Great Lakes Watershed Ecological Sustainability Strategy (WESS) Final Report

July 2015

Introduction

The Watershed Ecological Sustainability Strategy (WESS) is a collaborative effort of the Great Lakes Protection Fund, LimnoTech, Michigan State University (MSU) and The Nature Conservancy (TNC). WESS is designed to guide agricultural watershed management in the Great Lakes for clean, abundant water to meet the needs of people and nature. It is deployable from the farm-field to large-scale watersheds.

WESS transparently enables goal-setting and decision-making for all involved watershed parties, especially the agricultural supply chain (supply chain) and federal/state/local governments, interested in sustaining environmental health and economic activity.

The WESS framework/process is built on biological response curves to set real-world goals and widely-adopted models/algorithms that enable and quantify impacts of management decisions to reach those goals. At this point WESS is a first generation application, and is expected to improve over time as technology and information management systems advance, adoption expands, and demand grows for clean water from agricultural regions.

WESS was tested in real-world case study transactions (direct farmer payments, county drain assessments, nutrient service provider certification and farm operation certification) to demonstrate application potential. It has gone "live" and is now deployed in early stages of application across parts of the supply chain.

WESS was initiated by a multi-disciplinary team (Appendix A). Team expertise includes agricultural economics, aquatic ecology, computer modeling/simulations, agricultural production, project management, agricultural best management practices, agency/external relations and marketing/communications.

The project team drew content from other similar activities and adapted them to strengthen and leverage WESS. In particular, we benefitted from engagement with the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) and Agricultural Research Service (ARS), the Army Corps of Engineers and Michigan State University's Institute for Water Research. Their data, models and tools strengthened WESS and have helped prepare it for broader application.

This report provides a narrative evaluation of WESS' initiation from January 2012 – June 2015 in the Maumee, Saginaw Bay, and Paw Paw River watersheds. It summarizes the project process and assesses the project's impact. Materials and information developed during the course of the project are available at http://nature.ly/GLWESS

Process, Learning and Real-World Impact

1. WESS Workshops

Target Workshop Audience The project team held workshops in 2012 and 2015. The 2012 workshop brought together food industry and farm sector representatives to explore the potential for supply chain standards and product certification to promote farm-level conservation practices, specifically to target nonpoint source pollution. The 2015 workshop addressed WESS results and learning with a cross-section

of participants from the supply chain, government agencies and conservation practitioners. For WESS purposes the supply chain is defined broadly as the input, production and output sectors for food, beverage, fuel (grain ethanol) and specialty products derived from commodity crops such as corn, soy and wheat. In addition to the two structured workshops, project team members continue to engage with other audiences and members of the supply chain to advance the WESS concept (e.g. Coca Cola, Keurig Green Mountain, Field to Market, Kellogg, Cargill, General Mills, Bunge and may others). The team also continues to interact and work collaboratively on this concept with government agencies that have a governance role in this domain (e.g., U. S. Environmental Protection Agency, U. S. Department of Agriculture-Natural Resources Conservation Service, U. S. Geological Survey, Ohio Environmental Protection Agency, Michigan Department of Environmental Quality, and Michigan Department of Agriculture and Rural Development).

Workshop Learning and Impact

Overall, the workshops helped catalyze relationships that helped form the foundation for new field projects, both demonstration and real-world, with the supply chain, government agencies or both. The workshops helped the team better position and define WESS.

Four primary lessons emerged from the 2012 workshop, including but not limited to:

1. Business to business supply chain standards are preferable to business to consumer certification, which hinges on consumers' willingness to consistently pay more for a certified product. The food/beverage sector was overwhelmed at that time by various certification schemes (particularly regarding food safety) and was contemplating a "pre-competitive" standard for verification adopted by all major participants.
2. Spend more time on the input-side of the supply chain such as feed, seed, fertilizer and information services as they may be more subject to pressure, and this offers better opportunity to influence practices than on output markets.
3. From the food industry perspective, standards of grain commodities must be addressed at a large scale (e.g. North America corn/soy belt); isolated regional efforts (e.g. Great Lakes) will not get industry to an efficient scale that meets its needs.
4. Any successful standard must be outcome-based; the advisory panel and workshop participants strongly endorsed the WESS approach.

The 2012 workshop helped our team make connections which have, in turn, led to WESS application beyond the project's initial scope. For example, the team is starting to influence and make headway into companies serving North American and global markets (e.g. Kellogg, Bunge, General Mills and others). The first workshop also helped the team better understand the needs of the supply chain environment where WESS could offer value.

Since the 2012 workshop we have observed more attention focused on environmental outcomes across the supply chain, and a more serious movement by the industry to figure out what this means. At present the supply chain seems to be the most influential driver for change and it may be the best bet for advancing the WESS concept into broad-scale practice. Increasingly, companies are interested in making verifiable claims on the environmental performance of their growers/suppliers. The attributes of environmental performance vary; for some companies it is greenhouse gas reductions, for others it is water quality/quantity improvements, and still others are fine with "continuous improvement" for marketing purposes. Whatever the desired sustainability attributes(s) the scale of claims remains important to all companies. What we are finding is that WESS is attractive because it can work at the farm-field scale and roll up across large-scale watersheds.

The 2015 workshop allowed us to tell the WESS "story" and talk about real world applications and results; this proved invaluable. It seems that as WESS exposure increases and its application is understood and demonstrated, its attractiveness grows. A couple new lessons emerged. First, we are seeing that our transaction demonstrations are of broad interest. Second, we learned that in the Great Lakes, where corn/soy are rotated with other crops (e.g. dry beans or wheat), a standard imposed on these crops could carry over to corn/soy. Another point made (that was beyond the scope of this project but we want to pursue moving forward) is the potential to influence standards through capital financing (banks or other lenders).

2. Watershed Goals and Performance Management

WESS was designed to move from activity-based to outcome-based watershed management, shifting from "means"-based to "ends"-based conservation. To do this the project team established relationships between riverine/coastal water quality and agricultural practices (aquatic biological response curves), used that information to establish watershed-scale goals and then tested BMP performance transactions that are intended to reach those goals. The project team applied different models to set goals and then adapted them into tools to manage performance. The models/tools were prototyped in this project and continue to undergo revision and improvement.

The project team tested goal-setting in three watersheds for either riverine or coastal water outcomes:

* Paw Paw River sub-watersheds (riverine sediment goal),
* Maumee Watershed and Western Lake Erie (coastal water nutrient goal), and
* Saginaw Bay watersheds (riverine nutrient goals)

After the team established outcome-based water quality goals, it turned to developing a prototype environmental performance management tool to both guide management approaches and measure progress toward goals. Because agricultural practices change annually within a field and across a watershed, the team tested an accounting function to track the cumulative impacts of practices over multiple years. (Note: One of the emerging performance tools – the Great Lakes Watershed Management System - was developed by Michigan State University's Institute for Water Research and was adapted for transactions in the Paw Paw River and Saginaw Bay watersheds. The project team also developed a linked SWAT – WLEEM modeling system to assess agricultural management practices in the watershed in terms of their impact on Harmful Algal Blooms (HABs) in the Western Basin of Lake Erie.)

The project team intended and planned to provide a turn-key goal setting model using the latest modeling algorithms from the USDA, but delays in their model development process only allowed for a preliminary application for this project. While delayed, the refined version of the goal setting model is still underway and is scheduled for broader adoption in the Western Lake Erie Basin (WLEB) near year's end.

Goals/Performance Audience

There were three primary target audiences:

*Agricultural supply chain (new potential delivery pathway for conservation practices);
*Federal/state/local governments (current delivery pathway for conservation practices); and
*Scientific community (peer review and technical expertise).

The agricultural supply chain and governments generally understand WESS but their adoption of it varies as would be expected with a new concept in the early stage of development and application. We were

pleased with the uptake by the supply chain in a separate, industry-led project funded by USDA's Regional Conservation Partnership Program (RCPP). The RCPP application, which launches in 2015, will be the largest test deployment and a good "real world" example of broad application. We were also pleased to learn that Van Buren County Drain Commissioner will continue to deploy WESS tools in assessing landowner fees. The recent strong interest from the Michigan Agricultural Environmental Assurance Program (MAEAP) is also encouraging, as is the 4R Certification program's additional $1.35 million investment to measure the "triple bottom line" outcome impact.

While still early, members of the project team are already working outside this project with various agricultural supply chain sectors and federal/state/local governments to apply the WESS science/models at large watershed scales. For example, we anticipate other county drain commissioners will soon test it in additional Michigan counties and we are introducing it to Ohio drain managers in August.

In the near future the scientific community will have ample opportunity to critique the science and model applications in a special publication of the Journal of Great Lakes Research around the work done in the WESS project. Team members are now submitting manuscripts for this and other peer-reviewed publications.

Industry and government are slowly acknowledging that outcome-based watershed management is possible, that the WESS concept is a good (as far as we know the only) approach available at scale and that with it brings risk management capability. Behaviors and thinking are turning, as evidenced by the users mentioned above.

Goals/Performance Learning and Impact

The three-plus year project enhanced the team's learning in that it provided ample time to develop important relationships, gather important evidence and demonstrate/test some novel concepts. Here are some highlights:

WESS provides environmental risk management support to the supply chain through clear, real-world, goal-setting features, performance management and environmental claim verification. As a result, it may be, at this time, the most influential driver of change for environmental performance regarding water quality and flows. Two recent events - the 2014 Toledo water crisis and the recent Des Moines Water Works lawsuit against agricultural drain districts– have heightened agriculture's sense of awareness of the large scale problem with water. The WESS concept is positioned to help manage the solution to this problem. As a consequence, there is important space for building relationships and trust, and the WESS team members, as a result of this project, need to continue to work to occupy it.

To that end, the value of "stories", as well as good, demonstrable science and information as the backbone of those stories, is important. In some minds there is a mix of doubt and concern about "modeling" and basing management decisions upon it, so there is real value in establishing trust and, ultimately, space for understanding. There is demand for expanded goal-setting technology for application across the Great Lakes.

The team anticipates that confidence in the models will grow as they are adapted over time with new evidence-based information. On this note, model corroboration is important but expensive. Some think flow may be an adequate (and less costly surrogate) for nutrient loading models while others disagree. The team will have to work out these differing views in the future. At the same time, the team is urged

to develop WESS "version 2" information and technology as soon as possible in a user-friendly format (and while doing so assuring that dissolved reactive phosphorus is properly accounted for in drainage tile systems and other export pathways). Related to this we need to simplify the data input process and validate any simplified model revisions.
Unfortunately, nutrient goals for coastal waters are likely to be different than nutrient goals for rivers/streams. It is conceivable that, for example, a coastal waters goal may be insufficient for streams or rivers. Such discrepancies will create confusion so this problem needs attention in the near term.

The team recognizes that meeting environmental goals comes at a cost. The WESS technology must build that into the system and acknowledge that cost presents real-world challenges and opportunities. AgSolver, a new, Iowa-based company, may have a clever solution to that benefits both farmer and the environment. Some team members are now exploring the AgSolver product in the Saginaw Bay RCPP project.

Finally, to paraphrase a county drain project participant: "We can't do outcome-based work at scale without the WESS models and tools."

1. Farm Supply Chain Transactions to Meet Goals

The project team hypothesized that performance-based transactions within the agricultural supply chain would have potential to leverage the WESS concept, and therefore improve ecosystem function, at large scales. The supply chain was tested in three ways:

- modifying county drainage assessment protocols,
- measuring farmer willingness to engage in pay for performance programs,
- demonstrating verification of MAEAP and 4R retail fertilizer practices

For purposes of this project a transaction is defined as an exchange of an agricultural management practice to improve water quality for a monetary or business value (e.g. risk reduction). The WESS models/tools described above enable quantifiable, performance-based transactions; they provide value in the transactional exchange.

Process, Supply Chain Audience and Learning/Impact

County Drainage – In collaboration with the Van Buren County Drain Commissioner and the local County Conservation District, the team tested a new drain assessment approach that rewards farmers with reduced drain assessments in exchange for implementing conservation practices that keep soil sediments on the fields and out of the ditches/streams.

Drain Commissioners are the target audience as they have widespread jurisdiction over water flows in agricultural lands in the Great Lakes region. Although our project originated in Van Buren County the demonstration and results were shared with a broader audience of drain commissioners from across Michigan. This project was the first of its kind in Michigan and it has generated substantial interest from other Drain Commissioners, for the application of the models/tools or the novel transaction, or both.

In the Van Buren County demonstration the team certified conservation practices on a total of 43 fields, thereby enrolling them into the new drain assessment project. Overall, landowners experienced a reduction of 21% on their annual drain maintenance bill. Modifying the assessment was favorably received. The team learned that the Drain Commissioner will continue to use this transaction to inform county drain assessments in the future.

A broader positive sign of uptake was at this year's annual winter conference of the Michigan Association of County Drain Commissioners (MACDC), where we received overwhelming support after presenting results from the demonstration project. The team polled the audience during the presentation. Of the 67 participants attending, 30 were drain commissioners and drain office staff. Of these, almost 70% felt the approach we used was appropriate and were interested in learning how to deploy it in their own counties. There is demand for expanding the tools beyond Van Buren County. We think this is in part due to increased awareness (and maybe pressure) regarding water quality issues surfacing around the agricultural Midwest (e.g. the 2014 Toledo water crisis and the 2015 Des Moines Waterworks nutrient lawsuit).

Although there is demand for expanding the tools beyond Van Buren County, participants identified legal challenge concerns, managing the required "day of review" that accompanies any change in apportionment of drain assessments, and the need for third party assistance to manage the transactions as potential obstacles.

To bolster the evidence for managing watershed inputs to reduce drain management costs the team did briefly explore quantifying the linkage of sediment loading and drain maintenance costs but that proved beyond the scope, time and resources of the project. We learned that County Drain Commissioners do not routinely keep records that would allow this analysis; they establish maintenance costs and issue assessments based on the total cost of the maintenance project (which typically involves more activities than just sediment removal). Also, there are most surely economies of scale that drain commissions are missing by not working across watersheds. These topics and others remain for the future.

<u>Farmer Willingness to Engage</u>

The project objective was to secure better water quality outcomes using the right conservation practices to achieve greatest environmental benefit per dollar available. The primary audiences are the supply chain and government agencies (e.g. U.S. Farm Bill). Experimental auctions were held in 2013 with farmers in the Tiffin River Watershed within the Maumee River Basin to compare the cost-effectiveness of four program options, both to individual bidders and to group bidders. In 2014, the team held real, performance-based conservation auctions in two sub-watersheds of the Tiffin River Watershed to examine what influences farmer decisions in auctions. The Tiffin River SWAT (TRSWAT) model was used to quantitatively relate practices to outcomes in terms of phosphorus delivery to the outlet of the watershed.

The most cost-effective programs were direct payments and tax credits to farmers. The least cost-effective programs were BMP insurance (tied to direct payments) and product certification. BMP insurance looked time-consuming to farmers (and therefore farmers would require higher payments to participate). Product certification was not cost-effective for a different reason: It did not target environmentally sensitive fields, so although the cost was not high, the ecological benefits from many farm fields were low.

Two broad lessons emerged from the experimental auctions in 2013 concerning transaction types. First, when farmers are paid for ecological performance based on reliable models and all farmers participate, conservation practices really can get the best ecological "bang for the buck". Second, the best transactions are those that target high-impact conservation activities, and don't demand much farmer time to participate.

Farmer participation is essential for cost-effective pay-for-performance. The real conservation auctions held in two counties in the Maumee Basin in 2014 underscore this; because despite repeated contact, only 1% of landowners chose to participate in the auction. Although payments-for-performance were cost-effectively allocated to that small group, the payments would have been far more cost-effective if more landowners had participated. Clearly, there is a need to boost landowner participation in BMP auctions if pay-for-performance is to work at watershed scales. (Note: Generally, farm participation in conservation programs is relatively low. In 2010, 17% of U.S. farms received conservation payments.)

A follow-up survey highlighted ways to do this. Many landowners rent their land, so programs that explicitly target rented land may attract more participants (e.g., by focusing on an annual practice like winter cover crops and inviting renters). Another key principle is to keep participation simple and easy (e.g., by pre-identifying areas where practices would have high impact and offering fixed payments for specific BMP's in these zones).

General directions for the future:

a. *Reduce transaction costs*. Conservation-based transactions with farmers are more likely to succeed if we can reduce transaction costs/time. For example, fixed payments (or a range of fixed payments) for BMPs in high-impact areas could be substituted for auctions as a way to target conservation subsidies and streamline the transaction. The model-driven, outcome-based concept would still apply but with modifications. The Saginaw Bay RCPP project may help shed some light on the agricultural industry's effectiveness as a delivery mechanism for Farm Bill conservation enrollment and federal conservation payments. What we learned from the WESS auctions, and what we may learn from the upcoming RCPP project, may help inform the conservation transaction component and USDA's NRCS administration of the next farm bill.
b. *Identify conditions where agribusinesses are likely to set outcome-based water sustainability standards as part of their business model*. Access to easy-to-use technology based on our prototype ecological simulation models can assist industry by providing an evidence base for environmental benefits from BMP adoption. Within the industry there appears to be need to document and verify their business claims, and to manage reputational risk. Members of the team are working in other projects with supply chain sectors to test/deploy outcome-based sustainability processes.

<u>Farm stewardship certification – Michigan Agricultural Environmental Assurance Program (MAEAP)</u>
MAEAP is a voluntary farm certification program that provides farm certification and risk protection in exchange for verifiable demonstration of best management practices across a farm's operation. The team worked with the Michigan Department of Agriculture and Rural Development (MDARD) to determine if MAEAP could be deployed to help meet water quality goals at a watershed scale. MDARD is our initial target audience; we may explore MAEAP's attractiveness to other Great Lakes States. (During our first workshop MAEAP was favorably recognized by our advisory panel and industry attendees because it is both voluntary and has serious entrance requirements.)

After resolving data transfer issues the project team and MDARD found some surprisingly positive results: Our test of MAEAP in Saginaw Bay watersheds indicates that MAEAP has positive impacts on water quality in agricultural sub-watersheds and "moves the needle" toward the watershed goal. Interestingly, these findings interest the administration and the legislature because public funds support MAEAP so it must demonstrate a public benefit, and not simply underwrite risk management for participating farms.

MAEAP's water quality impacts are uneven across watersheds because participation in the program is not driven by watershed-scale outcomes. Informing MAEAP expansion with the WESS concept and models/tools will help focus the MAEAP "sales force" so they can target place, impact and practice effectiveness. We believe that MAEAP will soon adopt the Great Lakes Watershed Management System so the program has performance-based, outcome capabilities. We are encouraging MDARD to make this a high priority investment.

4R Nutrient Stewardship Certification

The 4R Certification Program is an independent auditing process to establish that nutrient retail businesses serving farmers within the Western Lake Erie Basin are demonstrating the highest level of best management practices (right place, amount, time and kind) for nutrient management and services.

The primary 4R target audience is nutrient agricultural retailers and secondarily the input sector of the supply chain and farmers.

4R was established in March 2014 by a broad array of agri-businesses, farm organizations and others (now the 4R Advisory Council) and is governed by a Nutrient Stewardship Council (NSC) consisting of industry, government, environmental and academic representatives. The Ohio Agri-Business Association (OABA) serves as the Program Administrator. 4R is designed for financial self-sufficiency within five years through enrollment and certification fees. At present The Fertilizer Institute and The Mosaic Company Foundation are contributing additional resources to help cover the program's rapid expansion and to further document its social, economic and environmental impacts.

4R can boast an impressive level of activity, market penetration and scale. In this regard its impact exceeded the expectations of all involved. As of April 30, 2015, there are a total of 16 certified nutrient service providers covering 1,113,000 acres serving 3,040 farmers in the OH-IN-MI region. Of this total, there are 630,000 acres and 1,580 farmers within the WLEB (about 13% of the agricultural acres). *Fifty* (50) additional companies have initiated the certification process. Others are beginning to deploy and leverage the 4R program. For example, MDARD will give 4R certified nutrient providers an incentive payment for each farmer they help become verified in MAEAP. In addition, Agro-Culture Liquid Fertilizers is offering their retail partners an audit rebate if they become 4R Certified.

In order to demonstrate the potential impact of 4R practices with respect to reducing phosphorus (P) delivery to the WLEB, the project team conducted an initial evaluation using a SWAT model of the entire Maumee basin. A matrix of four broad scenarios was developed based on a unique combination of crop-specific fertilizer P application rates and the level of incorporation into the soil. The "low" and "high" application rates specified for corn, soybeans, and wheat were defined based on the Tri-State fertilizer recommendations corresponding to 35 ppm and 25 ppm soil test P levels, respectively. The "low" and "high" incorporation cases were represented by assigning 20% and 80%, respectively, of applied nutrient mass below the upper 10 millimeters of soil. (For example, "low" incorporation may represent the extreme case of all commercial fertilizers being applied via broadcasting and/or all manure being surface applied.) The unique combinations were applied across all agricultural lands represented in the model (approximately 3.2 million acres) to represent a hypothetical fully "upscaled" adoption of 4R-type practices for the Maumee basin.

The results of the initial SWAT-based 4R scenarios are summarized here by comparing total P (TP) and DRP delivery near the Maumee River mouth for the various cases. Relative to the *high application / low*

incorporation scenario, which represents a "worst case" scenario for increasing P levels at the soil surface, the alternative scenarios produced the following results in terms of loading to Lake Erie:

- The *low application / low incorporation* scenario generated a 15% reduction in TP and a 26% reduction in DRP;
- The *high application / high incorporation* scenario generated a 20% reduction in TP and a 41% reduction in DRP; and
- The "best case" *low application / high incorporation* scenario generated a 26% reduction in TP and a 48% reduction in DRP.

The absolute reductions for these initial scenarios are overly optimistic, as a 100% "upscaling" of 4R-type practices to cropland acres in the Maumee basin is infeasible. Nevertheless, these initial results are promising with respect to potential P reductions, and DRP reductions in particular, that may be realized through 4R practices. They suggest that incorporation may well be as important, if not more important, than the application rate. This outcome can be explained by the propensity of upper-soil P removal by erosion/runoff during rainfall or snowmelt events, particularly for no-till or low-till fields.

Members of the WESS team will continue to evaluate 4R practice impacts at select local scales in cooperation with some 4R retail participants (e.g. Farmers Elevator).

One unexpected benefit of 4R is that the agribusiness community now understands the evidence and science connecting agriculture production to water pollution. In this respect, 4R is "changing the conversation" in the agricultural community.

Advancing WESS

What lies ahead as the WESS project closes down? What does the future hold for WESS?

WESS is positioned for growth and adoption at this important time in the evolution of agricultural stewardship as society raises the social, health and environmental bar for the production, processing and distribution of food. Water quality and quantity are under a particularly bright light. In this regard WESS's utilitarian attributes of informed goal-setting and management/accounting make it desirable for transactions and negotiations. WESS can create a win-win approach for environment performance as well as food production.

In this sense WESS is now viable. It has moved through the development and testing phases, and is now undergoing a large-scale application in the Saginaw Bay watershed. WESS could serve as the platform for managing the western Lake Erie watershed toward the 40% phosphorus reduction goal announced at the Great Lakes Summit of governors and premiers in June 2015 and it's relevant to the Great Lakes Quality Management Agreement goals, too. Members of the project are working toward that outcome.

WESS is ready to scale. Project team members have begun to move and/or are positioning the WESS concept in several U.S. geographies. Within the Great Lakes, WESS will require additional investment to expand coverages, streamline technological applications (it's not yet "user-friendly") and update future versions as technology and information rapidly evolve.

While WESS has passed over some important hurdles its value proposition is limited to a small (but growing) audience; it needs more exposure. Aligning WESS with agricultural industry needs and the shifting political expectations for environmental performance will underscore WESS's value.

APPENDIX

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