Report on the Performance of Wastewater Systems Utilizing Drip Dispersal in Tennessee

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Tennessee Department of Environment and Conservation

Executive Summary

Beginning in the mid-1990s and continuing to present the State of Tennessee has been issuing permits for systems relying on drip dispersal technology to transmit wastewater to the soil environment in a manner that does not constitute direct discharge to surface water or groundwater. The soil environment provides treatment of the wastewater and facilitates its return to the environment. For most of these systems, drip dispersal is the sole means by which wastewater is managed. These systems have been largely used in support of residential subdivisions with other rural establishments such as churches, schools, and businesses also relying on this technology. Performance of these systems, relative to their permit conditions, has been and continues to be highly variable.

One of the most challenging aspects of operating these systems within permit conditions involves the ability of the soil to receive and transmit the applied wastewater away from the point of application without resulting in prolonged soil profile saturation or ponding of wastewater on the surface of the ground. In many cases these ponded conditions result in overland flow of wastewater away from the identified land application area. Noncompliance of this type is particularly critical as in many cases the wastewater flows onto adjacent properties, residential yards, or drainageways and surface waters, but is not treated to levels or sampled at frequencies that are required for discharging systems.

The Tennessee Department of Environment and Conservation's Division of Water Resources conducted a survey of 420 land application areas supporting 374 land application systems in the state in January and February of 2024. The purpose of this statewide survey was to observe the hydraulic performance of the soil profile component of these systems and report the results in a manner that may inform design engineers, operating entities, local governing bodies, and future standard development.

Fourteen of the 374 permitted land application systems were either not in use or had not been constructed. Site observations at the remaining 360 land applications systems indicate approximately one-fourth of the systems exhibited notable performance issues, including wastewater not being appropriately controlled and, in many cases, leaving the land application area and entering adjacent properties and/or drainageways or surface waters; approximately one-fourth of the systems exhibited less severe, but nonetheless noncompliant issues such as localized saturation and ponding or areas that were overgrown preventing evaluation; and approximately one-half of the active systems did not exhibit any indication of noncompliance.

A. BACKGROUND

1.0 Introduction

This report summarizes the scope, method, and observations from the recent statewide survey of land application systems and associated land application areas. Land application of wastewater into soil is relatively widespread in Tennessee. Over 370 systems rely in whole or in part on land application of wastewater through drip dispersal (not including subsurface sewage disposal systems subject to TCA 68-221, Part 4). The Tennessee Department of Environment and Conservation's (Department) Division of Water Resources (Division) is responsible for permitting these systems and permit compliance oversight.

The design objective of these systems involves utilizing an area(s) of soil (land application area) capable of receiving the total daily volume of applied wastewater and transmitting it away from the points of application while maintaining an environment within the soil conducive to further treatment. These types of wastewater systems are not authorized to directly discharge to groundwater or surface water; instead, the systems return treated wastewater to the environment by percolation through an unsaturated soil profile, and evaporation and transpiration (ET). ET is recognized as being seasonally limited. Treatment in the soil profile occurs primarily through physical filtration, biological consumption of nutrients by organisms residing in the soil, and pathogen die-off related to residence time.

There are multiple methods to introduce wastewater to an area of suitable soil; however, drip dispersal technology is the most prominent method in the state utilized in support of these types of systems. Drip dispersal technology relies on pressurizing a network of drip dispersal lines containing pressure-compensating emitters. When pressurized, each emitter in that portion of the system begins dripping at a rate of approximately one-half gallon per hour. Typically, there are multiple short dosing events spaced equally throughout each 24-hour period.

The Division has observed challenges associated with this method of wastewater management in its role of permit compliance oversight. A common challenge and most difficult to resolve is hydraulic overload of the soil profile. The purpose of this statewide project was to obtain insight on the hydraulic performance of the soil profile component of these systems and report the results in a manner that may inform design engineers, operating entities, local governing bodies, and future standard development. This report provides a description of the survey and a summary of the resulting observations.

2.0 Background

In December of 2023 there were 374 systems in the state permitted to utilize drip dispersal technology, in whole or in part, to manage wastewater. Figure 1 illustrates the geographical distribution of these systems across the state.

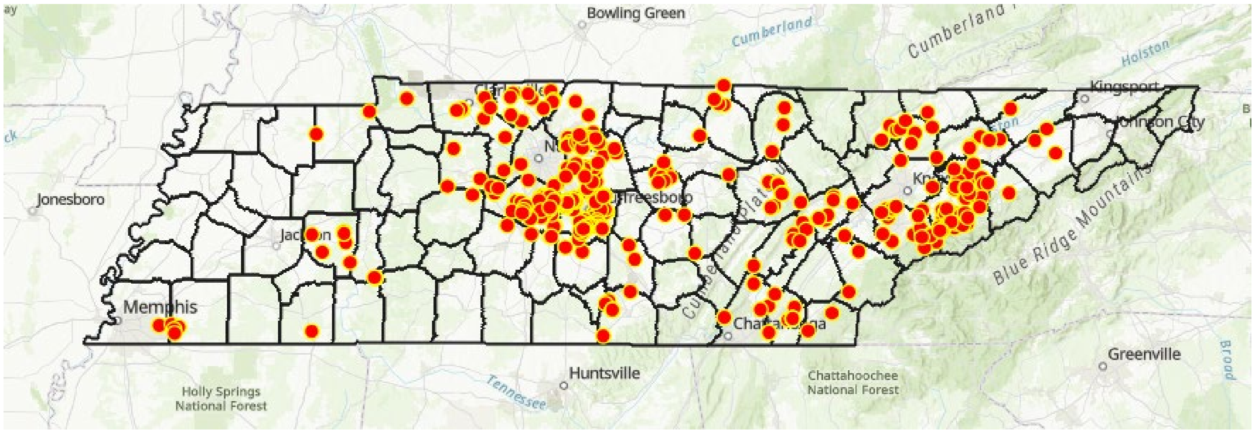

Figure 1. Distribution of Land Application Systems Utilizing Drip Dispersal in Tennessee

These systems are permitted through the Tennessee Water Quality Control Act (TNWQCA)[1]. Most systems are permitted through the State Operating Permit (SOP) process as non-discharging systems. As a result, the permit conditions do not support direct discharge to surface water or groundwater. Direct discharges to surface water or groundwater are governed by federal programs, National Pollutant Discharge Elimination Systems (NPDES) and Underground Injection Control (UIC), respectively. The Department has obtained primacy to implement both federal programs and accomplishes this through the TNWQCA. Some NPDES permits also include land application area components and are not identified as SOPs. NPDES permits with land application components would also not support direct discharge from the land application area.

While the state's SOP program does not support direct discharge to groundwater, UIC Authorization by Rule is required for these systems since they meet the definition of Subsurface Fluid Distribution Systems in both the federal and state UIC rules.

For this report a wastewater system utilizing drip dispersal to manage wastewater, in whole or in part, through the soil profile will be referred to as a "land application system" or "system" and the identified area(s) supporting drip dispersal will be referred to as the "land application area(s)". Figure 2 provides a timeline of the number of land application system permits issued in the state.

[1] TCA 69-3-101

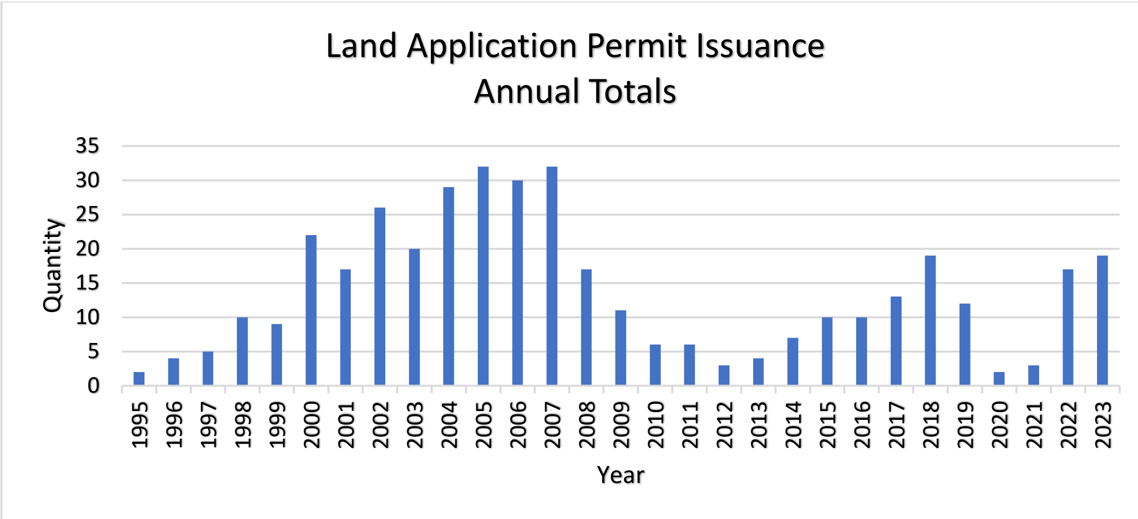

Figure 2. Land Application Permit Issuance – Annual Totals

Tennessee Code Annotated section 69-3-108(e) obligates any applicant seeking a new or expanded wastewater discharge into surface waters to first consider alternative methodologies such as land application or beneficial reuse. Land application involves the application of wastewater to an area with soil properties that allow for absorption of the wastewater, transmission of the wastewater away from the point(s) of application, and further treatment of the wastewater. Land application also provides for evaporation and transpiration of wastewater; however, these transport mechanisms are largely seasonal.

Figure 3 provides a conceptual model of a typical land application system supporting residential development. Wastewater from each home is directed through a collection system to a secondary treatment plant (sand filter, lagoon, manufactured unit, etc.). Secondary treatment plants are designed to reduce the strength of the wastewater as measured by five-day biochemical oxygen demand (BOD_5) to 45 milligrams per liter (mg/l). The resulting effluent is then pumped to and dispersed in an area of soil with suitable properties. Residence time in an appropriate soil profile is expected to result in continued pollutant reduction such that flow reaching groundwater does not compromise groundwater quality.

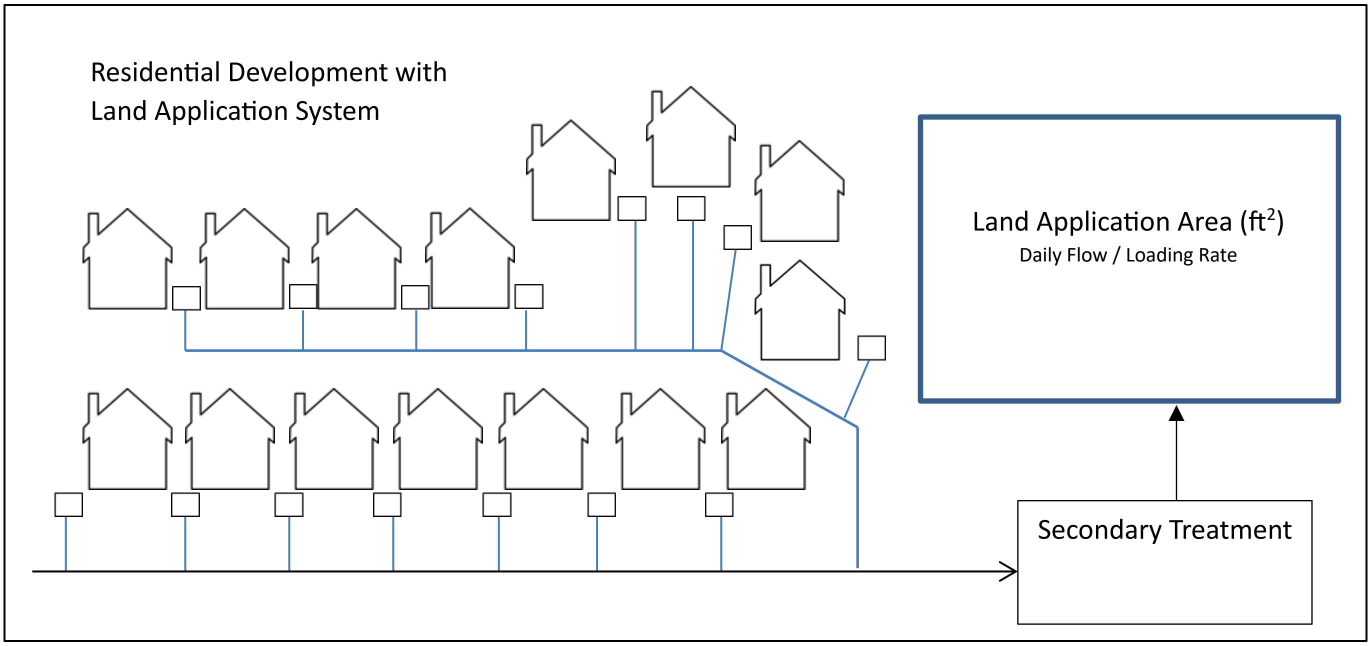

Figure 3. Conceptual Layout of Land Application System Supporting Residential Development

3.0 Permitting Process

The state's permitting process for land application systems has two components: 1) plans approval, and 2) operating permit issuance. Plans are prepared by a licensed engineer with the land application area component having been mapped by a licensed soil scientist. The applicant submits these plans and specifications to the Division. The plans typically include the design of the proposed wastewater collection system, a description of the unit that will treat the wastewater to secondary treatment levels, and identification of the proposed land application area(s) that will further treat the wastewater and facilitate its return to the environment.

Final plans and specifications are to be prepared by the licensed engineer in accordance with generally accepted engineering practices.[2] The Division reviews the plans submitted by the applicant pursuant to the procedural criteria set forth in Rule 0400-40-06-.03 and .04. It is the professional engineer's responsibility to ensure that the proposed land application area is appropriate, and that the system will meet permit requirements. Approval of the final engineering plans constitutes the applicant's permit to construct the system as designed.[3]

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[2] 0400-40-02-.05(2)

[3] The standard plan approval letter states: "TDEC's approval of this land application waste treatment system shall not be construed as creating a presumption of correct operation nor as warranting by the commissioner that the approved facilities will reach the designated goals. T.C.A. § 69-3-108(i). Similarly, TDEC's issuance of a state operating permit in no way guarantees that this land application system will function properly. Notwithstanding these approvals, owners and operators are required to ensure that operation of this system does not result in pollution of waters of the state, including groundwater."

The second component of the permitting process involves the application for an operating permit for the proposed system.[4] Operating permit elements include treatment levels, sampling frequencies, inspection frequencies, operator certification standards, standard conditions that must be maintained and a description of occurrences that are not allowed by the permit. Issuance of operating permits are subject to public notice, public comments, and public hearings, when requested. The maximum term for these operating permits is five years.

Construction of the system may not begin until the public comment period associated with the operating permit for the proposed system has closed.

3.1 Design Considerations

There are two primary design considerations that inform the size of the land application area supporting these systems. These are: 1) anticipated daily flow, and 2) the loading rate of the soil profile. The anticipated daily flow for a given system may be estimated in multiple ways. For subdivisions, the typical design is based on 300 gallons per day per home. The estimated loading rate of the soil profile is based on the texture and structure of the soil along with consideration of the soil profile's depth. Values ranging from 0.075 to 0.25 gallons per day per square foot are common. For example, the daily flow for a 30-home subdivision would be 9,000 gallons per day (30 homes x 300 gallons per day per home). If the loading rate for the soil profile is estimated to be 0.2 gallons per day per square foot, the land application area required to support the systems equals 45,000 square feet (9,000 gallons per day/0.2 gallons per day per square foot).[5] Therefore, the submitted design for this example would be expected to identify and utilize that amount of suitable soil area. Typically, the distribution network for these systems is established in independent zones with the dose volume being commensurate with the size of the zone.

3.2 Anticipated Performance

The land application area component (soil profile) of these systems is expected to accept and transmit the applied wastewater away from the point of application in a manner that does not result in prolonged saturation of the soil profile, persistent ponding of wastewater on the surface of the ground or overland flow of wastewater away from the application area. Furthermore, the soil environment is expected to provide an additional level of treatment such that groundwater quality is not compromised.

The land application area should be accessible, well-defined, and not overgrown with vegetation in support of maintainability, operability, and inspections by both the permittee and the Division.

Land application area performance for these systems is highly variable across the state. The following photographs are provided to illustrate this variability. Photo 1 reflects a dysfunctional land application area. Note the presence of saturated soils and ponding of wastewater. Photo 2 reflects a functional land application area. Note the lack of soil saturation and ponding of wastewater. Furthermore, note the

[4] Rule 0400-40-06

[5] An area loaded at 0.2 gallons per day per square foot results in the application of 2.25 inches of wastewater per week. This volume along with typical rainfall amounts in the state amounts to approximately 14 feet of fluid on the area annually.

uniform striping in Photo 2 with uptake of nutrients through the grass as compared to Photo 1 with indistinct green areas along with areas where the vegetation is distressed or dead. These systems are in areas of the state with similar soil conditions, they both serve subdivisions, and they are a similar age (~18 years old). Yet, they demonstrate remarkably different performance. The system in Photo 2 reflects achievement of the design objective and does not indicate any evidence of permit noncompliance; whereas the system in Photo 1 does not comply with permit conditions and is not meeting the design objective. The Division, and others, are striving to understand the cause(s) of the disparity illustrated by this example.

Photo 1. Dysfunctional Land Application Area

Photo 2. Functional Land Application Area

There are several permit conditions which, if violated, demonstrate a system malfunction. For example, these permits prohibit discharge of wastewater to any surface waters or to any location where it is likely to enter surface waters. The permits also prohibit operation of a drip irrigation system in a manner that creates a health hazard or a nuisance, surface saturation, and ponding within the land application area.

B. STATEWIDE SURVEY

1.0 Project Description

The Project, a survey of the existing land application systems and areas statewide, was conducted to obtain insight on the hydraulic performance of the soil profile component of these systems. Specifically, the land application area(s) for each land application system was evaluated relative to its hydraulic performance. The primary observations reported for each land application area were qualitative and included the presence or absence of saturated soils, ponding of wastewater, and overland flow of wastewater.

The Division considered the first step toward achieving the project objective was to inspect all existing systems across the state. This was accomplished by a select group of staff making targeted observations, in a small window of time and during a period of the year when the hydrology of the soil profile is the common limiting condition (winter months with negligible evapotranspiration).

The Division began the survey of sites during the second week of January. A week of very cold weather followed by a week of wet weather prevented completion of the project until the second week of February 2024. Local precipitation conditions leading up to each site visit were also documented to provide consistency with observations recorded.

The operating entity for each inspected system received an email announcing the project on December 28, 2023. Additional site-specific follow up notice was attempted prior to the actual visit.

Division staff inspectors utilized ArcGIS Survey123 to record their observations. The observations related to the performance of the land application area and matters that impacted those observations. For example, typical observations included whether the land application area was well defined, well-maintained or overgrown, and whether it was accessible to support walk-through. These types of observations go toward establishing that the inspection was being made at the correct location and that the inspector’s observations were not encumbered by vegetation.

As an initial matter, inspectors evaluated whether wastewater entered the land application area and engaged the soil such that observations about the performance of the land application area would be informative to the project. Inspectors observed the secondary treatment plant area (sand filter, lagoon, manufactured unit) to determine whether the wastewater was discharging to the drip field or bypassing the land application area and discharging, in whole or in part, at the secondary treatment plant. The performance of land application areas supporting systems where none or only a portion of the wastewater was reaching the land application area were not considered informative of the project objective.

Within the land application area, inspectors observed whether saturated soils or ponded conditions were present and whether those conditions indicated either infrastructure problems or an overloaded land application area, or both. Examples of infrastructure problems included broken pipes, failed emitters, and other damaged infrastructure components. In some cases, the infrastructure problems were so significant that the drip dispersal network was not apparently being utilized. The performance of land application areas with infrastructure problems that resulted in wastewater not fully engaging the drip dispersal network were not informative of the project objective.

In contrast, the observations of land application areas that receive all the flow and for which there is no indication of infrastructure problems most accurately reflect the performance of the soil profile and are most informative of the project. Inspectors made observations throughout these land application areas pertaining to hydraulic overload, saturation, and ponding. They further qualified ponded conditions as to whether the ponding was producing overland flow, whether the overland flow was leaving the land application area and whether the observed flow was entering surface water or surface drainage features. Inspectors also made observations pertaining to system construction including whether the drip lines were on the surface of the ground or buried, and drip line spacing.

2.0 Survey Observations

Division staff visited 420 land application areas supporting 374 land application systems. Nineteen staff were involved in conducting the visits. Division staff made standardized observations for each site along with site-specific notes. They also collected photographs and videos for most sites. Reports were prepared for each land application area and are available for review at the following link: https://www.arcgis.com/apps/dashboards/c83fa34306ce4283b6cdec1f8e35259a.

Utility or system representatives accompanied Division staff on 74% of the inspections.

Most (84%) of the land application areas in the state were inspected during the second week of January. The remainder were inspected the last week of January extending through the second week of February.[6]

Common characteristics related to system performance and hydraulic performance became evident during the data assessment component of the project. As a result, the systems were categorized into primary and secondary subpopulations based on survey observations (Table 1). The primary division was based on whether the observations collected at the system properly supported the project design objective of evaluating hydraulic performance of the land application area(s). Secondary divisions reflect significant variations within each primary subpopulation.

[6] One land application system supported by three land application areas was inadvertently overlooked in the January and February efforts. This system was inspected on March 11, 2024.

Table 1. Common Characteristics of Populations/Subpopulations			
Primary Subpopulation		Secondary Subpopulation	
X	Systems in which wastewater either did not reach the land application area or did not engage the soil area. These areas were not informative for evaluating land application area performance	X1	Systems that were permitted but were not operational. This includes systems that were either not in use or had not been constructed.
		X2	Systems that discharged all or a portion of their wastewater flow at the secondary treatment plant. Most or all the flow from these systems did not reach the land application area.
		X3	Systems that exhibited significant infrastructure problems in the land application areas such that the drip dispersal network was not engaged, or not fully engaged.
A	Land application areas that receive wastewater from systems and engage the soil profile. This subpopulation does support the project design objective of evaluating hydraulic performance of the land application area(s).	A1	Land applications areas with no observations that indicate malfunction.
		A2a	Land application areas where localized areas of soil saturation and ponding were observed.
		A2b	Land application areas where extensive areas of ponding and/or overland flow (slope dependent) were observed. This includes areas where overland flow remained within the land application area, ran off the land application area, and, in some cases entered drainage features or surface waters.
		A3	Land application areas that were so overgrown that it was impractical to make valid observations of the land application area.

Appendix A provides example photographs that illustrate each of these subpopulations except for X1 since they were not operational. The photographs in Appendix A are only provided as typical examples and are not exhaustive.

The land application areas supporting the systems in the "X" primary subpopulation were not informative for evaluating land application area performance.

Land application areas supporting systems in the "A" primary subpopulation were informative for evaluating land application area performance, with some of these systems being supported by multiple land application areas. Systems with multiple land application areas often had areas reflecting different "A" secondary subpopulations. For example, one land application system was supported by four land application areas: two A1, one A2a, and one A3 subpopulations.

Table 2 summarizes the number of systems and areas in each primary and secondary subpopulation. Reports were generated for 420 land application areas supporting 374 land application systems. The 14 systems that had not been installed or were not active (X1) are not informative of the project objective and were not evaluated further. Removal of the X1 population resulted in 360 land application systems currently managing wastewater. Of the 360 land application systems evaluated, observations of noncompliance were documented at 183 (Figure 4). Instances of noncompliance ranged in severity from complete bypass of wastewater from the system to lack of maintenance resulting in overgrown conditions preventing access to the area. It is important to note that instances of noncompliance identified during this project are specific to the characteristics being observed. Other characteristics pertaining to compliance such as fencing, signage, reporting, and secondary treatment plant effectiveness were not considered during this project.

Table 2. Subpopulation Distributions

Primary Subpopulation	Secondary Subpopulation	Land Application Systems (#)	Land Application Areas (#)	Description
X		55	57	Observations were not informative of project objective
	X1	14	14[1]	System Not Installed or Operational
	X2	25	26	Wastewater Discharging at Secondary Treatment (not reaching land application area)
	X3	16	17	Wastewater Discharging Through Infrastructure (not engaging drip dispersal network)
A		319	363	Observations were informative of project objective
	A1	177[2]	205	Areas with No Observed Malfunction
	A2a	77[2]	87	Areas with Localized Malfunction
	A2b	53[2]	57	Areas with Extensive Ponding and/or Overland Flow
	A3	12[2]	14	Areas Overgrown/Not Accessible
	Total	374	420	

1. A report was completed for each of these systems. However, the reports for these systems do not reflect an assessment of a land application area.
2. Many land application systems are supported by more than one land application area. Observations were made at some of the land application areas that fit into more than one subpopulation. For the purposes of this table, each land application system was only counted in the subpopulation of the most severe compliance issue, if any, observed at any of the land application areas supported by that system. The observations ranked in severity from most severe to least severe as follows: A2b (most severe noncompliance), A2a (less severe noncompliance), A3 (least severe noncompliance), and A1 (compliant). For example, there were 53 systems with at least one land application area in the A2b secondary subpopulation. These 53 systems may have also had areas in other performance subpopulations. Likewise, the 12 systems with land application areas in the A3 performance subpopulation may have had other areas in the A1 performance subpopulation but would not have areas in the A2a or A2b performance subpopulations.

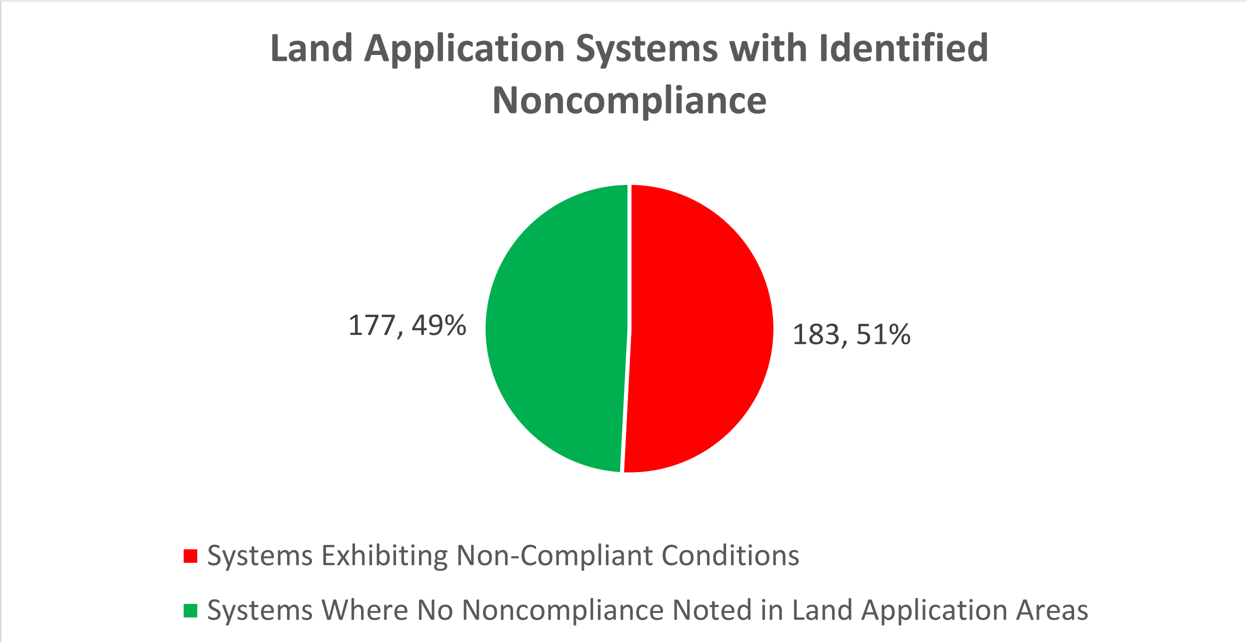

Figure 4. Systems with observed noncompliant conditions vs. Systems with no observed noncompliant conditions.

Of the previously listed subpopulations, three are indicative of major noncompliance: X2, X3, and A2b. Of the 360 systems actively managing wastewater, 94 (26%) exhibited conditions indicative of those subpopulations; 89 (25%) exhibited relatively minor indications of noncompliance (A2a, A3); 177 (49%) exhibited no observations of noncompliance (A1) (Figure 5).

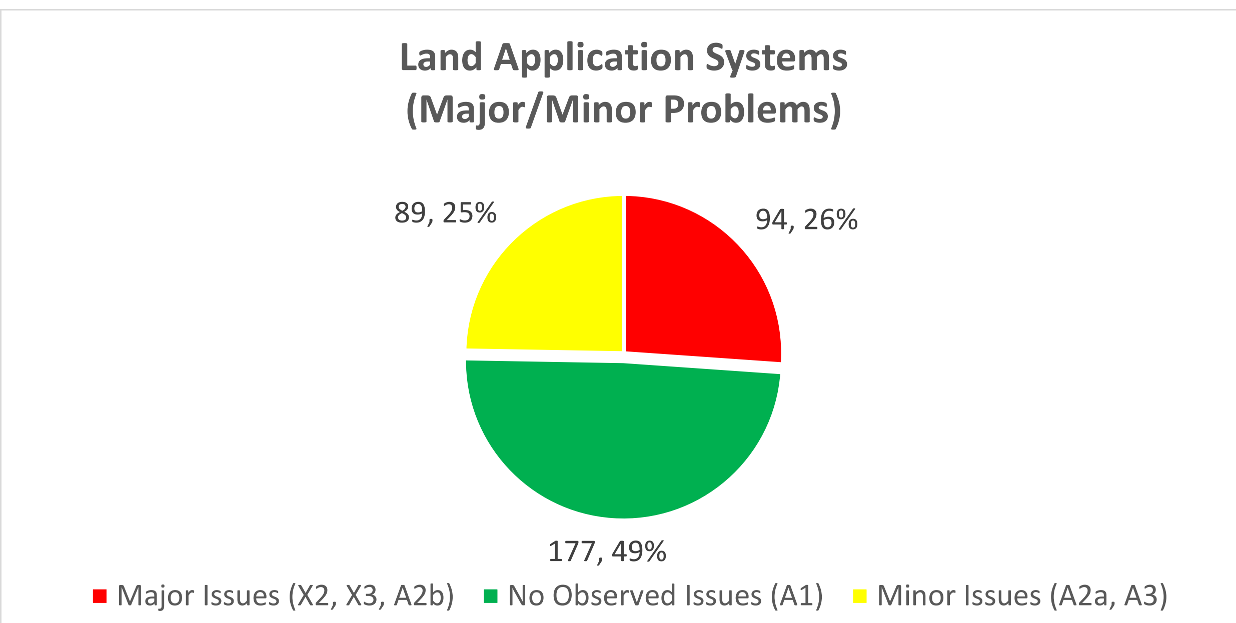

Figure 5. Major Issues Observed/Minor Issues Observed/No Observed Issues

Observations made at 363 land application areas supporting the 319 systems in the "A" primary subpopulation determined into which secondary subpopulation the areas were categorized. Of the total "A" subpopulation, 56% of the land application areas did not exhibit indications of noncompliance; 24% of the areas exhibited localized saturation and ponding (A2a); 16% of the areas exhibited extensive saturation and ponding including some with overland flow (slope dependent) and offsite wastewater migration (A2b); and 4% of the areas were too overgrown to evaluate (A3). Figure 6 depicts the occurrence of these secondary "A" subpopulations.

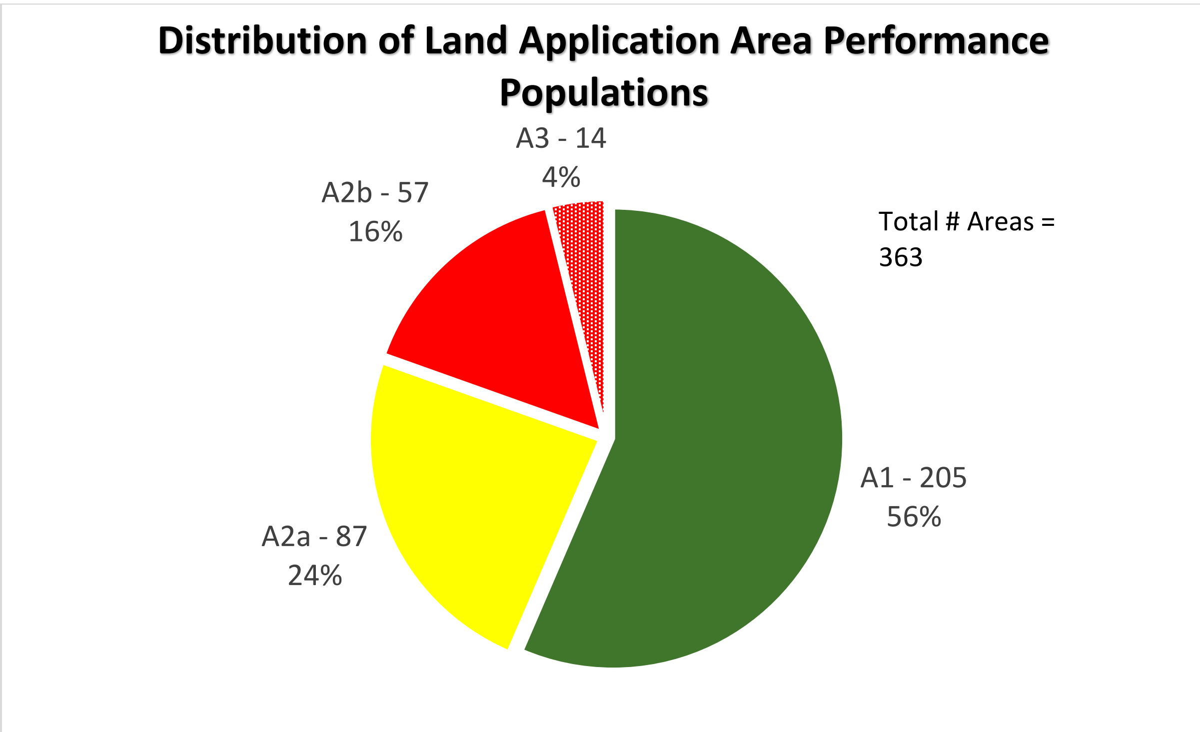

Figure 6. Occurrence of Land Application Area Performance Populations

3.0 Discussion

The project as described in this report is the first such effort to evaluate the performance of all land application areas utilizing drip dispersal in the state in a small window of time while utilizing a uniform set of observations. As such, there is no previous comprehensive data set to which a comparison can be made.

The observations made during these site visits were generally qualitative. No measurements of size of land application area, size of drip field footprint, degree of saturation, areal extent of ponding, or volume of observed flow were conducted.

The project was conducted with no foreknowledge of performance subpopulations. These subpopulations became evident during the data evaluation component of the project. Categorization of systems and areas into subpopulations was largely based on the standard observations collected at each site. When observations alone left any question to subpopulation determination, survey notes and pictures were utilized. In some cases, follow-up site visits were made as well as follow-up discussions with Division staff that conducted the site visits. While qualitative, the observations and associated subpopulation designations are considered by the Division to be of high confidence and consistency.

Rainfall events were interspersed throughout the site visit period. These events were documented in the intake form as to both date of event and amount. In some cases, follow-up visits were conducted to ensure earlier observations were not influenced by precipitation. Observations of ponding due to precipitation were not considered to be indications of malfunction. Ponding associated with surfacing wastewater exhibits characteristics significantly different than ponding associated with precipitation including smell, appearance, sheen, lush green vegetation, and dead or distressed vegetation.

The term "malfunction" is utilized in the report to describe a range of observations; all of which represent permit noncompliance. This report does not identify cause of noncompliance, nor does it proclaim site-specific or program-specific follow-up actions.

This report presents a survey of land application systems utilizing drip dispersal and a qualitative assessment of their performance. A general discussion of project conclusions is provided below:

1. The number of systems at which wastewater was being discharged to the environment without utilizing the land application area was notable and unexpected. These occurrences are not part of any approved design nor are they allowed by permit condition.
2. Over one-half of the land application areas supporting systems where wastewater was being dispersed through drip dispersal did not exhibit indications of malfunction or noncompliance.
3. Many instances of malfunction in the land application areas were relatively isolated and appeared to be associated with drip field infrastructure (i.e., emitters, valves, connections). Understanding the cause of these instances requires excavation and was beyond the scope of this project. Identifying and resolving these problems should be accomplished by the permittee through routine inspections and maintenance. Left unresolved the problems will persist and may become worse.
4. Instances of extensive land application area overload were common with many being extreme. However, assessing whether the overloaded area(s) was the entirety of the drip field or associated with independent zones that are being dosed too heavily or being dosed solely was not possible within the scope of the project. Likewise, there were examples of systems with multiple land application areas where one area was clearly overloaded but other areas did not indicate overload and, in some cases, did not appear to be in use. Therefore, even systems with extensive land application area overload may find remedy by balancing dose volumes and ensuring all available drip field is being utilized.
5. There are systems where all apparent land application area exhibits hydraulic overload such that repairs, or improved maintenance would not likely provide adequate remedy. Resolution of these situations may involve establishing additional land application area capacity or NPDES discharge capacity.

The results of this project support continued evaluation of problem cause and potential site-specific and program-specific remedies. Continued evaluation includes but is not limited to the following:

1. Comparison of system design flow to actual flow.
2. Determination of drip field installed. For example, if the design indicated two acres of land application area, was this amount installed? In some cases, the land application component of the system may have been planned for construction in stages with later stages not having been installed. In other cases, non-emitting infrastructure may have been installed in the land application area resulting in less-than-optimal land application area utilization.
3. Review of soil suitability and appropriateness of loading rates.
4. Determination of long-term acceptance rates for soils being dosed daily for extended periods of time. Does the utilization of soil in this manner decrease its expected performance longevity?
5. Regular execution of projects similar in scope to the one described in this report and projects that target certain subpopulations for more intensive evaluation.

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Appendix A

Photographic Examples of Performance Subpopulations

X2. Wastewater effluent being directed to adjacent ditch rather than the drip field.

X2. Wastewater effluent being discharged from the control building rather than to the drip field.

X2. Wastewater effluent being discharged from the pump vaults rather than to the drip field.

X2. Wastewater effluent being discharged from the sand filter rather than to the drip field.

X3. Infrastructure piping unearthed and disconnected by uprooted tree.

X3. Infrastructure piping failure allowing extensive effluent release.

A1. No apparent drip field overload or other malfunction.

A1. No apparent drip field overload or other malfunction.

A1. No apparent drip field overload or other malfunction.

A2a. Localized saturation/ponding. Likely associated with a damaged valve.

A2a. Localized saturation/ponding. Likely associated with a failed emitter.

A2a. Localized saturation/ponding. Likely associated with a failed emitter or damaged line.

A2b. Extensive saturation/ponding.

A2b. Extensive saturation/ponding.

A2b. Extensive saturation/ponding.

A2b. Extensive saturation/ponding.

A2b. Extensive saturation/ponding including overland flow leaving the land application area.

A2b. Extensive saturation/ponding including overland flow leaving the land application area.

A2b. Extensive saturation/ponding including overland flow leaving the land application area and entering drainageways or surface water.

A2b. Extensive saturation/ponding including overland flow leaving the land application area and entering drainageways or surface water.

A3. Drip field covered in dense vegetation.

A3. Drip field covered in dense vegetation.

A3. Entrance to drip field. Entire area grown up in small trees and briars.