CITY OF ELGIN

COOPER/PRESTON/BELLEVUE FLOOD STUDY

August 2009

Prepared by:

Carroll Engineering & Associates, Inc.
111 West Hurlbut Avenue
Belvidere, IL 61008 (815) 547-3406

I. Project Description

As a result of repeated flooding and property damage within localized areas, the City of Elgin contracted Carroll Engineering and Associates to complete, and subsequently summarize, an analysis of the storm and sanitary sewers within the problematic areas. The Study Area is located mainly along Cooper Avenue and Preston Avenue and is bounded on the north by Hartwell Ave., Polly Court on the east, Chester Ave. on the south and Dundee Avenue on the west. An additional area with a history of flooding lies along Bellevue Avenue between River Bluff Road and Cooper Avenue.

The study area is **not** located within a combined sewer area, although the sanitary sewer drains to the Fox River Water Reclamation district through combined sewers south of the study area. The storm sewer in the vicinity drains into the Fox River at the north end of Bellevue Avenue.

In order to gather the necessary information to analyze the system and complete the study, a land surveying crew obtained elevations on the major components of the sewer systems. The survey results (manhole rim and invert elevations) were then combined with records made from onsite inspections to compile an accurate picture of how the systems function.

II. Existing Conditions

As is commonly the case in older neighborhoods, parts of the sewer system are aging while other sections have been replaced more recently. The field inspections and sewer televising information revealed many deficiencies that would restrict the efficiency of the sewer systems. However, there was no individual problem (such as an illicit connection between storm and sanitary sewers) serious enough to be labeled a direct cause of the flooding.

In addition to the field inspections completed as part of the study, the City provided Carroll Engineering with records and documented instances when flooding occurred. From these existing records, which were composed mainly of resident contacts, it appears that the most critical area is near the intersection of Preston and Cooper Avenues. The information obtained from these contacts focus not only on the severity of the flooding but also their frequency.

It is clear that the intersection of Cooper and Preston does indeed flood during a moderate to heavy rain events. According to the documented records, the flooding occurs soon after a high-intensity rain begins but dissipates within a reasonable amount of time after the rain ceases. It does appear that street flooding, if significant enough, will cause property damage to adjacent homes and buildings. The records are quite clear in stating that the most significant property damage is due to surcharging into the basement floor drains via the sanitary services.

III. Analysis Method

In order to analyze the flooding problem within the study area, enough field information was gathered to create an accurate model of the City's sewer systems. This model was created within the SWMM software, a program respected within the industry and specifically designed to dynamically depict a sewer system.

In order to model the sanitary system, the as-built information from the survey was compiled and entered into the software. Also factored into the hydraulic model were any pertinent details recorded in the field inspections. These details included, for the most part, deficiencies noted in the sanitary structures. As there are three main components that comprise the flow within a sanitary sewer; flow values were added for wastewater, inflow and infiltration. The three components are summarized below:

Waste Water flows were based upon the number of properties (house, restaurants, etc.) that connect to each section of the sanitary sewer system. To provide a model of actual wastewater usage, the flow was varied over the hours of the day. This varied usage, or Diurnal Flow Variation, is based on the amount of wastewater entering the system over a 24-hour period.

Infiltration is caused by groundwater, and is based on defects such as cracks in the sewer as well as "allowable" flow amounts that are bound to enter any sewer system. The allowable infiltration rates and flow rates per defect are both based on accepted industry standards. However, these rates were increased at locations where previous soil borings indicated that the water table is above the sanitary sewer. In the critical flooding area near the intersection of Preston and Cooper, past soil borings indicate that the groundwater ranges from 4 feet to 8 feet below the ground surface. However, the sewer in the area ranges from 8 to 12 feet deep. This area is obviously prone to abnormally high amounts of infiltration, since the soil surrounding the pipe and most of the manhole structures is completely saturated. Since groundwater is a relatively constant presence, the infiltration rates were not varied over the 24-hour analysis period.

Inflow is based solely on defects observed in individual manholes that will allow storm water to enter the sanitary system. The flow amounts for each defect are based upon an accepted industry standard. However, the runoff amounts were varied over the 24-hour period to simulate the effect of an actual rain event.

In order to simulate a "worst-case" scenario, the model was constructed so that the peak storm water runoff coincides with the peak hour of wastewater flow (common times for showering, doing laundry, dishwashing, etc). Therefore, the model was established to simulate a storm that begins just before the peak hours of water usage. After the model was constructed, the data for each section of sanitary sewer was examined to determine critical factors such as flow rate, velocity and evidence of surcharging.

Similar to the sanitary sewer system, as-built information for the storm sewer was collected and entered into the SWMM software. Unlike the sanitary, however, the flow consisted entirely of storm water runoff rather than a compilation of wastewater flow, inflow/infiltration, etc. The runoff volumes were generated from data collected from past rainfall events within the City of Elgin. For the purposes of the system model, a 10 year

storm was chosen as the critical event. This choice was based on common current design standards for storm sewer within local communities. To further understand the existing capacity of the storm sewer, critical locations (i.e. multiple accounts of flooding) were analyzed. Paramount on the list of critical flooding areas is the intersection of Cooper Ave. and Preston Ave. The capacity of the storm sewer exiting this intersection was compared with the volume of downstream runoff generated from various storm events. For this evaluation, the flow was calculated using the formula Q = CIA, where Q is the flow, C is the runoff coefficient, I is the intensity and A is the drainage area in acres. The results are summarized below:

Time of Concentration:
total distance of 1330 feet /(0.5 ft/sec X 60s/min) + 10 min = 54 min
where 0.5 feet per seconds is the average speed of the runoff and 10 minutes is added for saturation time
Conservative Tc = 50 minutes
A = 47.4 acres (area upstream of the Cooper and Preston intersection)
C = 0.35 (assumed for typical residential areas)

2 Year Storm: (using conservative Tc of 50 min), I = 1.7 in/hr
Q = 0.35 x 1.7 x 47.4 = **28 cfs**

5 Year Storm: I = 2.1 in.hr
Q = 0.35 x 2.1 x 47.4 = **35 cfs**

10 Year Storm: I = 2.5 in/hr
Q = 0.35 x 2.5 x 47.4 = **41 cfs**

Storm Sewer Capacity: 24" diameter at 0.1% = **7.15 cfs**

Obviously, the existing storm sewer is extremely inadequate to carry the runoff from even a 2 year storm event. For this reason, the storm sewer will surcharge and eventually flood the intersection entirely during a heavy storm.

IV. Evaluation Results

Based on the age of the sanitary and storm sewer systems, the condition of the pipe and structure materials display all of the defects that one would expect. In other words, it is no surprise brick manholes are leaking, that the pipe has cracked in certain locations or that debris has accumulated within the pipes and structures.

Included with the documentation furnished by the City were televising tapes for the storm sewer. These tapes revealed many instances where a dip is present along a sewer run. Many of these dips were significant, and resulted in water standing at a depth greater than one-half of the pipe diameter. In three separate instances, the dips in the storm sewer were severe enough that sections of the pipe were completely full during dry weather conditions. Unsurprisingly, these dips were centralized on Cooper Avenue, a short distance downstream from the critical flooding area. Since the sewer does not run downstream at a constant slope, water cannot pass through without surcharging of the

upstream manholes and sewer. When the surcharging actually extends out of the structures and into the street, flooding is the result. Additionally, the sediment and other debris that accumulates wherever standing water is present will further constrict water flow.

More significant than the structural deficiencies within the system, however, is the undersized and slightly sloped storm sewer that runs west down Cooper Avenue. From Preston to Bellevue, the survey information consistently indicates slopes less 0.5%. Although the pipe increases to 27 inches in diameter, the hydraulic capacity is not nearly sufficient to handle storm water runoff from significant rain events. In essence, the undersize pipe is restricting flow to the point where the roadway is acting as a quasi-detention pond. Additionally, the storm sewer running north on Bellevue from Cooper to River Bluff has equally minimal slopes, although the diameter has been increased to 36 inches.

The majority of the deficiencies, however, are located within the sanitary system. Aside from the expected defects that increase water from inflow and infiltration, the capacity in certain areas of the system appears to be significantly inadequate. Once again, the critical area is the intersection of Cooper and Preston. The manhole (MH 015340) in this intersection receives flow from the north, south and east and discharges flow to the west. While the westerly pipe is greater in size than the three sewers flowing into the manhole, its slope is too minimal to carry the flow downstream (see Appendix E). Additionally, survey elevations from two sewer lengths downstream of the MH 015340 indicate that the pipe is back-pitched. In short, the sanitary sewer running in Cooper Avenue lacks capacity because it is under-sized and laid too flat. As the sewer backs up, the manholes begin to surcharge. The hydraulic pressure then forces sewage up the sewer services and into basement floor drains. The SWMM model indicates moderate to severe surcharging in the pipe both upstream and downstream of MH 015340. This surcharging is certainly significant enough not only to cause flooding through basement floor drains but also within the street itself.

V. Recommendations

While analysis of the sanitary sewer within the study area indicates that the system has adequate capacity for the expected wastewater usage, standards require that the sewer be designed to accept some of the inflow/infiltration (I/I) that will inevitably occur. However, when additional flows are added by I/I experienced in an aging system, the system capacity is not sufficient. However, it is simply not economically feasible to reconstruct the majority of the sanitary system within a short period of time. Corrective measures that will alleviate surcharging and reduce flooding while remaining economically viable are as follows:

a) Upsize sanitary sewer on Cooper Avenue from Cedar Street to Preston Avenue. This option would not only provide a larger pipe to carry the sanitary flow, but would eliminate the pipe sections with a slope well under the minimum (as defined by the Illinois Recommended Standard for Sewer Works). Using the current invert elevations for MH 015340 and 015389, there is an adequate elevation difference to install the pipe at a constant slope of 0.25%. At this slope a 15” diameter would

provide sufficient capacity for the anticipated flow. The increased capacity would not only alleviate flooding upstream near Preston, but also on Bellevue Avenue as well.

b) **Connect the sanitary sewer from the intersection of Preston and Congdon to the intersection of Bellevue and Congdon**. This option would divert a large portion of the sanitary flow away from the critical area of Cooper and Preston. Using the current invert elevations of MH 015358 and MH 015392, there is an adequate elevation difference to install the pipe at a constant slope of 0.70%.

c) **Install overhead sewers.** Installation of overhead sewers would eliminate the need for basement floor drains within the flood-prone areas. In this manner, the sanitary system could surcharge without flooding private property. This solution could be implemented on a house-by-house basis so that corrective measures can be immediately implemented in the most critical areas**.**

d) **Eliminate sources of I/I throughout the system.** Using a combination of pipe lining, manhole repair and removal and replacement of manhole lids, inflow and infiltration within the system can be greatly reduced. If the sanitary sewer would be utilized to carry wastewater with small amounts of I/I only, flooding would be greatly reduced if not eliminated entirely. This option has the advantage of being implemented in stages, in which the most deteriorated areas could be addressed first. Of course, any downstream areas would obviously benefit from the reduction of I/I.

With respect to the storm sewer, there is no quick and easy method to remedy the lack of capacity within the existing system. However, there are solutions that can certainly be implemented to alleviate the flooding issues.

a) **Upsizing sewer capacity on Cooper Ave.** This can be accomplished by removing and replacing the existing sewer, or (more simply) by constructing a parallel sewer to act as an overflow route when surcharging occurs. The upsized sewer will not only carry more runoff, but will also provide a storage volume to allow surcharging without street flooding. To make this option truly effective, the storm sewer capacity on Bellevue would have to be increased as discussed below.

b) **Upsizing sewer capacity on Bellevue Ave.** In the existing system, the storm sewer slope is minimal from Cooper to Storm Manhole 0018 (approx. 600 feet north of River Bluff), and then increases sharply from River Bluff to the river. If the existing 36 inch pipe could be upsized or supplemented with a parallel overflow sewer, the runoff could easily be carried to the river even during significant rain events.

c) **Divert portions of the drainage basin to detention areas.** The existing detention pond just west of Hiawatha is fairly large and could be upgraded to contain a greater storage volume. After a brief analysis, it was determined that the elevations simply do not allow for gravity sewer to be installed from the intersection of Cooper and Preston to the detention area. However, the elevations are sufficient to install a storm sewer from the intersection of Preston and Page directly east to the pond. This would redirect some runoff from the flood prone areas, and would provide an overflow route when the intersection of Cooper and Preston is flooded. It should be noted, however,

that a full topographic survey would be required to determine the extent of the pond upgrading necessary to handle the additional runoff.

As with any system of significant size, both the sanitary and storm sewers within the Study Area are complex. For this reason, the best option to alleviate flooding is not one solution but a combination of work efforts. Our recommendations have been outlined below.

Sanitary Sewer:
Due to the toxins and bacteria found in sewage, sanitary flow flooding into private residences and/or business presents obvious health concerns. Therefore, addressing the inadequacies of the sanitary sewer should be a priority for the City.

The first step to be taken would be further inspection of the sanitary sewer, focusing on the pipes themselves. This could be done with sewer televising and/or smoke testing. These investigations would allow major sources of I/I to be located and demarcated for repair. Also, it is very possible that an improper connection with the storm sewer and/or basement sump would be identified. The inspection could be done at a relatively low cost, especially if City forces were utilized. Reducing I/I would benefit the entire downstream sanitary system.

The second option we recommend is the implementation of a cost sharing plan for the installation of overhead sewer lines. Most importantly, this option puts responsibility into the resident's hand, and allows them to take an active role in eliminating their flooding problem. Typically, each resident would have to contract the work (to be completed in accordance with City Specifications) and would make a formal application for the cost sharing.

Of course, the long-term solution to the problem would be upsizing sewer capacity along Cooper Avenue. By increasing the pipe size and slope, the sewer would become be able to carry the necessary amount of flow through the Study Area.

Storm Sewer:
Similar to the sanitary sewer, the problem within the storm sewer system are a direct result of insufficient pipe capacity. Unlike the sanitary system, however, there are no localized solution options such as the elimination of I/I or the installation of overhead sewers. The City cannot utilize the existing detention area to the immediate west of Hiawatha since the elevations prevent a direct connection from the storm manhole at Cooper and Preston to the detention area.

The most effective solution would be upsizing the sewer capacity along Cooper and Bellevue. The existing grade drops significantly from the intersection of Preston and Cooper to the river outfall along Cooper and Bellevue Avenues. The topography should be utilized to increase pipe slopes exiting the Study Area. These increased slopes, in conjunction with greater pipe sizes, will make the storm sewer capacity adequate for a 10 year storm event.

Conclusion:
While the street flooding occurs regularly during significant rain events, it is our understanding that the flood duration is relatively short. It appears that the majority of the actual property damage is caused by sanitary sewer backup into the basement floor drains and less by the street flooding. For this reason, we believe that the sanitary sewer should be addressed first and foremost. The first action item recommended would be the location and elimination of Inflow and Infiltration (I/I).

However, the fact remains that the permanent solution to the flooding problem will be increasing the capacity of the storm and sanitary sewers along Cooper and Bellevue Avenues. Again, increasing capacity can be accomplished by rerouting flow currently in the system around the bottleneck. The construction of new or additional sewers will be costly, as the improvements to the underground sewer will entail reconstruction of these streets and other utilities that cannot be safetly supported during the excavations. It is very important to note that a full scale reconstruction would allow work simultaneously on the storm and sanitary sewer, reducing flooding in both systems.

Prepared by:

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Nicholas Becker, P.E.

SUMMARY OF APPENDICES

A. EXISTING CONDITIONS
Sanitary Sewer Defect Summary
Storm Sewer Defect Summary
Sanitary Sewer As-Built Information
Storm Sewer As-Built Information
Typical I/I Rates (MWRD Standard)
Soil Boring Log (indicative of groundwater conditions)

B. SANITARY SEWER – WASTEWATER FLOW
Daily Diurnal Flow Variation (distributed over 24 hour period)
Wastewater Flow Break Down

C. SANITARY SEWER - INFILTRATION
Infiltration Summary

D. SANITARY SEWER – INFLOW
Inflow Distribution (based on a 24 hour period)
Inflow Summary

E. SANITARY SEWER – CAPACITY ANALYSIS
Calculation of Maximum Sewer Capacity

F. STORM SEWER DRAINAGE AREAS
Drainage Basin Summary

G. SWMM Modeling
Cooper and Preston Sanitary Sewer Hydraulic Model
Aerial View – Sanitary Sewer
Cooper and Preston Storm Sewer Hydraulic Model
Aerial View – Storm Sewer
Bellevue and Cooper Sanitary Sewer Hydraulic Model
Aerial View – Sanitary Sewer
Bellevue and Cooper Storm Sewer Hydraulic Model
Aerial View – Storm Sewer

H. EXHIBITS
Sanitary Sewer Study Area
Storm Sewer Study Area
Storm Sewer Drainage Basins

CITY OF ELGIN

Cooper-Preston-Bellevue Study

Sanitary Sewer Manhole Defect Summary

Manhole Number	Street Name	Cross Street or Location Desc.	Surface	Cover Type	Structure Material	Structure Condition	Comments
015373	Preston Avenue	Ford Avenue	Asphalt	Traditional	Brick	Fair	Bench is Poor, Leaks
015374	Preston Avenue	Hartwell Avenue	Asphalt	Gasket	Brick	Fair	Debris in MH, Leaks
015377	Preston Avenue	Ludlow Avenue	Asphalt	Gasket	Brick	Fair	Leaks
015358	Preston Avenue	Congdon Avenue	Asphalt	Traditional	Brick	Fair	Ponding & Leaks
015355	Preston Avenue	Keep Avenue	Asphalt	Gasket	Brick	Fair	Poor Benchwall
015359	Congdon Avenue	Mid Block	Asphalt	Traditional	Brick	Fair	Debris in MH
015361	Congdon Avenue	Hiawatha Drive	Asphalt	Traditional	Block	Fair	Leaks, Debris, Standing Water
015495	Congdon Avenue	Mid Block	Grass	Traditional	Block	Poor	Bricks Missing, Standing Debris & Sewage, No Bench
015360	Congdon Avenue	Mid Block	Asphalt	Traditional	Block	Fair	Bricks Missing, Standing Debris & Sewage, No Bench
015350	Preston Avenue	Lincoln Avenue	Asphalt	Gasket	Brick	Fair	Bench is Poor
015348	Preston Avenue	Chester Avenue	Asphalt	Gasket	Brick	Fair	Leaks, No Benchwall
015345	Preston Avenue	Slade Avenue	Asphalt	Gasket	Brick	Fair	Leaks, No Benchwall
015341	Preston Avenue	Page Avenue	Asphalt	Gasket	Brick	Fair	Some roots
015343	Cooper Avenue	Mid Block	Asphalt	Traditional	Brick	Poor	Mortar Missing, Leaks
015340	Cooper Avenue	Preston Avenue	Asphalt	Gasket	Concrete	Fair	Leaks, Pipes running full
015458	Cooper Avenue	Between Preston & Liberty St.	Asphalt	Gasket	Concrete	Good	Leaks, Debris
015339	Cooper Avenue	Liberty Street	Asphalt	Traditional	Brick	Poor	Leaks
015457	Cooper Avenue	Liberty Street	Asphalt	Gasket	Concrete	Fair	Leaking at joints
015456	Cooper Avenue	Dundee Avenue	Asphalt	Gasket	Brick	Fair	Mortar & Bricks Missing
015459	Cooper Avenue	Morton Avenue	Asphalt	Gasket	Brick	Poor	Mortar Missing, Leaks, Bench is Poor
015460	Cooper Avenue	Morton Avenue	Asphalt	Gasket	Brick	Poor	Mortar & Bricks Missing, Cone is Poor
015461	Cooper Avenue	Hill Avenue	Asphalt	Gasket	Brick	Poor	Mortar Missing, Pipe running full
015462	Cooper Avenue	Duncan Avenue	Asphalt	Gasket	Brick	Poor	Mortar Missing, Bench is Poor
015463	Cooper Avenue	Bellevue Avenue	Asphalt	Gasket	Brick	Fair	No Benchwalls
015600	Cooper Avenue	Bellevue Avenue	Asphalt	Gasket	Concrete	Good	Pipes half full
015189	Cooper Avenue	Cedar Avenue	Asphalt	Gasket	Brick	Fair	Mortar & Bricks Missing, Leaks, Bench is Poor
015602	Cooper Avenue	Liberty Street	Asphalt	Traditional	Brick	Fair	
015332	Cooper Avenue	Dundee Avenue	Asphalt	Gasket	Brick	Poor	Mortar Gone, Leaking at Bottom
015329	Cooper Avenue	Morton Avenue	Asphalt	Traditional	Brick	Poor	Mortar & Bricks Missing, Leaks, Misaligned Frame
015324	Cooper Avenue	Hill Avenue	Asphalt	Gasket	Brick	Fair	Mortar & Bricks Missing, Bench is Poor
015317	Cooper Avenue	Duncan Avenue	Asphalt	Gasket	Brick	Fair	Mortar Missing
015314	Cooper Avenue	Bellevue Avenue	Asphalt	Gasket	Brick	Poor	Mortar Missing, Leaks, Bench is Poor
015402	Bellevue Avenue	North of River Bluff	Asphalt	Gasket	Brick	Poor	Mortar & Bricks Missing
015394	Bellevue Avenue	River Bluff Road	Asphalt	Gasket	Brick	Fair	Mortar & Bricks Missing, Leaking, Debris
015393				Not Found			
015401	Bellevue Avenue	Liberty Street	Asphalt	Gasket	Brick	Poor	Mortar & Bricks Missing, Leaking, Debris
015508	Bellevue Avenue	River Bluff Road	Asphalt	Gasket	Brick	Poor	
015400	Bellevue Avenue	Between River Bluff & Congdon Ave.	Asphalt	Gasket	Brick	Fair	Mortar & Bricks Missing, Misaligned Frame, Leaking, Debris
015392	Bellevue Avenue	Congdon Avenue	Asphalt	Gasket	Brick	Fair	Mortar & Bricks Missing, Leaking
015391	Bellevue Avenue	Between Congdon & Cooper Ave.	Asphalt	Gasket	Brick	Fair	South pipe flowing 3/4 full

CITY OF ELGIN

Cooper-Preston-Bellevue Study

Sanitary Sewer Manhole Defect Summary

Manhole Number	Street Name	Cross Street or Location Desc.	Surface	Cover Type	Structure Material	Structure Condition	Comments
015390	Bellevue Avenue	Between Congdon & Cooper Ave.	Asphalt	Gasket	Brick	Fair	
015500	Bellevue Avenue	Congdon Avenue	Asphalt	Gasket	Brick	Fair	
015499	Bellevue Avenue	Between Congdon & Cooper Ave.	Grass	Traditional	Brick	Fair	Eroded Benchwall

CITY OF ELGIN

Cooper-Preston-Bellevue Study

Storm Sewer Manhole Defect Summary

Manhole Number	Street Name	Surface	Cover Type	Structure Material	Structure Condition	Comments
SM0820046	Page Avenue	Asphalt	Closed Lid	Brick	Poor	
SM0820033	Cooper Avenue	Asphalt	Closed Lid	Brick	Fair	Leaves & Silt in MH
A11	Cooper Avenue	Asphalt	Closed Lid	Concrete	Fair	No Bench
SM0820032	Cooper Avenue	Asphalt	Open Grate	Brick	Fair	
A9	Cooper Avenue	Asphalt	Closed Lid	Brick	Fair	
SM0820010	Cooper Avenue	Grass	Closed Lid	Brick	Fair	Holding Water
SM0820009	Cooper Avenue	Concrete	Closed Lid	Concrete	Good	
A4	Cooper Avenue	Asphalt	Closed Lid	Brick	Poor	Holding Water
SM0820030	Cooper Avenue	Asphalt	Closed Lid	Brick	Fair	
SM0820031	Cooper Avenue	Asphalt	Closed Lid	Brick	Fair	Holding Water
SM0820029	Cooper Avenue	Asphalt	Closed Lid	Brick	Fair	
SM0820028	Cooper Avenue	Asphalt	Closed Lid	Brick	Fair	
SM0820027	Cooper Avenue	Asphalt	Closed Lid	Brick	Fair	
SM0820022	Bellevue Avenue	Asphalt	Closed Lid	Brick	Fair	
SM0820021	Bellevue Avenue	Asphalt	Closed Lid	Brick	Fair	Water Ponding
SM0820020	Bellevue Avenue	Asphalt	Closed Lid	Brick	Fair	
A5	Bellevue Avenue	Asphalt	Closed Lid	Brick	Fair	
SM0820019	Bellevue Avenue	Asphalt	Closed Lid	Brick	Fair	
SM0820018	Bellevue Avenue	Asphalt	Closed Lid	Brick	Fair	

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Storm Sewer Main Line Defect Summary

Manhole From	Manhole To	Street Name	Open Crack (OC)	Broken Pipe (BP)	Dip (DP)	Misalignment (MS)	Offset Joint (OJ)	Roots (RO)	Debris (DB)	Total Score	Overall Condition Rating
SM0820033	A11	Cooper Avenue			3				1 1	5	**F**
SM0820043	SM0820032	Preston Avenue	2	2	2 1 1 2	3				13	**P**
SM0820044	SM0820032	Preston Avenue			1	2 2				3	**F**
SM0820032	A9	Cooper Avenue			2 2				1	5	**F**
A9	C	Cooper Avenue			2 2 2 3	1				10	**P**
C	SM0820010	Cooper Avenue	1		3					4	**P (Due to full pipe)**
SM0820010	A	Cooper Avenue			3	3				6	**P (Due to full pipe)**
A	B	Cooper Avenue			3				3 3 3 3 3	15	**P**
B	SM0820030	Cooper Avenue			3				3 3 3 1	13	**P**
SM0820030	SM0820029	Cooper Avenue			3				3	6	**P (Due to full pipe)**
SM0820029	SM0820028	Cooper Avenue						2		2	**E**

Score Evaluation

0-3 = Excellent Condition (E)

3-7 = Fair - Minor to Moderate Hydraulic Loss (F)

>7 including a defect grade of 3 = Poor - Flow within pipe severly impeded (P)

Defect Grading

1.....	Minor.....	Small/Short/Isolated
2.....	Moderate.....	Cracks; noticeable but not significant misalignment; short dip or < 1/2 pipe; hanging roots
3.....	Major.....	Broken or collapsed pipe; open cracks; long dip or > 1/2 pipe; root blockage

A-3b

COOPER - PRESTON -BELLEVUE FLOOD STUDY

SANITARY SEWER AS BUILT INFORMATION

LOCATION	UPSTREAM MH #	DOWNSTREAM MH #	UP. RIM	UP. INV	UP. DEPTH	DOWN RIM	DOWN INV	DOWN DEPTH	PIPE DIA (inches)	LENGTH (ft)	SLOPE
	015350	015348	797.44	785.02	12.42'	796.15	783.34	12.81'	8	330	0.51%
Preston Ave	015348	015345	796.15	783.22	12.93'	793.46	779.27	14.19'	8	301	1.31%
Lincoln to Cooper	015345	015341	793.46	778.84	14.62'	789.07	777.42	11.65'	8	331	0.43%
	015341	015340	789.07	777.42	11.65'	783.54	775.52	8.02'	8	385	0.49%
	015373	015374	809.34	797.6	11.74'	815.51	796.04	19.47'	8	332	0.47%
Preston Ave	015374	015377	815.51	795.99	19.52'	807.34	794.38	12.96'	8	331	0.49%
Ford to Cooper	015377	015358	807.34	794.34	13.00'	799.66	789.75	9.91'	8	329	1.40%
	015358	015355	799.66	789.52	10.14'	789.89	779.71	10.18'	8	331	2.96%
	015355	015340	789.89	779.73	10.16'	783.54	775.27	8.27'	8	330	1.35%
	015359	015358	801.11	791.09	10.02'	799.66	789.58	10.08'	8	272	0.56%
Congdon Ave	015361	015495	805.03	794.54	10.49'	800.86	792.34	8.52'	8	480	0.46%
Hiawatha to West of Preston	015495	015360	800.86	792.16	8.70'	800.85	792.49	8.36'	8	26	-1.29%
	015360	015358	800.85	792.29	8.56'	799.66	789.52	10.14'	8	498	0.56%
	015343	015340	785.22	778.23	6.99'	783.54	775.55	7.99'	8	499	0.54%
	015340	015458	783.54	775.19	8.35'	784.07	774.85	9.22'	12	307	0.11%
	015458	015601	784.07	774.98	9.09'	788.38	776.74	11.64'	12	300	-0.59%
	015601	015339	788.38	776.78	11.60'	785.83	774.19	11.64'	12	28	9.25%
	015339	015457	785.83	774.23	11.60'	785.62	773.59	12.03'	12	22	2.92%
Cooper Ave	015457	015456	785.62	773.88	11.74'	788.55	773.48	15.07'	10	271	0.15%
West of Polly to	015456	015459	788.55	773.23	15.32'	787.83	772.25	15.58'	10	170	0.58%
Cedar	015459	015460	787.83	772.26	15.57'	788.03	772.6	15.43'	10	20	-1.70%
	015460	015461	788.03	772.54	15.49'	784.37	771.64	12.73'	10	319	0.28%
	015461	015462	784.37	771.52	12.85'	781.18	770.36	10.82'	10	330	0.35%
	015462	015463	781.18	770.35	10.83'	784.49	769.67	14.82'	10	331	0.21%
	015463	015600	784.49	769.68	14.81'	784.53	769.49	15.04'	10	19	0.98%
	015600	015189	784.53	769.22	15.31'	783.65	768.41	15.24'	12	313	0.26%
	015602	015332	785.96	778.02	7.94'	788.78	776.5	12.28'	8	361	0.42%
	015332	015329	788.78	776.45	12.33'	788.18	775.9	12.28'	10	80	0.69%
	015329	015324	788.18	775.7	12.48'	784.39	773.44	10.95'	10	330	0.68%
Cooper Ave	015324	015317	784.39	773.55	10.84'	781.54	771.52	10.02'	10	330	0.62%
Liberty to Bellevue	015317	015314	781.54	771.55	9.99'	784.82	769.68	15.14'	10	330	0.57%
	015317	015462	781.54	771.74	9.80'	781.18	771.54	9.64'	8 OF	10	2.00%
	015324	015461	784.39	774.24	10.15'	784.37	774.43	9.94'	8 OF	10	-1.90%
	015314	015600	784.82	769.73	15.09'	784.53	769.35	15.18'	10	17	2.24%
Dundee Ave	015333	015332	790.46	779.27	11.19'	788.78	776.62	12.16'	8	353	0.75%
At Cooper	015384	015332		No Info		788.78	779.9	8.88'	10	374	

COOPER - PRESTON -BELLEVUE FLOOD STUDY
SANITARY SEWER AS BUILT INFORMATION

LOCATION	UPSTREAM MH #	DOWNSTREAM MH #	UP. RIM	UP. INV	UP. DEPTH	DOWN RIM	DOWN INV	DOWN DEPTH	PIPE DIA (inches)	LENGTH (ft)	SLOPE
	015402	015394	785.88	775.34	10.54'	788.51	774.24	14.27'	8	426	0.26%
	015395	015394	788.17	774.71	13.46'	788.51	774.46	14.05'	8	65	0.38%
Bellevue Ave	015394	015393	788.51	774.37	14.14'		Not Found		8	249	
Cooper North	015393	015392		Not Found		779.75	773.04	6.71'	8	221	
	015392	015391	779.75	772.95	6.80'	777.76	771.86	5.90'	8	229	0.48%
	015391	015390	777.76	771.58	6.18'	777.97	770.77	7.20'	8	225	0.36%
	015390	015463	777.97	770.77	7.20'	784.49	769.56	14.93'	8	252	0.48%
Bellevue Ave	015401	015508	788.57	780.87	7.70'	788.55	779.39	9.16'	8	223	0.66%
River Bluff to	015508	015400	788.55	779.15	9.40'	786.19	776.17	10.02'	8	246	1.21%
Congdon	015400	015392	786.19	776.19	10.00'	779.75	772.85	6.90'	8	254	1.31%
Bellevue Ave	015500	015499	779.52	772.85	6.67'	777.80	771.06	6.74'	12	431	0.42%
Congdon South	015499	015390	777.80	770.96	6.84'	777.97	770.76	7.21'	12	35	0.57%

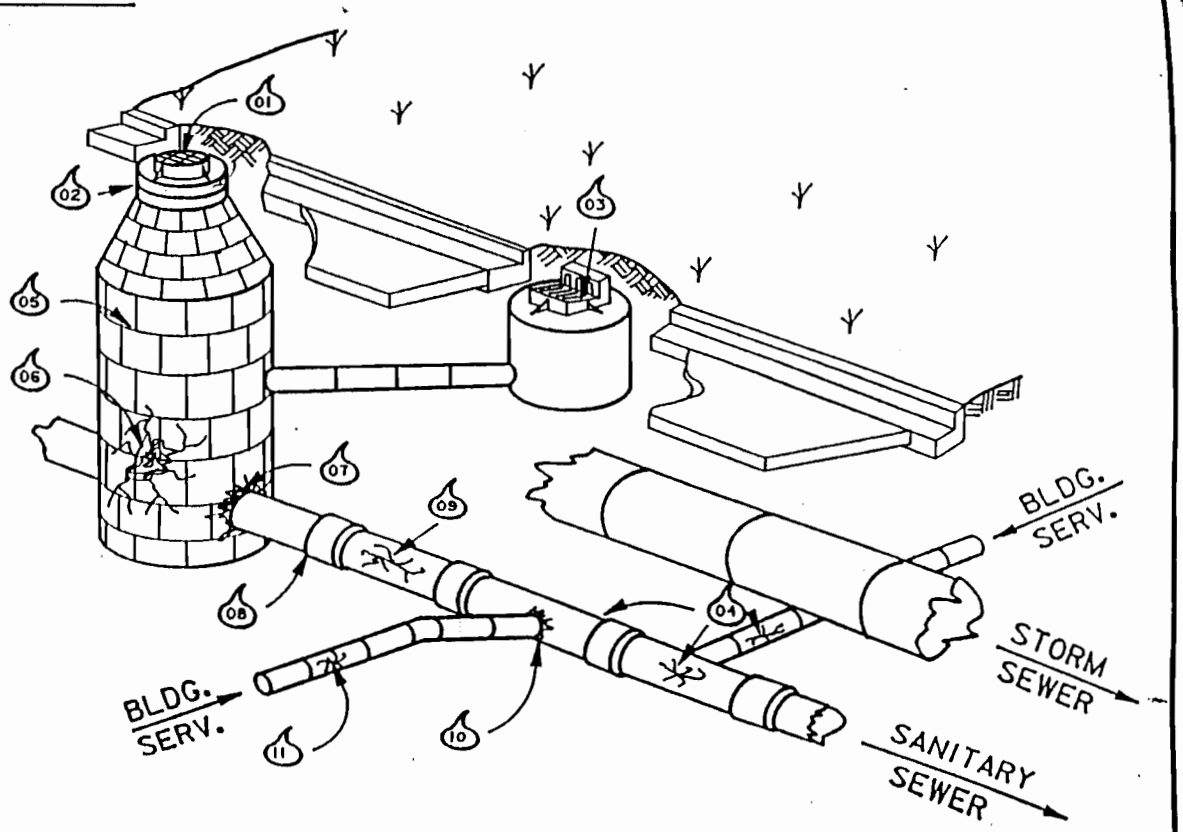
A-5

COOPER - PRESTON -BELLEVUE FLOOD STUDY
STORM SEWER AS BUILT INFORMATION

LOCATION	UPSTREAM MH #	DOWNSTREAM MH #	UP. RIM	UP. INV	UP. DEPTH	DOWN RIM	DOWN INV	DOWN DEPTH	PIPE DIA (inches)	LENGTH (ft)	SLOPE
Backyard	SM0820046	SI0180021	784.07	780.92	3.15'	780.94	779.39	1.55'	10	61	2.50%
Page to Cooper	SM0820046	SM0820033	784.07	780.78	3.29'	785.17	780.19	4.98'	10	388	0.15%
	SM0820033	A11	785.17	780.12	5.05'	No Info	No Info	5.10'	12	200	
	A11	SM0820032	No Info	No Info	5.10'	783.22	777.57	5.65'	12	342	
	SM0820032	A9	783.22	777.45	5.77'	783.88	777.38	6.50'	24	296	0.02%
	A9	C	783.88	777.59	6.29'	785.07	777.17	7.90'	24	238	0.18%
	C	SM0820010	785.07	777.11	7.96'	785.84	776.35	9.49'	24	34	2.23%
Cooper Ave	SM0820010	A	785.84	776.29	9.55'	785.62	776.7	8.91'	24	82	-0.50%
Backyards to	A	B	785.62	776.82	8.79'	786.25	776.52	9.73'	24	105	0.29%
Bellevue	B	SM0820030	786.25	776.71	9.54'	788.71	776.66	12.05'	24	176	0.03%
	SM0820030	SM0820031	788.71	776.73	11.98'	No Info	No Info		24	41	
	SM0820031	SM0820029	No Info	No Info	8.42'	787.56	775.83	11.73'	27	91	
	SM0820029	SM0820028	787.56	775.48	12.08'	784.14	774.72	9.42'	27	318	0.24%
	SM0820028	SM0820027	784.14	774.6	9.54'	781.44	773.77	7.67'	27	333	0.25%
	SM0820027	SM0820022	781.44	773.77	7.67'	784.82	775.53	9.29'	27	326	-0.54%
Preston Ave	SM0820043	SM0820032	788.94	783.28	5.66'	783.22	777.78	5.44'	15	408	1.35%
Page to Keep	SM0820044	SM0820032	789.62	784.17	5.45'	783.22	777.79	5.43'	18	311	2.05%
Cooper Ave	SM0820009	SM0820010	785.89	781.95	3.93'	785.84	781.51	4.33'	12	6	6.96%
At Liberty	A4	A	786.03	780.22	5.81'	785.62	780.09	5.52'	10	45	0.29%
	SM0820022	SM0820021	784.82	772.6	12.22'	777.09	772.19	4.90'	36	434	0.09%
	SM0820021	SM0820020	777.09	772.28	4.81'	780.14	771.24	8.90'	36	283	0.37%
Bellevue Ave	SM0820020	A5	780.14	770.22	9.92'	779.69	771.49	8.20'	36	10	-12.70%
Cooper to Logan	A5	SM0820019	779.69	771.33	8.36'	788.16	770.08	18.08'	36	483	0.26%
	SM0820019	SM0820018	788.16	770.21	17.95'	777.76	768.78	8.98'	36	576	0.25%
	SM0820018	SM0820017	777.76	768.35	9.41'	734.28	728.18	6.10'	36	273	14.71%

I/I SOURCES — PEAK FLOW RATE PER DEFECT*

	GALLONS/MINUTE	
INFLOW SOURCES	LOW	HIGH
01 PONDED MANHOLE COVERS	3.5	14.0
02 LEAKING FRAME/ADJUSTMENTS	2.0	7.0
03 DIRECT STORM CONNECTIONS	10.0	100.0+
04 INDIRECT STORM CONNECTIONS	1.0	75.0+
INFILTRATION SOURCES		
05 MANHOLE WALL LEAKS	0.5	3.0
06 M.H. STRUCTURAL DEFECTS	1.5	7.0
07 PIPE CONNECTION LEAKS	0.5	1.5
08 PIPE JOINT LEAKS	0.1	3.0
09 CRACKED PIPES	0.5	7.0
10 SERVICE CONNECTION LEAKS	0.5	3.0
11 SERVICE LINE LEAKS	0.5	7.0



*DATA FROM SUBURBAN COMMUNITY SSES REPORTS

AVERAGE PUBLIC SECTOR INFILTRATION/INFLOW (I/I) RATES

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO
ENGINEERING DEPARTMENT
12/01/89 LOCAL SEWERS TR:PG

FILE

SOIL AND MATERIAL CONSULTANTS, INC.

8 WEST COLLEGE DRIVE • ARLINGTON HEIGHTS, ILLINOIS 60004 • 312-870-0544

August 27, 1986
File No. 8769

City of Elgin
150 Dexter Court
Elgin, IL 60120

Attn: Mr. Syed R. W. Ally, P.E.
Civil Engineer II

Re: Geotechnical Investigation
Cooper Avenue Sanitary Sewer
Elgin, Illinois

Dear Mr. Ally:

We are submitting our report for the subsurface soil investigation completed for the planned sanitary sewer improvements along Cooper Avenue in the City of Elgin, Illinois.

The purpose of the investigation was to determine general subsurface soil and ground water conditions for use in design and construction of the proposed improvements.

SCOPE OF THE INVESTIGATION

The field investigation included layout of 4 borings at the approximate locations indicated on the enclosed sketch. We drilled the borings to a depth of 18.0 feet below the existing surface. The soils at each location were auger drilled and samples obtained using a shelby tube in predominantly cohesive soils and a split spoon in predominantly granular soils. Soil profiles were determined in the field and soil samples returned to the laboratory for additional testing including determination of moisture content, dry unit weight and unconfined compressive strength.

RESULTS OF THE INVESTIGATION

The enclosed boring logs indicate the soil conditions encountered at each bore location. The pavement is underlaid by poor soil conditions extending to depths of 4.0 feet to 12.5 feet. These soils are classified as black silts (topsoil), gray silt with organic matter, and loose silt. These soils are typically high

File No. 8769
Re: Cooper Avenue Sanitary Sewer
Elgin, Illinois

in moisture content, low in density and low in strength.

The underlying soils at boring 1 are predominantly silts mixed with lesser portions of clay and sand. Below a depth of 16.0 feet the soil is predominantly clay. At borings 2, 3 and 4 the underlying soils are satuarated sands and gravels in a medium dense to dense condition. These granular soils are further underlaid by very tough gray clays as represented by boring 2.

GROUND WATER

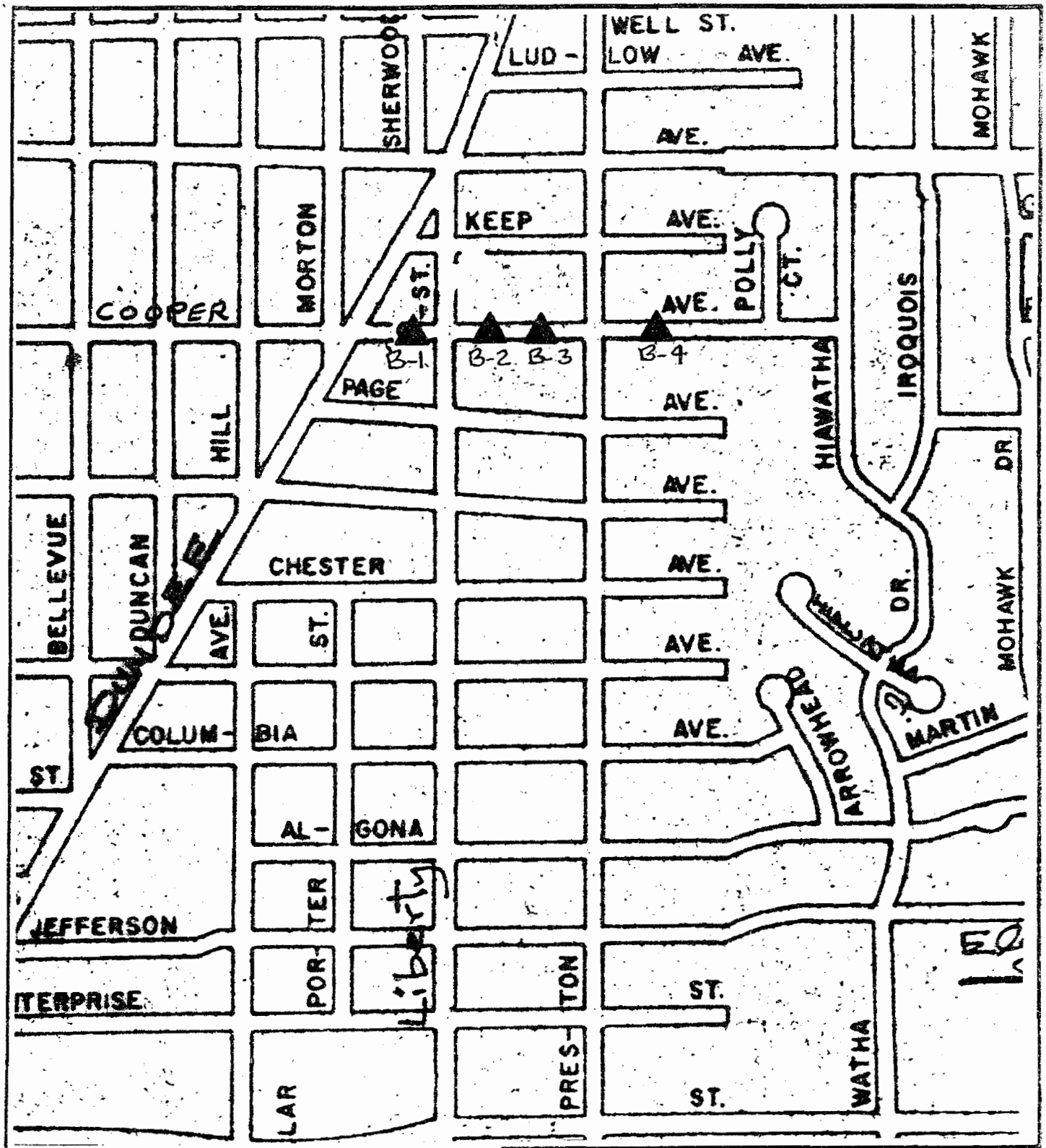
The boring logs indicate the depth at which ground water was encountered at the time of the drilling operations and during the period of these readings. It should be expected that fluctuations in the level of the ground water may occur due to variations in rainfall, temperature, soil permeability, and other factors not evident at the time of the water level measurements.

PIPE SUPPORT CONDITIONS

The following table summarizes the depths below existing grade at which suitable bedding soils are encountered, the magnitude of bearing at that depth, and other information:

Boring	Depth Below Existing Surface (feet)	Obtainable Bearing (lbs./sq. ft.)	Highest Recorded Water Level (feet)
1	4.0 to 9.0 9.0 to 15.0	3,000 +4,000	Dry
2	8.5 to 15.0	4,000	8.5
3	9.0 to 15.0	4,000	8.0
4	Below 12.5	+3,000	4.0

The pipe can be supported in the natural soils below all topsoil, organic material, low bearing soils and other unsuitable conditions. The pipe can also be supported at shallower depths than indicated in the above summary by removal of the underlying unsuitable soils and replacement with properly compacted fill. Some variation in the depth of removal can be anticipated due to naturally changing soil conditions. The removal should extend beyond the pipe as needed based on soil conditions encountered. The fill should be placed in lifts not to exceed 8.0 inches when uncompacted. Each lift should be compacted to the minimum compaction requirement prior to placement of the next lift.



LOCATION SKETCH

SOIL AND MATERIAL CONSULTANTS, INC.

Client CITY OF ELGIN

Project COOPER AVE. SANITARY SEWER

Proj. Location ELGIN, ILLINOIS

Proj. No. 8769 Date 8-26-86 Scale NONE

DAILY DIURNAL FLOW VARIATION

*Flow expressed as a function of Average Waste Flow (AWF)

MH NUMBER: 015350
Intersection Prestion/Lincoln
AWF = 0.024 cfs

TIME (hours)	FLOW * expressed	FLOW (cfs)
0	0.43	0.0103
1	0.26	0.0062
2	0.18	0.0043
3	0.15	0.0036
4	0.19	0.0046
5	0.41	0.0098
6	1.33	0.0319
7	1.6	0.0384
8	1.23	0.0295
9	1.07	0.0257
10	1.15	0.0276
11	1.1	0.0264
12	1.09	0.0262
13	1.17	0.0281
14	1.01	0.0242
15	0.95	0.0228
16	1.09	0.0262
17	1.29	0.031
18	1.54	0.037
19	1.34	0.0322
20	1.55	0.0372
21	1.52	0.0365
22	1.19	0.0286
23	0.82	0.0197

MH NUMBER: 015348
Intersection Preston/Chester
AWF = 0.012 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0052
1	0.26	0.0031
2	0.18	0.0022
3	0.15	0.0018
4	0.19	0.0023
5	0.41	0.0049
6	1.33	0.016
7	1.6	0.0192
8	1.23	0.0148
9	1.07	0.0128
10	1.15	0.0138
11	1.1	0.0132
12	1.09	0.0131
13	1.17	0.014
14	1.01	0.0121
15	0.95	0.0114
16	1.09	0.0131
17	1.29	0.0155
18	1.54	0.0185
19	1.34	0.0161
20	1.55	0.0186
21	1.52	0.0182
22	1.19	0.0143
23	0.82	0.0098

MH NUMBER: 015345
Intersection Preston/Slade
AWF = 0.014 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.006
1	0.26	0.0036
2	0.18	0.0025
3	0.15	0.0021
4	0.19	0.0027
5	0.41	0.0057
6	1.33	0.0186
7	1.6	0.0224
8	1.23	0.0172
9	1.07	0.015
10	1.15	0.0161
11	1.1	0.0154
12	1.09	0.0153
13	1.17	0.0164
14	1.01	0.0141
15	0.95	0.0133
16	1.09	0.0153
17	1.29	0.0181
18	1.54	0.0216
19	1.34	0.0188
20	1.55	0.0217
21	1.52	0.0213
22	1.19	0.0167
23	0.82	0.0115

MH NUMBER: 015341
Intersection Prestion/Page
AWF = 0.02 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0086
1	0.26	0.0052
2	0.18	0.0036
3	0.15	0.003
4	0.19	0.0038
5	0.41	0.0082
6	1.33	0.0266
7	1.6	0.032
8	1.23	0.0246
9	1.07	0.0214
10	1.15	0.023
11	1.1	0.022
12	1.09	0.0218
13	1.17	0.0234
14	1.01	0.0202
15	0.95	0.019
16	1.09	0.0218
17	1.29	0.0258
18	1.54	0.0308
19	1.34	0.0268
20	1.55	0.031
21	1.52	0.0304
22	1.19	0.0238
23	0.82	0.0164

DAILY DIURNAL FLOW VARIATION

*Flow expressed as a function of Average Waste Flow (AWF)

MH NUMBER: 015373
Intersection Prestion/Ford
AWF = 0.011 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0047
1	0.26	0.0029
2	0.18	0.002
3	0.15	0.0017
4	0.19	0.0021
5	0.41	0.0045
6	1.33	0.0146
7	1.6	0.0176
8	1.23	0.0135
9	1.07	0.0118
10	1.15	0.0127
11	1.1	0.0121
12	1.09	0.012
13	1.17	0.0129
14	1.01	0.0111
15	0.95	0.0105
16	1.09	0.012
17	1.29	0.0142
18	1.54	0.0169
19	1.34	0.0147
20	1.55	0.0171
21	1.52	0.0167
22	1.19	0.0131
23	0.82	0.009

MH NUMBER: 015374
Intersetion Preston/Hartwell
AWF = 0.015 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0065
1	0.26	0.0039
2	0.18	0.0027
3	0.15	0.0023
4	0.19	0.0029
5	0.41	0.0062
6	1.33	0.02
7	1.6	0.024
8	1.23	0.0185
9	1.07	0.0161
10	1.15	0.0173
11	1.1	0.0165
12	1.09	0.0164
13	1.17	0.0176
14	1.01	0.0152
15	0.95	0.0143
16	1.09	0.0164
17	1.29	0.0194
18	1.54	0.0231
19	1.34	0.0201
20	1.55	0.0233
21	1.52	0.0228
22	1.19	0.0179
23	0.82	0.0123

MH NUMBER: 015377
Intersection Prestion/Ludlow
AWF = 0.021 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.009
1	0.26	0.0055
2	0.18	0.0038
3	0.15	0.0032
4	0.19	0.004
5	0.41	0.0086
6	1.33	0.0279
7	1.6	0.0336
8	1.23	0.0258
9	1.07	0.0225
10	1.15	0.0242
11	1.1	0.0231
12	1.09	0.0229
13	1.17	0.0246
14	1.01	0.0212
15	0.95	0.02
16	1.09	0.0229
17	1.29	0.0271
18	1.54	0.0323
19	1.34	0.0281
20	1.55	0.0326
21	1.52	0.0319
22	1.19	0.025
23	0.82	0.0172

MH NUMBER: 015361
Intersection Congdon/Hiawatha
AWF = 0.067 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0288
1	0.26	0.0174
2	0.18	0.0121
3	0.15	0.0101
4	0.19	0.0127
5	0.41	0.0275
6	1.33	0.0891
7	1.6	0.1072
8	1.23	0.0824
9	1.07	0.0717
10	1.15	0.0771
11	1.1	0.0737
12	1.09	0.073
13	1.17	0.0784
14	1.01	0.0677
15	0.95	0.0637
16	1.09	0.073
17	1.29	0.0864
18	1.54	0.1032
19	1.34	0.0898
20	1.55	0.1039
21	1.52	0.1018
22	1.19	0.0797
23	0.82	0.0549

DAILY DIURNAL FLOW VARIATION

*Flow expressed as a function of Average Waste Flow (AWF)

MH NUMBER: 015495
Congdon Mid block
AWF = 0.003 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0013
1	0.26	0.0008
2	0.18	0.0005
3	0.15	0.0005
4	0.19	0.0006
5	0.41	0.0012
6	1.33	0.004
7	1.6	0.0048
8	1.23	0.0037
9	1.07	0.0032
10	1.15	0.0035
11	1.1	0.0033
12	1.09	0.0033
13	1.17	0.0035
14	1.01	0.003
15	0.95	0.0029
16	1.09	0.0033
17	1.29	0.0039
18	1.54	0.0046
19	1.34	0.004
20	1.55	0.0047
21	1.52	0.0046
22	1.19	0.0036
23	0.82	0.0025

MH NUMBER: 015360
Congdon Mid block
AWF = 0 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0
1	0.26	0
2	0.18	0
3	0.15	0
4	0.19	0
5	0.41	0
6	1.33	0
7	1.6	0
8	1.23	0
9	1.07	0
10	1.15	0
11	1.1	0
12	1.09	0
13	1.17	0
14	1.01	0
15	0.95	0
16	1.09	0
17	1.29	0
18	1.54	0
19	1.34	0
20	1.55	0
21	1.52	0
22	1.19	0
23	0.82	0

MH NUMBER: 015358
Intersection Preston/Congdon
AWF = 0.013 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0056
1	0.26	0.0034
2	0.18	0.0023
3	0.15	0.002
4	0.19	0.0025
5	0.41	0.0053
6	1.33	0.0173
7	1.6	0.0208
8	1.23	0.016
9	1.07	0.0139
10	1.15	0.015
11	1.1	0.0143
12	1.09	0.0142
13	1.17	0.0152
14	1.01	0.0131
15	0.95	0.0124
16	1.09	0.0142
17	1.29	0.0168
18	1.54	0.02
19	1.34	0.0174
20	1.55	0.0202
21	1.52	0.0198
22	1.19	0.0155
23	0.82	0.0107

MH NUMBER: 015355
Intersection Preston/Keep
AWF = 0.021 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.009
1	0.26	0.0055
2	0.18	0.0038
3	0.15	0.0032
4	0.19	0.004
5	0.41	0.0086
6	1.33	0.0279
7	1.6	0.0336
8	1.23	0.0258
9	1.07	0.0225
10	1.15	0.0242
11	1.1	0.0231
12	1.09	0.0229
13	1.17	0.0246
14	1.01	0.0212
15	0.95	0.02
16	1.09	0.0229
17	1.29	0.0271
18	1.54	0.0323
19	1.34	0.0281
20	1.55	0.0326
21	1.52	0.0319
22	1.19	0.025
23	0.82	0.0172

DAILY DIURNAL FLOW VARIATION

*Flow expressed as a function of Average Waste Flow (AWF)

MH NUMBER: 015340
Intersection Preston/Cooper
AWF = 0.012 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0052
1	0.26	0.0031
2	0.18	0.0022
3	0.15	0.0018
4	0.19	0.0023
5	0.41	0.0049
6	1.33	0.016
7	1.6	0.0192
8	1.23	0.0148
9	1.07	0.0128
10	1.15	0.0138
11	1.1	0.0132
12	1.09	0.0131
13	1.17	0.014
14	1.01	0.0121
15	0.95	0.0114
16	1.09	0.0131
17	1.29	0.0155
18	1.54	0.0185
19	1.34	0.0161
20	1.55	0.0186
21	1.52	0.0182
22	1.19	0.0143
23	0.82	0.0098

MH NUMBER: 015458
Cooper between Preston & Liberty
AWF = 0.005 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0022
1	0.26	0.0013
2	0.18	0.0009
3	0.15	0.0008
4	0.19	0.001
5	0.41	0.0021
6	1.33	0.0067
7	1.6	0.008
8	1.23	0.0062
9	1.07	0.0054
10	1.15	0.0058
11	1.1	0.0055
12	1.09	0.0055
13	1.17	0.0059
14	1.01	0.0051
15	0.95	0.0048
16	1.09	0.0055
17	1.29	0.0065
18	1.54	0.0077
19	1.34	0.0067
20	1.55	0.0078
21	1.52	0.0076
22	1.19	0.006
23	0.82	0.0041

MH NUMBER: 015601
Intersection Cooper/Liberty
AWF = 0.005 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0022
1	0.26	0.0013
2	0.18	0.0009
3	0.15	0.0008
4	0.19	0.001
5	0.41	0.0021
6	1.33	0.0067
7	1.6	0.008
8	1.23	0.0062
9	1.07	0.0054
10	1.15	0.0058
11	1.1	0.0055
12	1.09	0.0055
13	1.17	0.0059
14	1.01	0.0051
15	0.95	0.0048
16	1.09	0.0055
17	1.29	0.0065
18	1.54	0.0077
19	1.34	0.0067
20	1.55	0.0078
21	1.52	0.0076
22	1.19	0.006
23	0.82	0.0041

MH NUMBER: 015456
Intersection Cooper/Dundee
AWF = 0.003 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0013
1	0.26	0.0008
2	0.18	0.0005
3	0.15	0.0005
4	0.19	0.0006
5	0.41	0.0012
6	1.33	0.004
7	1.6	0.0048
8	1.23	0.0037
9	1.07	0.0032
10	1.15	0.0035
11	1.1	0.0033
12	1.09	0.0033
13	1.17	0.0035
14	1.01	0.003
15	0.95	0.0029
16	1.09	0.0033
17	1.29	0.0039
18	1.54	0.0046
19	1.34	0.004
20	1.55	0.0047
21	1.52	0.0046
22	1.19	0.0036
23	0.82	0.0025

DAILY DIURNAL FLOW VARIATION

*Flow expressed as a function of Average Waste Flow (AWF)

MH NUMBER: 015461
Intersection Cooper/Hill
AWF = 0.013 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0056
1	0.26	0.0034
2	0.18	0.0023
3	0.15	0.002
4	0.19	0.0025
5	0.41	0.0053
6	1.33	0.0173
7	1.6	0.0208
8	1.23	0.016
9	1.07	0.0139
10	1.15	0.015
11	1.1	0.0143
12	1.09	0.0142
13	1.17	0.0152
14	1.01	0.0131
15	0.95	0.0124
16	1.09	0.0142
17	1.29	0.0168
18	1.54	0.02
19	1.34	0.0174
20	1.55	0.0202
21	1.52	0.0198
22	1.19	0.0155
23	0.82	0.0107

MH NUMBER: 015462
Intersection Cooper/Duncan
AWF = 0.012 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0052
1	0.26	0.0031
2	0.18	0.0022
3	0.15	0.0018
4	0.19	0.0023
5	0.41	0.0049
6	1.33	0.016
7	1.6	0.0192
8	1.23	0.0148
9	1.07	0.0128
10	1.15	0.0138
11	1.1	0.0132
12	1.09	0.0131
13	1.17	0.014
14	1.01	0.0121
15	0.95	0.0114
16	1.09	0.0131
17	1.29	0.0155
18	1.54	0.0185
19	1.34	0.0161
20	1.55	0.0186
21	1.52	0.0182
22	1.19	0.0143
23	0.82	0.0098

MH NUMBER: 015395
Intersection Bellevue/River Bluff
AWF = 0.022 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0095
1	0.26	0.0057
2	0.18	0.004
3	0.15	0.0033
4	0.19	0.0042
5	0.41	0.009
6	1.33	0.0293
7	1.6	0.0352
8	1.23	0.0271
9	1.07	0.0235
10	1.15	0.0253
11	1.1	0.0242
12	1.09	0.024
13	1.17	0.0257
14	1.01	0.0222
15	0.95	0.0209
16	1.09	0.024
17	1.29	0.0284
18	1.54	0.0339
19	1.34	0.0295
20	1.55	0.0341
21	1.52	0.0334
22	1.19	0.0262
23	0.82	0.018

MH NUMBER: 015394
Intersection Bellevue/River Bluff
AWF = 0.004 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0017
1	0.26	0.001
2	0.18	0.0007
3	0.15	0.0006
4	0.19	0.0008
5	0.41	0.0016
6	1.33	0.0053
7	1.6	0.0064
8	1.23	0.0049
9	1.07	0.0043
10	1.15	0.0046
11	1.1	0.0044
12	1.09	0.0044
13	1.17	0.0047
14	1.01	0.004
15	0.95	0.0038
16	1.09	0.0044
17	1.29	0.0052
18	1.54	0.0062
19	1.34	0.0054
20	1.55	0.0062
21	1.52	0.0061
22	1.19	0.0048
23	0.82	0.0033

DAILY DIURNAL FLOW VARIATION

*Flow expressed as a function of Average Waste Flow (AWF)

MH NUMBER: 015392, 015393, 015508, 015400 Bellevue between River Bluff & Congdon AWF = 0.042 cfs		
TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0181
1	0.26	0.0109
2	0.18	0.0076
3	0.15	0.0063
4	0.19	0.008
5	0.41	0.0172
6	1.33	0.0559
7	1.6	0.0672
8	1.23	0.0517
9	1.07	0.0449
10	1.15	0.0483
11	1.1	0.0462
12	1.09	0.0458
13	1.17	0.0491
14	1.01	0.0424
15	0.95	0.0399
16	1.09	0.0458
17	1.29	0.0542
18	1.54	0.0647
19	1.34	0.0563
20	1.55	0.0651
21	1.52	0.0638
22	1.19	0.05
23	0.82	0.0344

MH NUMBER: 015390 015500, 015499, 015391 Bellevue between Congdon & Cooper AWF = 0.01 cfs		
TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0043
1	0.26	0.0026
2	0.18	0.0018
3	0.15	0.0015
4	0.19	0.0019
5	0.41	0.0041
6	1.33	0.0133
7	1.6	0.016
8	1.23	0.0123
9	1.07	0.0107
10	1.15	0.0115
11	1.1	0.011
12	1.09	0.0109
13	1.17	0.0117
14	1.01	0.0101
15	0.95	0.0095
16	1.09	0.0109
17	1.29	0.0129
18	1.54	0.0154
19	1.34	0.0134
20	1.55	0.0155
21	1.52	0.0152
22	1.19	0.0119
23	0.82	0.0082

MH NUMBER: 015460 Intersection Cooper/Morton AWF = 0.01 cfs		
TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0043
1	0.26	0.0026
2	0.18	0.0018
3	0.15	0.0015
4	0.19	0.0019
5	0.41	0.0041
6	1.33	0.0133
7	1.6	0.016
8	1.23	0.0123
9	1.07	0.0107
10	1.15	0.0115
11	1.1	0.011
12	1.09	0.0109
13	1.17	0.0117
14	1.01	0.0101
15	0.95	0.0095
16	1.09	0.0109
17	1.29	0.0129
18	1.54	0.0154
19	1.34	0.0134
20	1.55	0.0155
21	1.52	0.0152
22	1.19	0.0119
23	0.82	0.0082

MH NUMBER: 015400 Bellevue between River Bluff & Congdon AWF = 0.016 cfs		
TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0069
1	0.26	0.0042
2	0.18	0.0029
3	0.15	0.0024
4	0.19	0.003
5	0.41	0.0066
6	1.33	0.0213
7	1.6	0.0256
8	1.23	0.0197
9	1.07	0.0171
10	1.15	0.0184
11	1.1	0.0176
12	1.09	0.0174
13	1.17	0.0187
14	1.01	0.0162
15	0.95	0.0152
16	1.09	0.0174
17	1.29	0.0206
18	1.54	0.0246
19	1.34	0.0214
20	1.55	0.0248
21	1.52	0.0243
22	1.19	0.019
23	0.82	0.0131

DAILY DIURNAL FLOW VARIATION

*Flow expressed as a function of Average Waste Flow (AWF)

MH NUMBER: 015463
Intersection Cooper/Bellevue
AWF = 0.005 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0022
1	0.26	0.0013
2	0.18	0.0009
3	0.15	0.0008
4	0.19	0.001
5	0.41	0.0021
6	1.33	0.0067
7	1.6	0.008
8	1.23	0.0062
9	1.07	0.0054
10	1.15	0.0058
11	1.1	0.0055
12	1.09	0.0055
13	1.17	0.0059
14	1.01	0.0051
15	0.95	0.0048
16	1.09	0.0055
17	1.29	0.0065
18	1.54	0.0077
19	1.34	0.0067
20	1.55	0.0078
21	1.52	0.0076
22	1.19	0.006
23	0.82	0.0041

MH NUMBER: 015332
Intersection Cooper/Dundee
AWF = 0.017 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0073
1	0.26	0.0044
2	0.18	0.0031
3	0.15	0.0026
4	0.19	0.0032
5	0.41	0.007
6	1.33	0.0226
7	1.6	0.0272
8	1.23	0.0209
9	1.07	0.0182
10	1.15	0.0196
11	1.1	0.0187
12	1.09	0.0185
13	1.17	0.0199
14	1.01	0.0172
15	0.95	0.0162
16	1.09	0.0185
17	1.29	0.0219
18	1.54	0.0262
19	1.34	0.0228
20	1.55	0.0264
21	1.52	0.0258
22	1.19	0.0202
23	0.82	0.0139

MH NUMBER: 015333
Intersection Dundee/Page
AWF = 0.008 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0034
1	0.26	0.0021
2	0.18	0.0014
3	0.15	0.0012
4	0.19	0.0015
5	0.41	0.0033
6	1.33	0.0106
7	1.6	0.0128
8	1.23	0.0098
9	1.07	0.0086
10	1.15	0.0092
11	1.1	0.0088
12	1.09	0.0087
13	1.17	0.0094
14	1.01	0.0081
15	0.95	0.0076
16	1.09	0.0087
17	1.29	0.0103
18	1.54	0.0123
19	1.34	0.0107
20	1.55	0.0124
21	1.52	0.0122
22	1.19	0.0095
23	0.82	0.0066

MH NUMBER: 015329
Intersection Cooper/Morton
AWF = 0.011 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0047
1	0.26	0.0029
2	0.18	0.002
3	0.15	0.0017
4	0.19	0.0021
5	0.41	0.0045
6	1.33	0.0146
7	1.6	0.0176
8	1.23	0.0135
9	1.07	0.0118
10	1.15	0.0127
11	1.1	0.0121
12	1.09	0.012
13	1.17	0.0129
14	1.01	0.0111
15	0.95	0.0105
16	1.09	0.012
17	1.29	0.0142
18	1.54	0.0169
19	1.34	0.0147
20	1.55	0.0171
21	1.52	0.0167
22	1.19	0.0131
23	0.82	0.009

DAILY DIURNAL FLOW VARIATION

*Flow expressed as a function of Average Waste Flow (AWF)

MH NUMBER: 015324
Intersection Cooper/Hill
AWF = 0.008 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0034
1	0.26	0.0021
2	0.18	0.0014
3	0.15	0.0012
4	0.19	0.0015
5	0.41	0.0033
6	1.33	0.0106
7	1.6	0.0128
8	1.23	0.0098
9	1.07	0.0086
10	1.15	0.0092
11	1.1	0.0088
12	1.09	0.0087
13	1.17	0.0094
14	1.01	0.0081
15	0.95	0.0076
16	1.09	0.0087
17	1.29	0.0103
18	1.54	0.0123
19	1.34	0.0107
20	1.55	0.0124
21	1.52	0.0122
22	1.19	0.0095
23	0.82	0.0066

MH NUMBER: 015317
Intersection Cooper/Duncan
AWF = 0.015 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0065
1	0.26	0.0039
2	0.18	0.0027
3	0.15	0.0023
4	0.19	0.0029
5	0.41	0.0062
6	1.33	0.02
7	1.6	0.024
8	1.23	0.0185
9	1.07	0.0161
10	1.15	0.0173
11	1.1	0.0165
12	1.09	0.0164
13	1.17	0.0176
14	1.01	0.0152
15	0.95	0.0143
16	1.09	0.0164
17	1.29	0.0194
18	1.54	0.0231
19	1.34	0.0201
20	1.55	0.0233
21	1.52	0.0228
22	1.19	0.0179
23	0.82	0.0123

MH NUMBER: 015314
Intersection Cooper/Bellevue
AWF = 0.009 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0039
1	0.26	0.0023
2	0.18	0.0016
3	0.15	0.0014
4	0.19	0.0017
5	0.41	0.0037
6	1.33	0.012
7	1.6	0.0144
8	1.23	0.0111
9	1.07	0.0096
10	1.15	0.0104
11	1.1	0.0099
12	1.09	0.0098
13	1.17	0.0105
14	1.01	0.0091
15	0.95	0.0086
16	1.09	0.0098
17	1.29	0.0116
18	1.54	0.0139
19	1.34	0.0121
20	1.55	0.014
21	1.52	0.0137
22	1.19	0.0107
23	0.82	0.0074

MH NUMBER: 015189
Intersection Cooper/Page
AWF = 0.076 cfs

TIME (hours)	FLOW *	FLOW (cfs)
0	0.43	0.0327
1	0.26	0.0198
2	0.18	0.0137
3	0.15	0.0114
4	0.19	0.0144
5	0.41	0.0312
6	1.33	0.1011
7	1.6	0.1216
8	1.23	0.0935
9	1.07	0.0813
10	1.15	0.0874
11	1.1	0.0836
12	1.09	0.0828
13	1.17	0.0889
14	1.01	0.0768
15	0.95	0.0722
16	1.09	0.0828
17	1.29	0.098
18	1.54	0.117
19	1.34	0.1018
20	1.55	0.1178
21	1.52	0.1155
22	1.19	0.0904
23	0.82	0.0623

WASTEWATER FLOW BREAK DOWN

MH #	NO. OF HOUSES	FLOW PER HOUSE (GPD)	TOTAL GPD	CFS	COMMENTS
015350	44	350	15400	0.024	Estimated # of houses from South
015348	23	350	8050	0.012	
015345	25	350	8750	0.014	
015341	37	350	12950	0.02	
015373	20	350	7000	0.011	
015374	28	350	9800	0.015	
015377	38	350	13300	0.021	
015361	124	350	43400	0.067	
015495	5	350	1750	0.003	
015360	2	350	700	0.001	
015358	24	350	8400	0.013	Includes 1 large building
015355	38	350	13300	0.021	
015340	**23**	**350**	**8050**	**0.012**	**Critical Flow Collector**
015458	9	350	3150	0.005	
015602	10	350	3500	0.005	
015339	0	350	0	0	
015457	0	350	0	0	
015456	5	350	1750	0.003	Includes 1 business
015459	0	350	0	0	
015460	0	350	0	0	
015461	24	350	8400	0.013	
015462	23	350	8050	0.012	
015395	40	350	14000	0.022	
015394	7	350	2450	0.004	
015393	4	350	1400	0.002	
015508	4	350	1400	0.002	
015400	3	350	1050	0.002	
015392	66	350	23100	0.036	
015391	4	350	1400	0.002	
015500	2	350	700	0.001	
015499	7	350	2450	0.004	
015390	**5**	**350**	**1750**	**0.003**	**Critical Flow Collector**
015463	**9**	**350**	**3150**	**0.005**	**Critical Flow Collector**
015332	31	350	10850	0.017	Includes 1 fast food restaurant
015333	15	350	5250	0.008	
015329	20	350	7000	0.011	
015324	15	350	5250	0.008	
015317	28	350	9800	0.015	
015314	16	350	5600	0.009	
015600	**0**	**350**	**0**	**0**	**Critical Flow Collector**
015189	**141**	**350**	**49350**	**0.076**	**Critical Flow Collector**

INFILTRATION SUMMARY

MH #	PIPE LENGTH	PIPE DIA	ALLOWABLE INFILTRATION RATE*	ALLOWABLE INF.	DEFECT INFILTRATION		TOTAL INFILTRATION	
	FEET	INCH	Gal/(mile*in-dia*day)	GPD	GPM	GPD	GPD	CFS
015350	1100	8	500	833.3	45	64800	65633.3	0.01
015348	830	8	500	628.8	22.5	32400	33028.8	0.005
015345	1041	8	500	788.6	22.5	32400	33188.6	0.005
015341	1295	8	500	981.1	22.5	32400	33381.1	0.005
015340	1214	8	500	919.7	7.5	10800	11719.7	0.002
015343	0	0	500	0	14.5	20880	20880	0.003
015373	920	8	500	697	30	43200	43897	0.007
015374	1027	8	500	778	22.5	32400	33178	0.005
015377	1113	8	500	843.2	22.5	32400	33243.2	0.005
015358	601	8	500	455.3	7.5	10800	11255.3	0.002
015355	1290	8	500	977.3	30	43200	44177.3	0.007
015359	0	0	500	0	7.5	10800	10800	0.002
015361	3638	8	500	2756.1	127.5	183600	187632.6	0.029
	1348	10	500	1276.5				
015495	480	8	500	363.6	14.5	20880	21243.6	0.003
015360	26	8	500	19.7	7.5	10800	10819.7	0.002
015458	307	10	500	290.7	7.5	10800	11090.7	0.002
015339	330	10	500	312.5	1.5	2160	2472.5	0
015457	22	10	500	20.8	1.5	2160	2180.8	0
015456	271	10	500	256.6	7.5	10800	11056.6	0.002
015459	190	10	500	179.9	14.5	20880	21059.9	0.003
015460	0	10	500	0	29.5	42480	42480	0.007
015461	560	8	500	424.2	29.5	42480	43206.3	0.007
	319	10	500	302.1				
015462	560	8	500	424.2	29.5	42480	43216.7	0.007
	330	10	500	312.5				
015463	252	8	500	190.9	7.5	10800	11304.3	0.002
	331	10	500	313.4				
015600	19	10	500	18	0	0	18	0
015189	313	12	500	355.7	172	247680	248035.7	0.038
015602	0	8	500	0	7.5	10800	10800	0.002
015332	3725	8	500	2822	104.5	150480	153302	0.024
015329	80	8	500	60.6	14.5	20880	20940.6	0.003
015324	562	8	500	425.8	29.5	42480	43218.3	0.007
	330	10	500	312.5				
015317	1111	8	500	841.7	22.5	32400	33554.2	0.005
	330	10	500	312.5				
015314	494	8	500	374.2	29.5	42480	43166.7	0.007
	330	10	500	312.5				
015402	0	8	500	0	14.5	20880	20880	0.003
015394	3284	8	500	2487.9	134.5	193680	196167.9	0.03
015393	249	8	500	188.6	0	0	188.6	0
015401	0	8	500	0	14.5	20880	20880	0.003
015508	223	8	500	168.9	14.5	20880	21048.9	0.003
015400	246	8	500	186.4	7.5	10800	10986.4	0.002
015392	3885	8	500	2943.2	7.5	10800	13743.2	0.002
015391	229	8	500	173.5	7.5	10800	10973.5	0.002
015390	691	8	500	523.5	7.5	10800	11323.5	0.002
015500	0	12	500	0	105	151200	151200	0.023

INFILTRATION SUMMARY

MH #	PIPE LENGTH	PIPE DIA	ALLOWABLE INFILTRATION RATE*	ALLOWABLE INF.	DEFECT INFILTRATION		TOTAL INFILTRATION	
	FEET	INCH	Gal/(mile*in-dia*day)	GPD	GPM	GPD	GPD	CFS
015499	0	12	500	0	7.5	10800	10800	0.002
015189	5520	8	500	4181.8	172	247680	252526.6	0.039
	390	18	500	664.8				

*** Infiltration Rate of 500 Gallons per inch-diameter per Day is defined as "allowable" by the Metropolitan Water Reclamation District of Greater Chicago (MWRD)**

INFLOW DISTRIBUTION OVER TIME

(BASED ON A 24 HOUR STORM)

HOUR of STORM	TIME	FLOW RATE*
1	4:00am	0.6
2	5:00am	0.6
3	6:00am	0.6
4	7:00am	0.6
5	8:00am	0.6
6	9:00am	0.6
7	10:00am	0.8
8	11:00am	0.8
9	12:00pm	0.8
10	1:00pm	0.8
11	2:00pm	1.0
12	3:00pm	1.2
13	4:00pm	1.4
14	5:00pm	2.3
15	6:00pm	2.5
16	7:00pm	1.8
17	8:00pm	1.2
18	9:00pm	0.8
19	10:00pm	0.8
20	11:00pm	0.7
21	12:00am	0.6
22	1:00am	0.5
23	2:00am	0.4
24	3:00am	0.6

* FLOW RATE expressed as a function of the anticipated flow for each hour of the storm

Notes:

1) Base Infiltration volumes are based on the structure deficienies recorded in field inspections
2) Flow distribution over time is based Illinois Bulletin 70 data for cumulative percent of storm rainfall per storm time for 3rd Quartile storms.

INFLOW SUMMARY

MH #	DEFECT DESCRIPTION	DEFECT INFILTRATION		
		GPM	GPD	CFS
015350	Leaking Frame	7.0	10080	0.002
015348	Leaking Frame	7.0	10080	0.002
015345	Leaking Frame	7.0	10080	0.002
015341	Leaking Frame, Ponded Manhole	21.0	30240	0.005
015340	Ponded Manhole	14.0	20160	0.003
015343	Leaking Frame, Ponded Manhole	21.0	30240	0.005
015373	Leaking Frame	7.0	10080	0.002
015374	Leaking Frame	7.0	10080	0.002
015377	Leaking Frame	7.0	10080	0.002
015358	Leaking Frame, Ponded Manhole	21.0	30240	0.005
015355	Leaking Frame, Ponded Manhole	21.0	30240	0.005
015359	Leaking Frame	7.0	10080	0.002
015361	Leaking Frame	7.0	10080	0.002
015495	Leaking Frame	7.0	10080	0.002
015360	Leaking Frame	7.0	10080	0.002
015458	None	0.0	0	0
015339	Leaking Frame, Ponded Manhole	21.0	30240	0.005
015457	Ponded Manhole	14.0	20160	0.003
015456	Leaking Frame	7.0	10080	0.002
015459	Leaking Frame	7.0	10080	0.002
015460	Leaking Frame	7.0	10080	0.002
015461	Leaking Frame	7.0	10080	0.002
015462	Leaking Frame	7.0	10080	0.002
015463	Leaking Frame	7.0	10080	0.002
015600	Ponded Manhole	14.0	20160	0.003
015189	Leaking Frame	7.0	10080	0.002
015602	Leaking Frame, Ponded Manhole	21.0	30240	0.005
015332	Leaking Frame	7.0	10080	0.002
015329	Leaking Frame	7.0	10080	0.002
015324	Leaking Frame	7.0	10080	0.002
015317	Leaking Frame	7.0	10080	0.002
015314	Leaking Frame	7.0	10080	0.002
015402	Leaking Frame	7.0	10080	0.002
015394	Leaking Frame	7.0	10080	0.002
015393	None	0.0	0	0
015401	Leaking Frame	7.0	10080	0.002
015508	Leaking Frame	7.0	10080	0.002
015400	Leaking Frame	7.0	10080	0.002
015392	Leaking Frame	7.0	10080	0.002
015391	Leaking Frame	7.0	10080	0.002
015390	Leaking Frame	7.0	10080	0.002
015500	Leaking Frame	7.0	10080	0.002
015499	Leaking Frame	7.0	10080	0.002
015189	None	0.0	0	0

CARROLL ENGINEERING & ASSOCIATES

Calculations for Cooper - Preston Study	Job Number	Sheet No.
Made By: NTB	Date: 4/3/2009	
Checked By:	Date:	

Max. Capacity Evaluation - Sanitary Flow Volumes

Purpose: Analize Flow Conditions in the Sanitary Sewer at the Intersection of Preston Ave. & Cooper Ave

Method: Use Manning's Equation $Q = \left(\frac{1.49}{n}\right) A R^{2/3} \sqrt{S}$

To evaluate Inflow vs. Outflow assuming the pipe is running full. ($n = 0.013$)

San MH 015340

Inflow: From North (MH 015355) 8" Sewer at 1.35%
$Q = 1.14$ cfs

From South (MH 015341) 8" Sewer at 0.49%
$Q = 0.85$ cfs

From East (MH 015343) 8" Sewer at 0.54%
$Q = 0.89$ cfs

* Total In-Flow (Q_{MAX-IN}) = 2.88 cfs

Outflow: To West (MH 015458) 12" Sewer at 0.11%
$Q = 1.18$ cfs

* Total Out-Flow ($Q_{MAX-OUT}$) = 1.18 cfs

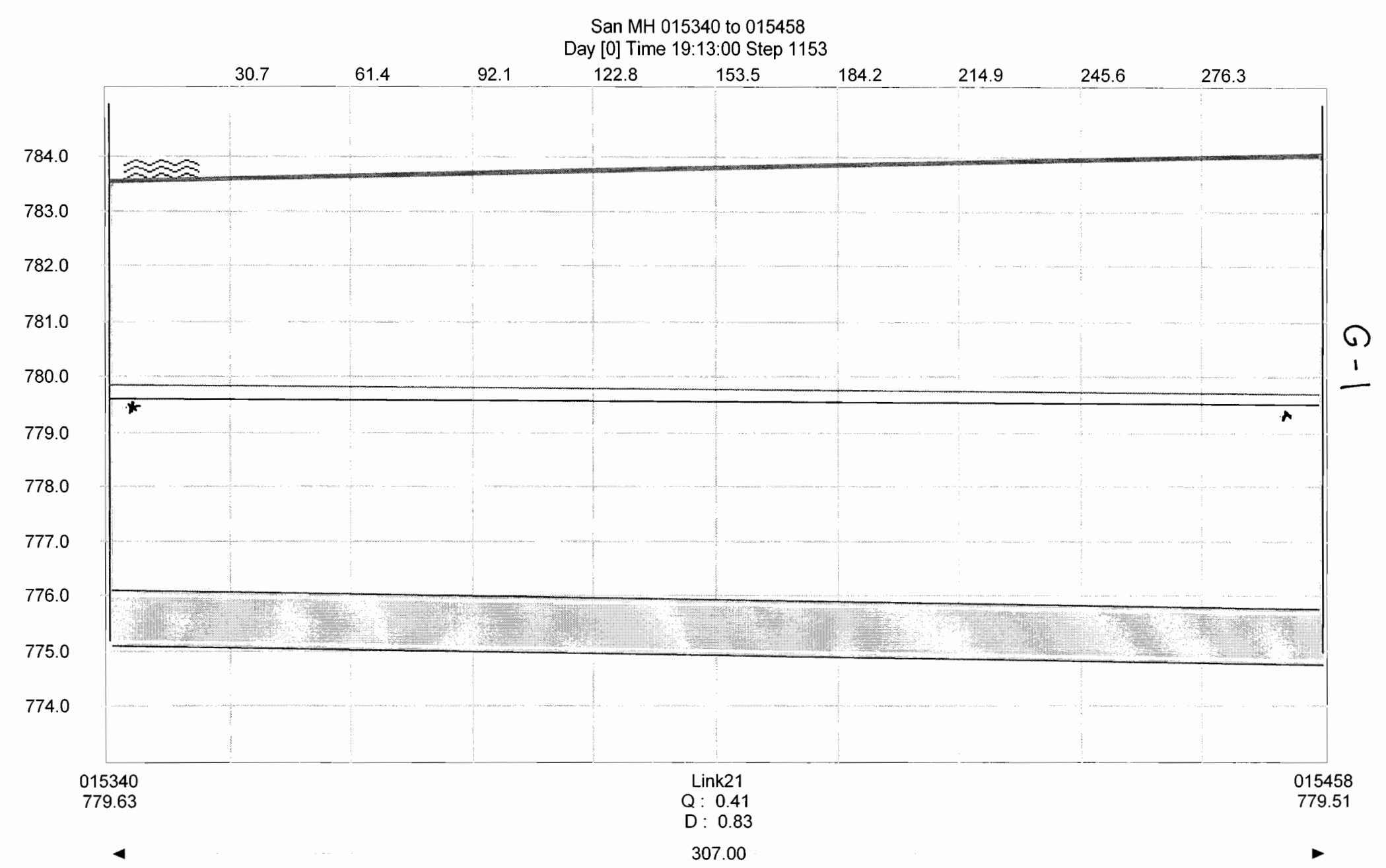
Conclusion: $Q_{MAX\,IN} > Q_{MAX-OUT}$

COOPER/PRESTON/BELLEVUE STUDY
DRAINAGE BASIN SUMMARY

STORM MANHOLE NUMBER	DRAINAGE or CATCHMENT AREA (ACRES)	WIDTH (FEET)	SLOPE OF BASIN (%)
SM 0046	7.0	700	1.7
SM 0033	4.9	385	3.0
SM 0044	10.1	700	4.5
	6.0	780	2.6
SM 0043	8.5	665	1.3
SM 0032	1.8	230	2.4
	10.1	610	0.6
SM "A"	3.6	210	2.4
SM 0029	4.2	245	1.7
	2.6	648	0.9
	9.8	788	1.7
SM 0030	3.5	100	1.6
SM 0028	9.4	315	3.6
SM 0027	11.6	330	3.3
SM 0022	20.0	750	1.2
	5.4	330	2.1
SM 0021	3.2	330	1.6
SM 0020	6.2	385	0.9
	26.0	980	0.8
	7.5	333	1.4
	28.0	718	0.7
SM 0018	3.6	385	2.6
SM 0017	2.0	385	5.6

Total Drainage Area - 195.0 Acre

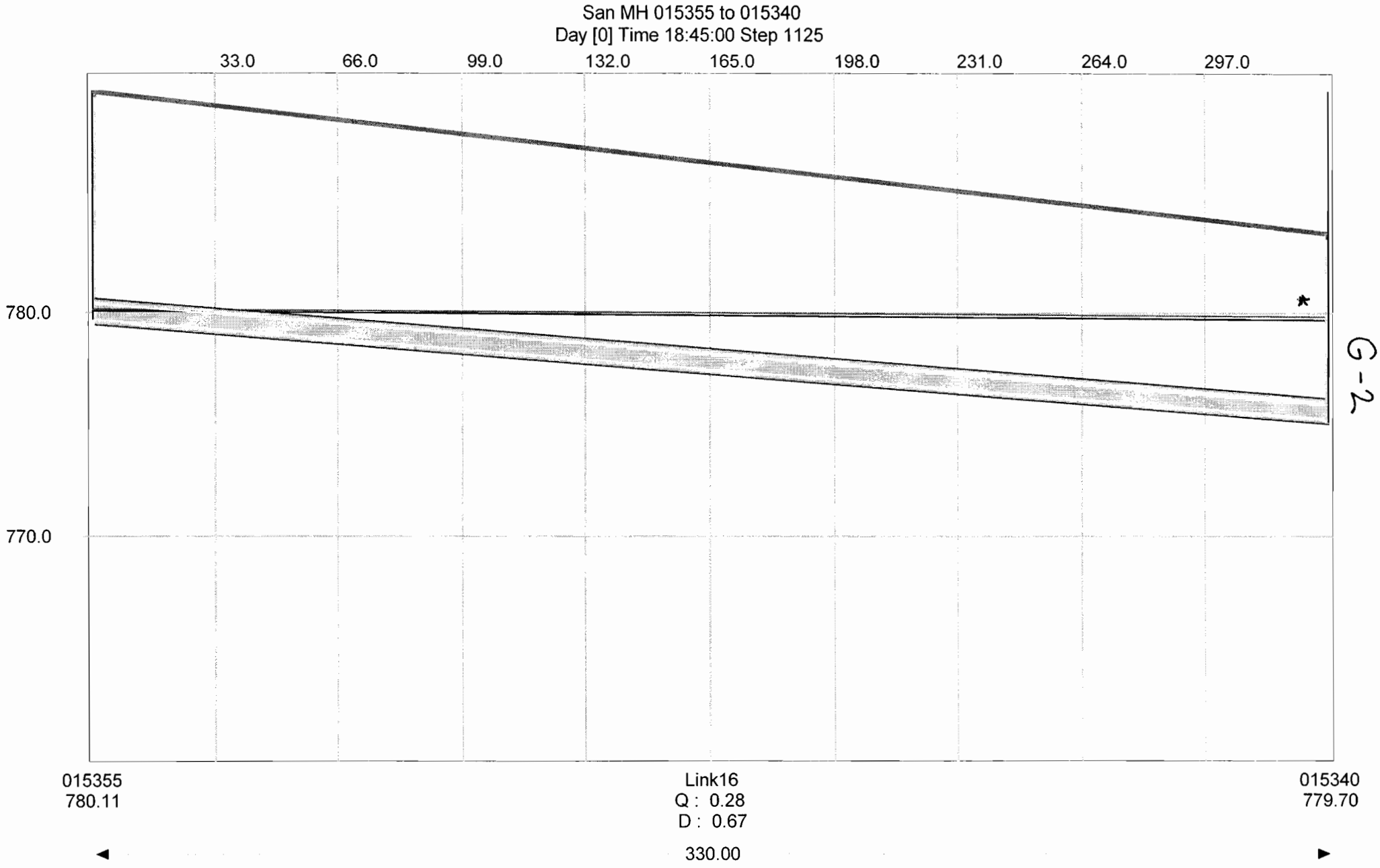
Note: The catchment area represents the acreage that drains to the listed manhole through upstream storm sewer



G-1

SANITARY SEWER SWMM MODEL. SEWER RUN JUST DOWNSTREAM OF COOPER & PRESTON INTERSECTION.

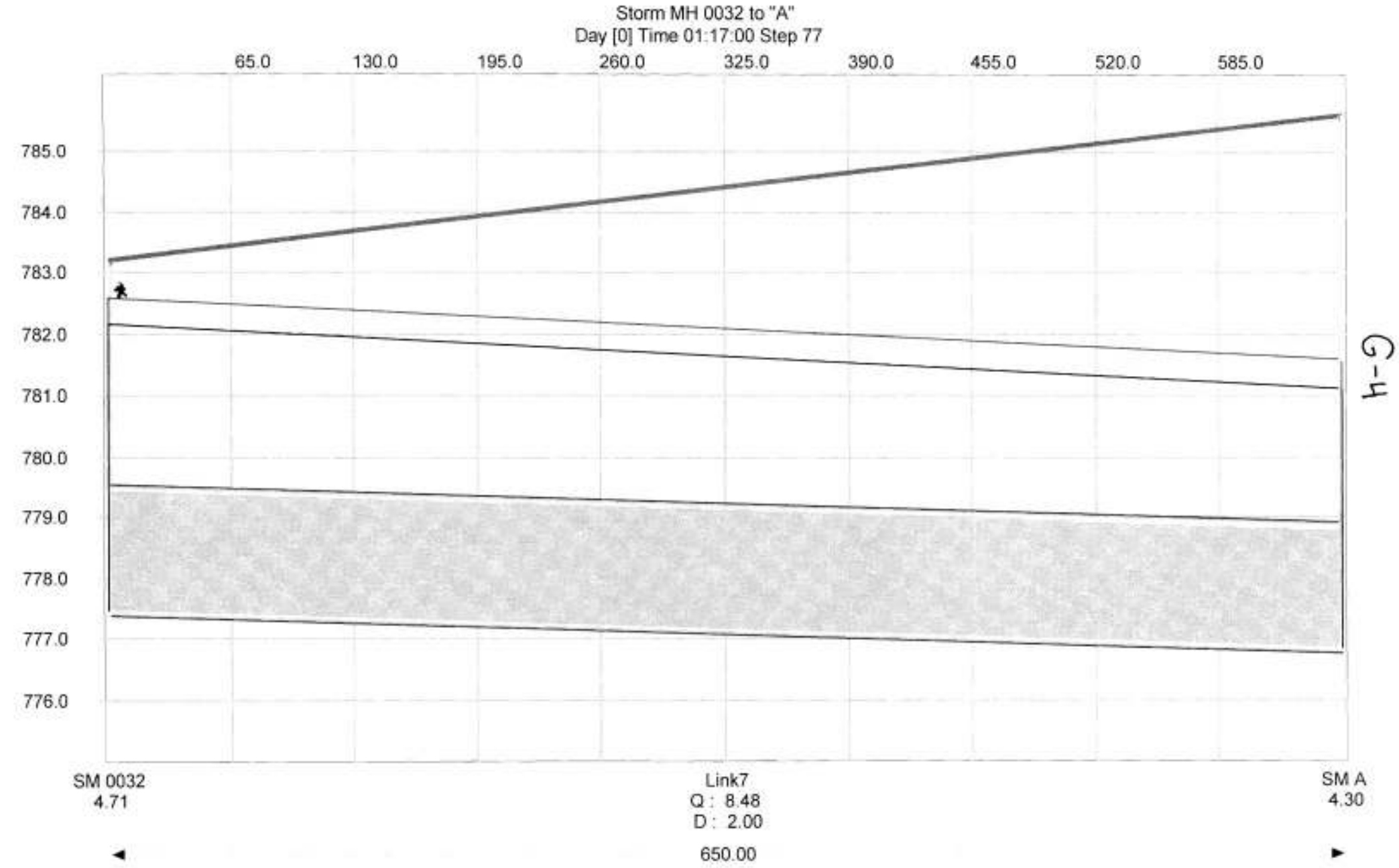
*MODEL DEPICTS SEVERE PIPE BACKUPS & MANHOLE SURCHARGING OVER ENTIRE PIPE LENGTH



G-2

SANITARY SEWER SWMM MODEL: SEWER RUN JUST UPSTREAM OF COOPER & PRESTON INTERSECTION. * MODEL DEPICTS SEVERE PIPE BACK UPS & MANHOLE SURCHARGING AT DOWN STREAM END

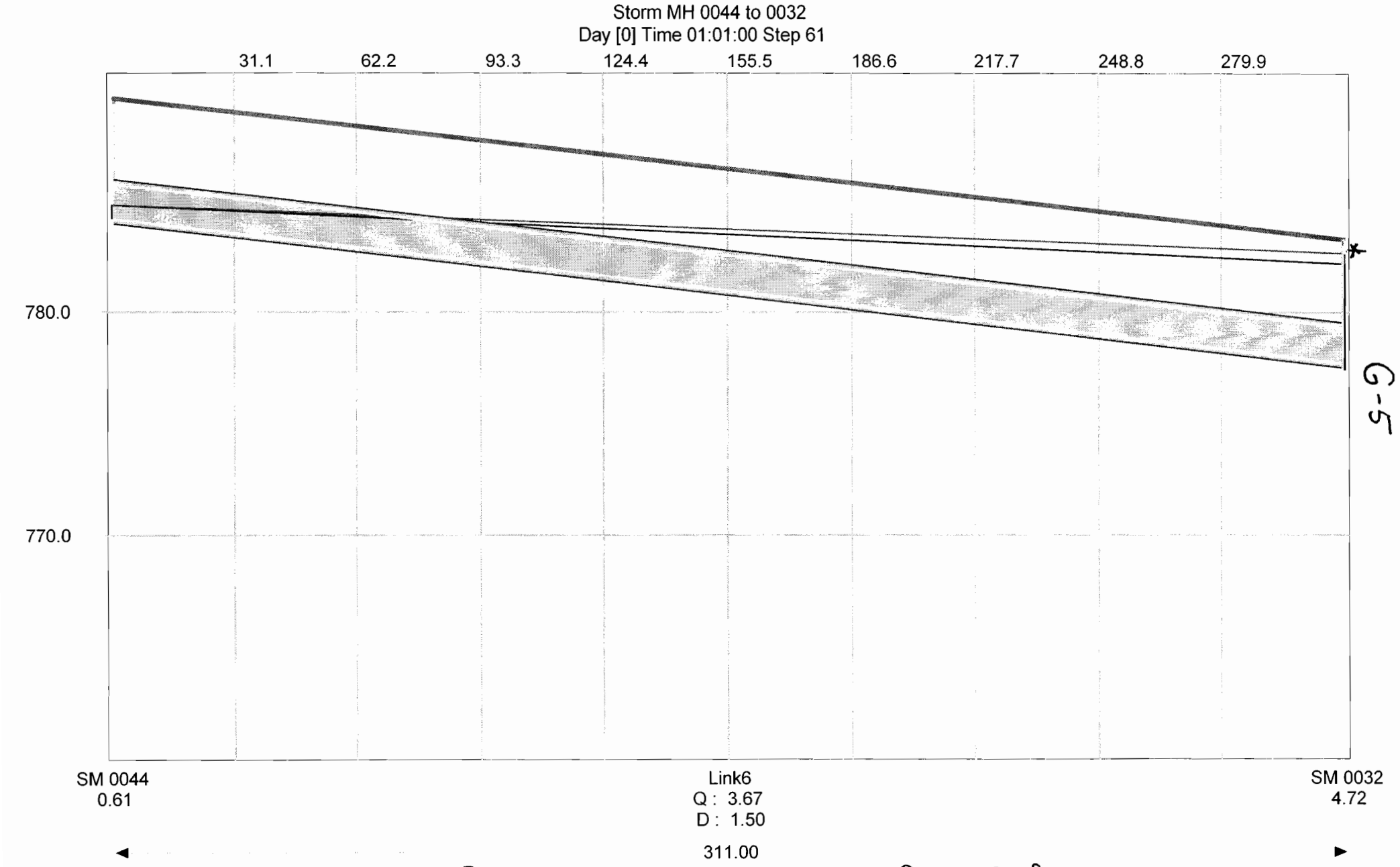

015356
015355
Kelp Ave
015494
015357
N
015458
10"
015340
Cooper Ave
COOPER
015343
015
015
018
Preston Ave
015342
8"
015341
Page Ave
015344
CITY OF ELGIN
PRESTON/COOPER INTERSECTION
SANITARY SEWER



G-4

STORM SEWER SWMM MODEL : SEWER RUN JUST DOWN STREAM OF COOPER & PRESTON INTERSECTION.

*MODEL DEPICTS SURCHARGING & FLOODING AT UPSTREAM END

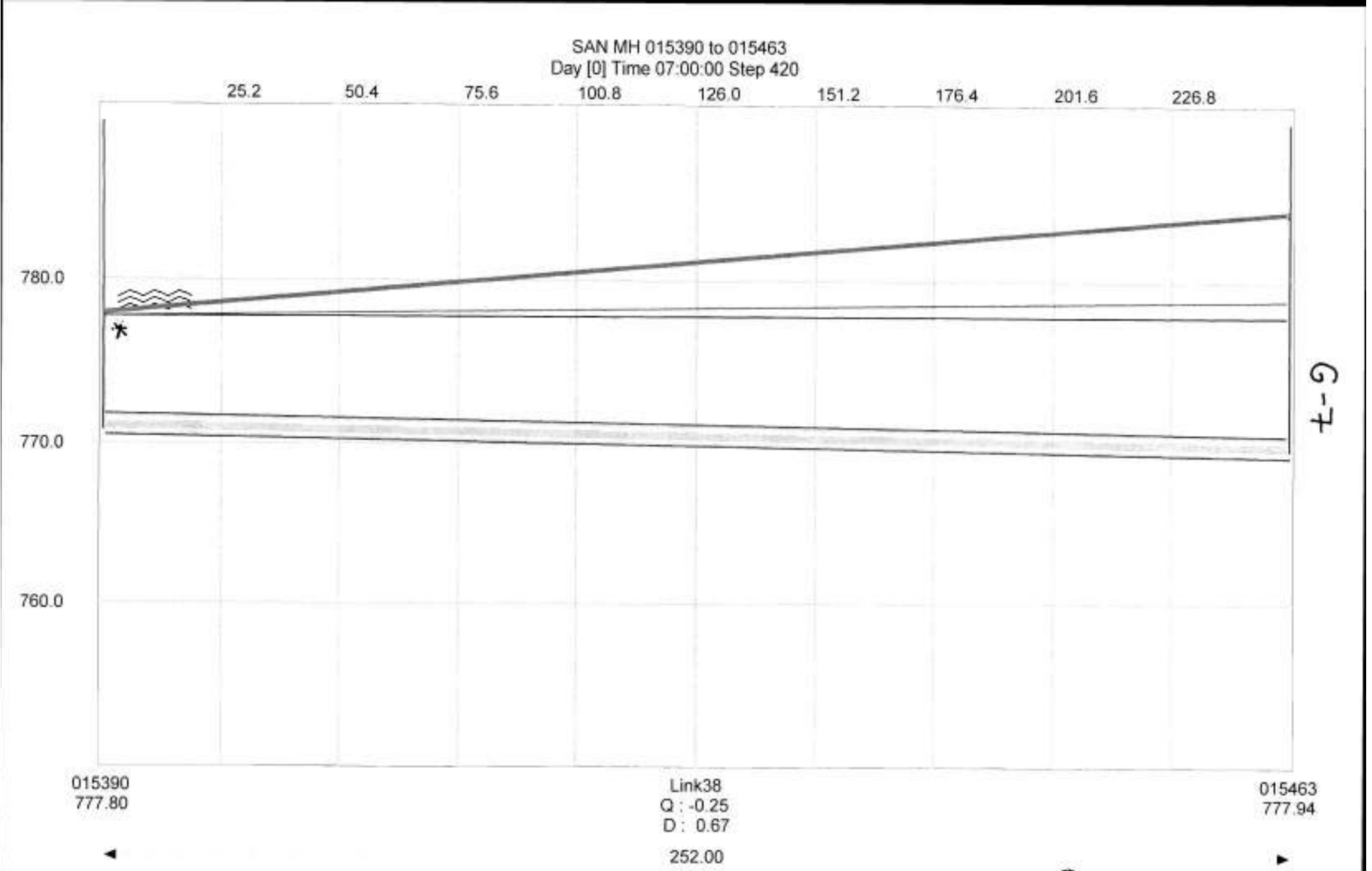


G-5

STORM SEWER SWMM MODEL : SEWER RUN JUST UPSTREAM OF COOPER & PRESTON INTERSECTION

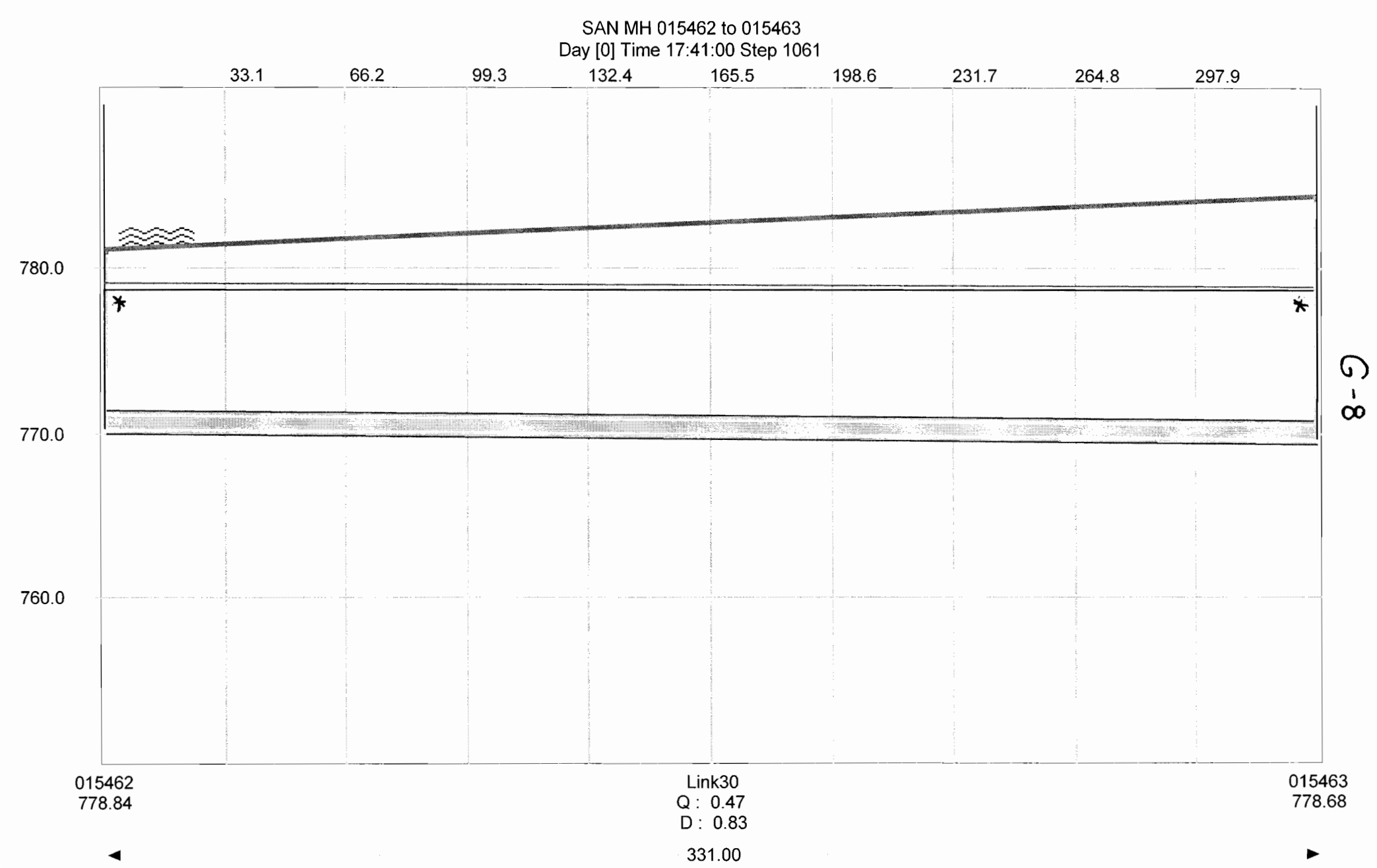
* MODEL DEPICTS SURCHARGING & FLOODING AT DOWN STREAM END.


N
Keep
Preston
Cooper
Page
12"
8"
SM0820044
18"
24"
C
A9
SM0820032
A11
15"
SM0820043
10"
CITY OF ELGIN
PRESTON/COOPER INTERSECTION
STORM SEWER



SANITARY SEWER SWMM MODEL SEWER RUN ON BELLEVUE FLOWING SOUTH TO COOPER AVE.

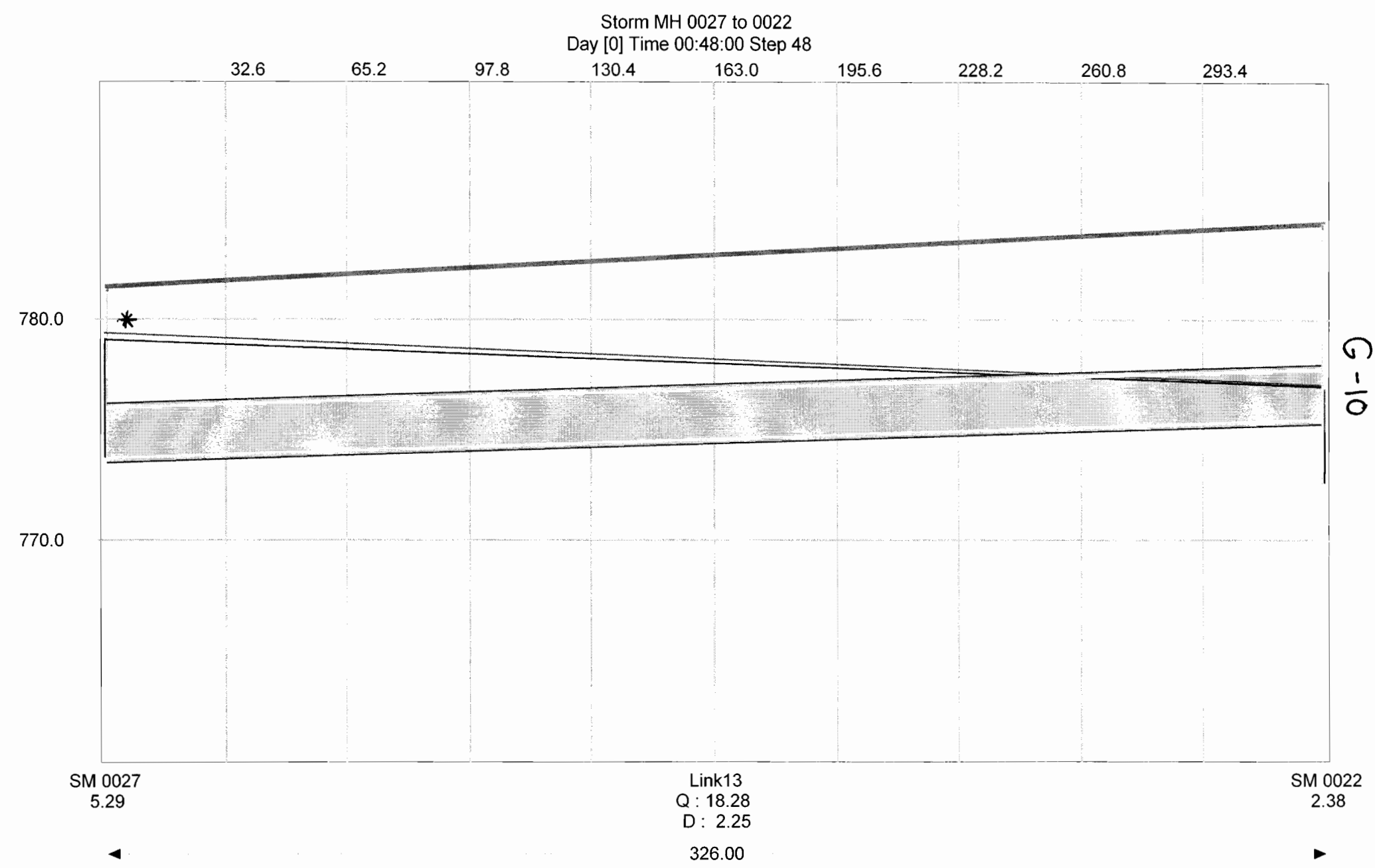
* MODEL DEPICTS SEVERE SURCHARGING AT UPSTREAM END



SANITARY SEWER SWMM MODEL : SEWER RUN ON COOPER FLOWING WEST TO BELLEVUE INTERSECTION

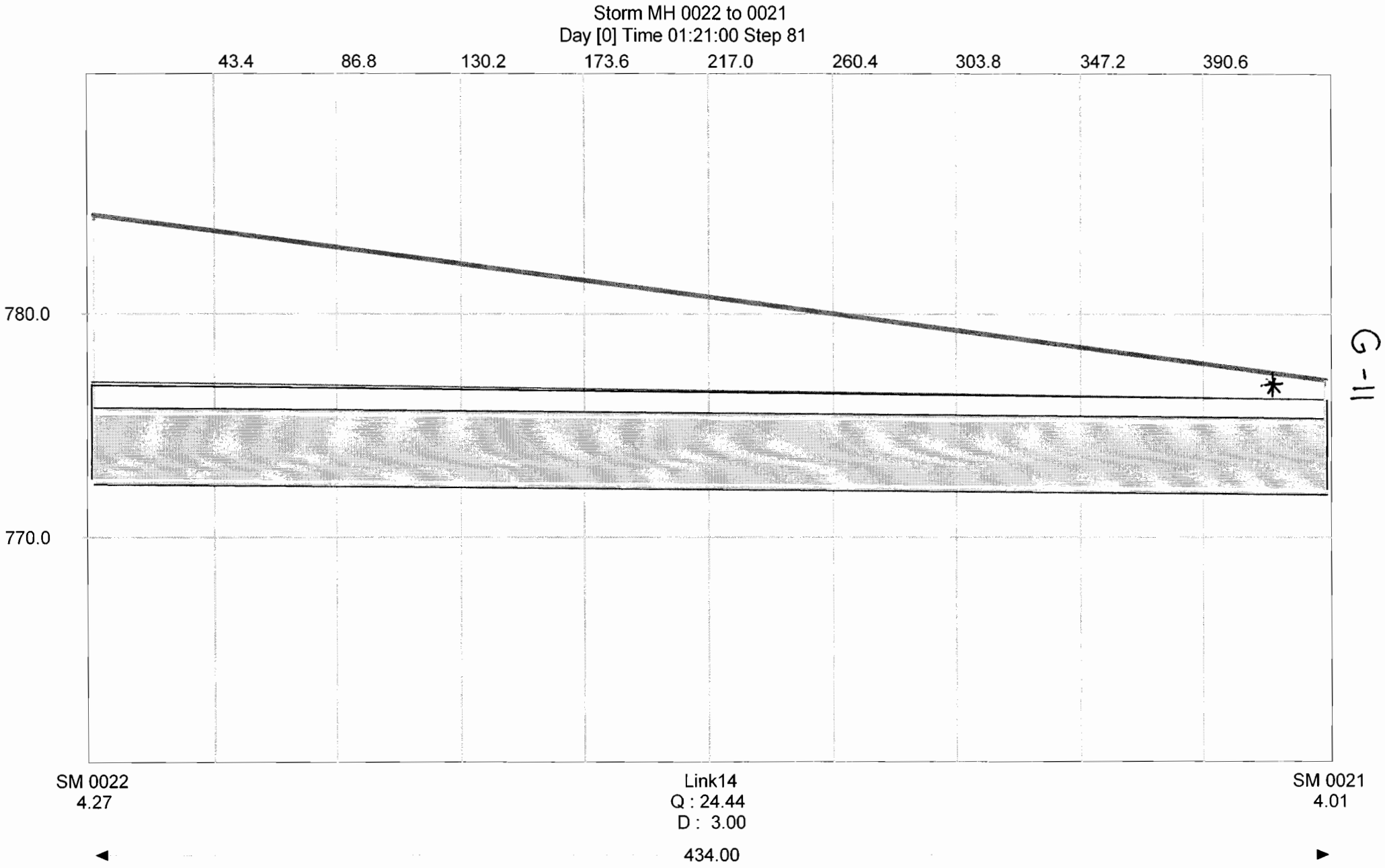
*MODEL DEPICTS SURCHARGING FOR ENTIRE PIPE LENGTH


N
SM082004
SM0820051
SM0820026
SM0820022
SM0820027
Cooper
Cooper
Cooper
Cooper
12"
12"
27"
27"
Cedar
Cedar
Bellevue
Bellevue
Duncan
Duncan
36"
10"
18"
12"
8"
10"
CITY OF ELGIN
BELLEVUE/COOPER INTERSECTION
STORM SEWER



G-10

STORM SEWER SWMM MODEL: SEWER RUN JUST UPSTREAM OF INTERSECTION OF BELLEVUE AND COOPER * MODEL DEPICTS SURCHARGING IN MH 0027



G-11

STORM SEWER SWMM MODEL: SEWER RUN JUST DOWNSTREAM OF BELLEVUE & COOPER INTERSECTION. * MODEL DEPICTS SURCHARGING ON BELLEVUE MANHOLES


N
015190
015322
015499
015390
12"
18"
8"
015463
015462
10"
Cooper Ave
015189
015600
015314
015317
12"
10"
Cedar Ave
Bellevue Ave
015
015
8"
Duncan Ave
015315
015318
015188
8"
15"
CITY OF ELGIN
BELLEVUE/COOPER INTERSECTION
SANITARY SEWER


N
S
E
W
Legend
Sanitary Manhole
Combined Basin
Study Area
Service Area
CITY OF ELGIN
PRESTON/COOPER/BELLEVUE STUDY
SANITARY SEWER
SERVICE AREA EXHIBIT

N

W E

S

Legend

- Storm Manhole
- Tee
- Inlet
- Basin
- Storm Study Area
- Storm Service Area
- Detention Pond

CITY OF ELGIN

PRESTON/COOPER/BELLEVUE STUDY

STORM SEWER

SERVICE AREA EXHIBIT

CITY OF ELGIN

PRESTON/COOPER/BELLEVUE STUDY
STORM SEWER
DRAINAGE EXHIBIT