# Michigan Technical Note

# USDA-Natural Resources Conservation Service

## AGRONOMY #35
## Manure Application Risk Index (MARI) Spreadsheet 4.0 and the Procedure - Determining Land Available for Winter Spreading of Manure
## April 2013

### GENERAL INFORMATION
### Using the NRCS-Michigan MARI, Spreadsheet 4.0 November 2008

1. **Soil Test Phosphorus** is now entered as PPM rather than lbs/ac. The risk vulnerability breaks still apply the same as the *Right-to-Farm Manure Generally Accepted Agricultural and Management Practices (GAAMPS)*. For any soil test P entry above 150 PPM (or 300 lbs/ac), the MARI spreadsheet macro is programmed to automatically rank a field as HIGH even though the total score may not rank HIGH vulnerability.
2. **Slope:** Any time the % slope is entered greater than 6%, no winter spreading is allowed per RTF GAAMPS for Waste Utilization. Therefore, the MARI spreadsheet macro is programmed to automatically rank a field as HIGH even though the total score may not rank HIGH risk.
3. **Concentrated flow:** If many (m) is selected, the MARI spreadsheet macro will automatically rank a field as HIGH even though the total score may not rank HIGH vulnerability.
4. **Nitrogen Leaching Index** is populated by reference in one of two methods. Once a soil series name is entered, a lookup command seeks the name in the Nitrogen Leaching Table. From the N leaching table, the program assigns the soil management group and the soil hydrologic group. N leaching is assigned by the user as low, medium, high, or see map. These are found directly below line 6. The MARI user must enter in the correct choice, l, m or h. If see map is the choice, tab over to the correct hydrologic group map. Open the map and find your farm location in the county to determine the correct vulnerability. MARI is programmed to enter an "m" for medium nitrate loss risk when hydrologic group B is selected.
5. **Manure Application Method:** A numbering system was set to represent four choices. Direct Inject is a 1; Surface Apply Incorporate within two days is a 2; Surface Apply Incorporate in 90 days is a 4; and Surface Apply Incorporate greater than 90 days is an 8.
6. **The Interpretation of MARI worksheet tab** was added to compare the MARI ranking score to the vulnerability table that is the same as the earlier version of MARI.
7. **The control C** macro command will truly clear all entries and their rankings as entered for a particular farm in version 4.0. This is a change from MARI version 2.0, December 2005.
8. **PRINTING**: If only one or two pages of data needs printing, tell the computer print command or it will print many blank MARI pages without any data**.** ***It is best to Print View before printing.***

# *A PROCEDURE FOR DETERMINING THE LAND AVAILABLE FOR WINTER SPREADING OF MANURE IN MICHIGAN as revised April 2013*

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## *Manure and Michigan Agriculture*

Manure is an important resource on Michigan livestock farms. It can supply all the phosphorus (P) needed by any Michigan crop and, depending on type and amount, all of the nitrogen (N). There is the potential to pollute surface water with phosphorus, nitrogen, or organic material if applied on fields too close to streams or in the late fall on tile drained land. This procedure describes those site-specific field features to be evaluated to achieve the objectives of Michigan Right-to-Farm's (RTF) Generally Accepted Agricultural and Management Practices (GAAMPS) for Manure Management and Utilization.

Manure collection, storage and treatment are costly. Daily hauling and spreading is the least costly method for handling manure for many livestock operations, but it is not always practical to find suitable spreading sites. Daily spreading of manure during the winter can reduce the manure storage needs of the farm, but can also contribute to non-point source pollution. Manure application, application date, and placement cannot always be made to avoid any high-risk soil condition such as frozen, snow covered or saturated soils. Phosphorus is usually the limiting nutrient for developing a nutrient plan based on crop utilization and management. Long-term field research with most of the soils and crop management systems found in Michigan determines the amount of fertilizer or manure P needed for optimum crop yields.

Research has determined the most effective sources of P, timing of P application, and placement methods for P fertilizers. Because of this research, successful agronomic management practices for P are available for Michigan crops.

Soil testing is the best method to determine the amount of plant available phosphorus in the soil. The Bray P1 soil test method estimates the soil P available to the crop. Michigan State University Soil Testing Laboratory uses the critical agronomic soil test levels to determine if a soil is nutrient deficient for that particular crop growth. The NRCS MI 590 job sheet; the MSU Fertilizer Bulletin, E2904, *Nutrient Recommendations for Field Crops in Michigan*; and the MSU Fertilizer spreadsheet 5.0 are available to determine field specific crop needs on an annual basis. Also, the Purdue computer software program, *Manure Management Planner* (MMP) is a tool that can prepare crop nutrient budgets for manure nutrient management plans. With all crop nutrient budgets, it is necessary to obtain a recent soil test (9 inches deep) to evaluate a field or portion of a field for winter spreading risk potential.

## *Manure and the Environment*

Environmental concerns with nutrients in manure involve P, N, and organic material in surface water. Phosphorus from manure, contained in runoff or sediment that reaches surface water can increase **eutrophication (***defined as an increase in the fertility status of natural waters that causes accelerated growth of algae or water plants*). Growth of algae or aquatic plants is limited by inadequate levels of P in surface water (lakes, ponds, bays). Large inputs of P to surface water from non-point sources such as agricultural fields by erosion or runoff can induce eutrophic conditions. This is particularly true if these fields have elevated levels of soil test P due to excessive manure applications. Point sources of P, such as discharge from waste water treatment plants, septic systems failure, or even direct residential effluent discharge into subsurface tile drainage lines can place P into surface water and contribute to eutrophication.

Michigan State University has always supported fertilizing to meet realistic yield goals with adequate phosphorus. However, some counties in Michigan now have a high percentage of soils testing high or very high in P, and on many livestock farms, some fields, receiving manure annually, are testing above 300 lbs available P (Bray P1) per acre. At this level, it is necessary to stop applying all sources of phosphorus including manure applications to be consistent with Right-to-Farm GAAMPS. For example, in some Michigan cropland fields and livestock farms, such as fields next to the barn, soil P levels are high enough to supply crop phosphorus for 10 years or more without any additional nutrient application.

Daily spreading of manure can contribute to non-point source pollution of surface waters because these applications can not be timed to avoid the high risk soil conditions such as frozen, snow covered, or saturated ground. The challenge is to develop a plan to utilize the nutrients in manure and at the same time maintain agricultural profitability and environmental quality. This procedure for assessing winter spreading describes one such approach, the **Manure Application Risk Index.**

***The Manure Application Risk Index***

The Manure Application Risk Index is an evaluation tool that can be used to identify areas where wintertime spreading of manure may cause potential risk for runoff losses of N or P. This index uses 12 field parameters (see Table 1) for making the evaluation. Each parameter is associated with a risk for nutrients to move and be transported on the landscape. The Manure Application Risk Index assigns an individual rating to: the presence of vegetative buffers, existence of concentrated flow, the N leaching index, and the rate of N applied. By either removing the risk factor or implementing appropriate management practices, the index can be altered. For example: using buffer areas and spreading setbacks from the stream edge or changing the rate of N or P applied will lower the risk. By evaluating the field features on each field, this assessment method can identify the location and acreage of low, medium, and high-risk fields on a farm.

Where manure production exceeds land availability, use the index to evaluate fields on other farms without livestock for their potential to serve as spreading sites. A cooperative agreement with other landowners covering sufficient land to properly utilize the manure may be necessary to sustain crop productivity levels, and avoid excessively high soil P levels. This method also can determine the manure storage needed based on the acreage available for winter spreading and the windows of opportunity for spreading.

***Using the Manure Application Risk Index***

The Manure Risk Index uses twelve specific field features to obtain an overall rating for each site. **There are three field features in the RTF GAAMPS that are limiting factors for winter spreading:**

1) ***Soil test P values.*** *(If a soil test P is >300 lbs/ac.*)

2) ***Slope.*** *(Application of manure to frozen or snow-covered soils should be avoided, but where necessary, (a) solid manure should only be applied to areas where slopes are 6% or less and (b) liquid manure should only be applied to soils where slopes are 3% or less. In either situation, provisions must be made to control runoff and erosion with soil and water conservation practices such as vegetative buffer strips between surface waters and land where manure is applied.)*

3) ***Concentrated water flow.*** *(If a concentrated flow outlets into a surface water body such as a waterway, watercourse, wetland, flowing stream, or county drain.)*

Any field having any one of these three limiting factors has a very high risk of polluted effluent moving offsite; therefore, they should be the lowest priority field considered for winter spreading, if at all.

Assigned to each feature is a value rating of VERY LOW, LOW, MEDIUM, or HIGH, based on the relationship between the feature and the potential for manure or P loss from a site. Each feature is assigned the appropriate rating based on field characteristics. Assigned to each feature is a *weighting factor*. Not all field features have the same influence and input because research has shown that relative differences exist in their importance to manure loss.

For example, buffer width (weighting factor = 1.5) is generally more important to manure (P) loss than the soil management group (weighting factor = 1.0). Currently, these weighting factors are the professional judgment of the scientists who developed the P and manure index. The Manure Application Risk Index is based on the best scientific judgment of professionals until more field research verifies it.

### *Calculation of the Manure Risk Index*

The current version of the Manure Application Risk Index is found in Table 2. This table, along with the Michigan Manure Application Risk Index Work Sheet, is to be used in conjunction with a field visit with the farmer or farm manager. The assessment will assist the planner in determining land suitability and available for winter spreading. Also, on a particular field, the Risk Index can give planning guidance to install conservation and management practices such as buffer strips or using setbacks.

First, from information gathered in the field, select a Manure Application Risk Index Rating (Value) for each field feature from the four categories: VERY LOW, LOW, MEDIUM, or HIGH. Multiply the rating value for the feature by its weighting factor to obtain the weighted value for that feature. Sum the Weighted values for all appropriate field features to determine the Manure Application Risk Index for the field. Compare the Manure Index with Table 3 to categorize Field Vulnerability to Manure Loss. Then determine appropriate management practices for various sites based on interpretation associated with site vulnerability ratings (see Table 4).

The following example illustrates the calculations used to compute the Manure Application Risk Index for a field.

### *Example - Manure Application Risk Index*

| **Field Feature** | **Weight Values for Manure Risk Index** |
|---|---|
| Soil Hydrologic Group B<br>field feature factor (low) | 2 * 1.0 = 2.0* |
| Soil Management Group<br>2.5c (loam) (low) | 2 * 1.0 = 2.0 |
| Percent Slope - 1%<br>(v. low) | 1 * 1.0 = 1.0 |
| Soil Test P Value 100 lb/ac<br>(Low) | 2 * 1.5 = 3.0 |
| Concentrated Water Flow<br>No gullies (v. low) | 1 * 1.5 = 1.5 |
| Nitrogen Leaching Index<br>Soil Hydrologic Group: B,<br>Tile drained (low) | 2 * 1.5 = 3.0 |
| Residue, cover or per crops<br>No tilled >40% cover (v. low) | 1 * 1.0 = 1.0 |
| Surface Water Setback,<br>None spreads next to ditch (high) | 8 * 1.0 = 8.0 |
| Vegetative Buffer Width<br>No buffer (high) | 8 * 1.5 = 12.0 |
| Manure P Application Rate<br>3000 gal/ac, dairy manure<br>Liquid pit, <50 lb. P/Ac (low) | 2 * 1.0 = 2.0 |
| Manure N Application Rate<br>72 lb. N/Ac (low) | 2 * 1.0 = 2.0 |
| Manure Application Method<br>Surface applied in January,<br>Not incorporated (v. high) | 8 * 1.0 = 8.0 |
| **Manure Risk Index for Field:** | **45.5** |

* Field feature factor (Hydrologic Group B = low =2 assigned from table 2) x weighting factor (assigned from table 1 = 1) 2 x 1 =2.

The MARI total of 45.5 is a Medium Risk Interpreting in to the field Vulnerability for Manure Loss table (Table 3). Therefore, there is some risk for runoff to transport manure into surface water from this field. Implementation of RTF GAAMPS for Manure such as using a grass buffer along the edge of the ditch and a setback of application 150 feet from the edge may reduce the risk of polluted runoff entering surface water. The implementation of these management practices and their impact on the Manure Application Risk Index follows.

***Example - Manure Application Risk Index with Buffers Added***

| **Field Feature** | **Weight Values for Manure Risk Index** |
|---|---|
| Soil Hydrologic Group (SHG) B<br>No change (low) | 2 * 1.0 = 2.0 |
| Soil Management Group<br>No change (low) | 2 * 1.0 = 2.0 |
| Percent Slope<br>No change (v. low) | 1 * 1.0 = 1.0 |
| Soil Test P Value<br>No change (low) | 2 * 1.5 = 3.0 |
| Concentrated Water Flow<br>No change (v. low) | 1 * 1.5 = 1.5 |
| Nitrogen Leaching Index HG<br>No change (low) | 2 * 1.5 = 3.0 |
| Residue, cover crops, per covers<br>No change (v. low) | 1 * 1.0 = 1.0 |
| Surface Water Setback (low)<br>>150 feet surface applies manure | 2 * 1.0 = 2.0 |
| Vegetative Buffer Width (low)<br>66 feet wide | 2 * 1.5 = 3.0 |
| Manure P Application Rate (low)<br>No change | 2 * 1.0 = 2.0 |
| Manure N Application Rate (low)<br>No change | 2 * 1.0 = 2.0 |
| Application Method (low)<br>No change | 8 * 1.0 = 8.0 |

**Re-evaluated Manure Risk Index is: 30.5**

The Manure Application Risk Index for this field is now Low. There is less potential for runoff to transport manure into surface water from this field. Incorporation of RTF GAAMPS for Manure, such as using a grass buffer along the edge of the ditch and staying 150 feet from the edge, reduces the risk of polluted runoff entering surface water. This lowers the Manure Application Risk Index from Medium (45.5) to Low (30.5).

TABLE 1 - Field Features and Weighting Factors Used in the Manure Risk Index

| *Field Features* | *Weighting Factor* |
|---|---|
| *Soil Hydrologic Group* | 1.0 |
| *Soil Management Group* | 1.0 |
| *Percent Slope* | 1.0 |
| *Soil Test P Value* | 1.5 |
| *Concentrated Water Flow* | 1.5 |
| *Nitrogen Leaching Index for Soil Hydrologic Group* | 1.5 |
| *Residue/Cover Crops or Perennial Cover* | 1.0 |
| *Surface Water Setback (RTF)* | 1.0 |
| *Vegetative Buffer Width* | 1.5 |
| *Manure P Application Rate* | 1.0 |
| *Manure N Application Rate* | 1.0 |
| *Application Method* | 1.0 |

The NRCS Michigan MARI Excel spreadsheet, Version 4, November 2008, is the best tool for assessing and documenting winter areas suitable for manure spreading with minimal risk of polluted runoff potential. A copy of the latest spreadsheet is found on the Michigan NRCS electronic Field Office Technical Guide (eFOTG) under Section IV, "Nutrient Management Tools and References" under the 590 conservation practice standard folder. *See the instructions tab for details on completing a MARI analysis on a field or portions of a field*. Also, see the Appendix at the end of this publication.

## TABLE 2 - Michigan Manure Application Risk Index

| ***Field Feature Factors*** | ***Very Low (1)*** | ***Low (2)*** | ***Medium (4)*** | ***High (8)*** |
|---|---|---|---|---|
| ***1. Soil Hydrologic Group (1.0)*** | A | B | C | D |
| ***2. Soil Management Group (1.0)*** | 5.0 | 2.5-4.0 | 1.5 | 0-1.0 |
| ***3. Percent Slope* (1.0)*** | 0-1.9 | 2-3.0 | 3.1-6 | >6 |
| ***4. Soil Test P Value (lbs/ac)* (1.5)*** | Medium (<79) | High (80-149) | Very High (150-300) | Excessive (>300) |
| ***5. Concentrated Water Flow* or Surface Inlet Discharge (1.5)*** | Ponds in flat field or no runoff | Few No direct flow offsite into surface water | Some Enters surface water through a designed buffer | Many Ephemeral channels discharge directly into surface water, no buffer |
| ***6. Nitrogen Leaching Index for Soil Hydrologic Group (1.5)*** | N/A | Low | Medium | High |
| ***7. Residue/Cover Crops or Perennial Cover (1.0)*** | >40% residue good perennial grass alfalfa or cover crop | 30%-39% residue fair perennial grass legume, small grain | 10-29% residue poor grass legume | <10% residue fall tillage or no cover |
| ***8. Surface Water Setback (1.0)*** | >300 ft to edge of stream | 150-299 ft to edge of stream | <150 ft incorporates manure | <150 ft surface applies manure does not incorporate |
| ***9. Vegetative Buffer Width (1.5)*** | >100 ft or if not applicable to the site | 66-99 ft | 20-65 ft | <20 ft |
| ***10. Manure Application Rate $P_2 0_5$ lbs/ac (1.0)*** | <30 | 31-60 | 61-99 | >100 |
| ***11. Manure N Application Rate lbs./ac (1.0)*** | <60 | 61-130 | 131-200 | >200 |
| ***12. Manure Application Method (1.0)*** | Injected | Surface applied and incorporated within 48 hours | Surface applied and incorporated within 3 month | Surface applied and unincorporated for at least 3 months |

*RTF GAAMPS limiting factors

## TABLE 3 - Field Vulnerability for Manure Loss

| ***Manure Application Risk Index for a Field 1/*** | ***Generalized Interpretation of Manure Application Risk Index*** |
|---|---|
| ***< 19*** | ***VERY LOW*** potential for manure movement from the field. If manure is managed, there is a low probability of an adverse impact to surface water. These fields have good potential for winter spreading. |
| ***19 - 37*** | ***LOW*** potential for manure movement from the field. The chance of organic material and nutrients getting into surface water exists. Buffers, setbacks, lower manure rates, cover crops, and crop residue practices alone or in combination may reduce impact. These fields have good potential for winter spreading. |
| ***38-75*** | ***MEDIUM*** potential for manure movement from the field. The chance of organic material and nutrients getting to surface water is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact. These fields have limited potential for winter spreading and only a partial area of the field may be acceptable. |
| ***> 75*** | ***HIGH*** potential for manure movement from the field and an adverse impact on surface water. Winter |

| | |
|---|---|
| | spreading should not be done on these fields. |

1/ Index breaks estimated by authors. Validation is pending. NRCS internal field evaluation completed in 2002-2003 provided 90-95% agreement with the low risk analysis of a score of 37 or lower.

### *Manure Risk Index Evaluation*

In the winter of 2002-2003, 10 county NRCS offices in southern Michigan monitored 219 fields for visual manure runoff where winter manure applications were applied. One hundred-seventy four fields ranked low risk for winter spread manure. Two fields out of the 174 had signs of manure runoff leaving the edge of the field. The average MARI low risk ranking was 32.

Seventy four fields had a Medium MARI Index ranking. The average MARI medium risk ranking was 41. Sixteen of the medium fields where manure was applied had visual signs of manure leaving the edge of the field.

Those sixteen fields generally had low residue cover (<10%); manure spread too close to surface water; manure spread in the setback zone; or surface applied manure flowing out of area via concentrated flow that was flooded. Therefore, because many field had visual signs of manure runoff leaving the edge of the field, the decision was made to plan winter manure spreading to fields or areas of fields that have a MARI ranking of LOW.

This decision was incorporated by MDEQ and EPA into the first CAFO General Permit for Michigan issued in 2002. However, the newer CAFO permits for Michigan of 2005 and beyond now have their own winter spreading evaluation criteria.

### *Manure Management Options Based on the Manure Application Risk Index*

Minimizing non-point source pollution of surface waters by manure applied to cropland, hay land, and pastureland requires management practices that control both the supply and transport of manure solids, liquids, and the attached nutrients. The basic objectives of environmentally sound manure management are to maintain good soil health; utilize the available nutrients; capture available nutrients; recycle N, P and K through the crops; and store nutrients in the soil for later use by the next crop. Determining the Manure Application Risk Index for soils is the first step in this process because this prioritizes the efforts needed to develop manure utilization plans that minimize runoff and manure losses. Trapping soil and manure particles enriched with nutrients N, P, and runoff containing nutrients is best accomplished with residue management, contour farming, and vegetation in buffers. Buffers are most beneficial adjacent to streams for entrapping P enriched sediments or organic material and protecting surface water quality. Implementing Right to Farm practices such as: soil and manure testing, 150 feet surface water setbacks, and evaluating winter spreading on lower risk fields all reduces the risk of impact to the environment. The higher the initial Manure Application Risk Index, the bigger the management challenges to select practices that will reduce the risk. *Manure Utilization planning is very site specific*, and requires a well-planned, coordinated effort between the farmers, certified crop advisors, soil conservationists, and other nutrient management planners.

## TABLE 4

***Management Options to Minimize Non-Point Source Pollution of Surface Waters by Manure***

*Soil tests* - Have a basic MSU soil test at least every three years to monitor build-up or decline of soil P.

*Residue management* - Use cover crops such as rye or oilseed radish after corn silage or other low residue crops to capture residual Nitrogen and reduce erosion and runoff.

*Cover crops* used with or ahead of fall manure applications will help capture nitrate N in the manure and residual nitrate - N in the soil.

*Crop residues or solid manure residues* can reduce runoff and erosion by 50% if 30% surface cover is maintained on the soil surface. Residues increase potential for soluble surface runoff.

*Calibrate manure spreaders and take manure samples* to take advantage of available P in manure. Match manure rates to crop yield goals and supplement with nutrients as needed.

*Surface Water Setback* - RTF GAAMPS require a minimum of 150 feet distance from the edge of a stream to lower the risk. Inject or incorporate surface applied manure within 48 hours to reduce the runoff risk.

*Vegetative Buffers* - RTF recommends a designed permanent buffer strip to get maximum effect. Field borders filter strips, strip cropping, riparian forest buffers, and natural vegetated stream banks are acceptable buffers, if they are the proper width, density, and maintained.

*Slope* - Apply liquid manure to frozen soils if slopes are less than or equal to 3%; solid manure to frozen soils if slopes are less than or equal to 6%. Incorporate both types of manure to meet RTF GAAMPS and prevent polluted runoff when slopes exceed these maximums. If *slopes* exceed maximum that are allowed under RTF GAAMPs for Manure Management and Utilization on frozen soils may disqualify a field with a high risk of polluted runoff from winter spreading, lack of vegetative cover, cover crops, or crop residue.

*Concentrated Flow* - Grass Waterways with filter strips adjacent to them will assist in reducing polluted manure runoff. If winter spread manure outlets into a surface water body such as a waterway, watercourse, wetland, flowing stream, or county drain without a vegetative buffer, the field should not be utilized for winter spreading.

*Soil Test P* - Soil test P exceeds 300 lb/ac. No more additional P from manure or other nutrient sources should be applied until nutrient harvest by crops reduces P test levels to less than 300 lb/acre. There is a high risk of P loss from the field.

*Manure Rate* - Exceeds annual P or N uptake of any crop grown in Michigan and, if available, can leach N into ground water or increase P in surface runoff.

# USE OF THE MANURE APPLICATION RISK INDEX (MARI) IN THE NATURAL RESOURCES CONSERVATION SERVICE

MARI is a planning tool that can be used in resource management plans, for water and soil quality, nutrient management, and ecosystem based planning assistance in watersheds. It is intended for the planner to communicate to the land user the relative potential for manure movement in the landscape. NRCS does not condone or promote the use of the index for placing any restrictions on land use or other regulatory purposes that could be construed by manipulating the parameters of the index.

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# MICHIGAN MANURE APPLICATION RISK INDEX WORKSHEET

| | | | |
|---|---|---|---|
| Farm: | | Date: | |
| Township | | Tract(s) | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Field # | | | | | | | | | | |
| Acres | | | | | | | | | | |
| **Field Features** | | | | | | | | | | |
| **I. SOIL** (Map Symbol) | | | | | | | | | | |
| 1. Soil Hydrologic Group (1.0) | | | | | | | | | | |
| | | | | | | | | | | |
| 2. Soil Management. Group (1.0) | | | | | | | | | | |
| | | | | | | | | | | |
| 3. Percent slope (1.0) | | | | | | | | | | |
| | | | | | | | | | | |
| **II. WATER QUALITY** | | | | | | | | | | |
| 4. Soil test P Value (lbs/ac) (1.5) | | | | | | | | | | |
| | | | | | | | | | | |
| 5. Concentrated Water Flow or | | | | | | | | | | |
| Surface Inlet Discharge (1.5) | | | | | | | | | | |
| | | | | | | | | | | |
| 6. Nitrogen Leaching Index for | | | | | | | | | | |
| Soil Hydrologic Group (1.5) | | | | | | | | | | |
| | | | | | | | | | | |
| **III. SURFACE COVER** | | | | | | | | | | |
| 7. Residue Cover/Cover Crops (1.0) | | | | | | | | | | |
| | | | | | | | | | | |
| 8 Surface Water Setback (1.0) | | | | | | | | | | |
| | | | | | | | | | | |
| 9. Vegetative Buffer Width (1.5) | | | | | | | | | | |
| | | | | | | | | | | |
| **IV. MANURE** | | | | | | | | | | |
| 10. Manure P application rate (1.0) | | | | | | | | | | |
| | | | | | | | | | | |
| 11. Manure N application rate (1.0) | | | | | | | | | | |
| | | | | | | | | | | |
| 12. Manure application method (1.0) | | | | | | | | | | |
| | | | | | | | | | | |
| *Field Features Index Totals* | | | | | | | | | | |
| | | | | | | | | | | |
| **v. low risk (acres) <19** | | | | | | | | | | |
| | | | | | | | | | | |
| **Low risk (acres) 19 - 37** | | | | | | | | | | |
| | | | | | | | | | | |
| **Medium risk (acres) 38-75** | | | | | | | | | | |
| | | | | | | | | | | |
| **High risk (acres) >75** | | | | | | | | | | |
| | | | | | | | | | | |

## FIELD FEATURE DEFINITIONS

1. **Soil Hydrologic Group** - A group of soils having similar runoff potential under similar storm and cover conditions. (NRCS FOTG Section II, Soils Database or NRCS EFM, Chapter 2, Soil Survey)

2. **Soil Management Group** - An alpha-numeric system used by MSU Crops and Soil Scientists to group soil series according to the dominant texture of the profile and natural drainage conditions. (NRCS FOTG Section II, Cropland Interpretations, Soil Survey Definitions or MSU Bulletin E-1262)

3. **Percent Slope** - Average percent of slope for the field landscape. (NRCS-Soil Survey, on site visit)

4. **Soil Test P Value** - Soil test phosphorus value based on Bray P1 soil test analysis taken at a depth of 9 inches. (Soil Test, MSUE County Average P Value)

5. **Concentrated Water Flow or Surface Inlet Discharge** - Is there a direct flow of surface runoff water when it rains or during snowmelt via concentrated flow (through a waterway or ephemeral gully) or pond area above a surface inlet through a tile drainage system? (On site visit)

6. **Nitrogen Leaching Index** - Based on high, medium, or low risk. It is the average annual water amount (in inches) expected to leach below the root zone with the potential of carrying soluble nutrients. (NRCS FOTG Section II and Soil Hydrologic Group databases)

7. **Residue Cover/Cover Crops** - Residue cover over winter depends on tillage method, manure type, crop residue, cover crops, CRP cover, or hay in field. All will reduce runoff depending on kind and amount. (On site visit)

8. **Surface Water Setback** - The distance from the field border to the edge of the stream or surface water body receiving runoff from the field. (On site visit)

9. **Buffer Width** - Width (ft) of the vegetation adjacent to the surface water body to be protected. (On site measured or planned width). ***Enter a zero (0)*** if a field slopes to a sensitive area or surface water body and no vegetative buffer is present to filter polluted runoff from spread manure. ***Enter n/a*** if liquid manure ponds in the field or behind a ditch spoil, or there are no sensitive areas or surface water adjacent to the field where polluted runoff leaves the edge of the field.

   **Vegetative Buffers** - Are strips or small areas of land in permanent vegetation. Conservation buffers help control potential pollutants and manage other environmental concerns. Filter strips, field borders, grassed waterways/vegetative filters, shelter belts, riparian buffers, and cross wind trap strips (streamside) buffers are all examples of conservation buffers.

10. /11. **Manure Rate of P, Rate of N** - Based on the type, amount, and kind of manure applied the amount of P (Phosphorus) pounds per acre and the amount of N (Nitrogen) pounds applied per acre. (On Site Manure Application) *The total N and P should include all sources of these two nutrients.*

12. **Manure Application Method** - How the manure is applied to the land. Symbols used are:
    - **1 - Direct Inject** - Manure injected below the land level while applying.
    - **2 - Surface applied and incorporated within 48 hrs.** - Manure broadcast applied on the land and worked in as soon as possible (<48 hours) after application.
    - **4 - Surface < 3 months** - Manure broadcast applied and left on the surface, but incorporated with tillage within 90 days of application.
    - **8 - Surface > 3 months** - Manure broadcast and left on the surface, but later incorporated or never incorporated greater than 90 days after application.

**APPENDIX**

**What tools are needed to complete the field features Inventory & Evaluation (I & E) for the Manure Application Risk Index or MARI spreadsheet?**

| **Field Feature Entry/symbol** | **Source** |
|---|---|
| Tile Drained Random or System | ***Enter Y- yes*** |
| Soil Series | ***Enter name of soil series: i.e. Oshtemo from the conservation plan soil maps or the Web soil survey.*** Do not use soil map unit symbols. Not case sensitive |
| **Soil** | |
| 1. Soil Hydrologic Group | Populates in MARI spreadsheet by soil series. Is the field tile drained? Random or System Tiled? ***Subsurface drainage can change the hydrologic group.*** |
| 2. Soil Management Group | *Populates MARI spreadsheet by soil series* |
| 3. Per Cent Slope | On site observation of the percent slope, direction and length. ***Enter per cent slope as a number 2% is 2.*** |
| **Water Quality** | |
| 4. Soil test P Value | Recent Soil Test P value in PPM. ***Enter PPM from most recent soil test data.*** |
| 5. Concentrated Water Flow or surface discharge | Use the hard cover soil survey if available to observe map symbols for concentrated flow and do a field investigation for surface inlets, flow paths etc. ***Enter: p- ponds; f-few; s-some; m- many*** |
| 6. Nitrogen Leaching Index (NLI) | Self populates in MARI SS or lookup in eFOTG Sec 2 based on soil hydrologic group and drainage. Using the Hydrologic Group Maps identify the NLI value as low, medium or high risk for a soil ***Enter: l-****low****; m-****medium****; or h-****high.*** |
| **Surface Cover** | |
| 7. Residue/Cover Crops | What is the present residue management system? How much residue cover remains over winter? Use Field observation, RUSLE 2 printout with planned tillage or no tillage system. ***Enter the percent cover that will be there when winter spreading. Cover can be from crop residue, cover crops, straw manure, etc. Enter number without the per cent symbol, .i.e. 2 not 2%.*** |
| 8. Surface Water Setback | Soil survey maps, aerial images, on site observation. ***Enter distance in feet from the edge of manure application to surface water.*** ***Enter:*** **(1)** ***≥*** *300 feet* **(2)** *150-299 feet* **(4)** **<** 150 feet manure is incorporated or injected at application. **(8)** < 150 feet manure is surface applied and not incorporated. |

| | |
|---|---|
| 9. Vegetative Buffer Width | Enter existing planned buffer width in feet. ***12- 12 ft.; 35-35 ft. etc. Can be existing buffer if it meets the NRCS practice standards: filter strip 393, Field border 386, Riparian Forest Buffer 391 etc. and the O & M required.***<br><br>***Enter 0*** if no buffer (i.e. filter strip) is present and the field is next to surface water or a sensitive area.<br><br>***Enter n/a*** only if there is another field or if manure ponds in the field after spreading (i.e. no polluted runoff entering surface waters of the state) |
| **Manure Management** | Manure test or manure book values based on the rate of manure that will be winter spread. |
| 10. Manure P Application Rate | Crop yield goal for current manure application rate.<br>***Enter $P_2O_5$ lbs./ac based on the rate on manure applied in tons/ac or 1000 gals /ac*** |
| 11. Manure N Application Rate | Crop Yield Goal, Current manure application rate.<br>***Enter total Nitrogen in lbs. /ac. Base on the tons/ac or 1000 gals/ac applied.*** |
| 12. Manure Application Method | Surface applied or incorporated. Time of application for manure or estimated days before incorporation.<br>***Enter :***<br>***1- Direct Inject***<br>***2- Surface applies incorporate within 2 days.***<br>***4- Surface applies incorporate within 90 days***<br>***8- Surface applies without incorporation* (> 90 days)** |

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MARI Development Team included: Dr. J. Lemunyon, Agronomist, NRCS, Ft. Worth, TX; J. J. Grigar, NRCS MI, State Agronomist; D. Pahl, CET, NRCS Centreville & Dr. R. Von Bernuth, MSUE Bio-Systems Engineering, provided Excel programming assistance. Additional clarification for MARI Inventory & Evaluation provided by: M. Thelen, Extension Director, MSUE, St. Johns, MI.