West Virginia GIS Technical Center
West Virginia University
Department of Geology and Geography | Eberly College of Arts and Sciences

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SUBJECT: 2022-23 Cooperating Technical Partners (CTP) Grant Progress Report (Oct. 1 – Dec. 31, 2022)

Dear Tim,

Below is a progress report of both the Program Management (PM) and Community Outreach and Mitigation Strategies (COMS) activities for the first quarter of the 2022-23 FEMA Cooperating Technical Partners (CTP) grant. Refer to the Statement of Work documents for more details about the activities.

PM Activities:

- **[TASK 1] Comprehensive State Business Plan** (PM and COMS). PROGRESS: Conducted preliminary discussions with State NFIP Coordinator Tim Keaton about content for Business Plan.

- **[TASK 2] Pre-Disaster Planning: Upload BLRA into SDE Tool.** Preload At-Risk Buildings from Statewide Flood Risk Assessment into FEMA's Substantial Damage Estimator Tool. PROGRESS: Preparing notification to WV Flood Listserv about updating floodplain structures into FEMA's SDE Tool.

- **[TASK 3] FEMA Restudies: Local Outreach about Flood Map Changes.** Communicate SFHA Map Changes to Affected Property Owners. PROGRESS: Preparing notification for WV Flood Listserv. Targeted outreach to communities undergoing flood restudies in which Preliminary NFHL published.

- **[TASK 4] LiDAR LOMAs on WV Flood Tool.** Promote LiDAR LOMAs Print Function on the WV Flood Tool. PROGRESS: In the process of updating the LiDAR LOMA training resources.
  Instructions | Overview Slides and Guide

- **[TASK 5] Community Audits of Minus Rated Structures.** Community outreach and documentation of minus-rated structures. Estimate 98,467 structures in high risk flood zones. Document mitigation status of Post-FIRM structures. PROGRESS: Setting up procedures for engaging flood-prone communities with Post-FIRM buildings with a Minus 3 Rating (lowest floor 3 or more feet below the BFE).

- **[TASK 6] Community Risk Profiles.** Develop and Verify Community Flood Risk Profiles. PROGRESS: Identifying key risk factors to display in community profiles. Detailed community profiles (flood characteristics, vulnerability indicators, and mitigation measures) were developed for Rainelle and White Sulphur Springs, Greenbrier County, WV, in support of COMS Special Project 1.

- **[TASK 7] Model Mitigation Measures.** Model Potential Mitigation Measures and Communicate to Communities. PROGRESS: Building flood adaptation models will be performed after the completion of new Building-Level Risk Assessments for Kanawha County. Flood inundation type and foundation are principal model inputs.

- **[TASK 8] Areas of Mitigation Interest.** Engage Communities to Validate Areas of Mitigation (AoMI) on WV Flood Tool. PROGRESS: This mitigation activity will correlate with outreach activities associated with courtesy floodplain management audits associated with PM Task 5 and COMS Task 1.

- **[Task A] WV Flood Tool**. Global outreach services that include updating the WV Flood Tool with new flood map products/reference layers. PROGRESS: New flood layers and building risk assessment layers were updated to the WV Flood Tool. Updates included Preliminary NFHL (Monroe, Summers) and Draft NFHL (Pocahontas); and map status graphics for FEMA Restudies and AFH. Migrating WV Flood Tool to new hardware and software network system. Created 3D visuals of mitigated closed and open foundations for display on Flood Tool.

- **[TASK B] Building Footprints and Building-Level Risk Assessments (BLRA).** WV BLRA integration with FEMA's USA structures program. PROGRESS: Completed building footprints for 30 counties. Nine counties are in progress. Building footprints are an important reference layer for flood-prone building inventories and flood visualizations.

- **[TASK C] Transportation Inundation Models.** Enhance transportation flood inundation models for roads, railroads, and bridges. PROGRESS: All the bridge inundation points for a 1% annual chance flood event were checked with the new FEMA elevation data. Road inundation models, statistics, and inundation models were updated for Greenbrier County. U.S. 60 is adversely affected by flooding in this county.

COMS Activities:

- **[SPECIAL PROJECT 1] Community Flood Impact Studies**. Map Riverine Flood Impacts of Vulnerably Disadvantaged Communities with Higher Stream Flow Change Forecast Models. PROGRESS: Completed detailed data analyses for Rainelle and White Sulphur Springs (Greenbrier Study products). 3D viewshed and building-level images created for study. Greenbrier Study summary report in progress. Proceeding with detailed flood impact studies of Camden-on-Gauley (Webster) Clendenin (Kanawha), and Richwood (Nicholas).

- **[SPECIAL PROJECT 2] Update BLRA.** Update the WV Building Level Risk Assessment (BLRA) from New Data Sources (e.g., Flood Studies, Building Characteristics). PROGRESS: Updated building-level risk assessments for Greenbrier, Hardy, Pocahontas, Monroe, McDowell, and Summers counties. In progress are Kanawha, Nicholas, and Webster counties. There are an estimated 98,467 structures in high risk flood zones

- **[SPECIAL PROJECT 3] Landslide Incident Mapping and Risk Assessments.** Map Landslide Incidents from the New FEMA LiDAR for 38 Counties. Correlate Climate Change (Precipitation) to Higher Landslide Incidents. PROGRESS: More than 30,000 landslide points have been mapped from the new lidar. To date, 102,500 landslide incidence points have been mapped from the new FEMA 1m elevation data. Review of Jackson, Roane, Calhoun, Upshur and Randolph counties still needed.

Supplemental Information on COMS Special Project 1: Community Flood Impact Studies

Supplemental Information about activity Community Flood Impact Studies. Below are slide extracts from FEMA's Region 3 Coffee Break Presentation on November 23 about "Utilizing University Partnerships in Hazard Mitigation Planning." These slides highlight the flood risk assessment findings presented to community focus group meetings for the towns of Rainelle and White Sulphur Springs, Greenbrier County, WV. The COMS1 project also partnerships with an NSF Civic Innovation Challenge (CIVIC) grant.

COMS Task 1: Community Hazard Planning (Focus Group Meetings)

White Sulphur Springs, WV (11/17/2022)

Rainelle, WV (11/18/2022)

- Feedback desired from Focus Groups:
  - What lessons were learned from the immediate response and longer-term recovery from the 2016 flood?
  - What priorities are needed for a stronger flood response and recovery plan in the event of a future flood?

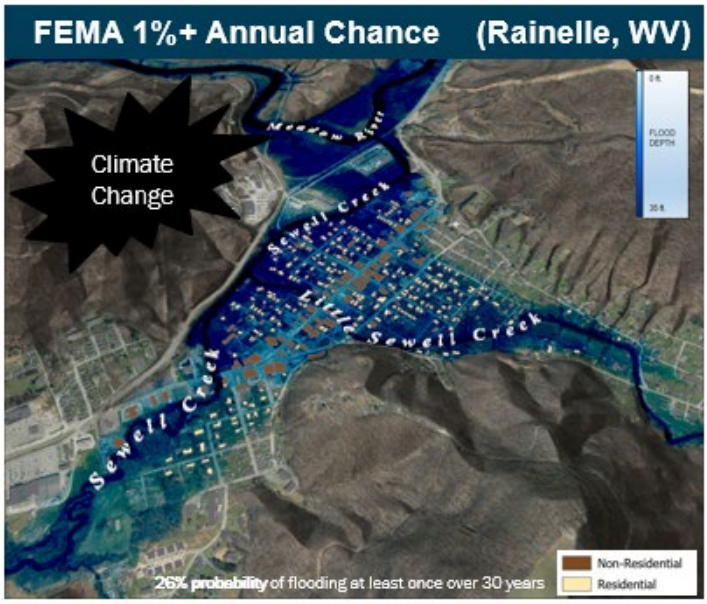
- Feedback of Flood Study Products:
  - Flood Characteristics and Models
  - Flood Risk Assessment (vulnerability, exposure, loss)
  - Mitigation Maps
  - Flood Visualization Tools

FEMA

This partnership example with other university faculty highlights social scientist Jamie Shinn's National Science Foundation research about the recovery and resiliency of two small communities in Greenbrier County – White Sulphur Springs and Rainelle – that were devastated by the 2016 flood. This research also supports a Community Outreach and Mitigation Strategies (COMS) project sponsored by FEMA Region III and the State Emergency Management Division to evaluate how various flood protection measures like mitigation reconstruction will adapt to the future impacts of climate change.

In November 2022, focus group meetings were led by Professor Shinn for these two communities to assess lessons learned from the 2016 flood and to identify ways to build resilience to future floods. The WV GIS Technical Center provided support by quantifying various risk factors facing these disadvantaged communities. This included presenting flood characteristics and new flood maps, vulnerability analysis, and quantifying mitigation measures implemented to date.

Community Hazard Planning (Flood Characteristics)



Category	Flood Characteristic (in context to 2016 Flood)	White Sulphur Springs	Rainelle
Frequency (new flood maps)	Probability that a flood of a specific size will be equaled or exceeded in any given year. FEMA Flood Models (new): 10-, 25-, 50-, 100-, 100+, and 500-year flood elevations. First Street Foundation Flood Models: 5-, 20-, 100-, and 500-year flood elevations.	2016 Flood Between 100- and 500-year FEMA Climate BFE+6ft FSF Climate 2052 or 30 years in the future	2016 Flood Between 100- and 500-year FEMA Climate BFE+1ft FSF Climate 2052 or 30 years in the future
Depth	Flood depth. Source USGS high-water marks	6 feet	8 feet
Velocity	Speed at which the floodwaters are flowing	High	Moderate
Duration	Measure of how long water remains above normal levels	24 hours	72 hours
Rise and Fall	Floodwater that rises very quickly with little or no warning	Quick Rise	Quick Rise

New flood maps and flood characteristics were presented at the community meetings in the context of the 2016 flood. The community of Rainelle is vulnerable to higher flood depths for an extended period of time, while White Sulphur Springs is subject to greater flood velocity flows that rise and fall quickly. Incorporated into the riverine flood analysis are climate change models that show an anticipated increase in flooding over time.

Community Hazard Planning (Risk Indicators)

Social Vulnerability Indicators
White Sulphur Springs and Rainelle

Vulnerability Indicators	White Sulphur Springs	Rainelle	State Ratio	National Ratio
Poverty Rate	14.4%	37.0%	17.3%	12.9%
Unemployment Rate	21.4%	33.6%	23.8%	14.7%
Vulnerable Ages Ratio	41.7%	39.8%	30.8%	28.3%
Disability Ratio	17.8%	26.9%	18.7%	13.0%
Population Growth Ratio	-9.1%	-20.9%	-3.2%	7.4%
Renter-Occupied Ratio	42.8%	43.0%	26.8%	36.0%
Housing Values Less than $50K	3.9%	37.5%	16.9%	6.6%
Housing Median Value	$125,700	$59,400	$119,600	$229,800

The red texts show more than 5% of difference, to the vulnerability side, from the state ratios.

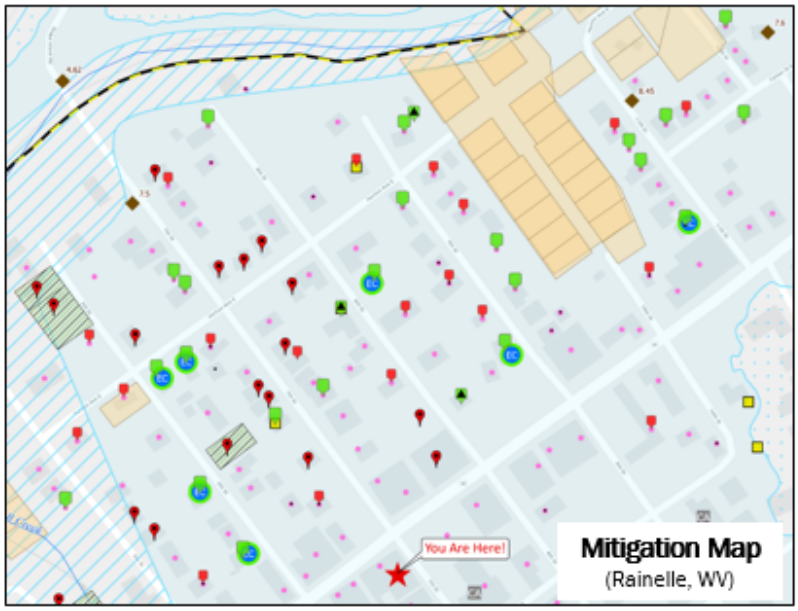
Building/Parcel Exposure
White Sulphur Springs and Rainelle

Category	Exposure Indicator	White Sulphur Springs	Rainelle	Ratio* in WV Incorporated Areas (2021)
Buildings by Flood Zone (Count & Value)	Total Primary Building Count in Floodplain	423 (Rank***: 12th)	338 (Rank: 18th)	59 (Median)
	Building Ratio b/w Floodplain & Community Total	26%	34%	9%
	Total Primary Building Value in Floodplain of Community	$40,881K (Rank: 16th)	$16,120K	$6,417K (Median)
	Median Building Value in Floodplain	$49K	$38K	$42K
	Building Count in Floodway** (High Velocity)	65 (Rank: 11th)	9	12 (Avg.)
	Percent Building Count in Floodway** (High Velocity & Depth)	15%	3%	8%
	New Maps: Bldgs. "Mapped In" SFHA	72 (Rank: 12th)	329 (Rank: 3rd)	19 (Avg.)
	New Maps: Bldgs. % Count "Mapped In" SFHA	17%	97%	14%
	New Maps: Bldgs. "Mapped Out" SFHA	118 (Rank: 8th)	0	19 (Avg.)
	New Maps: Bldgs. % Count "Mapped Out" SFHA	28%	0%	14%

Vulnerability, ***Exposure***, and Hazus ***Loss*** Indicators
for the disadvantaged communities of Rainelle and White Sulphur Springs

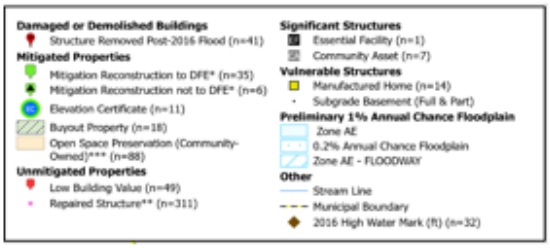
Social vulnerability, exposure, and loss estimates were presented at the community meetings. Risk indicators of special concern are signified by red text, contrasted with state and national statistics, and the rationale explained on why particular risk factors make the community more vulnerable to flood hazards.

Community Hazard Planning (Mitigation Measures)



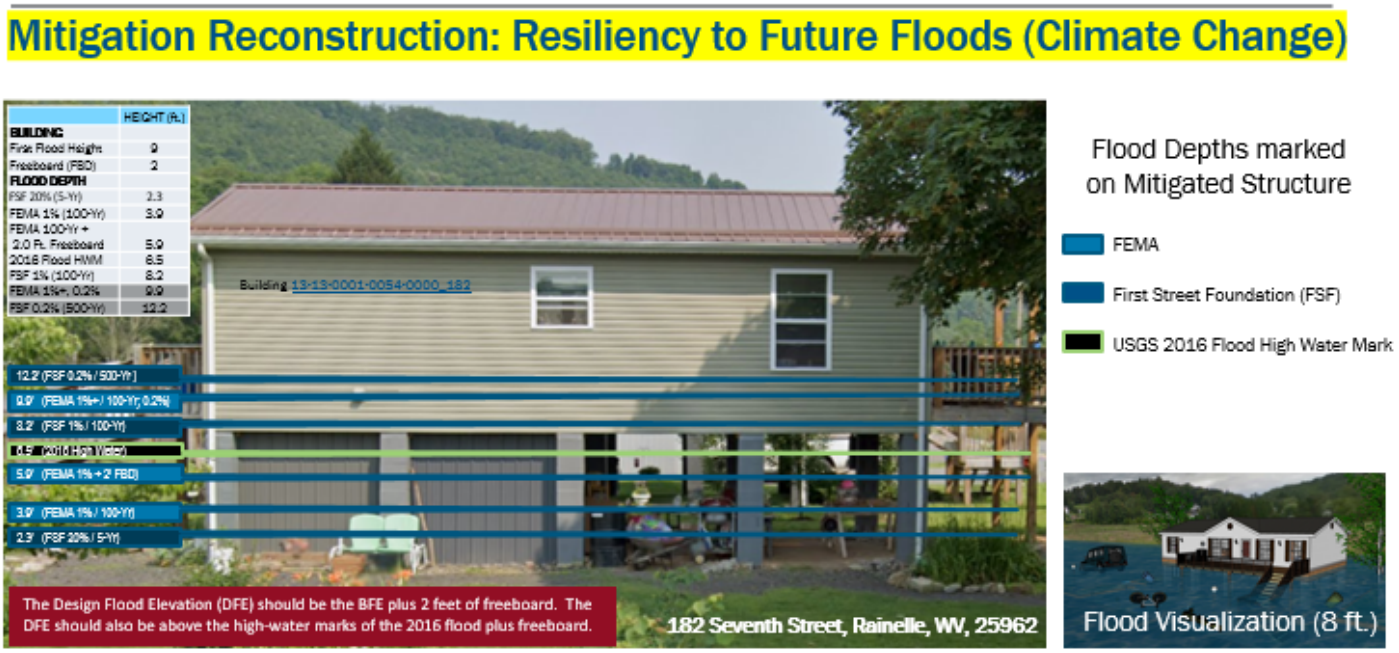
Mitigation Measures

Category	Mitigation Indicator	White Sulphur Springs	Rainelle
Mitigated Structures	Mitigation Reconstruction or Elevated Structures to Design Flood Elevation (DFE)	15	45
	Rehabilitated/Repaired Structures	394	278
	Unmitigated Low Value Structures	14	49
	Structures Removed (vacant parcel)	394	278
Open Space Preservation	Buyout Parcels (Deed Restricted)	16	18
	Community-Owned Vacant Parcels	66	88
	Area of Open Space Preservation (OSP)	5 Acres	3 Acres
	Ratio of Open Space Preservation (OSP to SFHA)	2.6%	4.5%
Building Value Recovery	Net Value 2016-2022 Tax Assessment Value	+ $6.1 Million	- $1.0 Million
Loss Avoidance 100-year Flood	Loss Avoidance by Elevating or Removing Structures (preliminary results)	$2.6 million	$2.3 million



Field verification and analysis of mitigation measures implemented by property owners and the community in context of the 2016 flood and local floodplain management regulations

Mitigated measures implemented since the 2016 flood by the community were field verified and evaluated in accordance with the local floodplain management regulations. Field verification of both communities show that for most mitigation reconstruction projects, the new structures were built to the proper design flood elevations. However, field surveys shows that substantially damaged residential structures were often repaired but not elevated above the base flood elevation, and thus in violation of FEMA's 50% Rule. To measure a community's recovery and resiliency to future floods, the net cumulative tax assessment of floodplain building values pre- and post-disaster, along with loss avoidance studies of elevated structures and property buyouts, were calculated.



How well are mitigated structures protected from changing environmental factors due to climate change? The new FEMA flood maps for Rainelle reveal that the mitigated structure above is a risk for the 1%+ (100-yr) and 0.2-percent chance (500-yr) floods.

Both the findings and community feedback from this Greenbrier flood study project will be published in a report and submitted to the state and FEMA. This includes determining how well mitigated structures are protected from the impacts of climate change. Flood visualizations can be used to portray how protection measures like mitigation reconstruction will adapt to the future impacts of climate change.

In summary, partnerships among faculty members expand the subject matter expertise for hazard mitigation planning. Without support from other academic partners at West Virginia University and other institutions, the scope of activities and accomplishments for various hazard mitigation projects would not be possible.

APPENDIX A: WVU Progress Tables for Cooperating Technical Partners (CTP) FY22 Grant.

Table 1. WV NFIP Program Management Tasks spearheaded by State NFIP Office and supported by WVU GIS Technical Center. Yellow highlighted tasks support NSF/CIVIC project.

WV NFIP PM TASKS: 8 focused PM activities spearheaded by State NFIP Office. Support from WVU GIS Technical Center to WV Emergency Management Division.	**Task #**	**Amount**	**WVU Staff supporting State NFIP Cadre**	**Progress**
Comprehensive State Business Plan (PM and COMS)	1	5,000	Kurt and Tim Keaton, State NFIP Coordinator	Conducted preliminary discussions with NFIP Coordinator Tim Keaton about content for Business Plan.
Pre-Disaster Planning: Upload BLRA into SDE Tool. Preload At-Risk Buildings from Statewide Flood Risk Assessment into FEMA's Substantial Damage Estimator Tool	2	5,000	Annie	Preparing notification to WV Flood Listserv about updating floodplain structures into FEMA's SDE Tool.
FEMA Restudies: Local Outreach about Flood Map Changes. Communicate SFHA Map Changes to Affected Property Owners	3	5,000	Behrang	Preparing notification for WV Flood Listserv. Targeted outreach to communities undergoing flood restudies in which Preliminary NFHL published.
LiDAR LOMAs on WV Flood Tool. Promote LiDAR LOMAs Print Function on the WV Flood Tool	4	5,000	Eric, Shannon	In the process of updating the LiDAR LOMA training resources. Instructions | Overview Slides and Guide
Community Audits of Minus Rated Structures. Community outreach and documentation of minus-rated structures.	**5**	15,000	Eric, Shannon	Setting up procedures for engaging flood-prone communities with Post-FIRM buildings with a Minus 3 Rating (lowest floor 3 or more feet below the BFE).
Community Risk Profiles. Develop and Verify Community Flood Risk Profiles	**6**	10,000	Behrang, Annie	Identifying key risk factors to display in community profiles. Detailed community profiles (flood characteristics, vulnerability indicators, and mitigation measures) were developed for Rainelle and White Sulphur Springs in support of COMS Special Project 1.
Model Mitigation Measures. Model Potential Mitigation Measures and Communicate to Communities	7	10,000	Sara, Shannon	Building flood adaptation models will be performed after the completion of new Building-Level Risk Assessments for Kanawha County. Flood inundation type and foundation are principal model inputs.
Areas of Mitigation Interest. Engage Communities to Validate Areas of Mitigation (AoMI) on WV Flood Tool	8	15,000	Shannon, Eric, Behrang, Annie	This mitigation activity will correlate with outreach activities associated with courtesy floodplain management audits associated with PM Task 5 and COMS Task 1.
PM Funding - State NFIP Led		*$70,000*		

Note: Refer to Statement of Work documents for more detailed information about Program Management (PM) and Community Outreach and Mitigation Strategies (COMS) activities.

Table 2. WVU-Led CTP Program Management (PM) Tasks. Floodplain Management and Mitigation Tasks program management tasks supported by the WVU GIS Technical Center. Yellow highlighted tasks support NSF/CIVIC project.

WVU Led NFIP PM TASKS: 3 primarily led by WVU staff focused PM activities primarily led by WVU staff	Task #	Amount	WVU Staff	Progress
WV Flood Tool. Global outreach services that include updating the WV Flood Tool with new flood map products/reference layers	**Task A**	155,000	All WVU staff	New flood layers and building risk assessment layers were updated to the WV Flood Tool. Updates included Preliminary NFHL (Monroe, Summers) and Draft NFHL (Pocahontas); and map status graphics for FEMA Restudies and AFH. Migrating WV Flood Tool to new hardware and software network system. Created 3D visuals of mitigated closed and open foundations for display on Flood Tool.
Building Footprints and Building-Level Risk Assessments (BLRA). WV BLRA integration with FEMA's USA structures program	**Task B**	15,000	Shannon, Sam	Completed building footprints for 30 counties. Nine counties are in progress. Building footprints are an important reference layer for flood-prone building inventories and flood visualizations.
Transportation Inundation Models. Enhance transportation flood inundation models for roads, railroads, and bridges.	**Task C**	10,000	Sara, Meagan	All the bridge inundation points for a 1% annual chance flood event were checked with the new FEMA elevation data. Road inundation models, statistics, and inundation models were updated for Greenbrier County. U.S. 60 is adversely affected by flooding in this county.
PM Funding – WVU Led		*$180,000*		

Table 3. WVU-Led COMS Tasks. Community Outreach and Mitigation Strategies (COMS) activities supported by WVU GIS Technical Center. Yellow highlighted tasks support NSF/CIVIC project.

WV COMS TASKS: Special projects performed by WV GIS Technical Center.	Task #	Amount	WVU Staff	Progress
Community Flood Impact Studies. Map Riverine Flood Impacts of Vulnerably Disadvantaged Communities with Higher Stream Flow Change Forecast Models.	Special Project 1	50,000	All WVU Staff	Completed detailed data analyses for Rainelle and White Sulphur Springs (Greenbrier Study products). 3D viewshed and building-level images created for study. Greenbrier Study summary report in progress. Proceeding with detailed flood impact studies of Camden-on-Gauley (Webster) Clendenin (Kanawha), and Richwood (Nicholas).
Update BLRA. Update the WV Building Level Risk Assessment (BLRA) from New Data Sources (e.g., Flood Studies, Building Characteristics).	Special Project 2	35,000	Sara, Meagan, Behrang	Updated building-level risk assessments for Greenbrier, Hardy, Pocahontas, Monroe, McDowell, and Summers counties. In progress are Kanawha, Nicholas, and Webster counties. There are an estimated 98,467 structures in high risk flood zones
Landslide Incident Mapping and Risk Assessments. Map Landslide Incidents from the New FEMA LiDAR for 38 Counties. Correlate Climate Change (Precipitation) to Higher Landslide Incidents.	Special Project 3	15,000	Sam Bower, Shannon	More than 30,000 landslide points have been mapped from the new lidar. To date, 102,500 landslide incidence points have been mapped from the new FEMA 1m elevation data. Review of Jackson, Roane, Calhoun, Upshur and Randolph counties still needed.
COMS Special Project Funding – WVU Led		$100,000		

Please contact me if you have any questions.

Sincerely,

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