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# Minnesota Phosphorus Site Risk Index Program User's Guide

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The purpose of the Minnesota Phosphorus Index (P Index) is to estimate the relative risk that phosphorus is being lost from an agricultural field and delivered to a nearby water body. The Minnesota Phosphorus Index program allows you to compare the risk of P loss from multiple fields, or from alternative management systems on a single field.

For updated information, go to <http://www.mnpi.umn.edu>.

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## Quick Start Guide

If you prefer a graphical version of this quick start guide showing screen images, download the “Quick Start Users Guide” from [www.mnpi.umn.edu](http://www.mnpi.umn.edu).

**1) Open or create a file.** From the File Menu, select “Open” (Ctrl-O) or “New” (Ctrl-N). A file can include many “scenarios”. A scenario is a single field and management system, which may extend over multiple years.

**2) Input or edit data.** Double-click on a scenario in the left-hand pane of the Scenario Management Window. This will open the Editor window where you can enter data about the field, crop rotation, etc. **Red text** indicates that you need to enter data to get a correct P Index result.

Fill in the three tabbed pages of the Editor window in order: Field Setup, Rotation Builder, and then the Yearly Data and Results page. On the Yearly Data and Results page, data from the Rotation Builder will be repeated for the full length of the evaluation, which may include several rotation cycles. If you change inputs on the Yearly Data and Results page, the cell will have a **yellow background** to show that you overrode data from the Rotation Builder. Undo overrides by using the Edit menu.

Add soil test information on the Yearly Data and Results page.

**3) View results.** P Index results are at the bottom of the Yearly Data and Results page. Note which component of the index is the greatest and see P Index Results (page 13) for suggested management changes.

**4) Close the editor.** Select Close from the Edit menu or click the X in the upper right corner of the window.

**5) Compare alternatives.** After closing the editor, you will be back in the main Scenario Management window. Select (click once) the name of the field you just set up, and then select “Insert Alternative” from the Edit menu. This creates a copy of your field. Open this alternative and change the management system so you can compare results to the original (base) management system.

**6) Create reports.** In the Scenario Management Window, select one or more scenarios. (Hold down the Ctrl key to click on multiple scenarios.) From the Reports menu, select New Single or New Comparison Report. A window will pop up with a list of items that can be included in the report. Select the items you want included, then click the “Create Report” button.

**Help.** Click on a “?” button, or press F1 to get help with the selected item. To see the entire help file select “Help” from the Help menu.

**Work more quickly.** Most commands can be activated from the main menu across the top of a window, a popup menu activated by right-clicking anywhere, or with the keyboard (see keyboard shortcuts on page 20).

# Creating and Managing Files

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## Scenario Management Window

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The first window to open when you start the program is the Scenario Management window. Use it to organize fields, management alternatives for each field, and reports.

**Create a file** by selecting “New” (Ctrl-N) from the File Menu. A file can contain many sites or fields. Double click on the new field to begin editing information about the field in the Editor Window.

**Create alternative management scenarios** for a field. The new field you created is the “base” management scenario. Select “Insert alternative” from the Edit menu to create an “alternative” scenario that is a copy of the base. Double-click this alternative scenario to open it and change some aspect of the management.

**Once you create “alternatives”, you can’t change the “base”.** Set up all the details of the base management scenario, first. Then go back to the main Scenario Management window and create one or more alternatives. In the alternatives, you cannot change basic information, such as the

name of the farm or soil type. In the base, any changes to basic information, such as the name of the farm, will also be changed in all the alternatives. You can tell if you are in a base or alternative by the information at the top of the Editor window.

See a **summary** of the inputs and results for a scenario by selecting “**Scenario Information**” or “**Scenario Recommendations**” from the Window menu. But first, select “**Abbreviations**” from the Help menu to see a list of the abbreviations used in the summary information window and in reports.

**“P” and circles in front of scenario names.** A “P” in front of a file, scenario, or report name indicates that a scenario needs processing. Usually, this means RUSLE2 needs to be run. A bullet in the circle before a scenario indicates that the selected report includes that scenario. A bullet in front of a report indicates that the selected scenario is in that report.

**Reports.** View and print results by selecting New Report from the Reports menu.

**See also:** Export Data to a Spreadsheet (page 14).

# Entering Data

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## Editor Window

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Open the Editor window from the main Scenario Management window by double-clicking on a field in the left-hand pane. All data about a single scenario (a field and management system) is entered in the Editor window. Only one scenario can be edited at a time.

The Editor Window has three tabs. Fill out the forms on all three to setup your field and management system.

- Field Setup Tab (page 5)
- Rotation Builder Tab (page 8)
- Yearly Data and Results Tab (page 11)

The **header at the top of the Editor Window** tells you the name of the farm and field, and whether you are in a base or alternative scenario. Once you create an alternative scenario, you cannot change the original, or base, scenario (except for some field setup information). In an alternative, you cannot change the field setup.

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## Field Setup Tab

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The Field Setup Tab is the first page of the Editor Window. Use it to describe the field being evaluated.

### County

From the drop down list on the Field Setup page, select the Minnesota county where the field is located.

### *How is this information used?*

The county determines the base rainfall and base snowmelt runoff volumes used by the P Index model, and determines the soils list and climate data used by RUSLE2.

### Farm

On the Field Setup page, enter a name for the farm or watershed being evaluated (for documentation purposes).

### Field

On the Field Setup page, enter a name for the field or site being evaluated (for documentation purposes).

### Scenario

On the Field Setup page, name the management system. This is useful if you will be evaluating alternative management systems for the same field.

### Starting Year

On the Field Setup page, indicate the first year to evaluate for this field.

You will be able to choose the number of years to evaluate on the Yearly Data and Results tab.

### Sediment Traps

On the Field Setup page, indicate whether any of the following structures exist to intercept field runoff.

**Buffers, filter strips, or terraces.** Only include these if they meet NRCS Practice Standards.

**Water and sediment control basins.** These are earth embankments or a combination ridge and channel generally constructed across the slope and minor watercourses to form a sediment trap and water detention basin.

**Impoundments with runoff storage,** including ponds and grade stabilization structures with a permanent pool.

If you have multiple sediment traps, choose the lowest on the list (i.e., impoundments).

If you do your own RUSLE2 sediment delivery calculation (outside of the P Index), DO NOT include any of these sediment traps in RUSLE2. They will be accounted for by the P Index model.

### *How is this information used?*

Sediment traps reduce the estimate of the amount of sediment from the field that reaches the nearest surface water body.

## **Landscape Depressions and Tile Inlets**

On the Field Setup page, indicate whether the field has natural depressions or drainage tile inlets. If you indicate there are depressions, you must indicate the contributing area – that is, the proportion of the field runoff draining to those depressions or inlets.

If there are multiple types of inlets, choose the one that drains the greatest proportion of the field.

If depressions are present, you must indicate the Contributing Area, i.e., the percentage of the field that drains to depressions or tile inlets.

“Depressions” are shallow, natural basins common in the prairie pothole region of Minnesota. Depressions trap most sediments and prevent them from reaching surface water.

Ponding occurs after a rainfall even if the depressions have drainage tile inlets. Within hours, sediments and associated phosphorus settle out of ponded water, thus reducing the P released to tile drain systems and surface water.

How is this information used? Depressions reduce the estimate of the amount of sediment from the field that reaches the nearest surface water body. Depressions with tile inlets trap less sediment than those without inlets. This only affects the estimate of sediment-bound P loss risk. The P Index model does not reduce soluble P loss risk is not reduced as distance to water increases, and so tile inlets do not increase risk.

### **Contributing Area (%) for Inlets**

On the Field Setup page, if the field has natural depressions (with or without surface tile inlets), estimate the percent of the field area that contributes runoff to those depressions.

#### ***How is this information used?***

Contributing area affects the estimate of the amount of sediment from the field that reaches the nearest surface water body.

### **Distance from Field to Water**

On the Field Setup page, indicate the distance from the edge of field to the bank of the nearest drainage ditch, stream, pond, or other surface water.

To change the units from feet to meters, go to the Unit menu on the Field Setup page.

Learn more about Identifying the Nearest Surface Water.

#### ***How is this information used?***

Distance to water affects the estimate of the amount of sediment from the field that reaches the nearest surface water body.

## **Tillage Orientation**

On the Field Setup page, indicate the general direction of the last field operation before winter. For a relatively flat field, choose Cross Slope.

“Cross slope” tillage is assumed to have a 10% relative slope in RUSLE2. RUSLE2 documentation recommends the 10% relative slope for ordinary contouring that has been laid out with survey instruments but does not have vegetative strips to guide operations.

#### ***How is this information used?***

Tillage orientation affects the estimate of snowmelt runoff, and is part of the RUSLE2 sediment delivery estimate.

## **Soil and Slope Information**

In the Field Setup page, click on the hillslope graphic or the “Edit soil and slope information” button to open the Soil and Slope Setup window.

Identify a slope that represents the “most limiting area of significant extent” in the field. In other words, choose a slope that is likely to delivery the most P to surface water, unless it represents less than 20% of the field. Usually, the most limiting area will have the steepest slope, but it may be the area nearest to surface water or with the heaviest manure application.

For more information about choosing a slope, see MN NRCS Agronomy Tech Note #MN-14.

See below for information on filling in the form on this window. Then click Close Window in the menu bar to return to the Field Setup Window.

#### ***How is this information used?***

The slope length, gradient, and soil type are used by RUSLE2 to estimate sediment delivery to the field edge. The P buffering class (based on soil

texture and pH) is used to estimate changes in soil test P (which affects the sediment-bound and soluble P loss estimates). The soil hydrologic group and subsurface drainage affect the runoff estimate (soluble P loss). Percent organic matter is used to estimate total soil P (sediment-bound P loss).

### **RUSLE2 Slope Segments**

Use the RUSLE2 Slope Segments table (in the Soil and Slope Setup window) to describe the profile of a slope in the field (or a sub-field if you are calculating the P Index for a portion of the field).

#### ***Choosing a slope***

**Identify the field slope.** A field has many slopes. Only one slope will be used to calculate sediment delivery for the whole field or sub-field. The slope should represent the “most limiting area of significant extent” in the field. In other words, identify the area that will most limit management because of erosion problems. Usually, this is the steepest part of the field, but it may be the area nearest to surface water or with the heaviest manure application. Only use that “most limiting area” if it is of “significant extent”, that is, more the 20% of the field.

See more about choosing a slope gradient and length on page 18.

If you haven’t measured the slope and gradient, select a representative slope and gradient for the soil type.

#### ***How can a single slope represent a field?***

Typically, sediment and phosphorus come from relatively small areas of a field. To characterize the risk of P loss from a field, it is more useful to characterize these critical source areas than to try to average losses across the whole field.

#### ***Entering data***

**Using multiple slope segments.** You can enter a simple slope with one segment (one gradient and slope length), or a complex slope with multiple slope segments. Using a complex slope including the toe slope will generate a more accurate (and probably lower) estimate of sediment delivery to the field edge. **To change the number of slope**

**segments**, select “Insert” or “Delete” from the edit menu, or by right clicking on a row.

Change the **slope length and gradient** by clicking on cells of the table or on text in the graphic. RUSLE2 has a total slope length limit of 1000 feet.

To change the units between feet and meters, go back to the Unit menu in the Field Setup window.

#### ***Background***

RUSLE2 is a model that estimates soil loss and sediment delivery. Sediment delivery to the edge of the field (or to the end of the slope modeled in RUSLE2) is a combination of soil loss minus soil deposited. RUSLE2 works in the background of the MN P Index. Contact your local Soil and Water Conservation District office for more information about RUSLE2, or go to <http://www.rusle2.org>

#### ***How is this information used?***

The slope length, gradient, and soil type is used by RUSLE2 to estimate sediment delivery to the field edge.

#### **Soil Type**

In the RUSLE2 Soil Slopes table (Soil and Slope Setup Window), select the dominant soil series for each segment of the slope. The drop down menu will show the list of soils for the county selected on the Field Setup page.

If you do not know the name of the soil, click on “Generic Soil List” (at the top of the Soil Type column), and choose a soil based on soil texture and organic matter level. **Warning:** If you choose a generic soil, you should check the P Buffering Class and Hydrologic Group. Default values will be generated, but they are not always appropriate. For example, if you have subsurface drainage, be sure the hydrologic group is A or B.

#### ***How is this information used?***

The soil type is used by RUSLE2 to estimate sediment delivery to the field edge, and is used to generate default values for the P Buffering Class, Soil Hydrologic Group, and Soil Organic Matter percentage.

## P Buffering Class

On the RUSLE2 Slope Segments Table, select one of the three soil groups based on texture and pH of the surface soil. If the soil pH is 7.4 or greater, select “calcareous”. If the soil pH is less than 7.4, indicate whether the soil texture is coarse or fine. When you select a soil series, the program will automatically select a P buffering class based on Soil Survey data.

### *How is this information used?*

The P buffering class (based on soil texture and pH) is used to estimate changes in soil test P since the last soil test. For example, manure applied to a calcareous soil will result in a smaller change in soil test P than the same amount of manure applied to a coarse-textured, non-calcareous soil. Soil test P affects the sediment-bound P and soluble P loss estimates.

## Soil Hydrologic Group and Subsurface Drainage

The hydrologic soil group (HSG) from Soil Survey data will be shown automatically in the RUSLE2 Slope Segments Table after you select a soil series and indicate whether there is subsurface drainage. You can override the selection, but this is not recommended for most users.

Indicate whether artificial subsurface drainage is installed in the field by clicking on the cell or entering “y” or “n”.

If the hydrologic soil group is C or D, and you indicate that there is subsurface drainage, then the hydrologic group may change to A or B.

Hydrologic soil groupings of A, B, C, or D indicate the tendency of water to runoff from the given soil. Group A soils have low runoff potential (high infiltration) and Group D soils have high runoff potential (low infiltration). The groupings are a function of soil texture and permeability.

### *How is this information used?*

The soil hydrologic group and subsurface drainage affect the runoff estimate (soluble P loss).

## Organic Matter Percent (OM%)

The default organic matter level is determined by the soil series selected in the RUSLE2 Slope Segments Table.

**Change the percent organic matter** when you enter soil test data on the Yearly Data and Results page. OM cannot be changed on the soil and slope page.

### *How is this information used?*

Percent organic matter, along with soil test P, is used to estimate total soil P (which affects sediment-bound P loss risk).

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## Rotation Builder Tab

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The Rotation Builder Tab is the second page of the Editor Window. Here, describe management practices that are repeated for the length of the evaluation.

To change the order of years after data has been entered, click and hold on the column header and drag the column to the desired position.

The program does not tie data to a calendar year. Thus, if you change the starting year in the Field Setup, data in the first column of the Rotation Builder or Yearly Data and Results remain in “Year 1”.

## Number of Years

Indicate the length of the crop rotation.

## Manure

Manure application data can be entered by clicking on the first row of either the Rotation Builder Tab or the Yearly Data and Results Tab. This will open the Manure Application Data window.

Data can only be added for the selected year of the rotation or scenario. The year begins October 13th and ends October 12th.

The **rate** of application can be entered as lbs P2O5/acre, or as tons or gallons of manure/acre. If you enter tons or gallons of manure, you must indicate the **P content of the manure** in lbs P2O5 per ton or gallon.

If you do not have a current manure P test, use a previous year’s test. Alternatively, use an estimate

from the Approximate Phosphorus Content of Manure table (page 24).

Only enter an **incorporation method** if used within 1 week of manure application. Between November 15<sup>th</sup> and March 31<sup>st</sup> the ground is assumed to be frozen or near-frozen, so no incorporation is allowed. If appropriate, the incorporation method must also be entered as a tillage method. If your incorporation method is not listed, choose one that leaves a similar amount of manure on the soil surface.

If you enter **multiple applications in one year**, you can put them in chronological order by clicking “Order Applications by Date” in the “Edit” menu.

For **daily scrape and haul** manure applications, calculate the average manure application per acre. Applications can be summarized and entered for just a few dates of the year. For example, if you generate 10 tons per day and it takes a month of daily applications to cover a 75-acre field. Then you have applied 10 tons X 30 days = 300 tons of manure or  $300/75 = 4$  tons/acre. In the P Index program, enter 4 t/ac on a date in the middle of the month.

If you enter manure applications from the Yearly Data and Results page, entries that had been made on the Rotation Builder page cannot be edited. You can choose to use or not use each application by clicking on the “Fixed” menu.

The amount, timing, and incorporation method determine how much P is buried and how much is available at the surface to be carried away by runoff. If rain falls before manure is incorporated, much of the soluble P will be susceptible to runoff losses.

The program assumes the following proportion of manure left on the soil surface after incorporation: Small disk, 50%; Large disk, 40%; Chisel with sweeps, 45%; Chisel with straight shanks, 35%; Chisel with twisted shanks, 25%; Disk-chisel, 15%; Moldboard plow, 5%; Injection, 0%.

If any amount of manure is applied, the erosion estimate is multiplied by the following “manure factors” to account for the reduced soil loss associated with manure applications. If incorporated, the manure factor for the 1st year =

0.75, 2nd year after application = 0.84, and 3rd year = 0.92. If not incorporated, 1st year = 1, 2nd year = 0.84, and 3rd year = 0.92.

## P Fertilizer

P fertilizer application data can be entered by clicking on the second row of either the Rotation Builder Tab or the Yearly Data and Results Tab.

Data can only be added for the selected year of the rotation or scenario. The year begins November 15th and ends November 14th.

Only consider incorporation methods used within 1 week of fertilizer application. If appropriate, the incorporation method must also be entered as a tillage method. If your incorporation method is not listed, choose one that leaves a similar amount of fertilizer on the soil surface.

If you enter fertilizer applications from the Yearly Data and Results page, entries that had been made on the Rotation Builder page cannot be edited. You can choose to use or not use each application by clicking on the “Fixed” menu.

The amount and incorporation method determine how much P is buried and how much is available at the surface to be carried away by runoff. If rain falls before fertilizer is incorporated, much of the soluble P will be susceptible to runoff losses.

## Fall Tillage

On the Rotation Builder Tab (or the Yearly Data and Results Tab), indicate the type of tillage used in the fall after the previous crop is harvested.

Enter the tillage type even if you already entered it as a manure or fertilizer incorporation method.

The choices are:

- No Tillage - No fall tillage.
- Ridge Till - Ridges are present going into the winter.
- Strip Till
- Light Disk
- Chisel or Heavy Disk
- Moldboard Plow

**If your tillage type is not listed**, choose one that leaves a similar amount of surface residue and field roughness over the winter. **If manure was injected** and there was no other fall tillage, account for the roughness created by choosing

either “anhydrous applied” in the next cell for a low disturbance manure injection or “light disk” as the fall tillage for a high disturbance manure injection.

Fall tillage is used to estimate snowmelt runoff losses of P.

### Fall Anhydrous Ammonia

Indicate whether anhydrous ammonia was injected in the fall. If manure was injected and there was no other fall tillage, account for the roughness created by choosing either “anhydrous applied” for a low disturbance manure injection or “light disk” as the fall tillage for a high disturbance manure injection.

The injection equipment affects snowmelt runoff P losses by reducing the amount of surface residue and increasing the roughness of the soil surface.

### Spring Tillage

On the Rotation Builder Tab (or the Yearly Data and Results Tab), indicate the type of tillage used in spring before the crop is planted.

Enter the tillage type even if you already entered it as a manure or fertilizer incorporation method.

If your tillage type is not listed, choose one that leaves a similar amount of cover after planting.

Spring tillage is considered in the RUSLE2 sediment delivery estimate. It is not a direct input to the MN P Loss Risk estimate.

### Crop Planted

On the Rotation Builder Tab (or the Yearly Data and Results Tab), select one of the crops listed in the drop-down menu.

**If your crop is not listed**, choose one that provides a similar amount of vegetative cover during the growing season and leaves a similar amount of residue over the winter.

For this crop:	Select this:
Dry beans or peas	Snap beans
Sweet peas	Snap beans
Sweet corn	Corn, silage
Any ungrazed, unharvested permanent vegetation	CRP

**Soybeans, wide row** assumes a 30” row.

**Soybeans, narrow row** assumes 7” row and a drill planter.

**Woodlands** are assumed to be in fair condition, with 50% to 75% cover, and not heavily grazed.

#### *How is this information used?*

The current year’s crop affects the amount of rainfall runoff. The previous year’s crop residue affects the amount of P in snowmelt runoff. Crop type determines the crop P removal rate used to estimate change in soil test P.

### Cover After Planting

Indicate the percent residue cover remaining after planting of cultivated crops. For forages, CRP land, and other perennials, choose >20% cover.

Cover affects the rainfall runoff estimate.

## Crop Yield

On the Rotation Builder Tab (or the Yearly Data and Results Tab), click on the “Crop Yield” cell to enter the historical average yield on this field. If you do not enter a value, the program defaults to a low value.

You must select a crop before entering a yield. No yield is needed for CRP or woodland.

For pasture, enter a stocking density in animal units per acre (a.u./ac). For a stocking density of 1.5 a.u./ac, the program assumes 0.25 t/ac (dry weight) of standing vegetation in the fall. For 1 a.u./ac, assume 0.5 t/ac, and for 0.75 a.u./ac, assume 0.75 t/ac.

Typical yield values for Minnesota and the low and high values allowed by the program:

Crop	Yield units	Typical yields	Allowed yields
Corn, grain	Bushels/acre	140	30-300
Corn, silage	Tons/acre	15	5-60
Soybeans	Bushels/acre	40	10-100
Wheat	Bushels/acre	55	10-150
Oats	Bushels/acre	70	30-200
Barley	Bushels/acre	75	30-150
Potatoes	Cwt/acre	300	50-700
Snap beans	Tons/acre		0.5-5
Sugarbeets	Tons/acre	20	2-40
Sunflowers	Pounds/acre	1300	300-2500
Alfalfa or other forage	Tons/acre	4	1-20
Pasture	Animal units/acre	1	0.1-3

Yield is used to estimate the P content of surface residue for use in the snowmelt runoff pathway.

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## Yearly Data and Results Tab

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The Yearly Data and Results Tab is the third page of the Editor Window. This tab shows P Index results for every year of the evaluation, and all the information used to calculate the P Index.

The program defaults to 150 ppm Olsen, unless you enter results from at least one soil test.

All other data is carried over from the Rotation Builder tab. The rotation data will be repeated as many times as needed for the number of years specified at the top of the Yearly Data and Results page.

Data entered on this page overrides data from the Rotation Builder page, and is highlighted in yellow and framed by curly brackets. Use the Edit Menu to clear any or all overridden entries and use values from the Rotation Builder.

The program will use RUSLE2 to calculate a sediment delivery value. You can override this value, if desired

After you make changes on the Yearly Data and Results page, be cautious about changing rotation information or starting years. For example, if you add a crop to the rotation, you may lose some unique manure application data entered on the Yearly Data and Results page.

The program does not tie data to a calendar year. Thus, if you change the starting year in the Field Setup, data in the first column of the Rotation Builder or Yearly Data remain in “Year 1”.

The crop year begins after harvest in the previous fall because fall conditions are used to estimate the spring snowmelt losses of P.

### Number of Years in the Evaluation

On the Yearly Data and Results page, indicate how many years into the future you want to estimate P loss risk. Long evaluations of 15 or 20 years are recommended where phosphorus applications are high. The drawbacks of longer evaluations are that RUSLE2 takes longer to process results and reports become more complicated.

An evaluation must be at least as long as the rotation.

## Soil Test P and % Organic Matter

Enter the latest soil phosphorus test for the field by clicking on the soil test cell in the Yearly Data and Results page. If no test results are provided, the program assumes an initial soil P level of 150 ppm Olsen, and a percent organic matter value that is representative for the soil series (or 5% if no soil is indicated).

Enter the month and date the soil was sampled. Choose the appropriate units and test type. The program will then convert these to ppm Olsen.

The year of the soil test cannot be earlier than the first year of the evaluation because the program needs management information to estimate soil tests for subsequent years.

If you enter multiple soil tests for a single year, the program will average the values and use the date of the first soil test.

If a soil test date is the same as a fertilizer or manure application date, the program assumes that the soil sample was taken before the P application.

Soil tests should be less than three years old.

The Bray soil test procedure may give inaccurate results at soil pH levels above 7.4. On high pH soils, Olsen soil test P results will be more meaningful than Bray.

For high P soils (>100 ppm Bray, >100 ppm Mehlich, or >50 ppm Olsen), ask for a "Nutrient Management Phosphorus Test." Standard analyses do not provide an accurate measure of high soil test P concentrations. (A description of the test is at

<http://soiltest.coafes.umn.edu/methods.htm#NUTRIENTMANAGEMENTP>.)

Soil test P and percent organic matter are used to estimate total particulate P attached to sediment. Soil test P is used alone to estimate soluble P in soil and runoff.

The program will estimate soil test P levels for subsequent years based on the initial soil test value, amount of P applied as fertilizer or manure, an average removal rate of 30 lb. P<sub>2</sub>O<sub>5</sub>/acre for harvested crops, and a soil P buffer factor that varies with soil texture and pH (calcareous soils).

Soil organic matter levels will not be adjusted for subsequent years, unless a new value is entered.

## Sediment Delivery

The sediment delivery value, in tons/acre/year, is generated from RUSLE2. If the cell says "Click to Update", the value does not reflect changes made to the input data and RUSLE2 needs to be run.

### How?

To calculate a sediment delivery value, or to enter your own value, click on any cell in the sediment delivery row. The "Setup and Run RUSLE2" dialog box will open.

Click "Run RUSLE2". If desired, you can rename the RUSLE2 profile and management files that are created by the MN P Index. (To open these files from within RUSLE2: 1) Save the RUSLE2 database by going to Scenario Management Window and clicking on "Export RUSLE2 database" in the RUSLE2 menu. 2) Start RUSLE2. 3) Select "Open alternate. . ." from the Database menu, and navigate to where you saved the database in step 1. 4) Open the profile file.)

If you want to enter **your own sediment delivery values** instead of using RUSLE2, select the "Override RUSLE2 Values" tab. Enter a "User Value" for each year and then select "Close" to return to the Editor Window. Curly brackets and yellow background in the Sediment Delivery row signal that you have entered your own sediment delivery values.

If you are not using the MN P Index to calculate the RUSLE2 value, read Using RUSLE2 to Calculate Sediment Delivery (page 19) for hints on generating a sediment delivery value, rather than a soil loss value.

### Background

RUSLE2 is a model that estimates soil loss and sediment delivery. Sediment delivery to the edge of the field (or to the end of the slope modeled in RUSLE2) is a combination of soil loss minus soil deposited. RUSLE2 works in the background of the MN P Index. Contact your local Soil and Water Conservation District office for more information about RUSLE2, or go to <http://www.rusle2.org>.

### ***How is this information used?***

The estimate of sediment delivery to the field edge will be multiplied by a factor (based on distance and sediment traps) to estimate the amount of sediment reaching surface water. The amount of sediment reaching water is multiplied by the amount of phosphorus attached to the sediment to estimate risk of sediment-bound P loss.

### **P Index Results**

P Index results are at the bottom of the Yearly Data and Results page.

The first of the four numbers is the total P loss risk index. Below that are the three components of the index: risk of loss of particulate P attached to eroded sediments, risk of loss of dissolved P carried by rainfall runoff, and risk of loss of dissolved P carried by snowmelt runoff in the spring.

The results of the Minnesota Phosphorus Index provide an estimate of the relative risk that a particular field is a source of phosphorus pollution to a nearby body of water. It is not an estimate of the actual amount of P that will be delivered to the water. The Index does not account for losses due to gully or wind erosion, which could be substantial.

The final P Index score is classified as follows:

0 to 1 = Very Low Risk. No management changes are recommended.

1 to 2 = Low Risk. Minor management changes are recommended.

2 to 4 = Medium Risk. Small improvements in management may be necessary to lower the risk of P losses. Avoid management practices that increase the risk of P losses.

4 to 6 = High Risk. Moderate improvements in management are recommended to reduce the risk of P losses.

>6 = Very High Risk. Multiple and possibly large improvements in management practices are recommended.

See also: Management Recommendations (page 15).

To test the effect of an alternative management practice:

- close the Editor Window,
- go to the Edit menu to insert an alternative scenario (this creates a duplicate of an existing scenario),
- open the editor by double-clicking on the new scenario, and
- change one or more components of the management system.

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### **Notes Windows**

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Notes windows can be used to attach miscellaneous information about any of the files, scenarios, or management inputs.

To edit notes, double click on any notes field.

You can attach notes to:

- A file (from the Scenario Management Window)
- A scenario (from the Scenario Management Window or Field Setup Tab)
- A year in the crop rotation (from the Rotation Builder Tab)
- A year in the scenario (from the Scenario Data Table)
- Fertilizer or manure applications (from the Manure and Fertilizer windows)
- Soil tests (from the Soil Test window)
- Reports (from the Reports print window)

# Viewing and Printing Results

---

## How to View Results

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Results of the MN P Index can be seen:

- In the Editor Window, Yearly Data and Results tab, in the bottom rows.
- In the Scenario Management Window, select “Scenario Information” from the Window menu to see inputs and results for the selected scenario.
- In the Scenario Management Window, select “New Report” from the Reports menu, to set up and print results.
- To compare results:
- Display the “Scenario Information” (under the Window menu in the Scenario Management Window).
- On the Mode menu, select “Freeze”. This freezes the information about the selected scenario. Now you can go back to the Scenario Management Window and open a different scenario.

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## Reports

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To create a report:

Select “New Report” from the Reports menu in the Scenario Management Window.

(Eventually, you will be able to select a template for the type of report you’d like.)

The Report Item Selection window will appear. Name the report and select the items you would like included in the report.

Click OK. The report will appear in a new window.

To change items, choose “Redo Item Selection” from the Edit menu.

To print, choose “Print” from the File menu.

To see a list of **abbreviations** used in the reports, select “Abbreviations” from the Help menu in the Scenario Management window.

You can also **export data and results** as tab-delimited text files that can be opened from database and spreadsheet software.

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## Export Data to a Spreadsheet

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Input data and results can be exported as a tab-delimited file that can be opened using spreadsheet or database software.

Select one or more scenarios in the Scenario Management Window.

From the File menu, select “Export Scenario Data.”

### Choose the amount of data to export:

**Basic** = The same input data and results shown in the Field Setup and Yearly Data and Results pages.

**Detailed** = Same as “Basic” plus you can choose to include detailed data about the slope and soils, P applications, and the rotation.

**Full** = The data will be exported as a tab-delimited text file (with the \*.txt extension). The resulting file can be opened from Excel or other spreadsheets. When you open it from Excel, you will be asked to specify that 1) it is a delimited file, and 2) the delimiters are tabs.

### Choose the format for the data:

**Standard** = the data is laid out as in the Editor window – with each column for a different crop year.

**Database** = the data is transposed so each crop year record is in a row. Unique identification keys are included so tables can be linked into a database. If you plan to import the data into database software, select “Tables in Different Files.” Then, 7 separate files will be created for:

- Inputs and results by crop year
- Inputs by rotation year
- Applied P by crop year
- Applied P by rotation year
- Scenario descriptions
- Slope and soil descriptions
- Soil test information

The data will be exported as a tab-delimited text file (with the \*.txt extension). The resulting file can be opened from Excel or other spreadsheets. When you open it from Excel, you will be asked to specify that 1) it is a delimited file, and 2) the delimiters are tabs.

# Interpreting Results

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## What the Numbers Mean

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The results of the Minnesota Phosphorus Index provide an estimate of the relative risk that a particular field is a source of phosphorus pollution to a nearby body of water. The final P Index score is classified as follows:

0 to 1 = Very Low Risk. No management changes are recommended.

1 to 2 = Low Risk. Minor management changes are recommended.

2 to 4 = Medium Risk. Small improvements in management may be necessary to lower the risk of P losses. Avoid management practices that increase the risk of P losses.

4 to 6 = High Risk. Moderate improvements in management are recommended to reduce the risk of P losses.

>6 = Very High Risk. Multiple and possibly large improvements in management practices are recommended.

See also: Management Recommendations.

**What the numbers do not mean.** The MN P Index does not estimate the actual amount of P that will be delivered to the water. The Index does not account for losses due to gully or wind erosion, which could be substantial.

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## Management Recommendations

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P losses can be reduced by using some combination of reduced P application rates, improved methods of P application, or adoption of practices such as conservation tillage or buffer strips that reduce the risk of P transport across the landscape. By noting which P loss pathway – erosion, rainfall runoff, or snowmelt – contributes most to the P loss risk, users can identify the causes of high risk values and suggest management practices that will be effective at reducing the risk.

**To reduce risk of losses of sediment-bound P in rainfall runoff:** Reduce erosion by reducing tillage, increasing residue cover, increasing biomass production (to improve soil structure), etc. Add sediment traps such as buffer strips. Control high soil test P levels.

**To reduce risk of losses of soluble P in rainfall runoff:** Reduce runoff by increasing surface cover, increasing infiltration, and by growing forages and other permanent vegetation. Reduce manure application rates. Incorporate or inject all manure and fertilizer, and control high soil test P levels.

**To reduce risk of losses of soluble P in snowmelt runoff:** Eliminate application of manure on frozen ground. Leave soil surface rough in the fall and till across the slope, rather than up and down. Although P lost in snowmelt can be reduced by decreasing the amount of surface residue, burying residue is not recommended because this will increase erosion and P lost via the other two pathways.

See also: Table 1: Management Recommendations (page 24).

# Using the P Index Effectively

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## Uses of the MN P Index

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### What is the risk of P loss from this field?

- 1) Describe the field by following the steps in Entering Data (page 5).
- 2) On the Yearly Data and Results tab, decide how many years to evaluate. If there are heavy manure applications, run an evaluation for as many as 20 years. This will help you learn whether P loss risk may increase over time as soil P levels build up.

### What if I change management practices?

Before making management changes, you can use the P Index to determine whether the proposed practice will effectively reduce P loss risk from high risk sites. On low risk sites, use the P Index to ensure that proposed practices will not increase risk.

- 1) Begin by entering all the data for the current management system used on the field.
- 2) Close the Editor Window and return to the Scenario Management Window.
- 3) Copy the scenario you just created by selecting “Duplicate Scenario” or “Insert Alternative” from the Edit menu.
- 4) Double-click on this new scenario to open the Editor Window where you can rename the management system and make changes to management practices. If you selected “Insert Alternative”, you will not be able to change field information such as soil and slope characteristics.
- 5) Close the Editor Window and return to the Scenario Management Window to create as many alternative scenarios as desired. Each one will be a duplicate of the original management scenario.
- 6) Choose a report that compares management alternatives.

### Where are the high risk sites where we should target resources?

If a stream or lake has elevated phosphorus levels, most of the phosphorus load may be coming from only a few sites in the watershed. Use the P Index to identify those sites and focus on the actions that will make the most difference.

- 1) If available, use a screening tool to narrow the number of fields to examine.
- 2) Create a new file (Select File/New) and insert as many fields as needed by selecting Insert Field from the Edit menu.
- 3) Double-click on each field to enter data. Set up 10-to-20-year runs for each site if P application rates are high. Shorter runs are acceptable if P applications rates are low to moderate.
- 4) Set up a report (page 14) that compares sites.
- 5) After identifying the high risk sites, compare alternative management strategies on those sites to determine how to reduce risk most effectively.

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## **Inappropriate Uses of the MN P Index**

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The Minnesota P Index has two main appropriate applications: 1) at a field scale, to provide a relative (unit-less) assessment of the risks of P losses to surface waters from erosion, rainfall runoff, and snowmelt runoff, and to help the user evaluate management options that can reduce the risk, and 2) at a watershed scale, to help target critical P loss sites and to identify the management practices that will most likely reduce P loss from a particular site.

The P Index cannot estimate actual P loads from a field, but it can rate the relative benefit of applying alternative management practices on alternative sites. Actual loads depend on the intensity and timing of rainfall relative to P applications, plant senescence, and soil

freeze/thaw. The P Index makes assumptions about these conditions.

The Minnesota P Index does not consider the environmental costs of P loading to surface waters, nor the cost of adoption of different practices to reduce P losses from specific fields.

The Minnesota P Index cannot be used alone to estimate changes in surface water quality, because it does not consider sensitivity of the receiving waters nor some sources of P, such as municipal and commercial waste or P-rich sediments previously deposited in the lake or stream.

The P Index provides general guidelines for interpreting results, but specific definitions of acceptable and unacceptable results must be determined by the user based on characteristics of the receiving waters and the users' objectives.

# Collecting the Needed Inputs

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## List of Inputs

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A “Data Collection Sheet” is available in pdf format from <http://www.mnpi.umn.edu> or from the Minnesota P Index program CD. By completing the “Data Collection Sheet” while out in the field, you can be sure you have all the information needed to run the P Index.

### The needed inputs are:

- Farm and field names
- County
- Presence of impoundments, sediment basins, buffers, filter strips, or terraces.
- Presence of natural depressions, surface tile inlets, or rock tile inlets.
- Percent of field contributing to those depressions or inlets.
- Tillage orientation.
- Distance to surface water.
- Presence of subsurface drainage.
- Description of critical slope (for use by RUSLE2). Include gradient and length for each segment of the slope.
- Dominant soil series for each slope segment. Or: soil texture (coarse or fine), whether soil is calcareous (pH>7.3), and Soil Hydrologic Group.
- Soil test phosphorus and organic matter
- Management system. For each year of the rotation:
  - Crop
  - Typical yield
  - Fall and spring tillage
  - Fall anhydrous ammonia applications (Yes or no. No need for rates.)
  - Residue cover after planting
  - Fertilizer P application rates
  - Manure P application rates

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## What is the “Nearest Surface Water”?

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The user must decide what is the nearest body of water where phosphorus enrichment could be a problem. Generally, the nearest permanent stream, lake, or wetland is the primary water quality concern. In addition, for purposes of the P Index, any drainage ditch or other water course that is wet most of the year and eventually empties to a stream or lake should be considered the nearest surface water. Sinkholes may also be considered surface water. A user may decide that a closed depression with no connection to other surface water is not a concern and will not be considered when calculating distance to surface water.

Relatively little soluble or sediment-bound P settles out of water flowing through ditches and similar water courses, unless the ditches are particularly long. For example, after water flows through a ditch for half a mile, only 10% to 20% of the suspended and dissolved P in the water will have been deposited. (Based on Wisconsin P Index research.)

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## Choosing a Slope

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Results from the P Index represent P loss risk from a whole field. However, to calculate a RUSLE2 erosion value, the user must choose a single, representative slope from within the field.

Selecting a representative slope is the most important step in getting a good RUSLE2 estimate and a good P loss risk estimate.

According to NRCS guidelines (Minnesota NRCS, 2004), choose the slope that represents the “most limiting area of significant extent.” “Most limiting area” means the slope with the greatest risk of erosion, or in this case, P loss. Generally, this is the steepest slope in the field, but it may be the longest slope or the slope with extremely high manure applications (if erosion is being calculated for the P Index). “Of significant extent” means that the “most limiting area” selected should represent the characteristics of at least 20% of the field.

Next, define where the slope starts and ends. The slope begins where overland flow originates and ends at the edge of the field or where concentrated flow begins (the location where sides of a hillslope intersect to collect overland flow in defined channels, such as grassed waterways or gullies). This slope may comprise several segments with different gradients – a gentle gradient near the top of the hill, a steeper side slope, and then a gentler toe slope. This is in contrast to the more common task of estimating soil loss, where it is necessary to use a simple slope with a single gradient. For estimating sediment delivery for the P Index, it is important to use a complex slope, including the toe slope where sediment deposition may occur. See Using RUSLE2 to Calculate Sediment Delivery.

### **Slope length and gradient**

Ideally, visit the site, identify the slope that represents the “most limiting area of significant extent”, and measure the slope length and gradient.

If you cannot visit the site, use a Soil Survey map to identify the most significant soils in the field. Choose a typical slope gradient and length for that soil type. Representative slope gradients and lengths are available from the USDA-NRCS electronic Field Office Technical Guide (eFOTG) as follows.

- 1) Go to <http://www.nrcs.usda.gov/technical/efotg/>
- 2) Click on Minnesota
- 3) Click on any Minnesota county
- 4) Click on Section II (in the left-hand navigation bar)
- 5) Click on A. County Soils Information
- 6) Click on the County you want
- 7) Click on n. HEL Interpretation
- 8) Click on HEL Classification

Representative soil gradients are also available from the USDA’s Soil Data Mart as follows.

- 1) Go to: <http://soildatamart.nrcs.usda.gov>
- 2) Select a State
- 3) Select a County
- 4) Select a Survey Area
- 5) Click on “Generate Report”
- 6) Select one or more soils
- 7) Select the report type “Component Legend” from the pull-down list
- 8) Click on “Generate Report”
- 9) The far right columns of the report show the “Pct. slope”. Use the RV (representative value).

### **Reference**

Minnesota NRCS. 2004. Agronomy Tech Note #14 transmitting technical note Agronomy #29: “Most Limiting Area for Conservation Planning” Available at <http://www.mn.nrcs.usda.gov/technical/ecs/TechNotes/AgtronTechNote14.pdf>. (In eFOTG, section 1, B, Technical Notes, Agronomy.)

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### **Using RUSLE2 to Calculate Sediment Delivery**

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RUSLE2 is used differently to calculate sediment delivery than for the more common task of calculating soil loss for conservation planning. RUSLE2 soil loss is an estimate of sediment movement within a field. It primarily indicates on-site soil degradation. RUSLE2 sediment delivery is an estimate of the amount of sediment leaving a field. It primarily indicates off-site damage. Sediment delivery is generally less than soil loss because it includes more soil deposition than is included in a soil loss estimate. See Table 2: Comparing RUSLE2 for Soil Loss And Sediment Delivery (page 27).

## Advanced Users

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### Keyboard and mouse shortcuts

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You can right-click almost anywhere to get a pop-up menu with the actions most likely to be needed.

To use the menus from the keyboard, Press Alt + *letter* + *letter*, where the first letter is the underlined letter of the menu and the second letter is the underlined letter of the menu item. (Or press Alt, and then use arrow keys to move among menus and menu items.)

On the Rotation Builder Tab, to change the order of years after data has been entered, click and hold on the column header and drag the column to the desired position.

Keyboard shortcuts are listed next to menu items and in the tables below.

#### General Actions in All Windows

<b>To do this:</b>	<b>Press this:</b>	<b>Menu:</b>	<b>Mouse alternative:</b>
Close window	Ctrl + W	File/Close	Click on X in upper right of window
Close window, or close program (if in Scenario Management Window)	Alt + F4	File/Exit	Click on X in upper right of window
Open context-sensitive help	F1	Help/Context Sensitive Help	
Open help	Shift + F1	Help/Help Topics	
Cancel action	Esc		
Open shortcut menu	Shift + F10		Right click

#### File and Scenario Management (From the Scenario Management Window)

<b>To do this:</b>	<b>Press this:</b>	<b>Menu:</b>	<b>Mouse alternative:</b>
Create new file	Ctrl + N	File/New	
Open an existing file	Ctrl + O	File/Open	
Save file	Ctrl + S	File/Save	
Save file with new name	F12	File/Save As . . .	
Exit program	Alt + F4	File/Exit	Click on X in upper right of window
Insert new field into the selected file	Ctrl + I	Edit/Insert Site	
Insert new scenario under the selected base scenario	Ins	Edit/Insert Alternative	
Edit the selected scenario	Ctrl + E	Edit/Edit	double click scenario
Delete selected scenario	Delete	Edit/Delete	
Duplicate scenario	Ctrl + D	Edit/Duplicate	
Print report (From the Report View, only.)	Ctrl + P	File/Print	

### Moving Around a Window

To do this:	Press this:	Menu:	Mouse alternative:
Move to next object	Tab		Click on object
Move to previous object	Shift + Tab		Click on object
Move among cells in a table	Arrows		Click on cell
Move among Editor window tabs	Arrows (first, use Tab key to highlight the tab)	View	Click on tab

### Entering Data

To do this:	Press this:	Menu:	Mouse alternative:
Open or close a pull-down list	F2 (or Alt + down arrow, if not in a table)		Click on box
Move through a pull-down list	up or down arrow (or press the first letter of desired list item)		Click on item
To enter data	Use Tab or Arrows to select the item. Type data. Then press Enter, if in a table; or press Tab if not in a table.		Click on item. (Double click required for some.) Type data. Then click on next cell.
Clear cell override	Ctrl + spacebar	Edit	
Calculate the MN P Index	F9	Apply	
Calculate RUSLE2	Shift + F9	Apply	Click on any sediment delivery cell.
Insert new test or application (in the P Application or the Soil Test Windows).	Ctrl + insert	Edit/Add	
Delete selected test or application (in the P Application or the Soil Test Windows).	Ctrl + delete	Edit/Delete	

### Entering Notes

To do this:	Press this:	Menu:	Mouse alternative:
Open file notes window (from the Scenario Management Window)		File/Edit File Notes	
Open scenario notes window (from the Scenario Management Window)			Double click notes window
Open scenario notes window (from the Editor Window)	Ctrl + T	Edit/Scenario Notes	
Open year, application, or test notes window (from the Editor Window)			Click notes box

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## Opening MN P Index scenarios in RUSLE2

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When the MN P Index calculates a sediment delivery value, it saves the inputs as RUSLE2 profile and management files. These files can be opened from within RUSLE2, if you have the RUSLE2 program.

To do so, first save the RUSLE2 database by going to Scenario Management Window and clicking on “Export RUSLE2 database” in the RUSLE2 menu. Then, start RUSLE2. Select “Open alternate. . .” from the Database menu (in RUSLE2), and navigate to where you saved the database. Finally, open the profile file.

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## Description of files

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### In the C:\Program Files\Minnesota P Index folder:

RUSLE2 – this folder contains all the files needed to run the RUSLE2 Soil Erosion Predictor in the background of the MN P Index. RUSLE2 will not be installed on your computer.

RUSLE2 MN P Index Database.gdb – the database used by RUSLE2, and including all the counties and soils for Minnesota.

MN P Index Icon 02.ico – the P Index icon

MN P Index Run Time Log.txt – This file shows the list of errors that occurred while using the P Index. The developers use this file to help troubleshoot problems.

MNPIhelp.cnt – the table of contents for the help file.

MNPIhelp.GID – a file created the first time you use the help file.

MNPIHELP.HLP – the help file for the MN P Index. Open this file by double clicking on the file name. Or open it from the MN P Index by pressing F1.

MNPSiteRiskIndex.exe – this is the MN P Index program.

MNPSiteRiskIndex.ini – This runtime configuration file is created after the first time the program is closed. It stores the list of previously opened files, and window sizes and positions. Delete this file if you want to return to default settings for the program. This file is preserved when you uninstall the program and install a new version.

MPIicon1 64X64.bmp – a larger version of the P Index icon

### In folders where you save files:

\*.MNP – Files with the .MNP extension contain the user’s data.

\*.MNT – Files with the .MNT extension contain the user’s template Scenarios.

## Resources

### **Minnesota Phosphorus Index web site**

<http://www.mnpi.umn.edu>

#### **The Minnesota Phosphorus Index Worksheet**

This paper version of the index is set up like a tax form, allowing you to see the structure of the model and the formulas used. Available on the web site.

#### **The Minnesota Phosphorus Index Technical Guide**

The Technical Guide includes a literature review and more details about the work behind the index. Available on the web site.

#### **RUSLE2**

The RUSLE2 soil loss prediction model and documentation are available at:

<http://www.rusle2.org>

### **Generic Environmental Impact Statement (GEIS) on Animal Agriculture**

<http://www.eqb.state.mn.us/geis/>

This study identified the need for and triggered the development of the Index.

### **Natural Resources Conservation Service (NRCS)**

The USDA NRCS Phosphorus Index Web page:  
<http://www.nrcs.usda.gov/technical/ECS/nutrient/pindex.html>

Minnesota NRCS Nutrient Management Web Page:

<http://www.mn.nrcs.usda.gov/technical/ecs/nutrient/nutrient.html>

### **Minnesota Pollution Control Agency (MPCA)**

MPCA Phosphorus Strategy

<http://www.pca.state.mn.us/water/phosphorus.html>

## Tables

**Table 1: Approximate Phosphorus (P<sub>2</sub>O<sub>5</sub>) Content<sup>(a)</sup> of Manure from Different Types of Livestock and for Different Management Conditions.**

Solid Manure		Liquid Manure		
Animal Species	P <sub>2</sub> O <sub>5</sub>	Animal Species	Waste Handling System	P <sub>2</sub> O <sub>5</sub>
	lb/ton			lb/1000 gal
Swine	8	Swine	Slurry <sup>b</sup>	35
Dairy	3		Anaerobic lagoon	2.2
Beef	4	Dairy	Slurry <sup>b</sup>	15
Poultry	46		Anaerobic lagoon	2.7
Turkey	50	Beef	Slurry <sup>b</sup>	17
Sheep <sup>c</sup>	10		Anaerobic lagoon	2.9
Horse <sup>c</sup>	4	Poultry	Slurry <sup>b</sup>	43
			Anaerobic lagoon	3.6
		Turkeys	Slurry <sup>b</sup>	39

Manure P from Grazed Livestock <sup>d</sup>	
Animal Species	Annual P <sub>2</sub> O <sub>5</sub> on Pasture Surface
	lb/acre per animal unit <sup>e</sup>
Dairy	29.7
Beef	31.2
Sheep	30.4
Horse	16.7

<sup>(a)</sup>Values adapted from MidWest Plan Service, 2001.

<sup>(b)</sup>Underfloor pits, outdoor storage tanks or basins, and continuous pumping systems with drag-hose injection.

<sup>(c)</sup>MidWest Plan Service, 1993.

<sup>(d)</sup>Assumes an annual grazing season of May 15 to Oct. 15.

<sup>(e)</sup>One animal unit is 1,000 lb of any type of livestock.

**Table 2: Management Recommendations for the Minnesota P Index**

<b>If . . .</b>	<b>And . . .</b>	<b>Then, try to . . .</b>	<b>By installing these practices:</b>	<b>NRCS Practice Standards</b>
<b>Sediment-bound P risk value is &gt;1.5,</b>	<b>The sediment delivery value is greater than 2 t/ac/yr.</b>	Reduce erosion by protecting the soil surface, improving soil structure, and increasing infiltration	Reduce tillage. Increase residue cover.	Residue Management (329A-C) Conservation Crop Rotation (328) Cover Crop (340)
		Trap sediment	Add buffers or filter strips.	Contour Buffer Strips (332) Field Border (386) Filter Strip (393) Sediment Basin (350)
		Reduce slope length or redirect runoff	Add terraces or contoured strips.	Terrace (600) Contour Strip Cropping (585)
	<b>Distance to water is &lt; 500 ft.</b>	Protect surface water from adjacent cropping	Divert runoff to safe location.	Diversion (386) Field Border (386) Filter Strip (393)
	<b>Soil test P is &lt;60 ppm Olsen, or &lt;85 ppm Bray or Mehlich.</b>	Prevent build-up of excess soil P	Apply manure and fertilizer at no more than crop P removal rates.	Nutrient Management (590)
	<b>Soil test P is &gt;60 ppm Olsen, or &gt;85 ppm Bray or Mehlich.</b>	Reduce soil P levels	Apply little or no manure or P fertilizer.	Nutrient Management (590)

<b>If . . .</b>	<b>And . . .</b>	<b>Then, try to . . .</b>	<b>By installing these practices:</b>	<b>NRCS Practice Standards</b>
<b>Soluble P in rainfall risk value is &gt;1.5,</b>	<b>The field is in southeast Minnesota.</b>	Focus on controlling runoff, which is particularly high in this region of the state.		
		Increase soil cover during peak rainfall times to increase infiltration and reduce runoff	Increasing residue left after planting row crops.	Residue Management (329A-C)
			Add a small grain or forage.	Conservation Crop Rotation (328) Pasture and Hayland Planting (512)
			Convert row crops to permanent vegetation.	Conservation Cover (327) Pasture and Hayland Planting (512)
	<b>Soil test P is &lt;60 ppm Olsen, or &lt;85 ppm Bray or Mehlich.</b>	Prevent build-up of excess soil P	Apply manure and fertilizer at no more than crop P removal rates.	Nutrient Management (590)

<b>Soil test P is &gt;60 ppm Olsen, or &gt;85 ppm Bray or Mehlich.</b>	Reduce soil P levels	Apply little or no manure or P fertilizer.	Nutrient Management (590)
<b>Manure or P fertilizer is surface applied.</b>	Reduce soluble P in runoff	Reduce manure and fertilizer applications. Inject or incorporate all manure and P fertilizer.	Nutrient Management (590)

**If . . .      And . . .      Then, try to . . .      By installing these practices:      NRCS Practice Standards**

<b>Soluble P in snowmelt risk value is &gt;1.5,</b>	<b>Field operations are oriented up and down slope</b>	Reduce snowmelt flow	Till and plant across the slope.	Contour Farming (330) Strip Cropping (585) Diversions (362) Terrace (600)
	<b>No tillage is used in the fall</b>	Increase surface storage of snowmelt by creating oriented roughness, but leave residue on the surface to control rainfall runoff.	If snowmelt P losses are high from fields with no fall tillage, consider ways to fracture the soil in the fall while minimizing burial of residue, such as by chisel plowing with narrow straight shovels, fall-applying anhydrous ammonia in regions where it is appropriate, or by using strip-till approaches.	
	<b>Manure is applied in the winter.</b>	Reduce soluble P sources	Eliminate late fall and winter manure application.	

**Table 3: Comparing RUSLE2 for Soil Loss and Sediment Delivery**

	To use RUSLE2 to estimate. . .	
	Soil loss for conservation planning	Sediment delivery for P Index
<b>Defining the slope</b>	Slope begins at the origin of overland flow and ends where deposition or concentrated flow begins.	Slope begins at the origin of overland flow, includes areas of deposition, and ends at the field edge or the start of concentrated flow.
<b>Slope shape</b>	Use simple slopes (only one gradient).	Use complex (segmented) slopes with multiple gradients. (To add segments in RUSLE2, use the advanced, science, or summary template. Choose the topography tab.)
<b>Buffers and filter strips</b>	Generally, do not include the filter strip at the bottom of the slope.	At this time, do not include the filter strip at the bottom of a slope. Based on current research, RUSLE2 gives too much credit to filter strips for reducing sediment delivery. The benefits of filter strips are accounted for in the P Index instead of RUSLE2.
<b>Terraces, diversions, and other sediment traps</b>	Only examine the slope down to the first terrace.  Do not consider sediment basins, because they do not reduce sheet erosion, although they can reduce sediment delivery and prevent gullies.	Use the full length of the slope, but do not include terraces and sediment control basins. These benefits of these sediment traps will be accounted for in the P Index.
<b>Single year results vs. rotation averages</b>	For conservation planning, use an average annual soil loss over the entire rotation.	Use the soil loss for each year of the rotation. This will give a more accurate impression of which years have the highest and lowest P loss risk. (To view single year results, use the science template. Select the “Erosion by Year” tab.)
<b>Templates</b>	Use the simple template.	Use the science template to accommodate complex slopes and to view annual results. (To change templates, go to Options/Template/Load.)