Electronically Filed in TPUC Docket Room on January 5, 2021 at 12:30 p.m.

SUPERIOR WASTEWATER SYSTEMS

Providing Superior Wastewater Service to Tennessee

December 9, 2020

21-00001

Via Hand Delivery
Chairman, Tennessee Public Utility Commission
c/o Ectory Lawless, Dockets and Records Manager
502 Deaderick Street, 4th Floor
Nashville, TN 37243

Re: Petition of Superior Wastewater Systems, LLC for a Certificate of Convenience and Necessity Amendment to Provide Wastewater Service to the Taliaferro Road Parcel in Williamson County

Ms. Lawless:

Superior Wastewater Systems, LLC files the attached Petition for a Certificate of Convenience and Necessity Amendment to provide wastewater service to the Taliaferro Road Parcel in Williamson County, Tennessee.

I have also enclosed a check in the amount of $25.00 for the required filing fee. Please contact me if you have any questions or need additional information.

Respectfully submitted,

John Powell, President

Enclosures

Cc: Michael Murphy, TDEC

P.O. Box 40
Arrington, TN 37014
615-496-8681

BEFORE THE TENNESSEE PUBLIC UTILITY COMMISSION
NASHVILLE, TENNESSEE

PETITION OF SUPERIOR WASTEWATER SYSTEMS, LLC TO AMEND SERVICE TERRITORY TO INCLUDE THE TALIAFERRO ROAD PARCEL IN WILLIAMSON COUNTY	)	**DOCKET NO. 21-00001**

PETITION OF SUPERIOR WASTEWATER SYSTEMS, LLC TO AMEND SERVICE TERRITORY TO INCLUDE THE TALIAFERRO ROAD PARCEL IN WILLIAMSON COUNTY

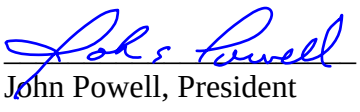
Superior Wastewater Systems, LLC (or "the Company") petitions the Tennessee Public Utility Commission ("the Commission") to amend the Company's service territory to include a proposed parcel called "Taliaferro Road" located in Williamson County, Tennessee.

Included in Attachment 1 is the testimony of John Powell, Owner and President of Superior Wastewater Systems, LLC related to this petition.

Attachment 2 contains the requirements per Commission Rule 1220-04-13-.17 (MINIMUM REQUIREMENTS FOR NEW AND AMENDMENTS TO CERTIFICATE OF CONVENIENCE AND NECESSITY) and the Company's response to each of the required items.

Superior Wastewater Systems, LLC possesses sufficient managerial, financial, and technical capabilities to provide wastewater services to the Taliaferro Road property. The Company therefore asks that the Commission amend the company's service area to include the Taliaferro Road Parcel.

Sincerely,



John Powell, President

ATTACHMENT 1

TESTIMONY OF JOHN POWELL

BEFORE THE TENNESSEE PUBLIC UTILITY COMMISSION
NASHVILLE, TENNESSEE

PETITION OF SUPERIOR WASTEWATER SYSTEMS, LLC TO AMEND ITS EXISTING SERVICE TERRITORY IN WILLIAMSON COUNTY	)	**DOCKET NO. 20-XXXX**

DIRECT TESTIMONY
of
JOHN POWELL

ON BEHALF OF SUPERIOR WASTEWATER SYSTEMS, LLC

December 9, 2020

Q1. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS FOR THE RECORD.

A1. My name is John Powell and my business address is 9539 Mullens Road, Arrington, TN 37014.

Q2. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A2. I am the owner and president of Superior Wastewater Systems, LLC ("SWS") a provider of wastewater utility service, regulated by this Commission.

Q3. WHAT ARE YOUR RESPONSIBILITIES FOR SWS?

A3. I am responsible for the day-to-day operation, permitting, and long-term planning. Among other things, this includes supervision of the system; review and approval of expenditures; reviewing and resolving customer issues; scoping and obtaining proposals for maintenance work; establishment of contracts; contact with regulatory personnel on existing and future permit requirements and issues; preparation of portions of and review of tariff documents; investigation of physical and operational conditions of the distribution systems; and evaluation of proposals for plant upgrades and replacement.

Q4. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A4. The purpose of my testimony is to present information to the Tennessee Public Utility Commission on the managerial, financial, and technical capabilities of

SWS in order to amend our Certificate of Convenience & Necessity to allow SWS to provide wastewater service to the Taliaferro Road property.

Q5. PLEASE DESCRIBE THE TALIAFERRO ROAD PARCEL SERVICE AREA.

A5. The proposed service territory encompasses the Taliaferro Road property in Williamson County. SWS ultimately anticipates providing wastewater service to 27 single family homes in this area.

Q6. DOES A NEED PRESENTLY EXIST FOR WASTEWATER SERVICE IN THIS AREA?

A6. Yes. Currently there is no provider of wastewater service in this area. Therefore, in order to address the need for adequate and timely wastewater service to the Taliaferro Road Property, SWS is asking the TPUC to amend our existing Certificate of Convenience & Necessity.

Q7. WHAT TYPE OF WASTEWATER COLLECTION AND WASTEWATER TREATMENT IS SWS PROPOSING TO PROVIDE SEWER SERVICE TO THIS AREA?

A7. Wastewater service to the Taliaferro Road Parcel will be provided by collection tanks at each home. Wastewater from the collection tanks will be gravity fed to force mains sending wastewater to the existing wastewater treatment system. An

Orenco Ax Max system will be used as outlined in the permit application. After being treated the affluent will be sent to drip fields.

Q8. WHAT IS THE CURRENT STATUS OF THE TALIAFERRO ROAD PARCEL DEVELOPMENT?

A8. The civil engineering design of the development is underway. The design includes soil analysis and many studies approved by the state and Williamson County the wastewater collection treatment and disposal systems. Construction activity will not commence until Williamson County and TDEC approval is granted to the overall development. The County and State permitting and approval process will continue through this year with site construction in late 2021.

Q9. DOES SWS POSSESS THE MANAGERIAL CAPABILITIES TO OPERATE A WASTEWATER DISTRIBUTION SYSTEM?

A9. Yes. As the Commission is aware, I have managed the operations of SWS since its inception in 2004. I am very proud that SWS has the lowest wastewater rates of any privately-owned utility in Tennessee. In addition, to my knowledge, the Commission has never had a customer complaint regarding SWS's operations. Finally, SWS has engaged legal, accounting and regulatory experts to advise and assist it with the managerial responsibilities of operating a wastewater distribution system.

Q10. DOES SWS POSSESS THE FINANCIAL CAPABILITIES TO OPERATE A WASTEWATER DISTRIBUTION SYSTEM?

A10. Yes. However, the entire cost of the Taliaferro Road Property wastewater system will be funded by the developer of the subdivision. Therefore, I do not expect that SWS's provision of wastewater service to this area to result in any drain on the financial resources of SWS. SWS will review and approve the wastewater system design and will field inspect and approve the construction. Upon completion and passing final inspection, the collection system will become the responsibility of SWS for ownership and operation.

Q11. DOES SWS POSSESS THE TECHNICAL CAPABILITIES TO OPERATE A WASTEWATER DISTRIBUTION SYSTEM?

A11. Yes. SWS has engaged a qualified engineer to be its wastewater distribution operator and to monitor and test the wastewater distribution system of SWS on a regular basis in compliance with TDEC rules.

Q12. WHAT RATES AND CHARGES WILL BE USED FOR THE TALIAFERRO ROAD PARCEL DEVELOPMENT?

A12. SWS intends to apply its existing wastewater rates to new customers in the Taliaferro Road Parcel development.

Q13. DOES SWS, ANY OF ITS AFFILIATES, OR YOURSELF HAVE ANY FINANCIAL INTEREST IN THE PROPOSED DEVELOPMENT, THE

CONSTRUCTION OF THE PROPOSED WASTEWATER SYSTEM, OR THE PROVISION OF MATERIALS & SUPPLIES FOR THE CONSTRUCTION OF THE PROPOSED WASTEWATER SYSTEM?

A13. No.

Q14. WHY DOES SWS WANT TO SERVE THIS NEW DEVELOPMENT AND WHAT BENEFIT IS IT TO THE EXISTING SEWER CUSTOMERS?

A14. SWS wants to provide service to the Taliaferro Road Parcel development because it is close in proximity to our existing service territory, meaning that it can be served with relatively few incremental resources. In addition, this increase in our customer base will provide SWS with a greater economy of scale to maintain low rates to our existing customers.

Q15. WILL SWS ABIDE BY THE ORDERS AND RULES OF THE COMMISSION?

A15. Yes.

Q16. IS SWS AWARE OF RULE 1220-04-13-.09 (7) WHICH REQUIRES THE CONSTRUCTION OF THE WASTEWATER SYSTEM TO BE COMPLETED WITHIN 3 YEARS OF TPUC'S WRITTEN APPROVAL OF THE CCN?

A16. Yes.

Q17. DOES THIS COMPLETE YOUR TESTIMONY?

A17. Yes, it does.

BEFORE THE TENNESSEE PUBLIC UTILITY COMMISSION
NASHVILLE, TENNESSEE

PETITION OF SUPERIOR WASTEWATER SYSTEMS, LLC TO AMEND ITS EXISTING SERVICE TERRITORY IN WILLIAMSON COUNTY	)	**DOCKET NO. 20-XXXX**

AFFIDAVIT

I, John Powell, on behalf of Superior Wastewater Systems, LLC herby certify that the attached direct testimony represents my opinion in the above referenced case.

_____
John Powell

Sworn to and subscribed before me this _____ day of _____, 2020.

_____
NOTARY PUBLIC

My Commission expires:_____

ATTACHMENT 2

TPUC CCN REQUIREMENTS AND COMPANY RESPONSES

EXHIBIT 1
APPLICANT AND SYSTEM INFORMATION

Exhibit 1.1	Name and Address Information
Exhibit 1.2	Organization Chart
Exhibit 1.3	Owners, Officers and Members
Exhibit 1.4	Affiliates
Exhibit 1.5	Corporate Information
Exhibit 1.6	Business License
Exhibit 1.7	Geographic Territory
Exhibit 1.8	Proposed Wastewater System Type
Exhibit 1.9	Estimated Wastewater Construction Dates
Exhibit 1.10	Proposed Building Phases
Exhibit 1.11	Developer Identification

Provide the legal corporate name, physical address and mailing address of the applicant.

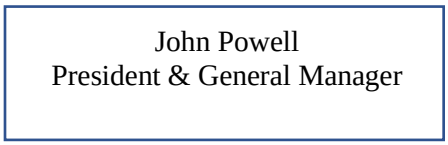
RESPONSE:
The identification information for Superior Wastewater Systems is as follows:

Superior Wastewater Systems, L.L.C.
9539 Mullens Road
Arrington, TN 37014

Note: Mailing address is identical to the physical address.

Provide an organizational chart showing each officer and any other key personnel by name and title.

RESPONSE:
The Organization Chart for Superior Wastewater Systems is as follows:



Mr. Powell is the owner of Superior Wastewater Systems, as well as the President and General Manager. There are no other officers or key personnel of the utility.

Provide a list of owners, members and officers of the wastewater utility. Provide the address, telephone number and percentage ownership of each individual. If different, list the names of owners, members and officers located in Tennessee.

RESPONSE:
Mr. Powell is the sole owner of Superior Wastewater Systems, as well as the President and General Manager. There are no other owners, officers or members of the utility. Mr. Powell's contact information is as follows:

Mr. John Powell
9539 Mullens Road
Arrington, TN 37014

Telephone: 615-395-7070

If the applicant has affiliated companies, provide a corporate organization chart showing all affiliate relationships. Describe in detail any transactions, direct or indirect, that occur or that are expected to occur between affiliated entities.

RESPONSE:
John Powell is the sole member of Superior Wastewater Systems, LLC. He is also the sole member of Ashby Communities, LLC. Ashby Communities, LLC will not be the developer on this project.

Provide a copy of the applicant's articles of incorporation, partnership agreement, and/or by-laws.

RESPONSE:
Attached is a copy of the Articles of Incorporation and Bylaws of Superior Wastewater System, formerly known as King's Chapel Capacity.

OPERATING AGREEMENT
OF
KINGS CHAPEL CAPACITY, LLC

RECITAL

Kings Chapel Capacity, LLC (KCC) is a limited liability company (LLC) organized pursuant to the laws of the State of Tennessee. This Operating Agreement (Agreement) is between and among KCC and its initial member and any joining members and is effective when adopted by the member whose signature appears below. The Agreement is intended to delineate the basic relationships between and among KCC and its member(s) without intending to contemplate all matters that may arise during the life of the LLC. The Agreement may not be the entire agreement and, as contemplated in TCA 48-206-101(b), may from time to time be modified or supplemented by other written unanimous agreements of the member(s). It is anticipated that other members will be joining the LLC at which time this Agreement will be amended or supplanted.

ARTICLE ONE
FORMATION, OPERATION, TERMINATION

1.1 Formation. The Articles of Organization for KCC were registered with the Secretary of State of Tennessee on May 13, 2004 establishing KCC as a legal entity separate and distinct from its member(s).

1.2 Activity. The activity of KCC will be to provide wastewater utility service to the Tennessee public, as regulated by the Tennessee Regulatory Authority.

1.3 Purpose of the LLC. The purpose of forming a limited liability company for KCC is to protect its member(s) from the legal and financial risk associated with acquiring, developing, and selling real property. Accordingly, any business activity associated with the LLC shall be conducted by and in the name of the LLC, and not by its member(s).

1.4 Termination. KCC may be terminated only by unanimous consent of its member(s).

ARTICLE TWO
MEMBERS, CONTRIBUTIONS, AND INTERESTS

2.1 Initial and Subsequent Members. The initial member of KCC as John E. Powell.

2.2 Member Contributions. John E. Powell's initial contribution to the LLC was $300.00. As additional members join the LLC, the existing members and the joining member contributions to the LLC will be in the nature and amount as the members elect among themselves.

2.3 Member Interests. While John E. Powell is the sole member of the LLC he will own 100% of the LLC. When other members join the LLC, the respective member interests will be determined as the members elect among themselves.

ARTICLE THREE
MEMBER RIGHTS, POWERS, AND OBASHBYATIONS

3.1 Member Share of Profits, Losses, Distributions, and Income Tax Attributes. While John E. Powell is the sole member of KCC he will be entitled to 100% % of KCC profits, losses, distributions, and income tax attributes. As additional members join KCC the LLC profits, losses, distributions, and income tax attributes will be determined as the members elect among themselves.

3.2 Member Voting. Each member will be entitled to one vote for each percentage of member interest that each member owns.

3.3 Member Meetings. While the LLC has only one member, member meetings will not be required. As additional members join the LLC, the timing, nature, and extent of member meetings shall be as the members determine among themselves.

3.4 Sale of Land and Assets. The sale of the KCC land or other assets valued at more than $1,000.00 will occur only upon the unanimous consent of its members.

3.5 Member Powers. John E. Powell, while the sole member of the LLC, will have the power to open and operate bank accounts of the LLC, to borrow funds on behalf of the LLC, and to mortgage, pledge, or otherwise encumber assets of the LLC. As additional members join the LLC, these powers will also be granted to the joining members as the members determine among themselves.

3.6 Member Duties. No limitations are placed upon the members respecting duties to KCC other than to endeavor to maximize the eventual profit of the LLC and to act lawfully and in good faith with respect to KCC and each other.

ARTICLE FOUR
INCOME TAX AND ADMINISTRATIVE MATTERS

4.1 Entity Choice For Income Tax Purposes. While the LLC has only one member the LLC will be treated as a disregarded entity having the nature of a sole proprietorship for federal income tax reporting purposes, unless and until "check-the-box" and other elections are made for tax reporting purposes characterizing KCC as an "S" corporation.

4.2 Financial and Administrative Record Keeping. The bookkeeping and administrative record keeping system of KCC will be satisfied by any reasonable system of recording

transactions. The system will include but not limited to recording member identity and capital account activity, property acquisitions and encumbrances, and financial activity necessary to facilitate balance sheet and income statement preparation.

4.3 Member Certificates. KCC member ownership interest certificates will not be issued. Member ownership shall be represented by membership interest percentages attributed to each member.

4.4 Management. As stated in the KCC Articles of Organization, KCC will be member managed.

4.5 Principal Office. The principal office of the LLC shall be located at 1413 Plymouth Drive, Brentwood, Tennessee 37027.

IN WITNESS WHEREOF, the initial member of KCC signs and adopts this Agreement as the operating agreement of Kings Chapel Capacity, LLC:

J. Powell — 5-13-2004

John E. Powell, Managing Member — Date

State of Tennessee

Department of State
Corporate Filings
312 Eighth Avenue North
6th Floor, William R. Snodgrass Tower
Nashville, TN 37243

ARTICLES OF ORGANIZATION (LIMITED LIABILITY COMPANY)

FILED
2006 MAY 13 PM 3:02
SECRETARY OF STATE

For Office Use Only

The undersigned acting as organizer(s) of a Limited Liability Company under the provisions of the Tennessee Limited Liability Company Act, § 48–205–101, adopts the following Articles of Organization.

1. The name of the Limited Liability Company is:
King's Chapel Capacity, LLC

(NOTE: Pursuant to the provisions of § 48–207–101, each limited Liability Company name must contain the words "Limited Liability Company" or the abbreviation "LLC" or "L.L.C.")

2. The name and complete address of the Limited Liability Company's initial registered agent and office located in the state of Tennessee is:
Kings Chapel Capacity, LLC
(Name)

1413 Plymouth Drive, Brentwood, TN 37027 TN
(Street Address) *(City)* *(State/Zip Code)*

Williamson
(County)

3. List the name and complete address of each organizer of this Limited Liability Company.
John Powell , 1413 Plymouth Drive, Brentwood, TN 37027
(Name) *(Include: Street Address, City, State and Zip Code)*

(Name) *(Street Address, City, State and Zip Code)*

(Name) *(Street Address, City, State and Zip Code)*

4. The Limited Liability Company will be: ***(NOTE: PLEASE MARK APPLICABLE BOX)***
☐ Board Managed ☒ Member Managed

5. Number of members at the date of filing 1.

6. If the document is not to be effective upon filing by the Secretary of State, the delayed effective date and time is:
Date _____, _____, Time _____ (Not to exceed 90 days.)

7. The complete address of the Limited Liability Company's principal executive office is:
1413 Plymouth Drive, Brentwood, TN 37027
(Street Address) *(City)* *(State/Country/Zip Code)*

8. Period of Duration:

9. Other Provisions:

10. THIS COMPANY IS A NON-PROFIT LIMITED LIABILITY COMPANY (Check if applicable) ☐

May 13th 06
Signature Date

Sole Member
Signer's Capacity

John Powell
Signature *(manager or member authorized to sign by the Limited Liability Company)*

John E Powell
Name *(typed or printed)*

SS-4249 (Rev. 7/01) Filing Fee: $50 per member (minimum fee = $300, maximum fee = $3,000) RDA 2458

236 8320

Secretary of State
Division of Business Services
312 Eighth Avenue North
6th Floor, William R. Snodgrass Tower
Nashville, Tennessee 37243

ISSUANCE DATE: 09/29/2004
REQUEST NUMBER: 04273119
TELEPHONE CONTACT: (615) 741-6488

CHARTER/QUALIFICATION DATE: 04/13/2004
STATUS: ACTIVE
CORPORATE EXPIRATION DATE: PERPETUAL
CONTROL NUMBER: 0469590
JURISDICTION: TENNESSEE

TO:
FARRIS MATHEWS BRANAN BOBANGO & HELLEN
618 CHURCH STREET
STE 300
NASHVILLE, TN 37219

REQUESTED BY:
FARRIS MATHEWS BRANAN BOBANGO & HELLEN
618 CHURCH STREET
STE 300
NASHVILLE, TN 37219

CERTIFICATE OF EXISTENCE

I, RILEY C DARNELL, SECRETARY OF STATE OF THE STATE OF TENNESSEE DO HEREBY CERTIFY THAT

"KING'S CHAPEL CAPACITY, LLC"

A LIMITED LIABILITY COMPANY DULY FORMED UNDER THE LAW OF THIS STATE WITH DATE OF FORMATION AND DURATION AS GIVEN ABOVE;
THAT ALL FEES, TAXES, AND PENALTIES OWED TO THIS STATE WHICH AFFECT THE EXISTENCE OF THE LIMITED LIABILITY COMPANY HAVE BEEN PAID:
THAT ARTICLES OF DISSOLUTION HAVE NOT BEEN FILED; AND
THAT ARTICLES OF TERMINATION OF THE EXISTENCE HAVE NOT BEEN FILED.

FOR: REQUEST FOR CERTIFICATE

ON DATE: 09/29/04

	FEES	
RECEIVED:	$20.00	$0.00
TOTAL PAYMENT RECEIVED:		$20.00

RECEIPT NUMBER: 00003590523
ACCOUNT NUMBER: 00000448

FROM:
FARRIS MATHEWS BRANAN BOBANGO&HEL(618 CH
618 CHURCH ST
SUITE 300
NASHVILLE, TN 37219-0000

THE GREAT SEAL OF THE STATE OF TENNESSEE XVI AGRICULTURE COMMERCE 1796

336 8320

Riley C Darnell

RILEY C DARNELL
SECRETARY OF STATE

Provide a copy of the applicant's license to engage in business within the State of Tennessee registered with the Secretary of State, inclusive of any assumed names of the Company.

RESPONSE:
Attached is a copy of the business license of Superior Wastewater Systems.

Tre Hargett
Secretary of State

Division of Business Services
Department of State
State of Tennessee
312 Rosa L. Parks AVE, 6th FL
Nashville, TN 37243-1102

Filing Information

Name: **Superior Wastewater Systems, LLC**

General Information

SOS Control #	**000469590**	Formation Locale:	TENNESSEE
Filing Type:	Limited Liability Company - Domestic	Date Formed:	04/13/2004
	04/13/2004 3:02 PM	Fiscal Year Close	12
Status:	Active	Member Count:	1
Duration Term:	Perpetual		
Managed By:	Member Managed		

Registered Agent Address
Superior Wastewater Systems, LLC
9539 MULLINS RD
ARRINGTON, TN 37014-9732

Principal Address
9539 MULLINS RD
ARRINGTON, TN 37014-9732

The following document(s) was/were filed in this office on the date(s) indicated below:

Date Filed	Filing Description	Image #
06/11/2019	2018 Annual Report	B0721-3362
06/01/2019	Notice of Determination	B0624-9175
01/24/2019	Articles of Amendment	B0617-5512
	Filing Name Changed From: KING'S CHAPEL CAPACITY, LLC To: Superior Wastewater Systems, LLC	
	Registered Agent Organization Name Changed From: KING'S CHAPEL CAPACITY, LLC To: SUPERIOR WASTEWATER SYSTEMS, LLC	
01/20/2018	2017 Annual Report	B0480-2739
02/03/2017	2016 Annual Report	B0343-4507
	Registered Agent Physical Address 1 Changed From: 1165 MEADOW BRIDGE LN To: 9539 MULLINS RD	
	Registered Agent Physical Postal Code Changed From: 37014-9109 To: 37014-9732	
02/02/2016	2015 Annual Report	B0195-0310
07/20/2015	2014 Annual Report	B0128-5335
	Principal Address 1 Changed From: 1165 MEADOW BRIDGE LN To: 9539 MULLINS RD	
	Principal Postal Code Changed From: 37014-9109 To: 37014-9732	
06/02/2015	Notice of Determination	B0107-4861
03/21/2014	2013 Annual Report	7307-1010
03/06/2013	2012 Annual Report	7159-1291

Filing Information

Name: **Superior Wastewater Systems, LLC**

03/05/2012	2011 Annual Report	7007-1329
Principal Address 1 Changed From: 1165 MEADOW BRIDGE LANE To: 1165 MEADOW BRIDGE LN		
Principal Postal Code Changed From: 37014 To: 37014-9109		
Registered Agent Physical Address 1 Changed From: 1413 PLYMOUTH DR To: 1165 MEADOW BRIDGE LN		
Registered Agent Physical City Changed From: BRENTWOOD To: ARRINGTON		
Registered Agent Physical Postal Code Changed From: 37027-6915 To: 37014-9109		
05/16/2011	2010 Annual Report	A0072-1141
Principal Address 1 Changed From: 1413 PLYMOUTH DRIVE To: 1165 Meadow Bridge Lane		
Principal City Changed From: BRENTWOOD To: Arrington		
Principal Postal Code Changed From: 37027 To: 37014		
05/14/2011	Mailing Address Update	
07/14/2010	2009 Annual Report	A0037-1184
06/03/2010	Notice of Determination	A0024-2321
02/24/2009	2008 Annual Report	6455-2229
04/18/2008	2007 Annual Report	6301-0799
Member Count Changed		
04/18/2007	2006 Annual Report	6033-1265
12/12/2006	2005 Annual Report	5899-1091
12/12/2006	Application for Reinstatement	5899-1092
08/21/2006	Dissolution/Revocation - Administrative	ROLL 5835-B
06/14/2006	Notice of Determination	ROLL 5809
04/18/2005	2004 Annual Report	5435-2138
Member Count Changed		
04/13/2004	Initial Filing	5127-2005

Active Assumed Names (if any)	**Date**	**Expires**

Provide a complete description of the geographic territory to be served by the applicant, including the name and location of development (subdivision) and the number of acres. Include the name of the subdivision or development and the name of the wastewater system as stated in the TDEC permit. In addition, provide a legible map of the area with the proposed service territory clearly and accurately plotted. The map should include:

- **i. The location of the wastewater system, i.e. treatment plant, pre-application treatment facilities, collection infrastructure, building(s) for equipment, drip fields, disposal fields and/or wetland cells. Include the physical address of the wastewater system and the associated latitude and longitude coordinates.**
- **ii. Names of surrounding streets and roads.**
- **iii. Map to show access roads and names of access roads (if available) and other utilities necessary to provide wastewater service.**
- **iv. All residences and habitable structures served by the wastewater system.**
- **v. Show any portion of the area that will not be served when the wastewater system becomes operational. If the wastewater system will be operational in phases, show the phases on the map.**

RESPONSE:
The Taliaferro Road Parcel is located in Williamson County. The proposed name of the subdivision is The Homes at Mulberry Meadows.

Taliaferro Road Parcel description:
Map 137, Parcel 35.00
8496 Taliaferro Road
College Grove, Tennessee 37060

A map of the entire subdivision is attached showing the site for the wastewater treatment facility.

1.4 Topography

Exhibit 1.4a



USGS Map of the Area

WASTEWATER TREATMENT SYSTEM
FOR
THE HOMES AT MULBERRY MEADOWS
TALIAFERRO ROAD
Map 137, Parcel 35.00
College Grove, Tennessee

Developer: McCanless and Company
PO Box 1687
Nolensville, TN 37165

Engineer: TSQUARE ENGINEERING
Consulting Civil Engineering
701 West Main Street * Franklin, TN 37064
(615) 678-8212 * Email tim@t2-eng.com

Surveyor: H&H Land Survey Inc.
PO Box 110097
Nashville, TN 37222
(615) 831-0756



LOCATION MAP
N.T.S.

Sheet Schedule

C-0.0	Cover Sheet
C-1.0	Existing Conditions & Demolition Plan
C-2.0	Overall Site Plan
C-2.1	Site Plan
C-2.2	Site Plan
C-2.3	Treatment Facility Detail Plan

Topographic Boundary Survey, including property lines, legal description, existing utilities, site topography with spot elevations, outstanding physical features and existing structure locations was provided by the following company:

H&H Land Survey Inc.
PO Box 110097
Nashville, TN 37222
(615) 831-0756

T-Square Engineering and its associates will not be held responsible for its accuracy or for design errors or emissions resulting from potential survey inaccuracies.

NOT FOR CONSTRUCTION
SUBJECT TO COUNTY APPROVAL

RESOURCE PROTECTION STANDARDS
THIS DEVELOPMENT WILL ADHERE TO THE RESOURCE PROTECTION STANDARDS SET FORTH IN ARTICLE 13 OF THE ZONING ORDINANCE CONCERNING NATURAL AND HISTORICAL RESOURCES, SUCH AS WATERWAY PROTECTION, STEEP TOPOGRAPHY AND SLIPPAGE SOIL PROTECTION, KARST TOPOGRAPHY PROTECTION, SPECIAL FLOOD HAZARD AREA PROTECTION, WETLAND PROTECTION, WOODLAND AND TREE PROTECTION, AND HISTORIC AND CULTURAL RESOURCE PROTECTION.
FLOOD NOTE
NO PORTION OF THIS PROPERTY IS LOCATED IN AN AREA DESIGNATED AS A 100 YEAR FLOOD ZONE AS EVIDENCED ON FEMA PANEL # 47187C0385F OF WILLIAMSON COUNTY, TN, DATED 09/29/2006.
OWNER OF RECORD
McCANLESS AND COMPANY PO BOX 1687 NOLENSVILLE, TN 37135
CIVIL ENGINEER
T-SQUARE ENGINEERING 701 WEST MAIN ST FRANKLIN, TN 37064 615.678.8212

REVISIONS

NO.	DATE

DATE: 9/30/2020
SCALE: AS SHOWN
DRAWN BY: T-SQUARE
REVIEWER: TT

THE HOMES AT MULBERRY MEADOWS

COVER SHEET
8496 Taliaferro Road
College Grove, TN

TIMOTHY E. TURNER
REGISTERED ENGINEER
AGRICULTURAL
STATE OF TENNESSEE

9–30–2020

PROJECT
19-0904

SHEET
C-0.0

P:\Projects\2019\19-0904 (Taliaferro Rd - Jim McCanless)\Production\19-0904 Wastewater Plan_recover.dwg, 0.0 CV, 9/30/2020 3:36:34 PM



NOT FOR CONSTRUCTION
SUBJECT TO COUNTY APPROVAL

N

GRAPHIC SCALE
(IN FEET)
200 0 100 200 400
SCALE: 1" = 200'

LEGEND

- PROPERTY LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- SOIL AREAS
- WATERWAY NATURAL AREA BUFFER
- EXISTING TREE CANOPY

RESOURCE PROTECTION STANDARDS
THIS DEVELOPMENT WILL ADHERE TO THE RESOURCE PROTECTION STANDARDS SET FORTH IN ARTICLE 13 OF THE ZONING ORDINANCE CONCERNING NATURAL AND HISTORICAL RESOURCES, SUCH AS WATERWAY PROTECTION, STEEP TOPOGRAPHY AND SLIPPAGE SOIL PROTECTION, KARST TOPOGRAPHY PROTECTION, SPECIAL FLOOD HAZARD AREA PROTECTION, WETLAND PROTECTION, WOODLAND AND TREE PROTECTION, AND HISTORIC AND CULTURAL RESOURCE PROTECTION.
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OWNER OF RECORD
McCANLESS AND COMPANY PO BOX 1687 NOLENSVILLE, TN 37135
CIVIL ENGINEER
T-SQUARE ENGINEERING 701 WEST MAIN ST FRANKLIN, TN 37064 615.678.8212

NO.	DATE	REVISIONS

DATE: 9/30/2020
SCALE: AS SHOWN
DRAWN BY: T-SQUARE
REVIEWER: TT

OVERALL EXISTING CONDITIONS

8496 TALIAFERRO ROAD
COLLEGE GROVE, TN

THE HOMES AT MULBERRY MEADOWS

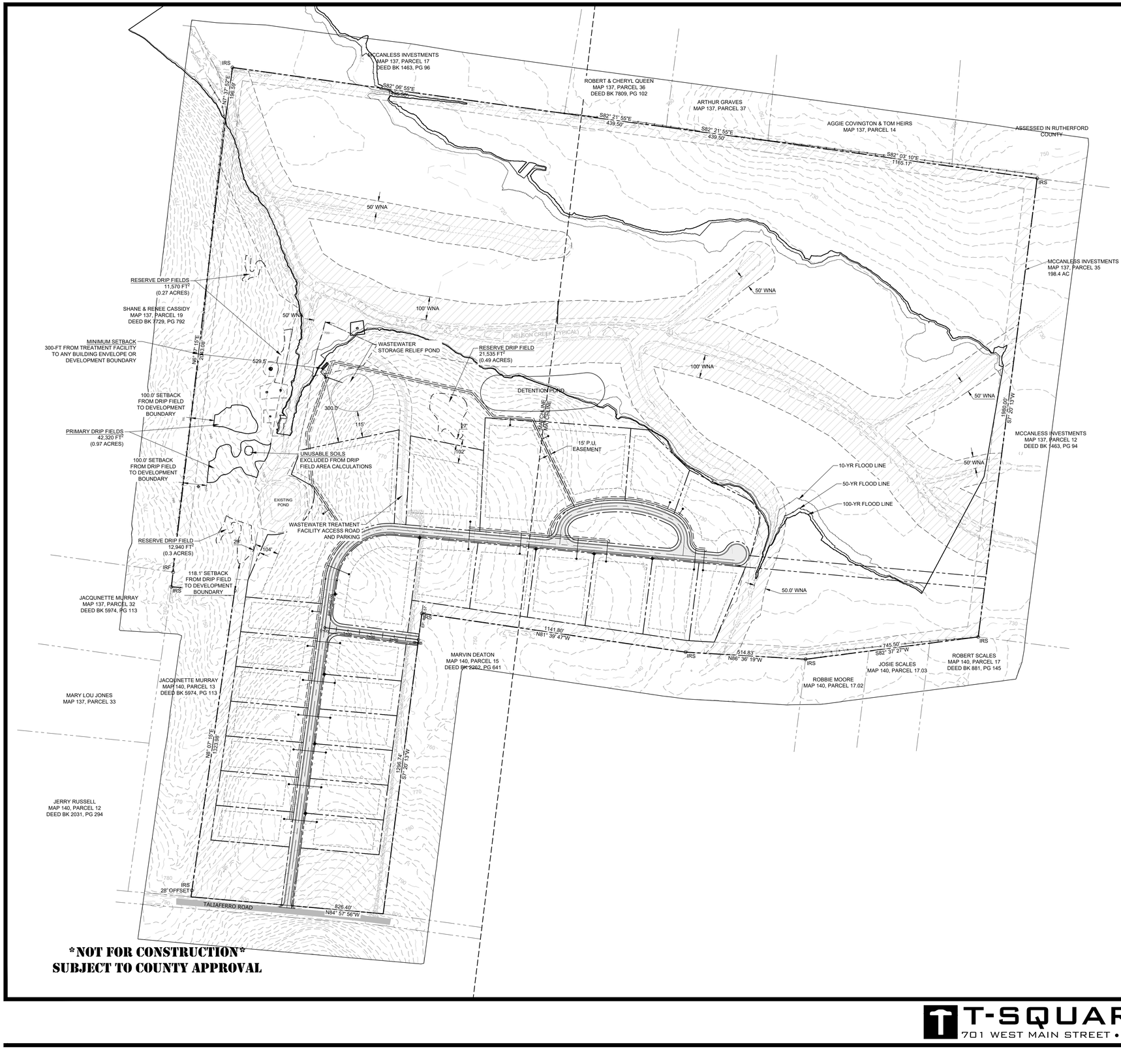
TIMOTHY E. TURNER
REGISTERED ENGINEER
AGRICULTURAL & BIOSYSTEMS
101743
STATE OF TENNESSEE
9–30–2020

PROJECT
19-0904

SHEET
C-1.0

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NOT FOR CONSTRUCTION
SUBJECT TO COUNTY APPROVAL

N

GRAPHIC SCALE
(IN FEET)
200 0 100 200 400
SCALE: 1" = 200'

LEGEND

- EXISTING PROPERTY LINE
- PROPOSED LOT LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED PAVEMENT
- PROPOSED LANDSCAPE BUFFER
- SOIL AREAS
- WATERWAY NATURAL AREA BUFFER
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REVISIONS

NO.	DATE

DATE: 9/30/2020
SCALE: AS SHOWN
DRAWN BY: T-SQUARE
REVIEWER: TT

THE MULBERRY MEADOWS

OVERALL SITE PLAN

8496 TALIAFERRO ROAD
COLLEGE GROVE, TN

TIMOTHY E. TURNER
REGISTERED AGRICULTURAL ENGINEER
STATE OF TENNESSEE

9–30–2020

PROJECT
19-0904

SHEET
C-2.0

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PRIMARY DRIP FIELDS
42,320 FT²
(0.97 ACRES)

N6° 37' 15"E
2043.08

IRS

JACQUINETTE MURRAY
MAP 140, PARCEL 13.00
DEED BK 3074, PG 113

RESERVE DRIP FIELD
12,940 FT²
(0.3 ACRES)

IRS

ZONE 3
2,281 LF
7 DISTAL ENDS

ZONE 4
2,355 LF
8 DISTAL ENDS

ZONE 2
2,546 LF
8 DISTAL ENDS

ZONE 5
2,320 LF
9 DISTAL ENDS

ZONE 1
2,480 LF
8 DISTAL ENDS

UNUSABLE SOILS
EXCLUDED FROM DRIP FIELD
AREA CALCULATIONS

RESERVE DRIP FIELDS
11,570 FT²
(0.27 ACRES)

28' OFFSET

IRS

N8° 07' 15"E
1323.98'

29'

104'

EXISTING
POND

ADVANTEX AXMAX225-35
FIXED-MEDIA FILTER
SEE ORENCO DETAIL SHEET

TALIAFERRO ROAD

15.0' P.U.
EASEMENT

WASTEWATER TREATMENT FACILITY
CONTROL BUILDING
CONTAINING PLC SYSTEM CONTROLS,
DISC FILTERS, AND UV DISINFECTION

EMERGENCY RELIEF
DISCHARGE LINE TO
STORAGE POND 2"Ø

116'

WASTEWATER
STORAGE
RELIEF POND

BP: 0+00.00

WASTEWATER TREATMENT FACILITY
ACCESS ROAD AND PARKING

N84° 51' 54"W
636.40'

RESERVE DRIP FIELD
21,535 FT²
(0.49 ACRES)

1296.74'
S7° 20' 13"W

EP: 4+04.57

IRS

102'

27'

10-YR FLOOD LINE

50-YR FLOOD LINE

100-YR FLOOD LINE

DETENTION
POND

KELSH CREEK (TYPICAL)

MARVIN DEXTON
MAP 140, PARCEL 15
DEED BK 2998, PG 841

MATCHLINE

LEGEND

- EXISTING PROPERTY LINE
- PROPOSED LOT LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED PAVEMENT
- PROPOSED LANDSCAPE BUFFER
- SOIL AREAS
- WATERWAY NATURAL AREA BUFFER
- EXISTING TREE CANOPY

GRAPHIC SCALE
(IN FEET)
100 0 50 100 200
SCALE: 1" = 100'

NOT FOR CONSTRUCTION
SUBJECT TO COUNTY APPROVAL

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CIVIL ENGINEER
T-SQUARE ENGINEERING 701 WEST MAIN ST FRANKLIN, TN 37064 615.678.8212

REVISIONS

NO.	DATE

DATE: 9/30/2020
SCALE: AS SHOWN
DRAWN BY: T-SQUARE
REVIEWER: TT

THE HOMES AT MULBERRY MEADOWS

SITE PLAN

8496 TALIAFERRO ROAD
COLLEGE GROVE, TN

TIMOTHY E. TURNER
REGISTERED ENGINEER
AGRICULTURE
POLK
10174
STATE OF TENNESSEE

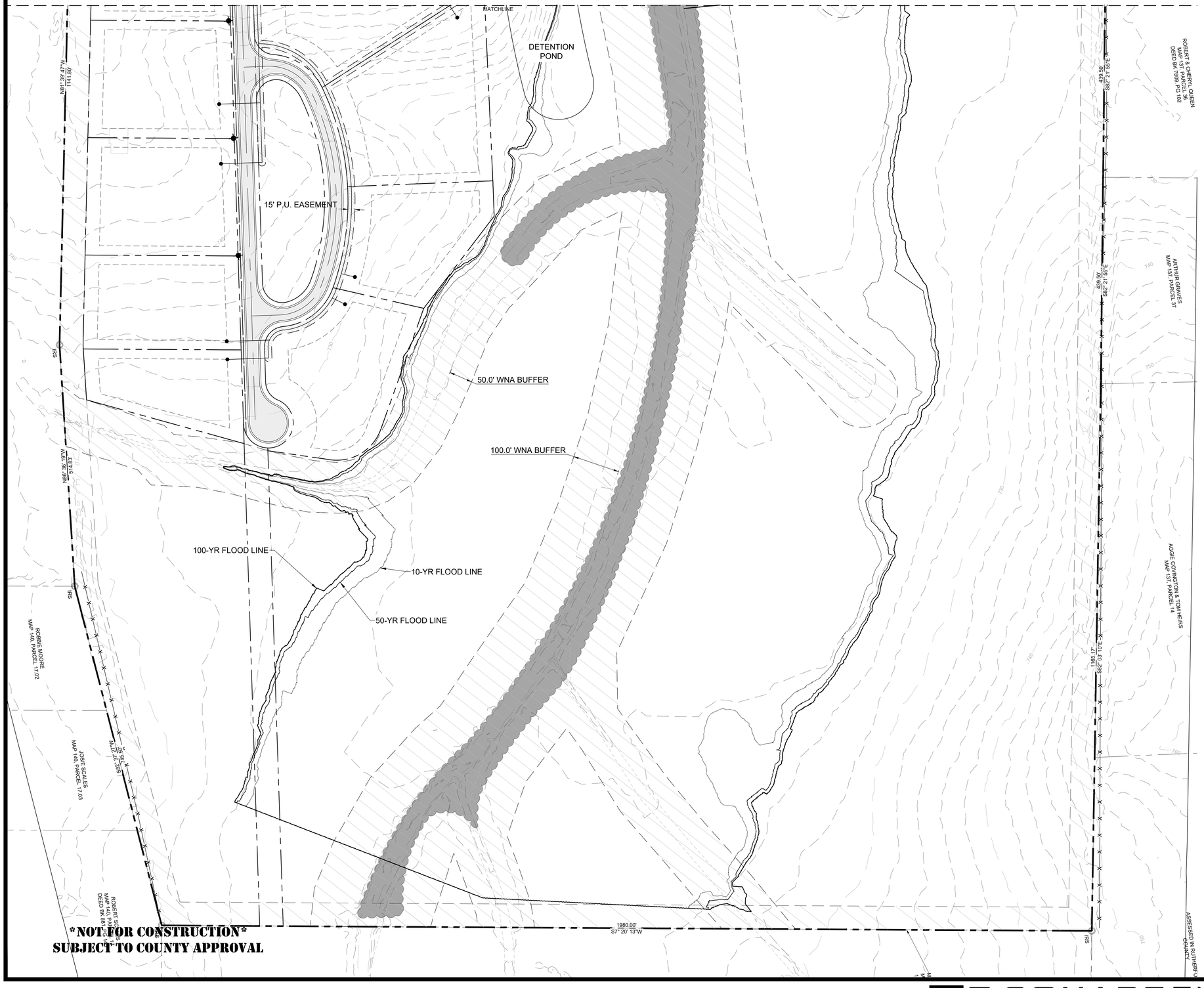
9–30–2020

PROJECT
19-0904

SHEET
C-2.1

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GRAPHIC SCALE
(IN FEET)
100 0 50 100 200
SCALE: 1" = 100'

LEGEND
- EXISTING PROPERTY LINE
- PROPOSED LOT LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED PAVEMENT
- PROPOSED LANDSCAPE BUFFER
- WATERWAY NATURAL AREA BUFFER

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NO.	DATE	REVISIONS

DATE: 9/30/2020
SCALE: AS SHOWN
DRAWN BY: T-SQUARE
REVIEWER: TT

THE HOMES AT MULBERRY MEADOWS

SITE PLAN

8496 TALIAFERRO ROAD
COLLEGE GROVE, TN

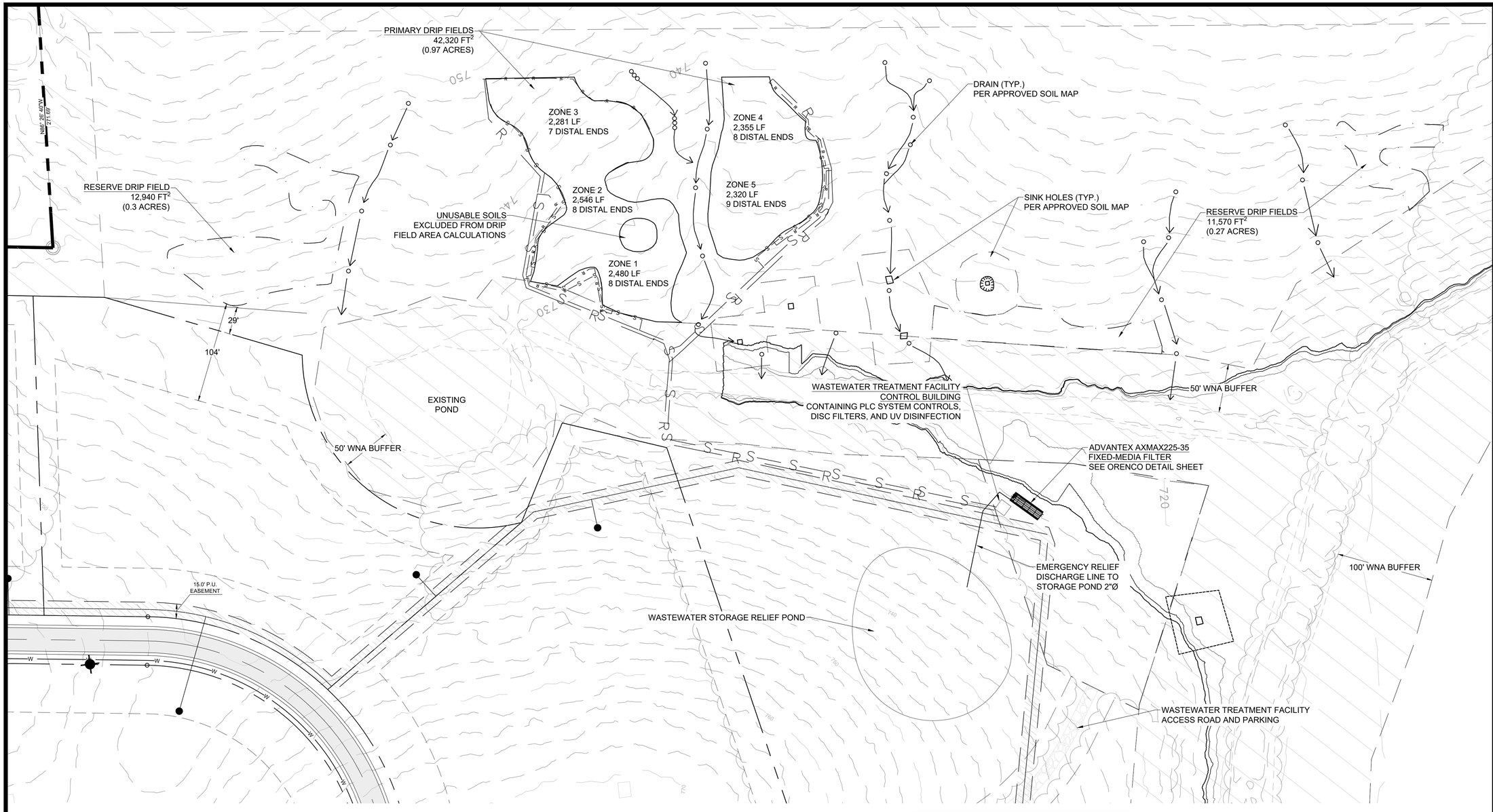
TIMOTHY E. TURNER
REGISTERED ENGINEER
AGRICULTURAL & BIOSYSTEMS
101743
STATE OF TENNESSEE
9–30–2020

PROJECT
19-0904

SHEET
C-2.2

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NOT FOR CONSTRUCTION
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LEGEND

- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- DRIP FIELD SUPPLY LINE
- DRIP FIELD SUPPLY MANIFOLD
- DRIP FIELD RETURN MANIFOLD
- DRIP FIELD FLUSH RETURN LINE
- DRIP FIELD SOLENOID VALVE
- AUTOMATIC AIR RELEASE VALVE
- DRIP FIELD CHECK VALVE
- PROPOSED UTILITY EASEMENT
- PROPOSED LOT LINE
- SOIL AREA
- WATERWAY NATURAL AREA BUFFER

GRAPHIC SCALE
(IN FEET)
50 0 25 50 100
SCALE: 1" = 50'

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REVISIONS

NO.	DATE

DATE: 9/30/2020
SCALE: AS SHOWN
DRAWN BY: T-SQUARE
REVIEWER: TT

THE HOMES AT MULBERRY MEADOWS

TREATMENT FACILITY DETAIL PLAN

8496 Taliaferro Road
College Grove, TN

TIMOTHY E. TURNER
REGISTERED ENGINEER
AGRICULTURAL
No. 101745
STATE OF TENNESSEE

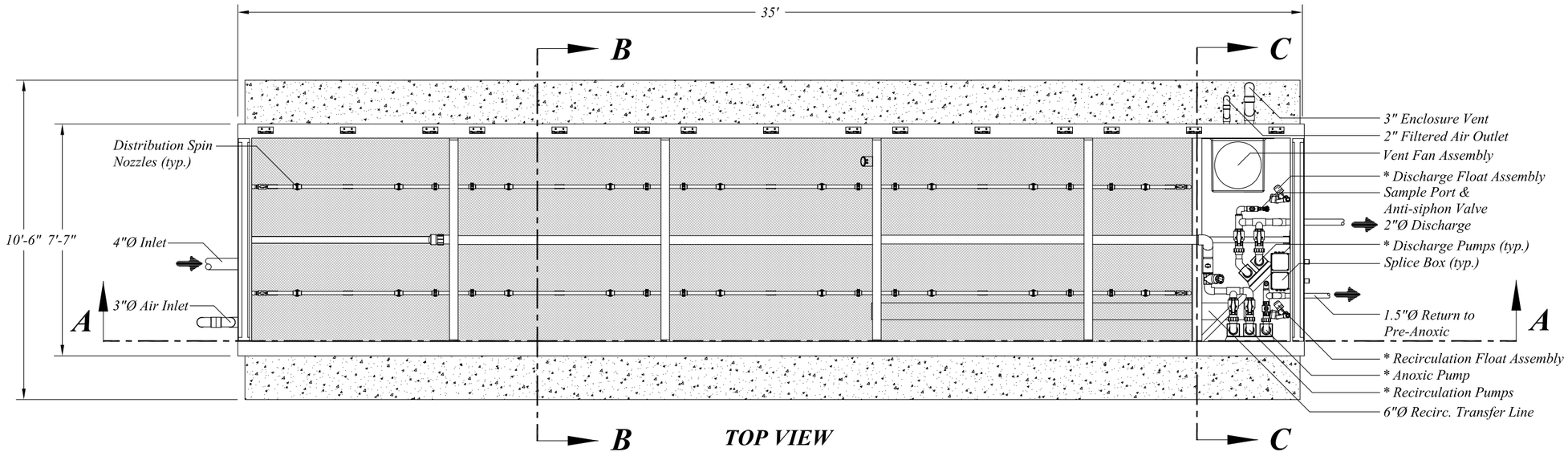
9–30–2020

PROJECT
19-0904

SHEET
C-2.3

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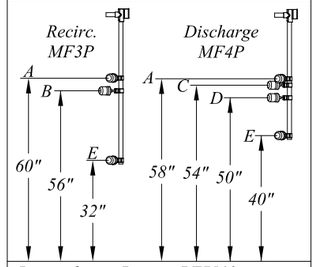
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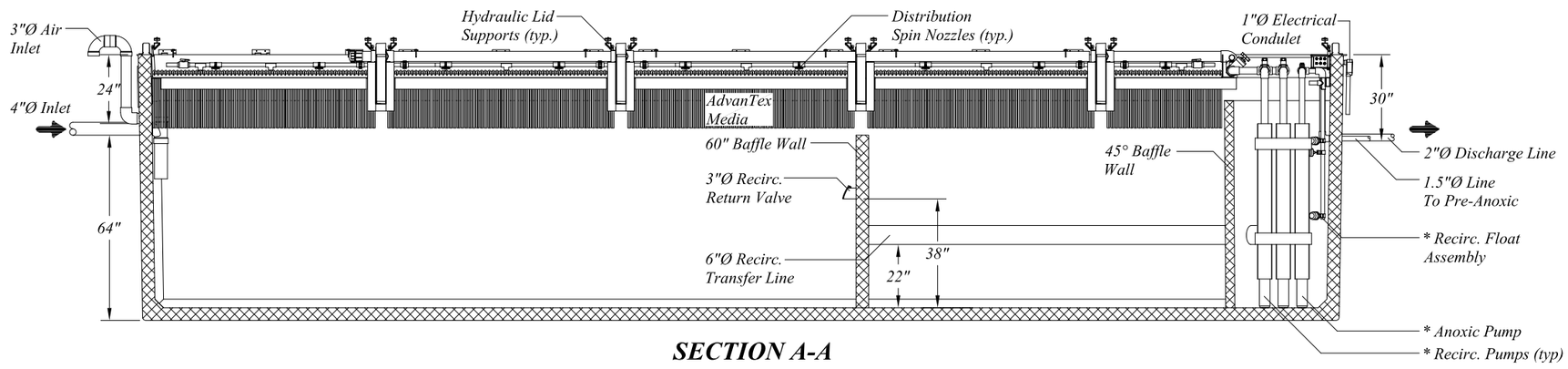
TOP VIEW

* *Float Functions & Pump Index*

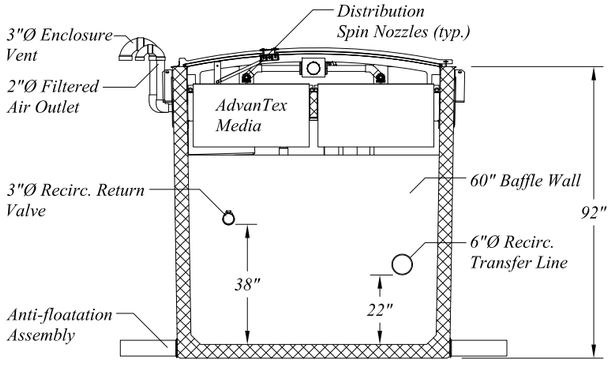
A	High Level Alarm / Lag Enable
B	Override Timer
C	Pump ON
D	Pump OFF
E	Redundant Off / Low Level Alarm



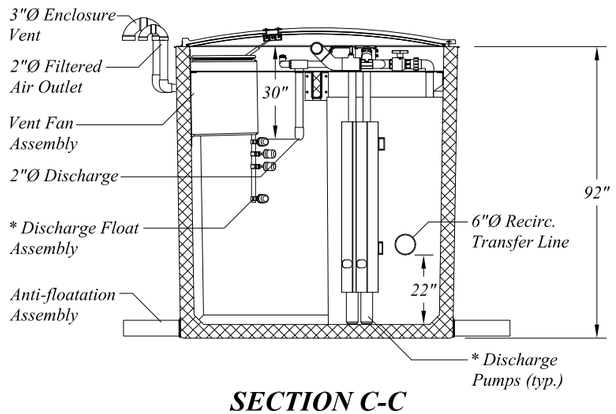
Recirculation Pumps: PF7510
Discharge Pumps: PF_____
Anoxic Return Pump: PF2005



SECTION A-A



SECTION B-B



SECTION C-C

Customer Approval

Signature: _____ Date: _____

Customer Name: _____

By this signature, Customer indicates that they have reviewed this Proposed System Configuration Drawing and found that it meets all of the designer's functional requirements and/or specifications.

Orenco SYSTEMS

© Orenco Systems, Inc.
Portions or all of this Proposed System Configuration Drawing, as appropriate, may be reproduced and integrated into the site-specific layout and configuration of a system by its designer.

Disclaimer: This Proposed System Configuration Drawing is provided solely as a design aid and illustrates one possible configuration of a system that would comply with Orenco's design criteria for the requirements and/or specifications that have been communicated to Orenco (based on third-party standards testing protocols and performance reports, as applicable). Design decisions, including the actual layout and configuration of the system and its viability for the project, are at the sole discretion of the systems's designer.

AdvanTex AX-Max225-35

System Details

Drawn By:	Ben Smith	Scale:	1" = 4'-0"
Reviewed By:	CSJ / NTB	Sheet:	1 OF 1
File Name:	MAX225-35.DWG	Rev: 2.0	Date: 9/05/2018

Provide a description of the type of proposed wastewater system to be constructed including the design capacity and the maximum potential number of customers the Utility will service in the proposed service area. Indicate the technology used for the wastewater system (e.g. membrane, sand filter, wetland cell and/or lagoon). The type of system and design capacity should match the type and design capacity of the associated TDEC permit and permit application.

RESPONSE:
Wastewater service to the Taliaferro Road Parcel will be provided by collection tanks at each home. Wastewater from the collection tanks will be gravity fed to force mains sending wastewater to the existing wastewater treatment system. An Orenco Ax Max system will be used as outlined in the permit application. After being treated the affluent will be sent to drip fields. The developer will bear all expenses of the engineering, treatment expansion, construction of a collection system and additional soils for drip fields. The Homes at Mulberry Meadows Subdivision will be a single-phase development consisting of 27 lots for single family dwellings.

AdvanTex® Treatment Systems

AX-Max™

Manufactured by **Orenco Systems®, Inc.**



This full-sized AdvanTex® AX-Max™ wastewater system was installed at a 50-site campground in the LaPine State Park, LaPine, Oregon, to handle design flows of 7,500 gpd (28.4 m³/day).

Decentralized Wastewater Treatment for Commercial Properties and Communities

Applications:

- Municipal systems
- Subdivisions, apartments
- Golf course developments, resorts
- Manufactured home parks
- Parks, RV parks, campgrounds
- Schools, churches, businesses
- Rest areas, truck stops

Orenco® SYSTEMS

814 Airway Avenue, Sutherlin, Oregon, USA 97479
Toll-Free: 800-348-9843 • +1-541-459-4449 • www.orenco.com

AdvanTex® AX-Max™ Treatment System

Reliable, Energy-Efficient Wastewater Treatment Everywhere!



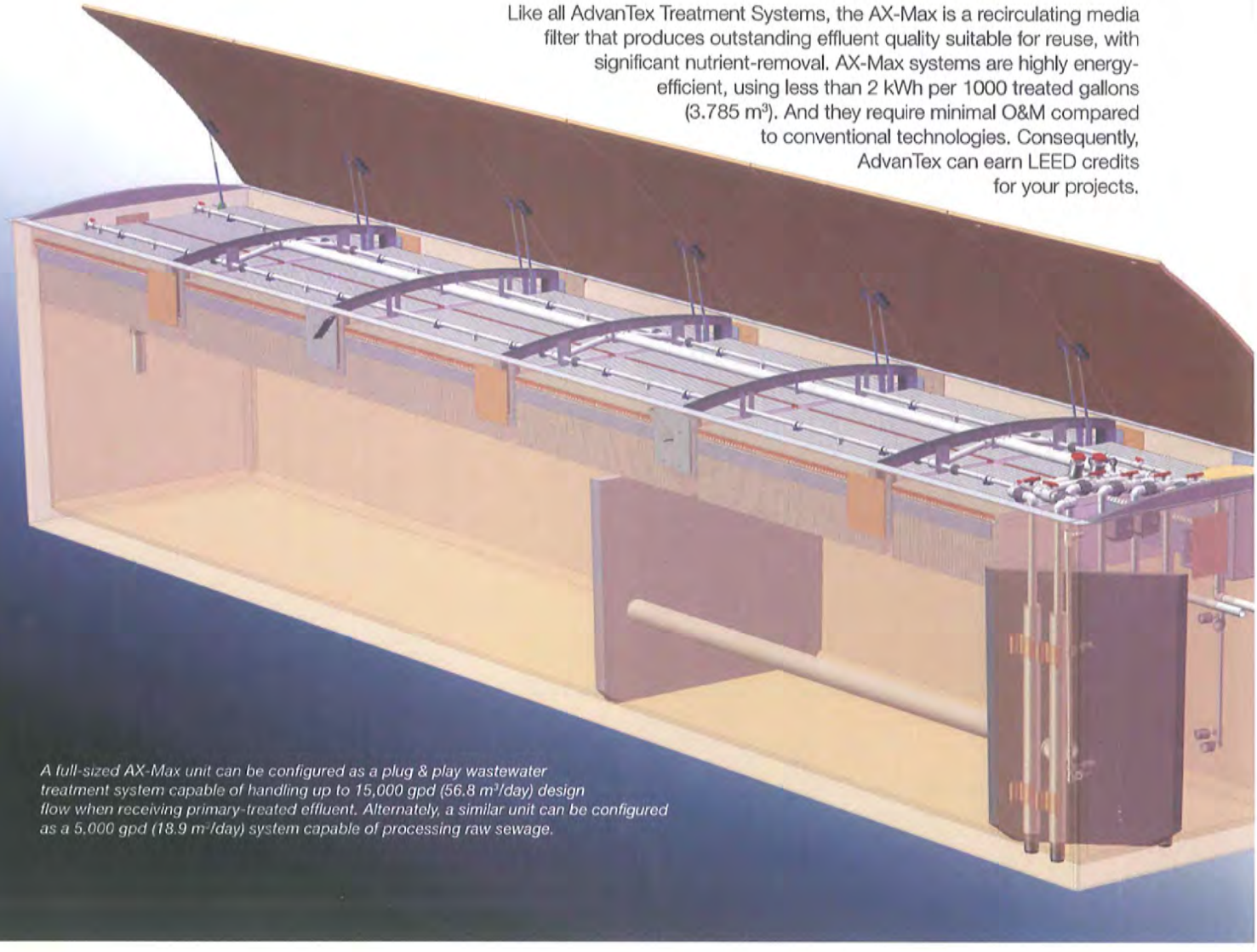
The Yakama Nations Housing Authority in Washington state added five AdvanTex® AX-Max units (background) to its ten AdvanTex AX-100 units, increasing the capacity of its wastewater system by 50%. Photo courtesy of Fextex Systems, Inc.

For more than 15 years, Orenco's AdvanTex® Treatment Systems have been providing reliable, energy-efficient wastewater treatment inside and outside the urban core. AdvanTex textile filter technology has been winning awards and coming out on top in field trials and demo projects, all over the world.

Orenco's newest product in the AdvanTex line is the AX-Max™: a completely-integrated, fully-plumbed, and compact wastewater treatment plant that's ideal for commercial properties and communities. It's also ideal for projects with strict discharge limits, limited budgets, and part-time operators.

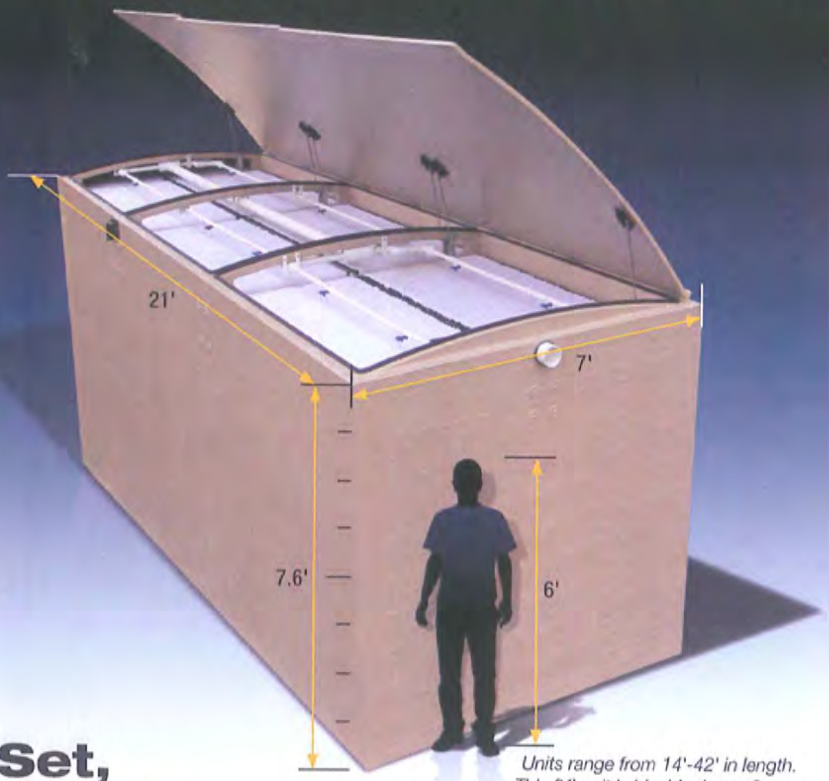
A Sustainable Solution for Wastewater Treatment

Like all AdvanTex Treatment Systems, the AX-Max is a recirculating media filter that produces outstanding effluent quality suitable for reuse, with significant nutrient-removal. AX-Max systems are highly energy-efficient, using less than 2 kWh per 1000 treated gallons (3.785 m^3). And they require minimal O&M compared to conventional technologies. Consequently, AdvanTex can earn LEED credits for your projects.



A full-sized AX-Max unit can be configured as a plug & play wastewater treatment system capable of handling up to 15,000 gpd (56.8 m^3/day) design flow when receiving primary-treated effluent. Alternately, a similar unit can be configured as a 5,000 gpd (18.9 m^3/day) system capable of processing raw sewage.

AdvanTex® AX-Max™ Treatment System



Units range from 14'-42' in length. This 21' unit is ideal for lower flows.

Set, Plumb, Wire, and Go

The AX-Max is pre-plumbed and easy to install, so AX-Max projects can meet the tightest deadlines. The entire system — including treatment, recirculation, and discharge — is built inside an insulated fiberglass tank that ranges from 14-42 feet (4.3-12.8 m) in length. AX-Max units can be installed above-ground — for maximum versatility in temporary or variable-flow situations — or in-ground. They can also be installed individually or in multi-tank arrays, treating up to 1 MGD (3,800 m^3/day).



For Every Climate and Condition

AX-Max systems provide excellent treatment anywhere, and they have been installed all over the world. For example, AX-Max systems have been installed at Malibu's famous beach parks and New Zealand's Glendhu Bay campground. Several more were installed in Soyo, Africa, to serve a new hospital and school. Other AX-Max systems have been installed on top of Alaska's frozen tundra and St. Lucia's volcanic rock. Still more have been installed in mining camps from Alberta to Texas and, in the Midwest, at a U.S. Department of Defense demo site.



Benefits

- Containerized, fully-plumbed
- Capable of meeting stringent permit limits
  - ~ Reuse-quality effluent
  - ~ Significant reductions in ammonia, total nitrogen
- Compact and versatile
- Above-ground or in-ground installation
- Easy to set
- Simple to operate
- Low energy usage: <2 kWh per 1000 treated gal. (<2 kWh per 3.785 m^3)*

  ** When treating domestic waste*



Textile Treatment Media

The treatment medium is a uniform, engineered textile. AdvanTex textile is easy to clean and allows loading rates as high as 50 gpd/ft^2 (2000 L/day/m^2) with primary-treated influent.



Effluent Distribution

High-quality, low-horsepower pumps micro-dose the treatment media at regular intervals, and proprietary spin nozzles efficiently distribute the effluent, optimizing treatment.



Telemetry Controls

Orenco's telemetry-enabled control panels use a dedicated phone line or ethernet connection, ensuring 24/7 monitoring and real-time remote control.

AdvanTex® AX-Max™ Treatment System

Carefully Engineered by Orenco

Orenco Systems has been researching, designing, manufacturing, and selling leading-edge products for small-scale wastewater treatment systems since 1981. The company has grown to become an industry leader, with about 300 employees and 300 points of distribution in North America, Australasia, Europe, Africa, and Southwest Asia. Our systems have been installed in more than 70 countries around the world.

Orenco maintains an environmental lab and employs dozens of civil, electrical, mechanical, and manufacturing engineers, as well as wastewater treatment system operators. Orenco's technologies are based on sound scientific principles of chemistry, biology, mechanical structure, and hydraulics. As a result, our research appears in numerous publications and our engineers are regularly asked to give workshops and trainings.

Powered by **Franklin Electric**

Orenco® SYSTEMS

814 Airway Avenue
Sutherlin, OR 97479 USA

T: 800-348-9843
T: 541-459-4449
F: 541-459-2884

www.orenco.com

ABR-ATX-MAX-1
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Orenco Systems®, Inc.

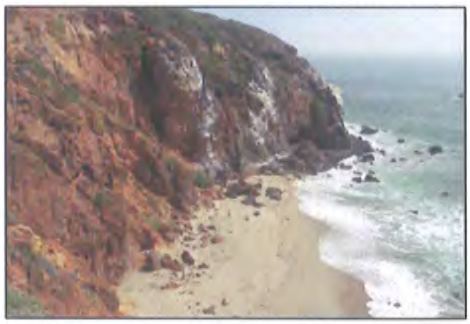
Project Summary



Installation photos courtesy of BioSolutions, Inc.

Point Dume State Beach and Preserve, Southern California

In spring, 2011, Los Angeles County needed to quickly upgrade restrooms at Malibu's Point Dume State Beach in time for the long — and busy — Memorial Day weekend. The county's engineer specified three AX-Max units, one for each restroom, and all three were installed in a matter of days. The small footprint of this configuration saved the county valuable space for visitor parking. After disinfection, the treated effluent is dispersed right into the sand. Point Dume is part of a large-scale upgrade of L.A. County beach parks, virtually all of which include AdvanTex Treatment Systems of various sizes and configurations.





Fully Supported by Orenco

AdvanTex Treatment Systems are part of a comprehensive program that includes ...

- Designer, installer, and operator training
- Design assistance, technical specifications, and plan reviews
- Installation and operation manuals
- Lifetime technical support

Distributed by:

Orenco® *Technical Data Sheet*

AdvanTex® AX-Max Treatment Systems

Applications

Orenco's AdvanTex® AX-Max is a complete, fully-plumbed, AdvanTex Wastewater Treatment Plant for residential, commercial, municipal, and mobile applications with medium-to-large-flows and permits requiring secondary treatment or better. It can be used as a stand-alone unit or in multi-unit arrays under adverse conditions in a wide range of environments. The AX-Max is ideal for:

- Small sites and poor soils
- At-grade or above-grade installations
- Mobile and temporary installations
- Disaster response sanitation
- Remote locations
- Extreme hot or cold climates

General

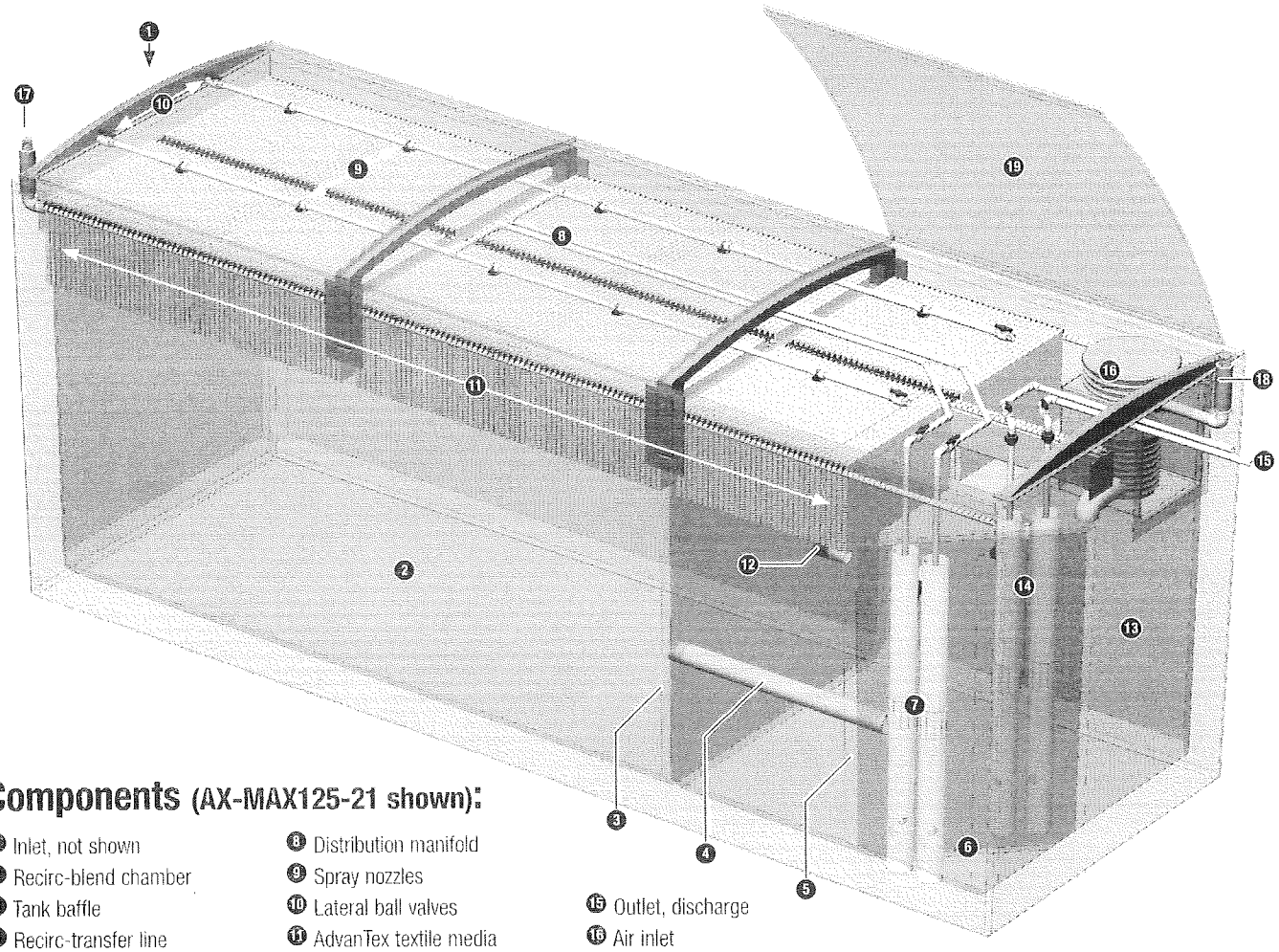
The AX-Max is a modular system that can be preceded by primary treatment or configured to incorporate primary, secondary, and tertiary wastewater treatment before reuse or dispersal.

The heart of the AX-Max system is the AdvanTex Recirculating Treatment Tank, a sturdy, watertight, corrosion-proof fiberglass tank that includes the same dependable, textile treatment media found in all AdvanTex products.

Standard Models

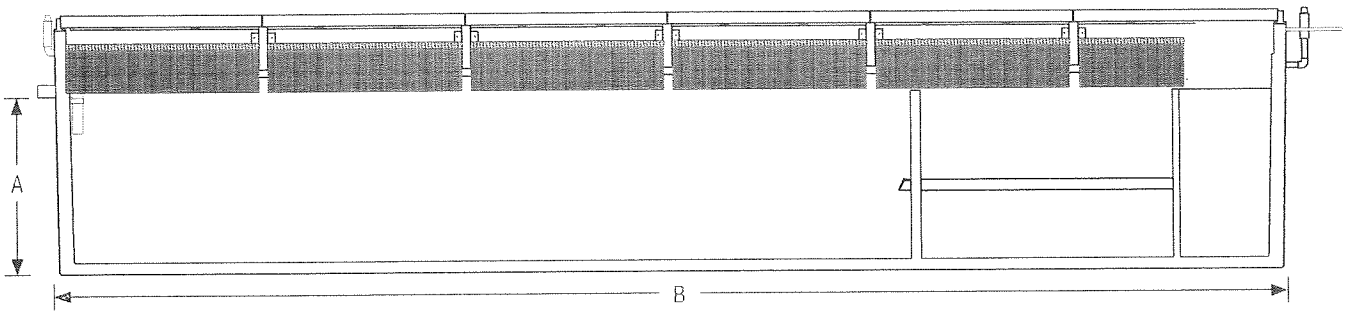
AX-MAX100-14, AX-MAX150-21, AX-MAX200-28, AX-MAX250-35, AX-MAX300-42 (Standard models without pump systems.)

AX-MAX075-14, AX-MAX125-21, AX-MAX175-28, AX-MAX225-35, AX-MAX275-42 (Standard models with pump systems.)

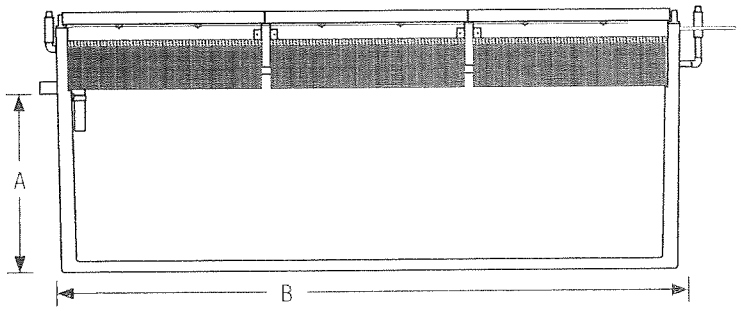


Components (AX-MAX125-21 shown):

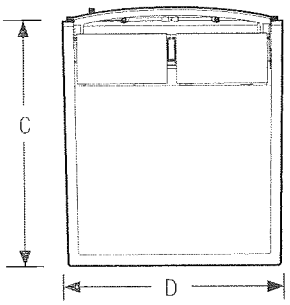
1. Inlet, not shown
2. Recirc-blend chamber
3. Tank baffle
4. Recirc-transfer line
5. Recirc-pump chamber baffle
6. Recirc-pump chamber
7. Recirc pumping assembly
8. Distribution manifold
9. Spray nozzles
10. Lateral ball valves
11. AdvanTex textile media
12. Recirc-return valve
13. Recirc-filtrate chamber
14. Discharge pumping assembly
15. Outlet, discharge
16. Air inlet
17. Vent fan assembly
18. Air outlet
19. Hinged lid, typical



AdvanTex AX-MAX275-42, side view



AdvanTex AX-MAX150-21, side view



AdvanTex AX-MAX, end view (all models)

Specifications

Nominal Dimensions*

Model	AX-MAX100-14	AX-MAX150-21	AX-MAX200-28	AX-MAX250-35	AX-MAX300-42
A, ft (m)	variable	variable	variable	variable	variable
B, ft (m)	14.0 (4.2)	21.0 (6.4)	28.0 (8.5)	35.0 (10.7)	42.0 (12.8)
C, ft (m)	7.6 (2.3)	7.6 (2.3)	7.6 (2.3)	7.6 (2.3)	7.6 (2.3)
D, ft (m)	7.5 (2.3)	7.5 (2.3)	7.5 (2.3)	7.5 (2.3)	7.5 (2.3)
Footprint, ft² (m²)	112.0 (10.4)	168.0 (15.6)	224.0 (20.8)	280.0 (26.0)	336.0 (31.2)
Model	**AX-MAX075-14**	**AX-MAX125-21**	**AX-MAX175-28**	**AX-MAX225-35**	**AX-MAX275-42**
A, ft (m)	5.7 (1.7)	5.7 (1.7)	5.7 (1.7)	5.7 (1.7)	5.7 (1.7)
B, ft (m)	14.0 (4.2)	21.0 (6.4)	28.0 (8.5)	35.0 (10.7)	42.0 (12.8)
C, ft (m)	7.6 (2.3)	7.6 (2.3)	7.6 (2.3)	7.6 (2.3)	7.6 (2.3)
D, ft (m)	7.5 (2.3)	7.5 (2.3)	7.5 (2.3)	7.5 (2.3)	7.5 (2.3)
Footprint, ft² (m²)	112.0 (10.4)	168.0 (15.6)	224.0 (20.8)	280.0 (26.0)	336.0 (31.2)

**See AdvanTex® AX-Max Treatment System drawings for exact dimensions and specific treatment configurations.*

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Commercial Treatment Systems

Design Considerations for AdvanTex® Treatment Systems

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Equations and Parameters Frequently Used In This Design Criteria

For recommendations regarding minimum hydraulic retention times, primary tankage, and configurations, see Table A, page 22.

Determining mass load in AdvanTex® systems *(For complete information on how to use these equations, see page 23.)*

Mass Load (lbs/day)	Mass Load (kg/day)
Concentration (mg/L) × (8.34 x 10^{-6}) × Flow (gpd)	Concentration (mg/L) × (0.001) × Flow (m^3/day)

Determining standard AdvanTex® stage sizing *(For complete information on how to use these equations, see pages 15-16.)*

	Design Avg (US Units)	Design Max. (US Units)	Design Avg (SI Units)	Design Max. (SI Units)
Based on Organic Loading Rate (OLR)	0.04 lbs BOD_5/ft^2•d	0.08 lbs BOD_5/ft^2•d	0.2 kg BOD_5/m^2•d	0.4 kg BOD_5/m^2•d
Based on Hydraulic Loading Rate (HLR)	25 gpd/ft^2	50 gpd/ft^2	1 m^3/m^2•d	2 m^3/m^2•d
Based on Total Nitrogen Loading Rate (TNLR)	0.014 lbs TN/ft^2•d	0.028 lbs TN/ft^2•d	0.07 kg TN/m^2•d	0.014 kg TN/m^2•d
Based on Ammonia Loading Rate (ALR)	0.01 lbs NH_3-N/ft^2•d	0.02 lbs NH_3-N/ft^2•d	0.05 kg NH_3-N/m^2•d	0.1 kg NH_3-N/m^2•d

Determining second stage AdvanTex sizing in two-stage systems *(For complete information on how to use these equations, see pages 16-17.)*

	Design Avg (US Units)	Design Max. (US Units)	Design Avg (SI Units)	Design Max. (SI Units)
Based on Organic Loading Rate (OLR)	0.02 lbs BOD_5/ft^2•d	0.04 lbs BOD_5/ft^2•d	0.1 kg BOD_5/m^2•d	0.2 kg BOD_5/m^2•d
Based on Hydraulic Loading Rate (HLR)	75 gpd/ft^2	125 gpd/ft^2	3 m^3/m^2•d	5 m^3/m^2•d
Based on Total Nitrogen Loading Rate (TNLR)	0.07 lbs TN/ft^2•d	0.014 lbs TN/ft^2•d	0.035 kg TN/m^2•d	0.07 kg TN/m^2•d
Based on Ammonia Loading Rate (ALR)	0.005 lbs NH_3-N/ft^2•d	0.01 lbs NH_3-N/ft^2•d	0.025 kg NH_3-N/m^2•d	0.05 kg NH_3-N/m^2•d

Determining anticipated treatment performance from standard AdvanTex systems *(For complete information on how to use these equations, see pages 25-25.)*

Based on BOD_5

$$BOD_{5e} = BOD_{5i} \times (1 - C_{BR})$$

where: BOD_{5e} = BOD_5 effluent from standard AdvanTex stage
BOD_{5i} = BOD_5 primary treated effluent value
C_{BR} = 0.90 coefficient

Based on TKN or NH_3-N

$$TKN_e = TKN_i \times (1 - C_{NR})$$

where: TKN_e = TKN effluent from standard AdvanTex stage
TKN_i = TKN primary treated effluent value
C_{NR} = 0.95 coefficient

Based on NO_3

$$NO_{3e} = (TKN_i - TKN_e) \times (1 - C_{DNR})$$

where: NO_{3e} = NO_3 effluent from standard AdvanTex stage
TKN_i = TKN primary treated effluent value
TKN_e = TKN effluent
C_{DNR} = 0.70 coefficient

Based on TN

$$TN_e = TKN_e + NO_{3e}$$

where: TN_e = TN effluent from standard AdvanTex stage
TKN_e = TKN effluent from standard AdvanTex stage
NO_{3e} = NO_3 effluent from standard AdvanTex stage

Determining anticipated treatment performance for total nitrogen from post-anoxic AdvanTex treatment stages

(For complete information on how to use these equations, see page 26.)

$$TN_{PAe} = TKN_e + NO_{3e} \times (1 - C_{DNR})$$

where: TN_{PAe} = TN effluent from post-anoxic stage
TKN_e = TKN effluent from standard Advantex stage
NO_{3e} = NO_3 effluent from standard AdvanTex stage
C_{DNR} = 0.70 coefficient

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Introduction

Orenco's AdvanTex® Treatment Systems were developed for the long-term processing of domestic- and commercial-strength wastewater to advanced treatment levels. The heart of all AdvanTex systems is a multiple-pass, packed-bed, fixed-film media filter that reliably provides high-quality effluent in a wide range of applications. These systems have undergone numerous national and international testing protocols, as well as multiple third-party field verification programs. This manual provides design information and guidance for commercial applications using an AdvanTex Treatment System. For other applications, contact Orenco or your local Orenco Dealer for more information.

AdvanTex® Model Descriptions

Three AdvanTex models are typically used in commercial applications. Your choice of model depends on system sizing requirements and site characteristics. All three operate in the manner described in the Treatment Process Description, and all perform similarly. For exact dimensions and specific treatment configurations, see AdvanTex Treatment System drawings.

AdvanTex AX20

AX20 Specifications

Length	91 inches (2311 mm)
Width	40 inches (1016 mm)
Height	31 inches (787 mm)
Dry weight	400 lbs (181 kg)
Treatment surface area	20 ft² (1.9 m²), nominal
Installation footprint	25 ft² (1.9 m²), actual
Installation methods	Partial burial or bermed installation; 6 inches (150 mm) above grade, minimum; antifloatation flanges available for areas with high groundwater
Recirculation-blend tankage	External
Recirculation method	Recirculating splitter valve

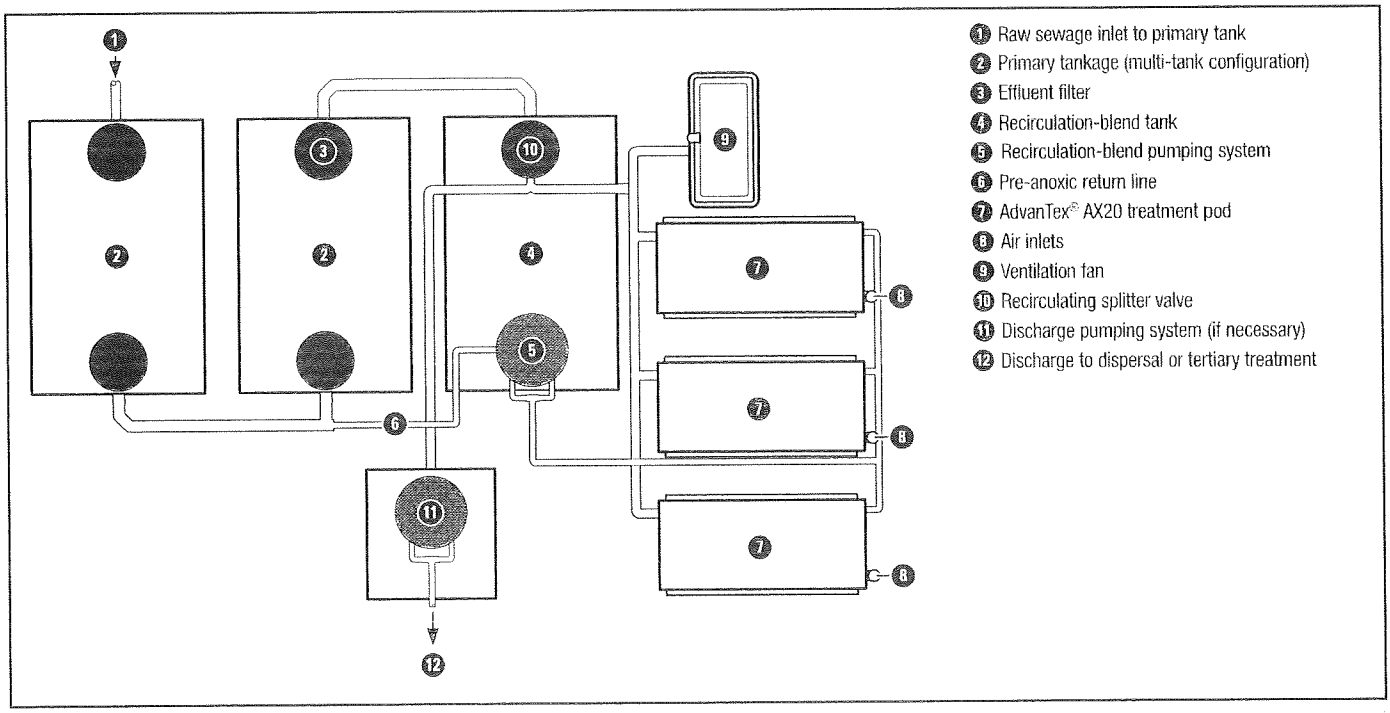


Figure 1. Example of an AdvanTex AX20 Commercial Treatment System

AdvanTex AX100

AX100 Specifications:

Length	191 inches (4851 mm)
Width	94 inches (2388 mm)
Height	42 inches (1067 mm)
Dry weight	1760 lbs (798 kg)
Treatment surface area	100 ft² (9.3 m²), nominal
Installation footprint	128 ft² (11.9 m²), actual
Installation methods	Partial burial or bermed installation; 6 inches (150 mm) above berm, minimum; 9 inches (230 mm) below natural grade, maximum
Recirculation-blend tankage	External
Recirculation method	Recirculating splitter valve

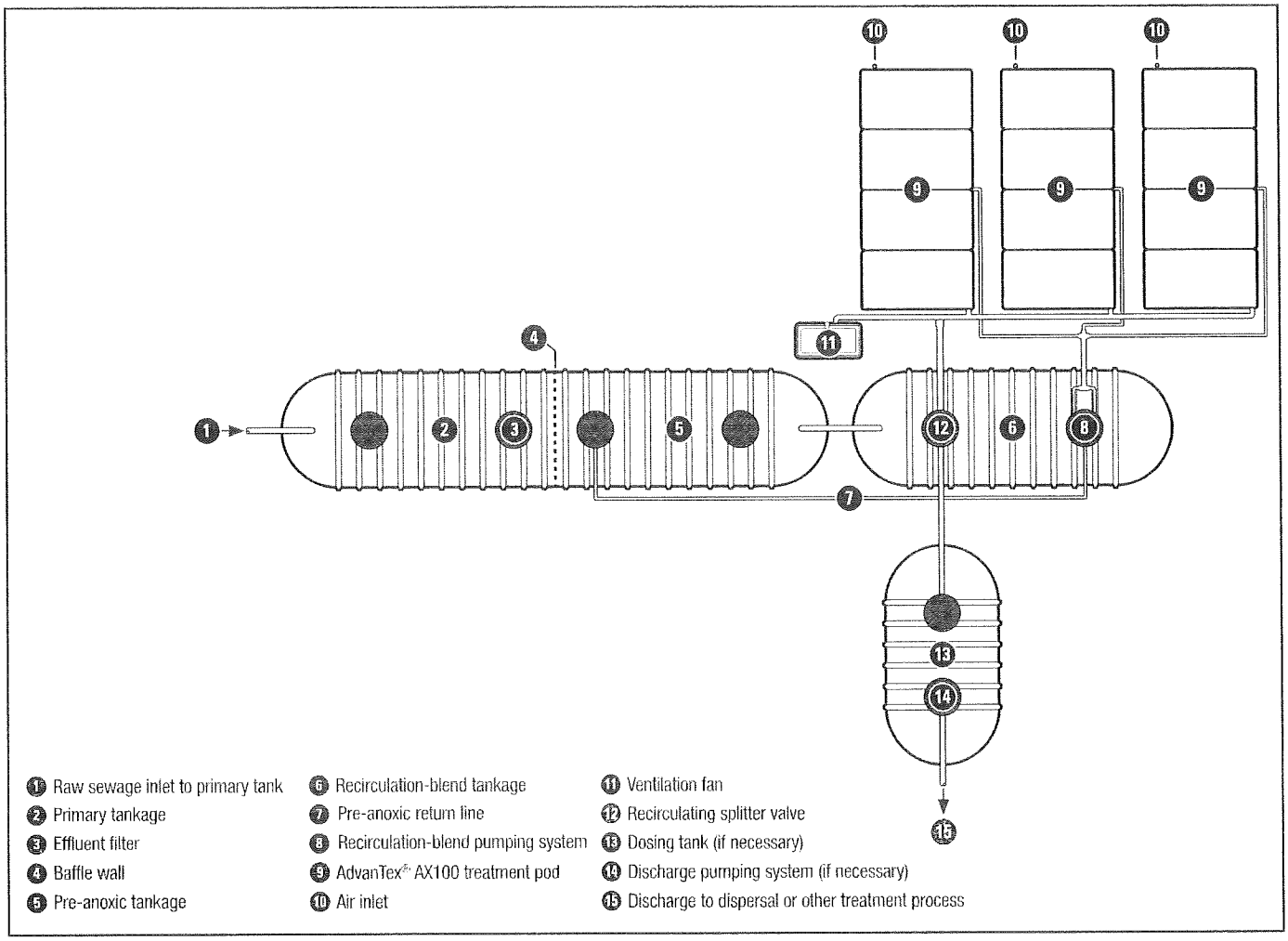


Figure 2. Example of an AdvanTex AX100 Commercial Treatment System

AdvanTex AX-Max™

AX-Max Specifications:

Length	14-42 ft (4.2-12.8 m)
Width	90 inches (2286 mm)
Height	97 inches (2464 mm)
Dry weight	Variable, up to 12,000 lbs (5440 kg)
Treatment surface area	25-300 ft^2 (2.3-27.9 m^2), nominal
Installation footprint	112-336 ft^2 (10.4-31.2 m^2), actual
Installation methods	Partial burial or bermed installation, or free-standing installation; 24-36 inches (610-910 mm) above grade or berm for ease of maintenance; antifloatation available for areas with high groundwater
Recirculation-blend tankage	Included
Recirculation method	Tank baffle wall, recirc-return valve

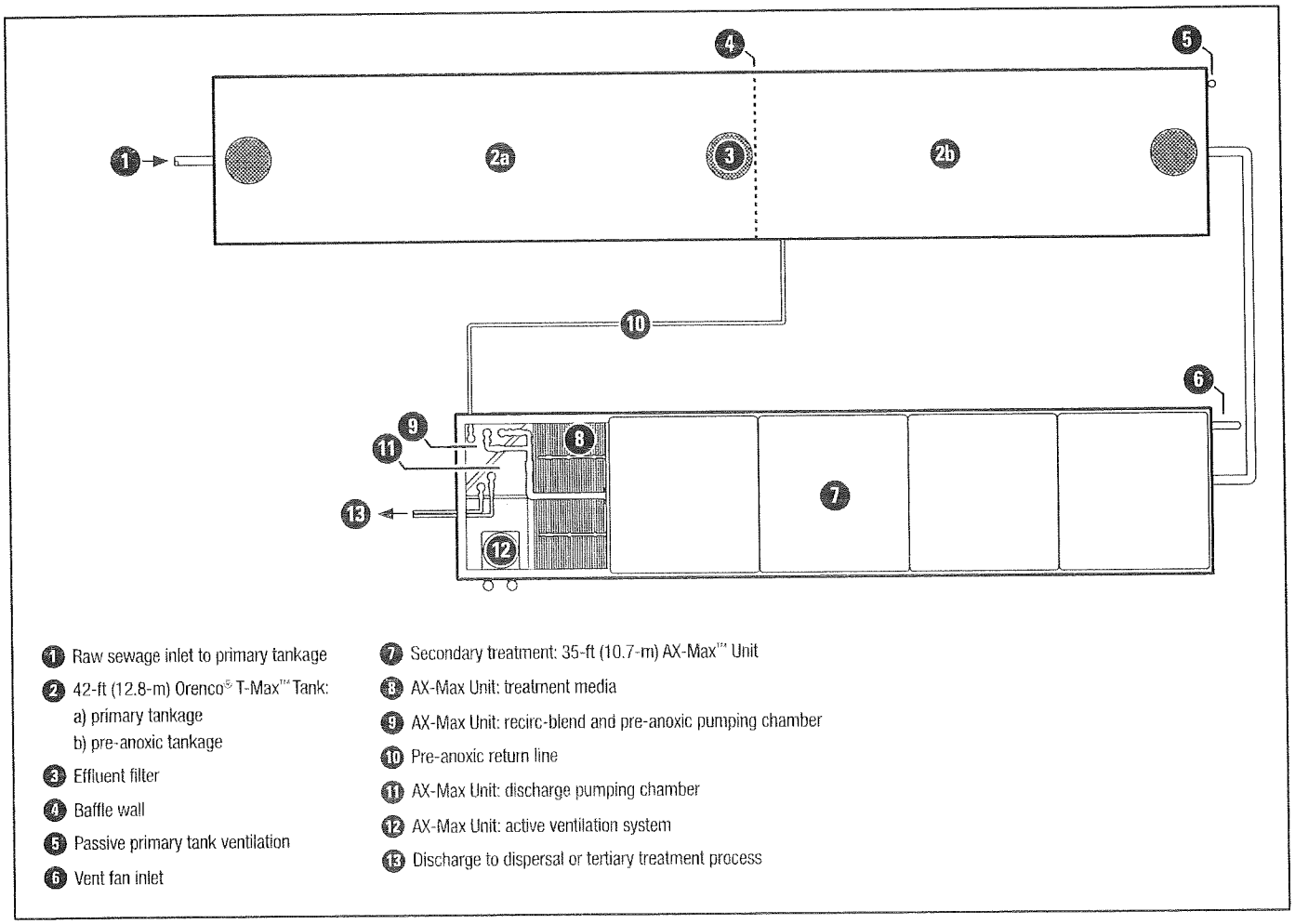


Figure 3. Example of an AdvanTex AX-Max Commercial Treatment System

Design Basis

To ensure that the system is designed properly for a given application, it is critical to first determine the design basis. The design basis for any treatment system consists of careful evaluation of several parameters that control the system's design and subsequent performance. Orenco's "*Engineered Project Questionnaire,*" NFO-ATX-ADM-2, is available to assist in identifying and characterizing these parameters. It can be downloaded from Orenco's Document Library at www.orenco.com, or you may contact Orenco or your local Orenco Dealer for a copy. This document provides a list of the typical design parameters necessary to determine the suitability of Orenco products to a given project and for forming the system's design basis.

Average Day and Maximum Day Flows

Flows may be defined or calculated differently by application and local regulation; however, as used in this document:

Design Average Flow **(Q_A)** is the average of the daily volume to be received for a continuous 12-month period expressed as a volume per day. For facilities having critical seasonal high hydraulic loading periods (e.g., recreational areas, campgrounds) the design average is based on the daily average flow during the seasonal period.

Design Maximum Day Flow **(Q_M)** is the largest volume of flow to be received during a continuous 24-hour period expressed as a volume per day. The Design Maximum Day Flow is highly dependent on the application and collection technology used. For Effluent Sewer (STEP), Grinder Sewer, and Vacuum Sewer, a typical value is two times the Design Average Flow ($2Q_A$).

For Conventional Gravity Sewer applications, a typical value for QM is four times the Design Average Flow ($4Q_A$) for new construction and can range to over ten times ($10Q_A\pm$) for existing systems. Make sure to carefully evaluate any existing flow information and regulatory requirements when establishing this design parameter.

Primary-Treated Effluent Wastewater Strength

Organic Constituents in Wastewater

The two primary organic constituents in wastewater used in determining applicability and sizing of AdvanTex Treatment Systems are biochemical oxygen demand (**BOD_5**) and total suspended solids (**TSS**). These constituents are typically quantified either in raw wastewater or after the primary treatment stage. In order to determine the waste load to the AdvanTex Treatment System, it is necessary to determine the constituent concentrations after primary treatment. These constituent concentrations are referred to as primary-treated effluent throughout this document, and all percent reduction estimates are calculated relative to these concentrations. If these constituents are provided as raw wastewater values, it is the responsibility of the designer to determine the appropriate primary treatment requirements to achieve the primary-treated effluent values used in the design. Industry experts typically estimate that appropriate primary treatment (see Appendix A for primary tank sizing recommendations) will provide 50% reduction of BOD_5 (down to a minimum of 150 mg/L) and 90% reduction of TSS (down to a minimum of 50 mg/L).

Nitrogen Constituents in Wastewater

The principal forms of nitrogen found in wastewater are Organic Nitrogen (**Organic-N**), Ammonia Nitrogen (**NH_3-N**), Ammonium Nitrogen (**NH_4-N**), Nitrite Nitrogen (**NO_2-N**), and Nitrate Nitrogen (**NO_3-N**). These are expressed either individually or as components of the following:

- **Total Kjeldahl Nitrogen (TKN)**, which is the sum of Organic-N + NH_3-N
- **Total Inorganic Nitrogen (TIN)**, which is the sum of NH_3-N + NO_2-N + NO_3-N
- **Total Nitrogen (TN)**, which is the sum of TKN + NO_2-N + NO_3-N

As with the organic constituent concentrations, the nitrogen constituent concentrations must be quantified after the primary treatment stage to determine waste load to the AdvanTex Treatment System and are listed as primary-treated effluent throughout this document. A thorough understanding of the nitrogen cycle and how it works within the wastewater system is important when designing a system to treat for these parameters. A brief description of the processes follows:

Ammonification

Nitrogen is usually introduced into the wastewater system as Organic-N and NH_4-N. Organic-N (including feces, urea, and other animal and vegetable matter) in wastewater is converted into NH_4-N by the process of ammonification. In ammonification, proteins, amino acids, and other nitrogen-containing compounds are biochemically degraded by heterotrophic bacteria. Ammonification typically occurs in primary tankage and transport lines, as well as in the secondary treatment process. Because of this, a raw wastewater ammonia measurement may be significantly lower than the true value. In these instances, TKN is a better measure of overall nitrogen content and should be used when determining waste load to the AdvanTex Treatment System.

Nitrification and Denitrification

Once primary treated effluent is introduced into the secondary treatment process, nitrogen removal occurs first by nitrification and then by denitrification. In the first step of nitrification, an ammonium-oxidizing autotrophic bacteria, (Nitrosomonas), converts ammonium to nitrite. In the second step of nitrification, a nitrite-oxidizing bacteria, (Nitrobacter), converts nitrite to nitrate. Both of these processes occur under aerobic conditions. Lastly, denitrification occurs when nitrate is converted to nitrogen gas by heterotrophic bacteria under anoxic conditions (DO < 0.5 mg/L).

Therefore, treatment for NH_3-N and TKN occurs through an aerobic process while treatment for NO_3-N, TIN, and TN occurs through a combination of aerobic and anoxic processes.

For more information about the nitrogen process in wastewater, see Metcalf & Eddy's "*Small and Decentralized Wastewater Management Systems,*" 4th Edition (1999). For information on pH and temperature effects on Nitrification and Denitrification, see *pH Effect on Nitrification* and *Temperature Effect on Nitrification and Denitrification* in the Design Considerations section on page 19.

Discharge Treatment Levels and Sampling Requirements

Discharge treatment levels and sampling requirements play a significant role in treatment facility design. Secondary treatment (effluent concentrations of BOD_5 and TSS of ≤ 30 mg/L based on a 30-day average) is a simple process typically requiring only a single-stage AdvanTex Treatment System. Additionally, advanced secondary treatment (BOD_5 and TSS of ≤ 10 mg/L based on a 30-day average) can typically be accomplished in the same manner. However many permits are now requiring some higher level of nitrogen treatment as well as providing values of "not to exceed" in place of "30-day average" or "30-day arithmetic mean." In these instances a safety factor of some kind is typically applied (or additional processes added) so that the discharge parameters are not exceeded even under maximum day flow conditions or maximum day primary-treated effluent concentrations.

Likelihood of System Expansion and Potential Permit Changes

Permits are typically limited in duration, and over the past two decades treated effluent discharge requirements have become stricter. In fact, many permit renewals are now asking for measurement of various constituents that were not part of the original treatment facility design. When designers are planning for future expansion, or for future modifications to permits, Orenco recommends using incremental engineering to plan for and provide space for potential future treatment upgrades. By understanding the various stages used in AdvanTex Treatment Systems, designers can lay out the treatment facility in a manner that allows for additional stages in the event that a planned build-out or future permit modification requires it. Please see sections titled *Treatment System Configurations* and *Process Stages* for more information.

Highly Variable or Seasonal Flow Considerations

Hundreds of AdvanTex systems are installed in parks, campgrounds, resorts, and lodges that experience highly variable flows (or complete shutdowns for long periods) due to seasonal use. AdvanTex systems are ideally suited for these applications. Shortly after the system is placed in service, a thin bacterial film develops in the upper portion of the textile media, and removal of BOD_5/TSS occurs the first day after being in service. Independent tests show that AdvanTex systems are capable of removing > 85% $cBOD_5$ and > 97% TSS within the first few days of operation. Many other technologies (especially suspended growth technologies) require weeks to treat to this level and struggle during periods of low loading.

The Operations & Maintenance (O&M) manual provided with each AdvanTex system can help guide the operator on appropriate O&M for systems with highly variable or seasonal flows, including the use of trending to automatically adjust recirculation ratios. For more information on determining which O&M method is best for a particular highly variable or seasonal flow application, contact Orenco.

Application Types

Applications can typically be classified into one of seven application types, each characterized by waste streams and usage characteristics. Table 1 lists each application type, examples, the criteria used to establish each type, and associated design notes.

It is important to note that the flow and constituent concentration ranges associated with each application type represent Orenco's observations from similarly classified applications. However, they do not represent actual flows and constituent concentrations of the applications at hand. The engineer is responsible for ensuring that wastewater in each project is properly characterized and, whenever possible, waste streams should be sampled and actual values used in the design.

Table 1. Application Types

Application Types	Examples	Characterization Criteria	Design Notes
Type 1: *Domestic Primary-Treated Effluent Quality (Blend of Black and Grey Water Waste)*	• Apartments • Condominiums • Mobile Home Parks • Municipal Systems • Planned Communities • Residential Subdivisions • Work Camps	• Waste streams are residential in nature • Contributions come from both black and grey water sources	• *Some "Type 1" applications have flow contributions that bias them toward another application type (e.g., communities serving primarily commercial core areas with minimal residential connections, or work camps with commercial kitchens serving meals for workers from other camps).* • *With appropriate primary treatment, primary-treated effluent typically ranges from:* – BOD_5 140-250 mg/L – TSS 40-140 mg/L – TKN 50-80 mg/L
Type 2: *Primarily Black Water Waste*	• Airport Facilities • Campgrounds • Fire Departments • Golf Courses • Manufacturing Facilities • Offices • Parks • Public Toilets/Rest Areas • RV Parks • Ski Resorts • Visitor Centers	• Waste streams are commercial in nature • Contributions come from primarily black water sources	• *Some "Type 2" applications have flow contributions that bias them toward another application type (e.g., facilities with restaurants or RV parks or campgrounds with flow contributions from dump stations exceeding 20% of the daily flow).* • *With appropriate primary treatment, primary-treated effluent typically ranges from:* – BOD_5 300-500 mg/L – TSS 80-250 mg/L – TKN 90-200 mg/L
Type 3: *Primarily Black Water Waste with Surge Flows*	• Churches • Schools	• Waste streams are commercial in nature and primarily from black water sources • Flows and primary treated effluent quality are heavily dependent on the facilities (e.g., schools with cafeterias and shower facilities vary significantly from those without)	• *Due to variations in daily waste volumes, flow equalization tankage should be strongly considered in order to optimize the treatment process.* • *With appropriate primary treatment, primary-treated effluent typically ranges from:* – BOD_5 300-500 mg/L – TSS 80-250 mg/L – TKN 90-150 mg/L
Type 4: *Primarily Black Water Waste with Pharmaceuticals or Toxic Inhibitors*	• Hospitals • Retirement Facilities • Veterinary Clinics	• Waste streams are commercial in nature and primarily from black water sources	• *Antibiotics and other pharmaceutical products in the waste stream may impair microorganism health in the primary tank and the AdvanTex unit.* • *The designer should note on the plan set that the wastewater treatment system can be negatively affected by the introduction of these substances and care should be taken to limit their discharge.* • *With appropriate primary treatment, primary-treated effluent typically ranges from:* – BOD_5 300-700 mg/L – TSS 100-350 mg/L – TKN 70-120 mg/L

Application Types	Examples	Characterization Criteria	Design Notes
Type 5: *Black Water with Restaurant Waste*	• Bars/Taverns • Casinos • Delis • Gas Stations • Hotels/Motels • Restaurants • Resorts • Shopping Centers • Strip Malls	• Waste streams are commercial in nature • Contributions range from primarily black water with some kitchen sources to primarily kitchen sources with some black water • Raw wastewater has significant grease and oil (G&O) contributions	• *Careful evaluation is required to properly size AdvanTex systems for "Type 5" applications. Waste strength varies significantly depending on the hours of business, menu, take-out vs. dine-in eating, dining seat turnover rate, catering and event hosting activities, etc.* • *Restaurant applications require a pre-anoxic return loop (see Process Stages section on page 12).* • *Restaurants and applications with greater than a 50% flow contribution from restaurants and BOD_5 values greater than 800 mg/L will require the use of pre-aeration and clarification (see Process Stages section on page 13).* • *Grease tanks must be sized to ensure that the maximum G&O contribution to the secondary treatment system does not exceed 25 mg/L. Recommended grease tank sizes are provided in Appendix A.* • *Kitchen dishwashing appliances used in conjunction with AdvanTex treatment must be high-temperature appliances.* • *For existing systems with low-temperature, chemical-type appliances, pre-aeration will be necessary.* • *With appropriate primary treatment, primary-treated effluent typically ranges from:* – BOD_5 300-1000+ mg/L – TSS 80-300 mg/L – TKN 90-200+ mg/L
Type 6: *Polishing Bioreactors*	• Organic Removal • Ammonia Removal	• Waste streams have typically been treated to secondary levels prior to polishing unit • These are sized based upon the organic and or ammonia removal loading rates provided in this document.	• *Polishing of lagoon or holding pond effluent requires removal of algae prior to introduction to the polishing bioreactor system.* • *Contact Orenco for support on all high-strength waste projects.*
Type 7: *High Strength Process Waste*	• Wineries • Breweries • Dairies • Food Processing Facilities • Slaughterhouses	• These are complex waste streams requiring careful evaluation	• *Chemical cleaning processes used in facilities that produce high-strength process waste must be addressed to ensure they are compatible with AdvanTex biological treatment processes.* • *All Type 7 applications require the use of a pre-anoxic return loop (see Process Stages).* • *All Type 7 applications will require the use of pre-aeration and clarification (see Process Stages).* • *Additional treatment processes, such as bioaugmentation (the addition of necessary nutrients required to speed up the rate of degradation of a contaminant), are often necessary in addition to the secondary treatment system.* • *Contact Orenco for support on all high-strength waste projects.*

Treatment System Configurations

This section shows the three most common treatment system configurations using an AdvanTex Treatment System. Determination of the appropriate configuration is based upon flow, primary treated effluent constituent concentrations, and discharge permit requirements.

Each configuration shows the applicable treatment stages utilized and where to find the information to properly size the systems.

For systems with restaurant waste contributions, adequate grease tankage or similar means are necessary to ensure that the maximum grease contribution to the secondary treatment system does not exceed 25 mg/L greases and oils. Levels above 25 mg/L will tend to clog the textile sheets prematurely, preventing adequate aeration and uniform delivery of wastewater constituents for effective biological breakdown.

The appropriate sizing equations are referenced in each figure. When multiple equations are referenced, each calculation should be performed and the largest resulting textile surface area must be used in the design. Please contact Orenco or the nearest Orenco Dealer for support regarding the appropriate configuration or sizing criteria.

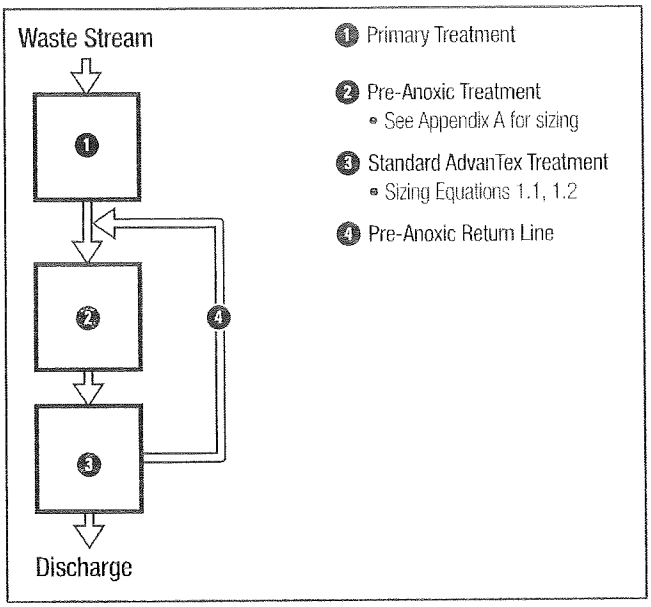


Figure 4. Treatment Diagram for Removal of Organics

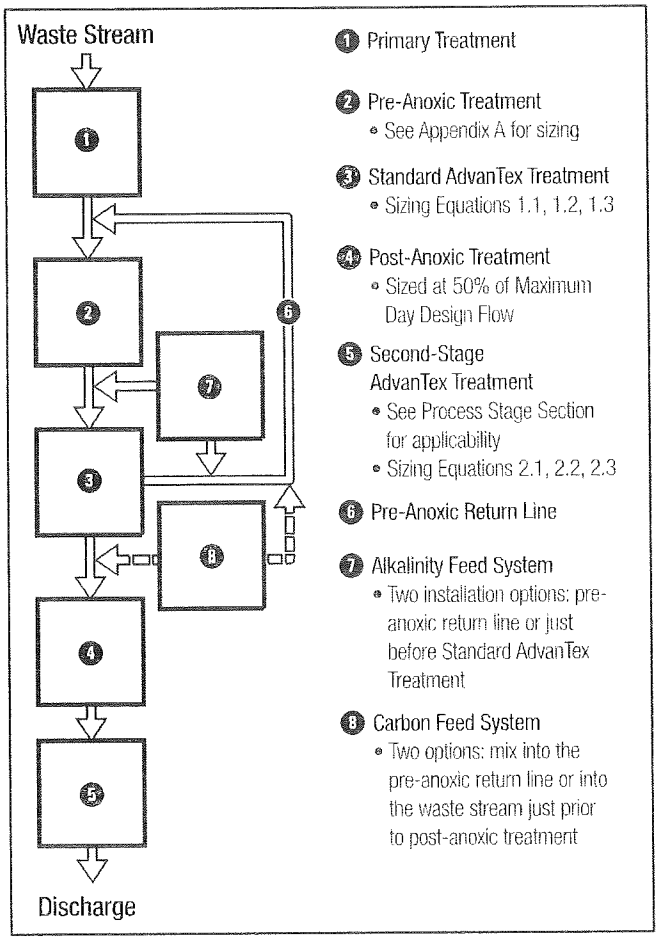


Figure 5. Treatment Diagram for Advanced Removal of Nitrogen

Standard AdvanTex Systems

Use for BOD_5/$cBOD_5$, TSS, and Nitrogen Discharge Limits

Organic removal is the simplest form of advanced treatment, typically requiring only primary and secondary treatment. When loaded at or below the applicable loading rates, standard AdvanTex Treatment Systems typically achieve treatment levels of < 10 mg/L BOD_5/$cBOD_5$ and TSS (based on 30-day average or 30-day arithmetic mean), and they typically provide reduction of total nitrogen (TN) > 60% and removal of ammonia (NH_3-N) of 95% (range 90-99%).

Figure 4 shows the typical configuration for discharge limits associated with these constituents. See the AdvanTex Unit Sizing section of this document for the sizing equation listed.

A pre-anoxic stage is recommended for all organic-only removal applications and it is required for systems with high-strength primary treated effluent (Application Types 5 & 7).

A two-stage AdvanTex system will be necessary for systems with discharge limits of NOT TO EXCEED 10 mg/L BOD_5/$cBOD_5$ or for discharge limits of ≤ 5 mg/L BOD_5/$cBOD_5$ based on a 30-day average or 30-day arithmetic mean.

AdvanTex Systems for the Advanced Removal of Nitrogen

Use for Systems with Permits Requiring Discharge Limits of 60-80% Removal of Total Nitrogen, Total Inorganic Nitrogen, or Nitrate Nitrogen

For wastewater systems with permit limits for TN, TIN, or NO_3-N requiring greater than 60% nitrogen reduction, pre-anoxic and post-anoxic treatment stages are needed, as well as the possible addition of both supplemental carbon and alkalinity. Figure 5 shows the typical configuration for systems with discharge limits requiring this level of treatment.

The nitrification occurring in the AdvanTex treatment stage is heavily influenced by the alkalinity required to buffer the process (7.14 mg/L alkalinity per 1 mg/L of ammonia-N). pH levels of 7.5 to 8.5 are ideal for complete nitrification and should be buffered to remain above a pH of 7 for all applications. The use of the pre-anoxic stage benefits overall operation of the system, since denitrification in this stage will return as much as 50% of the alkalinity consumed during nitrification. Even so, a supplemental alkalinity feeder may be necessary immediately preceding the AdvanTex treatment stage, to ensure sufficient alkalinity for nitrification.

Carbon addition should be balanced to the wastewater flows to ensure carbon-to-nitrogen (C:N) ratios are appropriate. C:N ratios need to be greater than 4:1 and preferably in the 6:1 range to ensure that denitrification occurs. Carbon is added in the post-anoxic stage to maintain the proper carbon-to-nitrogen ratio. For applications requiring greater than 80% removal of nitrogen, carbon addition in the pre-anoxic stage is also recommended.

See *pH Effect on Nitrification* and *Temperature Effect on Nitrification and Denitrification* in the Design Considerations section on page 19.

For permits with stringent organic removal requirements, an AdvanTex polishing unit is used after the post-secondary anoxic stage to remove excess carbon ($cBOD_5$) prior to discharge.

For TN, TIN, and NO_3-N discharge requirements of < 10 mg/L, or for applications with primary treated effluent TN values of > 150 mg/L and greater than 80% nitrogen removal requirements, it will be necessary to integrate a denitrification upflow filter, moving bed bioreactor (**MBBR**), or other denitrification technology into the treatment process. Contact Orenco for support prior to designing a system to meet these requirements.

AdvanTex Systems for the Advanced Removal of Ammonia

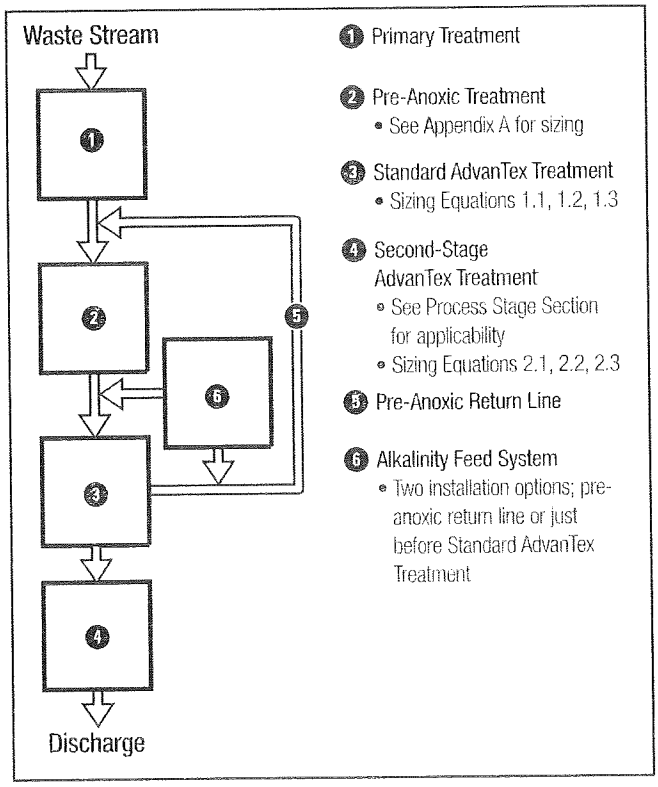


Figure 6. Treatment Diagram for Advanced Removal of Ammonia

Use for Systems with Permits Requiring Discharge Limits > 95% Removal of Ammonia or TKN

For wastewater systems requiring ammonia removal due to restrictive ammonia nitrogen (NH_3-N) or TKN discharge limits (>95% removal), a Second Stage AdvanTex system will be necessary following standard AdvanTex treatment. Figure 6 shows the typical configuration for discharge limits associated with this level of treatment.

The nitrification occurring in the AdvanTex system is heavily influenced by the alkalinity required to buffer the process (7.14 mg/L alkalinity per 1 mg/L of ammonia-N). pH levels of 7.5 to 8.5 are ideal for complete nitrification and should be buffered to remain above a pH of 7 for all applications. Immediately preceding the AdvanTex treatment stage, a supplemental alkalinity feeder may be necessary to ensure sufficient alkalinity for nitrification to break down ammonia.

Using a pre-anoxic stage helps buffer pH, as denitrification in this stage will return as much as 50% of the alkalinity consumed during nitrification. In addition, readily available BOD is consumed in the pre-anoxic denitrification stage, reducing the BOD load to the secondary treatment unit. Most application types provide adequate carbon in the incoming stream to achieve denitrification and subsequent alkalinity return, but in the design it is best to ensure that there is enough alkalinity added without relying on this occurrence. As operational data becomes available for the specific treatment system – demonstrating the return of alkalinity through denitrification – alkalinity feed rates can be adjusted downward.

See *pH Effect on Nitrification* and *Temperature Effect on Nitrification and Denitrification* in the Design Considerations section on page 19.

Process Stages – AdvanTex Treatment Systems

Primary Treatment Stage

Purpose and Description:

The primary treatment stage is designed to collect wastewater; segregate settleable and floatable solids (sludge and scum); accumulate, consolidate and store solids; digest organic matter; and discharge primary-treated effluent. Passive, energy-free primary tankage provides the most cost-efficient method of primary treatment available for nonindustrial sewage; BOD removal of >50% and TSS removal of > 90% (when using an effluent filter) are typically accomplished with passive primary treatment.

The primary treatment stage can be configured in several ways, including single- or multiple-compartment tanks, single tanks with meandering baffles (partitions), or multiple tanks in series. Some systems may utilize solids separation devices. Primary treatment includes effluent screening, and effluent may be discharged to the secondary treatment stage via gravity or pump.

Design Notes and Special Considerations:

The volume and configuration of primary tankage or inclusion of other primary treatment devices (e.g. solids separation) is dependent on the system, the application type, and the expected waste strength.

When using tankage for primary treatment, proper sizing ensures adequate volume for the development of the necessary microbial environments, appropriate sludge and scum storage, and surge volume. For recommendations on sizing of primary tankage, see Appendix A. The tank's structural soundness and watertightness are vital to the system's performance, and all tanks should be reviewed by the engineer and water-tested in the field after installation.

Pre-Anoxic Treatment Stage

Purpose and Description:

This process consists of recirculating a portion of the recirc-blend (or filtrate) from the AdvanTex secondary treatment system to an anoxic zone within the initial primary solids settling/collection chamber or, preferably, in a separate pre-anoxic tank. A pre-anoxic treatment stage tends to balance and lower concentrations by blending primary treated effluent with AX filtrate. It also provides an environment for denitrifying a portion of the nitrified filtrate.

The use of a pre-anoxic stage benefits all applications and is essential for those applications with high-strength waste (organic or nitrogen concentrations) and restrictive permit limits, as well as applications in which higher-quality effluent and enhanced overall removal performance are desired.

Design Notes and Special Considerations:

Orenco recommends the use of a pre-anoxic stage for all projects. For recommendations on sizing of pre-anoxic tankage (typically 1 day Q_M), see Appendix A. Pre-anoxic tankage volume is a component of the overall primary tankage. For an effluent sewer collection system (i.e. STEP Sytstem) the pre-anoxic tank is recommended to be sized at 50% of the values provided in Appendix A for gravity or onsite tankage options.

The Pre-anoxic return ratio ($\mathbf{R_{NOX}}$) is the ratio of flow of the pre-anoxic return loop in relation to the average day design flow.

For most applications, the R_{NOX} value is equal to 1± and therefore the return flow to the pre-anoxic stage ($\mathbf{Q_{RNOX}}$) is equal to the Average Day Design Flow ($\mathbf{Q_A}$).

Alkalinity is often added in this stage, because the pre-anoxic return line is a convenient place to add alkalinity while simplifying the overall system layout. The pre-anoxic return line can also be used to introduce supplemental carbon while still keeping the design simple. The establishment of denitrification in this stage reduces organic and nitrogen levels while returning about 50% of the alkalinity consumed during the first stage of secondary treatment (3.57 mg/L alkalinity per 1 mg/L NO_3-N denitrified).

Consider supplemental carbon addition in the pre-anoxic stage for ...

- Systems requiring significant total nitrogen reduction (> 80%)
- Systems with high nitrogen values in primary treated effluent (Application types 2, 3, & 5), resulting in low carbon-to-nitrogen (C:N) ratios (< 4:1)

Orenco offers liquid chemical feed units for adding alkalinity and supplemental carbon. There are advantages and disadvantages to various alkalinity sources and supplemental carbon products, so specific project conditions should be considered when making a selection.

Flow Equalization Stage

Purpose and Description:

Flow equalization (**EQ**) provides stability by leveling out peaks in flow and allowing consistent loading of the treatment system. EQ is strongly recommended for systems with variable flow patterns and restrictive discharge limits. EQ is especially important for systems that have highly variable flow patterns due to usage (e.g., resorts and churches) or collection method (e.g., conventional gravity collection).

The EQ stage consists of a tank or tanks fitted with a timed-dose-controlled pumping system. It follows the primary tank and pre-anoxic tank (if used) and is typically located before pre-aeration/clarification tankage (if used) or a recirculation-blend chamber.

Design Notes and Special Considerations:

EQ tank sizing recommendations vary for systems with significant fluctuations in flow. For support with EQ tank sizing, contact Orenco.

For schools and churches, Orenco typically recommends dividing the system's total weekly flow by six and using this value as the Design Average Flow, with one day allowed for recovery. Using this technique, an EQ tank equal to the Design Maximum Day Flow is generally adequate, but calculations should be performed to verify the tank sizing requirement.

By their nature, effluent sewer collection systems inherently provide a significant amount of flow equalization. When using this collection method, the addition of EQ tanks at the treatment site is only necessary for systems with extreme flow fluctuations (e.g., fairgrounds, racing venues, etc.) or highly restrictive permit requirements.

Pre-Aeration Treatment Stage

Purpose and Description:

Pre-aeration reduces organic waste strength prior to secondary treatment, with a target reduction of BOD_5 to less than 400 mg/L. It is used for applications with high strength waste streams (such as Type 7 applications and any application with a significant volume of restaurant waste, such as Type 5) to condition the waste stream prior to secondary treatment by raising dissolved oxygen levels.

An aeration tank, followed by a clarification tank, is situated between the primary treatment system (or pre-anoxic tank if used) and the secondary treatment system.

Design Notes and Special Considerations:

Pre-aeration units should be sized to provide the appropriate amount of oxygen to reduce organic waste strength or to reduce BOD_5 to less than 400 mg/L. For systems with extreme BOD_5 influent values, pre-aeration can be sized to accomplish approximately 50% reduction in BOD_5 values. For recommendations on sizing pre-aeration and clarification tanks, see Appendix A.

Pre-aeration is required for all Application Type 7 systems, as well as for systems that have greater than a 50% contribution of flow from restaurants (primarily Application Type 5 systems).

Standard AdvanTex Treatment Stage

Purpose and Description:

After primary or pre-anoxic treatment, effluent is transported to the recirculation-blend tank or chamber, where it is blended with AdvanTex filtrate. The blended wastewater is distributed over the AdvanTex textile media and percolates down through the media, where it is filtered, cleaned, and nitrified by the naturally occurring microorganisms populating the media. After treatment, a portion of the filtrate is returned to the recirculation-blend chamber while a portion is transported to the next treatment stage or to dispersal. Note that a portion of the recirc-blend (or filtrate) is often returned directly to the pre-anoxic treatment stage.

In the secondary treatment process, AdvanTex units filter and clean effluent from the primary treatment system. When loaded at or below the applicable loading rate, they typically achieve treatment levels of < 10 mg/L BOD_5/$cBOD_5$ and TSS (30-day average or 30-day arithmetic mean), with total nitrogen (TN) reduction typically > 60% and nitrification averages of 95% (range 90-99%).

For nitrogen loading rates and sizing requirements, refer to the *AdvanTex Unit Sizing* section of this document.

Post-Anoxic Treatment Stage

Purpose and Description:

The post-anoxic treatment stage provides additional denitrification after secondary treatment in wastewater systems that require significant (60-80%) reductions in TN, TIN, or NO_3-N. Nitrified AdvanTex filtrate from the secondary treatment stage is transported to an anoxic zone inside of the post-anoxic tank. During post-anoxic denitrification, BOD is consumed during the conversion of NO_3 to N_2 gas by facultative heterotrophic bacteria. The N_2 gas is then returned to the atmosphere.

Design Notes and Special Considerations:

Post-anoxic tanks are typically sized at 50% of the Maximum Day Design Flow. For denitrification to take place, oxygen levels must be depleted to the level that nitrate becomes the primary oxygen source for microorganisms. Requirements for effective denitrification include ...

- Dissolved oxygen levels < 0.5 mg/L (preferably < 0.2 mg/L)
- Carbon-to-nitrogen ratio of 4:1 to 8:1
- Sufficient residual alkalinity (100 mg/L ±) in the secondary treatment stage to ensure optimum pH in the post-anoxic stage
- Under these conditions, reduction of nitrate (NO_3) through conversion to nitrogen gas (N_2) should exceed 70%

A supplemental carbon feed unit is required for the post-anoxic stage to achieve the necessary carbon-to-nitrogen ratio for effective denitrification.

AdvanTex Treatment – Second Stage of Two-Stage Treatment

Purpose and Description:

A second stage of AdvanTex treatment can be used cost-effectively for enhanced nitrification or polishing:

- Nitrifying the waste stream for systems with very low ammonia (NH_3-N) or TKN discharge requirements – typically > 95% removal (nitrification)
- Removing any excess BOD_5 that is not consumed in the denitrification process following the post-anoxic stage on projects with restrictive BOD_5/$cBOD_5$ permit limits, typically 20 mg/L or less (polishing)
- Removing BOD_5 for systems with NOT TO EXCEED permit limits of < 10 mg/L BOD_5/$cBOD_5$ or 30-day average permit limits of ≤ 5 mg/L BOD_5/$cBOD_5$ (polishing)

The treatment mechanisms are the same as described under *Standard AdvanTex Treatment Stage* on page 13. For sizing requirements, refer to the AdvanTex Unit Sizing section of this document.

For information on the importance of pH and temperature on the nitrification process, see *pH Effect on Nitrification* and *Temperature Effect on Nitrification and Denitrification* in the Design Considerations section on page 19.

Disinfection Stage

Purpose and Description:

Secondary-treated effluent is usually clear and odorless, but it still contains pathogens at levels that can cause illness if ingested or released to the environment. Disinfection is required in many surface discharge or reuse systems. Disinfection can be achieved by any method that destroys pathogens; ultraviolet (UV) rays, chlorine (tablet or gas), and ozonation are the most common methods.

Due to the low turbidity of AdvanTex effluent and the fact that UV disinfection requires no chemicals and leaves no toxic residue, UV disinfection is the most common method used following AdvanTex systems.

Chlorination is also a common disinfection method that is utilized; however, handling issues and concerns about chemical residue make it less desirable than UV. Ozonation, another common method, is extremely effective and popular for re-use applications within facilities (e.g. toilet flushing), due to its ability to remove any residual color in the effluent stream. Ozonation is typically the least economical of the three methods in the lower flow applications common with decentralized systems.

Design Notes and Special Considerations:

UV disinfection lamps require cleaning and servicing on a regular basis (once a month to once a year, depending on effluent quality and UV system design).

Disinfection devices can be integrated into the treatment system and connected to the TCOM™ control system for monitoring and control.

Reuse applications, such as for toilet flushing and industrial processes, require a high level of effluent purity. Chlorination or ozonation are often used in these applications. In some circumstances, tertiary treatment may be required. This can include (in addition to chemical or ultraviolet disinfection) the use of fine mesh filter processes such as polishing filters; multi-media filtration; micro-, ultra-, or nano-filtration through membranes; reverse osmosis; or cloth/disc filters. Contact Orenco for more information.

Performance Requirements and Unit Sizing

Performance of Typical AdvanTex Systems

When loaded at or below the applicable loading rates, AdvanTex systems typically achieve <10 mg/L BOD_5 and TSS (30-day average or 30-day arithmetic mean). Total Nitrogen (TN) reduction typically exceeds 60%, with nitrification exceeding 95%, given liquid temperature levels greater than 50 F (10 C) and pH values between 7-9. The loading rates provided in AdvanTex Stage Sizing are based upon these minimum values for liquid temperature and pH. With additional components and configurations (see Treatment System Configurations), AdvanTex Treatment Systems can meet more stringent treatment levels.

Standard AdvanTex Stage Sizing

The primary criteria used to determine the amount of textile surface area necessary to meet treatment requirements are the daily flow volume (Average and Maximum Day), primary-treated effluent Organic Load, Organic Loading Rate (**OLR**), and Hydraulic Loading Rate (**HLR**). For facilities that require advanced nitrogen discharge levels (> 60% TN or > 95% NH3-N), the Ammonia Loading Rate (**ALR**) or Total Nitrogen Loading Rate (**TNLR**) should be used in conjunction with the organic and hydraulic loading rates to size the system. **The loading rate that corresponds to the largest textile surface area will control the design.** AdvanTex Treatment Systems must be sized so that the designed treatment area meets or exceeds that required by the controlling loading rate.

Standard AdvanTex Treatment Loading Rates – All Systems:

Organic Loading Rates (OLR)

- Design Average: 0.04 lbs $BOD_5/ft^2 \cdot d$ (0.2 kg $BOD_5/m^2 \cdot d$)
- Design Maximum Day: 0.08 lbs $BOD_5/ft^2 \cdot d$ (0.4 kg $BOD_5/m^2 \cdot d$)

The equation for determining OLR-based treatment area is as follows:

$$A_{OLR} = BOD_{5i} / OLR \qquad \textbf{Equation 1.1}$$

where: A_{OLR} = *Treatment area based on Organic Loading, ft² (m²)*
BOD_{5i} = *Primary treated effluent BOD_5 (organic) load, lbs/d (kg/d)*
OLR = *Organic loading rate, lbs/ft² • d (kg/m² • d)*

Hydraulic Loading Rates (HLR)

- Design Average: 25 gpd/ft² (1 $m^3/m^2 \cdot d$)
- Design Maximum Day: 50 gpd/ft² (2 $m^3/m^2 \cdot d$)

The equation for determining the HLR-based treatment area is as follows:

$$A_{HLR} = Q / HLR \qquad \textbf{Equation 1.2}$$

where: A_{HLR} = *Surface area based on Design Average Hydraulic Loading, ft² (m²)*
Q = *Influent hydraulic load, gpd (m^3/d)*
HLR = *Hydraulic loading rate, gpd/ft² • d ($m^3/m^2 \cdot d$)*

Systems with Total Nitrogen-Based Discharge Limits:

For systems requiring a greater than 60% removal rate for TN, TIN, or NO_3-N, the required textile area is determined by using the Total Nitrogen Loading Rate (TNLR) and the TN value (if available) or TKN value (if the TN value isn't available) in the primary treated effluent. (The value for TN and TKN should be the same after anaerobic primary treatment, but it will vary significantly if pre-aeration is used.)

Total Nitrogen Loading Rates (TNLR)

- Design average TNLR is 0.014 lbs $TN/ft^2 \cdot d$ (0.07 kg $TN/m^2 \cdot d$).

The equation for determining TNLR-based treatment size is as follows:

$$A_{TNLR} = (TKN_i \text{ or } TN_i) / TNLR \qquad \textbf{Equation 1.3}$$

where: A_{TNLR} = *Treatment area based on Total Nitrogen Loading, ft² (m²)*
TKN_i = *Primary treated effluent Total Kjeldahl Nitrogen load, lbs/d (kg/d)*
TN_i = *Primary treated effluent Total Nitrogen load, lbs/d (kg/d)*
$TNLR$ = *Total nitrogen loading rate, lbs/ft² • d ($kg/m^2 \cdot d$)*

Systems with Ammonia-Based Discharge Limits:

For applications requiring ammonia or TKN removal greater than 95%, use both the ALR (see below) and the TNLR (Equation 1.3) and choose the greater of the two values. ALR for primary-treated effluent ammonia and TNLR accounts for any organic nitrogen that may be converted to ammonia through the primary or secondary treatment processes (see Ammonification).

Ammonia Loading Rates (ALR)

- Design average ALR is 0.01 lbs NH_3-N/ft² • d (0.05 kg NH_3-N/m² • d)

The equation for determining ALR-based treatment area is as follows:

$$A_{ALR} = NH_3\text{-}N_i / ALR \qquad \textbf{Equation 1.4}$$

where: *AALR = Surface area based on NH3-N loading, ft² (m²)*
NH3-Ni = Primary treated effluent Ammonia load, lbs/d (kg/d)
ALR = Stage 1 Ammonia loading rate, lbs/ft² • d (kg/m² • d)

Second Stage AdvanTex Sizing in Two-Stage Systems

For the calculation of Second Stage AdvanTex treatment area, use BOD_{5e} and TKN_e — the treated effluent values from the Standard AdvanTex Treatment system. Standard AdvanTex Stage treated effluent values for BOD_5 and TKN are typically based upon 95% nitrification and 70% denitrification through the Pre-Anoxic Stage and Standard AdvanTex Treatment Stage. See Appendix B for example calculation.

Second Stage Organic Loading Rates (OLR)

- Design Average: 0.02 lbs BOD_5/ft² • d (0.1 kg BOD_5/m² • d)
- Design Maximum Day: 0.04 lbs BOD_5/ft² • d (0.2 kg BOD_5/m² • d)

The equation for determining OLR-based treatment area is as follows:

$$A_{OLR} = BOD_{5e} / OLR \qquad \textbf{Equation 2.1}$$

where: *A_{OLR} = Treatment area based on Organic Loading, ft² (m²)*
BOD_{5e} = Secondary treated effluent BOD_5 (organic) load, lbs/d (kg/d)
OLR = Organic loading rate, lbs/ft² • d (kg/m² • d)

Second Stage Hydraulic Loading Rates (HLR)

- Design Average: 75 gpd/ft² (3 m³/m² • d)
- Design Maximum Day: 125 gpd/ft² (5 m³/m² • d)

The equation for determining HLR-based treatment area is as follows:

$$A_{HLR} = Q / HLR \qquad \textbf{Equation 2.2}$$

where: *A_{HLR} = Surface area based on Design Average Hydraulic Loading, ft² (m²)*
Q = Influent hydraulic load, gpd (m³/d)
HLR = Hydraulic loading rate, gpd/ft² • d (m³/m² • d)

Second Stage Total Nitrogen Loading Rates (TNLR)

- Design average TNLR is 0.007 lbs TN/ft² • d (0.035 kg TN/m² • d).

The equation for determining TNLR-based treatment size is as follows:

$$A_{TNLR} = TKN_e / TNLR \qquad \textbf{Equation 2.3}$$

where: *A_{TNLR} = Treatment area based on Total Nitrogen Loading, ft² (m²)*
TKN_e = Secondary treated effluent Total Kjeldahl Nitrogen, lbs/d (kg/d)
TNLR = Total nitrogen loading rate, lbs/ft² • d (kg/m² · d)

Second Stage Ammonia Loading Rates (ALR)

- Design average ALR is 0.005 lbs NH_3-N/ft^2 • d (0.025 kg NH_3-N/m^2 • d)

The equation for determining ALR-based treatment area is as follows:

$$A_{ALR} = TKN_e / ALR \qquad \text{Equation 2.4}$$

where: A_{ALR} = *Surface area based on* NH_3-*N loading,* ft^2 (m^2)
TKN_e = *Secondary treated effluent Total Kjeldahl Nitrogen, lbs/d (kg/d)*
ALR = Ammonia loading rate, lbs/ft^2 • *d* (kg/m^2 • *d*)

Design Considerations

Recirculation-Blend Tank Sizing

AdvanTex AX20 and AX100 Treatment Systems require external recirculation-blend tankage. The following design considerations apply to recirculation-blend tankage for AX20 and AX100 systems:

- For standard AdvanTex Treatment Systems, recirculation-blend tankage should be sized to at least 75% of the design maximum day flow, or 100% average day design flow, whichever is greater.
- For Stage 2 AdvanTex Treatment Systems, recirculation-blend tankage should be sized to at least 25% of the design maximum day flow.

AdvanTex AX-Max units are configured with integral recirculation-blend capacity and do not require an external recirculation-blend tank.

Recirculation Pump Sizing

AX20 pods have five laterals and sixty-eight 1/8-inch (3-mm) diameter orifices in each pod. A residual pressure of 5 ft (1.5 m) is used to determine initial timed-dosing settings. Typically, residual pressure ranges from 3 to 6 ft (0.9 to 1.8 m). This may vary depending on system hydraulics or special treatment requirements. Table 3 provides sizing information for Orenco 4-inch (100-mm) submersible effluent pumps used in AdvanTex AX20 recirculation pumping assemblies with typical design configurations.

Table 3. Recirculation Pump Sizing, AX20

Number of Pods	Number and Operation of Pumps	Nominal Flow Rate	60 Hz Pump Selections	50 Hz Pump Selections
1	2 pumps, alternate dosing	30 gpm (1.9 L/sec)	½ hp (0.37 kW); PF3005	¾ hp (0.56 kW); PF3005
2	2 pumps, alternate dosing	50 gpm (3.2 L/sec)	½ hp (0.37 kW); PF5005	¾ hp (0.56 kW); PF5007
3	2 pumps, alternate dosing	75 gpm (4.7 L/sec)	1 hp (0.7 kW); PF7510	1 hp (0.7 kW); PF7510
4	2 pumps, 1 pump to 2 pods, alternate dosing	50 gpm (3.2 L/sec)	½ hp (0.37 kW); PF5005	¾ hp (0.56 kW); PF5007

AX100 pods have four laterals with two spin nozzles per lateral, for a total of eight spin nozzles. The pumping rate is about 50 gpm± per AX100 pod (minimum 6 gpm ± per nozzle at 3.0 psi, or 0.38 L/sec at 20.7 kPa). Adjusting pressure at the pod inlet can vary flow. Sufficient pump redundancy is required to ensure operational integrity with one or more inoperable pumps. Table 4 provides sizing information for Orenco 4-inch (100-mm) submersible effluent pumps used in AdvanTex AX100 recirculation pumping assemblies for typical design configurations.

Table 4. Recirculation Pump Sizing, AX100

Number of Pods	Number and Operation of Pumps	Nominal Flow Rate	60 Hz Pump Selections	50 Hz Pump Selections
1	2 pumps, alternate dosing	50 gpm (3.2 L/sec)	¾ hp (0.56 kW); PF5007	¾ hp (0.7 kW); PF5007
2	2 pumps, 1 pump per pod, alternate dosing	50 gpm (3.2 L/sec)	¾ hp (0.56 kW); PF5007	1 hp (0.7 kW); PF5010
3	2 pumps, simultaneous dosing	75 gpm (4.7 L/sec)	1 hp (0.7 kW); PF7510	1 hp (0.7 kW); PF7510
4	4 pumps, 1 pump per pod, alternate dosing	50 gpm (3.2 L/sec)	¾ hp (0.56 kW); PF5007	1 hp (0.7 kW); PF5010
5-6	4 pumps, 2 pumps per 2-3 pods, simultaneous or alternating dosing	75 gpm (4.7 L/sec)	1 hp (0.7 kW); PF7510	1 hp (0.7 kW); PF7510
7-9	6 pumps, 2 pumps per 2-3 pods, simultaneous or alternating dosing	75 gpm (4.7 L/sec)	1 hp (0.7 kW); PF7510	1 hp (0.7 kW); PF7510

AX-Max units are typically designed to accommodate a specific application, based on Design Average and Design Maximum Day flows, the application type's targeted treatment levels, and other factors. Because of this, AX-Max configurations vary and recirculation pumps for these units are determined on a project-by-project basis. Contact Orenco for more information.

AdvanTex TCOM™ Control System

The TCOM™ Control Panel is a telemetry-based panel — which can be connected to a landline, cellular service, Internet, or satellite service — that controls all sensors and pumping equipment. TCOM panels are an integral part of all commercial AdvanTex Treatment System equipment packages. Telemetry provides real-time operator monitoring and control of system components, as well as remote data collection of key operational parameters and events. Its communication function provides notice to system operators in the event of an alarm. Operators can call into the control unit, determine the cause of the alarm, and – often – address the situation without having to be physically present at the treatment facility.

The TCOM unit can be programmed to use trend data for adjusting timer settings automatically, based on established recirculation ratios, so frequent operator adjustment is not necessary for systems with flow variations. If additional equipment for pretreatment, tertiary treatment, or disinfection is required, the controls for each component can easily be incorporated into the TCOM control panel. This allows Orenco to contact the panel directly to assist the operator in system evaluation and troubleshooting or to manually override operations. TCOM control panels can also integrate into existing SCADA systems. Consult with Orenco early in the design process to discuss any integration needs.

Orenco's TCOM control panels are available with multiple enclosure types; however, for ease of operation, they should be protected from direct sunlight to protect the electronics and allow the operator access without direct exposure to the elements (rain, snow, etc.). This should be taken into account when determining location of the control unit. Shelters are recommended for panels whenever possible. Contact Orenco for a quote.

AdvanTex System Ventilation

Proper ventilation, achieved by active or passive ventilation, is critical for maintaining aerobic treatment processes in AdvanTex Treatment Systems.

Active Ventilation

Active ventilation is the preferred means of ventilating AdvanTex Systems and is required for the following systems:

- All systems with design maximum day flows > 10,000 gpd (37,854 L/day)
- All systems with average primary treated effluent waste strength > 200 mg/L BOD_5 and 100 mg/L TSS
- All systems with nitrogen discharge limits
- All AX-Max systems; *at least one* ventilation assembly is required per two connected units (AX-Max units are typically designed with a built-in active vent system and one vent system per unit is preferred)

Passive Ventilation

Passive ventilation is discouraged for commercial applications, but can be considered in AX20 or AX100 systems receiving primary-treated effluent of residential strength, with constituent concentrations of < 200 mg/L BOD_5 and < 100 mg/L TSS and with design maximum day flows < 10,000 gpd (37,854 L/day) for AX100 systems and 4,000 gpd (15,140 L/day) for AX20 systems. For proper function, it is critical for air movement to be greater than 5 cubic feet per minute (cfm) for every 100 ft^2 of treatment area (0.002 m^3/minute for every 9.3 m^2). It is also critical to ensure that there is a clear path for airflow through the system if the system relies on passive ventilation. If these conditions cannot be met, active ventilation should be used.

Although activated carbon media is included to adsorb and mitigate odors in AdvanTex passive ventilation systems, slight odors may occur during dosing events. Passively ventilated systems should be located in areas where this will not be perceived as a nuisance.

Anti-Buoyancy Features

AdvanTex AX20 pods come standard with anti-flotation flanges to help prevent the pod from floating out of the ground under saturated soil conditions. Always keep the top of the pod at least 6 inches (150 mm) above grade at all times. When buried to this level, pod spacing is 5 feet (1.5 m) between AX20 units. Contact Orenco for details.

AdvanTex AX100 Pods are designed for installation in areas that are free of water. AX100 pods can be bermed and free draining, but the bottom of each pod should be no more than 9 inches (230 mm) below the natural grade to protect it from floating in saturated conditions.

AX-Max units should be ordered with anti-buoyancy provisions if the unit will be partially buried. Spacing of the units varies, but at maximum bury of 6 feet (1.82 m) with high groundwater conditions, this spacing would be approximately 10 feet (3.04 m) between units. When the unit is set at natural grade and the material used for berming is free flowing, anti-buoyancy will not be necessary. Contact Orenco for details.

pH Effect on Nitrification

pH is extremely important for nitrification. (See Figure 7.) The effective reaction rate (RN) is 0.95 at a pH of 8±, dropping to 0.47 at a pH of 7, and dropping precipitously to 0.15 at a pH of 6. Nitrification effectively ceases at a pH of 5. The use of additional alkalinity to buffer the process is critical for all nitrogen removal configurations and the feed system should be sized to provide a minimum targeted residual of 80 mg/L, with a preferred residual target of 100 mg/L.

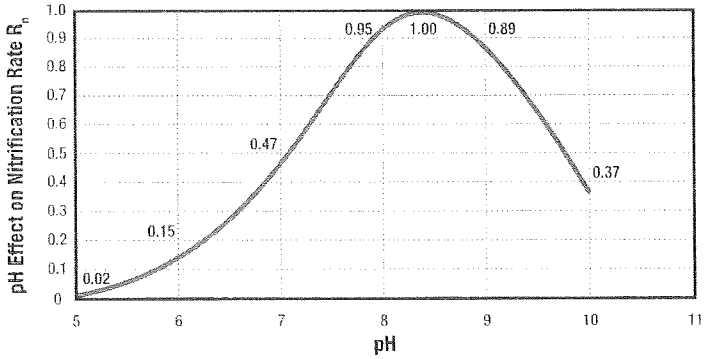


Figure 7. pH Effects on Nitrification

Cold Weather Considerations

The naturally occurring bacteria that populate the AdvanTex treatment media are active at temperatures above 44 F (6.7 C), with an optimal temperature range above 68 F (20 C). To ensure treatment in cold climates or areas with seasonal cold weather, it is recommended that the liquid temperature remain above 50 F (10 C). Temperature is especially important in the nitrification and denitrification process. If temperature values are expected to be below this threshold, contact Orenco for heating options and/or safety factors for design purposes.

Temperature Effect on Nitrification and Denitrification

Temperatures in the liquid stream and treatment media have an impact on both the nitrification and denitrification processes. As shown in Figure 8, the effect of temperature on nitrification and denitrification rates can be used to predict efficiency of the overall treatment process. Orenco bases performance on minimum temperature values of 50 F (10 C) during winter operation and 59 F (15 C) during summer operation. For actual liquid temperatures below these values, systems should be upsized to achieve treatment expectations described in this document.

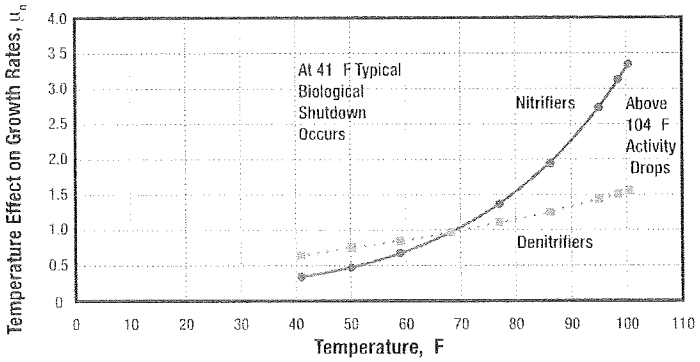


Figure 8. Temperature Effect on Nitrification and Denitrification

Following are cold weather considerations for AX20 pods, AX100 pods, and AX-Max units, as well as general cold weather considerations for all systems to prevent freezing and avoid damage due to frost heave:

AX20 and AX100 Pods

- Insulated foam-core lids with a minimum R-value of R-6 (RSI-1) are standard equipment to prevent heat loss through the top of AX20 and AX100 pods. If necessary, insulation board or spray-on insulation foam can be added during installation.
- The depth of the recirculation-blend tank can be increased — but the tank must still be accessible to operators for maintenance activities.
- Warm air ventilation is critical. High flows of cold air through the treatment unit can cause significant temperature drops.
- Orenco Fiberglass Shelters provide a climate-controlled environment — providing a temperature controlled air source for the treatment system, access to the control system, and equipment and storage for chemical feed equipment.

AX-Max Units

- Units are configurable for use in climates with extreme temperatures ranging from -60° F to 125° F (-51°C to 52 C).
- Units are constructed with 4-inch (100-mm) foam cells that provide an estimated insulation value of R-26 (RSI-5).
- Orenco Fiberglass Shelters provide a climate-controlled environment — providing a temperature controlled air source for the treatment system, access to the control system, and equipment and storage for chemical feed equipment.

General Cold Weather Considerations for All Systems

- Standard cold weather practices for AdvanTex systems include allowing all lines to drain back to tankage and insulating access lids on primary and recirculation-blend tankage.
- In extreme climates with long periods of subfreezing weather, a warm air source into the treatment pods or units or immersion heaters may be necessary to keep treatment temperatures above 50 F (10 C).
- In areas where snow typically accumulates each winter, air vents must be extended to ensure they are above peak snow levels.
- In areas where frost heave is a concern, backfilling access riser excavations with pea gravel is recommended.

Several times per year Orenco provides training on general wastewater concepts, design, and operation and maintenance at our facility in Sutherlin, Oregon, as well as throughout the United States and abroad. If you are interested in attending a training session, contact Orenco or your local Orenco Dealer.

Orenco staff is prepared to support the designer throughout the project cycle, from the initial evaluation of technologies, to the preliminary design, to a thorough and timely design review — all without cost. Orenco can also assist with the approval process and the evaluation of operational and life cycle costs.

Appendix A. Sizing for Primary and Pre-Anoxic Tankage

All secondary treatment systems are limited in their ability to break down and treat organic material. The purpose of primary tankage in AdvanTex Treatment Systems is to reduce and maintain organic material at a level that can be efficiently and economically treated by the AdvanTex treatment unit(s). Primary tankage can anaerobically digest organic material, remove solids, modulate flow, and provide emergency storage volume. To operate effectively, primary tankage must be properly designed and sized, structurally sound, watertight, and well-maintained.

For the application types defined in this Design Criteria, Table A provides recommended minimum tank volumes. To calculate recommended minimum tank volumes, multiply the Design Maximum Day Flow specified for the system by the necessary hydraulic retention time (HRT) in days. For example, if local regulations require a 10,000 gpd system design (based on Design Maximum Day Flow) for an office facility, Orenco recommends a minimum total tank volume of 30,000 gallons. (See Table A, Application Type 2.) To determine preferred tank volumes, add approximately 50% to the minimum values.

The minimums in Table A exceed those set by the United States Environmental Protection Agency (USEPA) and the regulatory requirements for nearly every state in the United States. With regard to tank sizing, larger hydraulic retention times result in improved primary treatment.* Research strongly indicates that the smaller volumes calculated by using the USEPA formula (based on 1940's information), as well as the listed volumes for most state and local health agencies, consistently produce poor quality effluent. They are also associated with increased pumpout frequencies and costs, increased need for secondary treatment capacity, and an increased need for maintenance activities, with their associated costs.

Orenco recommends the use of pre-anoxic tankage prior to the recirculation-blend tank for all systems. Recommended total primary tankage is provided in Table A, followed in parentheses by the recommended configuration of the primary tankage for specific treatment needs, if any, such as a pre-anoxic stage, aeration unit, clarification chamber, or flow equalization.

Table A is intended as a general guideline for decentralized wastewater treatment designs. The system designer is responsible for ensuring adequate primary treatment prior to the secondary treatment system. Check local regulations to ensure that the recommended minimum volumes meet applicable regulatory requirements. For questions about special cases where larger tankage or other measures may be necessary, or for general questions about flow equalization, please call Orenco at (800) 348-9843 or +1-541-459-4449.

*Metcalf & Eddy, "Wastewater Engineering Collection, Treatment, Disposal," 1972 (New York, McGraw Hill).

Winneberger, John H. Timothy, "Septic Tank Systems, A Consultant's Toolkit, Volume II The Septic Tank," 1984 (Butterworth Publishers, Ann Arbor Science).

Laak, Rein, "Wastewater Engineering Design for Un-Sewered Areas," 1980 (Butterworth Publishers, Ann Arbor Science).

Philip, H, et. al., "Septic Tank Sludges: Accumulation Rate and Biochemical Characteristics," 1993 Water Science & Technology.

Table A. Recommended Minimum HRTs, Primary Tankage and Configurations

Application Type	Hydraulic Retention Time (HRT) in Days		Minimum Volumes & Configurations for Primary Tankage	
	Grease Tankage[1]	Primary Tankage[2]	Without Aeration	With Aeration
Type 1, Residential quality waste[3] (includes apartments, condos, mobile home parks, municipal, planned communities, subdivisions, work camps)	n/a	2	2× design max. day flow (1P + 1A)	n/a
Type 2, Primarily black water waste [4,5] (includes airport facilities, campgrounds, fire departments, golf courses, marinas, offices, parks, public toilets, rest areas, RV parks[5], ski resorts, visitor centers)	3	3	3× design max. day flow (2P + 1A)	n/a
Type 3, Primarily black water waste with surge flows[6, 7] (includes churches and schools)	3	3	3× design max. day flow (2P + 1A with no flow equalization)	n/a
		4	4× equalized design day flow (2P + 1A + $1Q_M$ with flow equalization)	
Type 4, Primarily black waster waste with pharmaceutical concerns[8] (includes hospitals, retirement facilities, veterinary clinics)	3[4]	4	4× design max. day flow (3P + 1A)	4× design max. day flow (2P + 1A + 0.5 AE + 0.5 C)
Type 5, Black water waste and restaurant waste[9, 10] (includes bars/taverns, casinos, delis, gas stations, hotels/ motels, restaurants, resorts, shopping centers/strip malls)	3	n/a	4× design max. day flow (3P + 1A)	4× design max. day flow (2P + 1A + 0.5 AE + 0.5 C)
Type 6, Polishing bioreactors (includes polishing bioreactors for organic or ammonia removal, e.g. lagoon compliance)	n/a	n/a	n/a	n/a
Type 7, High-strength process waste[10] (includes wineries, breweries, dairy or food processing facilities, slaughterhouses)	n/a	n/a	n/a	4.5× design max. day flow (2P + 1A + 1AE + 0.5C)
All other applications	Contact Orenco for support with application types having characteristics not listed in this chart.			

Key: P = Primary Tankage A = Pre-Anoxic AE = Aeration Tankage C= Clarification Tankage EQ = Equalization Tankage

[1] *HRT is based on a separate kitchen design maximum day flow, integrated into the main flow prior to the primary septic tanks. Orenco recommends a grease tank for any facility with a commercial kitchen. Additional grease tankage provides increased reduction of organics, as well as separation of grease and oil (G&O) prior to secondary treatment. G&O concentrations entering secondary treatment should be limited to 25 mg/L. Chemical disinfection dishwashers can cause significant downstream problems due to the high volumes of sanitizing compounds and emulsifiers and should not be used in onsite treatment and soil dispersal applications.*

[2] *HRT is based on the sum of the Design Maximum Day Flows from all sources. This assumes each waste source has a separate primary tank and a watertight collection system. For systems using gravity collection to a single primary tank, add 1 day HRT (based on Design Maximum Day Flow). For grinder or vacuum collection systems feeding into primary tankage, the recommended volume for pre-anoxic tankage is 1.5 days HRT; the recommended volume for primary tankage is 2.5 days HRT for a total HRT of 4 days (based on Design Maximum Day Flow).*

[3] *Communities with gravity sewers should review 12+ months of documented wastewater flows to determine Design Maximum Day Flow.*

[4] *For systems with cafeteria or restaurant facilities, use the grease tankage listed.*

[5] *RV dump stations should have a minimum 7 days of storage; flow should be blended into the balance of the waste stream throughout the course of the day by timer-controlled pumps. Dump station flow contributions should not exceed 20% of the design maximum day flow.*

[6] *Flow equalization is strongly recommended for this application type to reduce the total treatment area required. If flow equalization is not used, base the total primary tankage volume and treatment area on Design Maximum Day Flow.*

[7] *If using flow equalization for this application type, base the total primary tankage on Equalized Design Day Flow (EDDF) to secondary treatment. EDDF = total weekly flow divided by 6, allowing 1 day for recovery.*

[8] *To reduce septage pumping in these and other specialized applications, we recommend using multiple tanks: The first should be small (0.5 to 0.75 day HRT); subsequent tanks should provide the remaining HRT requirements.*

[9] *For facilities with restrooms and kitchen, the primary tank volume is determined by summing the design maximum day flows of the restrooms and kitchen — and then multiplying by the HRT value in the primary tankage column. Kitchen dishwashing appliances should be high-temperature disinfection models only; low-temperature chemical disinfection dishwashers are not recommended.*

[10] *Pre-treatment (e.g., aeration) is necessary for this application type to reduce overall influent organic waste strength.*

Appendix B. Basic Equations

Converting Waste Constituent Concentrations and Flow to Mass

To convert constituent concentrations of the primary treated effluent (PTE, mg/L) and flow (gallons, imperial gallons, liters, or cubic meters) to mass/day (lbs/day or kg/day), use the following equation:

Equation B1

$$\text{Load} = \text{PTE Value (mg/L) x Conversion Factor x Flow (Q)}$$

A) Using flow in gallons to calculate pounds/day:

$$\text{Conversion Factor, } CF_G = \frac{1\text{ lb}}{453{,}592\text{ mg}} \text{ x } \frac{3.785\text{ L}}{1\text{ gal}} = 8.34 \text{ X } 10^{-6} \frac{\text{lbs} \cdot \text{L}}{\text{mg} \cdot \text{gal}}$$

B) Using flow in imperial gallons to calculate pounds/day:

$$\text{Conversion Factor, } CF_{IG} = \frac{1\text{ lb}}{453{,}592\text{ mg}} \text{ x } \frac{4.546\text{ L}}{1\text{ gal}} = 1.002 \text{ X } 10^{-5} \frac{\text{lbs} \cdot \text{L}}{\text{mg} \cdot \text{gal}}$$

C) Using flow in liters to calculate kilograms/day:

$$\text{Conversion Factor, } CF_L = \frac{1\text{ kg}}{1{,}000{,}000\text{ mg}} \text{ x } \frac{1\text{ L}}{1\text{ L}} = 1 \text{ X } 10^{-6} \frac{\text{kg}}{\text{mg}}$$

D) Using flow in cubic meters to calculate kilograms/day:

$$\text{Conversion Factor, } CF_{CM} = \frac{1\text{ kg}}{1{,}000{,}000\text{ mg}} \text{ x } \frac{1000\text{ L}}{1\text{ m}^3} = 0.001 \frac{\text{kg} \cdot \text{L}}{\text{mg} \cdot \text{m}^3}$$

Example 1

PTE value of 150 mg/L BOD_5; Flow of 1000 gallons per day

Determine BOD_5 mass load in pounds per day using Equation B1A:

$$BOD_5\ Mass\ Load = (150\ mg/L)\ x\ (8.34\ x\ 10^{-6}\ lbs \cdot L/mg \cdot gal)\ x\ 1000\ gpd = 1.25\ lbs/d$$

Example 2

PTE value of 150 mg/L BOD_5; Flow of 5 cubic meters per day

Determine BOD_5 mass load in kilograms per day using Equation B1D:

$$BOD_5\ Mass\ Load = (150\ mg/L)\ x\ (0.001\ kg \cdot L/mg \cdot m^3)\ x\ 5\ m^3/d = 0.75\ kg/d$$

Performing a Mass Balance Calculation for a Blended Waste Stream

Some applications are configured so that the waste stream to the treatment plant is made up from several contributing sources with varying flows and constituent concentrations. To determine the waste strength of a blended waste stream, a mass balance calculation must be performed.

The easiest way to perform the mass balance calculation is to prepare a table listing each source, the flow contribution from the source, and the constituent concentrations being treated.

- List contributing sources, anticipated flows and corresponding waste strengths
- Waste strengths are provided after primary tankage and are listed as primary-treated effluent (PTE)

Table B1: Sample Mass Balance Calculation Table

Source[1]	Design Flow[2], Q (gal or imp. gal or L or m^3)	Constituent 1: BOD_5 (mg/L)	Constituent 2: TSS (mg/L)	Constituent 3: TKN (mg/L)
Source 1	Q_{S1}	BOD_{5S1}	TSS_{S1}	TKN_{S1}
Source 2	Q_{S2}	BOD_{5S2}	TSS_{S2}	TKN_{S2}
Source 3	Q_{S3}	BOD_{5S3}	TSS_{S3}	TKN_{S3}
Source 4	Q_{S4}	BOD_{5S4}	TSS_{S4}	TKN_{S4}
Total Flow[3], Q_T		**BOD_{5B}**	**TSS_B**	**TKN_B**

[1] *The table can be built with as many contributing sources and constituents as needed; four sources and three constituents shown for simplicity.*

[2] *The actual unit of measure doesn't matter as long as the same unit of measure is used for all sources as they fall out in the equation.*

[3] *The total flow, Q_T is the sum of flow from all contributing sources.*

For Constituent 1 (BOD_5) the mass balance equation for blended waste strength concentration (BOD_{5B}) is:

Equation B2

$$\text{Blended } BOD_{5B}, \text{mg/L} = \frac{(Q_{S1} * BOD_{5S1}) + (Q_{S2} * BOD_{5S2}) + (Q_{S3} * BOD_{5S3}) + (Q_{S4} * BOD_{5S4})}{Q_T}$$

Example

Determine the blended BOD_{5B} given the following for a camp application and using Equation B2.

Table B2: Sample Equation Table

Source	Design Flow (gpd)	PTE BOD_5 (mg/L)
RV Dump Station	250	1800
Shower House w/ Restrooms	4500	225
Restrooms	1800	300
Camp Host Living Quarters	150	150
Total Flow (Q_T)	6700	BOD_{5B}

$$Blended\ BOD_{5B} = \frac{(250\ gpd * 1800\ mg/L) + (4500\ gpd * 225\ mg/L) + (1800\ gpd * 300\ mg/L) + (150\ gpd * 150\ mg/L)}{6700\ gpd} = 302\ mg/L$$

Determining Alkalinity Demand and Need for Supplemental Alkalinity Addition

Ensuring that the pH remains above 7 (and preferably above 7.5) at all times is critical for ammonia sensitive applications. Supplemental alkalinity should be included if influent alkalinity is insufficient to buffer the process. During nitrification, 7.14 mg/L alkalinity is used per mg/L TKN; during denitrification with a pre-anoxic return loop (at 100% denitrification), half of that — or 3.57 mg/L — is returned. Without a denitrification component, there is no return. To be conservative in our calculation of alkalinity need, we assume a 60% denitrification efficiency and a return of 2.14 mg/L during denitrification. To determine alkalinity need, multiply the primary treated effluent value for TKNi (in mg/L) by 5 (7.14 mg/L – 2.14 mg/L). Alkalinity demand can be calculated using the following equations and assuming complete nitrification of the denitrified effluent:

Equation B3

$$\text{Alkalinity Demand} = TKN_i \text{ mg/L} \times \frac{5 \text{ mg/L Alkalinity}}{1 \text{ mg/L TKN}}$$

Equation B4

$$\text{Alkalinity Need} = \text{Alk Demand} + \text{Target Residual Alk} - \text{Influent Alk}$$

As described in *pH Effect on Nitrogen* on page 19 of the Design Criteria, the target residual for alkalinity is 100 mg/L. If the result of Equation B4 is a positive number, the system will require supplemental alkalinity addition. If the result is a negative number, there is a likely surplus of alkalinity in the source water and the system should function without alkalinity addition.

Example

PTE values of 80 mg/L TKN and 160 mg/L alkalinity in waste stream

Target residual of 100 mg/L alkalinity

Determine the amount of alkalinity required to buffer the treatment process

Solving for Equation B3:

$$Alkalinity\ Demand\ = 80\ mg/L\ x \frac{5\ mg/L\ Alkalinity}{1\ mg/L\ TKN}\ = 400\ mg/L\ Alkalinity$$

Now solving for Equation B4:

$$Alkalinity\ Need\ = 400\ mg/L\ +\ 100\ mg/L - 160\ mg/L\ = 340\ mg/L$$

Therefore the system will require supplemental alkalinity addition to buffer the treatment process.

Anticipating Treatment Performance for Standard AdvanTex Stage

Standard AdvanTex Stage treated effluent values for BOD_5, TKN, and NH_3-N are typically based upon conservative estimates of 90% BOD_5 removal (Coefficient of BOD Removal, CBR), 95% nitrification (Coefficient of Nitrification, CNR) and 70% denitrification (Coefficient of Denitrification, CDNR). **The calculations below assume pH values are maintained between 7 and 8.4 and the temperature of the liquid stream is maintained above 50 F (10 C) at all times.**

Equation B5

$$BOD_{5e}\ =\ BOD_{5i}\ x\ (1 - C_{BR})$$

Equation B6

$$TKN_e\ =\ TKN_i\ x\ (1\ -\ C_{NR})$$

Equation B7

$$NH_{3e}\ =\ NH_{3i}\ x\ (1 - C_{NR})$$

Equation B8

$$NO_{3e}\ =\ (TKN_i\ -\ TKN_e)\ x\ (1\ -\ C_{DNR})$$

Example

PTE values of 225 mg/L BOD_{5i}, 120 mg/L TKN_i, and 100 mg/L NH_3-N in waste stream

Determine the value of BOD_{5e} and TKN_e after the Standard AdvanTex Stage

Solving for Equation B5:

$$BOD_{5e}\ =\ 225\ mg/L\ x\ (1\ -\ 0.90)\ =\ 22.5\ mg/L$$

Solving for Equation B6:

$$TKN_e\ =\ 120\ x\ (1\ -\ 0.95)\ =\ 6\ mg/L$$

Solving for Equation B7:

$$NH_{3e}\ = 100\ mg/L\ x\ (1\ -\ 0.95)\ =\ 5\ mg/L$$

Solving for Equation B8:

$$NO_{3e}\ =\ (120\ -\ 6)\ x\ (1 - 0.70)\ =\ 34.2\ mg/L$$

Therefore the estimated Total Nitrogen (TN_e) value after the Standard AdvanTex Stage is:

$$TN_e\ =\ TKN_e\ +\ NO_{3e}\ =\ 6\ mg/L\ +\ 34.2\ mg/L\ =\ 40.2\ mg/L$$

In a two-stage AdvanTex system, the treated effluent values from the Standard AdvanTex Stage (BOD_{5e}, TKN_e, and/or NH_{3e}) are used to calculate the treatment area of the second stage AdvanTex unit.

Anticipating Total Nitrogen Treatment Performance for Post Anoxic Stage

For projects requiring 60-80% TN, TIN, or NO_3-N reduction, the use of a post-anoxic stage for conversion of NO_3-N to nitrogen gas (N_2) is often the most cost-effective means. A C_{DNR} of 0.7 (70%) is used to anticipate the performance of the post-anoxic stage. **These calculations assume pH values are maintained between 7 and 8.4 and the temperature of the liquid stream is maintained above 50 F (10 C) at all times.**

Equation B9

$$TN_{PAe} = TKN_e + NO_{3e} \times (1 - C_{DNR})$$

Example

Using the example above, determine the value of TN_e after the Post Anoxic Stage

Solving for Equation B9:

$$TN_{PAe} = 6\ mg/L + 34.2\ mg/L\ x\ (1 - 0.70) = 16.3\ mg/L$$

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Appendix 1A: Example Design for an Apartment Complex (Application Type 1)

AdvanTex Treatment for Removal of Organics and Ammonia With $cBOD_5$, TSS, and NH_3-N Discharge Limits

Example: Forty-unit apartment complex consisting of twelve one-bedroom units and twenty-eight two-bedroom units. The system is to be discharged to a creek and permit requirements include organic and ammonia discharge limits.

Establishing a Design Basis

Flows

List contributing sources, anticipated flows, and corresponding waste strengths

Table 1A-1: Flows

Source	Max. Day Design Flow Per Unit (gpd)	Max. Day Design Flow (gpd)	Ave. Day Design Flow (gpd)
12 one-bedroom units	200	2,400	1,200
28 two-bedroom units	300	8,400	4,200
Total		**10,800**[1]	**5,400**

[1] *For Average Day Design Flow use 50% of Maximum Day Design Flow*

Discharge Type

Stream discharge

Influent (Primary Treated Effluent) and Permit Parameters

Table 1A-2: Influent and Permit Parameters

	BOD_5 (mg/L)	TSS (mg/L)	TKN (mg/L)	NH_3-N (mg/L)	Alkalinity (mg/L)
Primary Treated Effluent (Ave/Max)	140/250	40/140	50/80	40/70	60
Discharge Permit Requirement (30-day Average)	20	20	N/A	1 summer/3 winter	N/A

Other Design Considerations

Temperature effects

Temperature impacts the performance of a treatment system. For systems with stringent nitrogen limits, it is important to ensure liquid and treatment system temperatures are maintained above minimum levels. AX-Max systems are constructed within insulated vessels and are preferred for cold environments, though AX100 with external insulation added in the field can also be utilized.

Alkalinity needs

Because ensuring that the pH remains above 7 (and preferably greater than 7.5) at all times is critical for ammonia-sensitive applications, alkalinity addition should be included if influent alkalinity is insufficient to buffer the process. Using Equation 3B from Appendix B, the alkalinity demand for this project is:

$$Alkalinity\ Demand = 80\ mg/L\ TKN\ x\ \frac{5\ mg/L\ alkalinity}{1\ mg/L\ TKN} = 400\ mg/L$$

Equation B4 from Appendix B:

$$Alkalinity\ Need = 400\ mg/L + 100\ mg/L - 60\ mg/L = 440\ mg/L$$

Equation B1A from Appendix B:

$$Alkalinity\ Mass\ Load = (440\ mg/L)\ x\ (8.34\ x\ 10^{-6}\ lbs \bullet L/mg \bullet gal)\ x\ 5400\ gpd = 19.8\ lbs/d$$

The equation shows that a minimum addition of 19.8 pounds of alkalinity per day is required for this system to accomplish 100% removal of TKN (assuming complete ammonification occurs).

Design Specifics

Tankage Requirements

Primary tankage for apartment complexes is usually provided as either a single primary tank or through the use of several distributed primary tanks (locating smaller tanks next to each apartment block). If distributed primary tanks are used, pumps may be required if the treatment facility is located at an elevation higher than the primary tanks.

Apartment complexes fall within Application Type 1 in Appendix A; therefore total primary tank recommendations call for a minimum of 2 days' retention at maximum day design flow. Since a pre-anoxic tank is required and will be situated at the treatment site, provide a minimum of 1 day retention in primary and 1 day retention in pre-anoxic.

Table 1A-3: Sample Tank Sizing Recommendations

Tank Sizing	Max. Day Design Flow (gpd)	Recommended Minimum Primary Tank Size (Gallons)
Primary Tank	10,800	10,800 – use 12,000
Pre-Anoxic Tank	10,800	10,800 – use 12,000

A two-stage AdvanTex is required for ammonia removal. The configuration is as follows (see page 11):

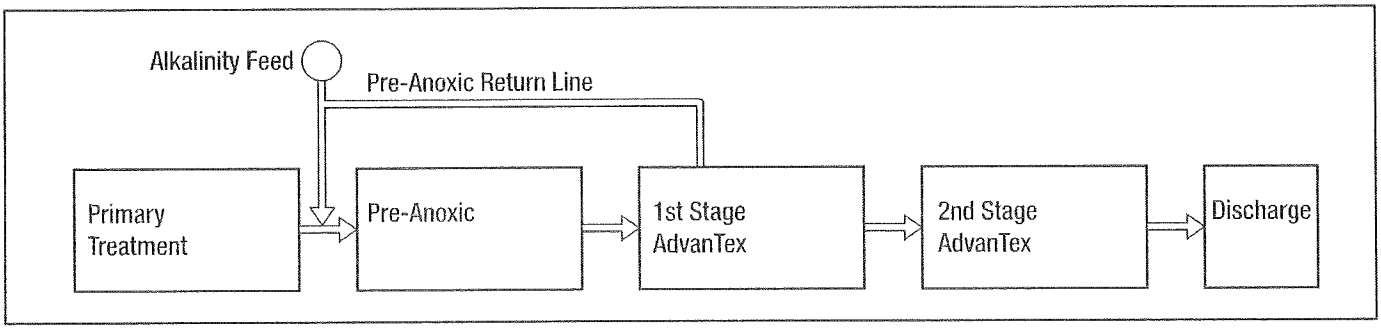


Figure 1A-1. Configuration for Alkalinity Removal

Loading Calculations — First Stage

For all first stage calculations, the design maximum day loading rates are double the average day design loading rates. Since the design maximum day flow is not greater than two times the average day design flow, the calculation for maximum day design load is unnecessary.

Organic Loading

Since BOD_5 is greater than TSS, the calculation for the most restrictive parameter (BOD_5) is necessary. Design Average OLR_A is 0.04 lbs $BOD_5/ft^2 \bullet d$. (See *Standard AdvanTex Stage Sizing*, Design Criteria page 15). Use Equation B1A from Appendix B to determine the pounds per day of Average Day Organic Load, OL_A:

$$OL_A = (140\ \text{mg/L}) * (8.34 \times 10^{-6}\ \text{lbs} \bullet \text{L/mg} \bullet \text{gal}) * (5{,}400\ \text{gpd}) = 6.31\ \text{lbs/d}$$

Determine the textile area required based on Average Day Organic Load, A_{OLRA} using Equation 1.1:

$$A_{OLRA} = \frac{(6.31\ lbs/d)}{0.04\ lbs/ft^2 d} = 158\ ft^2$$

Hydraulic Loading

Design average HLR_A is 25 gpd/ft^2.((See *Standard AdvanTex Stage Sizing*, Design Criteria page 15). Use Equation 1.2 to determine the textile area required based on Average Day Hydraulic Load:

$$A_{HLRA} = \frac{(5400\ gpd)}{25\ gal/ft^2 d} = \mathbf{216\ ft^2}$$

Total Nitrogen Loading

Design average $TNLR_A$ is 0.014 lbs TKN/ft² (from page 15). Use Equation B1 from Appendix B to determine the pounds per day of Average Day Nitrogen Load, TNL_A :

Determine the textile area required based on Average Day Nitrogen Load, A_{TNLRA} using Equation 1.3:

$$TNL_A, \text{lbs/d} = (50 \text{ mg/L}) * (8.34 \, x \, 10^{-6} \text{ lbs} \bullet \text{L/mg} \bullet \text{gal}) * (5{,}400 \text{ gpd}) = 2.25 \text{ lbs/d}$$

Ammonia Loading

$$A_{TNLRA} = \frac{(2.25 \, lbs/d)}{0.014 \, lbs/ft^2 d} = 161 \, ft^2$$

Design average ALRA is 0.01 lbs NH_3-N/ft². Use Equation B1 from Appendix B to determine the pounds per day of Average Day Ammonia Load, AL_A:

$$AL_A, \text{lbs/d} = (40 \text{ mg/L}) * (8.34 \, x \, 10^{-6} \text{ lbs} \bullet \text{L/mg} \bullet \text{gal}) * (5{,}400 \text{ gpd}) = 1.8 \text{ lbs/d}$$

Determine the textile area required based on Average Day Ammonia Load, AALRA using Equation 1.4:

$$A_{ALRA} = \frac{(1.8 \, lbs/d)}{0.01 \, lbs/ft^2 d} = 180 \, ft^2$$

The treatment area associated with the Hydraulic Loading Rate is the most restrictive; therefore, the first stage AdvanTex area should be a minimum of 216 ft².

Treatment Unit Options — First Stage

Option 1: Using AX-Max units – 216 ft² area

AX-MAX225-35 (Max unit includes recirc-blend tankage and discharge tankage)

Option 2: Using AX pod units – 216 ft² area

(3) AX100, 8100-gallon recirc tank (recirculation-blend tank sized at minimum of 75% of Q_M per page 17 of Design Criteria)

Loading Calculations — Second Stage

For all second stage calculations, the values used are based on the predicted performance of the first stage system. Per page 25 of the design criteria, the Standard AdvanTex Stage treated effluent values for BOD_5 and TKN are typically based upon 90% BOD_5 removal, 95% nitrification, and 70% denitrification through Pre-Anoxic Stage and First-Stage AdvanTex Treatment.

Organic Loading

Design Average OLR_A is 0.02 lbs BOD_5/ft²•d (from page 15). Use Equation B5 in Appendix B to determine the value of First-Stage AdvanTex effluent BOD_{5e}:

$$BOD_{5e} = 140 \, mg/L \, x \, (1 - 0.9) = 14 \, mg/L$$

Determine the pounds per day of Average Day Organic Load, OL_A using Equation B1 from Appendix B:

$$OL_{A2} = (14 \text{ mg/L}) * (8.34 \, x \, 10^{-6}) * (5{,}400 \text{ gpd}) = 0.32 \text{ lbs/d}$$

Determine the textile area required based on Average Day Organic Load, A_{OLRA} using Equation 1.1:

$$A_{OLRA} = \frac{(0.32 \, lbs/d)}{0.02 \, lbs/ft^2 d} = 16 \, ft^2$$

Hydraulic Loading

Design average HLR_A is 75 gpd/ft²; Design Maximum HLR_A is 125 gpd/ft² (from page 15). Determine the textile area required based on Average Day Hydraulic Load, A_{HLRA} using Equation 1.2:

$$A_{HLRA} = \frac{(5400\ gpd)}{75\ gal/ft^2 d} = 72\ ft^2$$

Determine the textile area required based on Maximum Day Hydraulic Load, A_{HLRA}, using Equation 1.2:

$$A_{HLRM} = \frac{(10800\ gpd)}{125\ gal/ft^2 d} = \mathbf{86.4\ ft^2}$$

Ammonia Loading

Design average ALR_A is 0.005 lbs NH_3-N/ft². Determine the value of First-Stage AdvanTex effluent TKN_e using Equation B6 in Appendix B:

$$TKN_e = 50\ mg/L\ x\ (1 - 0.95) = 2.5\ mg/L$$

Determine the pounds per day of Average Day TKN Load, TKN_e using Equation B1 from Appendix B:

$$\mathrm{TKN}_e = (2.5\ \mathrm{mg/L}) * (8.34\ x\ 10^{-6}) * (5{,}400\ \mathrm{gpd}) = 0.113\ \mathrm{lbs/d}$$

Determine the textile area required based on Average Day Ammonia Load, ALR_A using Equation 1.4:

$$A_{ALRA} = \frac{(0.113\ lbs/d)}{0.005\ lbs/ft^2 d} = 23\ ft^2$$

The treatment area associated with the Design Maximum Day Hydraulic Loading Rate is the most restrictive; therefore, the second stage AdvanTex area should be a minimum of 86 ft².

Treatment Unit Options — Second Stage

Option 1: Using AX-Max units – 86 ft² area

AX-MAX100-21 (Max unit includes recirc-blend tankage and discharge tankage)

Option 2: Using AX pod units – 86 ft² area

(1) AX100, 2700-gallon recirc tank or 2160-gallon discharge tank (2700-gallon recirculation-blend tank sized at minimum of 25% of Q_M per page 17 of the Design Criteria; 2160-gallon discharge tank size based on local regulation, but typically sized at minimum of 20% of Q_M)

Other Design Notes

- Ensure access to treatment site for maintenance activities
- Ensure availability of water at treatment site for maintenance activities
- Adequate alkalinity control
- Adequate temperature control

Appendix 2A: Example Design for a Campground (Application Type 2)

Standard AdvanTex Treatment for Removal of Organics With $cBOD_5$ and TSS Discharge Limits

Example: Campground with 5 RV spaces and dump station, 40 camping spaces, a shower house with restroom facility, a separate restroom only building, and living quarters for a camp host. System is to be discharged to a pressurized drainfield and permit requirements include organic ($cBOD_5$ and TSS) discharge limits.

Establishing a Design Basis

Flows

- List Contributing Sources, Anticipated Flows and Corresponding Waste Strengths
- Waste strengths are provided after primary tankage and are listed as primary-treated effluent (PTE)

Table 2A-1: Flows

Source	Design Maximum Day Flow[1] (gpd)	BOD_5 (mg/L)	TSS (mg/L)	TKN (mg/L)
RV Dump Station[2]	250	1,800	800	160
Shower House w/ Restrooms[3]	4,500	225	75	80
Restrooms[4]	1,800	300	100	120
Camp Host Living Quarters	150	150	60	60
Total Flow (Q_M)	**6,700**	**302[5]**	**108[5]**	**93[5]**

[1] *For Average Day Design Flow (Q_A), assume 50% of Maximum Day Design Flow (Q_M); Q_A = 3350 gpd*

[2] *Dump station flow calculated using 50 gallons/RV per day*

[3] *Typically equals Number of Sites × Usage per Site or Number of Visitors × Usage per Visitor (45 sites × 4 users per site × 25 gpcd)*

[4] *Typically equals Number of Sites × Usage/Site or Number of Visitors × Usage per Visitor (45 sites × 4 users per site × 10 gpcd)*

[5] *Total Waste Strength is determined by mass balance calculation using the volume and strength of each contributing source; see Equation B2 in Appendix B and example below*

Determine the mass balance for the blended concentration of BOD_{5B} using Equation B2 from Appendix B:

$$= \frac{(250\ \text{gal} * 1800\ \text{mg/L}) + (4500\ \text{gal} * 225\ \text{mg/L}) + (1800\ \text{gal} * 300\ \text{mg/L}) + (150\ \text{gal} * 150\ \text{mg/L})}{6700\ \text{gal}}$$

Using the calculations, the blended concentration of BOD_{5B} = 302 mg/L (approximately 300 mg/L).

Discharge Type

Pressurized drainfield.

Influent (Primary Treated Effluent) and Permit Parameters

Table 2A-2: Influent and Permit Parameters

	BOD_5 (mg/L)	TSS (mg/L)
Primary Treated Effluent (Ave/Max)	302	108
Discharge Permit Requirement (30-day Average)	20	20

Other Design Considerations

Seasonal use

Some camps are only used seasonally and flows may vary wildly during this period. For those with highly variable flow fluctuations with limited full occupancy, flow equalization and a corresponding downsizing of the treatment facility may be in order.

Temperature effects

Seasonally low temperatures may impact performance of a treatment system. For camps that are to be used during the winter months, there may be a need to address waste stream temperature effects. AX-Max systems are constructed within insulated vessels and are preferred for cold environments, though AX100 with external insulation added in the field can also be utilized.

Design Specifics

Tankage Requirements

Distributed primary tankage (locating tanks next to the flow sources) is the most common method of primary tankage due to the configuration of most campground facilities. The primary tanks may require the use of a pump if the treatment facility is located at an elevation higher than the primary tanks. Using a primary tank at the treatment area would likely require either a small STEP collection system or a gravity sewer (which increases the risk for I&I).

Campgrounds fall within Application Type 2 in Appendix A; therefore total primary tank recommendations call for a minimum of 3 days' retention at maximum day design flow. Since a pre-anoxic tank is recommended and will be situated at the treatment site, provide a minimum of 2 days retention at each distributed site, except for the RV dump station.

Table 2A-3: Sample Tank Sizing Recommendations

Tank Sizing	Max. Day Design Flow (gpd)	Recommended Minimum Primary Tank Size (Gallons)
RV Dump Station[6]	250	1,750; use 2,000
Shower House w/ Restrooms	4,500	9,000
Restrooms	1,800	3,600; use 4000
Camp Host Living Quarters	150	300; use 1,000 gallon minimum

[6] *Per note 5 in Appendix A. Primary tankage for RV dump station should be a minimum of 7 days*

Size for the Pre-Anoxic Tank at the Treatment Site: 6700 gallons, use 6,000 or 8,000 gallons. Since the system is only required to treat for organic constituents, it would be configured as shown below (see page 10):

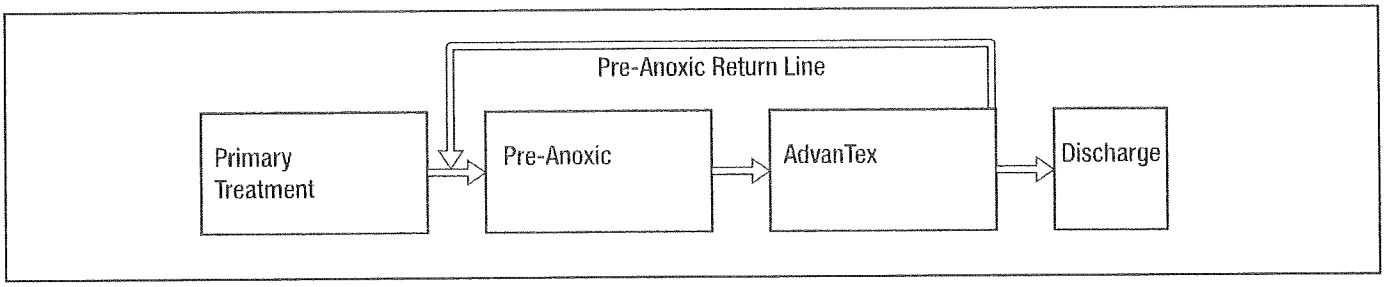


Figure 2A-1. Treatment Configuration for Organic Constituents

Loading Calculations

For all loading calculations, the design maximum day loading rates are double the design loading rates for average day. Since the design maximum day flow is not greater than two times the average day design flow, the calculation for maximum day design load is unnecessary.

Organic Loading

Since BOD_5 is greater than TSS, calculating for the most restrictive parameter (BOD_5) is necessary. Design Average OLR_A is 0.04 lbs $BOD_5/ft^2 \bullet d$.

Determine the pounds per day of Average Day Organic Load, OL_A using Equation B1A from Appendix B:

$$OL_A = (300\ \text{mg/L}) * (8.34 \times 10^{-6}\ \text{lbs} \bullet \text{L/mg} \bullet \text{gal}) * (3350\ \text{gpd}) = 8.4\ \text{lbs/d}$$

Determine the textile area required based on Average Day Organic Load, A_{OLRA} using Equation 1.1:

$$A_{OLRA} = \frac{(8.4\ lbs/d)}{0.04\ lbs/ft^2 d} = \mathbf{210\ ft^2}$$

Hydraulic Loading

Design average HLR_A is 25 gpd/ft² (from page 15). Determine the textile area required based on Average Day Hydraulic Load, A_{HLRA} using Equation 1.2:

$$A_{HLRA} = \frac{(3350\ gal/d)}{25\ gal/ft^2 d} = 134\ ft^2$$

The area associated with organic loading rate is the most restrictive and therefore the AdvanTex area should be a minimum of 210 ft².

Treatment Unit Options

Option 1: Using AX-Max units – 210 ft² area

AX-MAX225-35 (Max unit includes recirc-blend tankage and discharge tankage)

Option 2: Using AX pod units – 210 ft² area

(3) AX100, 5025-gallon recirc tank, 1500-gallon discharge tank. (Recirculation-blend tank sized at minimum of 75% of Q_M, equates to 5,025 gallon minimum, per page 17 of Design Criteria; discharge tank size based on local regulation, but typically sized at minimum of 20% of Q_M, equates to 1340 gallon minimum)

Other Design Notes

- RV dump waste should be limited to no more than 20% of the design flow (average or maximum day) and metered into the system using small doses, preferably with a timed dose system.
- Ensure access to the treatment site for maintenance activities.
- Ensure availability of water at the treatment site for maintenance activities.

Appendix 3A: Example Design for a School (Application Type 3)

AdvanTex Treatment for Removal of Organics and Nitrogen with $cBOD_5$, TSS, and TN Discharge Limits

Example: High School with cafeteria, gymnasium, and sports fields. System is to be discharged to a pressurized drainfield and permit requirements include organic ($cBOD_5$ and TSS) and total nitrogen (TN) discharge limits.

Establishing a Design Basis

Flows

School facilities include cafeteria and gym with seating for 800. Due to their weekly flow characteristics, schools are a perfect application for the use of equalization tankage to evenly distribute the flows over the week. Flow equalization provides a consistent, stable loading of the treatment system, as well as slightly reduces the system size.

Table 3A-1: Flows

Source	Max. Day Design Flow Per Unit (gpd)	Max. Day Design Flow (gpd)
400 students	25	10,000
60 Employees	15	900
School event seating, 800	5	4,000
Total		**14,900[1] or 10,500[2]**

[1] *For Average Day Design Flow, use the five-day average flow of 10,900 gpd*

[2] *If using Flow Equalization, see below*

Determine the Design Average Day Flow using Flow Equalization to reduce treatment capacity requirement:

$$Equalized\ Design\ Day\ Flow, Q_E = \frac{(10{,}900\ gpd\ x\ 4\ days) + (14{,}900\ gpd\ x\ 1\ day) + (4{,}000\ gpd\ x\ 1\ day) + (0\ gpd\ x\ 1\ day)}{6\ days^{3}} = 10{,}416\ gpd, use\ 10{,}500\ gpd$$

[3] *Allowing for one day for recovery (see pages 12-13)*

Discharge Type

Pressurized drainfield.

Influent (Primary Treated Effluent) and Permit Parameters

Table 3A-2: Influent and Permit Parameters

	BOD_5 (mg/L)	TSS (mg/L)	TKN (mg/L)	TN (mg/L)	Alkalinity (mg/L)
Primary Treated Effluent (Ave/Max)	280/350	50/100	160/200	N/A	120
Discharge Permit Requirement (30-day Average)	20	20	N/A	20	N/A

Other Design Considerations

Seasonal use

Most school applications see regular flows five days per week during the school year. For high schools there may be 1-2 days per week that see significant additional flows associated with sporting events or other activities. Flows during the summer months are typically only a fraction of the usage while school is in session. Flow equalization and a corresponding downsizing of the treatment facility is typically in order.

Temperature effects

Seasonally low temperatures may impact performance of a treatment system. For nitrogen sensitive applications, there may be a need to address waste stream temperature effects. This is especially true for systems with significant nitrogen removal requirements.

Alkalinity needs

Ensuring that the pH remains above 7 at all times is critical for ammonia sensitive applications. Therefore alkalinity addition should be included if influent alkalinity is insufficient to buffer the process.

Using Equation B3 from Appendix B provides the alkalinity demand for this project:

$$Alkalinity\ Demand = 160\ mg/L\ TKN\ x\ \frac{5\ mg/L\ alkalinity}{1\ mg/L\ TKN} = 800\ mg/L$$

Using Equation B4 from Appendix B provides the alkalinity need for the project:

$$Alkalinity\ Need = 800\ mg/L + 100\ mg/L - 120\ mg/L = 780\ mg/L$$

These equations show that alkalinity addition is required for this system.

Design Specifics

Tankage Requirements

Depending on the size of the facility, distributed tankage or a small gravity collection system to primary tankage is typically used. For systems with gravity collection, especially in areas with significant rainfall, an adjustment to the per capita flow may be necessary.

Schools fall within Application Type 3 in Appendix A; therefore total primary tank recommendations call for a minimum of 3 days' retention at maximum day design flow. Since a pre-anoxic tank will be used due to the nitrogen reduction requirement, two days of primary tankage will be recommended with an additional one-day pre-anoxic tank situated at the treatment site.

Table 3A-3: Sample Tank Sizing Recommendations (With Flow Equalization)

Source	Equalized Design Daily Flow (gpd)	Recommended Minimum Tank Size (gallons)
Grease Tankage	2,100[1]	6,300
Primary Tankage	10,500	21,000
EQ Tank	10,500	10,500
Pre-Anoxic Tank	10,500	10,500
1st Stage Recirculation Tank[2]	10,500	7,875
Post-Anoxic Tank	10,500	5,250
2nd Stage Recirculation Tank[3,4]	10,500	2,625
Discharge Tank	10,500	2,100

[1] *Grease flow estimated at 20% of Design Flow*

[2] *Only for AX100 Systems; volume included in AX-Max Systems*

[3] *Sized at 25% of Design Flow (see page 17)*

[4] *Only for AX100 Systems; volume included in AX-Max Systems*

Since the system is required to treat for organic constituents and provide nutrient reduction, it would be configured as shown in Figure 3A-1.

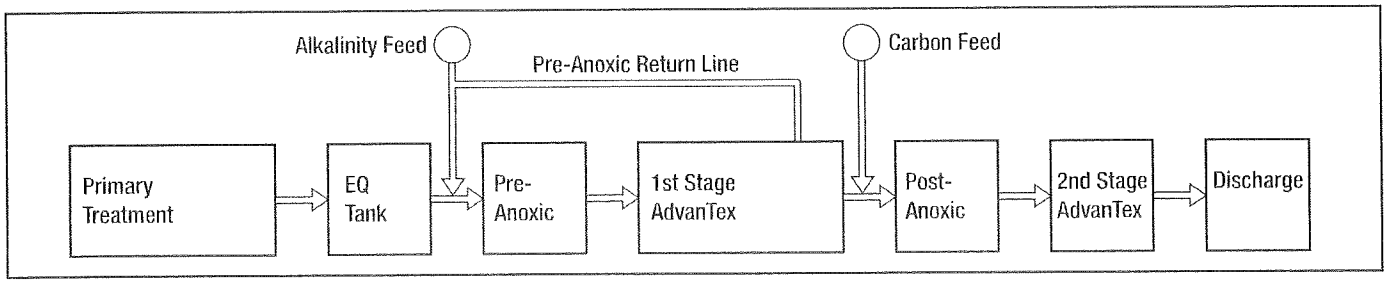


Figure 3A-1. Treatment Configuration for Organic Constituents

When using Flow Equalization, all calculations are performed with the Equalized flow considered as the Design Average Day Flow. Calculations for Maximum Day Design Flow are unnecessary.

Organic Loading – First Stage

Since BOD_5 is greater than TSS, the calculation for the most restrictive parameter (BOD_5) is necessary. Design Average OLR_A is 0.04 lbs $BOD_5/ft^2 \cdot d$ (from page 15).

Determine the pounds per day of Average Day Organic Load, OL_A using Equation B1A from Appendix B:

$$OL_A = (280\ mg/L) * (8.34 \times 10^{-6}\ lbs \cdot L/mg \cdot gal) * (10{,}500\ gpd) = 24.5\ lbs/d$$

Determine the textile area required based on Average Day Organic Load, A_{OLRA} using Equation 1.1:

$$A_{OLRA} = \frac{(24.5\ lbs/d)}{0.04\ lbs/ft^2 d} = 613\ ft^2$$

Hydraulic Loading — First Stage

Design average HLR_A is 25 gpd/ft² (from page 15).

Determine the textile area required based on Average Day Hydraulic Load, A_{HLRA}, using Equation 1.2:

$$A_{HLRA} = \frac{(10500\ gal/d)}{25\ gal/ft^2 d} = 420\ ft^2$$

Total Nitrogen Loading Calculations — First Stage

Design average $TNLR_A$ is 0.014 lbs TKN/ft² (from page 15).

Determine the pounds per day of Average Day Nitrogen Load, TNL_A, using Equation B1 from Appendix B:

$$TNL_A, lbs/d = (160\ mg/L) * (8.34 \times 10^{-6}\ lbs \cdot L/mg \cdot gal) * (10{,}500\ gpd) = 14\ lbs/d$$

Determine the textile area required based on Average Day Nitrogen Load, A_{TNLRA}, using Equation 1.3:

$$A_{TNLRA} = \frac{(14\ lbs/d)}{0.014\ lbs/ft^2 d} = \mathbf{1000\ ft^2}$$

The area associated with Total Nitrogen Loading Rate is the most restrictive and therefore the first stage AdvanTex area should be a minimum of 1000 ft².

Treatment Unit Options — First Stage

Option 1: Using AX-Max units – 1000 ft² area

(4) AX-MAX250-35; (1) T-MAX-14 (AX-Max unit includes recirc-blend tankage and discharge tankage)

Option 2: Using AX pod units – 1000 ft² area

(10) AX100, 7875-gallon recirc tank (Recirculation-blend tank sized at minimum of 75% of Q_M per page 17 of Design Criteria)

Loading Calculations — Second Stage

For all second stage calculations, the values used are based on the predicted performance of the first stage system. Per page 25 of the Design Criteria, the Standard AdvanTex Stage treated effluent values for BOD_5 and TKN are typically based upon 90% BOD_5 removal, 95% nitrification and 70% denitrification through the Pre-Anoxic Stage and first stage of AdvanTex Treatment Stage.

Organic Loading – Second Stage

Design Average OLR_A is 0.02 lbs $BOD_5/ft^2 \cdot d$ (from page 15). Use Equation B5 from Appendix B to determine the value of First-Stage AdvanTex effluent BOD_{5e}:

$$BOD_{5e} = 280\ mg/L\ x\ (1 - 0.9) = 28\ mg/L$$

Determine the pounds per day of Average Day Organic Load, OL_A using Equation B1 from Appendix B:

$$OL_{A2} = (28\ mg/L) * (8.34\ x\ 10^{-6}\ lbs \cdot L/mg \cdot gal) * (10{,}500\ gpd) = 2.45\ lbs/d$$

Determine the textile area required based on Average Day Organic Load, A_{OLRA} using Equation 1.1:

$$A_{OLRA} = \frac{(2.45\ lbs/d)}{0.02\ lbs/ft^2 d} = 123\ ft^2$$

Hydraulic Loading — Second Stage

Design average HLR_A is 75 gpd/ft² (from page 15). Use Equation 1.2 to determine the textile area required based on Average Day Hydraulic Load, A_{HLRA}:

$$A_{HLRA} = \frac{(10{,}500\ gal/d)}{75\ gal/ft^2 d} = \mathbf{140\ ft^2}$$

Total Nitrogen Loading — Second Stage

Design average $TNLR_A$ is 0.007 lbs TN/ft². Use Equation B6 from Appendix B to determine the value of First-Stage AdvanTex effluent TKN_e:

$$TKN_e = 160\ mg/L\ x\ (1 - 0.95) = 8\ mg/L$$

Determine the pounds per day of Average Day TKN Load, TKN_e, using Equation B1 from Appendix B :

$$TKN_e = (8\ mg/L) * (8.34\ x\ 10^{-6}\ lbs \cdot L/mg \cdot gal) * (10{,}500\ gpd) = 0.70\ lbs/d$$

Determine the textile area required based on Average Day Nitrogen Load, A_{TNLRA} using Equation 1.3:

$$A_{TNLRA} = \frac{(0.70\ lbs/d)}{0.007\ lbs/ft^2 d} = 100\ ft^2$$

The area associated with the Design Maximum Day Hydraulic Loading Rate is the most restrictive and therefore the second stage AdvanTex area should be a minimum of 140 ft².

Treatment Unit Options — Second Stage

Option 1: Using AX-Max units – 140 ft² area

AX-MAX150-28 (Max unit includes recirc-blend tankage and discharge tankage)

Option 2: Using AX pod units – 140 ft² area

(2) AX100, 2625-gallon recirc tank, 2100-gallon discharge tank (Recirculation-blend tank sized at minimum of 25% of Q_M per page 17 of the Design Criteria; Discharge tank size based on local regulation, but typically sized at minimum of 20% of Q_M)

Other Design Notes

- Ensure access to treatment site for maintenance activities.
- Ensure availability of water at treatment site for maintenance activities.

Orenco Systems® Inc. , 814 Airway Ave., Sutherlin, OR 97479 USA • 800-348-9843 • 541-459-4449 • www.orenco.com

The applicable design criteria for this system is revision 6.1 of document NDA-ATX-1, titled *Orenco® AdvanTex® Design Criteria, Commercial Treatment Systems*, which was published by Orenco in November, 2017. A copy of the design criteria can be downloaded from Orenco's online document library at www.orenco.com/corporate/doclibrary.cfm

Table 1 outlines standard AdvanTex loading rates, which is also outlined in the Orenco design criteria document.

Table 1. Standard AdvanTex Loading Rates

Permit Constituent or Parameter	Design AVERAGE Day	Design MAXIMUM Day
Hydraulic	25 gpd/sq.ft•d	50 gpd/sq.ft•d
BOD_5	0.04 lbs/sq.ft•d	0.08 lbs/sq.ft•d
TKN	0.014 lbs/sq.ft•d	0.028 lbs/sq.ft•d
NH_3-N	0.01 lbs/sq.ft•d	0.02 lbs/sq.ft•d

Given the project specific information of flow and influent constituents provided to Orenco, and considering the loading rates as outlined above, the following Table 2 summarizes the system sizing calculations. This system is hydraulically governed, with the hydraulic load yielding the highest square footage of textile required for treatment.

Table 2. Standard AdvanTex System Sizing

Permit Constituent or Parameter	Load Value (DMDF)	Loading Rate	AdvanTex Unit Size
Hydraulic, gpd:	60,000 gpd	50 gpd/sq.ft•d	1200 sq.ft.
Biochemical Oxygen Demand (BOD5) lbs:	60.09 lbs	0.08 lbs/sq.ft•d	751 sq. ft.
Total Suspended Solids (TSS), lbs:	40.06 lbs	0.08 lbs/sq.ft•d	501 sq. ft.
Total Nitrogen (TN), lbs:	20.03 lbs	0.028 lbs/sq.ft.•d	715 sq. ft.
Ammonia (NH3-N), Summer, lbs:	15.02 lbs	0.02 lbs/sq.ft•d	751 sq. ft.
Ammonia (NH3-N), Winter, lbs:	15.02 lbs	0.02 lbs/sq.ft•d	751 sq. ft'

The final design specifies the use of four (4) AX-MAX units, which will contain a nominal surface area of 1,200 square feet of treatment media. According to the AdvanTex System loading chart and Orenco design criteria, this AdvanTex treatment system should not be hydraulically loaded more than 50 gpd/square foot at Design Max Day Flow.

The recommended type and number of AX-MAX pods in the design satisfy Orenco's design criteria to achieve the effluent quality required in the existing SOP permit.

Provide the estimated dates for the commencement and completion of the construction of the system and the estimated date the wastewater system will be placed into service. If the wastewater system will be constructed or placed into service in phases, provide the anticipated dates for each phase.

RESPONSE:
After approval by the Tennessee Public Utility Commission, construction of the proposed collection system and additional drip fields for the Taliaferro Road Parcel will take approximately 60 days to complete and be immediately placed into service. All construction is being completed in a single phase.

If portions of the wastewater system will be built in phases, provide how many phases and the number of houses or units to be connected in each phase.

RESPONSE:
Construction of the wastewater system for the Taliaferro Road Parcel will be completed in a single phase and ultimately provide service to 27 single family homes.

Identify the builder or developer that has requested the utility to provide wastewater service.

RESPONSE:
See attached letter from the developer of the Taliaferro Road Parcel requesting Superior Wastewater System to provide wastewater service for the specific identifying information requested.

Jim McCanless
McCanless and Company
P.O. Box 1687
Nolensville, TN 37165

August 28, 2020

Mr. John Powell
Superior Wastewater Systems, LLC
P.O. Box 40
Arrington, TN 37014

Dear Mr. Powell

Please accept this letter as a formal request to provide waste water service to the following parcels:

Parcel 35.00 Map 137, 8496 Taliaferro Rd, College Grove TN.

We would like to initiate proceedings to include this project into the Superior Wastewater Systems service area. We initially anticipate Superior Wastewater Systems serving 27 single family residential homes.

Respectfully Requested

Jim McCanless



EXHIBIT 2
PROPERTY RIGHTS & PUBLIC NEED INFORMATION

Exhibit 2.1	Letter from Existing Utilities Declining to Provide Service
Exhibit 2.2	City and County Franchise Agreement
Exhibit 2.3	Developer/Construction Contractor/Utility Contracts

Provide a letter(s) from local government(s) and public wastewater utilities in or near the proposed service area stating that they do not provide wastewater service to the proposed service area and that they are unable or unwilling to provide wastewater service to the proposed service area within the ensuing twelve (12) months.

RESPONSE:
See attached letter from Williamson County. A letter has been requested from Nolensville College Grove Utility District. Filing will be updated upon receipt of letter.

Rogers C. Anderson
Williamson County Mayor

WILLIAMSON COUNTY GOVERNMENT

September 3, 2020

Mr. Jim McCanless
P.O. Box 1687
Nolensville, TN 37165

Re: Sewer Request for Property at:
8496 Taliaferro Road, College Grove, TN
Tax Map 137, Parcel 35.00

Dear Mr. McCanless:

On September 1, 2020, Williamson County received your request that sewer service be provided to the above-named property. In response to your inquiry, this correspondence confirms that Williamson County Government does not currently provide public sanitary sewer service to this property and has no plans in the foreseeable future to provide said service.

I hope this information is helpful. Should you need anything further, please do not hesitate to contact me.

Sincerely,

Rogers C. Anderson, Mayor
Williamson County

LETTER FROM NOLENSVILLE COLLEGE GROVE UTILITY DISTRICT WILL BE FILED UPON RECEIPT

As applicable, provide a copy of any application for a franchise and the franchise agreement issued by a city or county.

RESPONSE:
There are no applicable franchise agreements with the county related to the provision of wastewater service to the Taliaferro Road Parcel. In addition, the Taliaferro Road Parcel is not located within any municipal boundaries.

Provide all contracts or agreements between the builder(s) of the treatment and/or collection system, the utility, and the property and/or subdivision developer that show entitlement or ownership to the land, system specifications, cost for the wastewater system and timeline for the system to be built, and rights to the system once it is completed. Documents presented should be signed by all parties and bear marks or stamps, such as those provided by notaries or public officials, as necessary.

RESPONSE:
The contract between the parties for wastewater service at Taliaferro Road Parcel contains confidential information and is being provided under seal.

EXHIBIT 3
MANAGERIAL CAPABILITIES OF SWS

Exhibit 3.1	Biographies of Officers & Key Staff
Exhibit 3.2	State Wastewater Provider Status
Exhibit 3.3	Pending Mergers or Acquisitions
Exhibit 3.4	Construction Company Contractor's License

Provide a biography of all officers and/or key wastewater utility staff that demonstrate managerial ability. Include a list of certifications or professional licenses earned by officers or wastewater utility staff with documentation.

RESPONSE:
Mr. John Powell is the only officer of Superior Wastewater Systems. There are no other employees that would be considered as "key wastewater utility staff". Attached is a biography of Mr. Powell demonstrating his managerial experience.

John Powell

Education

Hendersonville High School 1978
Tennessee Tech University
Cookeville TN 1978 – 1981
Tennessee State University
Nashville 1981 – 1982

2004 – Present – President and General Manager, Superior Wastewater Systems

Manage all operations of Superior Wastewater Systems (formerly King's Chapel Capacity)

1986 to Present - Trailer Lease, Inc.

1985 Purchased A&R Semi Trailer Rental Nashville, TN.
1991 Purchased Guinns Semi Trailer Rental
1997 Purchased C&G Semi Trailer Rental
1998 Purchased B&H Semi Trailer Rental
1999 Purchased Ashland City Semi Trailer Rental

Negotiated the purchase and financing to acquire all of the above companies for my wife and me.

In 1991, the trailer rental company was renamed from A&R to Trailer Lease, Inc. Today Trailer Lease has the largest market share of business in the Middle Tennessee area. We have that market share because of 18 years of on-going service to our customers.

During the past several years we have made commercial real estate investments in Davidson County and Williamson County.

1986 Vice Chairman Finance, President Regan's 2nd Inaugural Taste of America

Responsible for all financial accounts and tracking of expenses related to this inaugural event. Managed a volunteer accounting staff of approximately 12, several of which were CPA's.

1983 President – BJ McAdams Truck line, Little Rock Arkansas.

Structure financing of $26,000,000.00 purchase of this corporation using several banks and financial institutions across the country. Took control completed refinancing of company, then resold back to original owners.

Identify all states where the applicant is certified as a wastewater provider and/or the status of certification in states where an application is pending.

RESPONSE:
Superior Wastewater Systems and Mr. John Powell have only provided wastewater service in Tennessee to the King's Chapel Subdivision and have no applications pending in any other states.

Provide copies of all contracts related to any pending merger or acquisition of the applicant, corporate parent or affiliate.

RESPONSE:
Neither Superior Wastewater Systems nor any of its affiliates have any pending or anticipated mergers or acquisitions that are being considered.

Provide proof that the party contracted to install the proposed system has a valid and current contractor's license by the applicable licensing board of the State of Tennessee.

RESPONSE:
See attached contractor's license. All construction costs will be funded by the developer.

STATE OF TENNESSEE
DEPARTMENT OF
COMMERCE AND INSURANCE

JOHN POWELL CONSTRUCTION LLC

363087

ID NUMBER: 71603
LIC STATUS: ACTIVE
EXPIRATION DATE: October 31, 2021

BOARD FOR LICENSING CONTRACTORS
CONTRACTOR

THIS IS TO CERTIFY THAT ALL REQUIREMENTS
OF THE STATE OF TENNESSEE HAVE BEEN MET

Attn:JOHH POWELL
JOHN POWELL CONSTRUCTION LLC
9539 MULLIENS ROAD
ARRINGTON, TN 37014

State of Tennessee

363087

BOARD FOR LICENSING CONTRACTORS

CONTRACTOR

JOHN POWELL CONSTRUCTION LLC

This is to certify that all requirements of the State of Tennessee have been met.

ID NUMBER: 71603
LIC STATUS: ACTIVE
EXPIRATION DATE: October 31, 2021
$500,000.00; HC; HRA; MU-A; MU-C; MU-D

IN-1313
DEPARTMENT OF
COMMERCE AND INSURANCE

EXHIBIT 4
TECHNICAL CAPABILITIES OF SWS

Exhibit 4.1	TDEC State Operating Permit Application
Exhibit 4.2	State Operator Certificate
Exhibit 4.3	Contact Information
Exhibit 4.4	Complaints, Notices or Administrative Actions
Exhibit 4.5	Design Engineer Certification

Provide a copy of the application for State Operating Permit ("SOP") filed with TDEC. Include the letter from TDEC indicating the receipt of a complete application. Include any engineering and/or design reports submitted to TDEC, such as the Design Development Report and the Detailed Soils Investigation Report. If an operating permit has been issued, provide a copy of the permit. The utility shall file a copy of the TDEC permit in the docket file prior to providing service.

RESPONSE:
Attached are the following documents related to the TDEC State Operating Permit application.

1. Draft of SOP-20021 from TDEC
2. Design Development Report
3. Detailed Soils Investigation Report
4. Wastewater Site Plan

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER RESOURCES
William R. Snodgrass - Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1102

November 17, 2020

Mr. John Powell
Managing Member
Superior Wastewater Systems
e-copy: john-powell@comcast.net
PO Box 40
Arrington, TN 37014

Subject: **Draft of State Operating Permit No. SOP-20021**
Superior Wastewater Systems - II
Taliaferro Road
Eagleville, Williamson County, Tennessee

Dear Mr. Powell:

Enclosed please find one copy of the draft state operating permit, which the Division of Water Resources (the division) proposes to issue. The issuance of this permit is contingent upon your meeting all of the requirements of the Tennessee Water Quality Control Act and the rules and regulations of the Tennessee Water Quality, Oil and Gas Board.

If you disagree with the provisions and requirements contained in the draft permit, you have thirty (30) days from the date of this correspondence to notify the division of your objections. If your objections cannot be resolved, you may appeal the issuance of this permit. This appeal should be filed in accordance with Section 69-3-110, Tennessee Code Annotated.

If you have questions, please contact the Nashville Environmental Field Office at 1-888-891-TDEC; or, at this office, please contact Ms. Anastasia Sharp at (615) 532-1508 or by E-mail at *Anastasia.Sharp@tn.gov*.

Sincerely,

Brad Harris, P.E.
Manager, Land-Based Systems

Enclosure

cc: Permit File
Nashville Environmental Field Office
Mr. Jay Russ, Certified Operator, Superior Wastewater Systems, SuperiorWasteWater@gmail.com

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER RESOURCES
William R. Snodgrass - Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1102

Permit No. SOP-20021

PERMIT

For the operation of Wastewater Treatment Facilities

In accordance with the provision of Tennessee Code Annotated section 69-3-108 and Regulations promulgated pursuant thereto:

PERMISSION IS HEREBY GRANTED TO

Superior Wastewater Systems - II
Taliaferro Road
Eagleville, Williamson County, Tennessee

FOR THE OPERATION OF

STEP effluent collection, advantex media filter, UV disinfection and drip irrigation system located at latitude 35.816873 and longitude -86.639574 in Williamson County, Tennessee to serve approximately 27 homes in the Taliaferro Road subdivision. The design capacity of the system is 0.0081 MGD and will be dispersed on approximately 0.93 acres of suitable soils.

This permit is issued as a result of the application filed on October 16, 2020, in the office of the Tennessee Division of Water Resources. This permit is contingent on the submission and department approval of construction plans, specifications and other data in accordance with rules of the department. Updated plans and specifications must be approved before any further construction activity.

This permit shall become effective on:

This permit shall expire on:

Issuance date:

for Jennifer Dodd
Director

A. GENERAL REQUIREMENTS

The treatment system shall be monitored by the permittee as specified below:

Parameter	**Sample Type**	**Daily Maximum**	**Monthly Average**	**Measurement Frequency**
Flow *	Totalizer			Daily
BOD_5	Grab	**45** mg/l	N/A	Once/Year
Ammonia as N	Grab	**Report**	N/A	Once /Quarter

* Report average daily flow for each calendar month.

Sampling requirements in the table above apply to effluent being discharged to the drip irrigation plots.

This permit allows the operation of a wastewater collection, treatment, and storage system with disposal of treated wastewater through approved land application areas. There shall be no discharge of wastewater to any surface waters or to any location where it is likely to enter surface waters. There shall be no discharge of wastewater to any open throat sinkhole. In addition, the drip irrigation system shall be operated in a manner preventing the creation of a health hazard or a nuisance.

The land application component shall be operated and maintained to ensure complete hydraulic infiltration within the soil profile, transmission of the effluent away from the point of application, and full utilization of the soil profile as a portion of the treatment system.

Instances of surface saturation, ponding or pooling within the land application area as a result of system operation are prohibited. Instances of surface saturation, ponding or pooling shall be promptly investigated and noted on the Monthly Operations Report. The report shall include details regarding location(s), determined cause(s), the actions taken to eliminate the issue, and the date the corrective actions were made. Any instances of surface saturation, ponding or pooling not associated with a major precipitation event not corrected within three days of discovery shall be reported to the local Environmental Field Office at that time for investigation. Surface saturation, ponding or pooling resulting in the discharge of treated wastewater into Waters of the State or to locations where it is likely to move to Waters of the State shall be immediately reported to the local Environmental Field Office, unless the discharge is separately authorized by a NPDES permit."

All drip fields shall be fenced sufficiently to prevent or impede unauthorized entry as well as to protect the facility from vandalism. Fencing shall be a minimum of four feet in height. Fencing shall be constructed of durable materials. Gates shall be designed and constructed in a manner to prevent or impede unauthorized entry. All designs are subject to division approval. Fence shall be installed prior to beginning of operation.

All drip lines shall be buried and maintained 6 to 10 inches below the ground surface.

The site shall be inspected by the certified operator or his/her designee, at a minimum, once per fourteen days (default) OR in accordance with an operating and maintenance inspection schedule in the permit administrative file record. The default inspection frequency will apply if an operating and maintenance inspection schedule is not submitted to be a part of the permit administrative file record. The operating and maintenance inspection schedule shall at a minimum evaluate the following via onsite visits or telemetry monitoring or a combination of the two:

- the condition of the treatment facility security controls (doors, fencing, gates, etc.),
- the condition of the drip area security controls (doors, fencing, gates, etc.),
- the condition of the site signage,
- the operational status of the mechanical parts of the treatment system (pumps, filters, telemetry equipment, etc.)
- the condition of the UV bulbs (if applicable)
- the condition of the land application area including the location of any ponding
- the name of the inspector
- the description of any corrective actions

Submission of the schedule, or revisions to the schedule, may be submitted to the division electronically. The schedule shall be submitted on or before the effective date of the permit. The permittee is responsible for maintaining evidence that the schedule, or revisions, have been submitted to the division.

B. MONITORING PROCEDURES

1. Representative Sampling

Samples and measurements taken in compliance with the monitoring requirements specified above shall be representative of the volume and nature of the monitored discharge, and shall be taken at the following location(s):

Effluent to drip irrigation plots.

2. Test Procedures

Unless otherwise noted in the permit, all pollutant parameters shall be determined according to methods prescribed in Title 40, CFR, Part 136.

C. DEFINITIONS

The "daily maximum concentration" is a limitation on the average concentration, in milligrams per liter, of the discharge during any calendar day.

The "***monthly average concentration***", other than for *E. coli* bacteria, is the arithmetic mean of all the composite or grab samples collected in a one-calendar month period.

A "grab sample" is a single influent or effluent sample collected at a particular time.

For the purpose of this permit, "*continuous monitoring*" means collection of samples using a probe and a recorder with at least one data point per dosing cycle.

A "quarter" is defined as any one of the following three-month periods: January 1 through March 31, April 1 through June 30, July 1 through September 30, and/or October 1 through December 31.

"Wastewater" for the purpose of this permit means "sewage" as defined in TCA 69-3-103

D. REPORTING

1. Monitoring Results

Monitoring results shall be recorded consistent with the general requirements imposed in Part A above OR in accordance with the operating and maintenance inspection schedule in the permit administrative file record and submitted quarterly.

Submittals shall be postmarked no later than 15 days after the completion of the reporting period. A copy should be retained for the permittee's files. Monitoring results shall be reported in a format approved by the division. Operation reports and any communication regarding compliance with the conditions of this permit must be sent to:

Division of Water Resources
Nashville Environmental Field Office
711 R.S. Gass Boulevard
Nashville, TN 37216

Sampling results may be submitted electronically to: DWRWW.Report@tn.gov.

The first operation report is due on the 15th of the month following the quarter containing the permit effective date. Until the construction of the treatment system is complete and the treatment system is placed into operation, operational reports shall report "monitoring not required".

2. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified in Rule 0400-40-05-.07(2)(h)2, the results of such monitoring shall be included in the calculation and reporting of the values required in the Quarterly Operation Report. Such increased frequency shall also be indicated.

3. Falsifying Reports

Knowingly making any false statement on any report required by this permit may result in the imposition of criminal penalties as provided for in Section 69-3-115 of the Tennessee Water Quality Control Act.

4. Signatory Requirement

All reports or information submitted to the commissioner shall be signed and certified by the persons identified in Rules 0400-40-05-.05(6)(a-c).

PART II

A. GENERAL PROVISIONS

1. Duty to Reapply

The permittee is not authorized to discharge after the expiration date of this permit. In order to receive authorization to discharge beyond the expiration date, the permittee shall submit such information and forms as are required to the Director of Water Resources (the "Director") no later than 180 days prior to the expiration date.

2. Right of Entry

The permittee shall allow the Director, or authorized representatives, upon the notification of permittee and presentation of credentials:

a. To enter upon the permittee's premises where an effluent source is located or where records are required to be kept under the terms and conditions of this permit, and at reasonable times to copy these records;

b. To inspect at reasonable times any monitoring equipment or method or any collection, treatment, pollution management, or discharge facilities required under this permit; and

c. To sample at reasonable times any discharge of pollutants.

3. Availability of Reports

All reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Division of Water Resources.

4. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems (and related appurtenances) for collection and treatment which are installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes adequate laboratory and process controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit. Backup continuous pH and flow monitoring equipment are not required.

The monitoring frequency stated in this permit shall not be construed as specifying a minimum level of operator attention to the facility. It is anticipated that visits to the treatment facility by the operator will occur at intervals frequent enough to assure proper operation and maintenance, but in no case less than one visit every fourteen days OR in accordance with an operating and maintenance inspection schedule in the permit administrative file record. If monitoring reports, division's inspection reports, or other information indicates a problem with the facility, the permittee may be subject to enforcement action and/or the permit may be modified to include increased parameter monitoring, increased monitoring frequency or other requirements as deemed necessary by the division to correct the problem. The permittee shall ensure that the certified operator is in charge of the facility and observes the operation of the system frequently enough to ensure its proper operation and maintenance regardless of the monitoring frequency stated in the permit

Dilution water shall not be added to comply with effluent requirements.

5. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations.

6. Severability

The provisions of this permit are severable. If any provision of this permit due to any circumstance, is held invalid, then the application of such provision to other circumstances and to the remainder of this permit shall not be affected thereby.

7. Other Information

If the permittee becomes aware that he failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Director, then he shall promptly submit such facts or information.

B. CHANGES AFFECTING THE PERMIT

1. Planned Changes

The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility.

2. Permit Modification, Revocation, or Termination

a. This permit may be modified, revoked and reissued, or terminated for cause as described in Section 69-3-108 (h) of the Tennessee Water Quality Control Act as amended.

b. The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

3. Change of Ownership

This permit may be transferred to another person by the permittee if:

a. The permittee notifies the Director of the proposed transfer at least 30 days in advance of the proposed transfer date;

b. The notice includes a written agreement between the existing and new permittees containing a specified date for transfer of permit responsibility, coverage, and liability between them; and

c. The Director, within 30 days, does not notify the current permittee and the new permittee of his intent to modify, revoke or reissue, or terminate the permit and to require that a new application be filed rather than agreeing to the transfer of the permit.

4. Change of Mailing Address

The permittee shall promptly provide to the Director written notice of any change of mailing address. In the absence of such notice the original address of the permittee will be assumed to be correct.

C. NONCOMPLIANCE

1. Effect of Noncompliance

Any permit noncompliance constitutes a violation of applicable State laws and is grounds for enforcement action, permit termination, permit modification, or denial of permit reissuance.

2. Reporting of Noncompliance

a. 24-Hour Reporting

In the case of any noncompliance which could cause a threat to public drinking supplies, or any other discharge which could constitute a threat to human health or the environment, the required notice of non-compliance shall be provided to the appropriate Division environmental field office within 24 hours from the time the permittee becomes aware of the circumstances. (The environmental field office should be contacted for names and phone numbers of emergency response personnel.)

A written submission must be provided within five days of the time the permittee becomes aware of the circumstances unless this requirement is waived by the Director on a case-by-case basis. The permittee shall provide the Director with the following information:

i. A description of the discharge and cause of noncompliance;

ii. The period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue; and

iii. The steps being taken to reduce, eliminate, and prevent recurrence of the non complying discharge.

b. Scheduled Reporting

For instances of noncompliance which are not reported under subparagraph 2.a. above, the permittee shall report the noncompliance on the Quarterly Operation Report. The report shall contain all information concerning the steps taken, or planned, to reduce, eliminate, and prevent recurrence of the violation and the anticipated time the violation is expected to continue.

3. Overflow

a. "***Overflow***" means the discharge of wastewater from any portion of the collection, transmission, or treatment system other than through permitted outfalls.

b. Overflows are prohibited.

c. The permittee shall operate the collection system so as to avoid overflows.

d. No new or additional flows shall be added upstream of any point in the collection system, which experiences chronic overflows (greater than 5 events per year) or would otherwise

overload any portion of the system. Unless there is specific enforcement action to the contrary, the permittee is relieved of this requirement after: 1) an authorized representative of the Commissioner of the Department of Environment and Conservation has approved an engineering report and construction plans and specifications prepared in accordance with accepted engineering practices for correction of the problem; 2) the correction work is underway; and 3) the cumulative, peak-design, flows potentially added from new connections and line extensions upstream of any chronic overflow point are less than or proportional to the amount of inflow and infiltration removal documented upstream of that point. The inflow and infiltration reduction must be measured by the permittee using practices that are customary in the environmental engineering field and reported in an attachment to a Monthly Operating Report submitted to the local TDEC Environmental Field Office on a quarterly basis. The data measurement period shall be sufficient to account for seasonal rainfall patterns and seasonal groundwater table elevations.

e. In the event that more than 5 overflows have occurred from a single point in the collection system for reasons that may not warrant the self-imposed moratorium or completion of the actions identified in this paragraph, the permittee may request a meeting with the Division of Water Resources EFO staff to petition for a waiver based on mitigating evidence.

4. Upset

a. "***Upset***" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

b. An upset shall constitute an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the permittee demonstrates, through properly signed, contemporaneous operating logs, or other relevant evidence that:

i. An upset occurred and that the permittee can identify the cause(s) of the upset;

ii. The permitted facility was at the time being operated in a prudent and workman-like manner and in compliance with proper operation and maintenance procedures;

iii. The permittee submitted information required under "Reporting of Noncompliance" within 24-hours of becoming aware of the upset (if this information is provided orally, a written submission must be provided within five days); and

iv. The permittee complied with any remedial measures required under "Adverse Impact."

5. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to the waters of Tennessee resulting from noncompliance with this permit, including such accelerated

or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge. It shall not be a defense for the permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

6. Bypass

a. "***Bypass***" is the intentional diversion of wastewater away from any portion of a treatment facility.

b. Bypasses are prohibited, unless:

i. The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

ii. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

iii. For anticipated bypass, the permittee submits prior notice, if possible at least ten days before the date of the bypass; or

iv. For unanticipated bypass, the permittee submits notice of an unanticipated bypass within 24 hours from the time that the permittee becomes aware of the bypass.

c. A bypass that does not cause effluent limitations to be exceeded may be allowed only if the bypass is necessary for essential maintenance to assure efficient operation.

d. "Severe property damage" when used to consider the allowance of a bypass means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

D. LIABILITIES

1. Civil and Criminal Liability

Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Notwithstanding this permit, the permittee shall remain liable for any damages sustained by the State of Tennessee, including but not limited to fish kills and losses of aquatic life and/or wildlife, as a result of the discharge of wastewater to any surface or subsurface waters. Additionally, notwithstanding this Permit, it shall be the responsibility of the permittee to conduct its wastewater treatment and/or discharge activities in a manner such that public or private nuisances or health hazards will not be created.

2. Liability Under State Law

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law.

PART III
OTHER REQUIREMENTS

A. CERTIFIED OPERATOR

The waste treatment facilities shall be operated under the supervision of a Biological Natural System certified wastewater treatment operator and collection system shall be operated under the supervision of a the grade I certified collection system operator in accordance with the Water Environmental Health Act of 1984.

B. PLACEMENT OF SIGNS

The permittee shall place a sign at the entrance to the land application area if fenced or all reasonsable approaches to the land application area. The sign should be clearly visible to the public. The minimum sign size should be two feet by two feet (2' x 2') with one inch (1") letters. The sign should be made of durable material

RECLAIMED WASTEWATER
DRIP IRRIGATION
(PERMITTEE'S NAME)
(PERMITTEE'S PHONE NUMBER)
TENNESSEE DIVISION OF WATER RESOURCES
Nashville Environmental Field Office
PHONE NUMBER: 1-888-891-8332

No later than sixty (60) days from the effective date of the permit, the permittee shall have the above sign(s) on display in the location specified. New facilities must have the signs installed upon commencing operation.

C. ADDITION OF WASTE LOADS

The permittee may not add wasteloads to the existing treatment system without the knowledge and approval of the division.

D. SEPTIC (STEP) TANK OPERATION

The proper operation of this treatment system depends, largely, on the efficient use of the septic tank. The solids that accumulate in the tank shall be removed at a frequency that is sufficient to insure that the treatment plant will comply with the discharge requirements of this permit.

E. SEPTAGE MANAGEMENT PRACTICES

The permittee must comply with the provisions of Rule 0400-48-01-.22. If the septage is transported to another POTW for disposal, the permittee shall note the amount of septage wasted in gallons and name of the facility the hauler intends to use for disposal of the septage on the monthly operation report. Sludge or any other material removed by any treatment works must be disposed of in a manner which prevents its entrance into or pollution of any surface or subsurface waters. Additionally, the disposal of such sludge or other material must be in compliance with the Tennessee Solid Waste Disposal Act, TCA 68-31-101 et seq. and Tennessee Hazardous Waste Management Act, TCA 68-46-101 et seq.

F. OWNERSHIP OF THE TREATMENT FACILITIES

a. The permittee shall own the treatment facilities (and the land upon which they are constructed) including the land to be utilized for drip or spray irrigation. Evidence of ownership of the treatment facility and land application site(s) must be furnished to the division for approval prior to initiation of operation the wastewater collection and treatment system for sewer service to any structure.

b. Where the treatment facility serves private homes, condominiums, apartments, retirement homes, nursing homes, trailer parks, or any other place where the individuals being served have property ownership, rental agreements, or other agreements that would prevent their being displaced in the event of abandonment or noncompliance of the sewerage system, ownership of the treatment facilities must be by a municipality, a public utility, a wastewater authority, or a privately owned public utility (having a Certificate of Convenience and Necessity from the Tennessee Public Utility Commission) or another public agency.

Attachment 1

RATIONALE

Superior Wastewater Systems - II

STATE OPERATION PERMIT NO. SOP-20021
Eagleville, Williamson County, Tennessee

Permit Writer: Ms. Anastasia Sharp

FACILITY CONTACT INFORMATION:
Mr. John Powell
Managing Member
Phone: (615) 496-8681
john-powell@comcast.net
8496 Taliaferro Road
Arrington, TN 37014

Activity Description:	Treatment of domestic wastewater via a decentralized waste water system to support construction of the Taliaferro Road Subdivision
Facility location:	Latitude 35.816873 and Longitude -86.639574
Name of the nearest stream:	No discharge allowed.
Treatment system:	STEP effluent collection, advantex media filter, UV disinfection and drip irrigation
Permit period:	This permit will be issued for a five year period effective from the issuance date on the title page.
Terms & Conditions:	BOD_5 is a standard measure of sewage strength. The 45 mg/L daily maximum limit is the required treatment standard for domestic waste water in Tennessee. Ammonia and BOD5 reporting serve to demonstrate the treatment system is meeting minimum treatment standards. Land application, versus stream discharge, enables reduced monitoring frequency for these parameters. Narrative conditions for drip disposal and septage management are proposed in support of proper system operation to prevent runoff to streams and avoidance of nuisance conditions.
Financial Security:	Municipalities and Utility Districts are government entities exempt from the financial security requirement in TCA 69-3-122.

Annual Maintenance Fee: An annual maintenance fee for the permit will apply after permit issue and upon receipt of an invoice. The fee is currently $350.00 for non-discharging facilities with influent flow less than 0.075 MGD.

Items Requisite for Operation: This draft permit proposes terms and conditions for planning purposes and to seek public comment on the potential water quality impacts of the proposed activity. Actual operation of the sewerage system is contingent on the following items (items may occur in any order):

- Approval of sewerage system construction plans and specifications per TCA 69-3-108(i),
- Final construction inspection and submission of O &M manual per Rule 0400-40-02-.09,
- Utility ownership of sewerage system assets consistent with Rule 0400-40-16-.02(8). Sewerage system assets broadly consist of those units integral to the collection, treatment and disposal of both the solid and liquid component of sewage (i.e. septic tanks and pumps, collection lines, treatment system and drip irrigation area and related appurtenances), and
- Final issue of the permit.

Superior Wastewater Systems - II

for the

The Homes at Mulberry Meadows Subdivision

Williamson County, TN

DESIGN DEVELOPMENT REPORT

&

DETAILED SOILS INVESTIGATION REPORT

Prepared For:

McCanless and Company

Jim McCanless

P.O. Box 1687

Nolensville, TN 37135

(615) 512-9192

Prepared by:

T-SQUARE ENGINEERING

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J. Detailed Soil Investigation Report

K. The Back-up wastewater disposal sites shall be identified and shown in the DDR. All proposed uses for the back-up sites shall be described in the DDR.

L. Cost Estimates

M. If auxiliary 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

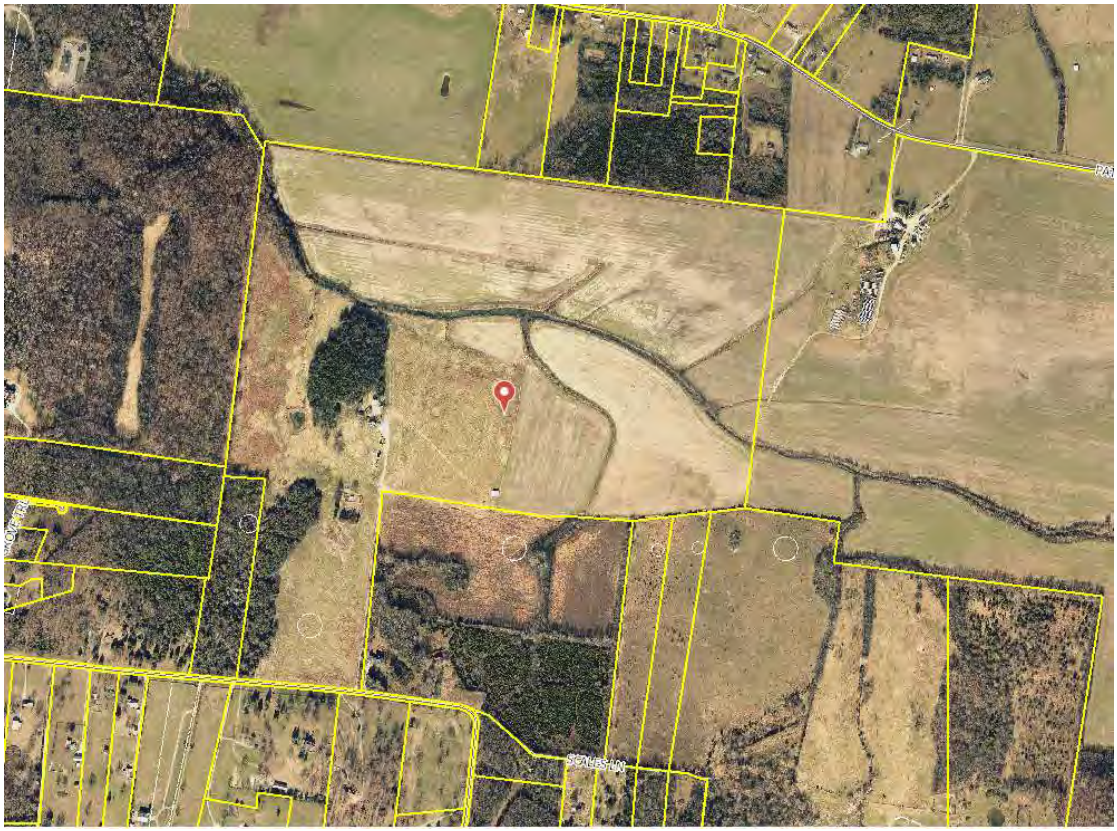
N. Staging or Phasing of Construction

APPENDIX

A. Site Description

1.1 Location Map

Exhibit 1.1



Street Address:
8496 Taliaferro Rd
College Grove, TN, 37060

GIS No. 137----03500
Williamson County, TN

1.2 Climate

The site is located in the North Temperate Zone of Middle Tennessee, which generally has mild climate year around, but still has four distinct seasons. The average temperature in winter is 39.2 degrees F. In the summer, the average temperature is 76.2 degrees F. The average annual temperature is 58.1 degrees F. The average annual precipitation ins 51.8 inches. This information is from the National Oceanic and Atmospheric Administration's Nation Climatic Data Center.

1.3 Geology (including subsurface hydrology)

The attached USGS map (exhibit 1.3a) **indicates that the surface drainage flow path from the Superior Wastewater Systems II wastewater treatment area is to the north, discharging into the Nelson Creek watershed. The site is comprised of approximately 196 acres. The topography of the site ranges from 0-30% slopes** with a majority of the site remaining undeveloped.

The property is bordered by Taliaferro Rd to the South, large-lot residential and agricultural properties to the North, East, and West. The subject property has mainly been used for agricultural use in the past. The property location is currently served by Nolensville College Grove Utility District district for potable water.

See the following exhibits below:

USGS Quad Map (showing surface flow)	Exhibit 1.3a
USDA soils information	Exhibit 1.3b
Geologic Map	Exhibit 1.3c

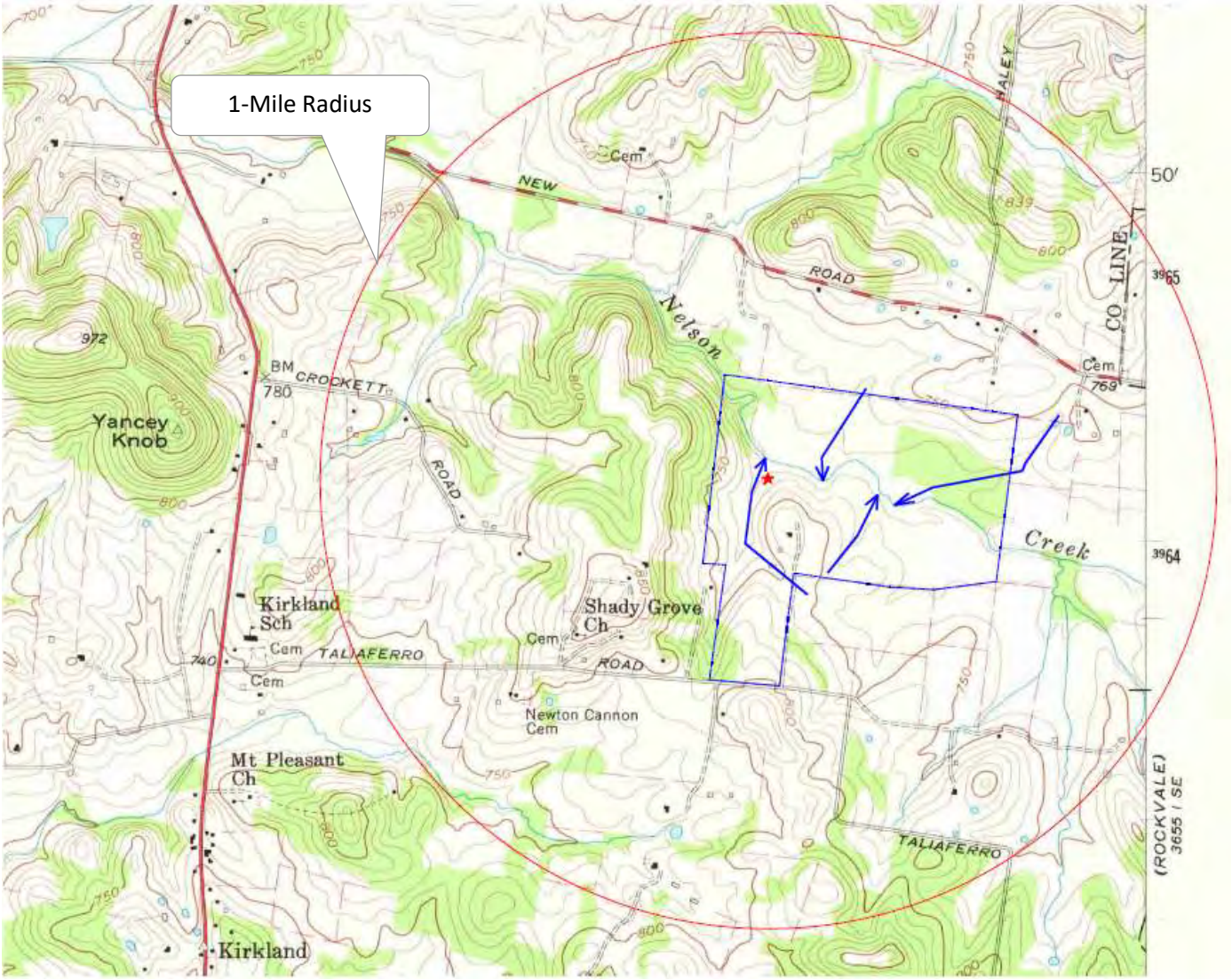
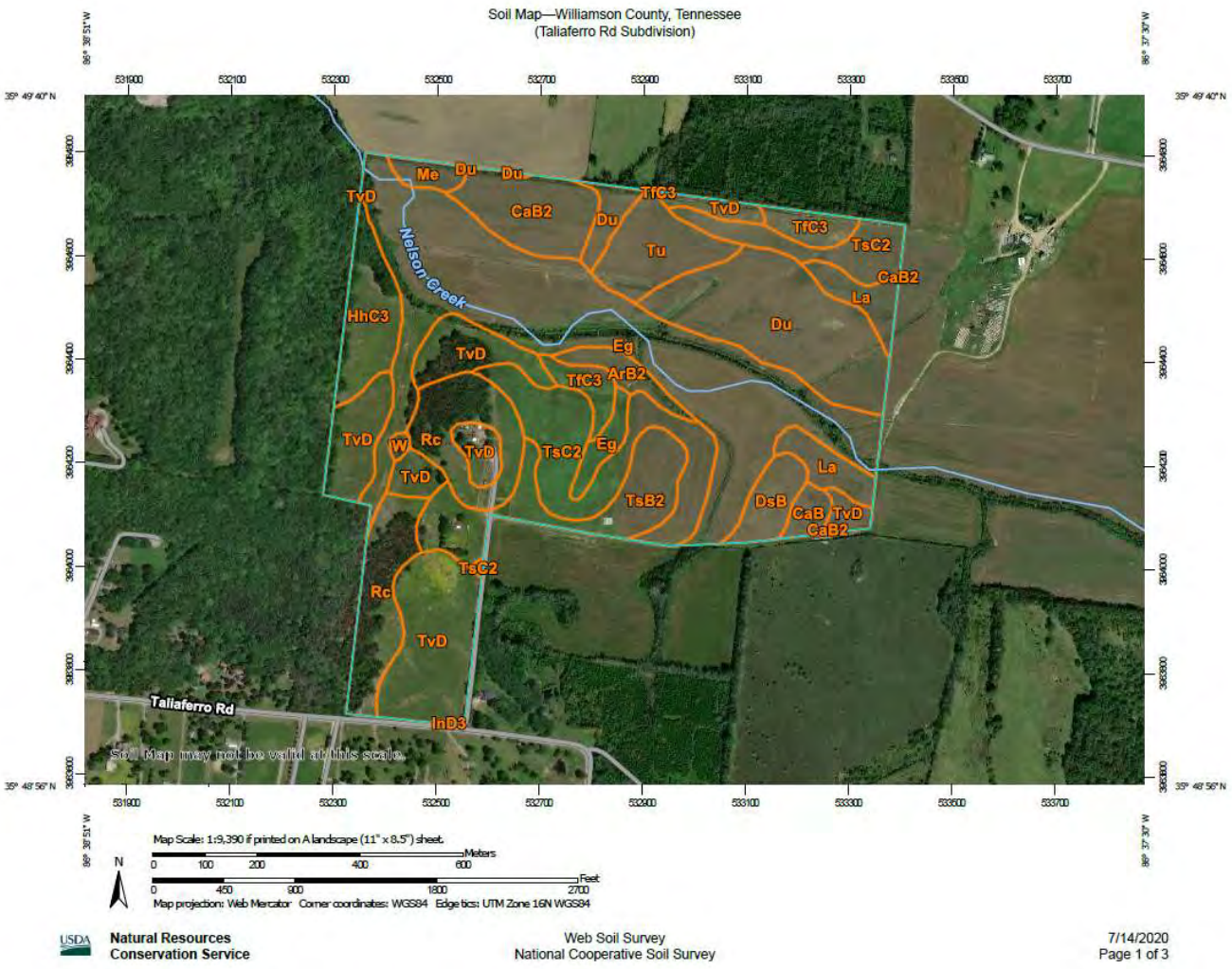
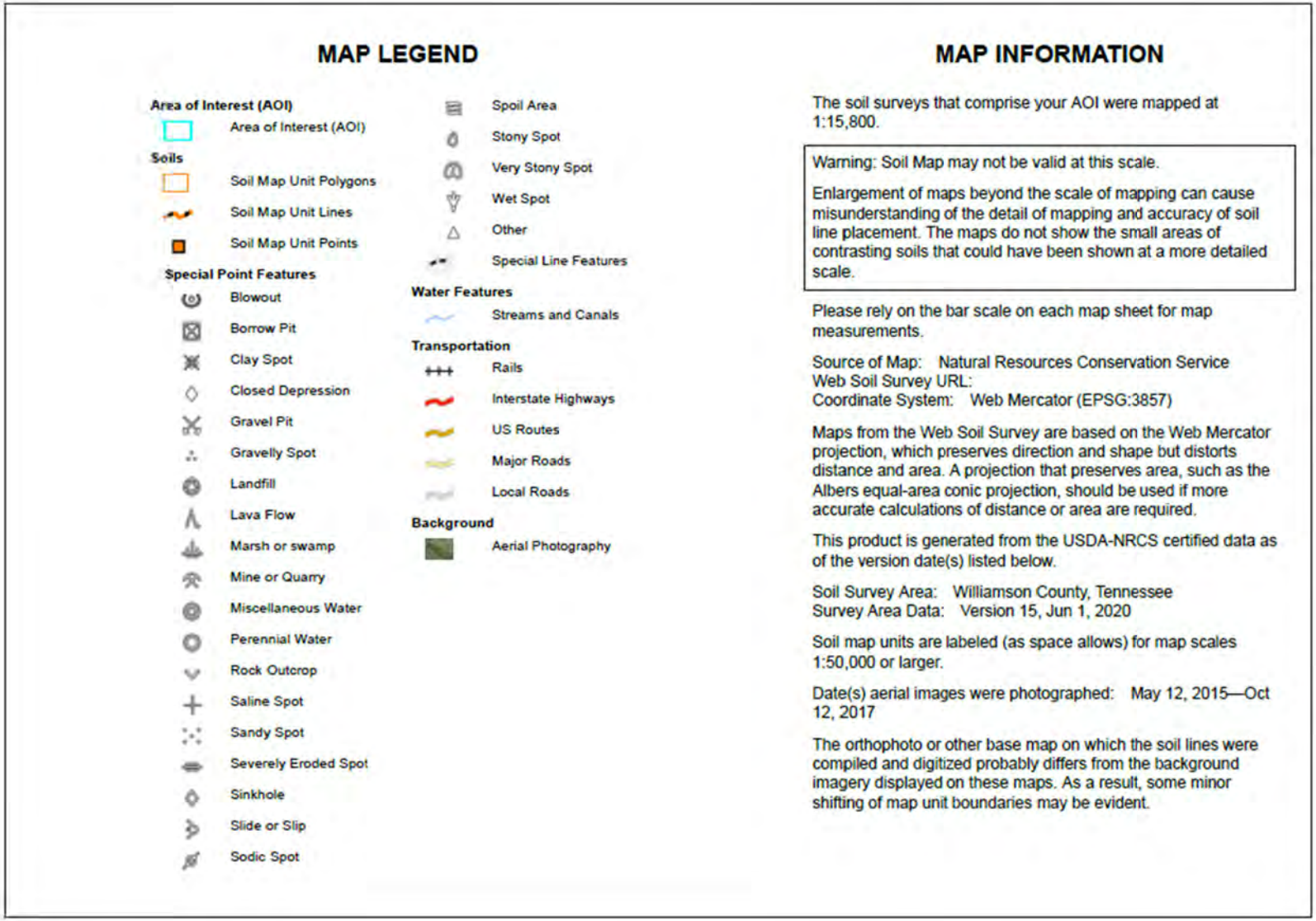


Exhibit 1.3a
USGS Quad Map
Watershed Drainage



NRCS Soils Map
Exhibit 1.3b

NRCS Soils Information
Exhibit 1.3b Cont.

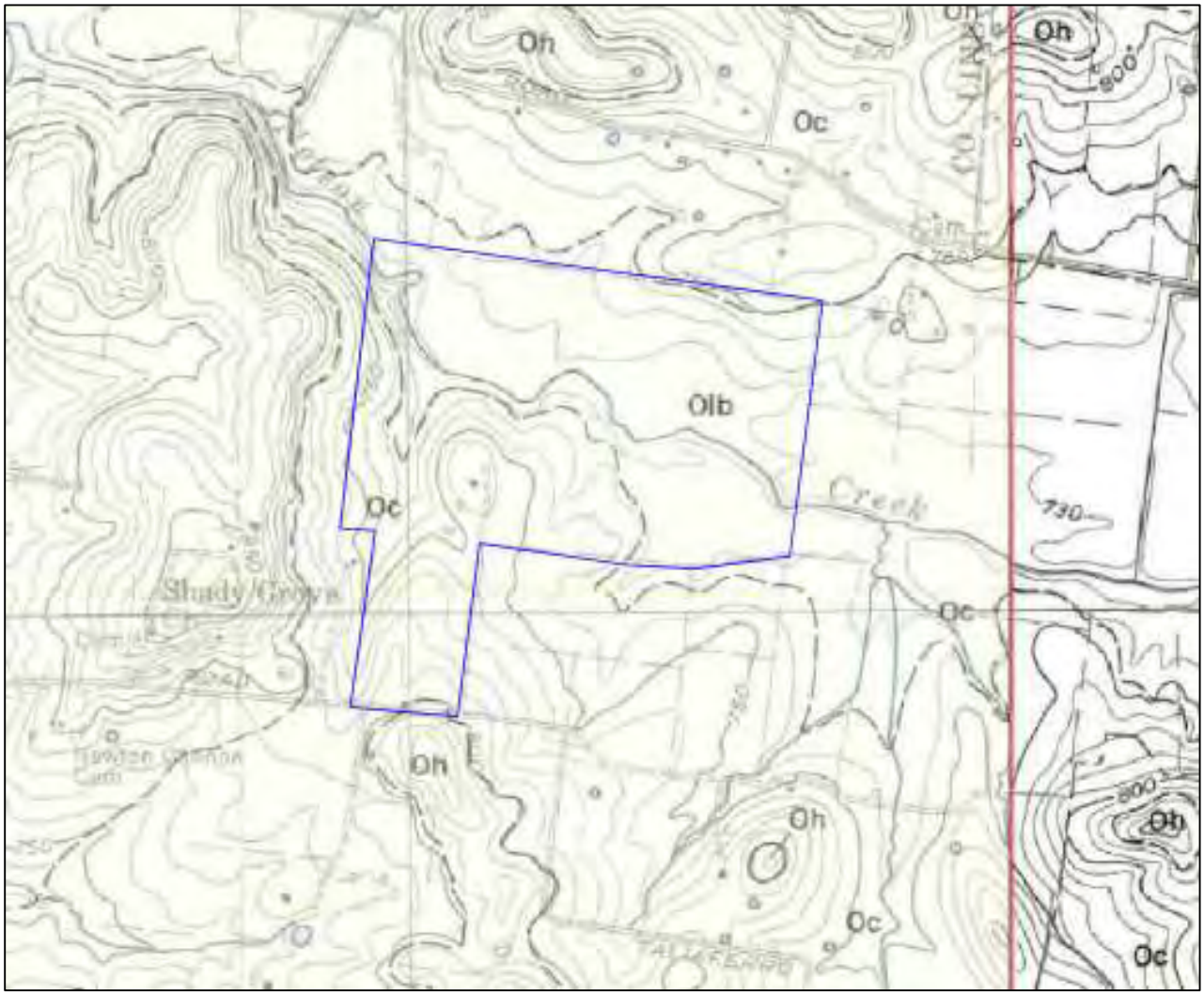


Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ArB2	Armour silt loam, 2 to 5 percent slopes, eroded	2.6	1.3%
CaB	Captina silt loam, phosphatic, 2 to 5 percent slopes	1.7	0.9%
CaB2	Captina silt loam, phosphatic, 2 to 5 percent slopes, eroded	8.6	4.4%
DsB	Dowellton silt loam, 2 to 5 percent slopes	3.7	1.9%
Du	Dunning silt loam, phosphatic	21.9	11.2%
Eg	Egam silt loam, phosphatic	50.7	25.9%
HhC3	Hampshire-colbert silty clay loams, 5 to 12 percent slopes, severely eroded	7.2	3.7%
InD3	Inman silty clay loam, 12 to 20 percent slopes, severely eroded	0.1	0.0%
La	Lanton silt loam, phosphatic	6.2	3.2%
Me	Melvin silt loam, phosphatic	1.7	0.9%
Rc	Rockland	16.8	8.6%
TfC3	Talbott silty clay, 5 to 12 percent slopes, severely eroded	4.9	2.5%
TsB2	Talbott silty clay loam, 2 to 5 percent slopes, eroded	11.6	5.9%
TsC2	Talbott silty clay loam, 5 to 12 percent slopes, eroded	20.8	10.6%
Tu	Tupelo silt loam, 0 to 2 percent slopes	7.6	3.9%
TvD	Talbott very rocky soils, 2 to 15 percent slopes	29.3	15.0%
W	Water	0.4	0.2%
Totals for Area of Interest		**195.8**	**100.0%**

NRCS Soils Information Cont.
Exhibit 1.3b Cont.

Exhibit 1.3c



Geologic Map

1.4 Topography

Exhibit 1.4a



USGS Map of the Area

Exhibit 1.4b



Williamson County
Topographic Map
(5-ft. Contour Interval)

1.5 Access

Access to the proposed wastewater treatment plant and drip dispersal areas will be from an access easement within the Subdivision, which the property fronts on. The treatment area and the drip dispersal areas will be fenced. See attached site plan for locations.

Exhibit 1.5
See Attached STEP Design Map

1.6 Water supply wells within 1,500 LF of facility

This project will not rely upon water supply wells for domestic water use. Nolensville College Grove Utility district will supply domestic water to the project.

The following map shows the location of water well records provided by the Tennessee Department of Environment and Conservation. The wells were located by latitude and longitude and are shown on the map at the location of registered wells.

There are no known wells within 1,500 LF of the proposed development including the proposed soil areas and treatment facility.

Superior Wastewater Systems - II -- 1500 FT Well Report



9/29/2020, 10:55:23 AM

WLTS Well Locations [PUBLIC]

0 – 100

> 100 – 200

> 200 – 300

7.5' Quadrangle Boundaries

Quadrangle 9th Boundaries

1:9,028

0 0.05 0.1 0.2 mi

0 0.1 0.2 0.4 km

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri,

T-Square Engineering, Inc.

Created by TDEC Water Well Web Application

1.7 Centralized Wastewater Treatment / Disposal (CWTD) Evaluation

a. Identify potential CWTD service area (topographic maps of area adjacent to the proposed project.):

The area surrounding the proposed project consists of mostly larger tract properties that would tend to lend themselves to the development of residential subdivisions if wastewater service were available. Some of these properties have one or more existing residences that consume large portions of those properties. It can be assumed that all of these existing residences are on septic systems. The drainage basin for this area appears to flow to the west of the property.

The property does not lay near any Urban Growth Boundaries in Williamson County, TN.

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).

The existing site for The Homes at Mulberry Meadows Subdivision currently contains structures that are in the jurisdiction of Williamson County Department of Sewage Disposal Management. The developer plans to build approximately 27 single-family homes. The developer is anticipating 3-4 years for completing the proposed site, depending on the market demands. The proposed treatment facility is designed to treat the domestic effluent of 8,100 gallons per day (GPD).

The proposed project site has no additional capacity to provide sewer services to adjacent properties, without additional expansion. Typically, design flows do not represent actual flows for a treatment facility, and additional capacity should be expected to accommodate potential adjacent subsurface sewage disposal system failures. Most of the suitable soils available on The Homes at Mulberry Meadows Subdivision site are dedicated to serve this proposed development, leaving no additional treatment capacity at the current design loading requirements.

It does not appear that this site would be suitable for a Centralized Wastewater Treatment/ Disposal facility, using the current proposed treatment technology.

c. Summary, conclusion, and plan of service regarding the potential CWTD systems within the identified service area.

The areas adjacent to, and in the vicinity of, the proposed Homes at Mulberry Meadows Subdivision have the potential to experience further residential growth. The planned use of the proposed project does not lend itself to the expansion of the system under current regulations to accommodate such growth. It does not appear that a larger CWTD would be suitable for this property.

B. Scaled Drawing

2.1 *Pre-application treatment facilities* – See Taliaferro Rd STEP System Design plan

2.2 *Storage Facilities* – See Taliaferro Rd STEP System Design plan

2.3 *Disposal Fields* – See Taliaferro Rd STEP System Design plan.

2.4 *Buffer Zones* – See Taliaferro Rd STEP System Design plan.

2.5 *Hand auger, test pit and soil boring locations* – See DSIR

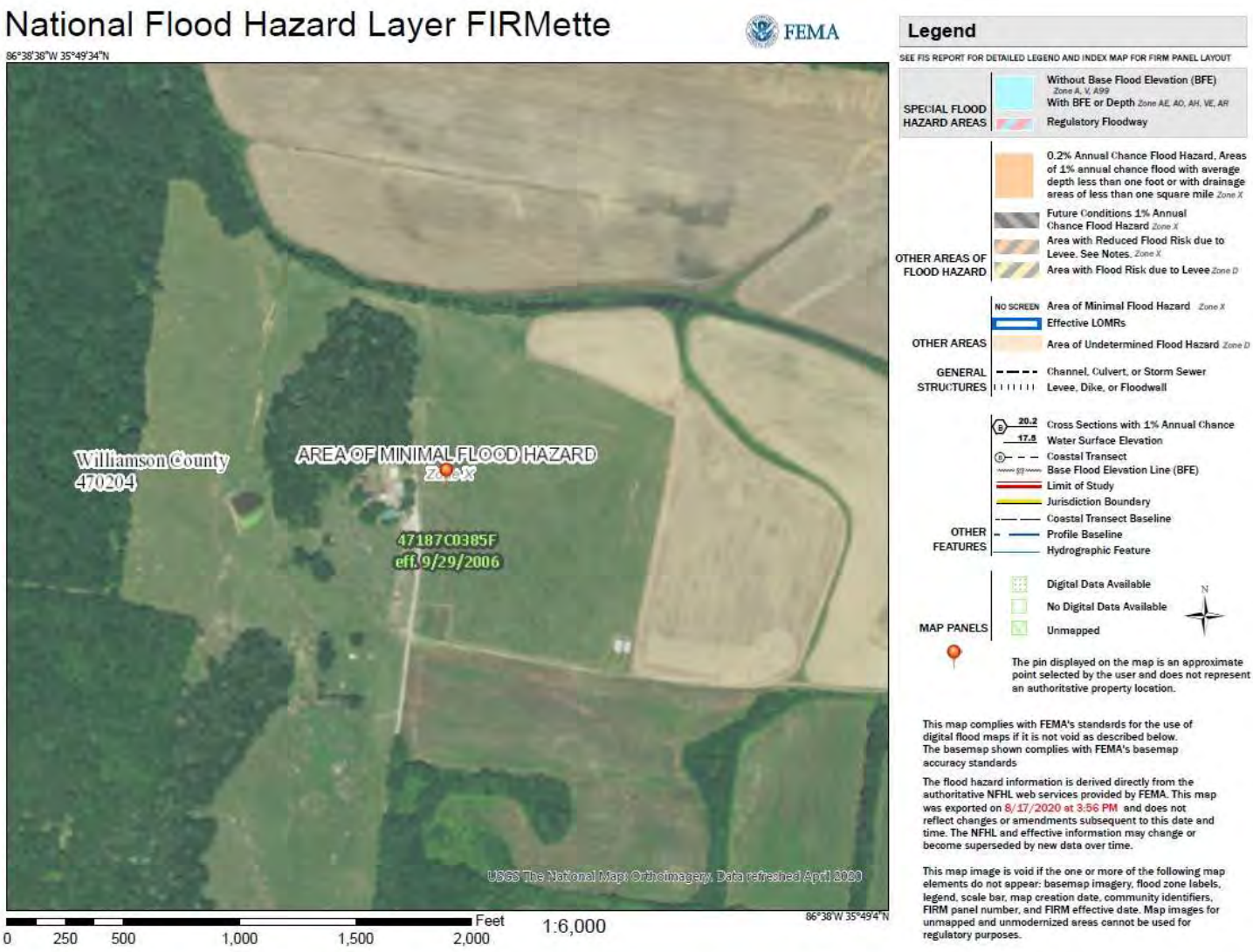
2.6 *Access roads and utilities* – See Taliaferro Rd STEP System Design plan.

2.7 *Watercourses* – See Taliaferro Rd STEP System Design plan.

2.8 *Drainage Structures* - See Taliaferro Rd STEP System Design plan.

2.9 *Flood Elevations with 10-year and 100-year flood plain elevations* – See Taliaferro Rd STEP Design plan.

Exhibit 2.9a



FEMA FIRMette – No FEMA Flood Plain on Property
See Site Plan for 10- and 100-year flood elevations.

2.10 *Residences and habitable structures within or adjacent to site*
See site and grading plans

2.11 *Wells within 500' of the site*
See 1.6 above

C. 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.

WASTEWATER TREATMENT SYSTEM DESIGN SPECIFICATIONS

Site: 8496 Taliaferro Rd, Franklin, TN, 37060

An Orenco Advantex treatment plant is proposed to treat the wastewater from The Homes at Mulberry Meadows Subdivision in Tennessee. The system will consist of the following components in series: (1) STEP/STEG collection system and (1) AX-MAX225-35 unit. The system will be capable of treating the daily design wastewater flow with the following maximum influent characteristics.

	Raw Influent	Effluent
3.1 *Average and Peak Daily Flows*		
Design flow (gpd)	8,100	8,100
Min. WW Temp (°C)	10	-
pH	6.5-8.5	6.5-8.5
3.2 Biochemical Oxygen Demand		
BOD5 (mg/L) (Septic Tank)	250-300	125-150
BOD5 (mg/L) (AX-MAX)	125-150	<30
BOD5 (mg/L) (Drip Field)	<30	BDL
3.3 Total Suspended Solids		
TSS (mg/L) (Septic Tank)	300	80-120
TSS (mg/L) (AX-MAX)	80-120	<10
TSS (mg/L) (Drip Field)	<10	BDL

3.4 *Ammonia Nitrogen, Total Kjeldahl Nitrogen, Nitrate plus Nitrite*

Nitrogen	**Influent (mg/l)**	**Effluent (mg/l)**
Total Nitrogen (AX-MAX)	40-60	<23
TKN (AX-MAX)	15-35	-
Ammonia (AX-MAX)	23	<2
Nitrate (Drip Field)	-	7
Nitrite (AX-MAX)	-	<10

3.5 *Total Phosphorus*

Normal waste streams are between 8 and 12 mg/L TP in the influent and we would normally use approximately 20-25% of that for cell growth in the biofilm.

Effluent 6-8 mg/L

3.6 *Chloride*
AX-MAX Influent: 30 mg/L
AX-MAX Effluent: < 30 mg/L

3.7 *Sodium Absorption Ratio*
$(Na^{+1})/(sqrt((Ca^{+2}+Mg^{+2})/2))$
Range: 5-9

3.8 *Electrical Conductivity*
Permeability range: < 0.5 mho/cm
Salinity Range: < 0.75-3.0 mho/cm

3.9 *Metals / Priority Pollutants*
Chloride and heavy metal concentrations are important to a treatment plant and process but it is uncommon for them to be outside of the generally accepted ranges unless the waste water is from a unique industrial operation. These values should be within the typical range specified in **Table 16-2 Suggested Values for Inorganic Constituents in Wastewater Applied to Land in Chapter 16 Design Guidelines for Wastewater Treatment Systems of Design Criteria for Sewage Works, Tennessee Department of Environment and Conservation.**

*Alkalinity - A supplemental alkalinity/pH feed system shall be provided as needed

D. Water Balance – determination of design wastewater loading rates for each disposal field

The **Armour** series consists of very deep well drained soils on stream terraces, foot slopes, and valley floors. These soils formed in old alluvium, valley fill, or in alluvium and the underlying residuum of limestone. Slopes range 0 to 20 percent. **TAXONOMIC CLASS:** Fine-silty, mixed, active, thermic Ultic Hapludalfs

The **Barfield** series consists of shallow, well drained to excessively drained, moderately slow permeable soils that formed in residuum from limestone. These soils are on nearly level to very steep uplands with medium to very rapid runoff. Slopes range from 1 to about 70 percent. **TAXONOMIC CLASS:** Clayey, vermiculitic, thermic Lithic Hapludolls

The **Braxton** series consists of very deep, well drained soils with moderately slow permeability. They are on undulating to hilly uplands and high terraces. They formed in old clayey alluvium or valley fill and residuum weathered from limestone. Slopes range from 2 to 50 percent. **TAXONOMIC CLASS:** Fine, mixed, active, thermic Typic Paleudalfs

The **Capshaw** series consists of deep and very deep, moderately well drained soils on stream terraces, in depressions and on upland flats. They formed in a thin layer of loess or old alluvium and in the underlying clayey residuum. Slopes range from 0 to 12 percent. **TAXONOMIC CLASS**: Fine, mixed, semiactive, thermic Oxyaquic Hapludalfs

The **Egam** series consists of very deep, well drained or moderately well drained soils that formed in clayey alluvium on flood plains and in depressions. Slopes are dominantly less than 2 percent but range from 0 to 5 percent. **TAXONOMIC CLASS**: Fine, mixed, active, thermic Cumulic Hapludolls

The **Harpeth** series consists of very deep, well drained, moderately permeable soils on high terraces and uplands. They formed in loess and alluvium over residuum from limestone. Slopes range from 2 to 12 percent. **TAXONOMIC CLASS**: Fine-silty, mixed, active, thermic Typic Paleudalfs

The **Sykes** series consists of very deep, well drained soils on foot slopes and stream terraces. They formed in 2 to 3 feet of silty alluvium and colluvium and the underlying clayey residuum from limestone or interbedded limestone and shale. Slopes range from 0 to 12 percent. **TAXONOMIC CLASS**: Fine-silty, mixed, active, thermic Typic Paleudalfs

The **Talbott** series consists of moderately deep, well drained soils that formed in clayey residuum weathered from limestone. These soils have moderately slow permeability. The slope ranges from 0 to 70 percent. **TAXONOMIC CLASS:** Fine, mixed, semiactive, thermic Typic Hapludalfs

See DSIR, page 12, Item 6.0, Determination of Design Percolation for Each Soil Type. The average "perc" for the soils used was found to be 0.31 in./hr.

E. Nitrogen Balance – Selection of cover crop and management scheme

Exhibit 5

The Homes at Mulberry Meadows Subdivision
Williamson County

NITROGEN LOADING

USING MASS
BALANCE EQUATION

Lwn	=		Allowable Loading rate based on Nitrogen Limits
Cp	=	**10**	maximum nitrogen concentration (mg/L)
Pr	=	table 16-2 (Chapter 16)	5-year return monthly precipitation, in./mon.
PET	=	table 16-2 (Chapter 16)	potential evapotranspiration, in./mon. (From Chap. 16)
U	=	100	nitrogen uptake by vegetation (lbs N/acre/year)
Cn	=	23	nitrogen concentration in applied wastewater
f	=	Varies	fraction of applied nitrogen removed by denitrification and volatization.
constant	=	**4.424**	combined conversion factor

Nutrient Loading Rate = Lwn = (Cp((Pr)-PET))+U(4.424)/(((1-f)*Cn)-Cp)

	Pr	PET	U (%/mo)	U/mo	% Denitr.	Lwn in/mo	Lwn in/wk	Lwn gal/sf/day
January	7.62	0.10	1	1.0	25	11.09	2.59	0.23
February	6.72	0.27	2	2.0	25	10.12	2.36	0.21
March	8.85	0.97	4	4.0	27	14.39	3.36	0.29
April	6.59	2.30	8	8.0	29	12.27	2.86	0.25
May	6.13	3.59	12	12.0	31	13.24	3.09	0.27
June	5.52	4.90	15	15.0	33	13.39	3.12	0.27
July	6.85	5.44	17	17.0	35	17.72	4.13	0.36
August	4.73	5.00	15	15.0	35	12.86	3.00	0.26
September	5.54	3.79	12	12.0	34	13.81	3.22	0.28
October	4.47	1.98	8	8.0	32	10.56	2.46	0.21
November	6.11	0.82	4	4.0	29	11.06	2.58	0.23
December	7.55	0.27	2	2.0	26	11.46	2.67	0.23

F. Background Groundwater Samples

No wells are located on the project site, but based on the past sampling, expected values would be:
Fecal coliform: 0/100 mL
Nitrate as N: 0.06 mg/L

G. Phosphorus & Other Constituent Loading Rates

Not a parameter requirement for the SOP.

Normally waste streams are between 8 and 12 mg/L TP in the influent and we would normally use about 20-25% of that for cell growth in the biofilm.

Effluent 6-8 mg/L

Constituent loading rates will be typical for residential domestic waste.

H. Determination of Wetted field area(s) and required storage volume

The Homes at Mulberry Meadows Subdivision

Area for Drip Irrigation

The total area required for drip irrigation at the design flow of 8,100 gpd will be as follows:

Loading rate: 0.2 gpd/sf
Area required: 40,500 sf = 0.93 acres Primary
100% Reserve Soils Area = 0.93 acres Reserve
Total = 0.93 + 0.93 = 1.86 Acres

Storage Pond Volume

Tennessee Department of Environment and Conservation does not require redundant storage, however, Williamson County regulations assume that wastewater can only be applied 20 days in December and February, and for 10 days in January. Williamson County also requires 40 days of storage rather than 50 days. The total storage calculations are simply the ability to store water that would have been applied during these days.

Storage Volume = 40 days effluent x 8,100 gpd = 324,000 gallons = 43,315 cu. Ft

I. Process Design for Pre-Application Treatment Facility

9.1 *Schematic of pump stations and unit processes*

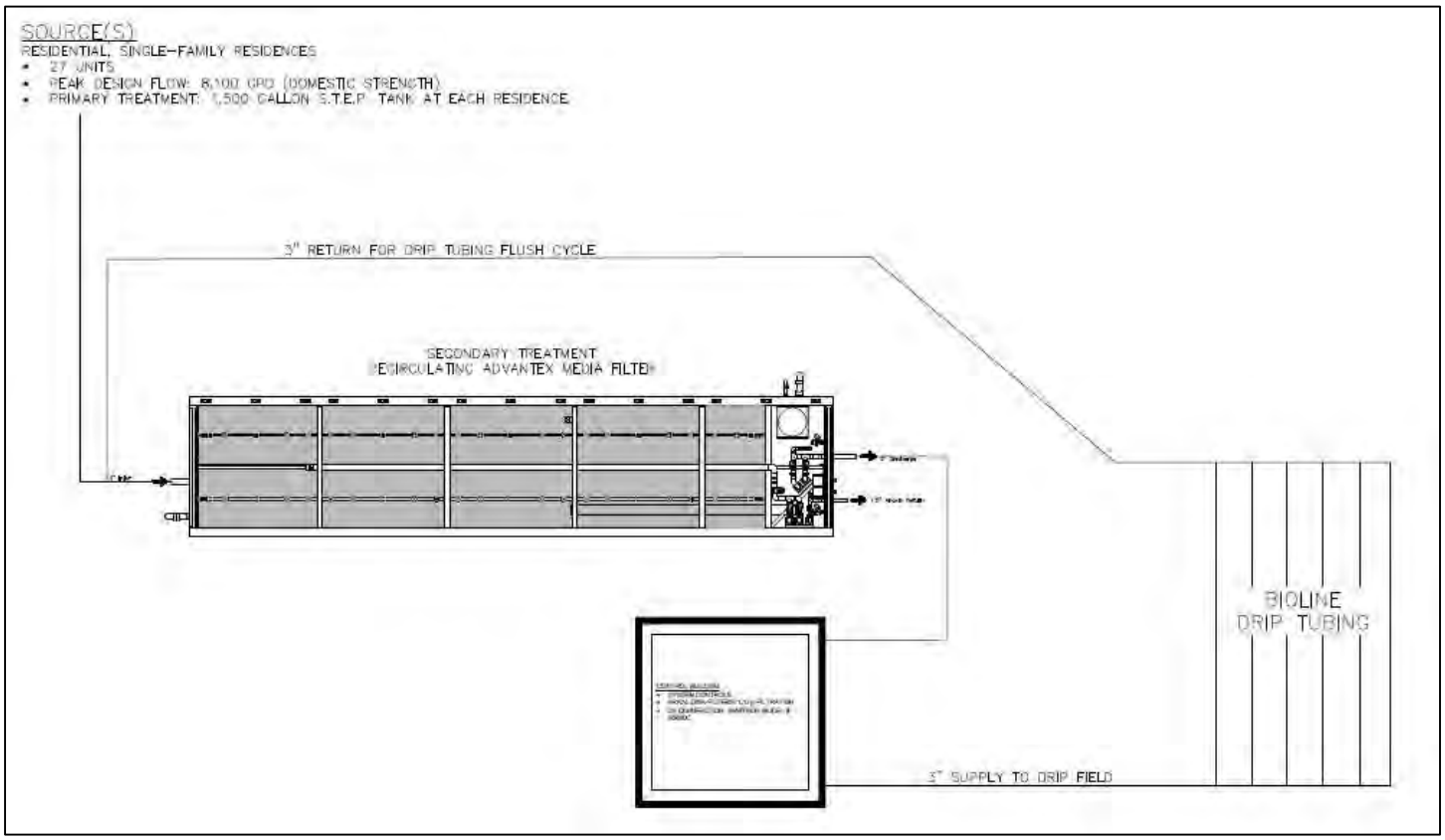


Exhibit 9

WASTEWATER PROCESS SCHEMATIC

9.2 *Basin volumes, loading rates, hydraulic detention times, etc. (aerobic or anaerobic)*

Collection system will be septic tank effluent with pump vault and filter at each building to pressure collection mains to deliver effluent through force mains to a recirculating drip field system. A final dose pump system will pressurize the drip system and/or deliver water to the redundant storage pond.

9.3 *Capacity of all pumps, blowers and other mechanical equipment. Pump curves and hydraulic calculations for the distribution system must accompany the DDR.*

See Pump calculations and specifications provided in the Engineering Report in Appendix.

9.4 *Design life of treatment and disposal system*

The design life of treatment and disposal system is expected to be 50 years.

4. DRIP DISPERSAL AND FINAL DOSING

T-SQUARE ENGINEERING

DRIP DISPERSAL AND FINAL DOSING CALCULATIONS
THE HOMES AT MULBERRY MEADOWS TREATMENT FACILITY

WILLIAMSON COUNTY, TN

BIOLINE DRIP EMITTER TUBING

USE BIOLINE 0.61 (0.57" I.D.) WITH EMITTERS SPACED 24"
BIOLINE TUBING REQUIRES 2.0 FT/SEC OR 1.6 GPM PER DISTAL END FOR FLUSHING CYCLES
BIOLINE RECOMMENDED OPERATING PRESSURE RANGES FROM 10 PSI to 45 PSI
FOR ZONES 1 THROUGH 5: MAX LATERAL LENGTH = 390 L.F.; USE INLET PRESSURE HEAD = 34.8 PSI

DAILY DESIGN FLOW = **8,100 gpd**
SOIL LOADING RATE = **0.20 gpd/ft²**
DRIP FIELD REQ'D = **40,500 ft²** **OR** **0.93 AC.**

ORENCO MONITORING SYSTEM PLC -- DRIP FIELD DOSING AND FLUSHING SEQUENCE

THE DRIP DIPSERSAL SYSTEM IS TO BE OPERATE ON SINGLE-ZONE DOSING CYCLES.
THE DRIP DISPERSAL SYSTEM IS TO BE FLUSHED BY SINGLE-ZONE FLUSHING CYCLES.
PLC CONTROLS TO PERFORM SEQUENCING OF ZONE DOSING AND ZONE FLUSHING
DUPLEX PUMPS IN FINAL DOSE TANK TO ALTERNATE AND OPERATE INDEPENDENTLY THRU DOSING SEQUENCE
DUPLEX PUMPS IN FINAL DOSE TANK TO OPERATE SIMULTANEOUSLY DURING FLUSH CYCLES
DUPLEX PUMPS IN FINAL DOSE TANK TO OPERATE SIMULTANEOUSLY DURING BACK-FLUSH OF DISC FILTERS

ZONE ELEVATIONS		ZONE #	EH
HIGH POINT ZONE 1	733.0 FT	ZONE 1	19.0 FT
HIGH POINT ZONE 2	739.0 FT	ZONE2	25.0 FT
HIGH POINT ZONE 3	747.0 FT	ZONE 3	33.0 FT
HIGH POINT ZONE 4	739.0 FT	ZONE 4	25.0 FT
HIGH POINT ZONE 5	733.0 FT	ZONE 5	19.0 FT

DOSE PUMP ELEVATION: **714.0 FT** (ASSUME THAT PUMP IS 8-FT BELOW GROUND ELEVATION)

ZONE #	TOTAL LENGTH OF BIOLINE	MAX. LATERAL LENGTH	DOSING PUMP RATE	# DISTAL ENDS	MIN. FLUSH RATE	INLET PRESSURE HEAD	ELEVATION HEAD
1	2,480 L.F	390 L.F	12.6 gpm	8	12.8 gpm	80.5 FT	19.0 FT
2	2,500 L.F	390 L.F	12.7 gpm	8	12.8 gpm	80.5 FT	25.0 FT
3	2,280 L.F	390 L.F	11.6 gpm	7	11.2 gpm	80.5 FT	33.0 FT
4	2,355 L.F	390 L.F	12.0 gpm	8	12.8 gpm	80.5 FT	25.0 FT
5	2,320 L.F	390 L.F	11.8 gpm	9	14.4 gpm	80.5 FT	19.0 FT

FIELD LOSSES FOR ZONE DOSING

FORCE MAIN SUPPLY LINE & ZONE MANIFOLDS - SCH 40 PVC PIPE

ZONE #	PUMP RATE	PIPE Ø	LENGTH	LOSS/100FT	FH LOSS*	TOTAL FIELD HL**
1	12.6 gpm	2	640	0.42 FT	3.2 FT	102.7 FT
2	12.7 gpm	2	730	0.42 FT	3.7 FT	109.2 FT
3	11.6 gpm	2	790	0.36 FT	3.4 FT	116.9 FT
4	12.0 gpm	2	740	0.38 FT	3.4 FT	108.9 FT
5	11.8 gpm	2	790	0.37 FT	3.5 FT	103.0 FT

** ASSUME AN ADDITIONAL 20% OF FRICTION LOSS THRU FITTINGS AND VALVES*

*** TOTAL FIELD HEAD LOSSES = FH LOSS + INLET HEAD PRESSURE + ELEVATION HEAD*

HEADWORKS HEAD LOSSES

ARKAL DISC FILTERS =		1 FT	(WITH CLEAN WATER & CLEAN FILTER)
	USE	5 FT	(FOR SAFETY FACTOR USE 5-FT)
2" ULTRASONIC METER=		1 FT	
	USE	3 FT	FOR DOSE METER, RETURN METER & SAFETY FACTOR
2" UV DISINFECTION =		10 FT	
HEADWORKS LOSSES =		18 FT	

TOTAL DYNAMIC HEAD FOR ZONE DOSING

ZONE #	PUMP RATE	TDH**
1	12.6 gpm	120.7 FT
2	12.7 gpm	127.2 FT
3	11.6 gpm	134.9 FT
4	12.0 gpm	134.9 FT
5	11.8 gpm	121.0 FT

*** TOTAL DYNAMIC HEAD = FH LOSS + INLET HEAD PRESSURE + ELEVATION HEAD + HEADWORK LOSSES*

FIELD LOSSES FOR SINGLE ZONE FLUSH CYCLE

FORCE MAIN SUPPLY LINE & ZONE MANIFOLDS - SCH 40 PVC PIPE

ZONE #	PUMP RATE	PIPE Ø	LENGTH	LOSS/100FT	FH LOSS*	TOTAL FIELD HL**
1	25.4 gpm	2	770 L.F	1.52 FT	14.1 FT	113.6 FT
2	25.5 gpm	2	810 L.F	1.53 FT	14.9 FT	114.4 FT
3	22.8 gpm	2	1,040 L.F	1.25 FT	15.6 FT	115.1 FT
4	24.8 gpm	2	935 L.F	1.45 FT	16.3 FT	121.8 FT
5	26.2 gpm	2	810 L.F	1.61 FT	15.7 FT	115.2 FT

** ASSUME AN ADDITIONAL 20% OF FRICTION LOSS THRU FITTINGS AND VALVES*

*** TOTAL FIELD HEAD LOSSES = FH LOSS + INLET HEAD PRESSURE + ELEVATION HEAD*

TOTAL DYNAMIC HEAD FOR SINGLE-ZONE FLUSH CYCLE

ZONE #	PUMP RATE	TDH**
1	25.4 gpm	131.6 FT
2	25.5 gpm	132.4 FT
3	22.8 gpm	133.1 FT
4	24.8 gpm	139.8 FT
5	26.2 gpm	133.2 FT

** *TOTAL DYNAMIC HEAD = FH LOSS + INLET HEAD PRESSURE + ELEVATION HEAD + HEADWORK LOSSES*

FINAL DOSE TANK - PUMP SPECIFCATION - USE DUPLEX ORENCO- 10 GPM PF-SERIES PUMPS

SINGLE ZONE DOSING: SINGLE PUMP OPERATION - ORENCO - PF 1007-12 (0.75 HP)
SINGLE-ZONE FLUSH: DUAL PUMP OPERATION - ORENCO - PF 1007-12 (0.75 HP)
ARKAL FILTER FLUSH: DUAL PUMP OPERATION - ORENCO - PF 1007-12 (0.75 HP)

Orenco SYSTEMS

Technical Data Sheet

PF-Series Submersible Effluent Pumps: 1-Phase, 60-Hz, 4-inch (100-mm)

Applications

Our PF-Series 4-inch (100-mm) Submersible Effluent Pumps are designed to transport screened effluent (with low TSS counts) from septic tanks or dosing tanks.These pumps are constructed of light-weight, corrosion-resistant stainless steel and engineered plastics, and are field-serviceable and repairable with common tools. PF-Series pumps are CSA certified to U.S. and Canadian safety standards for effluent pumps and also meet UL requirements.

PF-Series pumps are used in a variety of applications, including pressurized drainfields, packed-bed filters, mounds, aerobic units, effluent irrigation, liquid-only (effluent) sewers, wetlands, lagoons, and more. These pumps are designed to be used with a Biotube® pump vault or after a secondary treatment system.



C US
LR80980
LR2053896

Powered by Franklin Electric

Features/Specifications

To specify this pump for your installation, require the following:

- Minimum 24-hour run-dry capability (liquid end) with no deterioration in pump life or performance*
- Patented 1⁄8-inch (3-mm) bypass orifice to ensure flow recirculation for motor cooling and to prevent air bind
- Liquid-end repair kits available for better long-term cost of ownership
- TRI-SEAL™ floating impeller design on 10, 20, and 30 gpm (0.6, 1.3, and 1.9 L/sec) models; floating stack design on 50 and 75 gpm (3.2 and 4.7 L/sec) models
- Franklin Electric Super Stainless motor, rated for continuous use and frequent cycling
- Type SOOW 600-V motor cable (model PF751512 uses 14 AWG, SJOOW, 300-V cord)

** Not applicable for 5-hp (3.73 kW) models*

Standard Models

See specifications chart on page 2 for a list of standard pumps. For a complete list of available pumps, call Orenco.

Product Code Diagram

PF □ □ □ □ □ - □ - □

- CLK = ClickTight™ compatible
- Cord length, ft (m):‡
  Blank = 10 (3) 20 = 20 (6)
  30 = 30 (9) 50 = 50 (15)
- Check valve:
  Blank = no internal check valve
  CV = internal check valve†
- Voltage, nameplate:
  1 = 115* 2 = 230
- Frequency:
  1 = single-phase 60 Hz
- Horsepower (kW):
  05 = ½ hp (0.37) 07 = ¾ hp (0.56)
  10 = 1 hp (0.75) 15 = 1½ hp (1.11)
  20 = 2 hp (1.50) 30 = 3 hp (2.24)
  50 = 5 hp (3.73)
- Nominal flow, gpm (L/sec):
  10 = 10 (0.6) 20 = 20 (1.3)
  30 = 30 (1.9) 50 = 50 (3.2)
  75 = 75 (4.7)
- Pump, PF Series

* ½-hp (0.37 kW) only
† Available for 10 gpm (0.6 L/sec), 1/2 hp (0.37 kW)
‡ Note: 20-ft cords are available only for pumps through 1½ hp

Specifications

Pump Model	Design gpm (L/sec)	Horsepower (kW)	Phase	Nameplate voltage	Actual voltage	Design flow amps	Max amps	Discharge size and material[1]	Length in. (mm)	Min. liquid level in. (mm)	Weight lb (kg)	Rated cycles per day
PF100511 [9]	10 (0.6)	0.50 (0.37)	1	115	120	12.7	12.7	1 ¼ in. GFP	23.0 (660)	16 (406)	26 (12)	300
PF100511CV [9]	10 (0.6)	0.50 (0.37)	1	115	120	12.7	12.7	1 ¼ in. GFP	23.0 (660)	16 (406)	26 (12)	300
PF100512 [9]	10 (0.6)	0.50 (0.37)	1	230	240	6.3	6.3	1 ¼ in. GFP	23.0 (660)	16 (406)	26 (12)	300
PF100712 [4, 5, 9]	10 (0.6)	0.75 (0.56)	1	230	240	8.3	8.3	1 ¼ in. GFP	25.9 (658)	17 (432)	30 (14)	300
PF101012 [5, 6, 9]	10 (0.6)	1.00 (0.75)	1	230	240	9.6	9.6	1 ¼ in. GFP	27.9 (709)	18 (457)	33 (15)	100
PF102012 [5, 6, 7, 8]	10 (0.6)	2.00 (1.49)	1	230	240	12.1	12.1	1 ¼ in. SS	39.5 (1003)	22 (559)	48 (22)	100
PF200511 [9]	20 (1.3)	0.50 (0.37)	1	115	120	12.3	12.5	1 ¼ in. GFP	22.3 (566)	18 (457)	25 (11)	300
PF200512 [9]	20 (1.3)	0.50 (0.37)	1	230	240	6.4	6.5	1 ¼ in. GFP	22.5 (572)	18 (457)	26 (12)	300
PF201012 [4, 5, 9]	20 (1.3)	1.00 (0.75)	1	230	240	10.5	10.5	1 ¼ in. GFP	28.4 (721)	20 (508)	33 (15)	100
PF201512 [4, 5]	20 (1.3)	1.50 (1.11)	1	230	240	12.4	12.6	1 ¼ in. GFP	34.0 (864)	24 (610)	41 (19)	100
PF300511 [9]	30 (1.9)	0.50 (0.37)	1	115	120	11.8	11.8	1 ¼ in. GFP	21.3 (541)	20 (508)	28 (13)	300
PF300512 [9]	30 (1.9)	0.50 (0.37)	1	230	240	6.2	6.2	1 ¼ in. GFP	21.3 (541)	20 (508)	25 (11)	300
PF300712 [9]	30 (1.9)	0.75 (0.56)	1	230	240	8.5	8.5	1 ¼ in. GFP	24.8 (630)	21 (533)	29 (13)	300
PF301012 [4, 9]	30 (1.9)	1.00 (0.75)	1	230	240	10.4	10.4	1 ¼ in. GFP	27.0 (686)	22 (559)	32 (15)	100
PF301512 [4, 5]	30 (1.9)	1.50 (1.11)	1	230	240	12.6	12.6	1 ¼ in. GFP	32.8 (833)	24 (610)	40 (18)	100
PF302012 [5, 6, 7]	30 (1.9)	2.00 (1.49)	1	230	240	11.0	11.0	1 ¼ in. SS	35.5 (902)	26 (660)	44 (20)	100
PF303012 [5, 6, 7, 8]	30 (1.9)	3.00 (2.23)	1	230	240	16.8	16.8	1 ¼ in. SS	44.5 (1130)	33 (838)	54 (24)	100
PF305012 [5, 6, 7, 8]	30 (1.9)	5.00 (3.73)	1	230	240	25.6	25.8	1 ¼ in. SS	66.5 (1689)	53 (1346)	82 (37)	100
PF500511 [9]	50 (3.2)	0.50 (0.37)	1	115	120	12.1	12.1	2 in. SS	20.3 (516)	24 (610)	27 (12)	300
PF500512 [9]	50 (3.2)	0.50 (0.37)	1	230	240	6.2	6.2	2 in. SS	20.3 (516)	24 (610)	27 (12)	300
PF500712 [9]	50 (3.2)	0.75 (0.56)	1	230	240	8.5	8.5	2 in. SS	23.7 (602)	25 (635)	31 (14)	300
PF501012 [9]	50 (3.2)	1.00 (0.75)	1	230	240	10.1	10.1	2 in. SS	27.0 (686)	26 (660)	35 (16)	100
PF501512 [4]	50 (3.2)	1.50 (1.11)	1	230	240	12.5	12.6	2 in. SS	32.5 (826)	30 (762)	41 (19)	100
PF503012 [4, 5, 7, 8]	50 (3.2)	3.00 (2.23)	1	230	240	17.7	17.7	2 in. SS	43.0 (1092)	37 (940)	55 (25)	100
PF505012 [5, 6, 7, 8]	50 (3.2)	5.00 (3.73)	1	230	240	26.2	26.4	2 in. SS	65.4 (1661)	55 (1397)	64 (29)	100
PF751012 [9]	75 (4.7)	1.00 (0.75)	1	230	240	9.9	10.0	2 in. SS	27.0 (686)	27 (686)	34 (15)	100
PF751512	75 (4.7)	1.50 (1.11)	1	230	240	12.1	12.3	2 in. SS	33.4 (848)	30 (762)	44 (20)	100

1 *GFP = glass-filled polypropylene; SS = stainless steel. The 1 ¼-in. NPT GFP discharge is 2 7⁄8 in. octagonal across flats; the 1 ¼-in. NPT SS discharge is 2 1⁄8 in. octagonal across flats; and the 2-in. NPT SS discharge is 2 7⁄8 in. hexagonal across flats. Discharge is female NPT threaded, U.S. nominal size, to accommodate Orenco® discharge hose and valve assemblies. Consult your Orenco Distributor about fittings to connect hose and valve assemblies to metric-sized piping.*

2 *Minimum liquid level is for single pumps when installed in an Orenco Biotube® Pump Vault or Universal Flow Inducer. In other applications, minimum liquid level should be top of pump. Consult Orenco for more information.*

3 *Weight includes carton and 10-ft (3-m) cord.*

4 *High-pressure discharge assembly required.*

5 *Do not use cam-lock option (Q) on discharge assembly.*

6 *Custom discharge assembly required for these pumps. Contact Orenco.*

7 *Capacitor pack (sold separately or installed in a custom control panel) required for this pump. Contact Orenco.*

8 *Torque locks are available for all pumps and are supplied with 3-hp and 5-hp pumps.*

9 *ClickTight™ compatible.*

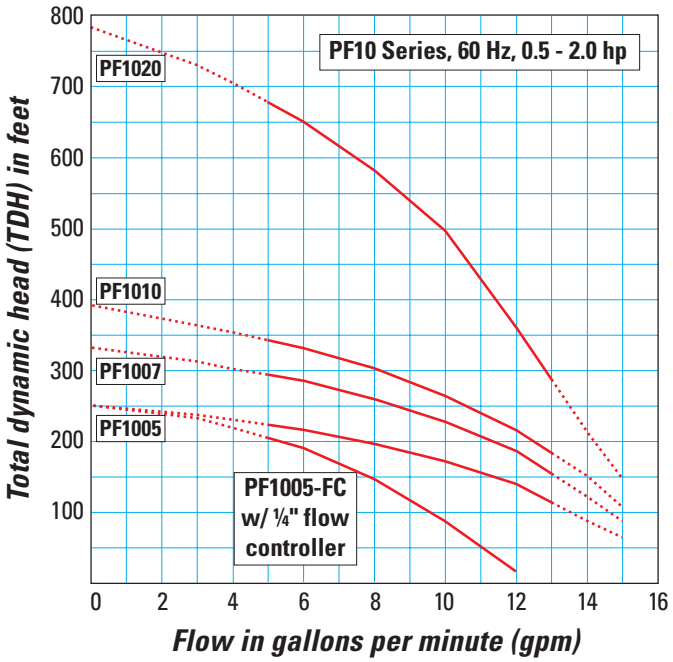
Materials of Construction

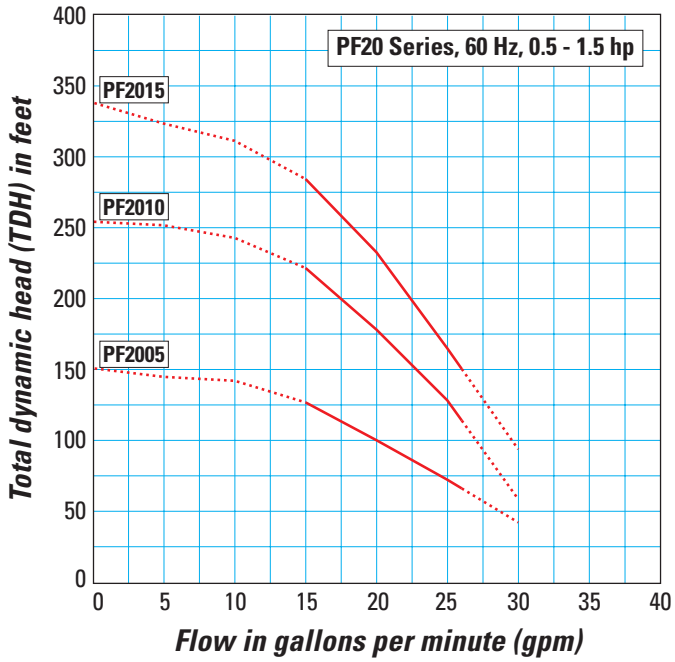
Discharge	Glass-filled polypropylene or stainless steel
Discharge bearing	Engineered thermoplastic (PEEK)
Diffusers	Glass-filled PPO (Noryl GFN3)
Impellers	Celcon® acetal copolymer on 10-, 20-, and 30-gpm models; 50-gpm impellers are Noryl GFN3
Intake screen	Polypropylene
Suction connection	Stainless steel
Drive shaft	7/16 inch hexagonal stainless steel, 300 series
Coupling	Sintered stainless steel, 300 series
Shell	Stainless steel, 300 series
Motor	Franklin motor exterior constructed of stainless steel. Motor filled with deionized water and propylene glycol for constant lubrication. Hermetically sealed motor housing ensures moisture-free windings. All thrust absorbed by Kingsbury-type thrust bearing. Rated for continuous duty. Single-phase motors are equipped with surge arrestors for added security. Single-phase motors through 1.5 hp (1.11 kW) have built-in thermal overload protection, which trips at 203-221˚ F (95-105˚ C).

Using a Pump Curve

A pump curve helps you determine the best pump for your system. Pump curves show the relationship between flow and pressure (total dynamic head, or TDH), providing a graphical representation of a pump's optimal performance range. Pumps perform best at their nominal flow rate. These graphs show optimal pump operation ranges with a solid line and show flow rates outside of these ranges with a dashed line. For the most accurate pump specification, use Orenco's PumpSelect™ software.

Pump Curves





Advantex® Treatment System Project Proposal

Project Name: Taliafero Road

Project Location: College Grove, TN

Application: New Subdivision

DESIGN PARAMETERS

The facility addressed in this proposal includes a residential community/subdivision. Projected wastewater flow rates and organic loading were provided and based upon projected usage for the facility.

Wastewater Flow Rates

Wastewater design flows for the service area were provided by T-Square Engineering, Inc and are outlined in the table below.

Table 1. Hydraulic Design Parameters —Design Maximum Day Flow (DMDF)

Hydraulic Design Parameters for Proposed Facilities		
Service Type	Flow Assumptions	DMDF (gpd)
New Subdivision	Regulatory Tables	9000

Wastewater Strengths

Predicted wastewater strengths for the service area were provided by T-Square Engineering, Inc and are outlined in the tables below. For nitrogen restrictive permit limits, the primary treated effluent should have a minimum temperature of 10ºC in the winter and 15ºC during summer months, with pH ranging from 7.2 to 8, and a residual alkalinity of greater than 100 mg/L maintained throughout the process. This will typically require an alkalinity feed system.

Table 2. Constituent Loading Assumptions

Parameter	DMDF, gpd	Concentration (mg/L)	Primary Treated Load (lbs/day)
Biochemical Oxygen Demand (BOD_5), mg/L:	9,000	140	10.52
Total Suspended Solids (TSS), mg/L:	9,000	40	3.00

Permit Limits and Loading Rates

The following table provides the discharge limitations as provided by T-Square Engineering, Inc. The scope of this proposal is pertinent only to BOD_5 and TSS.

Table 3. Permit Limits

Permit Constituent or Parameter	Average	Not to Exceed
Biochemical Oxygen Demand (BOD5), mg/L:	n/a	30
Total Suspended Solids (TSS), mg/L:	n/a	30

Table 4. Standard AdvanTex Loading Rates

Permit Constituent or Parameter	Design AVERAGE Day	Design MAXIMUM Day
Hydraulic	25 gpd/sq.ft•d	50 gpd/sq.ft•d
Organic	0.04 lbs/sq.ft•d	0.08 lbs/sq.ft•d

TECHNOLOGY DESCRIPTION & SIZING

Packed bed filters (PBFs) – incorporating treatment media such as sand, gravel, and textile – have been used successfully for decades to treat onsite wastewater flows. These filters reliably produce high quality effluent that is superior to that discharged by the majority of our nation's municipal treatment facilities. The most effective of these filters is AdvanTex Treatment System. This proposal provides an estimate of system sizing and costs based upon the information provided. This proposal does not constitute a design.

Table 5. Treatment Tank Minimum Recommendations

Tank Stage	HRT @ DMDF	VOLUME
Primary	2.0 days	18000 U.S. Gallons

Table 6. Standard AdvanTex System Sizing

Permit Constituent or Parameter	Load Value (DMDF)	Loading Rate	AdvanTex Unit Size
Hydraulic	9000 gpd	50 gpd/sq.ft•d	180 sq.ft.
Biochemical Oxygen Demand (BOD5), mg/L:	10.52 lbs	0.08 lbs/sq.ft•d	131 sq. ft.
Total Suspended Solids (TSS), mg/L:	3 lbs	0.08 lbs/sq.ft•d	38 sq. ft.

EQUIPMENT SELECTION

Table 7. Orenco AX-MAX Treatment Equipment

First Stage Treatment Unit(s):	AX-MAX225-35
First Stage Pump Basin Unit:	Included in AX-MAX225-35
First Stage Pumping Setup:	(1) D PF7510
First Stage Treatment Volume:	7264 U.S. Gallons
First Stage Pump Basin Volume:	Included in AX-MAX225-35

Table 8. Orenco AX-MAX Treatment System Costs

Project Estimated Costs	Total Low	Total High
Primary Treatment Subtotal	$1,375	$4,125
Secondary Treatment Subtotal	$96,669	$98,310
Discharge System Subtotal	$2,820	$3,950
Ancillary Equipment Subtotal	$9,600	$14,550
Materials and Equipment Subtotal	$110,464	$120,935
Shipping, Commissioning, and Operator Training	$7,023	$17,662
Total Project Estimate	$117,487	$138,597
Deduction if Anti-Flotation waived by designer	*($14,492)*	*($15,458)*

All estimates are for budgetary purposes only. Actual quotes will be produced once the design and project plans are completed and provided by the designer. All estimates include Orenco provided materials and are F.O.B. Sutherlin or Winchester, Oregon. Freight costs can be determined after plans are finalized and are the responsibility of the purchaser, but will typically range from 5-12% of materials.

Cost estimates do not include material and labor costs for site work, utilities, state or local taxes, permitting, inspections, administration, engineering, etc. Based on the parameters provided for the project, it appears that some form of disinfection will be required. The estimated cost for UV disinfection is not provided as part of this proposal.

SCHEDULING / MANUFACTURING

Lead Times

Lead times are currently estimated at 6-8 weeks upon time of purchase order.

Payment Terms & Conditions

100% at time of purchase order unless otherwise negotiated.

Warranty

The integrated equipment package proposed will be warrantied against manufacturer's defects in accordance with Orenco Systems Inc. standard warranty of Three (3) years from time of purchase. If the equipment is used as part of a retrofit or replacement package, the warranty will vary between one to three years depending on the situation.

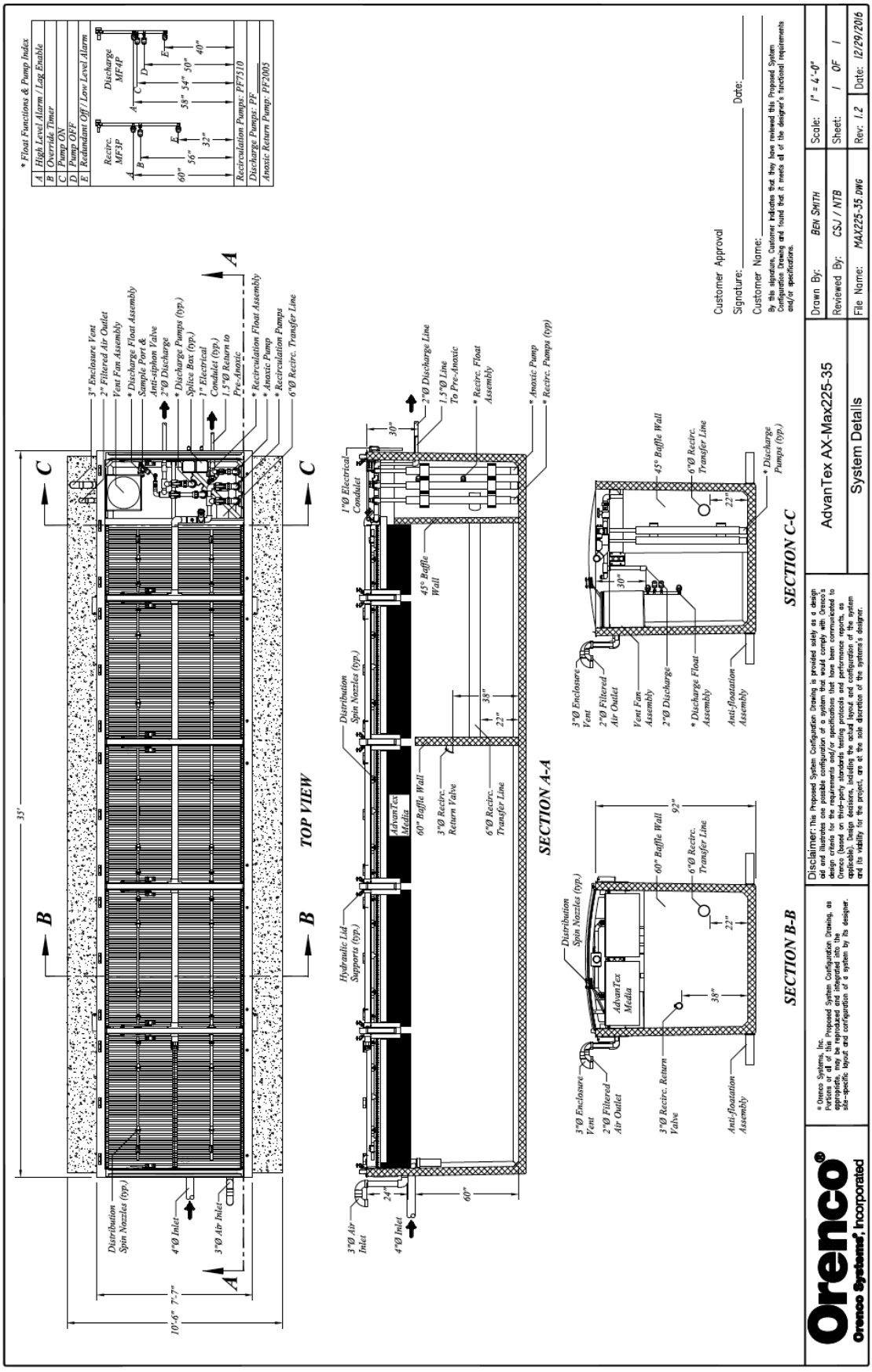
Proposal Period Validity

This proposal is valid for a period of sixty (60) days unless extended in writing by Orenco Systems Inc.

APPENDIX A: Estimated Cost Breakdown

WWTP Budgetary Estimate					
Qty	Primary Treatment Materials	Unit Low	Unit High	Total Low	Total High
1	Primary Tankage, Minimum 18000 U.S. Gallons - By Others	-	-	-	-
5	Primary Tank Access Equipment (range 1'-4' bury)	$275	$825	$1,375	$4,125
			Primary Treatment Subtotal	$1,375	$4,125
Secondary Treatment Materials					
1	AX-MAX225-35	$75,396	$76,838	$75,396	$76,838
1	Anti-Floatation Flange for AX-MAX225-35	$13,802	$13,802	$13,802	$13,802
1	D PF7515	$4,700	$4,800	$4,700	$4,800
1	Ventilation Assemblies	$2,580	$2,580	$2,580	$2,580
1	Float Assembly	$116	$140	$116	$140
1	Piping, fittings, glue	$75	$150	$75	$150
			Secondary Treatment Subtotal	$96,669	$98,310
Discharge System Materials					
	Volume Included in MAX System	-	-	-	-
1	Discharge Pumping Equipment	$2,820	$3,950	$2,820	$3,950
			Discharge System Subtotal	$2,820	$3,950
Ancillary Materials					
1	Telemetry Control Panel	$9,600	$14,550	$9,600	$14,550
1	Disinfection By Others	-	-	-	-
			Ancillary Equipment Subtotal	$9,600	$14,550
Shipping, Commissioning, and Operator Training					
	Commissioning and Operator Training	-	-	$1,500	$3,000
	Operation & Maintenance Manual	-	-	$0	$150
	Shipping (as percent of materials)	5% of Materials	12% of Materials	$5,523	$14,512

Only items shown are estimated. This budgetary estimate does not include materials and labor costs for controls building, site work, dispersal system, utilities, state or local taxes, permitting, inspections, administration, engineering, etc.	Materials and Equipment Subtotal	$110,464	$120,935
	Shipping and Commissioning	$7,023	$17,662
	Total Project Estimate	$117,487	$138,597
	Deduction if Anti-Flotation is waived	($14,492)	($15,458)


* Float Functions & Pump Index
A High Level Alarm / Lag Enable
B Override Timer
C Pump ON
D Pump OFF
E Redundant Off / Low Level Alarm
Recirculation Pumps: PF7510
Discharge Pumps: PF
Anoxic Return Pump: PF2005
TOP VIEW
SECTION A-A
SECTION B-B
SECTION C-C
Customer Approval
Signature:
Date:
Customer Name:
By this signature, Customer indicates that they have reviewed this Proposed System Configuration Drawing and found that it meets all of the designer's functional requirements and/or specifications.
Orenco Systems, Incorporated
Disclaimer: This Proposed System Configuration Drawing is provided solely as a design aid and illustrates one possible configuration of a system that would comply with Orenco's design criteria for the requirements and/or specifications that have been communicated to Orenco. Orenco expressly disclaims any warranty, guarantee and performance implied or otherwise, including the implied warranties of merchantability and fitness for a particular purpose. Design decisions, including the actual layout and configuration of the system and its viability for the project, are at the sole discretion of the system's designer.
AdvanTex AX-Max225-35
System Details
Drawn By: BEN SMITH
Reviewed By: CSJ / NTB
File Name: MAX225-35.DWG
Scale: 1" = 4'-0"
Sheet: 1 OF 1
Rev: 1.2
Date: 12/29/2016

J. Detailed Soil Investigation Report

LONNIE NORROD SOIL CONSULTING, LLC.

The McCanless and Company Property DSIR

8496 Taliaferro Rd. (Williamson County, TN tax map #137, parcel #35)

10-28-2019

Section 20.07

DETAILED SOILS INVESTIGATION REPORT

1.0 Site Description
- 1.1 Location Map
- 1.2 Topographic map and Extra-High Intensity Soil Map
- 1.3 Soil Survey map
- 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 Adsorption
  - 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

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

APPENDICES

APPENDIX 1.2 – TOPOGRAPHIC MAP AND EXTRA-HIGH INTENSITY SOIL MAPS PG 13

APPENDIX 1.3 – NRCS SOIL SURVEY MAP PG 15

APPENDIX 2.0 – SOIL SERIES DESCRIPTIONS (OSD) PG 19

APPENDIX 3.1 – SOIL PEDON DESCRIPTIONS PG 41

APPENDIX 3.3 – RESULTS FROM Ksat TESTING PG 51

APPENDIX 3.4 – RESULTS FROM SOIL CHEMISTRY TESTING PG 64

GLOSSARY OF ABBREVIATIONS:

LNSC- Lonnie Norrod Soil Consulting, LLC.

NRCS – Natural Resource Conservation Service

Ksat- Saturated Hydraulic Conductivity

TDEC – Tennessee Dept. of Environment and Conservation

DSIR – Detailed Soils Investigation Report

WCTZO- Williamson County Tennessee Zoning Ordinance

OSD – U.S.D.A. Natural Resources and Conservation Service Official Soil Descriptions

TSE – T-square Engeneering, Inc.

H&H – H and H Land Surveying, Inc.

Detailed Soil Investigation Report

INTRODUCTION:

The Following is a Detailed Soil Investigation Report (DSIR) prepared by Lonnie Norrod Soil Consulting (LNSC) for the McCanless and Company Property at 8496 Taliaferro Rd., College Grove, TN. The DSIR data was collected and compiled in accordance with the requirements set forth in Section 20.07 of Article 20: "Nontraditional Wastewater Treatment and Disposal Systems" of the Williamson County, Tennessee Zoning Ordinance (WCTZO) adopted May 14, 2012. The data in this report was collected and is presented in a form that will best reflect its application to a wastewater treatment system that utilizes drip dispersal technology as its means of application into the ground. The state of Tennessee Department of Environment and Conservation (TDEC) has the authority to permit the system and has specific guidelines and requirements concerning drip dispersal in "Chapter 17 : Design Guidelines for Wastewater Dispersal Using Drip Irrigation". Any reference to soils being suitable or unsuitable for drip dispersal in this report is based on the guidelines set forth in TDEC's "Chapter 17". "Chapter 17" assigns the hydraulic loading rate of soils for drip dispersal based on the most restrictive soil characteristics in the upper 20" of the soil profile. For this reason, much of the field data in this report is focused on that zone of the soil profile.

The soil mapping was performed by Mr. Lonnie Norrod of LNSC. The soil pedon descriptions were done Mr. Lonnie Norrod of LNSC accompanied by Mr. Kevin Dickerson of TDEC. Hydraulic conductivity testing, research data collection, and soil sample collection was performed by LNSC. T-square Engineering, Inc. performed the engineering duties and H and H Land Surveying, Inc. performed the surveying duties. The soil samples were collected by LNSC and sent to Waters Agricultural Laboratories, Inc. 2101 Calhoun Rd. Hwy 81 Owensboro, KY. 42301 for soil chemistry testing and particle size determinations. The hydraulic conductivity testing was done by LNSC utilizing a Compact Constant Head Permeameter called the Amoozemeter developed by Dr. Aziz Amoozegar.

Please contact Lonnie Norrod of LNSC at 615-969-4443 with any questions concerning the contents of this DSIR.

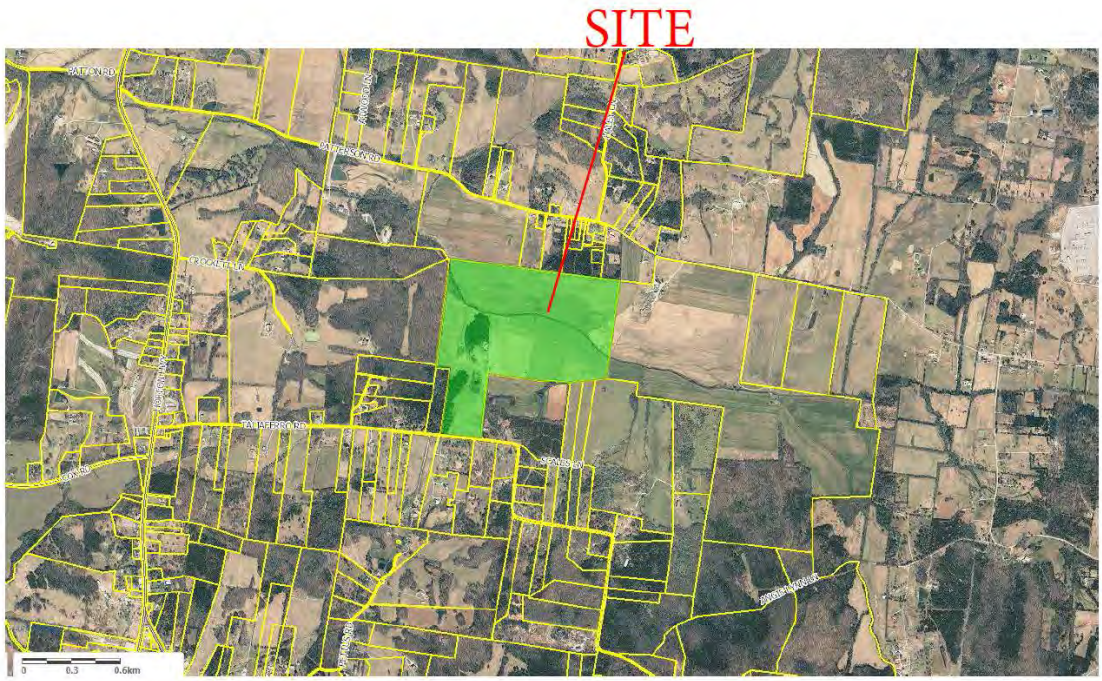
DETAILED SOIL INVESTIGATION REPORT

General Geology of the site:

The area that this DSIR was performed on is located near the boundary of the outer portion and the inner portion of the Nashville Basin Physiographic Region. The residuum of these soils in the higher elevations is weathered from the phosphatic lime stones, siltstones, and shale of the Bigby-Cannon and Hermitage formations. These geologic formations are made up of hills and ridges that have moderately steep to steep slopes and gently rolling or sloping ridgetops. In the lower elevations, the Carter's Formation is present. The Carter's underlies the Hermitage Formation and consists of non-phosphatic limestone. The Carter's landscape is mostly hilly and undulating. The contact between the inner and outer portions of the Nashville Basin is widely accepted as the boundary between the Hermitage Formation and the Carter's Formation. The entire geology of this site is of the Ordovician Period. The mineralogy of the soils found on this site is mixed making it very difficult to map soil units that are purely one soil series. For this reason, many soil complexes were mapped combining soils with very similar characteristics and predicted performances utilizing drip dispersal.

1.0 Site Description:

1.1 Location Map:



1.2 Topographic Map and Extra-High Intensity Soil Map

-The Topographic Map will be provided by H&H and will be contained within the DDR.

1.3 Soil Survey Map:

See Appendix 1.3 for the NRCS Soil Survey Maps

1.4 Hand Auger, test pit and soil boring locations:

-Hand auger holes were bored by LNSC at appropriate intervals in order to create the Williamson County Zoning Ordinance Extra-High Intensity Soil Map. These locations are marked on the field copy of the map and are not included on the final map. Holes were bored at a minimum frequency of every stake and center of square on a 50' grid system placed by SEC. Holes were bored at a greater frequency in some areas as needed to separate highly contrasting soils that exhibit very different characteristics and predicted performances.

- Nine pits were excavated and soil pedon descriptions were performed at these locations by Mr. Lonnie Norrod of LNSC accompanied by Mr. Kevin Dickerson of TDEC. These pit locations are numbered and marked on the Soil Maps displayed in Appendix 1.2.

2.0 Soil series descriptions (each soil series present)

-The Soil Pedon Descriptions in Appendix 3.1 and/or the Soil Series Descriptions (OSD)s in Appendix 2.0 make a note of all of the following physical characteristics noted below in this section. Only the soils considered suitable for drip dispersal were described in the Pedon Descriptions.

-The NRCS Official Soil Series Descriptions (OSD)s of all the soil series present are displayed in Appendix 2.0.

2.1 Texture
2.2 Permeability
2.3 Slope
2.4 Drainage
2.5 Depth to seasonal high water table (low chroma mottles)
2.6 Depth to bedrock (Greater than 60" unless otherwise stated)
2.7 Erodibility

-Appendix 2.7 displays a table with estimated Erodibility

3.0 Soil Characteristics (each soil series present)

3.1 Hand auger, test pits and soil boring logs:

--Hand auger holes were bored by LNSC at appropriate intervals to complete the soil map. The soil series and any special notes about the physical characteristics of the soil at these locations were noted in short hand on the field copy of the soil map. The field copy is not included in this report but was utilized in compiling the final soil maps which are included in this report in Appendix 1.2. The soil map notes and soil pedon descriptions show no water table, no horizons with a weak structure or structureless clay texture and no horizons with bedrock present less than 20" from the surface in any of the soil areas with a "20+" label. This includes the "Armour Overwash-Sykes Overwash 20+", the "Barfield Overwash 20+", the "Braxton-Mimosa-Sykes 20+", the "Egam Overwash 20+", the "Sykes-Armour 20+", and the "Sykes-Harpeth-Braxton 20+" units. The soil map units labeled "Talbott <20 OUT", "Talbott-Braxton <20 OUT", Talbott-Capshaw-Rock Outrop <20 OUT" and "Talbott-Rock Outcrop <20 OUT" have a horizon with a weak structured or structureless clay texture or a rock layer that is within 20" of the soil surface. There were no pedon descriptions performed in these units. The areas mapped "Disturbed" have cutting, filling and or compaction and are considered unsuitable for drip irrigation at this time.

-Nine pits were excavated and Soil Pedon descriptions were performed at numerous locations which are numbered and marked on the soil map displayed in Appendix 1.2.

3.2 Unified Soil Classification (USC): This data is compiled from NRCS Web Soil Surveys

Soil Series:	Depth in inches:	Unified Soil Classification
Armour	0-7 7-65	CL, CL-ML, ML CL
Barfield	0-10 10-30 30-49	CL-ML, CL, ML CL, CH, MH CL, GC, SC, GM
Braxton	0-10 10-18 18-30	ML, CL CL, CH CL, CH, MH
Capshaw	0-9 9-34 34-57	CL, CL-ML, ML CH, CL,MH CH, CL, MH
Egam	0-11 11-72	CL, CL-ML, ML CH, CL
Harpeth	0-9 9-65	CL, CL-ML, ML CH, CL, MH, ML
Sykes	0-8 8-28 2850 50-65	ML, CL-ML, CL CL MH, CH, CL MH, CH, CL
Talbott	0-6 6-37	CL-ML,CL MH-CH,CL

Reference: Web Soil Survey. Soil Survey Staff, National Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/

The following is a chart that describes the Abbreviations of the USC system from Wikipedia:

First and/or second letters

Letter	Definition
G	gravel
S	sand
M	silt
C	clay
O	organic

Second letter

Letter	Definition
P	poorly graded (uniform particle sizes)
W	well-graded (diversified particle sizes)
H	high plasticity
L	low plasticity

3.3 Results from saturated hydraulic conductivity (Ksat) testing:

-Twelve saturated hydraulic conductivity tests were performed and recorded. The results from the saturated hydraulic conductivity testing are displayed in Appendix 3.3. These tests were conducted utilizing an Amoozemeter. The tests were ran at 20" deep because TDEC assigns a hydraulic loading rate to a soil for drip dispersal based on its most limiting characteristics in the upper 20" of the soil profile. All of the of the Ksat results for the soil complex or soil series present that are mapped in the areas that are considered suitable for drip dispersal fall in the "moderately slow" hydraulic conductivity class as designated by the following chart from the NRCS Web Soil Survey with the exception of two which fell in the the "slow" category and one that fell in the "moderate" category.

Saturated Hydraulic Conductivity

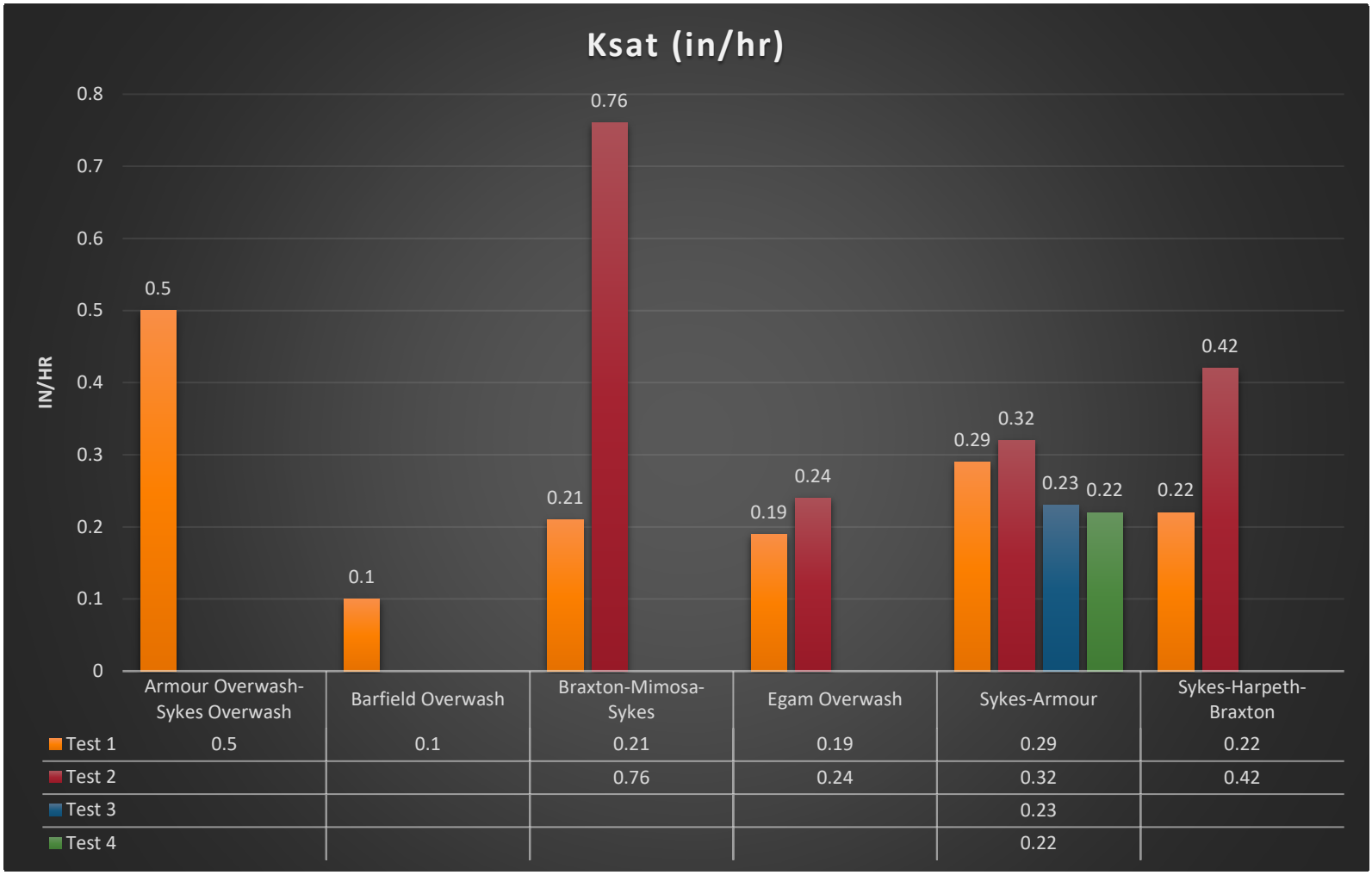
Saturated Hydraulic Conductivity in Relation to Soil Texture

Saturated hydraulic conductivity rates shown are in relation to texture and are only a general guide. Differences in bulk density may alter the rates shown below.

Soil Textural Classes & Related Saturated Hydraulic Conductivity Classes

Texture	*Textural Class*	*General*	*Ksat Class*	*in/hr*
Coarse sand	Coarse	Sandy	V. rapid	>20
Sands Loamy sands	Coarse	Sandy	Rapid	6 to 20
Sandy loam Fi.san.loam	Mod. coarse	Loamy	Mod. Rapid	2 to 6
v. fi. sa. loam loam silt loam silt	Medium	Loamy	Moderate	0.6 to 2
clay loam sa. cl. loam si. cl.	Mod. fine	Loamy	Mod. slow	0.2 to 0.6
sandy clay silty clay clay	Fine and very fine	Clayey	Slow	0.06 to 0.2
Cd horizon Natric horizon, fragipan, ortstein			V. slow or impermeabl	0 to 0.06

Reference: Web Soil Survey. Soil Survey Staff, National Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/



-The Ksats for the soils series and/or soil complexes in the preceding chart are and average of the last three readings from the Amoozemeter once the water flow from the auger hole had reached a "steady state".

3.4 Results from soil chemistry testing:

-The soil samples were taken from the field by LNSC and sent to Waters Laboratories for testing. The results of this testing is displayed in Appendix 3.4.

3.5 Engineering properties of soils proposed for any potential pond construction:

-The engineering criteria for the clay liner of a stabilization pond are as follows:

Clay Content: 40 to 70%

Permeability: 1*10(-7) to 1* 10(-6) cm/sec

Plasticity: 21 Plasticity Index

Consistency: medium stiff to stiff

-As indicated by the soil map prepared by LNSC and the Williamson County Soil Survey, there are significant amounts of clayey soils on the property. Potential areas of clay will be benchmarked as they are encountered during the construction process and will be unearthed and utilized for the pond liner. If there is an insufficient amount of clay on the property that meets the design criteria, clay will be hauled in to the site or a PVC liner will be purchased for the lining of the pond.

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

- Subsurface conditions contacted that would adversely affect the vertical or lateral drainage of the land treatment site would be the clay horizons that were encountered in some of the soil units and the shallow rock layer in the rocky units. There was no weak structured or structureless clay horizon or rock encountered within 20" of the soil surface in any of the soil map units labelled "20+". The drip lines will be installed at 8-10" deep so there will be a minimum buffer of 12" from the drip lines to the clay or rock layers in the suitable soil units.

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

-All soil map units labeled "20+"are areas that are considered suitable for wastewater drip dispersal according to the guidelines set forth in TDEC's "Chapter 17". Any of the soil map units labeled "<20 OUT" are considered not suitable for wastewater drip dispersal at this time.

6.0 Determination of design percolation for each soil type:

-According to the Ksat data collected, the following chart reflects the percolation rate for each soil map unit considered suitable for drip dispersal.

Soil Series or Soil Complex	**Ksat (in/hr) (Individual tests)**
Amour Overwash-Sykes Overwash	0.50
Barfield Overwash	0.10
Braxton-Mimosa-Sykes	0.21, 0.76
Egam Overwash	0.19, 0.24
Sykes-Armour	0.29, 0.32, 0.23, 0.22
Sykes-Harpeth-Braxton	0.22, 0.42
Overall Average:	**0.31 in/hr**

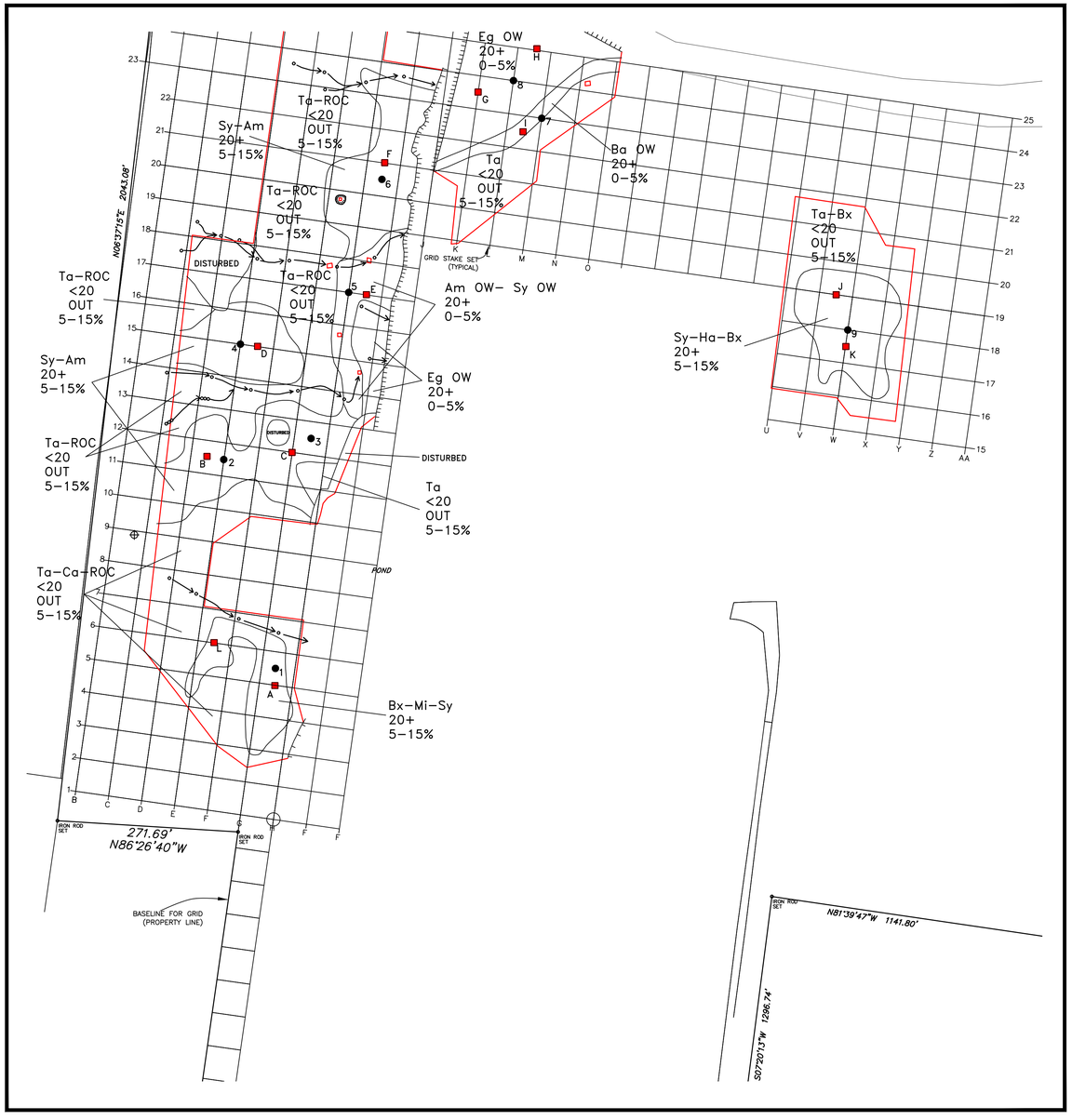
APPENDIX 1.2

EXTRA-HIGH INTENSITY SOIL MAP

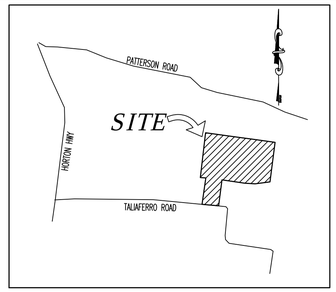
DETAIL

SCALE: 1"=100'

TO SHOW SOILS GRID



I HEREBY CERTIFY THAT THE SEPTIC AREA(S) SHOWN HEREON WERE FIELD STAKED AT A PRECISION EXCEEDING 1:1000

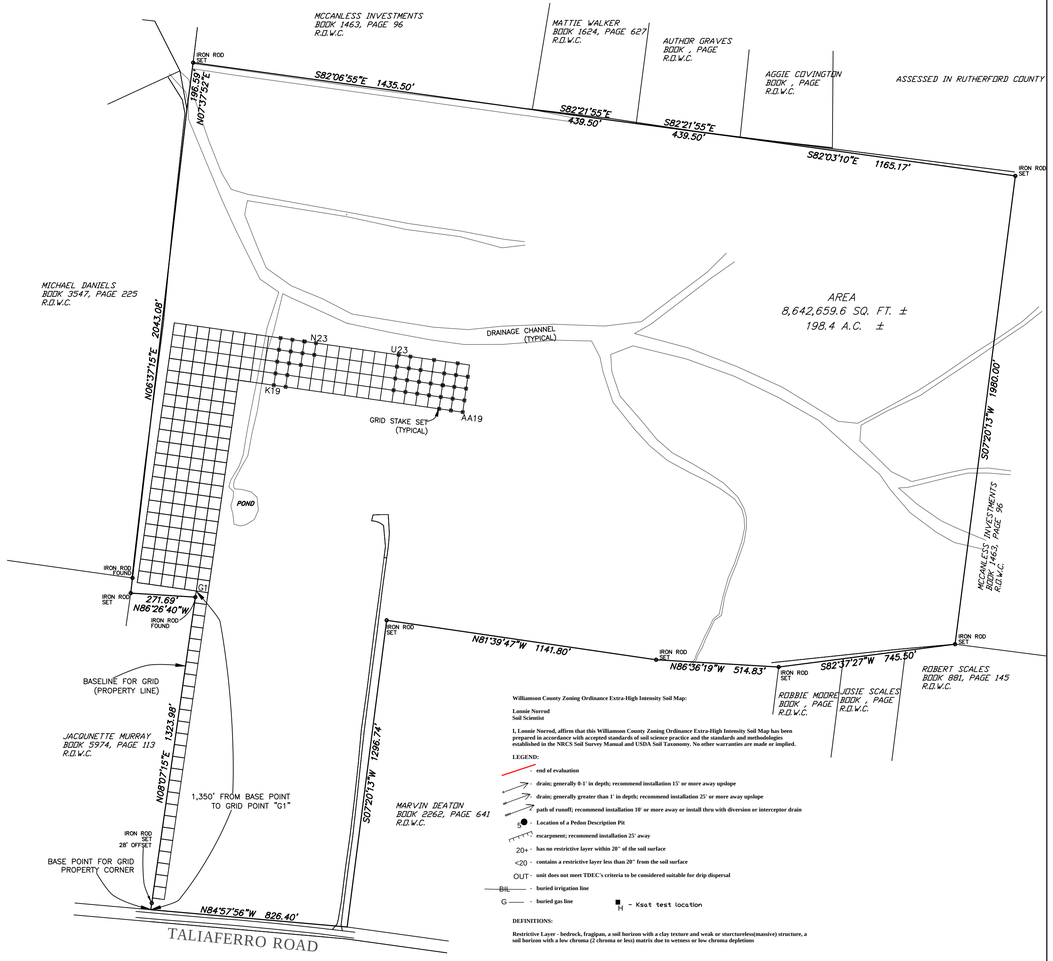


VICINITY MAP
NOT TO SCALE

SCALE: 1"=300'

TO SHOW ENTIRE PROPERTY

NOTE: DRAWING BELOW IS ON THE CORRECT COORDINATE SYSTEM!!!



Williamson County Zoning Ordinance Extra-High Intensity Soil Map:

Lonnie Norred
Soil Scientist

I, Lonnie Norred, affirm that this Williamson County Zoning Ordinance Extra-High Intensity Soil Map has been prepared in accordance with accepted standards of soil science practice and the standards and methodologies established in the NRCS Soil Survey Manual and USDA Soil Taxonomy. No other warranties are made or implied.

LEGEND:

- **end of evaluation**
- **drain; generally 0-1' in depth; recommend installation 15' or more away upslope**
- **drain; generally greater than 1' in depth; recommend installation 25' or more away upslope**
- **path of runoff; recommend installation 10' or more away or install thru with diversion or interceptor drain**
- 5 **Location of a Pedon Description Pit**
- **escarpment; recommend installation 25' away**
- 20+ **has no restrictive layer within 20" of the soil surface**
- <20 **contains a restrictive layer less than 20" from the soil surface**
- OUT **unit does not meet TDEC's criteria to be considered suitable for drip dispersal**
- Bil **buried irrigation line**
- G **buried gas line**
- H **Ksat test location**

DEFINITIONS:

Restrictive Layer - bedrock, fragipan, a soil horizon with a clay texture and weak or structureless(massive) structure, a soil horizon with a low chroma (2 chroma or less) matrix due to wetness or low chroma depletions

SOIL MAP UNITS:

Am OW-Sy OW - Armour Overwash-Sykes Overwash soil complex unit with no restrictive layer observed less 20+ than 20" from the soil surface

Ba OW - Barfield Overwash soil unit with no restrictive layer observed less than 20" from the soil surface 20+

Bx-Mi-Sy - Braxton-Mimosa-Sykes soil complex unit with no restrictive layer observed less than 20" from the 20+ soil surface

Eg OW - Egam Overwash soil unit with no restrictive layer observed less than 20" from the soil surface 20+

Sy-Am - Sykes-Armour soil complex unit with no restrictive layer observed less than 20" from the soil surface 20+

Sy-Ha-Bx - Sykes-Harpeth-Braxton soil complex with no restrictive layer observed less than 20" from the soil surface 20+

Ta - Talbott soil unit with a restrictive layer observed less than 20" <20 OUT

Ta-Bx - Talbott-Braxton soil complex unit with a restrictive layer observed less than 20" from the soil surface <20 OUT

Ta-Ca-ROC - Talbott-Capshaw-Rock Outcropping soil complex unit with a restrictive layer observed <20" from the soil surface <20 OUT

Ta-ROC - Talbott-Rock outcropping soil unit with a restrictive layer observed less than 20" from the soil surface <20 OUT

LICENSED PROFESSIONAL LONNIE NORRED TENNESSEE LIC. 10/3/19 SOIL SCIENTIST

H & H LAND SURVEYING, INC.
612A FITZHUGH BOULEVARD
SMYRNA, TENNESSEE 37167
PHONE: (615) 831-0756 / E-MAIL: handhland@bellsouth.net

50 HIGH INTENSITY SOILS GRID MAP

THE MCCANLESS & COMPANY PROPERTY
8496 TALIAFERRO ROAD
TAX MAP 137, PARCEL 35.00
DEED BOOK 422, PAGE 944, (R.O.W.C., TN)
EAGLEVILLE, WILLIAMSON COUNTY, TENNESSEE

Scale : 1" = 100'

0' 50' 100' 200' 300'

GRAPHIC SCALE

DRAWN BY: MAF	CHECKED BY: WBP

MK	DATE	BY	REVISIONS
			CHANGE

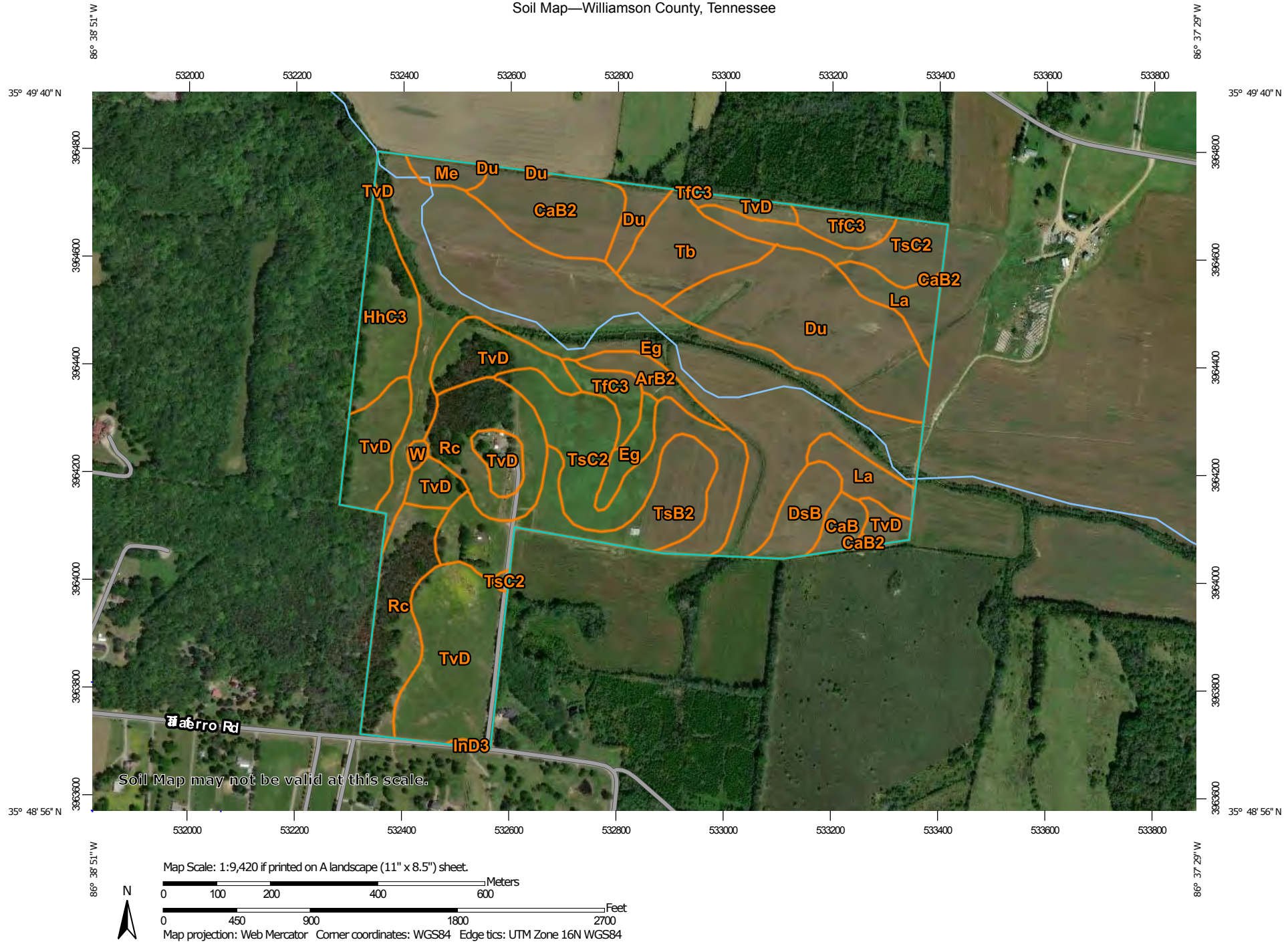
DATE: OCTOBER 1, 2019

JOB NO. 2019-0100

SHEET 2 OF 2

APPENDIX 1.3

NRCS SOIL SURVEY MAP



Map Scale: 1:9,420 if printed on A landscape (11" x 8.5") sheet.

N

0 100 200 400 600 Meters

0 450 900 1800 2700 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Williamson County, Tennessee
Survey Area Data: Version 13, Sep 16, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 12, 2015—Oct 12, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ArB2	Armour silt loam, 2 to 5 percent slopes, eroded	2.6	1.3%
CaB	Captina silt loam, phosphatic, 2 to 5 percent slopes	1.8	0.9%
CaB2	Captina silt loam, phosphatic, 2 to 5 percent slopes, eroded	8.5	4.3%
DsB	Dowellton silt loam, 2 to 5 percent slopes	3.9	2.0%
Du	Dunning silt loam, phosphatic	22.0	11.1%
Eg	Egam silt loam, phosphatic	51.0	25.7%
HhC3	Hampshire-colbert silty clay loams, 5 to 12 percent slopes, severely eroded	7.5	3.8%
InD3	Inman silty clay loam, 12 to 20 percent slopes, severely eroded	0.2	0.1%
La	Lanton silt loam, phosphatic	6.5	3.3%
Me	Melvin silt loam, phosphatic	1.6	0.8%
Rc	Rockland	17.1	8.6%
Tb	Taft silt loam, phosphatic	7.6	3.8%
TfC3	Talbott silty clay, 5 to 12 percent slopes, severely eroded	4.8	2.4%
TsB2	Talbott silty clay loam, 2 to 5 percent slopes, eroded	11.8	6.0%
TsC2	Talbott silty clay loam, 5 to 12 percent slopes, eroded	21.0	10.6%
TvD	Talbott very rocky soils, 2 to 15 percent slopes	30.1	15.2%
W	Water	0.4	0.2%
Totals for Area of Interest		**198.3**	**100.0%**

APPENDIX 2.0

OFFICIAL SOIL DESCRIPTIONS

LOCATION ARMOUR TN+AL KY

Established Series
Rev. RPS/DLN/JLN
04/2011

ARMOUR SERIES

The Armour series consists of very deep well drained soils on stream terraces, foot slopes, and valley floors. These soils formed in old alluvium, valley fill, or in alluvium and the underlying residuum of limestone. Slopes range 0 to 20 percent.

TAXONOMIC CLASS: Fine-silty, mixed, active, thermic Ultic Hapludalfs

TYPICAL PEDON: Armour silt loam - cultivated. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 8 inches, dark brown (7.5YR 3/2) silt loam; weak fine granular structure; very friable; many fine roots; moderately acid; clear smooth boundary. (5 to 10 inches thick)

A--8 to 17 inches, brown (10YR 4/3) silt loam; weak medium granular structure; friable; many fine roots; few angular fragments of chert; few fine black concretions; moderately acid; gradual smooth boundary. (0 to 8 inches thick)

Bt1--17 to 23 inches, brown (7.5YR 4/4) silty clay loam; weak fine and medium subangular blocky structure; friable; common fine roots; few faint clay films on faces of peds; few angular fragments of chert; few fine black concretions; moderately acid; gradual smooth boundary.

Bt2--23 to 48 inches, brown (7.5YR 4/4) silty clay loam; moderate medium subangular blocky structure; friable; few to common fine roots; common distinct clay films on faces of peds; few angular fragments of chert; common fine black concretions; strongly acid; clear smooth boundary.

Bt3--48 to 58 inches, reddish brown (5YR 4/4) silty clay loam; weak medium subangular blocky structure; friable; few fine distinct black stains on faces of peds and in pores ; common distinct clay films on faces of peds; few angular fragments of chert; common fine black concretions; strongly acid; gradual smooth boundary. (Combined thickness of the Bt horizon is 30 to 55 inches)

BC--58 to 75 inches, mottled reddish brown (5YR 4/4), strong brown (7.5YR 5/6), and light yellowish brown (10YR 6/4) silty clay loam; weak medium angular blocky structure; friable; few angular fragments of chert; strongly acid.

TYPE LOCATION: Williamson County, Tennessee; about 1 mile north of Franklin, Tennessee, on U.S. Highway 31; 1/4 mile south of Harpeth River Bridge on U.S. Highway 31; 300 feet east of U.S. Highway 31.

20

RANGE IN CHARACTERISTICS: Solum thickness ranges from 40 to more than 80 inches. Depth to limestone bedrock is greater than 5 feet. Reaction is moderately acid or strongly acid except the surface layer is less acid where limed. Fragments of gravel or chert range from 0 to 10 percent in the upper 40 inches. The fragments range up to about 3 inches in diameter. Below 40 inches the fragment content is dominantly 0 to 35 percent, but ranges to 60 percent.

The A or Ap horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. Texture is silt loam except a few severely eroded areas are silty clay loam.

Some pedons have a transitional horizon between the A and Bt horizons.

The Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 or 5, and chroma of 4 or 6. Some pedons have few to common mottles in shades of brown, yellow or red. Texture of the fine earth is dominantly silt loam or silty clay loam but includes loam below 40 inches.

The BC and C horizons, where present, have the same colors and textures as the Bt horizon. Some pedons developed in limestone residuum below 48 inches and have 2Bt, 2BC or 2C horizons. These horizons have a hue of 5YR to 2.5Y, value of 4 or 5 and chroma of 4 to 8. Mottles are in shades of brown, yellow, red, or gray. Texture of the fine earth is silty clay loam, clay loam, silty clay, or clay.

COMPETING SERIES: These are the Barnsdale, Dexter, Dossman, Goodwill and Hicks series in the same family and the closely related Ashton, Elk, Sandhill and Stiversville series. Barnsdall and Dexter soils are free of fragments and have less clay and more sand in the lower part of the solum and C horizon. Dossman soils formed in thick deposits of loess on dissected uplands and have a lower sand content in the control section. Goodwill soils have more sand in the lower B horizon. Hicks soils developed in a loess mantle and residuum of interbedded sandstone, siltstone and shale on upland ridgetops. Rippable bedrock is at 40 to 60 inches from the surface. Ashton soils are moderately acid to neutral and are mesic. Elk soils have a lighter colored surface layer and are mesic. Sandhill and Stiversville soils are fine-loamy and have bedrock at 40 to 60 inches from the surface.

GEOGRAPHIC SETTING: Armour soils are on stream terraces, foot slopes, and valley floors. Slopes range from 0 to 20 percent. These soils formed in old alluvium, valley fill, or in alluvium and the underlying clayey residuum of limestone. Near the type location, mean annual temperature is 59 degrees F. and average annual precipitation is 47 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Hicks and Stiversville series, and the Braxton, Hampshire, Inman, Maury, Sengtown, Byler, Tarklin, Humphreys, Hawthorne, and Mimosa series. The Braxton, Hampshire, Inman, Maury, and Sengtown soils are on uplands and are clayey. The Byler and Tarklin soils are on stream terraces and have a fragipan. Humphreys soils are on foot slopes and stream terraces and are fine-loamy. Hawthorne soils are on uplands and are loamy-skeletal.

DRAINAGE AND PERMEABILITY: Well drained; medium runoff; moderate permeability.

USE AND VEGETATION: Most of the areas are cleared and used for pasture, hay, small grain, tobacco, and corn. The native vegetation was mixed hardwoods including oaks, hickory, elm, hackberry, maple, beech, black walnut, ash, locust, yellow-poplar, and red cedar.

DISTRIBUTION AND EXTENT: The Nashville Basin and Highland Rim in Tennessee and the inner bluegrass region of Kentucky. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Maury County, Tennessee; 1955.

REMARKS: Diagnostic horizons recognized in this pedon are:

Ochric epipedon - 0 to 17 inches (Ap, A horizons)

Argillic horizon - 17 to 58 inches (Bt horizon)

National Cooperative Soil Survey
U.S.A.

LOCATION BARFIELD TN+AL GA

Established Series
Rev. RPS:CM
03/2004

BARFIELD SERIES

The Barfield series consists of shallow, well drained to excessively drained, moderately slow permeable soils that formed in residuum from limestone. These soils are on nearly level to very steep uplands with medium to very rapid runoff. Slopes range from 1 to about 70 percent.

TAXONOMIC CLASS: Clayey, vermiculitic, thermic Lithic Hapludolls

TYPICAL PEDON: Barfield silty clay loam--cultivated. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 6 inches; very dark brown (10YR 2/2) silty clay loam; moderate fine and medium granular structure; friable; many fine roots; common small brown and black concretions; slightly acid; abrupt smooth boundary. (3 to 8 inches thick)

Bw1--6 to 8 inches; very dark brown (10YR 2/2) silty clay; common medium faint dark brown (7.5YR 3/2) mottles; moderate fine and medium angular and subangular blocky structure; friable; common fine roots; common fine and medium brown and black concretions; few small fragments of chert; neutral; clear wavy boundary.

Bw2--8 to 12 inches; very dark grayish brown (10YR 3/2) clay; common fine and medium prominent brown (7.5YR 4/4) and olive brown (2.5Y 4/4) mottles; very dark brown (10YR 2/2) on faces of cracks and filling old root channels; moderate medium angular blocky structure; firm; common fine roots; common small dark brown and black concretions; neutral; clear wavy boundary. (Thickness of the Bw horizon ranges from 3 to 12 inches)

BC--12 to 16 inches; olive brown (2.5Y 4/4) channery clay; common medium prominent strong brown (7.5YR 5/6) and common fine distinct light olive brown (2.5Y 5/4) and olive brown (2.5Y 4/4) mottles; weak medium angular blocky structure; very firm; few fine roots; common small and medium reddish brown and black concretions; 20 percent thin fragments of limestone 2 to 8 inches across; mildly alkaline; clear wavy boundary. (0 to 6 inches thick)

C--16 to 18 inches; mottled olive brown (2.5Y 4/4), dark grayish brown (2.5Y 4/2), and yellowish brown (10YR 5/6) channery clay; 25 percent thin fragments of limestone 2 to 8 inches across; massive; very firm; common small and medium reddish brown and black concretions; mildly alkaline. (0 to 5 inches thick)

R--18 inches; limestone bedrock.

TYPE LOCATION: Rutherford County, Tennessee; 1/2 mile north of Floraton between Murray Branch and road on Fred Arnold's farm.

RANGE IN CHARACTERISTICS: Depth to limestone bedrock ranges from 8 to 20 inches. Reaction in each horizon ranges from slightly acid through mildly alkaline. Channers and flagstones of limestone range from 0 to about 20 percent in the A horizon and from 3 to about 35 percent in the B and C horizons. The mollic epipedon is 7 inches or more in thickness.

The A and Bw horizons have hue of 10YR, value of 2 or 3, and chroma of 2 or 3. In some pedons the lower part of the Bw horizon has hue of 10YR or 2.5Y value of 4 and chroma of 3 or 4. The texture is silty clay loam, silty clay, or clay.

The BC and C horizons, where present, have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 to 6. Mottles are in shades of brown, olive, and yellow. Some pedons have gray mottles just above bedrock. The texture is silty clay loam, silty clay, or clay.

COMPETING SERIES: Barfield is the only series in this family. Soils in closely associated families are the Ashwood, Fairmount, and Gladeville series. Ashwood soils are deeper than 20 inches to bedrock and have an argillic horizon. Fairmount soils are mesic. Gladeville soils are clayey-skeletal and less than 12 inches deep to bedrock.

GEOGRAPHIC SETTING: Barfield soils are on nearly level to very steep uplands. Slopes range from 1 to about 70 percent. The soil formed in limestone residuum. At the type location the mean annual temperature is 60 degrees F., and mean annual precipitation is 49 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Ashwood and Gladeville series and the Colbert, Mimosa, and Talbott series all of which have argillic horizons and are more than 20 inches deep to bedrock.

DRAINAGE AND PERMEABILITY: Well drained to excessively drained; medium to very rapid runoff; moderately slow permeability.

USE AND VEGETATION: About 50 percent has been cleared of original hardwood trees consisting chiefly of oak, hickory, red cedar, elm, maple, and redbud. Most of the cleared areas are used for pasture.

DISTRIBUTION AND EXTENT: The Nashville Basin and Southern Appalachian ridges and Valleys in Tennessee, Sand Mountain in Alabama, and possibly the Pennyroyal in Kentucky. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Rutherford County, Tennessee; 1974.

REMARKS: Diagnostic horizons recognized in this pedon are:

Mollic epipedon - 0 to 12 inches (Ap, Bw1, Bw2 horizons)

Cambic horizon - 6 to 12 inches (Bw1, Bw2 horizons)

National Cooperative Soil Survey
U.S.A.

LOCATION BRAXTON TN+AL KY

Established Series
Rev. DEL:RPS
04/2001

BRAXTON SERIES

The Braxton series consists of very deep, well drained soils with moderately slow permeability. They are on undulating to hilly uplands and high terraces. They formed in old clayey alluvium or valley fill and residuum weathered from limestone. Slopes range from 2 to 50 percent.

TAXONOMIC CLASS: Fine, mixed, active, thermic Typic Paleudalfs

TYPICAL PEDON: Braxton gravelly silt loam--cultivated. (Colors are for moist soil)

Ap--0 to 6 inches; dark brown (7.5YR 3/2) gravelly silt loam; moderate medium granular structure; friable; many fine roots; about 18 percent fragments of chert up to 3 inches across; strongly acid; clear smooth boundary. (4 to 8 inches thick)

Bt1--6 to 14 inches; reddish brown (5YR 4/4) clay; few streaks and coatings of dark brown (7.5YR 3/2) clay; moderate medium subangular blocky structure; firm; many fine roots; few faint clay films on faces of peds; about 14 percent fragments of chert up to 3 inches across; strongly acid; gradual smooth boundary.

Bt2--14 to 24 inches; yellowish red (5YR 4/6) clay; few streaks of brown (10YR 4/3) along old root channels; moderate medium subangular blocky structure; firm, few distinct clay films on faces of peds; about 10 percent fragments of chert up to 3 inches across; strongly acid; clear wavy boundary.

Bt3--24 to 36 inches; strong brown (7.5YR 5/6) clay; moderate medium angular blocky structure; very firm; common distinct clay films on faces of peds; few small black concretions, about 2 percent fragments of chert; strongly acid; gradual smooth boundary.

Bt4--36 to 65 inches; strong brown (7.5YR 5/6) clay, few fine and medium prominent pale brown (10YR 6/3) mottles; moderate fine angular blocky structure; very firm; few distinct clay films on faces of peds; common fine black concretions; strongly acid; gradual smooth boundary. (Combined thickness of the Bt horizons ranges from 50 to 80 inches or more.)

C--65 to 80 inches; brown (7.5YR 4/4) clay; massive; very firm; many fine black concretions; strongly acid. (0 to 18 inches thick)

R--80 inches; phosphatic limestone rock.

TYPE LOCATION: Williamson County, Tennessee; 2 miles east of Arrington on Adams Farm; 50 yards north of east-west gravel road on top of hill.

RANGE IN CHARACTERISTICS: Solum thickness and depth to bedrock range from 60 to 80 inches or more. Fragments of chert in the Ap horizon range from none to as much as 30 percent. Fragments of chert in the Bt horizons range from none to about 15 percent. The soil is strongly acid to moderately acid throughout except that the horizon above the bedrock is only slightly acid in some pedons. Base saturation ranges from 35 to about 50 percent. Transition horizons have colors and texture similar to adjacent horizons.

The A or Ap horizon has hue of 5YR, 7.5YR or 10YR, value of 3 to 5 and chroma of 2 to 4. Severely eroded areas also have chroma of 6. Pedons with value of 3 and chroma of 2 are less than 7 inches thick. The fine earth texture is silt loam, loam, or silty clay loam.

Some pedons have A and E horizons or transitional horizon that formed in loamy colluvium from sandstone and have loam texture.

The Bt horizon has hue of 7.5YR to 2.5YR, value of 4 or 5 and chroma of 4 to 8. Texture of the Bt horizon is silty clay or clay except the upper few inches in some pedons is silty clay loam. Most pedons have mottles in shades of red or brown in the lower part.

The C horizon has colors and texture similar to the lower part of the Bt horizon. Mottles in shades of brown, yellow and red ranges from none to common.

COMPETING SERIES: These are the Boxville series in the same family. Similar soils are the Capshaw, Dewey, Hampshire, Mimosa, and Talbott series. Boxville soils have more than 60 percent base saturation. Capshaw and Hampshire soils have a solum thickness of less than 60 inches. Dewey soils have base saturation less than 35 percent and kaolinitic mineralogy. Mimosa and Talbott soils have sola less than 60 inches thick over hard bedrock.

GEOGRAPHIC SETTING: These soils are on undulating to hilly uplands and high terraces. Slopes range from about 2 to 50 percent. They formed in old clayey alluvium or valley fill and residuum weathered from limestone. Near the type location, the average annual temperature is about 60 degrees F., and average annual precipitation is about 49 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the similar Hampshire and Mimosa series and the Armour, Maury and Stiversville series. Armour and Stiversville soils are fine-loamy. Maury soils are mesic.

DRAINAGE AND PERMEABILITY: Well drained; moderately slow permeability.

USE AND VEGETATION: Most of the soil is cleared and used largely for growing hay and pasture. A few areas are used for growing corn, tobacco, cotton, and small grains. The native vegetation was mixed hardwood forest.

DISTRIBUTION AND EXTENT: The Central Basin in Tennessee and possibly the inner bluegrass region of Kentucky. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Mercer County, Kentucky; 1930.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - from 0 to about 6 inches (Ap horizon).

LOCATION CAPSHAW TN+AL GA

Established Series
Rev. HCD-JCJ
09/2007

CAPSHAW SERIES

The Capshaw series consists of deep and very deep, moderately well drained soils on stream terraces, in depressions and on upland flats. They formed in a thin layer of loess or old alluvium and in the underlying clayey residuum. Slopes range from 0 to 12 percent.

TAXONOMIC CLASS: Fine, mixed, semiactive, thermic Oxyaquic Hapludalfs

TYPICAL PEDON: Capshaw silt loam - cultivated. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 7 inches; brown (10YR 4/3) silt loam; weak fine granular structure; very friable; many fine roots; common fine and medium black (10YR 2/1) manganese concretions; strongly acid; clear smooth boundary. (0 to 10 inches thick)

Bt1--7 to 12 inches; yellowish brown (10YR 5/6) silty clay loam; weak fine and medium subangular blocky structure; friable; common fine roots; few distinct yellowish brown (10YR 5/4) clay films on faces of peds; common fine black (10YR 2/1) concretions; strongly acid; gradual smooth boundary.

Bt2--12 to 19 inches; strong brown (7.5YR 5/6) silty clay loam; moderate medium subangular and angular blocky structure; friable; few fine roots; common distinct brown (7.5YR 5/4) clay films on faces of peds; common fine and medium black (10YR 2/1) manganese concretions; few fine and medium distinct yellowish brown (10YR 5/6) soft masses as iron accumulations; strongly acid; gradual wavy boundary.

Bt3--19 to 32 inches; light olive brown (2.5Y 5/4) clay; moderate medium angular blocky structure; firm; few fine roots; many distinct light olive brown (2.5Y 5/3) clay films on faces of peds; common fine and medium black (10YR 2/1) manganese concretions; many fine and medium prominent red (2.5YR 4/6) and yellowish brown (10YR 5/6) soft masses as iron accumulations; many fine and medium distinct grayish brown (2.5Y 5/2) iron depletions; strongly acid; gradual wavy boundary.

Bt4--32 to 46 inches; olive brown (2.5Y 4/4) clay; weak medium and coarse angular blocky structure; very firm; common distinct light olive brown (2.5Y 5/3)clay films on faces of peds; common fine and medium black (10YR 2/1) and dark brown (10YR 3/3) manganese and iron concretions; many medium distinct yellowish brown (10YR 5/4) soft masses as iron accumulations; many medium distinct light brownish gray (2.5Y 6/2) iron depletions; strongly acid; gradual wavy boundary. (Combined thickness of the Bt horizons is 22 to 54 inches.)

C--46 to 60 inches; 25 percent grayish brown (2.5Y 5/2), 25 percent yellowish brown (10YR 5/6), 25 percent gray (N 6/0), and 25 percent light olive brown (2.5Y 5/4) clay; massive; very firm; many medium and large black (10YR 2/1) manganese concretions; moderately acid.

TYPE LOCATION: Rutherford County, Tennessee; 1 mile east from Sharpsville on Halls Hill Pike, then south 1 mile on gravel road, 300 feet west of gravel road and 250 feet north of private drive to abandoned house site.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 40 to 60 inches. Depth to limestone or interbedded limestone and calcareous shale bedrock ranges from 40 to about 80 inches. Fragments of chert or gravel range from 0 to 10 percent in each horizon. Reaction is moderately acid or strongly acid in the Ap and Bt horizons and ranges from moderately acid to slightly alkaline in the C horizon and the subhorizons just above bedrock.

The A and Ap horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. Texture is silt loam or rarely loam.

Some pedons have a BE transitional horizon with colors similar to the Bt horizon. Texture is silt loam

The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 4 to 8, or hue of 2.5Y, value of 4 to 6, and chroma of 4 or 6. Below depths of 10 inches from its upper boundary there are few to many redox depletions of 2 or lower chroma, and most pedons have few to many yellowish red or red redox accumulations below that depth. In some pedons the Bt4 horizon is a combination of gray, brown, and yellow colors representing redox depletions and accumulations without a dominant matrix color. Texture is silty clay loam, silty clay, or clay.

The C horizon has hue of 2.5Y or 10YR, value of 5 or 6 and chroma of 1 to 4, or is neutral. Redoximorphic features range from common to many in shades of yellow, brown, and gray or is a combination of these colors representing redox accumulations and depletions without a dominant matrix color. Texture is commonly silty clay or clay and rarely silty clay loam.

COMPETING SERIES: The Carbonton series is the only competing series in this family. Carbonton soils formed in residuum of the Triassic Basin of the Southern Piedmont.

GEOGRAPHIC SETTING: Capshaw soils are on stream terraces, in slight depressions, and on broad nearly level uplands. Slopes range from 0 to 12 percent. The soil formed in old clayey alluvium, or partly in a thin mantle of loess or old alluvium and partly in underlying clayey residuum. Near the type location the average annual precipitation is 53.1 inches, and the average annual air temperature is 58.1 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Colbert, Lylerly, Conasauga, Mimosa, Tupelo, Egam, Arrington, Byler, Bradyville, and Talbott series. Talbott and Bradyville soils have reddish subsoils and are well-drained soils on uplands. Conasauga, Colbert, Lyerly, and Mimosa soils are on footslopes and hillsides. Byler soils are on stream terraces and have a fragipan. Tupelo soils are in slightly lower terrace positions and are somewhat poorly drained. Egam and Arrington soils have mollic epipedons and are on floodplains.

DRAINAGE AND PERMEABILITY: Moderately well drained; low to medium runoff; slow or very slow permeability.

USE AND VEGETATION: Most of the soil is cleared and used for corn, small grain, tobacco, hay, and pasture. A few areas are in woodland consisting of oak, hickory, maple, elm, hackberry, beech, dogwood, and red cedar.

DISTRIBUTION AND EXTENT: Nashville Basin, Highland Rim, and the Southern Appalachian Ridges and Valleys in Tennessee, northwestern Georgia, northern Alabama, and possibly Arkansas and Kentucky. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

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SERIES ESTABLISHED: Norris Area (Union County), Tennessee; 1943.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon: 0 to 7 inches (Ap horizon).
Argillic horizon: 7 to 46 inches (Bt horizon).

National Cooperative Soil Survey
U.S.A.

LOCATION EGAM TN+AL AR KY VA

Established Series
Rev. RPS:JCJ
04/2001

EGAM SERIES

The Egam series consists of very deep, well drained or moderately well drained soils that formed in clayey alluvium on flood plains and in depressions. Slopes are dominantly less than 2 percent but range from 0 to 5 percent.

TAXONOMIC CLASS: Fine, mixed, active, thermic Cumulic Hapludolls

TYPICAL PEDON: Egam silty clay loam--pasture. (Colors are for moist soil.)

Ap--0 to 7 inches; dark brown (10YR 3/3) silty clay loam; moderate medium granular structure; friable; many fine roots; moderately acid; clear smooth boundary. (6 to 10 inches thick)

A--7 to 22 inches; very dark grayish brown (10YR 3/2) silty clay loam; strong medium angular blocky structure, some medium prismatic structure that parts to angular blocky; firm; many fine roots; moderately acid; gradual smooth boundary. (6 to 30 inches thick)

Bw1--22 to 39 inches; very dark grayish brown (10YR 3/2) silty clay, few fine faint grayish brown mottles; weak medium prismatic structure parting to strong medium angular blocky; very firm; common fine roots largely between peds, few fine roots within peds; pressure faces on some peds; slightly acid; gradual smooth boundary. (0 to 30 inches thick)

Bw2--39 to 56 inches; dark brown (10YR 4/3) silty clay;strong medium angular blocky structure; firm; common fine roots; pressure faces on some peds; common fine and medium faint dark grayish brown (10YR 4/2) redox depletions; slightly acid; gradual smooth boundary.

Bw3--56 to 75 inches; brown (10YR 4/3) silty clay loam;moderate medium angular blocky structure; firm; few fine roots;common medium and fine faint dark grayish brown (10YR 4/2) redox depletions; slightly acid. (Combined thickness of the Bw horizon below the mollic epipedon ranges from 20 to 55 inches)

TYPE LOCATION: Davidson County, Tennessee; Tennessee State University farm; northwest corner of farm, 200 feet south of Cumberland River and 150 feet west of rock fence.USGS topo Quad: (unknown), latitude: (unknown); longitude (unknown).

RANGE IN CHARACTERISTICS: Depth to bedrock is greater than 60 inches. Thickness of the mollic epipedon ranges from 24 to 55 inches. Reaction is neutral to moderately acid in the A and B horizon, below about 50 inches it ranges from moderately alkaline to moderately acid.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 2 or 3. Some pedons have a few faint gray and brown mottles in the lower part. Texture is dominantly silty clay loam or silt loam but a few pedons are loam or silty clay.

The upper part of the Bw horizon is part of the mollic epipedon and in some pedons has colors like the A horizon. Below this, the Bw horizon has hue of 7.5YR to 2.5Y, value of 4 or 5 and chroma of 3 to 6. Redox features is shades of brown or gray are few to common and those with chroma 1 or 2 range from none to common.

Below about 50 inches, the Bw horizon or C horizon, where present, has hue of 7.5YR to 2.5Y, value of 4 to 6 and chroma of 1 to 6. Redox features are in shades of brown and gray and some pedons are mottled without a dominant matrix color. Texture is dominantly silty clay loam, silty clay or clay, but some pedons range to clay loam or coarser.

COMPETING SERIES: These are the Frioton series in the same family. Similar soils are the Agee, Arrington, Bowdre, Cannon, Catalpa, Godwin, Lanton, and Staser series in closely related families. Frioton soils have free carbonates in the solum. Arrington soils are fine-silty and Cannon and Staser soils are fine-loamy. Bowdre and Catalpa soils have mollic epipedons less than 20 inches thick. Agee, Godwin, and Lanton soils are more poorly drained. They have distinct or prominent gray mottles in the mollic epipedon or dominantly gray colors just below the mollic epipedon.

GEOGRAPHIC SETTING: Egam soils are on flood plains and in depressions. Slopes are most commonly 0 to 2 percent and range from 0 to about 5 percent. The soil formed in fine-textured alluvium. Near the type location average annual air temperature is about 59 degrees F., and average annual precipitation is about 47.3 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the similar Arrington, Agee, Godwin, Lanton, and Staser series and the Lynnville series which is fine-silty.

DRAINAGE AND PERMEABILITY: Well drained or moderately well drained; slow runoff; moderately slow permeability. Most areas are flooded for very brief periods. The flooding is rare to frequent.

USE AND VEGETATION: Nearly all areas are cleared and used chiefly for growing corn, soybeans, cotton, hay, and pasture. The original vegetation was hardwood forest, chiefly of oaks, maple, elm, gums, ash, sycamore, beech, and hickory.

DISTRIBUTION AND EXTENT: Nashville Basin and Great Valley regions of Tennessee, northwestern Georgia, northern Alabama, Arkansas, and Kentucky. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Lincoln County, Tennessee; 1938.

REMARKS: Diagnostic horizons recognized in this pedon are: Mollic epipedon - 0 to 39 inches (Ap, A, Bw1 horizons) Cambic horizon - 39 to 75 inches (Bw1, Bw2, Bw3 horizons)

National Cooperative Soil Survey
U.S.A.

LOCATION HARPETH TN

Established Series
Rev. DEL:JLP
04/2001

HARPETH SERIES

The Harpeth series consists of very deep, well drained, moderately permeable soils on high terraces and uplands. They formed in loess and alluvium over residuum from limestone. Slopes range from 2 to 12 percent.

TAXONOMIC CLASS: Fine-silty, mixed, active, thermic Typic Paleudalfs

TYPICAL PEDON: Harpeth silt loam - pasture. (Colors are for moist soil)

Ap--0 to 7 inches; brown (l0YR 4/3) silt loam; weak fine granular structure; friable, many fine roots; many fine tubular pores; strongly acid; abrupt smooth boundary. (6 to 16 inches thick)

BA--7 to 15 inches; strong brown (7.5YR 4/6) and brown (10YR 4/3) silt loam; weak fine granular structure parting to weak fine subangular blocky; friable; many fine roots; many fine tubular pores; few fine iron-manganese concretions; medium acid; clear smooth boundary.

Bt1--l5 to 25 inches; strong brown (7.5YR 4/6) silt loam; weak fine and medium subangular blocky structure; friable; common fine roots; many fine tubular pores; few faint clay films on faces of peds; few fine iron-manganese concretions; slightly acid; clear smooth boundary.

Bt2--25 to 35 inches; strong brown (7.5YR 4/6) silt loam; moderate fine and medium subangular blocky structure; friable; few fine roots; many fine tubular pores; common distinct clay films on faces of peds; common fine iron-manganese concretions; slightly acid; clear smooth boundary. (Combined thickness of the Bt ranges from 20 to 60 inches or more.)

2Bt3--35 to 49 inches; strong brown (7.5YR 4/6) clay loam; moderate fine and medium subangular blocky structure; friable; few fine roots; many fine tubular pores; common distinct clay films on faces of peds; common fine iron-manganese concretions; about 1 percent by weight pebbles of mixed sedimentary rocks 2 to 5 mm in diameter; slightly acid; gradual smooth boundary.

2Bt4--49 to 65 inches; strong brown (7.5YR 4/6) clay loam; many medium faint strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; common fine tubular pores; common distinct clay films on faces of peds; common fine iron-manganese concretions; about 1 percent by weight pebbles of mixed sedimentary rocks 2 to 5 mm in diameter; slightly acid.

TYPE LOCATION: Sumner County, Tennessee; west of Gallatin, 2.0 miles west along Long Hollow Pike from intersection of State Highway 25 and Long Hollow Pike, 200 feet north of road and 150 feet east of private drive.

RANGE IN CHARACTERISTICS:

Solum thickness and depth to limestone bedrock are more than 60 inches. Most pedons have a lithologic discontinuity however, this is not a requirement for the series. Content of fragments of gravel range from 0 to 10 percent in the A and Bt horizons and from 0 to 15 percent in the 2Bt horizons. This soil is slightly acid to strongly acid except the surface layer is less acid where limed. Most pedons have transition horizons with colors and textures similar to adjacent horizons.

The Ap horizon has hue of l0YR or 7.5YR, value of 3 or 4 and chroma of 4. Some pedons have surfaces layers less than 7 inches thick with hue of l0YR or 7.5YR, value of 3 and chroma of 2 or 3.

The Bt horizons have hue of 7.5YR or 5YR, value of 4 or 5 and chroma of 4 or 6. They are silt loam or silty clay loam. Some pedons contain few to common brownish mottles.

The 2Bt horizon has hue of l0YR, 7.5YR, or 5YR, value of 4 or 5 and chroma of 4 or 6. They are clay loam or silty clay loam except in some pedons, below about 48 inches, texture includes silty clay or clay. Most pedons contain few to common brownish mottles.

COMPETING SERIES: These are the Atwood, Lexington and Sykes series in the same family and the Armour, Crider, Kamie, Macon, Peridge and Ryker series. Atwood soils formed in marine or fluvitile sediments in the Southern Coastal Plains. Armour and Lexington soils have argillic horizons that decrease in clay content by 20 percent or more of the maximum within 60 inches of the soil surface. Crider, Peridge and Ryker soils are mesic. Kame and Macon soils are fine-loamy. Sykes soils have clayey discontinuities with moderately slow permeability within 48 inches of the surface.

GEOGRAPHIC SETTING: Harpeth soils are on nearly level to rolling high stream terraces and uplands. The soil formed in a silty mantle (presumably loess) 2 to 3 feet and underlying old loamy alluvial deposits. In many places this is underlain by clayey limestone residuum. Commonly slopes are complex and convex and range from 0 to 12 percent. Near the type location the average annual air temperature is about 58 degrees F and the average annual precipitation is about 48 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Armour and Sykes series and the Barfield, Byler, Inman, and Mimosa soils. Barfield and Inman soils, at similar elevations on nearby uplands, are clayey and are less than 40 inches deep to rock. Byler soils, on stream terraces at lower elevations, have a fragipan and are moderately well drained. Mimosa soils, on adjacent and nearby uplands, are clayey.

DRAINAGE AND PERMEABILITY: Well drained; moderate permeability; medium runoff.

USE AND VEGETATION: Nearly all areas are cleared and used for growing row crops, pasture and hay. Crops commonly grown are corn, soybeans, tobacco, small grains and alfalfa. The native vegetation was mixed hardwoods such as oaks, hickories, beech, sweetgum and popular.

DISTRIBUTION AND EXTENT: The Nashville Basin in Tennessee. The series is of small extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Rutherford County, Tennessee, January 1974.

REMARKS: In the past, the Harpeth soils were included with the Pembroke, Maury and Armour series in Tennessee. The site of the original Official Series Description is on the University of Tennessee Middle Tennessee Experiment Station
in Maury County, Tennessee. The area is mapped in the Maury series in the 1952 published soil survey of Maury County.

Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - from the surface of the soil to about 7 inches (Ap horizon).

Argillic horizon - from about 7 inches to about 65 inches (BA, Bt1, Bt2, 2Bt3, 2Bt4 horizon

ADDITIONAL DATA: Particle size and chemical data on this pedon was provided by the National Soil Survey Laboratory in Lincoln, Nebraska in 1986. (S85TN-165-001).

National Cooperative Soil Survey
U.S.A.

LOCATION SYKES TN

Established Series
SEM:RPS:JCJ
07/2001

SYKES SERIES

The Sykes series consists of very deep, well drained soils on foot slopes and stream terraces. They formed in 2 to 3 feet of silty alluvium and colluvium and the underlying clayey residuum from limestone or interbedded limestone and shale. Slopes range from 0 to 12 percent.

TAXONOMIC CLASS: Fine-silty, mixed, active, thermic Typic Paleudalfs

TYPICAL PEDON: Sykes silt loam - pasture. (Colors are for moist soil)

Ap--0 to 8 inches; dark brown (10YR 4/3) silt loam; moderate fine granular structure; very friable; many fine roots; 3 percent subrounded and rounded gravel; moderately acid; abrupt smooth boundary. (6 to 9 inches thick)

Bt1--8 to 19 inches; strong brown (7.5YR 4/6) silt loam; weak fine and medium subangular blocky structure; friable; many fine roots; common fine tubular pores; few faint clay films in pores and on ped faces; 3 percent subrounded and rounded gravel; moderately acid; clear smooth boundary.

Bt2--19 to 28 inches; strong brown (7.5YR 4/6) silty clay loam; moderate fine and medium subangular blocky structure; friable; common fine roots; common fine tubular pores; common distinct brown (7.5YR 4/4) clay films in pores and on ped faces; 12 percent subrounded and rounded gravel; less than 2 inches in diameter; moderately acid; gradual smooth boundary. (The Bt horizon ranges from 18 to 36 inches in thickness)

2Bt3--28 to 38 inches; strong brown (7.5YR 5/6) silty clay; common medium distinct light yellowish brown (10YR 6/4) mottles; moderate medium subangular blocky structure; firm, moderatley sticky, moderately plastic; few fine roots; few fine tubular pores; common distinct brown (7.5YR 5/4) clay films on faces of peds; moderately acid; clear smooth boundary.

2Bt4--38 to 50 inches; yellowish brown (10YR 5/6) clay; common medium distinct light yellowish brown (10YR 6/4) and strong brown (7.5YR 5/8) mottles; moderate medium and coarse subangular blocky structure; very firm, very sticky, very plastic; few fine tubular pores; common faint clay films on faces of peds; moderately acid; gradual smooth boundary.

2Bt5--50 to 65 inches; yellowish brown (10YR 5/6) clay; many medium distinct pale brown (10YR 6/3) and common fine prominent yellowish red (5YR 4/6) mottles; weak medium and coarse subangular blocky structure; very firm, very sticky, very plastic; few faint clay films on faces of peds; slightly alkaline. (Thickness of the 2Bt horizon ranges from 24 to 42 inches.)

2R--65 inches; limestone bedrock.

TYPE LOCATION: Smith County, Tennessee; southwestern part of the county; 0.4 mile west of State Hwy. 264 on Brush Creek-Hickman Road; southwest 1800 feet on Thomas Road; 300 feet south of the road in field.

RANGE IN CHARACTERISTICS: Solum thickness and depth to bedrock is greater than 60 inches. This soil is slightly acid to strongly acid except the layer just above bedrock ranges to mildly alkaline. Gravel and angular fragments of chert range from none to about 15 percent in each horizon. Depth to the 2Bt horizon ranges from 24 to 48 inches.

The A or Ap horizon has a hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. Pedons with value of 3 are less than 7 inches thick or have chroma of 4. Texture is silt loam.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5 and chroma of 4 or 6. Texture is silt loam or silty clay loam.

The 2Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5 and chroma of 4 to 8. Some pedons have hue of 2.5Y, value of 4 to 6, and chroma of 4 or 6 in the lower part of the 2Bt. Mottles are in shades of brown and red. The upper part is clay, silty clay or silty clay loam and the lower part is clay or silty clay.

The 2C horizon, where present, has hue of 10YR or 2.5Y, value of 5 or 6 and chroma of 3 to 6. Mottles are in shades of brown, red, and gray and some pedons are an evenly mottled pattern without a dominant matrix color. Texture is clay or silty clay.

COMPETING SERIES: These are Atwood and Lexington series in the same family and the Armour, Crider, Dellrose, Harpeth, Hicks, and Stiversville series in closely associated families. Atwood and Lexington soils have 2Bt horizons that are loamy instead of clayey. Armour soils do not have a clayey 2Bt horizon within 48 inches. Crider soils are on uplands, typically have redder colors and are mesic. Dellrose soils are on hillsides and are fine-loamy. Harpeth soils are on uplands and high stream terraces have redder colors and do not have slowly to very slowly permeable subsoils within 36 inches. Hicks soils are on upland ridgetops and have soft bedrock at a depth of 40 to 60 inches. Stiversville soils are on uplands, are fine-loamy, and have soft bedrock at a depth of 40 to 60 inches.

GEOGRAPHIC SETTING: Sykes soils are on foot slopes and high stream terraces. Slopes range from 0 to 12 percent. These soils formed in 2 to 3 feet of silty alluvium and colluvium and the underlying clayey residuum of limestone or interbedded limestone and shale. Near the type location average annual temperature is 58 degrees F. and average annual precipitation is 55 inches near the type location.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Armour, Dellrose, Hicks, and Stiversville series and the Arrington, Hampshire, Mimosa, Nolin, Ellisville, and Talbott series. Arrington, Nolin, and Ellisville soils are on adjacent flood plains and do not have an argillic horizon. Hampshire, Mimosa and Talbott soils are on adjacent uplands and have a fine-textured control section.

DRAINAGE AND PERMEABILITY: Well drained; moderate permeability in the upper part and slow or very slow in the lower part; low to medium runoff.

USE AND VEGETATION: Most areas of this soil are used for corn, tobacco, small grain, hay and pasture. The native vegetation was mixed hardwoods including oak, hickory, elm, hackberry, locust, yellow poplar and black walnut.

DISTRIBUTION AND EXTENT: The Nashville Basin in Tennessee. The series is of small extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Smith County, Tennessee; 1993.

REMARKS: Diagnostic horizons and features in this pedon are:

Ochric epipedon - 0 to 8 inches (Ap horizon)

Argillic horizon - about 8 to 65 inches (Bt and 2Bt horizons)

National Cooperative Soil Survey
U.S.A.

LOCATION TALBOTT TN+AL GA KY

Established Series
Rev. JCT:RPS
04/2001

TALBOTT SERIES

The Talbott series consists of moderately deep, well drained soils that formed in clayey residuum weathered from limestone. These soils have moderately slow permeability. The slope ranges from 0 to 70 percent.

TAXONOMIC CLASS: Fine, mixed, semiactive, thermic Typic Hapludalfs

TYPICAL PEDON: Talbott silt loam--cultivated. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 6 inches; brown (10YR 4/3) silt loam; moderate fine granular structure; friable; many fine roots; few fine black concretions; strongly acid; clear smooth boundary. (4 to 8 inches thick)

Bt1--6 to 10 inches; yellowish red (5YR 4/6) clay; few medium distinct brown (7.5YR 4/4) mottles; moderate medium angular and subangular blocky structure; firm; patchy clay films; common fine roots, few fine black concretions; few small fragments of chert up to 1 inch across; strongly acid; gradual smooth boundary.

Bt2--10 to 20 inches; yellowish red (5YR 5/6) clay; common fine and medium distinct yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) mottles; moderate to strong medium angular blocky structure; firm; plastic; continuous clay films; few fine roots; few fine dark brown and black concretions; strongly acid; gradual smooth boundary.

Bt3--20 to 25 inches; yellowish red (5YR 5/6) clay; common fine and medium distinct yellowish brown (10YR 5/6) and red (2.5YR 4/6) mottles; strong medium and coarse angular blocky structure; very firm, plastic; continuous clay films; few fine roots; few fine brown and black concretions; strongly acid; clear wavy boundary.

Bt4--25 to 31 inches; yellowish brown (10YR 5/6) clay; common fine and medium distinct mottles of yellowish red (5YR 4/6), light olive brown (2.5Y 5/6), and pale brown (10YR 6/3); moderate coarse angular blocky structure; very firm, plastic; continuous clay films; few fine black concretions; medium acid; gradual smooth boundary. (Thickness of the Bt horizon ranges from 12 to 35 inches.)

C--31 to 37 inches; light olive brown (2.5Y 5/4) clay; common fine and medium distinct yellowish brown (10YR 5/6), light brownish gray (10YR 6/2), and yellowish red (5YR 5/6) mottles; massive; very firm, plastic; few fine black and dark brown concretions; neutral. (0 to 10 inches thick)

R--37 inches; limestone rock.

TYPE LOCATION: Rutherford County, Tennessee; 7 miles from Murfreesboro Courthouse, southeast on U. S. Highway 41, 2 miles east on gravel road to Cedar Grove Church, 3/4 mile east of Church on gravel road, south 1/4 mile on gravel road to Lytle Creek, 325 feet south of Lytle Creek and 100 feet west of gravel road.

RANGE IN CHARACTERISTICS: Thickness of solum and depth to bedrock ranges from 20 to 40 inches. Rock fragments in this soil are normally less than 5 percent, but range from 0 to 10 percent in all horizons. It ranges from slightly acid to strongly acid except the horizons near bedrock ranges to mildly alkaline.

The Ap or A horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 to 4. Eroded areas also have hue of 5YR and chroma of 6. Pedons with value of 3 are less than 6 inches thick. Texture is silt loam, except eroded and severely eroded areas include silty clay loam, silty clay, or clay.

The E horizon, where present, has hue of 10YR or 7.5YR value of 4 to 6 and chroma of 2 to 4. Texture is silt loam.

In some pedons, the A and E horizons formed in cherty colluvium and have a texture of gravelly loam or gravelly silt loam. There are other pedons where the A and E horizons formed in loamy colluvium from sandstone and the texture is loam. These pedons have a discontinuity between the colluvium and the clayey Bt horizon.

The Bt horizon has hue of 7.5YR to 2.5YR, value of 4 or 5, and chroma of 4 to 8. The lower part of the Bt horizon also has hue of 10YR, value of 5, and chroma of 4 to 8. Mottles range from none to common in shades of brown, yellow, and red. Texture is silty clay or clay, except the upper few inches is silty clay loam in some pedons.

The BC and C horizons, where present, have hue of 2.5Y to 5YR, value of 4 to 6, and chroma of 4 to 8. Mottles range from few to many in shades of brown, yellow, red, and gray. In some pedons, it is mottled without a dominant matrix color. Texture is silty clay or clay.

COMPETING SERIES: These are the Archer, Bradyville, Conasauga, Mimosa and Winnsboro series in the same family and the Barfield, Braxton, Capshaw, Carbo, Colbert, Collegedale and Hampshire series in closely related families. Archer soils have sandy A horizons. Barfield soils are less than 20 inches to bedrock. Bradyville, Braxton, Capshaw, Colbert, Collegedale, Hampshire, Mimosa, and Winnsboro are all more than 40 inches deep to bedrock. In addition, Capshaw, Colbert, and Hampshire soils have B horizons with hue of 7.5YR or yellower. Carbo and Conasauga soils have a B horizon with hue of 7.5YR or yellower. In addition, Carbo soils have a B horizon with more than 60 percent clay.

GEOGRAPHIC SETTING: Talbott soils are on nearly level to steep upland slopes with gradients ranging from 0 to 70 percent. Some areas have Karst topography. The soil formed in clayey residuum weathered from limestone. At the type location, mean annual temperature is 60 degrees F., and mean annual rainfall is 50 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Barfield, Bradyville, Carbo, Capshaw, Colbert, and Collegedale series.

DRAINAGE AND PERMEABILITY: Well drained; medium and rapid runoff; moderately slow permeability

USE AND VEGETATION: Originally hardwoods, chiefly oak, hickory, elm, maple, and redcedar. Most of the areas are cleared. About 70 percent of the cleared areas are in pasture and hay. Crops include corn, small grain, tobacco, and soybeans. Many areas are idle.

DISTRIBUTION AND EXTENT: The Appalachian Ridge and Valley, Highland Rim and Nashville Basin in Tennessee, northern Georgia, and Alabama, and possibly Kentucky. The series is of large extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Jefferson County, Tennessee; 1936.

REMARKS: Diagnostic horizons recognized in this pedon are:

Ochric epipedon - 0 to 6 inches (Ap horizon)

Argillic horizon - 6 to 31 inches (Bt horizon)

National Cooperative Soil Survey
U.S.A.

APPENDIX 3.1

SOIL PEDON DESCRIPTIONS

TDEC - DWR Soil Pedon Description Form

Date: 9/20/19 Described By: CONNIE IVORROD QA/QC By: KEVIN DICKERSON

Site Name & Location: JAMES McCANLESS TALIAFERRO ROAD County: WILLIAMSON

Stop or Pit #: 1 6-5, 6-6 + H-5, H-6 CENTER SOP # (office use only):

Soil Series: BRAXTON / MIMOSA Drainage Class: WELL

Soil Control Section: FINE Ground Water or Water Table: NONE

Parent Material: RESIDUUM Erosion: SEVER

Climate: THERMIC Land Cover: MIXED GRASSES

Slope of Map Unit: 5-15% Slope of Pit: 9%

Geomorphic Description: UPLAND Latitude/Longitude (Center of soil area):

Physiographic Location: NASHVILLE BASIN

Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-3				SiL	1+2	F+M	GR+SBK	
AB	3-7				GRSiCl	2	M	SBK	
Bt1	7-16				SiCl	2	M	SBK	
Bt2	16-22				C	2	M	SBK	
Bt3	22-27				C	2	M	ABK + SBK	
Bt4	27 31				C	1	M	ABK + SBK	COMMON IRON MASSES + NODULE
Bt5	31-35				C	1	M	ABK + SBK	
C	35-43				C	0		M	COMMON IRON MASSES + NODULES

TDEC - DWR Soil Pedon Description Form

Date: 9/20/19 Described By: LONNIE NORROD QA/QC By: KEVIN DICKERSON

Site Name & Location: JAMES MCCLANESS TALIAFERRO ROAD County: WILLIAMSON

Stop or Pit #: 2 E-11 + E-12 SOP # (office use only):

Soil Series: ARMOUR Drainage Class: WELL

Soil Control Section: FINE SILTY Ground Water or Water Table: NONE

Parent Material: ALLUVIUM Erosion: NONE TO SLIGHT

Climate: THERMIC Land Cover: MIXED GRASSES

Slope of Map Unit: 5-15% Slope of Pit: 8%

Geomorphic Description: TERRACE Latitude/Longitude (Center of soil area):

Physiographic Location: NASHVILLE BASIN

Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
A_{P1}	0-3				SiL	1+2	F+M	GR	
A_{P2}	3-11				SiL	1	M	SBK	
AB	11-14				SiL	1	M	SBK	
B_{t1}	14-17				SiL	2	M	SBK	
B_{t2}	17-22				SiCl	2	M	SBK	
B_{t3}	22-28				SiCl	2	M	SBK	
B_{t4}	28-38				CL	2	M	SBK	

TDEC - DWR Soil Pedon Description Form

Date: 9/20/19 Described By: LONNIE NORROD QA/QC By: KEVIN DICKERSON

Site Name & Location: JAMES McCLANESS TALIAFERRO ROAD) County: WILLIAMSON

Stop or Pit #: 3 G-12 + G-13, H-12 + H-13 CENTER SOP # (office use only):

Soil Series: SYKES (LOAMY) Drainage Class: WELL

Soil Control Section: FINE Ground Water or Water Table: NONE

Parent Material: RESIDUUM Erosion: NONE TO SLIGHT

Climate: THERMIC Land Cover: MIXED GRASSES

Slope of Map Unit: 5-15% Slope of Pit: 8%

Geomorphic Description: UPLAND Latitude/Longitude (Center of soil area):

Physiographic Location: NASHVILLE BASIN

Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-3				SiL	1+2	F+M	GR+SBK	
Ap2	3-10				SiL	2	M	SBK	
Bt1	10-17				SiCl	2	M	SBK	
Bt2	17-24				GR SiCl	2	M	SBK	
Bt3	24-30				CL	2	M	SBK	
Bt4	30-35				CL	2	M	SBK	
2Bt5	35-40				C	1	M	SBK	COMMON MASSES + NODULES
2C	40-44				C	1	M	SBK	COMMON MASSES + NODULES

TDEC - DWR Soil Pedon Description Form

Date: 9/20/19 Described By: LONNIE NORROD QA/QC By: KEVIN DICKERSON

Site Name & Location: JAMES McCLANESS TALIAFERRO ROAD County: WILLIAMSON

Stop or Pit #: 4 E-15 SOP # (office use only):

Soil Series: SYKES (LOAMY) Drainage Class: WELL

Soil Control Section: FINE Ground Water or Water Table: NONE

Parent Material: ALLUVIUM OVER RESIDUUM Erosion: NONE TO SLIGHT

Climate: THERMIC Land Cover: MIXED GRASSES

Slope of Map Unit: 5-15% Slope of Pit: 5%

Geomorphic Description: UPLAND Latitude/Longitude (Center of soil area):

Physiographic Location: NASHVILLE BASIN

Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
A_{p1}	0 - 4				SiL	1+2	F+M	GR+SBK	
A_{p2}	4 - 8				SiL	1	M	SBK	
BA	8 - 14				SiCl	2	M	SBK	
B_{t1}	14 - 20				SiCl	2	M	SBK	
B_{t2}	20 - 26				L	2	M	SBK	
B_{t3}	26 - 33				GRCL	2	M	SBK	
B_{t4}	33 - 38				C	2	M	SBK	
$2B_{t5}$	38 - 42				C	1	M	ABK + SBK	
2C	42 44				C	0		M	

TDEC - DWR Soil Pedon Description Form

Date: 9/20/19 Described By: LONNIE NORROD QA/QC By: KEVIN DICKERSON

Site Name & Location: JAMES MCCLANESS TALIAFERRO ROAD County: WILLIAMSON

Stop or Pit #: 5 H-17 SOP # (office use only):

Soil Series: ARMOUR OVERWASH Drainage Class: WELL

Soil Control Section: FINE LOAMY Ground Water or Water Table: NONE

Parent Material: COLLUVIUM OVER ALLUVIUM Erosion: NONE TO SLIGHT

Climate: THERMIC Land Cover: MIXED GRASSES

Slope of Map Unit: 0-5% Slope of Pit: 4%

Geomorphic Description: TERRACE Latitude/Longitude (Center of soil area):

Physiographic Location: NASHVILLE BASIN

Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
A_{p1}	0-5				SiL	1&2	F+M	GR+SBK	
A_{p2}	5-11				SiL	1	M	SBK	
Ab	11-16				SiL	1	M	SBK	
ABb	16-21				SiL	2	M	SBK	
BAb	21-28				SiL	2	M	SBK	
$B_{t1}b$	28-34				L	2	M	SBK	
$B_{t2}b$	34-38				L	2	M	SBK	
$B_{t3}b$	38-41				CL	2	M	SBK	

TDEC - DWR Soil Pedon Description Form

Date: 9/20/19 Described By: LONNIE NORROD QA/QC By: KEVIN DICKERSON

Site Name & Location: JAMES McCLANESS TALIAFERRO ROAD County: WILLIAMSON

Stop or Pit #: 6 H-20 & H-21, I-20 & I-21 CENTER SOP # (office use only):

Soil Series: SYKES (LOAMY) Drainage Class: WELL

Soil Control Section: FINE LOAMY Ground Water or Water Table: NONE

Parent Material: ALLUVIUM OVER RESIDUUM Erosion: NONE TO SLIGHT

Climate: THERMIC Land Cover: MIXED GRASSES

Slope of Map Unit: 5-15% Slope of Pit: 7%

Geomorphic Description: TERRACE Latitude/Longitude (Center of soil area):

Physiographic Location: NASHVILLE BASIN

Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
A_{P1}	0-5				SiL	1+2	F+M	GR+SBK	
A_{P2}	5-11				L	1	M	SBK	
B_{t1}	11-21				CL	2	M	SBK	
B_{t2}	21-30				CL	2	M	SBK	
$2B_{t3}$	30-34				C	1	M	ABK+SBK	
2C	34-37				C	0		M	

TDEC - DWR Soil Pedon Description Form

Date: 9/20/19 Described By: LONNIE NORROD QA/QC By: KEVIN DICKERSON

Site Name & Location: JAMES MCCLANESS TALIAFERRO ROAD County: WILLIAMSON

Stop or Pit #: 7 M-23 SOP # (office use only):

Soil Series: BARFIELD OVERWASH Drainage Class: WELL

Soil Control Section: FINE SILTY Ground Water or Water Table: NONE

Parent Material: ALLUVIUM OVER RESIDUUM Erosion: NONE TO SLIGHT

Climate: THERMIC Land Cover: MIXED GRASSES

Slope of Map Unit: 0-5% Slope of Pit: 2%

Geomorphic Description: TERRACE Latitude/Longitude (Center of soil area):

Physiographic Location: NASHVILLE BASIN

Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-3				SiL	1+2	F+m	GR+SBK	
Ap2	3-8				SiL	1	M	SBK	
Bw1	8-20				SiL	1	M	SBK	
Bw2	20-26				SiCl	1	M	SBK	
Ab	26-30				SiCl	2	M	SBK	
Bwb	30-36				SiCl	1	M	SBK	
R	36								

TDEC - DWR Soil Pedon Description Form

Date: 9/20/19 Described By: LONNIE NORROD QA/QC By: KEVIN DICKERSON

Site Name & Location: JAMES MCCLANESS TALIAFERRO ROAD County: WILLIAMSON

Stop or Pit #: 8 L-24 SOP # (office use only):

Soil Series: EGAM (OVERWASH) Drainage Class: WELL

Soil Control Section: FINE LOAMY Ground Water or Water Table: NONE

Parent Material: ALLUVIUM Erosion: NONE TO SLIGHT

Climate: THERMIC Land Cover: MIXED GRASSES

Slope of Map Unit: 0-5% Slope of Pit: 1%

Geomorphic Description: FLOOD PLAIN / LOW TERRACE Latitude/Longitude (Center of soil area):

Physiographic Location: NASHVILLE BASIN

Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
A_{P1}	0-2				SiL	1+2	F+M	GR+SBK	
A_{P2}	2-9				CL	1	M	SBK	
B_W	9-18				CL	1	M	SBK	
A_b	18-33				SiCl	1	M	SBK	
$B_{W,b}$	33-38				SiCl	1	M	SBK	
$B_{W2}b$	38-42				C	1	M	SBK	

TDEC - DWR Soil Pedon Description Form

Date: 9/20/19 Described By: LONNIE NORROD QA/QC By: KEVIN DICKERSON

Site Name & Location: JAMES McCLANESS TALIAFERRO ROAD County: WILLIAMSON

Stop or Pit #: 9 V-18 SOP # (office use only):

Soil Series: SHALLOW SYKES Drainage Class: WELL

Soil Control Section: FINE Ground Water or Water Table: NONE

Parent Material: ALLUVIUM OVER RESIDUUM Erosion: MODERATE

Climate: THERMIC Land Cover: MIXED GRASSES

Slope of Map Unit: 5-15% Slope of Pit: 7%

Geomorphic Description: UPLAND Latitude/Longitude (Center of soil area):

Physiographic Location: NASHVILLE BASIN

Additional Notes: FLOATER ROCK @ 38" OPPOSITE SIDE OF PIT CLAY TEXTURE @ 36" MODERATE STRUCTURE TO 38"+

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-3				SiL	1+2	F+M	GR+SBK	
Ap2	3-8				SiL	2	M	SBK	
Bt1	8-13				SiCl	2	M	SBK	
Bt2	13-18				SiCl	2	M	SBK	
Bt3	18-22				GR SiC	2	M	SBK	
2Bt1	22-25				C	1	M	SBK	
2C	25-38				C	0		M	

APPENDIX 3.3

RESULTS FROM Ksat TESTS

A

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	10/17/19	Permeameter #:	
Location:	McCanless/Taliaferro Rd	Air Temperature (F) initial:	48
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Braxton-Mimosa-Sykes	[1]Soil Moisture Content (%):	dry
Pedon Number:	A	*[1] If not known, give a relative soil moisture content. i.e.*	
Horizon Tested:	Bt	*dry, moist, or wet.*	

Set-up Calculation	
Hole Depth (cm):	50.8
Distance from Bottom of Bubble Tube to soil surface (cm) = D:	
Desired Water Depth in Hole (cm):	
CHT Tube setting (cm) = d:	

H =	[2] Actual water level in hole (cm):		17.8
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)		Initial:	17.8
		Final:	17.8
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger		3.5

Outflow Chamber (s) used: [Associated **C**onversion **F**actor:]	105.0	(=20.0 cm^2) Set on 1 (Large Tank only) (=105.0 cm^2) Set on 2 (Both Tanks)

[4]Drop in Water	Outflow Chamber	Clock Time	Elapsed Time (between readings)		Outflow (Q)	Hydraulic Conductivity (Ksat)	
(cm)	(C.F.)	(hr:min)	(min) :	(min/60)	(cm^3/hr)	(cm/hr)	(in/hr)
Ex 4.9	20	10:17			392	0.4139	0.1629
Start			xxx	xxxx	xxxx	xxxxx	xxxxxx
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
8.20	105.0		30	0.500	1722.0	1.30319	0.51307
1.90	105.0		13	0.217	920.8	0.69683	0.27434
2.30	105.0		17	0.283	852.4	0.64505	0.25396
2.05	105.0		17	0.283	759.7	0.57494	0.22635
1.95	105.0		25	0.417	491.4	0.37189	0.14641
1.20	105.0		11	0.183	687.3	0.52012	0.20477
1.55	105.0		14	0.233	697.5	0.52786	0.20782
1.10	105.0		10	0.167	693.0	0.52446	0.20648
					Mean K:	0.52415	0.20636
					St. Dev:	0.0039	0.0015

Average of "steady state" readings:

0.21 in/hr

B

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	10/17/19	Permeameter #:	
Location:	McCanless/Taliaferro Rd	Air Temperature (F) initial:	49
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Sykes-Armour	[1]Soil Moisture Content (%):	dry
Pedon Number:	B	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:	Bt		

Set-up Calculation	
Hole Depth (cm):	50.8
Distance from Bottom of Bubble Tube to soil surface (cm) = D:	
Desired Water Depth in Hole (cm):	
CHT Tube setting (cm) = d:	

H =	[2] Actual water level in hole (cm):		17.8
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)		Initial:	17.8
		Final:	17.8
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger		3.5

Outflow Chamber (s) used: [Associated **C**onversion **F**actor:]	105.0	(=20.0 cm^2) Set on 1 (Large Tank only) (=105.0 cm^2) Set on 2 (Both Tanks)

[4]Drop in Water	Outflow Chamber	Clock Time	Elapsed Time (between readings)		Outflow (Q)	Hydraulic Conductivity (Ksat)	
(cm)	(C.F.)	(hr:min)	(min) :	(min/60)	(cm^3/hr)	(cm/hr)	(in/hr)
Ex 4.9	20	10:17			392	0.4139	0.1629
Start			xxx	xxxx	xxxx	xxxxx	xxxxxx
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
7.90	105.0		17	0.283	2927.6	2.21562	0.87229
2.90	105.0		13	0.217	1405.4	1.06358	0.41873
3.10	105.0		17	0.283	1148.8	0.86942	0.34229
2.60	105.0		17	0.283	963.5	0.72919	0.28708
3.75	105.0		25	0.417	945.0	0.71517	0.28156
1.75	105.0		11	0.183	1002.3	0.75851	0.29863
					Mean K:	0.73429	0.28909
					St. Dev:	0.0221	0.0087

Average of "steady state" readings:

0.29 in/hr

C

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	10/17/19	Permeameter #:	
Location:	McCanless/Taliaferro Rd	Air Temperature (F) initial:	56
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Sykes-Armour	[1]Soil Moisture Content (%):	dry
Pedon Number:	C	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:	Bt		

Set-up Calculation	
Hole Depth (cm):	50.8
Distance from Bottom of Bubble Tube to soil surface (cm) = D:	
Desired Water Depth in Hole (cm):	
CHT Tube setting (cm) = d:	

H =	[2] Actual water level in hole (cm):		15.2
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)		Initial:	15.2
		Final:	15.2
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger		3.5

Outflow Chamber (s) used: [Associated **C**onversion **F**actor:]	105.0	(=20.0 cm^2) Set on 1 (Large Tank only) (=105.0 cm^2) Set on 2 (Both Tanks)

[4]Drop in Water	Outflow Chamber	Clock Time	Elapsed Time (between readings)		Outflow (Q)	Hydraulic Conductivity (Ksat)	
(cm)	(C.F.)	(hr:min)	(min) :	(min/60)	(cm^3/hr)	(cm/hr)	(in/hr)
Ex 4.9	20	10:17			392	0.4139	0.1629
Start			xxx	xxxx	xxxx	xxxxx	xxxxxx
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
2.40	105.0		13	0.217	1163.1	1.10467	0.43491
2.20	105.0		14	0.233	990.0	0.94029	0.37019
2.45	105.0		16	0.267	964.7	0.91625	0.36073
2.95	105.0		21	0.350	885.0	0.84056	0.33093
3.30	105.0		24	0.400	866.3	0.82275	0.32392
1.50	105.0		11	0.183	859.1	0.81595	0.32124
					Mean K:	0.82642	0.32536
					St. Dev:	0.0127	0.0050

Average of "steady state" readings:

0.32 in/hr

THIS HOLE WAS PRESOAKED

D

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	10/17/19	Permeameter #:	
Location:	McCanless/Taliaferro Rd	Air Temperature (F) initial:	56
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Sykes-Armour	[1]Soil Moisture Content (%):	dry
Pedon Number:	D	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:	Bt		

Set-up Calculation	
Hole Depth (cm):	50.8
Distance from Bottom of Bubble Tube to soil surface (cm) = D:	
Desired Water Depth in Hole (cm):	
CHT Tube setting (cm) = d:	

H =	[2] Actual water level in hole (cm):		16.5
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)		Initial:	16.5
		Final:	16.5
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger		3.5

Outflow Chamber (s) used: [Associated **C**onversion **F**actor:]	105.0	(=20.0 cm^2) Set on 1 (Large Tank only) (=105.0 cm^2) Set on 2 (Both Tanks)

[4]Drop in Water	Outflow Chamber	Clock Time	Elapsed Time (between readings)		Outflow (Q)	Hydraulic Conductivity (Ksat)	
(cm)	(C.F.)	(hr:min)	(min) :	(min/60)	(cm^3/hr)	(cm/hr)	(in/hr)
Ex 4.9	20	10:17			392	0.4139	0.1629
Start			xxx	xxxx	xxxx	xxxxx	xxxxxx
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
2.00	105.0		17	0.283	741.2	0.62596	0.24644
0.20	105.0		13	0.217	96.9	0.08186	0.03223
2.75	105.0		24	0.400	721.9	0.60966	0.24002
2.25	105.0		21	0.350	675.0	0.57007	0.22444
1.25	105.0		12	0.200	656.3	0.55423	0.21820
					Mean K:	0.57799	0.22755
					St. Dev:	0.0285	0.0112

THIS HOLE WAS PRESOAKED

Average of "steady state" readings:

0.23 in/hr

E

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	10/17/19	Permeameter #:	
Location:	McCanless/Taliaferro Rd	Air Temperature (F) initial:	59
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Armour OW-Sykes OW	[1]Soil Moisture Content (%):	dry
Pedon Number:	E	*[1] If not known, give a relative soil moisture content. i.e.*	
Horizon Tested:	Bt	*dry, moist, or wet.*	

Set-up Calculation	
Hole Depth (cm):	50.8
Distance from Bottom of Bubble Tube to soil surface (cm) = D:	
Desired Water Depth in Hole (cm):	
CHT Tube setting (cm) = d:	

H =	[2] Actual water level in hole (cm):		15.2
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)		Initial:	15.2
		Final:	15.2
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger		3.5

Outflow Chamber (s) used: [Associated **C**onversion **F**actor:]	105.0	(=20.0 cm^2) Set on 1 (Large Tank only) (=105.0 cm^2) Set on 2 (Both Tanks)

[4]Drop in Water	Outflow Chamber	Clock Time	Elapsed Time (between readings)		Outflow (Q)	Hydraulic Conductivity (Ksat)	
(cm)	(C.F.)	(hr:min)	(min) :	(min/60)	(cm^3/hr)	(cm/hr)	(in/hr)
Ex 4.9	20	10:17			392	0.4139	0.1629
Start			xxx	xxxx	xxxx	xxxxx	xxxxxx
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
6.80	105.0		34	0.567	1260.0	1.19673	0.47115
1.30	105.0		6	0.100	1365.0	1.29646	0.51042
2.60	105.0		12	0.200	1365.0	1.29646	0.51042
					Mean K:	1.26322	0.49733
					St. Dev:	0.0576	0.0227

THIS HOLE WAS PRESOAKED

Average of "steady state" readings:

0.50 in/hr

F

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	10/17/19	Permeameter #:	
Location:	McCanless/Taliaferro Rd	Air Temperature (F) initial:	59
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Sykes-Armour	[1]Soil Moisture Content (%):	dry
Pedon Number:	F	[1] *If not known, give a relative soil moisture content. i.e.*	
Horizon Tested:	Bt	*dry, moist, or wet.*	

Set-up Calculation	
Hole Depth (cm):	50.8
Distance from Bottom of Bubble Tube to soil surface (cm) = D:	
Desired Water Depth in Hole (cm):	
CHT Tube setting (cm) = d:	

H =	[2] Actual water level in hole (cm):		15.2
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)		Initial:	15.2
		Final:	15.2
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger		3.5

Outflow Chamber (s) used: [Associated **C**onversion **F**actor:]	105.0	(=20.0 cm^2) Set on 1 (Large Tank only) (=105.0 cm^2) Set on 2 (Both Tanks)

[4]Drop in Water	Outflow Chamber	Clock Time	Elapsed Time (between readings)		Outflow (Q)	Hydraulic Conductivity (Ksat)	
(cm)	(C.F.)	(hr:min)	(min) :	(min/60)	(cm^3/hr)	(cm/hr)	(in/hr)
Ex 4.9	20	10:17			392	0.4139	0.1629
Start			xxx	xxxx	xxxx	xxxxx	xxxxxx
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
2.30	105.0		32	0.533	452.8	0.43008	0.16932
0.60	105.0		6	0.100	630.0	0.59837	0.23558
0.60	105.0		7	0.117	540.0	0.51288	0.20192
0.90	105.0		10	0.167	567.0	0.53853	0.21202
					Mean K:	0.54993	0.21651
					St. Dev:	0.0439	0.0173

Average of "steady state" readings:

0.22 in/hr

THIS HOLE WAS PRESOAKED

G

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	10/18/19	Permeameter #:	
Location:	McCanless/Taliaferro Rd	Air Temperature (F) initial:	62
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Egam OW	[1]Soil Moisture Content (%):	dry
Pedon Number:	G	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:	Bt		

Set-up Calculation	
Hole Depth (cm):	50.8
Distance from Bottom of Bubble Tube to soil surface (cm) = D:	
Desired Water Depth in Hole (cm):	
CHT Tube setting (cm) = d:	

H =	[2] Actual water level in hole (cm):		15.2
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)		Initial:	15.2
		Final:	15.2
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger		3.5

Outflow Chamber (s) used: [Associated **C**onversion **F**actor:]	105.0	(=20.0 cm^2) Set on 1 (Large Tank only) (=105.0 cm^2) Set on 2 (Both Tanks)

[4]Drop in Water	Outflow Chamber	Clock Time	Elapsed Time (between readings)		Outflow (Q)	Hydraulic Conductivity (Ksat)	
(cm)	(C.F.)	(hr:min)	(min) :	(min/60)	(cm^3/hr)	(cm/hr)	(in/hr)
Ex 4.9	20	10:17			392	0.4139	0.1629
Start			xxx	xxxx	xxxx	xxxxx	xxxxxx
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
1.30	105.0		14	0.233	585.0	0.55563	0.21875
2.20	105.0		20	0.333	693.0	0.65820	0.25913
1.40	105.0		17	0.283	518.8	0.49277	0.19400
1.60	105.0		19	0.317	530.5	0.50389	0.19838
0.80	105.0		10	0.167	504.0	0.47869	0.18846
					Mean K:	0.49178	0.19362
					St. Dev:	0.0126	0.0050

Average of "steady state" readings:

0.19 in/hr

THIS HOLE WAS PRESOAKED

H

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	10/18/19	Permeameter #:	
Location:	McCanless/Taliaferro Rd	Air Temperature (F) initial:	62
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Egam OW	[1]Soil Moisture Content (%):	dry
Pedon Number:	H	*[1] If not known, give a relative soil moisture content. i.e.*	
Horizon Tested:	Bt	*dry, moist, or wet.*	

Set-up Calculation	
Hole Depth (cm):	50.8
Distance from Bottom of Bubble Tube to soil surface (cm) = D:	
Desired Water Depth in Hole (cm):	
CHT Tube setting (cm) = d:	

H =	[2] Actual water level in hole (cm):		15.2
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)		Initial:	15.2
		Final:	15.2
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger		3.5

Outflow Chamber (s) used: [Associated **C**onversion **F**actor:]	105.0	(=20.0 cm^2) Set on 1 (Large Tank only) (=105.0 cm^2) Set on 2 (Both Tanks)

[4]Drop in Water	Outflow Chamber	Clock Time	Elapsed Time (between readings)		Outflow (Q)	Hydraulic Conductivity (Ksat)	
(cm)	(C.F.)	(hr:min)	(min) :	(min/60)	(cm^3/hr)	(cm/hr)	(in/hr)
Ex 4.9	20	10:17			392	0.4139	0.1629
Start			xxx	xxxx	xxxx	xxxxx	xxxxxx
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
2.05	105.0		14	0.233	922.5	0.87618	0.34495
2.25	105.0		20	0.333	708.8	0.67316	0.26502
1.80	105.0		17	0.283	667.1	0.63356	0.24943
1.95	105.0		19	0.317	646.6	0.61411	0.24178
1.00	105.0		10	0.167	630.0	0.59837	0.23558
					Mean K:	0.61535	0.24226
					St. Dev:	0.0176	0.0069

Average of "steady state" readings:

0.24 in/hr

THIS HOLE WAS PRESOAKED

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	10/18/19	Permeameter #:	
Location:	McCanless/Taliaferro Rd	Air Temperature (F) initial:	67
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Barfield OW	[1]Soil Moisture Content (%):	dry
Pedon Number:	I	[1] *If not known, give a relative soil moisture content. i.e.*	
Horizon Tested:	Bt	*dry, moist, or wet.*	

Set-up Calculation	
Hole Depth (cm):	50.8
Distance from Bottom of Bubble Tube to soil surface (cm) = D:	
Desired Water Depth in Hole (cm):	
CHT Tube setting (cm) = d:	

H =	[2] Actual water level in hole (cm):		15.2
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)		Initial:	15.2
		Final:	15.2
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger		3.5

Outflow Chamber (s) used: [Associated **C**onversion **F**actor:]	105.0	(=20.0 cm^2) Set on 1 (Large Tank only) (=105.0 cm^2) Set on 2 (Both Tanks)

[4]Drop in Water	Outflow Chamber	Clock Time	Elapsed Time (between readings)		Outflow (Q)	Hydraulic Conductivity (Ksat)	
(cm)	(C.F.)	(hr:min)	(min) :	(min/60)	(cm^3/hr)	(cm/hr)	(in/hr)
Ex 4.9	20	10:17			392	0.4139	0.1629
Start			xxx	xxxx	xxxx	xxxxx	xxxxxx
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
3.35	105.0		27	0.450	781.7	0.74242	0.29229
2.95	105.0		48	0.800	387.2	0.36775	0.14478
1.00	105.0		19	0.317	331.6	0.31493	0.12399
0.90	105.0		21	0.350	270.0	0.25644	0.10096
0.40	105.0		10	0.167	252.0	0.23935	0.09423
0.40	105.0		10	0.167	252.0	0.23935	0.09423
					Mean K:	0.24504	0.09647
					St. Dev:	0.0099	0.0039

Average of "steady state" readings:

0.10 in/hr

THIS HOLE WAS PRESOAKED

J

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	10/18/19	Permeameter #:	
Location:	McCanless/Taliaferro Rd	Air Temperature (F) initial:	49
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Sykes-Harpeth-Braxton	[1]Soil Moisture Content (%):	dry
Pedon Number:	J	*[1] If not known, give a relative soil moisture content. i.e.*	
Horizon Tested:	Bt	*dry, moist, or wet.*	

Set-up Calculation	
Hole Depth (cm):	50.8
Distance from Bottom of Bubble Tube to soil surface (cm) = D:	
Desired Water Depth in Hole (cm):	
CHT Tube setting (cm) = d:	

H =	[2] Actual water level in hole (cm):		15.9
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)		Initial:	15.9
		Final:	15.9
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger		3.5

Outflow Chamber (s) used: [Associated **C**onversion **F**actor:]	105.0	(=20.0 cm^2) Set on 1 (Large Tank only) (=105.0 cm^2) Set on 2 (Both Tanks)

[4]Drop in Water	Outflow Chamber	Clock Time	Elapsed Time (between readings)		Outflow (Q)	Hydraulic Conductivity (Ksat)	
(cm)	(C.F.)	(hr:min)	(min) :	(min/60)	(cm^3/hr)	(cm/hr)	(in/hr)
Ex 4.9	20	10:17			392	0.4139	0.1629
Start			xxx	xxxx	xxxx	xxxxx	xxxxxx
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
8.70	105.0		33	0.550	1660.9	1.47932	0.58241
2.90	105.0		22	0.367	830.5	0.73966	0.29121
1.90	105.0		16	0.267	748.1	0.66633	0.26234
1.20	105.0		12	0.200	630.0	0.56112	0.22091
1.55	105.0		16	0.267	610.3	0.54359	0.21401
1.10	105.0		11	0.183	630.0	0.56112	0.22091
					Mean K:	0.55528	0.21861
					St. Dev:	0.0101	0.0040

Average of "steady state" readings:

0.22 in/hr

THIS HOLE WAS PRESOAKED

K

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	10/18/19	Permeameter #:	
Location:	McCanless/Taliaferro Rd	Air Temperature (F) initial:	49
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Sykes-Harpeth-Braxton	[1]Soil Moisture Content (%):	dry
Pedon Number:	K	[1] *If not known, give a relative soil moisture content. i.e.*	
Horizon Tested:	Bt	*dry, moist, or wet.*	

Set-up Calculation	
Hole Depth (cm):	50.8
Distance from Bottom of Bubble Tube to soil surface (cm) = D:	
Desired Water Depth in Hole (cm):	
CHT Tube setting (cm) = d:	

H =	[2] Actual water level in hole (cm):		16.5
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)		Initial:	16.5
		Final:	16.5
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger		3.5

Outflow Chamber (s) used: [Associated **C**onversion **F**actor:]	105.0	(=20.0 cm^2) Set on 1 (Large Tank only) (=105.0 cm^2) Set on 2 (Both Tanks)

[4]Drop in Water	Outflow Chamber	Clock Time	Elapsed Time (between readings)		Outflow (Q)	Hydraulic Conductivity (Ksat)	
(cm)	(C.F.)	(hr:min)	(min) :	(min/60)	(cm^3/hr)	(cm/hr)	(in/hr)
Ex 4.9	20	10:17			392	0.4139	0.1629
Start			xxx	xxxx	xxxx	xxxxx	xxxxxx
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
11.10	105.0		36	0.600	1942.5	1.64053	0.64588
5.35	105.0		22	0.367	1532.0	1.29388	0.50940
3.60	105.0		16	0.267	1417.5	1.19715	0.47132
2.55	105.0		12	0.200	1338.8	1.13064	0.44513
3.20	105.0		16	0.267	1260.0	1.06413	0.41895
2.15	105.0		11	0.183	1231.4	1.03994	0.40943
					Mean K:	1.07824	0.42450
					St. Dev:	0.0470	0.0185

THIS HOLE WAS PRESOAKED

Average of "steady state" readings:

0.42 in/hr

L

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	10/18/19	Permeameter #:	
Location:	McCanless/Taliaferro Rd	Air Temperature (F) initial:	67
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Braxton-Mimosa-Sykes	[1]Soil Moisture Content (%):	dry
Pedon Number:	L	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:	Bt		

Set-up Calculation	
Hole Depth (cm):	50.8
Distance from Bottom of Bubble Tube to soil surface (cm) = D:	
Desired Water Depth in Hole (cm):	
CHT Tube setting (cm) = d:	

H =	[2] Actual water level in hole (cm):		17.1
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)		Initial:	17.1
		Final:	17.1
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger		3.5

Outflow Chamber (s) used: [Associated **C**onversion **F**actor:]	105.0	(=20.0 cm^2) Set on 1 (Large Tank only) (=105.0 cm^2) Set on 2 (Both Tanks)

[4]Drop in Water	Outflow Chamber	Clock Time	Elapsed Time (between readings)		Outflow (Q)	Hydraulic Conductivity (Ksat)	
(cm)	(C.F.)	(hr:min)	(min) :	(min/60)	(cm^3/hr)	(cm/hr)	(in/hr)
Ex 4.9	20	10:17			392	0.4139	0.1629
Start			xxx	xxxx	xxxx	xxxxx	xxxxxx
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
11.50	105.0		34	0.567	2130.9	1.70924	0.67293
17.90	105.0		47	0.783	2399.4	1.92459	0.75771
18.10	105.0		47	0.783	2426.2	1.94610	0.76618
18.00	105.0		47	0.783	2412.8	1.93535	0.76195
					Mean K:	1.93535	0.76195
					St. Dev:	0.0108	0.0042

THIS HOLE WAS PRESOAKED

Average of "steady state" readings:

0.76 in/hr

APPENDIX 3.4

RESULTS OF CHEMISTRY TESTING

Soil Analysis

Waters Agricultural Laboratories, Inc

2101 Calhoun Rd | Owensboro, KY 42301- | Phone (270) 685-4039

"Improving Growth... With Science"

Customer: 66277

LONNIE NORROD SOIL CONSULTING

277 RED WILLIAMS ROAD
CROSSVILLE, TN 38571
UNITED STATES

Sample ID: A

Grower: LONNIE NORROD SOIL CONSUL
Farm ID: LONNIE NORROD
Field ID: 0-4
Lab Number: 141318QO
Layer ID:

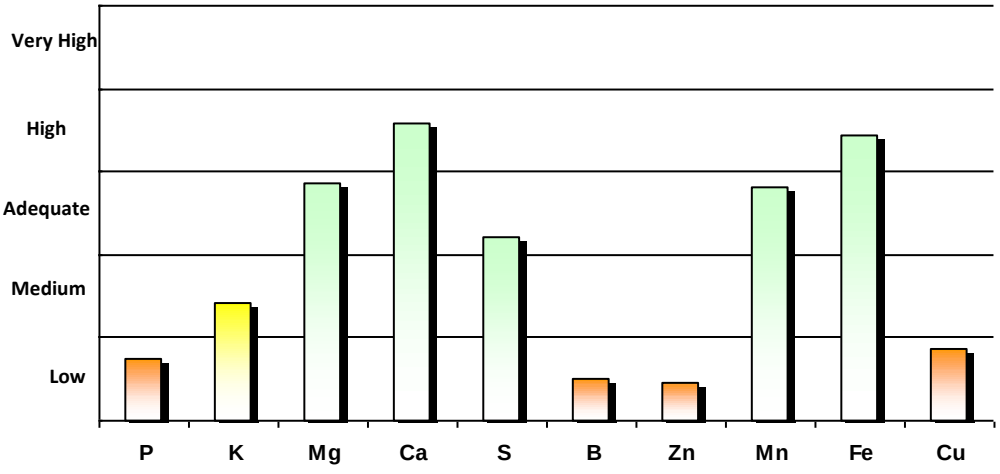
Received: 10/18/2019
Processed: 10/22/2019

Test Method: Mehlich III — **Soil Laboratory Data (lbs/a)** — **Target pH 6.5**

P	K	Mg	Ca	Soil pH	Buffer pH	S	B	Zn	Mn	Fe	Cu
Phosphorus	Potassium	Magnesium	Calcium		Adams-Evans	Sulfur	Boron	Zinc	Manganese	Iron	Copper
30 L	167 M	236 A	1629 H	5.2	7.15	55 A	0.5 L	1.8 L	175 A	286 H	1.3 L

Al	Na	NO3-N	NH4	Soluble Salts	Organic Matter	ENR	Mo	Ni	BiCarbs	
Aluminum	Sodium	Nitrate-N	Ammonia				Molybdenum	Nickel		
	102	ppm	ppm	mmhos/cm	2.33 %	47	ppm	ppm	meq/L	

Soil Analysis Ratings

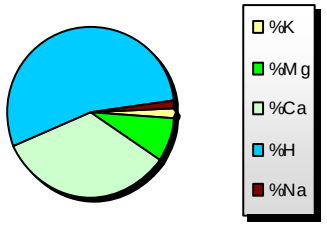


Cation Exchange Capacity 12.1 meq/100g

Base Saturation

K:	1.7 %	Mg:	8.0 %
Ca:	33.1 %	H:	55.3 %
Na:	1.8 %		

Base Saturation



Crop: NO CROP — **Fertility Recommendations (lbs/a)** — **Yield:**

Lime	Gypsum	N	P205	K20	Mg	S	B	Zn	Mn	Fe	Cu
Tons/Acre	Tons/Acre	Nitrogen	Phosphate	Potash	Magnesium	Sulfur	Boron	Zinc	Manganese	Iron	Copper
3.9											

* = Maintenance Recommendation

Comments

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Soil Analysis

Waters Agricultural Laboratories, Inc

2101 Calhoun Rd | Owensboro, KY 42301- | Phone (270) 685-4039

"Improving Growth... With Science"

Customer: 66277

LONNIE NORROD SOIL CONSULTING

277 RED WILLIAMS ROAD
CROSSVILLE, TN 38571
UNITED STATES

Sample ID: B

Grower: LONNIE NORROD SOIL CONSUL
Farm ID: LONNIE NORROD
Field ID: 0-4
Lab Number: 141319QO
Layer ID:

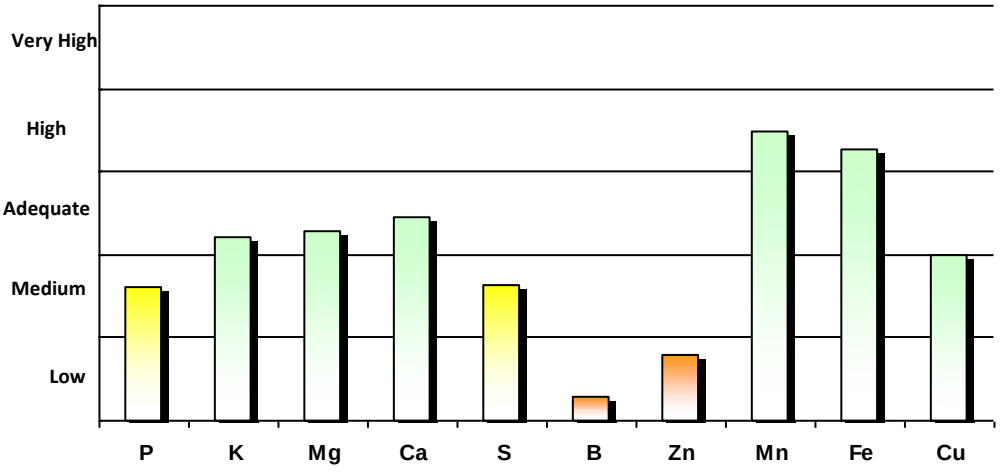
Received: 10/18/2019
Processed: 10/22/2019

Test Method: Mehlich III — **Soil Laboratory Data (lbs/a)** — **Target pH 6.5**

P	K	Mg	Ca	Soil pH	Buffer pH	S	B	Zn	Mn	Fe	Cu
Phosphorus	Potassium	Magnesium	Calcium		Adams-Evans	Sulfur	Boron	Zinc	Manganese	Iron	Copper
77 M	247 A	178 A	1176 A	5.2	7.00	41 M	0.3 L	3.2 L	296 H	256 H	3 A

Al	Na	NO3-N	NH4	Soluble Salts	Organic Matter	ENR	Mo	Ni	BiCarbs	
Aluminum	Sodium	Nitrate-N	Ammonia				Molybdenum	Nickel		
	60	ppm	ppm	mmhos/cm	2.6 %	52	ppm	ppm	meq/L	

Soil Analysis Ratings

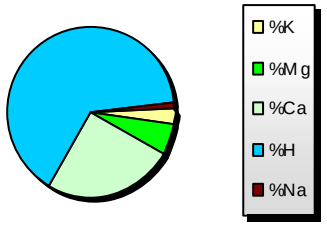


Cation Exchange Capacity 12.0 meq/100g

Base Saturation

K:	2.6 %	Mg:	6.1 %
Ca:	24.2 %	H:	66.0 %
Na:	1.1 %		

Base Saturation



Crop: NO CROP — **Fertility Recommendations (lbs/a)** — **Yield:**

Lime	Gypsum	N	P205	K20	Mg	S	B	Zn	Mn	Fe	Cu
Tons/Acre	Tons/Acre	Nitrogen	Phosphate	Potash	Magnesium	Sulfur	Boron	Zinc	Manganese	Iron	Copper
4.5											

* = Maintenance Recommendation

Comments

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Soil Analysis

Waters Agricultural Laboratories, Inc

2101 Calhoun Rd | Owensboro, KY 42301- | Phone (270) 685-4039

"Improving Growth... With Science"

Customer: 66277

LONNIE NORROD SOIL CONSULTING

277 RED WILLIAMS ROAD
CROSSVILLE, TN 38571
UNITED STATES

Sample ID: E

Grower: LONNIE NORROD SOIL CONSUL
Farm ID: LONNIE NORROD
Field ID: 0-4
Lab Number: 141320QO
Layer ID:

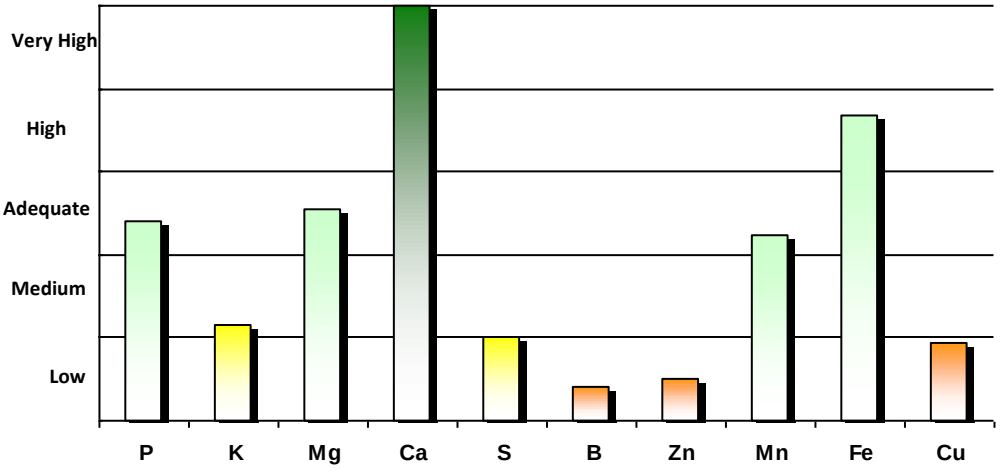
Received: 10/18/2019
Processed: 10/22/2019

Test Method: Mehlich III — **Soil Laboratory Data (lbs/a)** — **Target pH 6.5**

P	K	Mg	Ca	Soil pH	Buffer pH	S	B	Zn	Mn	Fe	Cu
Phosphorus	Potassium	Magnesium	Calcium		Adams-Evans	Sulfur	Boron	Zinc	Manganese	Iron	Copper
120 A	140 M	205 A	2745 VH	5.6	7.60	25 M	0.4 L	2 L	92 A	335 H	1.4 L

Al	Na	NO3-N	NH4	Soluble Salts	Organic Matter	ENR	Mo	Ni	BiCarbs	
Aluminum	Sodium	Nitrate-N	Ammonia				Molybdenum	Nickel		
	58				2.78	56				
	ppm		ppm	mmhos/cm	%		ppm	ppm	meq/L	

Soil Analysis Ratings

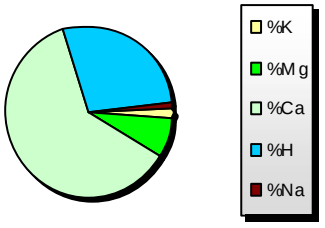


Cation Exchange Capacity 11.1 meq/100g

Base Saturation

K:	1.6 %	Mg:	7.6 %
Ca:	61.2 %	H:	28.5 %
Na:	1.1 %		

Base Saturation



Crop: NO CROP — **Fertility Recommendations (lbs/a)** — **Yield:**

Lime	Gypsum	N	P205	K20	Mg	S	B	Zn	Mn	Fe	Cu
Tons/Acre	Tons/Acre	Nitrogen	Phosphate	Potash	Magnesium	Sulfur	Boron	Zinc	Manganese	Iron	Copper
1.5											

* = Maintenance Recommendation

Comments

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Soil Analysis

Waters Agricultural Laboratories, Inc

2101 Calhoun Rd | Owensboro, KY 42301- | Phone (270) 685-4039

"Improving Growth... With Science"

Customer: 66277

LONNIE NORROD SOIL CONSULTING

277 RED WILLIAMS ROAD
CROSSVILLE, TN 38571
UNITED STATES

Sample ID: H

Grower: LONNIE NORROD SOIL CONSUL
Farm ID: LONNIE NORROD
Field ID: 0-4
Lab Number: 141321QO
Layer ID:

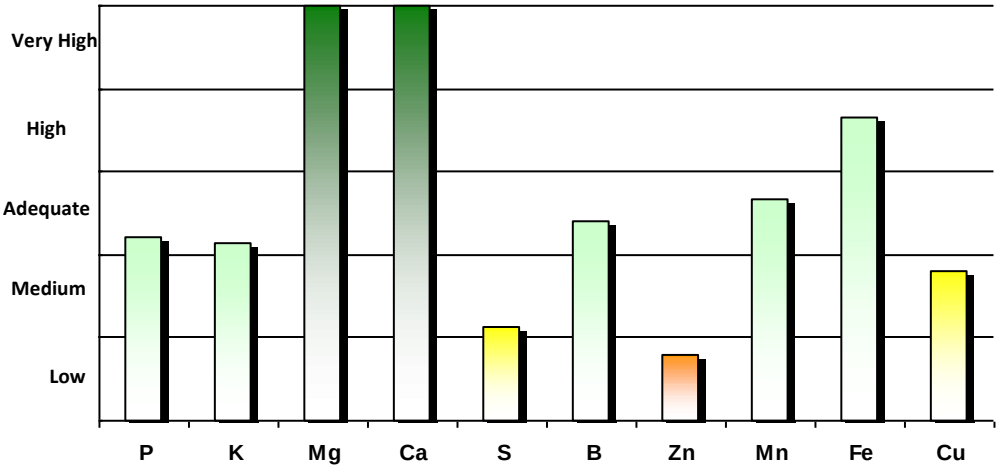
Received: 10/18/2019
Processed: 10/22/2019

Test Method: Mehlich III — **Soil Laboratory Data (lbs/a)** — **Target pH 6.5**

P	K	Mg	Ca	Soil pH	Buffer pH	S	B	Zn	Mn	Fe	Cu
Phosphorus	Potassium	Magnesium	Calcium		Adams-Evans	Sulfur	Boron	Zinc	Manganese	Iron	Copper
110 A	240 A	336 VH	6730 VH	6.6	7.75	28 M	1.7 A	3.2 L	155 A	330 H	2.7 M

Al	Na	NO3-N	NH4	Soluble Salts	Organic Matter	ENR	Mo	Ni	BiCarbs	
Aluminum	Sodium	Nitrate-N	Ammonia				Molybdenum	Nickel		
	67	ppm	ppm	mmhos/cm	2.68 %	54	ppm	ppm	meq/L	

Soil Analysis Ratings

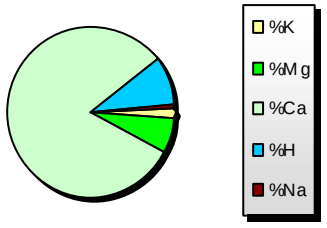


Cation Exchange Capacity 20.5 meq/100g

Base Saturation

K:	1.5 %	Mg:	6.8 %
Ca:	81.4 %	H:	9.7 %
Na:	0.7 %		

Base Saturation



Crop: NO CROP — **Fertility Recommendations (lbs/a)** — **Yield:**

Lime	Gypsum	N	P205	K20	Mg	S	B	Zn	Mn	Fe	Cu
Tons/Acre	Tons/Acre	Nitrogen	Phosphate	Potash	Magnesium	Sulfur	Boron	Zinc	Manganese	Iron	Copper

* = Maintenance Recommendation

Comments

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Soil Analysis

Waters Agricultural Laboratories, Inc

2101 Calhoun Rd | Owensboro, KY 42301- | Phone (270) 685-4039

"Improving Growth... With Science"

Customer: 66277

LONNIE NORROD SOIL CONSULTING

277 RED WILLIAMS ROAD
CROSSVILLE, TN 38571
UNITED STATES

Sample ID: I

Grower: LONNIE NORROD SOIL CONSUL
Farm ID: LONNIE NORROD
Field ID: 0-4
Lab Number: 141322QO
Layer ID:

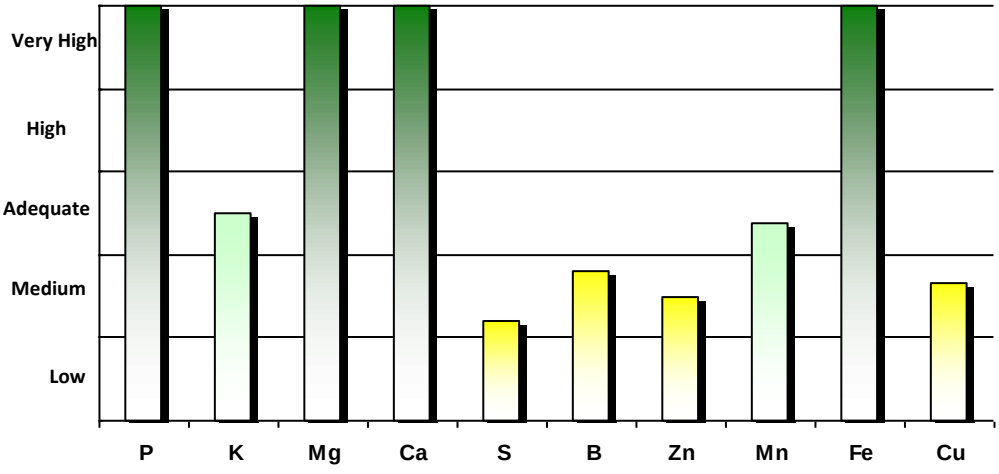
Received: 10/18/2019
Processed: 10/22/2019

Test Method: Mehlich III — **Soil Laboratory Data (lbs/a)** — **Target pH 6.5**

P	K	Mg	Ca	Soil pH	Buffer pH	S	B	Zn	Mn	Fe	Cu
Phosphorus	Potassium	Magnesium	Calcium		Adams-Evans	Sulfur	Boron	Zinc	Manganese	Iron	Copper
208 VH	275 A	301 VH	5269 VH	6.2	7.65	30 M	1.4 M	5 M	112 A	446 VH	2.5 M

Al	Na	NO3-N	NH4	Soluble Salts	Organic Matter	ENR	Mo	Ni	BiCarbs	
Aluminum	Sodium	Nitrate-N	Ammonia				Molybdenum	Nickel		
	57				2.83	57				
		ppm	ppm	mmhos/cm	%		ppm	ppm	meq/L	

Soil Analysis Ratings

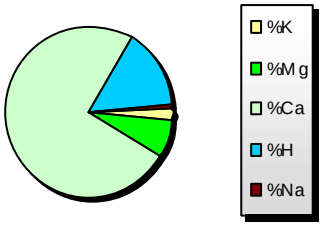


Cation Exchange Capacity	17.6	meq/100g

Base Saturation

K:	2.0 %	Mg:	7.1 %
Ca:	74.4 %	H:	15.8 %
Na:	0.7 %		

Base Saturation



Crop: NO CROP — **Fertility Recommendations (lbs/a)** — **Yield:**

Lime	Gypsum	N	P205	K20	Mg	S	B	Zn	Mn	Fe	Cu
Tons/Acre	Tons/Acre	Nitrogen	Phosphate	Potash	Magnesium	Sulfur	Boron	Zinc	Manganese	Iron	Copper
0.5											

* = Maintenance Recommendation

Comments

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Soil Analysis

Waters Agricultural Laboratories, Inc

2101 Calhoun Rd | Owensboro, KY 42301- | Phone (270) 685-4039

"Improving Growth... With Science"

Customer: 66277

LONNIE NORROD SOIL CONSULTING

277 RED WILLIAMS ROAD
CROSSVILLE, TN 38571
UNITED STATES

Sample ID: K

Grower: LONNIE NORROD SOIL CONSUL
Farm ID: LONNIE NORROD
Field ID: 0-4
Lab Number: 141323QO
Layer ID:

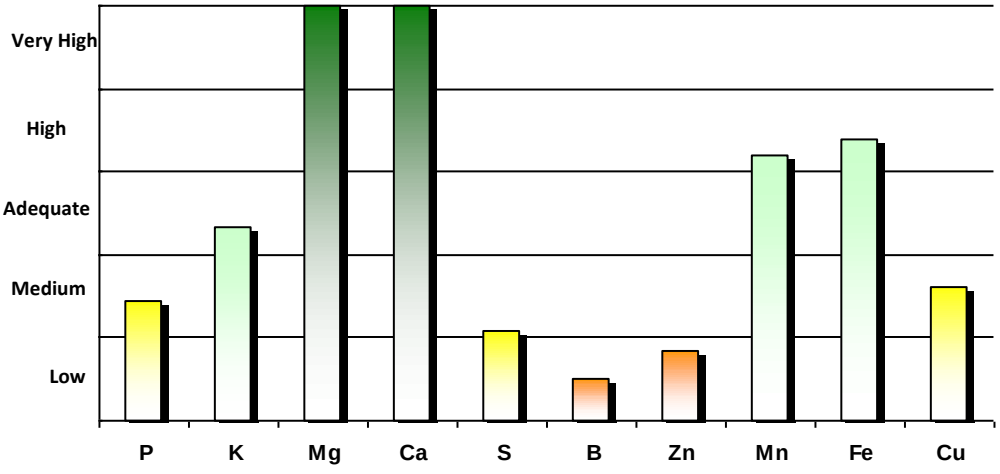
Received: 10/18/2019
Processed: 10/22/2019

Test Method: Mehlich III — **Soil Laboratory Data (lbs/a)** — **Target pH 6.5**

P	K	Mg	Ca	Soil pH	Buffer pH	S	B	Zn	Mn	Fe	Cu
Phosphorus	Potassium	Magnesium	Calcium		Adams-Evans	Sulfur	Boron	Zinc	Manganese	Iron	Copper
67 M	257 A	306 VH	2187 VH	5.5	7.50	27 M	0.5 L	3.4 L	241 H	279 H	2.4 M

Al	Na	NO3-N	NH4	Soluble Salts	Organic Matter	ENR	Mo	Ni	BiCarbs	
Aluminum	Sodium	Nitrate-N	Ammonia				Molybdenum	Nickel		
	46	ppm	ppm	mmhos/cm	2.46 %	49	ppm	ppm	meq/L	

Soil Analysis Ratings

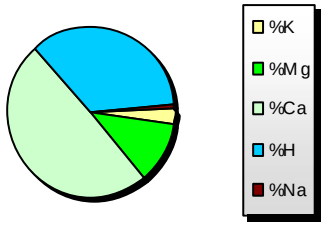


Cation Exchange Capacity 11.1 meq/100g

Base Saturation

K:	2.9 %	Mg:	11.4 %
Ca:	48.9 %	H:	35.8 %
Na:	0.9 %		

Base Saturation



Crop: NO CROP — **Fertility Recommendations (lbs/a)** — **Yield:**

Lime	Gypsum	N	P205	K20	Mg	S	B	Zn	Mn	Fe	Cu
Tons/Acre	Tons/Acre	Nitrogen	Phosphate	Potash	Magnesium	Sulfur	Boron	Zinc	Manganese	Iron	Copper
2.0											

* = Maintenance Recommendation

Comments

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Custom Analysis

Waters Agricultural Laboratories, Inc

2101 Calhoun Rd | Owensboro, KY 42301- | Phone (270) 685-4039

"Improving Growth... With Science"

Customer: 66277

LONNIE NORROD SOIL CONSULTING

277 RED WILLIAMS ROAD
CROSSVILLE, TN 38571
UNITED STATES

Project Information:

Grower: Lonnie Norrod
Farm ID: 6-12
Field ID:

Received: 10/18/2019
Processed: 10/21/2019

Lab ID	Sample ID	NO3-N ppm				
1041X	A	0.73				
1043X	B	0.92				
1045X	E	0.95				
1047X	H	2.33				
1049X	I	8.23				
1051X	K	1.24				

BDL = Below Detection Limit **-- = Analysis Not Performed For Analyte**

This document may be reproduced only in its entirety. As we have no control over the manner in which samples are collected, the analysis is based solely upon the samples as received. Liability is limited to the fee assessed on the referenced samples.

Soil Texture Determination Report

Waters Agricultural Laboratories, Inc

2101 Calhoun Rd | Owensboro, KY 42301- | Phone (270) 685-4039

"Improving Growth... With Science"

LONNIE NORROD SOIL CONSULTING [66277]

277 RED WILLIAMS ROAD
CROSSVILLE, TN 38571

Grower: Lonnie Norrod

DEPTH:
16-20"

Received: 10/18/2019
Processed: 10/22/2019

Sample ID	Lab Number	Soil Classification	% Silt+Clay	%Sand	%Clay	%Silt			
A	1042	CLAY LOAM	66.72	33.28	28.36	38.36			
B	1044	CLAY LOAM	78.68	21.32	30.32	48.36			
E	1046	CLAY LOAM	62.48	37.52	28.28	34.20			
H	1048	CLAY LOAM	74.84	25.16	36.40	38.44			
I	1050	CLAY LOAM	66.56	33.44	28.20	38.36			
K	1052	SILTY CLAY LOAM	89.28	10.72	40.40	48.88			

Comments

This document may be reproduced only in its entirety. As we have no control over the manner in which the sample was taken, the analysis is based solely on the sample as received. Accordingly, our liability is limited to the sample received and the fee assessed on same.

K. The Back-up wastewater disposal sites shall be identified and shown in the DDR. All proposed uses for the back-up sites shall be described in the DDR.

See Site Plan for soil reserve areas.

L. Cost Estimates

12.1 Engineered opinion of construction cost attached on following pages

Superior Wastewater System - II Wastewater Treatment & Dispersal
(The Homes at Mulberry Meadows Subdivision)

Opinion of Probable Construction Cost

Item No.	Item	Capital Costs
		STEP (8,100 GPD)
1	Supply and Return Force Main Lines	$120,000
2	Orenco AdvanTex AX-MAX225-35	$139,000
3	Pump Supply Building w/ Equipment	$60,000
4	13,000 LF Drip Dispersal lines w/ solenoids	$15,000
	Construction Cost	$334,000

Note:

T-Square Engineering, Inc. has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' method of determining prices, or over competitive bidding or market conditions. T-Square Engineering, Inc.'s opinions of Probable Cost are made on the basis of our experience and qualifications and represent our best judgement as an experienced and qualified professional engineering firm, familiar with the construction industry. T-Square Engineering, Inc. cannot and does not guarantee that proposals, bids or actual project costs will not vary from Opinions of Probable Cost prepared by T-Square Engineering, Inc. If prior to the Bidding or Negotiating Phase the owner wishes greater assurance as to Project Costs, the owner shall employ an independent cost estimator.

M. If auxiliary 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

Not applicable.

N. Staging or Phasing of Construction

The Homes at Mulberry Meadows Subdivision will be a single-phase development consisting of 27 lots for single family dwellings. There are currently several structures on the property which are included in the lot total and will be served by the alternative wastewater system.

Appendix

WASTEWATER TREATMENT SYSTEM
FOR
THE HOMES AT MULBERRY MEADOWS
TALIAFERRO ROAD
Map 137, Parcel 35.00
College Grove, Tennessee

Developer: McCanless and Company
PO Box 1687
Nolensville, TN 37165

Engineer: TSQUARE ENGINEERING
Consulting Civil Engineering
701 West Main Street * Franklin, TN 37064
(615) 678-8212 * Email tim@t2-eng.com

Surveyor: H&H Land Survey Inc.
PO Box 110097
Nashville, TN 37222
(615) 831-0756



LOCATION MAP
N.T.S.

Sheet Schedule

C-0.0	Cover Sheet
C-1.0	Existing Conditions & Demolition Plan
C-2.0	Overall Site Plan
C-2.1	Site Plan
C-2.2	Site Plan
C-2.3	Treatment Facility Detail Plan

Topographic Boundary Survey, including property lines, legal description, existing utilities, site topography with spot elevations, outstanding physical features and existing structure locations was provided by the following company:

H&H Land Survey Inc.
PO Box 110097
Nashville, TN 37222
(615) 831-0756

T-Square Engineering and its associates will not be held responsible for its accuracy or for design errors or emissions resulting from potential survey inaccuracies.

NOT FOR CONSTRUCTION
SUBJECT TO COUNTY APPROVAL

RESOURCE PROTECTION STANDARDS
THIS DEVELOPMENT WILL ADHERE TO THE RESOURCE PROTECTION STANDARDS SET FORTH IN ARTICLE 13 OF THE ZONING ORDINANCE CONCERNING NATURAL AND HISTORICAL RESOURCES, SUCH AS WATERWAY PROTECTION, STEEP TOPOGRAPHY AND SLIPPAGE SOIL PROTECTION, KARST TOPOGRAPHY PROTECTION, SPECIAL FLOOD HAZARD AREA PROTECTION, WETLAND PROTECTION, WOODLAND AND TREE PROTECTION, AND HISTORIC AND CULTURAL RESOURCE PROTECTION.
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OWNER OF RECORD
McCANLESS AND COMPANY PO BOX 1687 NOLENSVILLE, TN 37135
CIVIL ENGINEER
T-SQUARE ENGINEERING 701 WEST MAIN ST FRANKLIN, TN 37064 615.678.8212

REVISIONS

NO.	DATE

DATE: 9/30/2020
SCALE: AS SHOWN
DRAWN BY: T-SQUARE
REVIEWER: TT

THE HOMES AT MULBERRY MEADOWS

COVER SHEET
8496 Taliaferro Road
College Grove, TN

TIMOTHY E. TURNER
REGISTERED ENGINEER
AGRICULTURAL
STATE OF TENNESSEE

9–30–2020

PROJECT
19-0904

SHEET
C-0.0

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SUBJECT TO COUNTY APPROVAL

N

GRAPHIC SCALE
(IN FEET)
200 0 100 200 400
SCALE: 1" = 200'

LEGEND

- PROPERTY LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- SOIL AREAS
- WATERWAY NATURAL AREA BUFFER
- EXISTING TREE CANOPY

RESOURCE PROTECTION STANDARDS
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NO.	DATE	REVISIONS

DATE: 9/30/2020
SCALE: AS SHOWN
DRAWN BY: T-SQUARE
REVIEWER: TT

OVERALL EXISTING CONDITIONS

8496 TALIAFERRO ROAD
COLLEGE GROVE, TN

THE HOMES AT MULBERRY MEADOWS

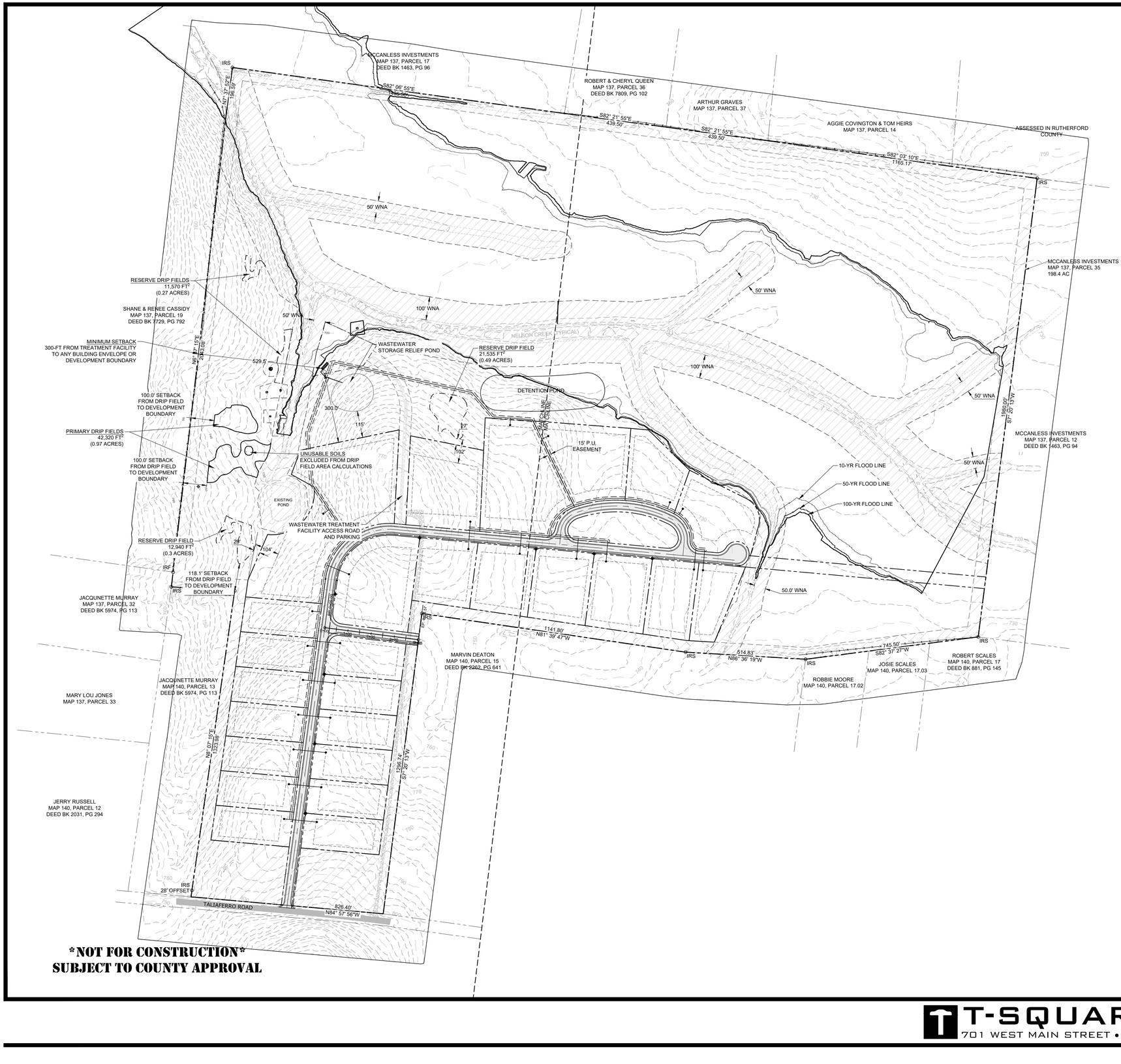
TIMOTHY E. TURNER
REGISTERED ENGINEER
AGRICULTURAL & BIOSYSTEMS
101743
STATE OF TENNESSEE
9–30–2020

PROJECT
19-0904

SHEET
C-1.0

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NOT FOR CONSTRUCTION
SUBJECT TO COUNTY APPROVAL

N

GRAPHIC SCALE
(IN FEET)
200 0 100 200 400
SCALE: 1" = 200'

LEGEND

- EXISTING PROPERTY LINE
- PROPOSED LOT LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED PAVEMENT
- PROPOSED LANDSCAPE BUFFER
- SOIL AREAS
- WATERWAY NATURAL AREA BUFFER
- EXISTING TREE CANOPY

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REVISIONS

NO.	DATE

DATE: 9/30/2020
SCALE: AS SHOWN
DRAWN BY: T-SQUARE
REVIEWER: TT

THE MULBERRY MEADOWS

OVERALL SITE PLAN

8496 TALIAFERRO ROAD
COLLEGE GROVE, TN

TIMOTHY E. TURNER
REGISTERED AGRICULTURAL ENGINEER
STATE OF TENNESSEE

9–30–2020

PROJECT
19-0904

SHEET
C-2.0

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PRIMARY DRIP FIELDS
42,320 FT²
(0.97 ACRES)

N6° 37' 15"E
2043.08

IRS

JACQUINETTE MURRAY
MAP 140, PARCEL 13.00
DEED BK 3074, PG 113

RESERVE DRIP FIELD
12,940 FT²
(0.3 ACRES)

IRS

ZONE 3
2,281 LF
7 DISTAL ENDS

ZONE 4
2,355 LF
8 DISTAL ENDS

ZONE 2
2,546 LF
8 DISTAL ENDS

ZONE 5
2,320 LF
9 DISTAL ENDS

ZONE 1
2,480 LF
8 DISTAL ENDS

UNUSABLE SOILS
EXCLUDED FROM DRIP FIELD
AREA CALCULATIONS

RESERVE DRIP FIELDS
11,570 FT²
(0.27 ACRES)

28' OFFSET

IRS

N8° 07' 15"E
1323.98'

29'

104'

EXISTING
POND

ADVANTEX AXMAX225-35
FIXED-MEDIA FILTER
SEE ORENCO DETAIL SHEET

TALIAFERRO ROAD

15.0' P.U.
EASEMENT

WASTEWATER TREATMENT FACILITY
CONTROL BUILDING
CONTAINING PLC SYSTEM CONTROLS,
DISC FILTERS, AND UV DISINFECTION

EMERGENCY RELIEF
DISCHARGE LINE TO
STORAGE POND 2"Ø

116'

WASTEWATER
STORAGE
RELIEF POND

BP: 0+00.00

WASTEWATER TREATMENT FACILITY
ACCESS ROAD AND PARKING

N84° 51' 54"W
636.40'

RESERVE DRIP FIELD
21,535 FT²
(0.49 ACRES)

1296.74'
S7° 20' 13"W

EP: 4+04.57

IRS

102'

27'

10-YR FLOOD LINE

50-YR FLOOD LINE

100-YR FLOOD LINE

DETENTION
POND

KELSH CREEK (TYPICAL)

MARVIN DEXTON
MAP 140, PARCEL 15
DEED BK 2998, PG 841

MATCHLINE

LEGEND

- EXISTING PROPERTY LINE
- PROPOSED LOT LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED PAVEMENT
- PROPOSED LANDSCAPE BUFFER
- SOIL AREAS
- WATERWAY NATURAL AREA BUFFER
- EXISTING TREE CANOPY

GRAPHIC SCALE
(IN FEET)
100 0 50 100 200
SCALE: 1" = 100'

NOT FOR CONSTRUCTION
SUBJECT TO COUNTY APPROVAL

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McCANLESS AND COMPANY PO BOX 1667 NOLENSVILLE, TN 37135
CIVIL ENGINEER
T-SQUARE ENGINEERING 701 WEST MAIN ST FRANKLIN, TN 37064 615.678.8212

REVISIONS

NO.	DATE

DATE: 9/30/2020
SCALE: AS SHOWN
DRAWN BY: T-SQUARE
REVIEWER: TT

THE HOMES AT MULBERRY MEADOWS

SITE PLAN

8496 TALIAFERRO ROAD
COLLEGE GROVE, TN

TIMOTHY E. TURNER
REGISTERED ENGINEER
AGRICULTURE
POLK
10174
STATE OF TENNESSEE

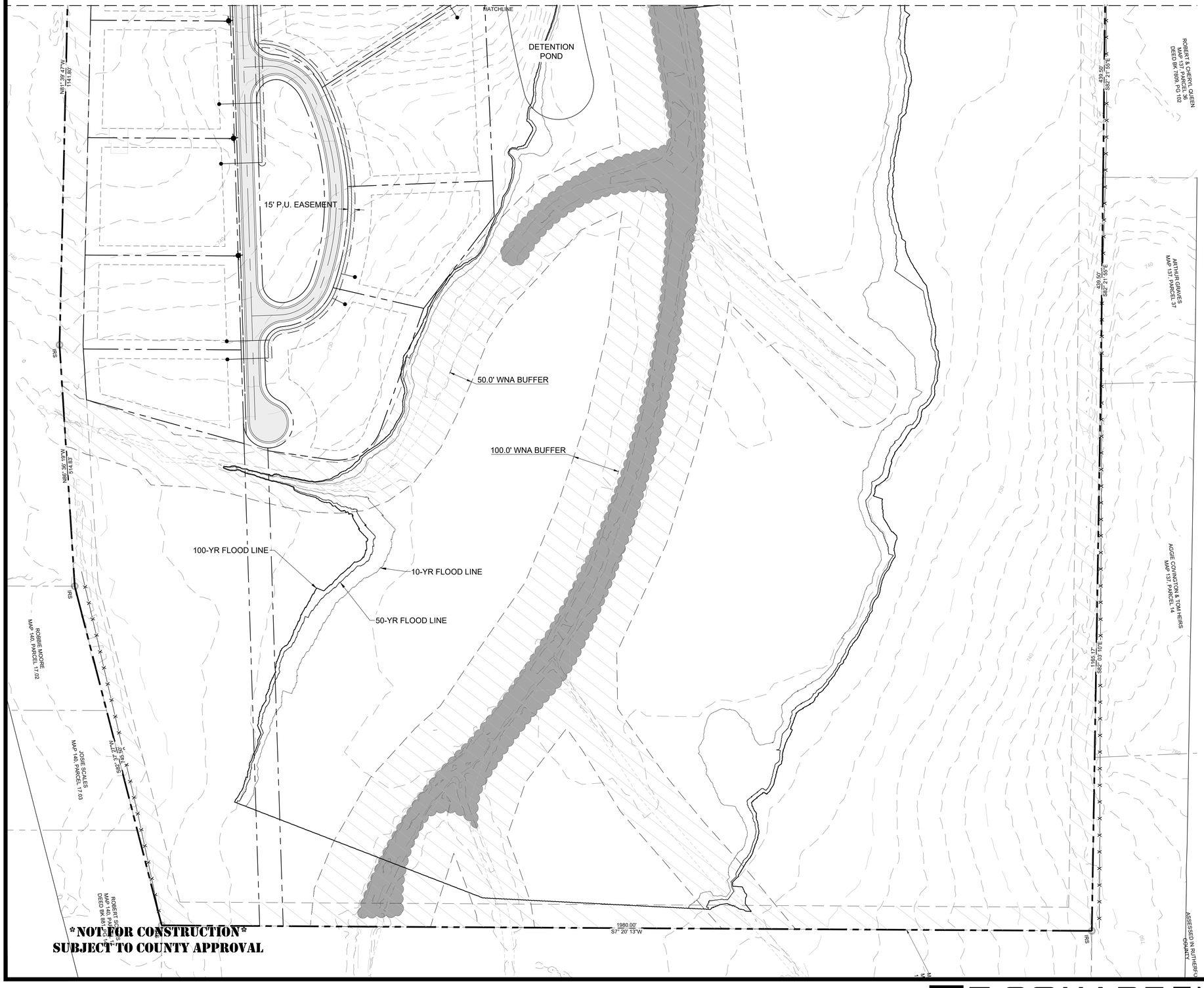
9–30–2020

PROJECT
19-0904

SHEET
C-2.1

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GRAPHIC SCALE
(IN FEET)
100 0 50 100 200
SCALE: 1" = 100'

LEGEND
- EXISTING PROPERTY LINE
- PROPOSED LOT LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED PAVEMENT
- PROPOSED LANDSCAPE BUFFER
- WATERWAY NATURAL AREA BUFFER

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NO.	DATE	REVISIONS

DATE: 9/30/2020
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DRAWN BY: T-SQUARE
REVIEWER: TT

THE HOMES AT MULBERRY MEADOWS

SITE PLAN

8496 TALIAFERRO ROAD
COLLEGE GROVE, TN

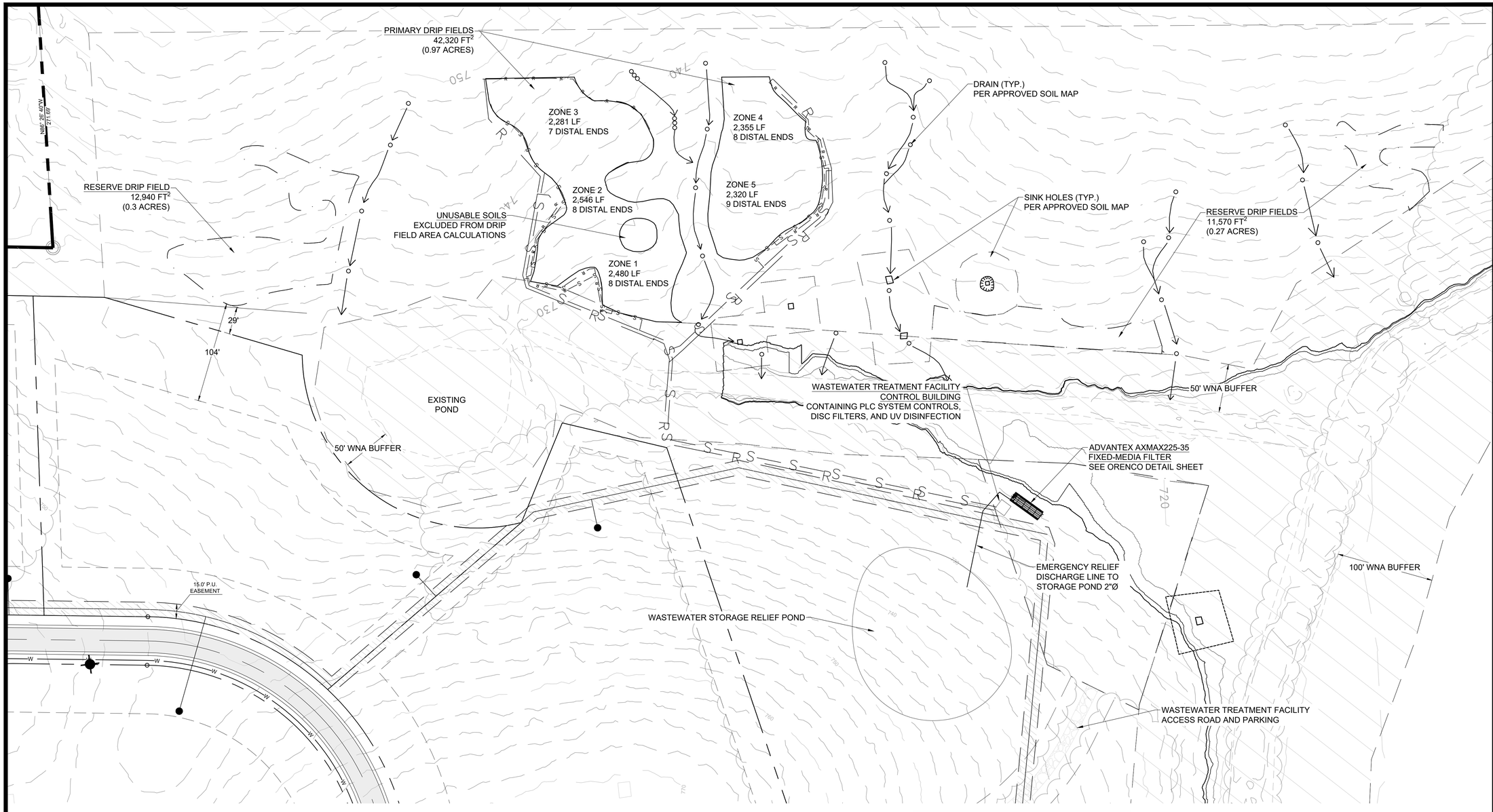
TIMOTHY E. TURNER
REGISTERED ENGINEER
AGRICULTURAL & BIOSYSTEMS
101743
STATE OF TENNESSEE
9–30–2020

PROJECT
19-0904

SHEET
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SUBJECT TO COUNTY APPROVAL

LEGEND

- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- DRIP FIELD SUPPLY LINE
- DRIP FIELD SUPPLY MANIFOLD
- DRIP FIELD RETURN MANIFOLD
- DRIP FIELD FLUSH RETURN LINE
- DRIP FIELD SOLENOID VALVE
- AUTOMATIC AIR RELEASE VALVE
- DRIP FIELD CHECK VALVE
- PROPOSED UTILITY EASEMENT
- PROPOSED LOT LINE
- SOIL AREA
- WATERWAY NATURAL AREA BUFFER

GRAPHIC SCALE
(IN FEET)
50 0 25 50 100
SCALE: 1" = 50'

RESOURCE PROTECTION STANDARDS
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REVISIONS

NO.	DATE

DATE: 9/30/2020
SCALE: AS SHOWN
DRAWN BY: T-SQUARE
REVIEWER: TT

THE HOMES AT MULBERRY MEADOWS

TREATMENT FACILITY DETAIL PLAN

8496 Taliaferro Road
College Grove, TN

TIMOTHY E. TURNER
REGISTERED ENGINEER
AGRICULTURAL
No. 101745
STATE OF TENNESSEE

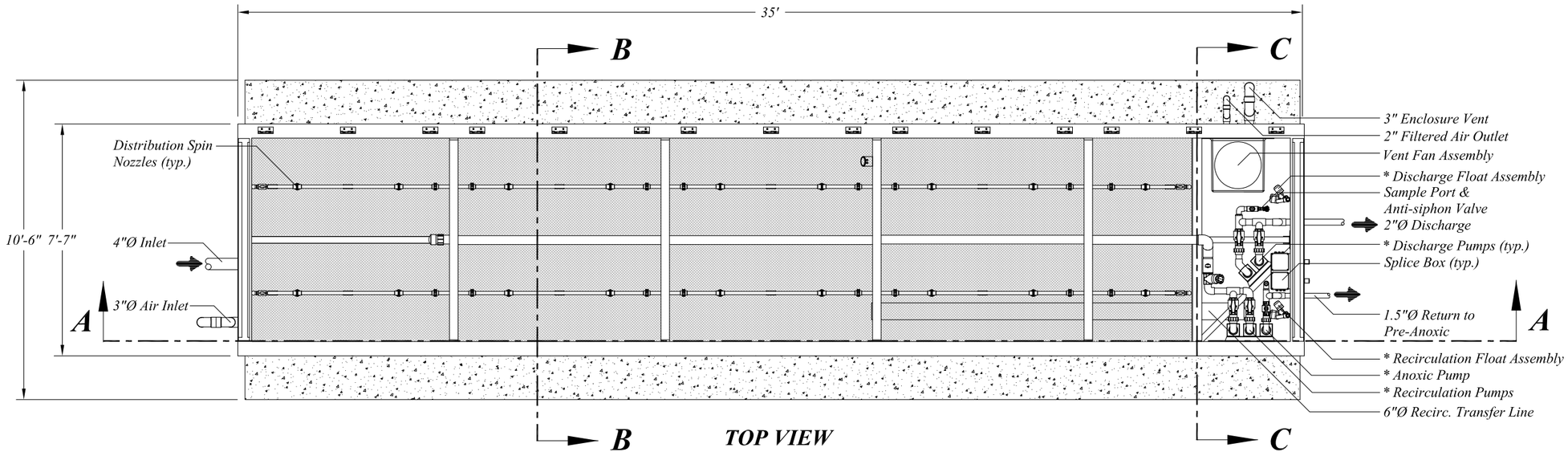
9–30–2020

PROJECT
19-0904

SHEET
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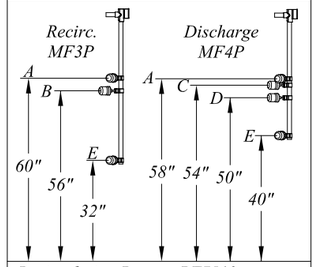
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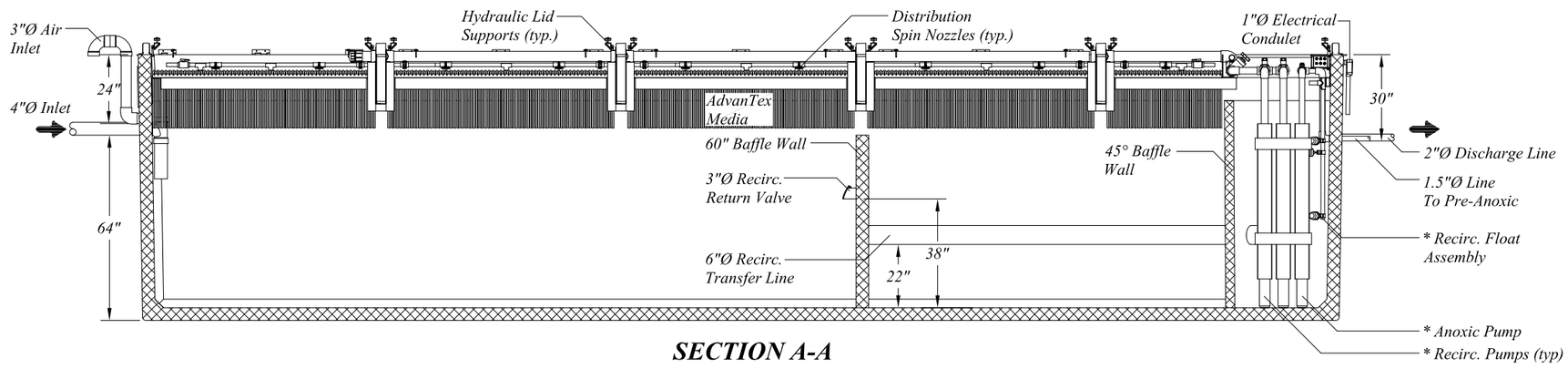
TOP VIEW

* *Float Functions & Pump Index*

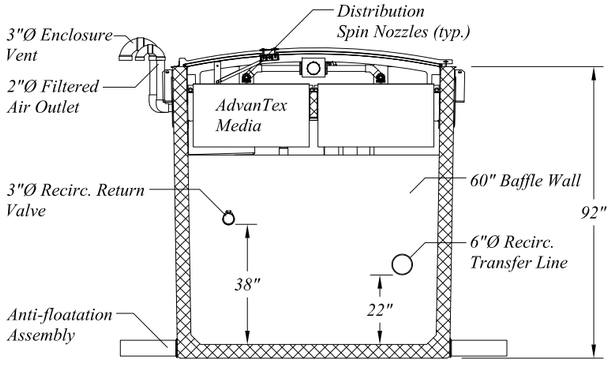
A	High Level Alarm / Lag Enable
B	Override Timer
C	Pump ON
D	Pump OFF
E	Redundant Off / Low Level Alarm



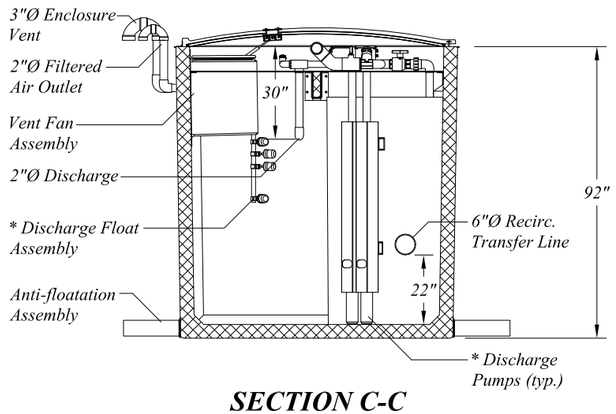
Recirculation Pumps: PF7510
Discharge Pumps: PF_____
Anoxic Return Pump: PF2005



SECTION A-A



SECTION B-B



SECTION C-C

Customer Approval

Signature: _____ Date: _____

Customer Name: _____

By this signature, Customer indicates that they have reviewed this Proposed System Configuration Drawing and found that it meets all of the designer's functional requirements and/or specifications.

Orenco SYSTEMS

© Orenco Systems, Inc.
Portions or all of this Proposed System Configuration Drawing, as appropriate, may be reproduced and integrated into the site-specific layout and configuration of a system by its designer.

Disclaimer: This Proposed System Configuration Drawing is provided solely as a design aid and illustrates one possible configuration of a system that would comply with Orenco's design criteria for the requirements and/or specifications that have been communicated to Orenco (based on third-party standards testing protocols and performance reports, as applicable). Design decisions, including the actual layout and configuration of the system and its viability for the project, are at the sole discretion of the systems's designer.

AdvanTex AX-Max225-35

System Details

Drawn By:	Ben Smith	Scale:	1" = 4'-0"
Reviewed By:	CSJ / NTB	Sheet:	1 OF 1
File Name:	MAX225-35.DWG	Rev: 2.0	Date: 9/05/2018

Provide a copy of the State Operator Certificate for the wastewater system operator of record. If the operator is a contract employee of the utility, provide a copy of the employment contract.

RESPONSE:
The operator of record for Superior Wastewater Systems is Mr. James Johnson. A copy of Mr. Johnson's State Operator Certificate is attached. Mr. Johnson is an independent contractor and his contract with Superior Wastewater Systems (formerly King's Chapel Capacity) is also attached.

Engagement Agreement

I, Jim Johnson, a certified holder of a class 4 wastewater operators license in Tennessee offer contract employment services to King's Chapel Capacity, LLC ("KCC") for the purpose of operating any of their facilities. The proposed engagement period is for an unspecified period of time and shall exist as long as services are being rendered or until terminated by either party. As payment for these services, KCC agrees to pay me a mutually agreed amount of $250.00 per month. I Understand I may be required to appear at State Administrative Conferences, State Board Hearings, and any Williamson County Proceedings.

Pursuant to this agreement, I agree to be the full-time operator of the aforesaid sewer wastewater system. This would entail, but not be limited to, inspecting and maintaining the system in accordance with all applicable Local, State and Federal laws and rules.

Either party can terminate with or without cause this agreement. If terminated by me, I agree to give KCC a 30-day written notice prior to the final day of my services. I also agree to perform the required and necessary services needed to operate and maintain the sewer system up until the final agreed upon date of work. If terminated by KCC, KCC agrees to compensate me for any work performed up to the time of termination and agrees to provide a 30-day severance.

James B. Johnson

Jim Johnson 1186
Operator

09-26-2018
Date

J. Powell

John Powell
Managing Member of KCC

9/26/18
Date

WATER AND WASTEWATER OPERATOR CERTIFICATION BOARD

NAME AND MAILING ADDRESS

James B Johnson
307 Stafford Ct.
Smyrna, TN 37167

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
WATER AND WASTEWATER OPERATOR CERTIFICATION BOARD

I.D. NO.	EXPIRATION DATE	RENEWAL NO.
1186	12/31/2020	101883

THIS IS TO CERTIFY THAT:

James B Johnson

IS IN GOOD STANDING WITH THE BOARD FOR THE CLASSIFICATIONS LISTED:

WW4

WHEN CORRESPONDING ALWAYS REFER TO YOUR I.D. NUMBER
AND SEND NOTIFICATION OF ADDRESS CHANGE

Provide the name, address, and telephone number of the technical contact person responsible for and knowledgeable about the applicant's proposed operations in Tennessee.

RESPONSE:
The operator of record for Superior Wastewater Systems is Mr. James Johnson. Mr. Johnson's contact information is as follows:

Jim Johnson
307 Stafford Court
Smyrna, TN 37167

615-419-7404

Provide a list of any complaint(s), notices of violations or administrative action filed with or issued by a regulatory agency. Identify the nature of the complaint, notices of violation or administrative action, which agency is involved, and how the issue was or is being resolved.

RESPONSE:
To our knowledge, Superior Wastewater Systems has never received a complaint from any end-use customer in the King's Chapel Subdivision that was filed with either the Tennessee Public Utility Commission (TPUC) or the Tennessee Department of Environment & Conservation (TDEC).

On its own motion, TPUC initiated a show cause proceeding against Superior Wastewater Systems for alleged violations of wastewater utility laws and rules relating to posting of financial security in Docket No. 14-00007. This docket was conditionally dismissed by TPUC in its April 22, 2016 Order based on the submission of a fully executed bond. To our knowledge, this incident represents the only complaint, notice of violation or administrative action taken by either TPUC or TDEC against Superior Wastewater Systems.

Provide a certification from a design engineer that the wastewater system was constructed in accordance with the TDEC approved construction plans and specifications. The certification shall be filed in the docket prior to providing service.

RESPONSE:
Superior Wastewater Systems will provide a certification from a design engineer that the wastewater system at Fox Parcel was constructed in accordance with the TDEC approved construction plans and specifications when construction is complete and before providing service to any end-use customers.

EXHIBIT 5
FINANCIAL CAPABILITIES

Exhibit 5.1	2019 Financial Statements
Exhibit 5.2	10-Year Pro Forma Income Statement
Exhibit 5.3	Chart of Accounts
Exhibit 5.4	Plant in Service
Exhibit 5.5	Depreciation Rates
Exhibit 5.6	Estimated Wastewater Construction Cost
Exhibit 5.7	Wastewater Ownership Statement
Exhibit 5.8	Wastewater Tariff
Exhibit 5.9	Estimated Annual Customer Additions
Exhibit 5.10	Local Bonding Requirements
Exhibit 5.11	Wastewater System Performance Bond for Construction
Exhibit 5.12	Funding Sources
Exhibit 5.13	Compliance with TPUC Financial Security Requirement

Provide the financial statements for the applicant covering the most recent year ended. Include a balance sheet, income statement and statement of cash flows.

RESPONSE:
Attached is the 2019 Annual Report of Superior Wastewater Systems (formerly King's Chapel Capacity) to the Tennessee Public Utility Commission.

STATE OF TENNESSEE

COUNTY OF Williamson

We the undersigned John Powell
and _____
of Superior Wastewater Systems, LLC
on our oath do severally say that the foregoing return has been prepared, under our direction, from the original books, papers and records of said utility; that we have carefully examined the same, and declare the same to be a correct statement of the business and affairs of said utility for the period covered by the return in respect to each and every matter and thing therein set forth, to the best of our knowledge, information and belief.

.....
(Chief Officer)

.....
(Officer in charge of accounts)

Subscribed and sworn to before me this.....
day of....., 20.....
.....
Notary Public, ...County, ...
My commission will expire.....
.....
(Seal)

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WATER SECTION

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Name of Respondent	This Report is:	Date of Report (Mo, Da, Yr)	Year of Report
Superior Wastewater Systems, LLC	(1) X An Original (2) __ A Resubmission	3-31-20	2019

IDENTIFICATION & OWNERSHIP

Report of: Superior Wastewater Systems, LLC
(REPORT THE EXACT NAME OF UTILITY)

Located at: 9539 Mullens Road
Arrington, TN 37014

Year Ended: 2019

Date Utility was Originally Organized:
April 13, 2004 with the Tennessee Secretary of State's Office

Location of Office Where Accounts and Records are Kept:
9539 Mullens Road
Arrington, TN 37014

Give the Name,Title,&Office Address of the Officer of the Utility to Whom Correspondence Should be Addressed Concerning this Report:
John Powell, General Manager
9539 Mullens Road, Arrington, TN 37014

Telephone: 615-834-1222

OFFICERS & MANAGERS

NAME	TITLE	SALARY
John Powell	President & General Manager	N/A

OWNERSHIP

Report every corporation or individual owning or holding directly or indirectly 5 percent or more of the voting securities of the reporting utility.

Name (a)	Address (b)	Percent Ownership In Utility (c)	Salary Charged Utility (d)	Meetings Attended During Year (e)
John Powell	9539 Mullens Road Arrington, TN 37014	100%	$0	N/A

Name of Respondent	This Report is:	Date of Report	Year of Report
Superior Wastewater Systems, LLC	(1) X An Original (2) ___ A Resubmission	(Mo, Da, Yr) 3-31-20	2019

INCOME STATEMENT

Account Name (a)	Ref Page (b)	Water (c)	Sewer (d)	Other (e)	Total (f)
Gross Revenue:					
Residential			$102,037		$102,037
Commercial			0		0
Industrial			0		0
Multi-Family			0		0
Other (Please Specify)			0		0
Other (Please Specify)			0		0
Other (Please Specify)			0		0
Other (Please Specify)			0		0
Total Gross Revenue			**$102,037**		**$102,037**
Operation & Maint. Expense	W3/S3		$89,502		$89,502
Depreciation Expense	F-5		0		0
Amortization Expense			0		0
Other Expense (Please Specify)			0		0
Other Expense (Please Specify)			0		0
Taxes Other Than Income	F-7		4,077		4,077
Income Taxes	F-7		0		0
Total Operating Expenses			**$93,579**		**$93,579**
Net Operating Income			**$8,458**		**$8,458**
Other Income:					
Nonutility Income			$0		$0
Other (Please Specify)			0		0
Other (Please Specify)			0		0
Other (Please Specify)			0		0
Other (Please Specify)			0		0
Total Other Income			**$0**		**$0**
Other Deductions:					
Misc. Nonutility Expenses			$0		$0
Other - Interest Expense			0		0
Other (Please Specify)			0		0
Other (Please Specify)			0		0
Other (Please Specify)			0		0
Total Other Deductions			**$0**		**$0**
Net Income			**$8,458**		**$8,458**

Name of Respondent	This Report is:	Date of Report	Year of Report
Superior Wastewater Systems, LLC	(1) X An Original (2) ___ A Resubmission	(Mo, Da, Yr) 3-31-20	2019

COMPARATIVE BALANCE SHEET

Account Name (a)	Ref Page (b)	Current Year (c)	Previous Year (d)
ASSETS			
Utility Plant in Service (101-105)	F5/W1/S1	$689,063	$689,063
Accum. Depreciation and Amortization (108)	F5/W2/S2	177,950	164,588
Net Utility Plant		**$511,113**	**$524,475**
Cash		$6,004	$4,177
Customer Accounts Receivable (141)		0	0
Escrow Deposits (132)		9,126	43
Other Assets (Please Specify)		0	0
Other Assets (Please Specify)		0	0
Other Assets (Please Specify)		0	0
Total Assets		**$526,243**	**$528,695**
LIABILITIES AND CAPITAL			
Common Stock Issued (201)	F-6	$0	$0
Preferred Stock Issued (204)	F-6	0	0
Other Paid-In Capital (211)		0	0
Retained Earnings (215)	F-6	-4,381	-12,838
Capital (Proprietary & Partnership-218)	F-6	169,114	177,812
Total Capital		**$164,733**	**$164,974**
Long-Term Debt (224)	F-6	$0	$0
Accounts Payable (231)		0	0
Notes Payable (232)		0	0
Customer Deposits (235)		2,760	2,760
Accrued Taxes (236)		0	0
Advances Payable		0	0
Escrowed Deposits (235.1)		99,836	88,685
Other Liabilities (Please Specify)		0	0
Other Liabilities (Please Specify)		0	0
Other Liabilities (Please Specify)		0	0
Advances for Construction		0	0
Contributions In Aid Of Const.-Net (271-2)	F-8	258,914	272,276
Total Liabilities		**$361,510**	**$363,721**
Total Liabilities & Capital		**$526,243**	**$528,695**

Name of Respondent	This Report is:	Date of Report (Mo, Da, Yr)	Year of Report
Superior Wastewater Systems, LLC	(1) X An Original (2) ___ A Resubmission	3-31-20	2019

NET UTILITY PLANT

Plant Accounts (101-107) Inclusive (a)	Water (c)	Sewer (d)	Other (e)	Total (f)
Utility Plant in Service (101)		$689,063		$689,063
Construction Work in Progress (105)		0		0
Other (Please Specify)		0		0
Other (Please Specify)		0		0
Other (Please Specify)		0		0
Other (Please Specify)		0		0
Other (Please Specify)		0		0
Other (Please Specify)		0		0
Total Utility Plant		**$689,063**		**$689,063**

ACCUMULATED DEPRECIATION AND AMORTIZATION OF UTILITY PLANT

Account 108 (a)	Water (c)	Sewer (d)	Other (e)	Total (f)
Balance First of Year		$164,588		$164,588
Credits During Year:				
Accruals charged to Depr. Account		$13,362		$13,362
Salvage		0		0
Other Credits (Please Specify):		0		0
Other Credits (Please Specify):		0		0
Other Credits (Please Specify):		0		0
Other Credits (Please Specify):		0		0
Total Credits		**$13,362**		**$13,362**
Debits During Year:				
Book/Historical Cost of Plant Retired		$0		$0
Cost of Removal		0		0
Other Debits (Please Specify):		0		0
Other Debits (Please Specify):		0		0
Other Debits (Please Specify):		0		0
Other Debits (Please Specify):		0		0
Total Debits		**$0**		**$0**
Balance End of Year		**$177,950**		**$177,950**

Name of Respondent	This Report is:	Date of Report (Mo, Da, Yr)	Year of Report
Superior Wastewater Systems, LLC	(1) X An Original (2) ___ A Resubmission	3-31-20	2019

CAPITAL STOCK (201 - 204)

(a)	Common Stock (b)	Preferred Stock (c)
Par or stated value per share	N/A	N/A
Shares Authorized	N/A	N/A
Shares issued and outstanding	N/A	N/A
Total par value of stock issued	0	0
Dividends declared per share for year	0	0

RETAINED EARNINGS (215)

(a)	Appropriated (b)	Unappropriated (c)
Balance first of year	0	-12,838
Changes during year NET INCOME/(NET LOSS)	0	8,458
Changes during year (Please Specify)		
Changes during year (Please Specify)		
Changes during year (Please Specify)		
Changes during year (Please Specify)		
Changes during year (Please Specify)		
Balance end of year	0	-4,380

PROPRIETARY CAPITAL (218)

(a)	Proprietor (b)	Partner (c)
Balance first of year	$177,812	
Deposits from Owners	-8,698	
Net Income	0	
Changes during year (Please Specify)	0	
Changes during year (Please Specify)	0	
Changes during year (Please Specify)	0	
Changes during year (Please Specify)	0	
Balance end of year	**$169,114**	

LONG-TERM DEBT (224)

Description of Obligation including Issue & Maturity Dates (a)	Interest Rate (b)	Year End Balance (c)
N/A	0.00%	$0
N/A	0.00%	0
N/A	0.00%	0
N/A	0.00%	0
N/A	0.00%	0
N/A	0.00%	0
N/A	0.00%	0
N/A	0.00%	0
N/A	0.00%	0
N/A	0.00%	0
N/A	0.00%	0
N/A	0.00%	0
Total Long-Term Debt		**$0**

Name of Respondent	This Report is:	Date of Report	Year of Report
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TAXES ACCRUED (236)

Description (a)	Water (b)	Sewer (c)	Other (d)	Total (e)
Balance First of year		$0		$0
Accruals Charged:				
Federal Income Tax		$0		$0
Local Property tax		0		0
State ad valorem tax		0		0
TN State Sales Tax		0		0
Regulatory Assessment Fee		0		0
Payroll Tax		0		0
Other Taxes (Please Specify)		0		0
Other Taxes (Please Specify)		0		0
Total Taxes Accrued		**$0**		**$0**
Taxes Paid				
Federal Income Tax		$0		$0
Local Property tax		0		0
State ad valorem tax		0		0
TN State Sales Tax		0		0
Regulatory assessment fee		0		0
Payroll Tax		0		0
TN Treasurer (Permit Fee)		0		0
TN Fran & Excise		0		0
Total Taxes Paid		**$0**		**$0**
Balance End of Year		**$0**		**$0**

PAYMENTS FOR SERVICES RENDERED BY OTHER THAN EMPLOYEES

Report all info concerning rate, management, construction, advertising, labor relations, or other professional services rendered to the Utility for which total payments during the year to any Corp, Ptnshp, indiv, or organization of any kind, amounted to $500 or more.

Name of Recipient	Amount	Description of Service
Premier Property Management	44,327	Employee Benefits
Middle TN Electric	9,566	Electric Supplier
Elaine Powell	8,400	Billing Services
WHN Consulting	8,100	Regulatory & Accounting Services
Rock City Machine	6,911	Maintenance & Repair
Evans, Jones & Reynolds	6,020	Legal Services
James Johnson	3,350	Testing Services
Grundy Insurance	2,721	Insurance
Wascon, Inc	1,899	Maintenance & Repair
Discount Plumbing	1,184	Maintenance & Repair
Smith Manus	1,179	Bonding Services
Shell	892	Materials & Supplies
USPS	870	Materials & Supplies
		See Attached Schedule F-7a for Additional Payments

Supplement to Page F-7

Name of Recipient	Amount	Description of Service
Rusty Temple	591	Maintenance & Repair
Al & Ralph's	550	Maintenance & Repair
All Points Septic	550	Maintenance & Repair

Name of Respondent	This Report is:	Date of Report	Year of Report
Superior Wastewater Systems, LLC	(1) X An Original (2) ___ A Resubmission	(Mo, Da, Yr) 3-31-20	2019

CONTRIBUTIONS IN AID OF CONSTRUCTION (271)

Description (a)	Water (b)	Sewer (c)	Total (d)
Balance First of Year		**$272,276**	**$272,276**
Add Credits During Year		0	0
Less Charges During Year		0	0
Balance End of Year		**$272,276**	**$272,276**
Less Accumulated Amortization		13,362	13,362
Net Contributions in Aid of Construction		**$258,914**	**$258,914**

ADDITIONS TO CONTRIBUTIONS IN AID OF CONSTRUCTION DURING YEAR (CREDITS)

Report below all developers or contractors agreements from which cash or property was received during the year (a)	Indicate "Cash" or "Property" (b)	Water (c)	Sewer (d)
Contractor or Developer #1			$0
Contractor or Developer #2			0
Contractor or Developer #3			0
Contractor or Developer #4			0
Contractor or Developer #5			0
Contractor or Developer #6			0
Contractor or Developer #7			0
Contractor or Developer #8			0
Contractor or Developer #9			0
Contractor or Developer #10			0
Contractor or Developer #11			0
Contractor or Developer #12			0
Contractor or Developer #13			0
Contractor or Developer #14			0
Contractor or Developer #15			0
Contractor or Developer #16			0
Contractor or Developer #17			0
Contractor or Developer #18			0
Contractor or Developer #19			0
Contractor or Developer #20			0
Contractor or Developer #21			0
Contractor or Developer #22			0
Contractor or Developer #23			0
Contractor or Developer #24			0
Contractor or Developer #25			0
Contractor or Developer #26			0
Contractor or Developer #27			0
Contractor or Developer #28			0
Contractor or Developer #29			0
Contractor or Developer #30			0
Total Credits During Year			**$0**

Name of Respondent	This Report is:	Date of Report	Year of Report
Superior Wastewater Systems, LLC	(1) X An Original (2) ___ A Resubmission	(Mo, Da, Yr) 3-31-20	2019

SEWER UTILITY PLANT ACCOUNTS

Acct No. (a)	Account Name (b)	Previous Year (c)	Additions (d)	Retirements (e)	Current Year (f)
351	Organization	$248,414	$0	$0	$248,414
352	Franchises	0	0	0	0
353	Land & Land Rights	10	0	0	10
354	Structures & Improvements	0	0	0	0
360	Collection Sewers - Force	171,854	0	0	171,854
361	Collection Sewers - Gravity	0	0	0	0
362	Special Collecting Structures	0	0	0	0
363	Services to Customers	0	0	0	0
364	Flow Measuring Devices	3,385	0	0	3,385
365	Flow Measuring Installations	400	0	0	400
370	Receiving Wells	15,000	0	0	15,000
371	Pumping Equipment	0	0	0	0
380	Treatment & Disposal Equipment	250,000	0	0	250,000
381	Plant Sewers	0	0	0	0
382	Outfall Sewer Lines	0	0	0	0
389	Other Plant & Miscellaneous Equipment	0	0	0	0
390	Office Furniture & Equipment	0	0	0	0
391	Transportation Equipment	0	0	0	0
392	Stores Equipment	0	0	0	0
393	Tools, Shop & Garage Equipment	0	0	0	0
394	Laboratory Equipment	0	0	0	0
395	Power Operated Equipment	0	0	0	0
396	Communication Equipment	0	0	0	0
397	Miscellaneous Equipment	0	0	0	0
398	Other Tangible Plant	0	0	0	0
	Total Sewer Plant	**$689,063**	**$0**	**$0**	**$689,063**

Name of Respondent	This Report is:	Date of Report	Year of Report
Superior Wastewater Systems, LLC	(1) X An Original (2) ___ A Resubmission	(Mo, Da, Yr) 3-31-20	2019

ANALYSIS OF ACCUMULATED DEPRECIATION BY PRIMARY ACCOUNT - SEWER

Account Number (a)	Account (b)	Average Service Life in Years (c)	Average Salvage Value in Percent (d)	Depreciation Rate Applied* (e)	Accumulated Depreciation Balance Previous Year (f)	Debits (g)	Credits (h)	Accumulated Depreciation Balance End of Year (i)
354	Structures & Improvements	0	0.00%	0.00%	$0	$0	$0	$0
360	Collection Sewers - Force	50	0.00%	2.00%	41,244	0	3,437	44,681
361	Collection Sewers - Gravity	0	0.00%	0.00%	0	0	0	0
362	Special Collecting Structures	0	0.00%	0.00%	0	0	0	0
363	Services to Customers	0	0.00%	0.00%	0	0	0	0
364	Flow Measuring Devices	10	0.00%	10.00%	3,809	0	0	3,809
365	Flow Measuring Installations	10	0.00%	10.00%	440	0	0	440
370	Receiving Wells	50	0.00%	2.00%	3,600	0	300	3,900
371	Pumping Equipment	0	0.00%	0.00%	0	0	0	0
380	Treatment & Disposal Equipment	26	0.00%	3.85%	115,496	0	9,625	125,121
381	Plant Sewers	0	0.00%	0.00%	0	0	0	0
382	Outfall Sewer Lines	0	0.00%	0.00%	0	0	0	0
389	Other Plant & Miscellaneous Equipment	0	0.00%	0.00%	0	0	0	0
390	Office Furniture & Equipment	0	0.00%	0.00%	0	0	0	0
391	Transportation Equipment	0	0.00%	0.00%	0	0	0	0
392	Stores Equipment	0	0.00%	0.00%	0	0	0	0
393	Tools, Shop & Garage Equipment	0	0.00%	0.00%	0	0	0	0
394	Laboratory Equipment	0	0.00%	0.00%	0	0	0	0
395	Power Operated Equipment	0	0.00%	0.00%	0	0	0	0
396	Communication Equipment	0	0.00%	0.00%	0	0	0	0
397	Miscellaneous Equipment	0	0.00%	0.00%	0	0	0	0
398	Other Tangible Plant	0	0.00%	0.00%	0	0	0	0
	Totals				**$164,589**	**$0**	**$13,362**	**$177,951**

*State basis used for percentages used in schedule.

Name of Respondent	This Report is:	Date of Report	Year of Report
Superior Wastewater Systems, LLC	(1) X An Original (2) ___ A Resubmission	(Mo, Da, Yr) 3-31-20	2019

SEWER OPERATION & MAINTENANCE EXPENSE

Acct No.	Description (a)	Amount (b)
701	Salaries & Wages - Employees	$0
703	Salaries & Wages - Officers, Directors & Stockholders	0
704	Employee Pensions & Benefits	42,904
710	Purchased Sewage Treatment	0
711	Sludge Removal Expense	0
715	Purchased Power	9,566
716	Fuel for Power Production	0
718	Chemicals	0
720	Materials & Supplies	689
730	Contractual Services	25,969
740	Rents	0
750	Transportation Expense	1,928
755	Insurance Expense	0
765	Regulatory Commission Expense	0
770	Bad Debt Expense	0
775	Miscellaneous Expenses	8,445
	Total Sewer Operation & Maintenance Expense	**$89,502**

SEWER CUSTOMERS

Description (a)	Customers First of Year (b)	Additions (c)	Disconnections (d)	Customers End of Year (e)
Metered Customers:				
5/8 Inch	268	9	0	277
3/4 Inch	0	0	0	0
1.0 Inch	0	0	0	0
1.5 Inch	0	0	0	0
2.0 Inch	0	0	0	0
2.5 Inch	0	0	0	0
3.0 Inch	0	0	0	0
4.0 Inch	0	0	0	0
6.0 Inch	0	0	0	0
8.0 Inch	0	0	0	0
Other (Please Specify)	0	0	0	0
Other (Please Specify)	0	0	0	0
Other (Please Specify)	0	0	0	0
Unmetered Customers	0	0	0	0
Total Customers	**268**	**9**	**0**	**277**

Name of Respondent	This Report is:	Date of Report	Year of Report
Superior Wastewater Systems, LLC	(1) X An Original (2) ___ A Resubmission	(Mo, Da, Yr) 3-31-20	2019

PUMPING EQUIPMENT

Description*** (a)	Lift Station #1 (b)	Lift Station #2 (c)	Lift Station #3 (d)	Lift Station #4 (e)
Make, Model, or Type of Pump				
Year Installed	**2006**			
Rated Capacity (GPM)	**75 GPM**			
Size (HP)	**1.5 HP**			
Power (Electric/Mechanical)	**Electric**			
Make, Model or Type of Motor	Orenco PJ51512 **Turbine**			

SERVICE CONNECTIONS

Description*** (a)	Service Connection #1 (b)	Service Connection #2 (c)	Service Connection #3 (d)	Service Connection #4 (e)
Size (Inches)	**1.0"**			
Type (PVC, VCP, etc)	**PVC**			
Average Length (Feet)	**50'**			
Connections-Beginning of Year	268	0	0	0
Connections-Added during Year	9	0	0	0
Connection-Retired during Year	0	0	0	0
Connections-End of Year	**277**	**0**	**0**	**0**
Number of Inactive Connections	0	0	0	0

COLLECTING MAINS, FORCE MAINS, & MANHOLES

Description (a)	Collecting Mains (b)	Force Mains (c)	Manholes (d)
Size (Inches)	**2.0"**	**6.0"**	**N/A**
Type	**PVC**	**PVC**	**N/A**
Length/Number-Beginning of Year	0	0	0
Length/Number-Added During Year	12,000 LF	2,000 LF	0
Length/Number-Retired During Year	0	0	0
Length/Number-End of Year	**12,000LF**	**2,000 LF**	**0**

***If more space is needed to list equipment please attach additional sheets as necessary.

Name of Respondent	This Report is:	Date of Report	Year of Report
Superior Wastewater Systems, LLC	(1) X An Original (2) ___ A Resubmission	(Mo, Da, Yr) 3-31-20	2019

TREATMENT PLANT

Description*** (a)	Treatment Facility #1 (b)	Treatment Facility #2 (c)	Treatment Facility #3 (d)	Treatment Facility #4 (e)
Manufacturer	**Orenco**			
Type	**P501512**			
Steel or Concrete	**Steel**			
Total Capacity	**560 GPM**			
Average Daily Flow	**36,500 Gal**			
Effluent Disposal	**Land**			
Total Gallons of Sewage Treated	**13,035,500**			

MASTER LIFT STATION PUMPS

Description*** (a)	Master Pump #1 (b)	Master Pump #2 (c)	Master Pump #3 (d)	Master Pump #4 (e)
Manufacturer	**Orenco**			
Capacity (GPM)	**75 GPM**			
Size (HP)	**1.5 HP**			
Power (Electric/Mechanical)	**Electric**			
Make, Model, or Type of Motor	**Turbine**			

OTHER SEWER SYSTEM INFORMATION

Present Number of Equivalent Residential Customer's * being served	277
Maximum Number of Equivalent Residential Customer's * that the system can efficiently serve	561
Estimated Annual Increase in Equivalent Residential Customers *	25/Year

* Equivalent Residential Customers = (Total Gallons Treated / 365 Days) / 275 Gallons Per Day.
Total Gallons Treated includes both sewage treated and purchased sewage treatment.

State any plans and estimated completion dates for any enlargements of this system:

N/A

If the present systems do not meet environmental requirements, please submit the following:

A. An evaluation of the present plant or plants in regard to meeting the requirements.

B. Plans for funding and construction of the required upgrading.

C. The date construction will begin. **N/A**

What is the percent of the certificated area that have service connections installed?

All (100%) of the certificated area of SWS have service connections in place.

***If more space is needed to list equipment please attach additional sheets as necessary.

Name of Respondent	This Report is:	Date of Report	Year of Report
Superior Wastewater Systems, LLC	(1) X An Original (2) ___ A Resubmission	(Mo, Da, Yr) 3-31-20	2019

SUPPLEMENTAL FINANCIAL DATA TO THE ANNUAL REPORT

Rate Base

Additions:		3
Plant In Service	$689,063	4
Construction Work in Progress	0	5
Property Held For Future Use	0	6
Materials & Supplies	0	7
Working Capital Allowance	0	8
Escrow Deposits	9,126	9
Other Additions (Please Specify)	0	10
Total Additions to Rate Base	**$698,189**	11
		12
		13
Deductions:		14
Accumulated Depreciation	$177,950	15
Accumulated Deferred Income Taxes	0	16
Pre 1971 Unamortized Investment Tax Credit	0	17
Customer Deposits	2,760	18
Contributions in Aid of Construction	258,914	19
Escrow Liability	99,836	20
Other Deductions (Please Specify)	0	21
Total Deductions to Rate Base	**$539,460**	22
		23
		24
Rate Base	**$158,729**	25

Adjusted Net Operating Income

Operating Revenues:		28
Residential	$102,037	29
Commercial	0	30
Industrial	0	31
Public Authorities	0	32
Multiple Family	0	33
Fire Protection	0	34
All Other	0	35
Total Operating Revenues	**$102,037**	36
		37
Operating Expenses:		38
Operation	$89,502	39
Depreciation	0	40
Amortization	0	41
Taxes Other Than Income Taxes	4,077	42
Income Taxes	0	43
Total Operating Expense	**$93,579**	44
		45
Net Operating Income	**$8,458**	46
Other (Please Specify)	0	47
Other (Please Specify)	0	48
Adjusted Net Operating Income	**$8,458**	49
		50
Rate of Return (Line 49 / Line 25)	**5.33%**	51
		52
		53
		54

All amounts should be calculated in a manner consistent with the last Rate Order issued by the Commission for this Company. 55

Superior Wastewater Systems SU-2
Activity Report for Escrow Account
For the Twelve Months Ended December 31, 2019

	Escrow Liability Required Per Books (Account 235.1)				Escrow Assets Provided Per Bank (Account 132.2)			
Month	Beginning Balance	Accrued Into Escrow	Removed From Escrow	Ending Balance	Beginning Balance	Deposited Into Escrow	Removed From Escrow	Ending Balance
January	$88,685.31	2,535.98	1,183.75	$90,037.54	$43.25	$3,700.00	$1,933.75	$1,809.50
February	90,037.54	1,585.63	314.96	91,308.22	1,809.50	0.00	0.00	1,809.50
March	91,308.22	1,946.80	1,899.10	91,355.91	1,809.50	1,700.00	1,899.10	1,610.40
April	91,355.91	1,890.98		93,246.89	1,610.40	0.00	0.00	1,610.40
May	93,246.89	955.68		94,202.58	1,610.40	0.00	0.00	1,610.40
June	94,202.58	3,135.97	8,602.15	88,736.40	1,610.40	7,000.00	6,911.15	1,699.25
July	88,736.40	2,330.85		91,067.24	1,699.25	7,500.00	0.00	9,199.25
August	91,067.24	1,870.79		92,938.03	9,199.25	2,500.00	7,171.17	4,528.08
September	92,938.03	2,164.22		95,102.25	4,528.08	2,500.00	0.00	7,028.08
October	95,102.25	1,645.19		96,747.44	7,028.08	0.00	0.00	7,028.08
November	96,747.44	1,718.35	402.27	98,063.52	7,028.08	2,500.00	402.27	9,125.81
December	98,063.52	1,937.59	165.00	99,836.10	9,125.81	0.00	0.00	9,125.81
Total		**$23,718.02**	**$12,567.23**			**$27,400.00**	**$18,317.44**	

Total Balance at End of Fiscal Year:

Escrow Assets	9,125.81
Escrow Liability	99,836.10
Net Escrow Assets (Shortfall)	**-90,710.29**

NOTE: This supplemental schedule to the Company's Annual Report is provided in conformance with the requirements of the TRA's Order in Docket 07-00062.

Provide a pro forma income statement for the wastewater utility for the first three (3) years of operations or for an expanded amended CCN, the first three years after the latest year-end financials. In the calculations of utility revenues show the number of consumers and the rates used in the calculations. Show operation and maintenance expenses by account number and provide the basis and/or assumptions used to arrive at these amounts.

RESPONSE:
Attached is a ten-year pro forma income statement for Superior Wastewater Systems' operations at the Taliaferro Road Parcel along with an outline of assumptions considered.

Superior Wastewater Systems **Exhibit 5.2**
Pro Forma Rate Calculation for Taliaferro Road Parcel **Schedule 1**
10 Year Income Projection

Item	SWS 2019 O&M Expense	SWS 2019 Customers	Unit Rate	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Projected Customers:													
Taliaferro Road Parcel				5	7	8	7	0	0	0	0	0	0
Cumulative Customer Count				**5**	**12**	**20**	**27**	**27**	**27**	**27**	**27**	**27**	**27**
Revenues:													
Service Charges - Current Tariff Rate			$35.11	$2,106.60	$5,055.84	$8,426.40	$11,375.64	$11,375.64	$11,375.64	$11,375.64	$11,375.64	$11,375.64	$11,375.64
Access Fees - Current Tariff Rate			7.00	1,848.00	1,260.00	588.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Revenue				**$3,954.60**	**$6,315.84**	**$9,014.40**	**$11,375.64**	**$11,375.64**	**$11,375.64**	**$11,375.64**	**$11,375.64**	**$11,375.64**	**$11,375.64**
Expenses:													
704 - Employee Pensions & Benefits	$42,904.32	277	$154.89	$774.45	$1,858.67	$3,097.78	$4,182.01	$4,182.01	$4,182.01	$4,182.01	$4,182.01	$4,182.01	$4,182.01
710 - Purchased Sewage Treatment	0.00	277	$0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
715 - Purchased Power	9,566.34	277	34.54	172.68	414.43	690.71	932.46	932.46	932.46	932.46	932.46	932.46	932.46
720 - Materials & Supplies	688.63	277	2.49	12.43	29.83	49.72	67.12	67.12	67.12	67.12	67.12	67.12	67.12
730 - Contractual Services	25,969.25	277	93.75	468.76	1,125.02	1,875.04	2,531.30	2,531.30	2,531.30	2,531.30	2,531.30	2,531.30	2,531.30
750 - Transportation Expense	1,928.11	277	6.96	34.80	83.53	139.21	187.94	187.94	187.94	187.94	187.94	187.94	187.94
775 - Miscellaneous Expense	8,445.06	277	30.49	152.44	365.85	609.75	823.16	823.16	823.16	823.16	823.16	823.16	823.16
408 - Taxes Other Than Income Taxes	4,077.17	277	14.72	73.60	176.63	294.38	397.41	397.41	397.41	397.41	397.41	397.41	397.41
Total Expenses	**$93,578.88**			**$914.70**	**$2,195.29**	**$3,658.81**	**$4,939.40**	**$4,939.40**	**$4,939.40**	**$4,939.40**	**$4,939.40**	**$4,939.40**	**$4,939.40**
Net Operating Income				**$3,039.90**	**$4,120.55**	**$5,355.59**	**$6,436.24**	**$6,436.24**	**$6,436.24**	**$6,436.24**	**$6,436.24**	**$6,436.24**	**$6,436.24**

***NOTE**: Monthly Service Charge excludes local and state bonding surcharges which will be billed specifically to Taliaferro Road Parcel customers.*

Superior Wastewater Systems **Exhibit 5.2**
Pro Forma Rate Calculation for Taliaferro Road Parcel **Schedule 2**
Assumptions Basis for Cost Estimates

Revenues

Revenues are based on SWS current tariff rate of $35.11 per month.
This rate excludes local and state bonding charges that will be specifically charged to Taliaferro Road Parcel homeowners.

Expenses

Expenses are based upon the 2019 actual O&M Expenses of SWS as shown in the 2019 Annual Report to the Tennessee Public Utility Commission (Pages F-3 and S-3).

SWS 2019 Customers

Customers are based upon the 2019 actual customer counts of SWS as shown in the 2019 Annual Report to the Tennessee Public Utility Commission (Page S-3).

Taliaferro Road Customer Buildout Projection - 2022 to 2025

Projected Customer Buildout per DDR Report, Section A. Site Description, Exhibit 1.7 (b), page 10.

Provide a chart of accounts for the wastewater utility, following the NARUC Uniform System of Accounts (USOA) for wastewater utilities.

RESPONSE:
Attached is a copy of the chart of accounts for Superior Wastewater Systems.

Superior Wastewater Systems
Account List

Account #	Account	Type
131.00	Cash	Bank
131.10	Cash:Cash - First Tennessee	Bank
131.20	Cash:Cash - Reliant	Bank
131.30	Cash:Cash - SunTrust	Bank
131.40	Cash:Cash - Bank of Nashville	Bank
132.00	Special Deposits	Bank
132.10	Special Deposits:Special Deposits-Cust. Deps.	Bank
132.20	Special Deposits:Special Deposits-Escrows	Bank
141.00	Customer Accounts Receivable	Accounts receivable (A/R)
124.00	Other Investments	Other Current Assets
151.00	Plant Materials & Supplies	Other Current Assets
174.00	Misc. Current & Accrued Assets	Other Current Assets
	Inventory Asset	Other Current Assets
	Inventory Asset-1	Other Current Assets
	Uncategorized Asset	Other Current Assets
101.00	Utility Plant in Service	Fixed Assets
103.00	Property Held for Future Use	Fixed Assets
104.00	Utility Plant Purchased or Sold	Fixed Assets
105.00	Construction Work in Process	Fixed Assets
108.00	Accumulated Depreciation	Fixed Assets
114.00	Acquisition Adjustment	Fixed Assets
115.00	Accumulated Amort of Acq. Adj.	Fixed Assets
122.00	Accu. Depr. of Non-Utility Prop	Fixed Assets
351.00	Utility Plant in Service:Organization	Fixed Assets
352.00	Utility Plant in Service:Franchises	Fixed Assets
353.00	Utility Plant in Service:Land & Land Rights	Fixed Assets
354.00	Utility Plant in Service:Structures & Improvements	Fixed Assets
355.00	Utility Plant in Service:Power Generation Equipment	Fixed Assets
360.00	Utility Plant in Service:Collection Sewers - Force	Fixed Assets
361.00	Utility Plant in Service:Collection Sewers - Gravity	Fixed Assets
362.00	Utility Plant in Service:Special Collecting Structures	Fixed Assets
363.00	Utility Plant in Service:Services to Customers	Fixed Assets
364.00	Utility Plant in Service:Flow Measuring Devices	Fixed Assets
365.00	Utility Plant in Service:Flow Measuring Installations	Fixed Assets
370.00	Utility Plant in Service:Receiving Wells	Fixed Assets
380.00	Utility Plant in Service:Treatment & Disposal Equipment	Fixed Assets
381.00	Utility Plant in Service:Plant Sewers	Fixed Assets
382.00	Utility Plant in Service:Outfall Sewer Lines	Fixed Assets
389.00	Utility Plant in Service:Other Plant & Misc. Equipment	Fixed Assets
390.00	Utility Plant in Service:Office Furniture & Equipment	Fixed Assets

391.00	Utility Plant in Service:Transportation Equipment	Fixed Assets
393.00	Utility Plant in Service:Tools, Shop & Garage Equipment	Fixed Assets
395.00	Utility Plant in Service:Power Operated Equipment	Fixed Assets
398.00	Utility Plant in Service:Other Tangible Plant	Fixed Assets
121.00	Non-Utility Property	Other Assets
186.00	Miscellaneous Deferred Debits	Other Assets
190.00	Accu. Deferred Income Tax	Other Assets
231.00	Accounts Payable	Accounts payable (A/P)
232.00	Notes Payable	Accounts payable (A/P)
235.00	Customer Deposits	Other Current Liabilities
235.10	Escrowed Deposits	Other Current Liabilities
236.00	Accrued Taxes	Other Current Liabilities
237.00	Accrued Interest	Other Current Liabilities
241.00	Misc. Current Liabilities	Other Current Liabilities
242.00	Long Term Debt	Long Term Liabilities
252.00	Advances for Construction	Long Term Liabilities
253.00	Other Deferred Credits	Long Term Liabilities
255.00	Accumulated Deferred FIT	Long Term Liabilities
201.00	Common Stock Issued	Equity
204.00	Preferred Stock Issued	Equity
211.00	Other Paid-In Capital	Equity
218.00	Proprietary Capital	Equity
265.00	Miscellaneous Operating Reserve	Equity
271.00	Cont in Aid of Construction	Equity
272.00	Accu. Amort. of CIAOC	Equity
281.00	ADFIT - Accu. Amort.	Equity
282.00	ADFIT - Liberalized Depr.	Equity
283.00	ADFIT - Other	Equity
30000	Opening Balance Equity	Equity
32000	Retained Earnings	Equity
	Opening Balance Equity {3}	Equity
400.00	Operating Revenues	Income
421.00	Nonutility Income	Income
521.10	Operating Revenues:Residential Revenues-Flat Rate	Income
521.20	Operating Revenues:Commercial Revenues-Flat Rate	Income
521.30	Operating Revenues:Industrial Revenues-Flat Rate	Income
521.40	Operating Revenues:P/A Revenues-Flat Rate	Income
521.50	Operating Revenues:M/F Revenues-Flat Rate	Income
521.60	Operating Revenues:Other Revenues-Flat Rate	Income
522.10	Operating Revenues:Residential Revenues-Measured	Income
522.20	Operating Revenues:Commercial Revenues-Measured	Income
522.30	Operating Revenues:Industrial Revenues-Measured	Income
522.40	Operating Revenues:P/A Revenues-Measured	Income
522.50	Operating Revenues:M/F Revenues-Measured	Income
524.00	Operating Revenues:Revenues from Other Systems	Income
530.00	Operating Revenues:Guaranteed Revenues	Income
536.00	Operating Revenues:Other Wastewater Revenues	Income

	Billable Expense Income	Income
	Markup	Income
	Sales of Product Income	Income
	Services	Income
	Uncategorized Income	Income
	Cost of Goods Sold	Cost of Goods Sold
401.00	Operating Expenses	Expenses
403.00	Depreciation Expense	Expenses
406.00	Amort. of Acq Adjustments	Expenses
407.00	Amortization Expense - Other	Expenses
408.00	Taxes Other Than Income	Expenses
409.10	Income Taxes-Utility Oper Inc.	Expenses
409.20	Income Taxes-Other Inc.	Expenses
410.10	Deferred Income Taxes	Expenses
410.20	Deferred Taxes - Other Inc	Expenses
411.10	Deferred Income Taxes - Credit	Expenses
411.20	Deferred FIT Credit-Other Inc.	Expenses
412.10	ITC Deferred to Future Periods	Expenses
412.11	ITC Restored to Oper. Income	Expenses
412.20	ITC Net - Non Utility	Expenses
412.30	ITC Nonutility-Restored to Inc.	Expenses
419.00	Interest and Dividend Income	Expenses
420.00	AFUDC	Expenses
426.00	Miscellaneous Nonutility Exp.	Expenses
427.00	Interest Expense	Expenses
701.00	Operating Expenses:S&W-Employees	Expenses
703.00	Operating Expenses:S&W-Officers & Stockholders	Expenses
704.00	Operating Expenses:Employee Pensions & Benefits	Expenses
705.00	Operating Expenses:Office Expense	Expenses
710.00	Operating Expenses:Purchased Wastewater Treatment	Expenses
711.00	Operating Expenses:Sludge Removal Expense	Expenses
715.00	Operating Expenses:Purchased Power	Expenses
716.00	Operating Expenses:Fuel for Purchased Power	Expenses
718.00	Operating Expenses:Chemicals	Expenses
719.00	Operating Expenses:Bank Charges	Expenses
720.00	Operating Expenses:Materials & Supplies	Expenses
721.00	Operating Expenses:Postage	Expenses
722.00	Operating Expenses:Office supplies	Expenses
724.00	Operating Expenses:Charitable Contributions	Expenses
730.00	Operating Expenses:Contractual Services-Billing	Expenses
731.00	Operating Expenses:Contractual Services-Prof.	Expenses
735.00	Operating Expenses:Contractual Services-Testing	Expenses
736.00	Operating Expenses:Contractual Services-Other	Expenses
740.00	Operating Expenses:Rents	Expenses
750.00	Operating Expenses:Transportation Expense	Expenses
751.00	Operating Expenses:Repair & Maintenance	Expenses
755.00	Operating Expenses:Insurance Expense	Expenses

756.00	Operating Expenses:Meals & Entertainment	Expenses
765.00	Operating Expenses:Regulatory Commission Expense	Expenses
770.00	Operating Expenses:Bad Debt Expense	Expenses
775.00	Operating Expenses:Miscellaneous Expense	Expenses
99999	Ask My Accountant	Expenses
	Purchases	Expenses
	Uncategorized Expense	Expenses

Provide a list of all plant-in-service account numbers with account names and estimated account balances as of the start of operations.

RESPONSE:
Superior Wastewater Systems' estimate of the journal entry to appropriately record the wastewater plant-in-service for the Taliaferro Road Parcel is as follows:

Account	Debit	Credit
353 – Land & Land Rights	$10	
360 – Collection Sewers-Force	120,000	
380 – Treatment & Disposal Equipment	214,000	
271 – Contributions in Aid of Construction		334,010

Provide the depreciation rates the applicant intends to use for each plant account that will be on the wastewater utility's books. Include the estimated useful life of each account. If no depreciation study has been performed, explain the basis for these rates.

RESPONSE:
Superior Wastewater Systems' current depreciation rates are shown in the Table below. Superior Wastewater Systems is proposing to use these same depreciation rates for new wastewater plant associated with the Taliaferro Road Parcel. However, all of the new wastewater plant will be funded through contributions in aid of construction (CIAOC), meaning that CIAOC will be amortized at the same rate as the depreciation expense resulting in a net zero expense.

Superior Wastewater Systems' current depreciation rates were originally proposed in Docket 04-00335 through the supplemental testimony of John Powell. However, the Commission Order in that Docket does not specifically mention any particular depreciation rates.

Plant Classification	Service Life (Yrs)	Depreciation Rate
360 – Collection Sewers-Force	50	2.00%
364 – Flow Measuring Devices	10	10.00%
365 – Flow Measuring Installations	10	10.00%
370 – Receiving Wells	50	2.00%
380 – Treatment & Disposal Equipment	26	3.85%

Provide the total estimated detailed cost of construction of the wastewater system to be constructed for the proposed service area. If the wastewater system will be constructed in phases, provide detailed construction cost estimates for each phase. Indicate whether the developer or the applicant will pay for the construction of the system.

RESPONSE:
The estimated cost of construction for the collection system for the Taliaferro Road Parcel is $334,000. See attached back up for detailed costs. All these costs will be funded by the developer of the Taliaferro Road Parcel.

Taliaferro Road Parcel

The Homes at Mulberry Meadows Subdivision

Cost Estimate

Source: DDR Report, Section L. Cost Estimates, Page 21

L. Cost Estimates

12.1 Engineered opinion of construction cost attached on following pages

Superior Wastewater System - II Wastewater Treatment & Dispersal
(The Homes at Mulberry Meadows Subdivision)
Opinion of Probable Construction Cost

Item No.	Item	Capital Costs
		STEP (8,100 GPD)
1	Supply and Return Force Main Lines	$120,000
2	Orenco AdvanTex AX-MAX225-35	$139,000
3	Pump Supply Building w/ Equipment	$60,000
4	13,000 LF Drip Dispersal lines w/ solenoids	$15,000
	Construction Cost	$334,000

Indicate the identity of the owner of the wastewater system once construction is complete. If a party other than the utility pays the cost of construction and transfers ownership of the wastewater system to the applicant, provide a detailed breakdown of the estimated amount of contributed capital that will be recorded on the applicant's financial books.

RESPONSE:
Once the construction of the wastewater collection system at the Taliaferro Road Parcel has been completed, title for the system including all drip fields will be transferred to Superior Wastewater Systems.

Superior Wastewater Systems' estimate of the journal entry to appropriately record the contributions in aid of construction for the transfer of the wastewater plant from the developer is as follows:

Account	Debit	Credit
353 – Land & Land Rights	$10	
360 – Collection Sewers-Force	120,000	
380 – Treatment & Disposal Equipment	214,000	
271 – Contributions in Aid of Construction		334,010

Provide a tariff showing products, services, terms, conditions and proposed rates to be charged for wastewater service. The tariff should include all pass-through fees, including but not limited to, customer deposits, disconnect or reconnect fees, late fees, tap fees, escrow fees, bond fees, franchise fees and taxes.

RESPONSE:
Attached is a copy of the pro forma tariff sheets for Superior Wastewater Systems' service to the Taliaferro Road parcel. All other existing tariff sheets of Superior Wastewater Systems, including the rules and regulations, will remain unchanged.

Superior Wastewater Systems
Wastewater Service Billing Summary

System	Monthly Charge
Ashby Communities – Sheet 2	$30.87
Hill and Roberts Parcels – Sheet 3	35.11
Fox Parcel – Sheet 4	35.11
Taliaferro Road Parcel – Sheet 5	35.11

Superior Wastewater Systems
Taliaferro Road Parcel Billing Rates

	Monthly Charge	Escrowed Amount
Collection System Operation and Maintenance (Tariff Items 1 – 4)	$8.95	$6.35
Treatment System Cost (Tariff Items 5 – 7)	6.23	2.90
Utility Cost (Tariff Items 11 and 13)	1.30	0.00
Disposal System Cost (Tariff Items 15 – 17)	1.53	0.88
Sampling and Testing Cost (Tariff Item 18)	7.00	0.00
Billing and Collection Cost (Tariff Item 20)	1.50	0.00
Miscellaneous Cost (Tariff Items 21 – 30 excluding Bonding)	8.60	0.00
Bonding Cost (Pass Through) **	0.00	0.00
Total	**$35.11**	**$10.13**

Incidental Rates:

Late Payment	5% of Bill.
Disconnection	$10.00
Reconnection	$15.00
Returned Check	$20.00
Access	$84.00

**** Bonding Cost incurred is passed through to the customer with no markup by the Company.**

Provide estimated costs and customers added by month for the first five (5) years based upon the construction build-out schedule for developments in the service area of the proposed wastewater system. For each year, by month, provide an estimated number of customers by customer class anticipated to be served by the wastewater system. Include the utility's basis and assumptions used for this projection. Provide this information in a spreadsheet in Microsoft Excel format with all assumptions clearly documented.

RESPONSE:
Attached is the estimated number of monthly customers to be added at the Taliaferro Road Parcel. This estimate, which was provided by the developer, is based on the anticipated home sales in the area. These monthly customer additions are also used in Superior Wastewater Systems' 10-year pro forma income statement provided as Exhibit 5.2.

Superior Wastewater Systems
Anticipated Customer Build-out for Taliaferro Road Parcel

Monthly Totals

	2021	2022	2023	2024	2025
January	0	0	0	0	0
February	0	0	0	0	0
March	0	0	0	0	0
April	0	0	2	2	0
May	0	0	1	1	2
June	0	0	1	2	1
July	0	0	2	1	2
August	0	1	1	2	1
September	0	2	0	0	1
October	0	2	0	0	0
November	0	0	0	0	0
December	0	0	0	0	0
Total	**0**	**5**	**7**	**8**	**7**

Cumulative Totals

	2021	2022	2023	2024	2025
January	0	0	5	12	20
February	0	0	5	12	20
March	0	0	5	12	20
April	0	0	7	14	20
May	0	0	8	15	22
June	0	0	9	17	23
July	0	0	11	18	25
August	0	1	12	20	26
September	0	3	12	20	27
October	0	5	12	20	27
November	0	5	12	20	27
December	0	5	12	20	27

NOTES:

Total number of lots in the Taliaferro Road parcel is 27.

Developer estimates construction to begin in 2021 with first home sales occuring in summer of 2022.

Provide documentation describing bonding requirements imposed by municipal governments for the proposed wastewater system.

RESPONSE:
All bonding requirements related to the construction of the wastewater system at Taliaferro Road Parcel will be paid by the developer of the parcels. At this time, Superior Wastewater Systems does not anticipate any local bonding surcharge to be assessed and passed through to the customers of the Taliaferro Road Parcel.

Demonstrate that the applicant has acquired a performance bond from the developer or builder of the wastewater system made payable to the Utility to ensure construction of the wastewater system. The performance bond should be for an amount equal to or greater than the cost of the system as provided in contracts between the builder, developer and/or utility.

RESPONSE:
All costs of construction of the wastewater system at Taliaferro Road Parcel will be paid by the developer, therefore Superior Wastewater Systems does not anticipate a performance bond will be necessary.

List all funding sources available to the applicant for the wastewater system proposed by the applicant.

RESPONSE:
Funding for the wastewater collection system at the Taliaferro Road Parcel will be supplied by the developer. After the wastewater system is completed, the developer intends to transfer title to the wastewater system, including drip fields over to Superior Wastewater Systems to operate. Superior Wastewater Systems will not be supplying any funding for construction of the wastewater system at the Taliaferro Road Parcel.

Provide information demonstrating compliance with the financial security requirement of Rule 1220-4-13-.07.

RESPONSE:
Refer to the Commission Order of June 18, 2018 in Docket 18-00050 approving financial security for Superior Wastewater Systems.