

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

**Program # 4**

**1. Name of the Planned Program**

Sustainable Use of 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
112	Watershed Protection and Management			30%	
133	Pollution Prevention and Mitigation			70%	
	<b>Total</b>			100%	

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

**1. Actual amount of FTE/SYs expended this Program**

Year: 2014	Extension		Research	
	1862	1890	1862	1890
<b>Plan</b>	0.0	0.0	5.0	0.0
<b>Actual Paid</b>	0.0	0.0	6.8	0.0
<b>Actual Volunteer</b>	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	129015	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	676255	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	294679	0

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

**1. Brief description of the Activity**

The main research objectives are to identify processes and mechanisms that characterize the fate of pollutants in soil and aquatic environments, to develop methods to remediate contaminated soil and water, and to identify and develop methods to control invasive aquatic plants. Good progress was made on these objectives. The fate and remediation program covers both fundamental and applied aspects, and deals with pesticides, volatile organic compounds, dyes, hormones and hormone-mimicking compounds, pharmaceuticals, petroleum hydrocarbons, munitions chemicals, and engineered nanomaterials. A special emphasis has been on the chemistry of pollutants at the soil-water interface. The objectives of the Invasive Aquatic Plant Program (IAPP) are to track occurrences of invasive aquatic plants, test novel controls and provide public outreach via talks, workshops and an invasive aquatic plant webpage. The webpage ([www.ct.gov/caes/iapp](http://www.ct.gov/caes/iapp)) is an online repository for aquatic vegetation maps, herbarium specimens, and research results. Since 2004 IAPP has surveyed over 200 lakes. The program has found approximately 60 percent contain one or more invasive plant species. IAPP has published numerous research articles, and presented at hundreds of public education events. IAPP boasts one of the largest "Long Term Ecological Research" lake databases in the US. IAPP outputs include; new scientific findings, scientific publications, newsletters, bulletins, talks and interviews. In addition, a large number of state residents are served directly by visitations to infested lakes and ponds, identification of problems, and assistance with management. Participation by members of lake associations in group discussions and workshops are particularly important because these stakeholders need guidance on how to control invasive aquatic plants based on the latest scientific information. Often endangered or threatened species are in areas needing management and IAPP works closely with the CT Department of Energy and Environmental Protection to mitigate damage to non-target species. The outputs were new scientific findings; scientific publications, newsletters, and fact sheets; talks and interviews; and the number of state residents served directly by analyzing soil samples and by identifying and controlling invasive aquatic weeds. These activities, services, or events are designed to provide new information that can be used by the general public and to seek their input on the research program and findings. Information was made available to all stakeholders on the CAES website and other social media, in newsletters and fact sheets, and in displays at the open house events or at agricultural fairs. Articles in the press have been written on the research, thereby enhancing awareness of the problems. Results of these output activities did achieve or will lead to specific outcomes, such as removing pesticides from soil and water, identifying mechanisms by which pollutants behave in soil, clearing lakes and ponds of invasive aquatic plants, and preventing loss of water quality.

## **2. Brief description of the target audience**

Stakeholder groups that directly benefit from this program include: farmers, lake associations, boaters, homeowners, water company officials, environmental organizations, extension specialists, corporate and municipal officials, pesticide producers, and the general public. Additional efforts were made to contact a broad base of under-represented and under-served groups, including members of minority organizations, women, and children.

## **3. How was eXtension used?**

eXtension was not used in this program

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

### **1. Standard output measures**

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	553	10	141	10

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

**Patent Applications Submitted**

Year: 2014  
 Actual: 0

**Patents listed**

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

**Number of Peer Reviewed Publications**

2014	Extension	Research	Total
<b>Actual</b>	0	9	0

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

**Output Target**

**Output #1**

**Output Measure**

- Total research papers

Year	Actual
2014	12

**Output #2**

**Output Measure**

- # of talks and interviews given to stakeholders

Year	Actual
2014	43

**Output #3**

**Output Measure**

- # of diagnostic tests performed

<b>Year</b>	<b>Actual</b>
2014	11200

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

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

O. No.	OUTCOME NAME
1	# of homeowners gaining knowledge on pesticide pollution and invasive aquatic plants
2	# of homeowners gaining knowledge about watershed protection and soil and water quality
3	# of lakes and ponds surveyed and/or cleared of invasive aquatic plants

## **Outcome #1**

### **1. Outcome Measures**

# of homeowners gaining knowledge on pesticide pollution and invasive aquatic plants

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

- 1862 Research

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

Change in Knowledge Outcome Measure

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

<b>Year</b>	<b>Actual</b>
2014	1623

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

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

Pollution affects human safety and health and threatens the vitality of the natural environment. We have addressed broad issues related to understanding the fate and biological accessibility of pollutants in the environment and the development of novel methods for removing pollutants from waste streams and decontaminating water and soil. We have also studied natural photochemical processes in the environment.

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

Projects on fate and remediation of chemical contaminants carried out in 2014 include: the bonding forces controlling adsorption of charged compounds on surfaces of natural organic matter and charred particles; the aggregation of engineered nanoparticles in soil; sunlight-driven reactions of organic compounds and dissolved natural organic matter in marine waters; bioavailability of pollutants in environmental particles in models simulating the human digestive tract; sunlight-driven detoxification of contaminants in waste waters; the potential use of biochar (a charcoal-like product of biomass waste) in environmental remediation and soil fertilization; removal of commodity fumigants in vent streams; remediation of crude oil spills on land and sea; and emission of climate-warming gases from soil. Studies were initiated to investigate the role of charred biomass in emissions of nitrous oxide from fertilizer in soil.

#### **Results**

Compounds with pKa values close to those of carboxyl/hydroxyl groups on carbonaceous surfaces have been shown to adsorb by very strong hydrogen bonds. Biochar particles have been shown to aggregate irreversibly with engineered nanoparticles such as nano-CeO<sub>2</sub>. Through sunlight-driven photochemical reactions, organic compounds and dissolved natural organic matter in marine waters can become degraded and can incorporate halogen from bromide and iodide in seawater. The bioavailability of polycyclic aromatic hydrocarbons was tested in a laboratory

model simulating the human digestive tract. Studies were done on optimizing conditions leading to photooxidation of pharmaceuticals and hormones in brackish wastewaters using oxidants such as hydrogen peroxide and persulfate. Methods were developed to remove a commodity fumigant (methyl bromide) in fumigation chamber vent streams. Progress was made on using biochar as an absorbent for remediating crude oil spills on land and at sea. Studies were initiated to investigate the role of charred biomass in emissions of nitrous oxide from fertilizer in soil.

#### 4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation

#### Outcome #2

##### 1. Outcome Measures

# of homeowners gaining knowledge about watershed protection and soil and water quality

##### 2. Associated Institution Types

- 1862 Research

##### 3a. Outcome Type:

Change in Knowledge Outcome Measure

##### 3b. Quantitative Outcome

Year	Actual
2014	11293

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

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

Farmers, landscapers, homeowners, and golf course managers frequently use commercially available fertilizers on specific areas of land. By law, all fertilizers are to contain a minimum or maximum of the guaranteed nutrient value as expressed on the label. In fact, the purity and label accuracy of these products is often critical to their successful use, as well as to efforts to minimize contamination of valuable soil and water resources. Notably, CAES was founded in 1875 for this very purpose. At the May 1, 1876 meeting of the Committee of the Trustees of Wesleyan University, the Preliminary Report of The Connecticut Agricultural Experiment Station stated that - the need for a fertilizer control system was so pressing and so vital to the interests of a considerable portion of the farmers of the State that it seemed absolutely necessary to turn the first efforts in this direction. Accordingly, analyses of fertilizers sold in the state were undertaken. - And so began a 140-year old product safety program for determining the composition and label accuracy of commercial fertilizers in the State of Connecticut.

**What has been done**

At the request of the CT Department of Agriculture, 93 commercially available fertilizer formulations were submitted to the CAES Department of Analytical Chemistry for analysis during the current period. The analytes of interest are varied and include moisture, sand, organic content, ash, various forms of phosphorus and nitrogen, and select micronutrients. Current samples are analyzed by methods and guidelines described in the Official Methods of Analysis and the Association of American Plant Food Control Officials, respectively.

**Results**

Of the submitted samples analyzed during the current period, 36% were found to be deficient in one or more requested analytes. Findings are reported back to CT Department of Agriculture inspectors, who then initiate a regulatory response and investigation.

**4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

**Outcome #3**

**1. Outcome Measures**

# of lakes and ponds surveyed and/or cleared of invasive aquatic plants

**2. Associated Institution Types**

- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2014	15

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

**Issue (Who cares and Why)**

Extensive growths of invasive aquatic weeds, such as Eurasian watermilfoil (*Myriophyllum spicatum*) and curly leaf pondweed (*Potamogeton crispus*) can significantly reduce water quality and alternative aquatic habitats. Stakeholders requested assistance with determining the species of aquatic vegetation and on integrated weed control.

### **What has been done**

Staff mapped native and invasive aquatic vegetation in 6 new and 9 previously surveyed water bodies. The effects of eight years of winter drawdown on invasive plants were quantified in the States largest lake. Tests on controlling a new introduction in the state -Brazilian waterweed (*Egeria densa*) in Fence Rock Lake with bottom placement of herbicide were successfully completed.

### **Results**

After eight years of surveillance, 60 percent of Connecticut lakes and ponds have been shown to contain invasive plants. These plants cover approximately 10 percent of the combined area of all Connecticut lakes and the problem is increasing. The coverage of Eurasian watermilfoil shows a negative relationship to drawdown depth and duration in Candlewood Lake. After no decrease in curly leaf pondweed in Grannis Lake in 2008 and 2009, grass carp were found to reduce the plants abundance in each year thereafter. We have largely restored Bashan Lake to preinfestation conditions after years of selective fall herbicide applications. Long-term benefits of this work will be the protection of native lake ecosystems and prevention of associated economic losses.

## **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
133	Pollution Prevention and Mitigation

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

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

- Economy
- Appropriations changes
- Competing Public priorities
- Other (Staff changes)

#### **Brief Explanation**

There were no external factors that negatively affected outcomes during this reporting period. However, the current economy, changes in state or federal appropriations, and resulting staff changes remain the primary external factors that could affect outcomes. Although a state hiring freeze has been reinstated, one new scientist was hired during this reporting period and the resulting research being initiated will positively impact this program.

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

#### **Evaluation Results**

"Before and after" and "during" evaluations were initiated to measure increased knowledge of aquatic plants and select other program issues. "During" evaluations were used to assess advances in stakeholder knowledge on soil and water quality issues. Direct stakeholder participation in the aquatic weed abatement programs, workshops and town meetings remains a value venue for results evaluation.

### **Key Items of Evaluation**

Written information on evaluation forms following workshops, held in different towns, was an important information collection method for program assessments. During this reporting period, there were 1050 citations (Google Scholar) for scientific articles written by several scientists for the planned program. These citations indicate that knowledge was gained by scientists and used in their studies.