

**V(A). Planned Program (Summary)**

**Program # 2**

**1. Name of the Planned Program**

Soil, Water and Natural Resources

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	1%		15%	
102	Soil, Plant, Water, Nutrient Relationships	20%		12%	
111	Conservation and Efficient Use of Water	11%		12%	
112	Watershed Protection and Management	15%		10%	
123	Management and Sustainability of Forest Resources	7%		5%	
131	Alternative Uses of Land	15%		6%	
132	Weather and Climate	4%		10%	
133	Pollution Prevention and Mitigation	10%		12%	
134	Outdoor Recreation	1%		1%	
135	Aquatic and Terrestrial Wildlife	1%		12%	
216	Integrated Pest Management Systems	5%		5%	
806	Youth Development	10%		0%	
	<b>Total</b>	100%		100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	17.3	0.0	8.0	0.0
Actual Paid Professional	10.2	0.0	11.0	0.0
Actual Volunteer	10.0	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
467841	0	1268679	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
467841	0	1158377	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	5157881	0

## V(D). Planned Program (Activity)

### 1. Brief description of the Activity

Research programs and Extension activities to:

- Develop new land use models for Michigan communities.
- Offer education to planners, elected officials and citizens on how these new models will reduce sprawl and ensure that the desirable outcomes will become reality.
  - Create new remediation strategies to clean up polluted soil and water. These strategies will be environmentally friendly, economically feasible and easy to implement with proper training.
  - Discover new knowledge about the composition, organization and fluctuations of microbial populations in the soils.
  - Develop a user-friendly computer program for nutrient management for Michigan crop and livestock producers to improve the management of fertilizer and manure nutrients on cropland to protect water resources and boost crop productivity.
    - Develop management techniques for potato and vegetable growers that includes cover crops.
    - Develop new nitrogen application recommendations for turf managers.
    - Develop a management system for Michigan inland lakes that does not involve sampling the lakes.
    - Develop Total Maximum Daily Load (TMDL) assessment tools for evaluation of Michigan watersheds.
    - Determine how wildlife responds to ecosystem management decisions in forest and agricultural systems
      - Develop fish population/community computer models for species important to Michigan. These models will be used to evaluate different fishery management strategies.
      - Develop web-based tools and models for natural resources managers so knowledge can be shared quickly and easily.
      - Develop computer models to assess how habitat management affects species important to Michigan, including white-tailed deer, salmon, trout and perch.
      - Promote and support value-added processing of forest products, including wood products, biofuels, maple syrup and other nontimber products.
      - Identify, prevent and control exotic invasive pests and diseases of forests.
      - Conduct educational programs to help farmers improve nutrient management and other practices to maintain and improve quality of groundwater and surface water.
        - Conduct educational programs with riparians and lake users to enhance their understanding of watershed management and inland lakes water quality issues.
        - Work with state agencies and local communities to encourage protection of community groundwater supplies through wellhead protection programs.
        - Educate and train health officials, consultants, engineers and riparians to improve onsite and decentralized wastewater treatment and design.

## 2. Brief description of the target audience

Michigan farmers, natural resource managers, private citizens, agriculture and natural resources industry representatives, state agencies, riparians and foresters.

## 3. How was eXtension used?

eXtension was one of the major components in 2012 for multi-state and integrated activities. Members and contributors consisted of both AgBioResearch and Extension staff (119 people contributed in 2012). The public website had 68,139 site visits (a 28% increase) and 151,906 pageviews (a 15% increase) in 2012. The Ask an Expert component had 2,072 questions answered for Michigan residents with 252 questions answered by other state experts and Michigan answering 261 questions from other states.

Ask an Expert statistics were analyzed for our program areas and found for Soil, Water and Natural Resources there were 8 staff paid by formula funds (1 fte). A few examples were:

Question: I live in Michigan, Allegan county, Otsego township. I have 5 acres of wooded land, very large trees, with a thick canopy. Over the last couple of years, more so this year, I have noticed a ground cover type of vine spreading very quickly. It is so thick on the ground it is choking out the woodland flowers and other plants. The plant has a sticky feel, and will attach to anything. It's more like Velcro, and has a rough texture. It will pull from the ground with little effort, but the large quantity is a concern. I am looking for some direction as to the correct method to remove it, and what to do to prevent it. Thanks, Mike

Answer: Mike, my friend, your question led me on a merry chase only to end up in my front yard. Your problem is my problem: one Sweet Woodruff sold in nurseries under that name. It also is from the genus: Galium and Synonym of *Asperula orderata* (*Asperula* [many leaved] and *odorata* {scented}). It is a very popular plant sold as a coverup for many other shrubs that leave the surrounding soil areas barren looking. Once it is planted - Look OUT! My efforts have been ongoing for about 10 years now in just a smallish plot. I'm sitting at my computer with three of the subject plants feeling their texture and knowing they are going into the garbage when i'm done with this message. Glyphosate (Roundup) may work with it but you have to be very careful of surrounding shrubs and trees, especially the younger ones of each variety. Because it does pull up very readily it can be controlled in smaller areas physically (sometimes) however I'm not sure that one person could control this critter by himself in large acreage such as what you have in Otsego. You could perhaps put a bounty of one or two cents per plant with a local scouting troupe to get rid of some of it. (This is done out east with Garlic Mustard with some success) Hopefully this identity will help you eradicate a pest from your environment. If nothing else you could dig up the plants and sell them to the public that wants them. Thank you for using the Ask an Expert System.

Question: I recently had MSU do a soil test to figure out exactly why my soil is so inadequate at producing quality grass. My soil test number is #L46EL4. My name is Ed Gall. Please reference my soil test results so that you can best address my questions - thanks! One question I have is if I choose the starter fertilizer option (option #1), how many times per year, and at what seasonal times, should I apply the starter? Also, you recommend compost since my organic matter is only 1.4% Is there an efficient way to spread compost? I have over an acre, so spreading it by hand is not a great option. Thanks for your time!!

Answer: You would use the starter fertilizer and work into the soil if grass has not gone in yet. If you work the starter fertilizer into the soil you can use 8 pounds per 1000 square feet of the 18-24-12 and this would meet the needs for both the phosphorus and potassium for the season. If the lawn has already gone in, use half this amount, 4 pounds per 1000 sq. ft. Space applications about 4 to 5 weeks apart. Two

applications this year is enough for this summer. Next year begin using a common lawn fertilizer like 29-3-3 or similar product. How often you apply is based on type of grass and available water. Kentucky bluegrass lawns benefit from 3-4 application per season. See the following schedule: <http://ohioline.osu.edu/hyg-fact/1000/1191.html> Low maintenance grasses like fescue only need 1-3 applications per season. If you have a lawn mixed with different grasses do not exceed the 3 application per season. Avoid fertilizing in the heat of mid summer and when grass is going dormant in October. A fertilizer application can be applied after lawn goes dormant in the fall. Do not fertilize a drought stressed lawn! Compost can be spread with a lawn spreader but it would be best if the site that produced the compost passed it through a screen first to remove larger particles.

Question: my arborvite is turning brown. See attached. Will I lose it ?

Answer: From the amount of browning on your plant I am going to assume that is dead, however you can make some small checks to see if disease or insects did the deed on your plant or as mentioned below maybe the soil became too acidic from the concrete and mortar that has leached into the soil since you planted the Arb. You did not mention the type of arborvitae that you had planted. I am going to assume they were either eastern arborvitae (*Thuja occidentalis*) or western arborvitae (*Thuja plicata*) These are the two species that are recommended for Michigan however there are others that do fairly well in the midwest, namely the Holmstrup or Techny varieties. Arbs like full sun and soil of average fertility that is well drained. They do best when given protection from the wind especially in the winter. If a plant is in the correct location it is less likely to develop problems. If your site is not appropriate for Arbs then it is best to select another plant that will do well in your conditions. I am concerned about the proximity of the tree to the brick and concrete wall very near it. Concrete can reduce the amount of water that is getting to the roots of the plant. I would suggest that you have a soil test before finding another variety to plant and then fertilize according to the recommendations of that test. You can get a soil test by contacting your local MSU extension office. Some local nurseries offer The Don't Guess - Test program in the spring. You can pick up an MSU soil test kit from a participating nursery. On the form for the soil test indicate that you want to grow arborvitae. Arbs usually have few problems if sited correctly. Probably the most common problem is winter browning. This website offers some information about winter browning. <http://urbanext.illinois.edu/focus/winterinjury.cfm> Leaf miner is an insect that causes damage that can resemble that of winter browning. Observe the new plants regularly. At the first signs of browning hold the branch tips to the light and look for small caterpillars feeding inside. If you see caterpillars prune and destroy the infested branches before June. Other potential problems include bagworm, heart rot, blight, canker and spider mites but these are not frequent when the plants are properly sited. Some of these problems are mentioned in the above website. It is always important to check your plants regularly for any signs of disease or insect damage. Problems are much easier to manage if caught early. If you notice a problem it is important to get a correct diagnosis before treating the problem. I hope this information was helpful. Thank you for using the Ask an Expert system.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	9498	28494	10266	20532

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

**Patent Applications Submitted**

Year: 2012  
 Actual: 2

**Patents listed**

MICL01884 - Soil Aggregate Porosity Contributions to Carbon Sequestration - PCT/US2011/056173, 10/31/2011. MICL02155 - Study on Epidemiology, Microbial Community and Management of Soilborne Diseases - 61/640,024, 4/30/2012.

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2012	Extension	Research	Total
Actual	1	46	47

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of research programs on soil, water and natural resources.

Year	Actual
2012	45

**Output #2**

**Output Measure**

- Number of adult participants trained in soil, plant, water and nutrient relationships.

Year	Actual
2012	2830

**Output #3**

**Output Measure**

- Number of adult participants trained in watershed protection and management.

Year	Actual
2012	3021

**Output #4**

**Output Measure**

- Number of youth participants trained in watershed protection and management.

<b>Year</b>	<b>Actual</b>
2012	10266

**Output #5**

**Output Measure**

- Number of adult participants trained in management and sustainability of forest resources.

<b>Year</b>	<b>Actual</b>
2012	625

**Output #6**

**Output Measure**

- Number of adult participants trained in alternative uses of land.

<b>Year</b>	<b>Actual</b>
2012	3022

**Output #7**

**Output Measure**

- Number of youth participants trained in alternative uses of land.  
Not reporting on this Output for this Annual Report

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Number of research programs to discover new knowledge about the composition, organization and fluctuations of microbial populations in the soils.
2	Number of adult participants with increased knowledge of watershed protection and management.
3	Number of youth participants with increased knowledge of watershed protection and management.
4	Number of adult participants with increased knowledge in management and sustainability of forest resources.
5	Number of research programs to determine how wildlife responds to ecosystem management decisions in natural resource and agricultural systems.
6	Number of adult participants with increased knowledge of alternative uses of land.
7	Number of adult participants with increased knowledge of soil, plant, water and nutrient relationships.
8	Number of research programs that deal with fish population dynamics and the management of Great Lakes fisheries.
9	Number of research programs that deal with the security, stewardship and management of Michigan's water resources.
10	Number of research programs that analyze key soil characteristics to better assess their agricultural and environmental contribution, including crop yield.
11	Number of research programs that explore the occurrence, transport and fate/effect of organic contaminants, chemicals, pesticides, pharmaceuticals and particulates in soils.
12	Number of research programs to develop new land use models for Michigan communities.

## **Outcome #1**

### **1. Outcome Measures**

Number of research programs to discover new knowledge about the composition, organization and fluctuations of microbial populations in the soils.

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Condition Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2012	7

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

Soils constitute a huge reservoir of microbes, whose activities have a profound impact on crop productivity, soil fertility and biogeochemistry. However, knowledge of the composition, organization and fluctuations of indigenous microbial populations in soil ecosystems is scarce, even though metabolism of such microbes drives many ecosystem level processes.

#### **What has been done**

Research to: understand temporal and spatial control of gene expression during development of soil bacteria; determine how well the most promising candidate strains of cereal-adapted rhizobia perform as superior biofertilizer inoculants for rice and wheat when scaled up to full-size farmer plots; investigate novel cultivation strategies and cultivation-independent techniques to advance our understanding of microbes and microbial communities in soils; and develop new technologies to control soilborne diseases.

#### **Results**

Research to increase knowledge of beneficial plant-microbe interactions of agricultural importance has resulted in the development of Center for Microbial Ecology Image Analysis System (CMEIAS) software ? free image analysis software designed to strengthen microscopy-based approaches for understanding microbial ecology. The system includes custom plug-ins for the host programs and interactive semi-automatic image editing and analysis of microbial abundance, luminosity and morphological diversity.

Researchers have successfully characterized the soil that is suppressive to potato common scab and established a program for fundamental soil-borne disease study. The research has also resulted in the discovery of a group of biological agents for disease control of potato, including *Bacillus amyloliquefaciens*.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships

#### Outcome #2

##### 1. Outcome Measures

Number of adult participants with increased knowledge of watershed protection and management.

##### 2. Associated Institution Types

- 1862 Extension

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2012	2658

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

With 41 of Michigan's 83 counties bordering on the Great Lakes or connecting waters. Michigan's coastal communities provide vital economic, social, and recreational opportunities for millions of residents and visitors. Near-record low Great Lakes water levels, the increased number and intensity of regional storms, and other natural and human hazards are putting more people and property at risk with major implications for human safety and the economic and environmental health of coastal communities. To accommodate more people and activity, and to balance growing demands on coastal resources, we must develop new policies, institutional capacities, and management approaches to guide the preservation and use of Great Lakes resources.

It is essential that Michigan residents of coastal communities understand these risks and learn what they can do to reduce their vulnerability and respond quickly and effectively when events occur. The Great Lakes Education Program engages a diverse and growing coastal population in applying the best available scientific knowledge, and uses its extension and education capabilities to support the development of resilient communities that are economically and socially inclusive, supported by diverse and vibrant economies, and function within the carrying capacity of their ecosystems.

###### **What has been done**

Since 1991, the Great Lakes Education Program has introduced more than 92,000 K-12 students through the help of teachers and adult volunteers to teach about the unique features of the Great

Lakes through a combination of classroom learning and hands-on experience. The program is designed to stimulate interest in the Great Lakes and help students and adults understand their role in protecting these vital freshwater resources.

Winner of both the John A. Hannah Award for MSU Extension Program Excellence and a National 4-H Program of Distinction Award, the Great Lakes Education Program is seen as a leader in vessel-based education. The program was developed as a collaborative effort between Michigan State University Extension, Michigan Sea Grant, the Huron-Clinton Metroparks, the National Oceanic and Atmospheric Administration, and a host of K-12 teachers and education specialists. It has served as a national model for implementing effective vessel-based education, as when in 2001, Texas Sea Grant used the Great Lakes Education Program as the developmental model for its Floating Classroom Program.

### **Results**

The Great Lakes Education Program (GLEP) has documented program outcomes through university research and seasonal assessments. Michigan State University, research conducted through the Department of Fisheries & Wildlife, found a highly significant increase in Great Lakes knowledge on the part of students, and a significant increase in girls' positive attitudes toward the Great Lakes. A second MSU study found participants effectively shared knowledge learned with family members and friends, and the parents of participants scored significantly higher on the Great Lakes behavior intentions scale than parents of non-participants.

Annual seasonal evaluations of the program are conducted with GLEP teachers and adult chaperones. Teacher evaluations have shown that their participation results in a high incidence of increased Great Lakes subject matter used in the classroom. Teachers also report the GLEP curriculum provides excellent support for addressing Michigan's Grade Level Content Expectations and Great Lakes Literacy principles. The 2012 teacher evaluations found that following GLEP participation, 90 percent of the students had greater responsibility for the Great Lakes; 64 percent included more Great Lakes science content in their classroom; 30 percent visited the Great Lakes more often; and 20 percent involved their students in new Great Lakes stewardship activities.

## **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
112	Watershed Protection and Management
806	Youth Development

### **Outcome #3**

#### **1. Outcome Measures**

Number of youth participants with increased knowledge of watershed protection and management.

#### **2. Associated Institution Types**

- 1862 Extension

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2012	9034

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

It is critical to get youth involved as early as possible in nature, understanding the environment, enjoying nature and becoming advocates for protecting our delicate ecosystem.

#### What has been done

One example in this area is where MSUE worked with several school systems to provide experiential learning opportunities around watershed protection. For example, MSUE worked with Sanborn Elementary students of Alpena Public Schools to use science and technology to study impacts of aquatic invasive species in their local Thunder Bay River Watershed. Rogers City Middle School students monitored water quality and the health of local Trout River. Alcona High School Environmental Science students partnered with the Northeast Michigan Council of Governments (NEMCOG) to study and develop a management plan for their local Black River Watershed.

#### Results

Qualitative evaluation of these experiences found that they provided amazing hands-on learning experiences for students and bring them into the community as valued partners addressing important environmental stewardship issues. Through their projects, students fostered a better understanding of the social, economic, and environmental importance of Michigan's water resources, and that their watersheds, the Great Lakes and people are interconnected. Educationally, these projects reflected wonderful case studies of applied principles and best practices of place-based education where youth, through their learning, engage in environmental stewardship leadership activities that enhance and provide community enhancement values.

These projects also illustrate community partners investing in youth learning and in trade benefiting from youth leadership. The Michigan Sea Grant, 4-H Youth programs, NOAA Thunder Bay National Marine Sanctuary, and many other water-interested partners in northeast Michigan directly supported these projects through the 4-H20 and NOAA B-WET water quality education programming in northeast Michigan. Collectively, these schools, community partners, and youth-led projects reflect a growing community or shared interest in water science education and watershed stewardship activities. These partners are networking and fostering school-community partnerships, sharing ideas and resources, and collaborating among their diverse water-related projects and activities.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
806	Youth Development

#### Outcome #4

##### 1. Outcome Measures

Number of adult participants with increased knowledge in management and sustainability of forest resources.

##### 2. Associated Institution Types

- 1862 Extension

##### 3a. Outcome Type:

Change in Action Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2012	519

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

The most recent statistics about Michigan's forest resource reveal that there are over 20 million acres of forest land in the state. Of this vast resource, over 40% of this forest acreage is owned by non-corporate and individual forest landowners. In addition, there is currently more than 440,000 family forest or private landowners in Michigan by most estimates. Consequently, this is a sizeable financial asset in Michigan (i.e. just considering the value of the land and timber alone) that is under control by private entities. But these same forest statistics also provide another startling fact about private forest owners. A large proportion of these owners are aging fast with over 39% of forest owners being 69 years of age or older. Therefore, as our society continues to age (e.g. the aging baby boomers) many landowners have begun to wonder what will happen to their beloved forest land after they are deceased. Thus, a shift in land ownership from one generation to the next will occur very soon as these current owners pass on.

###### **What has been done**

The MSUE Ties to the Land program is a broad overview of the interpersonal, financial and legal issues involved in successfully planning a transfer of forest property from one generation to the next. It is designed to inform landowners of what they need to consider and plan for in this transition process. The Ties to the Land program is a DVD-driven curriculum developed by Oregon State University that is coupled with interactive discussion and planning activities. The MSUE version has been adapted for Michigan. Additional resource materials as well as a panel of local professionals are incorporated into the Michigan program to offer general advice on

estate planning to participants.

### **Results**

A one-year follow-up survey was recently conducted of 40 participants in late 2010 Ties to the Land programs in Saginaw, Escanaba and Quinnesec.

Results found that participants have taken action as a result of participating in the Ties to the land program. Highlights include:

83 percent of respondents indicated that they have used the Ties to the Land resource workbook, with 100 percent finding it somewhat or very useful.

72 percent of respondents indicated that they discussed goals for their property within the last year, an additional 22 percent said that they intend to within the next 6-12 months.

44 percent have taken steps to increase family involvement in the property, with 17 percent indicating that they intend to within the next 6-12 months.

39 percent have explored options for a legal structure for estate planning purposes, and 28 percent said that they intend to within the next 6-12 months.

There are still significant barriers to succession planning for forest families:

61 percent haven't figured out fairness issues

47 percent indicated that lack of time prevents them from progressing on succession planning

44 percent said that their heirs are too dispersed

38 percent indicated that one or more heirs are disinterested

35 percent have difficulty finding qualified advisors

Many participants commented about the difference the Ties to the Land Program planning process made their family and how they see the future of their property. One participant commented that the program clarified differences in viewpoints and future goals for ownership. Another participant commented that the program was the starting gun for taking action to preserve our forest [and] added the human element to our thought process.

Participants in this survey represented 11,828 forest acres.

## **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources

## **Outcome #5**

### **1. Outcome Measures**

Number of research programs to determine how wildlife responds to ecosystem management decisions in natural resource and agricultural systems.

### **2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Condition Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2012	3

**3c. Qualitative Outcome or Impact Statement**

**Issue (Who cares and Why)**

A better understanding of wildlife-habitat relationships as influenced by natural and human wildlife habitat disturbances is needed in order to make more effective natural resources management decisions to sustain biodiversity and conserve wildlife populations, communities and habitat.

**What has been done**

Research to: understand the mechanisms of wildlife dynamics on landscape mosaics; develop a better understanding of wildlife-habitat relationships as influenced by natural and managed wildlife habitat disturbances; and uncover systematically informative morphological and molecular characteristics related to arthropods in order to revise classifications and test evolutionary hypotheses.

**Results**

Researchers have developed an elk survey methodology and model to estimate the population size in Michigan. This technique allows researchers to estimate the population size with a 95 percent confidence interval and uses a sightability model.

Research to understand the influences that farm management practices may have on the spread (and control) of bovine tuberculosis in free-ranging white-tailed deer suggests that the efficiency and effectiveness of a trap/test/cull management effort could be improved by vaccinating test-negative animals, should a vaccine be approved for free-ranging deer.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife

## **Outcome #6**

### **1. Outcome Measures**

Number of adult participants with increased knowledge of alternative uses of land.

### **2. Associated Institution Types**

- 1862 Extension

### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2012	2659

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

The need for this program is based on:

Many Michigan communities were unprepared for the transition from the old economy to the new economy and, as a result are currently in the process of developing relevant communities that are better situated to compete and thrive in the 21st Century.

High turnaround rates of locally elected and appointed officials have created an ongoing need for training programs addressing the fundamentals of local government, including basics of governance, finance, planning and zoning.

Many Michigan communities have appointed officials without adequate training in local governance and finance, planning, and zoning. Without these fundamental skills, many appointed and elected officials are not at the point where they can fully benefit from training on more advanced concepts that inform key policy issues in Michigan.

Local officials, community leaders, and general citizens have a need for greater awareness of government operations, budget, and land use decision makers' roles and responsibilities. Importantly, increased knowledge and awareness of these issues can lead to the development of more livable communities, the protection and conservation of natural resources, and better overall governmental and land use decisions throughout Michigan.

#### **What has been done**

MSUE's Greening Michigan Institute Workgroup Government and Public Policy conducted a series of trainings that focused on government officials and a set of trainings (called Citizen Planner and Firewise) that included the general public.

#### **Results**

Evaluation of the training for public officials found:

82.1% board members reported improved use of data and relevant information to inform their decision making

72.6% of the participants improved their understanding of relevant laws and the practical impacts of those laws on their boards

84.2% of the participants increased knowledge of their board's structure, functions and duties, and/or operational best practices

60.5% of the participants increased their knowledge of citizen input processes and /or methods to implement those practices

74.0% of the participants could identify and locate resources for quality information and/or apply that information to the solution of problems

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land

#### Outcome #7

##### 1. Outcome Measures

Number of adult participants with increased knowledge of soil, plant, water and nutrient relationships.

##### 2. Associated Institution Types

- 1862 Extension

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2012	2179

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

One example in this area is regarding corn residue. The quantity and quality of corn residue has increased in recent years impeding the performance of no-till planting equipment, increasing tire wear and reducing soil warming and drying in the spring. This has led to an increase in the number of acres that are tilled prior to planting soybeans increasing production costs and the potential for soil erosion. Soybean producers have a vested interest in reducing production costs

and preserving their soil resources. Non-farmers benefit from improved water quality when erosion is reduced or prevented.

**What has been done**

Planned, promoted, conducted and evaluated a high-profile educational program addressing one of the most current and relevant issues facing Michigan Soybean producers. We identified and invited two of the best Extension resources in the U.S to present at the program. Applied for and secured a grant from the Michigan Soybean promotion Committee to pay for the program. The program entitled, "Options for Managing Corn Residue Prior to Planting Soybeans" was held at the MSU Pavilion.

**Results**

Designed, distributed, collected and summarized and evaluation to measure the program's educational and financial impacts.

More than 130 soybean producers and agribusiness agronomists participated in the program. Evaluation results found:

39% of the participants said they were more likely to make long-term changes to their current corn residue management practices as a result of the information they learned at the program

77% indicated that they planned to leave more corn residue on the soil surface prior to planting soybeans

48% planned to use the information they learned at the program to change their residue management practices

37% expected these changes to earn or save them additional money.

The average amount of additional money saved was \$11.31 per acre.

Changes effected 5,865 acres with the total projected financial impact of the program to be \$66,312.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships

**Outcome #8**

**1. Outcome Measures**

Number of research programs that deal with fish population dynamics and the management of Great Lakes fisheries.

**2. Associated Institution Types**

- 1862 Research

### 3a. Outcome Type:

Change in Action Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2012	6

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Urban, industrial and agricultural development have caused remarkable changes in the lakes' flora and fauna and fauna associated habitats over the past 200 years. Today, the lakes have aquatic communities that are structurally and functionally volatile and exhibit rapid changes in species number and abundance. Successful fish management of the Great Lakes is now actively focused on the lakes as ecosystems.

#### What has been done

Research to: investigate areas of uncertainty for Great Lakes fishery management, particularly sea lamprey control and salmon stocking; determine how fish population dynamics are affected by the physical, chemical and biological environment; investigate how human activities bring about changes in aquatic habitats; and develop models capable of predicting response of fish to habitat alteration.

#### Results

In research evaluating the ecological significance of lake trout refuges, scientists found that relative abundance higher inside the refuges and increased at a greater rate than outside the refuge as expected. However, annual means in lake whitefish were surprisingly higher in areas outside of the refuges, while the rate of increase in relative abundance was higher in the refuge. These findings highlight the potential significance of refuges for enhancing populations of various species and will be important in informing future Great Lakes fisheries management and research.

A new, regional database characterizing locations of freshwater mussels in Michigan has been developed. While researchers have historically just considered fishes to assess landscape effects on aquatic environments, considering mussel response to landscape influences adds richer information and enhances the understanding of the broader responses of aquatic communities.

## 4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
134	Outdoor Recreation
135	Aquatic and Terrestrial Wildlife

## **Outcome #9**

### **1. Outcome Measures**

Number of research programs that deal with the security, stewardship and management of Michigan's water resources.

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Action Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2012	12

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

With growing concern about the connection between health and the marine environment, there is a corresponding emphasis on large freshwater lake ecosystems and human health. The Great Lakes serve as a highway for international maritime commerce and support a \$1 billion per year recreational and commercial fishing industry. They also supply drinking water for more than 15 million people. Holding about 20 percent of the world's fresh surface water, the degradation of the Great Lakes ecosystem through chemical and biological contamination presents an enormous challenge for the future.

#### **What has been done**

Research to: enhance the current water resources management structure through the ecosystems approach, development of a system to help create sustainable water resource management, understand how anthropogenic actions can affect food web structure and function, address critical questions that have relevance to specific problems in Michigan inland lake and Great Lakes integrity; help develop dynamic, interactive computer interfaces in resource-based recreation management; construct and evaluate a knowledge management system in resource-based recreation management; develop a landscape-based ecosystem management framework that integrates landscape ecology with natural resource policy and management; determine why sport fish populations, fish assemblages and lake food webs, and their response to perturbation vary among lakes; determine if pheromones can be used to control sea lamprey in streams, with a view to developing a viable new control strategy; and to improve design of engineered phytoecosystems for treatment of wastewaters and stormwaters.

#### **Results**

Research focused on developing management frameworks for lakes has resulted in the development of an extensive multi-state terrestrial and freshwater landscape database. The 6-state, 2,300 lake database is unprecedented in size and will provide natural resource managers

with a framework that more fully views lakes as complex systems coupled with human systems.

Research initiated to quantify the carbon storage potential of 12 landscape systems (three of which were duplicated on roof platforms in green roof media) with increasing levels of complexity, ranging from sedum to woody shrubs over the course of three years showed that landscape systems containing more woody structures had higher content than other landscape systems. Carbon storage on the green roofs ranged from 68 kg m<sup>2</sup> for a mixture of herbaceous perennials and grasses, down to 7 kg m<sup>2</sup> for a typical sedum-based extensive green roof.

Networked Neighborhoods for Eco-Conservation Online (NECO) is a web-based tool that helps link individuals in the Great Lakes region to map and share green practices was developed ? [www.iwr.msu.edu/neco](http://www.iwr.msu.edu/neco). This, in combination with other tools and models are being integrated into a process that will result in a series of physical and digital maps that are web accessible and interactive. The system will assist landowners and technicians in identifying and addressing critical areas related to soluble phosphorus and sediment delivery.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

#### Outcome #10

##### 1. Outcome Measures

Number of research programs that analyze key soil characteristics to better assess their agricultural and environmental contribution, including crop yield.

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2012	7

##### 3c. Qualitative Outcome or Impact Statement

###### **Issue (Who cares and Why)**

Understanding the variability of soil and landscape properties and their effect on crop yield is a critical component of site-specific agricultural and environmental management systems. This

includes factors such as nitrogen management, soil absorption and environmental interactions.

#### **What has been done**

Research to: study herbivore suppression of cyanobacteria and total phytoplankton biomass; effectiveness of nitrogen rates on soil quality and plant nutrition; study the characteristics of high content soil blends used in athletic fields and golf putting greens and how the properties of these soils change with time and use; and to explore diversification with cover crops to enhance nutrient cycling efficiency and rhizosphere traits for resilient, productive row crop systems.

#### **Results**

While much of the nation's crops withered under last year's punishing drought, MSU researchers dramatically increased corn and vegetable production on test farms using revolutionary new water-saving membranes. The subsurface water retention technology (SWRT) process uses contoured, engineered films, strategically placed at various depths below a plant's root zone to retain soil water. SWRT-improved irrigated sands produced 145 percent more cucumbers than did the control fields without water-saving membranes. Researchers also dramatically improved irrigated corn production, increasing yields 174 percent.

Researchers have documented that inland lakes in Michigan that have been invaded by zebra mussels have higher levels of algae that produce a toxin that can be harmful to humans and animals. Findings show that lakes that are home to zebra mussels have, on average, three times higher levels of a species of blue-green algae known as *Microcystis*. There have been documented cases in which animals, including cattle and dogs, died after drinking water with high levels of microcystins. The toxin is also believed to be responsible for liver damage in humans.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
133	Pollution Prevention and Mitigation

#### **Outcome #11**

##### **1. Outcome Measures**

Number of research programs that explore the occurrence, transport and fate/effect of organic contaminants, chemicals, pesticides, pharmaceuticals and particulates in soils.

##### **2. Associated Institution Types**

- 1862 Research

##### **3a. Outcome Type:**

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

Year	Actual
2012	7

### 3c. Qualitative Outcome or Impact Statement

#### Issue (Who cares and Why)

Michigan's 37 million acres of land support the plants and animals that provide our shelter, food and fiber. The land provides us with minerals and foods for our industry and our businesses. At the same time, human activities are generating and releasing large amounts of pollutants -- including pesticides, antibiotics and dioxins, and other industrial emissions -- that may end up in the soil. Research to investigate the fate and effect of these pollutants is critical to sustaining soil viability and health, and minimizing consequences to human health.

#### What has been done

Research to: investigate the transport of a group of engineered nanomaterials in the soil and water environments and develop an understanding of their interactions with other elements; evaluate the occurrence and human health risks of historic pesticide contamination of agricultural soils; understand the mechanisms by which chronic estrogen exposure brings about reproductive failure; determine the mechanistic functions and contributions of soil humus and clays to the immobilization of pesticides and POPs found in soils; evaluate the occurrence of antibiotics in animal farms and their mobility; and to control and convert rural waste to resources.

#### Results

Scientists seeking to address ways to recover phosphorus from wastewater have developed a media that can retain significant amounts of phosphorus. They are working with MetaMateria Technologies in Columbus, Ohio, to create a cost-effective material and to develop design equations that will provide the information engineers need to make use of the product and to know when it needs to be replaced.

Research over the past several decades shows that soil and water are being compromised by human wastewater treatment and disposal practices. Results obtained from recent pharmaceutical studies provide the basis to improve best management practices for land application of biosolids and will help shape the development of regulations for emerging contaminants.

### 4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
132	Weather and Climate
133	Pollution Prevention and Mitigation
216	Integrated Pest Management Systems

## **Outcome #12**

### **1. Outcome Measures**

Number of research programs to develop new land use models for Michigan communities.

### **2. Associated Institution Types**

- 1862 Research

### **3a. Outcome Type:**

Change in Action Outcome Measure

### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2012	3

### **3c. Qualitative Outcome or Impact Statement**

#### **Issue (Who cares and Why)**

What we do to our land is intimately tied to our drinking water quality, wildlife habitat, potential for flooding, our recreational open space and tourism, and many other quality of life issues. For example, urbanization of the rural landscape is claiming some of the country's richest farmland and creating challenges for areas where rural and urban interests collide. Some recipients indicate the, by 2020, farmers will only have enough land to meet the nation's domestic food needs.

#### **What has been done**

Research to: better understand how regional and continental processes affect local processes; increase management capacities among agencies to better integrate biological and human dimensions of management in dealing with wicked problems, such as wildlife health; and to help develop sustainable agro-ecosystems that protect public health, environmental quality and promote efficient and profitable resource use.

#### **Results**

Research to provide tools to help address climate change and prevent environmental harm has resulted in the development of predictive models that are being applied to agricultural systems as far away as Senegal, West Africa, where the shortage of food and hunger are major issues. The models predict what the agricultural production would be and how the weather will affect the cropping systems, providing some early warning analysis to agricultural producers.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
112	Watershed Protection and Management

131	Alternative Uses of Land
132	Weather and Climate
135	Aquatic and Terrestrial Wildlife

#### **V(H). Planned Program (External Factors)**

##### **External factors which affected outcomes**

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

##### **Brief Explanation**

The ongoing economic challenges being faced by Michigan -- including the recent federal funding sequestration process -- continue to affect this planned program area. Consequences have included fewer new hires, delaying the award of new financial obligations, reducing levels of continued funding, and renegotiating or reducing the current scope of assistance through formula funds or block grants. Although overall research FTEs only decreased by one -- from 65 FTEs to 64 FTEs this past year, we are down from 77.1 FTEs just two years ago. Attrition and faculty departures also continue to have an impact on program outcomes.

The extreme weather conditions during last year's growing season also delayed or greatly diminished some of the research projects being conducted at our various research centers both on- and off-campus, particularly related to plant research around food and biofuel crops.

We also opted in this year's annual reporting to revert back to our original 6 planned program areas for ease of reporting and better integration of research and Extension efforts. This has, once again, resulted in some instances in skewed results for some planned programs and outcome measures. This should be rectified after this year's reporting cycle.

#### **V(I). Planned Program (Evaluation Studies)**

##### **Evaluation Results**

As Hatch dollars are base funding for faculty salaries, there is a built-in evaluation mechanism through annual reviews of overall performance, research productivity and the leveraging of additional research dollars. In addition, many of the research projects have an evaluative element that is required by state and federal-level funding sources that provides documentation related to project assumptions, goals and outcomes. This information is used to determine the overall success of research initiatives; their contribution to providing practical, real-world solutions and resources to address challenges and problems; and

whether continuation funding and/or new dollars are appropriate and necessary as funds are available.

That said, the most notable qualitative impacts realized in this program were:

- An exploration of the tools to assist resource managers in managing Michigan's elk population led to the development of an elk survey methodology and model to estimate the animal's population size. This has allowed researchers to estimate the population size with a 95 percent confidence interval.
- An evaluation of approaches to the development of management frameworks for lakes has resulted in the development of an extensive multi-state terrestrial and freshwater landscape database. The 6-state, 2,300 lake database is unprecedented in size and will provide natural resource managers with a framework that more fully views lakes as complex systems coupled with human systems.
- Following more than a decade of research and evaluation, AgBioResearch scientists dramatically increased corn and vegetable production on test farms using revolutionary new water-saving membranes. The subsurface water retention technology (SWRT) process-improved irrigated sands produced 145 percent more cucumbers than did the control fields without water-saving membranes. Researchers also dramatically improved irrigated corn production, increasing yields 174 percent.
- Scientists who have created a media that can retain significant amounts of phosphorus are working with MataMeteria Technologies in Columbus, Ohio, to evaluate and develop design equations that will provide the information that engineers need to make use of the product and to know when it needs to be replaced.

Evaluation Results Not Previously Reported for this Area:

### **Soybean Harvest Equipment Field Day and PLOT Tour**

#### **Issue (who cares and why)?**

Past research has shown that preventable soybean harvest losses of 4 to 5% (2 to 2.5 bushels/acre) are common in normal years. However, the dry weather in 2012 created two conditions that could significantly increase harvest losses. The plants were short and excessive spider mite feeding caused the pods to be brittle increasing shatter losses. Michigan soybean producers could net an additional \$30 to \$40 per acre by learning and implementing information about measuring and reducing soybean harvest losses.

#### **What has been done?**

The MSUE Soybean educator worked with the Michigan Soybean Checkoff to plan, promote, conduct and evaluate a Soybean Harvest Equipment Field Day and Plot Tour in Jonesville on September 20, 2012.

#### **Results/Impact?**

- Developed a follow-up evaluation and mailed it to 120 participants of the 2012 Soybean Harvest Equipment Field Day and Plot Tour.
- Compiled and summarized the survey results.
- 38% (46) of the participants returned surveys

- 86% said that they utilized the information they learned about measuring and preventing harvest losses on their farms during the 2012 harvest.
- 74% said they **actually** earned additional money by implementing the new information they learned at the field day.
- The average amount of additional income was \$16.66 per acre applied to 9,999 acres, producing an **actual** financial impact of \$166,624 in 2012 alone.
- The participants also provided specific changes they made and listed soybean topics they wanted to learn more about.

### **Promoting the Use of Enviroweather**

#### **Issue (who cares and why)?**

Critical weather information for farmers can have a tremendous impact on both productivity and the environment.

#### **What has been done?**

During 2012 MSUE promoted the use of Enviroweather among small fruit growers to guide their Integrated Pest Management activities in order to optimize the effectiveness of their pest control actions and reduce the runoff of pesticides into bodies of water or leaching into ground waters.

These uses were related to consulting the Cranberry Fruit Worm phenology model for timing fruit worm control actions and the use of fruit rot predictive models to manage the risk of infections for mummy berry and anthracnose in blueberries. Also, growers used Enviroweather to obtain weather information for IPM decision making.

#### **Results/Impact?**

67 new users that impacted 3,695 acres.

### **Unwanted and Outdated Pesticides**

#### **Issue (who cares and why)?**

Unwanted and outdated pesticides stored on farm pose a great risk to groundwater and surface water contamination.

#### **What has been done?**

The Michigan Clean Sweep program helps protect the state's natural resources by pesticide pollution prevention. This program offers farmers the opportunity to safely and voluntarily dispose outdated, unused or unwanted pesticides without any cost.

#### **Results/Impact?**

The Eaton County Clean Sweep program was held as part of the annual Eaton County

Fall Conservation Tour in Sunfield, MI on September 6, 2012. It was jointly sponsored by the Ionia and Eaton County Conservation Districts, Crop Production Services and MSU Extension.

At this year's event, 42 farmers submitted 6,588 pounds of pesticides. Some of the most common materials collected were atrazine, glyphosate and chlordane. A small amount of DDT was also collected. By submitting these chemicals to proper authorities for disposal, farmers clearly eliminated a high risk for groundwater contamination. This program has gained in popularity every year because farmers do not have to submit tedious paperwork or authenticity of products at the point of disposal. No fees are charged.

## Key Items of Evaluation

Key research results include:

- The development of an elk survey methodology and model to estimate the animal's population size in Michigan has allowed researchers to estimate the population size with a 95 percent confidence interval and uses a sightability model.
- The development of an extensive multi-state terrestrial and freshwater landscape database. The 6-state, 2,300 lake database is unprecedented in size and will provide natural resource managers with a framework that more fully views lakes as complex systems coupled with human systems.
- Dramatically increased corn and vegetable production on test farms through the use of revolutionary new water-saving membranes. The subsurface water retention technology (SWRT) process-improved irrigated sands produced 145 percent more cucumbers than did the control fields without water-saving membranes. Researchers also dramatically improved irrigated corn production, increasing yields 174 percent.
- A media that can retain significant amounts of phosphorus has been developed as a tool to help recover phosphorus from wastewater. Scientists are working with MataMeteria Technologies in Columbus, Ohio, to create a cost-effective material and to develop design equations that will provide the information engineers need to make use of the product and to know when it needs to be replaced.

Results from MSUE Institute Workteams relevant to this area:

### Agriculture and Agribusiness Institute

- 1,717,760 lbs. -change in nutrient use in pounds
- 20,052 lbs. -change in pesticide use in pounds
- 273,732 tons Change in sediment retained
- 274,000 lbs. Change in nutrients retained in pounds
- 895 lbs. of active ingredients -change away from broad spectrum products
- 9,752 soil test with 6,460 from farms and 3,292 from households

### Children and Youth Institute

- 10,953 youth trained in biological science
- 41,051 youth educated on environmental education/earth sciences
- 2,058 youth report an increase in science knowledge, problem solving, critical thinking, and decision making skills
- 519 adults who increase knowledge and skills in science content areas to teach children and youth;

- 112 adults indicate increased confidence in their ability to engage youth in experiential, inquiry based science learning.

Evaluations from the Children and Youth Institute's Academic Success Workgroup found in 2012:

- 97.6% of the youth participating in programs reported an increase in science knowledge, problem solving, critical thinking, and decision making skills
  - 82.0% of participating youth indicating the ability to apply science knowledge and problem solving, critical thinking, and decision-making life skills.

Greening Michigan Institute

- 12,086 adults trained in natural resource stewardship
- 4,432 adults trained in government and public policy regarding land use and community development