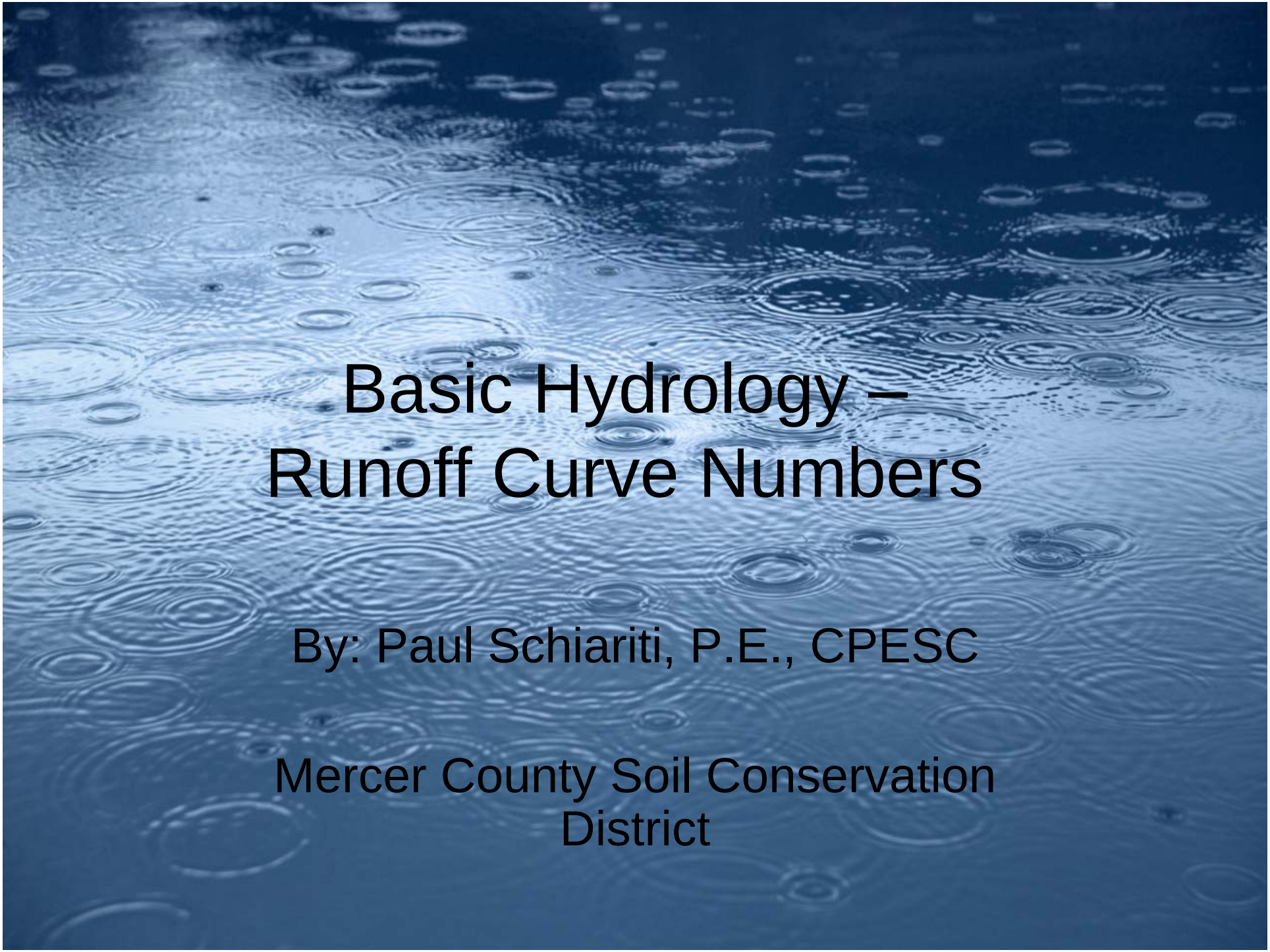


Basic Hydrology – Runoff Curve Numbers

By: Paul Schiariti, P.E., CPESC

Mercer County Soil Conservation District

The SCS Runoff Curve Number

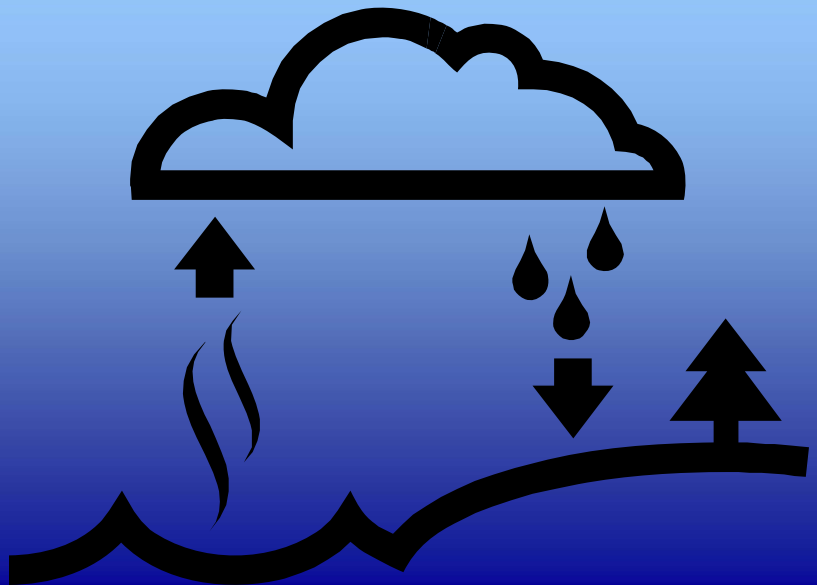
- The RCN (Runoff Curve Number) method was originally established by the SCS in 1954.
- It was originally designed to be an “Inter-Agency” tool for the estimation of runoff.
- ***It was therefore never subjected to peer or journal review by anyone outside the SCS.***

The SCS Curve Number

- The CN was initially developed as a design tool to estimate runoff from rainfall events on **Agricultural fields.**
- The sources of the original data are very obscure and difficult to verify.
- The method is now used as “The” method for computing peak runoff rates and volumes for Urban Hydrology.
- TR-55 (Technical Release no. 55), a simplified NRCS tool essentially joins the NRCS runoff equation with unit hydrograph theory for the computation of these runoff rates.

Really – What is it ?

- It is essentially a coefficient that reduces the total precipitation to runoff potential, after “losses” – Evaporation, Absorption, Transpiration, Surface Storage.
- Therefore the higher the CN value the higher the runoff potential will be.



The SCS Runoff Equation

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad \text{[eq. 2-1]}$$

where

Q = runoff (in)
P = rainfall (in)
S = potential maximum retention after runoff begins (in) and
I_a = initial abstraction (in)

$$I_a = 0.2S \qquad \text{[eq. 2-2]}$$

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)} \qquad \text{[eq. 2-3]}$$

$$S = \frac{1000}{CN} - 10 \qquad \text{[eq. 2-4]}$$

Figure 2-1 (runoff equation):

$$Q = \frac{\left[P - .2\left(\frac{1000}{CN} - 10\right)\right]^2}{P + 0.8\left(\frac{1000}{CN} - 10\right)}$$

where
Q = runoff (in)
P = rainfall (in)
CN = runoff curve number

The solution to this equation results in runoff depth in "watershed" inches.

What happens when you solve the SCS Runoff Equation for different CN Values and different Precipitation rates?

Note: The initial Abstraction is greater than or equal to the Rainfall for values to the left of the red line.

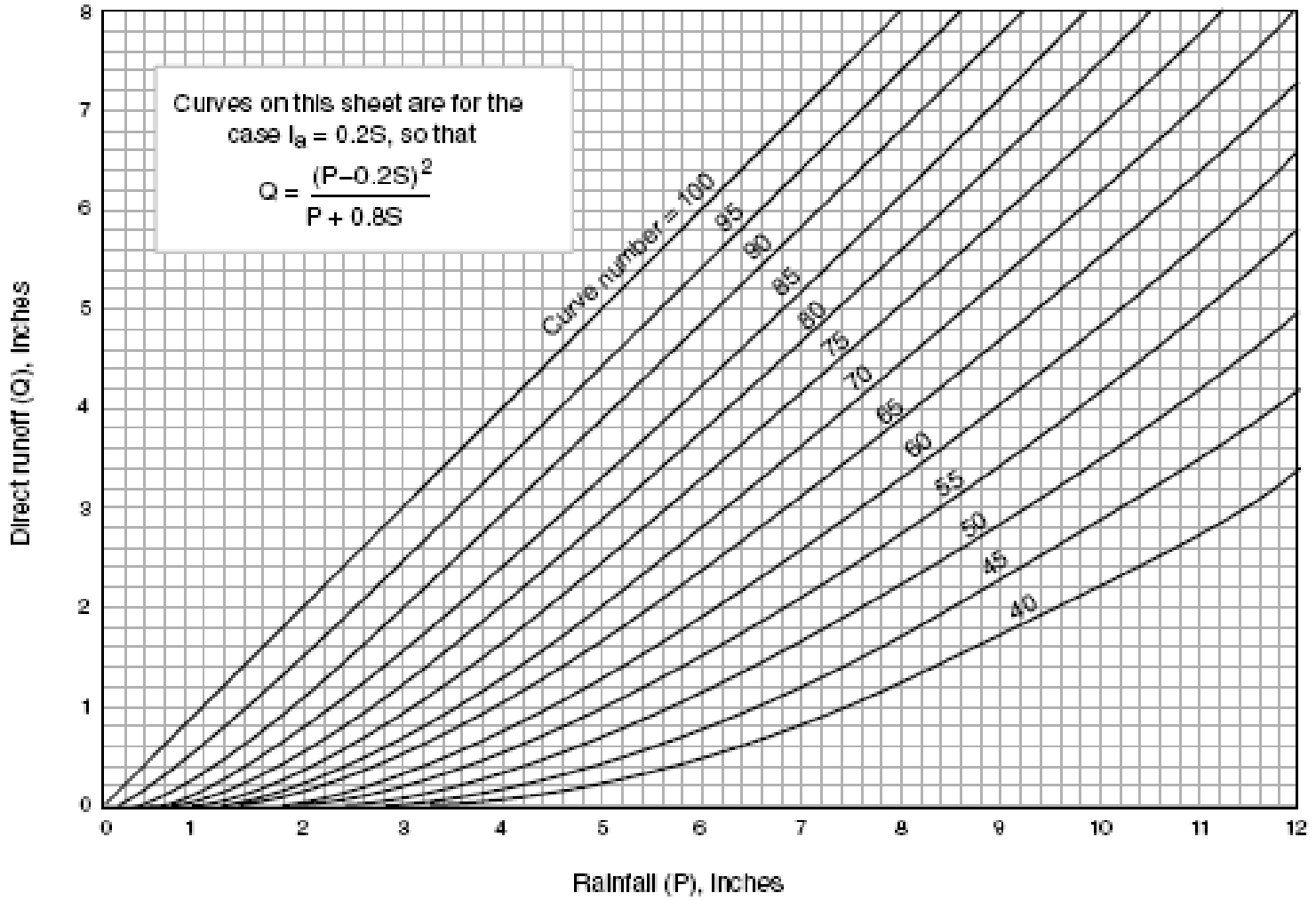
Table 2-1 Runoff depth for selected CN's and rainfall amounts 1/

Rainfall	Runoff depth for curve number of—												
	40	45	50	55	60	65	70	75	80	85	90	95	98
	Inches												
1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.08	0.17	0.32	0.56	0.79
1.2	.00	.00	.00	.00	.00	.00	.03	.07	.15	.27	.46	.74	.99
1.4	.00	.00	.00	.00	.00	.02	.06	.13	.24	.39	.61	.92	1.18
1.6	.00	.00	.00	.00	.01	.05	.11	.20	.34	.52	.76	1.11	1.38
1.8	.00	.00	.00	.00	.03	.09	.17	.29	.44	.65	.93	1.29	1.58
2.0	.00	.00	.00	.02	.06	.14	.24	.38	.56	.80	1.09	1.48	1.77
2.5	.00	.00	.02	.08	.17	.30	.46	.65	.89	1.18	1.53	1.96	2.27
3.0	.00	.02	.09	.19	.33	.51	.71	.96	1.25	1.59	1.98	2.45	2.77
3.5	.02	.08	.20	.35	.53	.75	1.01	1.30	1.64	2.02	2.45	2.94	3.27
4.0	.06	.18	.33	.53	.76	1.03	1.33	1.67	2.04	2.46	2.92	3.43	3.77
4.5	.14	.30	.50	.74	1.02	1.33	1.67	2.05	2.46	2.91	3.40	3.92	4.26
5.0	.24	.44	.69	.98	1.30	1.65	2.04	2.45	2.89	3.37	3.88	4.42	4.76
6.0	.50	.80	1.14	1.52	1.92	2.35	2.81	3.28	3.78	4.30	4.85	5.41	5.76
7.0	.84	1.24	1.68	2.12	2.60	3.10	3.62	4.15	4.69	5.25	5.82	6.41	6.76
8.0	1.25	1.74	2.25	2.78	3.33	3.89	4.46	5.04	5.63	6.21	6.81	7.40	7.76
9.0	1.71	2.29	2.88	3.49	4.10	4.72	5.33	5.95	6.57	7.18	7.79	8.40	8.76
10.0	2.23	2.89	3.56	4.23	4.90	5.56	6.22	6.88	7.52	8.16	8.78	9.40	9.76
11.0	2.78	3.52	4.26	5.00	5.72	6.43	7.13	7.81	8.48	9.13	9.77	10.39	10.76
12.0	3.38	4.19	5.00	5.79	6.56	7.32	8.05	8.76	9.45	10.11	10.76	11.39	11.76
13.0	4.00	4.89	5.76	6.61	7.42	8.21	8.98	9.71	10.42	11.10	11.76	12.39	12.76
14.0	4.65	5.62	6.55	7.44	8.30	9.12	9.91	10.67	11.39	12.08	12.75	13.39	13.76
15.0	5.33	6.36	7.35	8.29	9.19	10.04	10.85	11.63	12.37	13.07	13.74	14.39	14.76

1/ Interpolate the values shown to obtain runoff depths for CN's or rainfall amounts not shown.

If you plot the data from Table 2-1, P vs. Q, and you connect the points for each CN value you obtain a series of "curves", thus the name "Curve Number"

Figure 2-1 Solution of runoff equation.



Ground Cover Conditions and the Proper Selection of CN's

With all of the ambiguity surrounding the origin and development of CN values, ***it is crucial to use the CN value that best mimics the Ground Cover Type and Hydrologic Condition.***

TR-55 Runoff Curve Numbers for Cultivated Agricultural Lands

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2]	Hydrologic condition [3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1] Average runoff condition, and $I_a = 0.2S$

[2] Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

[3] Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

TR-55 Runoff Curve Numbers for Other Agricultural Lands

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element.[3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30[4]	48	65	73
Woods—grass combination (orchard or tree farm).[5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods.[6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30[4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.

2 *Poor:* <50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

TR-55 Runoff Curve Numbers for Urban Areas

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

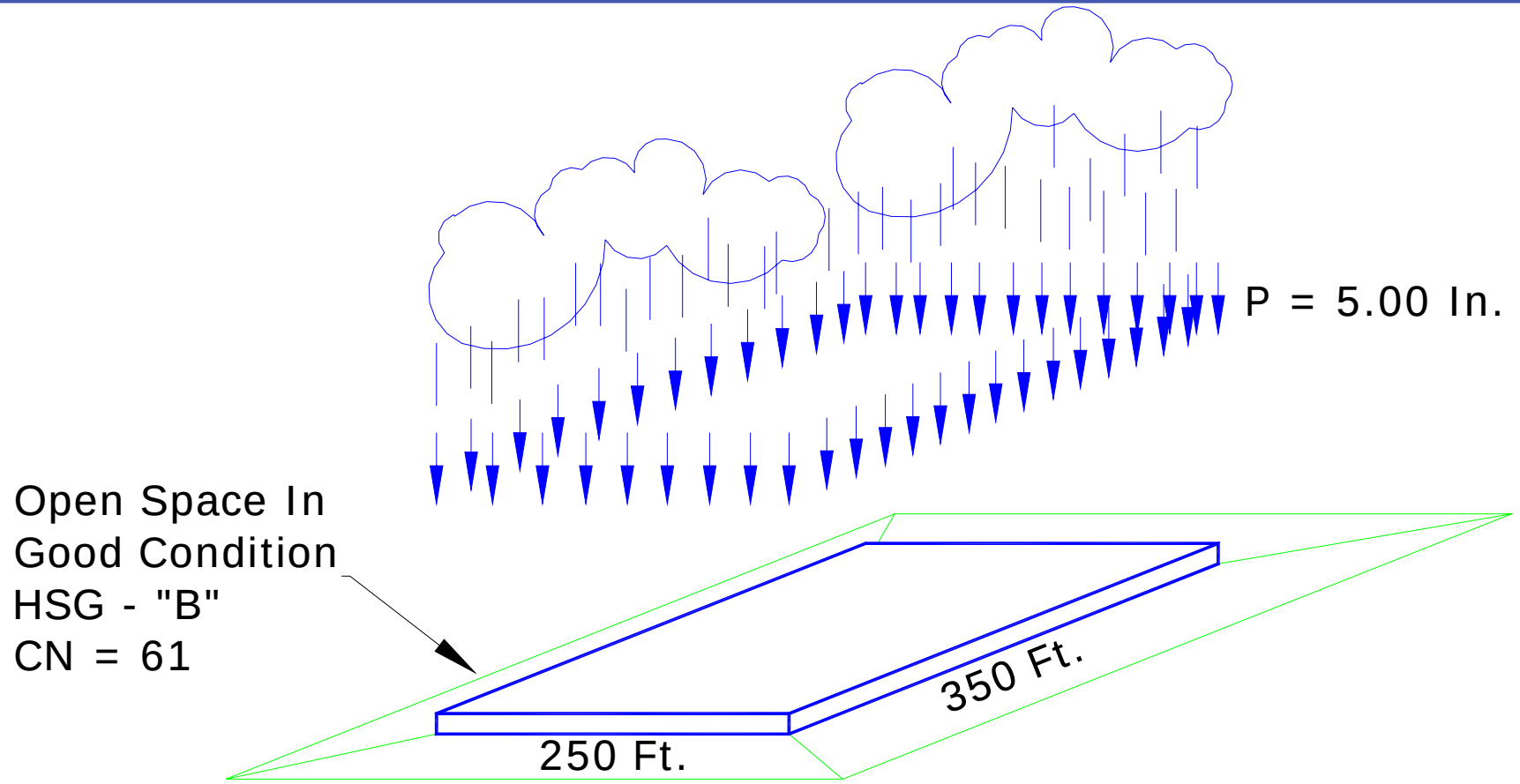
[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Lets take a look at an example:



How much runoff volume would be expected from this circumstance ?

Runoff Volume example (Continued):

1. Compute the Surface Storage:
   $S = (1000 / CN) - 10$
   $S = (1000 / 61) - 10 = 6.393$ Inches
2. Compute the Initial Abstraction:
   $I_a = 0.2 \times S$
   $I_a = 0.2 \times 6.393 = 1.279$ Inches
3. Compute the runoff in Watershed Inches:
   $Q = (P - I_a)^2 / (P - Ia + S)$
   $Q = (5.00 - 1.279)^2 / (5.00 - 1.279 + 6.393)$
   Q = **1.369 Inches *(Remember the original P=5.00 Inches)***
4. Compute the Runoff Volume:
   V = [1.369 In / (12 In / Ft)] x 250 Ft x 350 Ft =
   V = **9983 CF** or 9983 CF / (43560 SF / Ac) = **0.2293 Ac-Ft**

V_{PRECIP} = [5.000 In / (12 In / Ft)] x 250 Ft x 350 Ft = 36,458 CF
Therefore the CN reduced the Precipitation Volume by 75%!

Antecedent Moisture Condition (AMC)

Antecedent Moisture condition is the preceding relative moisture of the pervious surfaces prior to the rainfall event. This is also referred to as Antecedent Runoff Condition (ARC).

Antecedent Moisture is considered to be **low** when there has been little preceding rainfall and **high** when there has been considerable preceding rainfall prior to the modeled rainfall event.

For modeling purposes, we consider watersheds to be AMC II, which is essentially an average moisture condition.

How does Antecedent Moisture effect the CN Values ?

$$RCN(I) = \frac{4.2RCN(II)}{10 - 0.058RCN(II)}$$

Equation 5-12.

$$RCN(III) = \frac{23RCN(II)}{10 + 0.13RCN(II)}$$

Rainfall Groups for Antecedent Soil Moisture Conditions during Growing and Dormant Seasons

Antecedent Condition	Description	Growing Season 5-Day Antecedent Rainfall	Dormant Season 5-Day Antecedent Rainfall
Dry AMC I	An optimum condition of watershed soils, where soils are dry but not to the wilting point, and when satisfactory plowing or cultivation takes pace	Less than 1.4 in. or 35 mm	Less than 0.05 in. or 12 mm
Average AMC II	The average case for annual floods	1.4 in. to 2 in. or 35 to 53 mm	0.5 to 1 in. or 12 to 28 mm
Wet AMC III	When a heavy rainfall, or light rainfall and low temperatures, have occurred during the five days previous to a given storm	Over 2 in. or 53mm	Over 1 in. or 28 mm

The Runoff Curve Number (RCN) can be adjusted for differing AMC based upon the above equations and criteria.

Example:

$RCN_{II} = 74$

Compute RCN_I and RCN_{II}

$$RCN_I = \frac{4.2 \times 74}{10 - 0.058 \times 74} = \mathbf{54.4}$$

$$RCN_{III} = \frac{23 \times 74}{10 + 0.13 \times 74} = \mathbf{86.7}$$

Effect of Hydrologic Soil Group on Runoff Volumes and Peak Flow Rates

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

HSG	*Soil textures*
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

Hydrologic condition	Curve numbers for hydrologic soil group			
	A	B	C	D
Poor	68	79	86	89
Fair	49	69	79	84
Good	39	61	74	80
—	30	58	71	78
Poor	48	67	77	83
Fair	35	56	70	77
Good	30 4/	48	65	73

Erroneously using HSG “A” instead of HSG “B” for a 5.00 Inch Rainfall on a 5.0 Ac. Site, would cause an under-estimation of runoff volume of:

1.80 Inches $_{CN67}$ = 32,670 CF *(Correct)*

0.59 Inches $_{CN48}$ = 10,709 CF *(Incorrect)*

21,961 CF or 67%

What is the Correct Curve Number ?

RAWLES	B
RAWSON	B
RAYBURN	D
RAYCREEK	B
RAYFORD	C
RAYLAKE	D
RAYNAL	C
RAYNOLDSON	B
RAYOHILL	C
RAYPOL	C
RAZORBA	B
RAZORBACK	D
RAZSUN	D
READLYN	B
REALLIS	B
REAM	B
REAP	D
REARDAN	C
REAVILLE	C
REAVIS	B
REBA	C
REBECCA	B
RECK	D
RECKLOR	C
RED BAY	B
RED BLUFF	B
RED HILL	B
RED HOOK	C
RED SPUR	B
REDARROW	D
REDBELL	B
REDBIRD	B
REDBOW	C
REDBUD	C
REDCAMERON	D
REEDSCREEK	B
REEDSLAKE	B
REEDWEST	C
REEDY	C
REEFRIDGE	D
REELFOOT	C
REEPO	C
REESE	C
REESER	C
REESVILLE	C
REEUP	C
REFLECTION	B
REGAL	B/D
REGER	B
REGGAD	A
REGNAPS	C
REGRACIC	D
REHBURG	C
REHFIELD	B
REHM	C
REHOBETH	D
REICESS	B
REILLY	A
REINACH	B
REINECKE	B
REINER	B
REINHART	D
REIS	D
REK	C
REKIMA	D
RELAN	B
RELEEP	B
RELFE	A
RELIZ	D
RELYEA	B

The Soil is “Reaville”.

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area 2/	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)3/:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					

Established Turf Grass is considered to be “Open Space in Good Condition – CN = 74

What is the Correct Curve Number ? (Photo from the Web Soil Survey)

Mercer County, New Jersey (NJ021)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
LDXB	Lawrenceville and Mount Lucas silt loams, 2 to 6 percent slopes	3.9	34.5%
LDXB2	Lawrenceville and Mount Lucas silt loams, 2 to 6 percent slopes, eroded	1.8	16.0%
LDXC2	Lawrenceville and Mount Lucas silt loams, 6 to 12 percent slopes, eroded	5.6	49.5%
Totals for Area of Interest (AOI)		**11.3**	**100.0%**

Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Mercer County, New Jersey

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
LDXB	Lawrenceville and Mount Lucas silt loams, 2 to 6 percent slopes	C	3.9	34.5%
LDXB2	Lawrenceville and Mount Lucas silt loams, 2 to 6 percent slopes, eroded	C	1.8	16.0%
LDXC2	Lawrenceville and Mount Lucas silt loams, 6 to 12 percent slopes, eroded	C	5.6	49.5%
Totals for Area of Interest (AOI)			**11.3**	**100.0%**

What is the Correct Curve Number ?

This Agricultural Field is Soy Bean, planted in Straight rows and Contoured.

What is the Correct Curve Number ?

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2]	Hydrologic condition [3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1] Average runoff condition, and $I_a = 0.2S$

[2] Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

[3] Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

What is the Correct Curve Number ?

This Agricultural Field is Sweet Corn planted in Straight Rows

This is what the field looks like during the non-growing season.

What is the Correct Curve Number ?

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1/]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2/]	Hydrologic condition [3/]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

1 Average runoff condition, and I_a=0.2S

2 Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

3 Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

What is the Correct Cover Type and Treatment ?

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1/]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2/]	Hydrologic condition [3/]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80

Terraced Fields

Contoured Fields

Contoured fields are plowed or planted parallel to the contour and perpendicular to the flow of water.

What is the Correct Cover Type / Description ?

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element.[3]	Poor	48	67	77	83
	Fair	35	56	70	77

What is the Correct Cover Type / Description ?

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.[2/]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element.[3/]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30[4/]	48	65	73

What is the Correct Cover Type / Description ?

2/ *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing.2/	Poor	68	79	86	89
	Fair	49	69	79	84
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What is the Correct Cover Type / Description ?

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	Fair	35	56	70	77
	Good	30[4/]	48	65	73

Is this a Pasture, a Meadow or Brush? It really depends on the use. If this plot is mowed for hay, it is a Meadow. If it is grazed, it would be considered a Pasture, grassland or range. If is just left as is it could be considered Brush-weeds-grass mixture.

You may have to do a little research to determine the proper classification. However if it is the pre-development analysis, and the smallest CN is "surrendered" it should be accepted!

How much of a difference would the improper selection of a CN really make?

Drainage Area is 35.00 Acres

Time of Concentration = 0.75 Hours

Hydrologic Soil Group = B

$CN_{Pasture} = 61$

$CN_{Meadow} = 58$

$CN_{Brush} = 48$

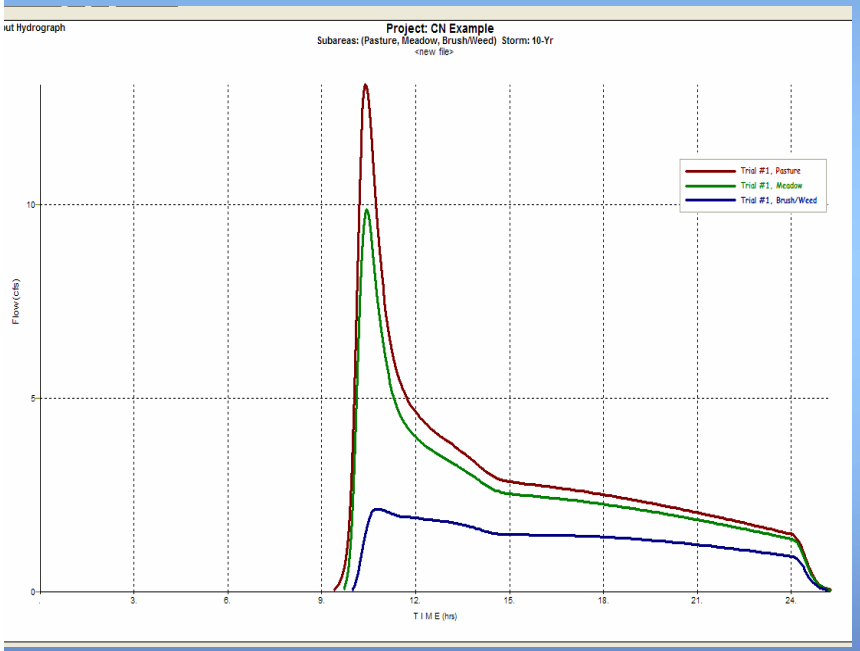
$P_2 = 3.30$ Inches

$P_{10} = 5.00$ Inches

$P_{100} = 8.30$ Inches

Compute the Peak Discharge Rates for the 2, 10, and 100 Year Storm Events.

How much of a difference would the improper selection of a CN really make?



PS CN Example

Mercer County, New Jersey

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS			
Pasture	2.44	13.10	44.53
	10.60	10.39	10.36
Meadow	1.32	9.89	38.92
	10.86	10.42	10.39
Brush/Weed	0.37	2.14	20.87
	19.33	10.81	10.41
REACHES			
OUTLET	3.70	24.58	103.95

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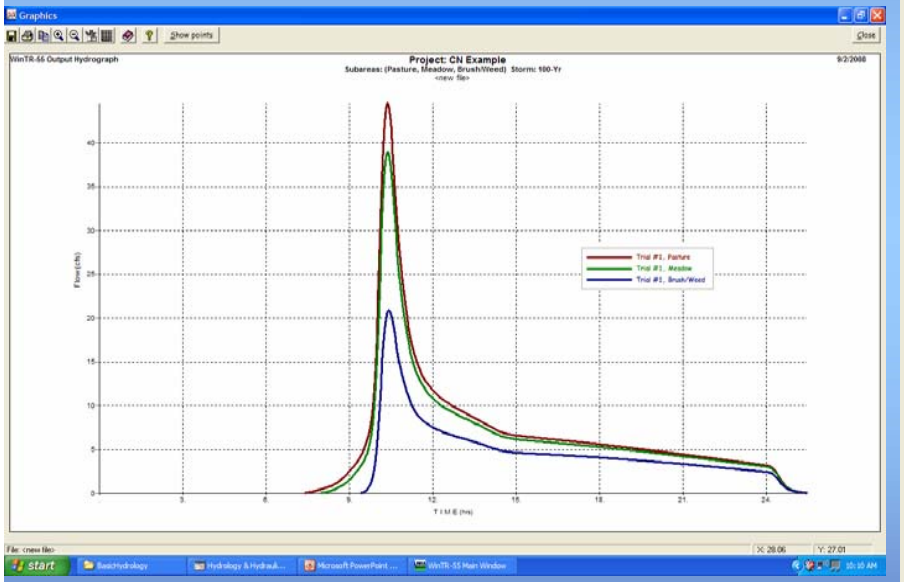
10 Year Storm Peak Discharge Rates

How much of a difference would the improper selection of a CN really make?



PS CN Example

Mercer County, New Jersey

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
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	10.86	10.42	10.39
Brush/Weed	0.37	2.14	20.87
	19.33	10.81	10.41
REACHES			
OUTLET	3.70	24.58	103.95

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100 Year Storm Peak Discharge Rates

Summary:

1. Always field verify the Pre-Development Ground Cover and Treatment.
2. If the analysis under estimates pre-development Curve Numbers, the analysis is “Conservative”.
3. If the analysis over estimates pre-development Curve Numbers, the analysis is “Incorrect”.
4. Understand the differences / subtleties in the Cover types for agricultural lands and cultivated agricultural lands.
5. Make sure the correct HSG is being applied.
6. If you disagree with a CN selection, understand how much of an effect it may have on the analysis.