Hydrology Technical Advisory Team

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- ❑ **Rules of the Road**
- ❑ **Agenda**
  - ▪ **Overview of Aquatic Potential Effects Analysis Approach**
  - ▪ **Assessment Reach Determination**
    - **Available information and knowledge**
  - ▪ **Status of Obtaining Existing Hydrology Information**
  - ▪ **Reach Classification Criteria Metrics**
  - ▪ **Hydrologic Alteration Metrics**
  - ▪ **Ecological Impact Mechanisms**

Potential Effects of Covered Activities

Challenges

- Quantify the potential effects
- Magnitude and Geographic Distribution of Covered Activities
  - 96 reaches / 360 miles of stream channel
- Uncertainties Associated with best available information

Solution – Conceptual Approach Incorporates

- A decision making process that addresses scientific uncertainty and allows for integration of natural resource and socioeconomic values
- A regional environmental flow assessment process that includes, as appropriate, reach specific information on habitat flow relationships for individual species.

Regional Approach

Ecological Limits of Hydrologic Alteration (ELOHA) (Poff et al. 2010)

- Environmental Flows: Quantity, timing and quality of water flows required to sustain freshwater ecosystems and the human livelihood and well-being that depend on these ecosystems

- The flow regime is a primary determinant of the structure and function of aquatic and riparian ecosystems for streams and rivers.

- Current scientific understanding of hydrologic controls on riverine ecosystems and experience gained from individual river reach studies support development of environmental flow standards at a regional scale.

- Scientific uncertainty will exist in the flow alteration–ecological response relationships, in part because of the confounding of hydrologic alteration with other important environmental determinants of river ecosystem condition (e.g. temperature).

Potential Effects Process Regional Approach

Step 1: Assessment Reach Determination
- Distribution of covered activities
- Ecological considerations

Step 2: Hydrologic Foundation
- Baseline Hydrographs
- Flow Data and Modeling
- Developed Hydrographs

Step 3: River Reach Classification
- Hydrologic classification
- Geomorphic sub classification
- River type

Step 4: Flow alteration for each analysis node
- Analysis of flow alteration
- Measures of flow alteration

Step 5: Flow-ecology Relationships (see EDT and IFIM)
- Flow-ecology hypothesis for each river type
- Ecological data for each analysis node
- Flow alteration-ecological relationship

Step 1: Assessment Reach Determination

Plan Area subdivided into preliminary drainages and reaches

- Drainage network reach hierarchy:
  - Confluences, covered activities, other hydro effect facilities
- GIS: Covered activities with potential hydrology effects overlaid on drainages
- Reach defined as segment from:
  - One confluence to the next confluence, or
  - Facility or covered activity to next confluence or covered activity
- ~35 drainages
- ~95 reaches and 360 miles of channel

Step 1: Assessment Reach Determination

Show Assessment Reach Table

Step 1: Assessment Reach Determination

Show Assessment Reach Maps

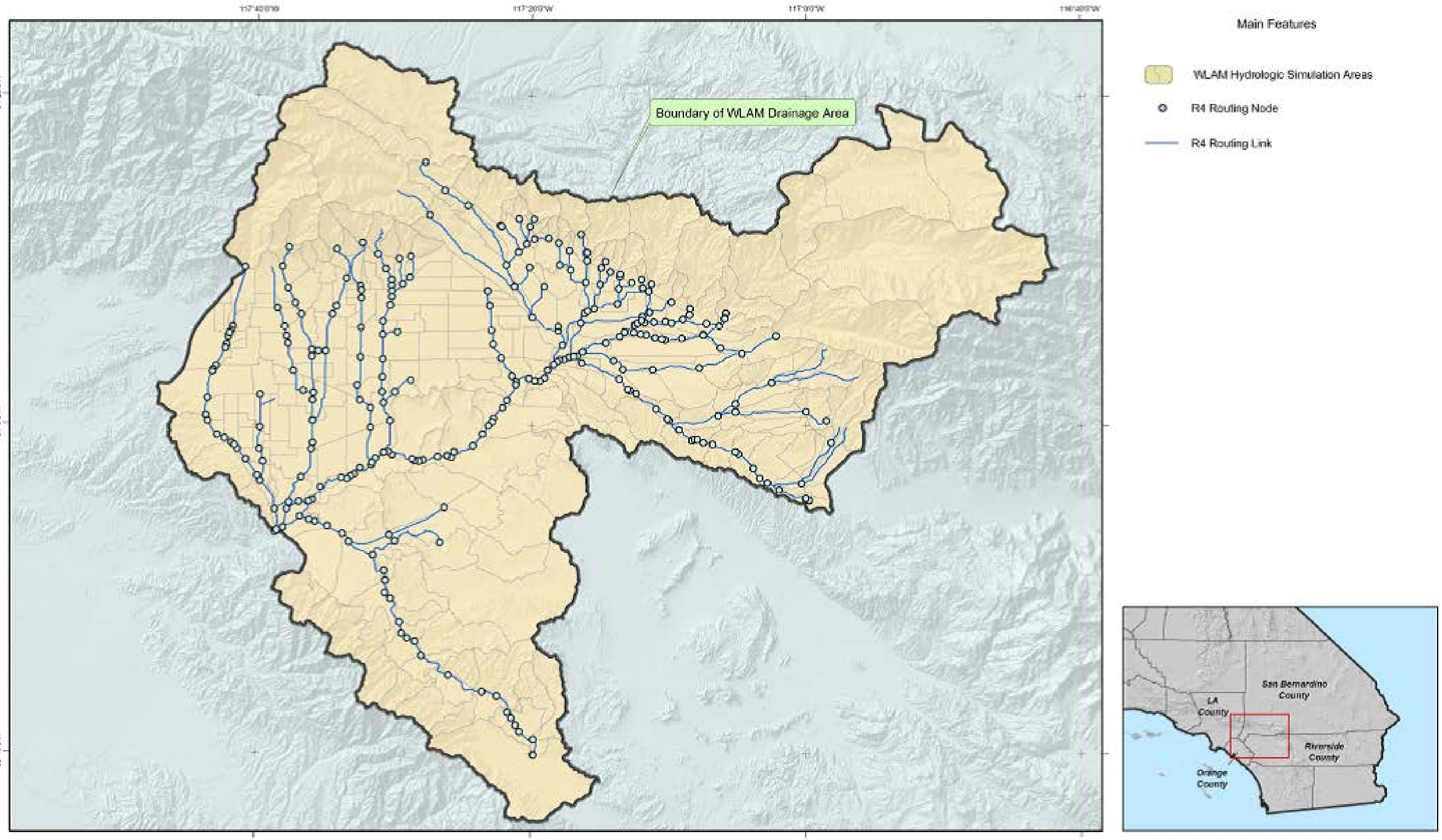
Step 2: Hydrologic Foundation

Collect Existing Information: Measured and Modeled Flow

- USGS gage data – analysis has been performed on USGS gage data
- Wildermuth's (WEI) Wasteload Allocation Model - request made to obtain daily modeled flow from SCS curve-based model and other studies
- Wildermuth's (WEI) Dry-Weather Discharge and Depth Analysis of the Santa Ana River
  - HEC-RAS and historic hydrologic analysis of dry-weather discharge conditions in the Santa Ana River draft reports (not yet available)
- USGS mainstem SAR sediment transport and habitat use study (in progress)
- Geoscience Active Recharge Project analysis –daily modeled flow from HSPF model
- Continuing to acquire hydrology data provided by agencies (e.g., wastewater treatment plant discharge)
- Continuing to acquire proposed flow alterations of of the covered activities

Modeled Hydrology Data

Wildermuth (WEI) Waste Allocation Model



Location of Hydrologic Sub Areas, Model Links and Nodes

Figure 2-4

Step 2: Hydrologic Foundation

Describe Baseline and Developed Conditions Hydrographs

- Baseline Condition: without covered activities
  - Existing conditions in the reaches
  - Include enough years of record to account for hydrologic variability
- Developed Condition: with covered activities/conservation measures
  - Direct (e.g., water-resource development)

Step 3: River Reach Classification

Groups channels with similar attributes and expected to respond similarly to hydrologic modification

- Condense channel complexity:
  - Categories of channel types for communication amongst stakeholders
  - Enhance understanding of processes common in complex systems
- Distribution of channel reaches with similar and dissimilar characteristics
  - Develop relationship metrics used for extrapolation to data limited areas
- Develop reference sites
  - Compare altered reaches with similar physical conditions to unaltered reaches

Step 3: River Reach Classification

Characteristic	Description	Significance	Data Source
Landscape Position	Landscape Unit (e.g., mountain, foothill, alluvial fan, lowland plain)	Dictates whether the reach functions as a source, transfer, or accumulation zone of water and sediment.	Topographic and geology maps
Geology/Lithology	Rock Type, texture, composition	Controls the availability and caliber of sediment supply and river structure and capacity for adjustment.	Geology maps and GIS layers
Artificial Features and Controls	Anthropogenic features that alter natural stream processes (e.g., dams, levees, recharge basins, effluent outfalls)	Numerous artificial controls alter the natural processes of the drainages in the study area, including levees that prohibit channel migration, dams that block sediment and alter hydrology, and stormwater and effluent outfalls that deliver water and sediment into the system. The location of these features and how they interact with natural processes needs to be identified.	Air photography, existing studies
Longitudinal Profile	Downstream changes in elevation/slope showing locations of tributary water and sediment inputs and geologic and artificial controls	Slope is a primary control on river characteristics including sediment transport, morphologic form, and habitat use. Changes in slope often coincide with landscape unit boundaries or geologic and artificial controls.	Digital Elevation Model (DEM) data analyzed in GIS
Contributing Drainage Area	The land area draining to the reach	Illustrates how the potential for increases in runoff and sediment changes along the stream profile and relative importance of tributary inputs.	Digital Elevation Model (DEM) data analyzed in GIS
Natural Hydrologic Regime	Perennial, intermittent, ephemeral, groundwater driven, snowmelt driven. Flood recurrence intervals, flood history plots, flow duration curves	The timing and frequency of flows with the capacity to influence morphology. Aids in the determination of which scale of event is the dominant control on morphology and how frequently that event occurs, and illustrates the importance of the daily flow regime on habitat suitability and maintenance.	Log-Pearson III flood frequency analysis of gage data, regional regression curves relating drainage area with flood magnitude, measured and modeled mean daily discharge
Valley Width	Measured from the toe of hillslopes or artificial levees.	Aids in the determination of lateral confinement and the presence/absence and size and distribution of floodplains.	Air photography and topographic data in GIS

Valley Confinement and Floodplain Access		
Confined Valley = Over 90% of the channel abuts bedrock or terraces. No floodplain or only isolated floodplain pockets (<10%). Channel planform imposed by valley configuration	Partly-Confined Valley = 10-90% of the channel abuts bedrock or terraces. Discrete floodplain pockets in an alternating or semi-continuous pattern. Channel planform constrained by valley configuration.	Laterally-Unconfined Valley = <10% of the channel abuts bedrock or terraces. Unconstrained channels with deformable banks and continuous floodplains along both banks

Step 3: River Reach Classification

Characteristic	Description	Significance	Data Source
Dominant Sediment Sources	Hillslope, debris flows, fluvial, bank failure	Describes the dominant sources and delivery mechanisms of sediment into the reach, including alteration of natural sediment sources.	Air photography, existing studies
Channel Morphologic Type	Bedrock, cascade, step-pool, plane bed, pool riffle, dune ripple, braided	Description of how sediment is assembled in the bed and linked with channel process. Important for describing habitat value and susceptibility to change.	Air photography, existing studies, field inspection
Bed and Bank Material Texture	Dominant caliber of the channel bed material (e.g., bedrock, boulder, cobble, gravel, sand, silt/clay)	A reflection of lithology, flow energy, and sediment supply. The relationship between bed material size and the prevailing flow regime affects channel morphology, habitat value, and susceptibility to change, and is an indicator of instability.	Air photography, existing studies, field inspection
Channel Dimensions	The typical width and depth of the channel in the reach	Channel size (and width to depth ratio) is often a reflection of flow regime, sediment caliber and supply, bank materials, and vegetation. Variability in channel size can also indicate instability and direct alteration (e.g., channelization). The width and depth configuration of the channel also controls hydraulics, including flow depths and habitat availability.	Air photography, existing studies and hydraulic models, field inspection
Vegetation Cover and Composition	The type and percent vegetation cover along the channel reach banks	Important for determining vegetation's role in channel migration, channel stability, and habitat value.	Air photography, existing studies, field inspection
Flow Stage, Sediment Transport Regime, and Geomorphic Adjustment	The sensitivity of geomorphic and habitat unit adjustments to flow stage and dominant sediment transport regime (e.g., bedload, mixed load, suspended load)	Describes the sensitivity of a channel reach to changes in sediment transport, bed morphology, bank erosion, and habitat units based on changes in flow stage. Consideration of a channel-forming flow or dominant flow that performs the most geomorphic work and is largely responsible for forming and sustaining channel form.	Existing studies, field inspection

Types of Flow Stage Behavior

Low Flow Stage	Bankfull Stage	Overbank/Threshold Stage
Low Flow Stage Reaches = Bedforms are sparsely vegetated and transient features easily reworked at low flow stage and replace at high flow stage (e.g., dune-ripple channel). Flow and sediment interactions at low stage are important for habitat diversity and value as substrate texture and bedforms are easily adjusted.	Bankfull Stage Reaches = Geomorphic units reflect the broader channel structure associated with the formative discharge stage. Morphology reflects constraints on the dimension, shape, and alignment of the channel and the distribution of flow within it. Most channel change (e.g., sediment mobilization, bar formation) occurs over a short time period in conjunction with formative discharge events.	Overbank/Threshold Stage Reaches = Channel morphology is largely static and only rarely reworked by large, infrequent flood events. Includes non-alluvial channels and channels formed downstream of dams or in urban areas where sediment supply is reduced and bed material is coarser than the available transport capacity,

Step 4: Flow Alteration for Each Analysis Node

Determine specific flow alteration for Plan Area reaches

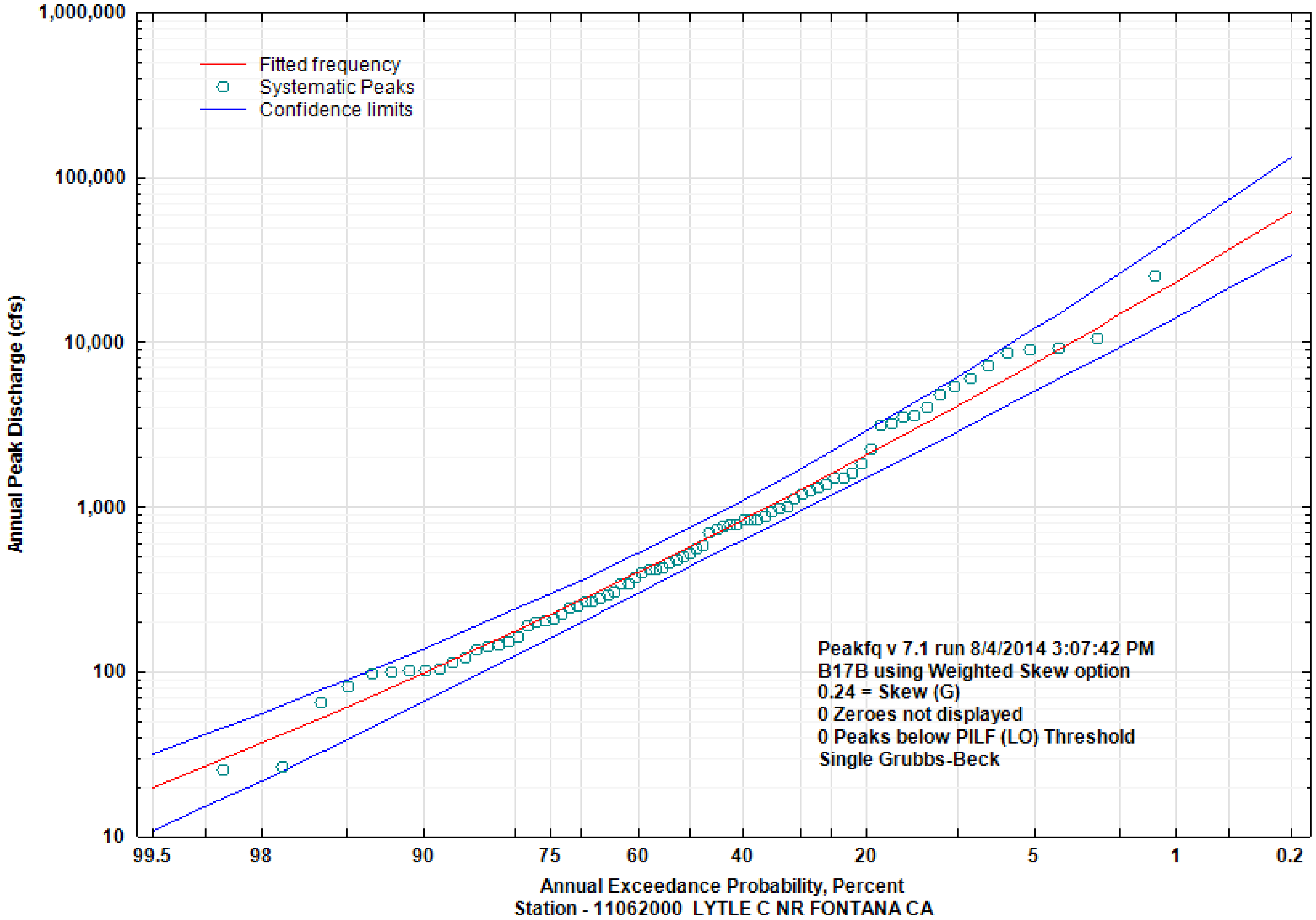
- Increasing degrees of flow alteration from baseline condition are associated with increasing ecological change
- Develop flow metrics to describe how covered activities alter the magnitude, frequency, duration, timing, and rate of change of flow events
- Calculate for each node the degree of hydrologic alteration
  - Daily exceedance values and life stage importance (e.g., 20, 50, 80%)
  - Channel maintenance flows: peak flows important for flushing of fine sediment, bed and bank scour, floodplain inundation, riparian recruitment
  - Implications of flow alteration on water quality, temperature, TDS

Stream Gage Analysis

USGS 11062000 Lytle Creek near Fontana (Reach 5)

- Peak Flow Recurrence Intervals

STAID	P1.25	P1.5	P2.	P2.33	P5.	P10.	P25.	P50.	P100.
11062000	174	306	567	737	2010	4040	8700	14500	23100



Stream Gage Analysis

USGS 11062000 Lytle Creek near Fontana (Reach 5)

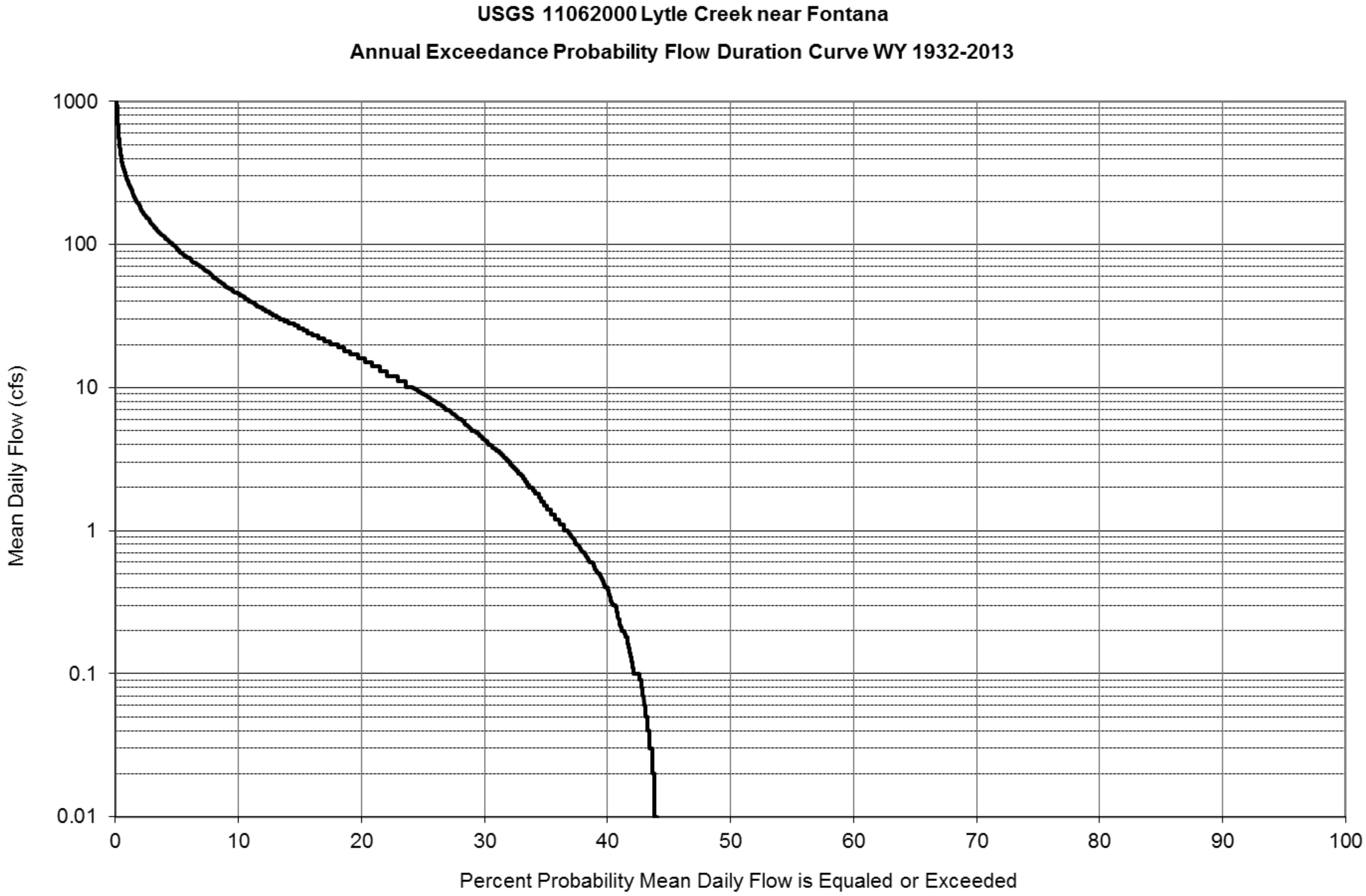
- Evaluation of gage descriptions to assess data quality and flow regulations and diversions upstream
- Isolate hydrologic effects of covered activities

REMARKS.--Records poor. No regulation upstream from station. Southern California Edison Co.'s Lytle Creek Conduit (station 11060900) diverts 2.3 mi upstream for power development and Fontana Water Co. collects water from an infiltration line (station 11061000) upstream for irrigation and domestic use. Abrupt changes in the combined discharge of Lytle Creek and diversions occurs at times, due to changes in diversion, the distances between diversion and gage locations, time of travel, and changes in surface and subsurface storage. Spill can occur from Southern California Edison Co.'s Lytle Creek forebay during unusually high flows. Water can be pumped from channel by two pumps at Miller Narrows at a point approximately 2 mi upstream. No water has been pumped out of channel since 1971. For records of combined discharge of Lytle Creek and diversions, see station 11062001. See schematic diagram of Santa Ana River Basin available from the California Water Science Center.

Stream Gage Analysis

USGS 11062000 Lytle Creek near Fontana (Reach 5)

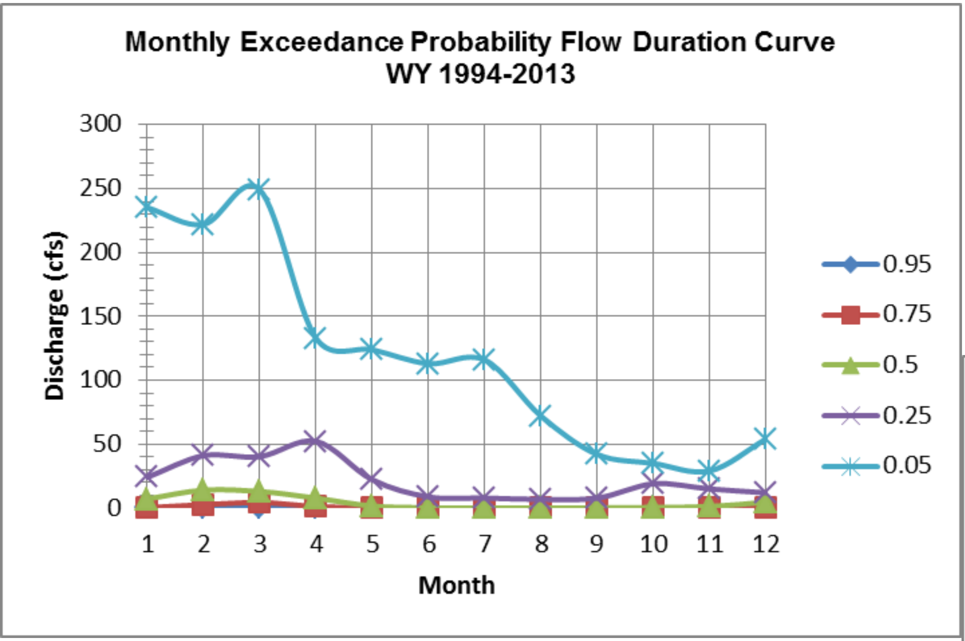
- Flow Duration Curve

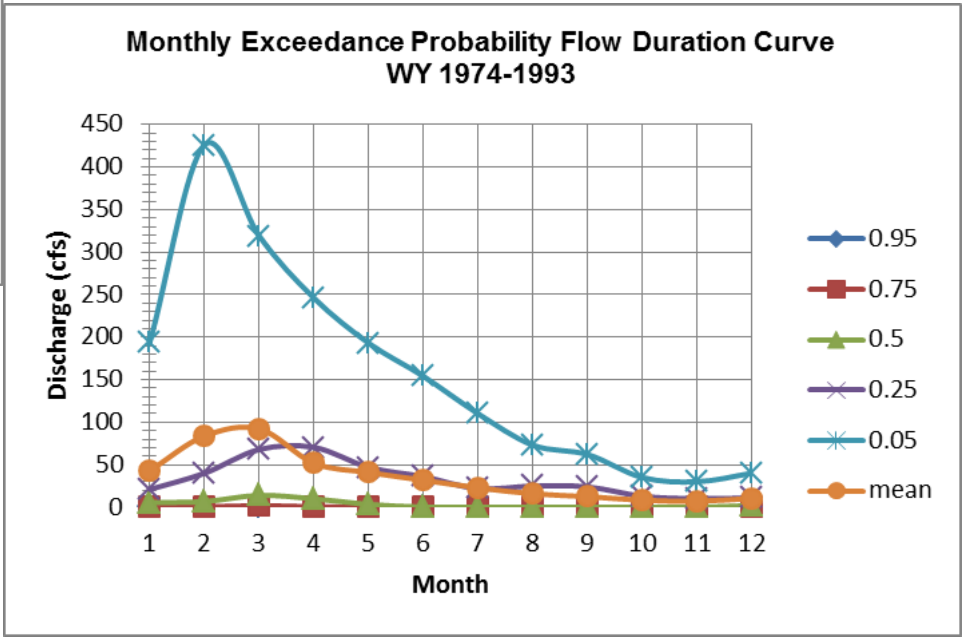


Stream Gage Analysis

USGS 11062000 Lytle Creek near Fontana (Reach 5)

- Exceedance Flow Trend Analysis

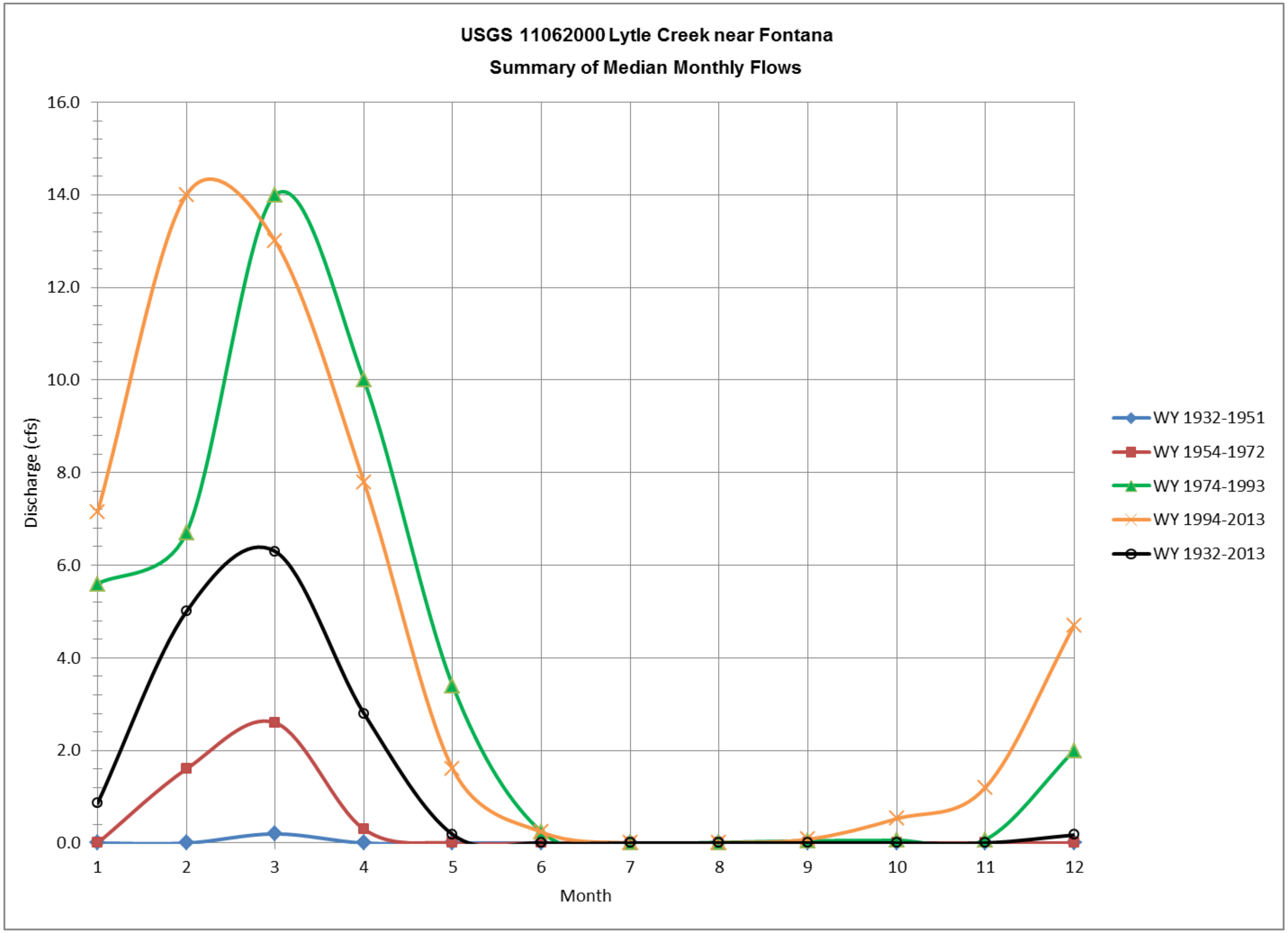




Stream Gage Analysis

USGS 11062000 Lytle Creek near Fontana (Reach 5)

- Trend Analysis of Median Monthly Flows



Step 5: Flow-Ecological Relationships

Develop flow-alteration response relationships that form a basis for developing environmental flow standards

- Develop flow-ecology hypothesis for each reach
  - (e.g. X% flow reduction = Y% habitat change)
- Level of analysis will be determined on an individual basis
  - Amount of existing information available
- Consider the value of informational components of various ecological models (e.g., IFIM and EDT) to assist in the analysis
  - Adapt components to specifics of life stage requirements of HCP species
  - Not proposing to implement a full IFIM or EDT study
- Quantify % ecological change to extent possible or use categorical responses (e.g., low, medium, high) or trajectory of change (+ / -)