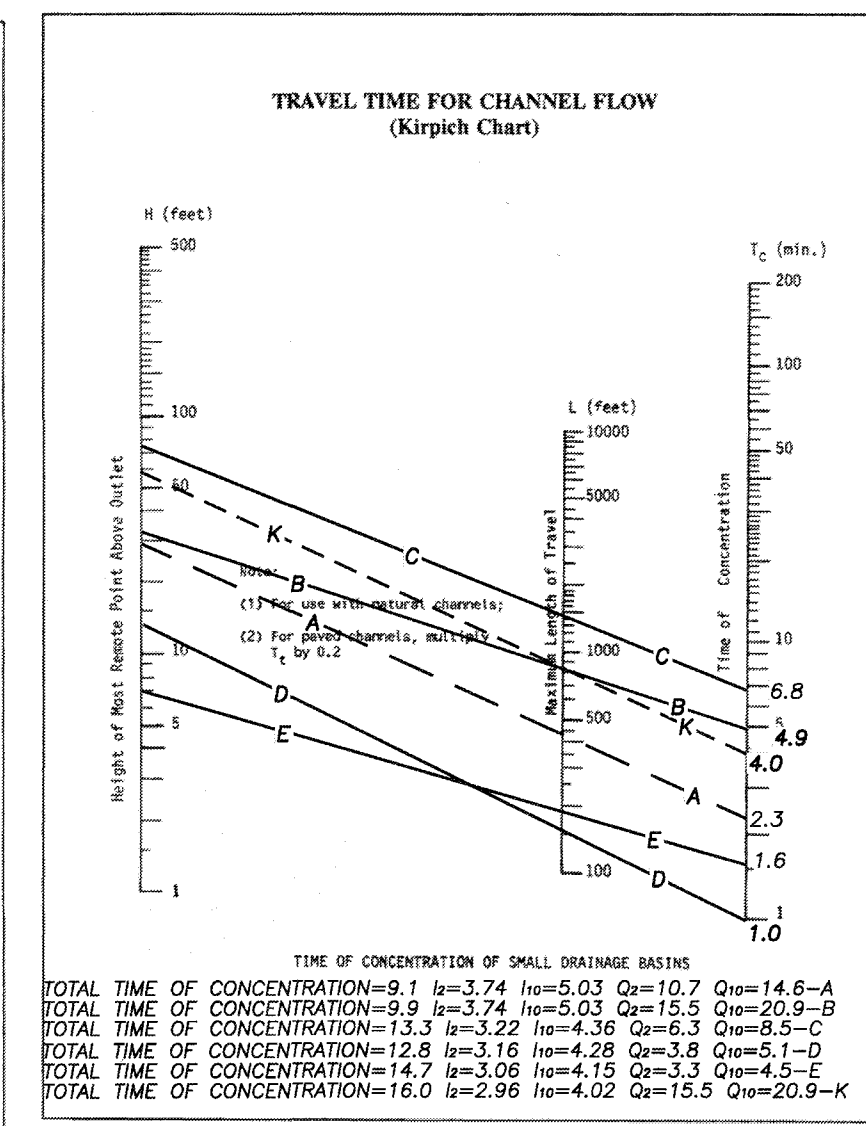
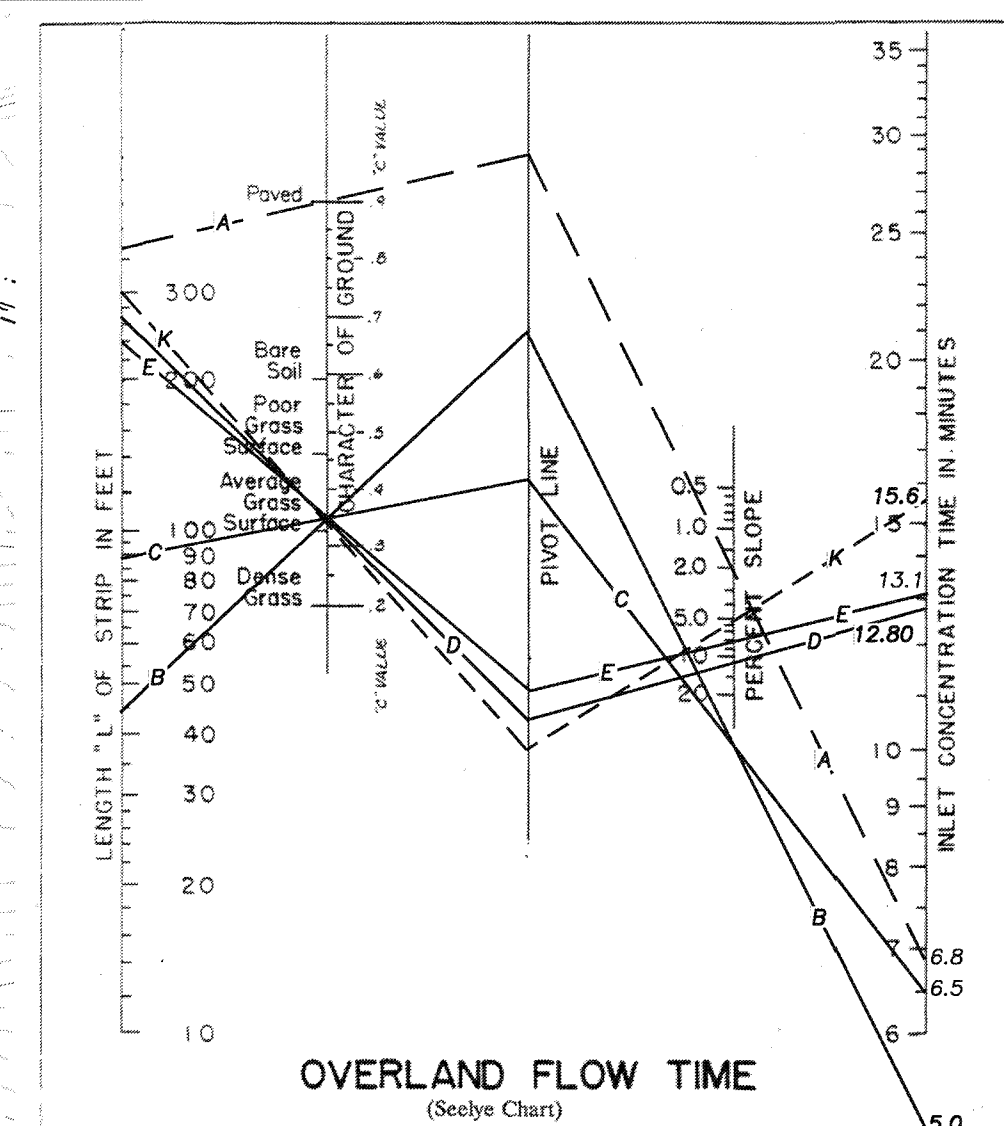
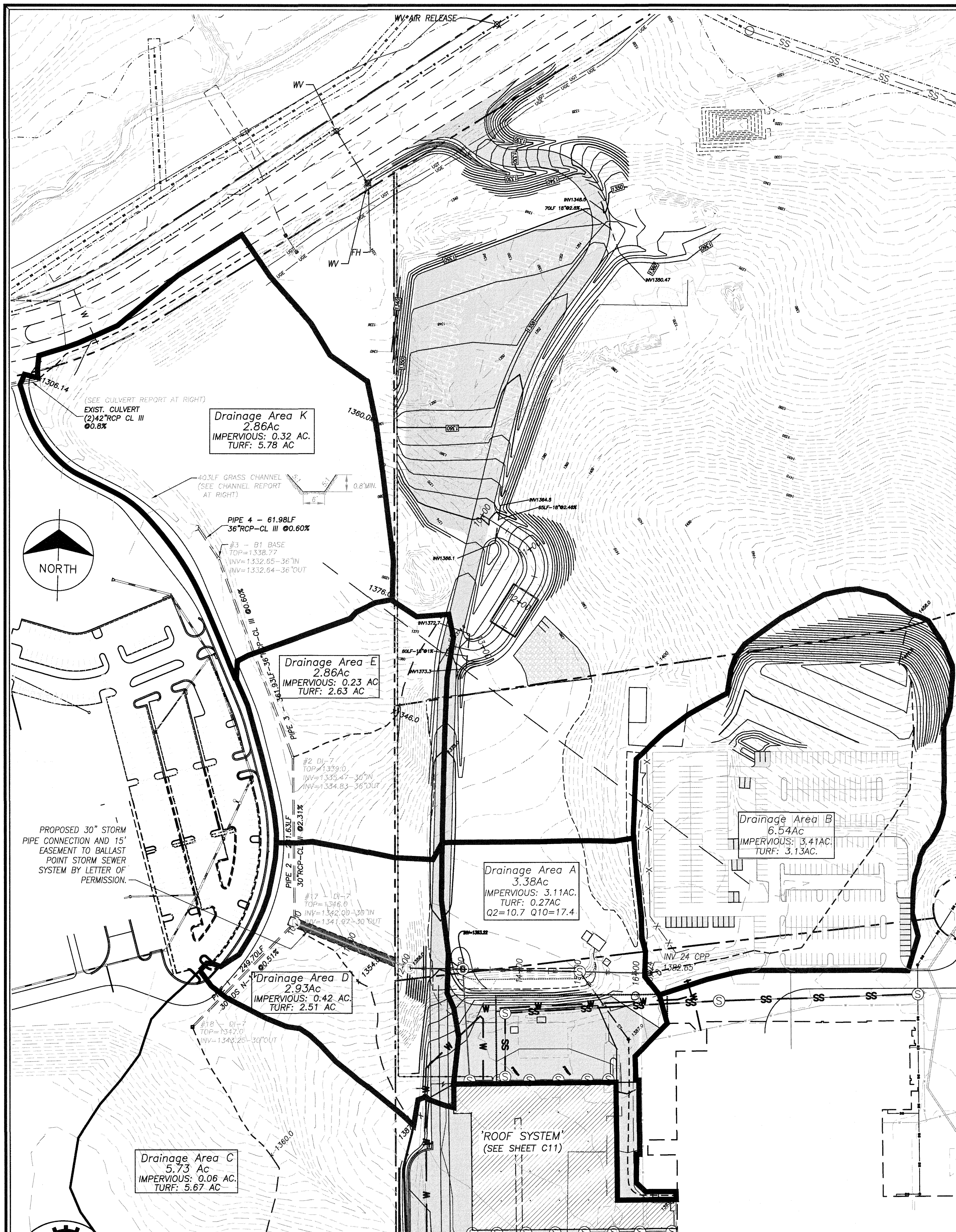




Source: Data Book for Civil Engineers, E.E. Seeley Plate 5-1 Source: VDOT Plate 5-3

Culvert Report	
Hydrow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Dec 26 2017	
Koyo Entrance Culvert	
Invert Elev Dn (ft)	= 1305.50
Pipe Length (ft)	= 64.00
Slope (%)	= 0.80
Invert Elev Up (ft)	= 1306.01
Rise (in)	= 42.0
Shape	= Circular
Span (in)	= 42.0
No. Barrels	= 2
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coef. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5
Calculations	
Qmin (cfs)	= 68.60
Qmax (cfs)	= 68.60
Tailwater Elev (ft)	= (dc+D)/2
Highlighted	
Qtotal (cfs)	= 68.60
Qpipe (cfs)	= 68.60
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 4.38
Veloc Up (ft/s)	= 6.82
HGL Dn (ft)	= 1308.16
HGL Up (ft)	= 1307.82
Hw Elev (ft)	= 1308.66
Hw/D (ft)	= 0.76
Flow Regime	= Inlet Control
Embankment	
Top Elevation (ft)	= 1311.86
Top Width (ft)	= 34.00
Crest Width (ft)	= 50.00

Channel Report	
Hydrow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Dec 26 2017	
Ditch Capacity - flattest slope	
Trapezoidal	
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 5.00, 5.00
Total Depth (ft)	= 0.80
Invert Elev (ft)	= 1360.14
Slope (%)	= 4.23
N-Value	= 0.013
Highlighted	
Depth (ft)	= 0.54
Q (cfs)	= 59.80
Area (sqft)	= 4.70
Velocity (ft/s)	= 12.73
Wetted Perim (ft)	= 11.51
Crit Depth, Yc (ft)	= 0.80
Top Width (ft)	= 11.40
EGL (ft)	= 3.06
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 59.80

BALLAST POINT STORM SEWER ANALYSIS WITH ALTEC FLOWS																		
Storm Sewer Tabulation																		
Page 1																		
Station	Len	Orig Area	Rsoff	Area x C	Tc	Rain	Total	Cap	Vel	Pipe	Invert Elev		HGL Elev		Grnd / Rtn Elev		Line ID	
Line	To	Incr	Total	Incr	Total	Inlet	Outlet	Flow	Vel	Size	Slope	On	Up	On	Up	On	Up	
Line	Line	(ft)	(sq)	(sq)	(sq)	(cfs)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	Exc	191.980	0.00	0.00	0.00	0.0	2.8	0.0	59.70	55.52	8.94	38	0.60	1352.27	1352.64	1355.00	1356.37	#4
2	1	361.025	0.00	0.00	0.00	0.0	0.0	59.70	56.07	8.45	38	0.60	1352.85	1354.85	1356.70	1358.17	1359.00	#3
3	2	281.830	0.00	0.00	0.00	0.0	1.5	0.0	55.20	67.50	11.35	30	2.31	1335.47	1341.97	1339.52	1344.33	#2
4	3	249.700	0.00	0.00	0.00	0.0	0.0	0.0	8.40	31.44	3.29	30	0.60	1342.00	1343.25	1344.33	1344.21	#1

Area 'A'						
C _{impenious} =	0.90					
C _{penious} =	0.33					
I ₂ =	3.77					
I ₁₀ =	5.08	TC=9.1 min.				
Structure	A _{impenious}	A _{penious}	A _{total}	C _{weighted}	Q ₂	Q ₁₀
Surf Area A	3.11	0.27	3.38	0.85	10.8	14.7
Area 'B'						
C _{impenious} =	0.90					
C _{penious} =	0.33					
I ₂ =	3.74					
I ₁₀ =	5.03	TC=9.9 min.				
Structure	A _{impenious}	A _{penious}	A _{total}	C _{weighted}	Q ₂	Q ₁₀
Surf Area B	3.41	3.13	6.54	0.63	15.3	20.6
Area 'C'						
C _{impenious} =	0.90					
C _{penious} =	0.33					
I ₂ =	3.22					
I ₁₀ =	4.36	TC=13.3 min.				
Structure	A _{impenious}	A _{penious}	A _{total}	C _{weighted}	Q ₂	Q ₁₀
Surf Area C	0.06	5.67	5.73	0.34	6.2	8.4
Area 'D'						
C _{impenious} =	0.90					
C _{penious} =	0.33					
I ₂ =	3.16					
I ₁₀ =	4.28	TC=13.8 min.				
Structure	A _{impenious}	A _{penious}	A _{total}	C _{weighted}	Q ₂	Q ₁₀
Surf Area D	0.42	2.51	2.93	0.41	3.8	5.2
Area 'E'						
C _{impenious} =	0.90					
C _{penious} =	0.33					
I ₂ =	3.06					
I ₁₀ =	4.15	TC=14.7 min.				
Structure	A _{impenious}	A _{penious}	A _{total}	C _{weighted}	Q ₂	Q ₁₀
Surf Area E	0.23	2.63	2.86	0.38	3.3	4.5

Tie-In Pipe	Q10	MAX Q10
Area A	14.67	
Area B	20.63	
Roof System	6.40	From on-site storm drain calculations
Total	41.70	98.17 30"@4.73%
Koyo Pipe 1		
Area C	8.39	8.39 Additional 30"@0.51%
Koyo Pipe 2		
Pipe 1	8.39	
Area D	5.16	
Tie-In	41.70	46.87 Additional 30"@2.31%
Total	55.26	62.33
Koyo Pipe 3		
Pipe 2	55.26	
Area E	4.46	4.46 Additional 36"@0.60%
Total	59.72	51.66

Koyo Culvert						
Cimpenious =	0.90					
Cpenious =	0.33					
I2 =	2.96					
I10 =	4.02	TC=16.0 min.				
Structure	A _{impenious}	A _{penious}	A _{total}	C _{weighted}	Q ₂	Q ₁₀
K	0.32	5.78	6.10	0.36	6.5	8.8
Koyo Roadside Channel = Koyo Pipe 3				59.72		
Area K=				8.8		
Q ₁₀ =				68.55		

