Supporting Information

Manuscript title:

Storm drains are sources of human fecal pollution during dry weather in three urban Southern California watersheds.

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Contains:

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Materials and Methods

Study sites. The three adjacent watersheds all belong to the Santa Barbara coastal hydrologic unit, and consist of creeks flowing south from their headwaters in the mountains to the Santa Barbara Channel (1,2). The Mission Creek watershed area is approximately 7,203 acres. The upper watershed is dominated by open space (mixed forest and chaparral), while the lower watershed is urbanized with mostly residential and commercial land uses, and some open space. Sampling locations M4-M9 and DM1-DM9 belonged to the Mission watershed. The Laguna Creek watershed is the most urbanized of the three watersheds studied, and comprised of approximately 2020 acres of almost entirely urban land. Only 22% (mainly upper watershed) consists of open space, while the remaining area consists of residential and some commercial land uses. Sampling locations M2 and M3 belonged to this watershed. Mission Creek and Laguna Creek converge in a lagoon on the beach that periodically flows directly to the ocean (location M1). The Arroyo Burro watershed encompasses approximately 6,311 acres, with mostly open space in the upper watershed; commercial and residential in the middle watershed and suburban and rural residential with some open space in the lower watershed. Sampling locations A2-A10 and DA1-DA6 were all in this watershed. All watersheds have few or no agricultural lands. Both Arroyo Burro and Mission Creek are Water Quality Limited Segments in the Clean Water Act Section 303-(d) List and both terminate at beaches frequently posted with warnings against recreational use based on fecal indicator bacteria levels that Santa Barbara County measures weekly.

References

(1) City of Santa Barbara *Stormwater treatment options for reducing bacteria in Arroyo Burro and Mission Creek watersheds,* Creeks Restoration and Water Quality Improvement Division, Santa Barbara, CA, 2002

(2) City of Santa Barbara *Existing conditions study of the Arroyo Burro, Mission, Sycamore, and Laguna Creek Watersheds*, Creeks Restoration/Water Quality Improvement Division, Santa Barbara, CA, 2005.

Tables

Table S1. Sampling locations and physical-chemical parameters, indicated as mean (SE, n=3) for phase I samples.

Site ID	Description	DO (mg/l)	Temp (°C)	Salinity (ppt)	pH
Mission/Laguna					
M1	Surf zone	8.7 (0.3)	16.1 (0.4)	33.2 (0.3)	8.2 (0.1)
M2	Lagoon	7.4 (0.6)	19.2 (0.4)	2.5 (1.4)	7.7 (0.2)
M3	Creek	5.5 (0.2)	19.7 (0.0)	0.5 (0.0)	7.4 (0.0)
M4	Lagoon	10.0 (0.4)	18.9 (0.8)	6.4 (2.1)	8.3 (0.1)
M5	Creek	5.2 (0.3)	18.4 (0.1)	0.5 (0.2)	7.8 (0.0)
M6	Drain	5.8*	21.8*	0.0*	7.8 (0.0)
M7	Creek	6.9 (0.5)	18.7 (0.2)	0.7 (0.0)	7.8 (0.0)
M8	Creek	nd	nd	nd	7.9 (0.1)
M9	Drain	7.7 (0.2)	19.5 (0.5)	0.0 (0.0)	7.9 (0.0)
Arroyo Burro					
A1	Surf zone	8.4 (0.3)	17.7 (0.5)	30.6 (1.8)	8.2 (0.0)
A2	Lagoon	13.4 (0.6)	18.7 (0.5)	0.1 (0.0)	8.1 (0.0)
A3	Lagoon	8.5 (0.7)	18.4 (0.6)	1.1 (0.7)	7.9 (0.0)
A4	Drain	8.8 (0.5)	17.6 (0.5)	0.0 (0.0)	8.2 (0.0)
A5	Creek	7.3 (0.5)	17.9 (0.6)	0.2 (0.2)	7.8 (0.0)
A6	Creek	7.8 (0.5)	17.9 (0.6)	0.0 (0.0)	7.9 (0.0)
A7	Creek	8.2 (0.4)	18.0 (0.3)	0.0 (0.0)	7.9 (0.0)
A8	Creek	nd	nd	nd	8.1 (0.0)
A9	Drain	nd	nd	nd	8.1 (0.0)
A10	Creek	2.7 (1.3)	18.4 (0.8)	0.0 (0.0)	7.7 (0.2)

*not replicated
nd: no data available

Figures

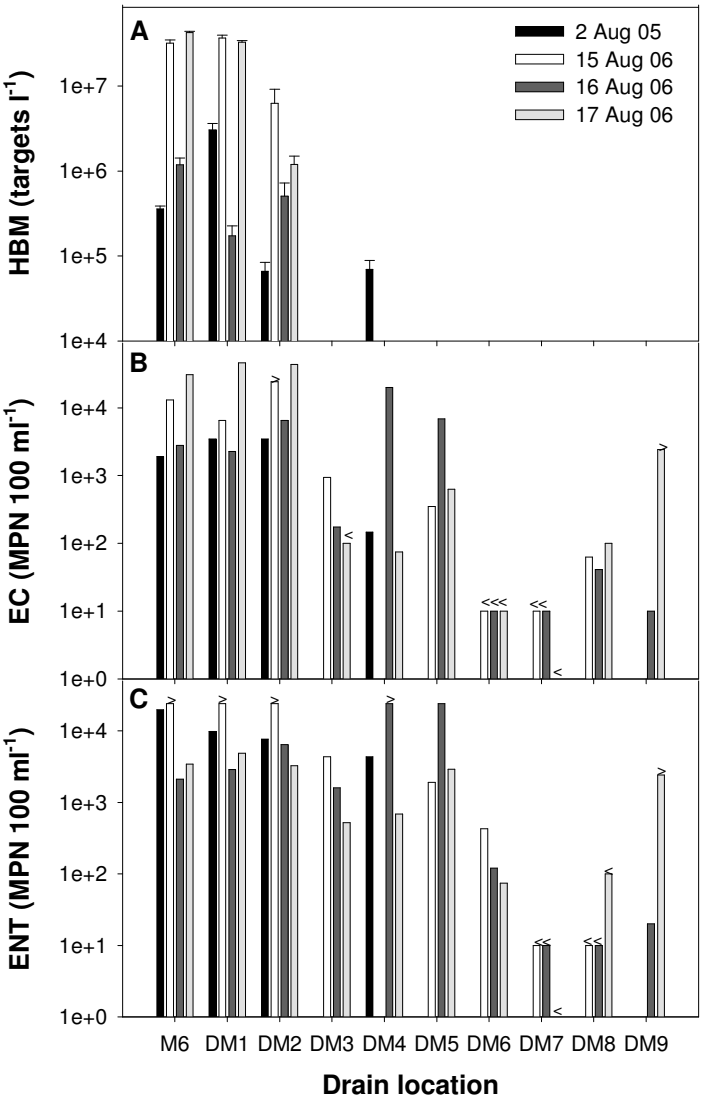

Figure S1. Concentrations of A) HBM, B) *E. coli*, and C) enterococci in the M6 drain network in the Mission Creek watershed. The absence of bars indicates that no data were available. The symbols "<" or ">" above a bar indicate out of range concentrations, with the actual concentrations being lower or higher than indicated by the bar, respectively. Error bars in part A) are the SE of the mean ($n \geq 3$) of qPCR replicates for a single sample.

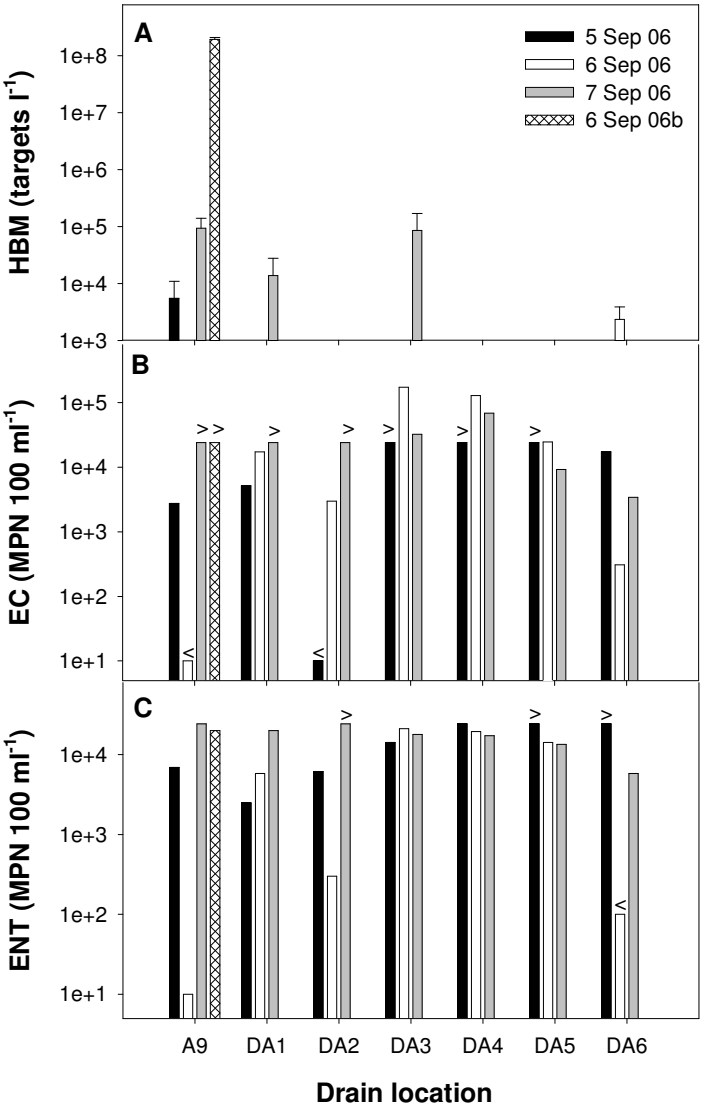

Figure S2. Concentrations of HBM and fecal indicator bacteria in the A9 drain network in the AB watershed. A) HBM, B) *E. coli*, C) enterococci. The symbols "<" or ">" above a bar indicate out of range concentrations, with the actual concentrations being lower or higher than indicated by the bar, respectively. Error bars in A) are the SE of the mean ($n \geq 3$) of qPCR replicates for a single sample.

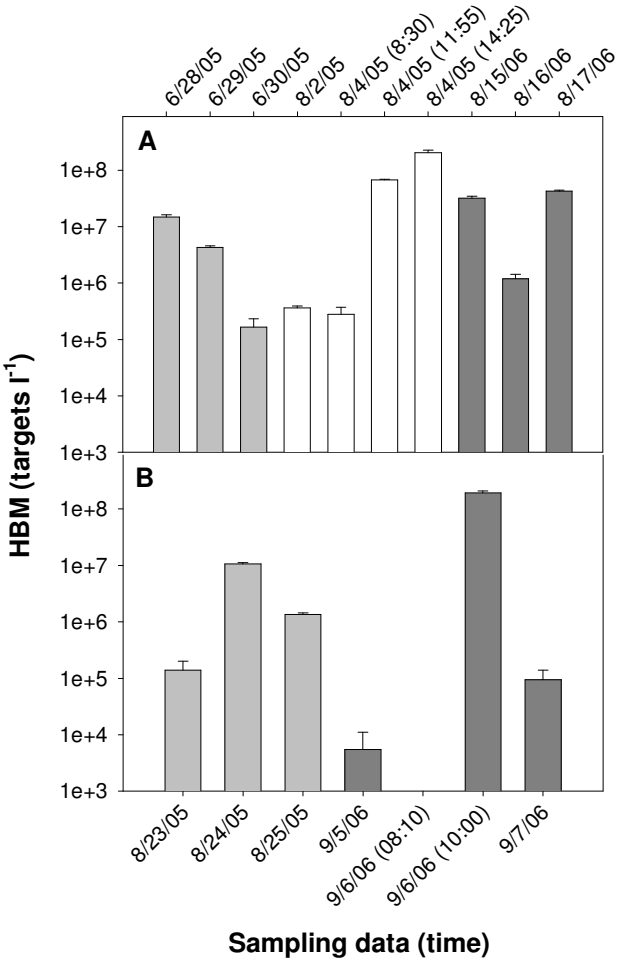

Figure S3. Summary of HBM concentrations associated with storm drain discharges into ML and AB for all sampling dates. A) Location M6. B) Location A9. Bars of the same shading were sampled within 3 days of each other. Error bars are SE of the mean ($n \geq 3$) of qPCR replicates for a single sample.

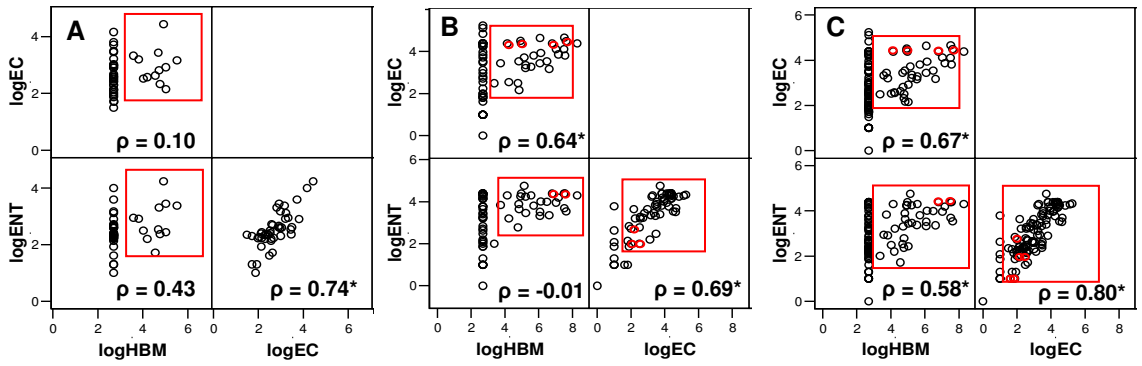

Figure S4. Scatter plots showing log-log correlation between HBM, EC and ENT for the two watersheds combined. A) creek samples only, B) drain samples only, C) creek and drain samples combined. Spearman's rank correlation coefficients (ρ) are indicated in each plot, with * if significant (all at $P \leq 0.001$). Non-significant correlations had $P \geq 0.05$. The subset of non-censored data, used for correlation analysis, was framed in the box, except red data points that were also out of range.