0003

ACT/015/018 #3

STATE OF UTAH
NATURAL RESOURCES
Oil, Gas & Mining

Norman H. Bangerter, Governor
Dee C. Hansen, Executive Director
Dianne R. Nielson, Ph.D., Division Director

355 W. North Temple • 3 Triad Center • Suite 350 • Salt Lake City, UT 84180-1203 • 801-538-5340

December 30, 1987

Mr. Ray Christensen, Director
Permitting & Compliance
Utah Power & Light Company
Mining Division
P.O. Box 310
Huntington, Utah 84528

Dear Mr. Christensen:

Re: Final Approval of PAP Amendment, C-2 Culvert Installation, Utah Power & Light Company, Deer Creek Mine, ACT/015/018-87D, Folder #3, Emery County, Utah

The Division received Utah Power & Light Company's (UP&L) response to the Division's October 21, 1987, technical deficiency letter on November 25, 1987. The response was reviewed by Thomas Munson, Division Hydrologist. Please refer to the attached memorandum for an explanation of the technical review and approval recommendation. This letter will serve as the Division's final approval for this permit change application. Utah Power & Light Company has now provided all of the information required by this office to finalize this permitting action.

The Division will forward extra copies of the approved plans to the appropriate state and federal agencies to update file copies of UP&L's approved mining and reclamation plan permit application. Thank you for your cooperation in completing this permitting action. As always, please call should you have questions or need additional information pertaining to this review.

Sincerely,

D. Wayne Hedberg

D. Wayne Hedberg
Data Management Coordinator

djh
Attachments
cc: J. Dryden
R. Hagen
G. Morris
P. Rutledge
T. Munson
J. Whitehead
P.F.O.

8992R/36

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STATE OF UTAH
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355 W. North Temple • 3 Triad Center • Suite 350 • Salt Lake City, UT 84180-1203 • 801-538-5340

December 23, 1987

TO: John Whitehead, Permit Supervisor

FROM: Tom Munson, Reclamation Hydrologist TM

RE: Review of C-2 Conveyor Culvert Installation, Utah Power and Light Company, Deer Creek Mine, ACT/015/018-87D, Folder #2, Emery County, Utah

History of Proposal

An inspection of the Deer Creek Mine occurred on September 2, 1987 and it was noted by Inspector #19 that a new culvert was being installed on the C-2 conveyor access road. The need for the operator to address the installation of this culvert and supply the necessary supporting calculations became apparent based on this inspection.

A phone call was made to Val Payne by myself, expressing the need for plans on this culvert installation, appropriate to insert into the PAP as an amendment. On September 21, 1987, the Division received plans from the operator.

A response to this plan was sent to the operator on October 21, 1987, and certain technical deficiencies that required additional inforamtion were identified. The operator's response to these technical deficiencies was received on November 25, 1987. This memo addressed the operator's response to the Division's October 21, 1987 Technical Deficiency letter.

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Analysis

Two items were requested in the Division's Technical Deficiency letter of October 15, 1987. One item was hydrologic sizing calculations for the culvert and its associated inlet and outlet protection. The second item was the necessary plans for inclusion into the PAP as an amendment, including revised certified maps and additional supporting calculations.

The hydrologic sizing calculations were shown in the form of the Rational Method for determining peak flow. The operator has incorrectly applied the Rational Method and determined a maximum flowrate of 4.45 CFS greater than the Division. Based on the operator's conservative estimate of 6.1 CFS, the remainder of the calculations for riprap and apron dimensions appear to be more than adequate to handle anticipated flows.

Recommendations

I recommend that this amendment be approved and the appropriate copies for insertion into the PAP be requested. If you feel the operator should change his plan and calculations to be more accurate, then please let him know. Also, the operator should be made aware of his errors in calculating the Rational Method and correct this in the future. Attached is a worksheet for applying the Rational Method which will help the operator with future calculations if he chooses to use this methodology for determining peak flow.

djh
Attachment
9486R/23

Rational Method of Peak Flow Determination

Q= CIA

where:

Q= flow in CFS

C= rational coefficient, $0 < C < 1$

I= rainfall intensity in in./hr.

A= drainage area in acres

Assumptions:

1. Rainfall occurs uniformly over the drainage area.

2. Peak rate of runoff can be reflected by the rainfall intensity averaged over a time period equal to the time of concentration of the drainage area.

3. The frequency of runoff is the same as the frequency of rainfall.

4. The relationship between peak discharges and size of drainage area is the same as the relationship between duration and intensity of rainfall.

5. The coefficient of runoff is the same for storms of various frequencies.

6. The coefficient of runoff is the same for all storms on a given watershed.

WATERSHED DETAILS

Length of basin (L)= 2200 ft. (0.42 mi.)

Difference in elevation (H)= 6600-6280= 320 ft.

Time of concentration (t_c) calculations

$$t_c \text{ (hrs.)} = \frac{L^{1.15}}{7700\ H^{0.38}}$$

$$= \frac{2200^{1.15}}{7700 \times 320^{0.38}}$$

= 0.1 hr. or 6 min. -1.

-or-

$$t_c \text{ (hrs.)} = \left[\frac{11.9\ L^3}{H}\right]^{0.385}$$

$$= \left[\frac{11.9 \times 0.42^3}{320}\right]^{0.385}$$

=0.1 hr. or 6 min. -2.

Rainfall Intensity

t_c = 6 min.

Method #1-

Refer to precipitation frequency tables (Richardson). Interpolate between the 5 & 10 min. durations under the 10-yr. return period. this gives 0.278 in. for 6 min. or

2.78 in./hr.

Method #2-

Power curve

$Y = Ax^B$

where A & B are constants and-

Y= rainfall, inches

x=duration, minutes

Using least squares for 5,10,15,30 min. duration (precip. freq. tables)----

A= 0.10

B= 0.56

$$\text{Intensity (I)} = 0.10\, t_c^{0.56} \times \frac{60}{t_c}$$

= 2.73 in./hr.

Rainfall Intensity (cont.)

t_c =6 min.

Method #3- -3.

Refer to graph-
Graph is utilized for all t_c's less than one hour.

Obtain one hour rainfall amount from precip. freq. tables which in this case equals 0.86 in.

Referring to graph this gives a correction factor of 0.32.

I =0.86 x 0.32 =0.275

Using equation:

$$i.p.h. = 0.275 \times \frac{1}{6 \text{ min.}} \times 60 \text{ min.}$$

= 2.75 in./hr

Method #4- -4.

The 10-yr. 24 hr. storm = 2.12 in.

Find inflection point on graph and take 1/2 t_c on either side of point.

Extend graph to ordinate and apply formula:

$$\frac{(D \times d_2)-(D \times d_1)}{6 \text{ min.}} = \text{in./min.}$$

where D= 24 hr. duration storm

$$= \frac{(2.12)(.56)-(2.12)(.43)}{6 \text{ min.}}$$

=.276 in./6 min.

= 2.76 in./hr.

SUMMARY OF METHODS--

Given:

C=0.20

A=40 acres

Method	Flow (CFS)
#1	22.2
#2	21.8
#3	22.0
#4	22.0

1. Chow, V.T., Handbook of Applied Hydrology, pg. 21.10

2. D'Appolonia, E., Engineering and Design Manual, Coal Refuse Disposal Facilities, Washington: U.S. Gov't Printing Office

3. OSM, Surface Mining Water Diversion Design Manual, 9/82, pg. 3-8

4. Discussion, Tom Suchoski

Table 2.27 Runoff Coefficients (continued)

Rural Areas

Topography and Vegetation	Soil Texture: Open Sandy Loam	Clay and Silt Loam	Tight Clay
Woodland			
Flat 0-5% slope	0.10	0.30	0.40
Rolling 5-10% slope	0.25	0.35	0.50
Hilly 10-30% slope	0.30	0.50	0.60
Pasture			
Flat	0.10	0.30	0.40
Rolling	0.16	0.36	0.55
Hilly	0.22	0.42	0.60
Cultivated			
Flat	0.30	0.50	0.60
Rolling	0.40	0.60	0.70
Hilly	0.52	0.72	0.82

The rainfall intensity used in equation 2.68 should be for the desired frequency and have a duration equal to the time of concentration of the area. The estimation of the time of concentration has been previously discussed under the section on time parameters for runoff hydrographs. The reason for selecting an i with a duration of t_c is that if a shorter duration is selected, the entire basin will not be contributing runoff and the i will be too large. If a duration greater than t_c is selected, i will be too small since a shorter duration rainfall will produce runoff from the entire basin and will have a higher intensity. The rainfall intensity-duration-frequency curves of Figure 2.17 can be reviewed to see that as the duration increases for a given frequency, the average intensity decreases.

As with any estimation procedure, considerable care should be exercised when applying the rational equation to estimate peak flows. For instance, the location of relatively impervious areas with respect to the point of flow estimation must be carefully considered. If flow from an impervious area has to cross an infiltrating area such as grass, the flows may be greatly reduced. If large impervious areas are present, they should be analyzed as separate units. The reason for this can be seen by considering the situation shown in Figure 2.39. In case A the impervious area is next to the outlet, while in case B the grass area is next to the outlet. Straightforward application of the rational

FROM: BARFIELD, ET AL, APPLIED HYDROLOGY & SEDIMENTOLOGY FOR DIST. AREAS
pg 112

Table 2.27 Runoff Coefficients.

Urban areas – The use of average coefficients for various surface types, which are assumed not to vary through the duration of the storm, is common. The range of coefficients, classified with respect to the general character of the tributary reported in use is:

Description of area	Runoff coefficients
Business:	
Downtown areas	0.70 to 0.95
Neighborhood areas	0.50 to 0.70
Residential:	
Single-family areas	0.30 to 0.50
Multi-units, detached	0.40 to 0.60
Multi-units, attached	0.60 to 0.75
Residential (suburban)	0.25 to 0.40
Apartment dwelling areas	0.50 to 0.70
Industrial:	
Light areas	0.50 to 0.80
Heavy areas	0.60 to 0.90
Parks, cemeteries	0.10 to 0.25
Playgrounds	0.20 to 0.35
Railroad yard areas	0.20 to 0.35
Unimproved areas	0.10 to 0.30

It is often undesirable to develop a composite runoff coefficient based on the percentage of different types of surface in the drainage area. This procedure is often applied to typical 'sample' blocks as a guide to selection of reasonable values of the coefficient for an entire area. Coefficients with respect to surface type currently in use are:

Character of surface	Runoff coefficients
Streets:	
Asphaltic and concrete	0.70 to 0.95
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Lawns: sandy soil:	
Flat, 2%	0.05 to 0.10
Average, 2% to 7%	0.10 to 0.15
Steep, 7%	0.15 to 0.20
Lawns; heavy soil:	
Flat, 2%	0.13 to 0.17
Average, 2% to 7%	0.18 to 0.22
Steep, 7%	0.25 to 0.35

The coefficients in these two tabulations are applicable for storms of 5-year to 10-year frequencies. Less frequent higher intensity storms will require the use of higher coefficients because infiltration and other losses have a proportionally smaller effect on runoff. The coefficients are based upon the assumption that the design storm does not occur when the ground surface is frozen.

(continued)

FROM: BARFIELD, ET AL, APPLIED HYDROLOGY & SEDIMENTOLOGY FOR DIST. AREAS
pg. 111

Table 11-1 Typical C Coefficients for 5- to 10-yr Frequency Design

Description of Area	Runoff Coefficients
Business	
Downtown areas	0.70–0.95
Neighborhood areas	0.50–0.70
Residential	
Single-family areas	0.30–0.50
Multiunits, detached	0.40–0.60
Multiunits, attached	0.60–0.75
Residential (suburban)	0.25–0.40
Apartment dwelling areas	0.50–0.70
Industrial	
Light areas	0.50–0.80
Heavy areas	0.60–0.90
Parks, cemeteries	0.10–0.25
Playgrounds	0.20–0.35
Railroad yard areas	0.20–0.40
Unimproved areas	0.10–0.30
Streets	
Asphaltic	0.70–0.95
Concrete	0.80–0.95
Brick	0.70–0.85
Drives and walks	0.75–0.85
Roofs	0.75–0.95
Lawns; Sandy Soil:	
Flat, 2%	0.05–0.10
Average, 2–7%	0.10–0.15
Steep, 7%	0.15–0.20
Lawns; Heavy Soil:	
Flat, 2%	0.13–0.17
Average, 2–7%	0.18–0.22
Steep, 7%	0.25–0.35

4. Determine the desired peak flow Q_p from Eq. 11-1.
5. Some design situations produce larger peak flows if design storm intensities for durations less than t_c are used. Substituting intensities for durations less than t_c is justified only if the contributing area term in Eq. 11-1 is also reduced to accommodate the shortened storm duration.

One of the principal assumptions of the Rational Method is that the predicted peak discharge has the same return period as the rainfall IDF relationship used in the prediction. Another assumption, and one that has received close scrutiny by investigators,[19,20] is the constancy of the runoff coefficient during the progress of individual

FROM: VIESSMAN, ET AL, INTRODUCTION TO HYDROLOGY, pg 508

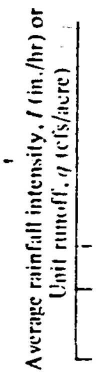

Fig. 1

storms anc
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Example 1
the area sh
applicable.

Solution:
1. Time of

$t_c = t_1$

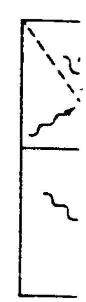

Fig. 1

1ST & 2ND METHODS

ESTIMATED RETURN PERIODS FOR SHORT DURATION PRECIPITATION (inches)

Station: Scofield Dam
Latitude: 39° 47'

Elevation: 7630
Longitude: 111° 07'

DURATION

RETURN PERIOD (years)	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
1	.15	.23	.29	.40	.51	.58	.65	.81	.96	1.11
2	.17	.27	.34	.47	.60	.69	.78	1.00	1.20	1.40
5	.22	.34	.43	.60	.76	.88 .90	1.00	1.29	1.55	1.82
10	.25	.39	.49	.68	.86	1.00	1.14	1.49	1.80	2.12
25	.31	.48	.60	.84	1.06	1.23	1.39	1.80	2.16	2.54
50	.33	.51	.64	.89	1.13	1.33	1.52	2.00	2.43	2.87
100	.36	.55	.70	.97	1.23	1.46	1.67	2.21	2.69	3.19

Station: Silver Lake Brighton
Latitude: 40° 36'

Elevation: 8700
Longitude: 111° 35'

DURATION

RETURN PERIOD (years)	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
1	.07	.11	.14	.19	.24	.42	.59	1.01	1.39	1.78
2	.10	.16	.21	.28	.36	.56	.75	1.22	1.64	2.08
5	.17	.26	.33	.46	.58	.80	1.01	1.53	2.00	2.48
10	.20	.31	.39	.54	.68	.92	1.16	1.74	2.26	2.80
25	.25	.38	.48	.67	.85	1.13	1.39	2.05	2.64	3.25
50	.28	.44	.56	.77	.98	1.28	1.57	2.30	2.95	3.62
100	.32	.50	.64	.88	1.12	1.45	1.76	2.54	3.24	3.96

FROM: RICHARDSON, E.A., ESTIMATED RETURN PERIODS FOR SHORT DURATION

3RD METHOD

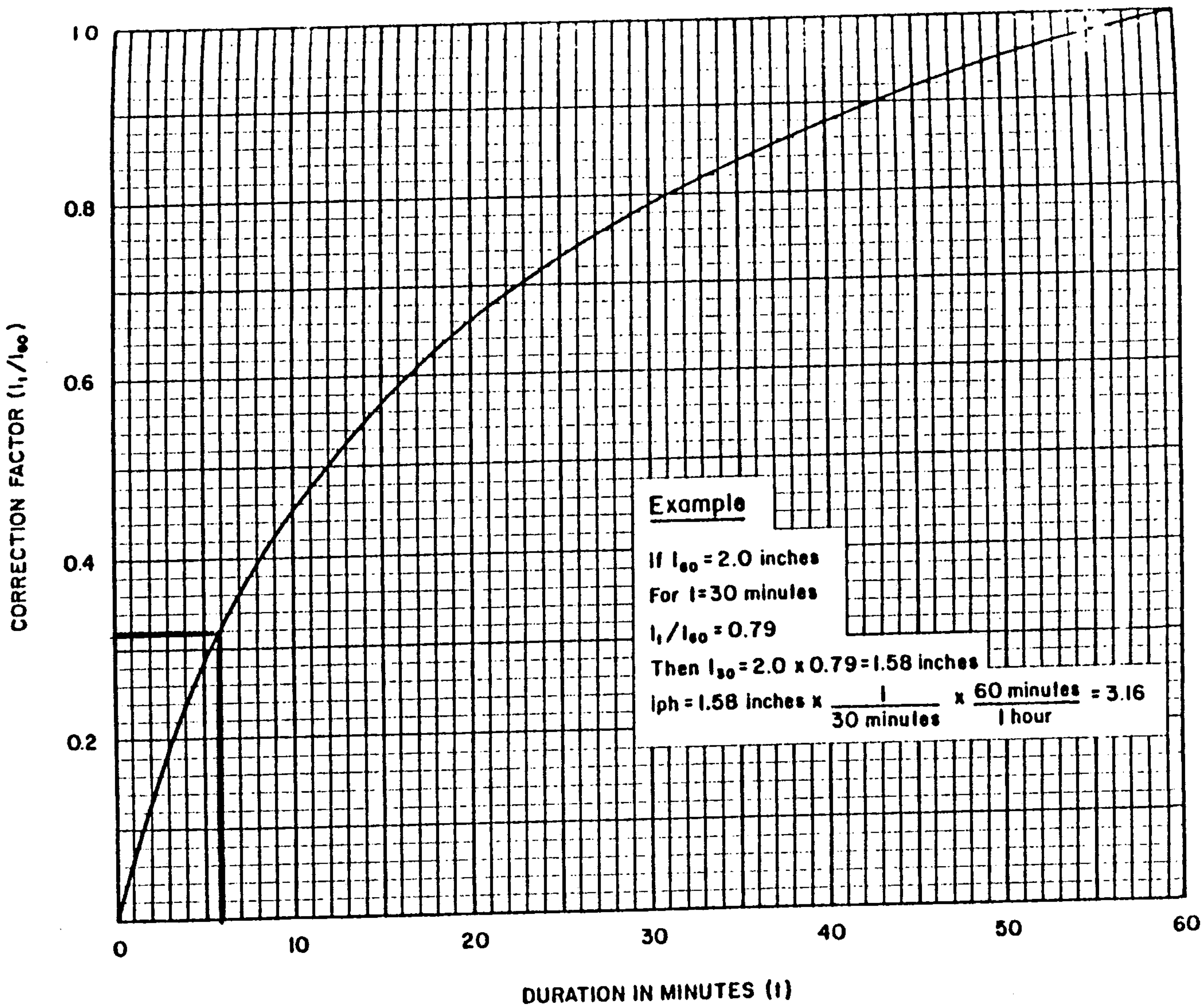

Figure 3.3. Conversion factors for durations less than one hour.

FROM: OSM, SURFACE MINING WATER DIVERSION DESIGN MANUAL, 9/82, pg 3.8

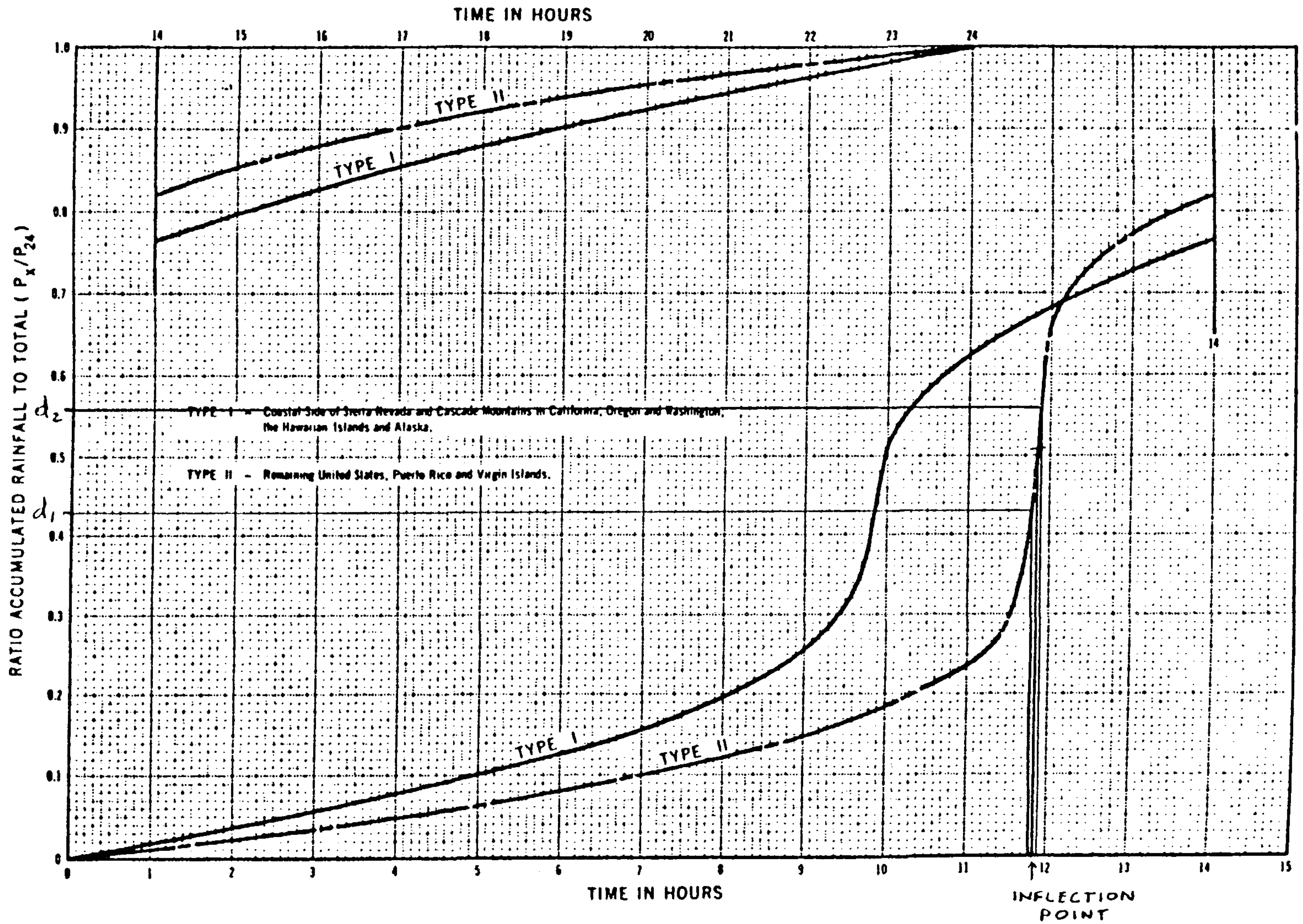

Figure 2. Twenty-four hour rainfall distributions (SCS).

FROM: McCUEN, R.H., GUIDE TO HYDROLOGIC ANALYSIS USING SCS METHODS, pg. 7

4th METHOD