ARTICLE XII

REGULATIONS
FOR
WASTEWATER TREATMENT
AND
LAND DISPOSAL SYSTEMS

WILLIAMSON COUNTY, TENNESSEE

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SECTION 1.0 - GENERAL

1.1 PURPOSE

Williamson County has long recognized the need for providing alternatives for wastewater treatment and disposal. In 1988, the Growth Management Plan identified land treatment and disposal as a viable alternative for providing public sewer service to development within Williamson County. However, Williamson County also recognizes that these alternative wastewater treatment and disposal systems must be properly regulated and bonded in order to protect the public health and safety.

The Tennessee Department of Environment and Conservation (TDEC), Division of Water Pollution Control, has not developed guidelines or regulations for the land disposal of effluent from various treatment methods. While Williamson County believes land disposal of effluent is a viable alternative, these alternatives must be properly regulated, permitted and monitored. The Tennessee Department of Environment and Conservation has chosen to approve and permit land disposal systems using drip irrigation without the formulation of specific design criteria or regulations. Consequently, there appears to be a great deal of variety in the type of control mechanisms being placed upon the entities providing these services.

The Williamson County Commission, Williamson County Planning Commission, and the Williamson County Water and Wastewater Authority believe it is inappropriate to allow land disposal facilities to be constructed in Williamson County without proper regulations and control mechanisms. These guidelines have been prepared to set the minimum standards for wastewater land disposal systems within Williamson County. These guidelines are not intended to replace the role of the Tennessee Department of Environment and Conservation, Division of Water Pollution Control, but to only provide some additional requirements and a consistent approach to approval of land disposal systems within Williamson County.

Much of the information contained in these guidelines has been taken directly from the Tennessee Department of Environment and Conservation's Design Criteria for Sewage Systems. Additional provisions have been added to the Tennessee Design Criteria in order to include items not currently addressed in the Division of Water Pollution Control Standards.

These regulations apply to all wastewater systems developed in Williamson County that utilize land as a treatment system or disposal system for the wastewater. Wastewater systems covered under these regulations will be required to have a Tennessee State operating permit for the wastewater system. It is not intended that these regulations will apply to facilities whose only disposal point is discharged to a receiving stream as permitted through the NPDES permitting system, nor is it intended for these regulations to apply to on-site septic systems utilizing land disposal to serve single residential lots, or non-residential lots.

1.2 AUTHORITY

The Williamson County Water and Wastewater Treatment Authority is authorized to adopt by majority vote of the board, regulations, including requirements for the posting of performance

bonds and maintenance bonds, governing the operation and maintenance of nontraditional sewage disposal systems that serve more than one (1) household. Such regulations shall be consistent with or more stringent than the Water Quality Control Act, compiled in Tennessee Code Annotated, title 69, chapter 3, part 1. Such regulations adopted pursuant to the Water Quality Control Act shall be approved in writing by the commissioner of environment and conservation. As used in these regulations, the phrase 'nontraditional sewage disposal systems' does not include subsurface sewage disposal systems that are subject to the permitting requirements of Tennessee Code Annotated, title 68, chapter 221, part 4, nor to wastewater collection and disposal systems that are owned or operated by a governmental entity. Such authority is expressly granted in Tennessee Code Annotated Section 68-221-607(16) (1999).

1.3 JURISDICTION

1. These wastewater disposal regulations of Williamson County shall govern all subdivisions of land within unincorporated Williamson County.

2. No building permit or certificate of occupancy shall be issued for any parcel or plat of land which was created by subdivision after the effective date of, and not in conformity, with the provisions of these wastewater treatment and land disposal regulations and no construction of any private or public improvement shall take place or be commenced except in conformity with these regulations.

3. In the event that a subdivision or parcel containing any part of a wastewater treatment and land disposal system to which these regulations apply are annexed by a municipality, following the effective date of such annexation, the Williamson County Water and Wastewater Authority shall continue administration of the bonds. Release of any bonds shall only occur upon concurrence of both the municipality and Williamson County.

1.4 POLICY

1.The existing and proposed public improvements shall conform to and be properly related to the proposals shown in the Comprehensive Plan, Official Map, and the Capital Budget and programs of the county, and it is intended that these regulations shall supplement and facilitate the enforcement of the provisions and standards contained in the Zoning Resolution, Comprehensive Plan Official Map, and Land Use Plan, Subdivision Regulations and Capital Budget and programs of Williamson County.

1.5 ENACTMENT

In order that wastewater treatment and disposal systems may be created in accordance with these purposes and policies, these regulations are hereby adopted.

1.6 INTERPRETATION, CONFLICT AND SEPARABILITY

1. In their interpretation and application, the provisions of these regulations shall be held to be the minimum requirements for promotion of the public health, safety and general welfare.

2. It is established that these regulations are not intended to interfere with, abrogate or annul any regulations, statutes or laws. In any case where these regulations impose restrictions different from those imposed by any other provision of these regulations, or any other regulation, law or statute, whichever provisions are more restrictive or impose higher standards shall control.

3. If any part or provision of these regulations or application thereof is adjudged invalid by any court of competent jurisdiction, such judgment shall be confined in its operation to the part, provision or application directly involved in all controversy in which such judgment was rendered. The remainder of these regulations shall be considered valid and in force.

1.7 SAVING PROVISIONS

1. These regulations shall not be construed as altering, modifying, vacating or nullifying any rights or obligations obtained by any person, firm or corporation by lawful action of the county as of the date of adoption of these regulations or any amendment hereto.

2. Expansion of a System Previously Approved by the Williamson County Water and Wastewater Authority and/or Williamson County Regional Planning Commission:

a. If a treatment and/or disposal system is in operation, is contained within an approved plat of subdivision, recorded in the Williamson County Register of Deeds' office, or is contained within an approved Preliminary Plat prior to (*the adoption of the amendments related to Regional Systems by the Williamson County Board of County Commissioners*)(March 9, 2009), that treatment and/or disposal system shall qualify as an "Existing System" as used within these Regulations and this Ordinance.

b. In the event an Existing System wishes to expand to serve more than the capacity that was proposed in the approved DDR and DSIR, then a Site Plan for the expanded treatment and/or disposal system shall be submitted in accordance with the requirements of this Article XII and the Zoning Ordinance for consideration and approval by the Williamson County Regional Planning Commission.

1.8 DEFINITIONS

1. For the purpose of these regulations, certain numbers, abbreviations, terms, and words used herein shall be used, interpreted, and defined as set forth in this section. Where words

within these regulations have not been defined, the standard dictionary definition shall prevail.

2. Unless the context clearly indicates to the contrary, words used in the present tense include the future tense; and words in the plural include the singular.

2.1 Words and Terms Defined:

Agent, Applicant, Developer, Subdivider - The owner of land proposed to be subdivided or his representative. One who, having an interest in land, causes it, directly or indirectly, to be divided into a subdivision. Consent shall be required from the legal owner of the premises.

Auxiliary Disposal Site - The auxiliary disposal sites are land or parcels that may be used for effluent disposal and may have other uses. Higher levels of treatment are required for auxiliary disposal sites. These sites shall provide opportunities for beneficial reuse of the treated effluent.

Back-up Wastewater Disposal Site - Back-up wastewater disposal sites or secondary disposal site is the back-up land or parcels used to provide a redundant wastewater disposal site, in the event the primary wastewater disposal site does not provide proper or adequate wastewater disposal. The back-up wastewater disposal site shall be established in the initial approval process and shall be owned by the wastewater treatment system.

Buffer Zone - Minimum distance from the wetted "disposal field" site area to a property line, habitable structure, water well, right-of-way line, water course or other location.

Easement - Authorization by a property owner for the use by another, and for a specified purpose, of any designated part of his property.

Effluent - The treated wastewater discharged from a wastewater treatment system and applied to the disposal site(s).

Existing System – See Section 1.7 – Savings Provision.

Final Plat - Map or plan of record of a subdivision and any accompanying material, as described in subdivision regulations.

Lot - A parcel of land that:

a. is undivided by any street or private road;

b. is occupied by or designated to be developed for buildings or principal uses which must meet all zoning and subdivision

requirements of these regulations and the Williamson County Zoning Ordinance;

c. contains the accessory buildings or uses customarily incidental to such building, use, or development, including such open spaces and yards as are designed and arranged or required by the Zoning Ordinance for such building, use, or development.

Nontraditional Sewage Disposal System – As used in these regulations, the phrase 'nontraditional sewage disposal system' does not include subsurface sewage disposal systems that are subject to the permitting requirements of Tennessee Code Annotated, title 68, chapel 221, part 4, nor to wastewater collection and disposal systems that are owned or operated by a governmental entity".

Non-residential Treatment and Disposal Use - These uses are designed to collect and treat raw wastewater, and store treated wastewater from nonresidential uses and to utilize land to dispose of the treated effluent. The system includes all components, such as treatment mechanisms and methodologies, collection lines, tanks, pump stations, storage ponds and disposal systems. These uses may be located on a development property and are subject to Site Plan approval by the Planning Commission.

Owner - Any person, group of persons, firm or firms, corporation or corporations, or any other legal entity, excluding homeowners associations or other trust indenture, having legal title to or sufficient proprietary interest in the wastewater treatment and disposal systems described in the regulations. Said Owner shall be required to employ on a full-time basis a person to hold a valid, current and applicable license issued by TDEC, Water & Wastewater Operators Certification Board. Said Owner shall also be required to hold a valid and current approval from the Tennessee Regulatory Authority to operate said system in the proposed location.

Preliminary Plat - The preliminary drawing or drawings, described in these regulations, indicating the manner or layout of the subdivision to be submitted to the Planning Commission for approval.

Regional System - A central sewage treatment facility with an accompanying collection network that qualifies as a Regional System in accordance with the provisions of Section 1.9 of this Article XII. Must be designed to properly provide for the safe treatment and disposal of the generated raw sewage. Subject to the approval of the appropriate state agency and the Planning Commission.

Residential Treatment and Disposal Use - These uses are designed to collect, treat, and store wastewater from residential uses and to utilize land to dispose of the treated effluent. Although these uses are intended to primarily serve residential uses, non-residential uses may also utilize these systems. The system includes all components, such as treatment mechanisms and methodologies, collection lines, tanks, pump stations, storage ponds and disposal systems. These uses are subject to Site Plan

approval by the Planning Commission. Disposal systems may be located on a development property, but are also subject to Site Plan approval.

Residential Disposal Use - These uses are designed to collect and possibly store treated residential wastewater received from offsite treatment facilities. These uses utilize land disposal of the treated effluent after it has been treated at a location offsite. The system includes all components such as collection lines, pump stations, storage ponds, and disposal systems. These uses are subject to Site Plan approval by the Planning Commission and may be located on a development property.

Sketch Plan - A generalized concept plan of subdivision offering information in regard to proposed improvements and natural features of the property in question prepared prior to preliminary plat to save time and expense in reaching general agreement as to the form of the plat and the objectives of these regulations.

Slope - The deviation of the land surface from the horizontal per unit horizontal distance changed, generally expressed in per cent, i.e. vertical rise or fall per foot dividing the horizontal distance between contour lines into the vertical interval of the contours as required by the appropriate regulations.

State of Tennessee Operating Permit - Permit issued by TDEC granting approval and authority for the operation of a wastewater treatment and disposal system within the State of Tennessee.

Tennessee Department of Environment and Conservation (TDEC) - Tennessee governmental agency responsible for regulatory compliance with environmental regulations, formerly, the Tennessee Department of Health and Environment (TDHE). TDEC and TDHE may be used interchangeably.

Unit – As utilized within this Article XII, is defined as 1 single family residential unit with the required equivalent to 300 gallons per day per unit.

Utility - Any construction of public roads, public water, public drainage, public sanitary facilities, or any other improvement that is or will be dedicated to public use.

Wastewater Disposal Site - The primary land or parcel used for the land disposal of the effluent. The wastewater disposal site or sites shall be restricted in their usage to only effluent disposal.

Wastewater Treatment System - The wastewater system used to collect, treat and store the wastewater. The system include all components such as collector lines, septic tanks, pump stations, treatment unit, storage ponds, disposal site and back-up disposal site.

1.9 SUBMITTAL AND REVIEW PROCESS

1. The Williamson County Water and Wastewater Authority, by the adoption of these Regulations, formally delegate the administration, implementation and review of these Regulations and the wastewater treatment and land disposal systems subject to these Regulations to the Williamson County Regional Planning Commission and its staff in accordance with Tennessee Code Annotated Section 68-221-607(12) (1999) and as amended.

2. Review and approval of the wastewater treatment and disposal systems will be required from the Tennessee Department of Environment and Conservation (TDEC). In addition to the requirements of the TDEC, the Williamson County Planning staff will also review the wastewater system on the basis of these additional criteria or regulations enacted by Williamson County. It is anticipated that this review and approval process will be accomplished on a concurrent basis. However, the Williamson County Planning staff will not approve the wastewater treatment and disposal systems until such time as the TDEC has completed its review and issued an approval letter and an operating permit for the facility.

3. Before a Site Plan (or Sketch Plan if applicable) for a proposed residential or non-residential use is filed for consideration by the Regional Planning Commission, a Site Plan for a nontraditional sewage treatment and/or disposal system use with sufficient capacity to serve the proposed development shall be approved by the Regional Planning Commission.

   a. If a new Regional System is proposed to be located on a residential development parcel, the Site Plan shall contain the treatment and disposal areas required to serve the development. The DDR and DSIR shall be filed concurrently with the Site Plan for the treatment and disposal system.

   b. If a residential use is proposed that utilizes an Existing System or an existing Regional System for treatment but where the required disposal area is to be located on the development parcel, then a Site Plan shall be filed for the disposal areas that will be used exclusively for the residential development. The DDR and DSIR shall be filed concurrently with the Site Plan for the disposal areas.

   c. If a nonresidential use is proposed, the Site Plan for the treatment and disposal areas shall be filed. The DDR and DSIR shall be filed concurrently with the Site Plan for the treatment and disposal system.

4. In order to minimize the number of alternative wastewater systems, to create a more efficient use of land in the unincorporated county, to encourage the provision of public utility service in a manner that is in the best interest of the public health and the environment, to minimize the cost of such utility service to the citizens of Williamson County, to encourage the coordination of services amongst the various utility districts and public utilities serving the unincorporated County, to encourage the efficient use of land for utility infrastructure by taking advantage of the natural topography in the unincorporated County, to minimize the maintenance responsibilities of the ultimate users of the public

utility service and to create a more uniform system access to public utility service for current and future residents of the unincorporated County, the Authority hereby creates a regional approach to the provision of public sewer service by alternative treatment and disposal means, and shall require compliance with said regional approach.

1. Regional System Requirements

a. New Residential Treatment and Disposal uses are only permitted in the Suburban Estate (SE) and Interchange (IC) districts, and only if they meet the criteria listed below for Regional Systems.

b. A Regional System is defined as a treatment system that contains sufficient land area to treat a minimum of 3,000 units (unit = 300 gallons per day per unit) as well as a 100% redundant land area; cannot be located within four (4) miles of another Regional System; cannot be located within the Urban Growth Boundaries as outlined in the Williamson County Growth Plan; and must meet all of the requirements of the Zoning Ordinance and as well as receive Site Plan approval from the Planning Commission. The Disposal System component may be located on the same site as the treatment system, but such co-location is not required.

c. Initial construction for a Regional System must contain the capacity to treat a minimum of 200 units (unit = 300 gallons per day per unit).

d. Nonresidential uses may have treatment and disposal systems on the same site as the nonresidential use. The treatment and disposal system shall be subject to Site Plan approval by the Planning Commission.

e. Residential uses may have disposal systems and the redundant disposal land area on the same site as the residential use; however, the land area must be owned and operated by the utility. The disposal system will be subject to Site Plan requirements of this Zoning Ordinance and this Article XII and must be approved by the Planning Commission.

f. New residential uses proposing to utilize a nontraditional treatment and disposal system must provide a letter of sewer availability from a Regional System provider or an Existing System. If no Regional System or existing system is available, then a Regional System must be created and constructed.

g. If a new (Regional) treatment system is located on a development parcel, the area required for the treatment component shall not be excluded from the Base Site Area for density calculation purposes.

h. Any existing systems previously classified by the Authority as a Regional System, shall remain classified as such following the adoption of these amendments. Further, any system existing at the adoption of these amendments may be reclassified as a Regional System, so long as it can be demonstrated that it meets all

of the criteria herein and in the Zoning Ordinance and may be expanded to serve as a Regional System.

5. For all Site Plans for treatment and/or disposal systems, the following shall be filed concurrently with the Site Plan:

    a. Written proof from the Tennessee Regulatory Authority of a valid and current Certificate of Convenience and Necessity issued to and in the name of the proposed Owner for the area to be served.

    b. Written proof from the Tennessee Secretary of State's office of valid legal existence of the Owner and the Agent, Applicant, Developer, Subdivider in good standing.

    c. Written proof that the person or entity contracted to install the proposed system has a valid and current contractor's license by the applicable licensing board of the State of Tennessee with the proper designation for the type of system proposed, and

    d. A filing fee of $1,500.00.

6. Approval of the DDR and DSIR by TDEC and approval of the DDR and DSIR by Williamson County for compliance with these Regulations will be required in conjunction with Site Plan approval of the treatment and/or disposal system.

7. Construction of Treatment and Disposal Facilities Prior to Final Plat/Final Site Plan Submittal

    A. Non-residential Development

    Prior to submittal to the Planning Commission of the final site plan for non- residential development, the construction of the wastewater treatment and disposal system shall be completed and approved by TDEC and the following shall be filed along with the submittal:

        1. an operating permit issued by TDEC,

        2. a letter from TDEC that the wastewater treatment and disposal system was installed and functioning;

        3. a sealed certification from the design engineer that the wastewater treatment and disposal system was constructed in accordance with the approved construction plans and specifications, and

        4. a letter from the Owner/utility provider that it has accepted the wastewater treatment and disposal system and is currently operating same.

    B. Residential Development Containing 200 lots or less

Prior to submittal to the Planning Commission of the final plat for residential development containing 200 lots or less, the construction of the wastewatertreatment and disposal system shall be completed and approved by TDEC and the following shall be filed along with the submittal:

1. an operating permit issued by TDEC,

2. a letter from TDEC that the wastewater treatment and disposal system was installed and functioning;

3. a sealed certification from the design engineer that the wastewater treatment and disposal system was constructed in accordance with the approved construction plans and specifications, and

4. a letter from the Owner/utility provider that it has accepted the wastewater treatment and disposal system and is currently operating same.

C. Residential Development Containing 201 lots or more

Where a proposed residential development/subdivision contains 201 lots or more, the Agent, Applicant, Developer, Subdivider and/or Owner may choose to construct the treatment and/or disposal facilities in stages or phases, so long as the first phase or stage is constructed to provide treatment and disposal for a minimum of 201 lots or its equivalent gallons per day prior to submittal to the Planning Commission of the first final plat along with the conditions outlined in 1-4 below. Subsequent phases or stages of construction shall provide treatment and disposal for a minimum of 50 lots or its equivalent gallons per day unless the treatment capacity necessary to fully complete the treatment system or disposal system is less than this amount. For each phase or stage following the initial construction, the treatment and disposal sufficient for the proposed number of lots within that stage or phase shall be constructed prior to submittal to the Planning Commission of the final plat for that section along with the conditions outlined in 1-4 below.

For each phase and in accordance with paragraph 1.9 (7)(C) herein, the construction of the wastewater treatment and disposal system shall be completed and approved by TDEC. Additionally, the following shall be filed along with the submittal:

1. an operating permit issued by TDEC,

2. a letter from TDEC that the wastewater treatment and disposal system was installed and functioning;

3. a sealed certification from the design engineer that the wastewater treatment and disposal system was constructed in accordance with the approved construction plans and specifications, and

4. a letter from the Owner/utility provider that it has accepted the wastewater treatment and disposal system and is currently operating same.

For all residential developments containing 201 lots or more, the primary and secondary disposal areas shall be dedicated and the land area dedicated for the primary and secondary disposal facilities sufficient to serve the entire proposed development shall be conveyed to the Owner/utility provider prior to submittal to the Planning Commission of the final plat for the first section. Construction of the disposal facilities in stages or phases is only permitted as provided herein.

During construction of later phases or stages of either the treatment system or disposal system, the Agent, Applicant, Developer, Subdivider and/or Owner shall provide adequate safeguards and protections for the existing treatment system or disposal system and for the land areas designated for future disposal, including, but not limited to, construction fencing around the original system(s) and erosion and siltation control measures in order to protect the original systems from any water runoff during the construction.

8. Where a non-residential development does not have a final plat, then the final site plan approved by the Regional Planning Commission which shows the location of the wastewater treatment and disposal system shall be recorded.

9. Operational reports shall be submitted to TDEC and Williamson County Planning Department on an annual basis for compliance review.

Table 1.9
DESIGN DEVELOPMENT REPORT
REQUIRED INFORMATION

1.0 Site Description:

- 1.1 Location map
- 1.2 Climate
- 1.3 Geology (including subsurface hydrology)
- 1.4 Topography
- 1.5 Access
- 1.6 Water supply wells within 1,500 L.F. of facility
- 1.7 Centralized Wastewater Treatment/Disposal (CWTD) Evaluation
  - a. Identify potential CWTD service area (topographic maps of area adjacent to proposed project).
  - b. Evaluation of the Facility for providing a CWTD system in the service area. (Nature and extent of the area to be served, including immediate and probable future development).
  - c. Summary, conclusion and plan of service regarding the potential CWTD systems within the identified service area.

2.0 Scaled drawing with 2 foot elevation contours showing the preliminary site layout including:

- 2.1 Pre-application treatment facilities
- 2.2 Storage facilities
- 2.3 Disposal fields
- 2.4 Buffer zones
- 2.5 Hand auger, test pit and soil boring locations
- 2.6 Access roads and utilities
- 2.7 Watercourses
- 2.8 Drainage structures
- 2.9 Flood elevations with 10 year, 50 year, and 100 year flood plain elevation noted
- 2.10 Residences and habitable structures within or adjacent to site
- 2.11 Wells within 500 ft. of the site

3.0 Design wastewater characteristics (influent to pre-application treatment and treated effluent to disposal fields). If the project involves an existing facility, then actual, recent data should be used:

- 3.1 Average and peak daily flows
- 3.2 Biochemical Oxygen Demand
- 3.3 Total Suspended Solids
- 3.4 Ammonia Nitrogen, Total Kjeldahl Nitrogen, Nitrate plus Nitrite
- 3.5 Total Phosphorus
- 3.6 Chloride
- 3.7 Sodium Adsorption Ratio

3.8 Electrical Conductivity
3.9Metals/Priority Pollutants

4.0 Water Balance/determination of design wastewater loading rates for each disposal field

5.0 Nitrogen Balance/selection of cover crop and management scheme

6.0 Background groundwater samples

7.0 Phosphorus and other constituent loading rates

8.0 Determination of wetted field area(s) and required storage volume

9.0 Process design for pre-application treatment facility

9.1 Schematic of pump stations and unit processes.
9.2 Basin volumes, loading rates, hydraulic detention times, etc. (aerobic or anaerobic).
9.3 Capacity of all pumps, blowers and other mechanical equipment. Pump curves and hydraulic calculations for the distribution system must accompany the DDR.
9.4 Design life of treatment and disposal system

10.0 Detailed Soil Investigation Report (reference Table 1.9.1)

11.0 The back-up wastewater disposal site(s) shall be identified and shown in the DDR. All proposed uses for the back-up site(s) shall be described in the DDR.

12.0 Cost Estimates

12.1 Detailed construction cost estimate for the wastewater treatment and disposal system. The cost estimate shall be calculated including all of the components, facilities and improvements to the land in order to build the wastewater treatment and disposal system which shall also include any off-site improvements and any components, facilities and improvements for auxiliary disposal. The cost estimate shall be submitted as part of the DDR shall be calculated utilizing recent actual construction costs for similar systems. Said cost estimate shall be created by the Design Engineer of the proposed system and who shall also seal and certify the cost estimate.

12.2 Detailed construction cost estimates for the collection system for each section of a residential development or the entire non-residential development shall be submitted or, in the case of future sections of a residential development, supplemented to the DDR filed in conjunction with the preliminary plat submittal. The cost estimate shall be calculated including all of the facilities and improvements to the land in order to construct the collection system for the applicable section of a residential development or the entire non-residential development. The cost estimate shall be calculated utilizing recent actual construction costs for similar systems. Said cost estimate shall be created by the Design

Engineer of the proposed collection system and who shall also seal and certify the cost estimate.

12.3 If the treatment or disposal system will be constructed in stages or phases in accordance with Section 1.9 of these Regulations, detailed construction cost estimates for the treatment system and for the disposal system for each section of a residential development shall be submitted or, in the case of future sections of a residential development, supplemented to the DDR filed in conjunction with the preliminary plat submittal. The cost estimate shall be calculated including all of the facilities and improvements to the land in order to construct the treatment system and the disposal system for the applicable section of a residential development or the entire non-residential development. The cost estimate shall be calculated utilizing recent actual construction costs for similar systems. Said cost estimate shall be created by the Design Engineer of the proposed treatment and disposal system and who shall also seal and certify the cost estimate

13.0 If auxiliary disposal sites are anticipated beyond the primary dedicated disposal site, these sites or disposal options must be presented for review. Beneficial reuse opportunities with treated wastewater will be considered on a case-by-case basis.

14.0 Staging or Phasing of Construction

If the Agent, Applicant, Developer, Subdivider and/or Owner chooses to stage or phase the construction of either the treatment system or disposal system, in accordance with these Regulations, provide a schedule of construction describing the stages or phases, provide detailed plans for protecting existing treatment or disposal upon construction of additional facilities and provide detailed plans for protecting land designated for future disposal during construction of facilities. For each stage or phase proposed after the first stage or phase, the Agent, Applicant, Developer, Subdivider and/or Owner shall supplement the DDR and, if necessary, the DSIR, with the information required by this Table 1.9, Sections 1.0 through 12.0. Such supplement shall be filed according to the same deadlines in Section 1.9 of these Regulations.

Table 1.9.1

DETAILED SOIL INVESTIGATION REPORT
REQUIRED INFORMATION

1.0 Site Description:

- 1.1 Location map
- 1.2 Topographic map
- 1.3 Soil Survey map (see Note 1)
- 1.4 Hand auger, test pit and soil boring locations

2.0 Soil series descriptions (each soil series present)

- 2.1 Texture
- 2.2 Permeability
- 2.3 Slope
- 2.4 Drainage
- 2.5 Depth to seasonal high water table
- 2.6 Depth to bedrock
- 2.7 Erodibility

3.0 Soil characteristics (each soil series present)

- 3.1 Hand auger, test pit and soil boring logs:
  - 3.1.1 Soil horizons
  - 3.1.2 Depth to groundwater
  - 3.1.3 Depth to rock
- 3.2 Unified Soil Classification
- 3.3 Results from saturated hydraulic conductivity testing
- 3.4 Results from soil chemistry testing:
  - 3.4.1 pH
  - 3.4.2 Cation Exchange Capacity
  - 3.4.3 Percent Base Saturation
  - 3.4.4 Sodium Exchange Potential
  - 3.4.5 Phosphorus Absorption
  - 3.4.6 Nutrients (N, P, K)
  - 3.4.7 Agronomic trace elements (for cover crop proposed)
  - 3.4.8 Mineralogy (clay)
- 3.5 Engineering properties of soils proposed for any potential pond construction.
  - 3.5.1 Clay content
  - 3.5.2 Permeability

3.5.3 Plasticity
3.5.4 Consistency

4.0 Identification of subsurface conditions adversely affecting vertical or lateral drainage of the land treatment site.

5.0 Delineation of soils and areas suitable and not suitable for wastewater drip or spray irrigation.

6.0 Determination of design percolation for each soil type.

NOTE 1: Soil Survey Maps shall be in accordance with the following requirements for an Extra High Intensity Soil Map

Extra High-Intensity Soil Maps

These are special use maps that show a high degree of soil map unit and landscape configuration detail. Each highly detailed soil map unit will be accompanied by site specific interpretations and recommendations (i.e. specific soil improvement practices). This type of map is to provide the information needed, relative to soil characteristics and landscape features, so that Williamson County is able to thoroughly evaluate a site and ascertain its suitability to support effluent disposal systems.

The base map shall be at a scale of 1:1200 or 1 inch equals 100 feet. The soil mapping grid stakes are to be set at intervals of 50 feet. Areas of 1000 square feet or more with a significant difference from the adjoining soil mapping units shall be delineated.

Soil line placement shall have a tolerance limit of 10 feet. With the available ground control, there should be no less than 41 soil observations per acre. Soil Observations should be made at each grid stake and the grid-box center. Any mappable landscape feature shall be located with absolute accuracy (i.e. drainways, embankments, field roads, wells, etc.).

These maps shall be clearly marked and labeled, in a conspicuous manner, as an *EXTRA HIGH-INTENSITY SOIL MAP*.

Williamson County will require ULTRA-HIGH-INTENSITY SOIL MAPPING if the sites have been disturbed (i.e. cut, filled, compacted, etc.) or sites that have been previously assessed and were found to be unsuitable soil conditions.

1.10 ASSURANCE FOR COMPLETION AND OPERATION OF IMPROVEMENTS (BONDING REQUIRMENTS)

It is the intention of these Regulations that a performance bond be required for all projects utilizing a non-traditional wastewater treatment and disposal system, utilizing land as the disposal location for the treated wastewater.

A. Performance Bond for Wastewater Treatment and Disposal System

1. Non-residential Development

A Performance Bond for Wastewater Treatment and Disposal shall be required. In order to determine the amount of the Performance Bond, the total cost of construction of the Wastewater Treatment and Disposal System shall be calculated taking into consideration and including all of the components, facilities and improvements to the land in order to build the wastewater treatment and disposal system which shall also include any off-site improvements and any components, facilities and improvements for auxiliary disposal. A cost estimate shall be submitted as part of the DDR, calculated utilizing recent actual construction costs for similar systems. Said cost estimate shall be created by the Design Engineer of the proposed system and who shall also seal and certify the cost estimate.

So long as the requirements of Section 1.9(8)(A) of these Regulations are met, then the Performance Bond for the wastewater treatment and disposal system shall equal thirty percent (30%) of the cost as calculated above. Said Performance Bond and its supporting surety shall be filed prior to and be a condition precedent to the recording of the final site plan in the case of a non-residential development. The Performance Bond for Wastewater Treatment and Disposal shall remain in effect for a minimum of one (1) year, at which time the Wastewater Authority and/or the Planning Commission may choose to convert the bond, remaining in the same amount, to a Maintenance Bond. The Maintenance Bond shall remain in effect for a minimum of two (2) years.

2. Residential Development Containing 200 lots or less

A Performance Bond for Wastewater Treatment and Disposal shall be required. In order to determine the amount of the Performance Bond, the total cost of construction of the Wastewater Treatment and Disposal System shall be calculated taking into consideration and including all of the components, facilities and improvements to the land in order to build the wastewater treatment and disposal system which shall also include any off-site improvements and any components, facilities and improvements for auxiliary disposal. A cost estimate shall be submitted as part of the DDR, calculated utilizing recent actual construction costs for similar systems. Said cost estimate shall be created by the Design Engineer of the proposed system and who shall also seal and certify the cost estimate.

So long as the requirements of Section 1.9(8)(B) of these Regulations are met, then the Performance Bond for the wastewater treatment and disposal system shall equal thirty percent (30%) of the cost as calculated above. Said Performance Bond and its supporting surety shall be filed prior to and be a condition precedent to the recording of the final plat in the case of a residential development of 200 lots or less. The Performance Bond for Wastewater Treatment and Disposal shall remain in effect for a minimum of one (1) year, at which time the Wastewater Authority and/or the Planning Commission may choose to convert the bond, remaining in the same amount, to a Maintenance Bond. The Maintenance Bond shall remain in effect for a minimum of two (2) years or until eighty percent (80%) of the building permits are issued for the entire residential development, whichever last occurs.

3. Residential Development Containing 201 lots or more

Where a proposed residential development/subdivision contains 201 lots or more, the Agent, Applicant, Developer, Subdivider and/or Owner may choose to construct the treatment and/or disposal facilities in stages or phases, so long as the first phase or stage is constructed to provide treatment and disposal for a minimum of 201 lots or its equivalent gallons per day and so long as all subsequent stages or phases are constructed to provide treatment and disposal for a minimum of 50 lots or its equivalent gallons per day, unless the treatment or disposal capacity necessary to fully complete the system is less than this amount.

a. Components of the Treatment Performance Bond

If the Agent, Applicant, Developer, Subdivider and/or Owner chooses to construct the treatment facilities in stages or phases, in order to determine the amount of the Performance Bond, the total cost of construction of the Wastewater Treatment System for the applicable section shall be calculated taking into consideration and including all of the components, facilities and improvements to the land in order to build the wastewater treatment system which shall also include any off-site improvements. A cost estimate shall be submitted as part of the DDR, calculated utilizing recent actual construction costs for similar systems. Said cost estimate shall be created by the Design Engineer of the proposed system and who shall also seal and certify the cost estimate.

b. Components of the Disposal Performance Bond

If the Agent, Applicant, Developer, Subdivider and/or Owner chooses to construct the disposal facilities in stages or phases, in order to determine the amount of the Performance Bond, the total cost of construction of the Wastewater Disposal System for the applicable section shall be calculated taking into consideration and including all of the components, facilities and improvements to the land in order to build the wastewater disposal system which shall also include any off-site improvements. A cost estimate shall be submitted as part of the DDR, calculated utilizing recent actual construction costs for similar systems. Said cost estimate shall be created by the Design Engineer of the proposed system and who shall also seal and certify the cost estimate.

c. Calculating the First Phase/Stage Treatment or Disposal Facilities Bond

For the first phase or stage, the treatment and disposal facilities for 201 lots shall be constructed prior to submittal of the first final plat. As a result, so long as the requirements of Section 1.9(8)(C) of these Regulations are met, then the Performance Bond for the wastewater treatment and disposal system shall equal thirty percent (30%) of the cost as calculated above. Said Performance Bond and its supporting surety shall be filed prior to and be a condition precedent to the recording of the final plat. The Performance Bond for Wastewater Treatment and Disposal shall remain in effect for a minimum of one (1) year, at which time the Wastewater Authority and/or the Planning Commission may choose to convert the bond, remaining in the same amount, to a Maintenance Bond. The Maintenance Bond shall remain in effect for a minimum of two (2) years or until eighty percent

(80%) of the building permits are issued for the first phase or stage of the residential development, whichever last occurs.

d. Calculating Subsequent Phases/Stages Treatment or Disposal Facilities Bond

For all subsequent phases or stages of the residential development after 201 lots, the treatment and disposal facilities sufficient to serve the number of lots proposed within that phase or stage shall be constructed prior to submittal of the final plat, with a minimum of treatment capacity for 50 lots or its equivalent gallons per day for all subsequent phases or stages. As a result, so long as the requirements of Section 1.9(8)(C) of these Regulations are met, then the Performance Bond for the wastewater treatment and disposal system for that phase or stage shall equal thirty percent (30%) of the cost as calculated above. Said Performance Bond and its supporting surety shall be filed prior to and be a condition precedent to the recording of the final plat. The Performance Bond for Wastewater Treatment and Disposal shall remain in effect for a minimum of one (1) year, at which time the Wastewater Authority and/or the Planning Commission may choose to convert the bond, remaining in the same amount, to a Maintenance Bond. The Maintenance Bond shall remain in effect for a minimum of two (2) years or until eighty percent (80%) of the building permits are issued for the applicable phase or stage of the residential development, whichever last occurs.

B. Performance Bond for the Collection System

A separate Performance Bond for the collection system(s) associated with each section of a residential development or for an entire non-residential development shall be required. A cost estimate shall be calculated utilizing recent actual construction costs for similar systems. Said cost estimate shall be created by the Design Engineer of the proposed collection system and who shall also seal and certify the cost estimate.

The Performance Collection Bond shall be equal to one hundred percent (100%) of the cost of the facilities and improvements to the land in order to construct the collection system for the applicable section of a residential development or the entire non-residential development. The Performance Collection Bond and supporting surety shall be filed prior to and be a condition precedent to the recording of the final plat of the applicable section in the case of a residential development or the recording of the final site plan in the case of a non-residential development. The Performance Collection Bond for Wastewater Treatment and Disposal shall remain in effect for a minimum of one (1) year, at which time the Wastewater Authority and/or Planning Commission may choose to reduce the bond to thirty percent (30%) maintenance until a minimum of eighty percent (80%) of the building permits are issued for the applicable section of the residential development or two years, whichever last occurs.

The Performance Collection Bond cannot be reduced to a Maintenance Collection Bond unless the following is provided to the Wastewater Authority and Planning Commission: 1) Letter from TDEC that the collection system is installed and functioning, 2) Sealed Letter from the Design

Engineer that the collection system is installed in accordance with the Design Plans, and 3) Letter from the Utility Provider that it has accepted the Collection System and is available for operation/connection.

C. Agreements

Agent, Applicant, Developer, Subdivider shall be required to execute performance agreements for the Wastewater Treatment and Disposal System and Collection System consistent with and in accordance with these Regulations for the provision of the wastewater treatment and disposal system and a maintenance agreement which shall be in a form acceptable to the Authority and binding upon all heirs, successors, and assigns of Agent, Applicant and Developer. Such agreements shall be executed prior to final plat approval in the case of residential developments, and final site plan approval in the case of non-residential developments. The Agent, Applicant, Developer, Subdivider, Owner and the Utility Provider shall be required to execute the agreements.

D. Beneficiary of the Bonds

The Performance Bonds shall be for the use and benefit of the Williamson County Water and Wastewater Authority and the Williamson County Regional Planning Commission. The Wastewater Authority shall have the power to establish the amount of the bonds and review said amount on an annual basis to determine if the amount is sufficient. The Wastewater Authority may also specifically delegate such review to the Williamson County Regional Planning Commission.

E. Additional Terms and Requirements

Applicable provisions of Section IV, "ASSURANCE FOR COMPLETION AND MAINTENANCE OF IMPROVEMENTS", of the Williamson County Subdivision Regulations, concerning the type of acceptable performance bonds and Williamson County Planning Commission's rights under the required bonds are incorporated herein and are made part of these regulations.

1.11 OWNERSHIP OF WASTEWATER TREATMENT AND DISPOSAL SYSTEM SITE

1. The wastewater treatment system, storage lagoons and land disposal site(s) and back-up disposal sites shall be owned and operated by the same entity. No homeowners association of trust indenture shall be permitted to own or operate any part of any wastewater treatment and disposal system. The Owner of the wastewater treatment and disposal system shall also be required to employ on a full-time basis a person to hold a valid, current and applicable operators license issued by TDEC, Water & Wastewater Operators Certification Board. Said Owner shall also be required to hold a valid and current approval from the Tennessee Regulatory Authority to operate said system in the proposed location. The treatment system and disposal site shall be dedicated or restricted so the only approved or acceptable use for the land disposal sites shall be for the purpose of providing wastewater treatment and disposal. The use of the land disposal sites as open space in the base site area calculations

for subdivisions is prohibited. All of the components of the wastewater system, including the wastewater septic tanks, if required, collection systems, pumping stations, treatment systems and storage lagoons land disposal sites shall be owned and operated by the same entity.

2. All required wastewater utility easements shall be shown on plat or site plan. Easements shall be provided to allow access to all components of the treatment system, i.e., septic tanks, pipelines, etc.

3. If auxiliary disposal sites are proposed (over and above the minimum area required for satisfactory operation of the treatment and disposal system), these sites will not be required to be owned by the same entity as the wastewater treatment and disposal system. A written contract or agreement between the owner of the treatment system and the owner of the auxiliary disposal site will be required. The contract will require the owner of the auxiliary disposal site to adhere to all conditions and requirements placed on the use of the auxiliary disposal sites by TDEC and/or Williamson County.

1.12 AMENDMENTS

These Regulations may be amended as the public health, safety and general welfare require and in accordance with Tennessee Code Annotated Section 68-221-607(16) (1999).

SECTION 2.0 - REQUIREMENTS FOR WASTEWATER SYSTEMS

2.1 GENERAL

These requirements shall apply to all wastewater treatment and disposal systems utilizing land application as a disposal method for the wastewater. These regulations do not apply to single residential or non-residential lots utilizing on-site septic tanks for their treatment and disposal of wastewater.

All wastewater treatment and disposal systems constructed in Williamson County using land for the disposal of the wastewater shall comply with the provisions of the State of Tennessee, Department of Environment and Conservation, Division of Water Pollution Control, Design Criteria for Sewage Works, Chapter 16, Slow Rate Land Treatment, effective April 2, 1996. The provisions of Chapter 16 shall apply unless amended or modified herein.

2.2 SLOW RATE LAND TREATMENT

STATE OF TENNESSEE

DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER POLLUTION CONTROL
DESIGN CRITERIA FOR SEWAGE WORKS
SLOW RATE LAND TREATMENT
CHAPTER 16
(April 2, 1996)

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SLOW RATE LAND TREATMENT

16.1 General

16.1.1 General

This chapter provides guidelines and criteria for the design of slow rate land treatment systems. It is not applicable to overland flow or rapid infiltration.

There are basically two types of slow rate systems. Type 1 systems are designed to apply the maximum amount of wastewater to the minimum amount of land area. The wastewater loading rate is limited by the maximum amount of a particular wastewater constituent that can be applied to a specific site. For wastewater from municipalities, the limiting design factor is usually either the hydraulic capacity of the soil or the nitrogen content of the wastewater. For industrial wastewater, the limiting design factor may be the hydraulic capacity of the soil, nitrogen or any other wastewater constituent such as metals, organics, etc. Type 2 systems are designed to apply the available wastewater to the maximum land area possible. The objective is usually crop irrigation and the design involves determining the water needs of the particular crop.

Although this chapter is written around Type 1 systems, the methodology can be adapted to satisfy Type 2 systems.

16.1.2 Applicability

Slow rate systems are designed and operated so that there is no direct discharge to surface waters. Disposal is by evaporation directly to the atmosphere, by transpiration to the atmosphere via vegetation uptake and by percolation to groundwater. A State of Tennessee Operating Permit is required for operation of slow rate land treatment systems.

6.1.3 Location

The disposal site should generally be relatively isolated, easily accessible and not susceptible to flooding. The site can be developed on agricultural land and/or forests or can include parks, golf courses, etc. Site location shall take into account dwellings, roads, streams, etc. A site approval by the Division will be required before review of the Engineering Report.

16.1.4 Topography

Maximum grades for wastewater spray fields should be limited to 8% for row crops, 15% for forage crops and 30% for forests. The maximum grade for any surface spreading system should be 10%. Ideally, any site should have a minimum slope of 2 - 3%. Sloping sites promote lateral subsurface drainage and make ponding and

extended saturation of the soil less likely than on level sites. Depressions, sink holes, etc., are to be avoided.

16.1.5 Soils

In general, soils with a USDA Soil Conservation Service permeability classification of moderately slow (0.2 to 0.6 inches/hour) or more are suitable for wastewater irrigation. However, groundwater and drainage conditions must also be suitable. Soils which are poorly drained, have high groundwater tables or restrictive subsurface soil layers are not suitable for slow rate land treatment without drainage improvements.

16.2 Soil Investigations

16.2.1 General

The land treatment soil investigation must characterize the infiltration rate, permeability, and chemical properties of the first 5 to 10 feet of the soil profile. It must verify Soil Conservation Service soil mapping. It must also determine the elevation of the seasonal high groundwater, establish the groundwater flow direction and gradient, and identify any subsurface conditions which may limit the vertical or lateral drainage of the land treatment site. The number of soil samples necessary to supply all of this information will be dependent on the nature of the particular site. As a minimum, however, TDHE recommends that at least one sample be taken for every acre in order to develop a detailed soils map of the site for the Engineering Report. Samples from soils with similar characteristics can be combined and the analyses can be performed on each soil group sample.

16.2.2 Saturated Hydraulic Conductivity Testing

Saturated vertical hydraulic conductivity testing is required for the most limiting horizon of each soil series present. The most limiting soil horizon should be determined from soil survey information. A minimum of three (3) tests for each soil series should be performed, unless the flooding basin method is used, in which case, only one test per series is needed. Testing for saturated horizontal hydraulic conductivity is additionally required when subsurface drainage systems are planned or when lateral subsurface drainage is the predominant drainage mechanism for the land treatment site.

Acceptable methods for saturated hydraulic conductivity testing are listed in Table 16-1. Percolation tests as performed for septic tank drain fields are not acceptable.

16.2.3 Soil Chemical Testing

The pH, Cation Exchange Capacity, and Percent Base Saturation, of each soil series must be determined from samples taken from the A and B horizons. These chemical

tests determine the retention of wastewater constituents in the soil and the suitability of the soil for different cover crops. A minimum of three (3) samples for each soil series should be taken. The samples can be mixed together and tested for each soil series if the series is uniform. Testing for soil nutrients (nitrogen, phosphorus and potassium) and agronomic trace elements may be included if appropriate for the vegetative management scheme.

Soil chemical testing should be in accordance with the latest edition of Methods of Soil Analysis published by the American Society of Agronomy, Madison, Wisconsin.

16.3 Pre-application Treatment Requirements

6.3.1 General

Wastewater irrigation systems have a demonstrated ability to treat high strength organic wastes to low levels. However, such systems require a high degree of management with particular attention paid to organic loading rates and aeration of the soil profile between wastewater applications.

The TDHE requires that all domestic and municipal wastewaters receive biological treatment prior to irrigation. This is necessary to:

a. Protect the health of persons contacting the irrigated wastewater.

b. Reduce the potential for odors in storage and irrigation.

Some industrial wastewaters may be suitable for direct land treatment by irrigation under intensive management schemes. The TDHE will evaluate such systems on a case-by-case basis.

16.3.2 BOD and TSS Reduction, and Disinfection

Pre-application treatment standards for domestic and municipal wastewaters prior to storage and/or irrigation are as follows:

a. Sites Closed to Public Access

All wastewater must be treated to a level afforded by lagoons which are designed in accordance with chapter 9.

Disinfection is generally not required for restricted access land treatment sites. The TDHE may, however, require disinfection when deemed necessary.

b. Sites Open to Public Access

Sites open to public access include golf courses, cemeteries, green areas, parks, and other public or private land where public use occurs or is expected to occur. Wastewater irrigated on public access sites must not exceed a 5-day Biochemical Oxygen Demand and Total Suspended Solids of 30 mg/l, as a monthly average. Disinfection to reduce fecal coliform bacteria to 200 colonies/100 ml is required.

The pre-application treatment standards for wastewater that is to be applied to public access areas will be reviewed by the TDHE on a case-by-case basis. More stringent pre-application treatment standards may be required as the TDHE deems necessary. TDHE recommends that the engineer give preference to pretreatment systems that will provide the greatest degree of reliability.

16.3.3 Nitrogen

Maximum nitrogen removal occurs when nitrogen is applied in the ammonia or organic form. Nitrate is not retained by the soil and leaches to the groundwater, especially during periods of dormant plant growth. Therefore, the pre-application treatment system must <u>not</u> produce a nitrified effluent.

The TDHE recommends that aerated or facultative wastewater stabilization ponds be used for pre-application treatment where possible. These systems generally produce a poorly nitrified effluent well-suited for wastewater irrigation. When mechanical plants are employed for pre-application treatment, they should be designed and operated to limit nitrification.

The Engineering Report should indicate the expected range of nitrogen removal in the pre-application treatment system. Predictive equations for nitrogen removal in facultative wastewater stabilization ponds have been developed by Pano and Middlebrooks (1982), and Reed (1985).

16.3.4 Treatment and Storage Ponds

The storage pond and irrigation pump station must be hydraulically separate from the treatment cells (i.e., pumping must not affect hydraulic detention time in these cells). The TDHE recommends the use of Chapter 9 of the Design Criteria for Sewage Works, as well as the United States Environmental Protection Agency's October 1983 Design Manual: <u>Municipal Wastewater Stabilization Ponds</u> as a reference for design of pre-application treatment ponds.

16.4 Inorganic Constituents of Treated Wastewater

Inorganic constituents of effluent from pre-application treatment should be compared with Table 16-2 to insure compatibility with land treatment site soils and cover crops.

16.5 Protection of Irrigation Equipment

Prior to pumping to the spray field distribution system, the wastewater must be screened to remove fibers, coarse solids, oil and grease which might clog distribution pipes or spray nozzles. As a minimum, screens with a nominal diameter smaller than the smallest flow opening in the distribution system should be provided. Screening to remove solids greater than one third (1/3) the diameter of the smallest sprinkler nozzle is recommended by some sprinkler manufacturers. The planned method for disposal of the screenings must be provided.

Pressurized, clean water for backwashing screens should be provided. This backwash may be manual or automated. Backwashed screenings should be captured and removed for disposal. These screenings should not be returned to the storage pond(s) or pre-application treatment system.

16.6 Determination of Design Percolation Rates

16.6.1 General

One of the first steps in the design of a slow rate land treatment system is to develop a "design percolation rate" (Perc). This value is used in water balance calculations to determine design wastewater loading(s) and, thus, spray field area requirements. The percolation rate is a function of soil permeability and drainage.

16.6.2 Design Values

The most limiting layer; i.e., A, B or C horizon, of each soil series must be identified. Any surface conditions which limit the vertical or lateral drainage of the soil profile must also be identified. Examples of such conditions are shallow bedrock, a high water table, aquitards, and extremely anisotropic soil permeability.

Values of saturated vertical hydraulic conductivity from soil testing are used to develop the design percolation rate.

Values of saturated vertical hydraulic conductivity must be modified by an appropriate safety factor to determine design percolation. The safety factor reflects the influence of several elements including: the fact that long periods of saturation are undesirable, the uncertainty of test values, the drainage characteristics of the land treatment site, the variation of permeability within and between different soil series, the rooting habits of the vegetation, the soil reaeration factors, and the long-term changes in soil permeability due to wastewater application. The TDHE recommends that the design percolation rate of land treatment sites be no more than 10 percent of the mean saturated vertical hydraulic

conductivity of the most limiting layer within the first five feet from the surface, in accordance with the following equation:

Perc = K x 0.10 Eq. 16-1

Where, Perc = Design percolation rate, (in/month)

K = Permeability of limiting soil layer, (in/month)

0.10 = Safety factor

Sites with seasonal high groundwater less than 5 feet deep may require drainage improvements before they can be utilized for slow rate land treatment. The design percolation at such sites is a function of the design of the drainage system.

16.7 Determination of Design Wastewater Loading

16.7.1General

The design wastewater loading is a function of:

a. Precipitation.
b. Evapotranspiration.
c. Design percolation rate.
d. Nitrogen loading limitations.
e. Other constituent loading limitations.
f. Groundwater and drainage conditions.
g. Average and peak design wastewater flows.

Therefore, developing the design wastewater loading is an iterative process. An initial value is selected from water balance calculations and used to determine wetted field area. This loading is then compared to nitrogen and other constituent loading limitations (reference Section 16.8). If the initial value exceeds these limitations, the design wastewater loading is reduced and the process is repeated. This iterative process is illustrated in Appendix 16-A.

16.7.2 Water Balance

Maximum allowable monthly wastewater hydraulic loadings are determined from the following water balance equation:

Lwh = (PET + Perc) – Pr Eq. 16-2

Where, Lwh=Maximum allowable hydraulic wastewater loading (in/month).

PET = Potential Evapotranspiration, (in/month)

Perc = Design percolation rate (in/month);

Pr = Five-year return monthly precipitation, (in/month).

Example water balance calculations are presented in Appendix A. From these, critical water balance months; i.e., months with the smallest allowable hydraulic wastewater loading, are identified.

16.7.3 Potential Evapotranspiration (PET)

Reliable field data for evapotranspiration are difficult to obtain. Therefore, values for average monthly potential evapotranspiration (PET) generated from vegetative, soil and climatological data are used in water balance calculations. The method used to estimate average monthly potential evapotranspiration for water balance calculations must be referenced in the Engineering Report. In addition, these values must be based on a record of 30 years of historical climatic data.

The Thornthwaite method is an empirical equation developed from correlations of mean monthly air temperatures with evapotranspiration from water balance studies in valleys of the east-central United States where soil moisture conditions do not limit evapotranspiration (The Irrigation Association, 1983, pp. 112 to 114). The Thornthwaite method is applicable to slow rate land treatment systems in the southeast United States, including Tennessee.

A modified version of the Thornthwaite equation is outlined below. Note that the results are expressed in inches, for a month period. Finally, for water balance calculations as described in this Section, a 30-year record of historical climatic data (referred to as the climatological normal) is required to determine monthly temperature normals used in the Thornthwaite equation.

$$PET = 0.63 \times S \times \left[\frac{(50 \times T-32)}{(9 \times I)}\right]^{A} \qquad \text{Eq. 16-3}$$

Where, PET = 0-day Thornthwaite Potential Evapotranspiration,(in)

S = Daylight hours, in units of 12 hours

T = Mean (normal) monthly air temperature, in degrees Fahrenheit

I = Annual heat index obtained by summing the 12 monthly heat indexes, i, where:

$$I = \left(\frac{T-32}{9}\right)^{1.514}$$

A=Power term derived from annual heat index, I, where:

$$A=0.000000675(I)^3 - 0.0000771(I)^2 + 0.01792(I) + 0.49239$$

Climatic information more appropriate to any specific location in Tennessee can be used, but its use must be documented in the Design Report. Also, other methods of calculating the PET can be used, provided that the use of an alternative method has been given prior approval by the TDHE.

16.7.4 Five-Year Return Monthly Precipitation

The TDHE requires the use of five-year return, monthly precipitation values in calculating the water balance. These values can be determined by either of the following methods:

a. Use the five-year annual rainfall and apportion this amount to each month, using each month's average for a 30-year period.

b. $Pr = Pr(Ave) + (0.85 \times \text{std. dev.})$ Eq. 16-4

where Pr(Ave) = average monthly precipitation from a 30- year historic record

std. dev. = standard deviation for same

Thirty-year records of precipitation (as well as temperature) are available for specific locations in Tennessee as well as for the four geographic divisions, shown in Figure 16-1. Climatic information can be obtained from the National Oceanic and Atmospheric Administration (NOAA)in Asheville, North Carolina. The source of any data that are used in designing a slow-rate irrigation system must be referenced in the Design Report.

16.8 Nitrogen Loading and Crop Selection and Management

16.8.1 General

Nitrate concentration in percolate from wastewater irrigation systems must not exceed 10 mg/L. Percolate nitrate concentration is a function of nitrogen loading, cover crop, and management of vegetation and hydraulic loading. The design wastewater loading determined from water balance calculations must be checked against nitrogen loading limitations. If, for the selected cover crop and management scheme, the proposed wastewater loading results in estimated percolate nitrate concentrations exceeding 10 mg/l, either the loading must be reduced or a cover crop with a higher nitrogen uptake must be selected.

16.8.2 Nitrogen Loading

In some instances, the amount of wastewater that can be applied to a site may be limited by the amount of nitrogen in the wastewater. A particular site may be limited by the nitrogen content of the wastewater during certain months of the year and limited by the infiltration rate during the remainder of the year.

Equation 16-5 is used to calculate, on a monthly basis, the allowable hydraulic loading rate based on nitrogen limits:

$$Lwn = \frac{Cp\,(Pr-PET) + U(4.424)}{(1 - f)(Cn) - Cp} \qquad \text{Eq. 16-5}$$

Where:

Lwn = allowable monthly hydraulic loading rate based on nitrogen limits, inches/month

Cp = nitrogen concentration in the percolating wastewater, mg/l. This will usually be 10mg/l

Pr = Five-year return monthly precipitation, inches/month

PET = potential evapotranspiration, inches/month

U = nitrogen uptake by crop, pounds/acre/month

Cn = nitrogen concentration in applied wastewater, mg/l (after losses in pre-application treatment)

f = fraction of applied nitrogen removed by denitrification and volatilization.

The values of Lwh and Lwn are compared for each month. The lesser of the two values, designated as Lwd, will be used in subsequent calculations to determine the amount of acreage needed.

The monthly values for nitrogen uptake by crops, U, can be derived by several methods:

1. Assume that the annual nitrogen uptake is distributed monthly in the same ratio as is the PET.

2. If data on nitrogen uptake versus time are available for the crops and climatic region specific to the project under design, then such information may be used.

Appendix A contains an example that illustrates the use of equations 16-2 and 16-5.

16.8.3 Cover Crop Selection and Management

Row crops may be irrigated with wastewater only when not intended for direct human consumption. Livestock must not be allowed on wet fields so that severe soil compaction and reduced soil infiltration rates can be avoided. Further, wet grazing conditions can also lead to animal hoof diseases. Pasture rotation should be practiced so that wastewater application can be commenced immediately after livestock has been removed. In general, a pasture area should not be grazed longer than 7 days. Typical regrowth periods between grazings range from 14 to 35 days. Depending on the period of regrowth provided, one to three water applications can be made during the regrowth period. At least 3 to 4 days drying time following an application should be allowed before livestock are returned to the pasture. Unmanaged, volunteer vegetation (i.e., weeds) is not an acceptable spray field cover. Disturbed areas in forest systems must be initially grassed and replanted for succession to forest.

Spray field cover crops require management and periodic harvesting to maintain optimum growth conditions assumed in design. Forage crops should be harvested and removed several times annually. Pine forest systems should be harvested at 20 to 25 year intervals. Hardwood forest systems should be harvested at 40 to 60 years. It is recommended that whole tree harvesting be considered to maximize nutrient removal. However, wastewater loadings following the harvesting of forest systems must be reduced until the hydraulic capacity of the site is restored. Spray field area to allow for harvesting and the regeneration cycle should be considered in design.

While high in nitrogen and phosphorus, domestic and municipal wastewaters are usually deficient in potassium and trace elements needed for vigorous agronomic cover crop growth. High growth rate forage crops such as Alfalfa and Coastal Bermuda will require supplemental nutrient addition to maintain nitrogen uptake rates assumed in design. Industrial wastewaters considered for irrigation should be carefully evaluated for their plant nutrient value.

16.9 Land Area Requirements

16.9.1 General

The land area to which wastewater is applied is termed a "field". The total land requirement includes not only the field area, but also land for any pre-application treatment facilities, storage reservoir(s), buffer zone, administration/maintenance structures and access roads. Field and buffer zone requirements are addressed in this Section. Land area for storage reservoirs is discussed in Section 16.10. All other land requirements will be dictated by standard engineering practices and will not be addressed in this document.

16.9.2 Field Area Requirements

The area required for the field is determined by using the following equation:

$$A = \frac{(Q_y + V)C}{Lwd} \qquad \text{Eq. 16-6}$$

where

A = field area, acres

Q_y = Flow, MG per year

V = net loss or gain in stored wastewater due to precipitation, evaporation and/or seepage at the storage reservoir, gallons per day

Lwd = design hydraulic loading rate, in/year

$$C = \frac{1{,}000{,}000 \text{ gal}}{\text{MG}} \times \frac{\text{ft}^3}{7.48 \text{ gal}} \times \frac{12 \text{ in}}{\text{ft}} \times \frac{\text{acre}}{43{,}560 \text{ ft}^2} = 36.83$$

The first calculation of the field area must be made without considering the net gain or loss from the storage reservoir. After the storage reservoir area has been calculated, the value of V can be completed. The final field area is then recalculated to account for V. The Appendix includes the use of Equation 16-6.

16.9.3 Buffer Zone Requirements

The objectives of buffer zones around land treatment sites are to control public access, improve project aesthetics and, in case of spray irrigation, to minimize the transport of aerosols. Since development of off-site property adjacent to the treatment site may be uncontrollable, the buffer zone must be the primary means of separating the field area from off-site property. Specific buffer zone requirements for varying system components and site conditions are provided in Section 2.4.5 of these regulations.

16.10 Storage Requirements

16.10.1 General

The design of a land application system must take into account that wastewater application will be neither continuous nor constant. Provisions must be made for containing wastewater when conditions exist such that either wastewater cannot be applied or when the volume of wastewater to be applied exceeds the maximum application rate.

The storage requirement can be determined by either of two methods. The first method involves the use of water balance calculations and is illustrated in Appendix A. The second

method involves the use of a computer program that was developed based upon an extensive NOAA study of climatic variations throughout the United States. The program entitled EPA-2 would probably be the most appropriate of the three programs available. For information on the use of the computer program, contact the National Climatic Center of NOAA at (704) 259-0448.

16.10.2 Estimation of Storage Requirements Using Water Balance Calculations

The actual wastewater that is available is compared to the actual amount that can be applied. Any excess wastewater must be stored. The actual wastewater volume must be converted to units of depth for that comparison. Equation 16-7 will be used:

$$Wp = \frac{Qm \times C}{Ap} \qquad \text{Eq. 16-7}$$

where

Wp = depth of wastewater, in inches

Qm = volume of wastewater for each month of the year, in million gallons

$$C = \frac{1{,}000{,}000 \text{ gd}}{\text{MG}} \times \frac{\text{ft}^3}{7.48 \text{ gal}} \times \frac{\text{acre}}{43{,}560 \text{ ft}^2} \times \frac{12 \text{ in}}{\text{ft}} = 36.83$$

Ap = field area, in acres

The months in which storage is required are cumulated to determine the maximum amount of total storage needed. The use of the method is illustrated in Appendix A.

The maximum storage amount in inches, over the field area, is converted to a volume, in cubic feet. A suitable depth is chosen and a storage basin surface area is calculated.

This storage basin will be affected by three factors: precipitation, evaporation and seepage. These three factors are determined and the result is V, which is then introduced back into equation 16-6. A new, final field area is calculated and a corresponding new storage volume is determined.

In Tennessee, the maximum seepage is 1/4 inch per day. This amount can be used unless the storage basin will be constructed so that a lesser seepage rate will result. In some cases, where an impervious liner will be constructed, the seepage rate will be zero.

16.11 Distribution System

16.11.1 General

The design of the distribution system is a critical aspect of the land application. The field area and the storage volume were derived with the assumption that wastewater would be evenly distributed. For high strength wastes or wastes with high suspended/settleable solids, sprinkler applications are preformed. Sprinklers will distribute these wastes more evenly over the treatment area whereas surface application may result in accumulation of solids and odors near the application point.

16.11.2 Surface Spreading

With surface spreading, wastewater is applied to the ground surface, usually by perforated pipe or by an irrigation-type ditch, and flows uniformly over the field by gravity. The uniform flow is critically dependent upon a constant slope of the field, both horizontal and perpendicular to the direction of flow. Several other factors are of importance:

a. Uniform distribution cannot be achieved on highly permeable soils. The wastewater will tend to percolate into the soil that is nearest to the point of application.

b. A relatively large amount of wastewater must be applied each time so that wastewater will reach all portions of the field. The dosing must account for the fact that the field area nearest the point of application will be wetted for a longer period of time and, thus, will percolate more wastewater.

c. Erosion and/or runoff may be a problem. Since a surface discharge will not be allowed to occur, a return system may be necessary.

16.11.3 Sprinkler Spreading

Sprinkler systems can be classified into one of three general categories: (1) solid set, (2) portable and (3) continuously moving. The following factors should be considered during design:

a. The hydraulic conditions within the distribution system must be given a thorough review. Head losses through pipes, bends, nozzles, etc., must be balanced so that the wastewater is uniformly applied to the field.

b. Design must consider the effects of cold weather. Nozzles, risers, supply pipes, etc., must be designed to prevent wastewater from freezing in the various parts.

c. Wind can distort the spray pattern. Also, aerosols may be carried off the field area. A properly designed buffer zone should alleviate most of the aerosol problems. Also,

the O&M manual can include a provision which would prevent spraying when the wind velocity is high enough to carry wastewater off the field area.

d. Crop selection is important. The higher humidity level may lead to an increase in crop disease.

e. Higher slopes can be used than in surface spreading (see Section 16.1.3). Also, slopes do not need to be constant. Further, the type of crop is nearly unlimited. Forests can be irrigated with solid set sprinklers. Forage crops can be irrigated with any of the three basic types of systems.

f. The system layout must take into consideration the method that will be used for harvesting the crop.

16.12 Spray Irrigation of Wastewater from Gray Water Facilities

16.12.1 General

This Section provides criteria for facilities that produce a "gray water" wastewater. These facilities include coin-operated laundries, car washes and swimming pool backwash filters. Wastewater disposal requirements are not as complex as are those for domestic wastewater. An engineering report which provides information on the design of the facilities must be submitted to the Division.

16.12.2 Site Location

16.12.2.1 The Division of Water Pollution Control must inspect and approve the proposed site prior to any construction being undertaken.

16.12.2.2 The site must be chosen such that the operation of the system will not affect surrounding property owners. No surface runoff or stream discharge will be allowed.

16.12.3 Design Flow

Since these are service enterprises, the amount of wastewater that is generated is directly related to the desire of people to use the facilities. Thus, an estimate of the number of potential users (and frequency) is extremely important. Various factors must be taken into consideration:

a. A rural setting would tend to have a shorter daily usage period than would an urban location.

b. An area that is predominately single-family houses would tend to have a lesser usage rate for laundries and car washes than would an area with apartment complexes.

c. The amount of water that washing machines use will vary among manufacturers and models. The Division recommends the use of water-saving machines.

The engineer should use 250 gpd/washer for laundries and 700 gpd/bay for car washes unless more reliable data is available.

16.12.4 Pre-treatment

16.12.4.1General

Facilities that produce gray water have different pretreatment requirements, designed not only to the type of facility but also to the specific establishment.

16.12.4.2 Laundries

a. All laundry wastewater (does not include sanitary wastes) shall pass through a series of lint screens. A series will consist of five screens, starting with a screen with 1-inch mesh and ending with a screen that is basically equivalent to a window screen.

b. Since some detergents produce a wastewater with a pH in the range of 11.0 - 11.5, some type of pH adjustment may be necessary. This may occur as a retrofit if the vegetation in the spray plots is being stressed by the high pH.

c. Disinfection will generally not be required unless the operation of the facilities will result in a potential hazard to the public. The need for disinfection will be determined by the Division on a case-by-case basis.

16.12.4.3 Car Washes

a. All car wash wastewater shall pass through a grit removal unit. The flow-through velocity shall be less than 0.5 feet per second. The grit removal unit shall be constructed to facilitate the removal of grit.

b. The use of detergents with a neutral (or nearly neutral) pH is recommended. The use of high-pH detergents may require neutralization if the vegetation is being stressed by the high pH.

16.12.4.4 Swimming Pools

a. A holding tank/pond shall be provided to receive the backwash water from the swimming pool filters. The solids shall be allowed to settle to the bottom before the supernatant is removed for disposition on the spray plots.

b. Dechlorination may be required if the vegetation on the plots is being stressed by the chlorine in the water.

c. If the entire pool volume is to be emptied, by using the spray plots, the rate shall be controlled so as to not exceed the application rate that is specified in Section 16.7.1.

16.12.5 Field Requirements

16.12.5.1 The maximum wastewater that can be sprayed on a site is based either on the nitrogen content of the wastewater or an amount equal to 10% of the infiltration rate of the most restrictive layer of soil which shall be determined with input from a qualified soil scientist.

16.12.5.2 The application of wastewater shall alternate between at least two separate plots. Each plot shall not receive wastewater for more than three consecutive days and must have at least three days rest between applications. Reserve land area of equivalent capacity must be available for all greg water systems.

16.12.5.3 Ground slopes shall not exceed 30%. Extra precautions must be taken on steep slopes (15-30%) to prevent runoff and erosion.

16.12.5.4 The field shall be covered with a good lawn or pasture grass unless an existing forested area is chosen. The ground cover should be a sturdy perennial that will resist erosion and washout. Forested areas should be chosen so that installation of sprinkler equipment will not damage the root systems of the trees and will not produce runoff due to the usual lack of grass in forested areas.

16.12.6 Application Equipment

16.12.6.1 Sprinklers shall be of a type and number such that the wastewater will be evenly distributed over the entirety of a plot. Information on sprinklers shall be included in the engineering report. In forest plots, sprinklers shall be on risers which shall be tall enough to allow the wastewater to be sprayed above the undergrowth. Sprinklers shall be of the type that are not susceptible to clogging.

16.12.6.2 All piping (excluding risers) shall be buried to a depth that will prevent freezing in the lines. An exception to this burial requirement can be made in the case where piping will be laid in forested areas. Burial in this case may be difficult, expensive and may kill some trees. All risers shall be designed such that wastewater will drain from them when wastewater is not being pumped. This can be accomplished by either draining all lines back into the pump sump or by placing a gravel drain pit at the base of each riser. Each riser would necessarily be equipped with a weep hole. Particular attention

must be given during the design so that the entire subsurface piping does not drain into these pits.

16.12.6.3 The engineering report must contain hydraulic calculations that show that each nozzle distributes an equivalent amount of wastewater. Differences in elevation and decreasing pipe sizes will be factors which need to be addressed.

16.12.6.4 The piping must be of a type that will withstand a pressure equal to or greater than 1-1/2 times the highest pressure point in the system. The risers should be of a type of material such that they can remain erect without support. The pipe joints should comply with the appropriate ASTM requirements. Adequate thrust blocks shall be installed as necessary.

16.12.6.5 A sump shall be provided into which the wastewater will flow for pumping to the spray plots. The pump can be either a submersible type, located in the sump, or a dry-well type, located immediately adjacent to the sump in a dry-well. The pump shall be capable of pumping the maximum flow that can be expected to enter the sump in any 10-minute period. The pump shall be operated by some type of float mechanism. The float mechanism shall activate the pump when the water level reaches 2/3 of the depth of the sump and should de-activate the pump before the water level drops to the point to where air can enter the intake.

If the distribution system is designed to drain back into the sump, the sump shall be enlarged to account for that volume.

If desired, the sump for laundries can also contain the lint screens. The screens shall, in any case, be constructed so that they cannot be bypassed. They shall be built so that they can be easily cleaned. A container shall be provided for disposal of the lint which is removed from the screens.

16.12.6.6 The pipe from the facility to the sump shall be large enough to handle the peak instantaneous flow that could be realistically generated by the facility. Flow quantities, head loss calculations, etc., shall be included in the engineering report.

16.12.7 Operation of System

16.12.7.1 The operator shall insure that wastewater is applied to alternate plots on a regular basis.

16.12.7.2 Monthly operating reports shall be submitted to the appropriate field office of the Division of Water Pollution Control. The parameters to be reported shall be delineated by field office personnel but should include, as a minimum, dates of spray plot alternation.

16.12.7.3 The owner of the system shall apply for and receive an operating permit from the Division prior to initiation of operation of the system.

16.12.7.4 The system operator shall inspect and maintain the pump and sprinklers in accordance with manufacturer's recommendations. An operations manual shall be located at the facility for ready reference.

16.12.7.5 The operator shall inspect the wastewater facilities on a regular basis. The inspection shall include the spray plots to determine whether or not runoff and/or erosion are or have occurred, the spray patterns of the sprinklers, the physical condition of the system (looking for damage due to adverse pH conditions), etc.

16.12.7.6 The spray plots shall be mowed on a regular basis to enhance evapotranspiration. Grass height shall not exceed 6".

16.12.7.7 The lint screen at laundries shall be cleaned on a schedule that is frequent enough to prevent upstream problems due to head loss through the screens. Disposition of the lint shall be in accordance with applicable requirements.

16.12.7.8 The grit traps at car washes shall be cleaned at a frequency that is sufficient to keep the trap in its designed operating condition.

16.12.7.9 If the car wash is equipped with an automatic wax cycle, the operator shall be especially attentive to the possibility of wax build-up on the sump, pump and all downstream piping.

16.12.7.10 The operator shall insure that the car wash facility is not used as a sanitary dumping station for motor homes or for washing trucks/trailers that are used for hauling livestock. If necessary, the facility shall be posted with signs which clearly indicate this prohibition.

16.12.7.11 The sludge holding tank/pond at a swimming pool facility shall be cleaned at a frequency that is sufficient to prevent solids from being carried over into the pump sump. Cleaning shall be performed in a manner that will minimize re-suspending the solids and allowing them to enter the pump sump.

16.13 Plan of Operation and Management

A plan of Operation and Management is required before an Operating Permit can be issued. The Plan is written by the owner or the owner's engineer during construction of the slow rate land treatment system. Once accepted by the Division, the Plan becomes the operating and monitoring manual for the facility and is incorporated by reference into the Permit. This manual must be kept at the facility

site and must be available for inspection by personnel from the Tennessee Department of Health and Environment.

This Plan should include, but not be limited to, the following information:

16.13.1 Introduction

a. System Description:

1. A narrative description and process design summary for the land treatment facility including the design wastewater flow, design wastewater characteristics, pre-application treatment system and spray fields.

2.A map of the land treatment facility showing the pre-application treatment system, storage pond(s), spray fields, buffer zones, roads, streams, drainage system discharges, monitoring wells, etc.

3.A map of force mains and pump stations tributary to the land treatment facility. Indicate their size and capacity.

4. A schematic and plan of the pre-application treatment system and storage pond(s) identifying all pumps, valves and process control points.

5. A schematic and plan of the irrigation distribution system identifying all pumps, valves, gauges, sprinklers, etc.

b. Discuss the design life of the facility and factors that may shorten its useful life. Include procedures or precautions which will compensate for these limitations.

c. A copy of facility's Tennessee Operating Permit.

16.13.2 Management and Staffing

a. Discuss management's responsibilities and duties.

b. Discuss staffing requirements and duties:

1.Describe the various job titles, number of positions, qualifications, experience, training, etc.

2.Define the work hours, duties and responsibilities of each staff member.

16.13.3 Facility Operation and Management

a. Pre-application Treatment System:

1. Describe how the system is to be operated.

2. Discuss process control.

3. Discuss maintenance schedules and procedures.

b. Irrigation System Management:

1. Wastewater Application. Discuss how the following will be monitored and controlled. Include rate and loading limits.

(a) Wastewater loading rate (inches/week)

(b) Wastewater application rate (inches/hour)

(c) Spray field application cycles

(d) Organic, nitrogen and phosphorus loadings (lbs/acre per month, etc)

2. Discuss how the system is to be operated and maintained.

(a) Storage pond(s)

(b) Irrigation pump station(s)

(c) Spray field force main(s) and laterals

3. Discuss start-up and shut-down procedures.

4. Discuss system maintenance.

(a) Equipment inspection schedules

(b) Equipment maintenance schedules

5. Discuss operating procedures for adverse conditions.

(a) Wet weather

(b) Freezing weather

(c) Saturated Soil

(d) Excessive winds

(e) Electrical and mechanical malfunctions

6. Provide troubleshooting procedures for common or expected problems.

7. Discuss the operation and maintenance of back-up, stand-by and support equipment.

c. Vegetation Management:

1. Discuss how the selected cover crop is to be established, monitored and maintained.

2. Discuss cover crop cultivation procedures, harvesting schedules and uses.

3. Discuss buffer zone vegetative cover and its maintenance.

d. Drainage System (if applicable):

1. Discuss operation and maintenance of surface drainage and runoff control structures.

2. Discuss operation and maintenance of subsurface drainage systems.

16.13.4 Monitoring Program

a. Discuss sampling procedures, frequency, location and parameters for:

1. Pre-application treatment system.

2. Irrigation System:

(a) Storage pond(s)

(b) Groundwater monitoring wells

(c) Drainage system discharges (if applicable)

(d) Surface water (if applicable)

b. Discuss soil sampling and testing:

c. Discuss ambient conditions monitoring:

1. Rainfall

2. Wind speed

3. Soil moisture

d. Discuss the interpretation of monitoring results and facility operation:

1. Pre-application treatment system.

2. Spray fields.

3. Soils.

16.13.5 Records and Reports

a. Discuss maintenance records:

1. Preventive.

2. Corrective.

b. Monitoring reports and/or records should include:

1. Pre-application treatment system and storage pond(s).

(a) Influent flow

(b) Influent and effluent wastewater characteristics

2. Irrigation System.

(a) Wastewater volume applied to spray fields.

(b) Spray field scheduling.

(c) Loading rates.

3. Groundwater Depth.

4. Drainage system discharge parameters (if applicable).

5. Surface water parameters (if applicable).

6. Soils data.

7. Rainfall and climatic data.

APPENDIX A

Due to the complexity of working with all of the variables that are inherent with land application systems, the most beneficial use of these criteria might be afforded by designing a slow-rate irrigation system for a hypothetical town in Tennessee. The following information is given:

Given: The town is in the Cumberland Plateau Section

The first step involves Equation 16-2, the water balance equation:

$$Lwh = (PET + Perc) - Pr \qquad \text{Eq. 16-2}$$

The Thornthwaite equation, Equation 16-3, will be used to derive the potential evapotranspiration (PET) term:

$$PET = 0.63 \times S \times \frac{50 \times (T-32)}{9 \times I}^{A} \qquad \text{Eq. 16-3}$$

The use of this equation requires that daylight hours at the particular latitude and the monthly air temperatures be used. Tennessee lies between latitudes of about 35^{O} and 36^{O} 40'. Since the latitudinal distance in Tennessee is not large, the daylight hours at the 36^{o} latitude will be adequate for any town in Tennessee. Table A-1 lists the average monthly daylight hours, in units of 12 hours, 36^{o} latitude.

Table A-1
Monthly Average Daylight Hours (S), in Units
of 12 hours, for the 36O Latitude 360

January	0.84
February	0.91
March	1.00
April	1.09
May	1.17
June	1.21
July	1.19
August	1.12
September	1.04
October	0.94
November	0.86
December	0.81

The National Oceanic and Atmospheric Administration has published information on air temperature. A 30-year monthly average for the Cumberland Plateau Section, for the period of 1951 - 1980, will be used. Table A-2 is used to show the monthly daylight hours, air temperature and PET for this system.

Table A-2
Data Used, and Results Derived, for PET

	S at 36 Degree Latitude	Air Temp. Degrees Fahrenheit	PET, inches per month
January	0.84	35.6	0.10
February	0.91	38.6	0.27
March	1.00	46.9	0.97
April	1.09	57.3	2.30
May	1.17	64.7	3.59
June	1.21	71.6	4.90
July	1.19	75.0	5.44
August	1.12	74.3	5.00
September	1.04	68.8	3.79
October	0.94	57.3	1.98
November	0.86	46.7	0.82
December	0.81	39.1	0.27

TOTAL = 29.43

Air temperature data for a specific location can be used, but its use must be documented by the NOAA. Also, other methods of calculating the PET can be used, provided that the use of an alternate method has been given prior approval by the TDHE.

Table A-3 is an indication of the Pr value in Eq. 16-2. Section 16.7.4 contains Equation 16-4 which is used in this case:

Pr = Pr (average) + (0.85 x std. dev.) Eq. 16-4

Table A-3
Five-Year Annual Rainfall, Using the 30-Year
Average Monthly Rainfall and Standard Deviation

	30-Year Average Rainfall, Inches	Standard Deviation	Pr Inches
January	5.46	2.54	7.62
February	4.83	2.22	6.72
March	6.45	2.82	8.85
April	4.95	1.93	6.59
May	4.75	1.62	6.13
June	4.32	1.41	5.52
July	5.06	2.10	6.85
August	3.60	1.33	4.73
September	4.10	1.69	5.54
October	3.08	1.63	4.47
November	4.39	2.02	6.11
December	5.43	2.49	7.55
TOTAL	56.42		76.68

An assumption is made that a site, with adequate acreage, has been selected, based on a site study. The following information is given:

Given: the most limiting soil layer has an infiltration rate of 0.3 inches/hour.

0.3 in/hr x 24 hr/day x 7 day/week x 0.10 = 5.04 in/week.

The 0.10 figure is the 10 percent design percolation limit.

Given: Wastewater can be applied in January only ten days, due to frozen soil, snow cover, etc.

Given: Wastewater can be applied in February and December on only 20 days.

Equation 16-2 can now be used to determine the maximum allowable monthly hydraulic wastewater loading, Lwh. Table A-4 illustrates the results:

Table A-4
Determination of Maximum Allowable Monthly
Hydraulic Wastewater Loading, D (allowed), Inches/Month

	(1) PET	(2) Pr	(3) (1)-(2)	(4) Perc. (3)(4)	(5) Lwh
January	0.10	7.62	-7.52	7.20	0
February	0.27	6.72	-6.45	14.40	7.95
March	0.97	8.85	-7.88	22.32	14.44
April	2.30	6.59	-4.29	21.60	17.31
May	3.59	6.13	-2.54	22.32	19.78
June	4.90	5.52	-0.62	21.60	20.98
July	5.44	6.85	-1.41	22.32	20.91
August	5.00	4.73	0.27	22.32	22.59
September	3.79	5.54	-1.75	21.60	19.85
October	1.98	4.47	-2.49	22.32	19.83
November	0.82	6.11	-5.29	21.60	16.31
December	0.27	7.55	-7.28	14.40	7.12
TOTALS	29.43	76.68	-47.25	234.00	187.07

Based upon a maximum infiltration rate of 5.04 in/week, a water loss (PET), and a precipitation water gain, column 5 illustrates the maximum yearly and monthly hydraulic wastewater application rates. These rates will be used in the design of the system unless other limitations occur.

The most important of those other limitations is the percolate nitrogen concentration. If percolating water from a slow rate (SR) system will enter a potable ground water aquifer, then the system should be designed such that the concentration of nitrate nitrogen in the receiving ground water at the project boundary does not exceed 10 mg/l. Section 16.8.1 indicates that the nitrate concentration in the percolate must not exceed 10 mg/l. The approach to meeting this requirement involves estimating an allowable monthly hydraulic loading rate based on an annual nitrogen balance and comparing these monthly rates to the monthly rates that are based on an application rate of 2.5 inches/week.

Equation 16-5 is used to determine monthly wastewater application rates based on a nitrate concentration of 10 mg/l.

$$Lwn = \frac{Cp\,(Pr - PET) + U\,(4.424)}{(1-f)\,(Cn) - Cp} \qquad \text{Eq. 16-5}$$

The following information is given:

Given: Cp = 10 mg/l

Given: Cn = 25 mg/l

Given: f = 25%

Given: U = 200 pounds/acre/year. This uptake is not constant; rather, the uptake is at a minimum in the cold months and is at a maximum in the warm months. Table A-5 indicates what percentage of U was allocated to each month.

Given: Pr and PET have been developed previously and have been included in Table A-5.

The monthly use of Equation 16-5 is illustrated in Table A-5. Also, this table includes a comparison of the monthly rates that were developed from the infiltration and the nitrogen bases.

Table A-5
Determination of Maximum Allowable Monthly Hydraulic
Wastewater Loading Based on Nitrogen Concentration
Comparison Between Infiltration and Nitrogen Loading Rates

	(2) Pr	(1) PET	U	(6)	(7) Lwn	(5) Lwn	(8) Lwd
	in.	in.	%	lbs.	in./mo.	in./mo.	in./mo.
January	7.62	0.10	1	2	9.61	0	0
February	6.72	0.27	2	4	9.39	7.95	7.95
March	8.85	0.97	4	8	13.05	14.44	13.05
April	6.59	2.30	8	16	12.99	17.31	12.99
May	6.13	3.59	12	24	15.04	19.78	15.04
June	5.52	4.90	15	30	15.88	20.98	15.88
July	6.85	5.44	17	34	18.80	20.91	18.80
August	4.73	5.00	15	30	14.86	22.59	14.86
September	5.54	3.79	12	24	14.13	19.85	14.13
October	4.47	1.98	8	16	10.94	19.83	10.94
November	6.11	0.82	4	8	10.09	16.31	10.09
December	7.55	0.27	2	4	10.34	7.12	0
TOTALS	76.68	29.43	100	200	155.12	187.07	133.73

As can be seen in Table A-5, soil infiltration is the limiting factor in the months of December, January and February. All other months have a limiting factor that is based on the nitrogen uptake rates of the crop.

The preliminary amount of land, Ap, that will be necessary for application of wastewater is determined by using Equation 16-6:

$$Ap = \frac{(Q_y + V)\,C}{(Lwd)} \qquad \text{Eq. 16-6}$$

The equation will be first solved without using the V term. The following information is given:

Given: Qy = MG per year = 36.5 MG
Given: Lwd = 133.73 inches/year (see column (8) Table A-5)
Given: C = 36.83

Substituting into Equation 16-6 gives the following:

$$Ap = 10.05 \text{ acres}$$

This preliminary acreage is used in determining storage needs. When the storage requirements are determined, the V term can then be a derived and the actual field area, Af, can be calculated.

Storage volume requirements will be performed here by using water balance calculations. The basic steps are as follows:

1.The available monthly wastewater volume is converted to a unit of depth, in inches, by using the following equation:

$$Wp = \frac{Qm \times 36.83}{Ap} \qquad \text{Eq. 16-7}$$

In using the equation, the Qm term is assumed to be either 3.1 MGM, 3.0 MGM or 2.8 MGM, depending on the number of days in any particular month. No yearly variation is taken into account. In actuality, infiltration and inflow (I/I) and daily flow variations will require actual flow values.

Table A-6 is illustrative of the use of Eq. 16-7.

Table A-6

Estimation of Storage Volume Requirements
Using Water Balance Calculations

	(8) Lwd	(9) Wp	(10) Change (9)-(8)	(11) Cumulative Storage
January	0.00	11.36	11.36	24.04
February	7.95	10.26	2.31	26.35(b)
March	13.05	11.36	-1.69	24.66
April	12.99	10.99	-2.00	22.66
May	15.04	11.36	-3.68	18.98
June	15.88	10.99	-4.89	14.09
July	18.80	11.36	-7.44	6.65
August	14.86	11.36	-3.50	3.15
September	14.13	10.99	-3.14	0.01(c)
October	10.94	11.36	0.42(a)	0.42
November	10.09	10.99	0.90	1.32
December	0.00	11.36	11.36	12.68
	133.73	133.74		

(a) Starting at October, in this example, will result in the maximum storage.
(b) Maximum storage.
(c) Rounding error; assume zero.

The storage volume is calculated by multiplying the maximum cumulative storage by the field area, as indicated below:

Storage volume = (26.35 in) (10.05 acres) (ft/12 in) (43,560 ft^2/acre)

= 961,000 ft^3 (rounded off)

The storage volume will be dependent upon three factors: precipitation, evaporation, and allowed seepage. To obtain the final volume, the following steps are used:

1.Calculate the area of the storage volume.

Assume a maximum depth of 10 feet

Area = Volume _ depth

Area = 961,000 ft^3 _ 10 ft
Area = 96,100 ft^2

2.Determine the monthly gain or loss in storage volume due to precipitation, evaporation and seepage in accordance with the following equation (see Table A-7):

Vm = (Pr - evaporation - seepage)

Column 14 is the result of using this equation. Precipitation has been presented previously in Table A-5. Evaporation is assumed to be 20 inches per year, distributed monthly in the same ratios of monthly PET to annual PET. Seepage rate shall not exceed 1/4 inch per day, in accordance with criteria in Chapter 9.

Vm is converted from inches (Column 14) to MG (Column 15) by using the following equation:

Vm = (Column 14) x 1 ft/12 in x 96,100 ft^2 x 7.48 gal/ft^3 x 1 MG/1,000,000 gal

Vm = (Column 14) x 0.0599

3. The monthly storage losses and gains are added for a yearly total, Vt. This term is inserted back into Eq. 16-6 to calculate the actual, final field area.

$$A = \frac{(Qy + Vt)C}{Lwd} \qquad \text{Eq. 16-6}$$

where Qy = 36.5 MG

Vt = -2.073 (from Column 15, Table A-7)

C = 36.83

Lwd = 133.73 in/year

Substituting into Eq. 16-6 yields the following:

Af = 9.48 acres

4. The water loss or gain is substracted or added to the monthly available wastewater, previously used in Eq. 16-7 (see Columns 15, 16 and 17, Table A-7).

5. The monthly available wastewater amounts, from column 17 of Table A-7, are converted to depths, in inches, by using Eq. 16-7.

$$Wf = \frac{Qm \times (36.83)}{A_f} \qquad \text{Eq. 16-7}$$

where

Qm = MG

Af = 9.48 acres

6. Substituting the monthly values of Q_{mf} into Eq. 16-7 yields column 18 of Table A-7. This is the amount of wastewater that will be available, in inches per month, for application to the field.

7. The available wastewater will be limited to field application due to weather, soil conditions, etc. This has been determined previously, was shown as Column 8 in Table A-5 and is re-indicated in Column 8 in Table A-7.

8. The difference between available wastewater and the amount that can be applied to the field is indicated in Column 19 of Table A-7. This column is derived by subtracting Column 8 from Column 18. A positive number indicates that more wastewater is available than can be applied; thus, storage is necessary. A negative number indicates that the soil can receive more wastewater than is received on a daily basis; thus, the wastewater that has been stored can be applied to the field along with the daily flow.

9. The cumulative storage is re-calculated, beginning with the storage basin(s) empty; in this case, at the beginning of October. This cumulative storage is shown in Column 20 of Table A-7 and indicates that a storage basin must be large enough to contain a volume of water equal to 27.00 inches of wastewater over the field area of 9.48 acres.

The final storage volume is determined as follows:

Vol. = (27.00 in) (9.48 acres) (ft/12 in) (43,560 ft2/acre)

Vol. = 929,000 ft3 (rounded off)

10. Without changing the surface area of 96,100 ft2, the depth is re-calculated:

Depth = Volume _ area

= 929,000 ft3 _ 96,100 ft2

Depth = 9.67 feet

Table A-7

	(2) (17) Water loss/gain, V Pr Wf inches (16)+(15)		(12) (18) Evap. Lwd inches inches	(13) (8) Wastewater Seepage, inches inches	(14) (19) (2)-(12)-(13) inches (18) - (8)	(15) (20) Qm MG	(16) Qmf MG
January	7.62 3.088		0.07 12.00	7.75 0.00	-0.20 12.00	-0.012 25.09	3.1
February	6.72 2.772		0.18 10.77	7.00 7.95	-0.46 2.82	-0.028 27.91	2.8
March	8.85 3.126		0.66 12.14	7.75 13.05	0.44 -0.91	0.026 27.00	3.1
April	6.59 2.852		1.56 11.08	7.50 12.97	-2.47 -1.91	-0.148 25.09	3.0
May	6.13 2.857		2.44 11.10	7.75 15.04	-4.06 -3.94	-0.243 21.15	3.1
June	5.52 2.682		3.33 10.42	7.50 15.88	-5.31 -5.46	-0.318 15.69	3.0
July	6.85 2.824		3.70 10.97	7.75 18.80	-4.60 -7.83	-0.276 7.86	3.1
August	4.73 2.715		3.40 10.55	7.75 14.86	-6.42 -4.31	-0.385 3.55	3.1
September	5.54 2.728		2.58 10.60	7.50 14.13	-4.54 -3.53	-0.272 0.02	3.0
October	4.47 2.823		1.34 10.97	7.75 10.94	-4.62 0.03	-0.277 0.03	3.1
November	6.11 2.883		0.56 11.20	7.50 10.09	-1.95 1.11	-0.117 1.14	3.0
December	7.55 3.077		0.18 11.95	7.75 0.00	-0.38 11.95	-0.023 13.09	3.1
Total	76.68	20.00	91.25	-34.57	-2.073	36.5	34.427
133.75		133.73					

Table 16-1
HYDRAULIC CONDUCTIVITY TEST METHODS

1.0 SATURATED VERTICAL HYDRAULIC CONDUCTIVITYa	
1.1 Laboratory Tests:b	
Constant Head Method (coarse grained soils)	ASTM D 2434-68 AASTHO T 215-70 Bowles (1978), pp 97-104 Kezdi (1980), pp 96-102
Falling Head Methodc (cohesive soils)	Bowles (1978), pp 105-110 Kezdi (1980), pp 102-108
1.2 Field Tests:	
Flooding Basin Methodc	U.S. EPA (1981), pp 3-13 to 15
Ring Permeameter Method	Boersma (1965) U.S. EPA (1981), pp 3-22 to 23
Double Tube Methodc	Bouwer and Rice (1967) U.S. EPA (1981), pp 3-17 to 24
Air-Entry Permeameterc Method	Bouwer (1966) Reed and Crites (1984), pp 176 to 180 Topp and Binns (1976) U.S. EPA (1981), pp 3-24 to 27
2.0 SATURATED HORIZONTAL HYDRAULIC CONDUCTIVITYd	
2.1 Field Tests:	
Auger Hole Method	Reed and Crites (1984), pp 165 to 168 U.S. EPA (1984), pp 3-32 to 35 U.S. Dept. of Interior (1978), pp 55-67
Slug Test	Bouwer and Rice (1976)

a. Other methods, properly documented, may be accepted by the TDHE. However, "standard" percolation tests as performed for septic tank drain fields are not acceptable.

b. These tests require undisturbed field samples properly prepared to insure saturation. Reconstructed field samples are not acceptable. A description of the field sampling technique should accompany the laboratory testing results.

c. Methods recommended by the TDHE.

d. Testing for saturated horizontal hydraulic conductivity is required at land treatment sites where drainage improvements are planned and where lateral, as opposed to vertical, subsurface drainage is the predominant drainage pathway.

Table 16-2
Suggested Values for Inorganic Constituents
in Wastewater Applied to Land

	Potential Problem and Constituent Severe	No Problem	Increasing
pH (std. units)	6.5 - 8.4		<5.0 >9.0
Permeability			
Electrical Conductivity (mho/cm)	>0.50	<0.50	<0.2
Sodium Adsorption Ratio (a)	<5.0	5.0 - 9.0	>9.0
Salinity			
Electrical Conductivity (mmho/cm)	<0.75	0.75 - 3.0	>3.0
Specific Ion			
Anions:			
Bicarbonate (meq/l)	<1.5	1.5 - 8.5	>8.5
(mg/l as CaCO3)	<150	150 – 850	>850
Chloride (meq/l)	<3.0	>3.0	>10
(mg/l)	<100	>100	>350
Fluoride (mg/l)	<1.8		
Cations:			
Ammonia (mg/l as N)	<5.0	5.0 – 30	>30
Sodium (meq/l)	<3.0	>3.0	>9.0
(mg/l)	<70	>70	
Trace Metals (mg/l):			
Aluminum	<10		
Arsenic	<0.2		
Beryllium	<0.2		
Boron	<0.5	0.5 - 2.0	>2.0
Cadmium	<0.02		
Chromium	<0.2		
Cobalt	<0.1		
Copper	<0.4		
Iron	<10		

Lead	<10
Lithium	<2.5
Manganese	<0.4
Molybdenum	<0.02
Nickel	<0.4
Selenium	<0.04
Zinc	<4.0

a. Sodium Adsorption Ratio = $\frac{Na+1}{SQR\ (Ca+2 + Mg+2)/\ 2)}$

Where, Na+1, Ca+2 and Mg+2 in the wastewater are expressed in milliequivalents per liter (meq/l). SQR represents 'square root of'.

2.3 REQUIREMENTS FOR DRIP EMITTER SYSTEMS

Chapter 16 of the Department of Environment and Conservation's Design Criteria does not address the use of drip emitter systems for the disposal of the treated effluent. Drip emitter systems are acceptable for use in disposal of the treated wastewater. The following provisions shall apply for drip emitter systems:

1. BUFFER ZONES, PUBLIC ACCESS AND PROTECTION OF WATER SUPPLY WELLS

Buffer zones are required to provide adequate access to buried drip lines and to ensure that no wastewater leaves the site. Specific buffer zone requirements for varying system components and site conditions are provided in Section 2.4.5 of these regulations.

In order to protect the drinking water aquifers, abandoned water supply wells within the treatment site must be identified along with all public water supply wells within 1,500 linear feet of any community land treatment site and all private water supply wells within 500 linear feet of any community land treatment site. Shallow wells within 500 feet of a community land treatment system will require monitoring along with all other monitoring wells.

Public access to the disposal field shall be restricted by posting signs and fencing of disposal fields. Fencing and access road gates shall be provided along property lines adjacent to residential and other developed areas. Fencing is required around all wastewater treatment systems, storage facilities, pump stations, and holding ponds.

2. SURFACE DRAINAGE AND RUN-OFF CONTROL

Drainage of storm run-off should be considered in the design of drip irrigation systems. All land application fields must be protected against flooding (below 10 year flood elevation), ponding and erosion. Run-off from upgradient areas should be redirected around the irrigation site. If properly designed and constructed, drip irrigation systems will not produce any runoff if surface applied or any surface flow of wastewater if subsurface applied. All areas that acquire a wet surface should have the hydraulic loading rate reduced to prevent the situation from recurring. Areas exhibiting a wet surface on a regular basis must be eliminated from future applications unless the surface wetting can be corrected. A reassessment of the design should be performed to determine if reconstruction or repair of the failing area would correct the deficiency. Any areas taken out of service because of failure will subsequently cause a reduction in the permitted system capacity.

Indirect runoff as a result of underflow, changes in slope, and shallow restrictive soil layers can be anticipated at some slow rate land treatment sites. Indirect runoff may be acceptable if it is dispersed over a wide area. However, monitoring of streams affected by such indirect runoff will be required.

Water resulting from line flushing must be dispersed over a wide area. No flush waters shall be permitted to flow off the site onto adjoining property. Direct discharge of these flows into any

water course is prohibited. Effluent from line flushing should be absorbed by the surrounding area within a few minutes of line flushing. Line flushing should not be performed during any rain event.

3. DISTRIBUTION SYSTEMS, MAINTENANCE AND CONSTRUCTION

Hydraulic calculations for the pump and distribution system must be submitted for review in the DDR. Field pressure and flow variation due to friction loss and changes in static head should not exceed plus or minus 10% of the design emitter pressure or flow. If this criterion cannot be met, revisions to field layout, emitter output, or any other viable option should be used to comply with this requirement. The system will not be allowed to initiate operations if the total flow or pressure variation is in excess of 10% of the design. The 10% difference should be the difference between any two emitters in the entire system.

Fields should be laid out so that the irrigation lines follow the contour of the site. The DDR submittal should contain the proposed line layout so that flushing flows and static head calculations can be addressed on a field by field basis. Each field should define total flow (gpm) proposed, total length of emitter piping, emitter spacing, line spacing, total numbering of lines and total number of lines to be included per flushing. This layout information should be shown on a topographic map. All proposed main line sizes and lengths along with individual irrigation line lengths should be shown. All return piping sizes and lengths should also be shown and should not exceed manufacturers' specifications to insure equal distribution to each emitter. Emitter and line spacing should be in accordance with manufacturers' recommendations.

System should be self-draining to prevent freezing during the winter months. The Plan of Operation and Management should address disinfection and flushing of emitter lines to prevent solids build-up. Flushing of lines should be performed according to the manufacturers' recommendations but at minimum on a bi-monthly basis. **Velocities must be a minimum of 2 feet per second at the end of each irrigation or return line during the flushing operation.** Calculations supporting the 2 feet per second velocity requirement should be included in the DDR.

Satisfactory operation of the drip irrigation system is necessary to safeguard the health of the public and to insure that the wastewater effluent is disposed of in an environmentally sound manner. Emitter manufacturers must supply documentation that placing the emitter in the root zone of the cover crop will not interfere with the emitter performance. Emitters should be buried no less than 5 inches nor more than 7 inches from the surface for optimum nutrient uptake. Variance from this depth of burial will be evaluated on a case by case basis if supported by manufacturers' recommendations. All systems must be equipped with audible and visual alarms to signal system malfunctions. Telemetry systems should also be installed where the facility is not manned during normal working hours. Monitoring equipment must be provided to detect a 5% change in flow rate to any given field. If a change is detected which shows a 10% variance, evaluations must be performed to determine if it is a result of clogging filters, force main breaks, emitter clogging, leaks in field lines, a flush valve failure, etc. The Plan of Operation and Management should address what actions are required to correct any such problem should it occur. Pumping equipment must be provided with pressure and flow sensitive controls which will disengage pumps if a main breaks or clogs.

Prior to pumping to the drip field distribution system, the wastewater must be screened to remove fibers, solids and other matter which might clog drip emitters. As a minimum, screens with a nominal diameter smaller than the smallest flow opening in the drip emitter tubing should be provided. Screening to remove solids greater than one-third (1/3) the diameter of the smallest drip emitter opening is recommended.

The wastewater storage requirements as determined for spray application disposal methods will also be required for drip emitter disposal method. The design percolation rate and wastewater loading rate as determined in Chapter 16 of TDEC Sewage Criteria shall be the maximum rates allowed for drip emitter systems.

2.4 OTHER REQUIREMENTS

1. Wastewater treatment systems that require septic tanks for proper operation will be required to have the septic tanks pumped on a regular basis. The septic tank pumping schedule shall be presented in the DDR. The septic tanks shall be pumped out at least every three (3) years (more often if required for proper operation of the system). The DDR shall present the specific septage disposal location to be used for the wastewater system.

2. Section 16.1.3 of Chapter 16 of the TDEC Design Criteria is revised as follows:

The disposal site shall be relatively isolated, easily accessible and not susceptible to flooding. In no event shall a disposal site be located within the 10 year floodplain. The limits of the 10 year floodplain shall be established by a field elevation survey utilizing FEMA cross-section data, or an equivalent engineering study which defines the site area having a 10% chance of storm water inundation in any given year. No disposal site shall be utilized when inundated or saturated with water. In no event shall a wastewater treatment system be located within the pre-existing boundary of the 100 year floodplain. The limits of the 100 year floodplain shall be established by a field elevation survey utilizing FEMA cross-section data, or an equivalent engineering study which defines the site area having a 1% chance of storm water inundation in any given year. Areas within the 10 year and/or 100 year floodplain boundaries cannot be manipulated in such a way that the pre-existing grade is changed. The primary disposal site shall be restricted so that its only acceptable use is for wastewater disposal. The use of the primary disposal site as a park, golf course, cemetery, outdoor institutional, recreational or other public use is prohibited.

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3. Section 16.3.2 of Chapter 16 of the TDEC Design Criteria is revised as follows:

BOD and TSS Reduction Disinfection - The primary wastewater disposal sites shall be closed to public access. Wastewater irrigated on sites closed to public access and restricted to only wastewater disposal sites must not exceed a 5-day BOD and total suspended totals of 30 mg/l as a monthly average. Disinfection to reduce fecal coliform bacteria to 200 colonies per 100 m/l is required. All wastewater treatment systems to achieve these parameters must be done in accordance with the Tennessee Department of Environment and Conservation Design Criteria.

4. Section 16.3.2, b. of Chapter 16 of the TDEC Design Criteria is hereby deleted.

5. Section 16.9.3, Buffer Zone Requirements, of Chapter 16 of the TDEC Design Criteria is revised as follows:

Buffer Zone Requirements

a) The objectives of buffer zones around wastewater system components are to control public access, improve project aesthetics and, in case of spray irrigation, minimize the transport of aerosols. Since development of off-site property adjacent to the disposal site may be uncontrollable, the buffer zone must be the primary means of separating the field area from off-site property. Table 16-3 gives minimum widths of buffer zones for varying system components and site conditions:

Table 16-3

Buffer Zones

Applicable for Treatment and Storage Areas and Primary, Secondary, and Auxiliary Areas					
	Development Boundaries	Internal Property Lines	Streams, Ponds, Roads	Habitable Structures	Drinking Water Wells (3)
Piping	25 ft	25 ft	25 ft (2)	50 ft	300 ft
Treatment Facility (including associated equipment/buildings	300 ft	150 ft	25 ft (2)	300 ft	300 ft
Storage Facility	100 ft	100 ft	100 ft	100 ft	300 ft
Application System					
Drip Emitters	25 ft	25 ft	50 ft (2)	100 ft	300 ft
Spray Nozzles (4)	25 ft	25 ft	50 ft (2)	100 ft	300 ft

Notes:

1. For purposes of this Section, development boundaries refer to properties that are a part of the base site area of the proposed development or the proposed sewage disposal area. However, this buffer zone may extend into, but not beyond, public road rights-of-way dedicated to a governmental entity and railroad rights-of-way.
2. These distances may be superseded by the Williamson County Stormwater Management Regulations.
3. Requirements for buffer areas in relation to potable water wells will be determined after reviewing groundwater pollutions susceptibility and groundwater recharge maps or by contacting the Division of Water Supply, Tennessee Department of Environment and Conservation. In no case shall a wastewater application system be located within 300 feet of a drinking water well. Wellhead Protection requirements may increase the buffer distances as necessary.
4. Designers must specify appropriate irrigations devices to prevent overspray under any conditions. In the event that noticeable overspray is observed, facilities will be adjusted or removed and relocated as needed. Drinking fountains, outdoor eating areas and other similar features (i.e. snack bars) located within the approved use area must be protected from overspray or contact with treated wastewater. Protection may be accomplished by relocating the irrigation system or relocating the protected facilities.

b. In addition to the 300 feet buffer zone required in Table 16.3 above, a minimum of two cross-sectional drawings shall be filed along with the site plan or sketch plan application (as applicable), demonstrating whether the pre-treatment facilities, storage facilities and the associated equipment storage buildings can be effectively screened from adjacent properties by existing vegetation and/or topographical features. Otherwise, the applicant may be required to provide a bufferyard at and opacity of 1.0, as defined in Divisions II and VII of the Williamson County Zoning Ordinance.

Upon consideration of the sketch plan or site plan application (as applicable) by the Williamson County Regional Planning Commission, the Planning Commission shall find that pre-treatment facilities, storage facilities and the associated equipment storage buildings either:

1. Have been effectively screened from view of adjacent properties by the prescribed buffer zone, or
2. Have not been effectively screened from view of adjacent properties by the prescribed buffer distances, and therefore require bufferyard in addition to the prescribed buffer zone.

Based upon such findings, the Planning Commission shall determine what bufferyard shall be required to accomplish the proper screening.

c. Pump stations and other such above-grade appurtenances shall be located in such a manner that they can be screened from adjacent properties. The Planning Commission may require a bufferyard up to a 1.0 opacity, to accomplish effective screening.

6. Section 16.9, Land Area Requirements, of Chapter 16 of the TDEC Design Criteria is revised as follows:

In addition to the primary wastewater disposal site(s), a back-up or secondary wastewater disposal site(s) shall be provided. The back-up disposal site shall be sized based on the design wastewater flow rates and the specific design hydraulic loading rate for the back-up disposal site(s). The back-up disposal site shall be owned by the wastewater system owner.

The back-up wastewater disposal site(s) shall be protected to prevent encroachment of any unauthorized vehicles or equipment. No encumbrance or physical structure shall be placed in such a manner so as to interfere with the wastewater disposal site's intended purpose. No activity will be allowed on the back-up wastewater disposal site(s) that will alter the soil characteristics or the design percolation rates for each soil type.

7. Under no circumstances shall the treatment unit, storage pond, disposal site and back-up disposal site be installed upon properties encumbered by easements.

8. Under no circumstances shall the treatment unit, storage pond, disposal site and back-up disposal site be installed on properties with grades in excess of 15% slope.

2.5 AUXILIARY DISPOSAL SITES

The use of auxiliary disposal sites shall be permissible, provided the minimum primary disposal sites are provided and restricted to public access. The auxiliary disposal sites which may be open to public access shall include golf courses, cemeteries, green areas, parks and other public or private lands where public use occurs or expected to occur. Effluent applied on auxiliary disposal sites where public access is permitted must be treated to higher levels. The effluent applied on public access sites must not exceed a 5-day Biochemical Oxygen Demand and Total Suspended Solids of 10 mg/l, as a monthly average. Disinfection to reduce fecal coliform bacteria to 20 colonies/100 ml is required. Turbidity must be less than 3 NTU.

The pre-application treatment standards for effluent that is to be applied to public access areas will be reviewed by the TDEC and Williamson County on a case-by-case basis. More stringent pre-application treatment standards may be required as the TDEC deems necessary. TDEC recommends that the engineer give preference to pretreatment systems that will provide the greatest degree of reliability.

The following management/operation guidelines shall also apply to auxiliary disposal sites:

1. Provisions must be made to allow the wastewater treatment system operators to discontinue the pumping of effluent to the site in the event of an obvious plant upset.

2. Effluent water will be controlled to the extent that run-off as a direct result of over watering is prevented.

3. All effluent water valves or outlets will be appropriately tagged to warn the public that the water is not safe for drinking, bathing, or direct contact.

4. All piping, valves, and outlets will be marked to differentiate effluent water from domestic or other potable water. A different pipe material has been used to facilitate water system identification.

5. All effluent water valves, outlets, and sprinkler heads will be operated only by authorized personnel. Where hose bibs are present on domestic and effluent water lines, differential sizes will be established to preclude the interchange of hoses.

6. Adequate means of notification will be provided to inform the public that effluent water is being used. Such notification will include the posting of conspicuous warning signs with proper wording of sufficient size so as to be clearly read. At golf courses, notices will also be printed on score cards and at all water hazards containing effluent reuse water.

7. Tank trucks used for carrying or spraying effluent water will be appropriately identified to indicate such.

8. Application or use of effluent water will be done so as to prevent or minimize contact with the public with the sprayed material and precautions shall be taken to ensure that effluent reuse water is not being sprayed on walkways, passing vehicles, buildings, picnic tables, domestic water facilities, or areas not under control of the user. Also;

a. Application of the effluent water should be practiced during periods when the grounds will have maximum opportunity to dry before use by the public unless provisions are made to exclude the public from areas during and after spraying with effluent water.

b. Windblown spray from the application of effluent water should not reach areas accessible to the public.

c. Effluent water will be kept completely separate from domestic water wells and reservoirs.

d. Drinking water fountains will be protected from direct or windblown effluent water spray.

9. Adequate measures will be taken to prevent the breeding of flies, mosquitoes, and other vectors of public health significance during the process of effluent land application.

10. Operation of the effluent application facilities will not create odors or discharge, slimes, or unsightly deposits of sewage origin in places accessible to the public.

11. Specific buffer zone requirements for varying system components and site conditions are provided in Section 2.4.5 of these regulations.

Amendments

Date	Book/Page	Section/Division
05/11/00	IV-1	4.1.2.a.1.
05/11/00	V-17	5.6.3.a.
05/11/00	full text; IV-1; V-17	4.1.2.a.1; 5.6.3.a
01/09/03	XII-1; XII-13; XII-5;XII-57; XII-61; XII-61	1.2; 1.10; 1.8.2.1; 2.3.1.c; 2.4.7; 2.4.8
11/09/04	XII-3; XII-4; XII-9; XII-10	1.7; 1.8; 1.9; Table 1.9
04/14/05	XII-3; XII-9; XII-8; XII-15	1.8;1.9.3;1.9.6; 1.11.1
02/09/06	XII-57	2.3.1.c
09/13/07	XII-29; XII-57; XII-59-61; XII-63	2.2 (16.9.3); 2.3.1; 2.4.5; 2.5.11
10/13/08		1.9 (7); 1.10 (A); 12.3; 14.0