Gun River Watershed Tillage Survey
Quality Assurance Project Plan

Gun River Watershed Management Plan Update Project
Tracking Number: #2020-0114
Grantee: Allegan Conservation District

August 24, 2021

Signatures/Approvals:

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I. Project Description and Summary

With support from the Michigan Department of Environment, Great Lakes and Energy (EGLE), Allegan Conservation District (ACD) will conduct a tillage survey of the HUC 10 Gun River Watershed (0405000307), a largely agricultural area located in Allegan and Barry Counties, Michigan

ACD will work with the Kalamazoo River Watershed Council (KRWC) to document tillage practices, crops planted, crop residue, and existing best management practices on cropland. All observations will be made from accessible roadways while driving the watershed. All fields and sites visible from roadways will be included in the survey. This inventory will be done as part of the Gun River Watershed Management Plan Update project to identify agriculture-based causes and sources of nonpoint source pollution. Table 1 lists specific personnel and summarizes their responsibilities.

Table 1. Personnel and Responsibilities

Organization	**Personnel**	**General Responsibilities**
ACD	Brian Talsma	Project management and oversight, field work, data entry and analysis, completion of WMP, incorporate tillage survey data and summary into WMP.
	Mike Ludlam	Field work
	Bonne Matheson	Field work and data entry
	Jenna Rasmusson	Field work and data entry
KRWC	Cheryl Vosburg	Field work, WMP comment and review
EGLE	Thad Cleary Pete Vincent Janelle Hohm	Technical Assistance

Contact information for the main personnel is provided below:

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II. Study Objectives

The purpose of this study is to obtain an understanding of general agricultural management practices used in the watershed, identify potential agricultural based sources and causes of nonpoint source pollution, determine areas where management practices could be altered to better protect water quality, and to prioritize these areas based on their potential to contribute nonpoint source pollutants to surface waters during runoff events.

Results and recommendations stemming from the collected data will be used to assist in the update of the Gun River Watershed Management Plan including:

- Identification of critical areas and prioritization of sites for future outreach and best management practice implementation efforts.
- Recommendations for best management practices to address specific sources of pollutants.
- Loading calculations and targets for future pollutant reductions.

III. Study Design

The basis for this inventory process was originally developed by EGLE's Nonpoint Source Program. Prior to the start of the inventory, EGLE completed several initial steps to prepare ACD for field data collection. ACD will use the tools provided by EGLE to collect information in portions of the Gun River Watershed. A timetable for each work task is included in Table 2, followed by a description of each work task.

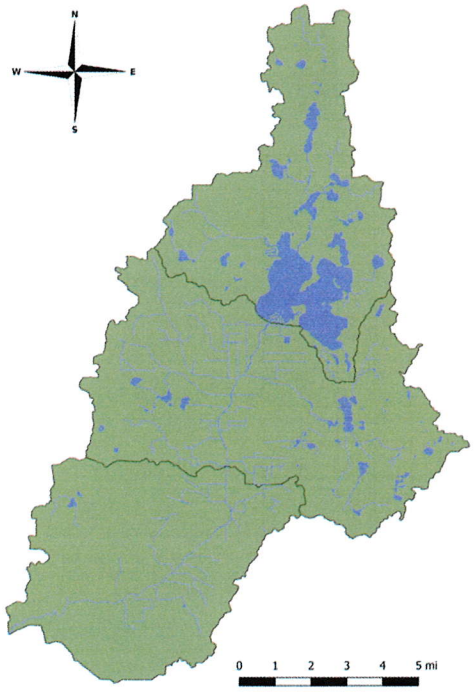

Figure 1: Map of the Gun River watershed.

Table 2. Timetable for Work Tasks

TASK	DESCRIPTION	2021												2022												2023											
		Jan-Mar			Apr-Jun			Jul-Sep			Oct-Dec			Jan-Mar			Apr-Jun			Jul-Sep			Oct-Dec			Jan-Mar			Apr-Jun			Jul-Sep			Oct-Dec		
Task 2	**Agriculture Inventory**																																				
A, B	Digitize fields, GIS analyses																																				
D	Field data collection																																				
	Fall 2021 tillage survey																																				
	Spring 2022 residue survey																																				
	Fall 2022 tillage survey																																				
	Spring 2023 residue survey																																				
	Data analysis																																				
E	Submit data to EGLE																																				

Preparatory Steps: Desktop Analysis and Map Production

EGLE hired contractors to review aerial photographs of the Gun River watershed (HUC 0405000307) and create maps to outline all individual crop fields within the watershed. This work is to be completed by October 2021 in time for the fall tillage survey.

Aerial photos will be overlaid with the HUC 10 watershed boundary to clearly delineate the area included in the inventory. Using best professional judgment, every individual field visible from aerial photographs will be identified within the watershed and field boundaries digitized for use in a geographic information system (GIS). Aerial photographs with high (0.5-1 foot) resolution will be used to get the best level of detail for each site. Fields will be digitized at a maximum scale of 1:4,000.

In addition to field digitization, contractors will hydro-enforce a high resolution digital elevation model of the watershed in order to accurately model surface water flows over the landscape.

ACD staff will also digitize animal feeding operations (AFO) in the watershed based on aerial photos. Aerial photos will be overlaid with the HUC 10 watershed boundary to clearly delineate the area included in the inventory. Using best professional judgment, every individual AFO visible from aerial photography will be identified within the watershed. Each AFO will be stored in a point layer in the project GIS.

Data layers for surface water bodies, areas where concentrated animal feeding operation (CAFO) manure could potentially be applied, and the local road network system will be added to the GIS by ACD staff. These additional data layers provide information that can help further refine what fields are high priorities based on their potential to contribute nonpoint source pollutants to surface waters. Inclusion of the road network will allow for easier navigation during windshield surveys.

These GIS layers will be added to ArcGIS Collector for use during windshield surveys.

Data Collection:

ACD will be responsible for conducting windshield surveys and collecting necessary data. ACD staff have attended a training presentation hosted by EGLE to learn in detail the purpose of the inventory, what data will be collected, and the proper methods and procedures for collecting data. In combination with ACD staff's solid foundation and understanding of agriculture, including knowledge of different crops and practices commonly used in the region, the expertise gained through this training will ensure ACD can successfully complete the inventory, and if needed, train new staff in this process. ACD will be equipped to make all necessary observations and collect all necessary data.

All data will be collected while driving the watershed during windshield surveys and recorded in ArcGIS Collector (see **Appendix A** for example attribute tables used during windshield surveys). Observations will be made from vehicles traveling on accessible roadways. Maps and geospatial datasets created by EGLE will be made available for ACD before inventories begin.

Windshield surveys will be completed by crews of two to four individuals as scheduling permits. A crew of three to four crew members is recommended to capture data in the most efficient and effective manner. One crew member will be responsible for driving during the windshield survey. In order to

collect the most accurate data possible, the driver may need to drive at a slow pace and/or make temporary stops on road shoulders so observations of field conditions can be made. The driver will maintain awareness of their surroundings while driving to maintain the safety of all crew members conducting the windshield survey and all others on the road. Because crew members will at times be driving at slower than typical speeds or may need to pull off onto the road shoulder, being extremely vigilant of the surrounding terrain and traffic is extremely important during the survey. Using hazard lights when driving at slow speeds or when making frequent stops is encouraged.

A second crew member, the field observer, will be responsible for making observations of field conditions and communicating these observations to the data recorder. Because this is the most demanding task, it may be beneficial to have two field observers. Fields on both sides of a two-lane road can be captured this way, making the survey faster and more efficient.

Another crew member, the data recorder, will be responsible for recording observations made by the field observer(s), and using digital or physical maps to navigate and determine which fields are being observed. Observations will be entered directly into the GIS attribute table for the observed field. Physical data sheets will be kept on hand in the case that technical difficulties prevent the use of a tablet or computer.

Four separate windshield surveys will be completed to collect data representative of two agricultural years (fall tillage and spring residue).

A fall tillage survey will be completed to collect information from croplands, specifically: the crop that was last planted, the type of tillage used after harvest of that crop, planting of a winter crop, and the presence or absence of any existing cover crops, filter strips, grassed waterways, or tile risers.

Based on the crop residue remaining on fields, the previous planted crop will be documented in the appropriate column on the data sheet. If a fall crop has been planted, (most typically wheat) this will also be noted. Staff will record any cover crop or over-wintering cash crop (e.g. winter wheat). Any observed tillage practices will also be recorded. Pre-populated categories are shown in Appendix A, but additional categories may be added as necessary. Other observations will be recorded in the "Notes" column of the data sheet.

When conducting windshield surveys, crew members may find that data cannot be collected from every field; some fields may not be visible from roadways or may have been missed during the survey. Several categories exist to document such fields, including fields that are "skipped" (because they were not visible), "pasture", or "not a field". If the crop cannot be identified by the residue remaining on the field at the time of the inventory, it can be labeled as "unknown".

A spring residue survey will also be completed to collect data on the planted crop and the percentage of crop residue remaining on fields after planting.

Based on Natural Resources Conservation Service (NRCS) guidance, at least 30 percent crop residue is needed on cropland fields in order to reduce erosion to tolerable soil loss levels for crop production. This guidance was used to create categories for observed crop residue remaining on fields: zero percent residue, less than 30 percent residue, greater than 30 percent residue, planted with a no-till method, and not planted yet (if the field has not been planted at the time of the inventory). Data collectors will use best professional judgement during windshield surveys to make accurate observations regarding

percent residue on cropland fields. The presence of manure application and field tiles will be noted in the "Notes" column should they be observed. Photographs documenting residue percentage on fields can be found at the following NRCS reference document https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_029000.pdf.
While these photographs were taken while standing on fields, it provides general guidance on the amount of residue that falls under each category included in this inventory.

An AFO survey will be conducted in conjunction with each spring residue survey. The type and number of animals will be recorded along with any manure or runoff concerns. When observers are unable to estimate the number of animals at an AFO (e.g. poultry and swine operations), the barn size will be measured using aerial photography and recorded in the "Notes" column. Additional notes may include details of runoff or manure concerns, details regarding hobby farms, and other observations.

Timing of Windshield Surveys:
The time period that tillage and residue data can be collected via windshield survey is limited and is highly dependent on weather, the amount of precipitation received, and field visibility (snow cover, vegetation cover). Because these factors can vary on a year-to-year basis, so does the precise time frame when windshield surveys should be conducted. A description of the general time frame and conditions required for data collection is listed below for each survey type.

Fall Tillage Survey:
Fall tillage information can be collected at two distinct times; either in late fall or early spring. If collecting information in late fall, the timing of the windshield survey will occur after most fall tillage has been completed, but before snow accumulation obscures visibility of field conditions. In a typical year, the best time to collect this data is late November to early December. However, if the amount of precipitation received in the fall is relatively high, landowners may be forced to wait to conduct fall tillage until field conditions improve, pushing the timing of a tillage survey to later in the year.

If an early spring time frame is selected for the fall tillage data collection, the timing of the windshield survey will occur after the snow cover has melted away, but before any spring tillage has occurred (typically late March to early April). If spring tillage has already occurred, it is not possible to collect information reflecting the tillage practices used the previous fall.

Spring Residue Survey:
Windshield surveys to collect spring residue data will be conducted after that season's crops have been planted, but before crops have grown enough to obstruct the view of crop residue remaining on fields. In a typical year, the general time frame spring residue data can be collected is late May to early June. The timing of crop planting will depend on temperature and precipitation received, which could push this time window earlier or later. If temperatures rise earlier in the year, the timing of planting could also be accelerated. Particularly wet conditions could push the time window for planting back further.

Iterations:
By collecting two fall tillage surveys and two spring residue surveys, a robust data set representative of two full calendar years can be used to analyze and make recommendations providing a more accurate understanding of the management practices used in the watershed.

Data Gaps:

It is possible that data collection will not be possible for all fields and sites. Fields may be too far from roadways to be seen clearly, new development may have altered the land use on sites, or fields could be taken out of production completely. The field data sheet key notes how these fields should be documented. During data analysis, the number of fields skipped or where data could not be collected will be used, so it is important that these fields are correctly categorized.

IV. Field Procedures and Trainings

EGLE provided ACD staff with a virtual training presentation in November of 2020 detailing the inventory process. This presentation included detailed descriptions of what data will be collected during each survey, the appropriate timing of each survey, how to transfer observations made during windshield surveys to the GIS software, and an overview of how the data will be compiled and analyzed to develop recommendations for future implementation efforts. In addition, EGLE staff will accompany ACD staff during the first iteration of the fall tillage and spring residue inventories to ensure observations made by ACD are representative of the parameters detailed in training presentations. If health restrictions do not permit in-person oversight by EGLE staff, ACD will take pictures during a trial observation day, and submit the pictures and data to EGLE staff to insure that field conditions are being accurately recorded.

V. Quality Control Procedures

To ensure that observations made during windshield surveys are both precise and accurate, ACD will take photographs of different field conditions observed during the first fall tillage and spring residue surveys. Photographs will clearly depict crops, tillage practices, and the amount of residue on the fields selected for photo-certification. The field number in each photograph will be noted and the completed data file shared so that observations made by data collectors can be reviewed and confirmed by EGLE. After EGLE review, if recorded observations do not look to be representative of field conditions seen in photographs, EGLE staff will accompany ACD on the next windshield survey and provide in-the-field instruction to provide better guidance for collecting data.

ACD will review the data after completion of each survey to ensure all fields and sites are accounted for during the windshield survey. If any inconsistencies are found, the field number and observation will be noted. Aerial photographs of the fields in question will be reviewed to see if issues can be rectified. Data will be shared with EGLE staff for review as well. EGLE staff will meet with ACD staff to discuss any inconsistencies or other questions as an additional data quality check.

VI. Data Analysis and Interpretations

EGLE will provide ACD with analysis results from the Agricultural Conservation Planning Framework (ACPF). The ACPF is a modeling tool developed for use in ArcGIS to identify opportunities for conservation practices. The tool analyzes hydrology in the watershed to recommend locations where practices may be most impactful. This information will be used to highlight potential priority areas and possible actions that will be identified and assessed in the Gun River Watershed Management Plan.

Analysis of windshield survey data will begin once any written data has been transferred from physical field data sheets to the GIS. After data is transferred, a different crew member will perform quality control by doing a random check of 10% of the entries to ensure data was copied correctly.

Priority areas are those that have a high likelihood of contributing nonpoint source pollutants to surface waters during runoff events based on the field conditions present and its proximity to surface water bodies. Sites will be highlighted as a priority based on several factors, including the tillage practice, percentage of crop residue, lack of buffers, presence of manure, and proximity to surface water bodies. More intensive fall tillage practices reduce the amount of crop residue on field surfaces during the winter and early spring. This reduction in crop residue increases the potential for soil erosion and the delivery of sediment and nutrients to surface waters during storm events and snowmelt events. Plowing is the most intensive tillage practice followed by chisel plowing. Depending on the crop that was planted on a field previously, little to no residue could be left after these tillage practices are implemented, especially if the vegetation of the observed previous crop is not very hearty (e.g. soybeans). Less intensive practices such as mulch till, strip till, planting a winter wheat crop or no tillage at all, result in more crop residue left on the soil surface or include a growing crop such as wheat, reducing the amount of sediment and nutrients reaching surface waters.

Depending on the crop that was planted, even sites where less intensive tillage practices were used, could still have little to no residue left. Fields that were observed to have zero or less than 30 percent residue during spring residue surveys, that are in proximity of a surface water body, and that have no buffer between fields and surface water bodies will be a priority for future best management practice implementation efforts due to the increased likelihood that runoff events could transfer sediment and nutrients unabated to surface waters.

VII. Data Reporting

Data will be collected during windshield surveys by ACD staff with experience and knowledge of agricultural crops and practices. Information will be recorded directly in the attribute table of the fields' GIS layer. A physical data sheet will only be used in the case of technical difficulties, and this data will be transferred to the attribute table when possible.

Statistical data and maps will be produced from the data and published in the Gun River Watershed Management Plan, along with a summary of methods and analysis.

Appendix A:

Field Data Sheets

Fall Tillage and Spring Residue Attribute Table with Possible Entries

ID	Date_21FT	Crop_21FT	Tillage_21FT	WinterCover_21FT	Notes_21FT	Date_22SR	Crop_22SR	Residue_22SR	Notes_22SR
		Corn	Plowed	Winter wheat (crop)			Corn	No residue	
		Corn silage	Chisel plowed	Grass			Corn silage	Less than 30%	
		Soybean	Mulch tilled	Legume			Soybean	More than 30%	
		Wheat	Strip tilled	Brassica			Wheat	Planted no till	
		Hay	No tillage	Mix			Hay	Not planted	
		Pasture					Pasture		
		Unknown					Unknown		
		Not a field					Not a field		
		Skipped					Skipped		

AFO Observations Field Data Sheet with Possible Entries

ID	Animal_Type	Animal_Number	Runoff_Issues	Manure_Issues	Notes1	Notes2
	Dairy	30-60	Yes	Yes		
	Beef	61-100	No	No		
	Poultry	101-150				
	Swine	151-500				
	Hobby	CAFO				
		See Notes				