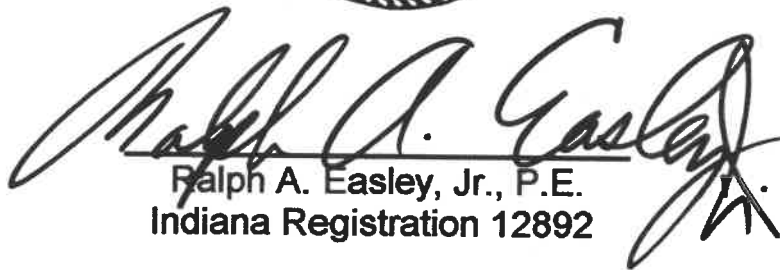


Drainage Study
for:
Alexander Estates II
Browning Road
Vanderburgh County, Indiana




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**DRAINAGE CALCULATIONS FOR ALEXANDER ESTATES II SUBDIVISION
BROWNING ROAD
VANDERBURGH COUNTY, INDIANA**

SITE LOCATION:

The proposed site is located outside of the City limits of Evansville in Vanderburgh County. More specifically, the site is located approximately 1000 feet west of Browning Road approximately 2000 feet north of the of Hillsdale Road.

EXISTING CONDITIONS:

Area: 1,346,056.5234 sf = 30.9012 Acres (gross)

Existing Use: Undeveloped with thick wooded growth

Proposed New Development: 7 lot family complex (subdivision)

Existing Drainage Pattern: The existing site is extremely steep. Computer analysis of grades indicate an average slope in excess of 10%. The proposed site drains in a pattern that is generally north and west into a system of small streams and swales which in turn discharge into an un-named Blue Line Stream that flows to the west into Little Pigeon Creek.

The proposed development drains into 3 sub-basins of the overall watershed described above.

1. Sub-basin "A" drains to a swale which collects 5.81 acres offsite south of the site and discharges in a northwesterly direction across the proposed lot 10. This sub-basin collects the runoff of the majority of lot 8, ½ of lot 9 and all of lot 10. The area of this sub-basin located within the proposed subdivision is 13.15 acres.
2. Sub-basin "B" drains to a swale which collects the 55.35 acres offsite south and east of the site and drains into said swale which drains in a northwesterly direction through lot 4 off the site and then across the northeast corner of lot 6. This sub-basin collects the runoff of lots 3, 4 and a portion of lots 6 and 8. The area of this sub-basin located within the proposed subdivision is 9.49 acres.
3. Sub-basin "C" drains offsite, overland, to the same swale that collects Sub-basin "B". This swale continues to flow to the west where it joins the swale from Sub-basin "A" offsite to the west of the proposed subdivision. This sub-basin collects the runoff from lot 7 and a portion of lots 6, 8 and 9. The area of this sub-basin located within the proposed subdivision is 7.38 acres.

Existing Watershed Geometry:

Area: = 1,346,056.5234 sf = 30.9012 Acres (gross)

Existing Structures = 671.7 SF (existing shed on lot 10)

Existing Pavement - 0 SF

Existing Gravel Drive and Parking = 1491 SF (portion of gravel drive leading to existing Alexander residence)

Remaining portion of property is undeveloped with thick wooded growth.

Undeveloped Runoff Coefficient, $C_u = 0.48$ for a woodland, turfed meadows, rough pasture, fallow brush with a slope greater than 10% as per Vanderburgh County Drainage Ordinance

Undeveloped Runoff Coefficient, $C_u = 0.48$

Kerby's "n" = 0.60 for deciduous timberland as per Table 3.4 of the HERPIC Manual.

Sub-basin Geometry:

Sub-basin "A"

Area of basin = 13.15 acres.

Length of basin = 955 feet

Height of basin = 457-429 = 28 feet

Slope of Basin = 28/955 = 0.029319

$$t_c = 0.827 [n * L / S]^{0.487}$$

$$t_c = 0.827 [0.60 * 955 / 0.029319]^{0.487}$$

$$t_c = 36.6 \text{ minutes}$$

From the Rainfall Intensity as per Vanderburgh County Drainage Ordinance
 $i = 2.607$ "/hour for a 10 year storm.

Sub-basin "B"

Area of basin = 9.48 acres.

Length of basin = 818 feet

Height of basin = 501-446 = 55 feet

Slope of Basin = 55/818 = 0.06723

$$t_c = 0.827 [n * L / S]^{0.487}$$

$$t_c = 0.827 [0.60 * 818 / 0.06723]^{0.487}$$

$$t_c = 28 \text{ minutes}$$

From the Rainfall Intensity as per Vanderburgh County Drainage Ordinance
 $i = 3.398$ "/hour for a 10 year storm.

Sub-basin "C"

Area of basin = 7.38 acres.

Length of basin = 575 feet

Height of basin = 503-442 = 61 feet

Slope of Basin = 61/575 = 0.10608

$$t_c = 0.827 [n * L / S]^{0.487}$$

$$t_c = 0.827 [0.60 * 575 / 0.10608]^{0.487}$$

$$t_c = 21.4 \text{ minutes}$$

From the Rainfall Intensity as per Vanderburgh County Drainage Ordinance
 $i = 3.965$ "/hour for a 10 year storm.

Proposed Development:

The following assumptions were made in trying to predict the amount of development for each individual lot:

1. Each home would have a footprint of 3000 SF
2. That a gravel drive of 16' width would lead from the road or the ingress/egress drive to each home.
3. That in addition to this drive there would also be a 400 SF parking pad outside of each garage area.
4. That each home would have a 1000 SF patio area consisting of a combination of concrete pads, walks, wood decks and plantings.
5. That a lawn or green area would be created for each home that would be equal to twice the footprint of the home or 6000 SF.

Sub-basin "A"

This sub-basin collects the runoff of the majority of lot 8, 1/2 of lot 9 and all of lot 10. The vast majority of the proposed development for lots 8, 9 and 10 fall within this sub-basin and will be analyzed as if all of it does

Proposed Watershed Geometry:

Area of basin = 13.15 acres.
Proposed Structures = 9000 SF
Proposed Roadway Pavement = 4000 SF
Proposed Gravel Drives = 16,800 SF
Proposed Patios = 3000 SF
Proposed Parking Pad = 1200 SF
Proposed Lawns = 18,000 SF
Area to be developed = 52,000 SF

Developed Runoff Coefficient =

$$\frac{(9,000 * 0.98) + (4000 * 0.98) + (16,800 * 0.90) + (3000 * 0.95) + (1200 * 0.98) + (18,000 * 0.40)}{52,000} =$$

Developed Runoff Coefficient, $C_d = 0.75$

Because the area to be developed is a relatively small percentage of the total sub-basin of where it is located, no retention is required as per Form 800 of the Vanderburgh County Drainage Ordinance. See attached Form 800 for Sub-basin "A".

Sub-basin "B"

This sub-basin collects the runoff of lots 3, 4 and a portion of lots 6 and 8. This basin collects about 1/3 of the proposed development of lot 8 and practically none of lot 6. This area will be analyzed as though 2 1/2 lots are to be developed within this basin.

Proposed Watershed Geometry:

Area of basin = 9.49 acres.
Proposed Structures = 7500 SF
Proposed Roadway Pavement = 4000 SF
Proposed Gravel Drives = 12,320 SF
Proposed Patios = 2500 SF
Proposed Parking Pads = 1000 SF
Proposed Lawns = 15,000 SF
Area to be developed = 42,320 SF = 0.97 acres

Developed Runoff Coefficient =

$$\frac{(7,500 * 0.98) + (4000 * 0.98) + (12,320 * 0.90) + (2,500 * 0.95) + (1000 * 0.98) + (15,000 * 0.40)}{42,320} =$$

Developed Runoff Coefficient, $C_d = 0.75$

Because the area to be developed is a relatively small percentage of the total sub-basin of where it is located, no retention is required as per Form 800 of the Vanderburgh County Drainage Ordinance. See attached Form 800 for Sub-basin "B".

Sub-basin "C"

This sub-basin collects the runoff of 1/2 of lot 6 (which includes all of the area of lot 6 to be developed), all of lot 7 and 1/2 of lot 9. This area will be analyzed as though 2 -1/2 lots are to be developed within this basin.

Proposed Watershed Geometry:

Area of basin = 7.38 acres.
Proposed Structures = 7500 SF
Proposed Roadway Pavement = 0 SF
Proposed Gravel Drives = 12,016 SF
Proposed Patios = 2500 SF
Proposed Parking Pads = 1000 SF
Proposed Lawns = 15,000 SF
Area to be developed = 38,016 SF = 0.87 acres

Developed Runoff Coefficient =

$$\frac{(7,500 * 0.98) + (12,016 * 0.90) + (2,500 * 0.95) + (1000 * 0.98) + (15,000 * 0.40)}{38,016} =$$

Developed Runoff Coefficient, $C_d = 0.72$

Because the area to be developed is a relatively small percentage of the total sub-basin of where it is located, no retention is required as per Form 800 of the Vanderburgh County Drainage Ordinance. See attached Form 800 for Sub-basin "C".

NOTE: due to the fact that it is impossible to determine the exact limits and locations of all development, the total number of lots analyzed is 8 while the subdivision has only 7 lots.

Project: Alexander Estates II - Sub-basin A

Designer: Easley Engineering

Detention Facility Design Return Period: 25

Release Rate Return Period: 10

Watershed Area (Au): 13.15

Developed Area (Ad): 1.19

Time of Concentration: 36.6 Minutes

Rainfall Intensity: (i10) = 2.607

Undeveloped Runoff Coefficient (Cu) = 0.48

Undeveloped Runoff Rate (Q=(Cu)(iu)(A,,) = 16.455384

Developed Runoff Coefficient (CD)= 0.75

Storm Duration	Rainfall Intensity	Inflow Rate	Outflow Rate	Storage Rate	Required Storage
td (hrs)	Id (in./hr)	Cd*Id*AD (cfs)	Cu*iu*Au (cfs)	I(td)_O (cfs)	[I(td)-O td]/12 (acre-ft)
0.083	7.208	6.43314	16.455384	-10.022244	-0.06932052
0.167	5.925	5.2880625	16.455384	-11.1673215	-0.15541189
0.250	5.033	4.4919525	16.455384	-11.9634315	-0.24923816
0.500	3.646	3.254055	16.455384	-13.201329	-0.55005538
1.00	2.078	1.854615	16.455384	-14.600769	-1.21673075
2.00	1.400	1.2495	16.455384	-15.205884	-2.534314
3.00	1.019	0.9094575	16.455384	-15.5459265	-3.88648163
4.00	0.836	0.74613	16.455384	-15.709254	-5.236418
5.00	0.684	0.61047	16.455384	-15.844914	-6.6020475

Peak storage requirement = 0 acre-feet = 0 cubic feet of storage.

Project: Alexander Estates II - Sub-basin B

Designer: Easley Engineering

Detention Facility Design Return Period: 25

Release Rate Return Period: 10

Watershed Area (Au): 9.4869

Developed Area (Ad): 0.97

Time of Concentration: 28 Minutes

Rainfall Intensity: (i10) = 3.398

Undeveloped Runoff Coefficient (Cu) = 0.48

Undeveloped Runoff Rate (Q=(Cu)(iu)(A,,) = 15.47351338

Developed Runoff Coefficient (CD)= 0.75

Storm Duration	Rainfall Intensity	Inflow Rate	Outflow Rate	Storage Rate	Required Storage
td (hrs)	Id (in./hr)	CdIdAD (cfs)	CuiuAu (cfs)	I(td)_O (cfs)	[I(td)-O td]/12 (acre-ft)
0.083	7.208	5.24382	15.47351338	-10.22969338	-0.07075538
0.167	5.925	4.3104375	15.47351338	-11.16307588	-0.15535281
0.250	5.033	3.6615075	15.47351338	-11.81200588	-0.24608346
0.500	3.646	2.652465	15.47351338	-12.82104838	-0.53421035
1.00	2.078	1.511745	15.47351338	-13.96176838	-1.1634807
2.00	1.400	1.0185	15.47351338	-14.45501338	-2.4091689
3.00	1.019	0.7413225	15.47351338	-14.73219088	-3.68304772
4.00	0.836	0.60819	15.47351338	-14.86532338	-4.95510779
5.00	0.684	0.49761	15.47351338	-14.97590338	-6.23995974

Peak storage requirement = 0 acre-feet = 0 cubic feet of storage.

Project: Alexander Estates II - Sub-basin C

Designer: Easley Engineering

Detention Facility Design Return Period: 25

Release Rate Return Period: 10

Watershed Area (Au): 7.38

Developed Area (Ad): 0.8727

Time of Concentration: 21.4 Minutes

Rainfall Intensity: (iu) = 3.965"/hr

Undeveloped Runoff Coefficient (Cu) = 0.48

Undeveloped Runoff Rate (Q=(Cu)(iu)(A,,) = 14.045616

Developed Runoff Coefficient (CD)= 0.72

Storm Duration	Rainfall Intensity	Inflow Rate	Outflow Rate	Storage Rate	Required Storage
td (hrs)	ld (in./hr)	Cd*ldAD (cfs)	CuiuAu (cfs)	I(td)_O (cfs)	[I(td)-O td]/12 (acre-ft)
0.083	7.208	4.52910355	14.045616	-9.51651245	-0.06582254
0.167	5.925	3.7229382	14.045616	-10.3226778	-0.14365727
0.250	5.033	3.16245535	14.045616	-10.88316065	-0.22673251
0.500	3.646	2.29094222	14.045616	-11.75467378	-0.48977807
1.00	2.078	1.30569883	14.045616	-12.73991717	-1.06165976
2.00	1.400	0.8796816	14.045616	-13.1659344	-2.1943224
3.00	1.019	0.64028254	14.045616	-13.40533346	-3.35133336
4.00	0.836	0.52529558	14.045616	-13.52032042	-4.50677347
5.00	0.684	0.4297873	14.045616	-13.6158287	-5.67326196

Peak storage requirement = 0 acre-feet = 0 cubic feet of storage.