

Drainage Calculation

Applebee's

To City of Wichita, KS

June 2009



516 S. Market
Wichita, Kansas 67202
(316) 264-0242

Drainage Calculation

Summary of Drainage Calculation:

The detention of storm water is achieved through the parking lot detention. The storage available around inlet area is used as detention basin. The drainage shows the detention area around the inlets.

Detention for the Drainage area 1 and 2 were achieved through inlet structure and the outlet size of the pipe from that inlet. Inlet area was checked to handle the 100-yr undeveloped storm and size of pipe was considered to detain the excess runoff using orifice equation. The available detention basins were modeled for 2- 5- 10- 25- and 100-yr storm event. The offsite undeveloped runoff from the area north of pizza hut was also considered while calculating the size of the pipe. The attached plan shows hydrological analysis. The summary of calculations is also attached in drainage plan.

Detention for the drainage area 3 and 4 were also achieved through on-site parking detention. Deter drains were used to achieve the detention in this case. The size of the deter pipes were calculated to carry the undeveloped 5 yr storm and the water elevation was checked for the developed 100 yr storm using orifice equation.

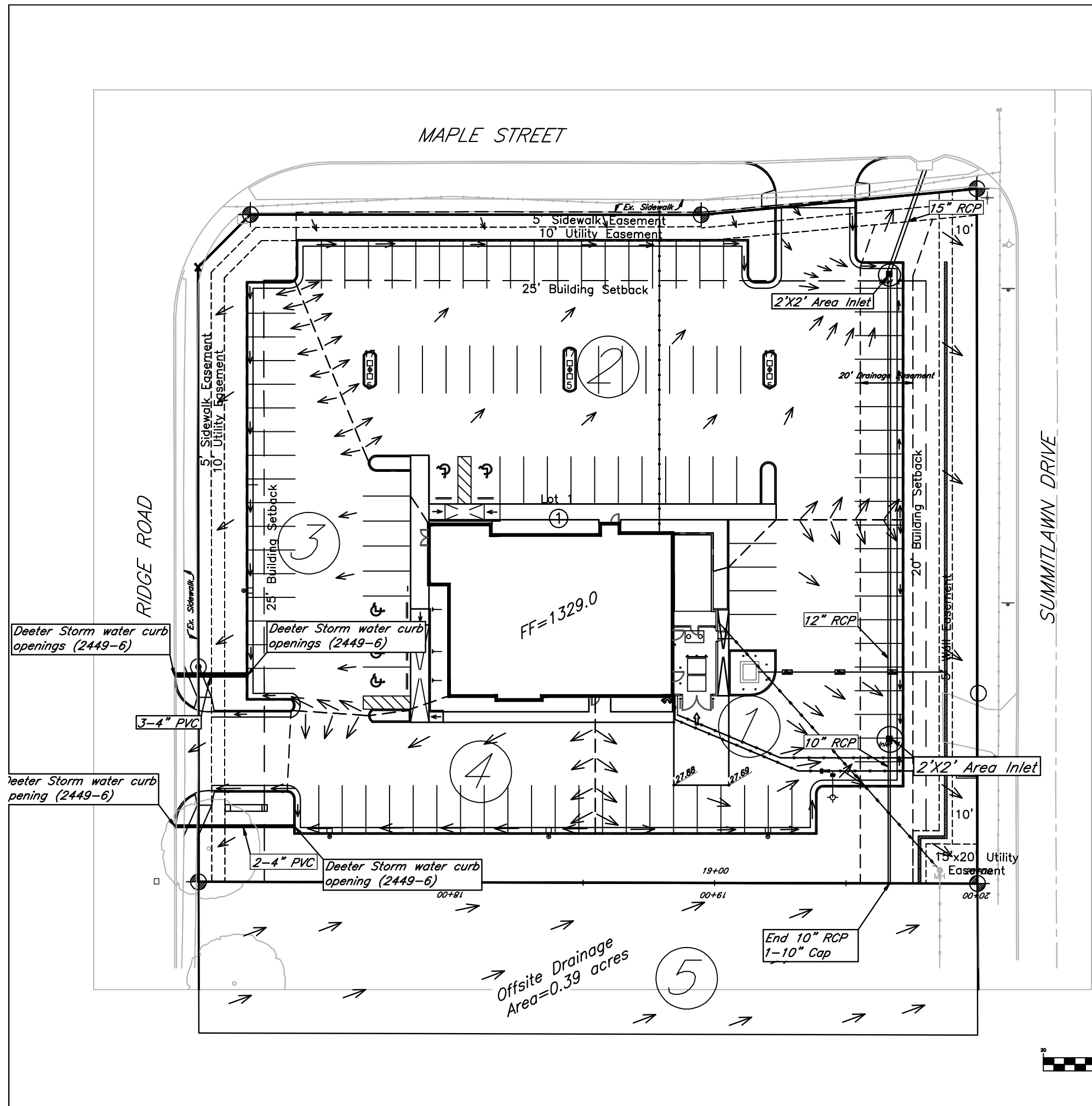
The summary of calculations is attached in drainage plan.

Note:

Existing and proposed site conditions have been modeled using the rational method. The Values for Rainfall Intensity and Runoff Coefficients were established using the *Drainage and Storm Sewer Policy for Design Criteria and Documentation, City of Wichita, Kansas*. A time of concentration of 15 minutes was used as it is the minimum inlet time. A proposed time of concentration of 15 minutes was also used.

Attachment:

Drainage Plan
Hydrological Analysis



Existing Site Drainage

Area #	Acres	Tc min	cfs														
			C2	C5	C10	C25	C100	I2	I5	I10	I25	I100	Q2	Q5	Q10	Q25	Q100
1	0.59	15	0.52	0.54	0.59	0.63	0.68	3.83	4.56	5.22	6.06	7.37	1.18	1.45	1.82	2.25	2.96
2	0.38	15	0.52	0.54	0.59	0.63	0.68	3.83	4.56	5.22	6.06	7.37	0.76	0.94	1.17	1.45	1.90
3	0.20	15	0.52	0.54	0.59	0.63	0.68	3.83	4.56	5.22	6.06	7.37	0.40	0.49	0.62	0.76	1.00
4	0.13	15	0.52	0.54	0.59	0.63	0.68	3.83	4.56	5.22	6.06	7.37	0.28	0.32	0.40	0.50	0.65

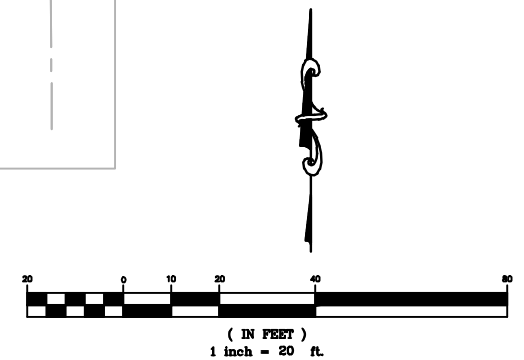
Proposed Site Drainage

Area #	Acres	Tc min	Proposed Q, cfs										Qout, cfs									
			C2	C5	C10	C25	C100	I2	I5	I10	I25	I100	Q2	Q5	Q10	Q25	Q100					
<i>Detention through Inlet and outlet size of pipe by orifice action</i>																						
1	0.38	15	0.68	0.69	0.73	0.75	0.80	3.83	4.56	5.22	6.06	7.37	0.99	1.20	1.45	1.73	2.24	0.65	0.78	0.93	1.10	1.37
2	0.59	15	0.68	0.69	0.73	0.75	0.80	3.83	4.56	5.22	6.06	7.37	1.54	1.86	2.25	2.68	3.48	1.15	1.36	1.61	1.89	2.02
<i>Detention through Deter Drain by orifice action</i>																						
3	0.20	15	0.68	0.69	0.73	0.75	0.80	3.83	4.56	5.22	6.06	7.37	0.52	0.63	0.76	0.91	1.18	Q100=0.66cfs, head=8.47'				
4	0.13	15	0.68	0.69	0.73	0.75	0.80	3.83	4.56	5.22	6.06	7.37	0.34	0.41	0.50	0.59	0.77	Q100=0.56cfs, head=4.78'				

Note:
 Site drainage calculations are developed using the Rational Method for peak runoff. "C" & "I" values are established from the City of Wichita Design Criteria.

Storm Water Detentions are achieved through inlet and deter drains. The drainage pattern of developed site is in accordance to the Mapleridge addition drainage plan.

BENCHMARK:
 City disc on southwest corner of Maple and Ridge, 69' south of centerline, 97' west of centerline and 10.5' north of face of sidewalk.
 Elevation= 1329.47 MSL



Applebee's
Drainage Plan
 Wichita, Kansas

PROJECT NUMBER			
KEM NO. 09041	FILE drainage	DATE 06/2009	SHEET 1 OF 1
DESIGN KM	DRAWN GP	REVISED	

516 S. Market, Wichita, KS 67202 316/264-0242

Summary for Pond Detention: Inlet 1

Inflow Area = 0.380 ac, Inflow Depth = 0.64" for 2-Year event
 Inflow = 0.98 cfs @ 0.25 hrs, Volume= 0.020 af
 Outflow = 0.65 cfs @ 0.25 hrs, Volume= 0.023 af, Atten= 34%, Lag= 0.0 min
 Primary = 0.65 cfs @ 0.25 hrs, Volume= 0.023 af

Routing by Stor-Ind method, Time Span= 0.00-2.00 hrs, dt= 0.25 hrs
 Peak Elev= 1,326.41' @ 0.25 hrs Surf.Area= 750 sf Storage= 151 cf

Plug-Flow detention time= 4.4 min calculated for 0.020 af (99% of inflow)
 Center-of-Mass det. time= 6.1 min (21.1 - 15.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,326.00'	4,843 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,326.00	4	0	0
1,326.40	730	147	147
1,326.80	2,083	563	709
1,327.20	3,930	1,203	1,912
1,327.80	5,839	2,931	4,843

Device	Routing	Invert	Outlet Devices
#1	Primary	1,326.00'	12.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=0.65 cfs @ 0.25 hrs HW=1,326.41' (Free Discharge)

↑ **1=Orifice/Grate** (Orifice Controls 0.65 cfs @ 2.17 fps)

Summary for Pond Detention: Inlet 1

Inflow Area = 0.380 ac, Inflow Depth = 0.78" for 5-Year event
 Inflow = 1.19 cfs @ 0.25 hrs, Volume= 0.025 af
 Outflow = 0.78 cfs @ 0.25 hrs, Volume= 0.027 af, Atten= 35%, Lag= 0.0 min
 Primary = 0.78 cfs @ 0.25 hrs, Volume= 0.027 af

Routing by Stor-Ind method, Time Span= 0.00-2.00 hrs, dt= 0.25 hrs
 Peak Elev= 1,326.45' @ 0.25 hrs Surf.Area= 894 sf Storage= 186 cf

Plug-Flow detention time= 4.5 min calculated for 0.024 af (99% of inflow)
 Center-of-Mass det. time= 6.2 min (21.2 - 15.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,326.00'	4,843 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,326.00	4	0	0
1,326.40	730	147	147
1,326.80	2,083	563	709
1,327.20	3,930	1,203	1,912
1,327.80	5,839	2,931	4,843

Device	Routing	Invert	Outlet Devices
#1	Primary	1,326.00'	12.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=0.78 cfs @ 0.25 hrs HW=1,326.45' (Free Discharge)

↑ **1=Orifice/Grate** (Orifice Controls 0.78 cfs @ 2.28 fps)

Summary for Pond Detention: Inlet 1

Inflow Area = 0.380 ac, Inflow Depth = 0.94" for 10-Year event
 Inflow = 1.45 cfs @ 0.25 hrs, Volume= 0.030 af
 Outflow = 0.93 cfs @ 0.25 hrs, Volume= 0.033 af, Atten= 36%, Lag= 0.0 min
 Primary = 0.93 cfs @ 0.25 hrs, Volume= 0.033 af

Routing by Stor-Ind method, Time Span= 0.00-2.00 hrs, dt= 0.25 hrs
 Peak Elev= 1,326.50' @ 0.25 hrs Surf.Area= 1,053 sf Storage= 232 cf

Plug-Flow detention time= 4.6 min calculated for 0.030 af (99% of inflow)
 Center-of-Mass det. time= 6.3 min (21.3 - 15.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,326.00'	4,843 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,326.00	4	0	0
1,326.40	730	147	147
1,326.80	2,083	563	709
1,327.20	3,930	1,203	1,912
1,327.80	5,839	2,931	4,843

Device	Routing	Invert	Outlet Devices
#1	Primary	1,326.00'	12.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=0.93 cfs @ 0.25 hrs HW=1,326.50' (Free Discharge)

↑ **1=Orifice/Grate** (Orifice Controls 0.93 cfs @ 2.40 fps)

Summary for Pond Detention: Inlet 1

Inflow Area = 0.380 ac, Inflow Depth = 1.14" for 25-Year event
 Inflow = 1.75 cfs @ 0.25 hrs, Volume= 0.036 af
 Outflow = 1.10 cfs @ 0.25 hrs, Volume= 0.040 af, Atten= 37%, Lag= 0.0 min
 Primary = 1.10 cfs @ 0.25 hrs, Volume= 0.040 af

Routing by Stor-Ind method, Time Span= 0.00-2.00 hrs, dt= 0.25 hrs
 Peak Elev= 1,326.55' @ 0.25 hrs Surf.Area= 1,224 sf Storage= 289 cf

Plug-Flow detention time= 4.8 min calculated for 0.036 af (99% of inflow)
 Center-of-Mass det. time= 6.5 min (21.5 - 15.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,326.00'	4,843 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,326.00	4	0	0
1,326.40	730	147	147
1,326.80	2,083	563	709
1,327.20	3,930	1,203	1,912
1,327.80	5,839	2,931	4,843

Device	Routing	Invert	Outlet Devices
#1	Primary	1,326.00'	12.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=1.10 cfs @ 0.25 hrs HW=1,326.55' (Free Discharge)

↑ **1=Orifice/Grate** (Orifice Controls 1.10 cfs @ 2.52 fps)

Summary for Pond Detention: Inlet 1

Inflow Area = 0.380 ac, Inflow Depth = 1.46" for 100-Year event
 Inflow = 2.24 cfs @ 0.25 hrs, Volume= 0.046 af
 Outflow = 1.37 cfs @ 0.25 hrs, Volume= 0.051 af, Atten= 39%, Lag= 0.0 min
 Primary = 1.37 cfs @ 0.25 hrs, Volume= 0.051 af

Routing by Stor-Ind method, Time Span= 0.00-2.00 hrs, dt= 0.25 hrs
 Peak Elev= 1,326.62' @ 0.25 hrs Surf.Area= 1,475 sf Storage= 389 cf

Plug-Flow detention time= 5.1 min calculated for 0.045 af (98% of inflow)
 Center-of-Mass det. time= 6.7 min (21.7 - 15.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,326.00'	4,843 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,326.00	4	0	0
1,326.40	730	147	147
1,326.80	2,083	563	709
1,327.20	3,930	1,203	1,912
1,327.80	5,839	2,931	4,843

Device	Routing	Invert	Outlet Devices
#1	Primary	1,326.00'	12.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=1.37 cfs @ 0.25 hrs HW=1,326.62' (Free Discharge)

↑ **1=Orifice/Grate** (Orifice Controls 1.37 cfs @ 2.68 fps)

Summary for Pond Detention: Inlet 2

Inflow Area = 0.590 ac, Inflow Depth = 0.64" for 2-Year event
 Inflow = 1.53 cfs @ 0.25 hrs, Volume= 0.032 af
 Outflow = 1.15 cfs @ 0.25 hrs, Volume= 0.036 af, Atten= 25%, Lag= 0.0 min
 Primary = 1.15 cfs @ 0.25 hrs, Volume= 0.036 af

Routing by Stor-Ind method, Time Span= 0.00-2.00 hrs, dt= 0.25 hrs
 Peak Elev= 1,325.42' @ 0.25 hrs Surf.Area= 906 sf Storage= 170 cf

Plug-Flow detention time= 2.4 min calculated for 0.028 af (89% of inflow)
 Center-of-Mass det. time= 5.1 min (20.1 - 15.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,324.91'	7,056 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,324.91	4	0	0
1,325.30	445	88	88
1,325.70	1,960	481	569
1,326.10	3,945	1,181	1,750
1,326.50	6,538	2,097	3,846
1,326.90	9,511	3,210	7,056

Device	Routing	Invert	Outlet Devices
#1	Primary	1,324.91'	15.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=1.15 cfs @ 0.25 hrs HW=1,325.42' (Free Discharge)
 ↑ **1=Orifice/Grate** (Orifice Controls 1.15 cfs @ 2.44 fps)

Summary for Pond Detention: Inlet 2

Inflow Area = 0.590 ac, Inflow Depth = 0.78" for 5-Year event
 Inflow = 1.85 cfs @ 0.25 hrs, Volume= 0.038 af
 Outflow = 1.36 cfs @ 0.25 hrs, Volume= 0.044 af, Atten= 26%, Lag= 0.0 min
 Primary = 1.36 cfs @ 0.25 hrs, Volume= 0.044 af

Routing by Stor-Ind method, Time Span= 0.00-2.00 hrs, dt= 0.25 hrs
 Peak Elev= 1,325.47' @ 0.25 hrs Surf.Area= 1,094 sf Storage= 219 cf

Plug-Flow detention time= 2.6 min calculated for 0.034 af (89% of inflow)
 Center-of-Mass det. time= 5.4 min (20.4 - 15.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,324.91'	7,056 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,324.91	4	0	0
1,325.30	445	88	88
1,325.70	1,960	481	569
1,326.10	3,945	1,181	1,750
1,326.50	6,538	2,097	3,846
1,326.90	9,511	3,210	7,056

Device	Routing	Invert	Outlet Devices
#1	Primary	1,324.91'	15.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=1.36 cfs @ 0.25 hrs HW=1,325.47' (Free Discharge)
 ↳ **1=Orifice/Grate** (Orifice Controls 1.36 cfs @ 2.55 fps)

Summary for Pond Detention: Inlet 2

Inflow Area = 0.590 ac, Inflow Depth = 0.94" for 10-Year event
 Inflow = 2.25 cfs @ 0.25 hrs, Volume= 0.046 af
 Outflow = 1.61 cfs @ 0.25 hrs, Volume= 0.053 af, Atten= 28%, Lag= 0.0 min
 Primary = 1.61 cfs @ 0.25 hrs, Volume= 0.053 af

Routing by Stor-Ind method, Time Span= 0.00-2.00 hrs, dt= 0.25 hrs
 Peak Elev= 1,325.53' @ 0.25 hrs Surf.Area= 1,303 sf Storage= 285 cf

Plug-Flow detention time= 2.9 min calculated for 0.042 af (89% of inflow)
 Center-of-Mass det. time= 5.6 min (20.6 - 15.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,324.91'	7,056 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,324.91	4	0	0
1,325.30	445	88	88
1,325.70	1,960	481	569
1,326.10	3,945	1,181	1,750
1,326.50	6,538	2,097	3,846
1,326.90	9,511	3,210	7,056

Device	Routing	Invert	Outlet Devices
#1	Primary	1,324.91'	15.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=1.61 cfs @ 0.25 hrs HW=1,325.53' (Free Discharge)
 ↳ **1=Orifice/Grate** (Orifice Controls 1.61 cfs @ 2.67 fps)

Summary for Pond Detention: Inlet 2

Inflow Area = 0.590 ac, Inflow Depth = 1.14" for 25-Year event
 Inflow = 2.71 cfs @ 0.25 hrs, Volume= 0.056 af
 Outflow = 1.89 cfs @ 0.25 hrs, Volume= 0.064 af, Atten= 30%, Lag= 0.0 min
 Primary = 1.89 cfs @ 0.25 hrs, Volume= 0.064 af

Routing by Stor-Ind method, Time Span= 0.00-2.00 hrs, dt= 0.25 hrs
 Peak Elev= 1,325.59' @ 0.25 hrs Surf.Area= 1,526 sf Storage= 369 cf

Plug-Flow detention time= 3.2 min calculated for 0.050 af (89% of inflow)
 Center-of-Mass det. time= 5.9 min (20.9 - 15.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,324.91'	7,056 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,324.91	4	0	0
1,325.30	445	88	88
1,325.70	1,960	481	569
1,326.10	3,945	1,181	1,750
1,326.50	6,538	2,097	3,846
1,326.90	9,511	3,210	7,056

Device	Routing	Invert	Outlet Devices
#1	Primary	1,324.91'	15.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=1.89 cfs @ 0.25 hrs HW=1,325.59' (Free Discharge)
 ↑ **1=Orifice/Grate** (Orifice Controls 1.89 cfs @ 2.80 fps)

Summary for Pond Detention: Inlet 2

Inflow Area = 0.590 ac, Inflow Depth = 1.46" for 100-Year event
 Inflow = 3.47 cfs @ 0.25 hrs, Volume= 0.072 af
 Outflow = 2.33 cfs @ 0.25 hrs, Volume= 0.082 af, Atten= 33%, Lag= 0.0 min
 Primary = 2.33 cfs @ 0.25 hrs, Volume= 0.082 af

Routing by Stor-Ind method, Time Span= 0.00-2.00 hrs, dt= 0.25 hrs
 Peak Elev= 1,325.67' @ 0.25 hrs Surf.Area= 1,854 sf Storage= 515 cf

Plug-Flow detention time= 3.5 min calculated for 0.064 af (89% of inflow)
 Center-of-Mass det. time= 6.2 min (21.2 - 15.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,324.91'	7,056 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,324.91	4	0	0
1,325.30	445	88	88
1,325.70	1,960	481	569
1,326.10	3,945	1,181	1,750
1,326.50	6,538	2,097	3,846
1,326.90	9,511	3,210	7,056

Device	Routing	Invert	Outlet Devices
#1	Primary	1,324.91'	15.0" Vert. Orifice/Grate C= 0.600

Primary OutFlow Max=2.33 cfs @ 0.25 hrs HW=1,325.67' (Free Discharge)
 ↳ **1=Orifice/Grate** (Orifice Controls 2.33 cfs @ 2.97 fps)