# Deriving Fire Defensibility Layers from Imagery



Amanda O'Connor

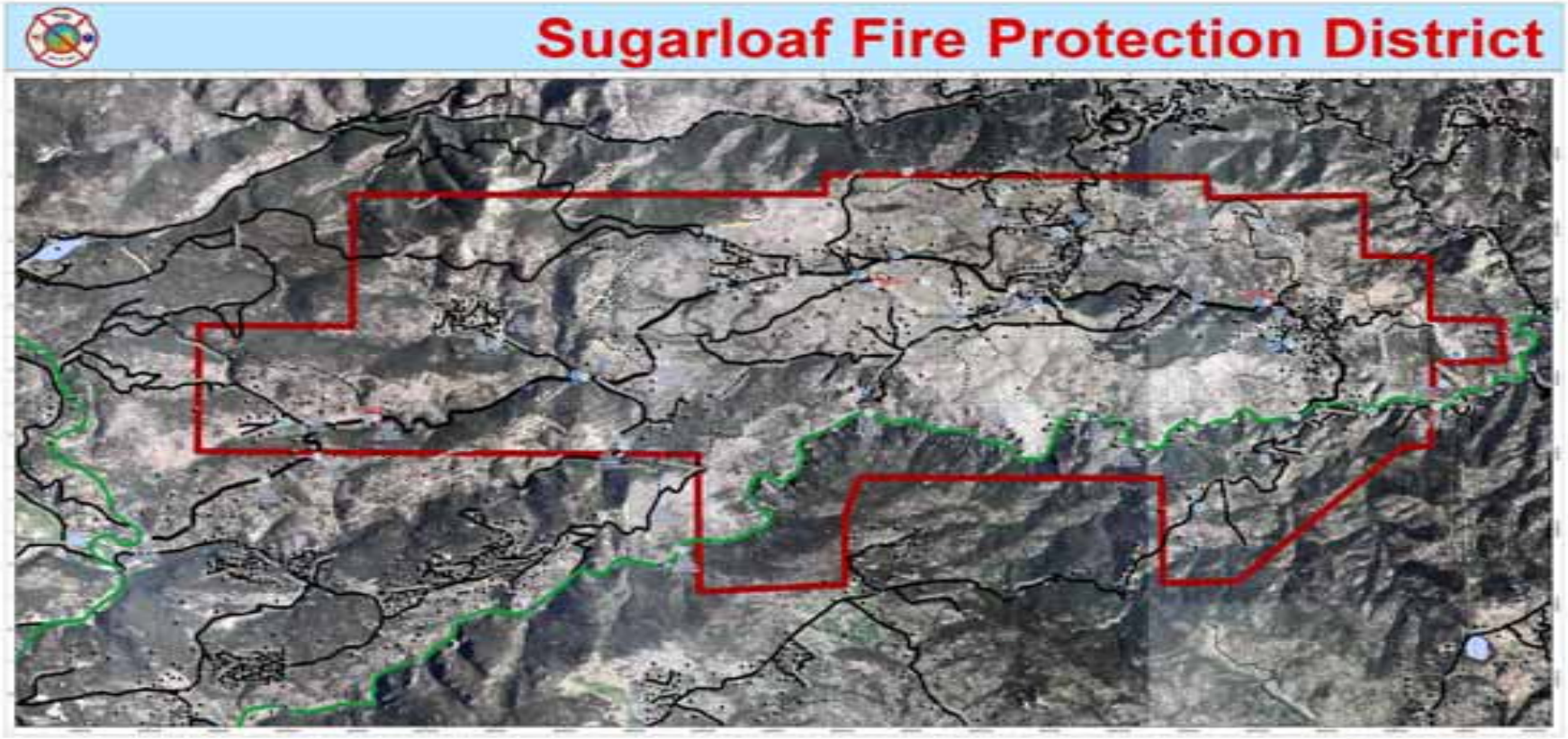
amandao@ittvis.com

*Engineered for life*

# Problem

- Sugarloaf fire department is an all volunteer department like many rural departments
- Wildfire prone area of the Colorado foothills
- Narrow roads, many homes, high winds, variable drought, every summer is watchful waiting for a fire
- Need tools for firefighters to be able to quickly ascertain the vegetation density around them
  - See quickly where an ATV/UTV can drive to put out hot spots
  - Determine accessibility of getting to a fire with larger 4wd vehicles
  - Make good decisions on fire breaks
  - Determine which houses at risk to apply treatments/build fire breaks

# Study Area




# State of the GIS

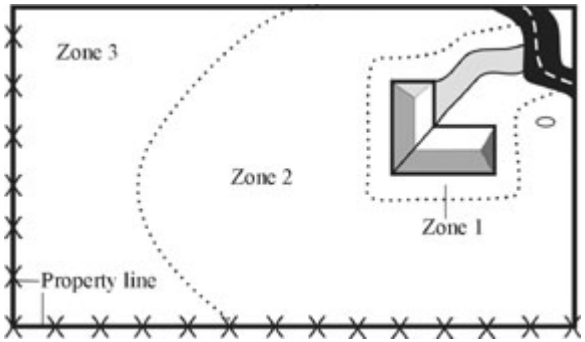
- Mapping of roads, trails, houses, landmarks completed
- RedZone Software Provided Initial constructs
  http://www.redzonesoftware.com
- Had imagery, but all true color (RGB)
- Needed infrared imagery for better vegetation mapping
- GeoEye graciously donated GeoEye-1 Pan and MSI imagery
- Vegetation cover variable
  - Pine beetle
  - Home owner/county/state mitigation that is ongoing
  - Seasonal changes
  - Need better vegetation layers for decision making

# Objectives

- Add vegetation density layer to SLFD GIS
- Try to keep simplistic for easy deployment
- Make derived vegetation layers simple to use
  - Buffer houses and roads
  - Include full area for wildland fire response
  - Provide tools for home owners to assess their risk

# Prescriptive Fire Mitigation

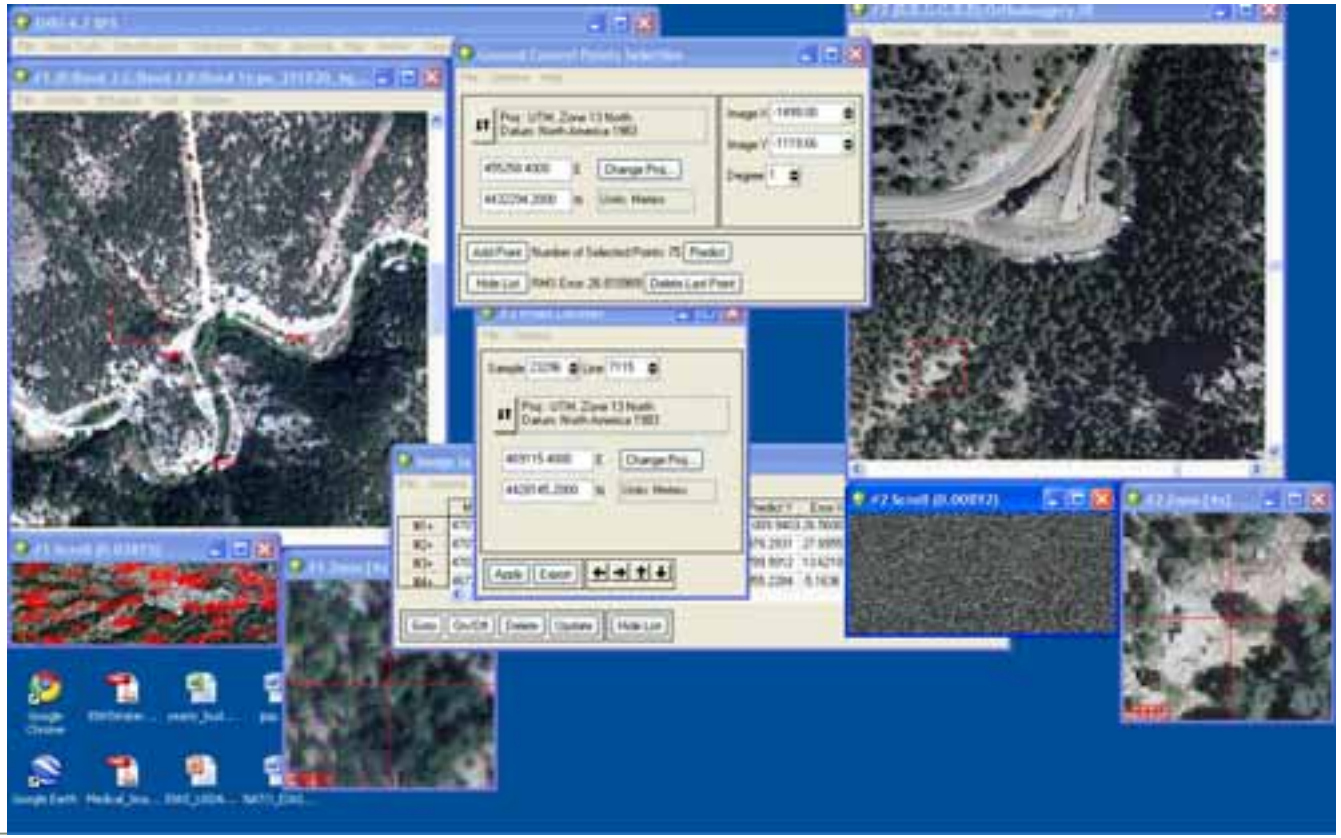
- Colorado state extension recommends 75-125 ft of defensible space around a dwelling
- Prescriptions for shrubs, trees based on diameter, slopes, grasses
  - Zone 1: Free of vegetation
  - Zone 2: Should have at least 10 feet between crowns, ladder fuels removed
  - Zone 3: Healthy forest, not over grown, snags undercontrol
- Multiple resources need to observe the state of each of these features
  - LiDAR for understory
  - High resolution IR imagery
  - DEM




Courtesy CO State Extension

# Preprocessing

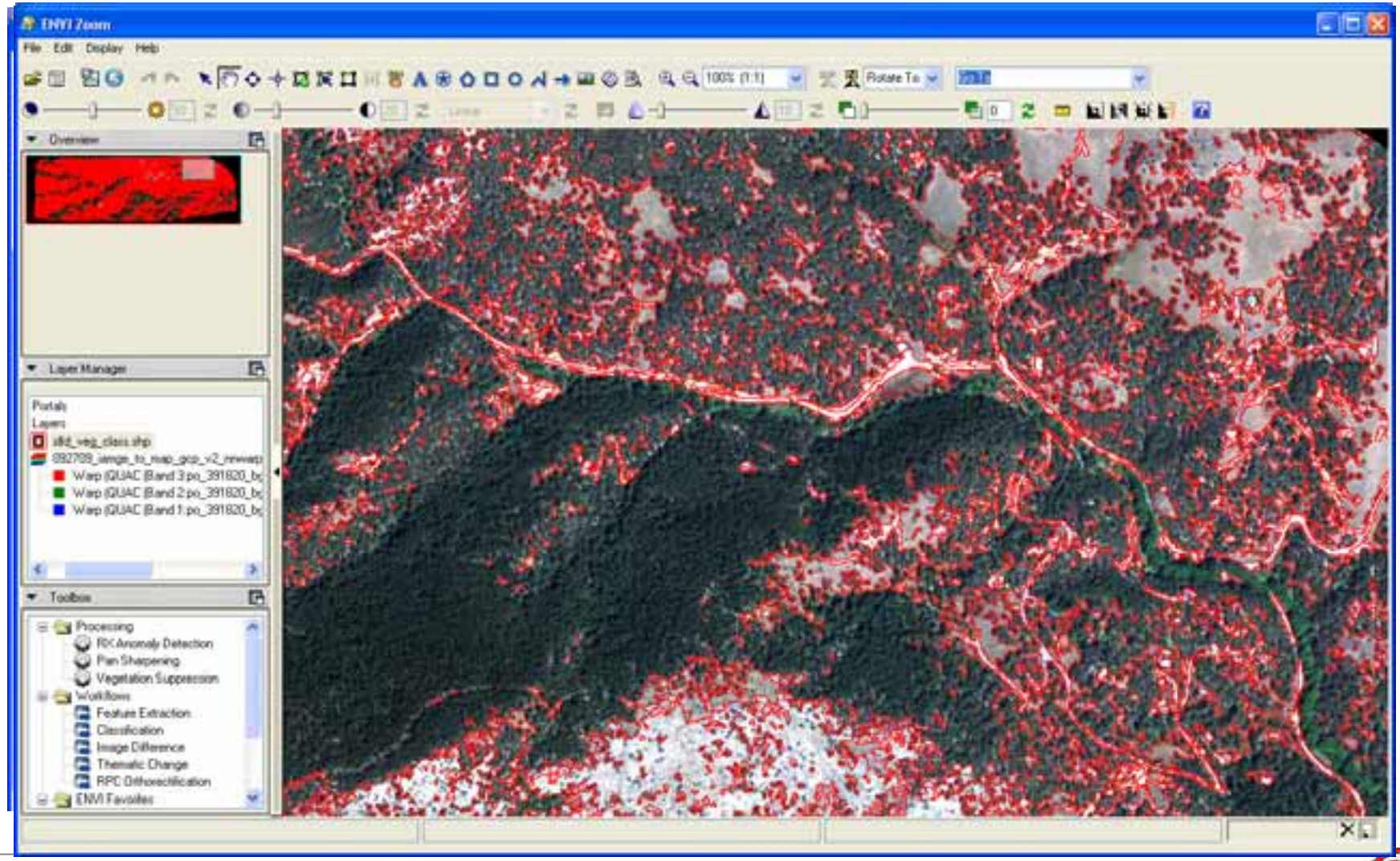
- Atmospheric Correction
- Geocorrection
  - Automated
  - Manual



# Classification

- Relatively simple process for taking pixels in an image and assigning to landcover classification
- Used ENVI EX for this project
- Discreet classes
- Useful for
  - General landcover analysis
  - Land cover change polygons with multi-temporal data
  - Mapping urban forest boundary
  - Mapping changes in forest quality, i.e. pine beetle damage

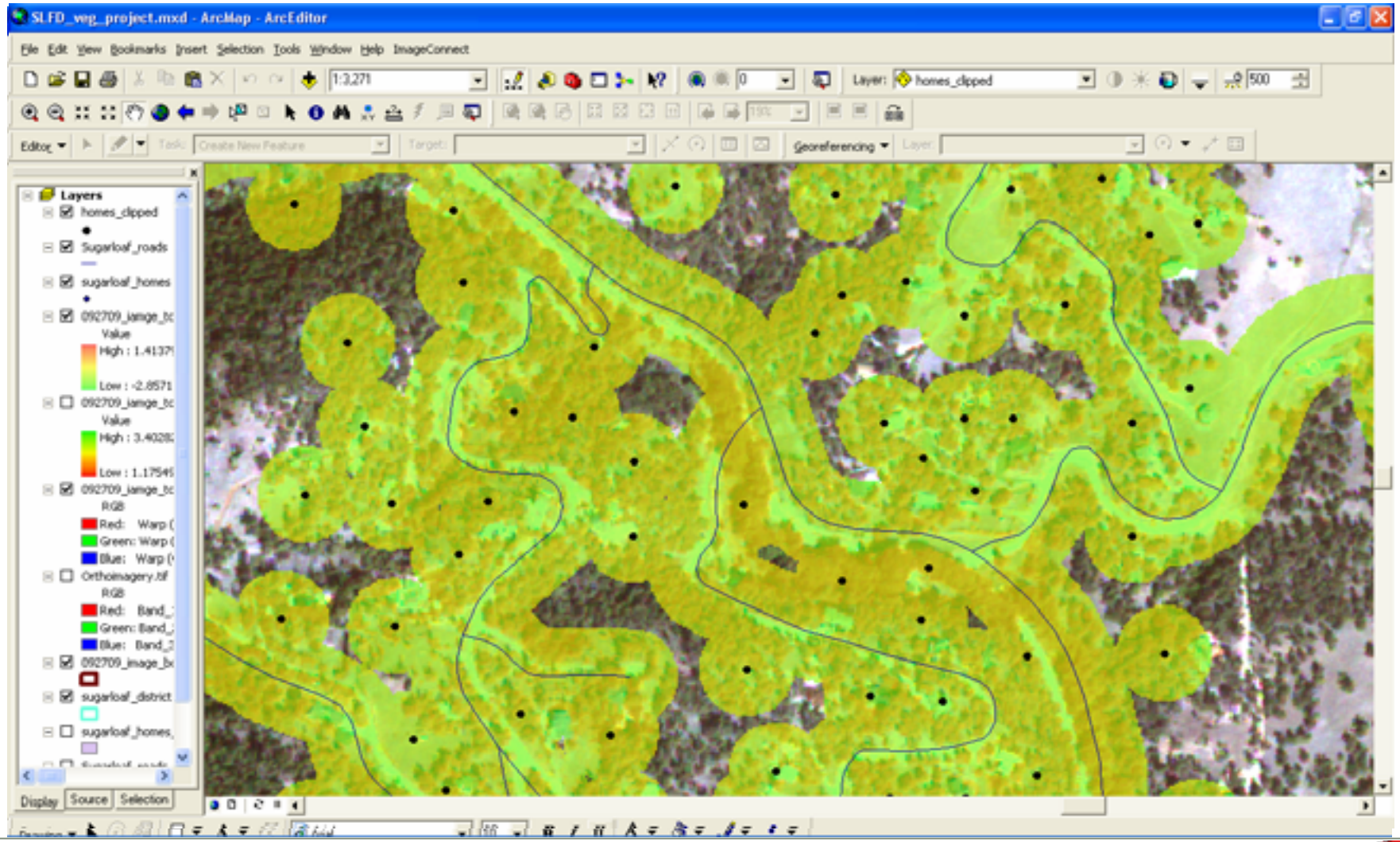
# ENVI EX for Classification



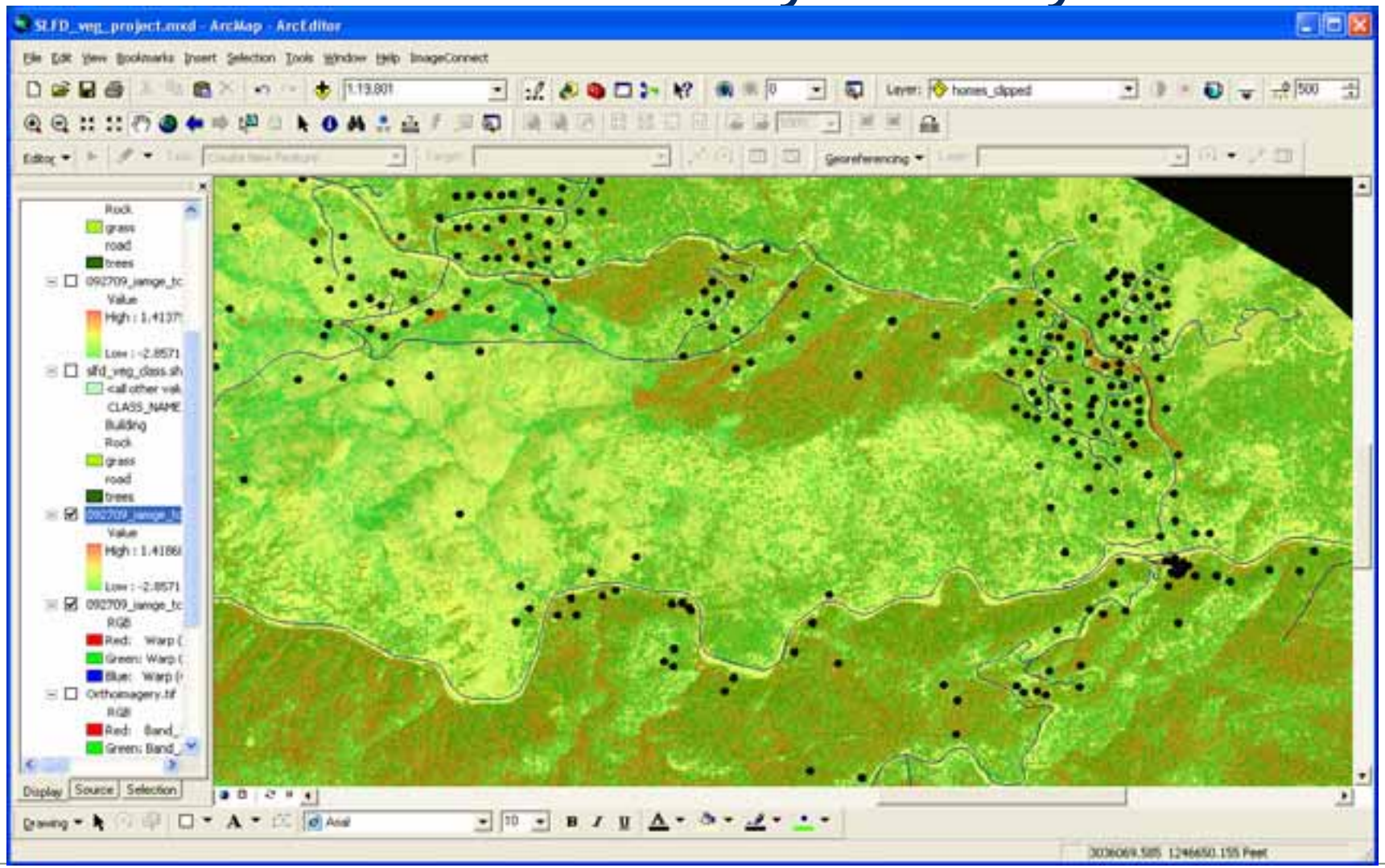
# NDVI

- Tried and true approach of measuring greenness
- It can be a snap shot of vegetation
- Can be used over time to show stress/growth
- Continuous classes
- Use limited by seasonality
  - Evergreens verses grasses that senesce
- One piece of the picture for fire prediction
  - Building materials, atmospheric moisture, drought conditions/severity, vegetation proximity, wind, topography, soil moisture, type of vegetation, etc.

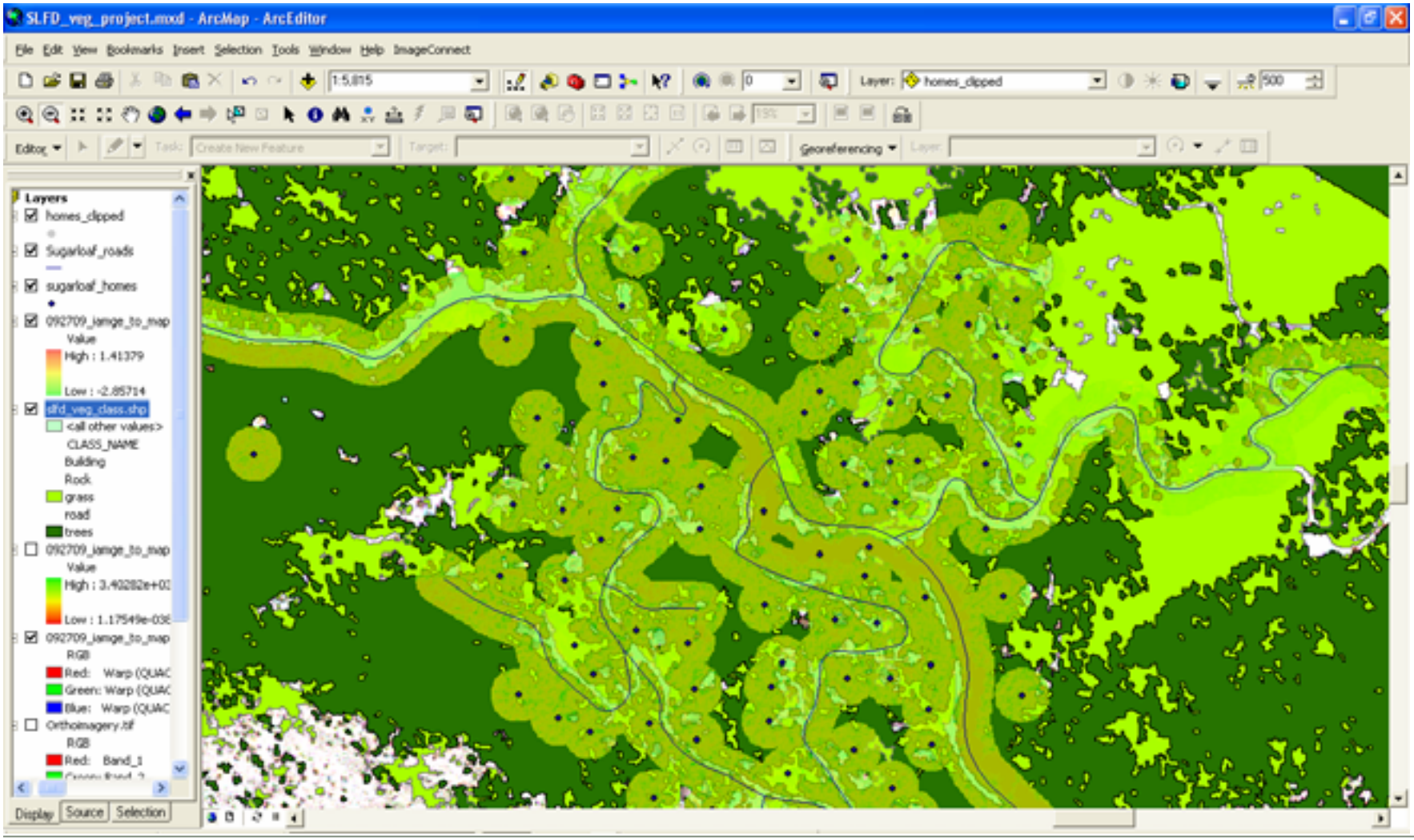
# NDVI Buffered Roads/Houses overlaid on imagery



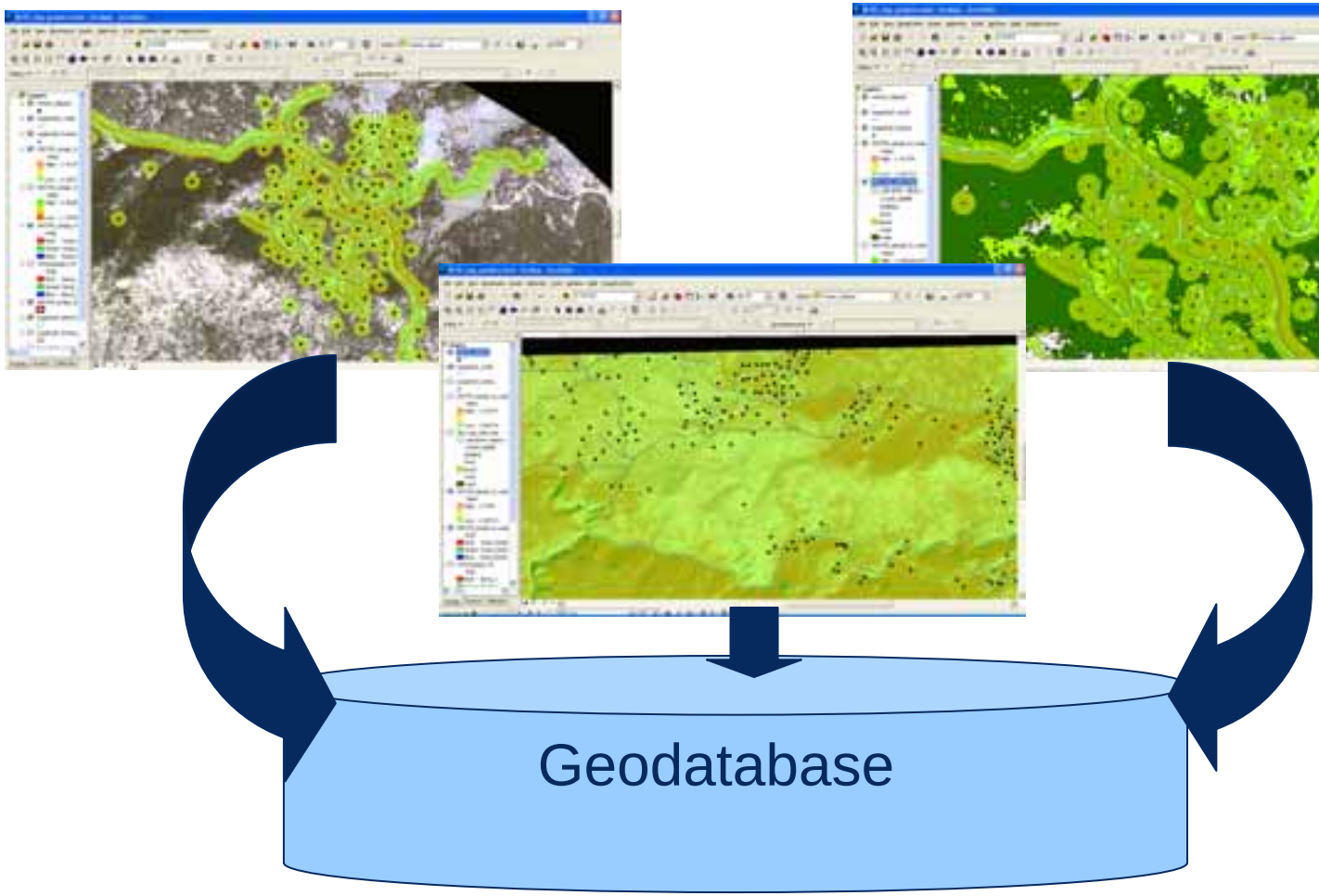
# NDVI for Cross Country Mobility



# Integrate classification



# Build Geodatabase



# Scripting

Atmospheric Correction (Optional)

Automated Georeferencing (Optional)

Run NDVI

Buffer Houses, Roads, Etc

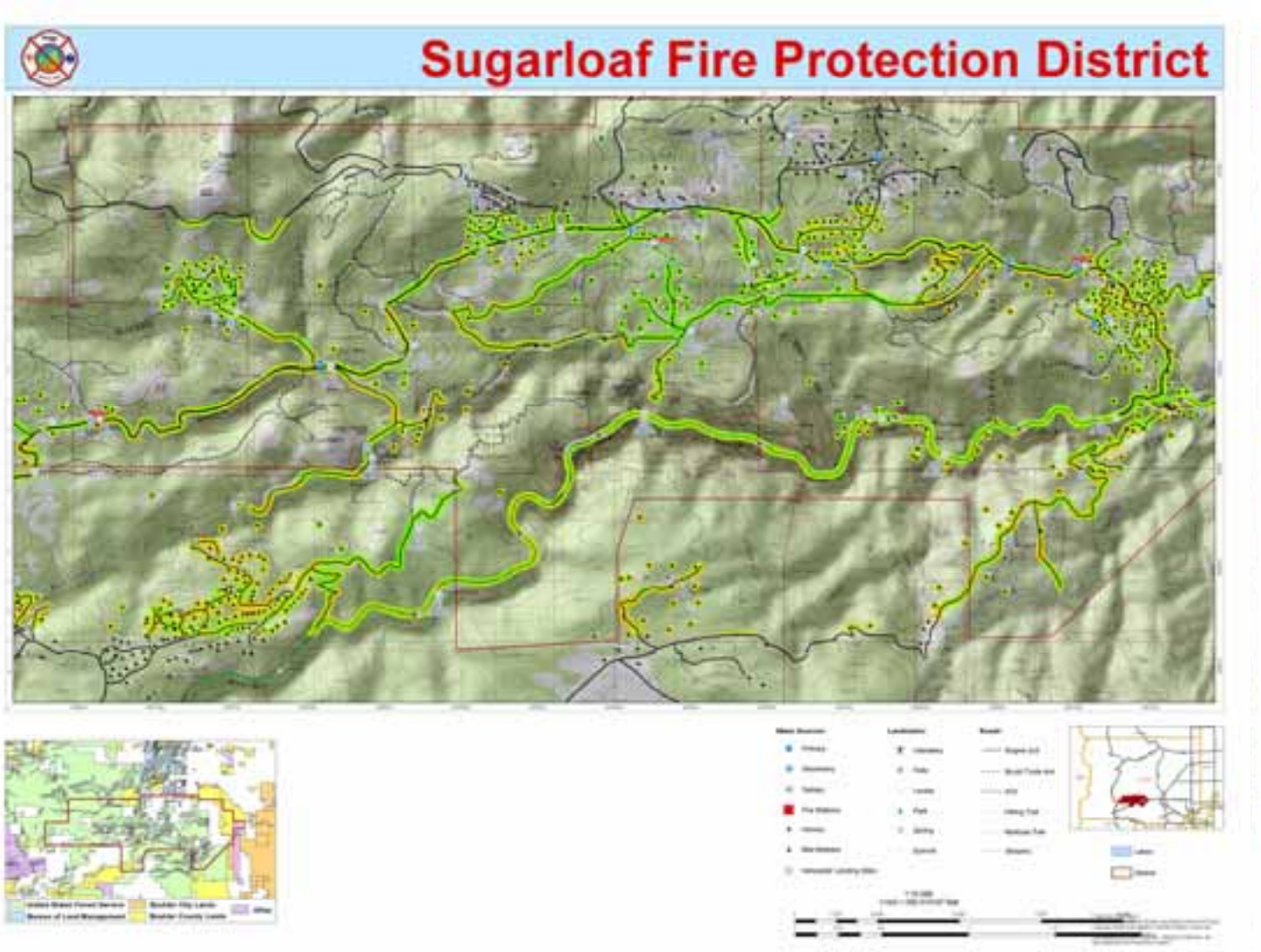
Create Mask of NDVI using Buffer

Output to GDB

Run script from ENVI or as a model through Python



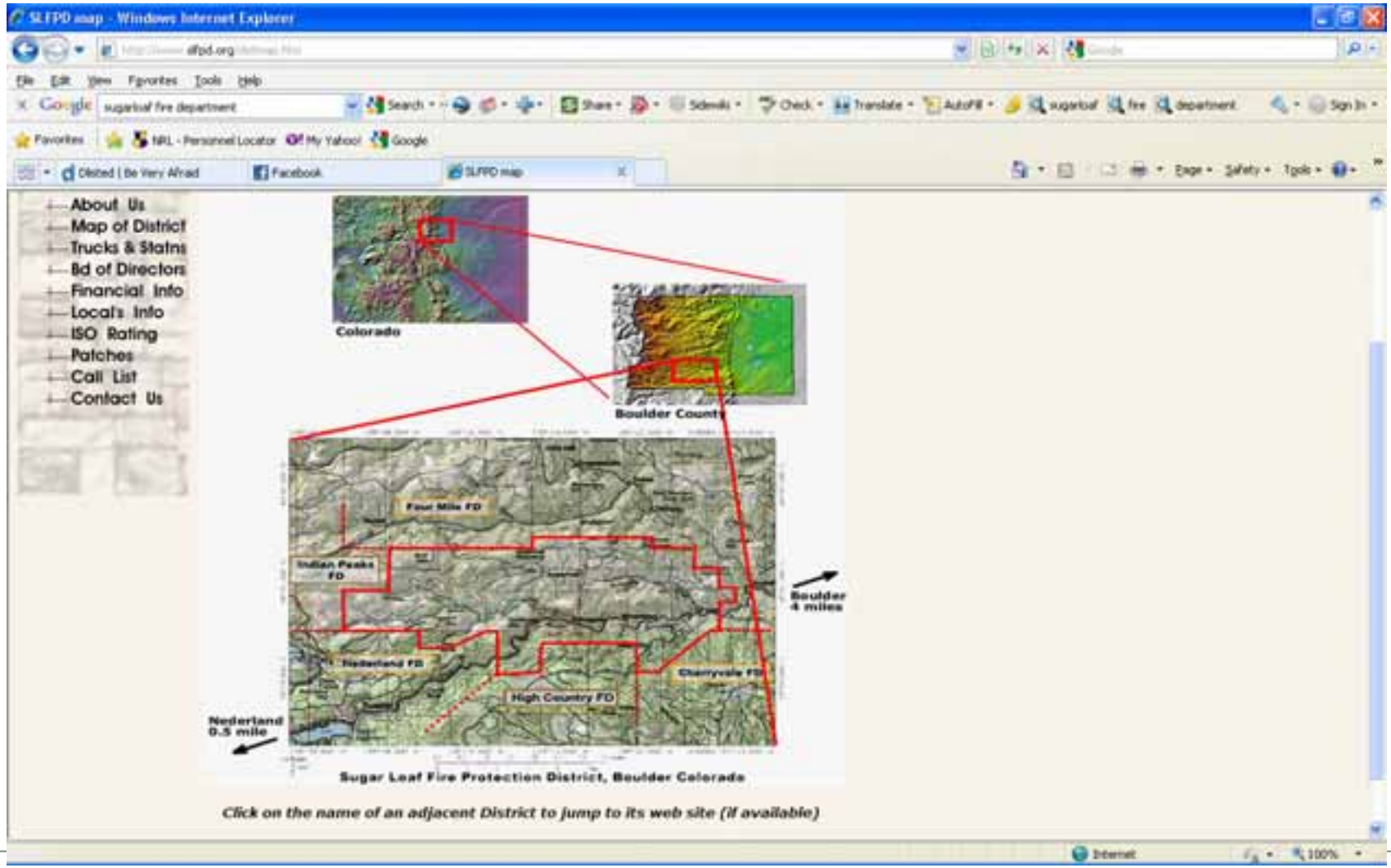
# Firefighter Products



# Challenges

- Availability of frequent Hi-Res multiband Imagery
  - NAIP in the future collecting NIR band data
  - There is lower resolution imagery
  - Larger pixels better for regional mapping and decisions vs. localized analysis
- Georeferencing vs Orthorectification
  - Mountainous area
  - Ortho distorts image severely in places
  - For a visual products georeferencing works better
  - But, can be time consumming to select many tie points needed for the terrain to match imagery to existing GIS
- Getting information beyond fire department
  - Existing webpage not a community resource
  - People could see these maps, but not have an idea of what needs to be done

# SLFD Existing Web Page



# Future Work

- NAIP Imagery to be collected as four band data
- GPS housing locations to get a more accurate layer
- Attend community meetings, solicit feedback as to how to make this info more approachable to homeowners
- Work with others in the area to incorporate this into fire risk models (vegetation, live on a dead end)
- Grants for funds to stand up a server to keep residents up to date on landcover phenomenon
  - Especially important as pine beetle begins to encroach on the rural urban interface

# Thank you!

- Thank you to GeoEye for providing recent GeoEye-1 four band data
- ITT VIS for use of ENVI and ENVI EX
- ESRI for access to ArcGIS
- RedZone LLC for assistance in building the GIS
- Sugarloaf Fire Department for GIS data collection, comments, and commitment to public safety

- Red zone web page
- Reorder classification
- Improve colors if possible
- Remove Arc Explorer, work with community