2020

User's Manual for the Prairie Pothole Management Support Tool (PPMST)

VERSION 1

IOWA STATE UNIVERSITY

GOALS OF THE PPMST:

- PROVIDE A RELATIVISTIC BASELINE ASSESSMENT AND ALTERNATIVE ANALYSIS OF POTHOLE FLOOD RISK

- SHOW THE RELATIONSHIP BETWEEN HUMAN AND ENVIRONMENTAL VARIABLES WITHOUT THE NEED FOR EXTENSIVE MODELING EXPERTISE

When and Why

This tool provides a singular numeric risk rank as output but has many contexts in which it may be useful.

This tool is specifically designed to be **easy to use,** with little to no external data requirements or technical knowledge.

This tool is best used as a preliminary assessment, before consulting any major technical/economic resources.

Situations in which this tool might be helpful include:

1. If you are evaluating the feasibility of farming a low spot on your field that fails to produce crop year after year,
2. If you are assessing additional drainage installations in your field,
3. If you are interested in wetland and wildlife conservation and are considering enrolling land in a conservation program,
4. If you are concerned about water quality and are looking for alternatives to draining portions of your field

Disclaimer

Last updated June 8, 2020

INTRODUCTION

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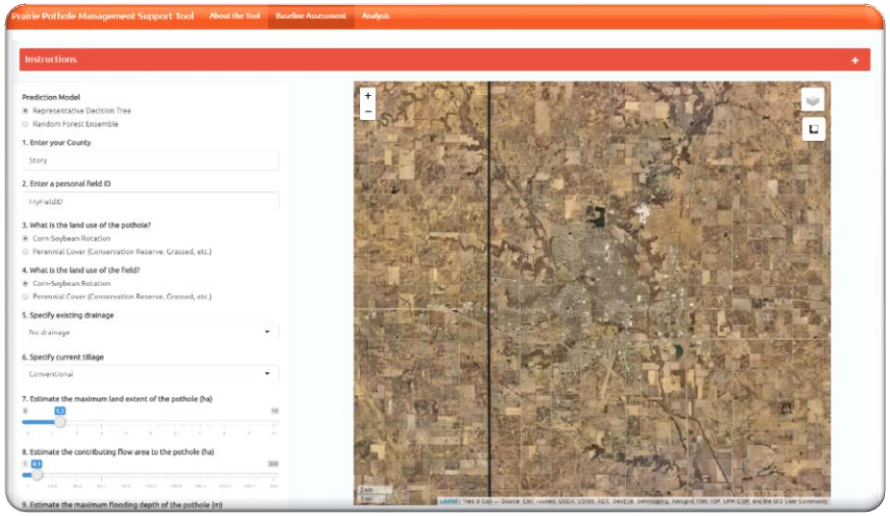
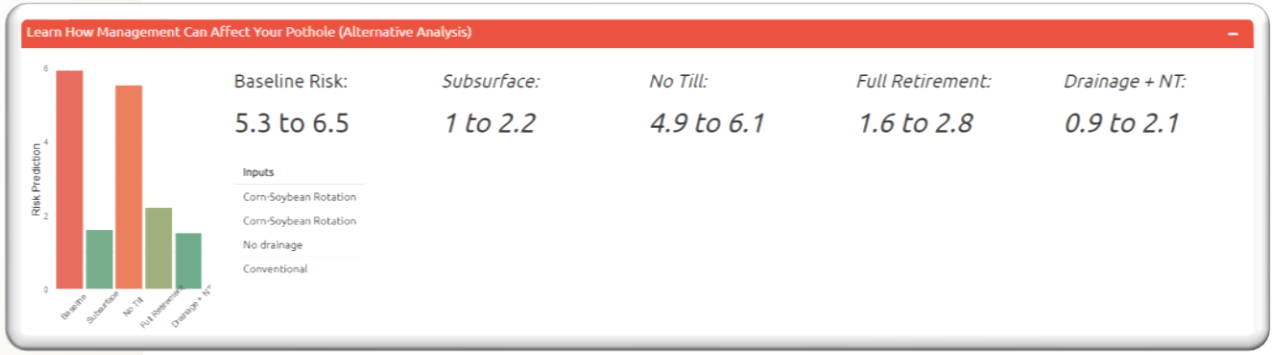
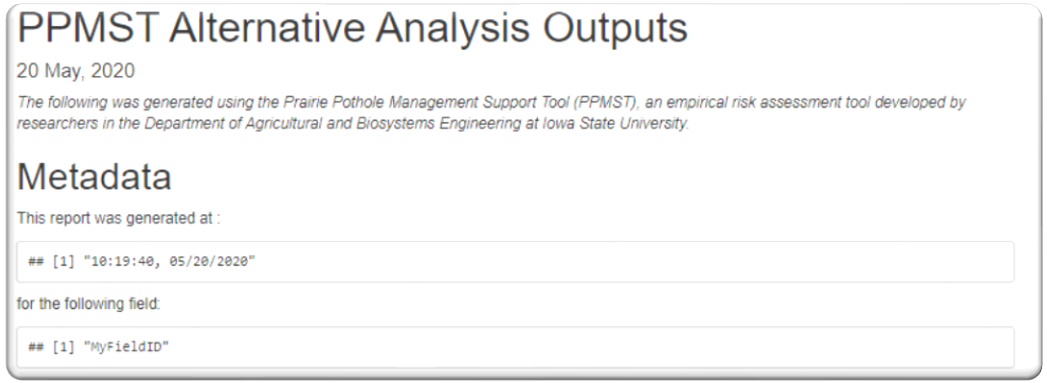
Tool Flowchart

1. Prairie Pothole Inputs
2. Analysis and Alternatives
3. Output Report







PPMST Alternative Analysis Outputs

20 May, 2020

The following was generated using the Prairie Pothole Management Support Tool (PPMST), an empirical risk assessment tool developed by researchers in the Department of Agricultural and Biosystems Engineering at Iowa State University.

Metadata

This report was generated at :

```
## [1] "10:19:40, 05/20/2020"
```

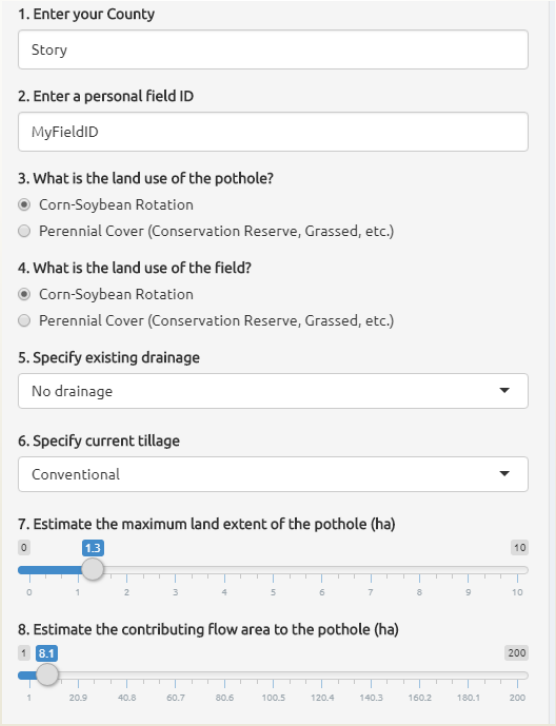
for the following field:

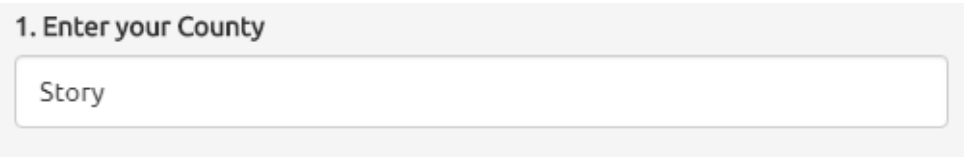
```
## [1] "MyFieldID"
```

1. Prairie Pothole Inputs

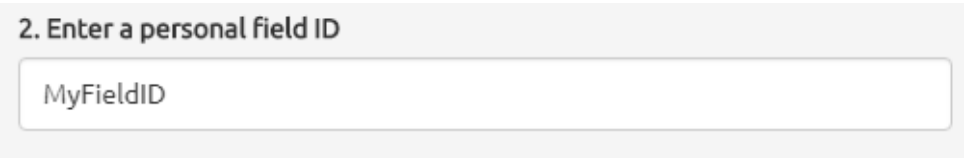
Found in the sidebar of the "Baseline Assessment" Tab.

1. **County**
2. **Field**
3. **Pothole Land Use**
4. **Field Land Use**
5. Drainage
6. Tillage
7. Pothole Area
8. Watershed Area
9. Pothole Depth
10. Watershed Slope
11. Shape

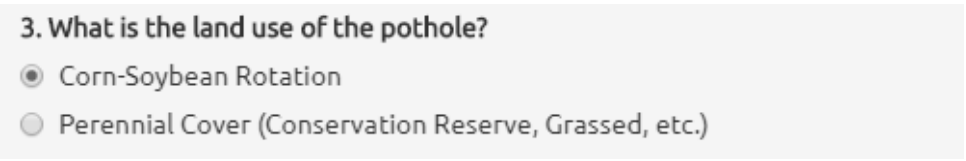




Type in the name of the county in which your pothole resides. This information is used in the output report as metadata.



Type in the ID by which you know your field (address, alphanumeric identifier, name, etc.). This is used for your reference and as metadata in the output report. This may include a pothole ID if there are multiple potholes in one field.



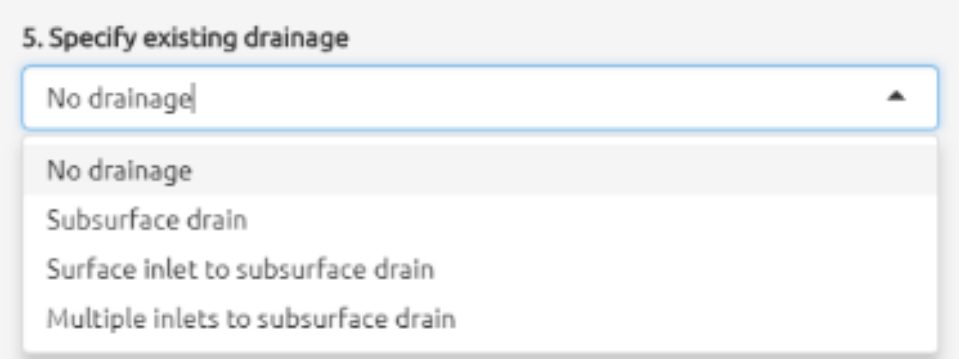
Click on the current land use of the pothole, whether it is actively planted every year or there is perennial vegetation (or no planting attempted).

Click on the current land use of the field, whether it is actively planted every year or there is perennial vegetation (or no planting attempted).

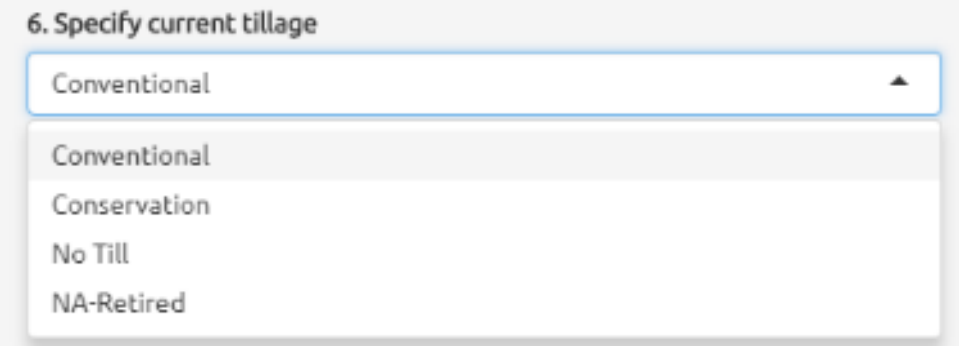
Prairie Pothole Inputs

Found in the sidebar of the "Baseline Assessment" Tab.

1. County
2. Field
3. Pothole Land Use
4. Field Land Use
5. **Drainage**
6. **Tillage**
7. Pothole Area
8. Watershed Area
9. Pothole Depth
10. Watershed Slope
11. Shape



*Select the existing drainage **in the pothole** from the dropdown list.*

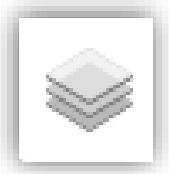


Select the existing tillage practices employed in the field from the dropdown list. If the pothole itself is not planted, this is the tillage used in the entire field (not just the pothole).

Prairie Pothole Inputs

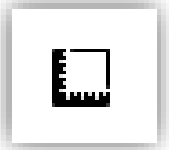
Found in the sidebar of the "Baseline Assessment" Tab.

1. County
2. Field
3. Pothole Land Use
4. Field Land Use
5. Drainage
6. Tillage
7. **Pothole Area**
8. Watershed Area
9. Pothole Depth
10. Watershed Slope
11. Shape



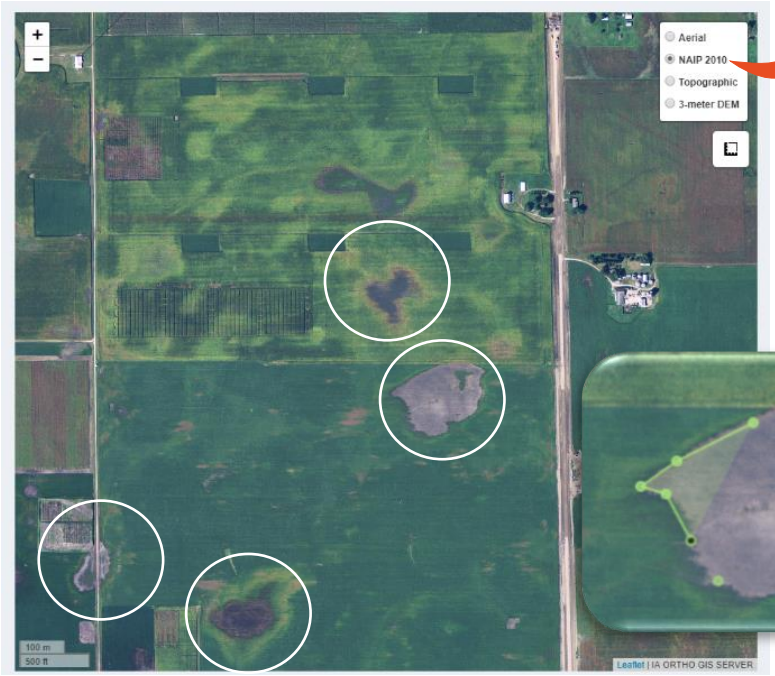
Toggle Basemap layers:

- *Aerial*
- *NAIP 2010*
- *Topographic*
- *3m DEM*

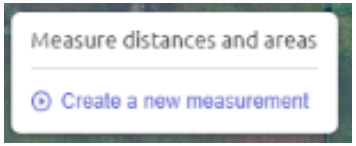


Measure Tool:

- *Distances*
- *Areas*

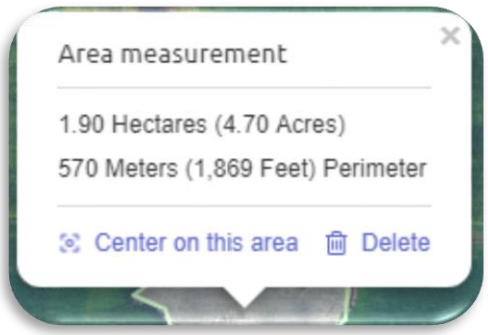


Toggle the NAIP 2010 imagery to easily identify potholes.

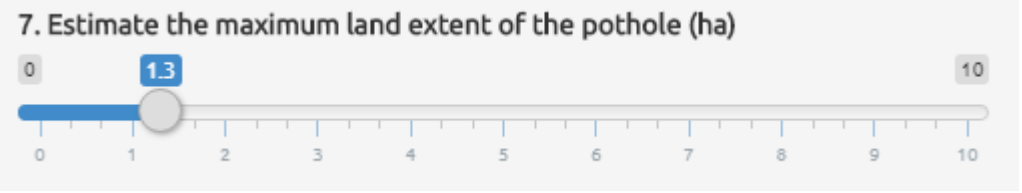


Hover the mouse over the measure tool and click 'create.'

Click on the outline of the pothole until completed. Double click or select "Finish" to end drawing.



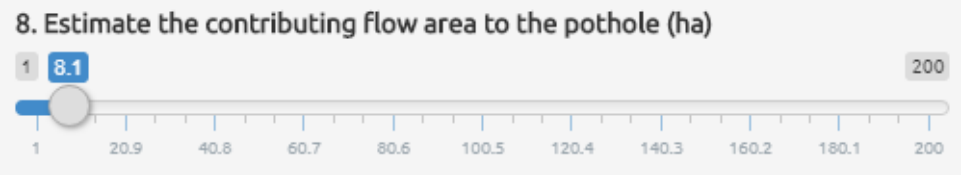
Copy the area (hectares) to number 7 in the sidebar inputs. The default is the average pothole size in the Des Moines Lobe.



Prairie Pothole Inputs

Found in the sidebar of the "Baseline Assessment" Tab.

1. County
2. Field
3. Pothole Land Use
4. Field Land Use
5. Drainage
6. Tillage
7. Pothole Area
8. **Watershed Area**
9. Pothole Depth
10. Watershed Slope
11. Shape



The default value for the watershed area is approximately 8 times larger than the pothole area. Observed ranges of watershed area are 3 to 11 times larger than the pothole area, but values may deviate from that range. A reasonable value for watershed area is 6-8x larger than your input pothole area.

If you are confident interpreting DEMs or topographic characteristics…

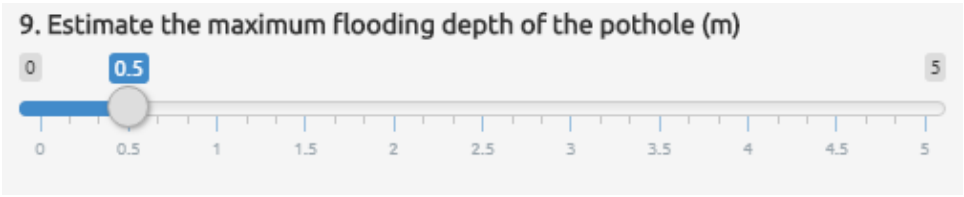
Once the pothole is fully delineated, change the map layer to 3m DEM. The DEM shows elevation differences where lighter colors are higher and darker colors are lower.

Roughly, draw an outline that cuts high and low areas in half (showing where flow splits). Generally, follow road lines (right side). This leads to a rough outline of the watershed. You may be able to do this freehand and identify where flow splits if you have a good working knowledge of your field.

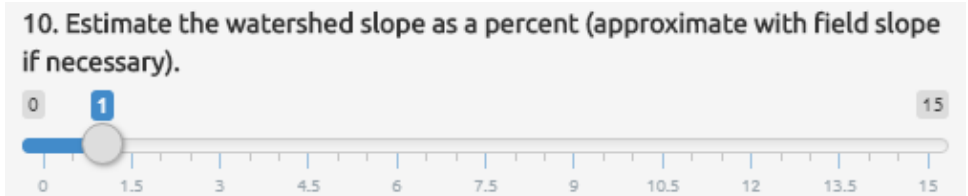
Prairie Pothole Inputs

Found in the sidebar of the "Baseline Assessment" Tab.

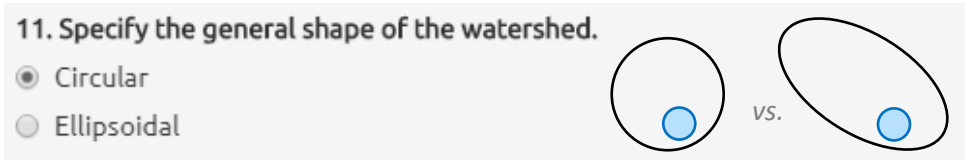
1. County
2. Field
3. Pothole Land Use
4. Field Land Use
5. Drainage
6. Tillage
7. Pothole Area
8. Watershed Area
9. **Pothole Depth**
10. **Watershed Slope**
11. **Shape**



Move the slider to select the maximum flood depth of the pothole. Average flood depth of potholes in the Des Moines Lobe is between 0.4 and 0.5 meters. This is the depth where the pothole would overflow into other portions of the field.



Move the slider to select the average watershed slope draining to the pothole. Prior knowledge of average field slope may be an appropriate estimate. This input is not used directly but is used to calculate a rough estimate of the maximum change in elevation across the watershed and an estimate of the longest flow path water where water drains in the watershed.



Based on your judgement of the placement of the pothole in the field or the elevation changes around the pothole, indicate whether you think the pothole's drainage area is more circular or ellipsoidal (for slope length and elevation change calculations).

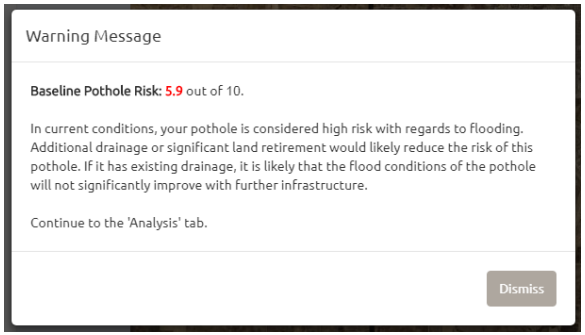
Copy to Analysis

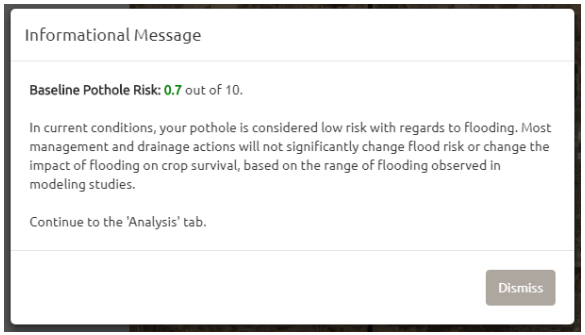
***IMPORTANT!** When finished, click the 'Copy to Analysis' button, otherwise your changes will not be reflected in the subsequent analysis.*

Baseline Assessment

Found in the sidebar of the "Baseline Assessment" Tab.

This pop-up appears after clicking the "Copy to Analysis" button.





After clicking the "Copy to Analysis" button, a pop-up will appear at the top of the screen and the rest of the app will turn gray. This pop-up provides a quick notification about your pothole's baseline conditions. This information will be repeated in the 'Analysis' tab. Click outside the pop-up or click on "Dismiss" and then navigate to the "Analysis" Tab for further information.

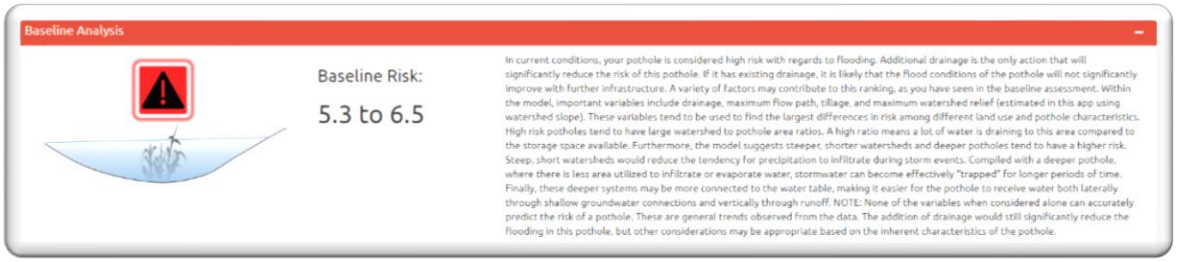
2. Analysis and Alternatives

Found in the main panel of the "Analysis" Tab.

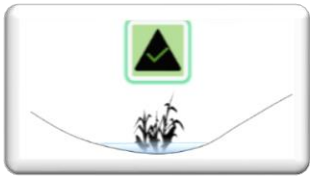
The Pothole Constants box contains information from the previous page.

The "Pothole Constants Saved from Baseline" dropdown box provides a copy of the inputs that were determined from the previous steps, completed in the "Baseline Assessment" tab. Any changes you make to the pothole parameters from here on should be completed in this dropdown. They can be redone in the "Baseline Assessment" tab, but make sure to click the 'Copy to Analysis' button afterwards. However, these values should not change for a single pothole when comparing different scenarios.

The Baseline Analysis box provides a narrative about the inherent conditions of your pothole.



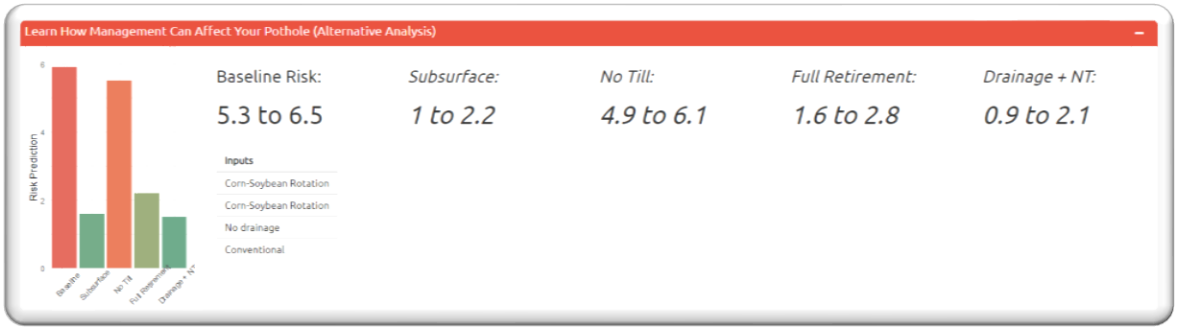
The "Baseline Risk" box is the only box visual on the "Analysis" tab when you arrive on the page. This box provides a visual cue as to the flood risk of your pothole via a warning icon and a conceptual image of flooding in the pothole (flood depths are drawn at 3 different levels depending on the risk of your pothole. A narrative is provided that discusses why certain variables in the assessment may have led to the risk level you are observing.



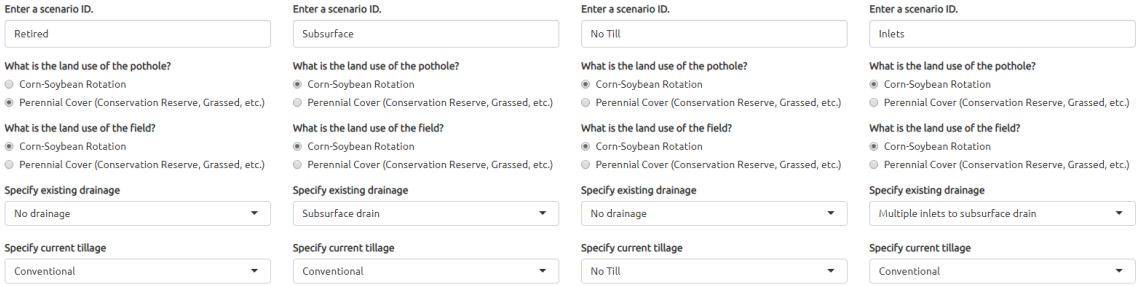
Analysis and Alternatives

Found in the main panel of the "Analysis" Tab.

This section covers the alternative analysis section of the tool.



The "Learn How Management Can Affect Your Pothole" box is the main point of interest for the tool. It provides the predicted risk from your existing conditions (Baseline Risk) and allows you to compare up to 4 additional scenarios side-by-side. A range of values for risk are provided, which considers the variation encountered when training the machine learning models. The midpoint of the range displayed is the true prediction of the model. At left, a graph of all scenario risks is displayed, color-coded from red (high values, bad) to green (low values, good). To the right of the graph is the baseline risk and land management inputs for the baseline scenario. The proceeding 4 columns display the risk for each alternative scenario and display the number of days in which the pothole might be expected to flood each year under those conditions.



The main changes you should make to assess alternatives are immediately below the risk output. You can create short names for each scenario (i.e. "No Till" or "Retired" or "CRP", etc.). Try to keep these IDs to 10 characters or less. The whole range of numerical characteristics (i.e. pothole area) are not provided here because those are characteristics that cannot realistically be changed for management purposes. ***Do not be concerned*** *if the risk value does not change as you choose different options. Some options do not significantly change the results in all cases.*

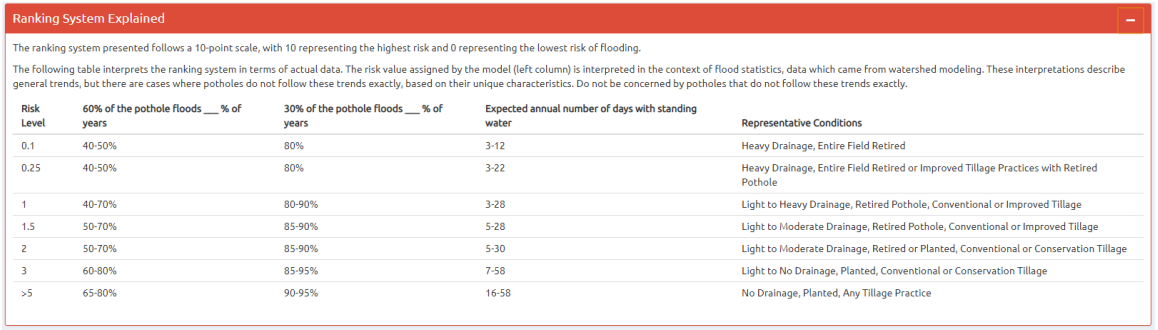
Analysis and Alternatives

The “Data Behind the Ranking System” dropdown will help you interpret the risk values you see in the prior panels, if you are interesting in seeing the underlying modeling data.

The table reports three columns that provide what conditions you might expect for the corresponding risk level and provides quantitative data that reflects metrics used to assign the risk level.

The “Data Behind the Ranking System” dropdown box can be toggled by clicking on the + or – sign at right end of the header. This displays a static dropdown table that contains a snapshot of the data on which the risk level is built. These rows report:

- *How frequently the pothole floods to 60% of its maximum area*
- *How frequently the pothole floods to 30% of its maximum area*
- *The range of the annual number of days with standing water, based on the middle 50% of the simulations (i.e. there are simulations with more extreme data than this range, but these are the most typical values).*



Ranking System Explained

The ranking system presented follows a 10-point scale, with 10 representing the highest risk and 0 representing the lowest risk of flooding.

The following table interprets the ranking system in terms of actual data. The risk value assigned by the model (left column) is interpreted in the context of flood statistics, data which came from watershed modeling. These interpretations describe general trends, but there are cases where potholes do not follow these trends exactly, based on their unique characteristics. Do not be concerned by potholes that do not follow these trends exactly.

Risk Level	60% of the pothole floods ___ % of years	30% of the pothole floods ___ % of years	Expected annual number of days with standing water	Representative Conditions
0.1	40-50%	80%	3-12	Heavy Drainage, Entire Field Retired
0.25	40-50%	80%	3-22	Heavy Drainage, Entire Field Retired or Improved Tillage Practices with Retired Pothole
1	40-70%	80-90%	3-28	Light to Heavy Drainage, Retired Pothole, Conventional or Improved Tillage
1.5	50-70%	85-90%	5-28	Light to Moderate Drainage, Retired Pothole, Conventional or Improved Tillage
2	50-70%	85-90%	5-30	Light to Moderate Drainage, Retired or Planted, Conventional or Conservation Tillage
3	60-80%	85-95%	7-58	Light to No Drainage, Planted, Conventional or Conservation Tillage
>5	65-80%	90-95%	16-58	No Drainage, Planted, Any Tillage Practice

Analysis and Alternatives

Found in the main panel of the "Analysis" Tab.

Future versions may include economic or environmental summaries.

Reserved for future development.

3.Output Report

Found at the bottom of the page on the "Analysis" Tab.

The report file is found wherever you chose to save the file on your computer.

When the alternative analysis is complete, click the "Save Report" button at the bottom of the page. Navigate to where you would like to save the file.

After navigating to the file on your device, clicking on the file will open a new web-browser page with a report formatting like the one at right.

PPMST Alternative Analysis Outputs

12 June, 2020

The following was generated using the Prairie Pothole Management Support Tool (PPMST), an empirical risk assessment tool developed by researchers in the Department of Agricultural and Biosystems Engineering at Iowa State University.

Metadata

This report was generated at :

```
## [1] "09:28:31, 06/12/2020"
```

for the following field:

```
## [1] "MyFieldID"
```

Summary of Inputs

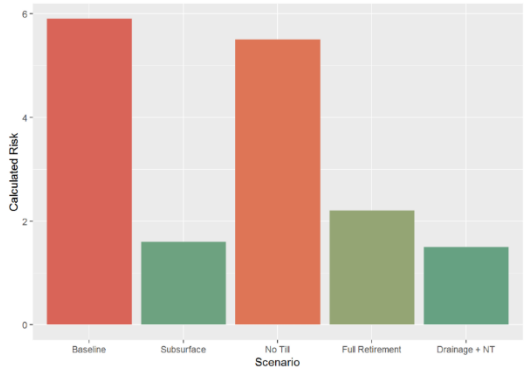
The following table summarizes the current inputs used in the PPMST:

Scenario	County ID	Field ID	Pothole Area (ha)	Watershed Area (ha)	Maximum Depth (m)	Watershed Relief (m)	Maximum Flow Path (m)	LULC of Pothole	LULC of Field	Drainage	Tillage
Baseline	Story	MyFieldID	1.3	8.1	0.5	2.57	257	Corn-Soybean Rotation	Corn-Soybean Rotation	No drainage	Conventional
Subsurface	Story	MyFieldID	1.3	8.1	0.5	2.57	257	Corn-Soybean Rotation	Corn-Soybean Rotation	Subsurface drain	Conventional
No Till	Story	MyFieldID	1.3	8.1	0.5	2.57	257	Corn-Soybean Rotation	Corn-Soybean Rotation	No drainage	No Till
Full Retirement	Story	MyFieldID	1.3	8.1	0.5	2.57	257	Perennial Cover (Conservation Reserve, Grassed, etc.)	Perennial Cover (Conservation Reserve, Grassed, etc.)	No drainage	NA-Retired
Drainage + NT	Story	MyFieldID	1.3	8.1	0.5	2.57	257	Corn-Soybean Rotation	Corn-Soybean Rotation	Subsurface drain	No Till

Results

Flood Risk

Figure 1: Predicted flood risk for all scenarios without uncertainty.



The following table summarizes the flood risk prediction, with uncertainty, for the input scenarios above.

Scenario	County ID	Field ID	Risk Prediction	Minimum Risk	Maximum Risk
Baseline	Story	MyFieldID	5.9	5.3	6.5
Subsurface	Story	MyFieldID	1.6	1.0	2.2
No Till	Story	MyFieldID	5.5	4.9	6.1
Full Retirement	Story	MyFieldID	2.2	1.6	2.8
Drainage + NT	Story	MyFieldID	1.5	0.9	2.1