Fawn Creek

Drainage Study
for:
Leo's Place
Vanderburgh Co. Indiana

January 29, 2002

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Indiana Registration 12892

Prepared by:
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DRAINAGE CALCULATIONS FOR LEO'S SUBDIVISION
OUTER EICHOFF ROAD
VANDERBURGH COUNTY, INDIANA

SITE LOCATION:

The proposed site is located north of the existing Ashley Place Subdivision and east of Eichoff Road.

GENERAL NOTES:

This property has several unique features which include being bound by a railroad track to the north, an abandoned oil well on site, an oil pipe line which is located along the west line, an old unmarked cemetery and existing grades that approach 18%. This site has been reviewed previously by this office for a different developer. The present developer, Lou Sons Development, LLC, have embraced the limitations of this site and intends to incorporate them into the design which will result in a marked reduction in the required earthwork to provide build-able lots.

EXISTING CONDITIONS:

Previous Use: Agricultural and wooded.

Gross Area = 20.3 Acres

EXISTING DRAINAGE PATTERN:

By inspection of County Planametric maps, this area is part of an 84.07 acre watershed. 37.04 acres of this watershed is located north of the adjacent railroad tracks and enters onto the site via a 3' x 3' box. The remaining 47.03 acreage encompasses that area of the subdivision proper (24.46 acres) and that offsite area that enters the property by overland flow into a series of ditches and swales that then exits the property through a homemade steel 8' diameter culvert.

By examination of satellite photos of this area a more detailed breakdown of existing land use was possible then was previously submitted. Those land uses are as follows:

Existing Watershed Geometry:

Area: 84.1 Acres (gross)	
Existing Lakes = 2.2 acres	C = 1.0
Existing Structures = 0.70 acres	C= 0.98
Existing Residential Lawn and Landscape = 6.0 acres	C=0.15
Existing Roads and Drives = 1.8 acres	C=0.85
Existing Wooded areas = 23.5 (slopes of 5% to 10%)	C=0.36
Existing Agricultural = 49.9 acres (slopes of 2% to 5%)	C=0.35

All undeveloped runoff coefficients were taken from the Vanderburgh County Drainage Ordinance with the exception of the runoff coefficient for Roads and Drives. This area is a combination of surfaces including: asphalt roadways, concrete driveways, gravel driveways and gravel roads. It was thus determined to use a more conservative value of 0.85 for the runoff coefficient.

$$\frac{(2.2*1)+(0.7*0.98)+(6.0*0.15)+(1.8*0.85)+(23.5*0.36)+(49.9*0.35)}{84.1}$$

The Undeveloped Runoff Coefficient = 0.37

L = 4798 feet
H = 555 - 441 = 114 feet
t_c = 22.2 minutes as per attached nomograph

From the Rainfall Intensity as per Vanderburgh County Drainage Ordinance
i = 3.89"/hour for a 10 year storm, 4.36"/hr for a 25 year storm and 5.43"/hr for the 100 year storm.

Q for the 10 year storm = CiA = 0.37 * 3.89 * 84.1 = 121.05 CFS
Q for the 25 year Storm = CiA = 0.37 * 4.36 * 84.1 = 135.67 CFS
Q for the 100 year Storm = CiA = 0.37 * 5.43 * 84.1 = 168.96 CFS

OFFSITE RUNOFF ESTIMATION

AREA NORTH OF RAILROAD TRACKS

This area enters the site via a 3' x 3' box culvert at the northeast corner of the proposed sub.

Area of watershed = 37.04 Acres
Runoff coefficient = 0.37
Height of watershed = 83 feet
Length of watershed = 2,966 feet
Time of concentration derived from nomagraph = 14.5 minutes
Rainfall Intensity (25 year event) = 5.122"/hr
Q25 = 0.37 X 5.122 X 37.04 = 70.17 CFS

AREA EAST OF SITE - SOUTH OF RAILROAD TRACKS

This area enters the site via overland flow. It crosses beneath the existing oilfield road by an 18" CMP.

Area of watershed = 19.97 Acres
Runoff coefficient = 0.37
Height of watershed = 22 feet
Length of watershed = 1,674 feet
Time of concentration derived from nomagraph = 12.5 minutes
Rainfall Intensity (25 year event) = 5.479"/hr
Q25 = 0.37 X 5.479 X 19.97 = 40.48 CFS

AREA EAST OF SITE - LAKE WATERSHED

This area provides the watershed for the lake located directly to the east of the proposed subdivision.

Area of watershed = 156,158.5372 SF or 3.58 Acres
Roads and Gravel Drives = 2000 SF - C=0.70
Lake Area = 35,337 SF or 0.81 Acres - C=1.0

Green Area = 118,821.5372 SF of 2.73 Acres
Weighted runoff coefficient = 0.54
Kerby's N = 0.3056
Height of watershed = 50 feet
Length of watershed = 736 feet
Slope of watershed = 0.0679 ft/ft
Time of concentration derived from Kerby's Formula = 19.43 minutes
Rainfall Intensity (25 year event) = 4.623"/hr
Q25 = 0.54 X 4.623 X 3.58 = 8.94 CFS

AREA EAST OF SITE - SOUTH OF LAKE

This area enters the site via a swale and crosses under the old oilfield road by means of a 12" cmp.

Area of watershed = 2.00 Acres
Runoff coefficient = 0.37
Kerby's N = 0.20
Height of watershed = 41 feet
Length of watershed = 687 feet
Slope of watershed = 0.0597 ft/ft
Time of concentration derived from Kerby's Formula = 15.9 minutes
Rainfall Intensity (25 year event) = 4.950"/hr
Q25 = 0.37 X 4.950 X 2.0 = 3.66 CFS

There is an area of 2.7 acres that drains from the proposed site and into the existing Ashley Place Development. To assure that there is not difficulties arising from the development of this area, the proposed design incorporates the capture of vast majority this developed runoff and directs it away from the existing development.

There is also 0.85 acres that drains from Ashley Place into the proposed development. This water will flow overland into the proposed road and by means of inlets and culvert, re-enter the existing ditch.

PROPOSED WATERSHED GEOMETRY:

Total area = 24.46 Acres

New Structures = 63 lots x 2500 sf/ea = 157,000 SF = 3.6 acres	C=0.98
Private driveways = 63 lots x 12' x 35.5' = 26,838 SF = 0.62 acres	C=0.96
Patios and walks = 63 lots x 100sf/ea = 6,300 SF = 0.14 acres	C=0.92
Roadways = 123,832.8 SF = 2.84 acres	C=0.95
Sidewalks = 27,448.73 SF = 0.63 acres	C=0.95
Yard Area = 16.63 acres	C=0.40

Developed runoff coefficient =

$$\frac{(3.6*0.98)+(0.62*0.96)+(0.14*0.92)+(2.84*0.95)+(0.63*0.95)+(16.63*0.40)}{24.46}$$

Developed runoff coefficient = 0.58

SEE FORM 800 - ATTACHED TO THIS REPORT

Developed runoff associated with the proposed sub-drainage areas are attached to this report along with worksheets indicating the procedure for the sizing and design of the individual Storm Sewer Systems.

STORM WATER DETENTION AND RELEASE DESIGN:

The proposed retention facility must be able to allow the discharge of the undeveloped Q for the 10 year event (121.05 CFS) and yet "demonstrate clearly that the post development peak rate of storm water runoff during a twenty-five (25) year return period storm is controlled sufficiently so that it will not exceed the peak runoff rate from the same Project site in its pre development condition during a ten (10) year return period storm."

It is the developers desire to install a retention lake as indicated on the plans. This lake will be fed by the major ditch which drains the watershed. A three weir outlet structure is proposed. Due to the existing ditch location, the proposed lot configuration and the lake design location, 24.34 CFS (at the 25 year rate of flow) will bypass the lake and discharge into the ditch at various locations downstream from the proposed lake location. Flow rates associated with these storm sewer reaches are as follows:

SYSTEM	Q 25 YEAR	Q 100
Storm System # 110 - # 108	Q = 3.64 CFS	Q = 4.51 CFS
Storm System # 125 - # 134	Q = 7.32 CFS	Q = 9.06 CFS
Watershed Below Lake	Q = 8.34 CFS	Q = 10.31 CFS
Storm System # 105 - # 106	Q =5.04 CFS	Q = 6.13 CFS
TOTAL	Q = 24.34 CFS	Q = 30.01 CFS

Therefore, the allowable rate of release is equal to the rate of the 10 year undeveloped storm (121.05 CFS) minus the 25 year rate of those systems bypassing the detention facility (24.34 CFS) to provide a compensatory release rate equal to 96.71 CFS.

Detention will be provided by the creation of a new lake. This lake will be created by excavating along approximately 280 lineal feet of the existing ditch and installing an earthen dam at the west end as indicated on plans. The normal or low water elevation will be 452.80. The detention or high water elevation will be 454.00. This provides for 35,637.03 cubic feet of storage (35,508 required).

The outlet control for the proposed lake will be provided by a concrete weir box. This design has been used by this office successfully in Warrick County, Indiana at Copper Creek Subdivision on Bell Road, the conceptual design of which was reviewed and approved by Morley and Associates and Commonwealth Engineering This structure allows for 3 separate weirs to function along the sides of a square structure located within the lake. An outlet pipe than carries the weir discharge to an existing ditch or creek.

The required weir to pass the 10 year event must be capable of passing 96.71 CFS, as stated above. The outlet control structure will then have 3 weirs with a combined length of 30 feet. Normal or low water elevation has been set at 452.80 and an allowable head of 1.2 feet to prevent water from backing up into the storm water systems that will be discharging into the lake and providing the required storage volume. Therefore, the highwater, or detention elevation will be 452.8 + 1.2 = 454.00 A computer analysis of the proposed weir design is as follows:

WEIRS

Enter up to 10 weirs.
Enter <Return> only for flowrate and length to end.

FLOWRATE (CFS)	LENGTH (FT)	COEFF (-)	HEAD (FT)
32.24	9.3	2.630	1.20

Because the outlet control box will have three weirs, the total Q discharging through the box at that elevation (454.00) providing the required detention volume is equal to 3 * 32.24 or 96.71 CFS.

To assure that there is reasonable safety due to the anticipated flow into the lake the following analysis indicates that, if the weirs are unobstructed, the developed 100 year Q for the watershed and the developed site would also be retained and would pass via the weirs provided.

SYSTEM	Q 25 YEAR	Q 100
Storm System # 119 - # 111	Q = 130.05 CFS	Q = 160.58 CFS
Storm System # 117 - # 124	Q = 7.82 CFS	Q = 9.55 CFS
Lake Watershed	Q = 9.94 CFS	Q = 12.23 CFS
TOTAL	Q = 147.81 CFS	182.36 CFS

WEIRS

Enter up to 10 weirs.
Enter <Return> only for flowrate and length to end.

FLOWRATE (CFS)	LENGTH (FT)	COEFF (-)	HEAD (FT)
60.79	9.3	2.630	1.83

Therefore, the water elevation at the 100 year event is equal to 454.63 feet. In an effort to provide even additional storage, the top of the Outlet Control Box has been set at 455.13

In the event that the weirs were to become completely obstructed, the orifice created by the top of the outlet control box would also act as a weir with a total inside length = 4 * 12 = 48 feet minus the corner conflict lengths (equal to the head dimension) 8 * 1.39' = 42.44

WEIRS

Enter up to 10 weirs.
Enter <Return> only for flowrate and length to end.

FLOWRATE (CFS)	LENGTH (FT)	COEFF (-)	HEAD (FT)
182.36	42.3	2.630	1.39

Therefore, the if the Outlet Control Box top is allowed to pass the 100 year event, the high water elevation would be 455.13 + 1.39 = 456.52

The discharge pipe out of the Outlet Control Structure has been sized to pass the 100 year event based on the following:

SEWER PIPES

Enter up to 10 pipes.
Enter <Return> only for flowrate and diameter to end.

FLOWRATE (CFS)	DIAMETER (IN)	FRICTION (FT^1/6)	SLOPE (%)	VELOCITY (FPS)
182.36	48.00	0.0110	1.15	14.51

The elevation of the top of the dam has been set at 458.02 and an emergency spillway provided adjacent to the proposed outlet structure. The spillway will have a width of 52 feet and a head of 1.00 based on the following computer analysis:

WEIRS

Enter up to 10 weirs.
Enter <Return> only for flowrate and length to end.

FLOWRATE (CFS)	LENGTH (FT)	COEFF (-)	HEAD (FT)
182.36	51.4	3.550	1.00

From the above analysis, the emergency spillway elevation is set at 456.52 (the high water elevation if both the weirs and the top of the Outlet Control Box have become obstructed or if the outlet culvert from the Outlet Control box has become obstructed). The highwater elevation would then be 456.52 + 1 foot of head = 457.52. Providing 0.5 feet of freeboard, confirms the top of dam elevation of 458.02.

At the discharge end of the Outlet Control Culvert, Erosion Control Practice 3.41 (Rock Chute) shall be implemented to reduce discharge velocity and prevent erosion of stream. It is proposed to leave the remainder of the existing natural ditch in place with little or no disturbance to it between the lake and the new box culvert to minimize erosion that will occur should the stream be disturbed This ditch has an average bottom width of at least 4 feet and side slopes that average 1 to 1. The bottom of the ditch slopes at about 1%. An analysis of this natural waterway is as follows:

NATURAL CHANNELS

VARIABLES LIST:

Y - FLOW DEPTH   B - CHANNEL BOTTOM WIDTH   S - CHANNEL SLOPE
Q - FLOWRATE   M - CHANNEL SIDE SLOPE   N - CHANNEL ROUGHNESS

VARIABLE TO BE SOLVED (Y, Q, B, M, S OR N) ? Y

Q (CFS) ? 212.37
B (FT) ? 4
M (FT/FT) ? 1

RESULTS
================
Y= 3.89 FT

S (FT/FT) ? 0.0102	A= 30.72 SF
N (FT^1/6) ? 0.035	P= 15.01 FT
	V= 6.91 FPS

The depth of the existing ditch is 4 feet or greater throughout this section of channel and should be sufficient to accommodate the 100 year event.

The existing ditch will require a culvert from structure # 104 to structure # 107. Water to discharge through this culvert include that storm water entering into the lake by the two proposed storm water systems, the lake watershed, two storm water systems which discharge into the ditch below the lake and that portion of the watershed itself that is below the lake. Structures 105 and 106 will not add any significant amount of discharge into the culvert due to the time lag of the storm in comparison to the time of concentration for these two sub-watersheds, but are added into the total discharge to provide additional capacity and a measure of safety. The 25 and 100 year flows associated with the systems are as follows:

SYSTEM	Q 25 YEAR	Q 100
Storm System # 119 - # 111	Q = 130.05 CFS	Q = 160.58 CFS
Storm System # 117 - # 124	Q = 7.82 CFS	Q = 9.55 CFS
Lake Watershed	Q = 9.94 CFS	Q = 12.23 CFS
Storm System # 110 - # 108	Q = 3.64 CFS	Q = 4.51 CFS
Storm System # 125 - # 134	Q = 7.32 CFS	Q = 9.06 CFS
Watershed Below Lake	Q = 8.34 CFS	Q = 10.31 CFS
Storm System # 105 - # 106	Q =5.04 CFS	Q = 6.13 CFS

The sum of these discharges is 172.15 CFS for the 25 year event.

The sum of these discharges is 212.37 CFS for the 100 year event.

MAN-MADE CHANNELS

VARIABLES LIST:

Y - FLOW DEPTH　B - CHANNEL BOTTOM WIDTH　S - CHANNEL SLOPE
Q - FLOWRATE　M - CHANNEL SIDE SLOPE　N - CHANNEL ROUGHNESS

VARIABLE TO BE SOLVED (Y, Q, B, M, S OR N) ? Y

Q (CFS) ? 212.37	RESULTS
B (FT) ? 8	================
M (FT/FT) ? 0	Y= 3.06 FT
S (FT/FT) ? 0.00277	A= 24.47 SF
N (FT^1/6) ? 0.013	P= 14.12 FT
	V= 8.68 FPS
	F= 0.87 SUB-CRITICAL FLOW

Y (FT) ? 4	RESULTS
B (FT) ? 8	================
M (FT/FT) ? 0	Q= 305.98 CFS
S (FT/FT) ? 0.002777	A= 32.00 SF
N (FT^1/6) ? 0.013	P= 16.00 FT

V= 9.56 FPS
F= 0.84 SUB-CRITICAL FLOW

The above analysis indicates that a 4' x 8' concrete box culvert would be sufficient and would provide an additional 30.5% capacity over what is required to discharge the 100 year event.

OPEN CHANNEL ANALYSIS

There are several open channels, either existing or new, that require analysis to verify that the geometry of said channels are adequate.

LOT 20 - Off site discharge into new 48" RCP

Q 25 = 113.97 CFS

MAN-MADE CHANNEL

VARIABLES LIST:

Y - FLOW DEPTH B - CHANNEL BOTTOM WIDTH S - CHANNEL SLOPE
Q - FLOWRATE M - CHANNEL SIDE SLOPE N - CHANNEL ROUGHNESS

VARIABLE TO BE SOLVED (Y, Q, B, M, S OR N) ? Y

Q (CFS) ? 113.97
B (FT) ? 4
M (FT/FT) ? 3
S (FT/FT) ? 0.0651
N (FT^1/6) ? 0.035

RESULTS
================
Y = 1.39 FT
A = 11.38 SF
P = 12.80 FT
V = 10.01 FPS
F = 1.84 SUPER-CRITICAL FLOW

LOT 21-22 - Swale to discharge into area drain at structure 118

Existing ditch that drains lake watershed to east

Q 25 = 8.79 CFS

EXISTING CHANNEL

VARIABLES LIST:

Y - FLOW DEPTH B - CHANNEL BOTTOM WIDTH S - CHANNEL SLOPE
Q - FLOWRATE M - CHANNEL SIDE SLOPE N - CHANNEL ROUGHNESS

VARIABLE TO BE SOLVED (Y, Q, B, M, S OR N) ? Y

Q (CFS) ? 8.79
B (FT) ? 1.79
M (FT/FT) ? 1
S (FT/FT) ? 0.0644
N (FT^1/6) ? 0.035

RESULTS
================
Y = 0.69 FT
A = 1.46 SF
P = 3.51 FT
V = 6.01 FPS

F = 1.52 SUPER-CRITICAL FLOW

Area drain serving lot 31

Q = 0.86 CFS

MAN-MADE CHANNELS

VARIABLES LIST:

Y - FLOW DEPTH   B - CHANNEL BOTTOM WIDTH   S - CHANNEL SLOPE
Q - FLOWRATE   M - CHANNEL SIDE SLOPE   N - CHANNEL ROUGHNESS

VARIABLE TO BE SOLVED (Y, Q, B, M, S OR N) ? Y

Q (CFS) ? 0.86
B (FT) ? 1
M (FT/FT) ? 3
S (FT/FT) ? 0.0581
N (FT^1/6) ? 0.035

RESULTS
=================
Y = 0.20 FT
A = 0.31 SF
P = 2.24 FT
V = 2.75 FPS
F = 1.28 SUPER-CRITICAL FLOW

Cutoff Swale - Lots 51 - 53

This Swale is designed to prevent storm water runoff from draining onto and over lots 55 - 57. This area has been designated "sub-lake watershed"

Q 25 = 2.46 CFS

MAN-MADE CHANNELS

VARIABLES LIST:

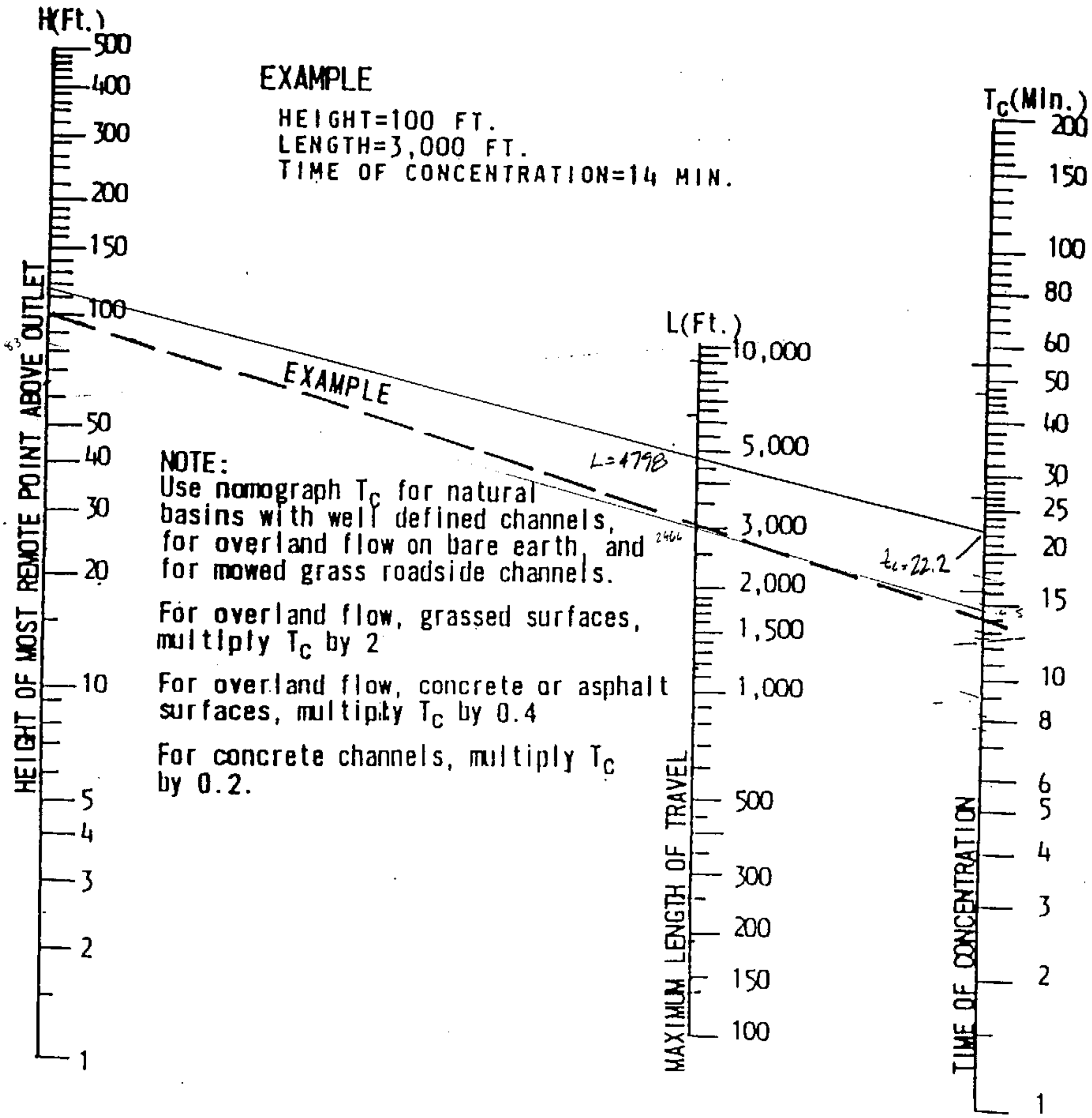
Y - FLOW DEPTH   B - CHANNEL BOTTOM WIDTH   S - CHANNEL SLOPE
Q - FLOWRATE   M - CHANNEL SIDE SLOPE   N - CHANNEL ROUGHNESS

VARIABLE TO BE SOLVED (Y, Q, B, M, S OR N) ? Y

Q (CFS) ? 2.46
B (FT) ? 1
M (FT/FT) ? 3
S (FT/FT) ? 0.0626
N (FT^1/6) ? 0.035

RESULTS
=================
Y = 0.33 FT
A = 0.65 SF
P = 3.07 FT
V = 3.78 FPS
F = 1.42 SUPER-CRITICAL FLOW

TOTAL WATERSHED

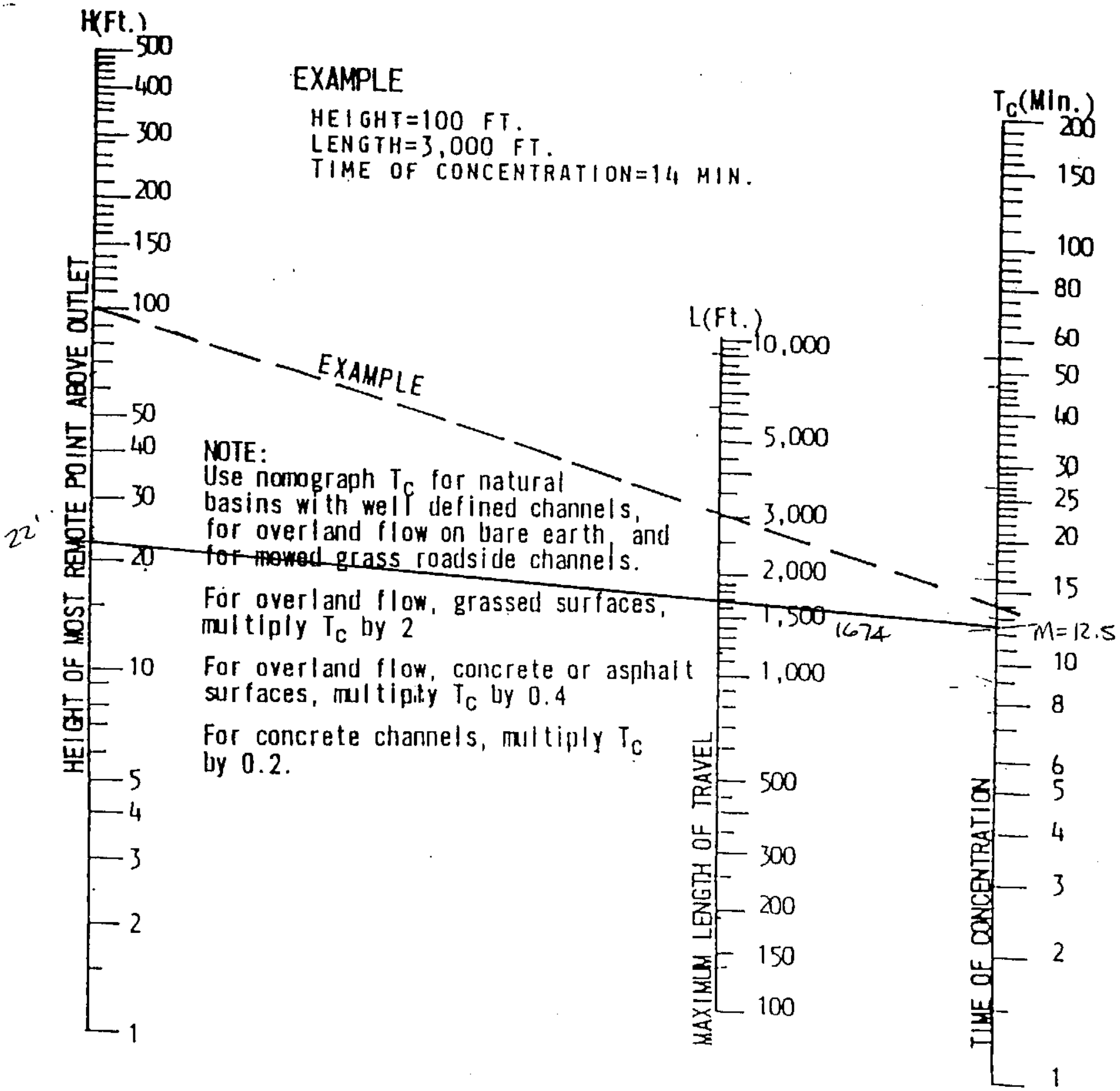


TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

FOR EXAMPLE: SEE 3) PAGE 41

FIG. 7-425.04 A

AREA EAST OF SITE -
SOUTH OF RR TRACKS

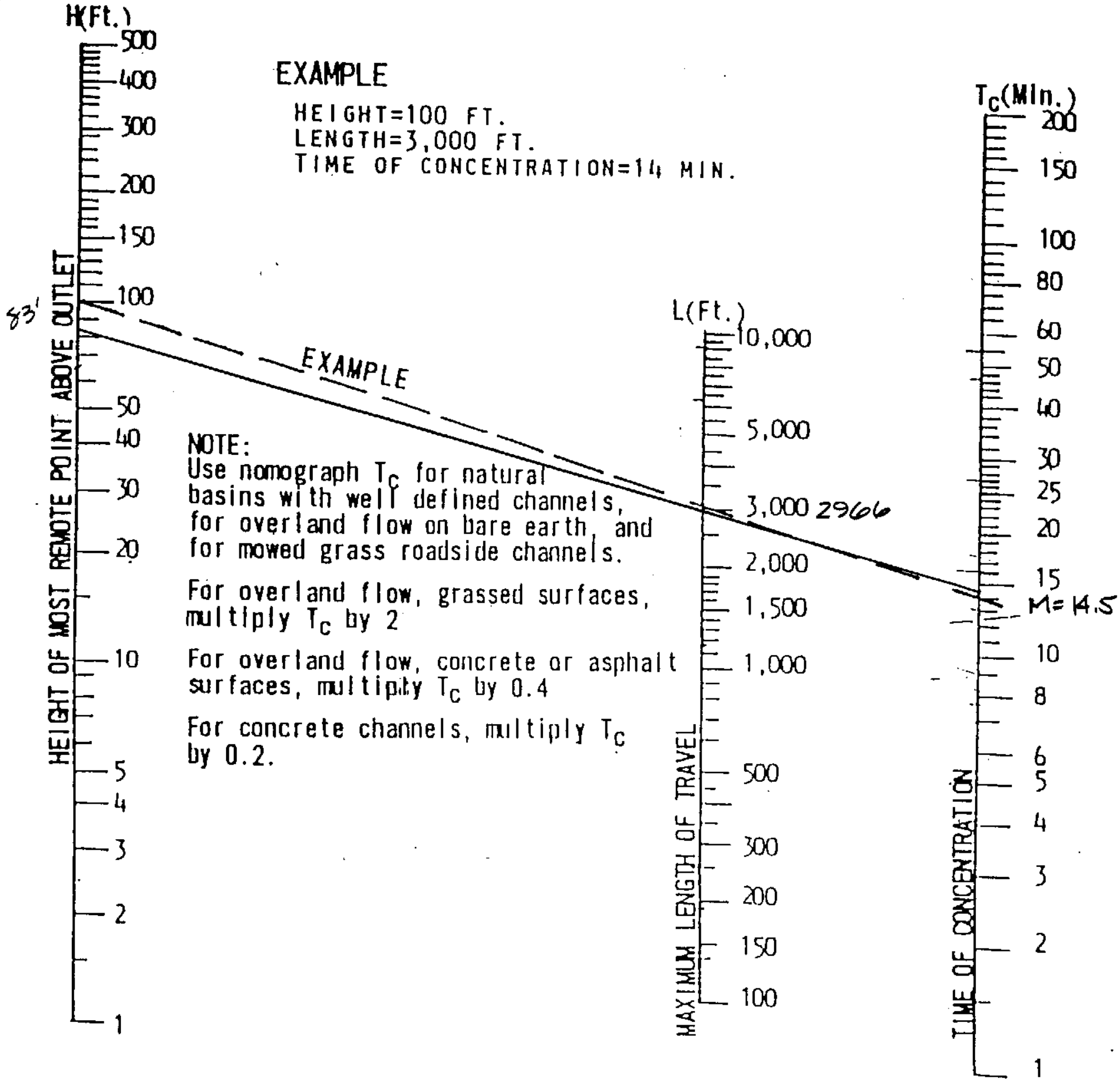


TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

FOR EXAMPLE: SEE 3) PAGE 41

FIG. 7-425.04 A

AREA NORTH OF RR TRACKS



TIME OF CONCENTRATION OF SMALL DRAINAGE BASINS

FOR EXAMPLE: SEE 3) PAGE 41

FIG. 7-425.04 A

J

Project: LOU SUBDIVISION

Designer: Easley Engineering

Detention Facility Design Return Period: 25 YEAR

Release Rate Return Period: 10 YEAR

Watershed Area: 24.46

Time of Concentration'. 22.2 minutes

Rainfall Intensity: (i,,) = 3.89

Undeveloped Runoff Coefficient (Cu) = 0.37

Undeveloped Runoff Rate (Q=(Cu)(iu)(A,,) = 35.205278

Developed Runoff Coefficient (CD)= 0.58

Storm Duration	Rainfall Intensity	Inflow Rate	Outflow Rate	Storage Rate	Required Storage
td (hrs)	Id (in./hr)	Cd'idAD (cfs)	CuiuAu (cfs)	I(td)_O (cfs)	[I(td)-0 td}/12 (acre-ft)
.170	5.925	84.05679	35.205278	48.851512	0.69206309
.33	4.571	64.8478628	35.205278	29.6425848	0.81517108
.50	3.646	51.7250728	35.205278	16.5197948	0.68832478
.67	3.123	44.3053764	35.205278	9.1000984	0.50808883
.83	2.601	36.8998668	35.205278	1.6945888	0.11720906
1	2.078	29.4801704	35.205278	-5.7251076	-0.4770923
1.5	1.739	24.6708452	35.205278	-10.5344328	-1.3168041
2	1.40	19.86152	35.205278	-15.343758	-2.557293
3	1.019	14.4563492	35.205278	-20.7489288	-5.1872322

Peak storage requirement = 0.81517108 acre-feet = 35,508.85 cubic feet of storage.

PROJECT LEO'S PLACE SUBDIVISION DATE 1/11/02 SHEET 5 OF ____

ENGINEER Andy Easley Engineering, Inc. DESIGN STORM 25 YEAR MANNINGS n 0.013

LINE #	Upstream Manhole	Dwnstream Manhole	Length (ft)	Cj	Aj (Acres)	CjAj	$\sum C_jA_j$	tj (min)	tcum min.	I "/hr	Q (cfs)	Pipe Diameter inches	Pipe slope (%)	Pipe capacity (cfs)	Velocity (ft/sec)	Travel Time (min)	Rim Elevation Upstream	Rim Elevation Downstream	Invert Elevation Upstream	Invert Elevation Downstream	Pipe Cover Upstream	Pipe Cover Downstream
1	2	1	4	5	6	7	8	9	10	10	12	13	14	15	16	17	18	19	20	21	22	23
1	101	102	29	0.61	0.68	0.4148	0.41	15.38	15.38	5.00	2.06	12	0.86	3.30	3.74	0.129	447.52	447.52	445.27	445.02	1.0	1..0
2	102	103	30.29	.79	.17	0.13	0.5491	9.42	15.51	5.0	2.74	15	9.97	20.40	10.06	0.050	447.52	444.50	445.02	442.0	1	1.0

Figure 7.2.1
Storm Sewer Design Sheet - Rational Method

PROJECT Leo's Place Subdivision DATE 1/14/02 SHEET ______ OF ______

ENGINEER Andy Easley Engineering, Inc. DESIGN STORM 25 YEAR MANNINGS n 0.013

LINE #	Upstream Manhole	Dwnstream Manhole	Length (ft)	Cj	Aj (Acres)	CjAj	$\sum C_jA_j$	tj (min)	tcum min.	I "/hr	Q (cfs)	Pipe Diameter inches	Pipe slope (%)	Pipe capacity (cfs)	Velocity (ft/sec)	Travel Time (min)	Rim Elevation Upstream	Rim Elevation Downstream	Invert Elevation Upstream	Invert Elevation Downstream	Pipe Cover Upstream	Pipe Cover Downstream
1	2	1	4	5	6	7	8	9	10	10	12	13	14	15	16	17	18	19	20	21	22	23
3	104	105	20.5								172.15	4 x 8	2.77	305.98	8.68	0.0393	451.00	451.57	444.99	444.42	1.76	2.9
4	105	106	29.0	0.88	0.35	0.31	0.308	8.40	8.40	6.34	178.49	4 x 8	2.77	305.98	8.68	0.0556	451.57	451.57	444.42	443.62	2.9	3.7
5	106	107	22.5	0.51	1.27	0.6477	0.9557	18.25	18.25	4.73	176.67	4 x 8	2.77	305.98	8.68	0.0432	451.57	449.00	443.62	443.00	3.7	1.0

Figure 7.2.1
Storm Sewer Design Sheet - Rational Method

PROJECT LEO'S PLACE SUBDIVISION DATE 1/3/02 SHEET 4 OF ____

ENGINEER Andy Easley Engineering, Inc. DESIGN STORM 25 YEAR MANNINGS n 0.013

LINE #	Upstream Manhole	Dwnstream Manhole	Length (ft)	Cj	Aj (Acres)	CjAj	$\sum C_jA_j$	tj (min)	tcum min.	I "/hr	Q (cfs)	Pipe Diameter inches	Pipe slope (%)	Pipe capacity (cfs)	Velocity (ft/sec)	Travel Time (min)	Rim Elevation Upstream	Rim Elevation Downstream	Invert Elevation Upstream	Invert Elevation Downstream	Pipe Cover Upstream	Pipe Cover Downstream
1	2	1	4	5	6	7	8	9	10	10	12	13	14	15	16	17	18	19	20	21	22	23
6	110	109	29	0.46	1.39	0.6394	0.64	17.36	17.36	4.814	3.07	15	1.0	6.46	4.37	0.111	456.07	456.07	453.57	453.28	1	1.29
7	109	108	117.14	0.79	0.15	0.12	0.76	11.31	17.47	4.805	3.64	15	2.80	10.81	6.71	0.291	456.07	453.00	453.28	450	1.29	1.50
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Figure 7.2.1
Storm Sewer Design Sheet - Rational Method

PROJECT LEO'S PLACE SUBDIVISION DATE 1/2/02 SHEET 1 OF

ENGINEER Andy Easley Engineering, Inc. DESIGN STORM 25 YEAR MANNINGS n 0.013

LINE #	Upstream Manhole	Downstream Manhole	Length (ft)	Cj	Aj (Acres)	CjAj	$\sum CjAj$	tj (min)	tcum min.	I "/hr	Q (cfs)	Pipe Diameter inches	Pipe slope (%)	Pipe capacity (cfs)	Velocity (ft/sec)	Travel Time (min)	Rim Elevation Upstream	Rim Elevation Downstream	Invert Elevation Upstream	Invert Elevation Downstream	Pipe Cover Upstream	Pipe Cover Downstream
1	2	1	4	5	6	7	8	9	10	10	12	13	14	15	16	17	18	19	20	21	22	23
Off	Site	N of	RR	0.38	37.04	14.0752	14.07	14.5	14.5	5.122	72.09											
Off	Site	E of	Sub.	0.38	19.97	7.5886	7.59	12.50	12.5	5.479	41.58											
8	119	118	255				21.66	14.5	14.5	5.122	110.96	48	1.81	193.25	13.39	0.3174	469.78	464.88	464.00	459.38	1.53	-105.46
Off	Site	Lake		0.38	3.58	1.3604	23.02	15.9	15.9	4.950	113.97											-113.97
9	118	117	25.89	0.44	0.461	0.2028	23.23	12.80	15.9	4.950	114.99	48	1.25	160.60	11.76	0.0366	464.88	465.38	459.38	459.06	1.25	2.07
																0						
Off	Site	Swale	East	0.38	2.00	0.76	23.987	15.9	15.9	4.950	3.76					0						
10	117	116	31.34	0.45	1.60	0.72	24.707	17.50	17.50	4.802	118.6	48	1.25	160.60	11.85	0.044	465.38	465.38	459.06	458.67	2.07	-111.89
11	116	115	35.15	0.68	0.29	0.1972	24.9042	12.23	17.50	4.802	119.59	48	1.25	160.60	11.87	0.049	465.38	465.19	458.67	458.23		
12	115	112	247.06	*	*	*	24.90	*	17.50	4.802	119.59	48	1.25	160.60	11.87	0.347	465.19	460.40	458.23	455.15		
13	114	113	29.00	0.43	3.681	1.58283	1.583	20.87	20.87	4.490	7.07	18	1.50	12.87	6.27	0	458.73	458.73	455.98	455.54	1.00	1.44
14	113	112	21.49	0.52	1.154	0.60008	2.183	13.26	20.94	4.490	9.80	18	1.84	14.25	7.34	0.049	458.73	460.40	455.54	455.15	1.44	3.50
15	112	111	43.24	*	*	0	27.08	*	17.50	4.802	130.05	48	1.25	160.60	12.12	0.059	460.40	459.34	455.15	454.09	1.0	1.0

Figure 7.2.1
Storm Sewer Design Sheet - Rational Method

PROJECT LEO'S PLACE SUBDIVISION DATE 1/3/02 SHEET 2 OF

ENGINEER Andy Easley Engineering, Inc. DESIGN STORM 25 YEAR MANNINGS n 0.013

LINE #	Upstream Manhole	Downstream Manhole	Length (ft)	Cj	Aj (Acres)	CjAj	ΣCjAj	tj (min)	tcum min.	I "/hr	Q (cfs)	Pipe Diameter inches	Pipe slope (%)	Pipe capacity (cfs)	Velocity (ft/sec)	Travel Time (min)	Rim Elevation Upstream	Rim Elevation Downstream	Invert Elevation Upstream	Invert Elevation Downstream	Pipe Cover Upstream	Pipe Cover Downstream
1	2	1	4	5	6	7	8	9	10	10	12	13	14	15	16	17	18	19	20	21	22	23
16	117A	117B	143.59	0.38	2.0	0.76	0.76	15.9	15.9	4.950	3.76	15	1.15	6.93	4.85	0.4934	484.00	484.00	481.25	479.60	1.25	2.9
17	117B	120	210.63	*	*	0.00	0.76	15.9	16.4	4.950	3.76	15	1.22	7.14	4.85	0.7238	484.00	479.53	479.60	477.03	2.9	1.0
							0.76									0						
19	121	122	49.00	0.57	0.44	0.2508	0.251	10.06	10.06	5.914	1.49	12	1.43	4.26	4.17	0.196	479.53	480.31	477.28	476.58	1	2.48
																0						
18	120	122	44.16	0.55	0.82	0.451	1.21	12.38	16.4	4.950	5.99	15	1.02	6.52	5.20	0.141	479.53	480.31	477.03	476.58	1	2.23
					*	0		*								0						
20	122	123	242.50	0.88	0.13	0.1144	1.58	5.517	16.4	4.950	7.82	15	8.29	18.60	[redacted]	0.331	480.31	459.23	476.58	456.48	2.23	1.25
21	123	124	24.75	*	*	0	1.58	*	16.4	4.950	7.82	15	10.01	20.43	[redacted]	0.034	459.23	456.50	456.48	454.00	1.25	1.0
							1.5762									0						
							1.5762									0						
							1.5762									0						
							1.5762									0						
							1.5762									0						

Figure 7.2.1
Storm Sewer Design Sheet - Rational Method

PROJECT LEO'S PLACE SUBDIVISION DATE 1/3/02 SHEET 3 OF

ENGINEER Andy Easley Engineering, Inc. DESIGN STORM 25 YEAR MANNINGS n 0.013

LINE #	Upstream Manhole	Downstream Manhole	Length (ft)	Cj	Aj (Acres)	CjAj	ΣCjAj	tj (min)	tcum min.	I "/hr	Q (cfs)	Pipe Diameter inches	Pipe slope (%)	Pipe capacity (cfs)	Velocity (ft/sec)	Travel Time (min)	Rim Elevation Upstream	Rim Elevation Downstream	Invert Elevation Upstream	Invert Elevation Downstream	Pipe Cover Upstream	Pipe Cover Downstream
1	2	1	4	5	6	7	8	9	10	10	12	13	14	15	16	17	18	19	20	21	22	23
22	125	126	77.18	0.40	.43	0.172	0.17	15.45	15.45	4.991	0.86	12	0.44	2.36	2.34	0.550	472.27	472.16	470.02	469.68	1	1.23
23	126	127	200.29	0.58	.43	0.25	0.4214	12.02	16.0	4.991	2.10	12	0.44	2.36	2.92	1.143	472.16	481.44	469.68	468.80	1.23	11.14
24	127	128	97.81	0.42	.29	0.1218	0.5432	12.02	17.14	4.839	2.63	15	0.32	3.65	2.74	0.595	481.44	475.76	468.80	468.49	11.14	5.77
25	128	129	29.03	0.51	.37	0.1887	0.7319	13.85	17.74	4.784	3.50	18	0.25	5.25	2.69	0.180	475.76	475.76	468.49	468.14	5.52	6.12
26	129	130	142.02	0.79	0.11	0.0869	0.8188	8.35	17.92	4.775	3.91	18	1.89	14.4	5.89	0.402	475.76	468.72	468.14	466.46	5.87	0.76
27	130	131	209.35	0.48	.48	0.2304	1.0492	12.84	18.32	4.732	4.96	21	0.21	7.26	2.74	1.273	468.72	475.53	466.46	463.97	0.26	10.06
28	131	132	39.34	0.46	.23	0.1058	1.155	16.05	19.59	4.669	5.393	21	0.21	7.26	2.8	0.234	475.53	471.33	463.97	463.51	9.56	6.32
29	132	133	30.15	0.78	.27	0.2106	1.3656	13.18	19.83	4.659	6.36	24	0.18	9.60	2.76	0.182	471.33	471.04	463.51	463.15	5.57	6.39
30	133	134	187.01	0.87	.24	0.2088	1.5744	10.16	20.01	4.650	7.32	24	9.31	69.03	12.54	0.248	471.04	451.00	463.15	447.75	5.64	1.75

Figure 7.2.1
Storm Sewer Design Sheet - Rational Method

PROJECT Leo's Place Subdivision DATE January 30, 2002 SHEET ______ OF ______

ENGINEER Andy Easley Engineering, Inc. DESIGN STORM 25 YEAR MANNINGS n 0.013

LINE #	Upstream Manhole	Downstream Manhole	Length (ft)	Cj	Aj (Acres)	CjAj	$\sum C_jA_j$	tj (min)	tcum min.	I "/hr	Q (cfs)	Pipe Diameter inches	Pipe slope (%)	Pipe capacity (cfs)	Velocity (ft/sec)	Travel Time (min)	Rim Elevation Upstream	Rim Elevation Downstream	Invert Elevation Upstream	Invert Elevation Downstream	Pipe Cover Upstream	Pipe Cover Downstream
1	2	1	4	5	6	7	8	9	10	10	12	13	14	15	16	17	18	19	20	21	22	23
32	502	501	37.98	0.45	1.72	0.774	0.77	22.65	22.65	4.326	3.39	15	0.32	3.65	2.92	0.2167	441.80	442.75	438.55	438.43	1.75	2.82
31	501	500	19.03	0.73	0.23	0.17	0.9419	5.174	22.65	4.326	4.075	15	4.40	13.55	8.18	0.0387	442.75	439.50	438.43	437.59	2.82	0.50

Figure 7.2.1
Storm Sewer Design Sheet - Rational Method

SUBDRAINAGE AREA 101

AREA 29629.2318

Houses	0	C= 0	n= 0
Patios & Walks	0	C= 0	n= 0
Roads	9066.58	C= .95	n= .02
Sidewalks	2063.2	C= .95	n= .02
Greenspace	18499.4518	C= .40	n= .40

Cd 0.60659932

nd 0.25725865

Length of watershed (L) 477.34

Height of watershed (H) 26.28

Slope of watershed (H/L)= 0.06

$t_c = 0.827\{(n*L)/\sqrt{S}\}^{0.467} = 15.38$

i_{25} 5.00

Q=ciA= 2.06

SUBDRAINAGE AREA 102

AREA 7216.77

		C=	n=
Houses	0	0	0
Patios & Walks	0	0	0
Roads	4750.86	0.95	.02
Sidewalks	895.56	0.95	.02
Greenspace	1570.35	0.25	.40

Cd 0.79768186

nd 0.10268699

Length of watershed (L) 216.96

Height of watershed (H) 3.05

Slope of watershed (H/L)= 0.01

$tc = 0.827\{(n*L)/\sqrt{S}\}^{0.467} =$ 9.42

i_{25} 6.07

Q=ciA= 0.80

SUBDRAINAGE AREA 105

AREA 15366.24

Houses	0	C= 0	n= 0
Patios & Walks	0	C= 0	n= 0
Roads	11256.65	C= 0.95	n= 0.02
Sidewalks	2717.48	C= 0.95	n= 0.02
Greenspace	1392.11	C= 0.15	n= 0.40

Cd 0.88

nd 0.05

Length of watershed (L) 362.46

Height of watershed (H) 5.81

Slope of watershed (H/L)= 0.02

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 8.40

i_{25} 6.34

Q=ciA= 1.96

SUBDRAINAGE AREA 106

AREA 55262.21

Houses	10,000	C= 0.95	n= 0.02
Patios & Walks	2104	C= 0.95	n= 0.02
Roads	6868.03	C= 0.95	n= 0.02
Sidewalks	1826.87	C= 0.95	n= 0.02
Greenspace	34463.31	C= 0.25	n= 0.40

Cd 0.51

nd 0.26

Length of watershed (L) 550.25

Height of watershed (H) 19.81

Slope of watershed (H/L)= 0.04

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$= 18.25

i_{25} 4.73

Q=ciA= 3.08

SUBDRAINAGE AREA 109

AREA 6569.8654

Houses	0	C=0	n=0
Patios & Walks		C=0	n=0
Roads	4631.62	C=0.95	n=0.02
Sidewalks	649.70	C=0.95	n=0.02
Greenspace	1288.5454	C=0.15	n=0.40

Cd 0.79

nd 0.09

Length of watershed (L) 340.25

Height of watershed (H) 4.34

Slope of watershed (H/L)= 0.01

$t_c = 0.827\{(n*L)/\sqrt{S}\}^{0.467} = 11.319$

i_{25} 4.798

Q=ciA= 0.57

SUBDRAINAGE AREA 110

AREA 60517.06

Houses 10000 C= 0.95 n= 0.02

Patios & Walks 2104 C= 0.95 n= 0.02

Roads 4627.99 C= 0.95 n= 0.02

Sidewalks 1285.85 C= 0.95 n= 0.02

Greenspace 42499.22 C= 0.25 n= 0.40

Cd 0.46

nd 0.29

Length of watershed (L) 452.29

Height of watershed (H) 16.93

Slope of watershed (H/L)= 0.04

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$= 17.365

i_{25} 4.814

Q=ciA= 3.07

SUBDRAINAGE AREA 113

AREA 50277.1041

Houses	7500	C= 0.95	n= 0.02
Patios & Walks	1578	C= 0.95	n= 0.02
Roads	8284.6397	C= 0.95	n= 0.02
Sidewalks	2052.1316	C= 0.95	n= 0.02
Greenspace	30862.3328	C= 0.25	n= 0.40

Cd 0.52

nd 0.25

Length of watershed (L) 377.67

Height of watershed (H) 23.27

Slope of watershed (H/L)= 0.06

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 13.258

i_{25} 5.344

Q=ciA= 3.21

SUBDRAINAGE AREA 114

AREA 160351.2286

Houses	22500	C=0.95	n=0.02
Patios & Walks	4734	C=0.95	n=0.02
Roads	10919.27	C=0.95	n=0.02
Sidewalks	2597.69	C=0.95	n=0.02
Greenspace	119600.2686	C=0.25	n=0.40

Cd 0.43

nd 0.30

Length of watershed (L) 639.45

Height of watershed (H) 23.27

Slope of watershed (H/L)= 0.04

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$= 20.876

i_{25} 4.490

Q=ciA= 7.07

SUBDRAINAGE AREA 116

AREA 12479.7116

Houses	0	C= 0	n= 0
Patios & Walks	0	C= 0	n= 0
Roads	5064.2287	C= 0.95	n= 0.02
Sidewalks	1357.0503	C= 0.95	n= 0.02
Greenspace	6058.4326	C= 0.40	n= 0.40

Cd 0.6829956

nd 0.20447577

Length of watershed (L) 362.59

Height of watershed (H) 19.43

Slope of watershed (H/L)= 0.05

tc= $0.827\{(n^*L)/\sqrt{S}\}^{0.467}$ = 12.23

i_{25} 5.527

Q=ciA= 1.08

SUBDRAINAGE AREA 117

AREA 69904.2824

Houses	11250	C= 0.95	n= 0.02
Patios & Walks	2367	C= 0.95	n= 0.02
Roads	5271.7201	C= 0.95	n= 0.02
Sidewalks	1522.04	C= 0.95	n= 0.02
Greenspace	49493.5223	C= 0.25	n= 0.40

Cd 0.45438708

nd 0.28904701

Length of watershed (L) 526.09

Height of watershed (H) 25.6

Slope of watershed (H/L)= 0.05

$t_c = 0.827\{(n*L)/\sqrt{S}\}^{0.467} =$ 17.50

i_{25} 4.802

Q=ciA= 3.50

SUBDRAINAGE AREA 118

AREA 20061.1368

Houses	1250	C= 0.95	n= 0.02
Patios & Walks	263	C= 0.95	n= 0.02
Roads	0	C= 0	n= 0
Sidewalks	0	C= 0	n= 0
Greenspace	18548.1368	C= 0.40	n= 0.40

Cd 0.4414807

nd 0.37134061

Length of watershed (L) 281.07

Height of watershed (H) 24.5

Slope of watershed (H/L)= 0.09

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$= 12.80

i_{25} 4.866

Q=ciA= 0.99

SUBDRAINAGE AREA 120

AREA 35650.4240

Houses	6250	C= 0.95	n= 0.02
Patios & Walks	1315	C= 0.95	n= 0.02
Roads	6535.3818	C= 0.95	n= 0.02
Sidewalks	1392.6207	C= 0.95	n= 0.02
Greenspace	20157.4215	C= 0.25	n= 0.40

Cd 0.55420681

nd 0.23485916

Length of watershed (L) 281.96

Height of watershed (H) 11.47

Slope of watershed (H/L)= 0.04

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 12.376

i_{25} 5.501

Q=ciA= 2.50

SUBDRAINAGE AREA 121

AREA 19165.8307

Houses 1250 C= 0.95 n= 0.02

Patios & Walks 263 C= 0.95 n= 0.02

Roads 6142.7947 C= 0.95 n= 0.02

Sidewalks 1223.8574 C= 0.95 n= 0.02

Greenspace 10286.1786 C= 0.25 n= 0.40

Cd 0.57431448

nd 0.22394357

Length of watershed (L) 201.96

Height of watershed (H) 9.3

Slope of watershed (H/L)= 0.05

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 10.063

i_{25} 5.914

Q=ciA= 1.49

SUBDRAINAGE AREA 122

AREA 5524.6094

Houses	0	C= 0	n= 0
Patios & Walks	0	C= 0	n= 0
Roads	3942.6858	C= 0.95	n= 0.02
Sidewalks	1044.6876	C= 0.95	n= 0.02
Greenspace	537.236	C= 0.25	n= 0.40

Cd 0.88192909

nd 0.05695278

Length of watershed (L) 171.25

Height of watershed (H) 4.8

Slope of watershed (H/L)= 0.03

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 5.517

i_{25} 7.075

Q=ciA= 0.79

SUBDRAINAGE AREA 125

AREA 18827.6232

Houses	0	C= 0	n= 0
Patios & Walks	0	C= 0	n= 0
Roads	0	C= 0	n= 0
Sidewalks	0	C= 0	n= 0
Greenspace	18827.6232	C= 0.40	n= 0.40

Cd 0.4

nd 0.4

Length of watershed (L) 318.32

Height of watershed (H) 18.5

Slope of watershed (H/L)= 0.06

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$= 15.45

i_{25} 4.991

Q=ciA= 0.86

SUBDRAINAGE AREA 126

AREA 18866.2050

Houses	5000	C= 0.95	n= 0.02
Patios & Walks	1052	C= 0.95	n= 0.02
Roads	0	C= 0	n= 0
Sidewalks	0	C= 0	n= 0
Greenspace	12814.205	C= 0.40	n= 0.40

Cd 0.57643188

nd 0.27810161

Length of watershed (L) 278.22

Height of watershed (H) 17.5

Slope of watershed (H/L)= 0.06

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 12.02

i_{25} 5.565

Q=ciA= 1.39

SUBDRAINAGE AREA 127

AREA 12448.1011

Houses	2500	C= 0.95	n= 0.02
Patios & Walks	526	C= 0.95	n= 0.02
Roads	0	C= 0	n= 0
Sidewalks	0	C= 0	n= 0
Greenspace	9422.1011	C= 0.25	n= 0.40

Cd 0.4201625

nd 0.30762607

Length of watershed (L) 165.76

Height of watershed (H) 4.5

Slope of watershed (H/L)= 0.03

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$= 12.029

i_{25} 5.563

Q=ciA= 0.67

SUBDRAINAGE AREA 128

AREA 15906.9709

Houses	1250	C= 0.95	n= 0.02
Patios & Walks	263	C= 0.95	n= 0.02
Roads	3504.9452	C= 0.95	n= 0.02
Sidewalks	878.7813	C= 0.95	n= 0.02
Greenspace	10010.2444	C= 0.25	n= 0.40

Cd 0.50949055

nd 0.2591337

Length of watershed (L) 304.17

Height of watershed (H) 10.79

Slope of watershed (H/L)= 0.04

$t_c = 0.827\{(n*L)/\sqrt{S}\}^{0.467} =$ 13.85

i_{25} 5.238

Q=ciA= 0.97

SUBDRAINAGE AREA 129

AREA 4909.2411

Houses	0	C=0	n=0
Patios & Walks	0	C=0	n=0
Roads	3051.2970	C=0.95	n=0.02
Sidewalks	724.3109	C=0.95	n=0.02
Greenspace	1133.6332	C=0.25	n=0.40

Cd 0.78835725

nd 0.10774892

Length of watershed (L) 233.11

Height of watershed (H) 7.37

Slope of watershed (H/L)= 0.03

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 8.347

i_{25} 6.349

Q=ciA= 0.56

SUBDRAINAGE AREA 130

AREA 21062.8359

Houses	2500	C= 0.95	n= 0.02
Patios & Walks	526	C= 0.95	n= 0.02
Roads	0	C= 0	n= 0
Sidewalks	0	C= 0	n= 0
Greenspace	18036.8359	C= 0.40	n= 0.40

Cd 0.47901595

nd 0.34540716

Length of watershed (L) 245.87

Height of watershed (H) 14

Slope of watershed (H/L)= 0.06

$t_c = 0.827\{(n*L)/\sqrt{S}\}^{0.467} =$ 12.845

i_{25} 5.417

Q=ciA= 1.25

SUBDRAINAGE AREA 131

AREA 10127.0239

Houses	2500	C= 0.95	n= 0.02
Patios & Walks	526	C= 0.95	n= 0.02
Roads	0	C= 0	n= 0
Sidewalks	0	C= 0	n= 0
Greenspace	7101.0239	C= 0.25	n= 0.40

Cd 0.45916313

nd 0.2864543

Length of watershed (L) 288.92

Height of watershed (H) 6

Slope of watershed (H/L)= 0.02

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 16.05

i_{25} 4.936

Q=ciA= 0.53

SUBDRAINAGE AREA 132

AREA 11746.0358

Houses	0	C= 0	n= 0
Patios & Walks	0	C= 0	n= 0
Roads	7062.4956	C= 0.95	n= 0.02
Sidewalks	1774.3994	C= 0.95	n= 0.02
Greenspace	2909.1408	C= 0.25	n= 0.40

Cd 0.77663099

nd 0.1141146

Length of watershed (L) 495.82
Height of watershed (H) 11.25
Slope of watershed (H/L)= 0.02

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 13.18

i_{25} 5.358

Q=ciA= 1.12

SUBDRAINAGE AREA 133

AREA 10355.4694

Houses	0	C= 0	n= 0
Patios & Walks	0	C= 0	n= 0
Roads	7264.0899	C= 0.95	n= 0.02
Sidewalks	1980.9779	C= 0.95	n= 0.02
Greenspace	1110.4016	C= 0.25	n= 0.40

Cd 0.87494004

nd 0.06074684

Length of watershed (L) 529.03

Height of watershed (H) 11.78

Slope of watershed (H/L)= 0.02

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 10.16

i_{25} 5.896

Q=ciA= 1.23

SUBDRAINAGE AREA 501

AREA 9876.3457

Houses	0	C= 0	n= 0
Patios & Walks	0	C= 0	n= 0
Roads	6795.72	C= 0.95	n= 0.02
Sidewalks	0	C= 0	n= 0
Greenspace	3080.6257	C= 0.25	n= 0.40

Cd 0.73165629

nd 0.13852944

Length of watershed (L) 519

Height of watershed (H) 14.5

Slope of watershed (H/L)= 0.03

tc= $0.827\{(n^*L)/\sqrt{S}\}^{0.467}$ = 5.174

i_{25} 6.983

Q=ciA= 1.16

SUBDRAINAGE AREA 502

AREA 74996.2034

Houses	8000	C= 0.95	n= 0.02
Patios & Walks	2104.00	C= 0.95	n= 0.02
Roads	13011.03	C= 0.95	n= 0.02
Sidewalks	2406.0	C= 0.95	n= 0.02
Greenspace	49475.1734	C= 0.20	n= 0.40

Cd 0.45522322

nd 0.2706869

Length of watershed (L) 638.6

Height of watershed (H) 13.20

Slope of watershed (H/L)= 0.02

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$= 22.65

i_{25} 4.326

Q=ciA= 3.39

SUBDRAINAGE AREA WATERSHED BELOW LAKE

AREA 139,970.6049

Houses 30000 C= 0.95 n= 0.02
Patios & Walks 6,312.00 C= 0.95 n= 0.02
Roads 0 C= 0 n= 0
Sidewalks 0 C= 0 n= 0
Greenspace 103658.6049 C= 0.40 n= 0.40

Cd 0.54268424

nd 0.30141816

Length of watershed (L) 559.7559
Height of watershed (H) 32
Slope of watershed (H/L)= 0.06

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 17.69

i_{25} 4.784

Q=ciA= 8.34

SUBDRAINAGE AREA NEW LAKE WATERSHED

AREA 141285.0709

Houses	17,500	C= 0.95	n= 0.02
Patios & Walks	3682	C= 0.95	n= 0.02
Roads	0	C= 0	n= 0
Water surface	31815	C= 1.0	n= 0.0
Greenspace	88288.0709	C= .40	n= .40

Cd 0.61756793

nd 0.25295573

Length of watershed (L) 511

Height of watershed (H) 28

Slope of watershed (H/L)= 0.05

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 15.77

i_{25} 4.962

Q=ciA= 9.94

SUBDRAINAGE AREA SUB-LAKE WATERSHED

AREA 40823.6581

Houses 7500.00 C=0.95 n=0.02
Patios & Walks 1578.00 C=0.95 n=0.02
Roads 0 C=0 n=0
Sidewalks 0 C=0 n=0
Greenspace 31745.6581 C=0.40 n=0.40

Cd 0.52230408

nd 0.315499

Length of watershed (L) 399.33
Height of watershed (H) 25
Slope of watershed (H/L)= 0.06

tc= $0.827\{(n*L)/\sqrt{S}\}^{0.467}$ = 15.11

i_{25} 5.033

Q=ciA= 2.46