A (Very) Brief Overview of Streamflow Hydrology: Natural and Human Processes That Influence Streamflow

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Big Picture: It's Complicated...

Natural

- Weather
- Soils, Geology, Topography
- Vegetation

Streamflow

Human

- Storage, Diversion, Consumptive Use
- GW Pumping, Land Cover Change
- Etc...Etc...Etc...
Hydrologic Cycle

Atmospheric Processes

Land Surface Processes

Subsurface Processes
Natural Factors Affecting High/Low Flow

- **Meteorology**
  - Includes precipitation, wind, temperature, solar radiation, etc.
  - Affects water supply and demand
  - Affects streamflow on short and long-term timescales (e.g., floods, water supply)

**Individual Weather Events**

**Sustained periods of above or below normal precipitation and/or ET**

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**U.S. Drought Monitor**

*September 17, 2013*

- **Legend**:
  - D0 Abnormally Dry
  - D1 Drought - Moderate
  - D2 Drought - Severe
  - D3 Drought - Extreme
  - D4 Drought - Exceptional

**Drought Impact Types**:
- + Short Term, typically 6 months (e.g., agriculture, grazedlands)
- + Long Term, typically 16 months (e.g., hydrology, ecology)

*The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.*

[http://droughtmonitor.unl.edu/](http://droughtmonitor.unl.edu/)

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Natural Factors Affecting High/Low Flow

- Antecedent Conditions
  - Typically only considered on shorter timescales, since they vary widely over longer periods
  - Significant effect on runoff and recharge generation
    - Saturation excess runoff
    - Rain on snow
    - Disturbances (e.g., fire, clearing)
Human Factors Affecting High/Low Flow

- **Land Cover Change**
  - increase in impervious surfaces, drainage/grading of wetlands, and other changes
  - can contribute to high runoff from precipitation events
  - can reduce groundwater recharge and baseflow
  - can result in higher peak flows and lower low flows

- **Consumptive Use**
  - surface water diversions
  - surface water depletions due to groundwater pumping (complex effect, difficult to quantify)

- **Storage**
  - storage typically reduces peak flows, increases low flows
  - can affect total flow in areas with high reservoir evaporation
Tools for Evaluating Streamflow

• Field Data and Analysis

• Common Measurements:
  ➢ Streamflow
  ➢ Groundwater elevation
  ➢ Meteorological conditions (temperature, wind speed, solar radiation, humidity, etc.)

• Common Uses:
  ➢ Water budget estimates
  ➢ Trend analysis
  ➢ Correlation analysis
Tools for Evaluating Streamflow

• Hydrologic Models

➤ What are Models?
  ▪ Computer software
  ▪ Mathematical relationships representing physical processes and/or system operations
  ▪ Calculate water balance based on natural and human factors

➤ Role of Models
  ▪ Isolate effects of individual factors (“numerical experiments”)
  ▪ Evaluate streamflow response to future changes (e.g., urbanization, climate change, etc.)
Reclamation Studies in California

• Current Long-Term Planning Studies in CA

- Evaluate water supply and demand under projected future conditions (climate, land use, etc.)

- Develop and evaluate alternatives to address projected imbalances in supply vs. demand

- For more information: http://www.usbr.gov/WaterSMART/bsp/
Summary:

• **Streamflow is Complicated…**
  - Many factors, some natural and some human
  - Factors act simultaneously
    …but with different locations and durations
  - Streamflow reflects complex interaction between factors in both space and time

• **Models are Important Tools for Understanding and Simulating Streamflow**
  - Represent relevant processes and interactions
  - Provide a means of isolating effects of individual factors – e.g., effects of groundwater pumping on streamflow
  - Allow us to evaluate complex interactions between factors
  - Models allow us to project future streamflow response to changing conditions