ITEM # __9___
Date: 12/16/14

COUNCIL ACTION FORM

SUBJECT: REQUEST FROM THE ISU BIOECONOMY INSTITUTE FOR A LETTER IN SUPPORT OF RESEARCH GRANT PROPOSAL

BACKGROUND:

On December 6, 2014, the City Council referred a request from the Bioeconomy Institute at Iowa State University for a letter in support of a research grant proposal to the U.S. Department of Energy. A copy of the research proposal is attached for Council review.

The grant funding that is being pursued by the ISU researchers is for a project that explores the effectiveness of planting perennial grasses in the watershed north of Ames as a means of mitigating flood risk in the community. Furthermore, the research will seek to determine the feasibility of creating a self-contained financial system that assures the on-going feasibility of this environmentally sensitive approach to mitigating flooding in Ames.

The City Council will recall that after reviewing the City's consultant study, it was decided that the following two construction projects would be pursued in an effort to reduce future flooding: 1) the expansion of the Highway 30 bridge opening and 2) channel improvements on Squaw Creek adjacent to Duff Avenue. It would seem the approach being analyzed in this research project would be compatible with two approved flood mitigation projects.

ALTERNATIVES:

1) The City Council can authorize the Mayor to send a letter in support of this research grant proposal to the Department of Energy.

2) The City Council can decline the request to send a letter in support of this research grant proposal to the Department of Energy.

MANAGER'S RECOMMENDED ACTION:

The City Council should understand that the City is not being asked to contribute any out-of-pocket funding for this research project. However, City staff will be asked to provide relevant background information to assist with the research. Furthermore, it would seem that the approach being analyzed in this research project would be compatible with two flood mitigation construction projects already approved by the City

Council. Therefore, it is the recommendation of the City Manager that the City Council approve Alternative #1, thereby authorizing the Mayor to send a letter in support of this research grant proposal to the Department of Energy.

Spatially and Temporally Optimized Landscapes for Bioenergy, Food, and Ecosystem Services

Innovation and Vision. Until now perennial grasses such as switchgrass and other native grasses have been regarded as bioenergy crops or commodities. We propose to enhance their economic viability by leveraging their ability to also provide ecosystem services. We will design and manage an agricultural landscape for energy, food, and environmental services by strategically placing crops at specific sites where they provide optimum economic and environmental benefits. We will use a portfolio of crops including corn (stover), sorghum and perennial grasses. This intentionally designed landscape will spur creation of a domestic bioenergy system at the local community level because land use is optimized and logistics costs are minimized.

Using their Profit Zone Manager our partner AgSolver has identified three broad classes of land: 1) land that is consistently profitable (for row crops), 2) land that is never profitable, and 3) land that is sometimes profitable. It should be possible to optimize outcomes based on differential responses of crops grown on these sites. Perennial grasses would be best for lowland and riparian sites that have a great deal of leverage on environmental outcomes. Corn would be grown where it is profitable, using sustainable agronomic practices to harvest a greater proportion of stover.

By thinking holistically about innovative landscape management options and quantifying their economic and downstream environmental impacts, we will be able to increase the viability and deployment of renewable bioenergy technologies. Our vision is a paradigm shift in both the physiographic design of agricultural landscapes and the urban-rural partnership – a paradigm shift favorable to the economics of reducing our dependence on foreign oil.

Focal Region. The Squaw Creek watershed (Figure 1), which drains into Ames, IA.

Current State-of-the-art Including Challenges. Investments in renewable bioenergy technology over the last decade have produced new high-yielding cultivars of switchgrass, established the value of biochar as a soil amendment on land planted to continuous corn, and optimized logistics including the unit operations of harvest, handling, storage, transport, and pre-conversion processing of biomass.[1] Nevertheless, substantial challenges remain in the viability and deployment of an industry based on biorenewables, including a) current harvesting of corn stover can accelerate carbon loss from soils; b) issues associated with finding suitable "marginal lands" for dedicated energy crops in highly productive cropland; and c) the gap between what biomass processing companies are willing to pay and what farmers are willing to sell their biorenewable crops for. These overarching issues are framed by d) farmers' desire for stewardship of the land and habitat, and e) exacerbated by financial risk to farmers and communities.

Overcoming the Challenges. We will address these challenges via the four objectives described below. Local players include DuPont and the City of Ames. *DuPont* is currently in the process of bringing online a 30-million gallon cellulosic ethanol facility five miles east of Ames. This plant has created significant demand for corn stover. Farmers have been more reluctant to harvest corn stover than anticipated because of their concern about negative long-term effects on soil quality. The *City of Ames*, has experienced frequent flooding, with concomitant loss of business activity and economic opportunities. At the same time, the City of Ames is converting its power plant from coal to natural gas and considering installing a gasifier. The biomass gasifier would provide

[1] Moore et al. (2014). Midwest Vision for Sustainable Fuel Production. *Biofuels* (submitted).

a local market for perennial grasses, could utilize off-spec corn stover and would generate a significant amount of biochar that could be applied to agricultural fields.

1. Engaging stakeholders and communities. We will build on the strong bioenergy and bio-feedstocks extension network we already have in place. We will form a *Stakeholder Community Board* to provide advice on our engagement portfolio, which will include formal collaborations with the ISU Extension Service, USDA Natural Resources and Conservation Service and the Squaw Creek Watershed Management Authority to organize and orchestrate on-farm demonstrations, outreach programs, and one-on-one consultations with farmers to foster adoption of the new intentionally designed landscape. We will also continue to build on our expertise across social media platforms as an effective dissemination and educational mechanism. Our decision support tool (see objective 4) will provide an internet-accessible and easy-to-use way for farmers to optimize land use. Taken together, our engagement portfolio will integrate information to technical, academic, local government and public audiences across the project and serve as the central source for dissemination of results.

2. Science-based design coupled with sentinel environmental monitoring. The scientific and agronomic underpinnings for the proposed designed landscape are strong. For example, research in Iowa[2] has demonstrated that growing perennial vegetation on 10% of small watersheds where the remaining land was in row crop production, reduced sediment loss by 90% and substantially reduced losses of P and N. In other research, we have demonstrated the value of biochar for building soil organic carbon and recycling plant nutrients that are harvested with the biomass crop. The use of advanced crop management strategies including use of annual and perennial cover crops, reduced tillage practices, and alternative crop species have been demonstrated to reduce soil erosion, reduce nutrient movement, and sequester carbon and otherwise improve ecosystem services. Finally, AgSolver's models access and use state-of-the art data from the best publically available databases.

2.1. Analysis at the watershed scale. During the *design phase* of the project we will use precision economic assessment tools developed by AgSolver[3] to identify fields and portions of fields within the Squaw Creek watershed that are not profitably farmed and develop a portfolio of alternative management options for these areas. Then we will use the APSIM cropping systems model to test these alternative management practices for each soil separately and feed landscape, hydrologic, and economic models such as SWAT and EPIC to answer "what-if" questions. The design phase of the project will enable us to define optimum sites for agronomic evaluations, agronomic interventions and weather station placement, and to choose sentinel sites for environmental monitoring. Baseline data will be obtained.

2.2. Strategic planting of perennial grasses on marginal lands. During the *execution phase* we will work with the Squaw Creek Watershed Authority, who will serve as an intermediary between the City of Ames and farmers for planting switchgrass and other perennials on marginal lands.

[2] Helmers MJ, Zhou X, Asbjornsen H, Kolka R, Tomer MD, Cruse RM. Sediment removal by prairie filter strips in row-cropped ephemeral watersheds. J. Environ. Qual. 41:1531-1539 (2012).

[3] AgSolver's analysis shows that farmers are losing money on a significant fraction (up to 30%) of most agricultural fields within central Iowa. The unprofitable areas are typically highly erodible marginal lands and closed depressions that flood frequently.

2.3. Data from plot studies and streamflow measurements. During the *execution phase* of the project we will initiate several carefully controlled field studies to evaluate alternative management practices. An example of a potential plot study tests the hypothesis that ~90% of corn stover can be sustainably harvested on prime agricultural land if cover crops are combined with soil biochar amendments. We will also collect streamflow and water quality data throughout the project and develop rating curves that will convert the stage height to discharge, needed for hydrologic modeling. We will take advantage of the network of 20 stage recording stations already installed in the Squaw Creek watershed.

3. Economic and life cycle analyses. The *evaluation phase* involves an economic assessment of the impact of growing herbaceous crops as part of a water management plan for a water drainage basin. Elements of this economic assessment include: the cost of cultivating and harvesting herbaceous crops in flood plains and as filter strips; flood risk mitigation in downstream communities; water quality improvements; impacts on wildlife and biodiversity; reductions in greenhouse gas emissions and other regulated pollutants; cost of fuels produced from the harvested biomass; and implications to the Renewable Fuel Standard. We will use our long-standing experience in economic modeling of energy markets and techno-economic and life cycle in the bioenergy field to quantify the potential of the proposed landscape design to be part of a commercially viable bioenergy supply chain. We will take into account benefits accrued to the city of Ames by flood risk mitigation, and the relationship to economics involved with the Renewable Fuel Standard.

4. Developing an integrated decision support tool. In partnership with AgSolver, information from objectives 1-3 will be used to develop a web-based software tool that will allow users to assess landscapes and design optimized systems for managing them. This tool will enable the information and methodologies developed here to be replicated over similar watersheds throughout the US Cornbelt, thereby reducing our dependence on foreign oil.

Target Level of Performance. TRL of 5-6 for this intentionally designed landscape.

Increased adoption and social sustainability. Currently allocation to cellulosic feedstock: 150,000 acres producing corn stover; negligible acres of perennial grasses for biofuel. Targets: 5,000 acres perennial grass; increase potential supply of sustainably harvested corn stover by 100%; define the value proposition for landowners and the City of Ames through positive economic return, reduced risk, and improvements in environmental and societal quality.

Environmental sustainability. Preliminary targets over baseline: increase biomass productivity 200%, GHG mitigation 50%, decrease sedimentation and P movement 75%, reduce NO3 load 40%, increase soil organic C 20%, decrease PM10 and PM50 50%, increase biodiversity 100%.

Projected Impact. Upon completion we will have created a local market for perennial grasses, enhanced the quantity of sustainability harvestable corn stover, and monetized ecosystem services through a new urban-rural partnership. When deployed as a replicable model, the FOA goals will be met while also contributing to the well-being of surrounding communities.

Key Technical Risks. Weather is always uncertain and poses risk to timely execution of agricultural operations.

Impact of EERE Funding on Proposed Project. The proposed project would not be possible without EERE funding.

Addendum

Proposed Project Team. *Dr. Kenneth Moore*, an agronomist who holds ISU's Charles F. Curtiss Distinguished Professorship, will serve as PI. In addition to his expertise in perennial grasses and cropping systems, Moore has substantial experience managing large and complex projects, including the $25M/5 year CenUSA USDA-NIFA-AFRI coordinated agricultural project. *Anne Kinzel*, the chief operating officer of CenUSA, is a lawyer and community organizer, and will serve as co-PI. The PI and co-PI have the well-demonstrated ability to manage large and complex projects and have worked together on prior projects with all ISU collaborators and all but two of the teaming partners.

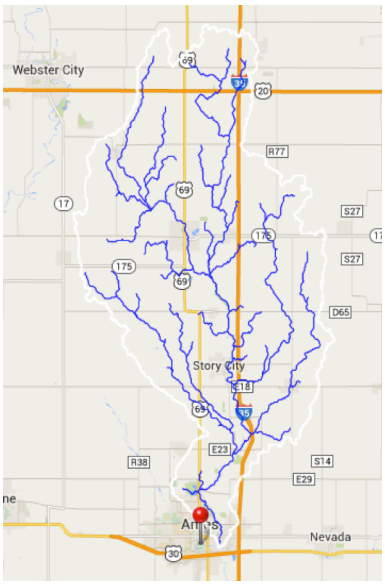

Figure 1. *Squaw Creek watershed, a 12 mile long x 5 mile wide region (~40,000 acres) is an environmentally sensitive part of the DuPont fuelshed. The red pin indicates the location of Ames, IA.*

Objective 1. Engaging stakeholders and communities. Led by *Anne Kinzel* and *Jill Euken*, ISU's highly accomplished extension specialist in the area of bioenergy, this team will include *Dr. Chris Anderson,* assistant director of ISU's Climate Science Program. His expertise is analyzing weather metrics and he works often with groups that have risk-based frameworks. Partnership roles of the *City of Ames*, *DuPont* and the *Squaw Creek Watershed Management Authority* have already been described.

Objective 2. Science-based design coupled with sentinel environmental monitoring. *Dr. David Laird* will lead the agronomic and environmental monitoring aspects. *Laird* is a professor in the ISU's Agronomy Department and an expert in biochar, soil science, soil carbon and nutrient cycling. *Dr. Kristie Franz* will lead the watershed-scale hydrologic modeling effort. She is an associate professor and directs the metrology program at ISU. Other team members include *Moore*, *Dr. Andy Lenssen*, a professor of agronomy and expert in perennial grasses and cropping systems, and *Dr. Sotirios Archontoulis*, an assistant professor of agronomy at ISU and the leading North American expert for the APSIM cropping system model. *Emmons and Olivier Resources*, environmental design professionals developing a 20-year strategic plan for the Squaw Creek watershed, will partner in Objective 2.

Objective 3. Economic and life cycle analyses. *Dr. Robert C. Brown*, ISU's Distinguished Professor of Mechanical Engineering, Director, Bioeconomy Institute and Center for Sustainable Environmental Technologies, will co-lead this team. He will be joined by *Dr. Bruce Babcock*, ISU's Cargill Endowed Professor of Energy Economics.

Objective 4. Developing a decision support tool. *Dr. David Muth* runs AgSolver a local company who developed simulation tools for coupling data management with simulation tools for the *1 Billion Ton Study*. *Muth* has extensive experience in accessing and using large public databases and integrating this data with a cloud computing framework.

Access to Facilities and Equipment. All project team members are well-established in their fields and have access to the equipment, lab space, and other facilities needed to perform this project. Iowa State University is designated as an EPSCoR institution.

ATTACHMENT 2

IOWA STATE UNIVERSITY
Bioeconomy Institute

1140 Biorenewables Research
Laboratory Building
Ames, Iowa 50011-3270
FAX 515-294-3091

November 19, 2014

Mayor Ann Campbell
Ames City Council
515 Clark Ave.
Ames IA 50010-6122

Re: Request for letter of commitment or support for grant application

Dear Mayor Campbell and Council Members:

With the assistance of ISU's Bioeconomy Institute we are developing a proposal, *Spatially and Temporally Optimized Landscapes for Bioenergy, Food, and Ecosystem Services* for submission to the US Department of Energy's Office of Energy and Renewable Energy (EERE) as part of the *Landscape Design For Sustainable Bioenergy* funding opportunity (FOA No. DE-FOA-0001179). The proposal is due on January 12, 2015, but due to the City's and Iowa State University's holiday schedules we wanted to provide ample time for you to consider this request for support.

The proposal involves designing and managing an agricultural landscape for energy, food, and environmental services, including mitigating downstream flood risks by strategically placing crops at specific sites where they provide optimum economic and environmental benefits. This intentionally designed landscape has the potential to spur creation of a domestic bioenergy system at the local community level as land use is optimized and logistics costs, minimized. We will focus on the Squaw Creek Watershed which drains into Ames and contributes to flooding events with increasing frequency.

As has been demonstrated by ISU researchers over the past decade, investments in renewable bioenergy technology have produced new high-yielding cultivars of switchgrass, established the value of biochar as a soil amendment, and optimized logistics including harvest, handling, storage, transport, and pre-conversion processing of biomass.[1] Despite these advances there are significant challenges remaining in the viability and deployment of a domestic biorenewables industry.

Our proposal addresses these challenges via four objectives which will involve working with the City of Ames, DuPont (Nevada Cellulosic Plant) and the Squaw Creek Watershed Management Authority. From the City of Ames we will be specifically interested in obtaining data that can inform our economic assessment of the impact of growing herbaceous crops within the Squaw Creek Watershed. We anticipate the assessment will include: the cost of cultivating and harvesting herbaceous crops in flood plains and as filter strips; **flood risk mitigation in downstream communities**; water quality improvements; impacts on wildlife and biodiversity; reductions in greenhouse gas emissions and other regulated pollutants; cost of fuels produced

[1] Moore et al. (2014). Midwest Vision for Sustainable Fuel Production. *Biofuels* (submitted).

from the harvested biomass; and implications to the Renewable Fuel Standard. An important aspect of this assessment will be to determine benefits that may available to the city of Ames through flood risk mitigation.

Of additional interest to us is the City's recent inquiry into the possibility of installing an RDF/Biomass gasifier. For the purposes of this project we simply want to understand if a biomass gasifier could provide a local market for perennial grasses and off-spec corn stover and generate a significant amount of biochar for application to agricultural fields. We will be including a gasifier in our analysis and would need to have access to city personnel and information involving the recently gasifier proposal.

If our proposal is successful we hope you will appoint a member of Council to our *Stakeholder Community Board* to provide advice to the project and to guide development of our engagement portfolio. This person will also serve as a liaison for communications between the project management team and the City.

We look forward to the City's involvement in the project as we believe we can generate information that will be of use in understanding the risks to Ames of future flood events and may provide a roadmap on how to reduce those risks.

Please send the letter of support to:

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Assistant Director, Bioeconomy Institute
1140c Biorenewables Lab
Iowa State University
Ames IA 50011-3270
(akinzel@iastate.edu)

Regards,

Ken Moore
Agronomy Department

Anne Kinzel
Bioeconomy Institute

cc Steve Schainker, Ames City Manager
encl.