

METROPOLITAN BEACHES COMMISSION  
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# WATER QUALITY REPORTS

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## **Introduction**

This report contains a basic analysis of enterococcus samples and swimming advisories posted at beaches in the metropolitan Boston area during the summer of 2005. There are eight regions of beaches considered, corresponding to the communities visited by the Metropolitan Beaches Commission during the summer of 2006: Lynn and Nahant, Revere, Winthrop, East Boston, South Boston, Dorchester, Quincy, and Hull.

**Background:** Enterococcus is an ‘indicator’ bacterium associated with the presence of other bacteria and viruses which can cause disease in humans. Enterococcus is measured by incubating a water sample for 24 hours and then counting the number of bacteria colonies present in the sample. Enterococcus replaced fecal coliform as the national water quality test for salt-water beaches in 2004, following studies conducted by the EPA which found that it has a greater correlation with swimming-associated gastrointestinal illness.

## **Enterococcus Exceedance Standards**

The EPA specifies that bathing water is unsafe for human swimmers if a single test sample exceeds 104 enterococcus colonies per 100 mL of water (104 C/100 mL). However, it is important to note that the threshold of 104 C/100 mL is not entirely safe. According to epidemiological studies, approximately 19 in 1,000 people will become sick from swimming in water just below this standard.<sup>1</sup>

Additionally, here in Massachusetts we often post a beach as unsafe for swimming if the geometric mean of at least 5 samples over a 30-day period exceeds 35 C/100 mL. This standard appears to focus on waters where data is collected infrequently or where bacteria levels do not fluctuate rapidly. A geometric mean calculated with 30 samples (daily measurements for a 30-day mean) probably will not accurately reflect the severity of any recent exceedances or the short-term suitability of the water for swimmers at a beach where conditions change rapidly.

For locations tested daily, DCR has specified use of a “5-day running geometric mean,” which is more appropriate for sites with daily testing than a 30-day mean, because it more accurately reflects the current condition of the site. It is also more appropriate because many beaches in the Boston Metropolitan area have rapidly fluctuating bacteria counts, so samples from a month ago may or may not have any bearing on the current condition of the beach.

It is important to note that though EPA does not specify a threshold for the 5-day mean, DCR uses the 35 C/100 mL threshold. However, there is somewhat of an ambiguity with DCR’s use of the 5-day

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<sup>1</sup> “Testing the Waters,” published by the National Resource Defense Council, 2005.  
<http://www.nrdc.org/water/oceans/ttw/chap2.pdf> , page 10.

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geometric mean: it is unclear whether '5-day' refers to five calendar days, or five sampled days. This becomes an issue when there are days without samples, and therefore the geometric mean can either be calculated with less samples, or with samples from farther in the past.

### **Data Analysis**

The analysis in these reports focuses on the overall state of water quality at a given beach, and how accurately the public is informed of swimming conditions on each beach. Exceedances are counted as days where any single sample exceeds 104 C/100 mL, or the 5-calendar-day geometric mean exceeds 35 C/100 mL. If testing is conducted weekly, a 30-day geometric mean is used. Days where both standards were exceeded are counted as a single day when totaling days of exceedance.

### **Definition of terms**

Any Exceedance: an event (day) where either the single-sample result was over 104 C/100 mL, the geometric mean was over 35 C/100 mL, or both.

Posting: the decision to post a swimming advisory at a beach, stating that the water may be for swimming. Posting decisions are currently made with data from the previous day's samples, introducing uncertainty in the accuracy of swimming advisories.

Accurate Posting: when a posting decision is made and corresponds with the samples taken that day. This can only be known after the sample for that day is processed (if one was taken!), which takes approximately 1 day.

Inaccurate Posting: when a posting decision is made and there was no exceedance on that day. This can only be known after the sample for that day is processed (if one was taken!), which takes approximately 1 day.

### **Antecedent Rainfall**

According to a recent paper published on the accuracy of water quality indicators in Boston Harbor, 0.21" of 48-h antecedent rain was a strong indicator of upcoming enterococcus exceedances.<sup>2</sup> Although the report did not have conclusive results for each of the beaches we examined in this study, the 0.21" threshold should be an adequate threshold of analysis. In the report, 0.21" of rain is considered to be sufficient rain to cause elevated levels of bacteria on a beach due to storm water runoff. Therefore, when examining the effectiveness of antecedent rainfall as a predictor, days are measured from the most recent day with at least 0.21" of rain unless otherwise specified. Where possible, the effectiveness of antecedent rainfall as a predictor is evaluated for each beach in the study area.

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<sup>2</sup> "Receiver Operating Characteristic Curve Analysis of Beach Water Quality Indicator Variables," Morrison et al. Applied and Environmental Microbiology, November 2003, p. 6405-6411, Vol. 69, No. 11.  
<http://aem.asm.org/cgi/content/full/69/11/6405>

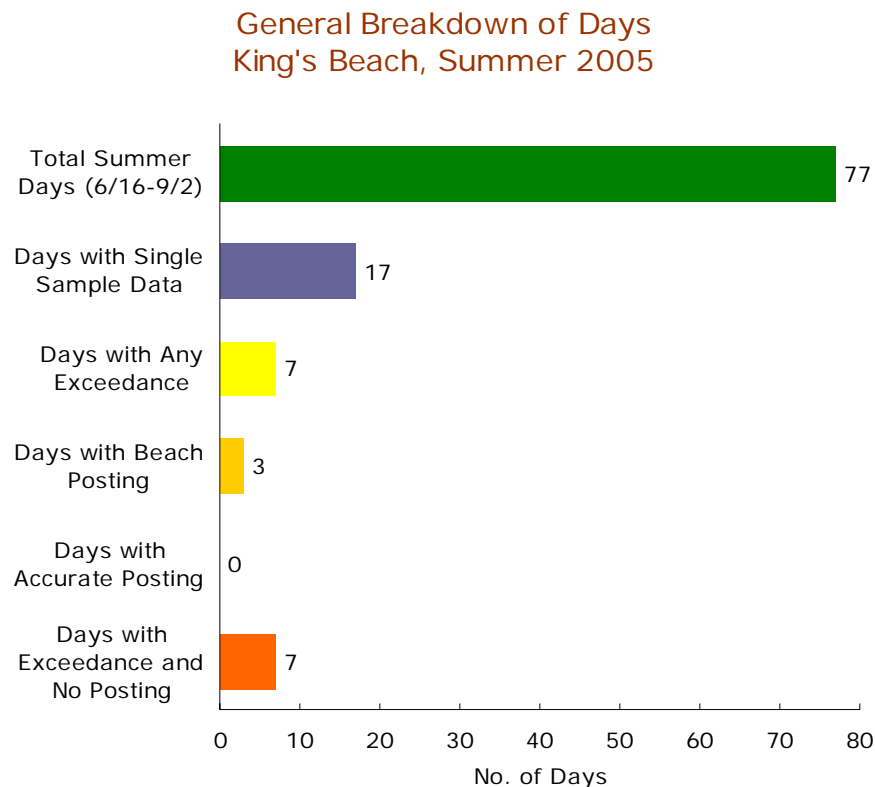
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## Lynn and Nahant

Although Lynn and Nahant can be seen as one local region, the area contains several beaches on the Nahant Bay. The two major beaches are King's Beach and Long Beach, which is also known in part as Lynn Beach or Nahant Beach (the name used for the DCR water sampling sites).

## King's Beach

There are three sampling sites along King's Beach, which are tested weekly. Although there is no specific DCR policy for King's Beach available with the sample data, based on when postings occurred in 2005 a policy can be inferred. As swimming advisories were not posted the day after an exceedance was found on a single site, but were posted after an exceedance was found on two or more sites, it seems that DCR's policy is to post an advisory for King's beach only if exceedance occurs at more than one site. Additionally, although a geometric mean based posting was never made, with weekly testing the only geometric mean standard which could be used is the EPA 30-day geometric mean. Swimming advisories can also be posted due to significant rainfall in the area.



In 2005, samples were collected from King's Beach on 17 of 77 days, or 22% of the time. Of those 17 days, there was an exceedance on 7 days (41% of sampled days). Only two of those days resulted in a posting because of the constraints of the DCR policy: the three other days of single sample exceedance

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only had exceedance at one sample site. One of the postings was not followed by additional testing, which resulted in an inaccurate holdover posting.

Three of the five days with single sample exceedances were not followed by additional testing. The weekly testing means that many more days of exceedance could have occurred. Testing was conducted the day after significant rainfall (>0.21”) on only two occasions, with no sample taken within three days of other rainfall events. This lack of supplemental testing prevents conclusive analysis from being done on the relationship between exceedance and rainfall and single sample exceedance as a predictor of subsequent exceedances. However, multiple-site exceedance did occur the day after a 2.04” rain and a 0.95” rain.

Breakdown of Postings

Days with...	No. of Days
Exceedance	7
Posting	3
Accurate Posting	0
Inaccurate Posting	2
Unverifiable Posting	1
Single Sample Exceedance	5
Single Sample Posting	2
Geo. Mean Exceedance	2
Geo. Mean Posting	0
Precipitation Posting	0
Holdover Posting	1

The geometric mean data is interesting. The 30-day geometric mean was calculated when 30 days since the first sample of the season (6/16) was taken, and then re-calculated whenever a new sample was taken. Although technically a geometric mean exceedance could be counted every day until a new sample was taken, each re-calculation that resulted in exceedance was counted as one day. Therefore, although there was a total of 6 days where the geometric mean of the last 30 days stayed above the 35 C/100 mL threshold, only two of those days are counted.

Regardless of the number of days with geometric exceedance, there were no swimming advisories posted as a result. Thus it seems that geometric means were not calculated or were not applied at King’s Beach, at least in July.

Of the single sample exceedances, three occurred at least four days after rainfall, raising questions about the possible source of the contamination. Also, the fact that a single sample taken 7 days isolated from any other sample reveals exceedance at a single site may suggest that King’s Beach has exceedances

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more often than existing data might show. Daily testing is the only way to determine the actual state of water quality on the beach.

### **Nahant Beach**

Nahant Beach has four sample sites, which are also tested weekly. Throughout the summer of 2005, there were no recorded single sample or geometric mean exceedances from 13 sampled days (17% of the summer). However, there are still some aspects of the samples which merit analysis.

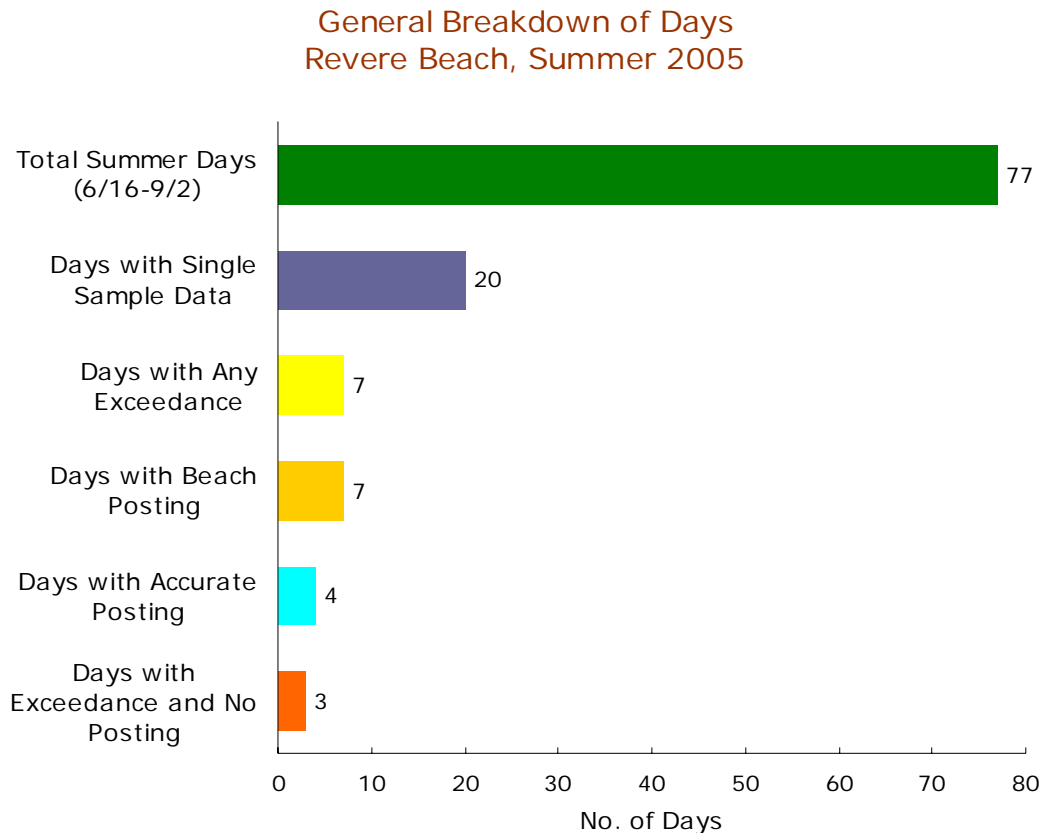
The first irregularity is that of the 13 sampled days, there were four samples from the site north of the bathhouse that were recorded as negative numbers. This may simply be an error, but the distributed occurrence throughout the summer suggests that it does carry meaning. This issue can probably be cleared up through contact with DCR or MWRA.

Additionally, samples were taken the day after a significant rainfall only once throughout the summer, although there were a total of six days with greater than 0.21” of rain. This is troubling because it makes it impossible to conclusively determine if there is any relationship between antecedent rainfall and exceedance. Ideally, daily samples would be taken for a year or more in order to establish that there is in fact no exceedance occurring on Nahant Beach, even after heavy rains.

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## Revere Beach

Revere beach has four sample sites, which were tested weekly in 2005. Daily samples were collected from July 23 to July 31 because of a broken sewage pipe in Lynn dumping raw sewage into the Saugus River. Samples were collected on a total of 20 days between June 16 and September 2, or 26% of the summer. Of those 20 days, there was an exceedance at one or more sampling sites on six days, and a 5-sample geometric mean exceedance on three days. The geometric mean was calculated using the last five samples (regardless of how recent) from all four sites.



On Friday, July 22, 2005, a sewage pipe in Lynn burst, causing millions of gallons of sewage to flow into the Saugus River before it could be repaired. Daily testing was conducted on Revere Beach as a result, and the swimming advisories were posted for seven days from the afternoon of July 22 to July 28. Samples were collected for 9 consecutive days instead of the single planned weekly test, increasing the number of days with single sample data from 12 to 20. During those 9 days of sampling, there were four days with single-day exceedances for at least one site, and three days with geometric mean exceedances. These exceedances are adequately explained by the broken sewage pipe. It is also important to note that there was no exceedance on July 24, two days after the event. At that time, the pipe was still broken and

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discharging into the Saugus River. If the tide or other currents were directing the flow from the Saugus River elsewhere when the samples were taken, then that would account for the low bacteria count. There may be other factors involved as well.

Including the exceedances from the burst pipe, there were 7 days with either single-sample or geometric mean exceedance out of the 20 days of sample data, for 35% of days sampled. Discounting the 9 sampled days following the burst pipe, there were 2 days with single-sample exceedance out of 11 days of data, or 18%. These figures suggest that there were between 27 and 14 days of exceedance during the entire summer. Both of these statistics are somewhat artificial, as weekly testing does not guarantee an accurate picture of exceedances through the summer. For example, only one day of sampling was immediately after a significant rainfall, and as rainfall has been shown in other locations to have some relationship with exceedance, there may be additional days which were missed because of weekly testing.

However, the two days of single site exceedance which occurred separate from the burst sewage pipe were also isolated from rainfall. On both occasions, July 21 and August 18, the exceedance was found at the Point of Pines sample site. That site is closest to the Saugus River and Lynn Harbor, which may have contributed to the exceedances. Daily testing would verify how often these dry-weather exceedances happen and whether or not wet-weather exceedances happen in addition. Localized posting, at the Point of Pines area only, for example, may also be a good policy for Revere Beach.

The current policy at Revere Beach does not post a swimming advisory on a beach if an exceedance occurred at only one sample site, which masks the exceedances at the Point of Pines site. This also means that last summer there were no postings due to single sample exceedance directly, but only the general posting from the broken sewage pipe (those postings were not directly based on sampling data). Beachgoers therefore were likely under the impression that with the exception of the pipe incident, Revere Beach was safe for swimming for the whole summer.

### **Winthrop Beach**

Winthrop Beach has only one sample site, and it is tested weekly. Throughout the summer of 2005, there were no recorded single sample or geometric mean exceedances from 13 sampled days (17% of the summer). Additionally, there were no swimming advisories posted due to precipitation. The highest sample recorded for the season was 54 C/100 mL, the day after 2.04" of rain, and the average bacteria colony count was 10 C/100 mL.

Additionally, samples were taken the day after a significant rainfall only once throughout the summer, when there were a total of six days with greater than 0.21" of rain. Although there is no data to suggest that exceedances are occurring, incomplete data makes it impossible to conclusively determine if there is any relationship between antecedent rainfall and exceedance. Though water quality appears quite good

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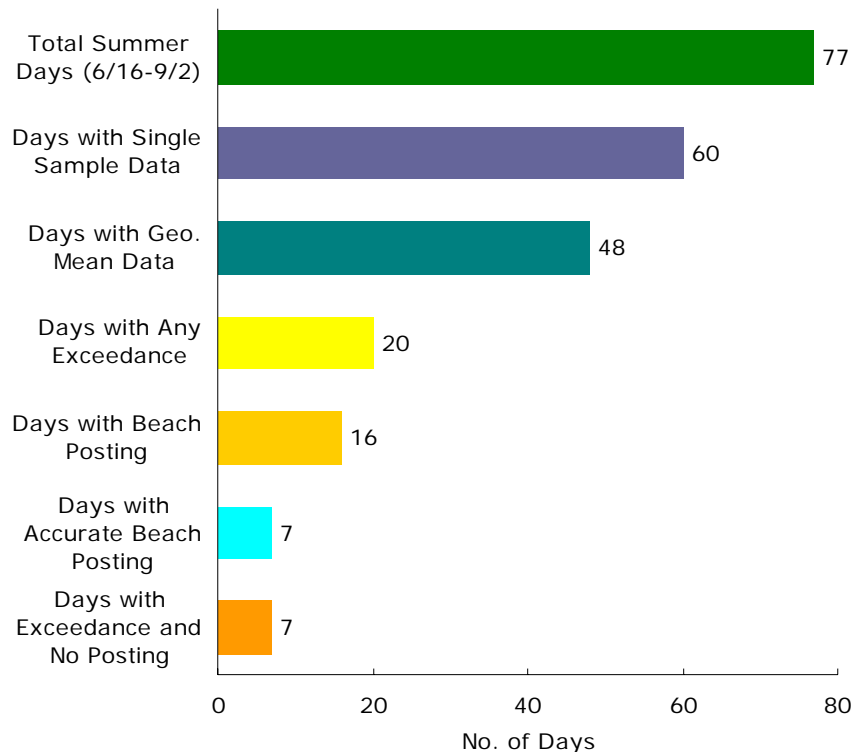
on this beach, ideally, daily samples would be taken for a year or more in order to confirm that there are no exceedances occurring on Winthrop Beach, even after heavy rains.

### **Constitution Beach**

Constitution Beach in East Boston has three sample sites along the length of the beach. According to the published sample data for 2005, “typically, two of the three sites must exceed 104 for DCR to declare a swimming advisory for the following day.”<sup>3</sup> Advisories would also be posted after 5-day geometric means in exceedance of 35 C/100 mL, or after significant rainfall events.

The decision to only post advisories at the beach if more than one sample site has an exceedance is a practical decision to reduce unnecessary postings. However, the DCR decision to not post an advisory at the beach if only one portion registers more than 104 C/100 mL does not signify that that area was safe on the day the sample was taken. This policy does decrease the number of unnecessary postings, but unfortunately it also masks the number of exceedances at Constitution Beach from beachgoers, and therefore masks the frequency of health risks as well.

General Breakdown of Summer Days  
Constitution Beach, Summer 2005



<sup>3</sup> “Constitution Beach, East Boston Bacteria Counts 2005,” published by the Massachusetts Water Resources Authority. [http://www.mwra.state.ma.us/harbor/pdf/2005\\_constitution.pdf](http://www.mwra.state.ma.us/harbor/pdf/2005_constitution.pdf)

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20 days in total had at least one exceedance out of the 60 days with single sample data. There may have been more days with geometric mean exceedances, but there was only sufficient continuous data to calculate 5-day geometric means for 48 days. There were only 16 postings, not all of them on days with sample data, for a total of 20.7% of the 77 days of summer from June 16<sup>th</sup> to September 2<sup>nd</sup>.

Samples were taken daily from July 1<sup>st</sup> to August 21<sup>st</sup>. After the 21<sup>st</sup>, there were two periods without testing which both immediately followed days of exceedance. DCR policy requires that advisory flags stay up until new samples have confirmed that they may be taken down. The periods without testing create holdover postings and unverifiable postings, where the validity of a posting cannot be confirmed and the beach remains posted for potentially unnecessary days. There were 6 days of holdover postings in 2005, and 7 unverifiable postings. Holdover postings and unverifiable postings often refer to the same day, for a combined total of 8 potentially usable days with swimming advisories posted, about 10% of the summer.

Breakdown of Postings

Days with...	No. of Days
Any Exceedance	20
Posting	16
Accurate Posting	7
Inaccurate Posting	2
Unverifiable Posting	7
Single Sample Exceedance without Posting	7
Single Sample Exceedance	14
Single Sample Posting	9
Geo. Mean Exceedance	11
Geo. Mean Posting	6
Precipitation Posting	2
Holdover Posting	6

Within the 60 days with single sample data, there were 14 days where at least one sample site registered over 104 C/100 mL. Of those 14 days, 6 days had exceedances at more than one site, which led to advisories being posted at the beach on the following day. With one anomalous exception, each of these postings was accurate in that the advisory was posted on a day which proved through sampling to have an exceedance at at least one sample site. This demonstrates that the DCR policy does usually post accurate advisories with regard to single-sample exceedances. However, this only means that when an advisory is posted, it is probably accurate; it does not mean that every day with unsafe water quality has an advisory posted.

Within the three sites at Constitution Beach, named North Site, Middle Site, and Recreation Center, the Middle Site only had 5 days of exceedance, while the other two had 9 to 10. According to maps on the Department of Public Health website, the North Site is actually in between the Middle Site and the

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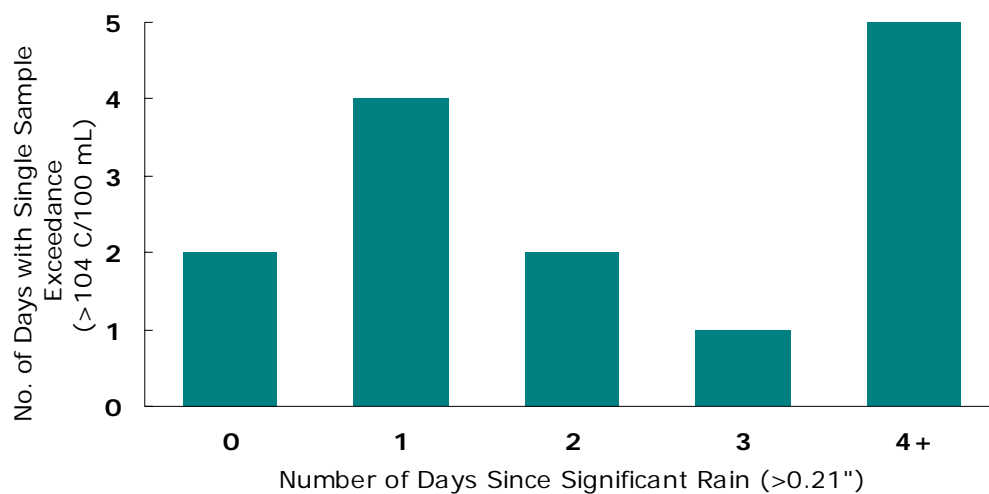
Recreation Center. This appears to be a confusion of some sort, and analysis on the specific location of exceedances cannot be attempted until the specific locations of the sampling sites are confirmed.

Using the geometric mean criteria specified by DCR, there were 11 days where the geometric mean was over 35 C/100 mL. Some of those days coincided with some of the 14 single-sample exceedances. Of the 11 days where a geometric mean exceedance was calculated from the single-sample data, only one day had a beach posting with geometric mean listed as an explanation. However, there were two more days with geometric mean postings after a three day period of no sampling. This highlights the ambiguity of the 5-day geometric mean especially as the 5 calendar day geometric mean does not result in any exceedances for the two days in question. Also, before August 21<sup>st</sup>, there were 9 other days where the geometric mean exceeded 35 C/100 mL. This suggests that the DCR did not calculate or use the 5-day geometric mean standard consistently, or that they were using a different standard than the one specified in the Bacteria Count report for 2005.

Of the two days with inaccurate posting, one (August 25<sup>th</sup>) was a day of holdover posting, as there had been no samples taken on the previous day. The other single day (July 8<sup>th</sup>) with inaccurate posting was anomalous, and does not suggest that DCR should make a different decision in the same situation in the future. Analysis of the samples from the previous day showed that all three sites along the beach had significant bacteria counts of at least 550 C/100 mL. DCR therefore posted advisories on the beach of high bacteria levels. However, sample analysis from July 8<sup>th</sup> showed that enterococcus levels had fallen below the 104 C/100 mL threshold at all three sites, although it was still elevated (48-71 C/100 mL). Therefore, there was no single-sample exceedance, and the beach did not necessarily need to be flagged. It is important to note in addition that there was 0.91" of rain on July 8<sup>th</sup>.

### Antecedent Rainfall

Antecedant Rainfall vs. Enterococcus Exceedance  
Constitution Beach, Summer 2005



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24-hour antecedent rainfall served as a strong predictor on 4 out of the 5 days with more than 0.21” of rain. However, precipitation was recorded as the reason for a beach posting on only two of those occasions. Additionally, 5 days of exceedance were recorded with no proximity to significant rainfall events, and some exceedance events lasted more than one day. Based on these results, it seems that antecedent rainfall, although helpful in predicting some exceedance events, is not a sufficient indicator of bacterial exceedance. The daily testing conducted during the summer of 2005 was therefore also necessary in order to protect public health.

Of the 5 days with exceedance in dry or mostly-dry weather, at least two seem to be a part of a major contamination event which seems anomalous. On August 20<sup>th</sup>, all three sample sites recorded enterococcus exceedances of between 235 and 1000 C/100 mL. There was no rain for 5 days previous, and a cursory search of news archives fails to uncover any specific events which might have caused the exceedance. Advisories were posted for the following day, and the beach had holdover postings until August 25<sup>th</sup>. However, as water quality sample data is missing from August 22<sup>nd</sup> until August 25<sup>th</sup>, the extent of the bacteria exceedances is unknown.

### **Tentative Conclusions**

The policy of only declaring an advisory if at least two of three sample sites have exceedances does reduce unnecessary postings, but at the same time drastically reduces the reported exceedance compared to the number of days there actually was a sample with an exceedance at that beach. Thus, the reported exceedances and inaccurate postings are reduced, but because of the DCR policy, not because of a reduction in exceedance. Also, the stated geometric mean policy was not carried out until late August, suggesting that the mean may not have been calculated before then, and the policy itself is somewhat ambiguous. Taken together, the reduction in postings masks the true state of water quality at Constitution Beach.

Additionally, antecedent rainfall did not prove to be a sufficient predictor of exceedance. Although several events were predicted successfully through this model, several other major bacteria events also happened in dry weather. Therefore, daily testing is necessary at this beach to reduce health risks during dry weather events. This data also suggests that there may be other sources of contamination as well.

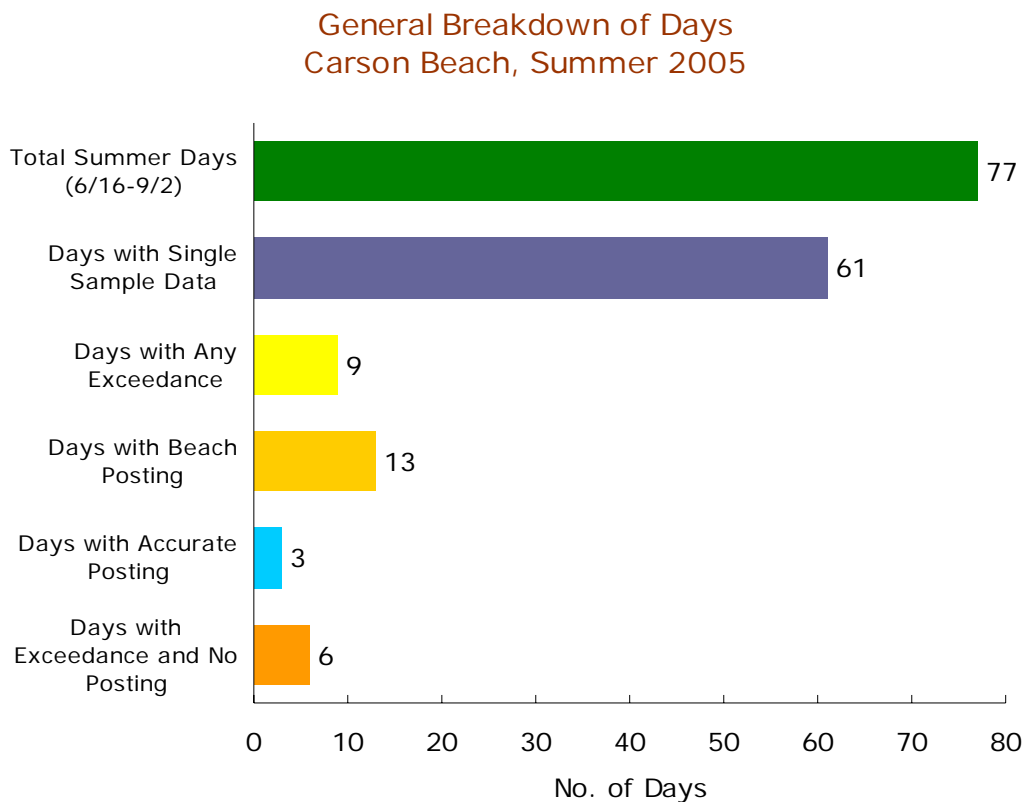
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## South Boston Beaches

The beaches of South Boston are separated into four different beaches, each with its own individual sample testing and advisory posting.

## Carson Beach

Carson Beach is the westernmost of the South Boston beaches. Unlike the other three beaches, there are two sample sites along Carson Beach; however, the DCR policy requires that the beach be posted even if only one site records an exceedance on the previous day. The specific policy states that a swimming advisory will be declared for the following day if at least one site exceeds 104 C/100 mL, or if a 5-day running geometric mean of all sites exceeds 35 C/100 mL, the single sample and geometric mean exceedance thresholds specified by the EPA. Additionally, advisories may also be posted the day after a significant rainfall, although the rainfall threshold is not specified.



During the summer of 2005, samples were collected on 61 of 77 days, or 79% of the time. On nine of those days (11.6%), a single sample or geometric mean exceedance was recorded. However, there were 13 days (17%) with swimming advisories posted, and often those advisories did not correspond to

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exceedances. Of those 13 days with swimming advisories, only three actually coincided with a single sample or geometric mean exceedance.

Samples were taken daily from July 1<sup>st</sup> to August 21<sup>st</sup>. After the 21<sup>st</sup>, there were two periods without testing which both immediately followed days of exceedance. DCR policy requires that advisory flags stay up until new samples have confirmed that they may be taken down. The periods without testing create holdover postings and unverifiable postings, where the validity of a posting cannot be confirmed and the beach remains posted for potentially unnecessary days. On Carson Beach, there were three days of unverifiable postings, from August 22<sup>nd</sup> to August 24<sup>th</sup>, and three days of holdover postings as a result, from August 23<sup>rd</sup> to August 25<sup>th</sup>.

The postings and exceedances are further broken down below.

Breakdown of Postings

Days with...	No. of Days
Any Exceedance	<b>9</b>
Posting	<b>13</b>
Accurate Posting	<b>3</b>
Inaccurate Posting	<b>7</b>
Unverifiable Posting	<b>3</b>
Single Sample Exceedance	<b>8</b>
Single Sample Posting	<b>8</b>
Geo. Mean Exceedance	<b>2</b>
Geo. Mean Posting	<b>0</b>
Precipitation Posting	<b>2</b>
Holdover Posting	<b>3</b>

For the 8 days with single sample exceedances, the following day had a beach advisory posted, as specified in the DCR policy. However, only two of these postings were accurate; the other six posted days later proved to have no exceedance. Therefore, single sample exceedance only worked as a predictor of next-day exceedance 25% of the time. Additionally, there were two days with geometric mean exceedance, and there were postings on both of those days. However, the geometric mean was never cited as a reason for beach posting and on August 15<sup>th</sup> the geometric mean exceedance did not lead to a beach advisory on the following day as specified in the DCR policy.

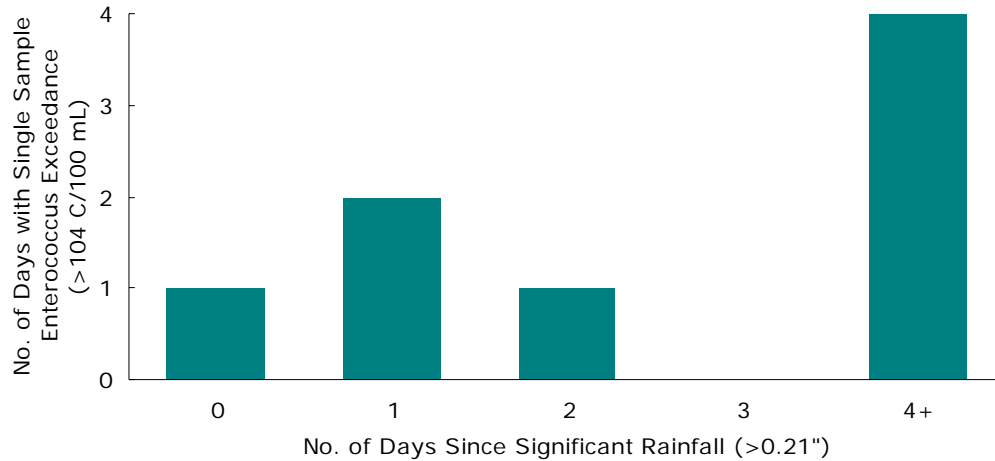
Antecedent rainfall also served as a poor predictor for exceedance: on the two days where swimming advisories were posted due to rainfall the previous day, there were no single sample exceedances, and one geometric mean exceedance. In other words, only one of the postings due to rainfall was an accurate posting. As mentioned previously, the exact threshold at which rainfall is considered enough to warrant a swimming advisory is unclear: advisories were posted after rainfall of 0.56” and 0.6”, but not

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after rainfall of 0.55” or 0.95”. The chart below analyzes the relationship between antecedent rainfall and single sample exceedance, using a threshold of 0.21” determined in a report on the effectiveness of water quality indicators.<sup>4</sup> Using a lower threshold than the one used by DCR is acceptable because doing so can only increase the correlation between rainfall and exceedance.

Antecedent Rainfall vs. Enterococcus Exceedance  
Carson Beach, Summer 2005



This data suggests that there may be a relationship between antecedent rainfall and some incidents of exceedance, but that there are also other exceedance events isolated from significant precipitation. Approaching the data from the opposite standpoint, rainfall is not guaranteed to cause exceedance every time, either. Of the six days with rainfall greater than 0.21”, only two were followed by single sample exceedance in the following three days.

The 23% (3 of 13) accuracy of posting for Carson Beach in 2005 is likely the most troubling statistic, and suggests that the current policy is not sufficient to predict exceedance. Ideally, faster sample testing methods would allow swimming advisory decisions to be made with more pertinent data.

### **M St. Beach**

The M St. Beach is east of Carson Beach, with only one sample site. The DCR policy for posting swimming advisories at M St. Beach is the same as the policy at Carson Beach: bacteria colony counts higher than 104 C/100 mL on a single day or a 5-day running geometric mean exceeding 35 C/100 mL

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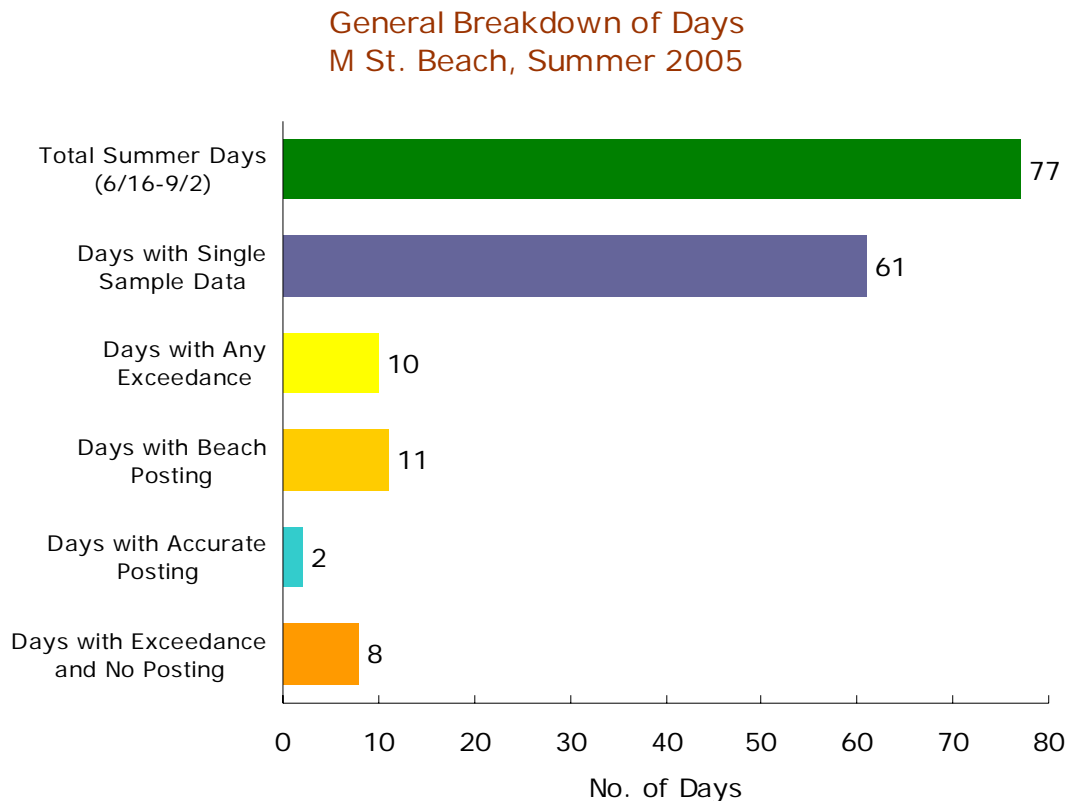
<sup>4</sup> “Receiver Operating Characteristic Curve Analysis of Beach Water Quality Indicator Variables,” Morrison et al. Applied and Environmental Microbiology, November 2003, p. 6405-6411, Vol. 69, No. 11.  
<http://aem.asm.org/cgi/content/full/69/11/6405>

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will prompt a swimming advisory for the following day. Just as at Carson Beach, significant rainfall can also lead to a swimming advisory.

The M St. Beach sample data also has a one-day gap: on August 9<sup>th</sup>, no sample could be collected due to tide. This would not be an issue except that it raises the ambiguity of a 5-day running geometric mean. The ambiguity lies in the difference between a calculation of the last 5 calendar days, where a missing day would simple reduce the number of samples averaged, and a calculation of the last 5 sampled days, where a missing day would be ignored and 5 samples would still be averaged.



The M St. Beach analysis looks strikingly similar to Carson Beach, with comparable numbers in most categories. M St. Beach had ten days of the 60 sampled (16.6%) with an exceedance. Two of those ten days had swimming advisories posted, while the other eight did not.

Just as at Carson Beach, there were also sampling gaps in late August which lead to unverifiable and holdover postings. The postings and exceedances for M St. Beach are broken down below.

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Breakdown of Postings

Days with...	No. of Days
Any Exceedance	<b>10</b>
Posting	<b>11</b>
Accurate Posting	<b>2</b>
Inaccurate Posting	<b>6</b>
Unverifiable Posting	<b>3</b>
Single Sample Exceedance	<b>6</b>
Single Sample Posting	<b>6</b>
Geo. Mean Exceedance	<b>4</b>
Geo. Mean Posting	<b>0</b>
Precipitation Posting	<b>2</b>
Holdover Posting	<b>3</b>

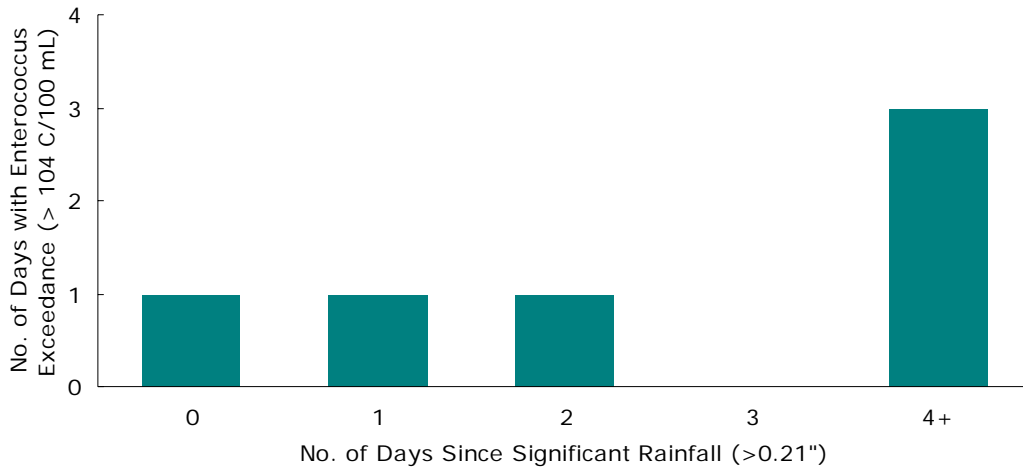
With regard to single sample exceedance, the DCR policy was followed. Unfortunately, this only resulted in two accurate postings. Of the other four single sample postings, one was unverifiable and three were inaccurate. The two precipitation postings and one holdover posting were also inaccurate.

Geometric mean exceedances, on the other hand, seem to have been ignored. In early July, there were three days where the 5-day geometric mean was over 35 C/100 mL, and there was a posting on only one of those days, not because of geometric mean exceedance, but due to a single sample exceedance. There was an additional day of questionable geometric mean exceedance, questionable because there was a day with no data in the previous 4 calendar days. If that day is taken into account and the geometric mean for August 10<sup>th</sup> is calculated with only four samples, the mean would be 42.3 C/100 mL, well over 35 C/100 mL. However, if an additional preceding day is factored in, so that the 5-day mean calculates the last 5 available sampled days, instead of calendar days, the geometric mean is 34.8 C/100 mL, just under the exceedance threshold. Therefore, the specific definition of a “5-day running geometric mean” can have a significant impact on the number of exceedances at a beach, especially if there are data gaps.

Antecedent rainfall on M St. Beach as it was applied as a predictor for exceedance did not perform well. Precipitation was listed as a reason for a swimming advisory twice during the summer, and there was no exceedance on either occasion. The following chart examines the proximity of exceedance events to significant rainfall of at least 0.21”, the same threshold used to analyze Carson Beach.

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## Antecedent Rainfall vs. Enterococcus Exceedance M St. Beach, Summer 2005



Although there are not many data points from which to draw a definitive conclusion, it appears that antecedent rainfall is not a consistent predictor of single sample exceedance. During the summer of 2005, there were six days with at least 0.21" of rain. Only two of those days were followed by exceedances in the following three days, accounting for three days of single sample exceedance. DCR did not decide to post a swimming advisory because of precipitation on either of those two days. Even if a swimming advisory was posted the day after every significant rainfall, only one day of single sample exceedance would have been included.

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### City Point Beach

City Point Beach is located east of M St. Beach, across from the southeast edge of Pleasure Bay. There is only one sample site, and DCR policy is the same as at M St. Beach. Samples throughout the whole summer often stayed below 10 C/100 mL for days at a time.

#### **Breakdown of Days and Postings City Point Beach, Summer 2005**

Total Summer Days (6/16-9/2)	<b>77</b>
Days with Single Sample Data	<b>60</b>
<b>Days with...</b>	<b>No. of Days</b>
Any Exceedance	<b>2</b>
Postings	<b>4</b>
Accurate Postings	<b>1</b>
Inaccurate Postings	<b>3</b>
Unverifiable Postings	<b>0</b>
Exceedance but No Postings	<b>1</b>
Single Sample Exceedance	<b>2</b>
Single Sample Posting	<b>2</b>
Geo. Mean Exceedance	<b>0</b>
Geo. Mean Postings	<b>0</b>
Precipitation Postings	<b>2</b>
Holdover Postings	<b>0</b>

As there were only 2 exceedances, they may be discussed specifically. Both exceedances were from single samples, and both happened one day after a significant rain (2.04” for one, 0.6” for the other). Strangely, only the exceedance after 0.6” of rain had a swimming advisory posted for that day; there was no posting after 2.04” of rain in early July. The geometric mean rarely went over 10 C/100 mL.

Two of the three inaccurate postings occurred on the day after an exceedance. This is a result of the DCR policy which requires a posted advisory the day after a single sample exceedance is found.

The third inaccurate posting was due to 0.56” of precipitation on the previous day. As with M St. Beach and Carson Beach, the threshold required for a swimming advisory due to rainfall is unclear. However, it does appear that significant rainfall is not always a precursor to exceedance, but only on certain occasions. Unfortunately, two days of exceedance after rainfall are not sufficient data to conclude that there is a specific trend.

### Pleasure Bay

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Pleasure Bay is located northeast of City Point Beach, has one sampling point, and the DCR policy is the same as M St. Beach and City Point Beach. Pleasure Bay had only one day with an exceedance during the summer of 2005, and it was accurately posted based on 0.6” of rainfall the day before.

### Breakdown of Days and Postings Pleasure Bay, Summer 2005

Total Summer Days (6/16-9/2)	77
Days with Single Sample Data	60
<b>Days with...</b>	<b>No. of Days</b>
Any Exceedance	1
Postings	3
Accurate Postings	1
Inaccurate Postings	2
Unverifiable Postings	0
Exceedance but No Postings	0
Single Sample Exceedance	1
Single Sample Postings	1
Geo. Mean Exceedance	0
Geo. Mean Postings	0
Precipitation Postings	2
Holdover Postings	0

Pleasure Bay had a swimming advisory posted on three of 77 summer days, or approximately 4% of the time. Within those three days, the single exceedance was covered, so 100% of exceedances had an advisory posted on the same day. Of the other two days with postings, one was posted because of 0.56” of rain, and the other was following the single sample exceedance, as specified in DCR policy. Also, there were no geometric mean exceedances at all for Pleasure Bay, and although the same data gaps appear in late August as at other locations, there were no exceedances to create unverifiable or holdover postings.

Although the single exceedance in 2005 was one day after significant rain, it is important to note that most days with significant rainfall were not followed by an exceedance. Pleasure Bay was the only beach on the south shore besides Nantasket to not have an exceedance on July 7<sup>th</sup> after 2.04” of rain the previous day. Nantasket Beach faces away from Boston Harbor and is physically removed from the other beaches, but Pleasure Bay is adjacent to the other South Boston beaches, all of which had exceedances on July 7<sup>th</sup>.

### **Tentative Conclusions.**

Carson Beach and M St. Beach are good examples of the inadequacy of 24-hour sampling. Daily testing is essential for analyzing and understanding the state of water quality at a given beach, but conditions change rapidly enough that 24 hours is often enough time for bacterial exceedance to wane. This led to

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many inaccurate postings. However, there does not presently seem to be a more effective method currently available to reduce inaccurate postings while maintaining the same public health standard. The sooner a quicker sampling method is found, the better.

Antecedent rainfall data can help, but is not a panacea. It did not have a strong relationship with enterococcus exceedance on any of the beaches during the summer of 2005.

Samples were collected on about 78% of summer days at all four beaches. Although many of those samples, especially at City Point and Pleasure Bay, did not reveal any exceedance for long stretches of time, it is important to note that the exceedance that did occur at Pleasure Bay did not follow any specific pattern, and daily testing is essential both for determining trends in exceedance, but also to catch all days where exceedance occurs in order to properly assess how good the water quality actually is.

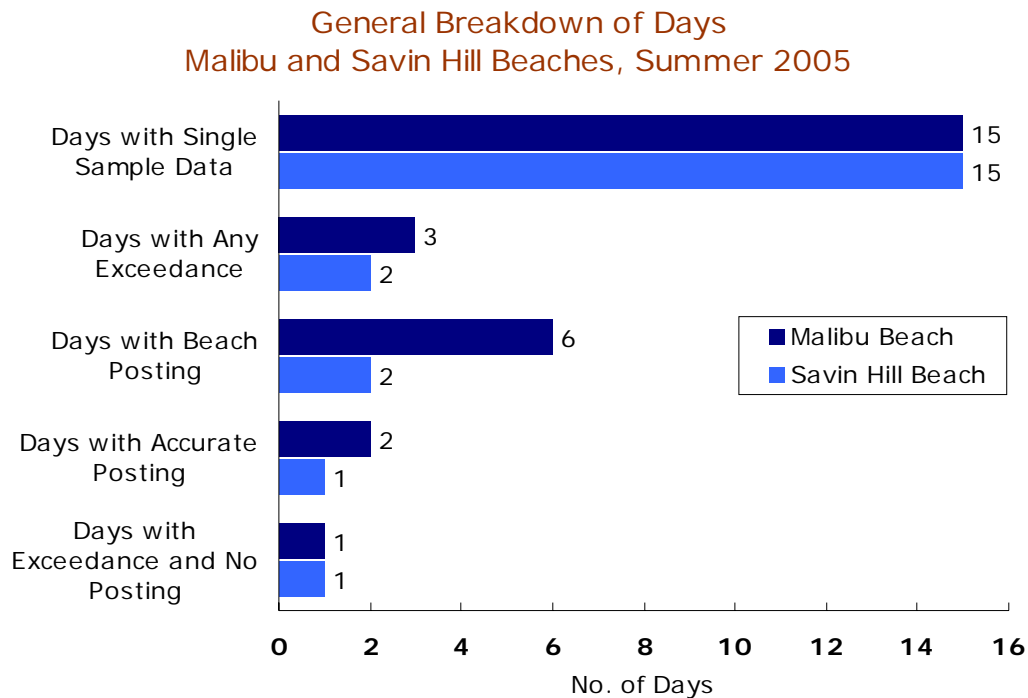
# METROPOLITAN BEACHES COMMISSION DRAFT

## Dorchester

There are two separate stretches of beach in the Dorchester area, which include Malibu Beach, Savin Hill Beach, and Tenean Beach. Malibu Beach and Savin Hill Beach are adjacent, and will be considered together.

## Malibu and Savin Hill Beaches

Sampling during the summer of 2005 at Malibu and Savin Hill Beaches was conducted weekly. The specific DCR policy regarding when swimming advisories should be posted is not available. Single samples are in exceedance when greater than 104 C/100 mL, and the limit for geometric means is 35 C/100 mL. The geometric mean is calculated (when possible) using a 30-day mean of at least 5 samples. Samples were collected for 15 days throughout the 77 day summer, or 19.5% of the time.



The three days of exceedance at Malibu Beach (two at Savin Hill) were consecutive, starting on July 7<sup>th</sup>. On July 6<sup>th</sup>, 2.04” of rain was recorded. It is possible that there was an exceedance on that day, as there was in many other locations, but no samples were collected. Regularly weekly testing took place on the 7<sup>th</sup>, and found an exceedance; additional samples were taken on the 8<sup>th</sup> and 9<sup>th</sup>. The single day of exceedance without posting refers to the 7<sup>th</sup>, as DCR did not decide to post an advisory due to rainfall, and there were no samples to show an exceedance.

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Savin Hill Beach had one day of accurate posting, July 8<sup>th</sup>, and then an inaccurate day of posting on July 9<sup>th</sup> as enterococcus levels receded below the exceedance threshold.

Malibu Beach was accurately posted on both July 8<sup>th</sup> and 9<sup>th</sup>, but no sample was taken on July 10<sup>th</sup> and the beach remained posted for four additional days until the next sample was taken. These holdover postings were likely unnecessary, and could have been prevented by additional daily testing.

Additionally, weekly testing may distort the statistics specified as indicators for measuring overall water quality such as the “Percentage and number of summer days that each Boston Harbor beach failed the safe swimming water quality test,” and the percentage of summer days that there was an inaccurate posting.<sup>5</sup> Because the indicators depend on total summer days, as opposed to the number of days tested, the impacts of the difference between weekly and daily testing can be dramatic and misleading. For example, on Malibu Beach during the summer of 2005, there were three recorded exceedances, or just 4% of summer days. However, those same three exceedances make up 20% of the total 15 sampled summer days. The actual number of days with exceedances cannot be tallied without consistent daily sampling throughout the entire summer.

It should also be noted that it is possible that there is a link between antecedent rainfall and exceedance, but weekly testing occurred the day after a rainfall event only once throughout the entire summer, so there is no way to know if precipitation caused other exceedances as well. No swimming advisories due to rainfall were reported.

### **Tenean Beach**

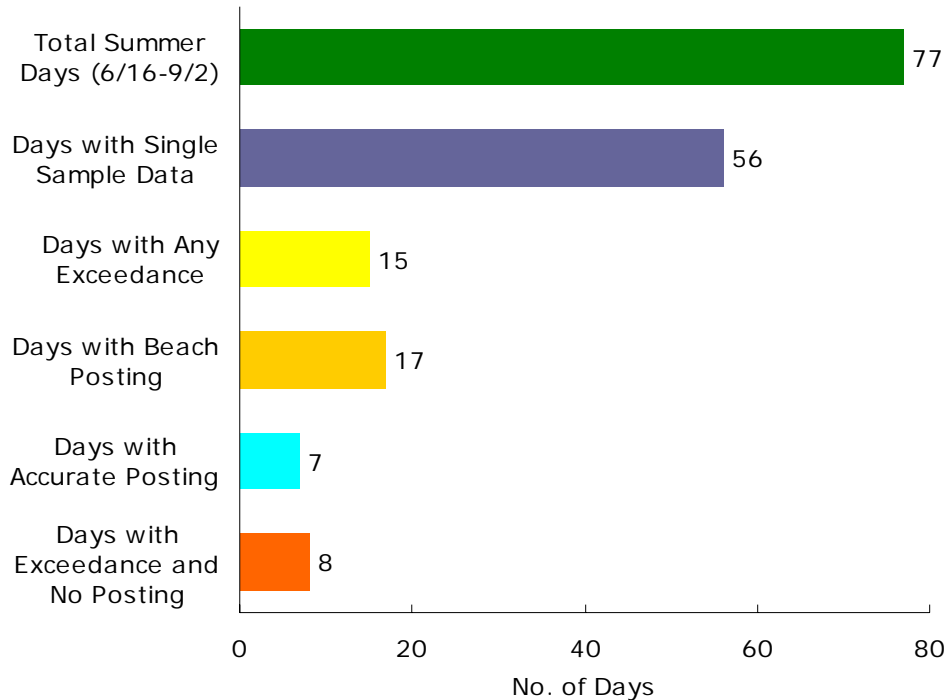
Unlike Malibu and Savin Hill, daily sampling was conducted at Tenean Beach from July 1<sup>st</sup> to August 21<sup>st</sup>, with a few isolated days of missing data where samples could not be collected because of tide or other unknown reason. Because of daily testing, the DCR policy for determining exceedance uses a 5-day geometric mean instead of a 30-day geometric mean.

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<sup>5</sup> “Boston’s Harbor and Waterfront: A Renaissance Underway,” Save the Harbor/Save the Bay, June 2005. p 31.

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## General Breakdown of Days Tenean Beach, Summer 2005



During the summer of 2005, samples were collected from Tenean Beach on 56 of 77 days, or 72.7% of the time. There were 15 days with exceedances within the 77 summer days (19.5%), including two days of geometric mean exceedance when no sample was collected. 7 of those 15 days also had swimming advisories posted, meaning that beachgoers were appropriately advised of unsafe water conditions less than 50% of the time.

Similar to several other beaches, days where samples were not taken led to unverifiable postings and holdover postings. The holdover posting and one of the unverifiable postings happened as a result of no data on July 9<sup>th</sup>, during the daily testing carried out by the DCR. The published sample data reads “no data,” giving no specific reason as to why a sample could not be collected. The second unverifiable posting occurred on August 31<sup>st</sup>, after the daily sampling period.

One of the geometric mean exceedances is also questionable, because of the same data gaps. The missing data highlights the ambiguity of a ‘5-day running’ geometric mean. The following analysis uses a 5 calendar day geometric mean, where if sample data is missing less samples are averaged for the mean. If a 5 sample day geometric mean were used, where the last 5 available samples are averaged, the geometric mean on August 9<sup>th</sup> would not be in exceedance. The difference between the methods results in a difference of more than 20 C/100 mL, and the threshold is 35 C/100 mL.

### Breakdown of Postings

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Days with...	No. of Days
Any Exceedance	15
Posting	17
Accurate Posting	7
Inaccurate Posting	9
Unverifiable Posting	1
Single Sample Exceedance	7
Single Sample Posting	7
Geo. Mean Exceedance	10
Geo. Mean Posting	6
Precipitation Posting	5
Holdover Posting	1

All seven single sample postings occurred the day following a single sample exceedance, as specified by DCR policy. This led to three accurate postings, three inaccurate postings, and one posting which was unverifiable against single sample data, but counted as accurate because of a significant geometric mean exceedance. Precipitation-based postings were similarly effective, resulting in two accurate postings, two inaccurate postings, and one unverifiable posting. The relationship between antecedent rainfall and exceedances is further explored below.

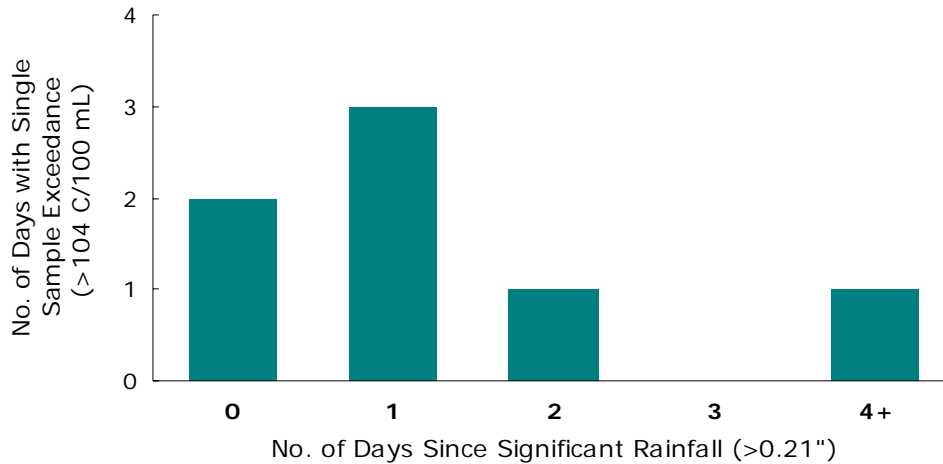
There were ten days with geometric mean exceedances scattered throughout the summer. However, at Tenean Beach as at other beaches, geometric mean exceedances were not listed as a reason for posting until mid-August. At Tenean Beach, there were six days where the geometric mean was the reason for posting. However, only two of those days had a geometric mean exceedance the day before to trigger the posting. The other four days were preceded by geometric means well below 35 C/100 mL. This suggests that the geometric mean was not being calculated as a 5-day running geometric mean, but using some other method. Therefore, despite the high number of geometric-mean based postings, it appears that the geometric mean was not applied properly throughout most of the summer at Tenean Beach.

**Antecedent Rainfall**

Posting decisions based upon antecedent rainfall did not follow any consistent pattern at Tenean Beach. Rainfall of 0.15” would lead to a posting, while 0.23” or 0.55” was insufficient. For two of the precipitation based postings, local rainfall information is not available for the preceding day, but Logan airport recorded one of those days as approximately 0.5”, and the other as 0.2”. Despite this inconsistency of posting, a relationship still seems to exist between antecedent rainfall and exceedance. 0.21” of rainfall was used as a threshold for significant precipitation.

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Antecedent Rainfall vs. Enterococcus Exceedance  
Tenean Beach, Summer 2005



This chart shows that most days of single sample exceedance on Tenean Beach occurred within 2 days of a rainfall event. Although this does not mean that every day with more than 0.21" of rain will be followed by an exceedance, it does show that exceedances tend to follow rainfall. However, the single exceedance that was isolated from rainfall, combined with gaps in the data, shows that a relationship between rainfall and exceedance cannot be relied on as a predictor for bacteria exceedances at this time. More daily sampling and rainfall data are needed before any such conclusions can be made.

## **Tentative Conclusions**

Although Malibu and Savin Hill Beaches appear to be mostly free from exceedance, it is important to note that weekly testing could potentially be masking the true state of water quality. Weekly testing also distorts some indicators suggested for judging overall water quality on the beaches. On the single occasion where samples were taken the day after a rain, high levels of bacteria were found. Therefore, testing should at least be performed following significant rainfall. Antecedent rainfall analysis of nearby Tenean Beach supports the idea that rainfall may lead to exceedance at Malibu Beach and Savin Hill Beach.

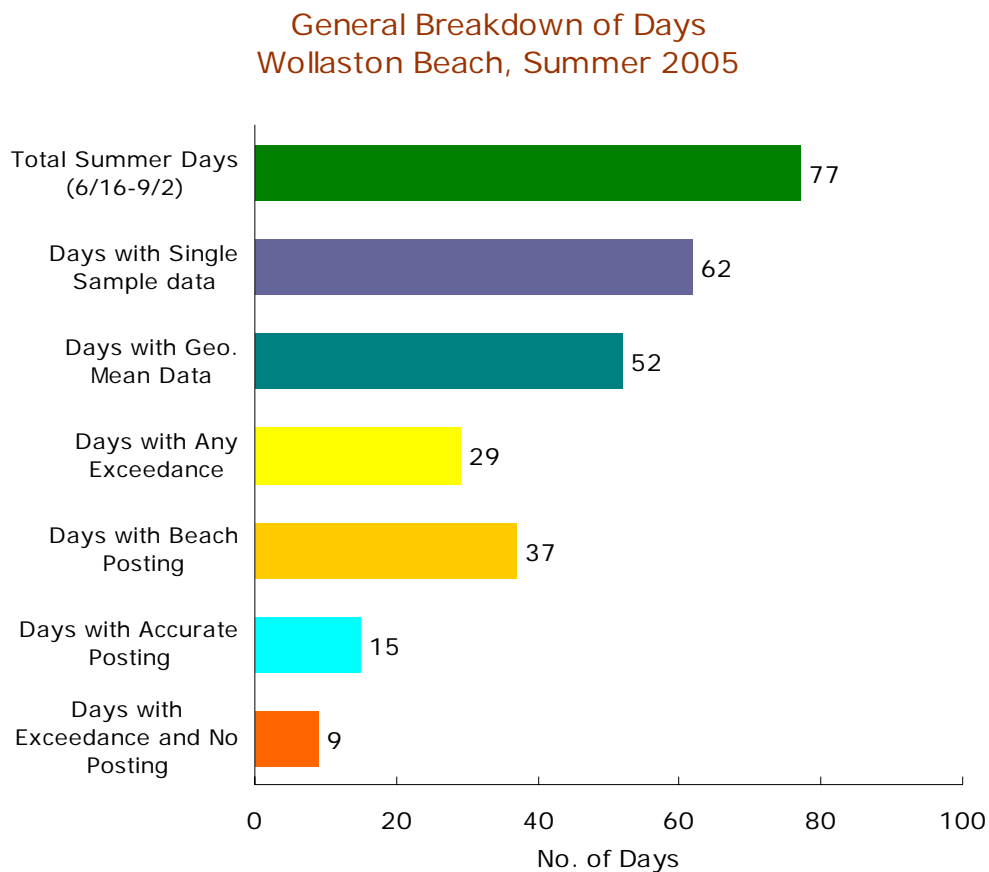
Problems with the geometric mean are very apparent at Tenean Beach, and the question of how a geometric mean is calculated for beaches with weekly testing must be resolved as well. Unless the DCR policy was misinterpreted, geometric mean exceedances are not being calculated correctly, leading to several false positives in August and no recognition of exceedance in July.

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## Wollaston Beach

There are four enterococcus sampling sites evenly spaced along Wollaston Beach, and the beach is large enough to warrant bacteria advisory postings limited to a single location. The specific policy in 2005 for Wollaston Beach specifies that a swimming advisory would be declared at any location with a single sample exceedance, or that a swimming advisory would be declared for the entire beach if the 5-day running geometric mean of all sites exceeds 35 C/100 mL. In addition, based on the 2005 beach posting records, an advisory for the entire beach would be posted if more than one site exceeded 104 C/100 mL or if there was heavy rainfall on the previous day.

This policy more accurately reflects the number of exceedances on the beach than the 2005 policy used at Constitution Beach, where single site exceedances do not result in advisory postings. However, the policy does mask incidences where the 5-day running geometric mean at a single site exceeds 35 C/100 mL, and only requires advisories when the mean of all sites exceeds that threshold. The policy also increases the incidence of advisories which after sample testing turn out to have been unnecessary.



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During the summer season in 2005, data was collected on 62 of 77 days, or approximately 80% of the summer. On 29 of those 62 days, or nearly 47%, water samples contained an exceedance. In total, advisories were posted 37 out of 77 days, or 48% of the time. The exceedances and postings are broken down below.

Breakdown of Postings

Days with...	No. of Days
Any Exceedance	<b>29</b>
Posting	<b>37</b>
(Single Site)	<b>16</b>
(Entire Beach)	<b>23</b>
Accurate Posting	<b>15</b>
Inaccurate Posting	<b>9</b>
Unverifiable Posting	<b>11</b>
Single Sample Exceedance	<b>24</b>
Single Sample Posting	<b>23</b>
Geo. Mean Exceedance	<b>15</b>
Geo. Mean Posting	<b>4</b>
Precipitation Posting	<b>5</b>
Holdover Posting	<b>1</b>

As the chart above suggests, there are several specific aspects of the beach data which may be cause for concern. First, although there were 15 days which exceeded the DCR specified criteria of an all-site 5-day geometric mean of 35 C/100 mL, the geometric mean was only listed as a reason on 4 days. Although 12 of those 15 days did have a posting on the following day, there is no evidence that the geometric mean was taken into account for most of them, especially early in the summer. Before August 20<sup>th</sup>, there was only one posting (July 13<sup>th</sup>) which cited the geometric mean as the reason, and then perhaps incorrectly. The Sachem St. site was posted because of a geometric mean exceedance, but according to the sample data available, the Sachem St. sample site did not actually exceed the geometric mean on July 12<sup>th</sup> or 13<sup>th</sup>.

Holdover posting, or an advisory that remains posted because additional testing since the original exceedance has not been conducted, accounts for 21.6% of summer postings, or about 10% of summer days. Holdover posting can be prevented by daily testing, as current policy requires that an advisory must remain posted until sample testing shows that the exceedance is not longer present. Unverifiable posting, where the validity of a bacteria advisory is unknown because no sample was taken, can be prevented in the same way. Unverifiable beach advisories make it difficult to ascertain how effective the current posting policy is or analyze the relationship between rainfall and exceedance. 11 of the 37 total posted days were unverifiable, in three different periods of 3-5 days. It is possible that those 11 days would have been reduced to as little as three days, if there was daily testing through the entire summer.

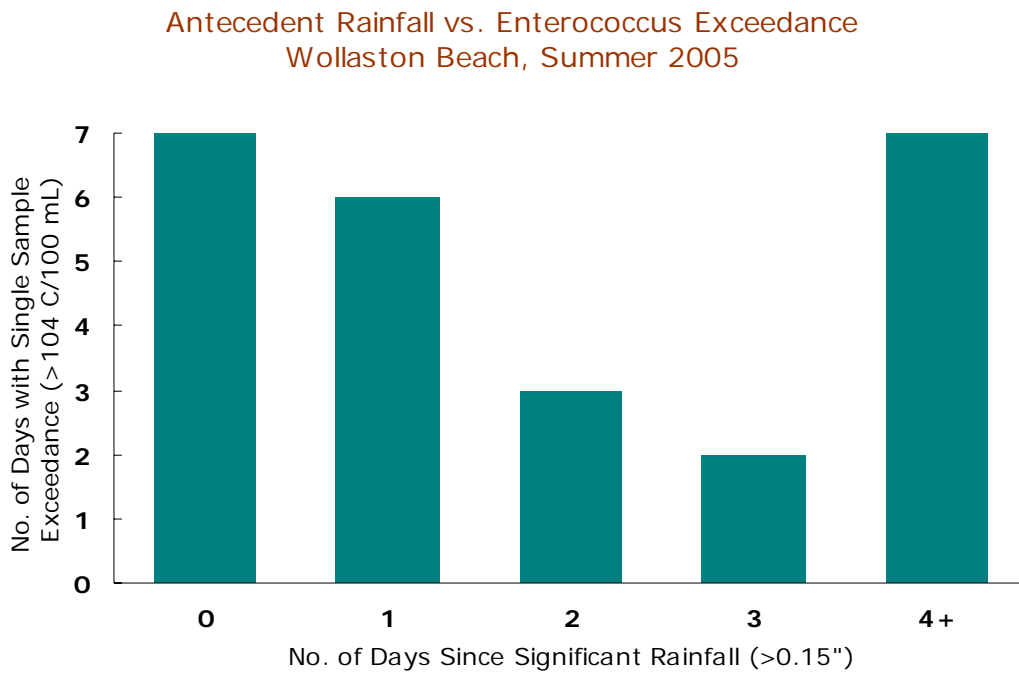
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Regardless of unverifiable postings, nine other postings turned out to be inaccurate. However, of these nine inaccurate postings, only two were for the entire beach, one of those being a holdover posting from four days previous. The other seven postings were advisories posted on one section of the beach because of a single site exceedance the previous day. A policy similar to the one at Constitution Beach, where single site exceedances are ignored, would eliminate the seven inaccurate postings. However, without these postings beachgoers would not be aware that there had been an exceedance at all.

### Antecedent Rainfall

For the purposes of analysis, 0.15” of rain was used as the threshold for significant rain. This is because a bacteria advisory was posted due to precipitation after a rainfall of only 0.15”, and therefore it is assumed that the antecedent rainfall policy at Wollaston Beach was based on a threshold of 0.15” or less.



This chart shows that there is a strong correlation between day-of or day-before rainfall and exceedance. Antecedent rainfall was an accurate predictor for exceedance when used at least on the 3 out of the 5 days precipitation was recorded as a reason for posting. Of the other two days, one occasion had no exceedance at all and the other had no sample data and therefore could not be verified. Antecedent rainfall is a good component of the effort to provide accurate public health advisories: there were two additional days with 2.04” and 0.55” of antecedent rainfall where a precipitation-based advisory would have been correct. It is unclear why an advisory was not declared after those precipitation events.

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Despite the success of antecedent rainfall prediction, the 7 days of exceedance isolated from rain events demonstrate that rainfall does not predict all exceedances. Daily testing is necessary to detect bacteria events that do not necessarily have overt indicators.

### **Tentative Conclusions:**

The 8 days lost to holdover postings may have been entirely unnecessary. Similarly, the unverifiable postings limit understanding of how well the Wollaston Beach posting policy is working. Therefore, daily testing for as long as advisories can be posted is necessary to ensure that both public health needs are being met and to reduce the nearly 50% of summer days with postings. Additionally, it appears that the geometric mean was not being calculated properly or at all before August 20<sup>th</sup>, which suggests that DCR may not be following the written policy that can be found with the sample data for 2005.<sup>6</sup>

Also, the methods through which the above analysis was generated require daily testing, both in order to find all exceedances and to evaluate the performance of the current beach posting policies. The antecedent rainfall analysis especially suggests that exceedances can and do occur isolated from rainfall. These “dry-weather” events are only observable through rigorous daily data collection.

### **Nantasket Beach, Hull**

Nantasket Beach faces the open ocean, and has four DCR-operated sampling sites. These sites were sampled on a weekly basis for twelve weeks beginning June 16<sup>th</sup>, and ending September 1<sup>st</sup>. Of the 48 total samples collected, no enterococcus counts of above 104 C/100 mL, the EPA standard, were recorded. The highest count sampled was 75 C/100 mL, with most samples remaining below 10 C/100 mL. During the entire summer (77 days from June 16 to September 2) there were no swimming advisories posted.

Though the evidence suggests that water quality on Nantasket Beach is quite good, samples were taken on just 1/7 of the summer days. Although the data certainly suggests that the water is safe to swim in every day of the summer, daily testing would make it a certainty. Also, the weekly testing by chance only tested the day after one significant rainfall of six total days with greater than 0.21” of rain. As exceedances were found after rainfall on other beaches, it is important to have daily testing for a full season in order to ensure that similar exceedances are not occurring on Nantasket Beach.

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<sup>6</sup> “Wollaston Beach Bacteria Counts,” provided by the Massachusetts Water Resources Authority, [http://www.mwra.state.ma.us/harbor/pdf/2005\\_wollaston.pdf](http://www.mwra.state.ma.us/harbor/pdf/2005_wollaston.pdf).

# METROPOLITAN BEACHES COMMISSION

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### Conclusions

It is clear from our analysis that DCR's testing protocols and posting policies are not uniform across the beaches in the study area, and that in some cases these practices mask the true state of water quality on a beach.

Moreover, the lack of daily testing makes it difficult to determine the true state of water quality on many of these beaches, difficult to evaluate the accuracy of the flagging and posting system, and nearly impossible to spot patterns or pinpoint causes that could lead to effective solutions to the pollution problems that remain.

It is important to note that in some cases, even daily testing might not be sufficient to understand the complicated factors (such as wind, tide, rain and the state of the pipes) that could be contributing to a particular problem on a particular beach. These aspects can often only be understood through higher-resolution surveys and more sophisticated modeling techniques.

Still, seasonal daily testing on nearly all of these beaches appears to be necessary to honestly inform the public about water quality in as close to real time as possible, and to evaluate both the true state of water quality and the accuracy of the flagging on each beach.

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**Technical Appendixes: Water Quality Data**

- Rain** - Indicates more than 0.21” of rain, the threshold designated as ‘significant rainfall.’
- Sample** - Indicates an exceedance, >104 C/100mL for single samples, and >35 C/100 mL for geometric means.

**Posting:** S indicates posting due to single sample exceedance, G indicates posting due to geo. mean exceedance, and P indicates posting due to precipitation. An asterisk (\*) indicates a holdover posting. Postings refer to advisories posted for the entire beach, unless otherwise specified.

**King’s Beach**

Date	Inches of Rainfall	Single Sample Results			30-day geo. mean	Postings
		Stacey Brook Outlet	Kimball Road (Lynn)	Nirvana		
6/16/2005	0.13	24	64	32		
6/17/2005	0.01					
6/23/2005	0	48	2	32		
6/24/2005	0					
6/30/2005		46	4	30		
7/1/2005	Trace					
7/2/2005	0					
7/3/2005	0					
7/4/2005	0					
7/5/2005	Trace					
7/6/2005	2.04					
7/7/2005	0	162	470	54		
7/8/2005	0.95		49	26		S
7/9/2005	0.2	460	360	170		
7/10/2005	0					S
7/11/2005	0	89	10	67		S*
7/12/2005	0					
7/13/2005	0					
7/14/2005	0	49	10	1		
7/15/2005	0					
7/16/2005	0				38.8471	
7/17/2005	0				39.19091	
7/18/2005	0.03				39.19091	
7/19/2005	Trace				39.19091	
7/20/2005	0				39.19091	
7/21/2005	0	140	43	75	42.77926	
7/22/2005	0.15	16	10	2	34.6231	

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7/23/2005	0	16	10	2	31.73849	
7/24/2005	0					
7/25/2005	0					
7/26/2005	0					
7/27/2005	Trace					
7/28/2005	0	185	6	1	28.26577	
7/29/2005	0				29.83962	
7/30/2005	0				29.83962	
7/31/2005	Trace				29.83962	
8/1/2005	0.56				29.83962	
8/2/2005	0.01				29.83962	
8/3/2005	Trace				29.83962	
8/4/2005	0	6	12	5	25.72627	
8/5/2005	0.55				20.83185	
8/6/2005	0				19.91772	
8/7/2005	0				13.49295	
8/8/2005	0				13.49295	
8/9/2005	0.02				11.30198	
8/10/2005	0				11.30198	
8/11/2005	0.23	5	6	27	10.9952	
8/12/2005	Trace				11.62202	
8/13/2005	0.07				11.62202	
8/14/2005	0.6				11.62202	
8/15/2005	0.13				11.62202	
8/16/2005	0				11.62202	
8/17/2005	0				11.62202	
8/18/2005	0	162	8	40	13.72797	
8/19/2005	0				10.30528	
8/20/2005	0				11.18566	
8/21/2005	0.02				12.64925	
8/25/2005	0	1	8	27	10.89637	
8/26/2005	0				10.89637	
9/1/2005	0.19	4	70	97	13.48515	
9/2/2005	0				13.48515	

**Nahant Beach**

Date	Inches of Rain	Single Sample Results				30-day geo. mean
		North of Bathhouse	Parking Section #9	Flagpole	North of Bathhouse	
6/16/2005	0.13	16	10	18	17	
6/17/2005	0.01					
6/23/2005	0	56	43	73	74	
6/24/2005	0					
6/30/2005		6	6	5	5	
7/1/2005	Trace					

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7/2/2005	0					
7/3/2005	0					
7/4/2005	0					
7/5/2005	Trace					
7/6/2005	2.04					
7/7/2005	0	65	27	13	-17	
7/8/2005	0.95					
7/9/2005	0.2					
7/10/2005	0					
7/11/2005	0					
7/12/2005	0					
7/13/2005	0					
7/14/2005	0	1	1	1	1	
7/15/2005	0					10.0973
7/16/2005	0					
7/17/2005	0					
7/18/2005	0.03					
7/19/2005	Trace					
7/20/2005	0					
7/21/2005	0	27	18	13	5	9.911011
7/22/2005	0.15					
7/23/2005	0	1	2	4	5	5.097734
7/24/2005	0					
7/25/2005	0					
7/26/2005	0					
7/27/2005	Trace					
7/28/2005	0	18	19	1	-4	5.322304
7/29/2005	0					
7/30/2005	0					
7/31/2005	Trace					
8/1/2005	0.56					
8/2/2005	0.01					
8/3/2005	Trace					
8/4/2005	0	2	1	2	2	4.271971
8/5/2005	0.55					
8/6/2005	0					
8/7/2005	0					
8/8/2005	0					
8/9/2005	0.02					
8/10/2005	0					
8/11/2005	0.23	10	10	2	-1	3.444448
8/12/2005	Trace					
8/13/2005	0.07					
8/14/2005	0.6					
8/15/2005	0.13					
8/16/2005	0					
8/17/2005	0					

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8/18/2005	0	10	32	67	93	6.661018
8/19/2005	0					
8/20/2005	0					
8/21/2005	0.02					
8/25/2005	0	40	11	11	-8	8.323353
8/26/2005	0					
9/1/2005	0.19	2	2	4	5	6.799141
9/2/2005	0					

**Revere Beach**

		@ Point of Pines	@ Oak Island St.	@ State Police	@ Shirley St.	5-sample geomean	Postings
6/16/2005	0.13	6	6	1	8		
6/17/2005	0.01						
6/23/2005	0	12	11	16	18		
6/24/2005	0						
6/30/2005		2	19	1	4		
7/1/2005	Trace						
7/2/2005	0						
7/3/2005	0						
7/4/2005	0						
7/5/2005	Trace						
7/6/2005	2.04						
7/7/2005	0	21	24	19	6		
7/8/2005	0.95						
7/9/2005	0.2						
7/10/2005	0						
7/11/2005	0						
7/12/2005	0						
7/13/2005	0						
7/14/2005	0	4	1	1	2	5.548574	
7/15/2005	0						
7/16/2005	0						
7/17/2005	0						
7/18/2005	0.03						
7/19/2005	Trace						
7/20/2005	0						
7/21/2005	0	120	44	16	87	9.215638	
7/22/2005	0.15						P
7/23/2005	0	16	400	13	14	10.93553	P
7/24/2005	0	3	45	10	65	15.0283	P
7/25/2005	0	118	57	71	410	22.57008	P
7/26/2005	0	92	4	73	154	43.57256	P
7/27/2005	Trace	16	4	130	35	37.07738	P
7/28/2005	0	57	13	18	6	32.43087	P

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7/29/2005	0	40	94	62	4	36.49876	
7/30/2005	0	29	14	1	1	18.97206	
7/31/2005	Trace	8	8	27	8	14.26631	
8/1/2005	0.56						
8/2/2005	0.01						
8/3/2005	Trace						
8/4/2005	0	48	1	1	4	9.891613	
8/5/2005	0.55						
8/6/2005	0						
8/7/2005	0						
8/8/2005	0						
8/9/2005	0.02						
8/10/2005	0						
8/11/2005	0.23	43	2	2	1	7.275812	
8/12/2005	Trace						
8/13/2005	0.07						
8/14/2005	0.6						
8/15/2005	0.13						
8/16/2005	0						
8/17/2005	0						
8/18/2005	0	200	43	10	8	7.166034	
8/19/2005	0						
8/20/2005	0						
8/21/2005	0.02						
8/25/2005	0	8	26	6	1	7.579897	
8/26/2005	0						
9/1/2005	0.19	33	1	1	32	6.665225	
9/2/2005	0						

**Winthrop Beach**

Date	Inches of Rain	@ Pearl Street
6/16/2005	0.13	21
6/17/2005	0.01	
6/23/2005	0	6
6/24/2005	0	
6/30/2005		6
7/1/2005	Trace	
7/2/2005	0	
7/3/2005	0	
7/4/2005	0	
7/5/2005	Trace	
7/6/2005	2.04	
7/7/2005	0	52
7/8/2005	0.95	

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7/9/2005	0.2	
7/10/2005	0	
7/11/2005	0	
7/12/2005	0	
7/13/2005	0	
7/14/2005	0	1
7/15/2005	0	
7/16/2005	0	
7/17/2005	0	
7/18/2005	0.03	
7/19/2005	Trace	
7/20/2005	0	
7/21/2005	0	1
7/22/2005	0.15	
7/23/2005	0	24
7/24/2005	0	
7/25/2005	0	
7/26/2005	0	
7/27/2005	Trace	
7/28/2005	0	1
7/29/2005	0	
7/30/2005	0	
7/31/2005	Trace	
8/1/2005	0.56	
8/2/2005	0.01	
8/3/2005	Trace	
8/4/2005	0	5
8/5/2005	0.55	
8/6/2005	0	
8/7/2005	0	
8/8/2005	0	
8/9/2005	0.02	
8/10/2005	0	
8/11/2005	0.23	5
8/12/2005	Trace	
8/13/2005	0.07	
8/14/2005	0.6	
8/15/2005	0.13	
8/16/2005	0	
8/17/2005	0	
8/18/2005	0	4
8/19/2005	0	
8/20/2005	0	
8/21/2005	0.02	
8/25/2005	0	1
8/26/2005	0	
9/1/2005	0.19	1

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9/2/2005	0	
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Constitution Beach

	Single Sample Results				5-day Geo. Mean				Postings
	North Site	Middle	Recreation Center		North	Middle	Rec	ALL	
6/16/2005	10	8	18	0.13					
6/17/2005	2	4	2	0.01					
6/23/2005	2	2	8	0					
6/24/2005	2	5	5	0					
7/1/2005	1	6	10	Trace					
7/2/2005	3	3	3	0					
7/3/2005	25	3	3	0					
7/4/2005	20	3	5	0					
7/5/2005	15	5	35	Trace	7.420557	3.8167789	6.909651	5.8058152	
7/6/2005	137000	18200	8450	2.04	79.027932	18.970598	26.596682	34.163553	
7/7/2005	1500	800	550	0	273.88902	57.979542	75.418127	106.196005	S
7/8/2005	70	48	71	0.95	336.51639	100.94825	142.00484	168.96732	S
7/9/2005	90	80	60	0.2	454.6202	194.66708	233.42072	274.38491	
7/10/2005	5	35	30	0	364.94253	287.28446	226.33413	287.3617	
7/11/2005	20	3	5	0	62.385888	50.317853	51.188536	54.36596	
7/12/2005	45	15	10	0	30.939309	22.715503	22.966783	25.272277	
7/13/2005	3	3	3	0	16.478408	13.04663	12.197554	13.789932	
7/14/2005	1	1	1	0	6.6998758	5.431007	5.3782688	5.8058152	
7/15/2005	6	1	2	0	6.9486911	2.6672686	3.1291346	3.8707757	
7/16/2005	10	3	3	0	6.0491869	2.6672686	2.8252345	3.5722301	
7/17/2005	3	5	30	0	3.519482	2.1411274	3.519482	2.9821764	
7/18/2005	5	3	20	0.03	3.8980598	2.1411274	5.1435208	3.5014707	
7/19/2005	85	20	55	Trace	9.4783401	3.8980598	11.463917	7.5099655	
7/20/2005	5	15	5	0	9.1389445	6.6998758	13.769591	9.4470151	
7/21/2005	1	2	24	0	5.7662841	6.1780085	20.870797	9.0592976	
7/22/2005	2	1	8	0.15	5.3171362	4.4776949	16.022592	7.2525103	
7/23/2005	25	10	5	0	7.3362105	5.6967905	12.142854	7.9764125	
7/24/2005	1090	70	55	0	12.220059	7.3188671	12.142854	10.278884	
7/25/2005	5	3	10	0	12.220059	5.304566	13.948477	9.6697812	
7/26/2005	5	5	10	0	16.860378	6.3714438	11.708049	10.794352	
7/27/2005	5	5	5	Trace	20.251412	8.7908701	10.657628	12.379865	
7/28/2005	2	1	1	0	12.220059	5.546664	7.7244317	8.0597932	
7/29/2005	1	1	1	0	3.0170882	2.3714406	3.4657242	2.9160709	
7/30/2005	5	5	5	0	3.0170882	2.6265278	3.0170882	2.8808413	
7/31/2005	3	35	3	Trace	2.7240699	3.8761592	2.3714406	2.9255714	
8/1/2005	20	10	10	0.56	3.5944318	4.4525377	2.7240699	3.5195357	
8/2/2005	1000	75	545	0.01	12.457309	10.558929	9.605004	10.810536	P
8/3/2005	5	5	425	Trace	17.187719	14.568467	32.223695	20.057147	S
8/4/2005	10	2	24	0	19.743505	12.129024	44.098476	21.939391	
8/5/2005	151	62	57	0.55	43.231011	13.598487	79.464711	36.015277	

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8/6/2005	5	20	15	0	32.76298	15.62056	86.177235	35.331129	
8/7/2005	5	10	35	0	11.354745	10.439611	49.765327	18.068809	
8/8/2005	15	85	195	0	14.144957	18.398149	42.584936	22.29516	
8/9/2005	25	40	25	0.02	16.989854	33.495011	42.93404	29.017312	
8/10/2005	15	35	5	0	10.705637	29.875514	26.38887	20.36024	
8/11/2005	24	2	64	0.23	14.65078	18.850175	35.272686	21.356901	
8/12/2005	106	22	57	Trace	26.985342	22.069878	38.886593	28.504226	
8/13/2005	10	5	15	0.07	24.883397	12.523051	23.281514	19.358737	
8/14/2005	5	10	3	0.6	18.03498	9.4906978	15.235176	13.764288	
8/15/2005	1180	380	1220	0.13	43.179124	15.291189	45.743083	31.142024	P
8/16/2005	135	5	10	0	60.995575	18.366621	31.556544	32.820033	S
8/17/2005	75	55	5	0	56.917971	22.060597	19.395835	28.986229	
8/18/2005	91	114	65	0	88.523319	41.229135	26.00596	45.615412	
8/19/2005	10	13	62	0	101.68659	43.450312	47.65703	59.492359	
8/20/2005	600	235	1000	0	88.821384	39.468421	45.798896	54.350987	
8/21/2005	160	45	230	0.02	91.891381	61.248894	85.743376	78.437643	S, G
8/22/2005					96.678111	62.919048	174.48505	102.00532	S
8/23/2005					98.648483	51.610877	242.49708	107.27851	S*
8/24/2005					309.83867	102.83482	479.58315	248.14941	S*
8/25/2005	29	6	2	0	68.117545	16.431677	21.447611	28.847395	S*
8/26/2005	11	11	106	0	17.860571	8.1240384	14.56022	12.831529	G
8/27/2005									G
8/28/2005									G*
8/29/2005									G*
8/30/2005									G*
8/31/2005									
9/1/2005	2	2	6	0.19					
9/2/2005	8	42	22	0					

Carson Beach

Date	Inches of rain	Single Sample Results		Geo. Mean for both sites	Posting
		I-St.	Bathhouse		
6/16/2005	0.13	24	16		
6/17/2005	0.01	48	6		
6/23/2005	0	6	5		
6/24/2005	0	2	2		
6/30/2005		10	1		
7/1/2005	Trace	18	1		
7/2/2005	0	20	3		
7/3/2005	0	110	3		
7/4/2005	0	3	5	5.926563	S
7/5/2005	Trace	3	3	5.864448	
7/6/2005	2.04	180	30	10.37383	
7/7/2005	0	230	840	23.26617	S
7/8/2005	0.95	32	56	27.55543	S

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7/9/2005	0.2	20	3	31.65288	
7/10/2005	0	3	3	31.65288	
7/11/2005	0	5	3	17.57046	
7/12/2005	0	3	3	6.480471	
7/13/2005	0	15	10	5.056871	
7/14/2005	0	4	2	4.13405	
7/15/2005	0	1	1	3.318574	
7/16/2005	0	5	140	4.873626	
7/17/2005	0	3	35	6.230844	S
7/18/2005	0	15	3	5.524068	
7/19/2005	Trace	20	5	7.111316	
7/20/2005	0	15	3	10.4057	
7/21/2005	0	2	2	6.208225	
7/22/2005	0.15	2	24	5.740803	
7/23/2005	0	3	25	6.041677	
7/24/2005	0	5	3	4.997659	
7/25/2005	0	5	3	4.477695	
7/26/2005	0	20	3	5.870345	
7/27/2005	Trace	3	5	5.22575	
7/28/2005	0	4	1	3.89806	
7/29/2005	0	2	6	3.81204	
7/30/2005	0	5	3	3.81204	
7/31/2005	Trace	3	3	3.15331	
8/1/2005	0.56	10	3	3.379634	
8/2/2005	0.01	25	15	5.321901	P
8/3/2005	Trace	10	3	5.832581	
8/4/2005	0	10	14	7.292298	
8/5/2005	0.55	6	1	7.002535	
8/6/2005	0	10	15	8.225311	
8/7/2005	0	3	3	5.664655	
8/8/2005	0	3	3	5.022102	
8/9/2005	0.02		30	5.038424	
8/10/2005	0	305	3	9.189152	
8/11/2005	0.23	21	13	9.938894	S
8/12/2005	Trace	2	354	15.22351	
8/13/2005	0.07	750	1150	55.03196	S
8/14/2005	0.6	3	3	32.64088	S
8/15/2005	0.13	40	70	36.50359	P
8/16/2005	0	5	25	33.76061	
8/17/2005	0	25	10	30.42292	
8/18/2005	0	13	41	14.53108	
8/19/2005	0	8	32	20.30942	
8/20/2005	0	3	60	15.43508	
8/21/2005	0.02	170	5	18.69648	
8/22/2005					S
9/23/2005					S*
8/24/2005					S*

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8/25/2005	0	2	10		S*
8/26/2005	0	6	2		
9/1/2005	0.19	8	13		
9/2/2005	0	25	1		

**M St. Beach**

Date	Inches of rain	Single Sample Results	5-day Geo. mean	Postings
		@ M-St.		
6/16/2005	0.13	8		
6/17/2005	0.01	4		
6/23/2005	0	1		
6/24/2005	0	2		
6/30/2005		1		
7/1/2005	Trace	62		
7/2/2005	0	45		
7/3/2005	0	3		
7/4/2005	0	10	9.650395	
7/5/2005	Trace	3	12.0218	
7/6/2005	2.04	440	17.79023	
7/7/2005	0	250	25.06842	S
7/8/2005	0.95	33	40.49539	S
7/9/2005	0.2	40	53.43399	
7/10/2005	0	5	59.18168	
7/11/2005	0	3	21.82333	
7/12/2005	0	5	9.97992	
7/13/2005	0	25	9.440875	
7/14/2005	0	4	5.956789	
7/15/2005	0	1	4.31736	
7/16/2005	0	50	7.578583	
7/17/2005	0	615	19.84125	
7/18/2005	0	10	16.5189	S
7/19/2005	Trace	5	17.27281	
7/20/2005	0	3	21.51728	
7/21/2005	0	5	13.57648	
7/22/2005	0.15	2	4.31736	
7/23/2005	0	5	3.75848	
7/24/2005	0	3	3.393458	
7/25/2005	0	105	6.909651	
7/26/2005	0	5	6.909651	S
7/27/2005	Trace	5	8.299351	
7/28/2005	0	2	6.909651	
7/29/2005	0	1	5.546664	
7/30/2005	0	5	3.017088	
7/31/2005	Trace	3	2.72407	

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8/1/2005	0.56	3	2.459509	
8/2/2005	0.01	70	5.007975	P
8/3/2005	Trace	5	6.909651	
8/4/2005	0	4	6.608062	
8/5/2005	0.55	16	9.235786	
8/6/2005	0	40	15.50464	
8/7/2005	0	80	15.92429	
8/8/2005	0	25	21.97121	
8/9/2005	0.02		33.63586	
8/10/2005	0	40	42.29485	
8/11/2005	0.23	1	16.81793	
8/12/2005	Trace	6	8.801117	
8/13/2005	0.07	1000	22.13364	
8/14/2005	0.6	3	14.84111	S
8/15/2005	0.13	9	11.01293	P
8/16/2005	0	25	20.96481	
8/17/2005	0	5	20.21412	
8/18/2005	0	8	7.696136	
8/19/2005	0	8	9.36411	
8/20/2005	0	5	8.325532	
8/21/2005	0.02	150	11.91358	
8/22/2005				S
9/23/2005				S*
8/24/2005				S*
8/25/2005	0	1		S*
8/26/2005	0	6		
9/1/2005	0.19	1		
9/2/2005	0	2		
9/2/2005	0	25		

**City Point Beach**

Date	Inches of Rain	Single Sample Results @ Farragut	5-day Geo. Mean	Posting
6/16/2005	0.13	1		
6/17/2005	0.01	1		
6/23/2005	0	16		
6/24/2005	0	4		
6/30/2005		1		
7/1/2005	Trace	51		
7/2/2005	0	3		
7/3/2005	0	3		
7/4/2005	0	3	4.244112	
7/5/2005	Trace	3	5.287021	
7/6/2005	2.04	3	3	

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7/7/2005	0	315	7.609552	
7/8/2005	0.95	32	12.21701	S
7/9/2005	0.2	3	12.21701	
7/10/2005	0	3	12.21701	
7/11/2005	0	5	13.53115	
7/12/2005	0	3	5.334537	
7/13/2005	0		3.408658	
7/14/2005	0	2	3.08007	
7/15/2005	0	1	2.340347	
7/16/2005	0	3	2.059767	
7/17/2005	0	5	2.340347	
7/18/2005	0.03	3	2.459509	
7/19/2005	Trace	3	2.667269	
7/20/2005	0	3	3.322699	
7/21/2005	0	22	4.949386	
7/22/2005	0.15	12	5.89649	
7/23/2005	0	30	9.345306	
7/24/2005	0	5	10.35055	
7/25/2005	0	3	10.35055	
7/26/2005	0	3	6.948691	
7/27/2005	Trace	5	5.832581	
7/28/2005	0	1	2.954177	
7/29/2005	0	2	2.459509	
7/30/2005	0	3	2.459509	
7/31/2005	Trace	5	2.72407	
8/1/2005	0.56	3	2.459509	
8/2/2005	0.01	3	3.063887	P
8/3/2005	Trace	5	3.68011	
8/4/2005	0	4	3.89806	
8/5/2005	0.55	11	4.563868	
8/6/2005	0	3	4.563868	
8/7/2005	0	3	4.563868	
8/8/2005	0	3	4.120627	
8/9/2005	0.02	15	5.367469	
8/10/2005	0	3	4.139189	
8/11/2005	0.23	30	6.560172	
8/12/2005	Trace	2	6.049187	
8/13/2005	0.07	5	6.699876	
8/14/2005	0.6	35	7.937105	
8/15/2005	0.13	300	19.93711	P
8/16/2005	0	3	12.57946	S
8/17/2005	0	20	19.93711	
8/18/2005	0	2	16.5987	
8/19/2005	0	10	12.91994	
8/20/2005	0	5	5.696791	
8/21/2005	0.02	3	5.696791	
8/25/2005	0	2		

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8/26/2005	0	2		
9/1/2005	0.19	32		
9/2/2005	0	8		

Pleasure Bay

		Single Sample Results		
		@ Broadway	Geometric mean	Postings
6/16/2005	0.13	1		
6/17/2005	0.01	14		
6/23/2005	0	2		
6/24/2005	0	1		
6/30/2005		1		
7/1/2005	Trace	1		
7/2/2005	0	5		
7/3/2005	0	5		
7/4/2005	0	5	2.626528	
7/5/2005	Trace	3	3.271947	
7/6/2005	2.04	20	5.956789	
7/7/2005	0	1	4.31736	
7/8/2005	0.95	8	4.742881	
7/9/2005	0.2	3	4.282255	
7/10/2005	0	3	4.282255	
7/11/2005	0	3	2.930156	
7/12/2005	0	3	3.650186	
7/13/2005	0		3	
7/14/2005	0	18	4.695254	
7/15/2005	0	1	3.567621	
7/16/2005	0	35	6.593492	
7/17/2005	0	3	6.593492	
7/18/2005	0.03	3	5.6327	
7/19/2005	Trace	3	3.936283	
7/20/2005	0	3	4.90355	
7/21/2005	0	1	2.408225	
7/22/2005	0.15	1	1.933182	
7/23/2005	0	10	2.459509	
7/24/2005	0	5	2.72407	
7/25/2005	0	3	2.72407	
7/26/2005	0	5	3.75848	
7/27/2005	Trace	3	4.682055	
7/28/2005	0	2	3.393458	
7/29/2005	0	1	2.459509	
7/30/2005	0	3	2.459509	
7/31/2005	Trace	5	2.459509	

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8/1/2005	0.56	35	4.020109	
8/2/2005	0.01	60	7.937105	P
8/3/2005	Trace	5	10.95106	
8/4/2005	0	1	8.79087	
8/5/2005	0.55	1	6.371444	
8/6/2005	0	3	3.89806	
8/7/2005	0	3	2.141127	
8/8/2005	0	5	2.141127	
8/9/2005	0.02	3	2.667269	
8/10/2005	0	20	4.855934	
8/11/2005	0.23	2	4.477695	
8/12/2005	Trace	12	5.908354	
8/13/2005	0.07	5	5.908354	
8/14/2005	0.6	3	5.908354	
8/15/2005	0.13	230	9.629552	P
8/16/2005	0	10	13.28618	S
8/17/2005	0	3	10.06904	
8/18/2005	0	2	8.383012	
8/19/2005	0	12	11.06145	
8/20/2005	0	10	5.908354	
8/21/2005	0.02	3	4.643984	
8/25/2005	0	1		
8/26/2005	0	1		
9/1/2005	0.19	1		
9/2/2005	0	6		

**Malibu and Savin Hill Beaches**

For postings, the beach is indicated in parentheses, for example S (M+SH) is a Single Sample posting at both Malibu and Savin Hill Beaches.

Date	Inches of Rain	Single Sample Results		Postings
		Malibu Beach Bathhouse	Savin Hill Beach Bayside	
6/16/2005	0.13	22	16	
6/17/2005	0.01			
6/23/2005	0	29	21	
6/24/2005	0			
6/30/2005		1	2	
7/1/2005	Trace			
7/2/2005	0			
7/3/2005	0			
7/4/2006	0			
7/5/2006	Trace			

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7/6/2005	2.04	390	550	
7/7/2005	0	106	138	S(M+SH)
7/8/2005	0.95	114	51	S(M+SH)
7/9/2005	0.2			S*(M)
7/10/2005	0			S*(M)
7/11/2005	0			S*(M)
7/12/2005	0			S*(M)
7/13/2005	0	2	8	
7/14/2005	0			
7/15/2005	0			
7/16/2005	0			
7/17/2005	0			
7/18/2005	0.03			
7/19/2005	Trace			
7/20/2005	0	48	32	
7/21/2005	0			
7/22/2005	0.15			
7/23/2005	0			
7/24/2005	0			
7/25/2005	0			
7/26/2005	0			
7/27/2005	Trace	2	2	
7/28/2005	0	1	6	
7/29/2005	0			
7/30/2005	0			
7/31/2005	Trace			
8/1/2005	0.56			
8/2/2005	0.01			
8/3/2005	Trace	4	1	
8/4/2005	0			
8/5/2005	0.55			
8/6/2005	0			
8/7/2005	0			
8/8/2005	0			
8/9/2005	0.02			
8/10/2005	0	49	1	
8/11/2005	0.23			
8/12/2005	Trace			
8/13/2005	0.07			
8/14/2005	0.6			
8/15/2005	0.13			
8/16/2005	0			
8/17/2005	0	24	11	
8/18/2005	0			
8/19/2005	0			
8/20/2005	0			
8/21/2005	0.02	25	4	

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8/25/2005	0			
8/26/2005	0	27	10	
9/1/2005	0.19			
9/2/2005	0			

**Tenean Beach**

Date	Inches of Rain	Single Sample Results	5-day Geo. mean	Postings
		@ Middle Site		
6/16/2005	0.13	205		
6/17/2005	0.01	92		
6/23/2005	0	54		
6/24/2005	0	25		
7/1/2005	Trace	22		
7/2/2005	0	3		
7/3/2005	0	3		
7/4/2006	0	15		
7/5/2006	Trace	3	6.165603	
7/6/2005	2.04	220	9.771822	
7/7/2005	0	2200	36.5625	S
7/8/2005	0.95	360	95.25156	S
7/9/2005	0.2		151.2054	S
7/10/2005	0	15	226.1048	S*
7/11/2005	0		228.1771	
7/12/2005	0	15	43.26749	
7/13/2005	0	5	10.40042	
7/14/2005	0	57	15.91318	
7/15/2005	0	4	11.43534	
7/16/2005	0	20	12.78808	
7/17/2005	0	3	9.268538	
7/18/2005	0.03	10	10.64675	
7/19/2005	Trace	3	5.908354	
7/20/2005	0	20	8.151931	
7/21/2005	0	52	9.868591	
7/22/2005	0.15	6	11.33603	
7/23/2005	0	25	13.61599	P
7/24/2005	0	5	15.08061	
7/25/2005	0		14.05291	
7/26/2005	0	30	12.24745	
7/27/2005	Trace	10	13.91579	
7/28/2005	0	6	9.740037	
7/29/2005	0	1	6.513556	
7/30/2005	0	10	7.096668	
7/31/2005	Trace	5	4.959344	
8/1/2005	0.56	5	4.31736	
8/2/2005	0.01	175	8.476091	P
8/3/2005	Trace	10	13.4337	S

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8/4/2005	0	2	9.736472	
8/5/2005	0.55	13	11.78681	
8/6/2005	0	20	15.55279	
8/7/2005	0	1000	22.03945	
8/8/2005	0	15	23.90116	S
8/9/2005	0.02		44.43919	
8/10/2005	0	3	30.8007	
8/11/2005	0.23	4	20.59767	
8/12/2005	Trace	59	10.15152	
8/13/2005	0.07	3	6.788731	G
8/14/2005	0.6	35	9.4242	G
8/15/2005	0.13	750	28.43364	G, P
8/16/2005	0	25	41.02121	S, G
8/17/2005	0	15	31.19294	G
8/18/2005	0	37	51.5552	
8/19/2005	0	64	58.16944	
8/20/2005	0	5	21.35387	G
8/21/2005	0.02	40	23.45852	
8/25/2005	0	6		
8/26/2005	0	8		
8/31/2005				P
9/1/2005	0.19	14		P
9/2/2005	0	10		

**Wollaston Beach**

Postings may indicate a specific section of the beach with an advisory. For example, S(S) indicates a posting due to single sample exceedance at Sachem St. M, C, S, and R stand for Milton, Channing, Sachem and Rice.

Date	Inches of Rainfall	Single Sample Results				5-Day Geometric Means					Postings
		Milton St.	Channing St.	Sachem St.	Rice Rd.	Milton St.	Channing St.	Sachem St.	Rice Rd.	All	
6/16/2005	0.13	2	103	102	40						
6/17/2005	0.01	81	195	420	430						
6/18/2005											S
6/19/2005											S*
6/20/2005											S*
6/21/2005	0.00	2	2	10	16						S*
6/23/2005	0.00	10	16	46	22						
6/24/2005	0.00	6	2	1	4						
6/30/2005	0.00	57	4	5	4						
7/1/2005	Trace	22	41	16	18	10.85165	6.370958	8.187844	10.02737	8.679891	
7/2/2005	0.00	3	3	500	3	11.76831	6.909124	17.90456	7.174428	10.10932	

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7/3/2005	0.00	3	3	3	3	9.249926	4.943372	10.37137	4.816449	6.913233	S(S)
7/4/2005	0.00	3	5	10	5	8.052528	5.937605	16.43752	5.03627	7.931808	
7/5/2005	Trace	15	5	240	3	6.165603	6.208594	35.65205	4.75468	8.97519	
7/6/2005	2.04	55	15	170	5	7.405656	5.077556	57.19398	3.68011	9.432077	S(S)
7/7/2005	0.00	890	580	190	415	23.12157	14.55178	47.13104	9.863842	19.88711	S(S)
7/8/2005	0.95	165	60	71	52	51.53352	26.49245	88.74306	17.45109	38.13223	S
7/9/2005	0.20	150	460	190	690	112.6896	65.44548	159.9135	46.7518	86.17112	S(M)
7/10/2005	0.00	3	30	20	5	81.67513	93.65046	97.28567	51.78072	78.78693	S
7/11/2005	0.00	25	45	30	3	69.75981	116.6633	68.76752	46.7518	71.52046	
7/12/2005	0.00	3	210	5	95	22.34352	95.21216	33.22207	34.81236	39.60509	
7/13/2005	0.00	3	25	15	5	10.02488	79.91903	24.34407	21.79349	25.53361	S(C,S)
7/14/2005	0.00	8	19	14	2	5.578003	42.2522	14.45001	6.772718	12.32366	
7/15/2005	0.00	14	81	1	1	7.59067	51.53735	7.937105	4.908728	11.11113	
7/16/2005	0.00	5	10	3	10	5.501563	38.14869	5.007975	6.245177	9.001049	
7/17/2005	0.00	5	30	100	60	6.093346	25.84997	9.117339	5.696791	9.510504	
7/18/2005	0.03	5	3	35	3	6.748785	16.91594	10.80099	5.143521	8.924039	
7/19/2005	Trace	3	15	5	3	5.546664	16.58042	9.499802	4.701509	8.005616	
7/20/2005	0.00	5	3	45	25	4.514402	12.18962	11.54061	7.162351	8.212372	P
7/21/2005	0.00	52	19	30	6	7.21119	9.572707	20.34302	9.654894	10.79074	S(S)
7/22/2005	0.15	24	11	14	4	9.868591	9.725984	26.29763	8.287512	12.02631	
7/23/2005	0.00	30	5	155	25	14.12165	7.215089	28.29037	7.162351	11.98686	
7/24/2005	0.00	10	5	5	3	17.9664	7.856271	20.4545	7.162351	11.99169	
7/25/2005	0.00	10	30	3	3	20.63798	8.818366	18.78513	7.162351	12.50925	
7/26/2005	0.00	3	15	70	10	11.66516	11.53143	20.22065	6.147978	11.3717	
7/27/2005	Trace	5	3	10	3	8.523982	8.477694	16.83739	5.477226	9.035224	
7/28/2005	0.00	1	24	44	25	4.31736	9.654894	20.37803	7.433739	8.91423	
7/29/2005	0.00	1	8	60	1	2.72407	10.44161	17.39665	4.347277	6.810314	
7/30/2005	0.00	3	10	3	3	2.141127	11.72031	15.97683	4.347277	6.461338	
7/31/2005	Trace	5	25	3	50	2.371441	11.36952	15.97683	6.947983	7.396496	
8/1/2005	0.56	20	30	485	50	3.129135	12.76186	22.05962	9.085603	9.458505	
8/2/2005	0.01	155	20	80	320	8.580065	17.50782	31.19701	19.78602	17.45013	P,S(S)
8/3/2005	Trace	135	35	845	15	22.88534	22.08167	49.4295	32.45342	30.00606	S
8/4/2005	0.00	86	81	6	6	44.77471	33.55281	56.77958	37.27919	42.22844	S
8/5/2005	0.55	8	16	5	1	49.18773	30.68774	62.88715	17.04796	35.66679	
8/6/2005	0.00	75	70	20	2000	64.07123	36.35467	33.23683	35.65205	40.75978	
8/7/2005	0.00	30	15	10	3	46.13398	34.32199	21.92813	14.01131	26.41	S(R)
8/8/2005	0.00	5	30	20	3	23.86427	33.56067	21.59433	10.83725	20.807	
8/9/2005	0.02	10	10	120	20	15.51846	27.23658	15.59769	11.36952	16.5463	
8/10/2005	0.00	3	3	5	3	12.75425	15.72505	15.13086	10.12909	13.24098	S(S)
8/11/2005	0.23	11	171	111	2	8.688025	23.33841	25.36622	11.36952	15.55062	
8/12/2005	Trace	68	162	27	11	10.2329	26.84154	26.66724	4.776789	13.67666	S

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8/13/2005	0.07	500	600	5	450	25.70387	49.63837	23.75781	11.01078	24.03588	S(C)
8/14/2005	0.60	5	65	15	5	22.37652	56.46545	22.64557	11.98927	24.20125	S
8/15/2005	0.13	2200	1600	780	6680	83.72456	131.5637	30.93633	31.58037	57.27548	P
8/16/2005	0.00	155	190	70	45	142.1152	262.6686	48.02751	49.59437	97.10528	S
8/17/2005	0.00	5	40	105	75	84.32044	206.1827	47.58475	90.73418	93.07991	S
8/18/2005	0.00	210	116	230	12	70.88963	195.0186	68.00307	92.05958	96.45263	S
8/19/2005	0.00	43	6	33	2	109.014	90.51961	93.13634	37.32833	76.53247	S
8/20/2005	0.00	150	200	35	45	63.71125	109.168	107.2627	53.83677	79.60857	G
8/21/2005	0.02	45	60	150	90	49.74991	63.15882	81.49195	26.26173	50.92325	S,G
8/22/2005											G
8/23/2005											G*
8/24/2005											G*
8/25/2005	0.00	2	10	10	29						
8/26/2005	0.00	690	32	13	8						
8/27/2005											S(M)
8/28/2005											S*(M)
8/29/2005											S*(M)
8/30/2005											S*(M)
8/31/2005											P
9/1/2005	0.19	16	52	103	46						P
9/2/2005	0.00	1	46	18	2						

Nantasket Beach

Date	Inches of Rain	Single Sample Results			
		North Site	Water St.	Bathhouse	Park St.
6/16/2005	0.13	16	5	38	6
6/17/2005	0.01				
6/23/2005	0	4	4	4	2
6/24/2005	0				
6/30/2005		5	1	2	5
7/1/2005	Trace				
7/2/2005	0				
7/3/2005	0				
7/4/2005	0				
7/5/2005	Trace				
7/6/2005	2.04				
7/7/2005	0	4	10	75	67
7/8/2005	0.95				
7/9/2005	0.2				
7/10/2005	0				
7/11/2005	0				

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7/12/2005	0				
7/13/2005	0				
7/14/2005	0	4	12	8	2
7/15/2005	0				
7/16/2005	0				
7/17/2005	0				
7/18/2005	0.03				
7/19/2005	Trace				
7/20/2005	0				
7/21/2005	0	6	4	2	8
7/22/2005	0.15				
7/23/2005	0				
7/24/2005	0				
7/25/2005	0				
7/26/2005	0				
7/27/2005	Trace				
7/28/2005	0	2	2	5	1
7/29/2005	0				
7/30/2005	0				
7/31/2005	Trace				
8/1/2005	0.56				
8/2/2005	0.01				
8/3/2005	Trace				
8/4/2005	0	1	2	2	6
8/5/2005	0.55				
8/6/2005	0				
8/7/2005	0				
8/8/2005	0				
8/9/2005	0.02				
8/10/2005	0				
8/11/2005	0.23	2	1	4	1
8/12/2005	Trace				
8/13/2005	0.07				
8/14/2005	0.6				
8/15/2005	0.13				
8/16/2005	0				
8/17/2005	0				
8/18/2005	0	6	4	8	5
8/19/2005	0				
8/20/2005	0				
8/21/2005	0.02				
8/25/2005	0	8	11	8	5
8/26/2005	0				
9/1/2005	0.19	6	2	4	1
9/2/2005	0				