Review of the AGWA Management Toolkit:

Explanations and examples of AGWA tools and features

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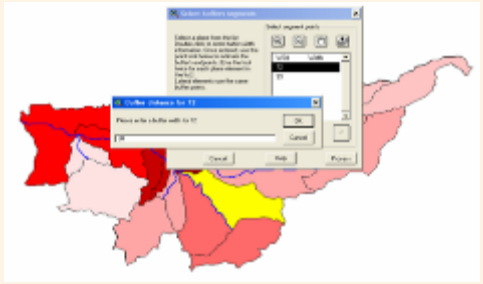
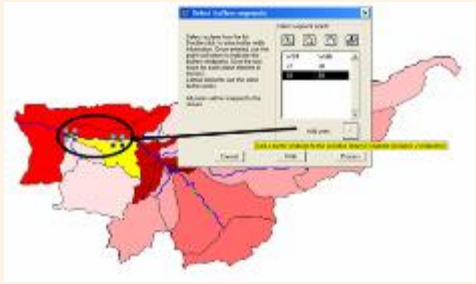
SedHyd

Management Tools

- **Land use and land cover modification**
  - **Based on common land use/vegetation types**
  - **Vegetation monitoring data**
  - **NRCS Ecological Site Descriptions**
- **Riparian buffer strips**
- **Detention and retention ponds/reservoirs**
- **Multi-watershed analysis for political/park boundaries**
- **Post-fire effects**
- **Residential development**

Evaluating the Effects of Riparian Buffers



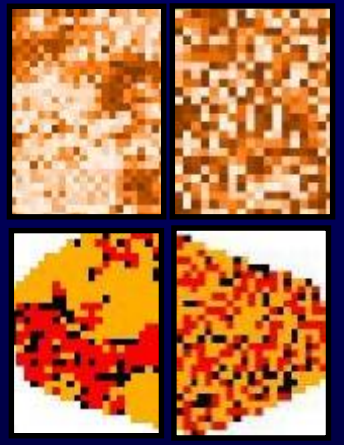


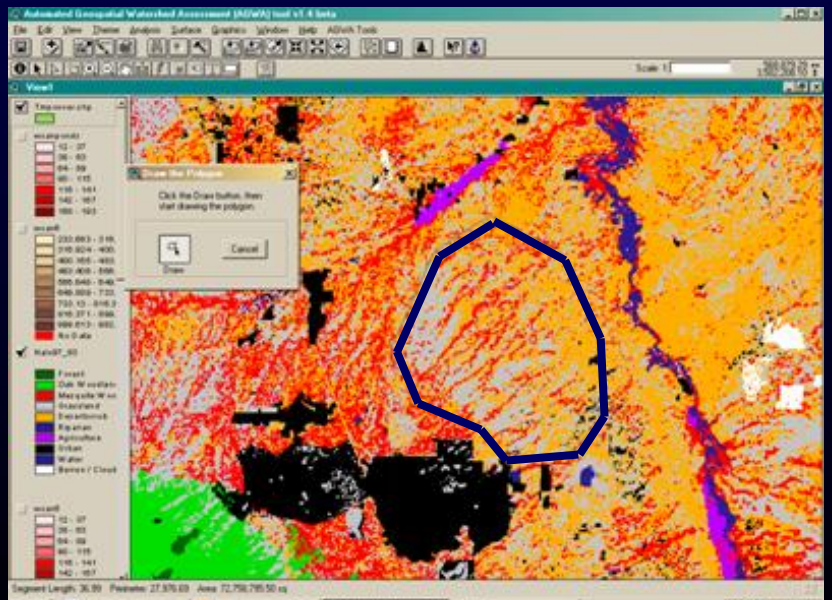
Land-Cover Modification Tool

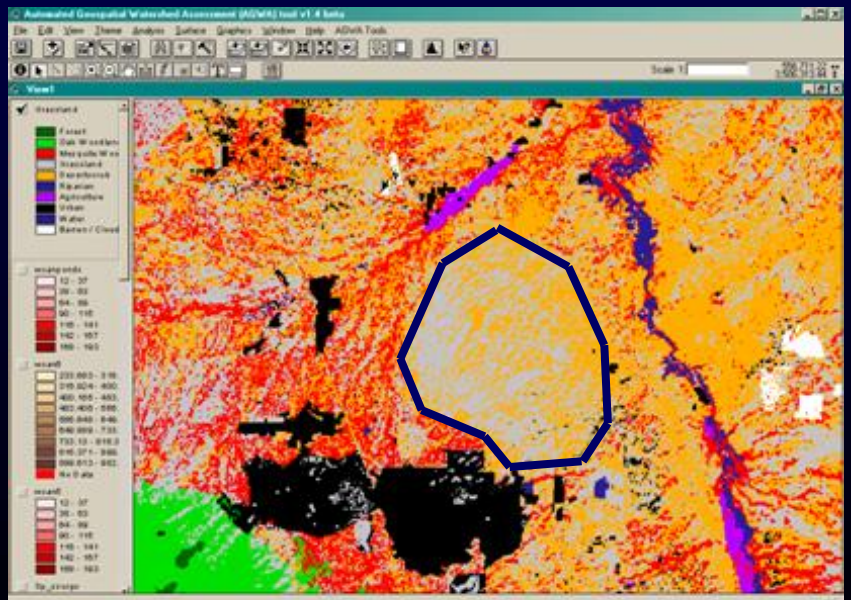
Allows user to specify type and location of land-cover alterations by either drawing a polygon on the display, or specifying selected features from a polygon map (i.e. a pasture).

Types of Land-Cover Changes:

- **Change entire user-defined area to new land cover (uniform)**
- **Change land-cover type to another (random or patchy/factal)**
- **Can specify % success of change due to practice (e.g. Shrub management, remove shrubs from hillslopes)**

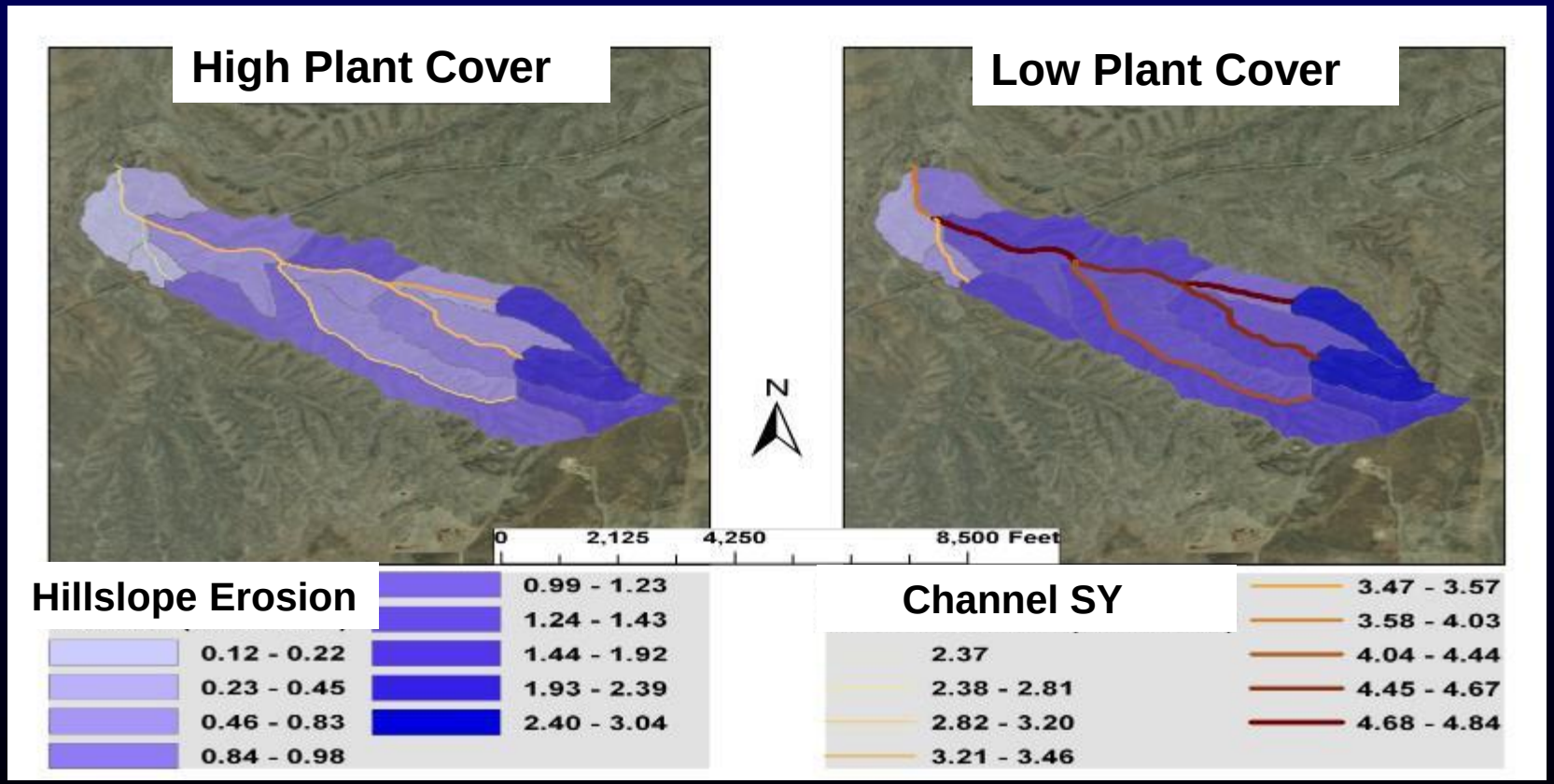






Example: Vegetation Change (K2-RHEM)

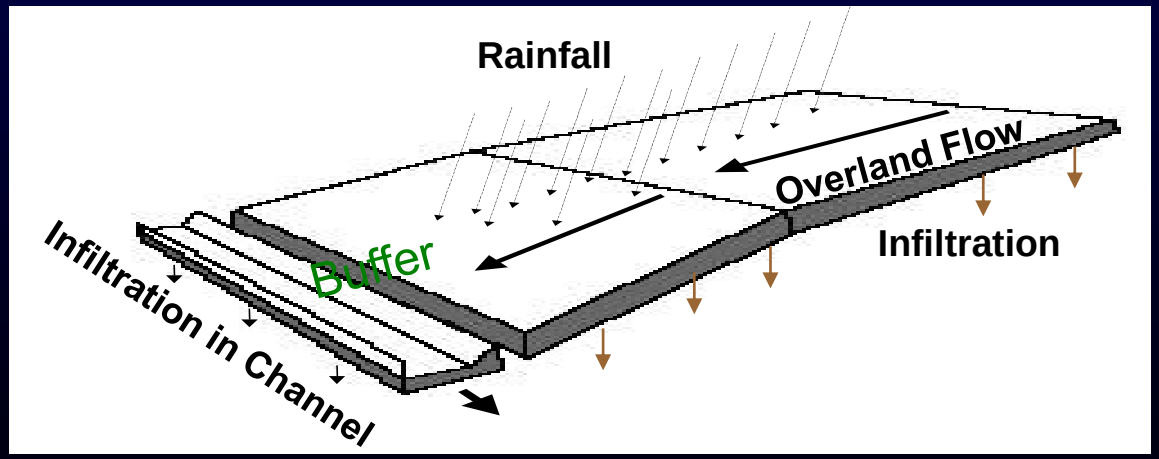
- Loamy Upland Ecological Site, Arizona
  - Historic native plant community (CC = 78%; GC = 72%)
  - Mesquite-Native plant community (CC = 25%; GC = 40%)
- 783 acre watershed with uniform vegetation
- One-hour – 10 year return period event

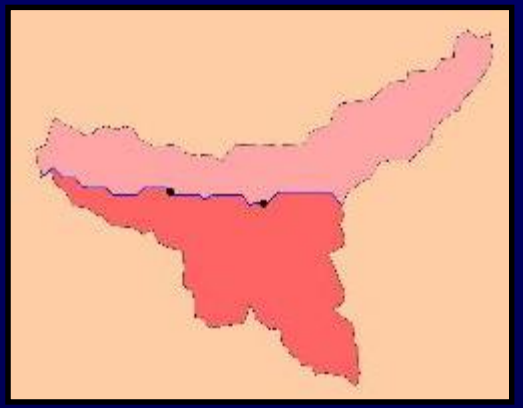


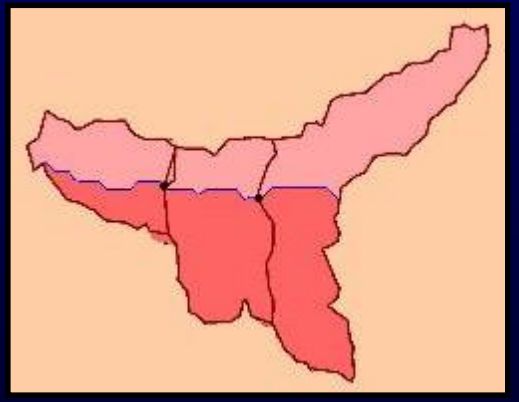
Management Tools Built into AGWA (Cont.)

Stream Buffer Tool

- User-defined geometry (length and width) for each buffer on the watershed
- Allows users to select a new landcover and slope for the buffer element
- Simulates the runoff / run-on process via interactive infiltration in KINEROS2)

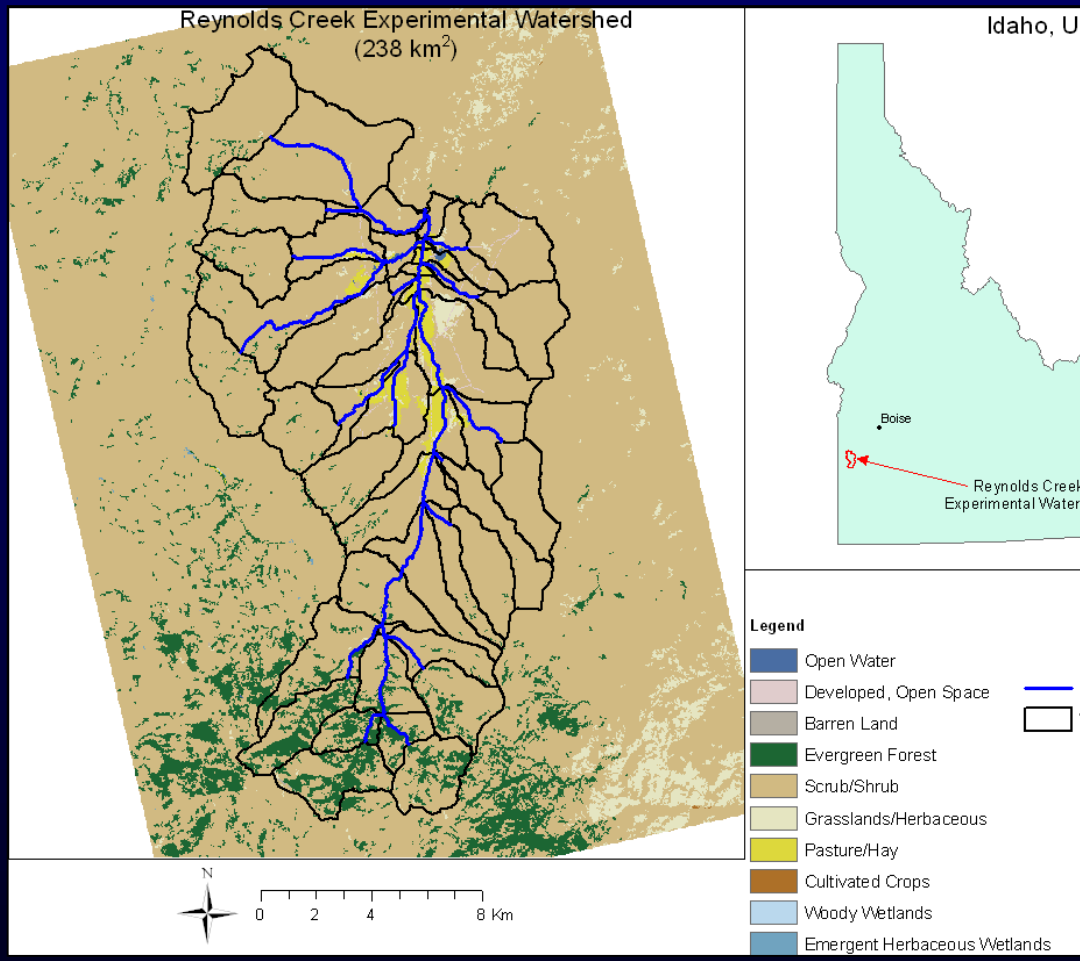






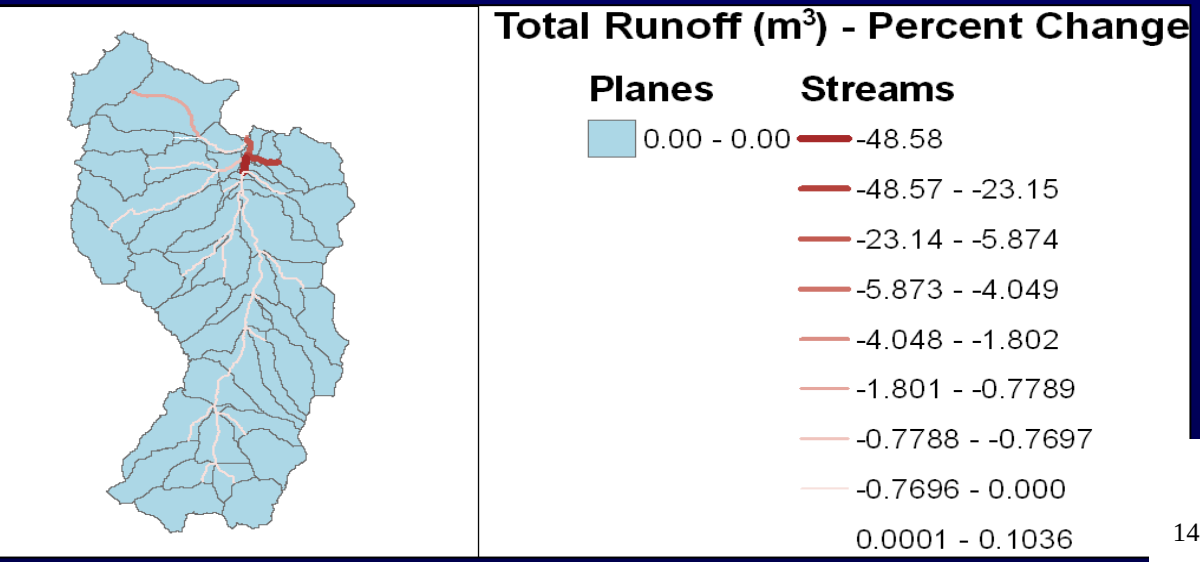
Stream Buffer Strip – Reynolds Ck. Exp. Watershed

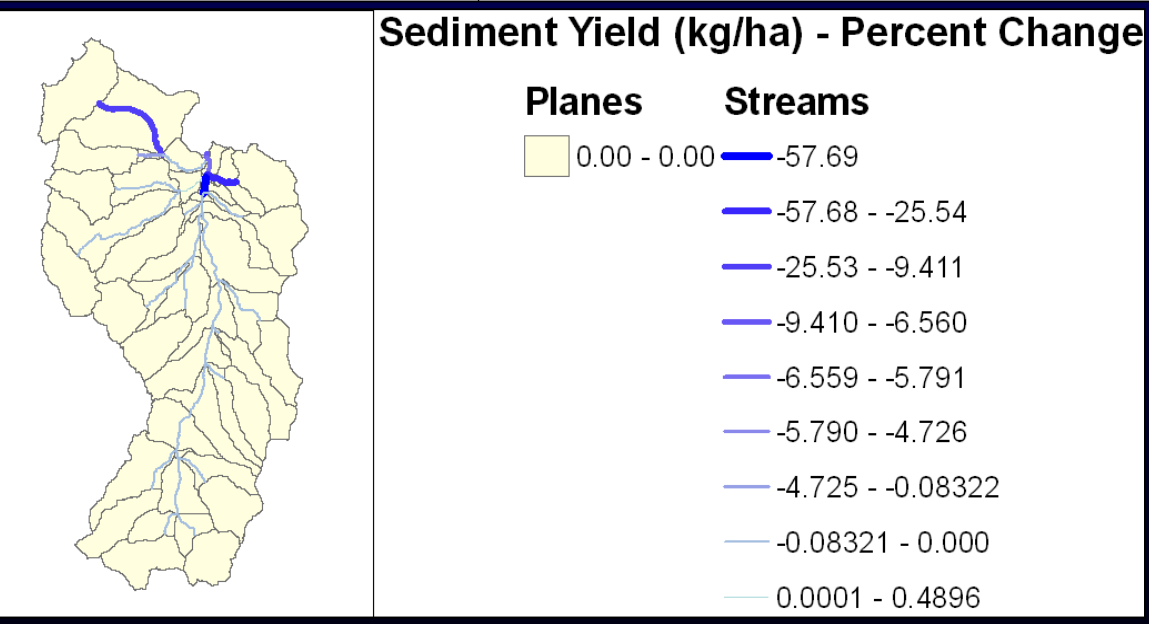
- AGWA used to set-up, parameterize and execute KINEROS using pre- and post-buffer installation for a 5 year 30 minute design storm
- The post-buffer installation simulates 5 m buffers on each side of the stream.
- The buffer strips are grass-lands with 80% cover, Manning's N=0.15, up from a watershed average of 0.05
- The buffer strips are placed on the entire channel network and compose approximately 0.3% of the watershed area



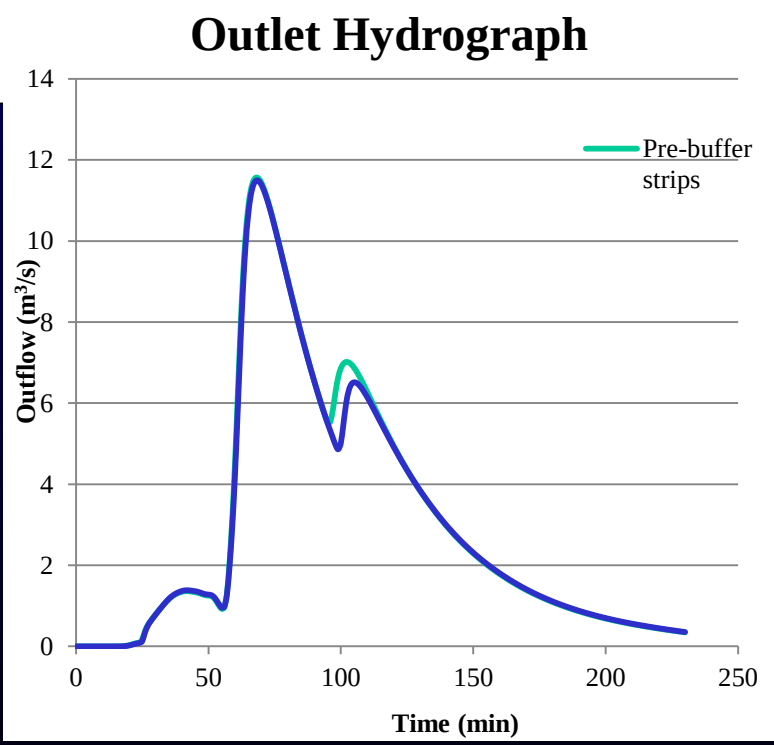
238 km^2

Stream Buffer Strip – Reynolds Ck.



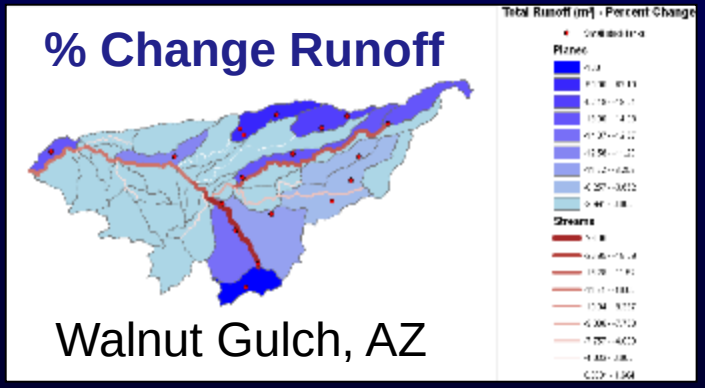


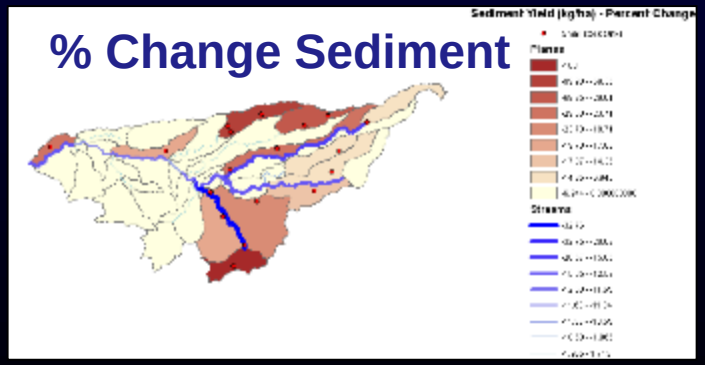
Apply a 5 year, 30 min. design storm uniformly on the pre- and post buffer watershed configuration stream.

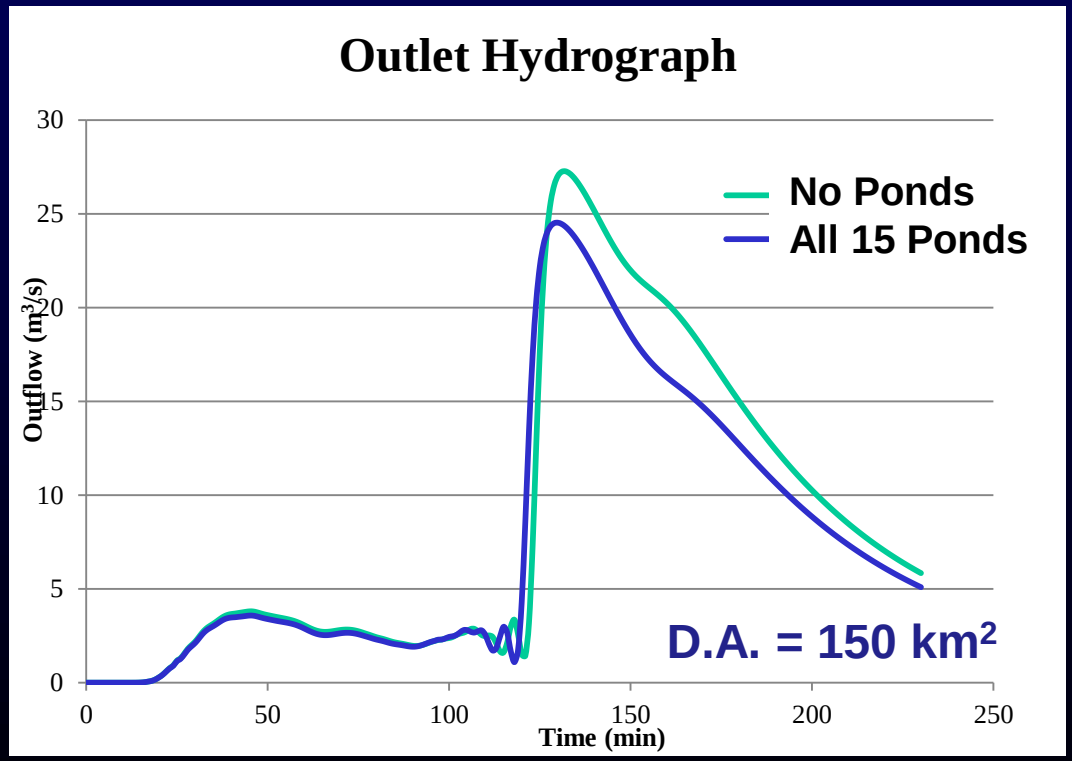


Stock Ponds/Reservoirs

- Can also be viewed as storm water and sediment retention structures for flood and water quality mitigation
- Watershed size: D.A. = 150 km^2
- Impact of 15 existing stock ponds
- 5 year 30 minute design storm
- 100% storm flow retention assumed



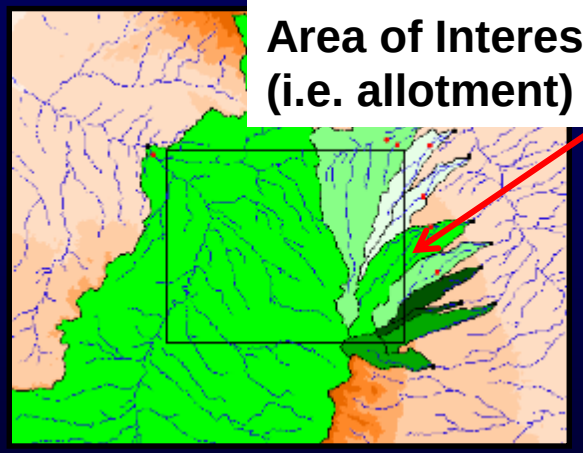


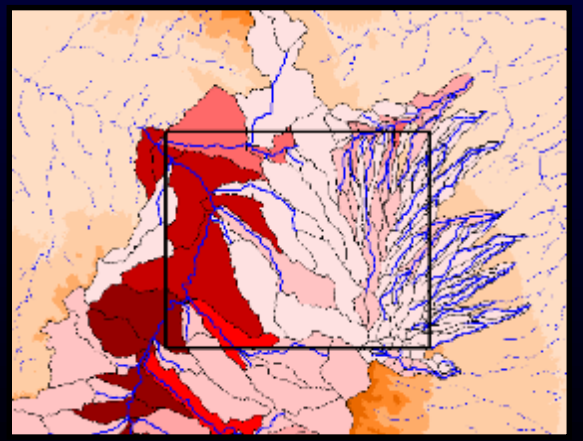


Multi-point, Multi-watershed Analysis

- **Designate multiple points of interest within a watershed for model output**
  - **Forces model to output hydrograph /sedigraph at that location**

- **Area of interest delineation, discretization, and model simulation**
  - **Automatically locates outlets for all watershed draining an area of interest**
  - **Attempts to cover the area with the fewest, and smallest, watersheds necessary**
  - **Discretizes the watersheds, parameterizes all model element and executes model**

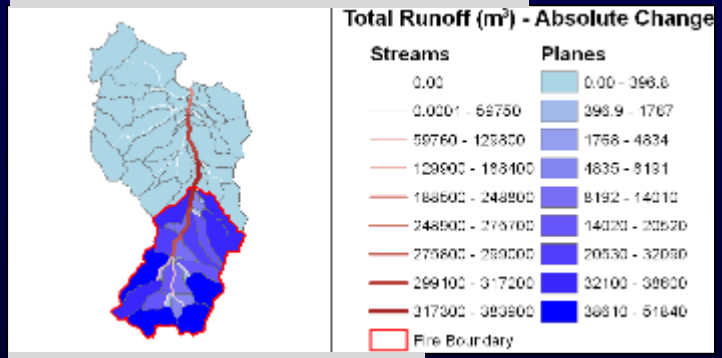




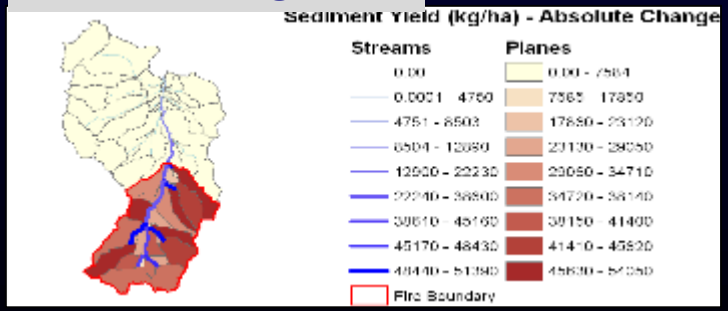
Example: Fire Effects

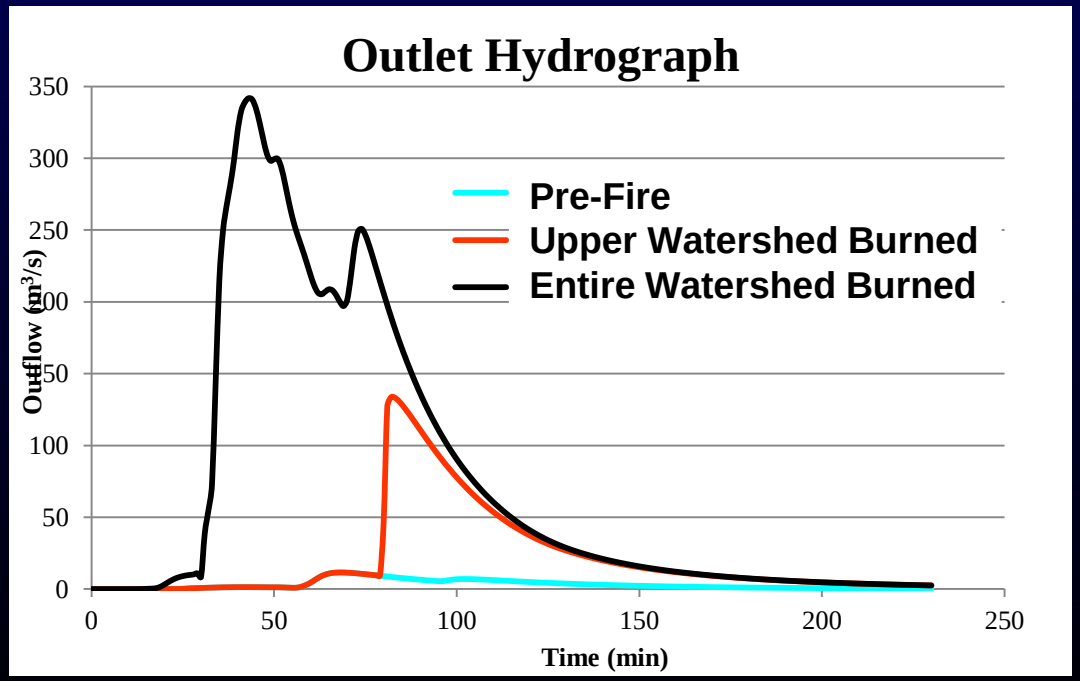
- Fire effects on the Reynolds Creek Watershed, Idaho
- Watershed size: 238 km^2
- Two fire scenarios: 35.4% and 100% burn; 5 year 30 minute design storm
- Fire reduced saturated hydraulic conductivity to 2.0 mm/hr and the Manning's N to 0.011.

Abs. Change Runoff



Abs. Change SY





Post-Fire Model Parameterization

- Select watersheds with relatively good rainfall and runoff observations pre-fire and post-fire
- Using this data compute post-fire model parameters as a function of burn severity and land cover type
  - Marshall Gulch, Aspen Fire, Arizona
  - Starmer Canyon, Cerro Grande Fire, New Mexico
- Also track recovery in roughness, CN, and Hyd. Cond. as a function of time and place sediment fences on Oracle Hill fire (results not presented here)

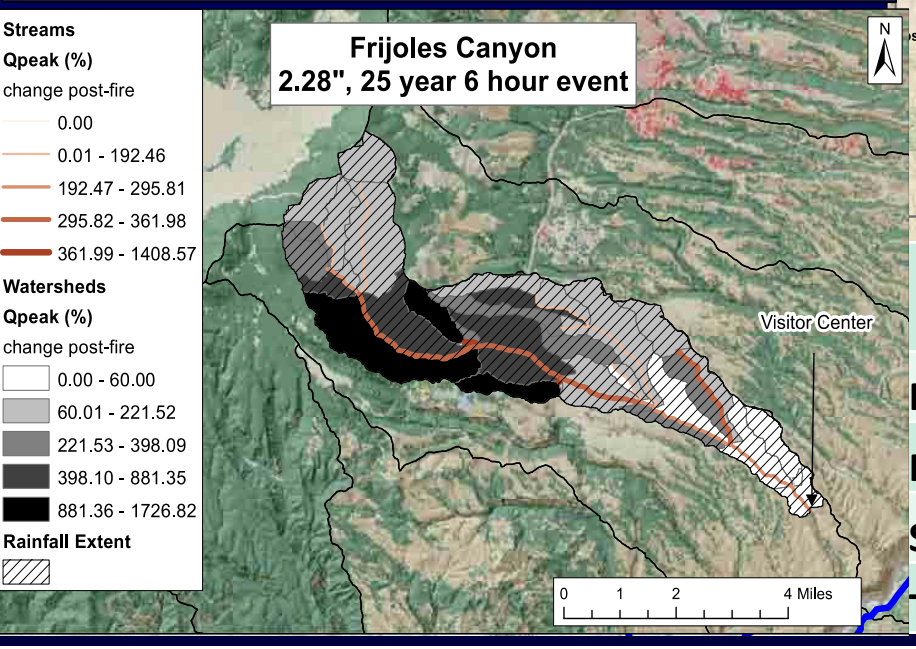
Canfield et al., 2005. Selection of parameter values to model post-fire runoff and sediment transport at the watershed scale in southwestern forests. Proc. ASCE Watershed Manage. Conf., July 19-22, Williamsburg, VA.

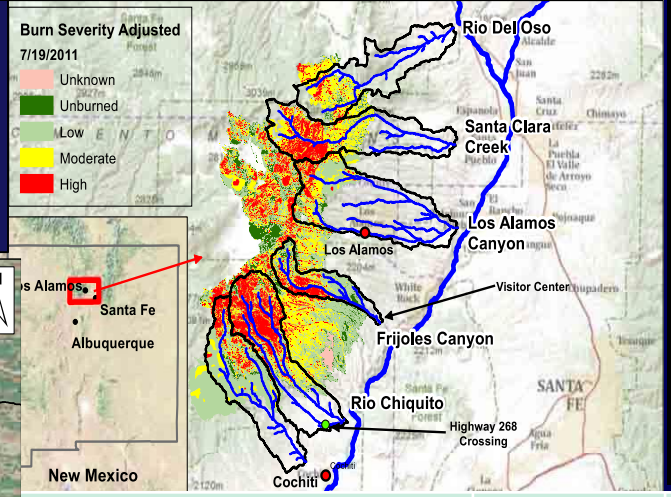
Goodrich et al., 2005. Rapid Post-Fire Hydrologic Watershed Assessment using the AGWA GIS-based Hydrologic Modeling Tool. Proc. ASCE Watershed Manage. Conf., July 19-22, Williamsburg, VA.

Post-Fire Assessments

- Define look-up table for pre- and post-fire model parameters as a function of land cover type and burn severity
  - SWAT (CN, roughness)
  - KINEROS2 (roughness, Interc., cover, Sat. Hydraulic Cond.)
- Pre-fire data and simulations can be done for any given watershed at any time in a non-crisis environment
- Directly import post-fire burn severity map as a shape file
- Run model with same rainfall input as pre-fire simulation
- Difference post- and pre-fire simulations and spatially display results
- Allows rapid visual recognition of watershed areas most prone to post-fire impacts so mitigation and remediation can be targeted
- Working on a tool to aid in the placement, and assess the impacts of fire fuels reduction (thinning – clearing)

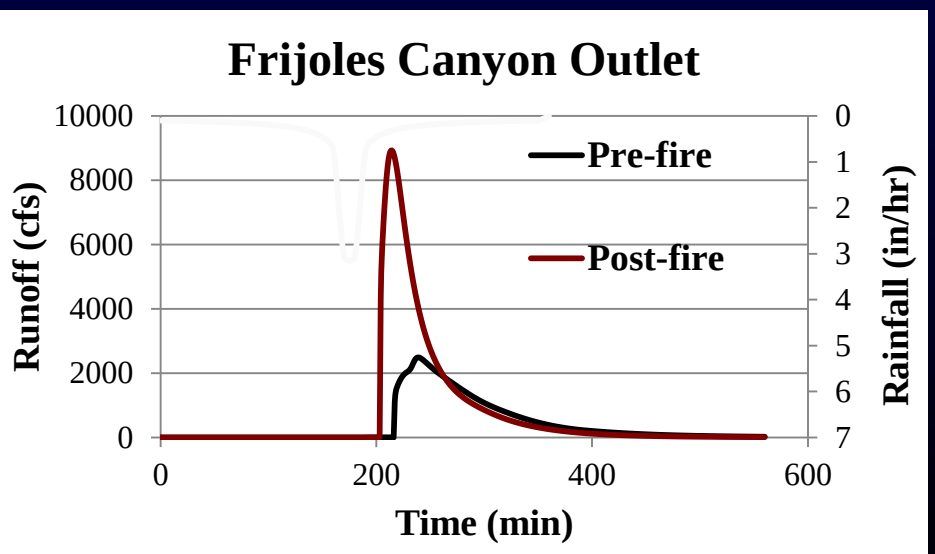
Las Conchas Fire - Frijoles Canyon Bandelier National Monument

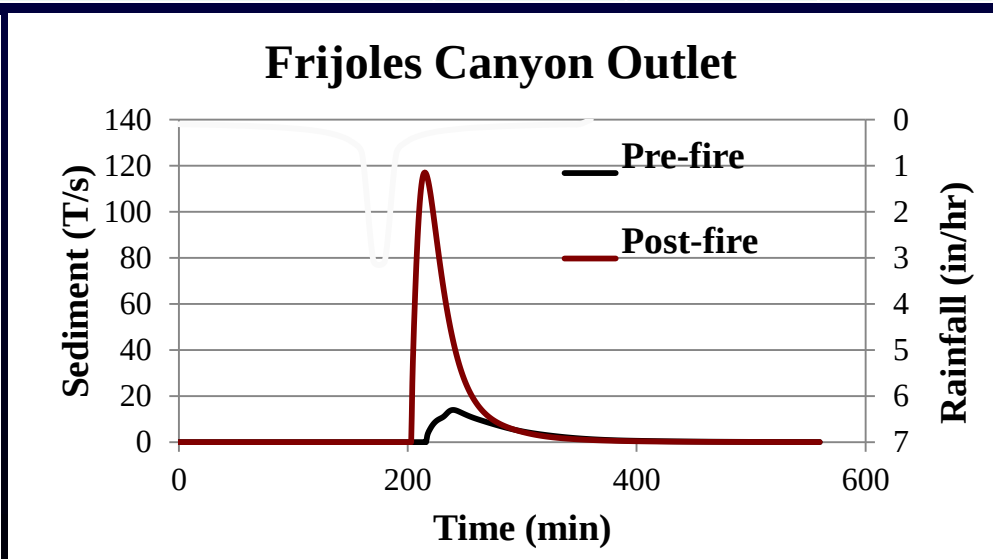




2.28", 25 year 6 hour design Storm

	Pre-fire Outlet	Post-fire Outlet	Percent Change
Peak Flow (cfs)	2490	8931	259
Peak Sediment (T/s)	13.98	117.07	737
Sediment Yield (tons/ac)	5.04	20.77	312
Total Sediment (tons)	59400	244829	312



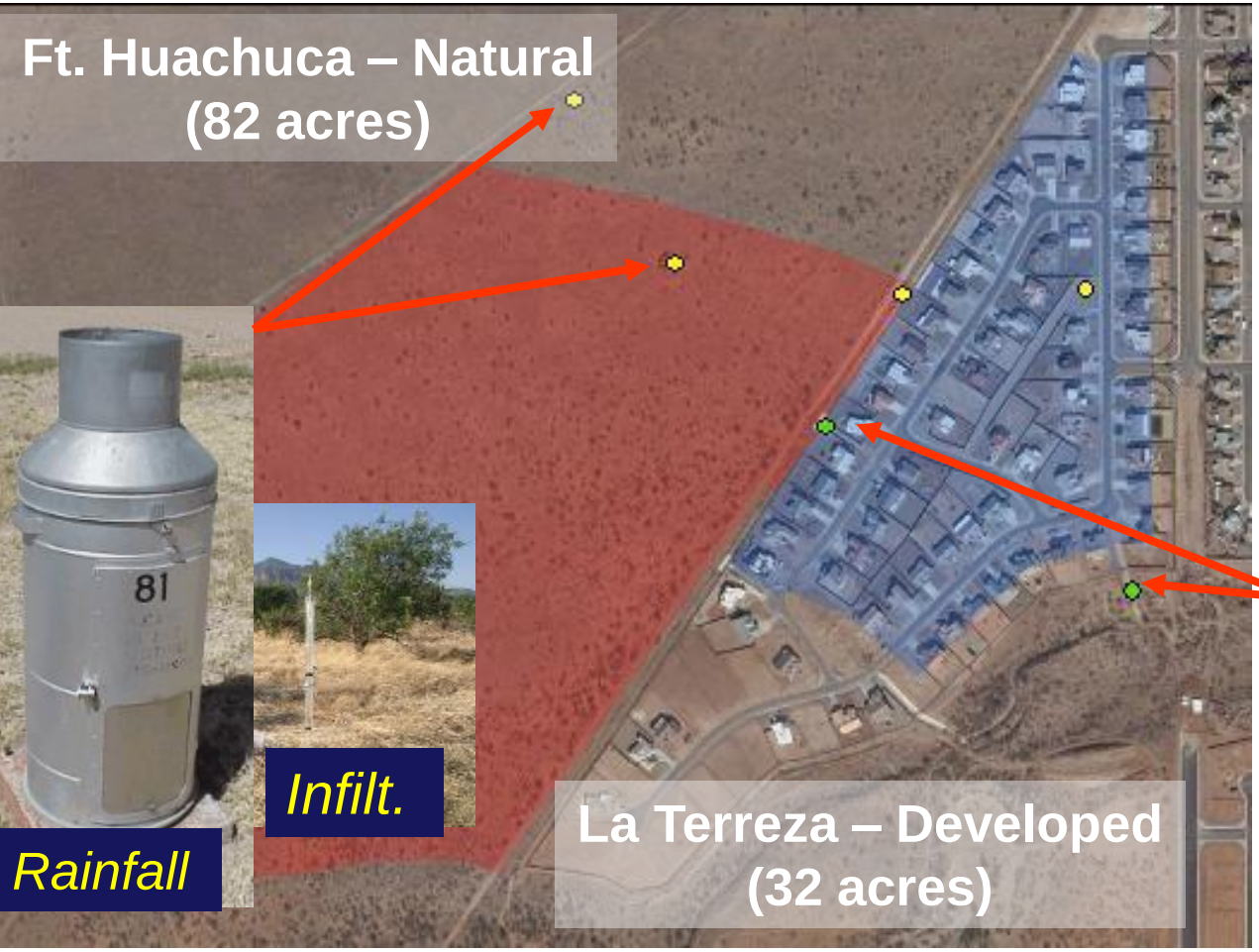


Residential Developments in the Southwestern U.S.

- While it is well known impervious areas increase runoff - what about constructed pervious areas (yards)?
- Majority of new home construction is tract housing
- Heavy machinery (bulldozers, scrapers) create compacted soils

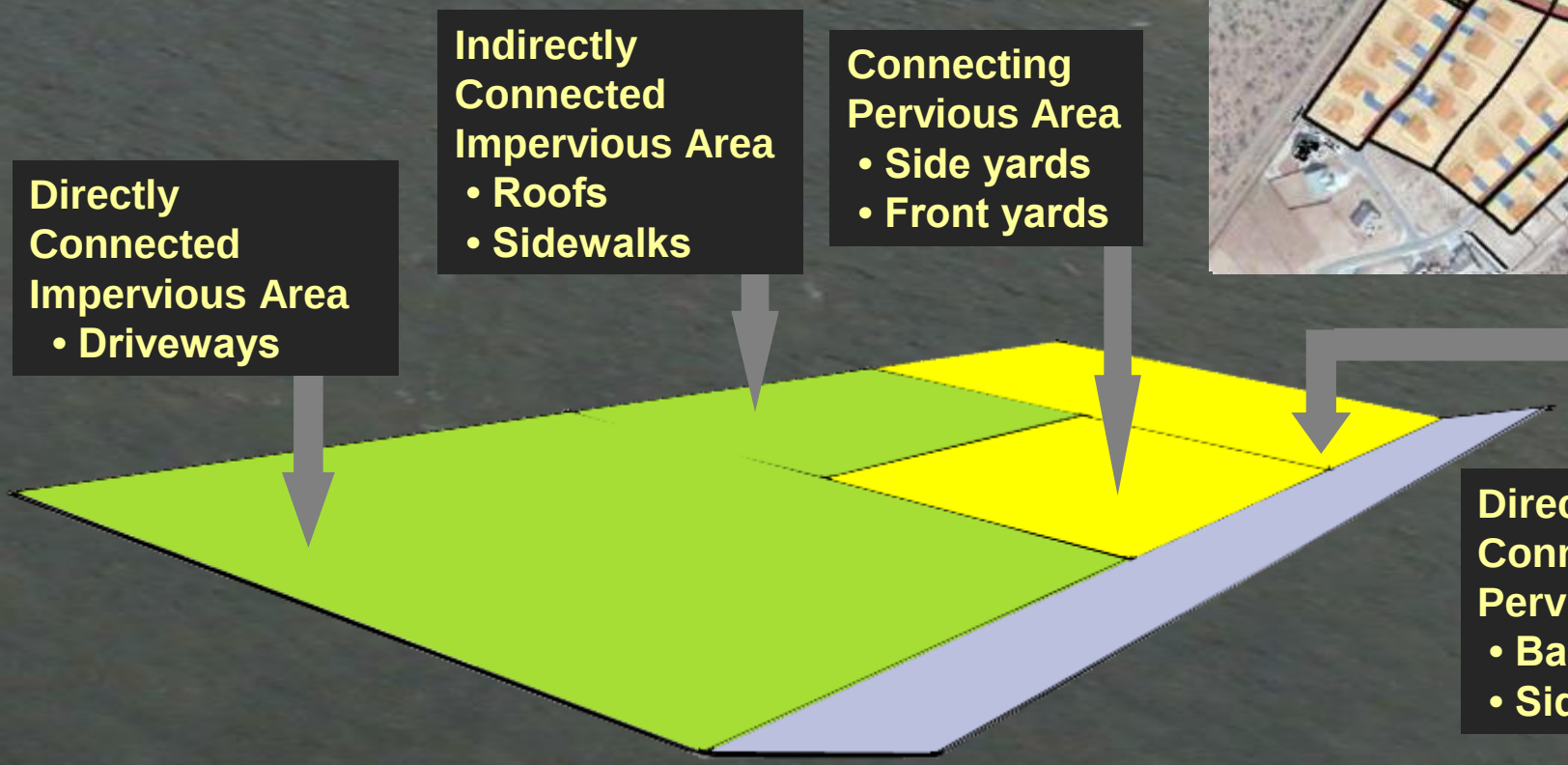
Hydrologic Observations

Rainfall, runoff, infiltration, and detailed land cover measurements on the natural watershed that flows into the La Terreza development



Runoff Model Parameterization, Urban Watershed

- Satellite Image is digitized to identify streets, rooftops, driveways, sidewalks, and yards
- Watershed area is divided into “elements”



Key Points

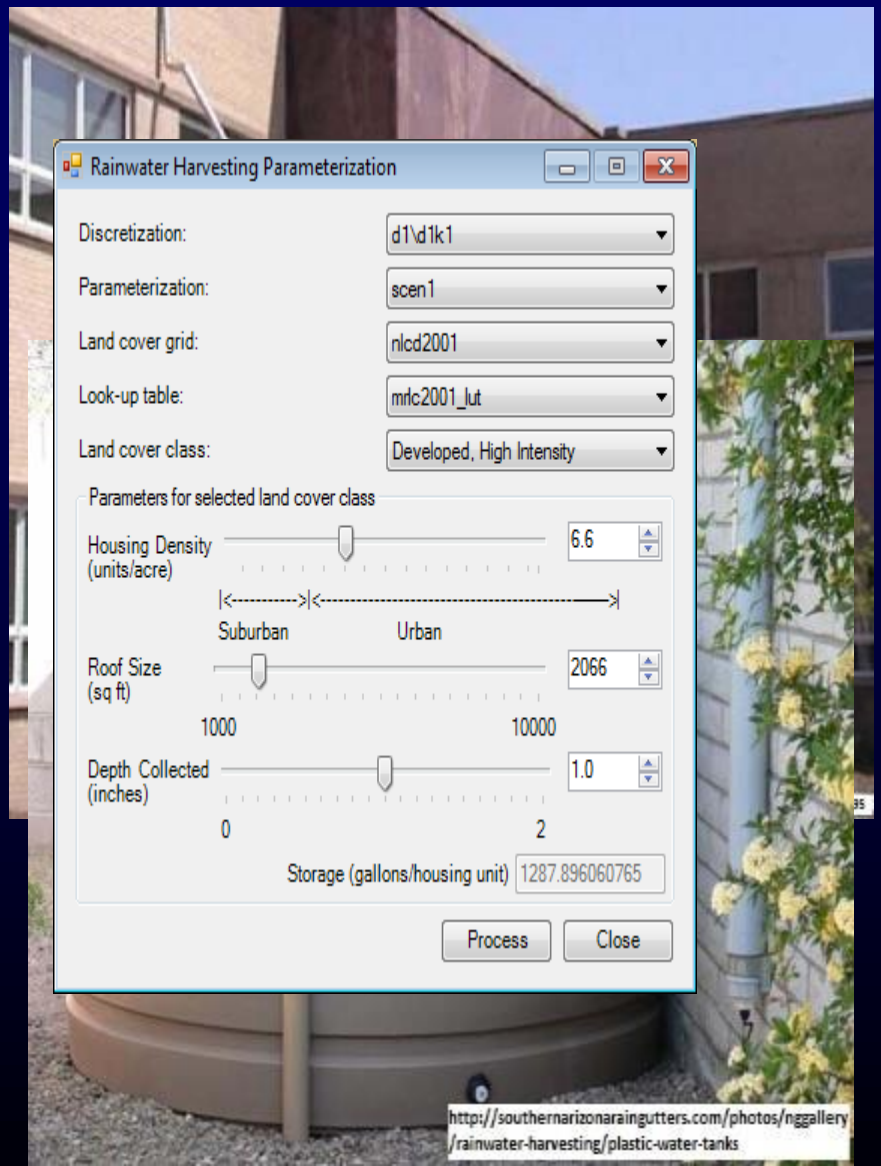
- Runoff increased by a factor of roughly 26 from grassland watershed to residential subdivision watershed

- Roughly 80% of this increase in runoff is from the constructed impervious surfaces (roofs, streets, and driveways)

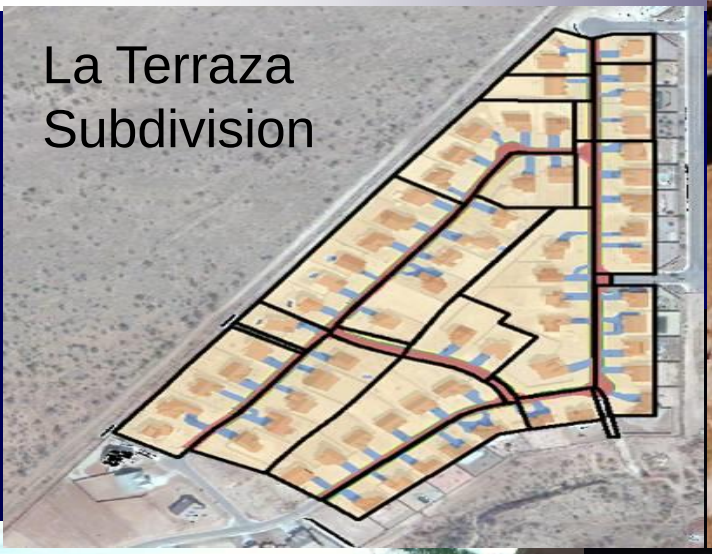
- 15 – 20% of the increase is due to the decrease in infiltration rates of pervious or infiltrating surfaces (yards, common space) due to subdivision earthwork preparation

K2 Rainwater Harvesting

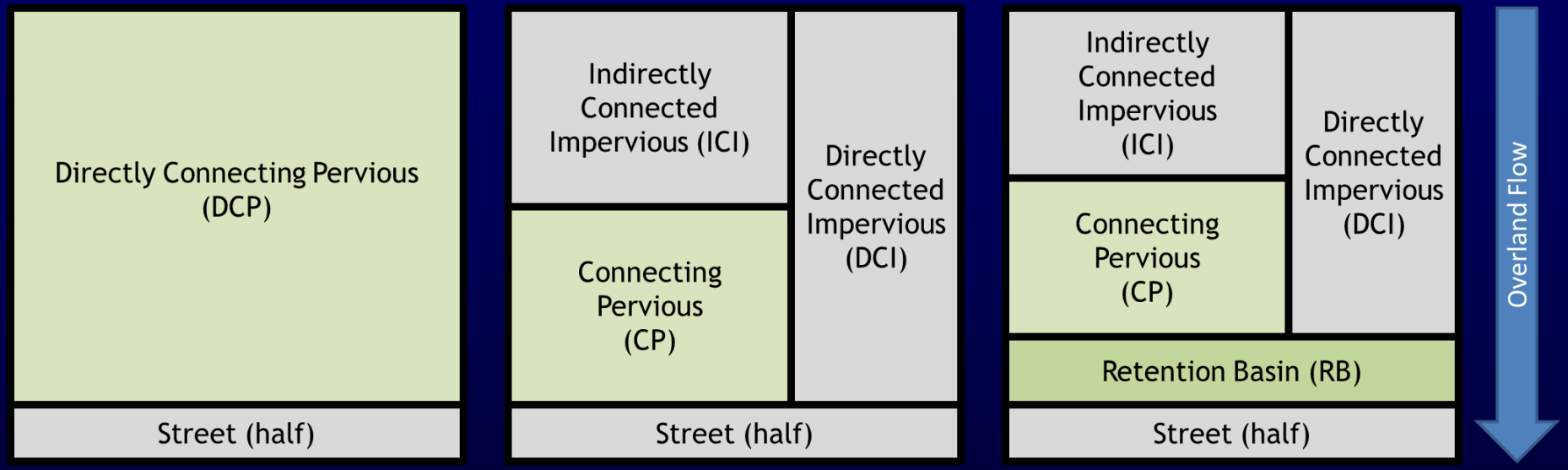
- Uses K2 interception term to simulate rainwater capture
- Can be calculated for different land cover classes to represent different properties for different housing/development densities



Green LID



KINEROS2 GI / LID Scenarios



- Pre-development
- Post-development
  - Without GI practices
  - With Permeable Pavements
  - With Rainwater Harvesting
- Post-development
  - With Retention Basins
  - With all GI practices

Modeling Tools to Evaluate Actual or Proposed Post-Development Hydrologic & Sediment Impacts Using AGWA

Whetstone Ranch Development in southeast Arizona near Benson (8,200 ac)

- **Simulate changes in runoff and sediment yield before and after proposed development**
- **How might some of the development impacts be mitigated?**