# Least Bell's Vireo – Stream Riparian Water Hydrographs and Fluvial Sediment: Reliance and Modifications on the Coastal Slope of California

Presented By:

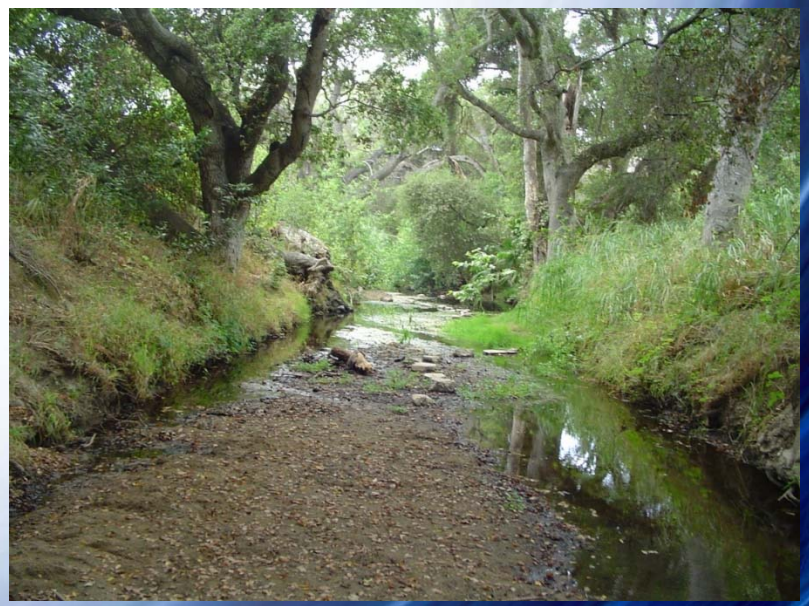
Tory R. Walker, PE, CFM, LEED GA

TORY R. WALKER ENGINEERING

RELIABLE SOLUTIONS IN WATER RESOURCES

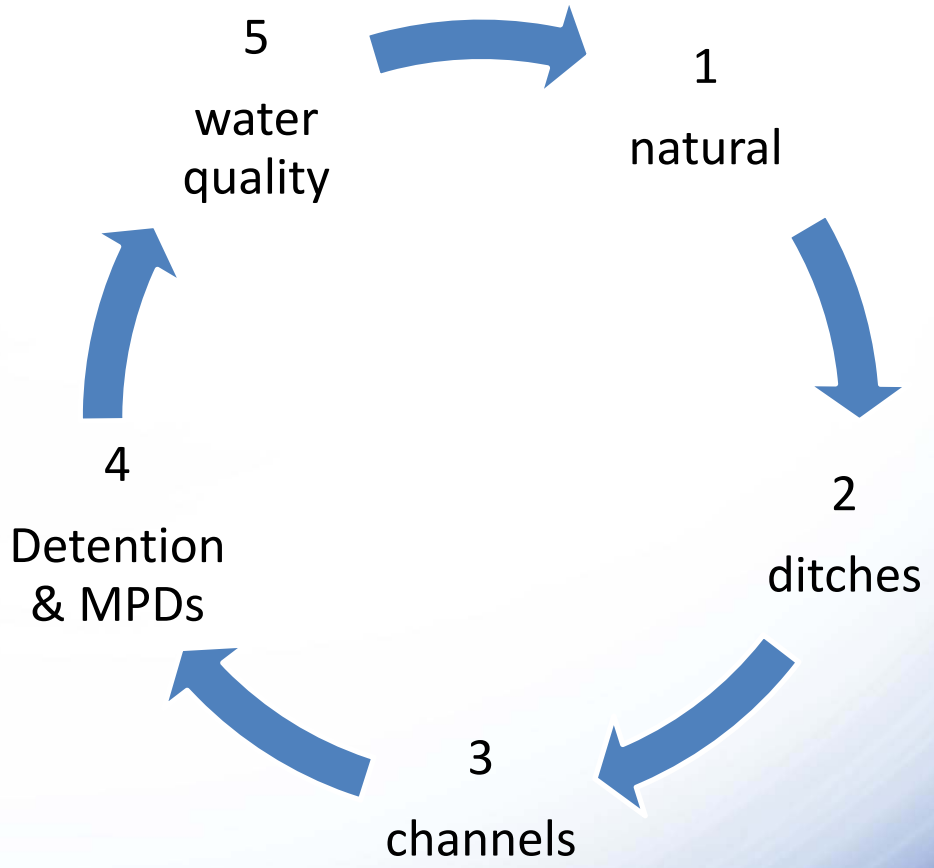
# Brief Overview

- Short History Lesson
- MS4 (Stormwater) Permit as a Catalyst
- Regional Factors & Influencers
- Hydromodification
- Case Studies



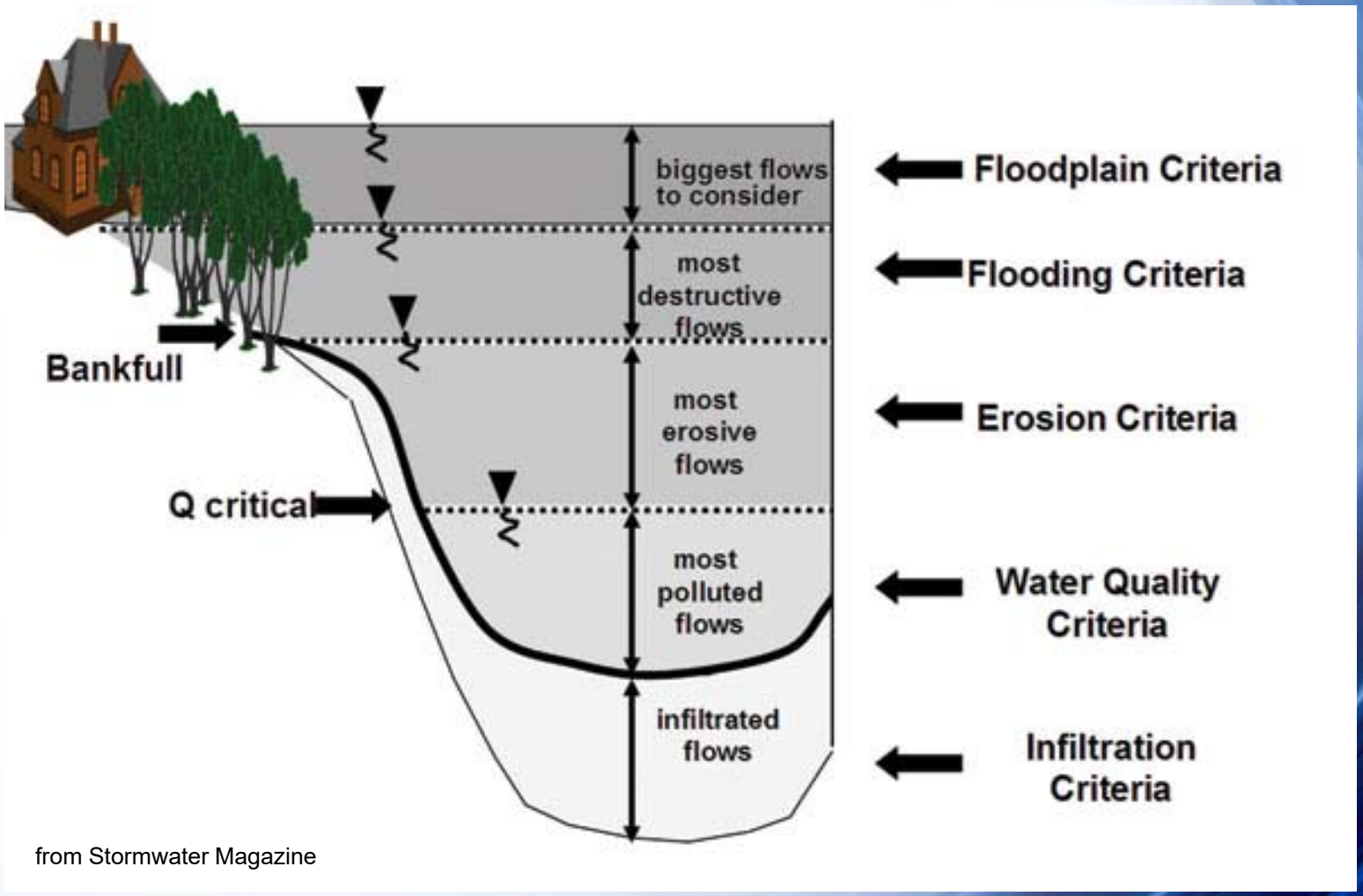
Tory R. Walker Engineering
RELIABLE SOLUTIONS IN WATER RESOURCES

# Short History Lesson on Floodplains & Channels




TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# What Are You Looking At?




from Stormwater Magazine

# MS4 Permits as a Catalyst

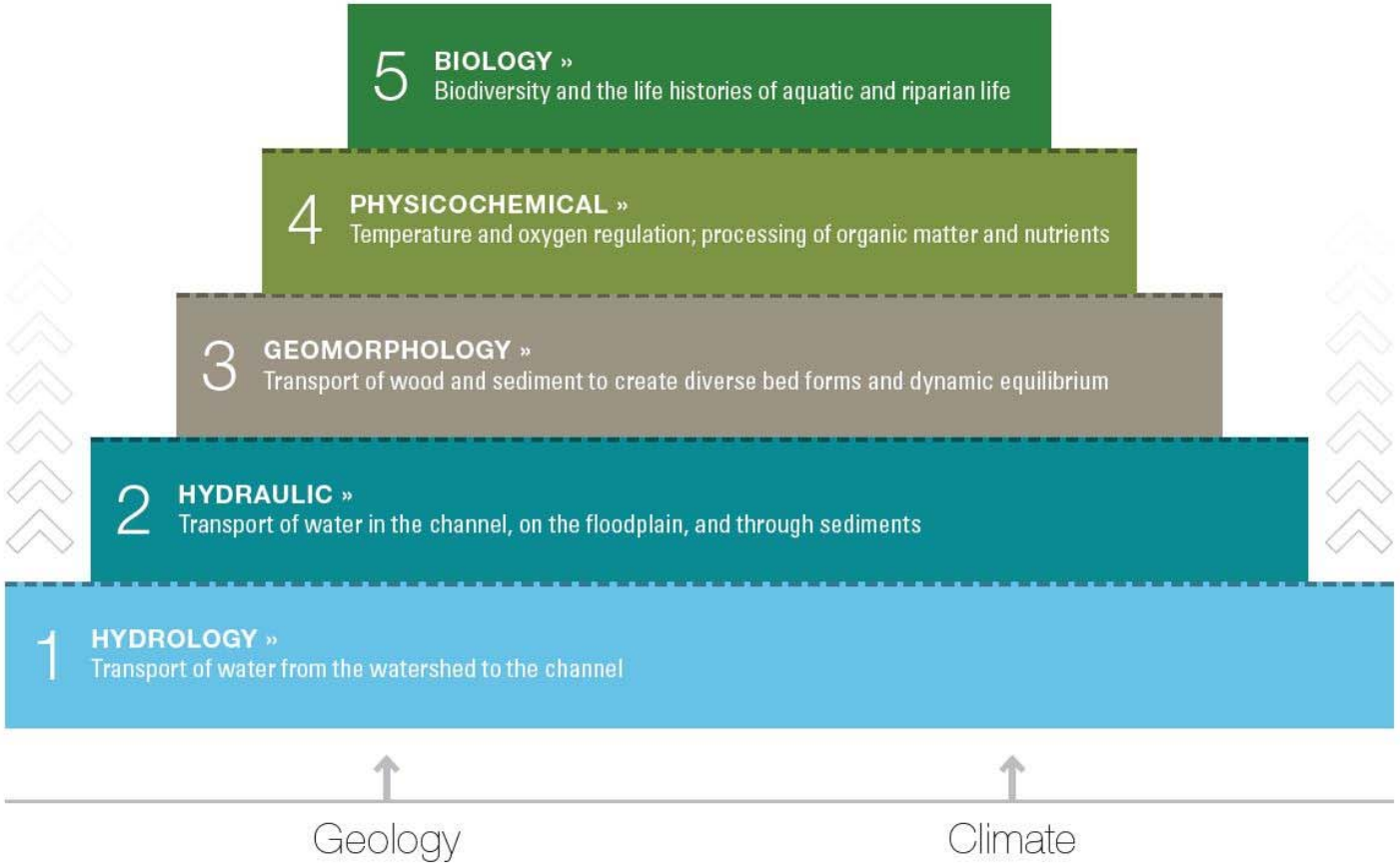
- Recent focus on problem of hydromodification
- Intention is commendable, science is lacking
  - Science has been imported
  - Approach is **over simplified**
  - Conservative assumptions
- Result is a convoluted set of rules with little resemblance to reality

**You can't legislate how nature should behave!**

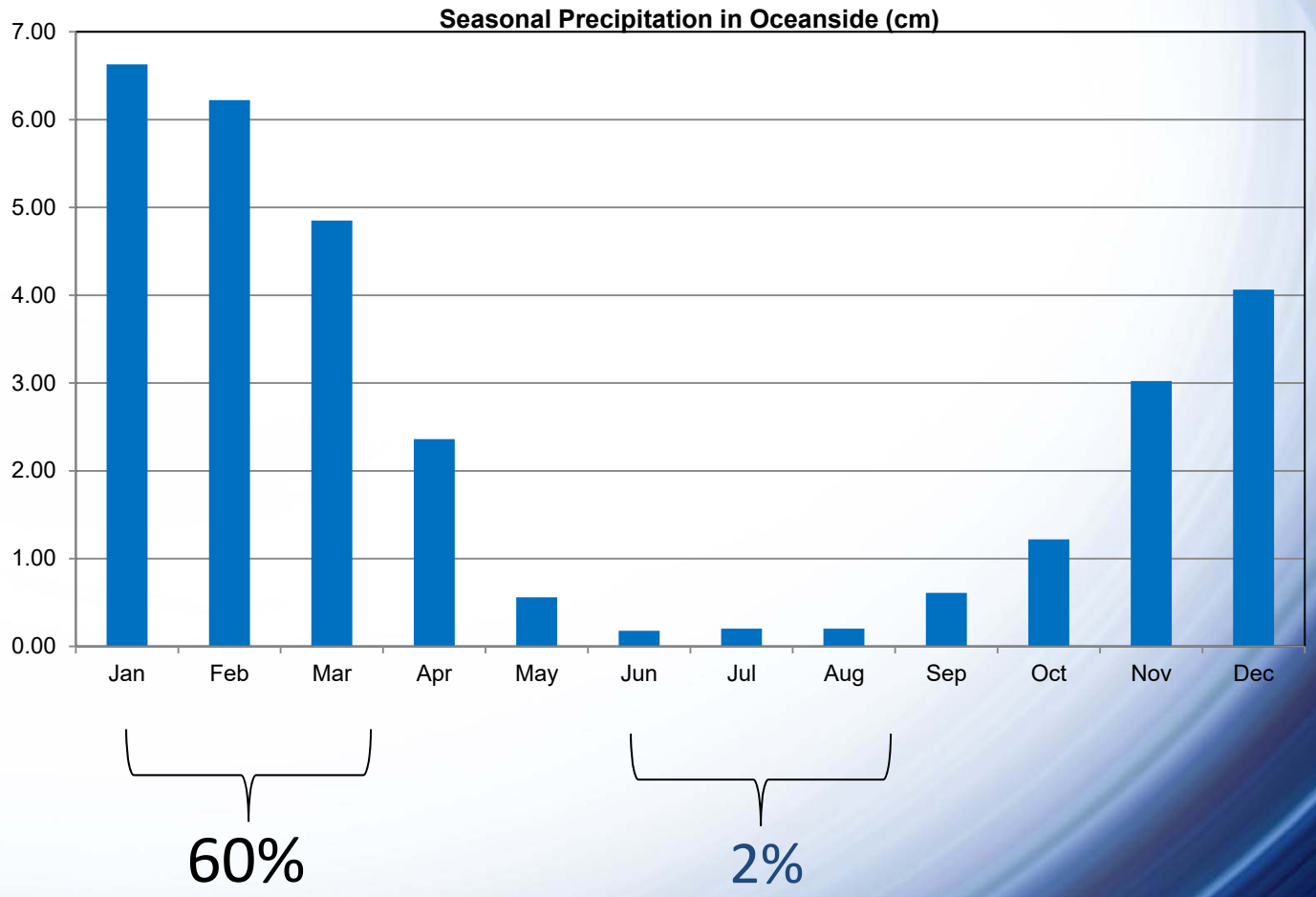
# Factors & Influencers

- **Climate** data and **geologic** data have influenced **urban development**
- Climatic and geologic factors should be more carefully considered
- Consider how **permits** should be written to properly address the impacts of hydromodification
- Present a more **effective approach** that is scientifically robust & practical

# Stream Functions Pyramid



# Climatic Influence- Seasonal



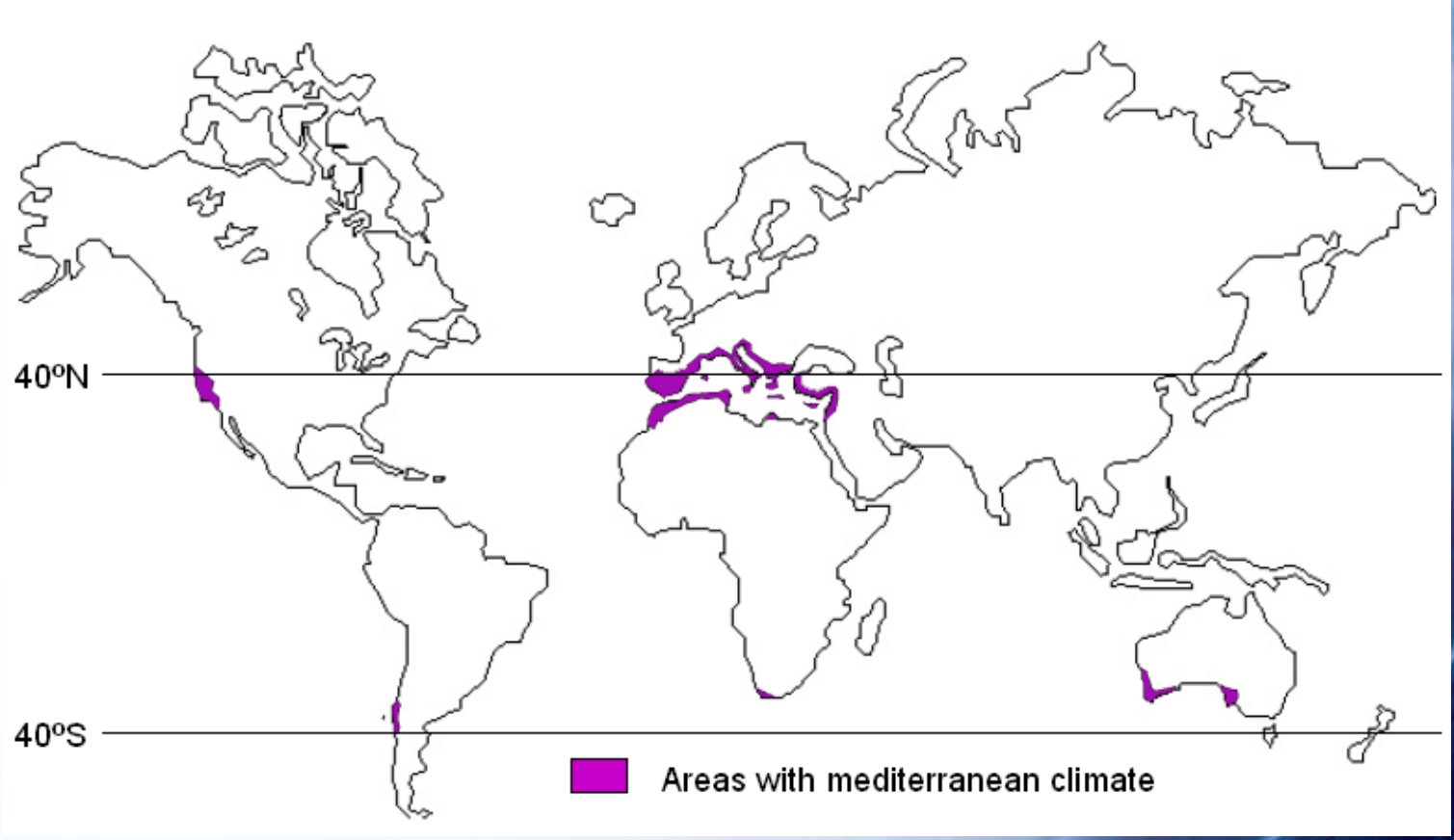

TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# Climatic Influence- Long Term Variation

TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# Climatic Influence

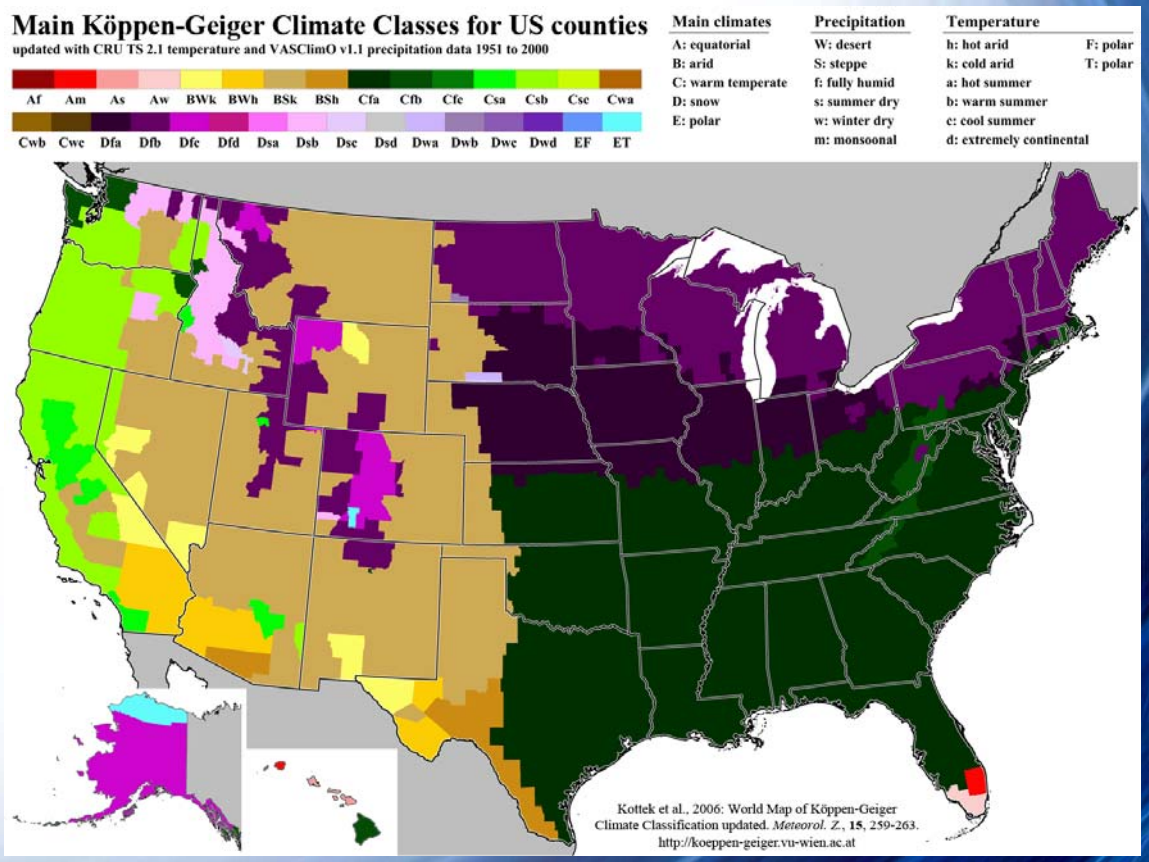
- SoCal climatic patterns do not represent most of the U.S.



# yet…

the majority of LID and hydromodification management tools have been developed & applied elsewhere, including:

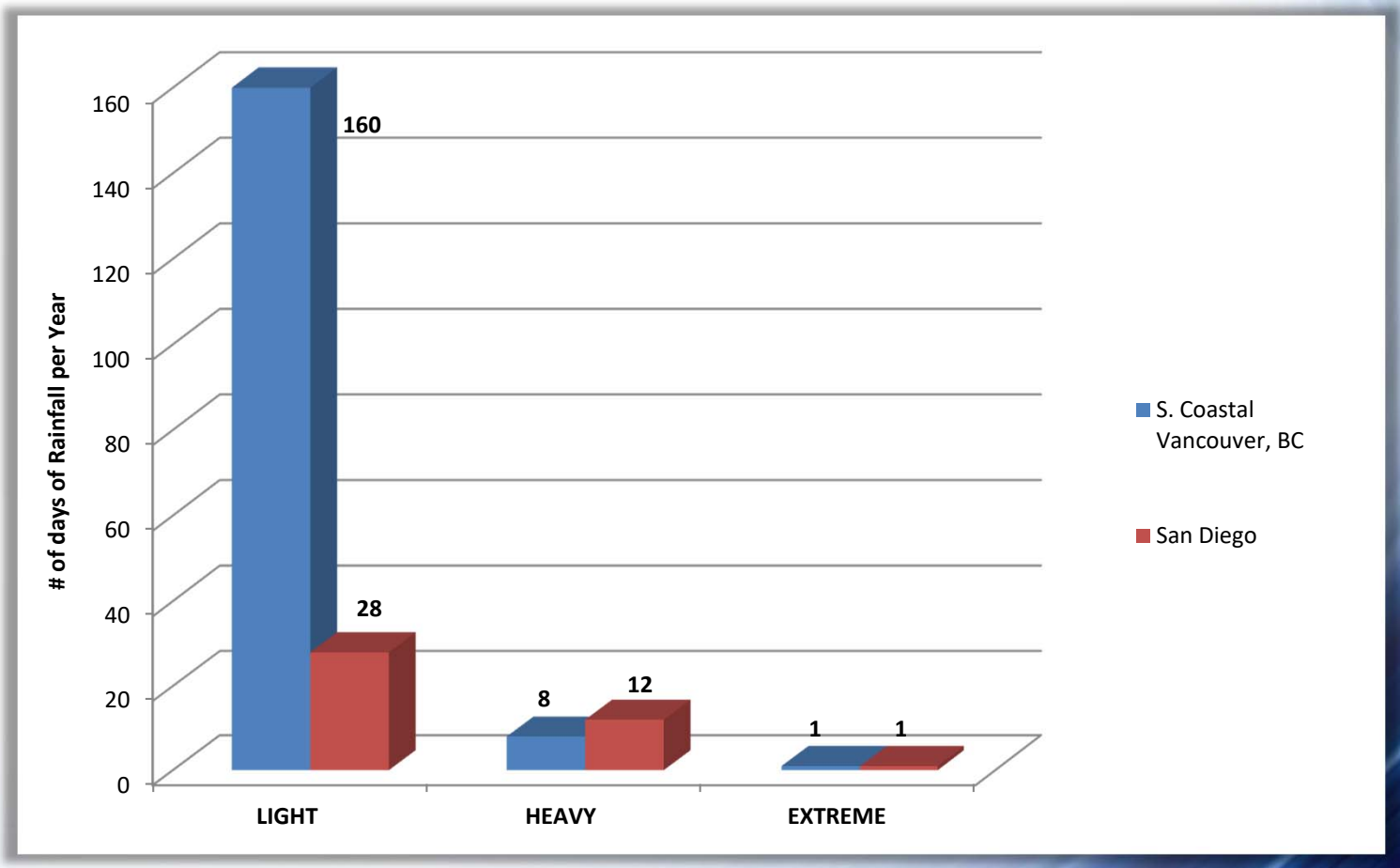
- Computer Simulation Models & Studies
- Stream restoration tools & techniques




TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

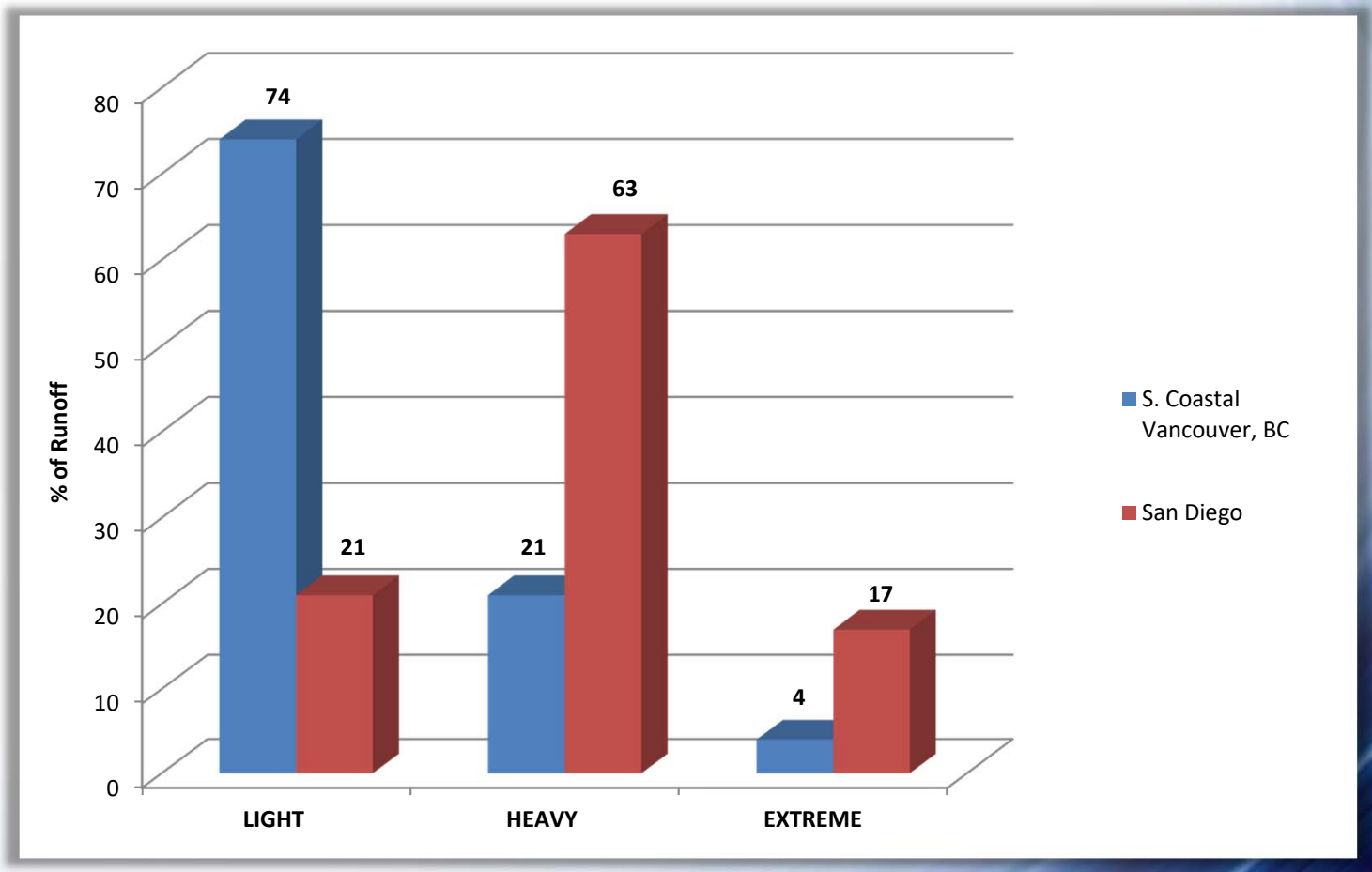
# Rainfall Distribution

## Typical Distributions of Annual Precipitation in Days per Year



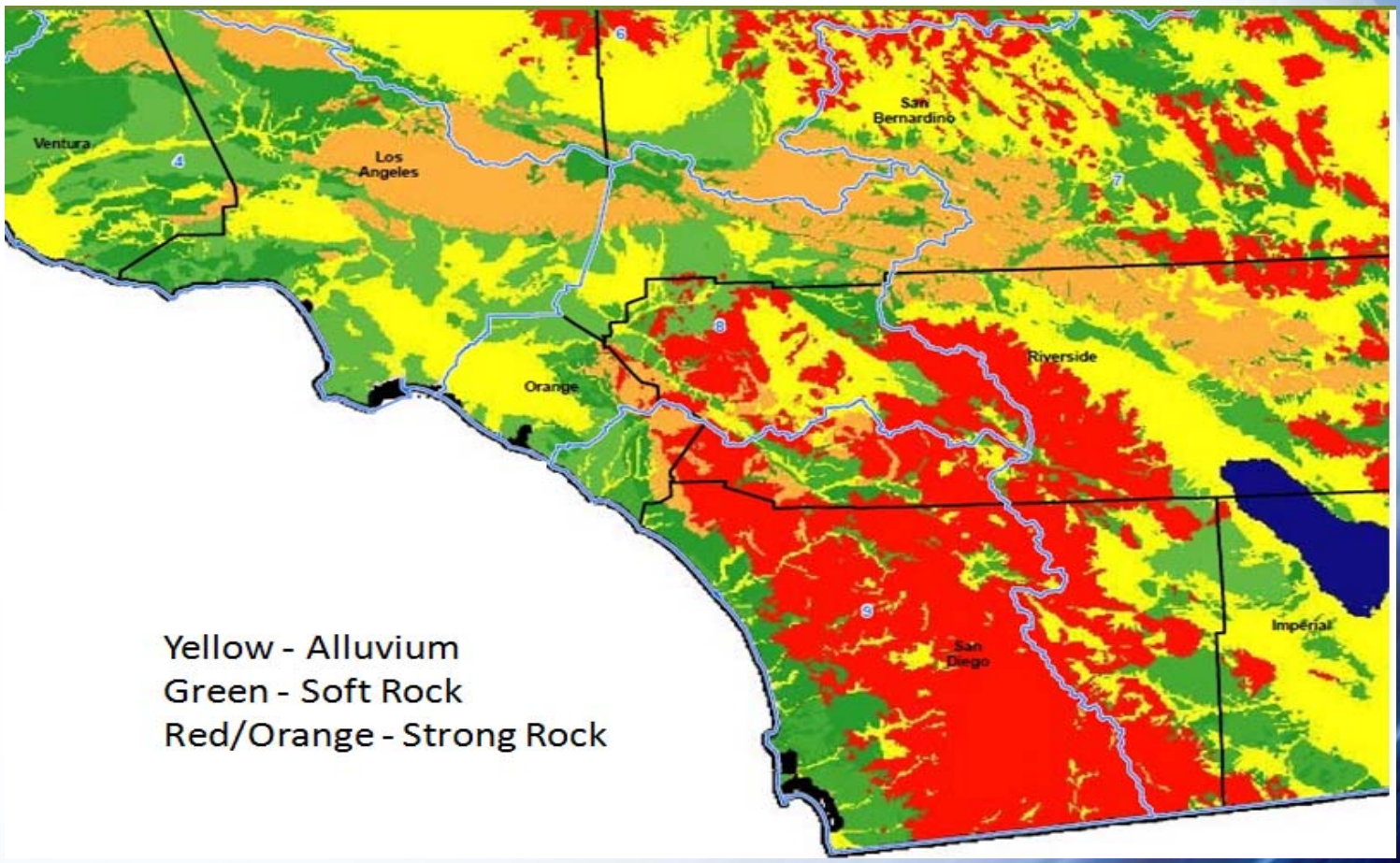
# Rainfall Distribution

## Typical Distributions of Annual Precipitation as Percentages




TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# Geological Influences



# Hydromodification

Simple Definition: Erosion of waterways and subsequent sediment deposition downstream, often due to modifications in the watershed

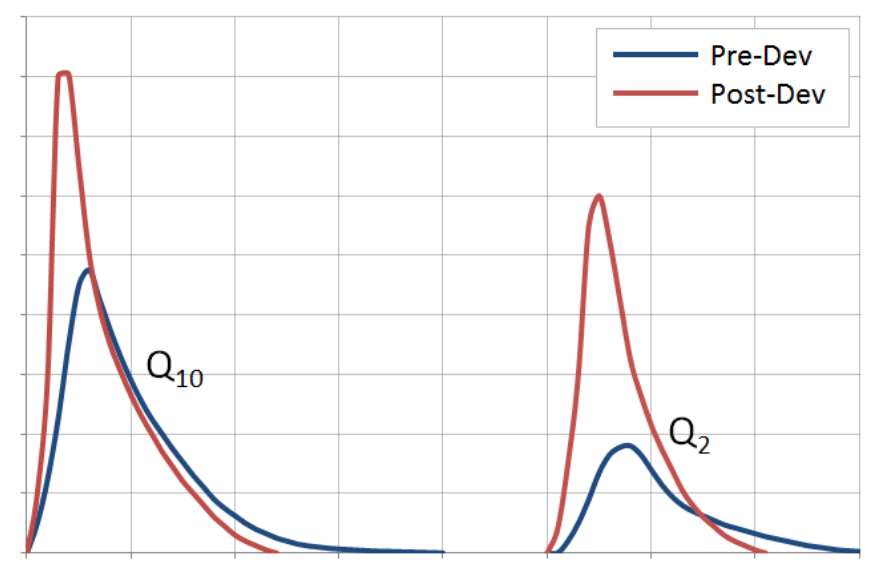
Examples include:

- Covering the land with impervious surfaces
  - Deprives waterways of sediment
  - Increased runoff volumes, durations, & peaks in those same waterways
- Flood Control Dams
  - Traps sediment
  - Reduces damaging peak flows & volumes

# Effects of Urbanization on Hydrology

## (Peak, Volume, Duration)

- Disrupts natural water balance
- Increases flood peaks
- Increases stormwater runoff
- Results in more frequent flooding
- Increases bankfull flows




TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# Historic Response to Hydromodification

- Impacts addressed by “improving” (channelizing and hardening) waterways
  - *Protecting adjacent lands from periodic flooding*
  - *Protecting against erosion*
  - *Often resulting in concrete lining or rock riprap lining*
  - *Allowing for more adjacent lands to be developed*
- Urban environment encroached upon previously flood-prone lands
- Habitat was assigned less value by society than potential uses of adjacent lands

# Hydromodification Degradation

- Many waterways in Southern California were not "improved" through the traditional approach
  - Various degrees of degradation resulted
- Common factors affecting stream degradation include:
  - Percentage and locations of impervious areas within watershed
  - Soils and geology of watershed
  - Sediment sizes within watershed
  - Slope of waterway
  - Time passed since development

# Oso Creek in San Juan Capistrano

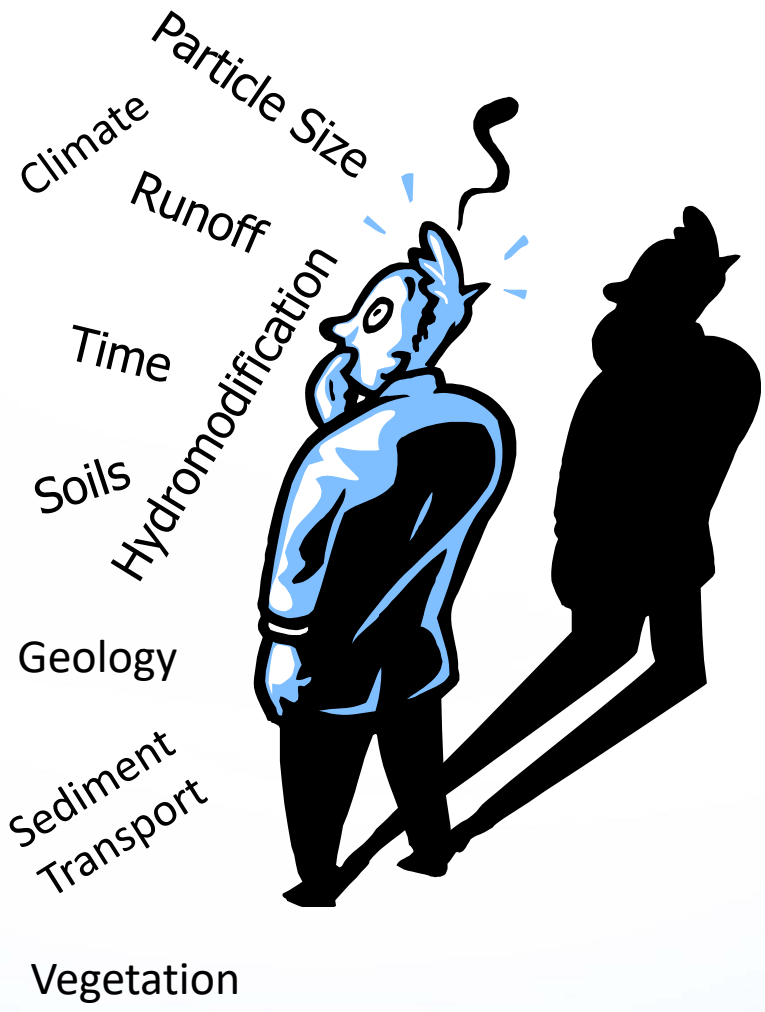
TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# Escondido Creek in Escondido

Tory R. Walker Engineering
RELIABLE SOLUTIONS IN WATER RESOURCES

# Agua Hedionda Creek in Vista

TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES




Consensus Based "Science"

The MS4 Permit FOG

TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# Hydromodification Myths

Common Myths (over-simplification):

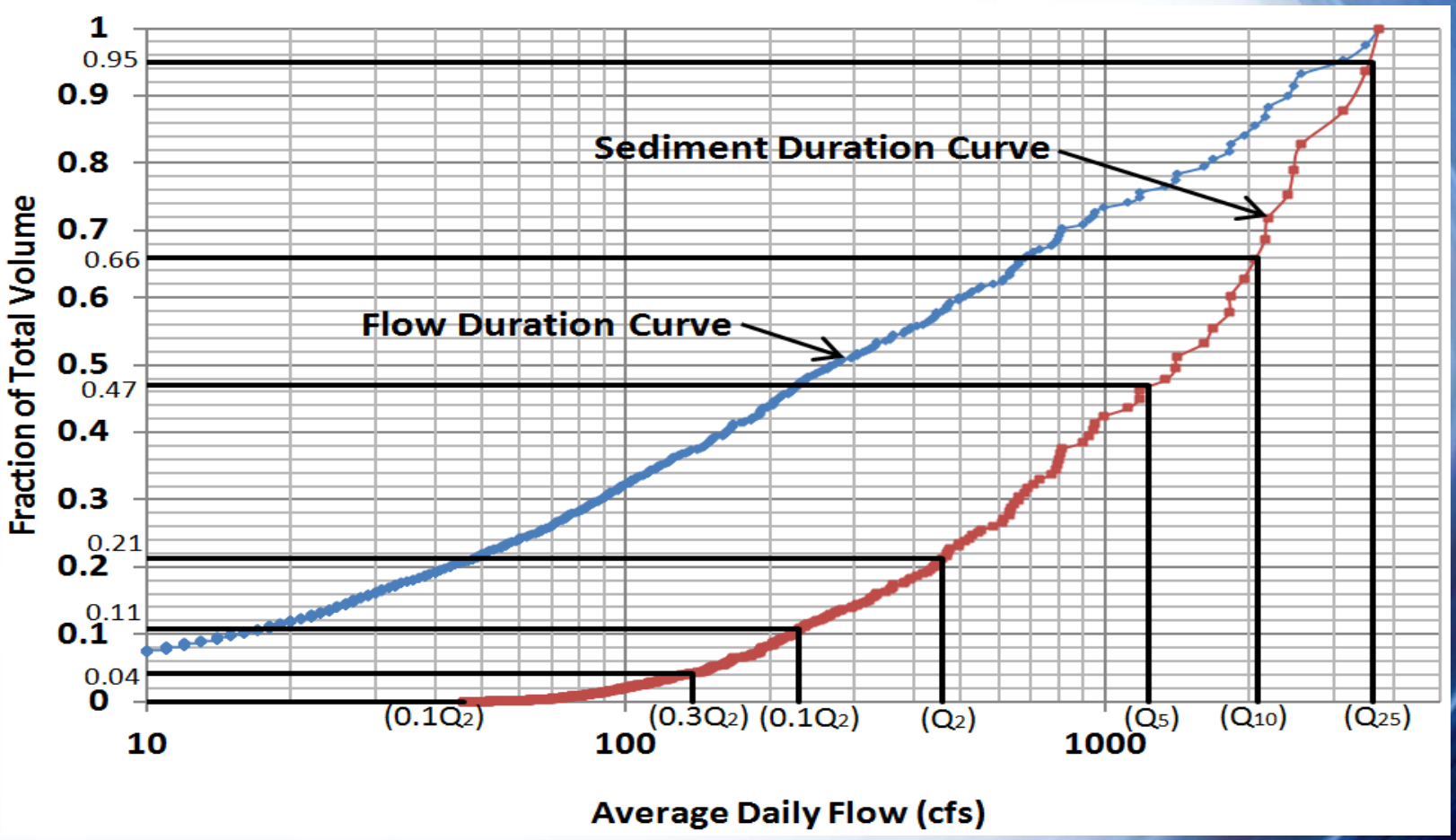
1. Precise definition of critical low-flow threshold ***is fundamental*** to determine hydromodification impacts
2. A small change in imperviousness ***of an already heavily altered system*** will change the erosion response
3. Many heavily altered watersheds and creeks can be restored **to natural (pre-Columbian)** conditions
4. Designing over-sized onsite hydromodification management facilities for new developments ***may significantly improve*** current problems

# Hydromodification and the SoCal MS4 Permit

- Fails to consider mitigating factors that exist in nature
  - *Wetland and riparian vegetation*
  - *Channel irregularities*
  - *Ability of many creeks to self-armor*
  - *Climatic Variation*
- Fails to consider fluvial systems that are in a state of dynamic equilibrium
- Assumes that critical low-flow threshold is the point at which a natural channel becomes unstable

**FACT: in Southern California, infrequent episodic events are far more influential!**

# Sediment Transport - Southern California




**Most sediment is transported during medium to extreme events**

# Sediment Transport - Tijuana River

53% of sediment transported occurs for peak flows larger than $Q_{10}$ *

- Typical range valid for non-Mediterranean climates is not representative of the optimum range of analysis in Southern California
- Misguided efforts to tightly control extremely small flows (i.e., 10% of $Q_2$) accomplishes very little of significance
- Greatly increases size of onsite hydromodification management facilities

* 73 years of daily data

TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# Systematic Approach to Hydromodification Management

- Observe response of fluvial system to previous increase in impervious area over time
- Study aerial photography and topography
- GIS analysis
- Hydraulic Models
- Other fluvial geomorphic tools

Fluvial Geomorphic Studies


Tory R. Walker Engineering
Reliable Solutions in Water Resources

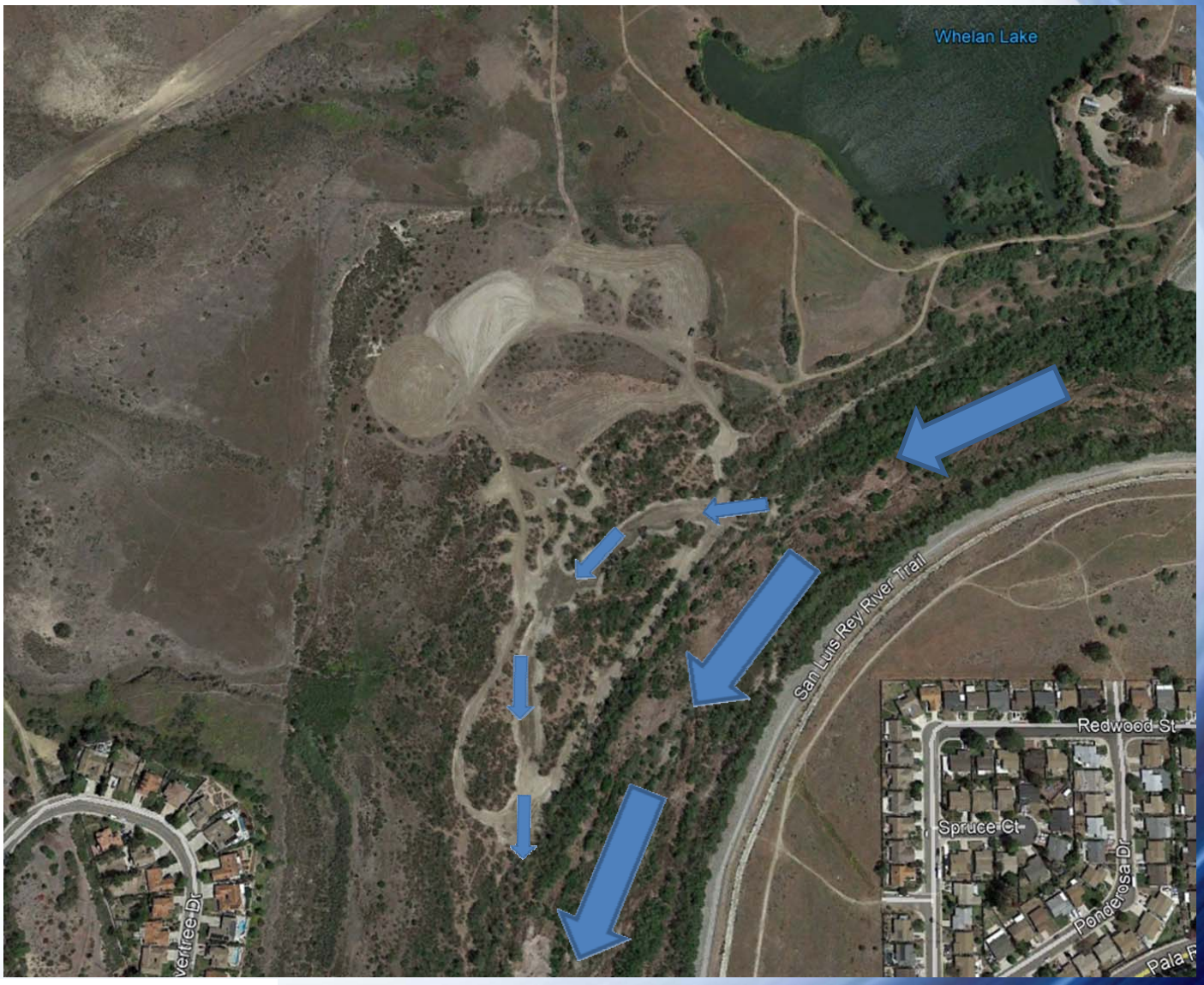
# A Balanced Approach

- Start with multidiscipline team of experts!
- Use the best available data, models and tools
- Rigorous adherence to the scientific method
- Further develop modeling tools based on local data
- Application to realities that characterize the Region
  - ✓ *Climatic*
  - ✓ *Geologic*
  - ✓ *Urban*
  - ✓ *Economic*
- **Calibrate parameters**

# Issues to Identify in Restoration Plan

- Re-establishment of natural creek functions
- Potential groundwater replenishment
- Protection of adjacent and downstream properties
- Downstream flood capacity preserved
- Protection of existing infrastructure, such as railroad and sewer lines
- **Stabilization of creek bed and banks?**

# Case Study: Whelan




TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# Case Study: Whelan

TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# Case Study: Whelan

TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# Case Study: Whelan

TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# Case Study: Whelan

TORY R. WALKER ENGINEERING
RELIABLE SOLUTIONS IN WATER RESOURCES

# QUESTIONS?

Tory Walker

(760) 414-9212

tory@trwengineering.com

TORY R. WALKER ENGINEERING

RELIABLE SOLUTIONS IN WATER RESOURCES