Development of a pathogen prediction tool for south County coastal communities

- Previous work has improved our understanding of untreated sewage transport in coastal ocean
- Next step is to develop an operational forecast model

The San Diego Union-Tribune

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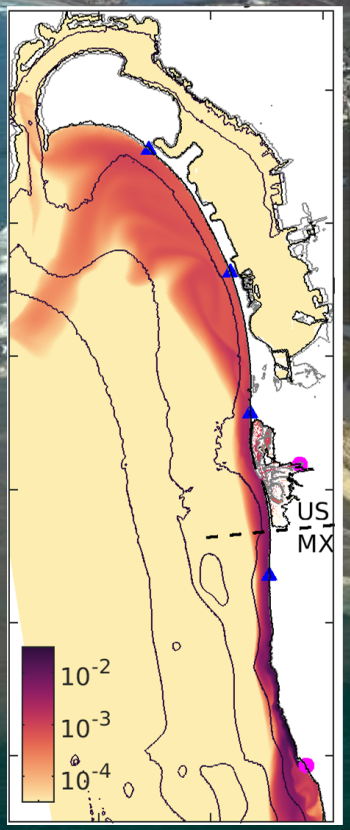
Tijuana sewage pounded South Bay beaches last year. EPA says help is on the way

Signs warn of contaminated ocean water in Imperial Beach on May 30, 2019. Recent rains have contaminated the water in the region near the mouth of the Tijuana River. (K.C. Alfred/The San Diego Union-Tribune)

Imperial Beach shoreline near the international border was closed for 295 days last year.

BY JOSHUA EMERSON SMITH, WENDY FRY

FEB. 13, 2021 7 AM PT



Prior SIO Modeling Work:

- showed importance of Pt. Bandera
- consistent with SD County ddPCR sampling
- funded by NSF and EPA

Photo: Serge Dedina

Development of a pathogen prediction tool for south County coastal communities

Next: Beach Forecasts of Human Illness Risk for the US/Mexico Border Region

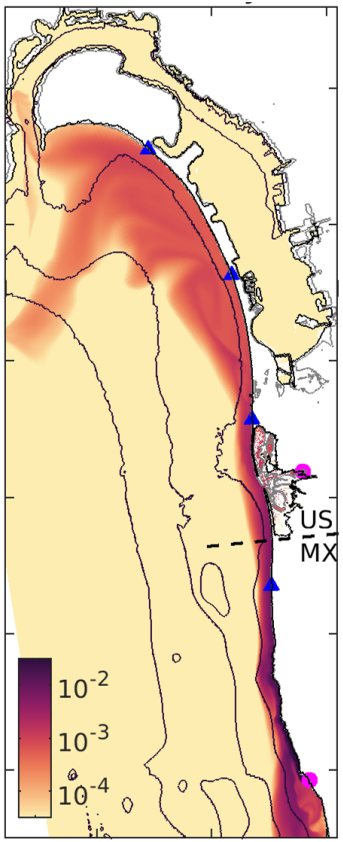
Scripps Institution of Oceanography, UC San Diego

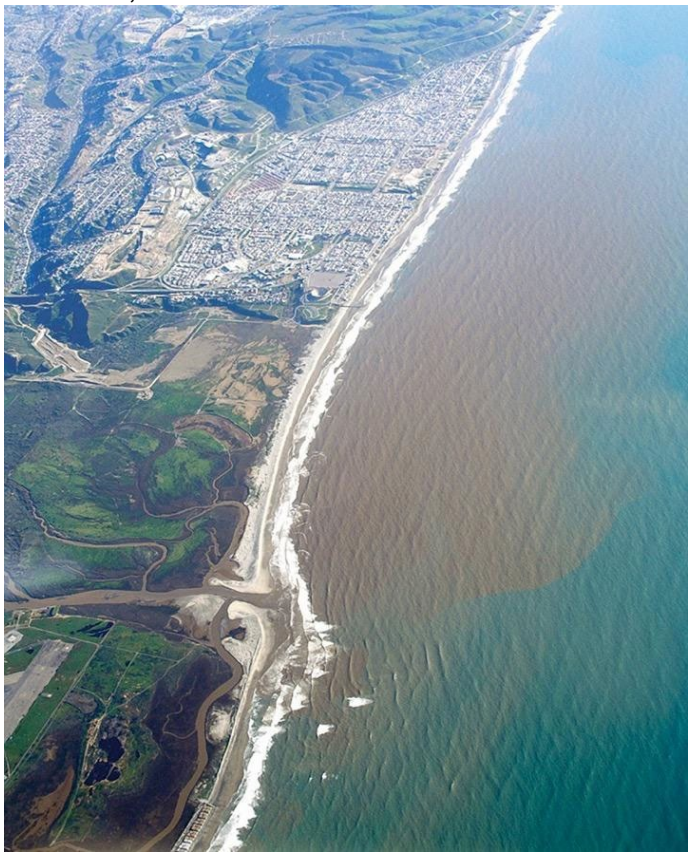
Feddersen, Giddings, Barton, Bowman, Send, Spydell, Cornuelle, Anderson

Goals

- Allow family in Chula Vista to know whether can take kids to the beach on the weekend
- Support water quality infrastructure investment validation via robust monitoring

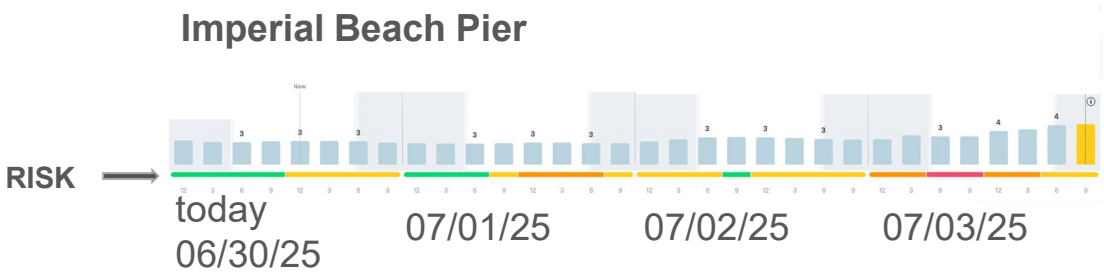
- Combine pathogen ecology & hydrodynamic models in forecast mode
- Leverage previous investment by NSF and NADB/EPA
- Provide regional 3-5 day forecasts for beach swimmers
- Interdisciplinary: Involves multiple SIO PIs
- Will complement Scripps airborne pathogen research and SDSU TJRE reserach





Pathogen Forecast Model potential webpage mockup

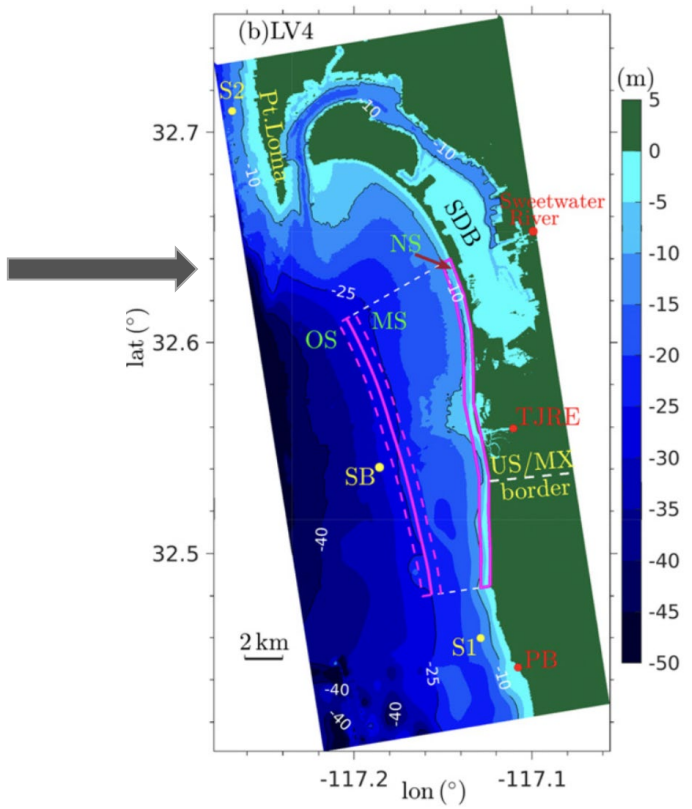
The pathogen model webpage will have information like this. Locations on the map will be clickable to show forecast (e.g., surfline/weatherunderground) of **Swimmer Illness RISK**.



Components
1. Computing
2. Pathogen Ecology Experiments
3. Real time Mooring Deployment
4. Measurements in Mexico

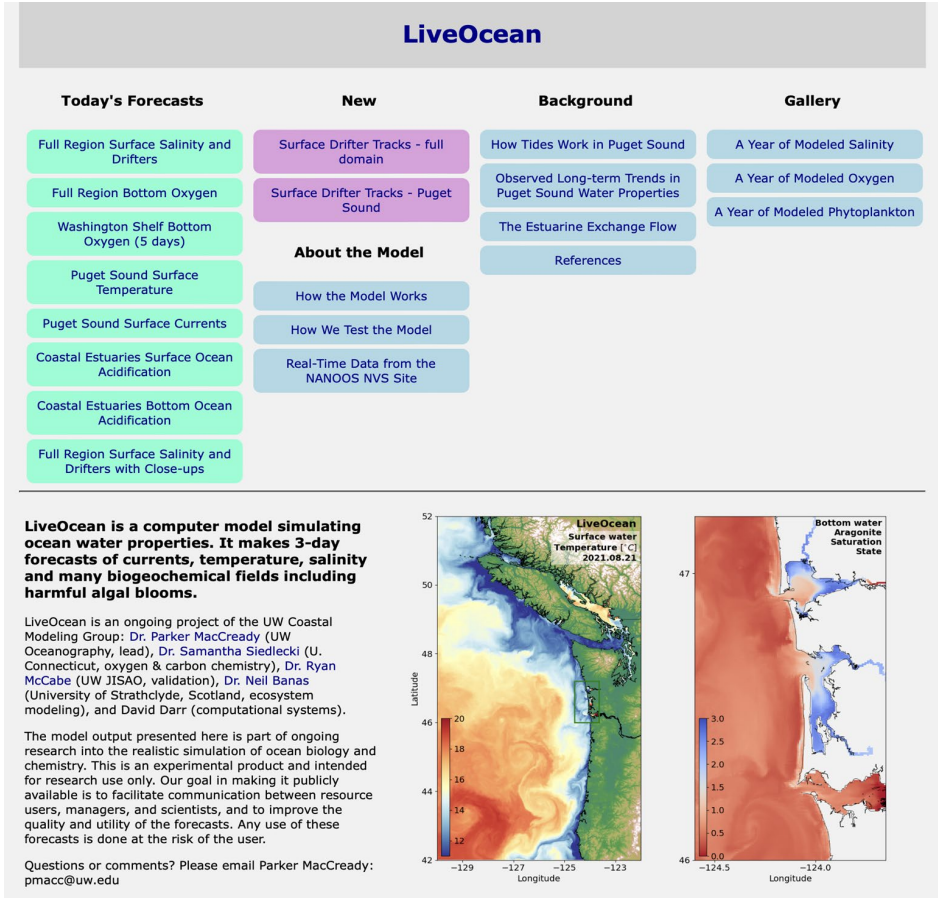
Resources

- Pathogen forecast model will be run locally on a 400 CPU cluster.
- Cluster is now operational.
- Software is currently being developed to run the forecasts.
- The region has been previously modeled and this software is being used for the Pathogen forecast model.
- The “Live Ocean” forecast model is public and similar. We are using this existing software for the Pathogen model.



Example of Another Forecast Model (LiveOcean)

- LiveOcean is an analogous forecast model system for Pacific Northwest focussed on Harmful Algal Blooms
- LiveOcean is open-source software which we will adapt to our purposes



Observations of pathogens to support pathogen transport model

Collect critical data to support the development of a pathogen transport model:

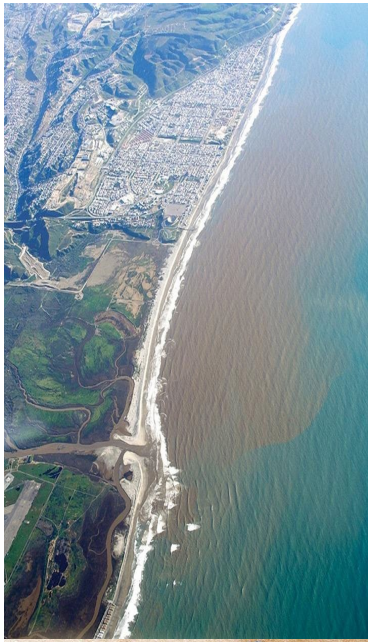
- Pathogen load
- Pathogen persistence

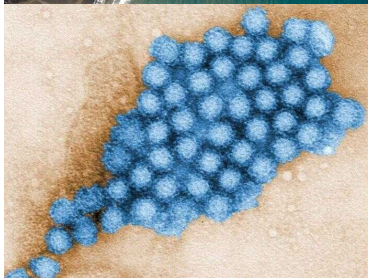
Initial efforts focused Norovirus, pathogen gives most swimmer risk

- Norovirus is a common food and water-borne pathogen that causes severe gastrointestinal symptoms
- Infectious at low numbers
- Previously detected following storm events at regional rivers (Tourmaline Creek and San Diego River)
- Other pathogens to follow

Due to small size and low abundance, Norovirus is difficult to capture and detect in water. We have:

- Developed methods to capture Norovirus at low cost, at the scale needed for developing and testing the model
- Optimized a ddPCR-based method for detecting Norovirus. The ddPCR methods will be extended to other pathogens to supplement ongoing efforts by San Diego County

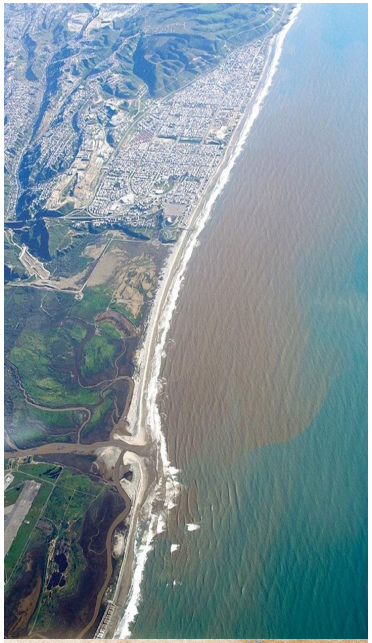


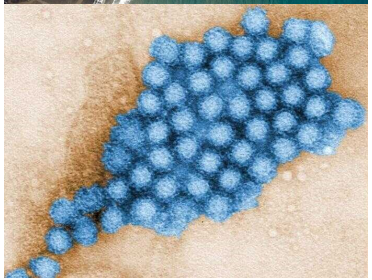


Observations of pathogens to support pathogen transport model

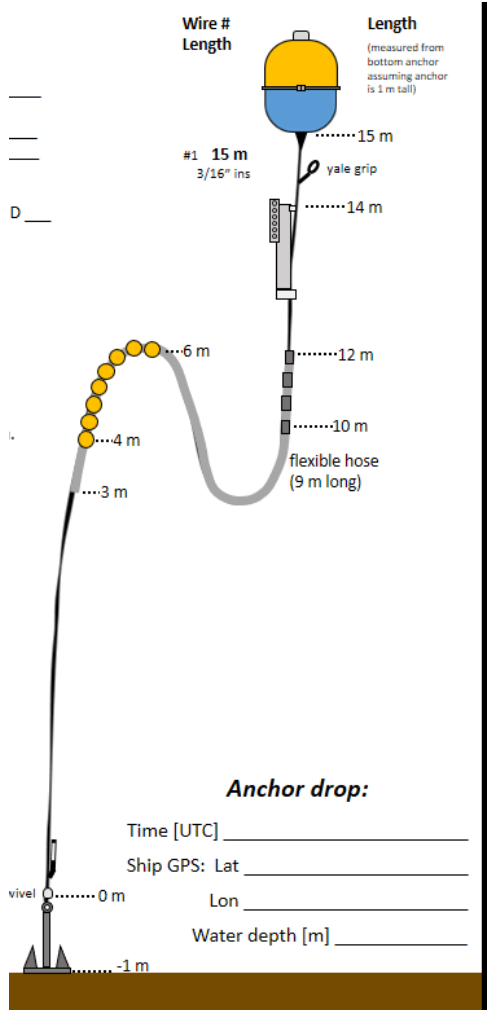
Preliminary field work in the TJR system and offshore of IB has started, with our full field program scheduled to begin in June.

Fieldwork will coincide with laboratory experiments to determine how long Norovirus and other pathogens are viable in the environment.





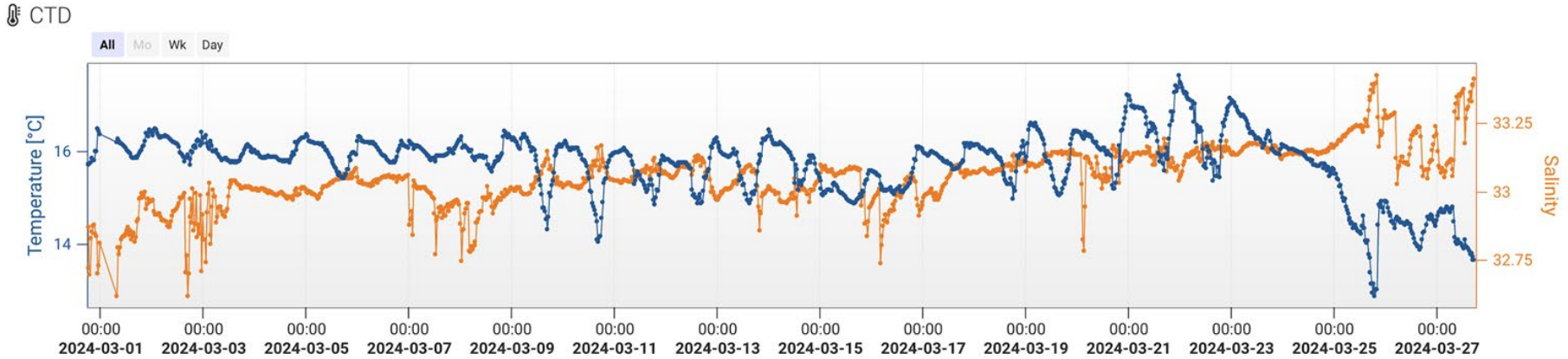
IB mini-mooring network to support model



- permits in hand
- test mooring in water
- sensors ordered
- mini-mooring bodies ready

Ongoing test deployment with real-time data

https://mooring.ucsd.edu/mini_moorings/ib-c/ib-c_01/



Tentative timeline:

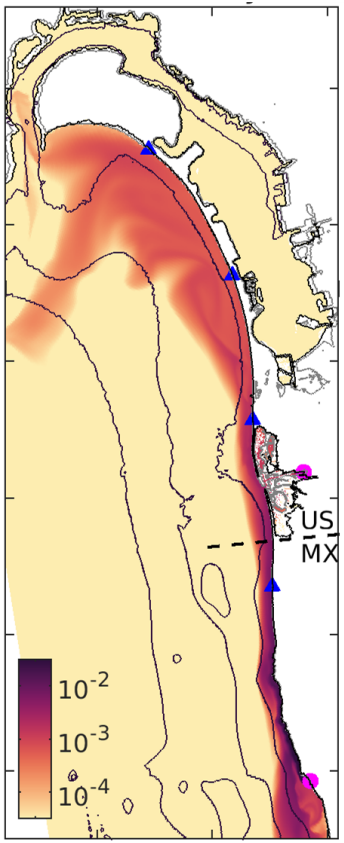
- March-May engineering test deployment
- June-July ADCP current sensor test deployment
- August-September test of one mooring with all sensors
- October-December trial operation of complete mini-mooring array
- 2025 begin of routine operation of array

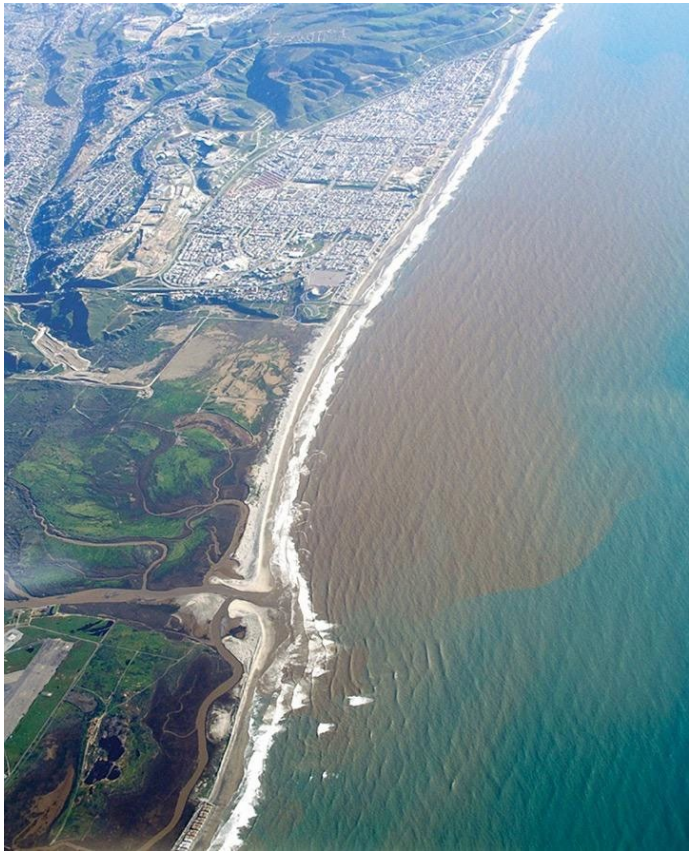
Current observations in Mexico to support model

UABC will deploy instruments in Mexico:

- Dra. Amaia Ruiz de Alegría Arzaburu
- 3 ADCPs from Pt. Bandera to Playas Tijuana
- Start this summer, maintain for a year
- Provide data to calibrate hydrodynamic model

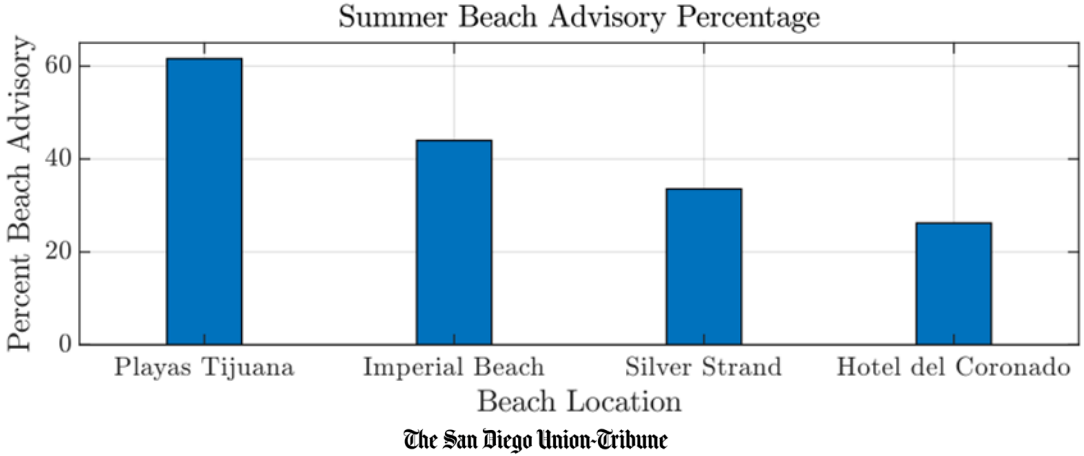
Questions?





Thank you State Senator Padilla, SD state Assembly Delegation, and many others for support

Model predicts large summer time beach advisory percentage



- *criticism*: HdC not that contaminated!
- but…FIB testing used culture based methods
- FIB die quickly
- norovirus lives a long time (14 d half life)
- summer 2022: county switched to ddPCR based method and…

ENVIRONMENT

Will Coronado, Imperial Beach shorelines be closed all summer? New testing reveals rampant Tijuana sewage

South Bay officials fear beach closures could have widespread social and economic impacts, possibly ending junior lifeguards and other programs

BY JOSHUA EMERSON SMITH

JUNE 14, 2022 3:57 PM PT

kpbs

KPBS Weekend Edition

Local

New pollution tests wreaking havoc on South San Diego County beaches

By Erik Anderson / Environment Reporter
Contributors: Roland Lizarondo
Published June 16, 2022 at 5:17 PM PDT

This is exactly what the 2017 NADB model predicted for summer 2017