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W.O. 0421

August 24, 2007

RECEIVED

SEP 1 2 2007

Preliminary Drainage Study

CITY OF SANTA BARBARA
PLANNING DIVISION

Site: 210 Meigs Road
Santa Barbara, CA

Evaluation Requirements: Planning requires the evaluation of Pre and Post development drainage flows anticipated for a 25 year frequency storm. The proposed development will be required to retain the difference between the pre and post development flows on-site so there is no additional drainage flow to the existing public drainage facilities.

Site: The proposed site will have five lots serviced by a road and cul-de-sac. The site breaks down as follows:

Figure 1 – Drainage Areas

Site	Area (sf)	Area (Ac)
Lot 1	8,179	0.19
Lot 2	7,821	0.18
Lot 3	8,451	0.19
Lot 4	8,268	0.19
Lot 5	10,859	0.25
Street	7,154	0.16
Total	**50,732**	**1.16**

Evaluate Pre-Development Flow: The County of Santa Barbara Flood Control method of hydrology calculations will be used to estimate runoff from the proposed development site.

To calculate this Figure 2 – Time of Concentration will be used estimate the time of concentration for the site. The site has 20' of fall over 440' of travel length. From Figure 2, the Time of Concentration Tc = 2.6 seconds. The County method uses a minimum Time of Concentration of 12 minutes. A **Tc = 12** minutes will be used for this evalution.

Based on a Time of Concentration of 12 minutes, the rainfall intensity for a 25 year frequency storm is estimated from Figure 3 – Rainfall Intensity for the South Coast. Rainfall Intensity

EXHIBIT M

$$i = 3.17 \text{ inches/hour}$$

The pre-development runoff coefficient is estimated from Figure 4 – Runoff Coefficient, using the value for "south coast agriculture". From the graph,

$$C = 0.68$$

Using the rational method to estimate runoff flow of Q = CiA the following table estimate the flow for each lot and total flow from the development.

Figure 6 – Pre-development Runoff

Site	Runoff Coeff.	Rainfall Intensity	Area (Ac)	Runoff Q (cfs)
Lot 1	0.68	3.17	0.19	0.409
Lot 2	0.68	3.17	0.18	0.388
Lot 3	0.68	3.17	0.19	0.409
Lot 4	0.68	3.17	0.19	0.409
Lot 5	0.68	3.17	0.25	0.539
Street	0.68	3.17	0.16	0.345
Total	~	~	1.16	2.499

Evaluate Post-Development Flow: The County of Santa Barbara Flood Control method of hydrology calculations will be used to estimate runoff from the proposed development site.

To calculate this Figure 2 – Time of Concentration will be used estimate the time of concentration for the site. The site has 20' of fall over 440' of travel length. From Figure 2, the Time of Concentration Tc = 2.6 seconds. The County method uses a minimum Time of Concentration of 12 minutes. A **Tc = 12** minutes will be used for this evalution.

Based on a Time of Concentration of 12 minutes, the rainfall intensity for a 25 year frequency storm is estimated from Figure 3 – Rainfall Intensity for the South Coast. Rainfall Intensity

$$i = 3.17 \text{ inches/hour}$$

The post-development runoff coefficient is estimated from Figure 4 – Runoff Coefficient, using the value for "south coast single family". From the graph,

$$C = 0.72$$

Using the rational method to estimate runoff flow of Q = CiA the following table estimate the flow for each lot and total flow from the development.

Figure 7 – Post-development Runoff

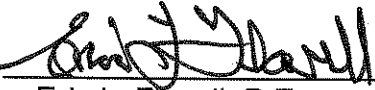| Site	Runoff Coeff.	Rainfall Intensity	Area (Ac)	Runoff Q (cfs)
Lot 1	0.72	3.17	0.19	0.434
Lot 2	0.72	3.17	0.18	0.411
Lot 3	0.72	3.17	0.19	0.434
Lot 4	0.72	3.17	0.19	0.434
Lot 5	0.72	3.17	0.25	0.571
Street	0.72	3.17	0.16	0.365
Total	~	~	1.16	2.649

On-site Retention: The City requires that this project retain the difference of the pre-development flow and the post-development flow on site. Estimate the required volume of storage required on-site to meet this requirement. The difference in flow is:

$$Q \text{ post} - Q \text{ pre} = Q \text{ ret}$$

$$2.649 \text{ cfs} - 2.499 \text{ cfs} = 0.15 \text{ cfs}$$

Estimate the volume of storage required to reduce the offsite flow to pre-development condition. Required storage is estimated in Figure 8 – Retention Storage Volume and based on that figure is estimated at 243 cubic feet. **V = 243 cubic feet.** This volume can be accommodated with a 3 foot diameter pipe 35 feet long or an open basin of equivalent volume plus free board.

Sincerely,
FLOWERS & ASSOCIATES, INC.
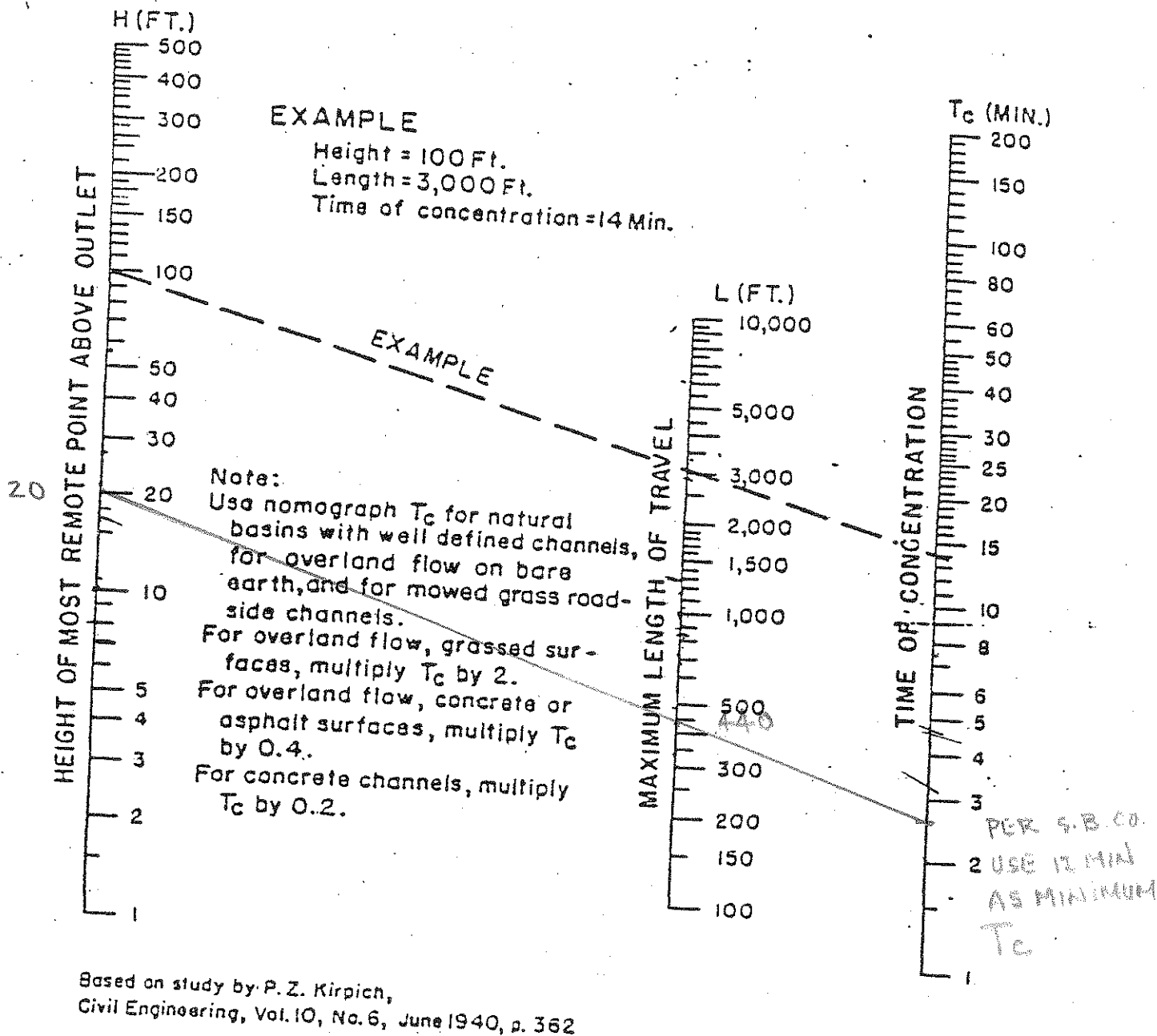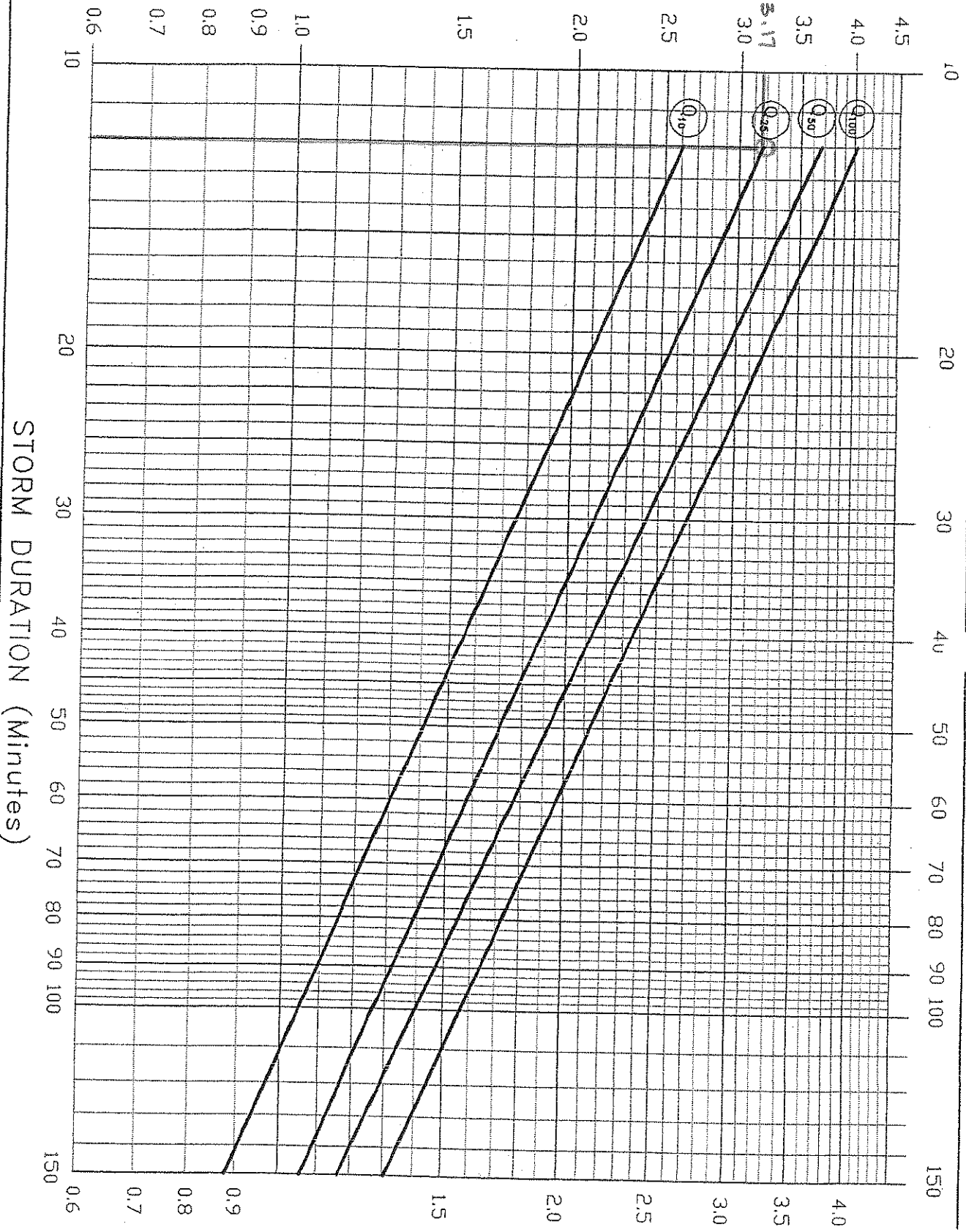
By: _____
Eric L. Flavell, P.E.
Vice President

REGISTERED PROFESSIONAL ENGINEER
ERIC L. FLAVELL
NO. 33000
Exp. 6-30-08
CIVIL
STATE OF CALIFORNIA

0421DrainageStudy_20070824.doc

H (FT.)

500
400
300
200
150
100

EXAMPLE
Height = 100 Ft.
Length = 3,000 Ft.
Time of concentration = 14 Min.

EXAMPLE

HEIGHT OF MOST REMOTE POINT ABOVE OUTLET

50
40
30
20

10

5
4
3
2
1

Note:
Use nomograph T_c for natural basins with well defined channels, for overland flow on bare earth, and for mowed grass roadside channels.
For overland flow, grassed surfaces, multiply T_c by 2.
For overland flow, concrete or asphalt surfaces, multiply T_c by 0.4.
For concrete channels, multiply T_c by 0.2.

L (FT.)

10,000

5,000

3,000

2,000

1,500

1,000

MAXIMUM LENGTH OF TRAVEL

500

300

200

150

100

T_c (MIN.)

200

150

100
80

60
50
40

30
25
20

15

10
8

6
5

4

3

TIME OF CONCENTRATION

2

1

PER S.B. CO.
USE 12 MIN
AS MINIMUM
T_c

Based on study by P. Z. Kirpich,
Civil Engineering, Vol. 10, No. 6, June 1940, p. 362

Fig. I-4 — Time of concentration of small drainage basins.

FIGURE 2 - TIME OF CONCENTRATION

RAINFALL INTENSITY-DURATION CURVES

SANTA BARBARA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

Feb. 25, 2004

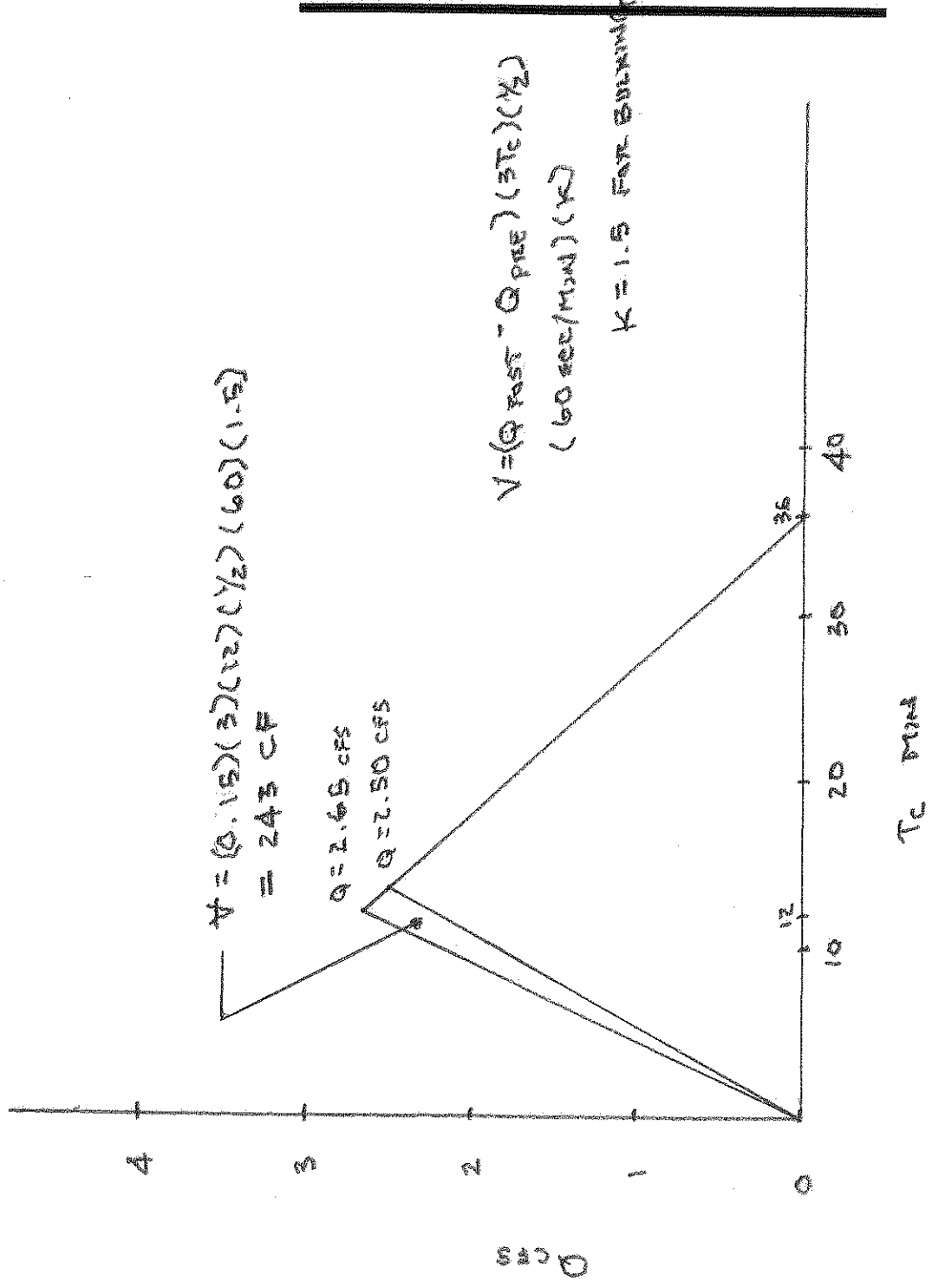SHEET 5 OF 6

Approved by:

FLOOD CONTROL DISTRICT / DATE

South Coast

FIGURE 3 - RAINFALL INTENSITY

LEGEND

①	COMMERCIAL
②	SOUTH COAST SINGLE FAMILY*
③	NORTH COUNTY SINGLE FAMILY,* SOUTH COAST AGRICULTURE
④	NORTH COUNTY AGRICULTURE

* Single family lots with an average of 10,000 sq. ft. or more, interpolate between Single Family and Agriculture.
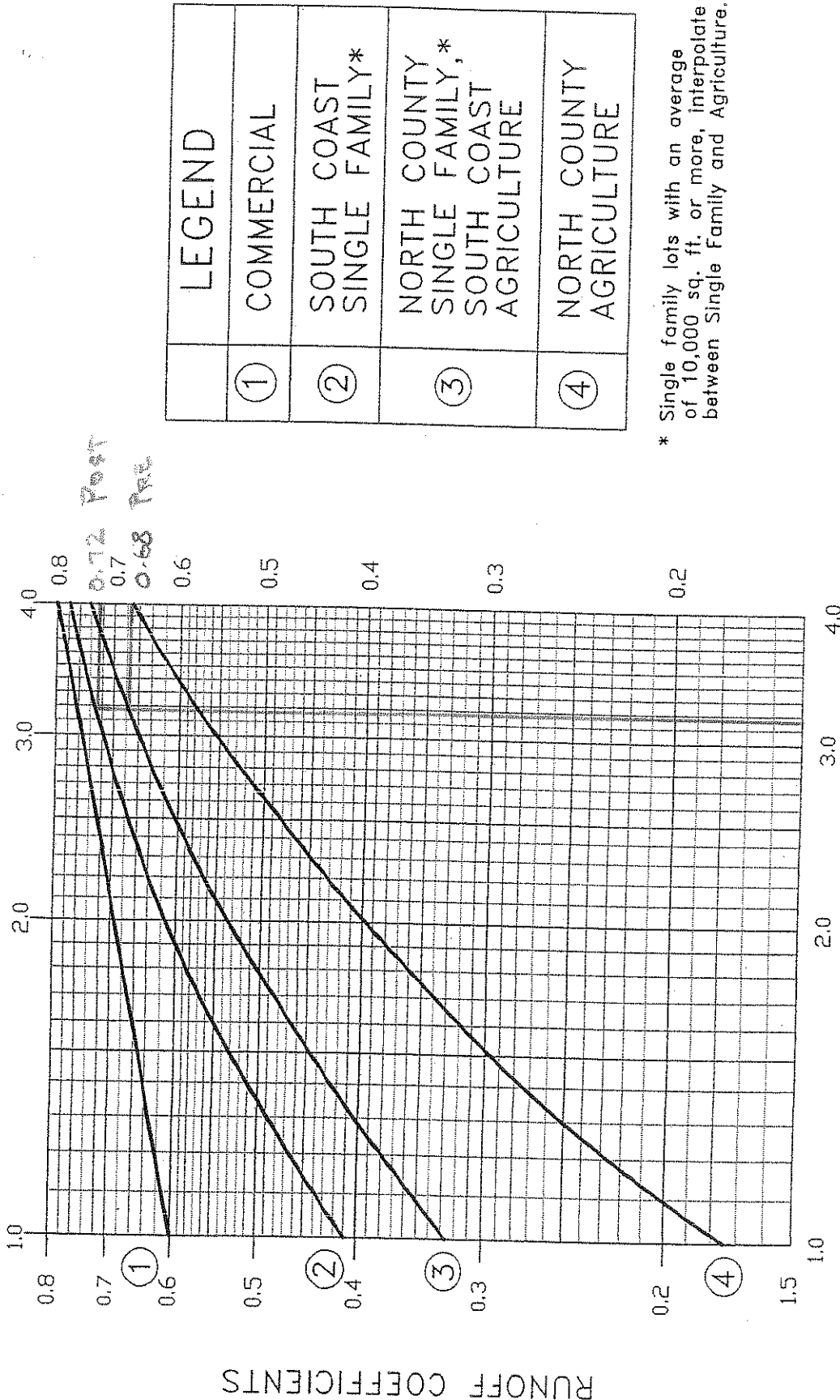
RUNOFF COEFFICIENTS

RAINFALL INTENSITY
(inches per hour)

0.72 Post
0.68 Pre

FIGURE 1 - RUNOFF COEFFICIENT

By ELF
Date 8/24/07
Chkd. By _____
Date _____

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W.O. # 0421
Ref. METERS ER
_____
Sht. 1 of 1

$$V = (Q_{POST} - Q_{PRE})(3T_C)(\tfrac{1}{2})$$
$$(60 \text{ sec}/\text{min})(K)$$
$$K = 1.5 \text{ FAT. BUILDING}$$

$$\forall = (0.15)(3)(12)(\tfrac{1}{2})(60)(1.5)$$
$$= 243 \text{ CF}$$

$$Q = 2.65 \text{ CFS}$$
$$Q = 2.50 \text{ CFS}$$

Q cfs

Tc min

RETENTION STORAGE VOLUME

FIGURE 8

SITE

MEIGS RD

LOT 1

LOT 2

LOT 3

LOT 4

LOT 5