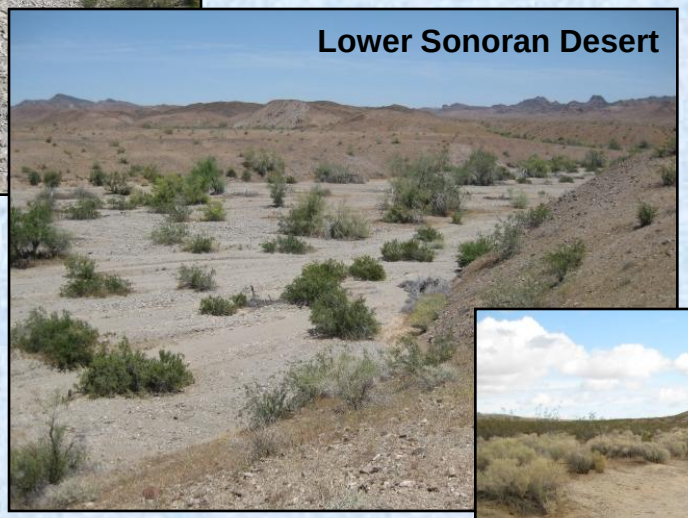
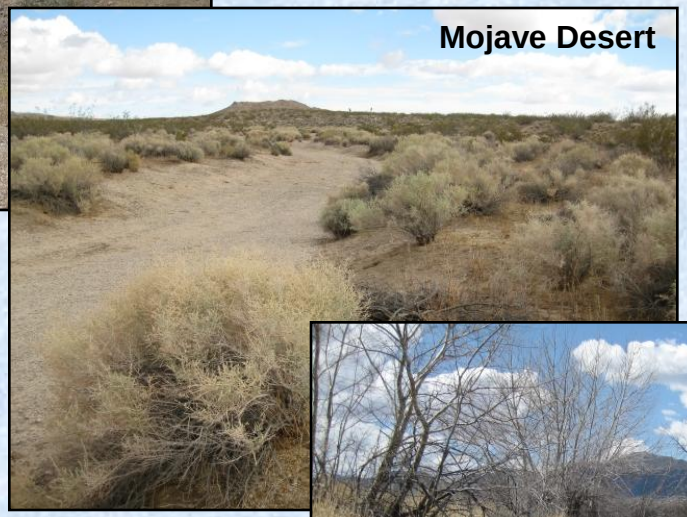
Episodic Stream Channels: Imperatives for Assessment and Environmental Planning in California

Costa Mesa, California
November 7-10, 2010





Ecological and Hydrological Significance of Episodic Streams

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The Ecological and Hydrological Significance of Ephemeral and Intermittent Streams in the Arid and Semi-arid American Southwest

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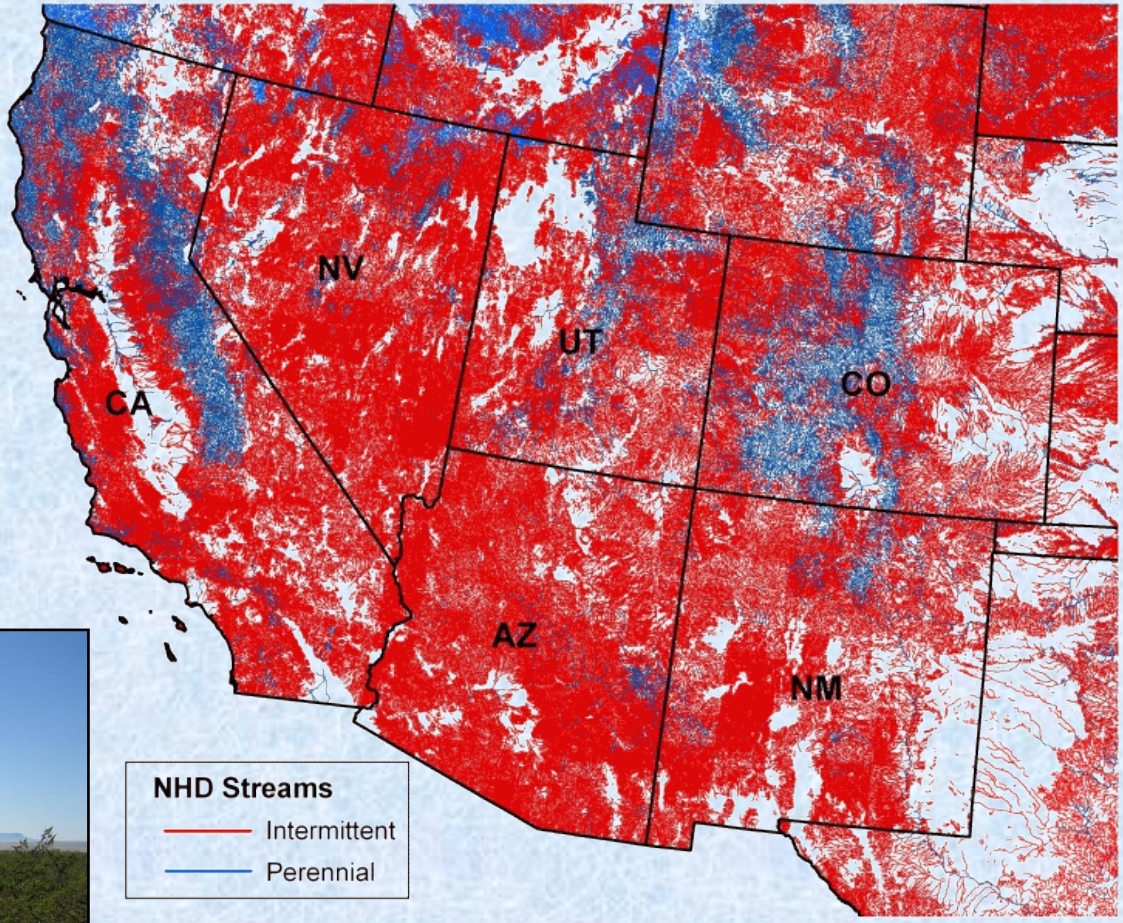
Levick, L., J. Fonseca, D. Goodrich, M. Hernandez, D. Semmens, J. Stromberg, R. Leidy, M. Scianni, D. P. Guertin, M. Tluczek, and W. Kepner. 2008. The Ecological and Hydrological Significance of Ephemeral and Intermittent Streams in the Arid and Semi-arid American Southwest. U.S. Environmental Protection Agency and USDA/ARS Southwest Watershed Research Center, EPA/600/R-08/134, ARS/233046, 116 pp.

Importance of Episodic Streams

Percent E/I

Arizona	94%
Nevada	89%
New Mexico	88%
Utah	79%
Colorado	68%
California	66%



National Hydrography Dataset
USGS, http://nhd.usgs.gov
Mapped at 1:100,000

Episodic Streams

- Predominant fluvial forms in arid and semiarid environments, supporting high biodiversity and habitat values relative to drier uplands

- Provide same ecosystem services as perennial streams
  - Watershed and Landscape hydrologic connections
  - Water supply protection and water-quality filtering
  - Wildlife habitat and movement/migration corridors
  - Sediment transport, storage & deposition
  - Groundwater recharge and discharge
  - Vegetation community support
  - Nutrient cycling and movement

- But function differently……

Hydrology of Episodic Streams

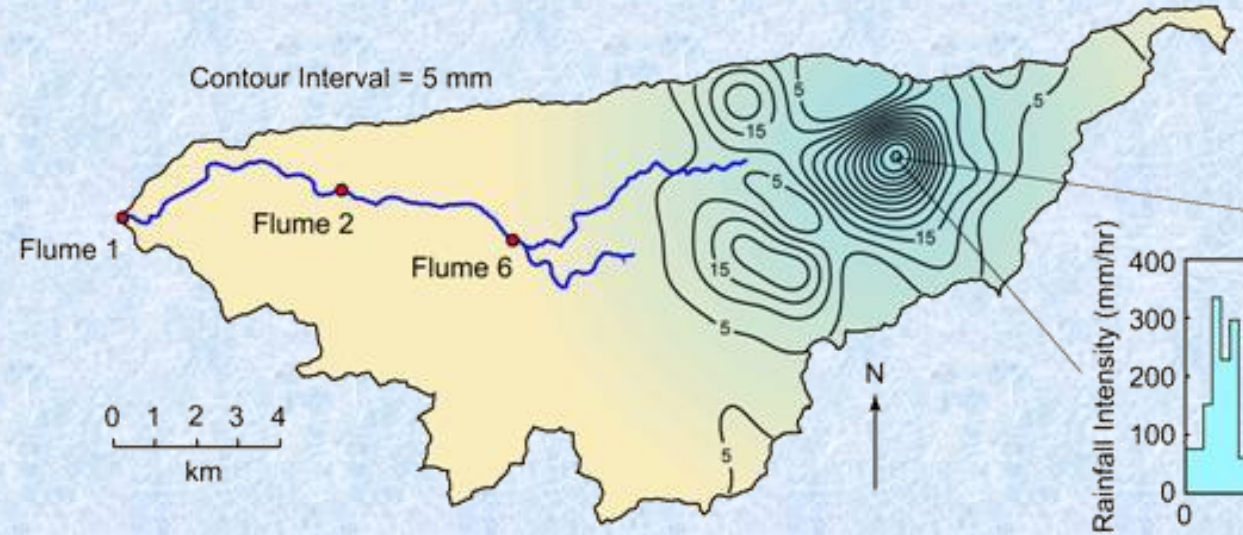
- Dryland hydrology is not like humid region hydrology
  - Desert streams frequently flow as **flash floods** from high-intensity, short duration thunderstorms (i.e. summer monsoons)
  - Flow occurs only after the watershed has had enough rain to saturate the soil and generate runoff
  - Flow may last days, hours or only minutes

Walnut Gulch Experimental Watershed, AZ, Flume 1

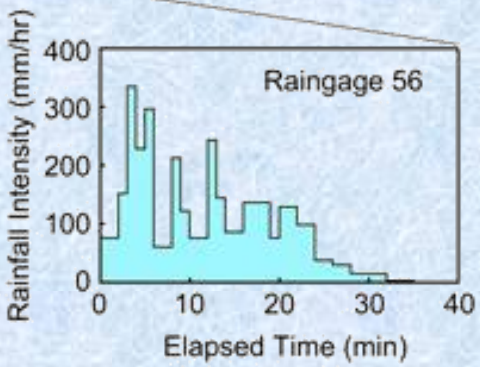
Hydrology of Episodic Streams

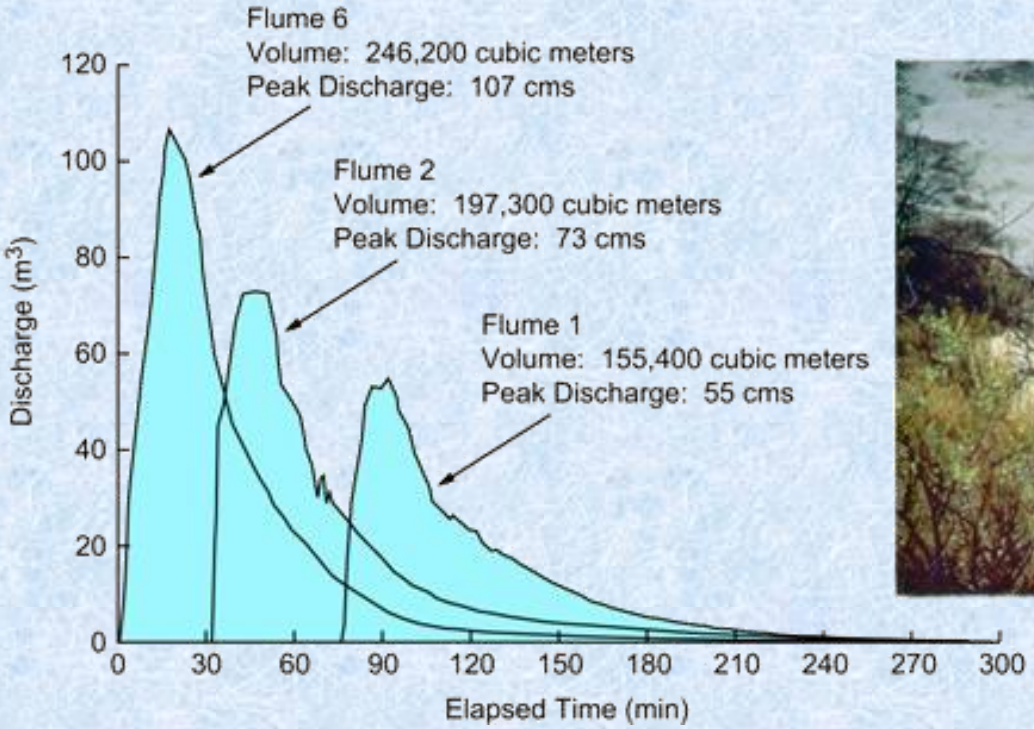
- High degree of spatial & temporal variability in climate & flood regime
  - Highly variable rainfall and episodic pulsed flows
  - Sparse vegetation cover and poorly developed soils produce more runoff and erosion per unit area for a given intensity of rainfall
  - Flood magnitude and duration are related to watershed size
  - Hydrographs show a steep rising limb, with a quick rise to peak flow, short time of peak flow, and a long, steep recession limb
  - High transmission losses result in significant downstream decreases in total flow volume, flood peak, and flow frequencies

Hydrology of Episodic Streams – Transmission Losses



Walnut Gulch Experimental Watershed, Tombstone, AZ
August 27, 1982 storm event



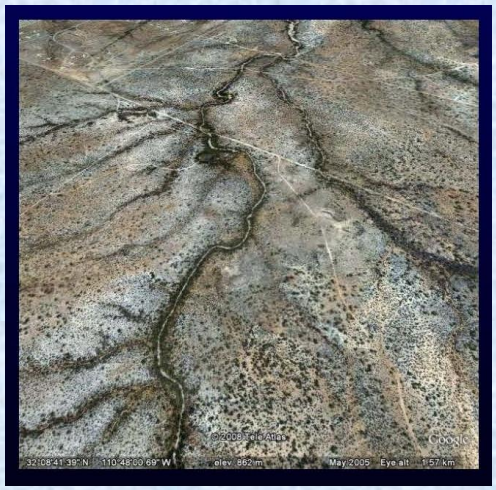


Sediment Transport in Episodic Streams

- High rates of Sediment Transport
  - High velocity turbulent flash floods move heavy sediment loads through watershed
  - Sediment does not always reach the watershed outlet – is remobilized and redistributed within the channel network during the next flow event
  - Cumulative effect is large sediment loads in downstream waters
    - Many Southwest TMDL's are for sediment

Ecology of Episodic Streams

- Lack of Ecological Data for Ephemeral and Intermittent Streams
- Lack of understanding & mapping of Biodiversity of E/I Streams
- Historical focus on perennial systems as preferable, high quality habitat , referring to E/I streams as “degraded” - not valued as habitat
- But – the health of the entire watershed depends on the health of all stream reaches



- Many wildlife species are known to be associated with these habitats but distribution and composition is not well understood or documented

Vegetation along Episodic Streams

- Vegetation in and along episodic streams can be denser and more diverse in comparison to surrounding uplands, providing many important functions
  - Protects soil from wind and water erosion
  - Moderates temperatures
  - Provides channel and stream bank roughness, influencing flow velocities, flow depths, and sediment transport and deposition
  - Contributes to channel features by stabilizing sand bars, and initiating formation of other depositional features (bars, benches, ridges or islands)
  - Influences biogeochemical cycles
  - Influences water/energy balance
  - Provides food and cover for wildlife
  - Is influenced by hydrologic regime:
    - Cottonwood germination dependent on disturbance and floods
    - Benefits from Transmission losses

Wildlife and Dryland Stream Systems

- Link between E/I streams and wildlife communities widely recognized yet understudied
- Many wildlife species are known to be associated with these habitats but distribution and composition is not well understood or documented
- Provide primary habitat, predator protection, movement corridors, migration stopover sites, breeding & nesting sites, shade, food sources, and water in temporary or permanent pools
- Dryland species have developed many special adaptations to the water-limited conditions of drylands:
  - heat evasion (daily or seasonal estivation, diurnal or nocturnal behavior)
  - water conservation strategies
  - water storage strategies
  - dehydration tolerance
  - heat tolerance
  - heat dissipation
  - very rapid development from egg to young

Wildlife Uses of Dryland Stream Systems

- Avian species are highly dependent on riparian corridors whether perennial, intermittent or ephemeral
- Reptiles and amphibians rely heavily on dry washes for breeding, and food
- Majority of benthic macroinvertebrates occur in ephemeral or intermittent streams
- Large mammals use dry washes for cover, shade, forage, nesting and breeding

Summary

- Ephemeral and intermittent streams constitute the vast majority of drainage ways in the Southwest
- Perform same ecosystem services as perennial streams: transport water, sediment and nutrients, and play an integral role in overall watershed function, including biological processes and vegetation and wildlife community support
- Flash floods, large transmission losses and high sediment loads are characteristics of dryland hydrology
- More research is needed on the *ecological and hydrological interactions* in dryland streams



Current Research

- "An Ecohydrological Approach to Managing Intermittent and Ephemeral Streams on Department of Defense Lands in the Southwestern United States"
  - Four year project, Funded by the Strategic Environmental Research and Development Program (SERDP), Dept. of Defense
  - Objectives
    - To develop an Ecohydrologically-based Classification for ephemeral and intermittent stream types based on hydrologic, geomorphic, and vegetative attributes
    - To assess the impacts of perturbations (e.g. climate change, military activities) on the hydrologic regimes and habitats of these systems, and the threatened, endangered and at-risk species that depend on them, to improve management decisions

An Ecohydrological Approach to Managing Intermittent and Ephemeral Streams on Department of Defense Lands in the Southwestern United States

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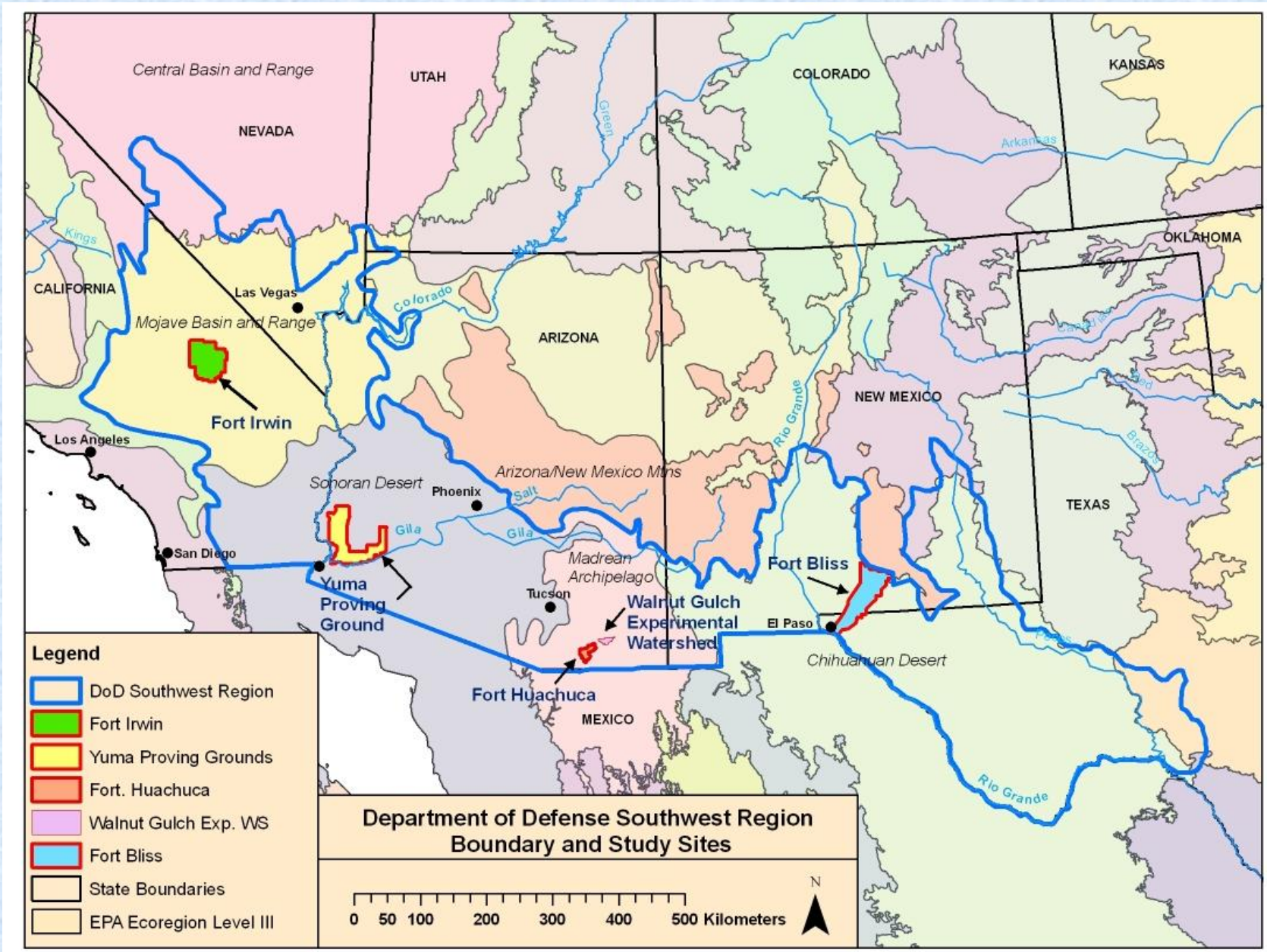
Study Sites on Southwestern DoD Lands



Ecohydrological Classification of E/I Streams

- Assumption: The hydrologic and geomorphic characteristics of the stream influences the riparian vegetation communities, which determine habitat types and values that support TER-S

- Methods
  - Riparian and Upland Vegetation and Geomorphic Field data collection
  - GIS/RS analysis of vegetation and geomorphology
  - Hydrologic modeling for flow permanence and extent
  - Analyze data and classify stream “types”
  - Identify species of concern and their habitat requirements
  - Link stream types to species habitat needs
  - Assess climate change and land use impacts on stream types & habitats

Ecohydrological Classification of E/I Streams

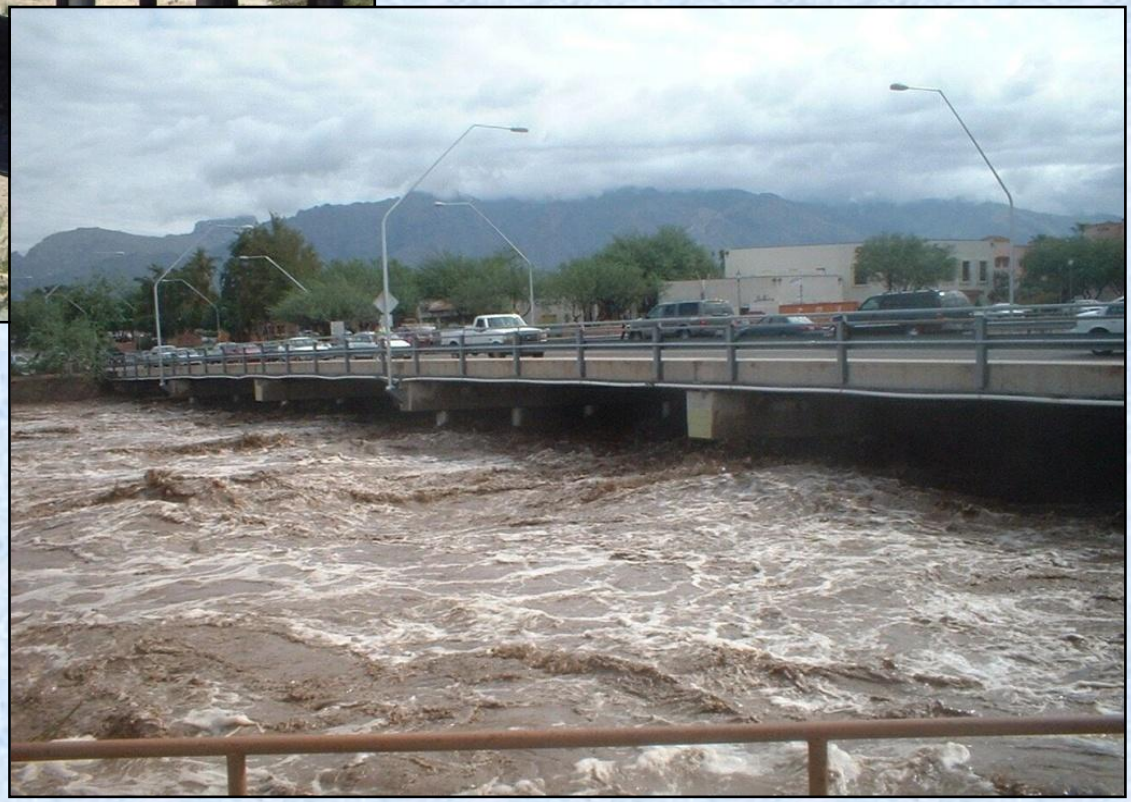
- Progress to date
  - Field trips to Ft. Bliss (Sept.) and Ft. Irwin (Oct.)
  - Initial GIS/RS data acquisition and analysis, hydrologic modeling



- Preliminary observations
  - Stream “type” variability related to geology, soils, topography, position on the landscape, climate
  - “Riparian vegetation” may be absent, only slightly different from uplands, or only in the channel; no typical riparian vegetation zone
  - Usual riparian vegetation and geomorphic terminology and concepts don’t quite fit these systems

Thank You!

Rillito River, Tucson, AZ
October 2007



July 31, 2006, Flood
after +10” of rain in 5 days
38,700 cfs