Clean Water Act Section 319(h) Nonpoint Source Pollution Control Program

Environmental Effects of
In-House Windrow Composting of Poultry Litter
TSSWCB Project Number 09-05
Revision #3

Quality Assurance Project Plan

Texas State Soil and Water Conservation Board

prepared by

Texas A&M AgriLife
Texas Water Resources Institute

Effective Period: Upon EPA Approval through October 2013
(with annual updates required)

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A1 APPROVAL PAGE

Quality Assurance Project Plan for *Environmental Effects of In-House Windrow Composting of Poultry Litter.*

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Title: Olfactometry Lab Manager

List of Acronyms

ACS	American Chemical Society
ARS	USDA-Agricultural Research Service
ATD	Automated Coupled Plasma Spectrometry
AWRL	Ambient Water Reporting Limit
BMP	Best Management Practice
CAR	Corrective Action Report
CFU	Colony-Forming Unit of Bacteria
COC	Chain of Custody
CWA	Clean Water Act
DOC	Demonstration of Capability
DQO	Data Quality Objective
EPA	Environmental Protection Agency
Extension	Texas AgriLife Extension Service
GC/MS-O	Gas chromatography/mass spectrometry-olfactometry
HAP	Hazardous Air Pollutants
ICP	Inductively Coupled Plasma Spectrometry
IWC	In-House Windrow Composting
LCS	Laboratory Control Standard
LOQ	Limit of Quantitation
MDL	Method Detection Limit
NIST	National Institute of Standards and Technology
NPS	Nonpoint Source
NRCS	USDA-Natural Resource Conservation Service
OPR	On-going Precision and Recovery
PBS	Phosphate Buffer Solution
PM	Project Manager
POSC	Poultry Science Department, Texas A&M University
QA	Quality Assurance
QC	Quality Control
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
Research	Texas AgriLife Research
RPD	Relative Percent Difference
SA	Sample Actual
SAML	Soil and Aquatic Microbiology Laboratory
SCSC	Soil and Crop Sciences Department, Texas A&M University
SOP	Standard Operating Procedure
SR	Sample Recovery
sVOC	Semi-volatile Organic Compound
SWFTL	Soil, Water, and Forage Testing Lab
TAMU	Texas A&M University
TMDL	Total Maximum Daily Load
TSSWCB	Texas State Soil and Water Conservation Board
TWRI	Texas Water Resources Institute
USDA	United States Department of Agriculture
VFA	Volatile Fatty Acid
VOC	Volatile Organic Compound
WQMP	Water Quality Management Plan
W-TAMU	West Texas A&M University

A4 PROJECT/TASK ORGANIZATION

The following is a list of individuals and organizations participating in the project with their specific roles and responsibilities:

U.S. Environmental Protection Agency

Henry Brewer, USEPA Texas Nonpoint Source PM

Provides project oversight and funding at the federal level. Responsible for overall performance and direction of the project at the federal level. Ensures that the project assists in achieving the goals of the clean water act (CWA). Reviews and approves the QAPP, project progress, and deliverables.

Texas State Soil and Water Conservation Board

Wesley Gibson , TSSWCB PM

Provides project overview at the State level. Responsible for ensuring that the project delivers data of known quality, quantity, and type on schedule to achieve project objectives. Tracks and reviews deliverables to ensure that tasks in the work plan are completed as specified. Reviews and approves QAPP and any amendments or revisions and ensures distribution of approved/revised QAPPs to TSSWCB participants.

Pamela Casebolt; TSSWCB QAO

Reviews and approves QAPP and any amendments or revisions. Responsible for verifying that the QAPP is followed by project participants. Monitors implementation of corrective actions. Coordinates or conducts audits of field and laboratory systems and procedures. Determines that the project meets the requirements for planning, quality assessment (QA), quality control (QC), and reporting under the TSSWCB Total Maximum Daily Load Program.

Texas Water Resources Institute

Kevin Wagner, Project Lead, TWRI Associate Director

The TWRI Project Lead is responsible for ensuring that tasks and other requirements in the contract are executed on time and with the QA/QC requirements in the system as defined by the contract and in the project QAPP; assessing the quality of subcontractor/participant work; and submitting accurate and timely deliverables to the TSSWCB PM. Responsible for supporting the development and ensuring the timely delivery of project deliverables, ensuring cooperation between project partners, providing fiscal oversight and completing project reporting.

Lucas Gregory, TWRI QAO

Responsible for determining that the QAPP meets the requirements for planning, QA and QC. Conducts audits of field and laboratory systems and procedures. Responsible for maintaining the official, approved QAPP, as well as conducting quality assurance audits in conjunction with TSSWCB personnel.

Texas AgriLife Extension Service – Poultry Science Department

Craig Coufal, Project Co-Lead

Responsible for demonstration of environmental effects of IWC and technology transfer. Responsible for overseeing scheduled demonstration activities, transport of runoff samples from Riesel to SAML, collection of raw and IWC poultry litter samples, and coordinating delivery of collected litter samples to SAML, SWFTL, and W-TAMU. This includes ensuring that personnel involved in collecting and processing environmental samples have adequate training and thorough knowledge of the QAPP and its requirements specific to the task or analysis performed. Responsible for oversight of all field activities at cooperator's farm ensuring that all QA/QC requirements are met, documentation related to the data collection and analysis are complete and adequately maintained, and that results are reported accurately. Responsible for ensuring that corrective actions are implemented, documented, reported and verified.

Texas AgriLife Research – Soil and Crop Sciences Department

Terry Gentry, Project Co-Lead, SAML Laboratory Director

Responsible for lab analysis of bacteria in in-house windrowing composting (IWC) and raw litter, and runoff. Responsible for supervision of laboratory personnel involved in generating bacteriological data for the project. Responsible for ensuring that laboratory personnel involved in generating bacteriological data have adequate training and thorough knowledge of the QAPP and its requirements specific to the analyses or task performed. Responsible for oversight of all laboratory operations ensuring that all QA/QC requirements are met, documentation related to the analysis is complete and adequately maintained, and that results are reported accurately. Responsible for ensuring that corrective actions are implemented, documented, reported and verified. Monitors implementation of measures in the lab to ensure complete compliance with project data quality objectives in the QAPP. Conducts in-house audits to ensure compliance with the approved QAPP and identify potential problems.

USDA Agricultural Research Service

Daren Harmel, Project Co-Lead

Responsible for management of Riesel demonstration site and collection of runoff from Riesel. Responsible for overseeing the installation and operation of environmental monitoring equipment and carrying out scheduled monitoring, sample collection, sample preparation and coordinating delivery of collected samples to SAML. This includes ensuring that field and laboratory personnel involved in collecting and processing environmental samples have adequate training and thorough knowledge of the QAPP and its requirements specific to the task or analysis performed. Responsible for oversight of all field activities at Riesel ensuring that all QA/QC requirements are met, documentation related to the data collection and analysis are complete and adequately maintained, and that results are reported accurately. Responsible for ensuring that corrective actions are implemented, documented, reported and verified.

Texas AgriLife Extension Service – Soil and Crop Sciences Department

Tony Provin, Soil, Water and Forage Testing Laboratory (SWFTL) Director

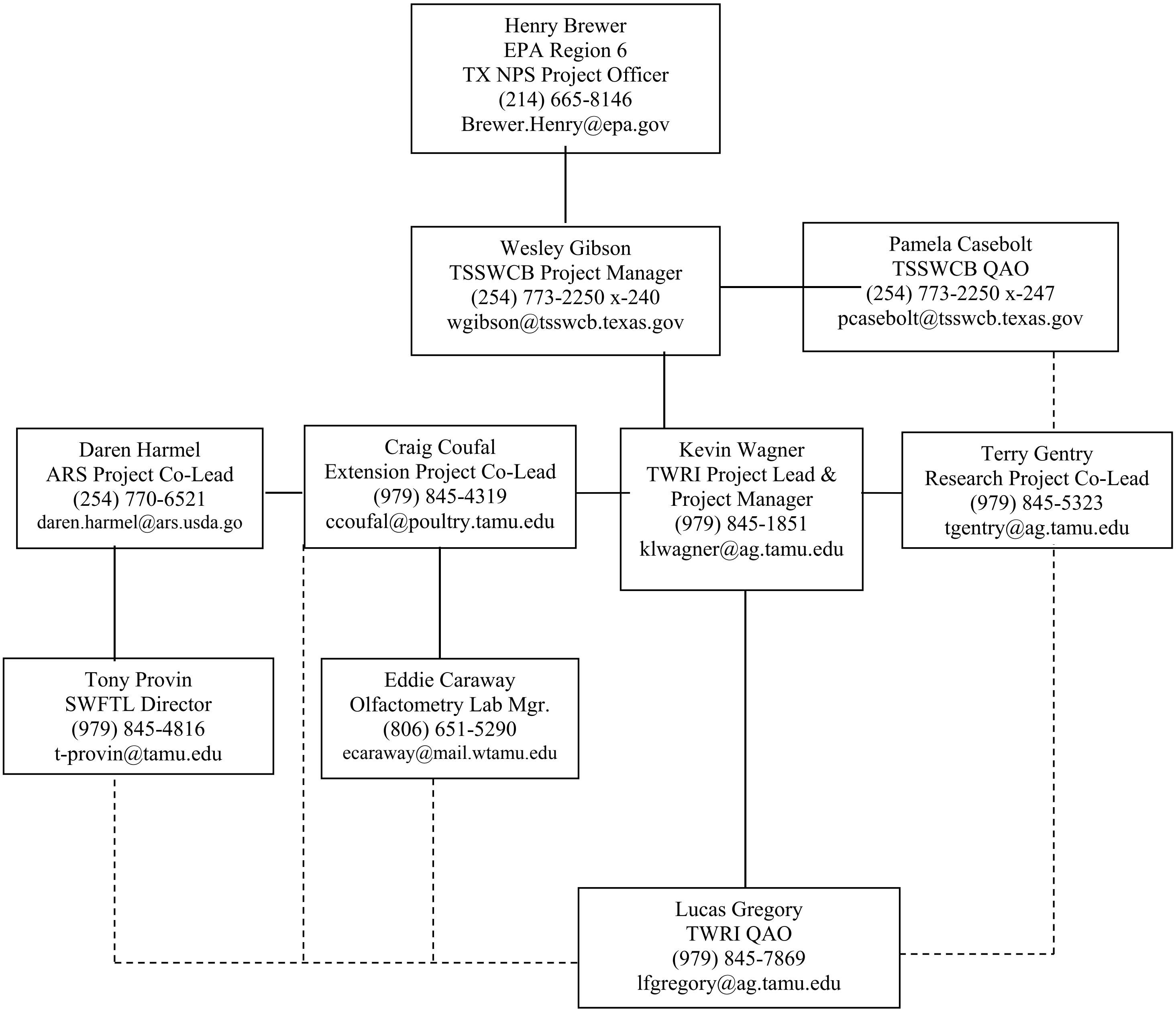
Responsible for lab analysis of nutrient levels in soil and litter samples. Responsible for supervision of laboratory personnel involved in generating analytical data for the project. Responsible for ensuring that laboratory personnel involved in generating analytical data have adequate training and thorough knowledge of the QAPP and its requirements specific to the analyses or task performed. Responsible for oversight of all laboratory operations ensuring that all QA/QC requirements are met, documentation related to the analysis is complete and adequately maintained, and that results are reported accurately. Responsible for ensuring that corrective actions are implemented, documented, reported and verified. Monitors implementation of the measures within the laboratory to ensure complete compliance with project data quality objectives in the QAPP. Conducts in-house audits to ensure compliance with the approved QAPP and identify potential problems.

West Texas A&M Univ. Olfactometry Laboratory (W-TAMU)

Eddie Caraway, Research Associate, Olfactometry Lab Manager

Responsible for analysis of volatiles. Responsible for supervision of laboratory personnel involved in generating volatiles analysis data for the project. Responsible for ensuring that laboratory personnel involved in generating volatiles analysis data have adequate training and thorough knowledge of the QAPP and its requirements specific to the analyses or task performed. Responsible for oversight of all laboratory operations ensuring that all QA/QC requirements are met, documentation related to the analysis is complete and adequately maintained, and that results are reported accurately. Responsible for ensuring that corrective actions are implemented, documented, reported and verified. Monitors implementation of the measures within the laboratory to ensure complete compliance with project data quality objectives in the QAPP. Conducts in-house audits to ensure compliance with the approved QAPP and identify potential problems.

Figure A4.1 Organization Chart



A5 PROBLEM DEFINITION/BACKGROUND

According to the *2008 Texas Water Quality Inventory and 303(d) List*, 295 waterbodies in Texas are impaired by bacteria. To address the bacteria impaired waterbodies, Texas is developing and implementing Total Maximum Daily Loads (TMDLs), TMDL Implementation Plans, and Watershed Protection Plans. Many of these waterbodies are located in the poultry producing regions of Texas. Poultry production has expanded significantly in recent years in Falls, Limestone, and surrounding counties. An estimated 550 new poultry houses have been built in this area, producing approximately 60 million broilers annually. If improperly managed, litter (the combination of bedding material and manure) removed from the facilities and land applied represents a threat to water quality through bacterial and nutrient runoff from these fields. By proactively planning for and addressing environmental issues, the impacts from new and existing facilities can be minimized for the long term. To achieve this, additional cost-effective best management practices (BMPs) are needed to reduce the environmental impacts. Furthermore, such BMPs must be demonstrated to area producers in order to achieve their adoption.

One such BMP is IWC of poultry litter. IWC is a litter management strategy used by commercial poultry producers to reduce pathogenic microorganisms in litter and improve the overall quality of the litter between successive flocks reared on the same litter. While some research has been published about the methodology of performing IWC and the subsequent reductions in bacterial loads in litter, and many managers in the poultry industry currently utilize this technique, no data have been published regarding the effects of land-applied IWC-treated litter on runoff water quality or other environmental impacts.

IWC is relatively simple to implement in a poultry house. After the birds are removed, the litter is piled into windrows down the length of the house. Natural bacterial metabolism generates heat within the piles. Within 48 hours, the internal temperature of the piles will surpass 131°F, a temperature sufficient to inactivate most pathogenic microorganisms (such as *E. coli*, *Salmonella* and various viruses) found in litter. Litter is typically left in piles for 5-9 days, and then spread out to be reused for the next flock of birds. Turning of the piles may also occur during this time to release moisture, increase aeration and assure that all parts of the litter pile are heated to inactivate pathogens. The IWC process has been referred to as a “pasteurization” procedure rather than composting, but the term “composting” is widely used in the literature and poultry industry.

If demonstration/evaluation of this practice shows it to be effective at reducing the loadings of nutrients, bacteria, and volatiles, this practice could then be added to the list of approved practices for Water Quality Management Plans (WQMP) for poultry operations. State law requires all poultry operations in Texas to operate in accordance with a TSSWCB certified WQMP. Additionally, if effective, the practice could be added to the NRCS Field Office Technical Guide. This would not only benefit Texas, but poultry operations nationwide.

A6 PROJECT/TASK DESCRIPTION

General Project Description

This project will demonstrate the environmental effects of treating poultry litter using IWC. The effect of IWC-treated litter on runoff water quality when the litter is land applied will be assessed along with other benefits. Data are needed to evaluate nutrient and *E. coli* losses in runoff water from land upon which IWC-treated poultry litter has been applied. It is anticipated that the IWC procedure should eliminate most *E. coli* in the litter, thus reducing the potential for bacterial contamination of water resources. If successfully demonstrated, IWC could be used by poultry producers as a standard, cost-effective BMP to reduce the microbial load of poultry litter before it is removed from poultry houses during whole house cleanouts. In addition, implementation of IWC as a BMP between flocks could also eliminate the need for caked litter removal, handling and disposal; thus, reducing the frequency (and potentially the total amount) of litter removed from poultry houses and needing final disposition.

To evaluate the potential benefit to surface water runoff quality, IWC will be performed at a private poultry facility (cooperator site) in either Limestone or Falls County. Bacteria, nutrients, and volatiles in raw and IWC litter will be evaluated prior to land application at USDA-ARS sites in Riesel. A 3 ton/ac application rate will be utilized. This rate is typical for pasture conditions in Central Texas. Additionally, through the use of laboratory and field evaluation of volatile concentrations from litter and from the application sites at Riesel by W-TAMU, the environmental impacts of using IWC poultry litter instead of raw litter will be demonstrated.

At the USDA-ARS watershed sites at Riesel, bacteria levels in runoff will be evaluated to determine the edge-of-field impacts of the BMP. Through a separate project, not funded by this or other CWA §319(h) funds, the water quality impacts of litter and commercial fertilizer application on nutrient runoff from the demonstration sites will be evaluated. Storm and base flow water quality samples will be collected from USDA-ARS watersheds in Riesel and analyzed for Nitrate (NO_3-N), Ammonia (NH_4-N), and Soluble Phosphorous (PO_4-P). Bacteria levels (*E. coli*) in the runoff from the Riesel watersheds will be analyzed by SAML. SWFTL will complete soil tests on samples taken from sites, to determine macro/micro nutrients, p.H., electrical conductivity (EC), organic matter (OM).

Results of the demonstration and practice evaluation will be distributed through publications and grower meetings conducted in year 3 of the project in poultry producing regions of Texas. POSC, SAML, and USDA-ARS, with assistance from TWRI, will develop outreach materials summarizing the results of the demonstration and the analysis of the environmental impacts of IWC poultry litter. These will be submitted to the TSSWCB for review prior to publication. POSC will conduct 6-9 grower meetings throughout the poultry producing areas of the state to present results of the IWC demonstration/evaluation. POSC will work with poultry integrators to deliver 2-3 programs for growers for each integrator (Sanderson Farms, Tyson, Pilgrim’s Pride). TWRI will assist POSC by developing press releases, meeting notification materials for distribution prior to the meetings, and post meeting summaries. TWRI, with assistance from POSC and SAML, will also develop, host, and maintain a project website for dissemination of project materials.

POSC, with assistance from TSSWCB, TWRI and USDA-ARS, will work with USDA-NRCS to make necessary revisions to various practice standards (i.e., 629 Waste Treatment, 633 Waste Utilization, 317 Composting Facility) to include IWC so that it can be used in TSSWCB Water Quality Management Plans and NRCS conservation plans. Finally, POSC will work with SAML, USDA-ARS, and TWRI to develop a final report summarizing the results of the project.

Environmental Data Collection Related Tasks, Objectives, Subtasks and Deliverables

Task 2: Quality Assurance

Objective: To develop data quality objectives (DQOs) and quality assurance/control (QA/QC) activities to ensure data of known and acceptable quality are generated through this project.

Subtask 2.1: TWRI will develop a QAPP for activities in Task 3 and 4 consistent with the most recent versions of EPA Requirements for Quality Assurance Project Plans (QA/R-5) and the TSSWCB Environmental Data Quality Management Plan.

Subtask 2.2: TWRI will submit revisions and amendments to the QAPP as needed.

Deliverables

- QAPP approved by TSSWCB and EPA in both electronic and hard copy formats
- Approved revisions and amendments to QAPP, as needed
- Data of known and acceptable quality as reported through Task 3 and 4

Task 3: Demonstration of IWC of Poultry Litter

Objective: To demonstrate and evaluate the effectiveness of IWC of poultry litter in reducing bacteria, nutrient, and volatile levels.

Subtask 3.1: POSC will work with integrators (primarily Sanderson Farms) in Limestone and Falls Counties to identify a cooperator (poultry grower) for conducting the IWC demonstration. The cooperator demonstration site will provide the poultry house where IWC will be performed and the IWC and raw litter for land application.

Subtask 3.2: IWC will be conducted by POSC at the cooperator site identified in Subtask 3.1 in years 1 and 2 to demonstrate and evaluate IWC utility prior to litter removal from poultry houses.

Subtask 3.3: Raw and IWC poultry litter samples will be collected by POSC prior to land application to evaluate the effect of composting on levels of bacteria, nutrients, and volatiles in the litter. Bacteria levels (*E. coli*) in the litter will be analyzed by SAML. Nutrient levels (N-P-K) in the litter will be analyzed by SWFTL. Volatiles emitted from the litter prior to land application will be analyzed by W-TAMU.

Subtask 3.4: Raw and IWC poultry litter will be applied by POSC at 3 tons/ac to the USDA-ARS Riesel site. Annual soil tests will be performed by SWFTL and by USDA-ARS.

Subtask 3.5: POSC will assess the cost of implementing IWC poultry operations for inclusion with educational materials as compared to conventional methods.

Deliverables

- Assessment of IWC impact on bacteria, nutrient, and volatile levels in litter for final report
- Assessment of cost of using IWC versus conventional methods for final report

Task 4: Analysis of Environmental Effects of IWC

Objective: To evaluate the environmental impacts of IWC of poultry litter.

Subtask 4.1: Runoff samples will be collected from two pastures at the USDA-ARS Riesel site for about one year prior to litter application and for about two years following litter application to evaluate the impacts of using IWC poultry litter versus raw poultry litter. Runoff samples will be collected from all other field- and watershed-scale sites at Riesel to quantify nutrient and bacteria from background sites and litter application sites. *E. coli* levels in water samples will be evaluated by SAML. Nutrient analysis (NO_3-N, NH_4-N, and PO_4-P) for water samples will be conducted by the USDA-ARS with funding from another project. SWFTL will complete soil tests on samples taken from sites, to determine macro/micro nutrients, p.H., electrical conductivity (EC), organic matter (OM).

Subtask 4.2: Runoff samples will also be collected from four 0.25 acre field sites at the USDA-ARS Riesel site for about 1 year prior to litter application and for about 2 years following litter application to compare the impacts of using IWC and raw poultry litter on bacteria and nutrient runoff. Two of the field sites will receive raw litter and two will receive IWC litter. Rainfall amounts, runoff, and quantities of *E. coli* and nutrients will be evaluated. *E. coli* levels in water samples will be evaluated by SAML. Nutrient analysis (NO_3-N, NH_4-N, and PO_4-P) for water samples will be conducted by the USDA-ARS with funding from another project. SWFTL will complete soil tests on samples taken from sites, to determine macro/micro nutrients, p.H., electrical conductivity (EC), organic matter (OM).

Subtask 4.3: POSC and W-TAMU will also evaluate other potential environmental benefits of using IWC poultry litter instead of raw litter. Through the use of field assessment of volatile levels at the litter application sites at Riesel by POSC and W-TAMU, the environmental impacts of using IWC poultry litter instead of raw litter will be demonstrated/evaluated.

Deliverables

- Assessment of impacts of IWC on plot, field, and watershed scale bacteria and nutrient loading for inclusion in final report
- Assessment of impacts of IWC on volatiles at land application sites for inclusion in final report

Environmental Data Collection Schedule

In order to produce results in a timely manner, the BMP demonstration/evaluation will follow the timeline described in Table A6.1.

Table A6.1. Project Plan Milestones

Task	Project Milestones	Agency	Start	End
2.1	Develop QAPP	TWRI	11/09	08/10
2.2a	QAPP Annual Revision #1	TWRI	03/11	08/11
2.2b	QAPP Annual Revision #2	TWRI	03/12	10/13
2.2c	QAPP Annual Revision #3	TWRI	05/13	07/13
3.1a	Identify cooperator (poultry grower) for IWC demo	POSC	04/10	05/11
3.1b	Identify cooperator (poultry grower) for IWC demo	POSC	04/10	05/12
3.2a	Conduct IWC at cooperator site	POSC	09/11	10/11
3.2b	Conduct IWC at cooperator site	POSC	05/12	05/12
3.3a	Collect raw and IWC poultry litter samples for analyses	POSC/SAML/SWFTL /W-TAMU	10/11	10/11
3.3b	Collect raw and IWC poultry litter samples for analyses	POSC/SAML/SWFTL /W-TAMU	05/12	05/12
3.4a	Apply raw and IWC poultry litter at Riesel	POSC/ARS	10/11	10/11
3.4b	Apply raw and IWC poultry litter at Riesel	POSC/ARS	05/12	05/12
3.5	Assess cost of implementing IWC vs conventional methods	POSC	08/11	10/13
4.1	Collect runoff samples from 2 pastures at Riesel for analyses	ARS/POSC/SAML	08/10	10/13
4.2	Collect runoff samples from 4 0.25 ac fields at Riesel for analyses	ARS/POSC/SAML	08/10	10/13
4.3	Evaluate other potential environmental benefits of IWC	POSC/ARS/ W-TAMU	04/10	04/13

Amendments to the QAPP

Revisions to the QAPP may be necessary to address incorrectly documented information or to reflect changes in project organization, tasks, schedules, objectives, and methods. Requests for amendments will be directed from the TWRI PM to the TSSWCB PM electronically. Amendments are effective immediately upon approval by the TWRI Project Manager, the TWRI QAO, the Laboratories, the TSSWCB PM, and TSSWCB QAO. They will be incorporated into the QAPP by way of attachment and distributed to personnel on the distribution list by the TWRI PM.

A7 QUALITY OBJECTIVES AND CRITERIA

The monitoring objectives for this project are to use quality assured methods to:

1. demonstrate and evaluate the effectiveness of IWC of poultry litter in reducing bacteria, nutrient, and volatile levels in the litter
2. evaluate the environmental impacts of IWC of poultry litter including:
    - runoff and volatile releases from 2 pastures where raw and IWC litter are applied
    - runoff from four 0.25 acre plots where raw and IWC litter are applied

Ultimately, the results will be provided to poultry growers and integrators throughout the poultry producing areas of Texas resulting in reduced runoff of bacteria and nutrients and other environmental impacts of poultry litter application.

The measurement performance specifications to support the project objective are specified in Table A7.1.

Ambient Water Reporting Limits And Laboratory Reporting Limits

It is not the objective of this project to evaluate ambient water quality conditions; thus, ambient water reporting limits (AWRLs) are not applicable and are not needed to yield data acceptable to meet project objectives. The limit of quantitation (LOQ) [formerly known as the reporting limit (RL)] is the minimum level concentration, or quantity of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. The LOQ for target analytes are set forth in Table A7.1. For *E. coli* analysis in water, the LOQ is a result of the sample volume filtered. Sample volumes routinely filtered for *E. coli* are 10, 1, 0.1, and 0.01 ml. Thus, the LOQ for *E. coli* for runoff water quality samples analyzed for this project is 10 cfu/100 ml.

Precision

The precision of laboratory data is a measure of the reproducibility of a result from repeated analyses. It is strictly defined as a measure of the closeness with which multiple analyses of a given sample agree with each other. Laboratory precision is assessed by comparing sample/duplicate pairs. Precision results are compared against measurement performance specifications and used during evaluation of analytical performance. Measurement performance specifications for precision are defined in Table A7.1.

Bias

Bias is a statistical measurement of correctness and includes components of systemic error. A measurement is unbiased when the value reported does not differ from the true value. Bias is determined through the analysis of laboratory control standards prepared with verified and known amounts of all target analytes in the sample matrix and by calculating percent recovery. For *E. coli* in water, SAML will routinely process and analyze BioBall^{TM} spiked Phosphate Buffer Solution (PBS) samples.

Table A7.1. Measurement Performance Specifications

PARAMETER	UNITS	METHOD	MATRIX	Limit of Quantitation (LOQ)	PRECISION (RPD)	BIAS (%R)	Laboratory Performing Analysis
Total Nitrogen	*mg/kg*	*SWFTL SOP 0082*	*Poultry Litter*	*200*	*30*	*NA*	*SWFTL*
Total Phosphorus	*mg/kg*	*SWFTL SOP 0036*	*Poultry Litter*	*200*	*30*	*NA*	*SWFTL*
Total Potassium	*mg/kg*	*SWFTL SOP 0036*	*Poultry Litter*	*200*	*30*	*NA*	*SWFTL*
Nitrate Nitrogen, extractable	*mg/kg*	*SWFTL SOP 0014*	*Soil*	*1.0*	*30*	*NA*	*SWFTL*
Extractable Phosphorus	*mg/kg*	*SWFTL SOP 0079*	*Soil*	*1.0*	*30*	*NA*	*SWFTL*
Extractable Potassium	*mg/kg*	*SWFTL SOP 0079*	*Soil*	*5.0*	*30*	*NA*	*SWFTL*
Electrical Conductivity	umol/cm	*SWFTL SOP 0015*	*Soil*	*N/A*	*N/A*	*NA*	*SWFTL*
p.H.	per Hydrogen	*SWFTL SOP 0015*	*Soil*	*N/A*	*N/A*	*NA*	*SWFTL*
Organic matter	percent	SWFTL SOP 0055	*Soil*	*N/A*	*N/A*	*NA*	*SWFTL*
Micro-nutrients (Cu,Fe,Mn,Zn)	ppm	SWFTL SOP 0013	*Soil*	*N/A*	*N/A*	*NA*	*SWFTL*
E. coli	*cfu/g*	*Dilution followed by enumeration using EPA 1603*	*Poultry Litter*	*NA*	*NA*	*NA*	*SAML*
Volatiles		*EPA TO-17 EPA TO-14*	*Poultry Litter*	*NA*	*±50%*	*NA*	*W-TAMU*
E. coli	*cfu/100 ml*	*EPA 1603*	*Water*	*10*	*3.27*∑Rlog/n*	*Detect - 144%*	*SAML*
Volatiles	*Odor strength (D/T values)*	*St. Croix Sensory 2008*	*Air*	*NA*	*±2%*	*±10%*	*Field*

St. Croix Sensory. 2008. THE NASAL RANGER® FIELD OLFACTOMETER OPERATION MANUAL, Version 6.2.

SAML will analyze one ongoing precision and recovery (OPR) sample for every batch of runoff samples. Results will be compared against the measurement performance specifications in Table A7.1 and used during evaluation of analytical performance.

An additional element of bias is the absence of contamination. This is determined through the analysis of blank samples processed in a manner identical to the sample. OPR samples must be accompanied by an acceptable method blank and processed according to method specifications. Requirements for blank samples are further discussed in Section B5.

Representativeness

Representativeness of each runoff event will be ensured by collection of flow-weighted samples throughout the entire hydrograph of each runoff event. Additionally, representativeness will be ensured by the analysis of runoff from 17 different sites representing a variety of land uses (pasture, native prairie, and cropland), litter application rates (0-6 T/ac), types of poultry litter (raw and IWC), and scales (plot, field, small watershed). Representativeness of litter evaluation will be ensured by representative sampling of litter into composite samples for analysis. Representativeness will be measured with the completion of sample collection in accordance with the approved QAPP.

Comparability

Confidence in the comparability of data sets from this project and those for similar uses is based on the commitment of project staff to use only approved sampling and analysis methods and QA/QC protocols in accordance with quality system requirements and as described in this QAPP. Comparability is also guaranteed by reporting data in standard units, by using accepted rules for significant figures, and by reporting data in a standard format.

Completeness

The completeness of the data is basically a relationship of how much of the data is available for use compared to the total potential data. Ideally, 100% of the data should be available. However, the possibility of unavailable data due to accidents, insufficient sample volume, broken or lost samples, etc. is to be expected. Therefore, it will be a general goal of the project(s) that 90% data completion is achieved.

A8 SPECIAL TRAINING/CERTIFICATION

No special certifications are required. However, new field and lab personnel will receive training in proper sampling and sample analysis. Before actual sampling or analysis occurs, they will demonstrate to the project co-lead responsible for the given sampling or analysis task (as described in Section A4) their ability to properly perform field sampling or analysis procedures. Training of new field and lab personnel will be documented and retained in the project QA file and will be available during a monitoring systems audit. Finally, SAML is NELAP® ™-accredited for enumerating *E. coli* in both non-potable and drinking water using USEPA Method 1603. SAML *Personnel, Training, and Data Integrity* requirements are provided in Section 17 of the SAML Quality Manual and *Demonstration of Capability (DOC)* and *On-Going Proficiency* requirements are provided in Sections 19.1 and 19.2, respectively.

A9 DOCUMENTS AND RECORDS

The documents and records that describe, specify, report, or certify activities, requirements, procedures, or results for this project and the items and materials that furnish objective evidence of the quality of items or activities are listed in Table A9.1.

Table A9.1. Project Documents and Records

Document/Record	Location	Retention*	Form
QAPP, amendments, and appendices	TWRI	5 years	Paper/Electronic
Chain of custody records	SAML/SWFTL/ W-TAMU	2 years	Paper/Electronic
Corrective action documentation	TWRI/SAML/SWFTL/ W-TAMU	2 years	Paper/Electronic
Lab data reports/results**	TWRI/SAML/SWFTL/ W-TAMU	2 years	Paper/Electronic
New field and lab staff training records	TWRI	2 years	Paper
Lab equipment calibration records & maintenance logs	SAML/SWFTL/ W-TAMU	2 years	Paper
Laboratory QA manuals and/or SOPs	SAML/SWFTL/ W-TAMU	5 years	Paper/Electronic
Instrument raw data files, readings and printouts**	SWFTL/W-TAMU	2 years	Paper/Electronic
Progress reports/final report	TWRI	5 years	Paper/Electronic

* Indicates minimum retention time of documents/records following the completion of the project.
** indicates documents and records that will be provided to TSSWCB during the course of this project.

Laboratory Test Reports

Data reports from each lab must document test results clearly and accurately. It is important that data are reported unambiguously, are accurate, and that the necessary information for the review, verification, validation, and interpretation of data is included. At the very minimum, test reports (regardless of whether they are hard copy or electronic) should include the following:

- Sample results
- Units of measurement
- Sample matrix
- Dry weight or wet weight (as applicable)
- Station information
- Date and time of collection
- Holding time

Electronic Data

Data will be submitted electronically to the TSSWCB on an annual basis during the course of the project. Additionally, the TSSWCB may elect to take possession of all other records at the conclusion of the specified retention period.

B1 SAMPLING PROCESS DESIGN

As stated in Section A7, the monitoring objectives for this project are to:

1. demonstrate and evaluate the effectiveness of IWC of poultry litter in reducing bacteria, nutrient, and volatile levels in the litter, and
2. evaluate the environmental impacts of IWC of poultry litter including:
    - runoff and volatile releases from 2 pastures where raw and IWC litter are applied
    - runoff from four 0.25 acre plots where raw and IWC litter are applied

To achieve these objectives, data collection efforts will involve collection and analysis of poultry litter, collection and analysis of edge of field runoff, and sampling and analysis of volatile organics and odor from litter and field application sites. Evaluations will take place at the USDA-ARS Grassland Soil and Water Research Laboratory near Riesel and cooperating poultry grower's farm. Constituents to be analyzed are listed in Table B1.1.

Table B1.1. Sampling Constituents

Parameter	**Matrix**	**Status**	**Reporting Units**
Total Nitrogen	Poultry Litter	Non-critical	mg/kg
Total Phosphorus	Poultry Litter	Non-critical	mg/kg
Total Potassium	Poultry Litter	Non-critical	mg/kg
Escherichia coli	Poultry Litter	Critical	cfu per gram (cfu/g)
Volatiles	Poultry Litter	Non-critical	
Nitrate Nitrogen, extractable	Soil	Non-critical	mg/kg
Extractable Phosphorus	Soil	Non-critical	mg/kg
Extractable Potassium	Soil	Non-critical	mg/kg
Electrical Conductivity	Soil	Non-critical	umol/cm
p.H.	Soil	Non-critical	per Hydrogen
Organic matter	Soil	Non-critical	percent
Micro-nutrients (Cu,Fe,Mn,Zn)	Soil	Non-critical	ppm
Escherichia coli	Water	Critical	cfu per 100 milliliters (cfu/100 ml)
Volatiles	Air	Non-critical	

Collection and Analysis of Poultry Litter for Nutrients and *E. coli*

Nutrient and bacteria concentrations in manures can vary substantially due to differences in feeding rations and methods of collection, handling, storage and moisture content. To evaluate IWC poultry litter versus raw litter, 6 replicate samples of each litter (i.e. 6 raw litter samples and 6 IWC samples) will be collected in years 2 and again in year 3 by POSC personnel from trucks prior to land application and transported to the SAML for *E. coli* analysis and SWFTL for nutrient analysis (N-P-K). POSC will place each sample into a sealable plastic storage bag. The plastic bag will be labeled with a permanent marker. POSC will submit samples to SAML and SWFTL as soon as possible after collection since changes in bacteria and nutrient levels within the bag can occur during storage. A Biosolid Sample Information Form will be submitted with litter samples submitted to SWFTL.

Collection and Analysis of Edge of Field Runoff

Edge-of-field runoff samples from seventeen Riesel watersheds (Figure B1.1) will be collected as generated by natural storm events by use of ISCO® automatic stormwater samplers. Site descriptions and management are listed in Table B1.2.

Stormwater samples are estimated at 510 based on 17 sampling sites x 30 expected/budgeted storm events over 36 months (i.e. 10 per year per site). USDA-ARS staff will collect samples from the ISCO® units at the conclusion of each storm event. Once samples are removed from the sampling units, samples will be stored under refrigeration until they are transported to the SAML in College Station to be analyzed for *E. coli* using EPA Method 1603. All sites at Riesel are accessible to USDA-ARS staff.

Collection and Analysis of Soil Samples

Soil samples will be collected annually from sites Y6, Y8, Y10, W12, W13, Y13, SW12, W10, SW17, Y14, P1, P2, P3, and P4 for routine analysis plus micronutrients and organic matter (i.e. pH, NO_3-N, P, K, Ca, Mg, Na, S, conductivity, Zn, Fe, Cu, Mn and organic C) by SWFTL.

Sampling and Analysis of Volatiles from Litter and Field Application Sites

Volatiles from litter and field application sites will be evaluated using gas chromatography/mass spectrometry–olfactometry (GC/MS-O) testing and human panelists to evaluate additional potential environmental benefits of IWC. The GC/MS-O assembly is based on a standard, research-grade gas chromatograph and mass spectrometer. Between the separation column and the GC/MS unit, a portion of the column exhaust is diverted to a sniffing port at which the operator continually observes the relative intensity of the odor associated with each volatile component exiting the column over time. The compounds appear at the olfactometry port in a predictable order related to their molecular weights (lightest early, heaviest later), and the operator records his assessment of the relative odor intensity of each volatile constituent that appears at the sniffing port using a touch-screen monitor. The remaining portion of the column exhaust passes through the GC/MS unit for identification and quantification of the individual compounds. Because each of the 300+ individual compounds known to be associated with environmental odors has a characteristic descriptor (e. g., p-ethyl phenol = "road kill;" trimethylamine = "fishy"), it is possible to verify the operator's assessment of the odor's hedonic character by comparing it in real time to the documented character of the compound identified by the GC/MS in parallel with the olfactometry step. The operator also assigns a relative strength (arbitrary units) to the odor of each compound, resulting in a so-called "aromagram."

To evaluate IWC poultry litter versus raw litter, duplicate samples of each litter (2 raw litter samples and 2 IWC samples) will be collected by W-TAMU personnel from trucks prior to application and transported to the W-TAMU lab for GC/MS-O. This will identify which odor compounds in the litter are offensive in nature and serve as baseline data for the odor content of the 2 types of litter.

Three small plots per litter type will also receive litter application by hand at the same rate as used in the large field applications (6 plots total). Duplicate headspace gas samples will be taken by W-TAMU personnel from an inverted container from each plot (12 total) and transported back to the W-TAMU lab for analysis by GC/MS-O. This will quantify odor compound volatilization post-application for comparison between the 2 litter types (raw and IWC).

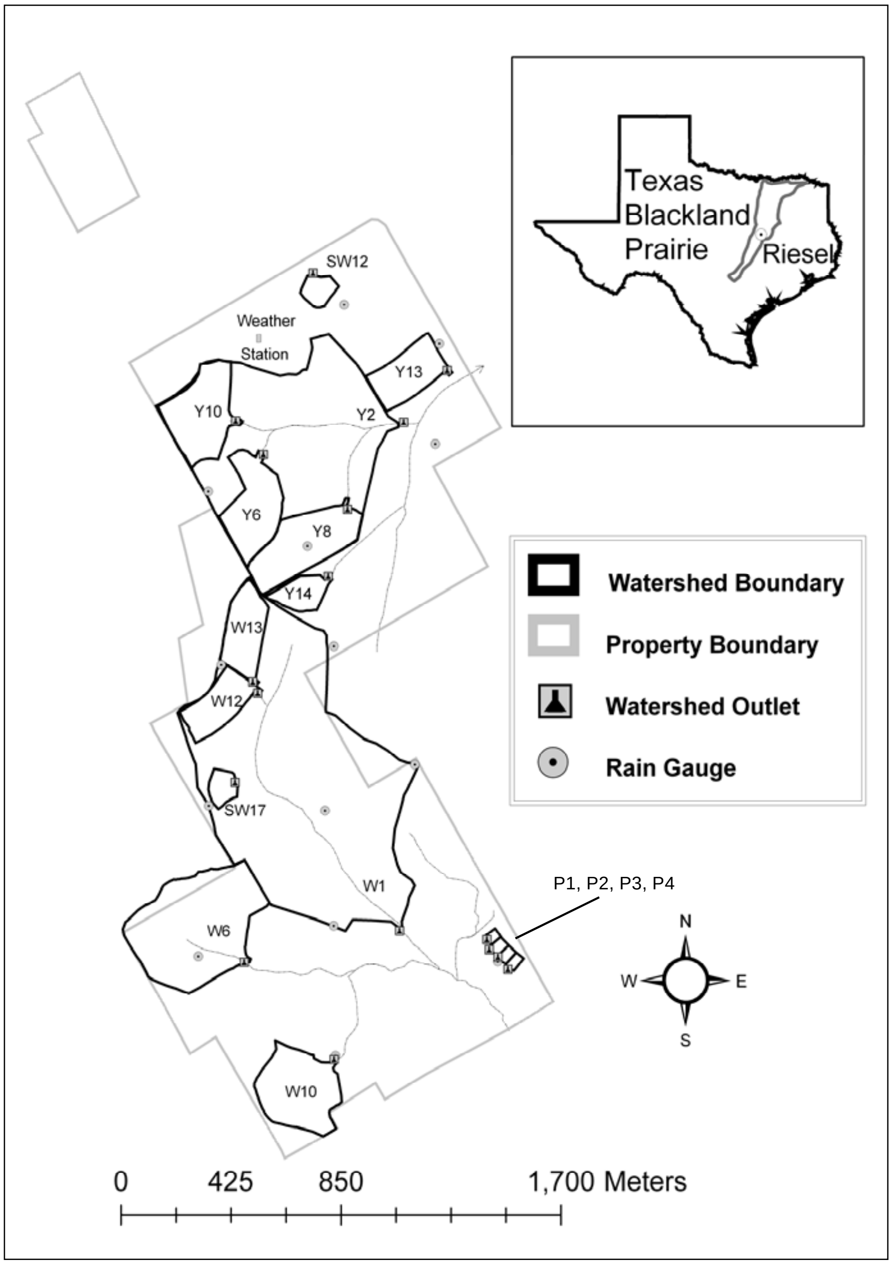


Figure B1.1. "Riesel Watersheds" formally known as the USDA-ARS Grassland Soil and Water Research Laboratory, Riesel, TX.

Table B1.2. Sample Sites

Station ID	Long Description (lat/long)	Area	Slope	Litter Type	Litter Rate	Landuse
Y6	31° 28'26"N / 96° 53'9"W	6.6	3.2	*NA*	0	Cropland
Y8	31° 28'22"N / 96° 52'54"W	8.4	2.2	Fresh	6	Cropland
Y10	31° 28'31"N / 96° 53'10"W	7.5	1.9	Fresh	3	Cropland
Y13	31° 28'36"N / 96° 52'39"W	4.6	2.3	Fresh	2	Cropland
W12	31° 27'56"N / 96° 53'7"W	4.0	2.0	Fresh	4	Cropland
W13	31° 27'57"N / 96° 53'8"W	4.6	1.1	Fresh	5	Cropland
SW12	31° 28'48"N / 96° 52'59"W	1.2	3.8	*NA*	0	Pasture
SW17	31° 27'45"N / 96° 53'14"W	1.2	1.8	IWC	3	Pasture
W10	31° 27'12"N / 96° 53'0"W	8.0	2.5	*NA*	0	Pasture
Y14	31° 28'11"N / 96° 52'55"W	2.3	1.6	Fresh	3	Pasture
Y2	31° 28'30"N / 96° 52'46"W	53	2.6	Both	Varied	Both
W6	31° 27'24"N / 96° 53'11"W	17.1	NA	*NA*	0	Both
W1	31° 27'27"N / 96° 52'48"W	71	2.2	Fresh	Varied	Both
P1	31° 27'25"N / 96° 52'35"W	0.1	3.0	Fresh	3	Pasture
P2	31° 27'24"N / 96° 52'34"W	0.1	3.0	IWC	3	Pasture
P3	31° 27'23"N / 96° 52'33"W	0.1	3.0	Fresh	3	Pasture
P4	31° 27'22"N / 96° 52'32"W	0.1	3.0	IWC	3	Pasture

Finally, odor sampling will be conducted using 10 human panelists. Human panelists will measure odor concentrations downwind of the land application area with Nasal Ranger field olfactometers. The same 10 panelists will rotate between the IWC poultry litter application site, the raw litter application site and a control site that will have no litter applied to it. Sampling will be conducted at times of 3 time intervals post-application per application (year). Odor concentrations will be monitored following the operational guidelines for the Nasal Ranger field olfactometer (see http://www.nasalranger.com/Operations.cfm for further details).

B2 SAMPLING METHODS

Specific requirements for sampling are outlined in following sections. Sample volume, container types, minimum sample volume, preservation requirements, and holding time requirements are listed in Table B2.1.

Table B2.1. Sample Storage, Preservation and Handling Requirements

Parameter	Matrix	Container	Preservation	Sample Volume	Holding Time
Total Nitrogen	Poultry Litter	Sealable plastic bags	Frozen	1 pint	6 months
Total Phosphorus	Poultry Litter	Sealable plastic bags	Frozen	1 pint	6 months
Total Potassium	Poultry Litter	Sealable plastic bags	Frozen	1 pint	6 months
Escherichia coli	Poultry Litter	Whirlpack® bags	4°C	1 pint	8 hours / 24 hours*
Volatiles	Poultry Litter	Sorbent Tubes**	4°C	6-13 liters of air	Up to 6 months
Nitrate Nitrogen, extractable	Soil	Sealable plastic bags	Oven Dried at 65°C	1 pint	6 months
Extractable Phosphorus	Soil	Sealable plastic bags	Oven Dried at 65°C	1 pint	6 months
Extractable Potassium	Soil	Sealable plastic bags	Oven Dried at 65°C	1 pint	6 months
Electrical Conductivity	Soil	Sealable plastic bags	Oven Dried at 65°C	1 pint	6 months
p.H.	Soil	Sealable plastic bags	Oven Dried at 65°C	1 pint	6 months
Organic matter	Soil	Sealable plastic bags	Oven Dried at 65°C	1 pint	6 months
Micro-nutrients (Cu,Fe,Mn,Zn)	Soil	Sealable plastic bags	Oven Dried at 65°C	1 pint	6 months
Escherichia coli	Water	Sterile bottles	4°C	100 ml	8 hours / 24 hours*
Volatiles	Air	Sorbent Tubes**	4°C	6-13 liters of air	Up to 6 months

**E. coli* samples should always be processed as soon as possible and within 8 hours. When transport conditions necessitate delays in delivery longer than 6 hours, the holding time may be extended and samples must be processed as soon as possible and within 24 hours.

**Two different types of tubes are used, GC/MS-olfactometry tubes and GC/MS tubes. The holding time is the same; however, the volume of air sampled is different for the 2 types (thus the range of 6-13 L for sample volume). Volume sampled is dependent on proximity to the source and intensity of odor at the sample location.

Collection of Poultry Litter for Nutrient and *E. coli* Analysis

To evaluate IWC poultry litter versus raw litter, 6 replicate samples of each litter (i.e. 6 raw litter samples and 6 IWC samples) will be collected in years 2 and again in year 3 by POSC personnel from trucks prior to land application and transported to the SAML for *E. coli* analysis and SWFTL for nutrient analysis (N-P-K).

POSC will place each sample into a sealable plastic storage bag. The plastic bag will be labeled with a permanent marker. POSC will submit samples to SAML and SWFTL as soon as possible after collection since changes in bacteria and nutrient levels within the bag can occur during storage. A Biosolid Sample Information Form will be submitted with litter samples submitted to SWFTL.

Collection of Soil Samples

One composite sample will be collected annually for each of the following sites Y6, Y8, Y10, W12, W13, Y13, SW12, W10, SW17, Y14, P1, P2, P3, and P4 according to the Texas AgriLife Extension Soil Sample Information Form. Approximately 1 pint of the composite soil sample is required for routine analyses. Sampling of areas such as small gullies, slight field depressions, terrace waterways, or unusual areas will be avoided.

To collect a composite sample, ARS will take a sample from 10 to 15 different areas using a spade, soil auger or soil sampling tube. Litter will be cleared from the surface making sure to not remove decomposed black material. When using a soil auger or sampling tool, ARS will make the core or boring 6 inches deep. When using a spade, ARS will (1) dig a V-shaped hole and take a 1-inch slice from the smooth side of the hole, then (2) take a 1 x 1 inch core from the center of the shovel slice. This will be repeated in 10 to 15 different places. Each of the 10-15 subsamples collected will be put in a clean plastic bucket or other non-metallic container and thoroughly mixed. Approximately one pint of the thoroughly mixed composite will be removed for submission to SWFTL.

Samples will be dried at 100^{o}F for approximately 24 hours before sending to SWFTL. ARS will completely fill the soil sample bag or other suitable pint container. ARS will complete the Texas AgriLife Extension Soil Sample Information Form. ARS will be sure to keep a record of the area represented by each sample. Also, ARS will be sure that sample numbers on sample bags correspond with sample numbers on the front page of the Texas AgriLife Extension Soil Sample Information Form. Samples will be delivered to the Soil, Water and Forage Testing Laboratory, 2478 TAMU, College Station, TX 77843-2478 if using USPS or 2610 F&B Road College Station, TX 77843-2478 if using another delivery service.

Collection of Runoff

Flow-weighted composite stormwater samples from edge-of-field watershed sites at Riesel will be collected using refrigerated ISCO® Avalanche full-size portable samplers with single bottle configuration into sterile polyethylene 4-gallon round bottles for runoff events with more than 1.2 mm of runoff, which is a very low “storm” threshold. This will allow calculation of event mean concentrations of *E. coli* for each rainfall runoff event. After the first sample is collected until the completion of the running program, the Avalanche cools the refrigerated compartment to 1^{o}C +/- 1. One hour after the last sample of the program is taken, the Avalanche adjusts its control to maintain the samples at 3^{o}C +/- 1.

Storm Event Holding Time

These samples will be retrieved from the refrigerated ISCOs and stored by ARS for transport by AgriLife Extension to the SAML for analysis. A minimum volume of 25 ml (and preferably 100 ml or more as available) collected by automatic samplers will be poured into sterile plastic bottles and stored in refrigeration at 4°C. Edge-of-field samples must be removed from automatic samplers, transported to the AgriLife Research laboratory, filtered, and placed in the incubator within 24 hours of the start of the stormwater runoff event, that is, from the first automatically collected stormwater sample. All samples will be transported by AgriLife Extension at 4°C to the SAML for analysis. All filtration and incubation will be performed in the laboratory. Samples must be stored at 4°C until processed by SAML. In the event samples cannot be collected, transported, processed and incubated within 24 hours, samples will still be analyzed but it will be noted that the target holding time was not met.

Sampling of Volatiles from Litter and Field Application Sites

To evaluate IWC poultry litter versus raw litter, duplicate samples of each litter (2 raw litter samples and 2 IWC samples) will be collected by W-TAMU personnel from trucks prior to application and transported to the W-TAMU lab for GC/MS-O.

Secondly, three small plots per litter type will also receive litter application by hand at the same rate as used in the large field applications (6 plots total). Duplicate headspace gas samples will be taken by W-TAMU personnel from an inverted container from each plot (12 total) and transported back to the W-TAMU lab for analysis by GC/MS-O.

Finally, the day after application of raw and IWC litter at Riesel, odor sampling will be conducted using 10 human panelists. Human panelists will measure odor concentrations downwind of the land application area with Nasal Ranger field olfactometers. The same 10 panelists will rotate between the IWC poultry litter application site, the raw litter application site and a control site that will have no litter applied to it. Sampling will be conducted at times of 3 time intervals post-application per application (year). Odor concentrations will be monitored following the operational guidelines for the Nasal Ranger field olfactometer (see http://www.nasalranger.com/Operations.cfm for further details)

Processes to Prevent Cross Contamination

To prevent cross-contamination, water samples will be collected directly into sample containers and litter and soil samples will be collected with cleaned probes/shovels into clean 5 gallon buckets for mixing. Probes and buckets are wiped with a cloth then "washed" with ambient soil from the next field to ensure that all soil residue from the previous field has been removed. Soil and litter subsamples will be placed into new plastic bags for transport to labs. Field QC samples as discussed in Section B5 are collected to verify that cross-contamination has not occurred.

Documentation of Field Sampling Activities

For all samples collected, station ID, sampling date and time, sample type, and sample collector's name/signature are recorded on the sample container and Chain of Custody (COC).

Recording Data

For the purposes of this section and subsequent sections, all field and laboratory personnel follow the basic rules for recording information as documented below:

- Legible writing in indelible, waterproof ink with no modifications, write-overs or cross-outs;
- Correction of errors with a single line followed by an initial and date;
- Close-outs on incomplete pages with an initialed and dated diagonal line.

Deviations from Sampling Method Requirements or Sample Design, and Corrective Action

Examples of deviations from sampling method requirements or sample design include but are not limited to such things as inadequate sample volume due to spillage or container leaks, failure to preserve samples appropriately, contamination of a sample bottle during collection, storage temperature and holding time exceedance, sampling at the wrong site, etc. Any deviations will invalidate resulting data and may require corrective action. Corrective action may include for samples to be discarded and re-collected. It is the responsibility of the TWRI QAO to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the TSSWCB PM both verbally and in writing in the project progress reports and by completion of a corrective action report (CAR).

CARs document: root cause(s); programmatic impact(s); specific corrective action(s) to address any deviations; action(s) to prevent recurrence; individual(s) responsible for each action; the timetable for completion of each action; and the means by which completion of each corrective action will be documented. CARs will be included with project progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TSSWCB immediately both verbally and in writing.

B3 SAMPLE HANDLING AND CUSTODY

Chain-of-Custody

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, and analysis. The COC form is used to document sample handling during transfer from the field to the laboratory. The sample number, location, date, changes in possession and other pertinent data will be recorded in indelible ink on the COC. The sample collector will sign the COC and transport it with the sample to the laboratory. At the laboratory, samples are inventoried against the accompanying COC. Any discrepancies will be noted at that time and the COC will be signed for acceptance of custody. In the instance that the field sample collector and laboratory sample processor are one in the same, a field-to-lab COC will be unnecessary. A copy of a blank COC form used on this project is included as Appendix B.

Sample Labeling

Samples will be labeled on the container with an indelible, waterproof marker. Label information will include site identification, date, sampler's initials, and time of sampling. The COC form will accompany all sets of sample containers.

Sample Handling

Following collection, runoff samples will be refrigerated until transported to the laboratory on ice in an insulated cooler. At the laboratory, samples will be placed in a refrigerated cooler dedicated to sample storage. The SAML Laboratory Director has the responsibility to ensure that holding times are met with water samples. The holding time is documented on the COC. Any problem will be documented with a CAR.

Litter and soil samples will be collected as outlined in Section B2 and placed in new sealable plastic bags for transport. The 1 pint soil samples, and the accompanying Texas AgriLife Extension Soil Sample Information Form, will be delivered to the Soil, Water and Forage Testing Laboratory, 2478 TAMU, College Station, TX 77843-2478 if using USPS or 2610 F&B Road College Station, TX 77843-2478 if using another delivery service, for nutrient analysis. Similarly, 1 pint litter samples and accompanying Biosolid Sample Information Form to SWFTL for nutrient analysis as well. No preservation is required for the soil samples or litter samples submitted to SWFTL. Litter samples submitted to SAML for *E. coli* analysis will be refrigerated and transported on ice immediately following collection. Litter samples collected for analysis of volatiles will be collected and transported to W-TAMU by W-TAMU staff.

Failures in Chain-of-Custody and Corrective Action

All failures associated with COC procedures as described in this QAPP are immediately reported to the TWRI PM and TWRI QAO. These include such items as delays in transfer, resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc. The TWRI PM and QAO will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data validity will invalidate data and the sampling event should be repeated. The resolution of the situation will be reported to the TSSWCB PM in the project progress report. CARs will be prepared by the TWRI QAO and submitted to the TSSWCB PM along with project progress report.

B4 ANALYTICAL METHODS

The analytical methods are listed in Table B4.1. Laboratories collecting Critical Data under this QAPP (i.e. *E. coli* by SAML) are compliant with the NELAP® standards. Copies of laboratory QMs and methods are available for review by the TSSWCB.

Soil Analysis for Nutrients, Micronutrients, and Organic Carbon

Phosphorus, K, Ca, Mg, Na and S are extracted using the Mehlich III extractant and are determined by ICP. The extractant is a dilute acid-fluoride-EDTA solution of pH 2.5 that consists of 0.2 N CH_3-COOH-0.25 N NH_4NO_3-0.015 N NH_4F-0.013 N HNO_3-0.001 M EDTA. The method estimates plant available pools of the elements listed above and is currently the only method recognized by Texas AgriLife Extension Service [Mehlich, A. 1978. New extractant for soil test evaluation of phosphorus, potassium, magnesium, calcium, sodium, manganese, and zinc. Commun. Soil Sci. Plant Anal. 9(6):477-492; Mehlich, A. 1984. Mehlich-3 soil test extractant: a modification of Mehlich-2 extractant. Commun. Soil Sci. Plant Anal. 15(12):1409-1416].

Soil pH (referred to as soil water pH) is determined in a 1:2 soil:water extract of the soil using deionized water. Samples are stirred and allowed to equilibrate for a minimum of 30 minutes after adding the water. The actual determination is made using a hydrogen selective electrode. [Schofield, R.K. and A.W. Taylor. 1955. The measurement of soil pH. Soil Sci. Soc. Am. Proc. 19:164-167].

Soil Cu and Zn concentrations are determined by extraction with a 0.005 M DTPA solution and ICP analysis [Lindsay, W.L., and W.A. Norvell. 1978. Development of a DTPA soil test for zinc, iron, manganese, and copper. Soil Sci. Soc. Amer. J. 42:421-428].

Soil organic C is determined by the method of McGeehan and Naylor (1988) and Schulte and Hopkins (1996) [McGeehan, S.L., and D.V. Naylor. 1988. Automated instrumental analysis of carbon and nitrogen in plant and soil samples. Comm. Soil Sci. Plant Anal. 19:493-505; Schulte, E.E., and B.G. Hopkins. 1996. Estimation of soil organic matter by weight by weight Loss-On-Ignition. p. 21-32. In: Soil Organic matter: Analysis and Interpretation. (ed.) F.R. Magdoff, M.A. Tabatabai and E.A. Hanlon, Jr. Special publication No. 46. Soil Sci. Soc. Amer. Madison, WI].
Soil electrical conductivity (measurement of soluble salts) is determined in a 1:2 soil:water extract of the soil using deionized water. Samples are stirred and allowed to equilibrate for a minimum of 30 minutes after adding the water. The actual determination is made using a conductivity probe and reported in umol/cm [Rhoades, J.D. 1982. Soluble salts. p. 167-178. In: A.L. Page, et al. (ed.). Methods of Soil Analysis: Part 2. Agronomy Monogr. 9. 2nd ed. ASA and SSSA, Madison, WI].

Nitrate-nitrogen (NO_3-N) is extracted from soils using a 1 N KCl solution. Nitrate is determined by reduction of nitrite (NO_2-N) to nitrate using a cadmium column followed by spectrophotometric measurement [Keeney, D.R. and D.W. Nelson. 1982. Nitrogen - inorganic forms. p. 643-687. In: A.L. Page, et al. (ed.). Methods of Soil Analysis: Part 2. Agronomy Monogr. 9. 2nd ed. ASA and SSSA, Madison, WI].

Litter Analysis for Nutrients

For litter samples, total nitrogen is determined by a combustion process [Sweeney, Rose A. 1989. Generic combustion method for determination of crude protein in feeds: Collaborative Study. J. Assoc. Off. Anal. Chem. 72: 770-774]. The minerals (K and P) are determined by ICP analysis of a nitric acid digest [Havlin, J.L. and P.N. Soltanpour. 1989. A nitric acid and plant digest method for use with inductively coupled plasma spectrometry. Commun. Soil Sci. Plant Anal. 14; 969-980.

Analysis of *E. coli* in Runoff and Poultry Litter

E. coli in water samples will be isolated and enumerated by SAML personnel using modified mTEC agar, EPA Method 1603 [EPA/821/R-02/023. September 2002. *Escherichia coli* in Water by Membrane Filtration Using Modified Membrane-Thermotolerant *Escherichia coli* (modified m-TEC) Agar]. The modified mTEC method is a single-step method that uses one medium and does not require testing using any other substrate. The modified medium contains a chromogen, 5-bromo-6-chloro-3-indolyl-ß-D-glucuronide, which is catabolized to glucuronic acid and a red- or magenta-colored compound by *E. coli* that produce the enzyme ß-D-glucuronidase. *E. coli* in litter samples will be diluted, then isolated and enumerated by SAML personnel using modified mTEC agar, EPA Method 1603

All laboratory sampling areas and equipment (not already supplied from the manufacturer as pre-sterilized) will be sterilized with at least one or in any combination of the following methods--ethyl alcohol, bleach, UV light, or autoclave. All disposables will be placed in a heat-resistant biohazard bag and autoclaved prior to disposal.

Table B4.1. Laboratory Analytical Methods

Parameter	Matrix	Method	Equipment Used
Total Nitrogen	Poultry Litter	SWFTL SOP 0082	Elementar Rapid N
Total Phosphorus	Poultry Litter	SWFTL SOP 0036	Inductively Coupled Plasma (ICP) Spectrometry
Total Potassium	Poultry Litter	SWFTL SOP 0036	ICP Spectrometry
Nitrate Nitrogen, extractable	Soil	SWFTL SOP 0014	Nitrate analyzer (Cd reduction)
Extractable Phosphorus	Soil	SWFTL SOP 0079	ICP Spectrometry
Extractable Potassium	Soil	SWFTL SOP 0079	ICP Spectrometry
Organic Matter	Soil	SWFTL SOP 0055	Elementar Vario Max CN
Electrical Conductivity	Soil	SWFTL SOP 0015	conductivity probe
pH.	Soil	SWFTL SOP 0015	hydrogen ion selective electrode
Micronutrients	Soil	SWFTL SOP 0013	ICP Spectrometry
E. coli	Poultry Litter	Dilution followed by enumeration using EPA 1603	Incubator, Filtering Apparatus
Volatiles	Poultry Litter	EPA TO-17 EPA TO-14	GC-MS/O
E. coli	Water	EPA 1603	Incubator, Filtering Apparatus

Lab Analysis of Volatiles from Litter and Field Application Sites

Sample collection will be conducted according to Section B2 and transported to the GC/MS Olfactometry laboratory at West Texas A&M University for analysis. Air flow for the pumps will be set at 200 mL/min for a total volume of 2-6 L on each sample tube. Determination of sample volumes collected will depend on proximity to the particular source (i.e. in-barn and fan samples will be 2 liters and property line samples should be 4-6 liters). For this project, samples taken from isolation chambers on standard GC/MS tubes should be at a rate of 200 ml/min for a total volume of 6 liters. This should be appropriate for any fan or inbarn samples as well. Any ambient samples should be taken at the same rate for 13 liters total volume. Industry standard stainless steel thermal desorption tubes are packed with 150 mg Tenax TA.

Thermal desorption tubes are conditioned at 240°C with a flow rate of 1 ml/min of Helium prior to sampling. All desorption tube samples are analyzed using a Markes UNITY® and Markes Ultra® automated thermal desorber (ATD) and a Varian 3800/Saturn 2000 GC equipped with a MS. Upon injection, samples are held at 225°C for 8 minutes. The column oven method begins at 40°C and is increased to 220°C at a rate of 8°C per minute for a total run time of 28 minutes. The column used is Varian® WCOT fused silica 30 m x 0.25 mm ID with HP-INNOWAX.

Method TO-15 (Winberry, 1989) and Method TO-17 (USEPA, 1999) are used for analysis. These methods document sampling and analytical procedures for the measurement of subsets of the 97 volatile organic compounds (VOCs) that are included in the 189 hazardous air pollutants (HAPs) listed in Title III of the Clean Air Act Amendments of 1990. VOCs are defined here as organic compounds having a vapor pressure greater than 10-1 Torr at 25EC and 760 mm Hg.

Standards for the Semi Volatile Organic Compounds (sVOCs) will be prepared in methanol, while the Volatile Fatty Acid (VFA) standards will be mixed in hexanes. Standards will be prepared using serial dilutions and injected onto clean tubes using a calibration solution loading rig (CSLR™) (Markes Intl. Ltd., Llantrisant, UK). The liquid calibration standard will be introduced through the injector septum in argon carrier gas (100 mL/min) using a standard GC syringe, then analyzed using the same GC/MS method used for the wind tunnel samples. Linear regression will be used to develop standard curves, which will then be used to quantify each compound. Coefficients of determination (R^2) will be determined for each standard curve. The most recent standard curves are included in Table B4.2.

Method detection limits (MDLs) are calculated per USEPA Method TO-17 for determination of VOCs in ambient air using active sampling onto sorbent tubes (EPA, 1999). According to this method, the standard deviation of seven replicates is multiplied by 3.14, the Student's t-value for the 99% confidence level for seven values, to get the MDL (EPA, 1999).

Table B4.2. VFA and SVOC Standard Curve Equations and R^2 values.

	Standard Curve Model Statements		
	Compound	**Equation**	**R^2**
VFA	Acetic Acid	Y=8e-06x	0.921
VFA	Propionic Acid	Y=3e-04x	0.822
VFA	Butyric Acid	Y=2e-04x	0.945
VFA	Isobutyric Acid	Y=3e-04x	0.816
VFA	Valeric Acid	Y=3e-04x	0.887
VFA	Isovaleric Acid	Y=2e-04x	0.846
VFA	Hexanoic Acid	Y=1.5e-03x	0.796
sVOC	Phenol	Y=2e-06x	0.990
sVOC	pCresol	Y=1e-04x	0.976
sVOC	4-Ethylphenol	Y=3e-06x	0.997
sVOC	Indole	Y=2e-06x	0.983
sVOC	Skatole	Y=2e-06x	0.993

Failures in Measurement Systems and Corrective Actions

Failures in field and laboratory measurement systems involve, but are not limited to such things as instrument malfunctions, failures in calibration, blank contamination, quality control samples outside QAPP defined limits, etc. In many cases, the field technician or lab analyst will be able to correct the problem. If the problem is resolvable by the field technician or lab analyst, then they will document the problem and complete the analysis. If the problem is not resolvable, then it is conveyed to the Task Co-Lead who will make the determination in coordination with the TWRI QAO. If the analytical system failure may compromise the sample results, the resulting data will not be reported to the TSSWCB as part of this project. The nature and disposition of the problem is reported on the data report. The TWRI QAO will include this information in the CAR and submit with the Progress Report which is sent to the TSSWCB PM.

B5 QUALITY CONTROL

Table A7.1 in Section A7 lists the required accuracy, precision, and completeness limits for the parameters of interest. Specific requirements are summarized in Table B5.1 and described below.

Table B5.1. Required Quality Control Analyses

Parameter	Matrix	Field Split	LCS	Lab Dup	Method Blank
Total Nitrogen	Poultry Litter	*NA*	*NA*	*NA*	*NA*
Total Phosphorus	Poultry Litter	*NA*	*NA*	*NA*	*NA*
Total Potassium	Poultry Litter	*NA*	*NA*	*NA*	*NA*
Nitrate Nitrogen, extractable	Soil	*NA*	*NA*	*NA*	*NA*
Extractable Phosphorus	Soil	*NA*	*NA*	*NA*	*NA*
Extractable Potassium	Soil	*NA*	*NA*	*NA*	*NA*
pH	Soil	*NA*	*NA*	*NA*	*NA*
Electrical Conductivity	Soil	*NA*	*NA*	*NA*	*NA*
Micro-nutrients	Soil	*NA*	*NA*	*NA*	*NA*
Organic matter	Soil	*NA*	*NA*	*NA*	*NA*
E. coli	Poultry Litter	*NA*	√	√	√
Volatiles	Poultry Litter	√	√	√	√
E. coli	Water	*NA*	√	√	√
Volatiles	Air	*NA*	*NA*	√	√

Field Split

A field split is a single sample subdivided by field staff immediately following collection and submitted to the laboratory as two separately identified samples according to procedures specified in the QAPP. Split samples are preserved, handled, shipped, and analyzed identically and are used to assess variability in all of these processes. Field splits will be collected and analyzed with each batch of litter samples collected for analysis of volatiles. The precision of field split results is calculated by relative percent difference (RPD) using the following equation:

$$\mathbf{RPD} = \frac{(X_1 - X_2) \times 100}{(X_1 + X_2) \div 2}$$

Measurement performance specifications are used to determine the acceptability of field split analyses as specified in Table A7.1.

Laboratory Control Sample

A laboratory control sample (LCS) consists of a sample matrix (e.g., deionized water, sand, commercially available tissue) free from the analytes of interest spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is used to establish intra-laboratory bias to assess the performance of the measurement system. The LCS is spiked into the sample matrix at a level less than or near the midpoint of the calibration for each analyte. The LCS is carried through the complete preparation and analytical process.

LCSs are run at a rate of one per preparation batch for the analysis of *E. coli* in water and poultry litter as well as volatiles in poultry litter.

Results of LCSs are calculated by percent recovery (%R), which is defined as 100 times the measured concentration, divided by the true concentration of the spiked sample. The following formula is used to calculate percent recovery, where %R is percent recovery; SR is the measured result; and SA is the true result:

$$\%R = SR/SA * 100$$

Measurement performance specifications are used to determine the acceptability of LCS analyses as specified in Table A7.1.

Laboratory Duplicates

One bacteriological duplicate analysis will be performed for each batch of runoff samples. Results of bacteriological duplicates are evaluated by calculating the logarithm of each result and determining the range of each pair. For quantitative microbiological analyses, the method to be used for calculating precision is the one outlined in Standard Methods for the Examination of Water and Wastewater, 20th Edition, section 9020 B.8.b.

$$RPD_{bacteria} = (\log X_1 - \log X_2)$$

The $RPD_{bacteria}$ should be lower than 3.27 * ΣRlog/n, where Rlog is the difference in the natural log of duplicates for the first 15 positive samples.

Measurement performance specifications are used to determine the acceptability of duplicate analyses as specified in Table A7.1. The specifications for bacteriological duplicates in Table A7.1 apply to samples with concentrations > 10 org./100mL.

Method blank

A method blank is a sample of matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as the samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. The method blanks are performed at a rate of once per batch. The method blank is used to document contamination from the analytical process.

A method blank will be run along with all water quality samples and will consist of 100-ml of PBS solution processed in the same manner as a field sample. The analysis of laboratory blanks should yield a value of no colonies detected. Samples associated with a contaminated blank shall be evaluated as to the best corrective action for the samples (e.g. reprocessing or data qualifying codes). In all cases the corrective action must be documented.

For volatiles in poultry litter, 10% of conditioned Blank tubes are analyzed as a quality control measure to assess conditioning efficiency. Additionally, 1 blank is run for every 10 field samples.

Failures in Quality Control and Corrective Action

Results of the analyses of QC samples (i.e. field splits, lab control standards, lab duplicates, and method blanks) will be routinely monitored and evaluated by the Project Co-Leads as follows. The SAML Lab Director will monitor and evaluate QC sample results for all *E. coli* analyses; the ARS Project Co-Lead will monitor and evaluate QC sample results for all nutrient analyses; and the Olfactometry Lab Manager will monitor and evaluate QC sample results for all volatiles analyses. The disposition of quality control failures and the nature and disposition of the problem is reported to the TWRI QAO. The TWRI QAO will discuss with the TWRI PM. Corrective action will involve identification of the possible cause (where possible) of the QC failure. Any failure that has potential to compromise data validity will invalidate data, and the sampling event will be repeated if possible. The resolution of the situation will be reported to the TSSWCB via CAR in the quarterly progress report. The CAR's will be maintained by the TWRI QAO and PM.

The definition of and process for handling deficiencies and corrective action are defined in Section C1.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

To minimize downtime of all measurement systems, spare parts for field and laboratory equipment will be kept in the laboratory, and all field measurement and sampling equipment, in addition to all laboratory equipment, must be maintained in a working condition. All field and laboratory equipment will be tested, maintained, and inspected in accordance with manufacturer's instructions. Records of all tests, inspections, and maintenance will be maintained and log sheets kept showing time, date, and analyst signature. These records will be available for inspection by the TSSWCB.

Failures in any testing, inspections, or calibration of equipment will result in a CAR and resolution of the situation will be reported to the TSSWCB in the quarterly report. The CARs will be maintained by the Project Leader and the TSSWCB PM.

B7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

All instruments or devices used in obtaining environmental data for this project will be calibrated according to and at the frequency recommended by the equipment manufacturer's instructions as each instrument has a specialized procedure for calibration and a specific type of standard used to verify calibration. The instruments requiring calibration include the GC/MS-O, ICP, Elementar Rapid N, and Nitrate Analyzer (Cd reduction) as listed in Table B4.1.

For instance, for the GC/MS-O, standard curves are repeated quarterly and quantification curves are updated. All information concerning calibration will be recorded in a calibration logbook by the person performing the calibration and will be accessible for verification during a laboratory audit.

All instruments or devices used in obtaining environmental data will be used according to appropriate laboratory practices.

Standards used for instrument or method calibrations shall be of known purity and be National Institute of Standards and Technology (NIST) traceable whenever possible. When NIST traceability is not available, standards shall be of American Chemical Society (ACS) or reagent grade quality, or of the best attainable grade. All certified standards will be maintained traceable with certificates on file in the laboratory. Dilutions from all standards will be recorded in the standards log book and given unique identification numbers. The date, analyst initials, stock sources with lot number and manufacturer, and how dilutions were prepared will also be recorded in the standards log book.

Failures in any testing, inspections, or calibration of equipment will result in a CAR and resolution of the situation will be reported to the TSSWCB in the quarterly report. The CARs will be maintained by the Project Leader and the TSSWCB PM.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

All standards, reagents, media, plates, filters, and other consumable supplies are purchased from manufacturers with performance guarantees, and are inspected upon receipt for damage, missing parts, expiration date, and storage and handling requirements. Labels on reagents, chemicals, and standards are examined to ensure they are of appropriate quality, initialed by staff member and marked with receipt date. Volumetric glassware is inspected to ensure class "A" classification, where required. Media will be checked as described in quality control procedures. All supplies will be stored as per manufacturer labeling and discarded past expiration date. In general, supplies for microbiological analysis are received pre-sterilized, used as received, and not re-used.

B9 NON-DIRECT MEASUREMENTS

A number of measurements collected by the USDA-ARS at Riesel will be utilized including watershed management, rainfall depth, discharge (Q) from each site for each event, and concentrations of nutrients (NO_3-N, NH_4-N, and PO_4-P) in each runoff sample. These data will be critical to meeting the data quality objectives of determining the bacteria and nutrient loadings resulting from the use of raw and IWC poultry litter. These measurements are performed using USDA-ARS funding and accepted practices. The USDA-ARS has a long-term and well respected monitoring program established at Riesel dating back to the 1930s.

B10 DATA MANAGEMENT

Field Collection and Management of Samples

All field collection will be completed as described in Section B2 of the QAPP. A COC is filled out in the field for each sampling event noting the site name, time and date of collection, sample type, comments, sample collector's name, and other pertinent data. Samples collected are labeled with site identification, date, sampler's initials, and time of sampling and transported to the lab as outlined in B3. Finally, the COC and accompanying sample bags/bottles are submitted to laboratory analyst, with relinquishing and receiving personnel both signing and dating the COC.

Laboratory Data

Once samples are received at the respective laboratories, they are logged and stored as described in Table B2.1 until processed. The COC will be checked for number of samples, proper and exact I.D. number, signatures, dates, and type of analysis specified. If any discrepancy is found, proper corrections will be made. All COC and analytical data will be manually entered into electronic spreadsheets. The electronic spreadsheets will be created in Microsoft Excel software on an IBM-compatible microcomputer with a Windows Operating System. The spreadsheets will be maintained on the computer's hard drive, which is also simultaneously saved in a network folder. Data manually entered in the spreadsheets will be reviewed for accuracy by the Project Co-Leads (as follows) to ensure that there are no transcription errors. The SAML Lab Director will monitor and evaluate data for all *E. coli* analyses; the ARS Project Co-Lead will monitor and evaluate data for all nutrient analyses; and the Olfactometry Lab Manager will monitor and evaluate data for all volatiles analyses. Paper and electronic copies of data will be housed in the individual laboratories for a period of two years following the conclusion of the project. Any COC's and analysis records related to QA/QC of lab procedures will be housed at the respective lab. All pertinent electronic data files will be backed up monthly on an external hard drive and stored in separate area away from the computer. All electronic files will be archived to CD upon project completion and stored with the final report for 5 years.

Data Validation

Following review of laboratory data, any data entry that is not representative of environmental conditions, because it was generated through poor field or laboratory practices, will not be submitted to the TSSWCB. This determination will be made by the Project Co-Leads, TWRI QAO, TSSWCB QAO, and other personnel having direct experience with the data collection effort. This coordination is essential for the identification of valid data and the proper evaluation of that data. The validation will include the checks specified in Section D2.

Data Dissemination

At the conclusion of the project, the Project Co-Leads will provide a copy of the complete project electronic spreadsheet via recordable CD to the TSSWCB PM, along with the final report. The TSSWCB may elect to take possession of all project records. However, summaries of the data will be presented in the final project report.

C1 ASSESSMENTS AND RESPONSE ACTIONS

Table C1.1 presents types of assessments and response actions for data collection activities applicable to the QAPP.

Table C1.1. Assessments and Response Actions

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight	Continuous	TWRI	Monitoring of project status and records to ensure requirements are being fulfilled.	Report to TSSWCB in Quarterly Report.
Internal Monitoring Systems Audit of Program Subparticipants	Dates to be determined by the TWRI	TWRI	Field sampling, handling and measurement; facility review; and data management as they relate to the project	45 days to respond in writing to the TWRI. TWRI will report problems to TSSWCB in Progress Report.
TSSWCB Monitoring Systems Audit	Dates to be determined by TSSWCB	TSSWCB	Field sampling, handling and measurement; facility review; and data management as they relate to the project	45 days to respond in writing to TSSWCB to address corrective actions
Laboratory Inspections	Dates to be determined by TSSWCB	TSSWCB	Analytical and quality control procedures employed at project laboratories	45 days to respond in writing to TSSWCB to address corrective actions

Internal audits of data quality and staff performance to assure that work is being performed according to standards will be conducted by all entities. Audits will be documented in a written laboratory journal and initialed by the Project Co-leader or PM of each respective entity. If audits show that the work is not being performed according to standards, immediate corrective action will be implemented and documented in the laboratory journal.

The TSSWCB QAO (or designee) may conduct an audit of the field or technical systems activities for this project as needed. Each entity will have the responsibility for initiating and implementing response actions associated with findings identified during the on-site audit. Once the response actions have been implemented, the TSSWCB QAO (or designee) may perform a follow-up audit to verify and document that the response actions were implemented effectively. Records of audit findings and corrective actions are maintained by the TSSWCB PM and TWRI QAO. Corrective action documentation will be submitted to the TSSWCB PM with the progress report. If audit findings and corrective actions cannot be resolved, then the authority and responsibility for terminating work is specified in agreements or contracts between participating organizations.

Corrective Action Process for Deficiencies

Deficiencies are any deviation from the QAPP. Deficiencies may invalidate resulting data and may require corrective action. Corrective action may include for samples to be discarded and re-collected. Deficiencies are documented in logbooks, field data sheets, etc. by field or laboratory staff. It is the responsibility of each respective entity's Project Co-Leader or PM, in consultation with the TWRI QAO, to ensure that the actions and resolutions to the problems are documented and that records are maintained in accordance with this QAPP. In addition, these actions and resolutions will be conveyed to the TSSWCB PM both verbally and in writing in the project progress reports and by completion of a CAR. All deficiencies identified by each entity will trigger a corrective action plan.

Corrective Action

CARs should:

- Identify the problem, nonconformity, or undesirable situation
- Identify immediate remedial actions if possible
- Identify the underlying cause(s) of the problem
- Identify whether the problem is likely to recur, or occur in other areas
- Evaluate the need for Corrective Action
- Use problem-solving techniques to verify causes, determine solution, and develop an action plan
- Identify personnel responsible for action
- Establish timelines and provide a schedule
- Document the corrective action

The status of CARs will be included with quarterly progress reports. In addition, significant conditions (i.e., situations which, if uncorrected, could have a serious effect on safety or on the validity or integrity of data) will be reported to the TSSWCB immediately.

The Project Co-Lead or PM or each respective entity is responsible for implementing and tracking corrective actions. Records of audit findings and corrective actions are maintained by the Project Co-Lead or PM of each respective entity. Audit reports and corrective action documentation will be submitted to the TSSWCB with the progress report.

C2 REPORTS TO MANAGEMENT

Quarterly progress reports developed by the PM and Project Co-Leaders will note project activities, items or areas identified as potential problems, and any variations or supplements to the QAPP. CAR forms will be utilized when necessary (Appendix A). CARs will be maintained in an accessible location for reference by all project personnel and at TWRI and disseminated to individuals listed in section A3. CARs that result in any changes or variations from the QAPP will be made known to pertinent project personnel and documented in an update or amendment to the QAPP.

If the procedures and guidelines established in this QAPP are not successful, corrective action is required to ensure that conditions adverse to quality data are identified promptly and corrected as soon as possible. Corrective actions include identification of root causes of problems and successful correction of identified problem. CARs will be filled out to document the problems and the remedial action taken. Copies of CARs will be included with the project's quarterly reports. These reports will discuss any problems encountered and solutions made. These reports are the responsibility of the QAO and the PM and will be disseminated to individuals listed in section A3.

Additional deliverables to be developed include:

- Assessment of IWC impact on bacteria, nutrient, and volatile levels in litter
- Assessment of cost of using IWC versus conventional methods
- Assessment of impacts of IWC on plot, field, and watershed scale bacteria and nutrient loading
- Assessment of impacts of IWC on volatiles at land application sites
- Outreach materials (1 Extension Fact Sheet and 1 refereed journal article)
- Revised practice standards (as appropriate)

These individual deliverables will be combined into a Final Report by TWRI and Co-Leads for submission to TSSWCB, published as a TWRI Technical Report (and elsewhere in journal articles and Extension fact sheets as appropriate), and posted on the project website. The final report for this project will be a culmination of the work conducted under this project and QAPP.

D1 DATA REVIEW, VERIFICATION AND VALIDATION

All data obtained from field and laboratory measurements will be reviewed and verified for conformance to project requirements, and then validated against the data quality objectives which are listed in Section A7. Only those data which are supported by appropriate quality control data and meet the data quality objectives defined for this project will be considered acceptable. This data will be submitted to the TSSWCB.

D2 VERIFICATION AND VALIDATION METHODS

All field and laboratory data will be reviewed, verified and validated to ensure they conform to project specifications and meet the conditions of end use as described in Section A7 of this document. Data review, verification, and validation will be performed using self-assessments and peer and management review as appropriate. The data review tasks to be performed include evaluation of:

- Sample documentation complete; samples labeled
- Field QC samples collected as prescribed in QAPP
- COC complete
- NELAP® Accreditation current
- Holding times not exceeded
- Collection, preparation, and analysis consistent with QAPP
- Bacteriological records complete
- QC samples analyzed at required frequency
- QC results meet performance and program specifications
- Results, calculations, transcriptions checked
- Laboratory bench-level review performed
- All laboratory samples analyzed for all parameters
- Nonconforming activities documented
- Outliers confirmed and documented; reasonableness check performed
- Absence of transcription error confirmed
- Sampling and analytical data gaps checked
- Verified data log submitted
- 10% of data manually reviewed

Potential errors are identified by examination of documentation and by manual or computer-assisted examination of corollary or unreasonable data. If a question arises or an error is identified, the Project Co-Lead responsible for generating the data will work to resolve the issue. Issues which can be corrected are corrected and documented. If an issue cannot be corrected, the responsible Project Co-Lead will consult with the Project Team to establish the appropriate course of action, or the data associated with the issue are rejected and not reported to the TSSWCB. Field and laboratory reviews, verifications, and validations are documented.

After the field and laboratory data are reviewed, another level of review is performed once the data are combined into a data set. This review step is performed by the Project Team. Data review, verification, and validation tasks to be performed on the data set include, but are not limited to, the confirmation of laboratory and field data review, evaluation of field QC results, additional evaluation of anomalies and outliers, analysis of sampling and analytical gaps, and confirmation that all parameters and sampling sites are included in the QAPP.

Another element of the data validation process is consideration of any findings identified during the monitoring systems audit conducted by the TSSWCB. Any issues requiring corrective action must be addressed, and the potential impact of these issues on previously collected data will be assessed. After the data are reviewed and documented, the Project Team validates that the data meet the data quality objectives of the project and are suitable for reporting to TSSWCB.

If any requirements or specifications of the QAPP are not met, based on any part of the data review, it will be documented and submitted to the TSSWCB with the data. This information is communicated to the TSSWCB by the TWRI in the QA section of the Final Report.

D3 RECONCILIATION WITH USER REQUIREMENTS

Data produced in this project will be analyzed and reconciled with project data quality requirements. Data meeting project requirements will be used by Extension to design education programs based on current, unbiased, science-based information and technology. The objective of the monitoring conducted under this QAPP is to provide the Extension Poultry Science education program with unbiased, science-based, quality assured data on the effectiveness of IWC for reducing bacteria, nutrients, and volatile levels in poultry litter thus reducing contamination of streams from runoff from land application of poultry litter and providing other off site benefits resulting from reduced levels of volatiles. No other decisions will be made by the project team based on the data collected. Data which do not meet requirements will not be submitted to the TSSWCB nor will it be considered appropriate for any of the uses noted above.

APPENDIX A. CORRECTIVE ACTION REPORT

Corrective Action Report

CAR #:______________

Date:____________________ Area/Location:_____________________

Reported by:____________________ Activity:__________________________

State the nature of the problem, nonconformance, or out-of-control situation:

____
____
____
____
____

Possible causes:

____
____
____

Recommended corrective action:

____
____
____

CAR routed to:________________________________

Received by:__________________________________

Corrective Actions taken:

____
____
____
____

Has problem been corrected? YES NO

Immediate Supervisor:_______________________________

Project Leader:__________________________________

Quality Assurance Officer:___________________________

APPENDIX B. CHAIN-OF-CUSTODY FORM

In-House Windrow Composting Project
CHAIN OF CUSTODY RECORD

Project Name:					# of containers	Analyses Required											
Station ID	Date	Time (24hr)	Matrix	Description													Sample ID

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:	Laboratory remarks:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:	Lab log #
Relinquished by: (Signature)	**Date:**	**Time:**	**Received for lab by: (Signature)**	**Date:**	**Time:**	**Laboratory Name:**