

May 26, 2006

City of Wichita, Kansas
Mr. Scott Lindebak, P.E.
Stormwater Engineer
455 N. Main
Wichita, KS 67202

Re: Supplemental Information for Drainage Plan – Sycamore Pond Addition

Dear Mr. Lindebak,

Please accept this letter as a supplemental condition to the attached drainage plan of Sycamore Pond Addition. At issue is the design of an outlet weir from the proposed detention pond that will limit the outflow from the pond to a maximum of 74.1 cfs. This structure will be designed in conjunction with the engineering design plans for the pond, and will be a separate structure controlling the outflow upstream and not connected to the existing 3'x7' RCBC structure under Seneca Street. This structure will also provide for a maximum 100 year water surface elevation of 1268.9 – the elevation set by the attached drainage calculations for the detention pond.

This report is being provided via email in pdf format for your records.

Thank you.

Regards,

Christopher M. Bohm, P.E.

Encl.

Sycamore Pond Drainage Plan

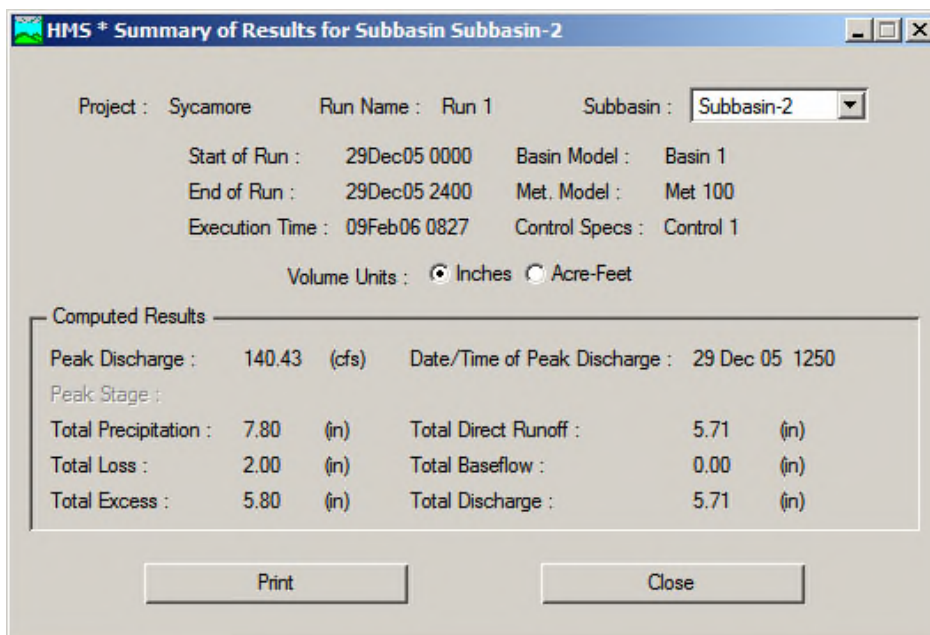
February 9, 2006

Existing Conditions:

The Sycamore Pond Addition is located on south Seneca Street (east side) near 50th Street South. The area is extremely flat and poorly drained. From the Soil Survey of Sedgwick County Kansas, the soil types are indicated as Ca and Cb, both of which fall into the Type B Hydrologic Group. South Seneca Gardens Second Addition abuts the property to the south, and has no provision for rear yard drainage. The challenge with this drainage plan will be to provide positive drainage to a new detention pond located near the southwest corner of the site.

Proposed Detention Pond:

From the site topography, the existing area draining to the location of the proposed pond is approximately 64.0 acres, Type B soils (See Map 1). This area extends into land located north of the Freedom Park Addition Site, per aerial photographic information taken from the 1984 South Seneca – Midland Valley Area Drainage Study. The time of concentration of the undeveloped ground can be approximated by the travel time along the longest drainage path. The drainage path distance is 2535 feet, with an average overland slope of less than 0.5 percent. There is no evidence of any defined channel or waterway that forms to discharge drainage, so overland sheet flow is assumed. From Attachment A, City of Wichita Drainage Policy, the average velocity at 0.5% slope is 0.77 feet per second for a grassed waterway, resulting in: $T_c = 2535 \text{ feet} / (0.77 \text{ f/s} * 60 \text{ s/minute}) = 55 \text{ minutes}$ (conservative). The SCS CN for this basin is selected as 69, pasture or range in fair condition. The rainfall event for analysis is the 100 year – 24 hour storm of 7.8 inches, distributed using the SCS Type II rainfall. Similarly distributed are the 2 year rainfall event of 3.5 inches, and the 5 year rainfall event of 4.5 inches.



Inputting this information into HEC-RAS as a basin yields the following runoff totals from the undeveloped site into the detention pond area:

Q100 = 140.4 cfs

Q5 = 69.8 cfs

Q2 = 50.3 cfs

The goal of the detention area is to target these outflows as maximum discharges from the proposed pond.

Developed Condition:

In the developed condition, a total of 69.6 acres will discharge to the pond. 43.5 acres of this basin will be developed with single family homes. For the post development analysis, an impervious percentage of 30 percent will be input into HEC-RAS for the area to be developed. The time of concentration will be dependent upon a major storm water sewer conduit which will bisect the site from east to west, terminating near the east side of the Addition. To calculate the developed area Tc, assume the following:

Initial Tc = 15 minutes from an individual lot.

Length of major SWD conduit through site = 1985 feet, with an assumed velocity of 5.0 feet per second (assumed 90 cfs through a 6'x3' RCBC), resulting in a travel time of 6.6 minutes, use 6 minutes.

Developed Tc = 15 minutes + 6 minutes = 21 minutes.

This basin will be routed with the balance of the area to the north, which will retain its existing time of concentration of 55 minutes, with a resulting area of 69.9 acres – 43.5 = 26.4 acres.

The proposed pond will have a static pool of 1264, and a maximum top elevation of 1268.0. The average area is 2.8 acres, with 4 feet of storage, resulting in 11.2 Acre feet of storage.

Proposed Pond Outlet

The proposed pond is situated next to an existing 7'x3' RCBC under Seneca. This box is partially blocked to the east (plat side) and also accepts drainage a 36" RCP and a 24" pipe that drain Seneca Street via curb inlets.

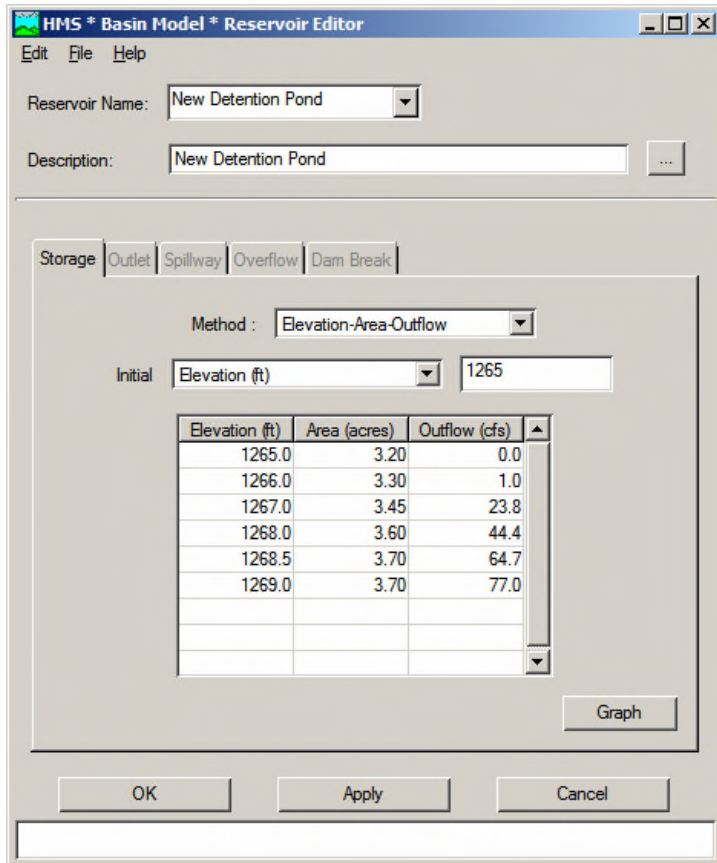
The RCBC is rated using AutoDesk Land Development Desktop Culvert Calculator, with a culvert length of 100 feet, Manning's friction factor of 0.013, and two feet of tailwater. Rating is performed at 5 cfs intervals (see box output sheet – Exhibit A). With the same elevation datum, both the 36" and 24" RCP's are rated using the Haestad Method's Flowmaster program up to full flow conditions. Beyond this point, the flow is assumed linear to the maximum flow at elevation of 1269,

determined by using StormCad, assuming a 300' pipe run at 0.5% grade, with a starting HGL elevation of 1266 (two feet of flow in the box). This information is tabulated as follows:

Pond Outlet Capacity – 3'x7' RCBC under Seneca minus side pipe flows

Elev (ft)	Head (ft)	24" RCP Q (cfs)	36" RCP Q (cfs)	7'x3' RCBC Q (cfs)	Qbox - Qpipes
1264	0	0	0		
1265	1	8	11.3		
1265.5	1.5	14.6	23.5	20	0
1266	2	16	37	50	0
1266.5	2.5	17.5	47.8	70	4.7
1267	3	19	47.2	90	23.8
1267.5	3.5	20.5	50.4	105	34.1
1268	4	22	53.6	120	44.4
1268.5	4.5	23.5	56.8	145	64.7
1269	5	25	60	162	77

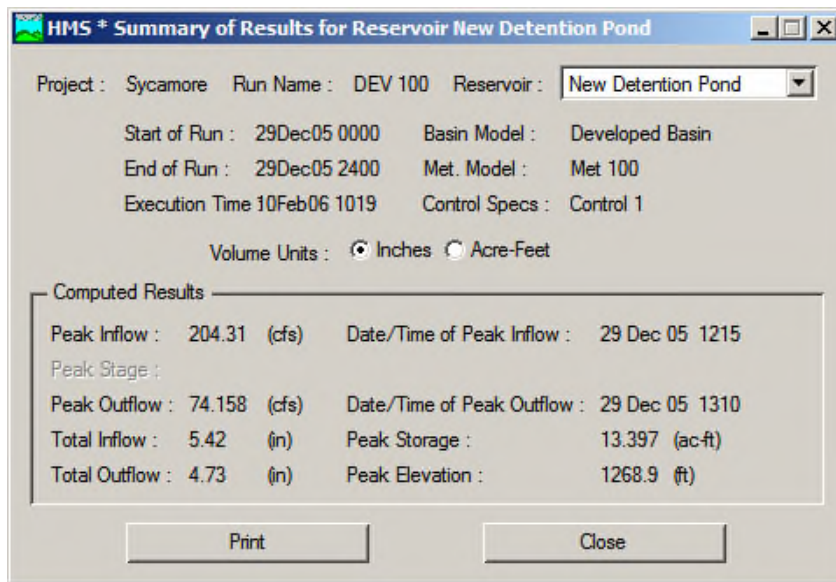
Pond Stage and storage and outflow are summarized as:



The data for the undeveloped area, developed area, and pond stage, storage, and discharge are modeled in HEC-RAS, with the following results:

Condition	Q2 (cfs)	Q5 (cfs)	Q100 (cfs)
Undeveloped	50.3	69.8	140.4
Developed	71.3 in - 17.6 out	100 in - 28.6 out	204.3 in - 74.1 out

For the 100 year run, the output from HEC-HMS is shown as:



The 100 year water surface elevation will be established at 1268.9 feet, with a minimum pad elevation on the lots of 1269.9 feet (MSL).

The detention pond provides a marked reduction in the runoff from the site for all of the modeled storms.

On-Site Storm Water Sewer System

Drainage basins within the platted area are detailed on the Drainage Area Map, Included as Map 1 with this report.

The Rational Method is used for analysis, with a minimum time of concentration of 15 minutes. Runoff coefficients for ¼ acre lots with type B soils are also used for the calculations.

A summary of each drainage basin and the corresponding calculation data follows:

SYCAMORE POND – ON SITE DRAINAGE BASIN CALCULATIONS

Basin	Area (sf)	Area (Ac)	Tc (min)	i2 (in/hr)	i100 (in/hr)	C2	C100	Q2 (cfs)	Q100 (cfs)
A	159383	3.7	15	3.83	7.37	0.44	0.61	6.2	16.4
B	45913	1.1	15	3.83	7.37	0.44	0.61	1.8	4.7
C	33488	0.8	15	3.83	7.37	0.44	0.61	1.3	3.5
D	81742	1.9	15	3.83	7.37	0.44	0.61	3.2	8.4
E	26476	0.6	15	3.83	7.37	0.44	0.61	1.0	2.7
F	233524	5.4	15	3.83	7.37	0.44	0.61	9.0	24.1
G	53087	1.2	15	3.83	7.37	0.44	0.61	2.1	5.5
H	30739	0.7	15	3.83	7.37	0.44	0.61	1.2	3.2
I	63069	1.4	15	3.83	7.37	0.44	0.61	2.4	6.5
J	31067	0.7	15	3.83	7.37	0.44	0.61	1.2	3.2
K	90476	2.1	15	3.83	7.37	0.44	0.61	3.5	9.3
L	37713	0.9	15	3.83	7.37	0.44	0.61	1.5	3.9
M	135480	3.1	15	3.83	7.37	0.44	0.61	5.2	14.0
AA	83860	1.9	15	3.83	7.37	0.44	0.61	3.2	8.7
BB	201804	4.6	15	3.83	7.37	0.44	0.61	7.8	20.8

Basins A through M will discharge through System 100, and Basins AA and BB will discharge through System 200.

Drainage System 100 – Will be a major drainage conduit through the center of the subdivision. The hydraulic data for this run is based upon each basin, as well as the conduit proper having a time of concentration of 15 minutes. The final design of the conduit will take into consideration the system travel time, and may indeed reduce the size of some of the conduits. All of the inflows from the side systems 300, 400 and 500 are included in this main conduit run.

Basin A: Street, Q100 = 16.4 cfs, use two 5' long type 1A curb inlets, capacity = 26 cfs, OK

Basin B: Backyard, Q100 = 4.7 cfs – use a Beehive Rear Yard Inlet R-2560-EA, at 1.0' foot of depth, Q inlet = 5.8 cfs - OK

<http://www.nfco.com/literature/brochures/gratecapacities.html> - inlet calculator

Basin C: Backyard, Q100 = 3.5 – Beehive Inlet OK

Basin D: Backyard, Q100 = 8.4 cfs – This is not part of the Sycamore Pond Plat – however the future development here will require two beehive inlets to handle the flow.

Basin E: Backyard, Q100 = 2.7 cfs – Beehive inlet OK

Basin F: Street, Q100 = 24.1, use two 5' long type 1A Inlets

Basin G: Backyard, Q100 = 5.5 cfs, Beehive inlet OK

Basin H: Backyard, Q100 = 3.2 cfs, Beehive Inlet OK

Basin I: Street, Q100 = 6.5 cfs, two type 1A Inlets OK

Basin J: Backyard, Q100 = 3.2 cfs, Beehive Inlet OK

Basin K: Backyard, Q100 = 9.3 cfs, need two beehive inlets to drain the concrete ribbon flume in this area.

Basin L: Backyard, Q100 = 3.9 cfs, Beehive Inlet OK

Basin M: Street, Q100 = 14.0 cfs, use two 5' long 1A Inlets\

Basin AA: Backyard, Q100 = 8.7 cfs, use two Beehive Inlets, OK

Basin BB: Street, Q100 = 20.8 cfs, use two 5' Type 1A inlets, also, 100 year overspill is allowed at this location.

System 200: Double inlet sump Near Seneca Street.

System 300: Backyard pipe serving Block 3

System 400: Backyard pipe serving Angel Acres 2nd Addition

System 500: Backyard system serving part of Block 2

Each storm water sewer system is evaluated with Haestad Methods Storm Cad Software, the results of which are indicated on the attached profiles. These profiles are generated with the 100 year storm for each system in the developed condition, with the full 100 year tail water starting hydraulic grade line.

Exhibit A - Culvert Rating (Seneca RCBC)

Culvert Calculator

All calculator output should be verified prior to design use

Entered Data:

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Shape ..... Rectangular
Number of Barrels ..... 1
Solving for ..... Headwater
Chart Number ..... 8
Scale Number ..... 3
Chart Description ..... BOX CULVERT WITH FLARED WINGWALLS; NO INLET TOP EDGE
  
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BEVEL

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Scale Description ..... WINGWALLS FLARED 0 DEGREES (SIDES EXTENDED STRAIGHT)
Overtopping ..... Off
Flowrate ..... 10.0000 cfs
Manning's n ..... 0.0130
Roadway Elevation ..... 1270.0000 ft
Inlet Elevation ..... 1264.0000 ft
Outlet Elevation ..... 1263.7500 ft
Height ..... 36.0000 in
Width ..... 84.0000 in
Length ..... 100.0000 ft
Entrance Loss ..... 0.5000
Tailwater ..... 2.0000 ft
  
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Computed Results:

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Headwater ..... 1265.4255 ft Outlet Control
Slope ..... 0.0025 ft/ft
Velocity ..... 0.7143 fps
  
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Messages:

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Outlet head > Inlet head.
Computing Outlet Control headwater.
Outlet not submerged.
Normal Depth: 5.4832 in
Critical Depth: 4.7857 in
Flow is subcritical.
Normal depth > critical depth.
Tailwater depth > normal depth.
M1 backwater profile.
Depth computed with direct step method.
Headwater: 1265.4255 ft
  
```

DIS-CHARGE	HEAD-WATER	INLET CONTROL	OUTLET CONTROL	FLOW TYPE	NORMAL DEPTH	CRITICAL DEPTH	OUTLET VEL.	OUTLET DEPTH	TAILWATER VEL.	TAILWATER DEPTH
Flow	ELEV.	DEPTH	DEPTH		DEPTH	DEPTH	VEL.	DEPTH	VEL.	DEPTH
cfs	ft	ft	ft		in	in	fps	ft	fps	ft
5.00	1265.41	0.41	1.41	M1	3.56	4.79	0.36	0.30	0.00	2.00
10.00	1265.43	0.66	1.43	M1	5.48	4.79	0.71	0.46	0.00	2.00
15.00	1265.48	0.87	1.48	M1	7.09	4.79	1.07	0.59	0.00	2.00
20.00	1265.50	1.06	1.50	M1	8.52	4.79	1.43	0.71	0.00	2.00
25.00	1265.54	1.24	1.54	M1	9.84	4.79	1.79	0.82	0.00	2.00
30.00	1265.58	1.40	1.58	M1	11.08	4.79	2.14	0.92	0.00	2.00
35.00	1265.64	1.55	1.64	M1	12.27	4.79	2.50	1.02	0.00	2.00
40.00	1265.70	1.70	1.70	M1	13.40	4.79	2.86	1.12	0.00	2.00
45.00	1265.84	1.84	1.78	NA	14.49	13.04	5.32	1.21	0.00	2.00
50.00	1265.98	1.98	1.86	NA	15.55	13.99	5.51	1.30	0.00	2.00
55.00	1266.11	2.11	1.96	NA	16.59	14.91	5.68	1.38	0.00	2.00
60.00	1266.24	2.24	2.06	NA	17.60	15.80	5.85	1.47	0.00	2.00
65.00	1266.36	2.36	2.16	NA	18.58	16.67	6.00	1.55	0.00	2.00
70.00	1266.48	2.48	2.28	NA	19.55	17.51	6.14	1.63	0.00	2.00
75.00	1266.60	2.60	2.41	NA	20.50	18.34	6.27	1.71	0.00	2.00
80.00	1266.72	2.72	2.55	NA	21.44	19.14	6.40	1.79	0.00	2.00
85.00	1266.83	2.83	2.71	NA	22.36	19.93	6.52	1.86	0.00	2.00

90.00	1266.95	2.95	2.88	NA	23.27	20.71	6.63	1.94	0.00	2.00
100.00	1267.28	3.16	3.28	M2	25.06	20.71	7.14	2.09	0.00	2.00
105.00	1267.49	3.27	3.49	M2	25.94	20.71	7.50	2.16	0.00	2.00
110.00	1267.72	3.37	3.72	M2	26.81	20.71	7.86	2.23	0.00	2.00
115.00	1267.88	3.48	3.88	M2	27.67	20.71	8.09	2.31	0.00	2.00
120.00	1268.00	3.58	4.00	M2	28.53	20.71	8.20	2.38	0.00	2.00
125.00	1268.01	4.01	0.00	NA	36.00	36.00	5.95	3.00	0.00	2.00
130.00	1268.12	4.12	0.00	NA	36.00	36.00	6.19	3.00	0.00	2.00
135.00	1268.27	4.27	0.00	NA	36.00	36.00	6.43	3.00	0.00	2.00
140.00	1268.39	4.39	0.00	NA	36.00	36.00	6.67	3.00	0.00	2.00
145.00	1268.48	4.48	0.00	NA	36.00	36.00	6.90	3.00	0.00	2.00
150.00	1268.61	4.61	0.00	NA	36.00	36.00	7.14	3.00	0.00	2.00
155.00	1268.76	4.76	0.00	NA	36.00	36.00	7.38	3.00	0.00	2.00
160.00	1268.91	4.91	0.00	NA	36.00	36.00	7.62	3.00	0.00	2.00
165.00	1269.07	5.07	0.00	NA	36.00	36.00	7.86	3.00	0.00	2.00
170.00	1269.23	5.23	0.00	NA	36.00	36.00	8.10	3.00	0.00	2.00
175.00	1269.39	5.39	0.00	NA	36.00	36.00	8.33	3.00	0.00	2.00
180.00	1269.56	5.56	0.00	NA	36.00	36.00	8.57	3.00	0.00	2.00
185.00	1269.74	5.74	0.00	NA	36.00	36.00	8.81	3.00	0.00	2.00
190.00	1269.92	5.92	0.00	NA	36.00	36.00	9.05	3.00	0.00	2.00