Benefit-Cost Analysis of Water Quality Investments for Coastal California Involving Human Health and Recreation

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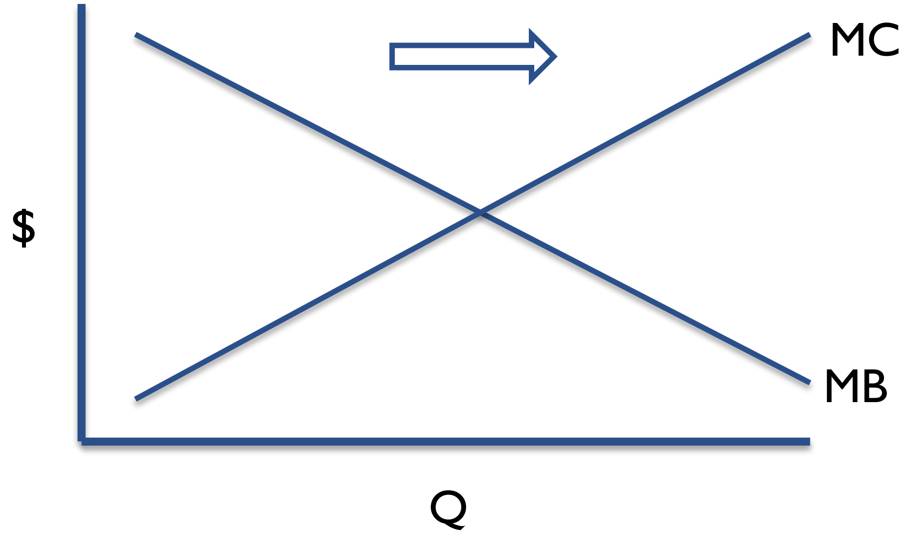
Overview and Context

- Municipalities face billions of dollars in water quality compliance costs
  - E.g. $49 billion for NYC, $ billions for Seattle, Los Angeles. Small communities proportionately.
- Affordability analyses suggest communities have a budget constraint on water quality compliance costs
  - ~2% of median household income, requires consideration for distributional/diversity issues.
- Diminishing returns to water quality investments



Do all WQ investments make sense?

The low but uncertain measured benefits of US water quality policy

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US investment to decrease pollution in rivers, lakes, and other surface waters has exceeded $1.9 trillion since 1960, and has also

A recent review summarized CBAs of the 112 major federal rules implemented over the period 2002–2012 across the entire US

Review finds C > B for most WQ CBAs (avg. B:C 0.37)

For decades, the benefits of CWA compliance were self-evident.

Low-hanging fruit in some contexts largely picked.

Ongoing investments must be strategic.

Wet Weather Bacteria TMDL

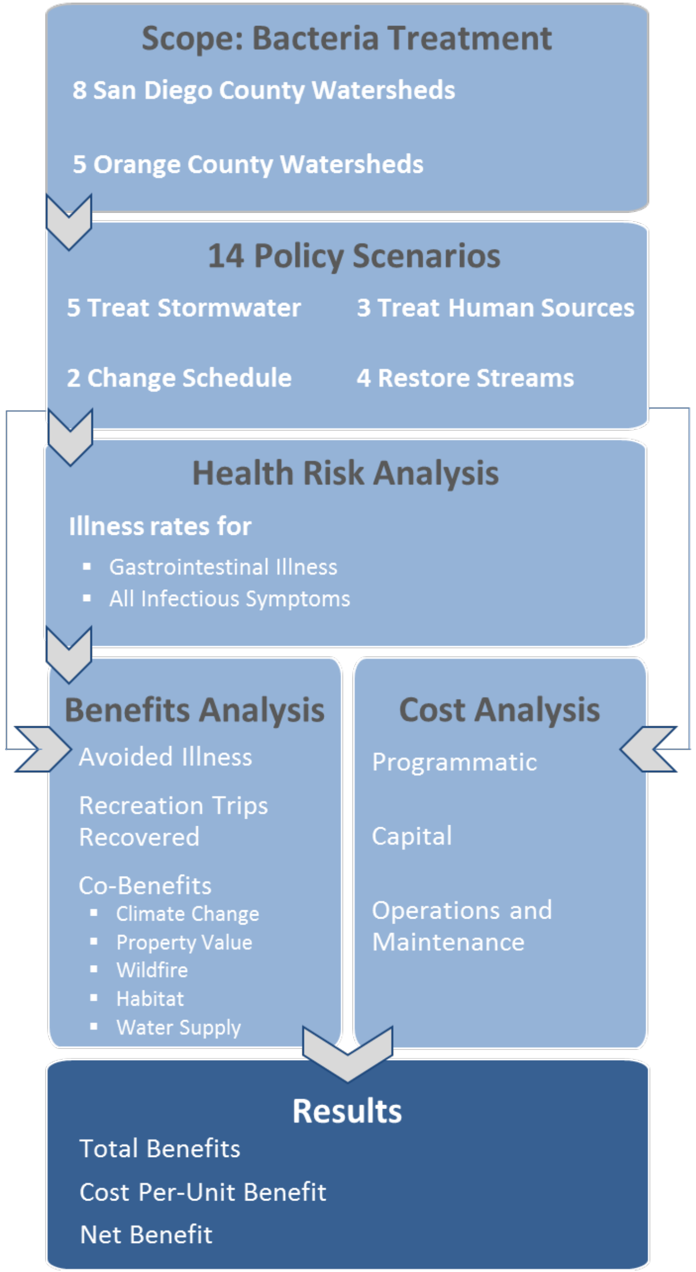
- Recreational water quality standards based on illnesses per exposure (2012 criteria 32 to 36 illnesses per 1000 exposures)
- Should they hold during wet weather?
- Orange Co., San Diego Co., City of San Diego face $billions to meet WQS during wet weather
- Are these investments best use of available funds for WQ?

Wet Weather Bacteria TMDL CBA Team Effort

- Surfer Health Study (SCCWRP & Soller Environmental)
- Stormwater BMP modeling (Tetra Tech)
- Riparian restoration BMP modeling (ESA)
- Sewer, septic, homeless camp modeling (Brown & Caldwell)
- Cost Benefit Analysis (Environmental Incentives and ECONorthwest)
- Steering committee of co-permittees, USEPA, SD RWQCB
- Analysis of benefits and costs of several possible strategies
- Technical Advisory Committee chaired by Ken Schiff (SCCWRP)
- Steering Committee, funding by co-permittees

Overview of Analysis

- Scenarios each alter an aspect of TMDL implementation
- Scenario bacteria concentrations are used to find illness rates
- Benefits analysis finds values for avoiding illnesses, regaining beach days and co-benefits of BMPs
- Cost analysis finds costs for BMPs to achieve scenario goals
- Results convey findings for total benefits, cost-effectiveness and net benefits



- Primary/Direct Benefits (All quantified and monetized)
  - Avoided Illness (gastrointestinal and all infectious illness)
  - Additional Beach Trips
- Co-Benefits (Bold quantified and monetized)
  - **Water Supply**
  - **Carbon Sequestration**
  - **Air Quality**
  - **Property Values**
  - Human Health and Well-Being
  - Flood Control
  - **Wildfire Risks**
  - **Riparian Habitat**
  - Recreation and Amenities
  - **Other Pollutant Removal**

Only likely (not potential) benefits quantified or described.

Human Sources scenario secondary effects not defined sufficiently for quantification.

Public Health Benefits

Wet day exposures (surfers and swimmers) × Average annual wet days × Change in illness rate × Value per avoided illness = Average annual benefit

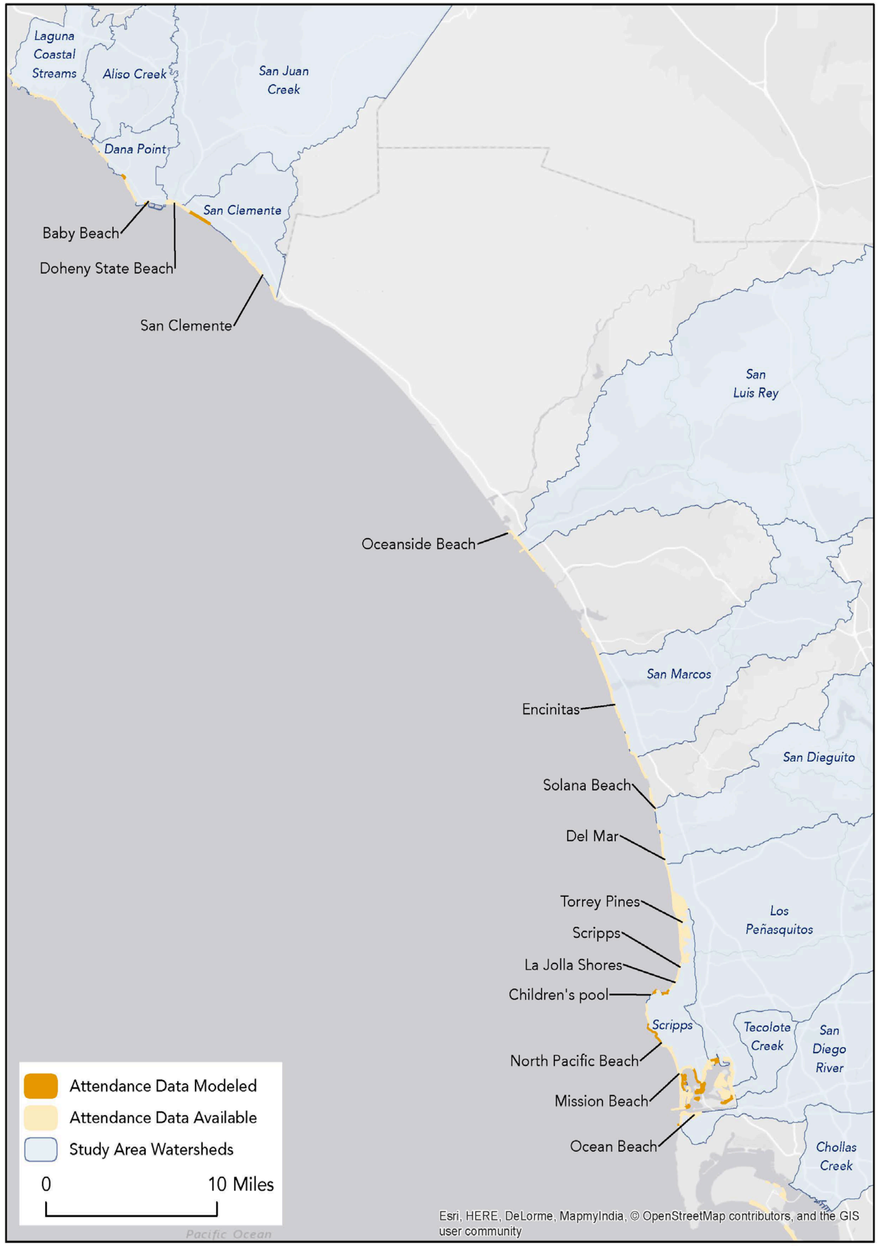
- Compiled all available beach attendance data
  - Including daily data and visitor type
- Developed statistical (econometric) model of exposures (surfers and swimmers) on wet days (storm, storm +1, +2, +3)
- Used peer-reviewed value of avoided illnesses based on literature review including willingness-to-pay, healthcare costs, and lost work/leisure time.

BENEFIT	VALUE (LOW)	VALUE (HIGH)
Avoided GI Illness	$78.9	$263
Avoided Any Non-GI Infectious Illness	$78.9	$2,630

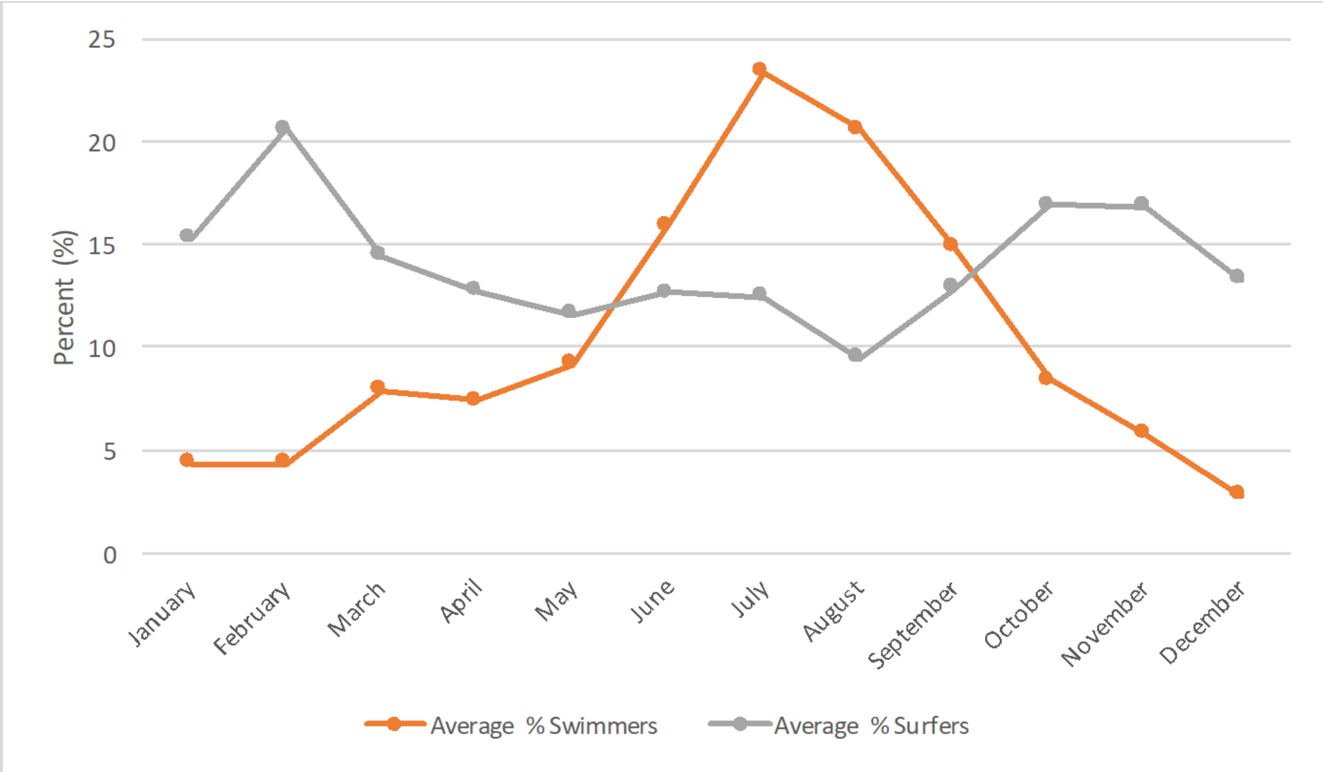
Recreation Benefits

Wet day forgone trips ✖ Average annual wet days ✖ Change in safe wet days ✖ Value per trip = Average annual benefit

- Calculated forgone trips based on beach attendance data for non-storm wet days
- Included all beach visitors (surfers, swimmers, and non-swimmers)
- Calculate change in safe wet days
- Trip value based on peer-reviewed survey-based study from San Diego County



Beach attendance data and modeling for daily estimates



Applied all available beach-specific attendance data (daily, weekly, monthly, annual)

Extrapolated with controls for beach type, geography

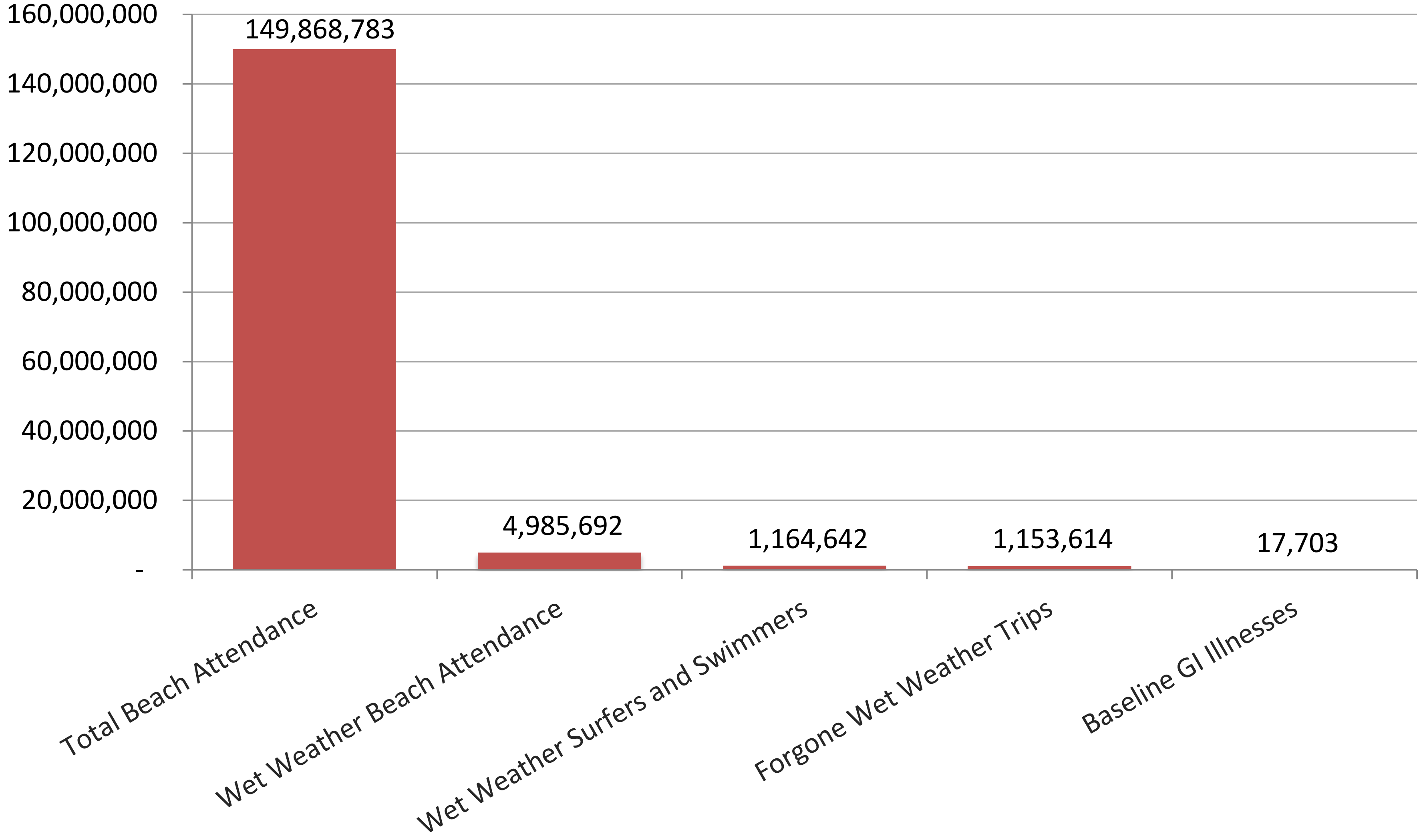
	ESTIMATE	STANDARD ERROR	p-VALUE
Precipitation (Inches)	-0.170	0.160	0.290
Mean Temperature	0.020	0.000	0.000
Rain	-0.680	0.110	0.000
Cloudy	-0.080	0.010	0.000
Rain One Day Ago	-0.290	0.090	0.000
Rain Two Days Ago	-0.180	0.110	0.110
Rain Three Days Ago	-0.330	0.100	0.000
Rain Four Days Ago	-0.250	0.070	0.000
Rain Five Days Ago	-0.230	0.080	0.010

Obs: 730, R-Sq: 0.680

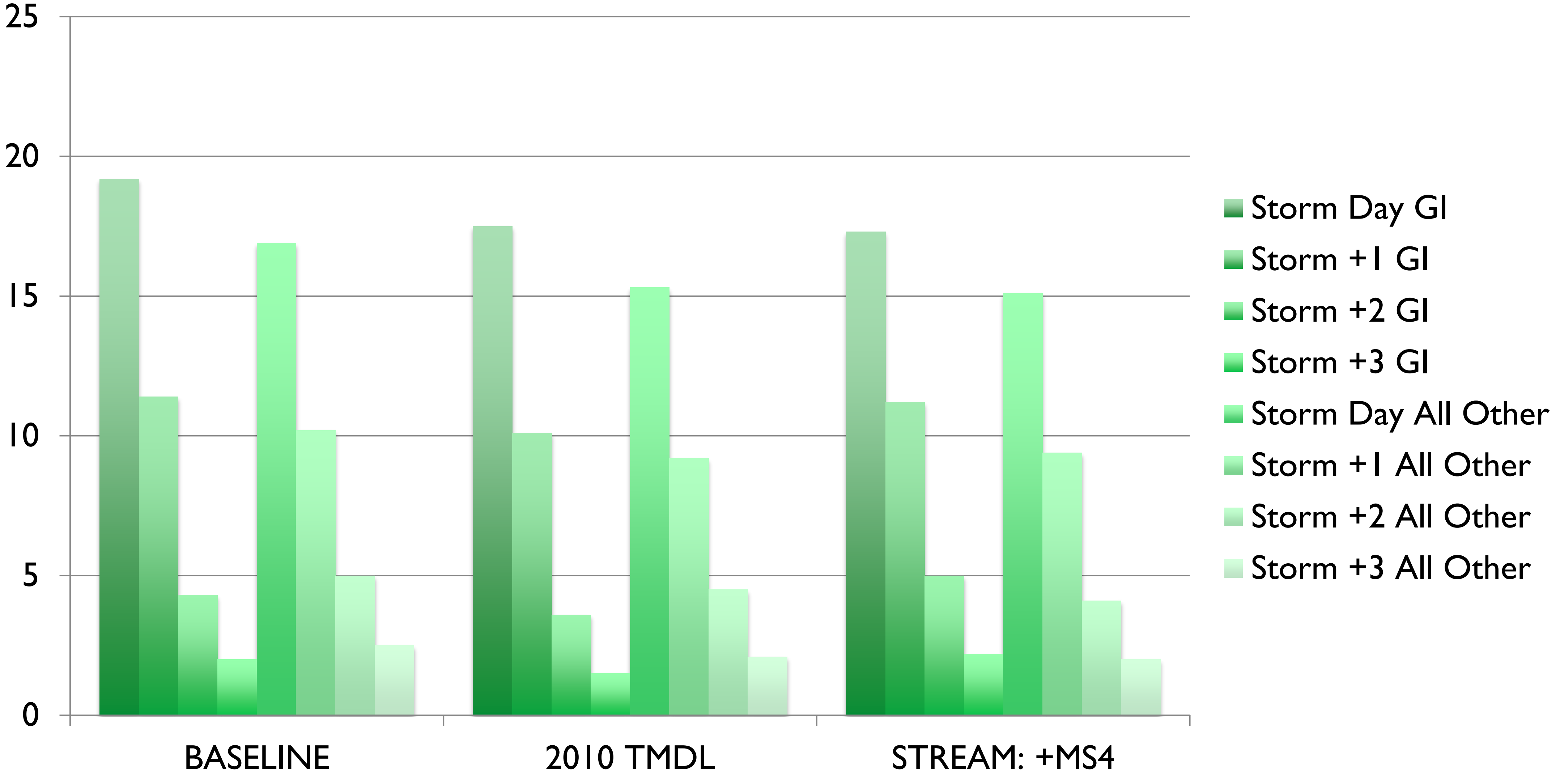
F-statistic: 55.467, df = (27; 702)

$$\ln(Attend_{it}) = \alpha_0 + \alpha_1 WEEKDAY_t + \alpha_2 MONTH_t + \alpha_3 BEACH_i + \alpha_4 PRECIP_{it} + \alpha_5 TEMP_{it} + \alpha_6 RAIN_{it} + \alpha_7 CLOUDY_{it} + \alpha_8 RAIN1_{it} + \alpha_9 RAIN2_{it} + \alpha_{10} RAIN3_{it} + \alpha_{11} RAIN4_{it} + \alpha_{12} RAIN5_{it} + \epsilon_{it}$$

Annual wet weather beach trips and exposures small share of total

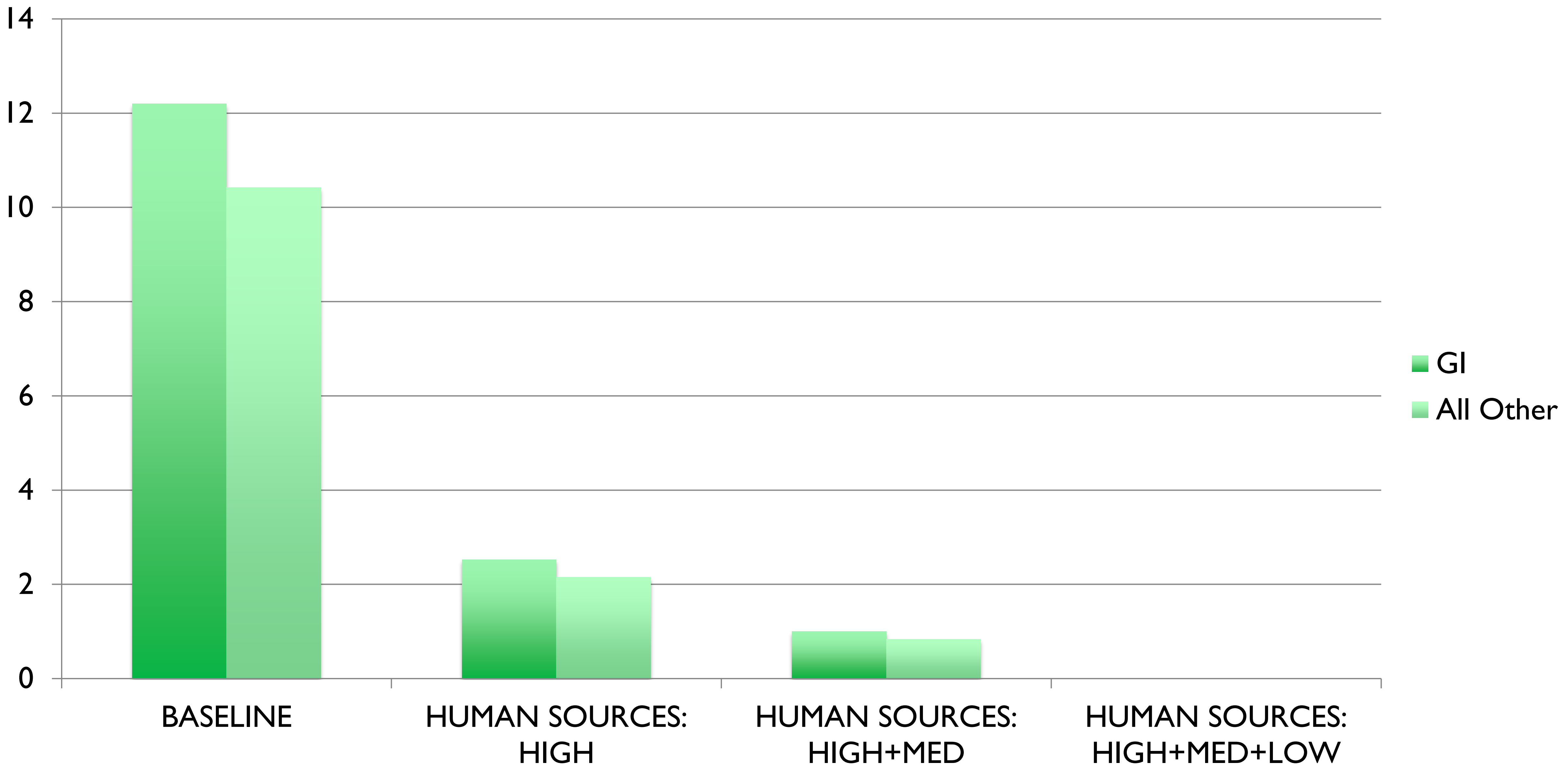


Baseline illness rates are low, and don't change much with BMPs



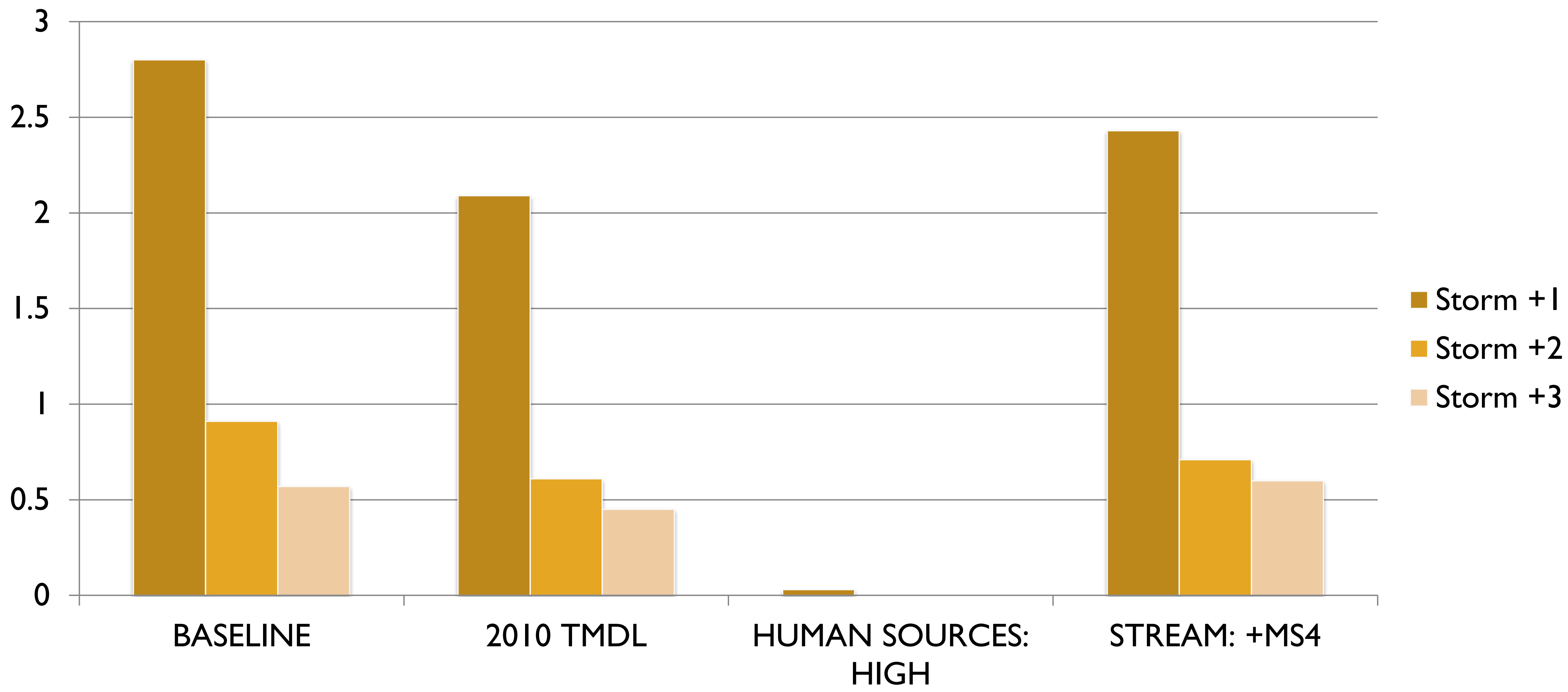
San Diego County, per 1000 exposures

Efforts targeting human pathogen sources have much more effect



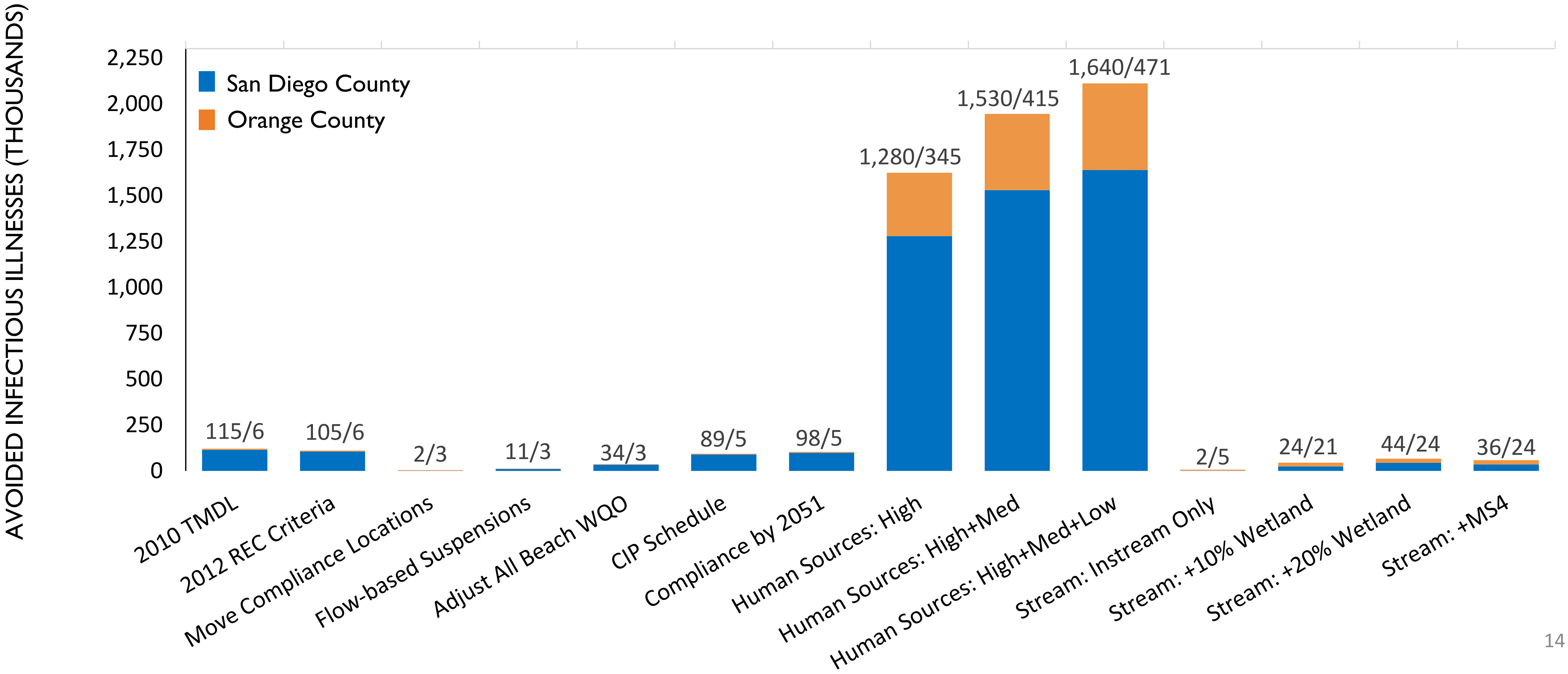
Average of all watersheds, per 1000 exposures

Change in unsafe swimming days follow similar patterns

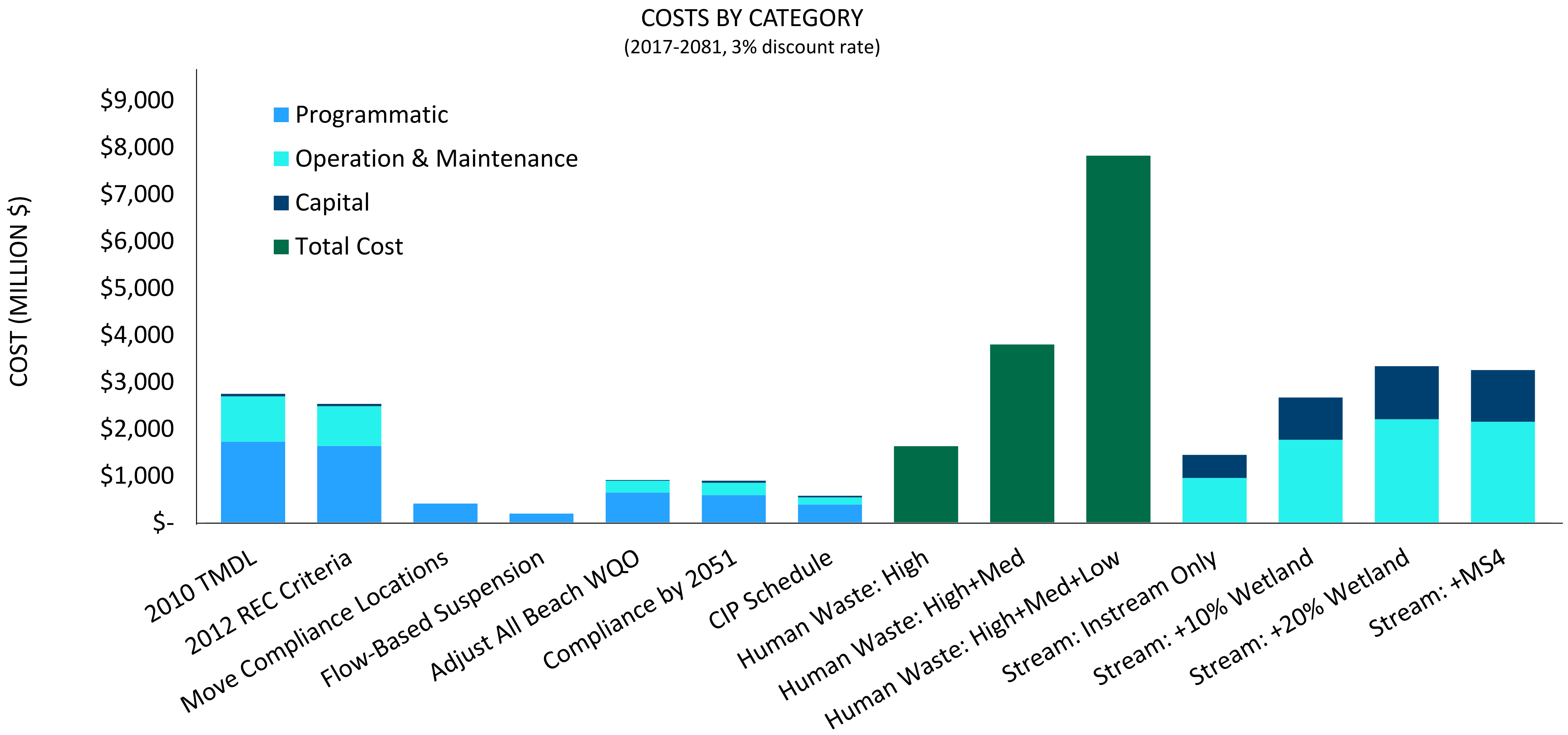


San Diego County Data

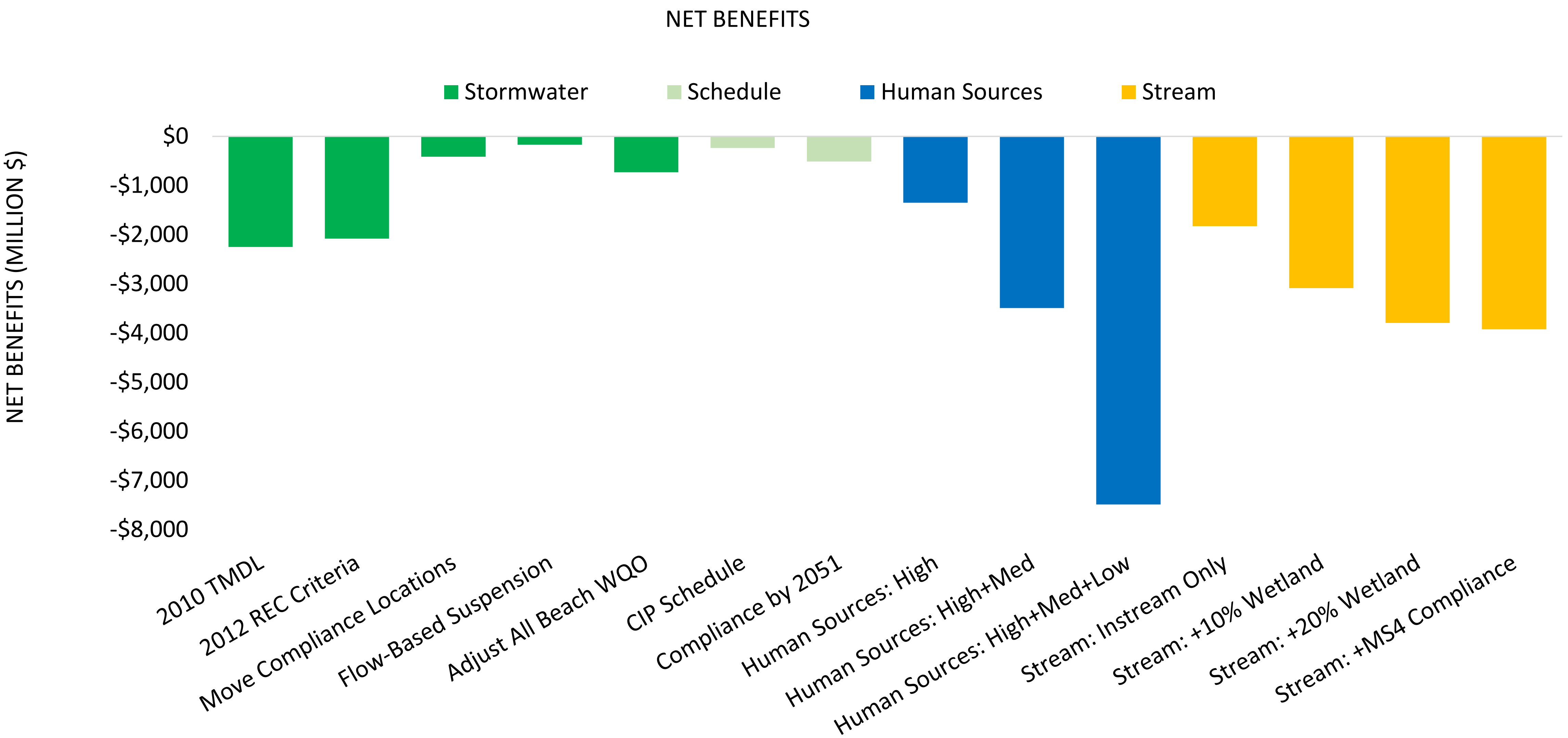
Avoided illnesses over 65 year timeframe are highest for direct human source pathogen control



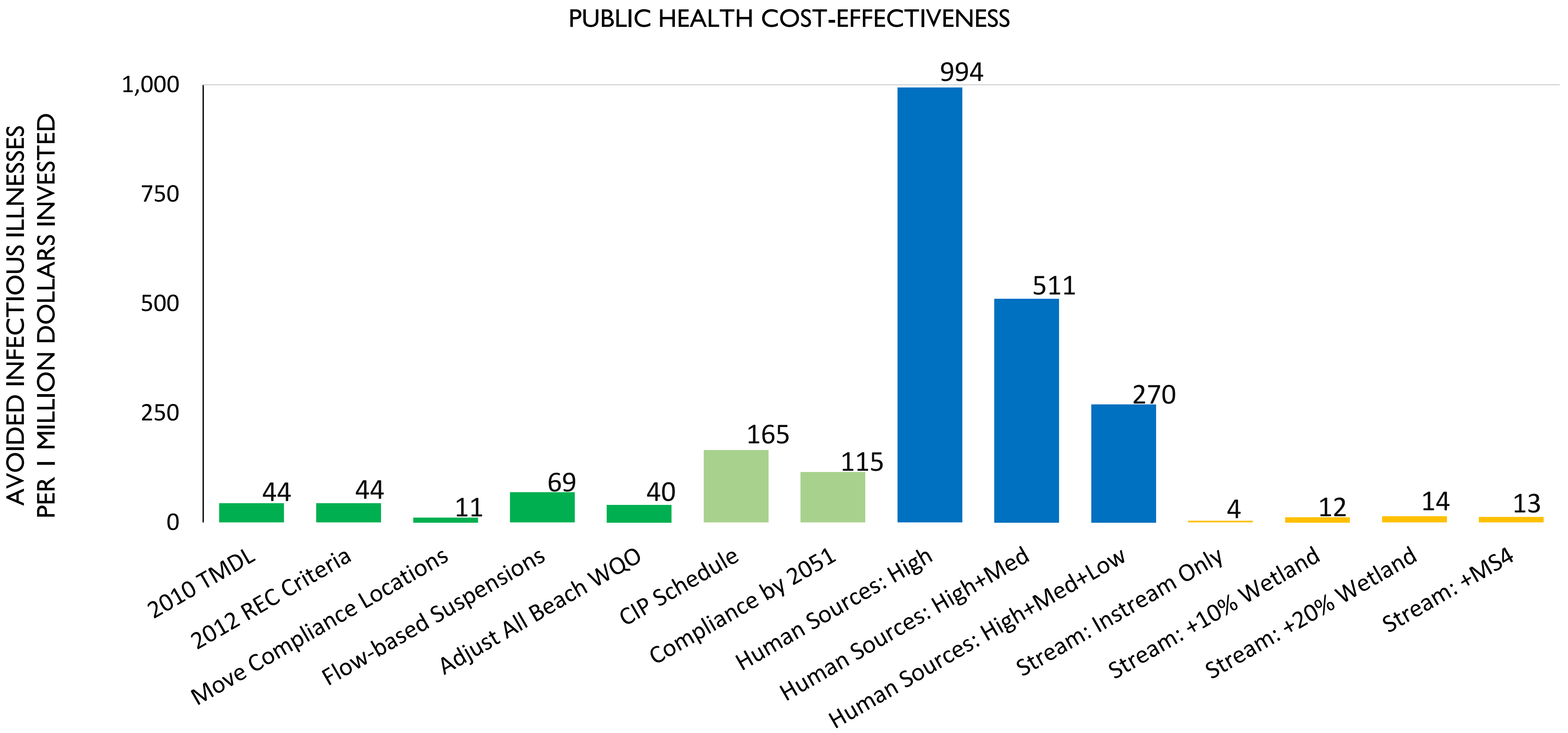
Scenario costs ~$1-$8 billion



Quantifiable net benefits are negative (including co-benefits)



Human source pathogen targeting is most cost-effective



Conclusions

- All water quality investments don't necessarily make sense
- $Total\ benefits\ \neq marginal\ benefits$
- Regulatory compliance should:
  - Determine local overall WQ budget (household **and** business affordability)
  - Identify locally highest value, most scarce water quality uses
  - Evaluate most cost-effective structural and non-structural strategies across all pollutants and constraints

https://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/docs/issue3/Final_CBA.pdf

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