

Cheryl's Hollow Addition
 City of Wichita, Kansas
 Drainage Plan Supporting Documentation
 October 7, 2004

Cheryl's Hollow Addition is located north of 13th Street North, ¼ mile west of 135th Street West. The site encompasses approximately 80 acres, and has points of drainage concentration near the southwest corner, middle east side, and northeast corner. Detention storage will be utilized to limit developed peak flows to existing condition peak flow rates.

South Drainage Basin to 13th Street North:

This developed basin consists of 36.2 acres of on-site drainage area combined with an off-site area of 17 acres, all draining to the north ditch of 13th Street and through an existing 42"x60" CMPA under 13th Street. The hydrological soil of the basin is Type C (USGS Soil Survey of Sedgwick County, Kansas).

Time of concentration for the entire southerly basin (on and off site areas) is determined as follows: Total longest path length = 1600 feet. Assume the first 400 feet is Short Grass Pasture at 0.5% slope, V1 = 0.20 f/s; the next 400 feet is Grassed Waterway at 0.5% slope, V2 = 0.20 f/s, assume balance of 800 feet is ditch flow at 2.0 f/s (V3). Time of Concentration is as follows:

$$T_c = \frac{400'}{(0.20 \text{ f/s})(60\text{s/min})} + \frac{400'}{(0.77\text{f/s})(60\text{s/min})} + \frac{800'}{(2.0 \text{ f/s})(60\text{s/min})}$$

$$T_c = 33 \text{ min} + 8.6 \text{ min} + 6.7 \text{ min} = 48 \text{ minutes.}$$

County records indicate an upstream drainage area of 72 acres for the 42"x60" CMPA under 13th Street, with a C factor of 0.40. Top of roadway over pipe = 1362.5, with an USFL of 1358.2 for the culvert pipe. This provides 4.3 feet of headwater (HW) for the culvert pipe. Assuming inlet control, and a HW of 4.3 feet, the culvert pipe can handle approximately 90 cfs (Hydraulic Charts for the Selection of Highway Culverts, FHA) reading the values for a 65"x40" CMPA.

The following southern basin values are taken to HEC1 to find the pre-developed flow to the culvert pipe under 13th Street North. Survey information indicates a total drainage area (natural) to the culvert of 47 acres.

- BA = 47 Acres = 0.0734 Sq. Miles
- SCS Lag = 0.6 T_c = .48 Hours
- SCS CN = 81 (Small Grain Crops, Type C Soil, Good Condition, TR-55)
- Rainfall event = 100 year, 24 hour storm, SCS Type II Distribution, total of 7.8 inches

The resulting Q100 = 95 cfs. This matches well with the pipe capacity indicated above.

The target flow from the developed subdivision combined with the undeveloped adjacent drainage basin will be 90 cfs. The detention pond flow cannot exceed this amount.

Developed Condition, South Basin: Plat drainage area to pond = 36.2 acres + 17 acres offsite. Composite CN = $\frac{17 \text{ ac}(81) + (36.2 \text{ ac})(94)}{53.2 \text{ acres}} = 90$

Use a developed time of concentration of 30 minutes, so $0.6T_c = 0.30 \text{ hours} = \text{SCS Lag}$. The pond will utilize a 3.8' wide notched weir for control, flow line elevation = 1359.0. Rating the weir with the equation $Q = CLH^{*1.5}$, where $C = 3.0$, $L = 4'$, and H (depth) varies, the rating is:

3.8' Notched Weir Stage-Discharge (South Pond)		
Elevation	H (feet)	Q (cfs)
1359	0	0
1359.5	0.5	4.0
1360	1	11.4
1360.5	1.5	20.9
1361	2	32.2
1361.5	2.5	45.0
1362	3	59.2
1362.5	3.5	74.6
1363	4	91.2
1363.5	4.5	108.8

Stage-Storage for the Proposed Pond is 1.9 acres at 1359, 2.2 acres at 1364.

Combining the developed basin characteristics and detention pond data to HEC1 result in a pond routing summary of Q100 = 94 cfs at 1363.07 elevation. See the attached HEC1 file RICKS.OUT for the calculations and report.

East Drainage Basin connecting to Copper Gate North Addition

From the Baughman Company, P.A. drainage plan for Copper Gate North, the receiving inlet allows for an offsite flow rate of 37.4 cfs. This will be the target outflow for the detention pond adjacent to Lots 17 and 18, Block A, Copper Gate North Addition.

The developed area draining to the pond location consists of 14.5 acres. Use a CN of 94 and T_c of 20 minutes for the developed condition. A static pool elevation of 1358 will be used for the pond, with a target 100 year water surface elevation of 1362.00.

Outlet flow from the pond will be controlled by a 24" RCP culvert connected to the storm water sewer system planned for Copper Gate North Addition, the connection point being between Lots 17 & 18, Block A.

Flow characteristics for the 24" culvert pipe are calculated using the FHA manual "Manual for the Selection of Highway Culverts". Based on inlet control, and available head, the outlet pipe can provide the following flows:

24" RCP Outlet Pipe

Elevation	Head (ft)	Q (cfs)
1358	-	-
1358.5	0.5	1
1359.0	1.0	4
1359.5	1.5	9
1360.0	2.0	13
1360.5	2.5	16
1361	3.0	22
1361.5	3.5	24
1362	4.0	29

Storage volumes are 0.8 acres at 1358, and 1.04 acres at 1363.

Routing through HEC-1 yields a peak outflow of 23.0 cfs at an elevation of 1361.24. This pond can be modified at the time of final design to conform to the storm water sewer system in Copper Gate North Addition.

North Drainage Basin:

The natural drainage concentrating at the northeast corner of the addition is 28.7 acres, with an SCS curve number of 81, and a Tc of 48 minutes. With this base information, HEC1 yields a pre developed Q100 of 58 cfs, which is the target flow of the detention pond.

In the developed condition, 24.1 acres of the subdivision drain to the new pond. Developed CN = 94, with a Tc of 20 minutes.

Using a 4.5' wide notched weir for an outlet provides the following stage-discharge information:

4.5' Notched Weir Stage-Discharge (North Pond)

Elevation	H (feet)	Q (cfs)	
1360.5	0	0	
1361	0.5	4.8	
1361.5	1	13.5	
1362	1.5	24.8	
1362.5	2	38	storage 1.5 acres
1363	2.5	53.4	elevation
1363.5	3	70	and 2.1
1364.0	3.5	88	elevation

Routing this pond in HEC1 results in an outflow of 47 cfs at an elevation of 1362.8, which is acceptable.

Please see the following pages for localized drainage calculations, inlet locations, storm water sewer system profiles, and other supporting information.

Storm Water Sewer System Design:

Design for the storm water sewer systems to serve this site utilize the following parameters:

Time of Concentration = 15 minutes (City of Wichita Minimum)
 Runoff factors are for Type C Hydrologic Soils, ¼ acre lot size, per City of Wichita Interim Drainage and Storm Water Sewer Policy.
 The rainfall intensity values are per said Attachment A, said drainage policy.

Each storm water sewer system has been modeled with StormCad (Hastead Methods) to determine the 100-year hydraulic grade line. In some instances, overspill to adjacent ponds is allowable for 100-year storm relief, although the systems are designed not to need this overspill

Calculations for localized runoff for the plat are as tabulated below:

BASIN	Description	Area (acres)	Tc (min)	C2	C100	I2	I100	Q2	Q100
A	Rear Yard	0.84	15	0.4	0.65	3.83	7.37	1.29	4.02
B	Rear Yard	0.49	15	0.4	0.65	3.83	7.37	0.75	2.35
C	Lots & Street	0.25	15	0.5	0.69	3.83	7.37	0.48	1.27
D	Lots & Street	0.32	15	0.5	0.69	3.83	7.37	0.61	1.63
E	Rear Yard	1.36	15	0.4	0.65	3.83	7.37	2.08	6.52
F	Rear Yard	0.35	15	0.4	0.65	3.83	7.37	0.54	1.68
G	Lots & Street	2.48	15	0.5	0.69	3.83	7.37	4.75	12.61
H	Lots & Street	2.89	15	0.5	0.69	3.83	7.37	5.53	14.70
I	Lots & Street	2.18	15	0.5	0.69	3.83	7.37	4.17	11.09
J	Rear Yard	1.72	15	0.4	0.65	3.83	7.37	2.64	8.24
K	Lots & Street	0.36	15	0.5	0.69	3.83	7.37	0.69	1.83
L	Lots & Street	0.38	15	0.5	0.69	3.83	7.37	0.73	1.93
M	Rear Yard	0.82	15	0.4	0.65	3.83	7.37	1.26	3.93
N	Lots & Street	0.64	15	0.5	0.69	3.83	7.37	1.23	3.25
O	Lots & Street	0.50	15	0.5	0.69	3.83	7.37	0.96	2.54
P	Lots & Street	1.10	15	0.5	0.69	3.83	7.37	2.11	5.59
Q	Lots & Street	3.34	15	0.5	0.69	3.83	7.37	6.40	16.98
R	Lots & Street	2.81	15	0.5	0.69	3.83	7.37	5.38	14.29
S	Rear Yard	1.76	15	0.4	0.65	3.83	7.37	2.70	8.43
T	Rear Yard	0.43	15	0.4	0.65	3.83	7.37	0.66	2.06
U	Rear Yard	1.07	15	0.4	0.65	3.83	7.37	1.64	5.13
V	Rear Yard	0.62	15	0.4	0.65	3.83	7.37	0.95	2.97
W	Lots & Street	2.56	15	0.5	0.69	3.83	7.37	4.90	13.02
X	Lots & Street	0.97	15	0.5	0.69	3.83	7.37	1.86	4.93
Y	Lots & Street	3.50	15	0.5	0.69	3.83	7.37	6.70	17.80

BASIN	Description	Area (acres)	Tc (min)	C2	C100	I2	I100	Q2	Q100
Z	Lots & Street	2.72	15	0.5	0.69	3.83	7.37	5.21	13.83
AA	Rear Yard	0.42	15	0.4	0.65	3.83	7.37	0.64	2.01
BB	Rear Yard	0.48	15	0.4	0.65	3.83	7.37	0.74	2.30
CC	Rear Yard	1.28	15	0.4	0.65	3.83	7.37	1.96	6.13
DD	Lots & Street	1.60	15	0.5	0.69	3.83	7.37	3.06	8.14
EE	Lots & Street	0.50	15	0.5	0.69	3.83	7.37	0.96	2.54
FF	Lots & Street	0.42	15	0.5	0.69	3.83	7.37	0.80	2.14
GG	Rear Yard	1.60	15	0.4	0.65	3.83	7.37	2.45	7.66
HH	Lots & Street	2.32	15	0.5	0.69	3.83	7.37	4.44	11.80
II	Lots & Street	1.12	15	0.5	0.69	3.83	7.37	2.14	5.70
JJ	Lots & Street	1.39	15	0.5	0.69	3.83	7.37	2.66	7.07
KK	Lots & Street	1.08	15	0.5	0.69	3.83	7.37	2.07	5.49
LL	Lots & Street	0.99	15	0.5	0.69	3.83	7.37	1.90	5.03
MM	Lots & Street	0.48	15	0.5	0.69	3.83	7.37	0.92	2.44
NN	Lots & Street	0.45	15	0.5	0.69	3.83	7.37	0.86	2.29
OO	Rear Yard	1.35	15	0.4	0.65	3.83	7.37	2.07	6.47
PP	Rear Yard	0.74	15	0.4	0.65	3.83	7.37	1.13	3.54
QQ	Lots & Street	0.59	15	0.5	0.69	3.83	7.37	1.13	3.00
RR	Lots & Street	1.85	15	0.5	0.69	3.83	7.37	3.54	9.41
SS	Lots & Street	1.82	15	0.5	0.69	3.83	7.37	3.49	9.26

The following pages contain the hydraulic performance calculations for each of the storm water sewer systems (1 through 11), along with a hydraulic profile for each system. Where multiple pipes are utilized, it is so noted on the documentation.

**STORM WATER SEWER SYSTEM
HYDRAULIC PROFILES**

**CHERYL'S HOLLOW
100-YEAR STORM EVENT**

Cheryl's Hollow Storm Water Sewer Line 1

Pipe	Up Node	Dn Node	Length (ft)	Size	Cap (cfs)	V avg (ft/s)	Up Invert (ft)	Dn Invert (ft)	S (ft/ft)	Q (cfs)
P-1	I-1	I-2	193	24 inch	16.28	2.25	1,361.20	1,360.20	0.005181	7.07
P-2	I-2	I-3	41	24 inch	20.9	4	1,360.10	1,359.75	0.008537	12.56
P-3	I-3	Outlet	143	36 inch	48.3	2.49	1,358.75	1,358.00	0.005245	17.59

Cheryl's Hollow Storm Water Sewer Line 2

Pipe	Up Node	Dn Node	Length (ft)	Size	Cap (cfs)	V avg (ft/s)	Up Invert (ft)	Dn Invert (ft)	S (ft/ft)	Q (cfs)
P-1	I-1	I-2	117	24 inch	18.71	2.07	1,363.20	1,362.40	0.006838	6.51
P-2	I-2	I-3	41	24 inch	15.8	4.66	1,362.30	1,362.10	0.004878	14.65
P-3	I-3	I-4	269	24 inch	15.11	5.47	1,362.00	1,360.80	0.004461	17.19
P-4	I-4	I-5	123	36 inch	38.03	2.73	1,359.80	1,359.40	0.003252	19.33
P-5	I-5	I-6	162	36 inch	37.05	3.89	1,359.30	1,358.80	0.003086	27.47
P-6	I-6	I-7	48	48 inch	80.29	3.13	1,357.80	1,357.65	0.003125	39.27
P-7	I-7	Outlet	175	48 inch	80.52	3.58	1,357.55	1,357.00	0.003143	44.97

Cheryl's Hollow Storm Water Sewer Line 3

Pipe	Up Node	Dn Node	Length (ft)	Size	Cap (cfs)	V avg (ft/s)	Up Invert (ft)	Dn Invert (ft)	S (ft/ft)	Q (cfs)
P-1	I-1	I-2	41	24 inch	13.68	5.67	1,360.95	1,360.80	0.003659	17.8
P-2	I-2	I-3	117	36 inch	39	4.47	1,359.70	1,359.30	0.003419	31.63
P-3	I-3	I-4	263	48 inch	79.22	2.69	1,358.20	1,357.40	0.003042	33.77
P-4	I-4	Outlet	90	48 inch	82.93	2.88	1,357.30	1,357.00	0.003333	36.21

Cheryl's Hollow Storm Water Sewer Line 4

Pipe	Up Node	Dn Node	Length (ft)	Size	Cap (cfs)	V avg (ft/s)	Up Invert (ft)	Dn Invert (ft)	S (ft/ft)	Q (cfs)
P-6	I-6	I-3	310	24 inch	12.85	1.2	1,361.25	1,360.25	0.003226	3.76
P-1	I-1	I-2	35	24 inch	17.1	0.78	1,361.15	1,360.95	0.005714	2.44
P-2	I-2	I-3	117	24 inch	16.2	1.51	1,360.85	1,360.25	0.005128	4.73
P-3	I-3	I-4	180	36 inch	44.46	2.17	1,359.25	1,358.45	0.004444	15.36
P-4	I-4	I-5	42	36 inch	79.72	1.3	1,358.45	1,358.30	0.003571	18.36
P-5	I-5	Outlet	400	36 inch	73.06	1.96	1,358.20	1,357.00	0.003	27.77

Cheryl's Hollow Storm Water Sewer Line 5

Pipe	Up Node	Dn Node	Length (ft)	Size	Cap (cfs)	V avg (ft/s)	Up Invert (ft)	Dn Invert (ft)	S (ft/ft)	Q (cfs)
P-1	I-1	I-2	62	24 inch	15.74	2.95	1,360.70	1,360.40	0.004839	9.26
P-2	I-2	Outlet	265	36 inch	46.71	1.91	1,359.30	1,358.00	0.004906	13.48

Cheryl's Hollow Storm Water Sewer Line 6

Pipe	Up Node	Dn Node	Length (ft)	Size	Cap (cfs)	V avg (ft/s)	Up Invert (ft)	Dn Invert (ft)	S (ft/ft)	Q (cfs)
P-1	I-1	I-2	47	36 inch	43.51	2.4	1,359.45	1,359.25	0.004255	16.98
P-2	I-2	I-3	130	36 inch	43.38	4.42	1,359.15	1,358.60	0.004231	31.27
P-3	I-3	I-4	170	48 inch	69.67	3.2	1,357.60	1,357.20	0.002353	40.22
P-4	I-4	Outlet	340	48 inch	81.7	3.37	1,357.10	1,356.00	0.003235	42.41

Cheryl's Hollow Storm Water Sewer Line 7

Pipe	Up Node	Dn Node	Length (ft)	Size	Cap (cfs)	V avg (ft/s)	Up Invert (ft)	Dn Invert (ft)	S (ft/ft)	Q (cfs)
P-1	I-1	I-2	177	24 inch	13.17	1.82	1,360.50	1,359.90	0.00339	5.44
P-2	I-2	I-3	265	36 inch	36.64	1.22	1,358.80	1,358.00	0.003019	8.59
P-3	I-3	I-4	41	48 inch	86.88	1.72	1,357.00	1,356.85	0.003659	21.61
P-4	I-4	I-5	137	48 inch	82.32	2.11	1,356.75	1,356.30	0.003285	26.54
P-6	I-5	Outlet	50	48 inch	90.84	2.11	1,356.20	1,356.00	0.004	26.54

Cheryl's Hollow Storm Water Sewer Line 8

Pipe	Up Node	Dn Node	Length (ft)	Size	Cap (cfs)	V avg (ft/s)	Up Invert (ft)	Dn Invert (ft)	S (ft/ft)	Q (cfs)
P-1	I-1	Outlet	150	24 inch	16	1.78	1,360.25	1,359.50	0.005	5.59