V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change, Environmental Quality and Stewardship

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources			15%	
102	Soil, Plant, Water, Nutrient Relationships			10%	
112	Watershed Protection and Management			15%	
132	Weather and Climate			15%	
133	Pollution Prevention and Mitigation			15%	
135	Aquatic and Terrestrial Wildlife			20%	
605	Natural Resource and Environmental Economics			10%	
	Total			100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.0	0.0
Actual Paid Professional	0.0	0.0	10.1	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	454248	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	1156043	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	1314947	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research to assist in the preservation of West Virginia's soil, water, forest and wildlife resources is a high priority in the West Virginia Experiment Station particularly given the extra stresses and uncertainty imposed by a changing climate. The focus of Station research is on studying, protecting and restoring environmental quality while developing economically effective and environmentally sustainable management practices for agriculture, forestry, mining and rural communities and anticipating and adapting to climate change. Our primary environmental research areas involve mine land restoration, soil science, ecosystem resiliency to climate change and other environmental stressors, water quality, wetlands, and aquatic and terrestrial wildlife ecology.

Contamination of soil and water with acid mine drainage from abandoned surface and underground mines and restoration of the landscape from surface mining are important issues in West Virginia. Research is being conducted to characterize the nature and scope of these problems and to develop cost effective remediation programs. Relevant research projects include restoring surface mines to productive forestland or grassland (including switchgrass as a possible feedstock for biofuels) and restoring lost aquatic ecosystem functions on reclaimed mine sites and watersheds. Progress continues in assessing the ecological functions of restored and created wetlands.

One project involved a study of amphibians in 12 mitigated and 12 natural wetlands in order to gauge whether mitigated wetlands are functionally equivalent to natural wetlands. This is an extremely important scientific and policy issue because many wetlands have been drained for development and federal law requires that any new development of wetlands be balanced by equivalent constructed wetlands. Wetlands are extremely important because of their ecological roles providing habitat, buffering rainfall events to reduce flooding and serving as nutrient and pollution sinks. The investigator has determined that, based on the diet composition and use and selection of prey by adult red-spotted newts, created wetlands provide an adequate prey base for generalist amphibian predators. Based on similar abundance of spring peeper and green frog metamorphs in created and natural wetlands, he also provided evidence for the assertion that created wetlands are functional replacements of natural wetlands with respect to wildlife habitat.

Negative impacts to headwater catchments resulting from large scale surface mining are pervasive in West Virginia. The state's mitigation program is critical to ensuring the restoration and maintenance of essential headwater functions such as flood mitigation, provision of clean water, and supplying food, nutrients, and energy to downstream fisheries. A recently completed study quantified the ecological benefits of the current stream mitigation process. This allowed the investigator to identify shortcomings in the current process and recommend changes that will ensure a maximally beneficial process. They are

now working to integrate this information into a spatially explicit modeling system that will allow state agencies, federal agencies, and industry partners to identify priorities for restoration and design strategic stream mitigation plans. Results from this research are being used to develop a state-wide stream mitigation trading and banking program based on functional stream ecosystem values. The results also are being integrated into a state-wide process to maximize stream restoration effectiveness in mined watersheds. The research team made almost 50+ presentations to state agencies, federal agencies, industry partners and conservation stakeholder groups from 2008-2012. Most notably, the team has attracted several additional complementary research projects totaling over $1 million in research grants from state, federal, and industry partners, thus highly leveraging their use of federal capacity funding.

Mountaintop removal mining is a dominant driver of land use/land cover changes in the Appalachian Region of the Eastern United States and is expected to increase in scale in the coming decades. While several studies quantify land use/land cover changes attributed to traditional surface mining and at regional scales, no studies focus specifically on mountaintop removal/valley fill mining practices at the watershed scale. Two studies were conducted to explore the impacts of mountaintop removal mining at the basin scale and the headwater scale. For the basin scale study, no statistically significant trends were detected in any of the time series. However, the headwater scale study, using simple hydrometric data and transfer function rainfall-runoff modeling a clear pattern was detected. The mined catchment has a higher magnitude response to rain events in terms of total specific discharge and peak specific discharge than the forested catchment. More rainfall is being converted to streamflow in the mined catchment and the event response is more rapid in the mined catchment as demonstrated by the time lag between peak precipitation and peak discharge and response time modeling. Analysis of the transfer functions used to describe catchment processes suggests that this more rapid response is being controlled by a rapid draining of a fast responding reservoir.

Several pathogens of man may be transmitted through contaminated drinking water. Primary pathogens such as those causing dysentery, cholera, shigellosis and typhoid fever are of major concern in developing counties where water and wastewater treatment are lacking or minimal. However, more attention has been directed recently to the role of opportunistic pathogens in causing waterborne disease, especially in developed countries despite the use of apparent adequate drinking water treatment. One project is focused on Cronobacter (Enterobacter) sakazakii, a pathogen most frequently associated with contaminated infant formula. Possibly, C. sakazakii may gain access to the powdered infant formula through the use of contaminated water used to reconstitute the liquid formula. Since relatively little is known about the ecology of this pathogen, the investigators are especially interested in the ability of C. sakazakii to respond to natural and artificial stressors the bacterium may encounter (survival in aquatic environments such as ground water, response to disinfection processes, efficiency of laboratory recovery methods, sensitivity to antibiotics following environmental stress, e.g.). Current efforts are centered on an examination of the response of C. sakazakii to a combination of low temperature and nutrient deprivation, a situation that may occur in cold-temperature groundwater environments. An understanding of the physiological response of C. sakazakii to such environmental stresses should be of assistance in the assessment of the ecology and distribution of this opportunistic pathogen in aquatic environments. Although observations are somewhat preliminary in nature at this point, findings will be shared with federal, state, and local agencies involved with the evaluation and regulation of water quality.Public health officials and regulatory agencies involved in policy decisions regarding water quality will be better informed about the significance of C. sakazakii as a potential waterborne pathogen.

At the request of USDA-ERS, a modified version of the Intergovernmental Panel on Climate Change model was used to estimate the change in soil carbon storage when land is removed from the Conservation Reserve Program (CRP) and returned to crop production. The model was not initially written to account for changes from CRP to another land use because land enrolled in the CRP was assumed to remain in the CRP. Therefore, equations needed to be adjusted to account for a change in land use that may generate lower soil carbon accumulation or, in the case of the CRP, losses in the soil carbon that was

increased under the previous land use. The model has now been updated to account for land use changes from CRP to crop rotations that may reduce the amount of stored carbon. The results of this analysis have been provided to USDA-ERS for review. The results of this project will be used to provide an assessment of the costs of crop and land management activities that could be implemented to increase the amount of carbon stored in agricultural soils. This information, combined with estimates of the biophysical potential for agricultural lands to sequester carbon will aid in determining appropriate policy and legislation activities to address issues of global concern.

Another investigator continued research on the conservation genetics of fish and wildlife populations. This year's work examined the genetic effects of lake sturgeon stocking. The results of the study demonstrated that multiple years of stocking is necessary to adequately represent the genetic diversity of the source population. Also, the number of released offspring and family sizes need to be equalized across years in order to maximize the effective population size.

2. Brief description of the target audience

The activities in this area are used to contribute to the body of knowledge in the environmental and natural sciences, and to inform policy makers, planners, regulatory agencies and public interest and citizens groups.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2012

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	15	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Presentations on research at professional meetings

Year	Actual
2012	8

Output #2

Output Measure

- Popular press articles on research

Year	Actual
2012	1

Output #3

Output Measure

- Completed graduate degree programs

Year	Actual
2012	15

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Reduce percentage of state streams classified as impaired by agricultural and forestry activities (%).
2	Number of State landowners adopting reclamation and watershed protection practices in consultation with Experiment Station Faculty.

Outcome #1

1. Outcome Measures

Reduce percentage of state streams classified as impaired by agricultural and forestry activities (%).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
As reported under goal 1, recreational fishing is an important state industry. In addition, impaired streams reduce water quality to communities that draw their drinking water from streams and can lead to increased flooding. Wetlands are often important contributors to stream health and quality of aquatic ecosystems.

What has been done
We have been working with the State Department of Natural Resources (DNR) to examine ways to improve the upper reaches of streams, both in terms of replanting trees around streams that had been removed in past forestry operations and restoring stream structure to create pools for trout and other species and to slow waterflow in storm events to reduce downstream flooding. Two streams are being restored now, Upper Shavers Fork, part of the Cheat River system and the upper reaches of the Cranberry River. Both formerly had native populations of trout before forestry operaitons and mining damaged the rivers. Another study has examined the effectiveness of constructed wetlands in replacing the ecological services of damaged or converted wetlands.

Results
So far the results of the stream restoration efforts have appeared to be positive. It will take time to evaluate the changes as trees around the streams grow to provide a better canopy to reduce stream temperatures and as species repopulate the habitat. We are undertaking a three year evaluation of the projects from an ecological and economic perspective.

The wetlands study has determined that, based on the diet composition and use and selection of prey by adult red-spotted newts, created wetlands provide an adequate prey base for generalist amphibian predators. Based on similar abundance of spring peeper and green frog metamorphs in created and natural wetlands, it also provided evidence for the assertion that created wetlands

are functional replacements of natural wetlands with respect to wildlife habitat.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Number of State landowners adopting reclamation and watershed protection practices in consultation with Experiment Station Faculty.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

This year evaluation consisted of annual evaluation of short term impacts as documented in Outputs and State Defined Outputs and Outcomes. As described in the plan of work, we will be developing a longer term program specific evaluation process in conjunction with our College Visiting Committee. This process and the timetable for evaluaiton will be determined at our Spring 2013 Visiting Committee Meeting.

Key Items of Evaluation

A group of researchers, research administrators and program leaders from the Department of Natural Resources met to evaluate our stream restoration efforts, our aquatic ecology efforts and our economic analyses of the benefits of stream restoration. While the agency was happy with each of the individual areas of research we determined that it would be better if the different disciplines worked together rather than separately. That discussion led to the decision to undertake a three year study that simultaneously examined the joint effects of stream restoration on stream ecology and economic benefits and costs.