Using GIS to identify hazards in the wild-land urban interface:

OPPORTUNITIES FOR SERVICE LEARNING

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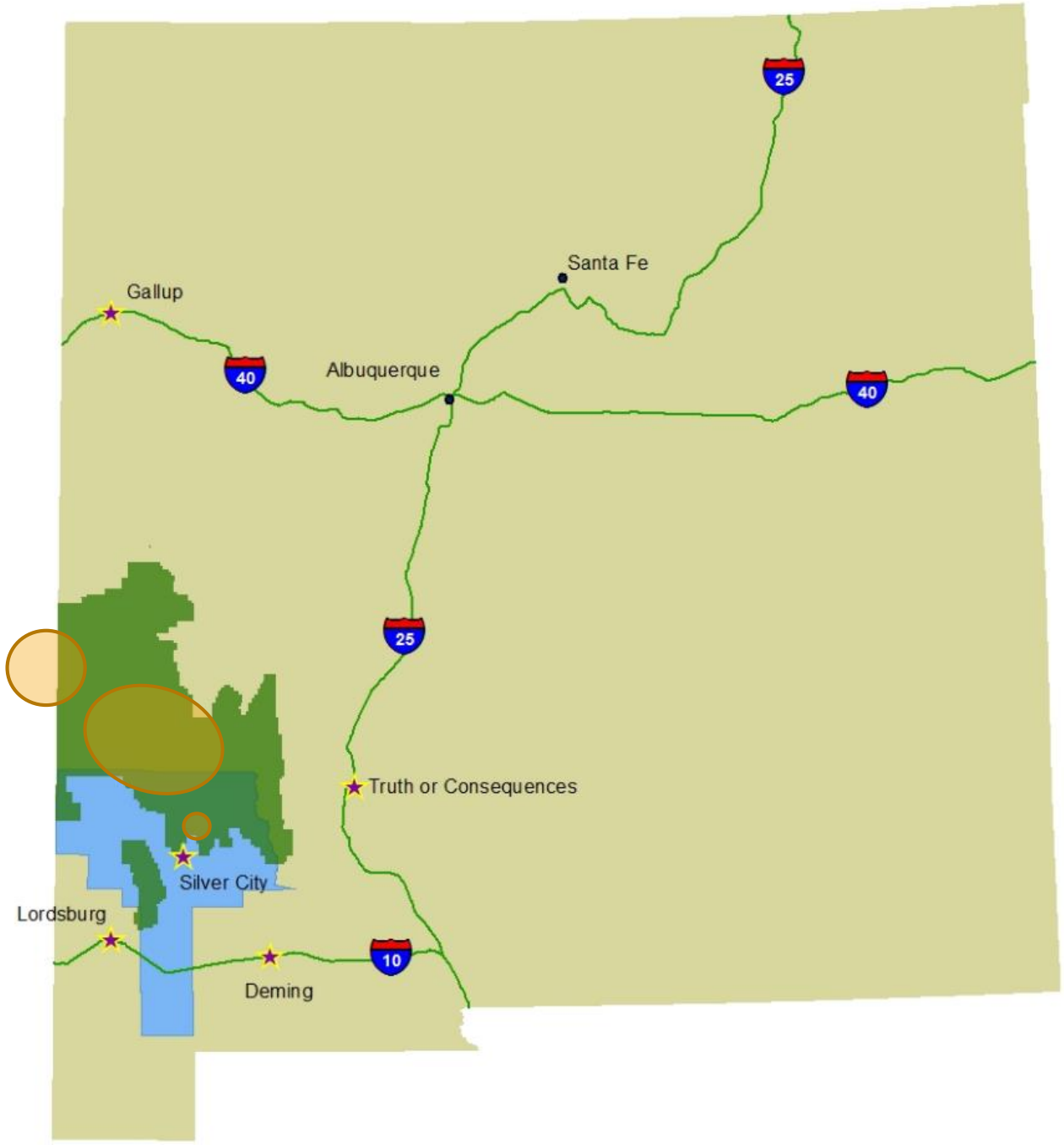
WNMU

Western New Mexico University

- 4 year, public institution with open enrollment
  - AA, BA/BS, Master's and certificate programs
  - 1510 full-time undergraduate students
- Geographic Information Systems introduced to campus in August 2012

WNMU campus. *Looking northwest into the Gila Wilderness.* *Photo © 2013, Jay Hemphill*



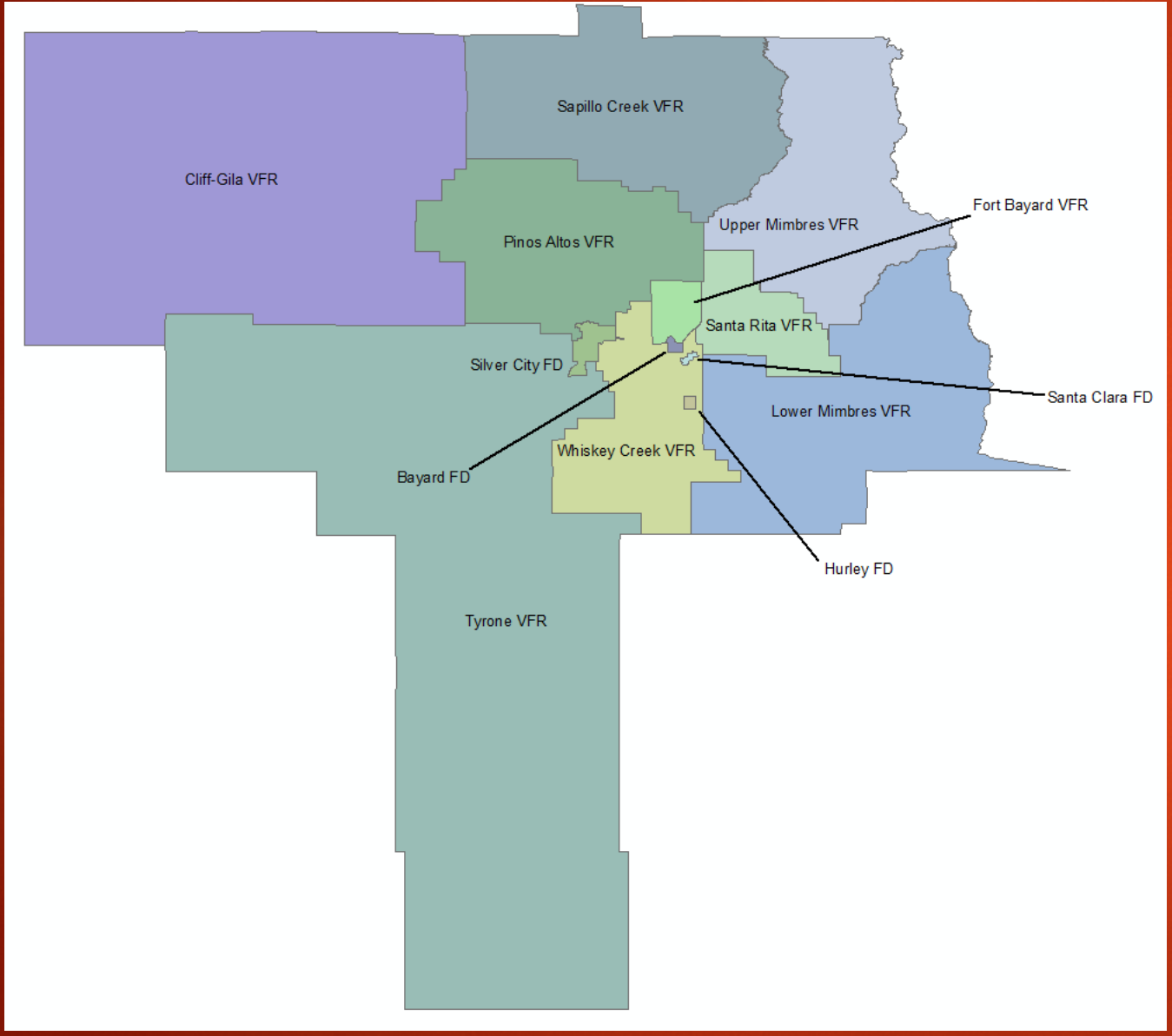
Silver City is adjacent to the 3.3 million acre Gila National Forest.

- **2011:** Wallow Fire (AZ/NM); Burned 408,887 acres, destroyed 72 structures, evacuated 6,000 people
- **2012**: Whitewater-Baldy Fire; biggest fire in NM history. Burned close to 300,000 acres
- **2014**: Silver Fire; Burned 138,705 acres

Wildland Urban Interface (WUI)

Any area where man-made improvements are built close to, or within, natural terrain and flammable vegetation and where high potential for wildland fire exists.

Grant County Fire Services



- **Nine volunteer fire rescue**
- **Four municipal departments**
- **Approximately 300+ firefighters; most are volunteers over the age of 60**
- **4,000 square miles**

Quail Ridge Fire

- **March 7, 2011 – 1800 acres**
- **Silver Acres – 135 houses**
- **13 homes lost (10%) within 1 sq. mi.**
- **Four dozen other structures lost**
- **Pets and livestock losses**
- **Map of area**

Fire Fighter Basics – 10 Standing Orders

LCES

- **Lookouts**
- **Communications**
- **Escape Routes**
- **Safety Zones**

- **Safety first!**
- **What is the fire doing now? Later?**
- **Current and predicted weather conditions**
- **LCES imbedded in all actions**
- **Developed from FF fatalities**

Fire Operations

- **Work from the “black” (burned areas)**
- **Anchor and flank**
- **Avoid frontal attack**
- **Maintain situational awareness at all times**

Wildland Urban Interface (WUI) Firefighting

- **Worst of both worlds**
- **Unpredictable wildland fire behavior**
- **Numerous structure-related hazards**
- **Apply LCES & 10 Standing Orders**

WUI Hazards

- **Natural and man-made fuels adjacent to or down slope of house**
- **Canyons and arroyos (chimneys)**
- **Narrow roads & driveways**
- **One way in & out access**
- **Power lines, fuel tanks, haz mat, etc.**

Photo © 2013, Jay Hemphill

The Project

- Pilot study
- Piños Altos Volunteer Fire Rescue (PAVFR), Town of Silver City, Grant County & WNMU collaboration
- Identify study area & develop rating sheet
- GIS students work with firefighters to collect data
- Map wildland-urban interface (WUI) hazards/analysis
- Data used by PAVFR to respond safely to a fire
- Educate property owners about WUI hazards

Western New Mexico University

- One Window's based computer lab on campus (2012)
  - XP platform with 512 MB RAM
  - could not run ArcGIS

- 2013/14: Grant proposal aimed to address economic development and education needs in Grant County through the use of GIS.
- Used wildland fire concerns as a collaborative platform

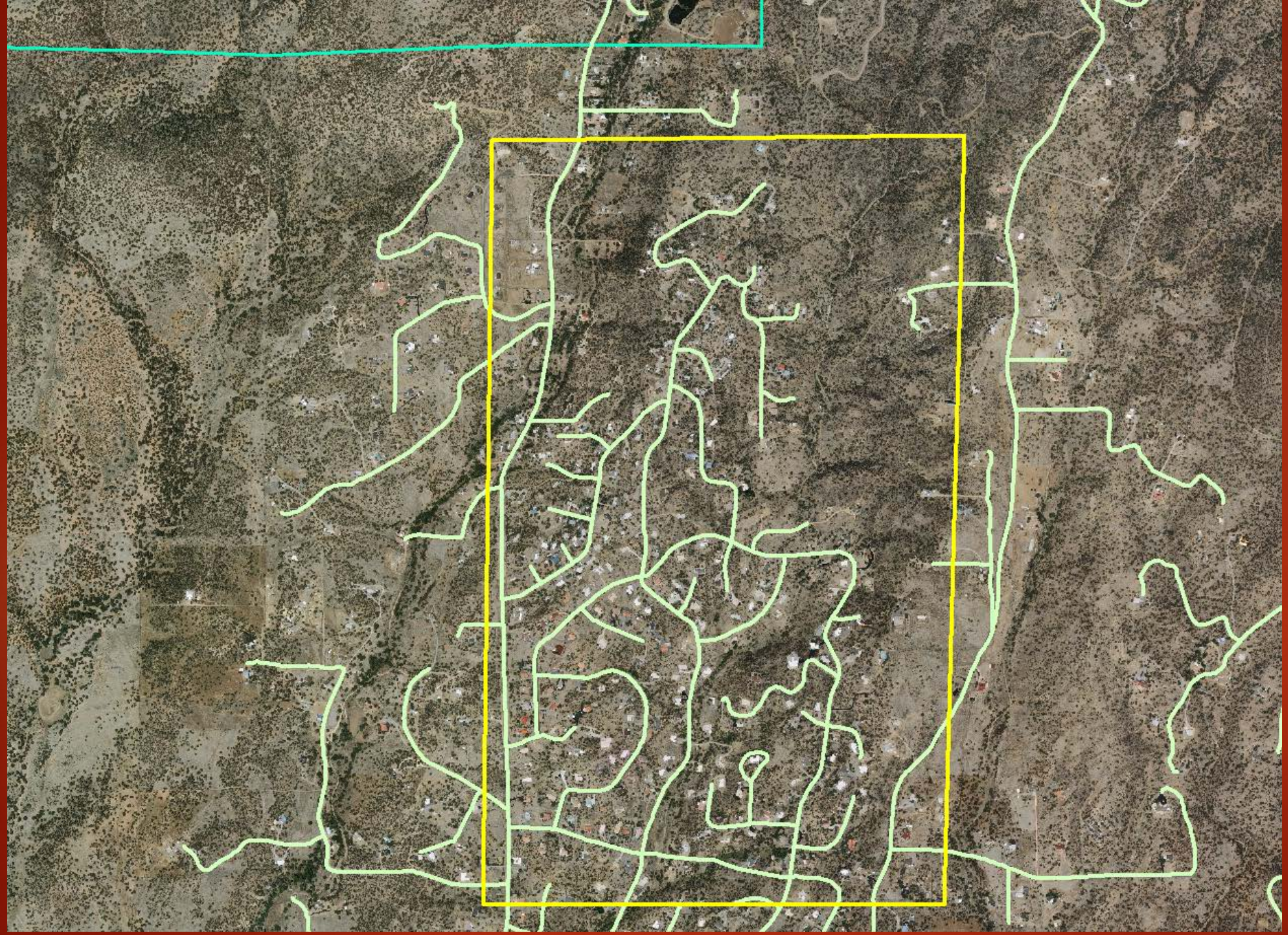
Indian Hills Area

- **Meets WUI definition**
- **< 1.5 miles from Gila NF**
- **361 houses within 1 sq. mi.**
- **22 houses per 40 acres**
- **Heavy fuel loading**
- **Fuels in close proximity to structures**

Indian Hills Area, cont'd.

- **Different topography than Quail Ridge**
- **Dominated by arroyos & chimneys**
- **Many one way in/out roads & driveways**
- **Chronic violations of trash burning and fireworks prohibitions**

COMPARISONS	Quail Ridge 	Indian Hills 
Property fire area	1 sq. mi.	1 sq. mi.
Number of structures	135	361
Structure density	0.21/acre	0.56/acre
Terrain	Open, rolling, shallow arroyos, primarily grassland	Hills and slopes, deep arroyos; primarily scrub oak and mixed conifer
Slope	Gentle to moderate	Gentle to steep
Fuels	Mostly light, some moderate	Light to extremely heavy
Road network	Through-roads, paved	Several one-way in/out; many unpaved; long narrow driveways



Study area


PRIVATE
ROAD
DEAD
END

Project Activities

- Student orientation
  - Station tour
  - WUI & Gila ecosystems (understanding place)
- Field safety briefing
- Field collection with firefighters
- Classroom data processing

Rating Sheet

- **Modified from National Fire Protection 299 rating form** *(NFPA, 2008. Standard for Reducing Structure Ignition Hazards from Wildland Fire)*
- **14 criteria**
  - **Fuels, slope, access, other**
  - **Construction materials**
  - **Defensible space**

WUI Mapping Project Rating Log

Address:	Date:	
Coordinates:	Name:	
Circle the appropriate score		
A. House Design (Max of 33 Points)	**Score**	**Notes**
1. Ingress and egress		
Driveway loop	1	
One way in/out with turnaround space	3	
One way in/out	5	
2. Driveway width		
Minimum of 20 ft	1	
Less than 20 ft	3	
3. Driveway length		
Less than 100 ft	1	
100 to 200 ft	3	
Greater than 200 ft	5	
4. Driveway surface		
Smooth road, grade <5%	1	
Rough road, grade >5%	3	
Other	5	
5. Driveway culvert or bridge		
No culvert or bridge	1	
Culvert or bridge supportive of heavy vehicles	3	
Culvert or bridge not supportive of heavy vehicles	5	
6. Average lot size		
More than 10 acres	1	
Between 1-10 acres	3	
Less than 1 acre	5	
7. Property number posted		
Present, 4 in. in size and reflectorized	1	
Present, but not reflectorized	2	
Not present	5	
B. Vegetation Type (Max. of 20 points)		
1. Fuel Types		
Light (grasses, forbs, saw grasses, and tundra)	1	
Medium (light brush and small trees)	5	
Heavy (dense brush, timber, and hardwoods)	10	
2. Defensible space		
More than 100 ft of treatment from buildings	1	
30-70 ft of treatment from buildings	5	
No defensible space treatment	10	

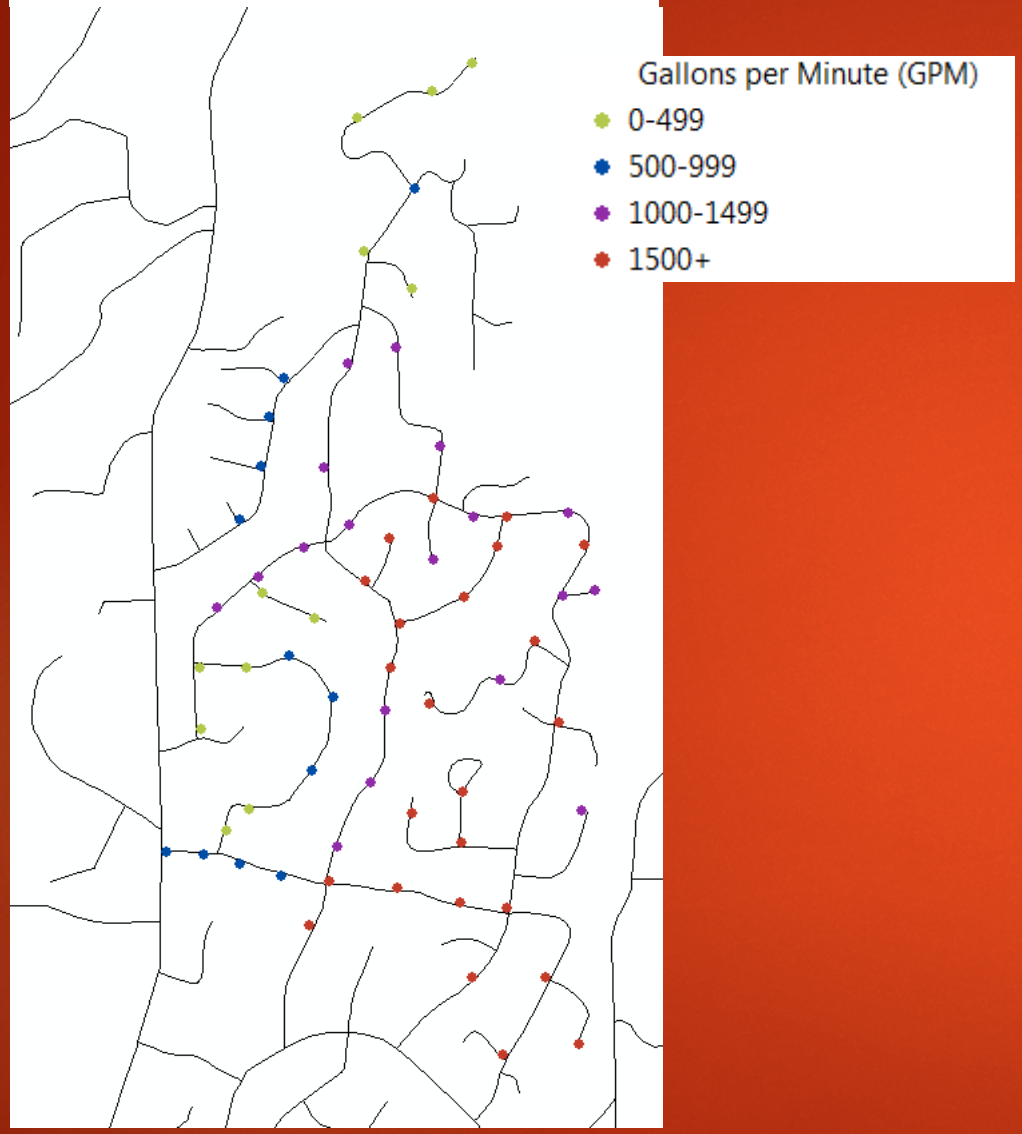
WUI Mapping Project Rating Log

C. Slope (Max of 10 Points)	Score	Notes
Less than 9%	1	
Between 10-20%	4	
Between 21-30%	7	
Between 31-40%	8	
Greater than 41%	10	
D. Roofing Material (Max of 10 Points)		
Metal or tile	1	
Composite (shingles)	3	
Wood	10	
E. Existing Building Construction (Max of 10 points)		
Noncombustible siding/deck	1	
Noncombustible siding/wood deck	5	
Combustible siding and deck	10	
F. Available Fire Protection (Max of 10 points)		
Fire hydrant of 500 GPM < 1000 ft from driveway	1	
Fire hydrant of 500 GPM > 1000 ft from driveway	5	
No hydrants or draft site available	10	
G. Utilities (Gas and Electric) (Max of 5 Points)		
Defensible space around propane tank or no tank	1	
No defensible space around propane tank	5	
F. Additional Rating Factors (1-15 points)		
Rough topography that contains steep canyons		
Heavy vegetation along driveway or downslope from house		
Areas that are periodically exposed to unusually severe fire weather and strong dry winds		
Additional factors that impact firefighter safety		
Total Score		
TOTAL POINTS (Max of 98 Points)		
Extreme Hazard	72-98	
High Hazard	56-71	
Moderate Hazard	40-55	
Low Hazard	14-39	

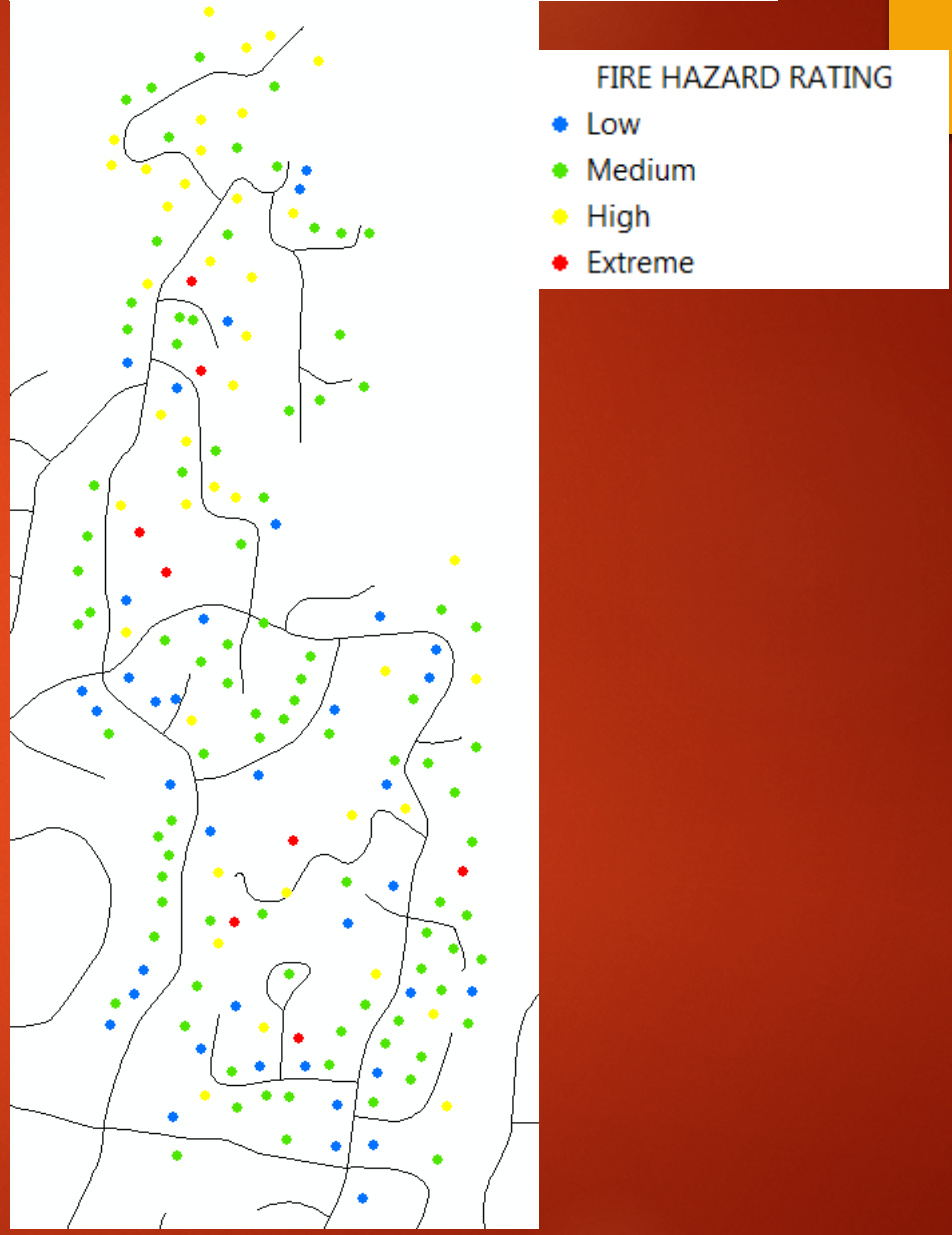
Workflow

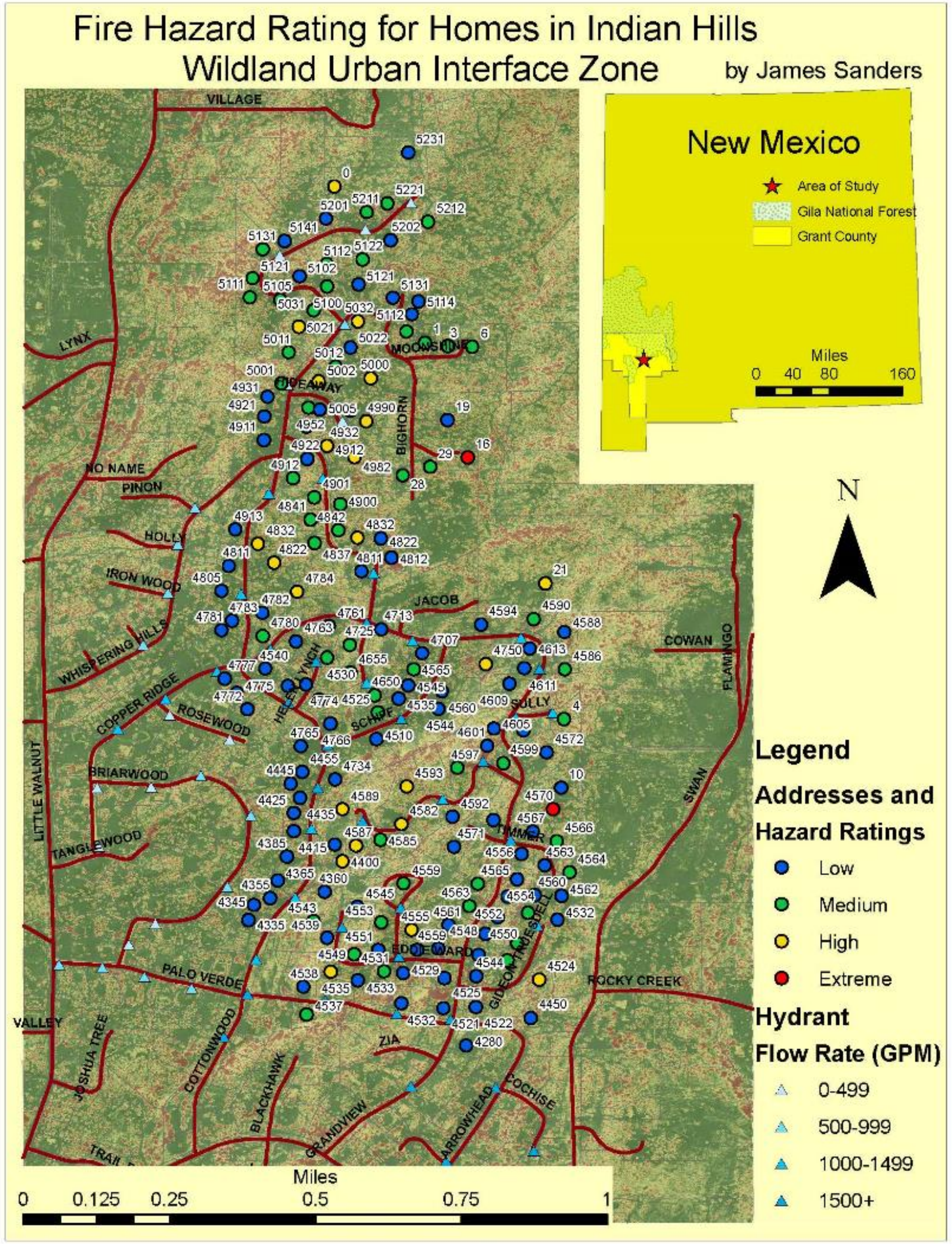
- Collect data
- Import to Excel
- Import to ArcMap
- Scripted labs develop basic GIS skills
- Final map project encourages independent exploration and critical thinking

Hydrant layer

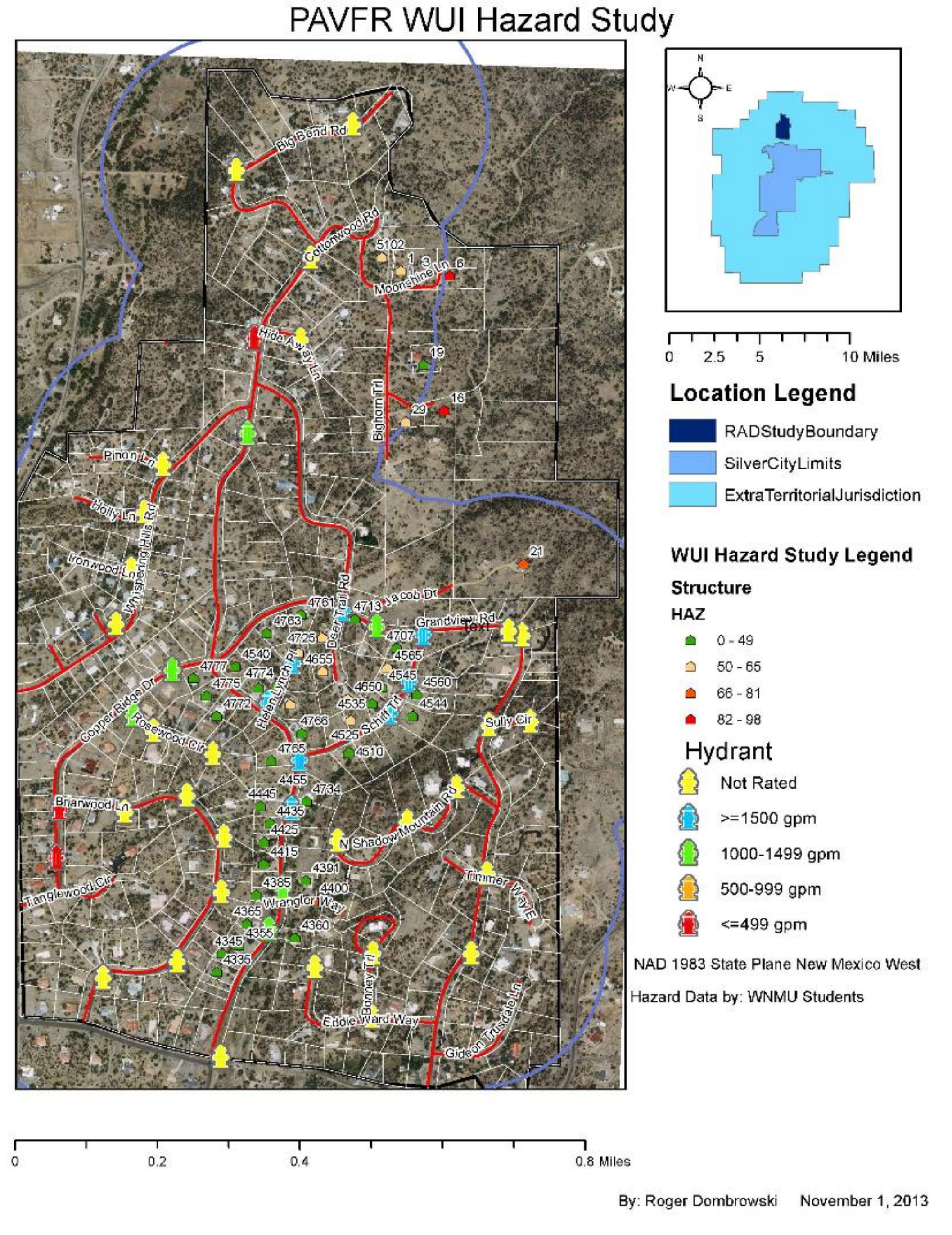


Raw Home Data, Classified

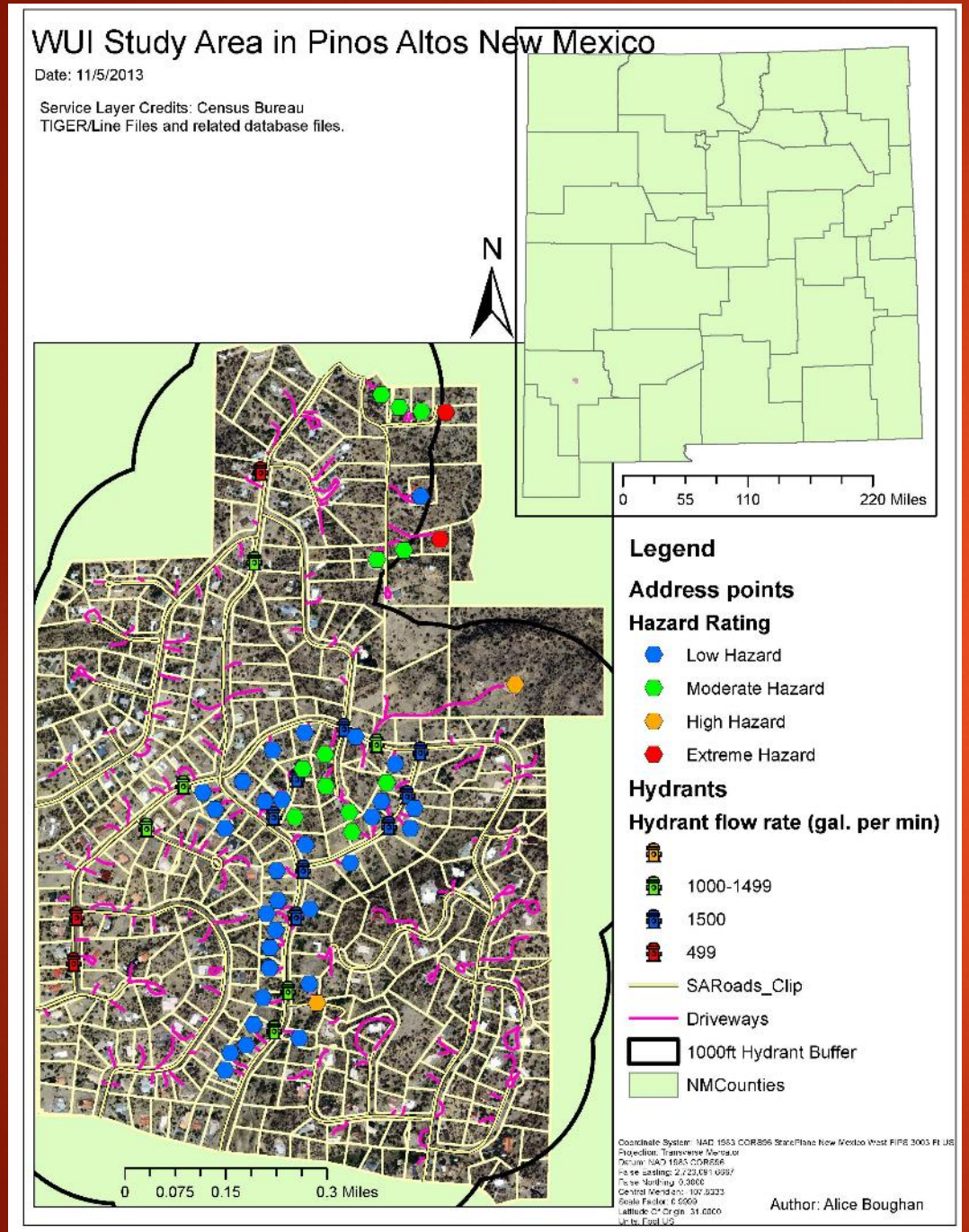


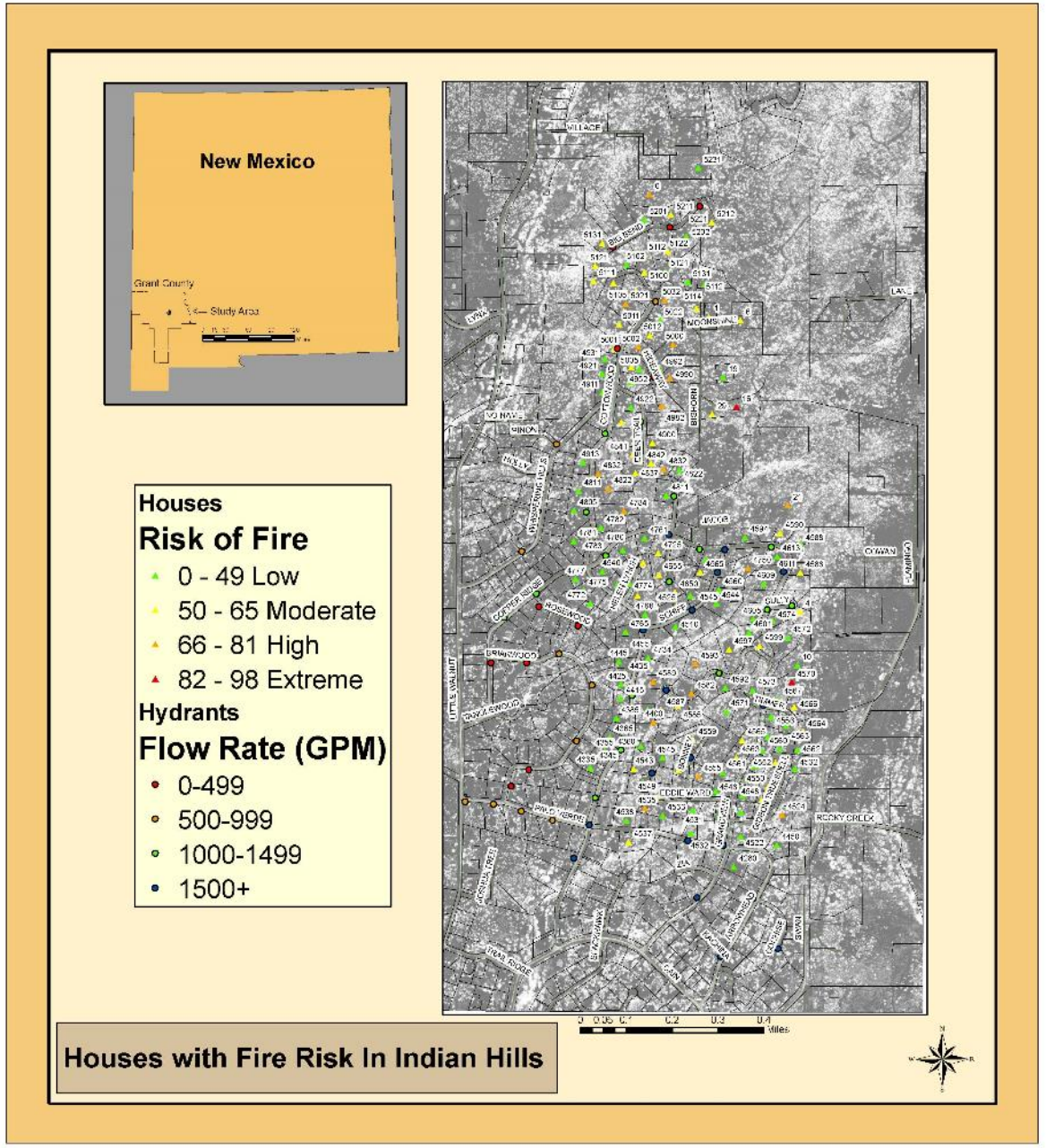


Fire Hazard Rating for Homes in Indian Hills
Wildland Urban Interface Zone
by James Sanders
New Mexico
Area of Study
Gila National Forest
Grant County
Miles
0 40 80 160
N
Legend
Addresses and Hazard Ratings
Low
Medium
High
Extreme
Hydrant Flow Rate (GPM)
0-499
500-999
1000-1499
1500+
Miles
0 0.125 0.25 0.5 0.75 1
VILLAGE
LYNX
NO NAME
PINON
HOLLY
IRON WOOD
WHISPERING HILLS
COPPER RIDGE
ROSEWOOD
BRIARWOOD
TANGLEWOOD
LITTLE WALNUT
PALO VERDE
VALLEY
JOSHUA TREE
COTTONWOOD
BLACKHAWK
GRANDVIEW
ZIA
ARROWHEAD
COCHISE
ROCKY CREEK
SWAN
COWAN
FLAMINGO
JACOB
SULLY
TIMMER
MOONSHINE
BIGHORN
HIDEAWAY



PAVFR WUI Hazard Study
Location Legend
RADStudyBoundary
SilverCityLimits
ExtraTerritorialJurisdiction
0 2.5 5 10 Miles
WUI Hazard Study Legend
Structure
HAZ
0 - 49
50 - 65
66 - 81
82 - 98
Hydrant
Not Rated
>=1500 gpm
1000-1499 gpm
500-999 gpm
<=499 gpm
NAD 1983 State Plane New Mexico West
Hazard Data by: WNMU Students
0 0.2 0.4 0.8 Miles
By: Roger Dombrowski November 1, 2013
Big Bend Rd
Cottonwood Rd
Moonshine Ln
Hide Away Ln
Bighorn Trl
Pinon Ln
Holly Ln
Ironwood Ln
Whispering Hills Rd
Jacob Dr
Grandview Rd
Copper Ridge Dr
Rosewood Cir
Sully Cir
Briarwood Ln
Tanglewood Cir
Shadow Mountain Rd
Timmer Way E
Wrangler Way
Eddie Ward Way
Gideon Trusdale Ln


WUI Study Area in Pinos Altos New Mexico
Date: 11/5/2013
Service Layer Credits: Census Bureau
TIGER/Line Files and related database files.
N
0 55 110 220 Miles
Legend
Address points
Hazard Rating
Low Hazard
Moderate Hazard
High Hazard
Extreme Hazard
Hydrants
Hydrant flow rate (gal. per min)
1000-1499
1500
499
SARoads_Clip
Driveways
1000ft Hydrant Buffer
NMCounties
0 0.075 0.15 0.3 Miles
Author: Alice Boughan


New Mexico
Grant County
Study Area
Houses
Risk of Fire
0 - 49 Low
50 - 65 Moderate
66 - 81 High
82 - 98 Extreme
Hydrants
Flow Rate (GPM)
0-499
500-999
1000-1499
1500+
Houses with Fire Risk In Indian Hills

Devon Grant

Project Status

- **Ongoing project; 176 properties evaluated to date in the Indian Hills Subdivision**
- **QA/QC of evaluations performed by USFS fire personnel, PAVFR volunteers and Silver City Fire Chief Tim Heidrick**
- **SP2015 estimated completion**

Silver City/Grant County Symposium on Preparedness 2013

- **Fire Simulation**
  - **FARSITE from USFS Fire Science Lab**
  - **Fire behavior simulation program**
  - **Landscape file (eight layers)**
  - **Wind, weather, and fuel moisture files**
  - **Does not take into account mitigations**

Simulation Parameters

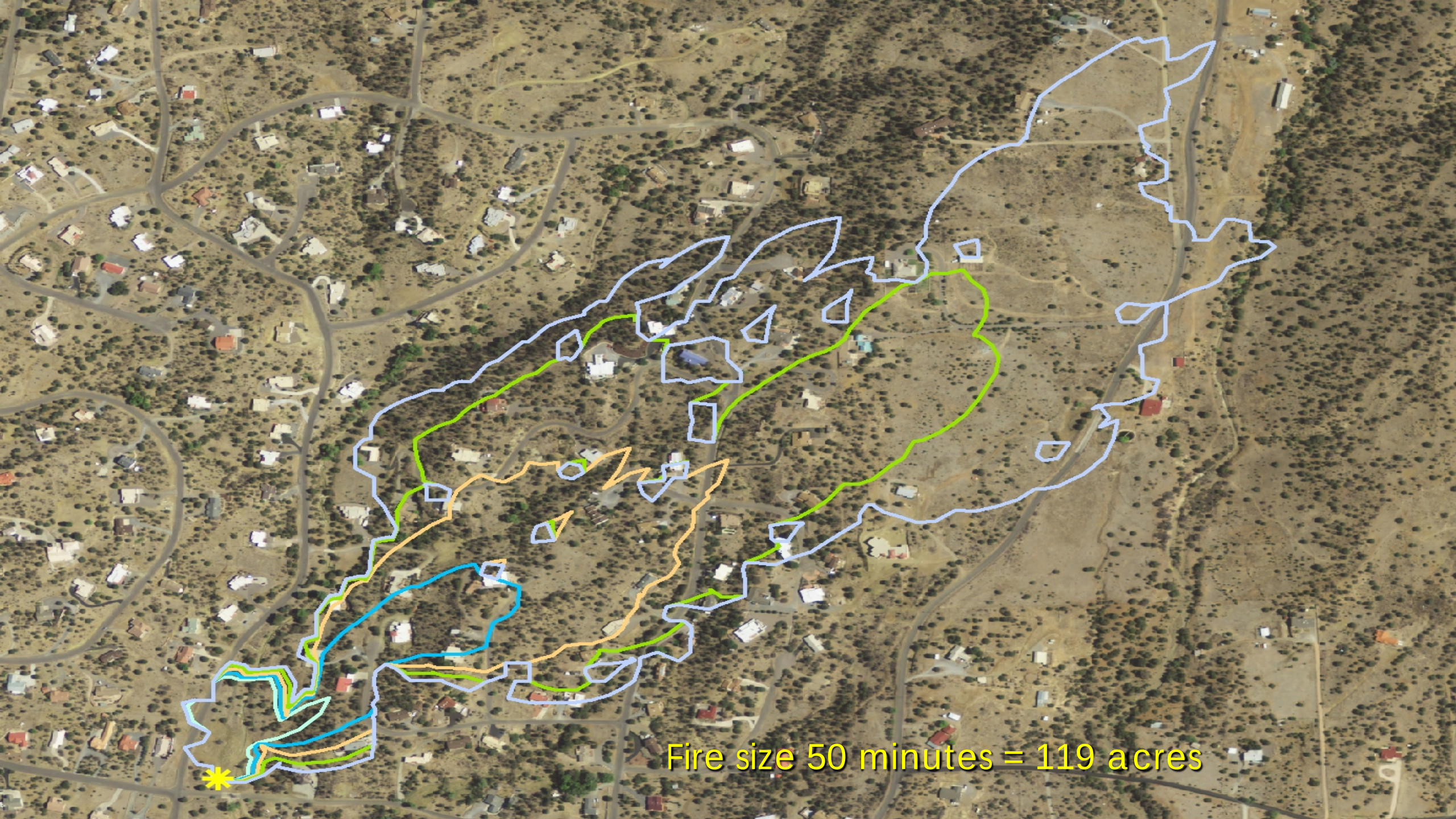
- **Typical early June day**
- **Temp @ 90 degrees**
- **Relative humidity in single digits**
- **Winds from SW at 15-20 mph**
- **Fire start at 2 pm**

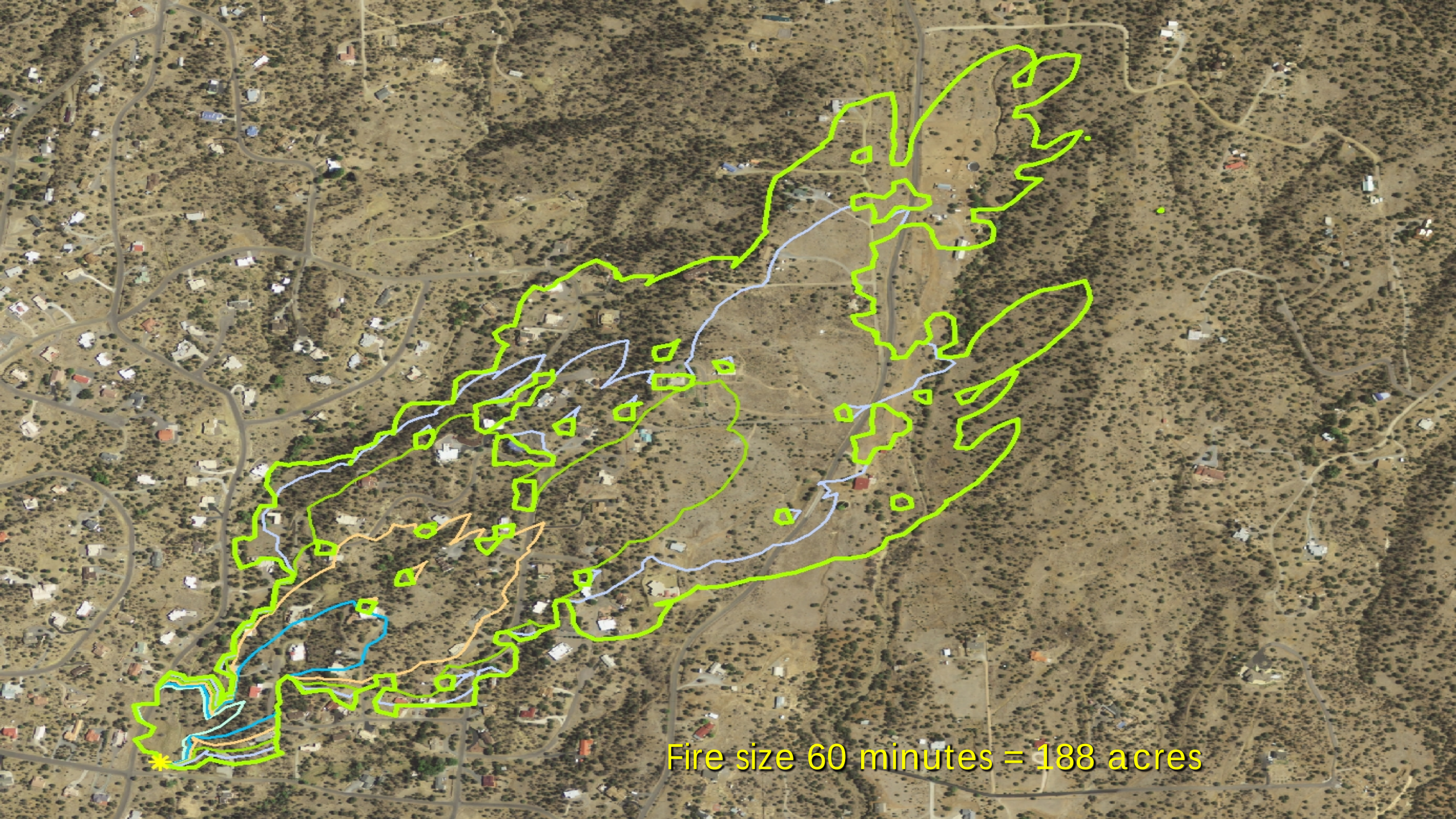

Fire size 10 minutes = 3 acres


Fire size 20 minutes = 10 acres


Fire size 30 minutes = 28 acres


Fire size 40 minutes = 64 acres


Fire size 50 minutes = 119 acres


Fire size 60 minutes = 188 acres

Taking Action

- Property owners can get started
- Conduct evaluation of property
- Visit *Firewise.org* web site for information
- Take action to reduce fire threat now
- Bottom line
  - Not enough firefighters to save all properties
  - No house is worth a life.

Geographic Inquiry

- Final project encourages independent exploration and critical thinking
- Builds capacity for teamwork among students
- Forges relationships with community members/organizations
- Students and educator expand GIS skills out of necessity

Contact Info

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