

Permit Fact Sheet

General Information

Permit Number	WI-0021008-11-0
Permittee Name and Address	CITY OF COLUMBUS 105 North Dickason Boulevard, Columbus, WI 53925
Permitted Facility Name and Address	Columbus Wastewater Treatment Facility 537 RIVER ROAD, COLUMBUS, WISCONSIN (NWQ, NWQ, SEC 19, T10N, R13E, DODGE COUNTY)
Permit Term	October 01, 2026 to September 30, 2031
Discharge Location	West bank of Crawfish River, ½ mile downstream of Hwy 16/60 bridge. NW ¼ of NW ¼, Section 19, T10N R13E
Receiving Water	Crawfish River in Lower Crawfish River Watershed of Upper Rock River Basin in Dodge County
Stream Flow (Q _{7,10})	9.4 cfs
Stream Classification	Warm Water Sport Fish (WWSF), non-public water supply
Discharge Type	Existing, Continuous
Annual Average Design Flow (MGD)	1.26 MGD
Industrial or Commercial Contributors	Metalcraft of Mayville, EK Machine, Enerpac, G.D. Roberts and Co., Inc. and American Packaging Corp.
Plant Classification	A1 - Suspended Growth Processes; B - Solids Separation; C - Biological Solids/Sludges; P - Total Phosphorus; D - Disinfection; L - Laboratory; SS - Sanitary Sewage Collection System
Approved Pretreatment Program?	N/A

Facility Description

The City of Columbus operates a wastewater treatment plant that serves a population of approximately 5500 residents with multiple industrial contributors. Columbus also treats wastewater from the Elba Sanitary District and the Village of Fall River as satellite collection systems. The facility consists of activated sludge treatment preceded by primary screening and grit removal, followed by secondary clarifiers, tertiary sand filters, chlorine disinfection and dechlorination, and post aeration. Treated effluent is discharged via outfall 010 to the Crawfish River on a continuous basis at an average 1 MGD. Sludge that is produced is aerobically digested, thickened by belt press with polymer, and stored on-site as cake prior to land application on Department approved sites.

An approved blending system is in place to handle high influent flow conditions. When influent flows peak during high precipitation events, the portion of the flow rate in excess of 5 MGD is diverted into blending tanks, which are repurposed aeration basin tanks that are otherwise unused during normal operations. Blended flow receives grit removal, primary

clarification in the blending tank, and bypasses the aeration basins, final clarifiers, and tertiary filtration, recombining with fully treated effluent and receiving disinfection and cascade aeration prior to discharge to the Crawfish River.

An additional in-plant flow diversion defined as an Other Bypass occurs at the tertiary sand filtration unit during high flow conditions. When flow from the secondary clarifiers exceeds approximately 1.2 MGD, effluent from the secondary clarifiers will overflow a weir structure prior to the sand filters and be directed around the sand filters, recombining with tertiary treated effluent prior to disinfection, dichlorination, and post-aeration at the cascade steps prior to discharge at outfall 010. Effluent flow will be upgraded and more represented after completion of the flow meter upgrade to include a flow meter after disinfection.

Substantial Compliance Determination

Enforcement during previous permit term included a Notice of Noncompliance (NON) issued December 2024 regarding a sanitary sewer overflow (SSO) forcemain break in the Crawfish River and an NON issued August 2025 regarding effluent limit violations associated with blending that occurred in summer 2024.

After a desktop review of all discharge monitoring reports, compliance schedule items, and inspection site visits on 9/8/2023 and 8/17/2025, the facility has been found to be in substantial compliance with their current permit. Compliance determination made by Jordan Main on 8/17/2025.

Sample Point Descriptions

Sample Point Designation		
Sample Point Number	Discharge Flow, Units, and Averaging Period	Sample Point Location, Waste Type/Sample Contents and Treatment Description (as applicable)
701	0.99 MGD (August 2020 – December 2025 Average)	Influent: 24-Hr flow proportional composite sampler located after the Huber screen. Influent flow is measured by magnetic flow meter at the same location.
106	1.12 MGD (August 2020 – December 2025 Average when outfall was in use)	BLENDING: Sample point for reporting blended flow during high flow events. Blended flow volume and duration is measured by flow totalizer after diversion from the influent wet well. Wastewater flow bypasses the aeration basins, final clarifiers, and tertiary filtration and then receives disinfection prior to discharge. The permittee shall notify the Department when blending occurs. See “Blending” requirements in the Standard Requirements section of the permit.
107	N/A – New Sample Point	In-Plant Diversion OTHER BYPASS: Sample point for reporting flow which bypasses the tertiary sand filter prior to disinfection.
103		Field Blank: Collect the mercury field blank using standard sampling handling procedure.
010	0.95 MGD (August 2020 – December 2025 Average)	Effluent: 24-Hr flow proportional composite sampler located after disinfection. Grab samples collected at the cascade aeration steps prior to discharge to the Crawfish River.
008	201 Dry US Tons (2025 Permit Application)	Aerobically digested, belt filter press thickened, Cake, Class B. Representative sludge composite samples shall be collected from the storage building.
009	N/A – No liquid sludge distributed	Aerobically digested, Liquid, Class B. Representative composite

Sample Point Designation		
Sample Point Number	Discharge Flow, Units, and Averaging Period	Sample Point Location, Waste Type/Sample Contents and Treatment Description (as applicable)
		sample of the liquid sludge to be land applied shall be collected from land application vehicles. This outfall is included as a contingency outfall and sampling is only required if land application of liquid sludge will occur.

Permit Requirements

1 Influent – Monitoring Requirements

1.1 Sample Point Number: 701- INFLUENT

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Flow Rate		MGD	Daily	Continuous	
BOD5, Total		mg/L	3/Week	24-Hr Flow Prop Comp	
Suspended Solids, Total		mg/L	3/Week	24-Hr Flow Prop Comp	
Mercury, Total Recoverable		ng/L	Quarterly	Grab	See Mercury section.

1.1.1 Changes from Previous Permit:

Influent limitations and monitoring requirements were evaluated for this permit term and no changes were required in this permit section.

1.1.2 Explanation of Limits and Monitoring Requirements

Monitoring of influent flow, BOD5 and total suspended solids is required by s. NR 210.04(2), Wis. Adm. Code, to assess wastewater strengths and volumes and to demonstrate the percent removal requirements in s. NR 210.05, Wis. Adm. Code, and in the Standard Requirements section of the permit. Mercury influent sampling is required at the same sample frequency of effluent sampling along with the in-plant mercury blank.

2 In-plant - Monitoring and Limitations

2.1 Sample Point Number: 106- BLENDING

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Flow Rate		MGD	Per Occurrence	Continuous	

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Time		hours	Daily	Calculated	Report the total duration of blending within a given day (12:00am - 11:59pm) in which blending occurs. See Blending Flow permit section.

2.1.1 Changes from Previous Permit:

In-plant limitations and monitoring requirements were evaluated for this permit term and the following changes were made from the previous permit. See additional explanation of limits under “Explanation of Limits and Monitoring Requirements” below.

Flow Rate: Sample Frequency and Type have been updated to reflect the standard language for permittees with approved blending.

2.1.2 Explanation of Limits and Monitoring Requirements

Effluent monitoring during is required at outfall 010 as defined in the permit during blending operations. Effluent limits effective at 010 remain effective when blending occurs.

2.2 Sample Point Number: 107- OTHER BYPASS

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Flow Rate		MGD	Per Occurrence	Continuous	Monitoring and reporting to begin per the Other Bypass Reporting compliance schedule. Start flow measurement at the commencement of bypass operations. Report flow in daily increments until operation ends and report daily bypass flow on the eDMR. See “Other Bypass Requirements” permit section.

Time		Hours	Per Occurrence	Calculated	Monitoring and reporting to begin per the Other Bypass Reporting compliance schedule. Start flow measurement at the commencement of bypass operations. Report the total duration of 'Other Bypass' within a given day (12:00am – 11:59pm) in which the other bypass occurs. See "Other Bypass Requirements" permit section.
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2.2.1 Changes from Previous Permit:

This sample point was added to reflect the existence of an Other Bypass around the tertiary sand filters during wet weather events.

2.2.2 Explanation of Limits and Monitoring Requirements

Flow Rate and Time Monitoring: The physical bypass point diverting flow around the tertiary sand filters has existed since the original plant construction in 1984, including a physical weir structure at which flows exceeding the design capacity of the sand filters are diverted automatically. The permit is being updated to require reporting of Other Bypass in accordance with s. NR 205.07(1)(u)3, Wis. Adm. Code. A schedule is included to allow for operational review and potential addition of monitoring equipment or calculation with a design-based value to facilitate representative monitoring of volume and duration for Other Bypass flow.

2.3 Sample Point Number: 103- GENERAL PLANT

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Mercury, Total Recoverable		ng/L	Quarterly	Blank	See Mercury section.

2.3.1 Changes from Previous Permit:

In-plant limitations and monitoring requirements were evaluated for this permit term and no changes were required in this permit section.

2.3.2 Explanation of Limits and Monitoring Requirements

Mercury Field Blank- Monitoring is included in the permit pursuant to s. NR 106.145, Wis. Adm. Code. Field blanks must meet the requirements under s. NR 106.145(9) and (10), Wis. Adm. Code. The permittee shall collect a mercury field blank for each set of mercury samples (a set of samples may include a combination of influent, effluent or other samples all collected on the same day). Field blanks are required to verify a sample has not been contaminated during collection, transportation or analysis.

3 Surface Water - Monitoring and Limitations

3.1 Sample Point Number: 010- Effluent

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Flow Rate		MGD	Daily	Continuous	Monitoring required per the Effluent Flow Meter compliance schedule.
BOD5, Total	Weekly Avg	24 mg/L	3/Week	24-Hr Flow Prop Comp	November - April
BOD5, Total	Weekly Avg	12 mg/L	3/Week	24-Hr Flow Prop Comp	May - October
BOD5, Total	Monthly Avg	24 mg/L	3/Week	24-Hr Flow Prop Comp	November - April
BOD5, Total	Monthly Avg	12 mg/L	3/Week	24-Hr Flow Prop Comp	May - October
BOD5, Total	Weekly Avg	250 lbs/day	3/Week	Calculated	November - April
BOD5, Total	Weekly Avg	130 lbs/day	3/Week	Calculated	May - October
Suspended Solids, Total	Weekly Avg	24 mg/L	3/Week	24-Hr Flow Prop Comp	November - April
Suspended Solids, Total	Weekly Avg	12 mg/L	3/Week	24-Hr Flow Prop Comp	May - October
Suspended Solids, Total	Monthly Avg	24 mg/L	3/Week	24-Hr Flow Prop Comp	November - April
Suspended Solids, Total	Monthly Avg	12 mg/L	3/Week	24-Hr Flow Prop Comp	May - October
Suspended Solids, Total	Weekly Avg	167 lbs/day	3/Week	Calculated	November - April
Suspended Solids, Total	Weekly Avg	83.4 lbs/day	3/Week	Calculated	May - October
Suspended Solids, Total	Monthly Avg	168 lbs/day	3/Week	Calculated	January, March, May, July, August, October, and December
Suspended Solids, Total	Monthly Avg	191 lbs/day	3/Week	Calculated	February
Suspended Solids, Total	Monthly Avg	175 lbs/day	3/Week	Calculated	April, June, September, and November

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
pH Field	Daily Max	9.0 su	5/Week	Grab	
pH Field	Daily Min	6.0 su	5/Week	Grab	
Dissolved Oxygen	Daily Min	6.0 mg/L	5/Week	Grab	
Nitrogen, Ammonia (NH3-N) Total	Daily Max	11 mg/L	3/Week	24-Hr Flow Prop Comp	
Nitrogen, Ammonia (NH3-N) Total	Weekly Avg	9.0 mg/L	3/Week	24-Hr Flow Prop Comp	April
Nitrogen, Ammonia (NH3-N) Total	Weekly Avg	8.1 mg/L	3/Week	24-Hr Flow Prop Comp	May - September
Nitrogen, Ammonia (NH3-N) Total	Weekly Avg	11 mg/L	3/Week	24-Hr Flow Prop Comp	October - March
Nitrogen, Ammonia (NH3-N) Total	Monthly Avg	6.0 mg/L	3/Week	24-Hr Flow Prop Comp	April
Nitrogen, Ammonia (NH3-N) Total	Monthly Avg	6.4 mg/L	3/Week	24-Hr Flow Prop Comp	May - September
Nitrogen, Ammonia (NH3-N) Total	Monthly Avg	9.7 mg/L	3/Week	24-Hr Flow Prop Comp	October - March
E. coli	Geometric Mean - Monthly	126 #/100 ml	Weekly	Grab	Limit effective May - September.
E. coli	% Exceedance	10 Percent	Monthly	Calculated	Limit effective May - September. See the E. Coli Percent Limit section. Enter the result in the DMR on the last day of the month.
Chlorine, Total Residual	Daily Max	38 ug/L	5/Week	Grab	Limit effective May - September.
Chlorine, Total Residual	Monthly Avg	13 ug/L	5/Week	Grab	Limit effective May - September.
Chlorine, Total Residual	Weekly Avg	13 ug/L	5/Week	Grab	Limit effective May - September.
Chloride		mg/L	Monthly	24-Hr Flow Prop Comp	Monitoring in 2029 only.
Mercury, Total Recoverable		ng/L	Quarterly	Grab	See Mercury section.
PFOS		ng/L	1/ 2 Months	Grab	Monitoring only. See PFOS/PFOA Minimization

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
					Plan Determination of Need schedule.
PFOA		ng/L	1/ 2 Months	Grab	Monitoring only. See PFOS/PFOA Minimization Plan Determination of Need schedule.
Phosphorus, Total	Monthly Avg	1.0 mg/L	3/Week	24-Hr Flow Prop Comp	Effective upon reissuance and this limit will be retained beyond the effective date of the final limits as it represents a minimum control level.
Phosphorus, Total		lbs/day	3/Week	Calculated	Report daily mass discharged using Equation 1a. in the Water Quality Trading (WQT) section.
WQT Credits Used (TP)		lbs/month	Monthly	Calculated	Report WQT TP Credits used per month using Equation 2c. in the Water Quality Trading (WQT) section. Available TP Credits are specified in Table 2 and in the approved Water Quality Trading Plan.
WQT Computed Compliance (TP)	Monthly Avg	0.225 mg/L	Monthly	Calculated	Report the WQT TP Computed Compliance value using Equation 3a. in the Water Quality Trading (WQT) section. Value entered on the last day of the month.
WQT Computed Compliance (TP)	6-Month Avg	0.075 mg/L	Monthly	Calculated	Compliance with the six-month average limit is evaluated at the end of each six-month period on June 30 & Dec. 31
WQT Computed Compliance (TP)	6-Month Avg	0.79 lbs/day	Monthly	Calculated	Report the WQT TP Computed Compliance value using Equation 3b. in the Water Quality Trading (WQT) section. Compliance with the six-

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
					month average limit is evaluated at the end of the six-month period on June 30 and Dec 31.
WQT Credits Used (TP)	Annual Total	244 lbs/day	Monthly	Calculated	The sum of total monthly credits used may not exceed Table 2 values listed in the permit. 2026-2030.
WQT Credits Used (TP)	Annual Total	232.5 lbs/day	Monthly	Calculated	The sum of total monthly credits used may not exceed Table 2 values listed in the permit. 2031
Phosphorus, Total	Monthly Avg	12.81 lbs/day	3/Week	Calculated	January.
Phosphorus, Total	Monthly Avg	17.0 lbs/day	3/Week	Calculated	February
Phosphorus, Total	Monthly Avg	15.44 lbs/day	3/Week	Calculated	March
Phosphorus, Total	Monthly Avg	12.07 lbs/day	3/Week	Calculated	April
Phosphorus, Total	Monthly Avg	10.96 lbs/day	3/Week	Calculated	May
Phosphorus, Total	Monthly Avg	10.85 lbs/day	3/Week	Calculated	June
Phosphorus, Total	Monthly Avg	11.63 lbs/day	3/Week	Calculated	July
Phosphorus, Total	Monthly Avg	13.38 lbs/day	3/Week	Calculated	August
Phosphorus, Total	Monthly Avg	14.12 lbs/day	3/Week	Calculated	September
Phosphorus, Total	Monthly Avg	13.37 lbs/day	3/Week	Calculated	October
Phosphorus, Total	Monthly Avg	13.22 lbs/day	3/Week	Calculated	November
Phosphorus, Total	Monthly Avg	11.35 lbs/day	3/Week	Calculated	December
Temperature Maximum		deg F	Daily	Continuous	Monitoring in 2029 only.
Nitrogen, Total Kjeldahl		mg/L	Quarterly	24-Hr Flow Prop Comp	
Nitrogen, Nitrite + Nitrate Total		mg/L	Quarterly	24-Hr Flow Prop Comp	
Nitrogen, Total		mg/L	Quarterly	Calculated	Total Nitrogen shall be calculated as the sum of reported values for Total Kjeldahl Nitrogen and Total Nitrite + Nitrate Nitrogen.

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Acute WET		TUa	See Listed Qtr(s)	24-Hr Flow Prop Comp	See WET section.
Chronic WET	Monthly Avg	2.2 TUc	See Listed Qtr(s)	24-Hr Flow Prop Comp	See WET section.

3.1.1 Changes from Previous Permit

Effluent limitations and monitoring requirements were evaluated for this permit term and the following changes were made from the previous permit. See additional explanation of limits under “Explanation of Limits and Monitoring Requirements” below.

- **Flow Rate:** Effluent flow reporting for outfall 010 will be reported from the flow meter upstream of the tertiary sand filters until the completion of the included compliance schedule. After the compliance schedule is complete, following the installation of a representative effluent flow meter, the effluent flow at 010 will be reported from the new final effluent flow meter.
- **Ammonia-** Daily max limits updated. Weekly average limits in October to March updated.
- **Chlorine-** Sampling frequency for chlorine increased to 5/week the minimum standard frequency for chlorine.
- **Chloride-** Sampling year updated and sampling frequency reduced to monthly based on data from previous permit term.
- **PFOS and PFOA–** Monthly monitoring is included in the permit in accordance with s. NR 106.98(2)(b), Wis. Adm. Code.
- **TP-** TMDL Limits updated to reflect changes in TMDL allocations for Columbus, see WQBEL.
- **WQT-** Parameters and reporting requirements updated to meet the standard WQT permit reporting requirements.
- **Temperature-** Updated to daily and continuous to reflect that the permittee has a continuous temperature probe. Monitoring only required in 2029.

3.1.2 Explanation of Limits and Monitoring Requirements

Detailed discussions of limits and monitoring requirements can be found in the attached water quality-based effluent limits (WQBEL) memo dated 11/17/2025.

Monitoring Frequencies- The Monitoring Frequencies for Individual Wastewater Permits guidance (April 12, 2021) recommends that standard monitoring frequencies be included in individual wastewater permits based on the size and type of the facility, in order to characterize effluent quality and variability, to detect events of noncompliance, and to ensure consistency in permits issued across the state. Guidance and requirements in administrative code were considered when determining the appropriate monitoring frequencies for pollutants that have final effluent limits in effect during this permit term. Sampling frequency for chlorine was increased to 5/week, the minimum sampling frequency for permittees using chlorine because the permittee has a dosing protocol that allows reduced sampling from the standard of daily. Chloride sampling has been reduced to monthly because the data from the previous permit term shows the permittee only needs 11 sample points. Other parameters were evaluated and found to be at the appropriate sampling frequency.

***add why staying at the minimum

Effluent Flow Location: An In-line magnetic flow meter located immediately upstream of the tertiary sand filters was previously used to report the volume of fully treated effluent flow discharged to Outfall 010. A schedule has been

included for the installation of a final effluent flow meter to measure the fully treated, total effluent volume discharged to comply with s. NR 108.06(4)(b), Wis. Adm. Code.

PFOS and PFOA – NR 106 Subchapter VIII – Permit Requirements for PFOS and PFOA Dischargers became effective on August 1, 2022. At the first reissuance of a WPDES permit after August 1, 2022, the new rule requires WPDES permits for major municipal dischargers with an average flow rate greater than 1 MGD but less than 5 MGD, at a minimum sample effluent once every two-months for PFOS and PFOA pursuant s. NR 106.98(2)(b), Wis. Adm. Code.

A sample frequency of 1/2 months means one sample is taken during any two-month period. Examples of 1/2 month sample would be every other month (Jan, March, May, etc.) or back-to-back months with a break in between (February & March, May & June, Aug & Sept, etc.). DMR Short Forms will be generated for the following time periods: January-February, March-April, May-June, July-August, September-October, and November-December. At a minimum one sample result will be present on each form.

The initial determination of the need for sampling shall be conducted for up to two years in order to determine if the permitted discharge has the reasonable potential to cause or contribute to an exceedance of the PFOS or PFOA standards under s. NR 102.04(8)(d)1, Wis. Adm. Code.

TMDL - A total maximum daily load (TMDL) was developed for the Rock River Basin to determine the maximum amounts of phosphorus and sediment that can be discharged to protect and improve water quality. The Rock River Basin's TMDL was approved by the Environmental Protection Agency (EPA) on September 28, 2011. These final effluent limits were derived from and comply with the applicable water quality criterion and is consistent with the assumptions and requirements of the EPA-approved wasteload allocation (WLA) for the Rock River. The entire report can be found at: <https://dnr.wisconsin.gov/topic/TMDLs/RockRiver/index.html>. The proposed permit includes limitations and requirements necessary to implement the recommendations of the TMDL.

- **Suspended Solids, Total:** The TMDL mass limits are in addition to the concentration limit for suspended solids. The approved total suspended solids TMDL limits for this permittee are expressed as weekly average and monthly average effluent limits and were already effective during the previous permit term.
- **Phosphorus:** Wasteload allocations specified in TMDLs are expressed as WQBELs (water quality based effluent limits). The WLA-derived WQBELs are consistent with the assumptions and requirements of the approved Rock River TMDL. The approved total phosphorus TMDL limits for this permittee are expressed as monthly average effluent limits and were already effective during the previous permit term. These limits have been further reduced to account for point source credit generation pursuant to a water quality trading agreement with the Town of Beloit Wastewater Treatment Facility.

Phosphorus – Phosphorus requirements are based on the Phosphorus Rules that became effective December 1, 2010 as detailed in NR 102 Water Quality Standards and NR 217 Effluent Standards and Limitations for Phosphorus. Chapter NR 217 of the Wis. Adm. Code addresses point source dischargers of phosphorus to surface waters. Currently in NR 217 Wis. Adm. Code there are two methods used to determine if a phosphorus limit is needed: a technology based effluent limit (TBEL) and a water quality based effluent limit (WQBEL). Based on the size and classification of the stream, the water quality criteria for the Crawfish River is 0.075 mg/L. In this case, the WQBEL is 0.225 mg/L (monthly average), 0.075 mg/L & 0.79 lbs/day (6-month average). For the reasons explained in the April 30, 2012 paper entitled 'Justification for Use of Monthly, Growing Season and Annual Average Periods for Expression of WPDES Permit Limits for Phosphorus Discharges in Wisconsin', WDNR has determined that it is impracticable to express the phosphorus WQBEL for the permittee as a maximum daily, weekly or monthly value. The final effluent limit for phosphorus is expressed as a six-month average. It is also expressed as a monthly average equal to three times the derived WQBEL (which equates to 0.225 mg/L). This final effluent limit was derived from and complies with the applicable water quality criterion. A phosphorus concentration limit is necessary to prevent backsliding during the term of the permit. The MCL limit of 1.0 mg/L will be retained in the permit.

The wastewater treatment facility is not able to meet the WQBEL. This permit authorizes the use of trading as a tool to demonstrate compliance with the phosphorus WQBELs. This permit includes terms and conditions related to the Water Quality Trading Plan (WQT-2025-0021) or approved amendments thereof. The total 'WQT TP Credits' available are

designated in the approved WQT Plan. The WQT Plan proposes to utilize buffer strips and cover crops on agriculture fields, conservation cover, and a grassed waterway. The WQT Plan proposes the generation of 244 lbs/yr of phosphorus credits for the next five years.

Additional WQT subsections in the permit provide information on compliance determinations, annual reporting and re-opening of the permit.

4 Land Application - Monitoring and Limitations

Municipal Sludge Description						
Sample Point	Sludge Class (A or B)	Sludge Type (Liquid or Cake)	Pathogen Reduction Method	Vector Attraction Method	Reuse Option	Amount Reused/Disposed (Dry Tons/Year)
008	B	Cake	Aerobic Digestion	Fecal Coliform	Injection	201
009	B	Liquid	Aerobic Digestion	Fecal Coliform	Injection	n/a
Does sludge management demonstrate compliance? Yes						
Is additional sludge storage required? No						
Is Radium-226 present in the water supply at a level greater than 2 pCi/liter? No						
If yes, special monitoring and recycling conditions will be included in the permit to track any potential problems in landapplying sludge from this facility						
Is a priority pollutant scan required? No						
Priority pollutant scans are required once every 10 years at facilities with design flows between 5 MGD and 40 MGD, and once every 5 years if design flow is greater than 40 MGD.						

4.1 Sample Point Number: 008- SLUDGE

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Solids, Total		Percent	Annual	Composite	
Arsenic Dry Wt	Ceiling	75 mg/kg	Annual	Composite	
Arsenic Dry Wt	High Quality	41 mg/kg	Annual	Composite	
Cadmium Dry Wt	Ceiling	85 mg/kg	Annual	Composite	
Cadmium Dry Wt	High Quality	39 mg/kg	Annual	Composite	
Copper Dry Wt	Ceiling	4,300 mg/kg	Annual	Composite	

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Copper Dry Wt	High Quality	1,500 mg/kg	Annual	Composite	
Lead Dry Wt	Ceiling	840 mg/kg	Annual	Composite	
Lead Dry Wt	High Quality	300 mg/kg	Annual	Composite	
Mercury Dry Wt	Ceiling	57 mg/kg	Annual	Composite	
Mercury Dry Wt	High Quality	17 mg/kg	Annual	Composite	
Molybdenum Dry Wt	Ceiling	75 mg/kg	Annual	Composite	
Nickel Dry Wt	Ceiling	420 mg/kg	Annual	Composite	
Nickel Dry Wt	High Quality	420 mg/kg	Annual	Composite	
Selenium Dry Wt	Ceiling	100 mg/kg	Annual	Composite	
Selenium Dry Wt	High Quality	100 mg/kg	Annual	Composite	
Zinc Dry Wt	Ceiling	7,500 mg/kg	Annual	Composite	
Zinc Dry Wt	High Quality	2,800 mg/kg	Annual	Composite	
Nitrogen, Total Kjeldahl		Percent	Annual	Composite	
Nitrogen, Ammonium (NH ₄ -N) Total		Percent	Annual	Composite	
Phosphorus, Total		Percent	Annual	Composite	
Phosphorus, Water Extractable		% of Tot P	Annual	Composite	
Potassium, Total Recoverable		Percent	Annual	Composite	
PCB Total Dry Wt	Ceiling	50 mg/kg	Once	Composite	Once in 2027.
PCB Total Dry Wt	High Quality	10 mg/kg	Once	Composite	Once in 2027.
PFOA + PFOS		ug/kg	Annual	Calculated	Report the sum of PFOA and PFOS. See PFAS Permit Sections for more information.
PFAS Dry Wt			Annual	Grab	Perfluoroalkyl and Polyfluoroalkyl Substances based on updated DNR PFAS List. See PFAS Permit Sections for more information.

4.1.1 Changes from Previous Permit:

Sludge limitations and monitoring requirements were evaluated for this permit term and the following changes were made from the previous permit. See additional explanation of limits under “Explanation of Limits and Monitoring Requirements” below.

PCB – Sampling year updated

PFAS –Monitoring is required annually pursuant to s. NR 204.06(2)(b)9, Wis. Adm. Code.

4.1.2 Explanation of Limits and Monitoring Requirements

Requirements for disposal, including land application of municipal sludge, are determined in accordance with ch. NR 204, Wis. Adm. Code. Ceiling and high-quality limits for metals in sludge are specified in s. NR 204.07(5), Wis. Adm. Code. Requirements for pathogens are specified in s. NR 204.07(6) and in s. NR 204.07 (7), Wis. Adm. Code for vector attraction requirements. Limitations for PCBs are addressed in s. NR 204.07(3)(k), Wis. Adm. Code.

PFAS- The presence and fate of PFAS in municipal and industrial sludges is an emerging public health concern. EPA has developed a draft risk assessment to determine future land application rates and released this risk assessment in January of 2025. The department is evaluating this new information. Until a decision is made, the “Interim Strategy for Land Application of Biosolids and Industrial Sludges Containing PFAS” should be followed

Collecting sludge data on PFAS concentrations from a wide range of wastewater treatment facilities will help protect public health from exposure to elevated levels of PFAS and determine the department’s implementation of EPA’s recommendations. To quantitate this risk, PFAS sampling has been included in this WPDES permit pursuant to ss. NR 214.18(5)(b) and NR 204.06(2)(b)9, Wis. Adm. Code.

4.2 Sample Point Number: 009- Liquid Sludge

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Solids, Total		Percent	Annual	Composite	
Arsenic Dry Wt	Ceiling	75 mg/kg	Annual	Composite	
Arsenic Dry Wt	High Quality	41 mg/kg	Annual	Composite	
Cadmium Dry Wt	Ceiling	85 mg/kg	Annual	Composite	
Cadmium Dry Wt	High Quality	39 mg/kg	Annual	Composite	
Copper Dry Wt	Ceiling	4,300 mg/kg	Annual	Composite	
Copper Dry Wt	High Quality	1,500 mg/kg	Annual	Composite	
Lead Dry Wt	Ceiling	840 mg/kg	Annual	Composite	
Lead Dry Wt	High Quality	300 mg/kg	Annual	Composite	
Mercury Dry Wt	Ceiling	57 mg/kg	Annual	Composite	
Mercury Dry Wt	High Quality	17 mg/kg	Annual	Composite	
Molybdenum Dry Wt	Ceiling	75 mg/kg	Annual	Composite	
Nickel Dry Wt	Ceiling	420 mg/kg	Annual	Composite	
Nickel Dry Wt	High Quality	420 mg/kg	Annual	Composite	

Monitoring Requirements and Limitations					
Parameter	Limit Type	Limit and Units	Sample Frequency	Sample Type	Notes
Selenium Dry Wt	Ceiling	100 mg/kg	Annual	Composite	
Selenium Dry Wt	High Quality	100 mg/kg	Annual	Composite	
Zinc Dry Wt	Ceiling	7,500 mg/kg	Annual	Composite	
Zinc Dry Wt	High Quality	2,800 mg/kg	Annual	Composite	
Nitrogen, Total Kjeldahl		Percent	Annual	Composite	
Nitrogen, Ammonium (NH ₄ -N) Total		Percent	Annual	Composite	
Phosphorus, Total		Percent	Annual	Composite	
Phosphorus, Water Extractable		% of Tot P	Annual	Composite	
Potassium, Total Recoverable		Percent	Annual	Composite	
PCB Total Dry Wt	Ceiling	50 mg/kg	Once	Composite	Once in 2027.
PCB Total Dry Wt	High Quality	10 mg/kg	Once	Composite	Once in 2027.
PFOA + PFOS		ug/kg	Annual	Calculated	Report the sum of PFOA and PFOS. See PFAS Permit Sections for more information.
PFAS Dry Wt			Annual	Grab	Perfluoroalkyl and Polyfluoroalkyl Substances based on updated DNR PFAS List. See PFAS Permit Sections for more information.

4.2.1 Changes from Previous Permit:

Sludge limitations and monitoring requirements were evaluated for this permit term and the following changes were made from the previous permit. See additional explanation of limits under “Explanation of Limits and Monitoring Requirements” below.

Sampling outfall added to allow for distribution or land application of liquid sludge as a contingency, if normal operations do not allow the production of cake sludge and distribution from Outfall 008.

PFAS –Monitoring is required annually pursuant to s. NR 204.06(2)(b)9, Wis. Adm. Code.

4.2.2 Explanation of Limits and Monitoring Requirements

Requirements for disposal, including land application of municipal sludge, are determined in accordance with ch. NR 204, Wis. Adm. Code. Ceiling and high-quality limits for metals in sludge are specified in s. NR 204.07(5), Wis. Adm. Code.

Requirements for pathogens are specified in s. NR 204.07(6) and in s. NR 204.07 (7), Wis. Adm. Code for vector attraction requirements. Limitations for PCBs are addressed in s. NR 204.07(3)(k), Wis. Adm. Code.

PFAS- The presence and fate of PFAS in municipal and industrial sludges is an emerging public health concern. EPA has developed a draft risk assessment to determine future land application rates and released this risk assessment in January of 2025. The department is evaluating this new information. Until a decision is made, the “Interim Strategy for Land Application of Biosolids and Industrial Sludges Containing PFAS” should be followed

Collecting sludge data on PFAS concentrations from a wide range of wastewater treatment facilities will help protect public health from exposure to elevated levels of PFAS and determine the department’s implementation of EPA’s recommendations. To quantitate this risk, PFAS sampling has been included in this WPDES permit pursuant to ss. NR 214.18(5)(b) and NR 204.06(2)(b)9, Wis. Adm. Code.

5 Schedules

5.1 Effluent Flow Meter

Required Action	Due Date
Submit Progress Report: Conduct a facility review and submit a progress report in preparation to install a representative final effluent flow meter capturing the total daily discharged volume on a continuous basis, including blended, bypassed, and recirculated flows prior to discharge to the receiving body.	12/31/2026
Submit Plans and Specifications: Submit plans and specifications for Department approval of a representative final effluent flow meter capturing the total daily discharged volume on a continuous basis, including blended, bypassed, and recirculated flows prior to discharge to the receiving body. Upon reissuance and until the Achieve Compliance date, the existing flow meter upstream of the tertiary sand filters will be used for eDMR reporting of Flow Rate as required in table 3.1 of the permit.	06/30/2027
Complete Installation: Complete installation of the approved flow meter.	06/30/2028
Achieve Compliance: The permittee shall begin monitoring and reporting Flow Rate for Sample Point 010 – Effluent on eDMRs as required in table 3.1 of the permit using the approved final effluent flow meter.	07/01/2028

5.1.1 Explanation of Schedule

A schedule has been included to provide time for plan submittal, review, and approval of a final effluent flow meter to comply with s. NR 108.06(4)(b), Wis. Adm. Code. Until schedule completion and installation of a representative final effluent flow meter, the flow meter located upstream of the tertiary sand filters (historically used to report effluent flow in previous permit terms) will continue to be used for eDMR reporting at Outfall 010.

5.2 Other Bypass Volume and Duration

Required Action	Due Date
Action Plan: Submit an action plan for review and approval to monitor the duration and volume of wastewater routed around the tertiary treatment process. Actions may include installation of additional monitoring equipment, flow measurement, or propose a representative calculation based on design values. If construction to the existing treatment plant or additional monitoring equipment is necessary, the permittee shall submit plans and specifications for Department approval prior to initiating	12/31/2026

construction.	
Initiate Actions: Initiate identified actions as approved.	06/30/2027
Complete Actions: Complete identified actions as approved.	12/31/2027
Achieve Compliance: The permittee shall begin monitoring and reporting Volume and Time for Sample Point 107 – Other Bypass on eDMRs using the approved method.	01/01/2028

5.2.1 Explanation of Schedule

A schedule has been included to provide time for operational review, proposal, and department approval of a representative monitoring or calculation method for the duration and volume of wastewater routed around the tertiary treatment process for Outfall 107 - Other Bypass.

5.3 Annual Water Quality Trading Report

As specified in the Permit, the permittee shall submit annual water quality trading reports in accordance with the following schedule.

Required Action	Due Date
Submit Annual WQT Report: Submit an annual WQT report that shall cover the previous year. The WQT Report shall include: The number of pollutant reduction credits (lbs/month) used each month of the previous year to demonstrate compliance; The source of each month's pollutant reduction credits by identifying the approved water quality trading plan that details the source; Results of the annual inspection of each nonpoint source management practice that generated any of the pollutant reduction credits used during the previous year; and Identification of noncompliance or failure to implement any terms or conditions of this permit with respect to water quality trading that have not been reported in discharge monitoring reports.	01/31/2027
Annual WQT Report #2: Submit an annual WQT report that shall cover the previous year.	01/31/2028
Annual WQT Report #3: Submit an annual WQT report that shall cover the previous year.	01/31/2029
Annual WQT Report #4: Submit an annual WQT report that shall cover the previous year.	01/31/2030
Annual WQT Report #5: Submit the 4th annual WQT report. If the permittee wishes to continue to comply with phosphorus limits through WQT in subsequent permit terms, the permittee shall submit a revised WQT plan including a demonstration of credit need, compliance record of the existing WQT, and any additional practices needed to maintain compliance over time.	01/31/2031
Annual WQT Report Required After Permit Expiration: In the event that this permit is not reissued by the expiration date, the permittee shall continue to submit annual WQT reports by January 31 each year covering the total number of pollutant credits used, the source of the pollution reduction credits, a summary of annual inspection reports performed, and identification of noncompliance or failure to implement any terms or conditions of the approved water quality trading plan for the previous calendar year.	

5.3.1 Explanation of Schedule

Reports are required that include the following information:

- Verification that site inspections occurred;
- Results of site inspection findings;
- Identification of noncompliance or failure to implement any terms or conditions of the permit or trading plan that have not been reported in discharge monitoring reports;
- Any applicable notices of termination or management practice registration; and
- A summary of credits used each month over the calendar year.

5.4 PFOS/PFOA Minimization Plan Determination of Need

Required Action	Due Date
Report on Effluent Discharge: Submit a report on effluent PFOS and PFOA concentrations and include an analysis of trends in monthly and annual average PFOS and PFOA concentrations. This analysis should also include a comparison to the applicable narrative standard in s. NR 102.04(8)(d), Wis. Adm. Code. This report shall include all additional PFOS and PFOA data that may be collected including any influent, intake, in-plant, collection system sampling, and blank sample results.	7/1/2027
Report on Effluent Discharge and Evaluation of Need: Submit a final report on effluent PFOS and PFOA concentrations and include an analysis of trends in monthly and annual average PFOS and PFOA concentrations of data collected over the last 24 months. The report shall also provide a comparison on the likelihood of the facility needing to develop a PFOS/PFOA minimization plan. This report shall include all additional PFOS and PFOA data that may be collected including any influent, intake, in-plant, collection system sampling, and blank sample results. The permittee shall also submit a request to the department to evaluate the need for a PFOS/PFOA minimization plan. If the department determines a PFOS/PFOA minimization plan is needed based on a reasonable potential evaluation, the permittee will be required to develop a minimization plan for department approval no later than 90 days after written notification was sent from the department. The department will modify or revoke and reissue the permit to include PFOS/PFOA minimization plan reporting requirements along with a schedule of compliance to meet WQBELs. Effluent monitoring of PFOS and PFOA shall continue as specified in the permit until the modified permit is issued. If, however, the department determines there is no reasonable potential for the facility to discharge PFOS or PFOA above the narrative standard in s. NR 102.04(8)(d), Wis. Adm. Code, no further action is required and effluent monitoring of PFOS and PFOA shall continue as specified in the permit.	7/1/2028

5.4.1 Explanation of Schedule

As stated above, NR 106 Subchapter VIII – Permit Requirements for PFOS and PFOA Dischargers became effective on August 1, 2022. S. NR 106.98, Wis. Adm. Code, specifies steps to generate data in order to determine the need for reducing PFOS and PFOA in the discharge. Data generated per the effluent monitoring requirements will be used to determine the need for developing a PFOS/PFOA minimization plan. As part of the schedule, the permittee is required to submit two annual Reports on Effluent Discharge.

If the department determines that a minimization plan is needed, the permit will be modified or revoked/reissued to include additional requirements.

5.5 Land Application Management Plan

A management plan is required for the land application system.

Required Action	Due Date
Land Application Management Plan Submittal: Submit an update to the management plan to optimize the land application system performance and demonstrate compliance with ch. NR 204, Wis. Adm. Code, by the Due Date. This management plan shall 1) specify information on pretreatment processes (if any); 2) identify land application sites; 3) describe site limitations; 4) address vegetative cover management and removal; 5) specify availability of storage; 6) describe the type of transporting and spreading vehicle(s); 7) specify monitoring procedures; 8) track site loading; 9) address contingency plans for adverse weather and odor/nuisance abatement; and 10) include any other pertinent information. Once approved, all landspreading activities shall be conducted in accordance with the plan. Any changes to the plan must be approved by the Department prior to implementing the changes.	12/31/2028

5.5.1 Explanation of Schedule

An up-to-date Land Application Management Plan is required that documents how the permittee will manage the land application of biosolids consistent with ch. NR 204, Wis. Adm. Code.

Other Comments

None

Attachments

Water Quality Based Effluent Limits dated 11/17/2025

Water Quality Trading Plan Approval Letter dated 11/10/2025

Water Quality Trading Plan dated 10/31/2025

Justification of Any Waivers From Permit Application Requirements

No waivers requested or granted as part of this permit reissuance.

Prepared By:

Jennifer Jerich, Wastewater Specialist

Date: 5/20/2026

Date amended post Fact Check:

Date amended post Public Notice:

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: 11/17/2025

TO: Jennifer Jerich – SCR

FROM: Nicole Krueger – SER *Nicole Krueger*

SUBJECT: Water Quality-Based Effluent Limitations for the Columbus Wastewater Treatment Facility
WPDES Permit No. WI-0021008-10

This is in response to your request for an evaluation of the need for water quality-based effluent limitations (WQBELs) using chapters NR 102, 104, 105, 106, 207, 210, 212, and 217 of the Wisconsin Administrative Code (where applicable) for the discharge from the Columbus Wastewater Treatment Facility in Dodge County. This municipal wastewater treatment facility (WWTF) discharges to Crawfish River, located in the Lower Crawfish River Watershed in the Upper Rock River Basin. This discharge is included in the Rock River Total Maximum Daily Load (TMDL) as approved by EPA on 09/28/2011. The evaluation of the permit recommendations is discussed in more detail in the attached report.

Based on our review, the following recommendations are made on a chemical-specific basis at Outfall 010:

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Six-Month Average	Footnotes
Flow Rate						1,2
BOD ₅ May – October November – April			12 mg/L 130 lbs/day 24 mg/L 250 lbs/day	12 mg/L 24 mg/L		1,3
TSS May – October November – April TMDL			12 mg/L 24 mg/L See Table	12 mg/L 24 mg/L See Table		1,3,4
pH	9.0 s.u.	6.0 s.u.				1
Dissolved Oxygen		6.0 mg/L				1
Ammonia Nitrogen April May – September October – March	11 mg/L 11 mg/L 11 mg/L		9.0 mg/L 8.1 mg/L 11 mg/L	6.0 mg/L 6.4 mg/L 9.7 mg/L		3
<i>E. coli</i> May – September				126#/100 mL geometric mean		1,5
Residual Chlorine	38 µg/L		13 µg/L	13 µg/L		1,3
Chloride						1,6
Mercury						1,2
PFOS and PFOA						7
Phosphorus TBEL s. NR 217.13 WQBEL TMDL				1.0 mg/L 0.225 mg/L See Table	0.075 mg/L 0.79 lbs/day	4,8
Temperature						1,2

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Six-Month Average	Footnotes
TKN, Nitrite+Nitrate, and Total Nitrogen						9
Acute WET						10,11
Chronic WET				2.2 TUc		10,11

Footnotes:

1. No changes from the current permit.
2. Monitoring only.
3. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Codes, are included in bold.
4. Additional phosphorus and TSS mass limitations are required in accordance with the waste load allocations specified in the Rock River TMDL.

Month	TSS Weekly Average Limit lbs/day	TSS Monthly Average Limit lbs/day	TP Monthly Average Limit lbs/day
January	167	168	12.81
February	167	191	17.00
March	167	168	15.44
April	167	175	12.07
May	83.4	168	10.96
June	83.4	175	10.85
July	83.4	168	11.63
August	83.4	168	13.38
September	83.4	175	14.12
October	83.4	168	13.37
November	167	175	13.22
December	167	168	11.35

5. Additional limit: No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 count/100 mL.
6. Monitoring at a frequency to ensure that 11 samples are available at the next permit issuance.
7. PFOS and PFOA monitoring is recommended at a frequency of once every two months in accordance with s. NR 106.98(2), Wis. Adm. Code.
8. Columbus is complying with the s. NR 217.13, Wis. Adm. Code phosphorus limits through water quality trading. The monthly average phosphorus limit is a technology-based limit which acts as an end of pipe minimum control level (MCL).
9. As recommended in the Department's October 1, 2019, Guidance for Total Nitrogen Monitoring in Wastewater Permits, quarterly total nitrogen monitoring is recommended for all municipal major permittees. Sections 283.37(5) and 283.55(1)(e), Wis. Stats, and ss. NR 200.065(1)(g) and NR 200.065(1)(h), Wis. Adm. Codes, provide the authority to request this monitoring during the permit term. Total Nitrogen is the sum of nitrate (NO₃), nitrite (NO₂), and total Kjeldahl nitrogen (TKN) (all expressed as N).
10. Annual acute and chronic WET testing is recommended. The Instream Waste Concentration (IWC) to assess chronic test results is 45%. According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), chronic testing shall be performed using a dilution series of 100%, 75%, 50%, 25% & 12.5%. The primary control water used in chronic WET tests conducted on Outfall 010 shall be a grab sample collected from the Crawfish River.

11. Sampling WET concurrently with any chemical-specific toxic substances is recommended. Tests should be done in rotating quarters, to collect seasonal information about this discharge. Testing should continue after the permit expiration date (until the permit is reissued).

Please consult the attached report for details regarding the above recommendations. If there are any questions or comments, please contact Nicole Krueger at Nicole.Krueger@wisconsin.gov or Diane Figiel at Diane.Figiel@wisconsin.gov.

Attachments (3) – Narrative, Thermal Table, & Map

E-cc: Jordan Main, Wastewater Engineer – SCR/Fitchburg
Lisa Creegan, Regional Wastewater Supervisor – SCR/Fitchburg
Diane Figiel, Water Resources Engineer – WY/3
Nate Willis, Wastewater Engineer – WY/3

Attachment #1
**Water Quality-Based Effluent Limitations for
The Columbus Wastewater Treatment Facility**

WPDES Permit No. WI-0021008-10

Prepared by: Nicole Krueger

PART 1 – BACKGROUND INFORMATION

Facility Description

The City of Columbus operates a wastewater treatment plant that serves a population of approximately 5000 residents with 5 industrial contributors. Columbus also treats wastewater from the Elba Sanitary District and the Village of Fall River. The facility is an activated sludge treatment preceded by primary screening and grit removal. Secondary clarifiers are followed by tertiary filtration, disinfection, dechlorination, and post aeration. A diversion and blending system are in place to handle high flow conditions. Treated effluent is discharged via Outfall 010 to the Crawfish River at an annual average design flow of 1.26 MGD. Sludge that is produced is stored on-site prior to land application on Department approved sites.

Attachment #2 is a map of the area showing the approximate location of Outfall 010.

Existing Permit Limitations

The current permit, which expired on June 30, 2025, includes the following effluent limitations and monitoring requirements.

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Six-Month Average	Footnotes
Flow Rate						1
BOD ₅ May – October November – April			12 mg/L 130 lbs/day 24 mg/L 250 lbs/day	12 mg/L 24 mg/L		2,3
TSS May – October November – April TMDL			12 mg/L 24 mg/L See Table	12 mg/L 24 mg/L See Table		3,4
pH	9.0 s.u.	6.0 s.u.				2
Dissolved Oxygen		6.0 mg/L				2
Ammonia Nitrogen April May – September October – March	17 mg/L 17 mg/L 17 mg/L		9.0 mg/L 8.1 mg/L 15 mg/L	6.0 mg/L 6.4 mg/L 9.7 mg/L		
<i>E. coli</i> May – September				126#/100 mL geometric mean		5
Residual Chlorine	38 µg/L		13 µg/L	13 µg/L		3
Phosphorus TBEL				1.0 mg/L		4

Attachment #1

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Six-Month Average	Footnotes
s. NR 217.13 WQBEL TMDL				0.225 mg/L See Table	0.075 mg/L	
Mercury						1
TKN, Nitrite+Nitrate, and Total Nitrogen						1
Chloride						1
Temperature						1
Acute WET						6
Chronic WET				2.2 TUc		6

Footnotes:

1. Monitoring only.
2. These limitations are not being evaluated as part of this review. Because the water quality criteria (WQC), reference effluent flow rates, and receiving water characteristics have not changed, limitations for these water quality characteristics do not need to be re-evaluated at this time.
3. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Codes, are included in bold.
4. Additional phosphorus and TSS mass limitations are required in accordance with the waste load allocations specified in the Rock River TMDL.

Month	TSS Weekly Average Limit lbs/day	TSS Monthly Average Limit lbs/day	TP Monthly Average Limit lbs/day
January	167	168	12.54
February	167	191	16.72
March	167	168	15.16
April	167	175	11.8
May	83.4	168	10.69
June	83.4	175	10.57
July	83.4	168	11.35
August	83.4	168	13.1
September	83.4	175	13.84
October	83.4	168	13.09
November	167	175	12.94
December	167	168	11.07

5. Additional final limit: No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 count/100 mL.
6. Annual acute and chronic WET testing is required in the current permit. The IWC for chronic WET was 45%.

Receiving Water Information

- Name: Crawfish River
- Waterbody Identification Code (WBIC): 829700
- Classification used in accordance with chs. NR 102 and 104, Wis. Adm. Code: Warm Water Sport Fish (WWSF) community, non-public water supply and recreational use.

Attachment #1

- Low flows used in accordance with chs. NR 106 and 217, Wis. Adm. Code: The following 7-Q₁₀ and 7-Q₂ values are from USGS Station at Highway 16 Bridge, where Outfall 010 is located. These flows were provided to the Department in July 2019.

7-Q₁₀ = 9.4 cubic feet per second (cfs)

7-Q₂ = 19.0 cfs

90-Q₁₀ = 16.2 cfs

Harmonic Mean Flow = 36.4 cfs using a drainage area of 140 mi²

The Harmonic Mean has been estimated based on average flow and the 7-Q₁₀ using an equation from U.S. EPA's *Technical Support Document for Water Quality-Based Toxics Control* (March 1991, EPA/505/2-90-001, pgs. 88-89).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-Q ₁₀ (cfs)	16	17	26	48	29	17	13	12	11	12	18	16
7-Q ₂ (cfs)	37	39	68	91	57	41	31	26	24	30	42	38

WQBEL evaluations previous to the 2019 memo used a 7-Q₂ flow of 6.2 cfs for limits calculations.

- Hardness = 324 mg/L as CaCO₃. This value represents the geometric mean of data from chronic WET testing from 10/13/2020 – 09/10/2024.
- % of low flow used to calculate limits in accordance with s. NR 106.06(4)(c)5., Wis. Adm. Code: 25%
- Source of background concentration data: Metals data from the Crawfish River at Old Highway 73 Bridge (Station ID 113086) is used for this evaluation. The numerical values are shown in the tables below. If no data is available, the background concentration is assumed to be negligible and a value of zero is used in the computations. Background data for calculating effluent limitations for ammonia nitrogen are described later.
- Multiple dischargers: None.
- Impaired water status: The Crawfish River at the point of discharge is not listed as impaired.

Effluent Information

- Design flow rate(s):
Annual average = 1.26 million gallons per day (MGD)
For reference, the actual average flow from 08/01/2020 – 09/30/2025 was 0.95 MGD.
- Hardness = 397 mg/L as CaCO₃. This value represents the geometric mean of four samples collected in January and February 2024 which were reported on the permit application.
- Acute dilution factor used in accordance with s. NR 106.06(3)(c), Wis. Adm. Code: Not applicable – this facility does not have an approved Zone of Initial Dilution (ZID).
- Wastewater source: Domestic wastewater with 5 industrial contributors: Metalcraft of Mayville, EK Machine, Enerpac, G.D. Roberts and Co., Inc. and American Packaging Corp.
- Water supply: Municipality waterworks and private wells.
- Additives: Columbus has included 4 additives in the permit application that have the potential to be present in Outfall 010. These additives are listed below:
 - Hawkins Inc. – Azone 15: Seasonal disinfection
 - Hawkins Inc. – Sodium Bisulfite: Seasonal dechlorination
 - Solenis – Praestol: Flocculant
 - Chem Trade – Hyper+Ion 1997: Phosphorus removal

Attachment #1

- An additive review is not necessary for any additives where either the toxicity is well documented and understood, can be controlled by a WQBEL, or are not believed to be present in the discharge. This is the case upon initial review of the listed additives and an additive review is not needed at this time.
- Effluent characterization: This facility is categorized as a major municipal, so the permit application required effluent sample analyses for all the “priority pollutants” except for the Dioxins and Furans as specified in s. NR 200.065, Table 1, Wis. Adm. Code. The permit-required monitoring for mercury, chloride, ammonia, phosphorus and chlorine is used in this evaluation.
- Effluent data for substances for which a single sample was analyzed is shown in the tables in Part 2, in the column titled “MEAN EFFL. CONC.”. Otherwise, substances with multiple effluent data are shown in the tables below or in their respective parts in this evaluation.

Copper Effluent Data

Sample Date	Copper (µg/L)	Sample Date	Copper (µg/L)	Sample Date	Copper (µg/L)
01/10/2024	6.5	01/26/2024	8.2	02/09/2024	6.9
01/15/2024	7.4	01/30/2024	6.5	02/13/2024	7.9
01/18/2024	8.4	02/02/2024	7.7	02/27/2024	7.3
01/23/2024	8.3	02/06/2024	6.5		
1-day P ₉₉ = 9.3 µg/L					
4-day P ₉₉ = 8.3 µg/L					

Chloride Effluent Data

	Chloride (mg/L)
1-day P ₉₉	417
4-day P ₉₉	343
30-day P ₉₉	302
Mean	280
Std	50.1
Sample size	24
Range	180 – 350

Mercury Effluent Data

	Mercury (ng/L)
1-day P ₉₉	0.575
4-day P ₉₉	0.457
30-day P ₉₉	0.321
Mean	0.258
Std	0.094
Sample size	14
Range	<0.2 – 0.54

*Results below the limit of detection (LOD) were included as zeroes in calculation of average.

The following table presents the average concentrations and loadings at Outfall 010 from 08/01/2020 – 09/30/2025 for all parameters with limits in the current permit to meet the requirements of s. NR 201.03(6), Wis. Adm. Code:

Parameters with Effluent Limits

	Average Measurement	Average Mass Discharged
BOD ₅	3.34 mg/L*	32.3 lbs/day
TSS	1.92 mg/L	27.8 lbs/day
pH field	7.5 s.u.	
Dissolved Oxygen	9.76 mg/L	
Ammonia Nitrogen	0.052 mg/L*	
<i>E. coli</i>	50.3 #/100 mL**	
Phosphorus	0.143 mg/L	1.26 lbs/day
Chlorine	3.13 µg/L*	

*Results below the limit of detection (LOD) were included as zeroes in calculation of average.

** The average measurement for bacteria is calculated as a geometric mean. Values reported below the LOD are replaced with a value of 1 for the calculation of the geometric mean.

**PART 2 – WATER QUALITY-BASED EFFLUENT LIMITATIONS
FOR TOXIC SUBSTANCES – EXCEPT AMMONIA NITROGEN**

Permit limits for toxic substances are required whenever any of the following occur:

1. The maximum effluent concentration exceeds the calculated limit (s. NR 106.05(3), Wis. Adm. Code)
2. If 11 or more detected results are available in the effluent, the upper 99th percentile (or P₉₉) value exceeds the comparable calculated limit (s. NR 106.05(4), Wis. Adm. Code)
3. If fewer than 11 detected results are available, the mean effluent concentration exceeds 1/5 of the calculated limit (s. NR 106.05(6), Wis. Adm. Code)

Acute Limits based on 1-Q₁₀

Daily maximum effluent limitations for toxic substances are based on the acute toxicity criteria (ATC), listed in ch. NR 105, Wis. Adm. Code. Previously daily maximum limits for toxic substances were calculated as two times the ATC. However, changes to ch. NR 106, Wis. Adm. Code, (September 1, 2016) require the Department to calculate acute limitations using the same mass balance equation as used for other limits along with the 1-Q₁₀ receiving water low flow to determine if more restrictive effluent limitations are needed to protect the receiving stream from discharges which may cause or contribute to an exceedance of the acute water quality standards. The mass balance equation is provided below.

$$\text{Limitation} = \frac{(\text{WQC}) (Q_s + (1-f) Q_e) - (Q_s - f Q_e) (C_s)}{Q_e}$$

Where:

WQC = Acute toxicity criterion or secondary acute value according to ch. NR 105, Wis. Adm. Code.

Q_s = average minimum 1-day flow which occurs once in 10 years (1-day Q₁₀)
if the 1-day Q₁₀ flow data is not available = 80% of the average minimum 7-day flow which occurs once in 10 years (7-day Q₁₀).

Q_e = Effluent flow (in units of volume per unit time) as specified in s. NR 106.06(4)(d), Wis. Adm. Code.

f = Fraction of the effluent flow that is withdrawn from the receiving water, and

C_s = Background concentration of the substance (in units of mass per unit volume) as specified in

s. NR 106.06(4)(c), Wis. Adm. Code.

If the receiving water is effluent dominated under low stream flow conditions, the 1-Q₁₀ method of limit calculation produces the most stringent daily maximum limitations and should be used while making reasonable potential determinations. This is not the case for Columbus, and the limits are set based on two times the acute toxicity criteria.

The following tables list the calculated WQBELs for this discharge along with the results of effluent sampling for all the detected substances. All concentrations are expressed in terms of micrograms per Liter (µg/L), except for hardness and chloride (mg/L) and mercury (ng/L).

Daily Maximum Limits based on Acute Toxicity Criteria (ATC)

RECEIVING WATER FLOW = 7.52 cfs, (1-Q₁₀ (estimated as 80% of 7-Q₁₀)), as specified in s. NR 106.06(3)(bm), Wis. Adm. Code.

SUBSTANCE	REF. HARD.* mg/L	ATC	MEAN BACK- GRD.	MAX. EFFL. LIMIT**	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	1-day P ₉₉	1-day MAX. CONC.
Chlorine		19.0		38.1			39.35	100
Arsenic		340	2	680	136	<1.1		
Cadmium	397	50.1	4.7	100	20.0	<0.19		
Chromium	301	4446	3	8892	1778	<1.1		
Copper	397	57.0	17.3	114			9.3	8.4
Lead	356	365		729	146	<4.3		
Mercury (ng/L)		830		1660			0.57	0.54
Nickel	268	1080		2161	432	<1.2		
Zinc	333	345		689	138	25		
Chloride (mg/L)		757	22.2	1514			417	350

* The indicated hardness may differ from the effluent hardness because the effluent hardness exceeded the maximum range in ch. NR 105, Wis. Adm. Code, over which the acute criteria are applicable. In that case, the maximum of the range is used to calculate the criterion.

** The 2 × ATC method of limit calculation yields a more restrictive limit than consideration of ambient concentrations and 1-Q₁₀ flow rates per the changes to s. NR 106.07(3), Wis. Adm. Code, effective 09/01/2016.

Weekly Average Limits based on Chronic Toxicity Criteria (CTC)

RECEIVING WATER FLOW = 2.35 cfs (¼ of the 7-Q₁₀), as specified in s. NR 106.06(4)(c), Wis. Adm. Code

SUBSTANCE	REF. HARD.* mg/L	CTC	MEAN BACK- GRD.	WEEKLY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	4-day P ₉₉
Chlorine		7.28		16.1			21.7
Arsenic		152	2	333	66.7	<1.1	
Cadmium	175	3.82	4.7	3.82	0.76	<0.19	
Chromium	301	326	3	715	143	<1.1	
Copper	324	28.3	17.3	42			8.3
Lead	324	87.1		192	38.4	<4.3	
Mercury (ng/L)		440		970			0.46
Nickel	268	120		265	53.0	<1.2	
Selenium		5.0		11.0	2.21	1	

Attachment #1

SUBSTANCE	REF. HARD.* mg/L	CTC	MEAN BACK- GRD.	WEEKLY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	4-day P ₉₉
Zinc	324	336		741	148	25	
Chloride (mg/L)		395	22.2	844			343

* The indicated hardness may differ from the receiving water hardness because the receiving water hardness exceeded the maximum range in ch. NR 105, Wis. Adm. Code, over which the chronic criteria are applicable. In that case, the maximum of the range is used to calculate the criterion.

Monthly Average Limits based on Wildlife Criteria (WC)

RECEIVING WATER FLOW = 4.04 cfs (¼ of the 90-Q₁₀), as specified in s. NR 106.06(4), Wis. Adm. Code

SUBSTANCE	WC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P ₉₉
Mercury (ng/L)	1.3		1.3			0.32

Monthly Average Limits based on Human Threshold Criteria (HTC)

RECEIVING WATER FLOW = 9.11 cfs (¼ of Harmonic Mean), as specified in s. NR 106.06(4), Wis. Adm. Code.

SUBSTANCE	HTC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P ₉₉
Antimony	373		2115	423	0.32	
Cadmium	370	4.7	2076	415	<0.19	
Chromium (+3)	3818000	3	21649892	4329978	<1.1	
Lead	140		794	159	<4.3	
Mercury (ng/L)	1.5		1.5			0.32
Nickel	43000		243831	48766	<1.2	
Selenium	2600		14743	2949	1	

Monthly Average Limits based on Human Cancer Criteria (HCC)

RECEIVING WATER FLOW = 9.11 cfs (¼ of Harmonic Mean), as specified in s. NR 106.06(4), Wis. Adm. Code.

SUBSTANCE	HCC	MEAN BACK- GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.
Arsenic	13.3	2	66.1	13.2	<1.1
Chloroform	1960		11114	2223	0.13

In addition to evaluating the need for limits for each individual substance for which HCC exist, s. NR 106.06(8), Wis. Adm. Code, requires the evaluation of the cumulative cancer risk. Because no effluent limits are needed based on HCC, determination of the cumulative cancer risk is not needed per s. NR 106.06(8), Wis. Adm. Code.

Conclusions and Recommendations

Based on a comparison of the effluent data and calculated effluent limitations, effluent limitations are required for chlorine. Limits and/or monitoring recommendations are made in the paragraphs below:

Total Residual Chlorine – Because chlorine is added as a disinfectant, effluent limitations are recommended to assure proper operation of the de-chlorination system. Section NR 210.06(2)(b), Wis. Adm. Code, states, “When chlorine is used for disinfection, the daily maximum total residual chlorine concentration of the discharge may not exceed 0.10 mg/L.” Because the WQBELs are more restrictive, they are recommended instead. Specifically, a daily maximum limit of 38 µg/L is required. Due to revisions to s. NR 106.07(2), Wis. Adm. Code, mass limitations are no longer required. **The weekly and monthly average effluent limit of 13 µg/L is recommended to continue in the reissued permit.**

The calculated weekly average limit of 16 µg/L is less stringent than the current weekly average limit of 13 µg/L.

If Columbus would like to request an increase to the existing permit limits chlorine, an assessment of their effluent data consistent with the requirements of ss. NR 207.04(1)(a) and (c), Wis. Adm. Code, must be provided. This evaluation is on a parameter by parameter basis and includes consideration of operations, maintenance and temporary upsets. If the facility can successfully demonstrate the need for increased effluent limitations required in ch. NR 207, Wis. Adm. Code, then a recalculation of the specific effluent limit may be provided.

Chloride – Considering available effluent data from the current permit term (01/12/2023 – 12/19/2023), the 1-day P₉₉ chloride concentration is 417 mg/L, and the 4-day P₉₉ of effluent data is 343 mg/L.

These effluent concentrations are below the calculated WQBELs for chloride, therefore no effluent limits are needed. **Chloride monitoring is recommended to ensure that 11 sample results are available at the next permit issuance to meet the data requirements of s. NR 106.85, Wis. Adm. Code.**

Mercury – The WQBEL for total recoverable mercury is set equal to the most stringent criterion of 1.3 ng/L, according to s. NR 106.06(6), Wis. Adm. Code, because the background concentration in the receiving water and similar inland streams is known to exceed 1.3 ng/L.

The current permit requires quarterly monitoring of the influent and effluent for total recoverable mercury. A total of 14 effluent sampling results are available from 05/10/2022 – 08/11/2025 for total recoverable mercury. The average concentration was 0.26 ng/L, and the maximum was 0.54 ng/L. Because the 30-day P₉₉ of available data (0.32 ng/L) is less than the most stringent WQBEL of 1.3 ng/L, **no WQBEL for mercury is required for permit reissuance. A minimum of annual mercury monitoring is recommended for permit reissuance, consistent with other major municipal dischargers.**

PFOS and PFOA – The need for PFOS and PFOA monitoring is evaluated in accordance with s. NR 106.98(2), Wis. Adm. Code.

Previous monitoring produced a PFOS result of 0.933 ng/L and a PFOA result of 3.81 ng/L which are less than one fifth of the respective criteria for each substance. Based on the types of indirect dischargers contributing to the collection system (metal finishers), **PFOS and PFOA monitoring is recommended at a once every two months frequency.**

PART 3 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR AMMONIA NITROGEN

The State of Wisconsin promulgated revised water quality standards for ammonia nitrogen in ch. NR 105, Wis. Adm. Code, effective March 1, 2004 which includes criteria based on both acute and chronic toxicity to aquatic life. The current permit has daily maximum, weekly average and monthly average limits. These limits are re-evaluated at this time due to the following changes:

- The maximum expected effluent pH has changed

Daily Maximum Limits based on Acute Toxicity Criteria (ATC)

Daily maximum limitations are based on acute toxicity criteria in ch. NR 105, Wis. Adm. Code, which are a function of the effluent pH and the receiving water classification. The acute toxicity criterion (ATC) for ammonia is calculated using the following equation:

$$\text{ATC in mg/L} = [A \div (1 + 10^{(7.204 - \text{pH})})] + [B \div (1 + 10^{(\text{pH} - 7.204)})]$$

Where:

A = 0.411 and B = 58.4 for a Warm Water Sport fishery, and
pH (s.u.) = that characteristic of the effluent.

The effluent pH data was examined as part of this evaluation. A total of 1347 sample results were reported from 08/03/2020 – 09/30/2025. The maximum reported value was 8.5 s.u. (Standard pH Units). The effluent pH was 8.2 s.u. or less 99% of the time. The 1-day P₉₉, calculated in accordance with s. NR 106.05(5), Wis. Adm. Code, is 8.3 s.u. The mean plus the standard deviation multiplied by a factor of 2.33, an estimate of the upper ninety ninth percentile for a normally distributed dataset, is 8.3 s.u. Therefore, a value of 8.6 s.u. is believed to represent the maximum reasonably expected pH, and therefore most appropriate for determining daily maximum limitations for ammonia nitrogen. Substituting a value of 8.2 s.u. into the equation above yields an ATC = 5.7 mg/L.

Daily Maximum Ammonia Nitrogen Effluent Limitations Calculation Method

In accordance with s. NR 106.32(2), Wis. Adm. Code daily maximum ammonia limitations are calculated using the 1-Q₁₀ receiving water low flow if it is determined that the previous method of acute ammonia limit calculation (2×ATC) is not sufficiently protective of the fish and aquatic life. The more restrictive calculated limits shall apply.

The calculated daily maximum ammonia nitrogen effluent limits using the mass balance approach with the 1-Q₁₀ (estimated as 80 % of 7-Q₁₀) and the 2×ATC approach are shown below.

Daily Maximum Ammonia Nitrogen Determination

	Ammonia Nitrogen Limit mg/L
2×ATC	11
1-Q ₁₀	27

The 2×ATC method yields the most stringent limits for Columbus.

Weekly and Monthly Average Limits based on Chronic Toxicity Criteria (CTC)

The weekly and monthly average ammonia nitrogen limits calculation from the previous memo do **not change** because there have been no changes in the effluent and receiving water flow rates. The calculations from the previous WQBEL memo are shown in Attachment #3.

Effluent Data

The following table evaluates the statistics based upon ammonia data reported from 08/03/2020 – 09/30/2025.

Ammonia Nitrogen Effluent Data

Ammonia Nitrogen mg/L	April	May - September	October - March
1-day P ₉₉	0.41	1.09	0.23
4-day P ₉₉	0.23	0.79	0.13
30-day P ₉₉	0.12	0.38	0.06
Mean*	0.07	0.07	0.03
Std	0.09	0.54	0.06
Sample size	65	351	385
Range	<0.026 - 0.392	<0.013 - 7	<0.019 - 0.392

*Values lower than the limit of detection were substituted with a zero

Reasonable Potential

The need to include ammonia limits in Columbus' permit is determined by calculating 99th upper percentile (or P₉₉) values for ammonia year-round and comparing those to the calculated limits. Based on this comparison, there is no reasonable potential for the discharge to exceed any of the calculated ammonia nitrogen limits. However, since the permit currently has weekly and monthly average limits year-round, **the limits must be retained regardless of reasonable potential**, consistent with s. NR 106.33(1)(b), Wis. Adm. Code:

- (b) If a permittee is subject to an ammonia limitation in an existing permit, the limitation shall be included in any reissued permit. Ammonia limitations shall be included in the permit if the permitted facility will be providing treatment for ammonia discharges.

Expression of Limits

Revisions to ch. NR 106, Wis. Adm. Code, in September 2016 aligned Wisconsin's WQBELs with 40 CFR § 122.45(d), which specifies that effluent limits for continuous dischargers must be expressed as weekly and monthly averages for publicly owned treatment works and as daily maximums and monthly averages for all other dischargers, unless shown to be impracticable. Because a daily maximum ammonia limit is necessary for Columbus, weekly and monthly average limits are also required under this code revision.

The methods for calculating limitations for municipal treatment facilities to conform to 40 CFR 122.45(d) are specified in s. NR 106.07(3), Wis. Adm. Code, and are as follows:

Whenever a daily maximum limitation is determined necessary to protect water quality, a weekly and monthly average limitation shall also be included in the permit and set equal to the daily maximum limit unless a more restrictive limit is already determined necessary to protect water quality.

In this case, the recommended daily maximum limits vary with effluent pH, so additional limits should be set equal to the highest recommended limit. Therefore, **a weekly average limit of 11 mg/L is recommended for October – March, equal to the newly calculated daily maximum limit.**

Conclusions and Recommendations

In summary, after rounding to two significant figures, the following ammonia nitrogen limitations are recommended. No mass limitations are recommended in accordance with s. NR 106.32(5), Wis. Adm Code. Limits to meet the requirements in s. NR 106.07, Wis. Adm Code, are addressed in the expression of limits section of this memo.

Final Ammonia Nitrogen Limits

	Daily Maximum mg/L	Weekly Average mg/L	Monthly Average mg/L
April	11	9.0	6.0
May – September	11	8.1	6.4
October – March	11	11	9.7

PART 4 – PHOSPHORUS

Technology-Based Effluent Limit

Subchapter II of Chapter NR 217, Wis. Adm. Code, requires municipal wastewater treatment facilities that discharge greater than 150 pounds of total phosphorus per month to comply with a monthly average limit of 1.0 mg/L, or an approved alternative concentration limit.

Because Columbus currently has a limit of 1.0 mg/L, this limit should be included in the reissued permit. This limit remains applicable unless a more stringent WQBEL is given.

Water Quality Based Limit

Revisions to the administrative rules for phosphorus discharges took effect on December 1, 2010. These rule revisions include additions to ch. NR 102 (s. NR 102.05), which establish phosphorus standards for surface waters. Revisions to ch. NR 217 (s. NR 217, Subchapter III) establish procedures for determining water quality-based effluent limits for phosphorus, based on the applicable standards in ch. NR 102.

The Department has developed a TMDL for the Upper and Lower Rock River Basins. The US EPA approved the Rock River TMDL on September 28, 2011. The document, along with the referenced appendices can be found at: <https://dnr.wisconsin.gov/topic/TMDLs/RockRiver/index.html>

Section NR 217.16, Wis. Adm. Code, states that the Department may include a TMDL-derived water quality-based effluent limit (WQBEL) for phosphorus in addition to, or in lieu of, a s. NR 217.13 WQBEL in a WPDES permit. The Rock River Basin TMDL was developed to protect and improve the water quality of phosphorus impaired waters within the basin. Because the Crawfish River was not 303(d) listed as impaired for phosphorus at the time of TMDL development, a s. NR 217.13, Wis. Adm. Code is recommended in addition to the TMDL-based limits. This WQBEL should be expressed in a manner consistent with the wasteload allocation and assumptions of the TMDL. If after two permit terms, the Department determines the nonpoint source load allocation has not been substantially reduced, the Department may include the s. NR 217.13 WQBEL unless these reductions are likely to occur.

Total Maximum Daily Load

The approved Rock River TMDL report provides effluent limitations that are given in lbs/month in the document *Final Rock River TMDL Report with Tables*. The monthly WLA were calculated as monthly averages in lbs/day as shown in the table below. **There are no changes recommended from the current permit.**

Because Fall River has regionalized with Columbus, the WLAs for both facilities is combined to calculate TMDL-based limits for Columbus. Delivery factors and downstream factors are not necessary in this transfer because both facilities are found within reach 51 in the Rock River TMDL, and the allocations were derived from the same compliance point. The table below describes the individual phosphorus allocations for these facilities and the combined allocation used to derive the TMDL phosphorus limits.

TMDL WLAs

Month	Columbus WWTF Monthly Total P WLA lbs/month ¹	Fall River WWTF Monthly Total P WLA ¹ lbs/month	Combined Monthly Total P WLA lbs/month
January	429.76	78.22	507.98
February	494.54	90.01	584.55
March	493.98	89.90	583.88
April	397.11	72.27	469.38
May	378.56	68.90	447.46
June	359.43	65.42	424.85
July	371.63	67.64	439.27
August	408.64	74.37	483.01
September	408.88	74.42	483.30
October	408.64	74.37	483.01
November	404.23	73.57	477.80
December	383.15	69.73	452.88

Footnotes:

1. Rock River TMDL Appendix P. Monthly Total Phosphorus Allocations by Wastewater Treatment Facility

The calculated monthly average limits based on the TMDL WLAs are shown in the table below, which are the same as in the previous limits memo:

Monthly Average TMDL-based Limits

Month	Combined Monthly Total P WLA lbs/month	Days/month	Monthly Ave Total P Effluent Limit ¹ lbs/day
January	507.98	31	16.39
February	584.55	28	20.88
March	583.88	31	18.83
April	469.38	30	15.65
May	447.46	31	14.43
June	424.85	30	14.16
July	439.27	31	14.17
August	483.01	31	15.58
September	483.30	30	16.11
October	483.01	31	15.58
November	477.80	30	15.93

Attachment #1

Month	Combined Monthly Total P WLA lbs/month	Days/month	Monthly Ave Total P Effluent Limit ¹ lbs/day
December	452.88	31	14.61

Footnotes:

1- Monthly average Total P effluent limit (lbs/day) = monthly Total P WLA (lbs/month) ÷ days per month

Point of Discharge Limits

Section NR 102.06(3)(a), Wis. Adm. Code, specifically names river segments for which a phosphorus criterion of 0.100 mg/L applies. For other stream segments that are not specified in s. NR 102.06(3)(a), Wis. Adm. Code, s. NR 102.06(3)(b), Wis. Adm. Code, specifies a phosphorus criterion of 0.075 mg/L. The phosphorus criterion of 0.075 mg/L applies for Crawfish River.

The conservation of mass equation is described in s. NR 217.13(2)(a), Wis. Adm. Code, for phosphorus WQBELs and includes variables of water quality criterion (WQC), receiving water flow rate (Qs), effluent flow rate (Qe), and upstream phosphorus concentrations (Cs) provided below.

$$\text{Limitation} = [(WQC)(Qs + (1-f) Qe) - (Qs - f Qe) (Cs)] / Qe$$

Where:

WQC = 0.075 mg/L for the Crawfish River

Qs = 100% of the 7-Q₂ of 19 cfs

Cs = background concentration of phosphorus in the receiving water pursuant to s. NR 217.13(2)(d), Wis. Adm. Code

Qe = effluent flow rate = 1.26 MGD = 1.95 cfs

f = the fraction of effluent withdrawn from the receiving water = 0

Section NR 217.13(2)(d), Wis. Adm. Code, specifies that the background phosphorus concentration used in the limit calculation formula shall equal the median of at least four samples collected during the months of May through October, and that all samples collected during a 28-day period shall be considered as a single sample and the average of these concentrations used to determine a median. Averaging begins at date of the first sample in the range of May through October.

A previous evaluation resulted in a WQBEL of 0.075 mg/L using a background concentration of 0.182 mg/L. Section NR 217.13(2)(d), Wis. Adm. Code, states that the determination of upstream concentrations shall be evaluated at each permit reissuance. Additional data were considered in estimating the background phosphorus concentration.

A review of all available in stream total phosphorus data from 10/21/2009 – 08/18/2010 stored in the Surface Water Integrated Monitoring System database indicates the median background total phosphorus concentration the Crawfish River in Columbus-Ludington (SWIMS station ID 113151) is 0.13 mg/L, approximately 2 miles upstream of Outfall 010.

Substituting a background concentration above criteria into the limit calculation equation above would result in a calculated limit that is less than the applicable criterion of 0.075 mg/L. However, s. NR 217.13(7), Wis. Adm. Code, specifies that “if the WQBEL calculated pursuant to the procedures in this section is less than the phosphorus criterion specified in s. NR 102.06, Wis. Adm. Code, for the water body, the effluent limit shall be set equal to the criterion.” Therefore, **the WQBEL is 0.075 mg/L.**

Limit Expression

According to s. NR 217.14(2), Wis. Adm. Code, because the calculated WQBEL is less than or equal to 0.3 mg/L, the effluent limit of 0.075 mg/L may be expressed as a six-month average. If a concentration limitation expressed as a six-month average is included in the permit, **a monthly average concentration limitation of 0.225 mg/L, equal to three times the WQBEL calculated under s. NR 217.13, Wis.**

Adm. Code shall also be included in the permit. The six-month average should be averaged during the months of May – October and November – April.

Mass Limits

A mass limit is also required, pursuant to s. NR 217.14(1)(a), Wis. Adm. Code, because the discharge is to a surface water that is to or upstream of a phosphorus impaired water. **This final mass limit shall be $0.075 \text{ mg/L} \times 8.34 \times 1.26 \text{ MGD} = 0.79 \text{ lbs/day}$ expressed as a six-month average.**

Water Quality Trading Minimum Control Level

A WQT plan has been submitted as an alternative compliance option to offset any total phosphorus discharged from Outfall 010 that exceed the s. NR 217.13, Wis. Adm. Code, WQBELs. The phosphorus WQBELs may be expressed as computed compliance limits, but a MCL must be set as a limit not to be exceeded at the outfall location. **Therefore, the phosphorus MCL of 1.0 mg/L as a monthly average is recommended during the reissued permit term to serve as the MCL.** This is equivalent to the current monthly average limit.

Effluent Data

The following table summarizes effluent total phosphorus monitoring data from 08/03/2020 – 09/30/2025.

Total Phosphorus Effluent Data

	Concentration mg/L	Mass lbs/day
1-day P ₉₉	0.67	6.64
4-day P ₉₉	0.38	3.60
30-day P ₉₉	0.21	1.93
Mean*	0.14	1.24
Std	0.14	1.37
Sample size	804	711
Range	<0.02 - 1.296	0 - 18.97

*Values lower than the limit of detection were substituted with a zero

Water Quality Trading Credits

Columbus has a water quality trading (WQT) agreement with the Town of Beloit. The monthly allocations that are sold to the Town of Beloit are shown below and the final monthly average phosphorus limits are calculated. The trade ratio for the credits sold to the Town of Beloit is 1.1.

Monthly Average TMDL-based Limits

Month	Monthly Ave Total P Effluent Limit lbs/day	Allocation sold to Town of Beloit WWTF lbs/day	Monthly Ave Total P Effluent Limit¹ lbs/day
January	16.39	3.58	12.81
February	20.88	3.88	17.00
March	18.83	3.39	15.44
April	15.65	3.58	12.07
May	14.43	3.47	10.96
June	14.16	3.31	10.85
July	14.17	2.54	11.63
August	15.58	2.20	13.38
September	16.11	1.99	14.12
October	15.58	2.21	13.37
November	15.93	2.71	13.22
December	14.61	3.26	11.35

Footnotes:

1- Monthly average TP = (Monthly average TP WLA from City of Columbus plus Fall River)/days per month

2- The final monthly average limit = monthly average total – allocation sold to Town of Beloit

The calculated monthly average TP limits are greater than the limits that are effective in the current permit. This is because Columbus had previously sold allocations to NASCO Education LLC which has since ceased discharge. The allocated limits from NASCO are moved back to Columbus.

The recommended TMDL-based monthly average phosphorus limits are shown below:

Monthly Average Phosphorus Limits

Month	Monthly Ave Total P Effluent Limit lbs/day
January	12.81
February	17.00
March	15.44
April	12.07
May	10.96
June	10.85
July	11.63
August	13.38
September	14.12
October	13.37
November	13.22
December	11.35

PART 5 – TOTAL SUSPENDED SOLIDS**TMDL Limits**

The Rock River TMDL also has wasteload allocations (WLA) for total suspended solids (TSS). For a municipal facility the limits for TSS must be expressed as weekly and monthly averages. The current

permit includes weekly and monthly concentrations limits as well as TMDL-based mass limits.

Because Fall River has regionalized with Columbus, the WLAs for both facilities is combined to calculate TMDL-based limits for Columbus. Delivery factors and downstream factors are not necessary in this transfer because both facilities are found within reach 51 in the Rock River TMDL, and the allocations were derived from the same compliance point. The table below describes the individual phosphorus allocations for these facilities and the combined allocation used to derive the TMDL phosphorus limits.

Monthly WLAs

Month	Columbus WWTF Monthly TSS WLA¹ tons/month	Fall River Monthly TSS WLA¹ tons/month	Combined Monthly TSS WLA tons/month
January	1.24	1.36	2.60
February	1.28	1.40	2.68
March	1.24	1.36	2.60
April	1.26	1.37	2.63
May	1.24	1.36	2.60
June	1.26	1.37	2.63
July	1.24	1.36	2.60
August	1.24	1.36	2.60
September	1.26	1.37	2.63
October	1.24	1.36	2.60
November	1.26	1.37	2.63
December	1.24	1.36	2.60

Weekly and monthly average limits are calculated from the monthly WLAs, shown below:

Total Suspended Solids Effluent Limitations

Month	Monthly TSS WLA (tons/month)	Days Per Month	Monthly Ave TSS Effluent Limit¹ (lbs/day)	Weekly Ave TSS Effluent Limit² (lbs/day)
January	2.60	31	168	237
February	2.68	28	191	270
March	2.60	31	168	237
April	2.63	30	175	247
May	2.60	31	168	237
June	2.63	30	175	247
July	2.60	31	168	237
August	2.60	31	168	237
September	2.63	30	175	247
October	2.60	31	168	237
November	2.63	30	175	247
December	2.60	31	168	237

Footnotes:

1- Monthly average TSS effluent limit (lbs/day) = maximum monthly TSS WLA (tons/month) ÷ days per month x 2,000 lbs/ton

2- Weekly average effluent limit (lbs/day) = monthly average limit (lbs/day) x multiplier

Attachment #1

The multiplier used in the weekly average limit calculation was determined according to implementation guidance. A coefficient of variation was calculated, based on TSS mass monitoring data, to be 1.3. However, it is believed that the optimization of the wastewater treatment system to achieve the WLA-derived TSS and phosphorus permit limits will reduce effluent variability. Thus, the maximum anticipated coefficient of variation expected by any facility is 0.6. This value, along with monitoring frequency, is used to select the multiplier. This value, along with monitoring frequency, is used to select the multiplier (1.41). The current permit specifies TSS monitoring as 3/week; if a different monitoring frequency is used, the stated limits should be reevaluated.

The current weekly average mass limits are more stringent than the calculated TMDL-based limits in this evaluation. An assessment of TSS data consistent with the requirements of ss. NR 207.04(1)(a) and (c), Wis. Adm. Code, must be provided in order to increase the TSS limits. This evaluation includes consideration of operations, maintenance and temporary upsets. An initial review suggests that the requirements of s. NR 207.04(1)(a), Wis. Adm. Code, do not appear to be met. **Therefore, the current weekly average limits for TSS are required to be retained in the reissued permit consistent with s. NR 207.04(2), Wis. Adm. Code.**

The current monthly average and weekly average mass effluent limitations should be included in the permit according to the table below, along with the currently imposed concentration limits.

TSS Limits

Month	Monthly Average TSS Effluent Limit (lbs/day)	Weekly Average TSS Effluent Limit (lbs/day)
January	168	167
February	191	167
March	168	167
April	175	167
May	168	83.4
June	175	83.4
July	168	83.4
August	168	83.4
September	175	83.4
October	168	83.4
November	175	167
December	168	167

Effluent Data

The following table summarizes effluent TSS monitoring data from 08/03/2020 – 09/30/2025.

TSS Effluent Data

	Concentration (mg/L)	Mass (lbs/day)
1-day P ₉₉	5.71	73.6
4-day P ₉₉	3.48	39.8
30-day P ₉₉	1.89	20.0
Mean*	1.20	11.9

Attachment #1

	Concentration (mg/L)	Mass (lbs/day)
Std	1.24	15.5
Sample Size	776	776
Range	<2 – 10.4	0 – 131.7

*Values lower than the limit of detection were substituted with a zero

TSS data from the end of May, June and July 2024 was removed in this evaluation due to high rainfall events. Data from these months are not representative of normal conditions.

PART 6 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR THERMAL

Surface water quality standards for temperature took effect on October 1, 2010. These regulations are detailed in chs. NR 102 (Subchapter II – Water Quality Standards for Temperature) and NR 106 (Subchapter V – Effluent Limitations for Temperature) of the Wisconsin Administrative Code. Daily maximum and weekly average temperature criteria are available for the 12 different months of the year depending on the receiving water classification.

In accordance with s. NR 106.53(2)(b), Wis. Adm. Code, the highest daily maximum flow rate for a calendar month is used to determine the acute (daily maximum) effluent limitation. In accordance with s. NR 106.53(2)(c), Wis. Adm. Code, the highest 7-day rolling average flow rate for a calendar month is used to determine the sub-lethal (weekly average) effluent limitation. These values were based off actual flow reported from 08/01/2020 – 09/30/2025.

The table below summarizes the maximum temperatures reported during monitoring from 01/01/2023 – 12/31/2023.

Monthly Temperature Effluent Data & Limits

Month	Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit	
	Weekly Maximum	Daily Maximum	Weekly Average Effluent Limitation	Daily Maximum Effluent Limitation
	(°F)	(°F)	(°F)	(°F)
JAN	51	52	67	118
FEB	50	50	67	117
MAR	47	48	62	99
APR	52	54	59	94
MAY	57	59	70	96
JUN	63	66	85	94
JUL	67	68	90	94
AUG	68	70	94	96
SEP	69	70	85	95
OCT	67	68	75	113

Attachment #1

Month	Representative Highest Monthly Effluent Temperature		Calculated Effluent Limit	
	Weekly Maximum	Daily Maximum	Weekly Average Effluent Limitation	Daily Maximum Effluent Limitation
	(°F)	(°F)	(°F)	(°F)
NOV	58	59	59	114
DEC	54	57	64	113

Reasonable Potential

Permit limits for temperature are recommended based on the procedures in s. NR 106.56, Wis. Adm. Code.

- An acute limit for temperature is recommended for each month in which the representative daily maximum effluent temperature for that month exceeds the acute WQBEL. The representative daily maximum effluent temperature is the greater of the following:
 - (a) The highest recorded representative daily maximum effluent temperature
 - (b) The projected 99th percentile of all representative daily maximum effluent temperatures
- A sub-lethal limitation for temperature is recommended for each month in which the representative weekly average effluent temperature for that month exceeds the weekly average WQBEL. The representative weekly average effluent temperature is the greater of the following:
 - (a) The highest weekly average effluent temperature for the month.
 - (b) The projected 99th percentile of all representative weekly average effluent temperatures for the month

Based on the available effluent data, no effluent limits are recommended for temperature. **Monitoring for one year is recommended to continue in the reissued permit.** The complete thermal table used for the limit calculation is attached.

PART 7 – WHOLE EFFLUENT TOXICITY (WET)

WET testing is used to measure, predict, and control the discharge of toxic materials that may be harmful to aquatic life. In WET tests, organisms are exposed to a series of effluent concentrations for a given time and effects are recorded. Decisions below related to the selection of representative data and the need for WET limits were made according to ss. NR 106.08 and 106.09, Wis. Adm. Code. WET monitoring frequency and toxicity reduction evaluation (TRE) recommendations were made using the best professional judgment of staff familiar with the discharge after consideration of the guidance in the *Whole Effluent Toxicity (WET) Program Guidance Document* (2022).

- Acute tests predict the concentration that causes lethality of aquatic organisms during a 48 to 96-hour exposure. To assure that a discharge is not acutely toxic to organisms in the receiving water, WET tests must produce a statistically valid LC₅₀ (Lethal Concentration to 50% of the test organisms) greater than 100% effluent, according to s. NR 106.09(2)(b), Wis. Adm Code.
- Chronic tests predict the concentration that interferes with the growth or reproduction of test organisms during a seven-day exposure. To assure that a discharge is not chronically toxic to organisms in the

Attachment #1

receiving water, WET tests must produce a statistically valid IC₂₅ (Inhibition Concentration) greater than the instream waste concentration (IWC), according to s. NR 106.09(3)(b), Wis. Adm Code. The IWC is an estimate of the proportion of effluent to total volume of water (receiving water + effluent). The **IWC of 45%**, shown in the WET Checklist summary below, was calculated according to the following equation, as specified in s. NR 106.03(6), Wis. Adm Code:

$$\text{IWC (as \%)} = Q_e \div \{(1 - f) Q_e + Q_s\} \times 100$$

Where:

Q_e = annual average flow = 1.26 MGD = 1.95 cfs

f = fraction of the Q_e withdrawn from the receiving water = 0

Q_s = $\frac{1}{4}$ of the 7-Q₁₀ = 9.4 cfs $\div$ 4 = 2.35 cfs

- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), a synthetic (standard) laboratory water may be used as the dilution water and primary control in acute WET tests, unless the use of different dilution water is approved by the Department prior to use. The primary control water must be specified in the WPDES permit.
- According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), receiving water must be used as the dilution water and primary control in chronic WET tests, unless the use of different dilution water is approved by the Department prior to use. The dilution water used in WET tests conducted on Outfall 010 shall be a grab sample collected from the receiving water location, upstream and out of the influence of the mixing zone and any other known discharge. The specific receiving water location must be specified in the WPDES permit.
- Shown below is a tabulation of all available WET data for Outfall 010. Efforts are made to ensure that decisions about WET monitoring and limits are made based on representative data, as specified in s. NR 106.08(3), Wis. Adm Code. Data which is not believed to be representative of the discharge was not included in reasonable potential calculations. The table below differentiates between tests used and not used when making WET determinations. Significant changes were made to WET test methods in 2004 and these changes were assumed to be fully implemented by certified labs by no later than June 2005. Data prior to July 1 2005 was excluded in this evaluation.

WET Data History

Date Test Initiated	Acute Results LC ₅₀ %				Chronic Results IC ₂₅ %				Footnotes or Comments
	<i>C. dubia</i>	Fathead minnow	Pass or Fail?	Used in RP?	<i>C. dubia</i>	Fathead Minnow	Pass or Fail?	Use in RP?	
04/19/2005	>100	>100	Pass	Yes					
10/24/2006	>100	>100	Pass	Yes	60.4	>100	Fail	No	1
12/05/2006					>100	92.1	Pass	Yes	
02/20/2007					87	>100	Pass	Yes	
06/12/2007					>100	>100	Pass	Yes	
09/26/2007	>100	>100	Pass	Yes					
10/25/2007					>100		Pass	Yes	
11/17/2009	>100	>100	Pass	No	>100	>100	Pass	No	2
03/04/2010					>100	>100	Pass	No	2
06/16/2010	>100	>100	Pass	No	>100	>100	Pass	No	2
06/07/2011	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
11/29/2011					>100	80.2	Pass	Yes	

Attachment #1

Date Test Initiated	Acute Results LC ₅₀ %				Chronic Results IC ₂₅ %				Footnotes or Comments
	<i>C. dubia</i>	Fathead minnow	Pass or Fail?	Used in RP?	<i>C. dubia</i>	Fathead Minnow	Pass or Fail?	Use in RP?	
03/07/2012	>100	>100	Pass	Yes					
05/22/2012					>100	>100	Pass	Yes	
08/14/2012					92	>100	Pass	Yes	
02/12/2013					>100	>100	Pass	Yes	
10/08/2013	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
01/29/2014	>100	>100	Pass	Yes					
08/11/2015	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
10/18/2016	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
02/07/2017	>100	>100	Pass	Yes	>100	90.7	Pass	Yes	
06/05/2018	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
07/23/2019	>100	>100	Pass	Yes	92.1	>100	Pass	Yes	
10/13/2020	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
10/19/2021	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
06/20/2023	>100	>100	Pass	Yes	>100	>100	Pass	Yes	
09/10/2024	>100	>100	Pass	Yes	>100	>100	Pass	Yes	

Footnotes:

1. *Qualified Data*. Unusual or upset conditions were present at the treatment plant during testing which calls into question the representativeness of the test results.
 2. *Tests done by S-F Analytical, July 2008 – March 2011*. The DNR has reason to believe that WET tests completed by SF Analytical Labs from July 2008 through March 31, 2011 were not performed using proper test methods. Therefore, WET data from this lab during this period has been disqualified and was not included in the analysis.
- According to s. NR 106.08, Wis. Adm. Code, WET reasonable potential is determined by multiplying the highest toxicity value that has been measured in the effluent by a safety factor, to predict the likelihood (95% probability) of toxicity occurring in the effluent above the applicable WET limit. The safety factor used in the equation changes based on the number of toxicity detects in the dataset. The fewer detects present, the higher the safety factor, because there is more uncertainty surrounding the predicted value. **WET limits must be given, according to s. NR 106.08(6), Wis. Adm. Code, whenever the applicable Reasonable Potential equation results in a value greater than 1.0.**

$$\text{Acute Reasonable Potential} = [(TU_a \text{ effluent}) (B)(AMZ)]$$

$$\text{Chronic Reasonable Potential} = [(TU_c \text{ effluent}) (B)(IWC)]$$

According to s. NR 106.08(6)(d), Wis. Adm. Code, TU_a and TU_c effluent values are equal to zero whenever toxicity is not detected (i.e. when the LC_{50} , IC_{25} or $IC_{50} \geq 100\%$).

Acute Reasonable Potential = 0 < 1.0, reasonable potential is not shown, and a limit is not required.

Chronic Reasonable Potential = 0 < 1.0, reasonable potential is not shown, and a limit is not required.

$$\text{Chronic Reasonable Potential} = [(TU_c \text{ effluent}) (B)(IWC)]$$

Chronic WET Limit Parameters

TU _c (maximum) 100/IC ₂₅	B	IWC
---	---	-----

Attachment #1

	(multiplication factor from s. NR 106.08(6)(c), Wis. Adm. Code, Table 4)	
100/80.2 = 1.25	2.1 Based on 6 detects	45%

$$[(TU_c \text{ effluent}) (B)(IWC)] = 1.2 > 1.0$$

Therefore, reasonable potential is shown for a chronic WET limit using the procedures in s. NR 106.08(6), Wis. Adm. Code, and representative data from 04/19/2005 – 09/10/2024.

Expression of WET limits

Chronic WET limit = $[100/IWC] TU_c = 2.2 TU_c$ expressed as a monthly average

The WET checklist was developed to help DNR staff make recommendations regarding WET limits, monitoring, and other related permit conditions. The checklist indicates whether acute and chronic WET limits are needed, based on requirements specified in s. NR 106.08, Wis. Adm. Code. The checklist steps the user through a series of questions, assesses points based on the potential for effluent toxicity, and suggests monitoring frequencies based on points accumulated during the checklist analysis. As toxicity potential increases, more points accumulate, and more monitoring is recommended to ensure that toxicity is not occurring. A summary of the WET checklist analysis completed for this permittee is shown in the table below. Staff recommendations based on best professional judgment are provided below the summary table. For guidance related to reasonable potential and the WET checklist, see Chapter 1.3 of the WET Guidance Document: <https://dnr.wisconsin.gov/topic/Wastewater/WET.html>.

WET Checklist Summary

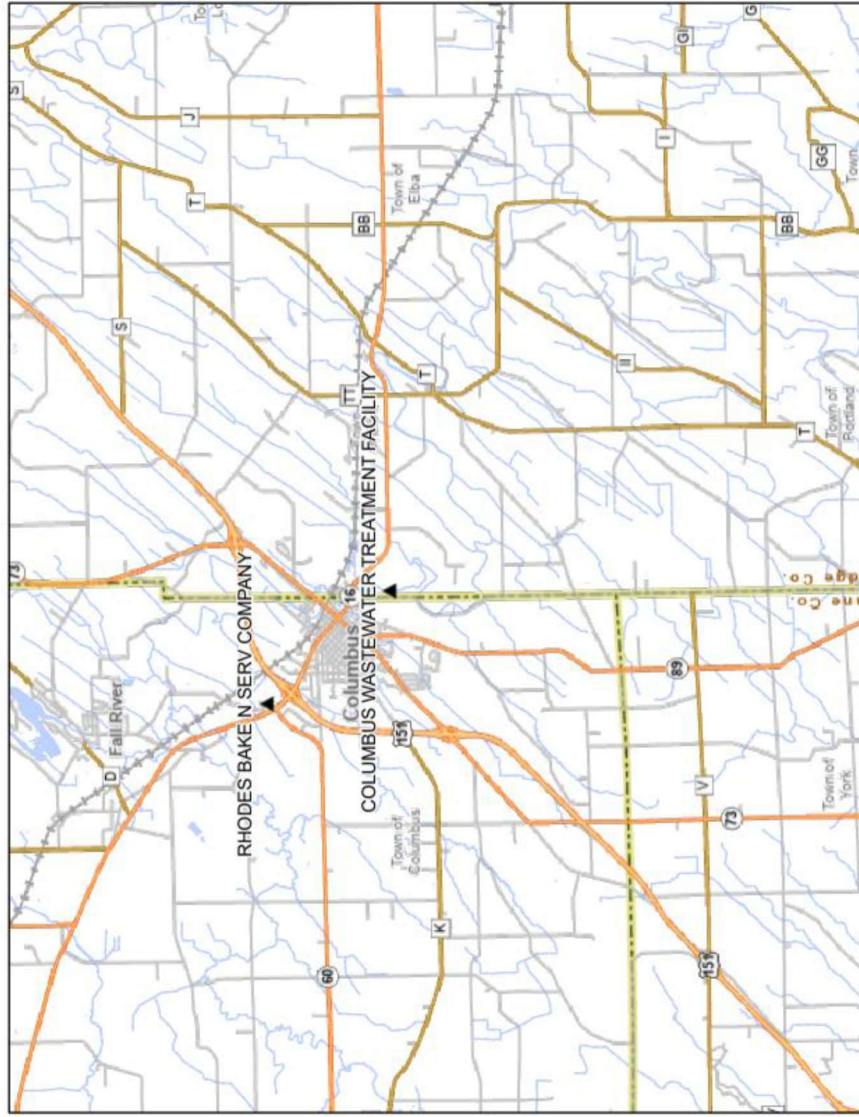
	Acute	Chronic
AMZ/IWC	Not Applicable. 0 Points	IWC = 45%. 10 Points
Historical Data	16 tests used to calculate RP. No tests failed. 0 Points	19 tests used to calculate RP. No tests failed. 0 Points
Effluent Variability	Little variability, no violations or upsets, consistent WWTF operations. 0 Points	Same as Acute. 0 Points
Receiving Water Classification	Warmwater sport fish 5 Points	Same as Acute. 5 Points
Chemical-Specific Data	Reasonable potential for limits for chlorine based on ATC; Ammonia nitrogen limit carried over from the current permit. Cadmium, zinc, chloride, mercury, ammonia and copper detected. Additional Compounds of Concern: Antimony, chloroform, phenol, and selenium 10 Points	Reasonable potential for limits for chlorine based on CTC; Ammonia nitrogen limit carried over from the current permit. Cadmium, zinc, chlorine, chloride, mercury, ammonia and copper detected. Additional Compounds of Concern: Antimony, chloroform, phenol, and selenium 10 Points

Attachment #1

	Acute	Chronic
Additives	1 Biocide and 3 Water Quality Conditioners added. Permittee has proper P chemical SOPs in place 6 Points	Some additives used more than once per 4 days. 6 Points
Discharge Category	5 Industrial Contributors. 9 Points	Same as Acute. 9 Points
Wastewater Treatment	Secondary or Better 0 Points	Same as Acute. 0 Points
Downstream Impacts	No impacts known 0 Points	Same as Acute. 0 Points
Total Checklist Points:	30 Points	40 Points
Recommended Monitoring Frequency (from Checklist):	1x yearly	1x yearly
Limit Required?	No	Yes Limit = 2.2 TU _c
TRE Recommended? (from Checklist)	No	No

- After consideration of the guidance provided in the Department's *WET Program Guidance Document* (2022) and other information described above, annual acute and chronic WET tests are recommended in the reissued permit.
- Sampling WET concurrently with any chemical-specific toxic substances is recommended. Tests should be done in rotating quarters, to collect seasonal information about this discharge. Testing should continue after the permit expiration date (until the permit is reissued).
- According to the requirements specified in s. NR 106.08, Wis. Adm. Code, a chronic WET limit is required. The chronic WET limit shall be expressed as 2.2 TU_c as a monthly average in the effluent limits table of the permit.
- A minimum of annual chronic monitoring is required because a chronic WET limit is required. Federal regulations in 40 CFR Part 122.44(i) require that monitoring occur at least once per year when a limit is present.
- A minimum of annual acute and chronic monitoring is recommended because Columbus is a major municipal discharger with a design flow greater than 1.0 MGD. Federal regulations at 40 CFR Part 122.21(j) require at least 4 acute and chronic WET tests with each permit application on samples collected since the previous reissuance. Therefore, annual monitoring is recommended in the permit term, so that data will be available for the next permit application.

Columbus Wastewater Treatment Facility



Legend:
▲ Surface Water Outfalls
— Rivers and Streams
- - - Intermittent Streams
□ Open Water

Latest Leaf Off Imagery
Red: Band_1
Green: Band_2
Blue: Band_3

Notes:



Service Layer Credits:
Latest Leaf Off Imagery: Basic Basemap (Cached)
Map projection: NAD 1983 HARN Wisconsin TM

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Date Printed: 10/20/2023 3:07 PM

2019 Ammonia Limits Calculations

Weekly Average & Monthly Average Limits based on Chronic Toxicity Criteria (CTC)

The ammonia limit calculation also warrants evaluation of weekly and monthly average limits based on chronic toxicity criteria for ammonia, since those limits relate to the assimilative capacity of the receiving water.

Weekly and monthly average limits based on chronic toxicity criteria for ammonia are also calculated to determine the weekly and monthly average limits to meet the requirements of s. NR 106.07(3).

Ammonia limits were last calculated in May 14, 2014. At this time, new stream low flows are available, so limits are re-calculated using the procedure in s. NR 106.32, Wis. Adm. Code.

Weekly average and monthly average limits for ammonia nitrogen are based on chronic toxicity criteria.

The 30-day chronic toxicity criterion (CTC) for ammonia in waters classified as a Warm Water Sport Fish Community is calculated by the following equation.

$$CTC = E \times \{ [0.0676 \div (1 + 10^{(7.688 - pH)})] + [2.912 \div (1 + 10^{(pH - 7.688)})] \} \times C$$

Where:

pH = the pH (s.u.) of the receiving water,

E = 0.854,

C = the minimum of 2.85 or $1.45 \times 10^{(0.028 \times (25 - T))}$ – (Early Life Stages Present), or

C = $1.45 \times 10^{(0.028 \times (25 - T))}$ – (Early Life Stages Absent), and

T = the temperature (°C) of the receiving water – (Early Life Stages Present), or

T = the maximum of the actual temperature (°C) and 7 – (Early Life Stages Absent)

The 4-day criterion is simply equal to the 30-day criterion multiplied by 2.5. The 4-day criteria are used in a mass-balance equation with the 7-Q₁₀ (4-Q₃, if available) to derive weekly average limitations. And the 30-day criteria are used with the 30-Q₅ (estimated as 85% of the 7-Q₂ if the 30-Q₅ is not available) to derive monthly average limitations. The stream flow value is further adjusted to temperature; 100% of the flow is used if the Temperature ≥ 16 °C, 25% of the flow is used if the Temperature < 11 °C, and 50% of the flow is used if the Temperature ≥ 11 °C but < 16 °C.

The rules provide a mechanism for less stringent weekly average and monthly average effluent limitations when early life stages (ELS) of critical organisms are absent from the receiving water. This applies only when the water temperature is less than 14.5 °C, during the winter and spring months. Burbot, an early spawning species, are not believed to be present in the Crawfish River, based on conversations with local fisheries biologists. So “ELS Absent” criteria apply from October through March, and “ELS Present” criteria will apply from April through September for a warm water sport fish classification.

Since minimal ambient data is available, the “default” basin assumed values are used for Temperature, pH and background ammonia concentrations, shown in the table below, with the resulting criteria and effluent limitations.

		Spring	Summer	Winter
		April	May – Sept.	Oct. - March
Effluent Flow	Qe (MGD)	1.26	1.26	1.26

Attachment #3

		Spring	Summer	Winter
		April	May – Sept.	Oct. - March
Background Information	7-Q ₁₀ (cfs)	9.4	9.4	9.4
	7-Q ₂ (cfs)	19	19	19
	Ammonia (mg/L)	0.09	0.07	0.17
	Temperature (°C)	9	23	3
	pH (s.u.)	7.97	8.21	7.97
	% of Flow used	50	100	25
	Reference Weekly Flow (cfs)	4.7	9.4	2.35
	Reference Monthly Flow (cfs)	8.075	16.15	4.0375
Criteria mg/L	4-day Chronic			
	Early Life Stages Present	6.4	2.6	6.4
	Early Life Stages Absent	9.1	2.6	10
	30-day Chronic			
	Early Life Stages Present	2.5	1.0	2.5
	Early Life Stages Absent	3.6	1.0	4.1
Effluent Limitations mg/L	Weekly Average			
	Early Life Stages Present	21	15	
	Early Life Stages Absent			23
	Monthly Average			
	Early Life Stages Present	13	8.9	
	Early Life Stages Absent			12

Antidegradation

The calculated weekly and monthly average limits shown above are less restrictive than the limits in the current permit. Without a demonstration of need for a higher limit in accordance with s. NR 207.04 Wis. Adm. Code, the current weekly and monthly limits should be continued in the reissued permit.

Effluent Data

The following table evaluates the statistics based upon ammonia data reported from January 2015 through July 2019, with those results being compared to the calculated limits to determine the need to include ammonia limits in the Columbus Wastewater Treatment Facility permit for the respective month ranges. That need is determined by calculating 99th upper percentile (or P₉₉) values for ammonia during each of the month ranges and comparing the daily maximum values to the daily maximum limit.

Ammonia Nitrogen mg/L	April	May – September	October – March
1-day P ₉₉	0.098	0.138	0.059
4-day P ₉₉	0.057	0.075	0.040
30-day P ₉₉	0.030	0.034	0.023
Mean*	0.018	0.017	0.016
Std	0.022	0.035	0.012
Sample size	60	276	324
Range	<0.011-0.037	<0.011 - 0.329	<0.011 - 0.117

*Values lower than the level of detection were substituted with a zero

Attachment #3

Where there are existing ammonia nitrogen limits in the permit, the limits are recommended to be retained regardless of reasonable potential, consistent with s. NR 106.33(1), Wis. Adm. Code:

(b) If a permittee is subject to an ammonia limitation in an existing permit, the limitation shall be included in any reissued permit. Ammonia limitations shall be included in the permit if the permitted facility will be providing treatment for ammonia discharges.

Conclusions and Recommendations:

In summary, after rounding to two significant figures, the following ammonia nitrogen limitations are recommended. No mass limitations are recommended in accordance with s. NR 106.32(5).

Months Applicable	Daily Maximum mg/L	Weekly Average mg/L	Monthly Average mg/L
April	17	11	6.0
May – September	17	10	6.4
October – March	17	18	9.7



November 10, 2025

Matt Admunson
City Administrator
105 N Dickason Blvd
Columbus, WI 53925

Subject: Columbus Wastewater Treatment Facility - WPDES Permit WI-0021008
Water Quality Trading Plan – CONDITIONAL APPROVAL

Dear Matt Admunson:

The Department recently received a water quality trading plan (WQT Plan) for compliance with phosphorus effluent limits at the Columbus Wastewater Treatment Facility. The initial plan was received in May of 2025 and updated versions were received in August of 2025 and October of 2025. Based on WDNR review, the final WQT Plan (dated October 2025) is in general conformance with the WDNR Water Quality Trading Guidance and Section 283.84 of the Wisconsin Statutes. The WQT plan proposes to utilize buffer strips and cover crops on agriculture fields, conservation cover, and a grassed waterway. Credit generation began with the first permit term WQT Plan approval (WQT-2020-0004). Credits generated from approved practices result in available credit quantities shown in Table 1. These credits will be incorporated into the reissued WPDES permit and will be used to demonstrate compliance with final phosphorus effluent limits. The interim credits generated from this WQT Plan are available until July 01, 2031. Available interim credits in 2031 are 11.5 pounds per year.

Table 1: Total Phosphorus Credits Available per WQT-2025-0021

Year	Available Credits (lbs/yr) – Interim	Available Credits (lbs/yr) – Long Term	Available Credits (lbs/yr) – Total
2026	23	221	244
2027	23	221	244
2028	23	221	244
2029	23	221	244
2030	23	221	244

The Department conditionally approves the WQT Plan as a basis for water quality trading during the next WPDES permit term. The Department has assigned the WQT plan a tracking number of WQT-2025-0021 and will be referenced as such in the draft WPDES permit. The final WQT plan will be included as part of the public notice package for permit reissuance. The draft WPDES permit will include a requirement for an annual trading report and effluent monitoring for total phosphorus.

If you have any questions or comments, please contact me at 608-419-4155 or at betsyjo.howe@wisconsin.gov.

Thank You,

A handwritten signature in black ink that reads "BetsyJo Howe". The signature is written in a cursive, flowing style.

BetsyJo Howe
South Central Region WQT Coordinator
Wisconsin Department of Natural Resources

e-CC:

Peter Gallun, City of Columbus
Tiffany Wagner, Ruckert-Mielke
Todd Rietmann, Columbia County
Jen Jerich, WDNR
Jordan Main, WDNR

Updated Water Quality Trading **PLAN**



Updated Water Quality Trading Plan

October 31, 2025

PREPARED FOR:

Columbus Utilities
950 Maple Avenue
Columbus, WI 53925

PREPARED BY:

Ruekert & Mielke, Inc.
W233 N2080 Ridgeview Parkway
Suite 300
Waukesha, WI 53188



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TABLE OF CONTENTS

1	INTRODUCTION	1
	1.1 PREVIOUS PLANNING EFFORTS	1
	1.1.1 Final Compliance Alternatives Plan	1
	1.1.2 Water Quality Trading Plan	1
	1.2 WWTF OPTIMIZATION ACTIVITIES AND POLLUTANT OFFSET NEEDED	1
2	CREDIT GENERATOR SITES	3
	2.1 COLWIS, LLC	3
	2.2 CURTIS STIBB	3
	2.3 WISCONSIN CONFERENCE OF SD	4
3	UPDATED TRADE RATIO	5
4	QUANTIFICATION OF CREDITS AND UPCOMING NEEDS	7
	4.1 METHOD FOR QUANTIFYING CREDITS	7
	4.2 CREDITS GENERATED	7
	4.3 CREDIT TIMELINE AND AGREEMENTS	7
	4.4 EXPECTED CHANGES IN EFFLUENT QUALITY AND FLOWS	8
	4.5 UPCOMING PERMIT TERM CREDIT NEEDS	8
5	PRACTICES DESIGN AND MAINTENANCE	9

LIST OF TABLES

Table 1. Credit Generator and User Catchment Delivery Fraction Summary	5
Table 2. Credit Generator Site Delivery Fraction Summary	5
Table 3. Credit Generator Site Delivery Factor Summary	6
Table 4. Updated Trade Ratio Calculation Summary	6
Table 5. Updated Phosphorus Credits Generated	7
Table 6. Water Quality Trading Agreements Summary	8

LIST OF FIGURES

Figure 1. Poly Aluminum Chloride Dose Response Results	2
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LIST OF EXHIBITS

Exhibit 1:	Credit User and Generator Location Map
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LIST OF APPENDICES

Appendix A:	Colwis, LLC Project Details: Site Map Updated Phosphorus Calculations Updated Snap Plus Modeling Updated Soil Sample Information
Appendix B:	Curtis Stibb Project Details: Site Map Updated Phosphorus Calculations Updated Snap Plus Modeling Updated Soil Sample Information
Appendix C:	WI Conference of SD Project Details: Site Map Updated Phosphorus Calculations Updated Snap Plus Modeling Updated Soil Sample Information Grassed Waterway Credit Quantification and Modeling Documentation
Appendix D:	Effluent Limit Compliance History: Prior Permit Term Credit Use Prior Permit Term Effluent Quality/Flows
Appendix E:	Prior Permit Term Annual Inspection Reports
Appendix F:	NRCS Conservation Practice Standards: Conservation Cover (Code 327) Cover Crop (Code 340) Filter Strip (Code 393) Grassed Waterway (Code 412)
Appendix G:	NRCS Technical Notes: Wisconsin Agronomy Technical Note 6 Wisconsin Agronomy Technical Note 7
Appendix H:	NRCS Operation and Maintenance Plans: Conservation Cover O&M Plan Cover Crop O&M Plan Filter Strip O&M Plan Grassed Waterway O&M Plan

1 INTRODUCTION

The City of Columbus Wastewater Treatment Facility (WWTF) received its renewed Wisconsin Pollutant Discharge Elimination System (WPDES) permit in December 2014. The permit contains an ultimate effluent total phosphorus (TP) water quality-based effluent limit (WQBEL) of 0.075 mg/L with a 6-month averaging period. These substantially reduced phosphorus limits stem from the changes to Wisconsin Administrative Code Chapters NR 217 and 102, more commonly referred to as the “Phosphorus Rule.” This rule was passed on December 1, 2010. Changes to NR 102 establish water quality standards for various surface waters in or adjacent to Wisconsin. Wisconsin Administrative Code NR 217 specifically outlines requirements for wastewater treatment facilities.

The City of Columbus WWTF discharges to the Crawfish River, which eventually flows into the Rock River. The WWTF therefore has two sets of limits for both TP and total suspended solids (TSS) in their WPDES permit: mass limits from the TMDL and WQBEL-based limits. The mass-based limits are meant to protect the Rock River, and the WQBEL-based limits are meant to protect the Crawfish River. The WQBELs are more restrictive than the TMDL-based limits.

The City of Columbus is achieving the mass-based wasteload allocations specified in the Rock River TMDL. However, Wisconsin Administrative Code mandates that the WWTF must meet the most stringent limit when multiple limits apply; therefore, the WQBEL-based limits govern for the City of Columbus WWTF and are the focus of this trading plan. The 0.075 mg/L limit is significantly lower than the technology-based limit of 1.0 mg/L that had been in place in previous permits.

1.1 Previous Planning Efforts

1.1.1 Final Compliance Alternatives Plan

In 2018, the City submitted the Final Compliance Alternatives Plan to the WDNR. The report included chemical optimization for phosphorus removal at the WWTF with additional WQT to supplement the chemical optimization. The report did not require a complete WQT Plan, however, WQT information was included as supplemental information to support the recommendation of WQT. The purpose of the report was to satisfy the requirements in for the wastewater treatment facility phosphorus compliance schedule.

1.1.2 Water Quality Trading Plan

In 2020, the City submitted the WQT Plan to WDNR outlining the three landowner agreements for WQT credits. The plan included credit quantification, site descriptions, trade ratio calculations, preliminary design, maintenance considerations, and an implementation timeline.

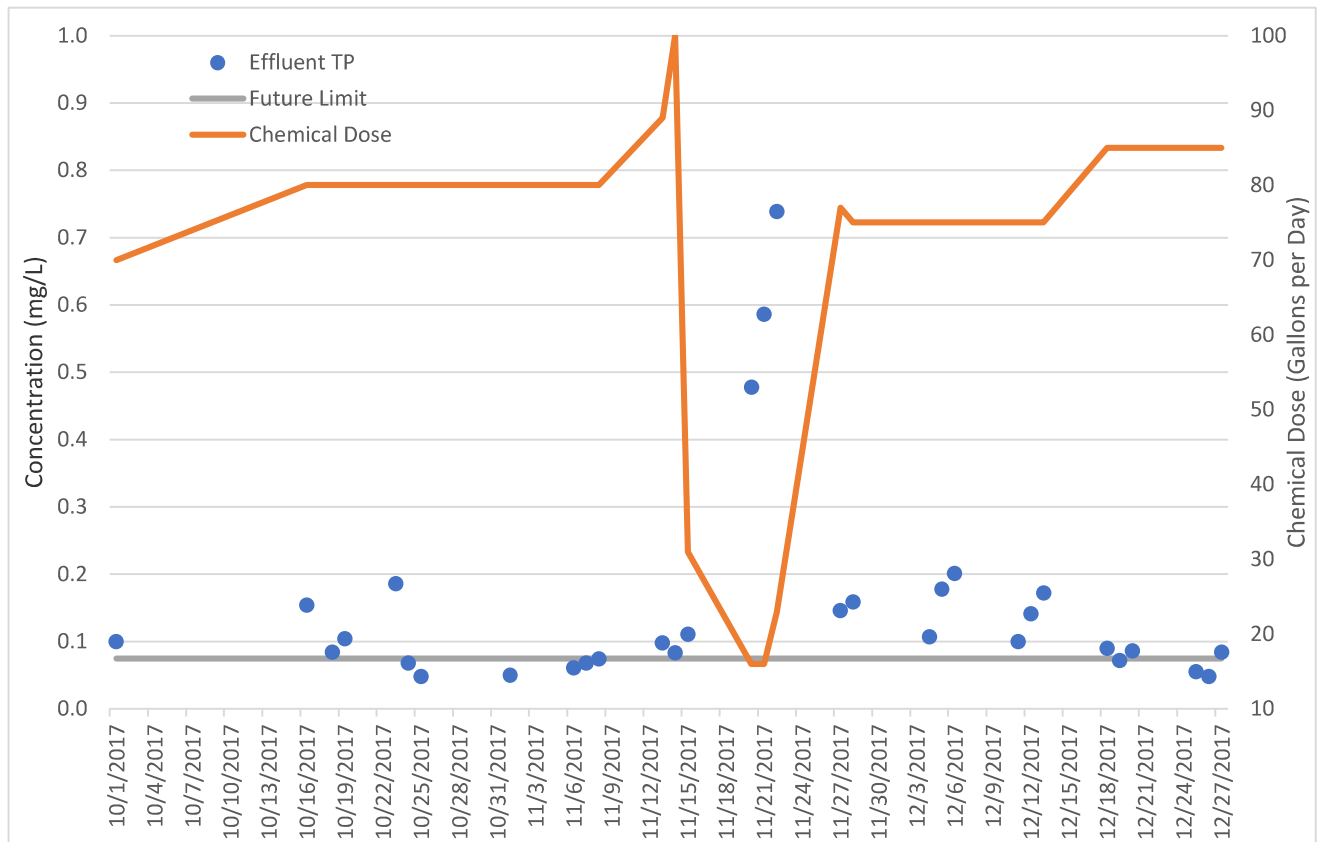
1.2 WWTF Optimization Activities and Pollutant Offset Needed

As discussed in the Final Compliance Alternatives Plan report, the WWTF staff were able to significantly reduce their effluent TP concentration using a Poly Aluminum Chloride (PAC) product.

The City tested Poly Aluminum Chloride (PAC) as an alternative to the ferric sulfate they have traditionally used. The City started their trial of this compound in October of 2017. The dose-response results with the PAC product is shown in Figure 1 below. At a dose of approximately 75 gallons per day, there was a significant decrease of the concentration of effluent TP, hovering around the future limit of 0.075 mg/L. Since the trial, the WWTF have continued to use the PAC product at a lower dose of 30 gallons per day and have not noticed any negative impacts on treatment operations. As a result, the City will use the PAC product as a long-term solution to optimize effluent phosphorus levels at the Columbus WWTF.

The City will continue to evaluate ways to optimize phosphorus removal at the treatment facility. More precise delivery pumps were implemented at the facility about three years ago. The City is evaluating having a redundant pump for greater chemical dose in times of peak flow rates through the facility. In the summer of 2024, the facility had very high flow rates due to intense rain events. The effluent phosphorus levels were high. Additional chemical dose will help in these circumstances.

Figure 1. Poly Aluminum Chloride Dose Response Results



Based on this pilot test of the PAC, WWTF are confident they can maintain an effluent concentration of approximately 0.1 mg/L.

To calculate the mass of phosphorus reduction required at the WWTF, not including a trade ratio, the following formula was used where the variable “x” denotes the effluent TP concentration at the WWTF:

$$(x \text{ mg/L} - 0.075 \text{ mg/L}) \times \text{MGD (average/design plant flow)} \times 8.34 \times 365 \text{ days}$$

The results of the analysis are as follows:

- The WWTF must maintain an average effluent TP concentration of 0.157 mg/L in order to offset 250 pounds per year with WQT with an actual flow at the WWTF of 1.0 MGD.
- The WWTF must maintain an average effluent TP concentration of 0.14 mg/L in order to offset 250 pounds per year with WQT with a design flow at the WWTF of 1.27 MGD.

2 CREDIT GENERATOR SITES

The City's WWTF is located partially in the northernmost HUC-12 area of the Lower Crawfish River watershed (070900011001) and partially in the southern most area of the Upper Crawfish River Watershed (070900010704).

The City has three WQT existing agreements. These agreements were started for the last permit term of the treatment facility.

- Colwis, LLC.
- Curtis Stibb, and
- Wisconsin Conference of SD

All three sites are located in Reach 51 of the Rock River TMDL area. This reach covers from Mauneshia River to Mud Creek. Per the TMDL, this reach requires a 30% TP reduction from the baseline load for nonpoint sources. The locations of these sites are shown in Figure 1. A summary of each credit generator site is below.

2.1 Colwis, LLC

The Colwis site is located near the confluence of the Crawfish River and the North Branch Crawfish River, approximately 6 miles northwest of the Columbus WWTF. The Crawfish River runs diagonally across the property from the southwest and joins the North Branch Crawfish River just northeast of the property line. The North Branch Crawfish River winds through the northern portion of the property before reaching the confluence. Due to this relatively high concentration of surface water on the property, opportunities were identified to optimize the property for nutrient removal.

In fall of 2020, buffer strips were constructed on the field just northwest of the Rhodes Bake-N-Serv building, and the field just northeast of the building has been put into conservation cover. The agricultural fields at this site have historically had a continuous corn rotation with soybeans intermixed every few years (i.e., three years of corn and one year of soybeans), with winter wheat occasionally planted. Fall chisel has typically been used at this site, and the site was not previously under a nutrient management plan.

Details of the installed practices, including location, updated phosphorus reduction credit estimates, updated Snap Plus modeling data, and updated soil sample information are provided in Appendix A.

2.2 Curtis Stibb

The Stibb Farm is located about 15 miles west and slightly north of the Columbus WWTF and discharges upstream of the WWTF outfall.

In 2018, Curtis Stibb contacted the City after a meeting was held with producers to discuss the water quality trading program potential. Columbia County set up a meeting at Stibb's property to determine potential for phosphorus reduction practices, which resulted in the formation of a conceptual plan for phosphorus reduction practice implementation. Curtis Stibb provided the County with details on his farming practices and land that were used in Snap Plus modeling to obtain phosphorus reduction credits.

In fall of 2020, four buffer strips were constructed and cover crops are planted on approximately 100 acres of agricultural field per year. The typical crop rotation on the agricultural fields in consideration is 3 to 4 years of corn with 1 year of soybeans. This site is typically strip tilled and is currently under a nutrient management plan. The Stibb Farm is not classified as a concentrated animal feeding operation (CAFO).

Details of the installed practices, including location, updated phosphorus reduction credit estimates, updated Snap Plus modeling data, and updated soil sample information are provided in Appendix B.

2.3 Wisconsin Conference of SD

The Wisconsin Conference is located near the confluence of the Crawfish River and the North Branch Crawfish River, approximately 6 miles northwest of the Columbus WWTF. The Crawfish River runs diagonally across the property from the southwest and joins the North Branch Crawfish River northeast of the property. The North Branch Crawfish River winds through the northern portion of the property before reaching the confluence. Due to this relatively high concentration of surface water on the property, there were several opportunities to optimize the property for nutrient removal. Several fields showed signs of erosion and required additional vegetative buffering along the river, and there were several low areas were identified that could have been taken out of production.

In fall 2020, two buffer strips, three conservation cover areas, and one grassed waterway was constructed at this site. The agricultural fields at this site have historically had a continuous corn rotation with soybeans intermixed every few years (i.e., three years of corn and one year of soybeans), with winter wheat occasionally planted. Fall chisel has typically been used, and the site was not previously under a nutrient management plan.

Details of the installed practices, including location, updated phosphorus reduction credit estimates, updated Snap Plus modeling data, and updated soil sample information are provided in Appendix C.

3 UPDATED TRADE RATIO

The WQT guidance developed by the WDNR uses trade ratios to ensure that load reductions generated by the implementation of pollutant management measures result in a net water quality improvement at the point of standards application. This ratio takes five factors into account in its calculation:

- **Delivery** – accounts for the distance between the credit generator and the credit user
- **Downstream** – accounts for the relative position of the credit generator to the credit user in the watershed
- **Equivalency** – accounts for different chemical forms of the traded pollutant
- **Uncertainty** – accounts for modeling inaccuracies when quantifying load reductions
- **Habitat Adjustment** – accounts for the wildlife habitat benefits of wetland restoration

The Spatially Referenced Regressions On Watershed Attributes (SPARROW) Model, was created by the United States Geological Survey (USGS) to provide estimates of phosphorus, nitrogen, and total suspended solids transport between upstream and downstream waterbodies. The delivery factor accounts for the distance between the credit generator and the credit user and the impact that distance has on the fate and transport of the pollutant in surface waters. This factor is accounted for when trading partners are located in different HUC-12 watersheds.

Using the WDNR Surface Water Data Viewer (SWDV) online map, catchment delivery fraction values were retrieved for the credit generator and user sites. These values are shown in Table 1 below.

Table 1. Credit Generator and User Catchment Delivery Fraction Summary

Site	Catchment Delivery Fraction
Curtis Stibb (Credit Generator)	0.51
Curtis Stibb (Credit Generator) – M Fields	0.56
Colwis, LLC (Credit Generator)	0.89
WI Conference of SD (Credit Generator)	0.89
Columbus WWTF (Credit User)	0.89

Using the values derived for each catchment, delivery fractions were calculated using the following equation:

$$\text{Delivery Fraction} = 1 - \frac{(\text{user del_frac} - \text{generator del_frac})}{\text{user del_frac}}$$

The calculated delivery fractions for each credit generator site is summarized in Table 2 below.

Table 2. Credit Generator Site Delivery Fraction Summary

Credit Generator Site	Delivery Fraction
Curtis Stibb	0.573
Curtis Stibb – M Fields	0.629
Colwis, LLC	1
WI Conference of SD	1

Incorporating this fraction into the trade ratio ensures that the natural attenuation of pollutants is accounted for, thereby protecting downstream water quality trading. The delivery fraction is then converted to a deliver factor using the following equation:

$$\text{Delivery Factor} = \frac{1}{\text{Delivery Fraction}} - 1$$

The calculated delivery factor for each credit generator site is summarized in Table 3 below.

Table 3. Credit Generator Site Delivery Factor Summary

Credit Generator Site	Delivery Fraction
Curtis Stibb	0.745
Curtis Stibb – M Fields	0.589
Colwis, LLC	0
WI Conference of SD	0

The trade ratio is then calculated with the following equation:

$$\text{Trade Ratio} = \text{Delivery} + \text{Downstream} + \text{Equivalency} + \text{Uncertainty} - \text{Habitat Adjustment} : 1$$

The updated trade ratios for each credit generator site is summarized in Table 4 below.

Table 4. Updated Trade Ratio Calculation Summary

Credit Generator Site	Delivery Factor	Downstream	Equivalency	Uncertainty	Prior Trade Ratio	Updated Trade Ratio
Curtis Stibb	0.745	0	0	2	2	2.745
Curtis Stibb – M Fields	0.589	0	0	2	2	2.589
Colwis, LLC	0	0	0	3	3	3
WI Conference of SD	0	0	0	3	3	3

When a nutrient management plan was in place, the uncertainty factor used for buffer strips was 2 and for cover crops was 2. Without a nutrient management plan, the uncertainty factor used for all practices was 3.

4 QUANTIFICATION OF CREDITS AND UPCOMING NEEDS

Columbus Utilities partnered with the Columbia County Land and Water Conservation Department to perform an updated analysis of the credit generator sites.

Updated SnapPlus models were run with soil samples within the last four years. The Phosphorus Trade Report estimates the annual pounds of phosphorus from cropland entering surface waters. These phosphorus loss calculations are based on a field's soil test phosphorus concentration, crops, tillage, nutrient management practices and estimates of average runoff and sheet and rill erosion for the predominant soil type.

Losses from concentrated flow channel or gully erosion with a field are not included in these calculations. Field runoff losses are calculated for each year as PTP (lb. P/field/yr). Fields are only included if there are at least 2 years of crops before the selected start year.

The PTPs calculated in these reports are then converted into phosphorus credits according to WDNR guidance, as described in Section 4.1 below.

4.1 Method for Quantifying Credits

All three proposed sites are in Reach 51 of the Rock River TMDL Area. This reach covers from Maunsha River to Mud Creek. Per the TMDL, this reach requires a 30% reduction of TP from the baseline load for nonpoint sources.

Credits were quantified for each practice by using the baseline pounds of total phosphorus (PTP) pre-trade and the improved PTP post-trade to determine the total PTP reduction. The TP Credit threshold is calculated by applying the TMDL percent reduction to the baseline TP loss.

4.2 Credits Generated

Updated phosphorus credit calculations are provided for each credit generator site in the corresponding appendix: Appendix A (Colwis, LLC), Appendix B (Curtis Stibb), and Appendix C (WI Conference of SD). A summary of the updated credits being generated is provided in Table 5 below.

Table 5. Updated Phosphorus Credits Generated

Credit Generator Site	Long Term Phosphorus Credits	Interim Phosphorus Credits
Curtis Stibb	76	23
Colwis, LLC	19	0
WI Conference of SD	126	0
Total	221	23

Interim phosphorus credits are available for use until July 2031. At that time, expired interim credits may be replaced with new interim credits or long-term credits.

4.3 Credit Timeline and Agreements

The credits will follow the same timeline as the WQT agreement duration, as summarized in Table 6 below.

Table 6. Water Quality Trading Agreements Summary

Credit Generator Site	Agreement Date	Agreement Duration
Curtis Stibb	April 7, 2020	5
Curtis Stibb	December 30, 2024 (Updated)	5
Colwis, LLC	March 16, 2020	10
WI Conference of SD	March 24, 2020	10

4.4 Expected Changes in Effluent Quality and Flows

A summary of effluent quality and flows for the prior permit term is provided in Appendix D.

There are no major changes expected for final effluent total phosphorus levels or flow rates through the wastewater treatment facility. The treatment facility had very high flow rates in the summer of 2024 due to several intense rain events. These events were in excess of 100-year events. When this happened, the existing phosphorus removal performance using chemical precipitation was not as efficient. The wastewater treatment facility is considering a larger chemical feed pump or second pump to operate in parallel in times of peak flow rate events. The increased chemical dose will help during times of higher flow rates through the facility.

Presently, the chemical dosage is adjusted manually by operators based on monitoring of performance of effluent total phosphorus several times a day using an online orthophosphorus meter and influent flow rates. The facility is considering an automated chemical dosage system to optimize performance of phosphorus removal. This change may have a marginal effect on effluent quality.

4.5 Upcoming Permit Term Credit Needs

A summary of the credit used over the prior permit term is provided in Appendix D. The average credits used per year for the last three full years (2022-2024) is 208. It is not anticipated that additional credits will be needed in the next permit term.

5 PRACTICES DESIGN AND MAINTENANCE

The practices were designed to conform with NRCS Conservation Practice Standards (Appendix F) for Conservation Cover (Code 327), Cover Crop (Code 340), Filter Strip (Code 393), and Grassed Waterway (Code 412). NRCS Wisconsin Agronomy Technical Notes (Appendix G) were also followed for seeding buffers with a no-till drill (Technical Note 6) as well as establishing cover crops using a seed mix of cereal rye and/or red clover (Technical Note 7).

Columbia County is responsible for inspecting the practices through an agreement between the City and the County. Certification inspections are conducted annually. Existing agreements between the City and landowners indicate that practices must be operated and maintained in accordance with the applicable NRCS Conservation Practice Standards identified in the introductory paragraph of this section. The Operation and Maintenance (O&M) Plans that outline necessary actions to ensure adequate performance and long life of the practices are provided in Appendix H.

The annual certification inspection shall follow these protocols:

- Each practice shall be inspected at a distance close enough to make valid observations of all inspection elements.
- Inspections shall be conducted under conditions that do not impair visibility (e.g., precipitation, fog, high water, or overgrown vegetation obstructing views).

The annual certification inspection shall include the following documentation:

- Date on which the inspection occurred.
- Weather conditions during the inspection.
- Photos of practices captioned in accordance with the WQT Plan naming convention.
- Summary of site conditions (e.g., adequate vegetation, absence of visible soil erosion).
- Confirmation that applicable O&M procedures have been carried out.

Provided that the WQT agreements remain in place and practices are being used to generate credits, WDNR may be granted access to project sites for inspections as needed. Such inspections will be coordinated through the City and the County.

In order to ensure proper tracking of the use of credits to meet the WQBEL, the City will maintain coordination with the WDNR. Among WQT-related logistics, the City is responsible for management practice registration forms, submitting annual reports, and if necessary, notice of the termination of a practice. The annual reports will notify the WDNR about any changes to the WQT agreement or compliance-related issues. If a practice permanently fails, the City will complete a Notice of Termination form along with additional coordination with WDNR staff.

Management Practice Registration Forms are provided in Appendix F for reference and use by the City as needed. The purpose of management practice registration is to ensure that the management practice is installed in accordance with the intended design of the WQT Plan. These make it easier for WDNR to review information related to the maintenance of the practice for trade verification and auditing.

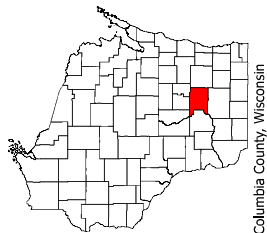
Exhibits

Exhibit 1: Credit User and Generator Location Map

**Credit User and Generator
Location Map**

Project #: 8220-10036
Drawn By: TMW
Approved By: TMW
Name: 1SiteLocation
Date Saved: 3/21/2025

Exhibit 1

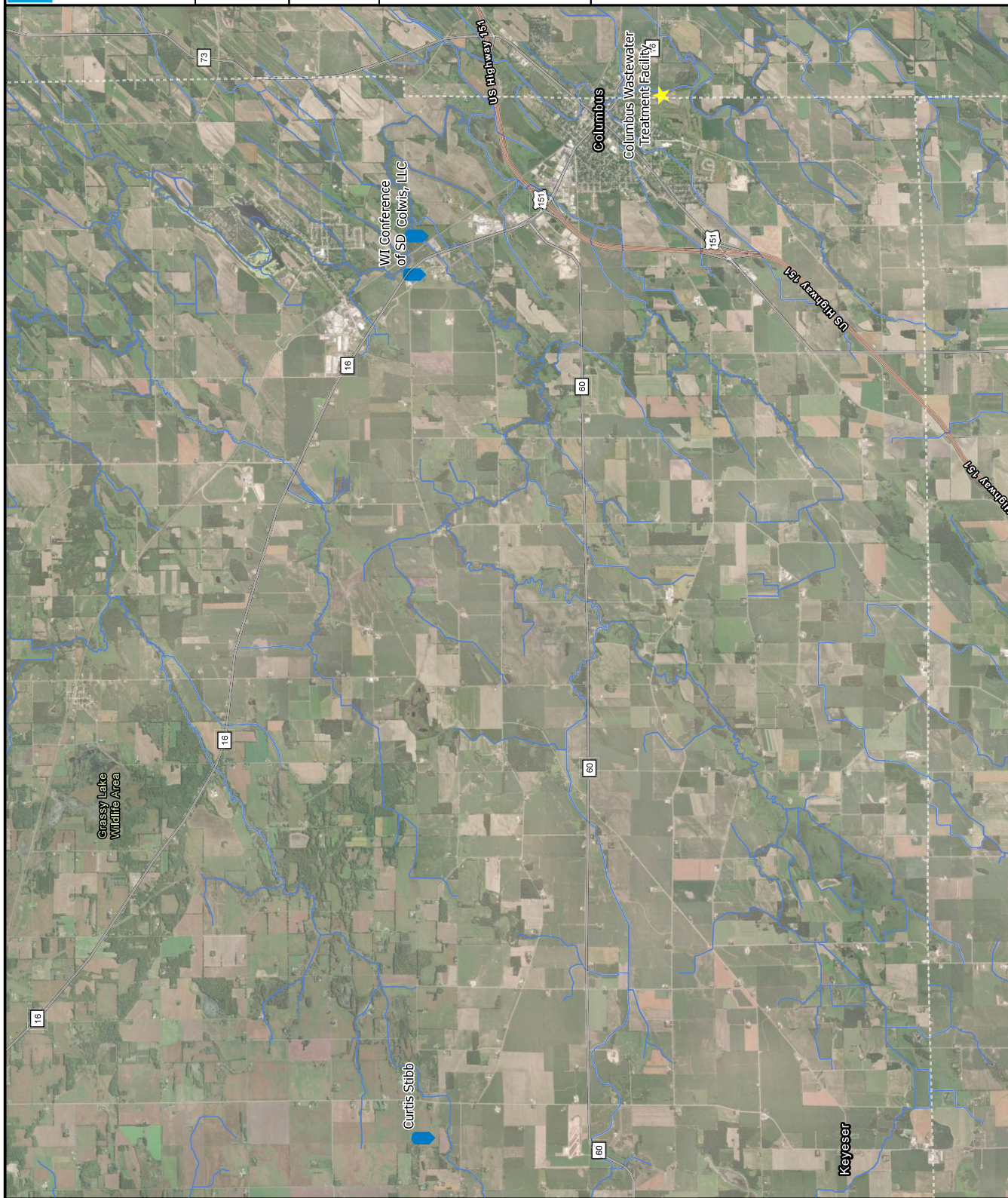


Columbia County, Wisconsin



Legend

- WDNR Waterways
- Credit User Site
- Credit Generator Sites



Appendix A: Colwis, LLC Project Details

Site Map

Updated Phosphorus Calculations

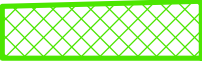
Updated Snap Plus Modeling

Updated Soil Sample Information

Colwis, LLC Site Map



 Field Borders

 Buffer-Conservation Cover

A80 Field label

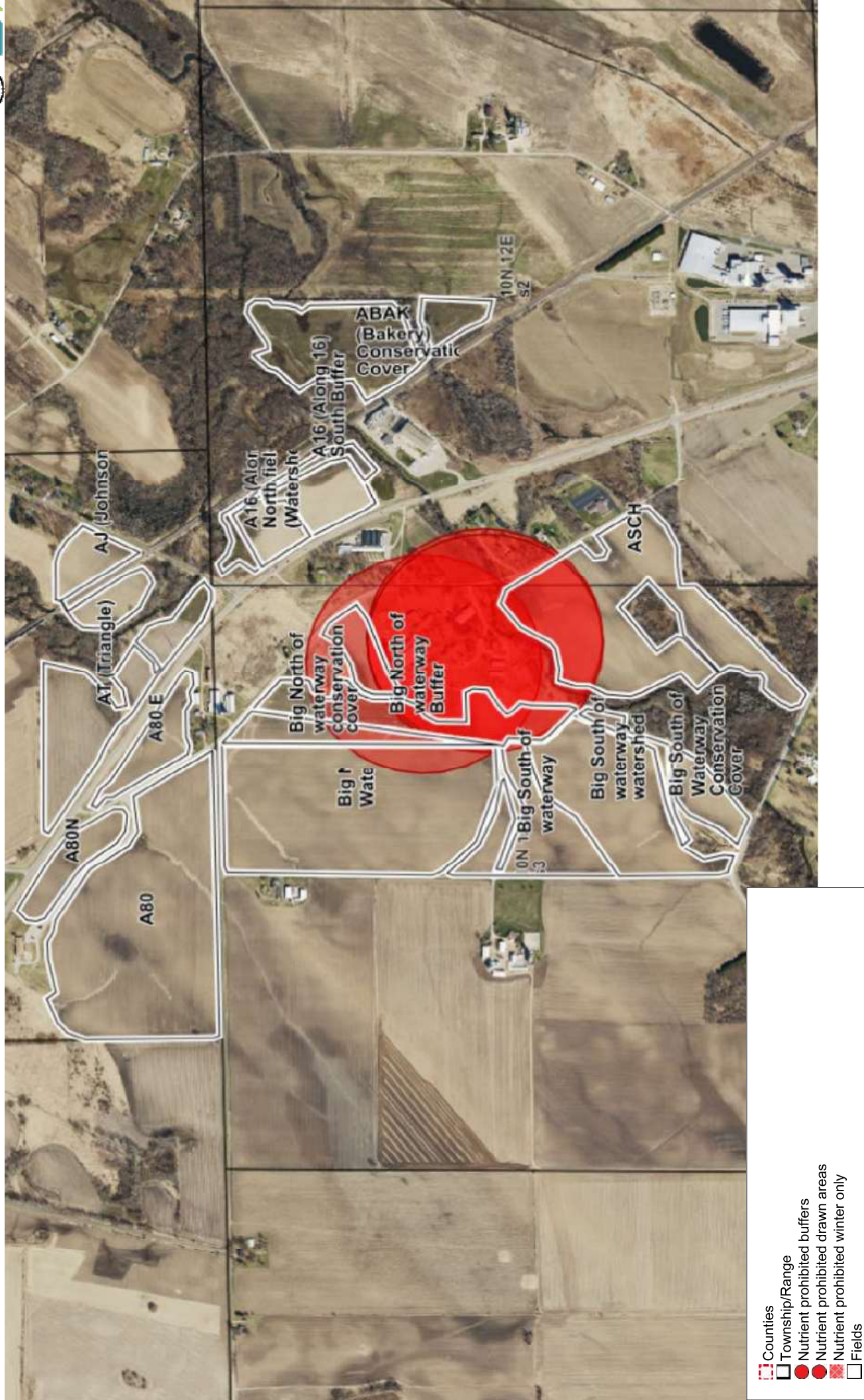


**2025 Updated Water Quality Trading Plan
Colwis, LLC
Phosphorus Credit Calculations**

Baseline TP Loss Calculations												
Practices (Listed on Map)	Location	Model Conditions	Acreage Used for Practices	Controlled Acreage	Rotation Length (years)	Average PTP	PTP Year 6	PTP Year 7	PTP Year 8	PTP Year 9	PTP Year 10	PTP Year 11
Buffer Strip	Field A16	Baseline PTP (pre-trade)	5	18	4	31	26	26	29	43	N/A	N/A
		Improved PTP (post-trade)				10	7	17	10	7	6	7
		Total Reduction				21	N/A	N/A	N/A	N/A	N/A	N/A
		Total Reduction With Trade Ratio				7	N/A	N/A	N/A	N/A	N/A	N/A
Conservation Cover	Field ABAK	Baseline PTP (pre-trade)	25	25	4	36	30	29	35	49	N/A	N/A
		Improved PTP (post-trade)				0	0	0	0	0	0	0
		Total Reduction				36	N/A	N/A	N/A	N/A	N/A	N/A
		Total Reduction With Trade Ratio				12	N/A	N/A	N/A	N/A	N/A	N/A

TP Credit Threshold Calculations										
Practices (listed on map)	Location	Field Acres	Current/Planned (post-trade) Conditions Avg	Pre-trade lb/acre/year	Post-trade lb/acre/year	Interim Reduction (negative values mean zero inteirm credits)	Long-Term Reduction	Trade Ratio	Long Term Credits	Interim Credits
Buffer Strip	Field A16	18	10	2	1	-45	21	3	7	-15
Conservation Cover	Field ABAK	25	0	1	0	-69	36	3	12	-23
Total									19	0

Credit Threshold	
TMDL Subbasin	Subbasin 51
pounds per acre per year	4.2
Percent Reduction	30



NM1: Narrative and Crops Report

Starting Year	2025
Reported For	Academ School/Bakery
Printed	2025-03-26
Plan Completion/Update Date:	2018-10-30
SnapPlus Version	20.4 built on 2021-06-03
T:\WC\DI\Programs\City of Columbus\2025-SNAPPlus update info	
I:\AcademySchool\withBuffersandConservationcoverupdate3-25-25.snapDb	

Prepared for:
Academ School/Bakery
attn:Academy School
Fall River , 53932

Farm has 19 fields totalling 346.6 cropped acres.
Farm Narrative: Rick Yeik is operator of Wisconsin Conference of Seventh Day Adventists Farm. Rotation is generally 2 to 3 years corn then soybeans and ocassionly winter wheat in rotation.

Annual Farm Notes:
No Annual Farm Notes

Spreader Calibration Methods: Custom applications, Equipment calibration, Amount applied / Acres

Narrative and Crops:

Field Name	Field Acres	2025	2026	2027	2028	2029	2030
A16 (Along 16) north Buffer	2.4	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
A16 (Along 16) North field (Watershed)	5.4	Corn grain Fall vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 46-55 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 46-55 bu/acre
A16 (Along 16) South Buffer	2.5	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre

Field Name	Field Acres	2025	2026	2027	2028	2029	2030
A16 (Along 16) South field (Watershed)	8.1	Corn grain Fall vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 46-55 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 46-55 bu/acre
A80	62.6	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre
A80 E	7.9	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre
A80N	7.6	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre
ABAK (Bakery) Conservati on Cover	25.3	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
ABNE Conservati on Cover (North next to school)	5.6	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
AJ (Johnson)	10.7	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 56-65 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre
ASCH	46.5	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre

Field Name	Field Acres	2025	2026	2027	2028	2029	2030
AT (Triangle)	22.2	Corn grain Fall vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 46-55 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre
Big North of Waterway	59.7	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Fall vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 66-75 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre
Big North of waterway Buffer	16.9	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
Big North of waterway conservatio n cover	7.9	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
Big South of waterway	17	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre
Big South of waterway Buffer	3.1	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
Big South of Waterway Conservati on Cover	6.4	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
Big South of waterway watershed	28.8	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre

Summary by Crop:

NOTE: Yields calculated using the midpoint of the SnapPlus yield goal range for each crop.

Crops Grouped By Category	2025	2026	2027	2028	2029	2030
Grass hay	70 175	70 175	70 175	70 175	70 175	70 175
Corn grain	277 49,999	241 43,501	206 37,183	277 49,999	277 49,999	252 45,486
Soybeans 15-20 inch row		36 1,818	70 4,235			24 1,212

WQ1: P Trade Report

Reported For	Academ School/Bakery	
Printed	2025-03-26	
Plan Completion/Update Date	2018-10-30	
SnapPlus Version	20.4 built on 2021-06-03	
T:\LWCD\Programs\City of Columbus\2025-SNAPPlus update info AcademySchoolwithBuffersandConservationcoverupdate3-25-25.snapDb		

Prepared for:
Academ School/Bakery
attn:Academy School
Fall River , 53932

The P Trade Report estimates the annual pounds of phosphorus (P) in surface runoff from cropland entering surface waters. These P loss calculations are based on a field's soil test P concentration, crops, tillage, nutrient management practices and estimates of average runoff and sheet and rill erosion for the predominant soil type. Losses from concentrated flow channel or gully erosion with a field are not included in these calculations. Field runoff losses are calculated for each year as **PTP** (lb P/field/yr). Fields are only included if there are at least 2 years of crops before the selected start year. Before using this report as part of a Water Quality Trade activity, phosphorus losses (PTP) must be converted into 'P credits' according to DNR guidance.

For more information go to <http://dnr.wi.gov/> and type keyword: **Water Quality Trading**

Questions? Please contact
DNRphosphorus@wisconsin.gov

This report was developed for Wisconsin DNR Water Quality Trading and Adaptive Management purposes and cannot be used to demonstrate compliance with NR 151 or NRCS 590 NM plan requirements.

P Trade Report				PTP					
Field Name	Soil Series	Soil Symbol	Acres	2025	2026	2027	2028	2029	2030
A16 (Along 16) north Buffer	OSSIAN	OsA	2	1	1	1	1	1	1
A16 (Along 16) North field (Watershed)	SAYBROOK	SeB2	5	2	6	3	2	2	2
A16 (Along 16) South Buffer	GILFORD	GaA	3	1	1	1	1	1	1
A16 (Along 16) South field (Watershed)	SAYBROOK	SeB2	8	3	9	5	3	2	3
A80	PLANO	PnB	63	71	68	66	64	62	61
A80 E	SAYBROOK	SeB2	8	12	10	10	10	9	9
A80N	PLANO	PnB	8	12	10	10	9	9	9

P Trade Report					PTP				
Field Name	Soil Series	Soil Symbol	Acres	2025	2026	2027	2028	2029	2030
ABAK (Bakery) Conservation Cover	GILFORD	GaA	25	0	0	0	0	0	0
ABNE Conservation Cover(North next to school)	JOY	JoA	6	1	1	1	1	1	1
AJ (Johnson)	GRELLTON VARIANT	GnA	11	7	7	6	9	6	5
ASCH	ST. CHARLES	SaB2	47	15	14	13	12	11	10
AT (Triangle)	PLANO	PnB	22	6	13	12	6	5	5
Big North of Waterway	PLANO	PnB	60	17	14	40	29	16	13
Big North of waterway Buffer	JOY	JoA	17	4	3	3	3	3	2
Big North of waterway conservation cover	SAYBROOK	SeB2	8	1	1	1	1	1	1
Big South of waterway	PLANO	PnB	17	15	14	14	13	13	12
Big South of waterway Buffer	JOY	JoA	3	0	0	0	0	0	0
Big South of Waterway Conservation Cover	SAYBROOK	SeB2	6	1	1	1	1	0	0
Big South of waterway watershed	PLANO	PnB	29	8	8	7	6	6	5
Total			347	177	181	194	171	148	139

FM6: Soil Test Report

Reported For	Academ School/Bakery		
Printed		2025-02-10	
Plan Completion/Update Date		2018-10-30	
SnapPlus Version	20.4 built on 2021-06-03		
T:\LWCD\Programs\City of Columbus\2025-SNAPPlus update info Academy School - with Buffers and Conservation cover updated 2025.snapDb			

Prepared for:
Academ School/Bakery
attn:Academy School
Fall River , 53932

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm		
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S
A16 (Along 16) north Buffer		2.4	OsA	OSSIAN	2016-11-04	Ag Source		1	1	7.2	2.9	71	121	0
A16 (Along 16) North field (Watershed)		5.4	SeB2	SAYBROOK	2016-11-04	Ag Source		1	1	6.5	1.3	41	140	0
A16 (Along 16) North field (Watershed)		5.4	SeB2	SAYBROOK	2022-11-21			1	1	6.6	1.9	42	125	0
A16 (Along 16) North field (Watershed)		5.4	SeB2	SAYBROOK	2023-11-30	Ag Source		1	1	6.5	1.6	27	148	0
A16 (Along 16) South Buffer		2.5	GaA	GILFORD	2016-11-04	Ag Source		1	1	6.9	2.3	68	105	0
A16 (Along 16) South field (Watershed)		8.1	SeB2	SAYBROOK	2016-11-04	Ag Source		2	2	7.1	2.1	68	124	0

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm		
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S
A16 (Along 16) South field (Watershed)		8.1	SeB2	SAYBROOK	2023-11-30	Ag Source		2	1	6.5	1.6	27	148	0
A16 (Along 16) South field (Watershed)		8.1	SeB2	SAYBROOK	2022-11-21			2	1	6.6	1.9	42	125	0
A80		62.6	PnB	PLANO	2016-11-04	Ag Source		13	12	6.4	3.4	37	117	0
A80		62.6	PnB	PLANO	2023-11-30	Ag Source		13	1	6.1	3.3	24	142	0
A80		62.6	PnB	PLANO	2019-12-19	Ag Source		13	1	6.2	3.5	24	126	0
A80 E		7.9	SeB2	SAYBROOK	2016-11-04	Ag Source		2	3	7.0	3.1	67	117	0
A80 E		7.9	SeB2	SAYBROOK	2023-11-30	Ag Source		2	2	6.6	3.0	42	154	0
A80 E		7.9	SeB2	SAYBROOK	2019-12-03	Ag Source		2	2	6.9	3.3	70	192	0
A80N		7.6	PnB	PLANO	2016-11-04	Ag Source		2	2	7.1	3.4	90	241	0
A80N		7.6	PnB	PLANO	2023-11-30	Ag Source		2	2	7.0	3.0	51	207	0
A80N		7.6	PnB	PLANO	2019-12-03	Ag Source		2	2	7.2	3.1	70	220	0
ABAK (Bakery) Conservation Cover		25.3	GaA	GILFORD	2016-11-10	AgSource Labs		5	4	7.3	5.9	6	41	0
ABNE Conservation Cover (North next to school)		5.6	JoA	JOY	2016-11-04	Ag Source		1	2	6.9	2.8	38	110	0
AJ (Johnson)		10.7	GnA	GRELLTON VARIANT	2016-11-04	Ag Source		2	2	6.7	1.3	70	98	0
AJ (Johnson)		10.7	GnA	GRELLTON VARIANT	2023-11-30	Ag Source		2	4	6.1	1.3	49	131	0
AJ (Johnson)		10.7	GnA	GRELLTON VARIANT	2019-12-03	Ag Source		2	4	6.0	1.2	51	89	0

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm		
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S
ASCH		46.5	SaB2	ST. CHARLES	2016-11-11	Ag Source		9	10	6.5	2.4	12	87	0
ASCH		46.5	SaB2	ST. CHARLES	2023-11-30	Ag Source		9	1	5.8	2.5	20	101	0
ASCH		46.5	SaB2	ST. CHARLES	2019-12-04	Ag Source		9	1	6.1	2.5	15	87	0
AT (Triangle)		22.2	PnB	PLANO	2016-11-04	Ag Source		4	5	6.8	2.9	40	91	0
AT (Triangle)		22.2	PnB	PLANO	2023-11-30	Ag Source		4	1	6.1	3.2	19	125	0
AT (Triangle)		22.2	PnB	PLANO	2019-12-03	Ag Source		4	1	6.3	3.3	37	65	0
Big North of Waterway		59.7	PnB	PLANO	2016-11-04	Ag Source		12	17	6.6	3.0	26	146	0
Big North of Waterway		59.7	PnB	PLANO	2023-11-30	Ag Source		12	1	5.7	3.1	18	127	0
Big North of Waterway		59.7	PnB	PLANO	2019-12-03	Ag Source		12	1	6.4	3.1	18	105	0
Big North of waterway Buffer		16.9	JoA	JOY	2016-11-04	Ag Source		3	5	6.8	3.2	40	198	0
Big North of waterway conservatio n cover		7.9	SeB2	SAYBROOK	2016-11-04			2	8	6.7	3.1	38	192	0
Big South of waterway		17	PnB	PLANO	2016-11-04	Ag Source		3	12	6.5	2.8	15	97	0
Big South of waterway		17	PnB	PLANO	2023-11-30	ag source		3	1	5.9	2.8	18	101	0
Big South of waterway		17	PnB	PLANO	2019-12-04	Ag Source		3	1	6.1	2.9	16	86	0
Big South of waterway Buffer		3.1	JoA	JOY	2016-11-04	Ag Source		1	3	6.7	2.6	12	93	0
Big South of Waterway Conservatio n Cover		6.4	SeB2	SAYBROOK	2016-11-04			1	1	6.8	2.2	23	95	0

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm		
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S
Big South of waterway watershed		28.8	PnB	PLANO	2018-11-05	Ag source		6	9	6.4	2.8	16	98	0
Big South of waterway watershed		28.8	PnB	PLANO	2023-11-30	Ag source		6	1	5.9	2.8	18	102	0
Big South of waterway watershed		28.8	PnB	PLANO	2019-12-03	Ag Source		6	1	6.1	2.9	16	86	0

Crop Year Soil Test Needed

Field Name	Soil Test Date	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
A16 (Along 16) north Buffer	2016-11-04						X								
A16 (Along 16) North field (Watershed)	2023-11-30													X	
A16 (Along 16) South Buffer	2016-11-04						X								
A16 (Along 16) South field (Watershed)	2023-11-30													X	
A80	2023-11-30													X	
A80 E	2023-11-30													X	
A80N	2023-11-30													X	
ABAK (Bakery) Conservation Cover	2016-11-10						X								
ABNE Conservation Cover(North next to school)	2016-11-04						X								
AJ (Johnson)	2023-11-30													X	
ASCH	2023-11-30													X	
AT (Triangle)	2023-11-30													X	
Big North of Waterway	2023-11-30													X	
Big North of waterway Buffer	2016-11-04						X								
Big North of waterway conservation cover	2016-11-04						X								

Field Name	Soil Test Date	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Big South of waterway	2023-11-30													X	
Big South of waterway Buffer	2016-11-04						X								
Big South of Waterway Conservation Cover	2016-11-04						X								
Big South of waterway watershed	2023-11-30													X	

Appendix B: Curtis Stibb Project Details

Site Map

Updated Phosphorus Calculations

Updated Snap Plus Modeling

Updated Soil Sample Information

Stibb Buffer Proposal



Stibb Waterway Proposal



Curtis Stibb

Owner

Columbia County LWCD

Designed: TO Checked:

Page ? of ?





**2025 Updated Water Quality Trading Plan
Wisconsin Conference of SD
Phosphorus Credit Calculations**

Baseline TP Loss Calculations											
Practices (Listed On Map)	Location	Model Conditions	Acreage Taken Out of Production	Controlled Acreage	Rotation Length (Years)	Average PTP	PTP Year 5	PTP Year 6	PTP Year 7	PTP Year 8	PTP Year 9
M4 Buffer Strip	Field M4	Baseline PTP (pre-trade)	2	18	4	12	18	12	8	10	N/A
		Improved PTP (post-trade)				3	4	3	3	2	4
		Interim Total Reduction				9	14	9	5	8	N/A
		Interim Total Reduction With Trade Ratio				5	1	1	1	1	N/A
M5 Buffer Strip	Field M5	Baseline PTP (pre-trade)	2	8	4	4	4	5	3	4	N/A
		Improved PTP (post-trade)				1	1	1	1	1	1
		Interim Total Reduction				3	3	4	2	3	N/A
		Interim Total Reduction With Trade Ratio				2	1	1	1	1	N/A
M6 Buffer Strip	Field M6	Baseline PTP (pre-trade)	2	6	4	4	6	3	2	3	N/A
		Improved PTP (post-trade)				1	1	1	1	1	1
		Interim Total Reduction				3	5	2	1	2	N/A
		Interim Total Reduction With Trade Ratio				1	2	1	0	1	N/A
M7 Buffer Strip	Field M7	Baseline PTP (pre-trade)	5	11	4	9	11	6	9	10	N/A
		Improved PTP (post-trade)				3	3	3	3	3	3
		Interim Total Reduction				6	8	3	6	7	N/A
		Interim Total Reduction With Trade Ratio				3	3	1	2	2	N/A
Cover Crops	Field H1	Baseline PTP (pre-trade)	0	29	5	62	66	147	13	10	75
		Improved PTP (post-trade)				28	44	24	20	34	20
		Interim Total Reduction				34	22	123	-7	-24	55
		Interim Total Reduction With Trade Ratio				17	7	41	-2	-8	18
Cover Crops	Field H1A	Baseline PTP (pre-trade)	0	19	5	49	95	28	21	15	87
		Improved PTP (post-trade)				21	27	18	16	27	16
		Interim Total Reduction				28	68	10	5	-12	71
		Interim Total Reduction With Trade Ratio				14	23	3	2	-4	24
Cover Crops	Field H4	Baseline PTP (pre-trade)	0	24	5	49	42	25	23	144	13
		Improved PTP (post-trade)				22	15	47	14	13	20
		Interim Total Reduction				28	27	-22	9	131	-7
		Interim Total Reduction With Trade Ratio				14	9	-7	3	44	-2
Cover Crops	Field M1	Baseline PTP (pre-trade)	0	73	4	62	84	62	61	40	N/A
		Improved PTP (post-trade)				61	24	95	96	30	24
		Interim Total Reduction				1	60	-33	-35	10	N/A
		Interim Total Reduction With Trade Ratio				0	20	-11	-12	3	N/A
Cover Crops	Field M3	Baseline PTP (pre-trade)	0	35	4	67	33	70	135	29	N/A
		Improved PTP (post-trade)				43	70	46	31	23	48
		Interim Total Reduction				24	-37	24	104	6	N/A
		Interim Total Reduction With Trade Ratio				12	-12	8	35	2	N/A
Cover Crops	Field D3	Baseline PTP (pre-trade)	0	18	5	33	68	37	29	17	15
		Improved PTP (post-trade)				28	24	12	33	38	33
		Interim Total Reduction				5	44	25	-4	-21	-18
		Interim Total Reduction With Trade Ratio				3	15	8	-1	-7	-6
Cover Crops	Field D4	Baseline PTP (pre-trade)	0	8	5	8	9	5	5	8	14
		Improved PTP (post-trade)				4	3	2	1	3	10
		Interim Total Reduction				4	6	3	4	5	4
		Interim Total Reduction With Trade Ratio				2	2	1	1	2	1
Cover Crops	Field D5	Baseline PTP (pre-trade)	0	12	5	114	51	68	77	201	171
		Improved PTP (post-trade)				22	13	10	10	26	51
		TMDL Threshold				4	4	4	4	4	4
		Baseline (lb/ac)				9	4	6	6	N/A	N/A
		Improved (lb/ac)				2	1	1	1	2	4
		Interim Total Reduction				92	38	58	67	175	120
		Long Term Reduction (lb/ac)				2	3	3	3	2	0
		Long Term Total Reduction (lb)				28	35	38	38	22	-3
		Interim Total Reduction With Trade Ratio				46	13	19	22	58	40
		Long Term Total Reduction With Trade Ratio				14	18	19	19	N/A	N/A
Cover Crops	Field R1	Baseline PTP (pre-trade)	0	8	5	7	6	3	7	12	7
		Improved PTP (post-trade)				3	2	2	3	4	2
		Interim Total Reduction				4	4	1	4	8	5
		Interim Total Reduction With Trade Ratio				2	1	0	1	3	2
Cover Crops	Field R1A	Baseline PTP (pre-trade)	0	20	5	16	14	6	22	28	12
		Improved PTP (post-trade)				7	5	4	11	11	5
		Interim Total Reduction				9	9	2	11	17	7
		Interim Total Reduction With Trade Ratio				5	3	1	4	6	2
Cover Crops	Field R4	Baseline PTP (pre-trade)	0	12	5	6	7	4	5	5	8
		Improved PTP (post-trade)				10	12	7	5	12	13
		Interim Total Reduction				-4	-5	-3	0	-7	-5
		Interim Total Reduction With Trade Ratio				-2	-2	-1	0	-2	-2
Cover Crops	Field F1	Baseline PTP (pre-trade)	0	33	5	30	32	14	21	24	58
		Improved PTP (post-trade)				8	9	8	10	8	7
		Interim Total Reduction				21	23	6	11	16	51
		Interim Total Reduction With Trade Ratio				11	8	2	4	5	17



**2025 Updated Water Quality Trading Plan
Wisconsin Conference of SD
Phosphorus Credit Calculations**

TP Credit Threshold Calculations										
Practices (listed on map)	Location	Field Acres	Current/Planned (post-trade) Conditions Avg	Pre-trade lb/acre/year	Post-trade lb/acre/year	Interim Reduction (negative values mean zero inteirm credits)	Long-Term Reduction	Trade Ratio	Long Term Credits	Interim Credits
M4 Buffer Strip	Field M4	18	3	1	0	-64	9	3	3	-25
M5 Buffer Strip	Field M5	8	1	1	0	-30	3	3	1	-11
M6 Buffer Strip	Field M6	6	1	1	0	-22	3	3	1	-8
M7 Buffer Strip	Field M7	11	3	1	0	-37	6	3	2	-14
Cover Crops	Field H1	29	28	2	1	-60	34	3	12	-22
Cover Crops	Field H1A	19	21	3	1	-31	28	3	10	-11
Cover Crops	Field H4	24	22	2	1	-51	28	3	10	-19
Cover Crops	Field M1	73	61	1	1	-245	1	3	0	-89
Cover Crops	Field M3	35	43	2	1	-80	24	3	9	-29
Cover Crops	Field D3	18	28	2	2	-42	5	3	2	-15
Cover Crops	Field D4	8	4	1	0	-25	4	3	2	-9
Cover Crops	Field D5	12	22	9	2	63	28	3	10	23
Cover Crops	Field R1	8	3	1	0	-27	4	3	2	-10
Cover Crops	Field R1A	20	7	1	0	-68	9	3	3	-25
Cover Crops	Field R4	12	10	0	1	-45	-4	3	-1	-16
Cover Crops	Field F1	33	8	1	0	-109	21	3	8	-40
Total									76	23

Credit Threshold	
TMDL Subbasin	Subbasin 51
pounds per acre per year	4.2
Percent Reduction	30



- Counties
- Township/Range
- Nutrient prohibited buffers
- Nutrient prohibited drawn areas
- Nutrient prohibited winter only
- Fields
- Grassed waterway
- Drinking well



Hwy 22 Fields Stibb

Farm: Stibb Grain and Livestock LLC, V20 Generated:3/25/2025, Crop year: 2025, Township Range Section:11N 10E s21



- Counties
- Township/Range
- Nutrient prohibited buffers
- Nutrient prohibited drawn areas
- Nutrient prohibited winter only
- Fields
- Grassed waterway
- Drinking well

NM1: Narrative and Crops Report

Starting Year	2025
Reported For	Stibb Grain and Livestock LLC
Printed	2025-10-31
Plan Completion/Update Date:	2018-02-22
SnapPlus Version	20.4 built on 2021-06-03
C:\Users\lcdtar\OneDrive - Columbia County Wisconsin\Team LCD - General\WC\Programs\City of Columbus\2025-SNAPPlus update info \Stibb\Stibbs Columbusfuturetrading9-1-25manure.snapDb	

Prepared for:
Stibb Grain and Livestock LLC
attn:Curt Stibb
N2151 Cty C
Rio, 53960

Farm has 39 fields totalling 740.5 cropped acres.

Farm Narrative: Curt Stibb operate 745 acres in Columbia County to the south of Rio on County C. Curt keeps about 150 to 200 animal units mostly Holstien Steers of various sizesfrom calves to 1500lb market weight. The manure is applied to different fields every year to help balance fertility. For the last six years we have been Variable Rate Applying Dap and Potash in the Spring or Fall to try to even out the soil tests across the farm.

There are fields that show excess Phosphorus applications since we are trying to even out P and K levels with VRT. Even though many fields average P levels are above optimum, I still have areas of the fields that are below optimum levels. They typically grow Corn, Soybeans, Alfalfa, and Winter wheat. Tillage is mostly zone tillage for corn and No Till for Soybeans and Wheat. He uses chisel plowing on a couple low lying fields. This plan is P based and uses the P Index for checking compliance with the NMP 590 Standard. All Fields Meet T for Tolerable Soil Loss with current farming practices.

The farm has mre than adequate land for the manure produced. Winter applied manure should be applied at less than 15 ton per ac to keep Phosphorus below the next crops use.

Curtis K Stibb
W5201 Hall Rd
Poynette, WI 53955

Annual Farm Notes:

No Annual Farm Notes

Spreader Calibration Methods: Custom applications, Equipment calibration, Amount applied / Acres

Narrative and Crops:

Field Name	Field Acres	2025	2026	2027	2028	2029	2030
D1	19.1	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 66-75 bu/acre
D2	16.8	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 36-45 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain No Till 191-210 bu/acre
D3	17.9	Corn grain Strip Till 231-250 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 66-75 bu/acre
D3A	21.8	Corn grain Strip Till 231-250 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 66-75 bu/acre
D4	8.1	Corn grain Strip Till 231-250 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 15-20 inch row No Till 56-65 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre
D5	11.6	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 15-20 inch row No Till 56-65 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre

Field Name	Field Acres	2025	2026	2027	2028	2029	2030
D6	11.9	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 15-20 inch row No Till 56-65 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre
F1	33.1	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre
H1	29.2	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 231-250 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 66-75 bu/acre
H1A	18.6	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 66-75 bu/acre
H2	26.4	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre
H3	21.5	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans to small grain cover crop Strip Till, cover crop no till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre
H3A	17.6	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre

Field Name	Field Acres	2025	2026	2027	2028	2029	2030
H4	24.2	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre
H4A	13.8	Corn grain Strip Till 191-210 bu/acre	Corn grain Spring Cultivation 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans to small grain cover crop No Till, cover crop no till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre
Hwy 22 North	42.7	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 15-20 inch row No Till 56-65 bu/acre	Winter wheat (grain) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre
Hwy 22 South	38.8	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre
M1	72.9	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain) to annual cover crop No Till, cover crop no till 81-100 bu/acre
M2	18.5	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre
M3	35.1	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre

Field Name	Field Acres	2025	2026	2027	2028	2029	2030
M4	16.3	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre
M4-Buffer	1.8	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre
M5	5.5	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre
M5 Buffer	1.5	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre
M6	3.5	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre
M6 Buffer	2.2	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre
M7	6.2	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre
M7 buffer	5.3	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre	Alfalfa None 5,6-6.5 ton/acre

Field Name	Field Acres	2025	2026	2027	2028	2029	2030
R1	8	Corn grain Strip Till 231-250 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre
R1A	19.7	Corn grain Strip Till 231-250 bu/acre	Soybeans 15-20 inch row No Till 56-65 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre
R2	11.9	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre
R3	33.9	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre
R4	11.6	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 15-20 inch row No Till 56-65 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre
S1	13.4	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 15-20 inch row No Till 56-65 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre

Field Name	Field Acres	2025	2026	2027	2028	2029	2030
S2	57.2	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain +straw) to annual cover crop No Till, cover crop no till 81-100 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Winter wheat (grain) to annual cover crop No Till, cover crop no till 81-100 bu/acre
S3	18.2	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre
S4	16.4	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre
S4 Low	6.1	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre
S5	2.2	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre	Corn grain Strip Till 191-210 bu/acre	Corn grain Strip Till 191-210 bu/acre	Soybeans 7-10 inch row No Till 66-75 bu/acre

Summary by Crop:

NOTE: Yields calculated using the midpoint of the SnapPlus yield goal range for each crop.

Crops Grouped By Category		2025	2026	2027	2028	2029	2030
Corn grain	Acres bu	472 94,636	429 86,015	376 75,388	468 93,834	442 88,621	362 72,581
Soybeans 7-10 inch row	Acres bu	173 12,197	151 10,646	117 8,249	124 8,742	181 12,761	131 9,236
Soybeans to small grain cover crop	Acres bu				38 2,679	22 1,551	107 7,544

Crops Grouped By Category	2025	2026	2027	2028	2029	2030
Winter wheat (grain +straw) to annual cover crop	85 7,693	130 11,765	137 12,399	57 5,159	85 7,693	
Soybeans 15-20 inch row		20 1,210	99 5,990			
Winter wheat (grain) to annual cover crop				43 3,892		130 11,765
Alfalfa	11 67	11 67	11 67	11 67	11 67	11 67

WQ1: P Trade Report

Reported For	Stibb Grain and Livestock LLC		
Printed	2025-10-31		
Plan Completion/Update Date	2018-02-22		
SnapPlus Version	20.4 built on 2021-06-03		
C:\Users\howebm\Desktop\Stibbs Columbusfuturetrading9-1-25manure10.10.25.snapDb			

Prepared for:
Stibb Grain and Livestock LLC
attn:Curt Stibb
N2151 Cty C
Rio, 53960

The P Trade Report estimates the annual pounds of phosphorus (P) in surface runoff from cropland entering surface waters. These P loss calculations are based on a field's soil test P concentration, crops, tillage, nutrient management practices and estimates of average runoff and sheet and rill erosion for the predominant soil type. Losses from concentrated flow channel or gully erosion with a field are not included in these calculations. Field runoff losses are calculated for each year as **PTP** (lb P/field/yr). Fields are only included if there are at least 2 years of crops before the selected start year. Before using this report as part of a Water Quality Trade activity, phosphorus losses (PTP) must be converted into 'P credits' according to DNR guidance.

For more information go to <http://dnr.wi.gov/> and type keyword: **Water Quality Trading**

Questions? Please contact
DNRphosphorus@wisconsin.gov

This report was developed for Wisconsin DNR Water Quality Trading and Adaptive Management purposes and cannot be used to demonstrate compliance with NR 151 or NRCS 590 NM plan requirements.

P Trade Report				PTP						
Field Name	Soil Series	Soil Symbol	Acres	2025	2026	2027	2028	2029	2030	
D1	TROXEL	TsA	19	10	8	14	13	28	6	
D2	SAYBROOK	SeB2	17	12	9	20	21	44	6	
D3	GRISWOLD	GrC2	18	24	12	33	38	33	8	
D3A	GRISWOLD	GrC2	22	21	11	37	45	40	9	
D4	TROXEL	TsA	8	3	2	1	3	10	2	
D5	DODGE	DoC2	12	13	10	10	26	51	15	
D6	LAPEER	LaD2	12	8	6	7	23	28	13	
F1	FRIESLAND	FrB	33	9	8	10	8	7	9	

P Trade Report					PTP					
Field Name	Soil Series	Soil Symbol	Acres	2025	2026	2027	2028	2029	2030	
H1	PLANO	PnB	29	44	24	20	34	20	18	
H1A	PLANO	PnB	19	27	18	16	27	16	15	
H2	PLANO	PnB	26	19	9	7	21	8	6	
H3	PLANO	PnB	22	13	24	8	16	8	22	
H3A	PLANO	PnB	18	7	15	6	13	6	16	
H4	SAYBROOK	SeB2	24	15	47	14	13	20	51	
H4A	TROXEL	TsA	14	5	17	10	9	10	21	
M1	FRIESLAND	FrB	73	24	95	96	30	24	61	
M2	FRIESLAND	FrB	19	13	15	10	8	12	13	
M3	GRISWOLD	GrB2	35	70	46	31	23	48	55	
M4	SALTER VARIANT	ScB	16	3	2	2	1	3	2	
M4-Buffer	GILFORD	GaA	2	1	1	1	1	1	1	
M5	SALTER VARIANT	ScB	6	1	1	1	1	1	1	
M5 Buffer	YAHARA	YaA	2	0	0	0	0	0	0	
M6	FRIESLAND	FrB	4	1	1	1	1	1	1	
M6 Buffer	FRIESLAND	FrB	2	0	0	0	0	0	0	
M7	GRELLTON VARIANT	GnA	6	2	2	2	2	2	2	
M7 buffer	GRELLTON VARIANT	GnA	5	1	1	1	1	1	0	
R1	GRELLTON	GeB	8	2	2	3	4	2	2	
R1A	SALTER	SbB	20	5	4	11	11	5	3	
R2	DODGE	DoB2	12	8	7	6	6	5	5	
R3	GRELLTON	GeB	34	12	9	14	17	11	8	
R4	LAPEER	LaC2	12	12	7	5	12	13	6	
S1	SISSON	SnB	13	8	6	5	7	7	5	
S2	FRIESLAND	FrB	57	6	15	66	8	4	9	

P Trade Report					PTP					
Field Name	Soil Series	Soil Symbol	Acres	2025	2026	2027	2028	2029	2030	
S3	GRISWOLD	GrC2	18	10	14	9	12	9	6	
S4	PLANO	PnB	16	7	8	6	7	5	4	
S4 Low	FRIESLAND	FrB	6	2	2	2	2	2	1	
S5	COLWOOD	CoA	2	0	0	1	0	0	1	
Total			659	419	457	485	464	484	403	

FM6: Soil Test Report

Reported For	Stibb Grain and Livestock LLC		
Printed		2025-02-10	
Plan Completion/Update Date		2018-02-22	
SnapPlus Version	20.4 built on 2021-06-03		
T:\LWC\DI\Programs\City of Columbus\2025-SNAPPlus update info \\Stibbs Columbus future trading -working draft.snapDb			

Prepared for:
Stibb Grain and Livestock LLC
attn:Curt Stibb
N2151 Cty C
Rio, 53960

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm			
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S	CEC
D1	Curts	19.1	TsA	TROXEL	2024-04-12	AgSource	A	4	4	6.0	4.4	55	149	0	0
D1	Curts	19.1	TsA	TROXEL	2020-01-09	AgSource	745725	4	4	5.8	3.5	37	96	0	11
D1	Curts	19.1	TsA	TROXEL	2015-12-11	AgSource	771852	4	7	6.5	3.4	56	130	0	13
D1	Curts	19.1	TsA	TROXEL	2011-11-16	AgSource	721667	4	23	7.0	3.4	36	109	0	13
D2	Curts	16.8	SeB2	SAYBROOK	2024-04-12	AgSource	A	3	4	6.6	3.8	39	188	0	0
D2	Curts	16.8	SeB2	SAYBROOK	2019-11-26	AgSource	742059	3	1	6.9	2.9	8	83	0	9
D2	Curts	16.8	SeB2	SAYBROOK	2015-11-02	AgSource	766752	3	7	7.1	3.0	23	115	0	14
D2	Curts	16.8	SeB2	SAYBROOK	2011-11-16	AgSource	721667	3	7	7.0	3.1	12	89	0	12
D3	Curts	17.9	GrC2	GRISWOLD	2024-04-12	Ag Source	A	3	8	6.0	3.9	42	186	0	0
D3	Curts	17.9	GrC2	GRISWOLD	2019-12-31	Ag Source	760583	3	16	6.6	3.0	14	102	0	12
D3	Curts	17.9	GrC2	GRISWOLD	2015-11-02	AgSource	766752	3	8	6.9	3.1	29	129	0	13
D3	Curts	17.9	GrC2	GRISWOLD	2011-11-16	AgSource	721667	3	16	7.0	3.1	23	124	0	12
D3A	Curts	21.8	GrC2	GRISWOLD	2024-04-12	Ag source	A	3	1	6.0	3.9	42	186	0	0
D3A	Curts	21.8	GrC2	GRISWOLD	2019-12-31	Ag Source	760583	3	1	6.6	3.0	14	102	0	0
D3A	Curts	21.8	GrC2	GRISWOLD	2015-11-02	AgSource	766752	3	8	6.9	3.1	61	204	0	13
D3A	Curts	21.8	GrC2	GRISWOLD	2011-11-16	AgSource	721667	3	16	7.0	3.1	23	124	0	12
D4	Degraf	8.1	TsA	TROXEL	2023-10-12	Ag Source	A	2	5	6.1	1.9	38	120	0	0

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm		
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S
D4	Degraf	8.1	TsA	TROXEL	2019-12-31	Ag Source	760583	2	3	6.2	3.6	39	125	0
D4	Degraf	8.1	TsA	TROXEL	2015-11-02	AgSource	766752	2	4	6.9	4.0	55	141	0
D4	Degraf	8.1	TsA	TROXEL	2011-11-16	AgSource	721667	2	4	7.0	4.1	44	126	0
D5	Degraf	11.6	DoC2	DODGE	2023-10-23	Ag Source	A	2	5	6.4	2.9	77	260	0
D5	Degraf	11.6	DoC2	DODGE	2019-12-31	Ag Source	760583	2	5	6.9	2.7	7	29	0
D5	Degraf	11.6	DoC2	DODGE	2015-11-02	AgSource	766752	2	5	6.9	2.9	58	127	0
D5	Degraf	11.6	DoC2	DODGE	2011-11-16	AgSource	721667	2	5	6.9	3.0	47	112	0
D6	Degraf	11.9	LaD2	LAPEER	2023-10-23	Ag Source	A	2	4	6.3	3.0	43	182	0
D6	Degraf	11.9	LaD2	LAPEER	2019-11-26	AgSource	742057	2	1	6.3	2.6	10	81	0
D6	Degraf	11.9	LaD2	LAPEER	2015-11-02	AgSource	766752	2	4	6.5	2.7	37	122	0
D6	Degraf	11.9	LaD2	LAPEER	2011-11-16	AgSource	721667	2	5	6.4	2.9	11	95	0
F1	Franz	33.1	FrB	FRIESLAND	2023-10-04	Ag Source	A	7	14	5.9	2.6	47	106	0
F1	Franz	33.1	FrB	FRIESLAND	2019-12-31	Ag Source	760583	7	14	5.9	1.9	24	87	0
F1	Franz	33.1	FrB	FRIESLAND	2015-11-02	AgSource	766752	7	14	5.9	2.6	72	154	0
F1	Franz	33.1	FrB	FRIESLAND	2011-11-16	AgSource	721665	7	14	6.4	2.1	25	95	0
H1	Home	29.2	PnB	PLANO	2023-11-27	Ag Source	A	4	12	6.2	4.5	141	225	0
H1	Home	29.2	PnB	PLANO	2019-12-31	Ag Source	760583	4	19	6.8	3.2	52	140	0
H1	Home	29.2	PnB	PLANO	2015-11-02	AgSource	766733	4	10	6.8	3.1	58	141	0
H1	Home	29.2	PnB	PLANO	2011-11-16	AgSource	721663	4	19	7.1	3.1	47	125	0
H1A	Home	18.6	PnB	PLANO	2023-11-27	AgSource	A	3	1	6.2	4.5	141	225	0
H1A	Home	18.6	PnB	PLANO	2019-12-31	AgSource	760583	3	1	6.8	3.2	52	140	0
H1A	Home	18.6	PnB	PLANO	2015-11-02	AgSource	766733	3	9	7.0	3.3	108	202	0
H1A	Home	18.6	PnB	PLANO	2011-11-16	AgSource	721663	3	19	7.1	3.1	47	125	0

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm		
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S
H2	Home	26.4	PnB	PLANO	2023-11-27	Ag Source	A	5	6	6.0	4.2	56	138	0
H2	Home	26.4	PnB	PLANO	2019-10-24	Agsource	736446	5	1	6.4	3.4	28	126	0
H2	Home	26.4	PnB	PLANO	2015-11-02	AgSource	766733	5	12	6.6	3.4	48	149	0
H2	Home	26.4	PnB	PLANO	2011-11-16	AgSource	721663	5	12	6.9	3.3	15	79	0
H3	Home	21.5	PnB	PLANO	2023-11-27	Ag Source	A	4	9	5.8	3.9	59	111	0
H3	Home	21.5	PnB	PLANO	2019-12-31	Ag Source	760583	4	16	6.8	3.1	26	116	0
H3	Home	21.5	PnB	PLANO	2015-11-02	AgSource	766733	4	8	6.8	3.5	43	130	0
H3	Home	21.5	PnB	PLANO	2011-11-16	AgSource	721663	4	16	7.2	3.2	32	89	0
H3A	Home	17.6	PnB	PLANO	2023-11-27	Ag Source	A	4	1	5.8	3.9	59	111	0
H3A	Home	17.6	PnB	PLANO	2019-12-31	Ag Source	760583	4	1	6.8	3.1	26	116	0
H3A	Home	17.6	PnB	PLANO	2015-11-02	AgSource	766733	4	8	7.1	3.9	61	183	0
H3A	Home	17.6	PnB	PLANO	2011-11-16	AgSource	721663	4	16	7.2	3.2	32	89	0
H4	Home	24.2	SeB2	SAYBROOK	2023-11-27	Ag Source	A	5	9	6.6	4.3	63	157	0
H4	Home	24.2	SeB2	SAYBROOK	2019-12-31	Ag Source	760583	5	16	6.9	3.4	23	82	0
H4	Home	24.2	SeB2	SAYBROOK	2015-11-02	AgSource	766733	5	12	7.0	3.9	39	100	0
H4	Home	24.2	SeB2	SAYBROOK	2011-11-16	AgSource	721667	5	23	7.0	3.4	36	109	0
H4A	Home	13.8	TsA	TROXEL	2023-11-27	Ag Source	A	3	1	6.6	4.3	63	157	0
H4A	Home	13.8	TsA	TROXEL	2019-12-31	Ag Source	760583	3	1	6.9	3.4	23	82	0
H4A	Home	13.8	TsA	TROXEL	2015-11-02	AgSource	766733	3	4	7.1	4.0	51	151	0
H4A	Home	13.8	TsA	TROXEL	2011-11-16	AgSource	721667	3	23	7.0	3.4	36	109	0
Hwy 22 North		42.7	RtC2	ROTAMER	2023-10-06	Ag Source	A	9	17	6.5	1.8	37	80	0
Hwy 22 North		42.7	RtC2	ROTAMER	2017-11-16	AgSource	703495	9	1	6.8	2.0	18	74	0
Hwy 22 South		38.8	RoC	RODMAN	2023-11-09	Ag Source	A	8	15	6.6	1.6	21	112	0

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm		
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S
Hwy 22 South		38.8	RoC	RODMAN	2017-11-16	AgSource	703496	8	1	7.1	1.8	28	103	0
M1	Moll	72.9	FrB	FRIESLAND	2024-01-02	AgSource	A	15	13	6.5	2.5	53	147	0
M1	Moll	72.9	FrB	FRIESLAND	2016-11-15	AgSource	785250	15	29	6.9	2.1	59	99	0
M2	Moll	18.5	FrB	FRIESLAND	2023-11-09	Ag Sourc	A	4	7	6.6	2.9	64	136	0
M2	Moll	18.5	FrB	FRIESLAND	2019-12-31	Ag Source	760583	4	7	7.2	2.7	59	136	0
M2	Moll	18.5	FrB	FRIESLAND	2016-11-15	AgSource	785250	4	7	7.2	2.7	59	136	0
M3	Moll	35.1	GrB2	GRISWOLD	2023-11-09	AgSource	A	4	14	7.0	3.2	86	230	0
M3	Moll	35.1	GrB2	GRISWOLD	2016-10-17	AgSource	781417	4	14	7.2	2.7	21	121	0
M4	Moll	16.3	ScB	SALTER VARIANT	2023-11-09	AgSource	A	3	8	6.4	3.1	66	185	0
M4	Moll	16.3	ScB	SALTER VARIANT	2016-10-17	AgSource	781417	3	8	7.0	2.5	78	94	0
M4-Buffer		1.8	GaA	GILFORD	2018-12-19	Average info from 2016		1	1	7.0	2.5	78	94	0
M5	Moll	5.5	ScB	SALTER VARIANT	2023-11-09	AgSource	A	1	3	5.8	2.9	76	144	0
M5	Moll	5.5	ScB	SALTER VARIANT	2016-11-15	AgSource	785250	1	3	6.8	2.4	12	85	0
M5 Buffer		1.5	YaA	YAHARA	2018-12-19	average from 2016 tests		1	1	6.8	2.4	12	85	0
M6	Moll	3.5	FrB	FRIESLAND	2023-11-09	AgSource	A	1	3	5.9	2.1	59	173	0
M6	Moll	3.5	FrB	FRIESLAND	2016-10-17	AgSource	781417	1	3	6.5	1.9	52	157	0
M6 Buffer		2.2	FrB	FRIESLAND	2018-12-19	averages from 2016		1	1	6.5	1.9	52	157	0
M7	Moll	6.2	GnA	GRELLTON VARIANT	2023-11-09	AgSource	A	1	6	6.3	3.6	43	128	0
M7	Moll	6.2	GnA	GRELLTON VARIANT	2016-11-15	AgSource	785250	1	6	7.1	3.6	36	64	0
M7 buffer		5.3	GnA	GRELLTON VARIANT	2018-12-19	averages from 2016 tests		1	1	7.1	3.6	36	64	0
R1	Rogstad	8	GeB	GRELLTON	2023-10-04	AgSource	A	2	11	5.5	2.3	59	98	0

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm		
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S
R1	Rogstad	8	GeB	GRELLTON	2019-12-31	Ag Source	760583	2	11	5.8	1.7	62	98	0
R1	Rogstad	8	GeB	GRELLTON	2015-11-02	AgSource	766736	2	11	6.1	2.1	74	127	0
R1	Rogstad	8	GeB	GRELLTON	2011-11-16	AgSource	721664	2	11	6.5	1.7	39	101	0
R1A	Rogstad	19.7	SbB	SALTER	2023-10-04	Ag Source	A	4	1	5.5	2.3	59	98	0
R1A	Rogstad	19.7	SbB	SALTER	2019-12-31	Ag Source	760583	4	1	5.8	1.7	62	98	0
R1A	Rogstad	19.7	SbB	SALTER	2015-11-02	AgSource	766736	4	11	6.1	2.1	74	127	0
R1A	Rogstad	19.7	SbB	SALTER	2011-11-16	AgSource	721664	4	11	6.5	1.7	39	101	0
R2	Rogstad	11.9	DoB2	DODGE	2023-10-24	Ag Source	A	2	3	5.5	2.4	65	156	0
R2	Rogstad	11.9	DoB2	DODGE	2019-11-26	AgSource	742055	2	1	6.6	2.2	16	92	0
R2	Rogstad	11.9	DoB2	DODGE	2015-11-02	AgSource	766736	2	5	6.4	2.5	45	134	0
R2	Rogstad	11.9	DoB2	DODGE	2011-11-16	AgSource	721664	2	5	6.9	2.2	14	72	0
R3	Rogstad	33.9	GeB	GRELLTON	2023-10-06	AgSource	A	7	14	6.1	1.6	51	118	0
R3	Rogstad	33.9	GeB	GRELLTON	2019-12-31	Ag Source	760583	7	14	6.4	1.6	42	141	0
R3	Rogstad	33.9	GeB	GRELLTON	2015-11-02	AgSource	766736	7	15	6.3	1.6	79	111	0
R3	Rogstad	33.9	GeB	GRELLTON	2011-11-16	AgSource	721664	7	15	6.2	1.5	43	118	0
R4	Rogstad	11.6	LaC2	LAPEER	2023-10-12	Ag Source	A	2	5	6.1	1.9	38	120	0
R4	Rogstad	11.6	LaC2	LAPEER	2019-12-10	AgSource	744200	2	1	7.1	1.9	17	85	0
R4	Rogstad	11.6	LaC2	LAPEER	2015-11-02	AgSource	766736	2	5	7.0	2.0	48	96	0
R4	Rogstad	11.6	LaC2	LAPEER	2012-11-02	AgSource	730374	2	5	7.3	1.9	22	102	0
S1	Schultz	13.4	SnB	SISSON	2023-10-24	AgSource	A	3	6	6.4	1.2	51	102	0
S1	Schultz	13.4	SnB	SISSON	2019-12-10	AgSource	744201	3	1	6.6	1.0	47	75	0
S1	Schultz	13.4	SnB	SISSON	2015-11-02	AgSource	766737	3	6	6.5	1.6	89	98	0
S1	Schultz	13.4	SnB	SISSON	2012-11-02	AgSource	730374	3	6	6.3	1.1	49	51	0

			Predominant					Samples				in ppm			
Field Name	Subfarm	Acres	Soil Map Symbol	Soil Name	Soil Test Date	Soil Test Lab	Lab Number	Rec. #	Actual #	pH	OM%	P	K	S	CEC
S1	Schultz	13.4	SnB	SISSON	2011-11-16	AgSource	721666	3	5	6.0	1.2	55	66	0	3
S2	Schultz	57.2	FrB	FRIESLAND	2020-01-09	AgSource	745721	11	1	6.3	2.1	20	93	0	0
S2	Schultz	57.2	FrB	FRIESLAND	2015-12-11	AgSource	771852	11	23	6.6	2.2	37	119	0	9
S2	Schultz	57.2	FrB	FRIESLAND	2011-11-16	AgSource	721666	11	23	6.6	1.9	14	81	0	8
S3	Schultz	18.2	GrC2	GRISWOLD	2023-10-12	Ag Source	A	4	8	5.9	2.8	45	124	0	0
S3	Schultz	18.2	GrC2	GRISWOLD	2019-10-24	AgSource	736447	4	1	6.2	2.5	18	93	0	0
S3	Schultz	18.2	GrC2	GRISWOLD	2015-11-02	AgSource	766737	4	8	6.4	2.6	41	124	0	10
S3	Schultz	18.2	GrC2	GRISWOLD	2011-11-16	AgSource	721666	4	8	7.0	2.5	10	48	0	10
S4	Schultz	16.4	PnB	PLANO	2023-11-16	AgSource	A	3	10	5.9	2.7	52	136	0	0
S4	Schultz	16.4	PnB	PLANO	2019-12-31	Ag Source	760583	3	10	6.0	2.6	37	146	0	6
S4	Schultz	16.4	PnB	PLANO	2015-11-02	AgSource	766737	3	5	6.4	2.9	21	69	0	11
S4	Schultz	16.4	PnB	PLANO	2011-11-16	AgSource	721666	3	10	6.8	2.6	21	63	0	10
S4 Low	Schultz	6.1	FrB	FRIESLAND	2023-11-16	Ag Source	A	1	1	5.9	2.7	52	136	0	0
S4 Low	Schultz	6.1	FrB	FRIESLAND	2019-12-31	Ag Source	760583	1	1	6.0	2.6	37	146	0	0
S4 Low	Schultz	6.1	FrB	FRIESLAND	2015-11-02	AgSource	766737	1	5	6.0	3.0	49	91	0	10
S4 Low	Schultz	6.1	FrB	FRIESLAND	2011-11-16	AgSource	721666	1	10	6.8	2.6	21	63	0	10
S5	Schultz	2.2	CoA	COLWOOD	2019-10-24	AgSource	736449	1	1	6.2	3.8	21	93	0	0
S5	Schultz	2.2	CoA	COLWOOD	2015-11-02	AgSource	766737	1	1	5.9	3.3	38	106	0	14
S5	Schultz	2.2	CoA	COLWOOD	2011-11-16	AgSource	721666	1	1	6.7	3.7	14	40	0	14

Crop Year Soil Test Needed

Field Name	Soil Test Date	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
D1	2024-04-12											X	
D2	2024-04-12											X	

Field Name	Soil Test Date	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
D3	2024-04-12											X	
D3A	2024-04-12											X	
D4	2023-10-12											X	
D5	2023-10-23											X	
D6	2023-10-23											X	
F1	2023-10-04											X	
H1	2023-11-27											X	
H1A	2023-11-27											X	
H2	2023-11-27											X	
H3	2023-11-27											X	
H3A	2023-11-27											X	
H4	2023-11-27											X	
H4A	2023-11-27											X	
Hwy 22 North	2023-10-06											X	
Hwy 22 South	2023-11-09											X	
M1	2024-01-02											X	
M2	2023-11-09											X	
M3	2023-11-09											X	
M4	2023-11-09											X	
M4-Buffer	2018-12-19						X						
M5	2023-11-09											X	
M5 Buffer	2018-12-19						X						
M6	2023-11-09											X	
M6 Buffer	2018-12-19						X						
M7	2023-11-09											X	
M7 buffer	2018-12-19						X						

Field Name	Soil Test Date	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
R1	2023-10-04											X	
R1A	2023-10-04											X	
R2	2023-10-24											X	
R3	2023-10-06											X	
R4	2023-10-12											X	
S1	2023-10-24											X	
S2	2020-01-09							X					
S3	2023-10-12											X	
S4	2023-11-16											X	
S4 Low	2023-11-16											X	
S5	2019-10-24							X					

Appendix C: WI Conference of SD Project Details

Site Map

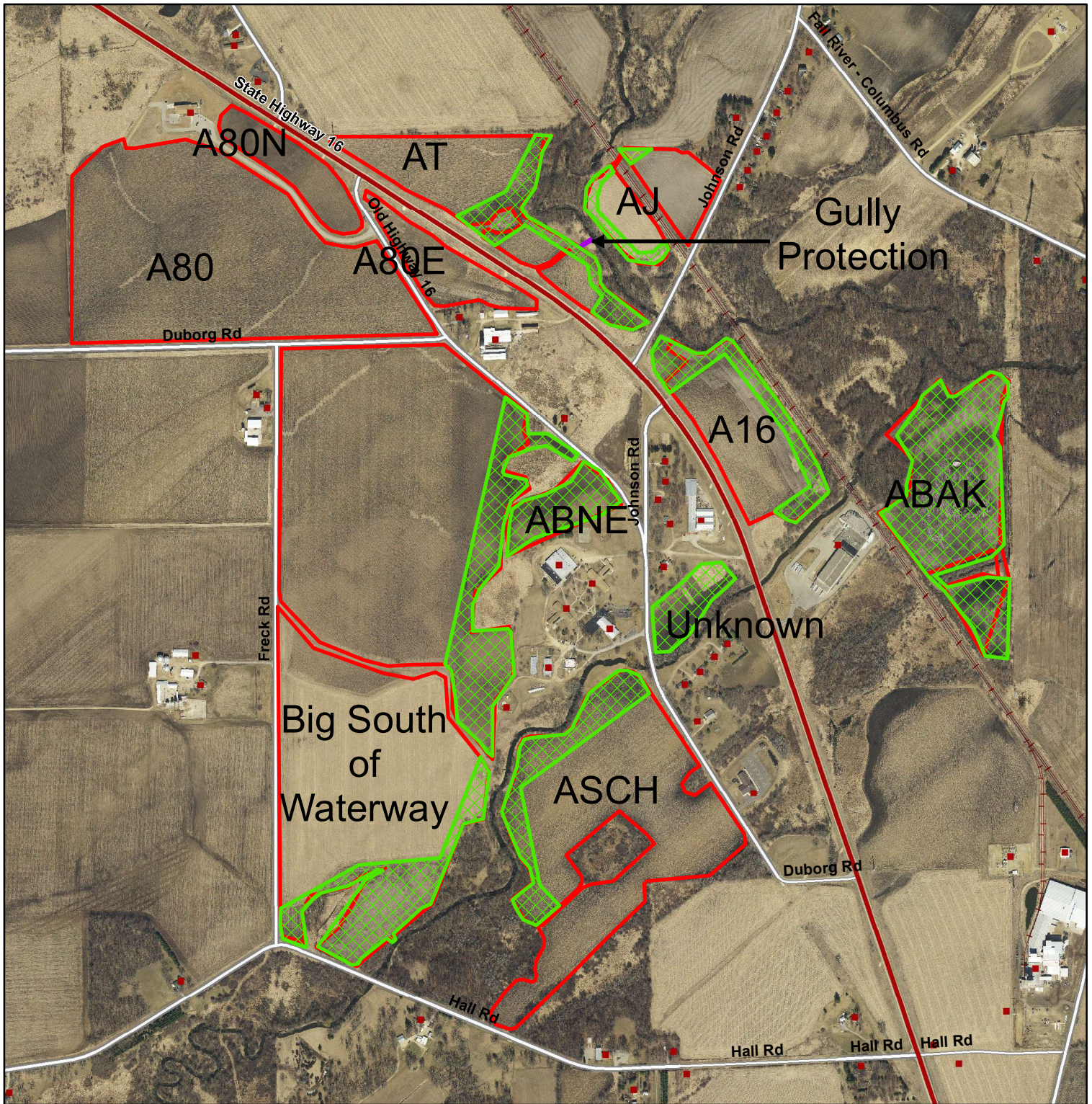
Updated Phosphorus Calculations

Updated Snap Plus Modeling

Updated Soil Sample Information

Grassed Waterway Credit Quantification & Modeling
Documentation

Wisconsin Conference Site Map



Buffer-Conservation Cover



Field Borders

A80

Field label

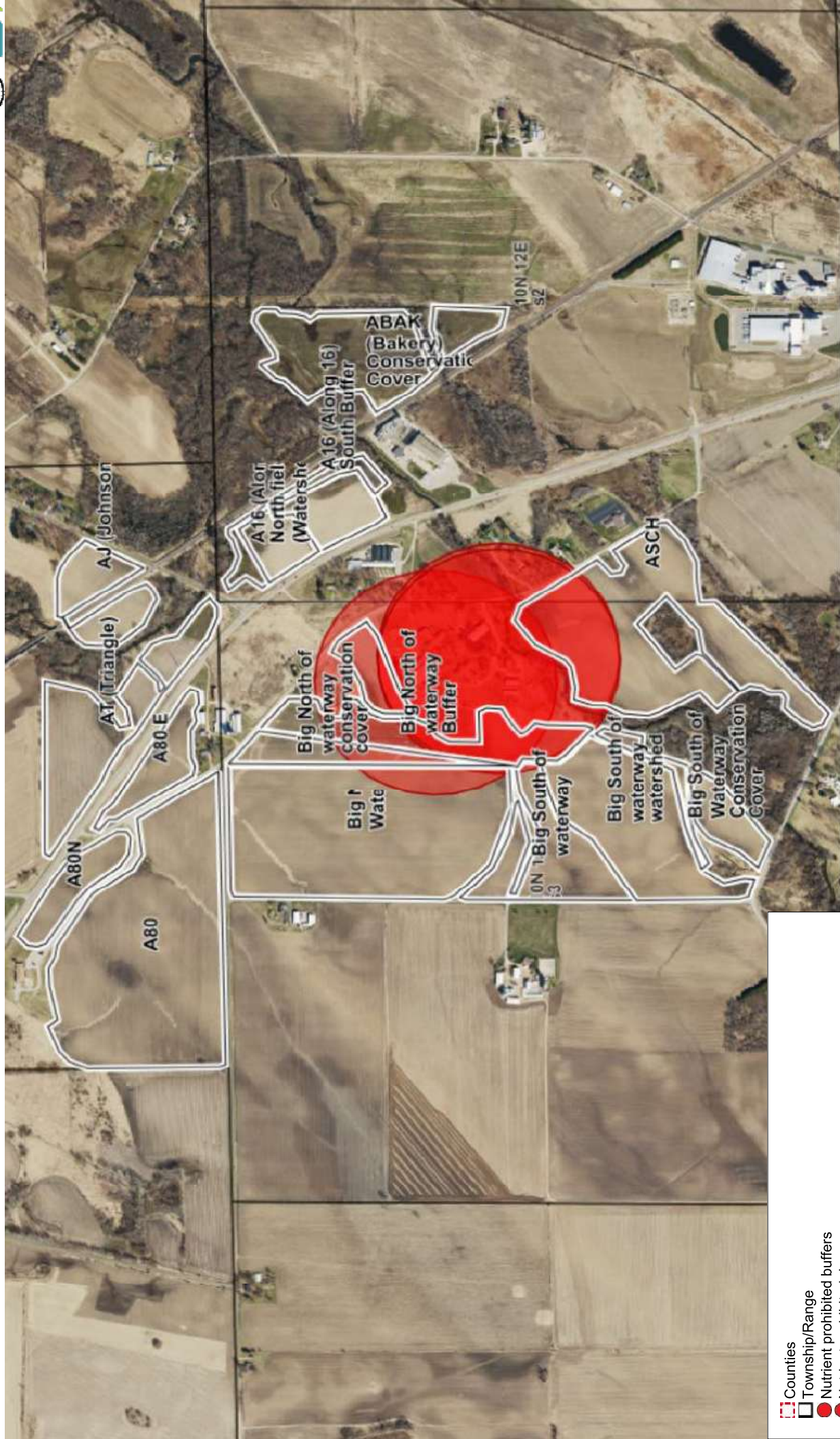


**2025 Updated Water Quality Trading Plan
Wisconsin Conference of SD
Phosphorus Credit Calculations**

Baseline TP Loss Calculations												
Practices (listed on map)	Location	Model Conditions	Acreage Used for Practices	Controlled Acreage	Rotation Length (years)	Average PTP	PTP Year 6	PTP Year 7	PTP Year 8	PTP Year 9	PTP Year 10	PTP Year 11
Buffer Strip & Conservation Cover	Field "Big North of Waterway"	Baseline PTP (pre-trade)	24	85	4	255	236	350	226	206	N/A	N/A
		Improved PTP (post-trade)				26	22	18	21	44	20	16
		Total Reduction				228	N/A	N/A	N/A	N/A	N/A	N/A
		Total Reduction With Trade Ratio				76	N/A	N/A	N/A	N/A	N/A	N/A
Buffer Strip & Conservation Cover	Field "Big South of Waterway"	Baseline PTP (pre-trade)	9	55	4	155	145	210	138	126	N/A	N/A
		Improved PTP (post-trade)				22	24	23	22	20	19	17
		Total Reduction				133	N/A	N/A	N/A	N/A	N/A	N/A
		Total Reduction With Trade Ratio				123	N/A	N/A	N/A	N/A	N/A	N/A
Conservation Cover	Field ABNE	Baseline PTP (pre-trade)	6	6	4	11	11	15	10	9	N/A	N/A
		Improved PTP (post-trade)				1	1	1	1	1	1	1
		Total Reduction				10	N/A	N/A	N/A	N/A	N/A	N/A
		Total Reduction With Trade Ratio				3	N/A	N/A	N/A	N/A	N/A	N/A
Gully Protection	Southwest of Field AJ	Baseline PTP (pre-trade)	N/A	11	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Improved PTP (post-trade)				N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Total Reduction				9	N/A	N/A	N/A	N/A	N/A	N/A
		Total Reduction With Trade Ratio				3	N/A	N/A	N/A	N/A	N/A	N/A

TP Credit Threshold Calculations										
Practices (listed on map)	Location	Field Acres	Current/Planned (post-trade) Conditions Avg	Pre-trade lb/acre/year	Post-trade lb/acre/year	Interim Reduction (negative values mean zero inteirm credits)	Long-Term Reduction	Trade Ratio	Long Term Credits	Interim Credits
Buffer Strip & Conservation Cover	Big North of Waterway	85	26	3	0	-103	228	3	76	-34
Buffer Strip & Conservation Cover	Big South of Waterway	55	22	3	0	-76	133	3	44	-25
Conservation Cover	Field ABNE	6	1	2	0	-14	10	3	3	-5
Practices (listed on map)	Location	% Reduction	Current/Planned (post-trade) Conditions Avg	Pre-trade lb/acre/year	Post-trade lb/acre/year	Interim Reduction (negative values mean zero inteirm credits)	Long-Term Reduction	Trade Ratio	Long Term Credits	Interim Credits
Grassed Waterway	Southwest of Field AJ	0.3	0	N/A	N/A	3	6	3	2	1
Total									126	0

Credit Threshold	
TMDL Subbasin	Subbasin 51
pounds per acre per year	4.2
Percent Reduction	30



- Counties
- Township/Range
- Nutrient prohibited buffers
- Nutrient prohibited drawn areas
- Nutrient prohibited winter only
- Fields

NM1: Narrative and Crops Report

Starting Year	2025
Reported For	Academ School/Bakery
Printed	2025-03-26
Plan Completion/Update Date:	2018-10-30
SnapPlus Version	20.4 built on 2021-06-03
T:\WC\DI\Programs\City of Columbus\2025-SNAPPlus update info	
I\AcademySchool\withBuffersandConservationcoverupdate3-25-25.snapDb	

Prepared for:
Academ School/Bakery
attn:Academy School
Fall River , 53932

Farm has 19 fields totalling 346.6 cropped acres.
Farm Narrative: Rick Yelk is operator of Wisconsin Conference of Seventh Day Adventists Farm. Rotation is generally 2 to 3 years corn then soybeans and ocassionly winter wheat in rotation.

Annual Farm Notes:
No Annual Farm Notes

Spreader Calibration Methods: Custom applications, Equipment calibration, Amount applied / Acres

Narrative and Crops:

Field Name	Field Acres	2025	2026	2027	2028	2029	2030
A16 (Along 16) north Buffer	2.4	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
A16 (Along 16) North field (Watershed)	5.4	Corn grain Fall vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 46-55 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 46-55 bu/acre
A16 (Along 16) South Buffer	2.5	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre

Field Name	Field Acres	2025	2026	2027	2028	2029	2030
A16 (Along 16) South field (Watershed)	8.1	Corn grain Fall vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 46-55 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 46-55 bu/acre
A80	62.6	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre
A80 E	7.9	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre
A80N	7.6	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre
ABAK (Bakery) Conservati on Cover	25.3	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
ABNE Conservati on Cover (North next to school)	5.6	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
AJ (Johnson)	10.7	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 56-65 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Fall Chisel, no disk 56-65 bu/acre
ASCH	46.5	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre

Field Name	Field Acres	2025	2026	2027	2028	2029	2030
AT (Triangle)	22.2	Corn grain Fall vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 46-55 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre
Big North of Waterway	59.7	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Fall vertical tillage 171-190 bu/acre	Soybeans 15-20 inch row Spring vertical tillage 66-75 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre
Big North of waterway Buffer	16.9	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
Big North of waterway conservatio n cover	7.9	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
Big South of waterway	17	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre
Big South of waterway Buffer	3.1	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
Big South of Waterway Conservati on Cover	6.4	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre	Grass hay None 2-3 ton/acre
Big South of waterway watershed	28.8	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre	Corn grain Spring vertical tillage 171-190 bu/acre

Summary by Crop:

NOTE: Yields calculated using the midpoint of the SnapPlus yield goal range for each crop.

Crops Grouped By Category	2025	2026	2027	2028	2029	2030
Grass hay	70 175	70 175	70 175	70 175	70 175	70 175
Corn grain	277 49,999	241 43,501	206 37,183	277 49,999	277 49,999	252 45,486
Soybeans 15-20 inch row		36 1,818	70 4,235			24 1,212

WQ1: P Trade Report

Reported For	Academ School/Bakery	
Printed		2025-03-26
Plan Completion/Update Date	2018-10-30	
SnapPlus Version	20.4 built on 2021-06-03	
T:\LWCD\Programs\City of Columbus\2025-SNAPPlus update info AcademySchoolwithBuffersandConservationcoverupdate3-25-25.snapDb		

Prepared for:
Academ School/Bakery
attn:Academy School
Fall River , 53932

The P Trade Report estimates the annual pounds of phosphorus (P) in surface runoff from cropland entering surface waters. These P loss calculations are based on a field's soil test P concentration, crops, tillage, nutrient management practices and estimates of average runoff and sheet and rill erosion for the predominant soil type. Losses from concentrated flow channel or gully erosion with a field are not included in these calculations. Field runoff losses are calculated for each year as **PTP** (lb P/field/yr). Fields are only included if there are at least 2 years of crops before the selected start year. Before using this report as part of a Water Quality Trade activity, phosphorus losses (PTP) must be converted into 'P credits' according to DNR guidance.

For more information go to <http://dnr.wi.gov/> and type keyword: **Water Quality Trading**

Questions? Please contact
DNRphosphorus@wisconsin.gov

This report was developed for Wisconsin DNR Water Quality Trading and Adaptive Management purposes and cannot be used to demonstrate compliance with NR 151 or NRCS 590 NM plan requirements.

P Trade Report				PTP					
Field Name	Soil Series	Soil Symbol	Acres	2025	2026	2027	2028	2029	2030
A16 (Along 16) north Buffer	OSSIAN	OsA	2	1	1	1	1	1	1
A16 (Along 16) North field (Watershed)	SAYBROOK	SeB2	5	2	6	3	2	2	2
A16 (Along 16) South Buffer	GILFORD	GaA	3	1	1	1	1	1	1
A16 (Along 16) South field (Watershed)	SAYBROOK	SeB2	8	3	9	5	3	2	3
A80	PLANO	PnB	63	71	68	66	64	62	61
A80 E	SAYBROOK	SeB2	8	12	10	10	10	9	9
A80N	PLANO	PnB	8	12	10	10	9	9	9

P Trade Report					PTP				
Field Name	Soil Series	Soil Symbol	Acres	2025	2026	2027	2028	2029	2030
ABAK (Bakery) Conservation Cover	GILFORD	GaA	25	0	0	0	0	0	0
ABNE Conservation Cover(North next to school)	JOY	JoA	6	1	1	1	1	1	1
AJ (Johnson)	GRELLTON VARIANT	GnA	11	7	7	6	9	6	5
ASCH	ST. CHARLES	SaB2	47	15	14	13	12	11	10
AT (Triangle)	PLANO	PnB	22	6	13	12	6	5	5
Big North of Waterway	PLANO	PnB	60	17	14	40	29	16	13
Big North of waterway Buffer	JOY	JoA	17	4	3	3	3	3	2
Big North of waterway conservation cover	SAYBROOK	SeB2	8	1	1	1	1	1	1
Big South of waterway	PLANO	PnB	17	15	14	14	13	13	12
Big South of waterway Buffer	JOY	JoA	3	0	0	0	0	0	0
Big South of Waterway Conservation Cover	SAYBROOK	SeB2	6	1	1	1	1	0	0
Big South of waterway watershed	PLANO	PnB	29	8	8	7	6	6	5
Total			347	177	181	194	171	148	139

FM6: Soil Test Report

Reported For	Academ School/Bakery		
Printed		2025-02-10	
Plan Completion/Update Date		2018-10-30	
SnapPlus Version	20.4 built on 2021-06-03		
T:\LWCD\Programs\City of Columbus\2025-SNAPPlus update info Academy School - with Buffers and Conservation cover updated 2025.snapDb			

Prepared for:
Academ School/Bakery
attn:Academy School
Fall River , 53932

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm		
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S
A16 (Along 16) north Buffer		2.4	OsA	OSSIAN	2016-11-04	Ag Source		1	1	7.2	2.9	71	121	0
A16 (Along 16) North field (Watershed)		5.4	SeB2	SAYBROOK	2016-11-04	Ag Source		1	1	6.5	1.3	41	140	0
A16 (Along 16) North field (Watershed)		5.4	SeB2	SAYBROOK	2022-11-21			1	1	6.6	1.9	42	125	0
A16 (Along 16) North field (Watershed)		5.4	SeB2	SAYBROOK	2023-11-30	Ag Source		1	1	6.5	1.6	27	148	0
A16 (Along 16) South Buffer		2.5	GaA	GILFORD	2016-11-04	Ag Source		1	1	6.9	2.3	68	105	0
A16 (Along 16) South field (Watershed)		8.1	SeB2	SAYBROOK	2016-11-04	Ag Source		2	2	7.1	2.1	68	124	0

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm		
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S
A16 (Along 16) South field (Watershed)		8.1	SeB2	SAYBROOK	2023-11-30	Ag Source		2	1	6.5	1.6	27	148	0
A16 (Along 16) South field (Watershed)		8.1	SeB2	SAYBROOK	2022-11-21			2	1	6.6	1.9	42	125	0
A80		62.6	PnB	PLANO	2016-11-04	Ag Source		13	12	6.4	3.4	37	117	0
A80		62.6	PnB	PLANO	2023-11-30	Ag Source		13	1	6.1	3.3	24	142	0
A80		62.6	PnB	PLANO	2019-12-19	Ag Source		13	1	6.2	3.5	24	126	0
A80 E		7.9	SeB2	SAYBROOK	2016-11-04	Ag Source		2	3	7.0	3.1	67	117	0
A80 E		7.9	SeB2	SAYBROOK	2023-11-30	Ag Source		2	2	6.6	3.0	42	154	0
A80 E		7.9	SeB2	SAYBROOK	2019-12-03	Ag Source		2	2	6.9	3.3	70	192	0
A80N		7.6	PnB	PLANO	2016-11-04	Ag Source		2	2	7.1	3.4	90	241	0
A80N		7.6	PnB	PLANO	2023-11-30	Ag Source		2	2	7.0	3.0	51	207	0
A80N		7.6	PnB	PLANO	2019-12-03	Ag Source		2	2	7.2	3.1	70	220	0
ABAK (Bakery) Conservation Cover		25.3	GaA	GILFORD	2016-11-10	AgSource Labs		5	4	7.3	5.9	6	41	0
ABNE Conservation Cover (North next to school)		5.6	JoA	JOY	2016-11-04	Ag Source		1	2	6.9	2.8	38	110	0
AJ (Johnson)		10.7	GnA	GRELLTON VARIANT	2016-11-04	Ag Source		2	2	6.7	1.3	70	98	0
AJ (Johnson)		10.7	GnA	GRELLTON VARIANT	2023-11-30	Ag Source		2	4	6.1	1.3	49	131	0
AJ (Johnson)		10.7	GnA	GRELLTON VARIANT	2019-12-03	Ag Source		2	4	6.0	1.2	51	89	0

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm		
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S
ASCH		46.5	SaB2	ST. CHARLES	2016-11-11	Ag Source		9	10	6.5	2.4	12	87	0
ASCH		46.5	SaB2	ST. CHARLES	2023-11-30	Ag Source		9	1	5.8	2.5	20	101	0
ASCH		46.5	SaB2	ST. CHARLES	2019-12-04	Ag Source		9	1	6.1	2.5	15	87	0
AT (Triangle)		22.2	PnB	PLANO	2016-11-04	Ag Source		4	5	6.8	2.9	40	91	0
AT (Triangle)		22.2	PnB	PLANO	2023-11-30	Ag Source		4	1	6.1	3.2	19	125	0
AT (Triangle)		22.2	PnB	PLANO	2019-12-03	Ag Source		4	1	6.3	3.3	37	65	0
Big North of Waterway		59.7	PnB	PLANO	2016-11-04	Ag Source		12	17	6.6	3.0	26	146	0
Big North of Waterway		59.7	PnB	PLANO	2023-11-30	Ag Source		12	1	5.7	3.1	18	127	0
Big North of Waterway		59.7	PnB	PLANO	2019-12-03	Ag Source		12	1	6.4	3.1	18	105	0
Big North of waterway Buffer		16.9	JoA	JOY	2016-11-04	Ag Source		3	5	6.8	3.2	40	198	0
Big North of waterway conservatio n cover		7.9	SeB2	SAYBROOK	2016-11-04			2	8	6.7	3.1	38	192	0
Big South of waterway		17	PnB	PLANO	2016-11-04	Ag Source		3	12	6.5	2.8	15	97	0
Big South of waterway		17	PnB	PLANO	2023-11-30	ag source		3	1	5.9	2.8	18	101	0
Big South of waterway		17	PnB	PLANO	2019-12-04	Ag Source		3	1	6.1	2.9	16	86	0
Big South of waterway Buffer		3.1	JoA	JOY	2016-11-04	Ag Source		1	3	6.7	2.6	12	93	0
Big South of Waterway Conservatio n Cover		6.4	SeB2	SAYBROOK	2016-11-04			1	1	6.8	2.2	23	95	0

Field Name	Subfarm	Acres	Predominant		Soil Test Date	Soil Test Lab	Lab Number	Samples		pH	OM%	in ppm		
			Soil Map Symbol	Soil Name				Rec. #	Actual #			P	K	S
Big South of waterway watershed		28.8	PnB	PLANO	2018-11-05	Ag source		6	9	6.4	2.8	16	98	0
Big South of waterway watershed		28.8	PnB	PLANO	2023-11-30	Ag source		6	1	5.9	2.8	18	102	0
Big South of waterway watershed		28.8	PnB	PLANO	2019-12-03	Ag Source		6	1	6.1	2.9	16	86	0

Crop Year Soil Test Needed

Field Name	Soil Test Date	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
A16 (Along 16) north Buffer	2016-11-04						X								
A16 (Along 16) North field (Watershed)	2023-11-30													X	
A16 (Along 16) South Buffer	2016-11-04						X								
A16 (Along 16) South field (Watershed)	2023-11-30													X	
A80	2023-11-30													X	
A80 E	2023-11-30													X	
A80N	2023-11-30													X	
ABAK (Bakery) Conservation Cover	2016-11-10						X								
ABNE Conservation Cover(North next to school)	2016-11-04						X								
AJ (Johnson)	2023-11-30													X	
ASCH	2023-11-30													X	
AT (Triangle)	2023-11-30													X	
Big North of Waterway	2023-11-30													X	
Big North of waterway Buffer	2016-11-04						X								
Big North of waterway conservation cover	2016-11-04						X								

Field Name	Soil Test Date	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Big South of waterway	2023-11-30													X	
Big South of waterway Buffer	2016-11-04						X								
Big South of Waterway Conservation Cover	2016-11-04						X								
Big South of waterway watershed	2023-11-30													X	

NRCS Classic Gully Erosion Estimator

Farmer / Cooperator Name: Wis. Conf. of 7th Day Adventist Corp.

Tract Number:

Evaluated By: Todd Rietmann

Evaluation Date: October 22, 2019

Field Number	Gully	Total Active Gully Length (Feet) *	Gully Average Top Width (Feet)	Gully Average Bottom Width (Feet)	Gully Average Depth (Feet)	Estimated Total Volume Eroded (FT ³)	Gully Formation: Estimated Number of Years	Soil Texture	Approximate Pounds of Soil per FT ³	Estimated Total Gully Soil Loss (Tons)	Estimated Gully Soil Loss Per Year (Tons/yr)
1		60.0	6.0	2.0	4	960.0	2.0	Loam	95	45.6	22.8
2		100.0	3.0	1.5	1	225.0	2.0	Loam	95	10.7	5.3
3		100.0	2.0	1.0	0.5	75.0	2.0	Loam	95	3.6	1.8
Total Estimated Annual Gully Soil Loss (Tons/yr):											29.9

Field Number	Gully	Total Active Gully Length (Feet) *	Gully Average Top Width (Feet)	Gully Average Bottom Width (Feet)	Gully Average Depth (Feet)	Estimated Total Volume Eroded (FT ³)	Gully Formation: Estimated Number of Years	Soil Texture	Approximate Pounds of Soil per FT ³	Estimated Total Gully Soil Loss (Tons)	Estimated Gully Soil Loss Per Year (Tons/yr)
1											
2											
3											
Total Estimated Annual Gully Soil Loss (Tons/yr):											

Field Number	Gully	Total Active Gully Length (Feet) *	Gully Average Top Width (Feet)	Gully Average Bottom Width (Feet)	Gully Average Depth (Feet)	Estimated Total Volume Eroded (FT ³)	Gully Formation: Estimated Number of Years	Soil Texture	Approximate Pounds of Soil per FT ³	Estimated Total Gully Soil Loss (Tons)	Estimated Gully Soil Loss Per Year (Tons/yr)
1											
2											
3											
Total Estimated Annual Gully Soil Loss (Tons/yr):											

Total Estimated Annual Gully Soil Loss (Tons/yr): 29.9

* Only measure the active gully erosion areas. Areas which have become stabilized are no longer a major resource concern.

Classic Gully Erosion Calculation Formula:

Appendix D: Effluent Limit Compliance History

Prior Permit Term Credit Use

Prior Permit Term Effluent Quality/Flows



**Updated Water Quality Trading Plan
Prior Permit Term Credit Use**

2021 TP Reduction Credits Used (lbs/month)												
Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
N/A	N/A	N/A	N/A	N/A	17.51	0	0	7.24	0	1.25	1.48	27.48
2022 TP Reduction Credits Used (lbs/month)												
Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2.94	5.44	8.32	0	12.98	8.91	2.75	39.89	39.34	0.72	10.83	1.11	133.23
2023 TP Reduction Credits Used (lbs/month)												
Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
25.61	15.91	29.04	39.58	20.81	-9.92	19.18	19.80	20.95	4.91	8.36	4.13	208.28
2024 TP Reduction Credits Used (lbs/month)												
Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2.561	-0.15	21.75	28.87	38.21	126.34	61.50	-8.65	-10.66	-5.08	4.94	2.20	286.37

Updated Water Quality Trading Plan
Prior Permit Term Effluent Quality/Flows

2021 Effluent Quality and Flow Summary																							
Jan		Feb		March		Apr		May		Jun		July		Aug		Sep		Oct		Nov		Dec	
Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.86	0.12	0.78	0.06	0.77	0.07	0.71	0.12	0.74	0.05	0.67	0.08	0.68	0.08
2022 Effluent Quality and Flow Summary																							
Jan		Feb		March		Apr		May		Jun		July		Aug		Sep		Oct		Nov		Dec	
Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)
0.67	0.09	0.69	0.11	0.89	0.11	1.17	0.07	1.01	0.12	0.8	0.12	0.78	0.09	1.2	0.2	1.35	0.19	1.1	0.08	1.23	0.11	1.25	0.08
2023 Effluent Quality and Flow Summary																							
Jan		Feb		March		Apr		May		Jun		July		Aug		Sep		Oct		Nov		Dec	
Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)
1.3	0.15	1.36	0.12	1.7	0.12	1.9	0.14	1.38	0.13	1.17	0.04	1.09	0.15	0.89	0.16	0.79	0.18	0.83	0.1	0.85	0.11	0.85	0.09
2024 Effluent Quality and Flow Summary																							
Jan		Feb		March		Apr		May		Jun		July		Aug		Sep		Oct		Nov		Dec	
Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)	Average Daily Flow (MGD)	TP Effluent Conc. (mg/L)
0.96	0.09	1.07	0.07	1.23	0.14	1.6	0.13	1.47	0.13	1.52	0.37	1.74	0.17	0.95	0.04	0.88	0.03	0.86	0.05	1.08	0.09	0.92	0.08

Appendix E: Prior Permit Term Annual Inspection Reports



COLUMBIA COUNTY

Land & Water Conservation

608-742-9670
FAX: 608-742-9840
E-MAIL: land.conservation@co.columbia.wi.us
WEBSITE: www.co.columbia.wi.us

112 East Edgewater Street
Portage, WI 53901

November 17, 2021

Re: City of Columbus Water Quality Trading Project—**2021 Annually Certification Inspection** of installed conservation practices.

Columbia County Land and Water Conservation has conducted site visits to inspect and review submitted documentation in regards to below listed conservation practices to ensure the practices are being maintain per Natural Resource Conservation Standards.

Landowner	Conservation practice
Rhodes Bake-N-Serv	Conservation Cover (25 acres)
Rhodes Bake-N-Serv	Buffer strip (5 acres)
Wisconsin Corp. Seventh Day Adv.	Buffer strip & Conservation Cover (34 acres)
Wisconsin Corp. Seventh Day Adv.	Conservation Cover (6 acres)
Wisconsin Corp. Seventh Day Adv.	Gully Stabilization/Grade Stabilization Structure
Curt Stibb	Field Edge Buffer/borders (11 acres)
Curt Stibb	2021 Annually Cover Crop installed (100 acres)

Columbia County Land and Water Conservation also has received SNAP Plus files in regards to Nutrient Management Planning for the Rhodes Bake-N-Serv, Wisconsin Corp. Seventh Day Adventist, and Stibb Farms to ensure Nutrient Management Plan Development.

Kurt Calkins
Director, Land & Water Conservation Department

Todd Rietmann
Senior Conservation Specialist, Columbia County Land & Water Conservation Department

Stibb Project

Buffer Strip photos as of 9/1/21



Cover crops planted after corn silage as of March 2021:



Planted after winter wheat as of March 2021:



WI Conference Project

5/11/2021



8/27/2021



Rock Chute 11/18/2021



Grassed Waterway 11/18/2021



Colwis Project

8/30/2021





COLUMBIA COUNTY

Land & Water Conservation

608-742-9670
FAX: 608-742-9840
E-MAIL: land.conservation@co.columbia.wi.us
WEBSITE: www.co.columbia.wi.us

112 East Edgewater Street
Portage, WI 53901

December 5th, 2022

Re: City of Columbus Water Quality Trading Project—**2022 Annually Certification Inspection**
of installed conservation practices.

Columbia County Land and Water Conservation has conducted site visits to inspect and review submitted documentation in regards to below listed conservation practices to ensure the practices are being maintain per Natural Resource Conservation Standards.

Landowner

Conservation practice

Rhodes Bake-N-Serv

Conservation Cover (25 acres)

Rhodes Bake-N-Serv

Buffer strip (5 acres)

Wisconsin Corp. Seventh Day Adv.

Buffer strip & Conservation Cover (34 acres)

Wisconsin Corp. Seventh Day Adv.

Conservation Cover (6 acres)

Wisconsin Corp. Seventh Day Adv.

Gully Stabilization/Grade Stabilization Structure
(In place and functioning)

Curt Stibb

Field Edge Buffer/borders (11 acres)

Curt Stibb

2022 Annually Cover Crop installed (100 acres)

Columbia County Land and Water Conservation have SNAP Plus files in regards to Nutrient Management Planning for the Rhodes Bake-N-Serv, Wisconsin Corp. Seventh Day Adventist, and Stibb Farms.

Kurt Calkins

Director, Land & Water Conservation Department

Todd Rietmann

Senior Conservation Specialist, Columbia County Land & Water Conservation Department

Seventh Day Conservation Cover and Buffer Strips 8/16/2022



Seventh Day Rock Chute 10/3/2022



Bakery Site Conservation Cover and Buffer Strips 8/16/22



Stibb Site Buffer Strip 9/21/2022



Stibb Site Cover Crop and Buffer 9/21/2022





COLUMBIA COUNTY

Land & Water Conservation

608-742-9670
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WEBSITE: www.co.columbia.wi.us

112 East Edgewater Street
Portage, WI 53901

December 5th, 2023

Re: City of Columbus Water Quality Trading Project—**2023 Annually Certification Inspection** of installed conservation practices.

Columbia County Land and Water Conservation has conducted site visits to inspect, and review submitted documentation in regards to below listed conservation practices to ensure the practices are being maintain per Natural Resource Conservation Standards.

Landowner	Conservation practice
Rhodes Bake-N-Serv	Conservation Cover (25 acres)
Rhodes Bake-N-Serv	Buffer strip (5 acres)
Wisconsin Corp. Seventh Day Adv.	Buffer strip & Conservation Cover (34 acres)
Wisconsin Corp. Seventh Day Adv.	Conservation Cover (6 acres)
Wisconsin Corp. Seventh Day Adv.	Gully Stabilization/Grade Stabilization Structure (In place and functioning)
Curt Stibb	Field Edge Buffer/borders (11 acres)
Curt Stibb	2023 Annually Cover Crop installed (100 acres)

Columbia County Land and Water Conservation have SNAP Plus files regarding Nutrient Management Planning for the Rhodes Bake-N-Serv, Wisconsin Corp. Seventh Day Adventist, and Stibb Farms.

Kurt Calkins
Director, Land & Water Conservation Department

Todd Rietmann
Senior Conservation Specialist, Columbia County Land & Water Conservation Department



Stibb cover crops



Stibb cover crops



Stibb buffer



Seventh Day buffer



Becker's buffer



Cross buffer bay
Seventh Day
2023 City Columbus



Stibb buffer



Seventh Day cover



Seventh Day buffer
Seventh Day Inspection photos



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112 East Edgewater Street
Portage, WI 53901

December 9th, 2024

Re: City of Columbus Water Quality Trading Project—**2024 Annually Certification Inspection**
of installed conservation practices.

Columbia County Land and Water Conservation has conducted site visits to inspect, and review submitted documentation regarding below listed conservation practices to ensure the practices are being maintain per Natural Resource Conservation Standards.

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Sincerely,

Kurt Calkins

Director, Columbia County Land & Water Conservation Department

Todd Rietmann

Senior Conservation Specialist, Columbia County Land & Water Conservation Department

2024 City of Columbus Best Management Practices

Seventh Day Conservation Cover 9/16/2024



Seventh Day Conservation Cover 9/16/2024



Seventh Day Conservation Cover 9/16/2024



Seventh Day Buffer Area 9/16/2024



Seventh Day Buffer Area 9/16/2024



Seventh Day Buffer Area 9/16/2024

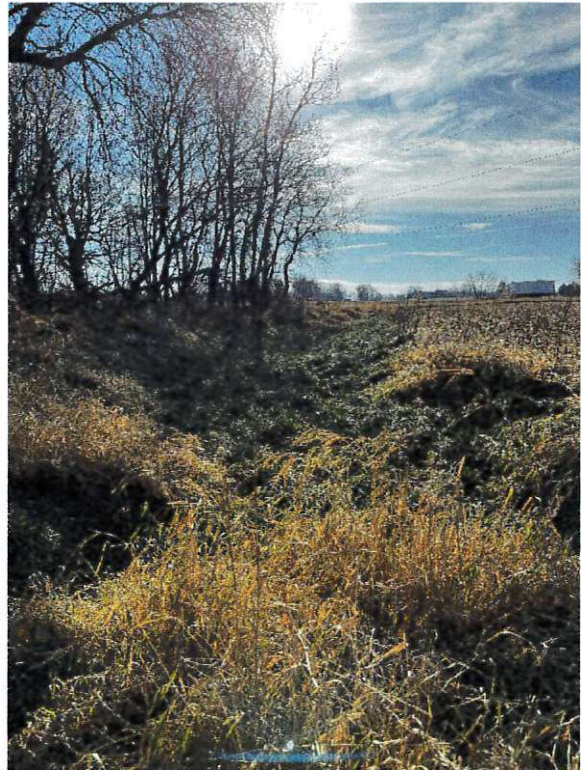


2024 City of Columbus Best Management Practices

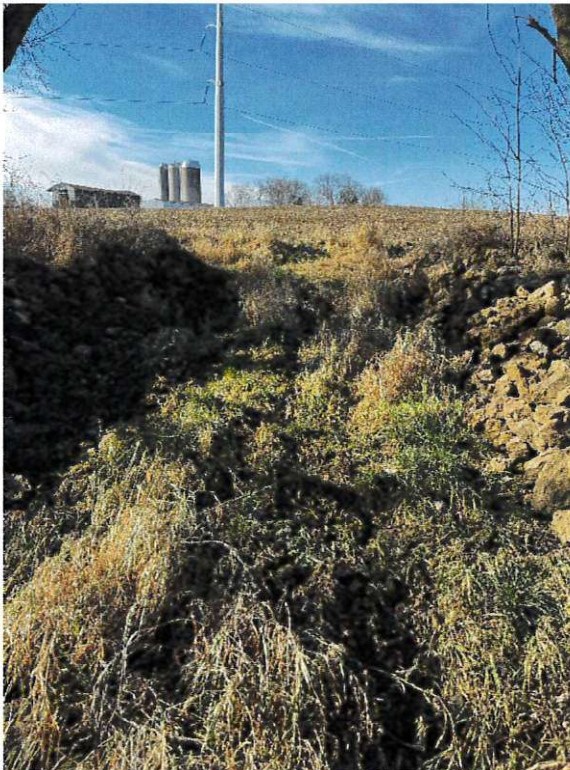
Seventh Day Waterway 12-9-2024



Seventh Day Waterway 12-9-2024



Seventh Day Waterway rock chute 12/9/24



Seventh Day Waterway rock chute 12/9/24



2024 City of Columbus Best Management Practices

Bakery site buffer area 9/16/2024



Stibb site cover crop 11/19/2024



Stibb site cover crop 11/19/2024



Stibb site cover crop 11/19/2024



Stibb site Buffer Area 11/19/2024



Appendix F: NRCS Conservation Practice Standards

Conservation Cover (Code 327)

Cover Crop (Code 340)

Filter Strip (Code 393)

Grassed Waterway (Code 412)



Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

CONSERVATION COVER

CODE 327

(ac)

DEFINITION

Establishing and maintaining permanent vegetative cover.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Reduce sheet, rill, and wind erosion.
- Reduce sediment transport to surface water.
- Reduce ground and surface water quality degradation by nutrients.
- Reduce emissions of particulate matter.
- Provide wildlife, pollinator, and other beneficial organism habitat.
- Improve soil health by maintaining or increasing soil organic matter quantity.
- Improve soil health by increasing soil aggregate stability.
- Improve soil health by enhancing habitat for soil organisms.
- Improve soil health by reducing compaction.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on most lands needing permanent vegetative cover. This practice may be used to conserve and stabilize archeological and historic sites. This practice does not apply to plantings for forage production or to critical area plantings that require special measures to ensure successful establishment. If the soil and water resource concerns meet minimum planning criteria and the only purpose of the planting is to provide wildlife habitat, Wildlife Habitat Planting (CPS 420) may be implemented.

CRITERIA

General Criteria Applicable to All Purposes

Select species that are adapted to the soil, ecological sites, and climatic conditions and are suitable for the planned purpose and site conditions.

Ensure that planting dates, seeding rates, planting methods, and care in handling and planting seed or planting stock are used to accomplish the planned purpose.

If the specific Rhizobium bacteria for selected legumes are not present in the soil, treat the seed with the appropriate available inoculum. Inoculate legumes at time of planting based on conservation objectives and site history. See USDA NRCS Plant Materials Technical Note No. 5 (Title 190), Using the Appropriate Legume Inoculant for Conservation Plantings.

Prepare the site by eliminating weeds that will impede the establishment and growth of selected species.

Apply nutrients and amendments as needed to ensure vegetation establishment and planned growth. Nutrients and amendments are not always needed for native plant establishment.

The established stand will produce a positive soil conditioning index (SCI) value. Use the SCI results available in the current NRCS erosion prediction technology.

For organic and transitioning-to-organic operations, all seeds, planting stock, materials, and methods used in the implementation of this practice standard must comply with the National Organic Program (NOP) Rules. See the USDA Organic Regulations and the NRCS resource page Conservation for Organic Farmers.

Additional Criteria to Reduce Sheet, Rill and Wind Erosion

Determine and maintain the amount of plant biomass and cover needed to reduce wind and water erosion to the planned soil loss objective by using the current NRCS erosion prediction technology. Soil erosion must not exceed the tolerable soil loss value for the critical dominant soil in the planning area.

Additional Criteria to Reduce Emissions of Particulate Matter

Establish plants that can tolerate the impacts of routine operations (e.g., orchard and vineyard alleys during mowing, spraying, or harvest operations) and provide sufficient ground cover in the planted area to minimize the generation of particulate matter.

Additional Criteria to Provide Wildlife, Pollinator, and Beneficial Organism Habitat

Plant a diverse mixture of tree, shrub, grass, and forb species to meet the habitat needs of the targeted species using approved habitat evaluation tools for the respective state.

Reduce pesticide exposures that could harm wildlife, pollinators, and other beneficial organisms.

Additional Criteria to Improve Soil Health

To maintain or improve soil organic matter, select plants that produce high volumes of organic material. Determine the amount of biomass needed by using the current soil conditioning index procedure.

CONSIDERATIONS

General Considerations

Use certified seed and planting stock that is adapted to the site when it is available.

When restoring or repairing sites, consider use of inoculant for native species when available.

When using Conservation Cover as a prairie strip, design a minimum width of 30 feet.

Mowing may be needed during the establishment period to reduce competition from weeds.

To mitigate for greenhouse gas emissions, select species that will store carbon in the soil via extensive root systems or in woody biomass.

Location of this practice in orchard/vineyard alleys can significantly reduce the particulate matter emissions associated with tractor traffic in the alleys when compared to bare alleys.

If nitrogen fertilizer is used on sites where nitrogen-responsive weeds are present, delay N application until the planted species are well established to avoid expected weed problems. If the site has poor or low-fertility soil, consider using slow-release nutrient sources in lieu of soluble fertilizer to improve the site without stimulating weeds.

To maximize spatial and temporal diversity, rotate management and maintenance activities (e.g., mow only one-fourth or one-third of the area each year) throughout the managed area.

Where wildlife management is an objective, encourage plant species and structural diversity to maximize wildlife use. Habitat evaluation tools can aid in selecting plants for food and cover.

As long as soil loss is within tolerable soil loss limits, use less dense seeding rates where ground-nesting pollinator and wildlife habitat are the primary purposes.

To provide habitat for natural enemies of crop pests, select a mix of plant species that provide year-round habitat or food (accessible pollen or nectar) for the desired beneficial species. Use a diverse mix of plant species that come into bloom at different times and provide a sequence of bloom throughout the year (e.g., plant at least three flowering species from each of the three bloom periods—spring, summer, and fall). Use habitat requirements of predatory and parasitic insects, spiders, insectivorous birds and bats, raptors, and predators of terrestrial rodents. Consult land grant university integrated pest management recommendations for beneficial habitat plantings to manage the target pest species. See USDA NRCS Agronomy Technical Note No. 9 (Title 190), Preventing or Mitigating Potential Negative Impacts of Pesticides on Pollinators using IPM and Other Conservation Practices.

Use native species that are appropriate for the identified resource concern and management objectives with the aim of reestablishing the native plant community for the site. It should be considered adequate if a native cover other than what was planted establishes and addresses the resource concern and landowner objectives .

During vegetation establishment, natural mulches, such as wood products or hay, can be used to conserve soil moisture, support beneficial soil life, and suppress competing vegetation.

Including a diverse mix of species enhances the above- and below ground ecosystem biodiversity.

Additional Considerations to Improve Soil Health

The effects of this practice are enhanced when it is integrated into a soil health management system. Refer to NRCS Soil Health Technical Note No. 4 (Title 450), “The Basics of Addressing Resource Concerns with Conservation Practices within Soil Health Management Systems on Cropland” for more information.

PLANS AND SPECIFICATIONS

Develop plans and specifications for each field or treatment unit according to the criteria and operation and maintenance requirements of this standard. Specifications must describe the requirements to apply this practice to achieve the intended purpose. Record the following specification components in an approved NRCS Conservation Practice Standard Conservation Cover (Code 327) implementation requirements document:

- All applicable purposes for the installation of this practice.
- Field numbers and installation locations referenced on the conservation plan map.
- Recommended plant species.
- Seeding rates and dates.
- Seedbed preparation procedures.
- Establishment methods.
- Management actions needed to ensure an adequate establishment.
- Soil loss estimates and SCI results, if applicable.

When applying this practice to perennial systems, such as orchards and vineyards, the establishment and management requirements apply only to the areas planted with this practice (e.g., the grassed alleyways are seeded and managed under this practice, but the vine row or tree row is managed separately).

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for this practice. Planned activities may include, but are not limited to, the following:

- Protect the cover from irreversible damage by traffic, implements, and herbicides.
- Periodic removal of some products (such as high value trees, medicinal herbs, nuts, and fruits) is permitted provided the conservation purpose is not compromised by the loss of vegetation or harvesting disturbance.
- Mowing and harvest operations in a perennial crop system (such as orchards, vineyards, berries, and nursery stock), will be accomplished in a manner that minimizes the generation of particulate matter.
- Mowing may be needed during the establishment period to reduce competition from weeds.
- Control noxious weeds and invasive species.
- If wildlife habitat enhancement is a purpose, maintenance practices and activities will occur during periods of the day or season to minimize negative impacts of disturbance.
- If wildlife habitat is a purpose, include the procedures necessary to conserve the cover's wildlife habitat functions.
- To support insects eaten by grassland nesting birds, spot treat noxious weeds to protect other forbs and legumes that benefit native pollinators and other wildlife.
- Revegetate bare spots when they occur.

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USDA ARS. 1997. Agricultural Handbook Number 703. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE). Washington, D.C. Accessed July 22, 2022. https://www.ars.usda.gov/ARSUserFiles/64080530/RUSLE/AH_703.pdf

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[595 KY GD Agronomy Tech Note 9 Preventing or Mitigating Potential Negative Impacts of Pesticides on Pollinators 2014 \(usda.gov\)](#)

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USDA NRCS. 2020. Plant Materials Technical Note No. 5 (Title 190), Using the Appropriate Legume Inoculant for Conservation Plantings. USDA, NRCS, Plant Materials Program. Washington, D.C. Accessed February 28, 2024. [National Plant Materials Technical Note 5: Using the Appropriate Legume Inoculant for Conservation Plantings \(usda.gov\)](#)



Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

COVER CROP

CODE 340

(ac)

DEFINITION

Grasses, legumes, and other forbs planted for seasonal vegetative cover.

PURPOSE

This practice is applied to support one or more of the following purposes:

- Reduce sheet, rill, and wind erosion.
- Maintain or increase soil organic matter.
- Improve soil aggregate stability.
- Improve habitat for soil organisms.
- Reduce water quality degradation by utilizing excess soil nutrients.
- Reduce weed and plant pest pressure.
- Improve moisture management.
- Reduce soil compaction.
- Supply nitrogen to the subsequent crop.
- Improve habitat for pollinators, beneficial organisms, or natural enemies of crop pests.

CONDITIONS WHERE PRACTICE APPLIES

All lands requiring seasonal vegetative cover for natural resource protection or improvement.

CRITERIA

General Criteria Applicable to All Purposes

Cover crops are established as part of a cropping system between production crops in rotation. Cover crops may be interseeded into production crops or planted in the alleyways of perennial trees or vine crops. Select species and planting dates that will not adversely affect crop yield or interfere with the harvest process.

Plant species selection, seedbed preparation, seeding rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with applicable local criteria and soil/site conditions.

Determine the method and timing of termination to meet the grower's objective and the current NRCS Cover Crop Termination Guidelines.

Where applicable for crop insurance, refer to the Risk Management Agency Good Farming Practice Handbook to determine the request process when an exception to the NRCS Cover Crop Termination Guidelines is supported as a good farming practice.

Cover crops must be compatible with other components of the cropping system such as crops, available equipment, and timing of operations.

Avoid selection of cover crop species with the potential to contaminate production crops (e.g., buckwheat cover crop in wheat production fields).

Ensure chemical applications used with previous crops and for the establishment of the cover crop are compatible with cover crop selections and purposes.

Do not burn cover crop residue.

Do not harvest cover crops for seed.

Time termination and method of termination to enable the cover crop to meet the specified purpose(s).

If the specific rhizobium bacteria for a selected legume is not expected to be sufficiently present in the soil, treat the seed with the appropriate inoculum.

Seed will be free of noxious weed seed.

For organic and transitioning to organic systems, comply with the National Organic Program (NOP) rules.

Additional Criteria to Reduce Sheet, Rill, and Wind Erosion

Time the cover crop establishment in conjunction with other practices to adequately protect the soil during the critical erosion periods.

Select cover crops that will have the physical characteristics necessary to provide adequate erosion protection.

Use the current erosion prediction technology to determine the amount of surface and canopy cover needed from the cover crop to achieve the predicted erosion reduction.

Additional Criteria to Maintain or Increase Soil Organic Matter Quantity

Select cover crop species that produce high volumes of aboveground biomass and root mass to maintain or increase soil organic matter.

The planned crop rotation including the cover crop and associated management activities will score a Soil Conditioning Index (SCI) value > 0 , and be higher than the benchmark system, as determined, using the current approved NRCS SCI procedure, with appropriate adjustments for additions to and subtractions from plant biomass.

Plant the cover crop as early as possible and terminate as late as practical (late vegetative stage or later) to maximize plant biomass production, while considering the time needed to prepare the field for planting the next crop, and soil moisture depletion.

Do not mechanically harvest cover crop biomass. Allow residues to remain on the surface following termination.

When integrating livestock as part of a soil health management system, control the frequency, intensity, and duration of grazing to maintain cover crop above ground vegetation.

Plan grazing events at later stages of maturity in order to maximize root biomass and to allow for at least 50% of the total above ground vegetation to remain with the majority to be flattened onto the soil surface.

Additional Criteria to Improve Soil Aggregate Stability

Select cover crops that contain at least one fibrous rooted grass in conjunction with other practices in a soil health management system to bind aggregates and support aggregate-building soil organisms.

Terminate the cover crop with a method that is consistent with maintaining the aggregate stability achieved by the growth of the cover crop and meets producer objectives.

Additional Criteria to Improve Habitat for Soil Organisms

Seed a minimum of 3 species of plants that includes 2 or 3 plant families to provide diverse soil organism food supply in conjunction with other practices in a soil health management system.

Do not mechanically harvest cover crop biomass. Allow residues to remain on the surface following termination.

Terminate cover crop in the late vegetative stage or later to maximize biomass production.

Additional Criteria to Reduce Water Quality Degradation by Utilizing Excess Soil Nutrients

Establish cover crops as soon as practical prior to or after harvest of the production crop.

Select cover crop species for their ability to effectively utilize nutrients.

Terminate the cover crop as late as practical to maximize plant biomass production and nutrient uptake.

Additional Criteria to Reduce Weed Pressures and Break Pest Cycles

Select cover crop species for their life cycles, growth habits, and other biological, chemical, and physical characteristics to provide one or more of the following:

- Suppress or compete with weeds.
- Break pest life cycles or suppress pests, including pathogens.
- Provide food or habitat for natural enemies of pests.
- Release compounds such as glucosinolates that suppress soilborne pathogens or pests.

Select cover crop species that do not harbor unmanageable pests or diseases of subsequent crops.

For weed suppression, leave terminated cover crop residue on the soil surface when appropriate.

Additional Criteria to Improve Moisture Management

In areas of limited soil moisture, terminate growth of the cover crop sufficiently early to conserve soil moisture for the production crop. Leave residues of cover crops on the soil surface.

In areas of potential excess soil moisture, allow the cover crop to grow as long as possible to maximize soil moisture removal.

Additional Criteria to Reduce Soil Compaction

Select cover crop species that can penetrate or prevent compacted layers.

Depending on characteristics of selected cover crops, plant cover crops early enough or terminate late enough to achieve potential increased root biomass or depth.

For near surface compaction or crusting issues, leave terminated cover crop residue on the surface.

Additional Criteria to Supply Nitrogen to Subsequent Crop

Legumes (with appropriate inoculants where necessary), either alone or in a seed mix, are used to improve fertility by providing the subsequent crop with a minimum of 20% but not more than 100% of the crop's estimated nitrogen requirement.

Use land grant university (LGU's) publications or cover crops analysis to estimate the amount of nitrogen in the cover crop. The nitrogen supplied by the cover crop must be credited in the nutrient budget for the subsequent crop.

Use LGU publications or field data to determine the effects of termination timing and termination methods (which may include incorporation, grazing, crimping, mowing or agrichemicals) on the amount of estimated available nitrogen for the subsequent crop.

Do not mechanically harvest biomass.

Additional Criteria to Improve Habitat for Pollinators, Beneficial Organisms, or Natural Enemies of Crop Pest

Use cover crop mixes that contain at least 50% forbs of known habitat, pollen, or nectar value to targeted pollinators or other beneficial organisms. Allow these forbs to achieve at least 50% bloom before termination.

Cover crop seeds must not be treated with systemic insecticide coatings that may pose a risk to beneficial organisms. Cover crops must not be exposed to pesticide sprays, seed coatings, or drift that can negatively impact the targeted pollinators or beneficial organisms. [See Agronomy Technical Note 9 for determining potential impacts.]

CONSIDERATIONS

General Considerations

Plant cover crops in a timely manner and when there is adequate moisture to establish a good stand. If soil moisture is insufficient and irrigation is available, irrigate newly seeded cover crops to ensure timely establishment and ground coverage.

Avoid cover crop species that harbor or carry over potentially damaging diseases or insects that can affect subsequent crops.

Cover crops may be used to improve site conditions for establishment of perennial species by providing early cover for emerging perennial seedlings. In such cases, meeting a primary purpose still applies.

Cover crops may be used (grazed, mowed, or harvested for silage) for emergency livestock forage needs when extreme weather conditions negatively affect the planned forage production.

Cover crops residues should be left on the soil surface to maximize mulching (physical) effects.

Cover crops, flattened to the soil surface can moderate soil temperatures, keeping soils cooler during hotter periods and warmer during cooler periods.

Cover crops can be selected and managed for allelopathic effects. Evaluate potential allelopathic effects to the subsequent crop.

Cover crops may be selected that release biofumigation compounds that inhibit soilborne plant pests and pathogens.

Seed a higher density cover crop stand to promote rapid canopy closure and greater weed suppression. Increased seeding rates (1.5 to 2 times normal) can improve the cover crop competitiveness with weed species.

Species can be selected to serve as trap crops to divert pests from production crops.

For wildlife plantings, select a mixture of two or more cover crop species from different plant families to increase soil biological diversity or to provide food and cover.

Select cover crop species or mixtures, and timing and method of termination that will maximize efficiency of nitrogen utilization by the following crop, considering soil type and conditions, season and weather conditions, cropping system, carbon (C) to nitrogen (N) ratio of the cover crop at termination, and anticipated nitrogen needs of the subsequent crop.

To ensure timely seeding of cover crops, employ planting methods that allow for early season growth such as interseeding or broadcast overseeding into standing crops.

Time the termination of cover crops to meet nutrient release goals. Termination at early vegetative stages may cause a more rapid release compared to termination at a more mature stage.

Both residue decomposition rates and soil fertility can affect nutrient availability following termination of cover crops. As an example, higher C to N plant residues in conjunction with lower soil fertility could slow the availability of N to growing plants.

Use diverse cover crop species mixtures with various C:N ratios or maturity that upon decomposition would allow nutrients to be released throughout the growing season of the next crop, enhancing nutrient cycling and nutrient retention.

Legumes add the most plant-available N if terminated when about 30 - 50 percent of the crop is in bloom (depending on species).

Cover crops can reduce pesticide losses by reducing erosion and adding organic matter.

Cover crop species selected for their ability to effectively utilize potential water quality degrading nutrients may also be used to conserve and cycle other nutrients as well.

When appropriate, refer to crop insurance criteria when deciding the timing of cover crop termination.

Considerations to Reduce Sheet, Rill, and Wind Erosion

Maximize the combined canopy and surface residue cover to attain a minimum of 90-percent cover during the period of potentially erosive wind or rainfall.

Considerations to Maintain or Increase Soil Organic Matter Quantity

Increase the diversity of cover crops (e.g., mixtures of several plant species or functional groups) to promote a wider diversity of soil organisms, and possibly promote increased soil organic matter.

Plant legumes or mixtures of legumes with grasses, brassicas, and other forbs to provide N through biological N fixation and to achieve a balanced C:N ratio which can maximize formation of stable soil organic matter.

Considerations to Improve Soil Health

In semiarid regions, where seasonal fallow is used, consider leaving sufficient residues to protect the soil surface during the fallow period, or growing a shallow-rooted cover crop that allows deep moisture storage. Reduce the intensity of tillage and increase soil surface coverage with vegetation and crop residues.

When applying agrichemicals, consider the potential impact on the soil organisms and consult with a pesticide professional to develop alternative application techniques or alternative agrichemicals that have lower adverse impacts on soil organisms.

Select diverse cover crops that have shallow, medium, and deep roots to maximize aggregate stability, to increase organic matter, and to improve water infiltration and improve soil structure.

The effects of this practice can be enhanced by being integrated into a soil health management system. Refer to Technical Note 450-4 for more information.

With increasing water infiltration due to improved soil health, ephemeral gully occurrences can be minimized.

The effects of this practice can be enhanced by utilizing animal wastes, or applying nonsynthetic mulches to supplement the biomass produced by cover crops.

Considerations to Reduce Water Quality Degradation by Utilizing Excess Soil Nutrients

Use deep-rooted species to maximize nutrient recovery.

When appropriate for the cropping system, mowing certain grass cover crops (e.g., sorghum-sudangrass, pearl millet) prior to heading and allowing the cover crop to regrow can enhance rooting depth and density.

PLANS AND SPECIFICATIONS

Develop implementation requirements for each field or treatment unit according to the criteria and operation and maintenance requirements of this standard. Specifications must describe the requirements to apply the practice to achieve the intended purpose. Record the following specification components in an approved CPS Cover Crop (Code 340) implementation requirements document:

- Field number and acres.
- Species of plants to be established.
- Contingency plan with specie options for substitution to achieve the intended purpose.
- Seeding rates.
- Seeding dates.
- Seeding depth.
- Establishment procedure including planting method.
- Rates, timing, and forms of nutrient application (if needed).
- Dates and method to terminate the cover crop.
- Other information pertinent to establishing and managing the cover crop.

OPERATION AND MAINTENANCE

Evaluate the cover crop to determine if the cover crop is meeting planned purposes. If the cover crop is not meeting the purposes, adjust the management.

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USDA NRCS Cover Crop Termination Guidelines. <https://www.nrcs.usda.gov/sites/default/files/2023-03/cover-crops-termination-guidelines-designed-v4-2019-updated.pdf>

USDA NRCS Organic Farming Handbook and other resources: [Organic Agriculture | NRCS \(usda.gov\)](#)

USDA, NRCS National Agronomy Manual, 4th Edition, Feb. 2011.

Website: <https://directives.sc.egov.usda.gov/landingpage/15836>

Wind Erosion Prediction System (WEPS) Website:

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/weps/>



**Natural Resources Conservation Service
CONSERVATION PRACTICE STANDARD**

FILTER STRIP

Code 393

(Ac)

DEFINITION

A strip or area of herbaceous vegetation that removes contaminants from overland flow.

PURPOSE

- Reduce suspended solids and associated contaminants in runoff and excessive sediment in surface waters.
- Reduce dissolved contaminant loadings in runoff.
- Reduce suspended solids and associated contaminants in irrigation tailwater and excessive sediment in surface waters.

CONDITIONS WHERE PRACTICE APPLIES

Filter strips are established where environmentally sensitive areas need to be protected from sediment, other suspended solids, and dissolved contaminants in runoff.

CRITERIA

General Criteria Applicable to All Purposes

Overland flow entering the filter strip will be uniform sheet flow.

Concentrated flow will be dispersed before it enters the filter strip.

The maximum gradient along the leading edge of filter strip will not exceed one-half of the up-and-down-hill slope percent, immediately upslope from the filter strip, up to a maximum of five percent.

Filter strips will not be used as a travel lane for equipment or livestock.

Additional Criteria to Reduce Dissolved Contaminants, Suspended Solids and Associated Contaminants in Runoff and Excessive Sediment in Surface Waters.

The filter strip will be designed to have a 10-year life span, following the procedure in Agronomy Technical Note No. 2, "Using Revised Universal Soil Loss Equation, Version 2 (RUSLE2) for the Design and Predicted Effectiveness of Vegetative Filter Strips (FVS) for Sediment," based on the amount of sediment delivery to the upper edge of the filter strip and ratio of filter strip flow length to length of flow path from the contributing area. The minimum flow length through the filter strip will be 20 feet for suspended solids and associated contaminants in runoff and 30 feet for dissolved contaminants and pathogens in runoff.

The filter strip will be located immediately downslope from the source area of contaminants.

The drainage area immediately above the filter strip will have a slope of one percent or greater.

Vegetation. The filter strip will be established to permanent herbaceous vegetation.

Species selected will be—

- Able to withstand partial burial from sediment deposition.
- Tolerant of herbicides used on the area that contributes runoff to the filter strip.
- Stiff stemmed and a high stem density near the ground surface.
- Suited to current site conditions and intended uses.
- Able to achieve adequate density and vigor within an appropriate period to stabilize the site sufficiently to permit suited uses with ordinary management activities.

Plant species, rates of seeding (lbs/ac), vegetative planting (plants/ac), minimum quality of planting stock (pure live seed [PLS] or stem caliper), and method of establishment shall be specified before application. Only viable, high quality seed or planting stock will be used.

Perform site preparation and seeding/planting at a time and in a manner that best ensures survival and growth of selected species. Successful establishment parameters, (e.g., minimum percent ground/canopy cover, percent survival, stand density) will be specified before application.

Schedule planting dates during periods when soil moisture is adequate for germination and establishment. Seeding will be timed so that tillage for adjacent crop does not damage the seeded filter strip.

Where the purpose is to remove phosphorus, remove (or harvest) the filter strip aboveground biomass at least once each year.

The minimum seeding and stem density will be equivalent to the seeding rate for a high quality grass hay seeding rate for the climate area or the density of vegetation selected in current water erosion technology to determine trapping efficiency, whichever is the higher seeding rate.

Additional Criteria to Reduce Suspended Solids and Associated Contaminants in Irrigation Tailwater and Excessive Sediment in Surface Waters.

Filter strip vegetation will be a small grain or other suitable annual plant.

The seeding rate shall be sufficient to ensure that the plant spacing does not exceed 4 inches (about 16–18 plants per square foot).

Establish filter strips prior to the irrigation season so that the vegetation is mature enough to filter sediment from the first irrigation.

CONSIDERATIONS

General Considerations.

Filter strip width (flow length) can be increased as necessary to accommodate harvest and maintenance equipment.

Filters strips with the leading edge on the contour will function better than those with a gradient along the leading edge.

Seeding rates that establish a higher stem density than the normal density for a high quality grass hay crop will be more effective in trapping and treating contaminants.

When needed, invasive plant species may be controlled through mowing, herbicides, and hand weeding.

Consideration for Reducing Suspended Solids and Associated Contaminants in Runoff.

Increasing the width of the filter strip beyond the minimum required will increase the potential for capturing more contaminants in runoff.

Considerations for Creating, Restoring or Enhancing Herbaceous Habitat for Wildlife and Beneficial Insects and Pollinators. Filter strips are often the only break in the monotony of intensively-cropped areas. The wildlife and pollinator benefits of this herbaceous cover can be enhanced by the following:

- When appropriate, use native grass species that fulfill the purpose(s) of the practice while also providing habitat for priority wildlife.
- Adding herbaceous plant species (including native forbs) to the seeding mix that are beneficial to wildlife and pollinators and are compatible for one of the listed purposes. Changing the seeding mix should not detract from the purpose for which the filter strip is established.
- Increasing the width beyond the minimum required. The additional area can increase food and cover for wildlife and pollinators.
- Management activities on filter strips (mowing, burning, or light disking), should not be done more often than every other year with frequency dependent on geographical location to maintain the purpose(s) of the practice.
- Management activities should be completed outside of the primary nesting, fawning, and calving seasons. Activities should be timed to allow for regrowth before the growing season ends.
- Organic producers should submit plans and specifications to their certifying agent for approval prior to installation, as part of the organic producer's organic system plan.

Considerations to Maintain or Enhance Watershed Functions and Values. Filter strips may be used to enhance connectivity of corridors and noncultivated patches of vegetation within the watershed, enhance the aesthetics of a watershed, and be strategically located to reduce runoff, and increase infiltration and groundwater recharge throughout the watershed.

Increase Carbon Storage. Increasing the width of the filter strip beyond the minimum required will increase potential for carbon sequestration.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice will be prepared for each field or treatment unit. Record the specifications using the implementation requirements document. The specifications will identify at a minimum the following:

- Practice purpose(s).
- Length, width (width refers to flow length through the filter strip), and slope of the filter strip to accomplish the planned purpose(s).
- Plant species selection and seeding/planting/sprigging rates to accomplish the planned purpose.
- Planting dates and planting method(s).
- Specific care and handling requirements of the seed or plant material to ensure that planted materials have an acceptable rate of survival.
- A statement that only viable, high quality, and adapted seed will be used.
- Site preparation instructions sufficient to establish and grow selected species.

OPERATION AND MAINTENANCE

For the purposes of filtering contaminants and nutrients (phosphorus), permanent filter strip vegetative plantings will be harvested and removed as appropriate to encourage dense growth, maintain an upright growth habit and remove nutrients and other contaminants that are contained in the plant tissue.

Control undesired weed species, especially State-listed noxious weeds.

If Conservation Practice Standard (CPS) Prescribed Burning (Code 338) is used to manage and maintain the filter strip, an approved burn plan must be developed.

Inspect the filter strip after storm events and repair any gullies that have formed, remove unevenly deposited sediment accumulation that will disrupt sheet flow, reseed disturbed areas and take other measures to prevent concentrated flow through the filter strip.

Apply supplemental nutrients as needed to maintain the desired species composition and stand density.

Periodically regrade and reestablish the filter strip area when sediment deposition at the filter strip-field interface jeopardizes its function. Reestablish the filter strip vegetation in regraded areas, if needed.

If grazing is used to harvest vegetation from the filter strip, the grazing plan must ensure that the integrity and function of the filter strip is not adversely affected.

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Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

GRASSED WATERWAY

CODE 412

(ac)

DEFINITION

A shaped or graded channel that is established with suitable vegetation to convey surface water at a nonerosive velocity using a broad and shallow cross section to a stable outlet.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding
- Prevent gully formation
- Protect/improve water quality

CONDITIONS WHERE PRACTICE APPLIES

This practice is applied in areas where added water conveyance capacity and vegetative protection are needed to prevent erosion and improve runoff water quality resulting from concentrated surface flow.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct grassed waterways to comply with all Federal, State, and local laws and regulations.

Capacity

Design the waterway to convey the peak runoff expected from the 10-year frequency, 24-hour duration storm. Increase capacity as needed to account for potential volume of sediment expected to accumulate in the waterway between planned maintenance activities. When the waterway slope is less than 1 percent, out-of-bank flow may be permitted if such flow will not cause excessive erosion. Ensure that the design capacity, at a minimum, will remove the water before crops are damaged.

Stability

Determine the minimum depth and width requirements for stability of the grassed waterway using the procedures in the NRCS National Engineering Handbook (Title 210), Part 650, Chapter 7, "Grassed Waterways," or Agricultural Research Service Agriculture Handbook 667, "Stability Design of Grass-Lined Open Channels." Base stability computations on the peak runoff expected from a 10-year, 24-hour duration storm.

Ensure that the vegetative species selected are suited to the site conditions and intended uses. Select species that have the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the waterway.

Width

Keep the bottom width of a trapezoidal waterway less than 100 feet unless multiple or divided waterways or other means are provided to prevent meandering of low flows.

Side slopes

Keep the side slopes flatter than a ratio of 2 horizontal to 1 vertical (2:1). Flatten the side slopes as needed to accommodate the equipment used for maintenance, tillage, and harvesting so that damage to the waterway is minimized.

Depth

The capacity of the waterway must be large enough so that the water surface of the waterway is below the water surface of the tributary channel, terrace, or diversion that flows into the waterway at design flow.

Provide 0.5 feet of freeboard above the designed depth when flow must be contained to prevent damage. Provide freeboard above the designed depth based on capacity conditions when the vegetation has the maximum expected retardance. To achieve the freeboard, extend side slopes at a slope equal to or flatter than the side slope of the design cross section.

Drainage

When needed to establish or maintain vegetation on sites having prolonged flows, high water tables, or seepage problems, use NRCS Conservation Practice Standards (CPSs) Subsurface Drain (Code 606), Underground Outlet (Code 620), or other suitable measures in waterway designs.

Where drainage practices are not practicable or adequate to solve these seepage problems, use NRCS CPS Lined Waterway or Outlet (Code 468) in place of NRCS CPS Grassed Waterway (Code 412).

Outlets

Provide a stable outlet with adequate capacity. The outlet can be another vegetated channel, an earthen ditch, a grade stabilization structure, filter strip, lined waterway, or other suitable outlet.

Vegetative establishment

Establish vegetation as soon as possible using the criteria listed under "Establishment of Vegetation" in NRCS CPS Critical Area Planting (Code 342) and/or the State planting guide. Use mulch; nurse crop; rock, straw, or hay bale dikes; fabric or rock checks; filter fences; or runoff diversion to protect the vegetation until it is established. Planting a close-growing crop (e.g., small grains or grasses) on the contributing watershed prior to construction of the grassed waterway can also significantly reduce the flow through the waterway during establishment. Provide livestock and vehicular crossings as necessary to prevent damage to the waterway and its vegetation.

CONSIDERATIONS

Where environmentally sensitive areas need to be protected from dissolved contaminants, pathogens, or sediment in runoff, consider establishment of an increased width of vegetation on the waterway above the flow area. Increasing the width of the established vegetation above the flow area will increase filtering of sediment and pathogens, and it will increase infiltration of runoff and nutrient removal.

Where sediment control is the primary concern, consider using vegetation in the waterway that can withstand partial burial and adding sediment control measures above the waterway, such as residue management. Consider increasing the channel depth and/or designing areas of increased width or decreased slope to trap and store sediment to reduce the amount of sediment that leaves a field. Provide for regular cleaning out of the waterway when trapping sediment in this manner.

Implement best management practices and use a system of additional conservation practices or a soil health management system in conjunction with the grassed waterway to minimize upstream runoff and concentrated flow.

Tillage and crop planting often takes place parallel to the waterway, resulting in preferential flow paths and erosion along the edges of the waterway. Consider installation of measures that ensure the runoff from adjacent areas will enter the waterway. Measures such as directing spoil placement or small swales can direct this preferential flow into the grassed waterway.

Livestock and vehicle crossings should occur perpendicular to the waterway. Consider locating crossings to minimize potential damage to the waterway. Crossing design must not interfere with design-flow capacity.

Avoid areas where unsuitable plant growth-limiting subsoil and/or substratum material, such as salts, acidity, root restrictions, etc., may be exposed during implementation of the practice. Where areas cannot be avoided, seek recommendations from a soil scientist for improving the condition; or, if not feasible, consider over-cutting the waterway and add topsoil over the cut area to facilitate vegetative establishment.

Avoid or protect, if possible, important wildlife habitat, such as woody cover or wetlands, when determining the location of the grassed waterway. Avoid placing trees and shrubs in or near the grassed waterway so they do not interfere with hydraulic functions or send roots into associated subsurface drainage. Medium or tall bunch grasses and perennial forbs may also be planted along waterway margins to improve wildlife habitat. Waterways with these wildlife features are more beneficial when connecting other habitat types (e.g., riparian areas, wooded tracts, and wetlands). When possible, select plant species that can serve multiple purposes, such as benefiting wildlife, while still meeting the basic criteria needed for providing a stable conveyance for runoff.

Water-tolerant vegetation may be an alternative to subsurface drains or stone center waterways on some wet sites.

Use irrigation in dry regions or supplemental irrigation as necessary to promote germination and vegetation establishment.

Wildlife habitat benefits can be provided by adding width of appropriate vegetation to the sides of the waterway. Care should be taken to avoid creating small isolated planting zones for wildlife. These can become population sinks where wildlife attracted to an area experience reproductive loss due to predation. Mowing may be appropriate to enhance wildlife values, but should be conducted to avoid peak nesting seasons and reduced winter cover whenever possible.

Consider planting diverse legumes, forbs, and flowering plants, such as milkweeds, that provide pollen and nectar for native bees and other pollinators adjacent to the waterway. In dry regions, these sites may be able to support flowering forbs with higher water requirements and thus provide bloom later in the summer.

For all organic or transitioning-to-organic operations, follow all National Organic Program rules.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for a grassed waterway that describe the requirements for applying the practice according to this standard. As a minimum, include—

- A plan view of the layout of the grassed waterway.
- Dimensions of the waterway, including length, grade, top width, bottom width, depth, and side slopes as applicable.
- Disposal requirements for excess soil material.
- Site-specific construction specifications that describe in writing the installation of the grassed waterway. Include specification for control of concentrated flow during construction and vegetative establishment.
- Vegetative establishment requirements.

OPERATION AND MAINTENANCE

Provide an operation and maintenance plan to review with the landowner. Include the following items and others as appropriate in the plan:

- Establish a maintenance program to maintain waterway capacity, vegetative cover, and outlet stability. Vegetation damaged by machinery, herbicides, or erosion must be repaired promptly.
- Protect the waterway from concentrated flow by using diversion of runoff or mechanical means of stabilization, such as silt fences, mulching, hay bale barriers, etc., to stabilize grade during vegetation establishment as necessary.
- After vegetation is established, remove any temporary measures, such as diversions or silt fences, that were installed so as to not interfere with design flow.
- Minimize damage to vegetation by excluding livestock whenever possible, especially during wet periods. Permit grazing in the waterway only when a controlled grazing system is being implemented.
- Inspect grassed waterways regularly, especially following heavy rains. Fill, compact, and reseed damaged areas immediately. Remove sediment deposits to maintain capacity of the grassed waterway.
- Avoid use of herbicides or pesticides that would be harmful to the vegetation or pollinating insects in and adjacent to the waterway area.
- Avoid using waterways as turn rows during tillage and cultivation operations.
- Mow or periodically graze vegetation to maintain capacity, reduce sediment deposition, and maintain suitable plant composition and vigor.
- Apply supplemental nutrients as needed to maintain the desired species composition and stand density of the waterway.
- Control noxious weeds.
- Do not use waterways as a field road. Avoid crossing with heavy equipment when wet.
- Lift tillage equipment and turn off chemical application equipment when crossing the waterway.

REFERENCES

USDA Agricultural Research Service. 1987. Stability Design of Grass-Lined Open Channels. Agriculture Handbook Number 667. Washington, D.C. <https://naldc-legacy.nal.usda.gov/catalog/CAT87216054>

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Appendix G: NRCS Technical Notes

Wisconsin Agronomy Technical Note 6: Establishing and Maintaining Introduced Grasses and Legumes

Wisconsin Agronomy Technical Note 7: Cover and Green Manure Crops Benefits to Soil Quality

Establishing and Maintaining Introduced Grasses and Legumes

INTRODUCTION

This technical note will provide guidance for the establishment of introduced (non-native) plantings of perennial herbaceous vegetation for the purpose of meeting the criteria in Wisconsin Natural Resources Conservation Service (NRCS), Field Office Technical Guide (FOTG), Section IV, Practice Standards 327, Conservation Cover; 645, Wildlife Upland Habitat Establishment; 342, Critical Area Planting; and 512, Forage and Biomass Planting. Additional ecological and engineering standards will reference this technical note. Refer to those standards for specific practice purposes and requirements.

BACKGROUND

Introduced stands of perennial herbaceous vegetation have the potential to control soil erosion and sedimentation, improve water quality, and create or enhance wildlife habitat if properly established and maintained.

Introduced species are typically easier and less expensive to establish than native grasses and forbs.

Seed sources are readily available, relatively inexpensive, and establishment methods are widely understood using common agricultural equipment.

Introduced plantings can provide high quality wildlife habitat with some degree of routine maintenance and cover management. These species will require some reoccurring interseeding to maintain a diverse plant community. Legumes adapted to wet and wet-mesic sites are typically short lived and will require routine reseeding to maintain plant diversity.

Introduced plantings are better adapted to the typical growing conditions in the Northern Planting Zone and tend to thrive in areas where sunlight intensity is moderate, temperature is moderate, and water is readily available. These plants produce most of their growth during the spring, late summer, and early fall when the soil and air temperatures are cooler. For this group of plants, the minimum air temperature for active shoot growth is 40-42 degrees F. Growth is maximized at 65-75 degrees F.

For erosion control, on critical areas, introduced species are the preferred vegetation.

TABLE OF CONTENTS

Description of Tables	2
Specie Selection and Seed Quality	3
Pure Live Seed.....	3
Inoculation.....	4
Criteria for Seed Mixture Development	4
Conservation Cover (327).....	4
Critical Area Planting (342).....	4
Forage And Biomass Planting (512).....	5
Seeding Dates	11
Temporary Cover and Companion Crops	12
Temporary Cover Crop	12
Companion Crops	12
Special Erosion Control Measures	12
Mulching.....	13
Hydroseeding.....	13
Sodding.....	13
Nutrient and Soil Amendment Recommendations	14

Fertilizer.....	14
Lime.....	14
Seedbed Preparation and Seeding Recommendations	14
Conventional Seeding	14
No-Till Planting	14
Dormant Seeding	15
Frost Seeding	15
Stand Evaluation	16
Cover Maintenance	16
Weed Control - Establishment Year	16
Weed Control - Established Cover	16
References.....	17

LIST OF TABLES

Table 1: Relationship Between Moisture Regimes, Drainage Classes, and Forage Suitability Groups	6
Table 2: Common Species and Recommended Pure Stand Seeding Rates.....	7
Table 3: Plant Morphology and Physiology Characteristics.....	8
Table 4: Summary of Seeding Requirements for Standards 327, 342, 512 (Introduced Species).....	10
Table 5: Recommended Seeding Dates by Planting Zone	11
Table 6: Plant Density and Stand Evaluation One Year After Planting.....	16
Table 7: Wildlife Habitat Mixes	18
Table 8: Seeding Mixtures Suitable for Critical Area Plantings.....	19
Table 9: Introduced Pollinator Habitat Mixes	21
Table 10: Forage and Hayland Planting Recommendations.....	21

SITE ASSESSMENT

Introduced plants are generally adapted to one or more soil moisture regimes: wet, wet-mesic, mesic, dry-mesic, and dry. These moisture regimes correlate to some degree with both drainage classes and forage suitability groups.

Drainage classes refer to the frequency and duration of wet periods under conditions similar to those under which the soil formed naturally. Alterations of the water regime by human activities are not considered in this case. These soil moisture regimes fall into one or more of the seven natural soil drainage classes.

Forage suitability groupings are an additional tool to provide guidance to planners. Forage Suitability Groups (FSG) are pasture and hay land soil interpretation reports that provide users with forage production guidance for the soils and climatic conditions present in their area of interest. The vast majority of forage plants utilized in Wisconsin are introduced grasses and legumes. For the purpose of this technical note, FSGs will focus on available water capacity, water table, and runoff potential. FSGs are divided into ten categories.

There is often no sharp division between moisture regimes, drainage classes and forage suitability groups, and oftentimes they blend or overlap into multiple categories. Understanding soil conditions plays an important role when planning a successful introduced herbaceous planting.

Refer to Table 1 correlating the five moisture regimes, seven drainage classes, and ten forage suitability groups.

SPECIE SELECTION AND SEED QUALITY

Evaluate the winter hardiness of species selected for planting. To ensure stand longevity, species listed as Hardy (H) or Very Hardy (VH) in Tables 2-8 of Wisconsin Circular A-1525, Forage Crop Variety Yield Trials for Wisconsin, are preferred. Varieties listed as Moderately Hardy-Plus (MH+) are acceptable.

Select species based on the site conditions looking closely at soil type and moisture regime. Tables 1, 2 and 3 will provide additional guidance for selecting species appropriate for the site conditions.

The recommended introduced species, listed in Table 2, are not identified as prohibited or restrictive

for planting statewide in accordance with Natural Resource Law 40, Invasive Specie Control. However, Kentucky Bluegrass, Smooth Brome grass, Redtop, Birdsfoot Trefoil, Red and White Clover are species that can propagate and spread with little difficulty due to their growth characteristics and should be evaluated carefully when plantings are planned in the vicinity of native remnants or natural areas.

- It is suggested that seed purchased be harvested within a 250 mile radius of the area where the planting will occur. This suggestion is less critical for introduced versus native species.
- For pollinator habitat, the recommended introduced bunch grasses are Orchardgrass, Tall Fescue, Perennial Ryegrass, and Timothy. Refer to Table 9 for introduced pollinator habitat mixtures.
- Kentucky Bluegrass, Brome grass, and Redtop are examples of sod-forming plants. Refer to Table 8 for additional examples.

Introduced mixtures for wildlife habitat must contain at least 50 percent grass seed per square foot. The exception to this criteria is the establishment of pollinator habitat.

Introduced mixtures for areas with shrub and tree plantings are not required to contain 25 percent sod forming grass seed per square foot. These seed mixtures must still contain at least 50 percent grass seed per square foot. Sod-forming grasses are not recommended in shrub and tree plantings.

Below are species with multiple scientific names. The underlined specie is the most recognized genus and specie in Wisconsin and is referenced as such in vegetative Standards 327, Conservation Cover; 342, Critical Area Planting; and 512, Forage and Biomass Planting.

- **Tall Fescue:** Schedonorus arundinaceus, Lolium arundinacea, Festuca arundinacea
- **Meadow Fescue:** Schedonorus pratense, Lolium pratense

Pure Live Seed

Pure Live Seed (PLS) is a means of expressing seed quality.

PLS is the percentage of seed in a seed lot that is both pure seed and viable seed. Pure seed is the percentage by weight of the seed (kind, cultivar,

variety) that is under consideration. Inert matter, weed seed, and other crop seed is excluded from pure seed. Total Viable Seed (TVS) is the percentage estimate of the potential for germination, which includes percent hard seed and/or dormant seed.

Example: Pure Live Alfalfa Seed

(1) XYZ Seed Company, 1000 Crop Seed Lane, Ft. Collins, CO	
(2) Alfalfa, VNS	(6) Germination: 92%
(3) Lot number: 1234	Hard seed: 5%
(4) Pure Seed: 99.00%	Dormant seed: --
Other Crop: 0.25%	T.V.S.: 97%
Weed Seed: 0.10%	(7) Date Tested: 10/2000
Inert material: 0.65%	(8) Origin: CO
(5) Noxious weed seed: dodder 1 per lb.	(9) Seed Treatment: none

$$\text{Pure seed} \times \text{TVS} = \text{PLS}$$

$$99\% \times 97\% = 96.03\%$$

The PLS for Lot number 1234 is 96.03%.

Nearly all species recommended for conservation plantings by NRCS uses PLS expressed in pounds or ounces per acre which is calibrated to seeds per square foot.

Seeding rates in this technical note are shown in pounds or ounces and seeds per square foot per acre.

Inoculation

Legumes are unique plants which have the ability to work with certain strains of bacteria (Rhizobia) to gather atmospheric nitrogen from the soil atmosphere and convert it to useable ammonia nitrogen. Nitrogen produced by this symbiotic relationship is virtually free and results not only in improved soil fertility, but increased protein and forage production in the legume host plant for the benefit of domesticated and wildlife heterotrophs.

Inoculate legume seed with the appropriate inoculant. Inoculants must not be exposed to sunlight or allowed to dry out prior to planting legumes.

CRITERIA FOR SEED MIXTURE DEVELOPMENT

Seed mixtures can consist of a grass component only or a grass and legume component, depending on the standard criteria and the purpose of the planting. Custom seeding mixtures can be developed from selected species listed in Table 2.

For other ecological Wisconsin standards such as Field Border (386), the planner will need to review the standard to determine the specific seeding

requirements for the intended purpose. The Field Border standard will direct the planner to use Standard 342, Critical Area Planting, for erosion concerns and Standard 327, Conservation Cover, when the purpose or concern is for establishing pollinator habitat. This also includes Wisconsin engineering standards such as Standard 635, Waste Treatment Strips.

It is important to reference program rules when determining seed mixtures. Some programs have preapproved required mixtures to meet program and cost requirements.

Conservation Cover (327)

Introduced Species

1. Wildlife Habitat Planting

A minimum of two grasses seeded at a minimum rate of 70 grass seeds per square foot, and at least one legume seeded at a minimum of 30 seeds per square foot.

Fifty percent of the seeds per square foot will comprise of grasses.

Refer to Table 7 for example mixtures.

For dormant and frost seedings, increase seeds per square foot by 15 percent.

2. Herbaceous Pollinator Habitat

At least one and a maximum of two bunch grasses seeded at a maximum rate of 30 seeds per square foot and a minimum of two legumes seeded at a minimum rate of 40 seeds per square foot.

Fifty percent of the seeds per square foot comprising of grasses is not a seed requirement for pollinator habitat planting mixtures.

For dormant and frost seedings, increase the seeds per square foot by 15 percent.

Critical Area Planting (342)

Introduced Species

- A minimum of 160 seeds per square foot for a solid grass planting or in combination with legumes.
- Fifty percent of the seeds per square foot will comprise of grasses and 25 percent of the seed

per square foot will consist of sod-forming grasses.

- For dormant seedings, increase the seeds per square foot by 15 percent.

Dormant seeding can be used when planting introduced species on concentrated and non-concentrated flow areas. When using dormant seedings on concentrated flow areas, the site must be mulched according to Standard 484, Mulching. Frost seeding is not an approved seeding method when using this standard.

Refer to Table 8 for example mixtures.

Forage and Biomass Planting (512)

Introduced Species

1. Pasture and Hayland Planting

- For pasture plantings, mixtures will have at least 1 grass and 1 legume. The mixture will have at least 50 percent grass seeds per square foot, and the total mix will have at least 60 seeds per square foot.
- For hayland establishment, mixtures and single specie plantings may be used as long as the total seeding rate is at least 60 seeds per square foot.

2. Interseeding of Grasses/Legumes Into Existing Pastures and Haylands

- Seeding rate is half of the pure stand seeding rate as specified in Table 2. Seeds per square foot for legumes will vary according to specie.
- Frost seeding is approved only for legumes into existing pastures at a seeding rate of two-thirds the recommended pure stand seeding rate.

Refer to Table 10 for pasture and hayland planting seed mixtures.

Table 1
Relationship Between Moisture Regimes, Drainage Classes, and Forage Suitability Groups

Moisture Regimes	Drainage Class	Forage Suitability Group
Wet Wet mineral or organic soils are typified by very poorly drained soil types.	Very poorly drained Water is removed from the soil so slowly that free water remains at or very near the ground surface during much of the growing season and mesophytic crops cannot be grown. The soils are commonly level or depressed and frequently ponded.	FSG 7 High water holding capacity, seasonal high water table, excessively wet, subject to ponding and flooding. FSG 10 High water holding capacity, seasonal high water table, organic surface layers, subject to ponding and flooding.
	Very poorly drained Somewhat poorly drained Water is removed slowly so that the soil is wet at a shallow depth for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops.	FSG 7, FSG 10 FSG 4 Moderate water holding capacity, generally sandy, seasonal high water table, excessively wet for half of growing season. FSG 7, FSG 10
Mesic Mesic sites will be found on most moderately well and well drained mineral soils which have moderate to very high Available Water Capacity. Mesic sites may occur on some somewhat poorly drained soils with low or very low Available Water Capacity.	Somewhat poorly drained Moderately well drained Water is removed from the soil somewhat slowly during some periods of the year. The soils are wet for only a short time within the rooting depth during the growing season.	FSG 4, FSG 7, FSG 10 FSG 1 Low water holding capacity, generally sandy, seasonal high water table. FSG 4 FSG 5 Moderate water holding capacity, no seasonal high water table, at times seasonal droughtiness, less than 12% slope. FSG 6 Moderate water holding capacity, no seasonal high water table, seasonal droughtiness, greater than 12% slope, runoff concerns. FSG 8 High water holding capacity, no seasonal high water table, less than 12% slopes.
	Well drained Water is removed from the soil readily but not rapidly. Water is available to plants throughout most of the growing season. Wetness does not inhibit growth of roots.	FSG 1, FSG 5, FSG 6, FSG 8 FSG 9 High water capacity, no seasonal high water table, runoff concern.
	Moderately well drained Well drained Somewhat excessively drained Water is removed from the soil rapidly. The soils are commonly coarse-textured.	FSG 1, FSG 4, FSG 5, FSG 6, FSG 8 FSG 1 FSG 2 Low water holding capacity, generally sandy, no seasonal high water table, 0 to 12% slopes. FSG 3 Low water holding capacity, generally sandy, no seasonal high water table, greater than 12% slopes, seasonal droughtiness. FSG 5, FSG 6 FSG 1, FSG 2, FSG 3, FSG 5, FSG 6
Dry-Mesic Dry-mesic sites are transitional between dry and mesic. They occur on some somewhat excessively drained and some well drained soils.	Well drained Somewhat excessively drained Excessively drained	FSG 1, FSG 2, FSG 3, FSG 5, FSG 6 FSG 2, FSG 3, FSG 6 FSG 2, FSG 3
Dry Dry sites occur mostly on well to excessively drained soils.	Well drained Somewhat excessively drained Excessively drained	FSG 1, FSG 2, FSG 3, FSG 5, FSG 6 FSG 2, FSG 3, FSG 6 FSG 2, FSG 3

Table 2
Common Species and Recommended Pure Stand Seeding Rates

Name	Genus and species	Plant Type	Moisture Regime	Single Species Seeding Rate (PLS) Lbs./Acre	Seeds/Lb.	Seeds/Ft ² /Lb./Ac.
Chewings Red Fescue	Festuca rubra L. ssp fallax	Grass	D, DM, M	5	350,000	8
Creeping Red Fescue	Festuca rubra	Grass	DM, M, WM	5	350,000	8
Festulolium	Festuca X Lolium	Grass	DM, M, WM	12	227,000	5.2
Italian or Annual Ryegrass	Lolium perenne L. ssp. multiflorum	Grass	DM, M, WM	20	227,000	5.2
Kentucky Bluegrass	Poa pratensis	Grass	D, DM, M, WM, W	8	2,177,000	50
Meadow Fescue	Schedonorus pratensis	Grass	DM, M, WM	12	227,000	5.2
Orchardgrass	Dactylis glomerata L.	Grass	D, DM, M, WM	10	653,000	15
Perennial Ryegrass	Lolium perenne	Grass	DM, M, WM	20	227,000	5.2
Redtop	Agrostis gigantea	Grass	M, WM, W	4	4,990,000	114.5
Smooth Bromegrass	Bromus inermis	Grass	D, DM, M, WM	20	136,000	3.1
Tall Fescue	Schedonorus arundinaceus	Grass	D, DM, M, WM	12	227,000	5.2
Timothy	Phleum pratense	Grass	DM, M, WM, W	8	1,230,000	28.2
Alfalfa	Medicago sativa	Legume	D, DM, M	12	219,000	5.0
Alsike Clover	Trifolium hybridum	Legume	M, WM, W	3	680,000	15.6
Birdsfoot Trefoil	Lotus corniculatus	Legume	DM, M, WM, W	7	375,000	8.6
Red Clover	Trifolium pratense	Legume	DM, M, WM	10	275,000	6.3
White Ladino Clover	Trifolium repens	Legume	DM, M, WM	3	871,650	20

Table 3
Plant Morphology and Physiology Characteristics

Common Name <i>Scientific Name</i>	Plant Type	Growth Habit	Practice Recommendation	Pure Stand Rate	Seeds per Ft ² /Lb/ Ac.	Wildlife Value	Retardance	Pollinator Habitat	Deep Rooted	Moisture Regime	Forage Suitability Group	pH	Flood Tolerance	Average Height at Maturity	Drought
Grasses															
Chewings Red Fescue <i>Festuca rubra L. ssp. fallax</i>	grass	perennial, cool season sod-forming	342, 512	5 lbs/ac	8	poor	D	no	no	D-M	2, 3, 5, 6, 8, 9	5.0 - 7.5	poor	1.5'	yes
Creeping Red Fescue <i>Festuca rubra</i>	grass	perennial, cool season sod-forming	342, 512	5 lbs/ac	8	poor	D	no	no	DM-WM	1, 4 to 9	5 - 7.5	poor	2'	yes
Festulolium <i>Festuca x Lolium</i>	grass	short-lived annual bunchgrass	342, 512	12 lbs/ac	5.2	fair	C	yes	no	DM-WM	1 to 9	5.0 - 7.5	moderate	1.5 - 2.0'	moderate
Italian (Annual) Ryegrass <i>Lolium perenne L. ssp. multiflorum</i>	grass	short-lived annual bunchgrass	327, 342, 512	12 lbs/ac	5.2	fair	C	yes	no	DM-WM	1, 4 to 9	5.0 - 7.5	moderate	1.5 - 2.0'	moderate
Kentucky Bluegrass <i>Poa pratensis</i>	grass	long-lived perennial cool season plant, sod-forming by rhizomes	327, 342, 512	8 lbs/ac	50	poor	D	no	no < 8"	D-W	1 to 9	5 - 7	fair	2.0'	yes
Meadow Fescue <i>Lolium pratense</i>	grass	perennial, cool season aggressive bunchgrass, with age produces thick sod	342, 512	12 lbs/ac	5.2	fair	D	no	no	DM-WM	1, 4 to 9	5 - 7.2	moderate	2 - 3'	yes
Orchard Grass <i>Dactylis glomerata</i>	grass	long-lived perennial bunchgrass, reproduces from seed	327, 342, 512	10 lbs/ac	15	fair	B	yes	no < 8"	D-WM	1 to 9	5.8 - 7.0	moderate	2.5'	yes
Perennial Ryegrass <i>Lolium perenne</i>	grass	short-lived perennial bunchgrass	327, 342, 512	20 lbs/ac	5.2	fair	C	yes	no	DM-WM	1, 4, 5, 6 to 9	5 - 7.5	moderate	1.5 - 2.0'	yes

Common Name Scientific Name	Plant Type	Growth Habit	Practice Recommendation	Pure Stand Rate	Seeds per Ft ² /Lb/Ac.	Wildlife Value	Retardance	Pollinator Habitat	Deep Rooted	Moisture Regime	Forage Suitability Group	pH	Flood Tolerance	Average Height at Maturity	Drought
Redtop <i>Agrostis gigantea</i>	grass	long-lived perennial cool season plant, sod-forming by stolons	327, 342, 512	4 lbs/ac	114.5	fair	C	no	yes < 2"	M-W	1, 4, 7	4.5 - 8.0	good	3'	no
Smooth Bromegrass <i>Bromus inermis</i>	grass	tall long-lived perennial cool season plant, sod-forming by rhizomes	327, 342, 512	20 lb/ac	3.1	fair	B	no	no < 12"	D-WM	1 to 9	6 - 7.5	brief fair	3 - 4'	yes
Tall Fescue <i>Schedonorus arundinaceus</i>	grass	perennial, cool season aggressive bunchgrass, with age produces thick sod	327, 342, 512	12 lbs/ac	5.2	fair	B	yes	yes > 14"	D-WM	1 to 9	5 - 9	moderate	2.5 - 3.0'	yes
Timothy <i>Phleum pratense</i>	grass	cool season short-lived perennial bunch grass, reproduces by seed	327, 342, 512	8 lbs/ac	28.2	fair	B	no	no < 8"	DM-W	1, 4 to 9	5.5 - 7.0	moderate	3.0'	no
Legumes															
Alfalfa <i>Medicago sativa</i>	legume	single crown, warm season perennial legume, has a deep tap root	327, 342, 512	12 lbs/ac	5	good	C	yes	yes > 14"	D-M	2-3, 5, 6, 8, 9	> 6.5	poor	2.5'	yes
Alsike Clover <i>Trifolium hybridum</i>	legume	perennial, single crown, upright short-lived legume	327, 342, 512	3 lbs/ac	15.6	good	D	yes	no < 8"	M-W	1, 4, 5, 7, 8, 9	> 6.2	moderate	1'	no
Birdsfoot trefoil <i>Lotus corniculatus</i>	legume	warm season perennial legume	327, 342, 512	7 lbs/ac	8.6	good	D	yes	no < 10"	DM-W	1, 4 to 9	> 5.5	moderate-good	.5 - 1'	moderate
Red Clover <i>Trifolium pratense</i>	legume	upright short-lived perennial legume, produces runners, deep taproot	327, 342, 512	10 lbs/ac	6.3	good	C	yes	yes > 14"	DM-WM	1 to 9	> 6.0	poor	2.0'	no
White Ladino Clover <i>Trifolium repens</i>	legume	shallow-rooted perennial legume, prostrate, spreads by stolons	327, 342, 512	3 lbs/ac	20	fair	D	yes	no	DM-WM	1, 4, 5, 7 to 9	> 5.5	fair to poor	1.0'	no

Table 4
Summary of Seeding Requirements for Standards 327, 342, 512 (Introduced Species)

327 - Conservation Cover							
Mix Type	Grasses		Legumes^a		Seeding Periods		
	No.	seeds/ft²	No.	seeds/ft²	Spring	Late Summer	Frost^b
Wildlife Habitat	≥2	≥70	≥1	≥30	X	X	X
Pollinator Habitat	1-2	≤30	≥2	≥40	X	X	X

(a) If more than 20% of legumes are hard seed, increase rate by % of hard seed.

(b) Increase rate 15% for frost and dormant seedings.

342 - Critical Area Planting							
Mix Type	Grasses		Legumes^a		Seeding Periods		
	No.	seeds/ft²	No.	seeds/ft²	Spring	Late Summer	Frost
Grasses Only	≥1	160			X	X	NR
Mixtures	≥1	≥80	≥1	See Notes	X	X	NR

(a) If more than 20% of legumes are hard seed, increase rate by % of hard seed.

(b) Increase rate 15% for dormant seedings. Seedings in concentrated areas must be mulched.

512 - Forage & Biomass Planting							
Mix Type	Grasses		Legumes^a		Seeding Periods		
	No.	seeds/ft²	No.	seeds/ft²	Spring	Late Summer	Frost
Pasture	≥1	See Notes	≥1	See Notes	X	X	NR
Hayland	Single species or mixture with ≥60 seeds/ft ²				X	X	NR
Interseeding		See Notes		See Notes	X	X	Legumes Only

(a) If more than 20% of legumes are hard seed, increase rate by % of hard seed.

Mix must be at least 60 seeds/ft² total. Grasses must be at least 50% of the mix.

Use 1/2 the pure stand rate for spring or late summer seeding. Use 2/3 pure stand rate for frost seeding.

SEEDING DATES

Date of seeding is a critical factor in determining whether a seeding will succeed or fail. The specific date that provides the best chance for success will vary from south to north and from year to year with prevailing moisture and temperature conditions. Late summer seeding is generally riskier than spring seeding. Planting at either end of the allowable range is riskier than the middle of the range. Refer to Table 5 for the recommended seeding dates.

Seeding outside of the established dates must be approved by the NRCS State Agronomist or Area Resource Conservationist prior to seeding. All variance requests shall provide documentation of the current soil moisture conditions and proposed timeframes for seeding to be completed.

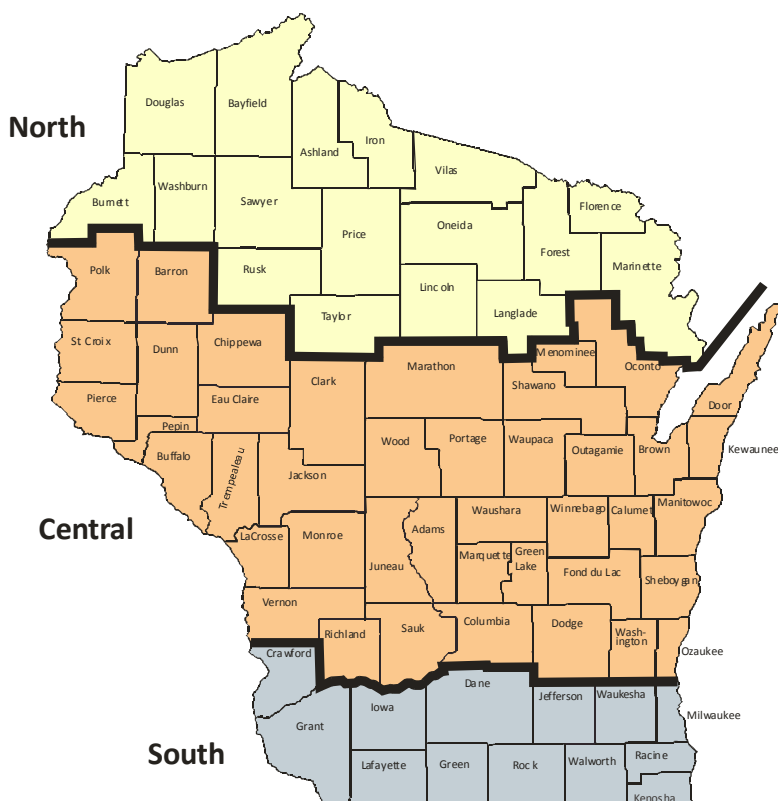
The frost seeding period in Wisconsin ranges from mid February to early March and will vary from year to year depending on the weather. Frost seeding is only allowed during active freezing and thawing cycles.

Table 5
Recommended Seeding Dates by Planting Zone

Planting Zone*	Spring	Late Summer	Dormant
North	5/1 – 6/15	7/15 – 8/10	11/1 – Freeze up
Central	4/15 – 6/1	8/1 – 8/21	11/1 – Freeze up
South	4/1 – 5/15	8/7 – 8/29	11/1 – Freeze up

*See Figure 1

Figure 1
Planting Zone Map



TEMPORARY COVER AND COMPANION CROPS

Temporary Cover Crop

All land will be established to permanent vegetative cover during the first year of the land use conversion, when possible. Temporary cover, during the first year, may be used if:

- the required seeds or plant stock are not available,
- the normal planting period for the species has passed, or
- where herbicide carryover will not allow establishment of permanent cover immediately.

If temporary cover is used, the permanent vegetative cover must be established by the end of the normal planting period of the following year.

Temporary Seeding Recommendations

1. Fields where planting is delayed due to lack of suitable seed or late planting, select one of the following species:
 - Forage sorghum – ½ bushel per acre (5/15 to 7/15)
 - Sorghum - Sudangrass hybrid – 1 bushel per acre (5/15 to 7/15)
 - Sudangrass – 1 bushel per acre (5/15 to 7/15)
 - Winter wheat - 2 bushels per acre (8/1 to 10/1)
 - Winter cereal rye - 2 bushels per acre (8/1 to 10/15)
 - Oats - 2 bushels per acre (4/1 to 9/1)
 - Annual ryegrass - 20 pounds per acre (4/1 to 9/1)
2. For fields with triazine herbicide carryover, select one of the following species:
 - Forage sorghum – ½ bushel per acre (5/15 to 7/15)
 - Sorghum - Sudangrass hybrid – 1 bushel per acre (5/15 to 7/15)
 - Sudangrass – 1 bushel per acre (5/15 to 7/15)

A bioassay test may be used to better determine chemical carryover.

A temporary cover will typically not be necessary on those areas where at least 50 percent of the ground is covered with either crop residue or vegetative cover.

Temporary cover crops must be clipped or destroyed before the plant produces viable seed, preventing excessive competition to the scheduled permanent seeding. Winter wheat and rye must be terminated by tillage, crimping, herbicides, or a combination before planting the permanent seeding.

Companion Crops

Companion crops can be used to reduce the amount of erosion on critical sites, suppress weeds, and provide added protection for permanent perennial vegetation seeded during first year plantings.

Companion crop recommendations:

- Oats - 2 bushels per acre (4/1 to 9/1)
- Winter wheat - 1 bushel per acre (8/1 to 10/1)
- Annual ryegrass - 6 pounds per acre (4/1 to 9/1)
- Spring wheat - 1 bushel per acre (4/1 to 6/1)

Companion crops shall be clipped after jointing or boot stage. Second and subsequent clippings are necessary when re-growth provides competition to the new planting. Clipping height should be above the developing seedlings. Where excessive growth has accumulated, the vegetation should be mowed and vegetation distributed uniformly. Companion crops seeded with late summer introduced grasses and legumes in most cases will not require clippings prior to the first killing frost. When the growing season is prolonged, clipping may be required for late summer plantings.

Winter cereal rye is not recommended as a companion crop with introduced season grasses. Biotoxin compounds secreted by cereal rye may inhibit germination or suppress introduced grass seedlings.

SPECIAL EROSION CONTROL MEASURES

Evaluate the need for additional soil erosion controls prior to and during the establishment period. Where erosion is determined to be a concern, alternatives shall be developed to divert water from the site or stabilize the soil surface.

When soil erosion control is an identified resource concern, increase grass composition above 50 percent of the mixture and increase the percentage of sod-forming grasses above 25 percent of the mixture.

Introduced mixtures for areas with shrub and tree plantings are not required to contain 25 percent sod forming grass seed per square foot. These seed mixtures must still contain at least 50 percent grass seed per square foot. Sod-forming grasses are not recommended in shrub and tree plantings.

Mulching

Wisconsin NRCS Standard 484, Mulching, shall be followed if program or practice design requires mulching.

Mulch shall consist of either natural and/or artificial materials such as plant residue (including cereal grain straw, grass hay, wood chips, bark and wood fiber), plastic, fabric, or other equivalent materials of sufficient dimension (depth or thickness) and durability to achieve the intended effect for the required time period. Mulch material shall be relatively free of disease, pesticides, chemicals, noxious weed seeds, and other pests and pathogens.

The type of mulching material selected should be based on cost, time of year, soils, percent slope, anticipated runoff velocities, and landscape position.

Mulching will be applied as soon as possible after seeding. Prepare the seedbed, apply the fertilizer and seed, then apply and anchor the mulch material.

When construction is completed and a permanent seeding delay is anticipated, plant temporary cover or apply a temporary mulch to the site to control erosion, or seed permanent vegetation and evaluate the status of the seeding, especially when seeding outside of the recommended dates. Reseeding may be required. All dormant plantings planned on concentrated flow areas will be mulched.

Hydroseeding

Hydroseeding typically consists of applying a mixture of cellulose fiber, seed, fertilizer, and stabilizing emulsion with hydromulching equipment to provide permanent or temporary protection to disturbed areas that are susceptible to erosion by water and wind. Hydroseeding may be used as the primary mulching method only when there is sufficient time remaining in the season to ensure adequate vegetation establishment and will provide adequate erosion control. Hydroseeding can be used

in conjunction with other mulching techniques. Hydroseeding advantages include:

- the protection of seeds from heat and birds during the germination process,
- a stabilized soil temperature,
- more even application of seeds than broadcast seeding,
- effective in keeping seeds from being washed away on slopes,
- provide added organic components to enrich the soil after the critical area is established,
- retention of moisture as seeds sprout, and
- allows for a better root formation as opposed to sodding.

Follow seeding dates outlined in Table 5 of this technical note.

Sodding

Specifications for site preparation, topsoiling, seedbed preparation and fertilizing are the same as conventional seeding. Sod shall consist of a dense, well rooted growth of a perennial desirable specie. All sod used shall be free of noxious weeds, diseases and insects. Only moist, fresh sod shall be used. The sod shall be sufficiently moist to withstand exposure during transport and transplanting operations. Sod should be placed on site within 24 hours after cutting and sod strips shall not have dry or dead edges.

Wet soil to a depth of two inches or more prior to laying the sod. Lay the sod from the lower end of the slope and work up slope. On steep slopes, stake the sod or peg with at least 6 inches or longer anchoring staplers. Tamp or roll the laid sod to insure uniform contact between the roots and soil surface. Outside edges of sodded areas shall be rolled in or banked flush with soil. On sites where surface drainage may try to follow sodded edges, extend sod strips 1 foot beyond the edges of the area sodded.

After laying sod, water thoroughly to wet the sod pad and the soil to a depth of 4 inches. In the absence of adequate rainfall, water during the first 30 days to keep underlying soil moist and allow the sod to become established. After the initial 30 day period, water as necessary to maintain adequate moisture in the root zone.

NUTRIENT AND SOIL AMENDMENT RECOMMENDATIONS

Fertilizer

Fertilizer will be applied according to a current soil test and will be consistent with University of Wisconsin recommendations found in Publication A-2809, Nutrient Application Guidelines for Field, Vegetable and Fruit Crops. A current soil test is defined as test results no older than four years from the time last tested to the date of the planned seeding. Guidelines for soil testing in Wisconsin can be found in Publication A-2100, Sampling Soils For Testing. In lieu of soil testing, apply 150 pounds of 20-10-10 fertilizer per acre, applicable only to Practice Standards 327, Conservation Cover; and 342, Critical Area Planting.

Lime

When alfalfa is part of the seeding mixture, the soil pH must be corrected to a minimum of 6.5. When birdsfoot trefoil, red clover or white ladino clover is a component of the seeding mixture, pH must be corrected to a minimum of 6.2. Liming material will be applied according to soil test recommendations. In lieu of soil testing, apply 2 tons of 80-89 lime or equivalent per acre, applicable only to Practice Standards 327, Conservation Cover; and 342, Critical Area Planting..

SEEDBED PREPARATION AND SEEDING RECOMMENDATIONS

Conventional Seeding

The seed is broadcasted or drilled into a partial or clean seedbed.

For conventional seeding, prepare a fine, firm seedbed to a minimum of 3 inches. All tillage operations shall be performed across the general slope of the landscape.

The seedbed should contain enough fine soil particles to provide uniform shallow coverage of the seed as well as contact with moisture and nutrients. It is important to have a firm seedbed. As a minimum, cultipack or roll before and after seeding. When walking on a properly prepared seedbed, the depth of your footprints should not exceed ¼ inch. Do not use heavy, no-till type drills to seed on conventionally prepared seedbeds. Heavy drills tend to sink into the soil and seeding depth will be difficult to control. Do not plant seed deeper than ¼ inch. The use of a drag

or similar equipment after seeding is not advised when small seeds are included in the mixture.

Advantages:

- May incorporate nutrients and soil amendments such as lime.
- Provides the opportunity to destroy perennial weeds.

Disadvantages:

- Soil erosion risk increases greatly.
- Erosion can wash away new seedlings or cover and smother the seedling with sediment.
- Higher field preparation cost.
- Annual weed competition can be greater.
- A nurse crop is often needed for erosion control and to suppress weed competition.
- Requires more trips across the field resulting in higher fuel cost.

No-Till Planting

No-till is the seeding of grasses and/or legumes in the absence of tillage using planting tools capable of drilling into an undisturbed soil surface and interseeding into existing herbaceous cover or prior-year crop residue.

No-Till Planting Into the Prior-Year Crop Residue

On cropland, leave the existing crop residue on the field without tillage. Soybean stubble is the preferred residue of choice. No-tilling into large amounts of non-fragile residue such as corn and small grain will reduce germination and seedling vigor. For spring weed control, when no-tilling introduced grasses and legumes, use a burndown chemical prior to or within four days after planting to kill weeds. Keep in mind that quackgrass and many broadleaf weeds are more consistently controlled when herbicides are applied early fall and a follow-up application in the spring.

Site Preparation for No-Till Interseeding Into Existing Grass Cover

Interseeding is a good way to improve existing stands of single species on fields utilized for pasture, wildlife, or idle land. Interseeding yields a mixture of grasses and legumes that gives the greatest benefit for wildlife or forage for livestock.

Land that has been in grass for many years usually has a thick layer of residue on the soil surface. In order to prepare a good seedbed for no-till interseeding and improve herbicide effectiveness, the litter or residue must be removed or altered. Existing vegetation shall be evaluated prior to seeding and a

management strategy developed to limit competition with new seedlings. Reducing competition of the existing stand is important for a successful interseeding. Options to prepare existing cover for no-till interseeding include herbicide application, grazing, mowing, haying, or burning the site.

- **Mowing:** Mow the site using a rotary mower or flail chopper to a height of 3 inches. The timing and type of mowing equipment selected shall be planned to uniformly distribute the mowed plant material over the field surface. Mowing should be planned before any known weeds produce mature seeds.
- **Burning:** Carry out a Prescribed Burn according to the requirements outlined in the plan. The burn plan must address safety concerns and document the appropriate timing for the burn to provide the maximum control of weeds and protect any existing desirable plants on the site.
- **Haying:** Harvest a hay crop from the site the year before the planned interseeding. The timing of the hay harvest should be planned to minimize the amount of re-growth that will occur prior to interseeding.
- **Grazing:** Graze the site immediately prior to herbicide application, if herbiciding is planned. The timing and duration of the grazing must be managed to prevent erosion or damage to sensitive environmental areas, but must be intensive enough to significantly reduce the existing vegetative cover. If possible, begin the grazing at a time of the year when the standing vegetation is green and growing to increase the palatability and feed value of the forage, resulting in a more uniform removal of the vegetation by grazing animals.
- **Herbicide Application:** Apply approved herbicides to kill or suppress existing vegetation and control weeds. The effectiveness of herbicides improves when combined with haying, grazing, or mowing.

A drill equipped for no-till planting shall be used to allow consistent penetration of disk openers.

Advantages:

- Soil erosion is minimized.
- Reduced energy usage.
- No nurse crop is required.
- Greater moisture availability due to lack of tillage.

- Drilling can occur under adverse conditions.
- Carbon sequestration improves.
- Seed placement is ensured.

Disadvantages:

- Increased herbicide use.
- No-till drill required.
- Nutrients and soil amendments cannot be incorporated.

To ensure success of the interseeding, regardless of the options selected above, the field will need constant maintenance by mowing and removal of the existing vegetation until the interseeded planting becomes well-established and can survive the competition of the existing vegetation.

Dormant Seeding

Seed is broadcasted and incorporated, no-tilled, or drilled into a partial or clean seedbed after the growing season and before freeze-up. The seed remains dormant until the following spring.

Seedbed preparation and conditions are similar to conventional seeding. A firm seedbed is strongly recommended for broadcast dormant seedings. Seed broadcasted without incorporation is more risky, and relies on snow, freezing, and thawing to embed seed. The approved dormant seeding date for introduced species statewide is November 1.

Advantages:

- Occurs at a time of year when labor is more available.
- Seedlings take advantage of early spring moisture.
- Soil erosion is minimized.

Disadvantages:

- Seeding rates should be increased.

Refer to the section, “Criteria for Seed Mixture Development,” to determine when dormant seeding is allowed.

Frost Seeding

Broadcast seed on top of existing stands of introduced grass species or on seedbeds prepared the previous fall. Frost seed in February to mid March when the freezing and thawing cycle is active to help incorporate the seed into the soil.

The soil surface is usually “honeycombed” with small cracks at this time during the year. Frost seeding SHALL NOT occur on fields covered with

solid ice or a snow cover depths greater than 2 inches. Frost seeding must be completed before the freeze and thaw cycle ends. Do not frost seed into winter wheat or winter rye cover crops. All commonly grown legumes can be frost seeded because of their greater seedling vigor, such as red clover, alsike clover, and white ladino clover. Alfalfa and birdsfoot trefoil are approved for frost seeding; however, these species at times are less successful and slower to establish.

Advantages:

- No special drill is required.
- Labor is more available in late winter.

Disadvantages:

- Stand establishment is normally less successful, particularly in dry years.
- The seeding rate must be increased.

Frost seeding is only recommended under the following conditions:

- legumes seeded into established pastures,
- seedbeds prepared in fall, and
- undisturbed sites that consist of fragile residue such as soybean stubble.

Frost seeding is not recommended in undisturbed non-fragile residue such as corn and small grain.

Refer to the section, “Criteria for Seed Mixture Development,” to determine when frost seeding is allowed.

STAND EVALUATION

To determine the overall success of the planting, a monitoring program should consider the number of seedlings across a field, seeding vigor, height, and growth stage and overall diversity of plants. Preliminary evaluation of spring and fall plantings should be completed four to six weeks after germination. This inspection of seeding density and distribution can be combined with an inspection for post planting weed control recommendations.

Several methods can be used to evaluate stand adequacy. Density measurements are taken by counting the number of individual plants and species within a standard one foot quadrant. As a general rule, there should be at least two sample sites per acre.

Table 6
Plant Density and Stand Evaluation One Year After Planting

Average Seedlings/Ft ²	Action/Condition
<1	Reseed.
1-3	Wait and re-evaluate next year.
4-5	Successful planting.
>6	Very good.

COVER MAINTENANCE

Weed Control - Establishment Year

Weed control during the establishment year is required to ensure survival of the new permanent seeding. Weed control during the seeding year will have precedent over nesting season concerns and is allowed until stand is established. Activities should be minimized when possible during the nesting season.

Mow early before weeds have a chance to smother out the new seeding. Mow before the companion crop or undesirable vegetation reach boot stage. Mow introduced plantings to a height of no less than 4 inches. Depending on the weather, mowing every 2 or 3 weeks throughout the growing season may be required to increase the probability of a successful stand. In addition, approved herbicides may be used on introduced plantings for additional weed control.

Weed Control - Established Cover

Any planned maintenance after establishment, should be done before May 15 or after August 1 to protect nesting species and reduce disruption of nesting activities. The impact of any disturbance to existing cover on wildlife and threatened or endangered species must be assessed and mitigated to the extent practicable or as required by law. In the majority of situations, established plantings will only require spot treatment without disturbing the entire unit.

To control undesirable plants during the primary nesting season, utilize one or more of the following spot treatment options:

- Spot mowing can be used to control annual weeds and to suppress perennial weeds. Spot mowing must be done before the target plant produces viable seed and must continue throughout the growing season as needed. Spot mowing is not the most effective treatment

option for biennial and perennial weeds but can be used to contain these plants until other control treatments can be implemented.

- Spot treatment of herbicides is often necessary for controlling invasive plants in introduced plantings. Spot treatment should be timed to treat weeds during active growth periods. Effective herbicide spot treatment can prevent the target plants from setting seed and spreading and dominating introduced stands. NRCS staff is prohibited from making herbicide recommendations.
- Spot Treatment by hand pulling or digging can be an effective control if the entire root is removed from the soil. Hand pulling/digging is most effective in the spring when the soil is moist and loose from the winter freeze/thaw cycle.

REFERENCES

Curtis, J. T., 1959. The Vegetation of Wisconsin: an Ordination of Plant Communities. University of Wisconsin Press, Madison.

USDA NRCS, Wisconsin Field Office Technical Guide, Section IV, Conservation Practice Standards and Specifications.

USDA, NRCS Wisconsin Field Office Technical Guide (FOTG), Section III, Conservation Management Systems.

University of Wisconsin Extension Publication A1525, Perennial Forage Crop Variety Update for Wisconsin.

University of Wisconsin Extension Publication A2809, Nutrient Application Guidelines for Field, Vegetable and Fruit Crops.

University of Wisconsin Extension Publication A2100, Sampling Soils For Testing.

Wisconsin Administrative Code, Department of Agriculture, Trade and Consumer Protection, Chapter ATCP 20, Seed Labeling and Sale.

Wisconsin State Statutes, Chapter 94, Plant Industry, ss. 94.38 to 94.46.

Table 7
Wildlife Habitat Mixes

Seed Calculator Code*	Mixtures	Pounds PLS per Acre	Seeds per Square Foot	Moisture Regime
327-16A	Timothy	2.5	71	DM, M
	Smooth Bromegrass	3.0	9	
	Alfalfa	6.0	30	
327-16B	Timothy	2.0	56	M, WM, W
	Orchardgrass	2.0	30	
	Red Clover	5.0	32	
327-16C	Timothy	2.0	56	DM, M
	Orchardgrass	2.0	30	
	Alfalfa	6.0	30	
327-16D	Timothy	2.5	71	M, WM
	Smooth Bromegrass	3.0	9	
	Red Clover	5.0	32	
327-16E	Timothy	2.0	56	M, WM
	Smooth Bromegrass	2.0	6	
	Orchardgrass	1.0	15	
	Red Clover	5.0	32	
	White Ladino Clover	0.5	10	
324-16F	Timothy	2.0	56	M, WM
	Orchardgrass	2.0	30	
	Red Clover	5.0	32	
	White Ladino Clover	0.5	10	
327-16G	Timothy	2.0	56	DM, M, WM
	Orchardgrass	2.0	30	
	Birdsfoot Trefoil	4.0	34	
327-16H	Tall Fescue	3.0	15	M, WM
	Red Clover	4.0	25	
	White Ladino Clover	1.0	20	
	Timothy	2.0	56	

*These codes represent the mixtures used in the Wisconsin Seed Calculator.

Table 8
Seeding Mixtures Suitable for Critical Area Plantings

Seed Calculator Code*	Moisture Regimes	Common Name	Scientific Name	Seeding Rate in lb/ac PLS	Seeding Rate in Seeds/Ft ² PLS	Capacity Retardance	Type of Site**
342-1	Dry-Mesic and Mesic Sites	Smooth Bromegrass	Bromus inermis	10	31	B	EB, WW, CSB
		Creeping Red Fescue	Festuca rubra	3	24		
		Alfalfa	Medicago sativa	3	15		
		Red Clover	Trifolium pratense	3	19		
		Kentucky bluegrass	Poa pratensis	1.5	75		
342-2	Dry-Mesic and Mesic Sites***	Smooth Bromegrass	Bromus inermis	15	47	B	EB, WW
		Alfalfa	Medicago sativa	7	35		
		Timothy	Phleum pratense	3	85		
342-3	Dry-Mesic and Mesic Sites	Kentucky bluegrass	Poa pratensis	1	50	B	CSB, EB, WW
		Smooth Bromegrass	Bromus inermis	10	31		
		Timothy	Phleum pratense	2	56		
		Tall Fescue	Schedonorus arundinaceus	2	10		
		Perennial Ryegrass	Lolium perenne	5	26		
342-4	Dry-Mesic and Mesic Sites	Smooth Bromegrass	Bromus inermis	20	62	B	EB, WW, CSB
		Creeping Red Fescue	Festuca rubra	5	40		
		Alfalfa	Medicago sativa	8	40		
		Red Clover	Trifolium pratense	4	25		
342-5	Dry-Mesic and Mesic Sites	Smooth Bromegrass	Bromus inermis	30	93	B	EB, WW, CSB
		Alfalfa	Medicago sativa	14	70		
342-6	Dry-Mesic, Mesic, and Wet Mesic Sites	Smooth Bromegrass	Bromus inermis	7	22	B	CSB, EB, WW
		Timothy	Phleum pratense	2	56		
		Creeping Red Fescue	Festuca rubra	1	8		
		Kentucky Bluegrass	Poa pratensis	1	50		
		Perennial Ryegrass	Lolium perenne	3	16		
		Red Clover	Trifolium pratense	3	19		
342-7	Mesic Sites***	Smooth Bromegrass	Bromus inermis	7	22	B	EB, WW
		Creeping Red Fescue	Festuca rubra	2	16		
		Kentucky bluegrass	Poa pratensis	3	150		
		Birdsfoot trefoil	Lotus corniculatus	2	17		
342-8	Mesic Sites***	Smooth Bromegrass	Bromus inermis	15	47	B	WW, EB
		Creeping Red Fescue	Festuca rubra	2	16		
		Kentucky Bluegrass	Poa pratensis	2	100		
342-9	Mesic Sites***	Kentucky Bluegrass	Poa pratensis	3	150	C	WW, EB
		Creeping Red Fescue	Festuca rubra	4	32		
		Perennial Ryegrass	Lolium perenne	10	52		
342-10	Mesic Sites	Smooth Bromegrass	Bromus inermis	14	43	B	EB, WW, CSB
		Timothy	Phleum pratense	3	85		
		Red Clover	Trifolium pratense	3	19		
		Perennial Ryegrass	Lolium perenne	4	21		
342-11	Mesic Sites	Smooth Bromegrass	Bromus inermis	32	99	B	EB, WW
		Creeping Red Fescue	Festuca rubra	8	64		

Seed Calculator Code*	Moisture Regimes	Common Name	Scientific Name	Seeding Rate in lb/ac PLS	Seeding Rate in Seeds/Ft ² PLS	Capacity Retardance	Type of Site**
342-12	Mesic Sites	Kentucky bluegrass	Poa pratensis	4	200	C	EB, WW
		Creeping Red Fescue	Festuca rubra	3	24		
342-13	Mesic Sites	Smooth Bromegrass	Bromus inermis	14	43	B	EB, WW, CSB
		Timothy	Phleum pratense	4	113		
		Red Clover	Trifolium pratense	3	19		
342-14	Mesic Sites	Smooth Bromegrass	Bromus inermis	15	43	B	EB, WW, CSB
		Timothy	Phleum pratense	3.5	99		
		Alsike Clover	Trifolium hybridum	2	32		
342-15	Mesic Sites	Smooth Bromegrass	Bromus inermis	15	47	B	EB, WW
		Timothy	Phleum pratense	3.5	99		
		Birdsfoot trefoil	Lotus corniculatus	3	26		
342-16	Wet Mesic Sites	Tall Fescue	Schedonorus arundinaceus	5	26	B	CSB, EB, WW
		Timothy	Phleum pratense	3	85		
		Perennial Ryegrass	Lolium perenne	3	16		
		Red Clover	Trifolium pratense	3	19		
		Smooth Bromegrass	Bromus inermis	6	19		
		Kentucky Bluegrass	Poa pratensis	2	100		
342-17	Wet Mesic Sites	Redtop	Agrostis gigantea	1	115	C	WW, CSB, EB
		Timothy	Phleum pratense	3	85		
		Red Clover	Trifolium pratense	5	32		
342-18	Wet Mesic Sites	Timothy	Phleum pratense	3	85	B	WW, CSB, EB
		Perennial Ryegrass	Lolium perenne	3	16		
		Red Clover	Trifolium pratense	3	19		
		Smooth Bromegrass	Bromus inermis	6	19		
		Kentucky Bluegrass	Poa pratensis	2	100		
342-19	Wet Mesic Sites	Redtop	Agrostis gigantea	1	115	C	WW, CSB, EB
		Timothy	Phleum pratense	1	28		
		Red Clover	Trifolium pratense	4	25		
		Kentucky Bluegrass	Poa pratensis	2	100		
342-20	Wet Sites***	Redtop	Agrostis gigantea	2	229	C	WW
		Alsike Clover	Trifolium hybridum	2	31		
		Kentucky Bluegrass	Poa pratensis	2	100		
342-21	Wet Mesic Sites	Redtop	Agrostis gigantea	3	344	C	WW
		Alsike Clover	Trifolium hybridum	3	47		

*These codes represent the mixtures used in the Wisconsin Seed Calculator.

**EB = Embankments; WW = Waterways; CSB = Channel and Streambanks

***Mixtures can be used on other site descriptions when not listed.

Table 9
Introduced Pollinator Habitat Mixes

Seed Calculator Code*	Mixtures	Pounds PLS per Acre	Seeds per Square Foot	Moisture Regime
327-17A	Timothy	0.5	14	DM, M
	Orchardgrass	1.0	15	
	Alfalfa	4.0	20	
	White Ladino Clover	1.5	30	
327-17B	Tall Fescue	3.0	16	WM, W
	Perennial Ryegrass	3.0	16	
	Red Clover	4.0	25	
	Alsike Clover	1.5	23	

*These codes represent the mixtures used in the Wisconsin Seed Calculator.

Table 10
Forage and Hayland Planting Recommendations

Forage Suitability Group	Seed Calculator Code ¹	Species	Lbs. PLS per Acre	Seeds per Square Foot
Hay Crop				
Group 1: Low water holding capacity, seasonal high water table.	512-H1	Red Clover	6	38
		Tall Fescue	6	31
		Timothy	1	28
Group 2: Low water holding capacity, 0 to 12 percent slopes.	512-H2	Alfalfa	12	60
	512-H3	Alfalfa Smooth Bromegrass	10 4	50 12
Group 3: Low water holding capacity, greater than 12 percent slopes.	512-H3	Alfalfa Smooth Bromegrass	10 4	50 12
Group 4: Moderate water holding capacity, seasonal high water table.	512-H4	Alsike Clover Tall Fescue Timothy	3 6 1	47 31 28
Group 5: Moderate water holding capacity, less than 12 percent slopes.	512-H3	Alfalfa Smooth Bromegrass	10 4	50 12
Group 6: Moderate water holding capacity, greater than 12 percent slopes.	512-H3	Alfalfa Smooth Bromegrass	10 4	50 12
Group 7: High water holding capacity, seasonal high water table.	512-H4	Alsike Clover	3	48
		Tall Fescue	6	31
		Timothy	1	28
Group 8: High water holding capacity, less than 12 percent slopes.	512-H5	Alfalfa Timothy	8 2	40 56
Group 9: High water holding capacity, greater than 12 percent slopes.	512-H6	Alfalfa Smooth Bromegrass Timothy	8 4 1	40 12 28

Forage Suitability Group	Seed Calculator Code ¹	Species	Lbs. PLS per Acre	Seeds per Square Foot
Group 10: Organic soils, wetlands, ledge outcrop.	---	Planting not feasible.	---	---
Rotation and Permanent Pastures				
Group 1: Low water holding capacity, seasonal high water table.	512-PP1	Alsike Clover Meadow Fescue	2 6	31 31
	512-PP1A	Alsike Clover Orchardgrass	2 3	31 45
	512-PP1B	Alsike Clover Timothy	2 1.5	31 42
Groups 2: Low water holding capacity, 0 to 12 percent slopes.	512-PP2	Alfalfa Smooth Bromegrass Orchardgrass	6 4 4	30 12 60
Group 3: Low water holding capacity, greater than 12 percent slopes.	512-PP2	Alfalfa Smooth Bromegrass Orchardgrass	6 4 4	30 12 60
Group 4: Moderate water holding capacity, seasonal high water table.	512-PP4	Alsike Clover	2	31
		Meadow Fescue	6	31
		Timothy	1	28
	512-PP4B	Birdsfoot Trefoil	3	26
		Meadow Fescue	6	31
		Timothy	1	28
Group 5: Moderate water holding capacity, less than 12 percent slopes.	512-PP5	Red Clover	5	32
		White Ladino Clover	1	20
		Orchardgrass	3	45
	512-PP5B	Meadow Fescue	6	31
		Red Clover	5	32
		White Ladino Clover	1	20
	512-PP5B	Festulolium	7	36
		Meadow Fescue	6	31
Group 6: Moderate water holding capacity, greater than 12 percent slopes.	512-PP6	Red Clover Orchardgrass Smooth Bromegrass	5 4 4	32 60 12
Group 7: High water holding capacity, seasonal high water table.	512-PP7	Alsike Clover	2	31
		Meadow Fescue	6	31
		Timothy	1	28
	512-PP7B	Redtop	1	115
		Birdsfoot Trefoil	3	26
		Meadow Fescue	6	31
	512-PP7B	Timothy	1	28
		Redtop	1	115
Group 8: High water holding capacity, less than 12 percent slopes.	512-PP8	White Ladino Clover	1	20
		Orchardgrass	3	45
		Meadow Fescue	6	31
	512-PP8B	White Ladino Clover	1	20
		Festulolium	7	36
		Meadow Fescue	6	31
Group 9: High water holding capacity, greater than 12 percent slopes.	512-PP9	Red Clover Orchardgrass Meadow Fescue	5 3 6	32 45 31

Forage Suitability Group	Seed Calculator Code ¹	Species	Lbs. PLS per Acre	Seeds per Square Foot
Group 10: Organic soils, wetlands, ledge outcrop.	---	Planting not feasible.	---	---
Pasture for Horses/Sheep				
Groups 1, 4, 7: Seasonal high water table.	512-PHS1	Kentucky Bluegrass	4	200
		Meadow Fescue	4	21
		White Ladino Clover	1	20
	512-PSH1A	Kentucky Bluegrass Meadow Fescue Birdsfoot Trefoil	4 4 3	200 21 26
Groups 5, 6, 7, & 8: Moderate to high water holding capacity.	512-PHS2	Kentucky Bluegrass	2	100
		Festulolium	7	36
		White Ladino Clover	1	20
	512-PHS2A	Kentucky Bluegrass Perennial Ryegrass White Ladino Clover	2 7 1	100 36 20
Groups 2 & 3: Low water holding capacity.	512-PHS3	Alfalfa Orchardgrass	6 3	30 45
Pasture for Hogs				
		Alfalfa OR Red clover Forage Rape OR Oats OR Sudangrass OR Hybrid Pearl Millet	12 10 25 35 2 bu/ac	60 63 --- --- ---
Summer Annuals for Supplemental Forage				
		Hybrid Pearl Millet Winter rye (fall planted) Forage Rape Forage Turnips and Swedes Rape and Kale	25 1½ - 2 bu/ac 4 bu/ac 1½-2 lbs./ac 4 lbs./ac	--- --- --- --- ---

¹These codes represent the mixtures used in the Wisconsin Seed Calculator.

Measuring the Benefits of the Cover Crop Practice

One of the goals of conservation planning is to consider the effects of conservation practices and systems on soil quality. A number of assessments tools exist to measure the impact of the Cover Crop practice.

Assessing Cover Crop Value as it relates to Soil Quality Benefits

1. The Revised Universal Soil Loss Equation (RUSLE2) and Wind Erosion Prediction System (WEPS) planning software is used to evaluate the impact of cover crop management decisions have on soil loss levels. In addition, RUSLE2 has the Soil Condition Index (SCI) that determines a relative value for anticipated Organic Matter based on management of the cover crop.
2. A soil health assessment is used to determine existing soil characteristics. Typical soil health assessments include soil organic matter levels, soil respiration rates, soil bulk density, soil penetrometer readings, soil infiltration rates and observation of soil cohesion utilizing the slake test.
3. Observable reduction in soil erosion (sheet, rill, ephemeral, and gully). Cover crops increase vegetative and residue cover during periods when erosion energy is high. The addition of cover crops to low residue cropping systems such as corn silage and vegetables can substantially decrease soil erosion.
4. Observable soil porosity improvements due to an increase of biomass, that when decomposed, increases soil organic matter content promoting increased microbial activity and aggregation of soil particles. As a result, soil porosity is increased and bulk density is decreased. **Caution:** avoid planting cover crops when soils are saturated to avoid compaction, or use alternative establishment methods such as aerial over seeding.
5. Observable soil aggregate stability which results in less soil crusting. Cover crops reduce soil crusting by protecting the soil surface from the direct impact of rain drops. The resulting increase of soil organic matter, improved infiltration, and increased aggregate stability will further reduce soil crusting and improve the uniformity of seed germination.
6. Adequate soil surface cover and the improved aggregate stability will reduce erosion and surface water run-off and increase water infiltration rates. Channels created by cover crop roots and earthworms form macropores that further improve infiltration. Cover crops, especially small grains, can effectively capture and utilize excess nitrogen to prevent infiltration below the crop root zone.
7. Cover crops reduce the volume of surface runoff resulting in reduced nutrient losses. Decomposition of cover crop or green manure biomass provides a slow release of nutrients to the root zone. Legume crops fix atmospheric nitrogen and provide nitrogen for the main crop. Legumes also capture more phosphorus than grass or small grains. Small grains are useful as catch crops to utilize end of season nitrogen, which reduces the potential for nitrogen leaching. Planting cover crops on continuous corn silage fields with a history of repeated manure applications during late summer is highly beneficial.
8. Nutrient Immobilization can be observed when decomposition releases available nitrogen to the next crop.

The carbon-to-nitrogen (C:N) ratio is a relative estimate of the nitrogen necessary to decompose an organic matter (crop residue) source. A C:N ratio of 50:1 or higher will temporarily “immobilize” soil nitrogen. The immobilization is a result of microbes consuming readily available soil nitrogen during the decomposition of crop residue. The nitrogen will remain immobilized until the microbes deplete the crop residue or other organic matter sources.

Young cereal rye plants have a 14:1 C:N ratio as compared to corn stalks with a 60:1 C:N ratio. The C:N ratio for most clover plants is generally 15:1, which allows nitrogen to quickly become available to the following crop.
9. Cover crops can reduce pesticide loss by reducing surface water runoff resulting in reduced pesticide losses. Increased organic matter increases soil biological activity that can increase the breakdown of pesticide residues.



10. Visible reduction in weed pressure is due to reduced light, seed/soil contact and soil temperatures. The release of chemical compounds by the cover crop (allelopathy) may also inhibit weed growth.

The potential for a negative impact on the primary crop can be reduced by killing the cover crop two to three weeks prior to planting and ensuring good seed/soil contact during seed placement.

11. Soil moisture can be improved when cover crops and green manure crops remove excess moisture from wet soils, resulting in reduction of “waterlogging” in poorly drained soils.

Specie Selection and Seed Quality

- » Select species that are adapted to soil, climatic, and ecological site conditions.
- » Select species suited for the planned purpose and specific site conditions.
- » Do not plant species identified as restricted or prohibited by law.
- » Inoculate legumes with the proper Rhizobium bacteria.
- » Non-commercial seed can be used, as long as the seed has been tested for germination.
- » Seeding rates are based on certified obtained from commercial sources.

Seedbed Preparation and Seeding

Site preparation shall be adequate to assure weed suppression and to promote germination and growth of the species planted. Seedbed preparation and seeding methods are determined as a result of the following:

- » Resource concern and/or objective for planting the cover crop
- » Cover crop life cycle (overwintering)
- » Current soil surface conditions, moisture levels, existing biomass (surface cover)
- » Planned harvest date of the primary crop
- » Estimated growing degrees units remaining prior to the average killing frost
- » Availability of labor/time and equipment

Seeding Methods

Wisconsin NRCS Conservation Practice Standard 340 - Cover Crop, supports several seeding and planting options to establish cover crops. Successful cover crop plantings require seeding within the recommended dates, seeding methods that ensure adequate seed to soil contact and sufficient soil moisture to support seedling growth.

Cover crops may be drilled, no-tilled, slurry applied, broadcast inter-seeded, over-seeded or frost seeded with or without incorporation depending on field conditions. Incorporation of seed following planting by light shallow tillage, or use of a ring roller, culti-packer or similar tool to embed the seed will result in a more uniform seedling emergence. The following non-traditional establishment methods can be used to expand the settings where cover crops can be utilized.

Slurry Seeded Cover Crops - Slurry-enriched seeding is a process that combines low-disturbance tillage, manure application and the seeding of cover crops into one operation. This technique is efficient and effective in un-tilled crop fields. Cover crop seed is mixed directly with liquid manure in the manure tanker. Cover crop species best suited to plant with this system include; cereal rye, wheat, annual ryegrass, oil seed radish, red, ladino and crimson clover.

For additional details on slurry seeding refer to the following link: <http://www.mccc.msu.edu/SlurrySeeding.html>.

Frost Seeding is categorized as broadcast or aerial seeding occurring mid to late March through early April during the active freezing and thawing cycle. Warm daytime temperatures combined with low overnight temperatures cause the surface of the soil to freeze and crack. Frost seeding takes skill in determining the exact conditions that are favorable and in assuring the crop will not freeze after emergence.

Guidelines when frost seeding cover crops:

1. Seedbed conditions must favor good seed to soil contact: a) un-tilled winter wheat or soybean residue fields are ideal seedbed conditions, b) frost seeding SHALL NOT occur on un-disturbed heavy residue corn fields or similar conditions, c) when seedbed preparation is necessary to prepare a uniform seedbed in the fall prior to freeze-up and maintain 30-70% residue surface cover.
2. Frost seeding SHALL NOT occur on areas covered with solid ice or snow cover depth greater than 2 inches.
3. Frost seeding shall be completed before the end of the freeze and thaw cycle. Note: Ideal frost seeding conditions vary from year to year, and in certain years the window for seeding may amount to a few days.

CAUTION: Because the risk for failure is high, this practice requires a variance from the Area Resource Conservationist or State Agronomist except for the red clover inter-seeded into dormant winter wheat.



Refer to UW-Publication— “Frost Seeding Red Clover in Winter Wheat” for additional details: <http://ipcm.wisc.edu/downloads/nutrient-managment/>

Broadcast inter-seeding or over-seeding without incorporation may be used to establish a cover crop into a fully mature crop scheduled for harvest in the near future. The terms inter-seeding and over-seeding, are used interchangeably defining seeding techniques where the cover crop is seeded over the top of an un-harvested crop without incorporation into the soil.

When broadcasting cover crops, seed germination depends on the presence of adequate moisture at the soil surface or within the crop residue layer. Dry conditions will result in poor germination due to limited seed to soil contact. The following guidelines will reduce the risk of seeding failure, when cover crops are broadcasted.

Guidelines for broadcasting cover crops:

1. Assess site for one or more of the following conditions: a) moist, friable soil surface, b) 30% soil surface residue cover to conserve surface moisture for seed germination and c) high probability of rainfall after seeding.
2. Seeding as early as possible within the recommended seeding dates will improve stand density and vigor.
3. Select species known to have the highest germination rate may favor broadcast methods. Below are specie groupings in numeric order beginning with the highest probabilities of successfully germinating:
 - » Group 1: small grains
 - » Group 2: annual/perennial rye grass
 - » Group 3: small seed brassicas
 - » Group 4: small seed legumes

Note: Large legume seed crops are not recommended for aerial seeding.

Additional guidelines when broadcasting cover crops into standing crops:

1. **Corn for grain:** Do not over-seed cover crops when corn is immature or green. Cover crops should be over-seeded after the corn has begun to dry down, silks are brown and leaves are dried up to the ear and turned down. This timing will minimize the potential for seed to be trapped in leaf whorls and will allow sunlight to reach the ground between the rows.
2. **Corn for silage:** Cover crops should not be over-seeded into corn that will be harvested as silage, more than 21 days prior to the planned harvest date.

3. **Soybeans:** Over-seed cover crops into standing un-harvested soybeans when 50% of the leaves are yellow and/or prior to 50% leaf drop.
4. **Red clover into winter wheat:** Over-seed red clover into dormant winter wheat by frost seeding during the active freeze and thaw cycle (late February to mid-March).
5. **Red clover into snap beans:** Over-seed red clover during the last cultivation of snap beans.

Fertilization

Cover crops usually follow heavily fertilized crops and do not require fertilization. Fall-planted fibrous rooted grasses or small grains will scavenge leftover nitrogen from the previous crop. Legume cover crops will add nitrogen to the system for the following crop. For these reasons, fertilizer is not required unless the site condition warrants it.

Seed Mixtures for Cover Crops

The seeding mixture used will depend on the objective and identified resource concern. Cover crops can include a diverse mix of grass, non-legume broadleaf and legume plants. The seed mixture should create a balanced stand of above ground biomass and root structure to enhance soil building. Seed mixtures that develop a full canopy will maximize snow retention, soil surface coverage, reduce soil erosion and may be utilized for livestock forage. A mixture of grasses, non-legume broadleaf (brassicas, buckwheat, etc.) and legume plants will improve the soil's biological activity. A mixture of plant species will feed beneficial organisms, improve soil structure, reduce compaction, improve water infiltration/water holding capacity and increase the amount of available nutrient exchange sites in the soil.

Cover crop mixtures are often recommended when the goal is to address multiple objectives and resource concerns. When considering multiple species mixtures, consider the effects of; specie growth characteristics, anticipated growing conditions, nutrient needs, planned seeding rate and the termination method and date.

Use the following references to evaluate cover crop species for growth characteristics and conservation benefits: [Table 2](#) “Identification and Comparison of Cover Crop Performance and Benefits by Species”.

[Table 3](#) “Morphology, Physiology and Growth Requirements”. “Midwest Cover Crop Decision Tool” <http://mccc.msu.edu/index.htm>.

Single and Multiple Species Seeding Rate Calculation

When designing cover crop seed mixtures, the seeding rate recommendation is based on the seeding method selected. Cover crops that are drilled, no-



tilled, or broadcast and incorporated, the minimum recommended seeding rate or higher can be planned. Cover crop seeding methods such as broadcast over-seeding or inter-seeding, slurry seeded, frost seeded and other methods, where seed to soil contact is of concern, a higher recommended seeding rate is required. When designing multiple cover crop seed mixtures, multiply the minimum seeding rate for each selected plant species by the planned percentage of each species. The “planned percentage” represents a general proportion of the seed to be planted per species and is not a direct calculation of seeds per square foot or an estimate of canopy cover or plant dominance of a given species. Refer to [Table 1](#) “Cover Crop Species Recommended for Planting in Wisconsin” for the recommended seeding rate per species.

A waiver from the State Agronomist or Area Resource Conservationist for NRCS is required when:

1. Less than **one pound** of seed per plant species is required when designing seed mixtures.
2. More than 4 species are included in the seed mixtures.
3. Cover crops are planted later than the recommended ending seeding date.

Calculating Seeding Rates and Mixes:

Minimum [Table 1](#) seeding rate range or higher per species multiplied by the planned percentage of each species will determine the pounds of seed per plant species to be planted per acre.

***Round up to the next full pound of seed if the seeding rate calculation results in a decimal of 0.5 or larger.**

Example Seeding Mixture Calculation Results

Spring Mix—Cover crop will be drilled into soybean stubble. The landowner selected the seed mixture below:

40% oats...minimum seeding rate 30 lbs./ac. ([Table 1](#))

40% oilseed radish 4 lbs./ac. ([Table 1](#))

20% field pea 65 lbs./ac. ([Table 1](#))

Actual seeding rates:

Oats= 30 lbs X 40% = 12 lbs for the mix per acre

Radish=4 lbs X 40%= 1.6 which rounded up is 2 lbs for the mix per acre

Pea=65 lbs X 20%=13 lbs for the mix per acre

Cover Crop Attributes

The following summary of cover crop attributes provides additional information (advantages and disadvantages) regarding the species listed in [Table 1](#).

Refer to [Table 2](#) for performance and roles of cover crops.

Alfalfa (*Medicago sativa*)

- » **Advantages:** nitrogen fixer, crude protein: 14-22%, forms arbuscular mycorrhizal associations, attracts pollinators, good at scavenging nitrogen from the soil, and break up compaction.
- » **Disadvantages:** produces autotoxicity and will not tolerate wet sites.

Annual Ryegrass (*Lolium multiflorum*)

- » **Advantages:** quick-growing non-spreading bunchgrass, establishes quickly even in gravelly or wet soils, excellent for trapping nitrogen, dense shallow root system improves water infiltration and enhances tilth, improves early season weed control, attracts few insect pests and generally can help reduce insect pest level, can be over-seeded into corn or soybeans after leaves turn yellow, self-pollinating, and forms arbuscular mycorrhizal associations.
- » **Disadvantages:** can host high densities of Penetrans Root-Lesion Nematode.

Barley, Spring/Winter (*Hordeum vulgare*)

- » **Advantages:** produces a deep fibrous root system, produces more biomass than any other small grain crop, will scavenge significant amounts of nitrogen, releases allelopathic chemicals that help suppress weeds, drastically reduces root-knot nematode populations, has a higher nutritional value than oats or wheat, works well in cocktail mixtures, prefers mesic soil conditions.
- » **Disadvantages:** fusarium head blight can be a problem when other small grains are planted within one year and disease problems (especially with tan spot) can be problematic, avoid planting barley after winter wheat.

Berseem Clover (*Trifolium alexandrinum*)

- » **Advantages:** extremely vigorous tall annual white clover, tolerant of wet conditions, crude protein: 27-29%, excellent nitrogen fixer, forms arbuscular mycorrhizal associations, flowers attract bees, excellent weed suppressor.
- » **Disadvantages:** none.

Buckwheat (*Fagopyrum esculentum*)

- » **Advantages:** provides quick soil cover, excellent weed suppressor, provides nectar for pollinators and other beneficial insects, loosens topsoil, rejuvenates low fertility soils,



dense fibrous root cluster in the top 10 inches of soil providing an extensive root surface area for nutrient uptake, extracts soil phosphorus from the soil better than most grain-type cover crops, residue decomposes quickly releasing nutrients to the next crop, excellent choice to follow early vegetables, popular honey bee pollinator.

- » Disadvantages: sets seed quickly, will reseed and may become a weed if flowers mature, frost sensitive, will not germinate/thrive in cold soils, and highly attractive to Japanese Beetles.

Canola/Rape (*Brassica napus*)

- » Advantages: flowers attract pollinators, good at scavenging nitrogen from the soil, crude protein: hay 16%, grain 21%, silage 12%, pasture 17%.
- » Disadvantages: susceptible to sclerotinia, host for Penetrans Root-Lesion Nematode.

Cereal Rye, Winter (*Secale cereale*)

- » Advantages: tremendous biomass production, can be seeded later in the fall than other cover crops, germinate at temperatures as low as 34°F and produce vegetative growth at 38°F, reduces nitrate leaching, excellent weed suppressor, secrete compounds that will inhibit germination of weeds such as lambquarters, redroot pigweed, dandelions, and Canada thistle, few diseases affect rye as compared to other small grains, can be over-seeded in field crops, can be grown on a wide range of soils and will increase the concentration of exchangeable K near the surface by means of its fibrous root system, tolerates triazines herbicides, excellent for scavenging nitrogen, medium water use.
- » Disadvantages: may become a weed when terminated too late, not recommended before corn in rotation, host for Penetrans Root-Lesion Nematode.

Chicory (*Cichorium intybus*)

- » Advantages: rapid growth, excellent forage crop, crude protein: 20-32%, attracts pollinators, rooting depth 4 to 5 feet, forms arbuscular mycorrhizal associations, used in mixtures, grows well under droughty conditions.
- » Disadvantages: none.

Cow pea (*Vigna unguiculata*)

- » Advantages: provides 50 to 100 pounds of nitrogen, attracts pollinators, forms arbuscular mycorrhizal associations.
- » Disadvantages: none.

Crimson Clover (*Trifolium incarnatum*)

- » Advantages: grows well on poorly drained soils, use as a winter kill annual, utilize as hay, pasture, favored legume of organic farmers, attracts pollinators, grows well in extreme heat.
- » Disadvantages: host for root knot nematode and Penetrans Root-Lesion Nematode.

Field Pea (*Pisum sativum*)

- » Advantages: residue breaks down and releases nitrogen quickly, provide nitrogen at a rate of 50 to 100 pounds per acre, mix well with oats and barley, excellent for soil building and water use is low.
- » Disadvantages: can lead to aphanomyces problems when in rotations with alfalfa, susceptible to sclerotinia.

Forage/Oilseed Radish (*Raphanus sativa*)

- » Advantages: deep root crop, excellent for compaction control, crude protein: 26-30%, good for scavenging nitrogen from the soil, flowers attract pollinators and excellent for grazing.
- » Disadvantages: winter kills at 25°F, odor during decay, host for root knot nematode, Penetrans Root-Lesion Nematode, and sugarbeet cyst nematode.

Forage Turnips (*Brassica rapa*)

- » Advantages: root crop, crude protein: leaf tops 16%, root 12-14%, forms arbuscular mycorrhizal associations, rated good for scavenging Nitrogen, flowers attract pollinators, excellent for grazing.
- » Disadvantages: can become a serious weed if allowed to go to seed, host for root knot nematode, Penetrans Root-Lesion Nematode, and sugarbeet cyst nematode.

Hairy Vetch (*Vicia villosa*)

- » Advantages: provides 60 to 120 pounds of nitrogen, attracts pollinators, used in a cocktail mixtures, only vetch species that can be fall seeded and reach maturity the next year, can withstand trampling from grazing animals during May and June, adapted to a wide range of soil types, but prefers loamy and sandy soils.



- » Disadvantages: stems are weak and have a tendency to lodge, when seeded with a small grain, the weak stems are supported by the tangling of the tendrils with the small grain stalks, do not plant hairy vetch with a winter grain if you desire to harvest grain for feed or sale, fall seeded hairy vetch will winterkill with temperatures less than 15 degrees with no snow cover, certain species of nematodes increase with hairy vetch, Spring/summer seeding is less successful.

Japanese Millet (*Echinochloa frumentacea*)

- » Advantages: fast growing annual grass, tolerates frequent clipping, makes excellent forage and hay, tolerate both droughty and wet soils, excellent feed source, good choice for converting land to vegetable production.
- » Disadvantages: will not germinate/thrive in cold soil, host for Penetrans Root-Lesion Nematode.

Oats (*Avena sativa*)

- » Advantages: provide quick weed suppressing biomass, naturally occurring compounds in roots and residue can hinder weed growth, excellent nutrient catch crop, improves productivity of legumes when planted in mixes, inexpensive to establish.
- » Disadvantages: slow to release nitrogen to following crops, unless growth is terminated in mid-vegetative stage (12 to 18 inches), host for Penetrans Root- Lesion Nematode.

Pearl Millet (*Pennisetum glaucum*)

- » Advantages: forms arbuscular mycorrhizal associations, excellent for grazing, low water use requirements, self-pollinator.
- » Disadvantages: slower to establish than sorghum or sudangrass, will not germinate/ thrive in cold soil.

Red Clover (*Trifolium pratense*)

- » Advantages: provides 70 to 120 pounds of nitrogen, crude protein: 15%, flowers attract bees and can be used in cocktail mixtures.
- » Disadvantages: host for root knot nematode and Penetrans Root-Lesion Nematode.

Sunflower (*Helianthus annuus*)

- » Advantages: deep rooted, effective in mining mobile nutrients deep in the soil profile, attracts pollinators, forms arbuscular mycorrhizal associations, can be used cocktail mixtures.

- » Disadvantages: may increase sclerotinia inoculum.

Sorghum-Sudangrass Hybrids (*Sorghum bicolor* x *S. bicolor* var. *Sudanese*)

- » Advantages: tall fast-growing heat-loving summer annual, suppress some nematodes species, seedling, shoots, leaves and roots secrete allelopathic compounds that suppress weeds, has an aggressive root system that relieves compaction, mowing stalks increases root mass 5 to 8 times compared with unmowed stalks and forces the roots to penetrate deeper making the root system an excellent subsoil aerator, drought tolerant, will tolerate a pH range of 5 to 9, nutrient uptake increases on sandy soils, self-pollinator, medium water use required, forms arbuscular mycorrhizal associations.
- » Disadvantages: requires fertile soils, mature plants terminated by frost-killed become quite woody.

Sudangrass (*Sorghum bicolor*)

- » Advantages: tall fast-growing heat-loving summer annual, suppress some nematodes species, seedling/shoots/leaves and roots secrete allelopathic compounds that suppress weeds, has an aggressive root system that relieves compaction, mowing stalks increases root mass 5-8 times compared with unmowed stalks and forces the roots to penetrate deeper, making the root system an excellent subsoil aerator, drought tolerant, will tolerate a pH range 5-9, nutrient uptake increases on sandy soils, self-pollinator, medium water use required, forms arbuscular mycorrhizal associations.
- » Disadvantages: requires fertile soils, frost damaged plants can cause prussic acid poisoning in livestock, drought stressed plants can cause nitrate poisoning, host for Penetrans Root-Lesion Nematode.

White Clover (*Trifolium repens*)

- » Advantages: crude protein 24-30%, forms arbuscular mycorrhizal associations, flowers attracts bees.
- » Disadvantages: will not tolerate droughty soils and has a shallow root system.

Triticale, Winter (*Triticum* x *Secale*)

- » Advantages: crude protein: hay 9-16%, grain 17%, self-pollinator, forms arbuscular mycorrhizal associations, excellent weed suppressor and excellent for grazing.



- » Disadvantages: seed is more expensive than wheat or rye.

Wheat, Winter/Spring (*Triticum aestivum*)

- » Advantages: excellent weed suppressing crop, can be over-seeded into corn or soybeans, produces a tremendous amount of biomass, excellent nitrogen scavenger.
- » Disadvantages: host for Penetrans Root-Lesion Nematode, when planted in rotation with other small grains within a year there can be disease problems (especially with tan spot).

Termination of Cover Crops:

Cover crops will be terminated by frost, harvest or grazing for forage, roller crimping, tillage, and/or with proper herbicide selection. Timely termination of in season cover crops is required to reduce soil moisture depletion, nitrogen immobilization, allelopathy and to prevent unwanted re-seeding. Timing of cover crop termination must meet the purpose of the cover crop as specified in the conservation plan. Manage cover crop surface residue and biomass production to meet objectives specified in the conservation plan. In vineyards and small fruit operations, grow cover crop in aisles, mow as necessary for mulch cover and maintain as short stubble. Adjust nitrogen application rates for the subsequent crop based on nitrogen credits for specific cover crop species from University of Wisconsin nutrient guidelines.

(a) Herbicide Termination:

Herbicide selection for termination must be made by a Certified Pesticide Applicator, Certified Crop Advisor or qualified Extension Specialist following pesticide labeling and must be compatible with the following main crop to be grown.

(b) Winter Kill Termination:

Insure that planned cover and biomass production levels can be achieved for the specific cover crop purpose from the conservation plan when using cover crop species that terminate by frost or winter kill. When the objective of the conservation plan is to allow fall manure applications to in high Nitrogen Leaching soils, winter kill termination is not an option and winter hardy cover crops must be used.

(c) Grazing/Haying Termination:

Cover crops grazed or harvested for forage as a termination method will have a specified amount of target residual biomass left in the field to meet the cover crop objective(s) outlined in the conservation plan. Employ additional termination methods as needed once grazing/haying has concluded and target biomass is achieved and documented. When cover

crops are grazed, potential adverse reactions from cover crop consumption by grazing animals must be monitored at all times.

(d) Tillage Termination:

Use inversion type tillage implements that will adequately bury and kill the cover crop.

(e) Roller/Crimper Termination:

Rolling/crimping will take place at the proper cover crop growth stage to limit regrowth potential. For small grains this stage is at the boot or grain head stage, for legumes the flowering stage. Direction of rolling/crimping will coincide with planting direction when no-till planting the subsequent crop. Crimpers must break the plant stems in three or more places to be effective. Crimping must be done prior to seed set stage in order to prevent tillering or reseeding of the cover crop.

For additional NRCS cover crop termination criteria refer to: "NRCS Cover Crop Termination Guidelines".

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/>

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Midwest Cover Crop Decision Tool: <http://mcccdev.anr.msu.edu/>

Planting Winter Cereal Rye after Corn Silage: <http://www.soils.wisc.edu/extension/covercrop.php>

NRCS Cover Crop Termination Guidelines: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/>

National Agricultural Aviation Association website:
<http://www.agaviation.org/>

UW Extension Publications: Cover Crop Termination,
Forage Herbicide Quick Sheet – Cereal Rye Forage after
Corn Silage, Forage Herbicides Quick Sheet – Spring-
Seeded Forages after Corn and Herbicide Rotation
Restrictions in Forage and Cover Cropping Systems
located at the Wisconsin Crop Weed Science Website:
<http://wcws.cals.wisc.edu>



Table 1: Cover Crop Species Recommended for Planting in Wisconsin

Species	¹ Minimum Seeding Rate in lbs. bu./ac. (incorporated seed)		² Minimum Seeding Rate in lbs. bu./ac. (non-incorporated seed)		Seeding Date (statewide)	Planting Depth (inches)
GRASSES	lbs.	bu.	lbs.	bu.		
Annual Ryegrass (Lolium multiflorum)	15	0.7	20	0.8	4/10-6/1, 8/1-9/1	¼ to ½
Barley, Spring (Hordeum vulgare)	50	1.0	63 to 75	1.3 to 1.6	4/10-6/15, 7/15-9/20	¾ to 1½
*Japanese Millet (Echinochloa frumentacea)	22	0.5	28	0.6	6/1-7/15	½ to ¾
*Sorghum:Sudangrass (Sorghum bicolor x S. bicolor var. Sudanese)	28	0.6	33	0.7	6/1-7/15	½ to 1½
*Sudangrass (Sorghum biclor)	28	1.0	33	1.2	6/1-7/15	½ to 1
*Pearl Millet (Pennisetum glaucum)	22	0.5	28	0.6	6/1-7/15	½ to ¾
Wheat, Spring (Triticum aestivum)	50	0.8	70 to 90	1.2 to 1.5	4/10-6/15, 7/15-9/1	¾ to 1½
Barley, Winter (Hordeum vulgare)	50	1.0	63 to 75	1.3 to 1.6	8/15-9/15	¾ to 1½
Cereal Rye, Winter (Secale cereale)	55	1	55	1	7/15-10/15	¾ to 1½
Oats (Avena sativa)	30	0.9	45 to 60	1.4 to 1.9	4/10-9/1	½ to 1½
Wheat, Winter (Triticum aestivum)	50	0.8	70 to 90	1.2 to 1.5	8/1-10/1	¾ to 1½
Triticale, Winter (Triticum x Secale)	50	1.0	70 to 90	1.3 to 1.9	8/1-10/1	¾ to 1½
NON-LEGUMES BROADLEAF	lbs.	bu.	lbs.	bu.		
*Buckwheat (Fagopyrum esculentum)	20	0.4	35	0.7	5/15-8/1	½ to 1
**Oilseed Radish (Raphanus sativus)	4	--	12	--	4/10-6/15, 7/15-8/15	½ to ¾
*Sunflower (Helianthus annuus) (part of a mix)	1	--	2	--	6/1-7/15	1 to 1½
*Chicory (Cichorium intybus) (part of a mix)	1	--	2	--	4/10-6/1, 8/1-9/1	½ to ¾
Rapeseed/Canola (Brassica napus)	2	--	6	--	4/10-6/15, 8/1-8/15	½ to ¾
Forage Turnips (Brassica rapa)	1	--	5	--	4/10-6/15, 7/15-8/15	¼ to ½
LEGUMES	lbs.	bu.	lbs.	bu.		
Alfalfa (Medicago sativa)	13	--	16	--	4/15-6/1, 8/1-8/30	¼ to ½
Berseem Clover (Trifolium alexandrinum)	9	--	17	--	6/1-8/1	¼ to ½
*Cowpea (Vigna unguiculata)	55	0.9	99	1.7	6/1-7/15	1 to 1½
*Field Pea (Pisum sativum)	65	2.6	100	4.0	4/10-6/15	1 to 1½
Hairy Vetch (Vicia villosa)	15	--	20	--	4/10-6/15, 7/15-9/15	1 to 1½
*Peas, Winter (Pisum sativum subsp. arvense)	65	2.6	100	4.0	8/1-9/1	1 to 1½
Red Clover (Trifolium pratense)	9	--	13	--	4/10-8/15	¼ to ½
White Clover (Trifolium repens)	7	--	9	--	4/15-6/1, 8/1-8/30	¼ to ½
Crimson Clover (Trifolium incarnatum)	11	--	17	--	6/1-8/1	¼ to ½

¹ Incorporated seed—Seeding methods used that provide good seed to soil contact (drilled, no-tilled, or broadcast and incorporated).

² Non-incorporated seed—Seeding methods used when broadcasting seed without mechanical incorporation (aerial, over-seeding/inter-seeding and frost seeding).

Cover crop seed mixture designs must include a minimum of 1 pound of seed per specie planted.

Note: lbs_bu/ac represent the numbers in sequence in the Table. For example: 15/0.7 refers to 15 lbs. or 0.7 bushel per acre.-

* Species with asterisk are not recommended for aerial seeding. Large seed legumes (cowpea, etc.) and summer annuals (Japanese millet, etc.) require adequate seed to soil contact.

** Spring seeding of oil seed radish must include the termination strategy to prevent the production of viable seed.



Table 2: Identification and Comparison of Cover Crop Performance and Benefits by Species

Species	Use ¹	N-Source	SoilBuilder	Erosion Fighter	Weed Fighter	Pest Fighter	N-Scavenger	Grazing	Quick Growth	Non-Fragile Residue	Pollinator	Deep Rooted
Alfalfa (<i>Medicago sativa</i>) ³	C	4	3	3	3	1	2	3	3	1	3	4
Annual Ryegrass (<i>Lolium multiflorum</i>)	C	0	3	3	2	2	3	4	4	2	0	2
Barley, Spring (<i>Hordeum vulgare</i>)	C	0	3	3	3	1	3	3	3	4	0	2
Berseem Clover (<i>Trifolium alexandrinum</i>) ³	C	4	2	2	2	1	1	4	2	1	3	1
Buckwheat (<i>Fagopyrum esculentum</i>)	C	0	2	3	3	1	3	1	4	0	4	4
Canola/Rapeseed (<i>Brassica napus</i>)	C	0	2	3	2	1	3	4	4	1	3	3
Cereal Rye, Winter (<i>Secale cereale</i>)	C	0	4	4	4	3	4	4	4	4	0	3
Chicory (<i>Cichorium intybus</i>)	E	0	2	2	2	0	2	3	2	1	2	3
Cowpea (<i>Vigna unguiculata</i>)	C	3	2	2	2	0	2	3	3	1	2	1
Crimson Clover (<i>Trifolium incarnatum</i>)	E	3	2	3	2	1	2	4	3	1	4	2
Field Pea (<i>Pisum sativum</i>)	C	2	2	2	1	1	1	2	3	1	2	2
Forage Turnips (<i>Brassica rapa</i>)	C	0	1	3	2	0	3	4	3	1	1	1
Forage/Oilseed Radish (<i>Raphanus sativus</i>)	E	0	2	3	2	1	4	3	3	1	3	3
Hairy Vetch (<i>Vicia villosa</i>)	C	4	2	2	3	2	1	0	2	1	2	4
Japanese Millet (<i>Echinochloa frumentacea</i>)	C	0	3	3	3	3	3	3	4	4	1	3
Oats (<i>Avena sativa</i>)	C	0	3	3	3	2	3	4	4	2	0	2
Peas, Winter (<i>Pisum sativum</i> subsp. <i>arvense</i>)	C	2	2	2	1	1	1	2	3	1	2	2
Pearl Millet (<i>Pennisetum glaucum</i>)	C	0	3	3	4	2	3	4	4	4	1	2
Red Clover (<i>Trifolium pratense</i>) ³	C	4	3	3	3	1	2	4	3	2	4	3
Sorghum-Sundangrass (<i>Sorghum bicolor</i> x <i>S. bicolor</i> var. <i>Sudanese</i>)	C	0	4	4	4	2	4	4	4	4	2	3
Sunangrass (<i>Sorghum biclor</i>)	C	0	4	3	4	3	4	4	4	4	2	3
Sunflower (<i>Helianthus annuus</i>)	E	0	2	2	2	1	3	1	3	3	3	4
Triticale, Winter (<i>Triticum</i> x <i>Secale</i>)	C	0	3	3	3	2	3	4	3	4	0	2
Wheat, Spring/Winter (<i>Triticum aestivum</i>)	C	0	3	3	3	2	3	4	3	4	0	2
White Clover (<i>Trifolium repens</i>) ³	C	2	2	1	1	2	3	3	3	3	2	0

¹ Use: C=Common Use – Considerable state knowledge regarding species use.
E=Emerging Use – Limited state knowledge regarding species use.

² Attribute Ratings: 0=Poor, 1=Fair, 2=Good, 3=Very Good, 4=Excellent

³ Legumes such as alfalfa and red clover may cause bloating of ruminant animals. Take necessary precautions to prevent bloat when grazing cover crops that contain these legumes.



Table 3: Morphology, Physiology and Growth Requirements

Species	Life Cycle	Growth Height	Preferred pH	Minimum Germination Temp	Heat Tolerance	Drought Tolerance	Shade Tolerance	Flood Tolerance	Low Fertility Tolerance	Winter Survival Dry Matter Production (lb/ac/yr)	Termination Information
GRASSES											
Annual Ryegrass (<i>Lolium multiflorum</i>)	winter annual	upright	5.5 - 7.0	40	good	good	very good	very good	good	seldom	1000 - 6000 freeze, tillage, chemical
Barley, Spring (<i>Hordeum vulgare</i>)	cool season annual	upright	6 to 8	38	fair	good	fair	good	very good	never	2000 - 5000 freeze, tillage, mow, chemical, roller crimper
Barley, Winter (<i>Hordeum vulgare</i>)	winter annual	upright	6.0 - 8.0	38	fair	good	fair	good	very good	expected	2000 - 5000 tillage, mow, chemical, roller crimper
Cereal Rye, Winter (<i>Secale cereale</i>)	cool season annual	upright	5.0 - 7.0	34	fair	very good	good	very good	excellent	expected	2500 - 6000 freeze, tillage, mow, chemical, roller crimper
Japanese Millet (<i>Echinochloa frumentacea</i>)	summer annual	upright	4.6 - 7.0	65	excellent	excellent	fair	fair	very good	never	1500 - 3500 freeze, tillage, chemical
Oats (<i>Avena sativa</i>)	cool season annual	upright	4.5 - 6.0	38	fair	good	good	very good	very good	never	2000 - 6000 freeze, mow, tillage, chemical
Pearl Millet (<i>Pennisetum glaucum</i>)	summer annual	upright	5.5 - 7.0	65	excellent	excellent	fair	fair	excellent	never	2000 - 6000 freeze, tillage, chemical
Sorghum-Sudangrass (<i>Sorghum bicolor</i> x <i>S. bicolor</i> var. <i>Sudanese</i>)	summer annual	upright	5.5 - 7.0	65	excellent	excellent	fair	good	good	never	3000 - 8000 freeze, tillage, chemical
Sunangrass (<i>Sorghum bickor</i>)	summer annual	upright	5.5 - 7.0	65	excellent	excellent	fair	good	good	never	3000 - 8000 freeze, tillage, chemical
Triticale, Winter (<i>Triticum</i> x <i>Secale</i>)	winter annual	upright	5.2 - 7.0	38	fair	good	fair	good	good	expected	2000 - 5000 tillage, mow, chemical, roller crimper
Wheat, Spring (<i>Triticum aestivum</i>)	cool season annual	upright	6.0 - 7.0	38	fair	good	fair	good	good	never	2000 - 5000 freeze, tillage, mow, chemical, crimper
Wheat, Winter (<i>Triticum aestivum</i>)	winter annual	upright	6.0 - 7.0	38	fair	good	good	good	good	expected	2000 - 5000 tillage, mow, chemical, roller crimper
NON-LEGUMES BROADLEAF											
Buckwheat (<i>Fagopyrum esculentum</i>)	summer annual	upright to semi-upright	5.0 - 7.0	50	excellent	good	fair	fair	very good	never	1500 - 2500 freeze, tillage, chemical, mow
Chicory (<i>Cichorium intybus</i>) (part of a mix)	short-lived perennial	upright	5.0 - 7.0	50	very good	very good	good	good	very good	expected	1500 - 2000 tillage chemical
Forage Turnips (<i>Brassica rapa</i>)	cool season annual	upright	5.3 - 6.0	45	good	fair	good	fair	good	seldom	1200 - 3000 freeze, tillage, chemical
Oilseed Radish (<i>Raphanus sativus</i>)	cool season annual	upright	6.0 - 7.0	45	good	very good	good	fair	good	seldom	1200 - 3000 freeze, tillage, chemical
Rapeseed/Canola (<i>Brassica napus</i>)	winter/cool season	upright	5.5 - 8.0	41	good	good	good	fair	good	seldom	1000 - 2500 freeze, tillage, chemical
Sunflower (<i>Helianthus annuus</i>) (part of a mix)	summer annual	upright	5.7 - 8.0	44	excellent	excellent	good	fair	very good	never	250 - 500 freeze, tillage, chemical, mow
LEGUMES											
Alfalfa (<i>Medicago sativa</i>)	cool season perennial	upright	6.5 - 7.0	42	good	good	fair	poor	poor	expected	3000 - 8000 tillage chemical
Berseem Clover (<i>Trifolium alexandrinum</i>)	summer annual	upright	5.0 - 7.0	42	very good	good	fair	fair	fair	never	1200 - 3000 freeze, tillage, chemical
Cowpea (<i>Vigna unguiculata</i>)	summer annual	semi-upright to climbing	5.5 - 6.0	58	excellent	very good	fair	very good	very good	never	2000 - 3600 freeze, tillage, chemical, mow
Crimson Clover (<i>Trifolium incarnatum</i>)	winter annual	upright to semi-upright	5.5 - 7.0	42	very good	good	fair	very good	very good	never	3500 - 5500 freeze, tillage, chemical
Field Pea (<i>Pisum sativum</i>)	cool season annual	climbing	6.0 - 7.0	41	fair	fair	fair	fair	fair	seldom	1200 - 3000 tillage, mow, chemical
Hairy Vetch (<i>Vicia villosa</i>)	winter/cool season annual	climbing	5.5 - 7.0	60	fair	good	good	good	good	expected	1800 - 4000 tillage, chemical, roller crimper
Peas, Winter (<i>Pisum sativum</i> subsp. <i>arvense</i>)	winter annual	climbing	6.0 - 7.0	41	fair	fair	fair	fair	fair	seldom or expected	1200 - 3000 tillage, mow, chemical
Red Clover (<i>Trifolium pratense</i>)	short-lived perennial	upright	5.0 - 8.0	41	very good	good	very good	good	very good	expected	2000 - 5000 tillage chemical
White Clover (<i>Trifolium repens</i>)	cool season annual	upright	5.5 - 6.5	42	fair	fair	fair	good	fair	expected	600 - 1000 tillage chemical



Appendix H: NRCS Operation and Maintenance Plans

Conservation Cover O&M Plan

Cover Crop O&M Plan

Filter Strip O&M Plan

Grassed Waterway O&M Plan

Operation & Maintenance Plan Conservation Cover (Code 327)

Expected Lifespan

The minimum expected lifespan of this practice is at least 5 year(s).

O and M requirements from CPS

A properly operated and maintained **Conservation Cover** is an asset to your farm operation and your agricultural land. Implementation of Conservation Cover will help you to achieve and maintain desired resource conditions by supporting one or more of the following purposes:

- Reduce sheet, rill, and wind erosion and sedimentation.
- Reduce ground and surface water quality degradation by nutrients and surface water quality degradation by sediment.
- Reduce emissions of particulate matter (PM), PM precursors, and greenhouse gases.)
- Enhance wildlife, pollinator and beneficial organism habitat.
- Improve soil health.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. The following are some requirements of the operation and maintenance program.

Operation and Maintenance

- Mowing and harvest operations in a perennial crop system such as orchards, vineyards, berries, and nursery stock shall be done in a manner which minimizes the generation of particulate matter.
- If wildlife habitat enhancement is a purpose, maintenance practices and activities shall not disturb cover during the reproductive period for the desired species. Exceptions should be considered for periodic burning or mowing when necessary to maintain the health of the plant community.
- Control noxious weeds and other invasive species.
- Mowing may be needed during the establishment period to reduce competition from weeds.
- To benefit insect food sources for grassland nesting birds, spraying or other control of noxious weeds shall be done on a "spot" basis to protect forbs and legumes that benefit native pollinators and other wildlife.
- Re-vegetate bare spots.

Specific Site Requirements



Operation & Maintenance Plan Cover Crop (Code 340)

Expected Lifespan

The minimum expected lifespan of this practice is at least 1 year(s).

O and M requirements from CPS

A properly operated and maintained Cover Crops Practice is an asset to your farm operation and your agricultural land. Implementation of Cover Crops will help you to achieve and maintain desired resource conditions by supporting one or more of the following purposes:

- Reduce erosion from wind and water.
- Maintain or increase soil health and organic matter content.
- Reduce water quality degradation by utilizing excessive soil nutrients.
- Suppress excessive weed pressures and break pest cycles.
- Improve soil moisture use efficiency.
- Minimize soil compaction.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. The following are some requirements of the operation and maintenance program.

Operation and Maintenance

- Evaluate the cover crop to determine if the cover crop is meeting the planned purpose(s). If the cover crop is not meeting the purpose(s) adjust the management, change the species of cover crop, or choose a different technology.
- Establish cover crop within the stated time period and maintain until the stated time/growth stage.

Specific Site Requirements

Operation & Maintenance Plan Grassed Waterway (Code 412)

Expected Lifespan

The minimum expected lifespan of this practice is at least 10 year(s).

Follow the operation and maintenance plan below to keep your grassed waterway functioning as intended:

- Establish a maintenance program to maintain waterway capacity, vegetative cover, and outlet stability. Vegetation damaged by machinery, herbicides, or erosion must be repaired promptly.
- Protect the waterway from concentrated flow by using diversion of runoff or mechanical means of stabilization, such as silt fences, mulching, hay bale barriers, etc., to stabilize grade during vegetation establishment as necessary.
- After vegetation is established, remove any temporary measures, such as diversions or silt fences, that were installed so as to not interfere with design flow.
- Inspect grassed waterway regularly, especially following heavy rains. Fill, compact, and reseed damaged areas immediately. Remove sediment deposits to maintain capacity of grassed waterway.
- Vegetation damaged by machinery, herbicides, or erosion must be repaired promptly.
- Minimize damage to vegetation by excluding livestock whenever possible, especially during wet periods. Permit grazing in the waterway only when a controlled grazing system is being implemented.
- Avoid use of herbicides that would be harmful to the vegetation in and adjacent to the waterway area.
- Avoid using waterways as turn-rows during tillage and cultivation operations. Maintain constructed width by lifting or disengaging tillage equipment properly. Avoid farming operations along the direction of the waterway, which can hinder water entry.
- Mow or periodically graze vegetation to maintain capacity and reduce sediment deposition. The designed height of the vegetation is from _____ inches to _____ inches. Conduct mowing to avoid peak nesting seasons and reduced winter cover.
- Apply supplemental nutrients as needed to maintain the desired species composition and stand density of the waterway.
- Control noxious weeds.
- Do not use the waterway as a field road. Avoid crossing with heavy equipment when wet.
- Repair all broken subsurface drain lines adjacent to or in the waterway.

Specific Site Requirements

Reset

Operation & Maintenance Plan Filter Strip (Code 393)

Expected Lifespan

The minimum expected lifespan of this practice is at least 10 year(s).

A properly operated and maintained **Filter Strip Practice** is an asset to your farm operation and your agricultural land. Implementation of Filter Strip will help you to achieve and maintain desired resource conditions by supporting one or more of the following purposes:

- Reduce suspended solids and associated contaminants in runoff and excessive sediment in surface waters.
- Reduce dissolved contaminant loadings in runoff.
- Reduce suspended solids and associated contaminants in irrigation tailwater and excessive sediment in surface waters.

This practice will require you to perform periodic operation and maintenance to maintain satisfactory performance. The following are some requirements of the operation and maintenance program.

Operation and Maintenance

- For the purposes of filtering contaminants and nutrients (phosphorus), permanent filter strip vegetative plantings will be harvested and removed as appropriate to encourage dense growth, maintain an upright growth habit and remove nutrients and other contaminants that are contained in the plant tissue.
- Control undesired weed species, especially State-listed noxious weeds.
- If Conservation Practice Standard (CPS) Prescribed Burning (Code 338) is used to manage and maintain the filter strip, an approved burn plan must be developed.
- Inspect the filter strip after storm events and repair any gullies that have formed, remove unevenly deposited sediment accumulation that will disrupt sheet flow, reseed disturbed areas and take other measures to prevent concentrated flow through the filter strip.
- Apply supplemental nutrients as needed, according to soil tests, to maintain the desired species composition and stand density.
- Periodically regrade and reestablish the filter strip area when sediment deposition at the filter strip-field interface jeopardizes its function. Reestablish the filter strip vegetation in regraded areas, if needed.
- If grazing is used to harvest vegetation from the filter strip it must be according to an NRCS approved grazing plan. The grazing plan must ensure that the integrity and function of the filter strip is not adversely affected. Grazing will be permitted only when the vegetation's root system has been sufficiently established and when soil moisture conditions support livestock traffic without excessive compaction.

Specific Site Requirements

Reset