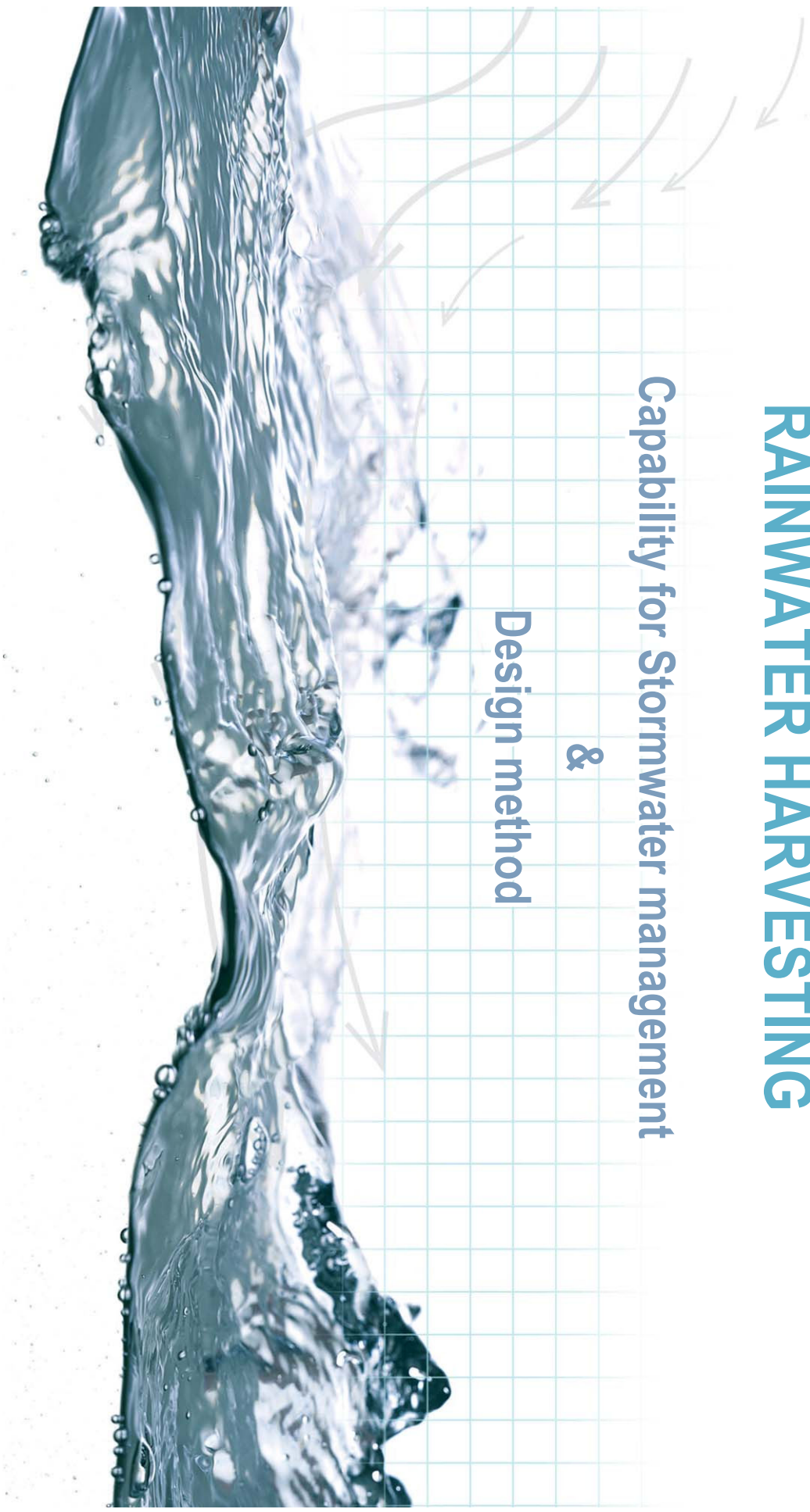




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RAINWATER HARVESTING

**Capability for Stormwater management
&
Design method**





Rainwater harvesting - viability

+ve aspects

- Saves water
 - (+operating carbon and resources)

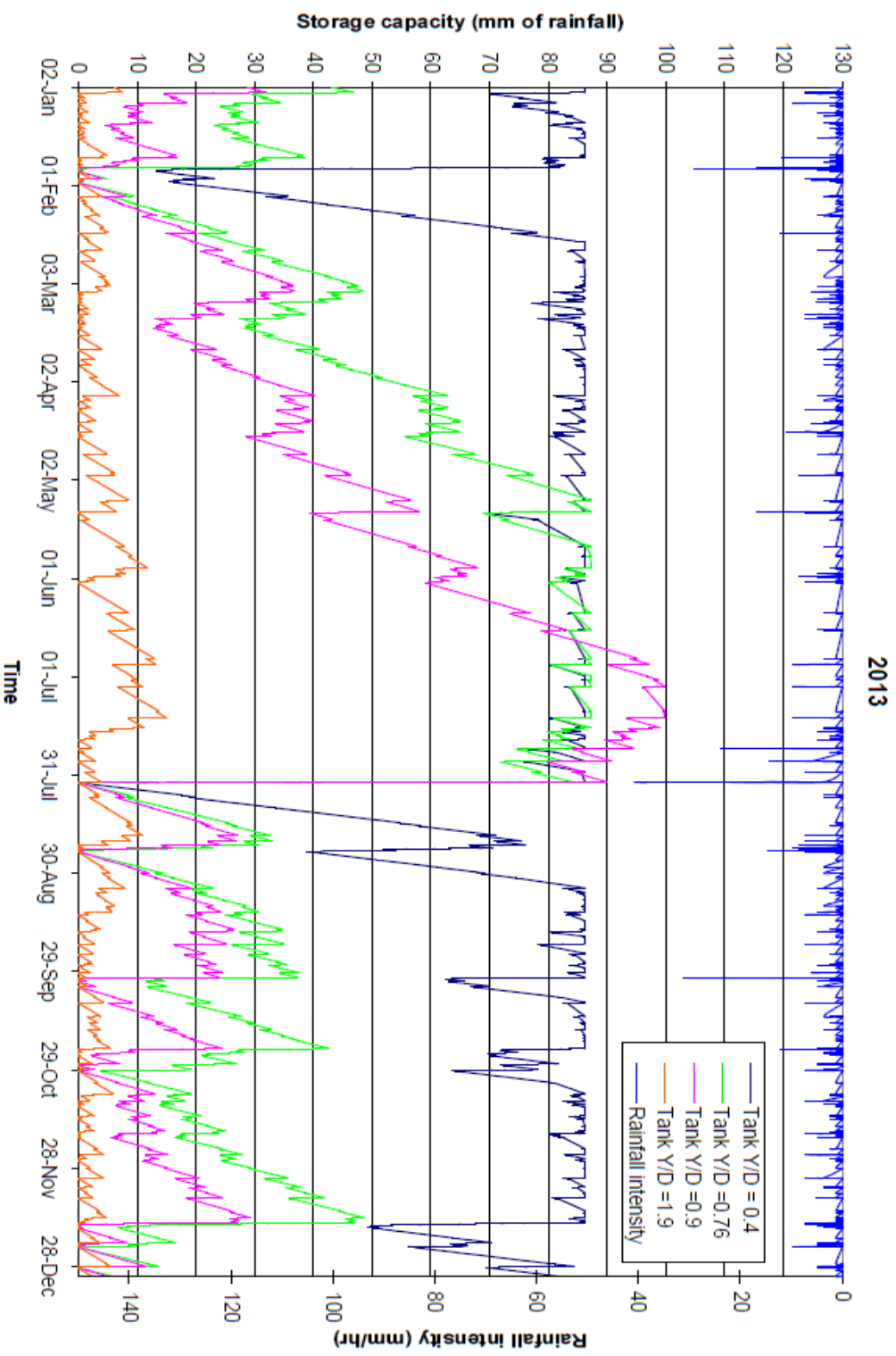
-ve aspects

- Construction costs
- Maintenance effort
- Construction carbon / WLC carbon
- **Added value of stormwater control potential**
 - IF it can be designed for





Tank Storage behaviour



Design - Y/D < 0.95



Y/D – Annual Yield & Demand

Regular Daily Demand (D)

- Toilets (21l/c/d)
- Washing machines (19l/c/d)

Yield (Y)

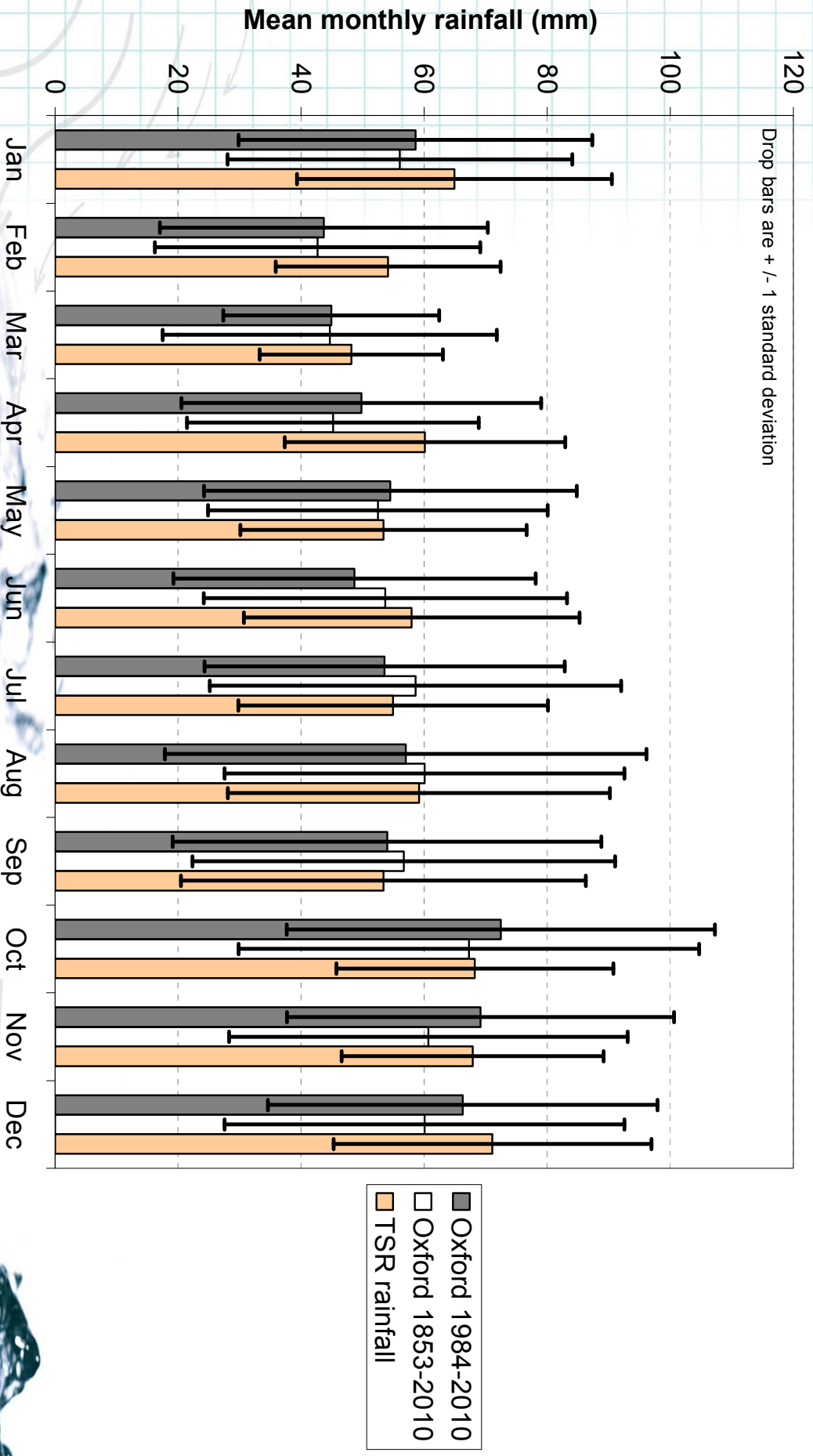
- Annual Rainfall
- Roof Area
 - 42m² – 2 bed, 50m² – 3 bed, 74m² – 4 bed

- **NB: Losses are important (150+events /yr)**





Annual rainfall





House occupancy

	Number of bedrooms in the property					Overall	
	0	1	2	3	4		≥5
Cherwell District							
Properties sample size	3	84	210	243	145	87	772
Number of occupants	3	118	362	579	431	295	1788
Mean occupancy	1.00	1.40	1.72	2.38	2.97	3.39	2.32
Standard deviation	0.00	0.58	0.66	0.97	1.12	1.24	0.92
Oxfordshire							
Properties sample size	28	514	1191	1044	809	311	3897
Number of occupants	31	716	2069	2453	2443	1138	8850
Mean occupancy	1.11	1.39	1.74	2.35	3.02	3.66	2.27
Standard deviation	0.42	0.56	0.73	1.02	1.17	1.32	0.95

Pilot study - Banbury



Digitised IW model



Pilot site - occupancy

	Number of bedrooms in the property					Overall
	1	2	2.5	3	4	
<i>Hanwell Fields Phase 2a survey</i>						
Properties sample size	0	9	0	21	4	34
Number of occupants	-	16	-	53	13	82
Mean occupancy	-	1.78	-	2.52	3.25	2.41
Standard deviation	-	0.44	-	1.12	1.26	0.98





Pilot study Y/D characteristics

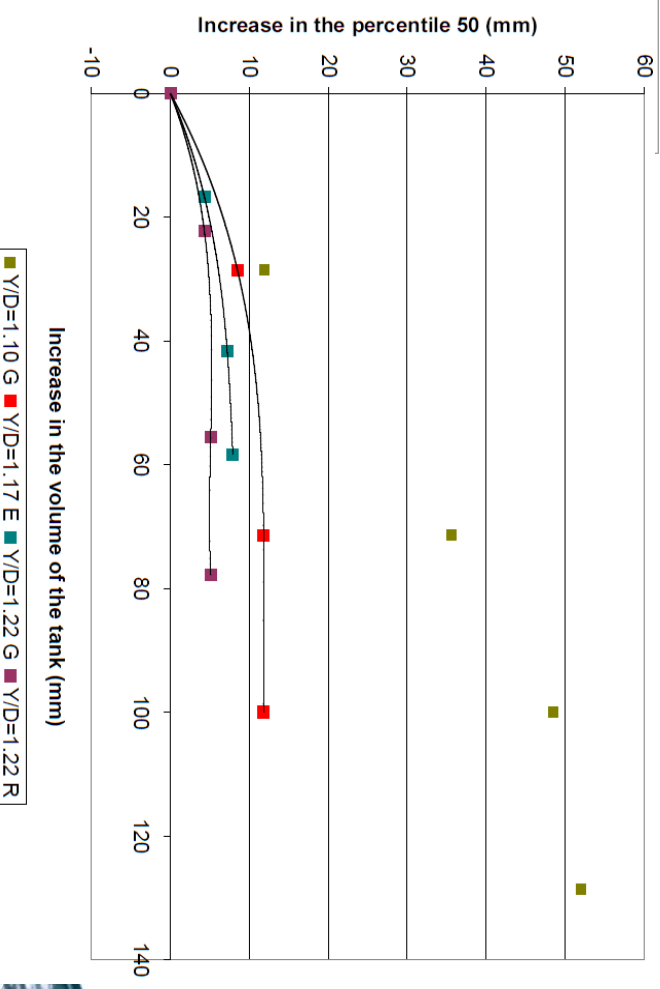
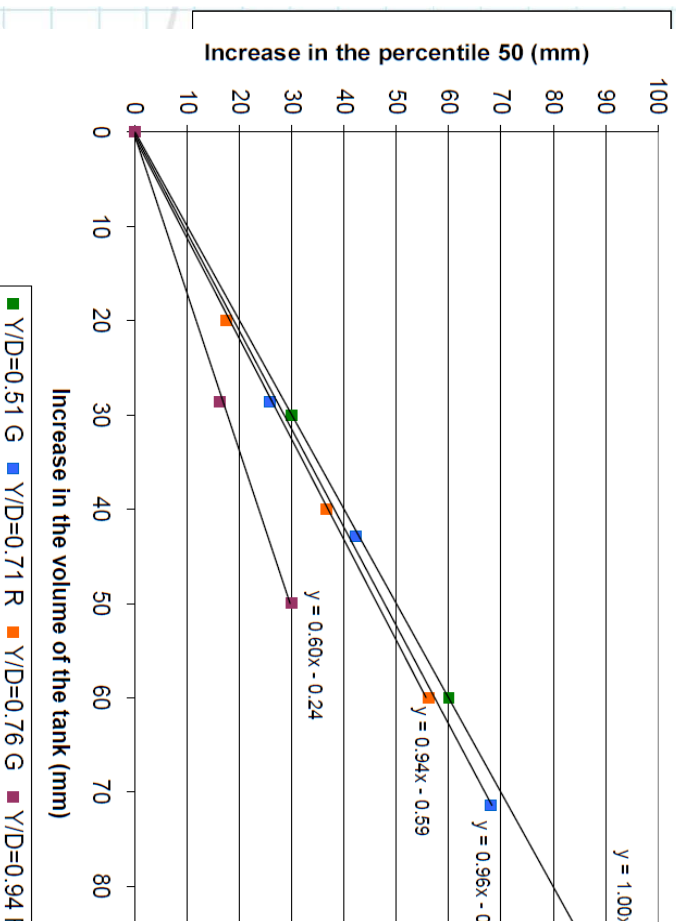
	Properties with statistical population occupancy (nr)	Properties with actual population occupancy (nr)
Total number of properties	66	34 (31)
Properties with Y/D < 0.75	19	13 (12)
Properties with Y/D < 0.80	38	15 (21)
Properties with Y/D < 0.85	41	21 (23)
Properties with Y/D < 0.90	45	22 (25)
Properties with Y/D < 0.95	55	24 (31)





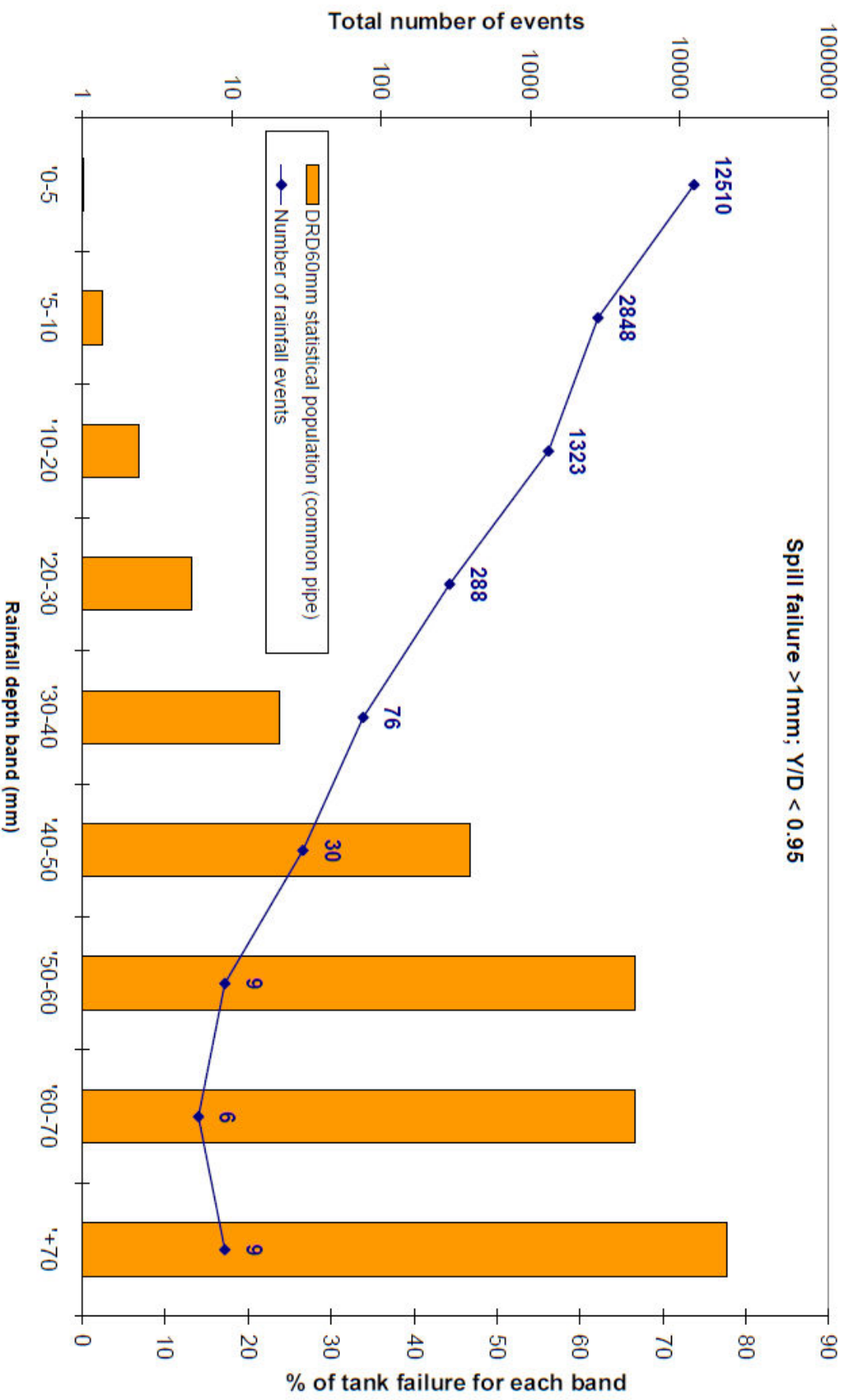
Tank storage

- Effective storage = Coef' x Tank volume + Ad
- Ad - allowance depth
- Ad to address uncertainty of depth = $f(Y/D)$





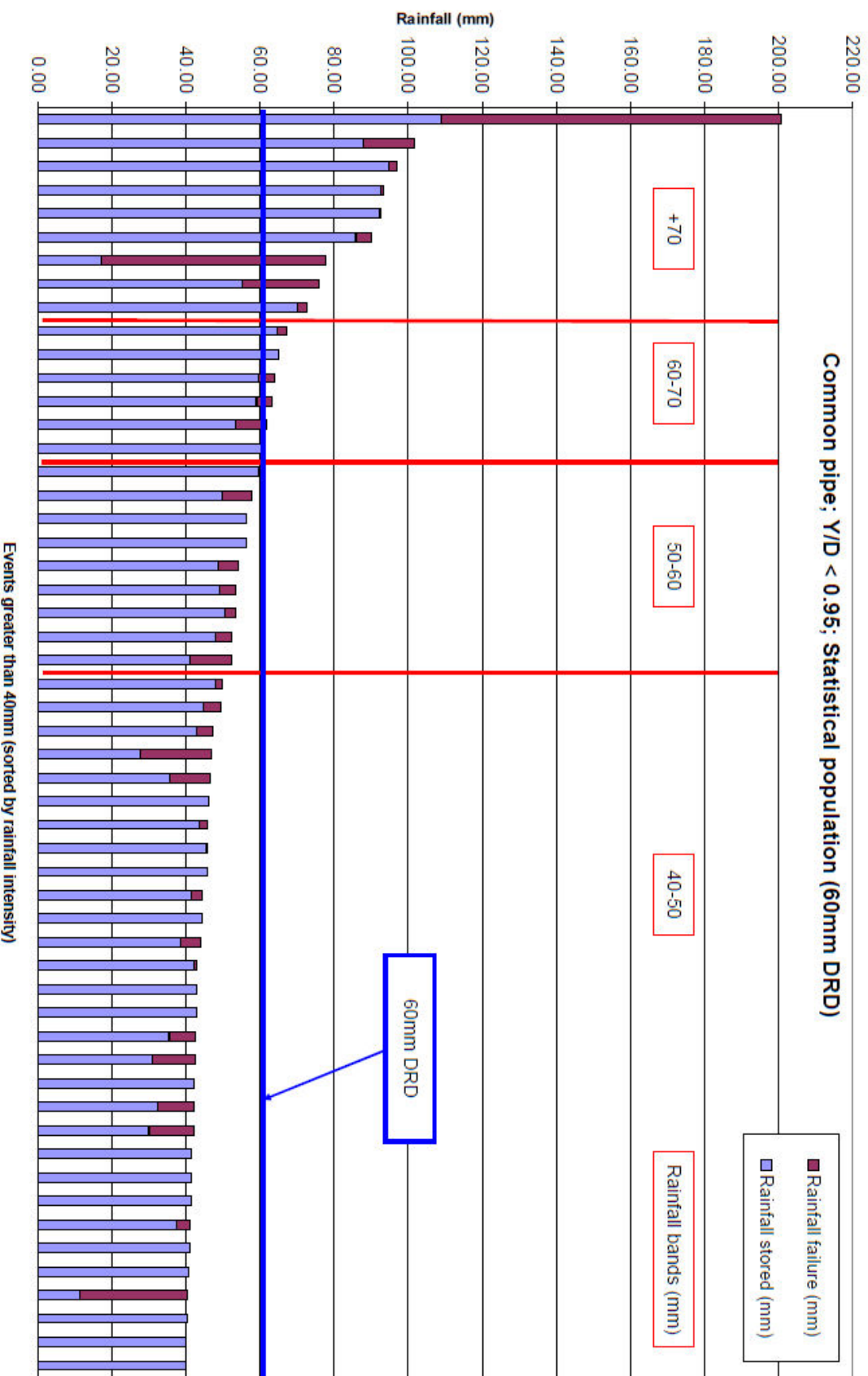
TSR performance – statistical population



Average % of properties failing with spill 1mm+

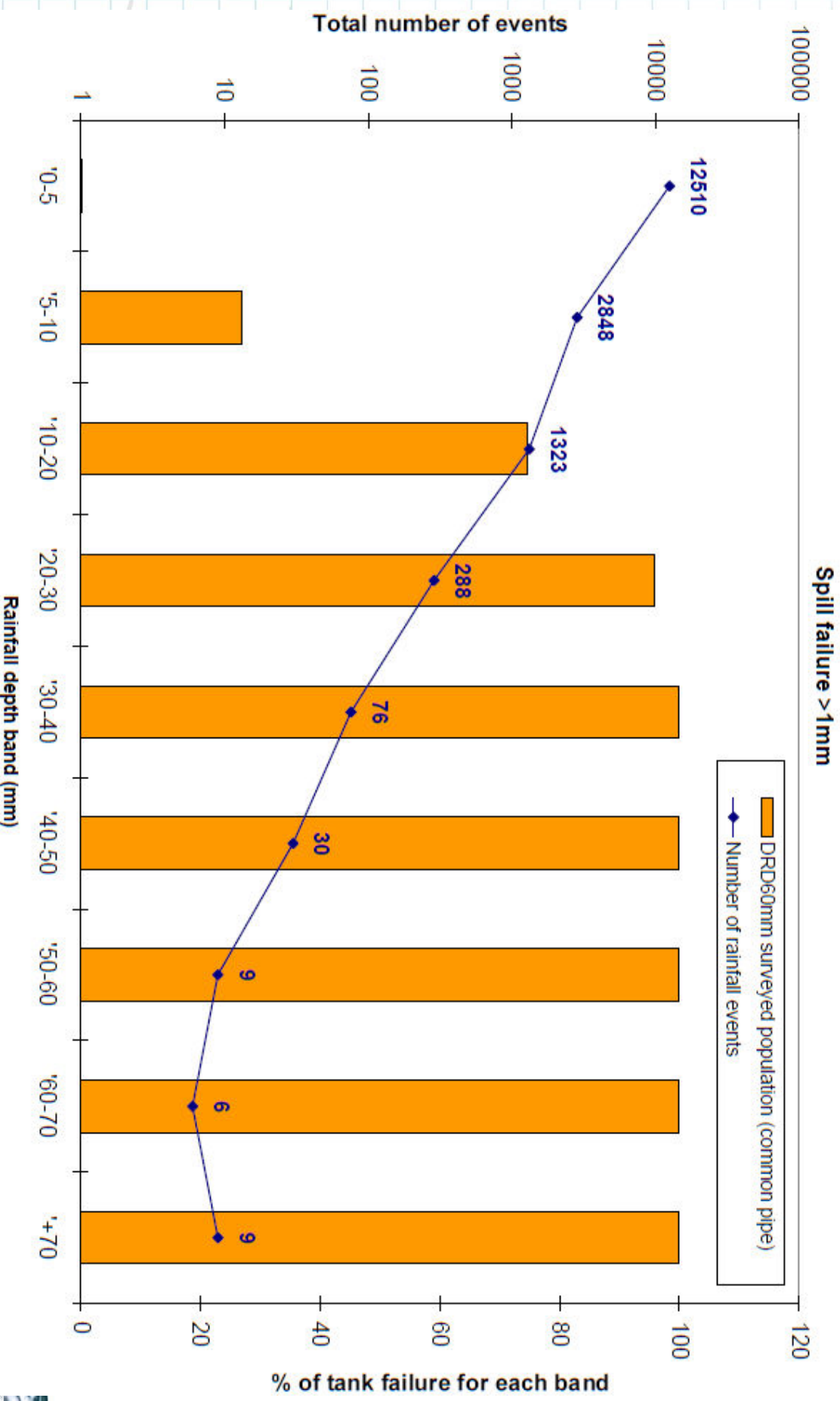


Statistical pop' – spill performance



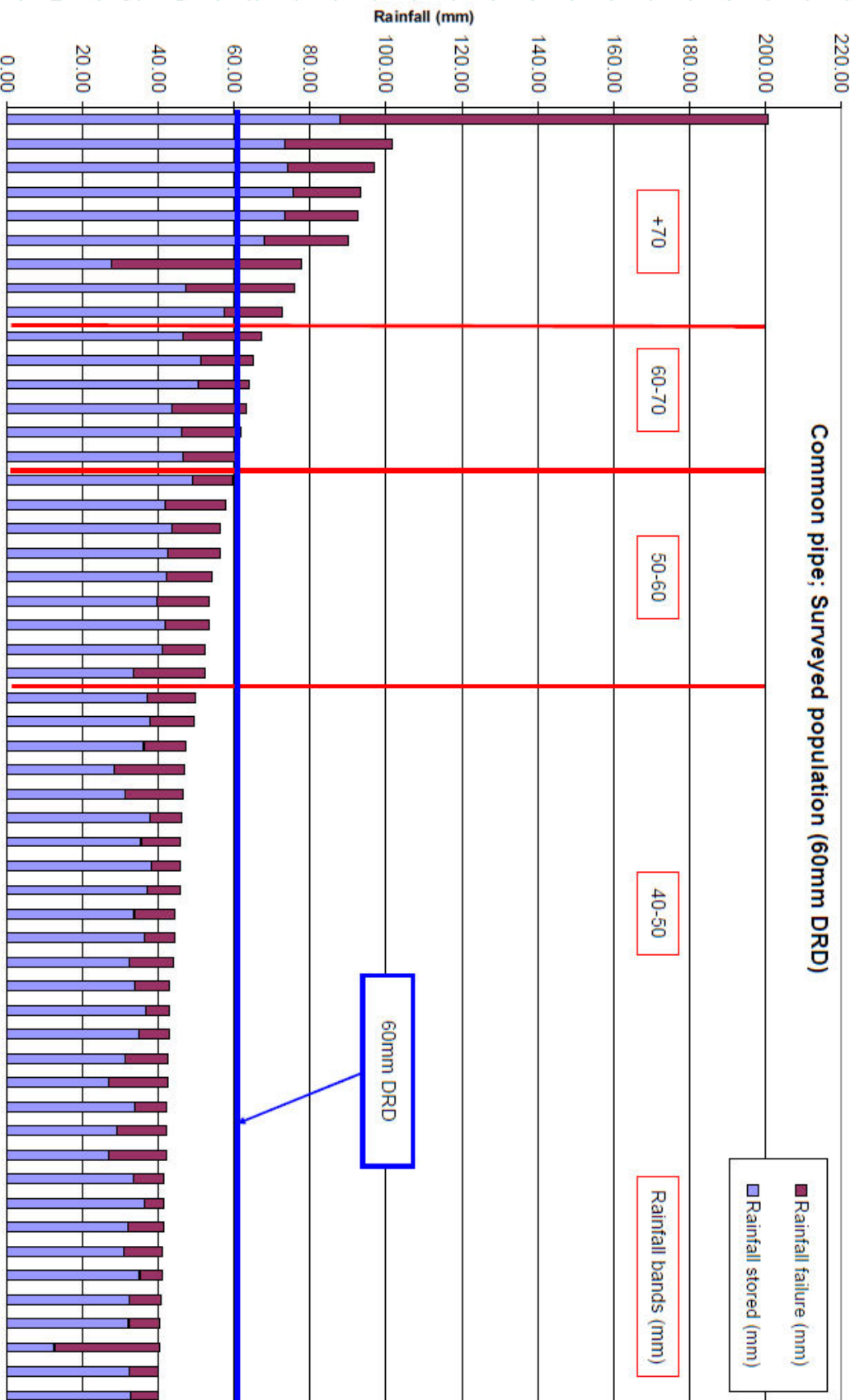


TSR performance – actual population





Actual pop' – spill performance

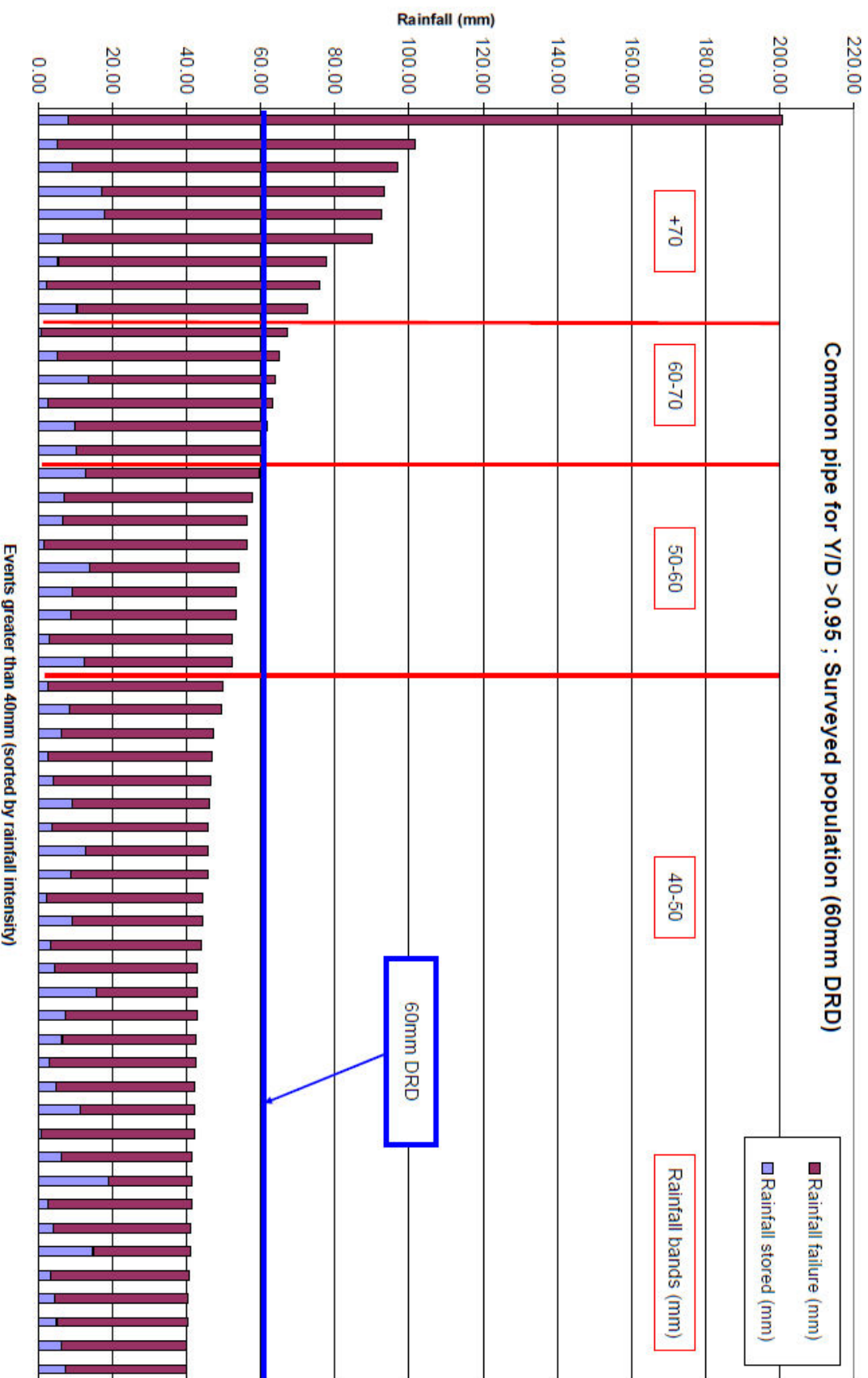


Events greater than 40mm (sorted by rainfall intensity)





Actual pop' with Y/D > 0.95 – spill performance

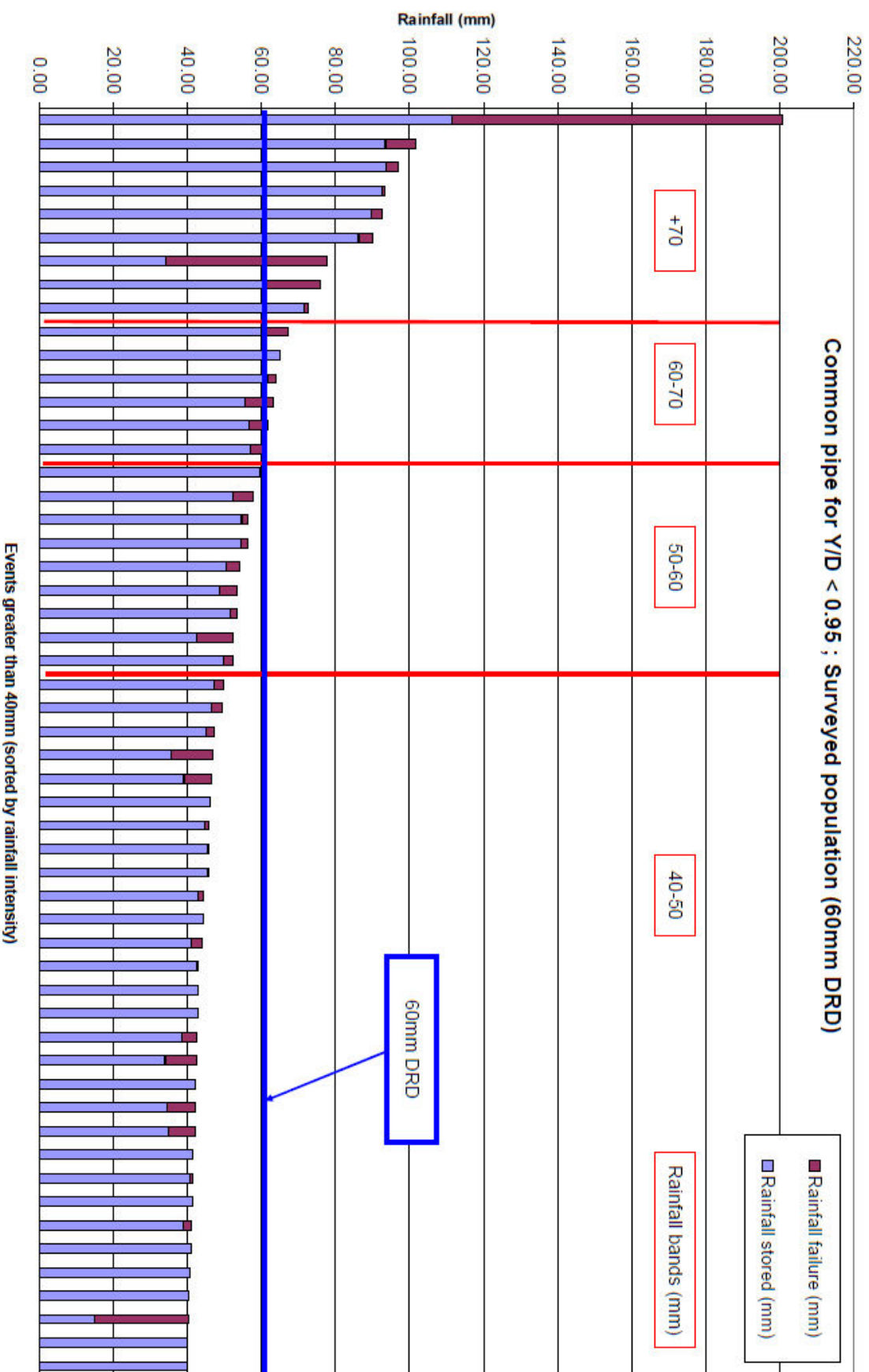


Events greater than 40mm (sorted by rainfall intensity)





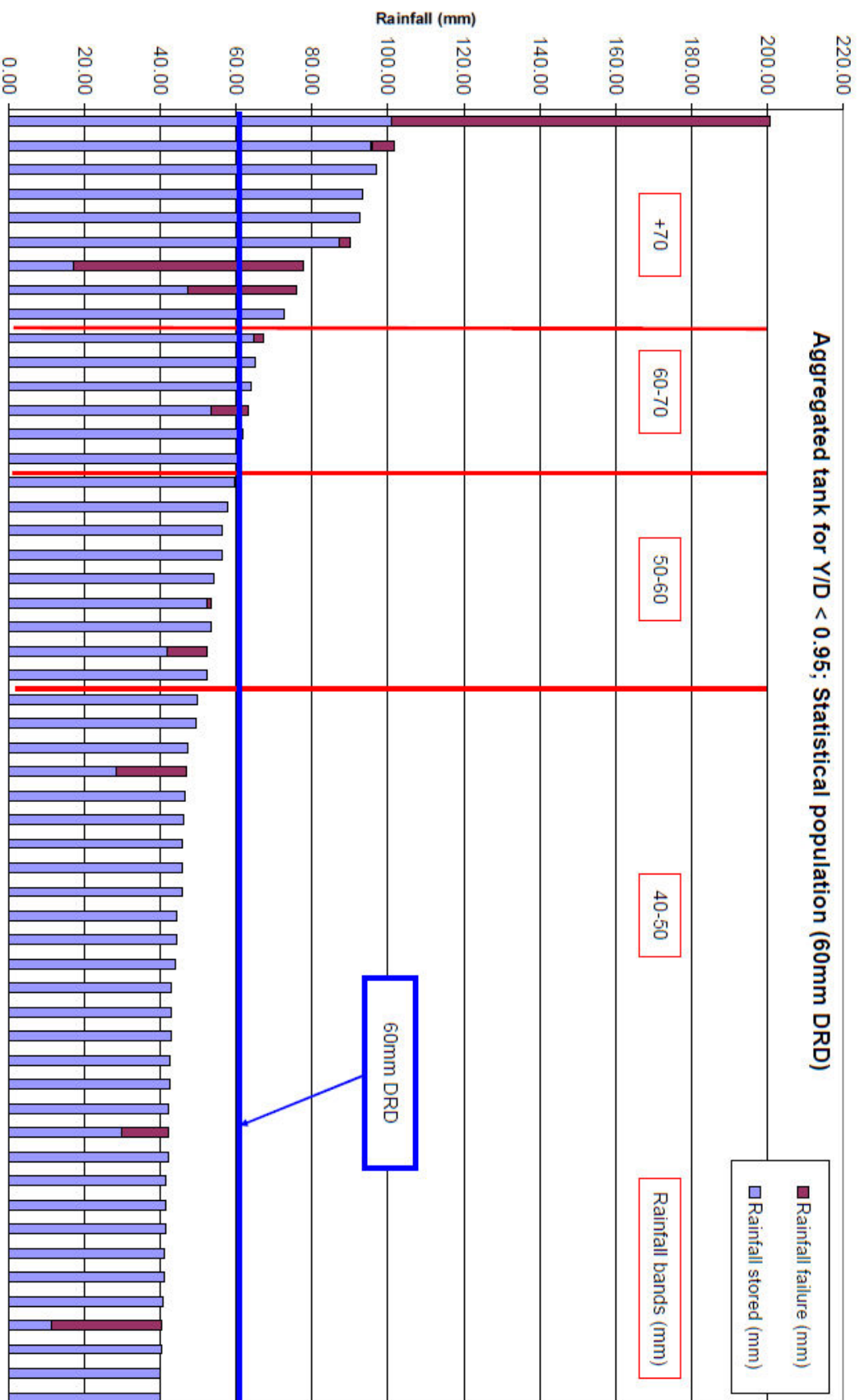
Actual pop' with Y/D < 0.95 – spill performance



Events greater than 40mm (sorted by rainfall intensity)



Actual pop' with Y/D < 0.95 – Communal tank



Events greater than 40mm (sorted by rainfall intensity)



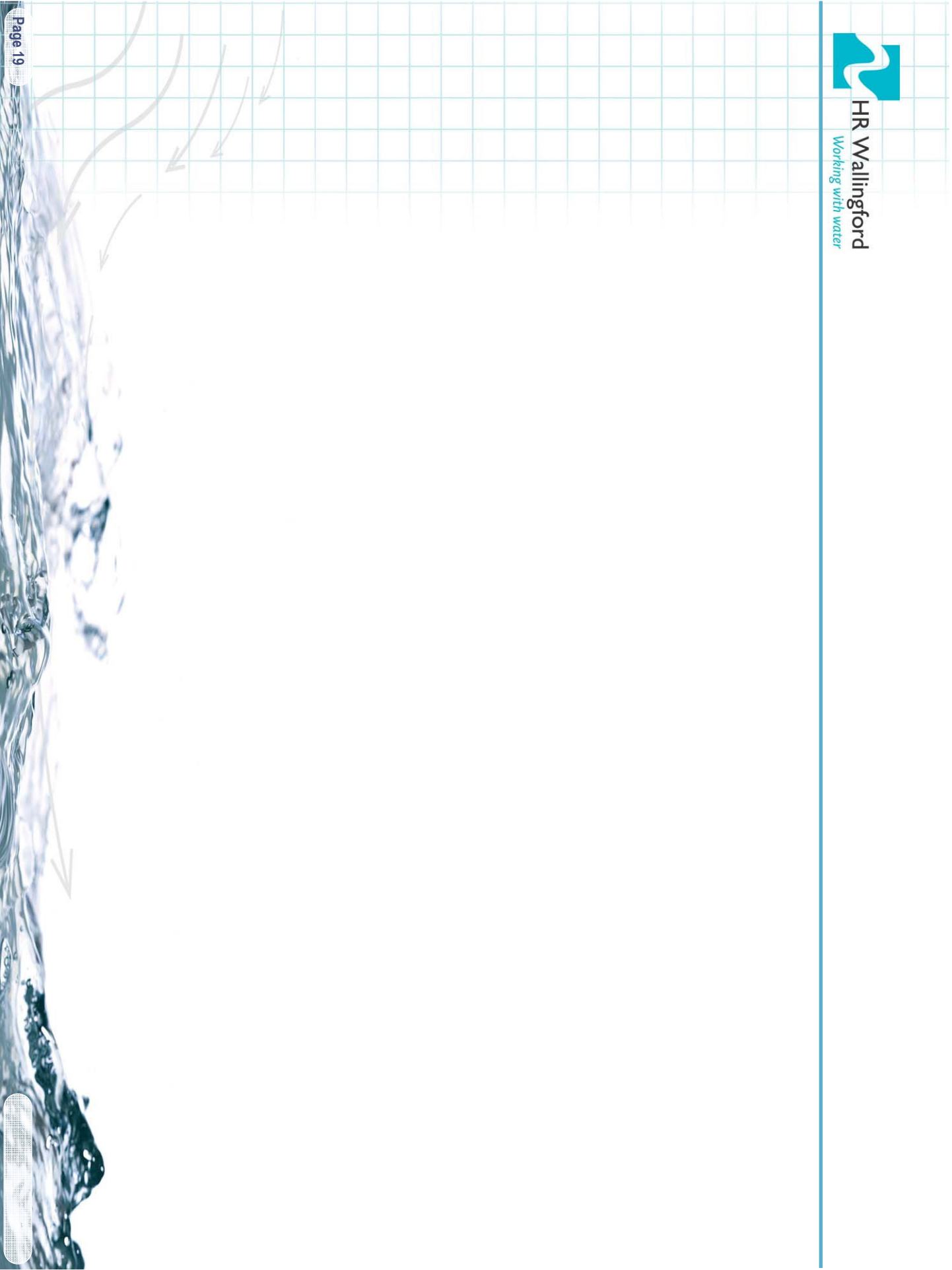
Conclusions

- 1. Rainwater harvesting can be designed for controlling stormwater to a specific storage rainfall depth**
- 2. Individual properties with rainwater harvesting require an allowance for a proportion of properties “failing”**
 - Function of Y/D ratio and assumed occupancy values and A_d
- 3. Communal performance no failure**
 - Minimum number of properties?? 10??





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