet Weather Evaluation Project, FDD Survey Follow-Up Investigation Report.

OHM
Advancing Communities

City of Ann Arbor

Sanitary Sewer Wet Weather Evaluation Project

FDD Survey Follow-Up Investigation

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APPENDIX B

Page Document

Survey Statistics

Total surveys completed

- 2350 surveys mailed
- 850 responses - 133 completed online; 717 returned by mail
- 36% response rate (Note: typical response rate for a municipal survey ranges from 20% to 40%.)

Validity of survey results

- Confidence level that the sample results represent responses from the entire set = 99%
- Margin of error = 3.6% +/-

Geographic dispersion of responses. TBD. Respondent addresses were mapped.

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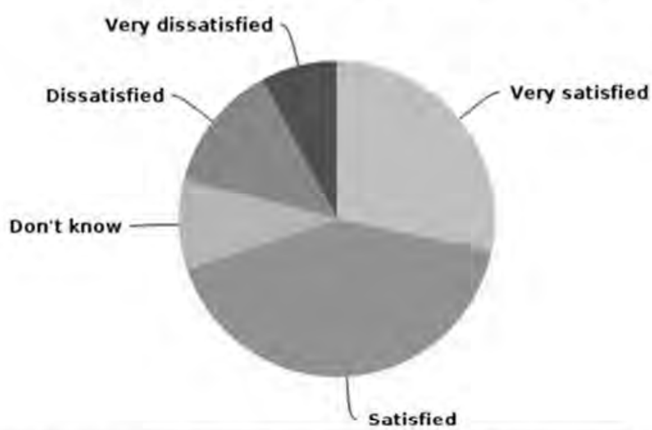
Question #3: Overall level of satisfaction regarding sump pump installation.

- Very Satisfied = 28%
- Satisfied = 42%
- Dissatisfied = 13%
- Very Dissatisfied = 8%
- Don't know = 9%



Key Finding: 70% of the respondents were satisfied with their sump pump installation.

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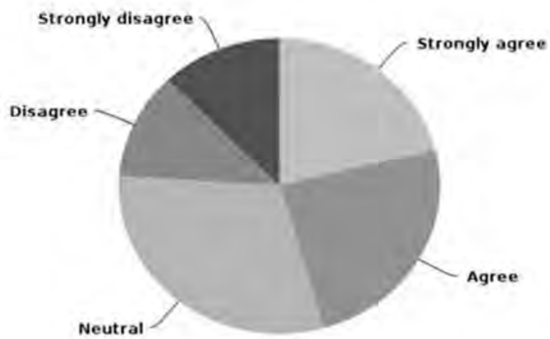
Question #4: I would recommend a sump pump installation to a neighbor:

- Strongly Agree = 21%
- Agree = 24%
- Neutral = 31%
- Disagree = 12%
- Strongly Disagree = 12%



Key Finding:
45% would recommend a sump installation to a neighbor. This is almost twice as many as those that would not.

OHM

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Question #7: Has the residence experienced sanitary sewage backups in the basement AFTER footing drain disconnection?

Yes = 9%
No = 84%
Don't Know = 7%

Key Findings:

- 100 of the 134 respondents that reported experiencing sanitary sewage backups PRIOR to FDD/sump pump installation did NOT experience them after FDD/sump pump installation.

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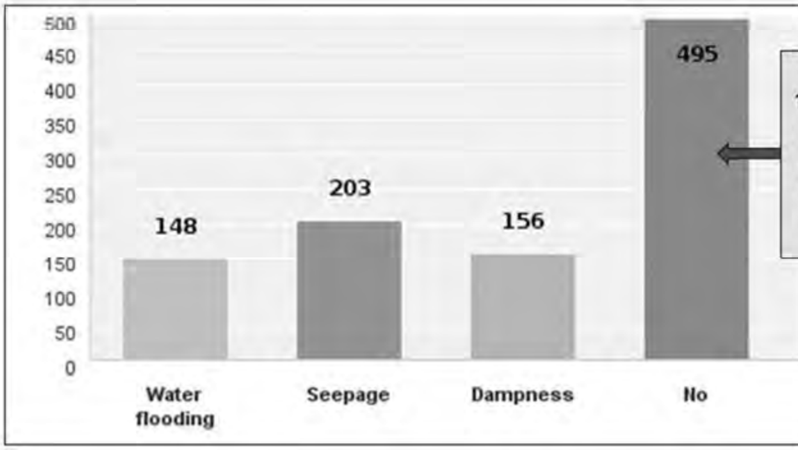
Question #11: Did the residence experience water flooding/seepage/dampness in the basement AFTER footing drain disconnection?

Key Finding: 106 respondents who reported no flooding/seepage/dampness BEFORE FDD said they did experience flooding/seepage/dampness AFTER FDD.



Key Finding: 178 with prior water issues reported no water issues after the FDD.

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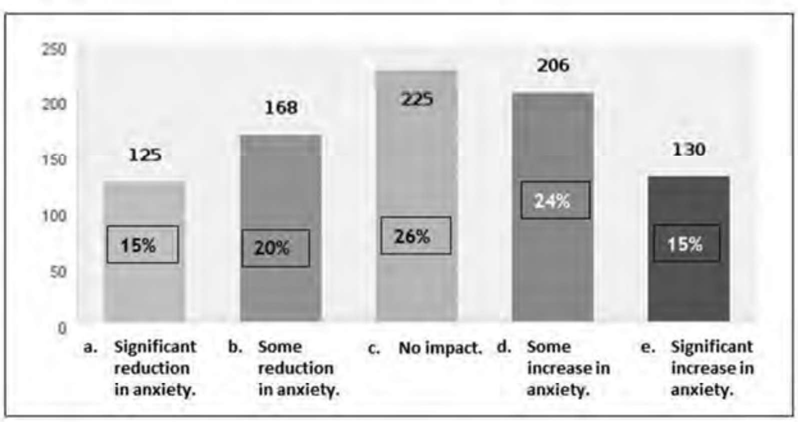
Question #14: How has the installation of a sump pump affected your peace of mind?



Key Finding: Almost 40% reported some or significant increase in anxiety - a major factor in the City's commitment to investigate survey issues.

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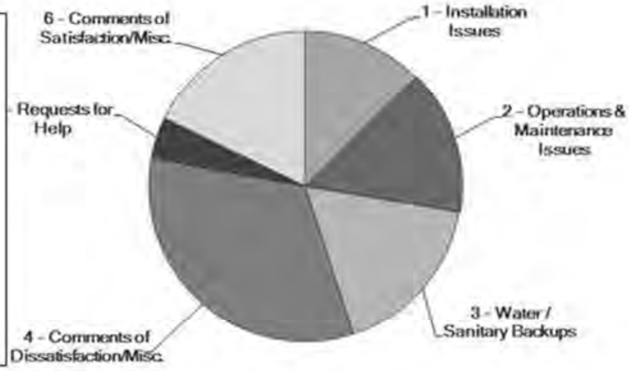
Prioritization of Survey Comments Focused on Water and/or Sanitary Backup in the Basement

Comments (by category)

1. Installation Issues = 50 (13%)
2. Operations & Maintenance Issues = 60 (15%)
3. Water/Sanitary Backups = 69 (17%)*
4. Comments of Dissatisfaction/Misc. = 131 (33%)
5. Requests for Help = 17 (4%)
6. Comments of Satisfaction/Misc. = 71 (18%)

Note: Any comment mentioning water/sanitary backup in the basement was put in Category #3.



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FDD Survey Mitigation Work Plan

1. Collect information on prioritized list to document the problems, identify common issues, and develop improvement recommendations.
2. Complete the investigation to coordinate with the project schedule for the SSWWEP.
3. Involve SSWWE/FDD CACs in the process of developing the improvement recommendations.

Objectives of Follow-Up Investigation

1. Document Problems
2. Identify Common Issues
3. Develop Recommendations

Process

Collect Background Information

a) Interviewed City, CDM, and contractor staff to understand processes and procedures

b) Collected files from the City for each house identified for follow-up

c) After the prioritization, City and CDM were contacted, as needed, on specific details of houses beyond what was available in the files

Process

Conduct Investigations

a) After the public meeting, homeowners were contacted and interviewed. If necessary, inspection visits were scheduled for houses

b) Conducted follow-up inspections and / or phone calls

c) Prepared detailed notes of each contact and inspection

Process

Document Results

a) Tabulated and summarized:

1) Findings on issues identified
2) Initial improvements recommended
3) Map of the results

b) Summary report will be prepared to outline investigation, findings, and recommendations

Process

Work with Subcommittee to create recommendations for future action

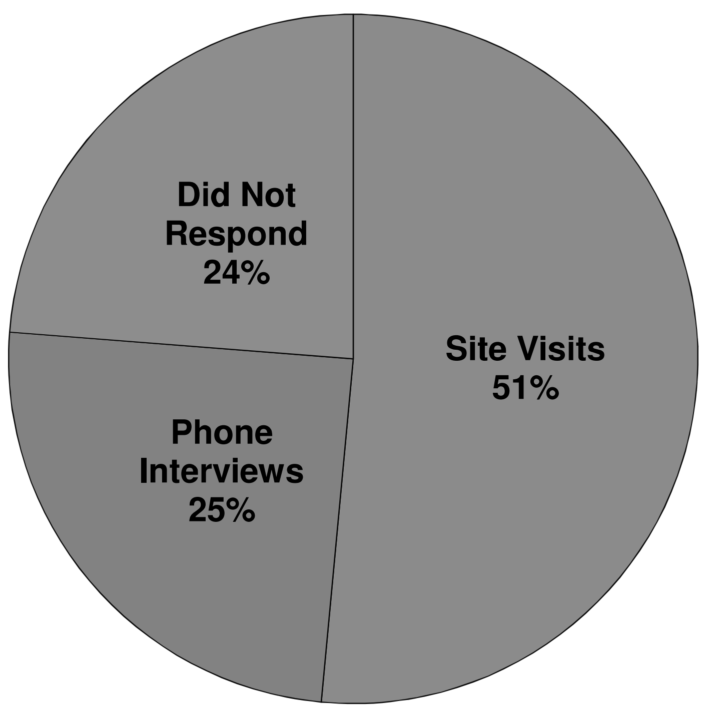
a) Subcommittee made of FDD & SSWWE CAC members

b) Met three times to review investigation results and create recommendations

c) Presented recommendations to full SSWWE CAC September 10th

Summary

Site Visits	52
Phone Interviews	25
Did Not Respond	24
Total	101

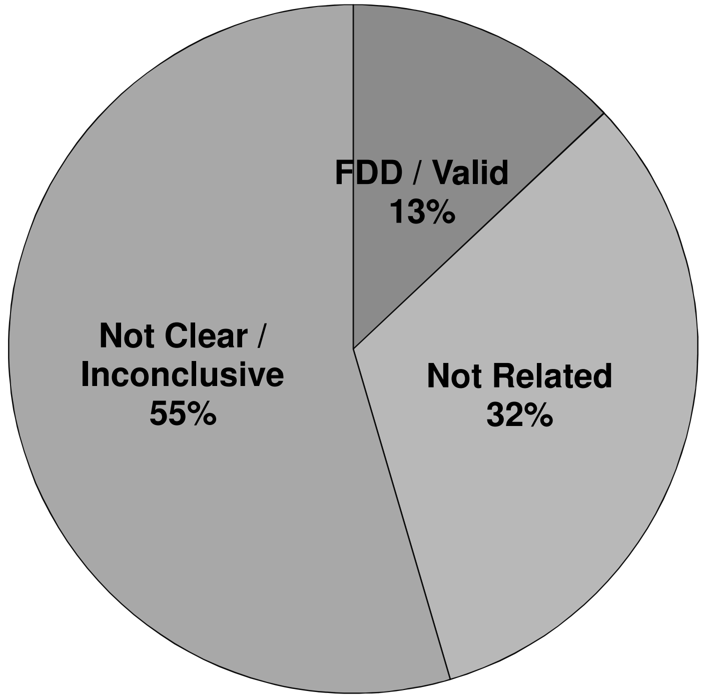


Results

Question:
What caused complaint of water in basement?

Answer:

FDD	10
Not Clear	25
Not FDD	42
Total	77



Reasons for Complaints of Water in Basement "Not Related to FDD"

1. Failed footing drain (interior or exterior)
2. External grading directed large amounts of water to house
3. Stormwater leaked through crack in wall, egress window, or other window
4. Failed sanitary lead
5. Existing sump had issues unrelated to FDD

Phone Call Findings

25 Houses

Initial Recommended Improvements:

All Items	Count
Televise exterior discharge pipe for bellies or breaks	4
Interior restoration (carpet, tiles, paint, etc.)	3
Landscape repairs	3
Fitting failure	1
Upgrade to larger-diameter pipe	1
Relocate cistern and repair wall	1

Site Visit Findings

52 Houses

Initial Recommended Improvements:

Top Five Most Frequent Items	Count
Need hole in discharge between check valve and pump	27
External grading	13
Landscape repairs	11
Air gap modification	8
Interior restoration (carpet, tiles, paint, etc.)	8

Summary of Findings

10 homes out of 850 (< 2%) surveyed were identified that the FDD installations were not installed according to specification and appeared to cause water issues.

At an incident rate of 2%, about 50 of 1800 homes may not have been installed according to specification.

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Go Forward Recommendations

1. City Staff: Correcting out of spec installations and educational outreach
2. OHM Best Practices
3. FDD/SSWWE CAC
   - Backup
   - Damage claims
   - Homeowner compensation

What You’re About to Hear

1. Recommendations that are a work in progress.
2. Differences in position that may seem quite stark.
3. The CAC and the City Staff and the Project Team will continue to work toward a common position.
4. The ultimate decision maker is City Council.

Out of Spec Installations & Educational Outreach

1. Retain contractor to correct out of spec installations
2. Begin with 10 identified in investigation and allow for others to emerge as investigation is completed and citizens notify the city
3. Create educational outreach for all sump pump owners on O & M
4. Key issue: liability for funding

Best Practices

1. Customer service
2. For new installations (if they occur)
3. For addressing out of spec installations
4. Majority of recommendations supported by CACs and City Staff

Sump Pump Backup System

1. Backup systems provided to City program FDD households
2. Cost estimate uncertain, probably $750,000+
3. CAC supports this recommendation
4. City Staff does not support
5. Key issue: addressing households that have already installed backup systems

Homeowner Damage Claims

1. Compensate homeowners for damages caused by FDD
2. Cost uncertain, may range from $160,000 to $1M
3. CAC supports this recommendation
4. City Staff does not support
5. Key issue: current claims process would not approve the vast majority of claims that could emerge

Homeowner Compensation

1. Compensate homeowners for ongoing costs related to sump pump system
2. Cost uncertain, may range from $300,000 per year for 5 years +
3. CAC supports this recommendation
4. City Staff does not support
5. Key issue: this recommendation appears to violate rate legislation regarding cost of service requirement

Summary

1. The CAC has been requested to develop alternative proposals that would be more acceptable to City Staff
2. City Staff has been requested to provide more rationale and detail to support its position
3. Ultimate test will be solutions that provide equity to all ratepayers.
4. Final recommendations due in November
5. City Council will make the final decision.

ID #	1
Neighborhood	Maple/Miller
FDD Installation Year	2005
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Large blue spruce was damaged by installation and is dead. Doesn’t know why battery back up isn't working.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Battery for back up was not maintained and was not functional upon visit. External grading contributes to high sump flows. Blue spruce tree had 40% root damage, owners believe damage occurred during external discharge installation.Tree is planted in lower, wet ground area; appears to have become infected and died.
Initial Recommended Improvements	Item
	Tree removal
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	2
Neighborhood	Maple/Miller
FDD Installation Year	2004
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Carpet and tiles not replaced. Calls for service and help not answered. One sump pump back up.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Homeowners experienced a sanitary sewer backup before the FDD and sump pump installation, which damaged the carpet and gas fireplace. There was a sump pump overflow in 2013; however no reason for the pump failure could be found. The pump operated on during inspection. Tile on floor was not restored.
Initial Recommended Improvements	Item
	Air gap on discharge
	Hole in discharge
	Wire tied to discharge
	Tile
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	Replace carpet
	Restore gas fireplace from sanitary back up pre FDD

ID #	3	
Neighborhood	Morehead	
FDD Installation Year	2001	
City- or DOM-Sponsored	City-Sponsored	
Summary of Complaints Listed on Survey	Part of pilot program after five sanitary floods and winning a class action lawsuit. Landscaping was not restored and calls about it were ignored.	
Contact Method	Home Visit	
What caused complaint of water in basement?	Not Related to FDD	
Description of Problem	Home is protected with check valve in right-of-way and in basement as this was one of the original pilot homes. Home sump is still being logged by CDM. Cleanout for external discharge not to grade.	
Initial Recommended Improvements	Item	
	Hole in pipe	
	Clean out raised to grade	
Homeowner Documented Costs	Item	
	Landscaping restoration	
OHM Estimation of Homeowner Costs	Item	

ID #	4
Neighborhood	Morehead
FDD Installation Year	2010
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Landscaping repair $200, Other costs related to the sump pump installation $100 tile replacement. City never did final inspection to verify completion. Floor tiles left undone and ceiling was not restored. Trench settled and no filling by city. The sump has air hammer every time it operates and no reply from city about what to do. No follow through!
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Landscaping was not restored completely. Tiles were not replaced. Pipe was not attached to wall. Vent hole was not present in discharge pipe.
Initial Recommended Improvements	Item
	Hole in pipe
	Tiles
	Pipe attached to wall
	Landscaping
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	5
Neighborhood	Dartmoor
FDD Installation Year	2008
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Landscaping not repaired. Has had sanitary back up since FDD was performed.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Sanitary back ups are the result of a pipe issue under the floor on the drop from the laundry and kitchen. Landscaping was not restored adequately.
Initial Recommended Improvements	Item
	Hole in pipe
	Wire tied to discharge
	Landscaping repair
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	6
Neighborhood	Bromley
FDD Installation Year	2007
City- or DOM-Sponsored	DOM-Sponsored
Summary of Complaints Listed on Survey	Clear water flooding caused damage in basement
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Battery back up has not been working for some time. Unsure about why clear water back up happened, pump looked good during onsite inspection and homeowner states it has not been changed. The tiles were not replaced after installation.
Initial Recommended Improvements	Item
	Replace tiles
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	7
Neighborhood	Morehead
FDD Installation Year	2010
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Unhappy had to provide backup pump. Unhappy with landscape restoration. Three sidewalk flags are damaged from work. Sinkhole in ROW from work.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Sidewalk likely damaged from undermining during installation, lead is centered on three broken slabs. Owner claims was not aware of sump pump relocation costs associated with the program during the phone interview.
Initial Recommended Improvements	Item
	Televise curb drain to show no structural issue
	Replace three slabs of sidewalk and restore
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	8
Neighborhood	Orchard Hills
FDD Installation Year	2007
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Pipe not attached to wall, carpet not replaced, landscaping not repaired, discharge not caulked, electric not behind drywall.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Homeowner declined entry to document; stated that they made all repairs themselves. Took exterior photos of discharge, which were OK.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	9
Neighborhood	Morehead
FDD Installation Year	2011
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Unhappy with aesthetics. Installers left pump, tiles not done, pipe on outside of finished wall with lettering facing out.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Recommend that in finished basements, construction personnel paint discharge pipe to match walls.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	10
Neighborhood	Maple/Miller
FDD Installation Year	2005
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Took two tries for the disconnection to occur. Work cracked wall and caused seepage in basement. Calls for claims about the wall were not answered.
Contact Method	Home Visit
What caused complaint of water in basement?	FDD / Valid
Description of Problem	During FDD work, contractor appears to have incorrectly connected FDs leading to sump, which resulted in poor FD drainage and basement wall damage. Contractor later reopened the floor and properly connected the FDs and the basement wall structural problem has not reoccurred. Homeowner fixed basement wall damage.
Initial Recommended Improvements	Item
	Hole in discharge
	Wire tied to discharge
Homeowner Documented Costs	Item
	basement wall repair
OHM Estimation of Homeowner Costs	Item
	Restoration in basement as result of basment wall failure

ID #	11
Neighborhood	Orchard Hills
FDD Installation Year	2008
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Basement wall leak cost to repair, two sets of landscaping work to stop water coming in the basement, multiple sump pump failures, check valve failures, costs to repair damage from sump damage.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Two sumps in home, one FDD and one on the addition. This home's entire backyard can only drain through the footing drains on the addition. All problems were with the addition. Property needs extensive grading to solve issue.
Initial Recommended Improvements	Item
	Raise cleanout to grade
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	12
Neighborhood	Glen Leven
FDD Installation Year	2004
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Main issue is that neighbors upstream discharge surface water at house and they have not been disconnected. Wants gravity system. Anxious about power failures.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	This property is located in a multiple home watershed and has flat grading in the rear yard. Two walls in basement have been replaced. Interior perimeter drain contributes to regular sump operation and regular sump replacement. No other items.
Initial Recommended Improvements	Item
	External Grading - homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	13
Neighborhood	Orchard Hills
FDD Installation Year	2009
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Damage to paint in house during installation. Upset insurance went up for sump rider. Did not believe statements of installer.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	One corner of house has exterior drainage issue contributing to pump cycles. Stairs were damaged and not repaired.
Initial Recommended Improvements	Item
	Repaint stairs
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	14	
Neighborhood	Dartmoor	
FDD Installation Year	2006	
City- or DOM-Sponsored	City-Sponsored	
Summary of Complaints Listed on Survey	Air gap does not have leaf guard. Concerned when out of town because no back up.	
Contact Method	Phone Call	
What caused complaint of water in basement?	Not Related to FDD	
Description of Problem	Air gap is cone style, no leaf guard is necessary. Homeowner needs some guidance on what will happen in the event of a sump pump failure, so that he can choose a backup system for his situation.	
Initial Recommended Improvements	Item	
Homeowner Documented Costs	Item	
OHM Estimation of Homeowner Costs	Item	

ID #	15
Neighborhood	Maple/Miller
FDD Installation Year	2005
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Unhappy with restoration. Anxiety over pump failure.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Restoration was not adequately performed.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	Landscaping reimbursement

ID #	16
Neighborhood	Orchard Hills
FDD Installation Year	2008
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Jack hammer caused cracks to worsen in basement. Homeowner stated that radon increased 100 fold after FDD and had to install mitigation system.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Cut with wet saws before jack hammer is used (this change has been made in the City's Program.) Continue or increase public education on radon.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	17
Neighborhood	Glen Leven
FDD Installation Year	2003
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Tiles were not replaced. Bend failed and had to fix himself. Unhappy with sump under bedroom.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Homeowner states Tiles were not replaced and a bend failed that he had to fix himself. Homowner stated had addressed the issue and just wanted program to know of his trouble
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	Tile replacement
	Fitting failure

ID #	18
Neighborhood	Packard/Stadium
FDD Installation Year	2006
City- or DOM-Sponsored	DOM-Sponsored
Summary of Complaints Listed on Survey	Restoration not completed. Unsure if air gap was present.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Greg Marker emailed Bidigare, who resolved restoration concern. Air gap was in photo.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	19
Neighborhood	Morehead
FDD Installation Year	2010
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Sewer backup cost $1300 to restore. Cost to add back up system. Landscaping not complete.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	$1300 damage caused by sanitary back up from lead, unrelated to sump.
Initial Recommended Improvements	Item
	Landscape repair
	Hole in discharge
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	20	
Neighborhood	Glen Leven	
FDD Installation Year	2011	
City- or DOM-Sponsored	City-Sponsored	
Summary of Complaints Listed on Survey	Unhappy with location of sump. Sanitary back up during city maintenance: routine main flushing. Unhappy with additional costs.	
Contact Method	Phone Call	
What caused complaint of water in basement?	Not Related to FDD	
Description of Problem	The homeowner's primary dissatisfaction is with the sidewalk program. Is a supporter of the FDD program generally and was not overly upset with sump pump location. The sanitary backup was result of main line jetting and no water in trap.	
Initial Recommended Improvements	Item	
Homeowner Documented Costs	Item	
OHM Estimation of Homeowner Costs	Item	

ID #	21
Neighborhood	Glen Leven
FDD Installation Year	2011
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Landscaping was not completed. Unhappy with sump under bedroom.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Sump discharge transfers noise directly into bedroom.
Initial Recommended Improvements	Item
	Hole in discharge
	Replace check valve with silent check valve
	Noise isolation hangers for discharge
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	22
Neighborhood	Maple/Miller
FDD Installation Year	2005
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	This was unnecessary and has made my home environment less desirable due to the noise and appearance of floor that was never repainted as promised.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Homeowner states that floor was not painted and is unhappy with the noise. Agreed site visit was not necessary.
Initial Recommended Improvements	Item
	Paint floor
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	23	
Neighborhood	Orchard Hills	
FDD Installation Year	2008	
City- or DOM-Sponsored	City-Sponsored	
Summary of Complaints Listed on Survey	Landscaping not completed. Multiple tries, still not done.	
Contact Method	Home Visit	
What caused complaint of water in basement?	Not Related to FDD	
Description of Problem	Landscaping was not completed in ROW or on property. Significant settlement of trench.	
Initial Recommended Improvements	Item	
	Landscaping	
	Hole in discharge	
Homeowner Documented Costs	Item	
OHM Estimation of Homeowner Costs	Item	

ID #	24
Neighborhood	Morehead
FDD Installation Year	2012
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Backup for $1500. Unhappy with drainage in neighborhood. Against the FDD program.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Owner stated that there was a back up at this home. Does not know why there was a $1500 claim in the survey, he states no such damage. Big issue is with the grading in the neighborhood.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	25
Neighborhood	Glen Leven
FDD Installation Year	2010
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Unhappy with sump location.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Sump is installed in area of finished basement and this upsets the resident. Sanitary backups were caused by failed pipe under the basement.
Initial Recommended Improvements	Item
	Hole in pipe
	Wire not tied to discharge
	recommend build box out for sump and piping or put behind wall
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	26
Neighborhood	Glen Leven
FDD Installation Year	2003
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Unhappy with communication with CDM. Unhappy with sump location. Unhappy about lack of back up.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Homeowner did not understand the reasons for the sump pump location and ramifications of an alternate location.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	27
Neighborhood	Packard/Platt
FDD Installation Year	2005
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Sump pump failure caused water flooding.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Major exterior grading and gutter issues directing significant water to FD, which is causing excessive pressure on pump. Floor drain goes to sump.
Initial Recommended Improvements	Item
	Gutter work - homeowner
	External grading - homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	Belongings damaged during basement pump failure

ID #	28
Neighborhood	Orchard Hills
FDD Installation Year	2009
City- or DOM-Sponsored	DOM-Sponsored
Summary of Complaints Listed on Survey	1) Repeated sound of water "rattling" through pipe after a rain; 2) danger of flooding basement if rainstorm knocks out power. This would flood more houses than before disconnect program!.They should have enlarged sanitary drain pipes instead of destroying integrity of basements.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Homeowner is unhappy with the idea of having a sump in the home.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	29
Neighborhood	Glen Leven
FDD Installation Year	2011
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Unhappy with restoration. Unhappy about not having back up system.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Unhappy with resotration, agreed to not have inspection performed.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	Landscaping costs

ID #	30
Neighborhood	Main/Miller
FDD Installation Year	FDD Not Installed
City- or DOM-Sponsored	No FDD
Summary of Complaints Listed on Survey	Unhappy with radon risk. Unhappy that FD were ever connected to sanitary in first place
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Home has not participated in the FDD program, although the homeowner stated on the survey that it had an FDD installation with significant issues.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	31
Neighborhood	Glen Leven
FDD Installation Year	Data Not Readily Available
City- or DOM-Sponsored	DOM-Sponsored
Summary of Complaints Listed on Survey	Unhappy had to include sump concealment in future basement finishing
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	$20,000 damage claim was for a failed wall behind partially finished basement that was discovered when finishing basement after FDD.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	32
Neighborhood	Bromley
FDD Installation Year	2007
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Sump pump wire rested in spot that prevented pump from operating. Called plumber, quickly found problem, fixed for $110; pump operation should be checked by installer so that wire cannot prevent proper function.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Based on phone interview, it is likely that the wire not being tied to the discharge led to a pump failure that cost the homeowner a service call.
Initial Recommended Improvements	Item
	Wire tied to discharge
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	costs from wire not tied to discharge

ID #	33
Neighborhood	Orchard Hills
FDD Installation Year	2007
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Concerned about pump failure causing water in the basement.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Pump appears to have failed early. Site visit would be needed to find out reasons. HO did not want an inspection.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	34
Neighborhood	Maple/Miller
FDD Installation Year	2005
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	A floor drain was installed in the laundry room, the drain is NOT the lowest point in the floor. The lowest point is the check valve next to it.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Pump appears to have failed early. Site visit would be needed to find out reasons. HO states check valve is low point of installation. HO did not want inspection.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	35
Neighborhood	Glen Leven
FDD Installation Year	2011
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Unhappy with location of sump.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Relatively sure that nothing was done incorrectly here. Homeowner was seeking more communication. Would recommend an installation to a neighbor.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	36
Neighborhood	Bromley
FDD Installation Year	2002
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Unhappy with sump in basement. Not sure if air gap is good enough.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Phone communication yielded no further understanding of problem.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	37
Neighborhood	Orchard Hills
FDD Installation Year	2007
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Sump pump location not discussed with resident. Concerned about lack of back up and what back up to install. Concerned about damage to landscaping possible carpet repair, and need to box out sump. Concerned about damp basement since FDD.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Believe sump location was discussed with homeowner and was not moved to unfinished area due to cost. Resident has finished basement and is concerned about no back up pump,. Discussed options per Ann Arbor literature. Dampness claim does not appear to be related to sump installation, Landscaping was removed during construction. Landscaping appears to be reestablished.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	38
Neighborhood	Orchard Hills
FDD Installation Year	2008
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Gravity drainage, which is what used to be in our house, is always best. The sump pump basin is not large enough and was not installed low enough in the ground to prevent water pooling in the crawl space - a major problem.
Contact Method	Home Visit
What caused complaint of water in basement?	FDD / Valid
Description of Problem	Owner requested alternative sump installation in crawl space. CDM preinspection had the disconnection tunneling the basement wall to place sump in crawl space. It is not clear if the homeowner was aware of the risk when they were unwilling to pay the additional costs to tunnel the foundation. It is unclear if the Contractor was not aware of or possibly did not inform homeowner that sump would be at a high point on the footing drain collection system when the disconnection was at a different elevation and location from the sump. Groundwater was now held in all of the FD's below this high point in the crawl space resulting in standing water in the crawl space area, mold in the crawl space, and damp basement conditions as the soils under the basement are continuously saturated.
Initial Recommended Improvements	Item
	Hole in discharge
	Start at disconnect, bore footing and connect to sump in crawl space
	Mold mitigation in crawlspace
	External grading - Homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	Time of Homeowner to figure out problem - 80 hours

ID #	39
Neighborhood	Glen Leven
FDD Installation Year	2003
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Homeowner does not have issues, just documenting some costs they paid as part of their existing sump.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Home had interior perimeter drain. No major issues in the home. Homeowner is happy with installation and would strongly recommend to a neighbor.
Initial Recommended Improvements	Item
	Hole in discharge
	Air gap
	External grading - Homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	40
Neighborhood	Packard/Huron Pkwy.
FDD Installation Year	2004
City- or DOM-Sponsored	DOM-Sponsored
Summary of Complaints Listed on Survey	Water in basement through window. Unsure about air gap.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	External grading issues and wall replacement put pressure on sump. Back fall on inlet to sump and rag used to plug space between pipe and sump.
Initial Recommended Improvements	Item
	Hole in discharge
	Wire tied to discharge
	FD into sump with Back fall , rag used to seal other inlet
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	41	
Neighborhood	Dartmoor	
FDD Installation Year	2006	
City- or DOM-Sponsored	City-Sponsored	
Summary of Complaints Listed on Survey	Unhappy about not having a back up system. Concerned about radon.	
Contact Method	Phone Call	
What caused complaint of water in basement?	Not Related to FDD	
Description of Problem	Per the phone interview with the resident, there do not seem to be any issues requiring correction. Homeowner reported being satisfied with the installation but unhappy with the concept of having a sump pump.	
Initial Recommended Improvements	Item	
Homeowner Documented Costs	Item	
OHM Estimation of Homeowner Costs	Item	

ID #	42
Neighborhood	Morehead
FDD Installation Year	2009
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Landscaping not finished. Unhappy with tile work. Concerned about radon risk.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Unsure if air gap issue was during installation or later installation of back up system. Would have to do internal inspection to determine if other items are present.
Initial Recommended Improvements	Item
	Air gap on discharge
Homeowner Documented Costs	Item
	Landscaping reimbursement
OHM Estimation of Homeowner Costs	Item

ID #	43
Neighborhood	Bromley
FDD Installation Year	2006
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Concerned that bend failed and that other parts will, too.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	External grading contributing to pressure on sump. System appears to be installed correctly.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
	reapir of bend failure after 1 year
OHM Estimation of Homeowner Costs	Item

ID #	44
Neighborhood	Main/Miller
FDD Installation Year	2005
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Mechanical failures of the check valves and Ferncos caused flooding and backup. Failure of back up system and subsequent destruction from water.
Contact Method	Home Visit
What caused complaint of water in basement?	FDD / Valid
Description of Problem	House had two sumps that went to sanitary, program upgraded pumps and rerouted with new piping and discharge to storm. Internal pipe size of 1.5 inch for two pumps with over 70 feet of piping in the basement and 15 bends. Three check valve failures of both at the same time have occurred since installation in 2005. During these failures water moves from one sump to the other back and forth till the pumps fail. One back up flooded and permanently damaged the battery back up as well as the basement.
Initial Recommended Improvements	Item
	Hole in discharge
	Wire to discharge
	upgrade discharge to 2" and run separate
	Replace check valves
	External grading - homeowner
Homeowner Documented Costs	Item
	Service calls to replace check valves
	Battery back up replacement
OHM Estimation of Homeowner Costs	Item
	Additional check valves self installed
	labor to clean up previous back up

ID #	45
Neighborhood	Glen Leven
FDD Installation Year	2003
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	During rain events, wall leaking from discharge after install.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Cannot link leaking wall to discharge. External grading contributing to wall leaking and possible high sump cycles.
Initial Recommended Improvements	Item
	Hole in discharge
	External grading - homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	sump replacements

ID #	46	
Neighborhood	Orchard Hills	
FDD Installation Year	2007	
City- or DOM-Sponsored	City-Sponsored	
Summary of Complaints Listed on Survey	Battery back up failed once and battery failed once. Sump is noisy under stairs. Sump took a fuse from box. Restoration was not adequate. Mold in basementthat was not present before.	
Contact Method	Home Visit	
What caused complaint of water in basement?	Not Related to FDD	
Description of Problem	Noise is normal level; silent check valves are an option for the Homeowner. Restoration issues were related to water service and gas company. Could not find reason for mold and dampness, house grading was adequate overall, with a couple small issues.	
Initial Recommended Improvements	Item	
	Hole in discharge	
	External grading - homeowner	
Homeowner Documented Costs	Item	
OHM Estimation of Homeowner Costs	Item	

ID #	47	
Neighborhood	Main/Stadium	
FDD Installation Year	2008	
City- or DOM-Sponsored	City-Sponsored	
Summary of Complaints Listed on Survey	Temporary to lawn caused seepage through wall. Contractor denied claim and homeowners installed a B-Dry system.	
Contact Method	Home Visit	
What caused complaint of water in basement?	Not Clear / Inconclusive	
Description of Problem	Appears temp to lawn caused flooding in basement. Homeowner installed Interior perimeter drain along one wall to solve weepage during temp to lawn event when Contractor deinied responsibility.	
Initial Recommended Improvements	Item	
	ROW restoration	
Homeowner Documented Costs	Item	
	installatiaon of B-dry	
	because temp to lawn caused wall seepage	
OHM Estimation of Homeowner Costs	Item	
	Reimbursement for damage in basement from temp to lawn	

ID #	48
Neighborhood	Glen Leven
FDD Installation Year	2011
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Unhappy with noise of sump. Unhappy with grading and sanitary back ups in the subdivision.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	All items mentioned were related to prior sanitary backups and sump that was installed in the 1970's. Would need site visit to ensure current installation is adequate.
Initial Recommended Improvements	Item
	Tiles replaced
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	49	
Neighborhood	Glen Leven	
FDD Installation Year	2004	
City- or DOM-Sponsored	City-Sponsored	
Summary of Complaints Listed on Survey	Whole house check valve sticking up under carpet in bathroom floor. Three sump failures with damages. Unsure about back up options.	
Contact Method	Home Visit	
What caused complaint of water in basement?	FDD / Valid	
Description of Problem	Floor drain sticking up above floor. Home appears to have a properly installed system, but has experienced three sump pump failures. It is suspected that this may be caused because of the lack of a weep hole in the discharge line. Some external grading putting pressure on pump.	
Initial Recommended Improvements	Item	
	Hole in discharge	
	Check valve up high, grind lid and concrete	
	External grading - homeowner	
	Replace tiles	
Homeowner Documented Costs	Item	
	sump replacements	
OHM Estimation of Homeowner Costs	Item	
	damage from prior 3 sump failures	

ID #	50
Neighborhood	Orchard Hills
FDD Installation Year	2009
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Cost $1000. I would like to remove the sump pump. Since installation we have had flooding (none in the 10+ years prior to the installation), had to pay to get it fixed, lost items due to flooding and have lost storage space due to pump. Plus we worry about additional flooding and pump failure. It prevents us from remodeling our basement.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Believe the addition put on front of house damaged footing drain and is the source of the issue at this home.
Initial Recommended Improvements	Item
	Hole in discharge
	Tie wire to discharge
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	51	
Neighborhood	Orchard Hills	
FDD Installation Year	2008	
City- or DOM-Sponsored	City-Sponsored	
Summary of Complaints Listed on Survey	When sump failed, floor drain did not take water.	
Contact Method	Home Visit	
What caused complaint of water in basement?	Not Clear / Inconclusive	
Description of Problem	Appears floor drain is higher than other parts of basement so water comes up in cracks during a sump pump failure. Some external grading issues.	
Initial Recommended Improvements	Item	
	Hole in discharge	
	External grading - homeowner	
Homeowner Documented Costs	Item	
OHM Estimation of Homeowner Costs	Item	

ID #	52
Neighborhood	Dartmoor
FDD Installation Year	2006
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Landscaping not complete. Concerned about sump failure.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Landscaping wasn't done. Hard surface restoration has failed. Air gap is too tight. Installation does not meet manufacturer recommendations.
Initial Recommended Improvements	Item
	Landscaping repair
	Air gap repair
	Hole in discharge 50
	asphalt at base of drive
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	sump failure

ID #	53	
Neighborhood	Glen Leven	
FDD Installation Year	2008	
City- or DOM-Sponsored	City-Sponsored	
Summary of Complaints Listed on Survey	Unsure what air gap is.	
Contact Method	Phone Call	
What caused complaint of water in basement?	Not Related to FDD	
Description of Problem	Homeowner is upset that only some of the houses were required to have an FDD.	
Initial Recommended Improvements	Item	
Homeowner Documented Costs	Item	
OHM Estimation of Homeowner Costs	Item	

ID #	54
Neighborhood	Orchard Hills
FDD Installation Year	2007
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Before installation we had no problem; after we had a wet basement three times, now we always worry it will happen again.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	All three failures were under warranty and was happy with response, especially CDM. Anxiety over sump.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	55
Neighborhood	Dartmoor
FDD Installation Year	2010
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Sump failures have created anxiety.
Contact Method	Home Visit
What caused complaint of water in basement?	FDD / Valid
Description of Problem	Prior to FDD program work, home had two new walls installed with new FDs and a new sump installed to address basement wall leaking and bowing. The FDD program installed a second sump pump to disconnect FD and to collect other two walls FD flows. The existing sump collects the majority of the flows and has had two sump pump failures due to suspected high flows. The FDD program sump pump has not failed yet, however it has a long discharge(40ft) with multiple fittings(11). Air gap has a minor issue that ought be resolved.
Initial Recommended Improvements	Item
	Hole in discharge
	Replace internal piping with 2"
	Repair air gap
Homeowner Documented Costs	Item
	sump failure
OHM Estimation of Homeowner Costs	Item

ID #	56
Neighborhood	Glen Leven
FDD Installation Year	2010
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Existing water problem in front corner did not change after FDD. New water problem at back of house occurred after FDD. Lid is sealed and does not know how to open.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	The front corner issue appears to be grading at the front of the house. The issue at the back of the house appears to be caused by downspouts that do not extend from the foundation. The problem is exacerbated by animal paths dug along the foundation, under the deck where the downspout terminates.
Initial Recommended Improvements	Item
	Hole in discharge
	External grading - homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	57
Neighborhood	Bromley
FDD Installation Year	2007
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Adding battery and/or water siphon backup=yes. Landscaping repair=yes. One more thing to worry about - especially when we have heavy rains. Battery. I wish I had not gotten it installed. The house was functioning well for about 40 years. In the last 5 years since the pump was installed, we have had dampness and a couple of sewage backups.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Comments about water in basement made on the survey were sanitary back ups due to pipe failure under floor of basement.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	landscaping repair

ID #	58
Neighborhood	Dartmoor
FDD Installation Year	2006
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	The Homeowner states they did not have seepage or flooding prior to the FDD. They did have major sanitary back up from localized main problem in 2001. They believe that the issue started after the FDD and that their landscaping work has fixed the problem caused by the FDD.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Home had external grading issues and likely partial footing drain issues that appear to coincide with the timing of the FDD. The two external grading projects (one large, one small) and the new gutter work appear to have solved the problem, provided the downspouts continue to direct flow away from the foundation.
Initial Recommended Improvements	Item
	Hole in discharge
	Tie wire to discharge
	External grading - homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	59
Neighborhood	Morehead
FDD Installation Year	2003
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Sump pump malfunction. Concerned about lack of a backup system. This has disrupted my basement design/style. In our yard and crawl space, we've had intermittent dampness, etc. and have waterproofed the crawl space and spent a lot of money for water drainage in yard.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	House complicated by addition constructed after FDD, hard to see what may have happened. Backup in external discharge likely caused flooding in basement. That was likely result of 2" external discharge being overwhelmed by heavy flow during rain events compounded by external grading issues.
Initial Recommended Improvements	Item
	Hole in discharge
	Expose cleanout and raise air gap
	Landscaping repair
	External grading - homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	2" external capacity issue during large storm event

ID #	60
Neighborhood	Glen Leven
FDD Installation Year	2009
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	The sump pump that was installed did not last. Flooding has been a significant concern since I bought the house in 2009. The previous owners claimed they never had water damage, but I have had 3 major floods and 3 or 4 minor floods since 2009. I just got a back up sump pump system installed last month, and I am hoping I can sleep better now whenever it rains.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Serious external grading issues and large neighbor watershed overwhelm back up pump in storm events.
Initial Recommended Improvements	Item
	Hole in discharge
	Tie wire to discharge
	External grading - homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	61
Neighborhood	Glen Leven
FDD Installation Year	2004
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	We indicated we did NOT want a sump pump in our basement. Our basement was DRY following the interior perimeter drain work done by the company. Since the disconnect sump pump installation we have had one serious flooding; one serious seepage. Since we were not given a choice in this matter (and we were told all of Ann Arbor would be required to have a disconnect pump (apparently no longer true) this has turned out to be a very unpleasant experience. Note: we were told if we wanted a backup system, generator, etc. we would have to pay for it.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	North side of property has grading issues and fresh wall with interior perimeter drain putting more pressure on pump. Check valve failure 13 months after installation should fall under warranty.
Initial Recommended Improvements	Item
	Hole in discharge pipe
	External grading - homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	landscaping repair

ID #	62
Neighborhood	Dartmoor
FDD Installation Year	2006
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Concerned about: power outages, having to install backup pump and pump failure when there is no power outage. We have new water issues due to the installation.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Contact made with home by phone, some comments form other home with exact same name erroneously made it in here. Phone interview with HO we both agreed inspection is not necessary.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	63
Neighborhood	Bromley
FDD Installation Year	2007
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Several flooding events since sump pump installation, none before, flooding events caused property damage and personal injury - very unhappy and anxious about sump pump each time it rains heavily. Replacing sump pump(s) $200. Replacing sump pump check valve $240. Other costs related to the sump pump installation $360.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Exterior grading steering large watershed to exterior stairwell. Drain and pump are overwhelmed, sometimes water comes through door, sometimes pump fails. Debris from stairs enter sump and interfere with pump.
Initial Recommended Improvements	Item
	External grading - homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	64
Neighborhood	Main/Stadium
FDD Installation Year	2005
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Water now comes up from the drainpipe when it rains and causes a pool of water on the basement floor. The seepage has not decreased since the pump was installed.
Contact Method	Home Visit
What caused complaint of water in basement?	FDD / Valid
Description of Problem	Owner requested an alternative sump pump installation and the installed system has resulted in poor drainage to the new sump and caused water to enter the basement at the base of the walls. Initial recommendation: Review options for providing better connection from disconnection to sump location.
Initial Recommended Improvements	Item
	Verify FD connected during alt. sump install (repair if needed)
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	65
Neighborhood	Bromley
FDD Installation Year	2006
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Defective pump on two occasions. Then the pump gave out after repairs and water seeped into basement from under floors flooding with nowhere else to go. Replaced new sump pump. Never had a problem until you installed this thing. Would never recommend doing this. We never had water or leakage in basement before. We built and have lived in this house for 40+ years!
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Two external grading issues causing a wall leak and extra pressure on sump pump. Floor drain is higher than floor so water comes in through cracks when pump does not function.
Initial Recommended Improvements	Item
	Change air gap to candy cane style.
	Hole in discharge
	Wire to discharge
	External grading - homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	66
Neighborhood	Glen Leven
FDD Installation Year	2003
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Weeping walls, water in window, drain backing up, clear water from check valve.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Homeowner had major sanitary back ups in the late 90s; would strongly recommend FDD/sump pump installation. External grading issues causing most of the water issues. Would have to perform site visit to verify causes of problems.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	67
Neighborhood	Main/Stadium
FDD Installation Year	2009
City- or DOM-Sponsored	DOM-Sponsored
Summary of Complaints Listed on Survey	We hadn't heard the pump run, so, a year or so ago I poured water into the sump until it ran just to make sure it worked. Our neighbor (higher than us) did some work that changed the surface drainage and caused significant seepage into our basement through the south wall and window wells, but the sump never ran.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Could not determine pump operation from phone interview; a site inspection would be necessary. Homeowner states sump never runs and believes the footing drains don't drain to sump, however he does not want site inspection.
Initial Recommended Improvements	Item
	External grading - homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	68
Neighborhood	Morehead
FDD Installation Year	2001
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	One back up from sump failure. Tiles not replaced. Part of pilot program and supportive of program.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	No issues in the basement, two overflows from before the pump was installed. Part of pilot program and huge advocate of mandatory FDD program.
Initial Recommended Improvements	Item
	Alter overflow
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	69	
Neighborhood	Morehead	
FDD Installation Year	2009	
City- or DOM-Sponsored	City-Sponsored	
Summary of Complaints Listed on Survey	Our sump pump failed about 1 year after install. Our basement flooded as we were out of town when this occurred. Our finished basement was ruined. We have no peace of mind! The sump pump that was installed in our home must have been a poor quality item. I called the city when it failed and asked about a warranty. I was told it had a 1 year warranty. When we went to replace it there were no pumps available with less than 5 yr. warranty. That fact leads me to believe the pump the city installed was of poor quality.	
Contact Method	Phone Call	
What caused complaint of water in basement?	Not Clear / Inconclusive	
Description of Problem	Reasons for flooding were not clear during the phone call. Did not want home visit. Made repairs themselves. Issue investigation process might have found a cause for the back up and damage.	
Initial Recommended Improvements	Item	
Homeowner Documented Costs	Item	
OHM Estimation of Homeowner Costs	Item	

ID #	70
Neighborhood	Glen Leven
FDD Installation Year	2012
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Concerned about pump failure.
Contact Method	Phone Call
What caused complaint of water in basement?	Not Related to FDD
Description of Problem	Homeowner states claim for landscaping damage in survey was not true.
Initial Recommended Improvements	Item
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	71	
Neighborhood	Maple/Miller	
FDD Installation Year	2005	
City- or DOM-Sponsored	City-Sponsored	
Summary of Complaints Listed on Survey	Pumps keep burning up, six pumps in 8 years.	
Contact Method	Home Visit	
What caused complaint of water in basement?	FDD / Valid	
Description of Problem	Home appears to have a properly installed system, but has experienced six (6) sump pump failures. This home is a high producer due to recent two wall replacements and external grading issues. Sump pump runs frequently. There is a long 1.5" discharge(35 ft) with multiple bends (15) that is likely increasing the head on an already stressed pumping situation.	
Initial Recommended Improvements	Item	
	Tie wire to discharge	
	Replace discharge with 2"	
	External grading - homeowner	
Homeowner Documented Costs	Item	
	previous pump failures	
OHM Estimation of Homeowner Costs	Item	
	damges from five previous sump failures	

ID #	72
Neighborhood	Packard/Platt
FDD Installation Year	Data Not Readily Available
City- or DOM-Sponsored	DOM-Sponsored
Summary of Complaints Listed on Survey	Water in basement after FDD, installed interior perimeter drain to address.
Contact Method	Phone Call
What caused complaint of water in basement?	FDD / Valid
Description of Problem	The DOM FDD discharges to a cistern that is located close to the basement wall and appears to be on top of a utility trench. Installation pics of cistern show it is not installed to manufacturers recommendations. HO reports basement wetness since work and claims Contractor denied claim. Contractor reports no other surface discharge was available for this home. The homeowner has installed a B-Dry system to address this increased wetness. Site visit will be needed to identify if other issues are present.
Initial Recommended Improvements	Item
	Relocate cistern
Homeowner Documented Costs	Item
	wall repair for incorrect cistern location
OHM Estimation of Homeowner Costs	Item

ID #	73
Neighborhood	Glen Leven
FDD Installation Year	2003
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Air gap discharged water to foundation and causeda leak in basement wall.
Contact Method	Home Visit
What caused complaint of water in basement?	FDD / Valid
Description of Problem	Home appears to have a properly installed sump pump, discharge system needs weep hole. During the winter of 2014, freezing of the downstream curb drain system caused discharge from the air gap next to the foundation wall. This caused basement leakage and damage. Reconfiguring the air gap to push overflow out from the house, and providing improved grading and impervious material next basement wall to prevent reoccurrence if future downstream discharge difficulty were to occur.
Initial Recommended Improvements	Item
	Hole in discharge
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	icing curb drain in winter 2014.

ID #	74
Neighborhood	Glen Leven
FDD Installation Year	2003
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	Air gap discharged water to foundation and caused flooding in basement.
Contact Method	Home Visit
What caused complaint of water in basement?	FDD / Valid
Description of Problem	Home appears to have a properly installed sump pump, discharge system needs weep hole. During the winter of 2014, freezing of the downstream curb drain system caused discharge from the air gap next to the foundation wall. This caused basement leakage and damage on two occasions. Reconfiguring the air gap to push overflow out from the house, and providing improved grading and impervious material next basement wall to prevent reoccurrence if future downstream discharge difficulty were to occur.
Initial Recommended Improvements	Item
	Hole in discharge
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item
	damage during icing curb drain in winter 2014.

ID #	75
Neighborhood	Glen Leven
FDD Installation Year	2003
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	No issues reported on survey. Home was connected to frozen curb drain.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Sump was plugged into a light rather than a separate circuit. No air gap installed. This home did not submit survey, investigation occurred during frozen curb drain investigation.
Initial Recommended Improvements	Item
	Hole in discharge
	Electric circuit for sump
	Check valve failing - homeowner
	Air gap installed
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	76
Neighborhood	Glen Leven
FDD Installation Year	2003
City- or DOM-Sponsored	City-Sponsored
Summary of Complaints Listed on Survey	No issues reported on survey. Home connected to frozen curb drain.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Multiple issues with water siphon backup and discharge installation. This home did not submit survey, investigation occurred during frozen curb drain investigation.
Initial Recommended Improvements	Item
	Hole in discharge
	Water siphon switch going bad - homeowner
	Discharge disconnecting from air gap - homeowner
	no check valve on siphon discharge - homeowner
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

ID #	77
Neighborhood	Maple/Miller
FDD Installation Year	2007
City- or DOM-Sponsored	DOM-Sponsored
Summary of Complaints Listed on Survey	Sump failure caused damage during a heavy rain during which road filled with water and backed up.
Contact Method	Home Visit
What caused complaint of water in basement?	Not Clear / Inconclusive
Description of Problem	Serious external grading issues on three sides of the house with no easy solution. Installed B-Dry system along two walls in the past. 1/3 horsepower pump (series 53 Zoeller). Pump runs on 20 sec cycles. New pump in 2013 after clear water back up during storm. High output could mean that standard diameter discharge lines aren't adequate to handle the flows from this property.
Initial Recommended Improvements	Item
	Hole in discharge
	Wire tied to discharge
	External grading - homeowner
	upgrade to 2" discharge
Homeowner Documented Costs	Item
OHM Estimation of Homeowner Costs	Item

Best Practices for FDDs

We have outlined some of the best practices that OHM has observed from FDD programs over the years. The City of Ann Arbor may already do many of these, and there are some items that the City may not wish to implement because of the specifics of the Ann Arbor process. We thought that outlining best practices from other programs would be a helpful comparison and might generate some ideas for improving the Ann Arbor program.

The results of the investigation identified three sets of Best Practices for the City of Ann Arbor to consider if/when it continues its FDD program(s).

1. Customer Service
2. New Installations
3. Retroactive Work

Specific recommendations for each of the three categories are as follows. Please note that no attempt was made to rank recommendations in order of importance.

1. Best Practices for Customer Service

a) Provide a single point of contact or "ombudsman" with the City or the Consultant that coordinates the program. The ombudsman should be present at the meetings between Contractors and residents as requested. Typical ombudsman roles include conflict resolution, resolving scope disputes, and resolving installation issues.

b) Inspect external grading during pre-installation inspection and if needed, provide written recommendations to the homeowner for reduction of flow to the new sump. (Isn't this an installation practice?)

c) Improve responsiveness to resident concerns. It is recommended that the responsible consultant return all citizen phone calls within 48 hours, all emails should be answered within one week and a City monitoring process established to ensure that all follow up is completed.

d) Maintain detailed records. Documentation for the program will need to reference what happened at each address. The file needs to include the communication log, pre-inspection notes, the contractor's submittal, the Contract between the resident and the Contractor, the internal and property video of existing conditions, the executed permits, the Contractor's statement of completion, the residents initial agreement of 90% completion, the payment of the 95%, the second season restoration sign off, the 5% payment, and the O&M turn over documents with the homeowner sign off after the meeting. The Development Offset Mitigation program needs to have the same documentation as the FDD.

e) Review written maintenance recommendations in a meeting with the homeowner as part of the O&M turnover of each system at the final inspection meeting. Go through the items on the document to ensure the homeowner understands how to maintain the system. If videos are available, they should be referenced and one should be watched with the homeowner.

f) Hold 5% of payment until work is completed. Allow 95% payment upon initial completion of the work. Final 5% to be paid at the end of the second growing season and upon receiving a signature from the homeowner stating that all work is complete and acceptable. For example, if restoration is done before May 5th, acceptance by homeowner is November 1st. If restoration is done before October 10th, acceptance is June 1st.

g) Require the Contractor to provide a 2-year warranty on sump pump system, including any damage resulting from failure.

2. Best Practices for New Installations

a) Prohibit alternate footing drain tap locations (trench across basement for alternate sump locations when needed). Disconnections must begin at the FD tie in to the sanitary, and the sump location must be trenched or tunneled to be eligible for payment.

b) Require wet saw to cut floors. The use of jack hammers in a basement without cutting first increases the risk of cracks being created or opening up further as a result of the work.

c) Require exposed pipes to be painted. If a pipe is put on the outside of a wall, it is recommended that it be painted to match walls as part of negotiation.

d) Require Contractors to follow PVC pipe and glue manufacturer's installation instructions. The glue used for pipe connections needs to be allowed to cure for the amount of time listed in the PVC and glue manufacturer's installation instructions to minimize the risk of fittings pulling apart or leaking. This is especially important in cases in which the pipe assembly is subject to added stress of being pulled through a bored hole.

e) Require pipe installations to be televised to show that there are no bellies that may trap water and freeze in the winter. This specifically applies to drilled, bored, or moled external discharges.

f) Ensure pumps are installed on blocks to reduce the potential for debris to enter pump and cause subsequent damage.

g) Videotape all properties and ROW before construction starts. Recommend Contractors are required to submit a video of the basement, property and ROW for two houses in each direction and state that all concerns unable to be verified on the videos will likely be the Contractors responsibility if the Engineer agrees construction likely caused the event. The onus for responsibility of damage to a property will be borne by the Contractor to show the condition was existing prior to construction via video when a damage claim is made.

h) Direct overflows away from foundations for any home whose basement wall shows existing issues before construction. This may necessitate candy cane style overflows if the wall below the discharge has known issues prior to construction.

i) Require certification of underground detention when used for sump discharge. If the use of underground detention (Cistern, drywell, or other) is employed, the City should require certification by an engineer of the following requirements. Representation at the negotiation of the work on behalf of the homeowner by the City Engineer is also recommended.

j) System design should be sized to detain a specific runoff volume, based on a design storm determined by the City.
k) System design should result in infiltration at that location as calculated by the new WCWRC storm water revisions
l) Inspection should be performed to verify that there is capacity to hold the required runoff volume in the well with actual sump operation after installation.
m) Inspection should be performed during dry well during installation to ensure that it is at least 15 feet away from any foundation or utility trench.
n) How about backup systems? What is your opinion on this one?

3. Best Practices for Retroactive Work on Installations not done according to spec:

a) <u>Require any pipe installations in question to be televised to show that there are no bellies that may trap water and freeze in the winter</u>. This specifically applies to drilled, bored, or moled external discharges. Bellies, if present, should be below the frost line; otherwise, the pipe should be replaced.
b) <u>Ensure curb drains and discharge pipes have positive slope.</u> Some curb drains follow road grade from tap-in location, resulting in low cover situations, which cause maintenance problems. HDPE pipe can be bent, so no need to follow road grade and 36” trenches are easily done.
c) <u>Ensure pump systems have hole in pipe between check valve and pump.</u>
d) <u>Ensure pumps are installed on blocks</u> to reduce the potential for debris to enter pump and cause subsequent damage.
e) <u>Evaluate all cisterns that were installed at Development Offset Mitigation homes.</u> Currently, one cistern is known to need relocation and reinstallation. All other cisterns should be inspected to identify and correct other potential issues before problems arise. (This seems overboard)
f) <u>Repair overflows that are not properly installed (e.g., discharge too close to foundation or other items as noted in inspection reports).</u> In some cases, overflows are either not present, or tee for overflow is below 90 out of the house and should be candy cane style that guides overflow away from the foundation of the home.

City of Ann Arbor
SSWWEP
Investigation of Sump Discharge Failure on Avondale
April 3, 2014

On Tuesday March 11, 2014, Judy Hanway posted a video to Basecamp of an air gap on a sump pump discharge line that was discharging water when the pump was running. The home was located at 1515 Avondale. Judy obtained the homeowners request for an investigation and Greg Marker from OHM performed an investigation on March 12 and 13.

Field Investigation Observations

Upon examining the conditions at 1515, we discovered that the house at 1511 had experienced some similar issues as well. Below is an outline of the field observations. The attached document depicts these observations on a sketch of the area.

- Two or three weeks prior to the investigation, the discharge at 1511 started backing up with water leaking out of the air gap. The backup was draining into the soil along the front wall then entering the basement. They had to remove cabinets, had drywall damage in half the basement, and had to remove carpet in half the basement.
- The 1511 property drainage slopes from rear to front, and the house has had footing drain failures previously in the basement along the rear wall, which has lead to historic water intrusion in the basement along the rear wall. This winter they have experienced water issues in the basement along the front wall due to the air gap discharging along the front wall.
- Because of the backup and water intrusion, 1511 disconnected from the exterior discharge and temporarily discharged to their lawn. Even after this disconnection, the 1511 exterior pipe continued to discharge water when the sump at 1515 operated. This indicates that there is a blockage in the curb drain downstream of 1511, causing the 1515 sump discharge to run backwards up the lead from 1511 and discharge at the external pipe adjacent to 1511.
- Due to these conditions, 1511 called a plumber who put an augur through their 2" discharge line to the tee at the curb drain and found the sump lead to be unobstructed. At this point, they contacted Anne Warrow at the City who indicated that the curb drain was likely frozen. Anne Warrow instructed the plumber to put an extension on the exterior discharge to get it away from the house, and to reroute the internal sump discharge back to the sanitary as a temporary measure.
- Later, the piping on the extension of the exterior discharge at 1511 froze (from 1515's water). This likely occurred because the extension ran over the surface and was susceptible to freezing. This caused the sump discharge from 1515 to begin to backup and leak out of the air gap at 1515. This was the condition that was video recorded by Judy Hanway and witnessed in the field during this investigation.
- 1515 then temporarily disconnected the interior discharge pipes from the exterior pipes with an extension on the discharge, and piped their discharge out on their lawn.
- During the field investigation, the storm sewer curb inlet adjacent to 1427 was examined. While the surface of the inlet was covered with snow and ice, the interior of the inlet was flowing free

and clear, likely due to the discharge of the relatively warm sump pump discharge from the four houses it collects (now down to two, 1427 and 1501).

Field Investigation Findings

The bore report for the curb drain shows that the pipe is two feet deep behind the curb. Based on the field investigation of the curb drain discharge at the inlet and the data provided in the bore log, we believe that the pipe is only 1.5 feet deep where it passes beneath the driveway at 1511. Given the observations made, we believe that the curb drain froze downstream of 1511, likely under the 1511 driveway where the shallow pipe is most exposed to cold temperatures. If the obstruction were any further downstream, it would have caused similar overflow issues at the adjacent houses (1501 and 1427).

In order for the curb drain to freeze at this point, cold water likely discharged through the pipe, causing an “icicle” effect under the driveway. In this condition, a small ice accumulation slowly builds, and as more cold water passes by, the ice obstruction grows until it blocks the pipe entirely. We believe that the source of the cold water is likely “dips” in the service leads from 1511 and 1515, where the water accumulates and stands for a time before being discharged downstream with the next pump cycle. Due to steepness of the road, we believe that is it unlikely that there are dips in the curb drain upstream of 1511. This could be verified by televising the curb drain.

Recommendations

Based on the field investigation performed and our findings above, we recommend the following:

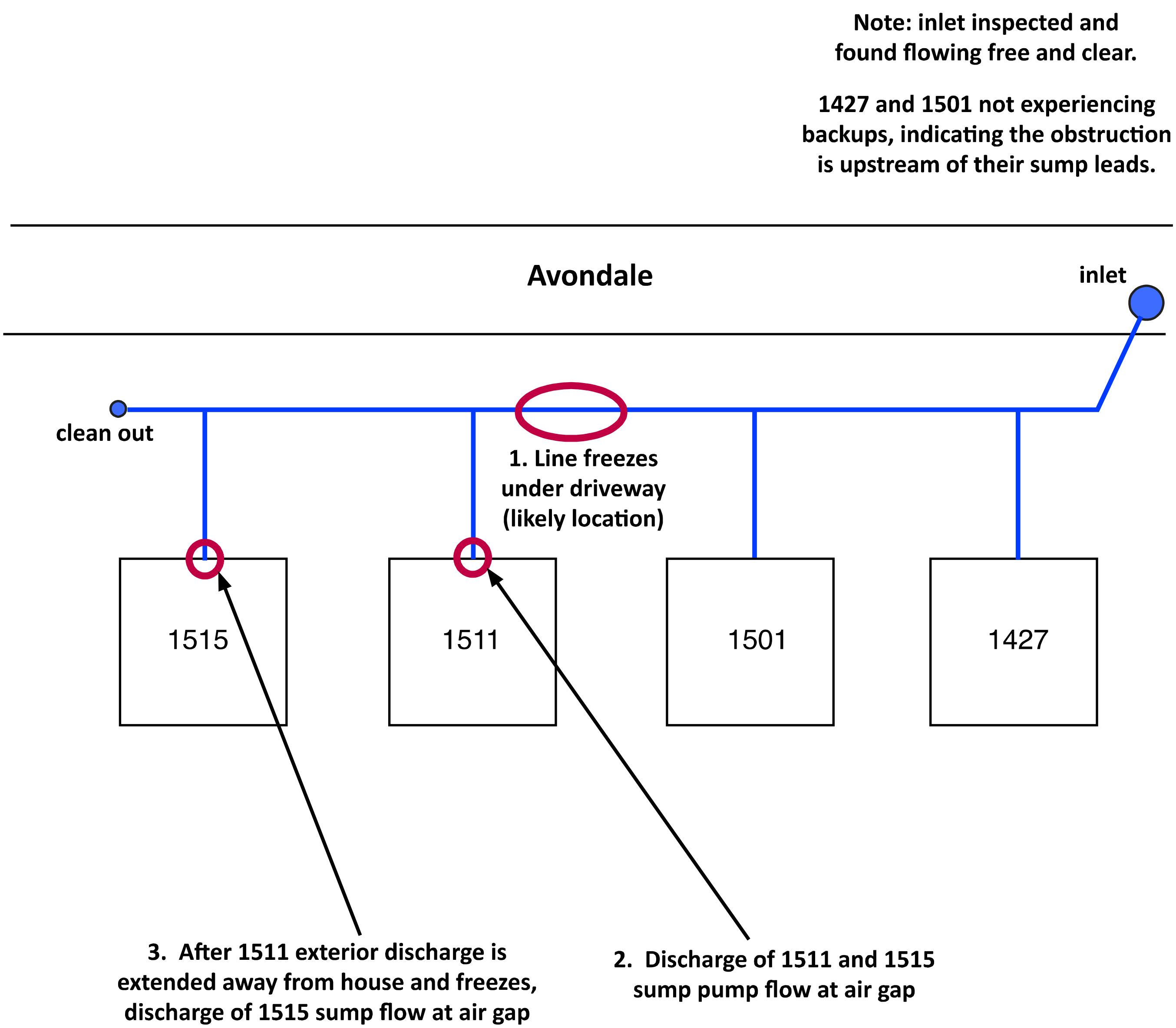
1. There is a clean out at the end of the curb drain run. As a short-term solution, it would be possible to auger the ice in the curb drain or heat the standing water in this run to get the curb drain operational and get 1511 and 1515 back on the collection system in preparation for the spring thaw and rains. It is understood from the City that this has occurred and that the line has been cleared.
2. Televise the curb drain and fix any irregularities. Televise the sump pump leads from 1511 and 1515, and if they are found to have dips in them where cold water can accumulate, reconstruct the leads without dips.

Conclusions

The conditions observed in March of 2014 along Avondale is a rare occurrence. Such issues were not widespread in the City this winter, occurring at only a handful of houses. The City’s FDD project manager indicated that this was the first winter that she can recall any issues like this occurring going back to the beginning of her tenure with the program (2006). The winter of 2014 was a particularly harsh winter, with a very long stretch of below freezing temperatures in Ann Arbor. While it is unfortunate that these issues occurred at a few houses, we do not believe that they are indicative of any widespread issues with the functioning of the City’s FDD program, the curb drain system, or the air gaps in general. Any isolated incidents of freezing that do occur should be investigated and then corrected.

City of Ann Arbor
SSWWEP
Investigation of Sump Discharge Failure on Avondale
March 31, 2014

Site Sketch
(not to scale)



October 28, 2014

City of Ann Arbor Sanitary Sewer Evaluation Project

Summary of Back-Up Systems from Other FDD Programs

Community	Year Program Initiated	Type of Program	Back-Up Options for Participants	City's Decision Basis for Providing Back-Up System
City of Auburn Hills	2002	Volunteer FDD under this project, with initial program funded by City. Communication to residents indicated that future mandatory program was a possibility, and further funding from the City was not guaranteed.	No back-up parts or labor offered.	None, no back-up system provided.
City of Farmington	2005	Volunteer FDD under this project, with initial program funded by City. Communication to residents indicated that future mandatory program was a possibility, and further funding from the City was not guaranteed.	Parts per owner, labor per city.	Proposed by DPW, approved by City Administrator.
City of Westland Pilot FDD	2006	Volunteer FDD under this project, with initial program funded by City. Communication to residents indicated that future mandatory program was a possibility, and further funding from the City was not guaranteed.	Parts per owner, labor per city.	Proposed by DPW, approved by City Administrator.
City of Romulus Pilot FDD	2006	Volunteer FDD under this project, with initial program funded by City. Communication to residents indicated that future mandatory program was a possibility, and further funding from the City was not guaranteed.	Parts per owner, labor per city.	Proposed by DPW, approved by City Administrator.
City of Westland FDD Program	2010	Volunteer FDD under this project, with initial program funded by City. Communication to residents indicated that future mandatory program was a possibility, and further funding from the City was not guaranteed.	Parts per owner, labor per city.	Proposed by DPW, approved by City Administrator.
City of Livonia Pilot FDD	2013	Volunteer FDD under this project, with initial program funded by City. Communication to residents indicated that future mandatory program was a possibility, and further funding from the City was not guaranteed.	Parts per owner, labor per city.	Proposed by DPW, approved by City Administrator.
City of Grand Rapids FDD	2012	Ordinance with surcharge for non-participants of $93/month. Basis for surcharge broken down by additional costs to City for connected footing drains.	Parts and labor included for a battery back-up for all participants.	Initial public outreach indicated residents didn't want the program without a back-up system. City legal review was performed on the program and approved. Ultimately the City Commission approved the program.

Back Up Pump Discussion

The decision about the installation of a backup pump in any given home that is undergoing a footing drain disconnection is dependent upon the individual factors inside the basement of the home and the homeowner preferences for maintenance of the sump and any back up or warning systems installed for that sump.

Each basement and house is unique in what it will need for a footing drain disconnection to be done in a manner that will meet the needs of that house and owner. In homes where there is a concrete floor and no finishing it may not make sense to install a backup pump at all. The additional mechanics and their subsequent maintenance, risk of them interfering with the primary pump, and risk of failure do not justify them compared to the clear water back up risk. In the homes where there is a minimal level of finishing, it may not make sense for that home to have a water siphon back up that could risk a water problem from the pressurized water supply or a stuck switch that results in a high water bill, so that home may want/choose a battery backup system. In the homes that have a standby generator they may choose a system that has two primary pumps set at two different levels. Some homeowners with lower finishing levels may not want the maintenance expense of a backup pump and may choose to use a high water alarm that will alert them when there is a problem so that they may address it themselves and not have the infrastructure of a backup system in the way that either increases maintenance costs or become a hassle when they have to do work in the sump.

OHM has advised our clients and we recommend that as part of an FDD program they offer a water pump, battery, and high water alarm for the homeowner to purchase at material cost as part of the project and the municipality pay the installation costs of those or any other back up system the owner provides, as long as it is done at the time of installation. We do not recommend the municipality pay for the pump or system itself due to the liability that occurs when a backup fails. We also believe it is important for the homeowner to invest in the backup system of their choice so they carefully evaluate what is best for their needs. These are mechanical systems that require maintenance and care to be ready when they are needed and to prevent them from interfering with the primary pumps operation.

In conclusion, the reason we do not “recommend backup systems” is that each house and its home owner is a unique situation where they have to be informed/educated of what their choices are, and talked through their situation to the conclusion of what is best for their home based on what that house and that homeowner needs/wants in regards to their basement and what the risk to that basement is for a clearwater backup. Ultimately that is a personal decision that cannot be one size fits all. In our past programs, backup pumps are only chosen in about one half of the homes due to the level of finishing making a backup the correct choice for them.

C. FDD Subcommittee Meeting Agendas and Meeting Summaries

Meeting Agendas and Summaries are included on the following pages for meetings that took place on:

August 4, 2014
August 25, 2014

August 4, 2014
FDD Subcommittee Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
FDD Mitigation Subcommittee Meeting
Monday, Aug 4, 2014 - 6:30 p.m. to 8:30 p.m.

Agenda

1. **Welcome –**

2. **Confirm Objectives**

3. **Review of July 14th Meeting Summary (Charlie)**

4. **Action Items from July 14 Meeting:**

   - **City response regarding request to establish panel/committee to investigate FDD issues and recommend corrections/compensation (Abby)**
   - **Summary of homeowner costs from Marker inspection report (Greg)**
   - **Number of homeowners that participated in original class action suit (Nick)**
   - **Review the contractor checklist (Mark)**
   - **Present feedback from homeowners with installations done according to spec. (Charlie)**
   - **Discuss televising pipes at home with curb drain freeze issues (Nick)**

5. **Go Forward Recommendation Discussion**

   - **Support the City's position?**
   - **Support the City's position with changes?**
   - **Develop alternatives?**

6. **Action Items - Prep for Aug 13 CAC**

7. **Close –**

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

FDD Subcommittee Meeting Summary
August 4, 2014

Subcommittee members:

• Colin Breed	• Vince Caruso	• Judy Hanway
• Peter Houk	• George Johnston	• Jim Osborn

SSWWE/FDD project team members:

• Lori Byron, Famous in Your Field	• Abigail Elias, City of Ann Arbor	• Charlie Fleetham, Project Innovations	• Nick Hutchinson, City of Ann Arbor
• Greg Marker, OHM Advisors	• Mark TenBroek, CDM	• Anne Warrow, City of Ann Arbor	

Meeting observers:

• Frank Burdick	• Jack Eaton, City Council

1. Welcome and desired outcomes – Charlie Fleetham

- Review July 14th Meeting Summary

- Post Construction Checklist (Note that although it is labeled "DOM Inspection Checklist" the information is the same as for the FDD Program.)

Reviews subcommittee objectives:

- Learn the results of Greg Marker's investigation f bout 5 ouseholds f he 50 hat reported flooding/seepage/dampness, or sanitary sewer backups on the 2013 FDD Survey or attended the Feb 2014 Public Meeting or were referred to Greg.

- To prepare to give a preliminary report at the August 13 CAC meeting and a full report at the September 3 Public Meeting.

2. Abigail Elias, City Attorney, discusses the City's position regarding out of spec installations

Greg Marker's investigation shows that for about 2% or roughly 40 homes – the footing drain disconnection and sump pump installation were not performed according to specification.

Responding first to the committee's tribunal suggestion, Abby gives background on municipal liability. municipality has broad immunity with certain specific exceptions, such as motor vehicle operations.

There is a limited xception for sewer backup events that meet 5 criteria:

- Claim must be filed within 45 days;
- Backup caused by a defect in the City's part of the system;

- The City had notice of the defect;
- The City did not act a reasonable timeframe to fix;
- And the defect was 51% or more the cause of the claimant's damage.

When the City is notified of a backup within a short window of time and field investigations determine that the backup was caused by a problem in the City's main, the City will give the homeowner a form to contact Belfor (catastrophe cleaning service.) The City is not obligated to fund this service but does so because of concerns for health, safety and welfare.

As background, prior to class action lawsuit, City would routinely pay claims up to $3500 for each incident of sanitary sewer backup. In the class action lawsuit, the City paid about $800,000 into he ool or bout 00 laimants. Around the same time, Public Act 222 was enacted which established the above five criteria for municipal liability.

Paying claims for which the City is not legally responsible could bring consequences:

- City could be removed from the claims process.
- Could damage the City's insurance ating, ncreasing osts.

The City's position is that although it is not legally obligated to fix the out of spec FDD installations, ill o o, s art f he ontract nd rogram management and because it's the right thing to do. Because the repairs would be funded as part the program, those expenditures will not impact surance atings.

Q. Who prepared the FDD specification?

A. It was originally created jointly by City, CDM Smith, and the Building Department in 002, and later pdated wo imes o eflect hanges he program.

FDD CAC member comments that he doesn't remember ever seeing the specification.

Q. Is the specification shared with homeowners?

A. Not the entire spec, unless the homeowner requests it. The full spec is a 30 page technical document. The homeowner's packet includes a scaled version of the spec.

Subcommittee member shares that Glendale neighborhood homeowners have experienced backups and reported those to the City. After a time, the City televised, jetted nd odded ipes, removing three blockages.

3. City's proposal regarding FDD operations & maintenance education

Abby shares that the City plans to create basic how to videos and text based instruction on topics such as: required maintenance, backup pros and cons and operational best practices.

Subcommittee member suggests that the City could help educate homeowners on how grading could impact drainage and increase the chance of flooding or seepage (grading was the most frequent contributing factor in flooding and seepage incidents reported on the survey.) Also include formation n he est cations or egress windows.

Q. Could providing education for homeowners impact the City's liability?

A. No, it would not.

Abby summarizes the City's position:

- Where there's been an installation that was not performed according to spec, the City will fix it.
- The City will create and provide education on operations and maintenance, backup systems, as well as proper grading.

Project team received ~900 survey responses and found about 150 who reported basement backups or flooding caused by FDDs.

Q. What about the other homeowners who did not respond to the survey?

A. The City does not plan to perform a site visit for every homeowner with an FDD and sump pump; the survey and the public meetings gave homeowners with issues an opportunity to share problems they encountered. It's possible that others who come forward could be included in he itigation rogram; how that will be handled is et o be determined by the City.

A subcommittee member comments that she is ot omfortable aking ecisions r recommendations on the FDD issue while the lawsuit against the City is still going through the court system.

Charlie shares with Abby that the SSWWE CAC and the subcommittee have discussed the issue of equity among homeowners who were forced to have an FDD and those who were not. Abby says that those are policy issues, that she alone cannot address, but if the CAC/subcommittee makes recommendations that impact policy that could entail more significant evaluation, cross multiple departments and governing bodies.

Q. Subcommittee member asks for clarification on the City's position on compensating a homeowner whose home was damaged by the out of spec FDD installation, will the City pay for the damages caused?

A. Abby says that requests for repair damage must go through the City's claim process, which again, has very narrow liability. Also wants to be careful not to raise expectations among homeowners that there might be payments. There is no current framework for paying damages the City is not legally liable for, as it may open them up to challenges of unfair compensation.

Q. Subcommittee asks for clarification on the role of the Insurance Review Board.

A. Insurance Review Board is made of City Council members and City Treasurer. They review the facts of each claim and make a recommendation on amounts above $5000. The insurance carrier monitors the City's claims paid. Claims over 500,000 are decided by the carrier.

Charlie asks the subcommittee if they want to consider making a recommendation to change the City's policy for FDD specific claims.

Vote is unanimous; yes, they wish to consider making a recommendation.

Abby requests that the group also develop the criteria for the policy recommendation, uch s dollar limits, and other possible policy r rogram ecommendations.

Ideas iscussed y ubcommittee embers:

- Requiring a professional engineer to inspect each installation before final sign off.
- City providing backup systems for all the FDDs installed in the target neighborhoods.
- City paying additional costs that FDD homeowners have, but non FDD homeowners do not, such as insurance premiums or loss of enjoyment of living space because of noise.
- Potential sewer bill rate reductions for homeowners who had an FDD.

A subcommittee member comments that he believes that most homeowners have sump pumps; it's normal and customary practice to pay for and maintain a sump pump, n ities cross he US and that compensating FDD homeowners for all associated costs isn't equitable. Another committee member responds that those homeowners chose to build or purchase newer homes; while purchasers of older homes within the City had expectations to not have the responsibility of a sump pump when they bought homes with footing drains connected to the sewer system.

Another committee member comments that there's a danger of setting a precedent that when there's a city wide problem, individual homeowners could refuse or delay participating until enough others have participated to resolve the issue.

Charlie suggests that the City and Greg Marker put together a list of potential improvements to the Program, if it were to go forward.

4. FDD investigation report – Greg Marker

Greg reviews the grid of cost estimations he provided:

- Initial ecommended provements
- Homeowner documented costs
- OHM estimation of homeowner costs

5. Contractor checklist – Mark TenBroek

Mark reviews the checklist conducted by CDM, post FDD construction.

After the contractors complete the footing drain disconnection and sump pump installation, an inspector inspects work, completes checklist, and takes photos of the interior and exterior.

Q. How does this process differ from what the subcommittee member recommended regarding having an engineer on site?

A. It's it more of a hands off process, as the contract is between the homeowner and the contractor and the inspector reviews the installation after it's complete.

6. Feedback from homeowners with installations according to specification:

- Charlie culled the 239 respondents who were satisfied or very satisfied and found that 8% complained about noise.
- Of those that were dissatisfied, about 43% expressed concern about noise.
- In otal bout 0% of all respondents expressed noise concerns.

Charlie requests that subcommittee members who've suggested that the City cover additional FDD costs – insurance remiums, atteries, ackups, tc., make a list of those items and approximate costs, f nown.

7. Televising of frozen curb drains in Avondale area

- City has televised the curb drains to find defects and found none.
- Next step is to contact homeowners to get permission to televise the pipe from the home to the curb drain.

Q. What about the curb drain depth – could that be the cause of the problem?

A. No, if the pipe has proper slope, the water will move through the pipe without issue, especially as the water is warm. Recommended burial depth is 18" to 24".

Q. How many freezing issues were there this winter?

A. There were three frozen curb drains, affecting four homes.

Q. How many frozen curb drains were there in other winters?

A. In he revious ix ears f nne arrow's involvement ith he DD rogram, here ave not been any frozen curb drains before 2014.

August 25, 2014
FDD Subcommittee Agenda and Meeting Summary

Ann Arbor Sanitary Sewer Wet Weather Evaluation Project
FDD Mitigation Subcommittee Meeting
Monday, Aug 25, 2014 - 6:30 p.m. to 8:30 p.m.

Agenda

1. **Welcome – Nick**
2. **Confirm Objectives and Timeline - Charlie**
3. **Review of Recent Meeting Results – Charlie**
   - **August 4th - FDD Subcommittee**
   - **August 13 - SSWWE CAC**
4. **Action Items from August 4th Meeting:**
   - **Process for implementing City Staff proposal to address FDD mitigation results – Nick**
   - **Best Practices Proposal – OHM**
   - **Subcommittee Proposal Cut Sheets - Charlie**
     - **Homeowner Compensation (non damage related)**
     - **Backup System for City FDD Program Residences**
     - **Allow Claims for Damages**
   - **Discuss Rate Reduction for FDD Program Residences – All**
5. **Go Forward Recommendation to CAC**
   - **Identify consensus recommendations**
   - **Identify non-consensus recommendations**
   - **Identify any open issues to discuss**
6. **Action Items - Prep for September 10 CAC**
7. **Close –**

Web: a2gov.org/SSWWE
Email: SSWWE@a2gov.org

FDD Survey Subcommittee Meeting Summary
August 25, 2014

Subcommittee members:

▪ Colin Breed	▪ Peter Houk	▪ George Johnston
▪ Judy Hanway	▪ Jim Osborn	

SSWWE /FDD project team members:

▪ Lori Byron, Famous in Your Field	▪ Abigail Elias, City of Ann Arbor	▪ Charlie Fleetham, Project Innovations	▪ Nick Hutchinson, City of Ann Arbor
▪ Greg Marker, OHM Advisors	▪ Cresson Slotten, City of Ann Arbor	▪ Mark TenBroek, CDM Smith	

Meeting observers:

Chip Florence	Darren McKinnon

1. Welcome – Nick Hutchinson

2. Meeting objectives – Charlie Fleetham

Review and discuss three documents:

- City Staff Draft Go Forward Process regarding FDD Mitigation
- Recommended Best Practices for FDDs
- FDD Subcommittee Recommendations Summary

3. City Staff Draft Go-Forward Process regarding FDD mitigation – Nick Hutchinson

Nick reviewed the high level outline of the process that the City would follow to implement DD mitigation plan.

Consultant/contractor would be responsible for corrective measures to bring out of spec FDD installations p o pecifications. This consulting party would also be charged with creating the educational materials including videos, as well as organizing and leading n dvisory ommittee.

A rough timeline has the RFP issued in early October and advisory group meetings to start in late winter/early Spring 2015. Corrective measures would be implemented starting Spring 2015.

Q. Would this be a consultant or a plumber or another entity?

A. It ould e ome ort f ngineering ompany hat as xpertise his ype f ork, nd could hire contractors and inspect the work.

Q. I on't elieve hat the taxpayers pay for work that was not installed ccording o specification. Why aren't the contractors being held responsible?

A. That would be ideal, however we believe it ould e ery ifficult nd ime consuming to pursue recourse. Standard installations have a one year warranty and these instances are well past the warranty, some by a decade or more. Also, some of the instances are clearly out of specification, while others aren't functioning optimally, but it's not clear that there was anything wrong with the installation.

Charlie will add commentary reflecting this discussion to the recommendations that will be shared with the CAC.

Several subcommittee members comment that it's fair to provide a deadline for claims, and that it hould e pen o ll DD articipants.

Q. How many instances are there? Will it be left open ended?

A. A total of 11 instances have been found so far in investigating ~150 complaints. Extrapolating that level of occurrence would result in about 50 75 instances of installations being out of spec.

Q. Because OHM did the investigation of the FDD Survey results and seem to have done a professional job, hy hould he ity pend ore esources ssuing n FP and going through the process? That seems like a waste of funds.

A. The consultant hired as a result of the RFP process would not redo the work that Greg Marker of OHM did; Greg has provided detailed notes and reports. Whatever entity is contracted would be able to continue the work that Greg started.

Q. Clarification on the educational videos – are they intended to instruct people on changing sump pumps?

A. No, the video is intended to provide education on sump pump ownership; concepts like operations and maintenance, and how to know when your pump should be replaced. They will provide visual educational content to compliment the

Charlie will note comments on the form and will send out a revised version to the FDD subcommittee before the September 10 CAC meeting.

4. Recommendations Best Practices for FDDs – Greg Marker

Nick clarifies that the document provides general best practices gleaned from a half dozen FDD projects. Some of the recommendations are items that the current program already does; others are modifications or new recommendations.

Greg reviews the recommendations, hich all nto hree ategories:

- Best practices for Customer Service
- Best practices for New Installations
- Best practices for Retroactive Work on Installations not done according to spec

Greg reviews Best Practices for Customer Service.

Q. Explain the verbiage about the 95%, in Section C.

A. It's a form of retainage that allows the contract holder to withhold 5% of payment for two growing seasons. Once restoration is complete, the contract holder can release the final 5% payment.

Comments and concerns:

- Some of these recommendations add considerable cost to the program; particularly items . (Ombudsman and extended meetings with homeowners)
- Questions whether item D is practical or not. (Reviewing written maintenance recommendations in a meeting with the homeowner)
- Believes that item E will drive the existing FDD contractors out of business, esulting n no contractors willing to do this type of work. (Requiring a 2 year warranty on sump pump system)
- Another CAC member comments that he's concerned too, about contractors wanting to take on liability for something they can't insure. Pumps already come with a one year warranty.

Greg reviews Best Practices for New Installations:

- External grading
- Alternate footing drain locations
- Require wet saws to cut the floors before jack hammering

A subcommittee member comments that he had asked about the wet sawing in his basement and was told that the smooth edges would not adhere to the cement. Greg disagrees with that contractor's advice.

Q. Are there FDDs were done that went to a dry well or were pumped to the yard?

A. Yes, Greg inspected one that outlet to a cistern. It was a DOM, so the City does not have specifics on it.

Greg reviews Best Practices for Retroactive Work on Installations not done according to spec:

- Ensure discharge drains and curb drains have positive slope.
- Ensure pumps have hole in pipe between check valve and pump.
- Ensure pumps are installed on blocks.

Q. How close is too close to the foundation for an air gap?

A. It depends on the specific home's situation. One with failed footing drains may need to be further away from the home or to have a splash block. A home with positive drainage can have an air gap that's right next to the home without creating problems.

5. FDD Mitigation Subcommittee Recommendation

Charlie mentions that this document – Backup System Recommendations Summary would represent the views of the SSWWE CAC, with the exception of #5, Policy Implications, as those considerations come from City Staff.

Position overview: provide back up systems for any of the 1800 City programmed FDDs. It's believed that many of the DOM sponsored installations received a backup system.

Cost estimates: $810,000 for battery backups
$1.35M for water siphon backups

Cresson reviews the Revenue Requirement Impact:

> Taking $1.24M as the total cost for backups, he nnual evenue rom he ewer und s $21M. By adding this amount on top of the current program costs, it would add a 5.4% rate increase. There is already typically a 3 to 4% increase annually that covers the costs of fuel, equipment, etc.

Q. Presented that way, it's a 5% rate increase in perpetuity, when the FDD program enhancements (backups) would be complete in a year or so.

A. Yes, rates could be increased for a period to fund these backup systems or the increase could be permanent and the funds then used for other maintenance items. The rate costs were calculated to give a basis of reference.

Q. Why is the cost for the water siphon backup so much? Some pumps are only $100.

A. Greg recommends the sturdiest pump for the water siphon backup. The inexpensive pumps can malfunction (often through a switch that sticks) and cause water to cycle repeatedly; this problem results in operational costs that more than exceed the expense of the pump itself. Also notes that water siphon pumps require inspections from a plumber every two years.

Subcommittee member suggestions:

- The program could pay for the battery backup, and give homeowners the option to pay the difference to upgrade to a water siphon backup.

- If the City no longer pursues FDDs, then that allocation can be diverted to making repairs, funding backups, etc.

Comments about the idea of refunding costs for FDD homeowners who purchased backup systems:

- Several say yes, the City should refund the amount spent on backup pumps.
- City staff member shares that checking receipt amounts and verifying would be a costly administrative endeavor. The City is equired o erform certain due diligence in order to verify hat the refunds were legitimate and doing so would be costly.

- A subcommittee member comments that doing so would be inviting trouble, based on other City initiatives

Subcommittee members in avor f roviding ackups t o harge:

3 yes, 1 no, 1 maybe

Subcommittee members in favor of refunding costs for those who paid their own backup costs:

3 yes, 2 no

Q. What is that amount annually in the CIP?

A. Yes, the subcommittee can make the recommendation to shift the FDD CIP allocation to be used to fund battery backups. The annual amount is about $2M to $2.4M. That amount may also be used for any projects that come from the SSWWE project, as well as any FDD mitigation work.

Discuss proposal to compensate FDD homeowners for damages caused by FDDs:

- Damages based on those out of spec installations found in the inspection, hich s about $30K
- Damages based on a broader definition of liability

Subcommittee member comments that he believes that some are the responsibility of a poor installation, hile thers are homeowner failure to maintain.

Q. CAC member asks for an order of magnitude on Section 4, 3B

A. $150,000

How many committee members would support 3A (paying damages for out of spec installations):

- Yes from all (assuming the costs are as discussed)

3B (paying all damages, whether installations were constructed according to spec or not):

- No, no, 3 yes with qualifications

Comment:

- I ave trouble saying no because it lumps all the different damages into the same bucket, when some are clearly different. Some people in this category may deserve compensation, while others may not.

Charlie will include a comment in the document noting that the category is too broad.

Homeowner Compensation (non damage related) – Recommendation Summary

- Non water/seepage/flooding damage costs

- Includes tangible items like insurance osts, and intangible costs like decreased enjoyment of home due to noise, etc.

Tangible cost estimate: $1M+
Intangible ost stimate: cannot estimate

CAC member comments that providing a backup could eliminate a great deal of the anxiety, which might mitigate the intangible costs.

Nick asks the subcommittee members for clarification on the specifics of the intangible costs: sump pump insurance costs, for example, would those be covered in perpetuity?

Q. What does does sump pump insurance cover?

A. A $50 or $60 annual premium typically covers about $5000 to $10,000 in amages nd repair.

Greg reviews maintenance costs, such as annual inspections, battery replacements every three years. Greg will update the estimated costs in he heet.

Q. What is the chance of failures in homes with a water siphon backup?

A. There's no rule of thumb for that because it depends so dramatically on how well the backup system was maintained.

Does the committee support having the intangible cost removed and included?

- CAC members support removing the intangible costs as a recommendation, but to include he ationale or em B. hould lso include rovisions, uch s ending when the home changes ownership.

- CAC members support excluding certain items, such as generators, replacement of the pump every five years.

Team will recalculate the costs to include multiple years of insurance premiums, maintenance of sump pump, maintenance of backup battery and estimating the home turnover.

Charlie comments that while some FDD homeowners experienced damage or anxiety after the FDD program, some of the FDD homeowners received a benefit in that they no longer have sanitary sewer basement backups.

Subcommittee members supporting:

- Two vote no to all.
- Two vote yes to 3 recurring costs with a limitation of house sale.
- One votes yes to 3 recurring costs and include he op et or ther onsideration.

Comments:

- Include the rationale section that the program was originally announced/intended as a city wide program, not a select group program.
- Not treating the FDD recipients in an equitable way will set a precedent for future problems that require broad participation.

Charlie asks if the subcommittee supports the City issuing n FP o ursue ontractor o repair out of spec installations or other repairs recommended by the CAC:

- Yes from all

Nick encourages subcommittee members to provide comments or suggestions to the Best Practices document:

- Two members want to strike the provision for the two year warranty on the installation. One wants to keep it. Another wants to warrant the work, but not make the contractor responsible for pump failures that are not related to the installation.
- Payments should be described as refunds or reimbursements.

Q. Is it less expensive to hire a contractor to repair the out of spec installations than to hire a staff member?

A. Repairing the out of spec FDD installations is a project with a finite end, while hiring a staff member is a longer term financial outlay.

Q. How will people be notified of the upcoming Public Meeting?

A. The meeting is scheduled for September 17. The public will be notified via:

Postcards
Email
Treetown Log
Clerk's Office calendar
Press release to media
Project website

6. Public Comment

1.) Regarding the recommendation to withhold payments or to have the contractors fund the costs of repairs, it should be easy for the City to hold contractors responsible. While some contractors may no longer be in business (and perhaps those are responsible for more of the sub standard installations), the contractors were all prequalified. Threatening to revoke prequalification status may give the City enough leverage to have the contractors fix out of spec installations.

2.) Because there have already been so many FDDs already done, it's becoming more and more difficult to find homes to meet the obligations of the DOM requirements for developers.

D. Developer Offset Mitigation (DOM) Considerations

<u>November 12, 2014</u>

Should DOM continue to be required?

- Yes. As long as there are still wet weather issues remaining in any portion of the City's sanitary system, development that adds flow to the sanitary system should offset-mitigate their additional flow.

Continue with DOM as is?

- No. As the wet-weather reaction of the City's sanitary system is different today than it was at the initiation of the DOM, it is appropriate to recommend modifications to the DOM.

Potential Changes to the DOM

- If development project flows do not pass through one of the 5 identified SSWWEP project areas, mitigation may be performed city-wide (i.e., elimination of the current 80/20 rule).
    - Development projects that are upstream of one of the 5 identified SSWWEP project areas (this does not include the Fuller/Glen diversion area) will need to mitigate flow upstream from their particular SSWWEP problem area.
    - Provide a map to developers identifying properties that fall upstream from the 5 identified SSWWEP project locations.
- Re-examine design flow rates used in the current DOM program (i.e., revise or replace Table A)
- Eliminate the current 20% recovery factor (i.e., developments will be required to offset 100% of the new flow added, rather than 120%).
- Evaluate the ability to allow an option for developers on a case-by-case basis to make an appropriate payment, based on the flow added by the development, which would be earmarked for projects that address wet weather flow in the sanitary sewer system, or to perform the implementation of such a project. Development in some areas may require immediate, specific, mitigation prior to the development adding flow to the sanitary system to avoid potentially impacting high risk downstream areas.
- Eliminate the 24-month requirement for developers to use DOM credits.
- Re-evaluate and make adjustments to the DOM program on a periodic basis moving forward.

The development community will be engaged by the City as part of the modification process to provide input and feedback on the proposed DOM program modifications.

VI. Public Engagement Materials

A. Basecamp Extraction

Basecamp is the project management tool used during this project. It was a place to share files, have discussions and collaborate on documents. Basecamp stores everything securely and can be accessed at anytime from anywhere by those given access to Basecamp.

Attached is a CD containing all information stored on Basecamp for the City of Ann Arbor SSWWEP – CAC Coordination.

B. Q & A Log

On the following page is a compiled list of questions and answers for the SSWWEP.

Sanitary Sewer Wet Weather Evaluation Project (SSWWEP) Compiled List of Questions and Answers

Last updated: 1/13/15

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1. WET WEATHER STUDIES, ADMINISTRATION, APPROACH, UPPER MALLETS, STORMWATER CALIBRATION, SSWWE

Q. What is the total estimated project costs of the three studies – Upper Malletts, Stormwater Model Calibration and the Sanitary Sewer Wet Weather project?

A. Upper Malletts Drainage Study - $215,000
Stormwater Hydraulic Model Calibration & Analysis Project - $900,000
Sanitary Sewer Wet Weather Evaluation Project - $1,250,000

Q. Are you accessing all of the historical data from previous studies?

A. Yes, all the data from the previous studies will be used to determine the baseline conditions for the current study. In the SSWWE study we will use flow metering data from past studies - including the flow data collected in 2000 and 2007 - to evaluate the effectiveness of the FDD program.

We will also coordinate with the other studies the City is performing to make sure that we are pooling and using all the relevant information. For an organization chart of the related wet weather studies that the City and/or County are currently performing, paste this url into your web browser **http://bit.ly/19WgWsM.**

Q. Can the City sponsor a blog location for residents to post comments on the Storm Water Management and FDD programs?

A. The City's website requires strict security protocol to protect its function from cyber attacks, which makes it challenging to add functions that allow for input from unsecure networks. However, we worked with the City's IT department and explored online tools that would allow the SSWWEP CAC to post questions and comments with a date stamp and to be notified of responses. Basecamp and wiki tools were two options explored. After reviewing the options, functions and solicit desired capabilities at the December 12 meeting, we selected and implemented Basecamp.

As for non-CAC members, the City does encourage residents to provide comments on the City's GovDelivery email list, to continue to email City personnel and to provide comments at public meetings. Additionally, all project documents and an extensive Q & A are posted on the City's project website at: www.a2gov.org/SSWWE.

Q. When does the Stormwater Calibration Modeling Study end?

A. November 2014.

Q. The Malletts Creek surface water study is happening simultaneously, could it address the sanitary flows in those neighborhoods?

A. The Malletts Creek Stormwater Conveyance Study is being administered by the Washtenaw County Water Resources Commissioner who does not have jurisdiction with the city's sanitary sewer system. However, the study is aware of the City's Footing Drain Disconnection Program and is taking into account the impacts the FDD program has on the existing stormwater system within the study area.

Q. Is the Malletts Creek project complete?

A. Yes, the project is complete. The final report is available on the project website, http://www.uppermallettsstudy.org/ > Final Report.

Q. Are the new Surface Water Impounds as proposed by the Upper Mallets CAC being justified by the City, the County, the Consultants, or the CAC (in part or in anyway) because of this "diminutive" flow from FDDs?

A. No. The recommendations from the Upper Malletts study address a need for stormwater retention in the Upper Malletts drainage area. Further analysis will be completed through the Stormwater Model Calibration & Analysis project.

Q. Are you addressing key environmental issues – like sanitary sewer overflows into the Huron River?

A. Understanding the risk and frequency of sanitary sewer backups and overflows is a key goal of this project. The level of service, risk and frequency of sanitary sewer overflows will be addressed during the alternatives evaluation.

Q. Has the City prioritized the disconnect studies to justify the 2001 decision?

A. A study of the effectiveness of the Footing Drain Disconnection program in reducing basement backups during wet weather has been in the City's Capital Improvement Program for several years. With the FDD program in place for ten years and City Council's partial suspension of the program, requesting further study, the City's Project Management team undertook the Sanitary Sewer Wet Weather Evaluation Study in 2013.

Q. How did City Council's recent postponed vote on approving a contract extension for CDM [the consultant on the City's FDD program] affect the SSWWE project?

A. The vote was on a contract with CDM for some portions of the FDD program that were not suspended and doesn't affect the SSWWE project.

Q. The Upper Mallet CAC has announced a Public Meeting for January 22, 2014. The SSWWE CAC scheduled a Public Meeting for January 16, 2014. It is assumed that participation at both meetings will be negatively impacted due to the close date proximity of both meetings. Is it intention of the City to maximize citizen participation and involvement for both of these meetings? What measures will be taken to accomplish this?

A. The SSWWE Public Meeting was rescheduled for Thursday, February 6 at Slauson Middle School Auditorium. All the FDD Survey respondents were invited by mail and email. A news release was sent to media outlets. The meeting is posted on the City's webpage for this project: www.A2gov.org/SSWWE, as well as the FDD project website, www.A2FDD.com.

Q. What about homes where the footing drains outlet to the yard? How do those impact the [stormwater calibration project] model results?

A. The model result is more conservative (worst case scenario), because modelers assumed that each FDD home contributed 4gpm to the stormwater system. In reality, some of the stormwater being outlet to yards would infiltrate the ground before reaching the stormwater system.

Q. The [stormwater calibration project] model is based on 4gpm. The ACO report uses 10 gpm. What would happen if your model used 10 gpm?

A. We don't know the impacts of a 10 gpm flow, but we do know that from the flow monitoring and direct sump pump measurements that some homes contribute less than 4 gpm, others contribute more. Because of these measurements, the City and the technical consultants are comfortable using the 4gpm figure.

Q. Do the [stormwater calibration project] modeling results validate the estimates that were made of the flows from footing drains when the program began?

A. Yes, in footing drain disconnection programs across the country, a flow of 3 to 5 gpm from each home is standard and our analysis supports similar findings.

Citizens Advisory Committees (SSWWE, FDD)

Q. Is there another group model to consider other than a Citizens Advisory Committee?

A. The Citizens Advisory Committee group model is based on a high performing team model developed by Project Innovations. The hallmarks of this model are: unified purpose, clear roles and responsibilities, consensus decision-making, transparent communications, collaborative goal setting/problem solving, and self-accountability. We considered a model based on appointments by our council members, but we believe that an open team based model is more appropriate in this situation.

Q. Will the Advisory Committee be open to everyone?

A. Yes.

Q. Who is the Advisory Committee accountable to?

A. The Citizens Advisory Committee will be self-accountable. This means that it will establish decision-making criteria and measure its decisions against these "standards." But, the Citizens Advisory Committee is not the final decision maker. Our City Council will make the final decision on the recommendations that emerge from the Citizens Advisory Committee. This is appropriate given the potential investment and citizen interest that will follow from the study's conclusions.

Q. Is the CAC responsible for recommending solutions to reduce sanitary sewer basement backups or for also recommending solutions to reduce sanitary sewer overflows?

A. Per Craig Hupy's discussion at the January 9th meeting, the CAC's charge is to *make recommendations regarding wet weather capacity within the sanitary sewer system*.

To accomplish this, the CAC is to:

1. Review the results from the flow analysis (delivered in December)
2. Review the results from the upcoming hydraulic analysis, which will reveal what impacts are affecting the sanitary sewer system. (Presented in May & June.)
3. Review alternatives.
4. Based on the engineering analysis, the alternatives available and community values, determine recommendations.

Q. Can you speak to the fact that you integrated a developer into the committee and that you removed a member?

A. Early in the process, the Committee set the standard that any resident would be able to join the committee at any time, as long as they were able to bring themselves up to speed. A resident who happens to work for a developer asked to join the CAC after it had started and did so, as did another resident. And yes, one member was removed the committee. This occurred after the committee established norms and that member violated the norms of conduct. There was a clear process for removal, which was communicated to that member.

Q. How many people on the CAC had sump pumps?

A. I think about half of the citizens on the committee had sump pumps. Others were interested because they had had basement backups or water in their basement.

Q. How will the public know that exports from Basecamp, the online messaging tool used by the Citizens Advisory Committee is available for viewing? Will there be a link on the project homepage?

A. Yes, the City will include the link on the project's webpage. The export file from Basecamp will include all the messages posted from the time the CAC began using Basecamp in December 2013. The first export file was published on the City's SSWWE project website on June 1, 2014.

Q. It seems like the better use of our [the joint CAC FDD investigation subcommittee] time would be to address issues with those who've had FDD installations.

A. Agreed, the major focus of the group would be devoted to the plan for resolving problems.

Q. City website indicates the existence of FDD CAC? Who are these members and why have they not been a part of the current SSWWE CAC?

Q. Is the FDD CAC an active group--ie, are they currently meeting? Why are their meetings not listed on the a2gov.org website as other CAC meetings are? Why are there no agendas, handouts or meeting notes from the FDD CAC meetings?

Q. Why is information not being shared more closely between the SSWWE CAC and the FDD CAC?

A. The members of the FDD CAC are:

- William Collins (from the Orchard Hills Study Area)
- George Johnston (from the Dartmoor Study Area)

- Robert White (from the Glen Leven Study Area)
- Deloris Mortimer (Ann Arbor at-large)
- Sonia Manchek (Ann Arbor at-large)

The FDD CAC is supported by staff from the City's Project Management and Systems Planning Units and staff of CDM Smith.

The FDD CAC meetings are held approximately every 6 - 8 weeks, and are currently held on Thursday mornings beginning at 7:30 am in Conference Room B at the W. R. Wheeler Service Center, located at 4251 Stone School Road. The meetings generally last approximately 90 minutes

As for meeting notes and agendas, we have not had requests for those items in the past, so we have not been posting them on the FDD website, but they are certainly available for your information and review. [FDD CAC meeting minutes for 2013 were provided to SSWWEP CAC members for review.]

Q. Is the FDD CAC ongoing or does it have a project end date like the SSWWE CAC?

A. The FDD CAC is open ended and its work depends somewhat on the recommendations of the SSWWE CAC. If FDDs are not recommended to go forward, then the FDD CAC's role will be to oversee the follow up work that results from the survey and investigation, but might not continue beyond that.

Q. If the FDD CAC is currently meeting, does it fall under the Michigan Open Meetings Act?

A. Citizens Advisory Committees do not fall under the Michigan Open Meetings Act. ("Advisory committees and the OMA – the OMA does not apply to committees and subcommittees composed of less than a quorum of the full public body if they "are merely advisory or only capable of making 'recommendations concerning the exercise of governmental authority.'") Open Meetings Act Handbook, Michigan.gov.

Non-committee members are welcome to attend these Citizens Advisory Committee meetings to observe the work and to provide comments at the end of the meeting, as they have done at the SSWWEP CAC meetings.

Q. Why is the interchange of information between CACs discouraged?

A. The purpose of the FDD CAC is to provide input into the operation of the FDD program. The purpose of the SSWWE CAC is to review technical information regarding the sanitary sewer system's performance in wet weather and make recommendations to council to mitigate the future risk of basement backups. The two CACs are not discouraged from interchanging information; FDD CAC members have attended SSWWE

CAC meetings and SSWWE project team members have attended FDD CAC meetings to facilitate information exchange.

Q. At the joint FDD SSWWE CAC meeting, an FDD CAC member asked when will the SSWWE CAC look forward?

A. Looking forward is the focus of the SSWWE project, evaluating the sanitary sewer conditions and function and recommending the solutions for the wet weather issues.

Q. At the joint FDD SSWWE CAC meeting, an FDD CAC member asked if SSWWE members have seen the hydraulic and hydrologic risk analysis. What is the SSWWE CAC members' opinion of that analysis?

A. One SSWWE CAC member says that he is reserving judgment until the entire picture is presented. Another says that the data is clear from the flow analysis that the FDD project removed significant flows in the five study neighborhoods, however there are still a few areas across the City that show problems. Analysis is still being done to uncover the issues. A couple of members comment that they feel the high ground water in Lawton/Churchill neighborhood contributes to the surface water issues. FDD CAC member comments that he is impressed to the results of the risk analysis and that there's been a vast improvement in the reduction of the risk. Wants to see the final report.

Q. Has the current FDD CAC read the survey comments?

A: The Footing Drain Disconnect FDD Survey Results were provided to the FDD CAC in late January 2014 and discussed a number of times at CAC meetings.

TOAG

Q. Representatives of the City have shown a chart of four concurrent sewer system and stormwater management related projects (http://bit.ly/19WgWsM). The chart shows an Over-Arching Technical Oversight & Advisory Group. Who are the members of this group?

Q. The City bubble chart describing the four water infrastructure projects and their five citizen- type subgroups- is headed by an Overarching Technical & Advisory Group plus a Technical Working Group. It is important for us to know who are they are.

Q. Also, if we continue to divert water from the Sanitary to the Surface system, some effect on the Huron would be counterproductive. I am asking the HRWC to join your studies.

Q. What is the role of the Technical Oversight & Advisory Group, who are the members and is Huron River Watershed Council involved?

A. The purpose of this group is to:

- Provide technical expertise, coordination, review, guidance, process overview, and quality assurance on all of the Wet Weather Projects.
- Ensure consistency and act as a liaison between the various Wet Weather Projects.
- Act as a resource for the community related to the Wet Weather Projects.

A. The Technical Working Group is an internal group of City & County Staff that meets to make sure that we are all up to date on what the other projects are doing. It consists of Cresson Slotten, Nick Hutchinson, Jennifer Lawson, Troy Baughman, Anne Warrow, and Harry Sheehan (County). The Technical Oversight & Advisory Group (TOAG) is essentially what you are describing above. The group just getting started up, and is made up of experts in many of the fields you mention, including the HRWC. We will be sending out more information on the TOAG in the near future to all of the CAC groups.

Q. Do TOAG member have veto powers?

A. No, they are an advisory body.

Q. Are the TOAG findings posted for the public?

A. Yes, the TOAG's reviews and recommendations are shared with the project managers, who then post them on the project websites. (This applies to the City's projects; the TOAG facilitator does not know if the Washtenaw County Water Resources office posted TOAG comments on Malletts Creek.)

Q. How often does the TOAG post its Basecamp content to the public?

A. It does not. The TOAG shares its findings with the project managers, who may do with it as they wish. As mentioned in the previous question, for City projects, the respective Project Managers have posted the TOAG's findings on project webpages.

2. SANITARY SEWER SYSTEM, CONDITION, FLOWS, CAPACITY

Footing Drain Flows, Metering/Monitoring, Modeling, Flow Measurements

Q. What is your criterion for determining whether or not FDD is working?

A. Determining the effectiveness of the FDD program is one of the major pillars of the SSWWE project. First, we are measuring the amount of stormwater/groundwater that enters the City's sanitary sewer system now. Then, we will compare it with the amounts that entered the system before the FDD program began. Finally, we will compare the amount of stormwater/ groundwater that was removed to the goal that was set for the FDD program.

Q. How did you come up with meter selection in 2013 versus prior years?

A. The 2013 metering sites were selected based on the 2001 study and the 2007 study meter locations. We also added several meters to monitor specific areas of concern along the City's trunk sanitary sewer lines and to measure flows from the Townships.

Q. Have you put monitors in homes that have participated in the Footing Drain Disconnection Program?

A. Yes, sump pump monitoring has been happening since 2002. Over 75 homes have been monitored to date. You can download and view the monitoring data [52MB file]. It is available on the City's project website www.a2gov.org/SSWWE > Library.

Q. Did you make a prediction in advance about the results?

A. Yes. We estimated peak flows of 3 to 5 gallons per minute per house – the same estimate made at the outset of the Footing Drain Disconnection program. This value is consistent with generally accepted standards for peak flows from footing drains. It should be noted that this is an accepted peak flow rate averaged over many houses. For any individual house, the actual peak flow from the footing drain can vary significantly.

Q. Why are there seven meters in Pittsfield Township?

A. Portions of Pittsfield Township discharge to the City's sanitary sewer system. Because of that, it is important to understand the wet weather flows coming from those areas when evaluating the City's sanitary sewer system capacity.

Q. Are you measuring rainfall that is in ground before a rain event?

A. The antecedent moisture model that we will use to perform the system modeling does account for the wetness conditions in the soils before and during a rainfall event.

Q. Are you considering stormwater retention system overflows in your model?

A. Yes, but not as part of this project. Stormwater retention systems that overflow or cause surface flooding issues will be evaluated as part of the City's Stormwater Model Calibration project.

Q. How will you measure storm flows that come from the County?

A. Storm flows from the County are relevant to the Stormwater Model Calibration project and will be accounted for there.

Q. Are you accounting for the addition of sump pump flows in the storm sewer system?

A. Yes, but not as part of this project. The Sanitary Sewer Wet Weather Evaluation project is focused on quantifying the effectiveness of the flows removed from the sanitary collection system. The City's Stormwater Model Calibration project will evaluate the impacts of dumping water from sump pumps into storm sewers.

2014 update: Per the Stormwater Model Calibration project, flows from footing drains have minimal effect on the City's stormwater system (noting that stormwater pipes are typically many times larger than sanitary pipes.) Analysis showed that stormwater flows generated by FDD installations generally contribute less than 2% of the pipe capacity and less than 2% of peak storm flows.

Q. How are you measuring flows from/to the Wastewater Treatment Plant (WWTP)? For what years?

A. Flows at the WWTP are measured using a system of flume flow meters. We will use flow data from the WWTP for the years 2000 through 2013. This time frame corresponds to the period of pre- and post-FDD flow metering.

Q. How are you factoring in high groundwater into your model?

A. The groundwater level affects how quickly groundwater seeps into the sanitary sewer system. Ground water levels are recorded in the flow metering data. The antecedent moisture model specifically simulates the ground water infiltration flow component in the sanitary sewer system.

Q. How are you measuring the 3 different flows (rainwater inflow, rainwater infiltration and ground water infiltration)?

A. In two ways: First, the flow metering records a single wet weather flow pattern from each storm. Second, we break down the wet weather flow pattern. The antecedent moisture model uses digital signal processing to separate the flow pattern into three wet weather flow components: rainwater inflow, rainwater infiltration and ground water infiltration. Each flow component reacts differently to rainfall, so each needs to be modeled independently.

Q. Why only a 6 month flow monitoring period? Winter is very unpredictable regarding rainfall.

A. The wetness conditions of the soils vary significantly from spring to summer, and monitoring from March through August is typically adequate to measure the impact that this variation has on wet weather flows in the sanitary sewer system. We also have a long period of record at the WWTP (over 10 years) to assess long-term system performance. Winter events are not usually used in the analysis because there are enough other events during the six-month period to accurately quantify the flows.

Q. Does the dry March that we had impact the credibility of your study?

A. Although March was dry, it was cool, and April was relatively wet. Together, these conditions preserved the typical spring wet weather flows that we hoped to record, and we believe there will be enough data to perform the flow evaluation.

December 2013 update: Over the six month monitoring period there were ample wet weather flows to record, including large rain events in June and August 2013.

Q. How many flow meters are there in the City?

A. Currently, there are no flow meters, except for the one at the WWTP. As part of the project, the team had about 34 flow meters installed in the same areas as were installed in the 2001 SSO Study. While the City does not have flow meters, they do have about 21 pressure stage recorders that measure the maximum amount of surcharging that the pipe experienced at the event. If the CAC felt that it were important, they could a recommendation that the City buy and install permanent flow meters.

Q. How much would a flow meter cost if the City were to install one permanently?

A. About $1000/month. That includes monitoring, maintenance, and periodic data recording and processing.

Q. The Washtenaw County Water Resources Commissioner and the Sanitary Contractor has indicated dilution rates of 2% to 7% from footing drains, and 40% from leaking pipes. Why is the City focusing efforts on FDDs rather than leaking pipes?

A. The purpose of the FDD project was to reduce the incidents of basement backups in the five neighborhoods that had experienced 50% of all reported basement backups in the City during wet weather. The next phase of the SSWWE project will investigate the system's hydraulic performance and will determine whether infiltration is a concern. That information will inform the recommendations made to City Council.

In addition, Evan Pratt, PE, Water Resources Commissioner, Washtenaw County, provided this information:

"Thank you for taking the lead on this item, and thank you to the CAC members for volunteering the time.

The list looks pretty comprehensive, and although I have not reviewed in detail since the sewers are not our area, it looked like one of your questions warrants response from this office, and subsequent clarification, as the numbers being questioned are unrelated. In summary, the smaller number is about flow in a large storm pipe, and the other is most likely about clean water entering a much smaller sewage pipe. Although I do not know the exact size of the sewer pipes in this neighborhood, they are much smaller than stormwater pipes, as detailed below. It is a point of fact that a flow component that eats up 36% of a 1' pipe will only eat up 1% of a 6' pipe. This is not an obvious point to folks who do not deal with these things on a daily basis, so the confusion is understood as I have clarified similar questions many times. Many of the other questions look similar to what people in other communities have raised when they are going through the process of learning the cause and potential solution to wet weather issues in sewage systems.

I would also like to clarify that my number was estimated to ensure conceptual cost estimates would not need to be revisited regardless of how the sewer study turns out. I was taught long ago to keep the initial concepts conservative, as spending less money on final design and installation is not usually an obstacle. Since the sewer study is not complete, we are providing a conceptual recommendation that will achieve and slightly exceed the stated goals the County's Upper Mallett's Creek Study to address flooding in the neighborhood, regardless of the outcome of the sewer study.

So there is no purpose to comparing capacities of different sized pipes designed for totally different purposes in determining the best strategies for sanitary sewer. As appropriately identified, the important issue is to determine where the clean water that gets into the sanitary sewer is coming from. I presume that the City's study will at some point include discussion on the breakdown between footing drain water, groundwater, and rainwater entering the sewer system through cracks or otherwise. While "leakage" may not be quite the right term, it sounds like folks have incorrectly interpreted the numbers as evidence that the majority of clean water entering the sewers is coming in through cracks and openings in pipes and manholes. I do not know the facts on this breakdown, so I will leave it to the City to present those facts.

I also offer the following detailed clarification in case there are CAC members who might like to see more back-up for the statements I have made above:

1. These numbers are unrelated in three ways. First, the numbers (2-7%) attributed to me are not a dilution rate for clean water in a sewage pipe, they reflect a very conservative estimate of how much capacity of the stormwater pipes only in Upper Malletts might be utilized if all 1700 homes in our study area were disconnected and discharged into a storm pipe in this neighborhood. The concern raised at the first public meeting for the stormwater study was that during a flood situation, full pipes could not handle any more water, a very reasonable concern in my opinion, so I promised we would account for that concern in any recommendation. I do not know what the 40% specifically references, but from prior discussion with Mr. Bill Higgins, I infer that the 40% may be a number in a sanitary sewer report identifying what percent of flows in the sanitary sewer system are attributed to rainwater, possibly on a City-wide basis, but it is also possibly a representation of plant capacity vs average pipe capacity – again, I don't know the source of the number so will leave it to the City to clarify. I presume that this 40% is also based on some actual field data collection during storms, and is a measure of the capacity used up for one particular type of storm (like the 25 year, 24 hour or the 10 year, 2 hour, etc) – typically, I understand this percent of the pipe or plant consumed by rain will vary depending on the amount of rainfall in a given storm, and whether or not the pipes are filled to capacity.

2. Secondly, while this may not be obvious to the layperson, it sounds like the response may need to explain that capacity design for sewage pipes and stormwater pipes (or other aspects of the respective systems) are unrelated. Sewage flows are predictable and much smaller than the massive amounts of water resulting from the wide range of rain events we see in the Midwest. The 10 States' standard design manual for sanitary sewers is used throughout the Midwest because sewer flows are generally the same throughout. But just in Michigan alone, there are 10 different zones of varying rainfall, and the amount of rain for all recurrence frequencies (10-year, 100-year, etc.) varies within each zone. The net result is that a sewage pipe is much smaller, so the same volume of water will take up a greater percentage of pipe capacity in a smaller sewage pipe than the much larger stormwater pipe. The example I used in talking to Mr. Higgins is the County storm pipes in Upper Malletts are mostly from 4' to 6' diameter. I don't know the size of the sanitary sewers, but 1' to 1.5' diameter might be typical. Due to the exponential relationship between diameter and cross-sectional area, along with the direct relationship between area and capacity, that the 4' pipe can carry 16 times as much water as a 1' pipe, although the diameter is 4 times larger. And the 6' pipe can carry 36 times as much water as a 1' pipe, 16 times as much as a 1.5' pipe. Obviously the same multiplier goes with the percentages of capacity – a flow component that eats up 36% of a 1' pipe will eat up 1% of a 6' pipe.

3. Third, the numbers attributed to me are rough conservative estimates to ensure there is space at each site for the worst case scenario flowing to our proposed solutions, so our calculated FDD volume is intended to be greater than what is calculated from real field data when the City's sewer study is complete. When the sewer study is complete, I would expect that regardless of the recommendations of that study, the size of the basins could be reduced a bit to account for only the groundwater component of footing drain flows in this neighborhood, because our stormwater calculations and modeling already account for rain that hits rooftops or other areas that may route rain into footing drains. Using more accurate numbers from the sewer study would allow us to still meet the stated goals of full protection for an event like 3/15/12. As noted above, I was taught long ago to keep the initial concepts conservative, as spending less money on final design and installation is not usually an obstacle. Since the sewer study is not complete, we are providing a conceptual recommendation that will achieve and slightly exceed the stated goals to address flooding in the neighborhood regardless of the outcome of the sewer study.

The main point of this email is to clarify that the numbers compared in Question #43 are unrelated, and what really matters is how the clean water is getting into the sewer so the best strategies can be compared.

If I understand the last question, I would suggest that it could be restated to say that folks are looking to understand where the clean water is coming from so they can understand and debate the most effective strategies to get water out of the sewer. The detailed point that I felt warranted a response from this office is that our purpose and method of arriving at an estimated FDD volume is different from the City's, and should not be used for the purpose of sanitary sewer evaluation, because I directed our consultant to over-estimate the impact on the stormwater volumes from FDDs. Again, the purpose was to ensure conceptual feasibility for recommendations to address flooding in the neighborhood, specifically with respect to the area and preliminary cost estimates needed for storage basins regardless of the outcome of the sewer study.

I trust this is helpful, if a bit lengthy, understanding that these are not issues that folks deal with on a daily basis. You all are asking good questions that frequently come up in communities with wet weather issues in their sewer and stormwater systems, and I appreciate the time volunteers are putting in to help the decision making process, since I live in the City and will no doubt help fund whatever the solution is through my utility bill!"

Q. Suggest you take a look at this SVFM 5.0 Area-Velocity Monitor from Greyline http://greyline.com/pdf/AVFM%205.0%20Brochure.pdf**. There are probably other pouch- like sensors which could be placed down the footing drain clean-out and left there for long periods, memory card/recorder on the pipe cap. Worth a try on suspected high-volume residences? (If a Torpedo using a controlled-flow plug can be installed without breaking concrete or modifying pipes, then something like this might be worthwhile.) Unit is for 6" or larger pipe, but sensor is about 1 1/2 x 6 and believe it could be inserted same as Torpedo plug.**

A. Flow velocity is measured with an ultrasonic Doppler signal continuously injected into the water. This high frequency sound (640 KHz) is reflected back to the sensor from particles or bubbles suspended in the liquid. If the fluid is in motion, the echoes return at an altered frequency proportionate to flow velocity. With this technique the instrument measures flow velocity with accuracy of ±2%.

Such a sensor requires a minimum solids content to reflect sound waves off for the doppler measurement. This is typically around 100 parts per million (ppm) solids. Raw sewage has around 300 ppm, and footing drain flow could be well below 100 ppm. There are also some issues with installation and maintenance outlined below. If it was possible to use a meter like this to measure FDD flows, we would already be doing it.

The Greyline meter is a standard Area-Velocity flow meter we use in our municipal applications. It will likely be in the $2000 to 3000 range for the equipment and $1200 range for deployment, collection, and interpretation of data. The equipment could be cheaper since we do not need hazardous environment box for this since it would be in someone’s basement (a technical issue listed below).

This installation will have the technical issues of:

- Virtually impossible to mount in a 4” pipe on a 90 degree turn without the creation of an automated system using an insert able placement tool and a band to hold the sensor that is not currently available
- The velocity sensor will likely not have enough solids to read the flow over the sensor to read velocity and we would likely not get velocity readings
- The pressure sensor will likely be intermittent as flow levels will not be high enough to accurately read
- The box will be outside the cleanout, the clean out cap will have to be retrofitted with something that lets the wire through.

Q. What refined data exists in quantifying footing water volume and duration?

Q. I also need a source for the 70-90% figure for total volume in the sanitary sewer system supposedly from connected footing drains. I’d like to see what CDM has to say about the basis for that number, which has been stated to be studies. I need a study to back up the figures. The SSO Report has no source for those numbers, as far as I know. Others documents have said 'studies have shown.' Are there studies?

Q. What is the backup for the claimed 90% dilution rate and annualization justification?

A. Note that the percentages typically mentioned are 70% to 90%. In addition to the flow monitoring analysis presented during October CAC meeting, and curb line monitoring data from previous question, see response below for multiple measurements conducted. The final results of the flow monitoring and engineering analysis will be presented to the CAC at the December 12 meeting and to the public at the January 16 meeting, as well.

This question was posed to CDM (who did the 2001 study), and their response is pasted below in italics. The key take away is that they were estimates – very soon we will have the actual values computed.

> Tables 6 & 7 and Figures 6-8 in the Duluth paper "Was it Worth the Price" that was presented to the "Best Practices" sub-group has some good study results. We also provided the sub-group with the Auburn Hills report. These studies both show fairly significant flow removal rates from FDD. There is not much dispute in the industry that FDD can be very effective at removing flows.
>
> The key questions for Ann Arbor is how much did their FDD program remove, and then given that knowledge, the current state of the system, and the desire of the public, what is the best way to move forward from here? Those items will be our focus for the next several months of the study. The first piece (how much flow was removed) will be ready very soon, and tabulated using multiple techniques and multiple measurements. The second piece (where to go from here) will be performed over the winter and spring. All options are on the table and will be explored, and the City has made it clear that they hope and expect that the CAC will make a recommendation.

Message from Mark TenBroek, CDM dated 11-7-13

The SSO report presented an estimate that 70%-90% of the observed I/I during wet weather was likely from connected footing drains in the study areas. This estimate was largely based on the following data sources:

- **Direct Storm Measurements** – CDM Smith identified 20 house leads in Ann Arbor during the SSO project that discharged directly to manholes. During two rain events, 14 of these locations in 4 of the study areas were measured using a bucket and stopwatch method while flow metering was concurrently taking place in sanitary sewers. A comparison of these measurements led to the conclusion that 70% to 90% of the I/I flows were sourced from connected footing drains.

- **Pilot FDD Monitoring** – Pilot FDD work was performed after the flow metering was completed to establish the range of expected flows generated by disconnected footing drains. These monitored sump pump flows were consistent with the directly monitored house leads, which estimated peak flows in the range of 3-5 gpm/home for large storm events.
- **Peer Community Observations** – Footing drain disconnection work had been performed in West Lafayette Indiana, Canton Township, and Auburn Hills prior to the Ann Arbor SSO study. These peer communities had observed reductions in I/I after the disconnection of these footing drain sources, but the percentage of I/I flow from these sources had not been quantified at the time of the SSO study.

After the SSO project was completed, additional data was collected as the FDD program proceeded to develop additional evidence of the source of I/I that was observed in the sanitary sewers, as described below:

- **Southeast Michigan Sump Pump Monitoring** – After the SSO project was completed, CDM Smith deployed a number of sump monitors in homes around SE Michigan that were of a similar vintage as the Ann Arbor homes, but where sump pumps had been installed. This was done as part of the DWSD Wastewater Master plan. The monitored sump pump flows were similar to that observed in the pilot FDD installations in Ann Arbor.
- **Continuing Ann Arbor FDD Sump Pump Monitoring** – CDM Smith installed a large number of sump pump monitors that were moved to new sump pumps as the FDD work was performed in Ann Arbor. This data collection was performed from 2001 until present. The results of that work show that while the peak footing drain flows are variable for individual homes, the average of the peak flows generated by footing drains was typically in the range of 3-5 gpm/home during large storm events.

Q. The only dispute I have ever had with the volume and rate of footing water is in using either a dry weather number or a wet weather number and extrapolating them beyond the storm event. If you look at the "spike" chart, the peak might be shown as producing high volume for, say, three minutes. During the event the volume rises from a "normal" flow to that peak then drops back toward that normal level. Yet in almost every instance, the elevated level is multiplied for a duration of an hour or longer. It is the peak/storm duration volumes we have to deal with, and that is what points to short term retention. This can be clarified. It does not make sense to me, to burden over 18,000 households (plus an unknown post disconnect number) with a sump

pump penalty instead of retention, if a projection of new water/sanitary/surface customers is considered. We have serious surface water problems. With all the technology available to us, we need to develop a means of determining which business or resident has a high volume footing drain problem, and resolve them and not impose sump pumps in low volume instances. If you recall the initial SSWWE meeting, there were accusations that the CAC's were biased and not necessarily representative of the public. Possibly their responsibility and duties need to be more clearly explained. For this reason I will remain independent. Thank you though for your inclusive mail, especially for your retention work.

A. Each sanitary collection system that we have studied is unique and has unique characteristics that drive the cost-effective engineering solution. The engineering options depend on the magnitude of the wet weather flows, the location that wet weather flows are generated, the location of hydraulic bottlenecks in the system, and many other factors. Examining these characteristics is the next step in the process - hydraulic capacity and alternatives evaluation. The first step was to quantify the impacts of FDD on the sanitary sewer flow. We had to understand that impact first, before we can evaluate further alternatives.

Storage is a very common method of addressing peak wet weather flow, and we will be including many examples in our presentation to the Best Practices sub-group of the CAC next week. A few things to keep in mind about storage:

- As you pointed out, storage can be very effective for systems with "spiky" peak flows and the timing of the peak flows has a tremendous impact on the storage size. That is why it is very important to understand the flow characteristics of the system (the step we are in now, and will be reporting on Dec 12).
- The viability of storage depends on the location of the bottlenecks, relative to the location of the wet weather flow generation. For example, if high wet weather flows and bottlenecks are upstream in the system, building storage downstream won't help. The storage has to be located upstream of the bottlenecks to work. That is why it is critical that we understand the hydraulic capacity of the system - that's the next step.
- For a traditional storage tank, a large amount of land has to be available near the location the storage is needed (very common for 2-5 acres or more needed). That can be a significant challenge in a built-out area. We understand that it was a concern with the SSO task force in 2001 - we have heard stories of concerns by the task force about putting tanks in parks and wooded areas and negatively impacting these natural resources.
- There are other alternatives to traditional storage tanks to store flow - linear storage and storage shafts. Linear storage can be accomplished

by constructing an oversized pipe - perhaps on the order of 6-12 feet in diameter for a length of several thousand feet to store the flow. Often, these are constructed by tunneling, which can reduce the surface impacts. One disadvantage of tunneling is that it can be more expensive than a traditional storage tank. We will be including several examples of tunnels in our material for the Best Practices group. Some communities have also built deep shafts for storage. Tunnels and shafts have the added risk of complex, deep underground construction. There are many examples of failed tunnels and storage shafts.

- Depending on the depth of pipes, and conflicts with other utilities, it may be possible to build linear storage with "open-cut" construction techniques. This has a short-term disturbance to the surface during construction, but can be less costly and have less risks than tunneling. The viability of this option depends on the location, the depth of the sewer, the presence of conflicting utilities, the extent of surface restoration impacts and other items.

As you can see, evaluating alternatives is complex and entails many competing decisions and values. The City and the OHM team can present engineering costs and impacts, but the optimal engineering solution is not necessarily the best solution for the community. Hence the need for a Citizens Advisory Committee to weigh these options and recommend what is best for the community to balance the ever competing challenges. These are the types of discussions we plan on having as part of the next step with the CAC.

A few technical items to address a few of your other comments:

- It is fairly straightforward to show that stormwater flows are much, much larger than FDD flows, and that FDD flows are much larger than normal sanitary flow. The conclusion is the same whether the computation is done based on stormwater volume or peak flows. This is not unique to Ann Arbor - it is a very common observation from systems around the Country. I'd be happy to review the basis of this conclusion with you.
- In making computations of stormwater volume, the duration should be matched with the duration of the rainfall being applied. Often, for stormwater computations, a peak-hour rainfall is used (something like 1.8-inchs in an hour), and so the volumetric computations are made on an hourly basis. This is often done to simplify the computations to illustrate basic concepts. You are correct that the impact depends on the pattern of the rise from the base condition to the peak condition and back to the base again. This is called a hydrograph. We examine the impact of the full hydrograph on the sewer system, and will often summarize the results in terms of the "peak flow" or hydrograph

"volume" to provide some simple metrics for comparison. Underlying these metrics are the detailed hydrographs. I'd be happy to review the underlying hydrographs with you, or the CAC. We will have hydrographs available for viewing at the Dec 12 CAC meeting if there is interest, and time depending.

- The City did indeed target the "wettest" area of the system with the five priority districts for FDD. The metering is showing that these five priority areas had peak flows that were 20-30 times average during wet weather events in 2000 before the FDD, when more common rates are 3-8 times average. As we presented in the October CAC, the post-FDD flows in these districts from 2013 appear to have been reduced to the more common range of peak flows during large rain events. On December 12, we will be reviewing the results of the full-evaluation of these flows, including the application of three scientific methods to quantify the impact of the FDD on sanitary flows.
- We are not aware of a technology that can determine which specific houses or businesses will have high FDD flow. It is very challenging to meter the flows from an individual footing drain before it is disconnected. While there are some indicators, the flow variations from house to house are very sporadic. There are instances of a very high flow FDD right next to a house that is very low. The best technique that we are aware of is to perform flow metering at the neighborhood level, and target those areas with the highest flow. Areas with a high propensity for basement backups are also an obvious target area. Pilot FDD with sump monitoring is then an effective method of verifying the appropriate areas. We understand that these techniques were the basis of the five priority areas identified in 2001.

Please note that I have intentionally kept this message at a summary level. I'd be happy to get into more details, but it is not effective to do so via email. If you would like to get into more details, I would be happy to meet with you. I did this a few weeks ago with a CAC member with a pad of paper, pencil and calculator, and I think it was very helpful.

Q. If you were to measure footing water and household water during a rain event and also during a time of day when the household use is very low, naturally most of the water will be from the footings, even though the amount and rate of flow is low. Thus large percentage numbers could be flashed without qualification.

A. Peak flows during rain events drive the design of sanitary sewer systems, and high peak flow can overload the system and cause basement backups and sanitary sewer overflows (SSOs). One objective of the SSWWEP is to identify alternatives to address basement backups and SSOs. For this reason, it is critically important that we understand the impact of FDDs on peak flows and the volumes generated from rain events. These will be the focus of the FDD evaluation phase of the SSWWEP.

Q. Craig Hupy/"diminutive" comparison. Craig Hupy was quoted in the Ann Arbor.com article on 4/20/2012 as follows: "When we started the FDD program, we were concerned about the additional load on the stormwater system," he said. "And even in the largest events, the modeling we did showed that it was a fraction of an inch — between an eighth and a quarter inch more water in the street — so it's diminutive compared to the water falling in the big events."

"If we didn't have the FDDs in that rain event, we would have had basement backups downstream of them. We didn't have any," Hupy added. "Given the intensity of that storm, she would have had surface flooding whether we had done or not done FDD, so I feel very comfortable saying FDD did not have a material effect on the surface flooding. "

The above Craig Hupy quote implies, on one hand, that the flow from FDDs is relatively small or "diminutive compared to water falling in the big events." The quote also implies that FDDs prevented sanitary back ups from some basements. How can the claim of "70% to 90% of total sanitary flow caused by footing drains" (as previously presented to the CAC) be reconciled with the "diminutive" statement above?

Q. Can the City provide a "lay man's" diagram that illustrates OHM's analysis of storm and sanitary flows?

A. Craig Hupy was speaking about the impacts of FDD flow on the stormwater system. Stormwater flows are much, much larger than the flows from the FDD, and the "diminutive" statement was in reference to that comparison. The statement that 70-90% of the total sanitary flows is caused by footing drains is a comparison of the flows in the separate sanitary sewer pipe. These are comparisons and percentages of flow in different systems. Because stormwater flows are much larger than FDD flows, and FDD flows are much larger than normal sanitary flow, the FDD flows are a relatively large component of the flow in the sanitary system, but a relatively small component of the flow in the stormwater system.

To further illustrate this point, we have outlined below a comparison between the flow generated from a single house from typical sanitary sewer flow, footing drain flow and stormwater flow. We have also prepared a comparison between a typical sanitary sewer pipe and a typical storm sewer pipes in the figure below.

<u>Comparison of stormwater runoff volume to FDD volume - a simple example:</u>

Ann Arbor characteristics from 2010 census (from semcog.org):
- 6,345 acres of single family housing
- 19,725 single family units

- 0.32 acres per avg single family parcel
- 43,560 square feet (sf) per acre
- results in 13,940 sf per avg single family parcel

Runoff from 1.8-inches of rain in an hour (common storm sewer design rainfall):
- 1.8 inches / 12 = 0.15 feet
- rain volume from average parcel = 0.15 ft x 13,940 sf = 2,091 cubic feet (cf)
- fairly common for residential area for 35% - 50% of rain to runoff as stormwater.
- **stormwater runoff range of 732 - 1046 cf**

Compare to sump pump volume:
- 3-5 gpm from a sump pump
- 180 gallons - 300 gallons in an hour
- 7.48 gallons per cubic foot
- **sump runoff range is 24 - 40 cf**

Compare to typical sanitary volume:
- 100 gallons per person per day typical (see reference below on typical household use)
- 2.2 people per household in Ann Arbor (from semcog.org)
- 2.2 people per house x 100 gallons results in 220 gallons per day per house
- That is 9 gallon per hour
- 7.48 gallons per cubic foot
- **Typical sanitary flow in an hour is about 1.2 cf**

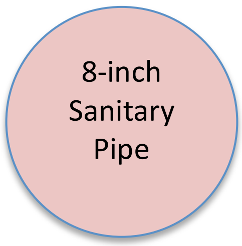
Note: the sump pump volume is probably a little over estimated, as 3-5 gpm is more typical for a larger storm in the 2-4 inch range over more than an hour. The rule of thumb for FDD flow is about 1 gpm per inch of rain on average. So for this example, 1.8 inches in an hour might produce something like 2 gpm. I used 1.8-inches of rain in an hour because that is a common storm sewer design rainfall, and keeping everything to the volume in an hour made the computations simple. Actual hydrograph computations of runoff would be more complex and more precise, but would show the same conclusions.

<u>Comparison between a typical sanitary pipe and a typical stormwater pipe:</u>

Because storm water flows are much larger than sanitary flows (as demonstrated above), the stormwater pipe tends to be much larger than the sanitary pipe in a typical street. Storm and sanitary pipes can have a tremendous range in sizes depending on the size of the area served and the slope or grade of the pipes. To illustrate the different carrying capacities, we have provided the illustration below that compares an 8-inch sanitary pipe to a 24-inch storm pipe, which are very common pipes sizes for city streets. We have also compared the capacity of the pipe to the flow from 50 footing drains, which would be a very common number of houses serves by pipes of this size.

Notes:

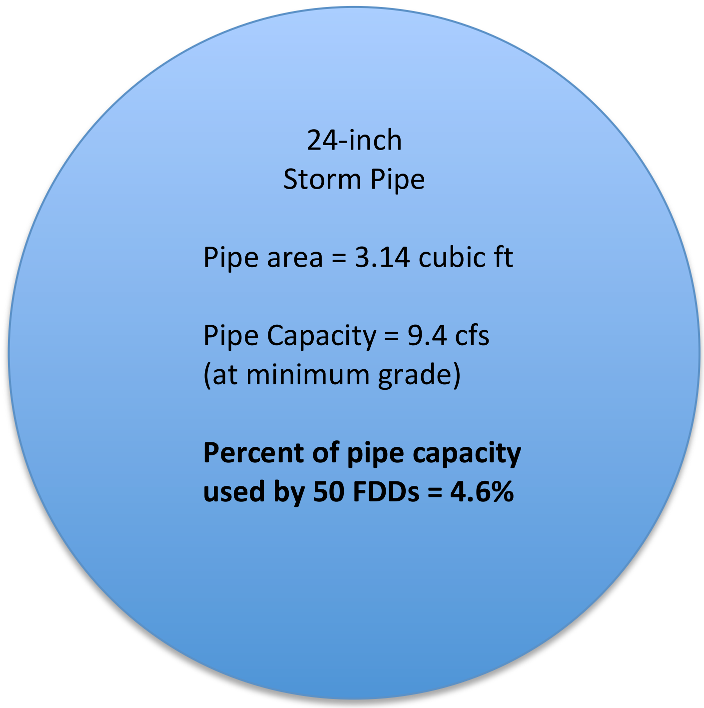
- These illustrations are to scale (the 24-inch pipe is three times the size of the 8-inch pipe in the illustration).
- The percent of pipe capacity used by 50 FDDs was based on 4 gpm per FDD, which results in a flow of 0.44 cubic feet per second (cfs) from 50 FDDs.



Pipe area = 0.35 cubic ft

Pipe Capacity = 0.60 cfs
(at minimum grade)

Percent of pipe capacity used by 50 FDDs = 73%



<u>Conclusions:</u>

1. Sump pump volume is a small fraction of stormwater runoff volume. Footing drain volume is a large portion of sanitary sewer wet weather volume.
2. Typical storm pipes have a much larger carrying capacity than typical sanitary pipes (15 times more in this examples).
3. Footing drain flow rates are a large fraction of the capacity of a typical sanitary sewer pipe. Footing drain flow rates are a small fraction of the capacity of a typical storm sewer.

Q. Do we have a control to other neighborhoods for the 2000 storm?
Is there a control for the three graphs OHM put up at the October 29 SSWWE CAC meeting? Robert C. (OHM) said that the whole City can act as a control because the FDDP has not had much impact on the volume of the system citywide. If so, doesn't that contradict the premise of the FDD program--which is to reduce sewer backups and avoid overflows into the Huron?

A. There is not an "ideal" control meter on a small upstream neighborhood without FDDs. However, the wastewater treatment plant (WWTP) is working as a suitable control district with some limitations. The limitations include changes in the system over the last 13 years such as new development (baseflow), and the fact that the flows at the WWTP may have decreased slightly themselves as a result of FDD. Because houses with FDD comprise only about 5% of the total houses in the City, the WWTP is functioning as a suitable control, despite these limitations. It should be noted that a decrease in flows at the WWTP as a result of FDD would tend to result in the <u>underestimation</u> of FDD flow removals in the priority neighborhoods, when the WWTP is used as a control.

Q. Have you considered measuring flow directly on the curb line to determine the flows from FDDs? (The "curb line" is the small PVC pipe that is installed to collect the FDD flow from several houses and connect it to a storm inlet.)

A. Subsequent to this comment, we contacted Martin Control Services (MCS), the City's flow metering contractor, to inquire about metering these connections. The best way to meter the flow from a pipe like this is a direct measurement with a bucket and stop watch during a rain event, because the flow and pipe size are too small for traditional continuous metering. MCS mobilized on the morning of October 31, 2013 during a moderate rainfall event (approximately 1-inch of rain over 12 hours) to make a direct measurement of the flow in a sample curb line in the Orchard Hills subdivision. The curb line they metered collects sump pump flow from 5 houses. MCS also made a measurement of the flow in the 10-inch pipe that was metered during the flow-metering program. These measurements, and subsequent analysis, show that approximately 66% of the total flow generated (i.e. the total of the flow in the 10-inch sanitary pipe and the footing drain flow in the curb line) is from footing drains. Additional information on this measurement was presented to the CAC at its December 12, 2013 meeting.

Q. What is the range of confidence interval in the flow results?

A. Statistics confidence levels were averaged for the 3 methods used to determine the flow removals. Those average confidence ranges varied from 38.1% to 99.8. Values above 95% are considered statistically significant. This was the base for 3 of the 5 priority districts – Orchard Hills, Bromley and Moorhead. While not statistically significant, Dartmoor was close at 90.1%. Glen level had the lowest value at 38.1%, and also had the lowest computed rate of flow removals.

Q. StormCorp looked for storms and noted flooding, as part of the Upper Malletts Study. The Chaucer Court neighborhood flooded badly during the 2012 storm, but had none this year. More catch basins were added this year, along with two manholes for sewer systems. In very high storm rate events, manholes can make a big difference. Morehead and Glen Leven both raise questions about phenomenology.

A. Regarding the Chaucer Court ponding differences in 2012 vs. 2013: we didn't just look at large storms, we also measured and analyzed for small storms, every single storm, large and small. Taken together, with the multiple scientific methods of analysis, and the high level of statistical confidence, the results are correct in this neighborhood.

Q. On Page 8 of the presentation slides handout, confidence levels on the slide for the summary results are lower than the confidence levels of single methods. Why is Glen Leven so low?

A. There are differences in results in Morehead and Glen Leven. From both analysis and experience, we know that results are not linear; completing 50% of the FDDs in a neighborhood doesn't necessarily mean a 50% reduction in flow. Glen Leven homes are older, closer together. Each house has a smaller drainage area, which makes for smaller flows. The next phase of the project, the hydraulic analysis of the sanitary sewer system in these neighborhoods may reveal other factors that have impacted the results in the Glen Leven area.

Q. In 2000, if you had measured flow in the five problem areas identified, would you have found those same areas [as having problems]? Wouldn't it have been better to save the money spent on the FDD Program and instead fix those issues?

A. In 2000, the flow was measured, in the five areas and across the city. There were many more problems across the sanitary sewer system in 2000 than there are today. The City's sanitary sewer system has fewer problems and more capacity as a result of the FDD program.

Q. It appears that the FDD Program didn't work in Glen Leven.

A. Yes, the FDD program was less effective in the Glen Leven target area.

Q. Can the results in Dartmoor be attributed to the higher percentage of multi-family homes?

A. That could contribute to the results.

Q. Houses are close in some neighborhoods; are there things that individual residents might have done, like install drains that could account for the lower flows?

A. The flows were measured at the neighborhood level, at the sanitary outlet from each neighborhood, so small changes in drainage between houses are unlikely to impact the results.

Q. Could fixing bad manholes and sewer pipes in some areas account for the flow removal results?

A. It is possible that sewer and manhole repairs could impact system flows. Typically a substantial program is needed to make a significant impact on wet weather flows, and the City did not conduct a substantial program.

The City has electronic records of all sanitary sewers that have been televised since summer of 2006. Please see referenced report (Report of CCTV Work Since 2006.xls). Prior to summer of 2006, records were not kept electronically. Records are archived and are less easily searchable. The same applies for repair work performed on the system. All the electronic records of repair work performed on the system is shown on the referenced "Citywide Sanitary System Improvements.PDF" map, posted on the City's project page at www.A2gov.org/SSWWE > Library.

Q. Does the City keep records of when it reviews manholes and plugs any openings?

A: As part of routine maintenance activities, City crews will plug pickholes in manhole covers in areas where street flooding is observed. Formal records have not been kept in the past. These plugs are viewed as a stop-gap measure until a formal policy is put in to place. The City's Stormwater Modeling project will be used as the basis for developing a formal policy on manhole sealing.

Q. In Morehead, there's hard packed clay, which creates a bathtub effect around each house. It's the same when you disturb the earth to install sewer pipes. How does that impact the differences in flows, pre and post FDD?

A. Prior to FDD, this "bathtub" effect can drive a lot of flow to the sanitary sewer through the footing drain. This flow is removed from the sanitary sewer by FDD.

Q. The same linear bath tub affect occurs at all sewer pipes. Hence if there is a leak or crack in an existing buried pipe, the same phenomena occurs. The linear bath tub of an undefined length of pipe can drive the same surface flow down to the bottom of the trench and into sanitary sewer. Can the city provide a history of all efforts to "camera inspect" and repair existing sanitary sewers since 2001?

A. The City has electronic records of all sanitary sewers that have been televised since summer of 2006. Please see referenced report (Report of CCTV Work Since 2006.xls). Prior to summer of 2006, records were not kept electronically. Records are archived and are less easily searchable. The same applies for repair work performed on the system. All the electronic records of repair work performed on the system is shown on the referenced "Citywide Sanitary System Improvements.PDF" map posted on the City's project page at www.A2gov.org/SSWWE > Library.

Q. Would a targeted approach make sense? Consider going after areas where streets are expected to flood during major rain events. Sealing sanitary manholes in these areas may help "cut the top off" I&I (inflow and infiltration) during the worst events.

A: The City has sealed manholes in the past in areas of know street flooding issues, and is continually reviewing and implementing sealing measures, where possible. This is something that can be considered as part of the alternatives analysis.

Q. During a storm event, when a street is flooded, how much water can flow thru a pick hole in a manhole cover?

A. See the Manhole Pickhole Computations spreadsheet [also available in the www.a2gov.org/SSWWE > Library] using the orifice equation to compute flow rates through pick holes of various sizes, varying standing water head and hole count. Most pick holes are either 3/4" or 1" in diameter, and most manholes have 2 pick holes. We used these for the computations, but you can vary the assumptions in the spreadsheet.

Q. Does the City have a program of plugging pick holes in sanitary sewer manhole covers? If so, what results have you seen?

A. The City has sealed manholes in the past in areas of known street flooding issues, and is continually reviewing and implementing sealing measures, where possible.

Q. An earlier response to a question about plugging pick holes in manhole covers said that they are plugged "as they are discovered". Is there a systematic check system in place to plug pick holes?

A. Not at this time, however the City plans to use the stormwater model (when project is completed) as a tool for developing a formal program. In addition, implementing a formal program is a likely recommendation that will come out of the CAC.

Q. Re: clogged holes in stormwater manhole covers. Does the City dedicate any resources to going out and doing this themselves in big water events? It is ice now, but there are also leaves, etc. If not, why not?

A. Yes, when a large storm event is forecasted, city field crews will visit a number of key locations throughout the city to ensure the inlets are clear of debris. Unfortunately, with over 15,000 inlets located citywide, not all locations can be visited.

Q. Gasketed manhole covers: why can't we include the installation of these in the CAC's final recommendation? These should at least be installed in low-lying areas, in all targeted neighborhoods, and at manholes affected by new road construction.

A. The City has begun to implement the gasketed manhole covers in the city. In addition, additional funding is being programmed into the City's Capital Improvement Program for the implementation of a citywide program for sealing lids and other manhole repairs/rehabilitation in flood prone and high-risk areas. The potential of hydrogen sulfide gas accumulation is an issue that will need to be evaluated as part of the program.

Q. How many man-hole covers are in each target neighborhood?

A. Number of sanitary manholes located in each target neighborhood:

Dartmoor – 216
Bromley – 55
Orchard Hills – 90
Morehead – 260
Glen Leven – 259
TOTAL – 880

Sanitary Sewer Backups

Q. How does the City learn about sewer backups?

A. Sewer backups are reported to our Field Services Unit at 734-794-6350 or www.a2gov.org/crs during normal business hours. For after hours, weekends and holidays, backups are reported to our Water Treatment Plan at 734-994-2840.

Q. How many sewer backups were reported in the June 5/6, 2000 storm event?

A. Approximately 200 homes reported basement flooding.

Q. How many sewer backups were reported during the June 27, 2013 event?

A. 34 backups were reported. Following investigation by City Field Operations, 9 of the 34 were determined to have possibly been caused by an issue with the city's sanitary system.

Q. How many homes have reported sewer backups since FDD work was completed in their homes?

A. As of 2012, approximately 2500 single family homes have been disconnected as part of the FDD program.

From 2001-2012, 70 homes have reported suspected sewer backups since they had FDD work competed in their home. It is not clear whether these reported incidents were a result of the city's sanitary sewer being overwhelmed during a storm event or if the incidents were caused by something different (blockage, tree roots, issue with private lead, etc.).

2014 update: Following the results of the 2013 FDD Survey, the City contracted with an experienced construction engineer to investigate all reports of sanitary sewer mentioned in the survey. The construction engineer investigated those homes and found no instances of an FDD causing sanitary sewer backups. Causes of the sanitary sewer back ups were typically failed sewer leads or broken pipes under the basement.

Q. Why are there backups in homes without footing drains?

A. A house without a footing drain may experience a sanitary sewage backup with the sanitary sewer backs up to a level above an adjacent basement floor elevation. One potential cause occurs when the sanitary sewer system is overwhelmed with infiltration and inflow during a large storm event and cannot keep up with the flows discharged to the sanitary sewer. In that case, the sewer flow becomes pressurized and sewage will leave the sewer systems at the low points in the system. If the low point in the system is a basement (or several basements), the sewage will back up in those basements. Another cause of a backup could simply be due to blockage in the sanitary sewer or the sanitary lead to the house.

Sanitary Sewer Capacity, Condition, Storage

Q. Do most sanitary sewers work by gravity?

A. Gravity sewers serve nearly all of the houses and businesses in Ann Arbor. Most sanitary sewers work by gravity, and the sanitary sewer pipes usually follow existing land contours to reduce pumping. Sometimes, we have to pump sewage from a low area or over a hill via pump station. Because of the topography of Ann Arbor, the City has very few pump stations.

Q. What is the capacity of our sanitary sewer system (minus the plant)?

A. The capacity of the sanitary sewer system, minus the plant, varies depending on location. Upstream pipes serving individual neighborhoods (typically 8-inch diameter sewers) have a capacity large enough to meet the needs of a smaller area, and downstream interceptors serving large portions of the City have a higher capacity. The key item is the capacity of the pipe, compared to the expected design flow under wet weather conditions. These values will be developed for the trunk sewers and interceptors in the Sanitary Sewer Wet Weather Evaluation (SSWWE) project.

Q. How much does it cost to treat stormwater vs. sanitary sewage?

A. There is no cost to treat stormwater at the pipe outlet, as this water is collected by a separate storm sewer pipe system, which ultimately discharged to the Huron River without an end-of-pipe treatment. Treatment and management of stormwater is handled through other mechanisms such as source control, street sweeping, public education programs and stormwater collection system maintenance. Stormwater does not make its way to the wastewater treatment plan, unless it enters the sanitary sewer system through defects, in the sanitary sewer system or private property sources like footing drains. The cost for treating sewage at the wastewater treatment plant is approximately $1400 per million gallons. Therefore, when any stormwater enters into the sanitary sewer system, unnecessary cost is incurred because all the flow which enters into the sanitary sewer pipes goes to the wastewater treatment plant.

Q. What is the actual capacity of our sanitary sewers? Is development overloading our sewers? Are you accounting for future development in your model?

A. The capacity of the sanitary sewer system and its ability to handle existing and projected future flows is part of the scope of this evaluation study. We'll address these items during the alternatives evaluation and will account for future development.

2014 update: Based on the metering and hydraulic analysis performed during the SSWWE Study, the City's sanitary sewer system has adequate capacity even with future growth, with the exception of five specific areas. Each of these areas shows a hydraulic anomaly that should be investigated further with on-site flow metering to determine the cause of the problem (such as a pipe blockage, or a crumbling manhole.)

Q. Are lift stations and pump stations the same thing?

A. Yes, they are devices used to raise sewage over low lying areas.

Q. Has the City performed a comprehensive inventory of the sanitary sewer system condition? If not, should doing so be a recommendation on the Final Report. This would establish a "baseline."

A. The City is currently programming into its Capital Improvement Plan a citywide asset management program for the sanitary system. This project will include performing a comprehensive condition analysis on the sanitary system.

Q. Cresson [Slotten] informed us that public officials in other communities have told him that Ann Arbor's water system is "tight". In some other place on Basecamp another CAC has asked after the practice of scoping the pipes in this system for leaks...the response seemed to imply that very little scoping had been done within a certain time frame. Cresson, on what basis have these public officials in other communities formed their professional approval?

A: This opinion has been offered by past consultants working on projects related to the City's system who have also worked in other communities, not officials from other communities.

In order to quantify the "tightness" of the Ann Arbor system, the consultant team benchmarked the A2 system to other sewer systems around the Midwest that have been analyzed by the consultant on other projects. This shows how the A2 system performs relative to other systems, and also help rank or prioritize the various districts within the city that have been modeled.

Q. Is there a norm, a standard, or code (City, County, or State) for how Ann Arbor is responsible for surveying their system?

A: There is no standard or code requirement for a utility to survey (i.e., video inspect) its sanitary sewer system. The City's goal is to video inspect its sanitary sewers within a 7-year period, based on available resources, to monitor their condition.

Q. How large are the sanitary sewer pipes?

A. The pipes in the neighborhoods are typically 8" or 12", which make up about 80% of the pipes in the system The transmission mains, however are about 48" or larger.

Q. How does stormwater get into the sanitary sewer system?

A. The role of the sanitary sewers is to transport wastewater from homes and businesses to the treatment plant. Along the way, some stormwater enters the sewer pipes. Some common sources of stormwater include – cracks in pipes or manholes, cross connections to the storm sewers or drains, and pick holes or vent holes in the manhole covers. The 2001 Task Force identified that 70 to 90% of the total sewer flow – in some portions of the system – was coming from footing drains during storm events.

Q. Can the city make storm sewers overflow into sanitary sewers?

A. No. Discharge of stormwater sources into the sanitary sewer system is prohibited by local ordinance. Why? Flows from the storm sewer system would quickly overwhelm the sanitary sewer system and lead to sewer overflows and backups into basements.

Q. What are the allowable flow rates for 2", 4", 6", and larger sanitary and surface water pipes?

A. The allowable flow rate of a pipe is dependent on not only its diameter, but also its slope and material. The pipe slope affects the velocity and carrying capacity of a pipe, and the material affects the friction in the pipe, which affects the carrying capacity. There are standard publications that tabulate the carrying capacity of standard concrete pipes laid at minimum slope, where the minimum slope is established to prevent the settling of sediment and debris in the pipe (maintain sufficient scouring velocity). One such standard publication is shown below. It is uncommon to build new sanitary sewer pipes that a are smaller than 8-inch, and for that reason, the enclosed standard publications begins at 8-inch diameter pipes. Carrying capacities for smaller pipes can be determined through a hydraulic computation, and will be performed with the hydraulic model where relevant and necessary. We can provide that data where relevant for specific pipes in the City's system.

MINIMUM GRADES FOR SEWERS

Velocities calculated from formulas:

$V = \sqrt{D} + 0.8$ (for sanitary sewers).

$V = 1.2\sqrt{D} + 1.3$ (for storm sewers).

$V = 1.1\sqrt{D} + 1.0$ (for combined sewers).

when V = minimum permissible velocity "flowing full", in feet per second.

D = diameter of sewer in feet.

Grades and discharges calculated from Kutter's formula for circular conducts flowing full, with n = 0.013.

Diameter of sewer in inches	Sanitary Sewers* (See 10 State Stds.)			Storm Sewers			Combined Sewers		
	Minimum Velocity Ft. per sec	Minimum Grade % Mich. Dept. of Health	Discharge at Min. Grade c.f.s.	Minimum Velocity Ft. per sec.	Minimum Grade %	Discharge at Min. Grade c.f.s.	Minimum Velocity Ft. per sec	Minimum Grade %	Discharge at Min Grade c.f.s.
8	1.6	.40	0.60						
10	1.7	.30	1.0	2.4	.40	1.3	2.0	.27	1.0
12	1.8	.22	1.4	2.5	.33	2.0	2.1	.22	1.6
15	1.9	.16	2.4	2.6	.25	3.2	2.2	.18	2.8
18	2.0	.13	3.6	2.8	.22	4.9	2.3	.16	4.2
20	2.1	.11	4.4	2.8	.20	6.0	2.4	.14	5.0
22	2.2	.10	5.7	2.9	.18	7.6	2.5	.13	6.5
24	2.2	.10	7.2	3.9	.17	9.4	2.6	.12	8.0
27	2.3	.09	9.0	3.1	.16	12.5	2.6	.12	10.8
30	2.4	.08	12.2	3.2	.15	16.5	2.7	.11	14.0
33	2.5	.08	15.0	3.3	.14	20.0	2.8	.10	17.2
36	2.5	.07	17.8	3.4	.13	24.0	2.9	.09	20.0
39	2.6	.07	22.0				3.0	.09	25.0
42	2.7	.06	25.0	3.5	.11	34.0	3.1	.09	31.0
45	2.7	.06	30.0				3.1	.08	36.0
48	2.8	.06	36.0	3.7	.10	47.0	3.2	.08	42.0
51	2.9	.05	38.0				3.3	.08	48.0

Q. How would changes in sanitary flow be accounted in terms of building permits, water sales, etc.?

A. We can quantify historic changes in the base sanitary flow from building permits, vacancies, and commercial/industrial changes with the flow metering data. We will also identify how projected trends in populations will impact future base flows. The future base flows will be accounted for during the alternatives evaluation.

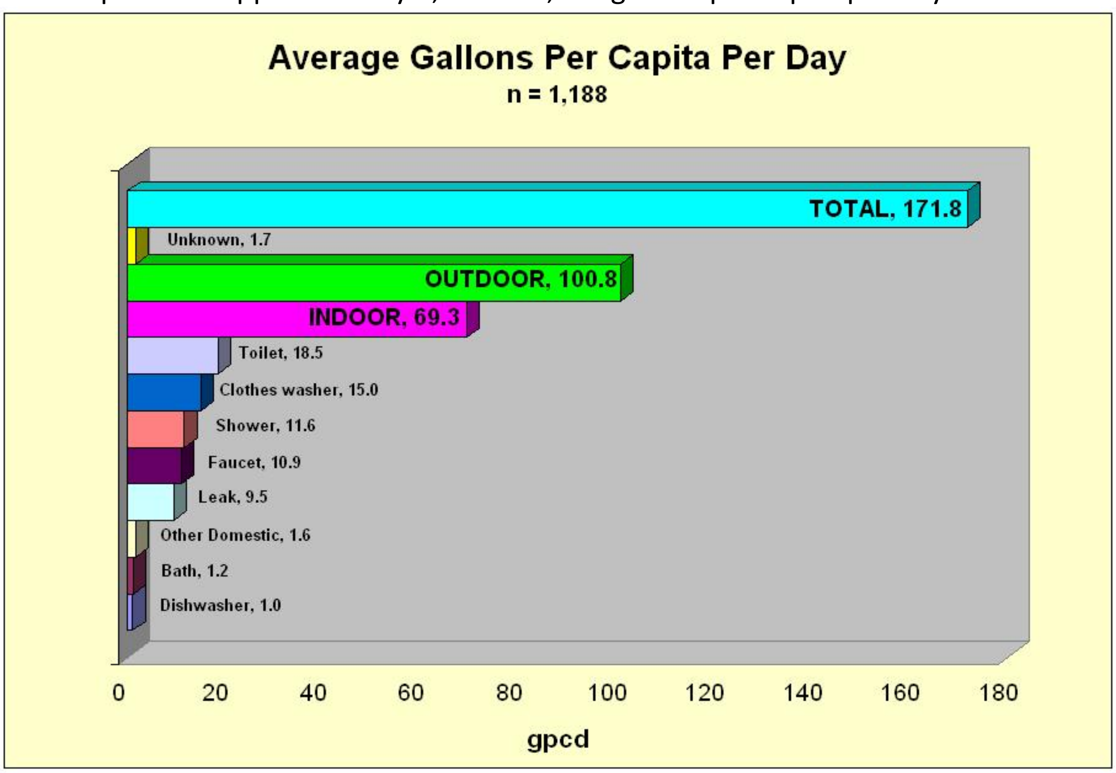
Q. How do you account for student population changes in summer?

A. Changes in student populations in the summer will have an effect on the base sanitary flow and this effect can be quantified from the flow metering data. This changing student population will not have an effect on the wet weather flows in the sanitary sewer system.

Q. What kind of impact does personal use have on storms and flows? (Showers, laundry, etc.) Could it be skewing the data?

A. The chart below shows typical water demand in a household. Note that this figure tabulates household water use, and it is reasonable to assume that this water use would be discharged to the sanitary sewer, except the "outdoor" component. The "outdoor" use component in the table below is for lawn sprinkling and other irrigation, and this water use generally does not make its way to the sanitary sewer.

For reference, the peak flow rates from the year 2000 metering (pre-FDD conditions) ranged from 1,900 to 7,600 gallon per capital per day for the five priority districts. Other studies and FDD programs have estimated that the peak flow generation of a footing drain from a rain event is in the range of 3 – 5 gallons per minute per footing drain, which equates to approximately 1,950 to 3,300 gallons per capita per day.



source: Residential End Uses of Water, AWWA Research Foundation, 1999
http://www.allianceforwaterefficiency.org/residential-end-uses-of-water-study-1999.aspx

Q. What impact did the postponement of the City's curbside fall leaf pick up have on the performance of the Storm and Sanitary sewer functions?

A. One focus of this study is the impact of the FDD program on the flows in the sanitary sewer system. As part of this study, the results will be quantified with statistical confidence from a statistical regression analysis. It is common to set a threshold of 95% statistical confidence or greater to have statistically significant results. For districts that meet this threshold, it means that there is a 95% or greater chance that the flow reductions are the result of the FDD program, and a 5% or less chance that the flow reductions are the result of some other effect such as the curbside fall leaf pickup schedule, variations in rainfall volume or intensity, variations in wetness conditions, or other variations. Statistical confidence values will be published with the FDD flow evaluation results.

The impacts on the stormwater system from the FDD program or other items such as the City's leaf pick up are not the focus of this study and would have to be taken up by other City initiatives or other studies.

Q. I want to make sure that what appears to be a footing drain success story also includes mention of what else could be causing those reductions.

A. Variations from different rainfall amounts, rainfall patterns and antecedent moisture conditions can "mask" the underlying changes in flows due to FDD. A scientific "control" for these items will be done with the FDD flow evaluation using three independent techniques that include scatter plots, meter correlations to a control, and continuous hydrologic modeling.

Q. Can the City provide a history of all efforts to "camera inspect" and repair existing sanitary sewers since 2001?

A. Yes. Maintenance records are on file with the City's Field Operations Unit. This information will be reviewed in conjunction with the next phase of the project, investigating and analyzing the hydraulic condition of the sanitary sewer system.

The City has electronic records of all sanitary sewers that have been televised since summer of 2006. Please see attached report (Q2.38 Report of CCTV Work Since 2006, also available on the website: www.A2gov.org/SSWWE > Library.) Prior to summer of 2006, records were not kept electronically. Records are archived and are less easily searchable. The same applies for repair work performed on the system. All the electronic records of repair work performed on the system is shown on the attached "Citywide Sanitary System Improvements.PDF" map, also available on the website: www.A2gov.org/SSWWE > Library page.

Q. Does the city have a formal program for sealing the existing sanitary sewers from storm water surface leaks and ground water infiltration (similar to Scio Township)?

A. Maintenance is routinely performed on the sanitary sewer system, which includes cleaning and televising, lining of existing sewer pipes, spot repairs, and repair or replacement of manholes.

Q. What else in the last 13 years might have affected the results observed from FDD? System maintenance and repairs, etc.?

A: See response to question above, as well. All the electronic records of repair work performed on the storm and sanitary systems are shown on the "Citywide Sanitary System Improvements.PDF" & "Citywide Storm System Improvements.PDF" maps. Both documents are available on the project webpage: www.A2gov.org/sswwe > Library page.

Q. Upon review of the attached Citywide Sanitary System Improvements.pdf map, very little work is indicated as having been completed in targeted areas. Why is that?

A. The work that has been performed in the five study areas has been FDDs. The condition of the sewers in these areas has not required other work.

Q. Can we get information regarding what is known about the existence of public sources I&I and the extent it has been corrected? Some examples of what might be public I&I were roof drains, parking lot or ramp drains, etc.

A. A number of changes to the collection system have been made through the years to address the observed basement backup problems, including the following:

a. Smoke Testing Georgetown Area – 1998

This study detailed the results of smoke testing performed in the Bromley and Orchard Hills study areas. The work was performed to document potential sources of rainwater inflow and infiltration that may have been the cause of basement backups in August, 1998. It also included a list, by address, of the number of downspouts potentially connected to the sanitary collection system. This report contained an inspection log of manholes in the two study areas. The inspection included cover type, manhole type and condition, wall type and condition, observed infiltration, and potential infiltration. Individual field inspection forms for each manhole are available.

b. Lansdowne Investigations – 1987

Three related reports prepared by Soil and Materials Engineers, Inc., McNamee Porter & Seeley, and Harza, document contributing factors to basement backups in the

Morehead area. These reports provide boring logs that document area geology, groundwater elevation data, and a recommendation for three relief sewer projects. These reports include information on the impacts of the August 22, 1987 storm event, a summary table listing the impacted residences, and a discussion of flow monitoring performed in the area.

c. Northeast Ann Arbor - Ann Arbor Internal Memoranda – 1982

This document provides a detailed review of the Bromley and Orchard Hills study areas and documents the basement backups that took place during a June 28, 1982 storm event. There is information regarding roof drain downspouts connected to the sanitary system and reference is made to a basement elevation survey conducted in 1970 for some homes in the study areas. There is also a reference, including some technical information, concerning the retention basin constructed in the Orchard Hills area in 1970. While there is mention of a flow meter installed in the Bromley area, data from that meter was not included in the document.

A program was conducted in the 1980's to disconnect roof drains from the sanitary sewer system. At this time, it is believed that most of the roof drains in the City have now been disconnected from the sanitary system. If areas where roof drain connections are suspected are located in the future, further investigation will be performed. Other sources of I&I may include leakage through manholes and manhole covers, aging sewer pipes, and leaking sanitary sewer leads from private properties. Although a comprehensive program does not currently exist, leakage through manhole covers in flood prone areas are addressed with temporary plugs in manhole pickholes as they are discovered. Also, the City has a biannual sewer-lining program to repair aging sewer pipes.

Q. An earlier response about the composition of flows in the sanitary sewer system is that 48% of the flow in the system comes from inflow and infiltration. Should we be trying to find out what is causing it?

A. Yes, in areas that are experiencing problems it makes sense to find out what's causing those high flows. In other areas, where there are no capacity issues, it's not as pressing an issue to remove the flow. In most systems throughout the Midwest, 25% to 60% of the sanitary sewer flows are from I & I (inflow and infiltration.) It's also a matter of weighing the cost of finding and removing the source of the infiltration against the benefits doing so would bring. The City's rotating maintenance program is intended to find some of those sources and remove them.

Q. The City posted field records of the sewer pipe cleaning and video inspection performed in the FDD study neighborhoods in 2011, 2012, 2103. As a follow-up to the video inspections and cleanings: Were any problems found? If so, what?

A: The sewer videos that are performed are evaluated by staff. Typically in any sewer system various degrees of deficiencies are noted. Major issues (such as partially collapsed pipe) are typically prioritized and addressed by Field crews. Other issues (such as root intrusion and varying degrees of pipe cracking or displaced joints) that need to be addressed in the system are prioritized and included in the Capital Improvements Plan (CIP) as future projects.

Q. How relevant are the various detention and retention projects being done to the results observed? When were the water clearances in the Pioneer/Allens Creek/Malletts Creek area done and could those have an impact?

A. These projects are projects related to the stormwater management system, not the sanitary sewer system. As such, these projects do not have an impact on the results observed.

Q. It appears that 100% disconnecting in some neighborhoods doesn't necessarily lead to better outcomes than those with 50% FDDs. Is that true?

A. It is very possible that the findings will show different effectiveness for flow removals from FDDs for the different districts, due to variations in the sub-surface, ground water conditions, and other differences between the districts. It is premature to draw those conclusions at this point, because the flow data presented has not yet been controlled for different rainfall amounts, rainfall patterns and antecedent moisture conditions. Those results will be ready at the next CAC meeting.

Q. Correlation of all this water data with actual basement flooding?

A. Maps of basement backup locations were displayed at the 12/12/13 CAC meeting.

Q. Is there a meter in 2013 that was on a control district that you can show us?

A. Yes, there are two. Although these meters were not installed in 2000, so we cannot use them for control comparisons, we can examine the 2013 flows and compare them to the post-FDD flows of the other districts. This information will be available at the next CAC meeting.

Q. Recent conversations with OHM indicate prelim info that some neighborhoods are showing greater footing drain flow than others. One idea is that some areas have homes with only one set of footing drains, (i.e.: exterior or interior of the footing, but not both). Can the approved contractors be contacted to provide their observations during the actual FDD installations?

A. CDM has investigated the occurrence of "bleeder type" footing drains in the various priority FDD areas based on their work on the FDD program. The have found the following:

- Approximately 55% of the houses in Glen Leven have “bleeder type” footing drains
- Approximately 5% of the houses in Dartmoor have “bleeder type” footing drains
- None of the houses in Orchard Hills, Bromley and Moorhead have “bleeder type” footing drains

The sump pump monitoring data that CDM collects was evaluated to see if the high occurrence of “bleeder type” footing drains may have an impact on the sump pump flows measured, and no difference was observed in the data. An analysis of statistical significance was not performed on this conclusion, but the results suggest that differences in the FDD flows are likely from other impacts besides “bleeder type” footing drains.

Q. Research has revealed that sanitary storage capacity may have been installed since 2001 in the Plymouth Road corridor. Is this correct? What impact DID this have on the Flow data recently presented by OHM and on the reduction of Sanitary Backups since 2001?

A. No, this is not correct. There was no detention installed since 2001. In the last 1960s, there was some detention installed in the Georgetown/Bluett area. It consists of a 58” x 94” arch pipe installed in 1969, which can handle 149,012 gallons of storage, and is still in service. In the late 1990’s and early 2000’s the area still experience numerous basement backups, which resulted in this area becoming one of the FDD study areas. So, it appears that this detention was insufficient to prevent basement backups.

Q. Regarding storage facilities that have been installed near Georgetown/Bluett, and one near Yost Blvd. The questions / info would be:
What are the size of these ?
When were they installed?
How effective were they?
What maintenance challenges or issues do they cause?
What lesson learned were gleaned from these?

If this storage capacity is in the street, buried somewhere, does it interfere with other utility pipes and lines when work needs to be done on one? I would think that some lines would need to cross over it or under it. If it is down deeper, then it would be hard to place such a system in a street that has existing lines and pipes.
Where exactly are these storage pipes located?In a street or in a field somewhere?

A: The facility near Yost Blvd (not Yost arena) & Salem Ct was installed in the late 60’s to provide relief for the Swift Run trunkline. The facility consists of three 54”x85” arch pipes which can handle 118,613 gallons of storage, and is still in service. Refer to the attached record drawing (Swift Run Storage Drawing) for more information. The facility is located in open area adjacent to the Swift Run drain. The need for additional relief was identified in the late 1990's which led to the construction of a relief sewer further downstream from this existing storage facility.

The facility in Bluett & Georgetown consists of a 58" x 94" arch pipe installed in 1969, which can handle 149,012 gallons of storage, and is still in service. The facility is located in the road right-of-way. Refer to the attached record drawing (Bluet Storage Drawing) for more information. In the late 1990's and early 2000's the area still experience numerous basement backups, which resulted in this area becoming one of the FDD study areas.

Conflict with existing utilities is a valid concern and will need to be considered during the alternative analysis phase when looking at storage as a possible alternative.

Q. Do these facilities [sanitary storage in the Georgetown/Bluett and Yost Blvd area, referenced in Question 1.60, 1.60b] need periodic clean out or other special maintenance beyond what an ordinary sanitary main requires?

A: These facilities do require more frequent maintenance beyond the typical periodic cleaning and maintenance cycles needed for ordinary sanitary mains.

Q. Is it possible to find out when a sewer pipe was cleaned in a particular neighborhood?

A. Yes, the City keeps records of the cleaning and televising.

Modeling

Q. How does your model track soil wetness?

A. The antecedent moisture model tracks the soil wetness using two techniques:

- The first technique uses the rainfall immediately preceding the storm to track the soil wetness conditions from recent storms.
- The second technique uses the air temperature to account for seasonal wetness conditions. (Cooler temperature periods tend to retain more moisture).

These techniques were identified and validated through extensive analysis of actual system flows from many systems around the state and the Midwest.

Q. Was account taken of the differences in soil conditions in saturation?

A. Yes, the project team members used a model designed specifically to account for differences in soil saturation (antecedent moisture.)

Q. What's the impact of wetlands on FDD?

A. Wetlands, if they function properly, tend to store surface runoff and gradually infiltrate the stored flow into the soil. Therefore, such flows would manifest themselves in the infiltration or groundwater component of flow metering flow data. The next CAC meeting will include a presentation on flow data and the inflow, infiltration, and baseflow components of flow data.

Q. Do return flow frequencies correlate with rainfall frequency?

A. No, they do not correlate because the same amount of rainfall can have vastly different impacts on the sewer system, depending on the amount of antecedent moisture (wetness conditions) at the time of the rainfall. A return flow frequency of 25 years means that, in any given year, there is a 4% chance of that level of flow occurring within the system.

Q. Does flow refer to what we flush or run down the drain? What's included?

A. Flow refers to personal and commercial use (what we flush, etc.) as well as the water that enters the sewer system through infiltration.

Q. Does the base flow in the hydraulic model include wet weather?

A. The base flow component includes the daily use, plus the groundwater infiltration that occurs year round. The wet weather component refers to the amount of inflow that enters the system after a rain event through footing drains, manhole covers, etc.

Q. Based on the hydraulic modeling results, can you say that any of the FDD study neighborhoods will have surcharging or flooding?

A. The model shows that the interceptor is full in certain areas, but does not show beyond-capacity flow in the neighborhood pipe. Project team members caution that without meters in all the pipes, there's no way to know whether an individual pipe might have a root intrusion or other obstruction.

At a future meeting, the project team will show maps of the system model with SSOs and historic basement backups overlaid.

Q. Looking at the map, can we say whether homes in the red areas will have basement backups?

A. A project team member opened the model and zeroed in on a particular red area, which shows that the sewer flows extend beyond the pipe (surcharging.) Any areas where flows extend beyond the pipe are problems for which the CAC will make recommendations to resolve. Basically there are two ways to fix these areas: take the flow out upstream or put in storage. The project team and the CAC will determine what types of projects can be done, the costs of those projects and how they mesh with community values.

Q. When you monitor the depth of flows in sanitary sewer pipes, do you monitor only flow or also depths in manholes?

A. Both.

Q. What does it mean to re-distribute metered flow in an area?

A. In Area A, for example, the metering shows that there's a significant flow coming from the area; however, it's unknown whether it originates from the north or the south. Additional meters located in upstream in the problem areas are needed to determine where the flows originate.

Q. In looking at the analysis for Area B, it looks like there's something significant blocking and backing up the flow.

A. Yes, we have depth sensors that prove that the flow reached a certain height in the pipes; however, according to the model, it should not have. Rather than spending millions of dollars to build a storage tank, the problem might be solved by reconstructing a couple of manholes. The same is true of Area C.

Q. How would anecdotal flooding data be entered into the model?

A. The best data to collect for a particular area that's having issues, like Glendale, would be to put depth sensors in the sanitary pipe. Troy Baughman believes the City does still have some peak flow recorders in place.

Q. Having 3 sewer lines blocked at one time in a 5 block area [Glendale] is totally unacceptable. Having modeling that does not catch this is also an issue. It is presented as a means to indicate basement backup potential but did not provide this in the Glendale neighborhood due to blockages. I agree that the model should be looked at by the TOAG with the Glendale map. The problem we are having is the lack of permanent gauging in the city to detect and prevent sewer backups. It is a much less expensive and better method to deal with backups. The cost of these gauges, which

do not need to be accurate to a 1/10 of a inch, have come down and could send data directly or picked up by garbage trucks on weekly rounds, to city hall to be used as an early warning system for repair assignments. Data could also be used to determine the effects of changes on the system such as new development or city efforts to reduce flows thru a special program, like new low flow toilet subsidies.

A. I totally concur that having multiple lines blocked at the same time in such a small area is unacceptable and that better tools are needed to proactively detect and correct these issues.

Metering is one technique to detect some of these blockages. Some of the issues with metering for detecting blockages is that it can be very expensive to completely meter every pipe in the City, it is reactionary (i.e. it detects an problem after a failure has occurred), and processing and managing the data generated by a large metering network can be onerous.

One challenge with metering to detect blockages is that the meter must be located upstream of the blockage, within the zone of influence of the backup from the blockage. "Within the zone of influence" is the critical element for a meter to be used for detection. Standards for sewer pipe design dictate that to maintain adequate scouring or self-cleaning velocities, the smaller pipes upstream in neighborhood are sloped steeper than the larger downstream interceptors. The smaller the pipe, the higher the steepness that is required. This means that the "zone of influence" is shorter in the smaller pipes in the upstream neighborhoods due to the higher steepness of the pipe, thus requiring many meters to provide full coverage for all of the upstream pipes. We are potentially talking about a very large number of meters to cover every pipe in the City (hundreds or maybe thousands of meters - for reference we had 30 meters in for 3-5 months for this SSWWE project at a cost of about $200,000). This goes beyond the typical application for metering, and is the reason that meters are more applicable to detect issues in the downstream interceptors, where the pipes are flatter and the zones of influence are much longer, thus requiring less metering, and making metering more practical for the interceptors.

Detecting blockages in the smaller upstream pipes is more commonly done through sewer video inspection and manhole inspection. There are processes for inspecting and tracking the condition of sewer pipes over time, so that a proactive replacement and repair process can be put in place. Just like roads, sewer pipes generally don't fail all at once, although sometimes they do if you have ever tracked some of the sewer sinkholes that have occurred in the region. But more generally, just like roads, they deteriorate over time, and by using a regular inspection program on a rotating basis (every 3-10 years), the condition of a pipe can be tracked so that it can be repaired before a catastrophic failure and blockage occurs. NASCO's Pipeline Assessment and Certification Program (PACP) provides a very common framework that is used to do this (reference: http://nassco.org/training_edu/pdfs/pacp-macp_overview.pdf).

For a system like Ann Arbor that does not have a rotating program in place for video inspection, it might be desirable to do "one full lap" fairly quickly (perhaps in a year or two) in the high priority areas. This would establish a baseline condition, identify places where failure is imminent, fix those high priority areas, and then identify the appropriate time frame for a rotating program, based on the condition and risks associated with pipes in specific areas. Such a process is proactive, likely cost effective compared to metering every pipe in the City, and generates valuable video data that can be used to track pipe conditions over time. This is currently the industry standard process for monitoring and maintaining sewers, and is the program we would generally recommend to address the risk of frequent sewer failures in the upstream pipes.
That being said, a smaller number of permanent meters on the interceptors and perhaps on several key neighborhood connections may also be a good idea. Permanent metering of the downstream interceptors would provide information on blockages where the meter is in the "zone of influence" of the blockage, but more importantly, it would provide a long-term record of flow data from the system which can be useful for assessing impacts from growth, changes from system deterioration leading to new inflow and infiltration sources, the effectiveness of a DOM program (if continued), and important operational data to understand how the system handles future large storm events.

Q. How much can the City grow? You've used 10% in your model, but is it built out?

A. Ann Arbor has little greenfield development areas, some in the northeast Nixon Road area. To give perspective, during Cresson Slotten's 27 years with the City, there has been very little population growth. What has grown is Ann Arbor's employment base, however that has a small impact on water/sewer usage compared to an increase in residents.

Q. A CAC member comments that the model may not show every problem. In an informal survey in his neighborhood, almost 50% of homeowners said that they'd had basement backups.

A. Showing the model together with the reported basement backups should help with this evaluation.

Q. How was growth factored into the hydraulic model? Why was 10% selected?

A. There were many complex ways to predict impacts of growth; population change, water consumption change, employment change. The 10% factor was selected to give the CAC a baseline to judge impacts.

Q. Is a 50-year rain the same at a 50-year flow frequency?

A. No, the 50-year flow frequency refers to a chance of recurrence. The antecedent moisture can have a big impact on how much flow is generated by the same rain event.

Q. The backbone model shows few problems, but looking at the neighborhood scenarios may not give enough information to accurately evaluate the issues.

A. The modeler may be able to extend the backbone model to include all the red pipes.

Can we determine whether the areas with red pipes shown on the maps are having a problem for only a minute or for hours?

A. The maps are showing the peak hour, the highest one-hour of flow in the system, running over two days.

Q. Are we [the CAC] possibly spinning our wheels here? Is City Council going to say, "we don't care about a 50-year plan you're recommending, we want a 25-year plan"?

A. We can't predict what City Council will do with recommendations, however we can give the CAC mitigation options and related costs, which will help to understand the costs, the level of protections that projects may afford and help create the case for making any particular decision.

Q. Can CAC members get a copy of the model maps for a longer review?

A. Because of Homeland Security restrictions, the City may not be able to distribute the model maps as they were shown during the meeting, but the project team will explore ways to convey the modeling results to the CAC without violating security restrictions.

Q. The April 2014 preliminary hydraulic presentation showed 50-year flows, why the change to 25-year flows?

A. When the contract limits from townships were added, growth was added and climate change, the 50-year system assessment showed many problems and also represents a very high level of service when you've already included both growth and climate change. The 25-year flows, with the added flows from growth and climate change are similar to 50-year flows without those conditions. If, after reviewing the results from the two proposed scenarios, the CAC wishes to evaluate a 50-year return flow frequency, the project team will do so.

Q. Given that water usage in the City is decreasing even though the population has increased, does it make sense to use lower growth numbers in the scenarios?

A. Yes, by using a 10% flow increase, you can allow for a range of impacts, whether those are from growth or climate change or some other factor.

Q. Scenario A shows a base of 29 cfs, with a wet weather inflow of 60 cfs, but you do not account for where it's coming from. Can you account for the sources of infiltration as well as how difficult the different sources might be to remove?

A. Yes, the project team expects to be able to show that analysis to the CAC in July. At this meeting [May], Murat can show the geographic areas contributing the additional wet weather flow, but not the component sources.

Q. Is Scenario B the same as a 50-year return frequency?

A. Yes, it's similar. Scenario B covers several different conditions: a certain amount of climate change or growth in the City or climate change.

Q. The U of M stadium was lowered to be below the flood plain; it may be constantly pumping water. Could that contribute to problems in Iroquois area?

A. Robert comments that the issues in the Iroquois area are very strange; the situations do not match the metering data, which do not show flow exceeding the capacity of the pipe. More investigation is required.

Q. How does the 8 MGD storage volume given as an example compare with that of Michigan Stadium?

A. If you assume that Michigan Stadium was a rectangle with dimensions of 300 feet by 500 feet and was 100 feet tall, that would be 112.2 million gallons (MG). For comparison purposes, a 10 MG storage tank that was 20 feet deep would be a square with an edge length of 260 feet.

Q. Who is responsible for uncovering the anomalies that were shown in the model?

A. The City. Field crews are investigating now, based on the model results, but the City cannot predict what it will find or when. Sometimes there is no obvious cause, such as a large obstruction.

Q. Is the reason the Scenario B does not include any increase from the townships that City Council would have to vote to approve any increases to contract limits and would not, without townships funding improvements?

A. Correct.

Stormwater, Flooding, Porous Pavement

Q. What is the capacity of our storm system?

A. For a given area, the storm sewers generally have a much larger capacity than the sanitary sewers. This is because the flow generated from a property from stormwater runoff is significantly larger than the sanitary sewage generated, and the range of flows within a storm sewer system are much higher than that of a sanitary sewer system. Please note: storm systems are not designed to handle all storm events! In large events, surcharging into the streets is expected. The streets hold the water until it can enter back into the storm water system. The Stormwater Model Calibration and Analysis Project will determine the capacity and effectiveness of our storm sewer system

Q. Are you studying how the flow from the recently installed sump pumps increases surface flooding?

A. Yes, this will be studied as part of the Stormwater Hydraulic Model Calibration & Analysis Project.

Q. Is it true that city-wide, stormwater flows play a small role in overall flooding, but in areas with high water tables, removing excess stormwater may relieve localized flooding problems?

A. It may be the case, but that issue has not been studied. The Comment section of the Executive Summary is a great place for CAC members to emphasize their opinion of the high importance of the issue.

Q. Some areas around the City experience extensive stormwater flooding. If that flooding was eliminated or reduced, would it decrease the flow to the sanitary sewer and eliminate the need to perform FDDs? Has this ever been studied?

A. Footing drain flow is generated from an area near the house where stormwater runoff and ground water are captured and drained to the footing drain. For stormwater runoff, this is generally a small area directly around the house, perhaps on the order of 5-20 feet from the foundation, depending on the grading and slopes around the house. This is why proper grading and extension of roof downspouts away from the house is so important.

There may be some homes where, in a large enough storm, surface flooding reaches the contributing area of a house that generates footing drain flows. However, it is not uncommon for backyard drainage from a number of homes to contribute to footing drain flows at the home located at the lowest elevation if this water cannot flow to the street and enter the stormwater system. In those locations, preventing stormwater from reaching the footing drain contributing area through better grading around these types of homes would reduce the flows to the footing drains during an extensive surface flooding event. However, the number of houses that occasionally experience this condition are small compared to the large number of houses with footing drains. The majority of footing drain flows are generated from houses without extensive surface flooding issues, where the footing drain flow is generated from the regular house contributing area.

The City has not studied in detail the impact of improving the stormwater system on reducing sanitary sewer flows. However, we do have some anecdotal observations that we may draw conclusions from. Prior to the FDD program, there were several areas around the City that experienced sanitary basement backups without extensive reports of surface flooding occurring (such as the **Orchard Hills and Bromley areas).** The significant footing drain flows in these areas were generated from the normal stormwater runoff captured from around the house. Now that FDDs have been competed in these target areas, the risk of sanitary basement backups has been greatly reduced, to the point where additional FDDs are not recommended. Additionally, on June 27, 2013, the City experienced a very large storm that produced extensive stormwater surface flooding, and there were very few reports of sanitary basement backups in the City.

Another contributor of flow into the sanitary sewer system is surface flooding in the streets above the sanitary manholes through holes that are used for removing these manholes. This source of additional flow into the sanitary sewer system was identified several years ago, and the City has installed plugs in many of these manhole holes in locations where flooding has been observed or the official City floodplain map showed flooding should occur for large storms to very cost effectively remove this source of wet weather flow in the sanitary sewer system. An ongoing study of the stormwater system is identifying additional localized surface flooding locations where these manhole holes should be plugged. The City is also installing better sealing manholes and solid manhole covers in areas where they are needed as street reconstruction or resurfacing is being performed.

These observations suggest that the footing drain flow generated from surface flooding that approaches the house is not a significant source of wet weather flows into the sanitary sewer system. That is not to say that these surface flooding issues are not important - it simply means that the main driver for addressing them should be to address the surface flooding problems, and not because of excessive flows in the sanitary sewer system.

While the reduction of surface flooding in some areas may cause a small reduction in the flows into the sanitary sewer system, the flow evaluation and modeling performed has shown that sufficient flows have been removed, and that additional FDDs are not necessary in these areas.

Q. What about FDD homes that are high producers of storm water flows, where those flows can't enter the stormwater system because it's overwhelmed. Those high producing homes may have graded their property and done everything possible to mitigate stormwater impacts but can still potentially cause sanitary backups in homes downstream, requiring FDDs in other homes. However, if the stormwater system were able to handle the larger rain events, the FDDs would not be required. Isn't the City failing its responsibility to ensure that the stormwater system has adequate capacity?

A. There's an important difference in level of service results between the sanitary sewer system and the stormwater system that may not be widely understood. In general, the level of service for the sanitary sewer system is expected to be higher (greater capacity, less frequent surcharging) because of the health, safety and regulatory issues related to sewage. It's different for the stormwater system; a community cannot economically or physically build a stormwater system that absorbs every drop of water from every inch of the City and prevents it from settling into homeowners' yards or the street. The capacity of a street to temporarily hold rain water is factored into the level of service for storm systems. When people complain about water in the streets, they don't realize that the streets function as a temporary storage device. Much of the stormwater system was designed to handle a storm of a size that recurs about once every five years, while some of the newer sections were designed to handle larger storms that have a 10% chance of occurring each year.

Q. The Malletts Creek Study developed several recommendations to address flooding in certain neighborhoods, like Lansdowne. If those projects were constructed, it could solve some of the stormwater issues in those areas.

A. Yes, the Malletts Creek Study developed its project recommendations based on the March 15, 2012 storm, an event that has a 10% chance of occurring every ten rains. That's a level of service that the stormwater system was not designed to meet, because of the relative infrequency of those storms, combined with the large capital costs. The Stormwater Calibration project includes modeling several different storms, to develop a standard for the stormwater system that meets community values for both level of service and economics.

Q. Will development in outlying townships (like Scio Township) that will increase impervious surfaces, increase flooding in Ann Arbor?

A. Developments throughout Washtenaw County must follow the County's stormwater management mandates, which require developers to use stormwater management best practices so as to not negatively impact the stormwater flows in the area.

Q. What would happen if Scio Township wanted to send more flow? Would Scio or Ann Arbor have to pay to build a bigger pipe?

A. The model used to evaluate sanitary sewer system capacity in the SSWWE project already assumes all the townships are at their contract capacity; however, in the event of a renegotiated contract, Scio would typically pay to upgrade infrastructure.

Q. Extensive site development is currently being performed in Pittsfield Township on Oak Valley Drive, near the Pittsfield Branch Library / Target. Does the storm water from this area flow to Upper Mallets Creek through the Churchill / Morehead neighborhoods? If so, what enforcement mechanisms are in place to prevent the same clogged and failed detention ponds that occurred at the A2 Ice Cube facility in April of 2013?

A. Developments in that area are outside the City boundaries and are under the enforcement responsibilities of Pittsfield Township.

Q. Does the hilliness of a community affect the stormwater flows?

A. Greg Marker believes that soil types have more impact on stormwater flows than elevation. Says that Michigan has the most widely varied soils in the country.

Q. After funding the 1997 Stormwater Master Plan, did the city add any storage and increase pipe size due to results of that study?

A: Many stormwater improvement projects (eg. regional detention, oversized storm sewer pipes for providing detention under roadways, etc.) have occurred since the 1997 B&V study. These project locations are identified on the Citywide Storm System Improvements map located in the website library. http://www.a2gov.org/Documents/Citywide_Storm_System_Improvements.pdf

In addition, the project team for the Citywide Stormwater Modeling & Analysis project is performing an analysis of the FDD impacts to the city's stormwater system. These findings will be shared with the CAC when completed.

Q. Will the City consider the use of porous pavements and porous unit paving for replacement streets especially at the work proposed by the Upper Mallets CAC for Scio Church and Mershon streets?

A. Any street reconstruction project will follow the City's Green Streets Policy. As part of this policy, engineers will evaluate the feasibility of using various infiltration methods.

Q. Could the use of porous pavements and porous unit paving be beneficial for the highly impacted streets near Churchill Park?

A. Any street reconstruction project will follow the City's Green Streets Policy. As part of this policy, engineers will evaluate the feasibility of using various infiltration methods.

Q. Was the use of porous pavements and porous unit paving considered for the new street construction on Madison between 7th and Main St?

A. Yes, it was. There were some areas where soils were suitable for infiltration and various infiltration methods were incorporated into the design.

Q. When the City did the storm water tank project at Pioneer HS, can CAC get a copy of the evaluation of the effectiveness?

A. A copy of the Pioneer High School BMP Water Quality Monitoring Program report dated March 30, 2012 can be found on the City's project webpage at www.A2gov.org/SSWWE > Library.

SSWWE Results, Recommendations, Alternatives

Q. Were any problems found in the target areas [when the sewer pipes were inspected and televised]?

A. Tree root issues were found just downstream of Dartmor, otherwise no major deficiencies were noted for the target areas. The area downstream of Dartmor was cleaned and is being programmed to be lined in the near future which will prevent future tree root intrusion.

Q. The rain gauges are very useful for data collection. Can you keep them in place?

A. There are already several permanent rain gauges located around the city. The City will consider the possibility of adding additional permanent rain gauges and flow meters during this study.

Q. How do all five districts compare in before FDD/after FDD storm response?

A. See the comparative graphs OHM developed for the five districts for the June 2000 storm, the June 27, 2013 storm and the August 12, 2013 storm; CAC October meeting materials and summary.

Q. How much more FDDs are needed when we're getting such good results from these 2600? What's the goal?

A. One aspect of the current study is the evaluation of system hydraulic deficiencies during a design rain event. The results of this analysis are anticipated to include an identification of additional capacity needs, if any.

Q. If all footing drains were disconnected, would we have enough sanitary capacity?

A. We don't have enough information to determine that right now. Disconnecting footing drains has returned some capacity to the sanitary sewer system, and this study will measure how much.

Q. Wouldn't installation of low flow fixtures (aerators, shower heads, toilets, and clothes washer) which in my house over last 5 years reduced on average daily water usage to approximately 100 gallons/day, be a significant factor in reducing peak flow in sanitary sewer and factor into whether a home should be forced to participant in FDD in that neighborhood?

A. Any reductions to base flows from low flow fixtures would be helpful in addressing the peak flows in the sanitary sewer system. However, this solution alone is not sufficient to fully address the issue. For example, some of the peak wet weather flows in the sanitary sewer in the priority districts prior to FDD were 30 times the levels of the sewage base flows. That means that even if the water consumption and resulting sewage base flows were reduced to zero during wet weather events, the remaining wet weather flow that is 30 times the level of the base flow would still have to be dealt with.

Q. What about SRF loans, that the City has gotten in the past, where all or a portion of the loan was forgiven?

A. Yes, that's true, the City has obtained some SRF loans, of which a portion was forgiven, typically those that involved improvements to water quality. Those were funded by the U.S. government's Stimulus Program and at some point, that program will no longer be available. The City cannot count on any portion of a loan being forgiven in the future.

Q. Are there SRF loans available for the sanitary sewer system also, or only for stormwater?

A. Yes, there are SRF loans available for sanitary sewer systems and the City mainly uses them for the water treatment plant. Each source of funding has different rules that govern how it can be used. The State's sanitary SRF program is much larger than it's stormwater program.

Q. I would like to know the relative costs of the various approaches being considered.

A: Relative costs were provided to the CAC as part of the detailed review and discussion of the various approaches. [See this presentation] from the July 2014 CAC meeting.

Q. I would assume that the City and your resources are looking into Storage Projects in SE Michigan and elsewhere. In quick look at www.dwsd.org there seems to be a predominance of Retention Basin projects ongoing in the area. A quick look will not reveal much on sump pumps.

Q. In the July 9, 2014 CAC meeting presentation of preliminary evaluation of alternatives, you list a cost for storage, what kind of storage is it? A tank, a large pipe?

A. The estimates were based on the total volume to be stored, not a particular type. They are intended to provide reference points only.

Q. Are different capital improvement projects competing for the same funds? Say roads vs. sewers?

A. No, road funding and revenue sources can only be used for transportation projects and sewer revenue for sewer system projects.

Q. Where will the additional funding for the reconnaissance and targeted metering come from?

A. From the sanitary sewer fund that is designated for repair and upgrades.

Q. What's the size of the pot for road funding?

A. There isn't time to respond to that during the CAC meeting, as the time is needed to cover material that is directly related to the SSWWE project, but anyone who wishes to discuss it with City staff outside the meeting is welcome to do so.

Q. If a project is on the CIP, does that mean it will be performed?

A. Often they are, but occasionally there are other influences at a higher decision making level that impact whether the project is performed when programmed.

Q. Can funds be "stockpiled" in order to fund larger projects than what is allocated each year?

A. Yes, in fact, the City stockpiled annual revenues to fund the work at the WWTP.

Q. Because FDDs were put on hold for the last two years, were those funds stockpiled?

A. A portion of the FDD program continued, some of the funds went to pay for the SSWWE study and others, and some were diverted to other projects within the same asset.

Q. A CAC member asks to have a City representative attend the March CAC meeting to discuss the City's budget availability for alternatives: "the City should present some cost/ budget data to us. It's possible that we could include in our final recommendation that the City increase fees on both the sewer and surface water portion of the Utility bills to each resident to help increase the budgets for our proposed solution."

A. The April 17 CAC meeting will focus on the hydraulic analysis at the neighborhood level, WWTP functions and capacity, FDD survey follow up and community values discussion. A budget presentation is planned for the May CAC meeting.

Q. Will there be a point where studies are no longer included on CIP, but instead all the funds are used to pay for infrastructure projects?

A. Studies are included on the CIP list, just as construction projects are included. But yes, the asset teams could determine that they want to stockpile funds for construction. There's a balancing act between building and infrastructure repairs and funding studies to determine how to solve a particular, more global issue. That what's happening right now, with the three related wet weather studies. Those can be thought of as similar to a master plan; developing a global solution to wet weather problems.

Q. City representatives have stated that all recommendations will be considered in resolving the Storm Water and FDD programs. Is this the City's position?

A. Yes.

Q. Does the City have available budget to complete the SSWWE study's six recommended projects, or will these be deferred until later, like the Malletts Creek Study projects?

A. These six projects are being entered into the current CIP process, and will be evaluated and programmed in comparison to all other projects funded from the Sanitary Sewer Fund. While City staff can't say for sure where they will end up, the Sanitary Fund is larger than the Storm Fund, and we anticipate they will be programmed.

Q. Will all the recommendations be posted on Basecamp for the public to review?

A. All the recommendations and presentation documents are posted on the project website's Library page.

Q. Will the Final Report include the CAC's recommendations on FDDs and mitigation? Concerned that Council is so overwhelmed with material, that the Executive Summary should be as brief as possible.

A. Yes, the team will create a 1-page overview of the recommendations and include in the front.

Q. Be sure to include information in the report about stormwater as well as installing permanent meters. Make it a more robust effort, City-wide, not just in target areas. Will be important in the Lawton and possible Glendale areas.

A. Yes, the recommendations are prominently included in the Executive Summary.

Q. Would the City think about bonding this [recommendations that might come out of the SSWWE project]?

A. Yes, it's possible. The City's current WWTP upgrades ($120M) were 7 or 8 years in the decision-making process.

Q. If the current study by OHM reveals that there are now only select areas with potential sanitary sewer "back ups" due to surcharging of the existing sewer pipes, is it possible to remedy this with auxiliary pumping stations located in manholes in the right-of-way, near these selected areas, in lieu of performing more FDDs?

A. Once we have completed the risk assessment portion of the project, then we will be exploring all options to mitigate sanitary surcharging.

Q. Have we discussed any other alternatives yet, such as increasing sanitary sewer storage?

A. The study includes an alternatives evaluation beginning Feb/Mar 2014, which will evaluate several alternatives to alleviate potential hydraulic system deficiencies, including storage.

Q. [What about storage] somewhere downstream, closer to the Treatment Plant, the idea being to avoid spills/EPA fines...The resolution of upstream flow capacity was quite completely covered in the 1997 report, showing pipes in red needing upsizing, and pipes in blue considered satisfactory. These pipes were shown regionally, within the City. In the 2001 Report, Sanitary storage was ranked at 100% in

several regions, and 95% in others (losing out to Disconnects). Your mail reiterates that probable solutions will be regional (or localized). I completely agree with this because it means we could spare much of the grandfathered residences and possibly new ones from what I consider a nightmare of new problems associated with pumps. And, at a rate of 600-700 disconnects per year (including homes with very low footing flow), it would take over 30 years before running out of Mitigation possibilities. Meanwhile we are supplying Sanitary service in alarming numbers within and outside of the City with no plan for increased Treatment Capacity (and $145,000,000 to just modernize but stay even in capacity?) The City/City Council selected the Disconnect process because there were more 100% areas than 95% areas; the ranking system being arbitrary and not scientific. (Some current Councilpersons like Consultants because they can choose to ignore their conclusions and recommendations. They have that right, but they are elected by us. I wonder how many of them or City Staff have sump pumps and are in a position to judge?)

A. Thanks for the feedback. I think a lot of these items will come up and be examined during the alternative evaluation. We will be preparing a similar map as the 2001 study color-coding the pipes by capacity available, with the impacts of the FDDs done to date reflected on the map. That should bring a lot of things into focus.

With respect to storage, if we find that it is needed, it will be a balancing act on where to locate it. Pushing it downstream closer to the plant will mean that added pipe capacity in the form of relief sewers are needed to get the flows from the neighborhood where the flow is generated to the storage tank, and that adds cost to the storage as an alternative. If you push it upstream closer to the source, you run into limited land availability. One option that might be a good idea to examine is the notion of “linear storage”, whereby flow is stored in an oversized pipe. This might allow us to get the storage closer to the source. Linear storage has its own disadvantages that we will have to review with the CAC and the City. The evaluation of all of this is really going to depend on the outcome from the hydraulic evaluation, and input from the public.

One item that I feel is necessary to set the record straight on is your comment that "The City/City Council selected the Disconnect process because there were more 100% areas than 95% areas; the ranking system being arbitrary and not scientific.” As I understand the history, that is not an accurate depiction of how the decision was made. It is my understanding that the City formed an SSO task force and conducted several public meetings, where the citizens on the task force examined the options and decided that they would rather disconnect FDDs than place storage tanks in the parks, woodlands and wetlands that were available for tank sites. The public made this recommendation to Council, and the City implemented the recommendation. It was a very similar process to the one being followed now.

Q. Are you expecting any action by Council regarding the FDD ordinance [as a result of the findings of the SSWWE Study]?

A. Yes, we think it's likely that the FDD ordinance would have to be modified, based on the results of the SSWWE Study, but we don't yet know the specifics.

Q. Can OHM clarify why "install backup pumps" is not one of their Best Practices for Footing Drain Disconnection Program suggestions? Did it not work out when other municipalities installed them?

A. In FDD Subcommittee meetings, Greg Marker, OHM construction engineer, was asked this question. He responded that installing a backup up pump isn't a unilateral recommendation because a back up pump is another mechanical device that brings additional operations and maintenance responsibilities. Homeowners should determine for themselves whether they wish to add a backup pump. In some communities where Greg has worked on FDD projects, the municipality offered backup pumps as an inducement to volunteers, however not all homeowners opted to have them installed.

For more detailed information on the approach taken by other municipalities, refer to the Backup Systems Summary from other programs 10.28.14.pdf document, located on the SSWWE website > Library page > Project Materials.

Q. What does "robust, incentivized" FDD program solution mean in the CAC recommendation?

A. Robust means a high quality pump, and includes a back up pump.

Q. [In our first SSWWE handout OHM Advisors stated] ***In the City's sanitary collection system, it was estimated in 2000 that 70-90% of the wet weather flow was coming from footing drains. Tackling that item first is very prudent and a reasonable course of action. By addressing the 70-90% of the problem, it is very likely that the City significantly reduced the risk of basement flooding,***

So, if a homeowner choses to have an FDD and sump pump installed, is it not a logical conclusion that the SEWER portion of the utility bill that is based on water use, should be reduced by 70% to 90% each month if the home now has reduced it's flow to the sanitary system by 70% to 90%?

A. The key term in the 70-90% removal rates is "wet weather flow." This is peak flow during large, design rainfall events. It typically rains about 150 hours out of 8,760 hours in a year in Michigan. So the vast majority of the time, the sanitary sewer system is not collecting wet weather flow.

We often find that although the wet weather inflow and infiltration sources like footing drains dominate the peak design flow, over the course of an entire year, it is common for them to be in the 2-5% range of total sanitary flow. So these wet weather flows are very short, intense bursts of flow that drive the performance and design conditions of a sanitary sewer system.

If I were to peg a typical sanitary sewer system, I would say the following:
Over the course of a **whole year**: (numbers picked not for precision, but to get the total to add to 100%)
3% of the flow is wet weather inflow and infiltration
60% of the flow is sewage from water consumption
37% is ground water infiltration

During **peak wet weather flow**: (numbers picked not for precision, but to get the total to add to 100%)
80% of the flow is wet weather inflow and infiltration
12% of the flow is sewage from water consumption
8% is ground water infiltration

Hope this helps illustrate the flow components. It also sheds some light on the potential for water conservation measures to make a significant dent in the peak flow. We published some information about these flow components in the flow metering report.

Rate Study

Q. What is the intent of a rate study?

A. During a Citizens Advisory Committee meeting, Craig Hupy clarifies that City staff would recommend to Council that a rate study be conducted. When a rate study occurs the rate consultant would be asked to examine creating a separate class of ratepayers.

Q. Will the rate study incentivize homeowners to get FDDs?

A. That’s not the intent of the rate study and there’s no recommendation to continue FDDs as a tool for City programs.

Q. Would the rate study cover sanitary and storm?

A. No, the rate study would cover sanitary and water.

Q. Can the water from a water-supplied back up system be metered separately for credit negotiations with the Water Department?

A. This question can be addressed in a future rate study, however, it would require a second separate meter.

3. FDDs, FDD PROGRAM, FDD SURVEY

FDD Program, Homeowners, Survey

Q. In what era were homes constructed where their footing drains were connected to the sanitary sewer system?

A. Most homes constructed between 1935 and 1980 have footing drains connected to the sanitary sewer system.

Q. How do you determine if a house has footing drains connected to the sanitary sewer?

A. An on-site assessment of each home is performed by the FDD Construction Manager to determine if the footing drains are connected to the sanitary sewer system.

Q. If significant structural work is done on a home, does the footing drain have to be disconnected?

A. Disconnection is required for any work done on a home that involves replacing or altering the existing footing drains such as foundation and/or basement wall work.

Q. How many FDDs have been done in Ann Arbor?

A. Approximately 2,800 FDDs have been completed since the start of the program in 2001. This includes the City's program and those performed under the Developer Offset Mitigation (DOM) program.

Q. I want to see how many total FDDS have been installed in each target neighborhood, and how many were installed in non-target neighborhoods. This data could be provided /collated in an "area summary" and that would satisfy the primary intent of the question, without revealing the actual addresses.

A: Completed FDD equivalents as of Nov, 2013:

Bromley	229
Dartmoor	297*
Glen Leven	537
Morehead	352
Orchard Hills	346
Other Areas	1356*

*include multi-family FDD equivalents

A citywide map of the locations where FDD has been performed is posted on the City's project web page at www.a2gov.org/SSWWE > Library.

Q. How many FDDs have been done since the summer of 2012?

A: The following FDDs have been done between 6/4/12 and 2/6/14:

Completed FDDs = 35
Developer Mitigation FDDs = 161
Dartmoor Multi-family FDD equivalents = 62.5

Q. What's the benefit of doing FDDs, if you can get the same stormwater reduction result from fixing the pipes? Or if pipes are deteriorating at a rate to offset any reductions from FDDs?

A. It is not clear that the same flow removals can be achieved by rehabilitation of the pipes. The analysis of effectiveness of the FDD program on flow removals will identify how much flow was removed from FDD's and how much remains from other sewer defects in the five priority areas. This information can then be used to answer this question, and assess the feasibility of non-FDD flow removal in the future.

Q. What about the strategy of doing FDDs throughout the City, rather than just in certain neighborhoods? Would that give you a better outcome?

A. Recall that the objective of the FDD program in the five priority districts was to address basement backups within those neighborhoods. To be effective in this objective, the FDDs had to target the neighborhoods with the basement backups. Evaluation of future FDDs as an alternative must consider the location of the FDDs relative to the capacity of the sanitary collection system and the risk of future basement backups. This evaluation, together with the evaluation of other options such as storage, will be evaluated in the next phase of the study.

Q. How old are the pipes in each of these neighborhoods and could infiltration via cracks, roots, etc. be causing stormwater to enter the sanitary sewer system? (Meaning that footing drains do not comprise as much of the flow as estimated.)

A. We prepared plots for the December CAC meeting that includes flow components, e.g. inflow, infiltration, base flow, etc., which will help assess how much stormwater is coming from other sources, and what these sources look like in the flow data. The decade of installation for the sanitary pipes in the 5 study areas are shown below

Orchard Hills & Bromley – 1960's
Dartmoor – 1950's to 2000's
Morehead – 1960's to 1990's
Glen Leven – 1950's to 1980's

Q. What is the distribution of FDDs throughout the city? Can we see a color map, a heat map? Additional map – backups in 2000 vs. 2013 comparison.

A. These FDD maps were displayed at the December 12 CAC meeting, and are posted on the project webpage at www.A2gov.org/SSWWE > Library. Click here to download and view the locations of FDDs performed under the City's program and the Developer Offset Mitigation program (DOM.)

Q. Please provide copies of the letters and post cards that were sent to homeowners informing them of the FDD program, and that their neighborhood was going to be part of the FDD program.

A. The homeowner packet is available online at the FDD Program website: www.a2FDD.com. Here's the direct link: http://www.a2fdd.com/Documents/FDD_Packet_v8.4_Master.pdf

Q. Who is responsible for updating the FDD page of the City's website? Why are there no recent updates?

A. The FDD page is maintained by CDM, in their role as consultants managing the FDD project. Project updates are posted each week. There has been little new information to report since the program was partially suspended.

Q. Can we get a cost so far for the City's FDD program? The SSO report listed the project with a projected cost of $80-130 million. Would be nice if this was broken down with what city paid for and what developers have paid for.... and how much

money the city has collected from them; an example was the file sent recently with UM's payment.

A: As of 2/8/14, the City costs for the City's FDD program are $20,020,569.40. Developer Offset Mitigation (DOM) is performed by, and at the expense of, the developer. The developer covers all of the costs for the mitigation work. The City does not have record of what these costs have been.

The single exception was for one project by the University of Michigan, where the University contributed funds to the City to cover the costs of the FDDs for its required offset mitigation. The contributed amount was $1,405,600.

Q. How does AA fund the FDDs that they mandate in the target areas? Does the city ever receive any payments for mitigation? From developers or from the townships?

The FDD program is funded from the Sanitary Sewer Fund, which is funded from user rates or bond sales. Developer Offset Mitigation (DOM) is performed by, and at the expense of, the developer. The developer covers all of the costs for the mitigation work. Developments within Townships that contribute flow to the City's system are required to perform developer mitigation in the same manner.

The single exception was for one project by the University of Michigan, which had at the time, constraints against use of its capital funds off-site. Because they owned no sites within the required mitigation area for the Michigan Stadium Renovation Project, they were unable to perform the FDDs themselves; so, the University contributed funds to the City to cover the costs of the FDDs for its required offset mitigation.

FDD Ordinances, legality

Q. Was FDD adopted by the state?

A. The State of Michigan does not have a specific requirement that communities must perform FDDs. FDD removals have been accepted by the State as a means of source removal for sanitary sewer overflows. Ann Arbor's Administrative Consent Order (ACO) with the State of Michigan required that the City perform 799 FDDs to control sanitary sewer overflows.

The State requires that participants in the State Revolving Fund (SRF) low-interest loan program implement the most cost-effective alternatives. Cost-effectiveness varies by systems and depends on the feasibility of all options including source removal, storage and transport and treatment.

Q. Administrative Consent Order entered into by the City with the Michigan Department of Environmental Quality (MDEQ) in 2003 indicates that the City would perform Footing Disconnects on 620 homes in the targeted areas. Those were completed between 2007 and 2009. Why, then, is the MDEQ ACO document continually referenced as justification to proceed with ADDITIONAL FDDs?

A. The ACO actually required the City to perform 799 equivalent FDDs, which have been completed. The ACO requirement has been cited when giving a history of the program.

Q. What is the legal justification (ordinance) behind the FDD program?

Q. What State or Universal code is the basis for the City Ordinance requiring homes constructed before 1982 to have footing drains disconnected from the City's sanitary sewer system and sump systems installed?

A. The Michigan Home Rule City Act was amended in 2002 to add Section 5j:

"A city, in order to protect the public health, may adopt an ordinance to provide for the separation of storm water drainage and footing drains from sanitary sewers on privately owned property. The legislative body of a city may determine that the sewer separation authorized by this section is for a public purpose and is a public improvement and may also determine that the whole or any part of the expense of these public improvements may be defrayed by special assessment upon lands benefited by the public improvement or by any other lawful charge. A special assessment authorized by this section shall be considered to benefit only land where the separation of storm water drainage and footing drains from sanitary sewers occurs." MCL 117.5j (emphasis added).

Although the City Council adopted Section 2:51.1 of the Ann Arbor City Code, which governs the current footing drain disconnection program, in 2001, the amendment to the Home Rule City Act in 2002 makes clear that the ordinance and footing drain program are authorized under Michigan law.

Amendments in 1987 to the federal Clean Water Act require municipalities to take steps to prevent sanitary sewer overflows. Such overflows, resulting in the discharge of pollutants into the rivers and streams, would violate the City's National Pollution Discharge Elimination System (NPDES) permit. Since the early 1980s the state construction code, which the City is obligated to follow, has prohibited connections of downspouts and footing or foundation drains to the sanitary sewer system. The City's footing drain disconnects are consistent with those obligations. The sump pumps that are installed with the connections to the storm sewer system are no different than the sump pumps builders or contractors install – and have installed – in properties constructed since the construction code change in the early 1980s.

A quick search has found that other states and municipalities have adopted similar statutes and ordinances requiring properties to disconnect historic connections to the sanitary systems and connect with storm sewer systems. Some ordinances impose criminal penalties if a property owner does not disconnect stormwater discharge to a sanitary sewer; other provide that the municipality can shut off the water supply to the property if the property owner does not disconnect.

After searching case law, we have not found any administrative agency or court decision that has found a footing drain disconnection program to be illegal.

Q. How can a local ordinance in 2001 (that doesn't mention the words "building code" or "construction code") make a STATE building code suddenly retroactive 19 years after the fact? If so, the FDD Ordinance would have purported in 2001 to retroactively modify a 1982 STATE building code to make that code also retroactive from 1982 to 1966.

A. See response above, particularly Clean Water Act requirements and state construction code obligations.

Q. Why do footing drains connected to the sanitary sewer system violate building codes in Ann Arbor, but not in other cities, like Jackson, Ypsilanti or Pittsfield Township?

A. The Building Code was not the impetus for the Footing Drain Disconnection program in Ann Arbor. The 2001 SSO Committee recommended an FDD program to reduce the number of sewage backups in the five neighborhoods where 50% of all sanitary sewer backups had been reported.

Q. The initial SSOE CAC report listed concerns of the CAC on the legality of entering private property to install sump pumps. These concerns, and other legal concerns, have recently been submitted to the City. Has the current Rebuttal as submitted by an Ann Arbor resident, reviewed by the current SWWE CAC, been reviewed by the City Attorney? If so, is the FDD program still considered to have legal backing to proceed?

Q. Does the City have legal authority to continue with the FDD program? Is there a private property issue that would make the FDD program illegal?

A. Yes, the FDD program is legal. Private property issues do not apply to this situation, as the sump pump installation belongs to the homeowner, not the City or a commercial operation. On January 9, 2014, the CAC met with Asst. City Attorney Abigail Elias, who responded to legal questions raised by an Ann Arbor resident.

Q. Per the review of 2001 SSO Report, legal concerns were raised regarding the FDD program and private property rights. What were the actual legal concerns of the SSO during the formulation of the report in 2001?

A. At the January 9, 2014 CAC meeting, a CAC member posed this question to Asst. City Attorney Abigail Elias. Ms. Elias responded that task force members were asking what legal actions needed to be taken to enact a Footing Drain Disconnection program.

Q. The SSOE report, Section Q, portrays an Implementation Plan Flow Chart for implementation of the FDD program the first "box" or step in the process states, *"Create legal framework for Footing Drain Disconnection (FDD) Program."* During A. Elias presentation at the Jan 9 2014 CAC meeting, the CAC was told that the City created a "Law" or Ordinance at that time in order create the legal framework. What were the actual legal precedents, and court cases utilized to create the new Ordinance?

A. As these were developed over a decade ago, the City's Attorney's office cannot recreate what precedents or court cases were used. They would be the same ones that are available today, barring those that were decided after the City's ordinance.

Q. Why was sanitary storage rejected in favor of disconnects and pumps?

A. This was a recommendation made by the SSO Task Force, and is documented in the report found at this link: http://www.a2fdd.com/SSORpt.htm. We encourage you to review that report so that you can get the complete information directly, rather than receiving a paraphrased version here.

Q. What are the details of the 2001 Sanitary Storage option especially for the Morehead area?

A. Sanitary storage was considered and evaluated by the SSO Task Force, which ultimately recommended the Footing Drain Disconnection program. It is documented in the report found at this link: http://www.a2fdd.com/SSORpt.htm. We encourage you to review that report so that you can get the complete information directly, rather than receiving a paraphrased version here.

As part of this project, we will be evaluating alternatives for addressing the risk of future basement backups from wet weather flows, and that alternative evaluation will consider options within all three fundamental alternatives, including a) source removal, b) transport and treat, and c) storage. Information about approaches other communities have put in place were researched, compiled and distributed to the CAC at the Dec 12 meeting.

Q. Why was the FDD program suspended?

A. See City Council resolution R-12-435 Link:
http://www.a2fdd.com/documents/Temporary Suspension of FDD.pdf

Q. $100 monthly fee for refusing a FDD, how was this figure calculated?

A. The charge is based on the operational costs at the WWTP, combined with the cost of additional conveyance capacity and conveyance O&M that would be required to handle flow generated by connected footing drains.

Q. Was this $100 fee applied to all homes in Ann Arbor? Or just in these targeted areas of homes complaining of basement backups?

A. The fee is only applicable to the targeted FDD Program homes that did not complete the work within the stated timeframe.

Q. Can a City apply these fess to just a PORTION of the City's homes? Or is that a neighborhood association fee?

A. The City can only charge to properties that it applies to.

Q. How is the homeowner charged? Is this "fee" or "fine" found on their tax bill? Or their water bill? Or does it come altogether separately?

A. The amount is charged monthly, and is billed quarterly on the homeowner's city utility bill.

Q. The current FDD program imposes a $100 per month ($1200 per year) penalty on homeowners who chose NOT to have a FDD or sump pump installed in their homes. This is a tax on homeowners in targeted neighborhoods, only. How is it that the City can impose a new tax without the approval of all voters in the city?

A. The $100 per month charge is a utility surcharge, not a tax. Voter approval is not required.

Q. How many homeowners have opted out of FDD?

A. Three homeowners have opted out.

Q. We have seen pieces for the cost information for a typical FDD installation. To evaluate this option going forward, we should get an estimate of the "all in" present value of the cost to perform an individual FDD. This would include contractor cost, city

costs, the installation related costs, average maintenance and repair/replacement costs going forward, and average remediation and cleaning costs associated with a pump failure (multiplied by failure rate). We will need this if we are considering further FDD as a possible recommendation.

A: This will be included in the review and consideration of alternatives. Based on the total costs of the FDD program to date and the number of FDDs performed, it is estimated that the total cost per FDD would be $9,000 to $11,000 per installation. This would not include annual maintenance costs after installation, or cleanup costs if a sump pump should fail. Annual costs for maintenance, replacement costs, and costs of unnecessary treatment of groundwater at the treatment plant will be estimated in the near future as part of the alternatives analysis

Q. Are the 620 FDDs that were required by the MDEQ Administrative Consent Order accounted for in the number of FDDs performed under the City's program or the Developer Offset Mitigation program? If so, in which category?

A. The FDDs required by the consent order are included in the total for the City program.

Q. How was the 2001 SSO Task Force's list of community values developed? Did they create it themselves or get it from some other source?

A. During the SSO project a variety of evaluation factors were developed by the CDM Smith team as well as by City staff and were presented to the Citizen Task Force.

Q. How many more houses in the City still have footing drains?

A. Based on the assumption that houses built between 1941 and 1980 have footing drains connected to sanitary sewer, the remaining potential FDD equivalents is approximately 15,000. Note: this includes both single family and multi-family properties.

We've discovered during our investigation work throughout the course of the program that, although some houses built prior to 1941 have connected footing drains, the majority do not have connected footing drains. Therefore, these homes are excluded from the above estimate.

Q. Prior to 2000, when people had a footing drain failure and replaced the footing drain, were they required to put a sump pump in?

A. This depends highly upon the individual circumstances, such as:

- Whether or not storm sewer was available to connect to
- Whether or not there is an acceptable discharge point

- Whether or not a gravity draining system is feasible
- Potential sump discharge point relative to lot dimensions
- Groundwater level
- Soil Conditions
- Extent of footing drain replacement/addition
- Whether or not the footing drain work was part of the original project or if the issue was discovered later

It should be noted that in many such cases, there would not have been storm infrastructure available to connect to, so many of the above factors presume that the sump would have to discharge to grade rather than connect to a curb drain like the system that was build with the FDD program.

Q. If a home's footing drains are not connected to an external collection system, what are the options?

A. The owner can pipe the stormwater collected in the footing drains to a rain garden, to the yard, a cistern or to the public system (with a right of way permit.)

Q. What are the basic number of houses/sump pumps per neighborhood?

A. This information was tabulated in the hand-out tables presented at the December CAC meeting. They are now part of the December CAC meeting handouts, posted in the Library of the www.A2gov.org/sswwe website.

Q. Why can't the FDD be done out at the street level rather than in residents' homes? Couldn't a separate storm line (for FDD water only) be constructed?

A. For a typical house with a footing drain connected, the footing drains beneath a house and the sanitary sewer lines in the house merge at a confluence point beneath the house foundation, and a single sanitary sewer service lead transports both flows to the sanitary sewer. Therefore, separation of the footing drain flow from the sanitary flow requires construction within the basement of the house.

That construction in the house entails the installation of sump pump and a sump pump discharge line transports the footing drain flows to a pipe in the street. Often, there is not a convenient location to connect this sump pump discharge line into the storm sewer system, so a curb-line drain is installed within the right-of-way behind the curb to collect the sump pump flow several houses. This curb line drain then connects to the storm sewer system at the next convenient storm manhole or curb inlet. Therefore, disconnection of the footing drains entails both construction within the homes and construction within the right-of-way at the street.

Q. Has the City studied the cost of reverse engineering of FDDs should that become necessary?

A. No.

Q. Was there an effort to look at other communities with FDD programs?

A. The project team has researched and provided reports of communities that have undergone FDD projects, as well as other approaches to mitigate wet weather effect on sanitary sewer systems. That document was provided to the CAC in preparation for its December 12 meeting. Additionally, Greg Marker (OHM Advisors) has personally acted as the Field Engineer for community programs in five communities (Farmington's Chatham Hills Subdivision, Auburn Hills' Bloomfield Orchards Subdivision, Westland, Romulus, Livonia.) He researched two others, which were included in a report provided a provided to the CAC and posted on the project website.

Q. Westland RPO and run-times Table 1, run times versus volumes - seems like a very high flow rate discharged. See 8341 Terri. 1 gallon per second? Many others are high too. Why? Was a bigger pump put it? How is this possible?

A. Information provided by consultant Project Manager, Robert Czachorski:

I would cite these reasons and comments for the difference:

The Westland project did use a Series 98 (1/2 HP) instead of the later Series 53 (1/3 HP). The Westland project did not use a line splitter for mounting the logger, and thus we figured out during it that sometimes the current was not enough to activate the logging device(that's why some houses had no data). There was likely lost time in the logging as it may have been a matter of split seconds at the start and the end not recorded by the logger. Another way to evaluate the loggers is by recording number of events and using a drawdown of each event (usually 6.5 gallons). Total run time is just another metric, however in the Westland case, it may be on the conservative side since the logging system was still in a testing phase and was likely missing some of each event.
I think the loggers likely missed split seconds at the beginning and end of the run cycle as the current was not high enough yet to activate the logger (a problem we corrected with the next pilot program by adding a line splitter to amplify the signal 10X). There is also rounding error in that the logger only records to the half-second, potentially losing up to one second each run cycle.

I also think that 1 gallon per second is not out of normal. The pump curve for the series 98 with 10 feet of head is 60 gallons per minute. See attached catalog sheet. My experience also supports that a cycle is about 6 seconds long to pump 6.5 gallons.

A catalog spec sheet on the Series 98 pump used in Westland is available on the City's project web page at www.A2gov.org/sswwe > Library.

Q. Did City of Farmington Chatham subdivision meter every home? And what was the cost? Did Ann Arbor meter homes?

A. Yes, all the homes in Chatham were metered. The estimated cost to meter a home is about $400 per home, and the metering period should be at least 8-10 months in order to capture multiple significant rain events. Anne Warrow and Mark TenBroek respond that the City metered about 40 homes for about a ten-month period, on a rotating basis, resulting in about 150 homes being metered.

Q. What can we learn from the outcome of the FDD program in Warren, Michigan?

A. Staff designing and implementing Warren's program consulted with City of Ann Arbor's FDD program manager, Anne Warrow leading into the formation of their pilot project. The Warren pilot program was performed in 2008 and planned to construct inside three areas with a history of backups, 15-20 houses with torpedo pumps in each area. The cleanouts were to be plugged in the traps and a torpedo pump installed. The 1" discharge was put on a splash block outside the house.

In the process of the program, 50 residents in each of the three areas were petitioned. The City received one response. They then offered to pay their water bill for one year, and received 3 responses. They expanded the offer to other parts of the City and ended up constructing 60 randomly. Three contractors were chosen with each being assigned 20. A total of 50 were done. No battery backups were installed; the cost for them was to be borne by the homeowners and no homeowner elected to purchase them. The agreement was for the homeowner to leave the system in place for one year and then they could do whatever they wanted with the system.

The pumps were metered and the results showed that 15,000+ of 45,000 homes would need to be disconnected for the program to be successful. Based on the lack of interest in the pilot and the high cost for the work, Warren's City Council moved forward with the OMI (Oakland Macomb Interceptor), relief sewer, and treatment plant upgrade plans which are all under construction and in the process of negotiating a user agreement to discharge excess to the OMI.

Q. An earlier response to a question about the FDD Program said that the Request for Qualifications (RFQ) for was sent out at program initiation to several contractors. How many is several?
Q. Who were the contractors who received RFQ's at program initiation?

A. We are unable to locate a listing of the contractors solicited at the start of the program, however a 2nd request for qualifications was sent out in 2003. A listing of those contractors can be found on the project website at www.a2gov.org/SSWWE > Project Library.

Q. How were the contractors who received the RFQ at program initiation selected?

A. Based on their submitted qualifications, interview and performance on a pilot home.

Q. What process did the city use to determine the four pre-qualified FDD contractors? Or, put another way, how does a company become a pre-qualified contractor for the city of Ann Arbor?

Q. Is there documentation that proves that the pre-qualified contractors met the pre-qualification requirements (such as a bidding process)?

Q. Did other contractors try to become pre-qualified? If so, what disqualified them? And, if any contractors were disqualified, who were they?

A. The City of Ann Arbor has developed a process for pre-qualifying contractors so that it is clear that they understand the methods and materials needed for a complete installation. The Request for Qualifications, RFQ-568 Prequal 2003b - Part 1.pdf [available on the City's project webpage at www.a2gov.org/sswwe > Library] was administered thru the City's Purchasing Office at the start of the program and is distributed to contractors seeking pre-qualification upon request. The RFQ requires letter of qualifications, along with information on the program specifications and asbestos tile removal requirements.

There were two contractors who were removed from pre-qualification due to performance. Landscape Construction and Michael Gross Contracting (MGC). MGC started with the FDD program in 2002 but had performance issues on the very first FDD installation. This was corrected by another contractor and MGC was removed from the prequalification list.

Q. Where (newspapers, trade web sites) was the RFQ publicly posted to attract applicants to become pre-qualified FDD contractors?

A: This went through the City's Procurement Office processes, following the solicitation policies in place at the time. Contractors inquiring about becoming pre-qualified have been allowed to apply throughout the program.

Q. Can the committee see maps with the number of houses in each neighborhood, along with pipe dimensions in each neighborhood?

These maps were available for viewing at the December CAC meeting. For security reasons, maps of the sewer system cannot be disseminated publically.

Q. What is the GPM of these sump pumps?

A. A half-horsepower pump will pump 60 GPM.

Q. What is a Fernco?

A. It's the name brand of the fitting that holds the check valve in place.

Q. Define head analysis.

A. It's the amount of pressure that water or the pumping system exerts on the system. Every 2.31' of water = 1lb of pressure.

Q. The head is determined by the head of the sump?

A. The head is increased by each bend because each bend increases the friction of the flow.

Gravity backup system, building code

Q. See the sketch of a backup system, created by Frank Burdick, and emailed to Ralph Welton for 6 specific questions regarding this sketch, as follows:

Q. The SSWWE CAC has submitted a suggested "gravity fed" back up system with backflow preventer for the new sump pumps. The CAC has requested a "plain English" code interpretation for this sketch because the first interpretation provided by the Building department was not decipherable.

Q. Please note, as the current FDDs are designed, this same sump crock "LID" is the only protection preventing sanitary back ups from adjacent floor drains from entering the sump crock and, hence, being discharged into the storm system. Why can't it be used as a protection from reverse flow?

Q. Is there a way to modify this sketch to comply?

Q. Could another sump crock be installed next to the sump pump crock in order to separately monitor and/or shut off the flow of potential sanitary back ups from being discharged to the storm system via the sump pump?

Q. Is the trap as drawn required and, if so, will an H2O trap primer be required?

Q. Is the "one paragraph" interpretation, citing code section P3302.1 Subsoil drains, as provided by Ralph Welton, negotiable or something that can be addressed with the State Plumbing Code Officials?

Q. How does Ralph Welton interpret the phrase..." approved location..." as noted in the above referenced Code (P3302.1)? Sump pumps were only one of the options listed.

Q. If the "gravity fed" back up system (as shown on the CAC submitted sketch and as noted in item 6 above) can be made to comply with applicable codes, will all existing homes with now existing FDDs be eligible for their sump locations to be modified so as to be equipped with a gravity fed back up system? Will the City pay ALL costs for these modifications to these existing FDDs?

A. At the close of our August 21st meeting, Mr. Frank Burdick submitted a drawing that proposed a backup mechanism in the event of sump pump failure. This drawing was included in the August CAC meeting summary. The core idea was to allow for a gravity feed backup to the sanitary sewer system in case of sump pump failure. Mr. Burdick requested the City to review the drawing for potential code issues. The City has now completed its review and has determined that the gravity feed backup to the sanitary sewer would be prohibited by the Michigan Plumbing Code, Section 1103.3 which states: "Storm water shall not be drained into sewers intended for sewage only." The Ann Arbor City Plumbing Code (Section 8:122) provides more specific language that would prohibit such a gravity feedback backup connection: "Sump pump discharges - footing drain: Discharges from sump pumps may not be connected to the sanitary sewer. Such discharges must connect directly to the storm sewer or be discharged in an alternative, approved manner. Such alternative drainage shall not create a drainage nuisance, and if so, must be handled in accordance with section 8:120 of this chapter."

Mr. Burdick also asked for the City to review whether or not any applicable codes could be changed by the City to allow for a gravity feed backup. As the City's code is supporting a State code which would prohibit such a connection, the City has indicated it will not ask the State to modify its Plumbing Code.

Q. Will the gravity supported back up system meet State Code?

A. The 2009 Michigan Plumbing Code's section 1104.2 requires "entirely separate" sanitary and storm drainage systems within a structure, thus disallowing the use of the discussed gravity supported back-up system.

Q. Why can't the common household emergency overflow be applied to the sump pump?

A. We are not sure what the question is referring to by “common household emergency overflow.” Sump pump installations are required to be performed in accordance with Michigan Building & Plumbing Codes, and are inspected for compliance.

Following is a series of questions about building codes as well as an alternate sump pump design, submitted by a citizen for consideration in use in the City’s Footing Drain Disconnection Program.

Unless identified as a reference to the 2009 Michigan Plumbing Code, references below to TABLES and SECTIONS beginning with “P” are references to the 2009 Michigan Residential Code. Per the Stille-Derossett-Hale Single State Construction Code Act, the 2009 Residential and Plumbing Codes are part of Michigan’s Uniform State Construction Code. See MCL 125.1504.

Q. Check on any proximity setbacks between a sump pump and a floor drain.

A. There are no measurement restrictions. A floor drain is a Plumbing Fixture. See SECTION P2719. Under Section P2601.2, a floor drain must be connected to the sanitary sewer system:

P2601.2 Connection. Plumbing fixtures, drains and *appliances* used to receive or discharge liquid wastes or sewage shall be connected to the sanitary drainage system of the building or premises in accordance with the requirements of this code. This section shall not be construed to prevent indirect waste systems.

The floor drain cannot be set up to act as a sump pit overflow drain because 2009 Michigan Plumbing Code section 1104.2 states:

The sanitary and storm drainage systems of a structure shall be entirely separate except where combined *sewer* systems are utilized. Where a combined *sewer* is utilized, the building *storm drain* shall be connected in the same horizontal plan through a single-wye fitting to the combined *sewer* not less than 10 feet (3048 mm) downstream from any soil *stack*.
The flow from the sump pump cannot flow into the sanitary drainage system. Sanitary drainage system is defined in the Plumbing Code as:

A drainage system that carries sewage and excludes storm, surface and ground water.
In addition, City Code Chapter 28, Section 2:42.3(8) prohibits both direct and indirect discharge from footing or foundation drains into the sanitary sewer system:

(8) No person(s) shall make connection of roof downspouts, foundation drains, areaway drains, or other sources of surface runoff or groundwater to a building sewer or building drain which in turn is connected directly or indirectly to the POTW [Publicly Operated Treatment Works].

City Code Chapter 28, Section 2:41.2f(1) defines the City's sanitary sewer system as "a sewer which carries wastewater and to which storm water and ground water are not intentionally admitted."

City Code Chapter 28, Section 2:43.2(1)(m) also prohibits discharge to the POTW of, (m) . . . stormwater, groundwater, or surface water, unless separate POTW facilities are available and identified for the discharges or unless the Administrator gives written permission to the user for a temporary discharge of the waters based on hydraulic capacity and treatment impacts.
City Code Chapter 33, Section 2:203(16) defines "stormwater" to include "footing drain discharges."

Q. Check on venting distance requirements for a floor drain. Indicate code requirements for plumbing vents thru the roof for these floor drains.

A. See attached TABLE P3105.1, venting distance from trap to vent. SECTION P3101.2.1, Methods of venting required.

P3101.2.1 Venting required. Every trap and trapped fixture shall be vented in accordance with one of the venting methods specified in this chapter.

Q. Check on any issues with depressing the floor by an inch or two between the sump and a floor drain.

A. See the response to the question, above. A floor drain is a plumbing fixture, which must connect to the sanitary sewer and may not be a means for a foundation or footing drain to discharge to the sanitary sewer system.

Q. Ralph Welton responded to my [Frank Burdick's] question about his enforcement of retroactive codes. He indicated that his charter or obligation is to enforce the codes and "regulations" of the city. He indicated that he is using the 2001 City Ordinance for his justification.

A. Mr. Welton clarified the above statement by stating the City's Construction Services only oversees installation methods based on City system requirements.

R102.2 Other laws. The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law.

City Code Chapter 28, Section 2:42.3(8), added in 1994, prohibits foundation or footing drain discharge to the sanitary sewer system. Statutes, regulations and City Code provisions governing sanitary and storm sewer systems govern those connections and discharges. The Chapter 28 amendment in 1994 was to bring City Code provisions into compliance with federal regulations.

Q. He [Ralph Welton] indicated that if we could change the Ordinance than he would enforce the language of the change. The consultant Project Manager directly asked him if the ordinance was changed, is there anything in the State Plumbing Code that would not allow the gravity supported back up system. Mr. Welton said that there was not anything in the Code that would prevent this. (Note, it is possible, that Mr. Welton misunderstood the question and thought that the consultant Project Manager was referring to the idea of installing a sanitary floor drain within a few feet of the sump pump.)

Q. Will the city consider a modification to the ordinance?

A. As it is documented that the City has recognized the negative impacts of footing drains flows to the sanitary sewer system dating back to at least 1987, it is unlikely that City staff will support a modification to the City ordinance that would allow footing drain flows to enter the sanitary system.

Q. How many times has a previously dry basement had stormwater flooding from the sump or along the seam of the wall and floor, after a FDD?

A. The December 2013 survey asked property owners about flooding, seepage and dampness in basements after a footing drain disconnection. This information is reported in the 2013 FDD Survey Summary Report is posted on the project website at the following link: http://www.a2gov.org/Documents/012414 FDD Survey Summary Report.pdf.

Q. 130 people are in the first triage [of survey respondents whose issues are being investigated], but 353 people had water issues. Why only 130?

A. The most significant issues reported were investigated first.

Q. I am concerned about mandates. Remember the sidewalks? I am frustrated. There is a $100 a month fee if you decided not to do an FDD. Is there a maintenance schedule for sump pump; you only find out they are not working when there is water in the basement.

A. Pumps manufacturers have recommended maintenance practices. The contractor installing the sump pump should provide this information to the property owner. Additionally, a general maintenance guide can be found on www.a2fdd.com.

Q. Did surveys indicate if the flooding was caused by disconnect or is it something we don't know?

A. Respondents were asked about flooding, dampness or seepage. The causes of those instances aren't known unless the person reported more details in the comments section. FDD investigation update: Greg Marker, PE, investigated 101 FDD homes with reported problems and found that the most common causes of water in the basement was poor drainage. However, in ten homes, he found problems with the FDD installation that caused water in basements. The City is developing a program to fix those out of spec installations.

Q. Regarding flooding in basement – did the surveys collect details on the cause of the flooding?

A. As mentioned in the previous question, respondents were asked about flooding, dampness or seepage. The causes of those instances aren't known unless the person reported more details in the comments section.

Q. Were there flooding issues identified to or related to changes regarding impervious surfaces surrounding the homes over time and whether there could be backups anticipated and prevented by sump pumps?

A. Unclear on the question, however the Citywide Stormwater Modeling Calibration & Analysis project will be studying the city's stormwater system and possible improvements.

Q. Is there explanation on why there is flooding after disconnection?
A. A number of factors can cause flooding after disconnection. For sanitary backups, the number of houses in the area that have had footing drains disconnected is important, because it can take many houses in an area to reduce the risk of basement backups from the sanitary sewer. The size and patterns of rainfall and the preceding wetness of the soils also plays a factor. Water seepage or stormwater issues can occur after footing drain disconnection depending on the extent of surface flooding or ground water levels. There is also the potential of a mechanical failure or power failure that can cause the sump pump not to operate.

FDD investigation update: Greg Marker, PE, investigated 101 FDD homes with reported problems and found that the most common causes of water in the basement was poor drainage. However, in ten homes, he found problems with the FDD installation that caused water in basements. The City is developing a program to fix those out of spec installations.

Q. Why is there not an explanation on sanitary flooding after sump pump installation? What does the sump pump installation have to do with these issues? Why are people

having to have multiple sump pumps installed? The people that have never had flooding before are the most concerned.

A. A critical mass of disconnections is necessary in an area before the risk of sanitary basement backup is significantly reduced. Once a critical mass has been achieved, it is likely that the frequency of sanitary backups will be greatly reduced. That appears to be the case in Ann Arbor, and will be verified with the risk evaluation. Some potential explanations for why someone who has never had flooding problems before might be experience flooding after FDD was contained in the previous answer. It is difficult to determine why some people need multiple pumps installed without examining the specifics of each case. Doing that is part of the work that OHM is performing with the follow up to the survey.

FDD investigation update: Greg Marker, PE, investigated 101 FDD homes with reported problems and found that the most common causes of water in the basement was poor drainage. However, in ten homes, he found problems with the FDD installation that caused water in basements. The City is developing a program to fix those out of spec installations.

Q. When the FDD program was first started, could you have done a smaller study first or testing to make sure it would work before going into a HUGE program that was going to cover a large part of the city?

A. Prior to the implementation of the FDD program, a pilot test with 11 homes was performed to evaluate the installation methods and expected effectiveness of the FDD work which lead to developing standards for the FDD Program.

Q. What type of study was done to get the desired results? What I'm hearing is that we did not get the desired results; some people that didn't have sanitary sewage backups before now have sanitary backups as a result of the footing drain disconnection and sump pump installed. That is not what we expected to happen; so why would we do that if we couldn't interpret that before we spend a lot of money?

A. The City conducted a sanitary sewer study in 2000 and 2001 and conducted a pilot footing drain disconnection program before embarking on the current program. For 4 out of 5 districts, the flow removal rates from the sanitary sewer system are meeting the goals of the program. FDD investigation update: Greg Marker, PE, investigated 101 FDD homes with reported problems. None of the homes that had suffered a sanitary sewer backup were related to the FDD program; some were the result of failed sewer leads or collapsed pipes under the home. He also found that the most common causes of water in the basement was poor drainage. However, in ten homes, he found problems with the FDD installation that caused water in basements. The City is developing a program to fix those out of spec installations, as well as others that may exist.

Q. At least one of the FDD 'pilot' homes, in the Dicken school area, got a water back up. Did they all? And also could give us the usage for the last 10+ years.

A: According to the 2001 SSO Report, water-powered backup pumps were installed on the 11 pilot homes. We're unclear on the usage question.

Q. H2O water supplied "back up" systems are the best back up systems available with the current technology. Why should homeowners be required to pay for additional water usage to "back up" City required sump pumps?

A. The cost of a reliable backup system is an issue that can be addressed in the future, if an FDD program is considered as an alternative going forward.

Q. Per the question above, the domestic water siphon "back up" system for sump pumps is more reliable than a 12 volt battery back-up system. The City's website states the following: *(This system) "Uses about 2 gallons of pressurized fresh water to pump out 1 gallon of sump water. Water usage will show up on the water bill."* What would the estimated flow rate be, to the Storm Sewer system, during PEAK FLOW periods, for one Target Neighborhood, such as Orchard Hills, if ALL of the ("99% of homes in this Target Area are equipped with FDDs per OHM") WERE equipped with water siphon back up systems? What would be impact to the Peak Flow rates to the Storm Sewer systems to the Morehead and Churchill areas? Can the City justify the "sustainability" impact of using this quantity of domestic water for the purposes of satisfying the goals of the FDD program?

A. The 2 to 1 computation is a relatively easy computation to make, but that condition only occurs in the rare condition of the failure of the sump pump. I can think of two primary failure modes of a sump pump: 1) when the pump itself burns out, and 2) power failure. Presumably in condition 1 - sump pump failure, the impacts on the storm system would be negligible, as it is not likely that very many would occur simultaneously. In condition 2 - power failure, the impact on the storm system would depend on the extent and frequency of power failures. It is this piece that is not so easy to quantify with our current information in hand. Perhaps the survey might help us understand this piece, by examining the answers to the questions about water in basement. I would suggest that we wait for those results before commenting further.

Q. Are these homeowner situations [from the post 2013 FDD Survey investigation] too different or are there common themes that can be addressed?

A. Yes, there are some common themes, for example alternate sump pump locations, lack of hole in the discharge line and external grading issues.

Q. Have you [Greg Marker] discovered problems similar to what Ann Arbor has experienced?

A. On a house-by-house basis, yes. In about 1% of situations, Greg encounters a program he can't resolve.

Q. Does Ann Arbor have more problems than other communities?

A. In Greg's experience, yes. He notes that the programs he's been involved in have had a field engineer on site for each installation as well as every contact between the homeowner and the contractor, which is a significant investment. Ann Arbor's program was larger in scale than the other communities and has been in place for more than a decade.

Q. Is it common for homes to have issues with a sanitary backup after a disconnection?

A. In all the cases Greg Marker has investigated so far, he has not found a backup caused by an FDD. All have been related to non-City sanitary issues.

Q. In total, how many contractors applied to be pre-qualified contractors for the FDD program?

A: The Request for Qualifications (RFQ) was sent out at program initiation to several contractors. In addition, other contractors have applied for pre-qualification over the years. At least 6 contractors have gone thru the pre-qualification process.

Q. Also, how would potential plumber applicants learn of the opportunity to apply?
Q. Where and how did the city advertise that there was an opportunity to apply to be a pre-qualified FDD contractor?

A: In the past, the RFQs were sent to many local contractors directly. Presently and in the future, the City would post such requests on an electronic bidding network (called Bidnet). Most contractors are subscribers to this system, and it has worked well in recent years for soliciting qualified contractors.

Q. Please explain why it's recommended that there be a small hole in the discharge line of a sump pump.

A. The pump manufacturer's instruction manual recommends a hole in the discharge line. As an example, see the installation instructions for Zoeller pumps, on the project website: www.A2gov.org/SSWWE > Library. (Highlights added.)

The manufacturer instructions identify the hole as necessary in assemblies with check valves to purge the unit of trapped air. They state agitation and/or a dry basin cause trapped air. In laymen terms, without the hole, a column of water can be present between the check valve and top of the pump and an air bubble can form or be drawn to the area where the impeller is trying to spin to eject water, thus the impellers will spin in air and not water, heating up and eventually burning up the motor. This is also known in the industry as "vapor lock".

The manufacturer's engineer has also said that if there is no hole present, a water column can be present from the impeller all the way through the check valve to the top of the discharge where it becomes gravity. That head of water puts pressure on the impellers during start up and increases the amperage necessary to get the impeller rotating. This will decrease the total number of cycles of the pump over its lifetime. A vent hole relieves this pressure after each pumping cycle to minimize any head on the impellers during start up as well as provide a way for any trapped air to rise through the impellers and escape.

Q. Regarding the follow up to the FDD Survey, why would homes where the homeowner was handy and did not experience significant problems be on the list for follow up?

A. Any homeowners who reported sump pump failures, water or sewage in the basement or requested a visit were put on the Survey triage list.

Q. To prevent mineral buildup, should homeowners be instructed to clean their pumps?

A. Greg Marker says that while pumps can be disassembled and cleaned, it's unlikely that homeowners would remove, disassemble and clean their pumps. Instead, there should be a small hole in the discharge line.

Q. Are homes with external grading issues not related to FDDs?

A. No, those are issues that are not part of the FDD program, which was put in place to solve a sanitary sewer backup issue, but if the CAC wishes to consider FDDs in any form going forward, external grading should be part of the program.

Q. Could a home with grading issues be fitted with a larger pump?

A. That may not solve the problem long term, because a larger pump pumps faster, but the problem of large amounts of water running along the basement walls remains.

Q. There are a number of possible fixes to reduce peak footing drain water particularly in a target area like Lansdowne, with external grading, if it can be shown that preventing surface water from entering the backfill is effective. (The two lakes adjacent to my house must have had a major dilution effect...) A possible "on-the-table" candidate?

A. This idea, as well as many others will be considered during the alternatives evaluation portion of the project.

Q. If the footing drain lead fails between the house and the sidewalk...who is responsible, homeowner or City?

A. The homeowner is responsible.

Q. How many times has the City fixed the problem of a FDD causing stormwater flooding from the sump, or compensated the homeowner for these sump pump or other repairs?

A. In a few instances where the City was aware of a sump pump installation not working as intended, the City has fixed the problem, such as upgrading the sump pump or adding a second pump. Investigation of city records was able to go back to 2007. During this timeframe 12 claims were identified as being at a property at which either a City FDD or a DOM FDD were performed. Of the 12 claims, one was approved.

More information about the claims received:

The City has not compensated any property owner for sump pump or other FDD system related repairs done by the property owner. Nor has the City compensated any property owner for system redesign or adjustment.

In situations where issues have arisen following installation regarding the design of a system, the City has worked with the property owner and contractor within the FDD program, including covering additional system costs where required. When an installation issue has been brought to the City's attention, the City has helped with getting the contractor to take care of the issue.

Unless discussed or included in the list below, none of those has been submitted to the City as a claim that would have been reviewed by the Board of Insurance Administration.

One property, previously identified as the one claim that was approved, came through as a claim involving a system design issue as well as other factors that resulted in a decision to pay the claim and to cover the cost of the redesigned system, which included installation of a sump pump (the original design did not have a sump pump).

Aside from that location, only 5 properties with claims to the Board of Insurance involved issues with installation and/or operation of an element of an FDD installation. The City did not pay any of these claims. The City does not know what the contractors did in terms of compensation to property owners for damages. Not all involved stormwater flooding in the basement:

• Claim in 2014 – referred to the plumbing contractor who installed the system to handle. The claim does not include a request for compensation; just for a broken sump pump fixture to be fixed, along with a request for a battery backup.

• Claim in 2011 – the check valve failed, resulting in a sanitary sewer backup – NOT stormwater flooding.

• Claim in 2010 – the claim was for a sanitary sewer backup. The City had previously worked with the property owner to get an additional sump pump and had covered that cost.

• Claim in 2008 – the plumbing contractor installed a temporary drain pipe (during winter installation) that didn't extend far enough from the house so water drained too close to the house; property owner installed a B-Dry system and wanted the City to cover 50% of the B-Dry system. The City denied the claim; the plumbing contractor was responsible for fixing the installation. (Not a sump pump issue.)

• Claim in 2008 – faulty operation of sump pump (frozen in "on" position so ran constantly). A different contractor fixed the check valve and the property owner wanted the City to cover the $200 repair. Although the property owner reported they had flooding in 2004 due to improper location of the drain by the plumbing contractor, the property owner did not submit a claim to the City. The original plumbing contractor relocated the drain and adjusted the sump pump. Poor workmanship in 2004 may have contributed to the problem in 2008. There was no flooding in 2008.

Q. I would like the City to provide to the CAC the data from the State Revolving Fund application from 2010 as it relates to Federal Funding.

A. There is no application form for State Revolving Funds; an agency seeking State Revolving Funds must submit an SRF Project Plan which is reviewed and rated by the

State. The [2010 SRF Project Plan for stormwater funding is linked here] and has been added to the City's webpage at [www.A2gov.org/SSWWE] > Library.

Q. What were the Federal Funds that were received in 2010, 2012 via the State Revolving Fund application actually used for as it relates to the FDD program per the application?

A: There were no federal funds used for any aspect of the FDD Program. The FDD program did use Strategic Water Quality Initiative Funds (SWQIF), which take the form of low interest loans from the State of Michigan, with no origination from Federal sources. The SWQIF funds were used to offset the costs of the in-home FDD work.

Q. Do you have an estimation of the expected lifetime of a pump is?

A. Each home has its own rate of flow that determines the life expectancy of the pump. Per Greg Marker, manufacturers offer general guidelines that pumps last ten years on average.

Q. Regarding the 10 homes that had problems because they were out of spec, did you find any patterns? Any particular contractors? How soon after the installation was made did you discover the failures?

A. We could not find any geographic patterns to the problems, nor any concentrations among particular contractors. Of the 100+ homes investigated, most had had footing drains disconnected and sump pumps installed between 2004 and 2008. The investigation was conducted in 2014.

Q. How can FDD installations be out of spec? Weren't they all inspected?

A. Three ways that an installation can be out of spec: out of compliance with building code, out of the manufacturer's installation instructions or out of industry standard best practices. None of the ten instances were out of building code, which is what the City inspector staff evaluates. These ten did not follow manufacturer's installation instructions or industry standard best practices.

Q. Is it anyone's intention to evaluate the FDD spec to see if they comply with code?

A. The FDD spec was developed with the input of building officials and other specialists, to be code compliant.

Q. What is a good, reliable backup system?

A. The most common backup system is battery backup. The second most popular is water-powered backup pump. The third type is a generator, to replace power sources. Each of these is progressively more expensive.

Q. It is my understanding that some of the initial FDDs performed for the city included backup pumps (water powered, I believe). Can the city provide information about this? I am specifically interested in any available information regarding the following:

- **Were any backup pumps included in city provided FDDs?**
- **If so, how many?**
- **When were these performed?**
- **Why did they stop?**
- **How were they funded?**
- **What type of backup (water, DC, other)?**
- **Any other information that might improve the understanding of this issue.**

A. As part of the initial Sanitary Sewer Overflow Study performed in 1999-2000, there were approximately 10 pilot footing drain disconnections performed to review the removal efficiency of removing flow from disconnected footing drains in residential homes. These homes had disconnections performed and sump pumps and monitors installed with data reviewed for 6 months to assist with the project review and preparation of the report. Initially, these homes had their sump pump discharges directed to the lawn outside the homes. These were subsequently directed to the storm drainage system the next summer.

This work was done under the CDM Smith SSO project contract, and included installation of backup sump pumps in many cases as an enticement to volunteers to have the work performed. This work was done as a data gathering effort.

Q. Is installing a floor drain with a sump pump in an attempt to have sump water discharge to the sanitary system?

A. The team understood the City's building official to say that installing a floor drain with an FDD would be viewed as an attempt to have sump water discharge to the sanitary system and would not pass inspection State Plumbing Code.

Q. You need to let people know about the radon issue. If you don't want to pay for the test, it's $10, but you need to let people know. I had to pay $800 for a mitigation system. Let people know.

A. Some of the CAC discussions on radon were that Washtenaw County has a naturally high level of radon. Anyone who lives in Washtenaw County should be aware of that risk and determine whether they wish to have a radon test. Another aspect the CAC discussed related to radon was that the City's spec required that the sump pump lid be sealed. There are also many other sources in a basement where radon can enter the home, such as cracks in the walls or around windows.

Q. Existing FDDs include a plastic lid or cover that is "sealed" with silicone caulk upon the initial installation. This lid must be removed to perform some of the "Operations and Maintenance Instructions" provided to the Homeowner, as well as the need to clean out the sludge mentioned in the questions above. The same lid is removed if the pump needs to be replaced. What assurance can the City provide that: a. Proper Radon infiltration protection can be maintained? b. Airborne contaminants and odor do not enter the home. c. (Per a previous question, that potential Sanitary sewer back ups from nearby sanitary floor drains, do not get discharged to Storm system via the FDD sump pump?)

A. After maintenance is complete, it is recommended that the sealed cover is replaced. Homeowners are responsible for determining their own radon risks.

Q. Has any before and after radon testing been done on homes where the FDD has been performed?

A. This is not done as part of the City program. The City is not aware if this has been done as part of the Offset Mitigation Program.

Q. Will we discuss radon tonight? Why were radon inspections mentioned in the 2001 SSO Report, but not performed for FDD homes?

A. Between the time the SSO Study was conducted and the FDD program was launched, the City consulted with radon mitigation experts, which resulted in the spec including a sealed cover on the sump pump. Notes that radon enters a home from many locations. Also notes that Washtenaw County is a pocket of high radon levels, with as many 40% of homes having radon issues.

Q. Are you looking at what happens in our basements/to us when our electricity fails?

A. Yes, the City and the FDD Citizen Advisory Committee want to know about property owners' experiences, positive and negative, with the FDD program. This is important and was the reason the FDD project team conducted surveys of property owners' FDD experiences.

Ongoing, we encourage property owners to report any issues with FDDs. When locations with issues are reported, program staff contacts the property owner to determine if the problem is related to the FDD program and requires modification or correction, or if the issue is a private property matter unrelated to the program.

We will continue to work with homeowners to resolve problems resulting from FDD installations. If property owners feel they have an issue with a disconnection, we ask that the owner report it, so that program staff can identify, investigate and resolve the issues. To report an issue, visit the FDD program webpage at www.a2fdd.com, click on the Contact Us link on the left side of the main page and let program staff know how to contact you.

Q. How are you going to deal with our sump pump issues?

A. If, after the SSWWE study is complete, the Citizens Advisory Committee recommends that FDD should be continued, alone or along with other methods of reducing sanitary sewer backups, the experiences of the current FDD participants with sump pumps will be carefully considered in the design of any new program. To that end, we have implemented the SSWWEP CAC's suggestion to conduct a survey of all property owners who've had an FDD. We've reviewed the results and are investigating the issues reported to determine the course of action.

2014 update: Based on the results of the FDD Survey investigation, conducted by the City, the City will institute a program to bring out-of-specification FDD installations into compliance. This is expected to begin in early 2015, once a contractor has been selected.

Q. Some homes have experienced new flooding and seepage as a result of the FDD installation. Many basements are "finished" with carpet, drywall perimeter walls, etc. What measures have been, or will be done, by the City to alert the homeowners of black mold that can be concealed by the "finish" materials in the basement? Refer to the following link: http://www.poison.org/current/indoor%20mold.htm

A. The Footing Drain Disconnection Survey conducted on behalf of the SSWWE CAC includes several questions about flooding and seepage. Based on the results, the City will investigate further and determine what measures to take.

Q. Has the operating cost of a sump pump for an individual homeowner been evaluated?

A. Yes, power costs were estimated at less than $2/yr for the average homeowner (these would vary) and that the sump pump would need to be replaced from time to time. It was estimated that the life of a sump pump was 7 years with a replacement cost of approximately $300.

Q. Some homeowners are on a fixed income (such as social security or retirement savings). What if the homeowner can't afford the replacement of pumps (some pumps have only lasted 1 year), back up batteries, generators, as well as additional costs of electricity? Does the City expect these homeowners to pay for all the back up systems, maintenance, etc.? This is an unfair burden.

A. As mentioned in August CAC meeting summary, electricity costs to run the sump pump average $2.00 per year. A replacement sump pump costs around $300 and is expected to last about seven years on average. These are costs that owners of homes built after 1982 already bear, as part of normal home ownership and maintenance. During the SSWWE project, the Citizens Advisory Committee suggested offering means-tested assistance for some maintenance items.

Q. The initial SSO CAC report listed concerns for periodic maintenance and inspections for the sump pump equipment. Is this or will this be done by the City?

A. Periodic maintenance and inspection of a sump pump is considered part of normal home ownership and maintenance, and is not performed by the City.

Q. What are the sump pump experiences on post-code new houses? i.e.: lifespan of sump pumps and check valves.

A.25. The City does not have information in this.

Q. The City is requiring the installation of the sump pumps. These are ultimately reducing the home's value due to new inherent flooding. Why should the homeowners be required to pay for additional costs for back up systems, revised (more distant) locations within the basements, and repairs to finishes and landscaping not completed by the contractor? Why doesn't the City cover all the related costs for the homeowner?

A. The existence of a sump pump does not reduce a home's value. If there are damages caused by an FDD installation, we urge the resident to report any incidents to the City. The City is looking into the legality of supplying backup systems for homeowners who've experienced frequent power outages, etc. This must be reviewed because backup systems are not required by State Building Code.

Update (11/6/14)

As the City has considered the matter of providing backup pumps to past City FDD participants, the following concerns were identified:

1. Recommendation requires all rate payers to pay for backup systems for FDD program participants, although backups are not required by Code.
2. Property owners typically pay for backup systems when building a new home or installing a sump for other reasons.
3. Differential treatment for different properties raises policy and community relations concerns.

Q. FDD installations disturb the floor slab. What is the impact of this on radon in the home?

A. During installation a section of the floor slab is removed to provide access to the plumbing beneath the floor. The new sump is installed in this space and completely sealed around the perimeter of the sump with new concrete. This prevents the movement of gasses around the sides of the sump. The sump itself, which is connected to the area below the basement floor, by the footing drains, includes a sealed and gasketed lid that will also prevent the movement of any gas from under the floor to the basement. Together, these two measures prevent gas from moving from the under floor area to the basement space.

Q. FDD installations disturb the aged waterproofing on the exterior of the foundations. Has the City quantified the cost impact for owners with FDDs?

A. The disconnection of the footing drains from the sanitary sewer does not typically disturb the waterproofing on the exterior of the foundation, as the sump discharge pipe comes out of the house above the level of the exterior waterproofing. If there is damage to the waterproofing, it will be restored at no additional cost.

Q. Why does the City not require re-waterproofing prior to back fill?

A. The disconnection of the footing drains from the sanitary sewer does not typically disturb the waterproofing on the exterior of the foundation, as the sump discharge pipe comes out of the house above the level of the exterior waterproofing. If there is damage to the waterproofing, it will be restored at no additional cost.

Q. Who inspects the excavation and waterproofing prior to backfill. Is there a typical Inspection Card that can be retrieved from City Records for each home?

A: The City plumbing inspector inspects the installation of the FDD discharge pipe. Documentation can be found on the City's E-Trakit system at: http://etrakit.a2gov.org/

Q. FDD installations can be destructive to existing finishes in some homes. Why does the city not require a "before and after" inspection / photos, of all existing and final conditions?

A. The FDD program staff does perform a pre and post inspection of every home that may include photos.

Q. FDD installations rely solely on the sump pump to get rid of footing water that is now allowed "into the house" at the sump pump location in lieu of staying on the exterior of the house at the former sanitary connection. Did the original designers of the FDD program consider the fact that pre-1982 homes were not built nor waterproofed with the critical function of a future sump pump installation?

A. There is no functional difference between a house built with a sump pump and one built without.

Q. FDD installations have the sensors and electronics installed close to the floor and susceptible to damage or "shut offs" from kids, pets, or common movements of storing/moving items in these basements. Why are these sensitive parts not installed up high and out of harms way?

A. The FDD Survey conducted December 2013-14 included questions about installations. If the issues mentioned were reported, the City will address those with the contractors.

Q. The current failure of many FDD sump pumps has caused NEW flooding in basements. Flooding is something that must be disclosed on Real Estate Disclosure forms. In addition, formally usable square footage in these home's basements have now been rendered unusable due the uncertainty of the operation of the sump pump and the inherent potential for unforeseen flooding. Is it the position of the City that it is acceptable to devalue these homes?

A. The 2013 FDD survey includes questions about flooding that may have occurred after the FDD and sump pump installation. This information will help us determine the extent of this issue. Investigations into wetness issues are underway. After we have that information, we can make a determination about a course of action. We confirmed with the City's Assessor that a sump pump by itself does not have an impact on the assessed value of a home. Post-survey update: the City initiated an investigation of reports of wetness in basements. Most of those incidents were caused by poor drainage on the property, however ten instances were found where the FDD installation did not meet specifications. Those situations will be corrected, as part of a City program in 2015.

Q. It is presumed, that the footing drain piping that was initially installed when the house was built, is laid with a slight slope so that it will "drain" or flow to the lowest point. The existing clean-outs and connection to the existing sanitary sewer, and FDD required sump pump presumably occur at this lowest point. In the event that a new FDD sump is not positioned at this lowest point, (ie: another location in the basement) due to the Homeowners' request, or due to other obstructions or restrictions, what is currently included in the FDD design to prevent sediment, sand, and other obstructions from "gathering" at the former low point in the footing pipe, and ultimately blocking the footing drain "upstream" of new FDD sump pump?

A. It is a misconception that the footing drains are sloped. Typically, they are not sloped to a low point. The only sloped sections may be those that lead from the perimeter to a connection, and often that may be to get to the elevation of the connection to the sanitary lead. Even so, in the alternate sump location scenario presented, there is a risk that the footing drain system will not function as effectively as before, or that the footing drains are configured in a way that causes sediment build-up. This is explained to the homeowner before an alternate sump location is approved and the reason the alternate sump location release form must be signed.

Q. Existing FDDs as designed, allow approximately 3" of standing water to remain in the bottom of the sump container. This water contains decomposed, organics, fertilizers, and other unknown substances. The water is only "pumped" out of the container when the water level reaches the flow setting on the pump (approx 7" depending on the pump design). Does this standing water in the sump container represent a health hazard? In your response please also consider the following: 1. Fresh air infiltration in homes is being substantially reduced for energy savings purposes. New windows and other energy saving efforts are making homes more "tight" and the residents more susceptible to airborne contaminants in the home. 2. FDD sump pumps with this standing water are installed in basements where the most furnaces with "air intakes" are also installed. In some cases, the new sump pump locations are very near the furnaces.

A. No, we are not aware of health hazards relating to the standing water in the bottom of sump containers. Installation of sump pumps follow all current Michigan building and plumbing codes.

Q. Existing FDDs as designed require maintenance for a wide variety of issues related to the continued operation of the sump pump and check valve. Considering the 3" of standing water in the question above, what prevents this standing water from getting further contaminated with dust, sand, other debris, creating sludge that can possibly cause the pump or check valve to fail?

A. The sump is installed with a sealed cover to prevent debris from entering the sump.

Q. Does the City consider that a homeowner (in lieu of a Certified /Licensed/Trained Contractor) should be responsible to perform the periodic re-installation of this lid, considering the environmental and Health/Safety concerns noted above?

A. It is the homeowner's decision as to whether or not they wish to hire a contractor to perform maintenance on their sump system or perform that maintenance themselves.

Q. A review of the 2001 SSO Report and input from a Citizen that was involved in the initial implementation of the FDD program, indicates that the initial program included

an inspection of each new FDD home to examine drainage from roofs, possible floor drains in stairwells that were contributing to the load, window-well drainage, poor foundation drainage, poor sloping of the ground near the foundation, and poor gutter and drainpipe discharges. This pre-install inspection was apparently all part of the FDD program. Each home was inspected to identify and rectify such faults as part of and prior to sump pump installation. Can the City provide evidence that these inspections have occurred on all subsequent 2700 FDD installations as well as evidence that the proper corrections to the drainage issues were rectified at each of the 2700 FDD home locations?

A. See the standard pre-inspection checklist (Pre-inspection Checklist), also available on the SSWWE > Library webpage) that was developed by the FDD CAC, which is based on the recommendations of people that have been through the FDD program.

Q. Per the review of 2001 SSO Report, page L-2 "Final Recommended Program," the following items were recommended to be FUNDED from the Sewage Collection Systems Users Fee: *Sump and sump pumps, *Back up systems (both water power or battery) check valves at specific houses, *basement restoration,* Radon gas testing and remediation, exterior discharge piping and *exterior site restoration.* The current FDD program requires the homeowner to fund these (*) and other costs involved with the FDD. Interior and exterior restorations do not fully restore the area back to the initial condition prior to the FDD installation. Why does the current FDD program NOT FUND 100% of the cost for the items noted with an asterisk (*) above and full restoration of interior and exterior conditions?

A. The program does fund exterior and interior site restoration. The question of backup systems was answered previously (the City is evaluating and determining whether it can do so, legally, as backup systems are not required by code.) Regardless of what was determined to be implemented as part of the original FDD program, all of these things can be considered as part of the alternatives analysis for the SWWEP study.

Q. FDD installations create a path for sanitary back up flooding to enter the sump pump "container" and be pumped back out to the new horizontal storm line at the curb and ultimately direct to the River. The lids on these containers are not always 100% watertight due to the penetrations required for pipes and wires, and due to periodic maintenance. How can this potential sanitary pollution of the storm system be legal and tolerated?

A. Sanitary pollution of the storm system is not legal. The goal of the SSWWE project is to evaluate the effectiveness of the FDD to date in removing wet weather flow from the sanitary sewer system and thereby reducing the potential of such occurrences.

Q. Can you tell us the cost of the FDD Program to date?

A. I don't have the exact figures, but in recent years, the Capital Improvement Program has had about $2.5M per year allocated to the FDD program.

Q. How much would it have cost to enlarge the sanitary sewer pipes rather than intruding into the integrity of our homes? Why wasn't that option more seriously considered? Even if the cost was double, it might have been better than to expose citizens to pump replacements forever.

A. The SSO Task Force weighed those issues and examined enlarging pipes, as well as FDDs and storage. Because the storage locations would have disrupted large swathes of green space and would have only pushed the problem further down the system, the Task Force ultimately recommended the FDD Program.

Q. Do you know how many people put in gas generators?

A. We did ask that question in the survey, however we don't know the number on the spot.

Q. My basement is flooded and I reported it to the City, but they said that they don't know why. I've got about a $6000 bill.

A. Please give me your information after the meeting and someone from the City will look into it.

Q. If it's all working so well, why are people still experiencing wetness in their basement?

A. Wetness in basement could be caused by a multitude of issues ranging from stormwater, groundwater seepage through the walls, sanitary sewage backing up into the basement, or other causes. The next phase of the study will evaluate the risk of sanitary sewer backups.

2014 update: Following the results of the 2013 FDD Survey, the City contracted with an experienced construction engineer to investigated reports of wetness in basements following an FDD. The engineer's investigations found that the primary cause of wetness in the basement was external grading. However, about 2% of installations were not performed according to specifications, which caused wetness in the basement.

Q. Will the City correct all FDD installations that are out of spec, or only those that caused water damage?

A. The City's mitigation program will address homes who's owners believe their FDD installation may be out of spec.

Q. How do I know if I have an out of spec installation?

A. If you have a concern, such as water in the basement, you can let the City know and when the mitigation project begins, your home can be investigated.

Q. I'm new to the area, my home is on Weldon. Did my home have an FDD?

A. Based on where you live, it's likely that your home had an FDD. Please give your address to one of the project team members and that individual will check the records and let you know.

Q. How do you know who the FDD homeowners are?

A. The City has a record of each address that underwent an FDD.

Q. I'd like to think that the City should review the specifications.

A. Thank you for your suggestion. The specifications have been reviewed multiple times. If there were to be an FDD program going forward, the specification would be reviewed again for continued code compliance and to incorporate the most recent best practice suggestions.

Q. Do you have a prediction as to how many people who have had FDDs will have problems in the future?

A. No, we don't have a prediction; however, when we begin the program to correct out of spec installations, there will be a notification for homeowners who have concerns.

Q. Wasn't doing a survey of the FDD households in your scope of SSWWE work?

A. Doing a survey of this level was not; detailed paper surveys were mailed to 2300 homes and then data manually entered, a very involved effort.

Q. The FDD Survey that was sent to all locations with a FDD indicates that the survey could be "Completed in Person" at focus group locations on lap stop stations. In addition these focus group meeting dates were to be announced on AnnArborNews.com, AnnArborChronicle.com, Treetown Log, and neighborhood newsletters. Were any of these focus group meetings actually held? What locations? How many participants? Did the announcements as noted above actually occur?

A. Announcements of the survey and its purpose were distributed to the media outlets. At the start of the survey we projected a need for focus groups because we were not confident about achieving our goal – 500 surveys returned (which would yield a 95%

confidence/4% margin of error result). We received more than 850 responses, creating statistically valid results.

Q. The FDD Survey was mailed on Tuesday 12/3 with deadline date of Friday 12/20. Due to this short duration and time frame during the Holiday Season, will the Survey Results, if received after 12/20, be tabulated in the data?

A. We received over 750 responses to the survey within the survey response period, which is about three times the typical response rate for surveys. Survey best practice advises that the highest volume of responses are received within *the first seven days* of the survey period and fall off sharply after that. This was our experience as well. Surveys received after the 12/20 deadline (about 80 additional surveys) were also tabulated in the data.

Q. The FDD Survey was announced to the local media via a press release. As no actual "news" outlets provided coverage for this "story," what other attempts were made by the City or the Consultants to the media, to solicit survey results from the FDD residents.

A. Because of the high response rate we received for the survey, there was no need to further solicit the media.

Q. What is the target date to receive collated results from the upcoming survey of homeowners with FDDs?

A. Survey results were received throughout December and early January. Preliminary results were presented to the CAC at its January 9, 2014 meeting and were presented to the public at the February 7 Public Meeting. The 2013 FDD Survey Summary Report is posted on the project website at the following link:
http://www.a2gov.org/Documents/012414 FDD Survey Summary Report.pdf

Air Gap

Q. What is the purpose of the air gap?

A. The purpose of the air gap is to provide an outlet for the footing drain in the event of an issue in the external discharge or the curb collection system or the stormwater system.

Q. Regarding air gap issues, what are the indications of a problem?

A. If the pump is running frequently 8-24 hours after a rain event, and water is splashing out of the air gap, the FDD installation has a problem and the homeowner should report it to the City.

Q. What will been done (if anything) to remedy the "air gap" problem present in most of the existing FDDs? The air gap allows the sump pump to discharge water right next to the home's foundation allowing it to eventually soak back down to the footing drains to be constantly just re-circulated. This excessive water is then allowed to permeate the un-compacted permeable freshly excavated soil caused by the tie-in of the discharge piping. In addition the waterproofing on the exterior of the foundation is compromised by both the excavation and exposure during the tie-in steps. This compromised waterproofing allows the water to enter the foundation. What does the City intend to do remedy this issue on existing FDDs?

Q. What design changes are being considered for potential new FDDs to remedy the air gap / discharge issue as described above.

A. The air gap is installed to allow for an emergency overflow, if the discharge line from the house to the storm sewer were to become blocked or if the storm sewer were to become blocked. Water only exits from the air gap in the rare occurrence when it is prevented from flowing freely through the discharge line into the storm sewer and prevents the sump pump water from flowing back into the sump.

The installation of the discharge pipe, at the air gap, requires a minimal area of excavation ranging in depth of 2-3 feet adjacent to the outside wall of the home. This excavation is backfilled and compacted by the contractors. In addition, if the contractor damages any waterproofing within this excavation, they are required to repair it.

We are unaware of any locations where there is compromised waterproofing. If such instances exist, they should be brought to the City's attention and will be investigated.

Q. Air gaps don't comply with code. Your specs are not code. What's your intention to remedy the problem with the air gaps not up to code?

A. We are not aware of any air gaps that do not comply with code. As part of the FDD Survey follow up investigation, an experienced construction engineer inspected a number of air gaps and didn't find any that did not comply with code. Homeowners who believe that their air gap is non-compliant should report it to the City.

Q. Are FDDs and air gaps as currently designed are susceptible to freeze ups? During the recent extreme cold temperatures, water continued to flow into some sump pits and be discharged. Many of the "air gap" locations were buried beneath snow drifts. What prevents the occasional pump discharge water from ice build up on the inside of the exterior discharge pipe near the grade and below grade? Is the lateral pipe that

takes the discharge to the curb, or other areas, buried below 42'? (ie the frost line in this region.) If not what prevents this lateral from freeze ups? In your response, please consider the current code for allowable exposed plumbing vent pipes that vent thru the roof of a structure, as this code should apply equally to the FDD piping near grade.

A. Water from sump discharges is typically around 50 degrees. The discharge pipe is installed with adequate slope, which prevents the water from standing and therefore freezing.

Check Valves

Q. Aren't check valves the reason that basement backups from sanitary sewers have dropped so dramatically?

A. No, check valves are not the reason that the number of reported basement backups dropped so dramatically. The flow metering data collected in the priority districts during 2013 shows that the flow depths were contained within the pipes at these locations during all of the storm events. This means that the water could not have reached a level where the check valves would activate. Therefore, the presence of check valves is not relevant to the evaluation of flows from the 2013 metering data.

Q. How many houses in 2000 that had backups didn't have check valves?

A. The City does not have any knowledge of check valves existing on homes prior to the start of the FDD Program.

Q. If you hook up a back flow preventer to a basement and sewage can't now backup to the basement; as the sewage pipe fills up; there no place for sewage to go. What happens in this case?

A. When the check valve is closed preventing sewer backup, but also sewage flow from the house cannot drain out to the city's sewer system. The homeowner will not be able to flush toilets, use sinks, etc.

Q. What is the City's building inspectors' experience with the reliability of a check valves. Do they prevent back ups? Do they prevent the use of the sanitary system in the house? How often do they need maintenance?

A. City plumbing inspectors indicated they only have experience in new installation inspections. Longevity, maintenance and reliability questions would need to be directed to plumbing contractors. The Plumbing Code requires that they conform to certain standards upon installation. SECTION P3008.

In the event that there is a sanitary sewer surcharge situation causing the check valve to close to prevent back-ups as designed, any plumbing fixture or appliance upstream of the check valve will not be able to drain until the surcharge has ended and the check valve has once again opened; and in the case of a home with a whole house check valve, no plumbing fixture will be able to drain until the surcharge has subsided and the valve has once again moved to the open position.

Q. Regarding FDDs performed: I do believe a "backflow preventer" is required as part of the installation of the water powered backup pump. This is to protect the city water supply, I think. I was informed that the city requires periodic testing of this backflow preventer. The implication was that a licensed plumber is required to do this. When I asked a plumbing company, they estimated this testing would cost about $125 if no repair was needed. Is it possible to get confirmation of this requirement, confirmation or estimation of the testing costs, and whether there are associated city inspection costs?

A: There is a backflow valve as part of the water powered back-up system that requires inspection by a certified plumber every 3 years (this inspection ensures that sump water is not mixing with the pressurized potable water). The estimated cost for this inspection is $90-$100. There are no associated City inspection costs.

Q. Regarding back flow preventers and required periodic testing by licensed plumbers, why can't the city get a bulk rate deal in a similar way to how AAA does with tow truck drivers? It should not need to cost $100 for an inspection. It doesn't take half a day.

A. Currently, the homeowner is responsible for having the inspections performed, not the City, therefore there is not an opportunity for a “bulk discount” under the current system. If the City were to coordinate the inspection effort in order to obtain such a discount, it would require additional City resources, and therefore additional administrative cost.

Counters/Sump Pump Monitors

Q. Does the City keep a record of homes that were metered?

A. Yes, the City keeps a record. The City metered about 40 homes for about a ten-month period, on a rotating basis resulting in about 150 homes being metered.

Q. What are the details of the 30-30 sump pump counters?

A. A pump test is performed when the sump pump monitor is installed. The data collected from the pump test is used to calibrate the monitor. The monitor records when the pump cycles on and when it cycles off. When the data is collected (the monitors can store several weeks of data) it is then converted to an approximate gallons per minute of water pumped from the sump pump, based on how often the pump cycles "on".

Q. How many counters are in place in Lansdowne and Churchill?

A. There are currently six sump pump monitors in the Lansdowne and Churchill areas.

Curb Drains

Q. Was the installation of the horizontal bored storm sewer lines recently installed along the curbs in target areas (for the purpose of connecting subsequent FDDs) paid for by Federal Stimulus grant funding?

A. No.

Q. OHM has indicated that the October 31, 2013, flow test performed on the horizontal bored curb line included 5 total FDD homes. It has also been stated that the location of many existing catch basins is such that only a limited number of homes (5,6,7,8) are connected to the new curb line before being discharged into the nearest catch basin. On Winsted Blvd, there is only one catch basin to handle the entire cul de sac. There are 10 to 12 homes per each side of the street. Will the capacity of the new horizontal bored curb line be adequate to accept the simultaneous flow from 10 to 12 FDD sump pumps?

There are 4 separate curb drains installed on Winsted to serve the existing homes located along this street. The curb drains on Winsted were installed with the intention of serving no more than 5 homes per curb drain. However, using the average peak flow of 4 gpm per home, a curb drain pipe at minimum slope (1%), can serve 68 homes (see below). If we use a sump pump maximum discharge rate of 30 gpm, a curb drain has the capacity to serve 9-10 homes.

-Pipe capacity for a 6" diameter HDPE at 1% slope, capacity is 0.61 cfs.

-Peak FDD production for 1 single-family FDD = 4 gpm = 0.009 cfs

-Maximum FDD equivalent for each curb drain run = curb drain capacity / peak FDD production = 0.61 cfs / 0.009 cfs = **68** single-family FDDs.

Q. What is the impact to the flow of the horizontal curb line IF the catch basin is totally surcharged from storm surface water flowing into it from along the curbs? **Note, this total surcharging DID occur during the March 2012 event, and it is also "substantially" full during most heavy storm events.**

A. The air gap outside a home is designed to allow for water to escape/discharge from a sump pump in case of an event where the downstream storm lead and/or curb drain is not flowing due to blockage, high flow conditions, etc.

Q. FDDs remove stormwater flow from the sanitary sewer system and redirect it to the storm sewer system. What if the storm sewer system is already at capacity?

A. When the storm sewer system reaches its capacity, storm water flows onto ground surfaces, such as roads and yards. Once the flow that had filled the storm sewer passes, the surface flow (the water in roads and yards) will enter the storm sewer. In homes with a sump pump, there is a pipe outside the home, constructed with an air gap. The air gap allows the flow to drain onto the ground, if the discharge line is full.

Q. I would like to know what type of drilling fluid/lubricant was used when the curb drains were dug?

A. A mixture of water and bentonite.

Q. Please provide all the product information that is available.

A. Following is the specification on for the bentonite drilling fluid:

Drilling Fluid
A drilling fluid of water and bentonite clay or a polymer shall be used. The fluid shall be inert. The fluid should remain in the tunnel to ensure the stability of the tunnel, reduce drag on the pulled pipe, and provide backfill within the annulus of the pipe and tunnel.

Leakage of drilling fluid through the soil shall be minimized. The Contractor will immediately clean up any drilling fluid that surfaces through fracturing. The Contractor is responsible for transporting all excess fluids to a disposal site and paying all disposal costs. Disposal shall be performed in compliance with all applicable environmental regulations, right-of-way, and work space agreements. Drilling fluid is not to be placed in storm drains or the sanitary sewer. The Contractor is responsible for all costs associated with mitigating the accidental release of drilling fluid on to private property, including but not limited to, lawns, footing drains, and basements.

Q. What information did the contractors who did this work have to provide to the City regarding this drilling fluid?

A. See above.

Q. Was there a difference between what method and/or products were used before 2006 and after 2006?

A. No, the same specification has been used.

Q. Did different contractors do this work [install curb drains]?

A. Three different contractors.

Q. What was the specified depth for burial of the curb drains?

A: The curb drain is to be installed, using an approved directional drilling (trenchless) method for the specified pipe at a depth 2-6 feet between existing storm sewer catch basins or other approved structures as directed by the Project Engineer. A minimum grade of 1% (one percent) shall be maintained for each curb drain section. Bellies, dips, and non-sloped sections will not be allowed.

Q. City workers who came and cleared the curb drain with pressurized water, told the homeowners on Avondale that this was not the only place where this had happened. In how many locations was there freezing of curb drains?

A: In three locations, impacting four homes.

Q. What could be done to prevent the freezing? Are there warming devices (similar to those people put on roofs to prevent ice dams) that could be installed to correct this problem?

The frost line in Michigan is much lower than 1.5 -2 feet. Why were the curb drains not installed deeper--ie, at 42+ inches?

A. Questions have been raised regarding the burial of the sump discharge lines at 24-inches deep, and whether this is indicative of a systemic defect in the City's FDD program. The City's 24" burial depth (minimum) standard is based on the following requirements and assumptions:

a) The sump discharge lines in the ROW and on private property is required to be constructed with a positive slope meeting the project specifications and the building code based on the size of the pipe. Each construction installation has been verified and approved by Planning & Development Services.

b) With the required slope, the pipes will not have standing water in them.

c) Sump pump discharge water is typically “warm” at about 55 degrees and will not have time to cool down and freeze in the sump lead or curb drain if positive slope is present.

d) The exiting storm sewer infrastructure that the curb drains connect to is often shallower than frost depth, making deeper curb drains infeasible.

These requirements and resulting conditions promote effective functioning of the sump discharge line and curb drain, even under extreme cold conditions like those experienced last winter. The specifications themselves are not indicative of any systematic defect in the City’s system.

B. It is possible that in some cases, such as the houses along Avondale that the sump leads may have “dips” or flat sections in them where the water could collect and cool. When it was pushed downstream with the next pumping cycle it became susceptible to freezing in the curb drain due to the “icicle” effect. If such sump discharge line and curb drain collector line dips exist, they do not meet the City’s specifications.

C. The City plans to investigate the reported cases of pipe freezing and identify any necessary corrective work.

Q. How many engineers think that burying curb lines at 24” have no chance of freezing?

A. The specification has been reviewed when it was created and has been reviewed several times since it was developed. The specific issue about burial depths has been reviewed and a pipe with a positive slope, carrying sump pump water, which is typically about 50-degrees should not freeze. However, if there is a belly, or a small dip in the line, it can trap a small amount of water that could freeze; that is what happened on Avondale.

Q. Were there claims for the frozen pipes on Avondale and did the city pay them?

A. No, the City did not receive any claims for 1511 or 1515 Avondale.

Q. Provide a look-up table for service lead size requirements. This is to help verify curb drain sizes with multiple connected sump pumps running concurrently.

A. The attached TABLE P3005.4.2 contains maximum DFUs allowed down drains, by size. TABLE P3201.7 has some info about maximum GPMs flowing down certain size traps. However, Plumbing Code is not appropriate to use for the design of curb drains.

Developer Offset Mitigation (DOM) Program

Q. What is the legal justification of the developer mitigation program?

A. The interface between the Developer Offset Mitigation Program and property owners who may take advantage of the program to fund their footing drain disconnect is simply a funding mechanism. It is purely voluntary for any property owner who is offered funding by a developer. The property owner is free to accept or refuse the offer. The ability of a property owner to accept or reject a developer's offer is distinct from an obligation to disconnect that the City might impose under Sec. 2:51.1 of the City Code.

While there might be disagreement as to the best way to minimize or limit the impact of a new development on the sanitary sewer system, the City is not legally required to pick the best option. This choice also has benefit of reducing risks of storm water overflows from combined sanitary and storm flows in the sanitary sewer system. In addition, property owners who take advantage of a developer's offer are not subject to the same subsidy limits as property owners whose footing drain disconnects are funded by the City.

Q. How does the Developer Offset Mitigation Program work? Are the disconnections mandatory?

A: Developer Offset Mitigation (DOM) is performed by, and at the expense of, the developer. The developer covers all of the costs for the mitigation work. Developers are required to offset any new flow to the sanitary sewer added by the development. While FDD is an option, and is the most common method chosen by developers, other methods to remove flow can be proposed and reviewed. All footing drain disconnections made under the DOM program are voluntary.

Q. Why can't the Developer Offset Mitigation Program pay for storage instead of the disconnect/sump pumps?

A. The Developer Offset Mitigation Program does not specify or require footing drain disconnections as the only option for peak flow mitigation.

Q. Regarding in lieu payments recommendation in the revised DOM proposal, would the City staff determine which projects would be required to perform immediate, specific mitigation?

A. Yes, largely. City staff reviews the developer's plans, negotiates with the developer regarding the specifics of the development and then makes recommendations, which are then sent to Council for final approval.

Q. What is Table A in the DOM Program?

A. Table A is a table of flow values used to calculate the flows that a development will generate. Table A is now a dated document, and the City and the development community both believe that it should be updated. The development community will be engaged in modifying the flow rates used in Table A.

Q. University of Michigan, MUNGER Graduate Dormitory (former Blimpie Burger location) Questions: a - d.

a. **What are the results of the FDD (Footing Drain Disconnect) Calculation Work Sheet for the Munger dormitory building? Please provide the calculations, number of FDD credits, and distribution of credits for this development.**
b. **What is the ratio of residents to the number of toilets/showers in the proposed design?**
c. **What is the anticipated peak flow output of sanitary discharge from this building?**
d. **What was the estimated total peak flow output from the structures formally occupying the footprint of the new proposed Munger dormitory.**

A. 35 FDD required. The calculations were provided to the requestor and were posted as a link on the project website: www.A2gov.org/SSWWE's library page.

Q. I am interested in why the DOM is not held to pre-qualified contractors as those in the FDDP are? I understand the response, the "A" to another CAC member's question, but it does not actually answer why. "DOM contractors are required to be licensed and the inspection/permitting process is the same for the City's program and the DOM program" appears to justify why the same process was not used, but then that raises the question of why pre-qualified contractors were required for the FDDP if they were in fact licensed and would go through the inspection/permitting process.

A. The intent of providing a list of pre-qualified contractors for the City's FDDP was to assist residents in selecting a contractor from a list of contractors who are already familiar with the methods and materials of the FDDP program as opposed to putting the burden entirely on the resident to find a qualified contractor on their own. In addition, a resident does have the ability to hire a contractor not on the pre-qualified; however the reimbursement process is different. The property owner must contract with and pay the non-prequalified contractor and then the property owner would need to submit to City for reimbursement.

Q. Is there is enough mitigation opportunity left; are there enough flows to offset or will a DOM (Developer Offset Mitigation) mandate throttle development?

A. There are still pockets of the City with high flows. There are also mitigation approaches other than performing FDDs, such as disconnecting swimming pools. And finally, if payment or construction work in lieu is determined to be acceptable, developers could opt to fund or complete one of the six SSWWE projects to fulfill mitigation obligations.

Q. If developers could continue to solicit homeowners for FDDs, would the City still use the 4GPM figure in the calculation?

A. As we look at the details of the Developer Offset Mitigation program going forward, City staffers will evaluate that.

Q. Developers who are considering purchasing a specific parcel would benefit from knowing whether that parcel is located in an area of the sanitary sewer system that has issues. Currently, the sanitary sewer system map is not made public, due to Homeland Security concerns.

A. It's true that the City does not publish the sanitary sewer system map details due to security concerns, however developers are welcome to meet with City staff to review specific properties and learn more about their sanitary sewer conditions. In addition, the City is moving forward with creating maps indicating the parcels upstream of the 5 project areas recommended by the SSWWEP study for use by developers.

Q. For the DOM program, has anything else been done, besides FDDs?

A. Yes, as was mentioned in the DOM FAQ and video, some developers have mitigated flows through other methods, such as:

- Renovating buildings and replacing old fixtures with low flow fixtures
- Disconnecting swimming pools from the sanitary sewer system
- Demolishing or disconnecting buildings from the system

Q. There has been discussion that some of the building & growth out on Jackson Ave, is not being required to 'offset'. Is this because they paid something towards the WWTP or is there another reason?

A: In prior years, Scio Twp has paid for improvements that have occurred in the collection system to specifically serve the township's contact capacity for the Jackson Road corridor. Until the actual flows from the Jackson Rd corridor exceed the contracted capacity, the township is not required to mitigate flows from this particular corridor. The township is required to mitigate new flows coming from other township connection points.

Q. If so, how large is the area? And are there other areas that are exempt?

A: The area is made up of the properties along Jackson Rd between Baker Road and Wagner Road. All other township areas are required to follow the DOM requirements.

Q. Are all the developers providing backups to the sump pumps they install for FDD volunteers?

A. The developers negotiate with homeowners, City staff does not know what they negotiate.

Q. Are most DOM FDDs performed by the prequalified contractors?

A. They don't have to be, any licensed plumber can do the work.

Q. Is CDM involved in the DOMP?

A. Yes, CDM makes an inspection, verifying that the disconnection has been performed. This cost is paid by the FDD program.

Q. I would like to know what complaints are about the DOM program? What are the major issues that people have with that?

A. We can use the survey data to parse out the respondents who had developer-sponsored disconnections.

Q. Were the DOM homes surveyed in the FDD survey?

A. Yes, surveys were mailed to all homes that participated in the City's FDD program and the DOM program.

Q. I feel that the City made a profit on the Developer Offset Mitigation FDD installations paid for by the University of Michigan, relating to its Stadium expansion.

A. While the City's FDD program covers $4,200 as reimbursement to the homeowner for footing drain disconnections and sump pump installation, this amount does not include the costs to design and construction the curb drains needed to reroute stormwater flows to the storm sewer system.

Based on the total costs of the FDD program to date and the number of FDDs performed, it is estimated that the total cost per FDD is about $9,000 to $11,000 per installation. This would not include annual maintenance costs after installation, or cleanup costs if a sump pump should fail. Annual costs for maintenance, replacement costs, and costs of unnecessary treatment of groundwater at the treatment plant will be estimated in the near future as part of the alternatives analysis.

Q. Have any homeowners been turned down for the DOM? Say, if they wanted too much?

A. While the City staff is not involved in developer/homeowner negotiations and cannot say if this is true, a construction engineer from a consulting engineering company reported that contractors have told him that they've declined homes where it was too costly (difficult) to pipe to the storm drain.

Q. Nice work on the DOM video. I think it cleared up some persisting misconceptions. It sounded like the people who had DOM disconnections got really good results and dryer basements. This is not consistent with the FAQs on the FDDP web site. It specifically says that FDD won't fix basement dampness. Have a look at FAQ 4 at this link: http://www.a2fdd.com/faq.htm **Why is there a discrepancy?**

A. The difference here is one of scale. The people on the video indicated that they had serious issues with water in their basement – i.e. problems with standing water, as some mentioned inches of standing water. Sump pumps can remedy that issue. What they don't do much for is minor seepage and "dampness" – a dehumidifier would probably needed to address that.

Q. Homeowners in the DOMP videos mentioned that the sump pump dried up flooding in their basements, how does that work?

A: A sump pump usually stands in a sump pit -- a hole with a gravel base about 2 feet deep and 18 inches wide -- dug in the lowest part of your basement or crawlspace. As the pit fills with water, the pump turns on. It moves the liquid out of the pit through pipes that run away from your home to the storm sewer or to a spot where the water can drain away from your foundation. Digging down under the floor will draw the water level down.

Q. I am curious about what "FDD credits" are. How does this translate into reducing sanitary peak flow, or at least not increasing it? One of my concerns is that this implied expansion of demand on the sanitary system will be offset by *mandatory* disconnects under the city program, rather than *voluntary developer* disconnects. This leads to the idea that the mandatory FDDs will be used to make room for future development.

A. The goal of the mandatory FDD program is to reduce the risk of potential basement backups in certain areas in the city where homes have experienced past backups. The developer offset mitigation is in place so that new flows generated by developments do not exacerbate or negatively impact the system during wet weather events. Staff created an FAQ regarding the City's mandatory FDD program vs developer offset mitigation program. The document is linked here and can be found on the City's SSWWE website > Library page.

Q. When the Stadium was expanded and the University paid for 140 FDDs ($1,405,600), were any of these FDDs done in the Target Areas? If not, where were they done?

A. The FDDs performed were upstream of the Michigan Stadium, which happened to include the Glen Leven area.

Q. In Scio Township, does the new Menards store or any future project have to pay the mitigation fees similar to mitigation fees for new projects in the City of Ann Arbor?

A. There are no mitigation fees. Scio Township developments that contribute flow directly to the City's sewer system are required to perform offset mitigation, unless the Township has purchased or constructed capacity in the City's sanitary system.

Q. Regarding a new project at 2250 Ann Arbor Saline Road – will DOM FDDs be required for this project? How many?

A: Yes, mitigation will be required. Plans have not been submitted yet, so no calculations can yet be performed.

4. WASTEWATER TREATMENT PLANT (WWTP)

Q. What's the capacity of the plant before the upgrade and what will it be in the future?

A. The plant's capacity is a more complex concept than a single number because the plant has capacity to accept and treat flows, as well as store flows for a period of time for treatment later. The current WWTP has a design capacity of 29.5 million gallons per day (MGD. Additionally, the plant has storage that can handle short peaks in flow rate that, if extrapolated to a daily rate, would be the equivalent of about 70 million gallons in a day. On average, the plant treats about 18.5 MGD, or about 60% of its capacity. The treatment capacity will not change with the plant upgrades; the upgrades are renovating old buildings and equipment, not increasing capacity. On the project website (www.a2gov.org/SSWWE) you can see a short video that explains the plant's functions and capacity.

Q. What are the current and planned normal and peak capacities?

A. The current present day average flow into the treatment plant is about 18-19 mgd. The projected need in 2025 is 24.3 mgd. The annual average daily design capacity of the City's current wastewater treatment facility is 29.5 mgd.

Q. What long range City/county Plans exist for new regional facilities?

A. For the City of Ann Arbor sanitary system, there are currently no planned or proposed new regional facilities. The City's Wastewater Treatment Plant is currently undergoing major renovations.

Q. 2.26 Can the treatment plant be expanded?

A. No. The wastewater treatment plant size is constrained by its physical location. It is surrounded by railroad tracks, a creek, and the river.

Q. What plans are underway to accommodate future expansion of City sewer/water services?

A. For the sanitary sewer system, the SSWWE project evaluated the current capacity of the sanitary sewer system, including a risk analysis of capacity concerns. It found adequate capacity for the future, based on current population and usage trends.

Q. Should there be an on-going County or Metro area infrastructure study, to accommodate growth?

A. An undertaking such as this would require substantial time and effort, and would require the consent and cooperation of all the involved municipalities. We recommend contacting the Southeast Michigan Council of Governments (SEMCOG), of which the City is a member, to learn more about what would be needed to undertake such a regional study.

Q. Does the waste water treatment plant operator log events which exceed these limits (excerpt from the WWTP Facilities Master Plan prepared by Black & Veatch in 2003 contains design parameters of the plant?)

If so, what is the recent history (last several years)? Please provide summaries of events when any of these limits were exceeded. I am also interested in learning more about situations described in the response to Q2.16: "...typically because plant flow increases faster than plant operators can react to bring equipment on-line that is not needed at the lower flow rates…."
This is to understand how issues involving wet weather events at the WWTP are related to plant capacity, or other parameters, such as rate of change in flow rates or other operational challenges.

A. A listing of WWTP overflows since 1999 is linked here and can be found on the project website at www.a2gov.org/SSWWE > Library.

Here is additional information about plant capacity from the 2004 WWTP Facility Master Plan and current capacities:

The capacity of the retention and equalization facility is a function of the intensity and duration of a given storm event. With a total retention and equalization volume of 16.76 million gallons (including chlorine contact volume), it is possible to formulate how many days of storage is available based on a given peak day flow. Assuming the plant can handle incoming flows of 2.5-times the 2025 AADF of 24.3 MGD (or 60.75 mgd) and the 2025 peak hour flow of 72.7 MGD, a total of 11.95 MGD would need to be diverted to the flow Equalization and Retention Facility (72.7 mgd – 60.75 mgd). At this rate of diversion the peak hour design flow of 72.7 mgd could be sustained for approximately 1.4 days (16.7 mg/11.95 mgd) before the capacity of the equalization facility is exceeded.

Since that master plan was developed, the disinfection process was changed to ultra-violet (UV) light. The hydraulic capacity of the UV system is around 48 MGD or so. Doing the same analysis that B&V performed for the WWTP Facility Master Plan but using 48 MGD as the amount "the plant can handle", the storage is around 16 hours. Treatment plant staff consider this as a worst-case scenario, and would characterize our storage as being from 16 hours to 1.4 days.

Q. Regarding Ann Arbor's WWTP capacity – it appears that the facility lost capacity when it switched to ultraviolet light from chlorine. Is this a true statement? If so, why was this done, and why was the chlorine equipment not kept to augment the ultraviolet during peak rain days?

A. The WWTP has the ability to fully treat 48 million gallons of wastewater per day on an average annual basis, including disinfection using the ultra violet (UV) light system. This does not mean 48 million gallons per day is the maximum flow that could be sent through the plant. Both prior to and following the conversion from chlorine to UV disinfection, the WWTP might have to bypass some of the treatment processes for a prolonged high flow, depending on specific plant conditions (e.g., storage available, equipment out of service, duration and volume of flow entering the plant, etc.). The decision to eliminate the chlorine disinfection system was based on the risks to human health and the environment that would result if one or more of the one-ton chlorine cylinders ruptured and leaked.

Q. During the June 27, 2013 storm, the treatment plant had an overflow. How many gallons?

A. Estimated 10,000 gallons. Note: the plant treats an average 19.2 million gallons per day (mgd).

Q. Has the EPA contacted the City about the June 27 overflow?

A. The City notified the Michigan Department of Environmental Quality (MDEQ) of the incident.

Q. What is the expected growth in capacity usage (as well as growth in usage since the initial studies in 2000)?

A. Ann Arbor 2004 WWTP Facility Master Plan conducted in 2004 forecasted continuing population growth. That Master Plan, predicted a 27% increase in flow between today's average flow and 2025, however, the state's economy has changed dramatically since 2004 and such large increases are no longer expected. In fact, data shows that water usage and sanitary sewer production is actually decreasing, not increasing.

Q. Does the discussion of the capacities relate to the current situation with the West plant down for refurbishment, or is it the combined system, assuming both plants are in service? How does the answer change given the status of the West plant?

A. Below are the responses from the WWTP Services staff:

- The projections would not have taken into account the west plant being off line for replacement.
- The flow estimate was based on a projection of growth which the plant is presently not near.
- The west plant would be available if and when the 2025 projection is met.
- If the flows were at the projected rate and the west plant is out of service, it is expected the time estimate to be reduced by about 1/3.

Q. Why doesn't the upgrade of the AA WWTP increase capacity with the second treatment plant activation?

A. The current dry weather average daily flow into the treatment plant is about 18-19 mgd. The projected need in 2025 was 24.3 mgd, based on a study conducted in 2004, however it's now considered unlikely that the need will be that great, based on population and water usage trends. The annual average daily design capacity of the City's current wastewater treatment facility is 29.5 mgd. The wastewater treatment plant size is also constrained by its physical location. It is surrounded by railroad tracks, a creek, and the river.

Q. With all the development in the last ten years, how can you know that the treatment plant has capacity in the future?

A. Ten years ago, the plant was not operating at capacity and over the last decade, the City has required that developers offset any flow they expect to add to the sanitary sewer system, removing even more flow from the system than the new development would add. This added capacity. This practice, as well an overall reduction in water consumption mean that the plant has adequate capacity now and in the future. Additionally, the CAC recommended continuation of the Developer Offset Mitigation program, with a few modifications. The DOM program helps to conserve capacity.

Q. Why wasn't the SSO consent agreement with the EPA mentioned in the WWTP video?

A. Because the City is no longer under the consent agreement.

Q. How is plant capacity is affected by the West plant being out of commission?

A. The 29.5 MGD capacity number mentioned in the video and FAQ doesn't take into account the storage capacity of the equalization basin, which is not impacted by the construction.

Q. Will the West plant be rebuilt or is it permanently out of commission?

A. Yes, rebuilding the West plant is the purpose of the $120M capital improvement project discussed in the video and FAQ.

Q. What is current capacity at the WWTP while the West plant is out of commission? And what will it be when the reconstruction of the West plant is complete?

A. It's 20.0 MGD currently and will be 29.5 MGD once construction is complete.

Q. Is it correct that even with future growth, the City will be using less water?

A. Yes, water usage is and has been decreasing in recent years.

Q. A CAC member asks how future predicted 2025 WWTP daily flows of 24.5 MGD reconcile with SEMCOG population growth of 4%?

A. The 2025 predicted flow of 24.5 MGD came from a 2004 Black & Veatch WWTP Facility Master Plan, which used SEMCOG (Southeast Michigan Council of Governments) data from an earlier point in time. However, since that master plan was developed, the economic and population situation in Michigan has changed significantly and we no longer expect to reach those projections by 2025.

Q. A CAC member looked up a report of a May 2011 SSO that caused sewage to come from several manholes. What caused it? Was there any follow up?

A. The May 2011 SSO was investigated and no defects in the pipe were found at that time. It's the City's practice to jet clean and TV after an SSO.

Q. The 10,000 SSO reported in 2013 – was that an operational issue or a capacity issue?

A. It was an operational issue. In addition to the large, sudden amount of rain that fell, there was a lot of flooding around the plant itself. An amount of sewage discharged from the plant's headworks during about a 10-minute period; operators noticed it and followed SSO reporting and clean up procedures.

Q. On Lohr Road, 1/2 mile north of Textile, 2miles south of Ellsworth, on the west side of the road, there is a sewage pumping plant, and a large one. It also has natural gas powered generators. I noticed tonight that on the maps, a red line, or "pipe" ran from it due east south of the airport, and then stops. Why? Where does all of this stuff go from that pumping plant? To Ann Arbor's WWTP, or to one in Belleville?

A. The flow from the pump station does not connect to the City's WWTP. We assume it flows to YCUA's (Ypsilanti Community Utilities Authority) system.

Q. Has/will the City investigated the possibility of utilizing the Ypsilanti Treatment for Storage? Could Ypsilanti Sanitary System (YCUA) which borders the Ann Arbor System and is of a lower elevation, has large capacity, does not exit to the Huron, services adjacent townships, etcetera; be contracted to accept Ann Arbor Sanitary Overflow?

A. Purely from a technical standpoint, there are constraints that would make this very challenging to implement. A major issue is that the YCUA plant is on the wrong side of the river, and the flow would need to be pumped in order to get under the river and back up to their plant.

Q. If townships exceed sewage contract capacity, does the City have to accept it? Are the contracts open ended?

A. Typically, the acceptor of the flow can require that the community adding flows build storage. In general, these municipal contracts are long-term and require multiple years notice before either party can terminate the contract.

Q. Do the sewer, water, and surface disposal customer rates compensate by area? (Twps pay more)?

A. Township islands within the City service area pay two times the City rate, unless other site-specific agreements are in place. Outside the City service area, the City contracts with Ann Arbor, Pittsfield, and Scio Townships for utility services on a sale for re-sale basis.

Q. Can the townships' contractual limits be increased arbitrarily, or must they be negotiated and voted on by Council?

A. These types of contracts typically require approval from the elected officials and involve lengthy negotiations for any changes, and allow for the accepting entity to require improvements as a condition of the contract.

Q. If a developer in a neighboring township wants to build a development and incorporate into the City of Ann Arbor, is the City obligated to accept the flow?

A. The geographic boundaries for which the City is contracted to service with municipal utilities have already been determined and in the modeling, the project team has assumed all those areas to be contributing their full contracted daily amounts.

Q. If all the choke points in the sanitary sewer pipe network in the neighborhoods were removed, could that have a negative impact on the WWTP?

A. It's possible that it could allow the flows to rush to the plant, and potentially overwhelm it.

5. CLIMATE CHANGE

Q. The March 15, 2012 rain in the Lawton area was a very significant event. Are climate change and large rain events going to be considered in your process? Are you taking into account long-term weather forecasts (climate change)?

A. Quantifying the impacts of climate change on long-term weather is a very complex technical issue. This item can be addressed by the CAC during the alternatives evaluation phase of the project. For example, the CAC can consider the cost versus the risk of failure (i.e. a larger storm overwhelming the system), where the risk includes an allowance for larger rainfalls as a result of climate change. We are reviewing the most up-to-date rainfall statistics and will consider these when making recommendations.

Large rain events produce very valuable data for a study like this and will be evaluated in this process. It is difficult to forecast the impacts of climate change on rainfall patterns. This study does not include a specific task to address climate change as part of the measurement. However, there is a phase of the study called "alternatives evaluation" where the project team will gather and evaluate different approaches to manage wet weather flows to the sanitary sewer system. During this alternatives evaluation phase, the project team, together with the Citizens Advisory Committee, will have the opportunity to consider the impacts of climate change when setting the future level of service for the system through the risk-based design approach. This item can be taken up by the Citizens Advisory Committee working with the subject matter experts in the Technical Oversight Advisory Group.

Q. How is climate change being considered in the modeling and hydraulic analysis of Ann Arbor's sanitary sewer system? How did you determine that 10% increase in peak flows was adequate to account for climate change in the future?

A. Response from consultant project manager, Robert Czachorski, PE:

The impact of climate change on rainfall is complex, and there is a lot of variability, depending on which scenario or even time of the year is considered. This variability has led to many generalizations in the CAC meetings, with varying ranges discussed. Because of this large variability, it is probably best to examine the data from the EPA and output from our hydrologic (flow) model directly to understand the impacts. I have outlined the results below. I believe that these show a strong basis for the CAC to recommend a 10% increase in peak flows to account for climate change.

EPA Rainfall Data
We computed the climate change impacts on rainfall using the EPA's National Stormwater Calculator, which was recently updated to include climate variability based on the Intergovernmental Panel on Climate Change protocols. The program has a low and high range, which varies from projecting less rainfall for the region to more rainfall for the region. The rainfall data shows that the annual average precipitation ranges from a decrease of 6% to an increase of 8.4%, depending on which scenario is selected. Below is a summary of the output from the program.

- **Attachment 1 – Fact Sheet on EPA's National Stormwater Calculator** – This is a reference for the program from EPA that we used to compute the climate change impacts on rainfall. Page 7 of the program was used to compute climate change impacts.

- **Attachment 2 – Near-term (2020-2049) "wet/warm" scenario for the near-term (6 – 35 years)** – This shows output from the EPA program for Ann Arbor for the near-term (6 – 35 years) using the wet/warm scenario, which is the high rainfall scenario. Page 2 of the document shows the annual rainfall changing from 34.70 to 36.28-inches, which is a 4.5% increase in annual precipitation. Note that 20-30 years is a common window for utility master planning.

- **Attachment 3 – Far-term (2045-2074) "wet/warm" scenario** – This shows output from the EPA program for Ann Arbor for the far-term (31 – 60 years) using the wet/warm scenario, which is the high rainfall scenario. Page 2 of the document shows the annual rainfall changing from 34.70 to 37.60-inches, which is an 8.4% increase in annual precipitation. Note that 30-60 years is beyond the common window used in utility master planning.

- **Attachment 4 – Near-term (2020-2049) "hot/dry" scenario** – This shows output from the EPA program for Ann Arbor for the near-term (6 – 35 years) using the hot/dry scenario, which is the low rainfall scenario. Page 2 of the document shows the annual rainfall changing from 34.70 to 33.55-inches, which is a 3.3% decrease in annual precipitation. This shows the wide variability in projected precipitation from the EPA program, depending on which scenario is used.

- **Attachment 5 – Far-term (2045-2074) "hot/dry" scenario** – This shows output from the EPA program for Ann Arbor for the far-term (31 – 60 years) using the hot/dry scenario, which is the low rainfall scenario. Page 2 of the document shows the annual rainfall changing from 34.70 to 32.61-inches, which is a 6.0% decrease in annual precipitation. This shows the wide variability in projected precipitation from the EPA program, depending on which scenario is used.

- **Attachment 6 – Near-term (2020-2049) Monthly Change in Precipitation** – This shows the output from the EPA program for Ann Arbor for the near-term change in monthly precipitation for the hot/dry scenario, the wet/warm scenario and the "median" scenario. Note that there is a large variability in the precipitation changes from month to month. For the wet/warm scenario, the monthly values vary from a 12% increase in March to a 3% decrease for August. For the hot/dry scenario, the monthly values vary from a 5% increase in March to a 13% decrease for August.

- **Attachment 7 – Far-term (2045-2074) Monthly Change in Precipitation** – This shows the output from the EPA program for Ann Arbor for the far-term change in monthly precipitation for the hot/dry scenario, the wet/warm scenario and the "median" scenario. Note that there is a large variability in the precipitation changes from month to month. For the wet/warm scenario, the monthly values vary from a 22% increase in March to a 6% decrease for August. For the hot/dry scenario, the monthly values vary from a 10% increase in March to a 24% decrease for August.

Impacts on Peak Flow in the Sanitary Sewer

There is a lot of variability in projected rainfall due to climate change. For the SSWWEP, we are most interested in how this change in rainfall may affect the peak flows in the sanitary sewer system. The sanitary sewer tends to have a larger reaction to rainfall in the spring when the ground is wet, and a smaller reaction in the summer when the ground is dry. This effect will tend to amplify the higher climate change rainfalls projects in the spring months.

For this reason, we re-ran our 60-year continuous hydrologic model of the system, but with the revised monthly rainfalls suggested by the EPA program (i.e. we changed each month in the 60-year historic rainfall by the percentage from the EPA program). To represent the worst-case scenario, we selected the scenario with the highest rainfall, which is the far-term, wet/warm scenario, even though the forecast period for this run (31-60 years) goes beyond the normal planning window for master plans. We did this to illustrate the worst-case impacts on peak flows, to give the CAC an upper-limit to consider for climate change impacts. The results are tabulated in Attachment 8, which is described below:

- **Attachment 8 – Output from frequency analysis for far-term wet/warm scenario** – This shows the output from 60-year continuous hydrologic model for the five downstream metering points. The impacts from climate change vary from meter to meter and for the various recurrence intervals. The bottom line total shows an increase of 10.4% for the 25-year flow and 11.4 % for the 50-year flow due to climate change. These increases in peak flows are greater than the annual increase in precipitation due to climate change (8.5% for the long-term wet/warm), because there is a greater increase in precipitation from climate change in the spring when the ground is wet, and the sanitary sewer has a larger reaction to rain in the spring.

Because the above peak flow increases represent the worst-case for the wet/warm scenario for the far term (31-60 year) period, and the increases are in the range of 10.4% to 11.4%, we recommend that the CAC consider a 10% increase in future peak flows for climate change. This represents a reasonable mid-range value for the far-term, and is most likely well beyond the worst-case scenario for the near term (6-35 years), which is a reasonable planning window for this study.

TOAG Review of Methodology and Concurrence
The TOAG's reviewed the climate change methodology used to evaluate risk for the SSWWEP. The TOAG asked its climate change expert, Dan Brown, for comments on climate change and at a CAC meeting, Dick Hinshon, TOAG chair, shared highlights from a Dan Brown memo on the SSWWE project's appropriate consideration of climate change. Amongst other things, this memo outlines the TOAG's conclusions that:

- The methodology used to assess impacts of climate change seems appropriate and standard.
- The methodology used is relatively standard and is similar to other stormwater assessments that have been conducted.
- The other Wet Weather studies being undertaken by Ann Arbor should similarly acknowledge and recognize the importance of climate change as a factor, which affects the City's infrastructure.

Conclusions
The methodology that we have used to assess the impacts of climate change on the sanitary sewer are based on sound science, that are consistent with the values published by EPA in their National Stormwater Calculator Program. The TOAG has reviewed the methodology and found it to be appropriate and standard. Based on these results, we are comfortable recommending that the CAC consider a 10% increase in peak flows to account for climate change. This value reflects the high-end of the ranges that have been published, and should provide a reasonable basis for evaluating the impacts of climate change on Ann Arbor's sanitary sewer system.

Q. Based on OHM's experience with projects in other community – do other communities typically account for growth, or climate change in determining future sanitary sewer improvement projects?

A. The consultant project manager says that most communities perform a study of their system as a result of an enforcement action. They then design the solution to meet MDEQ's 10-year standard. If the community is undertaking a study as a result of basement backups, it may design a solution that's more robust than the 10-year standard. To date, few or no communities have included climate change as factors in their design, probably because the EPA only recently released it modeling protocols for climate change rainfall data.

C. Infographics

i. Air Gap Information

In general, there have been two types of air gaps installed as part of the City's FDD program. Since the start of the FDD program an air gap has been utilized for the following reasons at all installations:

- **Anti-Siphon** – Since the basements of homes can be lower than the adjacent streets, the air gap prevents siphoning of water that may be present in the street drainage system back into basements if the street and curb drain system is flooded, the check valve in the discharge line has failed open, and the sump pump has stopped operating.
- **Code** – The interior plumbing and exterior plumbing in a building are covered by different building permits and separate inspections are required. The air gap provided for a point of demarcation between these two systems for code compliance purposes.
- **Positive Discharge** – If a component of the discharge piping (including discharge lead, curb drain, and catch basin) is plugged, frozen, or otherwise incapable of handling the sump pump discharge, the sump pump will continue to be able to pump flows from the basement to an area outside of the house, even if this discharge location is next to the foundation and some amount of recirculation can occur.

In 2012, the air gap arrangement was modified to include an atrium fitting (usually green) to improve the efficiency of the discharge during emergency situations and prevent debris and rodents from entering the discharge line. Example photos of the different style of air gaps used throughout the program are shown below. All are considered adequate to address the reasons stated above.

Photos 1 & 2 – Modified Air Gap w/Atrium, 2012 and Later

Photo 3 & 4 – Original (2001 – 2011) Air Gap Configurations

The results from the FDD survey conducted in December 2013, showed approximately 30% of the respondents indicated they did not have an air gap. It should be noted however, the example picture used in the survey was of the 2012 modified air gap with the green atrium fitting (example photo 1 & 2) which may have led to confusion by the respondents while completing the survey.

All of the varying styles have been tested for their ability to adequately discharge to ground in a case where the downstream discharge piping is plugged, frozen, or otherwise incapable of handling the flow. The testing showed that even for the most restrictive style shown on Photo 4, there is adequate capacity to convey the average peak flows from a sump pump. A description of the test procedures performed is outlined below.

The first step in the test was to determine the performance of the pump under normal conditions (i.e. no blockages downstream). This included performing 3 different pump tests where the volume of water discharged and the run time of the pump were recorded and then used to determine the pump's average discharge rate under normal conditions. Next, an inflatable plug was installed in the downstream discharge piping in order to force all of the flow to come out through the air gap (thus simulating a condition of complete blockage in the downstream discharge piping). The same test procedures were then repeated to determine the average discharge rate under a complete blockage simulation. Below is a photo taken during one of the field tests.

Photo 5 & 6 –Air Gap Field Tests

ii. **WWTP FAQ**

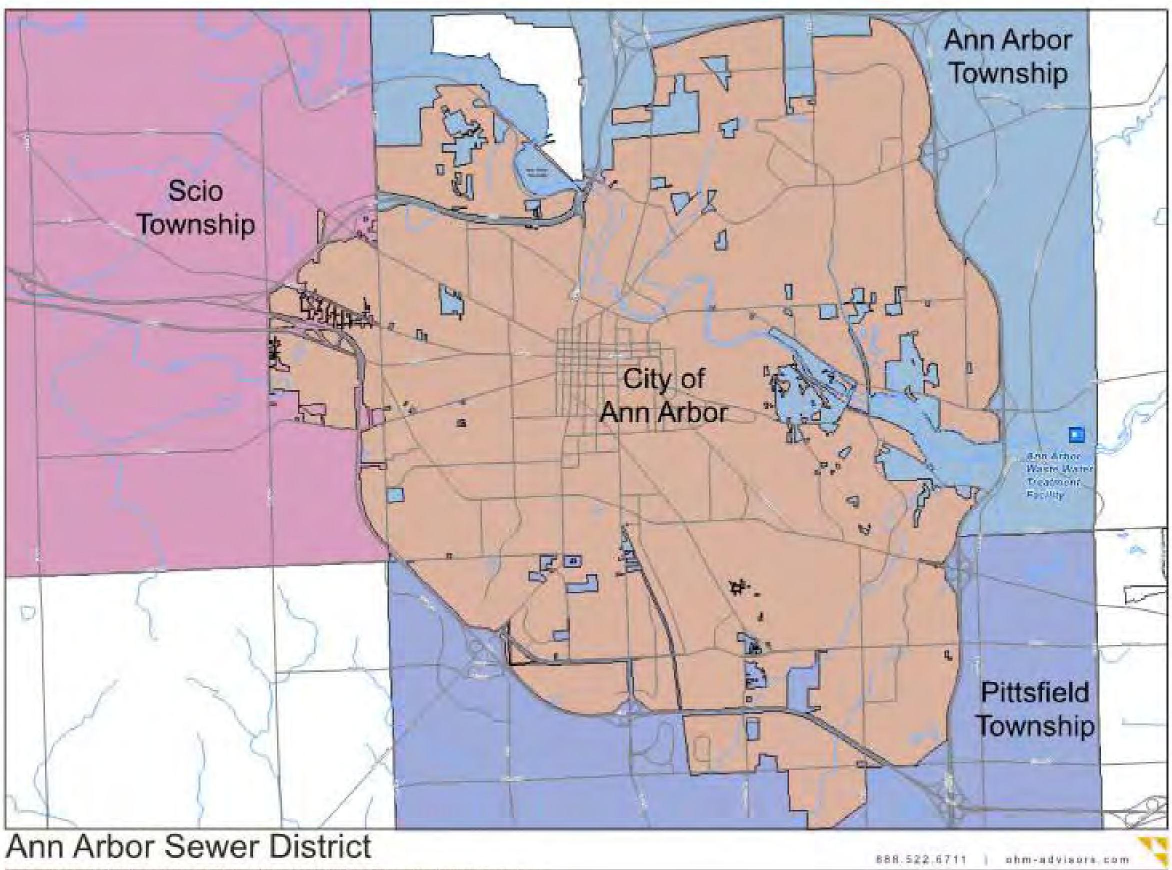
The City of Ann Arbor's Wastewater Treatment Plant (WWTP) is responsible for the effective collection, treatment and environmentally acceptable discharge of the wastewater generated by the greater Ann Arbor community.

The Wastewater Treatment Service Unit (WWTSU), a department of the City of Ann Arbor, is responsible for the operation and maintenance of the City's WWTP and eight sewage lift stations located around the City. The plant runs continuously, 24 hours a day, seven days a week, and WWTSU staff are on duty at all times.

Quick facts:

The City of Ann Arbor's WWTP is located at 49 South Dixboro Road, Ann Arbor, MI.

- WWTP services **110,000 residents** of the City of Ann Arbor.
- The Plant also services an additional **40,000 residents** from three surrounding townships – Pittsfield Township, Scio Township and Ann Arbor Township.
- The Ann Arbor WWTP receives and treats approximately **18.0 million gallons** of wastewater per day from the City and the three townships.
- The WWTP processes about **330,000 gallons per day** from industrial sources.
- The current WWTP has a design capacity of 29.5 million gallons per day (MGD) and consists of an older West Plant (constructed in the 1930s) and a newer East Plant (constructed in the late 1970s).
- The City's sanitary sewer collection system is made of about 370 miles of pipes and transmission mains, all feeding into the WWTP.
- Sewer pipes range in size from 8" in some neighborhoods, up to 72" in areas closest to the plant.



Q. What's meant by the term "sanitary sewer collection system"? What does it include?

A. The sanitary sewer collection system or wastewater collection infrastructure refers to the pipes, lift stations, and force mains that together, make up the City's wastewater collection system.

The City of Ann Arbor's sanitary sewer collection system is a network of about 370 miles of pipes all heading roughly northeast to the wastewater treatment plant. It helps to visualize

the sewer network like a tree; the leaves are houses, connected by small 4" service lines to 8-inch mains that run mostly beneath streets and then to 18-, 24- or 30-inch collectors, leading to larger and larger pipes, as large as 72-inches closest to the plant.

Most of the sanitary sewer collection system operates using gravity to move the waste through the pipes to the treatment plant. For gravity to do its job, the pipe needs to drop about half a foot per 100 feet of length, a slope of 0.5 percent, which is fast enough to keep everything moving, but not so fast that the liquid races away from the solids. Bigger pipes-30 inches or larger-can slope even less. But they all must flow downhill, powered by gravity.

The system generally moves downhill, but pipes sometimes need to cross rises. So the city has lift stations, where the contents of pipes are pumped to join other flows.[1]

Q. Are lift stations and pump stations the same thing?

A. Yes, they are both devices used to raise sewage over low---lying areas.

Q. How is sewage "treated"? What happens to the stuff that leaves our toilets?

A. Wastewater includes human waste from toilets, but it also includes everything from showers, sinks, and washing machines (plus all the things that people flush down toilets and shouldn't!) A high percentage of wastewater isn't fecal material; it's all the water we've used to bathe, wash clothes, dishes, cars, etc. Some industrial processes also create wastewater that gets added to our sanitary sewer system.

Wastewater treatment involves a series of physical, chemical and biological processes to remove contaminants from wastewater and household sewage. The goal of wastewater treatment is to create an environmentally safe liquid stream (or treated "effluent") and a solid waste (or treated "biosolids") that is disposed or reused as fertilizer.

Sewage treatment generally involves three stages called primary, secondary and tertiary treatment.

- Primary treatment consists of temporarily holding the sewage in a basin where heavy solids can settle to the bottom while oil, grease and lighter solids float to the surface. The settled and floating materials are removed and the remaining liquid may be discharged or subjected to secondary treatment.

[1] http://www.scientificamerican.com/article/treating-sewage/

- Secondary treatment removes dissolved and suspended biological matter. Secondary treatment is typically performed by water---borne micro---organisms in a managed habitat. Secondary treatment may require a separation process to remove the micro---organisms from the treated water prior to discharge or tertiary treatment.

- Tertiary treatment is sometimes defined as anything more than primary and secondary treatment in order to allow reinjection into a highly sensitive or fragile ecosystems. At the Ann Arbor WWTP, tertiary treatment consists of sand filtration to further reduce solids (and phosphorus attached to solids) in the effluent.

As a final step in the treatment process, water is sometimes disinfected chemically or physically (for example, by lagoons and microfiltration) prior to discharge into a stream, river, bay, lagoon or wetland or it can be used for the irrigation of a golf course, green way or park. If it is sufficiently clean, it can also be used for groundwater recharge or agricultural purposes. Ann Arbor's WWTP disinfects with UV light after tertiary treatment.

Q. What happens to the fluids or effluent after the sewage has been treated?

A. Effluent is the treated wastewater that is released from the wastewater treatment plant. In Ann Arbor, the effluent is discharged to the Huron River. The City has a National Pollutant Discharge Elimination System (NPDES) permit from the Michigan Department of Environmental Quality (MDEQ), which allows it to discharge effluent to the river, provided it has been treated according to standards set by MDEQ and the Federal Clean Water Act.

Plant Capacity, Construction & Costs

Q. What is the plant's current capacity? Can the plant accommodate future growth?

A. The current average flow into the treatment plant is around 18 million gallons per day (MGD.) The annual average daily design capacity of the City's wastewater treatment facility is 29.5 MGD. On an average day about 60% of the plant's capacity is used.

In 2004, the City commissioned a study of the wastewater treatment facility's condition and ability to accommodate future growth. The 2004 WWTP Facility Master Plan, created by Black & Veatch, projected need in 2025 at 24.3 MGD or about 82% of the plant's capacity. (These capacity numbers include both the East and West plants.)

However, since that master plan was developed, the economic and population situation in Michigan has changed significantly and we no longer expect to reach those projections. Additionally, because of widespread changes in water usage, sanitary sewer flows have not increased substantially in the past five years and aren't expected to in the next couple of decades.

Q. Plant design flow capacity is 29.5 million gallons per day (MGD), while the peak hourly flow is 70 million gallons per day (MGD.) What's the difference between design flow and peak hourly flow?

A. The plant was designed to reliably process an average of 29.5 million gallons per day, however it has additional features, such as equalization basins that allow it to temporarily store larger spikes in flow rates for treatment later. The design peak hourly flow is the largest volume of flow that the plant can handle during a one--‐hour period. Therefore, the plant is designed to be able to handle short peaks in flow rate that, if extrapolated to a daily rate, would be the equivalent of about 70 million gallons in a day.

Q. Can the City's Wastewater treatment plant be expanded?

A. No, the wastewater treatment plant footprint is constrained by its physical location. It is surrounded by railroad tracks, a creek, and the river. Nor does the plant need to be expanded – we are currently using about 60% of the plant's full capacity. Water usage, which is directly related to base sanitary sewer flows, has not increased in the last five years and projections are that Ann Arbor will actually use less water, not more in the future.

Q. How does the City make sure the WWTP is functioning effectively and will continue to have adequate capacity for the future?

A. The City of Ann Arbor commissioned a WWTP Facilities Master Plan in 2004. Performed by Black & Veatch, this Master Plan reviewed the plant's current age, infrastructure and processes and compared those to projected needs (population growth or decline, asset management.) The Master Plan made recommendations for repairs, renovations and upgrades to keep the WWTP functioning effectively. Many of the recommended renovations and repairs are underway now. You can see more details about the WWTP Facilities Master Plan at this link: http://bit.ly/1p700ND.

Q. What is current capacity at the WWTP while the West plant is out of commission? And what will the capacity be when the West plant reconstruction is complete?

A. It's 20.0 MGD currently and will be 29.5 MGD again once construction is complete.

Q. How is plant capacity impacted by the current renovations and the West plant being out of commission? Can the plant handle the flows, even during heavy rains?

A. Let's start with some details about plant capacity:

The design capacity of the East plant is 20.0 MGD, however that does not mean that the most the plant can treat is 20 million gallons of sewage per day. The capacity number mentioned in the WWTP video and this FAQ (29.5 MGD for the entire plant) doesn't take into account the storage capacity of the plant's equalization basin, which is not impacted by the construction.

The capacity of the retention and equalization facility is a function of the intensity and duration of a given storm event. With a total retention and equalization volume of 16.76 million gallons it is possible to formulate how many days of storage is available based on a given peak day flow.

Assuming the plant can handle incoming flows of 72.7 MGD, a total of 11.95 MGD would need to be diverted to the flow Equalization and Retention Facility (72.7 MGD – 60.75 MGD). At this rate of diversion the peak hour design flow of 72.7 MGD could be sustained for approximately 1.4 days (16.7 mg/11.95 MGD) before it exceeded the capacity of the equalization facility.

Since the WWTP Master Plan was developed, the disinfection process was changed to treatment using ultra---violet (UV) light. The hydraulic capacity of the UV system is around 48 MGD or so. Doing the same analysis that Black & Veatch performed for the WWTP Facility Master Plan but using 48 MGD as the amount "the plant can handle", the storage is around 16 hours. As this estimate was based on a series of worst---case scenarios and restrictions, treatment plant staff characterizes our storage as being from 16 hours to 1.4 days.

Q. Is it correct that even with future growth, the City will be using less water and therefore, less sanitary sewage?

A. Yes, water usage is and has been decreasing in recent years. This is true on a national level as well. According to a report from the U.S. Department of the Interior, the nation's water use peaked in 1980 and has been fairly steady since then, despite a 30% growth in population.[2]

<u>Sanitary Sewer Overflows</u>

Q. What is a Sanitary Sewer Overflow (SSO)?

A. Sanitary sewer overflows (SSOs) are discharges of raw or inadequately treated sewage from municipal separate sanitary sewer systems, which are designed to carry domestic sanitary sewage but not storm water. (Ann Arbor's sewer system is separate; the stormwater collection system has its own network of pipes, as does the sanitary sewer collection system. In some older communities, storm and sanitary sewer is collected in the same pipe system.)

When caused by rainfall, it is also known as wet weather overflow. When an SSO occurs, raw sewage may be released into basements, city streets, properties, rivers, and streams. The main causes of SSOs are:

- Infiltration and/or inflow of excessive stormwater into sewer lines during heavy rainfall.
- Rupture or blockage of sewer lines.

[2] http://cleantechnica.com/2009/11/06/us-water-use-declines-despite-30-population-increase/

- Malfunction of lift stations or electrical failure.
- Malfunction of treatment plant facilities or electrical failure.
- Human operator error at treatment plant facilities.

The City is required to report any SSOs that reach waters of the state to the MDEQ and to the Washtenaw County Health Department. Sewage discharges into basement may also occur, but there's no requirement to report those events to the Michigan Department of Environmental Quality under Section 324.3112(a) of the NREPA.

Q. How does stormwater get into the sanitary sewer system?

A. The role of the sanitary sewers is to transport wastewater from homes and businesses to the treatment plant. Along the way, some stormwater enters the sewer pipes. Some common sources of stormwater include:

- Cracks or joints in pipes or manholes
- Cross connections to the storm sewers or drains
- Pick holes or vent holes in the manhole covers
- Footing drains connected to the sanitary sewer system. The 2001 SSO Prevention Study Final Report identified that 70 to 90% of the total sanitary sewer flow – in some portions of the system – was coming from footing drains during rain events.

  Subsequent engineering studies found similar levels of stormwater from footing drains during rain events.

Q. How much does it cost to treat stormwater vs. sanitary sewage?

A. When any stormwater enters into the sanitary sewer system, unnecessary cost is incurred because all the flow from the sanitary sewer pipes goes to the wastewater treatment plant. By itself, there is no cost to treat stormwater at the pipe outlet, as this water is collected by a separate storm sewer pipe system and ultimately discharged to the Huron River without end-of-pipe treatment. Treatment and management of stormwater is handled through other mechanisms such as source control, street sweeping, public education programs, and stormwater collection system maintenance.

Stormwater does not make its way to the wastewater treatment plant unless it enters the sanitary sewer system through defects in the sanitary sewer system or private property sources like footing drains. The cost for treating sewage at the wastewater treatment plant is approximately $1400 per million gallons.

Q. If we're only using about 60% of the plant's capacity, why are there ever sanitary sewer overflows (SSOs)?

A. To understand how this situation can happen, it's helpful to know a few facts:

SSOs include all sewage overflows, ranging from partially treated sewage released into the Huron River when the plant gets overwhelmed, to small flows that surge out of the tops of manholes.

Accumulations of grease or clogs from paper and plastic products can create blockages in sewer pipes, causing backups. Tree roots can infiltrate sewer pipes, causing blockages and even breaking pipes. Sewer pipes fit together simply, with a bell joint, and tiny root hairs find their way to the nutrient---rich flow, then grow larger, eventually growing large enough to shatter the vitreous clay pipe that forms so many service lines or dislodge a joint if the pipes are cast iron.

One of the most common causes of SSOs are heavy rainfall events, which can cause massive influx of stormwater into sewer lines. The combined flow of wastewater and stormwater exceeds the capacity of the sewer system and sewage is released into local waterways to prevent flooding in homes, businesses and streets.

The system does have ample capacity to handle the average daily flows from our community. However, during more intense rainstorms, large amounts of rainwater enter the sanitary sewer system through footing drains, manholes and cracks in the pipes.

Some SSOs occur because plant flow increases faster than plant operators can react to bring equipment on---line that is not needed at the lower flow rates. The sewer system does not have water towers or storage tanks to accommodate regular fluctuations in wastewater volume (flow peaks at breakfast time and again in the evening between 5 and 10 pm), so it stores water in equalization tanks during periods of high flow and especially, storms. Wet weather overflows can occur when the mixture of sewage and high volumes of stormwater rushes through the system to the plant and exceeds its capacity before the equalization basins can be made active.

Q. Is there a record of SSOs in Ann Arbor?

A. Yes, the City reports all SSOs to the MDEQ and the Washtenaw County Health Department and keeps its own record. You can see the log of SSOs and their causes at this link: http://bit.ly/1t2FkG9.

Q. During the June 27, 2013 storm, there was an overflow at the treatment plant. How many gallons? And what caused it?

A. The City estimates that the overflow was about 10,000 gallons. This was reported to the MDEQ and the Washtenaw County Health Department. Press releases were also sent to local media outlets.

Plant operators characterize the overflow as an operational issue, rather than a capacity issue. Here are more details:

On June 27, 2013, a sudden and heavy thunderstorm hit Ann Arbor. The wastewater treatment plant flow volume tripled in half an hour, which was an unprecedented increase in plant flow over such a short period of time. Plant flow went from 18 million gallons per day (MGD) to 50 MGD within a 30---minute period, and peaked at over 65 MGD. This nearly instantaneous change in flow occurred faster than staff could react. Plant personnel redirected much of the plant flow into the retention and equalization facility and turned on additional equipment to handle the increased flow. After the stormwater flooding at the plant subsided, plant staff noticed debris on the ground, which was evidence of a sewage spill. All clean up procedures were followed, required reports filed and notifications made.

Q. City reports show a May 2011 sanitary sewer surcharge caused sewage to come from several manholes. What actions does the City take in those instances? What is the usual follow up procedure?

A. City field crews investigated the May 2011 manhole overflow and found no defects in the pipe at that time. It's the City's practice to jet clean and televise pipes after an SSO.

Maintenance and Repairs

Q. How is the sanitary sewer system maintained?

A. The City has developed a system maintenance plan, based on the characteristics of Ann Arbor's system and best practices among municipalities.

One method of ongoing preventative maintenance the City practices is televising its system. Televising or "TVing" pipes involves running a small robot camera through the pipes to identify cracks or blockages that could affect the sanitary sewer system operations.

Other maintenance measures include jetting rodding or cleaning pipes with high---pressure water.

In addition to responding to problems, the City practices preventative maintenance, striving to televise each pipe in the system once every seven years.

Renovations and Upgrades

Q. Why is the Wastewater Treatment Plant under construction? What kind of work is being done?

A. What we refer to as the WWTP is actually two plants --- an older West Plant (constructed in the 1930s) and a newer East Plant (constructed in the late 1970s). The West Plant is beyond its useful life and was taken out of service in 2006 due to its dilapidated condition. The current WWTP facilities capital improvement project involves demolishing the aged West Plant, building new facilities and upgrading treatment processes at the East Plant.

The entire project will cost $120 million and is the largest capital improvement project in the City's history.

For details on the demolition and reconstruction, visit this link: http://bit.ly/1iQIRjN.

iii. WWTP Infographic

The City of Ann Arbor's Wastewater Treatment Plant (WWTP) is responsible for the effective collection, treatment and environmentally acceptable discharge of the wastewater generated by the greater Ann Arbor community.

On the following page is an infographic depicting the WWTP.

Wastewater Treatment Plant

The City of Ann Arbor's Wastewater Treatment Plant (WWTP) is responsible for the effective collection, treatment and environmentally acceptable discharge of the wastewater generated by the greater Ann Arbor community.

System

Sewer pipe sizes vary from 8" to 72" closest to the WWTP

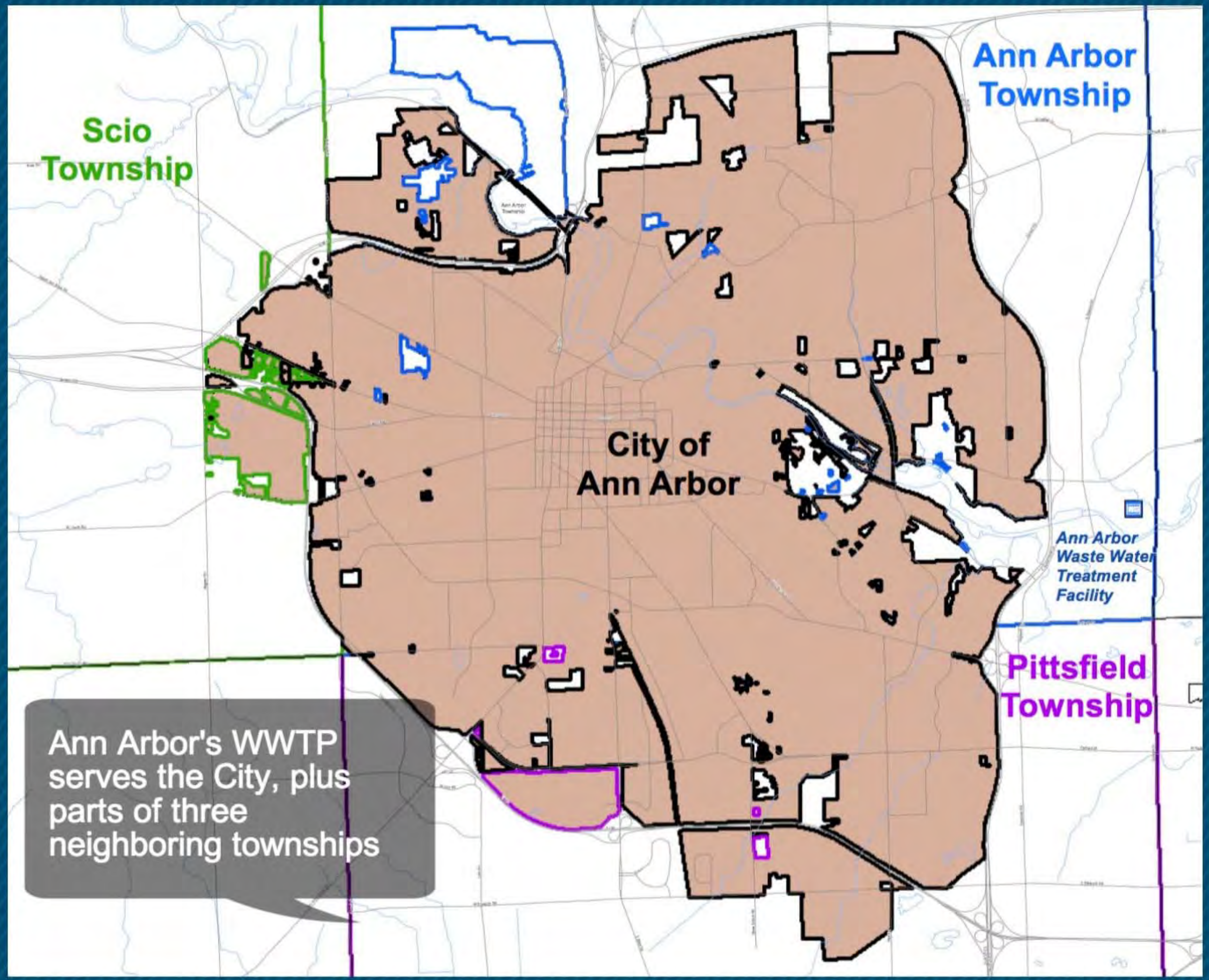
Capacity

Average Daily Flow | Permitted Design Flow

29.5 MGD Design Capacity

18.0 MGD Average Daily Flow

Currently using 60% WWTP Capacity



Capital Improvements at the Plant

The WWTP is actually two plants: West Plant (built in the 1930s) & East Plant (built in the late 1970s)

The West Plant was taken out of service in 2006 and is being reconstructed as part of the largest capital improvement project in the City's history.

$120M

Scheduled completion: Fall 2017

By the Numbers

- 110,000 residents of the City of Ann Arbor
- 40,000 residents from Ann Arbor, Pittsfield & Scio townships
- 370 miles of sewer pipe
- Treats approximately 18.0 million gallons per day (MGD)

iv. DOM Decision Tree

Developer Offset Program (DOM) is a program created to reduce flow to the sanitary sewer system.

The DOM program required new developments that will place additional burdens on the sanitary sewer system to offset the flow the new development will add.

On the following page is an infographic depicting the DOM Decision Tree.

Developer Offset Mitigation Decision Tree

Developer Offset Program (DOM) is a program created to reduce flow to the sanitary sewer system.

The DOM program requires new developments that will place additional burdens on the sanitary sewer system to offset the flow the new development will add.

v. DOM FAQ

Q. What is Developer Offset Mitigation or the developer Offset Mitigation Program?

A. The City of Ann Arbor created the Developer Offset Mitigation (sometimes called the Offset Mitigation Program) to protect the health and safety of our community and the environment, using a whole-city approach. The purpose of the Developer Offset Program (DOM) is to reduce overall flow to the sanitary sewer system. By reducing the flow in the sanitary sewer system, we do two important things:

1. Reduce sanitary sewer overflows

-and-

2. Reduce unnecessary treatment of stormwater.

The DOM program requires new developments that will place additional burdens on the sanitary sewer system to offset the flow the new development will add.

Q. Why was the Developer Offset Mitigation program created?

A. Large rainfall events can cause massive inflow of stormwater into the sanitary sewer pipes, temporarily exceeding the system's capacity. By reducing the amount of stormwater entering the sanitary sewer system, we can regain system capacity to reduce the chances of sanitary sewer overflows. Here's a little background information that will be helpful to understand the big picture:

<u>Footing Drains</u>

In structures built before 1981, footing drains (also known as foundation drains) were most often connected directly to the sanitary sewer system. In 1982, building code in Ann Arbor and many other cities changed to require footing drains to use sump pumps or similar systems to direct footing drain flows to the stormwater system.

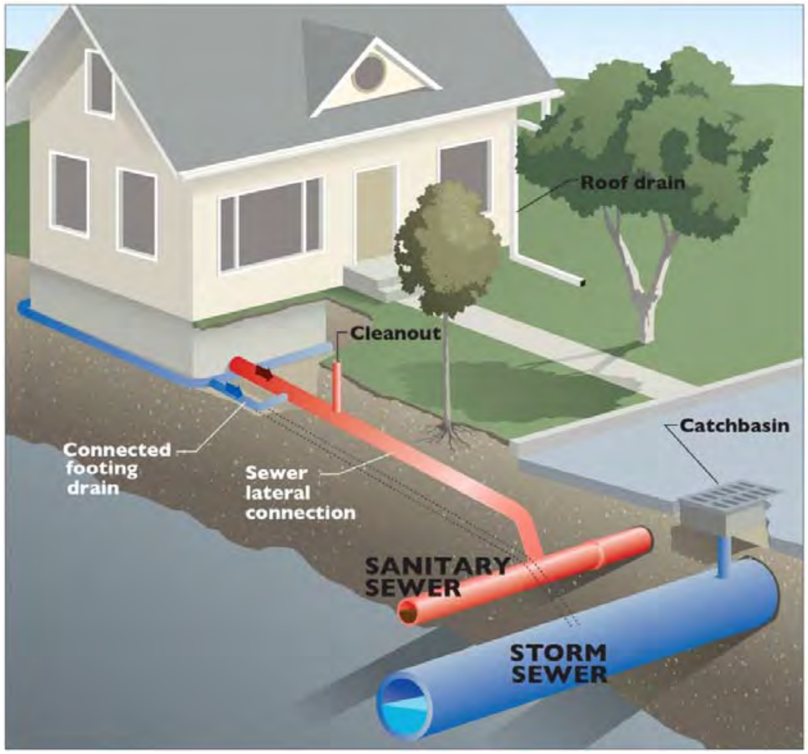


Figure 2: Footing drains direct stormwater flow away from a building. In many structures built before 1981, footing drains were connected directly to the sanitary sewer system.

Studies performed in Ann Arbor and in other cities have shown that footing drain flows during rain events are a major cause of system capacity issues and increase collection system flows by as much as 10-20 times the normal dry weather flow.

On average, each home with a connected footing drain adds 3,500 to 10,500 gallons per year of clean water that must be transported to the wastewater treatment plant and treated.

[Sources: City of Ann Arbor Sanitary Sewer Wet Weather Evaluation Study, 2013; City of Ann Arbor Sanitary Sewer Overflow Prevention Study, 2001]

A number of times during the 1980s, 1990s and early 2000s, large rainstorms caused the sanitary sewer system to exceed capacity, causing sewage to back up in homes in some neighborhoods.

<u>MDEQ Administrative Consent Order (ACO)</u>

As a result of sanitary sewer overflows from the City's Wastewater Treatment Plant into the Huron River, in 2003, the City and the Michigan Department of

Environmental Quality (MDEQ), entered into an Administrative Consent Order (ACO).

The ACO required that the City do two things:

1. Perform a total of 620 additional FDDs within 4 years to reduce the amount of stormwater flowing into the sanitary sewer system.

2. Demonstrate, on a project-by-project basis, offset mitigation for new development to create a net reduction in flow to the sanitary collection system.

Q. Are the Footing Drain Disconnection project and the Developer Offset Mitigation program the same? How are they different?

A. The Footing Drain Disconnection project and the Developer Offset Mitigation program are not the same. While both involve footing drain disconnections, they are separate programs, each with their own purpose and objectives.

The City's Footing Drain Disconnection project was intended to be a comprehensive City-wide program to disconnect all connected footing drains. The program started with 5 specific areas where the majority of the backups were occurring.

The Developer Offset Mitigation program was created to allow development in the City of Ann Arbor without exacerbating the problem of capacity of the City's sanitary sewer system during wet weather events.

Here are some of the major differences:

City's FDD Project	Developer Offset Mitigation
• Targeted in specific areas with a high risk of basement backups, historically • Mandatory • City pays for disconnection and sump pump installation • City initiates project with homeowner	• Citywide • Completely voluntary for homeowners • Developer pays for disconnection and sump pump installation • Developer/contractor solicits volunteers to agree to disconnection

Q. What does "offset" mean in the context of the Developer Offset Mitigation program?

A. The Developer Offset Mitigation program requires that the developer remove more sewer flow from the system than the new development will add during wet weather events.

As an example, if a new development is expected to add 1000 gallons of sewer flow to the system, the developer will be required to remove 1200 gallons (new development flow + 20%.)

Q. Why are developers required to perform footing drain disconnections to offset the sanitary sewer flow? Why not some other method of mitigating the flow?

A. Developers can propose other methods to mitigate (remove flow), however to date, the majority have chosen footing drain disconnects. Because the City has already developed its own Footing Drain Disconnection program to relieve basement backups in high-risk areas, FDDs are a pre-approved method for developers to use to mitigate sanitary flow.

For example, mitigation requirements might be met when an existing property is altered such that the flow to the sanitary sewer system is reduced or eliminated. In this case, a developer may be able to obtain credits based on the design flow rates of the existing configuration compared to the altered configuration. These credits could then be used:

- For a new development on the same site
- For development at another site
- In trade with another developer or contractor All mitigation credits, whether obtained through FDD or through other means, must be used to offset development within two years, unless the FDD project manager has approved a longer time limit.

Q. What are some methods other than footing drain disconnections that developers have used to mitigate sanitary sewer flow?

- Renovating buildings and replacing old fixtures with low flow fixtures
- Disconnecting swimming pools from the sanitary sewer system
- Demolishing or disconnecting buildings from the system

Q. How are mitigation amounts calculated? How many FDDs are required for each new development?

A. If the developer chooses to perform FDDs to mitigate the added flow, then the number of disconnections required is calculated based on a city document titled GUIDELINES FOR COMPLETION OF FOOTING DRAIN DISCONNECTIONS. The document outlines how the City calculates the amount of mitigation required for each new development, based on the scope of the proposed development.

Please see this entire document for additional details on determining the number of footing drain disconnections required, including calculation examples.

Q. How many disconnections and sump pump installations have been performed under the Developer Offset Mitigation Program?

A. As of 1/28/2014, there were 848 single family equivalent FDDs.

Q. How much do developers pay homeowners for performing an FDD?

A. Developers or contractors negotiate directly with homeowners; the City is not part of the negotiation process.

Q. When a developer chooses FDDs for mitigation credits, who contacts the homeowner? A developer's representative? Or does the developer use contractors? Do they use the same contractors as the City's FDD project? How does the developer present the proposition to the homeowner?

A. Typically, developers or contractors solicit volunteers who wish to have their footing drain disconnected for free. They often leave postcards or send letters to homeowners in a neighborhood, explaining the offer and what actions the homeowner needs to take advantage of the offer. The City is not involved with the contact between developers/contractors and homeowners. A majority of the FDDs done under the DOM program have been completed by one of the City's pre-approved contractors; however the developers are not required to use the City's pre-approved contractors.

Q. How were the DOM program's contractors selected? By the City or by the Developer?

A. The developer selects the contractor(s) that will perform the mitigation required for their development. Any contractor that is a licensed plumber and electrician with the ability to pull a City Building Permit can perform the work for a developer.

Q. I know that the City's FDD program is suspended in certain areas, pending the outcome of the Sanitary Sewer Wet Weather Evaluation study. Can homeowners who live in the City's FDD study areas volunteer for a DOM footing drain disconnection?

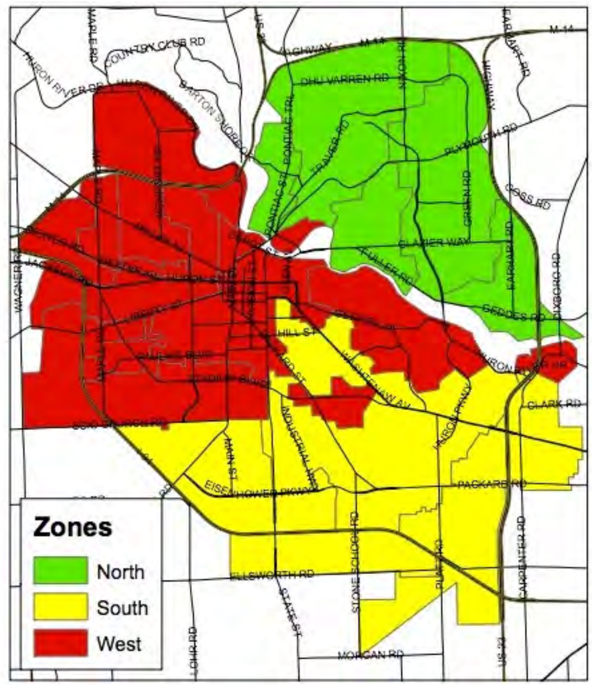
A. Yes.

Q. Are there any penalties if a homeowner rejects a developer's offer to disconnect footing drains and install a sump pump?

A. No. The homeowner can accept or decline and may negotiate as they wish with the developer. There is no penalty or sanitary sewer system surcharge for homeowners who are approached by developers for a footing drain disconnection and sump pump installation.

Q. How do developers determine which homeowners to approach for voluntary footing drain disconnections? Can developers contact homeowners in any area of the City for disconnections or only in areas near the new development?

A. The City has divided the sewer system into three main districts, North, South and West.



For developments within any of the three districts, 80% of the total mitigation credits must be obtained from disconnections located within the same district as the development.

The remaining 20% of the mitigation credits may be obtained from anywhere in the City of Ann Arbor.

Q. How many FDDs were performed under the City's mandatory program and how many were voluntary FDDs, funded by developers?

A. Voluntary FDDs, performed under the DOM program = 848 FDD equivalents
Total number of City--‐mandated FDDs = 1834 single family FDDs.
Total number of City--‐mandated multi--‐family FDDs = 62.5 FDD equivalents.

(In some areas, disconnections were performed on multifamily dwellings like apartment buildings, necessitating the need to refer to the disconnections as "equivalents".)

Q. Does the developer have to complete all mitigation (disconnects) before the Certificate of Occupancy (CO) is issued?

A. Yes, all disconnects must be completed and all must pass inspection before the final CO is issued.

Q. Is the City using mandatory FDDs to create capacity for development?

A. No, the City's FDD project and the Developer Offset Mitigation are separate programs, with different objectives and requirements. Refer to the comparison table in the answer to the third question in this section for more on the differences between the City's FDD project and the Developer Offset Mitigation program.

Q. Why can't the City use DOM money for something other than disconnects? Upsizing pipes in a neighborhood, for example?

A. The city does not get any funds from developers that can be utilized for any alternatives. The only "thing" the City receives from the DOM (other than permit fee revenue which goes to the Community Services Area, f.k.a. the Building Department) is the flow removal/reduction. The one exception to this is the University of Michigan Stadium Renovation project (see next question).

Developer Offset Mitigation (DOM) is performed by, and at the expense of, the developer. The developer covers all of the costs for the mitigation work.

Q. What about the University of Michigan's stadium expansion: why did U of M pay the City $10,000 per disconnect? And what did the City do with the funds? Will the City then perform mandatory disconnections to mitigate the Stadium's additional sewer flows?

A. At time of the renovations to the U of M stadium, the university had constraints against the use of its capital funds off-site. Because they owned no sites within the required mitigation area for the stadium renovation project, they were unable to perform the FDDs themselves. Instead, the University contributed funds to the City to cover the costs of the FDDs for its required offset mitigation.

The transaction was approved by the then Public Services Area Administrator. A separate Council resolution appropriated the funds.

The figure of $10,040 per disconnect includes the cost of disconnecting the home's footing drains, installing the sump pump, restoration work and constructing the curb drains that collect the footing drain flow and send it to the storm sewer system.

Q. What about new developments in townships that send their sewage to be treated at the City of Ann Arbor's Waste Water Treatment Plant; do they have to mitigate their flows by doing footing drain disconnections, too?

A. Developments within townships that contribute flow to the City's system are required to perform developer offset mitigation, unless the township has purchased or constructed capacity in the portion of the City's sanitary system taking the flow from the township development.

Q. In the event that developer offset mitigation is necessary for a township development, and given that the townships are outside the A2 city limits, within what area would 80% of the DOM have to be performed?

A. The mitigation would need to be performed in the district where the township flows enter the City's system. For example, a development in Scio Township (such as Suburban Chevrolet) performs disconnects in the west district, because this is where the development flows connect to the City's system.

Q. How many FDDs were performed since the Sanitary Sewer Wet Weather Evaluation project began?

A. The following FDDs have been done between 6/4/12 and 2/6/14:

Completed FDDs = 35
Developer Mitigation FDDs = 161
Dartmoor Multi---family FDD equivalents = 62.5

The SSWWE project was authorized by Council in February 2013, with flow monitoring starting in March 2013.

vi. DOM Infographic

Developer Offset Program is a program created to reduce overall flow to the sanitary sewer system, including both sanitary sewer flow and stormwater flow. Reducing the flow in the sanitary sewer system does two important things:

1. Reduces sanitary sewer overflows
2. Reduces unnecessary and costly treatment of stormwater.

On the following page is an infographic depicting the DOM program.

Developer Offset Mitigation

Developer Offset Program (DOM) is a program created to reduce overall flow to the sanitary sewer system, including both sanitary sewer flow and storm water flow. Reducing the flow in the sanitary sewer system does two important things:

1. Reduces sanitary sewer overflows
2. Reduces unnecessary and costly treatment of stormwater

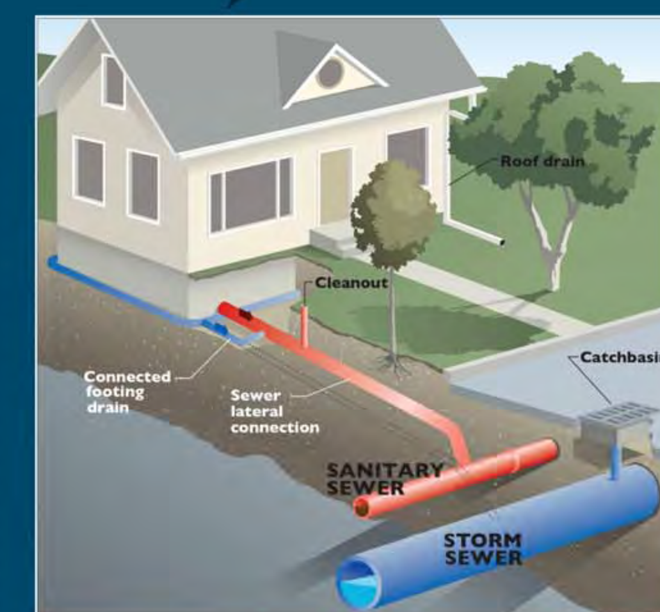
The Developer Offset Mitigation program requires that the developer remove 20% more sewer flow from the system than the new development will add.

Flow added to the system

Flow removed from the system

Footing Drains

On average, each home with a connected footing drain adds 3,500 to 10,500 gallons per year of clean water that must be transported to the wastewater treatment plant and treated.



DOM Program	City's FDD Program
City-wide	Concentrated in five areas with a large percentage of basement backups, historically
Completely voluntary	Mandatory in the five areas
Developer pays for disconnection and sump pump installation	City pays for disconnection and sump pump installation
Developer or contractor solicits volunteers to agree to disconnection and sump pump installation	City initiates project with homeowner

DOM	City's FDDP
840+*	1834

*Single family equivalents

[Data sources: City of Ann Arbor Sanitary Sewer Wet Weather Evaluation Study, 2013 City of Ann Arbor Sanitary Sewer Overflow Prevention Study, 2001]

vii. FDD Infographic

Footing drains are permeable pipes buried around the perimeter of a foundation, roughly at the depth of a basement floor, designed to keep water from entering the basement. In houses built before 1982, footing drains were often connected directly to sanitary sewer pipes.

On the following page is an infographic depicting the Footing Drain Disconnection program.

FOOTING DRAIN DISCONNECTION PROJECT

Footing drains are permeable pipes buried around the perimeter of a foundation, roughly at the depth of a basement floor, designed to keep water from entering the basement. In houses built before 1982, footing drains were often connected directly to sanitary sewer pipes.

DURING HEAVY RAINS, THE SANITARY SEWER SYSTEM GETS OVERLOADED

So, what's the big deal?

- $$$ wasted treating stormwater
- When the WWTP is overloaded, sewage is released to the Huron River
- Sewage can back up into basements

3,500 to 10,500

Gallons per year each connected home adds to the sanitary sewer system

70% to 90%

Amount of total volume in sanitary sewer systems contributed by connected footing drains

2000-2001

Sanitary Sewer Overflow (SSO) Task Force formed to study the problem, recommend solutions.

SSO Task Force evaluates 3 potential solutions:

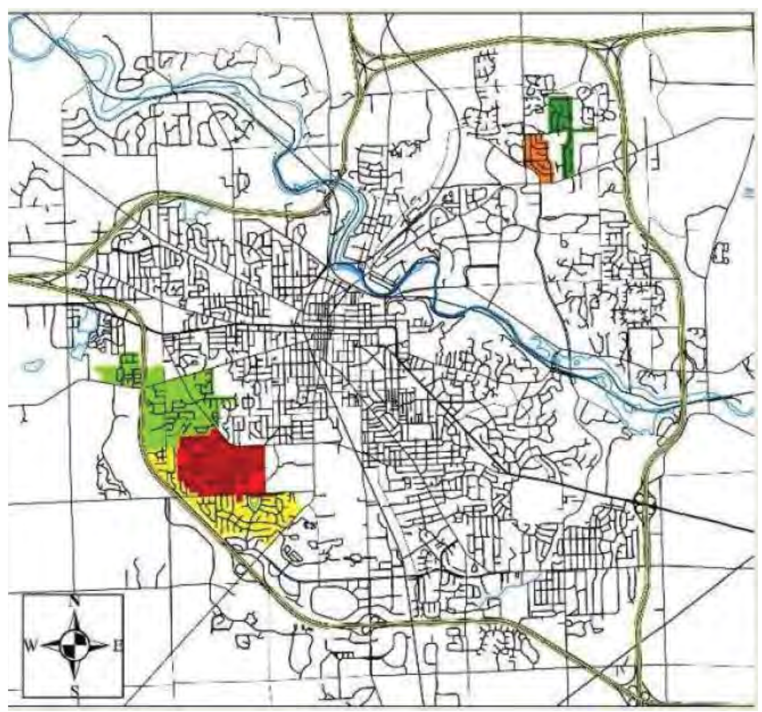
Footing Drain Disconnections	Bigger Sewer Pipes	Build More Storage
-lowest cost -addresses root cause	-$$$ -consumes green space -pushes problem downstream	-$$$ -consumes green space -pushes problem downstream

2003: City and EPA sign an Administrative Consent Order (ACO) to eliminate sanitary sewer overflows (SSOs) into the Huron River

775

Footing drain disconnections required by ACO

2003: SSO Task Force recommends Footing Drain Disconnections. City Council approves. FDDP pilot program begins in 5 areas with most basement backups.



2013: Sanitary Sewer Wet Weather Evaluation Project begins with 4 goals:

1. MEASURE HOW MUCH THE FDD PROGRAM REDUCED STORMWATER FLOW TO THE SANITARY SYSTEM.
2. ASSESS THE RISK OF FUTURE SEWER BACKUPS IN THE CITY.
3. RESEARCH AND EVALUATE NEW WAYS TO CONTROL THE IMPACTS OF STORMWATER ON THE SYSTEM.
4. DEVELOP A PLAN FOR MANAGEMENT OF THE SANITARY SYSTEM GOING FORWARD.

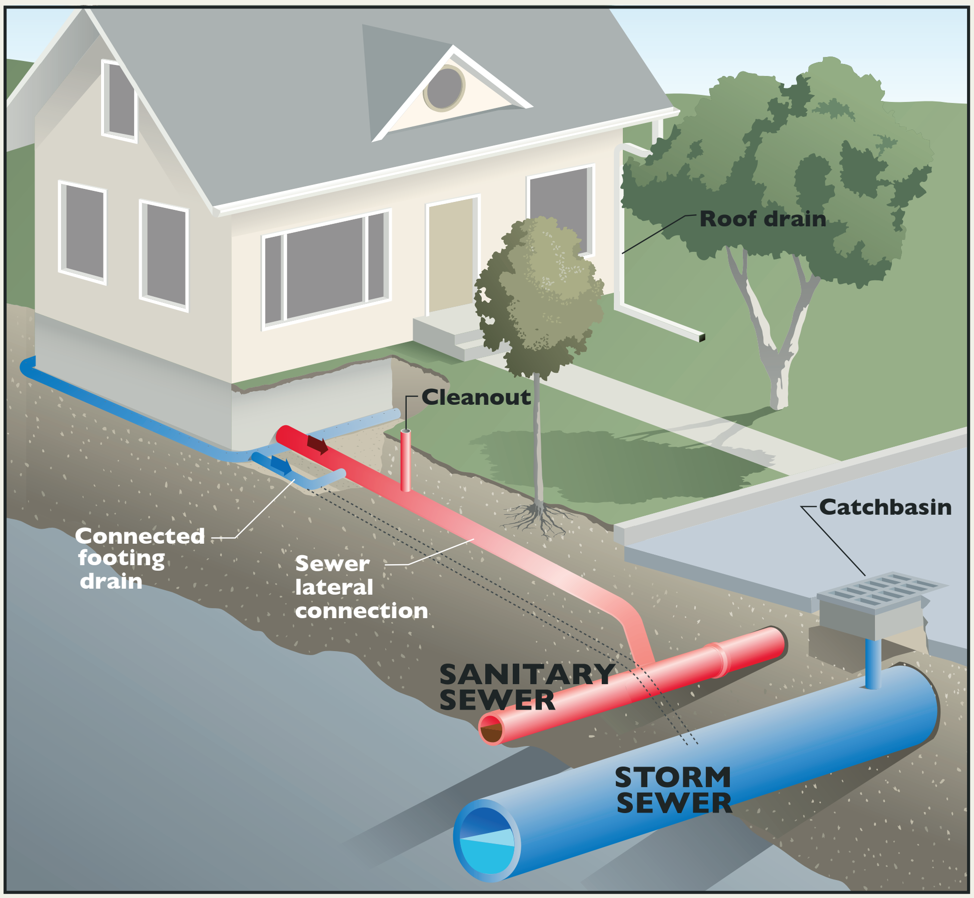
Next up: Project team and Citizens Advisory Committee will review project data, evaluate cost vs. future risk and make recommendation to City Council

viii. Initial CAC Handout on Project Background

See following pages.

FOOTING DRAIN DISCONNECTION PROJECT

Footing drains are permeable pipes buried around the perimeter of a foundation, roughly at the depth of a basement floor, designed to keep water from entering the basement. In houses built before 1982, footing drains were often connected directly to sanitary sewer pipes.



DURING HEAVY RAINS, THE SANITARY SEWER SYSTEM GETS OVERLOADED

3,500 to 10,500

Gallons per year each connected home adds to the sanitary sewer system

70% to 90%

Amount of total volume in sanitary sewer systems contributed by connected footing drains

2000-2001: Sanitary Sewer Overflow (SSO) Task Force formed to study the problem, recommend solutions.

SSO Task Force evaluates 3 potential solutions:

Footing Drain Disconnections

- lowest cost
- addresses root cause
- requires extensive coordination with individual homeowners

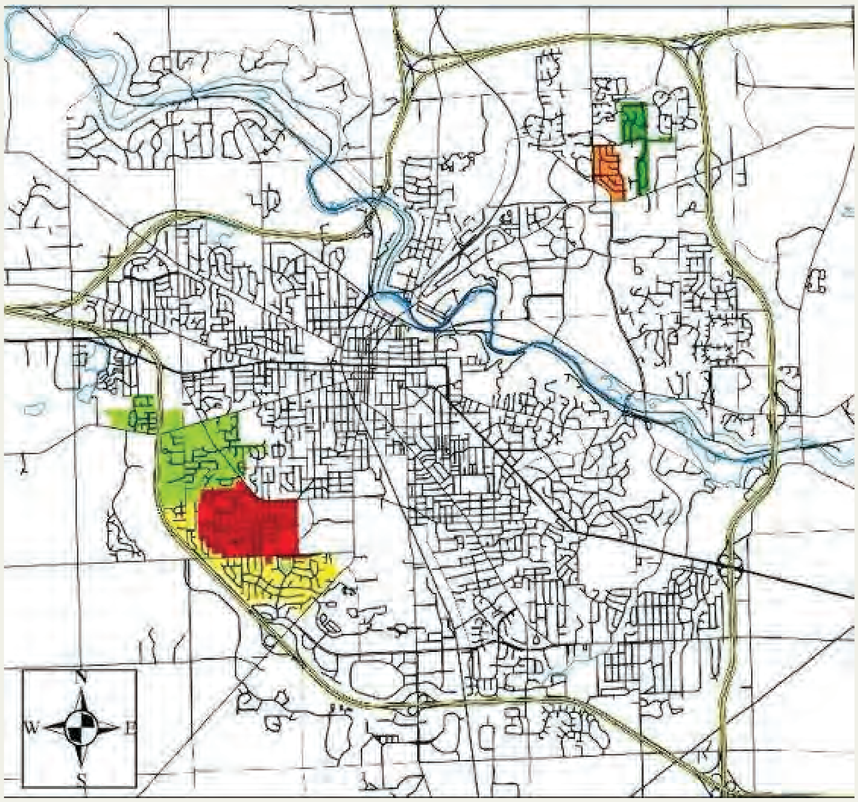
Bigger Sewer Pipes

-$$$
-disturbs natural features
-pushes problem downstream

Build More Storage

-$$$
-disturbs natural features

2001: SSO Task Force recommends Footing Drain Disconnections > City Council approves > FDDP pilot program begins in 5 areas with most basement backups.



2003: City and MDEQ sign an Administrative Consent Order (ACO) to eliminate sanitary sewer overflows (SSOs) into the Huron River

775

Footing drain disconnections required by ACO

2013: Sanitary Sewer Wet Weather Evaluation Project begins with 3 goals:

1. Measure how much the FDD program reduced stormwater flow to the sanitary sewer system.

2. Assess the risk of future sanitary sewer basement backups.

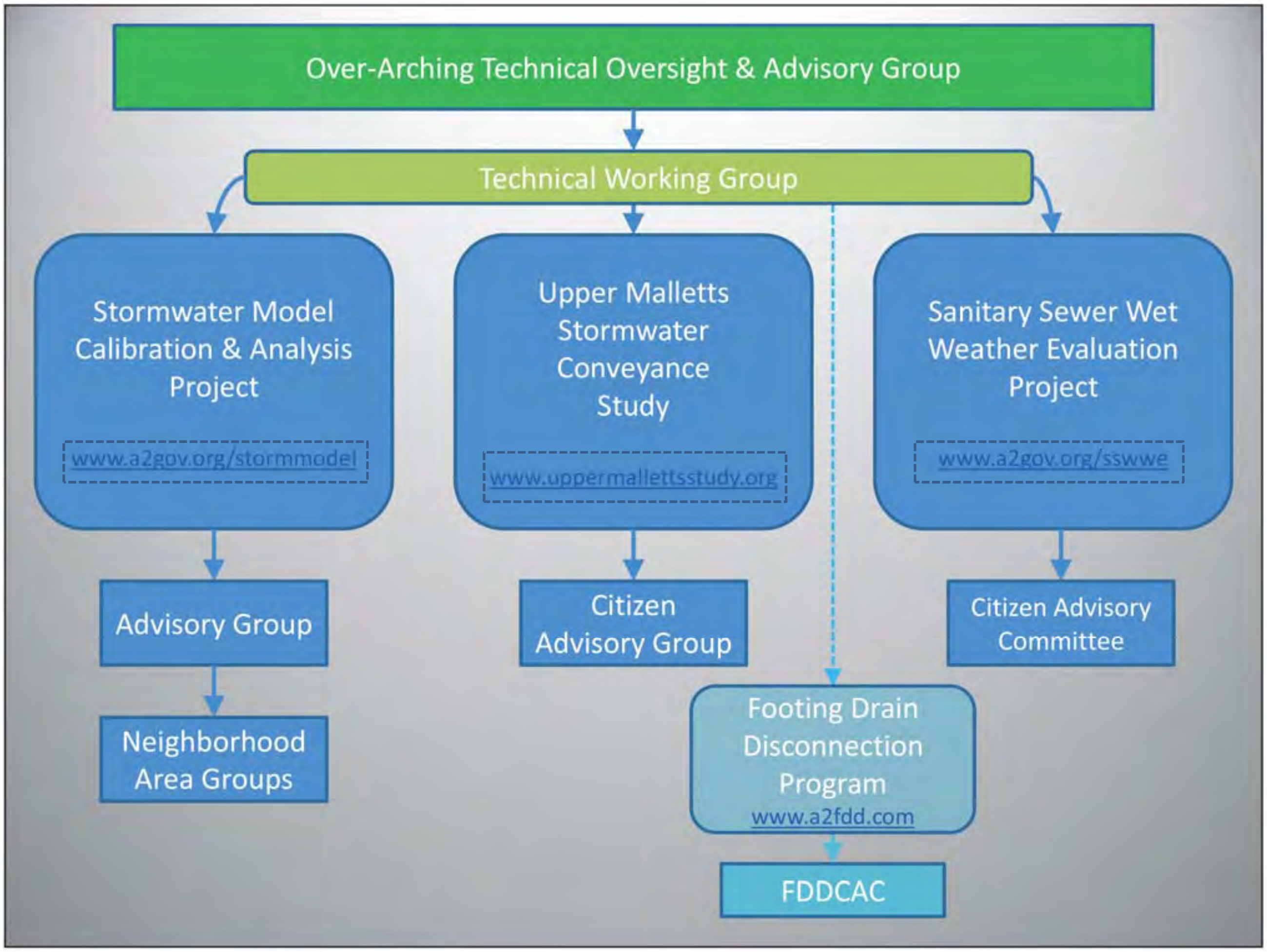
3. Research and evaluate new ways to control the impacts of stormwater on the sanitary sewer system.

Next up: Project team and Citizens Advisory Committee will review project data, evaluate cost vs. future risk and make recommendation to City Council

City of Ann Arbor 2013

Create infographics infogr.am

ix. Wet Weather Projects Org Chart



D. Videos

Citizens Advisory Committee Meetings (click play button below to view video)

* August 21, 2013	May 14, 2014
October 29, 2013	June 18, 2014
December 12, 2013	July 9, 2014
January 9, 2014	August 13, 2014
February 13, 2014	September 10, 2014
March 20, 2014	October 8, 2014
April 17, 2014	November 12, 2014

Public Meetings (click play button below to view video)

* April 23, 2013	February 6, 2014
September 17, 2014	November 19, 2014

Project Informational Videos (click play button below to view video)

Introduction with Robert Czachorski and Nick Hutchinson

FDD/DOM with Cresson Slotten

WWTP Introduction with Jen Lawson

Closing Video (password: CLOSE4)

* Did not start video recording meetings until October 2013.

VII. TOAG Submittals and Responses

A. April 8, 2014 – TOAG Response to Sanitary Sewer Evaluation Project Issues

Prepared by Dick Hinshon, TOAG Chair

The following summarizes the views of the Technical Oversight Advisory Group ("TOAG") regarding the Sanitary Sewer Evaluation Project that was presented and discussed at the February 13 TOAG meeting. This document incorporates comments from TOAG Members in response to an earlier Draft Document that was reviewed at the March 20, 2014 TOAG meeting.

Effectiveness of Footing Drain Disconnections on Removing Flows from the Sanitary Sewer System

At its February 13, 2014 meeting, TOAG Members reviewed information provided by the City and its consultant (OHM) regarding flow monitoring conducted in several neighborhoods over a 5 month period spanning April – August, 2013. The TOAG Members are in general agreement as to the following observations relating to the FDD Flow Monitoring conducted by the City:

1. A sufficient number of large wet weather events occurred over the 5 month period to create a data set for use in assessing Footing Drain Disconnection impacts on the City's Sanitary Sewer System;
2. The techniques and equipment used to collect flow and rainfall data during these wet weather events are acceptable; and
3. The neighborhoods selected for the study and the sites selected as metering locations are appropriated and should provide enough information to support the FDD impact analysis;
4. The decision to use three independent analytic techniques to compile and evaluate data (i.e. scatter plots; comparison to a control district; continuous predictive modelling) provides increased confidence in the accuracy of the results arising from the evaluation;
5. The analysis conclusively shows that the FDD Program has been highly effective in removing excess wet weather flows from the Sanitary Sewer System in the study areas;
6. The risk of sanitary sewage backups into basements is expected to be significantly reduced because of the Footing Drain Disconnection Program and the large quantity of flow that has been successfully removed from the Sanitary Sewer System.

Public Opinion Survey Results

The TOAG Members reviewed and discussed the results of the January 24, 2014 Report on the results of a Public Opinion Survey for the FDD Program. The TOAG Members are in general agreement as to the following observations relating to the Survey:

1. The number and percentage of respondents expressing dissatisfaction with the installation of their sump pumps as part of the FDD Program is unexpectedly high;
2. It is unclear as to the basis for this high degree of dissatisfaction, and it is difficult to determine what changes should be made to the FDD Program to address these concerns;
3. The procedures and methodology used for the Survey leave many questions unanswered and it is difficult to interpret and analyze the responses;
4. Follow up efforts may be warranted to obtain supplemental information to better understand the public's views, including evaluation of the data to determine if problems are attributable to certain Contractors or to certain neighborhoods; contacts to non-respondents to gauge whether their views are or are not similar to what was provided by survey respondents; attempt to clarify and distinguish flooding/wetness problems from sanitary sewage backup problems; etc.
5. Given the unexpectedly widespread expression of dissatisfaction, it would be appropriate for the City to conduct further evaluation to identify and correct problems before it resumes work on the Footing Drain Disconnection Program.

<u>Other Issues and Concerns</u>

TOAG Members have expressed concern over a number of issues that may or may not be related to the FDD Program, including:

1. Whether the disconnection of Footing Drains from the Sanitary Sewer System has exacerbated or incrementally worsened the City's ability to convey stormwater through the Storm Sewer System. If so, the transference of flow from the Sanitary System to the Storm System may be a factor which affects basement flooding/wetness;
2. Whether there are construction or installation flaws associated with the installation of Sump Pumps which could potentially increase the risk of basement flooding due to sump pump failure;
3. The increased potential for flooding during power outages in homes where no battery powered backup sump pump has been installed;
4. The potential for seepage/infiltration of standing water around the foundation due to poor compaction and/or ponding of water due to changes in drainage around the house after the new sump pump has been installed;
5. Water intrusion from basement egress windows and whether such problems may be mitigated by raising the height of the external window well;
6. Whether some of the remaining (Post FDD) basement backups of sanitary sewage are attributable to homeowner problems associated with the household sewer lead (e.g. tree roots, blockages, fractured pipe sections, etc.), and if so, how to best address this issue;
7. The need for a more effective public education program to better inform home owners about the differences between the Sanitary and Storm Sewer Systems and sewage backups as compared to wetness/seepage of stormwater into a basement.

B. June 17, 2014 – TOAG Comments re: Climate Change Issues

Prepared by Dan Brown and Dick Hinshon and reviewed/accepted by TOAG

The Technical Oversight and Advisory Group ("TOAG") has received several documents relating to Climate Change which were developed as part of the Sanitary Sewer Wet Weather Evaluation Project ("SSWWEP"). The documents reviewed by TOAG include:

- Powerpoint Slides presented to Citizens Advisory Council re: Climate Change issues;
- Climate Change "Risk Evaluation" document with Frequency Analysis plots;
- Write up entitled "Incorporating Climate Change in SSWWEP with summary table on flow rates
- Frequency analysis tables and plots comparing historic/current data observations

After reviewing that information, TOAG has developed this document to address questions about whether the SSWWEP approach to climate change is appropriate and consistent with other similar analyses being undertaken elsewhere.

1. Does the Sanitary Sewer study acknowledge that Climate Change is a factor that warrants consideration in the evaluation of wet weather events and their impact on wastewater flows and sewer system capability?

   Yes. While the results of the sanitary stormwater analysis may differ slightly in method than other larger climate studies already published, the implied trajectory of changes in precipitation are within the range of probable future projections.

2. Has the Sanitary Sewer study incorporated recent precipitation data into the statistical analysis of the return interval and the frequency of recurrence of rain events?

   The Sanitary Sewer study has analyzed a 60-year record of NCDC observations that includes data from hourly observations of total precipitation. This is a preferred approach to data analysis, but one which is infrequently utilized since hourly data is rarely available over long enough time periods to be climatologically significant. For Ann Arbor, looking over at least the last 50 years is critical, as major changes in total precipitation have occurred since the 1960s.

   Comparing the 1951-1980 and 1981-2010 periods:

   - Ann Arbor has seen an increase of about 25% in total annual precipitation.(GLISA)
   - While the size of the heaviest 1% of extreme storms (as defined by the 1951-1980 average) have remained relatively stable, the frequency of these heaviest 1% of storms increased by 38%.(GLISA)

From 1958 through 2010:

- Throughout Southern Michigan and the Southern Great Lakes Basin, both the volume and frequency of extreme storms have increased. The size of the heaviest 1% of storms has increased by about 4-8%. In the Midwest, the volume of precipitation falling in the heaviest 1% of storms each year has increased by 37% (3rd National Climate Assessment, 2014).

The Sanitary Sewer study results were generated using a different methodology, but the results are consistent with these findings.

3. Is the methodology used by the Consultant team for the Sanitary Sewer study appropriate?

The methodology seems appropriate and standard. The finding that the current 1% annual chance storm will be roughly equivalent to the future 4% annual chance storm under a high ("business as usual") emissions scenario is consistent with the findings of numerous other studies.

The margin of error in future projections could be presented more directly, and it would be beneficial for public engagement to present the technical information supporting these findings in a manner which is more accessible and easier to understand. For example, the term "return interval" is used on some of the presentation slides, and this is a term that may not be clearly understood by the general public without additional explanation and clarification.

4. Does the methodology provide an acceptable and scientifically defensible representation of return intervals for storm events and the incremental changes that may be attributable to Climate Change?

The methodology used here is relatively standard and is similar to other stormwater assessments that have been conducted. The EPA's National Stormwater Calculator, employed here, utilizes projections cited in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment (AR4) Physical Science report. While other downscaled or regionally specific climate models may provide additional context, the IPCC models and emission scenarios included in the stormwater calculator have been widely vetted and peer-reviewed at every phase of development. There is a larger margin of error inherent in the analysis of changes in climate at the regional or local scale, but this is a limitation of the state of the science and the current climate data available, not the method of the study conducted here.

5. What additional measures may need to be taken either in the future or on an ongoing process to ensure that the effects of Climate Change are being addressed?

The other Wet Weather studies being undertaken by Ann Arbor should similarly acknowledge and recognize the importance of climate change as a factor which affects the City's infrastructure. The most obvious impact of changes in precipitation patterns is on the City's Storm Sewer system, but the Sanitary Sewer System may also be affected to the extent that stormwater enters into the Sanitary Sewer System via footing drains, manholes, pipe joints, cracks, etc. The public may be less aware of the impacts of climate change on the Sanitary Sewer System, so it will be important for the consultant team to explain the increased risk of basement flooding due to the overall climate changes that are being observed.

C. September 18, 2014 – TOAG Meeting Submittal

On the following pages is the TOAG Submittal Packet for the Design Event Development and Design Event System Impact.

Advancing Communities℠

Engineering Advisors

City of Ann Arbor
Sanitary Sewer Wet Weather Evaluation Project

Technical Oversight and Advisory Group (TOAG) SUBMITTAL PACKET
Design Event Development and Design Event System Impact

September 11, 2014

OHM 34000 Plymouth Road Livonia, Michigan 48150 P 734.522.6711 www.ohm-advisors.com

TABLE OF CONTENTS PAGE

Introduction

In an effort to evaluate the existing City of Ann Arbor sanitary sewer system for current and potential future hydraulic deficiencies, a hydrologic and hydraulic model has been utilized. An overview of this modeling effort was presented to the TOAG on July 17, 2014, and the TOAG requested additional information about the design event development and impact on the City's sanitary sewer system. This packet provides the requested information for TOAG review and comment.

In order to utilize a hydraulic model to evaluate a sanitary sewer system, a design event needs to be established to provide a basis for evaluating the system. In the context of this report, a design event is considered an event that is expected to occur at an agreed upon return frequency acceptable by the community stake holders as well as regulatory agencies. It also includes appropriate flows to account for a variety of future conditions which can be used in a hydraulic simulation model for planning level capital improvement plan development purposes.

This submittal details the development of the design event to be used as part of the evaluation of the City of Ann Arbor sanitary sewer system. In addition, the report details the results of modeling simulations showing the impact of proposed design events on the sanitary sewer collector system as well as the wastewater treatment plant. For the City of Ann Arbor model, the development of a design event is impacted predominantly by these three considerations:

1. Return Frequency of Flow Event
2. Impact of Climate Change
3. Anticipated Growth

The subsequent sections of this submittal detail how each of these items were analyzed and selected to develop the design event for simulation. Other parameters, such as inflow and infiltration increases due to continual deterioration of the existing sanitary sewer infrastructure, are assumed to be small in scale compared to the above-mentioned considerations given the City's diligence in operation and maintenance activities to prevent these flow sources from increasing over time.

The selected design event was simulated in the hydraulic model to identify problem areas and explore potential solutions. This process identified six (6) potential hydraulic deficiencies in the downstream collector interceptors. These are not particular large issues compared to those identified in 2001, and an action plan was prepared for each area. The packet outlines the results of the hydraulic model and the action plans identified.

This submittal is comprised of the following seven (7) sections that provide the relevant details to address the TOAG's request:

1. **Frequency Analysis Methodology** – This section outlines the process used to develop the flow frequencies for selecting a design recurrence interval flow rate.

2. **Incorporation of Climate Change** – This section describes the potential impacts of climate change on the design recurrence interval flow and how this was incorporated into the design events.
3. **Incorporation of Future Growth** – This section summarizes the potential components of future growth in the City and how these were incorporated into the design events.
4. **Design Event Scenarios** – This section describes the development and components of the design event scenarios used to evaluate the system.
5. **Hydraulic Model Results** – This section shows the results of the simulation of the design event scenarios from the hydraulic model, which identifies six (6) areas of deficiency in the system.
6. **Project Action Plans** – This section provides an action plan to address each of the six (6) areas of deficiency identified in the hydraulic modeling.
7. **WWTP Impacts** – This section shows the impacts of the design event scenarios on the WWTP, which concludes that the WWTP can handle the flows.

1. Frequency Analysis Methodology

- This section shows the frequency analysis results from the continuous antecedent moisture hydrologic (flow) model.
- The analysis is performed by routing 60 years of historic rainfall through the model and performing a statistical analysis of the predicted 60 years of flow to develop a plot of the peak flow rate versus the annual probability of that flow occurring.
- Average recurrence intervals (10-yr, 25-yr, 100-yr, etc.) of these flows are determined from the reciprocal of the annual probability (i.e. annual probability of 0.01 = 100-year average recurrence interval). The frequency analysis plot for one sample district (Orchard Hills) is provided.
- Because the process uses a continuous antecedent moisture model and the historic rainfall to generate a long-term flow record, the resulting output provides information on the likelihood of various flows occurring, that accounts for variations in rainfall amounts, rainfall pattern and various wetness conditions.
- For the priority districts, the analysis was performed twice: once for the pre-FDD condition and once for the post-FDD condition.

Figure 1: Excerpt from City of Ann Arbor, Sanitary Sewer Wet Weather Evaluation, Volume 2: Flow Evaluation Report Frequency Analysis Results from the Continuous Antecedent Moisture Hydrologic (Flow) Model

VII. Frequency Analysis

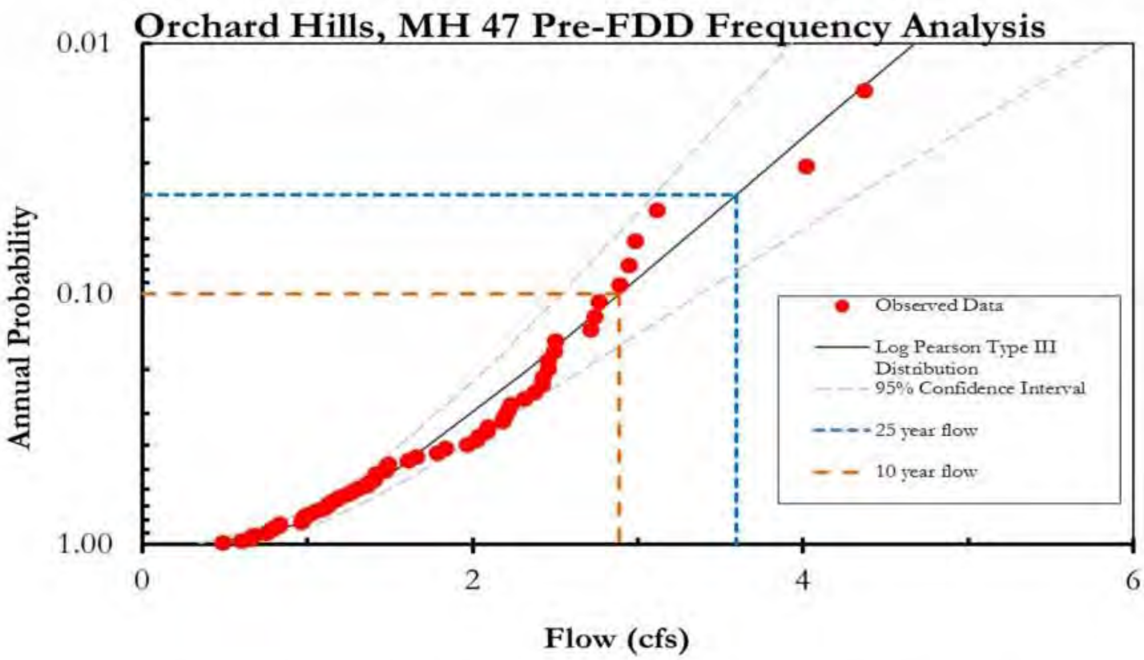
A frequency analysis is performed by routing 60 years of historic rainfall through the calibrated AMMs. Because the process uses the continuous AMM and the historic rainfall to generate a long-term flow record, the resulting output provides information on the likelihood of various flows occurring. It also accounts for variations in rainfall amounts, rainfall pattern and various wetness conditions. This results in 60 years of predicted flow that can be used in a statistical analysis of that flow to develop a plot of the peak flow rate versus the annual probability of that flow occurring. The historic rainfall and temperature data were obtained from the NOAA's National Climatic Data Center. The annual peak flow rates that occurred during the growth season (defined from April to October) were used to determine recurrence interval for flows in that sewer shed using a Log-Pearson Type III Distribution. The recurrence interval estimates the likeliness that a given flow rate will occur. The average recurrence interval can be related to frequency of occurrence. For example, over a long period of time, the 10-year flow can be expected to occur with an average interval of 10 years. This means there is a 10% probability of that flow being exceeded in a given year. This translates to yearly exceedance probabilities of 4% for 25 year, 2% for 50 year, and 1% for 100 year flows shown in Tables 10 and 11.

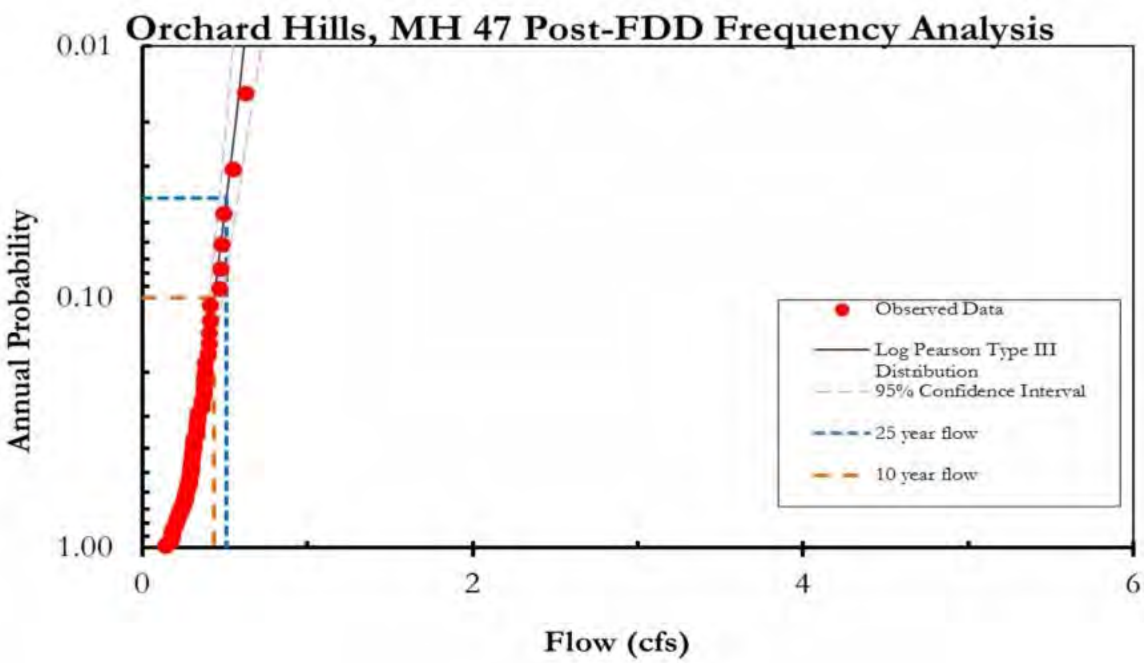
For the priority districts, the analysis was performed twice: once for the pre-FDD condition and once for the post-FDD condition. The results in the priority districts are summarized in Table 10, with figures available in Appendix H. These show a significant reduction in the design flow rates in the priority districts after FDD. The results for all the 2013 AMM districts are shown in Table 11 with supplemental figures in Appendix I.

Table 1: Recurrence Intervals of Pre- and Post-FDD Flow

Subdistrict	FDD status	Frequency Analysis Total Flow Rate (cfs)		
		10 year	25 year	100 year
Orchard Hills	Pre	2.89	3.60	4.67
	Post	0.44	0.51	0.62
Bromley	Pre	2.53	3.09	3.94
	Post	0.51	0.57	0.66
Dartmoor	Pre	6.83	8.21	10.29
	Post	4.06	4.78	5.85
Glen Leven	Pre	4.54	5.50	6.93
	Post	3.13	3.74	4.66
Morehead	Pre	6.11	7.42	9.37
	Post	1.78	2.06	2.46

Figure 2: Orchard Hills Pre- and Post-Frequency Analysis





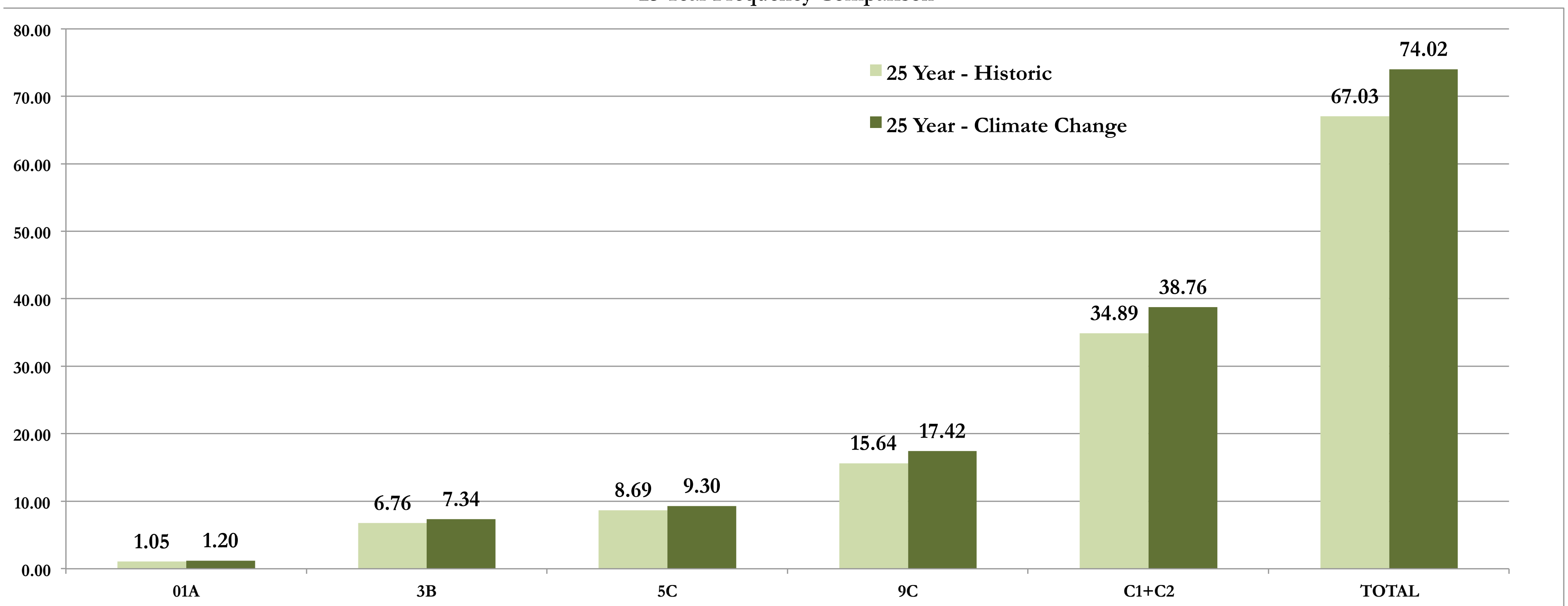
2. Incorporation of Climate Change

- We previously submitted to the TOAG the methodology used to account for climate change, and the TOAG previously reviewed the materials and provided comments.
- In the design scenarios, we are using a 10% flow increase to demonstrate the potential impacts of several variables, including the potential impact from climate change.
- The materials following provide the basis of a 10% increase in flows to represent a medium to high range of climate impacts on rainfall.
- Figure 3 shows climate change impacts on downstream meters, indicating an average peak flow variability of 10.4% for a 25-year flow frequency recurrence interval.
- Note that these meters are at locations where frequency analysis was performed and comprise 70% of the system by area, with the remaining downstream of the meters in the WWTP incremental district.

Figure 3: Ann Arbor Sanitary Sewer Wet Weather Evalution Project
Frequency Analysis - Historic Climate vs. Climate Change Summary
For Downstream System Meters - to Quantify System-Wide Peak Flow Change

Meter ID	Historic Frequency Analysis Total Flow Rate (cfs)				Climate Projected Frequency Analysis Total Flow Rate (cfs)				Climate Projected Frequency Analysis Percent (%) Change			
	10 year	25 year	50 year	100 year	10 year	25 year	50 year	100 year	10 year	25 year	50 year	100 year
01A	0.89	1.05	1.17	1.29	1.00	1.20	1.37	1.53	12.4%	14.3%	17.1%	18.6%
3B	5.72	6.76	7.52	8.28	6.13	7.34	8.25	9.18	7.2%	8.6%	9.7%	10.9%
5C	7.53	8.69	9.56	10.42	7.81	9.30	10.44	11.62	3.7%	7.0%	9.2%	11.5%
9C	14.20	15.64	16.67	17.67	15.67	17.42	18.68	19.90	10.4%	11.4%	12.1%	12.6%
C1+C2	31.82	34.89	37.06	39.16	35.01	38.76	41.45	44.08	10.0%	11.1%	11.8%	12.6%
TOTAL	**60.16**	**67.03**	**71.98**	**76.82**	**65.62**	**74.02**	**80.19**	**86.31**	**9.1%**	**10.4%**	**11.4%**	**12.4%**

25 Year Frequency Comparison



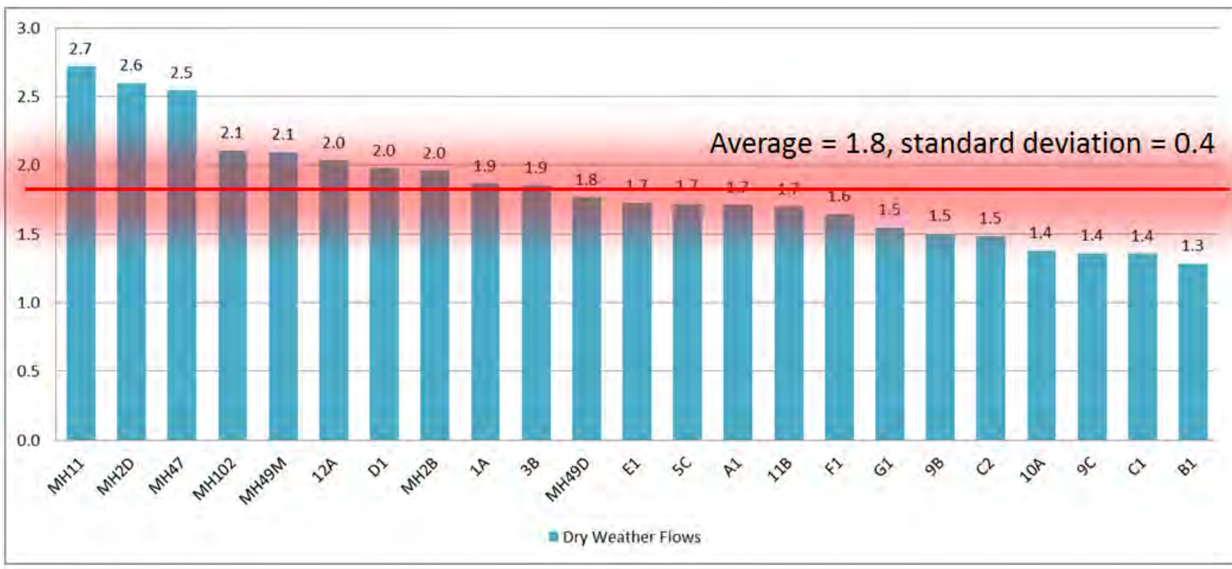
3. Incorporation of Future Growth

- Future growth in sanitary sewer flows will occur from two potential sources: 1) development and redevelopment within the City of Ann Arbor, and 2) growth in the contract customer communities of Scio, Pittsfield and Ann Arbor Townships.
- The City provided an estimate of the growth from "planned development" within the City and that information was used for future base sanitary flow increases from the City.
- A peaking factor of 2.0 was used to estimate the future peak flow from planned growth within the City. The basis for the development of this peaking factor is contained in the attachments.
- Growth in the customer contract communities was accounted for by increasing their flows to the peak contact limit.
- A summary of the future peak flow components is shown on the following pages.

Peaking Factor

In an effort to account for average daily diurnal variations in flows, an analysis was performed which utilized the temporary flow meters in the City in order to determine an average dry weather peaking factor. Figure 4 shows the variation in dry weather peaking factors for the meters evaluated as well as an average peaking factor and associated standard deviation. The peaking factor in the context of this analysis is defined as the ratio of the peak dry weather daily flow to the average dry weather daily flow.

Figure 4: Dry Weather Peaking Factor Variation



Based on this analysis, a dry weather flow peaking factor of 2.0 was considered reasonable.

Future Peak Flow Projections

The planned growth within the City and the peaking factor described above were used to develop a future increase in flows from the City due to planned growth. This was combined with the projected increase in flows from the contract customers reaching their contract limits to derive a future increase in flow due to growth. These components are summarized in the Table 1 below.

Table 1: Growth Components

Community	Anticipated Growth (CFS)
City of Ann Arbor	5.40[1]
Pittsfield Township	2.74[2]
Ann Arbor Township	8.67[3]
Scio Township	5.20[4]
Total	**22.01**

[1]Average, planned growth is 2.7 cfs and a peaking factor of 2.0 was used for maximum daily flow diurnals.

[2]Contract limit is 6.74 cfs and approximated, existing conditions 25 year storm flow contribution is 4.0 cfs.

[3]Contract limit is 8.67 cfs and no measurements were made regarding existing flow contributions.

[4]Maximum pumping capacity of 8.5 was used, excluding approximated, existing conditions 25 year storm flow contribution of 3.3 cfs.

4. Design Event Scenarios

- Three (3) design event scenarios were developed to evaluate the sanitary sewer systems. The components of these scenarios are depicted on the following page.

- Scenario A represents a 25-year recurrence interval wet weather flow rate and the flows from future growth tabulated earlier (contract customers at contract flow limits, and planned growth within the City with a peaking factor of 2.0).

- Scenario B represents has the same flow components as Scenario A, plus an additional 10% flow. This scenario was developed to understand how the system reacts to additional flows above those in Scenario A. Given the magnitude of the extra flow in Scenario B, this could account for one of the following:

    - Additional growth within the City or the contact customers beyond that assumed above.

    - An increase in the level of service from a 25-year recurrence interval to a 50-year recurrence interval (which is a 9% flow increase).

    - An increase in peak flows from larger rains due to climate change. A 10% increase in flows is more than is shown from the high-range rainfall increase in the near term (through 35 years).

  It should be noted that additional flow increase from growth in this scenario might be unlikely. Contract customers are limited by their contract capacity, and growth in the City may be offset by a Developer Offset Mitigation (DOM) FDD program. Such a DOM could in fact offset the planned growth contained in Scenario A, resulting in less base flow than is contained in Scenario A in the future.

- Scenario C represents has the same flow components as Scenario A, plus an additional 20% flow. Understanding the impacts of this scenario was desired by the CAC because it accounts for all four major flow increases simultaneously: 1) contract customers at their contract limits, 2) increase in flows in the City from planned growth without offset mitigation from a DOM, 3) flow increases from climate change, and 4) an increase in level of service from 25-year to 50-year recurrence interval flow.

Table 2: Peak Flow Components for Design Event Scenarios

Components	Scenario A	Scenario B	Scenario C
Existing Average Flow	29.7	29.7	29.7
25 yr., 24 hr. wet weather flow contribution	60.4	60.4	60.4
Anticipated Growth	22.01	22.01	22.01
10% additional increase[1]	n/a	8.74	8.74
Another 10% increase	n/a	n/a	8.74
Total Peak Flow	**112.11**	**120.85**	**129.59**

[1]Existing average flow is 29.7 cfs. Out of this, 27 cfs is approximated to be generated in the City of Ann Arbor, therefore, 10% of 27 + 10% of 60.4 wet weather contribution results in 8.74 cfs.

5. Hydraulic Model Results

- The hydraulic performance of the system has been evaluated for all three scenarios described in Section 4.

- The CAC selected Scenario B as the minimum level of protection desired for basement backups, and they desired to understand the impacts on the system for Scenario C.

- Maps depicting the hydraulic results for Scenarios B and C are on the following pages.

- Note that pipes shown in red on the maps are surcharged (i.e. the hydraulic grade line is higher than the top of the pipe). Pipes shown on the map in orange have a depth between 80% and 100% of the pipe diameter (not surcharged, but close), and pipes shown in blue have a depth that is less than 80% of the pipe diameter.

- In our evaluation of Scenarios B and C, the extent of the surcharging (red pipes) did not increase significantly. Such a minor difference could be accommodated in an upgrade project through a small incremental upsizing of an improvement project.

- As identified in Section 4, the change in peak flow rate projection between Scenarios B and C is approximately 9cfs, i.e. an increase of approximately 7% compared to Scenario B.

- A planning level analysis was performed in order to determine the percentage increase in storage volume needs between Scenarios B and C. It was determined that an additional 20% of total storage volume would be needed to accommodate Scenario C flows in the system.

Figure 5: Hydraulic Model Results Scenario B

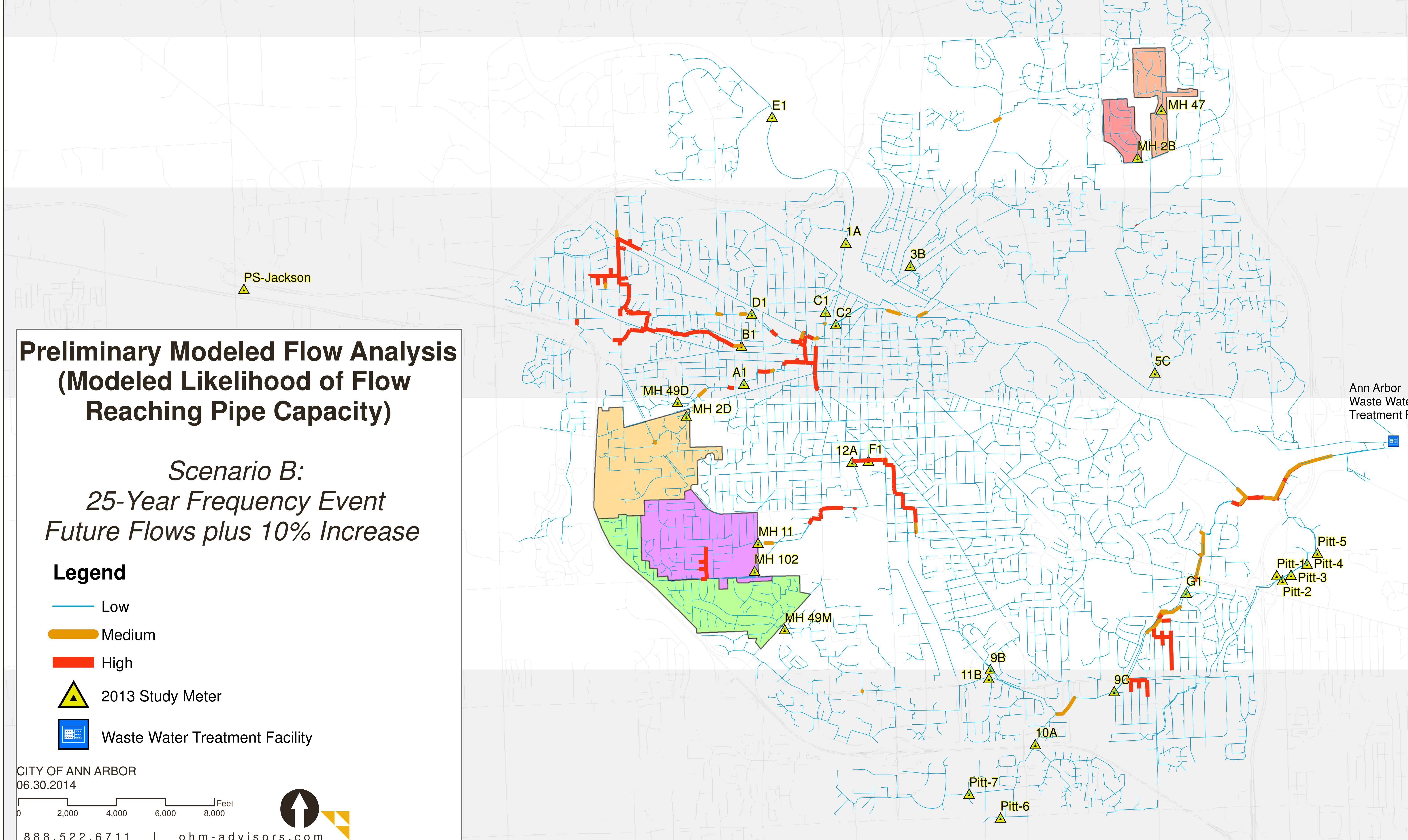
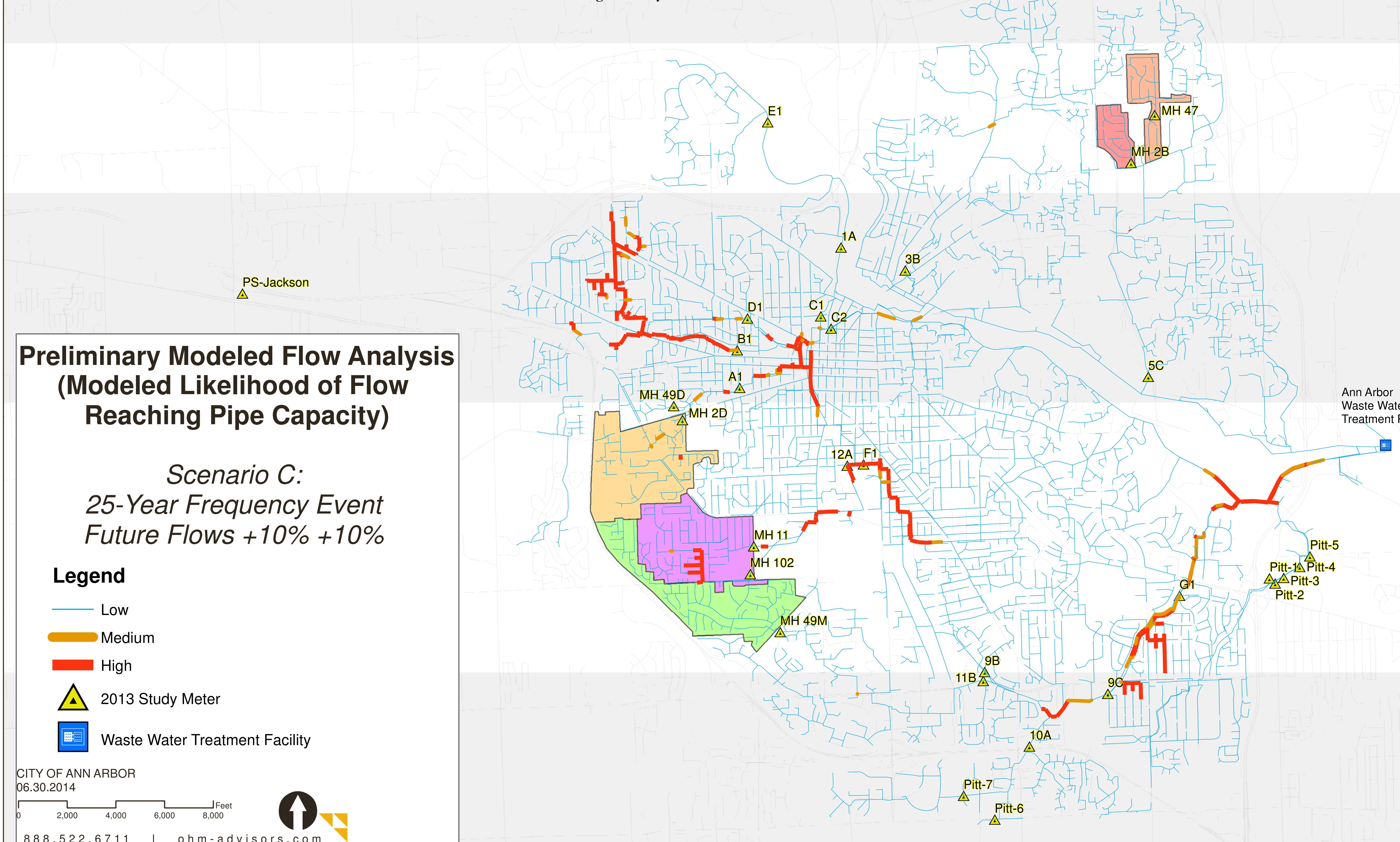


Figure 6: Hydraulic Model Results Scenario C



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6. Project Action Plans

- In Appendix A, you will find six action plans.
- Each of the six problem areas is unique and requires additional information and investigation to formulate improvements. These are not particular large issues compared to those identified in 2001, and an action plan was prepared for each area.
- Scenario B was simulated in the hydraulic model to identify problem areas and explore potential solutions. This process identified six (6) potential hydraulic deficiencies in the downstream collector interceptors.

7. WWTP Impacts

- The peak wet weather flows derived from this study were compared to WWTP capacity to assess the capability of the WWTP to handle the flows.
- The analysis showed that for the existing system, without growth or climate change, the WWTP has capacity to handle flows from the 100-year recurrence interval flow rate.
- The analysis showed that for Scenario C, the WWTP can handle the flow, without overflow from the equalization basin located at the WWTP
- Details of these findings are outlined in the memo on the following page.

MEMO

TO: SSWWEP CAC and TOAG
DATE: September 3, 2014
RE: City of Ann Arbor's WWTP – Available Capacity

Introduction

Recent correspondence received by members of the Sanitary Sewer Wet Weather Evaluation Citizen Advisory Committee (CAC) requested information pertaining to the available capacity of the City of Ann Arbor's waste water treatment plant (WWTP).

2003 Black & Veatch Study

A technical memo in a report from March 2003 by Black & Veatch Ltd. of MI discusses the existing conditions, flows and projected future flows of the WWTP. This report was part of an assessment provided under the Waste Water Treatment Plant Facilities Master Plan and an excerpt is included as Appendix B in this submittal. No improvements were recommended due to wet weather capacity issues. Key flow rates and conversions from MGD to cubic feet per second (cfs) are listed below for your convenience gleaned from the referenced document:

- Annual Average Daily Flow = 29.5 MGD (45.64 cfs)
- Average Daily Flow of Maximum 30 Day Avg. = 33.6 MGD (51.99 cfs)
- Peak Hourly Flow = 73.73 MGD (114 cfs)
- Sustained Peak Flow the WWTP is Designed to Treat = 60 MGD (93 cfs)
- Available Retention and Equalization Volume = 16.76 MG

Sanitary Sewer Overflows

Sanitary sewer overflows (SSOs) are reported to the MDEQ. Details on each reported SSO event and remediation actions in the City of Ann Arbor are available at the following website: http://www.deq.state.mi.us/csosso/find_event.asp. A summary of that information is included as Appendix C in this submittal.

No SSOs were indicated due to a lack of capacity at the WWTP, except 5/22/04, which was an unusually long duration event. One instance of a high wet weather flow rate over a decade is usually not an indication of a significant capacity issue.

Existing Condition Peak Flow

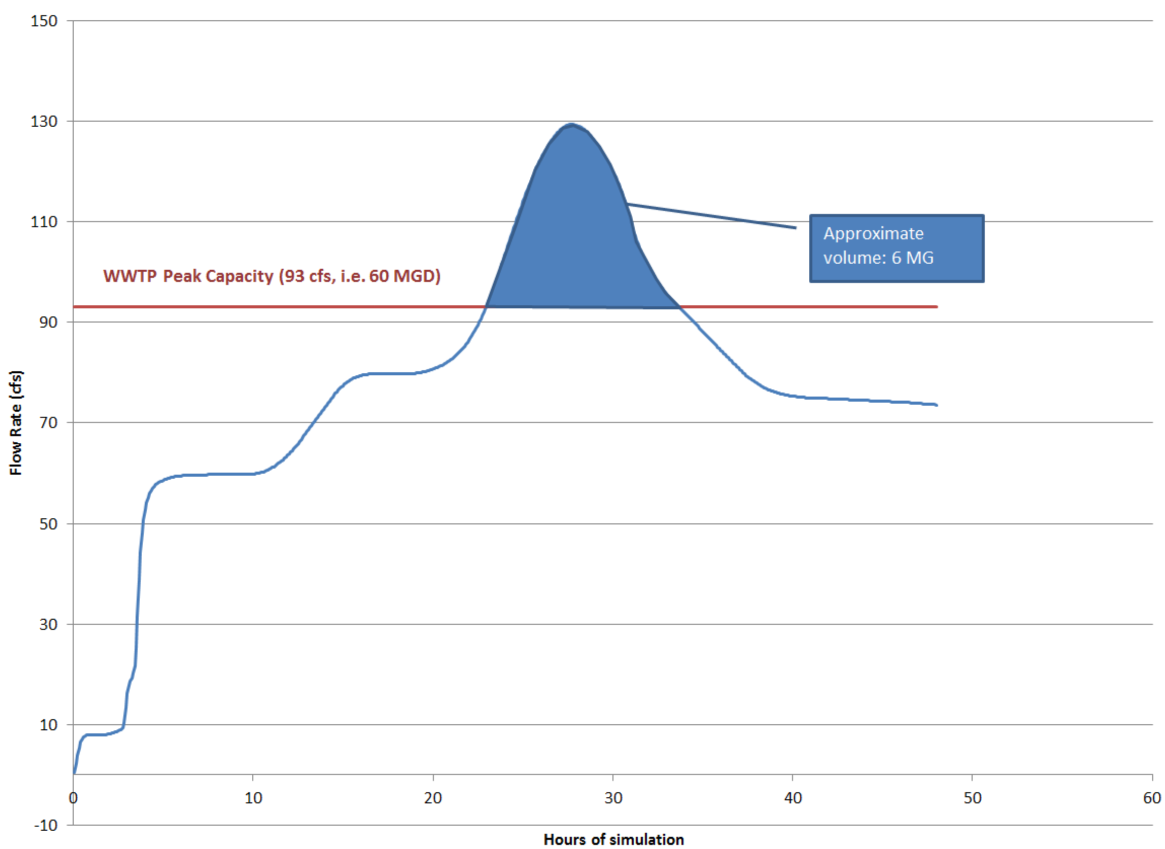
As part of the City of Ann Arbor Sanitary Sewer Wet Weather Evaluation Project, a hydrologic model was developed of the WWTP flows to estimate the peak flow rate for various frequencies, based on 60 years of historical National Oceanic and Atmospheric Administration (NOAA) rainfall data. The 10-, 25-, 50- and 100-year peak flow rates were estimated, as shown in Table 1 below, as well as data from a recent large event observed in 2013.

Table 1: City of Ann Arbor WWTP		Flow Rate Unit		% Peak Hourly Flow Capacity Remaining
		cfs	MGD	
Frequency Analysis Peak Flow Rate (60 yrs. of data)	10-yr	78.87	50.0	47.5%
	25-yr	90.13	58.25	26.3%
	50-yr	98.55	63.69	15.8%
	100-yr	107.04	69.18	6.6%
Large Storm Event Peak Flow Observed During Recent Monitoring Period	June 27, 2013	80.3	51.9	42.0%

Future Condition Peak Flow

The design event numerical model for Scenario C was used in order to evaluate the modeled hydrograph in relation to the WWTP capacity availability. The figure on the following page shows the hydrograph and associated equalization volume requirements above the peak hourly WWTP flow capacity. As can be seen from this figure, the modeled equalization basin requirements are less than the available volume.

Scenario C Modeled Design Event Hydrograph at the WWTP

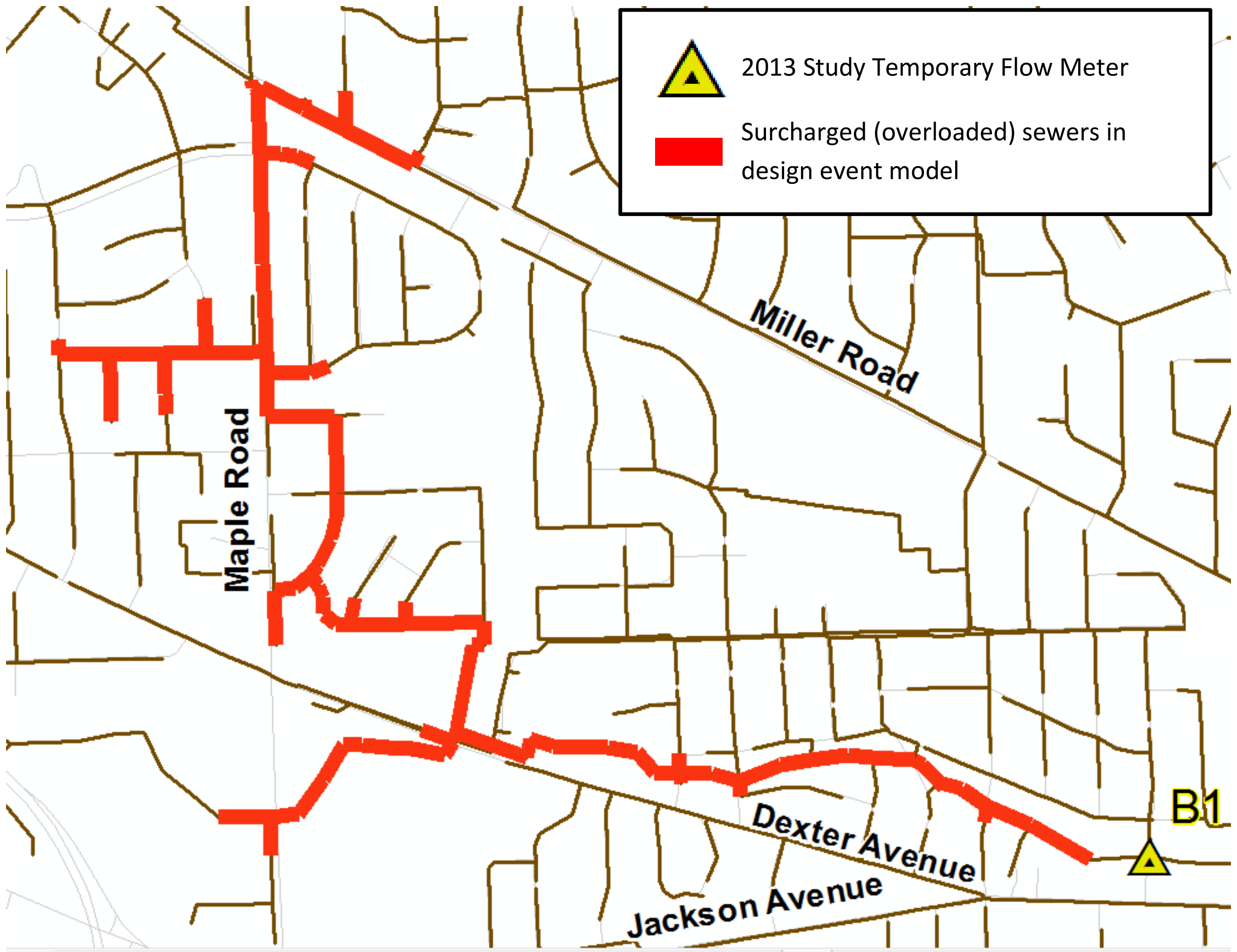


APPENDICES

Appendix A

Project Action Plans

Project Area (A)
Huron / West Park



Model Background

1. Existing model was calibrated to downstream meter (B1) using metering data. Flow distribution upstream of this meter in the current model is as identified in previous (2002) model.
2. Model includes infrastructure updates performed by the City since the development of the original model (2002).

Observations

1- Model shows flows that exceed the pipe capacities as identified in the adjacent figure, resulting in modeled surcharging as high as ~15 ft. above sewer bottom.
2- The City had previously recognized this as a problem area and constructed a relief sewer downstream of meter B1. Further work was planned but extent of improvements needed was yet to be identified.
3- The City complaint data (sanitary sewer backup report) does not show reported backups in this area.

Therefore, we do not have high confidence in the surcharging identified by the model and recommend action items listed below before making significant capital investments.

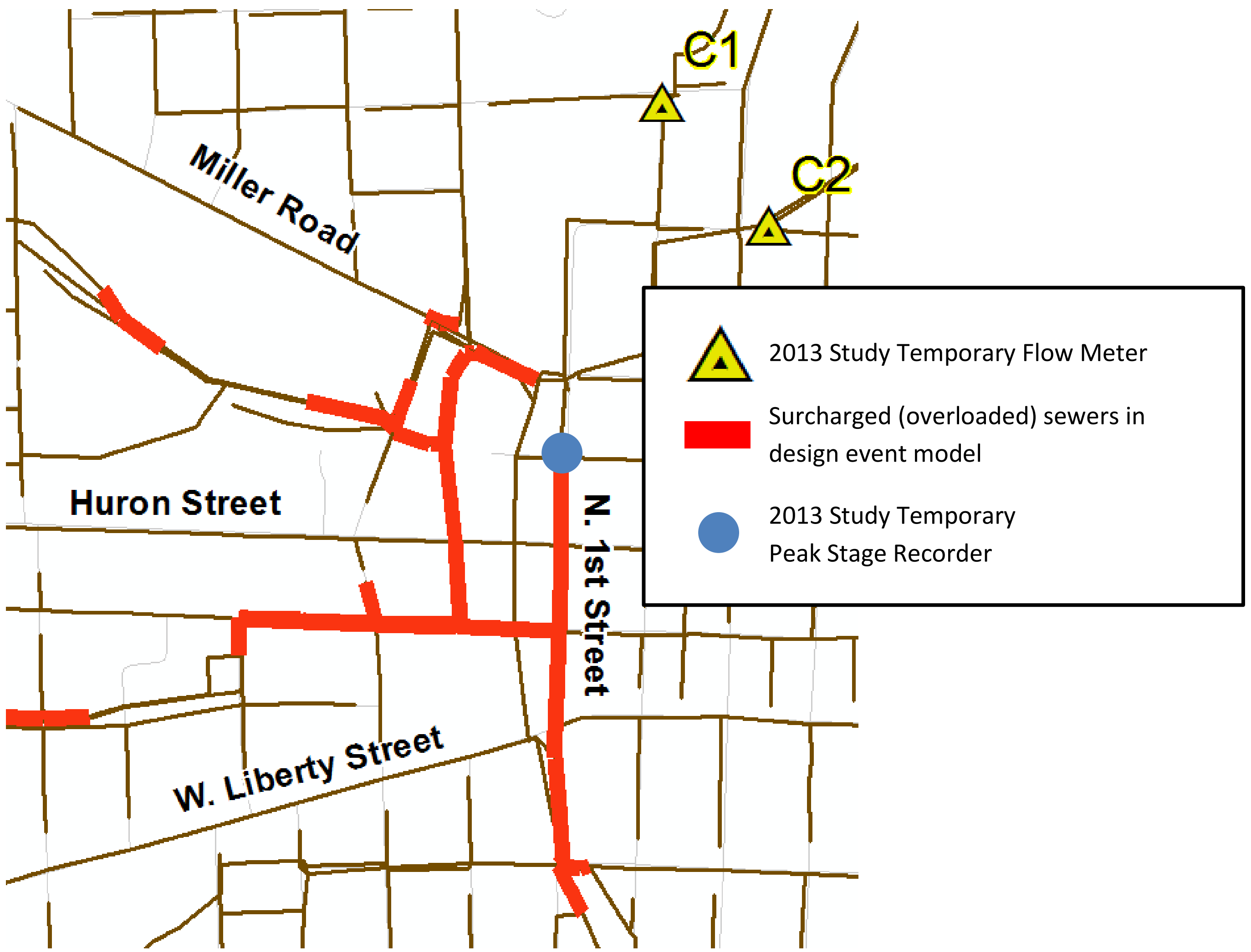
Suggested Action Plan for Further Investigation

Tasks Associated with Project	Expected Outcome
1. Identify locations for additional temporary metering and other data collection (e.g. video inspection) in order to better understand actual system performance. 2. Perform temporary flow metering and data collection. 3. Revise model based on findings 4. Re-run model for design event to identify deficiencies.	1. Flow metering and data collection report. 2. Revised model. 3. Proposed plan to address deficiencies, including capital improvements to be included in the City's capital improvement plan to address identified deficiencies.

- **Estimated investigation cost**: less than $100,000
- **Estimated timeline to complete**: approximately 8 months

CAC COMMENTS:

Project Area (B)
High Level / 1st Street



Model Background

1. Existing model was calibrated to downstream flow meter (C1/C2) as well as peak stage recorder (shown in figure). Flow distribution upstream of these meters in the current model is as identified in previous (2002) model.
2. Model includes infrastructure updates performed by the City since the development of the original model (2002).

Observations

1- Model calibration efforts show that very high hydraulic losses, i.e. blockages, needed to be applied in order to make the model match peak stage recorder (PSR) data (location of PSR is shown on map). These losses, i.e. blockages, are much higher than suggested by engineering standards.
2- Design event model calibrated to the PSR shows flows that exceed the pipe capacities, resulting in modeled surcharging as high as ~8 ft. above sewer bottom.
3- The City had previously recognized this as a problem area. Further work was planned but extent of improvements needed was yet to be identified.

Therefore, it is believed that further investigations are needed to resolve the unusual hydraulic losses before making significant capital investments.

Suggested Action Plan for Further Investigation

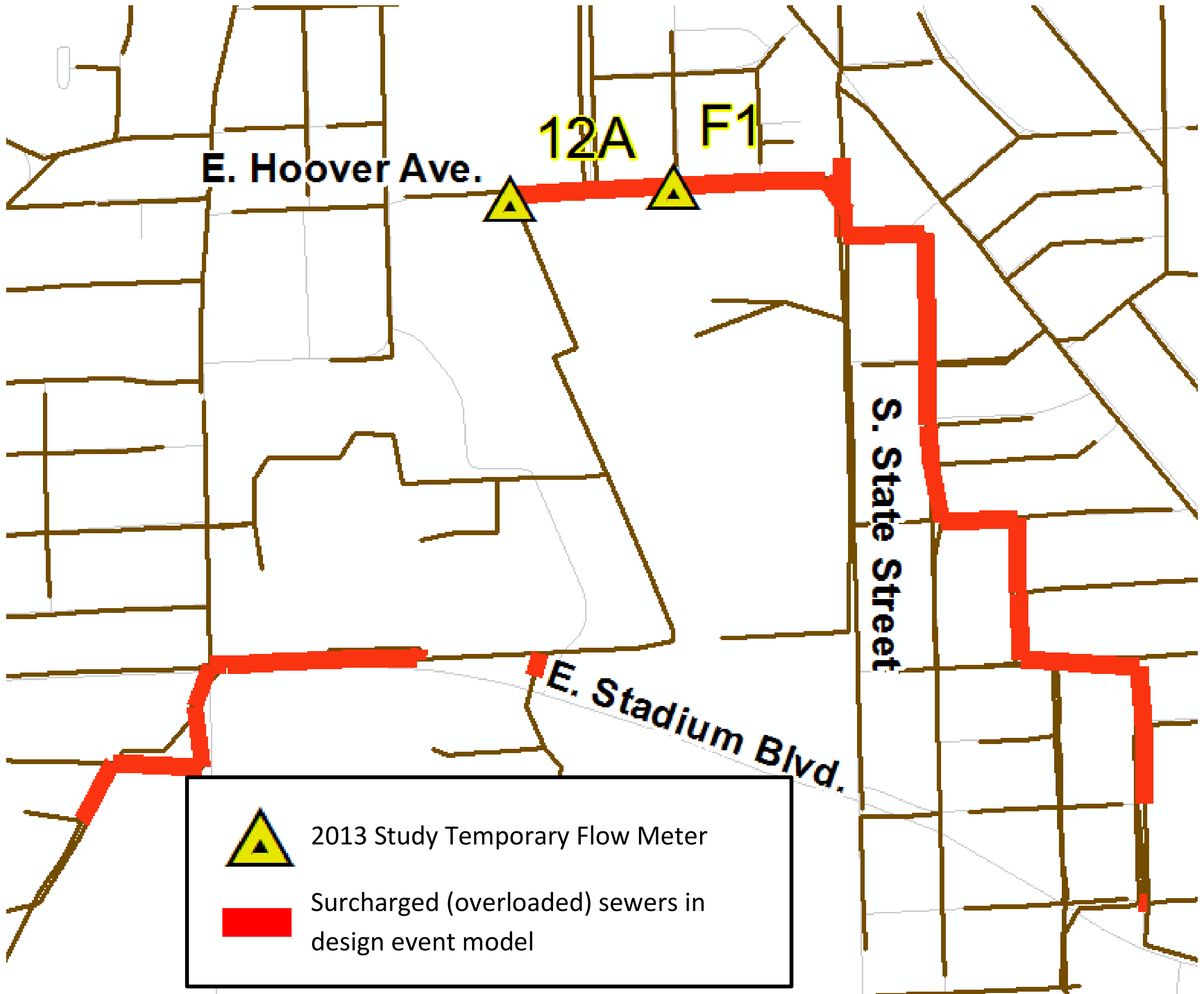
Tasks Associated with Project	Expected Outcome
1. Televise and physical inspect pipes and manholes. 2. Perform field hydrant testing if feasible. 3. Organize a storm event mobilization team to measure depths during storm events. 4. Perform continuous depth and flow meter monitoring at key locations, if needed.	1. Identification of obvious physical obstructions (e.g. root blockages) or, if not present, 2. Perform further field investigation in order to identify structures and conditions resulting in unexpectedly high depths in this area.

- **Estimated investigation cost**: Less than $100,000
- **Estimated timeline to complete**: 12 months

CAC COMMENTS:

The 18" sanitary sewer, set west of First St., runs north from Washington St directly under what is known as the Atrium Office building (315 W Huron).

Project Area (C)
High Level / State & Hoover



Model Background

1. Existing model was calibrated to downstream meter (F1/12A) using metering data. Flow distribution upstream of this meter in the current model is as identified in previous (2002) model.
2. Model includes infrastructure updates performed by the City since the development of the original model (2002).

Observations

1- Model calibration efforts show that very high hydraulic losses needed to be applied in order to make the model match flow meter data. These losses are much higher than suggested by engineering standards.
2- Design event model calibrated to the downstream flow meter shows flows that exceed the pipe capacities, resulting in modeled surcharging as high as ~8 ft. above sewer bottom.
3- The City had previously recognized this as a problem area. Further work was planned but extent of improvements needed was yet to be identified.
4- This is a known Sanitary Sewer Overflow (SSO) area - upstream of meter F1.

Therefore, it is believed that further investigations are needed to resolve the unusual hydraulic losses before making significant capital investments.

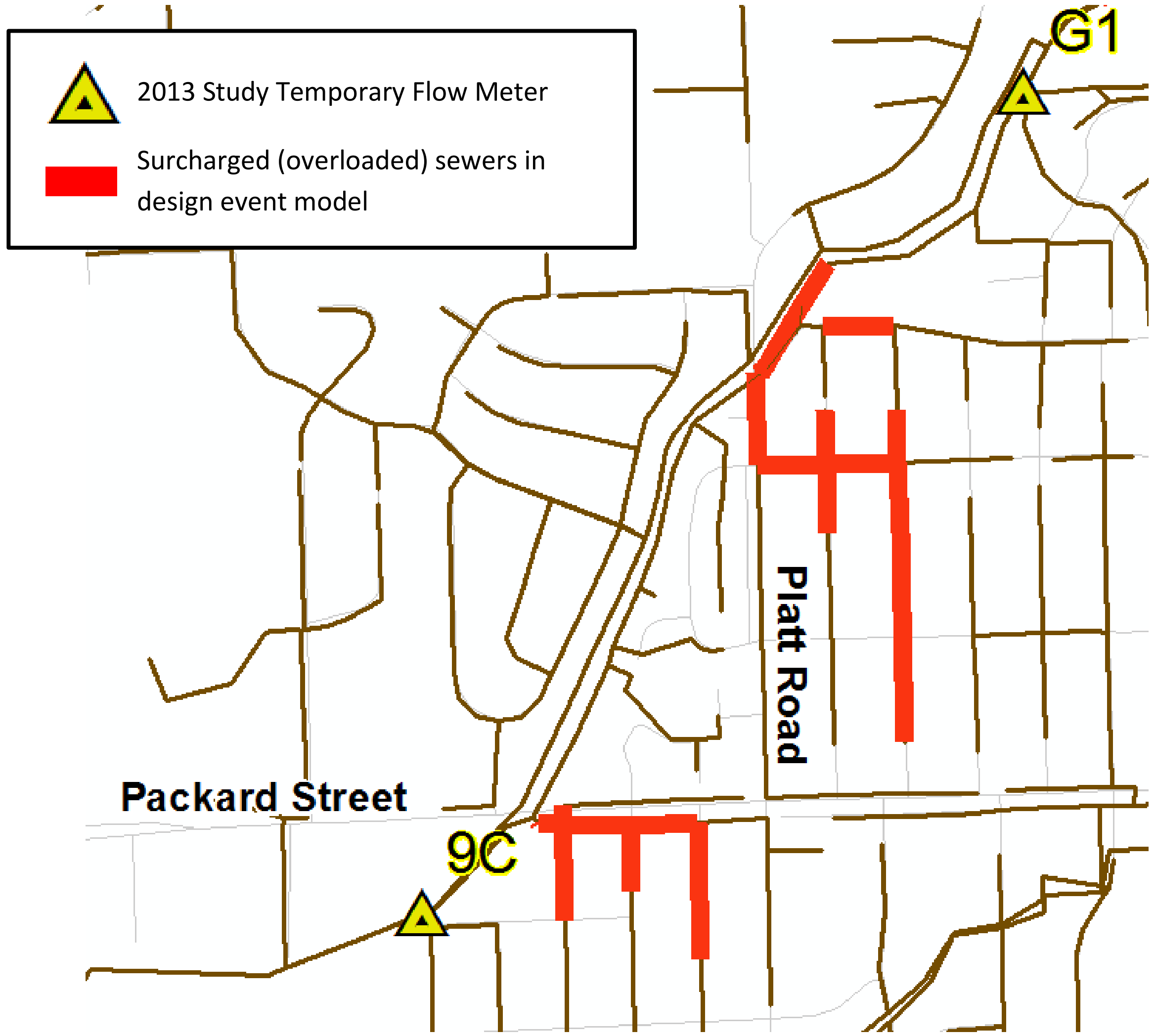
Suggested Action Plan for Further Investigation

Tasks Associated with Project	Expected Outcome
1. Televise and physical inspect pipes and manholes. 2. Perform field hydrant testing if feasible. 3. Organize a storm event mobilization team to measure depths during storm events. 4. Perform continuous depth and flow meter monitoring at key locations, if needed.	1. Identification of obvious physical obstructions (e.g. root blockages) or, if not present, 2. Perform further field investigation in order to identify structures and conditions resulting in unexpectedly high depths in this area.

- **Estimated investigation cost**: Less than $100,000
- **Estimated timeline to complete**: 12 months

CAC COMMENTS:

Project Area (D)
Pittsfield Valley



Model Background

1. Existing model was calibrated to downstream meter (G1) using metering data. Flow distribution upstream of this meter in the current model is as identified in previous (2002) model.
2. Model includes infrastructure updates performed by the City since the development of the original model (2002).

Observations

1- Model shows flows that exceed the pipe capacities as identified in the adjacent figure, resulting in modeled surcharging as high as ~11 ft. above sewer bottom.
2- The City had previously recognized this as a problem area as this area includes backup complaints.
3- This area is suspected of having high footing drain flows that maybe overloading the system. The area was not directly metered and so actual flows are not known. Model results are based on assumed flow distribution.

Therefore, it is believed that further investigations are needed before making significant capital investments (i.e., storage, relief sewer, FDD).

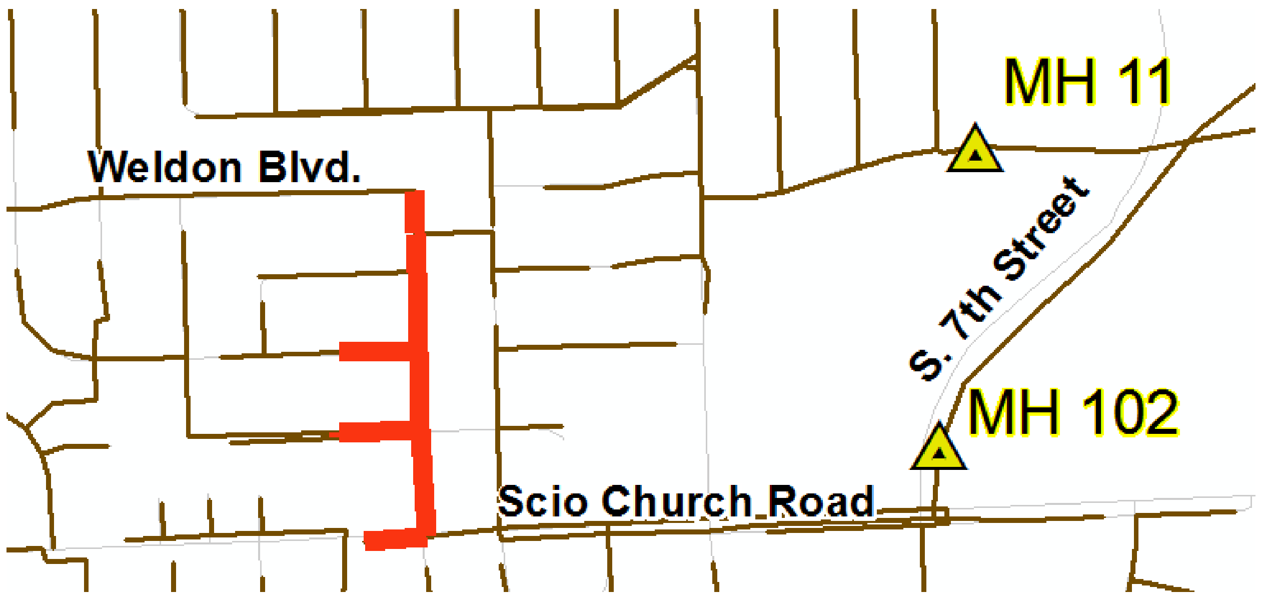
Suggested Action Plan for Further Investigation

Tasks Associated with Project	Expected Outcome
1. Ensure that all manhole pick holes are plugged before flow metering 2. Perform metering to understand flow magnitude and source. 3. Survey home owners to understand extent and cause of sanitary sewer basement backups. 4. Determination of cause of backups (i.e. is it high flows, system capacity constraints, or local, homeowner system issues).	1. Flow metering, data collection, and survey results report. 2. Revised model. 3. Proposed plan to address deficiencies, including capital improvements to be included in the City's capital improvement plan to address identified deficiencies.

- **Estimated inspection cost**: less than $100,000
- **Estimated timeline to complete**: approximately 8 months

CAC COMMENTS:

Project Area (E)
Glen Leven



2013 Study Temporary Flow Meter

Surcharged (overloaded) sewers in design event model

Model Background

1. Existing model was calibrated to downstream meter (MH11/MH102) using metering data. Flow distribution upstream of this meter in the current model is as identified in previous (2002) model.
2. Model includes infrastructure updates performed by the City since the development of the original model (2002).

Observations

1- Model shows flows that exceed the pipe capacities for approximately 1,800 ft., resulting in modeled surcharging as high as ~3 ft. above sewer bottom.
2- This is one of the high-priority footing drain disconnection areas (Glen Leven)
3- Metering data analysis indicated that footing drain disconnection was less effective in this area than in the other high-priority areas.
4- High flows from inflow & infiltration still exist in this district, either from remaining footing drains or other inflow & infiltration sources.

Therefore, it is believed that further investigations are needed before making significant capital investments.

Suggested Action Plan for Further Investigation

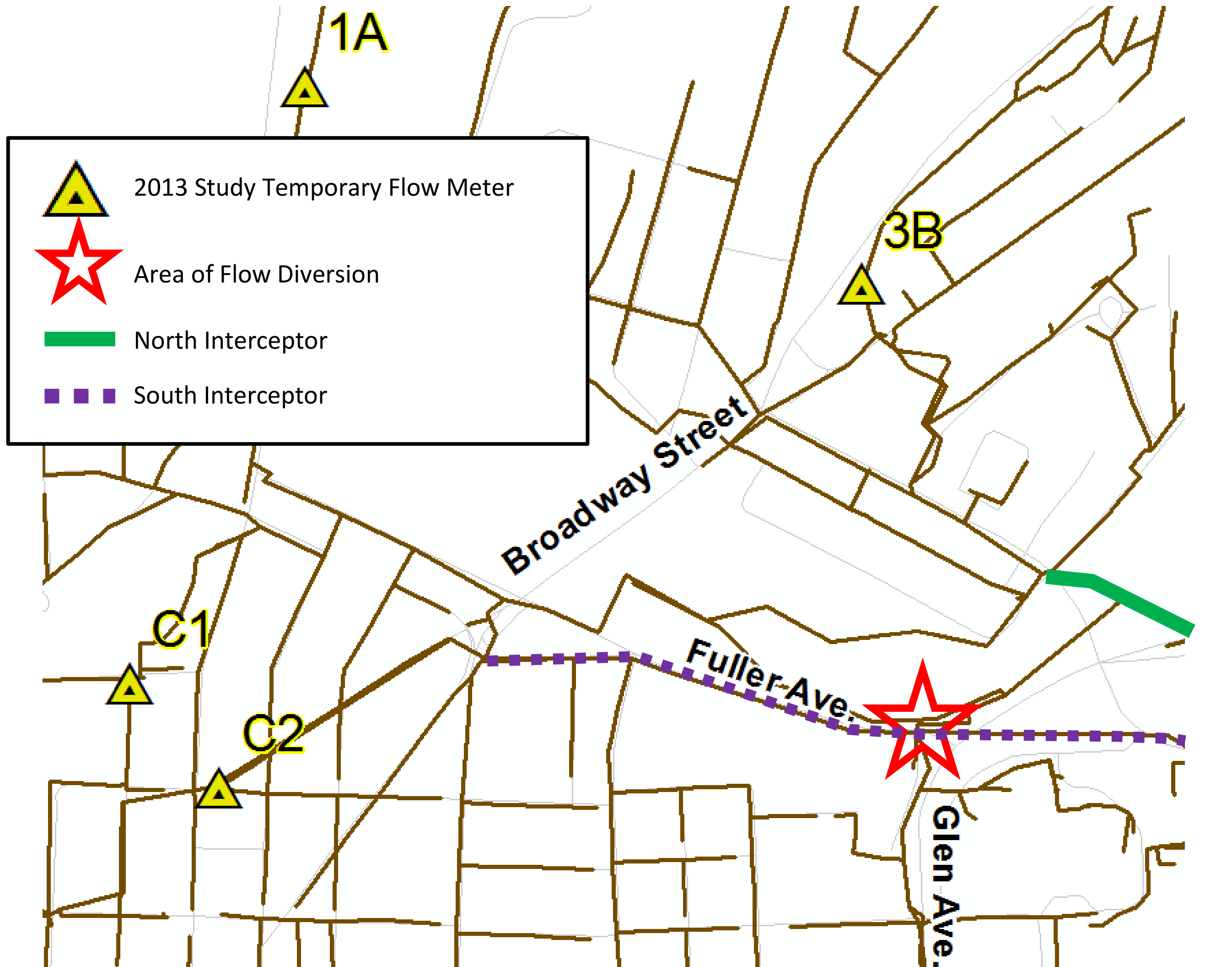
Tasks Associated with Project	Expected Outcome
1. Determine surcharge level that impacts basements. 2. Develop a scope and cost for sanitary sewer evaluation survey (SSES), inclusive of televising, manhole inspection, smoke testing, and temporary flow monitoring. 3. Prepare a preliminary cost estimate for relief sewer. 4. Perform cost effectiveness evaluation between construction of relief vs further I/I removal.	1. Evaluation results of whether surcharge is acceptable. 2. Cost estimates for SSES, I&I removal, and construction of relief sewer. 3. Recommendation for how to proceed based on cost estimates and community values.

- **Estimated investigation cost**: Less than $20,000
- **Estimated timeline to complete**: 3 months

CAC COMMENTS:

1. What is our level of confidence in the model in this area, and the prediction of 3-feet of surcharge?
2. There was some concerns expressed by Murat about the flow split between the two meters on this area. Does that affect the confidence?
3. Should the City consider some “free board” above the three feet of surcharge to provide some cushion before basements are impacted?

Project Area (F)
Diversion



Background Model

1. The diversion shown in the map helps move flow from the south interceptor to the north interceptor during high flows, thereby improving the performance of the south interceptor by making use of available capacity in the north interceptor.
2. Flow diversion is achieved in the sewer via a pipe with the top cut off. When the flow reaches the level of the cutoff top, it spills over into the diversion pipe to the north interceptor.
3. This diversion is currently modeled as a basic flow diversion.

Observations

1- There is concern that the diversion structure configuration in the field (sewer pipe with the top cut off) may not be adequately diverting flow and improvements maybe needed in order to make it operate as desired.

2- The City is considering temporary metering flows in the vicinity of this diversion structure in order to understand its current performance.

Therefore, before any further capital improvements are initiated in this area to improve structure efficiency, further evaluation is warranted.

Suggested Action Plan for Further Investigation

Tasks Associated with Project	Expected Outcome
1. Identify level of operational flexibility and control in the existing diversion structure. 2. Perform temporary flow metering and data collection 3. Implement proposed diversion structure design changes as necessary.	1. Flow metering and data collection report. 2. Determination of whether diversion needs modifications to function as intended. 3. Ann Arbor City staff to review findings and implement operational changes as needed.

- **Estimated investigation cost**: Tasks 1 & 2, less than $30,000
- **Estimated timeline to complete**: 4 months

CAC COMMENTS:

- A noticeable odor can be smelled in the area when this diversion is active.

- This project is not driven by potential basement backups, and is a sewer operations issue. As such, it is not really within the focus of the CAC, and should be a City focus as part of their operations of the system.

Appendix B

Black & Veatch Ltd. of MI Technical Memorandum
Waste Water Treatment Plant Facilities Master Plan
Service Conditions Assessment – Technical Memorandum No. 1
March 2003

City of Ann Arbor, Michigan
Water Utilities Department

Waste Water Treatment Plant
Facilities Master Plan

Service Conditions Assessment –
Technical Memorandum No. 1

March 2003
Revision 3

Prepared by

Black & Veatch Ltd. of Michigan
333 West Fort Street, Suite 1750
Detroit, Michigan 48226

I. Service Conditions Assessment

A. Introduction

This is the first in a series of five technical memorandums for the City of Ann Arbor Waste Water Treatment Plant's Facilities Master Plan. The purpose of Task Series 100, the Service Conditions Assessment, is to develop a basis of projection upon which future needs of the facility can be predicted. In the following discussion, the plant service areas, existing flow and pollutant loadings and regulatory requirements of the facility are documented. These parameters are then used to establish the future flow and loadings of the facility. The Service Conditions Assessment is the beginning of the Master Plan and is required to document current and projected future conditions at the facility so an organized schedule of future improvements can be identified. This document will focus on the liquid treatment train only and address the solids treatment process as required for understanding of the liquid processes. Solids handling, processing, and storage are addressed in a separate document entitled Solids Residuals Master Plan.

B. Wastewater Flows and Pollutant Loadings

1. Existing Conditions

The City of Ann Arbor Waste Water Treatment Plant (WWTP) has a permitted design flow of 29.5 million gallons per day (MGD). It currently serves the City of Ann Arbor and parts of the Townships of Ann Arbor, Scio, and Pittsfield. Figure 1-1 is a site plan of the facility. The plant consists of two separate treatment trains supported by several common treatment facilities. The West Plant was originally constructed in 1937 and expanded in 1947 and again in 1964 to its current configuration. The East Plant was constructed in 1977 and has underwent only minor changes since it was put in operation. The Raw Sewage Lift Station Building (1964), Screen and Grit Building (1964 and 1977), Flow Equalization and Retention Facility (1977), Tertiary Filter Building (1977), and ultraviolet (UV) disinfection facilities (2001) are common to both treatment trains.

The West Plant consists of ten (10) rectangular primary clarifiers, two (2) rectangular aeration tanks and five (5) circular final clarifiers. The East Plant consists of four (4) circular primary clarifiers, four (4) rectangular aeration tanks and four (4) circular final clarifiers. Design parameters are as follows:

- Design Year – 1995
- Design Population – 210,700
- Annual Average Daily Flow – 29.5 MGD
- Annual Average Daily Flow (West Plant) – 9 MGD
- Annual Average Daily Flow (East Plant) – 20.5 MGD
- Average Daily Flow of Maximum 30 Day Avg. – 33.6 MGD
- Average Flow of Maximum Day – 44.9 MGD
- Average Daily Sustained Flow – 38.0 MGD
- Peak Hourly Flow – 73.73 MGD
- Influent BOD_5 – 150 mg/l
- Influent TSS – 150 mg/l
- Influent Phosphorus – 7.2 mg/l

Appendix C

Summary of MDEQ Data on Reported SSOs within City of Ann Arbor

Event #	Outfall Discharge Start:	Outfall Discharge End:	Volume from this Outfall:	Outfall Location:	Reason For Discharge:	Precipitation Type:	Precipitation Amount:
1	9/20/2013 18:30	9/20/2013 19:30	(not specified)	Near Jackson Road and I-94	Raw sewage-grey water seeping from pickholes in manhole cover near Jackson Road and I-94 (along the I-94 ROW). Blockage caused by tree roots and lye. Unknown amount	None	0
2	9/20/2013 14:30	9/20/2013 15:30	0.001 Million Gallons	Intersection of Fuller Court and Fuller Road	Blockage in sewer line caused clearwater seeping from pickholes in manhole cover in wooded area near VA Hospital. Material collected in low lying area with woodchips.	None	0
3	9/16/2013 10:15	9/16/2013 10:30	0.0001 Million Gallons	Pauline Ave.	Sewage overflow from manhole into storm sewer due to grease blockage.	None	0
4	8/29/2013 15:00	8/29/2013 17:45	(not specified)	Nichols Arboretum	Discharge of raw sewage from Manhole in Nichols Arboretum due to tree root blockage in 8" sanitary sewer line. Flow discharged through a 1" pickhole in the manhole cover at a rate of approx 2 gallons per minute. Appeared to be greywater, no solids.	None	0
5	6/27/2013 17:20	6/27/2013 17:30	0.01 Million Gallons	Wastewater treatment plant storm sewer	Plant flow went from 18 MGD to over 50 MGD within a 30-minute period, and peaked at over 65 MGD. This nearly instantaneous change in flow occurred faster than staff could react.	Rain	5.86
6	6/27/2013 16:30	6/27/2013 18:30	0.00005 Million Gallons	237 Pineview Court	Sewage overflow due to heavy rains and tree root blockage in sanitary sewer line located near 237 Pineview Court. Dilute raw sewage released to storm sewer and Huron River.	Rain	2.5
7	12/24/2012 15:00	12/24/2012 19:30	0.001 Million Gallons	Nichols Arboretum	Blocked 8" sewer line due to tree roots resulted in overflow of raw sewage to ground in Nichols Arboretum.	None	0
8	5/24/2012 10:00	5/24/2012 11:00	0.00005 Million Gallons	727 Miller Road	Private sanitary lead clogged - overflowed from sanitary manhole - overland flow to storm system inlet	None	0
9	4/20/2012 11:00	4/20/2012 11:30	0.00005 Million Gallons	Near the address of 2008 Chalmers Drive	Construction activities along Mallets Cr streambank required heavy eqpt in creekbed. In an area where the 10" sanitary clay pipe was near the creekbed, the pipe was cracked when eqpt drove over it, causing a small release.	None	0
10	1/28/2012 14:00	1/28/2012 14:01	0.0003 Million Gallons	Wastewater treatment plant storm sewer	Power failure and restart with generators caused surge overflow of channesl at Screen & Grit Bldg. Overflowed to storm water well and system and ~300 gallons pumped to river.	None	0
11	1/21/2012 12:00	1/22/2012 16:00	0.003 Million Gallons	Bluffs Nature Area	Sewer clogged with roots resulted in overflow of raw sewage onto ground at Bluffs Nature Area.	None	0
12	1/8/2012 4:00	1/10/2012 3:00	0.000035 Million Gallons	Private residence address	Private lead at home located at 1320 W. Huron St. was plugged, resulting in release of 35 gal raw sewage to the ground.	None	0
13	7/12/2011 9:30	7/13/2011 12:00	0.0025 Million Gallons	739 Kuehnle	Sanitary sewer line (10" dia) ruptured near the intersection of Keunhnle and Sequoia. Sewage was released to roadside ditch and city storm sewer, which outlets to Honey Creek.	None	0.00

14	5/25/2011 16:30	5/25/2011 21:30	0.0012 Million Gallons	Division/Hoover/Hill St area	Heavy rain, plus inflow from area footing drains connected to sanitary sewer, overwhelmed sewer system and resulted in sewage overflow from manholes located near Hill/Division St. and Hoover/Division St. intersections.	Rain	3.00
15	3/10/2011 13:00	3/10/2011 14:30	0.00002 Million Gallons	2800 Jackson Road	Sewer blockage due to tree roots resulted in overflow of sewage from manhole onto ground, adjacent to EB I-94 at the Jackson Road on-ramp (near 2800 Jackson Road).	None	0.00
16	10/11/2010 21:30	10/12/2010 0:15	0.0005 Million Gallons	Hill Street near Cambridge	Sewer blockage resulted in overflow of sewage from manhole located on Hill Street near Cambridge. Sewage flowed onto pavement and into nearby stormsewer catch basin.	None	0.00
17	6/25/2010 0:00	6/25/2010 0:00	(not specified)	Pepper Pike St. (S. end) N of Glazier Way	Raw sewage discharged to ground in wooded area and to Miller's Creek at end of Pepper Pike Road, near Glazier Way. Overflow was the result of root blockage in pipe.	None	0.00
18	3/9/2010 13:00	3/9/2010 16:00	(not specified)	South of Glazier Way and east of Stanton Court	Blockage in 8" sanitary sewer, located south of Glazier Way and east of Stanton Court, resulted in overflow of sewage to storm sewer and Millers Creek.	None	0.00
19	3/1/2010 7:30	3/1/2010 13:00	0.097614 Million Gallons	Hogback south of Huron River Dr	Sewage overflow to ground and creek due to blocked 24" sanitary sewer located on Hogback Rd, just south of Huron River Drive. Blockage caused by dirt and grease.	None	0.00
20	2/17/2010 7:30	2/17/2010 14:00	(not specified)	Between State and Main St., 1/2 mile N of Eisenhower. Behind Hidden Valley Apts.	Unknown volume of sewage overflowed from manhole, located between State and Main Streets approx 1/2 mile north of Eisenhower, due to blockage in 10" sewer line caused by tree roots.	None	0.00
21	6/19/2009 7:45	6/19/2009 7:45	(not specified)	Longshore Drive at Argo Park	Corroded 12" sewer line resulted in release of unknown amount of sewage in Argo Park, west of Longshore Drive. Problem was discovered while crews were TV'ing the sewer.	Rain	0.00
22	3/17/2009 6:45	3/17/2009 7:05	0.001 Million Gallons	WWTP grounds	Overflow from sand filter backwash wet well to ground due to 2 airbound waste wash water pumps. Approx 1000 gal overflowed from the wash water well to the ground outside the sand filter building.	None	0.00
23	1/7/2009 14:15	1/7/2009 15:00	(not specified)	Bird Hills Nature Area	Sewer blockage of 8" line, due to tree roots, caused sewage overflow from manhole to the ground in the Bird Hills Nature Area, east of Bird Rd, south of Huron River Dr.	None	0.00
24	4/21/2008 8:00	4/21/2008 17:00	(not specified)	Washtenaw Ave, east of Huron Parkway	Illicit connection from Chili's Restaurant at Arborland Mall resulted in sewage being discharged to on-site detention pond and then into Mallett's Creek.	None	0.00
25	12/5/2006 23:10	12/6/2006 0:00	0.0005 Million Gallons	Jackson Rd, west of Maple	Sewer force main break at Jackson Ave, west of Maple St., resulted in discharge of raw sewage to storm sewer which discharged to Allen Creek.	None	0.00
26	11/27/2006 7:00	11/27/2006 7:30	0.0005 Million Gallons	Wastewater treatment plant storm sewer	Raw sewage overflow at WWTP from primary scum well due to failure of tank level sensors which control the pumps. Discharge to roadway and on-site storm sewer. No release to river occurred.	None	0.00
27	9/25/2006 0:00	9/25/2006 7:30	0.0005 Million Gallons	Jackson Rd at Park Lake Ave	Force main break at Parklake and Jackson Road resulted in discharge of raw sewage to First Sister Lake. Unsure of exact time discharge began. Volume of discharge is estimated.	None	0.00
28	9/11/2006 8:00	9/11/2006 8:20	0.0001 Million Gallons	GrayLake and Hilltop Rd intersection	6" force main break in Lakewood Subdivision near intersection of GrayLake and Hilltop Roads resulted in release of raw sewage to storm sewer and First Sister Lake. Overflow was discovered by contractors Monday morning at 8:00 am..	None	0.00

29	9/5/2006 7:00	9/5/2006 7:30	(not specified)	Jackson Rd at Park Lake Ave	Break in 6" forcemain in Lakewood Subdivision resulted in release of raw sewage to storm sewer and First Sister Lake. Unsure when release began; unknown quantity released. Overflow was discovered by contractors Monday morning at 7:00 am.	None	0.00
30	5/14/2006 20:30	5/14/2006 23:30	0.125 Million Gallons	Wastewater treatment plant, outfall 001	WWTP discharged treated effluent without ultraviolet disinfection for approx 20 minutes due to a Detroit Edison power outage. The outage caused one of two power feeds at the WWTP to be temporarily out of service.	Rain	0.78
31	1/19/2005 6:00	1/19/2005 9:00	0.00035 Million Gallons	Jackson Rd at Park Lake Ave	Sewer force main break near Jackson Rd and Park Lake Rd. caused sewage release to ground and Three Sisters Lake.	Snowmelt	0.00
32	6/22/2004 16:45	6/22/2004 16:45	(not specified)	2350 Parkwood Avenue	Grease blockage in sewer line caused raw sewage to discharge from manhole and flow into Malletts Creek.	None	0.00
33	5/22/2004 16:30	5/22/2004 18:30	0.5 Million Gallons	Wastewater treatment plant, outfall 001	Extremely high flows at WWTP (48 mgd) resulted in bypass of partially treated wastewater (no UV disinfection) from sand filters to Huron River.	Rain	2.50
34	8/14/2003 16:15	8/15/2003 16:00	13 Million Gallons	Wastewater treatment plant, outfall 001	Massive power outage in the northeast United States caused blackouts in portions of Michigan. Ann Arbor Wastewater Treatment Plant, operating on emergency generators, could provide only partial treatment of wastewater.	None	0.00
35	6/24/2002 16:10	6/24/2002 17:10	0.0007 Million Gallons	Jackson Rd and Mason St	Force main break located downstream of pump station near Jackson Rd and Mason St. intersection caused release of sewage to ground and First Sister Lake/Trib of Honey Creek	None	0.00
36	4/22/2002 8:25	4/22/2002 9:30	0.0002 Million Gallons	1730 Longshore	Plugged sanitary sewer main overflowed causing approx. 200 gallons of raw sewage to discharge to the ground and the Huron River.	None	0.00
37	10/16/2001 12:00	10/16/2001 12:30	0.002 Million Gallons	Wastewater treatment plant storm sewer	Influent channel at plant under construction. Heavy rainfall caused plant flows to inadvertently enter channel under construction where open drains allowed it to overflow out building and to storm sewer.	Rain	2.35
38	7/5/2001 17:00	7/5/2001 18:00	(not specified)	2350 Parkwood Avenue	Tree roots caused blockage in sanitary sewer near 2350 Parkwood Ave. Sewage seeped up through the soils and onto the ground, then into Mallett's Creek approx. 30 away. Overflow may have occurred intermittently for weeks.	None	0.00
39	7/10/2000 0:00	7/10/2000 0:00	(not specified)	4155 Clark Road	Heavy rains caused sewer to surcharge. Raw sewage discharged from manhole and flowed into small tributary of Huron River from 5:00 pm to 6:00 pm.	Rain	2.00

D. October 6, 2014 – TOAG Observations and Comments re: Sanitary Sewer Study Presentation
Prepared by Dick Hinshon, TOAG Chair

On September 18, 2014 the Technical Oversight and Advisory Group ("TOAG") received a presentation from the City's Consultant (OHM) on the Sanitary Sewer Wet Weather Evaluation Project ("SSWWEP"). The TOAG then discussed the findings and the draft recommendations for addressing several problem areas identified by the study. This document summarizes the views and comments of the TOAG on several key issues.

1. Frequency Analysis of Pre and Post Footing Drain Disconnection (FDD) Flows

Attachment 1 can be found on Page 600

Staff from Ann Arbor and OHM had previously briefed the TOAG members on February 13, 2014 regarding the approach being used to analyze the system response to wet weather events and to assess the pre and post FDD removal flows. As set forth in the April 8, 2014 TOAG document (see Attachment 1), the Group is generally satisfied with the techniques being used to monitor flows in the system and to determine the return frequency for large wet weather events.

However, TOAG Members noted that the Footing Drain Disconnection removal rates for wet weather flows vary markedly from one neighborhood to another. In particular, additional review and evaluation of the Glen Leven and Dartmoor areas may be warranted to explain why the post FDD wet weather flow rates remain so high. Detailed analysis of these neighborhoods may help identify the factors that are affecting the flows in these areas, confirm the inflow sources into the sanitary sewers, and ensure that the hydraulic model simulations can adequately represent the future wet weather flows that will be encountered.

2. Incorporation of Climate Change into the Analysis of Sanitary Sewer System Performance

Attachment 2 can be found on Page 602

Staff from Ann Arbor and OHM had previously provided TOAG Members with a report describing the approach being used to incorporated climate change impacts into the analysis of future system performance. As set forth in the June 17, 2014 TOAG document (see Attachment 2), the Group is generally satisfied with the analytical techniques being used to quantify climate change impacts, and believes that the study is appropriately incorporating this information into the SSWWE project analysis.

TOAG Members indicated that the recommendation to increase the 25 year Design Event flow rate by 10% is reasonable since this is a mid-range value which falls near the center of the climate change forecast models showing "best case" and "worst case" future conditions. TOAG Members noted that the 25 Year Frequency Event is probably fairly conservative with regard to the whole System, since large rain events typically show significant spatial variation in rainfall volumes and intensities over an area as large as the Ann Arbor Sanitary Sewer System service area. For that reason, the total flow from the Service Area is likely to be lower than what the model predicts since some areas would be expected to receive less rainfall than others.

However, it is also true that the rainfall volume and intensity in small portions of the Service Area could be higher than what is predicted for the 25 year event, and this could create some localized problems even though the model predicts that the system could handle a 25 year event. The information that is provided to the public will need to be carefully prepared to ensure that there is an understanding that providing a Sanitary Sewer System with the capability to convey a 25 Year Design Event does not guarantee that surcharging problems will be totally controlled.

3. Analysis of the System's Ability to Handle Future Growth (City and Suburban Areas)

Staff from OHM explained how the analysis of future growth was derived for both Ann Arbor and the neighboring Communities served by the Sanitary Sewer system. It was noted that the suburban contract maximum flow values have been incorporated into the future forecast even though most areas are not expected to actually convey flows at that rate during the planning period. For Ann Arbor, the projected growth was based on anticipated future development as identified by City planners. To account for variations in diurnal flow patterns OHM has applied a 2.0 peaking factor to the average day flow projection. Statistical analysis of actual peaking factors from various areas in the City shows that this is a conservative approach since the measured peaking factor averages 1.8 across the City.

TOAG Members questioned whether the future growth projections for the City are sufficient to accommodate redevelopment projects which might generate a substantial increase in flows. In particular, the potential for high density projects such as high rise buildings in the downtown area may need to be considered. It was noted that the Developer Offset Mitigation Program (DOMP) may provide an opportunity for offsetting such flow increases if this program is continued into the future. The TOAG Members expressed interest in having further discussion with City staff and the Consultant Team to consider the DOMP program and to weigh in on issues relating to continuing, modifying or eliminating the program.

4. Selection of Design Event Scenarios for Analysis and Hydraulic Model Simulation Results

Staff from OHM described the rationale for selecting two future scenarios (labeled as "Scenario B" and "Scenario C") for analysis, and described the similarities and differences of the two options. TOAG Members generally agreed that the two Scenarios are appropriate for the analysis since they show how the Sanitary Sewer System is expected to perform in the future with different assumptions on how to quantify the factors that influence wet weather flows.

The Hydraulic Model simulations show that the Scenario C total flow is about 7% higher than Scenario B. The Model predicts that the Sanitary Sewer System should be capable of conveying the 25 Year Design Event wet weather flows in most parts of the City under both Scenario B and Scenario C. However, the model indicates that there are 6 localized areas where surcharging of sewer lines may be problematic, and the Scenario C impacts are incrementally larger and more widespread as compared to Scenario B.

TOAG Members observed that many of the problem areas are located in places where sewer surcharging and backups have been reported, and the model appears to correlate with historical physical observations. However, a few of the areas identified as problematic by the model are neighborhoods where there is little historical information to corroborate the simulation, and the extent of actual sewer surcharging in these areas warrants further scrutiny.

5. Recommended Action Plans for Six Problem Areas

OHM Staff presented the proposed Action Plans for the six problem areas and solicited feedback and comments from TOAG Members on the recommended program. TOAG Members expressed support for conducting additional investigation of the target areas as the prelude to proceeding with design and construction of remedial projects. It was generally agreed that the selection of the appropriate remedial measure (i.e. storage, relief sewers, I/I flow reductions, etc.) should be deferred until more information is obtained to confirm the actual extent and severity of current and anticipated future wet weather system deficiencies in these problem areas. Furthermore, it is important that the evaluation of remedial measures consider a wide range of options including structural and non-structural solutions such as green infrastructure measures.

6. Evaluation of Wastewater Treatment Plant Impacts for the Design Event Scenarios

OHM Staff summarized the anticipated future flows to be delivered to the wastewater treatment plant for the two Design Scenarios, and presented information comparing these flows to the plant capacity for both treatment processes and wet weather storage units. TOAG Members acknowledged that the available capacity is expected to be adequate to handle the 25 Year Design Event wet weather flows, although it is recognized that this conclusion is based on a hypothetical wet weather hydrograph which shows that the peak wet weather influent flow rates occur over a fairly short period of time (i.e. < 8 hours). Furthermore, the simulation presumes that the Equalization Basin will be empty at the time of the storm so that all of the storage capacity is in fact available. There is no guarantee that these assumptions are correct, but it is also possible that the peak flows actually received during a 25 Year Event may be lower if the areas receiving the most intense rainfall are far enough from the wastewater plant to allow for peak flow attenuation due to the time of travel. It was generally agreed that the wastewater treatment plant impacts are not expected to be a significant issue, especially as compared to the surcharging problems predicted to occur in the six key areas.

7. Summary Observations/Next Steps

The TOAG Members were generally satisfied with both the analytical approach taken by OHM and the recommended Action Plans for the six problem areas. It was a consensus of the Group that the SSWWE project should proceed to develop the specific scope of work to be undertaken in each area, along with a cost estimate and schedule for completion. City staff were encouraged to move forward with the development of remedial projects that can be considered for funding through the CIP program once the additional information described in the recommended Action Plans has been obtained.