Continuous Flow Monitoring

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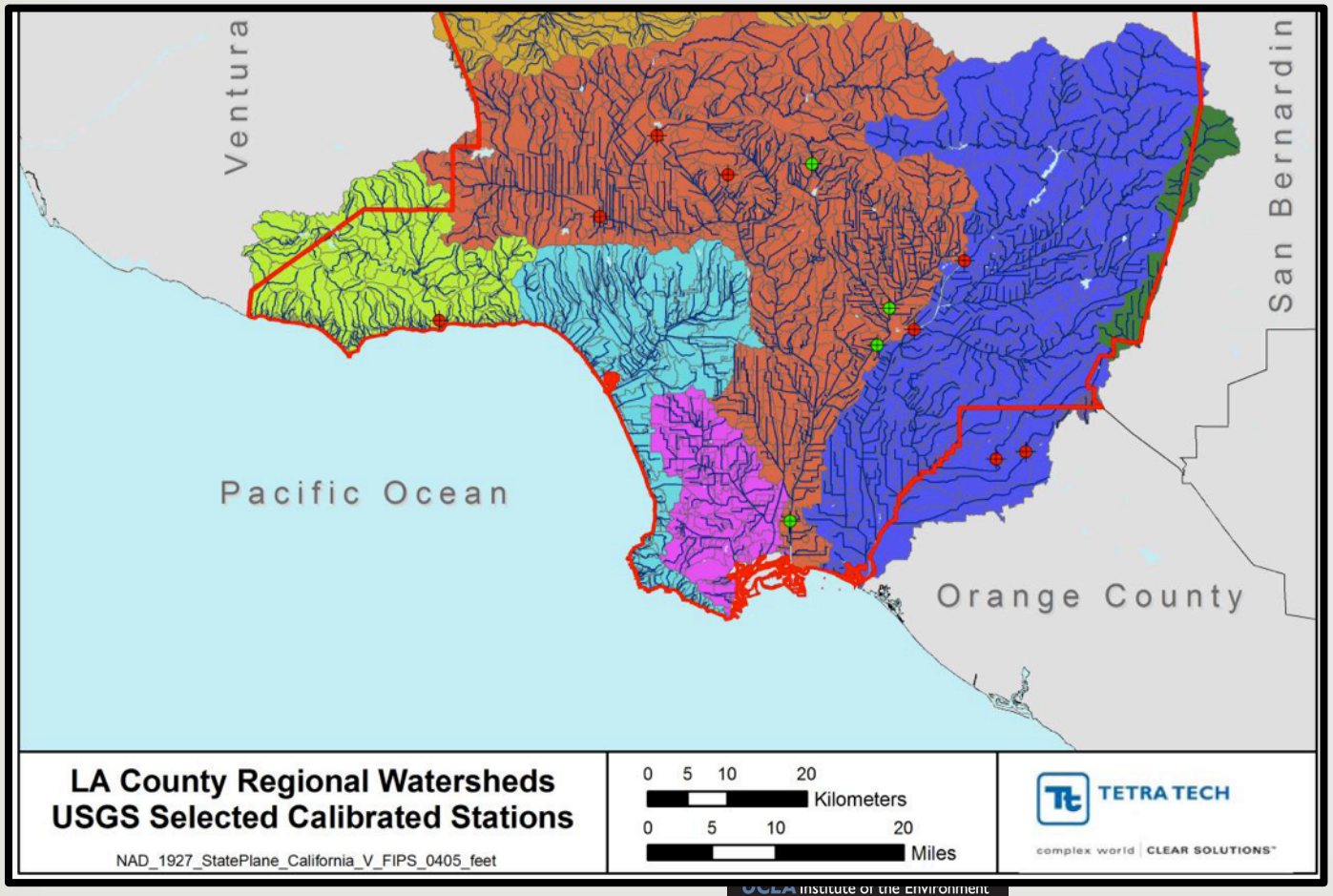
Overview

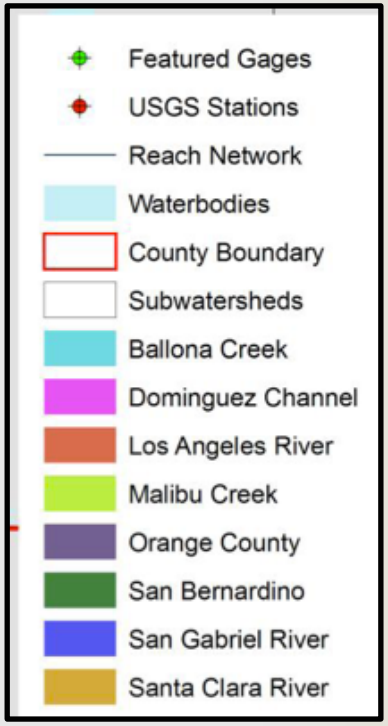
- Need for continuous streamflow and BMP monitoring
- Current regulatory requirements for monitoring
- Challenges
- A draft 3-point plan:
  - **Incentivize**
  - Ensure data quality and consistency
  - Create central shared repository
- Discussion

Need for long-term continuous streamflow and Hydromod-BMP monitoring

- Calibration/validation of hydrologic models
- Verification of BMP design/operation
- Quantification of in-stream flow duration changes
- Test assumptions that underpin our current hydromodification management approach
- Adaptive management

Existing streamflow gauge system is sparse, most on basins >100sq-mi





Tetra Tech, 2010. LA County Watershed Model Configuration and Calibration—Part I: Hydrology

Summary of selected MS4 permit monitoring requirements

- **San Diego County** – R9-2007-0001
  - HMP dated March 2011- see next slide for discussion of flow monitoring
- **Ventura County** – R4-2010-0108 (July 8, 2010)
  - Attachment F- Monitoring Program – requires protocols for ongoing monitoring
    - May meet this requirement by participation in SCCWRP study and SMC
- **N. Orange County** – R8-2009-0039, amended by R8-2010-0062
  - No specific hydromod monitoring requirements
- **S. Orange County** – R9-2009-0002
  - Hydromod Plan (Oct 25, 2012) monitoring components only include stream benthic community and channel incision and widening
  - No flow monitoring
- **LA County** – R4-2012-00175 (Nov 8, 2012)
  - Attachment E – Monitoring and Reporting Program
    - States that "Flow may be estimated using USEPA methods at receiving water monitoring stations where flow measuring equipment is not in place."
  - Requires HMP within 1-yr; to include monitoring and effectiveness assessment
- **Central Coast** – Resolution R3-2013-0032, Draft Post-Construction Requirements (July 12, 2013)
  - No apparent monitoring requirements
- **Phase II** – Small MS4 General Permit
  - Specifies flow monitoring using pressure transducer or stage gage, but time period not clear
  - Applies only to traditional permittees pop >50K that aren't doing ASBS, TMDL or 303d monitoring

San Diego County MS4 Permit

- Requires a monitoring program to evaluate HMP effectiveness, per Sect. D.1.g(1)(k) of the Regional Board Order R9-2007-0001
- Monitoring:
  - Streamflow - HOBO level loggers
  - Rating curve (stage-discharge relationship)
    - SonTek FlowTracker Acoustic Doppler Velocimeter
  - Sediment Transport
    - Turbidity -YSI 6600 meters with 6136 optical turbidity probes
    - Bedload transport - US BLH-84 handheld wading bedload sampler
  - Precipitation – portable rain gauges
  - BMP (inflow and) outflow

SCCWRP Hydromod Monitoring Framework

- **SCCWRP Tech Report 752 / Stein & Bledsoe 2013, Framework for Developing Hydromodification Monitoring Programs**
- Table 4 Recommended Field Indicators include:
  - Stream flow
    - Assessment endpoint: long term flow magnitude and duration
  - BMP inflow and outflow
    - Assessment endpoint: discharge magnitude and duration

Cost Estimates
(From SCCWRP TR752)

Table 6. Unit costs for one-time up front and recurring annual monitoring of major indicators.

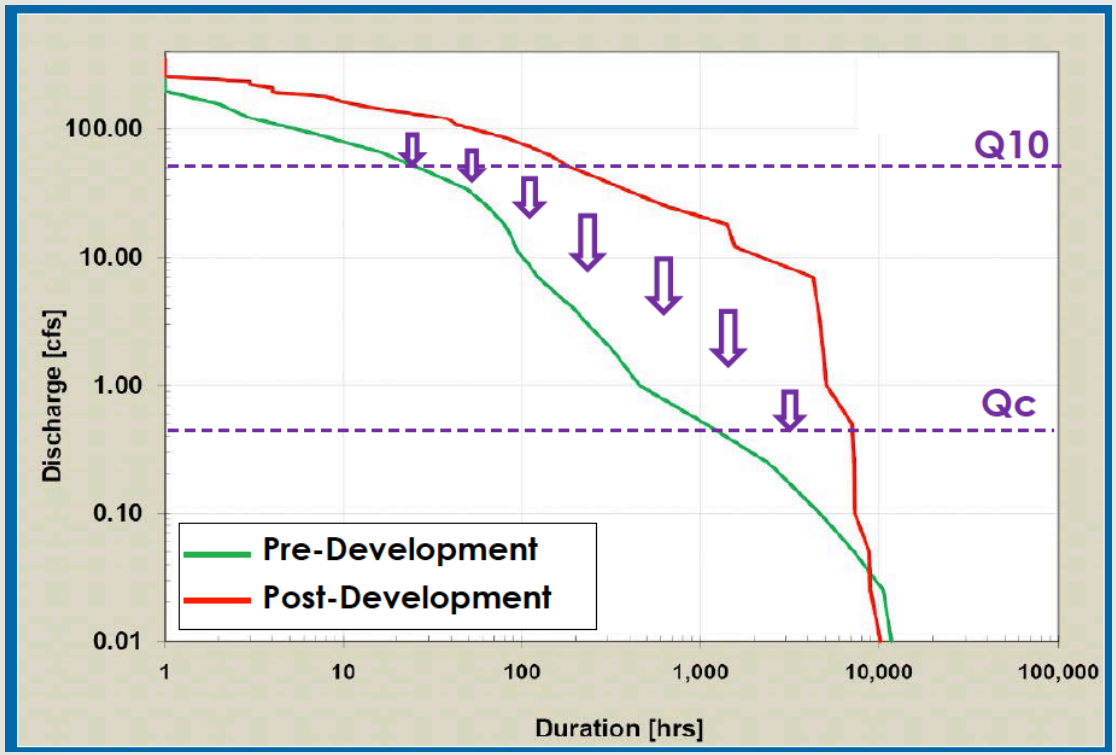
One time, up front costs	
Flow	
pressure tranducers	$1,250
station set up	$1,000
Total	***$2,250***
Biology and Geomorphology	
site recon & selection	*$2,000*
access and permits	$1,000
Total	***$3,000***

Recurring Annual Costs	
Flow	
annual data download/processing	***$5,000***
Biology and Geomorphology	
Field geomorphic assessment	$2,000
field collection of inverts and algae	$2,000
CRAM	$1,000
benthic inverts taxonomy	$600
diatoms taxonomy	$400
data entry, QA/QC	$500
Total	***$6,500***

Challenges

- Equipment costs
- Equipment security
- Labor costs:
  - Equipment installation
  - Development of a rating curve
    - Should have velocity and x-section measurements at a min of 6 stages representing the range of expected flows
  - Monitoring for significant x-sectional changes
  - Data downloads
  - Data integrity - QA/QC process
  - Data management
  - Data analysis and interpretation
- Resolution of precipitation data?

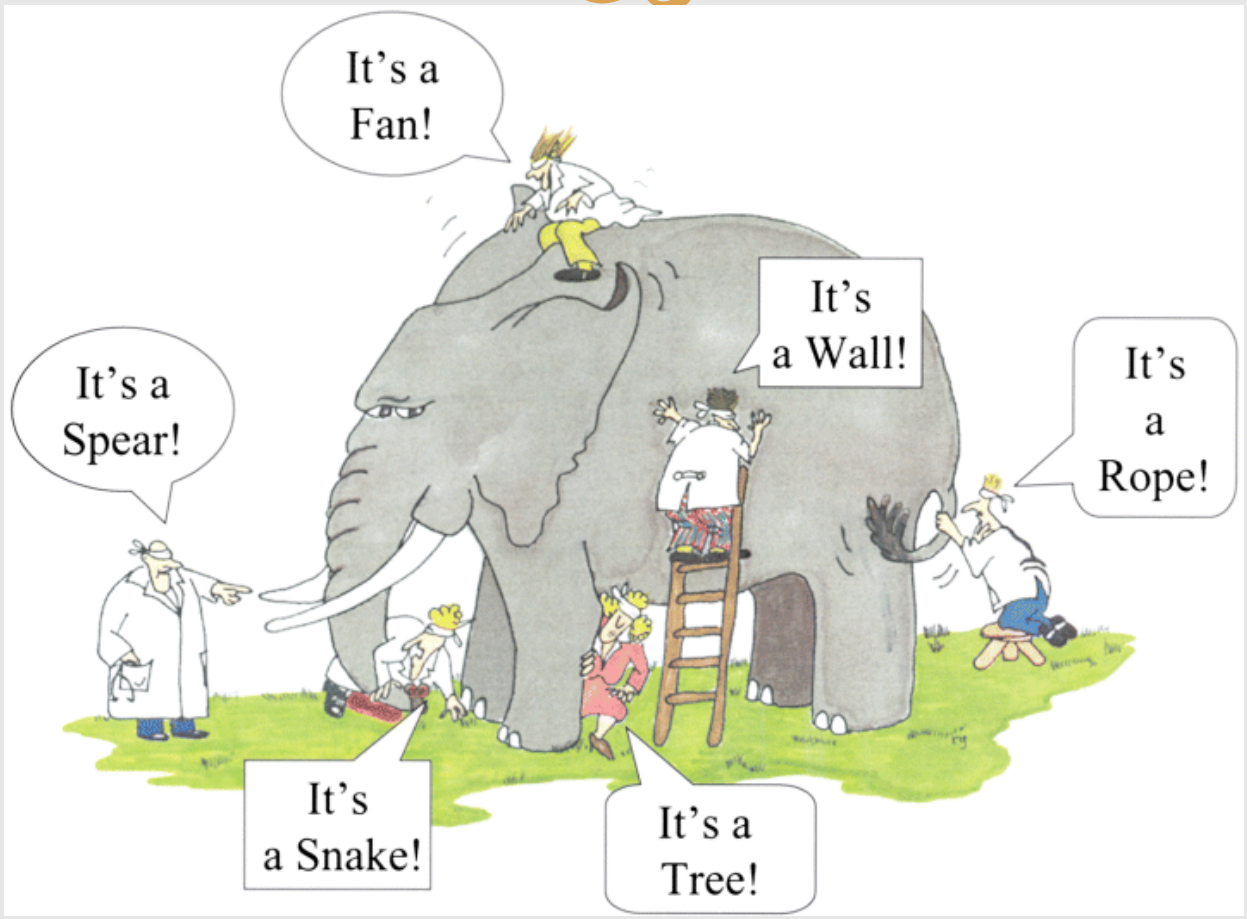
What's at Stake?



From Judd Goodman's presentation

Without continuous streamflow monitoring, no way to evaluate change in long-term duration of erosive flows.

Its the temporal analogue of this spatially inadequate sampling situation



So… A Draft 3-Point Plan for Moving Forward

1. **Incentivize continuous flow monitoring**
2. Ensure data quality and consistency
3. Utilize a central, shared repository

Incentivize!

- Better / cheaper equipment options
  - NEON aquatic monitoring – equipment standards/protocols
  - X-Prize to develop cheap and easy continuous streamflow data collection?
- Creative collaborations for data collection and processing
  - Could be great research project for local university or maybe even high school
- Establish a fund to pay for continuous stream flow monitoring in the most meaningful places, using fees from other projects where monitoring isn't useful

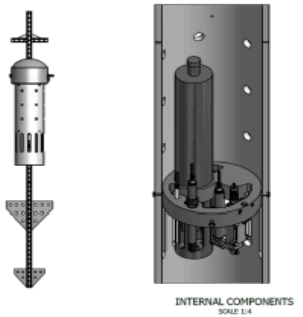
Data Quality / Consistency

- Establish standards for equipment deployment and data collection
- NEON Aquatic Monitoring protocols
  - June 25, 2013 NWQMC webinar presentation available at: http://acwi.gov/monitoring/webinars/NWQMC_NEON-presentation_06.25.2013.pdf

NEON Aquatic Monitoring

Aquatic Instrument System (AIS)

- **Aquatic In stream sensors**
  - Water temp, DO, turbidity, pH, conductivity
  - Chromophoric dissolved organic matter
  - Chlorophyll
  - Discharge/water level
  - Nutrient Analyzer
  - Photosynthetically active radiation (PAR)
- **Stream-side – meteorology**
  - Air temp, precipitation, barometric pressure, PAR, net radiation
  - Wind speed and direction
  - Camera
- **Groundwater sensors**
  - Temperature, level and conductivity



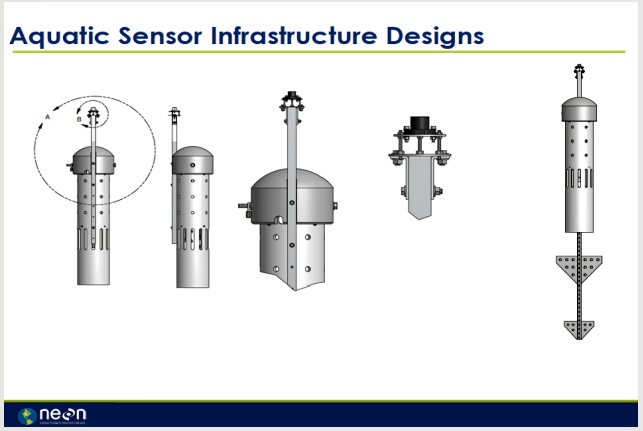
NEON Aquatic Monitoring

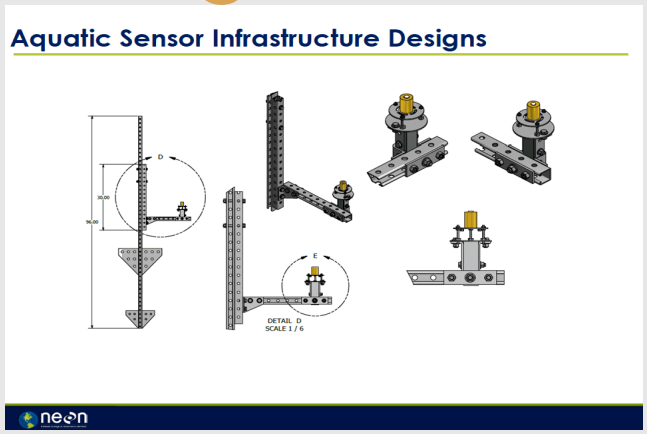
Sensors and Infrastructure Designs

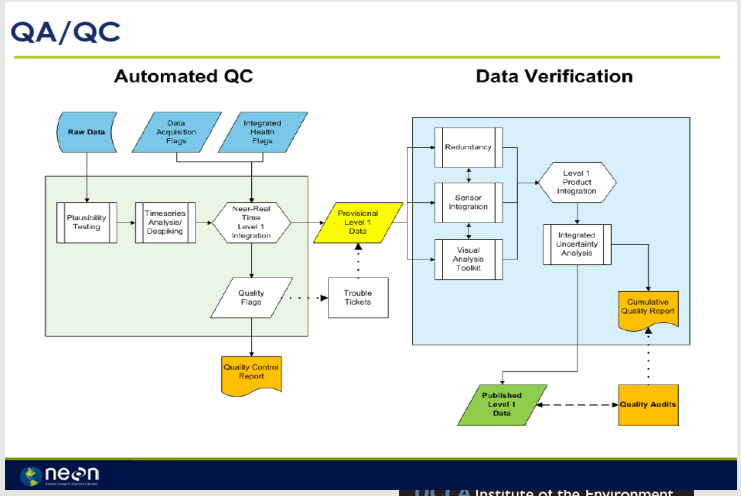
- COTS Sensors and Instruments
- Sensor measurement defined
- Sensor manufacturers being selected
  - Awaiting NSF approval
- Sensor installation designs ongoing
- Make designs available to the public

- Accepting applications for an instrumentation working group
  - General discussions
  - Workshops

NEON Aquatic Sensor Selection, Infrastructure Design, Data Management Protocols





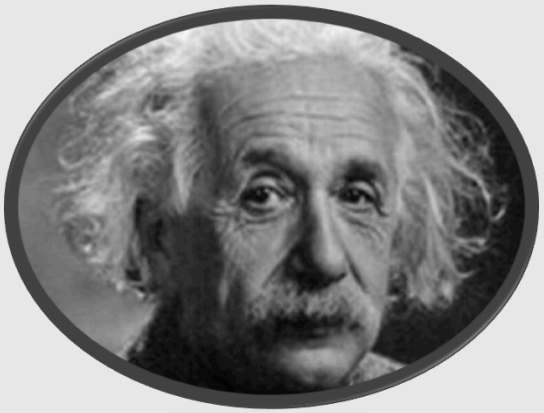


- All designs, protocols and data will be publically available
- Estimated by end of 2013

A Central Shared Repository

- Stream flow data → CEDEN
  - California Environmental Data Exchange Network - www.ceden.org
  - Central location to find and share information about CA's water bodies, including streams, lakes, rivers, and the coastal ocean.
  - Aggregates data from multiple monitoring efforts across the state and makes them available to public.
- BMP inflow/outflow data →?
  - Possibly incorporate into ASCE Water Quality Data Base or develop similar program
  - Establish standard set of reporting parameters
  - Use to inform new designs / compliance planning

Discussion



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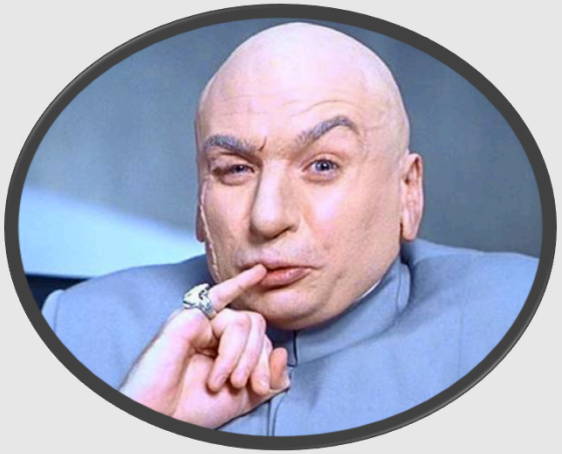

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SCCWRP Tech Report 752

- Appx A – Bibliography of Source Info on Streamflow Measurement
  1. Rantz, S.E., et al. (1982). Measurement and Computation of Streamflow: United States Geological Survey Water-Supply Paper 2175. Washington D.C.
     - Volume 1. Measurement of Stage and Discharge
     - Volume 2. Computation of Discharge
  2. Freeman, Lawrence A. et al. (2004). Use of Submersible Pressure Transducers in Water-Resources Investigations. United States Geological Survey Techniques of Water-Resources Investigations 08-A3: Reston, VA.
  3. Mueller, David S. and Wagner, Chad R. (2009). Measuring Discharge with Acoustic Doppler Current Profilers from a Moving Boat. United States Geological Survey Techniques and Methods 03-A22. Reston, VA.