Working in communities to characterize and reduce landslide impact –
NC example

presented by
Jennifer Bauer, LG
Appalachian Landslide Consultants, PLLC

AGI Policy and Critical Issues Webinar: Identifying and Reducing Landslide Risk April 17, 2019

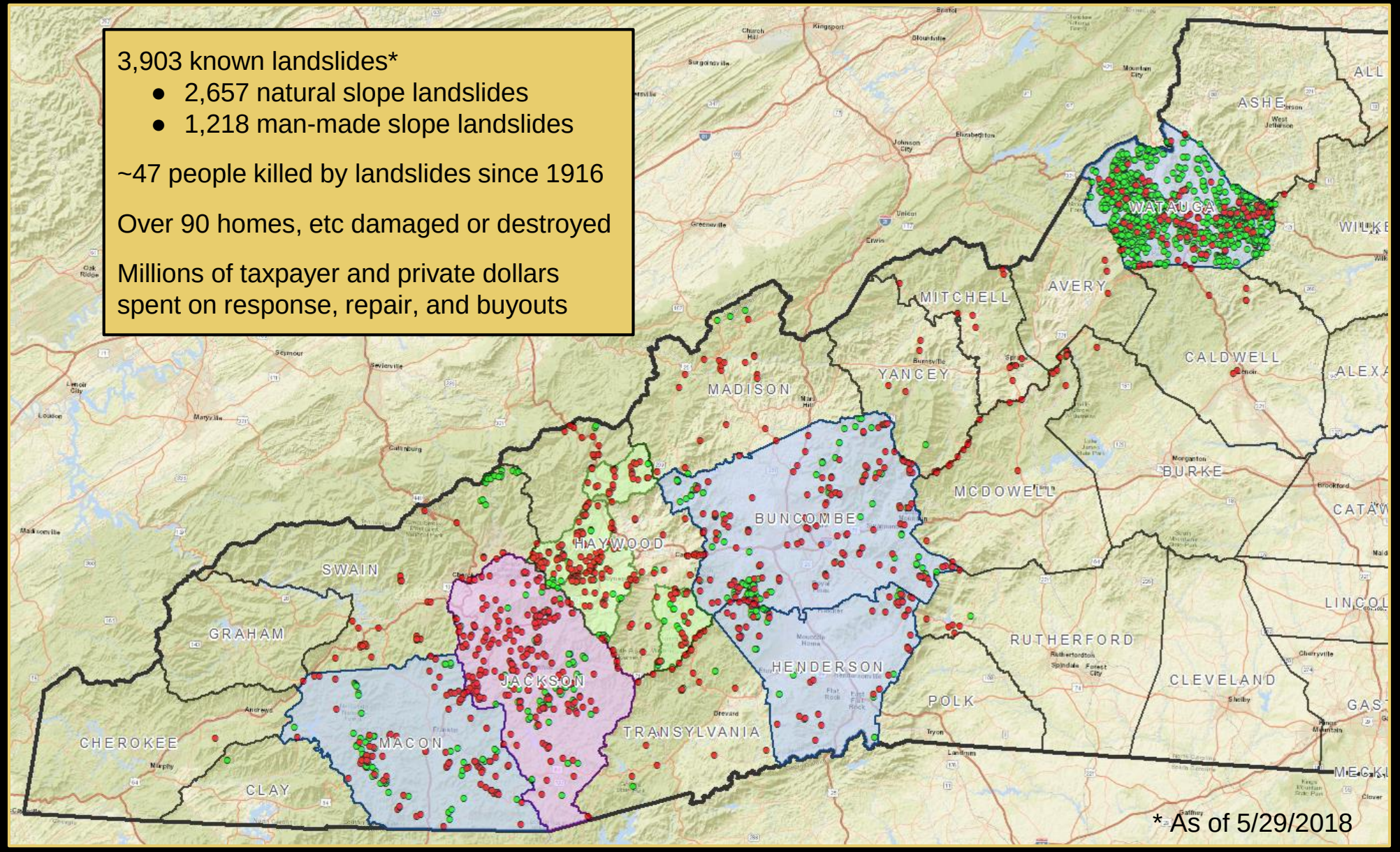
Aerial Image by NC Forest Service, from NCGS

2018 UAV Imagery N.C. Geodetic Survey, from NCGS

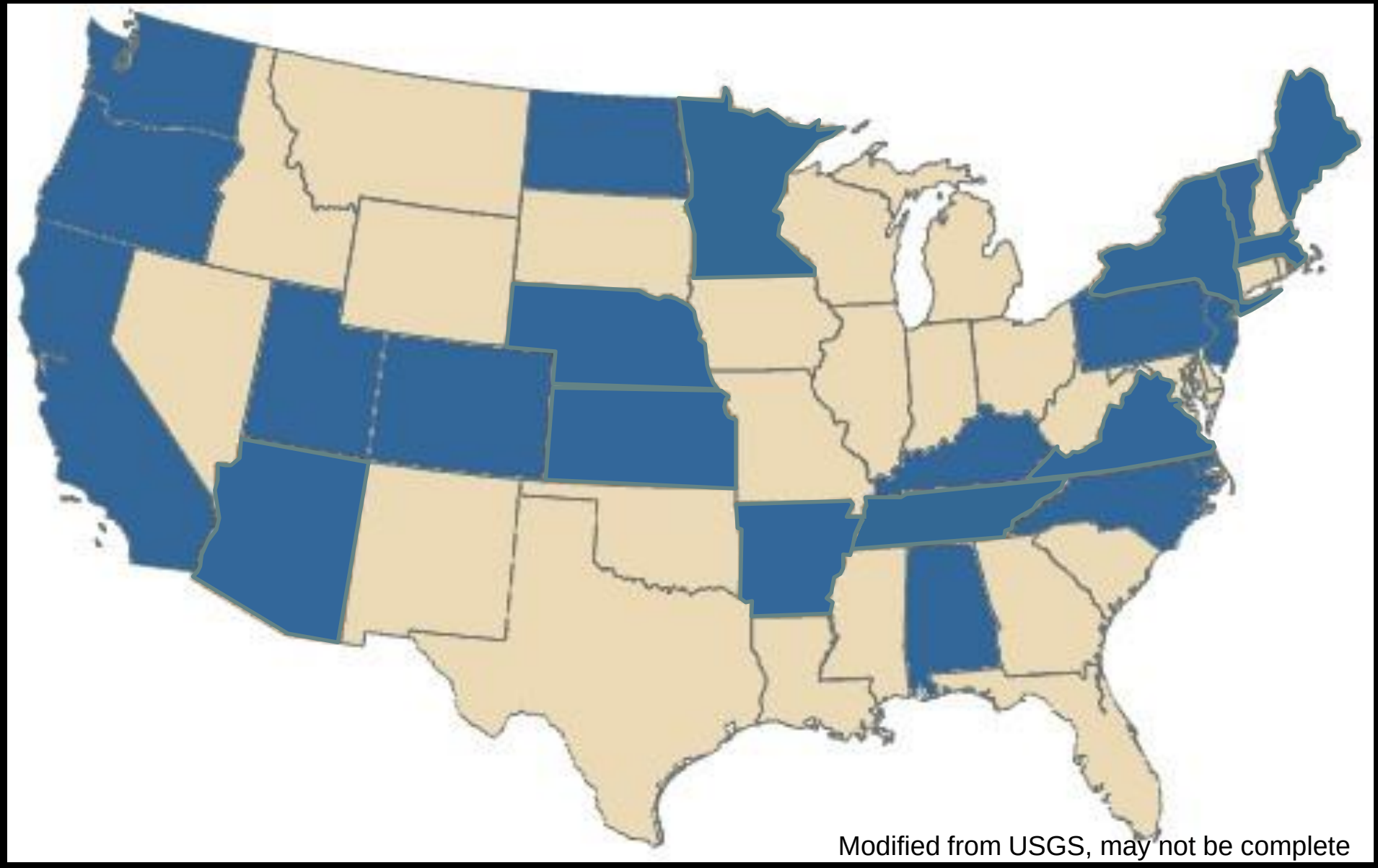
Hwy 176 area

- Polk Co, May 18, 2018
- One fatality
- 6 homes damaged or destroyed
- Multiple debris flows (27)

North Carolina landslide mapping

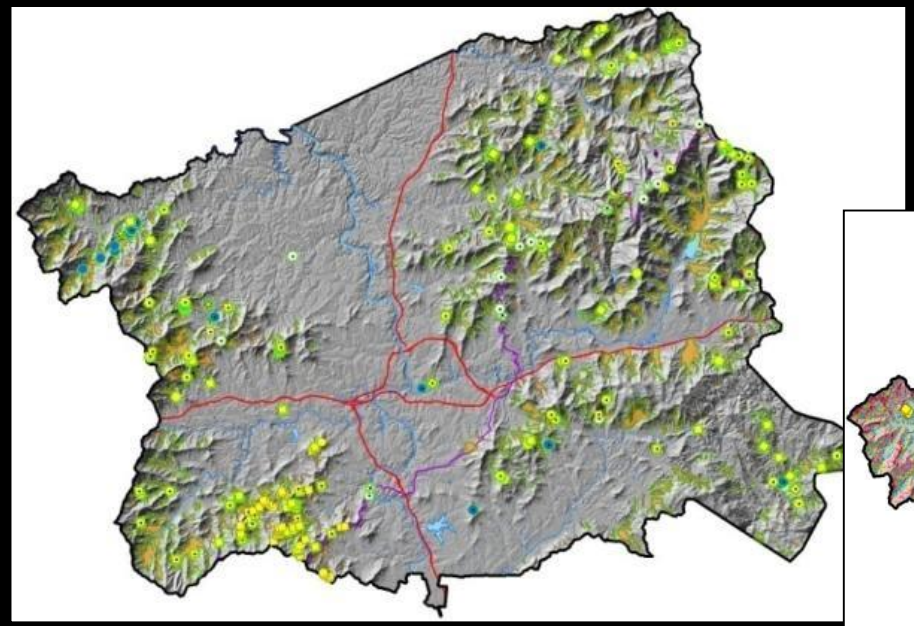


Landslide maps available (portions of the state)

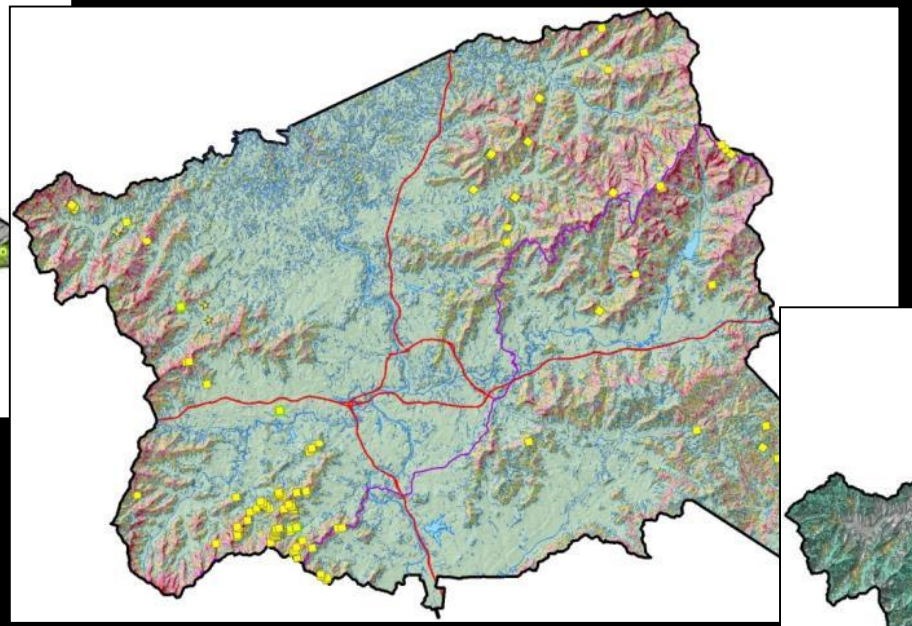


Modified from USGS, may not be complete

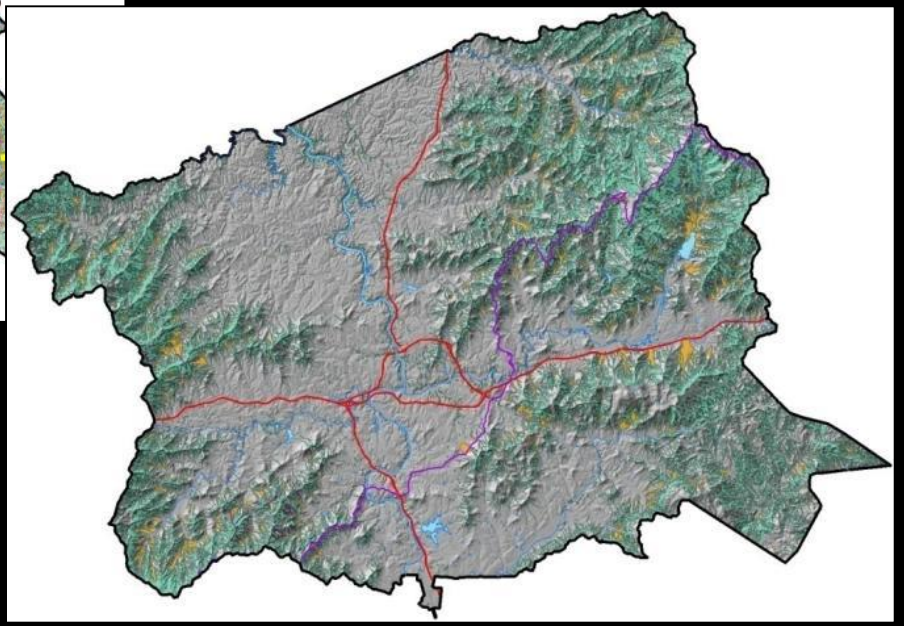
NCGS Landslide Inventory and Susceptibility Maps



Slope Movements –
Slope Movement Deposits Map



Stability Index Map



Potential Debris Flow Pathways Map

ALC

Project components

- Stakeholder outreach throughout
- Secure funding
- Inventory creation
- Susceptibility, hazard, risk modeling
- Map production and distribution
- Stakeholder and public education

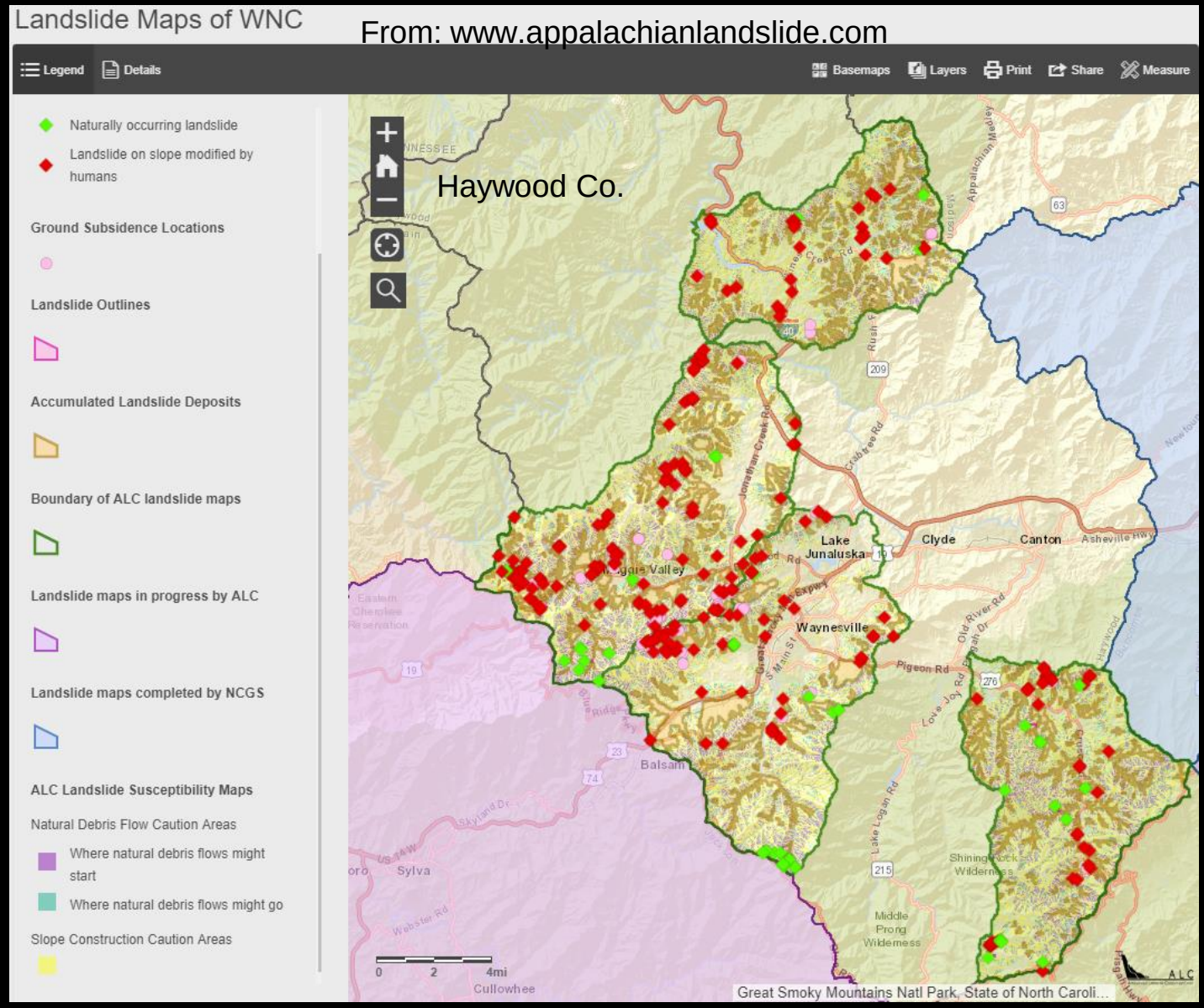
Inventory components

Identify landslide features through:

- Remote sensing
  - Historic air photos
  - Topography – lidar hillshade if available
- Database creation
  - Spatially tied
- Field verification

- Map production and distribution

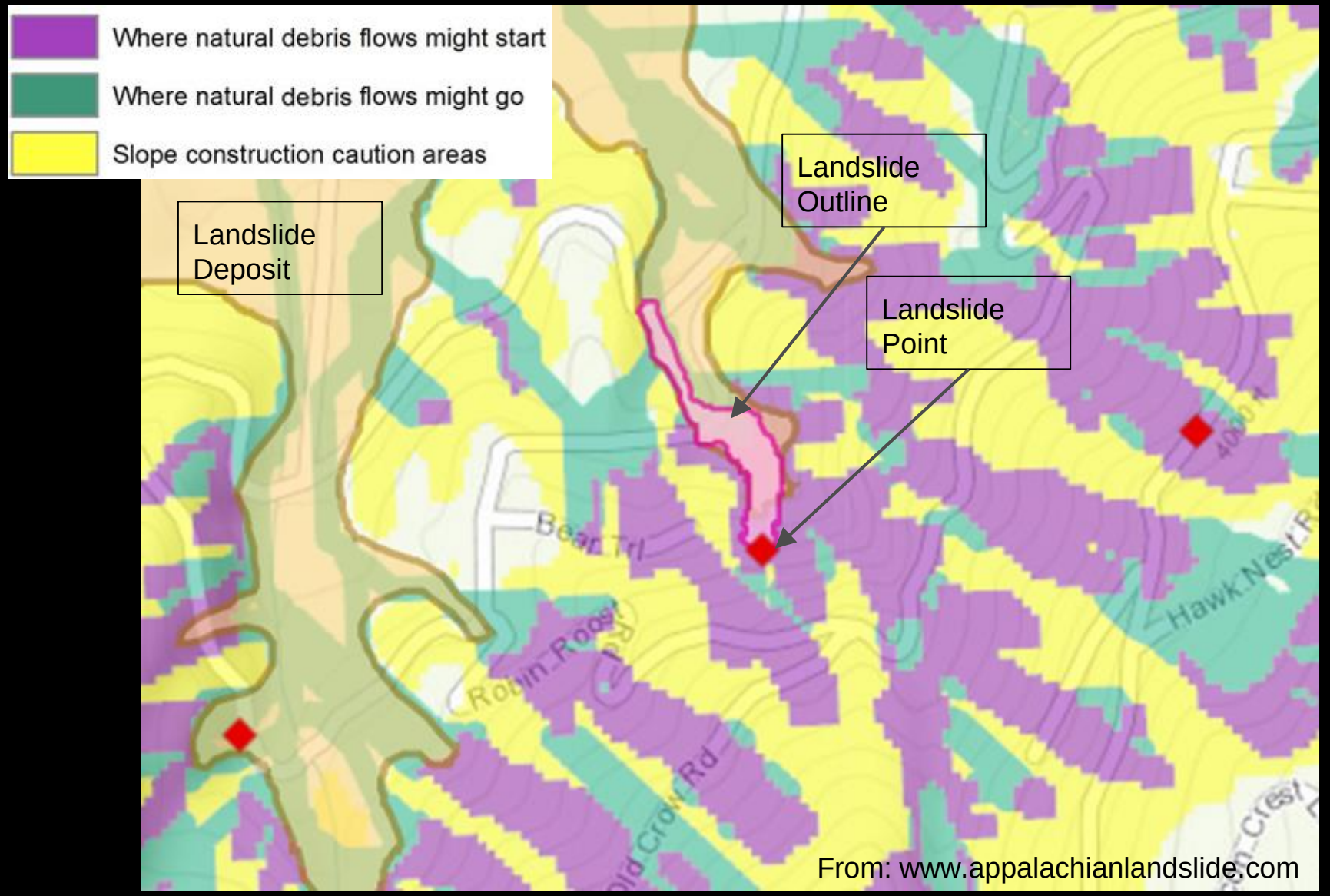
Example Landslide Inventory



Modeling components

- Susceptibility maps
  - Show areas where there is a higher likelihood of landslide occurrence
- Hazard maps
  - Combine with other factors such as rainfall or earthquake probability
- Risk maps
  - Identify structures/infrastructure that could be impacted, define value of impact

Example Landslide Inventory & Susceptibility Maps



Outreach components

- Identify stakeholders
  - Government
  - Emergency Management
  - Weather Service
  - Real Estate Industry
  - Non-profits
  - All affected and all opinions represented
- Pre-project meetings
  - Answer their questions
- Progress reports
  - Throughout project
- Transparent, accessible product

Example Landslide Inventory & Susceptibility Maps

User's Guide

JACKSON COUNTY LANDSLIDE MAPS
QUICK REFERENCE

Online at www.appalachianlandslide.com

LANDSLIDE INVENTORY MAP shows all known landslide features in the area. It is made up of both ancient evidence of past landslides and modern-day landslides.

See page 2 for more details

ACCUMULATED LANDSLIDE DEPOSITS are significant volumes of landslide debris that have accumulated as a result of past landslides. These landslide deposits are made up of loose soil and rock fragments from multiple landslide events of various ages from prehistoric to modern times.

LANDSLIDE LOCATIONS are the locations where known landslides have started. These include all types of landslides: fast/slow, large/small, old/new, active/inactive, rock/soil. These landslides may have started on natural, unmodified ground or from areas modified by humans in the form of road cuts, road embankments, house pads, etc.

LANDSLIDE OUTLINES are the areas affected by relatively recent landslides. Most of these outlines are of debris flow tracks, but some define the extent of active, slow-moving landslides.

GROUND SUBSIDENCE LOCATIONS show signs of potential instability (usually along roads) and are included in the inventory so that action can be taken to prevent landsliding in the future.

LANDSLIDE SUSCEPTIBILITY MAP shows areas that might be more susceptible to landslides during **extreme** rain events.

See page 3 for more details

NATURAL DEBRIS FLOW CAUTION AREAS

WHERE NATURAL DEBRIS FLOWS MIGHT START during extreme rain events. These slopes have similar characteristics to those where natural debris flows have initiated in the past. However, it takes very specific weather conditions to trigger landslides in these areas, therefore the likelihood of occurrence is relatively small. Since these slopes are marginally stable in their natural condition, extra care should be taken when modifying these slopes.

WHERE NATURAL DEBRIS FLOWS MIGHT GO during heavy rainfall events. Debris flows generally flow down existing drainages similar to streams, but they can fan out when they reach less steep ground and impact an area wider than shown here.

SLOPE CONSTRUCTION CAUTION AREAS have greater than 20 degree slope angles (36.4%, 2.7:1), which is the original, pre-construction slope angle where over 97% of landslides on modified slopes have started. Proper evaluation, design, construction, and maintenance of development in these areas are important.

Appalachian Landslide Consultants, PLLC

JACKSON COUNTY LANDSLIDE MAPS
LANDSLIDE INVENTORY GUIDE

The LANDSLIDE INVENTORY MAP shows all known landslide features in the area. It is made up of both ancient evidence of past landslides and modern-day landslides. Use this guide to find out **what it means** and **what to do** if you have a landslide feature on your property.

Is there a Landslide Inventory FEATURE in the area you are interested in?

NO

WHAT DOES IT MEAN?

This means there are not any **known** landslide features in your area. Landslides could have happened after the map was completed or a landslide could have been missed in the mapping effort.

WHAT TO DO?

Now take a look at the LANDSLIDE SUSCEPTIBILITY MAPS. If you still have concerns about the area, contact a **qualified** geologist or geotechnical engineer.

YES

Is it an ACCUMULATED LANDSLIDE DEPOSIT?

This area is made up of landslide debris (usually loose soil and rocks) and has been impacted by landslides in the **distant past**. It means that the mountains upslope have had significant landslide activity in prehistoric times.

Look at the LANDSLIDE SUSCEPTIBILITY MAPS to see if there is landslide potential in the area. **Be careful** when constructing homes, driveways, or roads in landslide deposits because the loose soil and boulders can become unstable when cut into and these deposits often have abundant groundwater and springs.

Is it a LANDSLIDE LOCATION?

There is a **known** landslide in your area. The location of the point is at the starting point or highest point of the landslide. Many of these are relatively small cut slope or fill slope failures, however, even a small landslide can cause major damage.

Look at the information provided with the landslide location to find out more about what is known about this particular landslide. If it is ACTIVE or has a HIGH POTENTIAL for future movement, you might want to contact a **qualified** geologist or geotechnical engineer. Refer to the LANDSLIDE OUTLINE to see the area impacted by this landslide (if available). Also look at the LANDSLIDE SUSCEPTIBILITY MAPS to see if there is additional landslide potential in the area.

Is it a LANDSLIDE OUTLINE?

This is the area impacted by a known landslide. It can range from a narrow debris flow track from a past landslide to a large area affected by a slow moving active landslide. The area impacted is not available for all landslides.

Look at the associated LANDSLIDE LOCATION for more information about the landslide. If you plan on building in this area, it would be a good idea to contact a **qualified** geologist or geotechnical engineer. Also look at the LANDSLIDE SUSCEPTIBILITY MAPS to see if there is additional landslide potential in the area.

Is it a GROUND SUBSIDENCE LOCATION?

This area is showing signs of excessive ground subsidence, meaning the ground has moved downhill a small amount but hasn't failed catastrophically. Subsidence can be an indication that the ground is unstable and could potentially turn into a landslide during a heavy rain event. These locations are usually in road or driveway fill slopes.

These are areas where potential landslides can be **prevented** by maintenance or repair. Make sure road drainage does not flow over these areas and all ditches and culverts are clean. Monitor the area for any signs of continued subsidence and call a **qualified** geologist or geotechnical engineer if you have concerns. Subsidence locations marked with a HIGH POTENTIAL for future movement should be given priority.

Appalachian Landslide Consultants, PLLC

Continued Conversation

Summary

Thank you!

presented by
Jennifer Bauer, LG
Appalachian Landslide Consultants, PLLC
jennifer@appalachianlandslide.com
(828) 209-8642