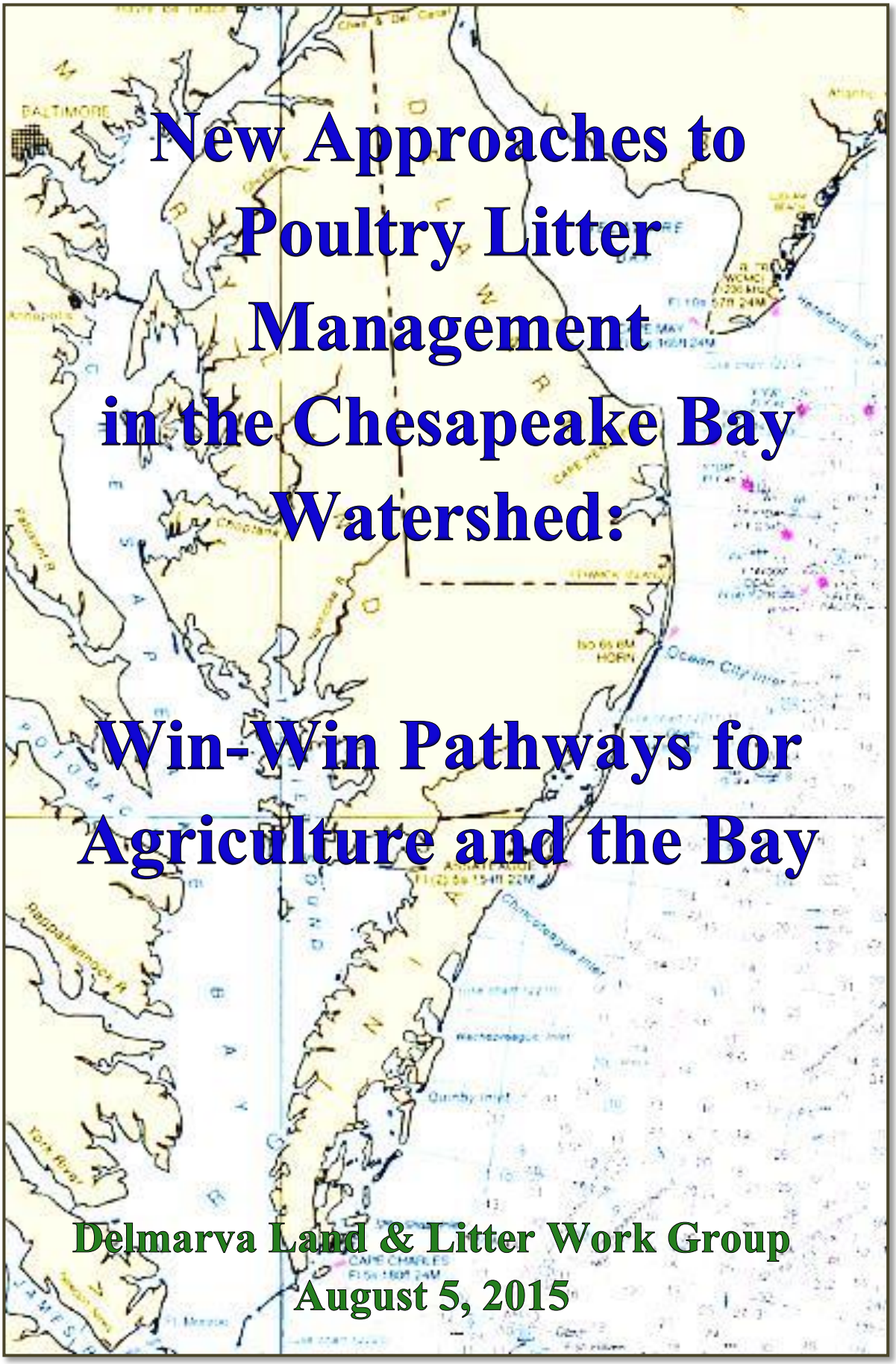


New Approaches to Poultry Litter Management in the Chesapeake Bay Watershed:

Win-Win Pathways for Agriculture and the Bay

Delmarva Land & Litter Work Group

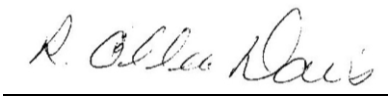
August 5, 2015

Delmarva Land & Litter Vision & Goals

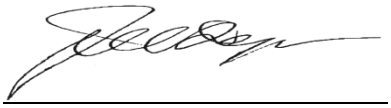
Delmarva farmers and their agri-business partners are respected stewards of the land, guardians of natural resources and champions of the rural cultural heritage in the Chesapeake Bay watershed:

Together with our partners we commit to provide catalytic leadership to accomplish the following goals by 2025:

- ***Delmarva agriculture is regionally neutral in importing and exporting nutrients, and wherever possible, nutrients are recycled locally to support sustainable agricultural operations; and***
- ***Nutrients are utilized in farming operations without negative environmental impacts.***



Allen Davis



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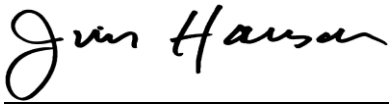
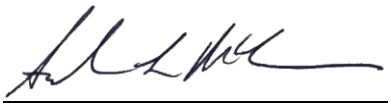
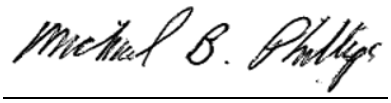


Jim Hanson

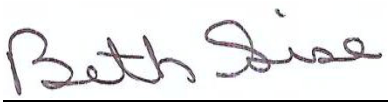


Andrew McLean, Co-Chair

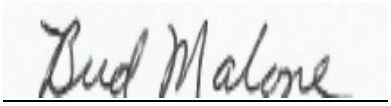
Bob Monley



Michael Phillips



Beth Sise



Bud Malone

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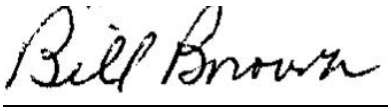
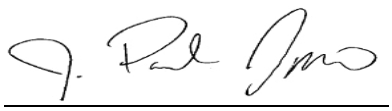
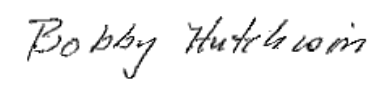


Bill Brown

Chip Bowling

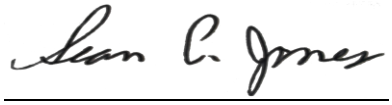


Paul Spies

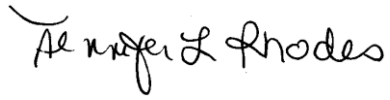


Bobby Hutchison, Co-Chair

Hans Schmidt



Sean Jones



Jennifer Rhodes

Foreword

This report outlines a new way forward for managing nutrient pollution associated with the storage, transport and land application of poultry litter on the Delmarva Peninsula. It was developed by a self-directed cadre of leaders which included grain producers, chicken growers, poultry integrators, conservationists, academic partners; along with agribusiness, finance and service providers. We had the honor and privilege of serving as the Co-Chairs of the leadership team that guided the project and produced this report.

"A healthy and productive Chesapeake Bay is underpinned by a vibrant and sustainable agricultural economy in the watershed"

The new way forward we are recommending begins with a new vision for the future; a future where a healthy and productive Chesapeake Bay is underpinned by a vibrant and sustainable agricultural economy in the watershed. Our vision does not force a choice between these two outcomes; we have high confidence that both can be achieved simultaneously.

Our report begins with a vision, because we believe that doing so provides a way to refocus conversations from current challenges to desired outcomes; to reenergize and strengthen agricultural, conservation and environmental collaboration and leadership in bay restoration efforts; and to expand innovative, multidisciplinary approaches to agricultural land management that deliver multiple solutions from the land.

In the future we envision, Delmarva farmers, and their agri-business partners, will deliver and be rewarded, not only for producing high value food, feed and fiber, but also clean energy and ecosystem services, such as clean water, flood control, nutrient recycling, carbon sequestration and provisioning of habitat. By doing so, they will earn society's respect as stewards of the land, guardians of natural resources and champions of the rural cultural heritage in the Chesapeake Bay watershed.

Towards this end, and together with our partners, the Delmarva Land & Litter Work Group commits to provide catalytic leadership to ensure the successful delivery of these multiple, high value solutions from the land.

We invite all Chesapeake Bay stakeholders to join us in an epic collaborative effort to achieve these outcomes.

Sincerely,

Bobby Hutchison, Co-Chair
Grain Producer
Cordova, Maryland

Andrew McLean, Co-Chair
Poultry Producer
Sudlersville, Maryland

Table of Contents

Project Overview …..……..…….. 1

Principal Findings……..……..……. 2

Barriers to Forward Progress……..... 4

Win-Win Pathways……..……. 8

Recommendations…….…….…..……. 9

Path Forward …..…..…..…..…..…..…….……..…..…….……..14

Acknowledgements……. 16

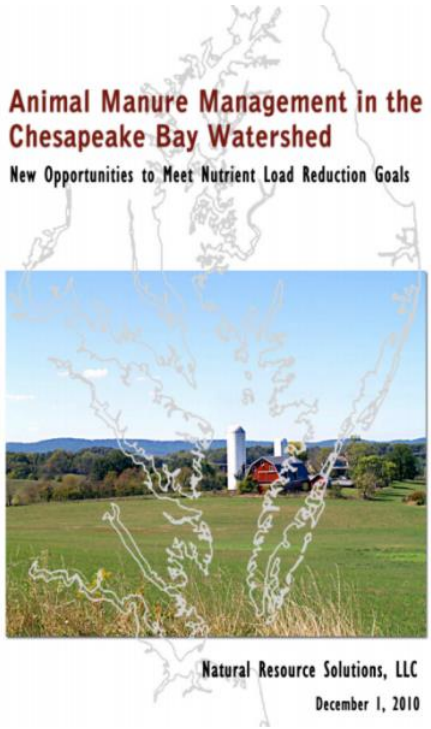
Project Leaders……..... 17

References…….….. 18

Project Overview

"In the Chesapeake Bay watershed, all sectors have a responsibility and moral obligation to reduce nutrient pollution"

Through the Delmarva Land and Litter Project, a "kitchen cabinet" Work Group composed of a diverse cross section of grain growers, poultry producers and integrators, academic experts, extension agents, along with conservation and business partners, came together to assess progress in managing nutrient pollution associated with the storage, transport and land application of poultry litter on the Delmarva Peninsula. One of the group's primary objectives was to broaden the dialogue with producers and value chain stakeholders on ways to utilize manure and poultry litter beyond what is needed to support crop production. The Work Group's mission was to review the "current state" of litter management and identify economically viable agronomic, technological or market based strategies, solutions and management models that can be deployed to abate agricultural nutrient pollution and utilize poultry litter that can no longer be land applied on phosphorous saturated soils.



The Work Group's efforts build on previous work completed under the Chesapeake Bay Manure Management Project, a 2009-2010 initiative, which culminated with the release of the report "*Animal Manure Management in the Chesapeake Bay Watershed- New Opportunities to Meet Nutrient Load Reduction Goals"*[1]. That initiative explored opportunities to harness emerging technologies and markets that can transform excess manure nutrients from animal agriculture operations into value added by-products that enhance net farm income and offset costs of containing or treating waste streams that cause environmental problems. A critical focus was put towards identifying ways manure could be managed to help meet environmental goals while simultaneously improving the farmers' bottom lines. A primary finding of the project was that while there were no "silver bullet" solutions for managing animal manure and litter, there were a number of components and collateral programs which, if better

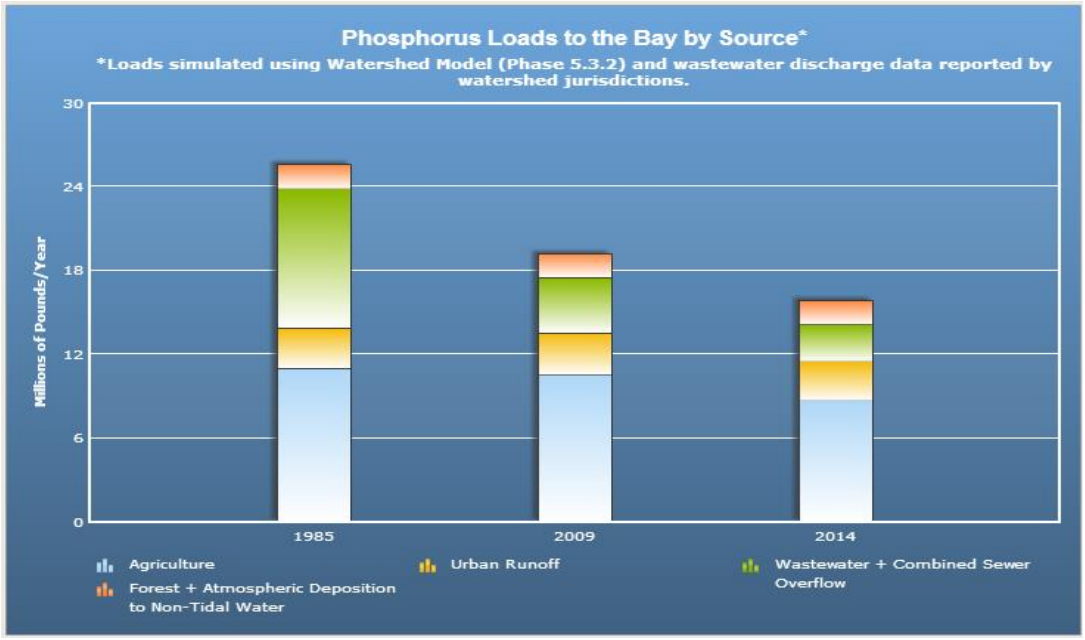
integrated, could help meet the nutrient reduction targets that were being established through the federal total maximum daily load program under section 303 (d) of the Clean Water Act.

The Delmarva Land and Litter Project began with one-on-one and small group listening sessions and information gathering interviews with chicken growers, grain producers, dairy farmers, poultry integrators, bankers, government officials, extension specialists, conservationists and value chain service providers. The objectives of these interviews was to obtain views on progress to date in addressing poultry litter related water quality challenges; surface fresh ideas for managing surplus manure and litter; and determine best strategies and tactics for engaging progressive leaders on solutions. Information gleaned from the interviews helped inform the Work Group which formulated the findings and recommendations outlined in this report.

Principal Findings

"Farmers have reduced nutrient loadings to the Bay and its tributaries. However, much work remains to be done"

Federal and state reports confirm that substantial progress has been made over the past five years in reducing nutrient pollution associated with animal agriculture operations. Aided by expanded soil testing, greater attention to nutrient management planning, the adoption of precision agriculture technologies, equipment and practices, as well as the transport of manure and litter away from areas with phosphorous saturated soils, farmers have reduced nutrient loadings to the Bay and its tributaries.[2] However, much work remains to be done if the ambitious pollution reduction goals established under the EPA's total maximum daily load program are to be achieved.



Based on our review of poultry litter land application and alternative use strategies developed over the past five years, we have concluded that many of the conclusions and recommendations in the 2010 "*Animal Manure Management in the Chesapeake Bay Watershed- New Opportunities to Meet Nutrient Load Reduction Goals"* report are still relevant and applicable today.

These and other findings we discerned through our work follow.

- In the Chesapeake Bay watershed, all sectors have a responsibility and moral obligation to reduce nutrient pollution.

- Land application of animal manure and litter in support of the nutrient needs for crop production remains the primary method of managing manure in the Chesapeake Bay Watershed. When litter can be land applied at proper agronomic levels, this remains the most cost-effective and technologically feasible method of managing manure.

"While the policies and practices of the past have produced some positive results, they will not meet the needs of tomorrow"

- In some areas, the long history and repeated application of manure and other fertilizers on the Delmarva Peninsula has resulted in fields having phosphorous levels in excess of levels needed for successful crop growth. Soils saturated with excess phosphorous can increase nutrient runoff and leaching to the Chesapeake Bay and its tributaries.

- A number of technologies can recover nutrients and energy as value added by-products from animal manure and poultry litter but most are still expensive to implement and are in various stages of development. Nutrient and energy technologies must be fully integrated and offer economically viable solutions if they are to be commercially accepted by either the farming or the investment community.

- Successful alternatives to today's land application of manure/poultry litter must change the material to a more concentrated, lighter by-product that is less costly to transport and apply (i.e. biochar), and/or convert the litter to a higher value product for new markets and uses, including: energy (heat, liquid fuels, electricity), nutrient products (mineral ash, organic fertilizers, compost), recycled material for bedding, or sterile ingredients for feed.

- Since the technologies for producing these value added products are not mature (or widespread), the operation and maintenance requirements for new technology waste-treatment systems are critical, and are often well

beyond the skill set available at the farm level. Hence, there is a growing need within the animal agriculture sector to have full service providers available if the technology is to be deployed appropriately.

- Progress in land application of manure and poultry litter shows that new techniques can not only benefit crop yields, but can also make more efficient use of nutrients applied and therefore minimize nutrient loss. Research data continues to reinforce the fact that with advancements in precision agriculture equipment and technology, "nutrient use efficiency" for plants can be further improved with more precise applications, such as accounting for point to point field variations, and/or the adoption of 4R nutrient stewardship techniques—right source, right rate, right time and right place.

- Government and market incentives to offset investments, costs of maintenance of existing and new technology systems, and marketing of manure and litter byproducts are needed in order to enable agricultural producers to achieve pollution reduction goals while remaining economically viable in the long-term.

- Despite regulatory concerns, moderate growth of the poultry industry continues on the Peninsula. A trend to more organic production, larger houses with larger animals is emerging.[3]

Barriers to Forward Progress

Over the course of the project, we identified a number of barriers that are impeding increased adoption of practices and technologies that can add to agricultural nutrient pollution. Chief among these are:

Fear and Erosion in Trust

Incomplete and/or outdated data documenting the scope, scale and location of poultry related nutrient pollution and the proliferation of inconsistent or nonaligned federal and state agricultural nutrient pollution regulations have driven many farmers to believe that politics rather than sound science are driving land management policy decisions. Many feel that the significant progress they have achieved over the past decade in controlling erosion, reducing inputs, and managing litter to mitigate environmental impacts, has not been recognized or given appropriate credit. Farmers and growers have a proud tradition of being stewards of the land. They are frustrated that their positive contribution to the

environment is not viewed more positively by environmentalists and some policy makers. On the positive side, consensus appears to be growing among environmental stakeholders in the watershed that sustainably managed farms are far better for the Bay than commercial land development.

Incomplete Data & Geographic Characterization

Ongoing concern about nutrient levels across the Chesapeake Bay Watershed has led many to believe that a better approach is needed to quantify nutrient levels, identify areas of excess phosphorous concentration and to find ways of achieving mass balance. While most are in agreement that mass balance calculations are the key to managing nutrients, additional research and analysis work is needed to help the Delmarva Peninsula evolve to become regionally neutral in importing and exporting nutrients.

Of significant concern and importance is the accuracy of the Chesapeake Bay Program's model and estimates of the amount of phosphorous coming from the poultry industry. A widely held industry view is that current data being modeled does not accurately reflect the number of birds or the amount of poultry litter that is being produced, and therefore misrepresents the actual concentration of phosphorus on the Delmarva Peninsula. It also does not capture and factor the benefits of conservation best management practices that are being voluntarily adopted by producers. Fortunately, the Chesapeake Bay Program recognizes the weaknesses of the current model and recently approved a series of recommendations, developed by a team of state agriculture department, Land Grant University and poultry industry representatives, designed to better estimate poultry litter production on the Peninsula. It is our understanding that EPA plans to begin incorporating these new estimates into the Chesapeake Bay Program model beginning in 2016. Like all models, the Chesapeake Bay model is limited by the quality and availability of the data. For this reason, it is incumbent on producers to provide quality data so their conservation and nutrient reduction contributions can be counted.

In site-specific areas or at the farm level, approved nutrient management plans, together with soil phosphorous levels, are used to determine application rates. Unfortunately, verified data is not readily available on a regional basis to determine how much and how efficiently litter can be land applied locally, and

whether poultry litter requires redistribution and transport to areas in need of nutrients to achieve the regional balance.

Slow Evolution of Alternative Use Technologies

Over the past five years, a variety of alternative technologies have been evaluated for converting manure and litter into value added products. The categories of greatest potential and possible net return on investment include:

- nutrient use (organic fertilizer, compost, biochar etc.);
- energy (biogas, heating oil, electricity, heating/cooling applications); and
- water re-use and management (flushing, irrigation, animal watering needs).

AgriRecycle, LLC, Seaford, DE

In the nutrient use arena, Perdue built a large-scale facility in Seaford, Delaware to capture and recycle nutrients from poultry litter. While the AgriRecycle facility has demonstrated its capability of producing a commercial fertilizer product, the facility has been unable to operate in a way to take advantage of its full production capacity and be economically viable.

In the manure-to-energy arena, scale matters. We found that the trend that is emerging for alternative uses of poultry litter is that larger projects tend to be better matched for technologies that generate electricity that can be sold into the grid, while smaller scale projects (i.e. farm scale) are better suited for technologies which can meet the heating needs of poultry houses. *Figure 1* shows the location and energy by-product of the demonstration projects previously tested, planned for installation or operating today in the Chesapeake Bay Watershed.

MANURE TO ENERGY OPERATIONS		
Location	**Farm-Technology Supplier**	**Energy Recovery/Byproduct**
1-Dorchester County, Maryland	*Murphy Farm – BHSL*	*house heat/cooling*
2-Lititz, Pennsylvania	*Flintrock Farm – Enginuity*	*house heat*
3-Milford, Pennsylvania	*Mac Curtis Farm – Total Energy*	*house heat*
4- Port Republic, Virginia	*Riverhill Farms – LEI Bio-Burner*	*house heat*
5-Lancaster, Pennsylvania	*Earl Zimmerman – Total Energy*	*house heat*
6-Strasburg, Pennsylvania	*Mark Rohrer – Global Refuel*	*house heat*
7-Wardensville, West Virginia	*Frye Poultry – Coaltec Gasifier*	*house heat>biochar*
8-Ft Seybert, West Virginia	*Mike Weaver Farm – Global Refuel*	*house heat*
9-Pocomoke City, Maryland	*Millennium Farms – Planet Found AE*	*100 KW elec gen*
10-Gettysburg, Pennsylvania	*Hillandale Farms – Energy Works*	*3.25 MW elec gen*

Figure 1

Significantly, farm scale projects in the watershed have been sponsored and supported with strong collaboration, and stakeholder funding from the National Fish and Wildlife Foundation, USDA, nonprofit organizations and key landowners. Without this financial support, the emergence and advancement of these technologies for on-farm poultry applications would not be possible.

"Technology continues to develop slowly and is emerging based on economies of scale and return on investment"

Today, multiple technology vendors are competing with different systems designed to meet house heating needs at poultry farms, and displace propane use. Through the dry heat offered by these systems, projected improvements in bird health and feed conversion rates may be realized.

Few anaerobic digestion (AD) processes have been advanced for treating poultry litter, as these processes are more typically employed on dairy farms where storage and handling of wetter forms of manure is routine. One project worth noting is the Maryland grant funded effort at Millennium Farms in Pocomoke City. Since nutrients are not destroyed in the digestion process, this system hopes to capture energy and extract phosphorous, leaving the residual nitrogen and potassium to be safely recycled on local farmland.

Our bottom line conclusion: technology continues to develop slowly and is emerging based on economies of scale and return on investment.

Inadequate Investments in Research, Demonstration and Monitoring

Capturing the steep learning curve in alternative uses of manure and litter requires thorough monitoring and credible third party involvement. Extracting valuable information during any demonstration project is very important and is more credible when the data provided is farm scale and is not provided solely by the vendor. It is also helpful when the academic community, the network of regulatory entities, and all critical stakeholders work closely together to get a complete data set that is deemed important. Unfortunately, little of this type of collaboration is happening today on Delmarva, especially with regard to production oriented research in high-yield

"On-farm project demonstrations, progress reports and on-site visits remain powerful learning experiences for farmers"

environments that contribute to higher nutrient removal rates from cropping *systems.*

Today's reality of basic and applied research funding doesn't promote or focus development along a continuum (i.e. from lab or bench scale testing through a pilot scale to full scale on-farm demonstrations). Yet, on-farm project demonstrations, progress reports and on-site visits remain powerful learning experiences for farmers. Unfortunately, the avenues for communicating and managing this information are not widespread. One institution that is attempting to bring more information about manure management techniques is the University of Nebraska at Lincoln (UNL) – through its Poultry Learning Center newsletter and on line programs. Lacking a formal clearinghouse in the Chesapeake Bay Watershed, several manure-to-energy projects will be evaluated with the help of the Maryland Finance Center.[4] The Center plans to document technical, environmental and financial feasibility of these projects and will post results on the UNL websites.

"Rules governing state manure and litter transport assistance are not uniform creating a complicated maze of bureaucratic obstacles for transporting litter"

Regulatory Incoherence

Within Delmarva, growers and haulers are aware that regulation and policy are not uniform from state to state, even though they all operate in the same region. For example, within the region, the number of days litter piles must be covered varies from 14-90 days depending on the size of the operation and the state that you are in.

Unfortunately the nutrient management planning requirements, as well as eligibility requirements and rules governing state manure and litter transport assistance are not uniform, thus creating a complicated maze of bureaucratic obstacles for responsible land application of poultry litter. The net effect of non-uniform and changing regulatory environments is financial uncertainty and unnecessary complexity for grain farmers, poultry growers, litter haulers, and integrators in managing nutrients associated with poultry production.

Win-Win Pathways for Agriculture and the Bay

Despite the significant progress that farmers and the poultry industry have achieved to date in reducing pollution from poultry litter on the Delmarva Peninsula, we believe that more must be done to meet the nutrient reduction targets that have been established for the agricultural sector. To achieve these goals, producers, industry leaders, value chain and academic partners, as well as

government officials need to work smarter. Strengthened and improved communication, coordination and collaboration amongst these stakeholders are critically needed. While the policies and practices of the past have produced some positive results, they will not meet the needs of tomorrow, where an ever growing population in the watershed will further threaten the economic viability of the agriculture sector, and the multiple economic and environmental contributions it provides.

The Delmarva Peninsula is a unique region and ecosystem defined in large part by its agriculture economy, and the environmental and aquatic attributes of the bay and its tributaries. To improve the delivery of environmental and economic values from the land, we recommend moving away from "silo management", where jurisdictions operate independently and manage for singular objectives. A new forum is needed for collaboration; one where public and private sector stakeholders committed to addressing nutrient pollution from animal agriculture operations can work across county, state and watershed boundaries and design and deploy better integrated and more uniform policies, programs and projects. In short, we believe that a new way forward is needed for addressing water quality challenges from animal agriculture operations. The new way forward that we are recommending embraces integrated and landscape scale strategies for managing nutrients, and utilizes economic incentives in the form of ecosystem service payments to compensate farmers for the environmental services they generate on their working farms.

"We believe that a new way forward is needed for addressing water quality challenges from animal agriculture operations"

Recommendations

As members of the Delmarva Land and Litter Work Group, we recommend that efforts to address nutrient pollution associated with poultry production on the Delmarva Peninsula should remain focused primarily along two pathways:

a) ***Responsible land application of animal manure and litter; and***

b) ***Alternative uses and markets for manure/poultry litter.***

In support of these efforts we have identified five major recommendations for the consideration of policy makers, government officials, farmers, chicken growers,

poultry integrators, agribusiness value chain partners, universities, conservationists and environmentalists, other Chesapeake Bay stakeholders and land management project funders. If implemented, we believe that significant progress could be achieved in meeting the nutrient reduction goals that have been established for the agricultural sector. The end result would be pathways for land management that will improve the health and productivity of agriculture and the Bay, while strengthening the economy that preserves and protects the region's rural cultural heritage.

1. Create and Support a Landscape Scale, Multi-Stakeholder Leadership Platform for Addressing Agricultural Nutrient Pollution

Across the country a new model is emerging for managing agricultural landscapes. Common characteristics of this model include efforts to implement landscape-scale solutions; the forming and empowerment of multi-stakeholder action teams and partnerships; the harmonization of policy frameworks; the establishment of financial rewards for stewardship of ecosystem services; energizing and coordinating research; and transforming and modernizing information networks.

"The new model we are recommending is less top-down regulatory driven and more bottom-up stakeholder led"

The new model we are recommending is less top-down regulatory driven and more bottom-up stakeholder led. It acknowledges the reality that farmers must plan and manage land sustainably to meet economic, social and environmental objectives. Under this model, coalitions composed of farmers, land managers, scientists, environmentalists and regulators work together to forge consensus on integrated policies, practices and projects at a landscape scale that will result in land being sustainably managed to produce food, feed, fiber, and energy while enhancing biodiversity, improving water quality and protecting and improving critical environmental resources.

Support for this type of public-private stewardship partnership model is growing, as evidenced in the passage of the 2014 Farm Bill, where a new Regional Conservation Partnership Program was established to support conservation projects designed by local partners. Of particular importance to us, the Chesapeake Bay Watershed is one of eight critical conservation areas established under the program. While the management model we envision would benefit from direct government support, private sector endorsement and financial investments will be required.

Proposed Action: We propose that farm, agribusiness, environmental, academic and government leaders involved in animal manure and poultry litter management come together to participate in a dialogue around how such a new model might work on Delmarva, along with how it could be formed, resourced, supported and replicated in other areas. The initial areas of focus and deliverables for the dialogue should include:

- a vision and mission statement;
- guiding principles to facilitate the effective functioning of the coalition;
- a set of desired economic, environmental and social outcomes;
- initiatives that can produce win-win outcomes for agriculture and the bay;
- mechanisms for sharing information, creating centralized and searchable databases and inventories of programs for addressing manure and litter challenges;
- the identification of common barriers and ways to collaborate more effectively in planning and delivering services;
- methods and mechanisms for monitoring success and measuring progress; and
- arrangements for funding and management support services.

We invite all stakeholders who share our vision and desired outcomes to join us in this dialogue and exploration of solutions that can be delivered from the land.

2. Invest in Mass Balance Research and Analysis

An ongoing integrated research program that uses validated "on the ground" and regularly updated data and proven methodologies are critically needed if we are to understand nutrient levels and pathways within Delmarva.

Proposed Action: We recommend that the land grant universities serving the Delmarva Peninsula collaborate, in partnership with poultry integrators and other stakeholders, in designing, implementing, and financing an ongoing integrated research program to model nutrients at all levels. Such an effort might begin at the county level, factoring up-to-date data on nutrient uses by crops grown, chemical fertilizer usage, poultry production with litter/nutrient estimates and a geographic

overlay of phosphorous saturated soils that would restrict land application. While data acquisition to support this research is necessary, it must be done in a way that preserves confidentiality as producers compete against their neighbors for yields, quality, markets and the price they receive for the commodities they produce. The results of this research must be updated annually and distributed to farmers and modelers so that the Bay model and farm practices can evolve together. Updated mass balance analyses would show how much potential "surplus" litter is available for an alternative use and indicate the kind and scale of technology that should be encouraged. For some areas it may be better to encourage redistribution of litter, while other areas may require larger scale alternative use technologies.

3. Support and Fund a Virtual Poultry Nutrient Management Resource and Demonstration Program

Mobile pyrolysis unit that converts poultry litter to biochar and heating oil; Source: FPPC

As was confirmed in the 2010 *Animal Manure Management in the Chesapeake Bay Watershed* report, there are many nutrient reduction technologies and systems in various stages of development in the watershed. Many technology providers are offering partial solutions, and while some of those claims have technical merit, they are usually not substantiated in a farm environment or have not qualified with "manure" feedstock. In addition, the large majority of solution providers do not provide a fully integrated solution for the farm – an important attribute for developing an economical solution.

This finding still holds today and reaffirms the need for an objective, third party evaluation support system where new technologies and integrated solutions sets can be "piloted", and data relative to technical and economic feasibility can be centrally gathered for use by producers and lending agencies.

Proposed Actions:

- Establish a center of excellence on the Delmarva Peninsula for ongoing nutrient management support, staffed by technical experts, practitioners, engineers and researchers. The center will support and shepherd regional demonstration of alternative use and precision agriculture technologies. Site visits and technical exchanges coordinated by the center will be third party credible, routine and cost effective.

- Establish a clearinghouse program for information and learning so that knowledge is readily accessible and past lessons learned are leveraged.

- Utilize a public/private sector funding mechanism to support the clearinghouse and demonstration programs for pilot scale deployment of manure and litter technologies.

4. Standardize Regulations for Manure and Litter Storage, Transport and Use

Throughout our information gathering phase of this project, we consistently heard from farmers, poultry producers and litter haulers that lack of uniformity in eligibility requirements and rules governing state manure and litter transport assistance programs on Delmarva were a major challenge in relocating litter to areas where its high nutrient value could be utilized without impacting water quality. The following recommendations are offered to help streamline and standardize programs, thereby facilitating the transport of litter away from areas with phosphorous saturated soils.

Proposed Action: We recommend the Maryland, Delaware, Virginia and Pennsylvania Departments of Agriculture work with a multi-stakeholder leadership platform in evaluating the benefits of harmonizing programs or establishing and jointly funding a regional manure and litter transport, storage and use program. Key areas of focus for this examination should include ways to:

- Adopt a goal of continuous improvement in nutrient use efficiency to encourage proper use of nutrients and less loss to the environment.

- Improve uniformity of regulations and work to eliminate different regulations across the region (state to state) for storing, transporting and using manure and poultry litter.

- Incentivize and fund precision application practices, technologies and equipment that can improve the placement and timing of nutrient applications.

- Simplify data collection and streamline transport programs.

- Provide indemnification protection for those who properly store, transport and apply manure and poultry litter.

- Encourage common biosecurity measures to reduce risk of contamination and the spreading of disease when litter is moved from individual farms to centralized collection facilities.

- Allow for in-field storage through the establishment of best management practices for constructing and locating piles.

5. Create and fund financing mechanisms that support bundled technologies

Because most on-farm or community scale alternative use technologies for manure and litter remain in a pilot scale phase of development, the need still exists for public and private sector programs to finance the deployment of bundled technologies and processes that deliver both nutrient reduction and energy recovery services along with value added end products. Towards this end, we recommend the following initiatives be undertaken.

Proposed Actions:

- Find and establish financing mechanisms (e.g. cost sharing, grants, commodity check-offs, low interest loan and loan guarantee programs) for advancing improved manure and litter solutions involving land application and alternative use of manure and litter.

- Prioritize competitive research funding, practice application and extension work supporting bundled technologies that concentrate and deploy nutrients effectively and are fully integrated into systems that link processes, byproducts, income and benefits for the farmer.

- Amend agricultural conservation programs to allow equipment that incorporates litter into the soil to be eligible for cost sharing.

- Leverage interest and generate supporting funds from industry.

- Develop an educational program on the value of litter to encourage its use in areas where it could be used without causing nutrient pollution.

- Analyze appropriate scale of technologies based on development of well-vetted environmental and economic considerations.

Path Forward

Through our work together exploring new ways to abate pollution associated with the storage, transport and land application of poultry litter on the Delmarva Peninsula, we have come to appreciate the reality that environmental, economic, energy and quality of life goals are all interconnected. Rather than pursuing each separately using our own individual lenses to assess options and measure progress, a better way forward would be for our communities to come together, forge consensus on the future we seek, and collaborate in actions to achieve shared goals. Maintaining a healthy bay and a vibrant agricultural economy in ways that support both will require a mammoth undertaking characterized by fresh thinking, a willingness to experiment with new approaches and the formation of trust relationships with communities that for decades have too often pursued win-lose, rather than win-win strategies. Aided by advancements in technology and our commitment to the stewardship and wise management of our natural resources, we are prepared, in a subsequent phase of work, to provide catalytic leadership in solving poultry related nutrient pollution problems on Delmarva. We invite other partners to join us in addressing this epic challenge.

Acknowledgments

The Delmarva Land & Litter Work Group is indebted to the following organizations, companies and agencies for their frank comments and thoughtful recommendations. We appreciate both their candor and their sincere desire to create and nurture win-win pathways for agriculture and the Bay.

A Allen Harim; Amick; **C** Centennial Farms; Center for Climate and Energy Solutions; Chesapeake Bay Commission; Chesapeake Bay Foundation; Chester River Association; **D** Deerfield Farms; Delaware Department of Agriculture; Delmarva Poultry Industry, Inc.; **E** Ellis Farms; Environmental Integrity; **F** Fanttell Farms; **H** Hatcher Communications; Hughes AgroEcology Center; Hughes AgroEcology Poultry Work Group; **J** Jones Family Farm; **K** Keith Campbell Foundation for the Environment; Kellogg Foundation; **M** Malone Poultry Consulting; Maryland Agriculture Commission; Maryland Agriculture Associates; Maryland Association of Soil Conservation Districts; Maryland Chesapeake Bay Cabinet; Maryland Department of Agriculture; Maryland Department of the Environment; Maryland Farm Bureau Federation; Maryland Grain Producers; Maryland League of Conservation Voters; Maryland State Soil Conservation Committee; MidAtlantic Farm Credit; Mountaire; **P** Perdue Farms Inc.; **S** Sustainable Chesapeake **T** The Nature Conservancy; Tyson Foods, Inc.; **U** University of Delaware; University of Maryland; **W** Waterkeepers Chesapeake; WestRhode Riverkeeper.

This self-directed project was funded through a grant from the Keith Campbell Foundation for the Environment. The project was facilitated and managed by Natural Resource Solutions, LLC, a conservation and natural resource management consulting and coalition building firm, located in Lutherville, Maryland

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[4]University of Maryland, Environmental Finance Center. http://efc.umd.edu/manuretoenergyinitiative.html#.VbaTB6RVhBc

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