MEMORANDUM

TO: Mayor and Council

FROM: Sue F. McCormick, Director, Water Utilities Department

DATE: August 18, 2003

SUBJECT: Resolution To Offset Development Sewage Flows Through Sanitary Flow Removal or Mitigation Practices

Your approval is requested for the attached resolution authorizing the Water Utilities Director to implement the Development Sewage Flow Offset-Mitigation Program.

The City of Ann Arbor and Michigan Department of Environmental Quality (MDEQ) have negotiated an Administrative Consent Order (ACO) to resolve alleged violations of the Natural Resources and Environmental Protection Act, 1994 PA 451 involving Sanitary Sewer Overflows (SSO). The terms of the ACO require that the City of Ann Arbor demonstrate on a project-by-project basis, offset-mitigation for new development in a manner consistent with MDEQ guidelines to effect a net reduction in flow to the system. Although the ACO is not premised on basement backups, the essence of the ACO involves wet weather flows in the sanitary system and addresses the excessive clean water in the sanitary sewer that causes capacity issues both in the collection system, resulting in basement backups, and at the wastewater treatment plant (WWTP), resulting in the release of partially treated plant overflows to the Huron River.

City Council approved a resolution (R-401-8-00) on August 7, 2000 that directed city staff to limit the potential for exacerbating sanitary sewer backups due to any new sewer connections. The standing policy does not address the SSOs at the WWTP. The attached resolution establishes a policy to prevent development from exacerbating both sanitary sewer backups and WWTP overflows. The proposed policy complies with the ACO by requiring development and changes in land use to remove 120% of the estimated net new contribution of flow to the sanitary system. This policy would apply city wide to any increase in flow greater than the equivalent flow from a duplex residential unit.

The ACO acknowledges that the City has customer communities that may propose new discharges into areas of the City's wastewater collection system that do not have capacity available. In those instances, Part 41 permits issued by the MDEQ to those jurisdictions will carry offset-mitigation requirements on the same basis as Ann Arbor.

The attached document "Development Sewage Flow Offset-Mitigation Program" explains the rationale and methodology used for the program and provides example calculations for determining offset requirements for proposed site developments.

Prepared by: Pete Perala, P.E., Senior Utilities Engineer, Field Services
Reviewed by: Sue F. McCormick, Director, Water Utilities Department
Approved by: Roger Fraser, City Administrator

RESOLUTION TO OFFSET DEVELOPMENT SEWAGE FLOWS THROUGH SANITARY FLOW REMOVAL OR MITIGATION PRACTICES

Whereas, City Council approved a resolution (R-401-8-00) on August 7, 2000 that directed city staff to explore options to limit the potential for exacerbating sanitary sewer backups;

Whereas, The Michigan Department of Environmental Quality (MDEQ) and the City of Ann Arbor have negotiated an Administrative Consent Order (ACO) to resolve alleged violations of the Natural Resources and Environmental Protection Act, 1994 PA 451; and

Whereas, Compliance with the ACO stipulates requirements for an Offset-Mitigation Program to reduce sanitary sewer flows for new connections to the sanitary system.

RESOLVED, That all property developments within the City of Ann Arbor requiring site plan submissions must offset-mitigate estimated sewage flows from the development;

RESOLVED, That all property developments within the City of Ann Arbor requiring application for a Part 41 Permit must offset-mitigate estimated sewage flows from the development;

RESOLVED, That County, public schools, colleges, universities and other government facilities on properties located within the City of Ann Arbor must offset-mitigate estimated sewage flows for new development;

RESOLVED, That offset-mitigation for new sanitary system connections into capacity constrained sewage districts must be offset or mitigated in the collection system upstream of the capacity constrained location;

RESOLVED, That properties requiring site plan submissions must disconnect on-site footing drains from the sanitary sewer if an approved discharge location exists;

RESOLVED, That properties annexing into the city must disconnect on-site footing drains from the sanitary sewer if an approved discharge location exists;

RESOLVED, That new sanitary system connections for parcels currently using on-site sewage disposal systems shall be exempt from offset-mitigation requirements;

RESOLVED, That new sanitary system connections for flow additions less than the equivalent flow from a duplex residential unit and not requiring a Part 41 Permit application shall be exempt from offset-mitigation requirements;

RESOLVED, That in locations where Ann Arbor Township, Pittsfield Township or Scio Township contribute flow and adequate transport capacity within the city has not been purchased by the township or constructed, the townships must agree to institute a policy equivalent to the City’s policy for offset-mitigate of new sanitary sewer flow;

RESOLVED, That the Water Utilities Director has the authority to implement the Development Sewage Flow Offset-Mitigation Program and to modify calculation tables and factors to meet the ACO requirements; and

RESOLVED, That City Council authorizes the City Administrator to take necessary administrative actions to implement this resolution.

Water Utilities Department
August 18, 2003

DEVELOPMENT SEWAGE FLOW
OFFSET-MITIGATION PROGRAM

GENERAL

All property developments, within the City of Ann Arbor, requiring Site Plan submissions must offset-mitigate estimated sewage flows from the development.

All property developments, within the City of Ann Arbor, requiring application for a Part 41 Permit must offset-mitigate estimated sewage flows from the development.

County, public schools, colleges, universities and other government facilities on properties located within the City of Ann Arbor, must offset-mitigate estimated sewage flows for new development.

Offset-mitigation for new sanitary system connections into capacity constrained sewage districts must be offset or mitigate upstream in the collection system of the capacity constrained location.

Properties requiring site plan submissions must disconnect on-site footing drains from the sanitary sewer if an approved discharge location exists.

Properties annexing into the city must disconnect on-site footing drains from the sanitary sewer if an approved discharge location exists.

New sanitary system connections for parcels currently using on-site sewage disposal systems shall be exempt from offset-mitigation requirements.

New sanitary system connections for flow additions less than the equivalent flow from a duplex residential unit and not requiring a Part 41 Permit application shall be exempt from offset-mitigation requirements.

Locations where Ann Arbor Township, Pittsfield Township or Scio Township contribute flow and adequate transport capacity, within the city, has not been purchased or constructed, the townships must agree to institute policy equivalent to the city policy for offset-mitigate of new sanitary sewer flow.

PROCEDURES/RATIONALE

The City of Ann Arbor has adopted the following procedures to determine a consistent and reasonable value for sanitary flow added to the sanitary system based on the scope of proposed development and estimated "clean water" removal from the sanitary by reducing or eliminating I/I sources or through accepted applicable water conservation efforts.

When the mitigation effort deals with reducing storm or ground water I/I from the sanitary system, the dry weather flows are peaked to correspond with a scenario in which the effects of a rain event happen to occur at the same time when the sanitary flow is at its peak on the normal diurnal curve.

When the mitigation involves removing sanitary flow dry weather flows are not peaked because the reduced sanitary flow is considered generally to be on the same diurnal pattern as all typical sanitary flows. This assumption is less relevant in communities with very distinct usage patterns in each district i.e. significant industrial districts, etc.

In general, the goal is to reduce sanitary flow during wet weather events. These rain events have shown to cause peak flows in the sanitary system that range from 9 to 31 times greater than the average dry weather flows. (Table E-6) This range of peak flows is primarily due to inflow through building footing drains and is accounted for by the assumed 4 GPM average flow contributed by each footing drain connection to the sanitary system. The variability of peak flows/surcharging throughout the system is due in part to the size of the infrastructure piping and number of homes within the sanitary district.

An analysis of footing drain response to rain events, in the year 2000, took place in five Ann Arbor neighborhoods. The average of the peak flows generated by each of the homes was estimated based on field data collected. (Figure 1) In each area, these peak flows were regressed and projections made to the 4" rainfall, the volume of the 25-year, 24-hour event in the Ann Arbor area according to NWS TP-40. These projected peak flows were shown to vary from 3 to 5 GPM for the different areas. Therefore, the average peak flow expected during the 25-year, 24-hour storm was found to be on average about 4 GPM or 5760 GPD.

The addition of sanitary flow by development is estimated by using Table-A. This estimate of average daily flow is then peaked. The peaking factor is applied to the flow because the effects of the rain event can occur at any time and could easily happen at the peak of a sanitary diurnal flow curve. Table E-5 shows actual system dry weather average and peak flows. A conservative, industry standard peaking factor of 4 times the average daily flow is used due to variability within the sanitary system. A system recovery factor of 1.2 is applied to all offset-mitigation calculations.

DRY WEATHER PEAKING FACTORS

An analysis of flow data was performed using data collected from the seven flow meters. These meters collected data between May and November 2000. A summary of the average daily, maximum, and minimum flows observed during dry weather flows in cubic feet per second (CFS) observed at each meter are shown in Table E-5. This data yields peaking factors of 1.5, 1.4, 1.5, 1.8, 1.6, 1.7 and 2.4. A typical industry standard peaking factor of 4 for dry weather sanitary flow is considered a conservative value to use in the Offset Mitigation calculations.

Table E-5. Daily Average Flows (cfs)

Study Area	No. Days Analyzed	Ave. Flow	Max Flow	Min Flow
Orchard Hills	35	0.15	0.22	0.06
Bromley	38	0.14	0.20	0.08
Dartmoor	27	0.93	1.36	0.43
Glen Leven North	32	0.08	0.14	0.03
Glen Leven South	34	0.22	0.36	0.07
Morehead	34	0.30	0.51	0.12
Liberty-Washington	8	0.43	1.03	0.06

WET WEATHER PEAKING FACTORS

The June 24-25, 2000 rain event caused sewer surcharging and high flows in each of the five study areas. Since the flow meters were installed during this period, valuable information was able to be collected. Table E-6 summarizes the amount of rainfall, the maximum flows recorded, and the calculated peaking factor for each of the study areas during this large storm. The peaking factor is calculated as the maximum flow recorded divided by the average daily dry weather flow. This factor becomes a measure of how responsive each study area is to wet weather. In general, the wet weather response ranged from 9 to 31 times the average dry weather flow between the different study areas.

Table E-6. Rainfall, Meter Level, Flow, and Peaking Factor for Study areas

Study Area	Total Rain (in.)	Meter Level Max. (in.)	Max. Flow (cfs)	Peaking Factor Q_{max}/Q_{av}	Peak Surcharge Meter (in.)	Peak Surcharge PLR** (in.)
Orchard Hills	2.9	104	2.3	15	94	88
Bromley	3.2	76	3.15	23	66	77 .0
	9.7	5.2	24	-----	-----	
Dartmoor	4.0	177	8.02	9	162	150
Glen Leven N.	4.0	84	4.2	31*	69	87
Glen Leven S.	4.0	9.7	5.2	24	-----	-----
Morehead	3.5	104	8.5	28	-----	81

* Used 0.14 as the average dry weather flow due to a meter calibration change after the June 25 event.
** PLR = Peak Level Recorder

SUMMARY OF FOOTING DRAIN RESPONSE

The monitoring performed in 2000 included several large storms, with one event that exceeded the 25-year, 24-hour criteria used to provide the upper limit of SSO control. Monitoring of the individual footing drains was also performed, but only under smaller
storm conditions because of the difficulty of mobilizing for each of the events. This monitoring was performed at the discharge from the house leads from individual homes to the sanitary sewer and could include I/I flows from the house lead in addition to footing drain sources. During this work, there was a high amount of variability in the flows produced by the footing drains at individual homes, with some producing very small flows and others producing flows that exceeded 10 GPM. In some cases, homes adjacent to one another that looked very similar produced very different peak flows.

For the monitored conditions, it was estimated that the percentage of flows sourced from footing drains in these areas ranged from 90% to 50% of the total wet weather flow observed in the sanitary sewers, depending on the area being monitored. To make projections of the peak flows expected under the 25-year, 24-hour storm conditions, the total flows calculated as being sourced from footing drain sources were plotted for each of the areas, based on the rainfall amounts. This is shown in the figure below.

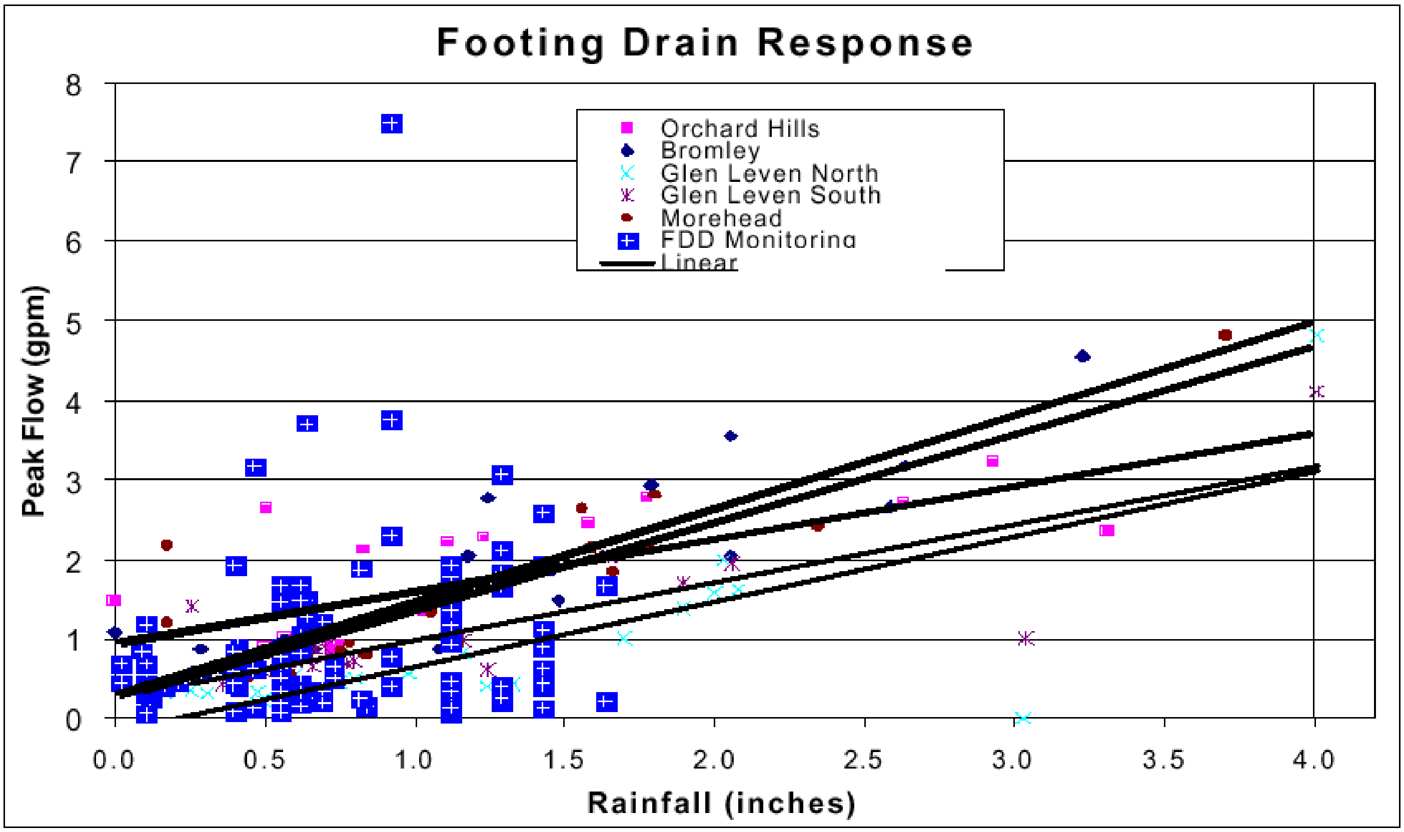

Figure 1 – Peak Flow Estimates by Area

* To better define the range and average peak flows from footing drain sources, 20 sump pump monitors have been installed in homes that have had Footing Drain Disconnections performed. The result of that monitoring, also shown in Figure 1, has been consistent with the monitoring performed in 2000. However, it should be noted that there have not been high intensity or high volume storms during the monitoring period in 2002. The monitoring efforts will continue to verify the peak flow estimates developed based on the 2000 sewer monitoring.

TABLE A

TYPE OF FACILITY OR USE	DESIGN DRY WEATHER FLOW RATE
Single Family Residence	350 gpd
Two Family Residence	700 gpd
Apartment to a single family unit (up to 400 sq. ft)	200 gpd
Motels with kitchenettes, apartments, townhouses, mobile homes, trailers, co-ops, etc. up to 600 sq. ft. of gross floor area	200 gpd/unit
Motels with kitchenettes, apartments, townhouses, mobile homes, trailers, co-ops, etc. up to 601 - 1200 sq. ft. of gross floor area	275 gpd/unit
Motels with kitchenettes, apartments, townhouses, mobile homes, trailers, co-ops, etc. greater than 1200 sq. ft. of gross floor area	350 gpd/unit
Motel unit less than 400 sq. ft	100 gpd/unit
Motel unit greater than 400 sq. ft.	150 gpd/unit
Hospital (without laundry)	150 gpd/bed
Hospital	300 gpd/bed
University housing, rooming house, institutions	75 gpd/capita
Cafeteria (integral to an office or industrial building)	2.50 gpd/capita
Non-Medical Office space	0.06 gpd/sf gr. floor area
General Industrial Space	0.04 gpd/sf gr. floor area
Medical Arts (doctor, dentist, urgent care)	0.10 gpd/sf gr. floor area
Auditorium/Theater	5 gpd/seat
Bowling alley, tennis court	100 gpd/crt - alley + food
Nursing Home	150 gpd/bed
Church	1.50 gpd/capita
Restaurant (16 seat minimum or any size with dishwasher)	30 gpd/seat
Restaurant (fast food)	20 gpd/seat
Wet Store – Food processing	0.15 gpd/sf gr. floor area
Wet Store no food (barber shop, beauty salon, etc.)	0.10 gpd/sf gr. floor area
Dry Store (no process water discharge)	0.03 gpd/sf gr. floor area
Catering Hall	7.50 gpd/capita
Market	0.05 gpd/sf gr. floor area
Bar, Tavern, Disco	15 gpd/occupant + food
Bath House	5 gpd/occ. + 5gpd/shower
Swimming Pool	20 gpd/capita
Service Stations	300 gpd/double hose pump
Shopping Centers	0.02 gpd/sf gr. sales area
Warehouse	0.02 gpd/sf gr. area
Laundry	425 gpd/laundry machine
Schools, nursery and elementary	10 gpd/student
Schools, high and middle	20 gpd/student
Summer Camps	160 gpd/bed
Spa, Country Club	0.30 gpd.sf. gr. floor area
Industrial Facility, Large Research Facility	“Determined by Authority of
Others (car wash, etc.)	Water Utilities Director”

Values in Table A (above) are from or derived from the following sources:

Michigan Guidelines for Subsurface Sewage Disposal, 1977
Schedule of Unit Assignment Factors, 1988, Oakland County Public Works (Michigan)
Basis of Design, Scio Township (Michigan)
Sewer Design, 1992, Los Angeles Bureau of Engineering
Equivalent Residential Unit Determination, University of Central Florida
Standard Handbook of Environmental Engineering, 1989, Robert Corbitt

SYSTEM RECOVERY FACTOR

A system recovery factor of 1.2 is applied to design dry weather flow rates (both peak and non-peak) to recover system capacity lost due to wet weather inflows and regional system flow increases from development.

Calculation Examples:

Site 1 - FDD (8-Unit Condominium)

8 units x 350 GPD/unit = 2800 GPD
Peak flow = 2800 GPD x 4 (peaking factor) x 1.2 (System Recovery Factor)= 13440 GPD (9.33 GPM peak flow)

Using 4 GPM/home footing drain flow (Value based on sump pump flow monitoring) 9.33/4 = 2.33 or 3 FDD: This development would be required to disconnect three footing drains from the sanitary sewer system.

Site 2 - Toilet Replacement - FDD Equivalent (10000 GPD Development)

Proposed development has 10000 (with 1.2 [System Recovery Factor]= 12000) GPD dry flow and reducing toilet flow would be on a similar diurnal usage curve

Use standard 350 GPD per household apply reductions of 28% and 55% yields 54 GPD removed per toilet - dry flow not peaked

12000/54 = 222 toilets

FDD uses peak flows
10000 x 4 (peaking factor) x 1.2 (System Recovery Factor)= 48000 GPD

4 GPM (FDD Flow Value) = 5760 GPD

48000/5760 = 8.33 FDD or 9 FDD

222 toilets or 9 FDD's

222/8.33 = 26.7 toilets/FDD or 27 toilets/FDD