3 TRANSIENT, MILES-LONG CLUSTERS OF ELEVATED ENTEROCOCCUS ALONG MONMOUTH AND OCEAN COUNTIES, AND THE POTENTIAL ROLE OF THE HUDSON-RARITAN PLUME

Rev. 4-10-12

Recreational beach water quality monitoring for the Cooperative Coastal Monitoring Program (CCMP) occurs in 4 coastal counties in NJ every Monday (or Tuesday if Monday is a holiday). In Monmouth County, about 60 bay and ocean stations are sampled between 730-1030 AM from May through September. Ocean recreational beaches are subject to opening and closing procedures of the State Sanitary Code and must be resampled (usually on Tuesday at 3 stations, the original failure plus 2 brackets) when initial bacteria concentrations from Monday's sampling exceed the primary contact standard of 104 enterococci per 100 mL of sample (http://www.njbeaches.org/).

In 2004, enterococcus replaced fecal coliform as the indicator bacteria, because it predicts disease rates and because it survives longer in marine water.

Since 2004, there have been 3 (out of about 420) unusual sampling events where there were miles-long clusters of enterococcus exceedences from the initial sampling taken along the ocean coastline in areas both with and without local storm drains. In all 3 cases all resampling results dropped well below the standard the following day. There have been two during dry weather in Monmouth County and one during wet weather. The wet weather cluster extended 25 miles from the north end of Sandy Hook to Seaside Park in Ocean County.***

At the meeting of the NJ Water Monitoring Council on 9/22/10, the MCHD gave an overview of this third event to the group and requested that the DEP and Rutgers begin working to specifically understand what rare and ephemeral hydrodynamic conditions are able to cause the Hudson Raritan plume, directly or indirectly, to become the predominant source of elevated bacteria levels along the NJ coast.

On 1/28/11, the DEP responded that they have been working closely with Stevens Institute of Technology to develop a high-resolution model that will predict the path of floatable slicks; and that this model can also be useful for particle tracking and other water quality parameters, and may be available by the summer of 2012.

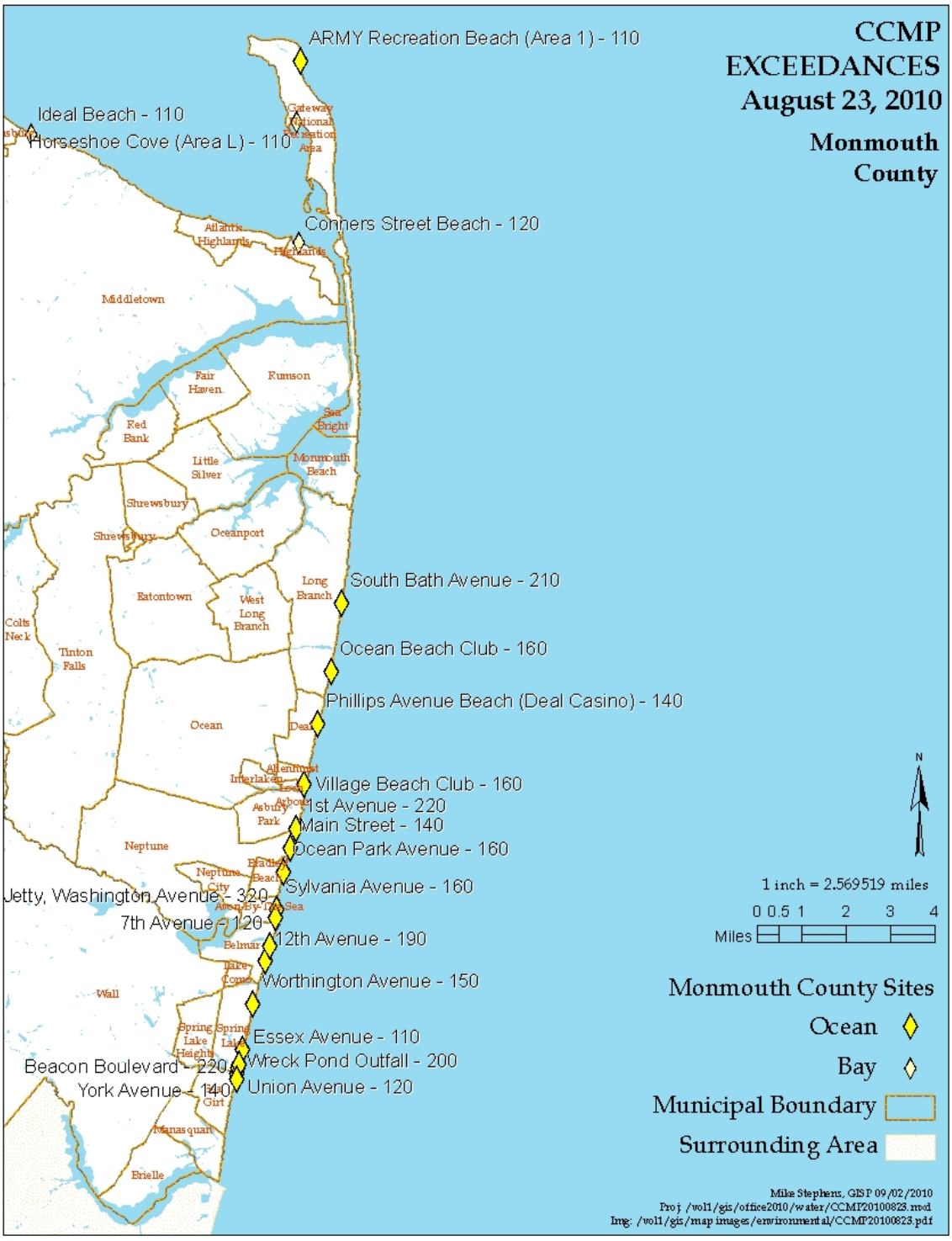
*** This report is about events when bacterial levels are higher than expected. See "Appendix B ("2011 Counterpoint: 3 Times Bacterial Levels Along The Shore Were Lower Than Expected") for 3 instances of when bacterial levels were lower during the summer of 2011.

I. 8/23/2010 (Wet Weather, 25 Ocean Exceedences in 2 Counties, 38 miles)

On 8/23/10, Monmouth County had 21 CCMP exceedences (4 in estuary, 1 outfall, 16 along the ocean) and Ocean County had 16 (9 estuary, 9 ocean). All 75 ocean resamples (3 per original failure) in both counties (as well as the 3 bay resamples at Ideal Beach in Monmouth) dropped below the standard by Tuesday morning's resampling on 8/24/10.

The 2 independent county health departments use 2 different labs: the MCHD uses Henderson Labs in Beachwood, and the OCHD uses the OC Utility Authority.

Health Departments in Monmouth posted 17 out of 18 single day advisories about the elevated bacteria on 8/23 (the National Park Service at Sandy Hook did not issue an advisory at Sandy Hook because federal policy does not allow it, and the ther sites with exceedences in Monmouth were non-bathing beaches).


CCMP
EXCEEDANCES
August 23, 2010
Monmouth
County
ARMY Recreation Beach (Area 1) - 110
Ideal Beach - 110
Horseshoe Cove (Area L) - 110
Conners Street Beach - 120
South Bath Avenue - 210
Ocean Beach Club - 160
Phillips Avenue Beach (Deal Casino) - 140
Village Beach Club - 160
1st Avenue - 220
Main Street - 140
Ocean Park Avenue - 160
Sylvania Avenue - 160
Jetty, Washington Avenue - 320
7th Avenue - 120
12th Avenue - 190
Worthington Avenue - 150
Essex Avenue - 110
Wreck Pond Outfall - 200
Beacon Boulevard - 220
York Avenue - 140
Union Avenue - 120
Middletown
Fair Haven
Rumson
Red Bank
Sea Bright
Little Silver
Monmouth Beach
Shrewsbury
Oceanport
Eatontown
West Long Branch
Long Branch
Colts Neck
Tinton Falls
Ocean
Deal
Neptune
Neptune City
Belmar
Wall
Spring Lake Heights
Spring Lake
Manasquan
Brielle
1 inch = 2.569519 miles
0 0.5 1 2 3 4
Miles
Monmouth County Sites
Ocean
Bay
Municipal Boundary
Surrounding Area
Mike Stephens, GISP 09/02/2010
Proj: /wol1/gis/office2010/water/CCMP20100823.mxd
Img: /wol1/gis/map images/environmental/CCMP20100823.pdf

The ocean exceedences started at the 2 most northern bay and ocean CCMP sites on Sandy Hook, closest to where the Hudson-Raritan Bay plume discharges into the ocean. There were no exceedences along the rest of Sandy Hook, Sea Bright, Monmouth Beach and northern Long Branch. Exceedences resumed near the storm water outfall at the South Bath Av. site in Long Branch

and continued until a few blocks south of the pier at Seaside Park in Ocean County – about 25 miles (LB-SP). There are a number of storm water outfalls in Monmouth County from Long Branch to Sea Girt, but there are no storm water outfalls past the Manasquan River and Point Pleasant Beach outfall during the last 10 miles of exceedences in Ocean County at the 8 stations between PPB and Seaside Park in Ocean County. The approximate distances are: 38 miles from Sandy Hook to Seaside Park; 12 miles from Sandy Hook to Long Branch; 25 miles from Long Branch to Seaside Park; 11.5 miles from the Manasquan River to Seaside Park; 4.5 miles from the Manasquan River to Mantoloking; 7 miles from Mantoloking to Seaside Park; 11 miles from Seaside Park to Barnegat Light.

Unusually, only 4 of the 16 bay sites in Monmouth had exceedences, compared with 16 exceedences out of the 43 ocean sites. Normally, when the ocean has this many exceedences the bay does too, when the exceedences are due to local rainfall and runoff. However, the rain in Monmouth County on Sunday was only moderate, probably less than a 6 month storm-frequency.

WX SITE INCHES OF RAIN	8/22/2010	8/23/2010	8/24/2010
	SUN	MON	TUES
KEANSBURG	0.36	0.05	0.05
HOLMDEL	0.63	0.26	0.49
OAKHURST	0.35	0.09	0.31
BRADLEY BCH	0.09	0.1	0.2
SEA GIRT	0.22	0.11	0.24
WARETOWN	0.61	0.06	0.15

Significantly, this was the first multi-day soaking storm all summer, and previous storms had been popup showers that were sporadically distributed and short lived. It had also been several weeks since the last rainfall; and we have seen the number of exceedences at the ocean increase when preceded by rainfall after an antecedent period of 1.5-2 weeks of dry weather. This is presumably due to the increase in the buildup of animal droppings during dry weather. So this rainfall may have produced runoff that was comparatively dense with bacteria because it was the first area wide storm in several weeks and because of the extended dry period that preceded it.

Note that the while Waretown rain gage across from the Barnegat Inlet had almost the highest amount of rain on Sunday, there were no exceedences at the ocean beaches near where the Inlet discharges into the ocean. Exceedences stopped a few blocks south of the Seaside Pier, about 10 miles to the north (but this is also I believe somewhere near where the CCMP sampling stations end until south of the Barnegat Inlet). Significantly, there was an exceedence in the estuary near the inlet, but since there were no exceedences at ocean beaches south of the Inlet on Long Beach Island, it is unlikely that the stormwater exiting the Inlet is the source of the exceedences at Seaside Park.

Since there are 9 sewer outfalls that discharge into the ocean from Sandy Hook to Seaside Park, DEP-Enforcement was specifically requested by the MCHD to advise if any sewer plants along the Monmouth and Ocean coastline reported bypasses or malfunctions over the weekend. That none were reported is consistent with the moderate rainfall reported locally. However, sewer plants in New York reported bypasses, as they normally do after most rain events. Combined Sewer Overflows (CSOs) in the metropolitan area (starting in Perth Amboy, 250 in NJ, and 450 in NY) also routinely discharge raw sewage, some when it rains as little as 0.1".

Northerly and northeast winds that occurred during this event cause the Hudson-Raritan plume to downwell along the beach, and pin local stormwater discharges against the shoreline. Additionally, the moderate amount of local rain may have produced a less forceful discharge that would tend to be overwhelmed by the downwelling force of the H-R plume, and so be less likely to clear out past the nearshore.

The force of the downwelling currents is evident on the Rutgers Institute of Marine and Coastal Science webpage "Rutgers University Coastal Ocean Observation Lab CODAR: Mid-Atlantic Bight - Center: Surface Currents".

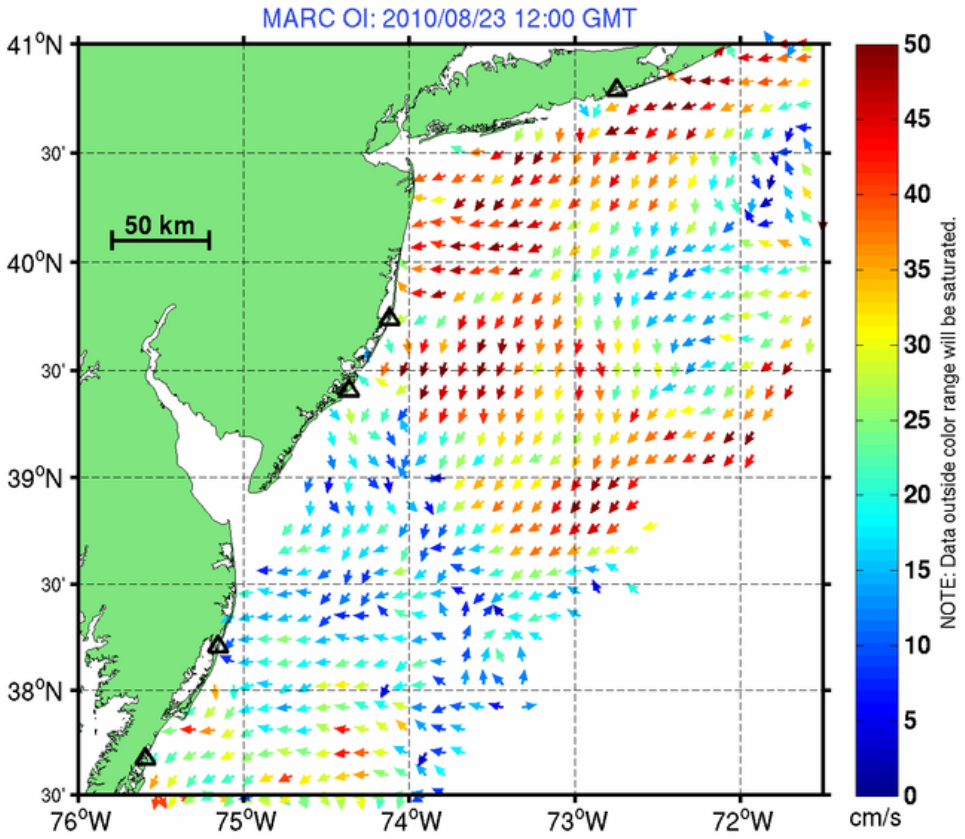
CODAR: Mid-Atlantic Bight - Center: Surface Currents

Current archived images are available between **1/1/2009** and **9/21/2010 8:00** . Images are available every hour on the hour.

Date: 08/23/2010 Hour: 12 Goto

Region: Central Region Map Type: OI Totals

<< Play | < Back | Stop | Forward > | Play >> | Faster | Slower



http://rucool.marine.rutgers.edu/index.php/CODAR-Mid-Atlantic-Bight-Center/

At 1:00 AM (5:00 GMT) on Monday 8/23/10, about an hour before low tide at Sandy Hook, current direction begins to predominate from the east and north. By the start of sampling around 8:00 AM (12 GMT), which was also the peak of high tide, the currents were driving into the Monmouth and Ocean coastline from the east and had significantly increased in velocity. It is possible that this may have contained rainfall runoff, locally and/or from the Hudson River plume, in the nearshore. Rainfall had ended locally from 10 to 18 hours earlier. The timing of the rainfall on Sunday (8/22/10) in Sea Girt was that all the rain fell between noon and 2:00 PM; and at Oakhurst, the rain fell between 2:00-3:00 and 6:40-10:00 PM (see Appendix for rain links). Sampling occurred around high tide (7:56 at Sandy Hook), and there would be a full moon 2 days later on 8/25.

As the CODAR webpage demonstrates, the velocity of the onshore currents continued through the afternoon. Around 3:00 PM (19 GMT), the predominant current direction from the east and north became mixed; it changed to being predominantly from the east and southeast around 8:00PM (0 GMT on 8/24); then changed to being predominantly from the east and northeast from 3:00 AM on 8/24/10 (7 GMT) through the time of resampling on Tuesday. In Monmouth resampling occurred from about 10:45 (14:45 GMT) to noon (1600 GMT).

The resamples all resulted in significantly lower enterococcus levels, with no coastal exceedences in either county. In Monmouth, about 40 of the 53 resamples were below the detection limit of 10 colonies. The leading edge of the 25-mile long coastline plume from Monday morning appears to have become diluted by the high-velocity currents from the east, which drove in offshore ocean water that flushed the coastline by the time resamples were taken 24 hours later on Tuesday morning.

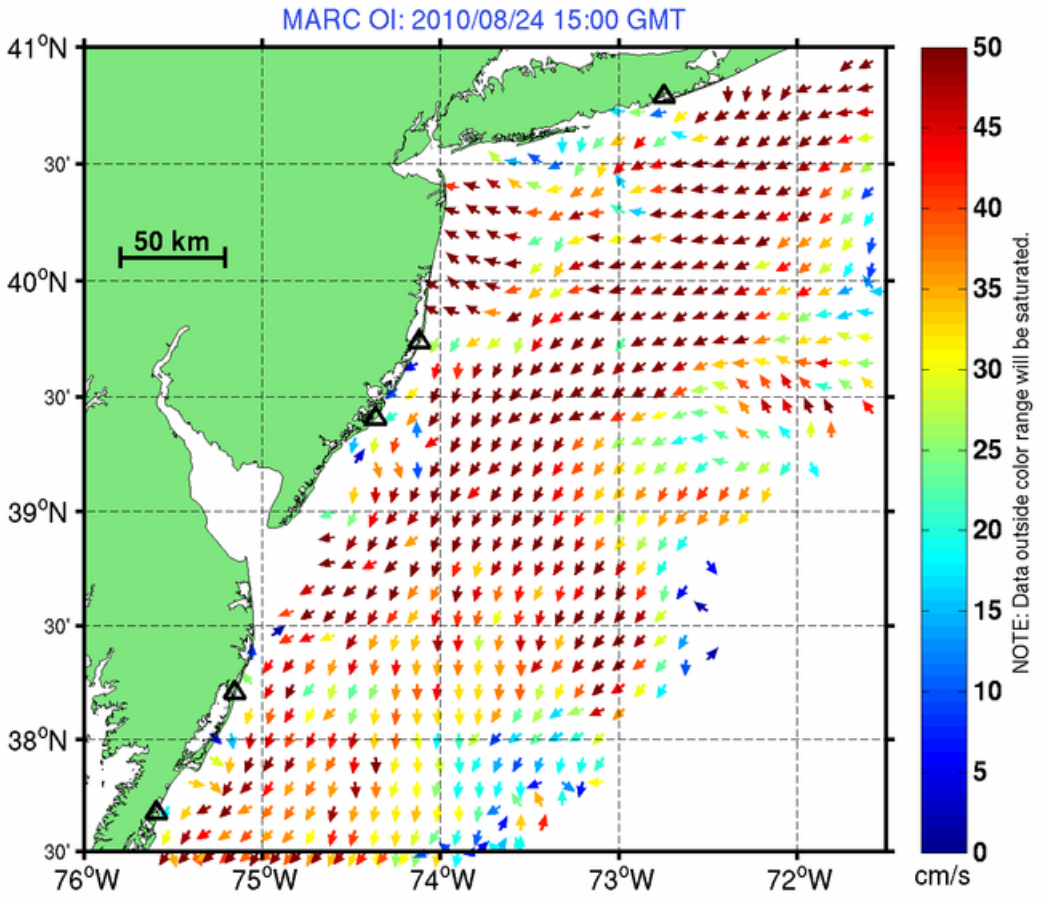
CODAR: Mid-Atlantic Bight - Center: Surface Currents

Current archived images are available between **1/1/2009** and **9/21/2010 9:00** . Images are available every hour on the hour.

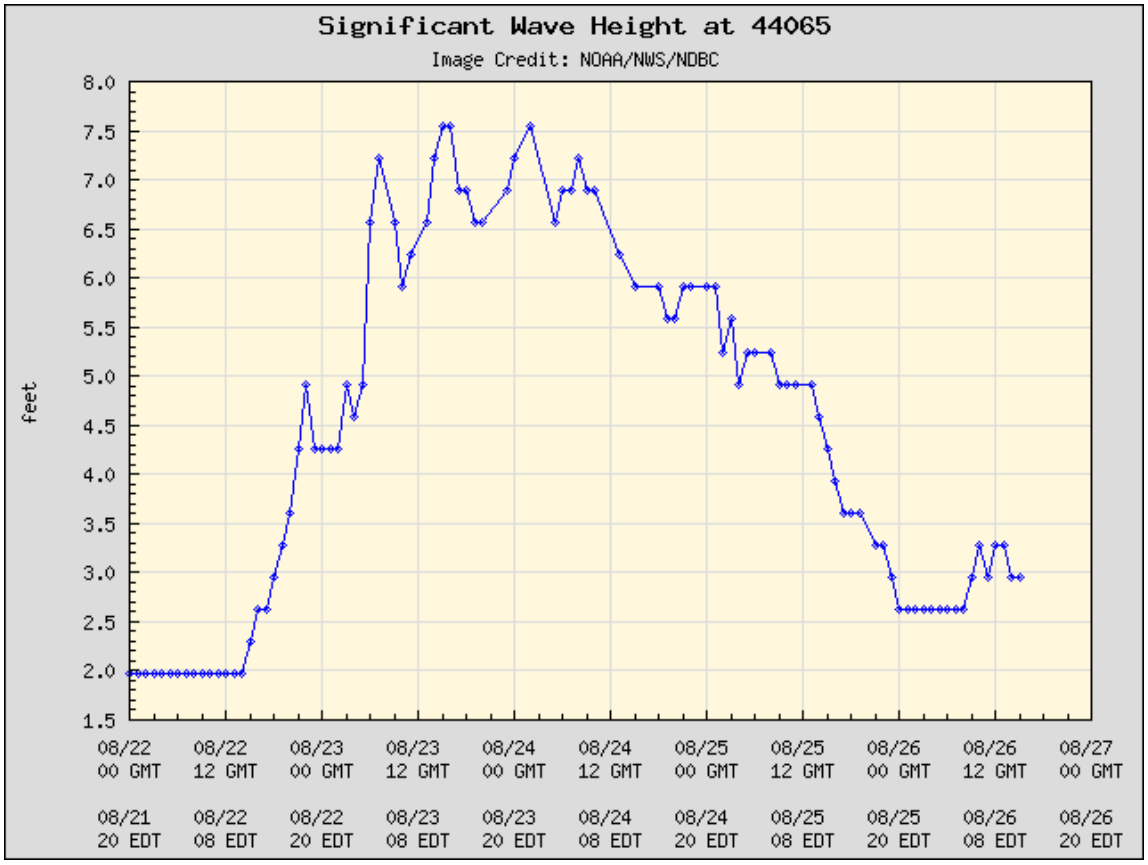
Date: 08/24/2010 Hour: 15 Goto

Region: Central Region Map Type: OI Totals

<< Play | < Back | Stop | Forward > | Play >> | Faster | Slower



Sampling occurred following high tide (7:56 at Sandy Hook); there would be a full moon 2 days later on 8/25. Large storm waves stir up the bottom and can suspend sediments from nearby storm water outfalls and resuspend the wrack line on the beach, both of which can be sources of bacteria. However this does not explain why the exceedences did not occur in other areas to the north of the south of the cluster.



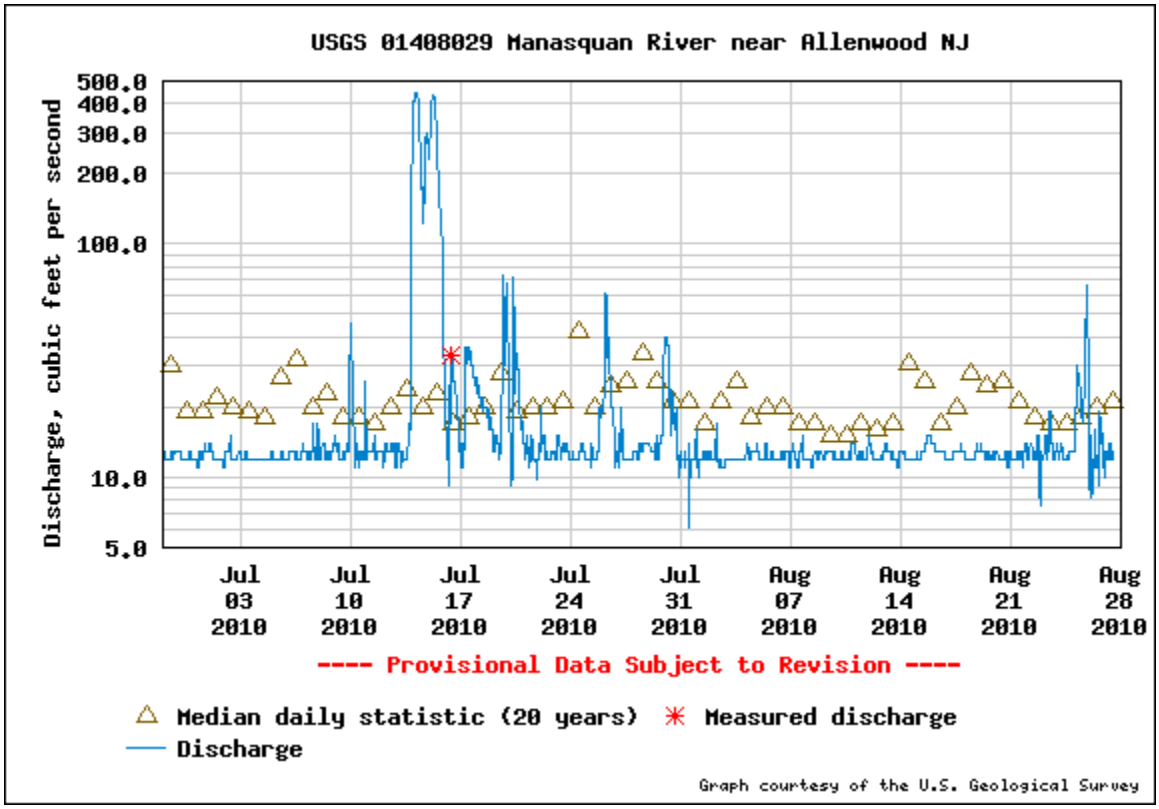
http://www.ndbc.noaa.gov/show_plot.php?station=44065&meas=sght&uom=E&time_diff=-4&time_label=EDT

The streamflow gage on the Manasquan at Allenwood for 8/22 and 8/23 indicated that the volume of the discharge was lower than previous storms within 60 days (about 20 cfs), so the rain-related discharge from the Manasquan River does not appear to be unusually large enough to account for the number of exceedences in Ocean County all the way to Seaside Park. The Shark River near Neptune City (25 cfs) was comparable to previous storms in the watershed within 60 days. In contrast, the gage on Hudson River at Poughkeepsie (the closest stream gage to NYC) shows a relatively significant storm within 60 days (35,000 cfs).

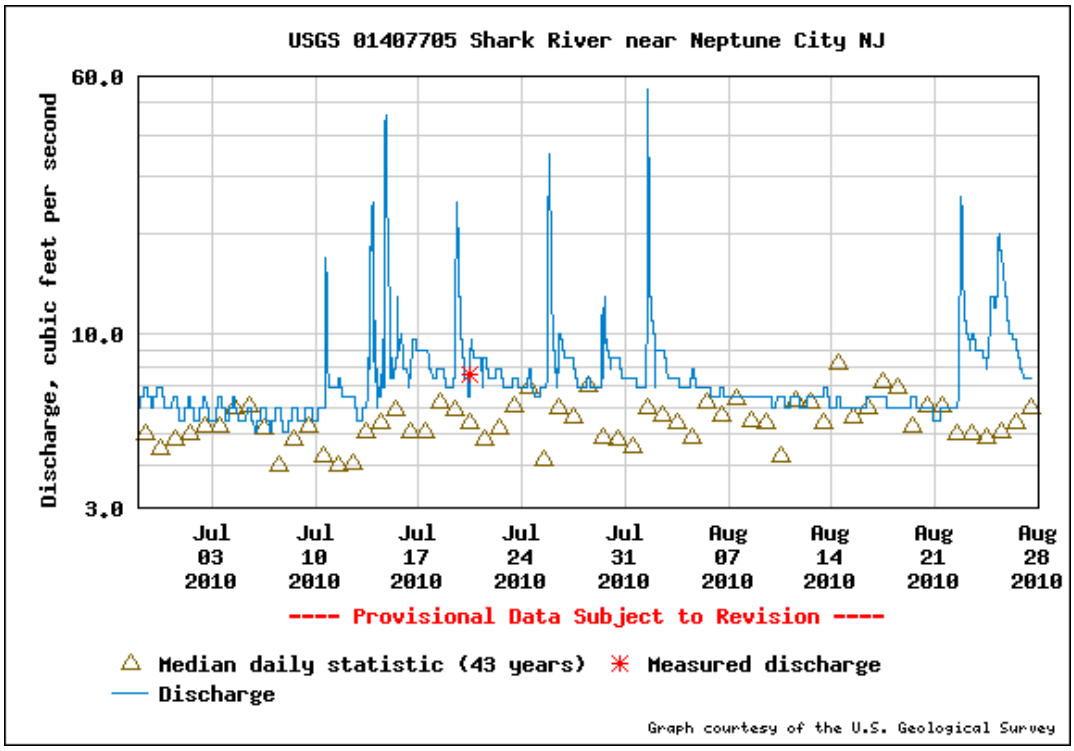
Since there are no storm drains along the ocean in Monmouth from Sandy Hook to Monmouth Beach, and the area in Monmouth with the exceedences has a number of storm drains or lake outfalls (see Appendix), it is reasonable to conclude at first that the downwelling forced locally-derived bacteria against the shoreline. What is different in the 11 mile area with the exceedences in Ocean County is that the only stormwater sources are the Manasquan River and a storm outfall in Point Pleasant Beach, and there are none for the next 10 miles of exceedences to Seaside Park.

These discharges are consistent with the rain forecast for the region:

“The heaviest rainfall will clearly fall over the Hudson Valley, the five boroughs of New York, Long Island, and Connecticut over the next three days with one to three inches of rain possible between this evening and Wednesday evening. The rest of the region will average between a half an inch and an inch of rain through Wednesday evening as the rain will be scattered and not as intense as the best lifting will be focused over the New York City metropolitan area and points north and east.”
http://www.nynjpaweather.com/2010/08/22/strong-upper-low-to-keep-northern-mid-atlantic-unsettled/



http://waterdata.usgs.gov/nwisweb/graph?agency_cd=USGS&site_no=01408029&parm_cd=00060&period=60



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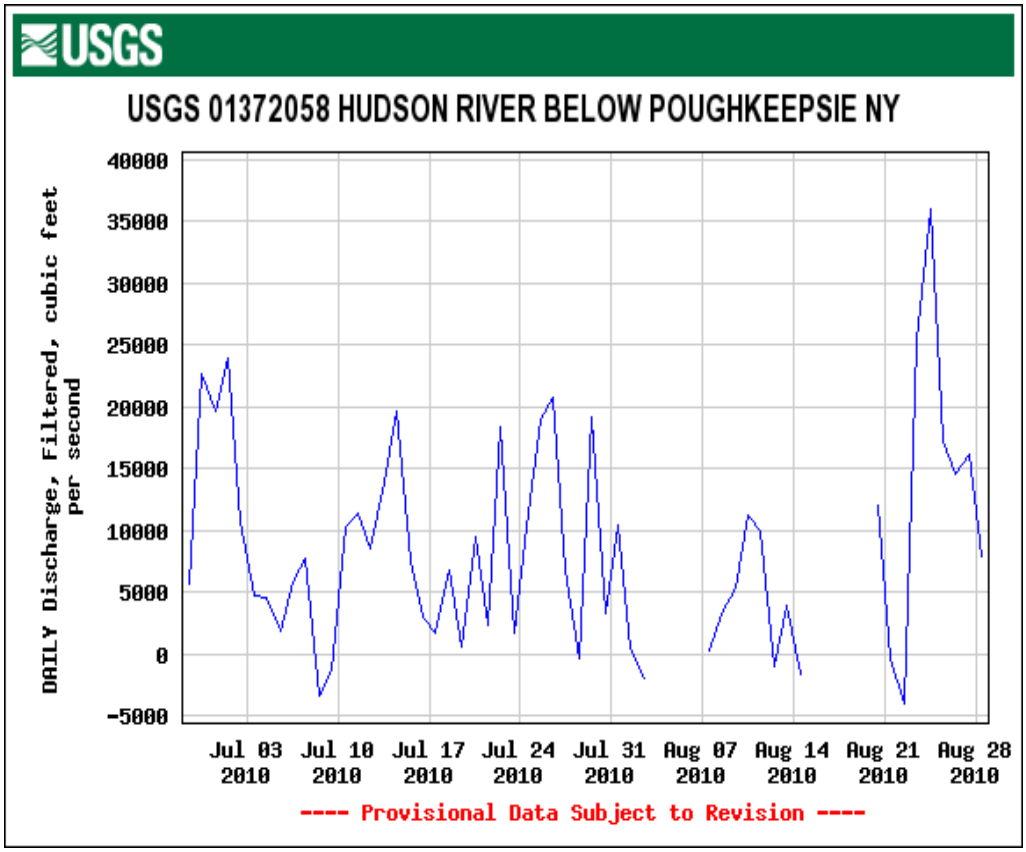


http://waterdata.usgs.gov/nwis/dv/?dd_cd=37_00060_00003&format=img_default&site_no=01372058&begin_date=20100628&end_date=20100828

See Appendix for other data.

II. 9/10/2007 (Dry Weather, 7 Ocean Exceedences in 3 miles with Storm Drains)

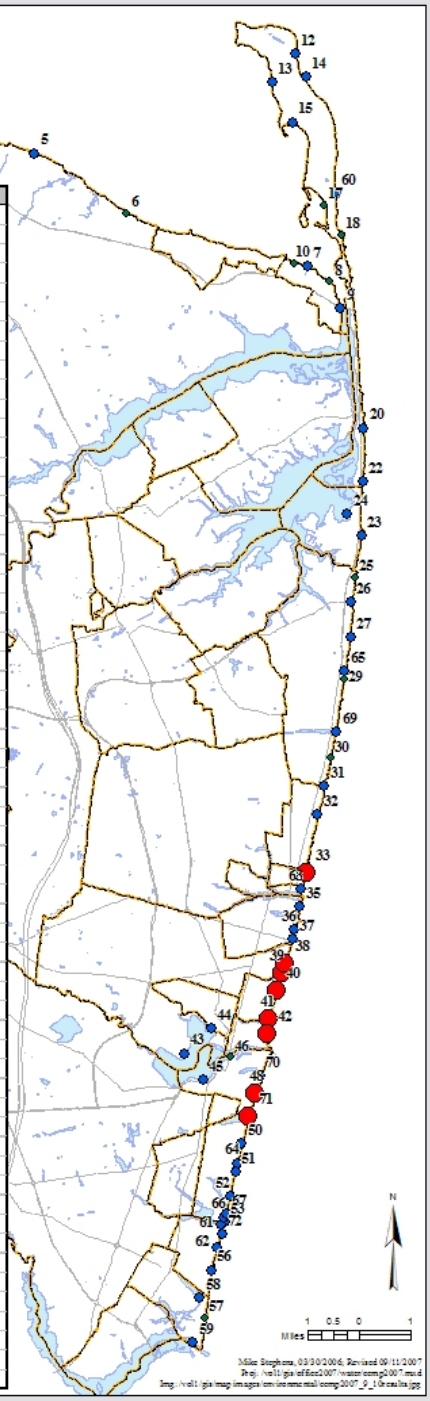
There was a dry weather plume on 9/10/07. Seven CCMP sites had elevated enterococcus, levels from Allenhurst to Belmar (from Deal lake to the north to the Shark River). The next day, the sampling results were all well below standard (the highest was 50 colonies).

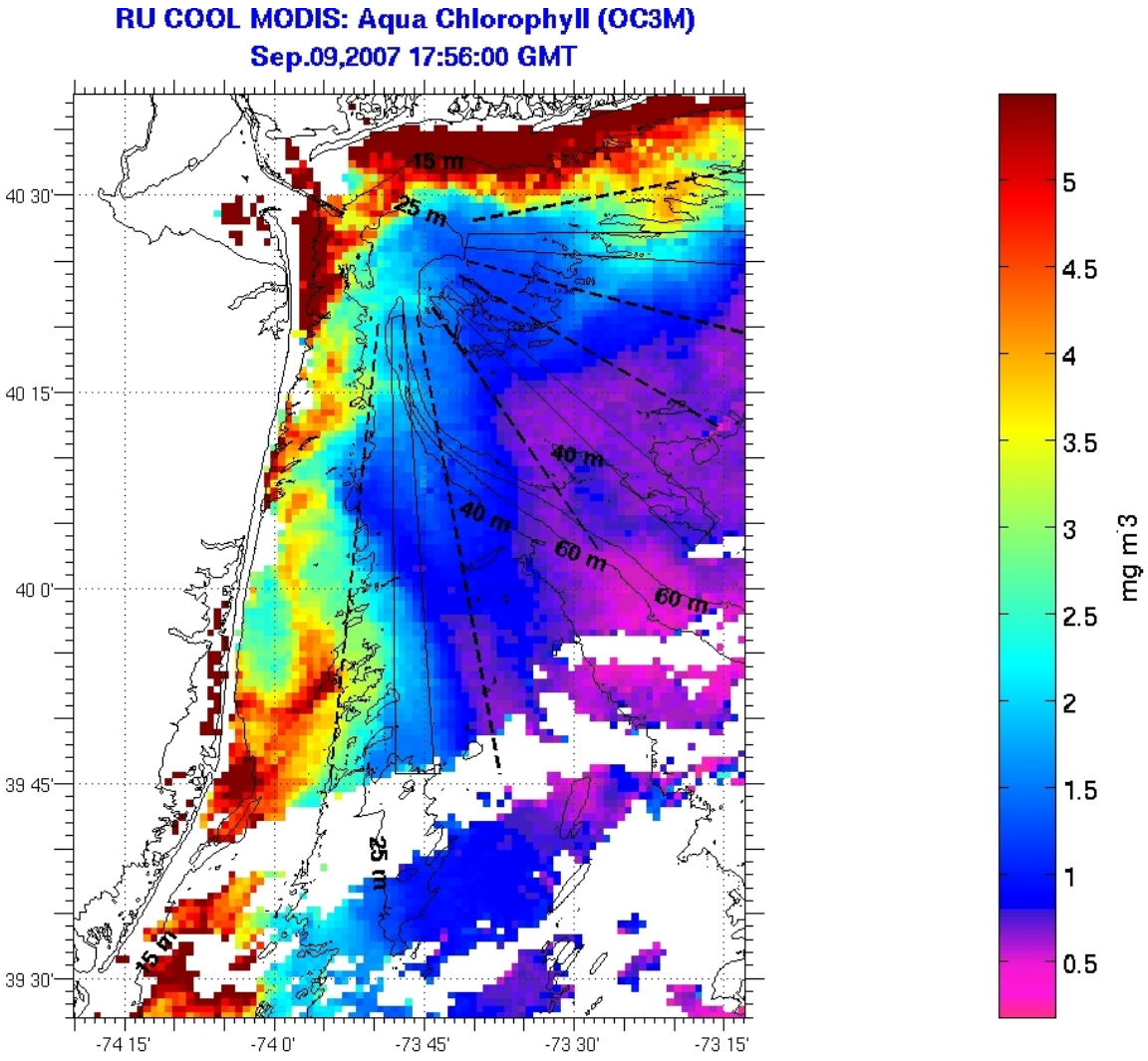
Coincident with this was a new moon, easterly winds, and larger than normal waves that may have been resuspending debris from wrack lines. These exceedences were clustered within a 3-mile area.

Josh Kohut of the Rutgers Institute of Marine and Coastal Science forwarded a Chlorophyll A map dated 9/9/10. It showed “that the Hudson River plume is moving more like a wave down the coast. You can see that the High CHl regions (orange to red) comes into contact with the beach then moves back offshore. It repeats this a couple times. Please note that these images are from Sunday (The last clear day).”

Monmouth County Health Department
CCMP 09-10-2007 Results

BOTTLE	SITE	TOWN		Result
1	BROAD STREET - NON-BATHING	KEYPORT	<	10
2	FRONT STREET - NON-BATHING	UNION BEACH		50
3	BEACHWAY & RARITAN - NON-BATHING	KEANSBURG	<	10
4	IDEAL BEACH - BATHING	MIDDLETOWN	<	10
5	PORT MONMOUTH & WILSON AVENUE - NON-BATHING	PORT MONMOUTH		10
6	THOMPSON AVENUE - BATHING	LEONARDO	<	10
7	RECREATION CENTER - BATHING	HIGHLANDS		20
8	MILLER STREET BEACH - BATHING	HIGHLANDS	<	10
9	SOUTH BAY AVENUE BEACH - BATHING	HIGHLANDS		20
10	CONNERS STREET BEACH - BATHING	HIGHLANDS	<	10
12	ARMY RECREATION BEACH - BATHING	SANDY HOOK		10
13	SANDY HOOK LIGHT - NON-BATHING	SANDY HOOK		10
14	FORT HANCOCK STP - BATHING	SANDY HOOK		10
15	HORSESHOE COVE - NON-BATHING	SANDY HOOK		20
17	SPERMACETTI COVE - NON-BATHING	SANDY HOOK	<	10
18	SURF BEACH - BATHING	SANDY HOOK	<	10
20	PUBLIC BATHING BEACH - BATHING	SEA BRIGHT		10
22	ISLAND VIEW WAY & OCEAN AVENUE - NON-BATHING	SEA BRIGHT		70
23	MONMOUTH BEACH CLUB - BATHING	MONMOUTH BEACH		30
24	WARFSIDE MANOR CONDOS, PARK AVENUE - NON-BATHING	MONMOUTH BEACH		10
25	7 PRESIDENTS PARK, ATLANTIC AVENUE - BATHING	LONG BRANCH	<	10
26	JOLINE AVENUE - BATHING	LONG BRANCH		50
27	LAIRD ST - BATHING	LONG BRANCH		60
29	SOUTH BATH AVENUE - NON-BATHING	LONG BRANCH	<	10
30	OCEAN BEACH CLUB - BATHING	LONG BRANCH	<	10
31	ELBERON BATHING CLUB - BATHING	ELBERON		20
32	DEAL CASINO - BATHING	DEAL		30
33	CEDAR AVENUE - BATHING	ALLENHURST		180
35	7TH AVENUE - BATHING	ASBURY PARK		50
36	3RD AVENUE - BATHING	ASBURY PARK		70
37	ASBURY AVENUE - BATHING	ASBURY PARK		80
38	MAIN AVE - BATHING	OCEAN GROVE		130
39	BROADWAY - BATHING	OCEAN GROVE		210
40	OCEAN PARK AVENUE - BATHING	BRADLEY BEACH		150
41	EVERGREEN AVENUE SOUTH - BATHING	BRADLEY BEACH		270
42	SYLVANIA AVENUE - BATHING	AVON		120
43	RIVERSIDE & THE PLAZA - BATHING	NEPTUNE TWP.		50
44	MYRON & WILSON AVE - NON-BATHING	NEPTUNE CITY		50
45	L STREET - BATHING (RAIN PROVISIONAL)	BELMAR		40
46	ROUTE 71 BRIDGE - NON-BATHING	BELMAR	<	10
48	12TH AVENUE - BATHING	BELMAR		320
50	WORTHINGTON AVENUE - BATHING	SPRING LAKE		70
51	WASHINGTON AVE - BATHING	SPRING LAKE		30
52	ESSEX AVENUE - BATHING	SPRING LAKE		20
53	BROWN AVENUE SOUTH - BATHING	SPRING LAKE		60
56	NEPTUNE PLACE - BATHING	SEA GIRT		60
57	EAST MAIN STREET - BATHING	MANASQUAN	<	10
58	STOCKTON LAKE - NON-BATHING			20
59	FISHERMAN'S COVE, MANASQUAN RIVER - NON-BATHING	MANASQUAN		10
60	AREA E - BATHING	SANDY HOOK		100
61	THE TERRACE - BATHING	SEA GIRT		60
62	PHILADELPHIA BOULEVARD - BATHING	SEA GIRT		30
63	VILLAGE BEACH CLUB - BATHING	LOCH ARBOR		20
64	NEWARK AVE - BATHING	SPRING LAKE		30
65	NORTH BATH AVENUE - BATHING	LONG BRANCH		20
66	YORK AVE - BATHING	SPRING LAKE		100
68	BEACON BVLD - BATHING	SEA GIRT		20
69	LAKE TAKANASEE BEACH CLUB - NON-BATHING	ELBERON		20
70	7TH AVE - BATHING	BELMAR		20
71	20TH AVE - BATHING	BELMAR		540
72	CHICAGO BVLD - BATHING	SEA GIRT		20




RU COOL MODIS: Aqua Chlorophyll (OC3M)
Sep.09,2007 17:56:00 GMT
15 m
25 m
40 m
60 m
40 30'
40 15'
40 0'
39 45'
39 30'
-74 15'
-74 0'
-73 45'
-73 30'
-73 15'
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
mg m^3

III. 6/6/2005 (Dry Weather, 6 Ocean Exceedences in 5 Miles, 2.5 Miles Without Storm Drains)

There was a dry weather plume of bacterial exceedences on 6/6/05, smaller than the one on 9/10/07, in the area where the Hudson-Raritan plume often impacts the shoreline in Monmouth County, from Sea bright to Long Branch. Resamples taken on 6-07-05 were all 10 or less than 10 colonies.

BOTTLE	ORDER FROM N TO S	ENT	STORM DRAIN	DATE	OCEAN BEACH SITE
20	1	140	N	06-Jun-05	SEA BRIGHT
22	2	960	N	06-Jun-05	ISLAND VIEW, MON BEACH
23	3	530	N	06-Jun-05	MON BEACH CLUB
25	4	200	Y	06-Jun-05	7 PRESIDENTS - ATLANTIC
26	5	50	Y	06-Jun-05	7 PRESIDENTS - JOLINE
27	6	140	Y	06-Jun-05	LAIRD AV LONG BRANCH
69	7	70	Y	06-Jun-05	LAKE TAKANASSE BEACH CLUB, LB
RESAMPLES TAKEN ON 6-07-05 WERE ALL 10 OR LESS THANN 10 COLONIES					

The most northerly 3 CCMP sites have no storm drains; the other 4 do. The area from Sea Bright to Lake Takanassee is about 5 miles long. Sites 1-3, that have no storm drains, are about 2.5 miles long.

There are no storm drains at Sandy Hook or along beaches to the south until the “7-Presidents – Atlantic” CCMP site, which is about 10.5 miles from the tip of Sandy Hook.

APPENDIX A – ADDITIONAL DATA FOR 8/23/10

RAIN WEBSITES USED

Rutgers Wx

Holmdel and Sea Girt
http://climate.rutgers.edu/njwxnet/dataviewer-stnpt.php

Weather Underground

Oakhurst - KNJOAKHU1, Oakhurst FD Station #1, Oakhurst

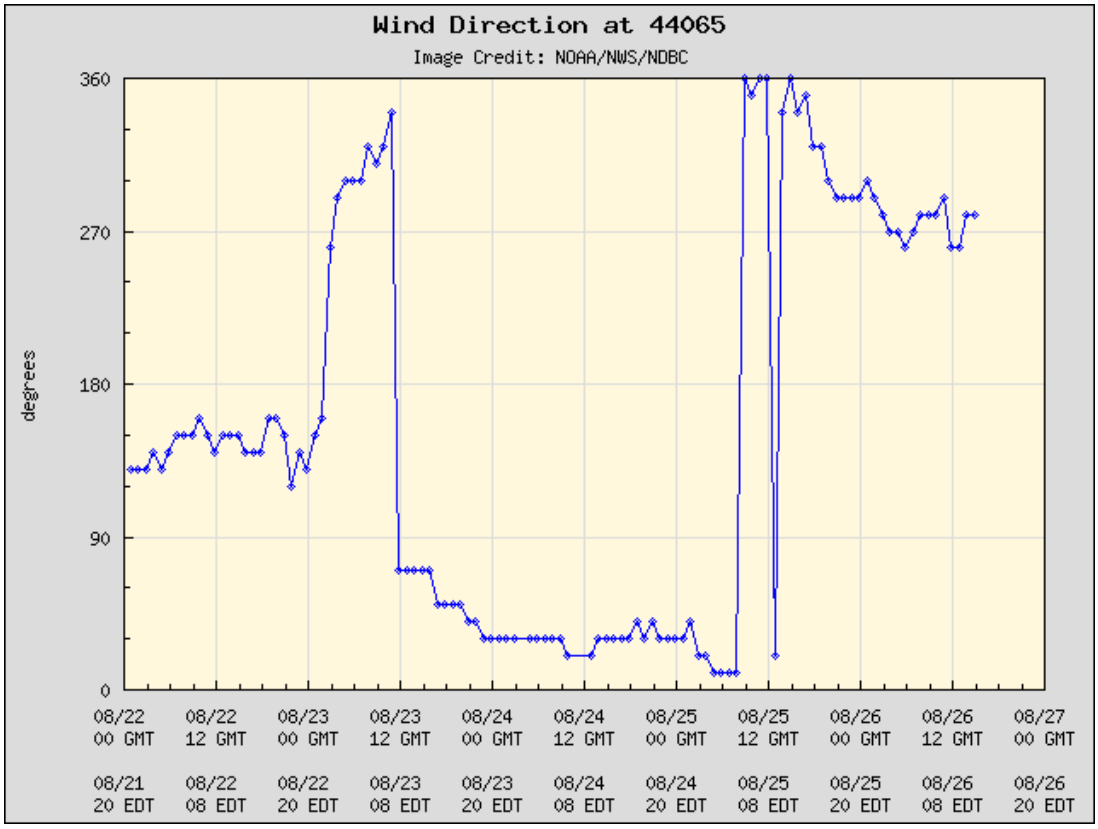
Bradley Beach - KNJBRADL1, Bradley Beach

Waretown - KNJWARET2, Oyster Creek, Waretown (across from the Barnegat Inlet)
http://www.wunderground.com/wundermap/?lat=40.29449844&lon=-73.99517822&zoom=10

USGS

Keansburg
http://waterdata.usgs.gov/nj/nwis/uv?cb_00045=on&format=gif_default&period=10&site_no=402657074085101

WIND DIRECTION



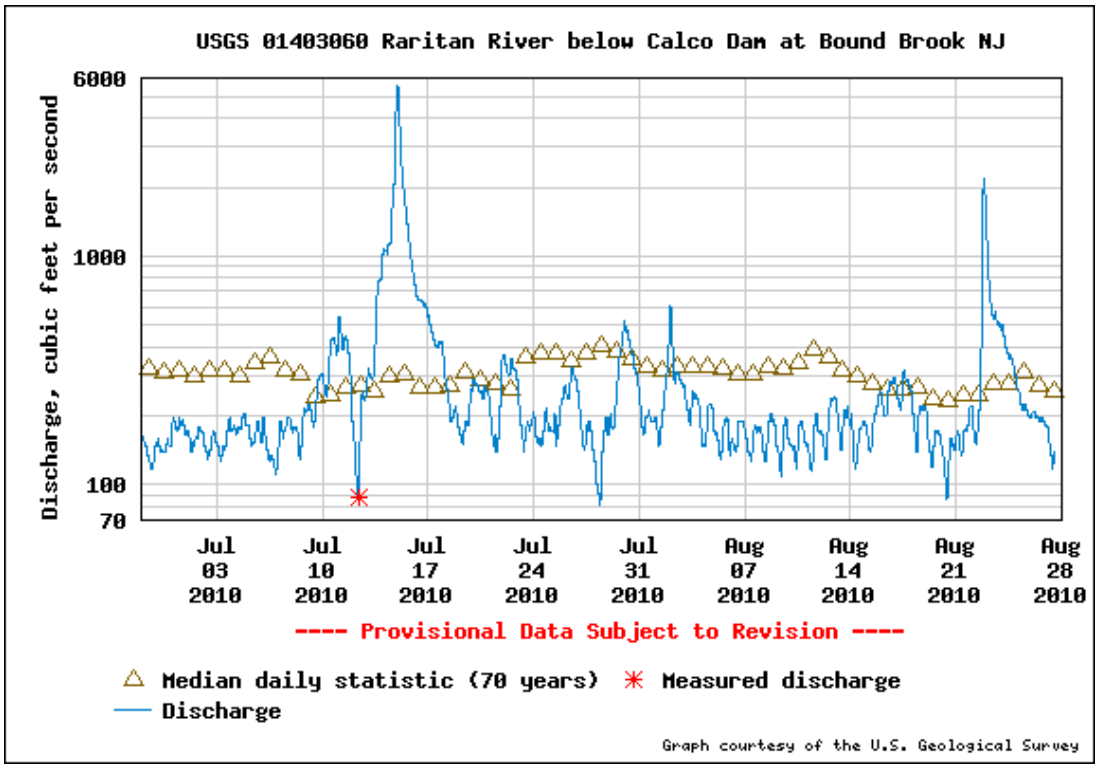
http://www.ndbc.noaa.gov/show_plot.php?station=44065&meas=wdir&uom=E&time_diff=-4&time_label=EDT

TIDES FOR SANDY HOOK STARTING WITH AUGUST 22, 2010.

Day		High /Low	Tide Time	Height Feet	Sunrise Sunset	Moon	Time	% Moon Visible
Su	22	Low	12:58 AM	0.4	6:14 AM	Set	4:11 AM	92
	22	High	7:00 AM	4.6	7:44 PM	Rise	6:34 PM	
	22	Low	1:04 PM	0.6				
	22	High	7:16 PM	5.3				
M	23	Low	1:39 AM	0.3	6:15 AM	Set	5:11 AM	97
	23	High	7:42 AM	4.8	7:42 PM	Rise	7:00 PM	
	23	Low	1:48 PM	0.5				
	23	High	7:56 PM	5.4				
Tu	24	Low	2:18 AM	0.2	6:16 AM	Set	6:11 AM	99
	24	High	8:21 AM	4.9	7:41 PM	Rise	7:24 PM	
	24	Low	2:30 PM	0.5				
	24	High	8:33 PM	5.4				

http://www.saltwatertides.com/cgi-local/newjersey.cgi

USGS STREAM GAGE RARITAN RIVER AT BOUND BROOK

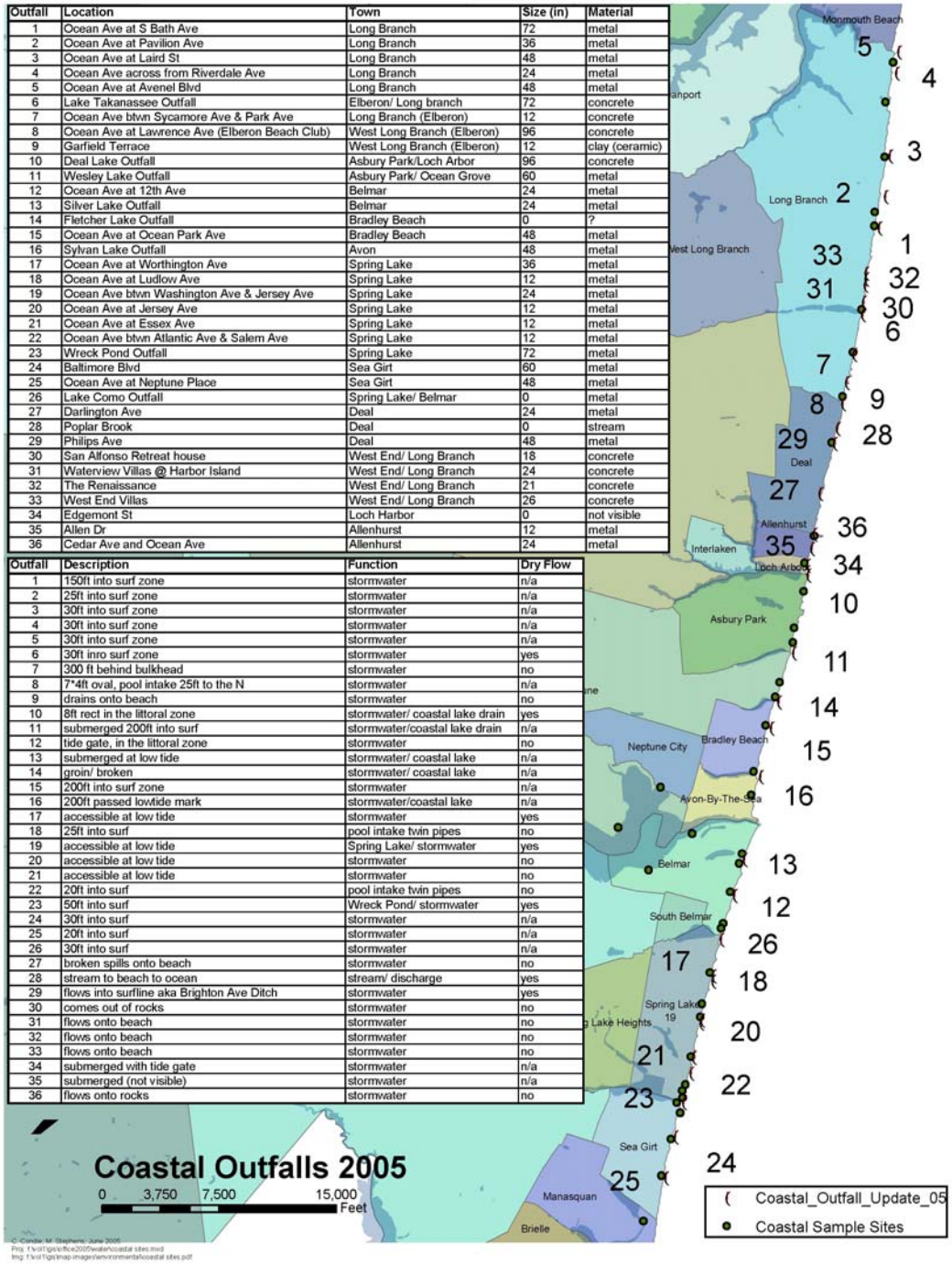


http://waterdata.usgs.gov/nwisweb/graph?agency_cd=USGS&site_no=01403060&parm_cd=00060&period=60

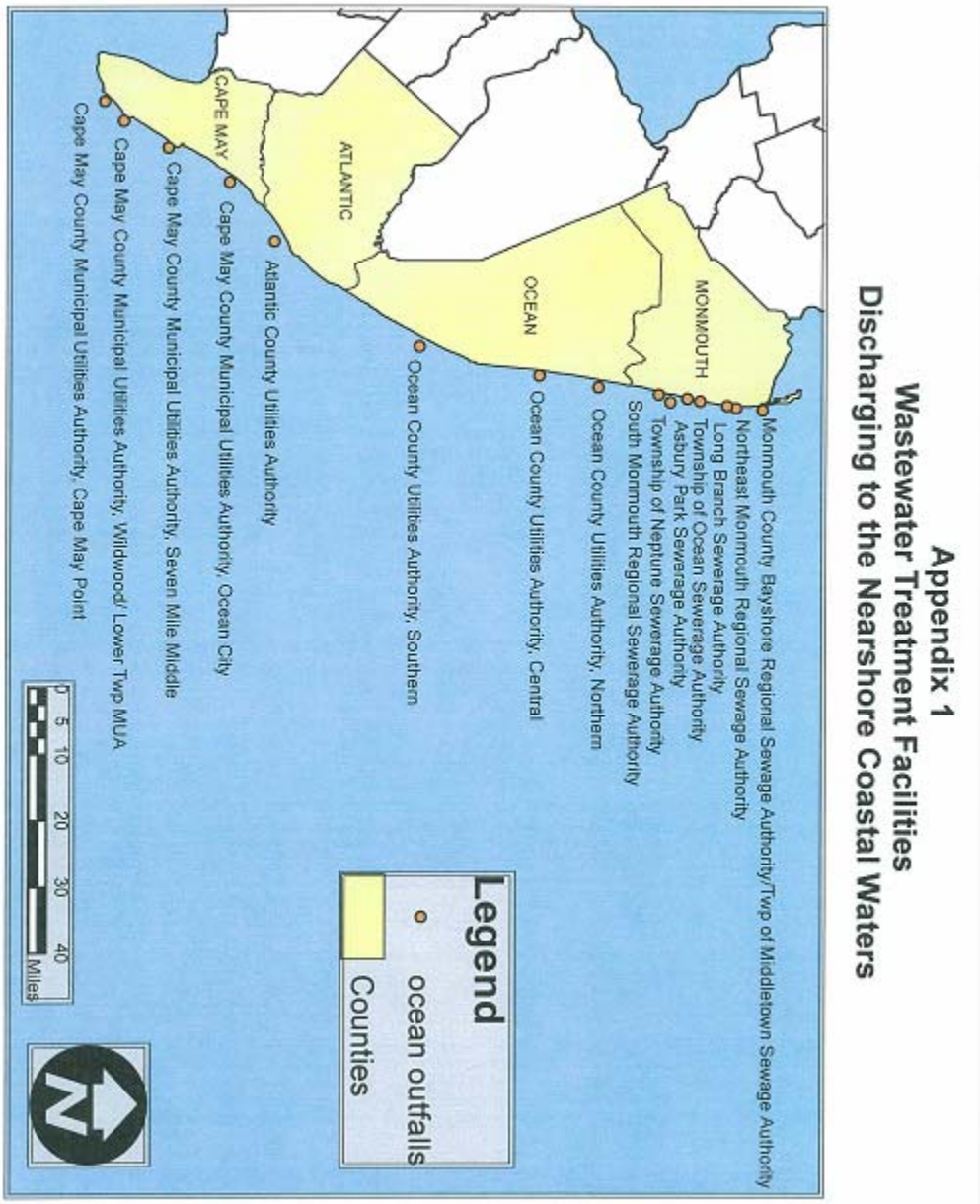
MONMOUTH STORM OUTFALLS

Outfall	Location	Town	Size (in)	Material
1	Ocean Ave at S Bath Ave	Long Branch	72	metal
2	Ocean Ave at Pavilion Ave	Long Branch	36	metal
3	Ocean Ave at Laird St	Long Branch	48	metal
4	Ocean Ave across from Riverdale Ave	Long Branch	24	metal
5	Ocean Ave at Avenel Blvd	Long Branch	48	metal
6	Lake Takanassee Outfall	Elberon/ Long branch	72	concrete
7	Ocean Ave btwn Sycamore Ave & Park Ave	Long Branch (Elberon)	12	concrete
8	Ocean Ave at Lawrence Ave (Elberon Beach Club)	West Long Branch (Elberon)	96	concrete
9	Garfield Terrace	West Long Branch (Elberon)	12	clay (ceramic)
10	Deal Lake Outfall	Asbury Park/Loch Arbor	96	concrete
11	Wesley Lake Outfall	Asbury Park/ Ocean Grove	60	metal
12	Ocean Ave at 12th Ave	Belmar	24	metal
13	Silver Lake Outfall	Belmar	24	metal
14	Fletcher Lake Outfall	Bradley Beach	0	?
15	Ocean Ave at Ocean Park Ave	Bradley Beach	48	metal
16	Sylvan Lake Outfall	Avon	48	metal
17	Ocean Ave at Worthington Ave	Spring Lake	36	metal
18	Ocean Ave at Ludlow Ave	Spring Lake	12	metal
19	Ocean Ave btwn Washington Ave & Jersey Ave	Spring Lake	24	metal
20	Ocean Ave at Jersey Ave	Spring Lake	12	metal
21	Ocean Ave at Essex Ave	Spring Lake	12	metal
22	Ocean Ave btwn Atlantic Ave & Salem Ave	Spring Lake	12	metal
23	Wreck Pond Outfall	Spring Lake	72	metal
24	Baltimore Blvd	Sea Girt	60	metal
25	Ocean Ave at Neptune Place	Sea Girt	48	metal
26	Lake Como Outfall	Spring Lake/ Belmar	0	metal
27	Darlington Ave	Deal	24	metal
28	Poplar Brook	Deal	0	stream
29	Philips Ave	Deal	48	metal
30	San Alfonso Retreat house	West End/ Long Branch	18	concrete
31	Waterview Villas @ Harbor Island	West End/ Long Branch	24	concrete
32	The Renaissance	West End/ Long Branch	21	concrete
33	West End Villas	West End/ Long Branch	26	concrete
34	Edgemont St	Loch Harbor	0	not visible
35	Allen Dr	Allenhurst	12	metal
36	Cedar Ave and Ocean Ave	Allenhurst	24	metal

Outfall	Description	Function	Dry Flow
1	150ft into surf zone	stormwater	n/a
2	25ft into surf zone	stormwater	n/a
3	30ft into surf zone	stormwater	n/a
4	30ft into surf zone	stormwater	n/a
5	30ft into surf zone	stormwater	n/a
6	30ft inro surf zone	stormwater	yes
7	300 ft behind bulkhead	stormwater	no
8	7*4ft oval, pool intake 25ft to the N	stormwater	n/a
9	drains onto beach	stormwater	no
10	8ft rect in the littoral zone	stormwater/ coastal lake drain	yes
11	submerged 200ft into surf	stormwater/coastal lake drain	n/a
12	tide gate, in the littoral zone	stormwater	no
13	submerged at low tide	stormwater/ coastal lake	n/a
14	groin/ broken	stormwater/ coastal lake	n/a
15	200ft into surf zone	stormwater	n/a
16	200ft passed lowtide mark	stormwater/coastal lake	n/a
17	accessible at low tide	stormwater	yes
18	25ft into surf	pool intake twin pipes	no
19	accessible at low tide	Spring Lake/ stormwater	yes
20	accessible at low tide	stormwater	no
21	accessible at low tide	stormwater	no
22	20ft into surf	pool intake twin pipes	no
23	50ft into surf	Wreck Pond/ stormwater	yes
24	30ft into surf	stormwater	n/a
25	20ft into surf	stormwater	n/a
26	30ft into surf	stormwater	n/a
27	broken spills onto beach	stormwater	no
28	stream to beach to ocean	stream/ discharge	yes
29	flows into surfline aka Brighton Ave Ditch	stormwater	yes
30	comes out of rocks	stormwater	no
31	flows onto beach	stormwater	no
32	flows onto beach	stormwater	no
33	flows onto beach	stormwater	no
34	submerged with tide gate	stormwater	n/a
35	submerged (not visible)	stormwater	n/a
36	flows onto rocks	stormwater	no



SEWER OUTFALLS



http://www.nj.gov/dep/wms/bmw/bathingbeach/reports/2009ccmp.pdf

APPENDIX B – 2011 COUNTERPOINT: 3 TIMES BACTERIAL LEVELS ALONG THE SHORE WERE LOWER THAN EXPECTED

During the summer of 2011 there were 3 unusual events when bacterial levels along the MC ocean shoreline were significantly lower than would be expected, based on past observations. Coincident with these 3 events were favorable hydrodynamic conditions and in 2 cases, exceptional rainfall.

The first was in July, when southerly winds and currents kept a dry-weather discharge of raw sewage in NYC - that occurred over several days and peaked at 10 million gallons per hour - from impacting ocean beaches in Monmouth. Raw sewage began bypassing into the Hudson River after a fire started at the North River Sewage Treatment Plant on 7/20/11. It wasn't until the afternoon of 7/23/11 that the plant was back online and all untreated discharges into the Hudson River had stopped. Because winds and currents were directed north during most of this event, sewage did not impact ocean beaches in Monmouth. This event demonstrates the role that winds and currents have in determining water quality at beaches. Understanding how winds and currents direct bacterial plumes in the ocean is essential to forecasting their impact on water quality in Monmouth County, since the old and failing infrastructure in the metropolitan area will more or less continue to discharge into the Hudson-Raritan Estuary as it has since the mid 19th century.

The second and third events occurred during August, which was the rainiest month in 150 years of record keeping according to the State Climatologist (the Rutgers Weather and Climate Network recorded 14.64 inches of rainfall at their Sea Girt station). On Sunday August 14, the day before beach sampling, about 4" - 7" of rain fell in Monmouth County (the highest amount was 6.91" at the Oceanic Bridge in Middletown). Normally, significant rainfall results in significant resampling, so on Tuesday morning, when Monday's sampling results would be available, 6 inspectors from various programs were assigned to resampling and posting beach advisories at the many beaches that were anticipated to fail. But there were only 2 failures out of the 60 sites that were sampled: one in the ocean at Spring Lake and the other at a bay beach in the Shark River. While winds were again from the south, this one factor by itself had never before been enough to void the effects of runoff, especially at bay beaches and ocean beaches near storm drains.

A couple of weeks later, this happened again. Hurricane Irene's rainfall in Monmouth averaged 6.30 inches over August 27th and 28th, with up to 11.27" recorded at Freehold. Beach samples were taken in the afternoon on Monday 9/29/11. Again, 6 inspectors were assigned to resampling on Tuesday, but once again there were only a few failures: 1 in the ocean at Loch Arbor, and 2 at beaches in Raritan Bay (which subsequently retained the elevated bacterial levels for several days). When Irene's eye passed over Monmouth around noon on 8/28/11, the tropical storm winds flipped from the east to the northwest,

blowing debris and storm water offshore. While there was more time between the end of the rainfall and the beginning of sampling than there was for the storm on 8/14/11, based on past experience, this still does not satisfactorily explain why there were so few failures.

Both these rain events occurred the day before coastal sampling on Monday, but with surprisingly few resamples. Both of these storms were also unique for the absence of floatables that should have been deposited along the bay and ocean shorelines after gushing from local storm drains and the 700 Combined Sewer Overflow (CSO) outfalls in NJ and NY. Since winds and currents were directed from the south or west during these events, storm water, sewage and floatables were directed away from beaches in Monmouth. But it is also reasonable to suspect that the unique volume and intensity of these storms scoured infrastructure until bacteria levels in outfalls actually started dropping due to dilution – something that has not been observed before.

In the news coverage that followed Irene, a spokesperson for NYC stated that bacterial levels rose but then began dropping in the discharges from CSOs. He explained that because there is a finite amount of sewage in any given CSO pipe, the discharges eventually became diluted with more and more rainwater, and the bacterial concentrations began to decrease.

This may also have been what happened at the MC beaches. Bacteria levels may not simply rise linearly as rain increases; with some huge amount of rainfall, bacteria levels in storm water may start to decrease due to dilution. This is similar to “sediment exhaustion” that has been observed in storm water contaminated sediment plumes: “Typically, sediment fluxes decrease through time due to sediment exhaustion effects, either during a prolonged storm event or during successive storms in quick duration; i.e. fluxes get smaller with each storm due to decreasing availability of easily mobilized and transported sediment (Taylor and Owens, 2009).

The likelihood that these 3 events would not have caused a record-breaking season for beach closures, made 2011 the luckiest summer in Monmouth County since the Coastal Cooperative Monitoring Program began mandatory beach closures in 1986. Compare this to 8/23/2010, when 0.6” of rain, which had been preceded by about 2 weeks of dry weather, fell during onshore, northeasterly winds. This one storm, a fraction of the storms in August 2011, caused 25 exceedences of the bathing standard at ocean beaches in two counties for over 38 miles, from Sandy Hook to Seaside Park.

REFERENCES

Taylor, Kevin G. and Owens, Philip N. 2009. Sediments in urban river basins: a review of sediment–contaminant dynamics in an environmental system conditioned by human activities. J Soils Sediments (2009) 9:281–303
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