Managing Water Quality in Intermittently Open Estuaries

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WRP Intermittently Open Estuaries: Science and Management Perspectives

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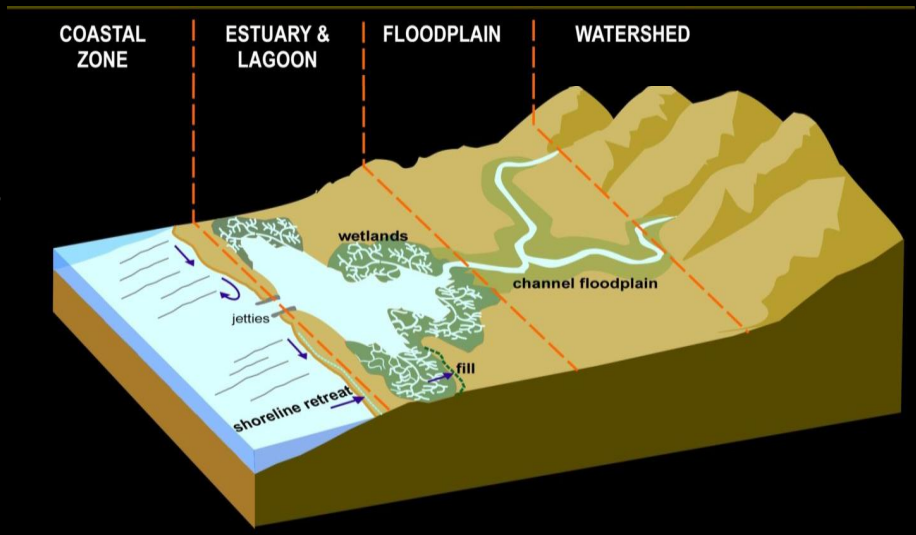
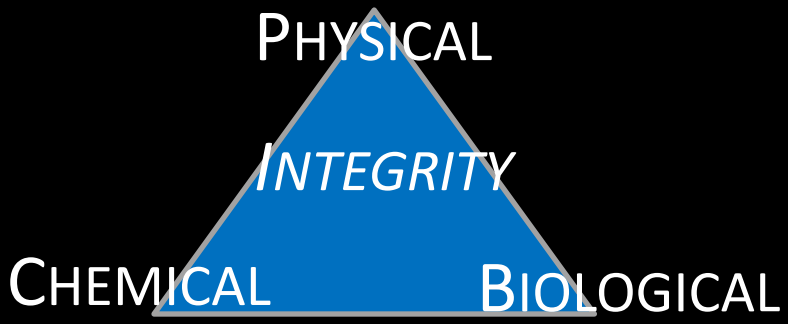
IOEs: Life on the Edge

- Subject to forcing from highly dynamic watershed and marine environment
  - Highly transient environments
  - Estuaries are small relative to watershed size
  - Extremely sensitive to anthropogenic influences
- Highly susceptible to “poor water quality” especially during inlet closure



What is "Water Quality" and Why is This a Problem for IOE Management?

- Clean Water Act "water quality" is defined as:



- Many existing water quality objectives were created around time of CWA (70s and 80s)
  - Chemically focused, based on old science
- When applied to IOEs, can force unrealistic expectations and unnecessary management actions

BENEFICIAL USES

REC1

REC2

AQUA

COMM

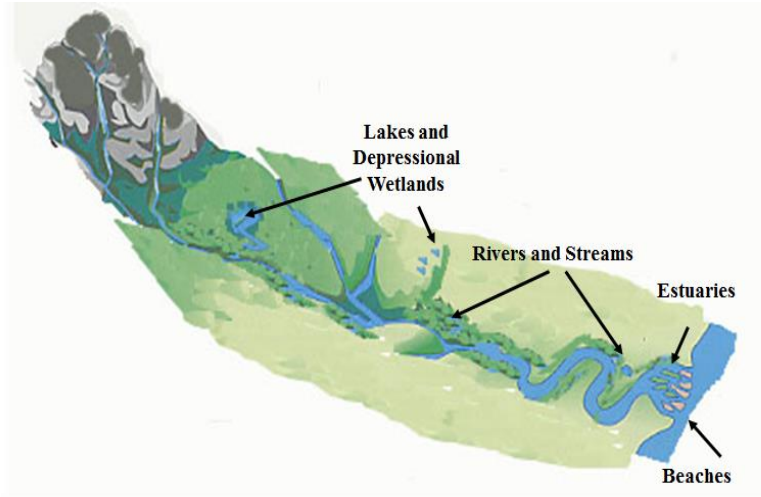
EST

MAR

RARE

Natural Landscapes, Especially Estuaries, Can Be a Source of Fecal Indicator Bacteria (FIB)

- Streams, wetlands, lagoons, etc. can provide natural sources of organic matter for bacterial regrowth
- In Southern California, estuaries are adjacent to some of the most prized recreational beaches in the world
- Current FIB WQO set to minimize risk to human health
- Puts optimal IOE management in direct conflict with "human" beneficial uses



In "Reference Estuaries" How Often Can we Exceed FIB WQO (San Onofre Estuary)

- Reference estuary is exceeding FIB WQO up to 100% of time

- Take home message: when open, estuaries have ability to readily influence beaches
  - Sets up a problem of competing uses

San Diego Estuary (Tiefenthaler et al. 2016)	E. Coli	Entero-coccus	Total Coliforms	Fecal Coliform
Winter Dry				
Single Sample Exceedances	54%	90%	4%	23%
30 Day Geomeans	70%	98%	56%	69%
Summer Dry				
Single Sample Exceedances	92%	80%	40%	54%
30 Day Geomeans	100%	100%	92%	72%

Tiefenthaler L., Sutula et al. 2006 SCCWRP TR #936

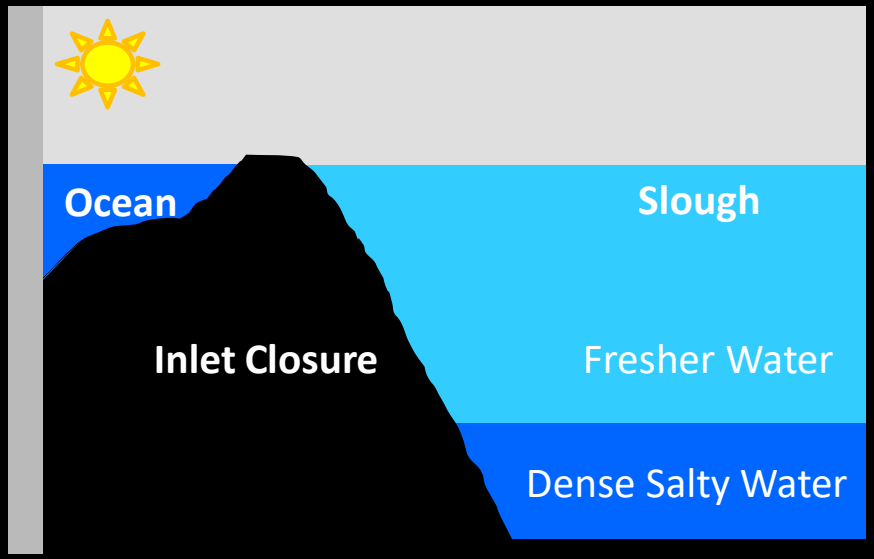
Example: Loma Alta Slough

- Bacteria TMDL mandates a > 99% load reduction to meet beach FIB WQO
- Sand berm managed to limit exposure to beach goers
  - Close inlet Memorial Day
  - No opportunity for overtopping, even during spring tides
  - Sets up hypereutrophic conditions within Slough
- Some BMPs considered:
  - UV Radiation of Loma Alta Creek Water
  - 100% diversion of Creek water to sanitary sewer

Dissolved Oxygen (DO) WQO Is Intended to Protect Aquatic Life Beneficial Uses

- Important indicator for eutrophication in IOE
  - We want to rely on this to protect our native fauna
- San Diego RWQCB Basin Plan establishes 5 mg/L as WQO
  - Chronic number based on data largely from East Coast species
  - No guidance on where it should be met--throughout the water column? Subtidal, intertidal?
  - Water Board policy on impairment = 10th percentile of 7-day average of <u>daily minima</u>

IOEs Have Naturally Low DO, At Times



Inlet Closure Can Cause "Salt Trap"

All Estuaries, but Especially Intertidal Dominated IOEs Have Lots of Source of Organic Carbon

% of Time That San Onofre and Topanga Creek (Reference Estuaries) Fall Below DO WQO

- Reference estuaries fall below DO WQO ~ 20-60% of the time
- Numeric objective itself is not unreasonable (5 mg/L)
  - Problem is we don't understand the frequency, duration that an IOE should be allowed to fall below it
  - Currently the fall back is ALL the time (or nearly so)

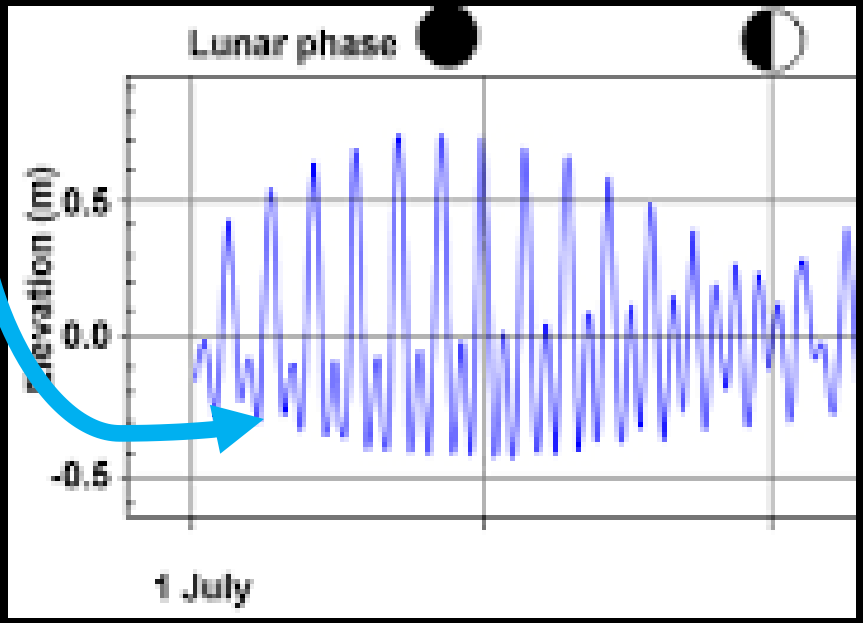
Percent of time DO in each of the reference estuaries falls within ranges associated with DO benchmarks.

% of Time Within Each DO Range	Topanga (2014)	Topanga (2009)	San Onofre (Summer)	San Onofre (Winter)
7+	63.6	18.1	32.4	42.4
5.8-7	10.2	14.7	4.6	33.8
5-5.8	6.5	10.3	3.1	8.1
4-5	3.0	10.6	3.5	4.9
2.8-4	5.9	16.1	5.9	7.7
0-2.8	10.8	30.2	50.6	3.2

Sutula, Largier et al. 2016 SCCWRP TR #936 and Sutula and Gillett 2016 TR 938

Need for Paradigm Shift From "7-day Average of Daily Minima" in IOEs

In IOE, DO minima coincide with periods of DAILY ebb tides, as carbon rich water drains from mudflats and marsh, in addition to nighttime respiration



Estuary	10th Percentile of 7-Day Mean of Daily Minima (mg/L)
San Onofre Creek (2014-2015)	0.1 – 3.5 mg/L
Topanga Creek (2008, 2014)	0.8 – 3.3 mg/L
San Elijo Lagoon (2008-16, NC)	0.7 – 3.5 mg/L

IOEs will consistently fail DO WQO using this approach to calculate "exceedances", with reference estuaries looking no better than a clearly impacted one.

What is the Way Forward?: Recommendations to Consider

Status quo is unexceptable, because existing WQO force tradeoff for between "climate ready" IOE management and water quality

Three Major Recommendations to Consider

- Embrace that fauna in these estuaries live "life on the edge," even more so with pending sea level rise, ocean acidification and hypoxia, changes in temperature and freshwater flow = urgency to create new paradigms
- Break down silos between "habitat restoration" and "water quality" communities
  - Remove discussion of goals from the "heat of the moment"
- Improve science of chemical and biological assessments

Breaking Down Siloes of Restoration Versus Water Quality

We've started to do this, but we still have a ways to go…..

Completed or Ongoing Restoration Projects that Have "Considered" Water Quality in Their Designs

- Malibu Lagoon – included as restoration objective
- Famosa Slough – restoration only way to fix eutrophication problem
- San Elijo Lagoon - water quality improvement key feature in preferred alternative
- Buena Vista Lagoon– EIR modeling analysis included consideration of water quality

Establish Chemical and Biological Objectives for IOE (or Improved Existing Ones)

- Chemistry
  - Structure expectations to sync with real requirements of resident and migratory species (water and sediment)
- Invertebrates
  - Benthic macroinvertebrate index (SQO) optimized for enclosed bays and habitats > 17 ppt– needs improvement for IOE in open state, not appropriate for closed condition
  - Pelagic invertebrates may be more appropriate for IOEs, but few studies exist at this point.
- Algae and vascular plants
  - Developed thresholds for macroalgal biomass, but this is a blunt tool
  - Benthic microalgae could be a scapel, but are completely understudied
  - Thus far, we have completely ignored seagrass habitats

Thank You!

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