May 8, 2013
Item No. 9
Supporting Document No. 5

SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD

2013 APR 26 PM 2 31

County of San Diego

RICHARD E. CROMPTON
DIRECTOR

DEPARTMENT OF PUBLIC WORKS

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April 26, 2013

Wayne Chiu, P.E.
California Regional Water Quality Control Board
San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123-4340

TENTATIVE ORDER NO. R9-2013-0001: MEETING WATER QUALITY STANDARDS FOR SAN DIEGO'S RECREATIONAL WATERS: A COST BENEFIT ANALYSIS

Dear Mr. Chiu:

The County of San Diego (County) appreciates the opportunity to comment on the following document admitted into the record for Tentative Order No. R9-2013-0001 on April 11, 2013: *Meeting Water Quality Standards for San Diego's Recreational Waters: A Cost Benefit Analysis*. This report was commissioned by the City of San Diego and written by economists from the Fermanian Business & Economic Institute (FBEI) at Point Loma Nazarene University in April 2011.

To our knowledge, the FBEI Report is the only analysis that attempts to evaluate the relationship between the benefits and costs of implementing the Total Maximum Daily Load (TMDL) for Indicator Bacteria for Beaches and Creeks. The County's position is that it is absolutely essential to consider both costs and benefits before moving forward with a regulation of this magnitude. Moreover, because the County believes the TMDL exceeds the Maximum Extent Practicable (MEP) standard that was established for stormwater in the federal Clean Water Act, it is also our opinion that a cost-benefit analysis is required under the California Water Code.

The FBEI Report's conclusions support the County's previously stated recommendations to 1) open a process to revisit the Basin Plan Amendment for this TMDL that is scientifically sound, incorporates recent and nearly completed studies, and provides a positive cost-benefit to taxpayers, and 2) re-open the TMDL <u>before</u> it is incorporated into the MS4 permit. Specifically, the FBEI report concludes that the costs to comply with the TMDL within the City of San Diego outweigh the potential benefits of its implementation by a factor of six-to-one. It would be reasonable to assume that a similar conclusion would apply throughout the County.

We note the following relevant recommendations from the FBEI Report (Section 6, pp. 27-28) for your consideration prior to adopting an MS4 permit that includes the Bacteria TMDL:

- "Scientific studies need to be conducted to more carefully document the correlation between TMDL standards and the incidence or risk of various illnesses. Alternative indicators of water quality may be necessary."
- "Data on illnesses related to swimming in San Diego City waters needs to be collected from health care providers and analyzed to better understand the scope and severity of water pollution risk in the area."
- "San Diego City residents should be polled with respect to their opinions about the current quality of the City's beaches and their willingness to pay for additional enhancements. This data needs to be analyzed to ascertain the difference in response between frequent and infrequent beachgoers."

In light of these and the other concerns we have expressed about the scientific basis and attainability of the TMDL in our written and oral comments, the County urges the Regional Board to exclude the Bacteria TMDL from the MS4 permit until these issues can be addressed in a responsible way for the taxpayers and citizens of San Diego County.

Sincerely,

CID TESORO, LUEG Program Manager
Department of Public Works

cc: David Gibson, Executive Officer
San Diego Regional Water Quality Control Board

ORANGE COUNTY
OC Public Works
Our Community. Our Commitment.

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April 26, 2013

By E-Mail

Wayne Chiu, P.E.
California Regional Water Quality Control Board, San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123-4353

Subject: Tentative Order No. R9-2013-0001: Meeting Water Quality Standards for San Diego's Recreational Waters: A Cost Benefit Analysis

Dear Mr. Chiu:

The County appreciates the opportunity to comment on the subject document that has been admitted into the record for Tentative Order No. R9-2013-0001. The Analysis provides important information to allow your Board to make better policy decisions with respect to the implications of the Tentative Order. We support the comments of the County of San Diego, which highlighted some key issues from the Analysis pertaining to the incorporation of the Total Maximum Daily Load (TMDL) for Indicator Bacteria for Beaches and Creeks into the Tentative Order.

As a consequence of the inclusion of the Analysis into the record, conforming changes should also be made in Section VI of the Fact Sheet that currently assumes that information provided in the Analysis is not available. In a number of places the Fact Sheet points to the lack of study of the economic benefits and seems to imply, contrary to the findings of the Analysis, that economic benefits of the Tentative Order will outweigh costs:

Page F-17 "Discussions of the financial and economic ramifications of municipal storm water management programs tend to focus on the significant costs incurred by municipalities in developing and implementing the programs. When considering the cost of implementing the programs, however, it is also important to consider the alternative costs that are incurred when programs are not fully implemented, as well as the economic benefits which result from effective program implementation."

Page F-19 "Economic considerations of municipal storm water management programs cannot be limited only to program costs. Evaluation of programs must also consider information on the benefits derived from environmental protection and improvement. Attention is often focused on municipal storm water management program costs, but the programs must also be viewed in terms of their value to the public."

Please contact me directly at (714) 955-0601 if you have any questions.

Sincerely,

Mary Anne Skorpanich, Manager
OC Watersheds

c: David Gibson, San Diego Regional Board
South Orange County Permittees
Orange County Technical Advisory Committee
County of San Diego
Riverside County Flood Control and Water Conservation District
City of San Diego

April 26, 2013

Via electronic mail to wchiu@waterboards.ca.gov
Mr. Wayne Chiu
California Regional Water Quality Control Board, San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123

Re: Objection to "April 2011 Meeting Water Quality Standards for San Diego's Recreational Waters, a Cost Benefit Analysis."

Dear Mr. Chiu:

The Natural Resources Defense Council, San Diego Coastkeeper, Orange County Coastkeeper, and Inland Empire Waterkeeper submit the following comments on San Diego County's request to include the document titled "April 2011 Meeting Water Quality Standards for San Diego's Recreational Waters, a Cost Benefit Analysis," ("San Diego Report") in the record for the Tentative National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds Within the San Diego Region, Tentative Order No. R9-2013-0001, NPDES Permit No. CAS0109266 ("Tentative Order").

We note that the deadline for submission of written comments on the Tentative Order passed on January 11, 2013. San Diego County has claimed that failure to include the San Diego Report in the administrative record and allow the Board to consider it would cause the County undue prejudice. However, the County has failed to demonstrate prejudice beyond this cursory assertion, and therefore its inclusion in the record is not justified. Further, the overall focus of the San Diego Report appears to primarily cover cost of programs to meet the terms of total maximum daily load ("TMDL") requirements for bacteria at San Diego beaches. Neither the TMDL nor the TMDL's waste load allocations that must be incorporated into the permit may be properly challenged through the adoption process for the Tentative Order. Therefore, the report is irrelevant to the Tentative Order's adoption.

In the event that the Regional Board accepts the San Diego Report into the record, we note the following issues regarding its claims. First, the San Diego Report states that its analysis is based on "[a]n alternative strategy . . . developed by Weston Water Solutions, Inc. for the City of San Diego in 2007 [that] features a tiered approach over 20 years . . . (referred to as 'the Strategic Plan'.)"[1] However, we were unable to locate any report detailing a 20 year approach or cost analysis at the weblink provided in the report. The City of San Diego Storm Water Division's webpage contains a 2007 report called "Strategic Plan for Watershed Activity Implementation."

[1] San Diego Report, at Executive Summary.

That document explicitly states it represents a "strategy for identifying and implementing watershed activities within the City's jurisdictional boundaries over the next ***five*** years."[2] Without the ability to review the original source data or analysis forming the basis for cost claims made in the San Diego Report, we are unable to provide full comment on the document.

Second, in the event the "Strategic Plan for Watershed Activity Implementation" does form the basis for stormwater program implementation costs claimed in the San Diego Report, the Watershed Activity Implementation document appears to include costs for practices such as street sweeping, greater than 10 percent of total claimed program costs, as part of its Watershed Permit Activities Cost Estimate and Watershed TMDL Activities Cost Estimate.[3] As the Regional Board has properly noted, "street sweeping and trash collection costs cannot be solely or even principally attributable to MS4 permit compliance, since these practices have long been expected from and implemented by municipalities."[4]

The San Diego Report also contains several unsupported assertions in its methodology for determining economic benefits of stormwater regulation, including that "in the case of beach closings in San Diego, most San Diego City residents can be expected to spend their money at other venues within the City." The San Diego Report further fails to consider indirect or non-market costs for health impacts, including people's "willingness to pay" to avoid illness, which are well documented in other studies.[5]

Given the lack of demonstrated prejudice to San Diego County, we urge the Board to reject the County's request to incorporate the San Diego Report into the record. If the Board accepts the report, we request that the Regional Board additionally accept the attached documents, to the extent they are not contained in the record already, which detail public health costs and economic impacts of beach tourism in California and directly relate to the subject of the San Diego Report.

Respectfully Submitted,

Noah Garrison
Project Attorney
Natural Resources Defense Council

Jill Witkowski
Waterkeeper
San Diego Coastkeeper

[2] City of San Diego, 2007, Strategic Plan for Watershed Activity Implementation, at Overview-1 (emphasis added).
[3] *Id*., at Appendix C, Appendix D.
[4] Tentative Order Fact Sheet, at F-19.
[5] See, e.g., Given, s., Pendleton, L.H., and Boehm, A.B., 2006, Regional Public Health Cost Estimates of Contaminated Coastal Waters: A Case Study of Gastroenteritis at Southern California Beaches, Environ. Sci. Technol, 40 (16), 4851-58.

Colin Kelly
Staff Attorney
Orange County Coastkeeper
Inland Empire Waterkeeper

Enclosures:

Given, S. Pendleton, L. Boehm, A. “Regional Public Health Cost Estimates of Contaminated Coastal Waters: A Case Study of Gastroenteritis at Southern California Beaches” *Environ. Sci. Technol.*, 2006, 40 (16), pp. 4851-485815 July 2006

Lew, D., Larson, D. “Valuing Recreation and Amenities at San Diego County Beaches” *Coastal Management*, 33:71–86, 2005

Hanemann, M. Pendleton, L.Mohn, C. “Welfare Estimates for Five Scenarios of Water Quality Change in Southern California” *Southern California Beach Valuation Project*, 2005

Pendleton, L. “Harnessing Ocean Observing Technologies to Improve Beach Management: Examining the Potential Economic Benefits of An Improvement in the Southern California Coastal Ocean Observing System” *University of California, Los Angeles*, 2004

Haile, R. Witte, J. et. al. “The Health Effects of Swimming in Ocean Water Contaminated by Storm Drain Runoff” *Epidemiology*, Vol. 10, No. 4. pp. 355-363. July 1999

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Environ. Sci. Technol. **2006**, *40,* 4851−4858

Regional Public Health Cost Estimates of Contaminated Coastal Waters: A Case Study of Gastroenteritis at Southern California Beaches

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We present estimates of annual public health impacts, both illnesses and cost of illness, attributable to excess gastrointestinal illnesses caused by swimming in contaminated coastal waters at beaches in southern California. Beach-specific enterococci densities are used as inputs to two epidemiological dose−response models to predict the risk of gastrointestinal illness at 28 beaches spanning 160 km of coastline in Los Angeles and Orange Counties. We use attendance data along with the health cost of gastrointestinal illness to estimate the number of illnesses among swimmers and their likely economic impact. We estimate that between 627,800 and 1,479,200 excess gastrointestinal illnesses occur at beaches in Los Angeles and Orange Counties each year. Using a conservative health cost of gastroenteritis, this corresponds to an annual economic loss of $21 or $51 million depending upon the underlying epidemiological model used (in year 2000 dollars). Results demonstrate that improving coastal water quality could result in a reduction of gastrointestinal illnesses locally and a concurrent savings in expenditures on related health care costs.

Introduction

Each year between 150 million and nearly 400 million visits are made to California (CA) beaches generating billions of dollars in expenditures, by tourists and local swimmers, and nonmarket values enjoyed mostly by local area residents (*1*, *2*). Nonmarket benefits represent the value society places on resources, such as beaches, beyond what people have to pay to enjoy these resources (see Pendleton and Kildow (*1*) for a review of the nonmarket value of CA beaches). In an effort to protect the health of beach swimmers, the CA State Legislature passed Assembly Bill 411 (AB411) in 1997 with formal guidance and regulations for beach water quality which are formally codified as a state statute (*3*). AB411 requires monitoring of bathing waters for fecal indicator bacteria (FIB, including total coliform (TC), fecal coliform (FC), and enterococcci (ENT)) on at least a weekly basis during the dry season (1 April through 31 October) if the beach is visited by over 50,000 people annually or is located adjacent to a flowing storm drain. Beaches can be posted with health warnings if single-sample or geometric mean standards for TC, FC, and ENT exceed prescribed levels (see Supporting Information (SI) for standards).

Based on AB411 water quality criteria and their professional judgment, CA county health officials posted or closed beaches 3,985 days during 2004 (*4*). Sixty percent (2,408 beach-days) of these occurred at Los Angeles and Orange County (LAOC) beaches (*4*), and nearly all (93%) of the LAOC advisories and closures were caused by unknown sources of FIB. The number of beach closures and advisories in CA (and the country as a whole) rises each year as counties monitor more beaches (*4*). Needless to say, public awareness of coastal contamination issues is growing, and in some cases strongly influencing the development of programs to improve coastal water quality. For example, public pressure on the Orange County Sanitation District (OCSD) prevented them from reapplying for a waiver from the USEPA to release partially treated sewage to the coastal ocean. Instead, OCSD plans to implement a costly upgrade to their sewage treatment plant. New stormwater permits issued by CA Regional Water Boards require counties and municipalities to implement prevention and control programs to meet coastal water quality criteria. The cost of such mitigation measures is difficult to determine, yet cost has been used as an argument in court challenges to the permits (*4*). In 2004 elections, voters in the city of Los Angeles approved a measure to spend $500 million on stormwater mitigation (*5*).

To understand the potential public health benefits of cleaning up coastal waters, we need a better idea of the magnitude of health costs associated with illnesses that are due to coastal water contamination. Several previous studies address the potential economic impacts of swimming-related illnesses. Rabinovici et al. (*6*) and Hou et al. (*7*) focused on the economic and policy implications of varying beach closure and advisory policies at Lake Michigan and Huntington Beach, CA, respectively. Dwight et al. (*8*) estimated the per case medical costs associated with illnesses at two beaches in southern California and used this to make estimates of public health costs at two Orange County beaches. Our study is novel in that it provides the first regional estimates of the public health costs of coastal water quality impairment.

While many different illnesses are associated with swimming in contaminated marine waters, we focus our analysis on gastrointestinal illness (GI) because this is the most frequent adverse health outcome associated with exposure to FIB in coastal waters (*9*, *10*). We estimate daily excess GI based on attendance data, beach-specific water quality monitoring data, and two separate epidemiological models developed by Kay et al. (*11*) and Cabelli et al. (*12*) that model GI based on exposure to fecal streptococci and ENT, respectively. Finally, we provide estimates of the potential annual economic impact of GI associated with swimming at study beaches.

We conduct our analysis using data from 28 LAOC beaches during the year 2000. Together, these beaches span 160 km of coastline (Figure 1, Table S1). We limit our analysis to these beaches and the year 2000 in particular because we were able to obtain relatively complete daily and weekly attendance and water quality data for these beaches during

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[†] University of California, Los Angeles.
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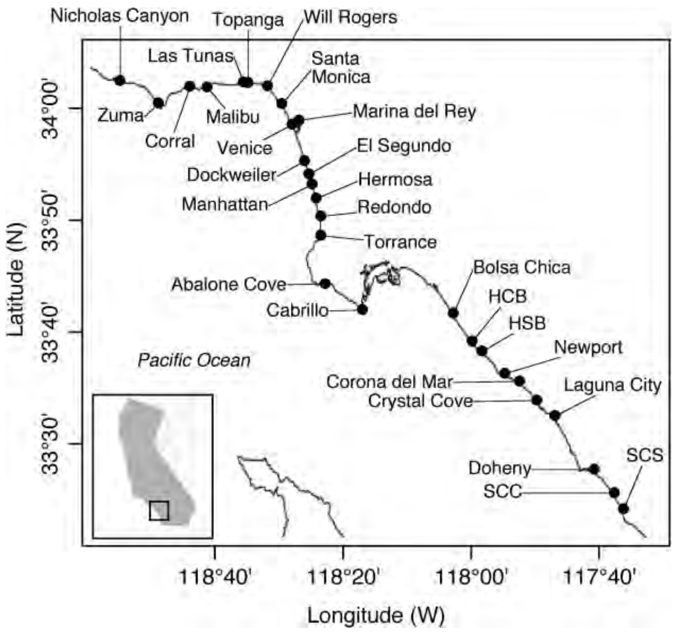

FIGURE 1. The 28 beaches considered in this study. HSB = Huntington State Beach, HCB= Huntington City Beach, SCC = San Clemente City Beach, and SCS = San Clemente State Beach.

this year. The 28 beaches represent a large, but incomplete, subset of the total beach shoreline in LAOC. Large stretches of relatively inaccessible beaches (e.g., portions of Laguna Beach, much of Malibu, and Broad Beach) were omitted from the analysis as were several large public beaches (e.g., Seal Beach and Long Beach) because of paucity of attendance and/or water quality data. The 1999−2000 and 2000−2001 winter rainy seasons were typical for southern CA (*13*), so 2000 was not particularly unique with respect to rainfall. A comparison of inter-annual water quality at a subset of beaches suggests that pollution levels in 2000 were moderate (data not shown). Thus, the estimates we provide can be viewed as typical for the region.

Methods

Number of Swimmers. Morton and Pendleton (*2*) compiled daily attendance data from lifeguards' records and beach management agencies. When data were missing, attendance was estimated using corresponding monthly median weekday or weekend values from previous years. (Table S1 shows the number of days in 2000 when data are available—for most beaches, this number approaches 366.) Because these data are based on actual counts, we do not need to factor in effects due to the issuance of advisories at a particular beach. Only a fraction of beach visitors enter the water. This fraction varies by month in southern CA from 9.56 to 43.62% (Table S2) (*14*). We applied the appropriate fraction to the attendance data to determine the number of individual swimmers exposed to coastal waters. Although research suggests the presence of FIB in sand in the study area (*15*, *16*), we do not consider the potential health risk that may arise from sand exposure because it has not been evaluated.

Water Quality Data. ENT data were obtained from the local monitoring agencies and are publicly available. Local monitoring agencies sample coastal waters at ankle depth in the early morning in sterile containers. Samples are returned to the lab and analyzed for ENT using USEPA methods. When ENT values are reported as being below or above the detection limit of the ENT assay, we assume that ENT densities were equal to the detection limit.

During 2000, monitoring rarely occurred on a daily basis; ENT densities were measured 14−100% of the 366 days in 2000, depending on monitoring site (Table S1). For example, Zuma beach was monitored once per week during the study period, while Cabrillo beach was monitored daily. To estimate ENT densities on unsampled days, we used a Monte Carlo technique. Normalized cumulative frequency distributions of observed ENT densities at each monitoring site were constructed for the 1999−2000 wet season (Nov 1, 1999 through Mar 31, 2000), 2000 dry season (April 1, 2000 through Oct 31, 2000), and the 2000−2001 wet season (Nov 1, 2000 through Mar 31, 2001). ENT densities on unsampled days during 2000 were estimated by randomly sampling from the appropriate seasonal distribution. Because day-to-day ENT concentrations at marine beaches are weakly correlated and variable (*17*), we chose not to follow the estimation method of Turbow et al. (*18*) who assumed a linear relationship between day-to-day ENT densities at two CA beaches. Comparisons between the Monte Carlo method and a method that simply used the monthly arithmetic average ENT density indicated the two provided similar results (data not shown).

The beaches in our study area (Figure 1) are of variable sizes; each beach may include 1−7 monitoring sites (Table S1). If more than one monitoring site exists within the boundaries of a beach, the arithmetic mean of ENT at the sites was used as a single estimate for ENT concentrations within the beach (*19*). There is considerable evidence that ENT densities at a beach vary rapidly over as little as 10 minutes (*17*, *20*). Therefore, even though we used up to 7 measurements or estimates to determine ENT at a beach on a given day, there is still uncertainty associated with our estimate because sampling is conducted at a single time each day.

Dose−Response. Of all the illnesses considered in the literature, GI is most commonly associated with exposure to polluted water (*10*−*12*, *21*−*26*). To estimate the risk of GI

TABLE 1. Dose−Response Models for Predicting GI[a]

name	original model	model converted to excess risk
model C (*12*)	$1000(P - P_o) = 24.2\ \log_{10}(\text{ENT}) - 5.1$	$(P - P_0) = (24.2\ \log_{10}(\text{ENT}) - 5.1)/1000$
model K (*11*)	$X = \text{Ln}(P/(1 - P)) = 0.201\ (\text{FS} - 32)^{1/2} - 2.36$	$(P - P_0) = (e^X/(1 + e^X)) - P_0$

[a] ENT = enterococci, FS = fecal streptococci. Both ENT and FS are in units of CFU or MPN per 100 mL water. P is the risk of GI for swimmers, P_0 is the background risk of GI.

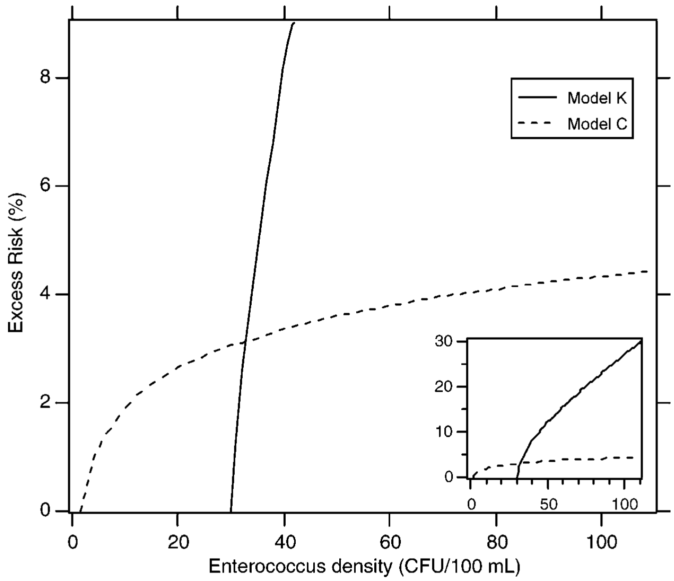

FIGURE 2. Dose−response relationships for the two epidemiological models. Excess risk of GI is shown as a function of ENT density. The inset more clearly shows the differences between the relationship for the randomized trial study (model K (*11*)) and the cohort study (model C (*12*)).

from swimming in contaminated marine waters in southern CA, we utilized two dose−response models (*11*, *12*) (Table 1) developed in epidemiology studies conducted elsewhere (in marine waters of the East U.S. coast and United Kingdom) (*18*, *27*). A local dose−response model for GI would be preferable, but does not exist. Haile et al. (*28*) conducted an epidemiology study at Los Angeles beaches and found that skin rash, eye and ear infections, significant respiratory disease, and GI were associated with swimming in waters with elevated FIB or near storm drains; however, they did not report dose−response models for illness and bacterial densities.

The two dose−response models (hereafter referred to as models C (*12*) and K (*11*)) are fundamentally different in that model C was derived from a prospective cohort study while model K was developed using a randomized trial study. Model C has been scrutinized in the literature (*20, 26, 29−31*). Among the criticisms are lack of ENT measurement precision and inappropriate pooling of data from marine and brackish waters. World Health Organization (WHO) experts (*10*) suggest that epidemiology studies that apply a randomized trial design, such as model K, offer a more precise dose−response relationship because they allow for better control over confounding variables and exposure (*26*). Thus, the WHO has embraced model K over cohort studies such as model C for assessing risk. We report GI estimates obtained from both models C and K in our study because they have both been applied in the literature (*8*, *18*), and form the basis for water quality criteria worldwide.

Models C and K were developed in waters suspected to be polluted with wastewater. The source of pollution at our study site during the dry season is largely unknown (*4*), although human viruses have been identified in LAOC coastal creeks and rivers (*32−36*) and an ENT source tracking study at one beach suggests sewage is a source (*37*). During the wet season, stormwater is a major source of FIB to coastal waters and Ahn et al. (*38*) detected human viruses in LAOC stormwater. Because we cannot confirm that all the ENT at our study site was from wastewater, there may be errors associated with the application of models C and K. In addition, there is evidence that dose−response relationships may be site specific (*30*). The results presented in our study should be interpreted in light of these limitations.

We converted incidence and odds, the dependent variables reported for model C and K, respectively, into risk of GI (P) (Table 1). P represents total risk of GI to the swimmer, and includes risk due to water exposure plus the background GI rate (P_0). Excess risk was calculated by subtracting the background risk from risk ($P - P_0$). While ENT is the independent variable for model C, model K requires fecal streptococci (FS), the larger bacterial group of which ENT are a subset, as the independent variable. We assumed that FS and ENT represent the same bacteria, following guidance from the WHO (*9*).

Models C and K provide different functional relationships between ENT and excess GI risk (Figure 2). Model C predicts relatively low, constant risks across moderate to high ENT densities relative to model K. At ENT less than 32 CFU/100 mL, model K predicts no excess risk; model C, however, does predict nonzero risks even at these low levels of contamination. The data range upon which each model was built varies considerably. Model C is based on measurements ranging

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from 1.2−711 CFU/100 mL and model K is based on measurements from 0−35 to 158 CFU/100 mL. We extrapolated models C and K when ENT densities were outside the epidemiology study data ranges. Given the lack of epidemiological data on illness outside the ranges, extrapolation of the models represents a reasonable method of estimating excess GI.

Excess Illness Due To Swimming. The excess incidence of GI on day *i* at beach *j* ($GI_{i,j}$) is given by the following expression:

$$GI_{i,j} = A_{i,j} f_i (P_{i,j} - P_o) \qquad (1)$$

$P_{i,j} - P_o$ is the excess risk of GI on day *i* at beach *j* as estimated from models C or K (Table 1), $A_{i,j}$ is the number of beach visitors, and f_i is the fraction of swimmers on day *i* (*14*). We assume P_0 is 0.06—the background risk for stomach pain as reported by Haile et al. (*28*) for beaches within Santa Monica Bay, CA. Daily values were summed across the year or season to estimate the number of excess GI per beach. Seasonal comparisons are useful in this region because of distinct differences between attendance and water quality between seasons. The wet season is defined as November through March and the dry season is defined as April through October. Note that the dry season corresponds to the season when state law mandates beach monitoring (*3*).

Public Health Costs of Coastal Water Pollution. GI can result in loss of time at work, a visit to the doctor, expenditures on medicine, and even significant nonmarket impacts that represent the "willingness-to-pay" of swimmers to avoid getting sick (sometimes referred to as psychic costs). Because there is a lack of information on the costs of waterborne GI, Rabinovici et al. (*6*) used the cost of a case of food-borne GI, $280 (year 2000 dollars) per illness from Mauskopf and French (*39*), as a proxy for the cost of water-borne GI for swimmers in the Great Lakes. The $280 per illness represents the willingness-to-pay to avoid GI and includes both market and nonmarket costs (*6*). Dwight et al. (*8*) conducted a cost of illness study for water-borne GI for two beaches in southern California (Huntington State Beach and Newport Beach) and determined the cost as $36.58 per illness in 2004 dollars based on lost work and medical costs. Discounting for inflation, this amount is equivalent to $33.35 in the year 2000 dollars. This value does not include lost recreational values or the willingness-to-pay to avoid getting sick from swimming. We use the more conservative estimate of Dwight et al. (*8*) to calculate the health costs of excess GI at LAOC beaches. However, we also provide more inclusive estimates of the cost of illness using Mauskopf and French's $280 willingness-to-pay value (*39*). Unless otherwise stated, all costs are reported in year 2000 dollars.

Results

Attendance and Swimmers. Beach attendance was higher during the dry season (from May through October) than in the wet season (November through April) (Figure 3). We estimate that the annual visitation to Los Angeles and Orange County (LAOC) beaches for the year 2000 approached 80 million visits.

Water Quality. Water quality (measured in terms of ENT concentration) varies widely across the beaches in the study. (Figure S1 shows the log-mean of ENT observations at each beach during the dry and wet seasons.) In general ENT densities are higher during the wet season compared to the dry. Water quality problems at a beach may exist chronically over the course of the year or may be confined to particularly wet days when precipitation washes bacteria into storm drains and into the sea. The most serious, acute water quality impairments can result in the issuance of a beach advisory or beach closure. According to CA state law, water quality exceeds safe levels for swimming if a single beach water sample has a concentration of ENT greater than 104 CFU/100 mL. Figure 4 illustrates the percentage of the days for which daily estimated ENT concentrations were in excess of the state single sample standard. Exceedances during the wet months generally outnumber exceedances during the dry months. The exceptions are Corral, Bolsa Chica, and Crystal Cove, which are all relatively clean beaches, even in the wet season. Doheny, Malibu, Marina Del Rey, Cabrillo, and Las Tunas had the worst water quality with over 33% of the daily estimates in 2000 greater than 104 CFU/100 mL, while Newport, Hermosa, Abalone Cove, Manhattan, Torrance, and Bolsa Chica had the best water quality with less than 5% of daily estimates under the standard.

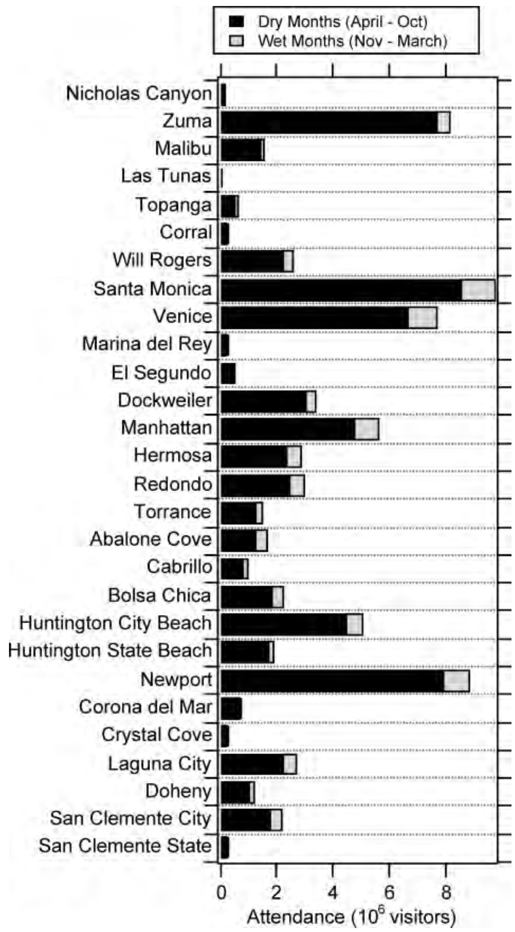

FIGURE 3. Beach attendance during wet and dry seasons 2000.

Estimates of Excess GI and Associated Public Health Costs due to Swimming. Figure 5 illustrates estimated annual excess GI at beaches based on models C and K; results are given for dry and wet months. Models C and K both indicate that Santa Monica, the beach with the highest attendance (Figure 3), has the highest excess GI of all beaches during wet and dry seasons. Both models predict that the three beaches with the lowest excess GI were San Clemente State, Nicholas Canyon, and Las Tunas, a direct result of these beaches being among the smallest and least visited in our study area (Figure 3).

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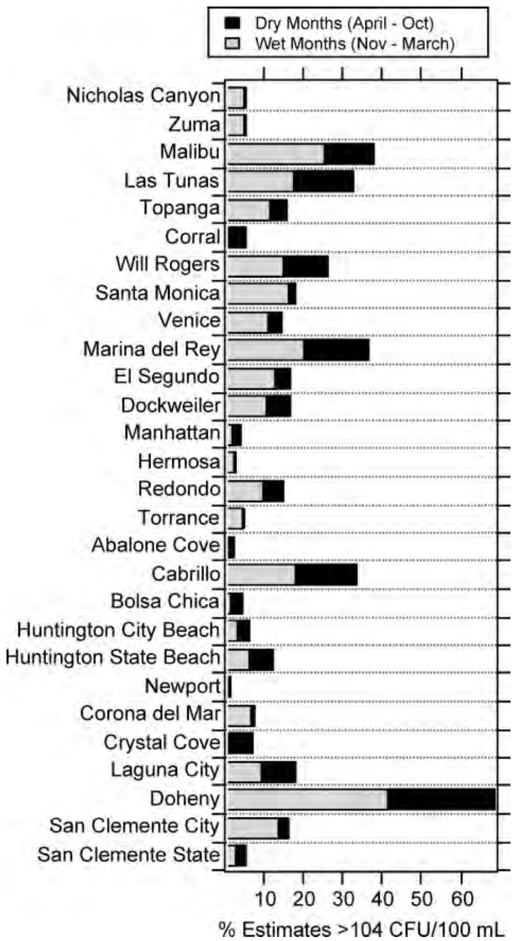

FIGURE 4. Percentage of days on which daily ENT estimates were greater than the CA Department of Health single-sample ENT standard of 104 CFU/100 mL.

There are marked seasonal differences between excess GI predictions. Although water quality is typically worse during the wet season compared to the dry (Figures 4 and S1), more excess GI are predicted for the dry season for most beaches. This result is driven by seasonal variation in attendance (Figure 3). The exceptions are model K predictions for Zuma that indicate 0 and 6647 excess GI during the dry and wet seasons, respectively. Zuma had no ENT densities greater than 32 CFU/100 mL during the dry season, hence the prediction of 0 excess GI.

Numerical predictions of excess GI for the entire year from model C and model K vary markedly between beaches. At 24 beaches, model K predicts between 18% and 700% greater excess GI than model C. The greatest difference in the estimated GI is at Doheny beach where models C and K predict 18,000 and 153,000 excess GI, respectively. At 4 beaches (Zuma, Hermosa, Torrance, and Newport), model K predicts between 1 and 90% lower incidence of GI than model C. These beaches are generally clean with ENT densities below the model K threshold of 32 CFU/100 mL for excess risk.

The public health burden of coastal contamination depends on both attendance and water quality. Figure 6 illustrates how excess GI, based on predictions from models C and K, varies as a function of water quality (percent of daily ENT estimates in exceedance of standard) and attendance. Red, yellow, and green symbols indicate beaches with increasing numbers of GI. If reduction of public health burden is a goal of local health care agencies, then beaches with a red symbol are candidates for immediate action. Nearly all beaches are categorized as high priority during the dry season based on model K (panels A and B). Model C indicates that dry weather mitigation measures at Venice, Zuma, Santa Monica, and Newport, some of the most visited beaches, would significantly reduce the public health burden (panel C), more so than wet weather mitigation measures (panel D).

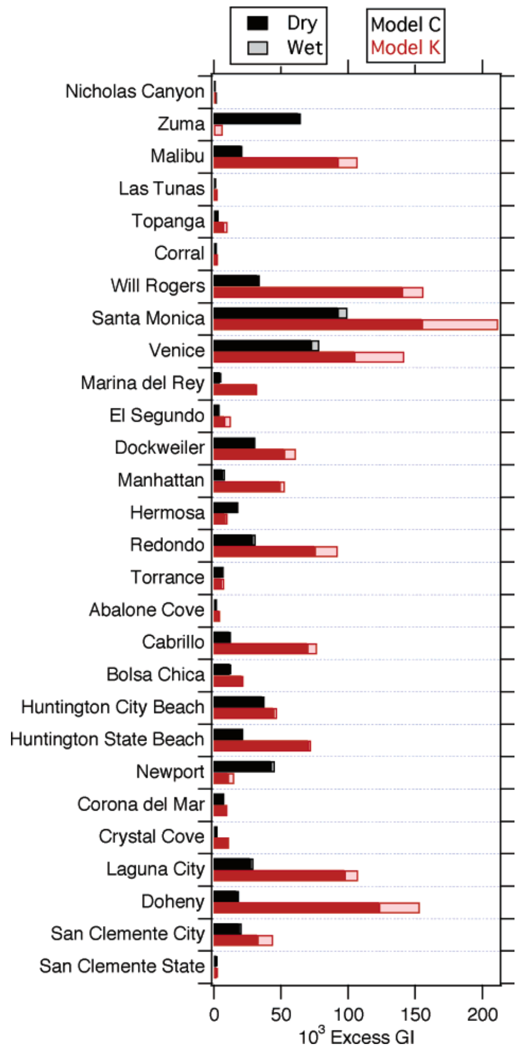

FIGURE 5. Excess GI by beach and season for models C and K.

Another way of prioritizing beach remediation is to examine the risk of GI relative to the USEPA guideline of 19 illnesses per 1000 swimmers (Figure S2). Model K indicates that at 19 and 15 of the 28 LAOC beaches during the wet and dry seasons, respectively, risk is greater than twice the EPA acceptable risk. Model C, on the other hand, indicates that only two beaches (Marina del Rey and Doheny) during the

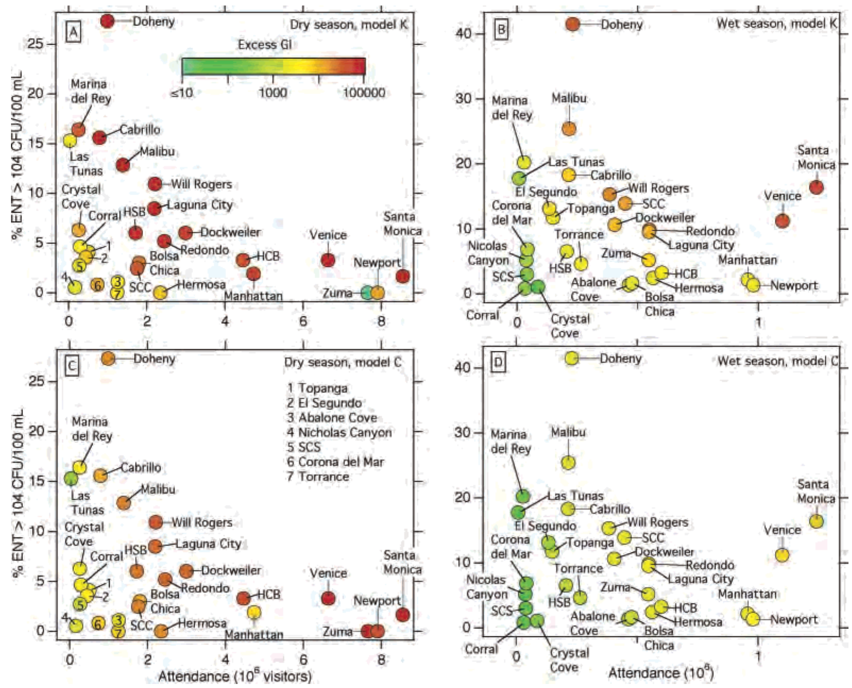

FIGURE 6. Excess GI at each beach as a function of % ENT in exceedance of the single sample standard and attendance. Results for the dry (panels A and C) and wet (panels B and D) seasons are shown for Models K (panels A and B) and C (panels C and D). Beaches are labeled; SCC is San Clemente City Beach, SCS is San Clemente State, HSB is Huntington State Beach, and HCB is Huntington City Beach. In panels A and C, numbers on symbols correspond to beaches, as indicated in the upper right corner of panel C. The color scale in panel A applies to all panels.

TABLE 2. Countywide Public Health Impacts and Costs for Wet and Dry Months (2000)

county/ region	season	GI cases model C	GI cases model K	health costs model C	health costs model K
Los Angeles					
	dry	394,000	804,000	$13,100,000	$28,800,000
	wet	33,800	189,000	$1,130,000	$6,310,000
	total	427,800	993,000	$14,230,000	$35,110,000
Orange					
	dry	185,000	420,000	$6,180,000	$14,000,000
	wet	15,000	66,200	$500,000	$2,210,000
	total	200,000	486,200	$6,680,000	$16,210,000
region total					
	dry	579,000	1,224,000	$19,280,000	$40,800,000
	wet	48,800	255,200	$1,630,000	$8,520,000
	total	627,800	1,479,200	$20,910,000	$51,320,000

dry season, and six (Marina del Rey, Doheny, Santa Monica, Las Tunas, Will Rogers, and Malibu) in the wet season fall into this "high" risk category.

Public Health Costs of Coastal Water Pollution. Table 2 summarizes the number of excess GI and associated public health costs during wet and dry periods by county and season. Based on the conservative cost of illness given by Dwight et al. (*8*), the estimated health costs of GI based on models C and K is over $21 million and $50 million, respectively. If we follow Rabinovici et al.(*6*) and use $280 per GI, the estimated public health impacts are $176 million based on model C and $414 million based on model K. For both LA and OC beaches, county-wide costs obtained using model K yield higher results than those obtained from model C, a direct result of the difference in GI estimates (Figures 5 and 6). Health costs are greater in the dry season compared to the wet suggesting that money may be well spent on dry-weather diversions.

Discussion

A significant public health burden, in terms of both numbers of GI and the costs of GI, is likely to result from beach water quality contamination in southern CA. The corollary to this finding is that water quality improvements in the region would result in public health benefits. Specifically, we make three key findings: (1) removing fecal contamination from coastal water in LAOC beaches could result in the prevention of between 627,800 and 1,479,200 GI and a public health cost of between $21 and $51 million (depending upon the epidemiological model used) each year in the region using the most conservative cost estimates and as much as $176 million or $414 million if we use the larger estimate of health costs (*6*, *39*); (2) even beaches within the same region differ significantly in the degree to which swimming poses a public health impact; and (3) public health risks differ between seasons. Findings (2) and (3) are not surprising given spatio−temporal variation in water quality (*17*, *40*) and attendance within the study site.

A previous study by Turbow et al. (*18*) estimated 36,778 excess HCGI (highly credible GI) per year from swimming at Newport and Huntington State beaches (*8*). Our estimates for the same stretch of shoreline are higher (68,011 and 87, 513 excess GI based on models C and K, respectively). Not only did we use a different measure of illness (GI vs. HCGI) we also used a Monte Carlo scheme to estimate ENT on unsampled days whereas Turbow et al. (*18*) used linear interpolation, and we used higher, empirically determined

(*14*) measures of the percent of beach goers that swim. Dwight et al. (*8*) used Turbow et al.'s (*18*) estimate to determine that the health costs of excess GI at the same beaches were $1.2 million. Our health cost estimates are higher ($2.3 and $2.9 million for models C and K, respectively), due to the higher incidence of ilness predicted by our models.

Beaches with chronic water quality problems are obvious candidates for immediate contamination mitigation. Many beaches in LAOC, however, are relatively clean and meet water quality standards on most days. Clean beaches with moderate to low levels of attendance do not represent a significant public health burden (Figure 6). Nevertheless, public health impacts are still substantial at heavily visited beaches (for instance those with over 6,000,000 visitors per year) even when water quality is good (e.g., Manhattan Beach) (Figure 6). Generally speaking, it will be more difficult to reduce contaminant levels at cleaner beaches. At beaches with high attendance and generally good water quality (like Newport Beach and Zuma), policy managers should continue dry weather source reduction efforts (e.g., education campaigns and watershed management), but should also recognize that the cost of eliminating all beach contamination may outweigh the marginal public health benefits of doing so.

Our estimates of the potential health benefits that might result from removing bacterial contamination from coastal water in LAOC beaches have limitations. First, we focus on a lower bound estimate of the health cost of GI that does not consider the amount a beach goer is willing to pay to avoid getting sick (estimates using higher, but less scientifically conservative estimates also are provided). Second, while we focus on the public health impacts from GI. Exposure to microbial pollution at beaches also increases the chance of suffering from various symptoms and illnesses (*28*, *41*). For instance, Haile et al. (*28*) and Fleisher et al. (*41*) document associations between water quality and respiratory illnesses, acute febrile illness, fever, diarrhea with blood, nausea, and vomiting, and earaches. Third, if the public believes swimming is associated with an increased risk of illness, they may be discouraged from going to the beach, resulting in a loss of beach-related expenditures to local businesses and recreational benefits to swimmers in addition to the loss in health benefits described here. Fourth, we consider GI occurring at a subset of LAOC beaches for which water quality and attendance data were available (Figure 1). Fifth, implicit in our analysis is the assumption that models C and K can be applied to LAOC beaches. Despite these limitations, the results reported here represent the best estimates possible in light of imperfect information. Future studies that establish dose−response relationships for the LAOC region or confirm incidence of swimming GI medically would improve estimates of public health burden and costs.

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Note Added after ASAP Publication

The Model C discussion in the Methods section published ASAP July 15, 2006 has been revised. The corrected version was published July 26, 2006.

Supporting Information Available

Tables S1 and S2, Figures S1 and S2, and the California state water quality standards. This material is available free of charge via the Internet at http://pubs.acs.org.

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The Health Effects of Swimming in Ocean Water Contaminated by Storm Drain Runoff

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ORIGINAL ARTICLES

The Health Effects of Swimming in Ocean Water Contaminated by Storm Drain Runoff

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Waters adjacent to the County of Los Angeles (CA) receive untreated runoff from a series of storm drains year round. Many other coastal areas face a similar situation. To our knowledge, there has not been a large-scale epidemiologic study of persons who swim in marine waters subject to such runoff. We report here results of a cohort study conducted to investigate this issue. Measures of exposure included distance from the storm drain, selected bacterial indicators (total and fecal coliforms, enterococci, and *Escherichia coli*), and a direct measure of enteric viruses. We found higher risks of a broad range of symptoms, including both upper respiratory and gastrointestinal, for subjects swimming (a) closer to storm drains, (b) in water with high levels of single bacterial indicators and a low ratio of total to fecal coliforms, and (c) in water where enteric viruses were detected. The strength and consistency of the associations we observed across various measures of exposure imply that there may be an increased risk of adverse health outcomes associated with swimming in ocean water that is contaminated with untreated urban runoff. (Epidemiology 1999;10:355–363)

Keywords: environmental epidemiology, gastrointestinal illness, ocean, recreational exposures, sewage, storm drains, waterborne illnesses, waterborne pathogens.

Runoff from a system of storm drains enters the Santa Monica Bay adjacent to Los Angeles County (CA). Even in the dry months of summer 10–25 million gallons of runoff (or non-storm water discharge) per day enter the bay from the storm drain system. Storm drain water is not subject to treatment and is discharged directly into the ocean. Total and fecal coliforms, as well as enterococci, are sometimes elevated in the surf zone adjacent to storm drain outlets; pathogenic human enteric viruses have also been isolated from storm drain effluents, even when levels of all commonly used indicators, including F2 male-specific bacteriophage, were low.[1]

Approximately 50–60 million persons visit Santa Monica Bay beaches annually. Concern about possible adverse health effects due to swimming in the bay has been raised by numerous interested parties.[2] Previous reports indicate that swimming in polluted water (for example, due to sewage) increases risks of numerous adverse health outcomes (Pruss[3] provides a recent review of this literature). To our knowledge, however, there has never been a large epidemiologic study of persons who swim in marine waters contaminated by heavy urban runoff.

These circumstances provided the motivation to study the possible health effects of swimming in the bay. We present here the main results from a large cohort study of people that addressed the issue of adverse health effects of swimming in ocean water subject to untreated urban runoff.

Methods

DESIGN AND SUBJECTS

The exposures of interest were distance swimming from storm drains, levels of bacterial indicators (total coli-

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forms, fecal coliforms, enterococcus, *Escherichia coli*) for pathogens that potentially produce acute illness, and human enteric viruses. We studied three beaches located in Santa Monica Bay (CA) that exhibited a wide range of pathogen indicator counts and a high density of swimmers (Santa Monica, Will Rogers, and Surfrider).

Persons who immersed their heads in the ocean water were potential subjects for this study. There was no restriction based on age, sex, or race. We excluded anyone who swam at the study beaches or in heavily polluted areas (that is, Mothers' Beach in Marina del Rey or near the Santa Monica Pier) within 7 days before the study date, or between the date of the beach interview and the telephone follow-up interview. We excluded subjects who swam on multiple days, as one of our primary questions was whether risk of health outcomes was associated with levels of indicator organisms on the specific day a subject entered the water. We targeted persons bathing within 100 yards upcoast or downcoast of the storm drain and persons bathing greater than 400 yards beyond a storm drain.

For this study, 22,085 subjects were interviewed on the beach from June 25 to September 14, 1995, to ascertain eligibility and willingness to participate. We found that 17,253 of these subjects were eligible and able to participate (that is, had a telephone and were able to speak English or Spanish). Of these, 15,492 (90% of the eligible subjects) agreed to participate. They were interviewed about their age, residence, and swimming, particularly immersion of the head into ocean water. The interviewer noted distance from the storm drain (within the categories 0, 1–50, 51–100, or 400 yards), gender, and race of the subject. (Distances from each drain were marked with inconspicuous objects such as beach towels and umbrellas.)

Nine to 14 days after the beach interview, subjects were interviewed by telephone to ascertain the occurrence(s) of: fever, chills, eye discharge, earache, ear discharge, skin rash, infected cuts, nausea, vomiting, diarrhea, diarrhea with blood, stomach pain, coughing, coughing with phlegm, nasal congestion, and sore throat. For this study we defined *a priori* three groupings of symptoms indicative of gastrointestinal illness or respiratory disease. In particular, following Cabelli *et al*,[4] subjects were classified as having highly credible gastrointestinal illness 1 (HCGI 1) if they experienced at least one of the following: (1) vomiting, (2) diarrhea and fever, or (3) stomach pain and fever. We also classified subjects as having highly credible gastrointestinal illness 2 (HCGI 2) if they had vomiting and fever. Finally, we classified subjects as having significant respiratory disease (SRD) if they had one of the following: (1) fever and nasal congestion, (2) fever and sore throat, or (3) coughing with phlegm.

We were able to contact and interview 13,278 subjects (86% follow-up). Of those interviewed, 1,485 were found to be ineligible because they swam (and immersed their heads) at a study beach or in heavily polluted waters between the day of the beach interview and the telephone follow-up. We excluded 107 subjects because they did not confirm immersing their faces in ocean water, leaving 11,686 subjects. One subject had a missing value for age, which we imputed (as the median value among all subjects) for inclusion in the adjusted analyses (discussed below). For the bacteriological analyses, we excluded an additional 1,227 subjects who had missing values, leaving 10,459 subjects. In the virus analyses we included only the 3,554 subjects who swam within 50 yards of the drain on days when viruses were measured (as the samples were collected only at the storm drain).

Collection and Analysis of Samples for Bacterial Indicators

Samples were collected on days that subjects were interviewed on the beaches. Each day, ankle depth samples were collected from each location (0 yards, 100 yards upcoast and downcoast of the drain, and one sample at 400 yards). One duplicate sample per site was collected daily. Samples were collected in sterile 1 liter polypropylene bottles and transferred on ice to the microbiology laboratory. All samples were analyzed for total coliforms, fecal coliforms, enterococcus, and *E. coli*. Densities of total and fecal coliforms and enterococci were determined using the appropriate membrane filtration techniques in Ref 5. *E. coli* densities were determined by membrane filtration using Hach Method 10029 for m-ColiBlue24 Broth.

Collection and Analysis of Samples for Enteric Viruses

For looking at enteric viruses, we collected samples from the three storm drain sites on Fridays, Saturdays, and Sundays, using Method 9510 C g of Ref 5. Ambient pH, temperature, conductivity, and total dissolved solids were measured. Samples as large as 100 gallons chosen to minimize the impacts of seawater dilution were filtered through electropositive filters at ambient pH. Adsorption filters were eluted in the field with 1 liter of sterile 3% beef extract adjusted to pH 9.0 with sodium hydroxide. Field eluates were reconcentrated in the laboratory using an organic reflocculation procedure.[6] All final concentrates were detoxified before analysis.[7]

All samples were analyzed for infectious human enteric viruses in Buffalo green monkey kidney cells (BGMK) by the plaque assay technique. Ten percent of the final concentrate was tested in this manner to determine whether there were a quantifiable number of viruses present. The remaining concentrate volume was divided in half and analyzed using the liquid overlay technique known as the cytopathic effect (CPE) assay.[8] The CPE assay generally detects a greater number of viruses than the plaque assay, but it is not quantitative. Flasks that did not exhibit CPE were considered to be negative for detectable infectious virus. We further examined any flask exhibiting CPE by the plaque-forming unit method to confirm the presence of infectious viruses.

Statistical Analysis

Our analysis addressed two main questions. First, are there different risks of specific outcomes among subjects swimming 0, 1–50, 51–100, and 400 or more yards from a storm drain? If pathogens in the storm drain result in increased acute illnesses, one would expect higher risks among swimmers closer to the drain. Second, are risks of specific outcomes associated with levels of specific bacterial indicators or enteric viruses?

To address the second question, we estimated risks arising from exposure to levels within categories defined *a priori* by existing standards or expert consensus. Specifically, for total coliforms we defined categories using 1,000 and 10,000 colony-forming units (cfu) per 100 ml as cutpoints, which are based on the California Code of Regulations (S.7958 in Title 17).[9] For fecal coliforms we created categories using cutpoints of 200 and 400 cfu per 100 ml, which reflect criteria set by the State Water Resources Control Board.[10] For enterococcus we used cutpoints of 35 and 104 cfu per 100 ml of water, which were established by the U.S. Environmental Protection Agency.[11] Finally, categories for *E. coli* were selected in meetings with staff from the Santa Monica Bay Restoration Project (SMBRP), Heal the Bay, and the Los Angeles County Department of Health Services. These meetings resulted in initially selecting categories based on cutpoints of 35 and 70 cfu per 100 ml, and then subsequently adding categories using cutpoints of 160 and 320 cfu per 100 ml; the latter were added because it is believed that *E. coli* comprises about 80% of the fecal coliforms. Using these knowledge-based categories, however, assumes a homogeneous risk between cutpoints. This might not be a reasonable assumption because the adequacy of these cutpoints is unclear, and because a large percentage of the subjects were in a single (that is, the lowest) category. Therefore, we further explored the bacteriological relations using categories defined by deciles.

In addition to considering total and fecal coliforms separately, we investigated the potential effect of the ratio of total to fecal coliforms. Motivation for this arose from our expectation that the risk of adverse health outcomes might be higher when the ratio is smaller, indicating a relatively greater proportion of fecal contamination. We used categories of this ratio defined by a cutpoint of 5 (where 5 corresponds to there being 5 times as much total as fecal coliform in the water). The human enteric virus exposure was reported as a dichotomous (that is, virus detected *vs* not detected) measure.

We first calculated simple descriptive statistics giving the number of subjects with each adverse health outcome who swam (1) at the prespecified distances from the drain or (2) in water with the prespecified levels of pathogens. From these counts we estimated the crude risk associated with each exposure. We then used logistic regression to estimate the adjusted relative risks of each outcome. For each exposure/outcome combination, we fit a separate model. All models adjusted for the potential confounding of: age (three categories: 0–12 years, 13–25 years, >25 years); sex; beach; race (four categories: white, black, Latino/a, and Asian/multiethnic/other); California *vs* out-of-state resident; and concern about potential health hazards at the beach (four categories: not at all, somewhat, a little, and very).

Results

Table 1 presents results for each of the adverse health outcomes by distance swimming from the storm drain. Across all distances, risks ranged from about 0.001 (that is, 1 per 1,000) for diarrhea with blood to about 0.1 for runny nose. The risk of numerous outcomes was higher for people who swam at the drain (0 yards away), in comparison with those who swam 1–50, 51–100, or >400 yards from the drain. In particular, we observed increases in risk for fever, chills, ear discharge, coughing with phlegm, HCGI 2, and SRD. In addition, the risks for eye discharge, earache, sore throat, infected cut, and HCGI 1 were also slightly elevated. A handful of outcomes exhibited small increased risks among swimmers at 1–50 yards (skin rash) or at 51–100 yards (cough, cough with phlegm, runny nose, and sore throat). Adjusted estimates of relative risk (RR) comparing swimmers at 0, 1–50, or 51–100 yards from the drain with swimmers at least 400 yards away from the drain showed similar relations as the aforementioned patterns of risks (Table 1). Among the positive associations for swimmers at the drain, RRs ranged in magnitude from about 1.2 (eye discharge, sore throat, HCGI 1) to 2.3 (earache), with varying degrees of precision; most of these RRs ranged from 1.4 to 1.6.

In Table 2 we see that the risk of skin rash increased for the highest prespecified category of total coliforms (that is, >10,000 cfu). Furthermore, the adjusted RR comparing swimmers exposed at this level *vs* those exposed to levels ≤1,000 cfu was 2.6. Whereas the RR for diarrhea with blood also suggested a positive association, this result was based on a single adverse health event (as evinced by the wide 95% CIs). When looking at deciles, in relation to the lowest exposure level (that is, the lowest 10%), we observed increased risks of skin rash at all other levels (Figure 1). The adjusted RRs ranged from 1.6 to 6.2, with five of the nine RRs in the 2–3 range. In addition, there were increased risks of HCGI 2 for all deciles except one (the eighth); the corresponding adjusted RRs ranged from 1.4 to 4.7, with varying levels of precision (Figure 1).

When looking at fecal coliforms, we again observed among those in the highest category (that is, >400 cfu) an increased risk for skin rash (Table 3). There were also *slight* increased risks for infected cut, runny nose, and diarrhea with blood in the highest category, as well as for nausea, vomiting, coughing, sore throat, and HCGI 2 in the middle category (200–400 cfu). The adjusted RRs also indicated positive associations for these outcomes (Table 3). When we used deciles to categorize subjects, however, in comparison with the lowest decile, we only observed marginal increased risks for infection and skin rash (not shown). In our investigation of the ratio of

TABLE 1. Adverse Health Outcomes by Distance Swimming from Drain: Number Ill, Acute Risks, Adjusted Relative Risk (RR) Estimates and 95% Confidence Intervals (CI)

	Distance from Drain (in Yards)										
	>400 (N = 3030)*		51–100 (N = 3311)			1–50 (N = 4518)			0 (N = 827)		
Outcome	No. Ill	Risk	No. Ill	Risk	RR (95% CI)†	No. Ill	Risk	RR (95% CI)†	No. Ill	Risk	RR (95% CI)†
Fever	138	0.046	158	0.048	1.06 (0.84–1.34)	208	0.046	1.07 (0.85–1.33)	59	0.071	1.61 (1.16–2.24)
Chills	72	0.024	85	0.026	1.07 (0.77–1.47)	108	0.024	1.05 (0.77–1.42)	31	0.037	1.60 (1.03–2.50)
Eye discharge	61	0.020	59	0.018	0.88 (0.61–1.27)	73	0.016	0.77 (0.55–1.09)	19	0.023	1.15 (0.67–1.98)
Earache	116	0.038	116	0.035	0.89 (0.68–1.16)	136	0.030	0.81 (0.63–1.04)	38	0.046	1.34 (0.91–1.98)
Ear discharge	21	0.007	19	0.006	0.78 (0.42–1.46)	25	0.006	0.80 (0.45–1.44)	13	0.016	2.09 (1.01–4.33)
Skin rash	23	0.008	30	0.009	1.16 (0.67–2.01)	53	0.012	1.50 (0.91–2.46)	4	0.005	0.62 (0.21–1.83)
Infected cut	17	0.006	16	0.005	0.79 (0.40–1.58)	37	0.008	1.51 (0.84–2.69)	6	0.007	1.48 (0.57–3.87)
Nausea	133	0.044	115	0.035	0.77 (0.60–1.00)	143	0.032	0.75 (0.59–0.95)	40	0.048	1.13 (0.78–1.65)
Vomiting	57	0.019	58	0.018	0.97 (0.67–1.40)	63	0.014	0.76 (0.53–1.09)	25	0.030	1.40 (0.85–2.31)
Diarrhea	204	0.067	163	0.049	0.70 (0.56–0.86)	202	0.045	0.69 (0.56–0.84)	53	0.064	1.04 (0.75–1.44)
Diarrhea with blood	7	0.002	2	0.001	0.26 (0.05–1.26)	3	0.001	0.27 (0.07–1.06)	2	0.002	0.87 (0.15–4.57)
Stomach pain	206	0.068	194	0.059	0.85 (0.70–1.05)	271	0.060	0.93 (0.77–1.12)	61	0.074	1.11 (0.82–1.51)
Cough	209	0.069	263	0.079	1.18 (0.97–1.42)	296	0.066	0.98 (0.82–1.18)	55	0.067	1.01 (0.73–1.38)
Cough and phlegm	90	0.030	114	0.034	1.16 (0.88–1.54)	143	0.032	1.09 (0.83–1.43)	39	0.047	1.65 (1.11–2.46)
Runny nose	273	0.090	351	0.106	1.18 (1.00–1.40)	371	0.082	0.95 (0.80–1.12)	74	0.089	1.10 (0.84–1.46)
Sore throat	190	0.063	244	0.074	1.17 (0.96–1.43)	304	0.067	1.12 (0.93–1.35)	59	0.071	1.25 (0.92–1.71)
HCGI 1	102	0.034	96	0.029	0.88 (0.66–1.17)	121	0.027	0.84 (0.64–1.10)	35	0.042	1.21 (0.81–1.82)
HCGI 2	26	0.009	28	0.008	1.04 (0.61–1.79)	32	0.007	0.90 (0.53–1.53)	15	0.018	1.64 (0.84–3.21)
Significant respiratory disease	139	0.046	177	0.053	1.18 (0.94–1.49)	205	0.045	1.03 (0.82–1.23)	63	0.076	1.78 (1.29–2.45)

The total number of swimmers in each category is given in parentheses (N). HCGI1, highly credible gastrointestinal illness with vomiting, diarrhea and fever or stomach pain and fever. HCGT2, highly credible gastrointestinal illness with vomiting and fever only. Significant respiratory disease, fever and nasal congestion, fever and sore throat or coughing with phlegm.
* Referent category (RR = 1.0).
† Adjusted for age, sex, beach, race, California *vs* out-of-state resident, and concern about potential health hazards at the beach.

total to fecal coliforms, we observed a consistent pattern of higher risks for diarrhea and HCGI 2 as the ratio category became lower (not shown, but available in Ref 12). Because any effect of this lower ratio should be stronger when there was a higher degree of contamination, indicated by total coliform counts in excess of 1,000 or 5,000 cfu, we then restricted our analysis to subjects swimming in water above these levels. In the first case, increased risks with decreasing cutpoints were observed for nausea, diarrhea, and HCGI 2.[12] When we restricted our investigation to subjects in water in which the total coliforms exceeded 5,000 cfu, we observed

TABLE 2. Adverse Health Outcomes by Total Coliform Levels: Number Ill, Acute Risks, Adjusted Relative Risk (RR) Estimates and 95% Confidence Intervals (CI)

	Total Coliforms (cfu/100ml)							
	≤1,000 (N = 7,574)*		>1,000–10,000 (N = 1,988)			>10,000 (N = 757)		
Outcome	No. Ill	Risk	No. Ill	Risk	RR†	No. Ill	Risk	RR†
Fever	368	0.049	88	0.044	0.92 (0.72–1.17)	42	0.055	1.23 (0.87–1.73)
Chills	193	0.025	51	0.026	1.03 (0.75–1.42)	9	0.012	0.51 (0.26–1.01)
Eye discharge	151	0.020	21	0.011	0.46 (0.29–0.74)	15	0.020	0.81 (0.47–1.41)
Earache	270	0.036	66	0.033	0.96 (0.72–1.27)	21	0.028	0.86 (0.54–1.38)
Ear discharge	51	0.007	15	0.008	1.22 (0.67–2.23)	2	0.003	0.46 (0.11–1.93)
Skin rash	65	0.009	14	0.007	0.75 (0.41–1.36)	19	0.025	2.59 (1.49–4.53)
Infected cut	49	0.006	11	0.006	0.97 (0.49–1.91)	3	0.004	0.82 (0.25–2.72)
Nausea	292	0.039	69	0.035	0.94 (0.72–1.24)	18	0.024	0.71 (0.43–1.16)
Vomiting	137	0.018	34	0.017	0.90 (0.61–1.33)	9	0.012	0.64 (0.32–1.29)
Diarrhea	434	0.057	85	0.043	0.80 (0.63–1.03)	33	0.044	0.95 (0.65–1.39)
Diarrhea with blood	8	0.001	2	0.001	1.08 (0.22–5.35)	1	0.001	1.73 (0.19–15.88)
Stomach pain	487	0.064	125	0.063	1.05 (0.85–1.29)	29	0.038	0.69 (0.47–1.02)
Cough	546	0.072	133	0.067	0.90 (0.73–1.10)	51	0.067	0.94 (0.69–1.28)
Cough and phlegm	267	0.035	58	0.029	0.81 (0.60–1.09)	27	0.036	1.03 (0.68–1.57)
Runny nose	703	0.093	170	0.086	0.93 (0.78–1.12)	67	0.089	1.06 (0.81–1.40)
Sore throat	534	0.071	116	0.058	0.83 (0.67–1.03)	47	0.062	0.95 (0.69–1.30)
HCGI 1	242	0.032	54	0.027	0.84 (0.62–1.14)	17	0.022	0.74 (0.44–1.23)
HCGI 2	72	0.010	16	0.008	0.89 (0.51–1.55)	5	0.007	0.83 (0.32–2.12)
Significant respiratory disease	396	0.052	84	0.042	0.80 (0.62–1.02)	42	0.055	1.11 (0.79–1.55)

The total number of swimmers in each category is given in parentheses (N).
* Referent category (RR = 1.0).
† Adjusted for age, sex, beach, race, California *vs* out-of-state resident, and concern about potential health hazards at the beach.

May 8, 2013
Item No. 9
Supporting Document No. 5

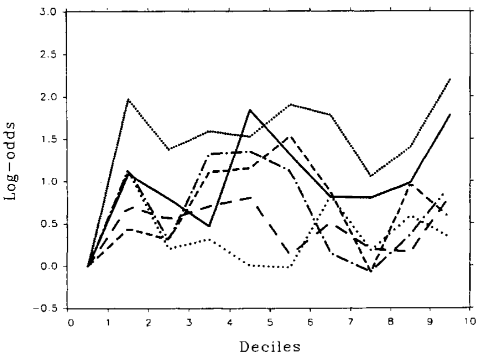

FIGURE 1. **Log odds of adverse health outcomes by deciles of exposure for selected bacterial exposures. —, Total coliform and skin rash; – – – ·, total coliform and HCGI 2; · · ·, Enterococci and infected cut; — — —, *E coli* and eye discharge; ···, *E coli* and skin rash; · — ··, *E coli* and infected cut. HCGI 2 = highly credible gastrointestinal illness with vomiting and fever only.**

increased risks with eye discharge, ear discharge, skin rash, nausea, diarrhea, stomach pain, nasal congestion, HCGI 1, and HCGI 2.[12] There was a consistent pattern of stronger risk ratios as the cutpoint became lower (when the analyses were restricted to times when total coliforms exceeded 1,000 or 5,000 cfu), with the strongest effects generally observed with the cutpoint of 2, as illustrated in Figure 2 for diarrhea, vomiting, sore throat, and HCGI1.

Table 4 gives results for the relation among enterococci and the adverse health outcomes. Again, we observed an increased risk of skin rash among those in the highest category (that is, >104 cfu). In addition, comparing the highest to other categories of exposure, there

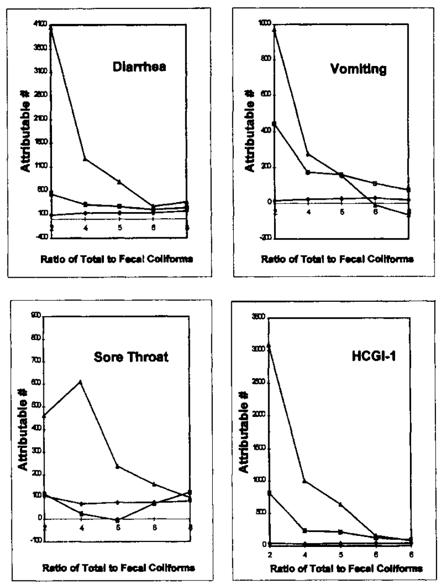

FIGURE 2. **Selected attributable numbers/10,000 exposed subjects for total to fecal coliforms. ◆, All days; ■, >1000; ▲, > 5000. HCGI 1 = highly credible gastrointestinal illness with vomiting, diarrhea and fever or stomach pain and fever.**

TABLE 3. Adverse Health Outcomes by Fecal Coliform Levels: Number Ill, Acute Risks, Adjusted Relative Risk (RR) Estimates and 95% Confidence Intervals (CI)

	Fecal Coliforms (cfu/100ml)							
	≤200 (N = 8,005)*		>200–400 (N = 768)			>400 (N = 1,636)		
Outcome	No. Ill	Risk	No. Ill	Risk	RR†	No. Ill	Risk	RR†
Fever	381	0.048	39	0.051	1.04 (0.74–1.46)	80	0.049	1.02 (0.80–1.32)
Chills	197	0.025	24	0.031	1.14 (0.74–1.76)	34	0.021	0.78 (0.54–1.14)
Eye discharge	149	0.019	11	0.014	0.70 (0.38–1.31)	30	0.018	0.97 (0.65–1.46)
Earache	275	0.034	26	0.04	0.93 (0.62–1.41)	57	0.035	1.00 (0.75–1.35)
Ear discharge	53	0.007	8	0.010	1.29 (0.60–2.73)	7	0.004	0.56 (0.25–1.24)
Skin rash	69	0.009	5	0.007	0.64 (0.26–1.60)	26	0.016	1.86 (1.17–2.95)
Infected cut	47	0.006	2	0.003	0.40 (0.10–1.65)	15	0.009	1.50 (0.83–2.74)
Nausea	289	0.036	38	0.049	1.29 (0.91–1.84)	57	0.035	0.93 (0.69–1.24)
Vomiting	133	0.017	18	0.023	1.33 (0.81–2.21)	31	0.019	1.07 (0.71–1.60)
Diarrhea	425	0.053	50	0.065	1.17 (0.86–1.60)	81	0.050	0.90 (0.70–1.15)
Diarrhea with blood	7	0.001	1	0.001	1.22 (0.15–10.01)	3	0.002	1.69 (0.42–6.75)
Stomach pain	495	0.062	51	0.066	1.04 (0.77–1.41)	103	0.063	0.98 (0.78–1.23)
Cough	551	0.069	70	0.091	1.34 (1.03–1.74)	117	0.072	1.06 (0.86–1.31)
Cough and phlegm	265	0.033	31	0.040	1.16 (0.79–1.70)	60	0.037	1.10 (0.82–1.47)
Runny nose	722	0.090	72	0.94	1.03 (0.79–1.33)	160	0.098	1.11 (0.93–1.34)
Sore throat	527	0.066	70	0.091	1.40 (1.07–1.82)	106	0.065	0.99 (0.80–1.24)
HCGI 1	239	0.030	28	0.036	1.18 (0.79–1.77)	50	0.031	0.99 (0.72–1.36)
HCGI 2	65	0.008	11	0.014	1.63 (0.85–3.12)	17	0.010	1.13 (0.65–1.95)
Significant respiratory disease	399	0.050	42	0.055	1.08 (0.77–1.50)	85	0.052	1.04 (0.81–1.33)

The total number of swimmers in each category is given in parentheses (N).
* Referent category (RR = 1.0).
† Adjusted for age, sex, beach, race, California *vs* out-of-state resident, and concern about potential health hazards at the beach.

TABLE 4. Adverse Health Outcomes by Enterococci Levels: Number Ill, Acute Risks, Adjusted Relative Risk (RR) Estimates and 95% Confidence Intervals (CI)

	Enterococci (cfu/100ml)							
	≤35 (N = 7,689)*		>35–104 (N = 1,863)			>104 (N = 857)		
Outcome	No. Ill	Risk	No. Ill	Risk	RR†	No. Ill	Risk	RR†
Fever	371	0.048	84	0.045	0.91 (0.71–1.16)	45	0.053	1.00 (0.72–1.40)
Chills	198	0.026	33	0.018	0.67 (0.46–0.97)	24	0.028	0.94 (0.60–1.48)
Eye discharge	149	0.019	25	0.013	0.69 (0.45–1.07)	16	0.019	1.01 (0.58–1.75)
Earache	270	0.035	57	0.031	0.82 (0.61–1.11)	31	0.036	0.88 (0.59–1.31)
Ear discharge	52	0.007	12	0.006	0.85 (0.45–1.62)	4	0.005	0.53 (0.19–1.51)
Skin rash	74	0.010	13	0.007	0.71 (0.39–1.30)	13	0.015	1.72 (0.89–3.31)
Infected cut	46	0.006	12	0.006	0.95 (0.49–1.82)	6	0.007	0.90 (0.37–2.18)
Nausea	271	0.035	72	0.039	1.07 (0.82–1.41)	41	0.048	1.19 (0.84–1.70)
Vomiting	130	0.017	34	0.018	1.13 (0.77–1.67)	18	0.021	1.20 (0.71–2.04)
Diarrhea	398	0.052	101	0.054	0.99 (0.78–1.25)	57	0.067	1.01 (0.75–1.36)
Diarrhea with blood	8	0.001	0	—	—	3	0.004	2.90 (0.66–12.68)
Stomach pain	464	0.060	126	0.068	1.09 (0.89–1.35)	59	0.069	0.97 (0.72–1.30)
Cough	554	0.072	121	0.065	0.91 (0.73–1.12)	63	0.074	1.00 (0.75–1.34)
Cough and phlegm	266	0.035	59	0.032	0.91 (0.68–1.22)	31	0.036	1.03 (0.69–1.54)
Runny nose	704	0.092	165	0.089	0.96 (0.80–1.15)	85	0.099	1.01 (0.79–1.30)
Sore throat	533	0.069	118	0.063	0.89 (0.72–1.10)	52	0.061	0.80 (0.59–1.09)
HCGI 1	230	0.030	51	0.027	0.92 (0.67–1.26)	36	0.042	1.31 (0.89–1.92)
HCGI 2	67	0.009	14	0.008	0.82 (0.46–1.48)	12	0.014	1.30 (0.67–2.51)
Significant respiratory disease	397	0.052	84	0.045	0.86 (0.67–1.11)	45	0.053	0.98 (0.70–1.37)

The total number of swimmers in each category is given in parentheses (N).
* Referent category (RR = 1.0).
† Adjusted for age, sex, beach, race, California *vs* out-of-state resident, and concern about potential health hazards at the beach.

were increased risks of nausea, vomiting, diarrhea with blood, HCGI 1, and HCGI 2. Our adjusted RRs suggested similar positive associations, except for diarrhea; although the risk increased from 0.05 to 0.07, the adjusted RR comparing the highest to lowest category was 1.0 (Table 4). When comparing the lowest to higher deciles, we observed increased risks in most categories for infected cut and skin rash (Figure 1). Other adverse health outcomes—infected cut, nausea, diarrhea, diarrhea with blood, HCGI 1, and HCGI 2—exhibited increased risks only in particular quantiles. In comparison with the lowest decile, the risk of each of these outcomes was higher in the 10th decile. For example, the risk for HCGI 2 was 0.007 in the first decile, but 0.015 in the 10th.

Table 5 presents results for *E. coli*. We once again found an increased risk of skin rash in the highest prespecified category (that is, >320 cfu). Furthermore, we observed slight increased risks in this highest category for eye discharge, earache, stomach pain, coughing with phlegm, runny nose, and HCGI 1 (Table 5). In our decile-based analysis, however, we only observed materially increased risks for eye discharge, skin rash, and infection (Figure 1).

Numerous adverse health outcomes exhibited higher risks among subjects swimming on days when samples were positive for viruses (Table 6). In particular, the risk of fever, eye discharge, vomiting, sore throat, HCGI 1, and HCGI 2, and to a lesser extent, chills, diarrhea, diarrhea with blood, cough, coughing with phlegm, and SRD were higher on days when viruses were detected. Our adjusted RR estimates showed similar relations, most ranging from 1.3 to 1.9 (Table 6). Additionally, adjusting for each bacterial indicator (one-at-a-time) also left these results essentially unchanged.[12] As expected, there was an association between presence of virus and fecal coliforms within 50 yards of the drain. The mean density of fecal coliforms when no virus was detected was 234.8 cfu (SD 542.5 cfu); whereas it was 2,233.8 (SD 2,634.1) when viruses were detected (N = 386). The median values were 47.8 and 452.6 cfu, respectively.

Discussion

We observed differences in risk for a number of outcomes when we compared subjects swimming at 0 yards *vs* 400+ yards. Most of the relative risks suggested an approximately 50% increase in risk. Furthermore, as evinced by both the risks and RRs, there is an apparent threshold of increased risk occurring primarily at the drain: no dose response is evinced with increasing closeness to the drain, but there is a jump in risk for many adverse health outcomes among those swimming at the drain. We also found that distance is a reasonably good surrogate for bacterial indicators, with higher levels observed closer to the drain.[12]

For bacterial indicators, we observed a relation among numerous higher exposures and adverse health outcomes. These increases were mostly restricted to the highest knowledge-based categories (no effect was observed below any existing standards). When looking at quantiles, we found higher risks of skin rash and infection at fairly low levels. In contrast with what one might expect, however, there was no clear dose-response pattern across increasing levels of bacteriological exposures.

TABLE 5. Adverse Health Outcomes by E. coli Levels: Number Ill, Acute Risks, Adjusted Relative Risk (RR) Estimates and 95% Confidence Intervals (CI)

	E. coli (cfu/100ml)													
	≤35 (N = 6,104)*		>35–75 (N = 1,620)			>75–160 (N = 1,145)			>160–320 (N = 518)			>320 (N = 991)		
Outcome	No. Ill	Risk	No. Ill	Risk	RR†	No. Ill	Risk	RR†	No. Ill	Risk	RR†	No. Ill	Risk	RR†
Fever	274	0.045	89	0.055	1.22 (0.95–1.56)	61	0.053	1.20 (0.90–1.60)	29	0.056	1.22 (0.81–1.84)	45	0.045	0.98 (0.70–1.37)
Chills	145	0.024	41	0.025	1.00 (0.70–1.44)	28	0.024	1.00 (0.66–1.52)	18	0.035	1.38 (0.82–2.33)	22	0.022	0.79 (0.49–1.26)
Eye discharge	116	0.019	30	0.019	0.99 (0.65–1.49)	14	0.012	0.65 (0.37–1.15)	6	0.012	0.61 (0.26–1.43)	23	0.023	1.36 (0.84–2.19)
Earache	214	0.035	45	0.028	0.75 (0.54–1.04)	33	0.029	0.78 (0.53–1.14)	18	0.035	0.91 (0.55–1.50)	47	0.047	1.25 (0.89–1.77)
Ear discharge	42	0.007	8	0.005	0.60 (0.28–1.28)	5	0.004	0.57 (0.22–1.46)	6	0.012	1.28 (0.52–3.15)	6	0.0066	0.67 (0.27–1.62)
Skin rash	57	0.009	15	0.009	1.01 (0.56–1.80)	7	0.006	0.66 (0.30–1.46)	6	0.012	1.21 (0.49–2.98)	15	0.015	2.04 (1.11–3.76)
Infected cut	42	0.007	7	0.004	0.53 (0.24–1.20)	3	0.003	0.33 (0.10–1.06)	3	0.006	0.66 (0.20–2.19)	9	0.009	1.02 (0.48–2.19)
Nausea	216	0.035	74	0.046	1.22 (0.93–1.61)	34	0.030	0.80 (0.55–1.16)	18	0.035	0.88 (0.53–1.46)	42	0.042	1.03 (0.73–1.47)
Vomiting	107	0.018	31	0.019	1.09 (0.72–1.64)	16	0.014	0.82 (0.48–1.40)	8	0.015	0.87 (0.41–1.85)	20	0.020	1.05 (0.63–1.74)
Diarrhea	310	0.051	101	0.062	1.14 (0.90–1.44)	63	0.055	1.00 (0.75–1.33)	25	0.048	0.80 (0.52–1.23)	56	0.057	0.91 (0.67–1.23)
Diarrhea with blood	5	0.001	3	0.002	2.06 (0.48–8.89)	1	0.001	1.03 (0.12–9.01)	2	0.004	3.98 (0.68–23.21)	0	—	—
Stomach pain	353	0.058	124	0.077	1.28 (1.03–1.59)	70	0.061	1.02 (0.78–1.33)	31	0.060	0.95 (0.64–1.40)	70	0.071	1.06 (0.80–1.40)
Cough	444	0.073	96	0.059	0.81 (0.64–1.02)	86	0.075	1.04 (0.82–1.33)	29	0.056	0.77 (0.51–1.14)	82	0.083	1.14 (0.88–1.48)
Cough and phlegm	226	0.037	41	0.025	0.66 (0.47–0.92)	34	0.030	0.78 (0.54–1.12)	11	0.021	0.53 (0.28–1.00)	43	0.043	1.12 (0.79–1.59)
Runny nose	566	0.093	136	0.084	0.87 (0.71–1.06)	105	0.092	0.96 (0.77–1.20)	38	0.073	0.76 (0.53–1.08)	108	0.109	1.12 (0.89–1.41)
Sore throat	417	0.068	99	0.061	0.86 (0.68–1.08)	82	0.072	1.02 (0.80–1.31)	29	0.056	0.78 (0.52–1.17)	75	0.076	1.04 (0.80–1.37)
HCGI 1	183	0.030	51	0.031	1.03 (0.75–1.42)	30	0.026	0.88 (0.59–1.30)	17	0.033	1.06 (0.63–1.80)	36	0.036	1.12 (0.76–1.64)
HCGI 2	48	0.008	21	0.013	1.55 (0.92–2.64)	8	0.007	0.85 (0.40–1.81)	6	0.012	1.25 (0.51–3.03)	10	0.010	1.04 (0.51–2.13)
Significant respiratory disease	319	0.052	71	0.044	0.82 (0.62–107)	58	0.051	0.96 (0.72–1.28)	21	0.041	0.74 (0.47–1.18)	56	0.057	1.03 (0.76–1.40)

The total number of swimmers in each category is given in parentheses (N).
* Referent category (RR = 1.0).
† Adjusted for age, sex, beach, race, California *vs* out-of-state resident, and concern about potential health hazards at the beach.

TABLE 6. Number Ill, Risks, and Adjusted Relative Risk (RR) Estimates of Adverse Health Outcomes by Virus

	Viruses				
	No (N = 3,168)*		Yes (N = 386)		
Outcome	No. Ill	Risk	No. Ill	Risk	RR (95% CI)†
Fever	126	0.040	23	0.060	1.56 (0.98–2.50)
Chills	65	0.021	10	0.026	1.25 (0.63–2.50)
Eye discharge	36	0.011	8	0.021	1.86 (0.85–4.09)
Earache	93	0.029	10	0.026	0.92 (0.47–1.80)
Ear discharge	15	0.005	0		
Skin rash	32	0.010	4	0.010	0.97 (0.34–2.82)
Infected cut	31	0.010	2	0.005	0.57 (0.13–2.40)
Nausea	101	0.032	12	0.031	0.93 (0.50–1.73)
Vomiting	44	0.014	10	0.026	1.86 (0.92–3.80)
Diarrhea	130	0.041	21	0.054	1.27 (0.78–2.07)
Diarrhea with blood	2	0.001	1	0.003	5.82 (0.45–75.72)
Stomach pain	191	0.060	23	0.060	0.92 (0.58–1.45)
Cough	181	0.057	28	0.073	1.22 (0.80–1.86)
Cough and phlegm	92	0.029	13	0.034	1.20 (0.66–2.18)
Runny nose	246	0.078	32	0.083	1.01 (0.68–1.49)
Sore throat	198	0.063	32	0.083	1.38 (0.93–2.06)
HCGI 1	72	0.023	15	0.039	1.69 (0.95–3.01)
HCGI 2	22	0.007	6	0.016	2.32 (0.91–5.88)
Significant respiratory disease	133	0.042	21	0.054	1.34 (0.83–2.18)

The total number of swimmers in each category is given in parentheses (N).
* Referent category (RR = 1.0).
† Adjusted for age, sex, beach, race, California *vs* out-of-state resident, and concern about potential health hazards at the beach.

When looking at the ratio of total to fecal coliforms using the entire dataset, no consistent pattern emerged.[12] This is not entirely surprising inasmuch as an analysis of all data points treats all ratios of similar numerical value equally. Thus, for example, even though a ratio of 5 when the total coliforms are very low may not increase risk, the same ratio may be associated with increased risks when the density of total coliforms is above 1,000 or 5,000 cfu. When the analysis was restricted to swimmers exposed to total coliform densities above 1,000 or 5,000 cfu, a consistent pattern emerged, with higher risks associated with low ratios.[12]

This is the first large-scale epidemiologic study that included measurements of viruses. A number of adverse health effects were reported more often on days when the samples were positive, suggesting assays for viruses may be informative for predicting risk. Norwalk-like viruses are a plausible cause of gastroenteritis.[4,13] Enteroviruses, the most common viruses in sewage effluent, can cause respiratory symptoms. Not only are viruses responsible for many of the symptoms associated with swimming in ocean water but also they die off at slower rates in sea water than do bacteria, and they can cause infection at a much lower dose.[14]

Our design substantially reduced the potential for confounding by restricting the study entirely to swimmers and making comparisons between groups of swimmers (for example, defined by distance from the drain) to estimate relative risks. Previous studies looking at the effects of exposure to polluted recreational water (for example, due to sewage outflows) have been criticized for comparing risks in swimmers with risks in nonswimmers.[4,14,15] In these earlier studies, background risks among subjects who swim *vs* those choosing not to swim may differ because there are many other (potentially noncontrollable) exposures/pathways that can produce the symptoms under investigation. By restricting the present study to swimmers, we have reduced potential differences between the background risks of exposed *vs* unexposed subjects (for example, swimmers choosing to swim at the drain *vs* those swimming at the same beach but farther away from the drain). Furthermore, we were able to adjust our relative risk estimates for a number of additional factors (listed above) that could confound the observed relations. Of course, this does not exclude the possibility that residual confounding in these factors, or other unknown factors, might have confounded the observed relations.

Nevertheless, any actual (that is, causal) effects may be higher than we observed in this study because both distance and pathogenic indicators are proxy measures of the true pathogenic agents. Also, recall that we excluded subjects who frequently entered the water at these beaches. If there is a dose-response relation such that higher cumulative exposures are associated with increased risk, then one may infer that persons who frequently enter the water and immerse their heads (for example, surfers) may have a higher risk of adverse health outcomes than the relatively infrequent swimmers included in this study.

In summary, we observed positive associations between adverse health effects and (1) distance from the drain, (2) bacterial indicators, and (3) presence of enteric viruses. Taken together, these results imply that there may be an increased risk of a broad range of adverse health effects associated with swimming in ocean water subject to urban runoff. Moreover, attributable numbers—that is, estimates of the number of new cases of an adverse health outcome that is attributable to the exposure of interest—reached well into the 100s per

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10,000 exposed subjects for many of the positive associations observed here.[12] This finding implies that these risks might not be trivial when we consider the millions of persons who visit these beaches each year. Furthermore, the factors apparently contributing to the increased risk of adverse health outcomes observed here are not unique to Santa Monica Bay (similar levels of bacterial indicators are observed at many other beaches). Consequently, the prospect that untreated storm drain runoff poses a health risk to swimmers is probably relevant to many beaches subject to such runoff, including areas on the East, West, and Gulf coasts of North America, as well as numerous beaches on other continents.

Acknowledgments

We thank the reviewers for their helpful comments.

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RE: Revised Tentative Order R9-2013-0001;
Cost Benefits Analysis and Errata Sheets posted April 19, 2013

Dear Messrs. Chiu and Becker:

This revised letter is being submitted in response to Mr. Becker's email of this date which rejected the April 26, 2013, letter from members of the Coalition that have participated in the process of the San Diego Regional Water Quality Control Board, Region 9's (RWQCB) development of Revised Tentative Order R9-2013-0001 published March 26, 2013. The Coalition consists of the following trade and professional associations, known as, the regulated community: Building Industry Association of San Diego County (BIASD), Business Leadership Alliance (BLA), Associated General Contractors, San Diego (AGC), NAIOP (National Association of Industrial & Office Properties), Associated Builders & Contractors (ABC), the San Diego Regional Chamber of Commerce (SDRRC), the San Diego Association of Realtors® (SDAR), the Alliance for Habitat Conservation, the Building Owners & Managers Association (BOMA), and the San Diego Chapter of the American Society of Landscape Architects. In its Ruling on Objections, Requests for Alternative Procedures, and Requests for Designation as Additional Parties to the Proceeding, dated April 3, 2013, the RWQCB designated the Coalition as a Designated Party to the proceedings.

Mr. Becker's email indicated that the Board was rejecting the Coalition's April 26 letter because it included written comments on the Board's proposed errata and provided the Coalition with an opportunity to submit a revised letter by 5:00 p.m. today that was limited to comments on the Cost Benefit Analysis. While the Coalition appreciates the opportunity to submit a revised version of its letter, please be advised that it does so under protest because, we respectfully submit and as indicated in the April 26 letter, the entire content of the letter was appropriate. Accordingly, we ask that both the April 26 letter and this letter be included in any administrative record of proceedings for the Permit.

The RWQCB held a hearing on Revised Tentative Order R9-2012-0001 on April 10 and 11, 2013. During the April 11, 2013, portion of those hearings the RWQCB admitted additional new evidence into the administrative record, including, but not limited to, a document labeled "April 2011 Meeting Water Quality Standards for San Diego's Recreational Waters, a Cost Benefit Analysis" (Hereinafter "Cost Benefit Analysis"). In his Notice of Public Hearing Continuation dated April 19, 2013, the Executive Officer of the RWQCB invited designated parties to submit written comments on the Cost Benefit Analysis prior to 5 p.m. April 26, 2013. Concurrent with the Executive Officer's Notice of Continuation, the RWQCB also released two versions "Errata Sheets," with each version presented as a separate "Option," and without explanation as to which the Board proposes to utilize.

Continuing Request for Additional Time

The Coalition experts and counsel have had limited time to review and prepare comments on the Cost Benefit Analysis and the Errata Sheets. The Coalition became aware that it would be given an opportunity to make written comments on the Cost Benefit Analysis at approximately 4:30 PM on April 19, 2013, and the Errata Sheets were released at approximately the same time. Thus, designated parties have had six days to prepare written comments on this new evidence. The Coalition strongly recommends that the RWQCB continue the public hearing on the draft permit for at least 30 days to allow sufficient time for board members, affected parties, and the public to review and consider the new information about the Cost Benefits Analysis and the major changes to water quality strategies and regulation envisioned in the Errata Sheets. This is a situation that requires a comment period extension. *See* 40 C.F.R. §§124.14(a)(4), (b); 124.10; Water Code §13167.5; *State Water Resources Control Board v. Office of Administrative Law* (1993) 12 Cal.App.4th 697. The RWQCB's release of new information in support of the Revised Draft Permit and proposed further modifications to a permit, relying, in whole or in part, on newly admitted evidence, should be considered, in effect, the preparation of a modified draft permit and revised fact sheet with fewer than five working days to review these revisions prior to the meetings at which the RWQCB will consider the Revised Tentative Order for adoption. Under the authority cited above, the release of this modified permit must be accompanied by a corresponding additional comment period on the significantly revised draft Order.

The Cost Benefit Analysis

Based on the limited opportunity the Coalition has had to review the Cost Benefit Analysis, it believes some general comments are in order. The Coalition members are not directly regulated by municipal stormwater permits; the Coalition is concerned that limited public funds will be required to be spent to implement unattainable requirements that lack scientific basis. The Coalition shares the goal of clean water and believes achieving this goal will be greatly enhanced when permit requirements are carefully evaluated using a cost benefit analysis that will ensure that there will be reasonable benefits derived from the expenditures. In fact, the Coalition believes that this is one of the purposes of Water Quality Improvement Plans – to spend taxpayer money wisely and achieve the greatest benefit for the funds expended. As far as the Coalition can determine, the report, conducted by the Fermanian Business & Economic Institute at Point Loma Nazarene University and prepared by the City of San Diego in April 2011, is the only analysis that attempts to evaluate the relationship between the benefits and costs of implementing the 2011 Bacteria Total Maximum Daily Load ("TMDL"). The Revised Draft Permit expressly acknowledges that cost is a factor to be considered and evaluated under the MEP standard and is required under Porter Cologne, Water Code §13241, and a more robust analysis applying the newly added Cost Benefit Analysis is required here. Any large scale, impactful project or program would analyze the costs and benefits before development occurred or the program was implemented; a cost-benefit analysis should also be developed before increased regulations of this magnitude are considered, and has not occurred.

Thank you for the opportunity to review the Cost Benefit Analysis and the Errata Sheets and for considering the Coalition's comments. Please let us know if you have any questions or would like to discuss these issues further before the next hearing.

Very truly yours,

Lisabeth D. Rothman

LDR:mld

cc: Mike McSweeney
Borre Winckel

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CLEAN WATER NOW

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To: SDRWQCB & Staff **Date:** April 19, 2013

Re: Cost Benefit Analysis (CBA) commissioned by the City of San Diego Transportation & Storm Water Department (CSDT&SWD) April 2011
Submitted & Allowed: Tentative Order R9-2013-0001

SDRWQCB:

Mark Twain wrote: **"Figures often beguile me, particularly when I have the arranging of them myself; in which case the remark attributed to Disraeli would often apply with justice and force: There are three kinds of lies: Lies, damned lies, and statistics."**

The Cost Benefit Analysis (CBA) in discussion fits this famous pithy quote almost perfectly. It should be seen with a jaundiced, cynical and skeptical eye because it's primary, pre-determined focus appears to be the past, present and future expenditures by the copermittees, not the actual or potential cumulative human health impacts. CWN contends that a CBA is the incorrect metric or analysis format (see preferred **Cost Effective Analysis** below).

Nor is there any addressing ***re*** the significant adverse ecological impacts, the impairments to the other biotic components, the indigenous plant and animal communities. How does one measure the worth in dollars of once healthy habitat turned into **"bacterial dead zones"**? Impaired, degraded ecosystems are incapable of even minor cleansing or anthropogenic pollutant loading abatement.

Several glaring challenges should be made as to the copermittee's chosen vendor and the motivation(s), the creation, conclusions and especially numerous flawed recommendations of the CBA. They purport to eschew unbiased objectivity, yet there is an implicit fiscal expectation to **"not bite the hand that feeds."**

If the generator, **Fernanian Business and Economic Institute (FBEI)**, produced documents and studies **not** supportive or **in concurrence** with their commissioning entities, their clients, they'd soon become **"Fermanian Out Of Business."**

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(cont.)

Several notations reveal how specious the proffered strategy by FBEI of delay or gradual implementation of TMDLs ***et al*** really is. They have admitted that their projections are estimates, yet insist on measuring **THEIR** estimates against the guaranteed, known improvements of ***post haste***, legally mandated TMDLs. To quote Mr. Spock, this is illogical, in a courtroom it would be denied as vague and ambiguous testimony, open to multiple interpretations hence irrelevant.

Copermittees cheaply buying such prolonged periods of time will only worsen the conditions, introduce more persistent contaminants, hence the forbidden ***"backsliding"*** will occur, putting permit holders into an even deeper (and yes), more expensive hole. Irreversible impacts have no expenditure upper limitations because they become unachievable, unobtainable and mortal to the environs.

A literal **Expanding Universe of Water-Borne Pollution**, the receiving waters and habitats will degrade and remediation will not be able to catch up, hence irreversible non-compliance will dominate.

Costs now **might** be 6:1 as **"guestimated"** by the study group. By 2025 they could go up to 10:1 or greater. It's like a car. Either changed the oil now for $24.95 or pay $2,495.00 in a few years for a valve and head job.

"Yet, the sizable six-to-one gap between costs and benefits estimated in this study will be difficult to narrow substantially even with a significant boost to benefit estimates. At the same time, there is no guarantee that achieving certain TMDL standards will achieve the increased number of days for beach access or the projected reduction in incidence of various illnesses. San Diego residents who never or rarely visit the area's beaches may be unwilling to pay the expense of water quality improvement, especially if it is marginal."
Page 14-15 FBEI Final Bacteriological

Additionally, the majority of the supporting studies/docs cited are antiquated. Databases and conclusions cited by FBEI, reached over 7 years ago have superseded their shelf life, aren't necessarily relevant due to improved analysis methodology, better science, and last but most importantly, public education.

It's accepted in the industry that environmental review analyses and documents like

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CEQA/NEPA require updated, current information to allow equitable peer review and encourage fair argument. This study by FBEI is therefore hopelessly derivative, it recycles and cannibalizes where more recent surveys, studies and polls are intuited.

FBEI emphasizes public education as a major BMP, but the argument can be made that polling of the public's desires 7 years or more ago has been surpassed, has changed significantly due to the public's increased awareness. And it's a known fact that many times those who answer polls are in fact already polarized about the subject or are disengaged but eager to give an uneducated opinion.

People respond ***in extremis*** to jeopardizing health and economic impacts upon themselves and to their families. Of course if a person polled (and their immediate loved ones) don't go to the beach it becomes an abstract topic, and if they're in dire economic straits as well, it's axiomatic that they won't want to fund improvements.

The FBEI study asserts that water quality improvements are significant this past decade, leading to far fewer beach closures. Isn't it tenable to propose, to estimate that this is directly attributable to the imposition of aggressive, strident NPDES Permits and the auspice, the specter and arrival of degradation-reversing TMDLs per federal law? The study ironically supports such a hypothesis or supposition.

Copermittee staffs are becoming **"encouraged and motivated"** to proactively and preemptively include the proposed orders in their calculations and projected budgets. Remove an assertive, mandated NPDES, take TMDLs either off the table or slow down their implementation and an insinuated, high-pollutant stasis will reign supreme.

(1) A **Cost Effectiveness Analysis** (CEA) might have been the more pertinent or appropriate format for assessment. Cost-effectiveness analysis is often used in the field of health services, where it may be inappropriate to monetize health effects in the same manner as a CBA.

Typically the CEA is expressed in terms of a ratio where the denominator is a gain in health from a measure (years of life, premature births averted, sight-years gained) and the numerator is the cost associated with the health gain. The most commonly used outcome measure is **Quality-Adjusted Life Years** (**QALY**).

(cont.)

(2) If the CBA had come to a different set of conclusions objectively, if it contradicted or countermanded, was contrary to the pre-disposed objectives, would the provider have even shared it with the stakeholders?

(3) Nowhere are the **CUMULATIVE** health impacts, the potential long term, synergistic, accumulation of impairments discussed. These should have been both **QUANTIFIED** and **QUALIFIED**, which lends credence to a CEA as the more appropriate methodology. Acute (single) **and** chronic toxicity impacts (multiple exposures) are not within the scope of this business and economic study, it was in fact drafted apparently without known, in-house expert medical discourse or input. There are no biologists or physicians within the FBEI team.

Unaddressed are the effects of multiple exposures resulting in complex ***symptomatologies*** (combined symptoms of each illness). The general medically accepted projected impacts of a series of singular exposure, single specific bacterial illness taking place sequentially over the course of decades of recreational (REC-1) immersion time are glaringly lacking.

Ex.: If, like myself, you've had all four (4) of the **"Beach related illnesses"** listed on Page 26 (Exhibit 19), especially been acutely symptomatic for more than one contemporaneously, nowhere in the study does it quantify that exponential potential. Different pathogenic bacteria have different impacts. There are no long term studies about this topic.

The singular epidemiology study is 15 years old. Emphasis on **OLD**:

"Fleisher, J., Kay, D., Wyer, M., & Godfree, A. (1998). Estimates of the severity of illness associated with bathing in marine recreational waters contaminated with domestic sewage. International Journal of Epidemiology , Vol. 27, 722-726."
Source: Page 31 of FBEI Study

(4) What of the toxicity-related illnesses from POPs, CECs, and other **known** mutagenic, teratogenic and carcinogenic substances usually found in urban runoff? This analysis ignores severe health impacts that a CEA might have included for stakeholder and/or Cal/EPA consideration.

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The three (3) bacteria tested for under AB 411 are not life-threatening: Urban runoff can be, hence this narrowly focused CBA isn't fully describing or taking into account sound medical science, not to mention significant levels determined by USEPA that trigger TMDL-related activities.

Storm drain outfalls more than 12" in diameter with significant flow discharges, plus creek and river mouth Points of Discharge (PODs) constitute de facto, life-threatening attractive and public nuisances.

(5) CBA **"Recommendations and Action Steps"** CWN comments in **red**:

"1) A priority should be placed on solutions to improving water quality that will require relatively low amounts of expenditures."

Comments: This is a poker tell that reveals the intent, the real goals and mission statement, the predisposed agenda. It is a blatant admission that cost trumps everything, is paramount due to the sole arc of this CBA methodology.

"2) Scientific studies need to be conducted to more carefully document the correlation between TMDL standards and the incidence or risk of various illnesses."

Comments: There have been ample studies by highly reputable university medical clinics to facilitate direct correlations. USEPA has an easily accessible database. As noted earlier, a 15 year-old epidemiological study is nearly without value.

"3) Chambers of Commerce and other civic organizations in the beach areas (e.g., Ocean Beach Main Street Association) should be consulted on their recommendations and support for ways to reduce the flow of contaminants and pollutants."

Comments: Duh. Truly, a Homer Simpson no-brainer. The Permit watershed stakeholder process, the WQIP Panel mechanism, as well as the locale-specific Integrated Regional Watershed Management Plans (IRWMP) already include this iterative, **"novel"** strategy. Let the local, lead enforcement agency do it: **Lead**.

"4) A collaborative approach involving government, business, and

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academic experts should be used to help develop some of the most <u>cost-effective</u> approaches to achieving the various water quality standards."

Comments: I underlined **"cost –effective"** because this CBA admits its critical deficiency, that a CEA is necessary but not provided by the submitter (CSDT&SWD).

"5) As suggested in the Strategic Plan, efforts to control pollution at its various sources need to be enhanced through greater monitoring and enforcement."

Comments: Isn't this why the NPDES Permits, TMDLs and the SDRWQCB exist, why storm water permits like the Proposed **Tentative Order R9-2013-0001** we're now considering are important?

"6) A more complete analysis of the relative importance of various causes of pollution in general runoff needs to be conducted (e.g., car washing, lawn pesticides, etc.) Aggressive public education needs to then be conducted, with possible restrictions implemented if necessary."

Comments: Once again, we have known the sources/causes for decades, they have been acknowledged, noted and reflected in the NPDES Permits themselves. So more studies==Buying more time while **<u>not</u>** in compliance. Public education is not only the least expensive activity, but is very difficult to measure.

"7) New parking lots should be required to have porous payments and follow other best management practices to reduce runoff and existing lots should be retrofitted in strategic areas.
8) As emphasized in the Strategic Plan, various programs and projects should be carefully evaluated as they are implemented to identify best management practices. Major expenditures or investments should first be piloted in one area before expanding them on a wider scope.
9) Public-private partnerships should be formed to implement the various projects entailing significant spending or investment."

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(cont.)

Comments: The proposed NPDES 2013 prescribes, encourages, describes or alludes to these three (3), numbers 7—9 respectively, especially the pilot project as a potential analog.
LID (permeable filtration) has been part of the Permit process for at least 5 years. Ditto for CalGreen (effective as of 1/01/2012).
All of the watershed management plans (and their identified stakeholder groups) cite specific BMPs submissions/proposals plus BETs in their reports.
The proposed WQIP Panel will include public-private partnerships where applicable.

"10) Data on illnesses related to swimming in San Diego City waters needs to be collected from health care providers and analyzed to better understand the scope and severity of water pollution risk in the area."

Comments: Health care providers aren't always contacted, so the databases are inherently deficient. Medical care affordability wasn't factored in, but obviously many can't afford to seek the care they need for minor illnesses nor can they afford to take days off of work. Then too, because of the symptoms, many recreational users assume they have a cold, flu or in the case of gastroentiritis, ate some funky food somewhere.
Statistical analyses of this type that delay/stall might not be even close to accurate or reflect the depth of the problem. If you don't get cancer until 10 years later from an acute exposure, or from chronic conditions, how could you possibly link the causal factor(s) with the effect(s)? Answer: You can't, it can't be proven.

"11) San Diego City residents should be polled with respect to their opinions about the current quality of the City's beaches and their willingness to pay for additional enhancements. This data needs to be analyzed to ascertain the difference in response between frequent and infrequent beachgoers."

Comments: Q.: And if all the polled SD residents read was this study or those provided by chronic non-compliance parties? A.: Water quality improvement game over.
The second sentence borders on the absurd: Of course frequent beachgoers are different, we're the ones predominantly getting ill.

"12) Methods to pay for the cost of implementing the Strategic Plan need

to be considered that would be the most equitable and efficient. For example, beachgoers might be asked to pay a somewhat larger share of the total cost burden through parking fees, sales taxes, or hotel fees because of the special value they place on clean beaches. In addition, or alternatively, water pollutants could be taxed more heavily."

Comments: Costs associated with implementation, including specific revenue and/or funding mechanisms, are the responsibility of the copermittees, **not** Cal/EPA. **"Equitable and efficient"** are the sole proprietary domain and ultimately the fiduciary accountability standard-bearers for local lead agency copermittees, for the elected and appointed officials, **not** for the SDRWQCB.

"13) Given its budget pressures and this study's finding of the sizable gap between expected costs and benefits, the City of San Diego should consider requesting relief from the San Diego Water Board in achieving various TDMLs or in extending the period in which they are accomplished. This would allow a more thorough analysis of the potential effectiveness of such standards in San Diego. It also would allow more time to determine if solutions featuring lower costs with smaller impacts on established communities can produce significant improvements in water quality."
Comments: More time? The federal Clean Water Act is written, it is based upon a gradual ratcheting down of prescriptions and it has already allowed ample time. Such laws were intended to reverse acknowledged existing impairments.

As for the "**if**" part, that is speculative beyond comprehension. Waking up 5 years from now only to find out that lower costs with smaller impacts aren't possible contradicts the spirit and intent of both the CWA and California's Porter-Cologne.

Moreover, what if 5 years passed and the costs and impacts were not smaller but instead growing? If the both the costs and negative impacts increased exponentially or logarithmically, would the copermittees then use **that** to justify non-compliance or avoidance?
As our science gets better, as levels of significance reflected by USEPA data are in fact tracing the arc of our increasing detection and diagnostic abilities, then there will be attendant increasing abatement and remediation requisites. Allowing more time to pass within that algorithm equals fiscal **and** physical Russian Roulette.

Conclusion:

In what now appears to be **déjà vu all over again**, San Diego copermittees are revisiting that delay tactic realm, attempting to turn the clock back.

Over 10 years ago, while the NPDES for 2002 in South OC was being discussed and considered, then SDRWQCB Chair John (Jack) Minan travelled with staff to a Laguna Niguel City Council Chambers workshop.

Two Orange County Health Care officials, one a medical physician, abjectly in denial, challenged staff and Chair Minan to insert the word **"may"** or **"might"** into warning signs and policy reproductions. They alleged (like this CBA)) that there was no incontrovertible proof, that there weren't direct links or enough epidemiological proof to sustain the NGO and legitimate medical contentions about urban runoff.

In spite of emerging epidemiological studies, they requested warnings, postings, and literature be allowed to be intentionally non-committal, vague, to avoid litigation, to give them the sanctuary of that dreaded metaphor **"safe harbor."** Eventually, and sadly, they prevailed, and here's how the signs read today:

And here's a historical poster that for CWN sums up what's happening while local lead agencies, copermittees responsible for monitoring and enforcement, ones who request stays and delays, who obfuscate and stall state and federal law compliance with their own statistical analyses:

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Commemorative Poster From Clean Water Now: November 9, 1999

Respectfully submitted,

Roger E. Bütow
Executive Director
Email: roger@clean-water-now.org

CLEAN WATER NOW is an innovative, science-based organization committed to solution-oriented collaboration as a means of developing safe, sustainable water supplies and preserving healthy ecosystems.

San Diego County Taxpayers Association

Taxpayers watchdog since 1945

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April 26, 2013

Wayne Chiu, P.E.
California Regional Water Quality Control Board, San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123-4340

Dear Mr. Chiu:

The report conducted by the Fermanian Business & Economic Institute (FBEI) at Point Loma Nazarene University entitled "Meeting Water Quality Standards for San Diego's Recreational Waters: A Cost Benefit Analysis" quantifies a substantial concern. The benefit of Tentative Order No. R9-2013-0001 is far outweighed by the costs.

Limited available taxpayer dollars requires water quality regulations to be balanced with other public benefit programs such as healthcare, education, and ensuring fiscally stable government agencies. We need to develop a scientifically-based plan that will improve water quality by providing net benefit to the region before spending billions.

Please contact me at (619) 234-6423 or at felipe@sdcta.org should you have any questions.

Sincerely,

Felipe Monroig
President and CEO

FM/sdk

CC: Dave Gibson, Executive Officer, San Diego Regional Water Quality Control Board
Christine Witte, Executive Assistant, San Diego Regional Water Quality Control Board

SAN DIEGO™ REGIONAL CHAMBER OF COMMERCE

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April 26, 2013

Wayne Chiu, P.E.
California Regional Water Quality Control Board, San Diego Region
9174 Sky Park Court, Suite 100
San Diego, CA 92123-4340

RE: April 2011 Meeting Water Quality Standards for San Diego's Recreational Waters, a Cost Benefit Analysis

Dear Mr. Chiu,

As a coalition of business leaders the San Diego Regional Chamber of Commerce ("The Chamber") is writing to express the importance of the document labeled "April 2011 Meeting Water Quality Standards for San Diego's Recreational Waters, a Cost Benefit Analysis" admitted into the record for the San Diego Regional Water Quality Control Board's Tentative Order No. R9-2013-0001 on April 11, 2013. While the Chamber and its 3,000 business members are not directly regulated by the municipal stormwater permits, we are concerned that limited public funds will be required to be spent to implement unattainable requirements that lack scientific basis.

We all want to achieve the goal of clean water but the requirements must be carefully evaluated using a cost-benefit analysis to ensure that there will be reasonable benefits derived from the expenditures. Businesses in all sectors of the economy rely and need clean water; however, water quality regulations must be balanced with other public benefit programs. Any large-scale, impactful project or program would analyze the costs and benefits before development occurred or the program was implemented; a cost-benefit analysis should also be developed before increased regulations of this magnitude are considered.

To the best of our knowledge, the report conducted by the Fermanian Business & Economic Institute (FBEI) at Point Loma Nazarene University and prepared by the City of San Diego in April 2011, is the only analysis that attempts to evaluate the relationship between the benefits and costs of implementing the 2011 Bacteria Total Maximum Daily Load (TMDL).

The FBEI Report's concludes that the costs-to-benefit ratio to comply with regulations, including the Bacteria TMDL, is a factor of **six-to-one**. We need to develop scientifically sound processes that will provide a positive cost-benefit to the taxpayers of this region before spending billions to implement capital projects and design programs that may not achieve the water quality targets.

SAN DIEGO™ REGIONAL CHAMBER OF COMMERCE

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We urge your board to note the recommendations provided in the FBEI report, including the recommendations to:

- document carefully the correlation between water quality standards and regulations to the risk to human health,
- Ensure that local residents are polled as to their opinions about the current quality of beaches and their willingness it to pay for additional enhancements and identify the difference in responses between those who frequent the beach, and those who go infrequently.

The Chamber urges the San Diego Regional Water Quality Control Board to only adopt elements in Tentative Order No. R9-2013-0001 that are cost effective and will produce results that are economically, environmentally, and socially beneficial.

Please contact Leah Hemze lhemze@sdchamber.org, or Mike Nagy mnagy@sdchamber.org for comments.

Sincerely,

Jerry Sanders
President & CEO

CC:
- Dave Gibson, Executive Officer, San Diego Regional Water Quality Control Board
- Christine Witte, Executive Assistant, San Diego Regional Water Quality Control Board

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