Technical Support Document B

Agricultural Survey Results for the Fox Illinois River Basin TMDL

Supporting the Fox Illinois River Basin Total Maximum Daily Load (TMDL) for Phosphorus and Total Suspended Solids

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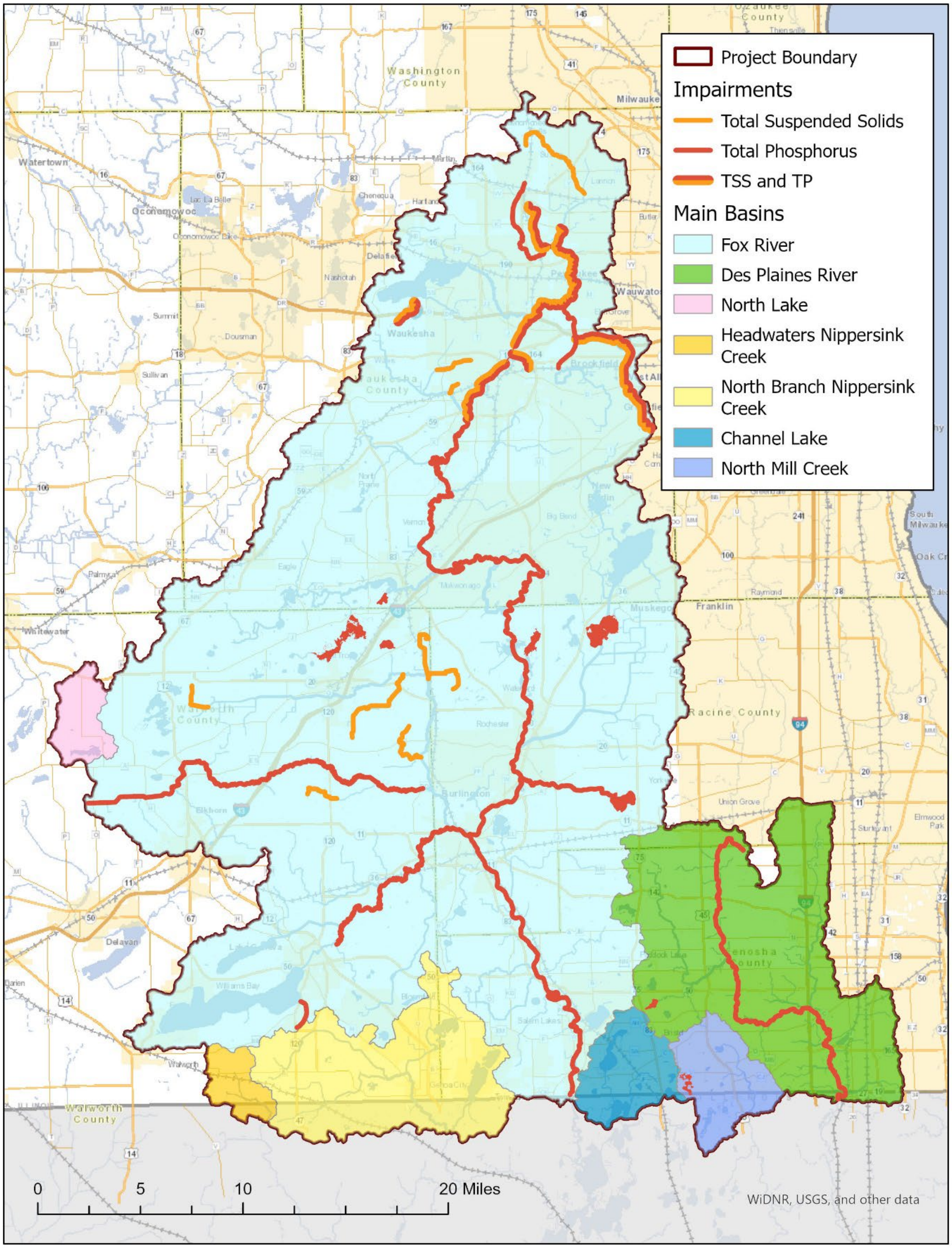
1. PROJECT BACKGROUND

The Department of Natural Resources, together with many partners, is working to improve the surface water quality of tributaries, streams, rivers, and lakes within the Fox Illinois River Basin. To strengthen these ongoing efforts, the Department is developing a Total Maximum Daily Load (TMDL) for the river basin. The TMDL for this study area, referred to as the Fox Illinois River (FOXIL) TMDL, will be a multi-year effort to address surface water quality impairments caused by phosphorus and total suspended solids. The TMDL study will provide a strategic framework and pollutant reduction goals for surface water quality improvement within the river basins.

The Fox Illinois River TMDL study area is located in southeastern Wisconsin. The study area includes the Fox River, the Des Plaines River, Nippersink Creek, North Mill Creek, and Channel Lake watersheds. The study area is primarily located in Racine, Kenosha, Walworth, and Waukesha counties. It is approximately bounded by Waukesha to the north, Lake Geneva to the southwest, and the western portions of Kenosha to the southeast. The TMDL study area covers approximately 1,060 square miles within Wisconsin, which is approximately 2 percent of the state. Within the study area, some lakes and streams are impaired (WDNR, 2022b), which means they are not meeting their water quality criteria. The extent of the TMDL and the waterbodies that are currently impaired are shown in Figure 1.1.

An important step in developing a TMDL is understanding land cover and agricultural practices within the watershed. The DNR worked with county conservationists in the project area to characterize land cover, crop rotations, tillage practices, and other land management practices. Information was collected from a formal survey and follow-up discussions, and the information will be incorporated into a watershed model. This report provides a detailed summary of the survey results.

FIGURE 1.1
Extent of Fox Illinois TMDL Study Area and Impairments



2. AGRICULTURAL SURVEY

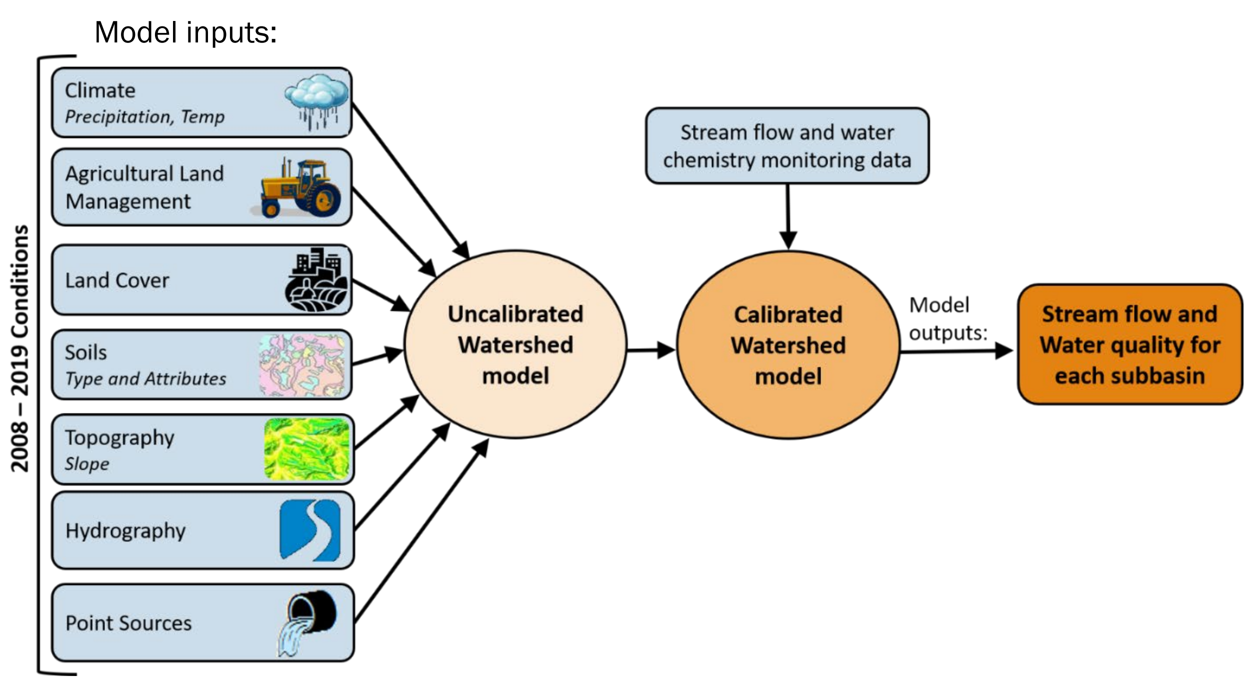
A detailed agricultural survey was sent to county conservationists in Waukesha, Walworth, Kenosha, and Racine Counties. The survey included questions about land cover, crop sequences, tillage, fertilizer and manure, soil phosphorus, grazing, irrigation, and tile drainage. The survey requested information for all HUC 12s within the study area for each county. Detailed information was not available for Waukesha County, so information gathered for Walworth, Kenosha, and Racine Counties were applied to Waukesha County. An example of the survey is provided in Appendix A.

2.1. Watershed Modeling

Information from the survey will be incorporated into a watershed model developed using the Soil and Water Assessment Tool (SWAT) model. The SWAT model will be developed for the entire Fox Illinois River study area and will be used to evaluate phosphorus and sediment loading in support of TMDL development. The detailed information for agricultural areas outlined in this report will be incorporated into the SWAT model; however, they may be adjusted through model calibration and additional feedback from agricultural practitioners and watershed managers in the study area.

Agricultural land cover and land management data are two of many important inputs for a SWAT model. Other important model inputs, shown in Figure 2.1, include data about precipitation, temperature, soil, slope, and point source locations and discharge characterizations. Water quality monitoring data is used to calibrate the model before the outputs of stream flow and stream loads are estimated.

FIGURE 2.1
Diagram of the Primary Model Inputs for the SWAT Watershed Model



3. LAND COVER ESTIMATES

Initial estimates of agricultural land cover were derived from the Wiscland 2.0 dataset (WDNR, 2016). The respondents to the agricultural survey were asked to review the land cover estimates and provide feedback on the accuracy of the estimates. Survey results were then used to refine the land cover data. The following sections describe the process to develop a final agricultural land cover dataset.

3.1. Wiscland 2.0

Wiscland 2.0 is a spatial dataset that characterizes land cover in Wisconsin. The dataset was developed as a collaborative effort between the DNR, the University of Wisconsin-Madison, and the Wisconsin State Cartographer's office (WDNR, 2016). Wiscland 2.0 classifies land cover at four different levels of detail, with Level 1 being the most generic and Level 4 being the most detailed. An example of the classification scheme for agricultural lands and grasslands is provided in Table 3.1. The Level 3 data for crop rotations (cash grain, continuous corn, dairy rotation, potato/vegetable) and for forage grassland (hay, pasture) were used to characterize the agricultural land cover in the Fox Illinois River TMDL study area. More information about the sequences in the crop rotations is provided in Section 4.

TABLE 3.1
Wiscland 2.0 Classification for Agriculture and Grassland

Level	Class ID	Class
1	2000	**Agriculture**
2	2100	Crop Rotation
3	2110	Cash Grain
3	2120	Continuous Corn
3	2130	Dairy Rotation
3	2140	Potato/Vegetable
2	2200	Cranberries
1	3000	**Grassland**
2	3100	Forage Grassland
3	3110	Hay
3	3120	Pasture
2	3200	Idle Grassland
3	3210	Cool-season Grass
3	3220	Warm-season Grass

3.2. Agricultural Surveys

Wiscland 2.0 was developed using data from 2008 to 2012, and some changes to land cover have occurred during that time. Maps showing the extent of the Wiscland 2.0 land cover and tables showing the percentage of each agricultural land cover class were provided to the survey respondents. Respondents were asked to review the results and provide input about the accuracy of the land cover estimates. The survey results were used to refine the land cover dataset so it more closely matched true conditions.

3.3. Agricultural Land Cover Refinements

Input from the surveys was used to refine the land cover originally estimated from Wiscland 2.0. Table 3.2 summarizes the changes indicated by Walworth, Racine, and Kenosha Counties. Details about the processing used to refine the land cover is provided in Appendix B.

TABLE 3.2
Refinements to Land Cover Based on Survey Results

County	Location	Wiscland 2.0 Land Cover	Updated Land Cover	Percent Updated	Explanation
Kenosha	Channel Lake	Dairy Rotation	Cash Grain	100%	The number of dairy farms has decreased, and no more dairy rotation exist in the Channel Lake subwatershed.
Kenosha	Countywide	Dairy Rotation	Cash Grain	40%	The number of dairy farms has decreased, and the Wiscland 2.0 dataset overrepresents the amount of dairy rotation in the county.
Racine	Near Wind Lake	Misc.	Sod	100%	Sod farms located near Wind Lake were not identified in Wiscland 2.0. The extent of the sod fields were delineated using the Cropland Data Layer (NASS, 2022) and aerial photographs.
Racine	Countywide	Continuous Corn	Cash Grain	100%	Very little continuous corn is farmed in the county.
Racine	Countywide	Dairy Rotation	Cash Grain	40%	The Wiscland 2.0 dataset overrepresents the amount of dairy rotation in the county.
Walworth	Countywide	Continuous Corn	Cash Grain	40%	The Wiscland 2.0 dataset overrepresents the amount of continuous corn in the county.
Walworth	Countywide	Dairy Rotation	Cash Grain	40%	The Wiscland 2.0 dataset overrepresents the amount of dairy rotation in the county. The majority of dairy rotation is concentrated south of Lake Geneva.
Waukesha	Countywide	Dairy Rotation	Cash Grain	60%	The number of dairy farms has decreased, and the Wiscland 2.0 dataset overrepresents the amount of dairy rotation in the county.
All	Basinwide	Pasture	Idle grassland	45%	The Wiscland 2.0 dataset classifies some golf courses and other grasses as pasture.

3.4. Final Agricultural Land Cover

The survey results were used to develop final land cover map for the watershed. A comparison of the Wiscland 2.0 estimates (WL), the survey estimates (S), and the updated land cover (U) for each county is provided in Figure 3.2. The percentages in Figure 3.2 represent the percent of agricultural area in each county that is within each land cover class for each estimate. The updated agricultural land use in the project area is shown in Figure 3.3.

FIGURE 3.1

Comparison of Land Cover Percentages by County

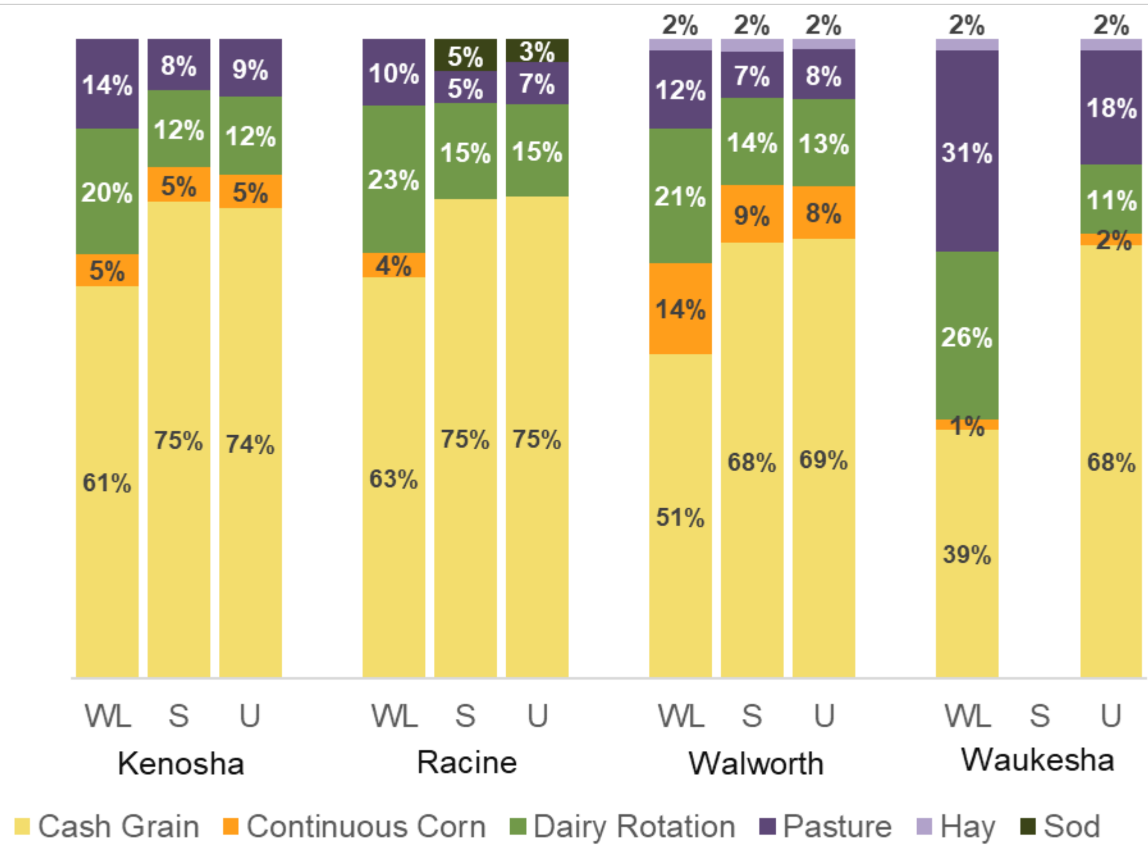
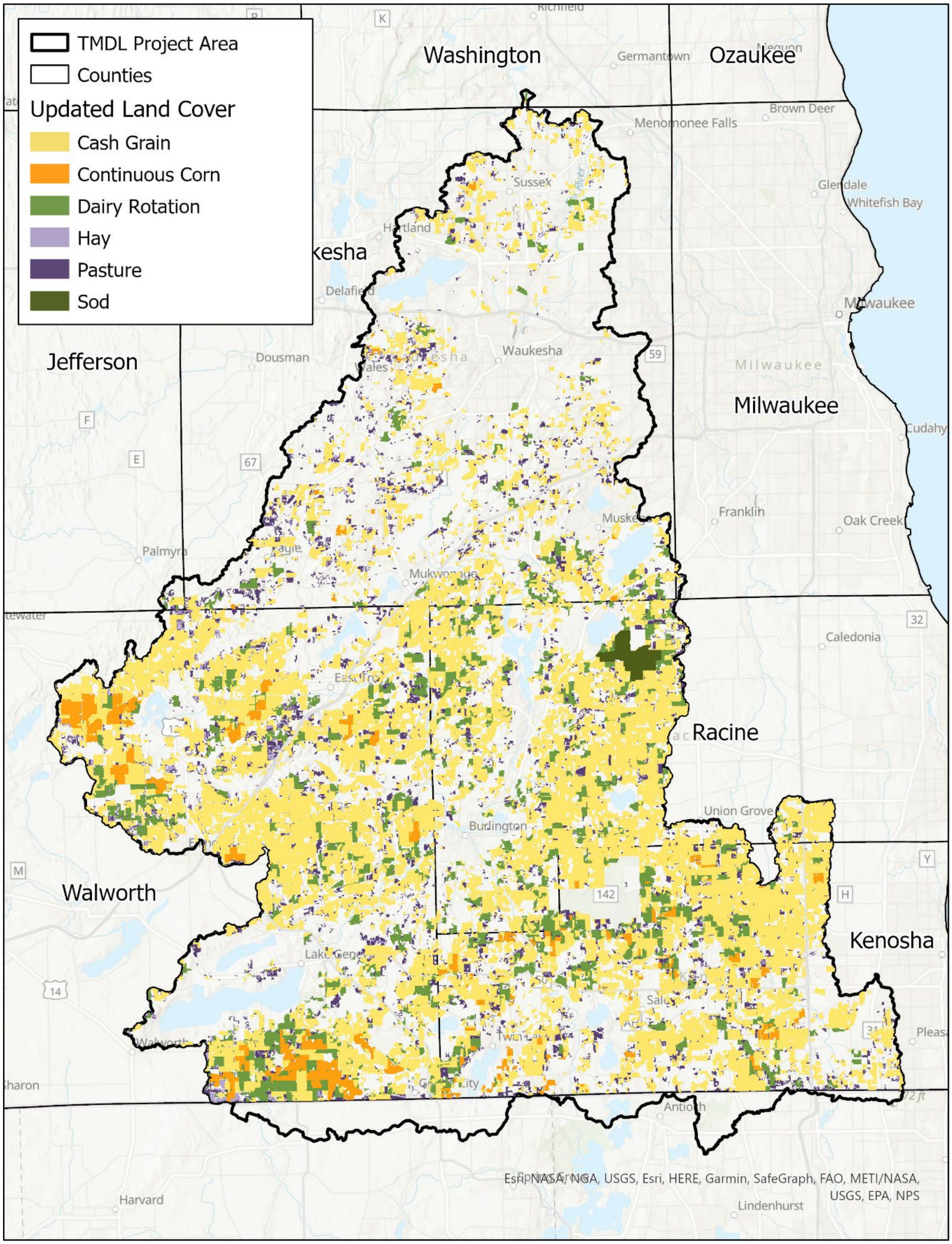


FIGURE 3.2

Fox Illinois TMDL Study Area Agricultural Land Use



4. CROP SUMMARY

The agricultural surveys included information about the crops grown in the study area. Predominant crops grown include corn for grain, corn for silage, soybeans, winter wheat, alfalfa, and sod. The sequence of crops for rotations, the average planting date, and the typical yield were all identified as part of the survey and are summarized below.

4.1. Crop Sequence

Six distinct agricultural land cover types were identified from the Wiscland 2.0 dataset and the survey responses. The agricultural land cover types include cash grain, continuous corn, dairy rotation, pasture, hay, and sod. The county survey results included descriptions of the crop sequences for dairy rotations and cash grain rotations. Sequences were simplified so the duration of a single rotation lasted six years. The six-year rotation period was selected so the rotations could be adequately represented in the SWAT modeling. The model will be run for a total of 12 years, which will allow for two full rotations to be modeled. A summary of the rotations that will be used for the model are summarized in Table 4.1.

TABLE 4.1
Crop Sequences for Agricultural Land Cover

	Rotation Year					
Rotation	**1**	**2**	**3**	**4**	**5**	**6**
Dairy Sequence 1	CS	Cs	SOY	WW	ALF	ALF
Dairy Sequence 2	CS	Cs	CS	ALF	ALF	ALF
Cash Grain Sequence 1	CG	SOY	CG	SOY	CG	SOY
Cash Grain Sequence 2	CG	SOY	WW	CG	SOY	WW
Continuous Corn	CG	CG	CG	CG	CG	CG
Continuous Hay	ALF	ALF	ALF	ALF	ALF	ALF
Sod	SOD	SOD	SOD	SOD	SOD	SOD

CS: corn silage, CG: corn grain, SOY: soybean, WW: winter wheat, ALF: alfalfa, SOD: sod

4.2. Planting and Harvesting

The county survey results were also used to estimate planting and harvesting dates. The average planting dates for selected crops are provided in Table 4.2. Alfalfa is assumed to be harvested four times at the end of May, June, July, and August.

TABLE 4.2
Approximate Planting and Harvest Dates for Crops

Crop	Approximate Planting Date	Approximate Harvest Date
Corn silage	May 15	September 15
Corn grain	May 15	November 1
Soybean	May 25	October 15
Winter wheat	October 15	July 15
Alfalfa	July 22	*
Sod	October 15	**

*Alfalfa is cut many times during the season
**Sod is harvested after approximately 1.5 to 2 years of growth

4.3. Crop Yields

Information about crop yields was also provided in the survey results. Although crop yields are not a direct input for the SWAT model, the information will be used during the calibration process to ensure the crop growth predicted in the model is consistent with actual crop growth. Table 4.3 summarizes the crop yield estimates from the survey.

TABLE 4.3
Target Crop Yield Estimates

Crop	Units	Typical Yield
Corn silage	Tons per acre	25-30
Corn grain	Bushels per acre	171-210
Soybean	Bushels per acre	46-65
Winter wheat	Bushels per acre	70-80

5. LAND MANAGEMENT

In addition to information about the crops grown, the SWAT model requires information about how agricultural land is managed. Land management includes tillage practices, chemical fertilizer applications, manure management, and irrigation and tile drainage. The following sections describe details about land management from the county surveys.

5.1. Tillage

Five predominant tillage practices were identified from the county surveys. Tillage practices include two main components: timing and type. The type of tillage implements identified in the surveys include chisel plow, field cultivator, vertical till, moldboard plow, and disk & chisel plow. Different tillage strategies are applied for different crop types, and most of the intensive plowing occurs in the fall after harvest. A summary of the predominant tillage strategies identified from the agricultural surveys is provided in Table 5.1. Moldboard and disk & chisel plows are not widely used in the study area, so they are not included in the generalized tillage categories.

TABLE 5.1
Tillage Strategies in the TMDL Study Area

			Percent of Land		
ID	**Fall Tillage**	**Spring Tillage**	**Dairy**	**Corn**	**Cash Grain**
Till 1	Chisel plow	Field cultivate (x2)	35%	40%	-
Till 2	Vertical till	Field cultivate	65%	30%	20%
Till 3	None	Vertical till	-	30%	-
Till 4	Field cultivate	None	-	-	35%
Till 5	Vertical till (corn), No till (soy & wheat)	Field cultivate (corn), No till (soy & wheat)	-	-	45%

5.2. Chemical Fertilizer

Non-manure fertilizer is applied to crops in the study area. Fertilizer is typically applied three times per year: once before planting, once at planting, and once during plant growth. The county survey results indicated only cash grain rotations, continuous corn, and sod receive non-manure phosphorus fertilizer. Average phosphorus application rates are summarized below:

- Cash grain rotation: 35 pounds of phosphorus as P_2O_5 per acre per year
- Continuous corn: 45 pounds of phosphorus as P_2O_5 per acre per year
- Dairy rotation: manure applications only
- Pasture and hay: no fertilizer application
- Sod: 45 pounds of phosphorus as P_2O_5 per acre at planting

5.3. Manure Management

Land that is managed as dairy rotation receives nutrients from manure spreading. Manure is typically managed by either collecting and storing the waste or collecting waste and spreading it throughout the growing season. The surveys indicated approximately 50 percent of dairy acres receive manure from stored waste and 50 percent of dairy acres receive manure from daily haul operations. The application methods that will be used in the model are summarized in Table 5.2.

The frequency of manure application depends on the crop type. Acres planted as corn grain and corn silage receive annual manure applications, acres planted as alfalfa receive an application of manure at planting, and acres planted as winter wheat and oats receive an application of manure once a year. Generally, acres planted as soybeans do not receive any manure application.

TABLE 5.2
Manure Application Methods in the TMDL Study Area

Type	% of Dairy Acres	Frequency	Timing	Followed by Incorporation?	Spreading Amount	Manure Concentration
Daily Haul	50	1 to 14 days	Late fall, winter, spring	No	25 tons per acre	3 pounds per ton
Storage	50	Twice a year	Spring, fall	Yes	12,500 gal. per acre	5 pounds per 1000 gal.

5.4. Irrigation and Tile Drainage

The survey results provided estimates of irrigation and tile drainage for the HUC 12s in the study area. A summary of irrigation and tile drainage for each county is provided in Table 5.3. The full results by HUC 12 are provided in Appendix C.

TABLE 5.3
Average Irrigation and Tile Drainage in the TMDL Study Area

County	Percent of fields with tile drainage	Percent of fields with irrigation
Kenosha	50 - 75	0
Racine	50 - 90	0 - 30
Walworth	0 - 35	0 - 5
Waukesha	Not Available	Not Available

5.5. Soil Phosphorus

The survey results provided estimates of soil phosphorus for the HUC 12s in the study area. A summary of soil phosphorus for each county is provided in Table 5.3. The full results by HUC 12 are provided in Appendix D.

TABLE 5.4
Average Soil Phosphorus in the TMDL Study Area

County	Average Soil P (ppm)
Kenosha	34 - 63
Racine	30 - 60
Walworth	30 - 80
Waukesha	Not available

5.6. Grazing and Pasture

The survey results provided information about grazing practices in the counties. Precise estimates about grazing in the study area were difficult to determine because most grazing occurs in small beef operations and house boarding operations. These operations are dispersed throughout the counties and are typically 50 acres or less. Therefore, specific information regarding these practices was not quantified.

6. SWAT MODEL INPUT SUMMARY

Data from the county surveys will be incorporated into the SWAT model, which is described in Section 2. The approach of using land cover datasets to map crop types, and local knowledge from county LWCDs to determine agronomic practices associated with each crop type, is consistent with methods described by Kirsch et al. (2002), Larose et al. (2007), and Heathman et al. (2008).

6.1. Final Agricultural Land Cover Dataset

The final agricultural land cover dataset shown in Figure 3.2 and described in Appendix B will be combined with the Wiscland 2.0 dataset for non-agricultural lands to create a final land cover dataset for the study area.

6.2. Final Land Management Table for SWAT

The county surveys provided detailed information about crop rotations and land management practices, and the information was simplified to minimize the number of combinations while maintaining an adequate level of detail. The final combinations of crop rotations and land management practices that will be incorporated into the model are provided in Table 6.1. The tillage categories in the table correspond to the tillage strategies described in Table 5.1. A more detailed breakdown of each category is provided in Appendix E.

TABLE 6.1
Final Land Cover and Land Management Categories

	Year							
SWAT Input	**1**	**2**	**3**	**4**	**5**	**6**	**Tillage**	**Fertilizer**
Dairy Sequence 1 - Till 1	Cs	Cs	S	Ww	A	A	1	Manure
Dairy Sequence 1 - Till 2	Cs	Cs	S	Ww	A	A	2	Manure
Dairy Sequence 2 - Till 1	Cs	Cs	Cs	A	A	A	1	Manure
Cash Grain Sequence 1 - Till 1	Cg	S	Cg	S	Cg	S	1	35 lb/ac
Cash Grain Sequence 1 - Till 3	Cg	S	Cg	S	Cg	S	3	35 lb/ac
Cash Grain Sequence 1- Till 4	Cg	S	Cg	S	Cg	S	4	35 lb/ac
Cash Grain Sequence 1- Till 5	Cg	S	Cg	S	Cg	S	5	35 lb/ac
Continuous Corn Sequence - Till 1	Cg	Cg	Cg	Cg	Cg	Cg	1	45 lb/ac
Continuous Corn Sequence - Till 3	Cg	Cg	Cg	Cg	Cg	Cg	3	45 lb/ac
Continuous Hay	A	A	A	A	A	A	None	None
Sod	Sod	Sod	Sod	Sod	Sod	Sod	None	45 lb/ac

The land cover and land management categories will be applied to fields within each county. Based on the survey results, not every county will include every category. A summary of the land cover and land management categories that will be applied for each county is provided in Table 6.2.

TABLE 6.2
Rotations and Tillage Categories Used in Counties

County	Dairy		Cash Grain		Cont. Corn		Hay	Sod
Kenosha	D1-T2	-	CG1-T5	-	CC-T1	CC-T3	-	-
Racine	D1-T1	D1-T2	CG1-T4	CG1-T5	-	-	-	Sod
Walworth	D1-T1	D2-T1	CG1-T1	CG1-T3	CC-T1	-	ContHay	-
Waukesha	D1-T2	-	CG1-T1	CG1-T5	CC-T1	-	ContHay	-

6.3. Incorporation of Land Management Table in SWAT

The agricultural classes selected for SWAT modeling are representative of typical agronomic behaviors in the study area while capturing variation in factors that have the greatest impact on runoff volumes, soil erosion, and phosphorus loading. The selected classes are not an exact reflection of each farm in the study area because the ability to simulate additional agricultural classes is limited by model processing times and data storage requirements. However, the selected classes do balance variability in agronomic practices with limitations imposed by the scale of the watershed modeling effort.

ACKNOWLEDGEMENTS

A special thank you to the county conservationists who took the time to complete the agricultural surveys. The county conservationists who assisted with this effort include Mark Jenks from Kenosha County, Chad Sampson from Racine County, Brian Smetana from Walworth County, and Alyssa Vaugh and Alan Barrows from Waukesha County.

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APPENDIX A

EXAMPLE OF AGRICULTRUAL SURVEY

APPENDIX B

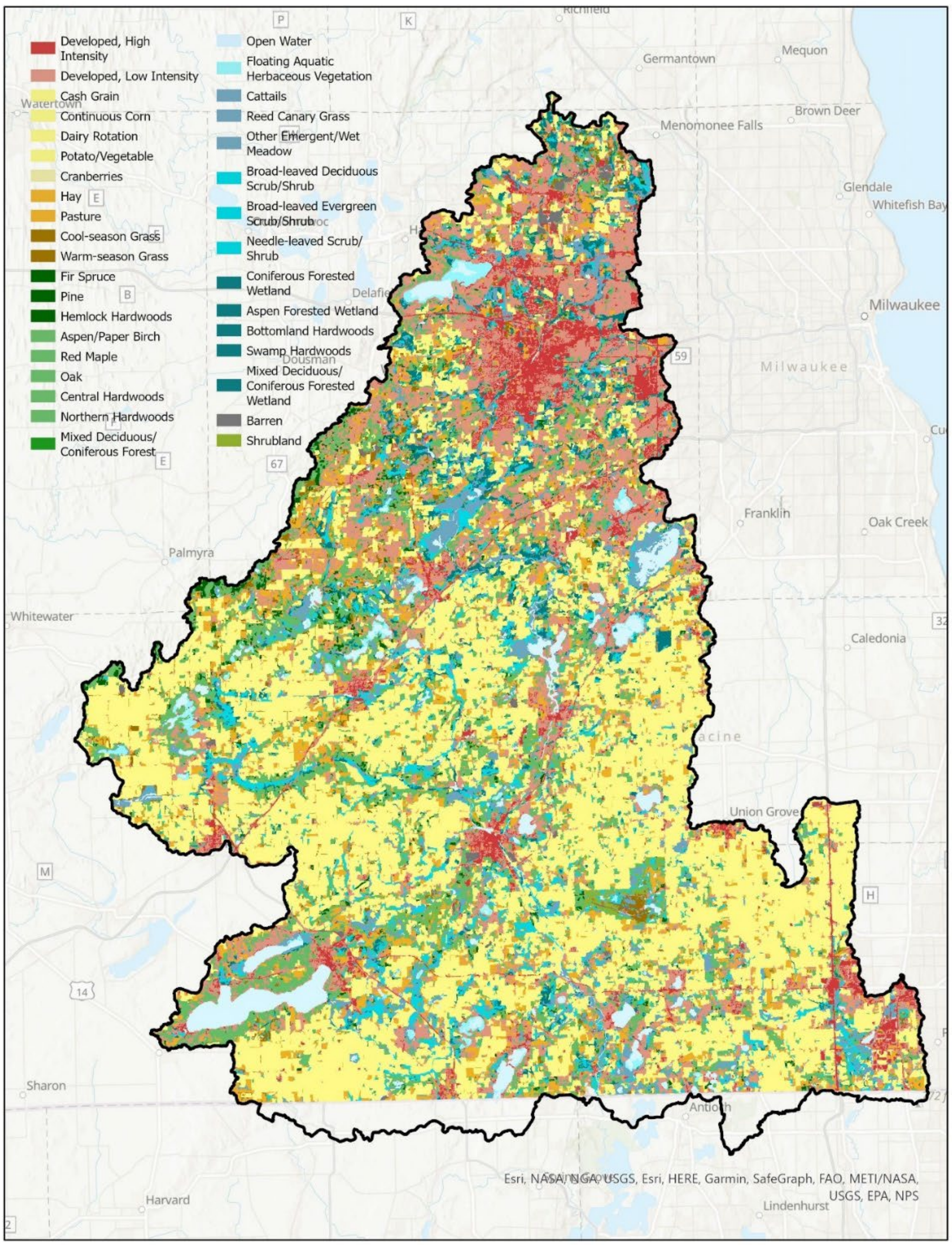
STEPS FOR UPDATING AGRICULTURAL LAND COVER

Step 1: Use Wiscland 2.0 as the baseline land cover for the study area.

Wiscland 2.0 (WDNR, 2016) is a spatial dataset that characterizes land cover in Wisconsin. The dataset was developed as a collaborative effort between the DNR, the University of Wisconsin-Madison, and the Wisconsin State Cartographer's office. Wiscland 2.0 classifies land cover at four different levels, with Level 1 being the most generic and Level 4 being the most detailed. The Level 3 Wiscland 2.0 dataset for the study area is shown in Figure B.1.

FIGURE B.1

Wiscland 2.0 Land Cover for TMDL Study Area



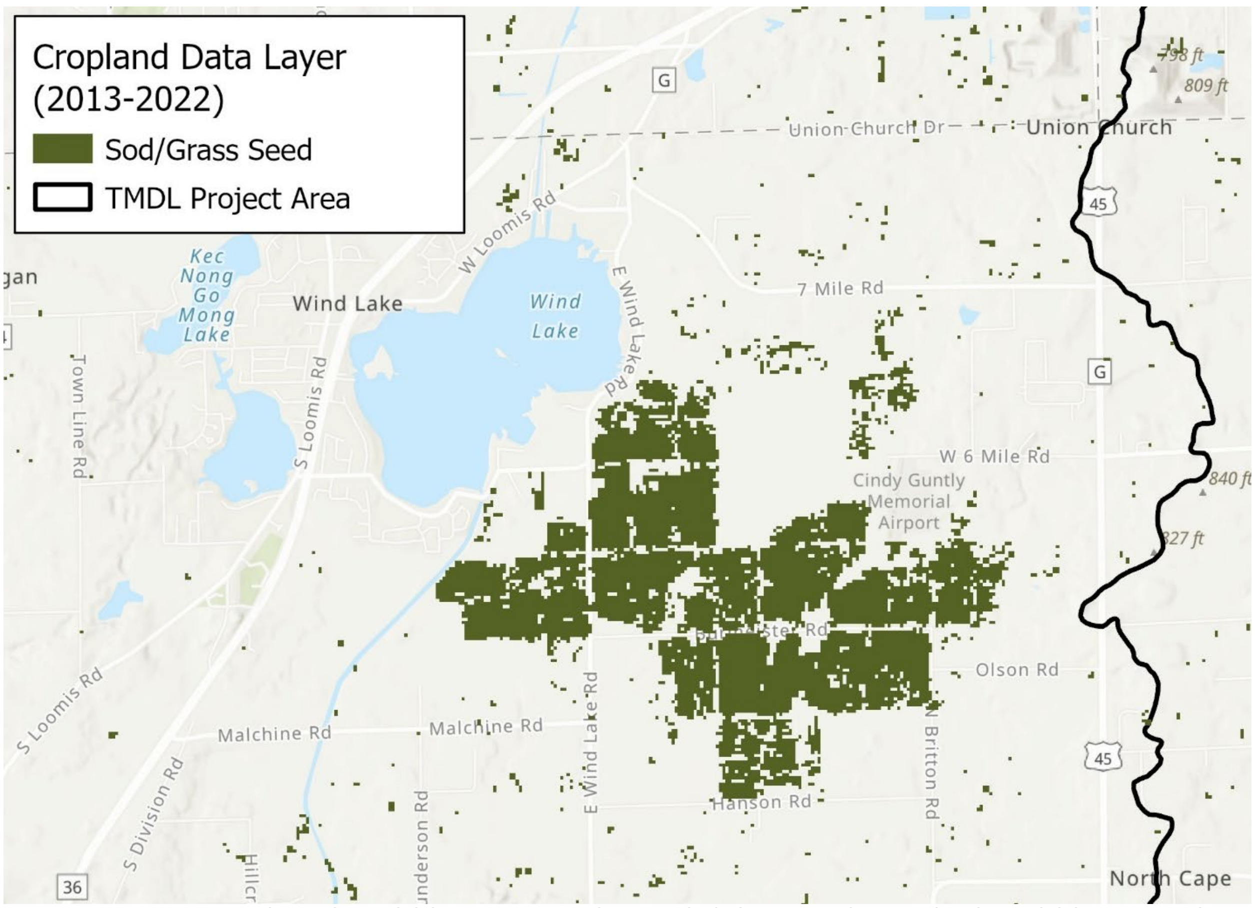
Step 2: Update areas in Racine County that are identified as sod farms.

The survey results from Racine County indicated a significant amount of land near Wind Lake is used for sod farming. Sod is not included as part of the Wiscland 2.0 dataset, so the areas around Wind Lake are misclassified. To identify the land used as sod, the Cropland Data Layer from 2013-2022 (NASS, 2013-2022), which includes a classification for sod/grass seed, was used. Additionally, aerial photographs were reviewed to delineate the approximate location of sod farms. The extents of land cover as sod from the cropland data layer is shown in Figure B.2, and aerial imagery of the area is shown in Figure B.3. In Figure B.3, the sod farms can be identified as the more vibrant green areas.

The final estimated extent of the sod farms used for the updated dataset is shown in Figure B.5. Note that some roads and other small parcels in the final extents may be misclassified as sod, but these discrepancies will be reconciled during the modeling process.

FIGURE B.2

Extent of Sod Land Cover from Cropland Data Layer (2013-2022)



Esri, NASA, NGA, USGS, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS

FIGURE B.3
Aerial Image of Sod Farms near Wind Lake

SEWRPC, Earthstar Geographics

Step 3: Convert dairy rotations to cash grain to match results from the surveys.

The survey results indicated dairy rotations were overrepresented in the Wiscland 2.0 dataset. The biggest driver of the changes to dairy rotation has been the decrease in the number of small dairies. An overview of changes to dairy rotations required for the updated land cover dataset are summarized in Table B.1. In order to systematically reduce the area of dairy rotations, the size of all fields classified as dairy rotation were identified. The smallest of these fields were removed from the dataset until the area of dairy rotations in a county matched the county survey. All of the removed areas were reclassified to cash grain. The extent of dairy rotations that are converted to cash grain is shown in Figure B.6.

Waukesha County did not have information about the extent of dairy rotations in the county. To determine the decrease in the area of dairy rotations in Waukesha County, the total number of dairy operations in Waukesha County was determined from the NASS census (NASS, 2017). Between 2002 and 2017, the number of dairy operations decreased from 52 to 22, and the number of dairy cattle decreased from nearly 4,000 to just over 1,600. The changes in dairy operations were compared with the other counties. Waukesha County has experienced a larger decrease in dairy operations than Kenosha, Racine, and Walworth Counties. To account for a decrease in dairy operations, the amount of dairy rotation in Wiscland 2.0 was assumed to overestimate actual dairy rotations by 60 percent, which is slightly higher than the 40 percent overestimation indicated in the other three counties.

TABLE B.1
Updates to Wiscland 2.0 Dairy Rotations

County	Location	Wiscland 2.0 Land Cover	Updated Land Cover	Percent Updated	Explanation
Kenosha	Channel Lake	Dairy Rotation	Cash Grain	100%	The number of dairy farms has decreased, and no more dairy rotation exist in the Channel Lake subwatershed.
Kenosha	Countywide	Dairy Rotation	Cash Grain	40%	The number of dairy farms has decreased, and the Wiscland 2.0 dataset overrepresents the amount of dairy rotation in the county.
Racine	Countywide	Dairy Rotation	Cash Grain	40%	The Wiscland 2.0 dataset overrepresents the amount of dairy rotation in the county.
Walworth	Countywide	Dairy Rotation	Cash Grain	40%	The Wiscland 2.0 dataset overrepresents the amount of dairy rotation in the county. The majority of dairy rotation is concentrated south of Lake Geneva.
Waukesha	Countywide	Dairy Rotation	Cash Grain	60%	The number of dairy farms has decreased, and the Wiscland 2.0 dataset overrepresents the amount of dairy rotation in the county.

Step 4: Convert a portion of continuous corn to cash grain.

The survey results from Racine County and Walworth County indicated the continuous corn rotation in the Wiscland 2.0 dataset was overrepresented. Very little continuous corn is grown in Racine County, and the continuous corn in Walworth County was overrepresented by approximately 40 percent. All continuous corn in Racine County was removed from the updated land cover dataset. In order to achieve the appropriate balance of continuous corn in Walworth County, the approach described in Step 3 was used. To systematically reduce the area of continuous corn, the size of all fields classified as continuous corn were identified. The smallest of these fields were removed from the dataset until the area of dairy rotations in a county matched the county survey. All removed areas were reclassified to cash grain. The extent of the continuous corn that was reclassified as cash grain is shown in Figure B.7.

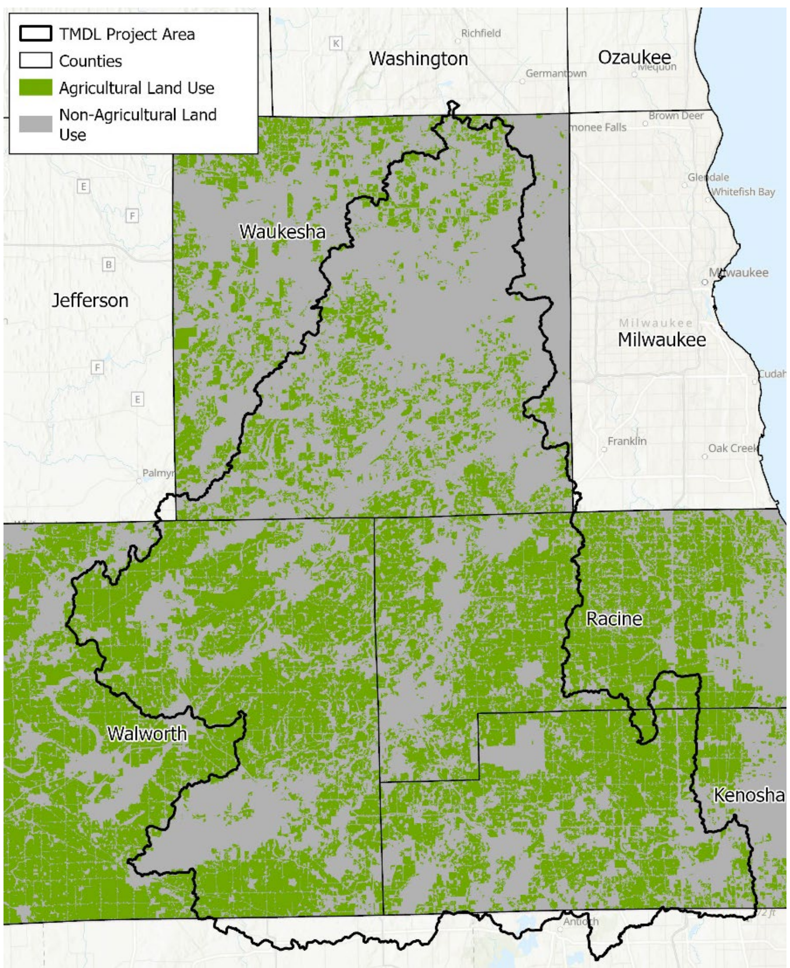
Step 5: Convert pasture and hay in non-agricultural areas to warm-season grass.

The results of the county surveys indicated pasture is difficult to estimate. Pasture that is grazed is typically limited to small beef operations and horse boarding operations. Additionally, areas in Wiscland 2.0 classified as pasture encompass areas that are known to not be pastures. The misclassified areas include turf grass and golf courses.

In order to estimate the actual extent of pasture that may be used for grazing, the 2010 land use data from the Southeast Regional Planning Commission (SEWRPC, 2010) was reviewed. The data were used to delineate agricultural versus non-agricultural areas. All Wiscland 2.0 pasture areas located in non-agricultural land use areas were removed from the final agricultural land cover dataset because these areas are likely golf courses and other turf grass. All Wiscland 2.0 pasture areas located agricultural land use areas were retained. The land use classification from SEWRPC is shown in Figure B.4. The extent of the pasture that was removed from the final land cover dataset is shown in Figure B.8.

FIGURE B.4

Agricultural and Non-Agricultural Land Use from SEWRPC 2010



Step 6. Combine changes in Steps 1 through 5 to establish final land cover dataset

A final agricultural land cover dataset was developed by applying the changes described in Steps 2 through 5 to the Wiscland 2.0 dataset described in Step 1. A comparison of the agricultural lands from the Wiscland 2.0 dataset and the updated dataset is provided in Figure B.9.

FIGURE B.5
Location of Sod Farms Added to Updated Land Cover

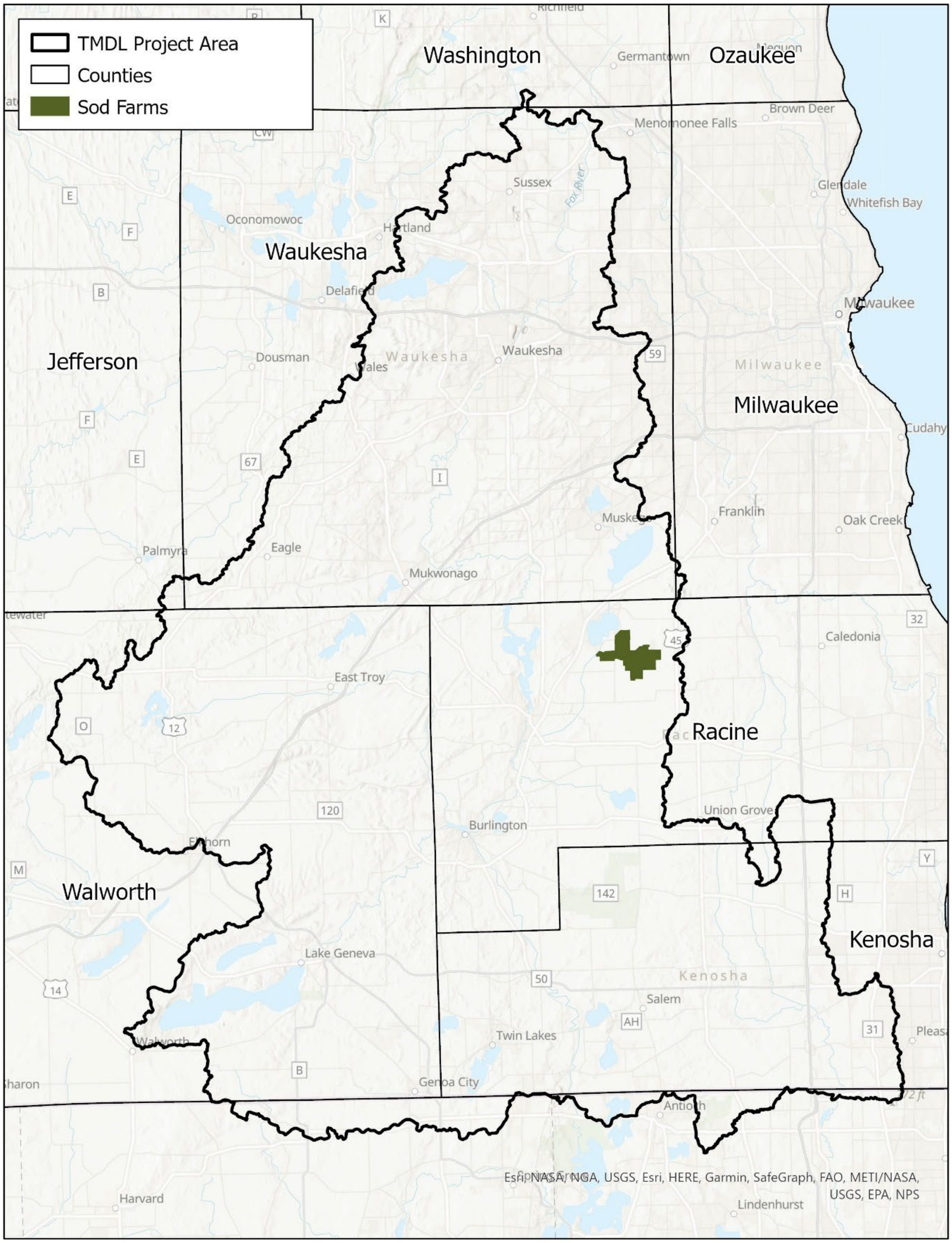


FIGURE B.6

Dairy Rotation Converted to Cash Grain for Updated Land Cover

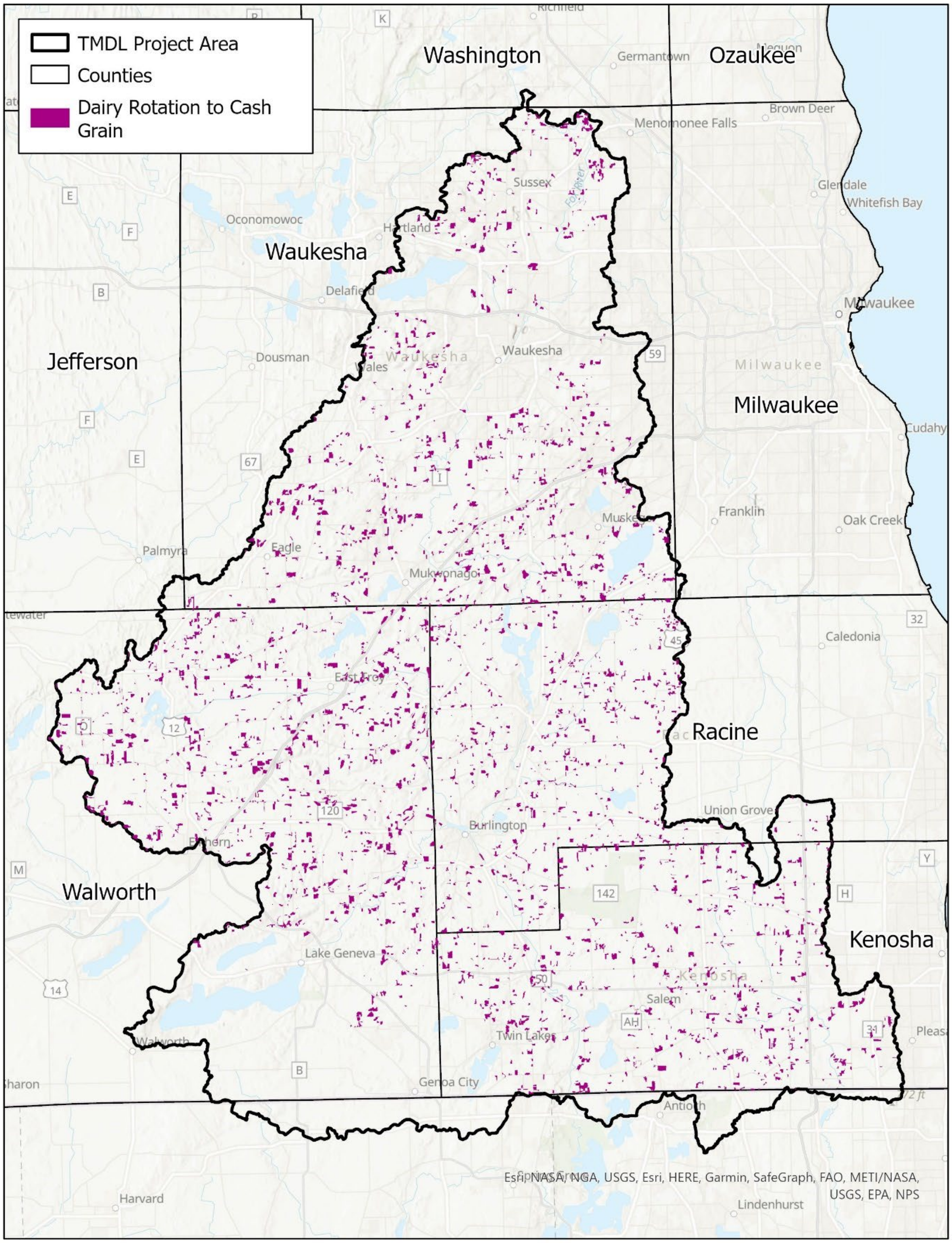


FIGURE B.7

Continuous Corn Converted to Cash Grain for Updated Land Cover

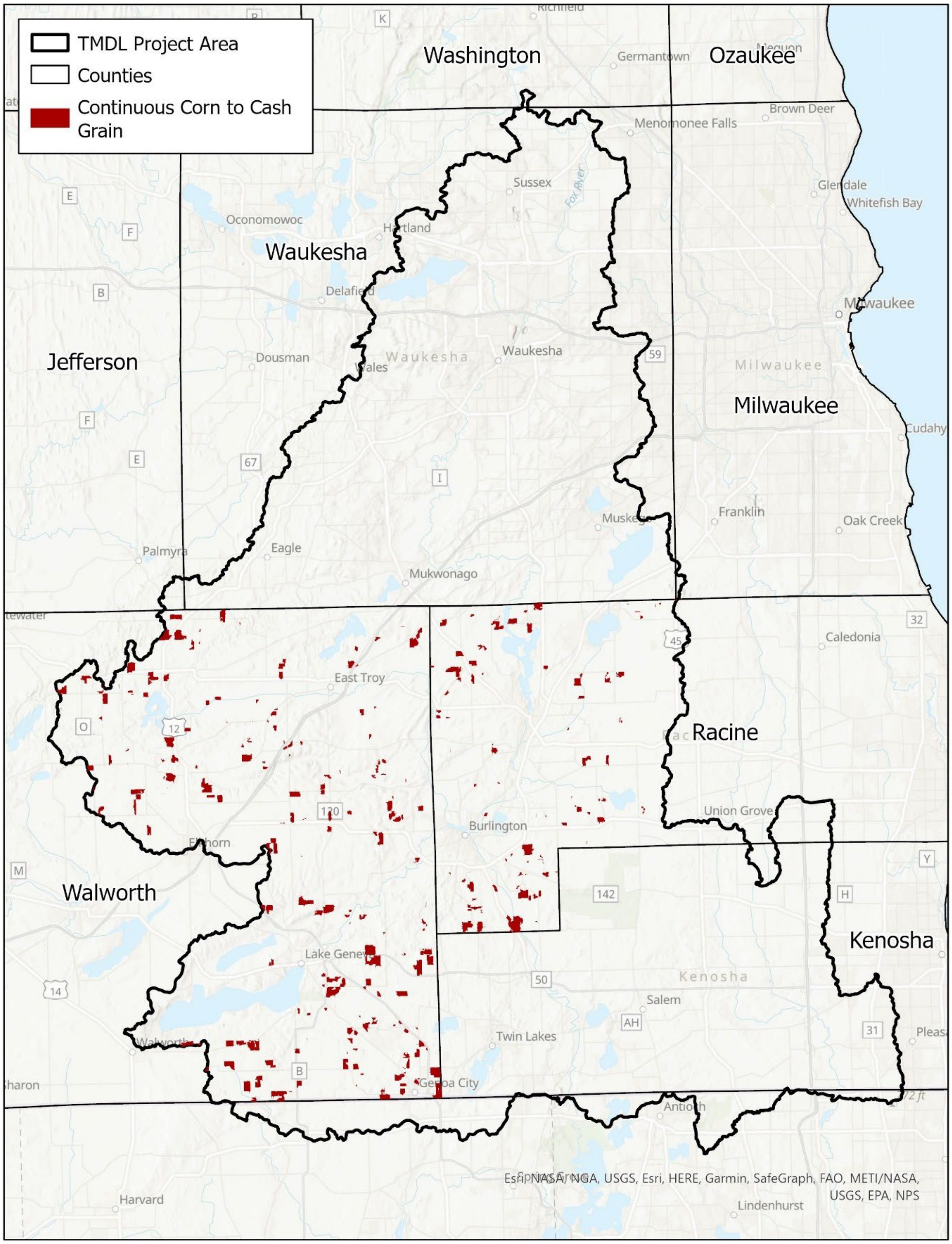


FIGURE B.8

Pasture Converted to Idle Grassland for Updated Land Cover

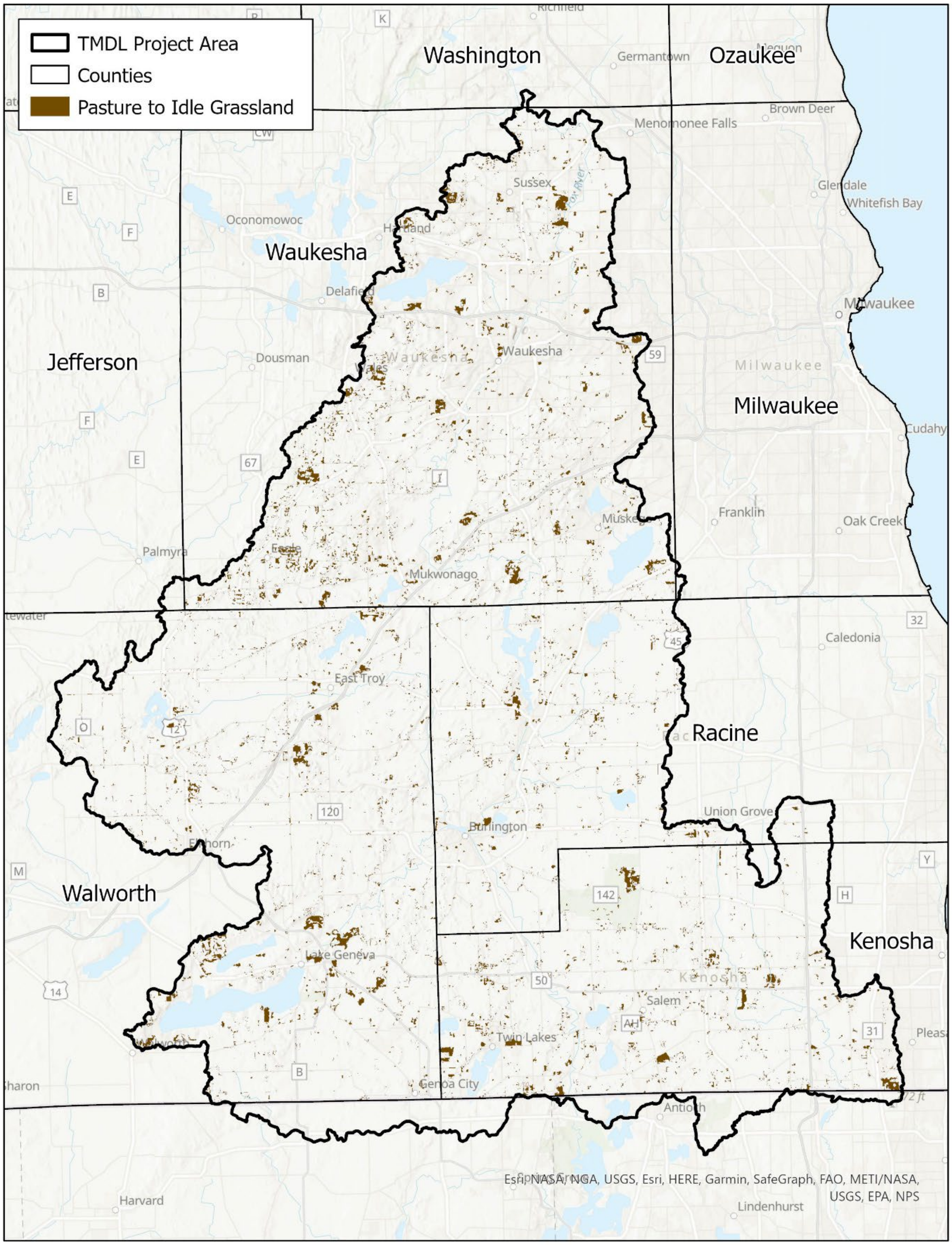
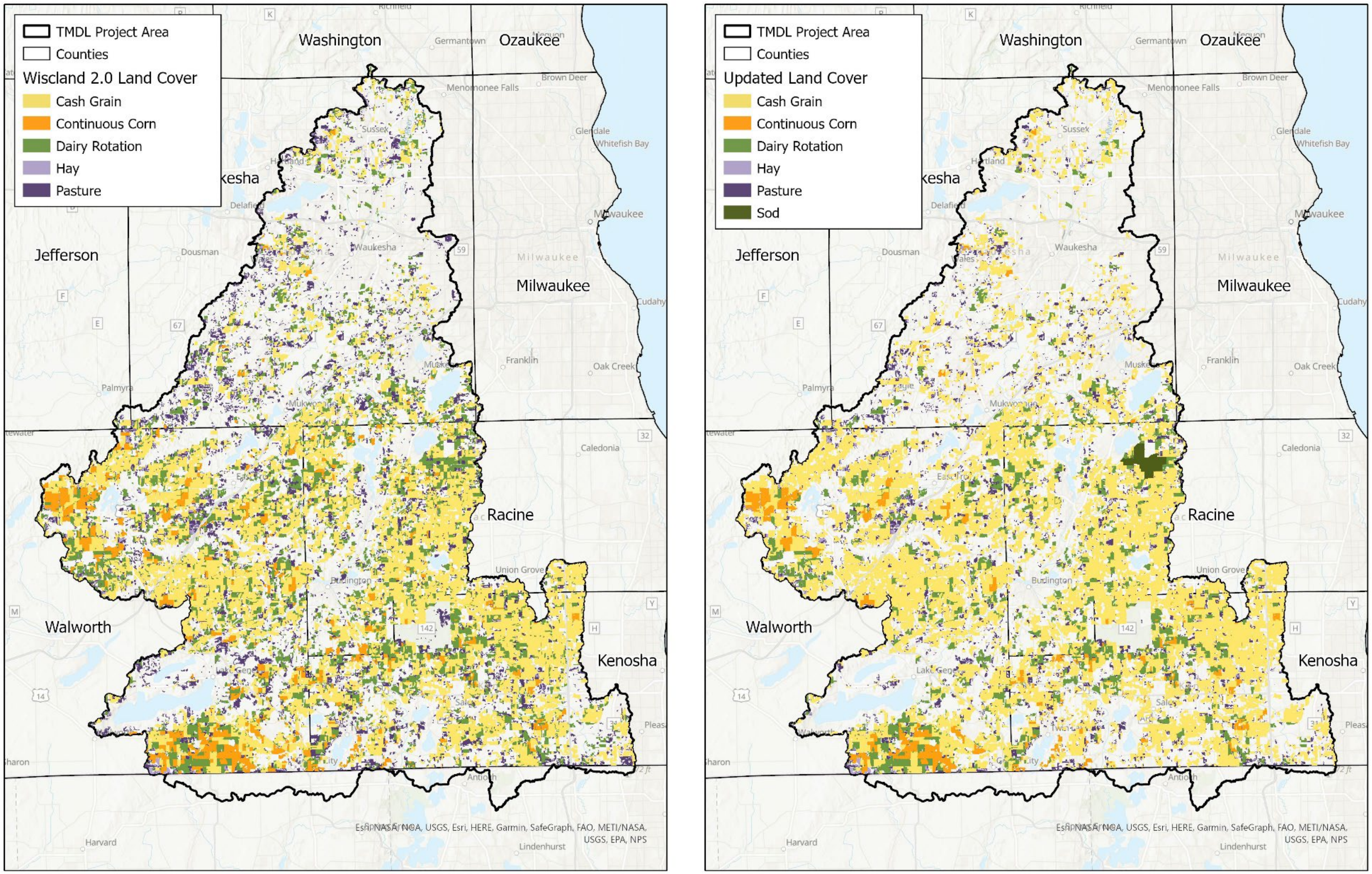


FIGURE B.9

Comparison of Wiscland 2.0 Land Cover and Updated Land Cover



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National Agricultural Statistics Service, 2017, Census of agriculture: Washington, D.C., United States Department of Agriculture – NASS, accessed at https://quickstats.nass.usda.gov/

Southeast Wisconsin Regional Planning Commission, 2010, Land use inventory: Waukesha, WI, accessed at https://geodata.wisc.edu/catalog/

Wisconsin Department of Natural Resources, 2016, Wiscland 2.0 Land Cover, Wisconsin 2016: Madison, WI, https://dnr.wisconsin.gov/maps/WISCLAND

APPENDIX C

IRRIGATION AND TILE DRAINAGE BY HUC 12

TABLE C.1

Tile Drainage and Irrigation for HUC 12s in Kenosha County

HUC 12	HUC 12 Name	Percent of fields with tile drainage	Percent of fields with irrigation
071200061002	Spring Brook-Fox River	50-75	0
071200061003	Palmer Creek-Fox River	50-75	0
071200060802	North Branch Nippersink Creek	50-75	0
071200040102	Kilbourn Road Ditch	50-75	<2
071200061005	Channel Lake	50-75	0
071200040103	Headwaters Des Plaines River	50-75	0
071200040201	North Mill Creek	50-75	0
071200061006	Bassett Creek-Fox River	50-75	0
071200061001	Hoosier Creek	50-75	0
071200040104	Jerome Creek-Des Plaines River	50-75	0
071200040101	Brighton Creek	50-75	0

TABLE C.2

Tile Drainage and Irrigation for HUC 12s in Racine County

HUC 12	HUC 12 Name	Percent of fields with tile drainage	Percent of fields with irrigation
071200061002	Spring Brook-Fox River	50	0
071200061003	Palmer Creek-Fox River	70	0
071200060604	White River	50	0
071200060704	Village of Big Bend-Fox River	50	0
071200040102	Kilbourn Road Ditch	80	0
071200060302	Muskego Lake	90	0
071200040103	Headwaters Des Plaines River	80	0
071200060705	Tichigan Lake-Fox River	50	10
071200060706	Eagle Creek	90	0
071200060304	Wind Lake Drainage Canal	70	30
071200060707	Long Lake-Fox River	70	0
071200060503	Honey Creek	50	0
071200060303	Goose Lake Branch Canal	70	30
071200061001	Hoosier Creek	90	0
071200040101	Brighton Creek	70	0

TABLE C.3

Tile Drainage and Irrigation for HUC 12s in Walworth County

HUC 12	HUC 12 Name	Percent of fields with tile drainage	Percent of fields with irrigation
071200060401	North Lake	0	1
071200060402	Silver Lake-Sugar Creek	5	0
071200060603	Ore Creek	10	0
071200060802	North Branch Nippersink Creek	20	0
071200060604	White River	10	0
071200060502	Spring Creek-Honey Creek	25	0
071200060903	Headwaters Nippersink Creek	30	0
071200060801	West Branch North Branch Nippersink Creek-North Branch Nippersink Creek	35	5
071200060602	Lake Geneva-White River	10	0
071200060403	Lake Wandawega-Sugar Creek	20	0
071200060601	Como Creek	20	0
071200060203	Mukwonago River	0	0
071200060503	Honey Creek	10	0
071200060202	Eagle Spring Lake	0	0
071200060501	Lauderdale Lakes-Honey Creek	30	5
071200060404	Sugar Creek	25	0

APPENDIX D

SOIL PHOSPHORUS BY HUC 12

TABLE D.1
Soil Phosphorus for HUC 12s in Kenosha County

HUC 12	HUC 12 Name	Average Soil P (parts per million)
071200061002	Spring Brook-Fox River	*
071200061003	Palmer Creek-Fox River	39
071200060802	North Branch Nippersink Creek	*
071200040102	Kilbourn Road Ditch	57
071200061005	Channel Lake	*
071200040103	Headwaters Des Plaines River	63
071200040201	North Mill Creek	45
071200061006	Bassett Creek-Fox River	*
071200061001	Hoosier Creek	*
071200040104	Jerome Creek-Des Plaines River	*
071200040101	Brighton Creek	34

*Note: * Indicates HUC 12s where an estimate is not available*

TABLE D.2
Soil Phosphorus for HUC 12s in Racine County

HUC 12	HUC 12 Name	Average Soil P (parts per million)
071200061002	Spring Brook-Fox River	60
071200061003	Palmer Creek-Fox River	60
071200060604	White River	30
071200060704	Village of Big Bend-Fox River	60
071200040102	Kilbourn Road Ditch	60
071200060302	Muskego Lake	30
071200040103	Headwaters Des Plaines River	30
071200060705	Tichigan Lake-Fox River	60
071200060706	Eagle Creek	60
071200060304	Wind Lake Drainage Canal	60
071200060707	Long Lake-Fox River	60
071200060503	Honey Creek	60
071200060303	Goose Lake Branch Canal	60
071200061001	Hoosier Creek	60
071200040101	Brighton Creek	30

TABLE D.3

Soil Phosphorus for HUC 12s in Walworth County

HUC 12	HUC 12 Name	Average Soil P (parts per million)
071200060401	North Lake	50
071200060402	Silver Lake-Sugar Creek	30
071200060603	Ore Creek	30
071200060802	North Branch Nippersink Creek	30
071200060604	White River	30
071200060502	Spring Creek-Honey Creek	30
071200060903	Headwaters Nippersink Creek	80
071200060801	West Branch North Branch Nippersink Creek-North Branch Nippersink Creek	70
071200060602	Lake Geneva-White River	35
071200060403	Lake Wandawega-Sugar Creek	35
071200060601	Como Creek	30
071200060203	Mukwonago River	25
071200060503	Honey Creek	35
071200060202	Eagle Spring Lake	30
071200060501	Lauderdale Lakes-Honey Creek	35
071200060404	Sugar Creek	35

APPENDIX E

DETAILED LAND COVER AND LAND MANAGEMENT CATEGORIES FOR SWAT MODELING

Dairy Sequence 1 - Till 1	Year 1 Spring	Year 1 Fall	Year 2 Spring	Year 2 Fall	Year 3 Spring	Year 3 Fall	Year 4 Spring	Year 4 Fall	Year 5 Spring	Year 5 Fall	Year 6 Spring	Year 6 Fall
Crop	Corn silage	Corn silage	Corn silage	Corn silage	Soybean	Winter wheat	Winter wheat	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa
Approx. Planting Date	15-May	-	15-May	-	25-May	15-Oct	-	22-Jul	-	-	-	-
Approx. Harvest Date	-	15-Sep	-	15-Sep	-	15-Oct	15-Jul	-	Four cuttings		Four cuttings	
Tillage	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow	None	Chisel plow	None	None	None	Chisel plow
Liquid manure applications	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	None	Liquid	None	None	None	None
Manure P (lb P2O5/ac)	37.5	37.5	37.5	37.5	37.5	37.5	-	37.5	-	-	-	-
Timing	Before till	Before till	Before till	Before till	Before till	Before till	-	Before till	-	-	-	-
Solid manure applications	None	None	None	Solid	None	None	None	Solid	None	None	None	Solid
Manure P (lb P2O5/ac)	-	-	-	75	-	-	-	75	-	-	-	75
Timing	-	-	-	After till	-	-	-	After till	-	-	-	After till
Other fertilizer application	None	None	None	None	None	None	None	None	None	None	None	None
Amount (lb P2O5/ac)	-	-	-	-	-	-	-	-	-	-	-	-
Timing	-	-	-	-	-	-	-	-	-	-	-	-

Dairy Sequence 1 - Till 2	Year 1 Spring	Year 1 Fall	Year 2 Spring	Year 2 Fall	Year 3 Spring	Year 3 Fall	Year 4 Spring	Year 4 Fall	Year 5 Spring	Year 5 Fall	Year 6 Spring	Year 6 Fall
Crop	Corn silage	Corn silage	Corn silage	Corn silage	Soybean	Winter wheat	Winter wheat	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa
Approx. Planting Date	15-May	-	15-May	-	25-May	15-Oct	-	22-Jul	-	-	-	-
Approx. Harvest Date	-	15-Sep	-	15-Sep	-	15-Oct	15-Jul	-	Four cuttings		Four cuttings	
Tillage	Cultivator	Vertical till	Cultivator	Vertical till	Cultivator	Vertical till	None	None	None	None	None	Vertical till
Liquid manure applications	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	None	Liquid	None	None	None	None
Manure P (lb P2O5/ac)	37.5	37.5	37.5	37.5	37.5	37.5	-	37.5	-	-	-	-
Timing	Before till	Before till	Before till	Before till	Before till	Before till	-	Before till	-	-	-	-
Solid manure applications	None	None	None	Solid	None	None	None	Solid	None	None	None	Solid
Manure P (lb P2O5/ac)	-	-	-	75	-	-	-	75	-	-	-	75
Timing	-	-	-	After till	-	-	-	After till	-	-	-	After till
Other fertilizer application	None	None	None	None	None	None	None	None	None	None	None	None
Amount (lb P2O5/ac)	-	-	-	-	-	-	-	-	-	-	-	-
Timing	-	-	-	-	-	-	-	-	-	-	-	-

Dairy Sequence 2 - Till 1	Year 1 Spring	Year 1 Fall	Year 2 Spring	Year 2 Fall	Year 3 Spring	Year 3 Fall	Year 4 Spring	Year 4 Fall	Year 5 Spring	Year 5 Fall	Year 6 Spring	Year 6 Fall
Crop	Corn silage	Corn silage	Corn silage	Corn silage	Corn silage	Corn silage	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa
Approx. Planting Date	15-May	-	15-May	-	15-May	-	20-May	-	20-May	-	20-May	-
Approx. Harvest Date	-	15-Sep	-	15-Sep	-	15-Sep	Four cuttings		Four cuttings		Four cuttings	
Tillage	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow	Cultivator, 2x	None	None	None	None	Chisel plow
Liquid manure applications	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	None	None	None	None	None
Manure P (lb P2O5/ac)	37.5	37.5	37.5	37.5	37.5	37.5	37.5	-	-	-	-	-
Timing	Before till	Before till	Before till	Before till	Before till	Before till	Before till	-	-	-	-	-
Solid manure applications	None	None	None	Solid	None	None	None	Solid	None	None	None	Solid
Manure P (lb P2O5/ac)	-	-	-	75	-	-	-	75	-	-	-	75
Timing	-	-	-	After till	-	-	-	After till	-	-	-	After till
Other fertilizer application	None	None	None	None	None	None	None	None	None	None	None	None
Amount (lb P2O5/ac)	-	-	-	-	-	-	-	-	-	-	-	-
Timing	-	-	-	-	-	-	-	-	-	-	-	-

Cash Grain Sequence 1 - Till 1	Year 1 Spring	Year 1 Fall	Year 2 Spring	Year 2 Fall	Year 3 Spring	Year 3 Fall	Year 4 Spring	Year 4 Fall	Year 5 Spring	Year 5 Fall	Year 6 Spring	Year 6 Fall
Crop	Corn grain	Corn grain	Soybean	Soybean	Corn grain	Corn grain	Soybean	Soybean	Corn grain	Corn grain	Soybean	Soybean
Approx. Planting Date	15-May	-	25-May	-	15-May	-	25-May	-	15-May	-	25-May	-
Approx. Harvest Date	-	1-Nov	-	15-Oct	-	1-Nov	-	15-Oct	-	1-Nov	-	15-Oct
Tillage	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow
Manure applications	None	None	None	None	None	None	None	None	None	None	None	None
Manure P (lb P2O5/ac)	-	-	-	-	-	-	-	-	-	-	-	-
Timing	-	-	-	-	-	-	-	-	-	-	-	-
Other fertilizer application	2x	None	2x	None	2x	None	2x	None	2x	None	2x	None
Amount (lb P2O5/ac)	35 (total)	-	35 (total)	-	35 (total)	-	35 (total)	-	35 (total)	-	35 (total)	-
Timing	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-

Cash Grain Sequence 1 - Till 3	Year 1 Spring	Year 1 Fall	Year 2 Spring	Year 2 Fall	Year 3 Spring	Year 3 Fall	Year 4 Spring	Year 4 Fall	Year 5 Spring	Year 5 Fall	Year 6 Spring	Year 6 Fall
Crop	Corn grain	Corn grain	Soybean	Soybean	Corn grain	Corn grain	Soybean	Soybean	Corn grain	Corn grain	Soybean	Soybean
Approx. Planting Date	7-May	-	25-May	-	7-May	-	25-May	-	7-May	-	25-May	-
Approx. Harvest Date	-	1-Nov	-	15-Oct	-	1-Nov	-	15-Oct	-	1-Nov	-	15-Oct
Tillage	Vertical	None	Vertical	None	Vertical	None	Vertical	None	Vertical	None	Vertical	None
Manure applications	None	None	None	None	None	None	None	None	None	None	None	None
Manure P (lb P2O5/ac)	-	-	-	-	-	-	-	-	-	-	-	-
Timing	-	-	-	-	-	-	-	-	-	-	-	-
Other fertilizer application	2x	None	2x	None	2x	None	2x	None	2x	None	2x	None
Amount (lb P2O5/ac)	35 (total)	-	35 (total)	-	35 (total)	-	35 (total)	-	35 (total)	-	35 (total)	-
Timing	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-

Cash Grain Sequence 1 - Till 4	Year 1 Spring	Year 1 Fall	Year 2 Spring	Year 2 Fall	Year 3 Spring	Year 3 Fall	Year 4 Spring	Year 4 Fall	Year 5 Spring	Year 5 Fall	Year 6 Spring	Year 6 Fall
Crop	Corn grain	Corn grain	Soybean	Soybean	Corn grain	Corn grain	Soybean	Soybean	Corn grain	Corn grain	Soybean	Soybean
Approx. Planting Date	7-May	-	25-May	-	7-May	-	25-May	-	7-May	-	25-May	-
Approx. Harvest Date	-	1-Nov	-	15-Oct	-	1-Nov	-	15-Oct	-	1-Nov	-	15-Oct
Tillage	None	Cultivator	None	Cultivator	None	Cultivator	None	Cultivator	None	Cultivator	None	Cultivator
Manure applications	None	None	None	None	None	None	None	None	None	None	None	None
Manure P (lb P2O5/ac)	-	-	-	-	-	-	-	-	-	-	-	-
Timing	-	-	-	-	-	-	-	-	-	-	-	-
Other fertilizer application	2x	None	2x	None	2x	None	2x	None	2x	None	2x	None
Amount (lb P2O5/ac)	35 (total)	-	35 (total)	-	35 (total)	-	35 (total)	-	35 (total)	-	35 (total)	-
Timing	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-

Cash Grain Sequence 1 - Till 5	Year 1 Spring	Year 1 Fall	Year 2 Spring	Year 2 Fall	Year 3 Spring	Year 3 Fall	Year 4 Spring	Year 4 Fall	Year 5 Spring	Year 5 Fall	Year 6 Spring	Year 6 Fall
Crop	Corn grain	Corn grain	Soybean	Soybean	Corn grain	Corn grain	Soybean	Soybean	Corn grain	Corn grain	Soybean	Soybean
Approx. Planting Date	7-May	-	25-May	-	7-May	-	25-May	-	7-May		25-May	-
Approx. Harvest Date	-	1-Nov	-	15-Oct	-	1-Nov	-	15-Oct	-	1-Nov	-	15-Oct
Tillage	Cultivator	Vertical	None	None	Cultivator	Vertical	None	None	Cultivator	Vertical	None	None
Manure applications	None	None	None	None	None	None	None	None	None	None	None	None
Manure P (lb P2O5/ac)	-	-	-	-	-	-	-	-	-	-	-	-
Timing	-	-	-	-	-	-	-	-	-	-	-	-
Other fertilizer application	2x	None	2x	None	2x	None	2x	None	2x	None	2x	None
Amount (lb P2O5/ac)	35 (total)	-	35 (total)	-	35 (total)	-	35 (total)	-	35 (total)	-	35 (total)	-
Timing	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-

Continuous Corn - Till 1	Year 1 Spring	Year 1 Fall	Year 2 Spring	Year 2 Fall	Year 3 Spring	Year 3 Fall	Year 4 Spring	Year 4 Fall	Year 5 Spring	Year 5 Fall	Year 6 Spring	Year 6 Fall
Crop	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain
Approx. Planting Date	7-May	-	7-May	-	7-May	-	7-May	-	7-May	-	7-May	-
Approx. Harvest Date	-	1-Nov	-	1-Nov	-	1-Nov	-	1-Nov	-	1-Nov	-	1-Nov
Tillage	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow	Cultivator, 2x	Chisel plow
Manure applications	None	None	None	None	None	None	None	None	None	None	None	None
Manure P (lb P2O5/ac)	-	-	-	-	-	-	-	-	-	-	-	-
Timing	-	-	-	-	-	-	-	-	-	-	-	-
Other fertilizer application	2x	None	2x	None	2x	None	2x	None	2x	None	2x	None
Amount (lb P2O5/ac)	45 (total)	-	45 (total)	-	45 (total)	-	45 (total)	-	45 (total)	-	45 (total)	-
Timing	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-

Continuous Corn - Till 2	Year 1 Spring	Year 1 Fall	Year 2 Spring	Year 2 Fall	Year 3 Spring	Year 3 Fall	Year 4 Spring	Year 4 Fall	Year 5 Spring	Year 5 Fall	Year 6 Spring	Year 6 Fall
Crop	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain
Approx. Planting Date	7-May	-	7-May	-	7-May	-	7-May	-	7-May	-	7-May	-
Approx. Harvest Date	-	1-Nov	-	1-Nov	-	1-Nov	-	1-Nov	-	1-Nov	-	1-Nov
Tillage	Cultivator	Vertical till	Cultivator	Vertical till	Cultivator	Vertical till	Cultivator	Vertical till	Cultivator	Vertical till	Cultivator	Vertical till
Manure applications	None	None	None	None	None	None	None	None	None	None	None	None
Manure P (lb P2O5/ac)	-	-	-	-	-	-	-	-	-	-	-	-
Timing	-	-	-	-	-	-	-	-	-	-	-	-
Other fertilizer application	2x	None	2x	None	2x	None	2x	None	2x	None	2x	None
Amount (lb P2O5/ac)	45 (total)	-	45 (total)	-	45 (total)	-	45 (total)	-	45 (total)	-	45 (total)	-
Timing	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-

Continuous Corn - Till 3	Year 1 Spring	Year 1 Fall	Year 2 Spring	Year 2 Fall	Year 3 Spring	Year 3 Fall	Year 4 Spring	Year 4 Fall	Year 5 Spring	Year 5 Fall	Year 6 Spring	Year 6 Fall
Crop	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain	Corn grain
Approx. Planting Date	7-May	-	7-May	-	7-May	-	7-May	-	7-May	-	7-May	-
Approx. Harvest Date	-	1-Nov	-	1-Nov	-	1-Nov	-	1-Nov	-	1-Nov	-	1-Nov
Tillage	Vertical	None	Vertical	None	Vertical	None	Vertical	None	Vertical	None	Vertical	None
Manure applications	None	None	None	None	None	None	None	None	None	None	None	None
Manure P (lb P2O5/ac)	-	-	-	-	-	-	-	-	-	-	-	-
Timing	-	-	-	-	-	-	-	-	-	-	-	-
Other fertilizer application	2x	None	2x	None	2x	None	2x	None	2x	None	2x	None
Amount (lb P2O5/ac)	45 (total)	-	45 (total)	-	45 (total)	-	45 (total)	-	45 (total)	-	45 (total)	-
Timing	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-	30-Apr, 30-Jun	-

Continuous Hay	Year 1 Spring	Year 1 Fall	Year 2 Spring	Year 2 Fall	Year 3 Spring	Year 3 Fall	Year 4 Spring	Year 4 Fall	Year 5 Spring	Year 5 Fall	Year 6 Spring	Year 6 Fall
Crop	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa	Alfalfa
Approx. Planting Date	20-May	-	-	-	-	-	20-May	-	-	-	-	-
Approx. Harvest Date	Four cuttings		Four cuttings		Four cuttings		Four cuttings		Four cuttings		Four cuttings	
Tillage	Cultivator, 2X	None	None	None	None	None	Cultivator, 2X	None	None	None	None	None
Manure applications	Liquid	None	None	None	None	None	Liquid	None	None	None	None	None
Manure P (lb P2O5/ac)	37.5	-	-	-	-	-	37.5	-	-	-	-	-
Timing	Before till	-	-	-	-	-	Before till	-	-	-	-	-
Other fertilizer application	None	None	None	None	None	None	None	None	None	None	None	None
Amount (lb P2O5/ac)	-	-	-	-	-	-	-	-	-	-	-	-
Timing	-	-	-	-	-	-	-	-	-	-	-	-

Sod	Year 1 Spring	Year 1 Fall	Year 2 Spring	Year 2 Fall	Year 3 Spring	Year 3 Fall	Year 4 Spring	Year 4 Fall	Year 5 Spring	Year 5 Fall	Year 6 Spring	Year 6 Fall
Crop	Sod	Sod	Sod	Sod	Sod	Sod	Sod	Sod	Sod	Sod	Sod	Sod
Approx. Planting Date	-	15-Oct	-	-	-	15-Oct	-	-	-	15-Oct	-	-
Approx. Harvest Date	-	-	-	-	20-May	-	-	-	20-May	-	-	-
Tillage	None	Cultivator, 2X	None	None	None	Cultivator, 2X	Cultivator, 2X	None	None	Cultivator, 2X	None	None
Manure applications	None	None	None	None	None	None	None	None	None	None	None	None
Manure P (lb P2O5/ac)	-	-	-	-	-	-	-	-	-	-	-	-
Timing	-	-	-	-	-	-	-	-	-	-	-	-
Other fertilizer application	None	1x	None	None	None	1x	None	None	None	1x	None	None
Amount (lb P2O5/ac)	-	45	-	-	-	45	-	-	-	45	-	-
Timing	-	1-Oct	-	-	-	1-Oct	-	-	-	1-Oct	-	-