carolina farm stewardship association

Conservation Planning Activity (CPA 116)
Soil Health Management Plan

ELMA C. LOMAX RESEARCH AND EDUCATION FARM
SEPTEMBER, 2023

by Amelia Bruss
CFSA Soil Health Technician

Carolinafarmstewards.org

Participant Information

Name: Dylan Alexander
Farm: Elma C. Lomax Research and Education Farm
Address: 3445 Attando Rd, Concord, NC 20825
County: Cabarrus
Email: dylan@carolinafarmstewards.org
Phone Number[redacted]
Farm Bill Program: CPA 116 Soil Health Management Plan
Contract Number: N/A
Farm and Tract Number: 1[redacted]

TSP Information

Name: Amelia Bruss
TSP Number: 22[redacted]
TSP # Expiration: N/A
Mailing Address: [redacted]
Email: amelia@carolinafarmstewards.org
Phone Number: [redacted]

CPA Information

CPA Name: 116 Soil Health Management Plan
Land Use(s): Vegetable Production
Units: Acres
Amount: 23 in production, 4.86 for contract

TSP Statement

I certify the work completed and delivered for this CPA:

• Complies with all applicable Federal, State, Tribal, and local laws and regulations.
• Meets the General and Technical Requirements for this CPA.
• The planned practices are based on NRCS Conservation Practice Standards (CPSs) in the state Field Office Technical Guide, where the methods will be implemented.
• Is consistent with and meets the conservation goals and objectives for which the program contract was entered into by the participant.
• Incorporates alternatives that are both cost-effective and appropriate to address the resource issue(s) and participant's objective(s).

TSP Signature _____Date_____

Participant's acceptance statement

I accept the completed CPA deliverables as thorough and satisfying my objectives.

Participant Signature _____ Date _____

NRCS administrative review completion by:

Signature _____ Title _____Date_____

General Farm Description:
The Elma C. Lomax Research and Education farm is a certified organic small-scale crop operation. Dylan Alexander manages most of the land, and the Farmer In Training program students tend various plots. Current crop production occurs on approximately 23 acres of open field space and two high tunnels.

Previously Installed or Implemented Conservation Practices:
None known.

Equipment, Technology & Management Practices:
Management practices: The farm is certified organic and is managed accordingly.
Equipment: The farm operates with minimal tillage equipment, only tilling if plots go into bed production, followed by a bed shaper and, in most cases, using plastic mulch for weed management. Fields are mowed, followed by a disc and occasionally a chisel plow if necessary. Production fields are mechanically cultivated using sweeps at most twice per crop season. Otherwise, weeds are managed with hand tools and tarps. Cover crops are terminated with a roller-crimper or flail mower and incorporated with a disc. In some minor fields, cover crops are terminated with plastic tarps. Fertility sources and organic pesticides are used minimally.

Soils, Climate & Topography:
The soil type (series) is a Cullen clay loam, which is characterized by loam in the surface 6" with accumulations of clay below 6" depth: clay, silty clay loam, and loam occur with increasing depth. This is typical of soils in this series. Topography in the area is characterized by gently rolling hills typical of the Piedmont region—slopes in the planning land unit range from 2% to 8%.
Cabarrus Co., NC, is classified as humid subtropical, with 45" annual rainfall and 3" of snow per year. An average summer high of 90 degrees F (July) and an average winter low of 29 degrees F (January). This location is classified as winter hardiness zone 8a: average annual extreme minimum temperature is 10-15 degrees F.

Each field is individually sampled yearly, and the most recent samples were taken on 06/21/2023. Fields that are in vegetable production are sampled in the fall before they go into production in the spring.
Approximately 20 sample cores are taken at an 8" depth in a zig-zag pattern across the field and collected in a bucket. The sampled cores are mixed, placed in a plastic zip bag labeled with appropriate field and farm information and date, and mailed to the NC State soil laboratory.

Environmentally Sensitive Areas in the Planning Area:
None known.

Compliance with Highly Erodible Land (HEL) or Wetland Determinations:
CLU 5 and 6 are determined as UHEL; this land is excluded from cropland use.

Federal, State, Tribal, and Local Laws, Regulations, Policies, and Their Associate Permit Requirements:
No knowledge of noncompliance.

Pre-Work Meeting Notes:
I have worked with Lomax previously on various technical assistance needs. From our previous work, a soil health plan would fit the farm well.
I contacted the participant about the program on 9/5/23 via email. Participant agreed that a soil health plan would fit the farm well and fit into their long-term goals. Scheduled initial site visit for 9/25/23.
Sent a follow-up email on 9/11/23 with information on the soil health plan, what I will be looking for, and what documents and record-keeping might be helpful to have.

Site Visit 9/25/23:
Participant and I walked fields 1, 2, 3, 4, and 5 and discussed resource concerns, alternatives, and long-term goals for the farm regarding soil health, productivity, and conservation. The participant was supplied with applicable conservation practice overview sheets.
Observed and discussed current conservation practices:
Field 1 - Observed compaction mostly in field AA.
Field 2- Field R is compacted and floods and is not used for anything other than cover crops.
Field 3- No major issues
Field 4- No major issues

The soil issues are consistent around the farm, and compaction is the biggest issue, with field AA and field R being the worst compaction acres. The most significant additions of organic matter are cover crops in all fields. Wood chips have been applied to some fields, and when applied, those fields were taken out of production for 5-6 years.
We sat down, looked at old field maps, and discussed what needed updating. Looked over field management record keeping such as field history and management, nutrient management, weed, pest, and disease prevention and management.

Participant's Objectives and Resource Concerns:

1. Build soil organic matter
2. Decrease compaction
3. Increase water infiltration
    a. The clay-loam soil type is consistent across the farm. In some areas, the B profile can be platy depending on conditions. Overall, there is a desired increase in soil organic matter in all farm fields to decrease compaction and increase productivity and drainage, with fields AA and R having the most significant compaction issues.

4. Increase the use and efficacy of cover crops
    a. Cover crops are used on all farm fields throughout the year. The biggest issue is deer pressure, eating the cover crops, therefore, not getting a good stand. The participant wants to address the deer issue so they can implement more no-till practices with cover crops.

Pasture Condition Scoresheet and Indicators of Rangeland Health

These resources are not applicable to this plan. The farm has not had livestock, nor does it intend to have livestock in the future.

Practice Schedule

Tract Number	**Field #**	**Practice Code**	**Practice Name**	**Planned Amount**	**Practice Units**	**Planned Date**
5017	1, 2	340	Cover Crop	4.86	Ac.	September 2023
5017	1, 2	484	Mulching	4.86	Ac.	September 2023

Conservation Practice Descriptions

Cover crops- A mix of legumes, grasses, and forbes will be planted for seasonal vegetative cover, adding organic matter and increasing water holding capacity. Multi-species covers will be planted in the fall. For fallow fields, a second succession of multi-species cover crops will be planted in spring for a summer cover. Practice is planned for the fall and spring of 2023.

Mulch- Mulch in the form of woodchips and/or straw will be used in field rows to reduce weed pressure and the need for mechanical cultivation. This practice will help improve soil organic matter, moisture management, and plant productivity. Practice is planned for the spring of 2024.

Short-term effects of proposed practices:
Reduced soil erosion/organic matter depletion and weed pressure, leading to improved crop performance. Fewer labor hours invested in weeding and fuel used for mechanical cultivation can lower operating costs and improve profitability.

Long-term effects of proposed practices:
Improved crop performance and resilience in the face of multiple crop stressors, owing to enhanced soil biological function (organic matter decomposition; multiple symbioses) due to less soil disturbance, more consistent plant cover, greater plant diversity, and gains in soil organic matter. These crop stressors include heat and drought, insect, disease, weed pressure, and nutrient limitations. Additionally, the soil will have better water-holding capacity.

Client interactions

Date	**Purpose**	**Results/Notes**	**Initials (TSP)**
9/5/2023	Farmer outreach	Emailed Mr. Alexander about the soil health management plan.	AB
9/25/2023	Site visit	Agreement to develop a soil health management plan (CPA116) and develop conservation practice-oriented alternatives to current management practices that threaten natural resources. Present: Amelia Bruss, Dylan Alexander	AB
10/10/2023	Inquiry about progress	Informed Mr. Alexander that progress will begin on October 16th.	AB
10/30/2023	Final follow-up prior to submitting CPA116 to NRCS	Discussed final details about management and plan specifications.	AB

USDA United States Department of Agriculture

Cabarrus County, North Carolina

Farm 1623
Tract 5017
2024 Program Year

CLU	Acres	HEL	Crop
1	7.69	NHEL	
2	0.8	NHEL	
3	3.07	NHEL	
4	2.44	NHEL	
5	8.43	UHEL	Noncropland
6	0.07	UHEL	Noncropland

Page Cropland Total: 23.0 acres

Map Created October 26, 2023

Base Image Layer flown in 2022

Common Land Unit
- Cropland
- Non-Cropland
- Tract Boundary

Wetland Determination Identifiers
- Restricted Use
- Limited Restrictions
- Exempt from Conservation Compliance Provisions

USDA FSA maps are for FSA Program administration only. This map does not represent a legal survey or reflect actual ownership, rather it depicts the information provided directly from the producer and/or the NAIP imagery. The producer accepts the data 'as is' and assumes all risks associated with its use. The USDA Farm Service Agency assumes no responsibility for actual or consequential damage incurred as a result of any user's reliance on this data outside FSA Programs. Wetland identifiers do not represent the size, shape, or specific determination of the area. Refer to your original determination (CPA-026 and attached maps) for exact boundaries and determinations or contact NRCS.

USDA United States Department of Agriculture

NORTH CAROLINA- Cropland In-Field Soil Health Assessment Worksheet

Soil Health Resource Concerns

CPT = Compaction
SOM = Soil Organic Matter Depletion
AGG = Aggregate Instability
HAB = Soil Organism Habitat Loss or Degradation

Location	Cabarrus County, NC
Field/CMU	Field 1
Tract#	5017
Client/Customer	Dylan Alexander
Planner	Amelia Bruss
Date	9/25/2023
Soil Map Units	CuB2
Soil Moisture	Well Drained
Topsoil Texture	Clay loam

Indicator Timing and Use Anytime | After Rain or Irrigation | With Adequate Moisture | Before a Tillage Event Primarily No-till Systems | Before Growing Season | During Growing Season | Interview	Meets Assessment Criteria (Yes/No)
Soil Cover | SOM, HAB • Surface cover from plants, residue or mulch; cover greater than 75%	☑ Y ☐ N
Residue Breakdown | SOM, HAB • Natural decomposition of crop residues is as expected with crop and conditions	☑ Y ☐ N
Surface Crusts | AGG • Crusting on no more than 5% of the field	☑ Y ☐ N
Ponding | CPT, AGG • No ponding within 24h following typical rainfall or surface irrigation event	☑ Y ☐ N
Penetration Resistance | CPT • Penetrometer rating <150 psi within top 6" depth and <300 psi in the 6-18" depth; • OR Slight or no resistance with wire flag inserted to 12"	☑ Y ☐ N
Water Stable Aggregates | HAB, AGG • Cylinder: At least 80% remains intact after 5 minutes with little cloudy water; • OR Strainer: soil remains intact with aggregates apparent; • OR Soil Quality Test Kit (SQTK): meets stability class 6	☐ Y ☑ N
Soil Structure | CPT, SOM, AGG, HAB • Granular soil structure in A horizon and no platy structure in A or B horizons	☐ Y ☑ N
Soil Color | SOM • No color difference between field and fencerow sample; • OR, Value is on the darker range using color chart and soil survey pedon description	☐ Y ☑ N
Plant Roots | CPT, SOM, HAB • Roots covered in a soil film (rhizosheaths) or are part of soil aggregates; • OR Living roots, if present, are healthy, fully branched and extend into subsoil	☑ Y ☐ N
Biological Diversity | SOM, HAB • Clearly evident; more than 3 different types of organisms observed without magnification	☑ Y ☐ N
Biopores | SOM, AGG, HAB • Presence of root or earthworm channels that extend vertically through the soil with some connecting to the surface	☑ Y ☐ N

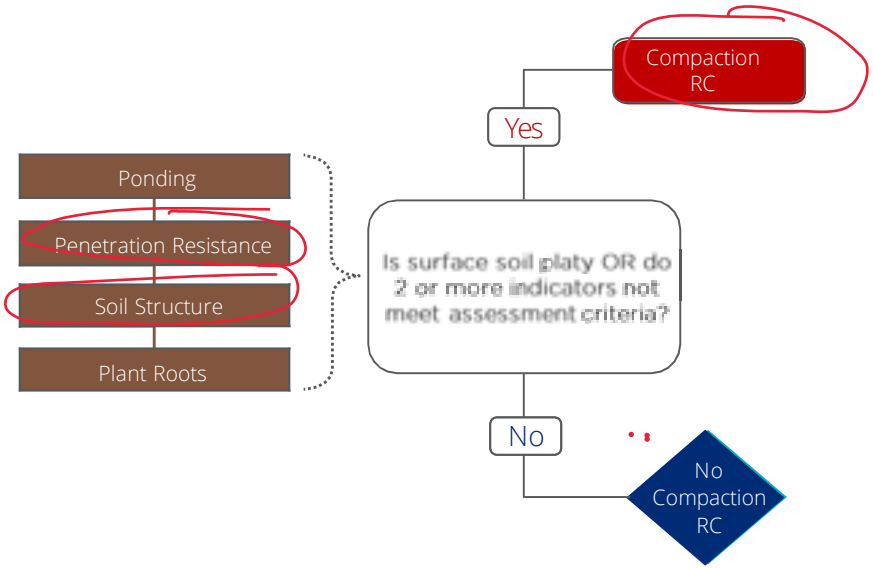
Natural Resources Conservation Service

NORTH CAROLINA- Cropland In-Field Soil Health Assessment Worksheet

Legend (for all RCs)
- = Field indicator
- = RC present
- = RC not present

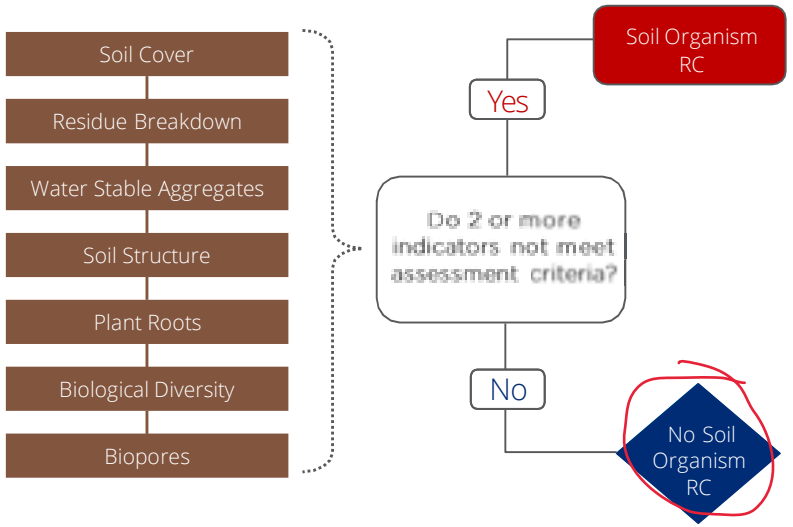
Compaction Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



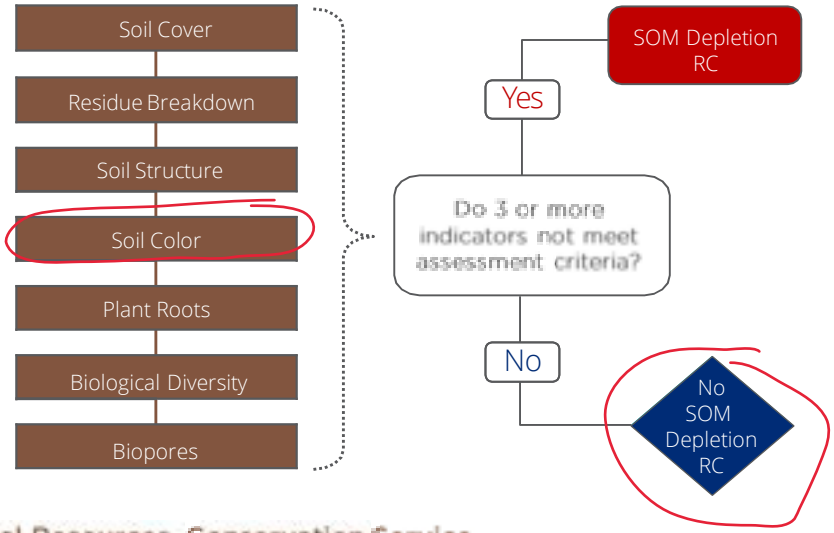
Soil Organism Habitat Loss or Degradation Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



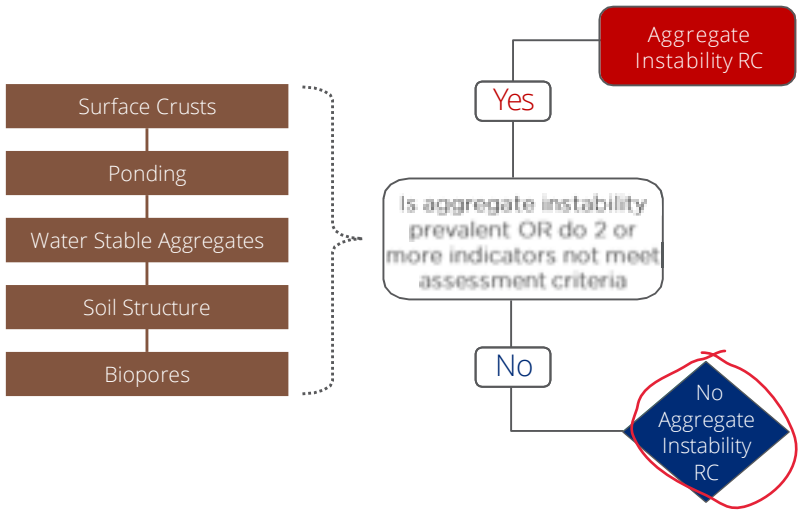
Soil Organic Matter Depletion Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



Aggregate Instability Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



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Management History – Interview

The following questions are offered as examples to guide a conversation with the client and help the planner more thoroughly understand current conditions, the client's management and how these may contribute to existing soil health resource concerns. Answers to these and other similar questions will be helpful in assessing some of the indicators. In North Carolina, contextual information from NC State CES to make planner/client discussions on soil health and potential practice treatments more aligned with the available science and supplement the knowledge base is available at: https://content.ces.ncsu.edu/soil-health-what-does-it-mean-in-north-carolina. The library of NCSU CES "Soil Facts" publications is available by web searching the term "NCSU Soil Facts".

. hat is the crop rotation

Summer crop, fall crop, winter cover crop

hat are the types and frequency of ground disturbing operations

- Mowing cover crops
- Discing crop residue
- Roto till only if going into bed preparations
- Cultivation sweeps no more than 2x per crop season

For how many months per year is the soil surface at least covered with plants, residue or mulch

If there are ever bare fields they are covered with a silage tarp for terminating previous crop or used for weed suppression, tarps are removed during rainfall events.

Are cover crops a consistent part of the cropping system

Yes, all fields on the farm get cover cropped at least once per year.
There is heavy deer pressure on the cover crops, except on sudan grass, leading to lots of weed regrowth. This is a huge challenge on the farm, they do not have the ability to fence the entire property.

If yes, for how many years has the field been continually cover cropped

Yearly since the property was purchased in

. ow are the cover crops terminated Ifchemically, what herbicide is used

Cover crops are mowed and then disc'd, moving more towards roller crimping depending on success of the cover crop.

. Is the field irrigated If yes, what type of irrigation system, and how many acre-inches are applied for each crop in the rotation described above

All fields are set up for drip irrigation but they have the ability to set up anything, there are many water hydrants all over the farm. Connects garden hose to hydrant and uses drip. All vegetable fields are irrigated, cover crops are not.

oes water pond or run off during or immediately after typical rainfall or irrigation events here in the field

Typically avoids Field AA due to compaction, no issues with ponding but drainage is not ideal. Drainage issues are more prevalent in middle of the field.

Are there problems with crop emergence or early crop growth here in the field

n/a

Is water management a concern i e , field too wet or too dry at planting

Not typically, irrigation is used if fields are too dry.

ther observations not captured in the assessment including plant condition, and recent weather and landscape characteristics that may affect assessment results

n/a

Instructions

- Pages 1 and 2 (Worksheet) of the In-Field Assessment can be printed and taken to the field without the remainder of the Assessment document.
- When conducting the field evaluation, it is often helpful to compare the indicators in the managed field to an unmanaged similar soil in an adjacent fencerow or field edge.
- The following *Field Assessment Indicator Details* pages provide guidance for assessing each indicator, and list conservation practices that can be considered for inclusion in a soil health management plan to address the resource concerns associated with each indicator.
- The first four indicators (soil cover, residue breakdown, surface crusts, ponding) represent surface conditions that either affect or are indicative of soil health and should be assessed observing conditions across the field.
- The remaining indicators represent subsurface conditions and are checked by digging down to at least 8 inches and evaluating each indicator to determine if it meets the assessment criteria.
- The subsurface indicators are best confirmed by looking at more than one location in the field. Select three representative locations in the field to evaluate the subsurface indicators. If conditions are not consistent for at least two of the locations, an additional site should be evaluated.
- Penetration resistance should be assessed in several locations in the field when there is adequate soil moisture. It is often helpful to verify compaction by checking for platy or massive structure in the holes dug for the other subsurface indicators.
- Whenever possible, take photos to include in your assessment. These can be added to the customer folder along with field observations and notes.
- Soil moisture can be determined with a handheld soil moisture meter if available, or qualitatively as: *dry, moist, field capacity, or saturated.*
- Soil texture can be estimated by the "feel method." Soil surveys can provide an estimate but should be verified in the field.

Useful assessment materials

- Shovel
- Wire flag
- Penetrometer
- Clear plastic cups or similar
- Wire sink strainers
- Water
- Small hand lens
- Texture-by-feel guide
- Camera

Considerations for using the assessment

The Cropland In-Field Soil Health Assessment is designed to be used as a diagnostic tool to help conservation planners determine if soil health resource concerns exist. It should not be used for comparing one field to another, or as a means of monitoring changes in a field over time, nor should it be assumed that it is a comprehensive assessment of all biological, physical, and chemical processes that are critical to soil function. Fields where multiple indicators do not meet assessment criteria will likely benefit from the implementation of a management system that utilizes as many soil health building practices as practical, to maximize biodiversity, presence of living roots and soil cover, and minimize disturbance (Refer to The Basics of Addressing Resource Concerns with Conservation Practices within Integrated Soil Health Management Systems on Cropland).

Normally, it will not be necessary to evaluate all eleven indicators but only those that will enable the planner to adequately assess field soil health and develop management alternatives if soil heath resource concerns exist. Numerous variables will contribute to the indicators not being equally useful during any single field visit. It is anticipated that some indicators will be more interpretable and representative of soil health than others depending on the soil, landscape position, climate, weather, time of year, and cropping system. Different indicators will have different optimal sampling time or conditions and thus, sampling time and field conditions should be noted. The timing symbols associated with each indicator provide a quick reference for the recommended conditions and time for assessing that indicator.

It is recommended that Field Office staff work with State technical specialists responsible for soil health resource concerns related to conservation planning to determine which indicators are likely to provide useful resource concern assessment information for their climate, soils, and cropping systems. In addition, State and Area specialists may find it necessary to adjust the assessment criteria of the indicators that are used to insure they provide meaningful assessment information for local systems and conditions.

Soil chemical properties (nutrients, pH, EC, etc.) are an important component of soil health, and can impact soil function, but are not part of the in-field assessment. These are best quantified by sending samples to a reputable soil testing laboratory. Additionally, there are physical and biological properties indicative of soil health that can be assessed by laboratory methods (Refer to Soil Health Methods Technical Note). The soil organic matter depletion resource concern can also be identified by tracking trends of lab analyses of SOM through time or determining soil conditioning index (SCI) by an NRCS-approved method. Quick in-field assessments of nutrients, pH, EC, etc. can be done to demonstrate, compare, and contrast the impact of management on nutrient cycling, or differences within a field and determine whether further soil testing is needed (NRCS - Soil Health for Educators). Although soil salinity can have negative impacts on soil health and should be evaluated as a resource concern, and considered in a management plan where appropriate, it has not been included in this assessment.

Soil Cover

A significant factor in promoting soil health is keeping the soil surface covered, particularly during fallow periods. Estimate the percent of soil surface covered with dead plant material, organic mulch or live plants (i.e., cover crop or cash crop). The crops may be different, but the percent cover will look the same. Take photographs of representative areas. Can be assessed at any time.

Conservation practices to address the resource concerns associated with the indicator: 329, 340, 345, 484, 512, 528

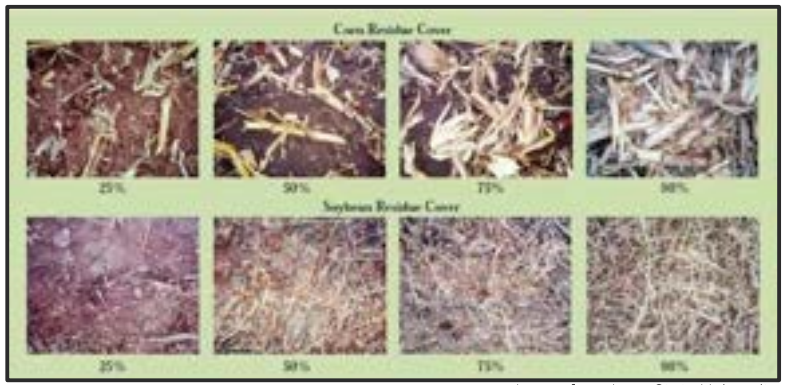

Image from Iowa State University

Residue Breakdown

Residue breakdown is the biological shredding, fragmenting, cycling, and/or incorporating of previous crop residue. The rate at which residue decomposes can be an indicator of management-influenced biological activity. Other factors that will influence the rate of residue breakdown include C:N ratio of the plant residue, crop species, residue amount and environmental conditions during residue decomposition. Breakdown is highly climate-dependent. Residue breakdown is assessed by looking at existing residue cover for signs of decomposition, shredding, and incorporation by soil organisms. Note the depth of litter and color and condition of most recent residue. The conversation with the producer will be helpful in providing information about management, residue age and plant types. Take photographs of representative areas. This indicator can be assessed at any time, but it will not be useful in full width tillage fields.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 595

Surface Crusting

Surface crusts can develop when soil is overworked and left uncovered, resulting in poor aggregate stability. Crusts inhibit seedling emergence and water infiltration. Determine if crusts are throughout the field or only in patches. Crusting can also occur in sodic (high sodium) or saline (high salts) soils. Crusts will remain intact when they are picked up. Assess for physical crusts after irrigation or rain and before next tillage.

Conservation practices to address the resource concerns associated with the indicator: 329, 340, 345, 484, 512, 528

Ponding

Standing water on the soil surface resulting from poor infiltration can be an indication of poor aggregate stability, surface crusting, lack of surface cover, poor soil structure, and/or compaction. Slow infiltration can also result from naturally occurring conditions, such as a fragipan or other slowly permeable layer close to the surface, or a clayey surface or subsurface texture. The best time to assess for ponding is within 24 hours of a typical rainfall or irrigation event. Determine if ponding occurs throughout the field or only in patches. Is ponding the result of inherent soil properties or landscape position? Producers are usually aware if this is an issue in their fields. This information is often best obtained during producer interview to determine the extent and severity of ponding.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

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Penetration Resistance

Soil compaction in agricultural systems can result from repeated wheel or hoof traffic, or repeated tillage at the same depth. Compaction inhibits water and gas movement through the soil in addition to interfering with root growth and soil organism movement and proliferation. Management-induced compaction typically occurs at depths of 2-8 inches but may be deeper depending on soil type and management. Resistance to penetration should be checked at 8-10 randomly-selected spots in the field. Penetration resistance increases as soils dry. Therefore, assess moist to wet soil.

Use one of these methods:

1. Hold a wire flag near the flag end inserting it into the soil observing how easily it bends. Compare the resistance to a known noncompacted area, such as in a fence row or other nonimpacted field border.

2. Use a penetrometer by applying slow, steady vertical downward pressure while observing the pressure gauge reading. Record depth of restrictive layers and resistance pressure.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

Water Stable Aggregates

The stability of soil aggregates in the presence of water is important for water infiltration and storage, gas exchange, and for plant growth and soil organism habitat. Highly degraded soils may not break apart or dissolve because high bulk density may affect how aggregates respond to water. To assess for water stable aggregates, use one of three methods:

Cylinder method: Take a soil ped about the size of a golf ball from the surface just below any residue that may be present and submerge it in water. Note the time. After 5 minutes observe the water in the container and estimate the amount of the ped (%) that remains intact. This method works best with air-dry soil.

Strainer method: Obtain a sample from the soil surface crumble any large peds (BB size or slightly larger; don't grind too fine). Place the soil in a sink strainer or small wire colander, level with top. Immerse in a bowl filled with water and allow to become fully saturated (about 1 minute). Turn strainer upside down on a flat surface. Soils with good aggregate stability will remain intact with aggregates apparent, while soils with poor aggregate stability will slump and have a pudding-like consistency. This method can be used with dry to field capacity soil moisture.

Soil Quality Test Kit method: See Chapter 9, Slake Test, in the SQTK Guide for procedure and scoring (Soil Quality Test Kit Guide). This method can be used with dry to field capacity soil moisture.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 528

Soil Structure

Soil structure affects water and gas movement, plant rooting, and soil organism habitat. Structure should be observed in the surface, and if possible, B horizon. Specifically look for granular or platy structure. Granular structure typically is associated with soils rich in organic matter and good aggregation. Platy structure is characterized by distinct layers that can be separated along the horizontal plane and is typically associated with a compacted layer, or often, E horizons. Sandy soils are less likely to exhibit granular structure. Other local, naturally occurring conditions will also affect structure.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

Soil Color

Color can be used as an indicator of loss or accumulation of organic matter. Typically, loss of SOM results in a lighter color, with accumulation resulting in darker colors. Color can be assessed in at least two ways.

1. Use a Munsell Color chart and soil survey pedon description for the field. The value is the number that reflects soil darkness. For example, a soil with color 10YR 3/6 is darker than a 10YR 5/6 soil. For the 10YR 5/6 sample, 10YR is the hue, 5 is the value, and 6 represents the chroma (brightness). A lower value number is darker than higher numbers. The assessment can be done at any soil moisture, but dry samples should be moistened prior to using the color chart.

Soil Color (cont.)

2. Compare relative color changes from field compared to fencerow or other undisturbed area at the field edge (typically darker). Exceptions to this are in semi-arid environments where irrigation and fertility in agronomically managed soils can lead to higher SOM levels compared to fencerows.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

Plant Roots

Plant roots exude simple and complex carbohydrates that influence the microbes, which also influence soil structure by forming soil aggregates. Plant roots recycle soluble soil nutrients. Root channels can remain from season to season and function as areas of carbon concentration and biological activity (see biopores indicator). Observe growth patterns of actively growing roots within the top 0-8" or deeper depending on the crop. Healthy roots are abundant, deep, not inhibited by restrictive layers, and well-branched. Observe plant roots to see if they are covered in a soil film (rhizosheaths) or are part of soil aggregates. The presence of rhizosheaths is highly species- and environment-dependent. Best done during times of active desirable plant growth and adequate soil moisture.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 512, 528

Biological Diversity

Rating based on observations of the presence of soil organisms within the residue or soil. Restrict observation to the area of the soil surface represented by the assessment hole, a shovel full of soil and the hole itself. Fungal hyphae will appear as white to light tan threads or masses. Look for active nodules if legumes are growing, meso- and macro-invertebrates such as earthworms or earthworm middens, mites, springtails, millipedes, roundworms beetles and ants. The best time to assess is during spring or fall or other times of the year when soils are moist to field capacity. Temperature will also affect the presence and activity of organisms.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 484, 528, 590, 595

Photo sources: NRCS, Global Soil Biodiversity Atlas, and (midden picture) lowalearningfarms.wordpress.com

Biopores

Plant roots and earthworms leave behind large pores called biopores. These biopores are important for rapid air and water exchange. In addition, earthworm channels tend to be enriched in organic matter, microbes, and nutrients. Old biopores provide excellent pathways for newly established roots. Look for continuous pores that will appear as channels, often connected to the soil surface. Biopores rich in organic matter may appear darker than the surrounding soil. Can be assessed at dry to field capacity soil moisture, but they will be easier to observe in moist to field capacity soils.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 528

Beare et al. 1995. Plant & Soil 170:5-22; Kuzyakov et al. 2015. Soil Biol Biochem 83:184-199

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Glossary of Terms

Aggregate – A group of primary soil particles that cohere to each other more strongly than to other surrounding particles due to biological, physical, and chemical processes.

Aggregate stability – A measure of the proportion of the aggregates in a soil that do not easily slake, crumble, or disintegrate.

Biopore – Soil pores, usually of relatively large diameter, created by plant roots, earthworms, or other soil organisms.

Clod – A compact, coherent mass of soil varying in size, usually produced by plowing, digging, etc., especially when these operations are performed on soils that are either too wet or too dry and usually formed by compression, or breaking off from a larger unit, as opposed to a building-up action as in aggregation.

Crust (soil), physical – A surface layer of soils, ranging in thickness from a few millimeters to 3 cm., that physical-chemical processes, in conjunction with the lack of biological aggregation processes, have caused to be much more compact, hard, and brittle when dry than the material immediately beneath it. *Not to be confused with a biological (microbiotic) soil crust.

Crust (soil), biological – An assemblage of cyanobacteria, algae, lichens, liverworts, and mosses that commonly forms an irregular living crust on soil surface, especially on otherwise barren, arid-region soils.

Eluviation – The removal of soil material in suspension (or in solution) from a layer or layers of a soil.

Horizon, A –The surface horizon of a mineral soil having maximum organic matter accumulations, maximum biological activity, and/or eluviation of materials such as iron and aluminum oxides and silicate clays.

Horizon, B – A soil horizon, usually beneath an A, E, or O horizon, that is characterized by one or more of the following:

1. Concentration of silicate clay, iron, aluminum, humus, carbonates, gypsum, or silica, alone or in combination
2. Blocky or prismatic structure
3. Coatings of iron and aluminum oxides that give darker, stronger, or redder color.

Horizon, soil – A layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical, and biological properties or characteristics such as color, structure, texture, consistency, kinds and number of organisms present, degree of acidity or alkalinity, etc.

Hyphae – Filaments of fungal cells. Many hyphae constitute a mycelium.

Ped – A unit of soil structure such as a block, column, granule, plate, or prism, formed by natural processes (in contrast with a clod, which is formed artificially).

Pedon – A three-dimensional body of soil with lateral dimensions large enough to permit the study of horizon shapes and relations.

Resource concern – An expected degradation of the soil, water, air, plant, or animal resource base to the extent that the sustainability or intended use of the resource is impaired.

Rhizosheath – Structures composed of mucilage and soil particles that form a cylinder around the root.

Soil color, chroma – Brightness.

Soil color, hue – Color or shade.

Soil color, value – The lightness or darkness of tones or colors.

Soil Health – The continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans.

Structure, granular – Imperfect spheres, usually sand-size.

Structure, blocky – Imperfect cubes with angular or rounded edges.

Structure, platy – A flattened or compressed appearance.

Structure, soil – The combination or arrangement of primary soil particles into secondary units or peds. The secondary units are characterized by size, shape, and grade (degree of distinctness).

Appendix and Additional Resources

Aggregate Stability
https://www.youtube.com/watch?v=7OYg6-_GW5Q
https://www.youtube.com/watch?v=z8xj5EiNNRo

Biological Activity, Fungi, etc.
http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1015&context=agronomyfacpub

Estimating Soil Moisture by Feel and Appearance -
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_051845.pdf

Field Book for Describing and Sampling Soils Version 3.0
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052523.pdf

Residue Cover
http://ianrpubs.unl.edu/live/g1931/build/g1931.pdf
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_029000.pdf

Science and Technology Training Library – This webinar library houses the soil health webinar series.
http://www.conservationwebinars.net/

Soil Crusts
http://soilquality.org/indicators/soil_crusts.html
http://www.fao.org/docrep/t1696e/t1696e06.htm

Soil Health Management Systems Principles – Factsheet: Principles for High Functioning Soils.
https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1388460&ext=pdf.

Soil Health Technical Note 450-03: Recommended Soil Health Indicators and Associated Laboratory Procedures (For quantitative assessment of soil health)
https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/soils/health/?cid=nrcseprd1315420

Soil Health Management Systems Technical Note 450-04: The Basics of Addressing Resource Concerns with Conservation Practices within Integrated Soil Health Management Systems on Cropland
https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/soils/health/?cid=nrcseprd1315420

Soil Health for Educators -
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/health/assessment/?cid=nrcs142p2_053870

Soil Quality Test Kit Guide -
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050956.pdf

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USDA United States Department of Agriculture

NORTH CAROLINA- Cropland In-Field Soil Health Assessment Worksheet

Soil Health Resource Concerns

CPT = Compaction
SOM = Soil Organic Matter Depletion
AGG = Aggregate Instability
HAB = Soil Organism Habitat Loss or Degradation

Location	Cabarrus County, NC
Field/CMU	Field 2
Tract#	5017
Client/Customer	Dylan Alexander
Planner	Amelia Bruss
Date	9/25/2023
Soil Map Units	CuB2, CuD2
Soil Moisture	Well Drained
Topsoil Texture	Clay loam

Indicator Timing and Use Anytime | After Rain or Irrigation | With Adequate Moisture | Before a Tillage Event Primarily No-till Systems | Before Growing Season | During Growing Season | Interview	Meets Assessment Criteria (Yes/No)
Soil Cover | SOM, HAB • Surface cover from plants, residue or mulch; cover greater than 75%	☑ Y ☐ N
Residue Breakdown | SOM, HAB • Natural decomposition of crop residues is as expected with crop and conditions	☑ Y ☐ N
Surface Crusts | AGG • Crusting on no more than 5% of the field	☑ Y ☐ N
Ponding | CPT, AGG • No ponding within 24h following typical rainfall or surface irrigation event	☑ Y ☐ N
Penetration Resistance | CPT • Penetrometer rating <150 psi within top 6" depth and <300 psi in the 6-18" depth; • OR Slight or no resistance with wire flag inserted to 12"	☑ Y ☐ N
Water Stable Aggregates | HAB, AGG • Cylinder: At least 80% remains intact after 5 minutes with little cloudy water; • OR Strainer: soil remains intact with aggregates apparent; • OR Soil Quality Test Kit (SQTK): meets stability class 6	☐ Y ☑ N
Soil Structure | CPT, SOM, AGG, HAB • Granular soil structure in A horizon and no platy structure in A or B horizons	☐ Y ☑ N
Soil Color | SOM • No color difference between field and fencerow sample; • OR, Value is on the darker range using color chart and soil survey pedon description	☐ Y ☑ N
Plant Roots | CPT, SOM, HAB • Roots covered in a soil film (rhizosheaths) or are part of soil aggregates; • OR Living roots, if present, are healthy, fully branched and extend into subsoil	☑ Y ☐ N
Biological Diversity | SOM, HAB • Clearly evident; more than 3 different types of organisms observed without magnification	☑ Y ☐ N
Biopores | SOM, AGG, HAB • Presence of root or earthworm channels that extend vertically through the soil with some connecting to the surface	☑ Y ☐ N

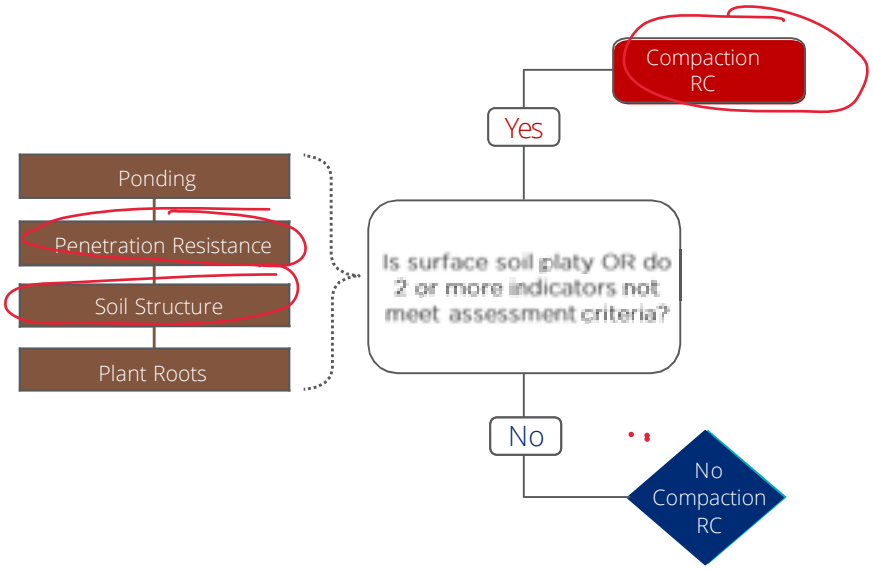
Natural Resources Conservation Service

NORTH CAROLINA- Cropland In-Field Soil Health Assessment Worksheet

Legend (for all RCs)
- = Field indicator
- = RC present
- = RC not present

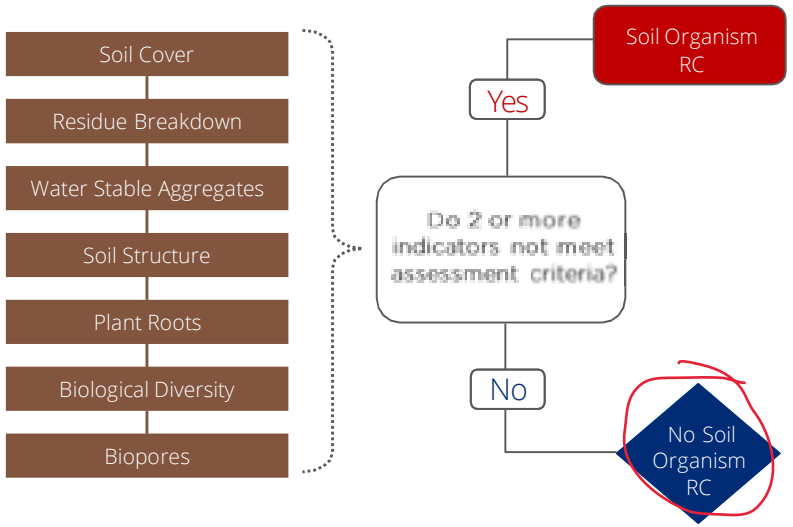
Compaction Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



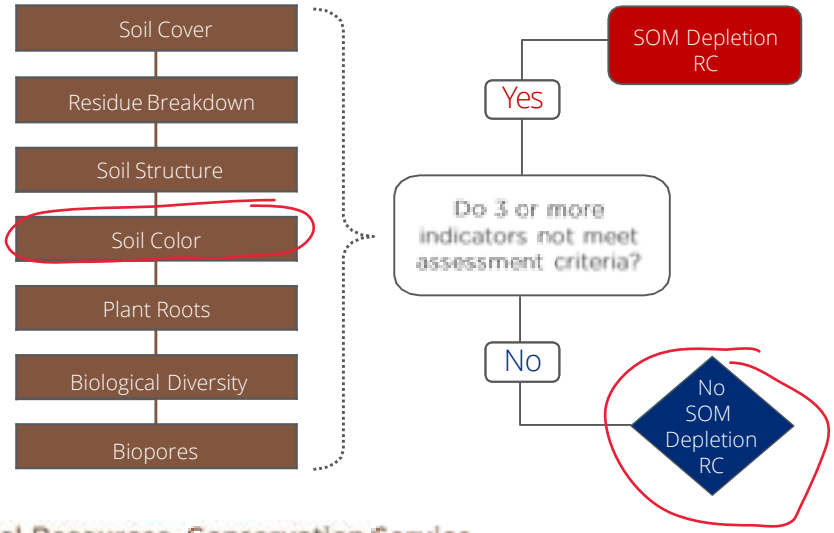
Soil Organism Habitat Loss or Degradation Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



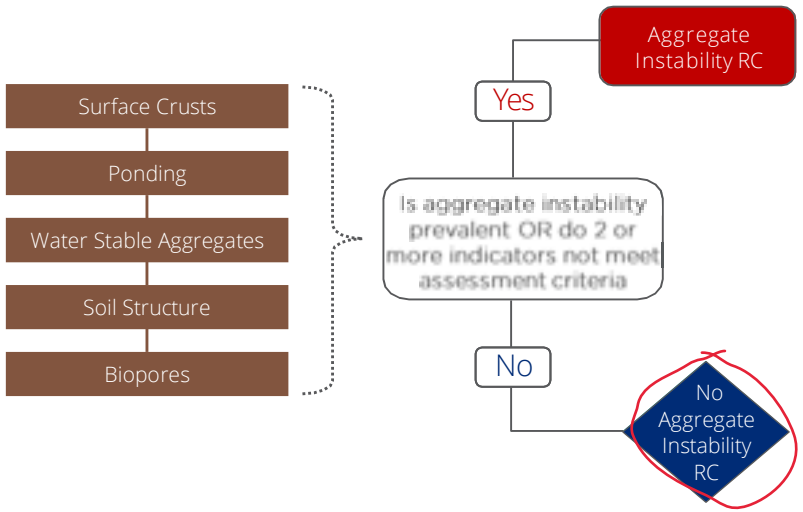
Soil Organic Matter Depletion Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



Aggregate Instability Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



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Management History – Interview

The following questions are offered as examples to guide a conversation with the client and help the planner more thoroughly understand current conditions, the client's management and how these may contribute to existing soil health resource concerns. Answers to these and other similar questions will be helpful in assessing some of the indicators. In North Carolina, contextual information from NC State CES to make planner/client discussions on soil health and potential practice treatments more aligned with the available science and supplement the knowledge base is available at: https://content.ces.ncsu.edu/soil-health-what-does-it-mean-in-north-carolina. The library of NCSU CES "Soil Facts" publications is available by web searching the term "NCSU Soil Facts".

. hat is the crop rotation

Summer crop, fall crop, winter cover crop

hat are the types and frequency of ground disturbing operations

- Mowing cover crops
- Discing crop residue
- Roto till only if going into bed preparations
- Cultivation sweeps no more than 2x per crop season

For how many months per year is the soil surface at least covered with plants, residue or mulch

If there are ever bare fields they are covered with a silage tarp for terminating previous crop or used for weed suppression, tarps are removed during rainfall events.

Are cover crops a consistent part of the cropping system

Yes, all fields on the farm get cover cropped at least once per year.
There is heavy deer pressure on the cover crops, except on sudan grass, leading to lots of weed regrowth. This is a huge challenge on the farm, they do not have the ability to fence the entire property.

If yes, for how many years has the field been continually cover cropped

Yearly since the property was purchased in

. ow are the cover crops terminated If chemically, what herbicide is used

Cover crops are mowed and then disc'd, moving more towards roller crimping depending on success of the cover crop.

. Is the field irrigated If yes, what type of irrigation system, and how many acre-inches are applied for each crop in the rotation described above

All fields are set up for drip irrigation but they have the ability to set up anything, there are many water hydrants all over the farm. Connects garden hose to hydrant and uses drip. All vegetable fields are irrigated, cover crops are not.

oes water pond or run off during or immediately after typical rainfall or irrigation events here in the field

Field R often has flooding and ponding and only gets used for cover cropping. Highly compacted.

Are there problems with crop emergence or early crop growth here in the field

Yes, in Field R.

Is water management a concern i e , field too wet or too dry at planting

Not in most fields, except field R is often too wet, irrigation is used if fields are too dry.

ther observations not captured in the assessment including plant condition, and recent weather and landscape characteristics that may affect assessment results

n/a

Instructions

- Pages 1 and 2 (Worksheet) of the In-Field Assessment can be printed and taken to the field without the remainder of the Assessment document.
- When conducting the field evaluation, it is often helpful to compare the indicators in the managed field to an unmanaged similar soil in an adjacent fencerow or field edge.
- The following *Field Assessment Indicator Details* pages provide guidance for assessing each indicator, and list conservation practices that can be considered for inclusion in a soil health management plan to address the resource concerns associated with each indicator.
- The first four indicators (soil cover, residue breakdown, surface crusts, ponding) represent surface conditions that either affect or are indicative of soil health and should be assessed observing conditions across the field.
- The remaining indicators represent subsurface conditions and are checked by digging down to at least 8 inches and evaluating each indicator to determine if it meets the assessment criteria.
- The subsurface indicators are best confirmed by looking at more than one location in the field. Select three representative locations in the field to evaluate the subsurface indicators. If conditions are not consistent for at least two of the locations, an additional site should be evaluated.
- Penetration resistance should be assessed in several locations in the field when there is adequate soil moisture. It is often helpful to verify compaction by checking for platy or massive structure in the holes dug for the other subsurface indicators.
- Whenever possible, take photos to include in your assessment. These can be added to the customer folder along with field observations and notes.
- Soil moisture can be determined with a handheld soil moisture meter if available, or qualitatively as: *dry, moist, field capacity, or saturated.*
- Soil texture can be estimated by the "feel method." Soil surveys can provide an estimate but should be verified in the field.

Useful assessment materials

- Shovel
- Wire flag
- Penetrometer
- Clear plastic cups or similar
- Wire sink strainers
- Water
- Small hand lens
- Texture-by-feel guide
- Camera

Considerations for using the assessment

The Cropland In-Field Soil Health Assessment is designed to be used as a diagnostic tool to help conservation planners determine if soil health resource concerns exist. It should not be used for comparing one field to another, or as a means of monitoring changes in a field over time, nor should it be assumed that it is a comprehensive assessment of all biological, physical, and chemical processes that are critical to soil function. Fields where multiple indicators do not meet assessment criteria will likely benefit from the implementation of a management system that utilizes as many soil health building practices as practical, to maximize biodiversity, presence of living roots and soil cover, and minimize disturbance (Refer to The Basics of Addressing Resource Concerns with Conservation Practices within Integrated Soil Health Management Systems on Cropland).

Normally, it will not be necessary to evaluate all eleven indicators but only those that will enable the planner to adequately assess field soil health and develop management alternatives if soil heath resource concerns exist. Numerous variables will contribute to the indicators not being equally useful during any single field visit. It is anticipated that some indicators will be more interpretable and representative of soil health than others depending on the soil, landscape position, climate, weather, time of year, and cropping system. Different indicators will have different optimal sampling time or conditions and thus, sampling time and field conditions should be noted. The timing symbols associated with each indicator provide a quick reference for the recommended conditions and time for assessing that indicator.

It is recommended that Field Office staff work with State technical specialists responsible for soil health resource concerns related to conservation planning to determine which indicators are likely to provide useful resource concern assessment information for their climate, soils, and cropping systems. In addition, State and Area specialists may find it necessary to adjust the assessment criteria of the indicators that are used to insure they provide meaningful assessment information for local systems and conditions.

Soil chemical properties (nutrients, pH, EC, etc.) are an important component of soil health, and can impact soil function, but are not part of the in-field assessment. These are best quantified by sending samples to a reputable soil testing laboratory. Additionally, there are physical and biological properties indicative of soil health that can be assessed by laboratory methods (Refer to Soil Health Methods Technical Note). The soil organic matter depletion resource concern can also be identified by tracking trends of lab analyses of SOM through time or determining soil conditioning index (SCI) by an NRCS-approved method. Quick in-field assessments of nutrients, pH, EC, etc. can be done to demonstrate, compare, and contrast the impact of management on nutrient cycling, or differences within a field and determine whether further soil testing is needed (NRCS - Soil Health for Educators). Although soil salinity can have negative impacts on soil health and should be evaluated as a resource concern, and considered in a management plan where appropriate, it has not been included in this assessment.

Soil Cover

A significant factor in promoting soil health is keeping the soil surface covered, particularly during fallow periods. Estimate the percent of soil surface covered with dead plant material, organic mulch or live plants (i.e., cover crop or cash crop). The crops may be different, but the percent cover will look the same. Take photographs of representative areas. Can be assessed at any time.

Conservation practices to address the resource concerns associated with the indicator: 329, 340, 345, 484, 512, 528

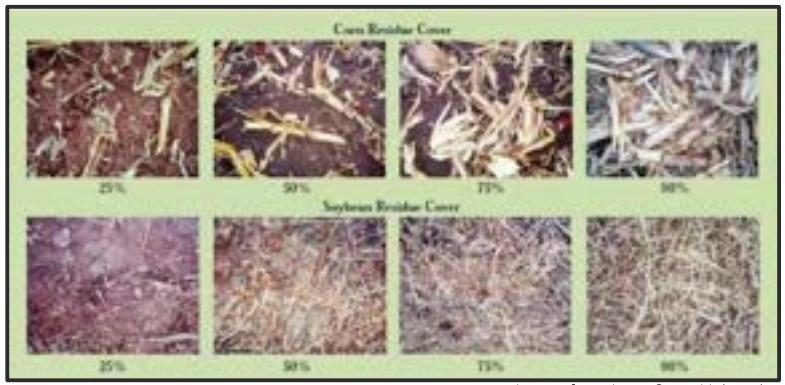

Image from Iowa State University

Residue Breakdown

Residue breakdown is the biological shredding, fragmenting, cycling, and/or incorporating of previous crop residue. The rate at which residue decomposes can be an indicator of management-influenced biological activity. Other factors that will influence the rate of residue breakdown include C:N ratio of the plant residue, crop species, residue amount and environmental conditions during residue decomposition. Breakdown is highly climate-dependent. Residue breakdown is assessed by looking at existing residue cover for signs of decomposition, shredding, and incorporation by soil organisms. Note the depth of litter and color and condition of most recent residue. The conversation with the producer will be helpful in providing information about management, residue age and plant types. Take photographs of representative areas. This indicator can be assessed at any time, but it will not be useful in full width tillage fields.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 595

Surface Crusting

Surface crusts can develop when soil is overworked and left uncovered, resulting in poor aggregate stability. Crusts inhibit seedling emergence and water infiltration. Determine if crusts are throughout the field or only in patches. Crusting can also occur in sodic (high sodium) or saline (high salts) soils. Crusts will remain intact when they are picked up. Assess for physical crusts after irrigation or rain and before next tillage.

Conservation practices to address the resource concerns associated with the indicator: 329, 340, 345, 484, 512, 528

Ponding

Standing water on the soil surface resulting from poor infiltration can be an indication of poor aggregate stability, surface crusting, lack of surface cover, poor soil structure, and/or compaction. Slow infiltration can also result from naturally occurring conditions, such as a fragipan or other slowly permeable layer close to the surface, or a clayey surface or subsurface texture. The best time to assess for ponding is within 24 hours of a typical rainfall or irrigation event. Determine if ponding occurs throughout the field or only in patches. Is ponding the result of inherent soil properties or landscape position? Producers are usually aware if this is an issue in their fields. This information is often best obtained during producer interview to determine the extent and severity of ponding.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

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Penetration Resistance

Soil compaction in agricultural systems can result from repeated wheel or hoof traffic, or repeated tillage at the same depth. Compaction inhibits water and gas movement through the soil in addition to interfering with root growth and soil organism movement and proliferation. Management-induced compaction typically occurs at depths of 2-8 inches but may be deeper depending on soil type and management. Resistance to penetration should be checked at 8-10 randomly-selected spots in the field. Penetration resistance increases as soils dry. Therefore, assess moist to wet soil.

Use one of these methods:

1. Hold a wire flag near the flag end inserting it into the soil observing how easily it bends. Compare the resistance to a known noncompacted area, such as in a fence row or other nonimpacted field border.

2. Use a penetrometer by applying slow, steady vertical downward pressure while observing the pressure gauge reading. Record depth of restrictive layers and resistance pressure.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

Water Stable Aggregates

The stability of soil aggregates in the presence of water is important for water infiltration and storage, gas exchange, and for plant growth and soil organism habitat. Highly degraded soils may not break apart or dissolve because high bulk density may affect how aggregates respond to water. To assess for water stable aggregates, use one of three methods:

Cylinder method: Take a soil ped about the size of a golf ball from the surface just below any residue that may be present and submerge it in water. Note the time. After 5 minutes observe the water in the container and estimate the amount of the ped (%) that remains intact. This method works best with air-dry soil.

Strainer method: Obtain a sample from the soil surface crumble any large peds (BB size or slightly larger; don't grind too fine). Place the soil in a sink strainer or small wire colander, level with top. Immerse in a bowl filled with water and allow to become fully saturated (about 1 minute). Turn strainer upside down on a flat surface. Soils with good aggregate stability will remain intact with aggregates apparent, while soils with poor aggregate stability will slump and have a pudding-like consistency. This method can be used with dry to field capacity soil moisture.

Soil Quality Test Kit method: See Chapter 9, Slake Test, in the SQTK Guide for procedure and scoring (Soil Quality Test Kit Guide). This method can be used with dry to field capacity soil moisture.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 528

Soil Structure

Soil structure affects water and gas movement, plant rooting, and soil organism habitat. Structure should be observed in the surface, and if possible, B horizon. Specifically look for granular or platy structure. Granular structure typically is associated with soils rich in organic matter and good aggregation. Platy structure is characterized by distinct layers that can be separated along the horizontal plane and is typically associated with a compacted layer, or often, E horizons. Sandy soils are less likely to exhibit granular structure. Other local, naturally occurring conditions will also affect structure.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

Soil Color

Color can be used as an indicator of loss or accumulation of organic matter. Typically, loss of SOM results in a lighter color, with accumulation resulting in darker colors. Color can be assessed in at least two ways.

1. Use a Munsell Color chart and soil survey pedon description for the field. The value is the number that reflects soil darkness. For example, a soil with color 10YR 3/6 is darker than a 10YR 5/6 soil. For the 10YR 5/6 sample, 10YR is the hue, 5 is the value, and 6 represents the chroma (brightness). A lower value number is darker than higher numbers. The assessment can be done at any soil moisture, but dry samples should be moistened prior to using the color chart.

Soil Color (cont.)

2. Compare relative color changes from field compared to fencerow or other undisturbed area at the field edge (typically darker). Exceptions to this are in semi-arid environments where irrigation and fertility in agronomically managed soils can lead to higher SOM levels compared to fencerows.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

Plant Roots

Plant roots exude simple and complex carbohydrates that influence the microbes, which also influence soil structure by forming soil aggregates. Plant roots recycle soluble soil nutrients. Root channels can remain from season to season and function as areas of carbon concentration and biological activity (see biopores indicator). Observe growth patterns of actively growing roots within the top 0-8" or deeper depending on the crop. Healthy roots are abundant, deep, not inhibited by restrictive layers, and well-branched. Observe plant roots to see if they are covered in a soil film (rhizosheaths) or are part of soil aggregates. The presence of rhizosheaths is highly species- and environment-dependent. Best done during times of active desirable plant growth and adequate soil moisture.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 512, 528

Biological Diversity

Rating based on observations of the presence of soil organisms within the residue or soil. Restrict observation to the area of the soil surface represented by the assessment hole, a shovel full of soil and the hole itself. Fungal hyphae will appear as white to light tan threads or masses. Look for active nodules if legumes are growing, meso- and macro-invertebrates such as earthworms or earthworm middens, mites, springtails, millipedes, roundworms beetles and ants. The best time to assess is during spring or fall or other times of the year when soils are moist to field capacity. Temperature will also affect the presence and activity of organisms.

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Photo sources: NRCS, Global Soil Biodiversity Atlas, and (midden picture) lowalearningfarms.wordpress.com

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Soil color, hue – Color or shade.

Soil color, value – The lightness or darkness of tones or colors.

Soil Health – The continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans.

Structure, granular – Imperfect spheres, usually sand-size.

Structure, blocky – Imperfect cubes with angular or rounded edges.

Structure, platy – A flattened or compressed appearance.

Structure, soil – The combination or arrangement of primary soil particles into secondary units or peds. The secondary units are characterized by size, shape, and grade (degree of distinctness).

Appendix and Additional Resources

Aggregate Stability
https://www.youtube.com/watch?v=7OYg6-_GW5Q
https://www.youtube.com/watch?v=z8xj5EiNNRo

Biological Activity, Fungi, etc.
http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1015&context=agronomyfacpub

Estimating Soil Moisture by Feel and Appearance -
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_051845.pdf

Field Book for Describing and Sampling Soils Version 3.0
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052523.pdf

Residue Cover
http://ianrpubs.unl.edu/live/g1931/build/g1931.pdf
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_029000.pdf

Science and Technology Training Library – This webinar library houses the soil health webinar series.
http://www.conservationwebinars.net/

Soil Crusts
http://soilquality.org/indicators/soil_crusts.html
http://www.fao.org/docrep/t1696e/t1696e06.htm

Soil Health Management Systems Principles – Factsheet: Principles for High Functioning Soils.
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NORTH CAROLINA- Cropland In-Field Soil Health Assessment Worksheet

Soil Health Resource Concerns

CPT = Compaction
SOM = Soil Organic Matter Depletion
AGG = Aggregate Instability
HAB = Soil Organism Habitat Loss or Degradation

Location	Cabarrus County, NC
Field/CMU	Field 3
Tract#	5017
Client/Customer	Dylan Alexander
Planner	Amelia Bruss
Date	9/25/2023
Soil Map Units	CuB2
Soil Moisture	Well Drained
Topsoil Texture	Clay loam

Indicator Timing and Use Anytime | After Rain or Irrigation | With Adequate Moisture | Before a Tillage Event Primarily No-till Systems | Before Growing Season | During Growing Season | Interview	Meets Assessment Criteria (Yes/No)
Soil Cover | SOM, HAB • Surface cover from plants, residue or mulch; cover greater than 75%	☑ Y ☐ N
Residue Breakdown | SOM, HAB • Natural decomposition of crop residues is as expected with crop and conditions	☑ Y ☐ N
Surface Crusts | AGG • Crusting on no more than 5% of the field	☑ Y ☐ N
Ponding | CPT, AGG • No ponding within 24h following typical rainfall or surface irrigation event	☑ Y ☐ N
Penetration Resistance | CPT • Penetrometer rating <150 psi within top 6" depth and <300 psi in the 6-18" depth; • OR Slight or no resistance with wire flag inserted to 12"	☑ Y ☐ N
Water Stable Aggregates | HAB, AGG • Cylinder: At least 80% remains intact after 5 minutes with little cloudy water; • OR Strainer: soil remains intact with aggregates apparent; • OR Soil Quality Test Kit (SQTK): meets stability class 6	☑ Y ☐ N
Soil Structure | CPT, SOM, AGG, HAB • Granular soil structure in A horizon and no platy structure in A or B horizons	☑ Y ☐ N
Soil Color | SOM • No color difference between field and fencerow sample; • OR, Value is on the darker range using color chart and soil survey pedon description	☑ Y ☐ N
Plant Roots | CPT, SOM, HAB • Roots covered in a soil film (rhizosheaths) or are part of soil aggregates; • OR Living roots, if present, are healthy, fully branched and extend into subsoil	☑ Y ☐ N
Biological Diversity | SOM, HAB • Clearly evident; more than 3 different types of organisms observed without magnification	☑ Y ☐ N
Biopores | SOM, AGG, HAB • Presence of root or earthworm channels that extend vertically through the soil with some connecting to the surface	☑ Y ☐ N

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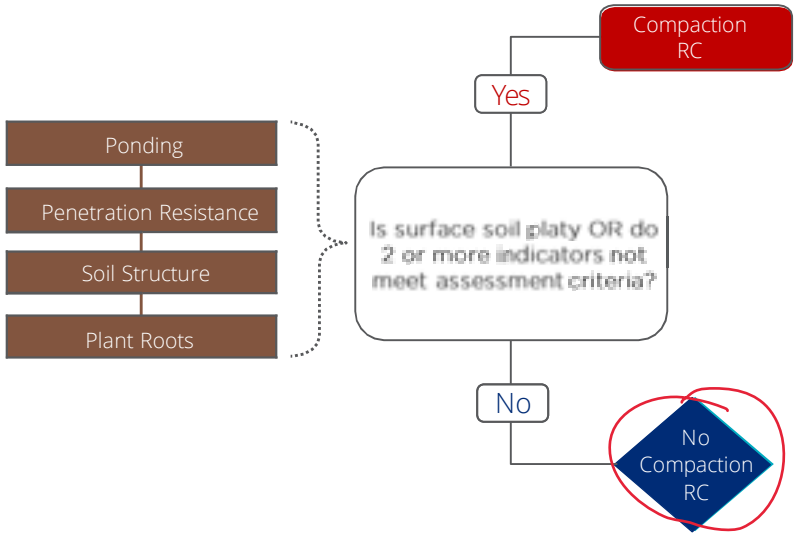
NORTH CAROLINA- Cropland In-Field Soil Health Assessment Worksheet

Legend (for all RCs)
- = Field indicator
- = RC present
- = RC not present

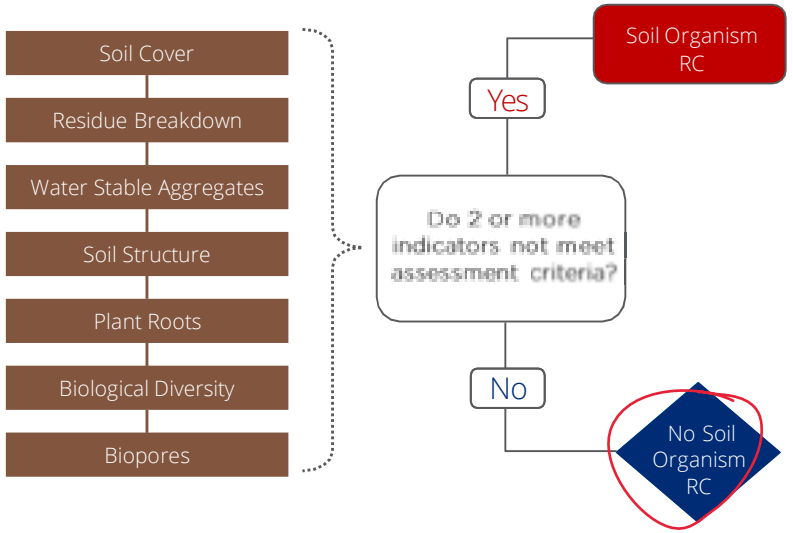
Compaction Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



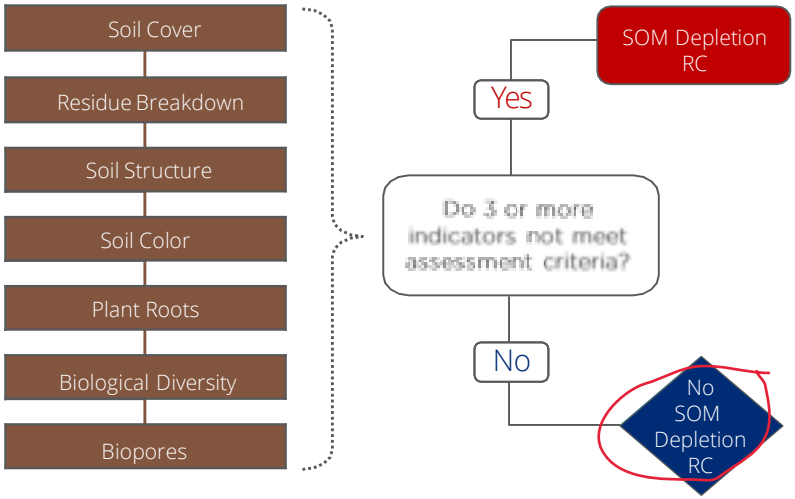
Soil Organism Habitat Loss or Degradation Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



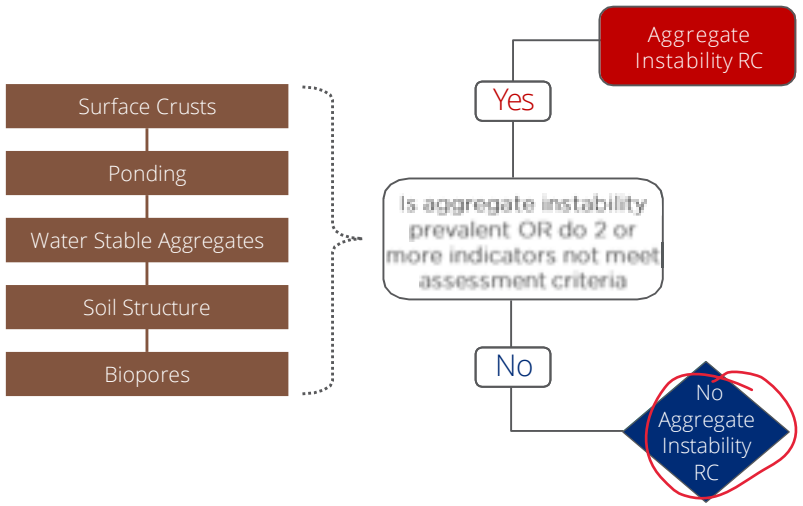
Soil Organic Matter Depletion Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



Aggregate Instability Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



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Management History – Interview

The following questions are offered as examples to guide a conversation with the client and help the planner more thoroughly understand current conditions, the client's management and how these may contribute to existing soil health resource concerns. Answers to these and other similar questions will be helpful in assessing some of the indicators. In North Carolina, contextual information from NC State CES to make planner/client discussions on soil health and potential practice treatments more aligned with the available science and supplement the knowledge base is available at: https://content.ces.ncsu.edu/soil-health-what-does-it-mean-in-north-carolina. The library of NCSU CES "Soil Facts" publications is available by web searching the term "NCSU Soil Facts".

. hat is the crop rotation

Summer crop, fall crop, winter cover crop

hat are the types and frequency of ground disturbing operations

- Mowing cover crops
- Discing crop residue
- Roto till only if going into bed preparations
- Cultivation sweeps no more than 2x per crop season

For how many months per year is the soil surface at least covered with plants, residue or mulch

If there are ever bare fields they are covered with a silage tarp for terminating previous crop or used for weed suppression, tarps are removed during rainfall events.

Are cover crops a consistent part of the cropping system

Yes, all fields on the farm get cover cropped at least once per year.
There is heavy deer pressure on the cover crops, except on sudan grass, leading to lots of weed regrowth. This is a huge challenge on the farm, they do not have the ability to fence the entire property.

If yes, for how many years has the field been continually cover cropped

Yearly since the property was purchased

. ow are the cover crops terminated Ifchemically, what herbicide is used

Cover crops are mowed and then disc'd, moving more towards roller crimping depending on success of the cover crop.

. Is the field irrigated If yes, what type of irrigation system, and how many acre-inches are applied for each crop in the rotation described above

All fields are set up for drip irrigation but they have the ability to set up anything, there are many water hydrants all over the farm. Connects garden hose to hydrant and uses drip. All vegetable fields are irrigated, cover crops are not.

oes water pond or run off during or immediately after typical rainfall or irrigation events here in the field

No

Are there problems with crop emergence or early crop growth here in the field

No

Is water management a concern i e , field too wet or too dry at planting

Not typically, irrigation is used if fields are too dry.

ther observations not captured in the assessment including plant condition, and recent weather and landscape characteristics that may affect assessment results

n/a

Instructions

- Pages 1 and 2 (Worksheet) of the In-Field Assessment can be printed and taken to the field without the remainder of the Assessment document.
- When conducting the field evaluation, it is often helpful to compare the indicators in the managed field to an unmanaged similar soil in an adjacent fencerow or field edge.
- The following *Field Assessment Indicator Details* pages provide guidance for assessing each indicator, and list conservation practices that can be considered for inclusion in a soil health management plan to address the resource concerns associated with each indicator.
- The first four indicators (soil cover, residue breakdown, surface crusts, ponding) represent surface conditions that either affect or are indicative of soil health and should be assessed observing conditions across the field.
- The remaining indicators represent subsurface conditions and are checked by digging down to at least 8 inches and evaluating each indicator to determine if it meets the assessment criteria.
- The subsurface indicators are best confirmed by looking at more than one location in the field. Select three representative locations in the field to evaluate the subsurface indicators. If conditions are not consistent for at least two of the locations, an additional site should be evaluated.
- Penetration resistance should be assessed in several locations in the field when there is adequate soil moisture. It is often helpful to verify compaction by checking for platy or massive structure in the holes dug for the other subsurface indicators.
- Whenever possible, take photos to include in your assessment. These can be added to the customer folder along with field observations and notes.
- Soil moisture can be determined with a handheld soil moisture meter if available, or qualitatively as: *dry, moist, field capacity, or saturated.*
- Soil texture can be estimated by the "feel method." Soil surveys can provide an estimate but should be verified in the field.

Useful assessment materials

- Shovel
- Wire flag
- Penetrometer
- Clear plastic cups or similar
- Wire sink strainers
- Water
- Small hand lens
- Texture-by-feel guide
- Camera

Considerations for using the assessment

The Cropland In-Field Soil Health Assessment is designed to be used as a diagnostic tool to help conservation planners determine if soil health resource concerns exist. It should not be used for comparing one field to another, or as a means of monitoring changes in a field over time, nor should it be assumed that it is a comprehensive assessment of all biological, physical, and chemical processes that are critical to soil function. Fields where multiple indicators do not meet assessment criteria will likely benefit from the implementation of a management system that utilizes as many soil health building practices as practical, to maximize biodiversity, presence of living roots and soil cover, and minimize disturbance (Refer to The Basics of Addressing Resource Concerns with Conservation Practices within Integrated Soil Health Management Systems on Cropland).

Normally, it will not be necessary to evaluate all eleven indicators but only those that will enable the planner to adequately assess field soil health and develop management alternatives if soil heath resource concerns exist. Numerous variables will contribute to the indicators not being equally useful during any single field visit. It is anticipated that some indicators will be more interpretable and representative of soil health than others depending on the soil, landscape position, climate, weather, time of year, and cropping system. Different indicators will have different optimal sampling time or conditions and thus, sampling time and field conditions should be noted. The timing symbols associated with each indicator provide a quick reference for the recommended conditions and time for assessing that indicator.

It is recommended that Field Office staff work with State technical specialists responsible for soil health resource concerns related to conservation planning to determine which indicators are likely to provide useful resource concern assessment information for their climate, soils, and cropping systems. In addition, State and Area specialists may find it necessary to adjust the assessment criteria of the indicators that are used to insure they provide meaningful assessment information for local systems and conditions.

Soil chemical properties (nutrients, pH, EC, etc.) are an important component of soil health, and can impact soil function, but are not part of the in-field assessment. These are best quantified by sending samples to a reputable soil testing laboratory. Additionally, there are physical and biological properties indicative of soil health that can be assessed by laboratory methods (Refer to Soil Health Methods Technical Note). The soil organic matter depletion resource concern can also be identified by tracking trends of lab analyses of SOM through time or determining soil conditioning index (SCI) by an NRCS-approved method. Quick in-field assessments of nutrients, pH, EC, etc. can be done to demonstrate, compare, and contrast the impact of management on nutrient cycling, or differences within a field and determine whether further soil testing is needed (NRCS - Soil Health for Educators). Although soil salinity can have negative impacts on soil health and should be evaluated as a resource concern, and considered in a management plan where appropriate, it has not been included in this assessment.

Soil Cover

A significant factor in promoting soil health is keeping the soil surface covered, particularly during fallow periods. Estimate the percent of soil surface covered with dead plant material, organic mulch or live plants (i.e., cover crop or cash crop). The crops may be different, but the percent cover will look the same. Take photographs of representative areas. Can be assessed at any time.

Conservation practices to address the resource concerns associated with the indicator: 329, 340, 345, 484, 512, 528

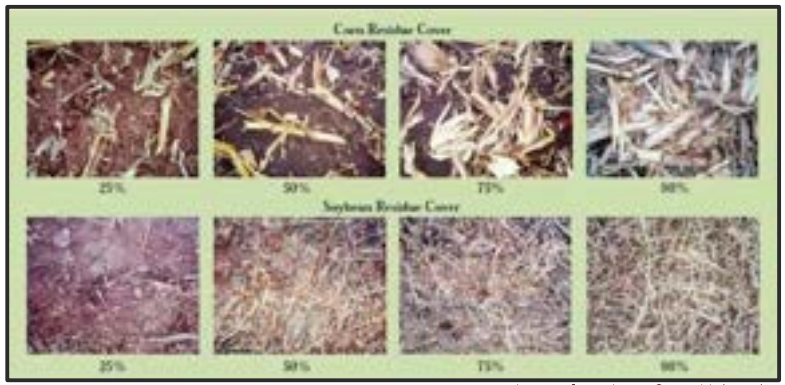

Image from Iowa State University

Residue Breakdown

Residue breakdown is the biological shredding, fragmenting, cycling, and/or incorporating of previous crop residue. The rate at which residue decomposes can be an indicator of management-influenced biological activity. Other factors that will influence the rate of residue breakdown include C:N ratio of the plant residue, crop species, residue amount and environmental conditions during residue decomposition. Breakdown is highly climate-dependent. Residue breakdown is assessed by looking at existing residue cover for signs of decomposition, shredding, and incorporation by soil organisms. Note the depth of litter and color and condition of most recent residue. The conversation with the producer will be helpful in providing information about management, residue age and plant types. Take photographs of representative areas. This indicator can be assessed at any time, but it will not be useful in full width tillage fields.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 595

Surface Crusting

Surface crusts can develop when soil is overworked and left uncovered, resulting in poor aggregate stability. Crusts inhibit seedling emergence and water infiltration. Determine if crusts are throughout the field or only in patches. Crusting can also occur in sodic (high sodium) or saline (high salts) soils. Crusts will remain intact when they are picked up. Assess for physical crusts after irrigation or rain and before next tillage.

Conservation practices to address the resource concerns associated with the indicator: 329, 340, 345, 484, 512, 528

Ponding

Standing water on the soil surface resulting from poor infiltration can be an indication of poor aggregate stability, surface crusting, lack of surface cover, poor soil structure, and/or compaction. Slow infiltration can also result from naturally occurring conditions, such as a fragipan or other slowly permeable layer close to the surface, or a clayey surface or subsurface texture. The best time to assess for ponding is within 24 hours of a typical rainfall or irrigation event. Determine if ponding occurs throughout the field or only in patches. Is ponding the result of inherent soil properties or landscape position? Producers are usually aware if this is an issue in their fields. This information is often best obtained during producer interview to determine the extent and severity of ponding.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

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Penetration Resistance

Soil compaction in agricultural systems can result from repeated wheel or hoof traffic, or repeated tillage at the same depth. Compaction inhibits water and gas movement through the soil in addition to interfering with root growth and soil organism movement and proliferation. Management-induced compaction typically occurs at depths of 2-8 inches but may be deeper depending on soil type and management. Resistance to penetration should be checked at 8-10 randomly-selected spots in the field. Penetration resistance increases as soils dry. Therefore, assess moist to wet soil.

Use one of these methods:

1. Hold a wire flag near the flag end inserting it into the soil observing how easily it bends. Compare the resistance to a known noncompacted area, such as in a fence row or other nonimpacted field border.

2. Use a penetrometer by applying slow, steady vertical downward pressure while observing the pressure gauge reading. Record depth of restrictive layers and resistance pressure.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

Water Stable Aggregates

The stability of soil aggregates in the presence of water is important for water infiltration and storage, gas exchange, and for plant growth and soil organism habitat. Highly degraded soils may not break apart or dissolve because high bulk density may affect how aggregates respond to water. To assess for water stable aggregates, use one of three methods:

Cylinder method: Take a soil ped about the size of a golf ball from the surface just below any residue that may be present and submerge it in water. Note the time. After 5 minutes observe the water in the container and estimate the amount of the ped (%) that remains intact. This method works best with air-dry soil.

Strainer method: Obtain a sample from the soil surface crumble any large peds (BB size or slightly larger; don't grind too fine). Place the soil in a sink strainer or small wire colander, level with top. Immerse in a bowl filled with water and allow to become fully saturated (about 1 minute). Turn strainer upside down on a flat surface. Soils with good aggregate stability will remain intact with aggregates apparent, while soils with poor aggregate stability will slump and have a pudding-like consistency. This method can be used with dry to field capacity soil moisture.

Soil Quality Test Kit method: See Chapter 9, Slake Test, in the SQTK Guide for procedure and scoring (Soil Quality Test Kit Guide). This method can be used with dry to field capacity soil moisture.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 528

Soil Structure

Soil structure affects water and gas movement, plant rooting, and soil organism habitat. Structure should be observed in the surface, and if possible, B horizon. Specifically look for granular or platy structure. Granular structure typically is associated with soils rich in organic matter and good aggregation. Platy structure is characterized by distinct layers that can be separated along the horizontal plane and is typically associated with a compacted layer, or often, E horizons. Sandy soils are less likely to exhibit granular structure. Other local, naturally occurring conditions will also affect structure.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

Soil Color

Color can be used as an indicator of loss or accumulation of organic matter. Typically, loss of SOM results in a lighter color, with accumulation resulting in darker colors. Color can be assessed in at least two ways.

1. Use a Munsell Color chart and soil survey pedon description for the field. The value is the number that reflects soil darkness. For example, a soil with color 10YR 3/6 is darker than a 10YR 5/6 soil. For the 10YR 5/6 sample, 10YR is the hue, 5 is the value, and 6 represents the chroma (brightness). A lower value number is darker than higher numbers. The assessment can be done at any soil moisture, but dry samples should be moistened prior to using the color chart.

Soil Color (cont.)

2. Compare relative color changes from field compared to fencerow or other undisturbed area at the field edge (typically darker). Exceptions to this are in semi-arid environments where irrigation and fertility in agronomically managed soils can lead to higher SOM levels compared to fencerows.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

Plant Roots

Plant roots exude simple and complex carbohydrates that influence the microbes, which also influence soil structure by forming soil aggregates. Plant roots recycle soluble soil nutrients. Root channels can remain from season to season and function as areas of carbon concentration and biological activity (see biopores indicator). Observe growth patterns of actively growing roots within the top 0-8" or deeper depending on the crop. Healthy roots are abundant, deep, not inhibited by restrictive layers, and well-branched. Observe plant roots to see if they are covered in a soil film (rhizosheaths) or are part of soil aggregates. The presence of rhizosheaths is highly species- and environment-dependent. Best done during times of active desirable plant growth and adequate soil moisture.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 512, 528

Biological Diversity

Rating based on observations of the presence of soil organisms within the residue or soil. Restrict observation to the area of the soil surface represented by the assessment hole, a shovel full of soil and the hole itself. Fungal hyphae will appear as white to light tan threads or masses. Look for active nodules if legumes are growing, meso- and macro-invertebrates such as earthworms or earthworm middens, mites, springtails, millipedes, roundworms beetles and ants. The best time to assess is during spring or fall or other times of the year when soils are moist to field capacity. Temperature will also affect the presence and activity of organisms.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 484, 528, 590, 595

Photo sources: NRCS, Global Soil Biodiversity Atlas, and (midden picture) lowalearningfarms.wordpress.com

Biopores

Plant roots and earthworms leave behind large pores called biopores. These biopores are important for rapid air and water exchange. In addition, earthworm channels tend to be enriched in organic matter, microbes, and nutrients. Old biopores provide excellent pathways for newly established roots. Look for continuous pores that will appear as channels, often connected to the soil surface. Biopores rich in organic matter may appear darker than the surrounding soil. Can be assessed at dry to field capacity soil moisture, but they will be easier to observe in moist to field capacity soils.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 528

Beare et al. 1995. Plant & Soil 170:5-22; Kuzyakov et al. 2015. Soil Biol Biochem 83:184-199

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Glossary of Terms

Aggregate – A group of primary soil particles that cohere to each other more strongly than to other surrounding particles due to biological, physical, and chemical processes.

Aggregate stability – A measure of the proportion of the aggregates in a soil that do not easily slake, crumble, or disintegrate.

Biopore – Soil pores, usually of relatively large diameter, created by plant roots, earthworms, or other soil organisms.

Clod – A compact, coherent mass of soil varying in size, usually produced by plowing, digging, etc., especially when these operations are performed on soils that are either too wet or too dry and usually formed by compression, or breaking off from a larger unit, as opposed to a building-up action as in aggregation.

Crust (soil), physical – A surface layer of soils, ranging in thickness from a few millimeters to 3 cm., that physical-chemical processes, in conjunction with the lack of biological aggregation processes, have caused to be much more compact, hard, and brittle when dry than the material immediately beneath it. *Not to be confused with a biological (microbiotic) soil crust.

Crust (soil), biological – An assemblage of cyanobacteria, algae, lichens, liverworts, and mosses that commonly forms an irregular living crust on soil surface, especially on otherwise barren, arid-region soils.

Eluviation – The removal of soil material in suspension (or in solution) from a layer or layers of a soil.

Horizon, A –The surface horizon of a mineral soil having maximum organic matter accumulations, maximum biological activity, and/or eluviation of materials such as iron and aluminum oxides and silicate clays.

Horizon, B – A soil horizon, usually beneath an A, E, or O horizon, that is characterized by one or more of the following:

1. Concentration of silicate clay, iron, aluminum, humus, carbonates, gypsum, or silica, alone or in combination
2. Blocky or prismatic structure
3. Coatings of iron and aluminum oxides that give darker, stronger, or redder color.

Horizon, soil – A layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical, and biological properties or characteristics such as color, structure, texture, consistency, kinds and number of organisms present, degree of acidity or alkalinity, etc.

Hyphae – Filaments of fungal cells. Many hyphae constitute a mycelium.

Ped – A unit of soil structure such as a block, column, granule, plate, or prism, formed by natural processes (in contrast with a clod, which is formed artificially).

Pedon – A three-dimensional body of soil with lateral dimensions large enough to permit the study of horizon shapes and relations.

Resource concern – An expected degradation of the soil, water, air, plant, or animal resource base to the extent that the sustainability or intended use of the resource is impaired.

Rhizosheath – Structures composed of mucilage and soil particles that form a cylinder around the root.

Soil color, chroma – Brightness.

Soil color, hue – Color or shade.

Soil color, value – The lightness or darkness of tones or colors.

Soil Health – The continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans.

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Soil Moisture	Well Drained
Topsoil Texture	Clay loam

Indicator Timing and Use Anytime | After Rain or Irrigation | With Adequate Moisture | Before a Tillage Event Primarily No-till Systems | Before Growing Season | During Growing Season | Interview	Meets Assessment Criteria (Yes/No)
Soil Cover | SOM, HAB • Surface cover from plants, residue or mulch; cover greater than 75%	☑ Y ☐ N
Residue Breakdown | SOM, HAB • Natural decomposition of crop residues is as expected with crop and conditions	☑ Y ☐ N
Surface Crusts | AGG • Crusting on no more than 5% of the field	☑ Y ☐ N
Ponding | CPT, AGG • No ponding within 24h following typical rainfall or surface irrigation event	☑ Y ☐ N
Penetration Resistance | CPT • Penetrometer rating <150 psi within top 6" depth and <300 psi in the 6-18" depth; • OR Slight or no resistance with wire flag inserted to 12"	☑ Y ☐ N
Water Stable Aggregates | HAB, AGG • Cylinder: At least 80% remains intact after 5 minutes with little cloudy water; • OR Strainer: soil remains intact with aggregates apparent; • OR Soil Quality Test Kit (SQTK): meets stability class 6	☑ Y ☐ N
Soil Structure | CPT, SOM, AGG, HAB • Granular soil structure in A horizon and no platy structure in A or B horizons	☑ Y ☐ N
Soil Color | SOM • No color difference between field and fencerow sample; • OR, Value is on the darker range using color chart and soil survey pedon description	☑ Y ☐ N
Plant Roots | CPT, SOM, HAB • Roots covered in a soil film (rhizosheaths) or are part of soil aggregates; • OR Living roots, if present, are healthy, fully branched and extend into subsoil	☑ Y ☐ N
Biological Diversity | SOM, HAB • Clearly evident; more than 3 different types of organisms observed without magnification	☑ Y ☐ N
Biopores | SOM, AGG, HAB • Presence of root or earthworm channels that extend vertically through the soil with some connecting to the surface	☑ Y ☐ N

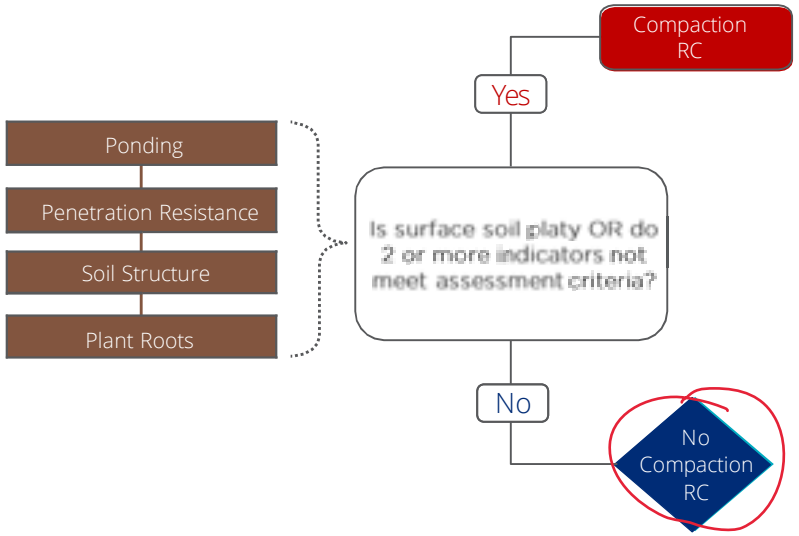
Natural Resources Conservation Service

NORTH CAROLINA- Cropland In-Field Soil Health Assessment Worksheet

Legend (for all RCs)
- = Field indicator
- = RC present
- = RC not present

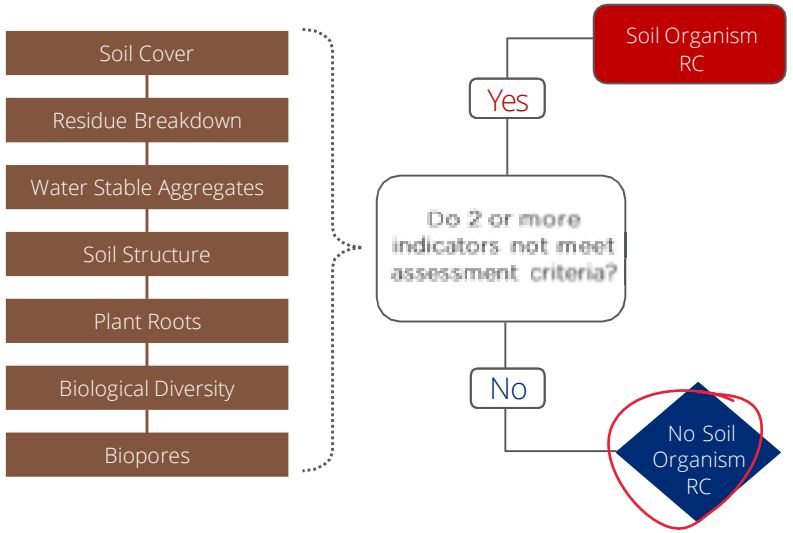
Compaction Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



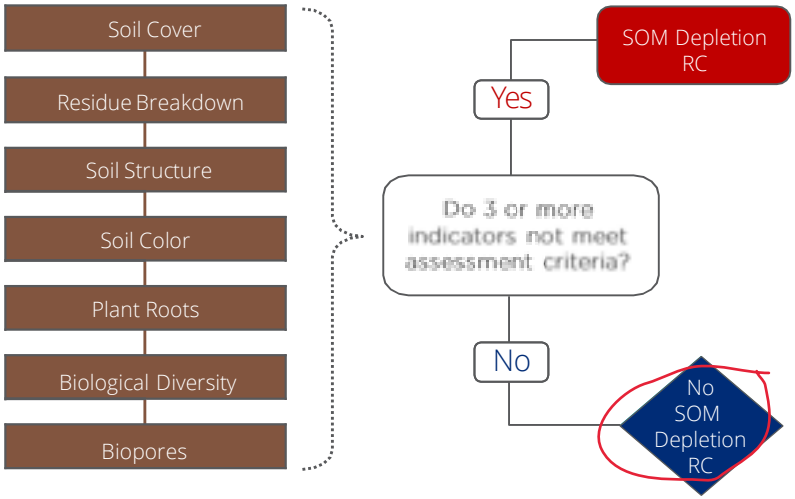
Soil Organism Habitat Loss or Degradation Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



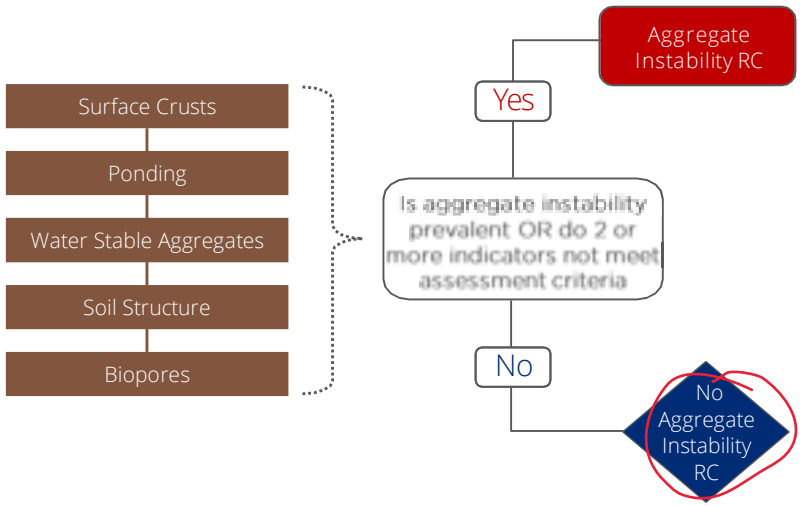
Soil Organic Matter Depletion Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



Aggregate Instability Resource Indicator Decision Tree

Circle the indicators that do not meet assessment criteria during the evaluation and follow decision tree below to determine if the given resource concern (RC) is present. Document on worksheet.



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Management History – Interview

The following questions are offered as examples to guide a conversation with the client and help the planner more thoroughly understand current conditions, the client's management and how these may contribute to existing soil health resource concerns. Answers to these and other similar questions will be helpful in assessing some of the indicators. In North Carolina, contextual information from NC State CES to make planner/client discussions on soil health and potential practice treatments more aligned with the available science and supplement the knowledge base is available at: https://content.ces.ncsu.edu/soil-health-what-does-it-mean-in-north-carolina. The library of NCSU CES "Soil Facts" publications is available by web searching the term "NCSU Soil Facts".

. hat is the crop rotation

Summer crop, fall crop, winter cover crop

hat are the types and frequency of ground disturbing operations

- Mowing cover crops
- Discing crop residue
- Roto till only if going into bed preparations
- Cultivation sweeps no more than 2x per crop season

For how many months per year is the soil surface at least covered with plants, residue or mulch

If there are ever bare fields they are covered with a silage tarp for terminating previous crop or used for weed suppression, tarps are removed during rainfall events.

Are cover crops a consistent part of the cropping system

Yes, all fields on the farm get cover cropped at least once per year.
There is heavy deer pressure on the cover crops, except on sudan grass, leading to lots of weed regrowth. This is a huge challenge on the farm, they do not have the ability to fence the entire property.

If yes, for how many years has the field been continually cover cropped

Yearly since the property was purchased

. ow are the cover crops terminated Ifchemically, what herbicide is used

Cover crops are mowed and then disc'd, moving more towards roller crimping depending on success of the cover crop.

. Is the field irrigated If yes, what type of irrigation system, and how many acre-inches are applied for each crop in the rotation described above

All fields are set up for drip irrigation but they have the ability to set up anything, there are many water hydrants all over the farm. Connects garden hose to hydrant and uses drip. All vegetable fields are irrigated, cover crops are not.

oes water pond or run off during or immediately after typical rainfall or irrigation events here in the field

No

Are there problems with crop emergence or early crop growth here in the field

No

Is water management a concern i e , field too wet or too dry at planting

Not typically, irrigation is used if fields are too dry.

ther observations not captured in the assessment including plant condition, and recent weather and landscape characteristics that may affect assessment results

n/a

Instructions

- Pages 1 and 2 (Worksheet) of the In-Field Assessment can be printed and taken to the field without the remainder of the Assessment document.
- When conducting the field evaluation, it is often helpful to compare the indicators in the managed field to an unmanaged similar soil in an adjacent fencerow or field edge.
- The following *Field Assessment Indicator Details* pages provide guidance for assessing each indicator, and list conservation practices that can be considered for inclusion in a soil health management plan to address the resource concerns associated with each indicator.
- The first four indicators (soil cover, residue breakdown, surface crusts, ponding) represent surface conditions that either affect or are indicative of soil health and should be assessed observing conditions across the field.
- The remaining indicators represent subsurface conditions and are checked by digging down to at least 8 inches and evaluating each indicator to determine if it meets the assessment criteria.
- The subsurface indicators are best confirmed by looking at more than one location in the field. Select three representative locations in the field to evaluate the subsurface indicators. If conditions are not consistent for at least two of the locations, an additional site should be evaluated.
- Penetration resistance should be assessed in several locations in the field when there is adequate soil moisture. It is often helpful to verify compaction by checking for platy or massive structure in the holes dug for the other subsurface indicators.
- Whenever possible, take photos to include in your assessment. These can be added to the customer folder along with field observations and notes.
- Soil moisture can be determined with a handheld soil moisture meter if available, or qualitatively as: *dry, moist, field capacity, or saturated.*
- Soil texture can be estimated by the "feel method." Soil surveys can provide an estimate but should be verified in the field.

Useful assessment materials

- Shovel
- Wire flag
- Penetrometer
- Clear plastic cups or similar
- Wire sink strainers
- Water
- Small hand lens
- Texture-by-feel guide
- Camera

Considerations for using the assessment

The Cropland In-Field Soil Health Assessment is designed to be used as a diagnostic tool to help conservation planners determine if soil health resource concerns exist. It should not be used for comparing one field to another, or as a means of monitoring changes in a field over time, nor should it be assumed that it is a comprehensive assessment of all biological, physical, and chemical processes that are critical to soil function. Fields where multiple indicators do not meet assessment criteria will likely benefit from the implementation of a management system that utilizes as many soil health building practices as practical, to maximize biodiversity, presence of living roots and soil cover, and minimize disturbance (Refer to The Basics of Addressing Resource Concerns with Conservation Practices within Integrated Soil Health Management Systems on Cropland).

Normally, it will not be necessary to evaluate all eleven indicators but only those that will enable the planner to adequately assess field soil health and develop management alternatives if soil heath resource concerns exist. Numerous variables will contribute to the indicators not being equally useful during any single field visit. It is anticipated that some indicators will be more interpretable and representative of soil health than others depending on the soil, landscape position, climate, weather, time of year, and cropping system. Different indicators will have different optimal sampling time or conditions and thus, sampling time and field conditions should be noted. The timing symbols associated with each indicator provide a quick reference for the recommended conditions and time for assessing that indicator.

It is recommended that Field Office staff work with State technical specialists responsible for soil health resource concerns related to conservation planning to determine which indicators are likely to provide useful resource concern assessment information for their climate, soils, and cropping systems. In addition, State and Area specialists may find it necessary to adjust the assessment criteria of the indicators that are used to insure they provide meaningful assessment information for local systems and conditions.

Soil chemical properties (nutrients, pH, EC, etc.) are an important component of soil health, and can impact soil function, but are not part of the in-field assessment. These are best quantified by sending samples to a reputable soil testing laboratory. Additionally, there are physical and biological properties indicative of soil health that can be assessed by laboratory methods (Refer to Soil Health Methods Technical Note). The soil organic matter depletion resource concern can also be identified by tracking trends of lab analyses of SOM through time or determining soil conditioning index (SCI) by an NRCS-approved method. Quick in-field assessments of nutrients, pH, EC, etc. can be done to demonstrate, compare, and contrast the impact of management on nutrient cycling, or differences within a field and determine whether further soil testing is needed (NRCS - Soil Health for Educators). Although soil salinity can have negative impacts on soil health and should be evaluated as a resource concern, and considered in a management plan where appropriate, it has not been included in this assessment.

Soil Cover

A significant factor in promoting soil health is keeping the soil surface covered, particularly during fallow periods. Estimate the percent of soil surface covered with dead plant material, organic mulch or live plants (i.e., cover crop or cash crop). The crops may be different, but the percent cover will look the same. Take photographs of representative areas. Can be assessed at any time.

Conservation practices to address the resource concerns associated with the indicator: 329, 340, 345, 484, 512, 528

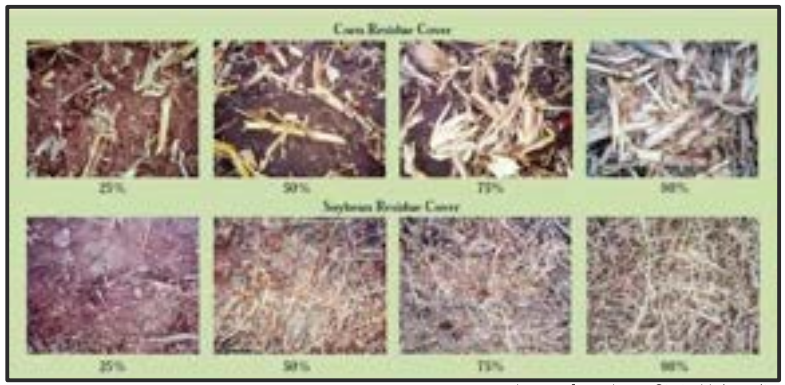

Image from Iowa State University

Residue Breakdown

Residue breakdown is the biological shredding, fragmenting, cycling, and/or incorporating of previous crop residue. The rate at which residue decomposes can be an indicator of management-influenced biological activity. Other factors that will influence the rate of residue breakdown include C:N ratio of the plant residue, crop species, residue amount and environmental conditions during residue decomposition. Breakdown is highly climate-dependent. Residue breakdown is assessed by looking at existing residue cover for signs of decomposition, shredding, and incorporation by soil organisms. Note the depth of litter and color and condition of most recent residue. The conversation with the producer will be helpful in providing information about management, residue age and plant types. Take photographs of representative areas. This indicator can be assessed at any time, but it will not be useful in full width tillage fields.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 595

Surface Crusting

Surface crusts can develop when soil is overworked and left uncovered, resulting in poor aggregate stability. Crusts inhibit seedling emergence and water infiltration. Determine if crusts are throughout the field or only in patches. Crusting can also occur in sodic (high sodium) or saline (high salts) soils. Crusts will remain intact when they are picked up. Assess for physical crusts after irrigation or rain and before next tillage.

Conservation practices to address the resource concerns associated with the indicator: 329, 340, 345, 484, 512, 528

Ponding

Standing water on the soil surface resulting from poor infiltration can be an indication of poor aggregate stability, surface crusting, lack of surface cover, poor soil structure, and/or compaction. Slow infiltration can also result from naturally occurring conditions, such as a fragipan or other slowly permeable layer close to the surface, or a clayey surface or subsurface texture. The best time to assess for ponding is within 24 hours of a typical rainfall or irrigation event. Determine if ponding occurs throughout the field or only in patches. Is ponding the result of inherent soil properties or landscape position? Producers are usually aware if this is an issue in their fields. This information is often best obtained during producer interview to determine the extent and severity of ponding.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

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Penetration Resistance

Soil compaction in agricultural systems can result from repeated wheel or hoof traffic, or repeated tillage at the same depth. Compaction inhibits water and gas movement through the soil in addition to interfering with root growth and soil organism movement and proliferation. Management-induced compaction typically occurs at depths of 2-8 inches but may be deeper depending on soil type and management. Resistance to penetration should be checked at 8-10 randomly-selected spots in the field. Penetration resistance increases as soils dry. Therefore, assess moist to wet soil.

Use one of these methods:

1. Hold a wire flag near the flag end inserting it into the soil observing how easily it bends. Compare the resistance to a known noncompacted area, such as in a fence row or other nonimpacted field border.

2. Use a penetrometer by applying slow, steady vertical downward pressure while observing the pressure gauge reading. Record depth of restrictive layers and resistance pressure.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

Water Stable Aggregates

The stability of soil aggregates in the presence of water is important for water infiltration and storage, gas exchange, and for plant growth and soil organism habitat. Highly degraded soils may not break apart or dissolve because high bulk density may affect how aggregates respond to water. To assess for water stable aggregates, use one of three methods:

Cylinder method: Take a soil ped about the size of a golf ball from the surface just below any residue that may be present and submerge it in water. Note the time. After 5 minutes observe the water in the container and estimate the amount of the ped (%) that remains intact. This method works best with air-dry soil.

Strainer method: Obtain a sample from the soil surface crumble any large peds (BB size or slightly larger; don't grind too fine). Place the soil in a sink strainer or small wire colander, level with top. Immerse in a bowl filled with water and allow to become fully saturated (about 1 minute). Turn strainer upside down on a flat surface. Soils with good aggregate stability will remain intact with aggregates apparent, while soils with poor aggregate stability will slump and have a pudding-like consistency. This method can be used with dry to field capacity soil moisture.

Soil Quality Test Kit method: See Chapter 9, Slake Test, in the SQTK Guide for procedure and scoring (Soil Quality Test Kit Guide). This method can be used with dry to field capacity soil moisture.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 528

Soil Structure

Soil structure affects water and gas movement, plant rooting, and soil organism habitat. Structure should be observed in the surface, and if possible, B horizon. Specifically look for granular or platy structure. Granular structure typically is associated with soils rich in organic matter and good aggregation. Platy structure is characterized by distinct layers that can be separated along the horizontal plane and is typically associated with a compacted layer, or often, E horizons. Sandy soils are less likely to exhibit granular structure. Other local, naturally occurring conditions will also affect structure.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

Soil Color

Color can be used as an indicator of loss or accumulation of organic matter. Typically, loss of SOM results in a lighter color, with accumulation resulting in darker colors. Color can be assessed in at least two ways.

1. Use a Munsell Color chart and soil survey pedon description for the field. The value is the number that reflects soil darkness. For example, a soil with color 10YR 3/6 is darker than a 10YR 5/6 soil. For the 10YR 5/6 sample, 10YR is the hue, 5 is the value, and 6 represents the chroma (brightness). A lower value number is darker than higher numbers. The assessment can be done at any soil moisture, but dry samples should be moistened prior to using the color chart.

Soil Color (cont.)

2. Compare relative color changes from field compared to fencerow or other undisturbed area at the field edge (typically darker). Exceptions to this are in semi-arid environments where irrigation and fertility in agronomically managed soils can lead to higher SOM levels compared to fencerows.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345

Plant Roots

Plant roots exude simple and complex carbohydrates that influence the microbes, which also influence soil structure by forming soil aggregates. Plant roots recycle soluble soil nutrients. Root channels can remain from season to season and function as areas of carbon concentration and biological activity (see biopores indicator). Observe growth patterns of actively growing roots within the top 0-8" or deeper depending on the crop. Healthy roots are abundant, deep, not inhibited by restrictive layers, and well-branched. Observe plant roots to see if they are covered in a soil film (rhizosheaths) or are part of soil aggregates. The presence of rhizosheaths is highly species- and environment-dependent. Best done during times of active desirable plant growth and adequate soil moisture.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 512, 528

Biological Diversity

Rating based on observations of the presence of soil organisms within the residue or soil. Restrict observation to the area of the soil surface represented by the assessment hole, a shovel full of soil and the hole itself. Fungal hyphae will appear as white to light tan threads or masses. Look for active nodules if legumes are growing, meso- and macro-invertebrates such as earthworms or earthworm middens, mites, springtails, millipedes, roundworms beetles and ants. The best time to assess is during spring or fall or other times of the year when soils are moist to field capacity. Temperature will also affect the presence and activity of organisms.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 484, 528, 590, 595

Photo sources: NRCS, Global Soil Biodiversity Atlas, and (midden picture) lowalearningfarms.wordpress.com

Biopores

Plant roots and earthworms leave behind large pores called biopores. These biopores are important for rapid air and water exchange. In addition, earthworm channels tend to be enriched in organic matter, microbes, and nutrients. Old biopores provide excellent pathways for newly established roots. Look for continuous pores that will appear as channels, often connected to the soil surface. Biopores rich in organic matter may appear darker than the surrounding soil. Can be assessed at dry to field capacity soil moisture, but they will be easier to observe in moist to field capacity soils.

Conservation practices to address the resource concerns associated with the indicator: 328, 329, 340, 345, 528

Beare et al. 1995. Plant & Soil 170:5-22; Kuzyakov et al. 2015. Soil Biol Biochem 83:184-199

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Glossary of Terms

Aggregate – A group of primary soil particles that cohere to each other more strongly than to other surrounding particles due to biological, physical, and chemical processes.

Aggregate stability – A measure of the proportion of the aggregates in a soil that do not easily slake, crumble, or disintegrate.

Biopore – Soil pores, usually of relatively large diameter, created by plant roots, earthworms, or other soil organisms.

Clod – A compact, coherent mass of soil varying in size, usually produced by plowing, digging, etc., especially when these operations are performed on soils that are either too wet or too dry and usually formed by compression, or breaking off from a larger unit, as opposed to a building-up action as in aggregation.

Crust (soil), physical – A surface layer of soils, ranging in thickness from a few millimeters to 3 cm., that physical-chemical processes, in conjunction with the lack of biological aggregation processes, have caused to be much more compact, hard, and brittle when dry than the material immediately beneath it. *Not to be confused with a biological (microbiotic) soil crust.

Crust (soil), biological – An assemblage of cyanobacteria, algae, lichens, liverworts, and mosses that commonly forms an irregular living crust on soil surface, especially on otherwise barren, arid-region soils.

Eluviation – The removal of soil material in suspension (or in solution) from a layer or layers of a soil.

Horizon, A –The surface horizon of a mineral soil having maximum organic matter accumulations, maximum biological activity, and/or eluviation of materials such as iron and aluminum oxides and silicate clays.

Horizon, B – A soil horizon, usually beneath an A, E, or O horizon, that is characterized by one or more of the following:

1. Concentration of silicate clay, iron, aluminum, humus, carbonates, gypsum, or silica, alone or in combination
2. Blocky or prismatic structure
3. Coatings of iron and aluminum oxides that give darker, stronger, or redder color.

Horizon, soil – A layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical, and biological properties or characteristics such as color, structure, texture, consistency, kinds and number of organisms present, degree of acidity or alkalinity, etc.

Hyphae – Filaments of fungal cells. Many hyphae constitute a mycelium.

Ped – A unit of soil structure such as a block, column, granule, plate, or prism, formed by natural processes (in contrast with a clod, which is formed artificially).

Pedon – A three-dimensional body of soil with lateral dimensions large enough to permit the study of horizon shapes and relations.

Resource concern – An expected degradation of the soil, water, air, plant, or animal resource base to the extent that the sustainability or intended use of the resource is impaired.

Rhizosheath – Structures composed of mucilage and soil particles that form a cylinder around the root.

Soil color, chroma – Brightness.

Soil color, hue – Color or shade.

Soil color, value – The lightness or darkness of tones or colors.

Soil Health – The continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans.

Structure, granular – Imperfect spheres, usually sand-size.

Structure, blocky – Imperfect cubes with angular or rounded edges.

Structure, platy – A flattened or compressed appearance.

Structure, soil – The combination or arrangement of primary soil particles into secondary units or peds. The secondary units are characterized by size, shape, and grade (degree of distinctness).

Appendix and Additional Resources

Aggregate Stability
https://www.youtube.com/watch?v=7OYg6-_GW5Q
https://www.youtube.com/watch?v=z8xj5EiNNRo

Biological Activity, Fungi, etc.
http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1015&context=agronomyfacpub

Estimating Soil Moisture by Feel and Appearance -
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_051845.pdf

Field Book for Describing and Sampling Soils Version 3.0
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052523.pdf

Residue Cover
http://ianrpubs.unl.edu/live/g1931/build/g1931.pdf
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_029000.pdf

Science and Technology Training Library – This webinar library houses the soil health webinar series.
http://www.conservationwebinars.net/

Soil Crusts
http://soilquality.org/indicators/soil_crusts.html
http://www.fao.org/docrep/t1696e/t1696e06.htm

Soil Health Management Systems Principles – Factsheet: Principles for High Functioning Soils.
https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1388460&ext=pdf.

Soil Health Technical Note 450-03: Recommended Soil Health Indicators and Associated Laboratory Procedures (For quantitative assessment of soil health)
https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/soils/health/?cid=nrcseprd1315420

Soil Health Management Systems Technical Note 450-04: The Basics of Addressing Resource Concerns with Conservation Practices within Integrated Soil Health Management Systems on Cropland
https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/soils/health/?cid=nrcseprd1315420

Soil Health for Educators -
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/health/assessment/?cid=nrcs142p2_053870

Soil Quality Test Kit Guide -
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_050956.pdf

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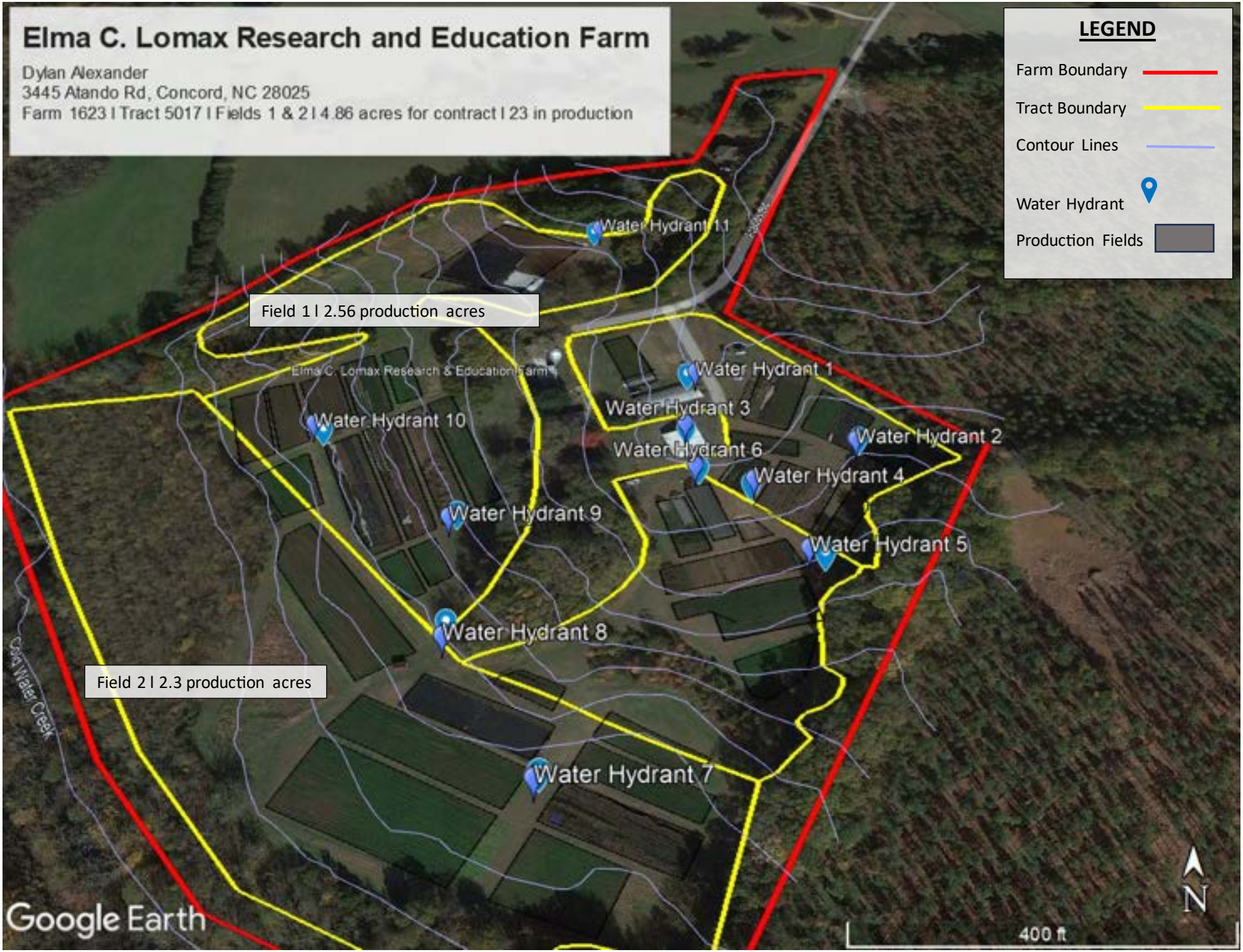

Elma C. Lomax Research and Education Farm
Dylan Alexander
3445 Atando Rd, Concord, NC 28025
Farm 1623 | Tract 5017 | Fields 1 & 2 | 4.86 acres for contract | 23 in production
LEGEND
Farm Boundary
Tract Boundary
Contour Lines
Water Hydrant
Production Fields
Field 1 | 2.56 production acres
Field 2 | 2.3 production acres
Water Hydrant 11
Water Hydrant 1
Water Hydrant 3
Water Hydrant 2
Water Hydrant 6
Water Hydrant 4
Water Hydrant 10
Water Hydrant 9
Water Hydrant 5
Water Hydrant 8
Water Hydrant 7
Cold Water Creek
Google Earth
N
400 ft

NCDA&CS Agronomic Division | Phone: (919) 664-1600 | Website: www.ncagr.gov/agronomi/ | Report No. FY23-SL034786

Predictive

Soil Report

Mehlich-3 Extraction

Links to Helpful Information

Client: Dylan Alexander
3445 Atando Road
Concord, NC 28025

Sampled County : Cabarrus

Client ID: 448638

Advisor:

Advisor ID:

Sampled: | Received: 06/22/2023 | Completed: 06/30/2023 | Farm: LOMAX

Agronomist's Comments:

This report provides Test Results and Recommendations for each sample submitted for testing. Look for Lime Recommendations and N-P-K Fertilizer Recommendations. The lime recommendation is always listed next to the first crop and will be based on the higher target pH if the pH targets for crop 1 and crop 2 differ. Application at the indicated rate will raise soil pH to the optimal level for the plant you specified and should be sufficient for 2 to 3 years, depending on soil type. Common target pH values are as follows: 5.0 for azalea, camellia, rhododendron and mt. laurel; 5.5 for centipedegrass; 6.0 for other lawn grasses, shrubbery, and; flowering plants; and 6.5 for vegetable gardens. N-P-K Recommendations are based on the nitrogen (N) needs of the plants being grown and the soil test results for phosphorus (P-I) and potassium (K-I); a 50 to 70 index for either is optimum. If the exact fertilizer cannot be found, find the closest match and adjust the rate accordingly. Refer to "Understanding the Soil Report" (last page of this report) for additional explanation and links to helpful information.

Sample ID: CT

Lime History:

Recommendations: Crop	Lime (tons/acre)	Nutrients (lb/acre) N	P_2O_5	K_2O	Mg	S	Mn	Zn	Cu	B	More Information
1 - Vegetables, other	0.0	80-100	60	0	0	0	pH$	0	0	0	Note: 6 Note: $
2 -	0.0										

Test Results [units - W/V in g/cm^3; CEC and Na in meq/100 cm^3; NO_3-N in mg/dm^3]: **Soil Class:** Mineral

HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	S-I	Mn-I	Mn-AI1	Mn-AI2	Zn-I	Zn-AI	Cu-I	Na	ESP	SS-I	NO_3-N
0.32	0.64	28.9	98	0.6	7.2	77	127	86	10	116	778	459		898	898	231	0.3	1		

Sample ID: E1

Lime History:

Recommendations: Crop	Lime (tons/acre)	Nutrients (lb/acre) N	P_2O_5	K_2O	Mg	S	Mn	Zn	Cu	B	More Information
1 - Vegetables, other	0.0	80-100	40	0	0	0	0	0	0	0	Note: 6
2 -	0.0										

Test Results [units - W/V in g/cm^3; CEC and Na in meq/100 cm^3; NO_3-N in mg/dm^3]: **Soil Class:** Mineral

HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	S-I	Mn-I	Mn-AI1	Mn-AI2	Zn-I	Zn-AI	Cu-I	Na	ESP	SS-I	NO_3-N
0.32	1.02	9.7	83	1.6	5.9	91	294	55	12	36	2051	1241		283	283	195	0.0			

North Carolina Tobacco Trust Fund Commission

Reprogramming of the laboratory-information-management system that makes this report possible is being funded through a grant from the North Carolina Tobacco Trust Fund Commission.

Thank you for using agronomic services to manage nutrients and safeguard environmental quality.

- *Steve Troxler, Commissioner of Agriculture*

Dylan Alexander

Agronomist's Comments:

This report provides Test Results and Recommendations for each sample submitted for testing. Look for Lime Recommendations and N-P-K Fertilizer Recommendations. The lime recommendation is always listed next to the first crop and will be based on the higher target pH if the pH targets for crop 1 and crop 2 differ. Application at the indicated rate will raise soil pH to the optimal level for the plant you specified and should be sufficient for 2 to 3 years, depending on soil type. Common target pH values are as follows: 5.0 for azalea, camellia, rhododendron and mt. laurel; 5.5 for centipedegrass; 6.0 for other lawn grasses, shrubbery, and; flowering plants; and 6.5 for vegetable gardens. N-P-K Recommendations are based on the nitrogen (N) needs of the plants being grown and the soil test results for phosphorus (P-I) and potassium (K-I); a 50 to 70 index for either is optimum. If the exact fertilizer cannot be found, find the closest match and adjust the rate accordingly. Refer to "Understanding the Soil Report" (last page of this report) for additional explanation and links to helpful information.

Sample ID: J

Lime History:

Recommendations: Crop	Lime (tons/acre)	Nutrients (lb/acre) N	P_2O_5	K_2O	Mg	S	Mn	Zn	Cu	B	More Information
1 - Squash/Pumpkin	0.0	90-120	30	0	0	0	0	0	0	0	Note: 6
2 -	0.0										

Test Results [units - W/V in g/cm³; CEC and Na in meq/100 cm³; NO_3-N in mg/dm³]: **Soil Class:** Mineral

HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	S-I	Mn-I	Mn-AI1	Mn-AI2	Zn-I	Zn-AI	Cu-I	Na	ESP	SS-I	NO_3-N
0.36	1.05	9.8	83	1.7	5.9	55	301	55	13	66	2782	1679		298	298	206	0.0			

Sample ID: V3

Lime History:

Dylan Alexander

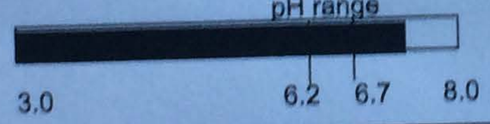
Lime Recommendations

Crop 1- Vegetable garden — 0.0 lb per 1,000 sq ft

Crop 2- — 0.0 lb per 1,000 sq ft

Test Results:

pH = 7.3

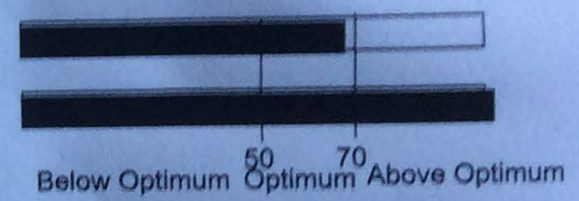


N-P-K Fertilizer Recommendations *

5 lbs per 1000 sq ft 21-0-0 Group D

Phosphorus Index (P-I) =69

Potassium Index (K-I) =157



Additional Test Results:

Soil Class	HM%	W/V	CEC	Mn-I	Zn-I	Cu-I	S-I
Mineral	0.41	0.97 g/cm³	17.1 meq/100 cm³	1994	194	182	37

**If you cannot find the fertilizer recommended here, choose one from the same Group (A, B, C or D) listed on the last page of this report.*

Note: This soil test does not measure nitrogen (N) levels. N fertilizer recommendations are based only on needs of the designated crop.

Sample ID: V1

Lime History:

Recommendations: Crop	Lime (tons/acre)	N	P_2O_5	K_2O	Mg	S	Mn	Zn	Cu	B
1 - Sweetpotato	0.9	60-90	150	20	0	0	0	0	0	0.5
2 -	0.0									

Nutrients (lb/acre)

More Information Note: 6

Test Results [units - W/V in g/cm^3; CEC and Na in meq/100 cm^3; NO_3-N in mg/dm^3]: **Soil Class:** Mineral

HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	S-I	Mn-I	Mn-AI1	Mn-AI2	Zn-I	Zn-AI	Cu-I	Na	ESP	SS-I	NO_3-N
0.27	0.93	11.8	83	2.0	5.5	13	66	65	15	38	425	272		82	82	167	0.1	1		

Sample ID: C

Lime History:

Recommendations: Crop	Lime (tons/acre)	N	P_2O_5	K_2O	Mg	S	Mn	Zn	Cu	B
1 - Corn, grain	0.0	120 - 160	20	0	0	0	pH$	0	0	0
2 -	0.0									

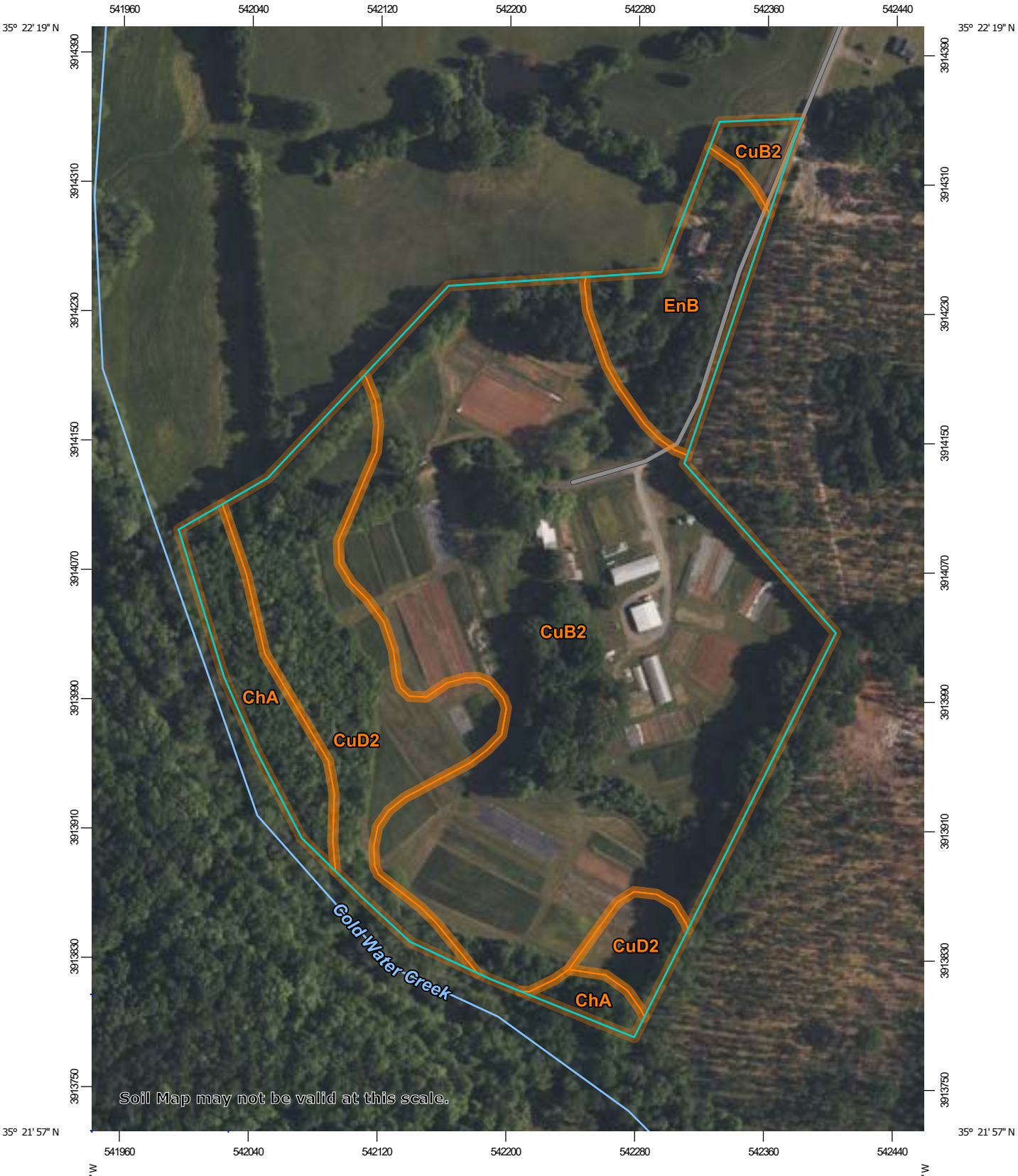
Nutrients (lb/acre)

More Information Note: 3 Note: $

Test Results [units - W/V in g/cm^3; CEC and Na in meq/100 cm^3; NO_3-N in mg/dm^3]: **Soil Class:** Mineral

HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	S-I	Mn-I	Mn-AI1	Mn-AI2	Zn-I	Zn-AI	Cu-I	Na	ESP	SS-I	NO_3-N
0.51	0.93	14.9	93	1.0	6.5	42	105	76	14	31	1038	632		307	307	200	0.1	1		

Soil Map—Cabarrus County, North Carolina
(Lomax Farm F1523 T5017)



Map Scale: 1:3,330 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 45 90 180 270

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cabarrus County, North Carolina
Survey Area Data: Version 23, Sep 13, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 13, 2022—May 9, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ChA	Chewacla sandy loam, 0 to 2 percent slopes, frequently flooded	2.1	6.6%
CuB2	Cullen clay loam, 2 to 8 percent slopes, moderately eroded	20.8	66.0%
CuD2	Cullen clay loam, 8 to 15 percent slopes, moderately eroded	6.0	19.1%
EnB	Enon sandy loam, 2 to 8 percent slopes	2.6	8.2%
Totals for Area of Interest		**31.5**	**100.0%**

Source Data for the Official Soil Survey

Cabarrus County - General

The traditional final product of the first generation soil survey mapping has been the soil survey publication. Each publication included soil map unit descriptions, series descriptions, tables of information (attributes), and maps. The new soil survey is a digital product named SSURGO. A web-based application, the Web Soil Survey, has been made available for public use. Electronic files may be downloaded from the Web Soil Survey. It consists of the newest NRCS SSURGO soils data, along with information from other official federal data sources such as US Geological Survey and the US Census Bureau. These generally include an orthophotographic background, roads, streams, coordinates, and other data for orientation and location purposes.

The Cabarrus County soil survey was published in 1988 and remains the official source of soil descriptions. An historical replica was made by scanning the soil survey publication. The archived soil survey manuscript and maps are available in Adobe PDF format. The soil maps have been digitized.

The official source of soil data is the Web Soil Survey. The SSURGO tabular and/or spatial data and interpretations may be downloaded from:

http://websoilsurvey.nrcs.usda.gov/app/

The data on this site is the most current.

The archived soil survey manuscript and maps are available from:

http://soils.usda.gov/survey/online_surveys/north_carolina/

Copies of the published soil survey and the historical replica may be obtained from:

CONCORD FIELD OFFICE

TELEPHONE: (704) 788-2107 **FAX:** (704) 795-6432
Mailing Address: 715 Cabarrus Avenue, West, Room 301
Concord, NC 28027-6214.

For further information, contact the NRCS field office or the NRCS resource soil scientist at:

SALISBURY AREA OFFICE - Resource Soil Scientist

TELEPHONE: (704) 637-2400 **FAX:** (704) 637-8077.
Mailing Address: 530 West Innes Street, Salisbury, NC 28144.

Disclaimer

The tabular data set is not designed for use as a primary regulatory tool in permitting or siting decisions, but it may be used as a reference source. This is public information and may be interpreted by organizations, agencies, units of government, or other groups or individuals based on their needs. The user, however, is responsible for the appropriate application of the data. Federal, State, or local regulatory bodies are not to reassign to the Natural Resources Conservation Service any authority for the decisions that they make. NRCS will not perform any evaluations of these data for purposes related solely to State or local regulatory programs.

The interpretations and analyses derived from these data do not eliminate the need for onsite sampling, testing, and detailed study of specific sites for intensive uses. Thus, these data and their interpretations are intended for planning purposes only. Files are dated and users are responsible for obtaining the latest version of the data.

Soil maps in the soil surveys may be copied or printed without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If the map is viewed or printed from an online or digital source, the viewing scale and printing scale may differ from the original publication scale. Please rely on the bar scale on each map sheet for proper map measurement.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

COVER CROP

(Ac.)

CODE 340

DEFINITION

Grasses, legumes, and forbs planted for seasonal vegetative cover.

PURPOSE

This practice is applied to support one or more of the following purposes:

- Reduce erosion from wind and water.
- Maintain or increase soil health and organic matter content.
- Reduce water quality degradation by utilizing excessive soil nutrients.
- Suppress excessive weed pressures and break pest cycles.
- Improve soil moisture use efficiency.
- Minimize soil compaction.

CONDITIONS WHERE PRACTICE APPLIES

All lands requiring seasonal vegetative cover for natural resource protection or improvement.

CRITERIA

General Criteria Applicable to All Purposes

Plant species, seedbed preparation, seeding rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with applicable local criteria and soil/site conditions.

Select species that are compatible with other components of the cropping system.

Ensure herbicides used with crops are compatible with cover crop selections and purpose(s).

Cover crops may be established between successive production crops, or companion-planted or relay-planted into production crops. Select species and planting dates that will not compete with the production crop yield or harvest.

Do not burn cover crop residue.

Determine the method and timing of termination to meet the grower's objective and the current NRCS Cover Crop Termination Guidelines.

When a cover crop will be grazed or hayed ensure the planned management will not compromise the selected conservation purpose(s).

Do not harvest cover crops for seed.

If the specific rhizobium bacteria for the selected legume are not present in the soil, treat the seed with the appropriate inoculum at the time of planting.

Additional Criteria to Reduce Erosion from Wind and Water

Time the cover crop establishment in conjunction with other practices to adequately protect the soil during the critical erosion period(s).

Select cover crops that will have the physical characteristics necessary to provide adequate erosion protection.

Use the current erosion prediction technology to determine the amount of surface and/or canopy cover needed from the cover crop to achieve the erosion objective.

Additional Criteria to Maintain or Increase Soil Health and Organic Matter Content

Cover crop species will be selected on the basis of producing higher volumes of organic material and root mass to maintain or increase soil

organic matter.

The planned crop rotation including the cover crop and associated management activities will score a Soil Conditioning Index (SCI) value > 0, as determined using the current approved NRCS Soil Conditioning Index (SCI) procedure, with appropriate adjustments for additions to and or subtractions from plant biomass.

The cover crop shall be planted as early as possible and be terminated as late as practical for the producer's cropping system to maximize plant biomass production, considering crop insurance criteria, the time needed to prepare the field for planting the next crop, and soil moisture depletion.

Additional Criteria Reduce Water Quality Degradation by Utilizing Excessive Soil Nutrients

Establish cover crops as soon as practical prior to or after harvest of the production crop. (i.e. before or after harvest)

Select cover crop species for their ability to effectively utilize nutrients.

Terminate the cover crop as late as practical to maximize plant biomass production and nutrient uptake. Practical considerations for termination date may include crop insurance criteria, the amount of time needed to prepare the field for planting the next crop, weather conditions, and cover crop effects on soil moisture and nutrient availability to the following crop.

If the cover crop will be harvested for feed (hay/balage/etc.), choose species that are suitable for the planned livestock, and capable of removing the excess nutrients present.

Additional Criteria to Suppress Excessive Weed Pressures and Break Pest Cycles

Select cover crop species for their life cycles, growth habits, and other biological, chemical and or physical characteristics to provide one or more of the following:

- To suppress weeds, or compete with weeds.
- Break pest life cycles or suppress of plant pests or pathogens.
- Provide food or habitat for natural enemies of pests.
- Release compounds such as glucosinolates that suppress soil borne pathogens or pests.

Select cover crop species that do not harbor pests or diseases of subsequent crops in the rotation.

Additional Criteria to Improve Soil Moisture Use Efficiency

In areas of limited soil moisture, terminate growth of the cover crop sufficiently early to conserve soil moisture for the subsequent crop. Cover crops established for moisture conservation shall be left on the soil surface.

In areas of potential excess soil moisture, allow the cover crop to grow as long as possible to maximize soil moisture removal.

Additional Criteria to Minimize Soil Compaction

Select cover crop species that have the ability to root deeply and the capacity to penetrate or prevent compacted layers.

CONSIDERATIONS

Plant cover crops in a timely matter and when there is adequate moisture to establish a good stand.

When applicable, ensure cover crops are managed and are compatible with the client's crop insurance criteria.

Maintain an actively growing cover crop as late as feasible to maximize plant growth, allowing time to prepare the field for the next crop and to optimize soil moisture.

Select cover crops that are compatible with the production system, well adapted to the region's

climate and soils, and resistant to prevalent pests, weeds, and diseases. Avoid cover crop species that harbor or carry over potentially damaging diseases or insects.

Cover crops may be used to improve site conditions for establishment of perennial species.

When cover crops are used for grazing, select species that will have desired forage traits, be palatable to livestock, and not interfere with the production of the subsequent crop.

Use plant species that enhance forage opportunities for pollinators by using diverse legumes and other forbs.

Cover crops may be selected to provide food or habitat for natural enemies of production crop pests.

Cover crops residues should be left on the soil surface to maximize allelopathic (chemical) and mulching (physical) effects.

Seed a higher density cover crop stand to promote rapid canopy closure and greater weed suppression. Increased seeding rates (1.5 to 2 times normal) can improve weed-competitiveness.

Cover crops may be selected that release biofumigation compounds that inhibit soil-borne plant pests and pathogens.

Species can be selected to serve as trap crops to divert pests from production crops.

Select a mixture of two or more cover crop species from different plant families to achieve one or more of the following: (1) species mix with different maturity dates, (2) attract beneficial insects, (3) attract pollinators, (4) increase soil biological diversity, (5) serve as a trap crop for insect pests, or (6) provide food and cover for wildlife habitat management.

Plant legumes or mixtures of legumes with grasses, crucifers, and/or other forbs to achieve biological nitrogen fixation. Select cover crop species or mixture, and timing and method of termination that will maximize efficiency of nitrogen utilization by the following crop, considering soil type and conditions, season and weather conditions, cropping system, C:N ratio of the cover crop at termination, and anticipated nitrogen needs of the subsequent crop. Use LGU- recommended nitrogen credits from the legume and reduce nitrogen applications to the subsequent crop accordingly. “If the specific rhizobium bacteria for the selected legume are not present in the soil, treat the seed with the appropriate inoculum at the time of planting.

Time the termination of cover crops to meet nutrient release goals. Termination at early vegetative stages may cause a more rapid release compared to termination at a more mature stage.

Both residue decomposition rates and soil fertility can affect nutrient availability following termination of cover crops

Allelopathic effects to the subsequent crop should be evaluated when selecting the appropriate cover crop.

Legumes add the most plant-available N if terminated when about 30% of the crop is in bloom.

Additional Considerations to Reduce Erosion by Wind or Water

To reduce erosion, best results are achieved when the combined canopy and surface residue cover attains 90 percent or greater during the period of potentially erosive wind or rainfall.

Additional Considerations to Reduce Water Quality Degradation by Utilizing Excessive Soil Nutrients

Use deep-rooted species to maximize nutrient recovery.

When appropriate for the crop production system, mowing certain grass cover crops (e.g., sorghum-sudangrass, pearl millet) prior to heading and allowing the cover crop to regrow can enhance rooting depth and density, thereby increasing their subsoiling and nutrient-recycling efficacy.

Additional Considerations to Increase Soil Health and Organic Matter Content

Increase the diversity of cover crops (e.g., mixtures of several plant species) to promote a wider diversity of soil organisms, and thereby promote increased soil organic matter.

Plant legumes or mixtures of legumes with grasses, crucifers, and/or other forbs to provide nitrogen through biological nitrogen fixation.

Legumes add the most plant-available N if terminated when about 30% of the crop is in bloom.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or treatment unit according to the planning criteria and operation and maintenance requirements of this standard. Specifications shall describe the requirements to apply the practice to achieve the intended purpose for the practice site. Plans for the establishment of cover crops shall, as a minimum, include the following specification components in an approved Cover Crop, 340, Implementation Requirements document:

- Field number and acres
- Species of plant(s) to be established.
- Seeding rates.
- Seeding dates.
- Establishment procedure.
- Rates, timing, and forms of nutrient application (if needed).
- Dates and method to terminate the cover crop.
- Other information pertinent to establishing and managing the cover crop e.g., if haying or grazing is planned specify the planned management for haying or grazing.

OPERATION AND MAINTENANCE

Evaluate the cover crop to determine if the cover crop is meeting the planned purpose(s). If the cover crop is not meeting the purpose(s) adjust the management, change the species of cover crop, or choose a different technology.

REFERENCES

A. Clark (ed.). 2007. Managing cover crops profitably. 3rd ed. Sustainable Agriculture Network Handbook Series; bk 9.

Hargrove, W.L., ed. Cover crops for clean water. SWCS, 1991.

Magdoff, F. and H. van Es. Cover Crops. 2000. p. 87-96 *In* Building soils for better crops. 2nd ed. Sustainable Agriculture Network Handbook Series; bk 4. National Agriculture Library. Beltsville, MD.

Reeves, D.W. 1994. Cover crops and erosion. p. 125-172 *In* J.L. Hatfield and B.A. Stewart (eds.) Crops Residue Management. CRC Press, Boca Raton, FL.

NRCS Cover Crop Termination Guidelines: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/climatechange/?cid=stelprdb1077238

Revised Universal Soil Loss Equation Version 2 (RUSLE2) website: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/rusle2/

Wind Erosion Prediction System (WEPS) website: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/weps/

USDA, Natural Resources Conservation Service, National Agronomy Manual, 4th Edition, Feb. 2011. Website: http://directives.sc.egov.usda.gov/ Under Manuals and Title 190.

USDA United States Department of Agriculture

Conservation Practice Overview

October 2017

CPS Mulching (Code 484)

Mulching is applying plant residues or other suitable materials to the land surface.

Practice Information

This practice is used on all lands subject to erosion and high runoff that need the additional protection. Mulching can be applied to achieve one or a combination of purposes. Purposes for utilizing this practice are—

- To help control soil erosion.
- Protect crops.
- Improve moisture management.
- Reducing irrigation energy.
- Prevent excessive bank erosion from water conveyance channels.
- Maintain or increase organic matter.
- Improve plant productivity and health.

Mulch materials may consist of natural or artificial materials of sufficient dimension (depth or thickness) and durability to achieve the intended purpose for the required time period.

Common Associated Practices

Conservation Practice Standard (CPS) Mulching (Code 484) is commonly applied with practices associated with a vegetation establishment such as CPSs Critical Area Planting (Code 342), Diversion (Code 362), Tree/Shrub Establishment (Code 612), Windbreak/Shelterbelt Establishment (Code 380), and others.

For further information, contact your local NRCS field office.

USDA is an equal opportunity provider, employer, and lender.

INPUT RECORD

To help you to keep track of the materials (fertilizers, pest control materials, soil amendments, adjuvants, etc.) that you apply to your farm, complete one of these forms for each parcel/block and maintain in your records to update as necessary.

NAME: LOMAX - J **CROP YEAR:** 2023

Date	Parcel ID	Material Applied (Brand Name, Manufacturer, Formulation)	Purpose	Rate/Amount
5/7	J	Allgenics C. Nitrate	Fertilization	3#
*Justification: Low Nitrogen				
4/15	J	P. Feather Meal	Fert	15#
Justification: ~~Base~~ Soil Test Rec.				
5/15	J	M. Spinosad	control cuc. beetles	4T/Gal @ 4Gal
Justification:				
Justification:				
Justification:				

*If material is a pesticide, please describe the mechanical, cultural, or physical methods you used to control the pest, and documentation that it was insufficient. Documentation can be a photo, or description of damage.

*If the material is a restricted use fertilizer, please provide results of a soil test recommending its application and rate.

INPUT RECORD

To help you to keep track of the materials (fertilizers, pest control materials, soil amendments, adjuvants, etc.) that you apply to your farm, complete one of these forms for each parcel/block and maintain in your records to update as necessary.

NAME: LOMAX – **CROP YEAR:** 2023

Date	Parcel ID	Material Applied (Brand Name, Manufacturer, Formulation)	Purpose	Rate/Amount
7/7	E1	WALLACE FARM COMPOST	SOIL BUILDING / FERT.	2 yd³
***Justification:**				
7/15	C	W. FARM COMPOST	SOIL BUILDING / FERT.	3 yd³
Justification:				
7/15	FY CT	W. FARM COMPOST	SOIL BUILDING/FERT	1.5 yd³
Justification:				
Justification:				
Justification:				

***If material is a pesticide, please describe the mechanical, cultural, or physical methods you used to control the pest, and documentation that it was insufficient. Documentation can be a photo, or description of damage.**

***If the material is a restricted use fertilizer, please provide results of a soil test recommending its application and rate.**

INPUT RECORD

To help you to keep track of the materials (fertilizers, pest control materials, soil amendments, adjuvants, etc.) that you apply to your farm, complete one of these forms for each parcel/block and maintain in your records to update as necessary.

NAME: LOMAX **CROP YEAR:** 2023

Date	Parcel ID	Material Applied (Brand Name, Manufacturer, Formulation)	Purpose	Rate/Amount
3/8	T1	MONTEREY BT	PEST CONTRA CABB Looper c-t worms	4t/G @ 3G
***Justification:** → VISIBLE damage found scouting				
3/8	C	MONTEREY BT	PEST CONTRL C. Looper c-t worm	1G @ 4t/G
Justification: DAMAGE TO CABBAGE/BROC PLANTS - 75%				
8/30	C	MONTEREY BT	Pest Control	2G @ 4t/G
Justification: Army worms eating beet leaves.				
9/1	9/1	C. NITRATE	NITROGEN	50#/acre = 25#
Justification: SOIL TEST				
Justification:				

***If material is a pesticide, please describe the mechanical, cultural, or physical methods you used to control the pest, and documentation that it was insufficient. Documentation can be a photo, or description of damage.**

***If the material is a restricted use fertilizer, please provide results of a soil test recommending its application and rate.**

INPUT RECORD

To help you to keep track of the materials (fertilizers, pest control materials, soil amendments, adjuvants, etc.) that you apply to your farm, complete one of these forms for each parcel/block and maintain in your records to update as necessary.

NAME: LOMAX - [redacted]

CROP YEAR: 2023

Date	Parcel ID	Material Applied (Brand Name, Manufacturer, Formulation)	Purpose	Rate/Amount
9/23	J	PELLET FEATH 15-0-0	NITROGEN	50#/acre - 1 50# BAG
***Justification:** SOIL TEST				
9/20	J	C. NITRATE	NITROGEN	50#/acre - 3#
Justification: SOIL TEST				
9/25	J	SPINOSAD · MOTERAM	TREAT HARLEQUIN BUGS	2oz/Gal. - 8 Gal.
Justification: · DAMAGE TO ~50% BRASS.				
9/25	E1	M. SPINOSAD	HARLEQUIN BUG	2oz/Gal. - 1 Gal.
Justification: DAMAGE TO 100% of KAPA & TURNIPS				
Justification:				

***If material is a pesticide, please describe the mechanical, cultural, or physical methods you used to control the pest, and documentation that it was insufficient. Documentation can be a photo, or description of damage.**

If the material is a restricted use fertilizer, please provide results of a soil test recommending its application and rate.

INPUT RECORD

To help you to keep track of the materials (fertilizers, pest control materials, soil amendments, adjuvants, etc.) that you apply to your farm, complete one of these forms for each parcel/block and maintain in your records to update as necessary.

NAME: LOMAX - T1 CROP YEAR: 2023

Date	Parcel ID	Material Applied (Brand Name, Manufacturer, Formulation)	Purpose	Rate/Amount
4/17	T1	MONTERFY SPINOSAD	control potato beetle	4T/Gal. @ 4Gal.
*Justification: - treated by hand first				
3/20	T1	C. NITRATE	raise N level	2#
Justification: LOW NITROGEN				
Justification:				
Justification:				
Justification:				

*If material is a pesticide, please describe the mechanical, cultural, or physical methods you used to control the pest, and documentation that it was insufficient. Documentation can be a photo, or description of damage.

*If the material is a restricted use fertilizer, please provide results of a soil test recommending its application and rate.