2016 NH Water & Watershed Conference

Jamie Houle, UNH Stormwater Center

Providing Data to Protect Water Quality Since 2004

Hydrodynamic Separator

Isolator Row

Subsurface Infiltration

Filter Unit

Porous Asphalt

Pervious Concrete

Retention Pond

Stone Swale

Veg Swale

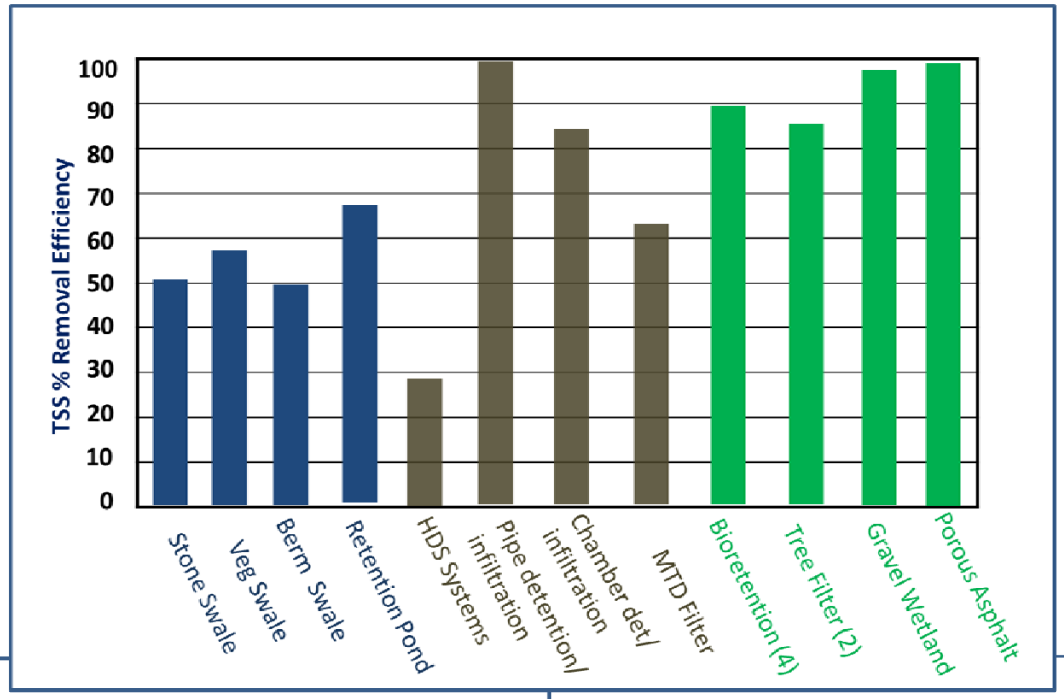
Gravel Wetland

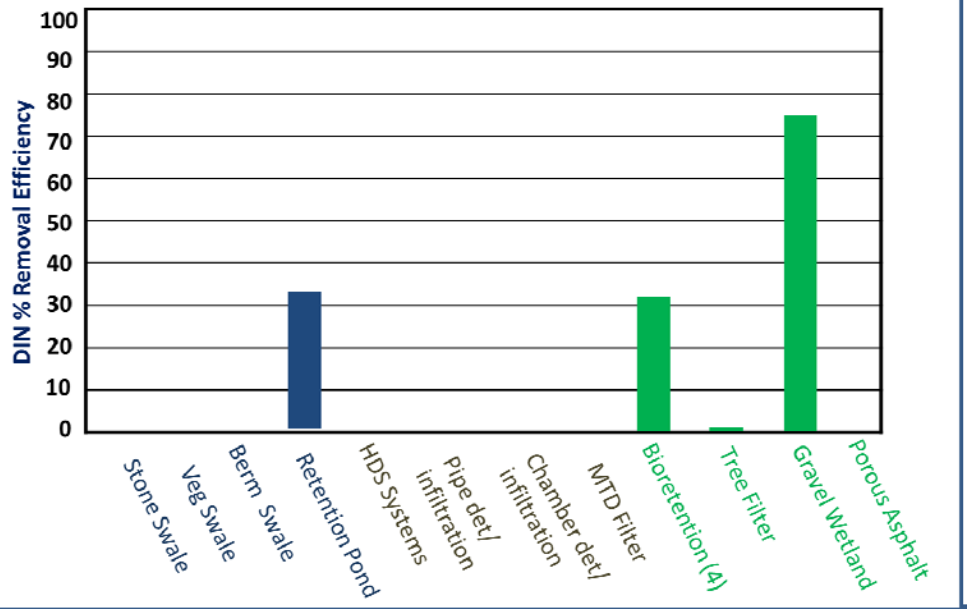
Sand Filter

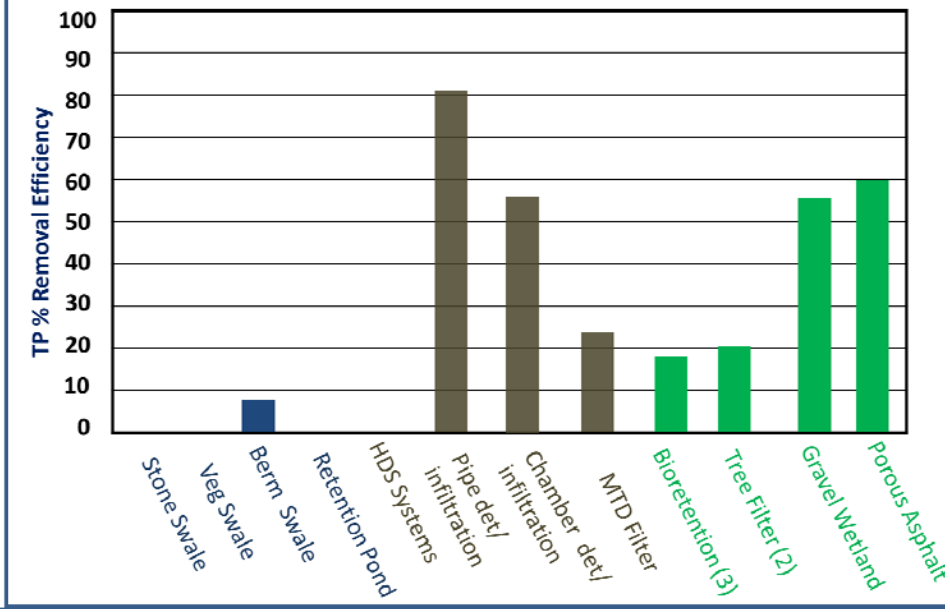
Bioretention Unit

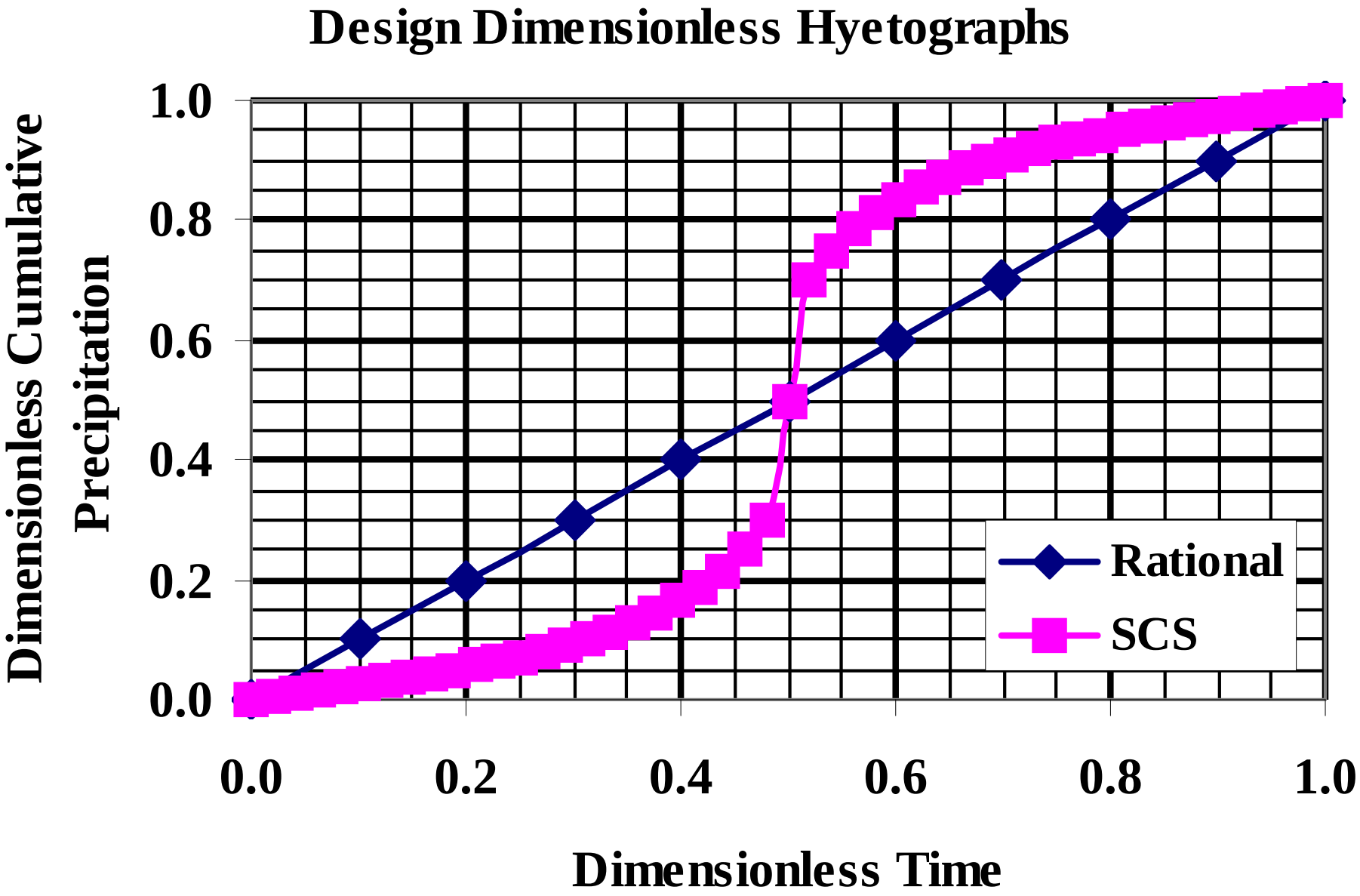
Tree Filter

Common Pollutant RE's

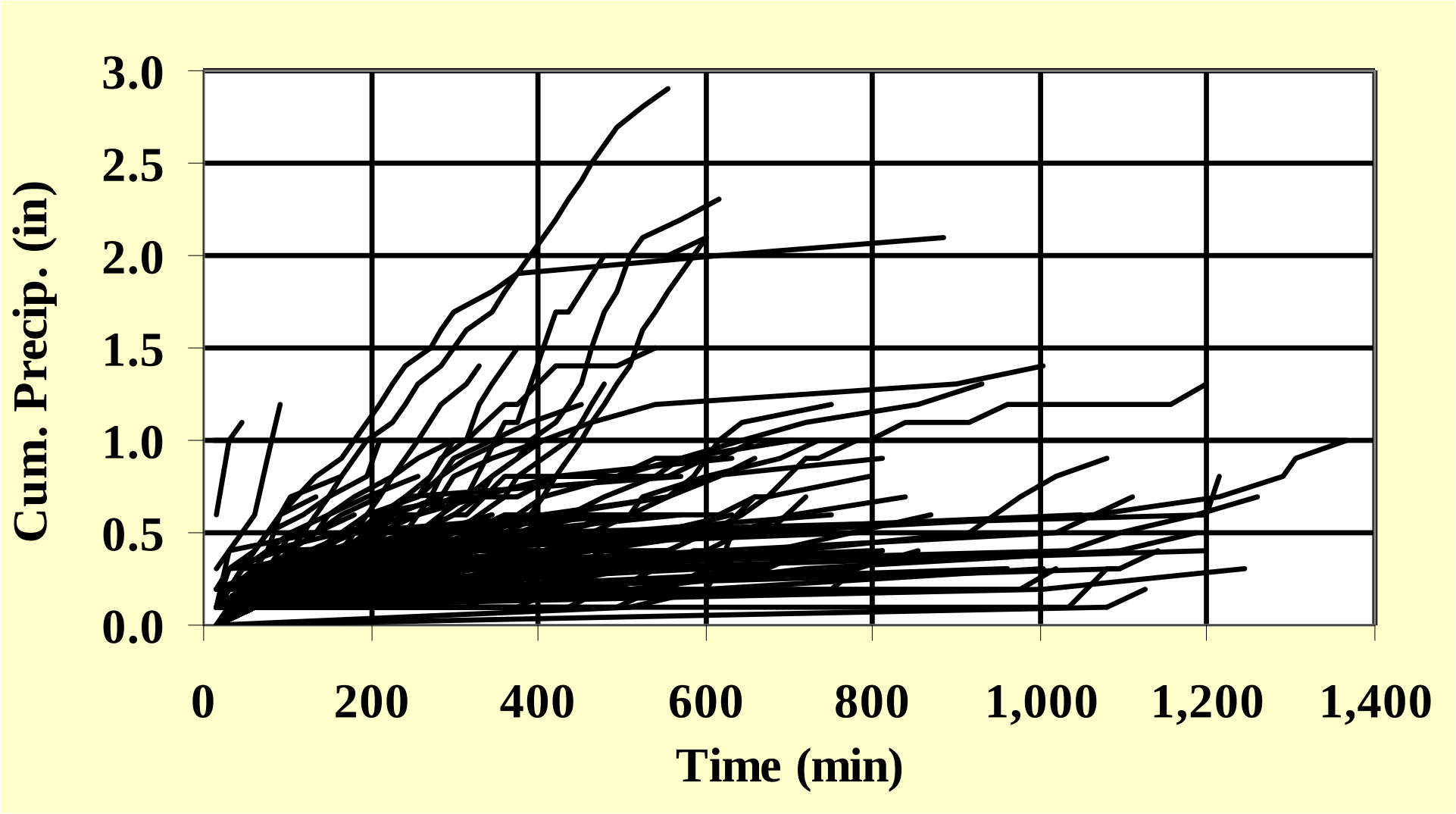




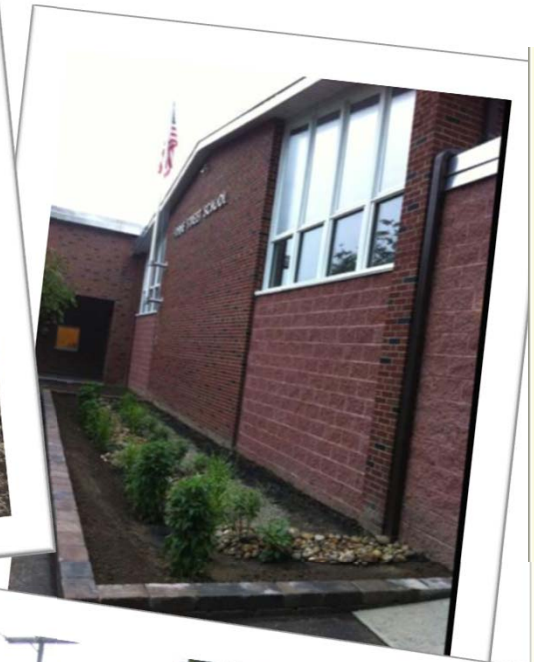



Design Dimensionless Hyetographs
Dimensionless Cumulative Precipitation
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Dimensionless Time
Rational
SCS

Sampling of Observed Hyetographs
Durham, NH NOAA Gage



Watershed approach for a small urban suburb



Performance analysis of two relatively small capacity urban retrofit stormwater controls

Sizing Details

System	WQV (cf)	Actual WQV(cf)	% of conventional design	Rain Event (in)	Sizing Method
SGWSC-1	7,577	720	10%	0.10	Static
IBSCS-2	1,336	310	23%	0.23	Dynamic

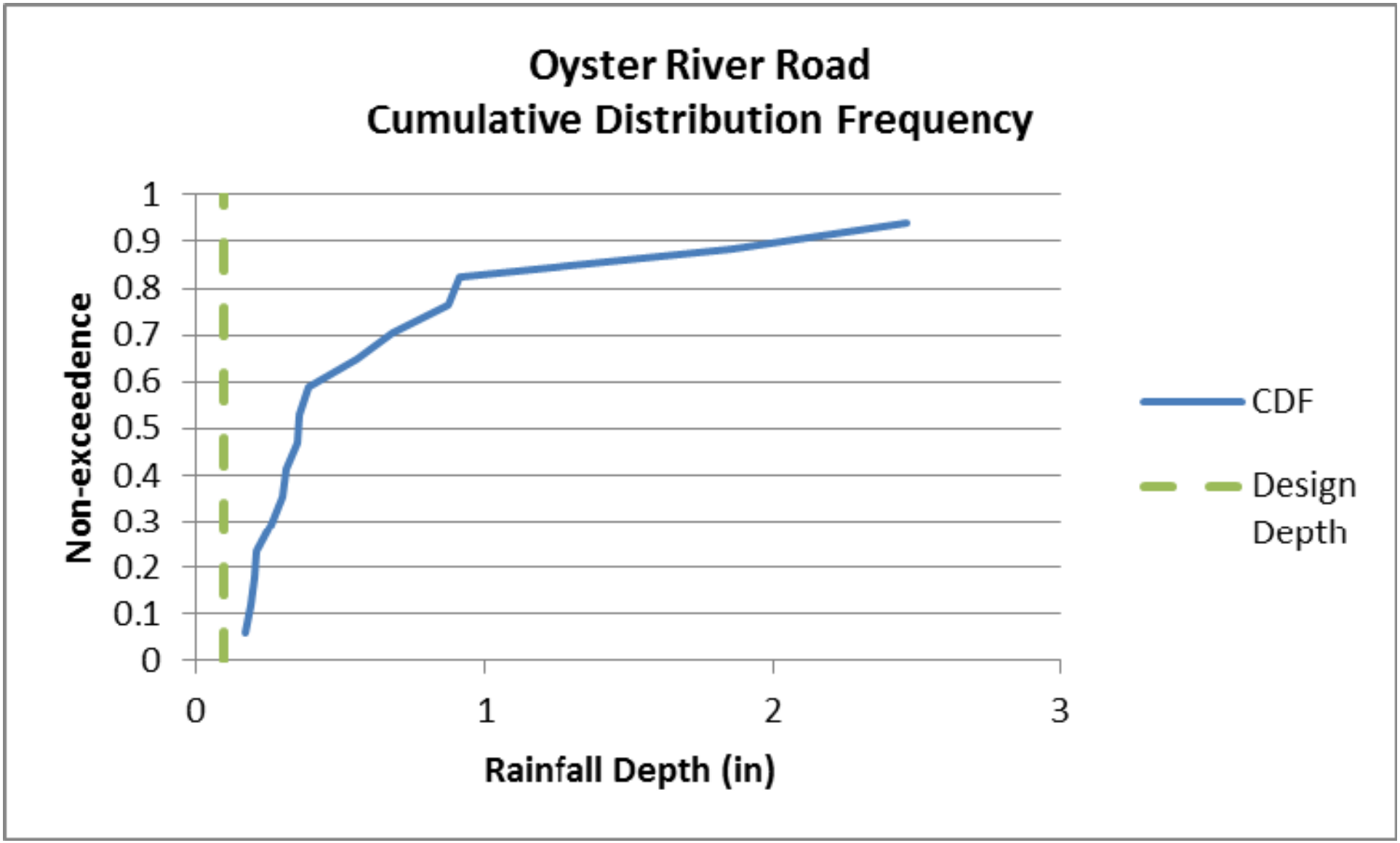
$$WQV = \left(\frac{P}{12}\right) x\ IA$$

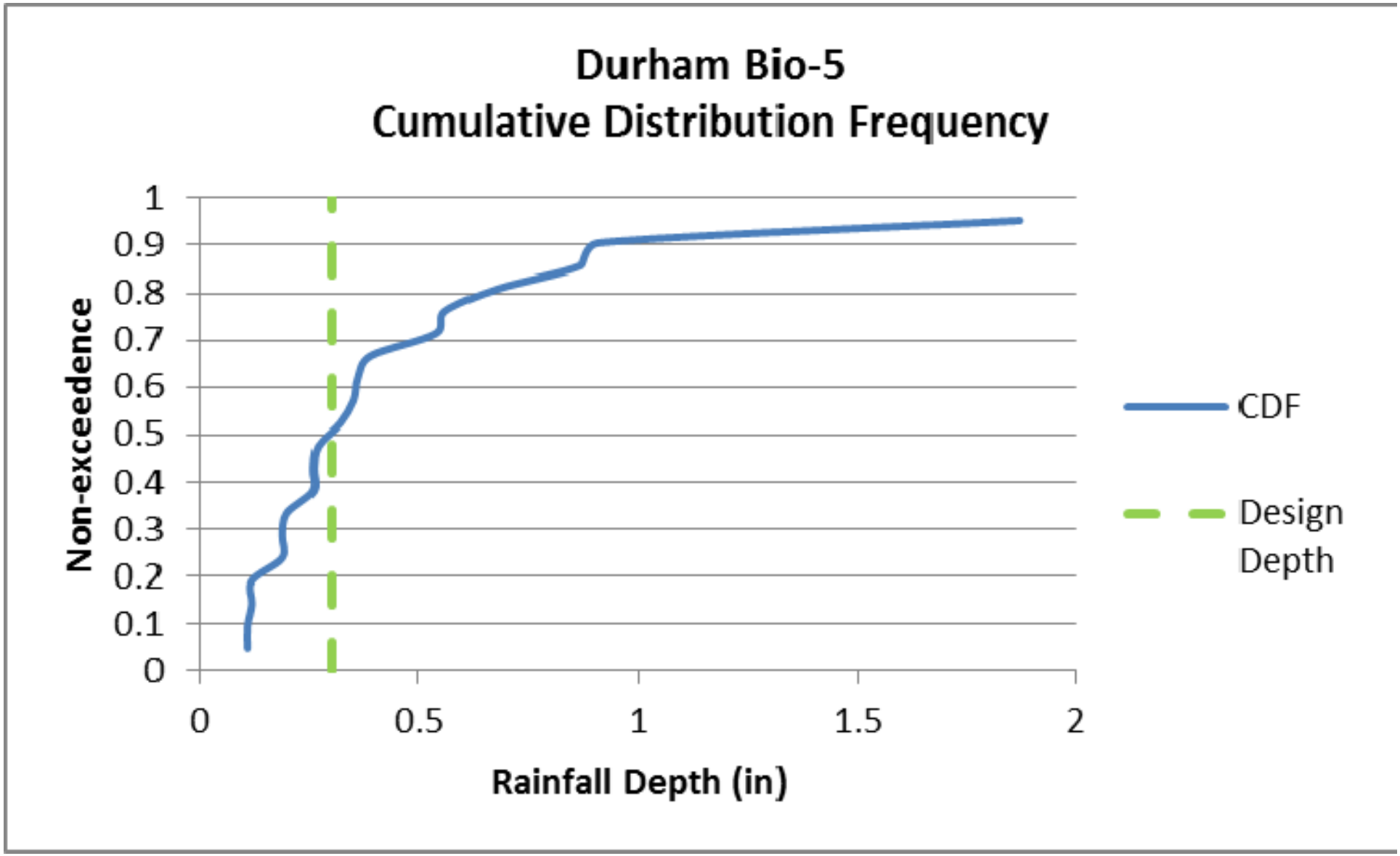
Dynamic Bioretention Sizing

$$Af = Vwq * \frac{df}{(i(hf + df)tf)}$$

Static SGW System Sizing

$$Q = CdA\sqrt{2gh}$$

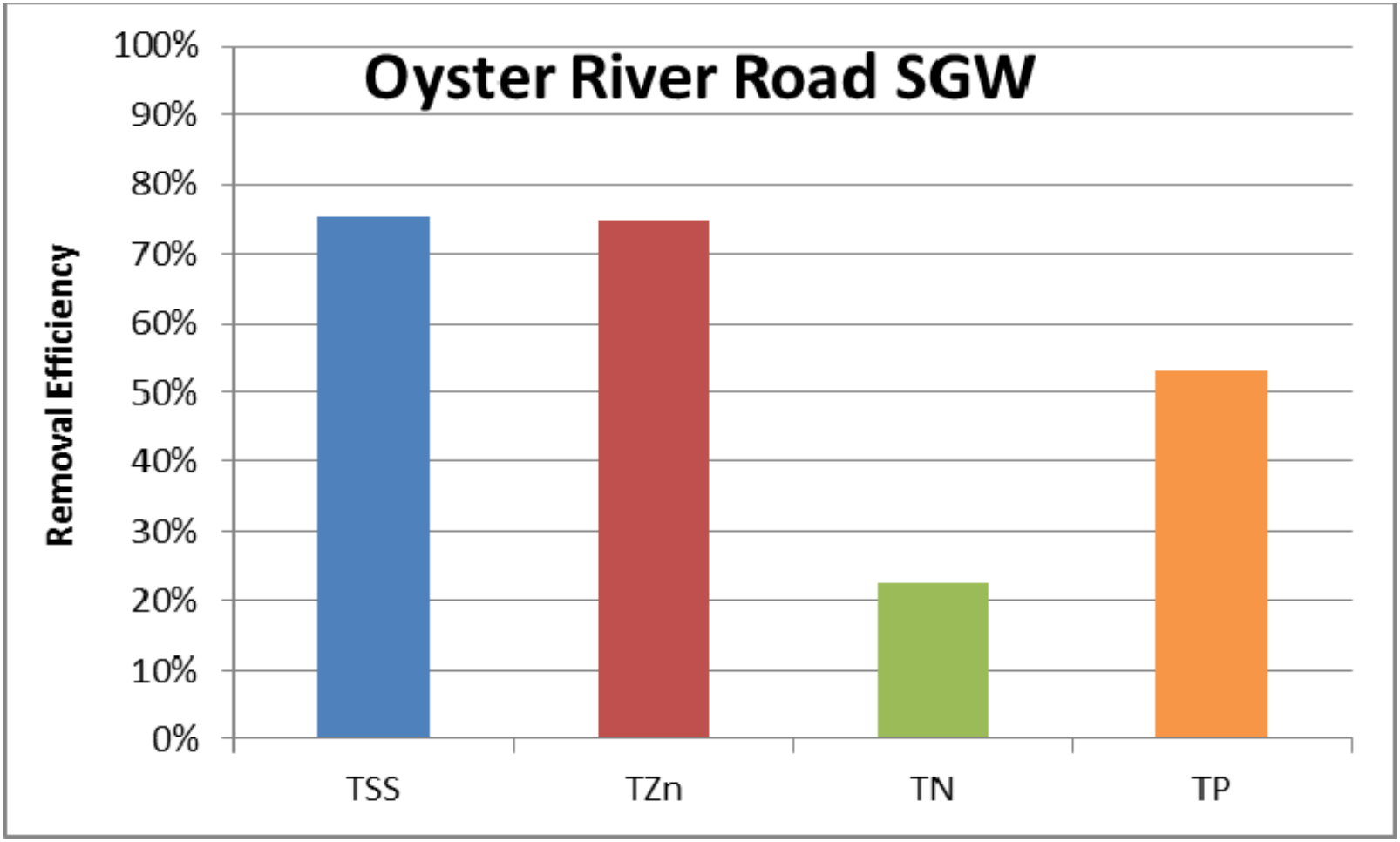

Oyster River Road
Cumulative Distribution Frequency
Non-exceedence
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1
2
3
Rainfall Depth (in)
CDF
Design Depth


Durham Bio-5
Cumulative Distribution Frequency
Non-exceedence
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.5
1
1.5
2
Rainfall Depth (in)
CDF
Design Depth

Performance Data SGWSC-1

Pollutant	Statistic	Influent	Effluent	Pollutant	Statistic	Influent	Effluent
TSS (mg/L)	n	15	15	Zn (mg/L)	n	9	9
	mean	107	17		mean	0.03	0.01
	DL	1	1		DL	0.01	0.01
	ER		84%		ER		76%
	AVGRE		54%		AVGRE		54%
	Median RE		75%		Median RE		75%
	SD	197	17		SD	0.03	0.01
	Cv	1.84	0.99		Cv	0.91	0.75
TN (mg/L)	n	15	15	TP (mg/L)	n	15	15
	mean	2.1	1.5		mean	0.27	0.11
	DL	0.5	0.5		DL	0.01	0.01
	ER		29%		ER		58%
	AVGRE		25%		AVGRE		52%
	Median RE		23%		Median RE		53%
	SD	0.47	0.40		SD	0.12	0.07
	Cv	0.23	0.27		Cv	0.43	0.61
DIN (mg/L)	n	11	11	PO_4 (mg/L)	n	13	13
	mean	0.3	0.4		mean	0.14	0.07
	DL	0.1	0.1		DL	0.01	0.01
	ER		-3%		ER		52%
	AVGRE		-11%		AVGRE		50%
	Median RE		-17%		Median RE		47%
	SD	0.2	0.3		SD	0.05	0.04
	Cv	0.57	0.72		Cv	0.37	0.53

Note: n – number of storms; DL – detection limit; ER – efficiency ratio; AVGRE – average removal efficiency; SD = standard deviation; Cv = coefficient of variation

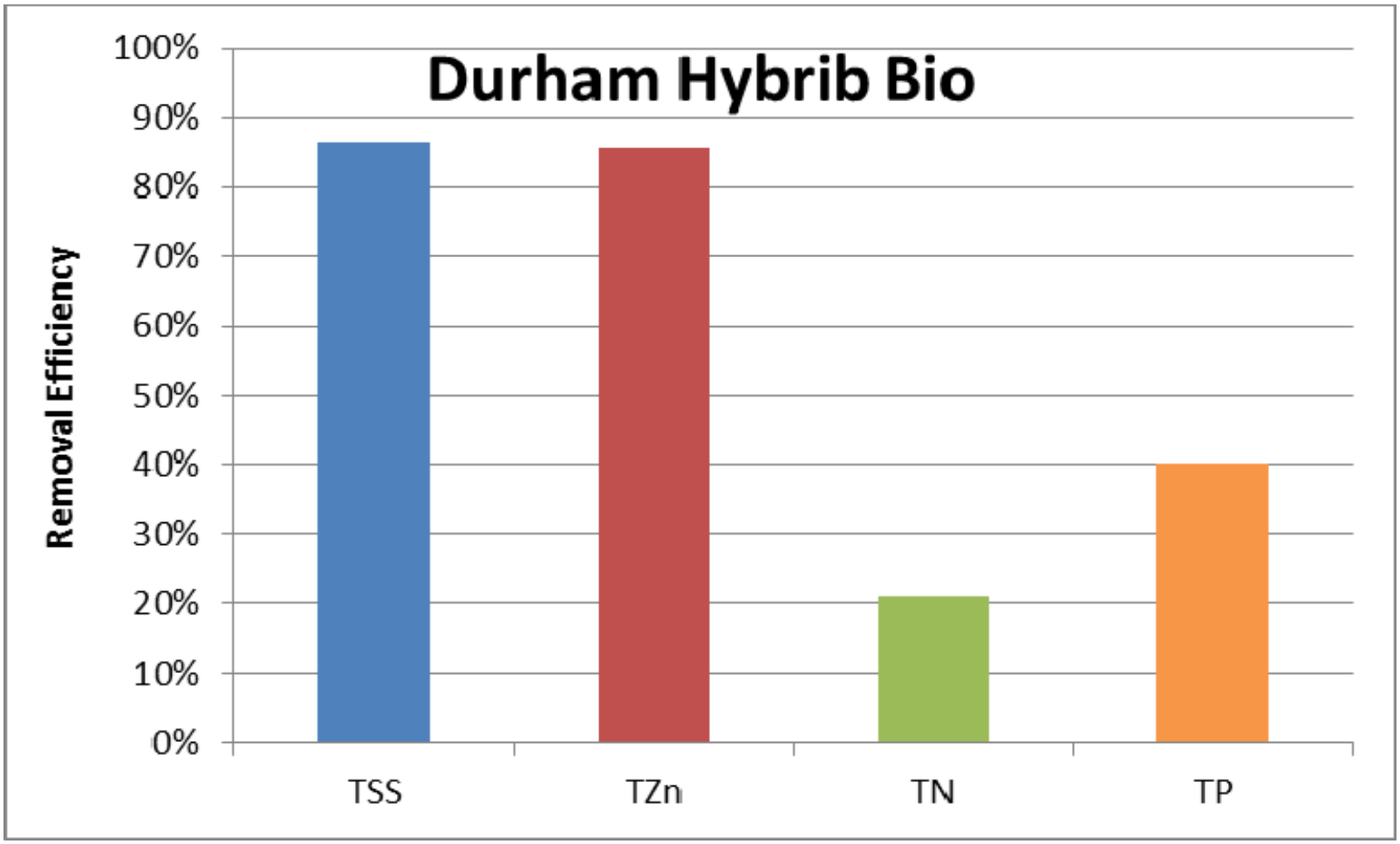


TSS (mg/L)		TZn (mg/L)		TN (mg/L)		TP (mg/L)	
Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
42	12	0.02	0.01	2.0	1.4	0.25	0.09

Performance Data IBSCS-2

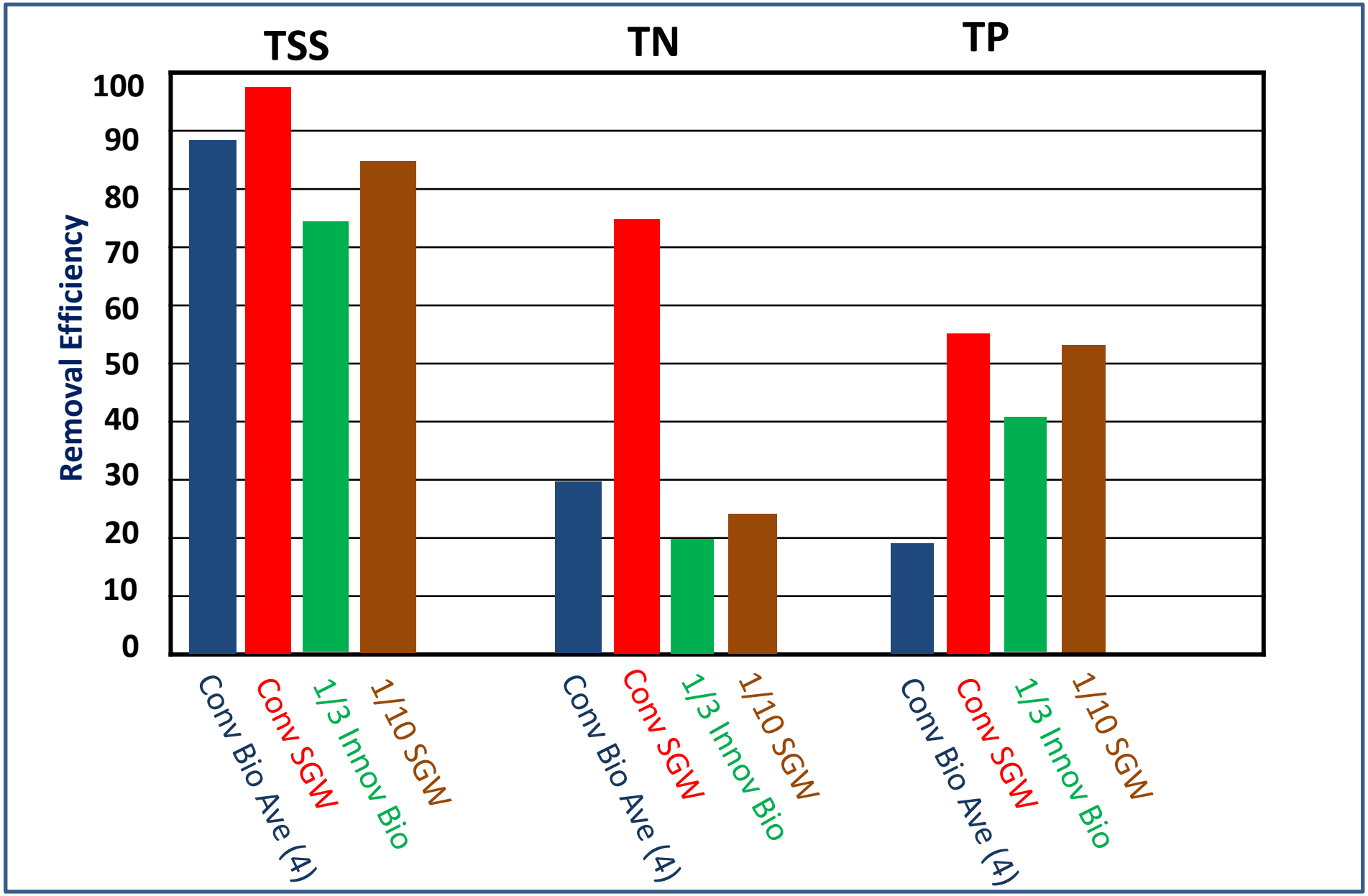
Pollutant	Statistic	Influent	Effluent	Pollutant	Statistic	Influent	Effluent
TSS (mg/L)	n	19	19	Zn (mg/L)	n	19	19
	mean	106	21		mean	0.11	0.02
	DL	1	1		DL	0.01	0.01
	ER		80%		ER		84%
	AVG RE		73%		AVG RE		83%
	Median RE		86%		Median RE		86%
	SD	91	28		SD	0.05	0.02
	Cv	0.85	1.31		Cv	0.48	1.06
TN (mg/L)	n	19	19	TP (mg/L)	n	18	18
	mean	1.9	1.4		mean	0.14	0.07
	DL	0.5	0.5		DL	0.01	0.01
	ER		29%		ER		52%
	AVG RE		19%		AVG RE		32%
	Median RE		21%		Median RE		40%
	SD	0.83	0.53		SD	0.07	0.06
	Cv	0.43	0.38		Cv	0.49	0.85
DIN (mg/L)	n	13	13	PO_4 (mg/L)	n	8	8
	mean	0.4	0.4		mean	0.04	0.03
	DL	0.1	0.1		DL	0.01	0.01
	ER		0%		ER		31%
	AVG RE		-24%		AVG RE		27%
	Median RE		0%		Median RE		38%
	SD	0.3	0.3		SD	0.02	0.01
	Cv	0.88	0.81		Cv	0.44	0.46

Note: n = number of storms; DL = detection limit; ER = efficiency ratio; AVG RE = average removal efficiency; SD = standard deviation; Cv = coefficient of variation

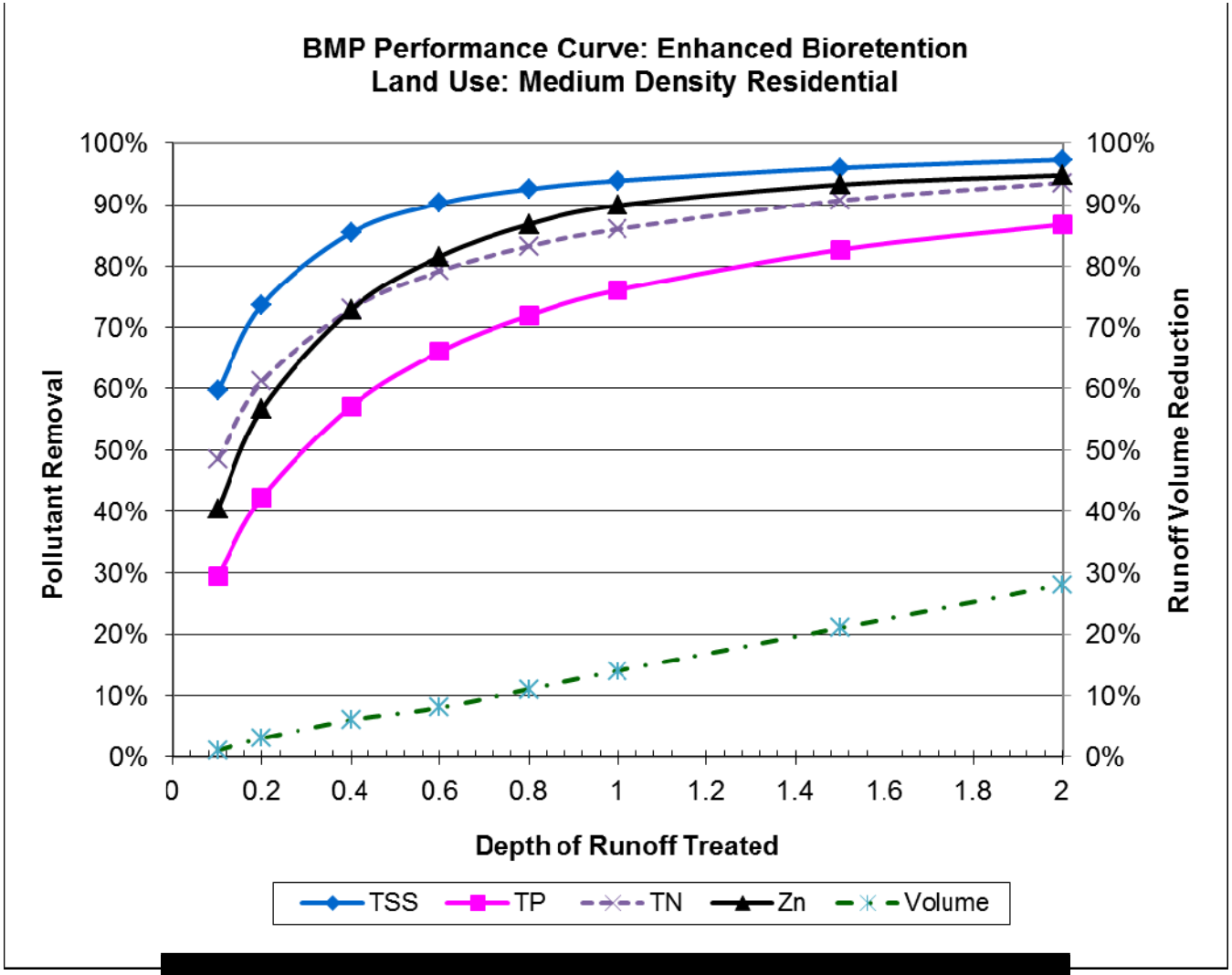


TSS (mg/L)		TZn (mg/L)		TN (mg/L)		TP (mg/L)	
Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
55	10	0.10	0.01	1.8	1.4	0.12	0.05

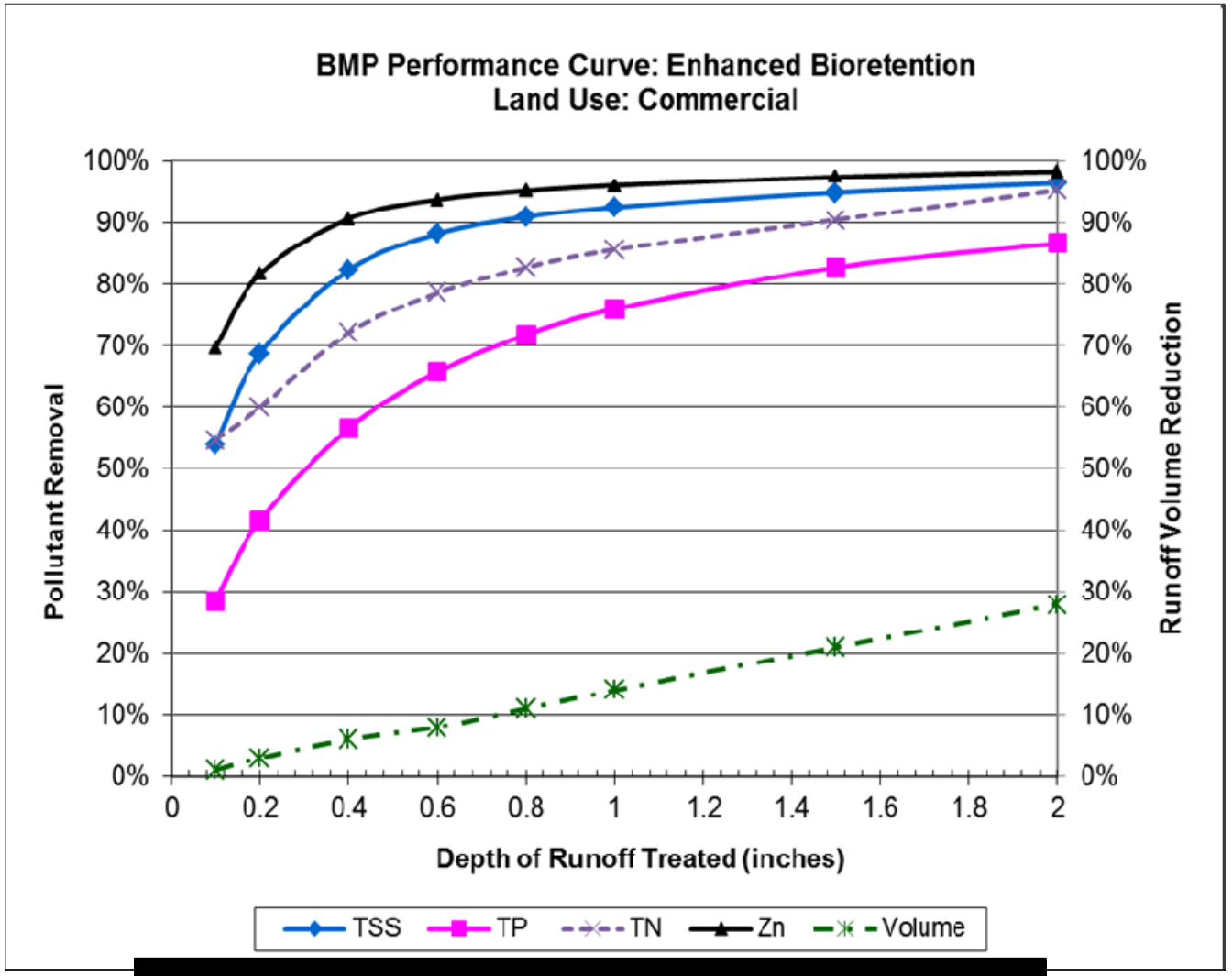
Comparative Removal Efficiencies



These results do not fit in any current model?



Analyte	Depth txt	Modeled RE	Measured
TSS	0.1	52	75
TZn	0.1	20	75
TN	0.1	TBD	23
TP	0.1	20	53



Analyte	Depth txt	Modeled RE	Measured
TSS	0.3	78	86
TZn	0.3	88	86
TN	0.3	TBD	21
TP	0.3	50	40

Pre-Existing Site

Field Measured Infiltration Results

Location	Double Ring (in/hr)
1	0.03
2	0.29*
3	0.08*
4	0.46*

DRI Median = 0.215 in/hr

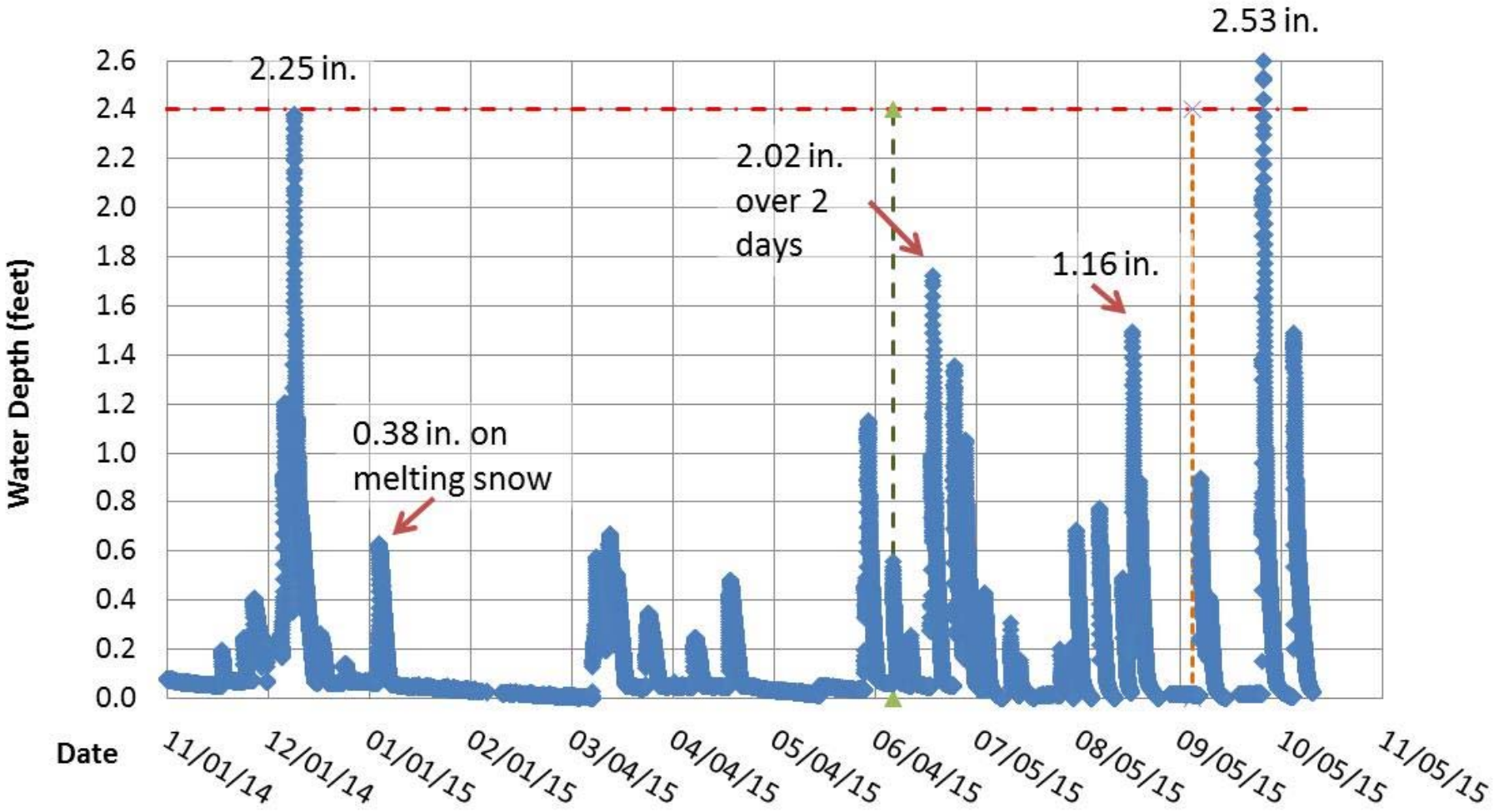

2014/07/31


2014/07/31

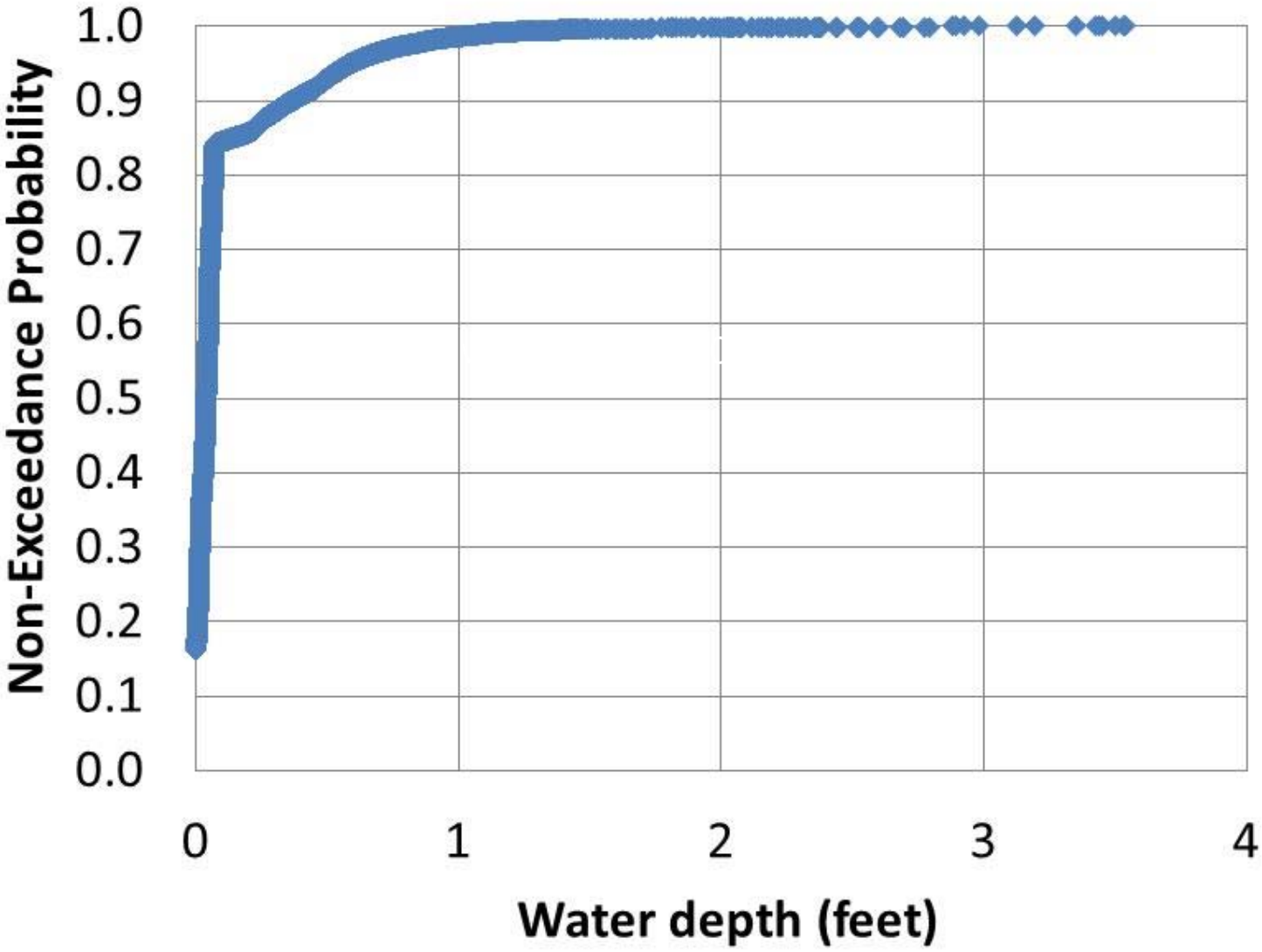

2014/08/09

Site Today

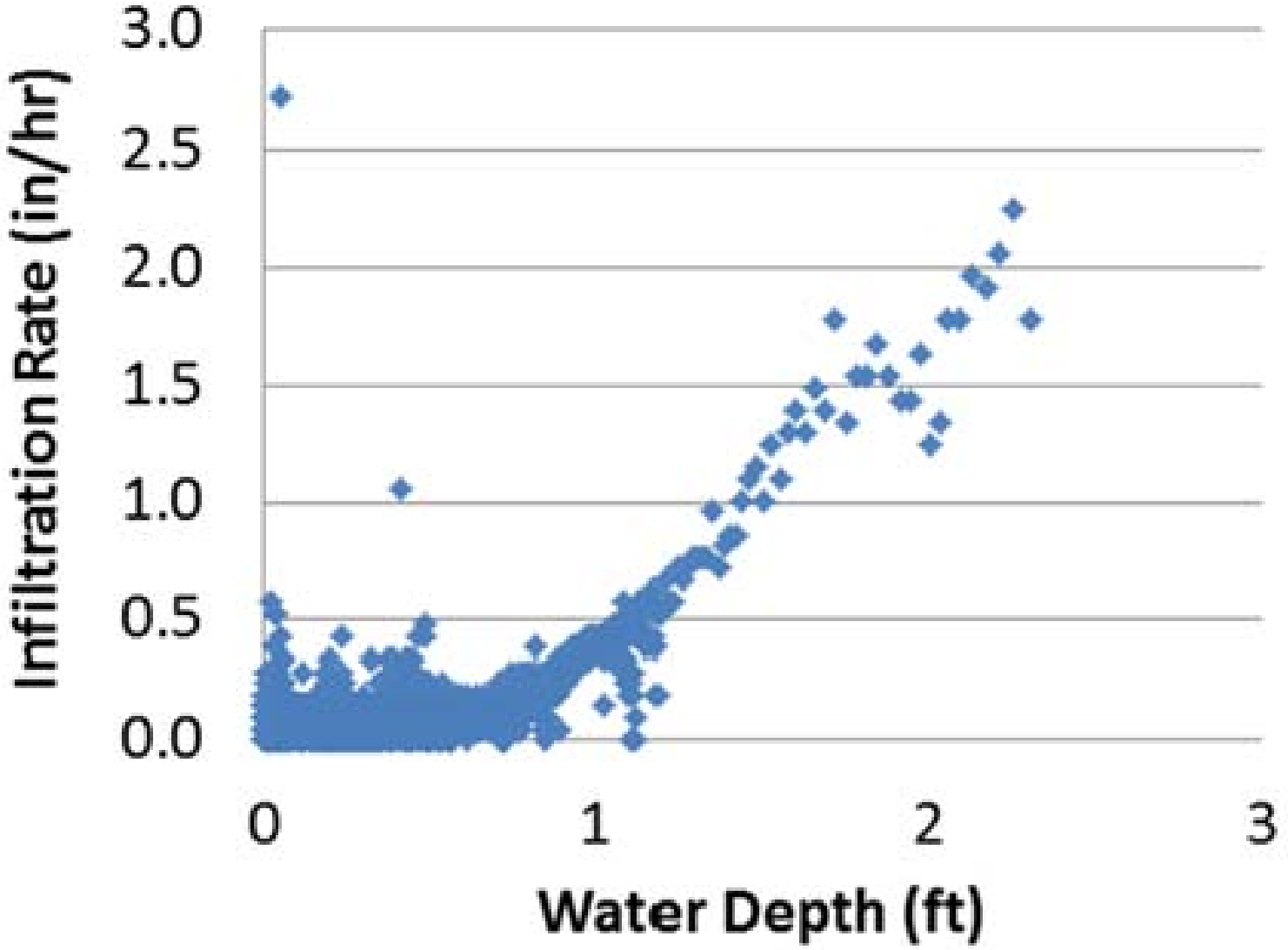

STOP
Lot A
Section 2
Permit
Required
P
Commuter
Faculty/Staff
876 CD7
04/26/2015


2.53 in.
2.25 in.
2.02 in. over 2 days
1.16 in.
0.38 in. on melting snow
Water Depth (feet)
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Date
11/01/14
12/01/14
01/01/15
02/01/15
03/04/15
04/04/15
05/04/15
06/04/15
07/05/15
08/05/15
09/05/15
10/05/15
11/05/15

Water Depth Probability



Changing Infiltration Rate

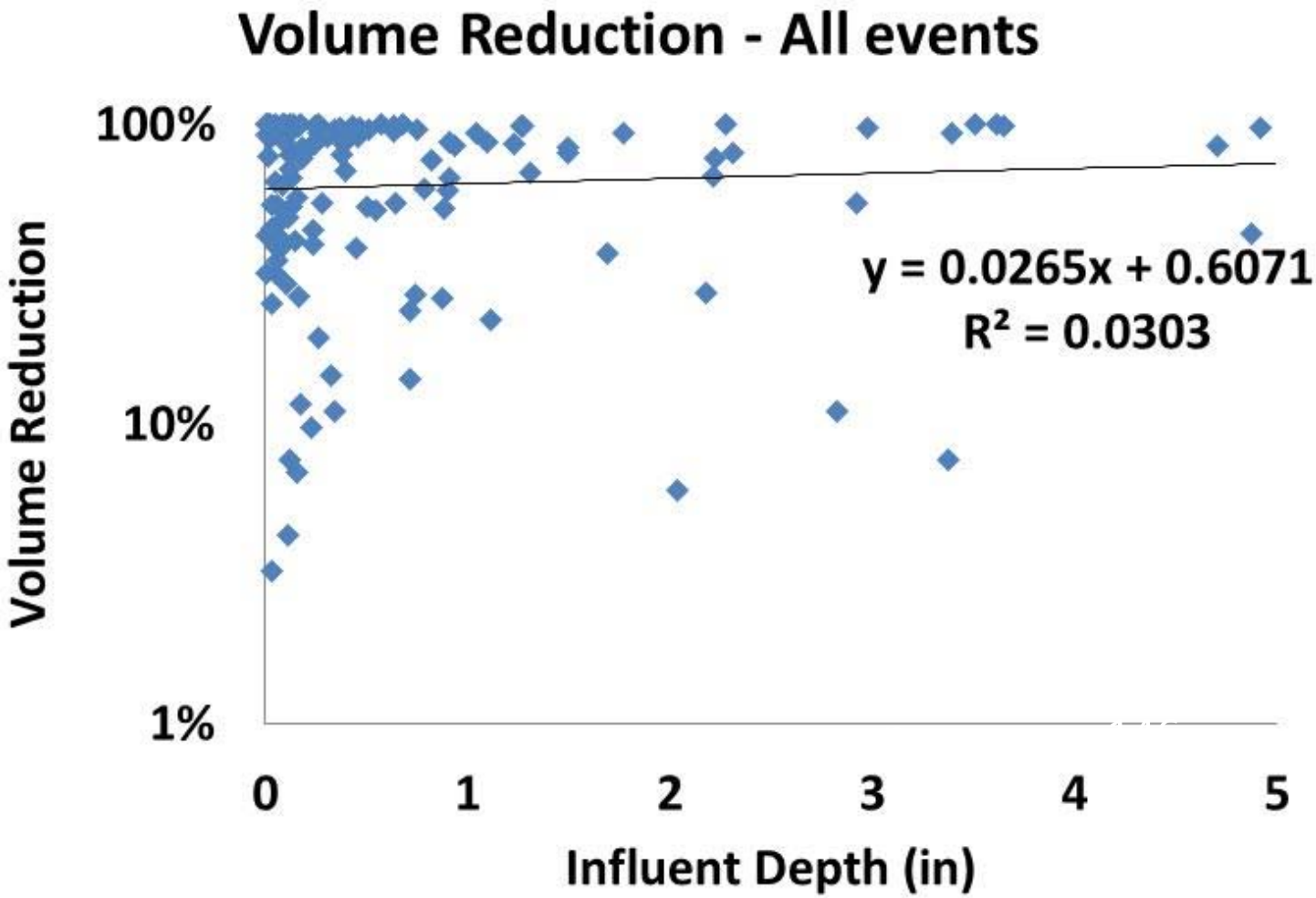


Infiltrated Volume

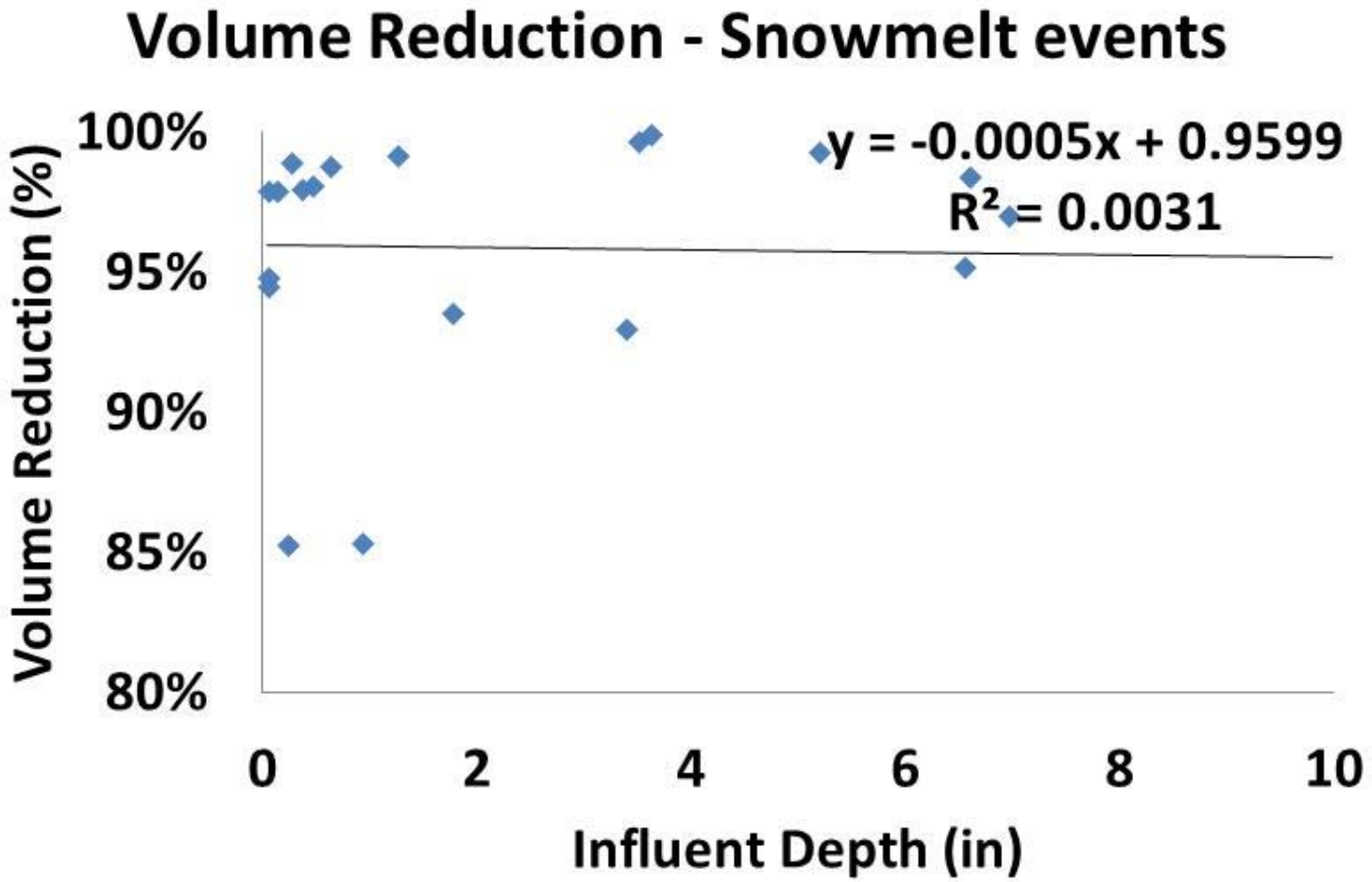
- For the 366 day period
  - 41.47 in. precip.
  - Precip. Volume = 87,300 ft^3
  - Runoff volume (C = 0.92) = 80,330 ft^3
  - Infiltrated volume = 64,583 ft^3 (estimated from water depth)
  - Volume reduction = 80%

UNHSC Tree Filter

Overall Hydraulic Performance – tree box filter all data



Overall Hydraulic Performance – tree box filter snowmelt




Questions???