Fort Dodge Stormwater Master Planning

Prepared By: Ralph C. Stark, Jr., P.E., C.F.M. Joel N. Krause, P.E., C.F.M.





Project Location





Project Background

Flooding History

- Localized flooding and storm sewer pipe surcharging in the vicinity of the Crossroads Mall
 - The area consists of approx. 505 acres, which is comprised mainly of commercial and industrial land
 - Flooding problems attributed to large runoff volumes and high peak flows
 - Localized flooding and surcharged storm sewer are common within watershed and have occurred as recently as summers of 2007 and 2010



Project Background Cont'd

Locations of flooding are:

- 1) Vicinity of Veterans Bridge
- 2) West of Mall along S 25th St.
- South of 5th Ave S and west
 of S 25th St
- 4) South of 5th Ave S and east of S 25th St
- 5) Along 8th Ave S between S 25th St and S 29th St
- 6) Along S 29th St just east of Mall





Project Background Cont'd

Flooding History

- In addition to flooding problems near the mall, much of total runoff volume is discharged to Gypsum Creek upstream of the existing 84" culvert just downstream of 5th Ave South
- City is concerned about capacity of the 84" culvert

84" culvert





Steps Taken to Alleviate Flooding

HR Green prepared a Watershed Analysis Report in August, 2010, based on Hydrocad (rational method) which documented the source of the flooding and potential solutions. Based on this report the city approved the preparation of a more detailed analysis based on the following:

- Infiltration practices or storage to reduce storm sewer conveyance needs
- XP-SWMM modeling recommended to:
 - Account for existing storage in pipes and on surface
 - Pressure flow in pipes
 - Division of flow between multiple interlinked systems



Existing Data and Proposed Modeling Approach

- City provided HR Green the latest GIS data
 - Contained roadway and storm sewer alignments, contours, aerial imagery, and other relevant spatial information
- ArcView GIS was used to organize and view the data
- XP-SWMM was used to analyze existing conditions of:
 - Gypsum Creek & 84" culvert
 - Sewer System
- Proposed conditions XP-SWMM model used to evaluate proposed storage and sewer improvement options



Gypsum Creek Watershed





Gypsum Creek Modeling

- The Geospatial hydrology toolkit from HEC-GeoHMS was used to determine the discharges from the Gypsum Creek watershed
 - HEC-GeoHMS is a public-domain extension for ArcGIS
 9.2/9.3 and one must have an ArcView license and Spatial Analyst Extension



Data Assembly

Create a terrain DEM of the project derived from LIDAR data

- Cut a channel through the terrain
- Blue lines depict channels
- Darker areas = lower elevations
- Lighter areas = higher elevations





Basin Processing

Build walls in order to correctly subdivide watersheds and direct water to a certain outlet

- Wall is shown by the white line
- Water does not flow across wall and the wall acts as a drainage divide
- Fill sinks
- Fill all depressions so that water flows through them and is not trapped





Stream and Watershed Characteristics

Flow Direction: Specify an outflow direction for each cell/subwatershed

A color is assigned to each flow direction

Flow Accumulation: Program counts the number of cells tributary to each cell. Cells with large accumulated areas are shown in lighter grays or white (not shown).





Stream and Watershed Characteristics Cont'd.

Define Watersheds: Define the locations of the streams based upon the specified watershed area

• One can define the watershed area for a stream, which may be set at 1 sq. mi. area

Result is a colored map showing all of the individual sub-basins

• Can have multiple outlets in the same project





Watershed for Gypsum Creek

- Select the downstream outlet for Gypsum Creek, which is the upstream end of the 84" culvert
- The overall watershed for the 84" culvert is shown in the red cross-hatching, which includes all of the individual sub-basins





Sub-Basins comprising Gypsum Creek Watershed

 Each sub-basin is labeled and the flow path of each channel within the sub-basin is shown in blue





River Profile Tool



 Shows a profile for a specific river reach, which is shown in cyan at the top



Longest Flow Path

- Program determines longest flow path within each sub-basin, which is shown by the green polylines
- To determine the cumulative flow path, add up the distances of the longest flow paths from all sub-basins so that you account for the most hydrologically remote point within the entire watershed





Segment Flow Path

- Program will divide the longest flow path within each sub-basin into 3 components, sheet flow, shallow concentrated flow, and channel flow
- Areas upstream of the blue dots consists of 100' sheet flow
- Areas downstream of blue dots and upstream of red dots, consist of shallow concentrated flow
- Areas downstream of red dots are channel flow





Interactive Longest Flow Path Tool

- If one does not like the way the program defines the longest flow path, you can modify it using the Interactive Longest Flow Path Tool
- The modified longest flow path is in red





Time of Concentration

- Tc calculations are done by utilizing the TR-55 Exporting Travel Time Parameters to Excel function in HEC-GeoHMS
- Blue = GIS provided data
- Green = User input
 - Mannings N
 - Paved/Unpaved
 - Channel Parameters
- Pink = Tc (hrs)

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Watershed Name	WE	WUS	WUZ	WU6	WU/	W03	WU8	W09	W10	W12	W11	'
Watershed ID	21	22	40	25	26	27	28	29	30	33	36	
Sheet Flow Characteristics												
Manning's Roughness Coefficient	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Flow Length (fi)	100	100	100	100	100	100	100	100	100	100	100	
Two-Year 24-hour Rainfall (in)	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	2.91	
Land Slope (1011)	0.0036	0.0105	0.016	0.0121	0.0125	0.0313	0.026	0.0006	8010.0	0.0132	0.0077	
Sheet Flow It (hr)	0,51	0.33	0.30	0.52	0.51	0.22	0.25	0.40	0.28	0.30	0.38	
Shallow Concentrated Flow Characteristics												
Surface Description (1 - unpaved, 2 - paved)	1	1	1	1	1	1	1	1	1	1	1.	
Flow Length (ft)	7830	7860	5157	3342	4011	11582.0007	9175.1024	2396 4432	3738.0501	6408.5543	4263.9171	
Westercourse clope (1/1)	0.0024	0.003	0.0028	1.40	1.02	0.0024	0.0017	1.20	0.0027	0.02	1.00	
Shallow Concentrated Flow Tr (hr)	0.78	2.47	1.69	0.80	1.05	4 11	3.03	0.51	1.04	1.60	1.00	
Channel Flow Characteristics	2.0	2.77			1.00	4.0	0.00	0.01	1.47	1.02	1.72	
Characteristics		10			- 20	20	-00	200		00		
(L7055-Sectional Flow Area (ILZ) Michael Desimates (9)	20	20	20	20	20	20	20	20	20	20	20	
Hudra (ic Radus - computed (ft)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-
Channel Sizze (f/ft)	0.0016	NaN	-0.0019	0.0039	0.0003	0.0053	NaN	0.0005	0.0013	0.0019	0.0031	
Manning's Roughness Coefficient	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
Average Velocity - computed (1%)	5.96	#VALUE!	#NUM!	9.31	2.58	10.85	#VALUEI	3 33	5.37	6.49	8.30	4
Flow Length (fl)	3339	0	3511	2828	3580	1817.4541	0	2616.0767	8703.8694	1182.5979	104,424	
Channel Flow Tt (hr)	0.16	#VALUEI	\$NUM	0.08	0.38	0.04	#VALUEI	0.23	0.45	0.05	0.00	\$1
Watershed Time of travel (hr)	3.42	#VALUE!	#NUM!	1.20	1.72	4.36	#VALUE!	1.15	1.97	2.28	1.50	#
Number of watersheds	16											
MXD Path	Gypsum mid											
Stored workbook												
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Soils Data

- Used County soils data available in the GIS database and applied it to the watershed area
- The closed polylines correspond to a particular soils type





Soils Attributes Table

th	Shape_Area	HSG_TSTADEL	PctA	PctB	PctC	PctD	1
571	204943.18175	В	0	100	0	0	
142	572937.379173	B	0	100	0	0	
2073	313378.052923	8	0	100	0	0	
937	7663989.147054	B	0	100	0	0	
0.47	79585,148658	8	0	100	- 0	0	
332	19179.205389	в	0	100	0	0	
722	89244.208599	8	0	100	0	0	
503	33199.037225	в	0	100	0	0	
808	3572.987217	в	0	100	0	0	
154	47028.524978	B	0	100	0	0	
377	12878.137189	8	0	100	0	0	
263	62621.510411	B	0	100	0	0	
226	8157.617564	8	0	100	- 0	0	
643	526,603031	В	0	100	0	D	
1722	100400-040080	0		100			2



Land Use

 Various land uses are depicted with different colors of shading





Runoff Curve Number Tables

 Soils and Land Use GIS data is combined to create a RCN layer. Each color represents a different RCN value.





Sub-Basin Summary Spreadsheet

Coralville - I Date: 02/23	I Jobs II /11				↓		Sul	b-Basin (Data						Ļ	Ļ
OBJECTID	GRIDCODE	Shape_Area_m2	HydroID	DrainID	NAME	Description	LossMet	TransMet	BasinSlope	BasinCN	Rain2Yr	LagMethod	BasinLag	Area_sqmiles	Tc	Acres
20	0	1746452	41	41	W01		SCS	SCS	2.12	78.0	2.91	CNLag	1.53	0.674	3.37	431.6
3	3	1278624	40	40	W02		SCS	SCS	2.92	78.0	2.91	CNLag	1.12	0.494	2.09	316.0
7	7	1549904	27	27	W03		SCS	SCS	2.32	78.0	2.91	CNLag	1.77	0.598	4.35	383.0
1	1	1707096	21	21	W04		SCS	SCS	2.24	78.0	2.91	CNLag	1.57	0.659	3.31	421.8
2	2	1489480	22	22	W05		SCS	SCS	1.96	78.0	2.91	CNLag	1.27	0.575	2.72	368.1
5	5	966020	25	25	W06		SCS	SCS	2.42	78.1	2.91	CNLag	0.94	0.373	1.19	238.7
6	6	614532	26	26	W07		SCS	SCS	3.84	79.1	2.91	CNLag	0.85	0.237	1.46	151.9
8	8	1596868	28	28	W08		SCS	SCS	2.60	77.8	2.91	CNLag	1.25	0.617	4.00	394.6
9	9	423052	29	29	W09		SCS	SCS	4.58	77.9	2.91	CNLag	0.60	0.163	0.96	104.5
10	10	2183484	30	30	W10		SCS	SCS	3.60	77.8	2.91	CNLag	1.36	0.843	1.93	539.6
16	16	1092352	36	36	W11		SCS	SCS	2.74	79.8	2.91	CNLag	0.64	0.422	1.40	269.9
13	13	865756	33	33	W12		SCS	SCS	2.69	78.0	2.91	CNLag	1.05	0.334	2.21	213.9
21	0	2165284	46	46	W13		SCS	SCS	3.64	79.4	2.91	CNLag	0.88	0.836	1.47	535.1
17	17	638784	37	37	W14		SCS	SCS	4.19	77.9	2.91	CNLag	0.61	0.247	1.26	157.8
19	19	1131060	39	39	W15		SCS	SCS	5.60	80.8	2.91	CNLag	0.68	0.437	3.27	279.5
18	18	212	38	38	W16		SCS	SCS	6.36	89.3	2.91	CNLag	0.01	0.0001	0.19	0.1

- Table is exported out of GIS
- Columns of importance are the watershed names, Tc, and areas
 - These 3 columns of data are then input into XP-SWMM for further analysis of the Gypsum Creek watershed and it's impact on the storm sewer system in the main business district of Fort Dodge, IA



- Once we imported the hydrologic data from GIS into XP-SWMM, we found that the peak water surface elevation upstream of the existing 84" culvert was surcharging the pipe and overtopping 5th Avenue South
- 10-yr peak water surface elevation is approx. 1108 using the Huff rainfall distribution





- Based upon previous coordination with City staff, there were no reported incidents of overtopping associated with the existing 84" culvert
 - HR Green decided to add existing storage in the upstream watershed so as to reduce the peak flows
 - Existing storage below elevation 1108 was modeled
 - 10-year peak water surface elevation was found to be approximately 1105, about 3 ft lower than previously modeled without any storage
 - City will need to ensure that the existing storage is preserved if watershed is developed in the future







XP-SWMM Sewer Model Development

- Preparation of GIS data
- Import of Data into XP-SWMM
- Evaluation of Existing Conditions
- Evaluation of Alternatives







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	FID Shape	ENTITY	LÆ	AYER	DATE_CONST	PLAN_TYPE	PLAN_NUMBE	PIPE_DIA	LENGTH	PIPE_MATER	UpstreamMH	Dwnstrm_MH	XP_SWMM_ID		- 1 h
	0 Polyline	Line	-24 inch sto	orm	1985	STORM	377	24	132	RCP	G2630	G2320	PG2630		
	1 Polyline	Line	-30 inch sto	orm	1985	STORM	377	30	624	RCP	G2620	G2600	PG2620		
yers –	2 Polyline	Line	-18 inch sto	orm	1985	STORM	377	18	414	RCP	G2650	G2640	PG2650		
Fort_D	3 Polyline	Polylin	-78 inch sto	orm	1998		0	78	247	RCP	G1030	G1020	PG1030		
•	4 Polyline		-78 inch sto	orm	1998	SUBD	16	78	1178	RCP	G1010	G1001	PG1010		
Mall pt	5 Polyline	Line	-78 inch sto	orm	1998		0	78	436	RCP	G1060	G1050	PG1060		
•	6 Polyline	Line	-78 inch sto	orm	1998		0	78	245	RCP	G1050	G1040	PG1050		
SANIT/	7 Polyline	Line	-78 inch sto	orm	1998		0	78	415	RCP	G1040	G1030	PG1040		
— H	8 Polyline	Line	-72 inch sto	orm	1998		0	72	110	RCP	G1070	G1060	PG1070		
XPSWN -	9 Polyline		-72 inch sto	orm	1998		0	72	855	RCP	G1080	G1070	PG1080		281
	10 Polyline	Line	-15 inch sto	orm	0		0	18	37	RCP	G2670	G1070	PG2680		
XPSWN -	11 Polyline	Line	-18 inch sto	orm	1985	STORM	377	18	371	RCP	G2660	G2650	PG2660		
▶ ⅠⅠ	12 Polyline	Line	-24 inch sto	orm	0		0	36	45		N1570	N1560	PN1570		
STORM -	13 Polyline	Line	-36 inch sto	ormsew	0		0	36	323		N1580	N1570	PN1580		
•	14 Polyline	Line	-36 inch sto	ormsew	0	STORM	271	36	195		N1510	N1505	PN1510		
STORM	15 Polyline	Line	-36 inch sto	ormsew	1968	STORM	271	36	72		N1540	N1530	PN1540		130/1
• L	16 Polyline	Line	-36 inch sto	orm sew	1968	STORM	271	36	44		N1530	N1520	PN1530		
Fort D	17 Polyline	Line	-36 inch sto	orm sew	1968	STORM	271	36	120		N1520	N1510	PN1520		200
	18 Polyline	Line	-36 inch sto	orm sew	1968	STORM	271	36	66		N1550	N1540	PN1550		320
Street	19 Polyline	Line	-36 inch sto	orm sew	1968	STORM	271	36	307		N1560	N1550	PN1560		
Fort D	20 Polyline	Line	-36 inch sto	ormisew	0		0	36	265		N1590	N1580	PN1590		
	21 Polyline	Line	-36 inch sto	ormisew	0	STORM	271	36	150		N1505	N1500	PN1505		1
City of	22 Polyline	Line	-21 inch sto	orm	0		0	21	65		G2283	G2282	PG2283		
	23 Polyline	Line	-18 inch sto	orm	0		0	18	49		G2282	G2281	PG2282		
KG	24 Polyline	Line	-18 inch str	orm	0			40	44		000084	00000	PG2281		Sector 2
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Item Gree Blu Fort_Doogs Fort_Doogs Fort_Doogs Comment Storm in 1 storm in 2 storm in 3 storm in 4 storm in 5 storm in 6 storm in 6 storm in 10 storm in 11 ra-3 int 10 storm in 11 ra-3 int 12 curb int 13 storm in 15 storm in 15 storm in 16 storm in 17 curb int 18 curb int 19 storm in 20 storm in	25 Polvine Record: 4 erobox. XPSWMM_MHI AYER R manhole manhole manhole manhole manhole manhole manhole take take take take manhole manhole take take take take take manhole manhole take take take take take take take tak	Line M_ELEV 1113.5 1113.5 1113.5 1111.5 1109.32 1114.05 1108.47 1112.38 1111.405 1108.28 1108.82 1108.82 1108.82 1108.82 1108.83 1111.83 1111.83 11105.4 1105.5 1105.5 1105.4 1105.5 1105.5 1105.4 1105.5 1105.5 1105.4 1105.5 1	-24 inch sto 1	orm All Show: All INVERTIDIA 30 0 0 0 0 0 0 0 0 0 78 78 78 78 0 0 0 0	0 Selected 1099.09 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Records (0 out	INVERT2DIA IN	18 24 Op INVERTZE 0 109 0 0 0 109 8 109 8 109 0 109 0 109 0 109 0 109 0 109 0 109 0 109 0 109 0 109 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	276 tions - 3.LE INVI 3.LE INVI 3.LE INVI 3.LE INVI 3.LE INVI 3.LE INVI 4.13 EAST 4.13 EAST 4.13 EAST 4.13 EAST 4.14 EAST 4.14 EAST 4.14 EAST 4.14 EAST 4.15 NORT 0 1.57 SOUT 0 0 0 0 0 0 0 0 0 0 0 0 0	ERT2DIR) H G G G G G G G G G G G G G G G G G G G	Instant Instant IG2270 4 2800 4 2620 4 2630 4 2630 4 2850 4 1020 4 1030 4 1030 4 1050 4 1050 4 1050 4 1570 4 1550 4 1550 4 1550 4 1520 4 1530 4 1530 4 1540 4 1590 4	POINT_X POINT_X 1744443.61981 1744443.61981 1744443.61981 1744443.61981 1744459.4275 1744599.48275 1746001.43953 1744599.48275 174598.4224246 1744598.24246 1744598.43953 1744598.43953 1744598.3315 1744598.43953 1744570.83315 1743074.97688 1743071.83712 1743072.32787 1743072.33718 1743072.33718 1743072.33718 1743075.19079 1743076.19079 1742812.14735	PG2270 POINT_Y 3646443.07458 3647056.87153 3647056.87153 3647056.71837 3647056.71837 3647791.13332 3647781.4698 3647981.313272 3647884.50182 3647884.50182 3647884.50182 3647884.55568 3649352.64285 3649352.64285 3650316.479423 3650136.28928 3650136.48132 3650186.3065 3649050.54673		













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6								G1001	1100.00	1093.03	78	1093.03	WEST	-	0	0.00	0	
7	PG1010	78	1178	G1010	G1001	1094.13	1093.03	G1010	1114.05	1094.13	78	1094.13	WEST	-	78	1094.13	EAST	
8	PG1020	78	277	G1020	G1010	1094.24	1094.13	G1020	1109.32	1094.24	78	1094.23	EAST		78	1094.23	WEST	
9	PG1030	78	247	G1030	G1020	1094.59	1094.24	G1030	1106.47	1101.37	18	1101.36	NORTH		18	1101.46	SOUTH	
10	PG1040	/8	415	G1040	G1030	1095.18	1094.59	G1040	1112.38	1095.18	0	1095.18	EAST		0	1095.18	WEST	
11	PG1050	78	245	G1040	G1050	1095.18	1094.61	G1050	1111.41	1094.61	0	1094.60	EAST		0	1094.91	WEST	$\left - \right $
12	PG1060	78	430	G1060	G1050	1095.44	1094.61	G1060	1109.20	1095.44	/8	1095.43	EAST		/8	1095.43	WEST	
13	PG1070	72	110	G1060	G1070	1095.44	1095.12	G1070	1108.28	1095.12	70	1095.11	EAST		10	1095.11	WEST	
14	PG1060	12		GIUGU	61070	1038.46	1055.12	G1000	1002.00	1090.47	54	1090.40	LAST		10	1105.08	3001H	
15	DC2020		206	62020	62001	1092 77	1092 12	G2001	1112 54	1107.24	15	1107.32	VVEST		15	1107.29	SOUTH	
17	PG2020	54	455	62020	62001	1094.79	1093.12	G2020	1112.04	1107.24	15	1107.25	SOUTH		0	0.00	300TH	$\left[+ \right]$
10	PG2040	54	229	62050	G2020	1095 21	1094.78	G2040	1113.47	0.00	15	0.00	0		0	0.00	0	
10	PG2030	54	230	62030	G2040	1096.03	1095 21	62070	1112.01	1109 51	15	1109 51	EAST		15	1109 51	WEST	
20	PG2070	54	222	62080	62050	1096 52	1096.03	62080	1114 43	1096 52	54	1096 52	SOUTH		54	1096 52	WEST	
21	PG2090	54	52	62090	G2080	1096 61	1096 52	G2000	1115 52	0.00	0	0.00	0	-	0	0.00	0	
22	PG2130	54	811	62130	62090	1098.07	1096.61	G2130	1113.02	1098.07	54	1098.06	FAST		48	1098.06	WEST	$\left[+ \right]$
23	PG2140	48	139	62140	62130	1098 23	1098.07	G2140	1114.16	1108.48	15	1108.47	SOUTH		15	1108 67	NORTH	
24	PG2170	48	703	62170	G2140	1099.04	1098.23	G2170	1113.99	1109.39	15	1109.39	SE		0	0.00	0	
25	PG2180	48	703	G2180	G2170	1099.85	1099.04	G2180	1115.20	1099.85	48	1099.84	EAST		36	1099.84	WEST	
26	PG2190	36	676	G2190	G2180	1100.58	1099.85	G2190	1116.00	0.00	0	0.00	0		0	0.00	0	
27	PG2200	36	676	G2200	G2190	1101.31	1100.58		1116.00				-					H
28	PG2210	36	676	G2210	G2200	1102.04	1101.31	G2210	1115.00	0.00	0	0.00	0		0	0.00	0	
29	PG2220	36	491	G2220	G2210	1102.57	1102.04	G2220	1111.00	0.00	0	0.00	0		0	0.00	0	
30	PG2230	36	113	G2230	G2220	1102.69	1102.57	G2230	1110.30	1102.69	0	0.00	0		0	0.00	0	
31	PG2231	15	67	G2231	G2230	1102.91	1102.69	G2231	1110.60	1102.91	0	0.00	0		0	0.00	0	
32	PG2232	24	409	G2232	G2231	1104.56	1102.91	G2232	1107.95	1104.56	0	0.00	0		0	0.00	0	
33	PG2233	15	412	G2233	G2232	1106.31	1104.56	G2233	1111.37	1106.31	0	0.00	0		0	0.00	0	
34	PG2234	18	12	G2234	G2233	1106.40	1106.31	G2234	1111.30	0.00	0	0.00	0		0	0.00	0	
35	PG2235	15	424	G2235	G2234	1106.50	1106.40	G2235	1113.43	0.00	0	0.00	0		0	0.00	0	
36	PG2236	15	424	G2236	G2235	1106.60	1106.50	G2236	1112.79	0.00	0	0.00	0		0	0.00	0	
37	PG2240	36	40	G2240	G2230	1102.82	1102.69	G2240	1110.50	0.00	0	0.00	0		0	0.00	0	
38	PG2250	30	358	G2250	G2240	1104.01	1102.82	G2250	1109.80	1104.01	30	1104.01	SOUTH		30	1104.01	NORTH	
39	PG2260	30	358	G2250	G2260	1104.01	1103.41	G2260	1109.25	1103.41	30	1103.41	NORTH		30	1103.41	SOUTH	 -
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Name	Storm	Length	Diameter (Hei	Upstream Inve	Downstream I	Max Flow	Roughness	Shape	Upstream N	lod Downstream	Conduit Slope		
31010	10Yr 2Hr	869.000	6.500	1094.130	1093.030	235.756	0.0130	Circular	G1010	G1001	0.13000		
31020.1	10Yr 2Hr	283.000	6.500	1094.240	1094.130	184.378	0.0130	Circular	G1020	G1010	0.03887		
\$1030.1	10Yr 2Hr	247.000	6.500	1094.590	1094.240	184.399	0.0130	Circular	G1030	G1020	0.14170		
\$1040.1	10Yr 2Hr	415.000	6.500	1095.180	1094.590	184.904	0.0130	Circular	G1040	G1030	0.14217		
\$1050.1	10Yr 2Hr	245.000	6.500	1095.180	1094.610	-137.270	0.0130	Circular	G1040	G1050	0.23265		
1060.1	10Yr 2Hr	436.000	6.500	1095.440	1094.610	125.103	0.0130	Circular	G1060	G1050	0.19037		
\$1062.1	10Yr 2Hr	180.000	3.000	1100.560	1095.440	-0.775	0.0130	Circular	G1062	G1060	2.84444		
\$1067.1	10Yr 2Hr	565.000	2.500	1104.990	1100.560	0.000	0.0130	Circular	G1067	G1062	0.00000		
1070.1	10Yr 2Hr	110.000	6.000	1095.440	1095.120	-125.487	0.0130	Circular	G1060	G1070	0.29091		
\$1080	10Yr 2Hr	855.000	6.000	1096.460	1095.120	87.101	0.0130	Circular	G1080	G1070	0.16000		
2020.1	10Yr 2Hr	296.000	4.500	1093.770	1092.230	50.556	0.0130	Circular	G2020	G2001	0.52027		
2040.1	10Yr 2Hr	455.000	4.500	1094.780	1093.770	50.570	0.0130	Circular	G2040	G2020	0.22198		
2050.1	10Yr 2Hr	238.000	4.500	1095.310	1094,780	50.545	0.0130	Circular	G2050	G2040	0.22269		
2070.1	10Yr 2Hr	330.000	1.000	1096.030	1095,310	8.625	0.0130	Circular	G2070	G2050	0.21818		
2080.1	10Yr 2Hr	222.000	4.500	1096.520	1096.030	81,776	0.0130	Circular	G2080	G2070	0.22072		
2090	10 Yr 2Hr	52 000	4 500	1096 610	1096 520	-36.863	0.0130	Circular	62090	62080	0.17000		
2110	10Vr 2Hr	498 000	4.500	1097 510	1096 610	-18 884	0.0130	Circular	G2110	62090	0.18000		
2110	1011211	313.000	1.000	1098.070	1007 510	6 947	0.0130	Circular	02110	02030	0.17891		
2130.1	1011 201	420.000	1.000	1030.070	1037.510	0.947	0.0130	Circular	02130	02110	0.17091		
2140.1	10YF 2Hr	139.000	4.000	1098.230	1098.070	10.998	0.0130	Circular	02140	02130	0.11511		
2170.1	10Yr 2Hr	553.000	4.000	1099.040	1098.230	-26.413	0.0130	Circular	G2170	G2140	0.14647		
2180.1	10Yr 2Hr	250.000	4.000	1099.850	1099.040	-34.512	0.0130	Circular	G2180	G2170	0.32400		
2190.1	10Yr 2Hr	253.000	3.000	1100.580	1099.850	-31.868	0.0130	Circular	G2190	G2180	0.28854		
2200.1	10Yr 2Hr	190.000	3.000	1101.310	1100.580	-45.357	0.0130	Circular	G2200	G2190	0.38421		
2201	10Yr 2Hr	267.000	1.750	1101.440	1101.310	29.757	0.0130	Circular	G2201	G2200	0.04869		
2210.1	10Yr 2Hr	262.000	3.000	1102.040	1101.310	-55.484	0.0130	Circular	G2210	G2200	0.27863		
2220.1	10Yr 2Hr	491.000	3.000	1102.570	1102.040	-41.118	0.0130	Circular	G2220	G2210	0.10794		
2230.1	10Yr 2Hr	113.000	3.000	1102.690	1102.570	-46.573	0.0130	Circular	G2230	G2220	0.10619		
\$2240.1	10Yr 2Hr	40.000	3.000	1102.820	1102.690	-52.190	0.0130	Circular	G2240	G2230	0.32500		
2241.1	10Yr 2Hr	258.000	2.250	1103.594	1102.820	-38.363	0.0130	Circular	G2241	G2240	0.30000		
2242	10Yr 2Hr	574.000	2.250	1105.312	1103.590	-14.964	0.0130	Circular	G2242	G2241	0.30000		
2250.1	10Yr 2Hr	172.000	2.500	1104.010	1102.820	21,767	0.0130	Circular	G2250	G2240	0.69186		
2260.1	10Yr 2Hr	145.000	2.500	1104.010	1103 410	-20.310	0.0130	Circular	G2250	G2260	0 41379		
2261.1	10 Yr 2Hr	10.000	1 000	1104 020	1103 410	-1.922	0.0130	Circular	G2261	G2260	6 10000		
2270.1	101/21	231.000	2 000	1103 790	1103.410	17 690	0.0130	Circular	62270	62260	0.16450		
2210.1	1011211	231.000	2.000	1103.780	1103.410	16 762	0.0130	Circular	02270	02200	1 39554		
2200.1	1011201	11 000	2.000	1102.040	1103.780	-10.702	0.0130	Circular	02200	02270	-1.30334		
2201	1011201	10.000	1,500	1102.700	1102.040	-0.913	0.0130	Circular	02201	02200	0.55000		
2202	10YF 2Hr	49.000	1.500	1103.000	1102.700	-0.034	0.0130	Circular	62282	62261	0.01000		
2283	10Yr 2Hr	65.000	1.750	1103.010	1103.000	-7.300	0.0130	Circular	G2283	62282	0.02000		
2284	10Yr 2Hr	65.000	1.000	1103.020	1103.010	-1.421	0.0130	Circular	G2284	G2283	0.02000		
2285	10Yr 2Hr	10.000	1.000	1103.050	1103.040	-3.228	0.0130	Circular	G2285	G2282	0.10000		
2286	10Yr 2Hr	10.000	1.000	1103.060	1103.050	5.711	0.0130	Circular	G2286	G2282	0.10000		
2287.1	10Yr 2Hr	10.000	1.000	1103.070	1103.060	6.538	0.0130	Circular	G2287	G2286	0.10000		
2400	10Yr 2Hr	434.000	2.500	1103.070	1101.650	-24.471	0.0130	Circular	G2400	G2180	0.33000		
2410.1	10Yr 2Hr	422.000	2.500	1104.500	1103.070	33.108	0.0130	Circular	G2410	G2400	0.33886		
2420.1	10Yr 2Hr	308.000	2.250	1104.810	1104.500	-10.626	0.0130	Circular	G2420	G2410	0.10065		
2430.1	10Yr 2Hr	237.000	1.500	1105.040	1104.810	-13.729	0.0130	Circular	G2430	G2420	0.09705		
2440.1	10Yr 2Hr	14.000	1.500	1105.040	1103.080	44,925	0.0130	Circular	G2430	G1080	14.00000		
2500	10Yr 2Hr	36.000	1 750	1104 780	1104 570	25.736	0.0130	Circular	G2500	G2410	0.58000		
2510	10Vr 2Hr	192 000	1 750	1105.000	1104.820	14 321	0.0130	Circular	02510	02500	0.09000		
2510	1011211	221 000	1.000	1105.000	1105.000	8 206	0.0130	Circular	02510	02510	0.00000		
2511	1011 2Hr	221.000	1.000	1105.010	1105.000	0.230	0.0130	Circular	02511	02510	0.00000		
2512	10YF 2Hr	214.000	1.500	1105.020	1105.010	5,191	0.0130	Circular	02512	02510	0.00000		
2513	TUYF 2Hr	170.000	1.250	1105.030	1105.020	5.702	0.0130	Circular	G2513	62512	0.01000		







Storage Alternative





Sewer Extended to Mall





Connection to 72" Outlet





Chosen Alternate





Phasing





Questions?

HR GREEN, INC. 420 N. Front Street, Suite 100 McHenry, IL 60050 Main: 815.385.1778 Fax: 815.385.1781 www.hrgreen.com