APPENDIX H

HYDROLOGY AND HYDRAULIC CALCULATIONS FOR DETENTION BASIN AND UNION MINE ROAD IMPROVEMENTS

Memorandum No. 1A

The consultant should provide the hydrology and hydraulic calculation methods and results for the noncontact water detention basin.

Introduction

This memorandum addresses the calculations and design of the noncontact water detention basin for Union Mine Disposal Site. The Union Mine Disposal Site is owned by El Dorado County (the County) and operated under contract by El Dorado Landfill. The landfill serves as a regional facility that receives refuse from the western portion of the County. It is the only operating municipal facility serving the western portion of the County. The landfill is classified as a Class III solid waste disposal site and is open to the public for the disposal of solid, nonhazardous residential, and commercial wastes. The active waste management unit is confined to approximately 33 acres in the northern portion of the 217-acre parcel owned by the County.

As part of the final closure plan, a surface-water management system was designed to collect noncontact surface runoff from a total of 59 acres. This total acreage is composed of 34 acres of the existing landfill area at final closure, 17 acres of the expansion area, and 8 acres of area upslope of the expansion area. These areas, along with the collection system, are denoted in Figure 1. All noncontact surface runoff will be collected in a system of lined perimeter ditches and pipelines and conveyed to the detention basin to allow settling of sediment prior to being discharged to Martinez Creek. All nonclassified surface-water drainage systems and storage basins were sized for the 100-year, 24-hour storm in accordance with Title 23, CCR, Chapter 15, Section 2541.

Methodology for Detention Basin Sizing

The detention basin was designed to provide adequate storage during the 100-year, 24-hour event, provide settling of sediment, and reduce the peak flow into Martinez Creek. The detention basin size was determined based on routing the 100-year, 24-hour storm event from the 59 acres of watershed through the basin. A recommended detention basin length to width ratio of 4 to 1 was assumed to allow for settling of sediment. The inflow to the basin was calculated using the Rational Method, and outflow from the basin was determined assuming weir and orifice flow.

Rainfall Distribution

The detention basin peak flow was determined based on the Soil Conservation Service (SCS) Type I rainfall distribution. The Type I rainfall distribution is applicable to the coastal side of the Sierra Nevada Mountains and is presented graphically in

Appendix A. The 100-year, 24-hour storm precipitation depth was obtained from records for the Placerville DSP site, which is maintained by the State of California Department of Water Resources. The 100-year, 24-hour precipitation amount for this site is 6.04 inches (Appendix A).

Inflow Conditions

The storm event was routed over a 24-hour period using 5-minute time intervals, which is the time of concentration for the watershed. Time of concentration calculations is presented in Appendix B. At each interval, the peak inflow to the basin was determined using the Rational Method (Appendix B):

$$q = CiA$$

q = Peak runoff rate, cfs

C = Runoff coefficient

i = Rainfall intensity for the design return period and for a duration equal to the time of concentration of the watershed, in/hr

A = Watershed area, acres

Runoff coefficients were estimated for the landfill assuming final closure and cover conditions. The average runoff coefficient for the landfill area was estimated to be 0.50. Calculations associated with this value are contained in Appendix B.

The rainfall intensity (i) was calculated for each 5-minute time step based on the rainfall amount for a Type I rainfall distribution during the 5-minute interval.

The detention basin will serve a watershed area of approximately 59 acres. This acreage includes the existing and expansion landfill areas. The peak flow from the watershed area was determined to be approximately 109 cfs.

Outlet Conditions

The outlet for the basin was assumed to consist of four risers, 24 inches in diameter, and 3 feet tall (Figure 2). The risers will be equipped with 2-inch holes the length of the riser to allow dewatering of the basin. The bottom 1 foot of the basin is dedicated for sediment storage.

The outlet flows were approximated assuming either weir flow or orifice flow through the risers (Appendix C). When the head on the risers is less than 1 foot, the following weir equation was used:

$$q = (N)*(9.739)*(Dr)*(H)^{3/2}$$

q = Flow, cfs

N = Number of risers

Dr = Diameter of riser, feet

H = Head on riser, feet

When the head on the riser is 1 foot or greater, the following orifice flow equation was used:

$$q = (N)*(3.782)*(Dr)^{2}*(H)$$

q = Flow, cfs

N = Number of risers

Dr = Diameter of riser, feet

H = Head on riser, feet

Reservoir Routing

The 100-year, 24-hour storm event was routed through the basin using the following reservoir routing equation (Appendix D):

$$(I_1 + I_2)/2 + (S_1/\Delta t - O_1) = (S_2/\Delta t + O_2)$$

I_1 = Inflow at Time Period 1, cfs

I_2 = Inflow at Time Period 2, cfs

O_1 = Outflow at Time Period 1, cfs

O_2 = Outflow at Time Period 2, cfs

S_1 = Storage at Time Period 1, cubic feet

S_2 = Storage at Time Period 2, cubic feet

Δt = Time period, seconds

A storage-outflow relationship was developed to utilize this method, which is dependent on the basin dimensions.

Results

The detention basin dimensions were determined to be 80 feet wide by 320 feet long with 2 to 1 (H:V) sideslopes. These dimensions were determined based on several reservoir routing analyses using varying basin dimensions. The resulting storage-outflow relationship is contained in Appendix E. Based on this relationship, the 100-year, 24-hour storm was routed through the basin assuming an initial water depth in the basin equal to the top of the risers. The resulting peak basin inflow was determined to be 109 cfs with a peak outflow of 98 cfs. The results of this routing are also presented in Appendix E.

The anticipated peak storage volume required for this runoff event was estimated to be 123,000 cubic feet. Storage must also be provided for direct precipitation within the basin, which is approximately 17,000 cubic feet. This volume was calculated based on 6 inches of precipitation occurring over the detention basin surface area of 33,000 square feet. The estimated total volume of storage required was 140,000 cubic feet, resulting in a depth of approximately 5 feet in the basin. Assuming the bottom foot of the basin is utilized for sediment storage and 1.5 feet is allotted for freeboard, the basin must be constructed to a depth of 7.5 feet deep. A schematic of the basin is shown in Figure 3.

The anticipated sediment trapping during this event was estimated by the following equation (Appendix F):

$$Vs = (K) * (Q)/A$$

Vs = Settling velocity of the selected particle size, feet per second. All soil particles greater than or equal to the selected particle size are to be retained in the basin.

K = An adjustment factor for nonideal settling basins, equal to 1.2

Q = Design overflow rate at the riser, cfs

A = Surface area of sediment basin, in square feet

The settling velocity was calculated to be approximately 0.0035 foot per second. This value was determined assuming the overflow rate at the riser equal to 98 cfs with a corresponding sediment basin surface area of 33,300 square feet. These values were obtained from the peak outflow and storage-outflow relationship presented in Appendix E. This settling velocity corresponds to an approximate particle diameter of

0.03 millimeter, which is representative of silt (Appendix F). Therefore, some silt and all clay particles will pass through the basin during the 100-year, 24-hour event (Appendix F).

The overflow rate at the riser will be less for storm events smaller than the 100-year, 24-hour storm. Based on the above equation, a smaller overflow rate will result in a smaller settling velocity and settling of particles smaller than those determined for the 100-year, 24-hour storm. Therefore, for storm events less than the 100-year, 24-hour storm event, more silt will be expected to settle in the basin.

SUBJECT Union Mine Disposal Site BY DATE
Figure 2 SHEET OF
PROJECT NO.

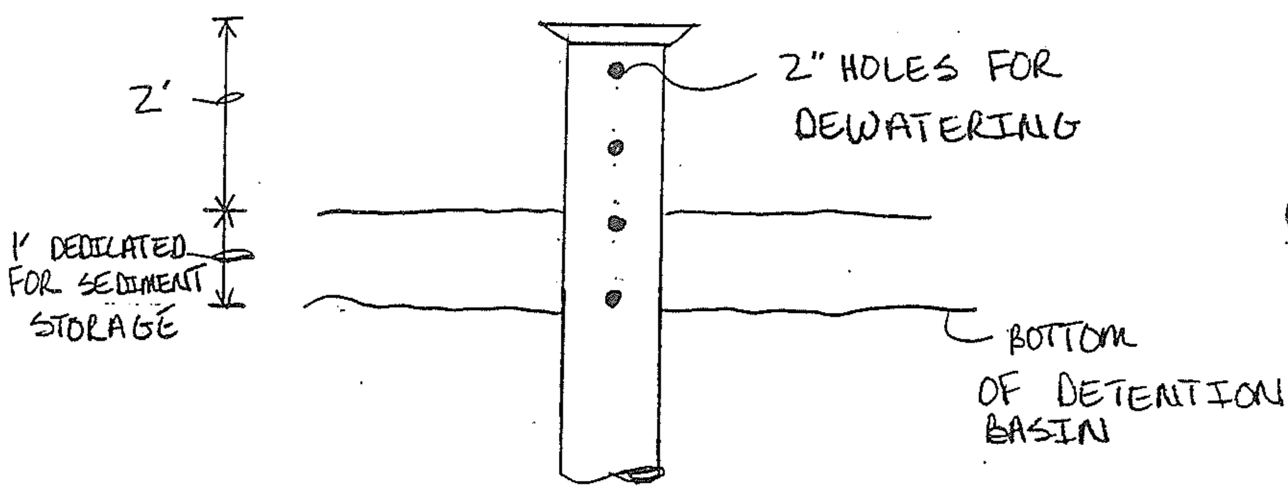

FIGURE 2

TYPICAL RISER

NTS

SUBJECT Union Mine Disposal Site BY DATE
Figure 3 SHEET OF
PROJECT NO.

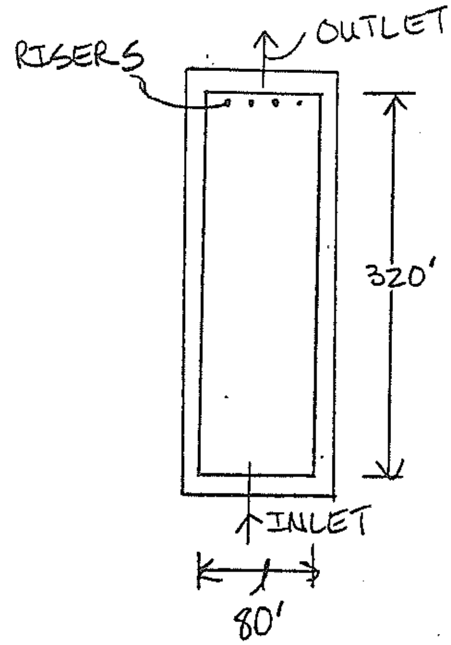

FIGURE 3

SCHEMATIC OF DETENTION BASIN

NTS

APPENDIX A

A GUIDE TO HYDROLOGIC ANALYSIS USING SCS METHODS

RICHARD H. McCUEN
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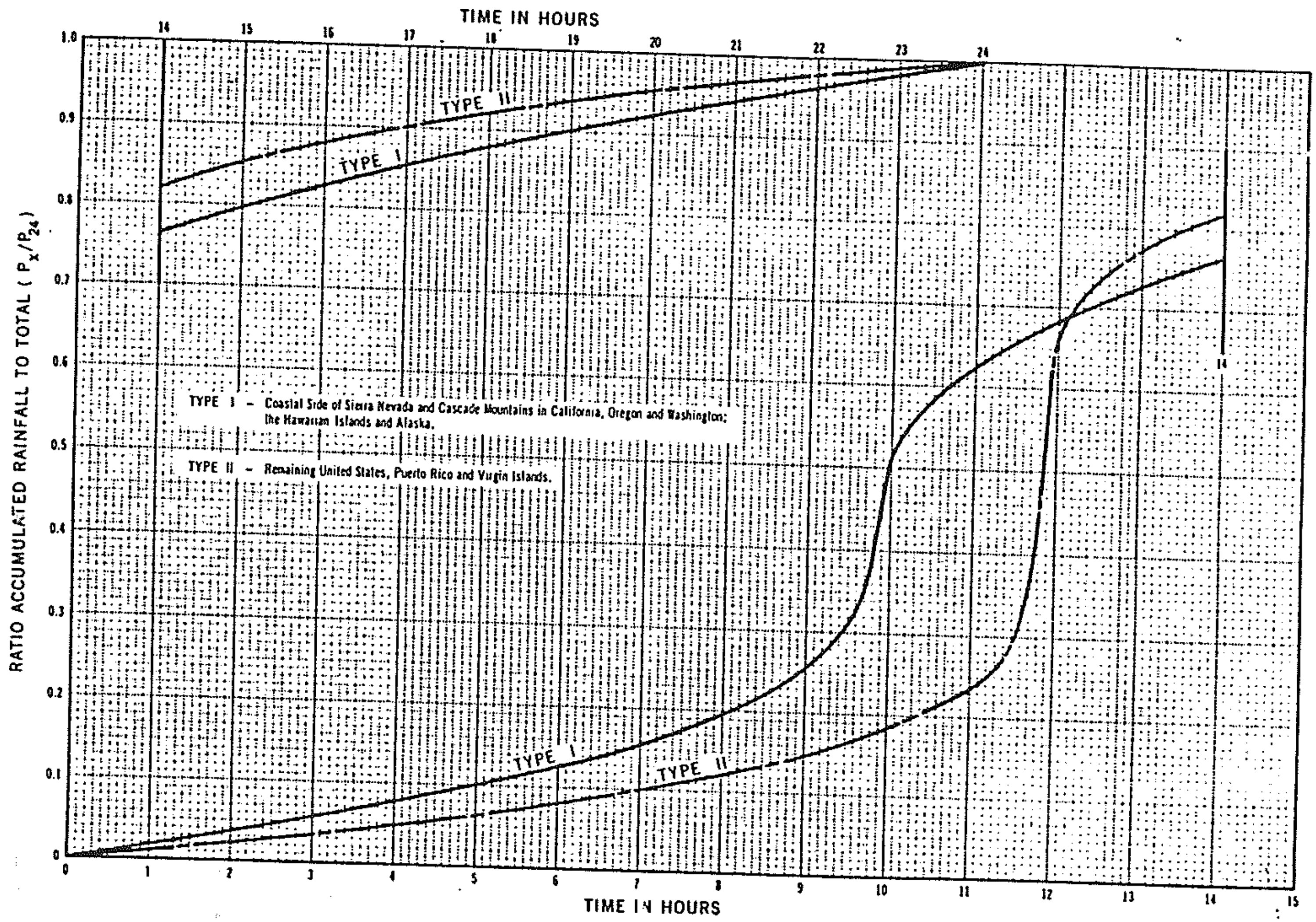

Figure 2. Twenty-four hour rainfall distributions (SCS).

Source: Richard H. McCuen. A Guide to Hydrologic Analysis Using SCS Methods. Prentice-Hall, Inc. 1982.

Department of
Water Resources

Bulletin No. 195

Rainfall Analysis for Drainage Design

Volume I. Short-Duration Precipitation Frequency Data

551.577

October 1976

Claire T. Dedrick
Secretary for Resources

The Resources Agency

Edmund G. Brown Jr.
Governor

State of California

Ronald B. Robie
Director

Department of Water Resources

MAXIMUM ANNUAL PRECIPITATION (UNITS=INCHES)
(TO CONVERT TO MILLIMETERS MULTIPLY BY 25.4)

STATION NO. BSN ORDER SUP	STATION NAME	ELEV	SEC	TWP	RNG	LOT	BNM	LATITUDE	LONGITUDE	COUNTY
A70 6964 0	PLACERVILLE OSP PL	1546	11	10N	10E	P	M	38.733	120.845	EL DORADO

M=MINUTES,H=HOURS,D=DAYS,C YR=CALENDAR YEAR,W YR=WATER YEAR,F YR=FISCAL YEAR
***** = NO DATA AVAILABLE

YEAR	5M	10M	15M	30M	1H	2H	3H	6H	12H	24H	C-YR
1940	0.11	0.15	0.20	0.31	0.47	0.69	0.90	1.68	2.37	2.95	45.20
1941	0.11	0.19	0.24	0.43	0.68	0.83	0.97	1.15	1.57	2.06	35.40
1942	0.22	0.40	0.57	0.79	0.95	1.35	1.49	1.99	2.23	3.20	39.90
1943	*****	*****	*****	*****	0.68	1.08	1.21	1.62	2.47	3.93	33.34
1944	*****	*****	*****	*****	0.57	0.79	0.95	1.30	2.07	2.93	33.80
1945	*****	*****	*****	*****	0.49	0.82	0.98	1.38	1.82	3.15	36.81
1946	*****	*****	*****	*****	0.32	0.52	0.59	1.02	1.68	2.01	21.20
1947	*****	*****	*****	*****	0.38	0.54	0.66	1.15	1.84	2.46	19.53
1948	*****	*****	*****	*****	0.33	0.54	0.81	1.43	1.60	2.81	27.82
1949	*****	*****	*****	*****	0.37	0.50	0.67	1.03	1.48	2.55	22.66
1950	0.14	0.23	0.33	0.54	0.77	0.91	1.03	1.20	2.21	4.04	31.31
1951	0.19	0.24	0.31	0.40	0.58	0.84	1.06	1.65	2.20	2.79	36.69
1952	0.09	0.16	0.23	0.32	0.40	0.55	0.70	1.19	1.92	3.01	36.05
1953	0.06	0.11	0.16	0.27	0.48	0.86	1.15	1.66	2.16	2.70	26.61
1954	0.15	0.17	0.19	0.32	0.37	0.55	0.65	1.20	1.63	2.57	37.17
1955	0.30	0.33	0.38	0.48	0.84	1.08	1.36	1.76	1.87	3.30	40.50
1956	0.10	0.20	0.26	0.29	0.31	0.55	0.65	1.09	1.37	1.96	25.46
1957	0.12	0.18	0.22	0.32	0.56	0.67	0.77	1.28	2.15	2.73	34.81
1958	0.13	0.24	0.29	0.36	0.61	0.86	1.11	1.68	2.46	3.19	42.95
1959	0.09	0.16	0.20	0.27	0.35	0.54	0.56	1.08	1.42	2.27	22.75
1960	0.22	0.24	0.25	0.30	0.48	0.75	0.88	1.61	2.12	3.29	31.12
1961	0.14	0.16	0.19	0.27	0.35	0.57	0.66	1.17	1.58	1.94	20.08
1962	0.21	0.25	0.26	0.29	0.52	0.90	1.17	2.01	3.23	5.43	36.41
1963	0.12	0.24	0.34	0.56	0.73	0.81	1.04	1.68	2.59	3.98	32.64
1964	0.14	0.16	0.18	0.21	0.37	0.59	0.80	1.08	1.49	2.19	39.11
1965	0.14	0.17	0.25	0.50	0.69	0.92	1.16	1.69	1.95	2.28	31.42
1966	0.08	0.12	0.15	0.17	0.30	0.53	0.66	1.29	1.74	2.26	23.01
1967	0.14	0.16	0.20	0.29	0.48	0.72	0.91	1.53	2.91	4.16	39.99
1968	*****	*****	*****	*****	0.30	0.50	0.70	1.20	1.90	2.50	31.10
1969	*****	*****	*****	*****	0.60	1.00	1.10	1.40	2.00	3.20	49.40
1970	*****	*****	*****	*****	0.70	0.80	1.10	1.70	2.30	3.00	48.40
1971	*****	*****	*****	*****	0.40	0.60	0.80	1.20	1.90	3.00	25.60
1972	*****	*****	*****	*****	0.80	1.00	1.20	2.10	2.40	2.50	24.40
1973	*****	*****	0.30	0.40	0.80	1.20	1.50	1.80	2.30	3.50	54.50
1974	*****	*****	0.40	0.50	0.70	1.00	1.20	1.60	2.30	3.10	34.20

PRECIPITATION DEPTH-DURATION-FREQUENCY TABLE

STATION NO. BSN ORDER SUP	STATION NAME	ELEV	SEC	TWP	RNG	LOT	BNM	LATITUDE	LONGITUDE	COUNTY
A70 6964 0	PLACERVILLE OSP PL	1546	11	10N	10F	P	M	38.733	120.845	EL DORADO

MAXIMUM PRECIPITATION (IN) FOR INDICATED DURATION D=DAYS H=HOURS M=MINUTES

RETURN PERIOD IN YEARS	5M	10M	15M	30M	1H	2H	3H	6H	12H	24H	C-YR
2	0.13	0.19	0.25	0.35	0.50	0.72	0.89	1.36	1.91	2.76	32.82
5	0.18	0.25	0.33	0.47	0.67	0.96	1.19	1.81	2.55	3.69	41.42
10	0.21	0.30	0.39	0.54	0.78	1.12	1.38	2.11	2.97	4.29	46.29
20	0.24	0.33	0.44	0.61	0.88	1.27	1.56	2.38	3.35	4.84	50.51
25	0.24	0.35	0.45	0.64	0.91	1.31	1.61	2.46	3.47	5.01	51.78
40	0.25	0.35	0.46	0.65	0.93	1.33	1.64	2.51	3.53	5.10	54.33
50	0.27	0.38	0.50	0.70	1.01	1.45	1.78	2.72	3.83	5.53	55.49
100	0.29	0.42	0.54	0.77	1.10	1.58	1.94	2.97	4.18	6.04	58.96
200	0.32	0.45	0.59	0.83	1.19	1.71	2.10	3.21	4.52	6.53	62.19
1000	0.37	0.53	0.69	0.97	1.39	1.99	2.46	3.75	5.28	7.63	69.17
10000	0.44	0.63	0.82	1.16	1.66	2.39	2.94	4.49	6.33	9.14	78.23
PMP	0.87	1.24	1.62	2.28	3.27	4.70	5.79	8.84	12.44	17.99	179.55

	5M	10M	15M	30M	1H	2H	3H	6H	12H	24H	C-YR
MEAN	0.143	0.203	0.265	0.373	0.535	0.769	0.947	1.446	2.035	2.941	33.467
CLOCK HR. COR.	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
CALCULATED SKEW	1.168	1.385	1.630	1.303	0.451	0.633	0.376	0.389	0.651	1.240	0.363
REGIONAL SKEW	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	0.400
SKEW USED	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	0.400

SLOPE OF LOG INTENSITY / LOG TIME = -.472 ; INTERCEPT (TIME=1 HOUR) =0.534 ; COEFFICIENT OF DETERMINATION = 0.999
1HR INTERCEPT / MEAN YR =0.01597 ; AVERAGE CALC CV / USED CV = 0.99

	5M	10M	15M	30M	1H	2H	3H	6H	12H	24H	C-YR
KURTOSIS	4.821	5.664	6.832	5.523	2.376	3.036	2.594	2.342	3.819	5.695	3.015
N	21	21	23	23	35	35	35	35	35	35	35
RECORD YEAR	1955	1942	1942	1942	1942	1942	1973	1972	1962	1962	1973
RECORD MAXIMUM	0.300	0.400	0.570	0.790	0.950	1.350	1.500	2.100	3.230	5.430	54.500
NORMILIZED MAX	2.756	2.878	3.213	3.003	2.297	2.619	2.169	2.161	2.833	3.387	2.433
CALC. COEF. VAR	0.399	0.338	0.358	0.371	0.337	0.289	0.269	0.209	0.207	0.250	0.258
REGN. COEF. VAR	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.291
USED COEF. VAR	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.341	0.291

	5M	10M	15M	30M	1H	2H	3H	6H	12H	24H	C-YR
MEAN/A	0.0043	0.0061	0.0079	0.0112	0.0160	0.0230	0.0283	0.0432	0.0608	0.0879	1.0000
RP10/A	0.0062	0.0088	0.0115	0.0163	0.0233	0.0335	0.0412	0.0630	0.0886	0.1281	1.3832
RP25/A	0.0073	0.0103	0.0135	0.0190	0.0273	0.0392	0.0482	0.0736	0.1036	0.1498	1.5472
RP50/A	0.0080	0.0114	0.0149	0.0210	0.0301	0.0432	0.0532	0.0813	0.1144	0.1653	1.6580
RP100/A	0.0088	0.0124	0.0163	0.0229	0.0328	0.0472	0.0581	0.0887	0.1246	0.1804	1.7611
RP1000/A	0.0111	0.0157	0.0206	0.0289	0.0415	0.0596	0.0734	0.1120	0.1577	0.2279	2.0668
RP10000/A	0.0133	0.0188	0.0246	0.0347	0.0497	0.0714	0.0880	0.1343	0.1891	0.2732	2.3377
PMP/A	0.0261	0.0371	0.0485	0.0682	0.0978	0.1405	0.1731	0.2642	0.3719	0.5374	5.3650

PEARSON TYPE III DISTRIBUTION USED
PROBABLE MAXIMUM PRECIPITATION ESTIMATE BASED ON 15 STANDARD DEVIATIONS
WHERE N IS SMALL (<25) RESULTS ARE NOT DEPENDABLE

From: State of California Department of Water Resources, Bulletin No. 195. Rainfall Analysis for Drainage Design, Volume I, Short-Duration Precipitation Frequency Data. October 1976.

APPENDIX B

SOIL AND WATER CONSERVATION ENGINEERING

Third Edition

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Talcott W. Edminster
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Tucson, Arizona

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occur once in 10 years; expensive, permanent structures will be designed for runoffs expected only once in 50 or 100 years. Selection of the design return period, also called recurrence interval, depends on the economic balance between the cost of periodic repair or replacement of the facility, and the cost of providing additional capacity to reduce the frequency of repair or replacement. In some instances the downstream damage potentially resulting from failure of the structure may dictate the choice of the design frequency.

4.5. Rational Method. The rational method of predicting a design peak runoff rate is expressed by the equation

$$q = 0.0028\ CiA \tag{4.1}$$

where q = the design peak runoff rate in m^3/s,
C = the runoff coefficient,
i = rainfall intensity in mm/h for the design return period and for a duration equal to the "time of concentration" of the watershed,
A = the watershed area in hectares.

The time of concentration of a watershed is the time required for water to flow from the most remote (in time of flow) point of the area to the outlet once the soil has become saturated and minor depressions filled. It is assumed that, when the duration of a storm equals the time of concentration, all parts of the watershed are contributing simultaneously to the discharge at the outlet. One of the most widely accepted methods of computing the time of concentration was developed by Kirpich (1940),

$$T_c = 0.0195\ L^{0.77} S^{-0.385} \tag{4.2}$$

where T_c = time of concentration in min (see Appendix A),
L = maximum length of flow in m,
S = the watershed gradient in m per m or the difference in elevation between the outlet and the most remote point divided by the length, L.

Hydrologists are not in agreement as to the best procedure for computing the time of concentration. Mockus (1961) prepared a nomograph (see Appendix B) for computing the time of concentration which considers length of the main channel, topography, vegetal cover, and infiltration rate. Horn and Schwab (1963) found that Mockus' values of watershed lag gave slightly better estimates of the actual runoff than several other methods when taken equal to the time of concentration.

U.S. SCS (1972) developed the "Upland Method" for estimating time of concentration. With this method the length of flow is divided by an estimated

Source: Schwab, et al. Soil and Water Conservation Engineering, Third Edition. John Wiley & Sons. 1981.

SUBJECT Union Dive Disposal Site BY J. Cherry DATE 11/5/91
SHEET 1 OF 1
PROJECT NO. SAC 26423.5C

Calculation of Time of Concentration for Final Closure of Existing Landfill

$$Tc = .0195\, L^{0.77}\, S^{-.385}$$

Tc = time of concentration, minutes
L = maximum length of flow, meters
S = watershed gradient, meter/meter

$$L = 700\,ft \left(\frac{1m}{3.28\,ft}\right) = 213\,m$$

S = .10 (maximum allowable slope of closed landfill)

$$Tc = .0195\,(213m)^{.77}\,(.10)^{-.385} = 3\ \text{minutes}$$

No rainfall data available for this time period

Use Tc = 5 minutes

SECOND EDITION

Introduction to Hydrology

Warren Viessman, Jr.
Environment and Natural Resources Policy Division
Library of Congress

John W. Knapp
Virginia Military Institute

Gary L. Lewis
University of Nebraska

The Late
Terence E. Harbaugh

Thomas Y. Crowell
HARPER & ROW, PUBLISHERS
New York Hagerstown Philadelphia San Francisco London

Rational Formula

The Rational Formula for estimating peak runoff rates was introduced in the United States by Emil Kuichling in 1889.[18] Since then it has become the most widely used method for designing drainage facilities for small urban areas and highways. Peak flow is found from

$$Q_p = CIA \tag{11-1}$$

where

Q_p = the peak runoff rate (cfs)
C = the runoff coefficient (assumed to be dimensionless)
I = the *average* rainfall intensity (in./hr), lasting for a critical period of time, t_c
t_c = the time of concentration
A = the size of the drainage area (acres)

The runoff coefficient can be assumed to be dimensionless because 1.008 acre-in./hr is equivalent to 1.0 ft^3/sec. Typical C values for storms of 5- to 10-yr return periods are provided in Table 11-1.

The rationale for the method lies in the concept that application of a steady, uniform rainfall intensity will cause runoff to reach its maximum rate when all parts of the watershed are contributing to the outflow at the point of design. That condition is met after the elapsed time, t_c, the time of concentration, which usually is taken as the time for water to flow from the most remote part of the watershed.

Figure 11-1 graphically illustrates the relationship. The IDF curve is the rainfall intensity-duration-frequency relation for the area and the peak intensity of the runoff is $Q/A = q$ which is proportional to the value of I defined at t_c. The constant of proportionality is thus the runoff coefficient, $C = (Q/A)/I$. Note that Q/A is a point value and that the relationship, as it stands, yields nothing of the nature of the rest of the hydrograph. The RRL Method described in a later section and the time-area concepts in Chapter 7 are extensions of the Rational Method that attempt to improve upon this limitation.

Rational Method Applications

Most applications of the Rational Formula in determining peak flow rates utilize the following steps:

1. Estimate the time of concentration of the drainage area.
2. Estimate the runoff coefficient, Table 11-1.
3. Select a return period T_r and find the intensity of rain that will be equaled or exceeded, on the average, once every T_r years. To produce equilibrium flows, this design storm must have a duration equal to t_c. The desired intensity is easily read from a locally derived IDF curve such as Fig. 5-12 or 11-3 using a rainfall duration equal to the time of concentration.

Source: Warren Viessman, Jr., et al. Introduction to Hydrology. Second Edition. Harper & Row, Publishers. 1977.

***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

Assume C = .30

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

Source: Viessman, et al. Introduction to Hydrology, 2nd Edition. Harper & Row, Publishers, Inc. 1977.

SUBJECT Union Mine Disposal Site BY J. Cherry DATE 11/5/91
SHEET 1 OF 1
PROJECT NO. SAC 26423.5C

Adjustment of C (Runoff Coefficient) for closed landfill

For Lawns, heavy soil ⇒ C = 0.30

This coefficient only applicable for 10-yr event

Adjust based on rainfall

Placerville DSP

10-yr, 5min precip = .21 inches
100-yr, 5min precip = .29 inches

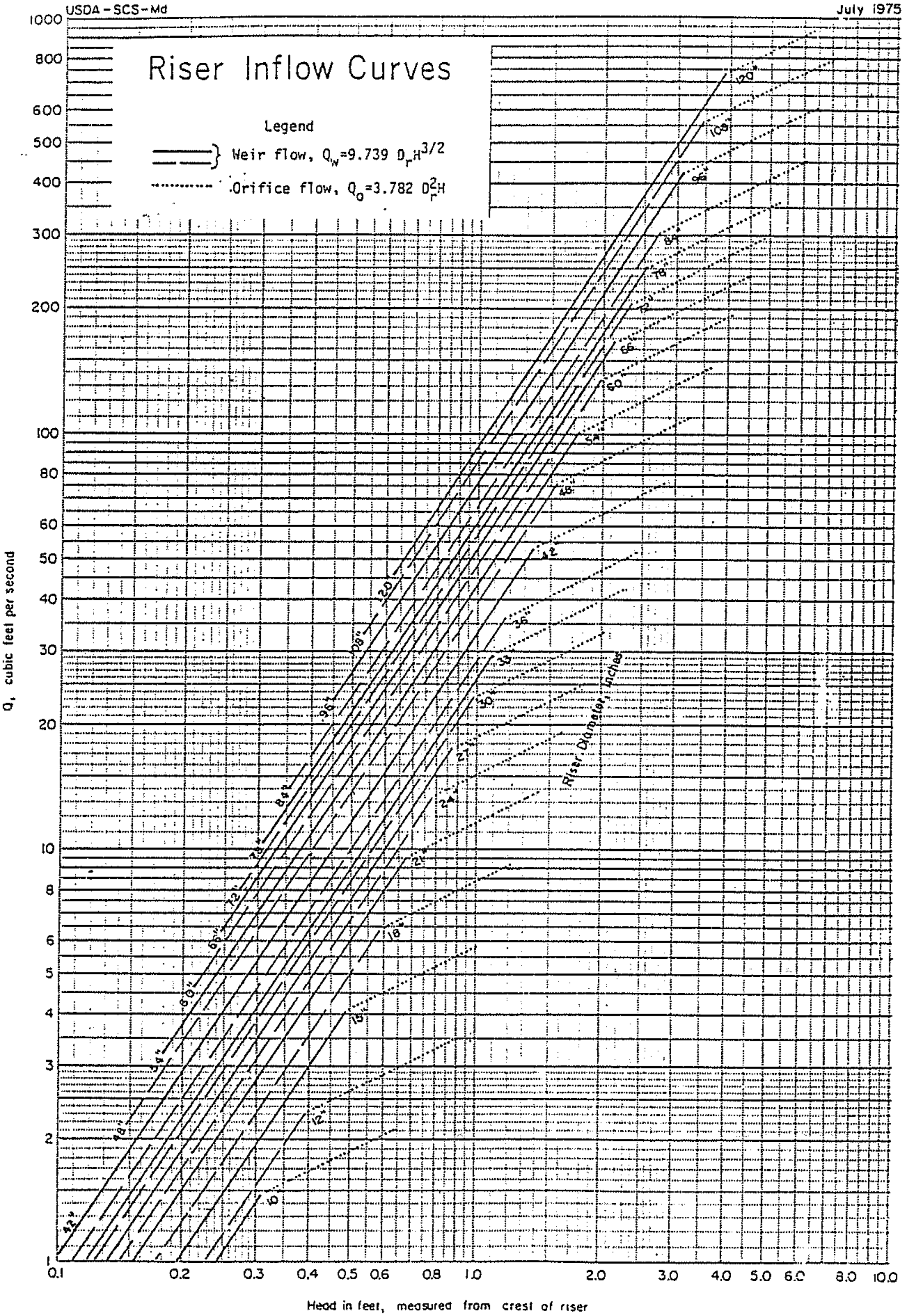
Assume C for 100-yr = 1.0 (conservative)
Ratio by rainfall

$$((.21 * .3) + (1 * (.29 - .21)))/.29 = .49$$

Use C = 0.50

USDA - SCS - Md

July 1975



APPENDIX C

OPEN-CHANNEL HYDRAULICS

VEN TE CHOW, Ph.D.

Professor of Hydraulic Engineering
University of Illinois

McGRAW-HILL BOOK COMPANY

New York Toronto London

1959

well-known form

$$V = \frac{1.49}{n} R^{2/3} S^{1/2} \qquad (5\text{-}6)$$

where V is the mean velocity in fps, R is the hydraulic radius in ft, S is the slope of energy line, and n is the coefficient of roughness, specifically known as *Manning's n*. This formula was developed from seven different formulas, based on Bazin's experimental data, and further verified by 170 observations.[1] Owing to its simplicity of form and to the satis-

---

a linear measure of roughness and $\phi(R/k)$ is a function of R/k. If $\phi(R/k)$ is considered dimensionless, n will have the same dimensions as those of $k^{1/6}$, that is, $L^{1/6}$.

On the other hand, of course, it is equally possible to assume that the numerator of $1.486/n$ can absorb the dimensions of $L^{1/3}T^{-1}$, or that $\phi(R/k)$ involves a dimensional factor, thus leaving no dimensions for n. Some authors, therefore, preferring the simpler choice, consider n a dimensionless coefficient.

It is interesting to note that the conversion of the units for the Manning formula is independent of the dimensions of n, as long as the same value of n is used in both systems of units. If n is assumed dimensionless, then the formula in English units gives the numerical constant $3.2808^{1/3} = 1.486$ since 1 meter = 3.2808 ft. Now, if n is assumed to have the dimensions of $L^{1/6}$, its numerical value in English units must be different from its value in metric units, unless a numerical correction factor is introduced for compensation. Let n be the value in metric units and n' the value in English units. Then, $n' = (3.2808^{1/6})n = 1.2190n$. When the formula is converted from metric to English units, the resulting form takes the numerical constant $3.2808^{1/3+1/6} = 3.2808^{1/2} = 1.811$, since n has the dimensions of $L^{1/6}$. Thus, the resulting equation should be written $V = 1.811R^{2/3}S^{1/2}/n'$. Since the same value of n is used in both systems, the practical form of the formula in the English system is $V = 1.811R^{2/3}S^{1/2}/1.2190n = 1.486R^{2/3}S^{1/2}/n$, which is identical with the formula derived on the assumption that n has no dimensions.

In a search of early literature on hydraulics, the author has failed to find any significant discussion regarding the dimensions of n. It seems that this was not a problem of concern to the forefathers of hydraulics. It is most likely, however, that n was unconsciously taken as dimensionless in the conversion of the Manning formula, because such a conversion, as shown above, is more direct and simpler.

Now, considering the approximations involved in the derivation of the formula and the uncertainty in the value of n, it seems unjustifiable to carry the numerical constant to more than three significant figures. For practical purposes, a value of 1.49 is believed to be sufficiently accurate [16].

Manning mentioned that the simplified form of the formula had been suggested independently by G. H. L. Hagen prior to Manning's own work, according to a statement by Major Cunningham [17]. Hagen's formula was believed to have appeared first in 1876 [7]. It is also known that Philippe-Gaspard Gauckler [18] had an early proposal of the simplified form of Manning's formula in 1868 and that Strickler [19] presented independently the same form of the formula in 1923.

[1] For the derivation of the exponent of R, use was made of Bazin's experimental data on artificial channels [12]. For different shapes and roughnesses, the average value of the exponent was found to vary from 0.6499 to 0.8395. Considering these variations, Manning adopted an approximate value of $2/3$ for the exponent. On the

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n (*continued*)

Type of channel and description	Minimum	Normal	Maximum
B. LINED OR BUILT-UP CHANNELS			
B-1. Metal			
a. Smooth steel surface			
1. Unpainted	0.011	0.012	0.014
2. Painted	0.012	0.013	0.017
b. Corrugated	0.021	0.025	0.030
B-2. Nonmetal			
a. Cement			
1. Neat, surface	0.010	0.011	0.013
2. Mortar	0.011	0.013	0.015
b. Wood			
1. Planed, untreated	0.010	0.012	0.014
2. Planed, creosoted	0.011	0.012	0.015
3. Unplaned	0.011	0.013	0.015
4. Plank with battens	0.012	0.015	0.018
5. Lined with roofing paper	0.010	0.014	0.017
c. Concrete			
1. Trowel finish	0.011	0.013	0.015
2. Float finish	0.013	0.015	0.016
3. Finished, with gravel on bottom	0.015	0.017	0.020
4. Unfinished	0.014	0.017	0.020
5. Gunite, good section	0.016	0.019	0.023
6. Gunite, wavy section	0.018	0.022	0.025
7. On good excavated rock	0.017	0.020	
8. On irregular excavated rock	0.022	0.027	
d. Concrete bottom float finished with sides of			
1. Dressed stone in mortar	0.015	0.017	0.020
2. Random stone in mortar	0.017	0.020	0.024
3. Cement rubble masonry, plastered	0.016	0.020	0.024
4. Cement rubble masonry	0.020	0.025	0.030
5. Dry rubble or riprap	0.020	0.030	0.035
e. Gravel bottom with sides of			
1. Formed concrete	0.017	0.020	0.025
2. Random stone in mortar	0.020	0.023	0.026
3. Dry rubble or riprap	0.023	0.033	0.036
f. Brick			
1. Glazed	0.011	0.013	0.015
2. In cement mortar	0.012	0.015	0.018
g. Masonry			
1. Cemented rubble	0.017	0.025	0.030
2. Dry rubble	0.023	0.032	0.035
h. Dressed ashlar	0.013	0.015	0.017
i. Asphalt			
1. Smooth	0.013	0.013	
2. Rough	0.016	0.016	
j. Vegetal lining	0.030	.....	0.500

n = .02 for design

SUBJECT Union Mine Disposal Site BY J. Cherry DATE 1/4/91
SHEET 1 OF 2
PROJECT NO. SAC26423.5C

Determination of Channel Sizes for Upslope Area
All calculations based on information and graphs contained in Chow's Open Channel Hydraulics.

Mannings Eqn:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Q = flow in cfs
n = roughness coefficient
A = Cross Sectional area, ft^2
R = hydraulic radius, ft
S = slope, ft/ft

Assumed all ditches are shotcrete-lined ⇒ n = .02

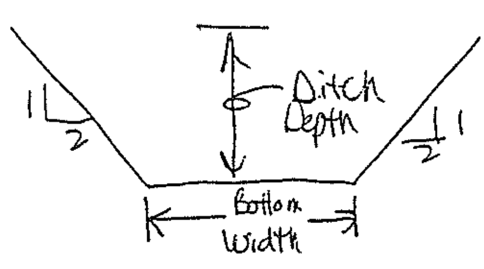
$$S = \frac{1370-1250}{2200} = .055 \quad \text{(average slope)}$$

For each ditch, cross section dimensions were determined based on Manning's eqn. and Velocity heads

Velocity head = $V^2/2g$

V = Velocity, ft/sec
g = gravitational acceleration = 32.2 ft^2/s

Ditch	Bottom Width, ft	Slope	Q, cfs	Normal Depth, ft	Velocity ft/sec	Velocity Head, ft	Ditch Depth
A	0	.055	32.4	1.19	11.5	2.0	3.0
B	0	.055	64.8	1.54	13.6	2.88	4.0
C	3	.055	194.4	1.7	17.8	4.92	6.0
D	0	.055	43.2	1.3	12.8	2.5	3.5



SUBJECT Union Mine Disposal Site BY J. Cherry DATE 11/4/91

SHEET 2 OF 2

PROJECT NO. SAC 26423.5C

For each ditch, the velocity heads were the controlling depth. A freeboard of 1 foot was added to each velocity head.

APPENDIX D

graph. Thus storage in a reservoir depends only on the outflow, contrasted to the dependence on the inflow and outflow in river routing (Eq. 7-3).

For convenience, S is often defined as the "surcharge storage" or the storage above the emergency spillway crest, which simply means that the overflow rate is zero when S is zero. If the graphed storage-outflow relationship is found to be linear, and if the slope of the line is defined as K, then

$$S = KO \tag{7-14}$$

and the reservoir is called a *linear reservoir.* Note that routing through a linear reservoir is a special case of Muskingum river routing shown in Fig. 7-1 using $x = 0.0$ in Eq. 7-3. Note also that the outflow rate in Fig. 7-1 is increasing only while the inflow exceeds the outflow. This observation is consistent with the assumptions that the inflow immediately goes into storage over the entire pool surface and that the outflow depends only on this storage.

Routing through a linear reservoir is easily accomplished by first dividing time into a number of equal increments and then substituting $S_2 = KO_2$ into Eq. 7-4 and solving for O_2, which is the only remaining unknown for each time increment.

To route an emergency flood through a nonlinear reservoir, the storage-outflow relationship and the continuity equation, Eq. 7-4, are combined to determine the outflow and storage at the end of each time increment Δt. Equation 7-4 can be rewritten as

$$I_n + I_{n+1} + \left(\frac{2S_n}{\Delta t} - O_n\right) = \frac{2S_{n+1}}{\Delta t} + O_{n+1} \tag{7-15}$$

in which the only unknown for any time increment is the term on the right side. Pairs of trial values of S_{n+1} and O_{n+1} could be generated that satisfy Eq. 7-15 and checked in the storage-outflow curve for confirmation. Rather than resort to this trial procedure, a value of Δt is selected and points on the storage outflow curve are replotted as the "storage indication" curve shown in Fig. 7-4. This graph allows a *direct* determination of the outflow O_{n+1} once a value of the ordinate $2S_{n+1}/\Delta t + O_{n+1}$ has been calculated from Eq. 7-15. The second unknown, S_{n+1}, can be read from the S-O curve or found from Eq. 7-15. This row-by-row numerical integration of Eq. 7-15 with Fig. 7-4 is illustrated using $\Delta t = 1$ hr in Example 7-3.

Example 7-3 Given the triangular-shaped inflow hydrograph and the $2S/\Delta t + O$ curve of Fig. 7-4, find the outflow hydrograph for the reservoir assuming it to be completely full at the beginning of the storm. (See Table 7-3.)

Source: Warren Viessman, Jr., et al. Introduction to Hydrology, Second Edition. Harper & Row, Publishers. 1977.

INTRODUCTION TO HYDROLOGY, Second Edition

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APPENDIX E

STAGE-STORAGE-OUTFLOW RELATIONSIPS FOR UNION MINE DETENTION BASIN

J. CHERRY SAC26423.4C 1NOV91

BASIN WIDTH= 80 DELTA T (MIN)= 5

BASIN LENGTH= 320

ASSUME 2:1 SIDE SLOPES

DEPTH FT	SURFACE AREA FT2	STORAGE FT3	STORAGE/ΔT CFS	HEAD FT	OUTFLOW CFS	S/ΔT+O/2 CFS
0	25,600	0	0	0		0
1	27,216	26,400	88	0		88
2	28,864	54,400	181	0		181
3	30,544	84,000	280	0		280
3.5	31,396	99,400	331	0.5	28	345
4	32,256	115,200	384	1	61	414
4.5	33,124	131,400	438	1.5	91	483
5	34,000	148,000	493	2	121	554
5.5	34,884	165,000	550	2.5	151	626
6	35,776	182,400	608	3	182	699
7	37,584	218,400	728	4	242	849

UNION MINE DISPOSAL SITE

SURFACE-WATER DETENTION BASIN DESIGN

		BASIN AREA (SQ. FT.) =	25,600
		NUMBER OF RISERS =	4
		RISER DIAM. (IN) =	24
DR. AREA (AC.) =	59	STOR. @ WEIR CREST (CF) =	84,000
RUNOFF COEF. =	0.5	STOR. @ ORIFICE FLOW (CF) =	115,200
24-HR PRECIP. =	6.04	INITIAL STORAGE (CF) =	84,000

PERIOD	TIME (HR)	PRECIP. DIST. (%)	CUMM. PRECIP. (IN)	INFLOW RATE (CFS)	AVG. INFLOW (CFS)	S1-01/2 Δt (CFS)	S2+02/2 Δt (CFS)	OUTFLOW (CFS)	STORAGE (FT3)
0	0.000	0.000	0.00			280		0.00	84000
1	0.083	0.001	0.01	3.12	1.56	280	282	2.04	84000
2	0.167	0.003	0.02	3.12	3.12	280	283	2.62	84397
3	0.250	0.004	0.03	3.12	3.12	280	283	2.89	84506
4	0.333	0.006	0.04	3.12	3.12	280	283	3.01	84555
5	0.417	0.007	0.04	3.12	3.12	280	283	3.07	84578
6	0.500	0.009	0.05	3.12	3.12	280	284	3.10	84589
7	0.583	0.010	0.06	3.12	3.12	280	284	3.11	84594
8	0.667	0.012	0.07	3.12	3.12	280	284	3.11	84596
9	0.750	0.013	0.08	3.12	3.12	280	284	3.12	84597
10	0.833	0.015	0.09	3.12	3.12	280	284	3.12	84598
11	0.917	0.016	0.10	3.12	3.12	280	284	3.12	84598
12	1.000	0.018	0.11	3.12	3.12	280	284	3.12	84598
13	1.083	0.019	0.11	3.12	3.12	280	284	3.12	84598
14	1.167	0.020	0.12	3.12	3.12	280	284	3.12	84598
15	1.250	0.022	0.13	3.12	3.12	280	284	3.12	84598
16	1.333	0.023	0.14	3.12	3.12	280	284	3.12	84598
17	1.417	0.025	0.15	3.12	3.12	280	284	3.12	84598
18	1.500	0.026	0.16	3.12	3.12	280	284	3.12	84598
19	1.583	0.028	0.17	3.12	3.12	280	284	3.12	84598
20	1.667	0.029	0.18	3.12	3.12	280	284	3.12	84598
21	1.750	0.031	0.18	3.12	3.12	280	284	3.12	84598
22	1.833	0.032	0.19	3.12	3.12	280	284	3.12	84598
23	1.917	0.034	0.20	3.12	3.12	280	284	3.12	84598
24	2.000	0.035	0.21	3.12	3.12	280	284	3.12	84598
25	2.083	0.037	0.22	3.65	3.39	280	284	3.26	84657
26	2.167	0.038	0.23	3.65	3.65	281	284	3.47	84742
27	2.250	0.040	0.24	3.65	3.65	281	284	3.57	84781
28	2.333	0.042	0.25	3.65	3.65	281	284	3.61	84799
29	2.417	0.044	0.26	3.65	3.65	281	285	3.64	84808
30	2.500	0.045	0.27	3.65	3.65	281	285	3.64	84812
31	2.583	0.047	0.28	3.65	3.65	281	285	3.65	84813
32	2.667	0.049	0.29	3.65	3.65	281	285	3.65	84814
33	2.750	0.050	0.30	3.65	3.65	281	285	3.65	84814
34	2.833	0.052	0.31	3.65	3.65	281	285	3.65	84815
35	2.917	0.054	0.32	3.65	3.65	281	285	3.65	84815
36	3.000	0.056	0.34	3.65	3.65	281	285	3.65	84815
37	3.083	0.057	0.35	3.65	3.65	281	285	3.65	84815
38	3.167	0.059	0.36	3.65	3.65	281	285	3.65	84815
39	3.250	0.061	0.37	3.65	3.65	281	285	3.65	84815
40	3.333	0.062	0.38	3.65	3.65	281	285	3.65	84815
41	3.417	0.064	0.39	3.65	3.65	281	285	3.65	84815
42	3.500	0.066	0.40	3.65	3.65	281	285	3.65	84815
43	3.583	0.067	0.41	3.65	3.65	281	285	3.65	84815
44	3.667	0.069	0.42	3.65	3.65	281	285	3.65	84815
45	3.750	0.071	0.43	3.65	3.65	281	285	3.65	84815
46	3.833	0.073	0.44	3.65	3.65	281	285	3.65	84815
47	3.917	0.074	0.45	3.65	3.65	281	285	3.65	84815
48	4.000	0.076	0.46	3.65	3.65	281	285	3.65	84815
49	4.083	0.078	0.47	4.37	4.01	281	285	3.85	84893

50	4.167	0.080	0.48	4.37	4.37	281	285	4.13	85007
51	4.250	0.082	0.50	4.37	4.37	281	286	4.26	85059
52	4.333	0.084	0.51	4.37	4.37	281	286	4.31	85083
53	4.416	0.086	0.52	4.37	4.37	281	286	4.34	85094
54	4.500	0.088	0.53	4.37	4.37	281	286	4.35	85099
55	4.583	0.090	0.55	4.37	4.37	281	286	4.36	85102
56	4.666	0.092	0.56	4.37	4.37	281	286	4.36	85103
57	4.750	0.094	0.57	4.37	4.37	281	286	4.36	85103
58	4.833	0.096	0.58	4.37	4.37	281	286	4.37	85104
59	4.916	0.098	0.59	4.37	4.37	281	286	4.37	85104
60	5.000	0.100	0.61	4.37	4.37	281	286	4.37	85104
61	5.083	0.103	0.62	4.37	4.37	281	286	4.37	85104
62	5.166	0.105	0.63	4.37	4.37	281	286	4.37	85104
63	5.250	0.107	0.64	4.37	4.37	281	286	4.37	85104
64	5.333	0.109	0.66	4.37	4.37	281	286	4.37	85104
65	5.416	0.111	0.67	4.37	4.37	281	286	4.37	85104
66	5.500	0.113	0.68	4.37	4.37	281	286	4.37	85104
67	5.583	0.115	0.69	4.37	4.37	281	286	4.37	85104
68	5.666	0.117	0.71	4.37	4.37	281	286	4.37	85104
69	5.750	0.119	0.72	4.37	4.37	281	286	4.37	85104
70	5.833	0.121	0.73	4.37	4.37	281	286	4.37	85104
71	5.916	0.123	0.74	4.37	4.37	281	286	4.37	85104
72	6.000	0.125	0.76	4.37	4.37	281	286	4.37	85104
73	6.083	0.128	0.77	5.52	4.94	281	286	4.68	85231
74	6.166	0.130	0.79	5.52	5.52	282	287	5.13	85416
75	6.250	0.133	0.80	5.52	5.52	282	288	5.34	85501
76	6.333	0.135	0.82	5.52	5.52	282	288	5.44	85540
77	6.416	0.138	0.83	5.52	5.52	282	288	5.49	85558
78	6.500	0.140	0.85	5.52	5.52	282	288	5.51	85566
79	6.583	0.143	0.86	5.52	5.52	282	288	5.52	85570
80	6.666	0.146	0.88	5.52	5.52	282	288	5.52	85572
81	6.750	0.148	0.90	5.52	5.52	282	288	5.52	85573
82	6.833	0.151	0.91	5.52	5.52	282	288	5.52	85573
83	6.916	0.153	0.93	5.52	5.52	282	288	5.52	85573
84	7.000	0.156	0.94	5.52	5.52	282	288	5.52	85573
85	7.083	0.159	0.96	6.77	6.15	282	289	5.86	85710
86	7.166	0.162	0.98	6.77	6.77	283	290	6.35	85910
87	7.250	0.166	1.00	6.77	6.77	283	290	6.58	86001
88	7.333	0.169	1.02	6.77	6.77	283	290	6.68	86043
89	7.416	0.172	1.04	6.77	6.77	283	290	6.73	86063
90	7.500	0.175	1.06	6.77	6.77	284	290	6.75	86072
91	7.583	0.178	1.08	6.77	6.77	284	290	6.76	86076
92	7.666	0.181	1.10	6.77	6.77	284	290	6.77	86078
93	7.750	0.185	1.11	6.77	6.77	284	290	6.77	86079
94	7.833	0.188	1.13	6.77	6.77	284	290	6.77	86079
95	7.916	0.191	1.15	6.77	6.77	284	290	6.77	86079
96	8.000	0.194	1.17	6.77	6.77	284	290	6.77	86079
97	8.083	0.198	1.20	8.91	7.84	284	291	7.35	86313
98	8.166	0.202	1.22	8.91	8.91	284	293	8.19	86655
99	8.250	0.206	1.25	8.91	8.91	285	294	8.58	86813
100	8.333	0.211	1.27	8.91	8.91	285	294	8.76	86885
101	8.416	0.215	1.30	8.91	8.91	285	294	8.84	86918
102	8.500	0.219	1.32	8.91	8.91	285	294	8.88	86934
103	8.583	0.225	1.36	12.47	10.69	285	296	9.86	87331
104	8.666	0.231	1.39	12.47	12.47	286	299	11.27	87904
105	8.750	0.237	1.43	12.47	12.47	287	300	11.92	88167
106	8.833	0.242	1.46	12.47	12.47	288	300	12.22	88289
107	8.916	0.248	1.50	12.47	12.47	288	301	12.36	88344
108	9.000	0.254	1.53	12.47	12.47	288	301	12.42	88370
109	9.083	0.262	1.58	17.46	14.97	288	303	13.80	88928
110	9.166	0.270	1.63	17.46	17.46	290	307	15.78	89731

111	9.250	0.279	1.68	17.46	17.46	291	309	16.69	90101	
112	9.333	0.287	1.73	17.46	17.46	292	309	17.11	90271	
113	9.416	0.295	1.78	17.46	17.46	292	310	17.30	90349	
114	9.500	0.303	1.83	17.46	17.46	293	310	17.39	90385	
115	9.583	0.323	1.95	42.76	30.11	293	323	24.26	93172	
116	9.666	0.342	2.07	40.63	41.70	298	340	33.67	96990	
117	9.750	0.362	2.19	42.76	41.70	306	348	38.01	98747	
118	9.833	0.413	2.49	109.05	75.91	310	386	58.47	107047	
119	9.916	0.464	2.80	109.05	109.05	328	437	85.78	118124	
120	10.000	0.515	3.11	109.05	109.05	351	460	98.35	123219	← Peak Storage
121	10.083	0.526	3.18	23.52	66.29	362	428	81.03	116197	
122	10.166	0.538	3.25	25.66	24.59	347	371	50.55	103836	
123	10.250	0.549	3.32	23.52	24.59	321	345	36.53	98150	
124	10.333	0.560	3.38	23.52	23.52	309	332	29.51	95300	
125	10.416	0.572	3.45	25.66	24.59	303	328	26.85	94223	
126	10.500	0.583	3.52	23.52	24.59	301	325	25.63	93728	
127	10.583	0.590	3.56	14.97	19.24	300	319	22.18	92329	
128	10.666	0.596	3.60	12.83	13.90	297	311	17.71	90515	
129	10.750	0.603	3.64	14.97	13.90	293	307	15.65	89681	
130	10.833	0.610	3.68	14.97	14.97	291	306	15.28	89531	
131	10.916	0.617	3.73	14.97	14.97	291	306	15.11	89462	
132	11.000	0.624	3.77	14.97	14.97	291	306	15.03	89431	
133	11.083	0.629	3.80	10.69	12.83	291	303	13.84	88948	
134	11.166	0.634	3.83	10.69	10.69	290	300	12.14	88257	
135	11.250	0.639	3.86	10.69	10.69	288	299	11.36	87940	
136	11.333	0.644	3.89	10.69	10.69	287	298	11.00	87794	
137	11.416	0.649	3.92	10.69	10.69	287	298	10.83	87726	
138	11.500	0.654	3.95	10.69	10.69	287	298	10.76	87696	
139	11.583	0.659	3.98	9.98	10.33	287	297	10.53	87603	
140	11.666	0.663	4.01	9.98	9.98	287	297	10.23	87483	
141	11.750	0.668	4.03	9.98	9.98	286	296	10.09	87427	
142	11.833	0.673	4.06	9.98	9.98	286	296	10.03	87402	
143	11.916	0.677	4.09	9.98	9.98	286	296	10.00	87390	
144	12.000	0.682	4.12	9.98	9.98	286	296	9.99	87385	
145	12.083	0.686	4.14	8.02	9.00	286	295	9.45	87168	
146	12.166	0.690	4.16	8.02	8.02	286	294	8.68	86853	
147	12.250	0.693	4.19	8.02	8.02	285	293	8.32	86708	
148	12.333	0.697	4.21	8.02	8.02	285	293	8.16	86642	
149	12.416	0.701	4.23	8.02	8.02	285	293	8.08	86611	
150	12.500	0.705	4.26	8.02	8.02	285	293	8.05	86597	
151	12.583	0.708	4.28	8.02	8.02	285	293	8.03	86591	
152	12.666	0.712	4.30	8.02	8.02	285	293	8.02	86588	
153	12.749	0.716	4.32	8.02	8.02	285	293	8.02	86586	
154	12.833	0.720	4.35	8.02	8.02	285	293	8.02	86586	
155	12.916	0.723	4.37	8.02	8.02	285	293	8.02	86585	
156	12.999	0.727	4.39	8.02	8.02	285	293	8.02	86585	
157	13.083	0.730	4.41	7.13	7.57	285	292	7.78	86488	
158	13.166	0.734	4.43	7.13	7.13	284	292	7.43	86345	
159	13.249	0.737	4.45	7.13	7.13	284	291	7.27	86280	
160	13.333	0.740	4.47	7.13	7.13	284	291	7.19	86250	
161	13.416	0.744	4.49	7.13	7.13	284	291	7.16	86236	
162	13.499	0.747	4.51	7.13	7.13	284	291	7.14	86229	
163	13.583	0.750	4.53	7.13	7.13	284	291	7.13	86226	
164	13.666	0.754	4.55	7.13	7.13	284	291	7.13	86225	
165	13.749	0.757	4.57	7.13	7.13	284	291	7.13	86224	
166	13.833	0.760	4.59	7.13	7.13	284	291	7.13	86224	
167	13.916	0.764	4.61	7.13	7.13	284	291	7.13	86224	
168	13.999	0.767	4.63	7.13	7.13	284	291	7.13	86224	
169	14.083	0.770	4.65	5.61	6.37	284	290	6.72	86058	
170	14.166	0.772	4.66	5.61	5.61	284	289	6.12	85816	
171	14.249	0.775	4.68	5.61	5.61	283	289	5.85	85705	

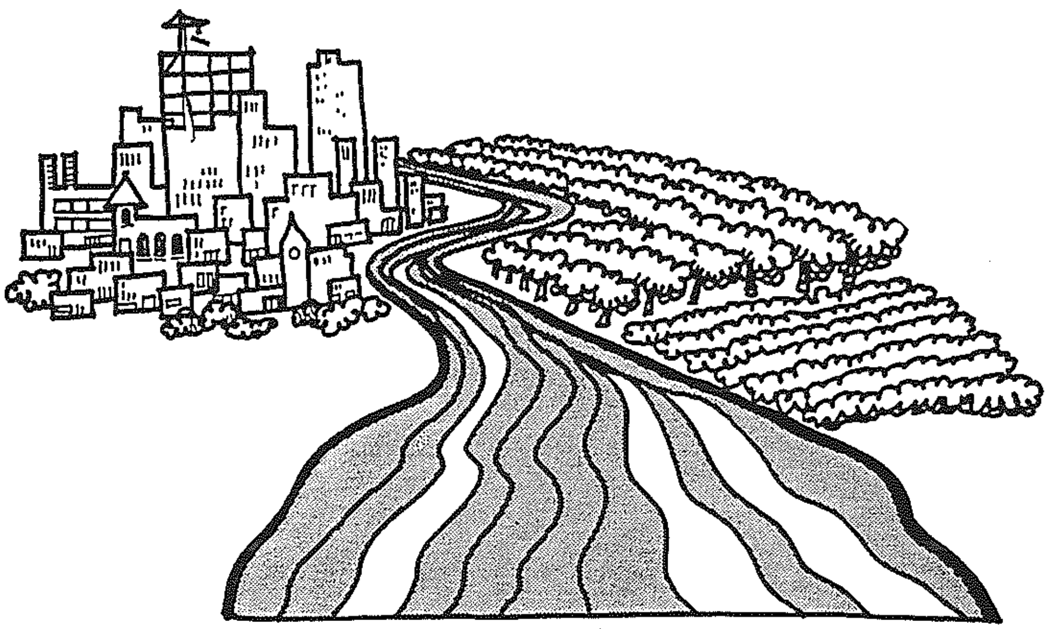
172	14.333	0.778	4.70	5.61	5.61	283	288	5.72	85653
173	14.416	0.780	4.71	5.61	5.61	283	288	5.66	85630
174	14.499	0.783	4.73	5.61	5.61	283	288	5.64	85619
175	14.583	0.785	4.74	5.61	5.61	283	288	5.62	85614
176	14.666	0.788	4.76	5.61	5.61	283	288	5.62	85612
177	14.749	0.791	4.78	5.61	5.61	283	288	5.62	85611
178	14.833	0.793	4.79	5.61	5.61	283	288	5.61	85610
179	14.916	0.796	4.81	5.61	5.61	283	288	5.61	85610
180	14.999	0.798	4.82	5.61	5.61	283	288	5.61	85610
181	15.083	0.801	4.84	5.61	5.61	283	288	5.61	85610
182	15.166	0.804	4.85	5.61	5.61	283	288	5.61	85610
183	15.249	0.806	4.87	5.61	5.61	283	288	5.61	85610
184	15.333	0.809	4.89	5.61	5.61	283	288	5.61	85610
185	15.416	0.812	4.90	5.61	5.61	283	288	5.61	85610
186	15.499	0.814	4.92	5.61	5.61	283	288	5.61	85610
187	15.583	0.817	4.93	5.61	5.61	283	288	5.61	85610
188	15.666	0.819	4.95	5.61	5.61	283	288	5.61	85610
189	15.749	0.822	4.97	5.61	5.61	283	288	5.61	85610
190	15.833	0.825	4.98	5.61	5.61	283	288	5.61	85610
191	15.916	0.827	5.00	5.61	5.61	283	288	5.61	85610
192	15.999	0.830	5.01	5.61	5.61	283	288	5.61	85610
193	16.083	0.832	5.03	4.28	4.94	283	288	5.25	85463
194	16.166	0.834	5.04	4.28	4.28	282	287	4.73	85250
195	16.249	0.836	5.05	4.28	4.28	282	286	4.48	85151
196	16.333	0.838	5.06	4.28	4.28	282	286	4.37	85106
197	16.416	0.840	5.07	4.28	4.28	282	286	4.32	85085
198	16.499	0.842	5.09	4.28	4.28	281	286	4.30	85076
199	16.583	0.844	5.10	4.28	4.28	281	286	4.29	85071
200	16.666	0.846	5.11	4.28	4.28	281	286	4.28	85069
201	16.749	0.848	5.12	4.28	4.28	281	286	4.28	85068
202	16.833	0.850	5.13	4.28	4.28	281	286	4.28	85068
203	16.916	0.852	5.15	4.28	4.28	281	286	4.28	85068
204	16.999	0.854	5.16	4.28	4.28	281	286	4.28	85068
205	17.083	0.856	5.17	4.28	4.28	281	286	4.28	85068
206	17.166	0.858	5.18	4.28	4.28	281	286	4.28	85068
207	17.249	0.860	5.19	4.28	4.28	281	286	4.28	85068
208	17.333	0.862	5.21	4.28	4.28	281	286	4.28	85068
209	17.416	0.864	5.22	4.28	4.28	281	286	4.28	85068
210	17.499	0.866	5.23	4.28	4.28	281	286	4.28	85068
211	17.583	0.868	5.24	4.28	4.28	281	286	4.28	85068
212	17.666	0.870	5.25	4.28	4.28	281	286	4.28	85068
213	17.749	0.872	5.27	4.28	4.28	281	286	4.28	85068
214	17.833	0.874	5.28	4.28	4.28	281	286	4.28	85068
215	17.916	0.876	5.29	4.28	4.28	281	286	4.28	85068
216	17.999	0.878	5.30	4.28	4.28	281	286	4.28	85068
217	18.083	0.880	5.32	4.28	4.28	281	286	4.28	85068
218	18.166	0.882	5.33	4.28	4.28	281	286	4.28	85068
219	18.249	0.884	5.34	4.28	4.28	281	286	4.28	85068
220	18.333	0.886	5.35	4.28	4.28	281	286	4.28	85068
221	18.416	0.888	5.36	4.28	4.28	281	286	4.28	85068
222	18.499	0.890	5.38	4.28	4.28	281	286	4.28	85068
223	18.583	0.892	5.39	4.28	4.28	281	286	4.28	85068
224	18.666	0.894	5.40	4.28	4.28	281	286	4.28	85068
225	18.749	0.896	5.41	4.28	4.28	281	286	4.28	85068
226	18.833	0.898	5.42	4.28	4.28	281	286	4.28	85068
227	18.916	0.900	5.44	4.28	4.28	281	286	4.28	85068
228	18.999	0.902	5.45	4.28	4.28	281	286	4.28	85068
229	19.083	0.904	5.46	4.28	4.28	281	286	4.28	85068
230	19.166	0.906	5.47	4.28	4.28	281	286	4.28	85068
231	19.249	0.908	5.48	4.28	4.28	281	286	4.28	85068
232	19.333	0.910	5.50	4.28	4.28	281	286	4.28	85068

233	19.416	0.912	5.51	4.28	4.28	281	286	4.28	85068
234	19.499	0.914	5.52	4.28	4.28	281	286	4.28	85068
235	19.583	0.916	5.53	4.28	4.28	281	286	4.28	85068
236	19.666	0.918	5.54	4.28	4.28	281	286	4.28	85068
237	19.749	0.920	5.56	4.28	4.28	281	286	4.28	85068
238	19.833	0.922	5.57	4.28	4.28	281	286	4.28	85068
239	19.916	0.924	5.58	4.28	4.28	281	286	4.28	85068
240	19.999	0.926	5.59	4.28	4.28	281	286	4.28	85068
241	20.083	0.928	5.60	3.30	3.79	281	285	4.01	84960
242	20.166	0.929	5.61	3.30	3.30	281	284	3.63	84804
243	20.249	0.931	5.62	3.30	3.30	281	284	3.45	84732
244	20.333	0.932	5.63	3.30	3.30	281	284	3.37	84698
245	20.416	0.934	5.64	3.30	3.30	281	284	3.33	84683
246	20.499	0.935	5.65	3.30	3.30	281	284	3.31	84676
247	20.583	0.937	5.66	3.30	3.30	281	284	3.30	84673
248	20.666	0.938	5.67	3.30	3.30	281	284	3.30	84671
249	20.749	0.940	5.68	3.30	3.30	281	284	3.30	84671
250	20.833	0.941	5.69	3.30	3.30	281	284	3.30	84670
251	20.916	0.943	5.70	3.30	3.30	281	284	3.30	84670
252	20.999	0.945	5.70	3.30	3.30	281	284	3.30	84670
253	21.082	0.946	5.71	3.30	3.30	281	284	3.30	84670
254	21.166	0.948	5.72	3.30	3.30	281	284	3.30	84670
255	21.249	0.949	5.73	3.30	3.30	281	284	3.30	84670
256	21.332	0.951	5.74	3.30	3.30	281	284	3.30	84670
257	21.416	0.952	5.75	3.30	3.30	281	284	3.30	84670
258	21.499	0.954	5.76	3.30	3.30	281	284	3.30	84670
259	21.582	0.955	5.77	3.30	3.30	281	284	3.30	84670
260	21.666	0.957	5.78	3.30	3.30	281	284	3.30	84670
261	21.749	0.958	5.79	3.30	3.30	281	284	3.30	84670
262	21.832	0.960	5.80	3.30	3.30	281	284	3.30	84670
263	21.916	0.961	5.81	3.30	3.30	281	284	3.30	84670
264	21.999	0.963	5.82	3.30	3.30	281	284	3.30	84670
265	22.082	0.965	5.83	3.30	3.30	281	284	3.30	84670
266	22.166	0.966	5.84	3.30	3.30	281	284	3.30	84670
267	22.249	0.968	5.84	3.30	3.30	281	284	3.30	84670
268	22.332	0.969	5.85	3.30	3.30	281	284	3.30	84670
269	22.416	0.971	5.86	3.30	3.30	281	284	3.30	84670
270	22.499	0.972	5.87	3.30	3.30	281	284	3.30	84670
271	22.582	0.974	5.88	3.30	3.30	281	284	3.30	84670
272	22.666	0.975	5.89	3.30	3.30	281	284	3.30	84670
273	22.749	0.977	5.90	3.30	3.30	281	284	3.30	84670
274	22.832	0.978	5.91	3.30	3.30	281	284	3.30	84670
275	22.916	0.980	5.92	3.30	3.30	281	284	3.30	84670
276	22.999	0.982	5.93	3.30	3.30	281	284	3.30	84670
277	23.082	0.983	5.94	3.30	3.30	281	284	3.30	84670
278	23.166	0.985	5.95	3.30	3.30	281	284	3.30	84670
279	23.249	0.986	5.96	3.30	3.30	281	284	3.30	84670
280	23.332	0.988	5.97	3.30	3.30	281	284	3.30	84670
281	23.416	0.989	5.97	3.30	3.30	281	284	3.30	84670
282	23.499	0.991	5.98	3.30	3.30	281	284	3.30	84670
283	23.582	0.992	5.99	3.30	3.30	281	284	3.30	84670
284	23.666	0.994	6.00	3.30	3.30	281	284	3.30	84670
285	23.749	0.995	6.01	3.30	3.30	281	284	3.30	84670
286	23.832	0.997	6.02	3.30	3.30	281	284	3.30	84670
287	23.916	0.998	6.03	3.30	3.30	281	284	3.30	84670
288	23.999	1.000	6.04	3.30	3.30	281	284	3.30	84670
289									

APPENDIX F

Manual of Standards for

EROSION & SEDIMENT CONTROL MEASURES



ABAG ASSOCIATION OF BAY AREA GOVERNMENTS

REVISED EDITION JUNE 1981

4. The sediment storage zone shall consist of sufficient volume to retain sediment expected to be captured by the basin between maintenance cleanouts. For a once-per-year cleaning, storage for an entire season's soil capture shall be provided. This volume is in addition to the settling zone volume of the basin and may be estimated using the Universal Soil Loss Equation for incoming sediment and assuming basin efficiency for retaining sediment.

5. The sediment settling zone shall always be kept free of sediment. Within it, particles of sediment settle to the storage zone. The sediment settling volume shall be based upon a minimum 2-foot depth to the storage zone.

6. The surface area of the sediment basin shall be calculated at the height of the rim of the riser as follows:

$$A \text{ (sq. ft.)} = \frac{K\,Q \text{ (cfs)}}{Vs \text{ (ft/sec)}}$$

where: A is the surface area of the sediment basin, in square feet;

Q is the design overflow rate at the riser or spillway, in cubic feet per second;

Vs is the settling velocity of the selected particle size, expressed in feet per second. (All soil particles greater than or equal to the selected particle size are to be retained in the basin.)

K is an adjustment factor for nonideal settling basins, equal to 1.2.

7. The design overflow rate at the riser, Q, shall be calculated by the Rational Method, or other approved method, and shall be based upon a minimum rainfall intensity of the 10-year-frequency, 6-hour duration rainfall total, averaged over 6 hours, for the site in question. Runoff computation shall be based upon the soil cover conditons expected to prevail in the contributing drainage area during the anticipated effective life of this sediment basin.

8. The settling velocity, Vs, which shall be for the 0.02-millimeter particle, is 0.00096 feet per second. (This particle size is recommended. The local jurisdiction may select another particle size based upon the efficiency desired.)

9. The basin configuration shall be such that the length is greater than or equal to the width.

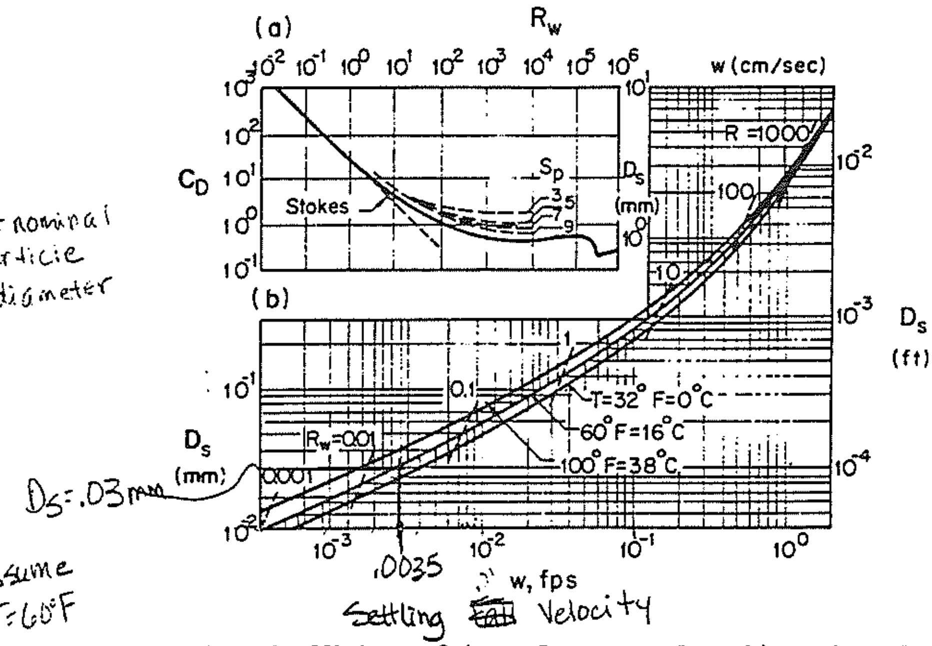
Source: Association of Bay Area Governments. Manual of Standards for Erosion and Sediment Control Measures. June 1981.

SEDIMENT TRANSPORT TECHNOLOGY

by
DARYL B. SIMONS
and
FUAT ŞENTÜRK

Water Resources Publications
Fort Collins, Colorado 80522, USA
1977

Ds- nominal particle diameter



Assume T=60°F

Fig. 4.3 Coefficient of drag C_D versus Reynolds number R_w for spheres and natural sediments with shape factors S_p equal to 0.3, 0.7, and 0.9.

For falling spheres Eq. 4.27 yields:

$$\frac{\pi}{6} D_s^3 \gamma_s' = \frac{\pi}{8} C_D \frac{\gamma}{g} D_s^2 w^2$$

and

$$w^2 = \frac{4}{3} \frac{g}{C_D} \frac{\gamma_s'}{\gamma} D_s \quad (4.28$$

In regions where Stokes law applies C_D, as defined by Eq. 4.23, can be substituted giving:

$$w = \frac{g}{18} \frac{D_s^2}{\nu} \frac{\gamma_s'}{\gamma} \quad (4.2$$

which is identical to Eq. 4.25.

Source: Simons & Sentürk. Sediment Transport Technology. Water Resources Publication, Fort Collins, CO. 1977.

An Introduction to Geotechnical Engineering

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D_5 = .03mm

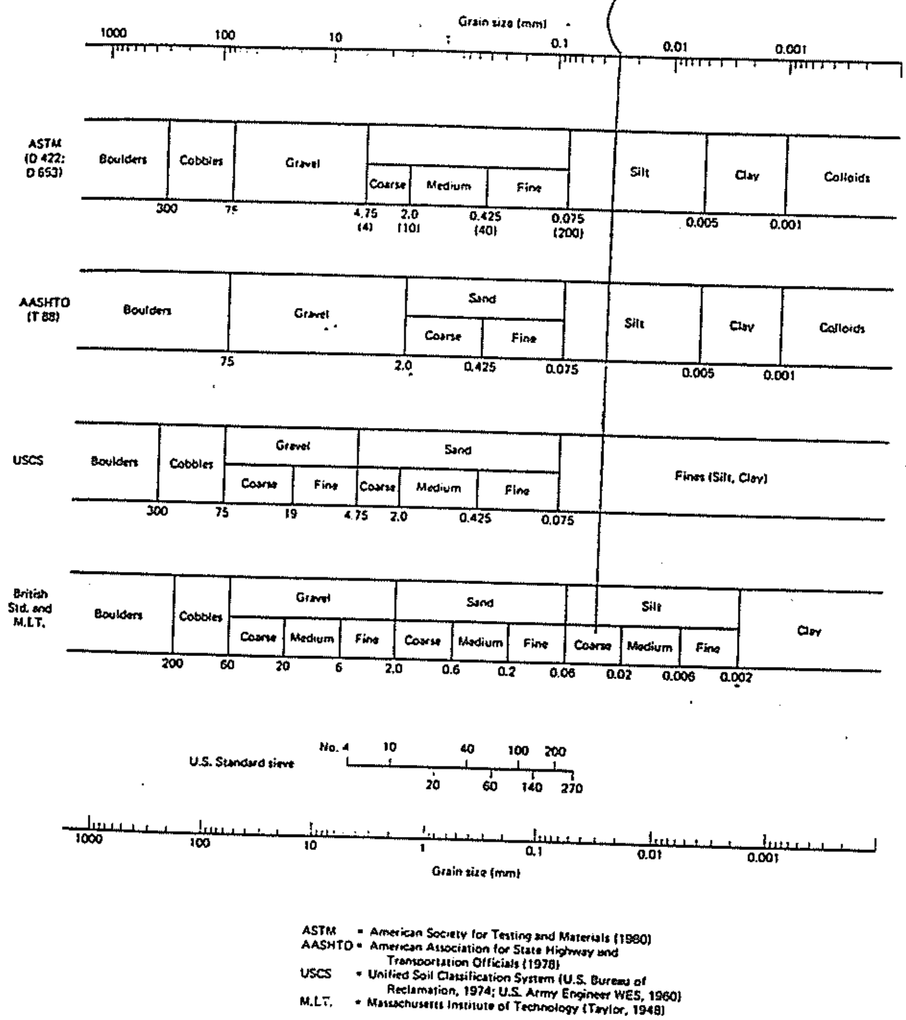


Fig. 2.3 Grain size ranges according to several engineering soil classification systems (modified after Al-Hussaini, 1977).

The range of possible particle sizes in soils is tremendous. Soils can range from boulders or cobbles of several centimetres in diameter down to ultrafine-grained colloidal materials. The maximum possible range is on the order of 10^8, so usually we plot grain size distributions versus the *logarithm* of average grain diameter. Figure 2.3 indicates the divisions between the various textural sizes according to several common engineering classification schemes. It should be noted that traditionally in the

Source: Robert D. Holtz and William D. Kovacs. An Introduction to Geotechnical Engineering. Prentice-Hall, Inc. 1981.

Memorandum No. 1B

Proposed drainage improvements along Union Mine Road.

Drainage improvements proposed along Union Mine Road consist of shotcrete-lined interceptor ditches (A, B, C, and D) to collect all surface runoff from the upslope area located west of the existing landfill. The purpose of the interceptor ditch is to prevent any upslope water from mingling with the noncontact surface water collected on the east side of Union Mine Road. This design will allow the upslope runoff to be directly discharged to Martinez Creek without being routed to a detention basin.

Interceptor Ditches A, B, and C were designed to flow south and interceptor Ditch D will flow north. Collected upslope runoff will be conveyed to a central collection location located at the southwest corner of the expansion area (Figure 1). The existing 12-inch culvert located at this point of collection will be replaced with two 36-inch culverts to convey water under Union Mine Road. This water will either be siphoned or pumped to the upslope bypass pipeline located on the south side of the expansion area, and ultimately be directly discharged into Martinez Creek.

The upslope watershed has been preliminarily identified as shown in Figure 2, with a resulting total area of 220 acres. This watershed area will be better defined during final design when more accurate survey information of this area is obtained. The upslope watershed was divided into four subareas, and the resulting peak flow from each area was calculated for the 100-year, 24-hour storm. Peak flows were determined by using the Rational Method (Appendix A):

$$q = CiA$$

q = Peak runoff rate, cfs

C = Runoff coefficient

i = Rainfall intensity for the design return period and for a duration equal to the time of concentration of the watershed, in/hr

A = Watershed area, acres

The runoff coefficient for the upslope area was determined to be 0.43 (see Appendix A). The rainfall intensity of 2.52 inches per hour was obtained from the Placerville DSP precipitation gage based on the watershed's time of concentration of 10 minutes (Appendix B). (The time of concentration calculation is provided in Appendix A.)

For each subarea, the following peak runoff rates were determined:

Subarea	Ditch Section	C	i (in/hr)	A (acres)	Q (cfs)
1	A	0.43	2.52	30	32.4
2	B	0.43	2.52	30	32.4
3	C	0.43	2.52	120	129.6
4	D	0.43	2.52	40	43.2

Manning's equation was used to determined the appropriate ditch size based on the calculated peak flows (Appendix C). The following sizes were determined for each ditch:

Ditch	Q (cfs)	Depth (feet)	Bottom Width (feet)
A	32.4	3.0	0
B	64.8	4.0	0
C	194.4	5.5	3
D	43.2	3.5	0

Other drainage improvements along Union Mine Road consist of (1) plugging or removing existing culverts beneath Union Mine Road along the length of the proposed interceptor ditch, and (2) filling the area located at the southwest corner of the expansion area landfill to the final landfilled expansion area elevation. The "fill" area will be filled with clean material to prevent ponding of surface runoff in this area. Surface runoff will be routed around the fill area by interceptor Ditch D. Another collection ditch may be required on the east side of Union Mine Road at the base of the fill area. This determination will be made during final design when better survey data of the fill area are available.

ATTACHMENT D:
ARCHAEOLOGICAL SITE RECORD

ARCHAEOLOGICAL SITE RECORD

Permanent Trinomial: ________
Other Designations: U-1

Page 1 of 5

1. County: El Dorado

2. USGS Quad: Placerville NE, 7.5 minute, 1949 Photorevised 1973

3. UTM Coordinates: Zone 10
   SW = ~688470 E, 4279080 N
   SE = ~689200 E, 4279080 N
   NW = ~428070 E, 4280010 N
   NE = ~428080 E, 4280010N

4. Township 19N Range 10E ; SE 1/4 of NW 1/4 of Section 12

5. Map Coordinates: 440 mmS 165 mmE (from NW corner of map)

6. Elevation: 350 meters (1150 feet) msl to 396 meters (1300 feet) msl

7. Location: Approximately 4.8 kilometers (3 miles) south of the town of El Dorado, off Union Mine Road, from Route 49. Site is along dirt landfill road that lies southeast of the landfill site.

8. Prehistoric ________ Historic XX Historic Indian ________

9. Site Description: The Union Mine is part of the Church and Union mines district, originating with a claim, patented as the Hermitage Ledge in the early 1850s by the partnership of Hoover, Crow and Company. In 1855-56, the mines were owned by a partnership called Dr. Frost and Brother. In 1852, a ten-stamp mill was added that was steam-powered until 1857 and the conversion to hydraulic power with water obtained from the Diamond Springs Ditch (otherwise known as No Name Creek). The trustees of the Church-Union Gold Company of New York controlled the mines in 1865, and recovered gold valued at $600,000 from 1851 to 1868. The Mine was owned and operated from 1871 to 1886 by a partnership variously called Alvinza Hayward and Hobart or Hayward and Hobart, and renamed the Springfield District. It was idle from 1886 to ca. 1896, when a 30-stamp mill was built by the Union Gold Mine Company. By 1915, the Mine was owned by the John A. Finch Estate and directed by a Washington state firm. Between 1936 and 1937, the Montezuma-Apex Mining Company extracted ore from the Union Mine and trucked it to their mill in Nashville, about 4.5 miles to the south. Onsite mining became sporadic after 1937, and by 1940 the mining activity ceased. In 1962 El Dorado County obtained the property for a landfill, which operated as an open burn dump until 1969, when it was converted to a Class III solid waste landfill. Only footings with mining features remain on the site.

10. Area: ~250 m (NWxSE) x ~200 m (NExSW)
    Method of Determination: USGS Quad

11. Depth: 2000 feet, Springfield Shaft
Method of Determination: Engineering Report

12. Features:

Feature 1: Big Cut Stope: The shaft entrance is located on the west edge of the existing Union Mine Landfill site at an elevation of 1325 feet msl, and the top measures approximately 10 feet across. The natural rock walls are relatively smooth. One milled and greatly weathered board from the original structure lies across the top of the shaft, with other pieces of wood scattered in the immediate vicinity. The iron hoist cable lies 7 feet southwest of the shaft, on top of a sizeable, vegetated rock dump. This shaft is abutted on the north and west sides by the existing landfill, with modern garbage scattered in the general vicinity. Depth is unknown.

Feature 2: Unnamed Adit: This stope, a step-like excavation underground for the removal of ore, is located in the southwest corner of the proposed Union Mine Landfill Expansion, lies at an elevation of approximately 1200 feet msl. The opening is circa 20 feet across, with a height varying from 4 to 6 feet. The entrance slopes approximately 2 feet before leveling out, and at the time of survey, 4 inches of standing water were present. The stope extends into the hillside at a bearing of ca. 180 degrees south. The nearby stream, Diamond Springs Ditch (No Name Creek), lies at the base of the stope's rock dump, north of the stope.

Feature 3. Footings for Stamp Mill: Footings for 10 stamp batteries were made of 3 feet of Portland cement for each of 2 footings. Numerous iron screws, 1 inch diameter each, protrude vertically through the cement. The main concrete battery footing is 12.5 feet x 11 feet x 5 feet high. One small side structure is located east of main footings and is 3 feet x 2 feet x 2.3 feet tall. Footings are located ca. 6 feet south of the adjacent dirt landfill road. A trail to the Golden Gate Adit extends west of these footings, which perhaps served the Minerva and Pendar adits, as well.

Feature 4. Series of 3 Mill Terraces: Located approximately 100 feet south of Feature 3, on a moderately sloped, relatively unvegetated hill, lies an eroded series of mill terraces. Situated east/west, the ten stamp mill was constructed in 1852 and was steam-powered until 1857, when the mill was powered by a water wheel with consistently flowing water obtained from the Diamond Springs Ditch , or No Name Creek. Two historic, grafted fruit trees (probably apple) are situated approximately 6 feet west of the terraces and three other apple trees stand in the immediate vicinity. Items found on the lowest terrace include one broken brick, two flattened metal cans opened with a church key, one steel can, one piece of broken brown glass, one small piece of sheet metal, and a slight deposit of historic burned wood and charcoal. No items were collected.

Feature 5. Golden Gate Adit: The entrance to this adit lies approximately 30 feet west of Diamond Springs Ditch (No Name Creek), at an elevation of 1200 feet msl, approximately 150 feet south of Feature 3. Vegetation in the immediate vicinity is overgrown, indicating the early excavation of this adit probably ca. 1850. The portal measures ca. 5.5 feet across and 3 feet high. The adit has a downwardly sloped entrance, with a floor under approximately 3 inches of standing water. Piles of waste rock and debris from the adit have filled the area in front of the portal to a level terrace.

Feature 6. Footings for Stamp Mill: This was a 20 stamp mill, with four batteries of 5 stamps, each 18 feet long, 2.5 feet wide, and 2 feet, 5 inches high. The footings together are 30 feet long. The original walls were made of lime cement and later refurbished with Portland Cement. Located on the south side of the existing landfill, the stamp batteries have undergone considerable damage. One-inch diameter metal screws protrude vertically from the batteries, which have been broken by earthmoving equipment from the Union Mine Landfill. Modern debris, including truck tires, broken pipes and household garbage, surround the footings. One historic cut nail and several broken bolts from the footings were found on site. No items were collected.

Feature 7, Pendar Adit: This adit lies ca. 15 feet south of the Diamond Springs Ditch at an elevation of ca. 1200 feet msl. Its sides are approximately 4.5 feet apart, with a height of ca. 3 feet. It is situated on a hill adjacent to, and approximately 90 feet southwest Feature 6. Waste rock from the adit was dispersed on both sides of the drainage and was probably used for a wheelbarrow slope on its north side. Trees and roots have fallen over the portal, collapsing ca. 15 feet of the adit. Historic items associated with this feature include milled and greatly weathered planks, perhaps from the original mining activity, and 5 evaporated milk cans, opened with a church key. No items were collected.

Feature 8, Minerva Adit: Situated on the eastern rim of the current Union Mine Landfill, this adit has been collapsed by the landfill's earthmoving activities. Its portal is inundated with orange colored water that obscures the perimeters of the adit, which lies approximately 200 feet north of Feature 5, at an elevation of ca. 1250 feet msl.

13. Artifacts: Artifacts were found in association with the mill site (Feature 4: one broken brick, two flattened metal cans, one steel can, one piece of broken brown glass, one small piece of sheet metal, and a slight deposit of historic burned wood and charcoal), and with the footings for Springfield Shaft Stamp Batteries (one historic cut nail and broken bolts from the footings). No items were collected.

14. Non-Artifactual Constituents and Faunal Remains: Two grafted apple trees associated with Feature 4 (series of three terraces for original mill site).

15. Date Recorded: March 28 and April 26, 1991.

16. Recorded by: Carolyn Rice

17. Affiliation and Address: ERC Environmental and Energy Company, Inc., 201 Spear Street, Suite 1660, San Francisco, California 94105.

18. Human Remains: None Observed

19. Site Disturbances: Features 1 and 6, the Big Cut Stope and Springfield Shaft battery footings, have been severely eroded by earthmoving activities associated with the Union Mine Landfill. Springfield Shaft, itself, has been obscured by bulldozing. Other features have been slightly disturbed by road grading for the landfill. Feature 3, stamp battery footings near the Golden Gate Adit, has been littered with modern bottles and food wrappers. Based on surface evidence, it is estimated that 75-80 percent of the site is intact. Additional impacts that may affect up to 100 percent of the site, will occur as a result of the proposed Union Mine Landfill Expansion.

20. Nearest Water: The Diamond Springs Ditch, otherwise known as No Name Creek, flows east/west on the site, between both sides of the mine features described in this

record. This stream is a tributary of Martinez Creek, which flows east of this portion of the Church-Union Mine district. Diamond Springs Ditch (No Name Creek) is fed by intermittent drainage courses flowing adjacent to the existing and proposed landfill sites. Seasonal rainfall and drainage from the mine workings, along with local springs, feed the ditch primarily during winter and spring months.

21. Vegetation Community (site vicinity): Upper Sonoran life zone, (~150-1220 m elevation) is marked by blue oak, interior live oak, digger pine woodland, woodland-grass savanna, manzanita, chamise, ceanothus, and chaparral. A riparian zone containing alder, broad-leaf maple, bracken fern, thimbleberry, poison oak, California holly and blackberry, among other species, line both sides of Diamond Springs Ditch, otherwise known as No Name Creek.

22. Onsite Vegetation: As vegetation community described above, with the addition of two grafted apple trees.

23. Site Soil: Brown sandy loam with ca. 5-15 feet of waste rock and materials from road construction fill overlying the bedrock along Diamond Springs Ditch (No Name Creek).

24. Surrounding Soil: Brown Sandy Loam.

25. Geology: Metamorphosed sedimentary rock of the Mariposa Formation with intermittent fracture sets containing gold deposits.

26. Landform: The site's configuration generally slopes moderately to steeply to the south and east into the existing canyon and gullies.

27. Slope: 2 to 35 percent.

28. Exposure: Moderately open to sun and wind.

29. Landowner(s) (and/or tenants) and Address: El Dorado County Solid Waste Department, 7563 Green Valley Road, Placerville.

30. Remarks: This study was done in conjunction with the El Dorado County Union Mine Landfill Expansion/Closure Environmental Impact Report (ERCE).

31. References: This record was filed in conjunction with the above-named EIR by Carolyn Rice and J. Lenore Pigniolo for ERC Environmental and Energy Company, Inc., in April 1991.

Ch2M Hill. 1990/1991. Preliminary Closure and Postclosure Maintenance Plan. Sacramento.

Church Union Gold Company. 1865 Church Union Gold Company: A Description of its Resources and the Report of Professor Silliman and its Advantages. New York: Francis and Loutrel, Stationers and Steam Printers.

Clark, William B. and D.W. Carlson. 1956. El Dorado County Mines and Geology. California Journal of Mines and Geology Bulletin #52 Number 4. October .

Francis, Valentine and Company. Mines and Mining in El Dorado County, California, the Mineral Belt, Principal Mines, etc. San Francisco: Francis, Valentine and Company Printers and Engravers.

Storer, T.I. and R.L. Usinger, 1968. Sierra Nevada Natural History, Berkeley: University of California Press.

32. Name of Project: El Dorado County Union Mine Landfill Expansion/Closure Environmental Impact Report.

33. Type of Investigation: Surface survey.

34. Site Accession Number: No collections.

35. Photos: 35 mm black and white prints
Church-Union Roll #1, Frames 1 through 21

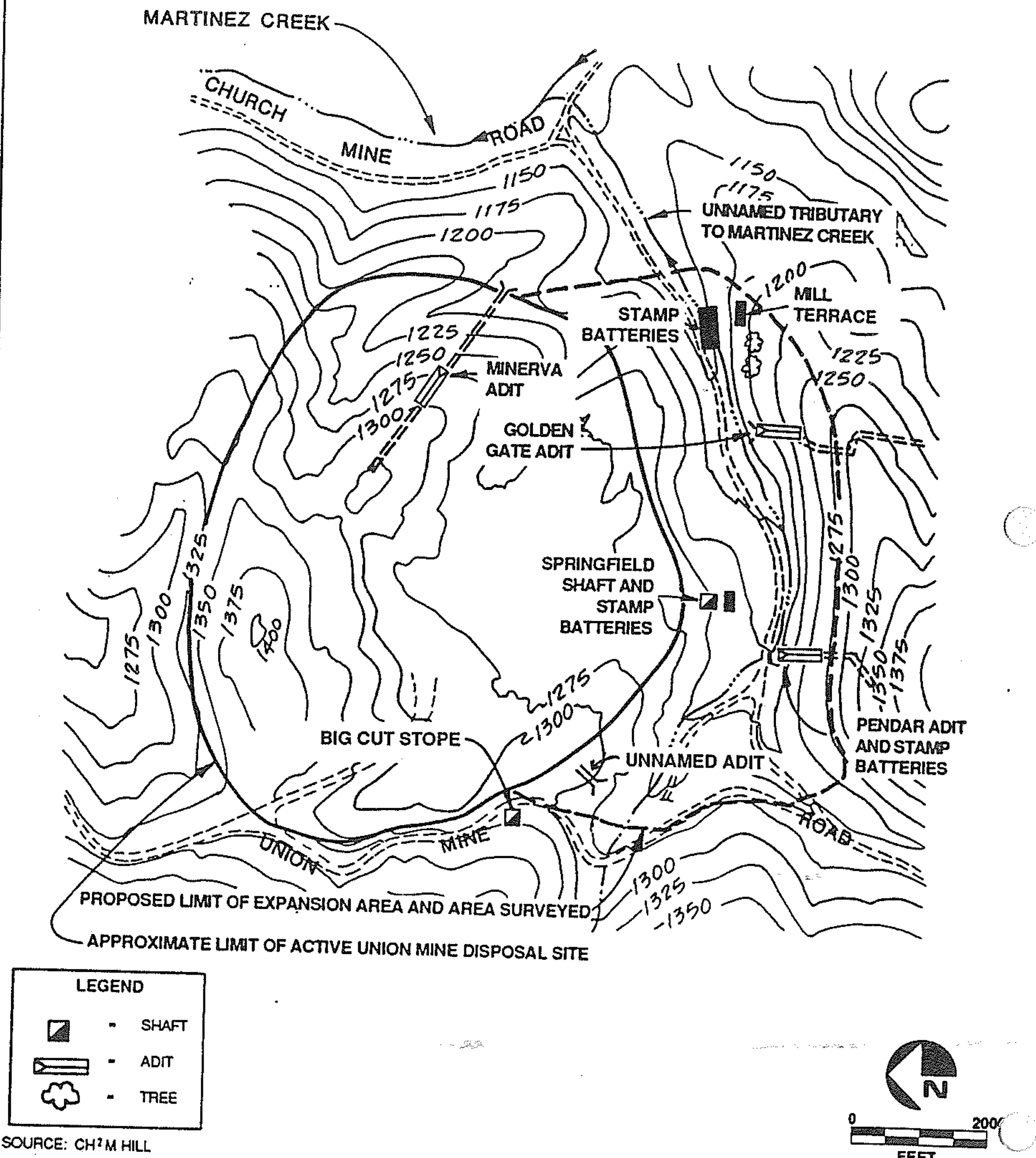
State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

ARCHEOLOGICAL SITE MAP

Page 1 of 1

Permanent Trinomial: ______________ Mo. | Yr.

Other Designations: U-1



SOURCE: CH²M HILL

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

ARCHEOLOGICAL PHOTOGRAPHIC RECORD

Page 1 of 1 .

Permanent Trinomial: ______________ Mo. Yr.

Other Designations: U-1

Camera and Lens Types
Fuji Automatic DL50 35 mm

Film Type and Speed
Black and White 125 ASA

On File at: ERCE
221 Main Street, 14th Floor
San Francisco, CA 94105

Mo.	Day	Time	Exposure/ Frame	Subject/Description	View Toward	Accession Number
4	28	11AM	1	F-1 Big Cut Stope	E	
4	28	"	2	" from above	S	
"	"	"	3	Iron cable from hoist	N	
4	28	11:20	4	Unnamed Adit	S	
"	"	11:25	5	"	W	
4	28	12:00	6	Riparian plant (unidentified)	N	
"	"	12:20	7	Footings for Stamp Batteries	NE	
"	"	"	8	"	"	
4	28	12:45	9	Series of 3 Mill Terraces with 2 associated fruit (apple?) trees	SW	
"	"	1:00	10-13	Panorama from NE corner, facing NW	SW	
4	28	1:30	14	Golden Gate Adit	S	
"	"	1:35	15	" , close-up	S	
4	28	2:00	16-19	Panorama from NW corner, facing SW	S/SW	
"	"	2:25	20	Springfield Shaft Stamp Batteries	S	
4	28	3:00	21	Pendar Adit	S	