

Potential Ambient Water Effects



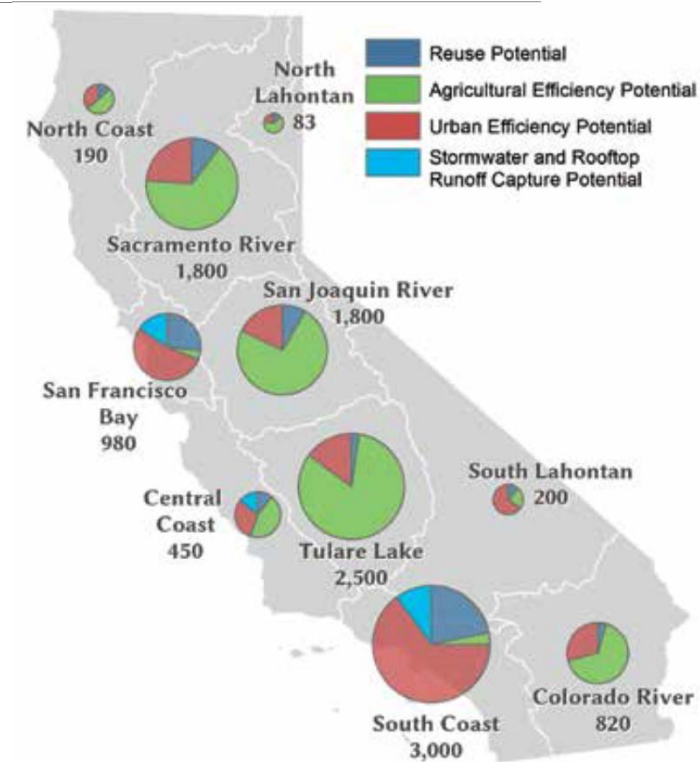
RESEARCH THEME #3

OCTOBER 29, 2014



Why Ambient Water Issues

- ❑ Past work on water reuse has focused heavily on human health issues
- ❑ Relatively less attention on ecological health issues
- ❑ Desire to increase reuse of wastewater AND stormwater
 - Wastewater use for IPR and DPR
 - Stormwater traditionally managed as a waste product NOT as a resource
 - State recycled water policy calls for an increase in stormwater use by 500,000 acre feet by 2020 and 1 million acre feet by 2030

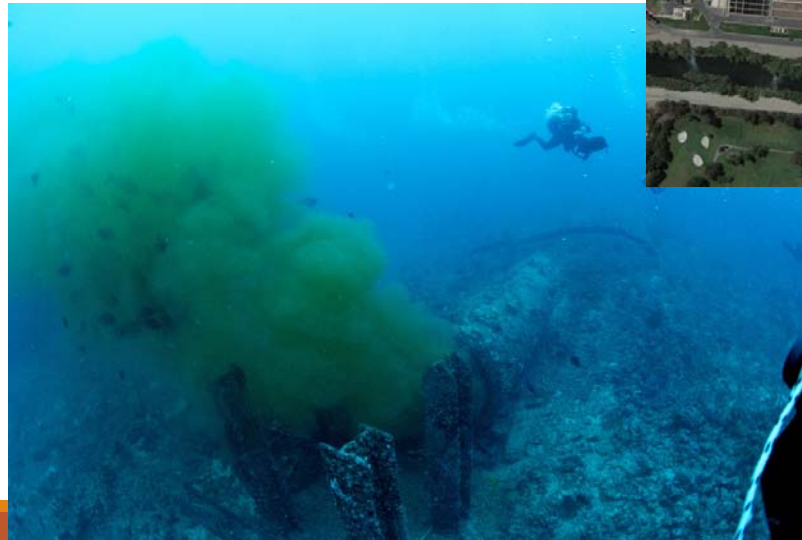


Management Drivers

- ❑ Water rights issues may limit diversions, capture, or alternative uses
- ❑ In-stream flow requirements for fisheries
 - San Francisco Region (San Pablo Bay)
- ❑ Sensitive species needs
 - State or Federal Endangered Species Act
- ❑ Hydromodification management
 - Reduced hydromodification effects vs. changes in substrate composition
- ❑ Biointegrity programs
 - Potential future flow requirements to protect instream biological condition
 - Salinity effects on instream biota
- ❑ Water Quality
 - Effects on ocean plume behavior associated with more concentrated salts/brine
 - Change in instream dilution of urban pollutants

Potential Effects on the Ambient Environment

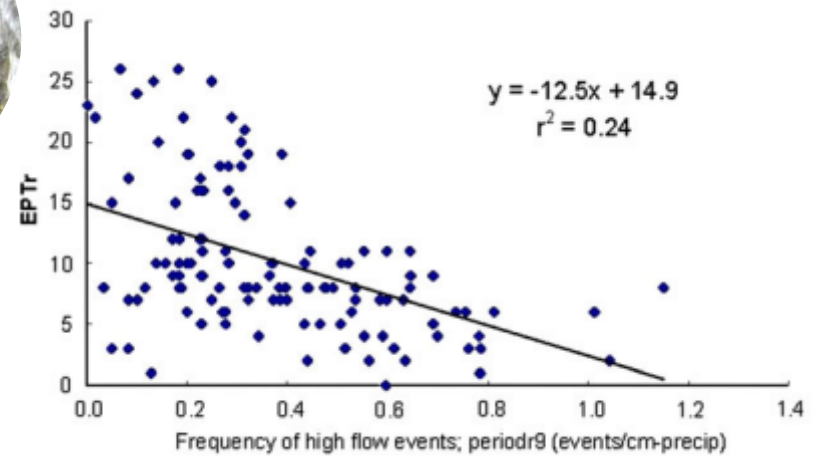
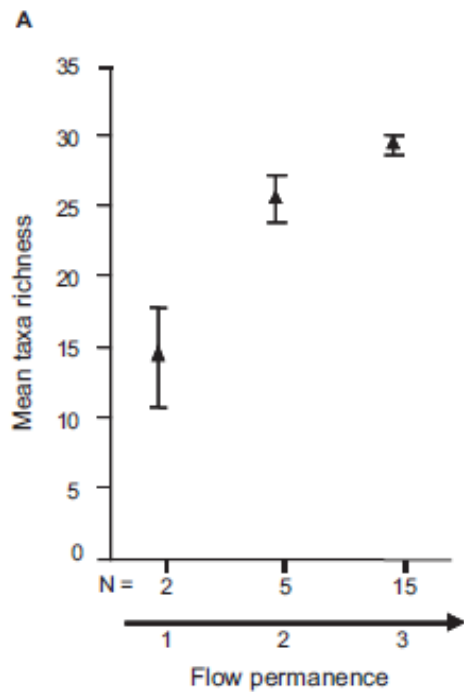
- ❑ Changes in flow patterns
- ❑ Changes in concentration
- ❑ Environmental fate



Flow Effects on Species Needs

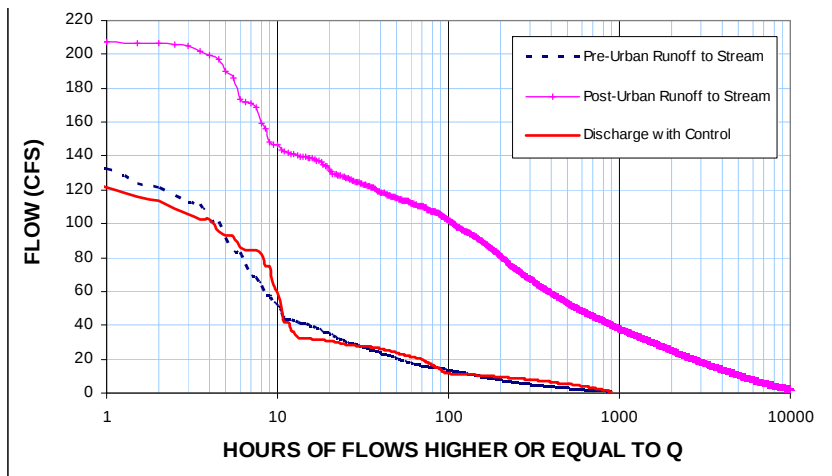


Flow Effects on Biological Indicators



Alvarez and Pardo. 2007. Fund. Appl. Limn.

Flow Effects on Hydromodification



Flow Effects : Science Needs

- ❑ Develop flow-ecology relationships to protect desired beneficial uses
 - Sensitive species
 - Fisheries
 - Benthic invertebrates and other bioassessment targets

- ❑ Develop models to better predict how reduced flow may affect stream morphology
 - Changes to water balance of watersheds
 - Potential management tool to meet hydromodification management requirements



**Recommendations for Determining
Regional Instream Flow Criteria for Priority Tributaries
to the Sacramento-San Joaquin Delta**

A report to the
California State Water Resources Control Board

Concentration Effects: Stream Impacts

- ❑ Many urban streams are dominated by wastewater effluent during the dry season
 - Reduced wastewater effluent may alter dilution characteristics and affect instream concentrations

- ❑ Stormwater can account for 30-40% of the total annual volume discharged
 - Increased stormwater use can reduce contaminant loading → help achieve TMDL compliance

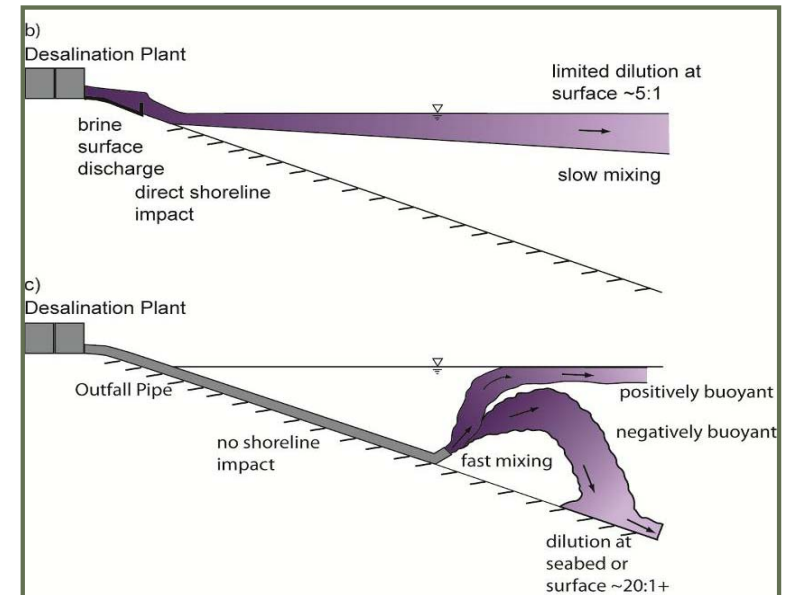


Concentration Effects: Ocean Impacts

- ❑ Changes in the behavior of effluent plumes
 - Reduced volume → higher concentrations
 - Salts, reclamation byproducts, emerging contaminants
 - less mixing/dispersion of plume due to lower volumes
 - increased buoyancy plume



Effects on condition of benthos and fish



Concentration Effects: Science Needs

- ❑ Conduct studies to determine how recycled water practices can be designed to optimize application of BMPs to help meet water quality objectives
 - Centralized vs. distributed systems
 - BMP retrofit for multiple functions
 - Optimum physical and biological design parameters

- ❑ Refine existing models (both nearfield and regional circulation) and *in situ* measurements to assess the initial dilution occurrence of more concentrated (denser) wastewater plumes.

- ❑ Evaluate effects of contaminants of emerging concern on in-stream, and marine and estuarine receiving water biological communities.
 - Chronic effects of higher salts and brines on marine benthic communities
 - Toxicity and bioaccumulation of emerging contaminants and their transformation products

Environmental Fate

- ❑ Water quality requirements for contact recreation
 - Surface water augmentation

- ❑ Infiltration limits for groundwater quality or geotechnical stability issues
 - Groundwater recharge

- ❑ Few new science needs
 - Mostly site specific monitoring issues
 - Application of existing models



Summary of Ambient Environment Research Needs

Develop an assessment and management framework for considering effects on the ambient environment as part of recycled water policies

Include mechanisms to increase coordination among public and private agencies

- ❑ Flow-ecology relationships
 - ❑ Effects on hydromodification
 - ❑ BMP optimization to meet water quality objectives
 - ❑ Fate and transport of denser wastewater plumes
 - ❑ Effect of salts, brines, disinfection byproducts, and other CECs
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Thank You

Eric Stein

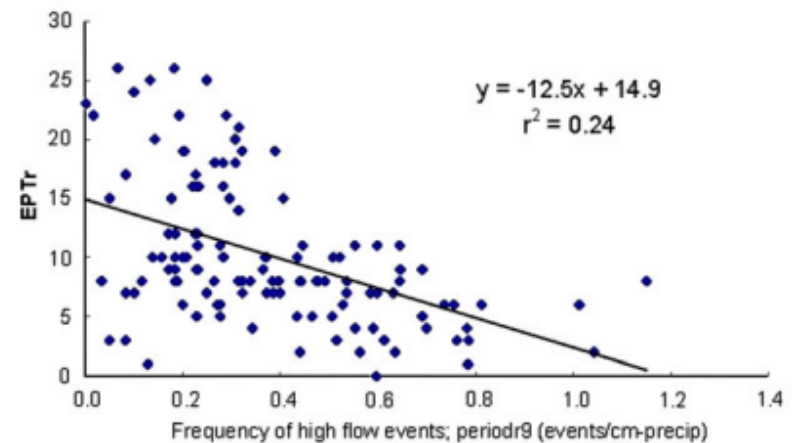
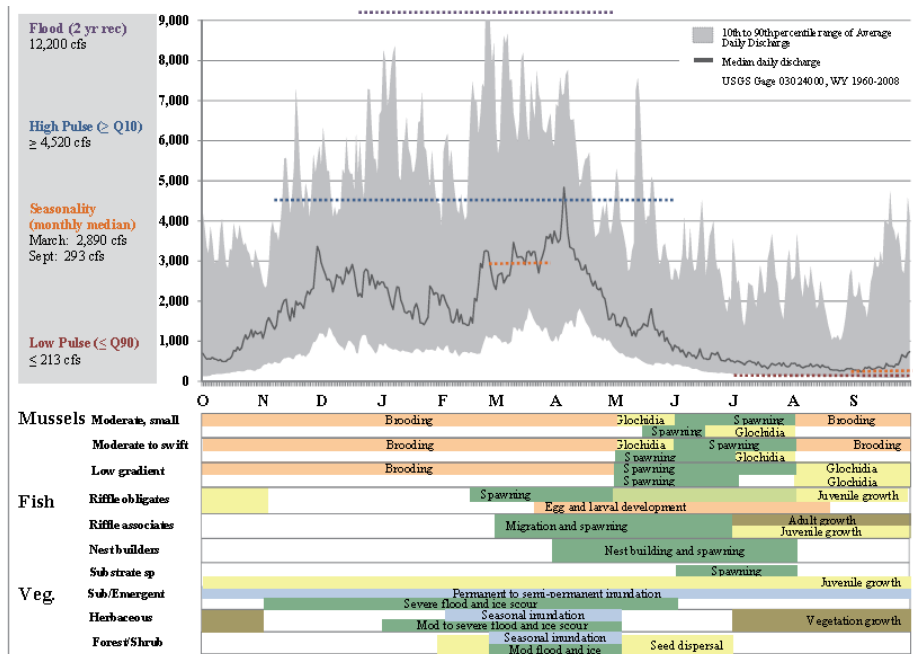
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EXTRA SLIDES

Flow Effects on Biological Indicators

- Flow-ecology program to inform in-stream flow management targets



Concentration Effects: Science Needs

- ❑ Determination of potential sublethal /chronic effects of elevated salinity to sensitive life stages, especially for California benthic species.
- ❑ Evaluation of potential ecological risk of chemicals, including CECs, in water reclamation plant discharges (e.g. RO brine)
- ❑ Modeling/assessment of plume behavior
 - turbulence impacts on plankton
 - risk of increased benthic effects near outfall

Concentration Effects: SCCWRP Research

- ❑ Targeted and non-targeted analysis of contaminants with the greatest potential for ecological and human health impacts

- ❑ Bioanalytical screening for known and unknown chemicals/by-products that indicate the potential for adverse outcomes and that direct toxicity identification evaluation (TIE)

- ❑ Stressor Identification
 - Macro- and molecular level indicators of toxicity to benthic invertebrates and fish
 - Sentinel estuarine and marine species inhabiting ocean outfall zones

SCCWRP Research

Hydrology/Biology

- ❑ Predictive tools to evaluate changes in flow duration associated with land use and management actions
- ❑ Development of in-stream flow-ecology relationships

Geomorphology

- ❑ Tools/models to assess risk of hydromodification to changing land use practices

Ecotoxicology

- ❑ Watershed modeling to predict changes in pollutant loading under various BMP scenarios
 - ❑ Bioanalytical tool development for screening of water quality (CECs)
 - ❑ Causal assessment/stressor ID studies
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General Assumptions

Increased water reuse has the potential to impact quality of receiving waters

- Receiving water effects may be an issue in streams and the ocean due to reuse of stormwater and wastewater, respectively
- Surface water augmentation would involve RO quality discharges; therefore, minimal concerns for ambient quality of lakes and reservoirs
- Stormwater reuse affects primarily stream habitats
 - Seasonality of stormwater capture
 - Changes in baseflow due to increased infiltration
- Wastewater reuse can affect either stream or ocean habitats

Issues to Investigate

Hydrology/Biology

Return to historical conditions  loss of instream habitat

Geomorphology

Reduced hydromodification effects  changes in substrate composition

Ecotoxicology

Reduced discharge volume  higher salinity (TDS), chemical concentrations

Concentration Effects: Drivers

- ❑ Water quality standards
 - Effluent concentrations
 - Receiving water limits

- ❑ Total Maximum Daily Loads (TMDLs)
 - Instream flow can be a component of load reduction

- ❑ Biological endpoints
 - Chemical effects on biology
 - Toxicological responses