

Worksheet 2 – Underground Outlet Design (CPS 620)

Design Reach			Length in design reach (Feet)	Input "Q" this reach (CFS)	Input upper reaches (CFS)	Total required "Q" (CFS)	Minimum grade in reach (Ft/Ft)	Pipe Size (Inches)	Allowable capacity (CFS)	Allowable velocity (FPS)	Cooperator:		
Line	Sta.	to Sta.									County:	Tract/Field:	
												Job Class:	/
												Comments:	
												Designed by:	Date:
												Checked by:	Date:
												Certified by:	Date:

DESIGN SKETCH

5 Minute Rainfall Intensities for Ten and Twenty Year Frequency Storms

Chart 1

<u>County</u>	<u>10 Year Ft./Sec.</u>	<u>25 Year Ft./Sec.</u>
Allegany	0.00015	0.00017
Anne Arundel	0.00015	0.00019
Baltimore	0.00015	0.00018
Calvert	0.00015	0.00019
Caroline	0.00016	0.00019
Carroll	0.00015	0.00018
Cecil	0.00015	0.00018
Charles	0.00015	0.00019
Dorchester	0.00016	0.00019
Frederick	0.00015	0.00018
Garrett	0.00015	0.00017
Harford	0.00015	0.00018
Howard	0.00015	0.00018
Kent	0.00015	0.00019
Montgomery	0.00015	0.00018
Prince George's	0.00015	0.00019
Queen Anne's	0.00015	0.00019
Somerset	0.00016	0.00020
St. Mary's	0.00015	0.00019
Talbot	0.00016	0.00019
Washington	0.00015	0.00018
Wicomico	0.00016	0.00020
Worcester	0.00016	0.00020

Figure 1 - PEAK FLOW ESTIMATES FOR GALVANIZED K-STYLE ROOF GUTTER

5" TOP WIDTH K STYLE GUTTER

AREA = 0.1192 sq.ft. WP = 1.042 ft N = 0.012

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.071	0.100	0.123	0.142	0.159	0.174	0.188	0.201

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.225	0.246	0.266	0.285	0.302	0.318	0.334	0.349

6" TOP WIDTH K STYLE GUTTER

AREA = 0.1671 sq.ft. WP = 1.204 ft N = 0.012

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.114	0.160	0.197	0.227	0.253	0.278	0.300	0.321

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.359	0.393	0.424	0.454	0.481	0.507	0.532	0.556

7" TOP WIDTH K STYLE GUTTER

AREA = 0.2482 sq.ft. WP = 1.5 ft N = 0.012

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.190	0.267	0.328	0.379	0.423	0.464	0.502	0.536

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.599	0.656	0.709	0.758	0.804	0.847	0.889	0.928

NOTE: AREA AND WP ARE BASED ON ARMCO GALVANIZED K STYLE GUTTER

Figure 2 - PEAK FLOW ESTIMATES FOR ALUMINUM K-STYLE ROOF GUTTER

5" TOP WIDTH K STYLE GUTTER

AREA = 0.1042 sq.ft. WP = 0.9333 ft N = 0.012

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.061	0.086	0.106	0.123	0.137	0.150	0.162	0.173

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.194	0.212	0.229	0.245	0.260	0.274	0.287	0.300

6" TOP WIDTH K STYLE GUTTER

AREA = 0.154 sq.ft. WP = 1.1167 ft N = 0.012

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.105	0.147	0.180	0.208	0.233	0.255	0.276	0.294

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.329	0.361	0.389	0.417	0.442	0.466	0.488	0.510

7" TOP WIDTH K STYLE GUTTER

AREA = 0.2278 sq.ft. WP = 1.3333 ft N = 0.012

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.178	0.251	0.308	0.356	0.397	0.435	0.470	0.502

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.562	0.615	0.665	0.711	0.754	0.794	0.833	0.870

NOTE: AREA AND WP ARE BASED ON ALCOA AND ARMCO ALUMINUM K STYLE GUTTER

Figure 3 - PEAK FLOW ESTIMATES FOR SCHEDULE 40 1/2 ROUND ROOF GUTTER

4" TOP WIDTH 1/2 ROUND GUTTER

AREA = 0.044 sq.ft. WP = 0.524 ft N = 0.011

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.023	0.033	0.040	0.047	0.052	0.057	0.062	0.066

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.074	0.081	0.087	0.093	0.099	0.104	0.109	0.114

6" TOP WIDTH 1/2 ROUND GUTTER

AREA = 0.098 sq.ft. WP = 0.785 ft N = 0.011

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.068	0.095	0.117	0.135	0.151	0.166	0.179	0.191

PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.214	0.234	0.253	0.271	0.287	0.302	0.317	0.331

8" TOP WIDTH 1/2 ROUND GUTTER

AREA = 0.175 sq.ft. WP = 1.05 ft N = 0.011

PITCH IN 100 FT.	1/2"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
SLOPE FT/FT	0.00042	0.00083	0.00125	0.00167	0.00208	0.00250	0.00292	0.00333
Q CFS	0.147	0.207	0.254	0.293	0.327	0.359	0.388	0.414

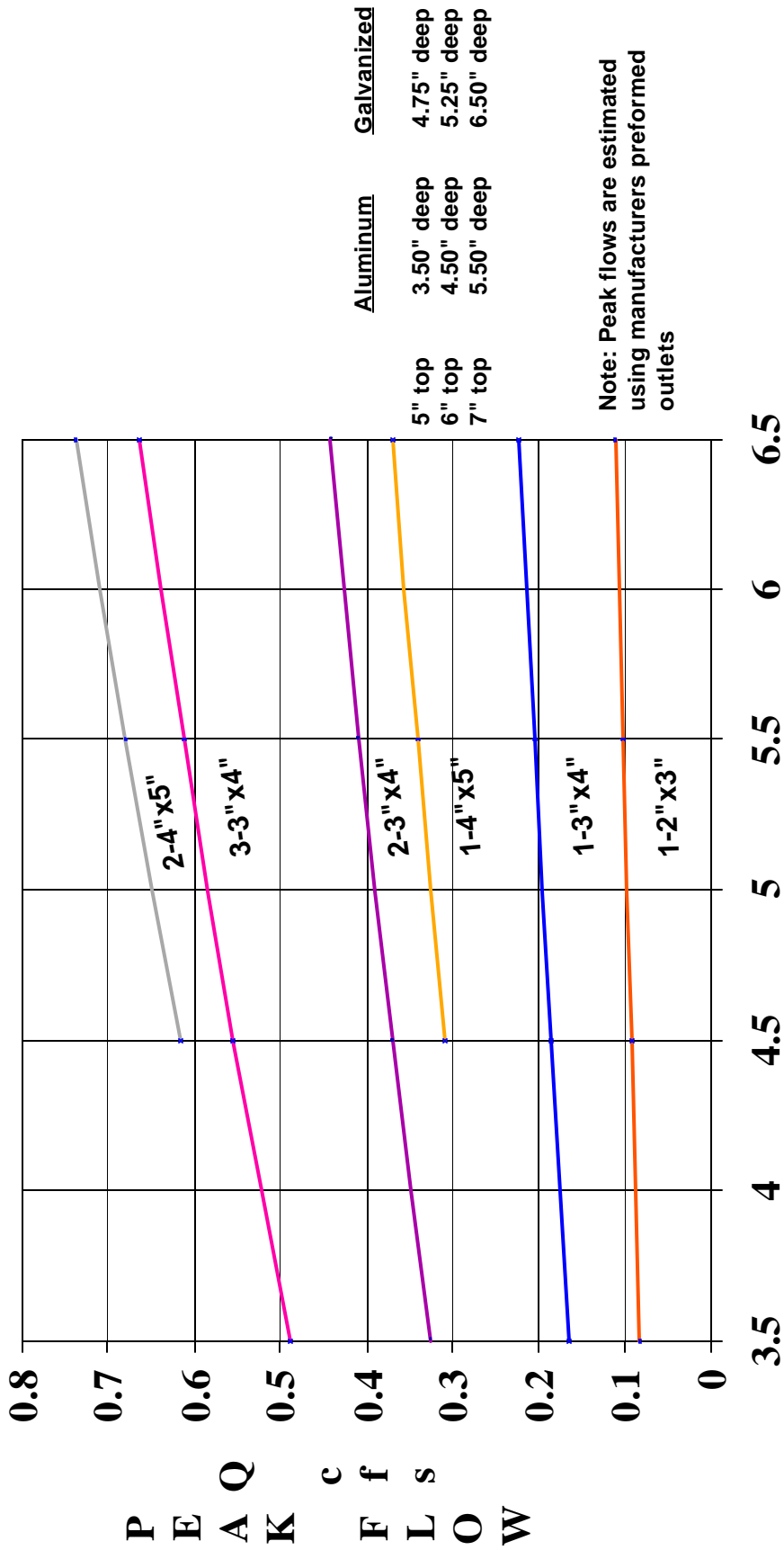
PITCH IN 100 FT.	5"	6"	7"	8"	9"	10"	11"	12"
SLOPE FT/FT	0.00417	0.00500	0.00583	0.00667	0.00750	0.00833	0.00917	0.01000
Q CFS	0.463	0.507	0.548	0.586	0.621	0.655	0.687	0.717

NOTE: AREA AND WP ARE BASED ON 1/2 OF CIRCULAR SCHEDULE 40 PIPE

DOWNSPOUT OUTLET SIZING

LEADER PIPE SIZING

Figure 4



DEPTH OF ROOF GUTTER (INCHES)

DOWNSPOUT LEADER SIZING

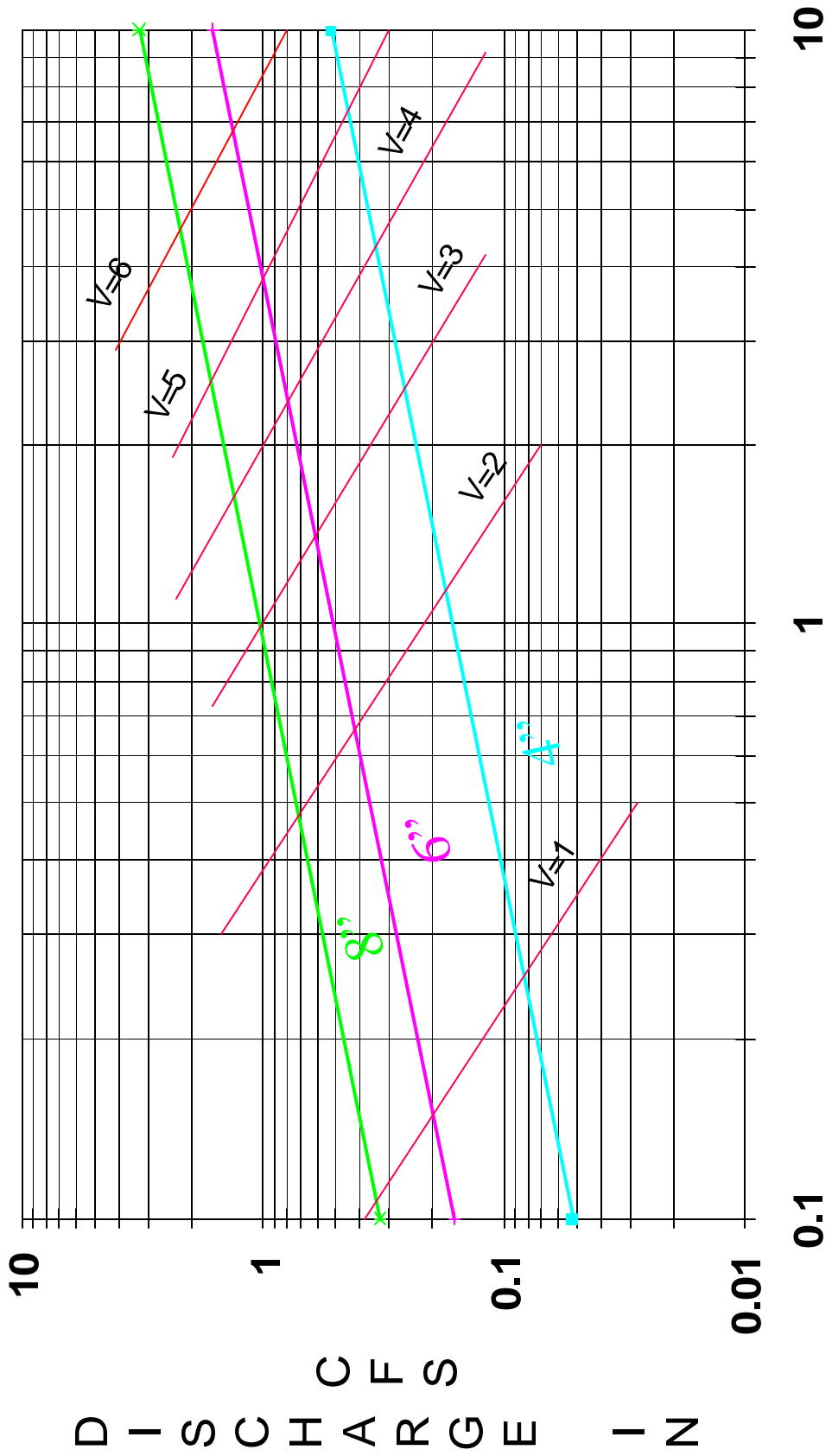
- From 0 - 1.0 cfs use a 4" diameter downspout leader pipe
- From 1.0 - 2.5 cfs use a 6" diameter downspout leader pipe
- From 2.5 - 4.8 cfs use a 8" diameter downspout leader pipe

UNDERGROUND OUTLET DRAIN CHART

CORRUGATED PLASTIC DRAIN TUBING

FIGURE 5

MANNING N=0.015



UNDERGROUND OUTLET DRAIN CHART

SMOOTH SURFACE TUBING

FIGURE 6

MANNING N=0.011

