

Contact Recreation in Town Lake as Impacted by Fecal Coliform Bacteria

The TCEQ 2004 guidance document states that:

“Contact recreation is a use assigned to all water bodies, except for special cases. Full support of the contact recreation use is not a guarantee that the water is completely safe of disease-causing organisms.” (TCEQ, 2003)

It further states:

“For routinely monitored bacteria data, the following long-term geometric averages have been developed: fecal coliform, 200 colonies/100 mL; E. coli 126 colonies/100 mL... A fecal coliform criterion on 400 colonies/100 mL, an E. coli criterion of 394 colonies/100 mL ... may also apply to individual samples. The contact recreation use is not supported if the geometric average of the samples collected exceeds the mean criterion or if the criteria for individual samples are exceeded greater than 25 percent of the of the time.” (TCEQ, 2003)

Based on all current water quality data, Town Lake fully supports contact recreation use. The geometric sample means for fecal coliform and E. coli are 93 and 87 colonies/100 mL respectively, which are below their respective water quality criteria. Individual fecal coliform samples exceeded the 400 colonies/100 mL standard in 14.1% of the samples based on 3,206 samples. Individual E. coli samples exceeded the 394 colonies/100 mL standard in 10.6% of the samples for the 1,253 samples.

While swimming in Town Lake is normally prohibited for a number of safety concerns, there is an increasing interest in holding special swimming events in there. While Town Lake does not exceed contact recreation standards overall, certain locations may exceed these standards under specific conditions, most notably after rainfall events.

The following analyses were performed to assess the safety of Town Lake following a rainfall event and to provide guidance to those persons organizing, operating, overseeing and participating in these athletic events. Samples were first segregated by location to determine the spatial variability of bacteria levels in Town Lake. Samples at each site were grouped in several antecedent rainfall classes to determine the impacts of rainfall depth and the duration of these impacts. Four antecedent periods were used: 1-, 3-, 5- and 7-day; and four rainfall classes: 0.00, 0.00-0.50, 0.51-1.00, and >1.00 inches during the period. For these analyses, only fecal coliform were used since the amount of distributed E. coli data is limited at this time.

The results of the spatial analyses may be found in Table 1. Moving downstream from Red Bud Island, the mean fecal coliform count increases, reaching a peak at the Congress Avenue Bridge and then decreasing as one moves farther downstream toward Longhorn Dam. The major increase in bacterial counts is between the raw water intake for Green Water Treatment Plant and the First Street Bridge. Shoal Creek and other storm water discharges enter Town Lake in this area. These results indicate that there is a spatial

Table 1: Fecal coliform levels in Town Lake at various locations.

Location	Geometric Sample Mean (col./100mL)	Percent Samples Exceeding 400 col./100ml (%)
Below Red Bud Island	16	3
At Loop 1 (MoPac)	32	8
Austin High Boat Dock	113	9
At Lamar Street	170	23
At Green Treatment Plant	143	11
At First Street	251	29
At Congress Avenue	338	49
Near Pleasant Valley Park	114	36
Basin near Longhorn Dam	92	21

variation in fecal coliform in Town Lake. Some sites appear to exceed the contact recreation standard; however, these results include all fecal coliform samples collected at the location, including those collected during storm events. Because fecal coliform levels generally increase with rainfall and contact recreation use is less likely to occur during a storm event, these samples are often excluded from analyses. This will become clearer in the following analyses using antecedent rainfall.

The results of the rainfall analyses may be seen in Tables 2-15 and Figures 1-14. Data at Congress Avenue and Pleasant Valley Park were not used because the data were limited at these sites. Further, for larger antecedent rainfall depths with 1- and 3-day periods, the samples sets at Loop 1 and Austin High School boat dock were smaller than those recommended by TCEQ for evaluation of the contact recreation use.

In general, the fecal coliform counts rise with increasing antecedent rainfall depths. As the antecedent period becomes shorter, a given rainfall depth will result in a higher fecal coliform count. For example, geometric mean of the fecal coliform count below Red Bud Island with a 7-day antecedent rainfall between 0.51 and 1.00 inches is 14 colonies/100 mL. The same rainfall in a 1-day antecedent period results in a geometric sample mean of 78 colonies/100 mL. The percent samples exceeding the 400 colonies/100 mL standard follows the same trend. As one moves downstream in Town Lake, the impacts of rainfall increase, following a trend similar to those noted in the spatial analyses.

Summary

The following summarizes the results of the analyses and separates contact recreation into three categories: safe under otherwise safe conditions, use caution, and use extreme caution. In the first category, this study determined that Town Lake meets contact recreation standards under these conditions, if the lake is otherwise safe for contact recreation. In the second category, meaning that people should use caution before entering the Town Lake, the study indicates that the bacteria levels may exceed those deemed appropriate for contact recreation. In the third category, the study determined there is a strong probability that bacteria levels will exceed contact recreation standards.

Special precautions should be taken under these conditions. These may include moving the event to another part of the lake, postponing the event to a later date or flushing the Town Lake with water from Lake Austin to name a few. As with all natural water bodies, swimmers should swim at their own risk and not beyond their abilities.

Above Loop 1 (MoPac) – Contact recreation is safe under otherwise safe conditions.

Loop 1 to Lamar –

- 1 inch of rain within 72 hours prior to use (3 days) - use caution. Signage should be posted.
- More than 0.5 inch of rain within 24 hours prior to use (1 day) - use caution. Signage should be posted.
- More than 1 inch of rain within 24 hours prior to use (1 day) - use extreme caution. Signage should be posted and special precautions taken.
- All other times - safe under otherwise safe conditions.

Lamar to Longhorn Dam –

- More than 1 inch of rainfall within 7 days prior to use - use extreme caution. Signage should be posted and special precautions taken.
- Between 0.5 and 1 inch of rain within 5-7 days prior to use - use caution. Signage should be posted.
- Between 0.5 and 1 inch of rain within 3 days prior to use - use extreme caution. Signage should be posted and special precautions taken.
- More than 0.5 inch of rain within 1 day prior to use - use extreme caution. Signage should be posted and special precautions taken.
- Less than 0.5 inch of rain within 1 day prior to use - use caution. Signage should be posted.
- All other times, safe under otherwise safe conditions.

Reference

Texas Commission on Environmental Quality. 2003. Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data, 2004. Surface Water Quality Program. Austin, TX 78711.

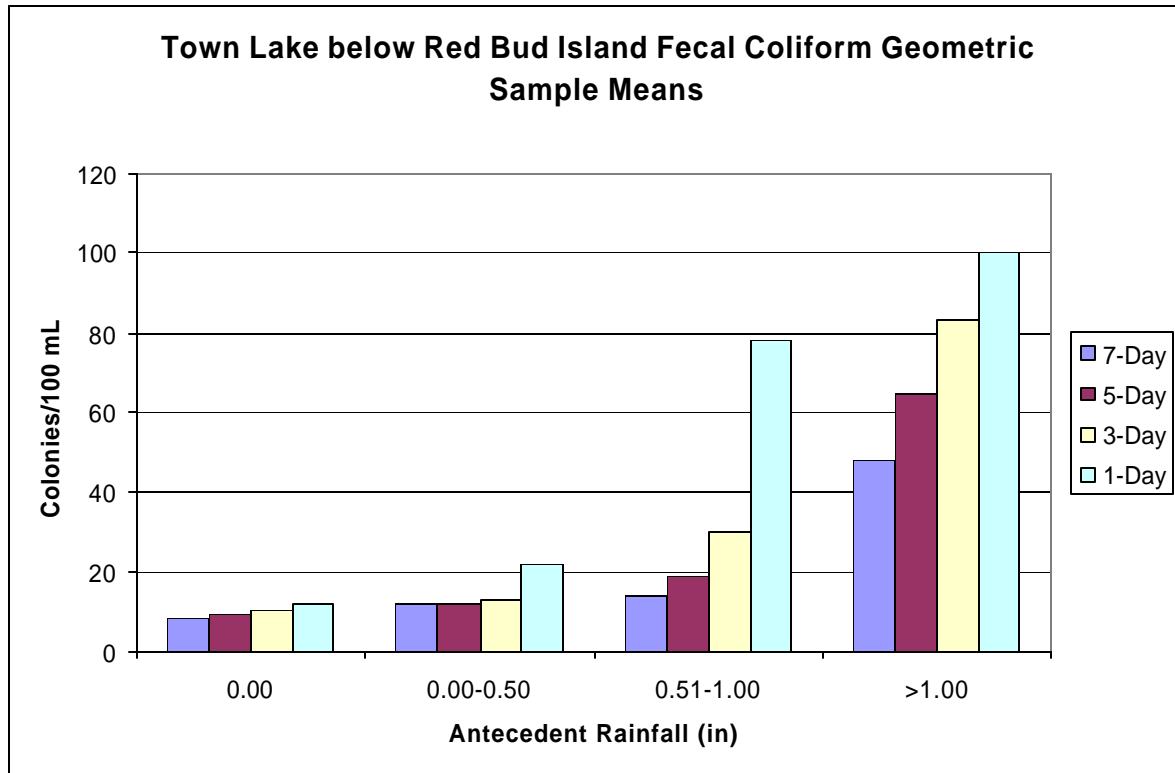


Figure 1: Fecal coliform geometric sample mean (colonies/100 mL) below Red Bud Island separated by antecedent rainfall conditions.

Table 2: Fecal coliform geometric sample mean (colonies/100 mL) below Red Bud Island separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	8	9	10	12
0.01-0.50	12	12	13	22
0.51-1.00	14	19	30	78
>1.00	48	65	83	100

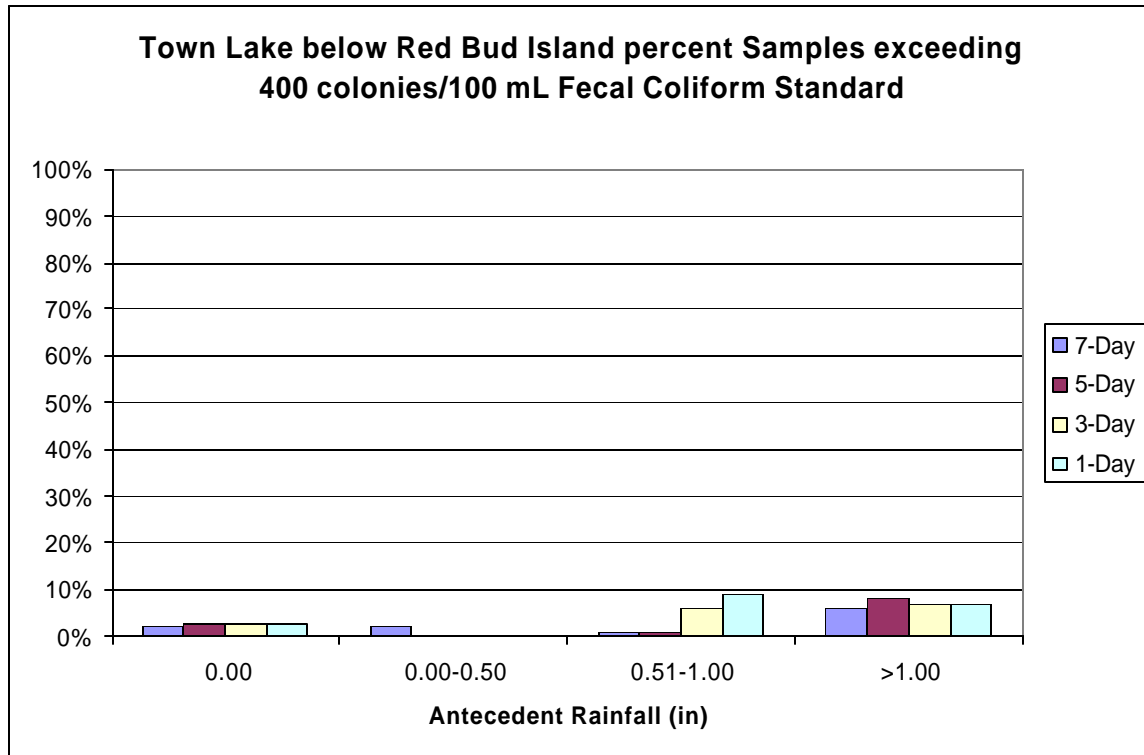


Figure 2: Percent of fecal coliform samples exceeding 400 colonies/100 mL below Red Bud Island separated by antecedent rainfall conditions.

Table 3: Percent of fecal coliform samples exceeding 400 colonies/100 mL below Red Bud Island separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	2	3	3	3
0.01-0.50	2	0	0	0
0.51-1.00	1	1	6	9
>1.00	6	8	7	7

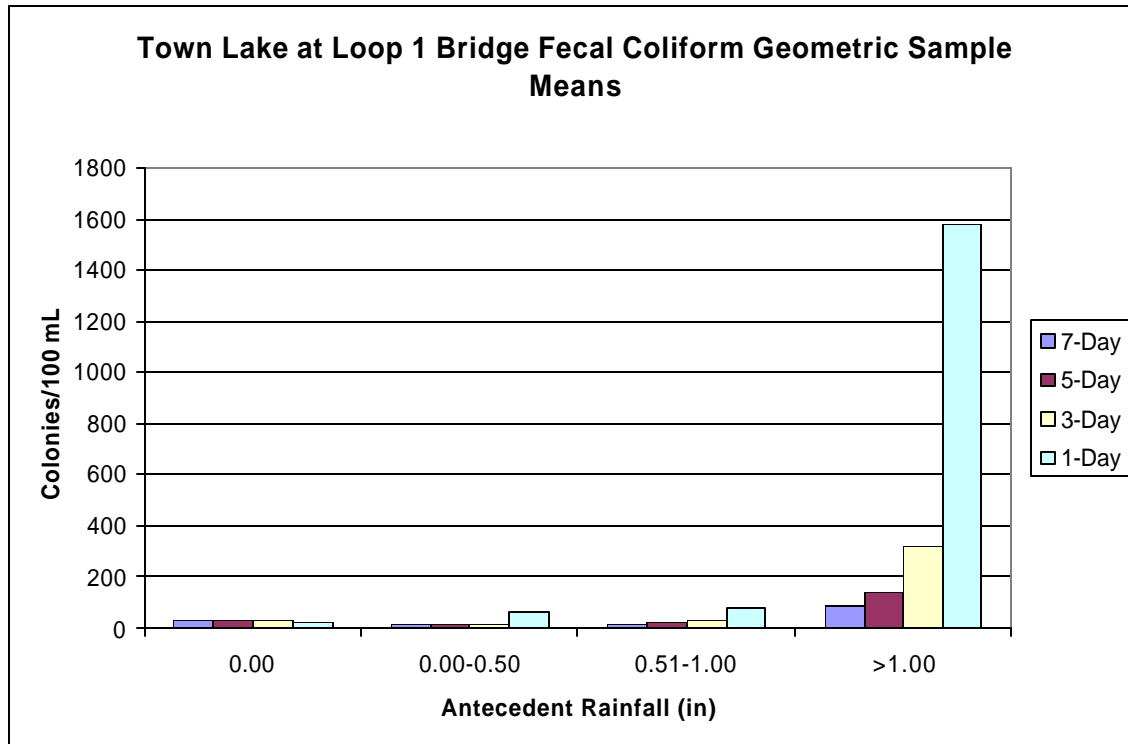


Figure 3: Fecal coliform geometric sample mean (colonies/100 mL) at Loop 1 (MoPac) Bridge separated by antecedent rainfall conditions.

Table 4: Fecal coliform geometric sample mean (colonies/100 mL) at Loop 1 (MoPac) Bridge separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	28	30	27	23
0.01-0.50	17	16	17	68
0.51-1.00	17	23	26	82
>1.00	86	136	320	1577

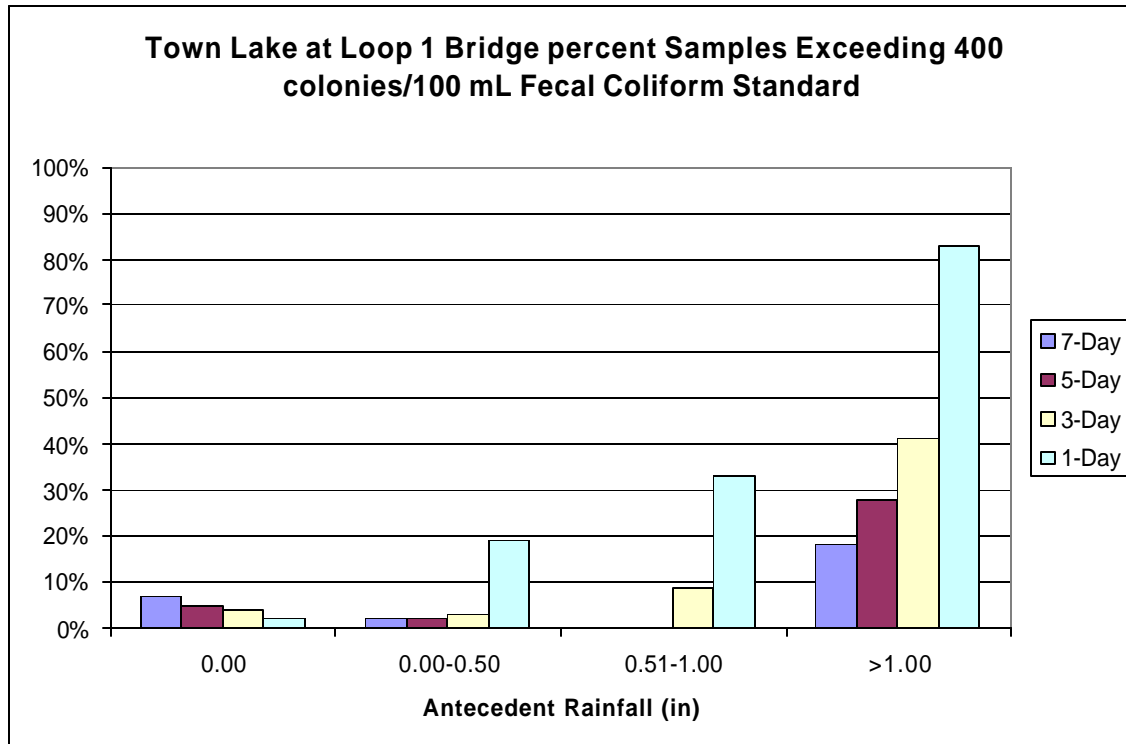


Figure 4: Percent of fecal coliform samples exceeding 400 colonies/100 mL at Loop 1 (MoPac) Bridge separated by antecedent rainfall conditions.

Table 5: Percent of fecal coliform samples exceeding 400 colonies/100 mL at Loop 1 (MoPac) Bridge separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	7	5	4	2
0.01-0.50	2	2	3	19
0.51-1.00	0	0	9	33
>1.00	18	28	41	83

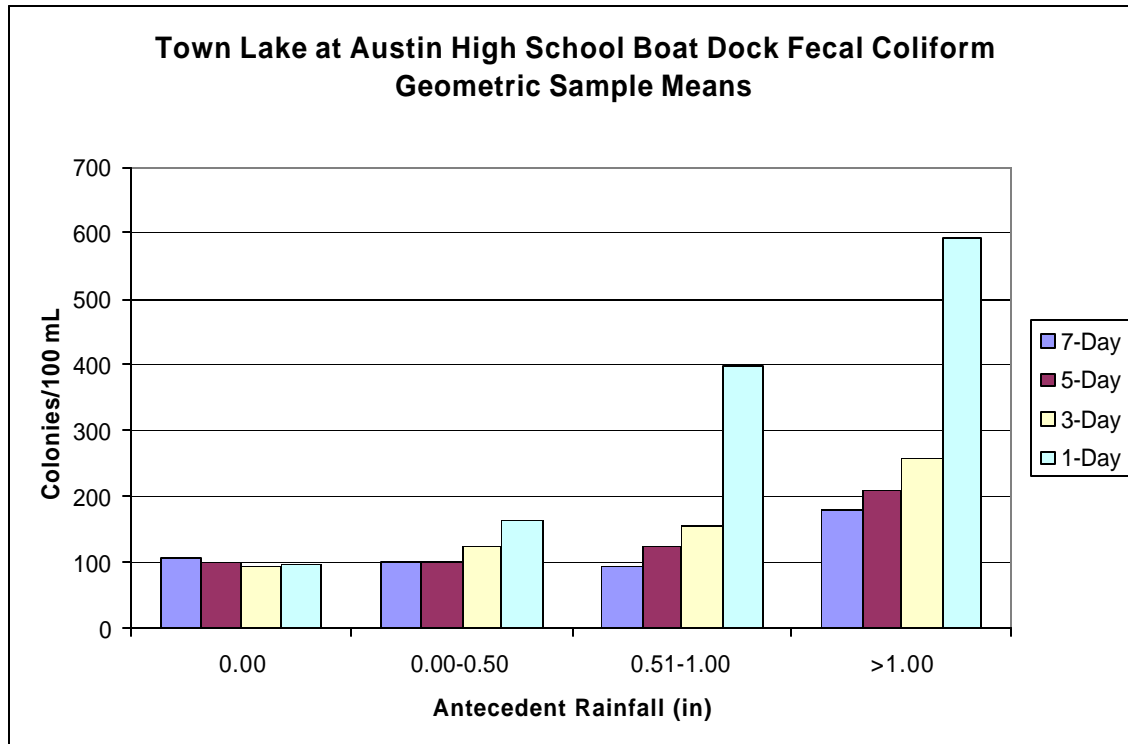


Figure 5: Fecal coliform geometric sample mean (colonies/100 mL) at the Austin High School boat dock separated by antecedent rainfall conditions.

Table 6: Fecal coliform geometric sample mean (colonies/100 mL) at the Austin High School boat dock separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	106	99	93	96
0.01-0.50	101	102	125	164
0.51-1.00	94	124	155	398
>1.00	108	208	258	594

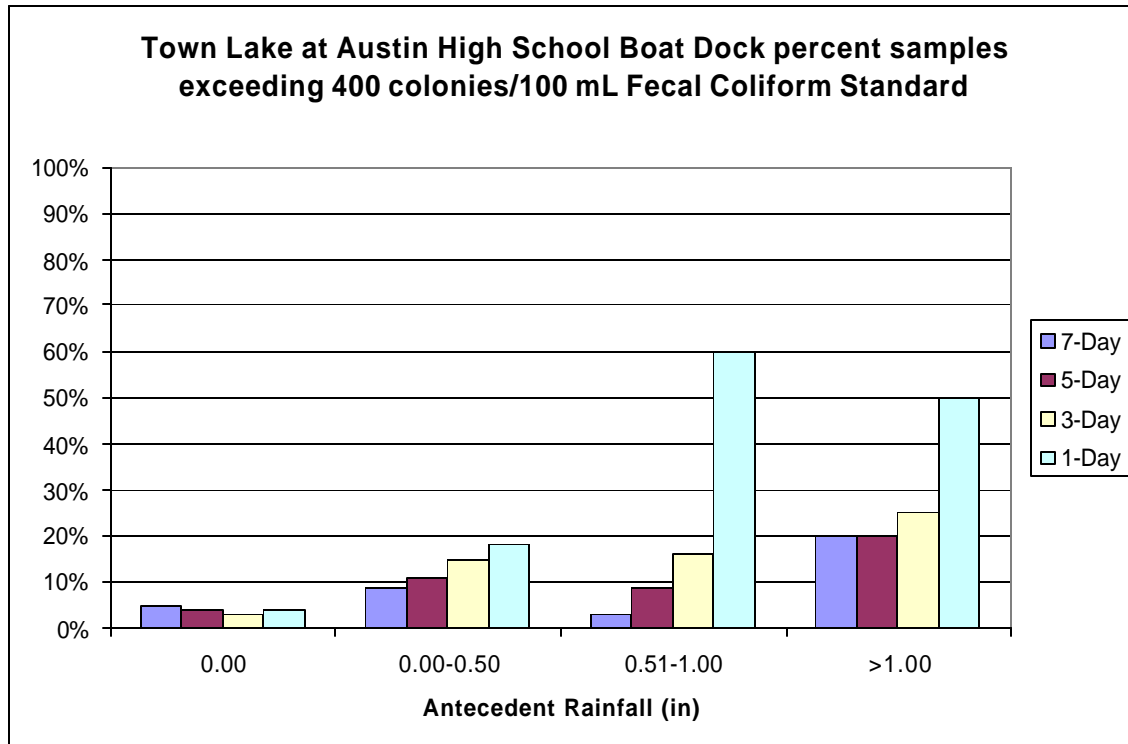


Figure 6: Percent of fecal coliform samples exceeding 400 colonies/100 mL at the Austin High School boat dock separated by antecedent rainfall conditions.

Table 7: Percent of fecal coliform samples exceeding 400 colonies/100 mL at the Austin High School boat dock separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	5	4	3	4
0.01-0.50	9	11	15	18
0.51-1.00	3	9	16	60
>1.00	20	20	25	50

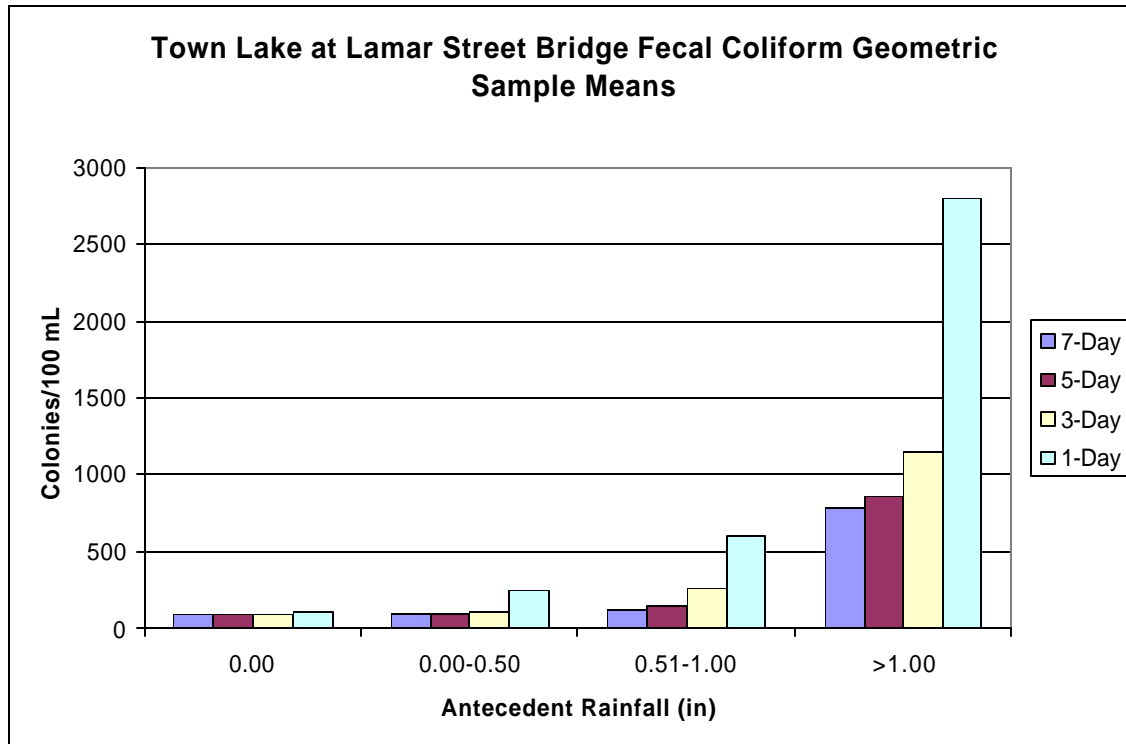


Figure 7: Fecal coliform geometric sample mean (colonies/100 mL) at the Lamar Street Bridge separated by antecedent rainfall conditions.

Table 8: Fecal coliform geometric sample mean (colonies/100 mL) at the Lamar Street Bridge separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	79	79	85	107
0.01-0.50	100	95	114	242
0.51-1.00	118	147	257	599
>1.00	783	857	1148	2798

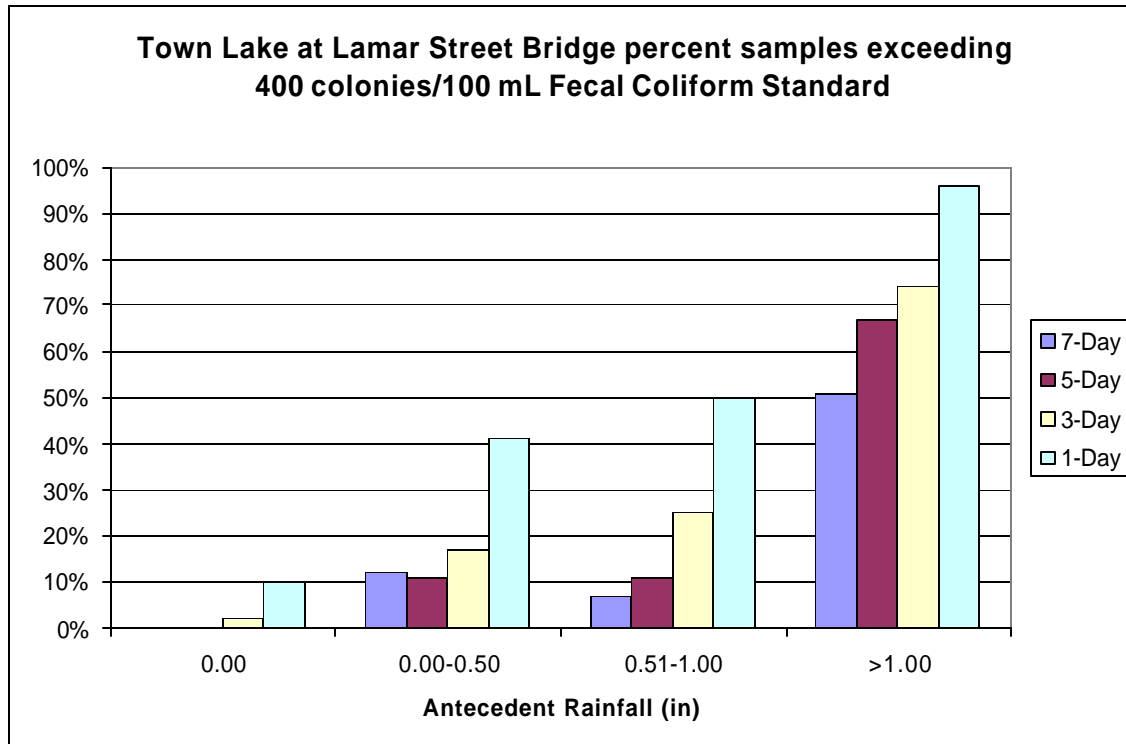


Figure 8: Percent of fecal coliform samples exceeding 400 colonies/100 mL below at the Lamar Street Bridge separated by antecedent rainfall conditions.

Table 9: Percent of fecal coliform samples exceeding 400 colonies/100 mL below at the Lamar Street Bridge separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	0	0	2	10
0.01-0.50	12	11	17	41
0.51-1.00	7	11	25	50
>1.00	51	67	74	96

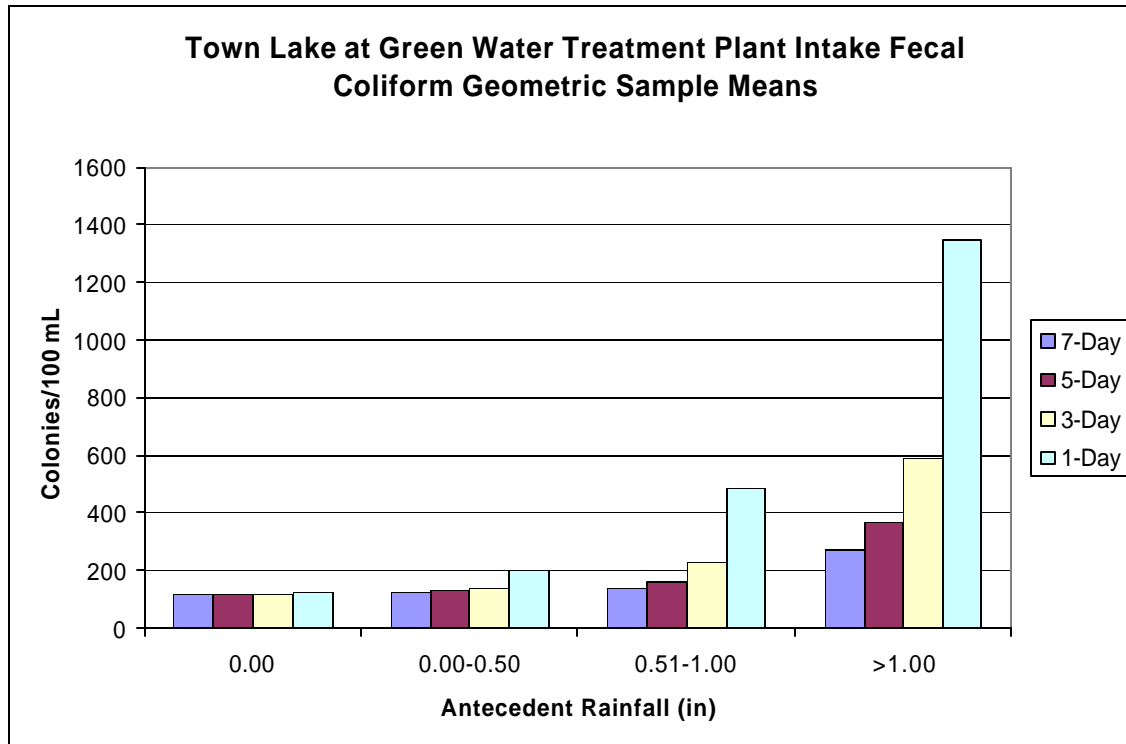


Figure 9: Fecal coliform geometric sample mean (colonies/100 mL) at the raw water intake for Green Water Treatment Plant separated by antecedent rainfall conditions.

Table 10: Fecal coliform geometric sample mean (colonies/100 mL) at the raw water intake for Green Water Treatment Plant separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	119	114	114	122
0.01-0.50	121	126	137	197
0.51-1.00	137	160	227	485
>1.00	270	367	590	1351

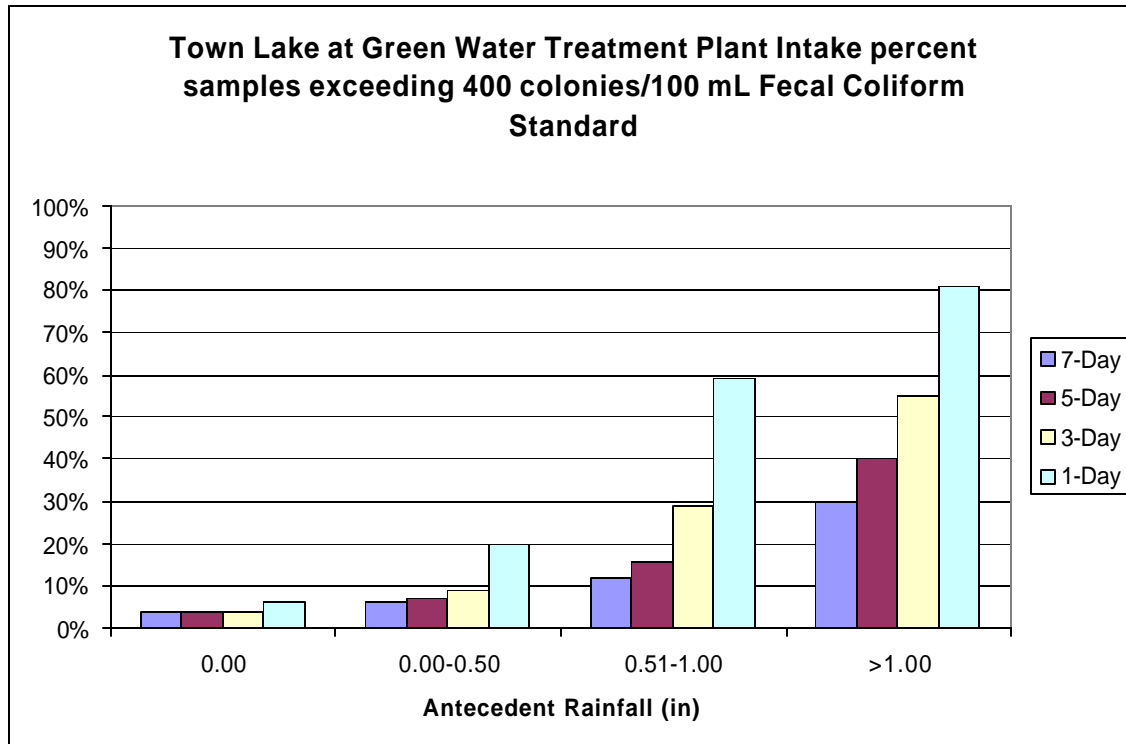


Figure 10: Percent of fecal coliform samples exceeding 400 colonies/100 mL below at the raw water intake for Green Water Treatment Plant separated by antecedent rainfall conditions.

Table 11: Percent of fecal coliform samples exceeding 400 colonies/100 mL below at the raw water intake for Green Water Treatment Plant separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	4	4	4	6
0.01-0.50	6	7	9	20
0.51-1.00	12	16	29	59
>1.00	30	40	55	81

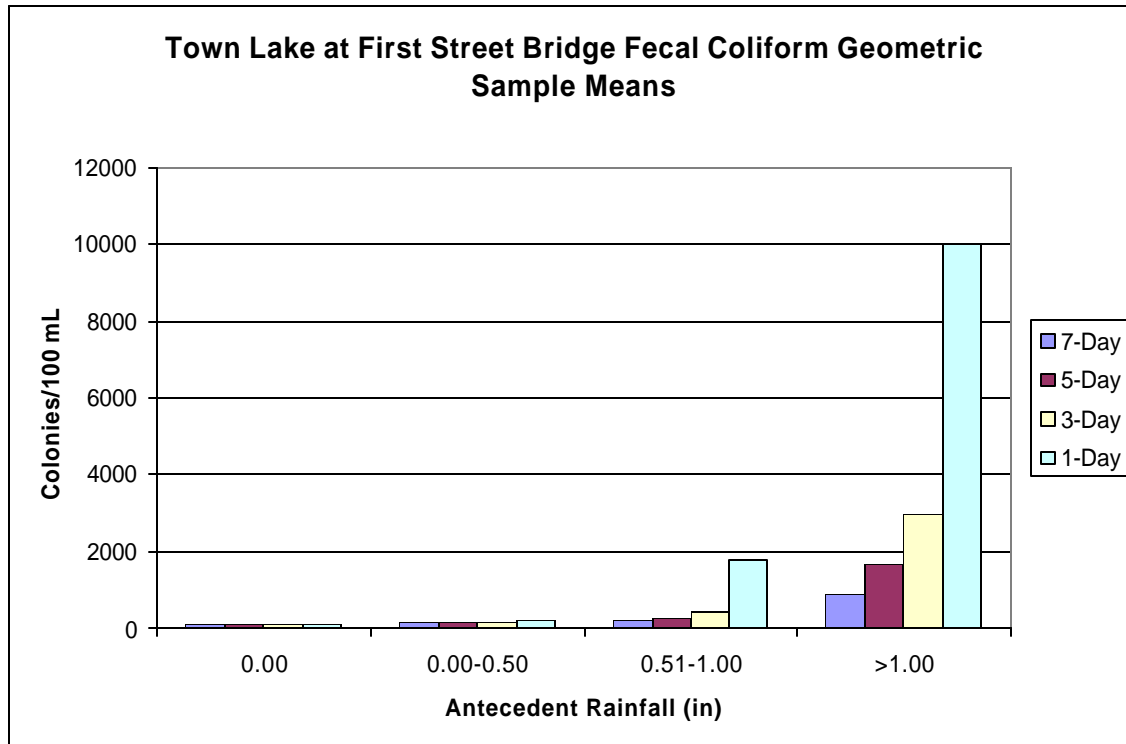


Figure 11: Fecal coliform geometric sample mean (colonies/100 mL) at the First Street Bridge separated by antecedent rainfall conditions.

Table 12: Fecal coliform geometric sample mean (colonies/100 mL) at the First Street Bridge separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	85	85	90	118
0.01-0.50	136	132	169	200
0.51-1.00	210	263	446	1787
>1.00	884	1622	2964	10039

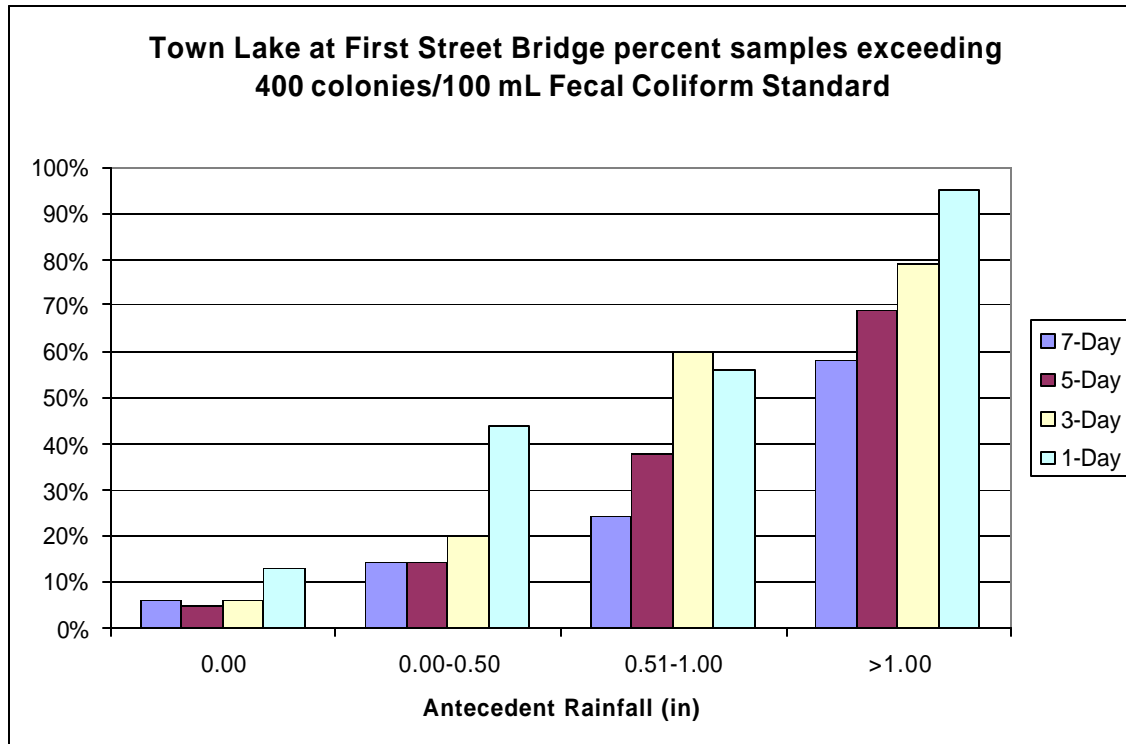


Figure 12: Percent of fecal coliform samples exceeding 400 colonies/100 mL at the First Street Bridge separated by antecedent rainfall conditions.

Table 13: Percent of fecal coliform samples exceeding 400 colonies/100 mL at the First Street Bridge separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	6	5	6	13
0.01-0.50	14	14	20	44
0.51-1.00	24	38	60	56
>1.00	58	69	79	95

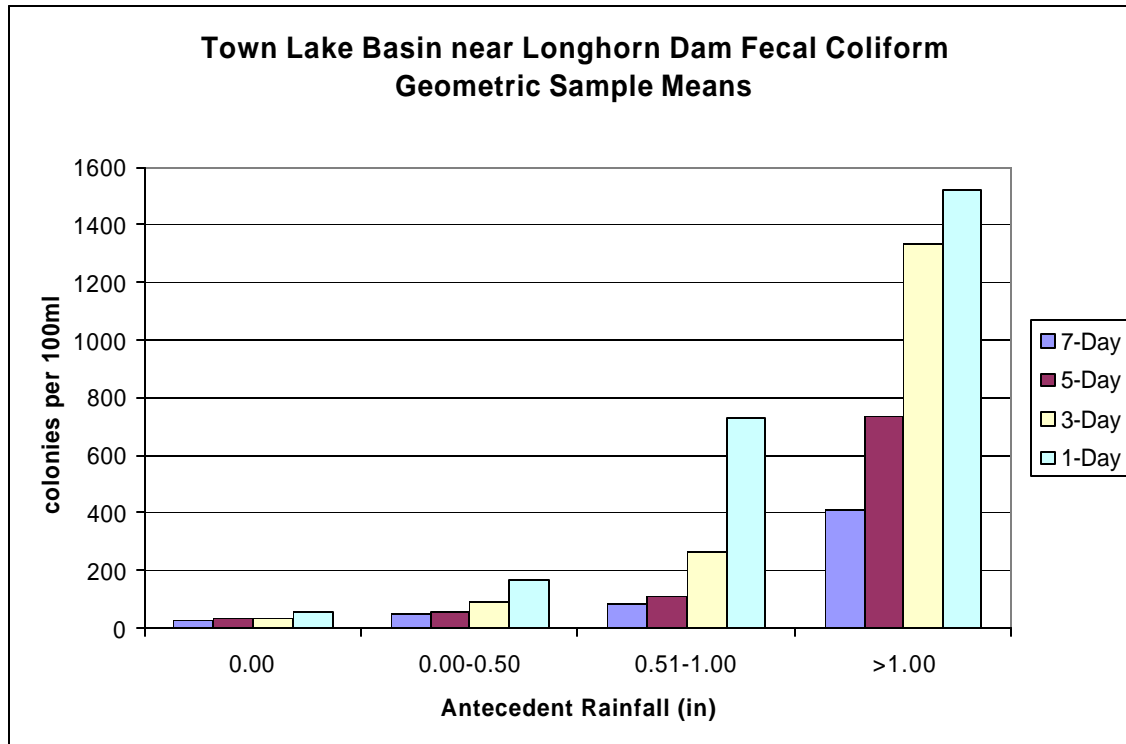


Figure 13: Fecal coliform geometric sample mean (colonies/100 mL) in the basin near Longhorn Dam separated by antecedent rainfall conditions.

Table 14: Fecal coliform geometric sample mean (colonies/100 mL) in the basin near Longhorn Dam separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	29	30	33	58
0.01-0.50	52	59	91	167
0.51-1.00	84	112	265	732
>1.00	416	737	1337	1521

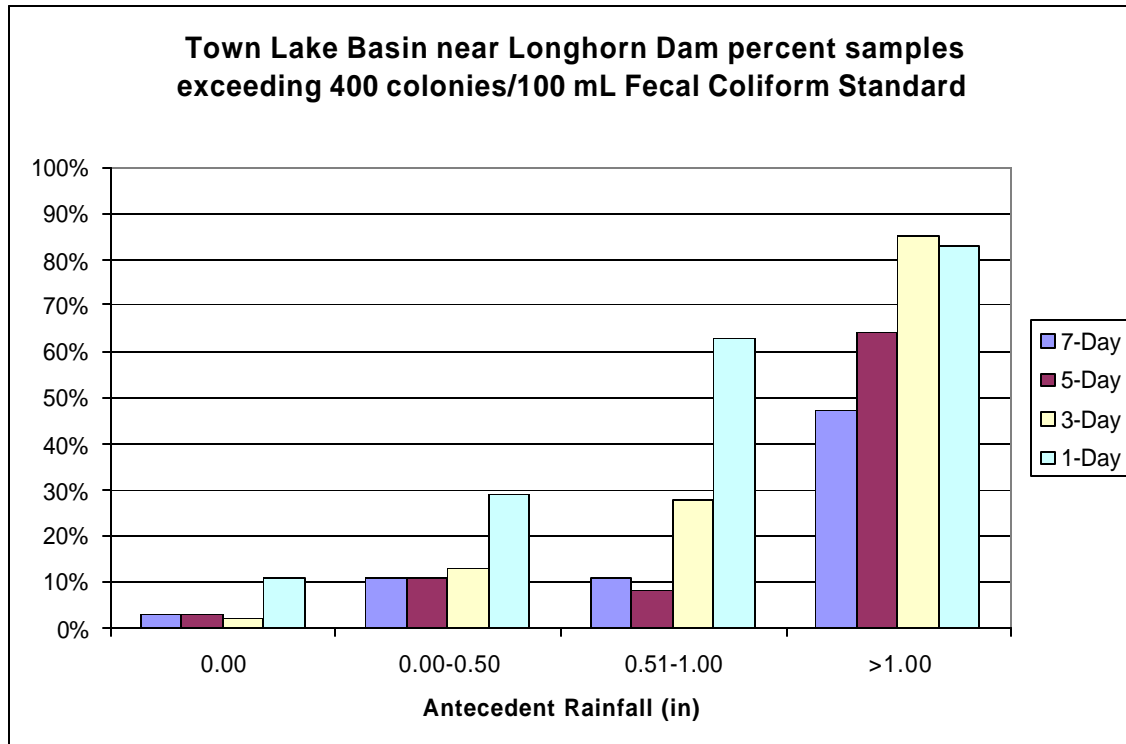


Figure 14: Percent of fecal coliform samples exceeding 400 colonies/100 mL in the basin near Longhorn Dam separated by antecedent rainfall conditions.

Table 15: Percent of fecal coliform samples exceeding 400 colonies/100 mL in the basin near Longhorn Dam separated by antecedent rainfall conditions.

Rainfall Depth (in)	7-day	5-day	3-day	1-day
0.00	3	3	3	11
0.01-0.50	11	11	13	29
0.51-1.00	11	8	28	63
>1.00	47	64	85	83