NEW BRITAIN – HARTFORD BUSWAY

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INLAND WATER RESOURCES DIVISION

CITY OF HARTFORD / TOWN OF WEST HARTFORD, CT

100% DRAINAGE DESIGN SUBMISSION

NOVEMBER 2008
REVISED MARCH 2009
REVISED AUGUST 2009
REVISED OCTOBER 2009
REVISED DECEMBER 2009
REVISED MAY 2010
REVISED JUNE 2010

State Project No. 63-643
FLATBUSH AVENUE

Connecticut Department of Transportation

URS Corporation AES
500 Enterprise Drive
Rocky Hill, CT 06067

VN ENGINEERS, Inc.
90 High Street
Westerly, RI 02891
401-596-3726

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DRAINAGE SUBMISSION

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CITY OF HARTFORD / TOWN OF WEST HARTFORD, CT

STATE PROJECT No. 63-643
FLATBUSH AVENUE

NOVEMBER 2008
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CONNECTICUT DEPARTMENT OF TRANSPORTATION

PREPARED BY

VN ENGINEERS, Inc.
90 High Street
Westerly, Rhode Island 02891
401-596-3726
for
URS CORPORATION AES
500 Enterprise Drive
Rocky Hill, CT 06067

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- Time of Concentration
- Gutter Flow
- Storm Sewer Design
- Hydraulic Grade Line

C. Outlet Protection
D. Existing Condition Drainage Model
E. Existing Conditions Report
F. Drainage Pipe & Culvert Selection Justification

100% DRAINAGE DESIGN

A. Project Description

This project consists of a portion of the New Britain – Hartford Busway located in the City of Hartford and Town of West Hartford (Sta. 332+00 to Sta. 450+00). The Busway will be a dedicated Bus Rapid Transit (BRT) facility along a 9.4-mile corridor between downtown New Britain and downtown Hartford. The corridor for the Busway follows and abandoned railroad right-of-way from New Britain to Newington Junction and lies mainly within the Amtrak right-of-way, essentially parallel to the active rail line, north of Newington Junction. The Busway will be two lanes wide (one in each direction).

There is one bus station within the vicinity of the project limits located at Flatbush Avenue. A bridge structure is proposed over the railroad tracks, with grade re-profiling occurring on Flatbush Avenue and Newfield Avenue and New Park Avenue.

B. Purpose of Report

The Purpose of this report is to: 1) provide documentation relating to the analysis of the adequacy and use of existing drainage structures, 2) documentation of gutter flow analysis and storm sewer design of new drainage facilities and existing drainage facilities to convey a 10-year storm event.

C. Design Criteria

The design criteria used in all drainage evaluations was extracted from the Connecticut Department of Transportation (CDOT) *Drainage Manual,* January, 2000, as revised, unless otherwise noted. The Federal Highway Administration

Hydraulics Design Series and *Highway Engineering Circulars,* were used as directed by the *Drainage Manual.*

The roadway drainage was designed and analyzed for a 10-year storm event. Maximum spacing of catch basins, minimum pipe size, and minimum pipe slope conform to the *Drainage Manual.* The design allows for flooding of the shoulder and half a travel lane.

Hydraflow Storm Sewers, 2005 software, version 11.0.0.9 was utilized to conduct the drainage calculations in this report.

D. Proposed Drainage Systems

There is one proposed drainage system in SPN. 63-643 and it is identified as System No. 2 in this report. System No. 2 also discharges mainline Busway drainage in SPN. 155-H025.

SYSTEM NO. 2 - STA. 343+50 TO STA. 363+00

The proposed Busway drainage system is designed to tie into an existing 30" R.C.P. lateral crossing underneath the Busway alignment at Sta. 352+00. The existing drainage system travels to the east on Flatbush Avenue and discharges at an existing outlet in a retaining wall structure at Park River at elev. 31.36'. The design accounts for the anticipated bus station run off of 6.50 c.f.s for a 10-year storm event. Coordination with the station designers is ongoing and a proposed connection point is identified in project 155-H025.

System 2 is approximately 10.74 acres in size comprised of the proposed Busway run off, New Park Avenue, Flatbush Avenue and New Field Avenue roadways, and existing commercial parking lots located south of Flatbush Avenue.

Primary treatment was considered for System 2. Due to the urban nature of the surroundings sufficient space to provide detention ponds is extremely limited. One location considered for primary treatment measures is at the intersection of Flatbush Avenue and Newfield Ave; on the southwest corner of the intersection. However, the site has been identified as a potential location for a "future" inter-modal transportation facility.

E. Temporary Drainage

The existing drainage on Flatbush Avenue will require maintenance during the construction of the project. The proposed drainage will be coordinated to be installed early in the project to facilitate the roadway alignment shift on Flatbush Avenue.

F. Drainage Condition Survey

An existing drainage survey field review was conducted on August 28, 2008 and on September 3, 2008 and documented in a Drainage Condition Field Review memo attached to this document.

APPENDIX A

DESIGN CHECKLIST
&
RESPONSE TO COMMENTS

Project No	63-643
Roadway	BUSWAY
Town	HARTFORD / WEST HARTFORD
Date	08/21/09
Designed By	JOSEPH BAMBARA
Signature of Engineer	

Final Design Checklist (Plans 85% to 90% Complete)
Allow a 4 5 week review time

The Final Design Submission should include the following

a Disposition of Semi Final Design comments with written responses justifying comments not incorporated
☑ Included ☐ Not Included ☐ Not Applicable

b Final Drainage Report and Final Plans
☑ Included ☐ Not Included ☐ Not Applicable

c Final scour report
☐ Included ☐ Not Included ☒ Not Applicable

d Final floodway analysis report
☐ Included ☐ Not Included ☒ Not Applicable

e Final SCEL report
☐ Included ☐ Not Included ☒ Not Applicable

f Final hydraulic design report
☐ Included ☐ Not Included ☒ Not Applicable

Provide justification for items **Not Included** Justification should correspond to the designated letter

URS

Flatbush Avenue over Busway and Amtrak: 63-643

DESIGN REVIEW RECORD

DOCUMENT BEING REVIEWED:	Final Plans For Review Comments	REVIEWED BY: Paul Corrente Transportation Supervising Planner Environmental Planning, Bureau of Policy and Planning REVIEW DATE: 2-18-2010 Responses prepared by: Checked by:

ITEM NO.	SHEET	COMMENT	RESPONSE AND ACTION TAKEN
1	TYP-03	▪ Provide process aggregate under guiderail.	See URS Response to Comments.
2	MDS-01 – 02 & MDS 14-16	▪ The provided E & S details are outdated. The guide sheets are being updated to reflect the 2002 E & S Guidelines. These sheets when completed should be included into the plans or omitted in its entirety. ▪ There are a number of duplicate E & S details. Please clarify.	See URS Response to Comments. MDS 14-16 removed from plan set.
3	General	▪ All relative plan sheets should illustrate the Flatbush Avenue Busway Station, Busway and Access Road for clarify and to ensure cohesion between the different designs. ▪ If landscaping required please provide plans at the earliest convenience for review and comment. ▪ The attached MBR for retaining wall 101 will impact the proposed corner entrance to the Flatbush Avenue Station. ▪ Retaining wall 101 does not take into account the proposed stairs connecting the bridge and Busway station.	See URS Response to Comments.
4	DRG-02	▪ Is it possible to transverse RCP through the retain wall from the MH located at Sta. 19+72 RT with the use of deep structures?	The number of penetrations of the drainage pipe through the retaining was kept to a minimum. The only location where is occurs on Flatbush Ave. is a Sta. 22+00 LT.

URS

Flatbush Avenue over Busway and Amtrak: 63-643

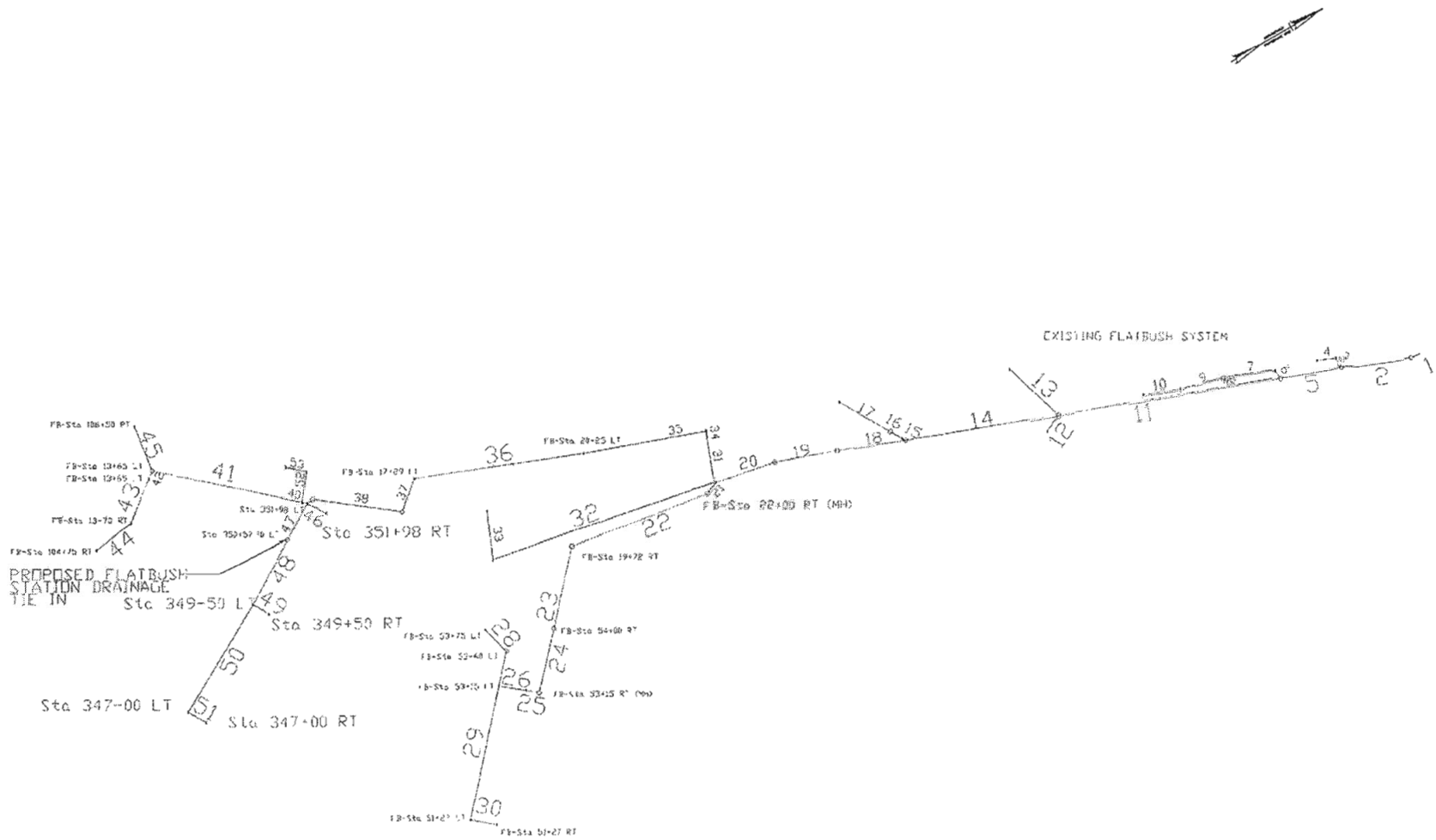
DESIGN REVIEW RECORD

DOCUMENT BEING REVIEWED:	Final Plans For Review Comments	REVIEWED BY: Paul Corrente Transportation Supervising Planner Environmental Planning, Bureau of Policy and Planning REVIEW DATE: 2-18-2010 Responses prepared by: Checked by:

ITEM NO.	SHEET	COMMENT	RESPONSE AND ACTION TAKEN
5	ILL-01	▪ Pole 155-007 interferes with the corner entrance to the Busway Station. ▪ Pole 155-002 interferes with the proposed stairs connecting the bridge and station.	The illumination for Flatbush Avenue breakout project is going to be redesigned to include decorative light fixtures. The design will take into account the corner entrance and stairs to the proposed station.
6	UTL-01	▪ Is the designer the confident that this proposed watermain will not impact any of proposed drainage between the Station Busway Mainline and Access Road? ▪ Please ensure and verify that jacking pit does not temporarily impact wetland 21c.	▪ See attached profile of the proposed watermain for clearances for the Flatbush & Busway drainage systems. The bus station to be checked by station designer. ▪ No VN Participation.
7	XSC	▪ Some of the RCP drainage locations are incorrect. Please clarify.	See URS Response to Comments.
		If you have any questions regarding these comments, please contact Mr. Paul Corrente at 860 594-2932.	

APPENDIX B

SYSTEM 2



SYSTEM NO. 2 GRAPHIC

REV.	DATE	REVISION DESCRIPTION	SHEET NO.
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-

Plotted: 5/10/2010
Border Version: 5/31/07

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS, BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OR ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Date Printed: 5/10/2010

DESIGNED/DRAFTED: J. Dambara
CHECKED BY: C Lanphear

NOT TO SCALE

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

ENGINEERS: VN ENGINEERS, INC. / URS CORPORATION AES
APPROVED BY: Robert Gomez, P.E.
DATE:

VN ENGINEERS, INC.

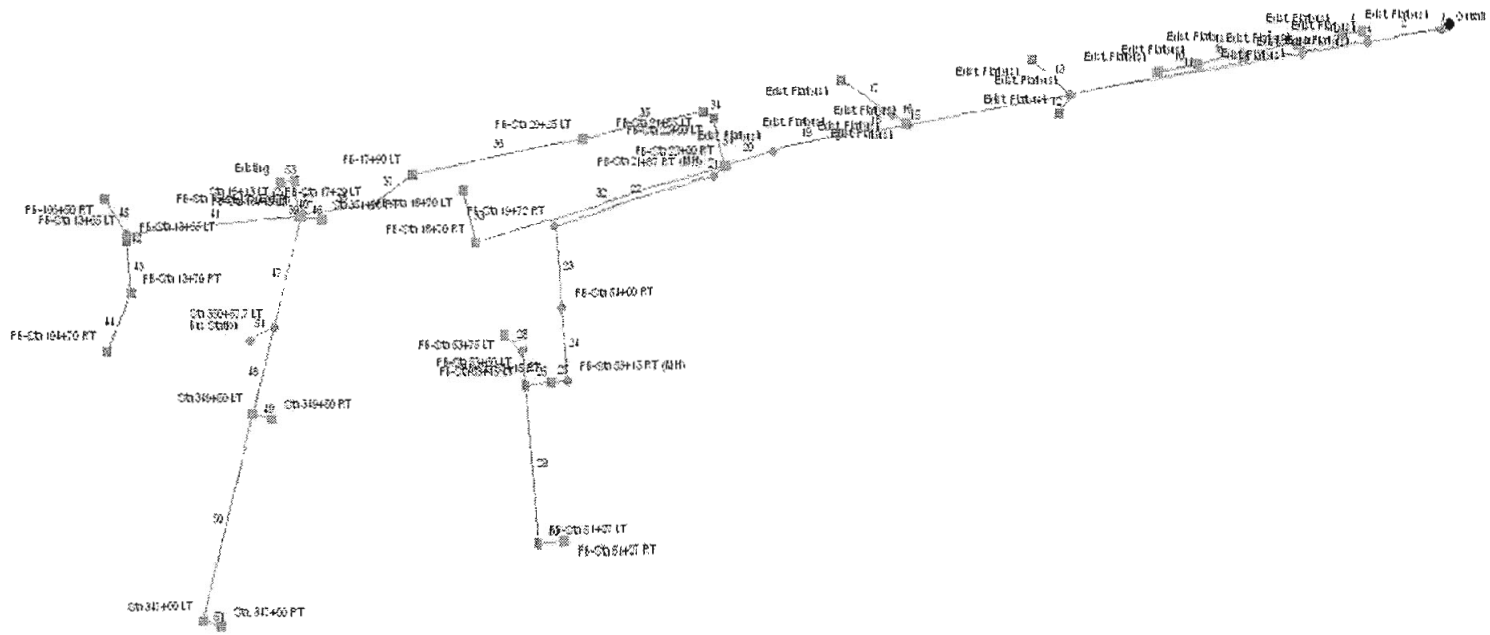
PROJECT TITLE: NEW BRITAIN - HARTFORD BUSWAY

TOWN: WEST HARTFORD/ HARTFORD

DRAWING TITLE: DRAINAGE PLAN

PROJECT NO. 155-H025
DRAWING NO.
SHEET NO.

Hydraflow Plan View



System 2	No. Lines: 54	06-25-2010

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	Exist. Flatbush	25.70	30 c	12.8	31.36	31.40	0.312	33.10	33.47	0.18	33.65	End
2	Exist. Flatbush	25.87	30 c	92.9	31.45	32.41	1.034	33.76	34.48	0.51	34.99	1
3	Exist. Flatbush	0.36	12 c	14.0	40.46	41.29	5.929	40.63	41.54	0.11	41.54	2
4	Exist. Flatbush	0.32	12 c	25.5	41.29	43.20	7.502	41.62	43.44	n/a	43.44 j	3
5	Exist. Flatbush	25.83	30 c	82.1	32.51	33.41	1.096	35.11	35.82	0.40	36.22	2
6	Exist. Flatbush	0.96	12 c	12.2	41.26	41.50	1.961	41.63	41.92	0.20	42.12	5
7	Exist. Flatbush	0.76	12 c	69.6	41.50	41.76	0.374	42.13	42.30	0.05	42.35	6
8	Exist. Flatbush	0.22	12 c	4.2	41.76	42.00	5.744	42.38	42.38	0.01	42.39	7
9	Exist. Flatbush	0.61	12 c	59.5	41.76	42.02	0.437	42.39	42.50	0.02	42.52	7
10	Exist. Flatbush	0.49	12 c	49.5	42.02	42.80	1.577	42.56	43.10	n/a	43.10 j	9
11	Exist. Flatbush	25.80	30 c	299.2	39.66	40.91	0.418	42.16*	44.96*	0.34	45.30	5
12	Exist. Flatbush	1.13	12 c	26.6	43.11	43.97	3.236	45.70*	45.76*	0.03	45.80	11
13	Exist. Flatbush	1.94	12 c	64.3	41.21	42.00	1.229	45.64*	46.09*	0.09	46.18	11
14	Exist. Flatbush	24.59	30 c	207.0	41.41	45.15	1.807	45.34	47.06	0.40	47.46	11
15	Exist. Flatbush	1.78	15 c	5.6	46.05	46.22	3.021	48.01*	48.02*	0.02	48.04	14
16	Exist. Flatbush	0.73	15 c	18.0	46.32	47.87	8.611	48.06	48.21	n/a	48.21 j	15
17	Exist. Flatbush	0.81	15 c	79.3	47.87	48.12	0.315	48.38	48.63	0.05	48.67	16
18	Exist. Flatbush	23.72	30 c	92.5	45.25	46.47	1.319	47.68	48.24	0.09	48.34	14
19	Exist. Flatbush	23.88	30 c	85.0	47.17	49.06	2.224	48.60	50.69	0.12	50.69	18
20	FB-Sta 22+00 RT	24.00	30 c	63.0	52.03	53.29	2.000	53.15	55.39	0.69	56.08	19
21	FB-Sta 21+87 RT (	9.41	18 c	18.0	55.45	55.81	2.000	56.32	57.31	0.21	57.52	20
22	FB-Sta 19+72 RT	9.55	18 c	210.0	56.07	60.27	2.000	57.52	61.45	n/a	61.45 j	21
23	FB-Sta 54+00 RT	9.62	18 c	97.0	61.94	62.91	1.000	63.07	64.10	0.10	64.19	22
24	FB-Sta 53+15 RT (	9.68	18 c	84.0	64.40	65.24	1.000	65.54	66.43	0.64	67.07	23
25	FB-Sta 53+15 RT	9.69	18 c	20.0	65.24	65.44	1.000	67.25*	67.42*	0.23	67.65	24
26	FB-Sta 53+15 LT	9.27	18 c	33.0	65.44	65.77	1.000	67.69*	67.95*	0.96	68.91	25
27	FB-Sta 53+60 LT	7.02	18 c	40.0	65.77	66.17	1.000	69.09*	69.27*	0.18	69.46	26
28	FB-Sta 53+75 LT	7.05	18 c	30.0	66.17	66.47	1.000	69.46*	69.59*	0.25	69.84	27
29	FB-Sta 51+27 LT	2.41	18 c	184.0	66.82	68.66	1.000	69.31	69.45	0.15	69.60	26
30	FB-Sta 51+27 RT	1.35	18 c	34.0	68.66	69.00	1.000	69.64	69.63	0.06	69.69	29
31	FB-Sta 22+00 LT	13.39	30 c	56.0	53.29	53.85	1.000	56.43*	56.49*	0.13	56.62	20
32	FB-Sta 18+70 RT	1.67	12 c	330.0	56.62	81.37	7.500	56.90	81.92	n/a	81.92	20

System 2 | Number of lines: 54 | Run Date: 06-25-2010

NOTES: c = cir; e = ellip; b = box; Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
33	FB-Sta 18+70 LT	1.35	12 c	63.0	81.37	82.00	1.000	82.10	82.49	n/a	82.49 j	32
34	FB-Sta 21+85 LT	12.70	30 c	15.0	53.85	54.00	1.000	56.63*	56.65*	0.11	56.75	31
35	FB-Sta 20+25 LT	12.66	30 c	156.0	54.00	55.56	1.000	56.76	56.82	0.20	57.02	34
36	FB-Sta 17+90 LT	12.04	30 c	222.0	55.56	56.67	0.500	57.33	57.83	n/a	57.83	35
37	FB-Sta 17+29 LT	11.63	30 c	63.0	60.43	60.75	0.508	61.53	61.90	0.24	62.14	36
38	FB-Sta 16+26 LT (E	11.77	30 c	90.0	60.75	61.20	0.500	62.49	62.52	0.24	62.75	37
39	Sta 351+98 LT	11.77	30 c	3.0	61.20	61.24	1.333	62.87	62.86	0.31	63.17	38
40	FB-Sta 16+13 LT	5.96	24 c	4.0	63.25	63.29	1.000	63.95	64.36	0.28	64.64	39
41	FB-Sta 13+65 LT	5.85	15 c	222.0	63.32	71.09	3.500	64.64	72.06	n/a	72.06 j	40
42	FB-Sta 13+65 LT	5.32	15 c	8.0	71.09	71.17	1.000	72.10	72.10	0.23	72.33	41
43	FB-ta 13+70 RT	2.91	12 c	62.0	71.17	71.79	1.000	72.58*	72.99*	0.18	73.17	42
44	FB-Sta 104+70 RT	2.53	12 c	73.0	71.79	72.52	1.000	73.22*	73.59*	0.16	73.75	43
45	FB-Sta. 106+50 RT	0.65	12 c	50.0	71.09	71.59	1.000	72.55	72.56	0.01	72.57	41
46	Sta 351+98 RT	0.49	12 c	25.0	65.87	66.00	0.520	66.16	66.30	0.10	66.39	39
47	Sta 350+57.7 LT	7.56	30 c	135.0	61.24	62.57	0.985	63.32	63.49	n/a	63.49 j	39
48	Sta 349+50 LT(2)	2.08	12 c	103.0	64.37	64.89	0.505	65.06	65.58	0.30	65.88	47
49	Sta 349+50 RT	0.49	12 c	25.0	66.62	66.75	0.520	66.91	67.05	0.10	67.14	48
50	Sta 347+00 LT	1.37	12 c	246.0	65.89	67.12	0.500	66.42	67.65	0.25	67.90	48
51	Sta. 347+00 RT	0.70	12 c	25.0	67.12	67.25	0.520	68.03	68.04	0.02	68.06	50
52	Sta 16+13 LT (2)	0.08	15 c	40.0	66.60	67.00	1.000	66.70	67.11	n/a	67.11	40
53	Existing	0.05	15 c	18.0	67.68	67.96	1.556	67.75	68.05	0.03	68.05	52
54	Bus Station	5.62	15 c	34.0	62.57	62.92	1.029	63.49	63.87	0.49	64.36	47

System 2 | Number of lines: 54 | Run Date: 06-25-2010

NOTES: c = cir; e = ellip; b = box; Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	12.8	0.00	10.86	0.00	0.00	8.58	0.0	26.7	3.0	25.70	14.90	6.48	30	0.31	31.40	31.36	33.47	33.10	41.10	41.10	Exist. Flatbush
2	1	92.9	0.00	10.86	0.00	0.00	8.58	20.0	26.4	3.0	25.87	27.10	5.70	30	1.03	32.41	31.45	34.48	33.76	46.06	41.10	Exist. Flatbush
3	2	14.0	0.01	0.07	0.90	0.01	0.06	5.0	6.0	5.7	0.36	5.64	3.15	12	5.93	41.29	40.46	41.54	40.63	44.99	46.06	Exist. Flatbush
4	3	25.5	0.06	0.06	0.90	0.05	0.05	5.0	5.0	6.0	0.32	6.34	1.82	12	7.50	43.20	41.29	43.44	41.62	45.00	44.99	Exist. Flatbush
5	2	82.1	0.00	10.79	0.00	0.00	8.52	20.0	26.1	3.0	25.83	27.91	5.29	30	1.10	33.41	32.51	35.82	35.11	46.26	46.06	Exist. Flatbush
6	5	12.2	0.05	0.21	0.90	0.05	0.19	5.0	8.6	5.1	0.96	3.24	3.34	12	1.96	41.50	41.26	41.92	41.63	45.20	46.26	Exist. Flatbush
7	6	69.6	0.00	0.16	0.00	0.00	0.14	0.0	7.6	5.3	0.76	1.42	1.60	12	0.37	41.76	41.50	42.30	42.13	45.96	45.20	Exist. Flatbush
8	7	4.2	0.04	0.04	0.90	0.04	0.04	5.0	5.0	6.0	0.22	5.55	0.61	12	5.74	42.00	41.76	42.38	42.38	45.50	45.96	Exist. Flatbush
9	7	59.5	0.03	0.12	0.90	0.03	0.11	5.0	6.3	5.6	0.61	1.53	1.39	12	0.44	42.02	41.76	42.50	42.39	45.72	45.96	Exist. Flatbush
10	9	49.5	0.09	0.09	0.90	0.08	0.08	5.0	5.0	6.0	0.49	2.91	1.82	12	1.58	42.80	42.02	43.10	42.56	46.10	45.72	Exist. Flatbush
11	5	299.2	0.00	10.58	0.00	0.00	8.33	0.0	25.2	3.1	25.80	17.23	5.26	30	0.42	40.91	39.66	44.96	42.16	47.31	46.26	Exist. Flatbush
12	11	26.6	0.21	0.21	0.90	0.19	0.19	5.0	5.0	6.0	1.13	4.16	1.44	12	3.24	43.97	43.11	45.76	45.70	48.07	47.31	Exist. Flatbush
13	11	64.3	0.36	0.36	0.90	0.32	0.32	5.0	5.0	6.0	1.94	2.57	2.47	12	1.23	42.00	41.21	46.09	45.64	47.04	47.31	Exist. Flatbush
14	11	207.0	0.00	10.01	0.00	0.00	7.82	10.0	24.5	3.1	24.59	35.83	5.57	30	1.81	45.15	41.41	47.06	45.34	53.05	47.31	Exist. Flatbush
15	14	5.6	0.22	0.37	0.90	0.20	0.33	5.0	7.5	5.3	1.78	7.29	1.45	15	3.02	46.22	46.05	48.02	48.01	52.12	53.05	Exist. Flatbush
16	15	18.0	0.00	0.15	0.00	0.00	0.14	0.0	7.0	5.4	0.73	12.32	1.64	15	8.61	47.87	46.32	48.21	48.06	53.07	52.12	Exist. Flatbush
17	16	79.3	0.15	0.15	0.90	0.14	0.14	5.0	5.0	6.0	0.81	2.36	1.74	15	0.32	48.12	47.87	48.63	48.38	55.35	53.07	Exist. Flatbush
18	14	92.5	0.00	9.64	0.00	0.00	7.48	0.0	24.1	3.2	23.72	30.62	5.62	30	1.32	46.47	45.25	48.24	47.68	54.77	53.05	Exist. Flatbush
19	18	85.0	0.00	9.64	0.00	0.00	7.48	10.0	23.9	3.2	23.88	39.75	7.62	30	2.22	49.06	47.17	50.69	48.60	59.00	54.77	Exist. Flatbush
20	19	63.0	0.26	9.64	0.90	0.23	7.48	5.0	23.6	3.2	24.00	58.00	8.35	30	2.00	53.29	52.03	55.39	53.15	61.50	59.00	FB-Sta 22+00 RT
21	20	18.0	0.00	4.04	0.00	0.00	2.93	0.0	23.6	3.2	9.41	14.85	7.11	18	2.00	55.81	55.45	57.31	56.32	60.00	61.50	FB-Sta 21+87 RT

System 2 | Number of lines: 54 | Run Date: 06-25-2010

NOTES: Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80; Return period = 10 Yrs.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
22	21	210.0	0.00	4.04	0.00	0.00	2.93	0.0	22.9	3.3	9.55	14.85	5.93	18	2.00	60.27	56.07	61.45	57.52	65.00	60.00	FB-Sta 19+72 RT
23	22	97.0	0.00	4.04	0.00	0.00	2.93	0.0	22.7	3.3	9.62	10.50	6.58	18	1.00	62.91	61.94	64.10	63.07	68.50	65.00	FB-Sta 54+00 RT
24	23	84.0	0.00	4.04	0.00	0.00	2.93	0.0	22.4	3.3	9.68	10.50	6.59	18	1.00	65.24	64.40	66.43	65.54	72.00	68.50	FB-Sta 53+15 RT
25	24	20.0	0.15	4.04	0.90	0.14	2.93	5.0	22.4	3.3	9.69	10.50	5.48	18	1.00	65.44	65.24	67.42	67.25	77.00	72.00	FB-Sta 53+15 RT
26	25	33.0	0.11	3.89	0.90	0.10	2.80	5.0	22.2	3.3	9.27	10.50	5.24	18	1.00	65.77	65.44	67.95	67.69	77.00	77.00	FB-Sta 53+15 LT
27	26	40.0	0.00	2.87	0.00	0.00	2.01	0.0	20.1	3.5	7.02	10.50	3.98	18	1.00	66.17	65.77	69.27	69.09	79.02	77.00	FB-Sta 53+60 LT
28	27	30.0	2.87	2.87	0.70	2.01	2.01	20.0	20.0	3.5	7.05	10.50	3.99	18	1.00	66.47	66.17	69.59	69.46	71.00	79.02	FB-Sta 53+75 LT
29	26	184.0	0.66	0.91	0.70	0.46	0.69	20.0	20.0	3.5	2.41	10.50	1.96	18	1.00	68.66	66.82	69.45	69.31	73.00	77.00	FB-Sta 51+27 LT
30	29	34.0	0.25	0.25	0.90	0.23	0.23	5.0	5.0	6.0	1.35	10.50	1.51	18	1.00	69.00	68.66	69.63	69.64	73.00	73.00	FB-Sta 51+27 RT
31	20	56.0	0.24	5.02	0.90	0.22	4.03	5.0	22.2	3.3	13.39	41.01	2.73	30	1.00	53.85	53.29	56.49	56.43	61.50	61.50	FB-Sta 22+00 LT
32	20	330.0	0.07	0.32	0.90	0.06	0.29	5.0	5.6	5.8	1.67	9.75	6.54	12	7.50	81.37	56.62	81.92	56.90	85.00	61.50	FB-Sta 18+70 RT
33	32	63.0	0.25	0.25	0.90	0.23	0.23	5.0	5.0	6.0	1.35	3.56	2.85	12	1.00	82.00	81.37	82.49	82.10	85.00	85.00	FB-Sta 18+70 LT
34	31	15.0	0.09	4.78	0.90	0.08	3.81	5.0	22.1	3.3	12.70	41.01	2.59	30	1.00	54.00	53.85	56.65	56.63	60.00	61.50	FB-Sta 21+85 LT
35	34	156.0	0.31	4.69	0.90	0.28	3.73	5.0	21.3	3.4	12.66	41.01	3.85	30	1.00	55.56	54.00	56.82	56.76	64.00	60.00	FB-Sta 20+25 LT
36	35	222.0	0.16	4.38	0.90	0.14	3.45	5.0	20.3	3.5	12.04	29.00	4.32	30	0.50	56.67	55.56	57.83	57.33	70.00	64.00	FB-Sta 17+90 LT
37	36	63.0	0.00	4.22	0.00	0.00	3.31	0.0	19.9	3.5	11.63	29.23	5.46	30	0.51	60.75	60.43	61.90	61.53	70.00	70.00	FB-Sta 17+29 LT
38	37	90.0	0.00	4.22	0.00	0.00	3.31	0.0	19.5	3.6	11.77	29.00	3.86	30	0.50	61.20	60.75	62.52	62.49	69.00	70.00	FB-Sta 16+26 LT
39	38	3.0	0.09	4.22	0.90	0.08	3.31	5.0	19.5	3.6	11.77	47.36	3.44	30	1.33	61.24	61.20	62.86	62.87	69.38	69.00	Sta 351+98 LT
40	39	4.0	0.70	1.86	0.90	0.63	1.67	5.0	19.5	3.6	5.96	22.62	4.78	24	1.00	63.29	63.25	64.36	63.95	69.00	69.38	FB-Sta 16+13 LT
41	40	222.0	0.00	1.14	0.00	0.00	1.03	0.0	6.0	5.7	5.85	12.08	5.25	15	3.50	71.09	63.32	72.06	64.64	78.00	69.00	FB-Sta 13+65 LT
42	41	8.0	0.47	1.02	0.90	0.42	0.92	5.0	5.7	5.8	5.32	6.46	5.24	15	1.00	71.17	71.09	72.10	72.10	78.00	78.00	FB-Sta 13+65 LT

System 2 | Number of lines: 54 | Run Date: 06-25-2010

NOTES: Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80; Return period = 10 Yrs.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
43	42	62.0	0.08	0.55	0.90	0.07	0.50	5.0	5.4	5.9	2.91	3.56	3.70	12	1.00	71.79	71.17	72.99	72.58	78.00	78.00	FB-ta 13+70 RT
44	43	73.0	0.47	0.47	0.90	0.42	0.42	5.0	5.0	6.0	2.53	3.56	3.23	12	1.00	72.52	71.79	73.59	73.22	76.00	78.00	FB-Sta 104+70 R
45	41	50.0	0.12	0.12	0.90	0.11	0.11	5.0	5.0	6.0	0.65	3.56	0.83	12	1.00	71.59	71.09	72.56	72.55	77.00	78.00	FB-Sta. 106+50
46	39	25.0	0.09	0.09	0.90	0.08	0.08	5.0	5.0	6.0	0.49	2.57	2.49	12	0.52	66.00	65.87	66.30	66.16	69.38	69.38	Sta 351+98 RT
47	39	135.0	0.00	2.18	0.00	0.00	1.47	0.0	8.4	5.1	7.56	40.71	3.18	30	0.99	62.57	61.24	63.49	63.32	70.05	69.38	Sta 350+57.7 LT
48	47	103.0	0.09	0.44	0.90	0.08	0.40	5.0	7.8	5.3	2.08	2.53	3.60	12	0.50	64.89	64.37	65.58	65.06	70.28	70.05	Sta 349+50 LT(2)
49	48	25.0	0.09	0.09	0.90	0.08	0.08	5.0	5.0	6.0	0.49	2.57	2.49	12	0.52	66.75	66.62	67.05	66.91	70.28	70.28	Sta 349+50 RT
50	48	246.0	0.13	0.26	0.90	0.12	0.23	5.0	5.5	5.9	1.37	2.52	3.27	12	0.50	67.12	65.89	67.65	66.42	70.87	70.28	Sta 347+00 LT
51	50	25.0	0.13	0.13	0.90	0.12	0.12	5.0	5.0	6.0	0.70	2.57	0.99	12	0.52	67.25	67.12	68.04	68.03	70.87	70.87	Sta. 347+00 RT
52	40	40.0	0.01	0.02	0.90	0.01	0.02	5.0	11.8	4.5	0.08	6.46	1.63	15	1.00	67.00	66.60	67.11	66.70	70.50	69.00	Sta 16+13 LT (2)
53	52	18.0	0.01	0.01	0.90	0.01	0.01	5.0	5.0	6.0	0.05	8.05	1.58	15	1.56	67.96	67.68	68.05	67.75	70.66	70.50	Existing
54	47	34.0	1.74	1.74	0.62	1.08	1.08	8.0	8.0	5.2	5.62	6.55	5.69	15	1.03	62.92	62.57	63.87	63.49	69.72	70.05	Bus Station

System 2 | Number of lines: 54 | Run Date: 06-25-2010

NOTES: Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80; Return period = 10 Yrs.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet Ht (in)	Curb Inlet L (ft)	Grate Inlet area (sqft)	Grate Inlet L (ft)	Grate Inlet W (ft)	Gutter So (ft/ft)	Gutter W (ft)	Gutter Sw (ft/ft)	Gutter Sx (ft/ft)	Gutter n	Gutter Depth (ft)	Gutter Spread (ft)	Inlet Depth (ft)	Inlet Spread (ft)	Inlet Depr (in)	Byp line No
1	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
2	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
3	Exist. Flatbush	0.05	0.00	0.05	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.02	0.80	0.03	0.41	2.00	Off
4	Exist. Flatbush	0.32	0.00	0.32	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.03	1.60	0.05	0.78	2.00	3
5	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
6	Exist. Flatbush	0.27	0.00	0.27	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.03	1.50	0.04	0.73	2.00	4
7	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
8	Exist. Flatbush	0.22	0.00	0.22	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.03	1.35	0.04	0.66	2.00	6
9	Exist. Flatbush	0.16	0.00	0.16	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.03	1.25	0.04	0.60	2.00	8
10	Exist. Flatbush	0.49	0.00	0.49	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.04	1.85	0.06	0.91	2.00	9
11	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
12	Exist. Flatbush	1.13	0.00	1.13	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.05	2.50	0.08	1.23	2.00	Off
13	Exist. Flatbush	1.94	0.00	0.12	1.82	Curb	6.0	2.31	0.00	0.00	0.00	2.500	4.00	0.020	0.020	0.013	0.06	3.05	0.09	1.51	2.00	Off
14	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
15	Exist. Flatbush	1.19	0.00	1.19	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.05	2.55	0.08	1.26	2.00	Off
16	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
17	Exist. Flatbush	0.81	0.00	0.81	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.04	2.20	0.07	1.09	2.00	13
18	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
19	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
20	FB-Sta 22+00 RT	1.40	0.00	1.40	0.00	Comb	6.0	2.31	0.00	2.31	1.35	7.499	4.00	0.080	0.020	0.013	0.07	0.92	0.07	1.09	2.00	15
21	FB-Sta 21+87 RT	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
22	FB-Sta 19+72 RT	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off

System 2 | Number of lines: 54 | Run Date: 06-25-2010

NOTES: Inlet N-Values = 0.016 ; Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80; Return period = 10 Yrs. ; * Indicates Known Q added

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
23	FB-Sta 54+00 RT	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
24	FB-Sta 53+15 RT	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
25	FB-Sta 53+15 RT	0.81	0.00	0.81	0.00	Comb	6.0	2.31	0.00	2.31	1.35	4.500	4.00	0.040	0.020	0.013	0.05	1.27	0.06	0.97	2.00	Off
26	FB-Sta 53+15 LT	0.59	0.00	0.59	0.00	Comb	6.0	2.31	0.00	2.31	1.35	4.500	4.00	0.040	0.020	0.013	0.05	1.15	0.05	0.88	2.00	28
27	FB-Sta 53+60 LT	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
28	FB-Sta 53+75 LT	7.05	0.00	7.05	0.00	Comb	6.0	2.31	3.13	2.31	1.35	Sag	4.00	0.020	0.020	0.000	0.44	22.17	0.61	22.17	2.00	Off
29	FB-Sta 51+27 LT	1.62	0.00	1.62	0.00	Comb	6.0	2.31	3.13	2.31	1.35	Sag	4.00	0.020	0.020	0.000	0.06	3.17	0.23	3.73	2.00	Off
30	FB-Sta 51+27 RT	1.35	0.00	1.35	0.00	Comb	6.0	2.31	3.13	2.31	1.35	Sag	4.00	0.020	0.020	0.000	0.04	2.17	0.21	3.41	2.00	Off
31	FB-Sta 22+00 LT	1.29	0.00	1.29	0.00	Comb	6.0	2.31	0.00	2.31	1.35	7.500	4.00	0.040	0.020	0.013	0.06	1.40	0.06	1.05	2.00	20
32	FB-Sta 18+70 RT	0.38	0.00	0.38	0.00	Comb	6.0	2.31	0.00	2.31	1.35	7.500	4.00	0.040	0.020	0.013	0.04	0.87	0.04	0.66	2.00	17
33	FB-Sta 18+70 LT	1.35	0.00	1.35	0.00	Grate	6.0	2.31	0.00	2.31	1.35	7.500	4.00	0.040	0.020	0.013	0.06	1.42	0.07	1.07	2.00	26
34	FB-Sta 21+85 LT	0.49	0.00	0.49	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.040	0.020	0.013	0.05	1.20	0.06	0.91	2.00	Off
35	FB-Sta 20+25 LT	1.67	0.00	1.67	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.040	0.020	0.013	0.07	1.87	0.09	1.43	2.00	34
36	FB-17+90 LT	0.86	0.00	0.86	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.040	0.020	0.013	0.06	1.47	0.07	1.12	2.00	35
37	FB-Sta 17+29 LT	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
38	FB-Sta 16+26 LT	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
39	Sta 351+98 LT	0.49	0.00	0.49	0.00	Comb	6.0	2.31	0.00	2.31	1.35	0.003	4.00	0.040	0.020	0.013	0.17	4.30	0.20	3.16	2.00	Off
40	FB-Sta 16+13 LT	3.77	0.00	3.77	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.040	0.020	0.013	0.10	2.55	0.12	1.95	2.00	39
41	FB-Sta 13+65 LT	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
42	FB-Sta 13+65 LT	2.53	0.00	2.53	0.00	Comb	6.0	2.31	0.00	2.31	1.35	7.500	4.00	0.040	0.020	0.013	0.07	1.80	0.08	1.36	2.00	45
43	FB-Sta 13+70 RT	0.43	0.00	0.43	0.00	Comb	6.0	2.31	0.00	2.31	1.35	7.500	4.00	0.040	0.020	0.013	0.04	0.92	0.04	0.71	2.00	44
44	FB-Sta 104+70 R	2.53	0.00	2.53	0.00	Comb	6.0	2.31	0.00	2.31	1.35	7.500	4.00	0.040	0.020	0.013	0.07	1.80	0.08	1.36	2.00	Off

System 2 | Number of lines: 54 | Run Date: 06-25-2010

NOTES: Inlet N-Values = 0.016 ; Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80; Return period = 10 Yrs. ; * Indicates Known Q added

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
45	FB-106+50 RT	0.65	0.00	0.65	0.00	Comb	6.0	2.31	0.00	2.31	1.35	7.500	4.00	0.040	0.020	0.013	0.04	1 08	0.05	0.83	2.00	Off
46	Sta 351+98 RT	0.49	0.00	0.49	0.00	Comb	6.0	2.31	0.00	2.31	1.35	0.003	4.00	0.040	0.020	0.013	0.17	4.30	0.20	3.16	2.00	52
47	Sta 350+57.7 LT	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
48	Sta 349+50 LT	0.49	0.00	0.49	0.00	Comb	6.0	2.31	0.00	2.31	1.35	0.003	4.00	0.040	0.020	0.013	0.17	4.35	0.20	3.18	2.00	47
49	Sta 349+50 RT	0.49	0.00	0.49	0.00	Comb	6.0	2.31	0.00	2.31	1.35	0.003	4.00	0.040	0.020	0.013	0.17	4.35	0.20	3.18	2.00	46
50	Sta 347+00 LT	0.70	0.00	0.70	0.00	Comb	6.0	2.31	0.00	2.31	1.35	0.003	4.00	0.040	0.020	0.013	0.19	5.50	0.22	3.63	2.00	48
51	Sta. 347+00 RT	0.70	0.00	0.70	0.00	Grate	6.0	2.31	0.00	2.31	1.35	0.003	4.00	0.040	0.020	0.013	0.19	5.50	0.22	3.63	2.00	49
52	Sta 16+13 LT (2)	0.05	0.00	0.05	0.00	Comb	6.0	2.31	0.00	2.31	1.35	0.005	4.00	0.040	0.020	0.013	0.07	1.67	0.08	1.26	2.00	Off
53	Existing	0.05	0.00	0.05	0.00	Comb	6.0	2.31	0.00	2.31	1.35	0.005	4.00	0.040	0.020	0.013	0.07	1.67	0.08	1.26	2.00	52
54	Bus Station	5.62	0.00	0.00	5.62	MH	6.0	6.00	2.00	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.00	0.00	0.00	0.00	0.00	Off

System 2 | Number of lines: 54 | Run Date: 06-25-2010

NOTES: Inlet N-Values = 0.016 ; Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80; Return period = 10 Yrs. ; * Indicates Known Q added

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	30	25.70	31.36	33.10	1.74	3.65	7.05	0.77	33.87	1.346	12.8	31.40	33.47	2.07	4.35	5.91	0.54	34.02	0.911	1.129	0.144	0.33	0.18
2	30	25.87	31.45	33.76	2.31	4.74	5.46	0.46	34.23	0.816	92.9	32.41	34.48	2.07	4.35	5.95	0.55	35.03	0.923	0.870	0.808	0.92	0.51
3	12	0.36	40.46	40.63	0.17*	0.09	4.01	0.25	40.88	5.913	14.0	41.29	41.54	0.25**	0.16	2.28	0.08	41.63	1.202	3.557	n/a	1.37	0.11
4	12	0.32	41.29	41.62	0.33	0.23	1.42	0.03	41.65	0.343	25.5	43.20	43.44 j	0.24**	0.15	2.22	0.08	43.52	1.200	0.772	n/a	1.00	0.08
5	30	25.83	32.51	35.11	2.50	4.91	5.26	0.43	35.54	0.939	82.1	33.41	35.82	2.41	4.85	5.32	0.44	36.26	0.821	0.880	0.722	0.90	0.40
6	12	0.96	41.26	41.63	0.37*	0.27	3.59	0.20	41.83	1.959	12.2	41.50	41.92	0.42**	0.31	3.08	0.15	42.07	1.290	1.625	0.199	1.34	0.20
7	12	0.76	41.50	42.13	0.63	0.52	1.46	0.03	42.17	0.206	69.6	41.76	42.30	0.54	0.44	1.75	0.05	42.35	0.329	0.267	0.186	1.00	0.05
8	12	0.22	41.76	42.38	0.62	0.51	0.42	0.00	42.38	0.017	4.2	42.00	42.38	0.38	0.27	0.80	0.01	42.39	0.096	0.057	0.002	1.00	0.01
9	12	0.61	41.76	42.39	0.63	0.52	1.16	0.02	42.41	0.131	59.5	42.02	42.50	0.48	0.37	1.62	0.04	42.54	0.312	0.221	0.132	0.50	0.02
10	12	0.49	42.02	42.56	0.54	0.43	1.13	0.02	42.58	0.138	49.5	42.80	43.10 j	0.30**	0.19	2.50	0.10	43.19	1.216	0.677	n/a	1.00	n/a
11	30	25.80	39.66	42.16	2.50*	4.91	5.26	0.43	42.59	0.937	299	40.91	44.96	2.50	4.91	5.26	0.43	45.39	0.937	0.937	2.804	0.79	0.34
12	12	1.13	43.11	45.70	1.00	0.79	1.44	0.03	45.73	0.239	26.6	43.97	45.76	1.00	0.79	1.44	0.03	45.80	0.239	0.239	0.064	1.00	0.03
13	12	1.94	41.21	45.64	1.00	0.79	2.47	0.09	45.73	0.703	64.3	42.00	46.09	1.00	0.79	2.47	0.09	46.18	0.703	0.703	0.452	1.00	0.09
14	30	24.59	41.41	45.34	2.50	4.91	5.01	0.39	45.73	0.852	207	45.15	47.06	1.91	4.01	6.13	0.58	47.64	0.986	0.919	1.902	0.69	0.40
15	15	1.78	46.05	48.01	1.25	1.23	1.45	0.03	48.04	0.179	5.6	46.22	48.02	1.25	1.23	1.45	0.03	48.05	0.179	0.179	0.010	0.50	0.02
16	15	0.73	46.32	48.06	1.25	1.23	0.60	0.01	48.07	0.031	18.0	47.87	48.21 j	0.34**	0.27	2.69	0.11	48.33	1.131	0.581	n/a	0.15	0.02
17	15	0.81	47.87	48.38	0.51*	0.46	1.74	0.05	48.42	0.315	79.3	48.12	48.63	0.51	0.46	1.74	0.05	48.67	0.315	0.315	0.250	1.00	0.05
18	30	23.72	45.25	47.68	2.43	4.87	4.87	0.37	48.05	0.698	92.5	46.47	48.24	1.77	3.72	6.37	0.63	48.87	1.091	0.895	0.828	0.15	0.09
19	30	23.88	47.17	48.60	1.43	2.90	8.22	1.05	49.65	2.059	85.0	49.06	50.69	1.63**	3.40	7.03	0.77	51.46	1.382	1.721	n/a	0.15	0.12
20	30	24.00	52.03	53.15	1.12*	2.13	11.25	1.97	55.12	1.998	63.0	53.29	55.39	2.10	4.41	5.45	0.46	55.85	0.328	1.163	0.733	1.50	0.69
21	18	9.41	55.45	56.32	0.87*	1.06	8.89	1.23	57.55	2.000	18.0	55.81	57.31	1.50	1.77	5.32	0.44	57.75	0.789	1.395	0.251	0.48	0.21

System 2 | Number of lines: 54 | Run Date: 06-25-2010

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
22	18	9.55	56.07	57.52	1.45	1.75	5.46	0.46	57.98	0.726	210	60.27	61.45 j	1.18**	1.49	6.41	0.64	62.09	0.896	0.811	n/a	0.99	n/a
23	18	9.62	61.94	63.07	1.13*	1.43	6.74	0.71	63.78	0.999	97.0	62.91	64.10	1.19**	1.50	6.41	0.64	64.74	0.898	0.948	0.920	0.15	0.10
24	18	9.68	64.40	65.54	1.14*	1.44	6.74	0.71	66.24	1.000	84.0	65.24	66.43	1.19**	1.50	6.43	0.64	67.07	0.903	0.951	0.799	1.00	0.64
25	18	9.69	65.24	67.25	1.50	1.77	5.48	0.47	67.72	0.852	20.0	65.44	67.42	1.50	1.77	5.48	0.47	67.89	0.851	0.852	0.170	0.50	0.23
26	18	9.27	65.44	67.69	1.50	1.77	5.24	0.43	68.12	0.779	33.0	65.77	67.95	1.50	1.77	5.24	0.43	68.38	0.779	0.779	0.257	2.25	0.96
27	18	7.02	65.77	69.09	1.50	1.77	3.98	0.25	69.34	0.448	40.0	66.17	69.27	1.50	1.77	3.97	0.25	69.52	0.447	0.448	0.179	0.75	0.18
28	18	7.05	66.17	69.46	1.50	1.77	3.99	0.25	69.71	0.451	30.0	66.47	69.59	1.50	1.77	3.99	0.25	69.84	0.450	0.450	0.135	1.00	0.25
29	18	2.41	66.82	69.31	1.50	1.77	1.36	0.03	69.34	0.053	184	68.66	69.45	0.79	0.94	2.55	0.10	69.55	0.177	0.115	0.211	1.50	0.15
30	18	1.35	68.66	69.64	0.98	1.22	1.10	0.02	69.66	0.028	34.0	69.00	69.63	0.63	0.70	1.92	0.06	69.69	0.122	0.075	0.026	1.00	0.06
31	30	13.39	53.29	56.43	2.50	4.91	2.73	0.12	56.55	0.107	56.0	53.85	56.49	2.50	4.91	2.73	0.12	56.61	0.107	0.107	0.060	1.13	0.13
32	12	1.67	56.62	56.90	0.28*	0.18	9.28	1.34	58.24	7.495	330	81.37	81.92	0.55**	0.44	3.79	0.22	82.14	0.649	4.072	n/a	1.50	n/a
33	12	1.35	81.37	82.10	0.73	0.61	2.21	0.08	82.17	0.186	63.0	82.00	82.49 j	0.49**	0.39	3.50	0.19	82.68	0.604	0.395	n/a	1.00	0.19
34	30	12.70	53.85	56.63	2.50	4.91	2.59	0.10	56.74	0.096	15.0	54.00	56.65	2.50	4.91	2.59	0.10	56.75	0.096	0.096	0.014	1.04	0.11
35	30	12.66	54.00	56.76	2.50	4.91	2.58	0.10	56.86	0.095	156	55.56	56.82	1.26	2.47	5.12	0.41	57.22	0.373	0.234	0.365	0.50	0.20
36	30	12.04	55.56	57.33	1.77	3.73	3.23	0.16	57.50	0.119	222	56.67	57.83	1.16**	2.23	5.40	0.45	58.28	0.446	0.283	n/a	0.72	n/a
37	30	11.63	60.43	61.53	1.10*	2.07	5.61	0.49	62.02	0.507	63.0	60.75	61.90	1.15**	2.20	5.30	0.44	62.33	0.434	0.471	0.297	0.56	0.24
38	30	11.77	60.75	62.49	1.74	3.64	3.23	0.16	62.65	0.120	90.0	61.20	62.52	1.32	2.62	4.50	0.31	62.83	0.278	0.199	0.179	0.75	0.24
39	30	11.77	61.20	62.87	1.67	3.48	3.38	0.18	63.05	0.134	3.0	61.24	62.86	1.62	3.37	3.49	0.19	63.05	0.145	0.139	0.004	1.61	0.31
40	24	5.96	63.25	63.95	0.70*	0.98	6.07	0.57	64.52	0.999	4.0	63.29	64.36	1.07	1.71	3.49	0.19	64.55	0.222	0.610	0.024	1.50	0.28
41	15	5.85	63.32	64.64	1.25	1.23	4.77	0.35	65.00	0.820	222	71.09	72.06 j	0.97**	1.02	5.74	0.51	72.57	0.918	0.869	n/a	1.00	0.51
42	15	5.32	71.09	72.10	1.01	1.06	5.03	0.39	72.49	0.703	8.0	71.17	72.10	0.93**	0.97	5.46	0.46	72.56	0.841	0.772	0.062	0.50	0.23

System 2 | Number of lines: 54 | Run Date: 06-25-2010

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
43	12	2.91	71.17	72.58	1.00	0.79	3.71	0.21	72.79	0.668	62.0	71.79	72.99	1.00	0.79	3.70	0.21	73.21	0.668	0.668	0.414	0.83	0.18
44	12	2.53	71.79	73.22	1.00	0.79	3.23	0.16	73.38	0.506	73.0	72.52	73.59	1.00	0.79	3.23	0.16	73.75	0.506	0.506	0.370	1.00	0.16
45	12	0.65	71.09	72.55	1.00	0.79	0.82	0.01	72.56	0.033	50.0	71.59	72.56	0.97	0.78	0.83	0.01	72.57	0.029	0.031	0.016	1.00	0.01
46	12	0.49	65.87	66.16	0.29*	0.19	2.51	0.10	66.26	0.519	25.0	66.00	66.30	0.30**	0.20	2.47	0.10	66.39	0.499	0.509	0.127	1.00	0.10
47	30	7.56	61.24	63.32	2.08	4.37	1.73	0.05	63.37	0.033	135	62.57	63.49 j	0.92**	1.64	4.62	0.33	63.82	0.409	0.221	n/a	0.80	0.27
48	12	2.08	64.37	65.06	0.69*	0.58	3.60	0.20	65.26	0.505	103	64.89	65.58	0.69	0.58	3.60	0.20	65.78	0.506	0.505	0.520	1.50	0.30
49	12	0.49	66.62	66.91	0.29*	0.19	2.51	0.10	67.01	0.519	25.0	66.75	67.05	0.30**	0.20	2.47	0.10	67.14	0.499	0.509	0.127	1.00	0.10
50	12	1.37	65.89	66.42	0.53*	0.42	3.27	0.17	66.58	0.499	246	67.12	67.65	0.53	0.42	3.27	0.17	67.81	0.498	0.499	1.227	1.50	0.25
51	12	0.70	67.12	68.03	0.91	0.75	0.93	0.01	68.05	0.034	25.0	67.25	68.04	0.79	0.67	1.05	0.02	68.06	0.041	0.038	0.009	1.00	0.02
52	15	0.08	66.60	66.70	0.10*	0.04	1.81	0.05	66.75	0.999	40.0	67.00	67.11	0.11**	0.06	1.45	0.03	67.15	0 534	0.767	n/a	1.50	n/a
53	15	0.05	67.68	67.75	0.07*	0.03	1.86	0.05	67.81	1.552	18.0	67.96	68.05	0.09**	0.04	1.31	0.03	68.08	0.560	1.056	n/a	1.00	0.03
54	15	5.62	62.57	63.49	0.92	0.97	5.78	0.52	64.01	0.942	34.0	62.92	63.87	0.95**	1.00	5.61	0.49	64.36	0.881	0.912	0.310	1.00	0.49

System 2 | Number of lines: 54 | Run Date: 06-25-2010

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump.

Tc

Line No.	Inlet ID	Inlet Time (min)	Tc (min)	n-val Pipe
1	Exist. Flatbush	0.0	26.7	0.020
2	Exist. Flatbush	20.0	26.4	0.020
3	Exist. Flatbush	5.0	6.0	0.020
4	Exist. Flatbush	5.0	5.0	0.020
5	Exist. Flatbush	20.0	26.1	0.020
6	Exist. Flatbush	5.0	8.6	0.020
7	Exist. Flatbush	0.0	7.6	0.020
8	Exist. Flatbush	5.0	5.0	0.020
9	Exist. Flatbush	5.0	6.3	0.020
10	Exist. Flatbush	5.0	5.0	0.020
11	Exist. Flatbush	0.0	25.2	0.020
12	Exist. Flatbush	5.0	5.0	0.020
13	Exist. Flatbush	5.0	5.0	0.020
14	Exist. Flatbush	10.0	24.5	0.020
15	Exist. Flatbush	5.0	7.5	0.020
16	Exist. Flatbush	0.0	7.0	0.020
17	Exist. Flatbush	5.0	5.0	0.020
18	Exist. Flatbush	0.0	24.1	0.020
19	Exist. Flatbush	10.0	23.9	0.020
20	FB-Sta 22+00 RT	5.0	23.6	0.013
21	FB-Sta 21+87 RT (MH)	0.0	23.6	0.013

System 2 | Number of lines: 54 | Date: 06-25-2010

NOTES: ** Critical depth

Line No.	Inlet ID	Inlet Time (min)	Tc (min)	n-val Pipe
22	FB-Sta 19+72 RT	0.0	22.9	0.013
23	FB-Sta 54+00 RT	0.0	22.7	0.013
24	FB-Sta 53+15 RT (MH)	0.0	22.4	0.013
25	FB-Sta 53+15 RT	5.0	22.4	0.013
26	FB-Sta 53+15 LT	5.0	22.2	0.013
27	FB-Sta 53+60 LT	0.0	20.1	0.013
28	FB-Sta 53+75 LT	20.0	20.0	0.013
29	FB-Sta 51+27 LT	20.0	20.0	0.013
30	FB-Sta 51+27 RT	5.0	5.0	0.013
31	FB-Sta 22+00 LT	5.0	22.2	0.013
32	FB-Sta 18+70 RT	5.0	5.6	0.013
33	FB-Sta 18+70 LT	5.0	5.0	0.013
34	FB-Sta 21+85 LT	5.0	22.1	0.013
35	FB-Sta 20+25 LT	5.0	21.3	0.013
36	FB-17+90 LT	5.0	20.3	0.013
37	FB-Sta 17+29 LT	0.0	19.9	0.013
38	FB-Sta 16+26 LT (EXIST)	0.0	19.5	0.013
39	Sta 351+98 LT	5.0	19.5	0.013
40	FB-Sta 16+13 LT	5.0	19.5	0.013
41	FB-Sta 13+65 LT	0.0	6.0	0.013
42	FB-Sta 13+65 LT	5.0	5.7	0.013

System 2 | Number of lines: 54 | Date: 06-25-2010

NOTES: ** Critical depth

Line No.	Inlet ID	Inlet Time (min)	Tc (min)	n-val Pipe
43	FB-Sta 13+70 RT	5.0	5.4	0.013
44	FB-Sta 104+70 RT	5.0	5.0	0.013
45	FB-106+50 RT	5.0	5.0	0.013
46	Sta 351+98 RT	5.0	5.0	0.013
47	Sta 350+57.7 LT	0.0	8.4	0.013
48	Sta 349+50 LT	5.0	7.8	0.013
49	Sta 349+50 RT	5.0	5.0	0.013
50	Sta 347+00 LT	5.0	5.5	0.013
51	Sta. 347+00 RT	5.0	5.0	0.013
52	Sta 16+13 LT (2)	5.0	11.8	0.013
53	Existing	5.0	5.0	0.013
54	Bus Station	8.0	8.0	0.013

System 2 | Number of lines: 54 | Date: 06-25-2010

NOTES: ** Critical depth

APPENDIX C

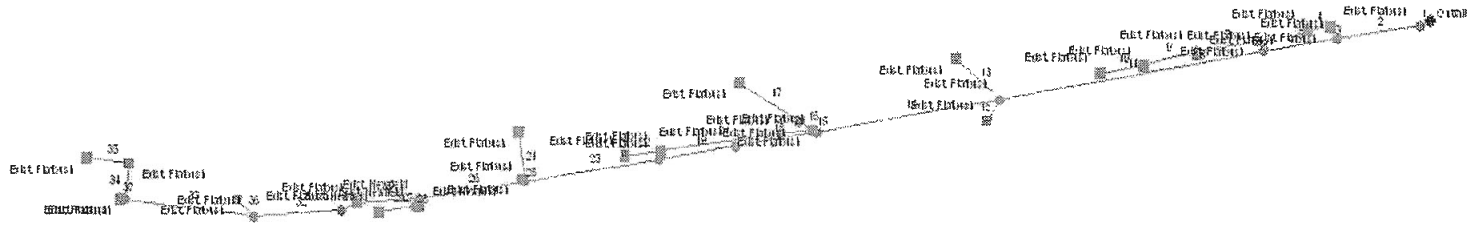
OUTLET PROTECTION

System 2 Outlet – Is proposed to discharge through an existing retaining wall structure at the Park River located east of the project limits. Thus outlet protection is not applicable.

APPENDIX D

EXISTING CONDITION DRAINAGE MODEL

Hydraflow Plan View



System 2-Revised Pre Condition	No. Lines: 37	06-01-2010

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	Exist. Flatbush	20.10	30 c	12.8	31.36	31.40	0.312	32.86	33.23	0.14	33.37	End
2	Exist. Flatbush	20.27	30 c	92.9	31.45	32.41	1.034	33.53	34.04	0.51	34.55	1
3	Exist. Flatbush	0.36	12 c	14.0	40.46	41.29	5.929	40.63	41.54	0.11	41.54	2
4	Exist. Flatbush	0.32	12 c	25.5	41.29	43.20	7.502	41.62	43.44	n/a	43.44 j	3
5	Exist. Flatbush	20.24	30 c	82.1	32.51	33.41	1.096	34.85	35.20	0.41	35.60	2
6	Exist. Flatbush	0.96	12 c	12.2	41.26	41.50	1.961	41.63	41.92	0.20	42.12	5
7	Exist. Flatbush	0.76	12 c	69.6	41.50	41.76	0.374	42.13	42.30	0.05	42.35	6
8	Exist. Flatbush	0.22	12 c	4.2	41.76	42.00	5.744	42.38	42.38	0.01	42.39	7
9	Exist. Flatbush	0.61	12 c	59.5	41.76	42.02	0.437	42.39	42.50	0.02	42.52	7
10	Exist. Flatbush	0.49	12 c	49.5	42.02	42.80	1.577	42.56	43.10	n/a	43.10 j	9
11	Exist. Flatbush	20.22	30 c	299.2	39.66	40.91	0.418	42.16*	43.88*	0.21	44.09	5
12	Exist. Flatbush	1.13	12 c	26.6	43.11	43.97	3.236	44.32	44.42	n/a	44.59 j	11
13	Exist. Flatbush	1.94	12 c	64.3	41.21	42.00	1.229	44.26*	44.71*	0.09	44.81	11
14	Exist. Flatbush	18.95	30 c	207.0	41.41	45.15	1.807	44.12	46.61	n/a	46.61 j	11
15	Exist. Flatbush	1.77	15 c	5.6	46.05	46.22	3.021	47.19	47.18	0.05	47.23	14
16	Exist. Flatbush	0.73	15 c	18.0	46.32	47.87	8.611	47.27	48.21	n/a	48.21 j	15
17	Exist. Flatbush	0.81	15 c	79.3	47.87	48.12	0.315	48.38	48.63	0.05	48.67	16
18	Exist. Flatbush	17.94	30 c	92.5	45.25	46.47	1.319	47.03	47.89	n/a	47.89 j	14
19	Exist. Flatbush	18.12	30 c	85.0	47.17	49.06	2.224	48.35	50.48	0.09	50.48	18
20	Exist. Flatbush	0.99	12 c	36.0	47.62	50.26	7.333	47.89	50.68	n/a	50.68	15
21	Exist. Flatbush	0.61	12 c	135.0	50.26	51.98	1.274	50.83	52.31	n/a	52.31 j	20
22	Exist. Flatbush	0.43	12 c	41.0	51.98	52.40	1.024	52.42	52.68	n/a	52.77 j	21
23	Exist. Flatbush	18.32	24 c	153.0	49.16	52.77	2.359	50.57	54.29	0.80	54.29	19
24	Exist. Flatbush	1.83	15 c	51.0	53.87	57.07	6.275	55.05	57.61	n/a	57.61 j	23
25	Exist. Flatbush	0.54	12 c	4.0	55.77	56.09	8.000	55.96	56.47	0.06	56.53	23
26	Exist. Newfield	17.12	24 c	121.0	53.17	55.38	1.826	54.62	56.85	n/a	56.85	23
27	Exist. Newfield	5.54	15 c	9.0	56.99	57.07	0.889	58.24*	58.40*	0.32	58.71	26
28	Exist. Newfield	2.16	15 c	6.0	60.57	61.22	10.833	60.90	62.21	0.07	62.28	27
29	Exist. Newfield	4.31	15 c	40.0	57.27	59.12	4.625	58.84	59.95	n/a	59.95 j	27
30	Exist. Flatbush	11.68	24 c	70.0	56.51	57.60	1.557	57.67	58.81	n/a	58.81	26
31	Exist. Flatbush	8.62	18 c	19.0	59.01	59.65	3.368	59.92	60.77	0.23	61.00	30
32	Exist. Flatbush	8.75	18 c	100.0	59.70	60.17	0.470	61.20*	62.84*	0.29	63.13	31

System 2-Revised Pre Condition | Number of lines: 37 | Run Date: 06-01-2010

NOTES: c = cir; e = ellip; b = box; Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
33	Exist. Flatbush	8.84	30 c	145.0	60.47	61.20	0.503	63.46	63.61	0.05	63.66	32
34	Exist. Flatbush	3.07	15 c	37.0	65.50	67.11	4.351	66.01	67.81	n/a	67.81	33
35	Exist. Flatbush	2.75	15 c	48.0	67.26	67.96	1.458	68.03	68.62	n/a	68.62 j	34
36	Exist. Flatbush	0.49	15 c	25.0	64.77	65.76	3.960	64.97	66.04	n/a	66.04	32
37	Exist. Flatbush	5.98	15 c	5.0	63.40	64.54	22.800	63.87*	67.28*	0.37	67.65	33

System 2-Revised Pre Condition | Number of lines: 37 | Run Date: 06-01-2010

NOTES: c = cir; e = ellip; b = box; Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	12.8	0.00	8.00	0.00	0.00	6.44	0.0	24.8	3.1	20.10	14.90	5.88	30	0.31	31.40	31.36	33.23	32.86	41.10	41.10	Exist. Flatbush
2	1	92.9	0.00	8.00	0.00	0.00	6.44	20.0	24.5	3.1	20.27	27.10	5.33	30	1.03	32.41	31.45	34.04	33.53	46.06	41.10	Exist. Flatbush
3	2	14.0	0.01	0.07	0.90	0.01	0.06	5.0	6.0	5.7	0.36	5.64	3.15	12	5.93	41.29	40.46	41.54	40.63	44.99	46.06	Exist. Flatbush
4	3	25.5	0.06	0.06	0.90	0.05	0.05	5.0	5.0	6.0	0.32	6.34	1.82	12	7.50	43.20	41.29	43.44	41.62	45.00	44.99	Exist. Flatbush
5	2	82.1	0.00	7.93	0.00	0.00	6.38	20.0	24.1	3.2	20.24	27.91	4.82	30	1.10	33.41	32.51	35.20	34.85	46.26	46.06	Exist. Flatbush
6	5	12.2	0.05	0.21	0.90	0.05	0.19	5.0	8.6	5.1	0.96	3.24	3.34	12	1.96	41.50	41.26	41.92	41.63	45.20	46.26	Exist. Flatbush
7	6	69.6	0.00	0.16	0.00	0.00	0.14	0.0	7.6	5.3	0.76	1.42	1.60	12	0.37	41.76	41.50	42.30	42.13	45.96	45.20	Exist. Flatbush
8	7	4.2	0.04	0.04	0.90	0.04	0.04	5.0	5.0	6.0	0.22	5.55	0.61	12	5.74	42.00	41.76	42.38	42.38	45.50	45.96	Exist. Flatbush
9	7	59.5	0.03	0.12	0.90	0.03	0.11	5.0	6.3	5.6	0.61	1.53	1.39	12	0.44	42.02	41.76	42.50	42.39	45.72	45.96	Exist. Flatbush
10	9	49.5	0.09	0.09	0.90	0.08	0.08	5.0	5.0	6.0	0.49	2.91	1.82	12	1.58	42.80	42.02	43.10	42.56	46.10	45.72	Exist. Flatbush
11	5	299.2	0.00	7.72	0.00	0.00	6.19	0.0	22.9	3.3	20.22	17.23	4.12	30	0.42	40.91	39.66	43.88	42.16	47.31	46.26	Exist. Flatbush
12	11	26.6	0.21	0.21	0.90	0.19	0.19	5.0	5.0	6.0	1.13	4.16	2.35	12	3.24	43.97	43.11	44.42	44.32	48.07	47.31	Exist. Flatbush
13	11	64.3	0.36	0.36	0.90	0.32	0.32	5.0	5.0	6.0	1.94	2.57	2.47	12	1.23	42.00	41.21	44.71	44.26	47.04	47.31	Exist. Flatbush
14	11	207.0	0.00	7.15	0.00	0.00	5.68	10.0	21.9	3.3	18.95	35.83	5.13	30	1.81	45.15	41.41	46.61	44.12	53.05	47.31	Exist. Flatbush
15	14	5.6	0.03	0.40	0.90	0.03	0.36	5.0	9.4	4.9	1.77	7.29	1.63	15	3.02	46.22	46.05	47.18	47.19	52.12	53.05	Exist. Flatbush
16	15	18.0	0.00	0.15	0.00	0.00	0.14	0.0	7.0	5.4	0.73	12.32	1.71	15	8.61	47.87	46.32	48.21	47.27	53.07	52.12	Exist. Flatbush
17	16	79.3	0.15	0.15	0.90	0.14	0.14	5.0	5.0	6.0	0.81	2.36	1.74	15	0.32	48.12	47.87	48.63	48.38	55.35	53.07	Exist. Flatbush
18	14	92.5	0.00	6.75	0.00	0.00	5.32	0.0	21.5	3.4	17.94	30.62	5.52	30	1.32	46.47	45.25	47.89	47.03	54.77	53.05	Exist. Flatbush
19	18	85.0	0.00	6.75	0.00	0.00	5.32	10.0	21.1	3.4	18.12	39.75	7.09	30	2.22	49.06	47.17	50.48	48.35	59.00	54.77	Exist. Flatbush
20	15	36.0	0.10	0.22	0.90	0.09	0.20	5.0	9.0	5.0	0.99	6.27	4.48	12	7.33	50.26	47.62	50.68	47.89	53.27	52.12	Exist. Flatbush
21	20	135.0	0.04	0.12	0.90	0.04	0.11	5.0	6.2	5.6	0.61	2.61	2.01	12	1.27	51.98	50.26	52.31	50.83	56.98	53.27	Exist. Flatbush

System 2-Revised Pre Condition | Number of lines: 37 | Run Date: 06-01-2010

NOTES: Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80; Return period = 10 Yrs.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Up	Dn	Up	Dn	Up	Dn	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
22	21	41.0	0.08	0.08	0.90	0.07	0.07	5.0	5.0	6.0	0.43	2.34	1.84	12	1.02	52.40	51.98	52.68	52.42	58.21	56.98	Exist. Flatbush
23	19	153.0	0.00	6.75	0.00	0.00	5.32	0.0	20.7	3.4	18.32	22.58	7.46	24	2.36	52.77	49.16	54.29	50.57	61.97	59.00	Exist. Flatbush
24	23	51.0	0.34	0.34	0.90	0.31	0.31	5.0	5.0	6.0	1.83	10.51	2.56	15	6.27	57.07	53.87	57.61	55.05	61.57	61.97	Exist. Flatbush
25	23	4.0	0.10	0.10	0.90	0.09	0.09	5.0	5.0	6.0	0.54	6.55	3.51	12	8.00	56.09	55.77	56.47	55.96	61.29	61.97	Exist. Flatbush
26	23	121.0	0.00	6.31	0.00	0.00	4.92	0.0	20.3	3.5	17.12	19.87	6.97	24	1.83	55.38	53.17	56.85	54.62	65.23	61.97	Exist. Newfield
27	26	9.0	0.00	2.06	0.00	0.00	1.59	0.0	20.2	3.5	5.54	3.96	4.52	15	0.89	57.07	56.99	58.40	58.24	65.77	65.23	Exist. Newfield
28	27	6.0	0.40	0.40	0.90	0.36	0.36	5.0	5.0	6.0	2.16	13.82	5.12	15	10.83	61.22	60.57	62.21	60.90	65.23	65.77	Exist. Newfield
29	27	40.0	1.66	1.66	0.74	1.23	1.23	20.0	20.0	3.5	4.31	9.03	4.24	15	4.62	59.12	57.27	59.95	58.84	66.12	65.77	Exist. Newfield
30	26	70.0	2.47	4.25	0.70	1.73	3.33	20.0	20.0	3.5	11.68	18.35	6.03	24	1.56	57.60	56.51	58.81	57.67	66.80	65.23	Exist. Flatbush
31	30	19.0	0.00	1.78	0.00	0.00	1.60	0.0	7.3	5.4	8.62	12.53	6.85	18	3.37	59.65	59.01	60.77	59.92	67.90	66.80	Exist. Flatbush
32	31	100.0	0.00	1.78	0.00	0.00	1.60	0.0	6.9	5.5	8.75	4.68	4.95	18	0.47	60.17	59.70	62.84	61.20	70.07	67.90	Exist. Flatbush
33	32	145.0	0.00	1.69	0.00	0.00	1.52	0.0	5.6	5.8	8.84	18.91	1.81	30	0.50	61.20	60.47	63.61	63.46	70.80	70.07	Exist. Flatbush
34	33	37.0	0.07	0.58	0.90	0.06	0.52	5.0	5.4	5.9	3.07	8.76	5.42	15	4.35	67.11	65.50	67.81	66.01	70.66	70.80	Exist. Flatbush
35	34	48.0	0.51	0.51	0.90	0.46	0.46	5.0	5.0	6.0	2.75	5.07	3.82	15	1.46	67.96	67.26	68.62	68.03	70.76	70.66	Exist. Flatbush
36	32	25.0	0.09	0.09	0.90	0.08	0.08	5.0	5.0	6.0	0.49	8.35	3.04	15	3.96	65.76	64.77	66.04	64.97	70.16	70.07	Exist. Flatbush
37	33	5.0	1.11	1.11	0.90	1.00	1.00	5.0	5.0	6.0	5.98	20.04	9.56	15	22.80	64.54	63.40	67.28	63.87	70.74	70.80	Exist. Flatbush

System 2-Revised Pre Condition | Number of lines: 37 | Run Date: 06-01-2010

NOTES: Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80; Return period = 10 Yrs.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
2	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
3	Exist. Flatbush	0.05	0.00	0.05	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.02	0.80	0.03	0.41	2.00	Off
4	Exist. Flatbush	0.32	0.00	0.32	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.03	1.60	0.05	0.78	2.00	3
5	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
6	Exist. Flatbush	0.27	0.00	0.27	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.03	1.50	0.04	0.73	2.00	4
7	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
8	Exist. Flatbush	0.22	0.00	0.22	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.03	1.35	0.04	0.66	2.00	6
9	Exist. Flatbush	0.16	0.00	0.16	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.03	1.25	0.04	0.60	2.00	8
10	Exist. Flatbush	0.49	0.00	0.49	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.04	1.85	0.06	0.91	2.00	9
11	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
12	Exist. Flatbush	1.13	0.00	1.13	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.05	2.50	0.08	1.23	2.00	Off
13	Exist. Flatbush	1.94	0.00	0.12	1.82	Curb	6.0	2.31	0.00	0.00	0.00	2.500	4.00	0.020	0.020	0.013	0.06	3.05	0.09	1.51	2.00	Off
14	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
15	Exist. Flatbush	0.16	0.00	0.16	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.03	1.25	0.04	0.60	2.00	Off
16	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
17	Exist. Flatbush	0.81	0.00	0.81	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.04	2.20	0.07	1.09	2.00	13
18	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
19	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
20	Exist. Flatbush	0.54	0.00	0.54	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.04	1.90	0.06	0.94	2.00	15
21	Exist. Flatbush	0.22	0.00	0.22	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.03	1.35	0.04	0.66	2.00	20
22	Exist. Flatbush	0.43	0.00	0.43	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.04	1.75	0.05	0.86	2.00	21

System 2-Revised Pre Condition | Number of lines: 37 | Run Date: 06-01-2010

NOTES: Inlet N-Values = 0.016 ; Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80; Return period = 10 Yrs. ; * Indicates Known Q added

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
23	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
24	Exist. Flatbush	1.83	0.00	1.83	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.06	3.00	0.09	1.48	2.00	17
25	Exist. Flatbush	0.54	0.00	0.54	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.04	1.90	0.06	0.94	2.00	22
26	Exist. Newfield	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
27	Exist. Newfield	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
28	Exist. Newfield	2.16	0.00	2.16	0.00	Comb	6.0	4.62	0.00	4.62	2.70	2.500	4.00	0.020	0.020	0.013	0.06	3.20	0.10	1.57	2.00	25
29	Exist. Newfield	4.31	0.00	4.31	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.08	4.15	0.13	2.04	2.00	28
30	Exist. Flatbush	6.07	0.00	6.07	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.09	4.70	0.14	2.32	2.00	25
31	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
32	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
33	Exist. Flatbush	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.000	0.00	0.00	0.00	0.00	0.00	Off
34	Exist. Flatbush	0.38	0.00	0.38	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.03	1.70	0.05	0.83	2.00	24
35	Exist. Flatbush	2.75	0.00	2.75	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.07	3.50	0.11	1.72	2.00	34
36	Exist. Flatbush	0.49	0.02	0.50	0.00	Comb	6.0	2.31	0.00	2.31	1.35	2.500	4.00	0.020	0.020	0.013	0.04	1.85	0.06	0.91	2.00	30
37	Exist. Flatbush	5.98	0.00	5.97	0.02	Comb	6.0	4.62	0.00	4.62	2.70	2.500	4.00	0.020	0.020	0.013	0.09	4.65	0.14	2.30	2.00	36

System 2-Revised Pre Condition | Number of lines: 37 | Run Date: 06-01-2010

NOTES: Inlet N-Values = 0.016 ; Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80; Return period = 10 Yrs. ; * Indicates Known Q added

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	30	20.10	31.36	32.86	1.50	3.08	6.54	0.66	33.52	1.259	12.8	31.40	33.23	1.83	3.84	5.23	0.42	33.65	0.727	0.993	0.127	0.33	0.14
2	30	20.27	31.45	33.53	2.08	4.36	4.65	0.34	33.86	0.565	92.9	32.41	34.04	1.63	3.38	6.00	0.56	34.60	1.010	0.787	0.731	0.92	0.51
3	12	0.36	40.46	40.63	0.17*	0.09	4.01	0.25	40.88	5.913	14.0	41.29	41.54	0.25**	0.16	2.28	0.08	41.63	1.202	3.557	n/a	1.37	0.11
4	12	0.32	41.29	41.62	0.33	0.23	1.42	0.03	41.65	0.343	25.5	43.20	43.44 j	0.24**	0.15	2.22	0.08	43.52	1.200	0.772	n/a	1.00	0.08
5	30	20.24	32.51	34.85	2.34	4.77	4.24	0.28	35.13	0.498	82.1	33.41	35.20	1.79	3.75	5.39	0.45	35.65	0.779	0.638	0.524	0.90	0.41
6	12	0.96	41.26	41.63	0.37*	0.27	3.59	0.20	41.83	1.959	12.2	41.50	41.92	0.42**	0.31	3.08	0.15	42.07	1.290	1.625	0.199	1.34	0.20
7	12	0.76	41.50	42.13	0.63	0.52	1.46	0.03	42.17	0.206	69.6	41.76	42.30	0.54	0.44	1.75	0.05	42.35	0.329	0.267	0.186	1.00	0.05
8	12	0.22	41.76	42.38	0.62	0.51	0.42	0.00	42.38	0.017	4.2	42.00	42.38	0.38	0.27	0.80	0.01	42.39	0.096	0.057	0.002	1.00	0.01
9	12	0.61	41.76	42.39	0.63	0.52	1.16	0.02	42.41	0.131	59.5	42.02	42.50	0.48	0.37	1.62	0.04	42.54	0.312	0.221	0.132	0.50	0.02
10	12	0.49	42.02	42.56	0.54	0.43	1.13	0.02	42.58	0.138	49.5	42.80	43.10 j	0.30**	0.19	2.50	0.10	43.19	1.216	0.677	n/a	1.00	n/a
11	30	20.22	39.66	42.16	2.50*	4.91	4.12	0.26	42.42	0.575	299	40.91	43.88	2.50	4.91	4.12	0.26	44.15	0.575	0.575	1.721	0.79	0.21
12	12	1.13	43.11	44.32	1.00	0.79	1.44	0.03	44.35	0.239	26.6	43.97	44.42 j	0.45**	0.35	3.27	0.17	44.59	1.339	0.789	0.210	1.00	0.17
13	12	1.94	41.21	44.26	1.00	0.79	2.47	0.09	44.35	0.703	64.3	42.00	44.71	1.00	0.79	2.47	0.09	44.81	0.703	0.703	0.452	1.00	0.09
14	30	18.95	41.41	44.12	2.50	4.91	3.86	0.23	44.35	0.506	207	45.15	46.61 j	1.46**	2.96	6.39	0.64	47.24	1.231	0.868	n/a	0.69	n/a
15	15	1.77	46.05	47.19	1.14	1.17	1.51	0.04	47.22	0.155	5.6	46.22	47.18	0.96	1.01	1.74	0.05	47.23	0.201	0.178	0.010	0.98	0.05
16	15	0.73	46.32	47.27	0.95	1.00	0.73	0.01	47.28	0.036	18.0	47.87	48.21 j	0.34**	0.27	2.69	0.11	48.33	1.131	0.583	n/a	0.15	0.02
17	15	0.81	47.87	48.38	0.51*	0.46	1.74	0.05	48.42	0.315	79.3	48.12	48.63	0.51	0.46	1.74	0.05	48.67	0.315	0.315	0.250	1.00	0.05
18	30	17.94	45.25	47.03	1.78	3.74	4.79	0.36	47.39	0.616	92.5	46.47	47.89 j	1.42**	2.87	6.26	0.61	48.49	1.202	0.909	n/a	0.15	0.09
19	30	18.12	47.17	48.35	1.18*	2.29	7.91	0.97	49.33	2.222	85.0	49.06	50.48	1.42**	2.88	6.28	0.61	51.10	1.207	1.714	n/a	0.15	0.09
20	12	0.99	47.62	47.89	0.27*	0.17	5.82	0.53	48.42	7.320	36.0	50.26	50.68	0.42**	0.31	3.14	0.15	50.84	1.326	4.323	n/a	0.50	n/a
21	12	0.61	50.26	50.83	0.57	0.46	1.33	0.03	50.85	0.184	135	51.98	52.31 j	0.33**	0.23	2.68	0.11	52.42	1.238	0.711	n/a	0.50	n/a

System 2-Revised Pre Condition | Number of lines: 37 | Run Date: 06-01-2010

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
22	12	0.43	51.98	52.42	0.44	0.33	1.30	0.03	52.44	0.220	41.0	52.40	52.68 j	0.28**	0.18	2.39	0.09	52.77	1.172	0.696	0.285	1.00	0.09
23	24	18.32	49.16	50.57	1.41	2.36	7.76	0.94	51.50	2.187	153	52.77	54.29	1.52**	2.55	7.17	0.80	55.09	1.822	2.004	n/a	1.00	0.80
24	15	1.83	53.87	55.05	1.18	1.20	1.53	0.04	55.09	0.165	51.0	57.07	57.61 j	0.54**	0.51	3.59	0.20	57.81	1.256	0.710	n/a	1.00	0.20
25	12	0.54	55.77	55.96	0.19*	0.11	5.03	0.39	56.36	7.987	4.0	56.09	56.47	0.38	0.27	1.98	0.06	56.53	0.589	4.288	0.172	1.00	0.06
26	24	17.12	53.17	54.62	1.45	2.45	7.00	0.76	55.39	1.758	121	55.38	56.85	1.47**	2.47	6.94	0.75	57.59	1.723	1.740	n/a	0.75	n/a
27	15	5.54	56.99	58.24	1.25*	1.23	4.52	0.32	58.56	1.746	9.0	57.07	58.40	1.25	1.23	4.52	0.32	58.71	1.745	1.745	0.157	1.00	0.32
28	15	2.16	60.57	60.90	0.33*	0.26	8.18	1.04	61.95	10.818	6.0	61.22	62.21	0.99	1.05	2.06	0.07	62.28	0.280	5.549	0.333	1.00	0.07
29	15	4.31	57.27	58.84	1.25	1.23	3.51	0.19	59.03	1.054	40.0	59.12	59.95 j	0.83**	0.87	4.98	0.38	60.34	1.730	1.392	n/a	1.00	0.38
30	24	11.68	56.51	57.67	1.16*	1.89	6.19	0.60	58.26	1.557	70.0	57.60	58.81	1.21**	1.99	5.87	0.54	59.35	1.362	1.459	n/a	0.59	n/a
31	18	8.62	59.01	59.92	0.91*	1.13	7.64	0.91	60.83	3.365	19.0	59.65	60.77	1.12**	1.42	6.07	0.57	61.35	1.922	2.644	0.502	0.40	0.23
32	18	8.75	59.70	61.20	1.50*	1.77	4.95	0.38	61.58	1.643	100	60.17	62.84	1.50	1.77	4.95	0.38	63.22	1.642	1.643	1.643	0.75	0.29
33	30	8.84	60.47	63.46	2.50	4.91	1.80	0.05	63.51	0.110	145	61.20	63.61	2.41	4.85	1.82	0.05	63.66	0.096	0.103	0.149	1.00	0.05
34	15	3.07	65.50	66.01	0.51*	0.47	6.50	0.66	66.67	4.344	37.0	67.11	67.81	0.70**	0.71	4.33	0.29	68.10	1.463	2.904	n/a	1.50	n/a
35	15	2.75	67.26	68.03	0.77	0.79	3.49	0.19	68.21	0.894	48.0	67.96	68.62 j	0.66**	0.66	4.15	0.27	68.89	1.404	1.149	n/a	1.00	n/a
36	15	0.49	64.77	64.97	0.20*	0.13	3.70	0.21	65.19	3.951	25.0	65.76	66.04	0.28**	0.20	2.38	0.09	66.13	1.124	2.537	n/a	1.00	n/a
37	15	5.98	63.40	63.87	0.47*	0.42	14.25	3.16	67.03	22.779	5.0	64.54	67.28	1.25	1.23	4.88	0.37	67.65	2.033	12.406	0.620	1.00	0.37

System 2-Revised Pre Condition | Number of lines: 37 | Run Date: 06-01-2010

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump.

Tc

Line No.	Inlet ID	Inlet Time (min)	Tc (min)	n-val Pipe
1	Exist. Flatbush	0.0	24.8	0.020
2	Exist. Flatbush	20.0	24.5	0.020
3	Exist. Flatbush	5.0	6.0	0.020
4	Exist. Flatbush	5.0	5.0	0.020
5	Exist. Flatbush	20.0	24.1	0.020
6	Exist. Flatbush	5.0	8.6	0.020
7	Exist. Flatbush	0.0	7.6	0.020
8	Exist. Flatbush	5.0	5.0	0.020
9	Exist. Flatbush	5.0	6.3	0.020
10	Exist. Flatbush	5.0	5.0	0.020
11	Exist. Flatbush	0.0	22.9	0.020
12	Exist. Flatbush	5.0	5.0	0.020
13	Exist. Flatbush	5.0	5.0	0.020
14	Exist. Flatbush	10.0	21.9	0.020
15	Exist. Flatbush	5.0	9.4	0.020
16	Exist. Flatbush	0.0	7.0	0.020
17	Exist. Flatbush	5.0	5.0	0.020
18	Exist. Flatbush	0.0	21.5	0.020
19	Exist. Flatbush	10.0	21.1	0.020
20	Exist. Flatbush	5.0	9.0	0.020
21	Exist. Flatbush	5.0	6.2	0.020

System 2-Revised Pre Condition | Number of lines: 37 | Date: 06-01-2010

NOTES: ** Critical depth

Line No.	Inlet ID	Inlet Time (min)	Tc (min)	n-val Pipe
22	Exist. Flatbush	5.0	5.0	0.020
23	Exist. Flatbush	0.0	20.7	0.020
24	Exist. Flatbush	5.0	5.0	0.020
25	Exist. Flatbush	5.0	5.0	0.020
26	Exist. Newfield	0.0	20.3	0.020
27	Exist. Newfield	0.0	20.2	0.020
28	Exist. Newfield	5.0	5.0	0.020
29	Exist. Newfield	20.0	20.0	0.020
30	Exist. Flatbush	20.0	20.0	0.020
31	Exist. Flatbush	0.0	7.3	0.020
32	Exist. Flatbush	0.0	6.9	0.020
33	Exist. Flatbush	0.0	5.6	0.020
34	Exist. Flatbush	5.0	5.4	0.020
35	Exist. Flatbush	5.0	5.0	0.020
36	Exist. Flatbush	5.0	5.0	0.020
37	Exist. Flatbush	5.0	5.0	0.020

System 2-Revised Pre Condition | Number of lines: 37 | Date: 06-01-2010

NOTES: ** Critical depth

APPENDIX E

EXISTING CONDITIONS REPORT

URS

Washington Division

DRAINAGE CONDITION FIELD REVIEW

RE: CTDOT Proj# 155-H025, NEW BRITAIN – HARTFORD BUSWAY

DESCRIPTION: **Flatbush Avenue and Mainline Existing Drainage Field Review.**
MEETING DATES: 8/26/08, 9/3/08 (UPDATED 3/17/09)
LOCATION: Busway Project

PERSONS IN ATTENDANCE:

NAME	ORGANIZATION	PHONE #	E-Mail
Robert Gomez	URS-WD	860-529-8882	robert.gomez@wgint.com
Craig Lanphear	VN	401-596-3726	clanphear@vnengineers.com

Field Review 8/26/08:

Flatbush Avenue
The field review began with an office walk through of the entire drainage design. We then proceeded to Flatbush Avenue were each existing inlet was inspected for signs of deterioration. The Outfall pipe at Flatbush was located and inspected from the top of the bridge abutment wall. The catch basins located in the northern portion of the new development just south of Flatbush Avenue were also inspected. The goal of the inspection was to field verify the survey provided by Garg and CTDOT. There are a couple of pipes in the survey that are not taken back to their source and one manhole that is labeled as a Sanitary Manhole that is shown tied in with the stormwater system on Flatbush at Sta. 20+30 LT. It is suspected that it is a labeling issue. However, no issues were found on Flatbush Avenue that would preclude the proposed drainage design utilizing portions of the existing drainage system. We will resolve the issues with CTDOT survey.The proposed design will replace portions of the existing drainage system on Flatbush and New Field Avenue and the connection points were located in the field. There is a significant amount of utilities in the area that will require close coordination to resolve constructability issues.

Station 345+40, Behind Raymore and Flanagan. This outfall was identified in the Baker PD plans as a potential outfall. This outfall was inspected in the field and it was determined that it would not be used for this project. This determination was made after discussions with the City of West Hartford.

Sta. 363+00 to 381+00, behind movie theater. This area was inspected for the possibility of including a swale drainage system in this area as shown in the PD plans.

It was determined after looking at the survey and existing conditions that a swale would not be appropriate for this area.

Sta. 381+00 to 384+20, Underneath I-84 Ramps. This area was inspected to be used as a potential storm water detention area. Currently it is being used as a staging area for work being done on Farmington Avenue. This area is paved and does not appear to have any catch basins. Runoff from this area sheet flows into Kane Brook and has caused significant erosion in two areas on the south bank of Kane Brook.

Sta. 431+00 to 437+00, Area under the I-84 ramps and connection to the Park River Conduit. We searched this area again for any sign of the Park River Conduit. We were able to find two structures that were also located by the CTDOT survey at Station 435+40, (100' Left). These structures appear to be a sanitary system that runs parallel to the Park River Conduit. If it is not possible to connect to these structures then we may have to connect to the west side of the Park River Conduit in this area. The Park River Conduit will have to be located in the field with test pits to confirm its location if we connect at this location.

Field Review 9/3/08:

Kane Brook Area. This area was inspected for the inclusion of two new outfalls. There are two existing endwalls located near the opening of the culvert that goes under the railroad. These endwalls are in very poor condition. It should also be noted that the endwall on the north side of the Brook is experiencing significant erosion coming from above near the pier for the ramps. We have before and after photographs of this area and we have recommended that CTDOT Maintenance crews move to stop the erosion before the pier or culvert sustain any damage. It is difficult to determine the extent of the erosion from the pictures and we recommend that this matter be investigated further. The Busway project will likely connect two new outfalls to the west of these apparently abandoned outfalls. The existing outfalls should be removed and stabilized. We requested survey of these existing outfalls and it was provided by CTDOT, however, it is not clear what active drainage systems if any lead to these pipes. There is an existing sewer running parallel along the north bank of Kane Brook that will require coordination with the drainage design work.

Kane Station Area. Station 386+00 to 387+50. We searched for signs of any existing drainage in this area and found nothing. The area is heavily wooded and it was difficult to get in close to the right-of-way line to try to find anything connected to the collapsing endwall on the north side of Kane Brook.

Station 395+00, Court Street and Francis Avenue. This area was investigated as a possible outfall location. The drainage structures along Francis Avenue were surveyed by CTDOT. From the street level these structures appear older but in good condition. Additional rights of way would be required to facilitate a connection to Francis Avenue from the Busway.

Subsequently, it was determined during design that the drainage will not implement a connection at Francis Avenue.

Station 405+20, Outfall at Hamilton Street. The proposed drainage outfall connection will connect on the south side of Hamilton Street under an existing parking lane. The catch basins in the area look older but appear to be functioning adequately. These will all be replaced by the proposed construction.

Subsequently, it was determined in design that the drainage will not implement a connection on Hamilton Street.

Sta. 405+50 to 439+00 along Francis Avenue and the Park Street Outfall. The existing manholes appear to be in good condition showing no signs of settlement in the street. The existing stormwater system is extensive with laterals feeding into Park Street from adjacent streets, such as Francis Avenue, Hazel Street, Orange Street among others located west of the project. There is a parallel sanitary sewer line along Park Street.. On Park Street, we inspected all manholes and catch basins for condition and found nothing out of the ordinary. The survey was field verified and a few questions were raised. The CTDOT survey shows a stormwater pipe at Francis Avenue connecting to the sanitary system on Park Street. We think this may be an error and will confirm with CTDOT survey. The manholes and catch basins then proceed to the east on Park and eventually outfall to a connection to the Park River Conduit on the south side of Park Street east of Bartholomew Avenue. This Park River Conduit connection structure appears to be in good condition.

Sta 439+00 to 444+00, north side of Busway. In this area the PD plans called for a fill section and a ditch. This will not work as the Busway is considerably below the grade of the surrounding area. There are no existing drainage systems/structures in the area that facilitate a connection. The drainage from Sta. 440+50 to the project limits will connect to the Lochner's drainage system to the east.

Flatbush Avenue Outfall

Sta. 31+50 - Outfall to Park River Looking East

Sta. 17+50 – On Flatbush Ave. -Viewing West near Railroad tracks

Sta. 18+00 – On Flatbush Ave. View to West where new bridge will be.

Sta. 18+00 – On Flatbush Ave. View of intersection of New Field Avenue looking northeast.

Sta. 22+00 – On Flatbush Avenue looking east.

Sta. 52+00 - View of New Field Avenue looking north toward Flatbush Avenue

Sta. 49+00 - View of New Field Avenue looking north toward Flatbush Avenue further south.

Kane Brook Area Photos

Sta. 385+00 - View of north side of Kane Brook with erosion behind exposed pipe section

Sta. 385+00 - View of north side of Kane Brook with erosion behind exposed pipe section

Sta. 385+00 - View of culvert under railroad

Sta. 385+00 - View of endwall on south side of Kane Brook draining the old parking lot under the I-84 ramps.

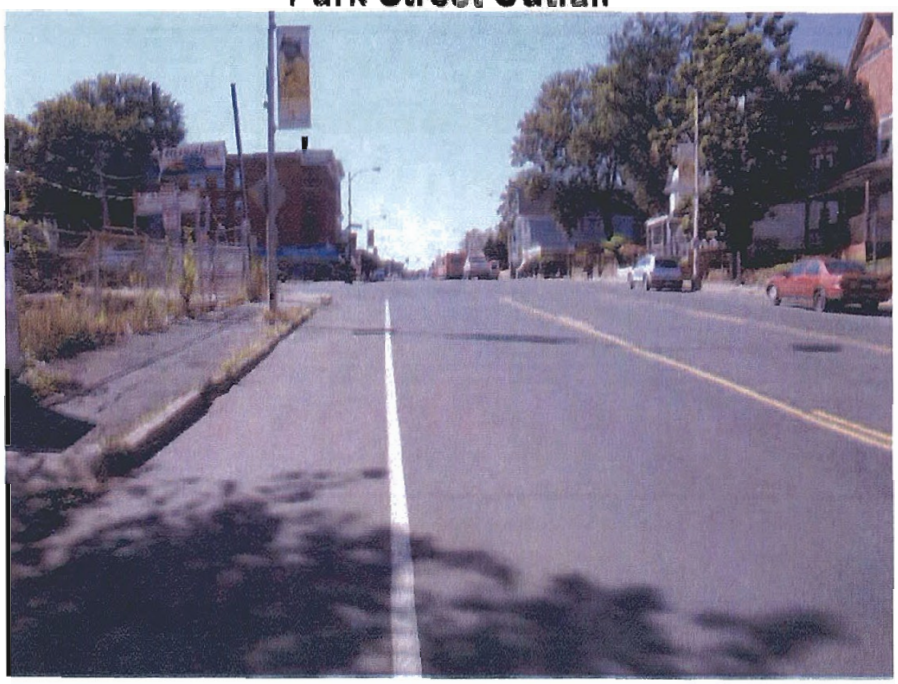
Sta. 385+00 Close up view of endwall on south side of Kane Brook draining the old parking lot under the I-84 ramps.

Hamilton Street Outfall

STA. 405+50 - View to east on Hamilton Street "North of Busway"

Sta. 405+50 - View to north at intersection of Hamilton and Francis
View to northeast on Francis Avenue. "North of Busway"

Park Street Outfall



Sta. 417+00 = On Park Street viewing west to Francis Avenue on Left
"North of Busway"

Sta. 418+00 – On Park Street view at intersection of Orange Street looking northwest.
"North of Busway"

Sta. 420+50 – On Park Street at Bartholomew view to the west. "South of the Busway"

Sta. 423+00 – On Park Street view of intersection of Park Street and Bartholomew Avenue looking west. "South of Busway"

Sta. 424+00 – On Park Street View along Park Avenue looking west toward I-84, "South of Busway"

Sta. 424+50 – On Park Street Existing Structure connecting to the Park River Conduit of Park Street east of Bartholomew Avenue, "South of Busway"

Laurel Street Area

Sta 441+00 View looking to southeast towards proposed Busway. The elevation here is higher than the Busway.

Park River Conduit

View of entrance to Park River Conduit off Farmington Avenue.

Flatbush Avenue Outfall

Sta. 31+50 - Outfall to Park River Looking East

Sta. 17+50 – On Flatbush Ave. -Viewing West near Railroad tracks

FORM 2: STORM SEWER SYSTEM – DRAINAGE STRUCTURES

Station, Offset: 351+98, 14' LT

Type: TYPE "C" CATCH BASIN

Project No. 155-H025

Route No. BUSWAY

Date 9/5/08

Condition

	Good	Fair	Poor	N/A
Cover	☐	☒	☐	☐
Grate	☐	☒	☐	☐
Top	☐	☒	☐	☐
Crack, Spall, Settlement	☐	☒	☐	☐
Siltation, Debris	☐	☒	☐	☐

Remarks/Findings:

EXISTING CATCH BASIN TIES INTO EXISTING MANHOLE WITH 30" RCP UNDER RAILROAD TO THE EAST

Recommendations:

RE BUILD CATCH BASIN TO TIE IN PROPOSED DRAINAGE FROM EAST OF BUSWAY AS WELL AS BUSWAY DRAINAGE FROM SOUTH & NORTH

APPENDIX F

DRAINAGE PIPE & CULVERT SELECTION JUSTIFICATION

VN ENGINEERS, INC.

DRAINAGE MEMORANDUM

RE: CTDOT PROJECT #63-643, NEW-BRITAIN-HARTFORD BUSWAY

DESCRIPTION: DRAINAGE PIPE AND CULVERT SELECTION JUSTIFICATION DOCUMENTATION

DATE: DECEMBER 9, 2008
REVISED AUGUST 26, 2009

PREPARED BY: CRAIG LANPHEAR
REVISED BY JOSEPH BAMBARA

With respect to the consideration of alternative pipe materials for the subject project we offer the following:

The following pipe materials where considered in design of the drainage system: RCP, HDPE, PVC, corrugated metal, and corrugated aluminum. RCP or HDPE are the only pipe materials that are suitable for use in this project due to the deep embedment depth of several of the drainage systems and the increased loading of the travelway. Following are notable elements regarding the use of alternative piping materials.

1. Type II bedding may be required if native soils is found to be unsuitable.

2. HDPE max. fill cover should be limited to 8'. Over 8' requires pipe strength calculations.

3. HDPE, PVC and metal pipe is only recommended for longitudinal installations on local and collector roads not heavy loads as experienced on the Busway.

4. HDPE is not recommended where parallel utility lines are present.

   ·System 2 will require parallel pipe installations adjacent to existing utility lines on Flatbush Avenue, New Park Avenue, and New Field Avenue.

   ·The project lies within an urban environment of which may require future utility work adjacent to drainage lines.

5. Several systems implement a minimum slope of 0.5% to achieve outlet elevation objectives which will require precision placement, extensive inspection and documentation.