Goodwin Fire Post-Burn Runoff Calibration

Yavapai County, Arizona

Dan Cherry, Yavapai County

Linda Potter, Atkins North America, Inc.

Presentation Topics

Goodwin Fire statistics

Post-fire activities

Flood Event

Calibration Activities

Goodwin Fire statistics

Dan Cherry, Yavapai County

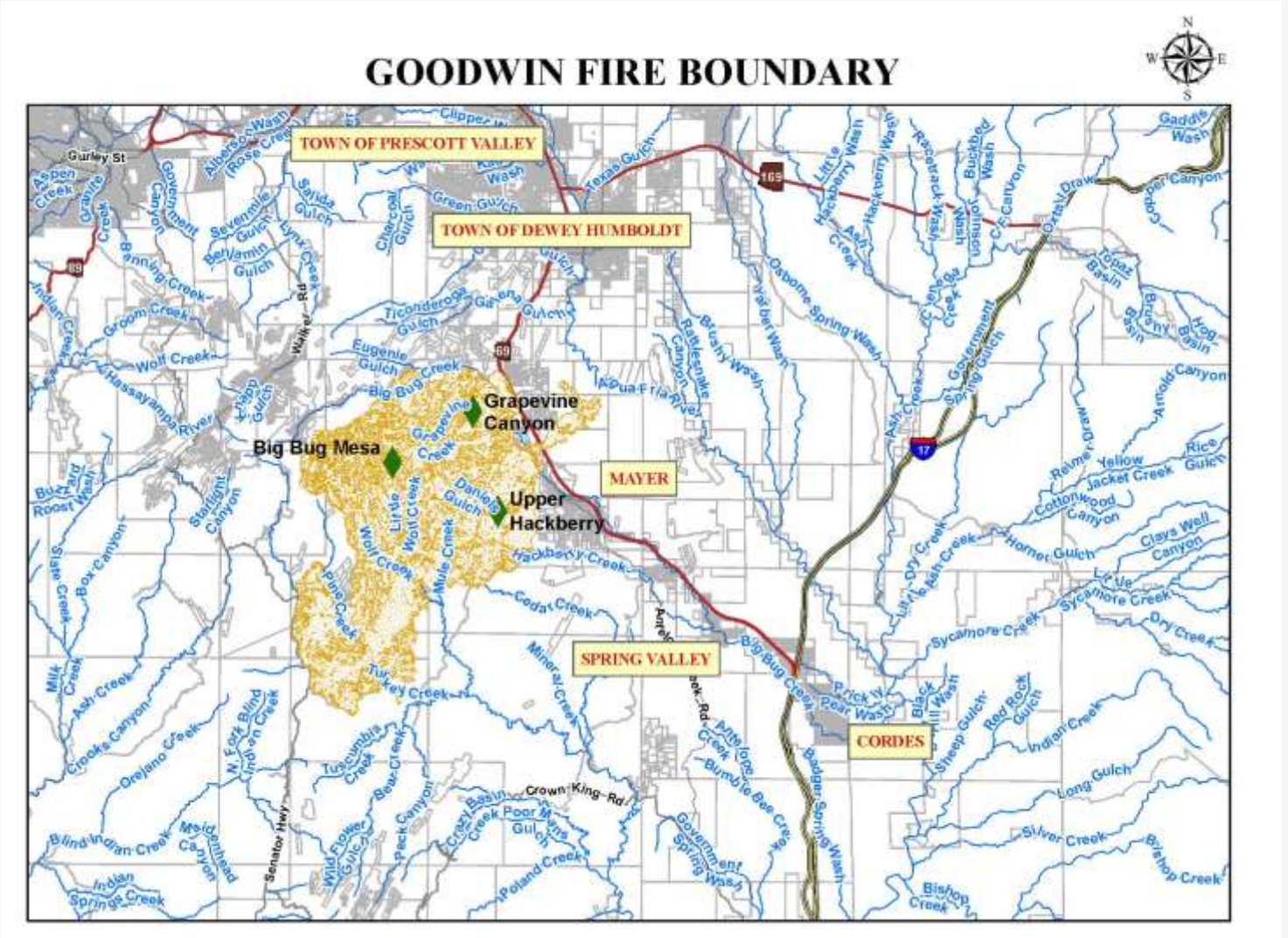
Goodwin Fire

Wildland fire in Yavapai County, Arizona

- Start date: June 24, 2017, ~4:00 pm
- Containment: July 10, 2017
- Over 28,000 acres in Prescott National Forest
- Big Bug Mesa near Mayer, Arizona
- Cause: listed as under investigation

Location

- Near Mayer, Arizona
- Drains to Big Bug Creek
  - Flows through the communities of Mayer, Spring Valley, and Cordes Lakes
- Effective study from 2014
- Flood Control District has good quality topographic mapping of floodplain and vicinity



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Big Bug Creek through Mayer and Spring Valley

Note interface with residential structures and transportation

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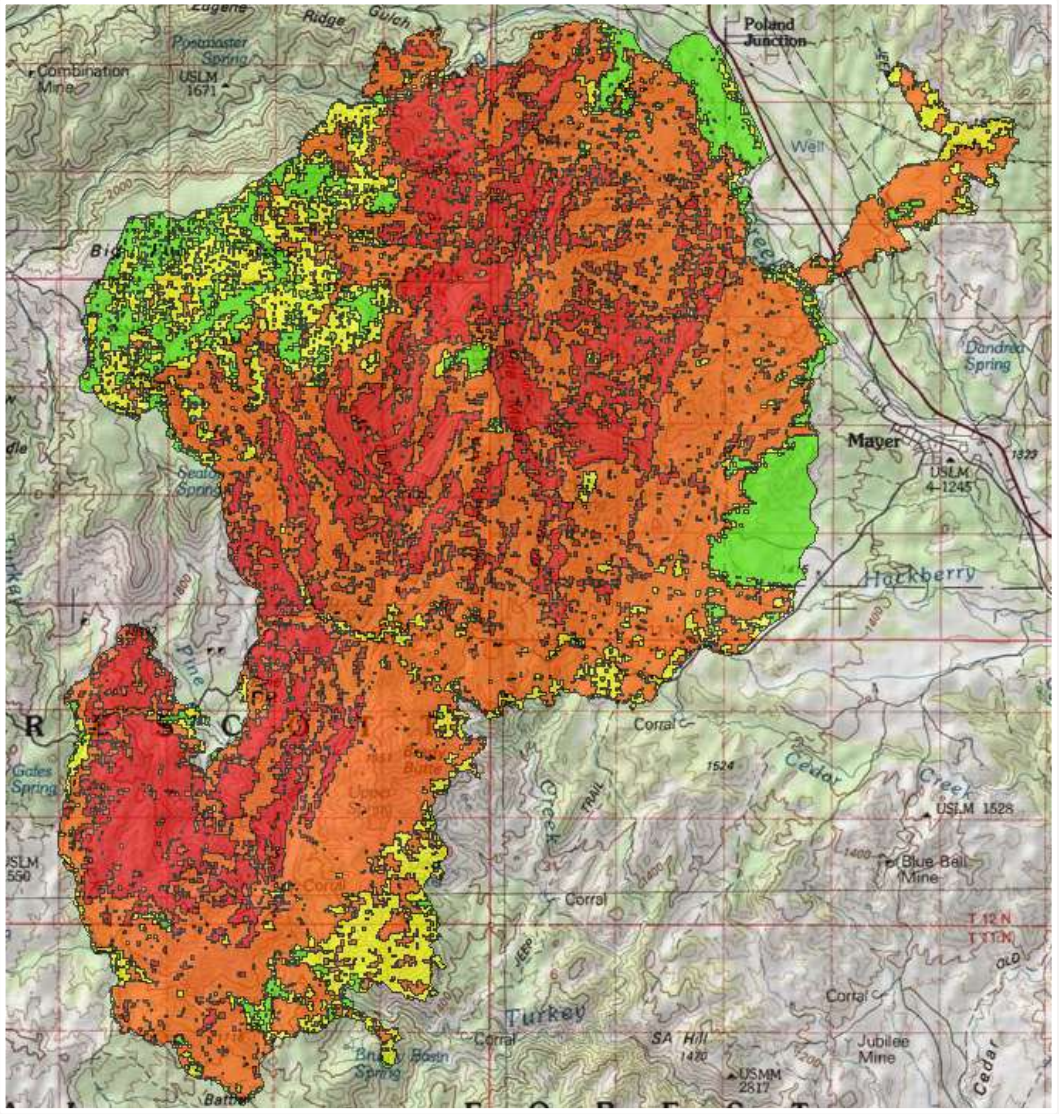
Burn Intensity Map

- Burned Area Emergency Response (BAER) team from the forest service provided support
- 78% of fire identified as severe or moderate burn intensity
- 22,000 acres
- Over 10,000 acres of water repellent soils per BAER team



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Post-Fire activities

Recovery and Flood Warning

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Post-fire activities

Concerns:

- Downstream populated areas
- State Route 69 transportation corridor
- Low-lying mobile homes and houses

Public meetings held

Precipitation and flow gages

Re-seeding

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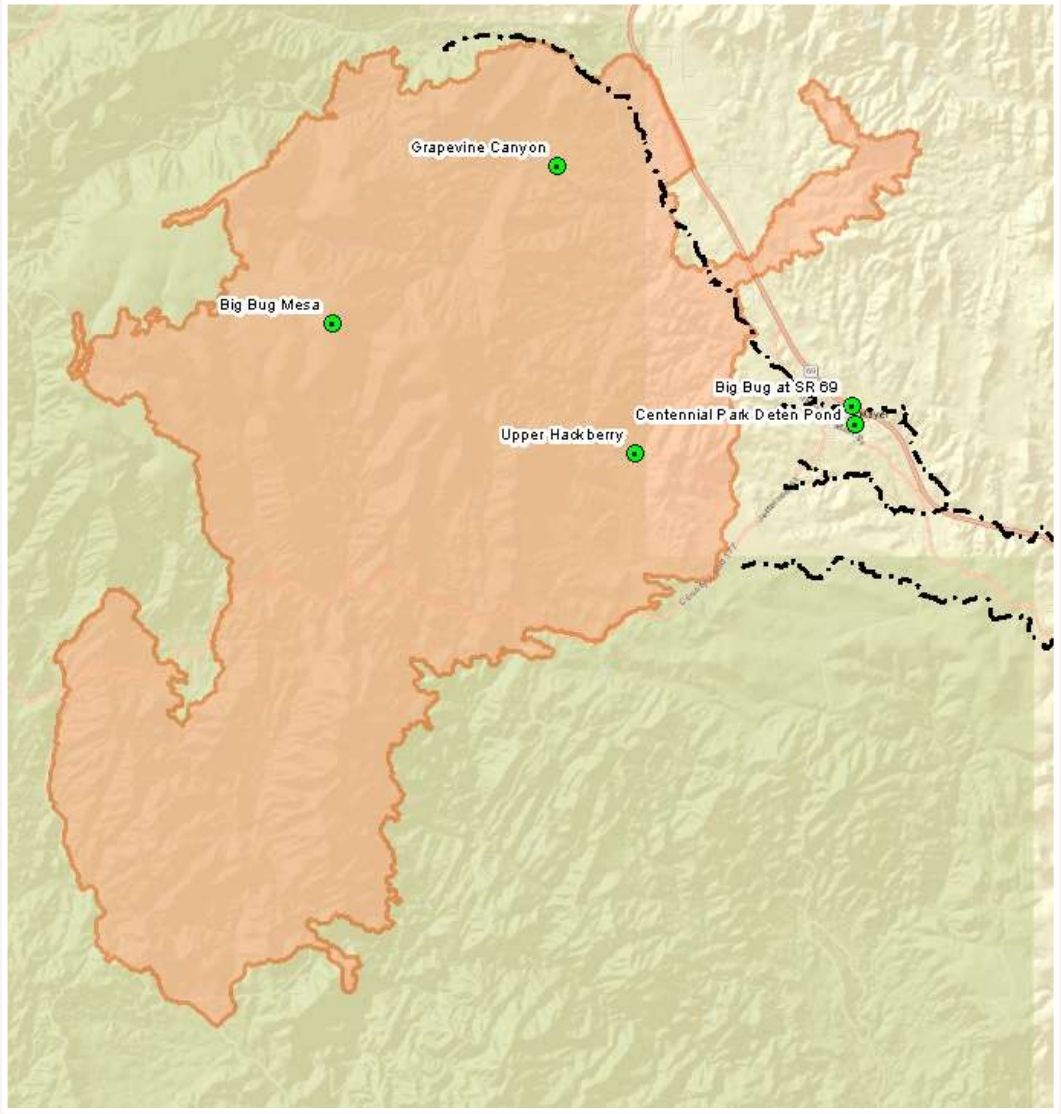
Gage installation

Four new gages installed in burned watershed, two existing gages

- Grapevine Canyon
- Big Bug Mesa
- Upper Hackberry
- Radar flow sensor on State Route 69 at Big Bug Creek



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Gage pictures

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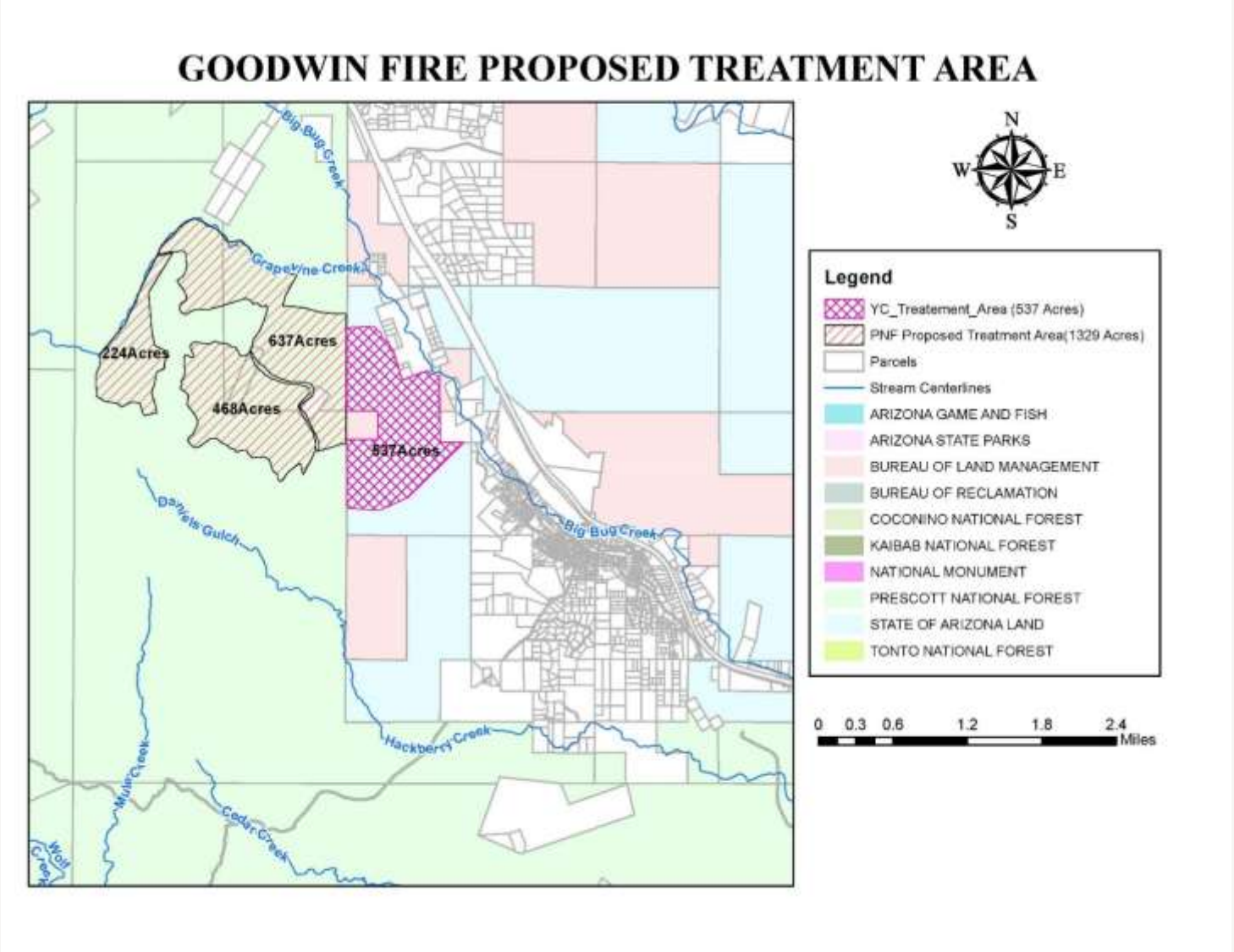
Seeding and mulching

NRCS Emergency Watershed Protection Grant



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Flood Event

July 19, 2017

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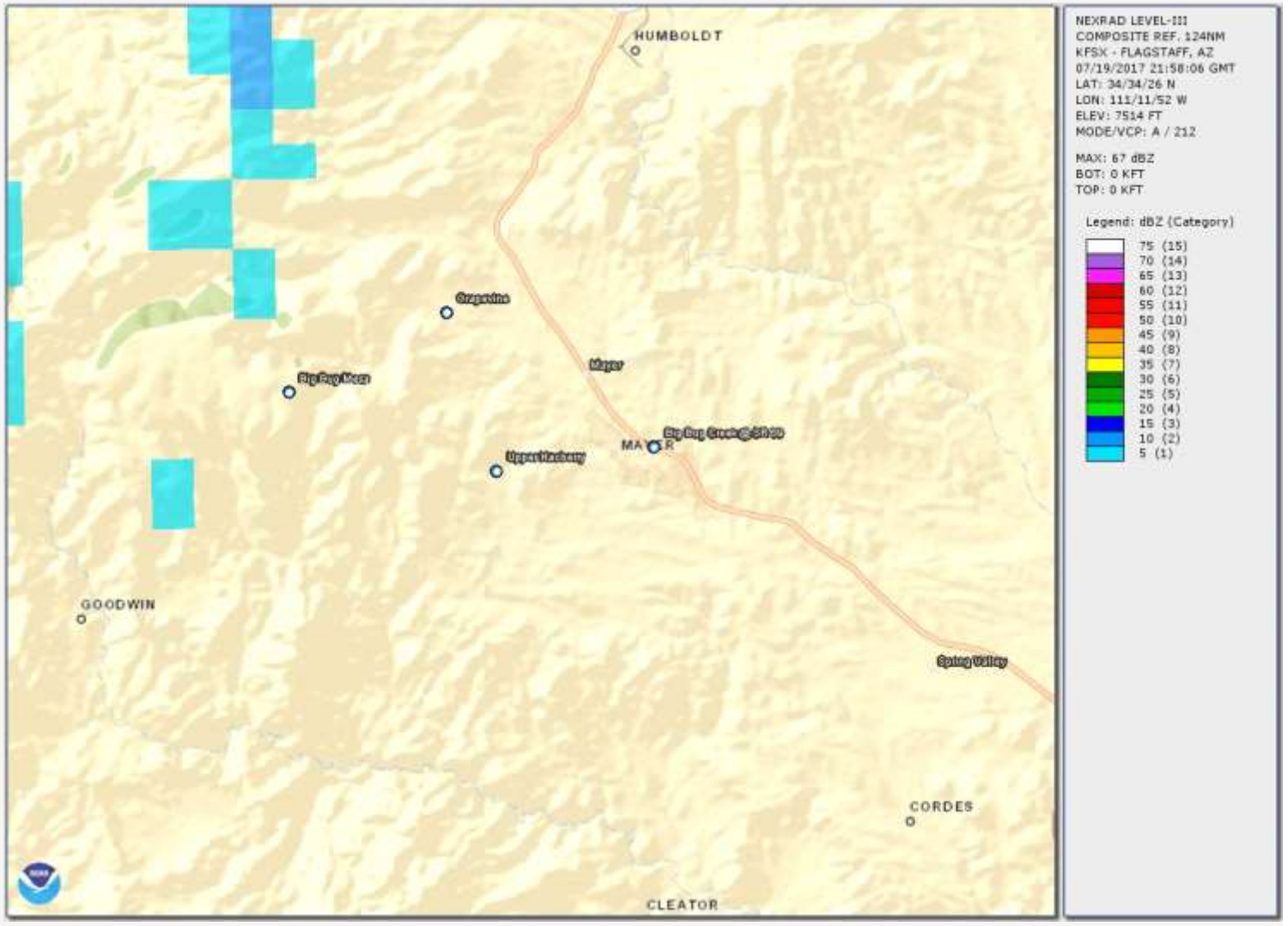
Monsoon Storm Activity

- July 13, 2017 first flush event
- July 19, 2017 monsoon storm
  - Grapevine gage: 2.01” in 26 minutes
  - Big Bug Mesa gage: 1.26” in 21 minutes
- ~25- to 50-year frequency event



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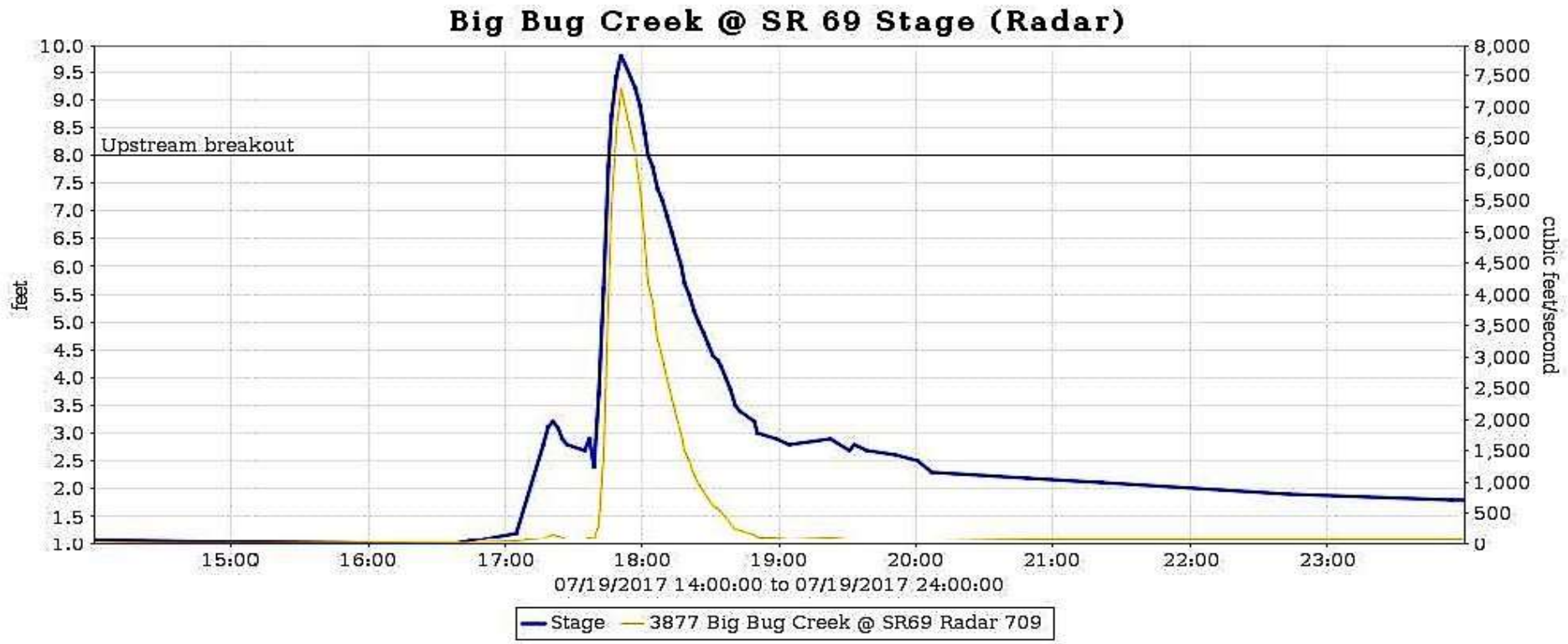
Flow at S.R. 69

Peak discharge 7,000 cfs, 10 feet of depth



July 19th Flood

- 50 people evacuated
- Two mobile home parks flooded
- S.R. 69 overtopped
- Local roads closed and damaged

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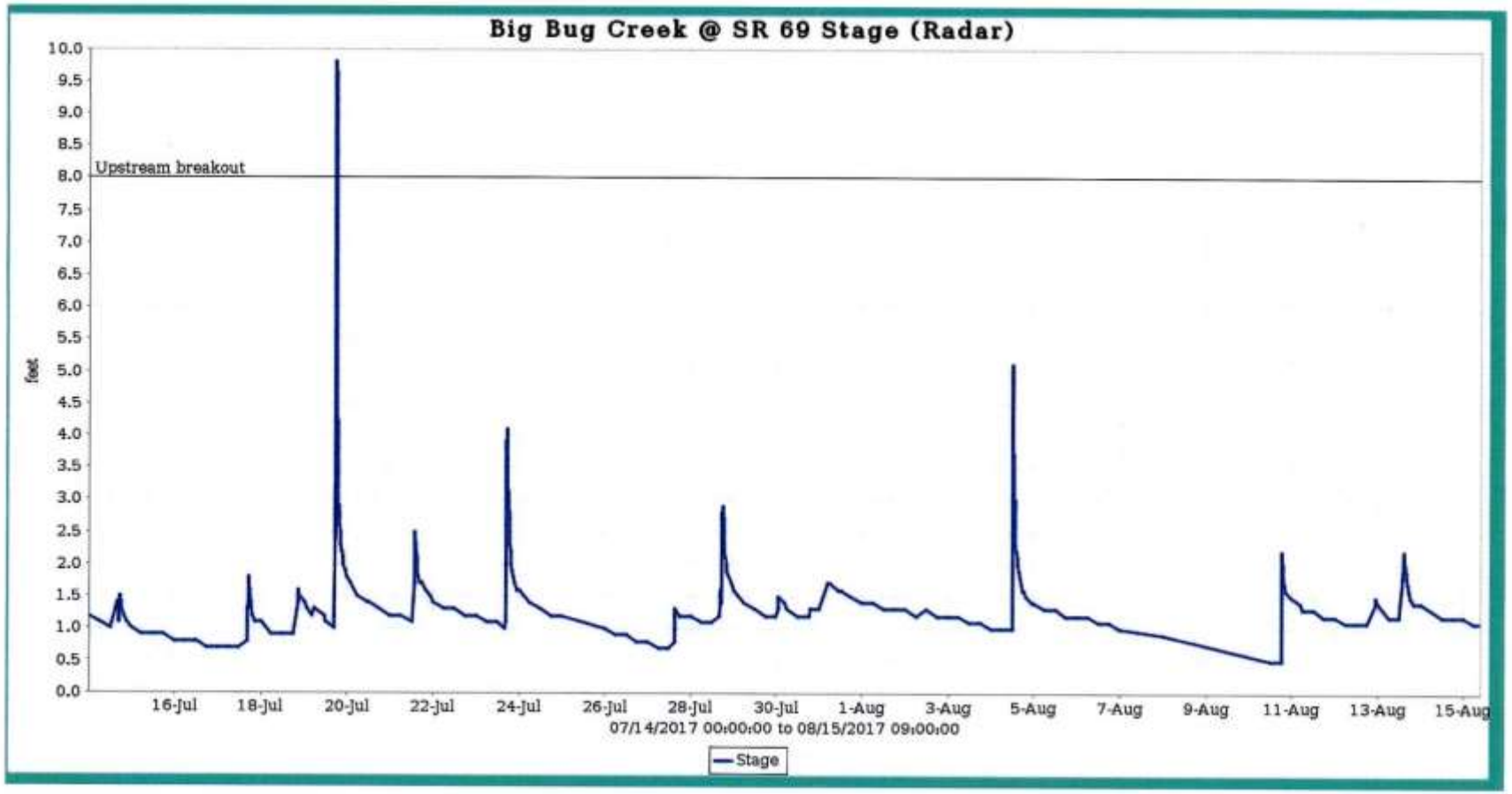
Hydrologic response in burn area



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High water marks, post-flood data collection

- Time was of the essence
- Ash residue, water marks, and flotsam
- Gathered flood inundation limits, cross sections, high water marks
- Drone aerial and ground photography and video

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Calibration

Hydrologic Modeling

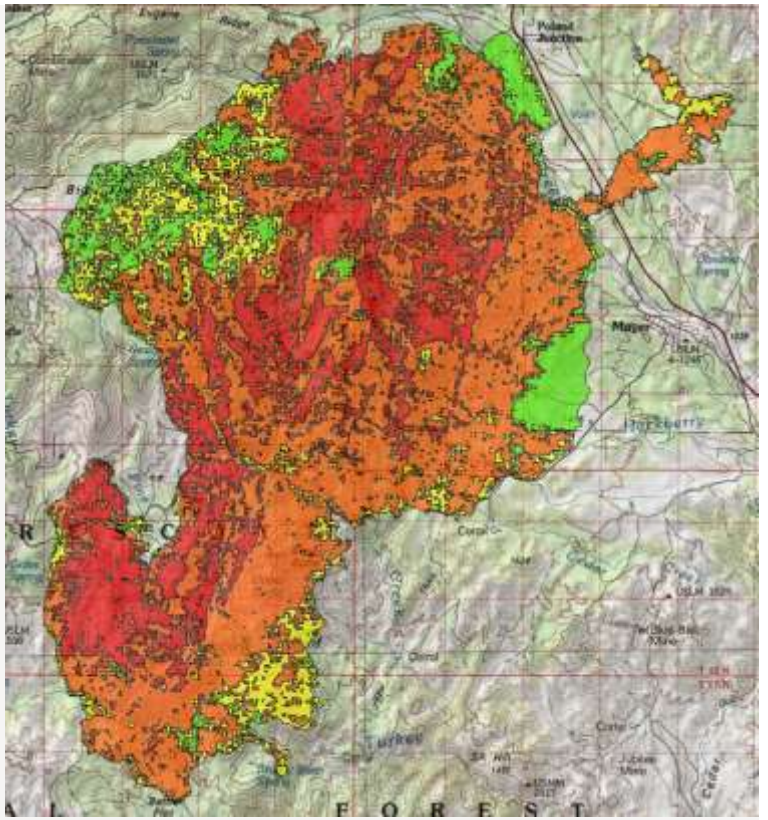
Methodology:

- HEC-HMS using Curve Number (CN) method
- Lag per SCS watershed method
- Muskingum-Cunge reach routing method

Before 7/17 flood occurred:

- Post-burn model created
- CN increases estimated using BAER team recommendations (2007 Higginson and Jarnecke)

Description	CN
A UB	50
A Low	55
A Mod	60
A High	65
B UB	70
B Low	77
B Mod	80
B High	85
C UB	83
C Low	86
C Mod	91
C High	94
D UB	91
D Low	91
D Mod	93
D High	94



High	burn severity CN	=	pre-fire CN + 15
Moderate	burn severity CN	=	pre-fire CN + 10
Low	burn severity CN	=	pre-fire CN + 5

Maximum CN value is 100

After 7/17 flood:

- Calibration
- Radar downloaded from NOAA
- Distribution and total rainfall from gages

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Calibration

What can be changed:

- ✖ Precipitation
- ✖ Area, length, slope
- Curve Number (CN)
- Lag time (function of CN)
- Routing
  - Roughness
  - ✖ Shape
- ✖ Impervious area
  - Hydrophobic not impervious

Goal: Peak, timing, shape match

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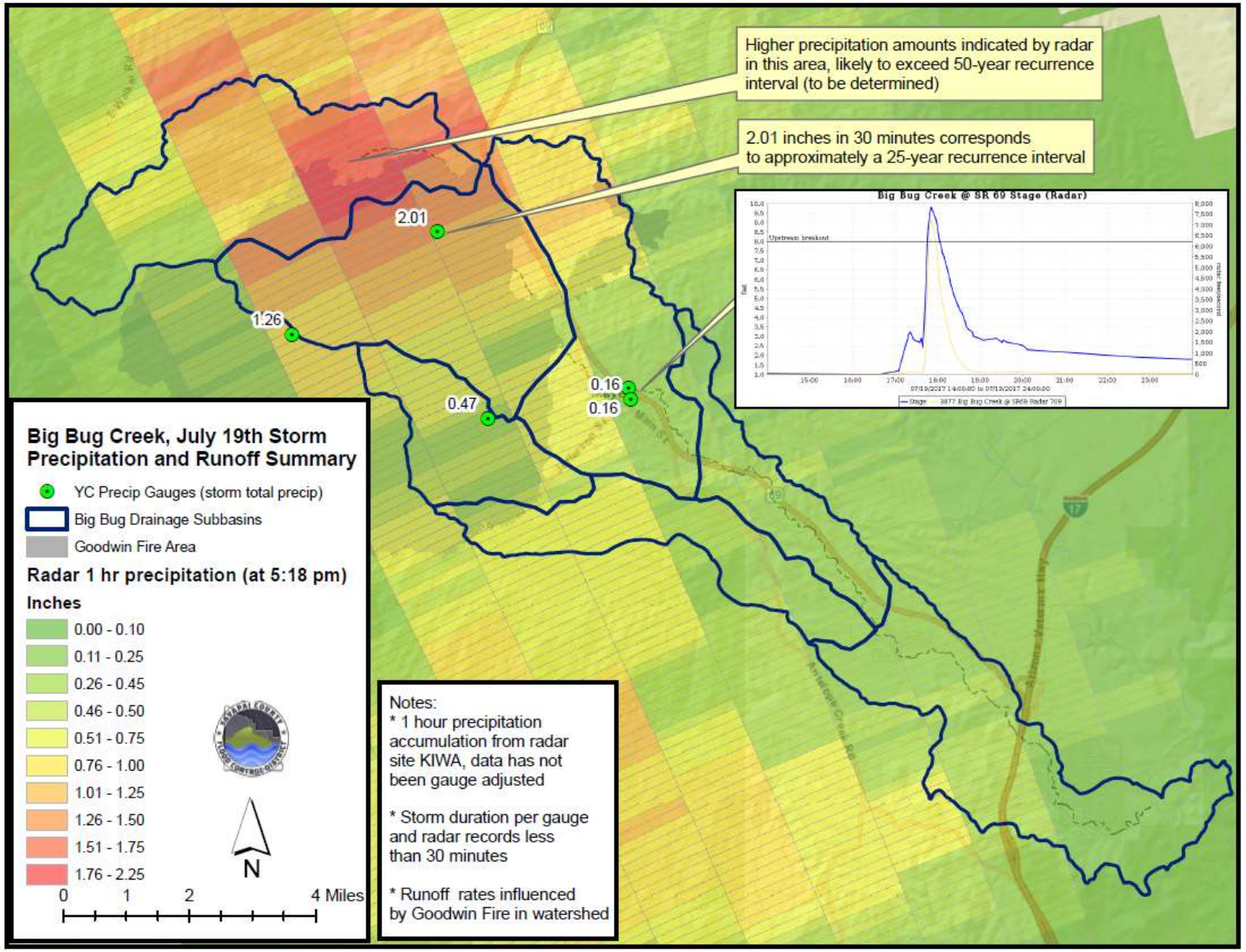
Calibration steps

1. Precipitation into model
2. Routes in burn area
3. Trial and error – CN and Lag

Precipitation: Radar vs. gage

- Fair coverage from Phoenix and Flagstaff radar
- Slight shift compared to actual measurements
- Adjusted radar to match



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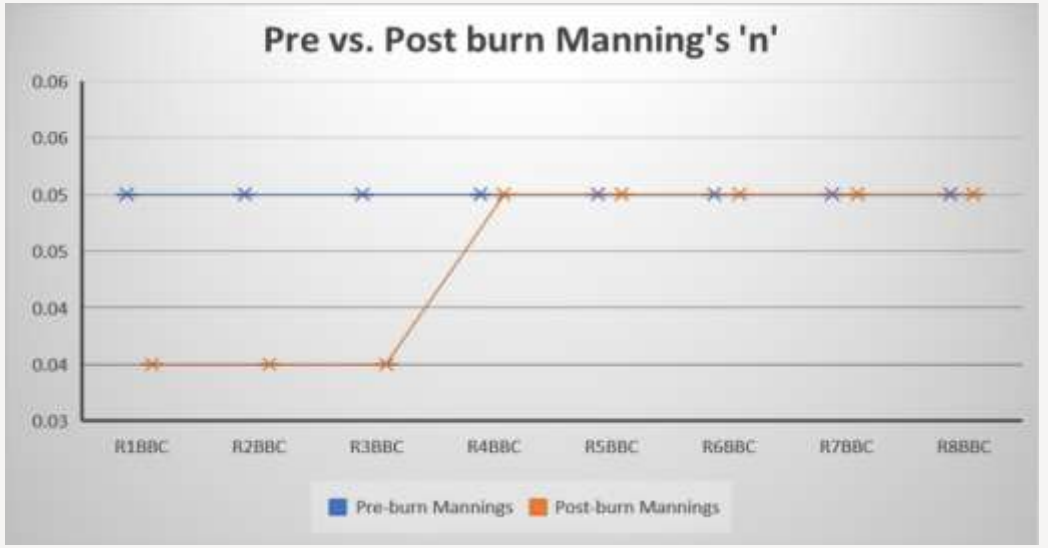
Reach routing

Roughness reduced in burn areas from 0.05 to 0.035

Account for reduction in vegetation

In Arizona, vegetation is in the channel

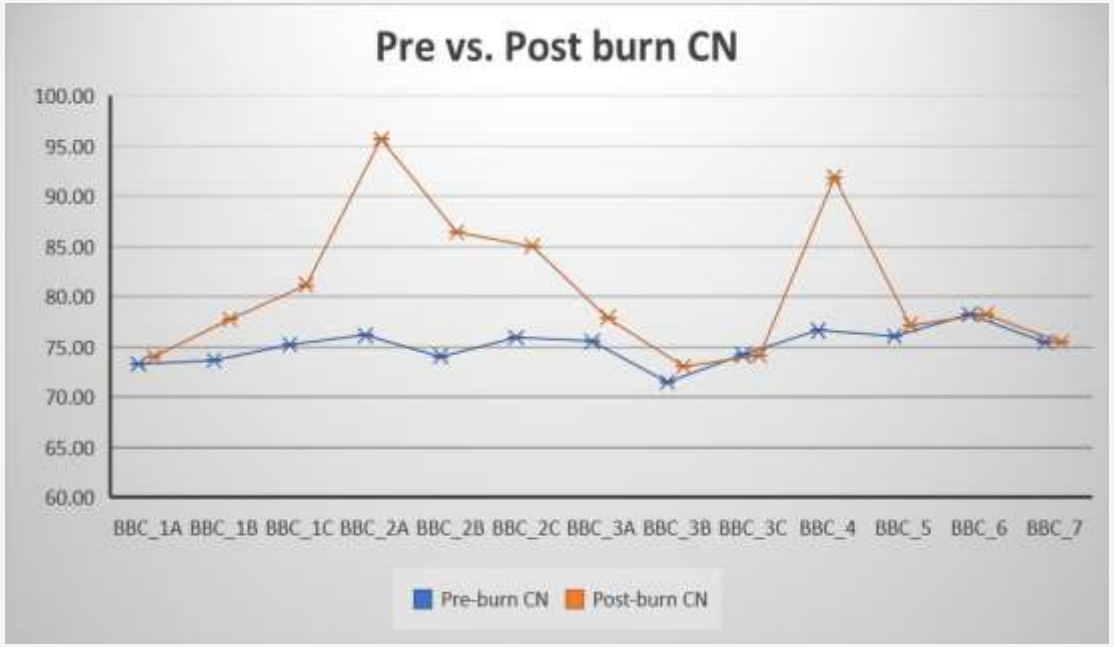


Curve Number

- Pre-burn model CNs modified using trial and error
- Goal: uniform recommendation on post burn increases
- Final CNs using a percent increase based on burn severity

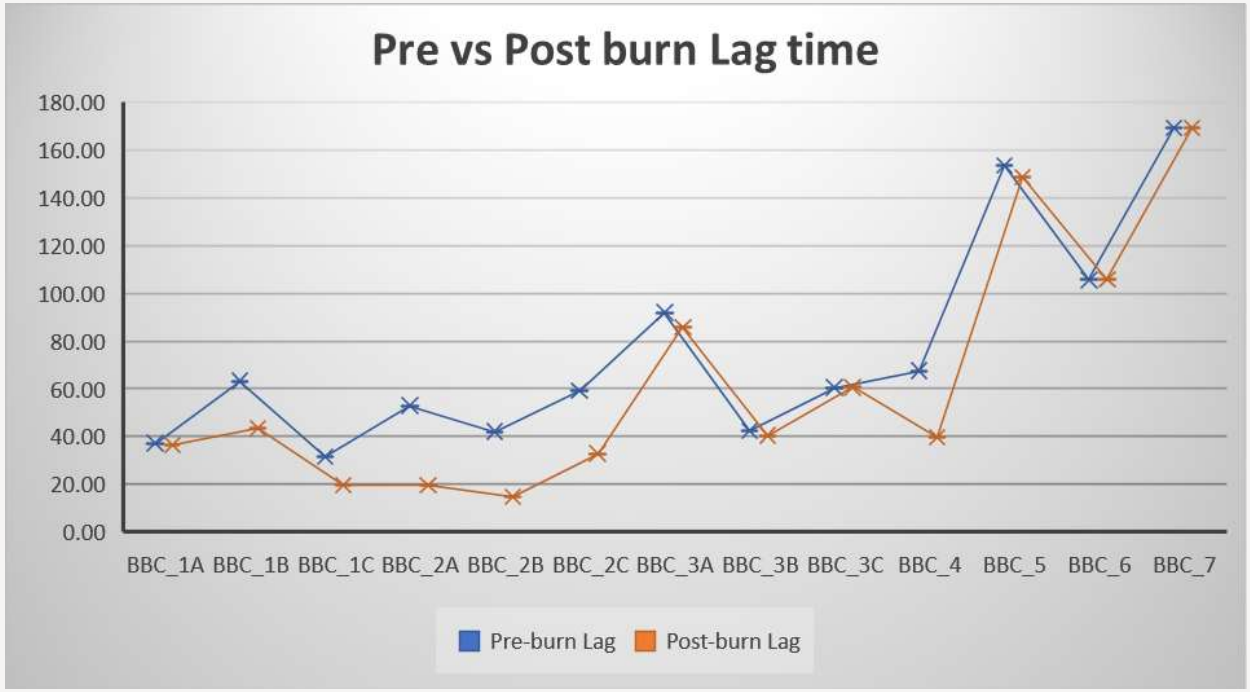
Burn Intensity	% increase
Low	1.1
Moderate	1.3
High	1.5

- (Note: table above says % increase but is actually a factor, i.e. 1.1 or 10%)
- CN composite increases of up to 20



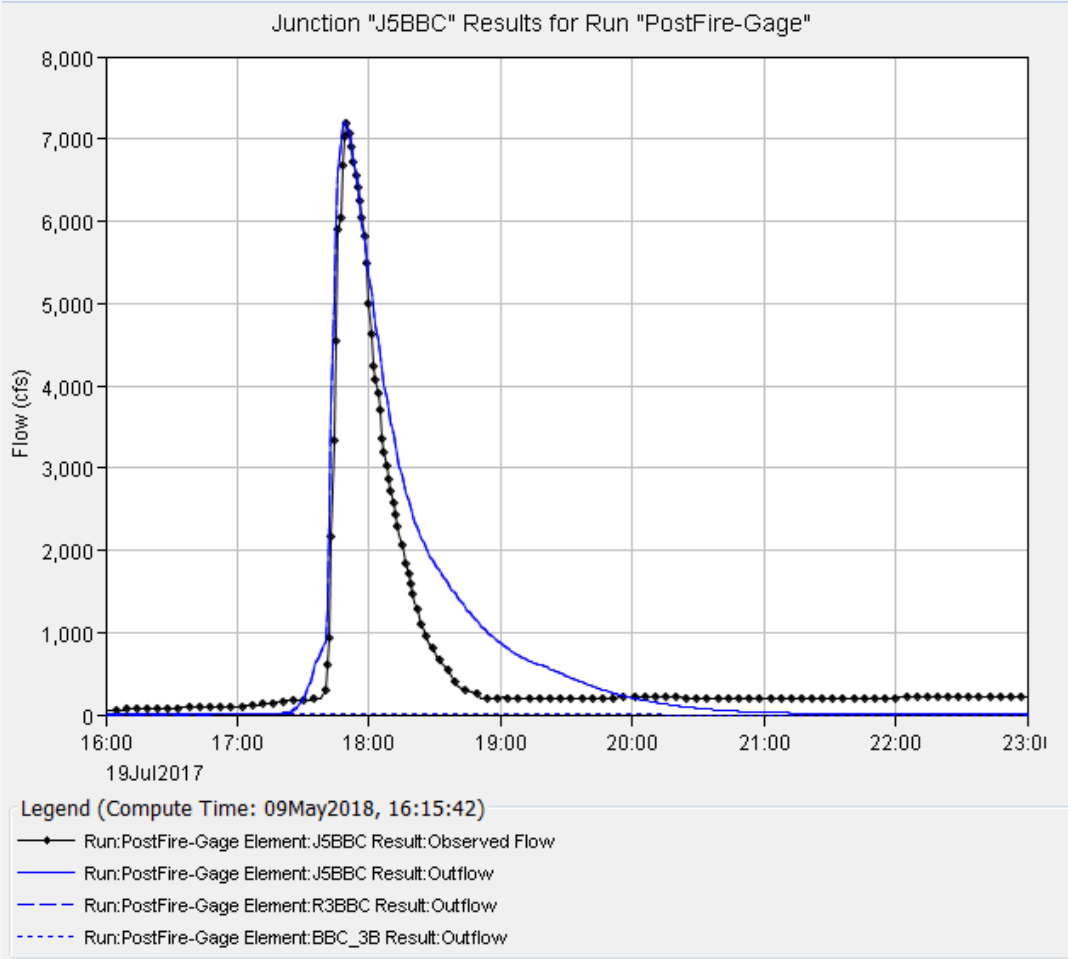
Lag Time

- Function of CN
- Quicker timing in post-burn event



Results

Good match in timing and peak

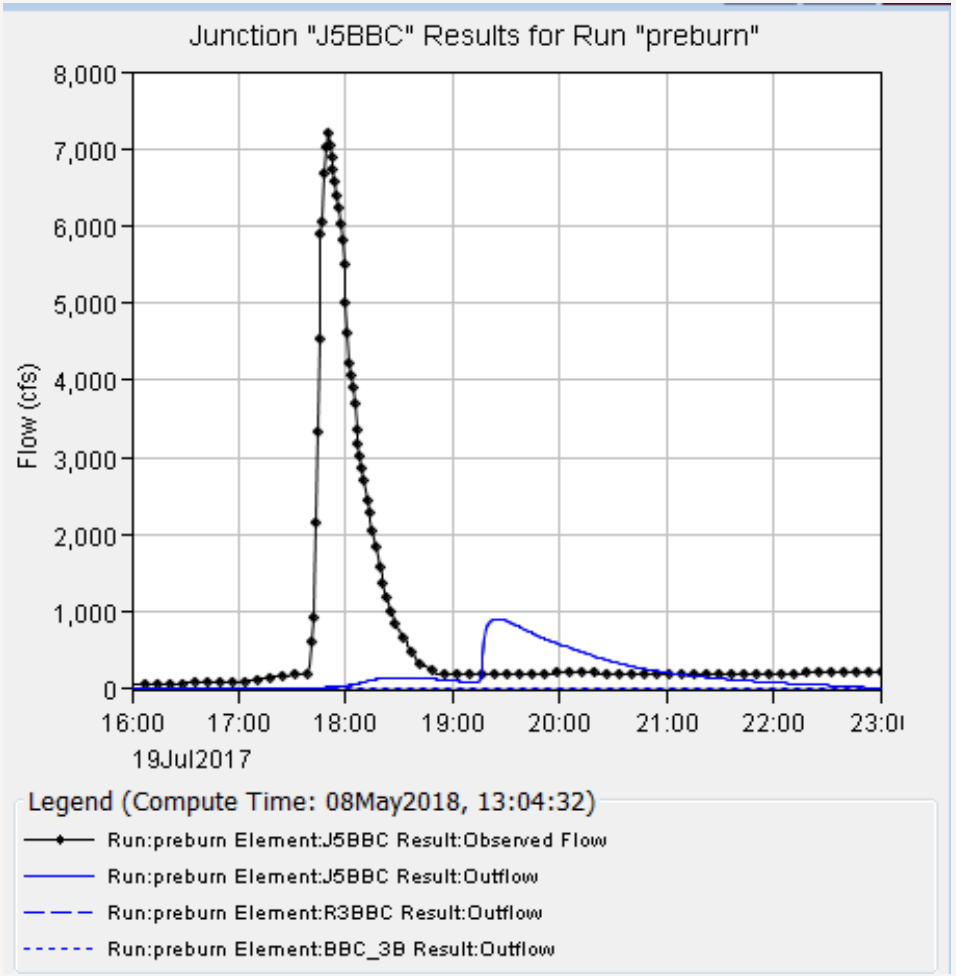


Results

Post burn runoff for this storm:

7x pre-burn conditions

1.5 hours faster arrival time at S.R 69



Recommendations

Post burn models:

CN increased based on burn severity as follows:

Burn Intensity	% increase
Low	1.1
Moderate	1.3
High	1.5

Routing roughness adjustments for burned areas as applicable

Questions?

Contacts:

Dan Cherry
Yavapai County
928-771-3183

Linda Potter
Atkins North America, Inc.
480-538-1545

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