

## WVU Extension Fertility Recommendation Tool (FRT) for Small Farms

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### **Introduction**

Nutrient management planning (NMP) is a required activity for WV farms that are defined as animal feeding operations (AFO) and routinely land apply stored manure. If the farming operation regularly applies stored manure and/or wastewater, then a certified nutrient management planner should prepare a NMP using the West Virginia Manure management Planner software found at this web site (<http://www.purdue.edu/agsoftware/mmp/>). This NMP software must be used when farm operations are planning to apply manure to fields that have soil test results with Phosphorus in the very high range.

The majority of WV farm operations are not considered AFOs and do not require a structured nutrient management plan prepared by a certified planner. These operations are often pastoral, and cycle manure nutrients during the winter feeding period on pasture and/or hayland. Farms growing crops including hay, vegetables, and fruits also are not required to develop NMPs but doing so adds economic and environmental sustainability to the enterprise. The associated FRP spreadsheet with its tables and links to web resources will allow non-AFO pasture-based livestock, fruit and vegetable farmers to develop soil type and field-specific fertility recommendations in a condensed format.

### **WVU Extension Recommendation System**

WVU-Davis College Soil Testing Lab provides a free service to WV citizens. The lab uses the Mehlich-1 extracting solution. The WVU Soil Testing Lab recommendations do not account for differences in soil types. The fertility ratings include 4 categories: low, medium, high, and very high.

WVU Extension has developed a nutrient management system that is incorporated into the WV version of “Manure Management Planner” (MMP) software developed by Purdue University. This recommendation system is used with both the WV MMP software and the WV SFRT. These tools use the dominant soil type found in the field and use that soil’s productivity potential or potential yield for selected crops. The WVU Extension recommendation system was adapted from the Virginia Agronomic Land Use Evaluation System (VALUES). VALUES can be found

in the Department of Conservation and Recreation’s Virginia Nutrient Management Standards and Criteria, [www.dcr.virginia.gov/documents/StandardsandCriteria.pdf](http://www.dcr.virginia.gov/documents/StandardsandCriteria.pdf).

### **Field Size and Soil Type Determination**

Determining the treatable acres of a farm field is an essential part of building a nutrient management plan. Knowing the field’s dominant soil type is needed with this fertility recommendation system because soil type is used to determine yield potential for each crop. The use of a dominant soil in a field to determine yield potential of the intended crop is the main reason WVU Extension Service has developed this system. The WVU Soil Testing Lab provides specific fertility recommendations by crop, but does not consider the yield potential differences found in individual soils series. The Lab assumes an average yield potential for all of the WV soils.

Web resources make finding field size and dominant soil type easy for the landowner and technical service provider. NRCS offers a useful tool called Web Soil Survey that may be used to determine a field’s size and dominant soil type.

Using the Web Soil Survey:

- To begin, open your browser, and go to the Web Soil Survey home page (or search for Web Soil Survey): <http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>
- Click on the green START WSS button.
- On the left hand side of the Web Soil Survey page, under Quick Navigation, click on Address and enter the farm address. Note: if the address does not work, you can also zoom into a state/county and locate the farm yourself.
- You can also use the following tools at the top of the interactive map:



Zoom in



Zoom out

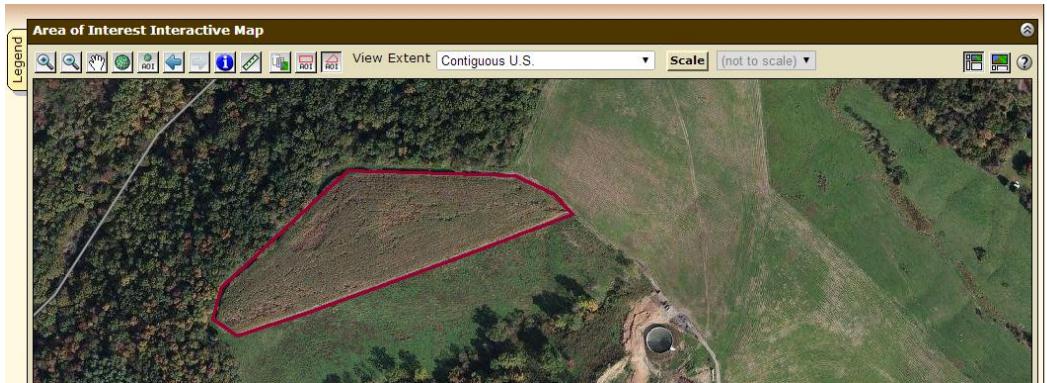


Pan (move in any direction)

- Once you are in the correct area, the interactive map will display an aerial photo, with additional layers for reference such as roads, streams, etc. Zoom in on the map until you can see the entire field that you need.
- Next, you will define an Area of Interest (AOI) in order to extract soils information. The AOI will be an irregularly shaped polygon that you trace on the screen. Click on the AOI Polygon tool shown below, then apply the tool by clicking on the map to trace around the outline of your farm or field as best as you can.



- An example is shown below. The AOI polygon tool is used to click once at each “corner” of the field. When you have completely defined the boundary of your field, double-click to end. (You can also start over by pressing the Escape key).



- Once you have created an AOI, the Web Soil Survey tool will extract soils data for your polygon. Be patient! This process can take a few minutes. The final AOI will be outlined for you.
- Once your AOI is created, at the top of the screen, click on the Soil Map tab (as shown below) to switch to a view with individual soils, soil names, and acreage information.

First, click Soil Map tab to view soil information

Press to save as PDF.

Next, view soils data here, including dominant soil (soil type with highest % in your AOI) and total acres.

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CwC	Culleoka-Westmoreland silt loams, 8 to 15 percent slopes	6.8	89.2%
CwE	Culleoka-Westmoreland silt loams, 25 to 35 percent slopes	0.7	9.6%
DgC	Dormont and Guernsey silt loams, 8 to 15 percent slopes	0.1	1.2%
<b>Totals for Area of Interest</b>		<b>7.7</b>	<b>100.0%</b>

- Items to note:
  - **Dominant soil:** This is the soil type in your AOI with the highest Percent of AOI (in this example, it is CwC, or Culleoka-Westmoreland silt loams, 8 to 15 percent slopes).
  - **Total acreage for AOI:** in this example, the field is 7.7 acres.
- You can now save this information for future use by pressing the Printable Version button (at the top right of the map) and saving the file as a PDF document.

Having an aerial photo of the farm that includes tract numbers, field names or numbers and locations of sensitive features to be avoided is a standard part of a NMP. Use the web soil survey site to generate this map and then draw in the field boundaries and highlight the sensitive or set back areas so the landowner has a visual record of the plan.

### **Set Backs and Sensitive Areas**

The nutrient management planning process includes consideration of areas that are vulnerable to loss of Nitrogen, Phosphorus, and pathogens in manures. Examples of these areas include wetlands, riparian areas, or field segments adjacent to surface waters. A set of guidance documents can be found in the WV Field Office Technical Guide under the Nutrient Management Practice Standard 590. Use the voluntary BMP attachment “Title 6, Procedural Rule, State Department of Agriculture, Series 22B, Best Management Practices for Fertilizer and Manures” when storing and applying fertilizers and developing a plan that is independent of USDA programs such as EQIP. When developing a NMP associated with USDA programs the recommendations must follow guidance from two documents. The Nitrogen management document “WVCPA\_WS590-2 Nitrogen Application Criteria Based on Environmental Sensitivity of Sites” is used with Table #1 found in the spreadsheet tab “Soil Productivity”. The second document is “WVARGFS590\_1 Run Off Risk of Manure Fact Sheet”. Use these documents to determine best set back areas and timing of nitrogen to reduce non-point losses.

### **Locating the Field Office Technical Guide on the Web**

These documents can be found in the WV NRCS Field Office Technical Guide (FOTG), using Firefox or another web browser. Enter NRCS FOTG, click on the link and then click on the icon “Go to Your State’s FOTG.” Click on the State of WV and then click on any WV county. That will bring up the WV FOTG. You will see a drop-down arrow with a Section I in the box. Click on the arrow and choose Section IV. Look for the Conservation Practices and click on that link. All the practices will load. Scroll down to Nutrient Management (AC) 590 and click on that folder.

## **Spreadsheet Components**

The FRT spreadsheet has eight tabs found at the bottom of the screen. The first and most important tab is the field information sheet. This is the active page where the planner enters farm and field information (including soil type and intended crop), soil testing laboratory conducting the soil test, and soil test results. From this information the spreadsheet determines the soil productivity group and the expected crop yield. The spreadsheet generates two fertilization recommendations. The classical or deficiency correction approach is based on the concept that a nutrient should be applied only if there is a reasonable expectation of a crop response. The second recommendation is based on nutrient removal. This is typically described as the sufficiency or maintenance approach. It uses crop removal coefficients, allowing the farmer the option of replacing all nutrients removed from the field during harvest of the crop. Fertilizer recommendations are based on how much nutrient a specific crop is likely to remove from the soil and how much nutrient will be needed to replace it. It does not account for the soil's ability to supply essential nutrients in the following years. When all soils on a livestock farm have nutrient levels in the high or optimum range, legume and manure management becomes the predominant fertility management driver, resulting in minimal fertilizer needs while maintaining crop productivity.

## **How to fill the Field Information Cells and Produce a Fertilizer Recommendation**

If you are putting together a nutrient management plan with multiple fields, consider writing a narrative statement about the farming enterprise that includes total treatable acres, number and types of animals, and crops grown on the farm. On the spreadsheet tab named "Field information," enter the landowner's name, address, and contact information into the top portion of the form. Then enter a USDA or farmer-provided field name and tract number. Using the web soil survey, determine the field acres and dominant soil type and enter these into the spreadsheet. The Dominant Soil cell has a drop-down menu. Next, click on the intended crop and a drop-down menu will show up. Choose the crop and this cell will be filled and the cell below will also fill. This is a conversion step that takes the intended crop and fits it into Productivity and Environmental Sensitivity, Table 1. Environmental sensitivity determines what the soil's limitations are so you can adjust the timing of nitrogen applications to reduce losses.

Click on space to the right of the cell "Lab conducting Soil Test." A drop-down menu will allow you to choose a lab from a selection of Mid-Atlantic soil testing labs used by WV farmers. Next enter the soil test results found on the soil test report sheet provided by the lab, including the soil pH, Lime Requirement, soil test P/P<sub>2</sub>O<sub>5</sub> and K/K<sub>2</sub>O. The spreadsheet will auto fill the remainder of the cells, giving the field's soil fertility rating for P and K. This rating system has a minus and plus, (L-, L and L+) for each fertility level, resulting in expanded fertilizer recommendations.

## **Using the Vegetable Recommendation Tab**

This tab is similar to the agronomic crops tab with a few exceptions. Chose the dominant soil in the garden or field. This results in a productivity potential for field corn for the given soil type. Data is not available for yield productivity potential for individual vegetable crops. Picking a dominant soil also provides the environmental sensitivity in the same way as the crop recommendation page. The list of vegetables are located at the intended crop line. Click on that box and a drop down menu comes up. Enter your vegetable and then fill the soil test results into the soil test information area in the manner as the crops. This will generate a fertilizer recommendation only. This tab will not provide a crop removal result as data is unavailable to provide this. Fertility notes for vegetable production include a broadcasting P and K fertilizer with starter Nitrogen followed by sidedressing or fertigating additional Nitrogen beside plants during mid- season.

## **List of Tables**

The first tab, “Field Info Crops” in the spreadsheet generates a crops recommendation and the second tab, “Field Info Vegetables” generates a vegetable recommendation. They contain results from the following supporting tables.

### **Tab: Veg Fert Recommends**

Table 9. Vegetable Crop recommendations for N-P-K on Low/Medium/ High and Very High Soils.

Table 7. Soil Testing Laboratories, Extraction methods used, soil test nutrient used in their reports and the conversion factor used to convert their soil test K/P to the Va. Tech. soil test K/P in PPM.

### **Tab: Soil Productivity**

Table 1. West Virginia Soil Productivity Groupings for Various Crop Categories with Environmental Sensitivity Ratings.

### **Tab: Expected Yield Lookup**

Table 2. Expected Crop Yield by Soil Productivity Groups.

Table 3. Lookup Table Relating Intended Crop to a Crop Class in Table 2. This table generates yield results on the recommendation page.

Table 4. Lookup Table for Crop Class off set in Table 1. This table generates soil productivity potentials on the recommendation page.

**Tab: Fert Recommend**

Table 5. Fertilizer Recommendations for Different Intended Crops Based on Soil Productivity Rating. N-P-K in pounds per acre for each soil yield grouping and crop.

**Tab: Nutrient Removal**

Table 6. Crop Yield and Crop Nutrient Content. Used to calculate nutrient removal across different yield levels.

**Tab: Soil Testing Lab**

Table 7. Soil Testing Laboratories, Extraction methods used, soil test nutrient used in their reports and the conversion factor used to convert their soil test K/P to the Va. Tech. soil test K/P in PPM.

Table 8. Definition of Soil Fertility Ratings Based on Mehlich 1 Extraction Evaluated By ICP Expressed as Pounds of Oxide Per Acre.

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**TITLE 61**  
**PROCEDURAL RULE**  
**STATE DEPARTMENT OF AGRICULTURE**

**SERIES 22B**  
**BEST MANAGEMENT PRACTICES FOR FERTILIZERS AND MANURES**

**61-22B-1. General.**

- 1.1. Scope. -- The rules establish voluntary best management practices to prevent or minimize the entry of nutrients from fertilizers and manures into groundwater while maintaining and improving the soil and plant resources of this state.
- 1.2. Authority. -- W. Va. Code '22-12-5(c).
- 1.3. Filing Date. -- November 5, 1992.
- 1.4. Effective Date. -- December 6, 1992.
- 1.5. This is a new procedural rule.

**61-22B-2. Definitions.**

- 2.1. "Best Management Practices" means activities, procedures and practices to prevent or remedy the introduction of fertilizer or manure residues into groundwater to the extent technically feasible and economically practical. Best Management Practices are designed to maintain the health and long-term productivity of the soil, water and related plant and animal resources and to minimize the threat of soil, waste and nutrient contamination to the waters of the state.
- 2.2. "Commissioner" means the commissioner of agriculture of the state of West Virginia or his or her duly authorized agent.
- 2.3. "Fertigation" means the application of fertilizers or manures by an irrigation system.
- 2.4. "Fertilizer" means any substance containing one or more recognized plant nutrients which is used for its plant nutrient content and which is designed for use or claimed to have value in promoting plant growth.



The term fertilizer does not include agricultural liming materials, wood ashes, gypsum, unmanipulated animal or vegetable manures and other products exempted by regulation of the commissioner.

2.5. "Manure" means any substance composed of excreta of animals, other than man, and may include bedding or other materials normally associated with the substance as well as water associated with or added to the substance.

2.6. "Non-point source" means a diffuse source of substances that have the potential to impair the beneficial uses of groundwater resulting from activities over a relatively large area, the effects of which must normally be addressed or controlled by a management or conservation practice.

2.7. "Point source" means a source of substances that have the potential to impair the beneficial uses of groundwater resulting from an activity over a small area and generally is limited to mixing, loading and storage sites or feedlots. A source is not considered a point source until a discharge of substances occurs.

2.8. "Twenty-five (25) year twenty-four (24) hour rainfall event" means the maximum 24-hour precipitation event with a probable recurrence interval of once in twenty-five (25) years, as defined by the National Weather Service, U.S. Department of Commerce, in Technical Paper Number 40, "Rainfall Frequency Atlas of the United States", May 1961, and subsequent amendments, or equivalent regional or state rainfall probability information developed therefrom

### **61-22B-3. Protection of Groundwater From Point Sources.**

3.1. Each person should store and handle fertilizers and manures in a manner to prevent pollution by minimizing losses to the groundwaters in this state.

3.2. Each person should store fertilizers inside a sound structure or device having a cover or roof top, sidewalls, and a base sufficient to prevent contact with precipitation and surface water. Each person should store manure in a facility that meets or exceeds the standards of the Soil Conservation Service Field Office Technical Guide. If these conditions are not met then no person should store fertilizer or manure:

3.2.a. without a tarpaulin or other suitable covering to prevent seepage or run-off to surface or groundwater;

3.2.b. on land within one hundred (100) feet of shallow wells, or wells that do not meet the Water Well Design Standards set by WV 64 CSR 46 et seq. (effective June 8, 1984);

3.2.c. on land within fifty (50) feet from surface water, including springs, ponds, wet areas or other collection points for surface water;

3.2.d. on land within fifty (50) feet of an open portal of a sinkhole;

3.2.e. on land that has a slope greater than fifteen percent (15%), unless measures are taken to divert runoff of precipitation from the slopes above the storage area from the fertilizer or manure;

- 3.2.f. on land that has a seasonable groundwater table that is less than two (2) feet from the surface;
- 3.2.g. on land that has less than twenty (20) inches of soil over bedrock or an impervious pan; or
- 3.2.h. on land that has a reasonable expectation of having a flood event resulting from a twenty-five (25) year - twenty-four (24) hour frequency storm during the storage period.
- 3.3. Each person should conduct mixing and loading operations for liquid fertilizers or for fertilizers containing pesticides at least one hundred (100) feet from any wellhead or within a watertight loading pad.
- 3.4. When cleaning equipment used for storing or applying fertilizers or manures, each person should use extreme care that waste water or spillage from the operation is recovered and applied at normal agronomic rates or otherwise disposed of in a manner that will not contaminate groundwater.
- 3.5. All persons owning a dry or abandoned well in the area where fertilizers or manures are stored and used should plug the well according to the Water Well Design Standards WV 64 CSR 46 et seq. (effective June 8, 1984).
  
- 3.6. All persons practicing fertigation should use a proper antibacksiphon device.

**61-22B-4. Protection of Groundwater From Non-Point Sources.**

- 4.1. No person should apply manure or fertilizers containing nitrogen to land:
  - 4.1.a. with less than ten (10) inches of soil over fractured bedrock;
  - 4.1.b. that is snow-covered and frozen, frozen or saturated;
  - 4.1.c. within fifty (50) feet of a wellhead;
  - 4.1.d. that is in imminent danger of being inundated by floodwater; or
  - 4.1.e. that drains into a sinkhole with an open portal unless that sinkhole has a twenty (20) foot vegetative buffer zone with at least ninety percent (90%) of the land in the buffer zone covered with vegetation.
- 4.2. No person should apply fertilizers containing nitrogen to land that has coarse textured soils when the application occurs in the fall, unless that application is made to support the growth of a fall cover crop.
- 4.3. Each person applying fertilizers or manures should:
  - 4.3.a. utilize alternate crop rotations to reduce the amount of fertilizers or manures needed to maintain crop production and to utilize nitrogen residuals in the soil;
  - 4.3.b. utilize practices to enhance soil condition that reduces nitrate leaching (such as practices to improve soil tith and increase organic matter of the soil);

4.3.c. utilize conservation tillage, grassed waterways, contouring, vegetative buffer zones or other effective conservation practices to reduce fertilizer or manure residue runoff into sinkholes, wells or other potential sites for groundwater contamination;

4.3.d. plan the application of fertilizers containing nitrogen so that the application is made as close as practically possible to the time when the crop requires the nitrogen;