

APPENDIX C

The following memos summarize the evaluation and recommendations of the Soil Health Advisory Committee (“Committee”) for priority conservation practices:

- Cover Crops
- Conservation Tillage: No Till and Reduced Tillage
- Prescribed Grazing
- Pasture & Hay Planting
- Conservation Cover
- Critical Area Planting
- Conservation Crop Rotation
- Nutrient Management
- Integrated Pest Management
- Agroforestry*

While the memos are specific to a conservation practice, the full suite of priority conservation practices will be eligible for the Healthy Soils Program which is recommended to include two new initiatives—a Healthy Soils Competitive Fund and *Cover Crop+*.

The Healthy Soils Competitive Fund would be an annual competitive funding cycle targeted toward producers that don’t currently qualify for existing state programs and/or producers interested in conducting on-farm research to support their soil health goals. Eligible conservation practices would include the 10 practices recommended by the SHAC, and the application process would be simplified to build engagement with producers and partners. Contracts would have a 5-year term and include support for soil sampling and data collection to evaluate soil health metrics

Cover Crop+ would leverage the success of the state’s existing cover crop program with a requirement for extended season or multispecies cover crops and engage in multi-year planning. The program would also consider greater ability to integrate livestock, and stacking of conservation practices beyond cover crops to maximize ecosystem benefits. The latter could include additional payments to the producer. Contracts would have a 5-year term and include support for soil sampling and data collection to evaluate soil health metrics.

In addition to the recommended initiatives, the Committee also recommends the department quantify the potential benefits, consistent with the Program goals, that could be achieved with broad adoption of the Healthy Soils Program towards the state’s water quality and climate change goals. Estimates should be based on the best available tools.

Please see the memos for additional details on incorporating specific conservation practices into the Healthy Soils Program.

Each memo contains the following sections:

- **Reference box** (upper right corner) providing the average NRCS Conservation Practice Physical Effect score of relevant resource concerns, the tons of CO₂e sequestered annually per unit of practice installed (based on COMET 1.0) and Soil Health Outcome Quadrant based on the work of Tully et al.
- **Definition** based on NRCS standards. Note, Maryland NRCS is the state's lead for technical standards of conservation practices that programs will align to.
- **NRCS Practice Standard** (numeric)
- **Background** information on the conservation practice's current adoption levels and existing financial and technical assistance available in Maryland
- **Analysis** of the environmental and economic benefits of the conservation practice to achieve improved soil health. Analysis represents information from invited presenters to the SHAC
- **Objective** for the conservation practice within the context of the Healthy Soils Program to obtain soil health outcomes consistent with the 2017 legislation:
 - Improve health, yield, and profitability of soils
 - Increase biological activity and carbon sequestration in agricultural soils
 - Promote further education and adoption of healthy soil practices
- **Options** (incentives) considered by the Committee to achieve the objective
- **Recommendations**

*Note: a suite of Agroforestry conservation practices were also recommended by the Committee but are not included in the memos. A more detailed discussion of the selection of priority conservation practices for inclusion in the Healthy Soils Program is contained in the program report.

COVER CROPS

3 NRCS	0.37 MtCO ₂ e/ac/yr	4 Quad
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Definition: Plants generally grown in the off-season to recover unused plant nutrients from the root zone, control soil erosion, suppress weeds, and improve the soil.

NRCS practice standard: 340, and multiple Conservation Stewardship Program (CSP) enhancement options

Background: Maryland has run a successful state program to incentivize cover crops since 2006 with an annual program budget of approximately \$24 million. Maryland has averaged 462,000 acres annually over the last five years, ranking us first nationally in the percentage of acres planted to cover crops according to the USDA Agricultural Census (2017).

The department continues to encourage the early establishment of cover crop varieties, and added an incentive in 2019 to encourage greater use of aerial seeding (via helicopter or airplane) to better allow early establishment of cover. The department also retained its incentive for delayed termination after May 1. This extended growing season maximizes nutrient uptake and benefits soil quality. Participation in the extended season incentive, particularly earlier planted cover crops, has increased each year. Interest in multi-species cover crops has also increased annually. Federal funding for traditional cover crops is also available.

Additionally, farmers continue to plant commodity cover crops without financial assistance that also provide nutrient uptake in the fall.

Analysis: Data presented to the Committee demonstrates a positive return on investment for cover crops with continued seasonal use, and multiple benefits to the soil ecosystem. Consideration for time of planting and specie(s) selection are especially important to maximize benefits to the soil and the operator.

Objective: To incentivize the increased adoption of cover cropping practices that maximize soil health outcomes.

Committee Option(s):¹

1. The program will support diverse plantings that keep fields covered during winter fallow periods.
 - a. Advantages:
 - i. Producers are familiar with this program, understand how it works, and are able to leverage it to support their operations without drastically changing their rotations.
 - ii. Infrastructure exists at the state level to measure, certify, and support winter cover crop plantings.

¹ See Grazing memo for discussion of incorporating livestock into cropland systems

- b. Disadvantages:
 - i. Program inflexibility cuts some producers out of the program (e.g. minimum acreage req., early planting deadlines, more diverse mixes of species, etc.)
 - ii. Soil health benefits of long term perennial cover are not captured in a winter only program.
- 2. The program will support diverse plantings at any time of year.
 - a. Advantages:
 - i. Allows for maximum flexibility in rotations and planning.
 - ii. Long-term cover crop plantings can rest fields for longer periods reducing pest pressures.
 - b. Disadvantages:
 - i. Program criteria will be needed to establish requirements and eligibility.
 - ii. The line between cover crop, a change in crop rotation, and long term perennial cover will need to be drawn.
- 3. Structure financial assistance based on size of operation and seed cost (e.g. bulk seed order and \$/acre programs)
 - a. Advantages:
 - i. Different options for support will open programs up to smaller farms
 - ii. Programs can continue in ways that are familiar to producers that have been involved for decades without cutting out potential new participants
 - b. Disadvantages:
 - i. New infrastructure will need to be created (administrative and likely physical)
 - ii. Bulk seed purchasing can push producers into a cover crop regime they may not have planted otherwise - limited autonomy for species selection
- 4. Increase technical assistance opportunities to support farmers in cover crop management (i.e. species selection, planting dates, and termination methods)
 - a. Advantages:
 - i. Recommendations can be individualized to meet producer needs
 - ii. Existing network of technical assistance providers and tools - e.g. SCDs, UM Extension, Cover Crop Council
 - b. Disadvantages:
 - i. Administering program across multiple providers and recommendations is harder for the state to manage and track
- 5. Structure incentives based on outcomes/performance achieved by practice implementation
 - a. Advantages
 - i. Drives operator behavior if incentivized correctly
 - ii. Likely offers greater flexibility to operator
 - iii. Possible opportunity for state and private partnership
 - b. Disadvantages
 - i. Limited state and producer experience

- ii. Producer risk tolerance for payment model
 - iii. Relies on producer interest in soil health
 - iv. Selection and process for “outcome” metric(s) is undetermined, including measure and verification process
6. Structure incentives to enable a soil health mindset in whole-farm decision making
- a. Advantages
 - i. Engages producers early to build knowledge of soil health principles and benefits
 - ii. Drives holistic, long-term commitment to soil health
 - iii. Likely offers greater flexibility to operator
 - iv. Complements SCD role and conservation planning objectives
 - b. Disadvantages
 - i. Less capacity, currently, for department and SCD in proactive outreach
 - ii. Potentially less quantitative than other incentives

Committee Recommendation(s):

Given the long-standing Cover Crop Program, additional incentives should leverage producer participation to the greatest extent possible, encourage management explicitly aimed at improving soil health, and address gaps in existing program eligibility. To differentiate between cover crops and conservation crop rotation for purposes of the Healthy Soils Program, cover crops would be defined as annual, often unfertilized cover grown to reduce fallow periods within a crop rotation. Conversely, Conservation Crop Rotation would be incentivized as the addition of perennial cover within a planned crop rotation where such cover is grown for harvest (i.e. commodity) or forage.

Accordingly, the Committee recommends two new program initiatives—Healthy Soils Competitive Fund and *Cover Crop+*—to address the options listed above and the stated objective. Both initiatives are voluntary measures designed to provide financial assistance for early practice adoption, but can be complemented by soil health evaluations such that future program incentives could consider outcome/performance-based payments (Option 5). Likewise programs will be promoted by MDA and partner networks to create robust interest in whole-farm decision management (Option 6).

The Department should prioritize financial incentives to encourage the adoption and evolution of cover crop management within Maryland in a way that is available to farms of all sizes (Option 3), that supports plantings beyond the traditional fall planting season (Option 2), and that supports species, mixes, planting methods, and termination options not currently eligible for the existing Cover Crop Program (Option 1). All three options could be eligible proposals under the Healthy Soils Competitive Fund, which should prioritize applications that result in year-round cover (cash crop and cover crops).

In parallel, the Department should also provide financial incentives to increase the adoption of multispecies and extended season cover crops among producers currently using fall-planted cover crops (Option 1) to couple water quality and soil health benefits. As producers across the state adopt/evolve new cover crop management techniques, the Department should provide appropriate tools and access to technical support (Option 4). Both of these latter options are recommended to be eligible for funding from *Cover Crop+*.

CONSERVATION TILLAGE

2.5 NRCS	0.2-0.31 MtCO ₂ e/ac/yr	2 Quad
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NRCS Definition: Limiting soil disturbance activity to manage the amount, orientation, and distribution of crop and plant residue on the soil surface

NRCS practice standard: 329: Residue and Tillage Management, No-Till and 345: Residue and Tillage Management, Reduced Till, both with multiple Conservation Stewardship Program (CSP) enhancement options

Background: The USDA Agricultural Census (2017) reported Maryland has over 1 million acres of cropland under conservation tillage, with 74% of cropland acres practicing no-till. These high adoption rates rank Maryland second nationally based on percentage of acres.

The state currently offers three conservation grant options to promote conservation tillage: 1) Low Interest Loans for Agricultural Conservation ([LILAC](#)) are available through select lending institutions for the purchase of eligible conservation equipment or the installation of best management practices; 2) State [Income Tax](#) subtraction allows the deduction of eligible conservation equipment purchases from taxable income; and 3) [Manure Injection](#) grants help farmers using liquid manures in their fields. Eligible expenses can include equipment rental/leases and operating costs.

Federal funding for conservation tillage is available, but limited contracts have occurred over recent fiscal years, according to Maryland NRCS.

Analysis: Data presented to the Committee shows a positive return on investment for conservation tillage, with continued use, due to reduced labor and fuel costs. Conservation tillage has multiple demonstrated benefits to the soil ecosystem. However, diversified vegetable operations and organic operations have challenges in transitioning to conservation tillage.

Additionally, water quality impacts can also be associated with conservation tillage particularly in areas with surface manure applications and transport risks (Sharpley et al., 2001; He et al., 2006).

Objective: To incentivize the adoption of Conservation Tillage, as appropriate, to increase soil health outcomes.

Committee Option(s):

1. Structure incentives based on reducing emissions below a farm's baseline (e.g. fuel reduction).
 - a. Advantages
 - i. Metrics are well established, and relative to soil carbon sequestration, may be easier to measure
 - b. Disadvantages
 - i. Emissions reductions are tied to available technology that is outside of the producer's control
2. Structure incentives based on carbon sequestration potential based on a farm's baseline
 - a. Advantages

Sharpley, A., P. Kleinman and R. McDowell. 2001. Innovative management of agricultural phosphorus to protect soil and water resources. *Communications in Soil Science and Plant Analysis* 32: 7-8.

He, Z.L., M. K. Zhang, P. J. Stoffella, and X. E. Yang 2006. Phosphorus concentrations and loads in runoff water under crop production. *SSSA* 70: 1807-1816.

- i. The soil can operate as a, potentially, large store for carbon relative to emission reductions
 - b. Disadvantages
 - i. Changes in soil carbon are difficult to measure and ensure over the long term
- 3. Structure incentives based on outcomes/performance achieved by practice implementation
 - a. Advantages
 - i. Drives operator behavior if incentivized correctly
 - ii. Likely offers greater flexibility to operator
 - iii. Possible opportunity for state and private partnership
 - b. Disadvantages
 - i. Limited state and producer experience
 - ii. Producer risk tolerance for payment model
 - iii. Relies on producer interest in soil health
 - iv. Selection and process for “outcome” metric(s) is undetermined, including measurement and verification process
- 4. Structure incentives to enable a soil health mindset in whole-farm decision making
 - a. Advantages
 - i. Engages producers early to build knowledge of soil health principles and benefits
 - ii. Drives holistic, long-term commitment to soil health
 - iii. Likely offers greater flexibility to operator
 - iv. Complements SCD role and conservation planning objectives
 - b. Disadvantages
 - i. Less capacity, currently, for department and SCD in proactive outreach
 - ii. Potentially less quantitative than other incentives

Committee Recommendation(s):

The Committee recommends two new program initiatives -- Healthy Soils Competitive Fund and *Cover Crop+* -- to address the options listed above and the stated objective. Both initiatives are voluntary measures designed to provide financial assistance for early practice adoption, but can be complemented by soil health evaluations such that future program incentives could consider outcome/performance-based payments (Option 3). Likewise programs will be promoted by MDA and partner networks to create robust interest in whole-farm decision management (Option 4).

The Department should prioritize the adoption and evolution of conservation tillage management within Maryland to incentivize avoided emissions from tillage passes (Option 1) and maximize the soil carbon retained by continued conservation tillage (Option 2). Both options could be eligible proposals under the Healthy Soils Competitive Fund. For example, the Healthy Soils Competitive fund could support Organic producers interested in evaluating reduced tillage (in footprint and/or intensity) impacts to crop yield and weed pressures.

Increasing carbon sequestration through adoption of cover crops with significant carbon inputs will do little in the long term if soils are regularly tilled. To that end, the department should consider incentives for producers to bundle conservation tillage with those fields enrolled in *Cover Crop+*. The department, as appropriate,

should also consider opportunities to stack/bundle other conservation practices within *Cover Crop+* to maximize soil health benefits.

Sharpley, A., P. Kleinman and R. McDowell. 2001. Innovative management of agricultural phosphorus to protect soil and water resources. *Communications in Soil Science and Plant Analysis* 32: 7-8.

He, Z.L., M. K. Zhang, P. J. Stoffella, and X. E. Yang 2006. Phosphorus concentrations and loads in runoff water under crop production. *SSSA* 70: 1807-1816.

PRESCRIBED GRAZING

3.3 NRCS	0.26 MtCO ₂ e/ac/yr	4 Quad
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NRCS Definition: Managing the harvest of vegetation with grazing and/or browsing animals

NRCS practice standard: 528 and multiple Conservation Stewardship Program (CSP) enhancement options

Background: Prescribed grazing, also called rotational grazing, is used to improve or maintain forage quantity and quality for grazing animals, decrease surface compaction, and address soil erosion, nutrient runoff, and soil quality. Implementing prescribed grazing is best achieved through a Prescribed Grazing Plan developed through the Soil Conservation District. A Prescribed Grazing Plan will assess the current pasture condition by a pasture condition score (PCS) and recommend the necessary infrastructure (e.g. pasture seeding, fencing, watering facility, etc.) to achieve a PCS of 30 or greater. Likewise, the Prescribed Grazing Plan will outline the recommended stocking rates and grazing rotation schedules to improve the PCS.

Federal funding for prescribed grazing (and associated infrastructure) is available with increasing demand in recent fiscal years, according to Maryland NRCS. State funding is also available for infrastructure necessary to achieve prescribed grazing, but cost-share for the Prescribed Grazing Plan is not provided. State data, as of June 2019, suggests prescribed grazing has been adopted on less than 10% of available acres in Maryland. The largest impediment to prescribed grazing in Maryland, according to Soil Conservation Districts, are higher than recommended stocking rates for livestock particularly equine.

Analysis: Data presented to the Committee shows a neutral to positive return on investment for prescribed grazing when compared to conventional grazing, due to reduced labor and manure management, reduced fuel costs, and improved animal health. Prescribed grazing also has multiple demonstrated benefits to the soil ecosystem, though opinions on its ability to sequester large volumes of soil carbon are mixed. The transition of cropland to perennial pasture or the adoption of prescribed grazing in heavily degraded pastures are assumed to sequester greater carbon; however, site variability is high and the need for additional pasture acreage may lessen carbon sequestration potential (Via, 2020).

While the integration of grazing livestock into cropland systems is not explicitly included in the NRCS standard, soil health benefits are assumed and considered in the Options section below.

Objective: To incentivize Prescribed Grazing to accelerate the adoption of well-managed, perennial systems that maximize soil health outcomes.

Committee Option(s):

1. Focus cost-share programs on improving grazing management within existing pasture operations by an improved flat rate system with simplified rate calculations and greater consistency among SCDs.
 - a. Advantages
 - i. Infrastructure support for pasture operations is largely available through state and federal programs. State cost-share has been expanded to better support grazing operations.
 - ii. State program administration is centralized and generally able to adjust policy/protocols
 - iii. Existing WIP goal with strong growth potential

- b. Disadvantages
 - i. Diversity in operations and livestock across the state make consistent program guidelines more difficult to apply
 - ii. Carbon sequestration potential is variable and highly site dependent
 - iii. Producer flexibility and technical assistance support to rotate between annuals and forage production may be lacking
2. Encourage integration of livestock into cropland systems through state cover crop program
 - a. Advantages
 - i. Grazing cover crops may be easy “on ramp” option to trial with producers
 - ii. State cover crop program evaluates incentives annually
 - b. Disadvantages
 - i. Pathogen transfer concerns when animals are moved between multiple operations
 - ii. Logistics of moving livestock adds complexity to operations
 - iii. State cover crop program is a fixed budget. Inclusion of a livestock grazing incentive would require reduction elsewhere in the program
 3. Structure incentives based on outcomes/performance achieved by practice implementation
 - a. Advantages
 - i. Drives operator behavior if incentivized correctly
 - ii. Likely offers greater flexibility to operator
 - iii. Possible opportunity for state and private partnership
 - b. Disadvantages
 - i. Limited state and producer experience
 - ii. Producer risk tolerance for payment model
 - iii. Relies on producer interest in soil health
 - iv. Selection and process for “outcome” metric(s) is undetermined, including measurement and verification process
 4. Structure incentives to enable a soil health mindset in whole-farm decision making
 - a. Advantages
 - i. Engages producers early to build knowledge of soil health principles and benefits
 - ii. Drives holistic, long-term commitment to soil health
 - iii. Likely offers greater flexibility to operator
 - iv. Complements SCD role and conservation planning objectives
 - b. Disadvantages
 - i. Less capacity, currently, for department and SCD in proactive outreach
 - ii. Potentially less quantitative than other incentives

Committee Recommendations:

The Committee recommends two new program initiatives -- Healthy Soils Competitive Fund and *Cover Crop+* -- to address the options listed above and the stated objective. Both initiatives are voluntary measures designed to provide financial assistance for early practice adoption, but can be complemented by soil health evaluations such that future program incentives could consider outcome/performance-based payments (Option 3). Likewise programs will be promoted by MDA and partner networks to create robust interest in whole-farm decision management (Option 4).

Specific to the inclusion of Prescribed Grazing within the initiatives, the Department should incentivize Prescribed Grazing on cropland to increase perennial cover (Option 1) and promote the integration of livestock into cropping systems (Option 2). Both options could be eligible proposals under the Healthy Soils Competitive Fund, and could leverage existing state cost-share (MACS program) for supporting infrastructure such as fencing, water facilities, heavy use areas, etc.

The integration of livestock on cropland has the potential to improve soil health and increase carbon sequestration potential. Accordingly, the Department should incentivize livestock grazing of cover crops under the *Cover Crop+* program and provide (incentives and/or eligibility) for grazing of cover crops by livestock not owned by the owner of the land where cover crop is established.

PASTURE & HAY PLANTING

1.3 NRCS	0.22 MtCO ₂ e/ac/yr	4 Quad
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NRCS Definition: Establishing adapted and compatible species, varieties, or cultivars of herbaceous plantings suitable for pasture or hay production.

NRCS practice standard: 512 and multiple Conservation Stewardship Program (CSP) enhancement options

Background: Pasture and hay planting is the one-time establishment of perennial forage for livestock expected to persist for at least 5 years. The NRCS standard is broadly written to accommodate several scenarios for improved animal and environmental health, but for improving soil health it is recommended to “maximize biodiversity by selecting plants from at least two of the four functional groups (cool-season grass, cool-season broadleaf, warm-season grass, and warm-season broadleaf).”

The USDA’s Agricultural Census indicated 133,321 acres of permanent pasture and 184,714 acres of forage in Maryland in 2017, and Maryland NRCS indicates demand is increasing for the conversion of cropland into pasture and hay systems. Both federal and state cost-share is available for the conservation practice.

Analysis: Data presented to the Committee generally shows a positive economic and environmental benefit from the conversion of cropland to perennial pasture.

Carbon sequestration benefits assume the partial conversion of a conventionally managed continuous grain rotation to a grain-forage rotation where the forage crop is unfertilized (Swan et al.).

Objective: To incentivize Pasture and Hay Plantings as diverse, perennial forages to maximize soil health outcomes.

Committee Option(s):

1. Focus cost-share programs on conversion of cropland to grazing operations
 - a. Advantages
 - i. Establishment of perennial cover and living roots is key principle of soil health
 - ii. Existing WIP goal
 - iii. Infrastructure support for pasture operations is largely available through state and federal programs. State cost-share has been expanded to better support grazing operations.
 - b. Disadvantages
 - i. State infrastructure to handle processing of additional animals does not currently exist. Solution is outside scope of Healthy Soils Program
 - ii. Decisions and market drivers are operator specific, and state programs cannot be preferential
 - iii. Lease terms would need to be addressed (i.e. transition from annual to perennial systems)

2. Increase education about land tenure to build soil health (annual nature of many land rental agreements can prevent investment in conservation).
 - a. Advantages:
 - i. Several Conservation Leasing initiatives are already underway in Maryland
 - ii. TNC and partners have completed surveys in MD and PA to assess demographics and attitudes of non-operating landowners (NOLs) that can inform strategy
 - b. Disadvantages:
 - i. Large, cross-cutting nature of this issue makes deliverables and timeline harder to define

3. Structure incentives based on outcomes/performance achieved by practice implementation
 - a. Advantages
 - i. Drives operator behavior if incentivized correctly
 - ii. Likely offers greater flexibility to operator
 - iii. Possible opportunity for state and private partnership
 - b. Disadvantages
 - i. Limited state and producer experience
 - ii. Producer risk tolerance for payment model
 - iii. Relies on producer interest in soil health
 - iv. Selection and process for “outcome” metric(s) is undetermined, including measurement and verification process

4. Structure incentives to enable a soil health mindset in whole-farm decision making
 - a. Advantages
 - i. Engages producers early to build knowledge of soil health principles and benefits
 - ii. Drives holistic, long-term commitment to soil health
 - iii. Likely offers greater flexibility to operator
 - iv. Complements SCD role and conservation planning objectives
 - b. Disadvantages
 - i. Less capacity, currently, for department and SCD in proactive outreach
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Committee Recommendation(s):

The Committee recommends two new program initiatives -- Healthy Soils Competitive Fund and *Cover Crop+* -- to address the options listed above and the stated objective. Both initiatives are voluntary measures designed to provide financial assistance for early practice adoption, but can be complemented by soil health evaluations such that future program incentives could consider outcome/performance-based payments (Option 3). Likewise programs will be promoted by MDA and partner networks to create robust interest in whole-farm decision management (Option 4).

Specific to the inclusion of Pasture and Hay Planting within the initiatives, the Department should prioritize the adoption and evolution of Pasture and Hay Planting within Maryland to incentivize biodiverse plantings to promote increased biological activity, and living cover and roots for longer periods consistent with Option 1. For example, funds from the Healthy Soils Competitive Fund could provide producer flexibility to trial new forage mixes for pastured-animals or incorporating forage into crop rotations (see also Conservation Crop

Rotation memo). Additionally, adoption of the practice could leverage existing state cost-share (MACS program) for supporting infrastructure such as pasture seeding, fencing, etc. However, financial assistance should not prioritize pasture systems over cropland systems to avoid preferential resources among agricultural sectors (see Option 1.b.ii).

To support producers electing to transition leased land from annual to perennial systems, MDA should work with partners and key stakeholders to increase appreciation/demand of longer lease terms that could accelerate adoption of conservation investments on rented land and improve soil health outcomes (Option 2).

CONSERVATION COVER and CRITICAL AREA PLANTING

4 NRCS	1.26 MtCO ₂ e/ac/yr	4 Quad
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NRCS Definition: Conservation Cover: establishing and maintaining permanent vegetative cover, and Critical Area Planting: establishing permanent vegetation on sites with, or expected to have, high erosion rates, and on sites that have conditions that prevent the establishment of vegetation with normal practices

NRCS practice standard: 327: Conservation Cover and some Conservation Stewardship Program (CSP) enhancement options; 342: Critical Area Planting

Background: Both conservation cover and critical area plantings establish permanent vegetation to reduce soil erosion, nutrient runoff, and soil compaction. However, they are applied differently on the landscape.

Conservation cover is often used to retire marginal cropland to perennial plantings that attract pollinators, wildlife, and beneficial insects. Conservation cover is incentivized through several federal programs, but is most widely used with the USDA Conservation Reserve Enhancement Program (CREP) designed to retire sensitive lands from production under 10-15 year contracts. Vegetation is often diverse, low-medium density plantings.

In contrast, critical area plantings are used to stabilize the soil on critically eroding areas. This can include stabilizing an area disturbed by installation of a structural conservation practice (e.g. waste storage structure). Vegetation is often high density plantings and may include woody plantings.

Both federal and state cost-share is available for conservation cover and critical area plantings.

Analysis: Data presented to the Committee shows the conversion of sensitive lands to perennial unfertilized herbaceous cover has demonstrated environmental benefits. However, economic benefits are more site specific, though CREP incentives can often offset lost crop revenue in enrolled areas. The Maryland CREP program has been successful at enrolling marginal fields often converted to conservation cover, but the pace of new enrollment and re-enrollment in CREP has been declining for some years. Several factors influence this decline.

Critical area plantings are more limited in their landscape application, but often result in permanent land retirement.

Objective: To incentivize Conservation Cover and Critical Area Planting to accelerate the adoption of permanent perennial systems on retired or marginal farmland that lead to long-term soil health outcomes.

Committee Option(s):

1. Increase education about land tenure to build soil health (annual nature of many land rental agreements can prevent investment in conservation).
 - a. Advantages:
 - i. Several Conservation Leasing initiatives are already underway in Maryland
 - ii. TNC and partners have completed surveys in MD and PA to assess demographics and attitudes of non-operating landowners (NOLs) that can inform strategy
 - b. Disadvantages:

- i. Large, cross-cutting nature of this issue makes deliverables and timeline harder to define role of Healthy Soils Program
2. Consider Healthy Soils Program's role to promote conservation cover as mitigation strategy for saltwater intrusion
 - a. Advantages
 - i. Strong research and state planning underway to guide efforts
 - ii. State program may offer flexibility unavailable through federal programs
 - iii. Transitioned areas have high carbon storage potential per unit of land
 - b. Disadvantages
 - i. Does not address other state acreage that is potentially marginal
 - ii. Operators may prefer commodity crop transition option versus land retirement
 - iii. Easement options would need to consider program (departments') authority, and criteria to address easement terms once the land is fully inundated. Models and precedence for the latter are limited.
3. Structure incentives based on outcomes/performance achieved by practice implementation
 - a. Advantages
 - i. Drives operator behavior if incentivized correctly
 - ii. Likely offers greater flexibility to operator
 - iii. Possible opportunity for state and private partnership
 - b. Disadvantages
 - i. Limited state and producer experience
 - ii. Producer risk tolerance for payment model
 - iii. Relies on producer interest in soil health
 - iv. Selection and process for "outcome" metric(s) is undetermined, including measurement and verification process
4. Structure incentives to enable a soil health mindset in whole-farm decision making
 - a. Advantages
 - i. Engages producers early to build knowledge of soil health principles and benefits
 - ii. Drives holistic, long-term commitment to soil health
 - iii. Likely offers greater flexibility to operator
 - iv. Complements SCD role and conservation planning objectives
 - b. Disadvantages
 - i. Less capacity, currently, for department and SCD in proactive outreach
 - ii. Potentially less quantitative than other incentives

Committee Recommendation(s):

The Committee recommends a new program initiative—Healthy Soils Competitive Fund—to address the options listed above and the stated objective. The initiative is a voluntary measure designed to provide financial assistance for early practice adoption, but can be complemented by soil health evaluations such that future program incentives could consider outcome/performance-based payments (Option 3). Likewise programs will be promoted by MDA and partner networks to create robust interest in whole-farm decision management (Option 4).

Specific to the inclusion of Conservation Cover and Critical Area Planting within the initiative, the Department should incentivize the multiple environmental benefits (nutrient, carbon, etc.) that can be gained when retiring marginal farmland to diverse, perennial cover. State programs can offer increased flexibility for producers to elect to retire sensitive lands and should consider areas with increasing salinity due to saltwater intrusion as eligible to receive funding from the Healthy Soils Competitive Fund (Option 2). For example, the Healthy Soils Competitive Fund could support producers facing the particular challenges of working with saline soils and controlling invasive species when evaluating cover species selection.

Additionally, to support producers electing to install perennial practices on leased land, MDA should work with partners and key stakeholders to increase appreciation/demand of longer lease terms that could accelerate adoption of conservation investments on rented land and improve soil health outcomes (Option 1).

CONSERVATION CROP ROTATION

3 NRCS	0.22 MtCO ₂ e/ac/yr	4 Quad
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NRCS Definition: Growing crops in a planned sequence on the same field

NRCS practice standard: 328 and multiple Conservation Stewardship Program (CSP) enhancement options

Background: Conservation crop rotation is used to accomplish several purposes including improving soil moisture efficiency, reducing plant pressures, and increasing soil health and organic matter. The NRCS recommendations to improve soil health suggest longer rotations of perennial sod crops with deep root systems to build organic matter in the soil profile, include high biomass crops in at least one-third of the crop rotation, or to utilize cover crops with high residue production crops in one-half the rotation especially when rotations are dominated by low residue crops.

Federal funding for conservation crop rotation is available, but limited contracts have occurred over recent fiscal years, according to Maryland NRCS. State funding for the practice is not available.

Analysis: Data presented to the Committee consistently shows a positive return on investment for conservation crop rotation when compared to a monoculture system. Diverse crop rotations can disrupt disease and pest pressures, improving crop yield, and can decrease needs for herbicide and insecticide inputs. Diverse crop rotations can also lessen a farm's economic risks depending on market opportunities and influences.

Increased soil carbon through conservation crop rotation was greatest with the addition of cover crops or perennial crops when compared to grain only rotations (Cavigelli, 2020). Positive effects were also noted from several field studies when considering tillage, crop rotation, and cover crops' combined influences on the soil. This may suggest a synergy between practices for optimizing soil health outcomes.

Objective: To incentivize Conservation Crop Rotation to increase rotation schedule, add plant diversity, and maximize soil health outcomes.

Committee Option(s):

1. Structure incentives to promote perennial cover within a rotation¹
 - a. Advantages:
 - i. Additional plant species in a rotation can lower pest and disease pressure, reducing pesticide, herbicide, and fungicide use, thereby reducing soil disturbance
 - ii. Greatest soil carbon potential
 - iii. Longer crop sequences (4 or more years) are more effective than shorter rotations
 - iv. Adding animals to graze perennial cover (and other, more short term cover) can have positive soil health outcomes
 - b. Disadvantages:
 - i. Depending on species selected, additional equipment may be needed for planting, management, and termination

¹See Cover Crop Memo for more detailed discussion of cover crops planted during shorter fallow periods. Cavigelli, M. Conservation Crop Rotation and Soil Health, 11 December 2020 webinar.

- ii. The distinction between a cover crop planting and a change in rotation will need to be established
 - iii. Markets for perennial crops may be less developed than annual crops
- 2. Structure incentives based on outcomes/performance achieved by practice implementation
 - a. Advantages
 - i. Drives operator behavior if incentivized correctly
 - ii. Likely offers greater flexibility to operator
 - iii. Possible opportunity for state and private partnership
 - b. Disadvantages
 - i. Limited state and producer experience
 - ii. Producer risk tolerance for payment model
 - iii. Relies on producer interest in soil health
 - iv. Selection and process for “outcome” metric(s) is undetermined, including measurement and verification process
- 3. Structure incentives to enable a soil health mindset in whole-farm decision making
 - a. Advantages
 - i. Engages producers early to build knowledge of soil health principles and benefits
 - ii. Drives holistic, long-term commitment to soil health
 - iii. Likely offers greater flexibility to operator
 - iv. Complements SCD role and conservation planning objectives
 - b. Disadvantages
 - i. Less capacity, currently, for department and SCD in proactive outreach
 - ii. Potentially less quantitative than other incentives

Committee Recommendation(s):

While Conservation Crop Rotation can be applied to achieve several purposes, the Committee recommends a delineation of the practice to 1) achieve known soil health benefits; and 2) to differentiate the practice from Cover Crops for incentive purposes within the Healthy Soils Program. It is recommended Conservation Crop Rotation be incentivized as the addition of perennial cover within a planned crop rotation where such cover is grown for harvest (i.e. commodity) or forage. Conversely, Cover Crops will be incentivized for purposes of the Healthy Soils Program as annual, often unfertilized cover grown to reduce fallow periods within a crop rotation. Opportunities to incentive grazing are applicable to both practices.

Accordingly, the Committee recommends a new program initiative - Healthy Soils Competitive Fund - to address the options listed above and the stated objective. The Healthy Soils Competitive Fund should enable a producer to trial/evaluate expanding crop rotations that include perennial cover (Option 1). Trial/evaluations objectives may also include economic evaluation as producers assess market opportunities for perennial crops as compared to potential/realized savings from reduced inputs should the new cover mitigate pest and disease pressure.

The Healthy Soils Competitive Fund is a voluntary measure designed to provide financial assistance for early practice adoption, but can be complemented by soil health evaluations such that future program incentives

could consider outcome/performance-based payments (Option 2). Likewise programs will be promoted by MDA and partner networks to create robust interest in whole-farm decision management (Option 3).

In addition to the Healthy Soils Competitive Fund, the Department should leverage existing program initiatives such as conservation equipment rentals and equipment purchase incentives to support producer integration of perennial cover.

NUTRIENT MANAGEMENT

0.3 NRCS	0.11-1.75 MtCO ₂ e/ac/yr	1 Quad
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NRCS Definition: Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments while reducing environmental impacts

NRCS practice standard: 590 and multiple Conservation Stewardship Program (CSP) enhancement options

Background: Nutrient Management has been a regulatory requirement for Maryland producers since the 1998 Water Quality Improvement Act. By law, all farmers grossing \$2,500 a year or producing 8,000 pounds or greater of livestock must follow a Nutrient Management Plan (NMP) in Maryland. An NMP specifies the amount of nutrients recommended to achieve crop yields based on soil analysis, manure or organic analysis (if applicable), and documented crop yield. An NMP must be prepared by those certified in the state. By March 1, producers must submit an Annual Implementation Report to document, by crop type, the total nutrients applied, source of nutrients, and whether manure was imported or exported from the farm during the previous calendar year. Additional laws regulate [nutrient management](#) requirements for greater environmental protections.

Producers in Maryland are increasingly adopting precision nutrient management based on the 4R principles: **Right rate, Right source, Right timing, and Right place.** Precision nutrient management exceeds Maryland's regulatory requirements. Federal funding for precision nutrient management is available, and several contracts have been awarded over recent fiscal years, according to Maryland NRCS. State cost-share for precision nutrient management is not available, but producers can utilize three programs (([LILAC](#), State [Income Tax](#) subtraction, and [Manure Injection](#) grants) for equipment that enables precision nutrient management.

Analysis: Data presented to the Committee shows that the economic benefits of precision nutrient management are highly farm dependent. For example, variable rate nutrient application is often a savings but can require additional equipment, soil sampling, and data analysis. Farm size (total acreage and field size(s)) and homogeneity of soil fertility levels also influence outcomes. In contrast, precision nutrient management consistently shows improved water quality with continued use. Scientific data on any impacts of synthetic fertilizer inputs on soil health was not reviewed by the Committee.

Carbon sequestration benefits for nutrient management in COMET are based on two scenarios: 1) improved nitrogen fertilizer management including reduced rates, source (use of nitrification inhibitors) and timing; and 2) replacing synthetic nitrogen sources with organic amendments. The latter scenario has a higher carbon sequestration estimate (Swan et al.), but would need to be appropriately balanced with water quality concerns depending on the source selected and on-farm measures taken to mitigate run-off.

Objective: To incentivize the knowledge and adoption of precision nutrient management techniques at appropriate scales for all production systems to maintain compliance with Maryland's nutrient management regulations and maximize soil health outcomes.

Committee Option(s):

1. Incentivize adoption of 4R practices for both organic and inorganic inputs, including engagement with custom applicators that support producers.
 - a. Advantages
 - i. More precise nutrient applications reduce input costs
 - ii. Available spatial data with a higher resolution (e.g. grid sampling , yield mapping) can inform farm decisions
 - b. Disadvantages
 - i. Producers may need access to more specialized equipment
 - ii. Organic sources can be difficult to obtain within the state and variable nutrient content of organic sources make applications harder to manage
2. Incentivize reduction up to elimination of synthetic N in appropriate areas (i.e. lower soil P fields)
 - a. Advantages
 - i. Reducing synthetic N applications can have a positive impact on soil health
 - ii. Precision techniques are familiar to many farmers already
 - iii. Use of organic amendments can improve soil quality (improved organic carbon, infiltration, soil aggregation, microbial activity, etc.)
 - iv. Less fossil fuels are used in the production of organic amendments
 - b. Disadvantages
 - i. Applying certain organic amendments in residential areas can be challenging (e.g. odor)
 - ii. Producers may need more specialized equipment
 - iii. Variable nutrient content of organic sources make applications harder to manage
 - iv. Organic inputs are more difficult for farmers to acquire in the state
 - v. Use of certain uncomposted high-phosphorus organic inputs (e.g. poultry manure) can have a negative impact.
3. Prioritize education and equipment access instead of direct payments.
 - a. Advantages:
 - i. Equipment sharing can make nutrient management techniques more accessible to smaller scale farmers
 - ii. Providing educational resources directly to farmers could increase the desire to adopt 4R nutrient management practices
 - iii. Funding can help producers access and transport hard-to-acquire inputs.
 - b. Disadvantages
 - i. In some places, equipment sharing networks would need to be established
 - ii. Biosecurity becomes an issue, especially for animal operations, with equipment sharing
4. Structure incentives based on outcomes/performance achieved by practice implementation
 - a. Advantages
 - i. Drives operator behavior if incentivized correctly
 - ii. Likely offers greater flexibility to operator
 - iii. Possible opportunity for state and private partnership
 - b. Disadvantages
 - i. Limited state and producer experience
 - ii. Producer risk tolerance for payment model
 - iii. Relies on producer interest in soil health
 - iv. Selection and process for “outcome” metric(s) is undetermined, including measurement, modeling and verification process, and requires study.

5. Structure incentives to enable a soil health mindset in whole-farm decision making
 - a. Advantages
 - i. Engages producers early to build knowledge of soil health principles and benefits
 - ii. Drives holistic, long-term commitment to soil health
 - iii. Likely offers greater flexibility to operator
 - iv. Complements SCD role and conservation planning objectives
 - b. Disadvantages
 - i. Less capacity, currently, for department and SCD in proactive outreach
 - ii. Potentially less quantitative than other incentives

Committee Recommendation(s):

The Department should prioritize financial incentives that allow producers to advance the 4R principles of nutrient management tailored to their operation, with particular focus on nutrient source, nutrient rate, and nutrient timing. Incentives should be consistent with Maryland's current regulatory framework, or alternatively, provide a mechanism for in-field outcome measurement (e.g., SOC and/or OM) or research without compliance concerns. Likewise, the Committee recognizes that nutrient management is inherently site specific, and all management decisions must be inclusive of nutrient loss considerations. Accordingly, the Committee recommends a new program initiative - Healthy Soils Competitive Fund - to address the options listed above and the stated objective.

The Healthy Soils Competitive Fund is a voluntary measure designed to provide financial assistance for early practice adoption, complemented by soil health evaluations to inform future program incentives for outcome/performance-based payments (Option 4). Likewise programs will be promoted by MDA and partner networks to create robust interest in whole-farm decision management (Option 5).

Specific to the inclusion of Nutrient Management within the initiative, the Department envisions funds available for on-farm trials, in collaboration with appropriate technical expertise, to evaluate practice outcomes (Options 1-2). As needed, a producer could request a research exemption from the Department.

The adoption of organic nutrient applications (options 1 and 2) should be explicitly named as eligible for funding under the Healthy Soils Competitive Fund. As nutritionally appropriate soil amendments become more available in the state, and policy initiatives to divert organic wastes increase, the Healthy Soils Program can support producer access to these nutrient sources consistent with all state regulations.

In addition to the Healthy Soils Competitive Fund, the Department should leverage existing program initiatives such as manure transport, conservation equipment rentals, and purchase incentives to increase access to organic nutrient sources where appropriate (Option 3).

Lastly, it is recommended the Department expand opportunities for technical assistance that addresses the intersect of soil health management and annual nutrient management planning.

Integrated Pest Management

2 NRCS	Variable MtCO ₂ e/ac/yr	4 Quad
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NRCS Definition: A site specific combination of pest prevention, pest avoidance, pest monitoring, and pest suppression strategies.

NRCS practice standard: 595 and multiple Conservation Stewardship Program (CSP) enhancement options

Background: Integrated pest management (IPM) is used to keep pests from causing economic or human/environmental health related damages and to avoid the use of chemical pesticides where possible. The practice is implemented through pest population monitoring, site inspections, and the use of various pest control methods including cultural, physical, biological, and chemical controls. Pesticides are generally used as a last resort, after other control options have been exhausted.

Implementation levels of IPM across the state are not well known. Based on data provided by NRCS, financial and technical assistance for IPM was provided in 30 contracts in 2018, no contracts in 2019, and 36 contracts in 2020. All of the sites were located in either Dorchester or Wicomico Counties. Cost share for IPM is not available through state programs. This limited data makes quantifying the adoption rate and variability of IPM strategies difficult to summarize.

Analysis: IPM implementation is highly site and operation dependent, so estimating greenhouse gas reductions, carbon sequestration potential, and water quality benefits is difficult. However, studies shared with the Committee support the idea that reduced pesticide applications will positively impact macro and microbial soil life with the potential to improve soil health over the long term (Tooker, 2020).

Like the environmental benefits of IPM, economic benefits are also variable. Older studies and meta-analysis published by Virginia Tech report the use of IPM generally results in lower pesticide use, lower production (input) costs, decreased risk, and higher net returns to producers (Norton and Mullen, 1994). Modern IPM requires additional technical expertise and commitment to an adaptive, evolving strategy. IPM implementation will likely be a balancing act of positive economic impacts and risks associated with trying new pest control methods.

Objective: To incentivize the knowledge and adoption of IPM techniques at appropriate scales for all production systems and maximize soil health outcomes.

Committee Option(s): ¹

1. Additional funding for UME offices should be pursued, instead of cost share or outcomes-based payments
 - a. Advantages:
 - i. Though IPM has many direct benefits for producers, the soil health impacts are variable depending on the site, and specific practices adopted. Increasing funding for educators/TSP's could provide more focused support for IMP practice adoption.
 - ii. UME expertise and outreach strength would bring more producers to both state and UME programs for assistance

Norton, George W. and J. Mullen. 1994. Economic Evaluation of Integrated Pest Management Programs: A Literature Review. Virginia Cooperative Extension. Publication 448-120.

Tooker, J. Integrated Pest Management, 11 December 2020 webinar.

- b. Disadvantages:
 - i. New funding will need to be identified and secured to expand UME networks
 - ii. Quantifying changes in soil health due to outreach programs will be more challenging than incentive program enrollment
2. Incentivize the reduction up to elimination of synthetic inputs, with care to differentiate the spectrum of pesticides and identify those with greatest adverse impact to soil biota
- a. Advantages:
 - i. Reducing synthetic N applications can have positive soil health impacts
 - ii. Use of organic amendments can improve soil quality (improved organic carbon, infiltration, soil aggregation, microbial activity, etc.). Improved soil quality, especially in terms of biodiversity, can limit the impacts of pests and diseases
 - iii. Less fossil fuels are used in the production of organic amendments
 - b. Disadvantages:
 - i. Applying organic amendments in residential areas can be challenging (e.g. odor)
 - ii. Producers may need more specialized equipment
 - iii. Variable nutrient content of organic sources make applications harder to manage
3. Structure incentives based on outcomes/performance achieved by practice implementation
- a. Advantages
 - i. Drives operator behavior if incentivized correctly
 - ii. Likely offers greater flexibility to operator
 - iii. Possible opportunity for state and private partnership
 - b. Disadvantages
 - i. Limited state and producer experience
 - ii. Producer risk tolerance for payment model
 - iii. Relies on producer interest in soil health
 - iv. Selection and process for “outcome” metric(s) is undetermined, including measurement and verification process
4. Structure incentives to enable a soil health mindset in whole-farm decision making
- a. Advantages
 - i. Engages producers early to build knowledge of soil health principles and benefits
 - ii. Drives holistic, long-term commitment to soil health
 - iii. Likely offers greater flexibility to operator
 - iv. Complements SCD role and conservation planning objectives
 - b. Disadvantages
 - i. Less capacity, currently, for department and SCD in proactive outreach
 - ii. Potentially less quantitative than other incentives

1. See Crop Rotation, Nutrient Management, and Cover Crop memos for a more detailed discussion of the effects of lengthening/diversifying rotations, effects of organic inputs/reduction in synthetic inputs, and the benefits of perennial cover crops respectively.

Committee Recommendation(s):

The soil health impacts of Integrated Pest Management are variable and represent a prime opportunity for additional technical assistance. The Committee recommends Option 1 be prioritized for evaluation between the Department and University of Maryland Extension for potential collaboration.

Upon feedback from the University of Maryland Extension on readiness to proceed to financial incentives, the Committee recommends a new program initiative—Healthy Soils Competitive Fund—to potentially complement expanded technical assistance and to increase local research findings. Specifically, the Healthy Soils Competitive Fund will provide flexibility for a producer to define research objectives related to alternative pest management and/or reduced inputs to control pests. Funds are envisioned to be applied on small plot or field trials, in collaboration with appropriate technical expertise, to evaluate practice outcomes. Outcomes could include economic evaluation such as savings from reduced applications compared to potential/realized yield impacts, if any.