Understanding The Now:
Efforts to Reduce Indicator Bacteria Concentrations

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Presentation Outline

- Sources and Migration Pathways
- Efforts to Reduce Fecal Indicator Bacteria (FIB)
  - In dry weather
  - In wet weather
- Outcomes
- Conclusions and Takeaways

Sources and Migration Pathways

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FIB Sources & Categorization Framework

Common Human Waste Sources

- Sanitary Sewer Overflows (SSOs)
- Leaky Sewer Pipes (Exfiltration)
- Illicit Connections to MS4
- Leaky or Failing Septic Systems
- Porta-Potties
- Bathers and Open Defecation
- Boats and RVs
- Dumpsters and Trash Cans
- Garbage Trucks
- Illegal Dumping
- Illegal Discharges
- Gray Water Discharges

Common Non-Human Sources Related to Human Activities

- Pets (Dogs, Cats, etc.)
- Livestock (Horses, Cows, etc.)
- Rodents (Mice, Rats, etc.)
- Dumpsters and Trash Cans
- Garbage Trucks
- Animal Manure/Compost
- Washwater
- Green Waste
- Litter
- Grease Bins/Traps
- Irrigation Runoff

Common Non-Human Sources Independent of Human Activity

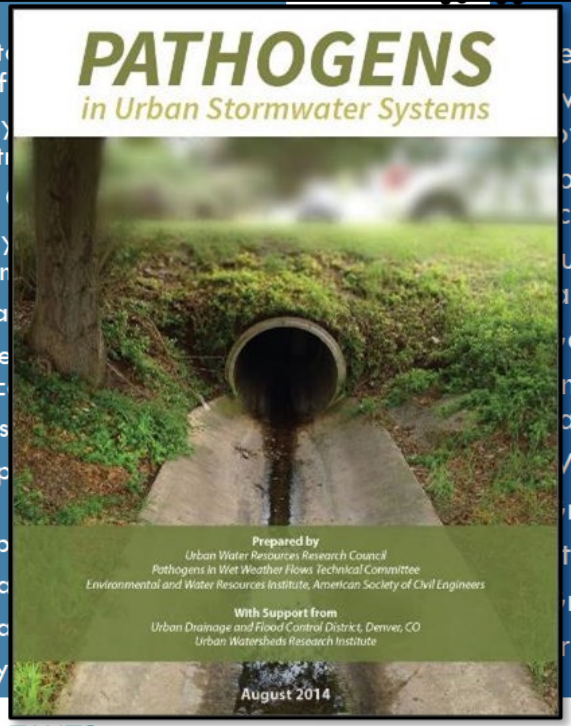
- Birds (Geese, Gulls, Pigeons, etc.)
- Wildlife (Raccoons, Birds, Deer, Coyote, etc.)
- Non-Fecal Sources:
  - Decaying Plants
  - Algae and Biofilms
  - Soil/Sediment

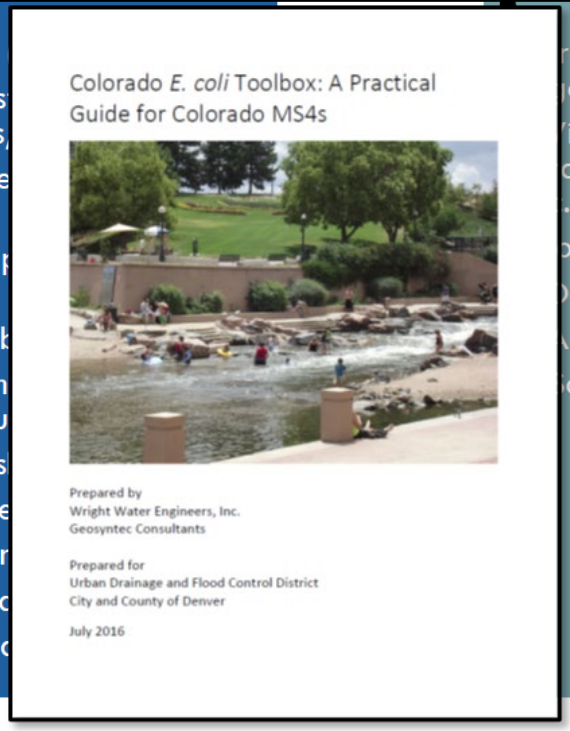
FIB Sources & Categorization Framework

For further discussion of sources & categorization framework, see available nationwide guidance:

Common Human Waste Sources

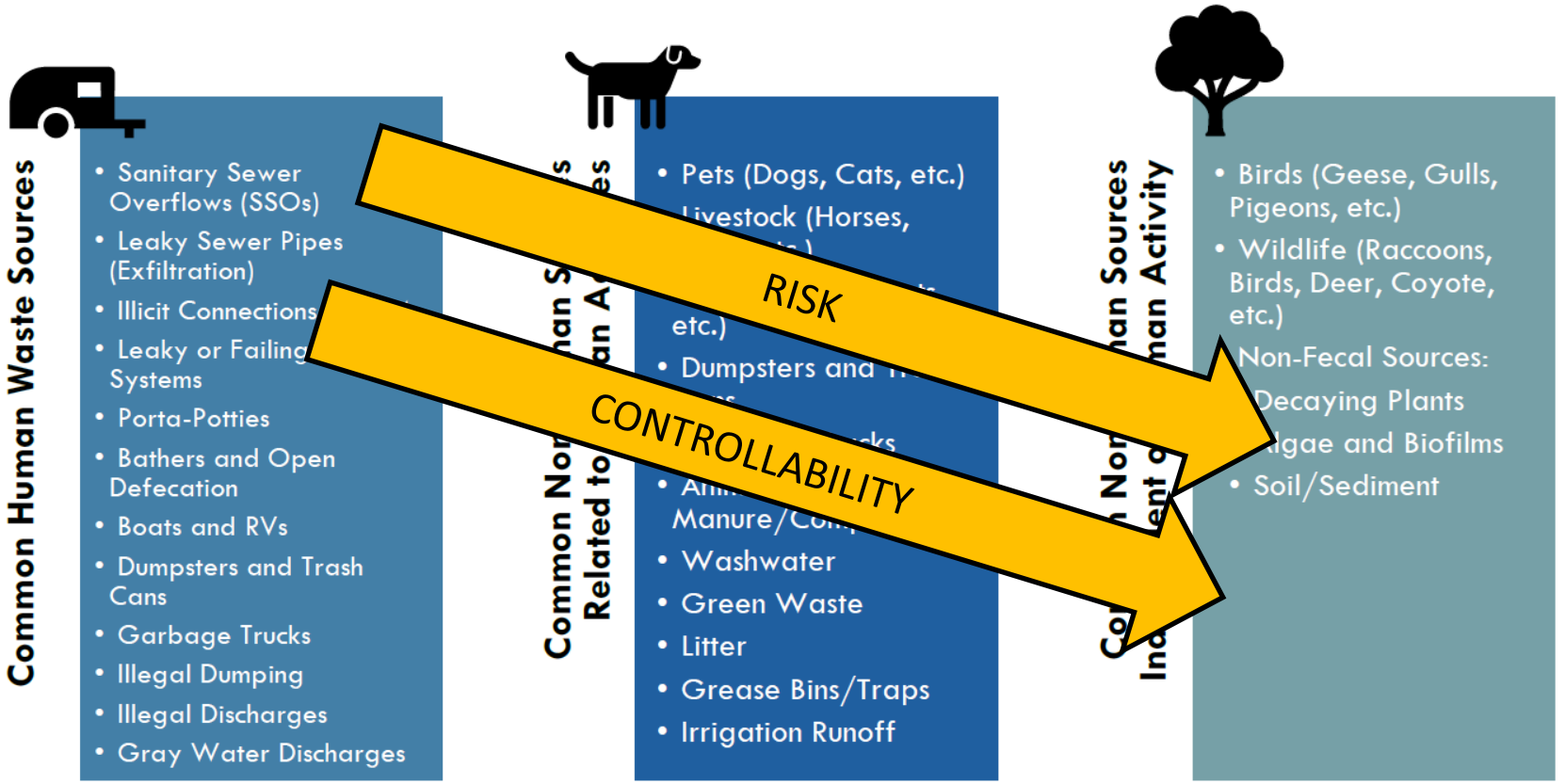
- Sanit… Overf…
- Leaky (Exfilt…
- Illicit …
- Leaky Syster…
- Porta…
- Bathe… Defec…
- Boats
- Dump… Cans
- Garb…
- Illega…
- Illega…
- Gray…



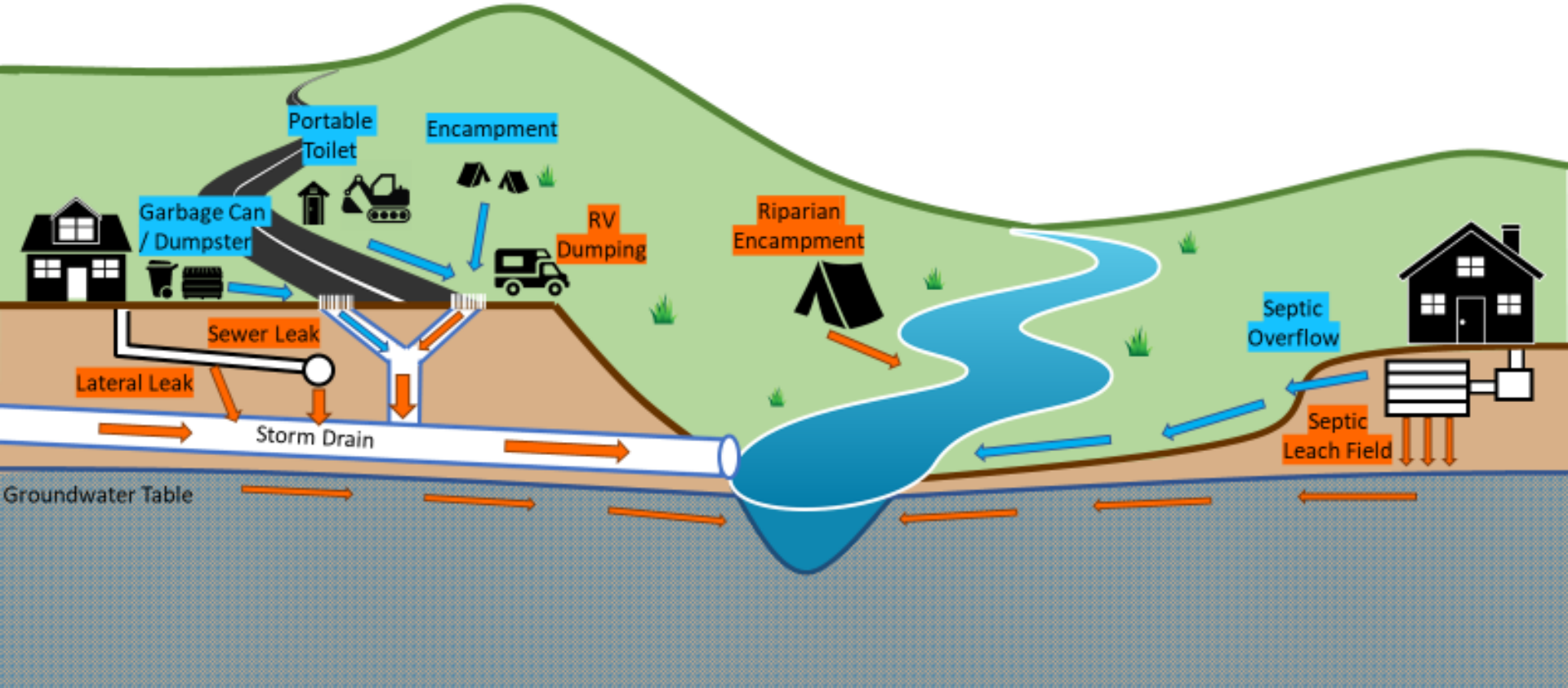


- …rds (Geese, Gulls, …eons, etc.)
- …ildlife (Raccoons, …ds, Deer, Coyote, …)
- …n-Fecal Sources:
- …ecaying Plants
- …lgae and Biofilms
- …oil/Sediment

FIB Sources & Categorization Framework



Conceptual site model of typical dry and wet weather **human waste sources** and their migration pathways



Efforts to Reduce FIB

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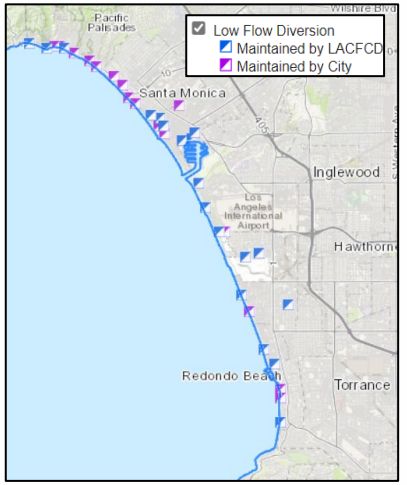
Low Flow Diversions (LFDs) to Sanitary Sewer



- Dry weather strategy
- Numerous examples across coastal Southern California (e.g., Santa Monica Bay Beaches)
- Benefits (dry weather only)
  - Achieves MS4 compliance (by preventing discharge)
  - May improve receiving water quality (multi-pollutant)
  - May improve health risk (where waste sources diverted)
- Limitations
  - High cost per diversion (up to $1M+)
  - Not feasible everywhere (e.g., no nearby sewer, sewer owner restrictions, easement challenges, no power access)
  - Minimal wet weather benefit (even disincentivizes IDDE so waste sources persist in wet weather)
  - Environmental impact (e.g., power, prevents natural flows)

Low Flow Treatment (e.g., UV disinfection)

- Dry weather strategy
- Numerous examples across coastal Southern California (e.g., Santa Barbara, Orange, and SD Counties)
- Benefits (dry weather only)
  - Achieves MS4 compliance (by meeting concentration limits)
  - May improve receiving water quality (multi-pollutant)
  - May improve health risk (where pathogens sterilized)
- Limitations
  - High cost per system (often $1M+)
  - Requires pretreatment to remove solids and organics
  - Not feasible everywhere (e.g., easement challenges, no power access, vandalism risks)
  - Minimal wet weather benefit (even disincentivizes IDDE so waste sources persist in wet weather)
  - Environmental impact (e.g., power, sterilizes natural fauna)

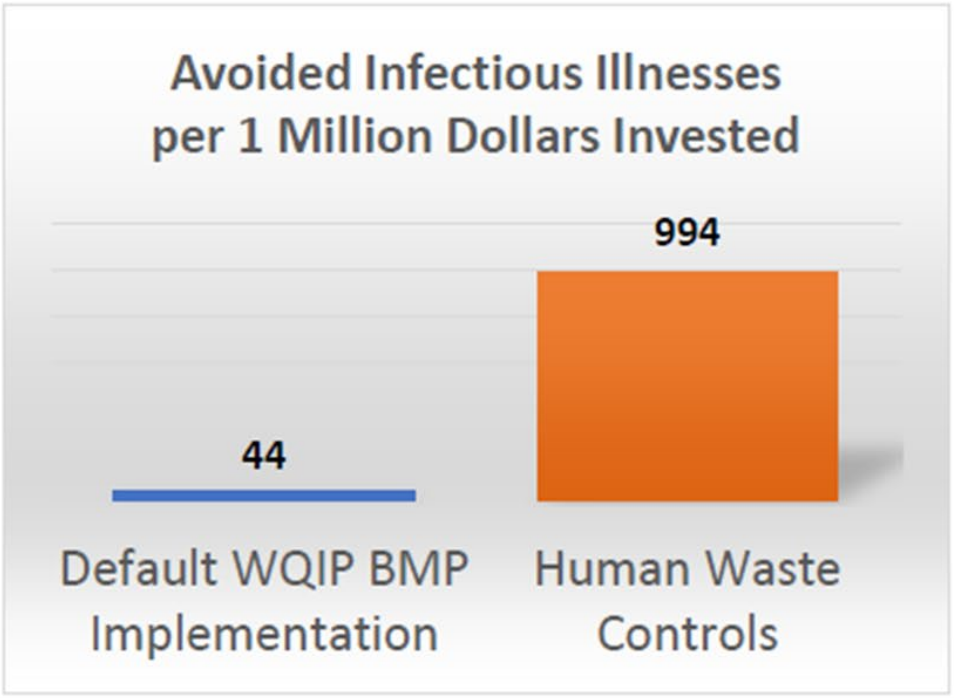
Stormwater Capture and Green Infrastructure (GI)

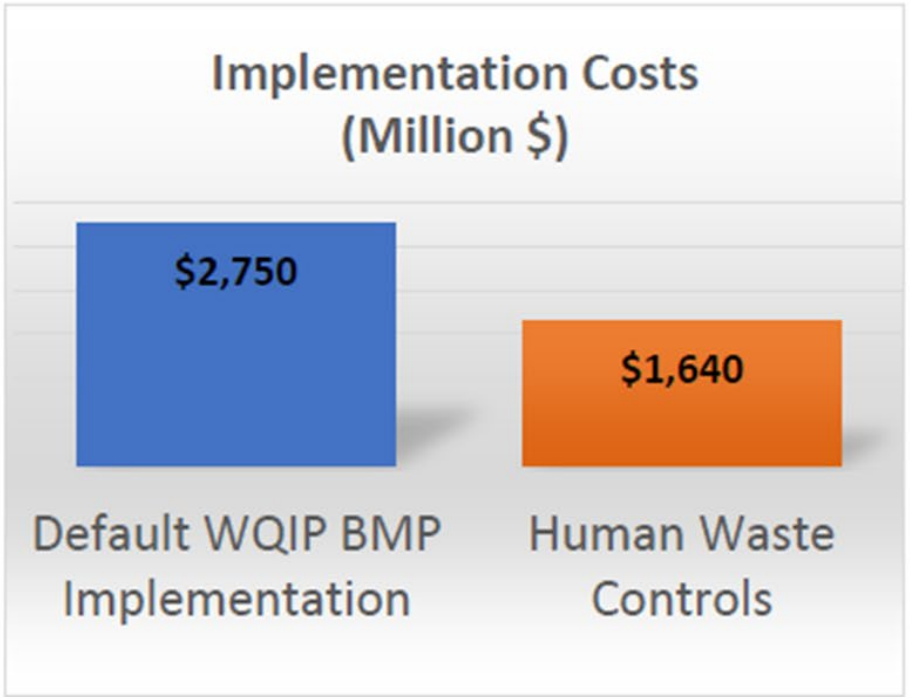
- Mostly wet weather strategy
- Numerous examples across Southern California (especially LA, SD)
- Benefits
  - Achieves *interim* wet weather compliance through Reasonable Assurance Analysis (RAA) modeling
  - Projects often multi-benefit and/or sited in disadvantaged communities
- Limitations
  - High cost (>$15B in LA/SD regions) is beyond available funding
  - Reduces volumes and loads but possibly not FIB concentrations, so unknown if it will actually achieve FIB objectives in receiving waters
  - Not currently designed for human waste/pathogen reduction, e.g.,
    - Green streets often designed for surface runoff capture, missing belowground waste inputs
    - Siting based on opportunity and maximizing volume capture (or FIB load), not maximizing *pathogen* capture

Human Waste Control Strategy

- Dry and wet weather strategy
- Examples: South OC (dry and wet), SD County (dry only)
- Benefits
  - Controls pollutants at the source (typically preferred strategy for stormwater)
  - May improve receiving water quality (multi-pollutant)
  - Designed to reduce health risk (by reducing pathogen loading)
  - Lower cost than structural controls – greater illness risk reduction per dollar
- Limitations
  - Often does not reduce FIB significantly, so compliance outcome is less certain
    - May require regulatory modification (Basin Plans, TMDLs), otherwise structural controls may still be needed
  - Intermittent human waste sources may be infeasible to identify and abate

Premise for Human Waste Control Strategy





Data Source: Cost Benefit Analysis of San Diego Region Bacteria TMDLs

Outcomes
(aka, What's Working?)

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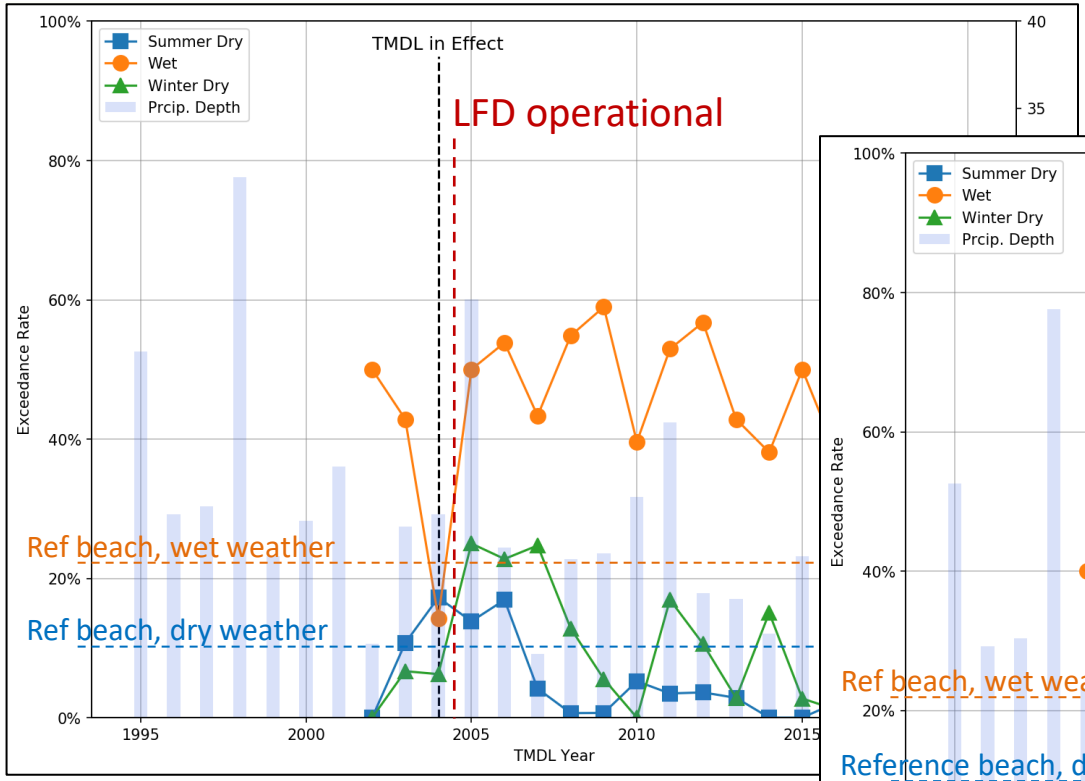
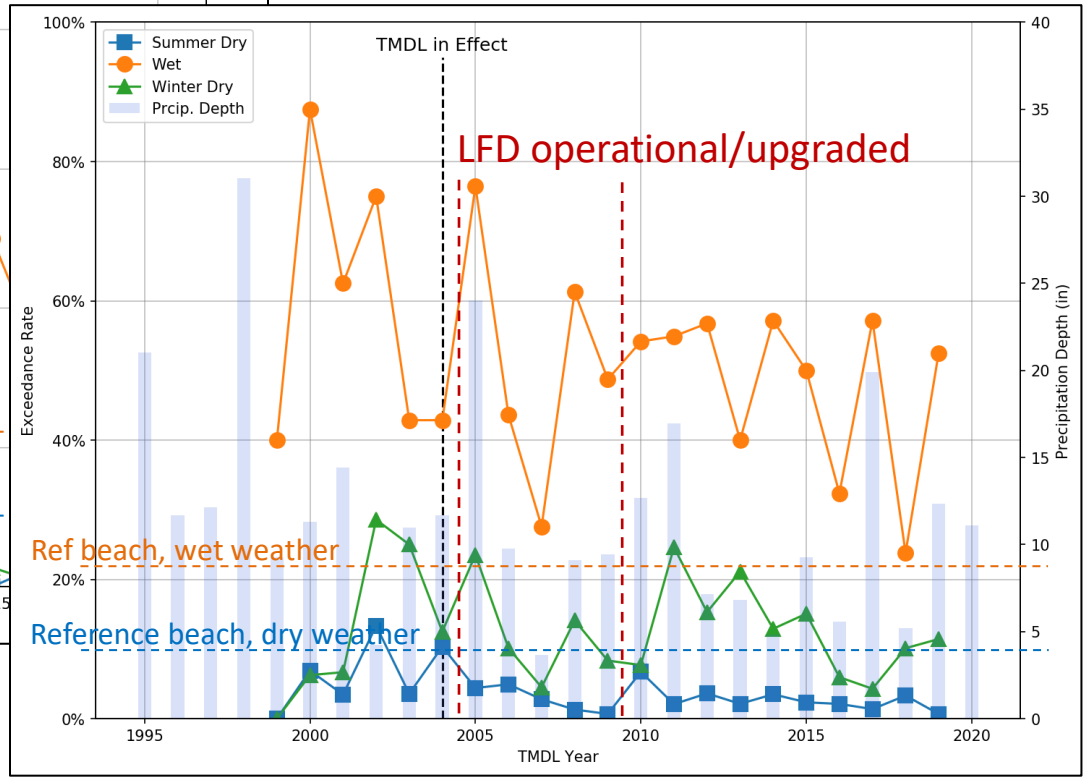
LFDs at Santa Monica Bay Beaches

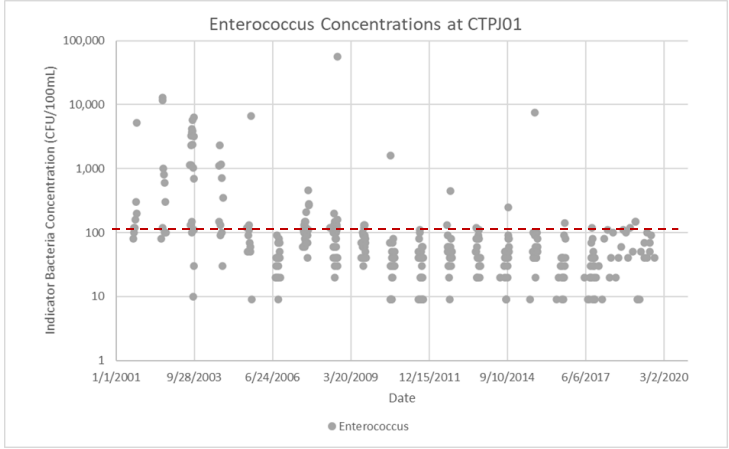


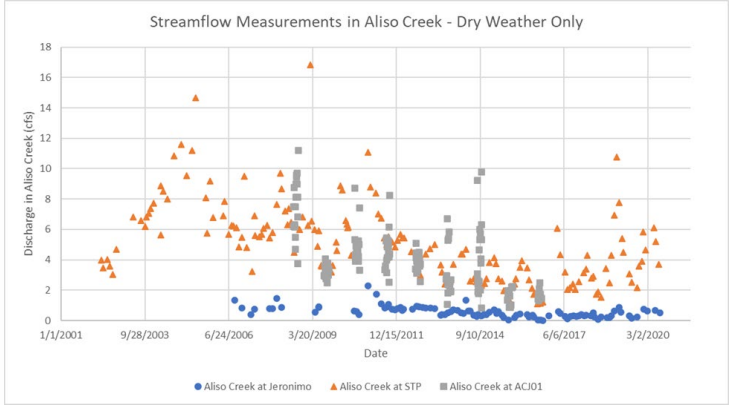
Dry weather improvement evident, though objectives still occasionally exceeded



Human Waste Control Strategy in South OC

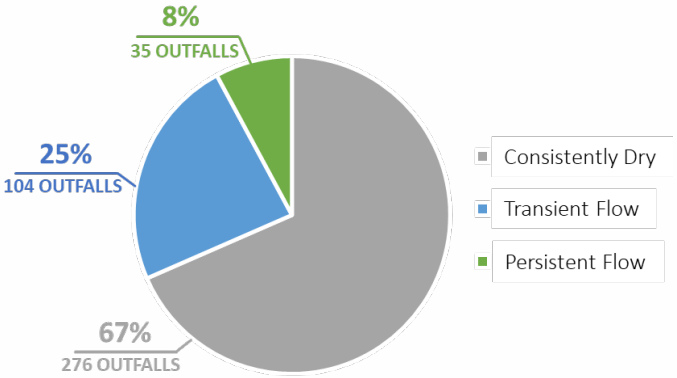
- Controlling sources of both bacteria and unnatural flows
- Methods: enhanced IDDE (including with advanced analytical forensics) and targeted low flow structural controls
  - Diversions, UV disinfection, wetlands
- Outcome: 2021 dry weather TMDL compliance demonstration showed
  - Receiving water limits met at 22 of 29 TMDL beach and creek segments, and
  - For many others, >90% bacteria load reduction from TMDL baseline (in Aliso, San Juan, and Salt Creeks)

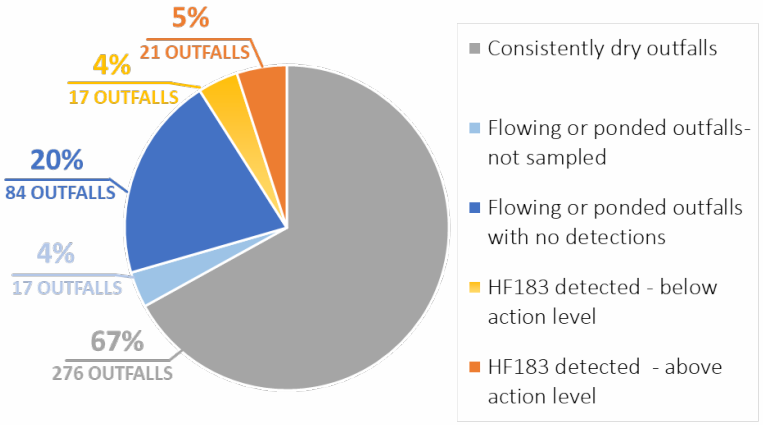




Human Waste Control Strategy in SD County

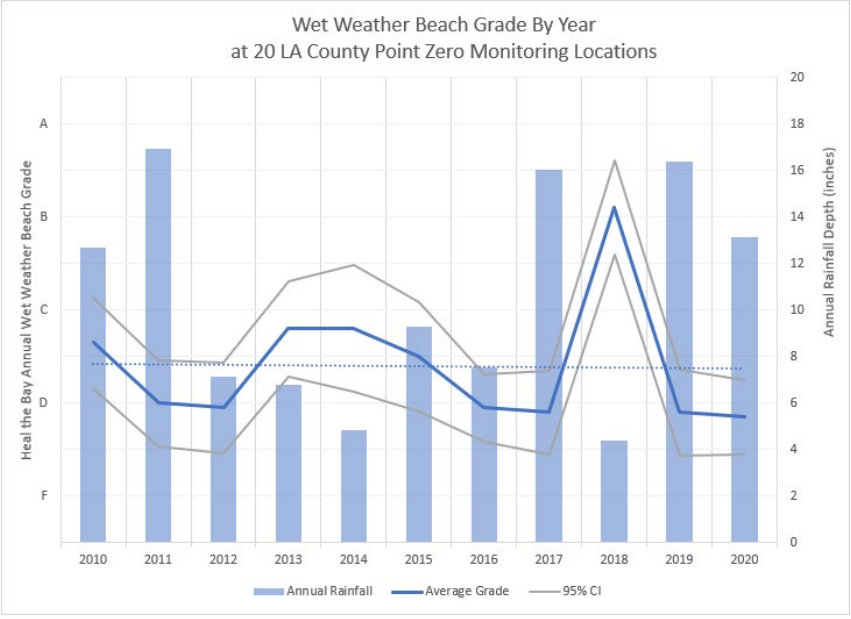
- Over 400 outfalls screened for flow condition and HF183
  - Many screened multiple times annually
  - Follow-up investigation and abatement conducted at outfalls with elevated HF183
  - Flow and HF183 detections tracked annually to demonstrate progress
- Results Support
  - Bacteria TMDL compliance at most outfalls (via no flow)
  - Source demonstration at others (via no/low human waste contribution)
- Similar screening also being conducted in other watersheds





What's working for wet weather?

- We don't know yet!
- Anticipate load reductions from stormwater capture projects, but meeting FIB objectives will be challenging because not all storms can be captured everywhere
- Variability in wet weather data makes it challenging to see statistically significant improvement, even where significant partial structural implementation is complete



Source: unpublished Geosyntec analysis

Conclusions

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Conclusions / Takeaways

1. **Dry weather** FIB compliance is often (but not always) feasible using structural controls and/or source controls
   - Easier at beaches than creeks
   - Source control typically less compliance-certain but more sustainable
2. **Wet weather** compliance is the greater challenge, and FIB is driving much of SoCal's GI-heavy TMDL implementation activity
   - There may be examples of compliance, but they tend to be outfall-specific, using a non-receiving water permit pathway (e.g., 85th percentile retention, load reduction, implementation-based), and not watershed-scale
     - These pathways vary significantly region-to-region
   - There are not examples we're aware of for long-term wet weather attainment of receiving water limits (both single sample/STV and geomean) for an urban receiving water

Conclusions / Takeaways

3. Risk-based implementation approaches are growing, but it's early so we don't know effect on FIB or risk-proxies, or how/whether it will achieve compliance
   - Was intended as a science-based, "true source control" solution that better targets drivers of risk, and for much lower cost than structural controls
   - However, question remains whether wet weather waste/ pathogen sources can be controlled at watershed-scale
     - SD Investigative Order actions and proposed LA Pathogen Study may help to answer
     - If 'no', then are structural solutions (e.g., GI or treatment) our final option?

THANK YOU

Questions? Please reach out!

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EXTRAS

Conclusions / Takeaways

4. The means to reach a solution that is both health-protective AND feasible will likely require:
   - More research (to fill key remaining knowledge gaps)
   - Affordable implementation solutions that truly reduce risk
   - Modified standards (making site specific modifications more accessible, where science supports)
     - Also legislation modifications due to AB411?
   - Attainable MS4 permit compliance demonstration pathways (science-based, legally-defensible) that incentivize the right actions

How to Measure “What’s Working”?

- *Permit compliance* defines success for the MS4 agencies
  - In some areas is based on implementation of an approved plan
  - In other areas (e.g., LA and SD regions), numeric targets for FIB must be achieved
  - Structural BMPs including LFDs and GI are generally effective for achieving this in dry weather…
  - …but it’s uncertain whether this has measurable affect on illness risks
- So what do we know about illness risks?
  - CA studies that actually measure risk (e.g., SHS, prior epi studies) suggest low baseline illness rates… but questions have been raised
  - SD CBA concluded alternate approach could provide greater risk reduction at much lower cost
    - State of the science has enabled this by providing advanced tools (e.g., DNA markers, viruses, bacterial community analysis), to compliment traditional IDDE tools, to identify high-risk sources of waste
    - Sewage sources have successfully been identified and abated using MST in many urban source investigations
    - 2018 SD Water Board Triennial Review for REC-1 WQOs cited these studies and noted the need to update MS4 permits to emphasize human sources/health risks

RESULTS

Source: Cost Benefit Analysis of San Diego Region Bacteria TMDLs

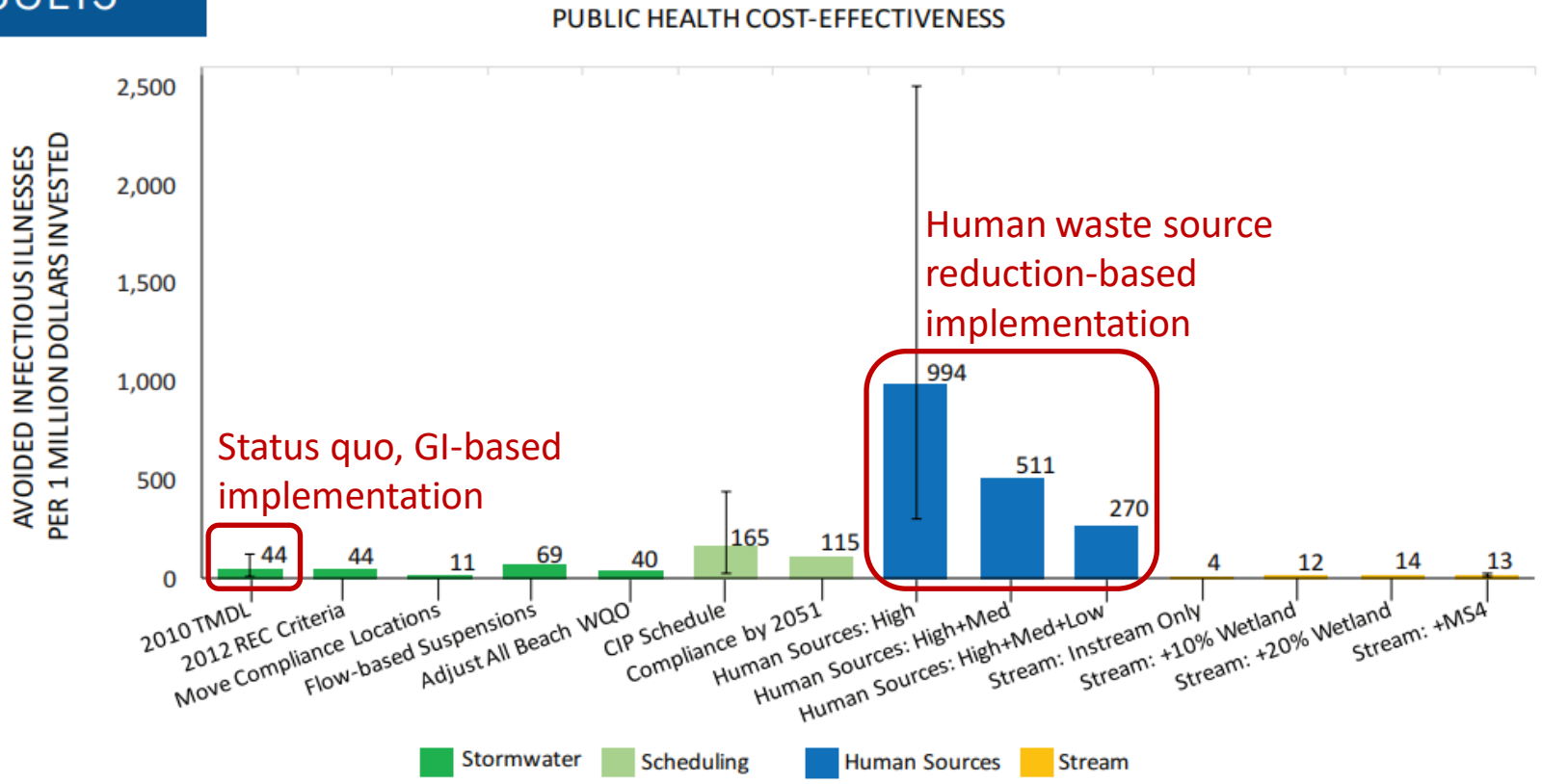

Figure 2: A chart showing number of illnesses avoided throughout the 65-year analysis period per million dollars invested. Human Sources scenarios (blue bars) provide many times greater cost-effectiveness compared to other scenarios. Whiskers indicate the ranges of uncertainty calculated using appropriate methods for each scenario; creating statistical high and low bracket values based on the important drivers of uncertainty in each scenario's benefits and costs.

Key Source Investigation #1: San Diego River Investigative Order (IO)

- ~$4-5M Investigation currently being performed
  - Led by SCCWRP
  - Funded by NPDES Permittees in the lower SD River Watershed
- Study Objectives:
  1. *Quantify the loading of fecal contamination to the San Diego River from human sources (in dry and wet weather, with focus on wet weather)*
  2. *Use the loading estimates to compare relative contributions among the sources of human fecal inputs (which is the greatest potential source of human fecal inputs?)*
  3. *Identify the factors that might lead to the greatest risk of loading (where and when does the greatest human fecal loading occur?)*
  - ➢ Inform control actions to be implemented by Permittees based on study results
- Sources Being Investigated:
  - Sanitary Sewers (including Exfiltration, Overflows, and Illicit Connections)
  - Homeless Populations
  - Private Sewer Laterals
  - Onsite Wastewater Treatment Systems (OWTS)

Key Source Investigation #2: LA Region Pathogen Reduction Study

- ~$9M Investigation Currently Proposed
  - Led by the Gateway Water Management Authority (GWMA)
  - Funding sought by the Safe, Clean Water Program
- Study Objectives:
  1. *Determining the sources with the highest risk to human health*
  2. *Identifying the beaches and inland waterbodies within the MS4 Permit area where the risk to human health is higher*
  3. *Identifying management actions to address high-risk sources and areas more effectively*
- Sources to be Investigated:
  - Stormwater runoff
  - Exfiltration from sanitary sewers
  - Homeless encampments
  - Illicit connections / illicit discharges