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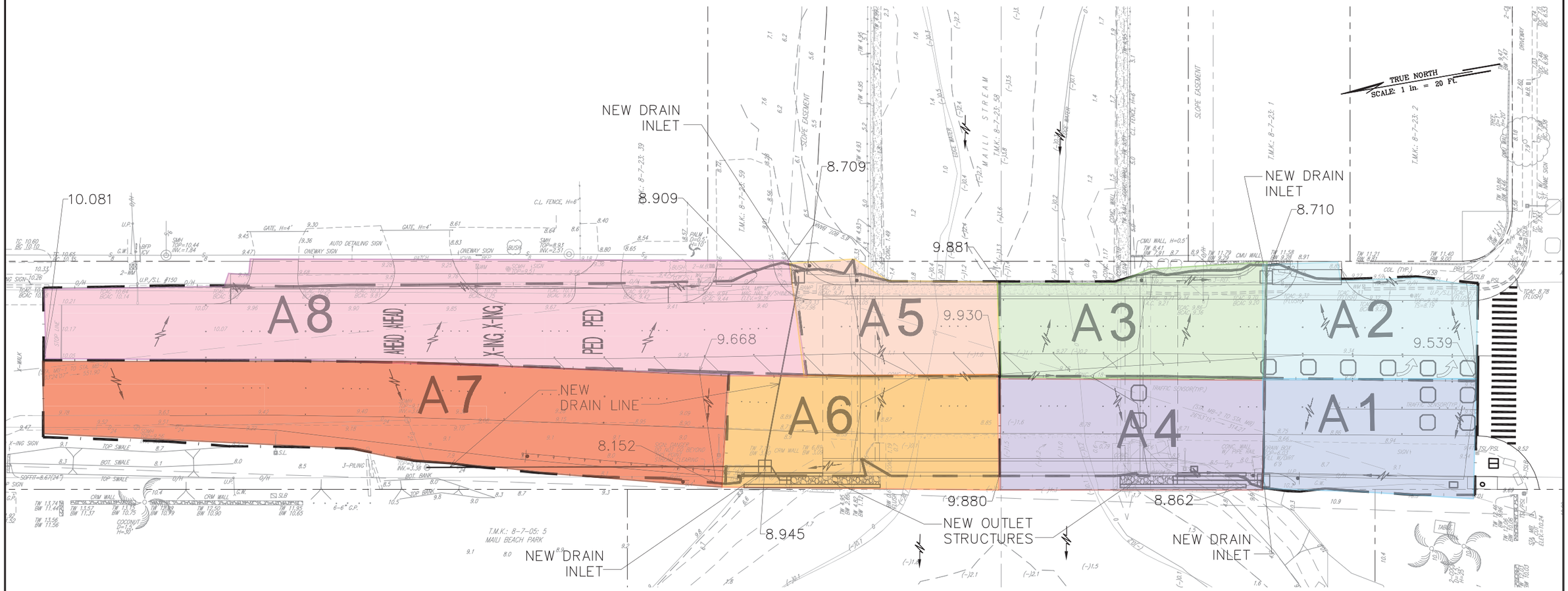
Project Managers, Planners, & Engineers
American Council of Engineering Companies, Member

Farrington Highway: Replacement of Maipalaoa Bridge
CWB-NOI CBMP Plan

Attachment A.2
Item 1.6a – Quantity of Storm Sewer

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
OAHU	HAW.				



LEGEND:

DIRECTION OF FLOW

DRAIN AREA BOUNDARY

9.00 — ELEVATION CALLOUT

GRAPHIC SCALE:

20' 10' 0 20' 40'

SCALE: 1" = 20'

SURVEY PLOTTED BY	
DRAWN BY	
TRACED BY	
DESIGNED BY	
QUANTITIES BY	
CHECKED BY	
DATE	
ORIGINAL PLAN	
NOTE BOOK	
No.	

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

DEVELOPED DRAINAGE

FARRINGTON HIGHWAY
REPLACEMENT OF MAIPALAOA BRIDGE
FEDERAL AID PROJECT NO. BR-093-1(21)

Scale:AS NOTED Date:

SHEET No. OF SHEETS

NOAA Atlas 14, Volume 4, Version 2
Location name: Waianae, Hawaii, US*
Coordinates: 21.4099, -158.1702
Elevation: 7 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

S. Perica, D. Martin, B. Lin, T. Parzybok, D. Riley, M. Yekta, L. Hiner, L.-C. Chen, D. Brewer, F. Yan, K. Maitaria, C. Trypaluk, G. M. Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.278** (0.244-0.316)	**0.368** (0.327-0.422)	**0.483** (0.425-0.555)	**0.571** (0.498-0.660)	**0.692** (0.594-0.807)	**0.785** (0.661-0.921)	**0.880** (0.724-1.04)	**0.978** (0.784-1.17)	**1.11** (0.851-1.35)	**1.21** (0.895-1.49)
10-min	**0.380** (0.334-0.433)	**0.504** (0.448-0.579)	**0.661** (0.582-0.760)	**0.782** (0.682-0.905)	**0.947** (0.813-1.11)	**1.08** (0.906-1.26)	**1.21** (0.992-1.43)	**1.34** (1.07-1.60)	**1.52** (1.17-1.85)	**1.66** (1.23-2.04)
15-min	**0.476** (0.418-0.542)	**0.631** (0.561-0.724)	**0.827** (0.729-0.951)	**0.979** (0.853-1.13)	**1.19** (1.02-1.38)	**1.35** (1.13-1.58)	**1.51** (1.24-1.79)	**1.68** (1.34-2.01)	**1.90** (1.46-2.31)	**2.08** (1.53-2.56)
30-min	**0.705** (0.620-0.802)	**0.934** (0.831-1.07)	**1.23** (1.08-1.41)	**1.45** (1.26-1.68)	**1.75** (1.51-2.05)	**1.99** (1.68-2.34)	**2.23** (1.84-2.65)	**2.48** (1.99-2.97)	**2.82** (2.16-3.42)	**3.08** (2.27-3.78)
60-min	**1.02** (0.894-1.16)	**1.35** (1.20-1.55)	**1.77** (1.56-2.03)	**2.09** (1.82-2.42)	**2.53** (2.17-2.96)	**2.88** (2.42-3.38)	**3.23** (2.65-3.82)	**3.58** (2.87-4.29)	**4.06** (3.12-4.94)	**4.44** (3.28-5.46)
2-hr	**1.38** (1.20-1.56)	**1.81** (1.60-2.07)	**2.38** (2.09-2.74)	**2.82** (2.46-3.27)	**3.43** (2.93-4.00)	**3.89** (3.27-4.57)	**4.37** (3.58-5.18)	**4.85** (3.88-5.81)	**5.50** (4.22-6.71)	**6.02** (4.44-7.42)
3-hr	**1.55** (1.36-1.76)	**2.08** (1.85-2.39)	**2.76** (2.43-3.18)	**3.29** (2.86-3.80)	**4.00** (3.41-4.65)	**4.54** (3.81-5.33)	**5.10** (4.18-6.03)	**5.67** (4.52-6.78)	**6.44** (4.91-7.80)	**7.03** (5.16-8.64)
6-hr	**1.98** (1.72-2.26)	**2.65** (2.35-3.04)	**3.55** (3.12-4.09)	**4.25** (3.70-4.91)	**5.18** (4.42-6.04)	**5.90** (4.94-6.92)	**6.62** (5.42-7.83)	**7.37** (5.86-8.80)	**8.36** (6.36-10.1)	**9.12** (6.68-11.2)
12-hr	**2.43** (2.09-2.78)	**3.28** (2.90-3.78)	**4.46** (3.92-5.16)	**5.39** (4.68-6.25)	**6.64** (5.67-7.75)	**7.62** (6.38-8.96)	**8.62** (7.05-10.2)	**9.65** (7.67-11.5)	**11.0** (8.40-13.4)	**12.1** (8.87-14.9)
24-hr	**2.84** (2.43-3.32)	**3.92** (3.35-4.58)	**5.42** (4.62-6.34)	**6.61** (5.61-7.75)	**8.26** (6.95-9.73)	**9.57** (7.99-11.3)	**10.9** (9.03-13.0)	**12.3** (10.1-14.8)	**14.3** (11.5-17.3)	**15.9** (12.6-19.4)
2-day	**3.35** (2.81-3.96)	**4.70** (3.95-5.55)	**6.62** (5.54-7.84)	**8.16** (6.80-9.70)	**10.3** (8.54-12.4)	**12.1** (9.91-14.5)	**13.9** (11.3-16.8)	**15.9** (12.8-19.4)	**18.7** (14.7-23.0)	**20.9** (16.2-25.9)
3-day	**3.69** (3.12-4.34)	**5.20** (4.40-6.13)	**7.36** (6.19-8.68)	**9.09** (7.62-10.8)	**11.5** (9.59-13.7)	**13.5** (11.1-16.1)	**15.6** (12.7-18.7)	**17.8** (14.4-21.5)	**20.9** (16.6-25.6)	**23.4** (18.3-28.9)
4-day	**4.04** (3.42-4.73)	**5.71** (4.85-6.70)	**8.10** (6.85-9.52)	**10.0** (8.44-11.8)	**12.7** (10.6-15.1)	**14.9** (12.4-17.8)	**17.2** (14.1-20.6)	**19.6** (16.0-23.7)	**23.1** (18.4-28.2)	**25.8** (20.3-31.8)
7-day	**4.62** (3.93-5.41)	**6.54** (5.56-7.67)	**9.28** (7.87-10.9)	**11.5** (9.70-13.5)	**14.6** (12.2-17.3)	**17.2** (14.3-20.4)	**19.8** (16.3-23.8)	**22.7** (18.5-27.4)	**26.7** (21.4-32.6)	**30.0** (23.6-37.0)
10-day	**4.98** (4.23-5.83)	**7.06** (5.99-8.25)	**10.0** (8.48-11.7)	**12.4** (10.5-14.6)	**15.8** (13.2-18.7)	**18.6** (15.4-22.1)	**21.5** (17.6-25.7)	**24.6** (20.0-29.6)	**29.0** (23.2-35.3)	**32.6** (25.6-40.1)
20-day	**5.73** (4.88-6.72)	**8.14** (6.91-9.52)	**11.6** (9.78-13.5)	**14.3** (12.1-16.8)	**18.3** (15.3-21.6)	**21.5** (17.8-25.5)	**24.9** (20.4-29.7)	**28.5** (23.2-34.3)	**33.7** (26.9-41.0)	**37.9** (29.8-46.5)
30-day	**6.72** (5.72-7.88)	**9.52** (8.08-11.1)	**13.4** (11.3-15.7)	**16.5** (13.9-19.4)	**20.7** (17.3-24.5)	**24.1** (20.0-28.7)	**27.7** (22.7-33.0)	**31.4** (25.5-37.7)	**36.5** (29.1-44.4)	**40.6** (31.9-49.8)
45-day	**7.93** (6.76-9.27)	**11.2** (9.51-13.0)	**15.6** (13.2-18.2)	**18.9** (16.0-22.2)	**23.5** (19.7-27.8)	**27.1** (22.5-32.1)	**30.7** (25.2-36.6)	**34.3** (28.0-41.3)	**39.3** (31.5-47.8)	**43.1** (34.0-52.9)
60-day	**8.97** (7.65-10.5)	**12.5** (10.7-14.6)	**17.2** (14.6-20.2)	**20.8** (17.6-24.4)	**25.5** (21.4-30.1)	**29.1** (24.2-34.6)	**32.7** (27.0-39.1)	**36.4** (29.6-43.7)	**41.2** (32.9-50.1)	**44.8** (35.3-55.0)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Replacement of Maipalaoa Bridge (10 YR)

Location	Drainage Area ac	Longest Distance ft	Elevation High ft	Elevation Low ft	Average Slope ft/ft	Time of Conc min	Correction Factor	Rainfall Inten-10y in/hr	Runoff Coeff.	Q 10-yr cfs	Notes:
1	0.0883	120	9.8	8.9	0.82%	10.0	2.3	2.09	0.82	0.3475	
2	0.0803	123	9.8	8.8	0.88%	10.0	2.3	2.09	0.95	0.3644	
3	0.0987	126	9.8	8.8	0.78%	10.0	2.3	2.09	0.95	0.4478	Includes bridge surface flow
4	0.0974	134	10.0	8.8	0.83%	10.0	2.3	2.09	0.95	0.4420	Includes bridge surface flow
5	0.1010	117	10.0	8.9	0.91%	10.0	2.3	2.09	0.95	0.4584	Includes bridge surface flow
6	0.0725	106	10.0	8.9	1.02%	10.0	2.3	2.09	0.95	0.3290	Includes bridge surface flow
7	0.2390	45	9.8	8.6	2.66%	10.0	2.3	2.09	0.86	0.9821	Includes bridge surface flow
8	0.2280	315	10.8	8.9	0.59%	10.0	2.3	2.09	0.94	1.0226	
TOTAL	**1.0052**									**4.394**	

Drainage Area = Area of subbasin (acre)
Longest Distance = Longest travel path of water runoff in subbasin (feet)
Elevation High = Highest elevation point in subbasin (feet)
Elevation Low = Lowest elevation point in subbasin (feet)
Slope (S) = Average slope in subbasin determined from high/low elevation and longest distance (feet/feet)
Time of Concentration (Tc) = Based on Plate 3 or Plate 5
Correction Factor = Based on Plate 4
Rainfall Intensity (I) = Point precipitation frequency estimates, NOAA (2.53 inches)
Runoff Coefficient (C) = Based on surface type, referenced "Hydraulic Engineering" text by Roberson, Cassidy, Chaudhry
Discharge (Q) = Based on rational method (cfs)

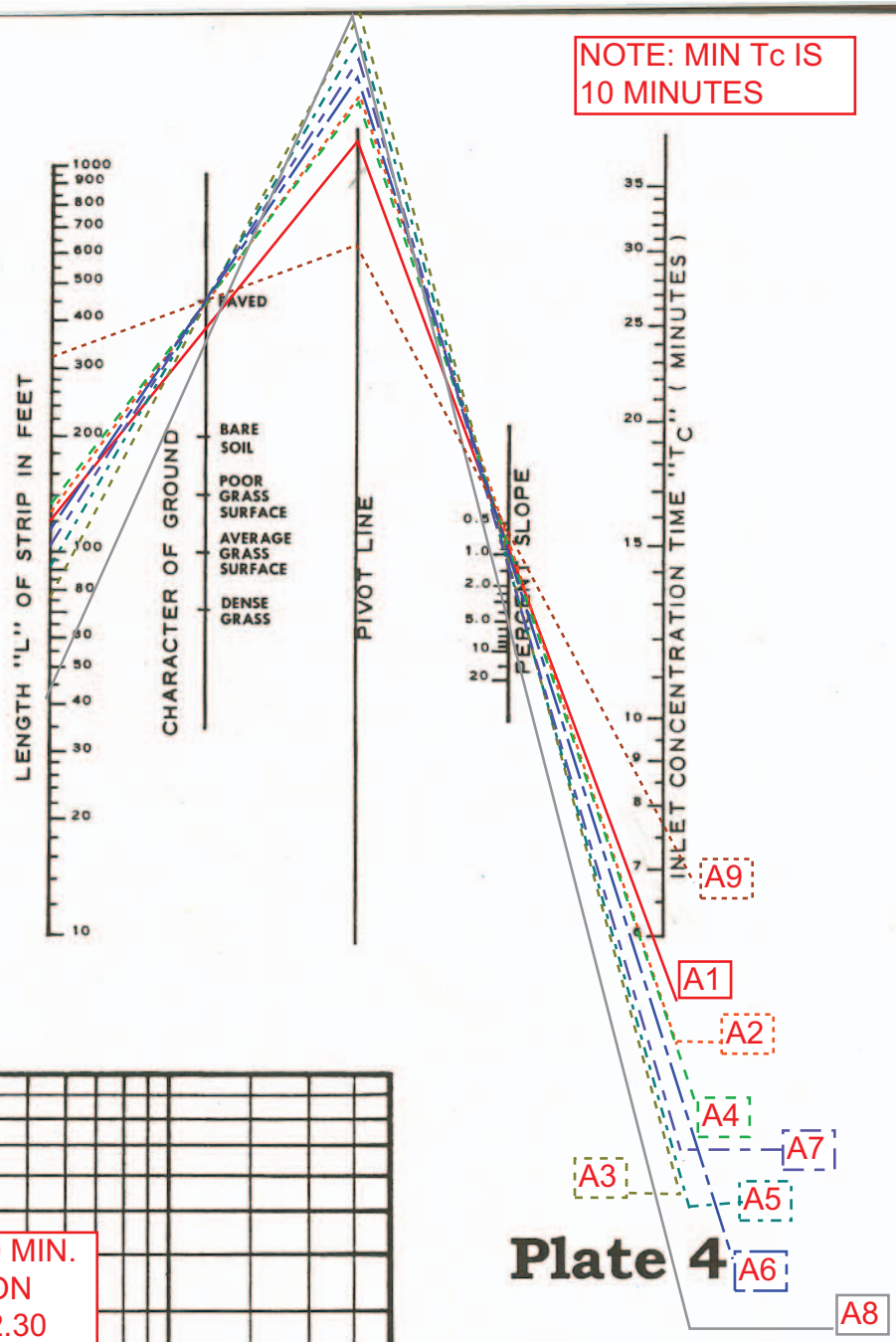
C	
0.05-0.10	Grass-covered Sandy Soil (2% or less)
0.10-0.16	Grass-covered Sandy Soil (2% to 8%)
0.10-0.16	Grass-covered Clay Soil (2% or less)
0.17-0.25	Grass-covered Clay Soil (2% to 8%)
0.9	Existing Pavement
0.95	New Pavement

DEVELOPED DRAINAGE

NOTE: MIN Tc IS 10 MINUTES

Plate 3

Overland Flow Chart



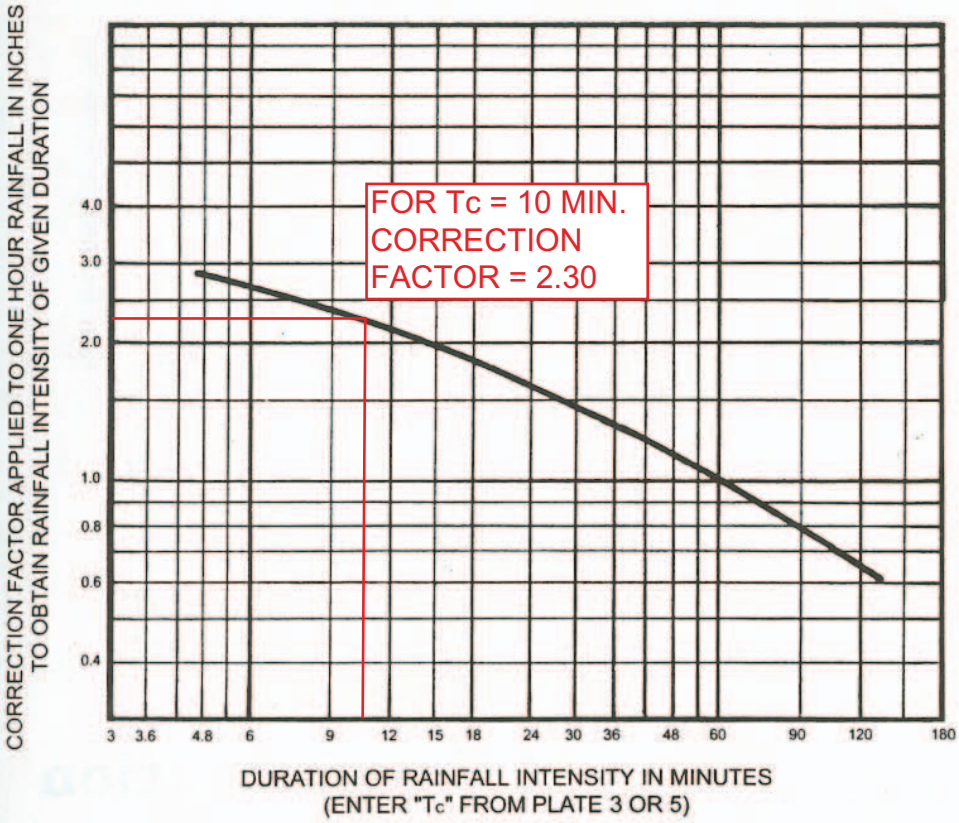


Plate 4

CORRECTION FACTOR

FOR CONVERTING 1 HR. RAINFALL TO RAINFALL INTENSITY OF VARIOUS DURATIONS

TO BE USED FOR AREA LESS THAN 100 ACRES

(See Plate 6 for area more than 100 acres)