INTRODUCTION

The Shoe Carnival facility located at the southeast corner of Baumgart and Heinlein Road is planning a warehouse addition on the site. The easterly warehouse addition will be approximately 55,000 square feet. This addition will be very similar to the 1994 addition which currently makes up the east end of the facility. The new addition will lie adjacent to the 1994 warehouse addition and will utilize the remaining real estate left undeveloped at this end of the site.

This addition will also include construction of a loading dock along the south side of the building which will be depressed. This area can effectively serve as a detention area. Also, the remaining area to be paved south of the loading dock shall be sloped to the south and toward an area drain which will be restricted with an orifice plate to allow the remaining paved area to serve as a storm water storage basin as well. All other downstream inlets on this line have been restricted in this same manner. All runoff from the roof of this new addition will be piped to the south and through the loading dock area.

The northerly warehouse addition will be approximately a 32,700 square foot addition which will occupy what is currently a parking lot. This building addition will occupy the whole area once used for parking and detention. This addition will leave no room for storage elsewhere. There are several area drains which empty the parking lot into the existing roadside ditch along Heinlein Road. It has been suggested that the 4" and 6" pipes which empty this lot were sized to limit the outflow from this lot. In order to replace this detention element, the owner will continue the stormwater piping being installed along the north side of the proposed easterly warehouse addition farther west across the adjoining 1994 addition. Three down drains which currently discharge directly into the roadside ditch will be rerouted into this storm sewer. By doing so, the north half of the 1994 addition will be accounted for and stored in the loading dock south of the 1994 addition.

This rerouting of the runoff from the 1994 addition should more than compensate for the runoff from the proposed north addition.

It is the intent of this report to define the stormwater storage requirements as established by the current drainage ordinance and to provide a means of handling the increase in runoff anticipated from the proposed development in the manner acceptable to the drainage board.

METHOD

The Rational Method (Q = cia) will be used to compute the 10-year undeveloped flow. This value will be used as the allowable outflow rate for the developed site.

"c" = Runoff Coefficient. The existing land to be replaced with the east additional slopes slightly from west to east. The area is currently cultivated fields ranging from 2% to 5% in slope. This suggests an undeveloped runoff coefficient of 0.24 be used as shown in Table 803 of the drainage ordinance. The existing land for the north addition is already improved but will be assumed undeveloped for this report in order to account for the stormwater storage being lost by the building addition. A value of 0.24 will also be used for the existing condition. This assumption will allow us to evaluate the impact of this project without having to account for or reflect previously reported storm water values from earlier reporting. Both the north addition and the 1994 addition will be analyzed with this 0.24 factor so that a fair comparison can be made between the two.

"i" = Intensity. Kerby's Formula will be used to determine the Time of Concentration for the undeveloped site and the corresponding 10-year intensity will be calculated. For the area flowing from the west and east towards the east property line a value of 10 minutes was calculated. The resulting 10 year intensity equals 5.38 (See Appendix B). For the area flowing north to Heinlein Road a value of ten (10) minutes was also used. The resulting 10 year intensity equals 5.38.

"a" = Area. The undeveloped contributory area flowing east into the north/south ditch is 1.89 acres. This area includes the proposed building, the adjoining loading dock expansion and the adjacent service pavement. The area flowing north into the Heinlein Road ditch from the north addition is 0.75 acres. The area flowing north from the north half of the 1994 addition is 0.62 acres. The entire 1994 addition which will now end up in the south loading dock which will add 1.24 acres to the 1.89 acres described above.

In addition, a developed "c" factor of 0.9 will be used based on the proposed land use and anticipated surface improvements for all areas being analyzed.

To the product of the developed "c" value and the area "a", a range of intensity value for different duration storms having a 25 year and 100 year specified return rate will be multiplied to compute expected inflow rates.

The difference between the inflow rates and outflow rates for each interval will establish the required storage for that interval. From this data a curve can be generated and the peak or largest value attained will be used as the required storage basin capacity.

The required storage to accommodate the 25 year storm attributable to the east addition and the entire 1994 addition will be made available in the truck dock area and truck staging areas south of the additions. The outlet pipes to this truck well will be limited in size to control the release rate. Some rework of the existing piping may be required.

No runoff will be allowed to enter the ditch along the east property line for it is believed to be a sensitive issue with the adjoiners.

Since all detention requirements will be met in the south loading dock area, there will be no proposed detention for the new north addition. Two 8" drains from the original structure and 1978 addition will be rerouted to the Heinlein Road roadside ditch and all roof drainage from the north addition will be discharged directly onto the lawn area immediately adjacent to the north addition.

RESULTS

The required storage volume based on a 10/25 year analysis for the east addition is 9,872 cf. The storage being designed and accommodated for is 13,035 cf, providing a surplus of 3,163 cf to be credited against the north addition. The required storage for the north addition is 1799 cf.

The available storage volume in the truck well extension:

- From elevation 387.85 (trench drain) to elevation 389.14 (recessed dock area in front of new and 1984 addn) = 13,039 cf
- The available storage in the truck parking lot south of the new addition = 9,648 cf
- Total available storage = 22,687 cf
- Available storage volume south of the recessed dock that lies south of the 1984 addition on service pavement = 15,000 cf

Total of docks and adjacent paved area south of docks = *37,687 cf*

SUMMARY

The allowable outflow rate for the easterly addition and the 1994 addition combined is 3.80 cfs. An 8" diameter outlet pipe from the existing loading dock south of the 1994 addition and an 8" diameter pipe from the new addition together will be used to drain the trench drain.

The existing trench drain currently has three drains–two of the three drains will be plugged. The new trench drain south of the new addition will contain the second 8" diameter outlet pipe. For maintenance reasons the 8" outlet pipe will be increased to a 12" pipe beyond the outlet point by using a 12"x8" reducer. An 8" cleanout will also be installed on this line. The roof drains from the north end of the proposed addition and the north end of the 1994 addition will be routed to the east end of the south loading dock as previously stated. The pipe will be cast into the east end of the trench drain to provide for as much grade on this pipe as possible. An emergency outlet pipe will be set in the structure at the northeast corner of the proposed addition to act as a relief point should the outlet pipe downstream become obstructed. Should the loading dock outlet pipes become obstructed the water will run out of the south end of the dock area across the service area pavement and onto the nearest parking lot drain. The entire south parking lot will allow for significantly more storage than should ever be needed, even under the worst possible conditions. As previously mentioned, all of these drains have an orifice plat atop them to restrict the outflow, thus negating the concern that the release of stormwater from this area is uncontrolled. The end result should produce a stormwater management that is in accordance with the current ordinance and effective in limiting the stormwater discharge from this site. For the most part this system should also be maintenance free.

APPENDICES INDEX

APPENDIX "A"
DRAINAGE PLAN

UNDEVELOPED "C" FACTOR = 0.24

Taken from Table 803 of the Vanderburgh County Drainage Ordinance as the runoff coefficient to be used for turf areas with flat slopes 2%±.

Undeveloped "C" Factor of 0.4% was also used to analyze this north area. This value was used as a weighted value to take into consideration.
Lawn at 0.24 (20%) = .05

Lawn at 0.90 (80%) = .72/.77/2 = 0.385 Approximately 0.40

WEIGHTED DEVELOPED "C" FACTOR = 0.90

Taken from Table 803 Vanderburgh County Drainage Ordinance as the runoff.

Coefficient to be used for rooftops.

TIME OF CONCENTRATION
(North Addition)

$$TC = .827\left[\frac{(N)(L)}{\sqrt{S}}\right]^{.467}$$ (Kerby's Formula)

N = 0.3 Turf Pavement
L = Length
S = Slope

L = 100'
H = 390.85 - 389.00 = 1.85'
S = 1.85 ÷ 100 = 1.85

$$Tc = .827\left[\frac{(0.3)(100)}{\sqrt{.0185}}\right]^{.467} = 10.27 \text{ minutes (use 10 minutes)}$$

$$i( ) = \frac{C(T)^{\alpha}}{(Tc+d)^{\beta}}$$

C = 1.9533 T = duration
α = 0.1747 Tc = Time of Concentration (10 yr. undeveloped)
d = 0.522
β = 1.6408

$$i_{10} = \frac{1.9533(10)^{0.1747}}{(10/60+0.522)\ 1.6408} = \frac{2.9206}{.5423} = 5.38$$

Check Table (807) = 1.47

*Additional minutes denotes flow from buildings and lawn area within the apartment project located in the upper reaches of this watershed north of the Lloyd Expressway.

TIME OF CONCENTRATION
(East Addition)

TIME OF CONCENTRACTION

$$TC = .827\left[\frac{(N)(L)}{\sqrt{S}}\right]^{.467}$$

(Kerby's Formula)

N = 0.4 Coefficient Grass
L = Length
S = Slope

L = 100'
H = 392.0 - 390.0 = 2.0'
S = .0093

$$Tc = .827\left[\frac{(0.4)(100)}{\sqrt{.02}}\right]^{.467} = 11 \text{ minutes} \cong 10 \text{ minutes}$$

INTENSITY

$$i( ) = \frac{C(T)^{\alpha}}{(Tc+d)^{\beta}}$$

C = 1.9533
α = 0.1747
d = 0.522
β = 1.6408

T = duration
Tc = Time of Concentration (10 yr. undeveloped)

$$i_{10} = \frac{1.9533(10)^{0.1747}}{(10/60+0.522)\ 1.6408} = \frac{2.9206}{.5423} = 5.38$$

APPENDIX "C"
STORAGE VOLUME DATA

PROJECT: shoe carnaval east add \ 94 add DATE: 10/14/98
ENGINEER:BERNARDIN LOCHMUELLER AND ASSOCIATES, INC

DESIGN RETURN PERIOD:	5\10\25\100		
RELEASE RATE PERIOD:	5\10\25\100		
WATERSHED AREA (ACRES):	2.94		
TIME OF CONCENTRATION UNDEV. (min):	10		
RAINFALL INTENSITY (INCHES/HR):	5.38	5.385966	4.111052
UNDEVELOPED RUNOFF COEFFICIENT:	0.24		
UNDEVELOPED RUNOFF RATE (CFS):	3.80		
DEVELOPED RUNOFF COEFFICIENT:	0.9		

25 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	REQUIRED STORAGE (ACRE-FT)
0.08	8.02	21.21	3.80	17.41	0.116
0.17	6.20	16.40	3.80	12.60	0.178
0.25	5.26	13.93	3.80	10.13	0.211
0.33	4.62	12.22	3.80	8.42	0.232
0.42	4.09	10.81	3.80	7.01	0.245
0.50	3.72	9.84	3.80	6.04	0.252
0.58	3.42	9.06	3.80	5.26	0.254
0.67	3.15	8.33	3.80	4.53	0.253
0.75	2.94	7.78	3.80	3.98	0.249
0.83	2.76	7.31	3.80	3.51	0.243
0.92	2.59	6.85	3.80	3.05	0.234
1.00	2.45	6.49	2.90	3.59	0.299
1.25	2.11	5.59	2.90	2.69	0.281
1.50	1.86	4.93	2.90	2.03	0.253
1.75	1.67	4.41	2.90	1.51	0.220
2.00	1.51	3.99	2.90	1.09	0.182
2.50	1.27	3.37	2.90	0.47	0.097
3.00	1.10	2.91	2.90	0.01	0.003
4.00	0.87	2.29	2.90	-0.61	-0.202

PEAK STORAGE (ACRE/FT):	0.30
PEAK STORAGE (CUBIC FT):	13035.46

PROJECT: shoe carnaval east add DATE: 10/06/98
ENGINEER:BERNARDIN LOCHMUELLER AND ASSOCIATES, INC

DESIGN RETURN PERIOD:	5\10\25\100		
RELEASE RATE PERIOD:	5\10\25\100		
WATERSHED AREA (ACRES):	1.89		
TIME OF CONCENTRATION UNDEV. (min):	20		
RAINFALL INTENSITY (INCHES/HR):	3.92	3.774167	3.204868
UNDEVELOPED RUNOFF COEFFICIENT:	0.24		
UNDEVELOPED RUNOFF RATE (CFS):	1.71		
DEVELOPED RUNOFF COEFFICIENT:	0.9		

25 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	REQUIRED STORAGE (ACRE-FT)
0.08	8.02	13.63	1.71	11.92	0.079
0.17	6.20	10.54	1.71	8.83	0.125
0.25	5.26	8.96	1.71	7.24	0.151
0.33	4.62	7.86	1.71	6.15	0.169
0.42	4.09	6.95	1.71	5.24	0.183
0.50	3.72	6.33	1.71	4.62	0.192
0.58	3.42	5.82	1.71	4.11	0.199
0.67	3.15	5.35	1.71	3.64	0.203
0.75	2.94	5.00	1.71	3.29	0.206
0.83	2.76	4.70	1.71	2.99	0.207
0.92	2.59	4.40	1.71	2.69	0.206
1.00	2.45	4.17	1.45	2.72	0.227
1.25	2.11	3.60	1.45	2.14	0.223
1.50	1.86	3.17	1.45	1.71	0.214
1.75	1.67	2.84	1.45	1.38	0.201
2.00	1.51	2.57	1.45	1.11	0.186
2.50	1.27	2.16	1.45	0.71	0.148
3.00	1.10	1.87	1.45	0.42	0.105
4.00	0.87	1.47	1.45	0.02	0.007

PEAK STORAGE (ACRE/FT): 0.23
PEAK STORAGE (CUBIC FT): 9872.03 ← Reqd storage for EAST Add ONLY

North + EAST Add 13035 CF
less EAST Add 9872 CF
3163 CF

this exceeds the 1799 CF reqd. for the North Add.

PROJECT: shoe carnaval north add DATE: 10/07/98
ENGINEER:BERNARDIN LOCHMUELLER AND ASSOCIATES, INC

DESIGN RETURN PERIOD:	5\10\25\100
RELEASE RATE PERIOD:	5\10\25\100
WATERSHED AREA (ACRES):	0.75
TIME OF CONCENTRATION UNDEV. (min):	10
RAINFALL INTENSITY (INCHES/HR):	5.38 5.385966 4.111052
UNDEVELOPED RUNOFF COEFFICIENT:	0.4
UNDEVELOPED RUNOFF RATE (CFS):	1.62
DEVELOPED RUNOFF COEFFICIENT:	0.9

25 YEAR STORM

STORM DURATION (HRS)	RAINFALL INTENSITY (INCH/HR)	INFLOW RATE (CFS)	OUTFLOW RATE (CFS)	STORAGE RATE (CFS)	REQUIRED STORAGE (ACRE-FT)
0.08	8.02	5.41	1.62	3.79	0.025
0.17	6.20	4.18	1.62	2.57	0.036
0.25	5.26	3.55	1.62	1.94	0.040
0.33	4.62	3.12	1.62	1.50	0.041
0.42	4.09	2.76	1.62	1.14	0.040
0.50	3.72	2.51	1.62	0.90	0.037
0.58	3.42	2.31	1.62	0.69	0.034
0.67	3.15	2.12	1.62	0.51	0.028
0.75	2.94	1.99	1.62	0.37	0.023
0.83	2.76	1.86	1.62	0.25	0.017
0.92	2.59	1.75	1.62	0.13	0.010
1.00	2.45	1.66	1.23	0.42	0.035
1.25	2.11	1.43	1.23	0.19	0.020
1.50	1.86	1.26	1.23	0.02	0.003
1.75	1.67	1.13	1.23	-0.11	-0.016
2.00	1.51	1.02	1.23	-0.21	-0.036
2.50	1.27	0.86	1.23	-0.37	-0.078
3.00	1.10	0.74	1.23	-0.49	-0.123
4.00	0.87	0.59	1.23	-0.65	-0.216

PEAK STORAGE (ACRE/FT): 0.04
PEAK STORAGE (CUBIC FT): 1799.64

← Storage which should be accounted for w/ North Ackl.

APPENDIX "D"
OUTLET CONTROL STRUCTURE ANALYSIS

OUTLET CONTROL STRUCTURE
East Addition and 1994 Addition

ORIFICE EQUATION

Primary Outlet Pipe

$Q = cdA\sqrt{2gh}$

$cd = Cc \times Cv = (.62)(.97) = .60$

Allow Outflow $Q = CIA = (0.24)(5.39)(2.94) = 3.80$ cfs

$c = 0.24$
$i = 5.39 / Tc = 10$ min.
$a = 2.94$ acres

Allow HW = Top of Dock to Trench Grate 389.14 - 387.85

$$(3.80) = Q = (.60)(A)\sqrt{2(32.2)(1.29)}$$

$$A = \frac{3.80}{5.47} = 0.6947 = \frac{\Pi d^2}{4}$$

$d = 0.94'$ if one hole is used

For two outlets (one @ each dock trench grate)

$$A = \frac{1.90}{5.47} = 0.6947 = \frac{\Pi d^2}{4}$$

$d = 0.67'$ or 8"

Suggest: One 8" diameter outlet pipe be used in each loading dock

APPENDIX "E"
BASIN VOLUMES