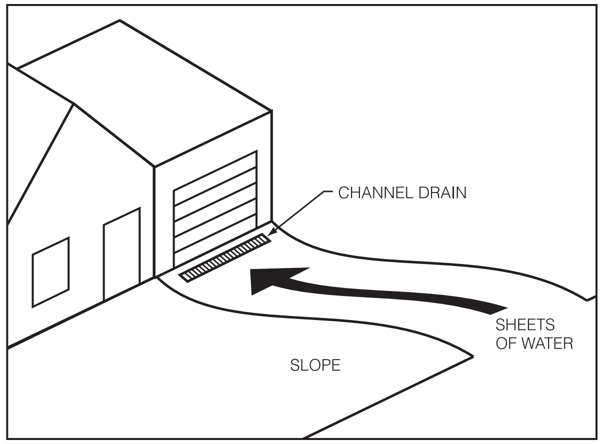


Figure 4-3: Trench drainage

Trench drains enable the designer to modestly slope hardscapes rather than shape extreme slopes to area grates.

Computing the Runoff Potential

Rational Method

A frequently used formula for computing the peak rate of runoff from small drainage areas (i.e., less than about 200 acres) is the Rational Method. The equation is:

$$q = CiA$$

where:

- q = peak runoff rate, cubic feet per second (cfs) or gallons per minute (gpm)
- C = Runoff coefficient (between 0 and 1)
- i = rainfall intensity, inches per hour (iph) for the design storm frequency and for the time of concentration of the drainage area
- A = area of drainage area (in acres or square feet)

The equation is based on the theory that the peak rate of runoff from a small area is equal to the intensity of rainfall multiplied by a coefficient which depends on the characteristics of the drainage area, including land use, soils and slope, and by the size of the area.

Drainage area boundaries are independent of property lines. It is important to consider all parts of a drainage area, even if they are beyond the property line. Take into account sources of surface and subsurface water.

Sample Calculation

How to calculate the pipe size and grate size for exterior drainage applications.

Step 1: Calculate the total surface area to be drained. (Feet length x Feet width)

Step 2: Determine the coefficient of runoff for the type of soil **(see chart below).**

Table 4-1

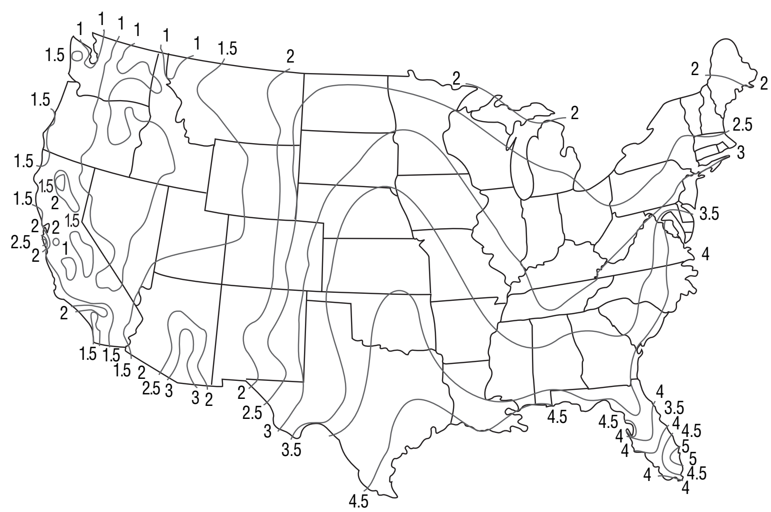
Soil Texture	Coefficient of Runoff	Soil Texture	Coefficient of Runoff
Concrete or Asphalt	1.00	Loam - Bare	.60
Gravel - Compact	.70	Loam - Light Vegetation	.45
Clay - Bare	.75	Loam - Dense Vegetation	.35
Clay - Light Vegetation	.60	Sand - Bare	.50
Clay - Dense Vegetation	.50	Sand - Light Vegetation	.40
Gravel - Bare	.65	Sand - Dense Vegetation	.30
Gravel - Light Vegetation	.50	Grass Areas	.35
Gravel - Dense Vegetation	.40		

Note: The above data is approximate. Coefficient of Runoff = Runoff/Rainfall

Step 3: Determine the maximum 1 hour rainfall expected in 100 years.

Figure 4-4: 100 Year Rainfall Map

One hour rainfall in inches to be expected once in 100 years



Step 4: Compute the total gallons per minute runoff using the following formula:

Rational Formula: $Q = CiA/96.23$

Where: Q = the runoff from an area, in gallons per minute

A = the areas to be drained **(Step 1)**

C = the coefficient of runoff **(Step 2)**

i = the intensity of rainfall, in inches per hour **(Step 3)**

Step 5: Select the pipe size by using the following table. Table based on smooth wall sewer and drain pipe or coextruded dual wall corrugated pipe.

Table 4-2

3"	Pipe < 46 gal/minute	6"	Pipe < 180 gal/minute
4"	Pipe < 79 gal/minute	8"	Pipe < 316 gal/minute

Table assumes flow velocity of 2 feet per second

An adjustment for single wall corrugated pipe can be calculated comparing the manning "n" values below. For example, single wall corrugated pipe could conduct approximately 25% less gpm than smooth wall or dual wall corrugated pipe.

	Manning "n"
Smooth wall sewer and drain pipe or dual wall corrugated pipe	0.010 - 0.013
Single Wall Corrugated Plastic Pipe, 3-8 in.	0.01 - 0.016

Step 6: Select the appropriate grate or combination of grates required **(See chart.)**.

Area grate selection chart

Capacity GPM	NDS Part Numbers Green	Black	Gray	Grate Fits Pipe Size	Grate Open Surface Area (in^2)
3.4	16	14	15	3"	2.6
4.5	01	02	03	3"	3.5
5.0	13	11	12	4"	3.8
5.6	07	08	09	4"	4.2
12.0	50	40	60	6"*	9.1
12.5	70	74	–	3"	9.5
13.6	05	04	06	3.4"	10.4
15.0	20	10	30	6"*	11.5
17.8	772	771	773	6"*	13.6
19.0	75	78	–	4"	14.5
33.4	80	90	–	6"*	25.5
37.2	950	970	960	6"*	28.4
45.2	990	980	999	3 ,4 ,6"	34.4
61.7	1212	1211	1210	3, 4, 6"	47.0
78.7	1280	1290	–	3, 4, 6"	60.0
136.5	1812	1811	1810	3, 4, 6 ,8"	104.0

* Use with Spee-D Basin

Channel grate selection chart

Capacity GPM	NDS Part Numbers Various Colors	Outlet Fits Pipe Size	Grate Open Surface Area (in^2)
25.2/ft	240, 241, 242, 243, 244, 251	3, 4"	19.3/ft
14.7/ft	541, 542, 543, 544, 551	2"	11.3/ft
2.6/ft	8001, 8002, 8003	1 1/2"	2.0/ft

See sample surface drain design problem, Appendix B.