

**University Station
Annual Stormwater Budget**

Annual Water Budget Summary

Month	A		B		C	D	E	Final Aquifer Recharge ³ A+B+C+D+E (MG)	
	Runoff from Impervious Area (MG)	EVAPORATION (MG)	EVAPOTRANSPIRATION (MG)	Stormwater Infiltration (from Roof and Pervious Areas) (MG)	Parking Area Runoff Directed to Infiltration Systems ² (MG)	Proposed Monthly Consumption Reduced for Average Demands ¹ (MG)	Proposed Monthly Consumption Demands with Evaporative		Potential Loss to Irrigation (MG)
Jan	5.05	(2.00)	0.00	4.92	2.75	(3.01)	(3.01)	0.00	2.67
Feb	4.59	(1.81)	0.00	4.47	2.49	(2.72)	(2.72)	0.00	2.43
Mar	6.95	(2.72)	0.24	6.56	3.60	(3.01)	(3.01)	0.00	4.43
Apr	7.41	(2.76)	1.68	5.71	2.77	(2.91)	(2.91)	0.00	2.80
May	7.10	(2.43)	3.78	4.02	1.02	(3.01)	(3.26)	(0.50)	-1.14
Jun	7.17	(2.09)	5.42	3.32	0.00	(2.91)	(3.49)	(1.00)	-3.26
Jul	6.39	(0.10)	6.60	3.06	0.00	(3.01)	(3.82)	(1.00)	-1.85
Aug	4.85	0.00	5.80	2.56	0.00	(3.01)	(3.82)	(1.00)	-2.26
Sep	6.19	(2.04)	4.02	2.91	0.34	(2.91)	(3.49)	(0.50)	-2.78
Oct	7.35	(2.68)	2.30	5.09	2.27	(3.01)	(3.26)	0.00	1.43
Nov	6.61	(2.53)	0.79	5.73	3.00	(2.91)	(2.91)	0.00	3.29
Dec	7.29	(2.88)	0.00	7.11	3.97	(3.01)	(3.01)	0.00	5.18
Annual	76.96	(24.04)	30.64	55.47	22.21	(35.43)	(38.70)	-4.00	10.93

¹In the approved prior FEIR the original water budget noted that Title V estimates represent a maximum daily demand. For average daily demands, Title V estimates were reduced by 50%. After the correction for average daily flows, a further reduction of 15% was assumed for water conserving fixtures, which will be used in the University Station project as required by the MA Plumbing Code.

²An analysis of the daily rain data (2000 to 2009) from the Norwood Airport indicates that 98.4% of all rain events produce less than 2" of rainfall. From this same data, 87.2% of the total rainfall volume was a result of rain events of less than 2". Review of the onsite infiltration systems indicates that upto 2" of rainfall can be stored and infiltrated prior to any outflow. There are 40.6 acres of non-roof impervious area being directed to infiltration systems and for the purpose of this analysis, it has been assumed that 85% of the monthly rainfall can be infiltrated. We used the Norwood Airport daily records as the closest station at the same elevation and valley climate condition as the locus and compared that data to the NOAA Great Blue Hill monthly data for evapotranspiration.

³This analysis indicates that volume of stormwater available to recharge the aquifer and improve groundwater baseflow to the Neponset River. This analysis accounts for all potable and irrigation demands associated with the University Station project.

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UNIVERSITY STATION RAINFALL BUDGET

University Station	
Impervious Area (ac)	64
Roof Area Recharged (ac)	21
Pervious Area (ac)	46
Total (ac)	130

Month	Rainfall (in)	Potential Evapotranspiration (in)	Potential Infiltration (in)	Total Water Budget for Site (MG)
Jan	2.93	0	2.93	10.34
Feb	2.66	0	2.66	9.39
Mar	4.03	0.19	3.84	14.23
Apr	4.30	1.35	2.95	15.17
May	4.12	3.03	1.09	14.54
Jun	4.16	4.34	0.00	14.69
Jul	3.71	5.29	0.00	13.09
Aug	2.81	4.64	0.00	9.92
Sep	3.59	3.22	0.37	12.66
Oct	4.26	1.84	2.42	15.05
Nov	3.83	0.63	3.20	13.53
Dec	4.23	0	4.23	14.93
	44.63	24.53	23.69	157.55

POTENTIAL RECHARGE

Month	Infiltration from Pervious Area (MG)	Recharge from Roofs (MG)	Potential Loss to Irrigation ¹ (MG)	Parking Area Runoff Directed to Infiltration Systems ² (MG)	Total Infiltration (Recharge) ³ (MG)
Jan	3.29	1.63	0.00	2.75	7.67
Feb	2.99	1.48	0.00	2.49	6.96
Mar	4.32	2.24	0.00	3.60	10.16
Apr	3.32	2.39	0.00	2.77	8.47
May	1.23	2.29	(0.50)	1.02	4.05
Jun	0.00	2.32	(1.00)	0.00	1.32
Jul	0.00	2.06	(1.00)	0.00	1.07
Aug	0.00	1.56	(1.00)	0.00	0.57
Sep	0.41	2.00	(0.50)	0.34	2.25
Oct	2.72	2.37	0.00	2.27	7.36
Nov	3.60	2.13	0.00	3.00	8.73
Dec	4.75	2.35	0.00	3.97	11.08
	26.63	24.84	-4.00	22.21	69.68

¹Assumes that 20% of the pervious area will be irrigated @ 1" per week mid May thru Mid September

²An analysis of the daily rain data (2000 to 2009) from the Norwood Airport indicates that 98.4% of all rain events produce less than 2" of rainfall. From this same data, 87.2% of the total rainfall volume was a result of rain events of less than 2". Review of the onsite infiltration systems indicates that upto 2" of rainfall can be stored and infiltrated prior to any outflow. There are 40.6 acres of non-roof impervious area being directed to infiltration systems and for the purpose of this analysis, it has been assumed that 85% of the monthly rainfall can be infiltrated.

³Only considers recharge from roof and pervious surfaces. Potential irrigation volume has been deducted.

POTENTIAL RUNOFF

Month	Runoff from Impervious Area ¹ (MG)
Jan	5.05
Feb	4.59
Mar	6.95
Apr	7.41
May	7.10
Jun	7.17
Jul	6.39
Aug	4.85
Sep	6.19
Oct	7.35
Nov	6.61
Dec	7.29
	76.96

¹Accounts for impervious walks and paved areas, not building roofs.

Month	EVAPORATION (MG)
Jan	2.00
Feb	1.81
Mar	2.72
Apr	2.76
May	2.43
Jun	2.09
Jul	0.10
Aug	0.00
Sep	2.04
Oct	2.68
Nov	2.53
Dec	2.88
	24.04

Month	EVAPOTRANSPIRATION (MG)
Jan	0.00
Feb	0.00
Mar	0.24
Apr	1.68
May	3.78
Jun	5.42
Jul	6.60
Aug	5.80
Sep	4.02
Oct	2.30
Nov	0.79
Dec	0.00
	30.64

EVAPOTRANSPIRATION CALCULATION (BASED ON BLUE HILL TEMP DATA)

Month	Temp (d F)	Temp (d C)	i	ET (cm) (unadjusted)	Daylight Factor	ET (cm) (adjusted)	ET (in)
Jan	25.70	-3.5	0	0.00	0	0	0
Feb	26.40	-3.1	0	0.00	0	0	0
Mar	34.40	1.3	0.14	0.47	1.03	0.49	0.19
Apr	44.70	7.1	1.68	3.08	1.11	3.42	1.35
May	55.30	12.9	4.22	6.10	1.26	7.69	3.03
Jun	64.10	17.8	6.86	8.75	1.26	11.03	4.34
Jul	69.70	20.9	8.75	10.49	1.28	13.42	5.29
Aug	68.10	20.1	8.19	9.99	1.18	11.79	4.64
Sep	61.20	16.2	5.94	7.87	1.04	8.18	3.22
Oct	51.10	10.6	3.12	4.88	0.96	4.68	1.84
Nov	40.60	4.8	0.93	1.99	0.81	1.61	0.63
Dec	29.80	-1.2	0	0.00	0	0	0
		I=	39.83	53.62		62.31	24.53

ET (in cm) = 1.62*(10T/I)^a from Hydrology & Hydraulic Systems by Ram S. Gupta © 1989 pg 79-81
a = 1.125366757

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UNIVERSITY STATION WATER DEMAND

Month	Days	Proposed Monthly Consumption (228,367 GPD) in MG	Evaporative Cooling Estimated for Office Buildings (MG)*
Jan	31	7.08	0.00
Feb	28	6.39	0.00
Mar	31	7.08	0.00
Apr	30	6.85	0.00
May	31	7.08	0.25
Jun	30	6.85	0.58
Jul	31	7.08	0.81
Aug	31	7.08	0.81
Sep	30	6.85	0.58
Oct	31	7.08	0.25
Nov	30	6.85	0.00
Dec	31	7.08	0.00
Annual	365	83.35	3.28

*As part of the Westwood Station project, evaporative cooling estimates were generated for 1.5 MSF of office space. The University Station Office space has been reduced to 325,000 sf or just 22% of the previous project. Therefore the previous evaporative cooling estimates have been reduced to 22% of the Westwood Station estimate.