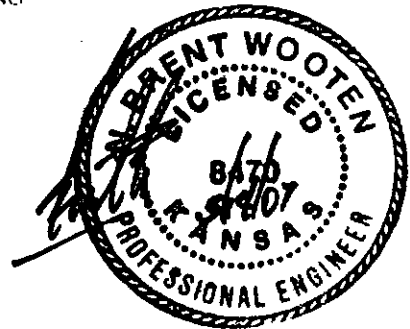


DRAINAGE PLAN
PRAIRIE POND PLAZA
2ND ADDITION
TO
WICHITA, SEDGWICK COUNTY, KANSAS

PREPARED BY



12 MAY 2007





DRAINAGE PLAN PRAIRIE POND PLAZA 2ND ADDITION

FINAL REPORT

**Prepared by Baughman Company, P.A.
10 MAY 2007**

**By N. Brent Wooten, P.E.
Trevor R. Kurth, I.E.
Nicholas H. Jefferson, I.E.**

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WICHITA

Public Works, Engineering Division
Final Drainage Plan Submittal Checklist

Reviewer: _____ Date: _____
 Subdivision Name: PEAIRIE POND PLAZA 2nd Location: 14300 E ; KELLOGG
 Total Land Area Of Ownership: 17 Acres
 Type: Residential _____ Commercial _____ Industrial _____ Recreation _____ Municipal _____ Other _____
 Applicant: Taylor Enterprises Contact: Don Taylor Phone #: _____
 Engineer: Boylmarc Co. PA Contact: TREVOR KURTH Phone #: 262-7271

Please check the appropriate box:

I = Included; NA = Non-Applicable; R= Required prior to development
(If "NA" is checked, an explanation must be entered)

Tab 1. Project Narrative	Applicant		Engr	
	I	NA	I	NA
A. Site Location Map, using USGS Map	<input checked="" type="checkbox"/>			
B. Discussion of development, existing conditions, and proposed impacts on stormwater, wetland, riparian, and flood plain	<input checked="" type="checkbox"/>			
C. Discussion of offsite conditions	<input checked="" type="checkbox"/>			
D. Summary of runoff calculations (pre/post development) No increase in peak discharge for all storm series	<input checked="" type="checkbox"/>			
E. Narrative description of the type and function of the permanent best management practices that are incorporated into the site design	<input checked="" type="checkbox"/>			
F. Copy of the plat	<input checked="" type="checkbox"/>			
G. Preliminary grading plan (The final grading plan shall be sealed, signed and dated prior to Engineering receiving the final sanitary sewer plans. One plan sheet and PDF shall be submitted to the Subdivision Engineer.)	<input checked="" type="checkbox"/>			
H. Professional Engineer seal, signature and date on cover of report	<input checked="" type="checkbox"/>			
I. CD of drainage plan in PDF format (one file) and one paper copy bound with this checklist included behind the cover		<input checked="" type="checkbox"/>	Upon Approval, CD will be provided	

Tab 2. Existing Conditions Runoff Calculations	Applicant		Engr	
	I	NA	I	NA
A. Copy of applicable orthophoto showing proposed project boundaries (preferable in color)	<input checked="" type="checkbox"/>			
B. Runoff Method (Rational, Hydrograph Method, or other approved methods by Engineering)	<input checked="" type="checkbox"/>			
C. Existing topography (no greater than 2-foot contours, 1-foot recommend)	<input checked="" type="checkbox"/>			
D. Total Site Area and Total Impervious Area (acres)	<input checked="" type="checkbox"/>			
E. Benchmarks used for site control	<input checked="" type="checkbox"/>			
F. Streams, creeks, and waterway labeled	<input checked="" type="checkbox"/>			
G. Predominant soils from USDA soil surveys, and/or on site soil borings	<input checked="" type="checkbox"/>			
H. Location and boundaries of natural features such as wetlands, lakes, and ponds with the normal water elevation noted	<input checked="" type="checkbox"/>			
I. Location of existing roads, buildings, parking lots and other impervious areas.	<input checked="" type="checkbox"/>			



WICHITA

J. Location of existing utilities (e.g., water, sewer, gas, electric) and easements	X			
K. Location of existing conveyance systems such as storm drains, inlets, catch basins, channels, swales, and areas of overland flow	Y			
L. Flow paths	X			
M. Location and dimensions of existing channels, bridges or culvert crossings	X			
N. Existing conditions hydrologic analysis for runoff rates, volumes and velocities showing methodologies used and supporting calculations (2, 5, 10, 25 & 100 year, 24-hour storm events) or Critical Duration	Y			
O. Assumed pre-developed runoff curve numbers	X			
P. Existing time of concentrations used in calculations	Y			
Q. Evaluate immediate downstream drainage capacity, not to exceed more than 0.25 miles downstream of site	Y			
R. Existing structural elevations (e.g., invert of pipes, manholes, etc.)	Y			
S. Cross-section data for open channels	Y			
T. Ground water elevations, if applicable		Y	NA	

Tab 3. Post-Development Hydrologic Analysis	Applicant			Engr	
	I	NA	Explanation / Location in Plan	I	NA
A. Proposed (post-development) conditions hydrologic and hydraulic analysis for runoff rates, volumes, HGL, and velocities showing the methodologies used and supporting calculations for all applicable design storms (2, 5, 10, 25 & 100 year, 24-hour storm events)	Y				
B. Proposed time of concentrations used in calculations	X				
C. Assumed post-developed runoff curve numbers	X				
D. Proposed contours for detention facilities (to equal area used in outlet rating curves)	X				
E. Preliminary sizing calculations for stormwater controls including contributing drainage area, storage, and outlet configuration	X				
F. Stage-storage-discharge or outlet rating curves and inflow and outflow hydrographs for storage facilities	Y				
G. Final analysis of potential upstream/downstream impact/effects of project, where necessary	X				
H. Existing and proposed structural elevations (e.g., invert of pipes, manholes, etc.)	Y				
I. Design water surface elevations and normal pool elevation for ponds.	X				
J. Typical detail for outlet structures, embankments, spillways, grade control structures, conveyance channels, etc. To include height, width, elevation, and/or diameter.	X				
K. Proposed limits of clearing and grading	X				
L. Location of existing and proposed roads, buildings, parking lots and other impervious areas.	X				
M. Location of existing and proposed utilities (e.g., water, sewer) and easements		X	See Utility Plan		
N. Location of existing and proposed conveyance systems such as storm drains, inlets, catch basins, channels, swales, and areas of overland flow	X				
O. Preliminary location and dimensions of proposed channel modifications, such as bridge or culvert crossings	X				



WICHITA

P. Preliminary selection and location of stormwater controls	X				
Q. Emergency overflow structure's flow path	X				
R. Detention facility provides one-foot of freeboard above the HWL and emergency outfall shown (top of berm elevation shown)	Y				
S. The 100-year 24-hour HWL delineated on the plan for detention pond	X				
T. Lowest opening elevations table on the plat for structures located adjacent to channels or ponds	X				
U. Stormwater Management Facilities located within a Reserve	X				
V. Maintenance responsibility of stormwater management facility shall be specified in the plat text (e.g. HOA, Lot Owners Association, or lot)	Y				
W. Off-site drainage easements or agreements required, where necessary	X				

Tab 4. Floodplain Submittal	Applicant		Engr	
	I	NA	I	NA
A. Provide source of flood profile	X			
B. Nearest base flood elevations		X	No FEMA on site	
C. Delineation of pre-developed regulatory floodplain/floodway limits		X		
D. Delineation of post-developed regulatory floodplain and floodway limits		Y		
E. Floodplain boundary determination per elevation (project limits shown)		Y		
F. Provide source of floodway data table and discharges		X		
G. Provide all hydrologic and hydraulic study information for site-specific floodplain studies, unnumbered Zone A area elevation determinations and flood plain map revisions or required permits		X		
H. Provide regulatory floodway and four natural profile models (10, 50, 100, and 500-yr) for existing and future watershed conditions		X		
I. Location of floodplain/floodway limits and relationship of site to upstream/downstream properties (floodplain limits to be per elevation and scaled location)		X		
J. Flood plains and floodways located within a Reserve, where necessary		X		

Tab 5. Federal, State and Local Permits (to be provided prior to construction unless otherwise specified)	Applicant		Engr	
	I/R	NA	I/R	NA
A. US Army Corps of Engineers - Regulatory program permits (404 water quality certification)		X	Site is ready for development	
B. Kansas Department of Agriculture - Division of Water Resources Permits (Stream Obstruction, Channel Change, Flood Plain Fill, Levee, Water Appropriations, Dam safety permit, etc.)		X	because of re-plat.	
C. Federal Emergency Management Agency (FEMA) Letter of Map Changes (LOMA, LOMR, LOMR-f, CLOMR, etc.) Shall be included and approved when project modifies the limits of the floodway.		Y		
D. Kansas Department of Transportation		Y		
E. Sedgwick County Right-of-way Permit		X		

PROJECT NARRATIVE

EXISTING CONDITIONS

The site is located at the corner of 143rd East and Kellogg Avenue. The site is approximately 17 acres and drains to the south. This property was previously platted as Prairie Pond Plaza Addition. There is an existing pond and outfall which was constructed as the above mentioned plat. The existing outfall is 2-36" RCP which then drains into the KDOT ROW into the existing box culvert. The site is undeveloped at this time but has been mass graded and a temporary dirt drive is located on the property.

There is approximately 36 acres of drainage encroaching the property from the north and enters the existing pond. This pond was sized to handle the offsite runoff as well as the sites developed runoff.

There is no FEMA SFHA as of May 10, 2007.

PROPOSED CONDITIONS

The site is proposed to be developed into 6 commercial lots with associated utilities and drainage systems. The lots are served by storm water sewer (as shown) and will have internal storm systems which are not shown.

The site will be light commercial with a single road through the plat. The only major change from Prairie Pond Plaza Addition is the location of the roadway and a lot shift. The overall boundary and reserve has stayed the same.

OFFSITE CONDITIONS

The site generally drains to the south and through an existing 4x4 RCBC under Kellogg Avenue. A portion of the site drains to the west and then south and under 143rd Street East through a 24" RCP.

Approximately 36 acres drains from the north and into the existing pond. The pond is sized for the 100-year storm event and discharges through 2-36" RCP.

EXISTING CONDITIONS RUNOFF CALCULATIONS

DRAINAGE METHODS & STANDARDS

The following methods and standards, although not a complete list, were used in calculating the existing conditions runoff values.

- STORM SERIES
 - SCS Curve Number Method utilized for site runoff
 - 24-hour; 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, 100-yr Storm Events

- OFFSITE FLOW
 - HydraFlow Hydrographs utilized for site runoff (Appendix B)
 - Time of Concentration using City of Wichita minimum 15 min
 - Existing CN = 80

- SITE FLOW
 - Rational Method used for site runoff
 - Time of Concentration using City of Wichita minimum 15 min
 - Existing 'C' = 0.70

SITE CHARACTERISTICS

The current site is considered open space and generally drains to the south and east and sheet flows into the existing pond. The site is just upstream of Kellogg Avenue and drains under via a 4x4 RCBC. The current outlet from the pond is 2-36" RCP under Kellogg Drive. The site is currently platted as Prairie Pond Plaza Addition. There are currently utilities that serve the site that will be re-located along with Kellogg Drive. The pond and outlet configuration will remain the same.

EXISTING CONDITIONS HYDROLOGIC ANALYSIS

The existing conditions analysis was re-run using information from the previously approved Prairie Pond Plaza Addition drainage plan. The site has been graded to flow to the pond and then discharges out the existing 2-36" RCP. The site does accept approximately 36 acres of runoff from the north.

DOWNSTREAM DRAINAGE CAPACITY

The existing structures appear to be sufficient to convey the sites runoff under Kellogg Avenue. The proposed pond system was approved by KDOT upon the platting of Prairie Pond Plaza Addition. No change is expected in the discharge points or detention facility.

POST-DEVELOPMENT HYDROLOGIC ANALYSIS

DRAINAGE METHODS & STANDARDS

The following methods and standards, although not a complete list, were used in developing the drainage and grading plans.

- STORM SERIES
 - SCS Curve Number Method utilized
 - 24-hour; 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, 100-yr Storm Events Modeled
- Developed Site Runoff
 - Calculated in HydraFlow Hydrographs (Appendix B)
 - Developed CN = 80
 - Minimum Tc = 15 min

DETENTION FACILITIES

There is one existing detention facility in this addition. This system was built with the Prairie Pond Plaza Addition plat. No change in the facility or outlets is expected. The pond accepts drainage from the north as well as 15 acres of the proposed site. The pond is currently (and will in the future) discharge less than the existing conditions.

- **Existing Pond (Reserve A)**

The existing pond is located in Reserve A and is currently detaining the sites runoff and offsite runoff from the north. The pond has a static water surface of a 1317.0 and discharges out of 2-36" RCP at an elevation of 1320.0. The pond was proposed in Prairie Pond Plaza Addition. The pond drains via the above mentioned pipes and then under Kellogg Avenue via a 4x4 RCBC. The ponds hydraulics were re-calculated for this report and are enclosed in Appendix B. The pond will have a 100-year water surface of approximately 1324.0. A one-foot freeboard will be provided to the adjacent lots.

DETENTION SUMMARY

Detention has been provided to limit the developed runoff to existing conditions. The following table represent the ponds inflow and outflow for the 24-hour, 100-year storm event.

Existing Pond

POND	INFLOW	OUTFLOW	100-yr WSE	OUTLET
Existing Pond	296 cfs	108 cfs	1324.0	2-36" RCP

POTENTIAL UPSTREAM/DOWNSTREAM IMPACTS

No potential upstream impacts are expected with this development. The site was approved as its current configuration with the City of Wichita as well as KDOT to discharge into their ROW.

FLOODPLAIN SUBMITTAL

SOURCE OF FLOODPLAIN INFORMATION

This site is not located in any FEMA SFHA. This is per FEMA FIRM Panel 395 of 700 for Sedgwick County, Kansas, effective February 2, 2007. The FEMA FIRM for this area is attached as Exhibit 6.

FEDERAL, STATE, & LOCAL PERMITTING

US ARMY CORPS OF ENGINEERS

There does not appear to any USACOE permitting needed on the site at this time. There does not appear to be any stream threads or wetlands on the subject property and no work is expected on the high bank of the creeks.

KANSAS DEPT OF AGRICULTURE - DWR PERMITTING

There does not appear to be any DWR jurisdiction on this site.

FEMA

There is no FEMA SFHA on this site.

KANSAS DEPT OF TRANSPORTATION

There does not appear to be any KDOT permitting needed on the proposed project. A KDOT permit was obtained prior to the original Prairie Pond Plaza plat approval. The pond and outfall is not expected to change, only internal lot lines and utilities. No KDOT permitting is expected.

SEDGWICK COUNTY ROW

There does not appear to be any Sedgwick County Permitting on the proposed project.

SUPPORTING CALCULATIONS

APPENDIX A: USGS Soils Survey

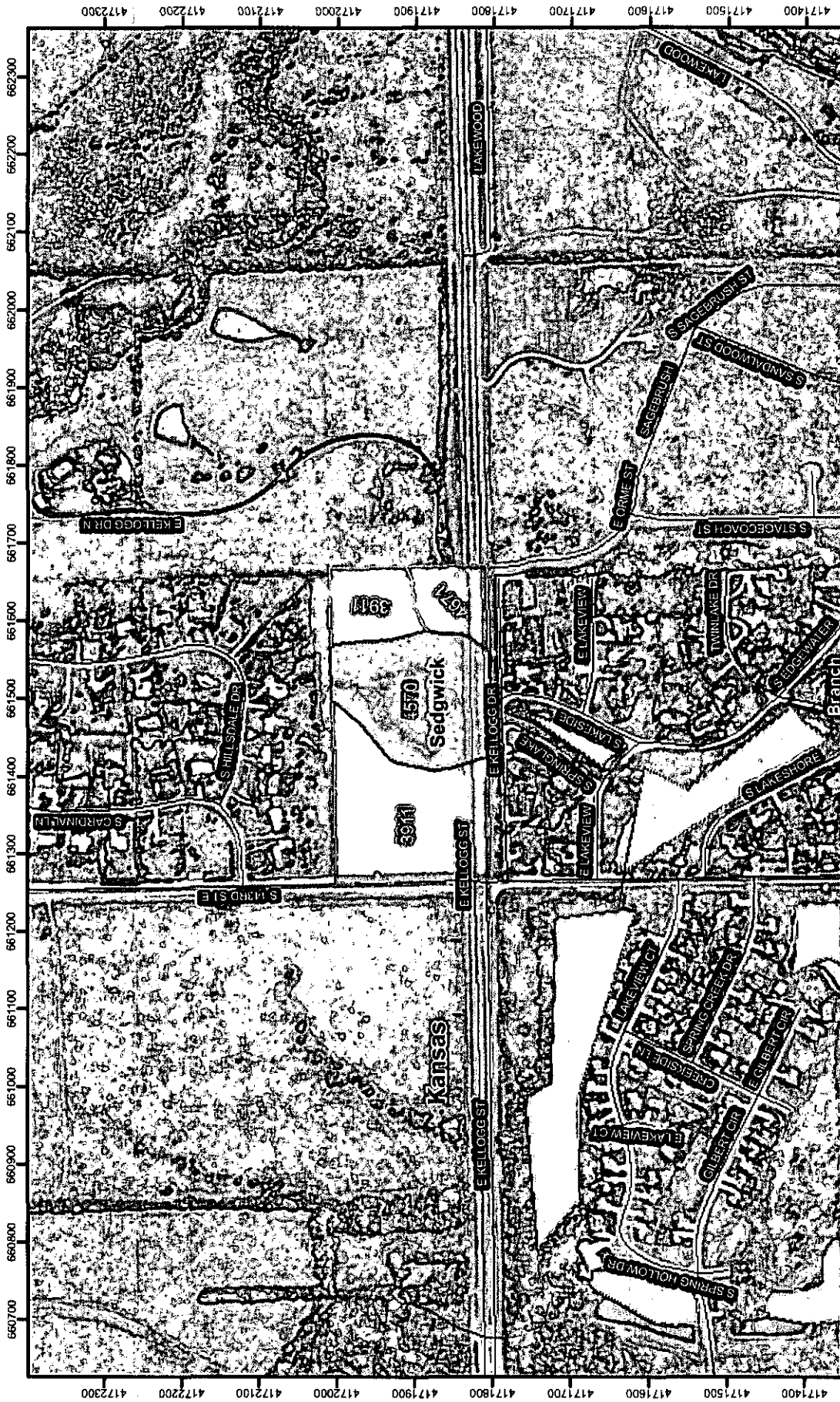
**APPENDIX B: HydraFlow Hydrographs
-Existing Pond**

**APPENDIX C: HydraFlow Express
-Storm Sewer System**

USGS Soils Survey

HYDROLOGIC SOIL GROUP RATING FOR SEDGWICK COUNTY, KANSAS

Prairie Pond Plaza



HYDROLOGIC SOIL GROUP RATING FOR SEDGWICK COUNTY, KANSAS

Prairie Pond Plaza

MAP LEGEND

Hydrologic Soil Group
{Dominant Condition, &t;}

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available
- Soil Map Units
- Cities
- Detailed Counties
- Detailed States
- Interstate Highways
- Roads
- Rails
- Water
- Hydrography
- Oceans

MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>

Coordinate System: UTM Zone 14
Soil Survey Area: Sedgwick County, Kansas
Spatial Version of Data: 1
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
10/1/1991; 3/20/1996

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Tables - Hydrologic Soil Group

Summary by Map Unit - Sedgwick County, Kansas

Soil Survey Area Map Unit Symbol	Map Unit Name	Rating	Total Acres in AOI	Percent of AOI
3911	Rosehill silty clay, 1 to 3 percent slopes	D	11.1	54.5
4570	Clime silty clay, 3 to 7 percent slopes	C	7.1	34.9
4671	Irwin silty clay loam, 1 to 3 percent slopes	D	2.2	10.7

Description - Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Parameter Summary - Hydrologic Soil Group

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates

that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie.

The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Component Percent Cutoff:

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Lower

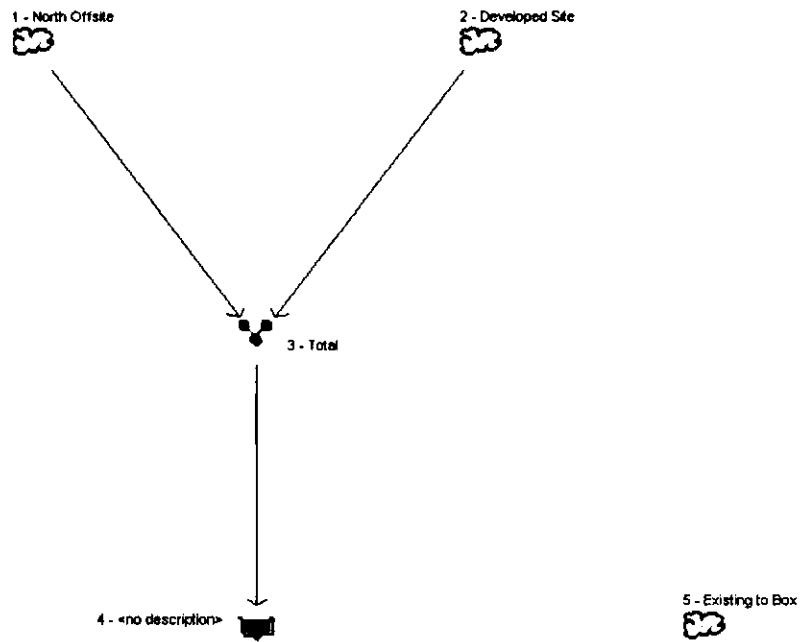
The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

HydraFlow Hydrographs

Existing Pond

Watershed Model Schematic

Hydraflow Hydrographs by Intelisolve v9.02



Legend

<u>Hyd. Origin</u>	<u>Description</u>
1	SCS Runoff North Offsite
2	SCS Runoff Developed Site
3	Combine Total
4	Reservoir <no description>
5	SCS Runoff Existing to Box

Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	---	---	49.12	-----	-----	111.88	-----	-----	206.84	North Offsite
2	SCS Runoff	-----	-----	21.15	-----	-----	48.17	-----	-----	89.05	Developed Site
3	Combine	1, 2	-----	70.27	-----	-----	160.05	-----	-----	295.89	Total
4	Reservoir	3	-----	1.995	-----	-----	33.98	-----	-----	108.02	<no description>
5	SCS Runoff	-----	-----	70.95	-----	-----	161.60	-----	-----	298.76	Existing to Box

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description	
1	SCS Runoff	49.12	2	722	3.224	---	----	-----	North Offsite	
2	SCS Runoff	21.15	2	722	1.388	---	----	-----	Developed Site	
3	Combine	70.27	2	722	4.612	1, 2	----	-----	Total	
4	Reservoir	1.995	2	1038	1.610	3	1320.36	3.43	<no description>	
5	SCS Runoff	70.95	2	722	4.656	---	----	-----	Existing to Box	
existing_pond.gpw					Return Period: 2 Year			Monday, May 14, 2007		

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.02

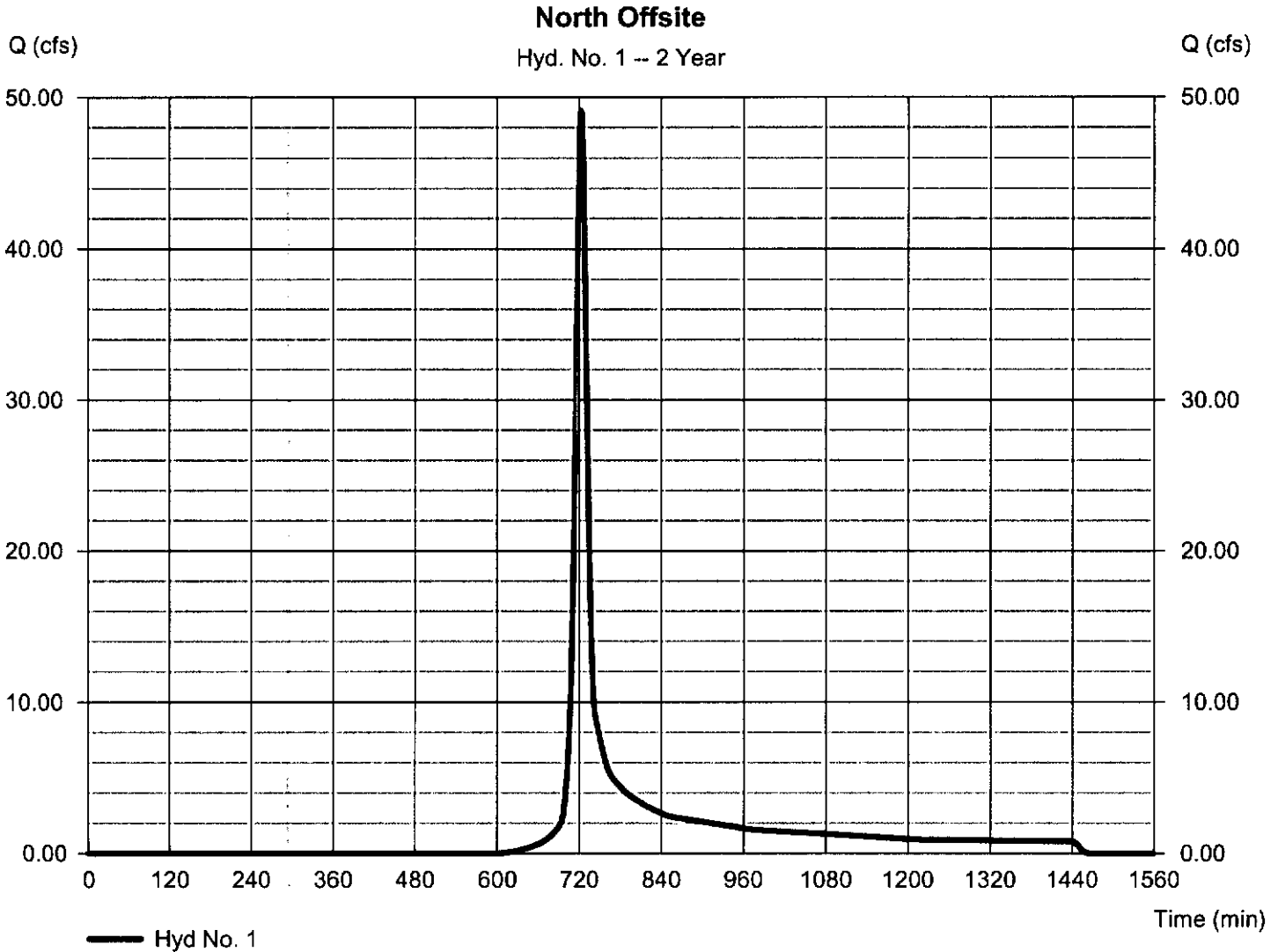
Monday, May 14, 2007

Hyd. No. 1

North Offsite

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 36.000 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 2.80 in
Storm duration = 24 hrs

Peak discharge = 49.12 cfs
Time to peak = 722 min
Hyd. volume = 3.224 acft
Curve number = 80
Hydraulic length = 0 ft
Time of conc. (Tc) = 15.00 min
Distribution = Type II
Shape factor = 484



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	111.88	2	722	7.200	---	----	----	North Offsite
2	SCS Runoff	48.17	2	722	3.100	---	----	----	Developed Site
3	Combine	160.05	2	722	10.300	1, 2	----	----	Total
4	Reservoir	33.98	2	740	7.298	3	1321.63	5.02	<no description>
5	SCS Runoff	161.60	2	722	10.400	---	----	----	Existing to Box
existing_pond.gpw					Return Period: 10 Year			Monday, May 14, 2007	

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.02

Monday, May 14, 2007

Hyd. No. 1

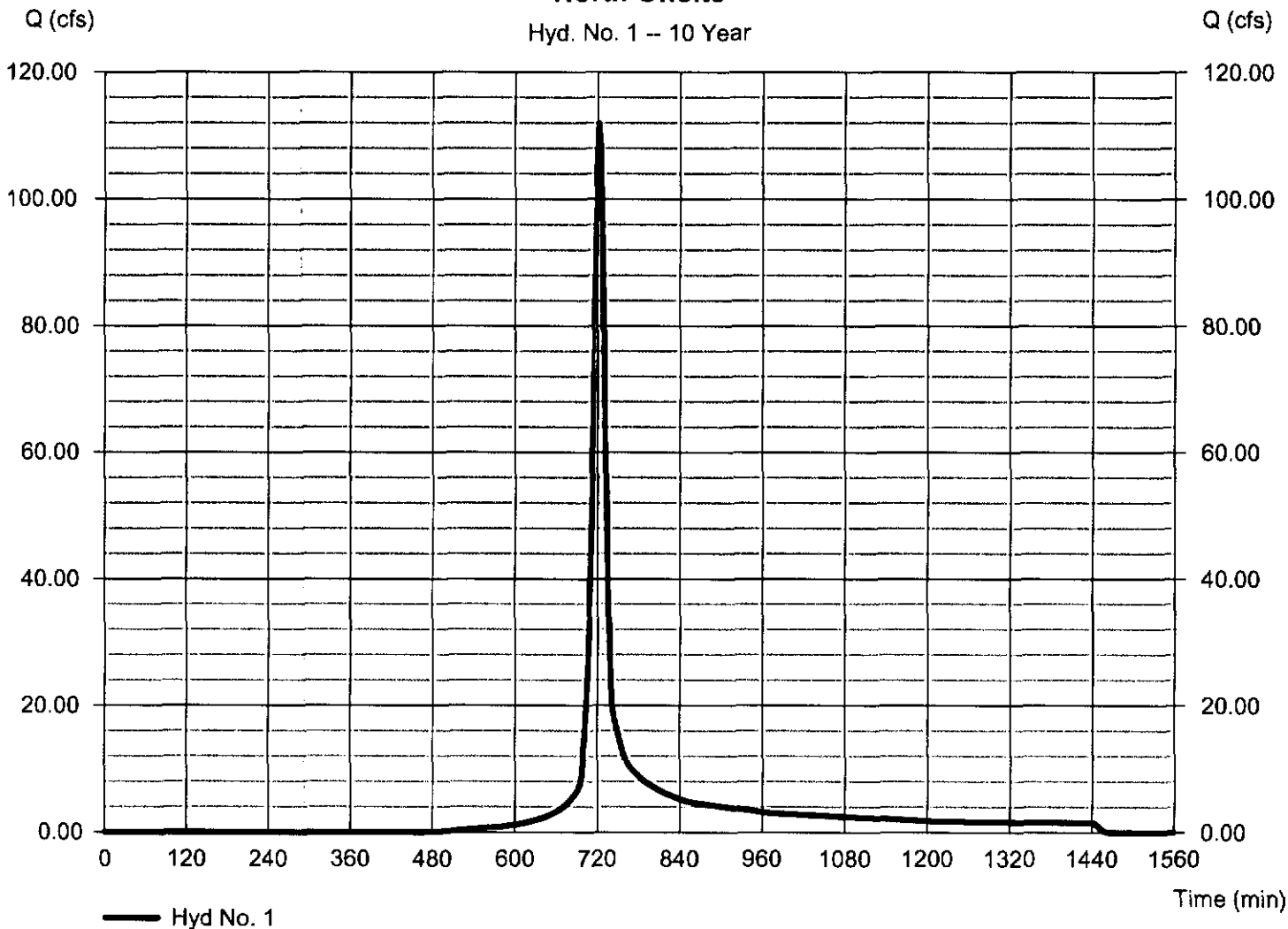
North Offsite

Hydrograph type = SCS Runoff
 Storm frequency = 10 yrs
 Time interval = 2 min
 Drainage area = 36.000 ac
 Basin Slope = 0.0 %
 Tc method = USER
 Total precip. = 4.50 in
 Storm duration = 24 hrs

Peak discharge = 111.88 cfs
 Time to peak = 722 min
 Hyd. volume = 7.200 acft
 Curve number = 80
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 15.00 min
 Distribution = Type II
 Shape factor = 484

North Offsite

Hyd. No. 1 -- 10 Year



— Hyd No. 1

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.02

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	206.84	2	722	13.462	---	----	----	North Offsite
2	SCS Runoff	89.05	2	722	5.796	---	----	----	Developed Site
3	Combine	295.89	2	722	19.258	1, 2	----	----	Total
4	Reservoir	108.02	2	734	16.256	3	1324.03	8.46	<no description>
5	SCS Runoff	298.76	2	722	19.444	---	----	----	Existing to Box
existing_pond.gpw					Return Period: 100 Year		Monday, May 14, 2007		

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.02

Monday, May 14, 2007

Hyd. No. 1

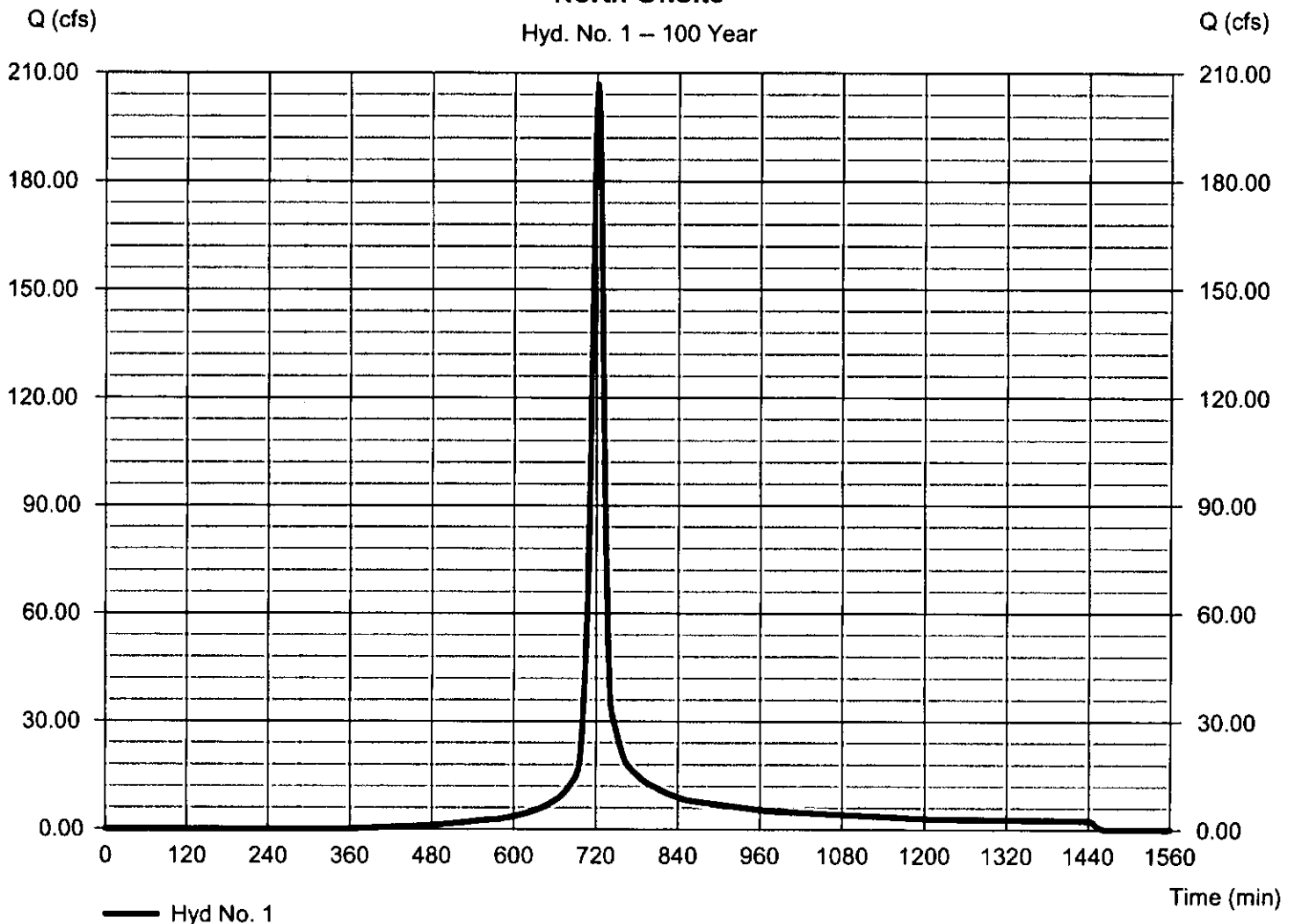
North Offsite

Hydrograph type = SCS Runoff
 Storm frequency = 100 yrs
 Time interval = 2 min
 Drainage area = 36.000 ac
 Basin Slope = 0.0 %
 Tc method = USER
 Total precip. = 6.90 in
 Storm duration = 24 hrs

Peak discharge = 206.84 cfs
 Time to peak = 722 min
 Hyd. volume = 13.462 acft
 Curve number = 80
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 15.00 min
 Distribution = Type II
 Shape factor = 484

North Offsite

Hyd. No. 1 - 100 Year



Hydraflow Rainfall Report

Hydraflow Hydrographs by Intelisolve v9.02

Monday, May 14, 2007

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	-----
2	71.8477	13.3000	0.8718	-----
3	0.0000	0.0000	0.0000	-----
5	75.7517	14.2000	0.8271	-----
10	86.7192	15.3000	0.8244	-----
25	103.3028	16.6000	0.8227	-----
50	116.5747	17.3000	0.8234	-----
100	124.5734	17.6000	0.8144	-----

File name: wich15min.IDF

$$\text{Intensity} = B / (T_c + D)^E$$

Return Period (Yrs)	Intensity Values (In/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.70	4.62	3.90	3.38	2.99	2.69	2.45	2.24	2.08	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.58	5.43	4.65	4.08	3.64	3.30	3.02	2.79	2.59	2.42	2.28	2.15
10	7.25	6.05	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.81	4.38	4.03	3.73	3.48	3.26	3.08	2.91
50	9.05	7.66	6.67	5.92	5.34	4.87	4.48	4.16	3.88	3.64	3.43	3.25
100	9.83	8.35	7.30	6.49	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: GB rainfall.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.80	0.00	3.30	4.50	5.77	6.80	6.90
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

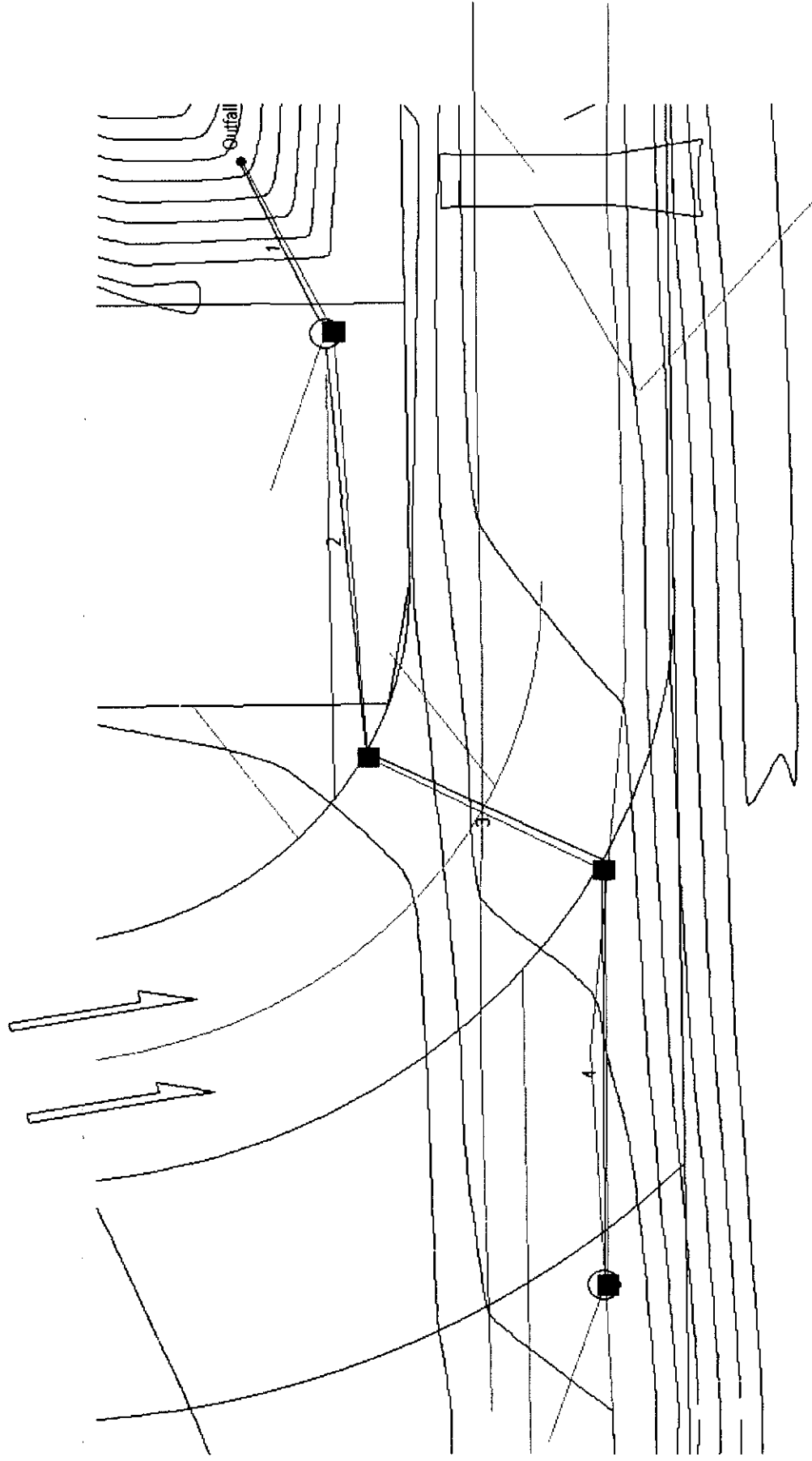
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HydraFlow StormSewers

SWS System

Hydraflow Plan View



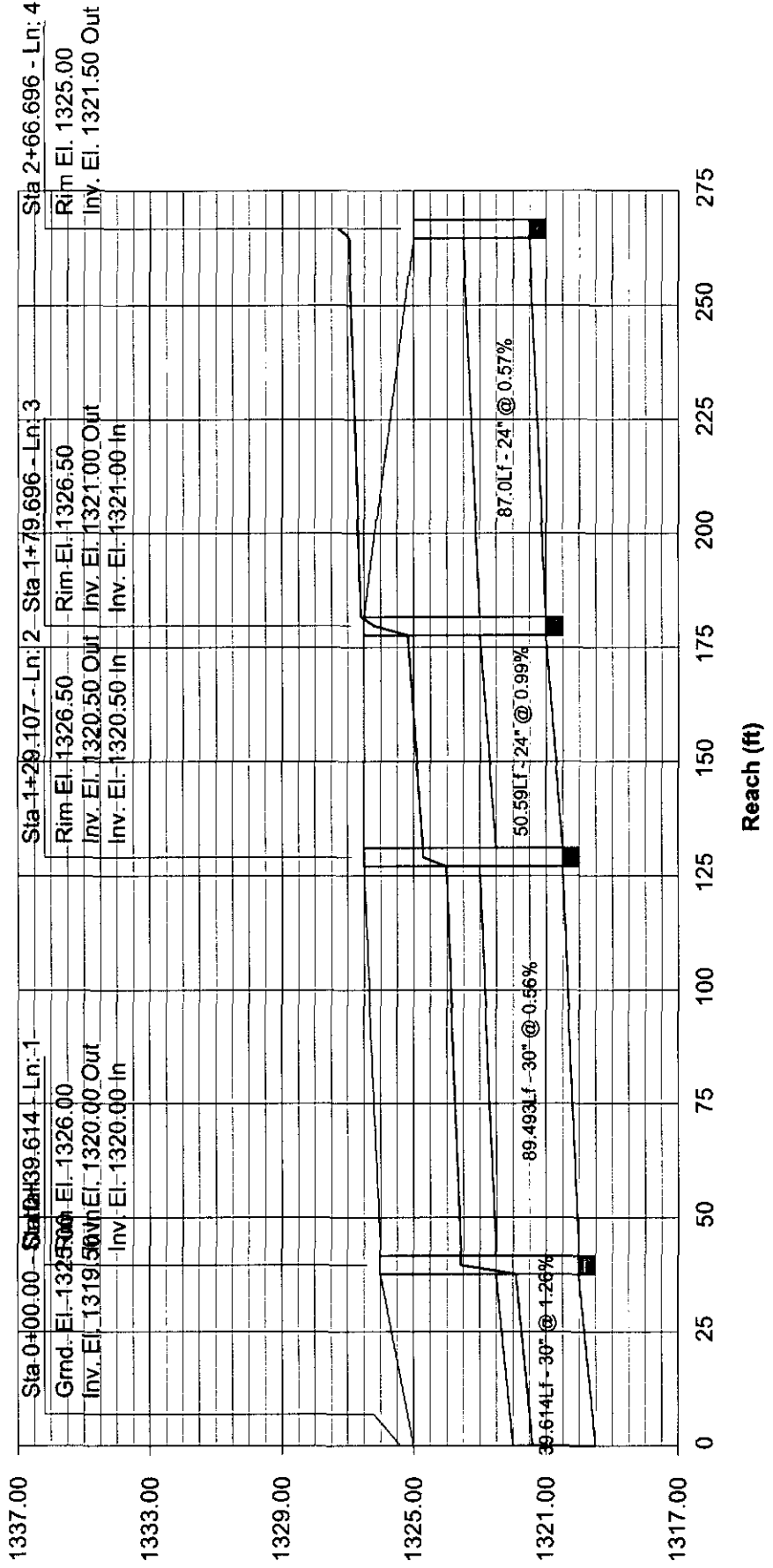
Project File: sws.stm

No. Lines: 4

05-14-2007

Storm Sewer Profile

Elev. (ft)



Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data							Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Dmg area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (In)	Line type	N value (n)	J-loss coeff (K)		Inlet/Rim El (ft)
1	End	39.6	153.9	DrGrt	0.00	0.70	0.70	15.0	1319.50	1.26	1320.00	30	Cir	0.013	0.64	1326.00
2	1	89.5	21.9	Curb	0.00	1.40	0.70	15.0	1320.00	0.56	1320.50	30	Cir	0.013	1.31	1326.50
3	2	50.6	-57.8	Curb	0.00	1.40	0.70	15.0	1320.50	0.99	1321.00	24	Cir	0.013	1.35	1326.50
4	3	87.0	61.6	DrGrt	0.00	2.90	0.70	15.0	1321.00	0.57	1321.50	24	Cir	0.013	1.00	1325.00

Project File: sws.stm

Number of lines: 4

Date: 05-14-2007

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		32.13	30 c	39.6	1319.50	1320.00	1.262	1321.40	1321.90	n/a	1323.57	End
2		28.80	30 c	89.5	1320.00	1320.50	0.559	1323.57*	1324.01*	0.70	1324.71	1
3		21.79	24 c	50.6	1320.50	1321.00	0.988	1324.71*	1325.18*	1.01	1326.19	2
4		14.81	24 c	87.0	1321.00	1321.50	0.575	1326.59*	1326.97*	0.35	1327.31	3

Project File: sws.stm

Number of lines: 4

Run Date: 05-14-2007

NOTES: c = cir; e = ellip; b = box; Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; i - Inlet control.

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)		Depth (ft)	Spread (ft)	Depr (in)
1		3.57	0.00	3.57	0.00	DrGrt	6.0	6.00	2.00	Sag	2.00	0.050	0.013	0.21	10.57	0.21	10.57	0.21	10.57	0.00	Off
2		7.15	0.00	7.15	0.00	Curb	6.0	6.00	2.00	Sag	2.00	0.080	0.013	0.53	9.40	0.64	9.40	0.64	9.40	2.00	1
3		7.15	0.00	7.15	0.00	Curb	6.0	6.00	2.00	Sag	2.00	0.080	0.013	0.53	9.40	0.64	9.40	0.64	9.40	2.00	2
4		14.81	0.00	14.81	0.00	DrGrt	6.0	6.00	2.00	Sag	2.00	0.050	0.013	1.90	77.96	1.90	77.96	1.90	77.96	0.00	3

Project File: sws.stm

Number of lines: 4

Run Date: 05-14-2007

NOTES: Inlet N-Values = 0.016 ; Intensity = 124.57 / (Inlet time + 17.60) ^ 0.81; Return period = 100 Yrs. ; * Indicates Known Q added

Hydraulic Grade Line Computations

Line	Size (in)	Q (cfs)	Downstream							Len (ft)	Upstream							Check		JL coeff (K)	Minor loss (ft)		
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)		Sf (%)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)			Ave Sf (%)	Energy loss (ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	30	32.13	1319.50	1321.40	1.90	4.00	8.03	1.00	1322.40	n/a	39.6	1320.00	1321.90	1.89**	3.99	8.05	1.01	1322.90	n/a	n/a	n/a	0.64	n/a
2	30	28.80	1320.00	1323.57	2.50	4.91	5.87	0.54	1324.10	0.493	89.5	1320.50	1324.01	2.50	4.91	5.87	0.54	1324.55	0.493	0.493	0.441	1.31	0.70
3	24	21.79	1320.50	1324.71	2.00	3.14	6.94	0.75	1325.46	0.929	50.6	1321.00	1325.18	2.00	3.14	6.94	0.75	1325.93	0.928	0.929	0.470	1.35	1.01
4	24	14.81	1321.00	1326.59	2.00	3.14	4.71	0.35	1326.94	0.429	87.0	1321.50	1326.97	2.00	3.14	4.71	0.35	1327.31	0.429	0.429	0.373	1.00	0.35

Project File: sws.stm

Number of lines: 4

Run Date: 05-14-2007

Notes: ** Critical depth.

General Procedure: Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles. The computed HGL is checked against inlet control.

- Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.
- Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.
- Col. 3 Total flow rate in the line.
- Col. 4 The elevation of the downstream invert.
- Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.
- Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.
- Col. 7 Cross-sectional area of the flow at the downstream end.
- Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).
- Col. 9 Velocity head (Velocity squared / 2g).
- Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).
- Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).
- Col. 12 The line length.
- Col. 13 The elevation of the upstream invert.
- Col. 14 Elevation of the hydraulic grade line at the upstream end.
- Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.
- Col. 16 Cross-sectional area of the flow at the upstream end.
- Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).
- Col. 18 Velocity head (Velocity squared / 2g).
- Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18).
- Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).
- Col. 21 The average of the downstream and upstream friction slopes.
- Col. 22 Energy loss. Average $S/100 \times \text{Line Length}$ (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.
- Col. 23 The junction loss coefficient (K).
- Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

Line No.	Area Dn (sqft)	Area Up (sqft)	Byp Ln No	Coeff C1 (C)	Coeff C2 (C)	Coeff C3 (C)	Capac Full (cfs)	Crit Depth (ft)	Cross Sl, Sw (ft/ft)	Cross Sl, Sx (ft/ft)	Curb Len (ft)	Defl Ang (Deg)	Depth Dn (ft)	Depth Up (ft)	DnStm Ln No	Dmg Area (ac)	Easting X (ft)	EGL Dn (ft)	EGL Up (ft)	EGL Jnct (ft)	Energy Loss (ft)
1	4.00	3.99	Sag	0.20	0.50	0.90	46.08	1.89	0.050	0.050	...	153.9	1.90	1.89**	Outfall	0.70	1650.57	1322.40	1322.90 i	1323.57	1.167
2	4.91	4.91	1	0.20	0.50	0.90	30.65	1.79	0.080	0.050	6.00	21.9	2.50	2.50	1	1.40	1561.32	1324.10	1324.55	1325.25	0.441
3	3.14	3.14	2	0.20	0.50	0.90	22.49	1.65	0.080	0.050	6.00	-57.8	2.00	2.00	2	1.40	1537.61	1325.46	1325.93	1326.94	0.470
4	3.14	3.14	3	0.20	0.50	0.90	17.15	1.36	0.050	0.050	...	61.6	2.00	2.00	3	2.90	1450.62	1326.94	1327.31	1327.66	0.373

Project File: sws.stm

Number of lines: 4

Date: 05-14-2007

NOTES: i Inlet control; ** Critical depth

Flow Rate (cfs)	Sf Ave (ft/ft)	Sf Dn (ft/ft)	Grate Area (sqft)	Grate Len (ft)	Grate Width (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Gutter Depth (ft)	Gutter Slope (ft/ft)	Gutter Spread (ft)	Gutter Width (ft)	HGL Dn (ft)	HGL Up (ft)	HGL Jnct (ft)	HGL Jmp Dn (ft)	HGL Jmp Up (ft)	Incr CxA	Incr Q (cfs)	Inlet Depth (ft)	Inlet Eff (%)
32.13	n/a	n/a	2.00	4.00	2.00	1325.00	1326.00	0.21	Sag	10.57	2.00	1321.40	1321.90	1323.57 i	...	...	0.49	3.57	0.21	100
28.80	0.493	0.493	...	...	...	1326.00	1326.50	0.53	Sag	9.40	2.00	1323.57	1324.01	1324.71	...	...	0.98	7.15	0.64	100
21.79	0.929	0.929	...	...	...	1326.50	1326.50	0.53	Sag	9.40	2.00	1324.71	1325.18	1326.19	...	...	0.98	7.15	0.64	100
14.81	0.429	0.429	2.00	4.00	2.00	1326.50	1325.00	1.90	Sag	77.96	2.00	1326.59	1326.97	1327.31	...	...	2.03	14.81	1.90	100

Project File: sws.stm

Number of lines: 4

Date: 05-14-2007

NOTES: i Inlet control; ** Critical depth

Inlet ID	Inlet Loc	Inlet Spread (ft)	Inlet Time (min)	I Sys (in/hr)	I Inlet (in/hr)	Invert Dn (ft)	Invert Up (ft)	Jump Loc (ft)	Jump Len (ft)	Vel Hd Jmp (ft)	Vel Hd Dmp (ft)	J-Loss Coeff	Junct Type	Known Q (cfs)	Cost RCP (\$)	Cost CMP (\$)	Line ID	Line Length (ft)	Line Size (in)
	Sag	10.57	15.0	7.17	7.30	1319.50	1320.00	...	...	0.00	0.00	0.64	Dp-Grate	0.00	2,342	2,108		39.61	30
	Sag	9.40	15.0	7.22	7.30	1320.00	1320.50	...	...	0.00	0.00	1.31	Curb	0.00	5,114	4,603		89.49	30
	Sag	9.40	15.0	7.24	7.30	1320.50	1321.00	...	...	0.00	0.00	1.35	Curb	0.00	2,756	2,480		50.59	24
	Sag	77.96	15.0	7.30	7.30	1321.00	1321.50	...	...	0.00	0.00	1.00	Dp-Grate	0.00	4,468	4,021		87.00	24

Project File: sws.stm

Number of lines: 4

Date: 05-14-2007

NOTES: Intensity = 124.57 / (Inlet time + 17.60) ^ 0.81 -- Return period = 100 Yrs. ; i Inlet control; ** Critical depth

Line Slope (%)	Line Type	Local Depr (in)	n-val Gutter	n-val Pipe	Minor Loss (ft)	Northing Y (ft)	Pipe Travel (min)	Q Byp (cfs)	Q Capt (cfs)	Q Carry (cfs)	Line Rise (in)	Runoff Coeff (C)	Line Span (in)	Area A1 (ac)	Area A2 (ac)	Area A3 (ac)	Tc (min)	Throat Ht (in)	Total Area (ac)	Total CxA	Total Runoff (cfs)	Vel Ave (ft/s)	Vel Dn (ft/s)
1.26	Cir	...	...	0.013	n/a	467.00	0.10	0.00	3.57	0.00	30	0.70	30	0.00	0.00	0.00	15.7	...	6.40	4.48	32.13	8.04	8.03
0.56	Cir	2.00	...	0.013	0.70	460.37	0.26	0.00	7.15	0.00	30	0.70	30	0.00	0.00	0.00	15.4	6.0	5.70	3.99	28.80	5.87	5.87
0.99	Cir	2.00	...	0.013	1.01	415.68	0.12	0.00	7.15	0.00	24	0.70	24	0.00	0.00	0.00	15.3	6.0	4.30	3.01	21.79	6.94	6.94
0.57	Cir	...	...	0.013	0.35	414.98	0.31	0.00	14.81	0.00	24	0.70	24	0.00	0.00	0.00	15.0	...	2.90	2.03	14.81	4.71	4.71

Project File: sws.stm Number of lines: 4 Date: 05-14-2007

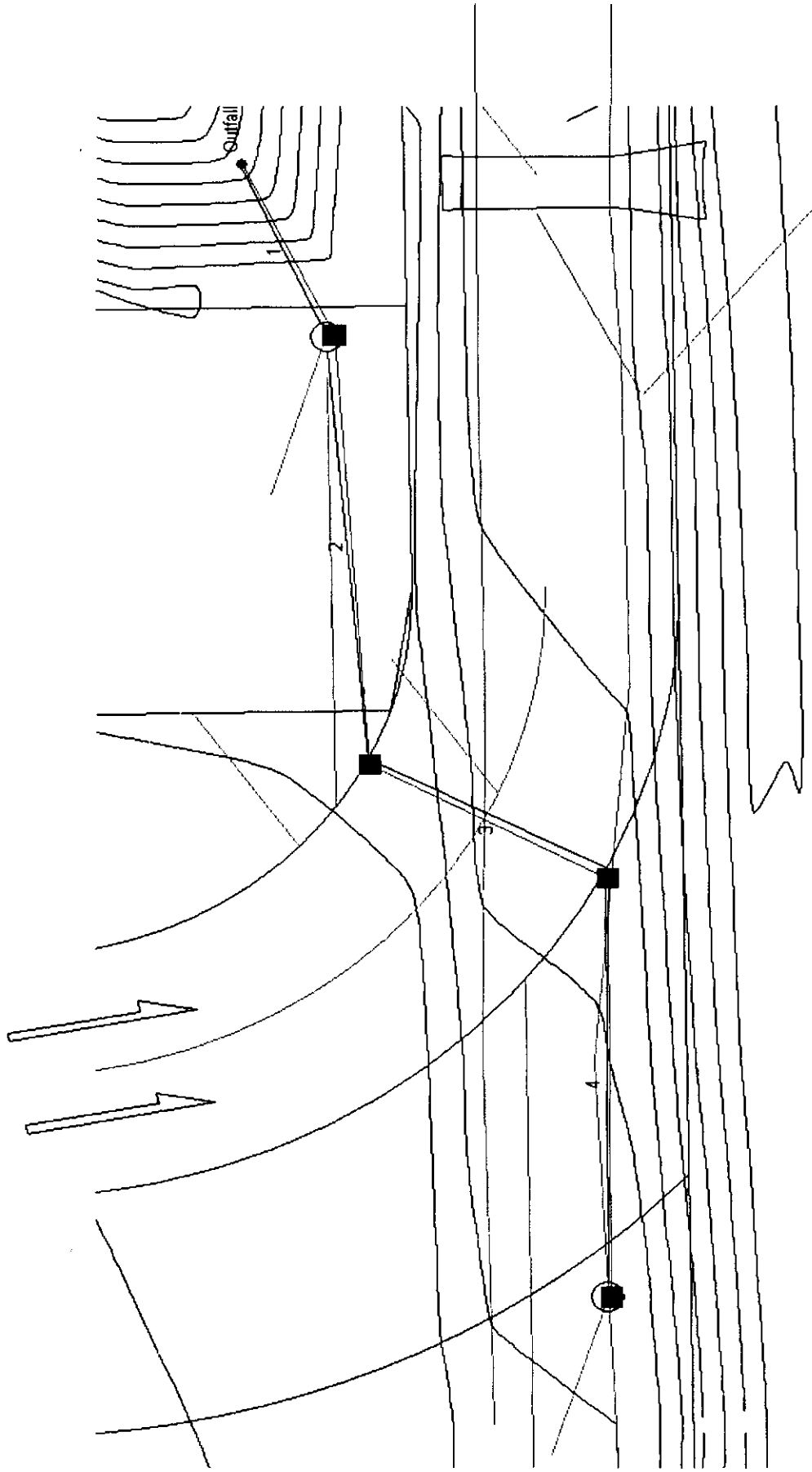
NOTES: i Inlet control; ** Critical depth

Vel Hd Dn (ft)	Vel Hd Up (ft)	Vel Up (ft/s)	Cover Dn (ft)	Cover Up (ft)	Storage (cft)
1.00	1.01	8.05	3.00	3.50	158.33
0.54	0.54	5.87	3.50	3.50	439.21
0.75	0.75	6.94	4.00	3.50	158.90
0.35	0.35	4.71	3.50	1.50	273.26

Project File: sws.stm Number of lines: 4 Date: 05-14-2007

NOTES: i Inlet control; ** Critical depth

Hydraflow Plan View



Project File: sws.stm

No. Lines: 4

05-14-2007

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data						Line ID	
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drmg area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)		J-loss coeff (K)	Inlet/Rim El (ft)
1	End	39.6	153.9	DrGrt	0.00	0.70	0.70	15.0	1319.50	1.26	1320.00	30	Cir	0.013	0.64	1326.00
2	1	89.5	21.9	Curb	0.00	1.40	0.70	15.0	1320.00	0.56	1320.50	30	Cir	0.013	1.31	1326.50
3	2	50.6	-57.8	Curb	0.00	1.40	0.70	15.0	1320.50	0.99	1321.00	24	Cir	0.013	1.35	1326.50
4	3	87.0	61.6	DrGrt	0.00	2.90	0.70	15.0	1321.00	0.57	1321.50	24	Cir	0.013	1.00	1325.00

Project File: sws.stm

Number of lines: 4

Date: 05-14-2007

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		16.80	30 c	39.6	1319.50	1320.00	1.262	1321.40	1321.37	n/a	1322.19	End
2		15.17	30 c	89.5	1320.00	1320.50	0.559	1322.19	1322.24	0.35	1322.59	1
3		11.53	24 c	50.6	1320.50	1321.00	0.988	1322.65	1322.74	0.33	1323.07	2
4		7.91	24 c	87.0	1321.00	1321.50	0.575	1323.22	1323.31	0.11	1323.42	3

Project File: sws.stm

Number of lines: 4

Run Date: 05-14-2007

NOTES: c = cir; e = ellip; b = box; Return period = 2 Yrs. ; i - Inlet control.

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)	Depth (ft)		Spread (ft)	Depr (in)
1		1.91	0.00	1.91	0.00	DrGrt	6.0	6.00	2.00	4.00	2.00	Sag	2.00	0.050	0.050	0.013	0.14	7.64	0.14	7.64	0.14	7.64	0.00	Off
2		3.82	0.00	3.82	0.00	Curb	6.0	6.00	2.00	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.37	6.17	0.48	6.17	0.48	6.17	2.00	1
3		3.82	0.00	3.82	0.00	Curb	6.0	6.00	2.00	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.37	6.17	0.48	6.17	0.48	6.17	2.00	2
4		7.91	0.00	7.91	0.00	DrGrt	6.0	6.00	2.00	4.00	2.00	Sag	2.00	0.050	0.050	0.013	0.54	23.68	0.54	23.68	0.54	23.68	0.00	3

Project File: sws.stm

Number of lines: 4

Run Date: 05-14-2007

NOTES: Inlet N-Values = 0.016 ; Intensity = 71.85 / (Inlet time + 13.30) ^ 0.87; Return period = 2 Yrs. ; * Indicates Known Q added

Hydraulic Grade Line Computations

Line	Size (in)	Q (cfs)	Downstream							Len (ft)	Upstream							Check		JL coeff (K)	Minor loss (ft)		
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)		Sf (%)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)			Ave Sf (%)	Energy loss (ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	30	16.80	1319.50	1321.40	1.90	4.00	4.20	0.27	1321.67	n/a	39.6	1320.00	1321.37	1.37**	2.75	6.10	0.58	1321.95	n/a	n/a	n/a	0.64	n/a
2	30	15.17	1320.00	1322.19	2.19	4.56	3.33	0.17	1322.36	0.124	89.5	1320.50	1322.24	1.74	3.64	4.16	0.27	1322.51	0.199	0.161	0.144	1.31	0.35
3	24	11.53	1320.50	1322.65	2.00	3.14	3.67	0.21	1322.86	0.260	50.6	1321.00	1322.74	1.74	2.90	3.97	0.25	1322.99	0.237	0.248	0.126	1.35	0.33
4	24	7.91	1321.00	1323.22	2.00	3.14	2.52	0.10	1323.32	0.122	87.0	1321.50	1323.31	1.81	2.99	2.65	0.11	1323.42	0.107	0.115	0.100	1.00	0.11

Project File: sws.sim

Number of lines: 4

Run Date: 05-14-2007

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

General Procedure: Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles. The computed HGL is checked against inlet control.

- Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.
- Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.
- Col. 3 Total flow rate in the line.
- Col. 4 The elevation of the downstream invert.
- Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.
- Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.
- Col. 7 Cross-sectional area of the flow at the downstream end.
- Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).
- Col. 9 Velocity head (Velocity squared / 2g).
- Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).
- Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).
- Col. 12 The line length.
- Col. 13 The elevation of the upstream invert.
- Col. 14 Elevation of the hydraulic grade line at the upstream end.
- Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.
- Col. 16 Cross-sectional area of the flow at the upstream end.
- Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).
- Col. 18 Velocity head (Velocity squared / 2g).
- Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18).
- Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).
- Col. 21 The average of the downstream and upstream friction slopes.
- Col. 22 Energy loss. Average $S/100 \times \text{Line Length}$ (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.
- Col. 23 The junction loss coefficient (K).
- Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

Line No.	Area Dn (sqft)	Area Up (sqft)	Byp Ln No	Coeff C1 (C)	Coeff C2 (C)	Coeff C3 (C)	Capac Full (cfs)	Crit Depth (ft)	Cross Sl, Sw (ft/ft)	Cross Sl, Sx (ft/ft)	Curb Len (ft)	Defl Ang (Deg)	Depth Dn (ft)	Depth Up (ft)	DnStm Ln No	Drng Area (ac)	Easting X (ft)	EGL Dn (ft)	EGL Up (ft)	EGL Jnct (ft)	Energy Loss (ft)
1	4.00	2.75	Sag	0.20	0.50	0.90	46.08	1.37	0.050	0.050	...	153.9	1.90	1.37**	Outfall	0.70	1650.57	1321.67	1321.95 i	1322.19	0.516
2	4.56	3.64	1	0.20	0.50	0.90	30.65	1.30	0.080	0.050	6.00	21.9	2.19	1.74	1	1.40	1561.32	1322.36	1322.51	1322.86	0.144
3	3.14	2.90	2	0.20	0.50	0.90	22.49	1.20	0.080	0.050	6.00	-57.8	2.00	1.74	2	1.40	1537.61	1322.86	1322.99	1323.32	0.126
4	3.14	2.99	3	0.20	0.50	0.90	17.15	1.00	0.050	0.050	...	61.6	2.00	1.81	3	2.90	1450.62	1323.32	1323.42	1323.53	0.100

Project File: sws.stm

Number of lines: 4

Date: 05-14-2007

NOTES: i Inlet control; ** Critical depth

Flow Rate (cfs)	Sf Ave (ft/ft)	Sf Dn (ft/ft)	Grate Area (sqft)	Grate Len (ft)	Grate Width (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Gutter Depth (ft)	Gutter Slope (ft/ft)	Gutter Spread (ft)	Gutter Width (ft)	HGL Dn (ft)	HGL Up (ft)	HGL Jnct (ft)	HGL Jmp Dn (ft)	HGL Jmp Up (ft)	Incr CxA	Incr Q (cfs)	Inlet Depth (ft)	Inlet Eff (%)
16.80	n/a	n/a	2.00	4.00	2.00	1325.00	1326.00	0.14	Sag	7.64	2.00	1321.40	1321.37 j	1322.19 i	1321.36	1320.89	0.49	1.91	0.14	100
15.17	0.161	0.124	...	...	...	1326.00	1326.50	0.37	Sag	6.17	2.00	1322.19	1322.24	1322.59	...	...	0.98	3.82	0.48	100
11.53	0.248	0.260	...	...	...	1326.50	1326.50	0.37	Sag	6.17	2.00	1322.65	1322.74	1323.07	...	...	0.98	3.82	0.48	100
7.91	0.115	0.122	2.00	4.00	2.00	1326.50	1325.00	0.54	Sag	23.68	2.00	1323.22	1323.31	1323.42	2.03	7.91	0.54	100

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Number of lines: 4

Date: 05-14-2007

NOTES: i Inlet control; ** Critical depth

Inlet ID	Inlet Loc	Inlet Spread (ft)	Inlet Time (min)	i Sys (in/hr)	i Inlet (in/hr)	Invert Dn (ft)	Invert Up (ft)	Jump Loc (ft)	Jump Len (ft)	Vel Hd Jump (ft)	Vel Hd Dr (ft)	Vel Hd Up (ft)	J-Loss Coeff	Junct Type	Known Q (cfs)	Cost RCP (\$)	Cost CMP (\$)	Line ID	Line Length (ft)	Line Size (in)
	Sag	7.64	15.0	3.75	3.90	1319.50	1320.00	11.88	8.54	0.34	0.94	0.64	0.64	Dp-Grate	0.00	2,342	2,108		39.61	30
	Sag	6.17	15.0	3.80	3.90	1320.00	1320.50	....	....	0.00	0.00	1.31	1.31	Curb	0.00	5,114	4,603		89.49	30
	Sag	6.17	15.0	3.83	3.90	1320.50	1321.00	....	....	0.00	0.00	1.35	1.35	Curb	0.00	2,756	2,480		50.59	24
	Sag	23.68	15.0	3.90	3.90	1321.00	1321.50	0.00	0.00	1.00	1.00	Dp-Grate	0.00	4,468	4,021		87.00	24

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NOTES: Intensity = 71.85 / (Inlet time + 13.30) ^ 0.87 -- Return period = 2 Yrs. ; i Inlet control; ** Critical depth

Line Slope (%)	Line Type	Local Depr (in)	n-val Gutter	n-val Pipe	Minor Loss (ft)	Northing Y (ft)	Pipe Travel (min)	Q Byp (cfs)	Q Capt (cfs)	Q Carry (cfs)	Line Rise (in)	Runoff Coeff (C)	Line Span (in)	Area A1 (ac)	Area A2 (ac)	Area A3 (ac)	Tc (min)	Throat Ht (in)	Total Area (ac)	Total CxA	Total Runoff (cfs)	Vel Ave (ft/s)	Vel Dn (ft/s)
1.26	Cir	...	...	0.013	n/a	467.00	0.19	0.00	1.91	0.00	30	0.70	30	0.00	0.00	0.00	16.3	...	6.40	4.48	16.80	5.15	4.20
0.56	Cir	2.00	...	0.013	0.35	460.37	0.48	0.00	3.82	0.00	30	0.70	30	0.00	0.00	0.00	15.8	6.0	5.70	3.99	15.17	3.75	3.33
0.99	Cir	2.00	...	0.013	0.33	415.68	0.23	0.00	3.82	0.00	24	0.70	24	0.00	0.00	0.00	15.6	6.0	4.30	3.01	11.53	3.82	3.67
0.57	Cir	0.013	0.11	414.98	0.58	0.00	7.91	0.00	24	0.70	24	0.00	0.00	0.00	15.0	...	2.90	2.03	7.91	2.58	2.52

Project File: sws.sim

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NOTES: i Inlet control; ** Critical depth

Vel Hd Dn (ft)	Vel Hd Up (ft)	Vel Up (ft/s)	Cover Dn (ft)	Cover Up (ft)	Storage (cft)
0.27	0.58	6.10	3.00	3.50	134.42
0.17	0.27	4.16	3.50	3.50	369.20
0.21	0.25	3.97	4.00	3.50	156.12
0.10	0.11	2.65	3.50	1.50	271.04

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NOTES: i Inlet control; ** Critical depth

DRAINAGE PLAN

Scale 1:100