Electronically Filed in TPUC Docket Room on September 9, 2020 at 10:30 a.m.

SUPERIOR WASTEWATER SYSTEMS
Providing Superior Wastewater Service to Tennessee

September 9, 2020 **20-00109**

<u>Via Hand Delivery</u>
Chairman, Tennessee Public Utility Commission
c/o Sharla Dillon, 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 Fox Parcel in Williamson County

Ms. Dillon:

Superior Wastewater Systems, LLC files the attached Petition for a Certificate of Convenience and Necessity Amendment to provide wastewater service to the Fox 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
John Powell, President

Enclosures

Cc: Michael Murphy, TDEC

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

EXHIBIT 1
APPLICANT AND SYSTEM INFORMATION

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 1.1**

Petition to Amend CCN to provide service to Fox Parcel

Exhibit 1.1 – Name and Address Information

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

<u>RESPONSE</u>:
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.

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 1.2**

Petition to Amend CCN to provide service to Fox Parcel

Exhibit 1.2 – Organization Chart

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

<u>RESPONSE</u>:

The Organization Chart for Superior Wastewater Systems is as follows:

John Powell
President & General Manager

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

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 1.4**

Petition to Amend CCN to provide service to Fox Parcel

Exhibit 1.4 – Affiliates

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 will be developing this contiguous project and building all of the infrastructure which will include the additions to the Wastewater Facility now operated by Superior Wastewater Systems.

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:

Powell

John E. Powell, Managing Member

5-13-2004

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)

For Office Use Only

FILED

RECEIVED
STATE OF TENNESSEE
2004 MAY 13 PM 3:02
RILEY DARNELL
SECRETARY OF STATE

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
(Street Address) *(City)* TN *(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 04
Signature Date

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

Sole Member
Signer's Capacity

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

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

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

RECEIPT NUMBER: 00003590523
ACCOUNT NUMBER: 00000448

Riley C Darnell

RILEY C DARNELL
SECRETARY OF STATE

336-8320

Exhibit 1.6 – Business License

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 04/13/2004 3:02 PM	Date Formed:	04/13/2004
Status:	Active	Fiscal Year Close	12
Duration Term:	Perpetual	Member Count:	1
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**

Petition to Amend CCN to provide service to Fox Parcel
Exhibit 1.7 – Geographic Territory

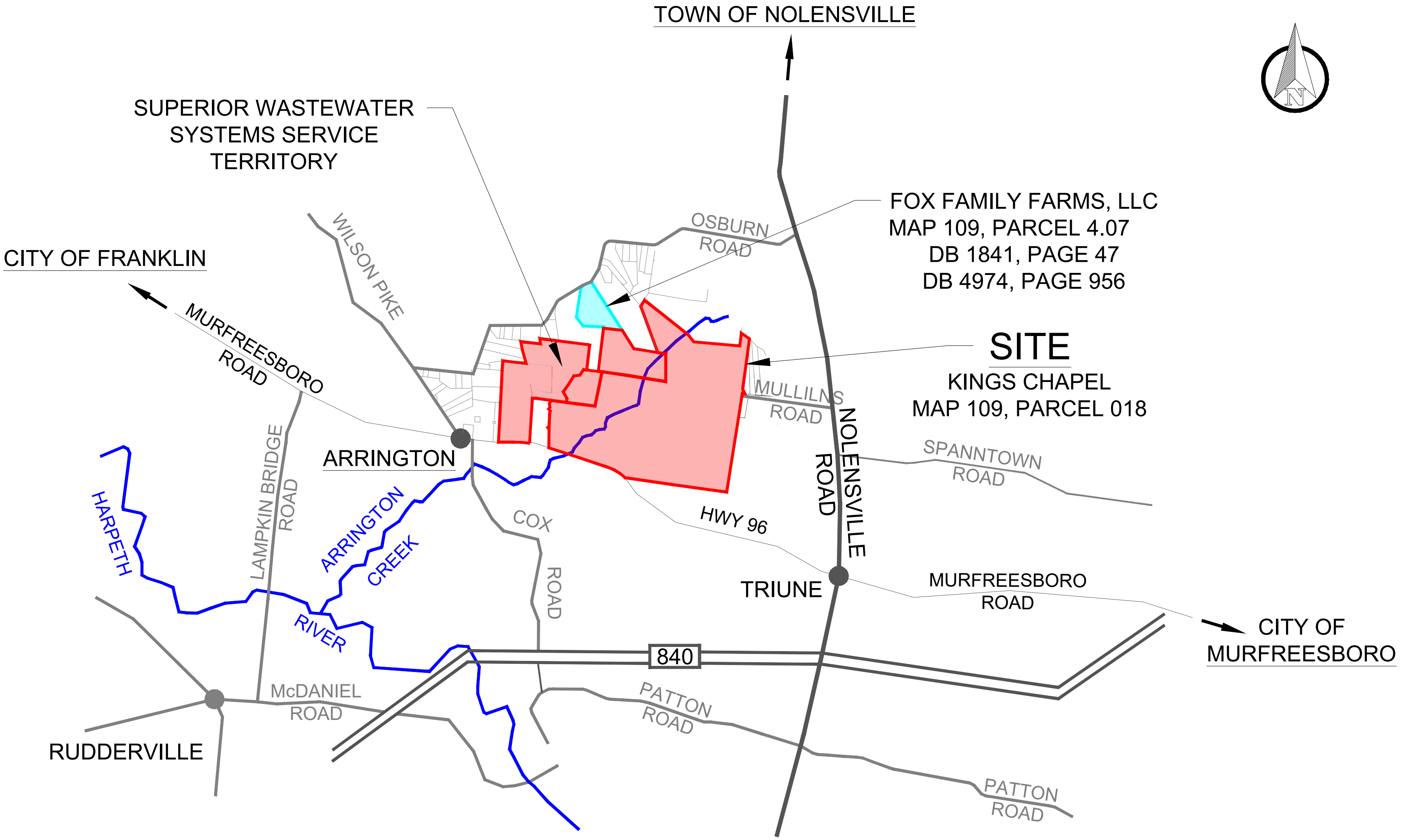
Provide a complete description of the geographic territory to be served by the applicant, including the name and location of development (subdivision) and the number of acres. Include the name of the subdivision or development and the name of the wastewater system as stated in the TDEC permit. In addition, 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 Fox Parcel is located in Williamson County directly adjacent to the Superior Wastewater Systems Service Territory.

Fox Parcel description:
Map 109 & 86, Parcels 4.07 & 4.06 on Williamson County tax maps
Fox Family Farms
2193 Osburn Rd
Arrington, TN 37014

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



LOCATION MAP

N.T.S.

CIVIL INFRASTRUCTURE ASSOCIATES

307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

KING'S CHAPEL COMMUNITY
ARRINGTON, TENNESSEE
WILLIAMSON COUNTY

CHECKED BY:

DRAWN BY:

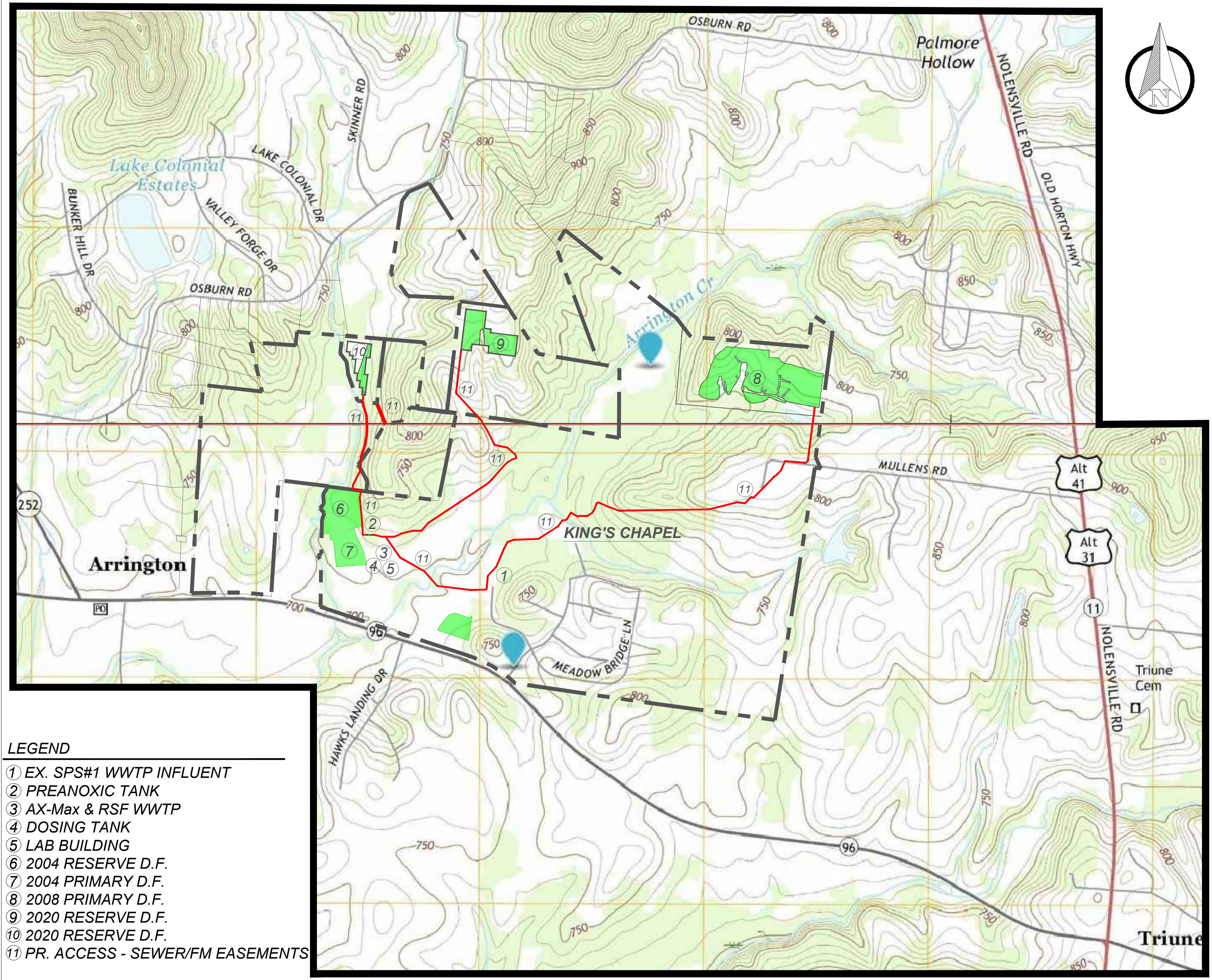
CIA PROJECT No:

ORIGINAL ISSUE DATE: August 2020

APPENDIX 1
LOCATION MAP

SCALE: N.T.S.

PLOT DATE: 8/26/2020 10:09:09 AM (MWARNER)



LEGEND

1. ① EX. SPS#1 WWTP INFLUENT
2. ② PREANOXIC TANK
3. ③ AX-Max & RSF WWTP
4. ④ DOSING TANK
5. ⑤ LAB BUILDING
6. ⑥ 2004 RESERVE D.F.
7. ⑦ 2004 PRIMARY D.F.
8. ⑧ 2008 PRIMARY D.F.
9. ⑨ 2020 RESERVE D.F.
10. ⑩ 2020 RESERVE D.F.
11. ⑪ PR. ACCESS - SEWER/FM EASEMENTS

CIVIL
INFRASTRUCTURE
ASSOCIATES

307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

KING'S CHAPEL COMMUNITY
ARRINGTON, TENNESSEE
WILLIAMSON COUNTY

CHECKED BY:

DRAWN BY:

CIA PROJECT No:

ORIGINAL ISSUE DATE: August 2020

APPENDIX 3
USGS TOPO

DATE: 2016 US TOPO

SCALE: N.T.S.

PLOT DATE: 8/26/2020 9:59:12 AM (MWARNER)

Exhibit 1.8 – Proposed Wastewater System

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 Fox 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. Maximum potential number of customers in the proposed service area is anticipated to be 78.

Drip Irrigation Pump
PF501512-50

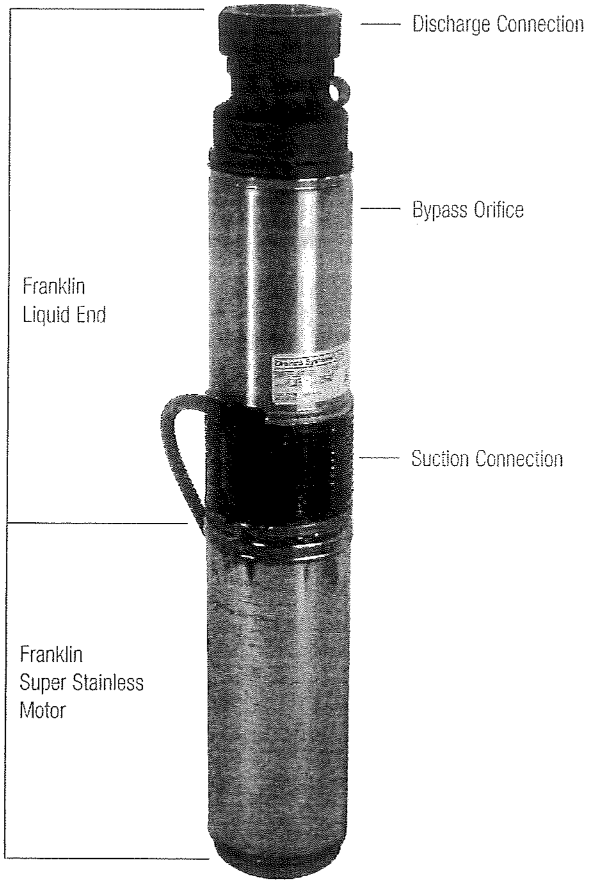
Orenco® *Technical Data Sheet*

PF Series 60-Hz, 4-inch (100-mm) Submersible Effluent Pumps

Applications

Our 4-inch (100-mm) Submersible Effluent Pumps are designed to transport screened effluent (with low TSS counts) from septic tanks or separate dosing tanks. All our pumps are constructed of lightweight, corrosion-resistant stainless steel and engineered plastics; all are field-serviceable and repairable with common tools; 60-Hz PF Series models are CSA certified to the U.S. and Canadian safety standards for effluent pumps, meeting UL requirements.

Orenco's Effluent Pumps are used in a variety of applications, including pressurized drainfields, packed bed filters, mounds, aerobic units, effluent irrigation, 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 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, 15, 20, and 30 gpm (0.6, 1.0, 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
- Five-year warranty on pump or retrofit liquid end from date of manufacture against defects in materials or workmanship

** Not applicable for 5-hp (3.73 kW) models*

Standard Models

See specifications chart, pages 2-3, for a list of standard pumps. For a complete list of available pumps, call Orenco.

Product Code Diagram

PF 50 15 1 2 ☐ - 50

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*
200 = 200
2 = 230
4 = 460

Frequency:
1 = single-phase 60 Hz
3 = three-phase 60 Hz

Horsepower (kW):
03 = ⅓ hp (0.25)
05 = ½ hp (0.37)
07 = ¾ hp (0.56)
10 = 1 hp (0.75)
15 = 1-½ 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)
15 = 15 (1.0)
20 = 20 (1.3)
30 = 30 (1.9)
50 = 50 (3.2)
75 = 75 (4.7)

Pump, PF Series

* ½-hp (0.37kW) only

† Available for 10 gpm (0.6 L/sec), 1/2 hp (0.37 kW) only

‡ Note: 20-ft cords are available only for single-phase pumps through 1-½ hp

Specifications

Pump Model	Design gpm (L/sec)	Horsepower (kW)	Phase	Nameplate voltage	Actual voltage	Design flow amps	Max amps	Impellers	Discharge size and material[1]	Length, in. (mm)	Min. liquid level,[2] in. (mm)	Weight,[3] lb (kg)	Rated cycles/day
PF100511	10 (0.6)	0.50 (0.37)	1	115	120	12.7	12.7	6	1 ¼ in. GFP	23.0 (660)	16 (406)	26 (12)	300
PF100511CV	10 (0.6)	0.50 (0.37)	1	115	120	12.7	12.7	6	1 ¼ in. GFP	23.0 (660)	16 (406)	26 (12)	300
PF100512	10 (0.6)	0.50 (0.37)	1	230	240	6.3	6.3	6	1 ¼ in. GFP	23.0 (660)	16 (406)	26 (12)	300
PF10053200	10 (0.6)	0.50 (0.37)	3	200	208	3.8	3.8	6	1 ¼ in. GFP	23.0 (660)	16 (406)	26 (12)	300
PF100712[4,5]	10 (0.6)	0.75 (0.56)	1	230	240	8.3	8.3	8	1 ¼ in. GFP	25.9 (658)	17 (432)	30 (14)	300
PF10073200[4,5]	10 (0.6)	0.75 (0.56)	3	200	208	5.1	5.2	8	1 ¼ in. GFP	25.4 (645)	17 (432)	31 (14)	300
PF101012[5,6]	10 (0.6)	1.00 (0.75)	1	230	240	9.6	9.6	9	1 ¼ in. GFP	27.9 (709)	18 (457)	33 (15)	100
PF10103200[5,6]	10 (0.6)	1.00 (0.75)	3	200	208	5.5	5.5	9	1 ¼ in. GFP	27.3 (693)	18 (457)	37 (17)	300
PF102012[5,6,7,8]	10 (0.6)	2.00 (1.49)	1	230	240	12.1	12.1	18	1 ¼ in. SS	39.5 (1003)	22 (559)	48 (22)	100
PF102032[5,6,8]	10 (0.6)	2.00 (1.49)	3	230	240	7.5	7.6	18	1 ¼ in. SS	37.9 (963)	20 (508)	44 (20)	300
PF10203200[5,6,8]	10 (0.6)	2.00 (1.49)	3	200	208	8.7	8.7	18	1 ¼ in. SS	37.9 (963)	20 (508)	44 (20)	300
PF150311	15 (1.0)	0.33 (0.25)	1	115	120	8.7	8.8	3	1 ¼ in. GFP	19.5 (495)	15 (380)	23 (10)	300
PF150312	15 (1.0)	0.33 (0.25)	1	230	240	4.4	4.5	3	1 ¼ in. GFP	19.5 (495)	15 (380)	23 (10)	300
PF200511	20 (1.3)	0.50 (0.37)	1	115	120	12.3	12.5	4	1 ¼ in. GFP	22.3 (566)	18 (457)	25 (11)	300
PF200512	20 (1.3)	0.50 (0.37)	1	230	240	6.4	6.5	4	1 ¼ in. GFP	22.5 (572)	18 (457)	26 (12)	300
PF20053200	20 (1.3)	0.50 (0.37)	3	200	208	3.7	3.8	4	1 ¼ in. GFP	22.3 (566)	18 (457)	26 (12)	300
PF201012[4,5]	20 (1.3)	1.00 (0.75)	1	230	240	10.5	10.5	7	1 ¼ in. GFP	28.4 (721)	20 (508)	33 (15)	100
PF20103200[4,5]	20 (1.3)	1.00 (0.75)	3	200	208	5.8	5.9	7	1 ¼ in. GFP	27.8 (706)	20 (508)	33 (15)	300
PF201512[4,5]	20 (1.3)	1.50 (1.11)	1	230	240	12.4	12.6	9	1 ¼ in. GFP	34.0 (864)	24 (610)	41 (19)	100
PF20153200[4,5]	20 (1.3)	1.50 (1.11)	3	200	208	7.1	7.2	9	1 ¼ in. GFP	30.7 (780)	20 (508)	35 (16)	300
PF300511	30 (1.9)	0.50 (0.37)	1	115	120	11.8	11.8	3	1 ¼ in. GFP	21.3 (541)	20 (508)	28 (13)	300
PF300512	30 (1.9)	0.50 (0.37)	1	230	240	6.2	6.2	3	1 ¼ in. GFP	21.3 (541)	20 (508)	25 (11)	300
PF30053200	30 (1.9)	0.50 (0.37)	3	200	208	3.6	3.6	3	1 ¼ in. GFP	21.3 (541)	20 (508)	25 (11)	300
PF300712	30 (1.9)	0.75 (0.56)	1	230	240	8.5	8.5	5	1 ¼ in. GFP	24.8 (630)	21 (533)	29 (13)	300
PF30073200	30 (1.9)	0.75 (0.56)	3	200	208	4.9	4.9	5	1 ¼ in. GFP	24.6 (625)	21 (533)	30 (14)	300
PF301012[4]	30 (1.9)	1.00 (0.75)	1	230	240	10.4	10.4	6	1 ¼ in. GFP	27.0 (686)	22 (559)	32 (15)	100
PF30103200[4]	30 (1.9)	1.00 (0.75)	3	200	208	5.8	5.8	6	1 ¼ in. GFP	26.4 (671)	22 (559)	33 (15)	300
PF301512[4,5]	30 (1.9)	1.50 (1.11)	1	230	240	12.6	12.6	8	1 ¼ in. GFP	32.8 (833)	24 (610)	40 (18)	100
PF30153200[4,5]	30 (1.9)	1.50 (1.11)	3	200	208	6.9	6.9	8	1 ¼ in. GFP	29.8 (757)	22 (559)	34 (15)	300
PF301534[4,5]	30 (1.9)	1.50 (1.11)	3	460	480	2.8	2.8	8	1 ¼ in. GFP	29.5 (685)	22 (559)	34 (15)	300
PF302012[5,6,7]	30 (1.9)	2.00 (1.49)	1	230	240	11.0	11.0	10	1 ¼ in. SS	35.5 (902)	26 (660)	44 (20)	100
PF30203200[5,6]	30 (1.9)	2.00 (1.49)	3	200	208	9.3	9.3	10	1 ¼ in. SS	34.0 (864)	24 (610)	41 (19)	300
PF303012[5,6,7,8]	30 (1.9)	3.00 (2.23)	1	230	240	16.8	16.8	14	1 ¼ in. SS	44.5 (1130)	33 (838)	54 (24)	100
PF303032[5,6,8]	30 (1.9)	3.00 (2.23)	3	230	240	10.0	10.1	14	1 ¼ in. SS	44.3 (1125)	27 (686)	52 (24)	300
PF305012[5,6,7,8]	30 (1.9)	5.00 (3.73)	1	230	240	25.6	25.8	23	1 ¼ in. SS	66.5 (1689)	53 (1346)	82 (37)	100
PF305032[5,6,8]	30 (1.9)	5.00 (3.73)	3	230	240	16.6	16.6	23	1 ¼ in. SS	60.8 (1544)	48 (1219)	66 (30)	300
PF30503200[5,6,8]	30 (1.9)	5.00 (3.73)	3	200	208	18.7	18.7	23	1 ¼ in. SS	60.8 (1544)	48 (1219)	66 (30)	300
PF500511	50 (3.2)	0.50 (0.37)	1	115	120	12.1	12.1	2	2 in. SS	20.3 (516)	24 (610)	27 (12)	300
PF500512	50 (3.2)	0.50 (0.37)	1	230	240	6.2	6.2	2	2 in. SS	20.3 (516)	24 (610)	27 (12)	300
PF500532	50 (3.2)	0.50 (0.37)	3	230	240	3.0	3.0	2	2 in. SS	20.3 (516)	24 (610)	28 (13)	300
PF50053200	50 (3.2)	0.50 (0.37)	3	200	208	3.7	3.7	2	2 in. SS	20.3 (516)	24 (610)	28 (13)	300
PF500534	50 (3.2)	0.50 (0.37)	3	460	480	1.5	1.5	2	2 in. SS	20.3 (516)	24 (610)	28 (13)	300
PF500712	50 (3.2)	0.75 (0.56)	1	230	240	8.5	8.5	3	2 in. SS	23.7 (602)	25 (635)	31 (14)	300
PF500732	50 (3.2)	0.75 (0.56)	3	230	240	3.9	3.9	3	2 in. SS	23.7 (602)	25 (635)	32 (15)	300

Specifications, cont.

Pump Model	Design gpm (L/sec)	Horsepower (kW)	Phase	Nameplate voltage	Actual voltage	Design flow amps	Max amps	Impellers	Discharge size and material[1]	Length, in. (mm)	Min. liquid level,[2] in. (mm)	Weight,[3] lb (kg)	Rated cycles/day
PF50073200	50 (3.2)	0.75 (0.56)	3	200	208	4.9	4.9	3	2 in. SS	23.1 (587)	26 (660)	32 (15)	300
PF500734	50 (3.2)	0.75 (0.56)	3	460	480	1.8	1.8	3	2 in. SS	34.8 (884)	25 (635)	31 (14)	300
PF501012	50 (3.2)	1.00 (0.75)	1	230	240	10.1	10.1	4	2 in. SS	27.0 (686)	26 (660)	35 (16)	100
PF50103200	50 (3.2)	1.00 (0.75)	3	200	208	5.7	5.7	4	2 in. SS	26.4 (671)	26 (660)	39 (18)	300
PF501034	50 (3.2)	1.00 (0.75)	3	460	480	2.2	2.2	4	2 in. SS	26.4 (671)	26 (660)	39 (18)	300
PF501512[4]	50 (3.2)	1.50 (1.11)	1	230	240	12.5	12.6	5	2 in. SS	32.5 (826)	30 (762)	41 (19)	100
PF50153200[4]	50 (3.2)	1.50 (1.11)	3	200	208	7.0	7.0	5	2 in. SS	29.3 (744)	26 (660)	35 (16)	300
PF503012 [4, 5, 7, 8]	50 (3.2)	3.00 (2.23)	1	230	240	17.7	17.7	8	2 in. SS	43.0 (1092)	37 (940)	55 (25)	100
PF50303200 [4, 5, 6]	50 (3.2)	3.00 (2.23)	3	200	208	13.1	13.1	8	2 in. SS	43.4 (1102)	30 (762)	55 (25)	300
PF503034 [4, 5, 8]	50 (3.2)	3.00 (2.23)	3	460	480	5.3	5.3	8	2 in. SS	40.0 (1016)	31 (787)	55 (25)	300
PF505012 [5,6,7,8]	50 (3.2)	5.00 (3.73)	1	230	240	26.2	26.4	13	2 in. SS	65.4 (1661)	55 (1397)	64 (29)	300
PF505032 [5,6,7,8]	50 (3.2)	5.00 (3.73)	3	230	240	16.5	16.5	13	2 in. SS	59.3 (1506)	49 (1245)	64 (29)	300
PF751012	75 (4.7)	1.00 (0.75)	1	230	240	9.9	10.0	3	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	4	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.*

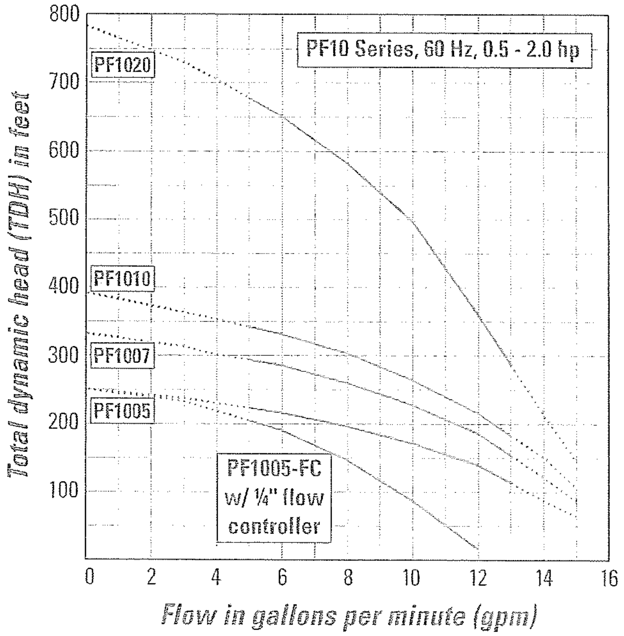
Materials of Construction

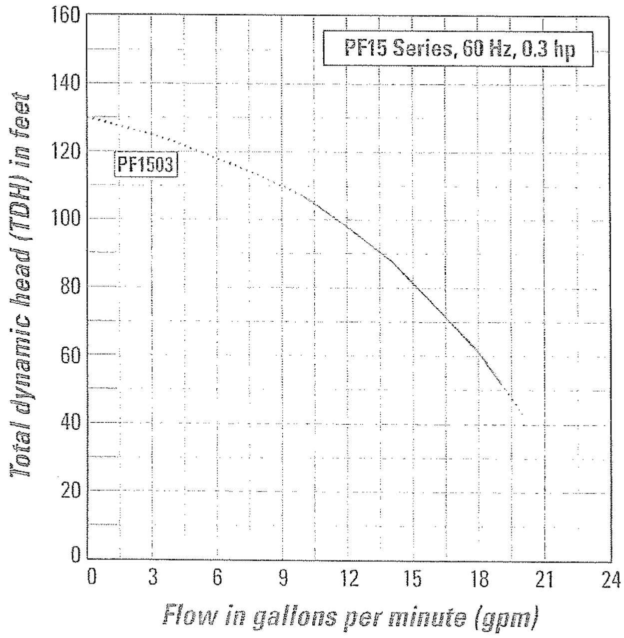
Discharge	Glass-filled polypropylene or stainless steel
Discharge bearing	Engineered thermoplastic (PEEK)
Diffusers	Glass-filled PPO (Noryl GFN3)
Impellers	Celcon® acetal copolymer on 10-, 20, and 30-gpm models; 50-gpm impellers are Noryl GFN3
Intake screen	Polypropylene
Suction connection	Stainless 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 and 200 and 230 V 3-phase motors 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).

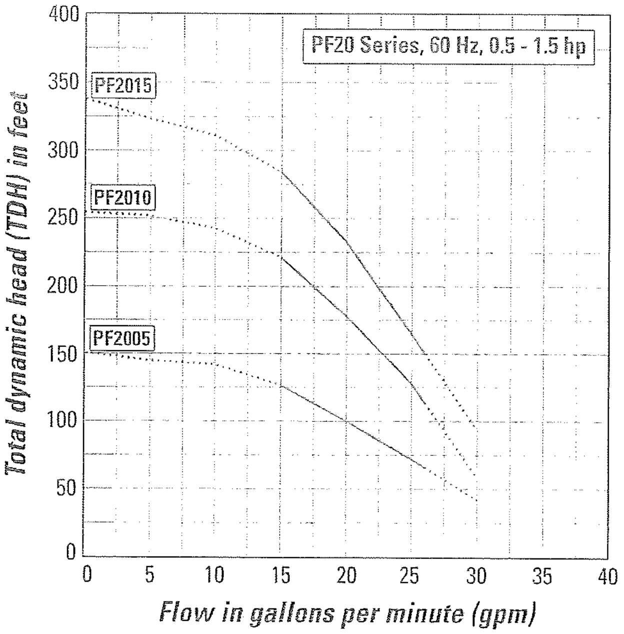
Using a Pump Curve

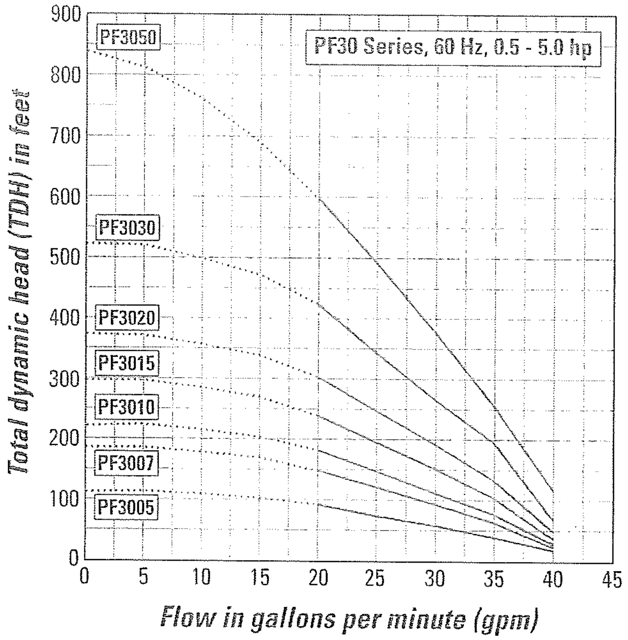
A *pump curve* helps you determine the best pump for your system. Pump curves show the relationship between flow and pressure (total dynamic head, or TDH), providing a graphical representation of a pump's optimal performance range. Pumps perform best at their nominal flow rate. These graphs show optimal 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

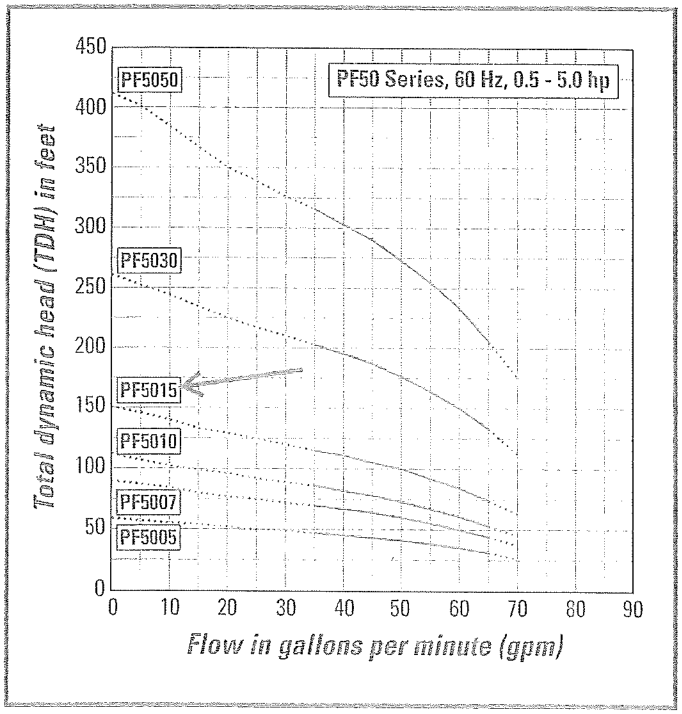


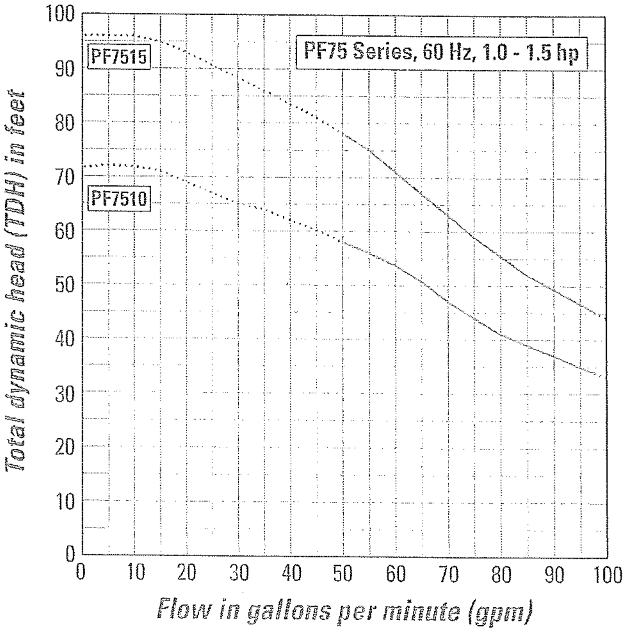






Pump Curves, cont.



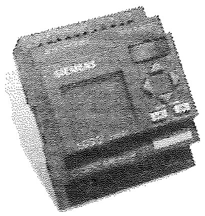


Orenco SYSTEMS *Technical Data Sheet*

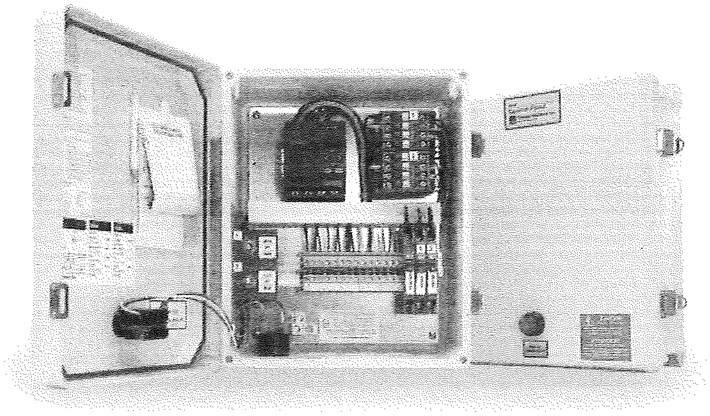
MVP-Duplex Control Panel

Applications

Orenco's MVP-Duplex control panel has a dual-mode feature, making it ideal for both timed- and demand-dosing in two-pump alternating systems. All MVPs include an easy-to-use, programmable logic unit that incorporates many timing and logic functions, such as multiple timing intervals to adjust for changing flow conditions and a built-in elapsed time meter and counter.



The programmable logic unit is the brain of the MVP-Duplex control panel



Orenco® MVP-DAX1DM control panel accommodates both timed- and demand-dosing applications

c UL US LISTED

Features/Unique Specifications

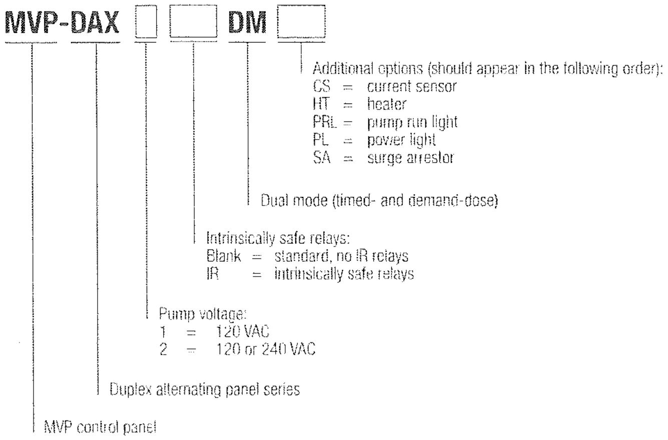
To specify this panel for your installation, require the following:

- Programmable for timed- or demand-dosing applications
- Built-in elapsed time meter and counters
- Digital timed-dose function accurate within 1%
- Multiple timer settings for optimum dosing during normal and peak flow conditions
- Pump alternation continues during override conditions
- Built-in programming keys for field-adjustable timer settings without a portable computer
- Ability to use EEPROM card to change panel functions
- High- and low-level alarm conditions differentiated by steady or blinking LED light
- Silenced alarms automatically reactivated after 12 hours if condition is not corrected
- Standard 120 VAC output for remote alarm activation
- Timed delays on float inputs to prevent chattering
- Ability to use one model of float for all functions
- Visual indicators of float positions
- Redundant-off function as standard
- UL 508 listing in US and Canada

Standard Models

MVP-DAX1DM, MVP-DAX2DM

Product Code Diagram



Additional options (should appear in the following order):
CS = current sensor
HT = heater
PRL = pump run light
PL = power light
SA = surge arrestor

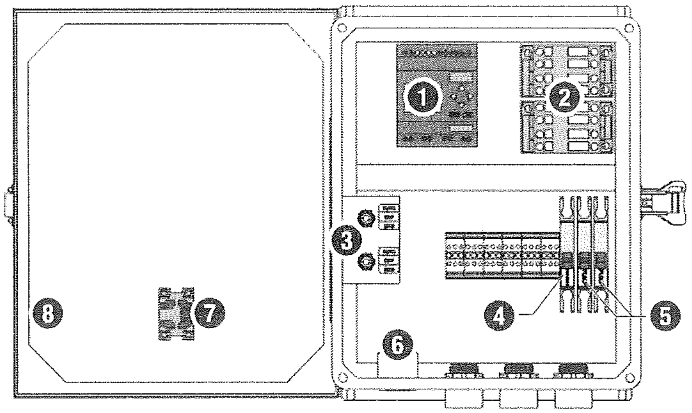
Dual mode (timed- and demand-dose)

Intrinsically safe relays:
Blank = standard, no IR relays
IR = intrinsically safe relays

Pump voltage:
1 = 120 VAC
2 = 120 or 240 VAC

Duplex alternating panel series

MVP control panel



Orenco® MVP-DAX1DM 120 V panel

Standard Components

Feature	Specification(s)
1. Programmable Logic Unit	120 VAC programmable logic unit with built-in LCD screen and programming keys. Provides control functions and timing for panel operation.
2. Motor-Start Contactors	120 VAC: 16 FLA, 1 hp (0.75 kW), 60 hz; 2.5 million cycles at FLA (10 million at 50% of FLA) 240 VAC: 16 FLA, 3 hp (2.24 kW), 60 hz; 2.5 million cycles at FLA (10 million at 50% of FLA)
3. Toggle Switches	Single-pole, double-throw HOA switch. 20 A, 1hp (0.75 kW).
4. Controls Circuit Breaker	10 A, OFF/ON switch. Single-pole 120 V*. DIN rail mounting with thermal magnetic tripping characteristics.
5. Pump Circuit Breakers	20 A, OFF/ON switches. Single-pole 120 V or double-pole 240 V. DIN rail mounting with thermal magnetic tripping characteristics.
6. Audible Alarm	95 dB at 24 in. (610 mm), warble-tone sound.
7. Visual Alarm	7/8-in. (22-mm) diameter red lens, "Push-to-silence." UL Type 4X rated, 1 W LED light, 120 VAC.
8. Panel Enclosure	Measures 11.5 in. high × 9.5 in. wide × 5.4 in. deep (290 × 240 × 135 mm). UL Type 4X rated. Constructed of UV-resistant fiberglass; hinges and latch are stainless steel. Conduit couplings provided.
Dual-Mode Operation	Programmable for timed- and demand-dosing.
MVP-DAX1DM Panel Ratings	120 VAC, 1 hp (0.75 kW), 16 A, single phase, 60 hz.
MVP-DAX2DM Panel Ratings	240 VAC, 3 hp (2.24 kW), 16 A, single phase, 60 hz.

Optional Components

Feature	Specification(s)	Product Code Adder
Intrinsically Safe Control Relays	120 VAC. Listed per UL 698A, for Class 1 Div. 1, Groups A, B, C, D hazardous locations. Larger enclosure required.	IR
Current Sensor	120 VAC. Go/no-go operation. Pump fail indicator light on panel. Manual reset switch.	CS
Heater	Anti-condensation heater. Self-adjusting: radiates additional wattage as temperature drops.	HT
Pump Run Lights	7/8-in. (22-mm) diameter green lens. UL Type 4X rated, 1 W LED light, 120 VAC.	PRL
Power Light	7/8-in. (22-mm) diameter green lens. UL Type 4X rated, 1 W LED light, 120 VAC.	PL
Surge Arrestor	120 V. Status light on unit. Protects incoming power supply from electrical surges.	SA

* *240 VAC units available for int'l markets*

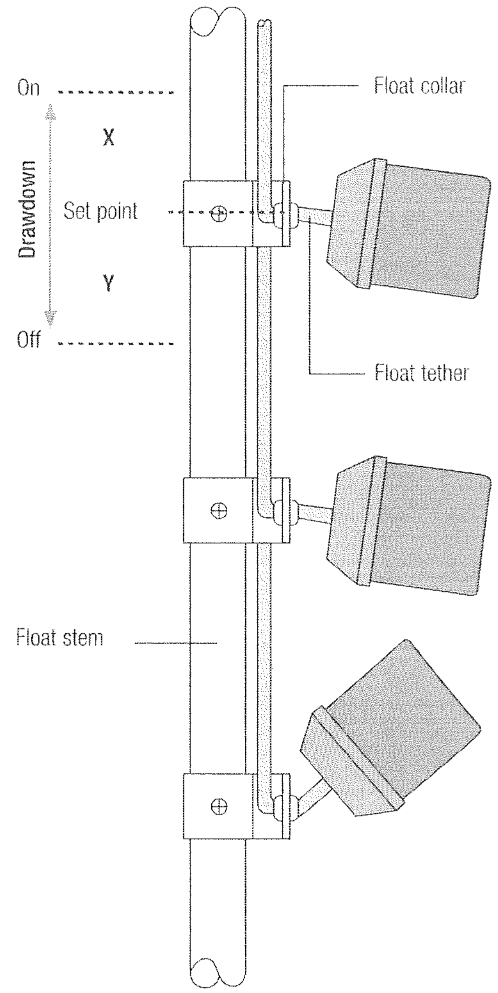
** *120 VAC output for remote alarms comes standard.*

Orenco SYSTEMS *Technical Data Sheet*

Float Switch Assemblies

Applications

Float switches are used to signal liquid level positions for alarm and pump control applications. Orenco float switch assemblies can be mounted in pump vaults, effluent screens, pump basins, and risers.



The "On" and "Off" positions describe normally open floats. For normally closed floats, the functions are reversed.

Materials of Construction

Float housing	Impact-resistant, noncorrosive PVC plastic for use in liquids up to 140° F (60° C)
Float cord	Flexible 2-conductor (UL, CSA) SJOW; CPE cord jacket with EPDM insulated conductors
Float collar	ABS

General

All models listed are UL listed and CSA certified for use in water or sewage. Non-mercury float switches (models B, C, N, and P) are used where components containing mercury are prohibited.

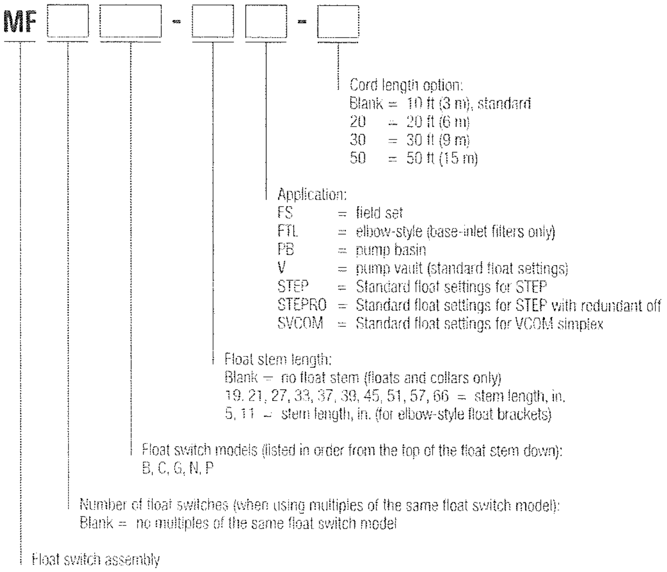
Float switches are typically ordered in assemblies that include one or more switches mounted on a 1-inch PVC float stem. ABS float collars are used to provide secure mounting that is easily adjustable.

Normally-open "P" float switches have a blue cap for easy identification; normally-closed "N" float switches have a red cap.

Standard Models

B, C, G, N, P

Product Code Diagram



Cord length option:
Blank = 10 ft (3 m), standard
20 = 20 ft (6 m)
30 = 30 ft (9 m)
50 = 50 ft (15 m)

Application:
FS = field set
FTL = elbow-style (base-inlet filters only)
PB = pump basin
V = pump vault (standard float settings)
STEP = Standard float settings for STEP
STEPRO = Standard float settings for STEP with redundant off
SVCOM = Standard float settings for VCOM simplex

Float stem length:
Blank = no float stem (floats and collars only)
19. 21, 27, 33, 37, 39, 45, 51, 57, 66 = stem length, in.
5, 11 = stem length, in. (for elbow-style float brackets)

Float switch models (listed in order from the top of the float stem down):
B, C, G, N, P

Number of float switches (when using multiples of the same float switch model):
Blank = no multiples of the same float switch model

Float switch assembly

Note:

When ordering float switch assemblies, remember to list float switches from the top of the float stem down. An "MFPBN-" product code indicates one "P" switch at the top of the stem, one "B" in the middle of the stem, and one "N" switch at the bottom of the stem; an "MF2PN-" indicates "P" switches at the top and middle of the stem, and one "N" switch at the bottom of the stem.

Signal- and Motor-Rated Float Switch Matrix

Float	State[1]	Type	IR[2]	Volts	Amps	hp	Tether	X	Y	Drawdown[3]
Signal-rated mechanical floats[4] (for control switch applications)										
P Model[a]	Normally open	Mechanical	Yes	n/a	n/a	n/a	2.00 in.	1.50 in.	0.50 in.	2.00 in.
N Model[a]	Normally closed	Mechanical	Yes	n/a	n/a	n/a	2.00 in.	1.50 in.	0.50 in.	2.00 in.
Motor-rated floats[4] (for pump switch applications)										
B Model	Normally open	Mechanical	No	120V	13A	1/2 hp	2.00 in.[b]	2.50 in.	1.50 in.	4.00 in.
				240V	13A	1 hp	3.00 in.	3.00 in.	1.50 in.	4.50 in.
							4.00 in.	3.25 in.	1.50 in.	4.75 in.
C Model	Normally open	Mechanical	No	120V	13A	1/2 hp	2.00 in.	3.00 in.	2.50 in.	5.50 in.
				240V	15A	2 hp	3.00 in.[b]	3.50 in.	3.00 in.	6.50 in.
							4.00 in.	4.00 in.	3.50 in.	7.50 in.
							5.00 in.	4.50 in.	4.00 in.	8.50 in.
							6.00 in.	5.25 in.	4.25 in.	9.50 in.
G Model	Normally open	Mercury	Yes	120V	15A	3/4 hp	2.00 in.	1.50 in.	3.00 in.	4.50 in.
				240V	15A	2 hp	3.00 in.[b]	1.75 in.	3.00 in.	4.75 in.
							4.00 in.	2.00 in.	3.50 in.	5.50 in.

a. Suitable for use with VCOM and MVP.

b. Standard tether length

Notes

[1] *State: normally open or normally closed*

The default state of a float — normally open or normally closed — refers to the contact positions in the float when the float is resting (down). Float switches have an internal contact. The terms "normally open" (N/O) and "normally closed" (N/C) refer to the state of the float switch contact in the down position. A normally open float switch has an open contact (off) in the down position and a normally closed float switch has a closed contact (on) in the down position. Different panel functions require different types of float switches. Most applications require float switches that are normally open. One notable exception is the redundant off and low-level alarm function that requires a normally closed float switch, except with MVP and VCOM panels.

[2] *IR (intrinsically safe relay)*

Approved for use with intrinsically safe, Class I, Division 1 applications, where reliable float switch operation with very low current is required.

[3] *Drawdown*

Drawdown (in inches) refers to the difference in liquid level between a float switch's activation and deactivation points. Drawdown can be altered by adjusting the tether length of the float switch cord. When selecting float switches, keep in mind that any float switch that can directly start and stop a pump (one that has no motor contactor in the control panel) should have a drawdown capability, to avoid rapid cycling of the pump.

[4] *Signal-rated or motor-rated*

Every float has a maximum amount of current it can handle. Exceeding these limits may cause premature failure. Signal-rated or "control" floats are used to activate pump control panels and alarms. Only low-amperage signals pass through these float switches, hence the float switch is "signal-rated." All Orenco panels that use motor contactors can use signal-rated float switches. In some systems, a float switch is used to directly start and stop a pump. In this application, the current that is running the pump passes through the float switch as well, and the float switch must be "motor-rated." In most instances, a motor-rated float switch can be used as a signal float switch.

Technical Data Sheet HV200BSX

Discharge Assemblies

Orenco Systems Incorporated
800-348-9843

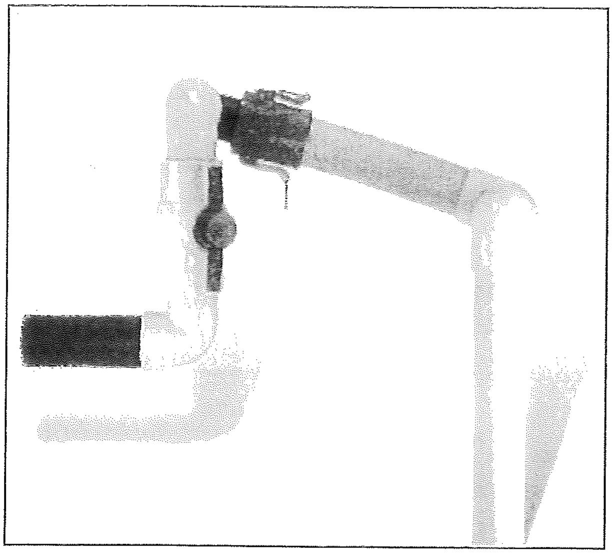
Applications

Orenco Discharge Assemblies are used to convey effluent from a pump to the exterior of a riser or pump basin. They come in the following configurations:

- High head, for use with submersible turbine pumps
- Low head, for use with common effluent pumps
- Drainback, for use with shallowly buried tanks and transport lines in cold climates

Two additional applications are available:

- The cold weather kit coupled with a high-head discharge assembly is intended for use with deeply buried tanks and transport lines in cold weather
- The external flex extension is recommended for installations where tank settling may occur to avoid line breakage during settling.



High head style shown with optional quick-disconnect

General

Orenco Discharge Assemblies are corrosion-resistant and adjustable for a proper fit. Discharge assemblies are composed of PVC valves and flexible hose that simplify installation and maintenance. The flexible hose damps vibrations from the pump and allows for easy installation. Cam-style quick-disconnect fittings are available on all configurations. All parts are either solvent welded or threaded and sealed with Teflon® paste.

Teflon® is a registered trademark of DuPont.

Standard Models

HV100, HV125, HV150, HV200

Nomenclatures

BSX
HV 200 ☐-☐

Configuration:
Blank = field cut (high-head style)
H = high-head style pump
L = low-head style pump
DB = drainback (always field cut)

Options:
B = ball valve
C = check valve
FC = flow controller (1" diameter only)
AS = antisiphon
X = external flex hose
Q = quick disconnect
S = true-union ball check valve*
PR = high pressure

Discharge diameter:
100 = 1"
125 = 1-1/4"
150 = 1-1/2"
200 = 2"

Pump discharge assembly

**Available for 1-1/2" discharge only*

HV CW ☐☐☐-KIT-☐☐☐*

Drain hole:
Blank = 1/8" drain holein elbow
NDH = No drain hole

Kit

Discharge diameter:
100 = 1"
125 = 1-1/4"
150 = 1-1/2"
200 = 2"

Cold weather application

Pump discharge assembly

** Always ordered with high head discharge assembly*

HVX ☐☐☐-☐☐☐

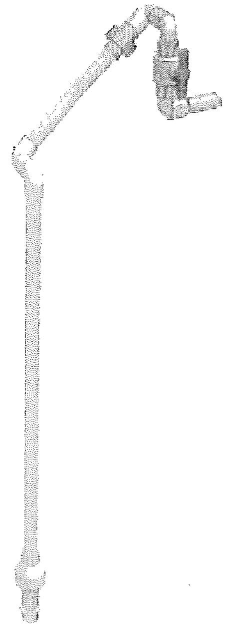
Discharge connection (inches):
Blank = same as discharge diameter
100 = 1"
125 = 1-1/4"
150 = 1-1/2"
200 = 2"

Discharge diameter (inches):
100 = 1"
125 = 1-1/4"
150 = 1-1/2"
200 = 2"

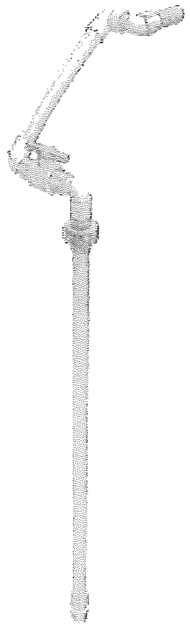
Flex extension

Pump discharge assembly

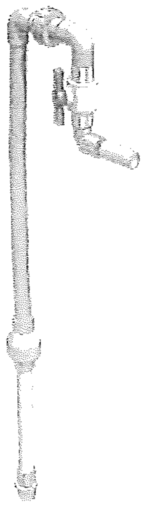
Discharge Assemblies (continued)



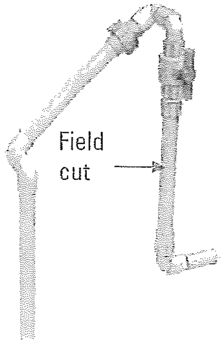
High head style



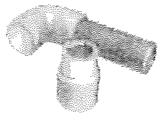
Drainback style



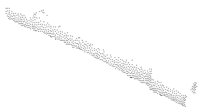
Low head style



High head style with cold weather kit installed



Cold weather kit



External flex extension

Materials of Construction

Component	Material
Anti-siphon valve	Schedule 40 PVC
Ball valve	Schedule 40 PVC
Check valve	Schedule 40 PVC
Pipe and fittings	Schedule 40 PVC
Flexible hose	PVC
External flex hose	PVC
Flow control disc	Schedule 80 PVC
Gate valve	Schedule 80 PVC
Unions	Schedule 80 PVC
High-pressure flex hose	Special elastomer compound

Component Working Pressure Ratings

True union ball check valve	200 psi (14 bar) at 73° F (23° C)
All other valves	150 psi (10 bar) at 73° F (23° C)
Unions	150 psi (10 bar) at 73° F (23° C)

Hose Specifications

Thickness and working pressures at 73° F (23°C)

Flexible hoses	Size (U.S. Nominal)	Wall thickness	Working pressure	Bursting pressure
(standard and external)	1 in.	0.11 in. (2.8 mm)	100 psi (7 bar)	355 psi (24 bar)
	1.25 in.	0.13 in. (3.3 mm)	80 psi (6 bar)	250 psi (17 bar)
	1.5 in.	0.13 in. (3.3 mm)	65 psi (4 bar)	200 psi (14 bar)
	2 in.	0.16 in. (4.1 mm)	60 psi (4 bar)	175 psi (12 bar)
Flexible hoses	**Size (U.S. Nominal)**	**Wall thickness**	**Working pressure**	**Bursting pressure**
(high-pressure)	1 in.	0.235 in. (6.0 mm)	250 psi (17 bar)	N/A
	1.25 in.	0.24 in. (6.1 mm)	250 psi (17 bar)	N/A
	1.5 in.	0.24 in. (6.1 mm)	250 psi (17 bar)	N/A
	2 in.	0.22 in. (5.6 mm)	200 psi (14 bar)	N/A

Ultra-Corr™ PVC Gravity Sewer and Storm Drain Pipe is manufactured by PW Eagle and is a unique combination of PVC pipe technology and innovative engineering design. Ultra-Corr™ sewer pipe brings to the marketplace a cost effective, high quality sewer and drain pipe system. It features a seamless, uniform, cross-sectional wall, radial corrugations which are perpendicular to the axis of the pipe, and a smooth interior for excellent flow characteristics.

Ultra-Corr™ sewer pipe's design enables it to resist earth and impact loads normally associated with sewer and drain pipe installation. Its outstanding chemical and corrosion resistance, along with an integral bell and rubber gasket joint make it an excellent choice for sanitary sewer systems and other drainage applications.

Ultra-Corr™ sewer pipe is available in 24-, 27-, 30-, and 36-inch sizes.

Proven in worldwide applications, Ultra-Corr™ sewer pipe is the optimized profile PVC pipe design, offering strength with economy as well as excellent flow rates.

30" Diameter Riser Pipe

Ultra-Corr™

Standards

Ultra-Corr™ PVC sewer pipe is manufactured to meet or exceed the requirements of the following:

ASTM F794 Specification for Polyvinyl Chloride (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

ASTM F949 Specification for Polyvinyl Chloride (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.

AASHTO M304 Specification for Polyvinyl Chloride (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter.

24" - 36" *Ultra-Corr*™ pipe meets or exceeds section properties in AASHTO Standard Specifications for Highway Bridges Section 17, Soil-Thermoplastic Pipe Interaction Systems.

Mechanical Properties

24" - 36" *Ultra-Corr*™ pipe has a minimum pipe stiffness (F/Δy) of 46 psi, the same as SDR 35. Its tough, durable rib design is capable of withstanding a substantial impact loading when tested in accordance with ASTM D2444.

Hydraulics

The smooth interior wall of *Ultra-Corr*™ pipe provides excellent flow characteristics and resists the build-up of solids. The long length of *Ultra-Corr*™ pipe (14 feet) and the reduced number of required joints yield a Manning flow coefficient of n = .009 under full flow conditions — the lowest resistance of any sanitary sewer or drain pipe.

Chemical & Abrasion Resistance

The chemical resistance of PVC pipe is legendary. Acids, alkalies, and normally diluted hydrocarbons have no effect on the pipe and its gaskets. Aggressive soil conditions due to sulphates, carbonates or sea water are tolerated easily by *Ultra-Corr*™ pipe, as are most industrial effluents and acid rain.

PVC pipe has been subject to abrasion tests by several independent laboratories. These tests prove that PVC pipe will resist abrasion better than concrete and steel pipe. Where abrasive flows are encountered, PVC pipe offers exceptional resistance to wear.

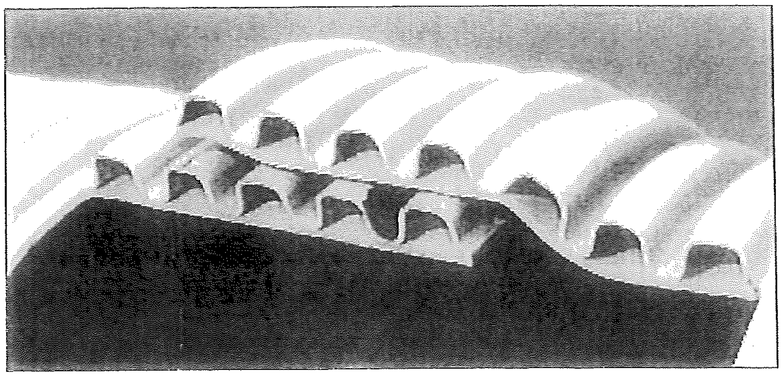
PVC's durability ensures that *Ultra-Corr*™ pipe will have a long life requiring little maintenance. Your sales representative will be glad to give specific recommendations concerning *Ultra-Corr's*™ chemical and abrasion resistance.

Joint Performance

An infiltration rate of less than 50 U.S. gal./inch dia./mile/day can be assured using the *Ultra-Corr's*™ patented joint design. Catch-basin cave-ins are eliminated because the *Ultra-Corr*™ joint will not permit infiltration of fine bedding materials. The manhole adapters supplied with *Ultra-Corr*™ pipe are equally tight.

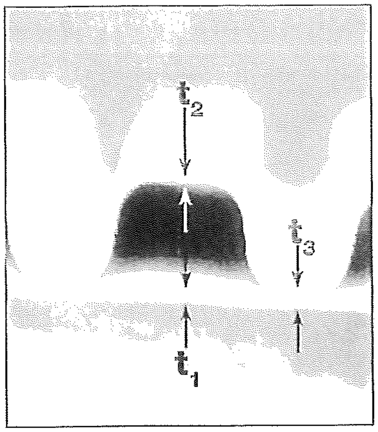
Field Cutting and Joining

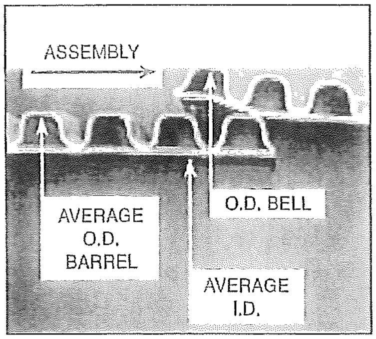
Because the corrugations are perpendicular to the axis of the pipe, the pipe can be cut between any corrugation. The rubber gasket can then easily be placed between the corrugations and the pipe joined together to form a watertight seal. Gasket material meets the requirements of ASTM F477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.



Before assembly, clean and lubricate bell I.D. to third corrugation.

Dimensions





The standard laying length is 14 feet

Ultra-Corr™ Dimensions

Nominal Pipe Size (inches)	Average I.D. (inches)	Avg. O.D. Barrel (inches)	Min. Thickness			Approx. Weight (lbs/ft)	Approx. Bell O.D. (inches)
			Inner Wall t_1 (inches)	Outer Wall t_2 (inches)	At Valley t_3 (inches)		
24	23.48	25.58	0.115	0.085	0.123	18.2	28.7
27	26.46	28.86	0.125	0.091	0.137	20.2	32.5
30	29.48	32.15	0.135	0.105	0.147	26.0	35.8
36	35.49	38.74	0.180	0.125	0.171	36.1	43.4

Fittings

In-Line Fittings

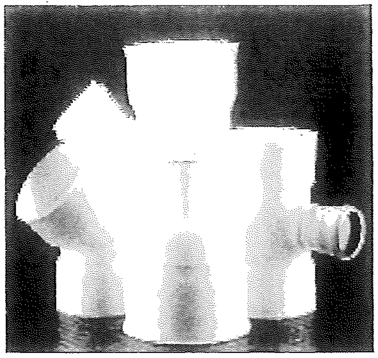
A complete line of fittings is available with *Ultra-Corr™* sealing dimensions - no adapters are required. Use ASTM D3034 SDR35 PVC Sewer Pipe in 4" or 6" sizes for service laterals.

Repair Couplings

Sleeve couplings are available for repairs. The sleeve coupling is manufactured to fit the *Ultra-Corr™* outside dimensions and is constructed as a straight sleeve with no stop shoulder. This style coupling will facilitate most repairs.

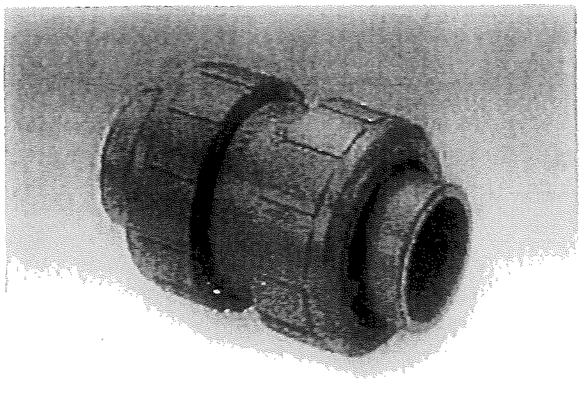
Socket Couplings

In the event two spigots need to be joined, socket couplings are available. These couplings are very similar to the sleeve couplings except that they employ a stop shoulder at the center of the coupling.



Tapping Saddles

While in-line fittings for lateral connections are available, future connections may also be made using the same tee or wye tapping saddle as currently used with SDR35.
The corrugations act as a locking guide for the stainless steel strap which prevents slipping of the saddle. A saddle gasket, available from PW Eagle, is all that is required to



True Union Ball Check Valve

Specifications

Sizes: True Union : 1 /2" - 2"
Single Union: 3" - 4"
Models: Socket, Threaded, Flanged (ANSI), Butt End
Bodies: PVC, CPVC, PP and PVDF
Seats: EPDM, FKM, PTFE
Seals: EPDM, FKM, PTFE
Option: Foot Valve

Sizes 1/2" - 4" PVC/EPDM/FKM Models are available with NSF-61 Certification

Standard Features (Sizes 1/2" - 2")

- Uniseat/seal of EPDM or FKM
- Ball is the only moving part. It unseats to permit flow in one direction but seals against seat to prevent backflow.
- May be used vertically or horizontally
- Minimum shut-off of 5 psi
- All sizes rated for full vacuum service
- Solid thermoplastic ball

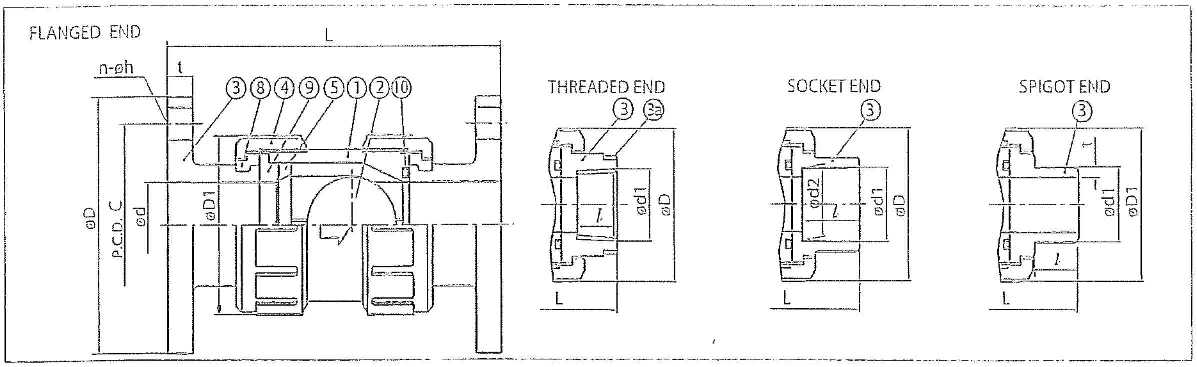
Options:

- PTFE coated FKM uniseat/seal
- Spring-loaded ball to assist ball in seating faster

Parts List - True Union (Sizes 1/2" - 2")

PARTS			
NO.	DESCRIPTION	PCS.	MATERIAL
1	Body	1	PVC, CPVC, PP, PVDF
2	Ball	1	PVC, CPVC, PP, PVDF
3	End Connector	2	PVC, CPVC, PP, PVDF
4	Union Nut	2	PVC, CPVC, PP, PVDF
5	Stop Ring (A)	1	PVC, CPVC, PP, PVDF
8	Stop Ring (B)*	1	PVDF
9	Seat	1	EPDM, FKM, PTFE
10	O-Ring	1	EPDM, FKM, PTFE
3a	Ring**	1	Stainless Steel 304

* Used for flanged end
** Used for CPVC body, threaded end; 1/2" - 1"



Dimensions (Sizes 1/2" - 2")

NOMINAL SIZE		FLANGED						THREADED					SOCKET											SPIGOT(BUTT END)				
		ANSI CLASS 150											PVC, CPVC PP, PVDF				PP, PVDF (DIN) DIN 16962				PP, PVDF (IPS)			PP, PVDF				
																								DIN 3442		PP	PVDF	
INCHES	mm	D	C	n	h	L	t	d1	l	L	d	D1	d1	d2	l	L	d1	d2	l	L	d1	l	L	d1	l	t	t	L
1/2	15	3.50	2.38	4	0.62	5.12	0.47	1/2-14NPT	0.59	3.39	0.59	1.89	0.848	0.836	0.688	3.43	0.768	0.760	0.57	3.19	0.83	0.87	3.31	0.787	0.728	0.098	0.075	4.00
3/4	20	3.88	2.75	4	0.62	6.10	0.55	3/4-14NPT	0.67	4.06	0.79	2.36	1.058	1.046	0.719	3.86	0.965	0.957	0.63	3.70	1.03	1.00	4.43	0.984	0.866	0.106	0.075	4.35
1	25	4.25	3.12	4	0.62	6.50	0.55	1-111/2NPT	0.79	4.45	0.98	2.76	1.325	1.310	0.875	4.37	1.240	1.232	0.71	4.13	1.30	1.13	4.35	1.260	0.866	0.118	0.094	4.75
1 1/4	30	-	-	-	-	-	-	11/4-111/2NPT	0.87	5.00	1.22	3.78	1.670	1.655	0.938	4.92	-	-	-	-	-	-	-	-	-	-	-	-
1 1/2	40	5.00	3.88	4	0.62	7.56	0.63	11/2-111/2NPT	0.98	5.94	1.57	3.78	1.912	1.894	1.094	5.94	1.947	1.937	0.93	5.62	1.89	1.37	5.57	1.969	1.260	0.181	0.118	5.75
2	50	6.00	4.75	4	0.75	8.43	0.63	2-111/2NPT	1.10	6.97	2.01	4.17	2.387	2.369	1.156	6.77	2.461	2.445	1.08	6.69	2.36	1.50	6.49	2.480	1.417	0.228	0.118	6.50

Ball Valves

kbi

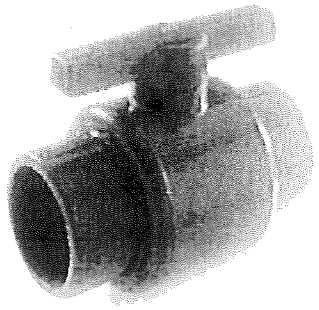
Call u

HOME OWNERS DISTRIBUTORS ARCHITECTS

Commercial Ball Valves (Solvent)

Features:

- EPDM O'rings.
- Meets/exceeds ASTM schedule 80 dimensional and material standards.
- Precision molded micro-finish ball for long life.
- HMW-HDPE "floating seals" resist sticking.
- High quality series, ideal for all residential, industrial and commercial irrigation applications.
- Pressure rated at 235 psi (tested to 500 psi static @ 73°F).
- Patent pending "Stem-Lock" design.
- Full port design and schedule 80 sockets.
- Molded in the USA by KBI.
- Replacement handles available.
- Listed by IAPMO as meeting the requirements of the Uniform Plumbing Code (UPC).
- NSF Standard 61 listed.



Model	Size	Connection	Case
LT-0500-S	1/2"	Solvent	36
LT-0750-S	3/4"	Solvent	24
LT-0750-S	1"	Solvent	18
LT-1250-S	1 1/4"	Solvent	8
LT-1500-S	1 1/2"	Solvent	6
LT-2000-S	2"	Solvent	4

Some fields might not be applicable for

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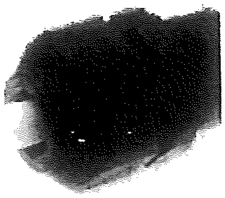
GAS SEALS

Features | Specifications | Print Data Sheet

Features

ALL NEW PRODUCTS!



Heyco® TITE Straight-Thru NPT LTCG's

For Flexible Cords. NPT HUBS – For use in clearance or threaded holes.

US and Foreign Patents Pending.

- Widest range of cable and/or thread sizes available. Includes six threads and seven bodies, for cables ranging from .065" (1,7mm) to 1.260" (32,0mm).
- "Ratchet design" of sealing nut assembly provides superior anti- vibration protection and ensures a firm grip on the cable.
- Integral "Sealing Ring" ensures a Superior seal at mounting location every time.
- Acme threads on body prevent skipping and speed installation.
- We recommend using the cordgrip with the smallest maximum diameter that will fit your application.
- All nylon construction with Buna N Sealing Gland resists salt water, weak acids, gasoline, alcohol, oil, grease, and common solvents. This feature is not assessed by UL certification or testing.
- Suitable for NEMA 6P enclosures.
- Working Temperatures: -22°F to (-30°C) to -212°F (100°C).
- Protection class IP 68 per DIN 40050 up to 70 psi (5 bar) water pressure.
- **Locknuts are NOT included.** Nylon or steel locknuts available separately.
- Standard flammability rating 94V-2.

Consult Factory
Now Available in V
Polyamide

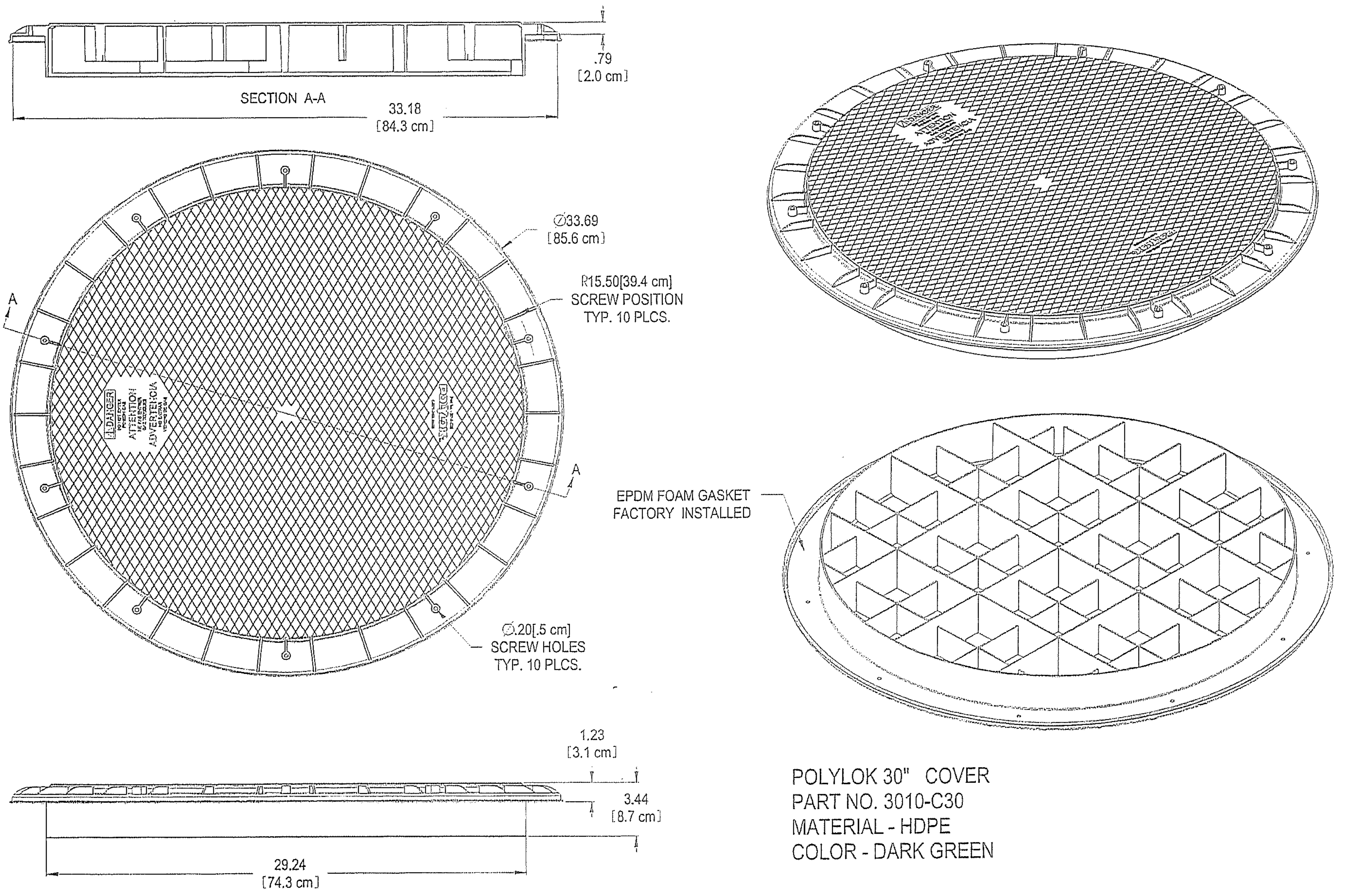
Consult Factory f
Multiple or Flat Ca
Sealing Glands

Quick Specs

Material	Polyamide 6/6 "Nylon" w/Buna N Sealing Gland
Certifications Ⓤ	Listed Underwriters' Laboratories File# E-51579
Ⓢ	Certified by Canadian Standard Association File# LR93876C
Flammability Rating	94V-2 Standard – Consult factory for V0 material
Temperature Rating	-22°F (30°C) to 212°F (100°C)
IP rating	IP 68 per DIN 40050 up to 70 psi (5 bar) water pressure

Box 517 Toms River, NJ 08754 • 732-286-1800 • 800-526-4182 • Fax: 732-244-8843 • Toll Free Fax: 800-358

Heyco® TITE Liquid Tight Straight-Thru Cordgrips
For Flexible Cords. NPT HUBS – For use in clearance or threaded holes.



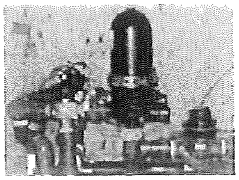
POLYLOK 30" COVER
PART NO. 3010-C30
MATERIAL - HDPE
COLOR - DARK GREEN

Arkal Filters

Spin Klin Fully Automatic Disc Filters

- 2" Spin Klin® Compact (stand alone)
- 2" Spin Klin® Automatic (Self-cleaning) Disc Filter Batteries

2" Spin Klin® Automatic (Self-cleaning) Disc Filter Batteries



Size: 3" - 6" inlet/outlet manifold diameter

Capacity: low flow (10-120 m^3/hr)

Operation: Modular, Fully Automatic Disc Filtration

Standard Features:

- Uniquely efficient. Precise particle separation.
- Innovative filter design captures and stores large amounts of solids
- Low energy and water consumption.
- Long-term operation with barely any maintenance.
- Operation is easy and requires no filter media replacement
- Continuous flow during backwash

Special Features:

- Automatic backwashing for self-cleaning.
- The flushing cycle has a regulated volume, is short and environmentally friendly as it minimizes the use of flush water and automatically cleans the filter element. This saves labor and costs - minimum maintenance, and eliminates forever the need to replace filter media.
- Compact design

2" Automatic Disc Filter Batteries - Technical Data

data	2 units		3 units		4 units	
Maximum pressure:	10 bar	145 psi	10 bar	145 psi	10 bar	145 psi
Minimum pressure:	2.8 bar	38 psi	2.8 bar	38 psi	2.8 bar	38 psi
Flow rate (40-140 mesh, 100-400μ):	40 m^3/h	176 gpm	60 m^3/h	264 gpm	80 m^3/h	352 gpm
Flow rate(55μ):	26 m^3/h	114 gpm	40 m^3/h	176 gpm	53 m^3/h	233 gpm
Flow rate(20μ):	15 m^3/h	66 gpm	23 m^3/h	101 gpm	32 m^3/h	141 gpm
Filtration surface area:	1760 cm^2	272 in^2	2640 cm^2	410 in^2	3520 cm^2	544 in^2
Filtration volume:	2640 cm^3	160 in^3	3960 cm^3	240 in^3	5290 cm^3	323 in^3
Filter length:	545 mm	2115/32"	845 mm	339/32"	1145 mm	453/32"
Filter height:	815 mm	323/32"	815 mm	323/32"	815 mm	323/32"
Filter width:	720 mm	2811/32"	720 mm	2811/32"	720 mm	2811/32"
Weight(Polyester coated):	79 kg	174 lbs	100 kg	220 lbs	121 kg	266 lbs
Weight(Stainless steel):	70 kg	154 lbs	90 kg	198 lbs	110 kg	242 lbs

Installation & Maintenance Instructions

3–WAY MINIATURE SIZE SOLENOID VALVES
NORMALLY CLOSED, NORMALLY OPEN AND UNIVERSAL OPERATION
1/8 NPT — 3/64, 1/16, 3/32 AND 1/8 ORIFICE
BRASS AND STAINLESS STEEL CONSTRUCTION

BULLETIN

8320

Form No.V6055R2

DESCRIPTION

Bulletin 8320 valves are 3-way, direct-acting, miniature size solenoid valves with all three pipe connections located in the valve body. Valves are of rugged brass or stainless steel construction. Standard valves have a General Purpose NEMA Type 1 Solenoid Enclosure. Valves may also be equipped with a solenoid enclosure which is designed to meet NEMA Type 4 — Watertight, NEMA Type 7 (C or D) Hazardous Locations — Class I, Groups C or D and NEMA Type 9 (E, F or G) Hazardous Locations — Class II, Groups E, F or G. Installation and Maintenance Instructions for the Explosion-Proof/Watertight Solenoid Enclosure are shown on Form No. V5391.

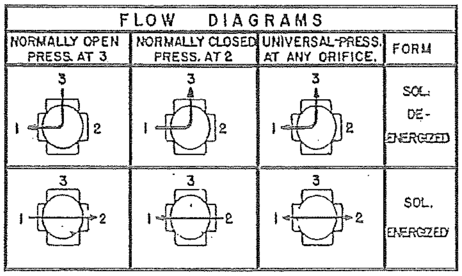
OPERATION

Normally Closed: Applies pressure when solenoid is energized; exhausts pressure when solenoid is de-energized. When solenoid is energized, flow is from Connection "2" to Connection "I." Connection "3" is closed. When solenoid is de-energized, flow is from Connection "I" to Connection "3." Connection "2" is closed.

Normally Open: Applies pressure when solenoid is de-energized; exhausts pressure when solenoid is energized. When solenoid is energized, flow is from Connection "I" to Connection "2." Connection "3" is closed. When solenoid is de-energized, flow is from Connection "3" to Connection "I." Connection "2" is closed.

Universal: For normally closed or normally open operation, selection or diversion of pressure can be applied to Connection "I," "2" or "3."

NOTE: To change from normally closed to normally open or universal operation, consult factory.



MANUAL OPERATOR (Optional)

Manual operator allows manual operation during an interruption of electrical power or when otherwise desired. Two types of manual operators are available — push type (Suffix MO) and screw type (Suffix MS). To operate valve manually with push type operator, push stem at base of valve body as far upward as possible. Valve will now be in the same position as when the solenoid is energized. Removing pressure from stem will release manual operator to original position. To operate valve with a screw type manual operator, rotate manual operator stem at base of valve body clockwise until it hits a stop. Valve will now be in the same position as when the solenoid is energized. Rotate manual operator stem fully counterclockwise before operating valve electrically.

INSTALLATION

Check nameplate for correct catalog number, pressure, voltage and service.

TEMPERATURE LIMITATIONS

For maximum valve ambient and fluid temperatures, refer to chart below. For higher ambient and fluid temperatures, consult factory. Check catalog number prefix and watt rating on nameplate to determine the maximum temperatures.

Construction	Watt Rating	Catalog Number Prefix	Coil Class	Maximum Ambient Temp.°F	Maximum Fluid Temp.°F
A-C Construction (Alternating Current)	6	None, DA or S	A	77	180
		DB, LB, SB DF, FT or SF	H or F	122	200
		HT	H	140	200
	9*	None, DP or SP	F	77	180
D-C Construction (Direct Current)	9.7	None, FT HT, LB, S or SF	A,F or H	77	120

*Catalog Nos. 8320B130, 8320B131, 8320B134, 8320B135, 8320B138, 8320B139, 8320A140, 8320A141, 8320A144, 8320A145, 8320A148 and 8320A149 are limited to a fluid temperature of 140°F.

POSITIONING

This valve is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertical and upright so as to reduce the possibility of foreign matter accumulating in the core tube area.

MOUNTING

For mounting dimensions of mounting bracket, refer to Figure 1.

PIPING

Connect piping or tubing to valve according to markings on valve body. Refer to flow diagrams provided. Apply pipe compound sparingly to male pipe threads only; if applied to valve threads, it may enter the valve and cause operational difficulty. Pipe strain should be avoided by the proper support and alignment of piping. When tightening the connections, do not use the valve body or solenoid as a lever. Wrenches applied to valve body or piping are to be located as close as possible to connection point.

IMPORTANT: For the protection of the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Periodic cleaning is required depending on service conditions. See Bulletins 8600, 8601 and 8602 for strainers.

WIRING

Wiring must comply with Local and National Electrical Codes. Housings for all solenoids are provided with accommodations or connections for 1/2 inch conduit. The general purpose solenoid enclosure may be rotated to facilitate wiring by removing the retaining cap or clip. CAUTION: When metal retaining clip disengages, it will spring upward. Rotate solenoid enclosure to desired position. Replace retaining cap or clip before operating.

NOTE: Alternating current (A-C) and direct current (D-C) solenoids are built differently. To convert from one to the other, it is necessary to change the complete solenoid, including the plugnut/core tube sub-assembly and core assembly.

SOLENOID TEMPERATURE

Standard catalog valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched with the hand only for an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

MAINTENANCE

WARNING: Turn off electrical power supply and depressurize valve before making repairs. It is not necessary to remove the valve from the pipe line for repairs.

CLEANING

A periodic cleaning of all solenoid valves is desirable. The time between cleanings will vary depending on medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. Clean valve strainer or filter when cleaning solenoid valve.

PREVENTIVE MAINTENANCE

1. Keep the medium flowing through the valve as free from dirt and foreign material as possible.
2. While in service, operate the valve at least once a month to insure proper opening and closing.
3. Periodic inspection (depending on medium and service conditions) of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. Replace any parts that are worn or damaged.

IMPROPER OPERATION

1. Faulty Control Circuit: Check the electrical system by energizing the solenoid. A metallic click signifies the solenoid is operating. Absence of the click indicates loss of power supply. Check for loose or blown-out fuses, open-circuited or grounded coil, broken lead wires or splice connections.
2. Burned-Out Coil: Check for open-circuited coil. Replace coil, if necessary.
3. Low Voltage: Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.
4. Incorrect Pressure: Check valve pressure. Pressure to valve must be within range specified on nameplate.
5. Excessive Leakage: Disassemble valve and clean all parts. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

COIL REPLACEMENT (Refer to Figure 1)

Turn off electrical power supply and disconnect coil lead wires. Proceed in the following manner:

1. Remove retaining cap or clip, nameplate and cover. CAUTION: When metal retaining clip disengages, it will spring upward.
2. Slip the yoke containing the coil, sleeves and insulating washers off the plugnut/core tube sub-assembly. Insulating washers (2) are omitted when a molded coil is used.
3. Slip coil, sleeves and insulating washers from yoke.
4. Reassemble in reverse order of disassembly paying careful attention to exploded view provided for identification and placement of parts.

CAUTION: Solenoid must be fully reassembled as the housing and internal parts are part of and complete the magnetic circuit. Place an insulating washer at each end of coil, if required.

VALVE DISASSEMBLY

Depressurize valve and turn off electrical power supply. Proceed in the following manner:

1. Remove retaining cap or clip and slip the entire solenoid enclosure off the plugnut/core tube sub-assembly. CAUTION: When metal retaining clip disengages, it will spring upward. NOTE: For valve with an Explosion-Proof/Watertight Solenoid Enclosure, the solenoid may be removed as a complete unit by unscrewing the solenoid base sub-assembly.
2. Unscrew valve bonnet with special wrench adapter provided in the Spare Parts Kit (special wrench adapter Order No. 158-477-1).
3. Remove plugnut/core tube sub-assembly with valve bonnet and bonnet gasket attached.
4. Remove core spring, core assembly and body gasket.
5. Unscrew end cap or manual operator assembly and remove disc spring, disc, disc holder and body gasket.
6. All parts are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete Spare Parts Kit for best results.

VALVE REASSEMBLY

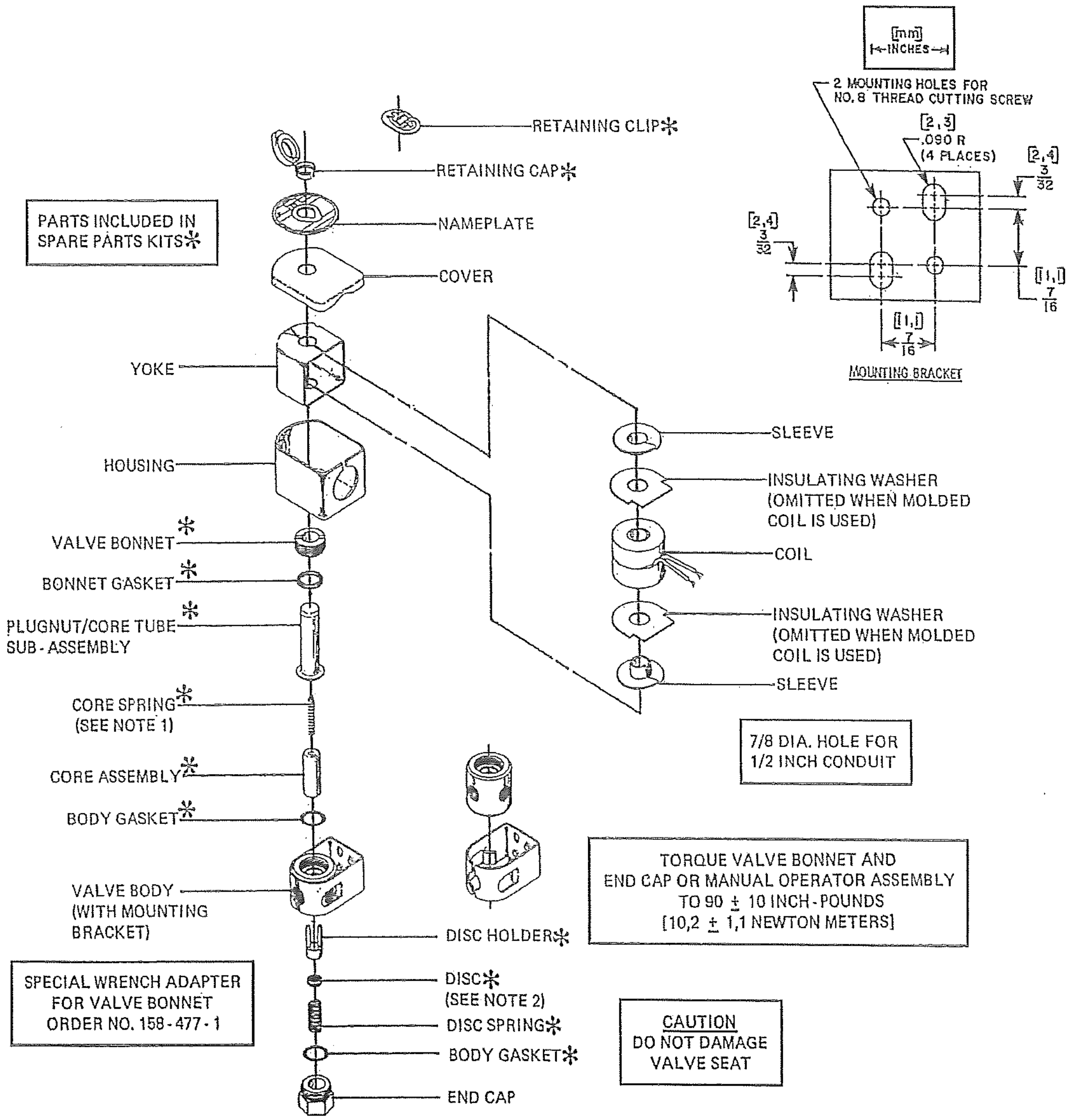
1. Reassemble in reverse order of disassembly paying careful attention to exploded view provided for identification and placement of parts.
2. Lubricate all gaskets with Dow Corning Corporation's MOLYKOTE® 111 compound or an equivalent high grade silicone grease.
3. Replace disc holder, disc, disc spring, body gasket and end cap. IMPORTANT: Some valves have a disc with a conical point on one side. Be sure conical point on disc faces orifice in valve body. Torque end cap (or manual operator assembly) to 90 ± 10 inch-pounds [10,2 ± 1,1 newton meters].
4. Replace body gasket and install core spring into core assembly. Install wide end of core spring into core assembly first, closed end protrudes from top of core assembly.
5. Position core assembly and core spring into plugnut/core tube sub-assembly. Install plugnut/core tube sub-assembly with core assembly and core spring in valve body. Torque valve bonnet to 90 ± 10 inch-pounds [10,2 ± 1,1 newton meters].
6. Replace solenoid enclosure and retaining cap or clip. NOTE: For valves with an Explosion-Proof/Watertight Solenoid Enclosure, the solenoid may be assembled as a complete unit.
7. After maintenance, operate the valve a few times to be sure of proper operation.

SPARE PARTS KITS

Spare Parts Kits and Coils are available for ASCO valves.
Parts marked with an asterisk (*) are supplied in Spare Parts Kits.

ORDERING INFORMATION FOR SPARE PARTS KITS

When Ordering Spare Parts Kits or Coils, Specify Valve Catalog Number, Serial Number and Voltage.



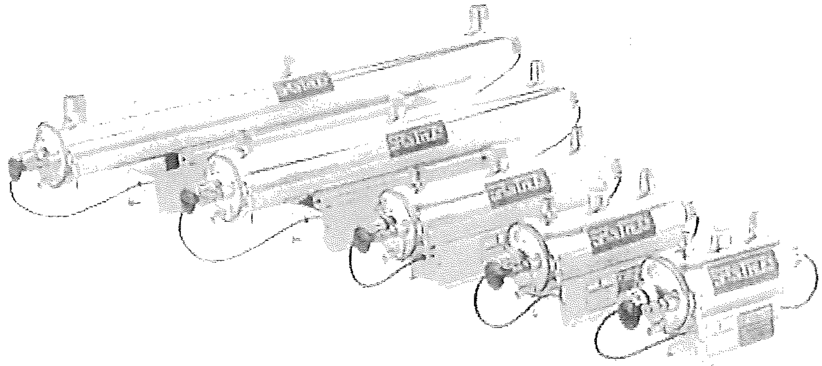
NOTES:
1. INSTALL WIDE END OF CORE SPRING IN CORE ASSEMBLY FIRST. CLOSED END OF CORE SPRING PROTRUDES FROM TOP OF CORE ASSEMBLY.
2. IF DISC HAS A CONICAL POINT ON ONE SIDE, BE SURE CONICAL POINT ON DISC FACES ORIFICE IN VALVE BODY.

Bulletin 8320
General Purpose Solenoid Enclosure Shown.
For Explosion-Proof Solenoid Enclosure, See Form No. V-5391.

Figure 1.

SANITRON Sanitron® Ultraviolet Water Purifiers

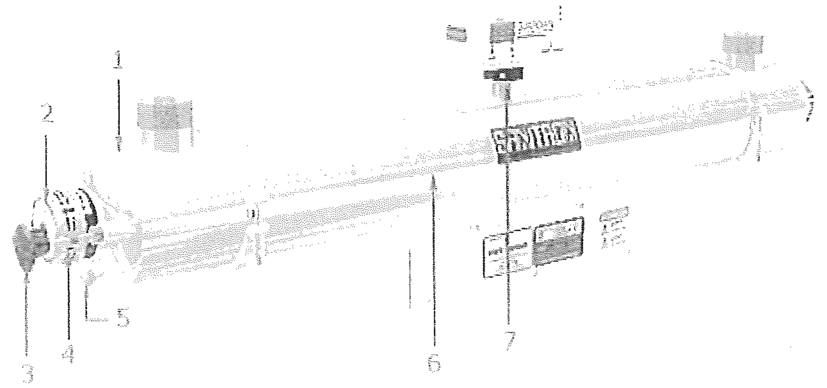
Sanitron® Product Overview



- 2 to 416 gallons per minute [gpm], 120 to 25,000 gallons per hour [gph]
- Potable & high purity water applications
- 316 Stainless Steel, electropolished and passivated inside and out
- Easy Off™ Retainer Cap for effortless lamp change
- Drain Plug for in place drainage of the purifier
- Sight port to view germicidal lamp operation
- Removable flanged head for easy disassembly
- Patented dual action wiper mechanism for cleaning of the quartz sleeve
- Model S2400C has heads that can be removed & rotated
- Protective Coating for seawater & corrosive environments available
- UL Approved Ballasts

Sanitron® Water Purifiers are manufactured under patents owned by the Atlantic Ultraviolet Corporation. Made in the USA.

Sanitron® Special Features



1- **Removable Flanged Head** Units disassemble completely and easily in the event that repairs are necessary. No special tools or fixtures required. (Models S2400C and larger feature dual removable heads.)

2- **Quick Lamp Change** Exclusive Easy-Off™ Retainer Cap enables effortless lamp replacement without shut down of water pressure or drainage of tank. No tools required.

3- **Patented Dual Action Wiper Mechanism** Facilitates periodic cleaning of quartz sleeve without interruption of purifier operation. No disassembly required. Complies with U.S. Public Health Guidelines.

4- **Wiper Lock** Lock wiper mechanism in retracted position.

5- **Drain Plug** Convenient, in-place drainage of purifier chamber.

6- **Stainless Steel Construction** Chamber, head and clamp are electropolished and passivated stainless steel for an attractive finish and dependable service. (Models S17A, S23A, S37C, S50C, S2400C and larger are manufactured in Type 316 Stainless Steel.

7- **Sight Port Plug** Visible glow provides positive indication of germicidal lamp operation. (Unit shown with optional Guardian™ Digital Ultraviolet Monitor in sight port).

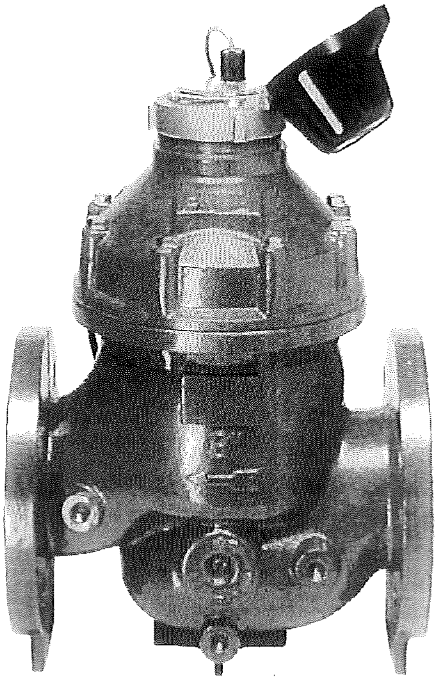
NETAFIM™
GROW MORE WITH LESS

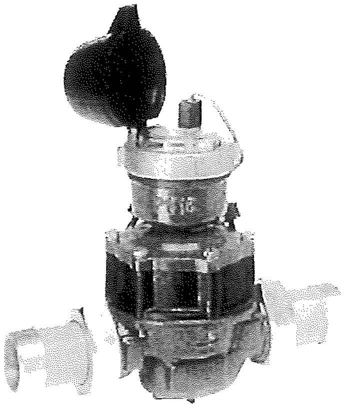
WATER METERS

HYDROMETERS

SAVE SPACE WITH A VALVE AND WATER METER IN ONE UNIT

SUPERIOR HYDRAULIC PERFORMANCE AND RELIABLE FLOW MEASURING





APPLICATIONS

- High pressure, remote control applications
- For communication with irrigation controllers and central control units
- For use as a remote master valve for automated operation
- For variety of pilot options: manual electric, pressure reducing manual electric

SPECIFICATIONS

- Sizes: 1 ½", 2", 3", 4", 6" and 8"
- Maximum Working Pressure:
  Manual Electric - 235 psi
  Pressure Reducing Manual Electric - 140 psi
  Higher pressures available
- Minimum Working Pressure: 21.75 psi
- Maximum Liquid Temperature: 140° F
- Connections: Flanged, Threaded
- Register Options: Reed Switch, Photo Diode or ER Digital
- Reed Switch Register Pulse Outputs: 0.1 or 1.0
- Photo Diode Register Pulse Outputs: 0.0015, 0.0021 or 0.0074
- ER Digital Register Pulse Outputs:
  Gallons - .1, 1, 10, 100, 1000
  Acre Feet - .0001, .001, .01
- Body: Cast Iron, Epoxy Coated
- Valve Diaphragm: Reinforced Natural Rubber

PRODUCT ADVANTAGES

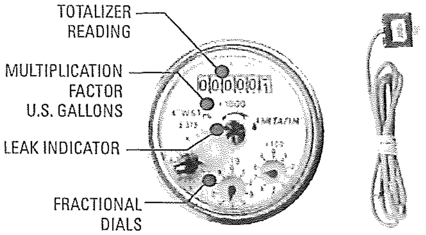
- Double-chambered valve provides quick acting and positive opening and closing.
- Rugged, heavy-duty construction with corrosion-resistant body for reliable performance.
- Stainless steel encapsulated registers guaranteed against fogging due to moisture.
- Globe configuration with built-in straightening vane requires no straight pipe installation saving space.
- Low head loss for energy efficiency and +/-2% accuracy across all flow ranges.

REED SWITCH REGISTER GALLON TOTALIZER

The Reed Switch Register has a low frequency pulse output for communicating with control and monitoring equipment. A leak indicator in the center of the dial registers the lowest flow through the meter. Flows are totalled in U.S. Gallons and each dial face indicates the multiplication factor (located directly under the totalizer reading). Three small fractional dials measure quantities smaller than the totalizer reading.

ELECTRICAL SPECIFICATIONS

- Maximum contact current: 50 mA
- Maximum contact voltage: 48 VDC



REED SWITCH GALLON TOTALIZER

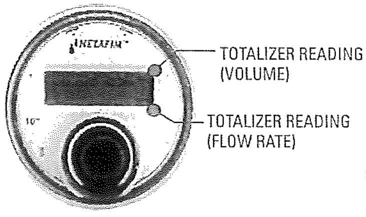
ELECTRONIC (ER) DIGITAL REGISTER

GPM RATE OF FLOW WITH GALLON OR ACRE FEET TOTALIZER

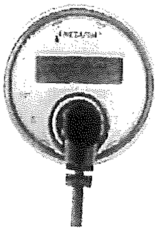
Combines standard digital register features with dry pulse output capabilities. Clearly displays the rate of flow and volume readings in Gallons or Acre Feet. Mounted inside an IP68 stainless steel glass encapsulated cap. Multi-line digital LCD readout displays 9 digits for Total Volume in U.S. Gallons (U.S.G.) or Acre Feet and 4 digits for Rate of Flow in Gallons per Minute (GPM). It's programmable to a wide variety of pipe sizes. Register is interchangeable with common tools.

ELECTRICAL SPECIFICATIONS

- Minimum voltage: 3.6 VDC
- Maximum contact current: 200 mA
- Maximum contact voltage: 40 VDC
- Maximum distance between meter and control board: 65'



ER REGISTER



ER REGISTER WITH PULSE OUTPUT CONNECTION

PHOTO DIODE REGISTER GALLON TOTALIZER

A sensor combines an IR light source and a light sensitive diode in one package. Signals are created when the light beam created by the IR light is interrupted by a rotating element. The Photo Diode Register includes pulse output (open collector) for communicating with control and monitoring equipment. This register requires a constant supply of DC power. Flows are totalled in U.S. Gallons based on the multiplication factors indicated on the dial face.

ELECTRICAL SPECIFICATIONS

- Positive powers the IR light (Yellow wire): current min. 15 to a max. 25 mA through a resistor. Maximum voltage: 28 VDC
- Output (Transparent wire): Open collector, max. load 2 mA
- Ground (Bare wire)

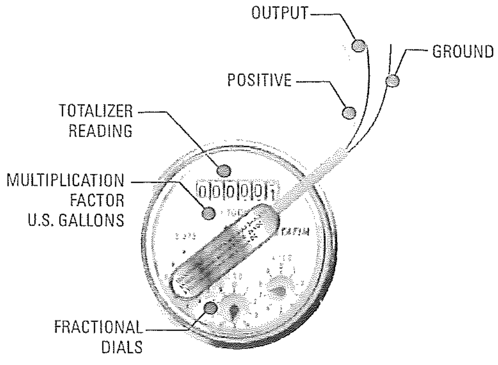


PHOTO DIODE GALLON TOTALIZER

REED SWITCH REGISTERS LOW FREQUENCY

METER SIZE	PULSE OUTPUT (GALS/PULSE)	PULSE OUTPUT (PULSE/GAL)
1 1/2", 2", 3", 4"	1	1
6", 8"	10	0.1

ELECTRONIC (ER) DIGITAL REGISTERS

METER SIZE	REGISTER TOTALIZER	PULSE OUTPUT (GALS/PULSE)	FLOW RATE UNITS
1 1/2" TO 3"	GALLON	.1, 1, 10, 100, 1000	GPM
4" to 8"	GALLON	1, 10, 100, 1000	GPM

PHOTO DIODE REGISTERS

METER SIZE	STANDARD FREQUENCY		HIGH FREQUENCY	
	GALLONS/PULSE	PULSE/GALLON	GALLONS/PULSE	PULSE/GALLON
1 1/2"	0.1	10	0.0053	187.900
2"	0.1	10	0.0085	117.000
3"	0.1	10	0.025	48.710
4"	0.1	10	0.0556	17.993
6"	1	1	0.174	5.747
8"	1	1	0.317	3.152

RECOMMENDED RESISTOR VALUES

VOLTAGE (V+)	RESISTOR VALUE	
	Ω	W
5	180	0.25
6	220	0.25
9	330	0.25
12	470	0.50
24	1,000	1.00

NOTE:
Correct polarity of the leads should be checked carefully to prevent damage to the sensor.

PERFORMANCE DATA

METER SIZE	LOWEST FLOW RATE +/- 5% ACCURACY	LOWEST FLOW RATE +/- 2% ACCURACY	NOMINAL FLOW RATE +/- 2% ACCURACY	MAXIMUM FLOW RATE +/- 2% ACCURACY
1 1/2"	1.8 GPM	4.4 GPM	44 GPM	55 GPM
2"	5.3 GPM	20 GPM	66 GPM	95 GPM
3"	14 GPM	53 GPM	176 GPM	220 GPM
4"	21 GPM	79 GPM	264 GPM	380 GPM
6"	53 GPM	198 GPM	660 GPM	860 GPM
8"	97 GPM	357 GPM	1,189 GPM	1,500 GPM

CV VALUES

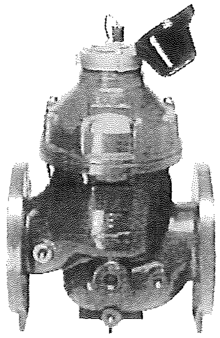
METER SIZE	CV (FLOW RATE AT 1.0 PSI HEADLOSS)
1 1/2"	23 GPM
2"	35 GPM
3"	92 GPM
4"	139 GPM
6"	347GPM
8"	624 GPM

ΔP = (Q/Cv)²
P = psi
Q = GPM = desired pressure loss
Cv = flow at which 1 psi of head loss occurs

FLOW RATE (GPM) VS. PRESSURE LOSS (PSI)

METER SIZE	FLOW RATE IN GPM													
	1.8	4.4	5.3	14	20	21	53	55	79	97	95	125	150	198
1 1/2"	0.01	0.04	0.1	0.4	0.8	0.8	503	5.7						
2"			0.02	0.2	0.3	0.4	2.3	2.5	5.1	7.7	7.4			
3"				0.02	0.05	0.1	0.3	0.4	0.7	1.1	1.1	1.8	2.7	4.6
4"						0.02	0.1	0.2	0.3	0.5	0.5	0.8	1.2	2.0
6"							0.02	0.03	0.05	0.1	0.1	0.1	0.2	0.3
8"										0.02	0.02	0.04	0.1	0.1

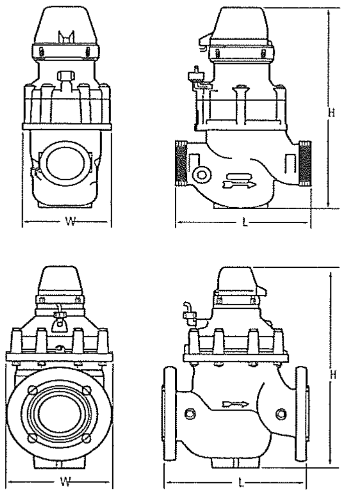
☐ ± 2% Accuracy Pressure loss in psi = (GPM/Cv)²
☐ ± 5% Accuracy EXAMPLE: 2" Hydrometer, design flow @ 55 GPM (55 GPM / 35)^2 = 2.5 psi headloss



FLOW RATE (GPM) VS. PRESSURE LOSS (PSI)

METER SIZE	FLOW RATE IN GPM													
	220	250	300	357	380	400	500	700	860	900	950	1,000	1,250	1,500
1 1/2"														
2"														
3"	5.7													
4"	2.5	3.2	4.7	6.6	7.5									
6"	0.4	0.5	0.7	1.1	1.2	1.3	2.1	4.1	6.1					
8"	0.1	0.2	0.2	0.3	0.4	0.4	0.6	1.3	1.9	2.1	2.3	2.6	4.0	5.8

☐ ± 2% Accuracy Pressure loss in psi = (GPM/Cv)²
☐ ± 5% Accuracy EXAMPLE: 2" Hydrometer, design flow @ 55 GPM (55 GPM / 35)^2 = 2.5 psi headloss



DIMENSIONS & WEIGHT

METER SIZE	L LENGTH	W WIDTH	H HEIGHT	WEIGHT (LBS.)
1 1/2"	6 5/16"	4 15/16"	10 7/16"	4
2"	8 11/16"	4 15/16"	13"	7
3"	11 1/4"	8 1/16"	17"	52
4"	14 3/16"	9"	18 1/16"	65
6"	19 11/16"	14 15/16"	24 13/16"	245
8"	23 9/16"	17 11/16"	30 11/16"	309

INSTALLATION REQUIREMENT:
Globe configuration Hydrometers have no straight pipe installation requirements.

ORDERING INFORMATION - ER DIGITAL REGISTERS

36 HM SIZE REGISTER VOLUME FLOW RATE OUTPUT 1 OUTPUT 2 CONTROL OPTION

SIZE

15 = 1.5"
2 = 2"
3 = 3"
4 = 4"
6 = 6"
8 = 8"

REGISTER

ER = ER DIGITAL REGISTER
EM = ER DIGITAL REGISTER W/OUTPUT MODULE

VOLUME

1 = GALLONS
2 = ACRE FEET

FLOW RATE

1 = GPM

OUTPUT 1 AND OUTPUT 2 **

A = NO OUTPUT
C = .1 GALLON PER PULSE
D = 1 GALLON PER PULSE
E = 10 GALLONS PER PULSE
F = 100 GALLONS PER PULSE
G = 1000 GALLONS PER PULSE
H = 0.0001 ACRE FT. PER PULSE
I = 0.001 ACRE FT. PER PULSE
J = 0.01 ACRE FT. PER PULSE

OUTPUT C: Can be either Gallons or Acre Feet

** Pulse rate is based on volume units. If volume is in Acre Feet and Option D is chosen for Output 1 or 2, it will result in 1 pulse every acre foot of water that passes through the meter. To convert Acre Feet to Gallons per Pulse, multiply by 325,850.

CONTROL OPTION

M = MANUAL
MEL = MANUAL ELECTRIC
RC = REMOTE CONTROL
PR = PRESSURE REDUCING
PRMEL = PRESSURE REDUCING MANUAL ELECTRIC
PRRC = PRESSURE REDUCING REMOTE CONTROL
PRPS = PRESSURE REDUCING & SUSTAINING
PRPSEL = PRESSURE REDUCING & SUSTAINING ELECTRIC PRESSURE SUSTAINING
PS = PRESSURE SUSTAINING
PSEL = ELECTRIC

ORDERING EXAMPLE:

36HM15ER11EEMEL

1 1/2" Hydrometer, ER Register, Volume in Gallons, Flow Rate in Gallons per Minute, Pulse Output 1 is 10 Gallons per Pulse, Pulse Output 2 is 10 Gallons per Pulse, Manual Electric Control

ORDERING INFORMATION REED SWITCH & PHOTO DIODE REGISTERS

METER SIZE	MODEL NUMBER	REGISTER TYPE	GALLONS/ PULSE	CONNECTION
1 1/2"	36HM1.5TG	REED SWITCH	1	UNION
	36HM1.5TG.1	PHOTO DIODE	0.1	UNION
	36HM1.5TG-.0053	PHOTO DIODE	0.0053	UNION
2"	36HM2TG	REED SWITCH	1	THREADED
	36HM2TG.1	PHOTO DIODE	0.1	THREADED
	36HM2TG-.0085	PHOTO DIODE	0.0085	THREADED
3"	36HM3FG-1	REED SWITCH	1	FLANGE
	36HM3FG.1	PHOTO DIODE	0.1	FLANGE
	36HM3FG-.0025	PHOTO DIODE	0.0205	FLANGE
4"	36HM4FG	REED SWITCH	10	FLANGE
	36HM4FG1	REED SWITCH	1	FLANGE
	36HM4FG-0.566	PHOTO DIODE	0.0566	FLANGE
6"	36HM6FG	REED SWTICH	10	FLANGE
	36HM6FG1	PHOTO DIODE	1	FLANGE
	36HM6FG-.1739	PHOTO DIODE	0.1739	FLANGE
8"	36HM8FG-10	REED SWITCH	10	FLANGE
	36HM8FG1	PHOTO DIODE	1	FLANGE
	36HM8FG-.3173	PHOTO DIODE	0.3173	FLANGE

MAXIMUM PRESSURE: 235 psi
Call Netafim USA Customer Service for Item Numbers
6" and 8" sizes are Non-Stock, Special Order items

NETAFIM™
GROW MORE WITH LESS

NETAFIM USA
5470 E. HOME AVE.
FRESNO, CA 93727
CS 888 638 2346
www.netafimusa.com

Unions

kbi

Made with Pride in the U.S.A. by

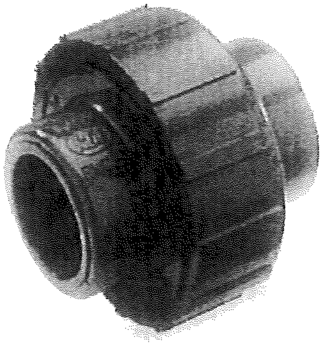
The Professional's Choice

Call u

HOME OWNERS DISTRIBUTORS ARCHITECTS

Unions (Solvent)

Features:
- EPDM O'rings.
- Meets/exceeds ASTM schedule 80 dimensional and material standards.
- Made of high-impact PVC Type II material.
- Molded in the USA by KBI.
- Pressure rated at 235 psi (tested to 500 psi static @ 73°F).
- Listed by IAPMO as meeting the requirements of the Uniform Plumbing Code (UPC).
- NSF Standard 61 listed.



Model	Size	Connection
U-0500-S	1/2"	Solvent x Solvent
U-0750-S	3/4"	Solvent x Solvent
U-1000-S	1"	Solvent x Solvent
U-1250-S	1 1/4"	Solvent x Solvent
U-1500-S	1 1/2"	Solvent x Solvent
U-2000-S	2"	Solvent x Solvent
U-2500-S	2 1/2"	Solvent x Solvent
U-3000-S	3"	Solvent x Solvent
U-4000-S	4"	Solvent x Solvent

Some fields might not be applicable for

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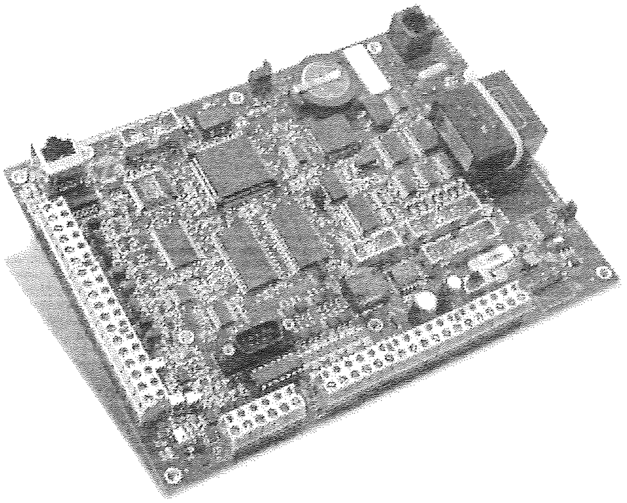
Technical Data Sheet

Orenco® TCOM Remote Telemetry Board

Applications

Orenco's line of affordable TCOM remote telemetry units give facility managers, operators, and maintenance providers the ability to remotely monitor and control the performance of mechanical equipment in real time. Ideal for:

- Wastewater Collection and Treatment
- Water Systems
- Environmental Monitoring
- Industrial Processes



Orenco® TeleComm™ (TCOM) ATRTU NET remote telemetry board

Features/Unique Specifications

To specify this panel for your installation, require the following.

- Automatic call-out to e-mail capable devices during alarm conditions or when panel detects trends that could lead to system failure
- Ability to maintain logs for system conditions and events, such as Motor Run Time, Motor Cycles, and Alarm Conditions
- Downloadable logs into a *.dif or ASCII format for simple conversion to common spreadsheet or word processor programs
- No proprietary computer software needed for remote monitoring and control. VT100 protocol allows remote access and control from any computer modem (Mac or PC) with a simple communications program (e.g. Windows® HyperTerminal)
- Bluetooth® adapter available.
- Multi-level password security to ensure that only qualified personnel can remotely access site
- Simple interface using status, reference, and control parameters (Points). Points are viewable/editable by the operator. The following "point" types are supported:
  - Digital: on or off condition
  - Analog: numeric range (± 20,000,000)
  - Date: mm/dd/yy format
  - Time: 24 hour clock
  - Label: Text (7 character max)
- Program logic (rules) consists of simple conditional "If ... Then" declarations. Rules can be written based on several operands, including the following:
  - Input / Output status
  - Point status
  - Date: mm/dd/yy format
  - Time of day: 24 hour clock
  - Timers
  - Historical data (allows for control optimization or detection of trends)
- Schedule Functions to control digital "Points" based on date or day of week/time
- Automatic daylight savings time adjustment
- Optional graphical interface software to view system status and permit interactive system control
- Ability to upload new programming remotely
- Ability to upload firmware updates remotely

Model: ATRTU-NET
Hardware Specifications

Physical Size

- 5.75" x 8.0"

Terminations

- Removable terminal blocks with screw compression terminals
- Accepts 16 to 22 AWG solid or stranded wires

Digital Input Features

- Eight inputs
- Discrete or pulse (25 pulse/sec maximum)
- Self powered: 24 VDC at 10 mA maximum
- Yellow LED input indicators
- Optically isolated
- Expandable to 16 inputs with expansion board

Analog Input Features

- Eight inputs
- Expandable to 16 inputs with expansion board
- 0-5 VDC input signal, or 4-20 mA input with jumper)
- Linear or 10k ohm thermistor scaling
- 12-bit analog-to-digital resolution

Digital Output Features

- Eight outputs
- Expandable to 16 outputs with expansion board

Analog Output Features

- Two outputs
- 4-20 mA output signal
- 10 bit digital to analog resolution

Communication Ports

- RS 232 port – 9 pin (Bluetooth adapter available)
- On board modem: 33.6 k baud (RJ11 phone jack)
- Ethernet port (10 base T, RJ45 jack)
- Serial modbus port (RS422/485 terminals)

Sensor/External Relay Power Supply

- 5 VDC, 30 mA maximum
- 24 VDC, 350 mA maximum

Power Requirements

- 24 VDC, 1.2 A

Environment

- 32° F to 122° F (0° C to 50° C)
- 5% to 95% RH, non-condensing

Firmware Specifications

Safety Features

- Non-volatile memory backup of program
- Lithium battery backup of data and program settings (1-year storage without power)
- Hardware Watchdog Timer to restart system in the event of a program corruption
- Battery backup to allow continued monitoring and alarm functions during power outage (optional)

Logs

- Activity log (a minimum of 2048 defined digital events)
- Alarm log (up to 240 board-level events)
- Custom designed user logs for recording flow, level, alarms, etc. (up to 32 individual logs, with a total of 65,472 logged data points)
- Maintenance log (up to 64 entries of 60 characters)

Control Parameters (Points)

- 672 available control parameters

Program Logic (Rules)

- 800 available rules

Schedules

- 64 available events (time and day or date-based) events

Alarm Callout Capability (Mailboxes)

- 16 destinations (mailboxes) available for alarm event notifications
- E-mail capable (POP3/SMTP e-mail server required)

Networking Protocols

- Ethernet
  a. Modbus TCP-capable (permits peer-to-peer communications, up to 16 peers)
  b. HTTP Web server-capable
  c. TELNET text terminal compatible
- Serial modbus (permits our controller to act as master or slave)
  a. As "master," modbus permits connection to off-the-shelf, non-proprietary devices that support modbus protocols. Can control and monitor up to 32 clients.
  b. As "slave," modbus permits connection to and communication with modbus servers.

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

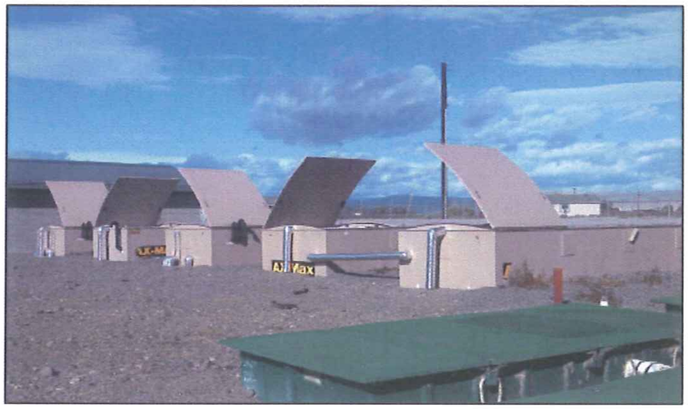
Applications:

- 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!



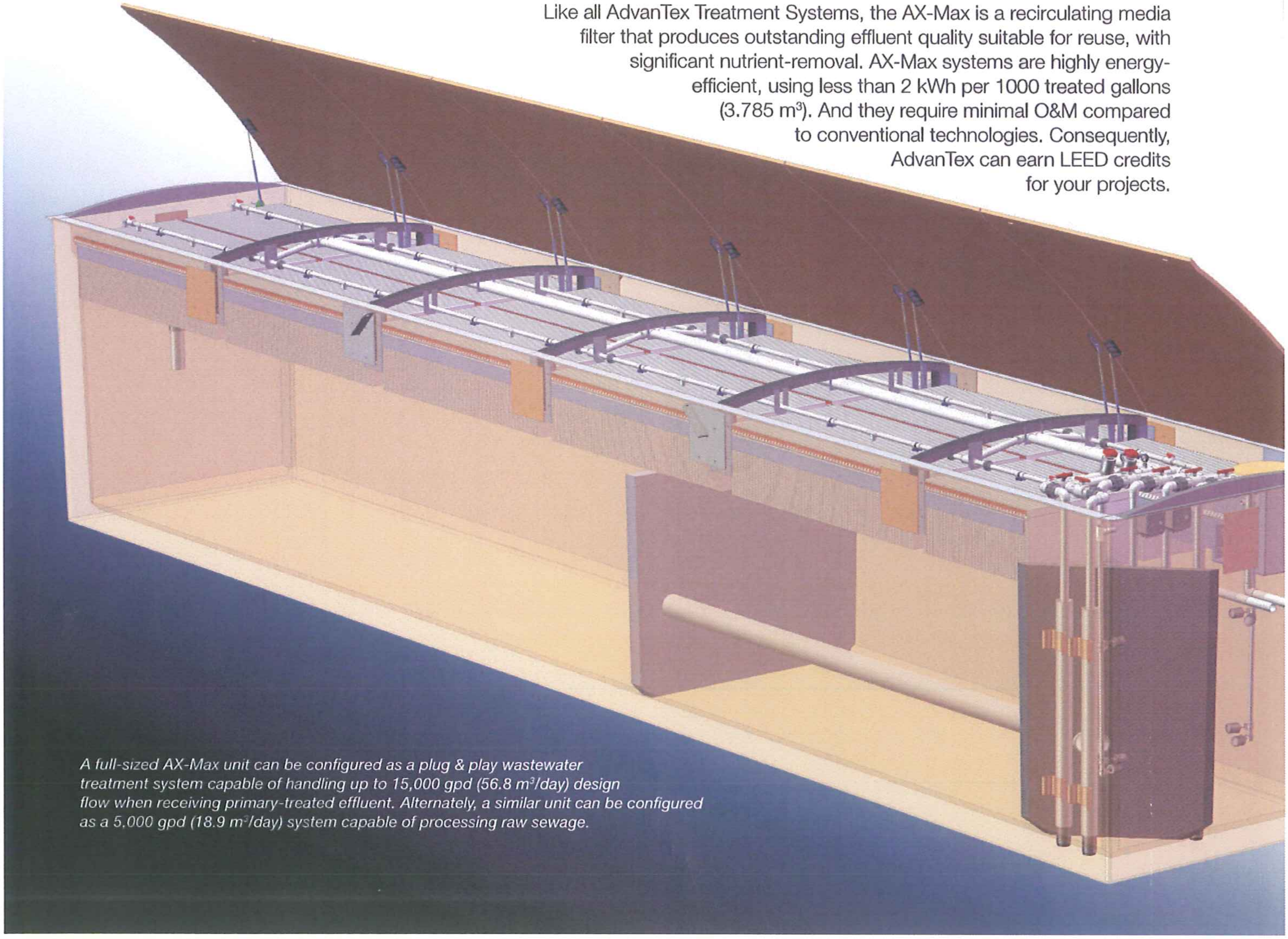
The Yakama Nations Housing Authority in Washington state added five AdvanTex® AX-Max units (background) to its ten AdvanTex AX-100 units, increasing the capacity of its wastewater system by 50%. Photo courtesy of Fextex Systems, Inc.

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.

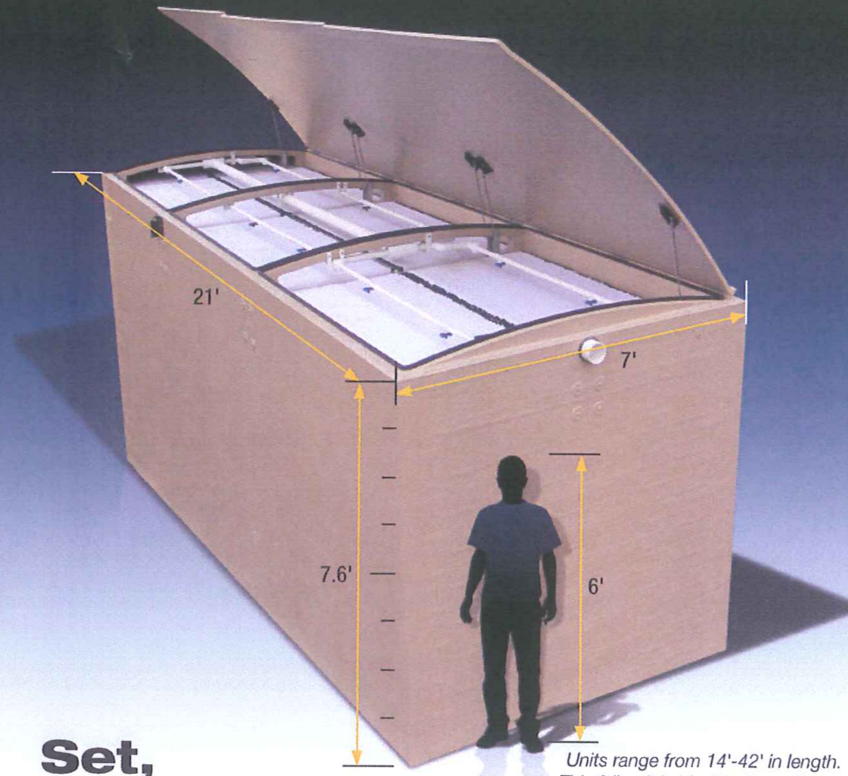
A Sustainable Solution for Wastewater Treatment

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 m³). 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 m³/day) design flow when receiving primary-treated effluent. Alternately, a similar unit can be configured as a 5,000 gpd (18.9 m³/day) system capable of processing raw sewage.

AdvanTex® AX-Max™ Treatment System



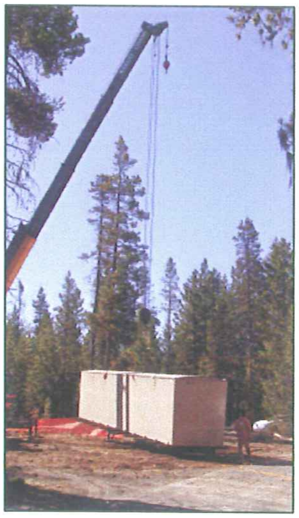
Units range from 14'-42' in length. This 21' unit is ideal for lower flows.

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 m³/day).

For Every Climate and Condition

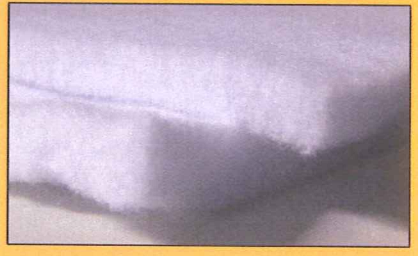
AX-Max systems provide excellent treatment anywhere, and they have been installed all over the world. For example, AX-Max systems have been installed at Malibu's famous beach parks and New Zealand's Glendhu Bay campground. Several more were installed in Soyo, Africa, to serve a new hospital and school. 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 m³)*

** 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/ft² (2000 L/day/m²) 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

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Sutherlin, OR 97479 USA

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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

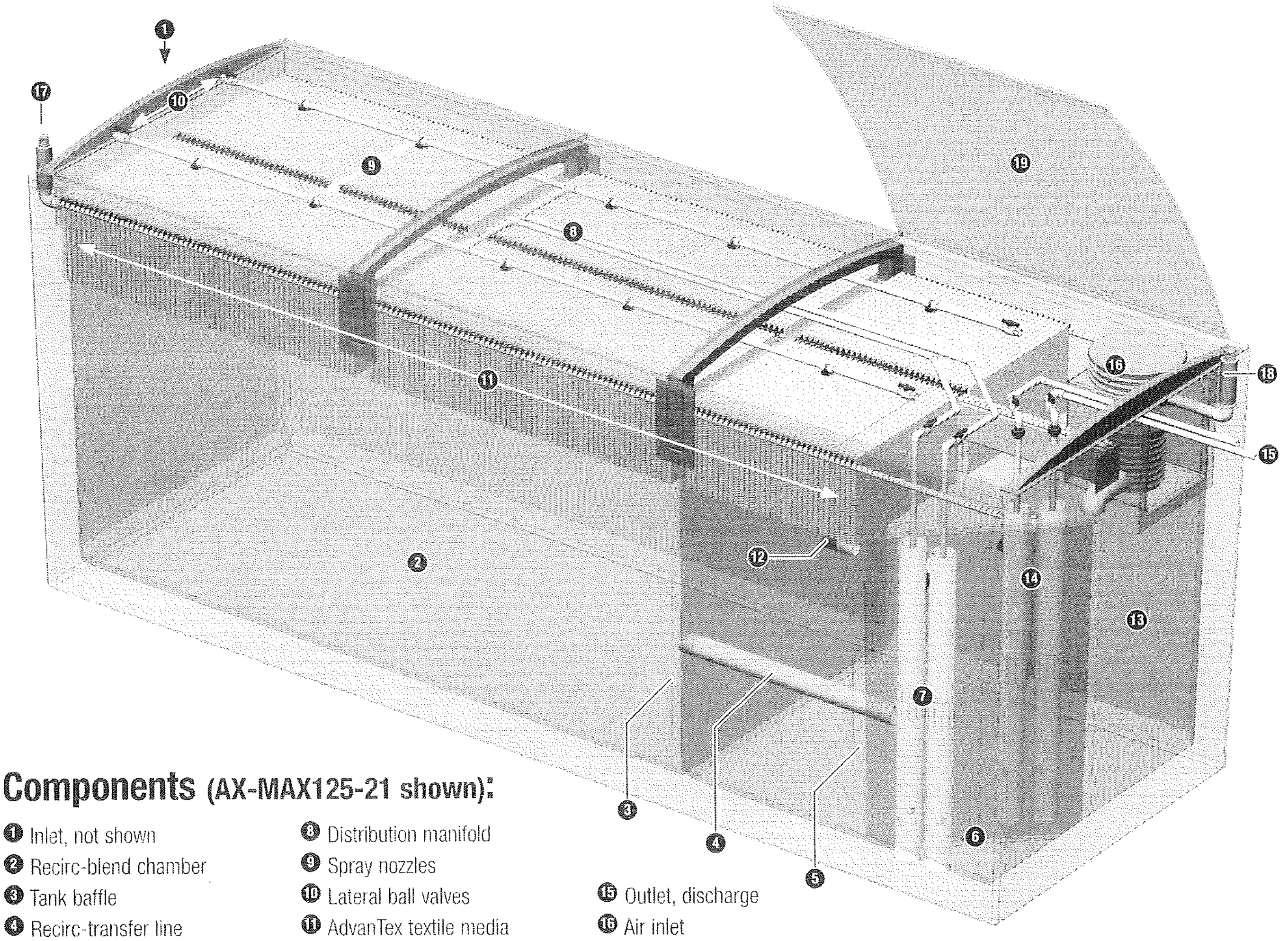
The AX-Max is a modular system that can be preceded by primary treatment or configured to incorporate primary, secondary, and tertiary wastewater treatment before reuse or dispersal.

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

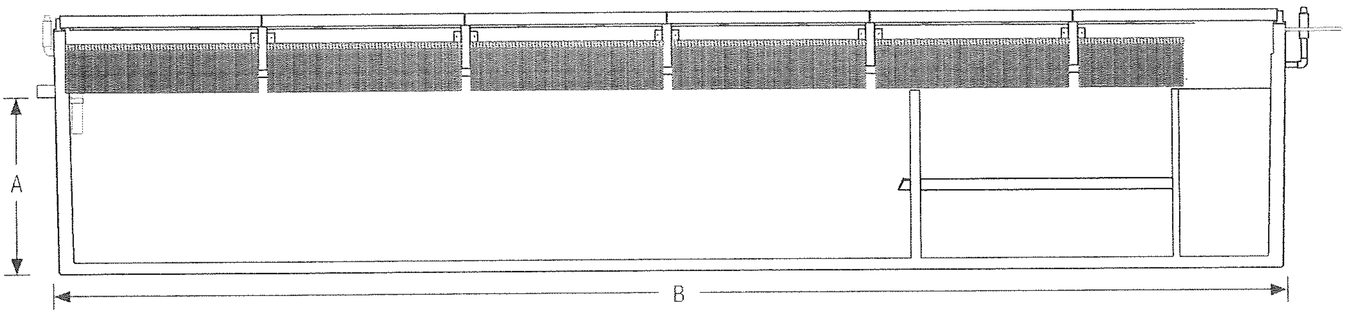
AX-MAX100-14, AX-MAX150-21, AX-MAX200-28, AX-MAX250-35, AX-MAX300-42 (Standard models without pump systems.)

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

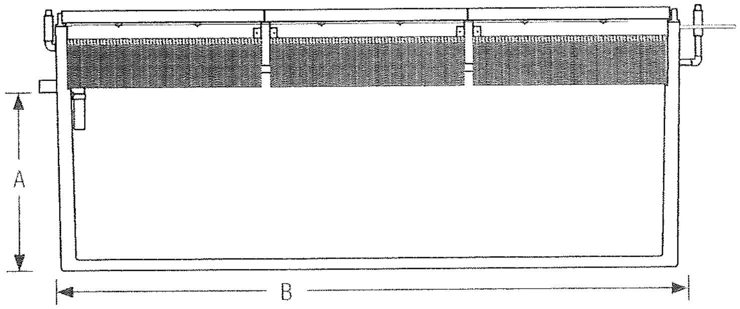


Components (AX-MAX125-21 shown):

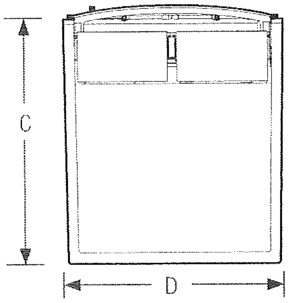
❶ Inlet, not shown
❷ Recirc-blend chamber
❸ Tank baffle
❹ Recirc-transfer line
❺ Recirc-pump chamber baffle
❻ Recirc-pump chamber
❼ Recirc pumping assembly
❽ Distribution manifold
❾ Spray nozzles
❿ Lateral ball valves
⓫ AdvanTex textile media
⓬ Recirc-return valve
⓭ Recirc-filtrate chamber
⓮ Discharge pumping assembly
⓯ Outlet, discharge
⓰ Air inlet
⓱ Vent fan assembly
⓲ Air outlet
⓳ 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.*

Commercial Treatment Systems

Design Considerations for AdvanTex® Treatment Systems

Table of Contents . . . . *Page*

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

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 ft^2 (1.9 m^2), nominal
Installation footprint	25 ft^2 (1.9 m^2), 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

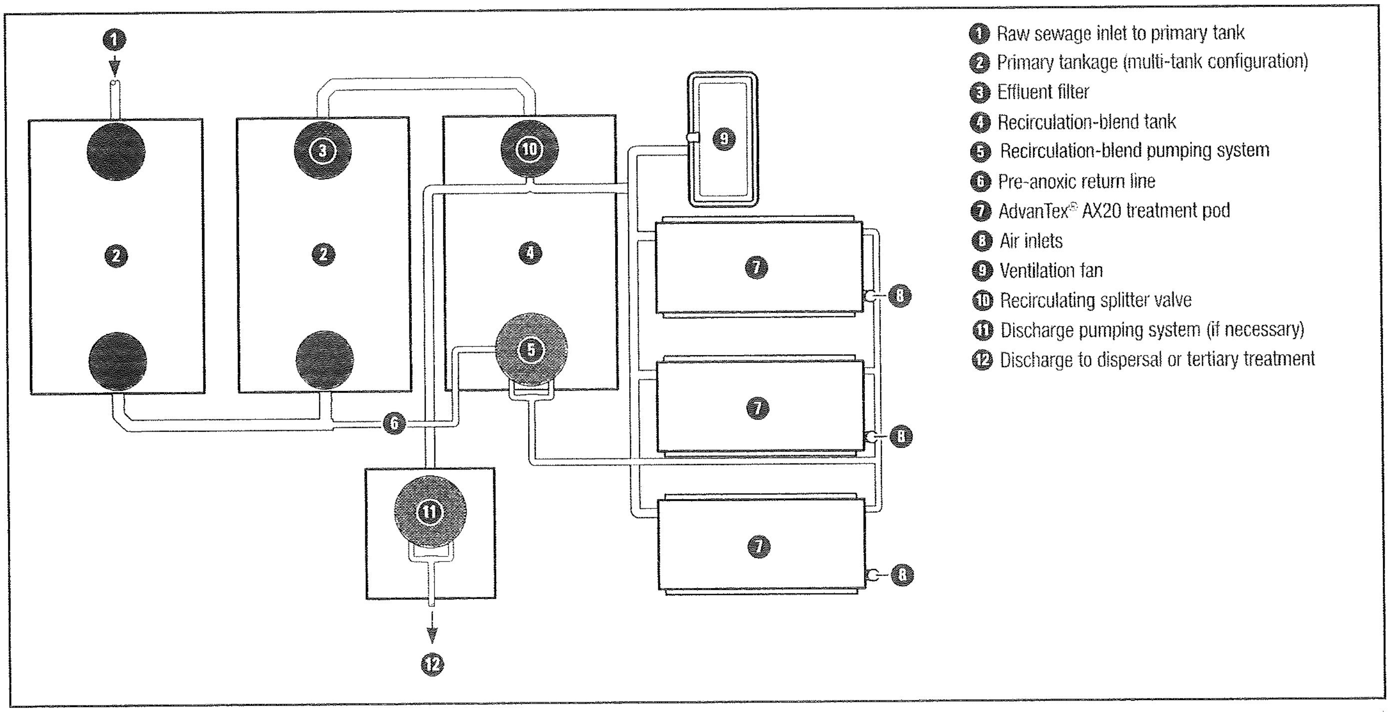


Figure 1. Example of an AdvanTex AX20 Commercial Treatment System

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 ft^2 (9.3 m^2), nominal
Installation footprint	128 ft^2 (11.9 m^2), 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

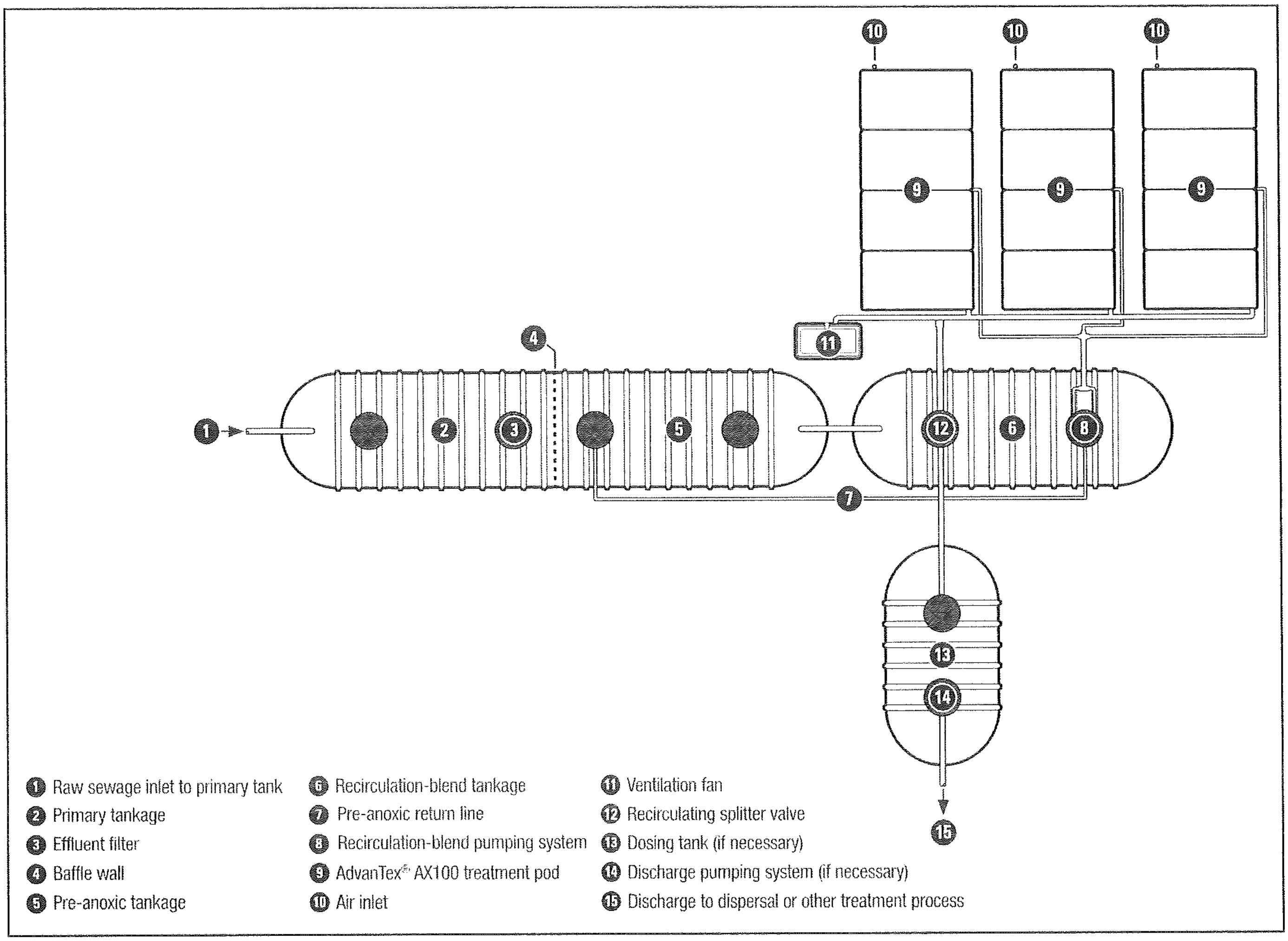
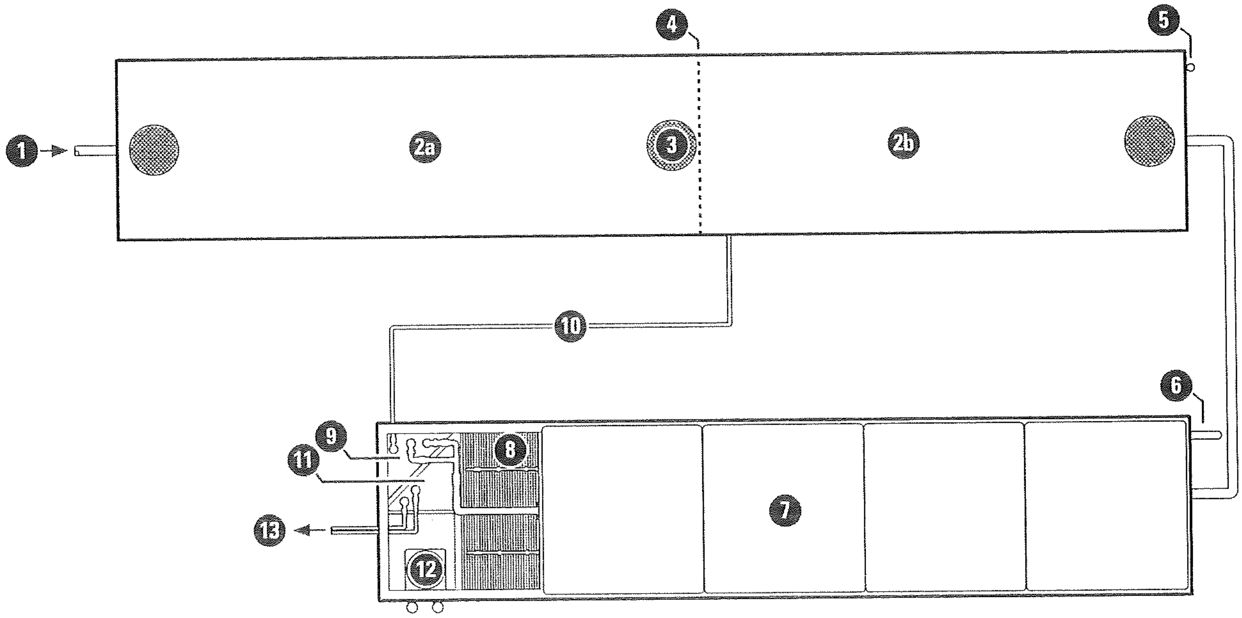


Figure 2. Example of an AdvanTex AX100 Commercial Treatment System

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 ft² (2.3-27.9 m²), nominal
Installation footprint	112-336 ft² (10.4-31.2 m²), 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



① Raw sewage inlet to primary tankage

② 42-ft (12.8-m) Orenco® T-Max™ Tank:
  a) primary tankage
  b) pre-anoxic tankage

③ Effluent filter

④ Baffle wall

⑤ Passive primary tank ventilation

⑥ Vent fan inlet

⑦ Secondary treatment: 35-ft (10.7-m) AX-Max™ Unit

⑧ AX-Max Unit: treatment media

⑨ AX-Max Unit: recirc-blend and pre-anoxic pumping chamber

⑩ Pre-anoxic return line

⑪ AX-Max Unit: discharge pumping chamber

⑫ AX-Max Unit: active ventilation system

⑬ Discharge to dispersal or tertiary treatment process

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.

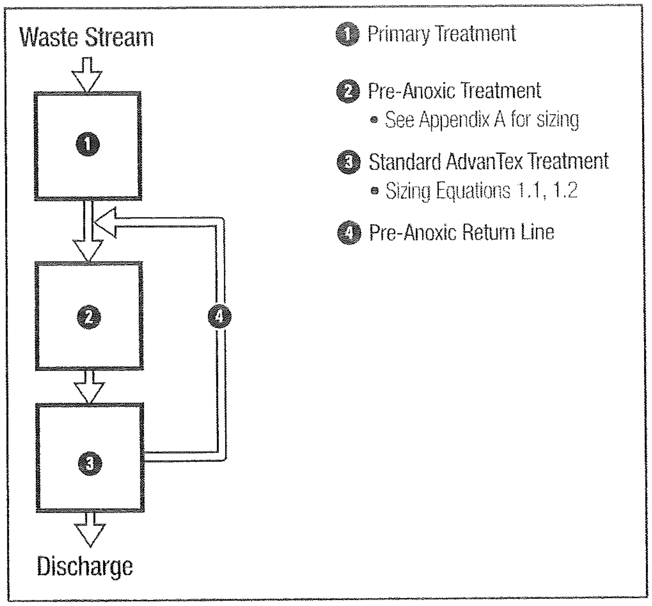


Figure 4. Treatment Diagram for Removal of Organics

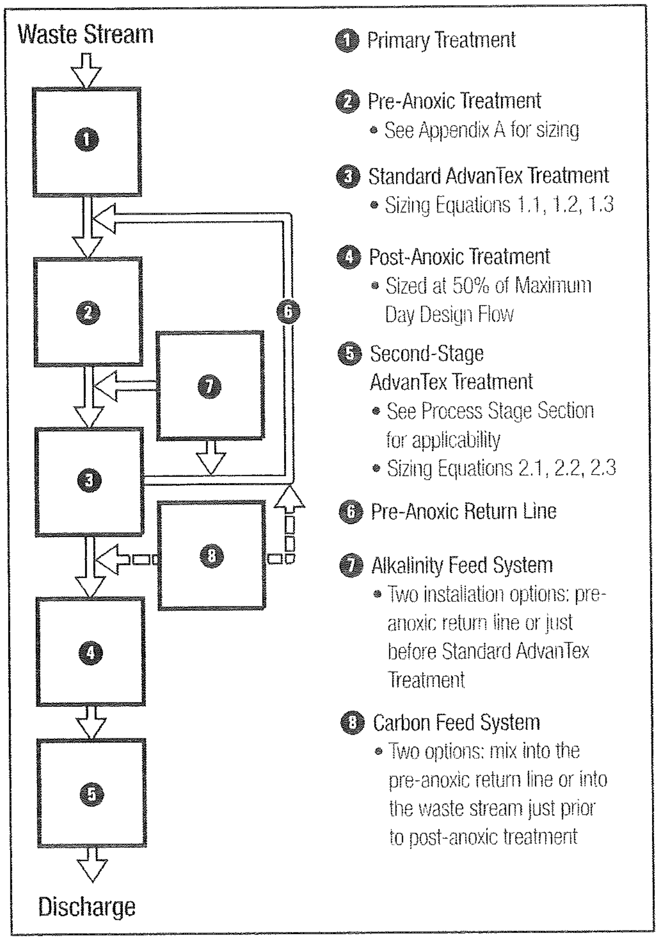


Figure 5. Treatment Diagram for Advanced Removal of Nitrogen

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

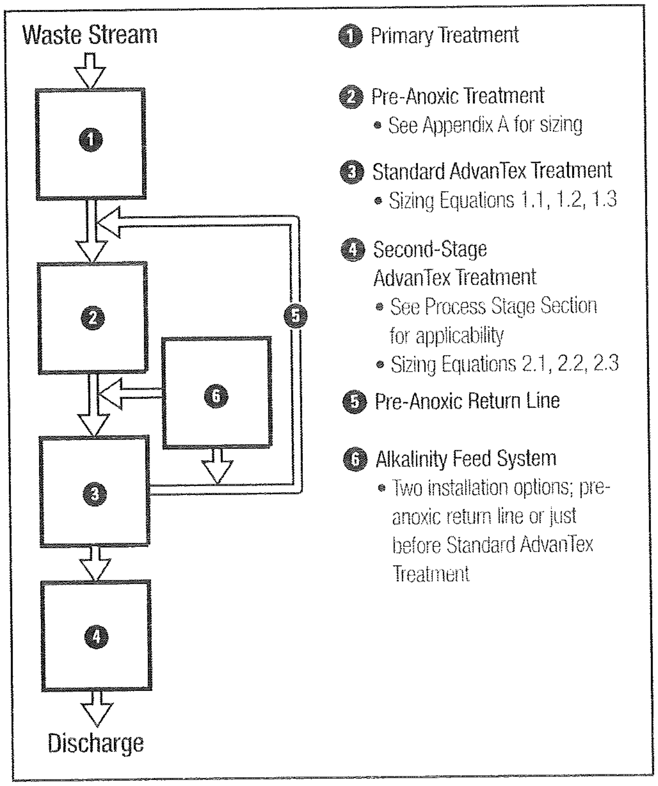


Figure 6. Treatment Diagram for Advanced Removal of Ammonia

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 (**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 (**Q_{RNOX}**) is equal to the Average Day Design Flow (**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 $BOD_5/ft^2 \bullet d$ (0.2 kg $BOD_5/m^2 \bullet d$)
- Design Maximum Day: 0.08 lbs $BOD_5/ft^2 \bullet d$ (0.4 kg $BOD_5/m^2 \bullet d$)

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, ft^2 (m^2)*

BOD_{5i} = *Primary treated effluent BOD_5 (organic) load, lbs/d (kg/d)*

OLR = *Organic loading rate, $lbs/ft^2 \bullet d$ ($kg/m^2 \bullet d$)*

Hydraulic Loading Rates (HLR)

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

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, ft^2 (m^2)*

Q = *Influent hydraulic load, gpd (m^3/d)*

HLR = *Hydraulic loading rate, $gpd/ft^2 \bullet d$ ($m^3/m^2 \bullet d$)*

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 $TN/ft^2 \bullet d$ (0.07 kg $TN/m^2 \bullet d$).

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, ft^2 (m^2)*

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, $lbs/ft^2 \bullet d$ ($kg/m^2 \bullet d$)*

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:

$$A_{ALR} = TKN_e / ALR$$ **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.

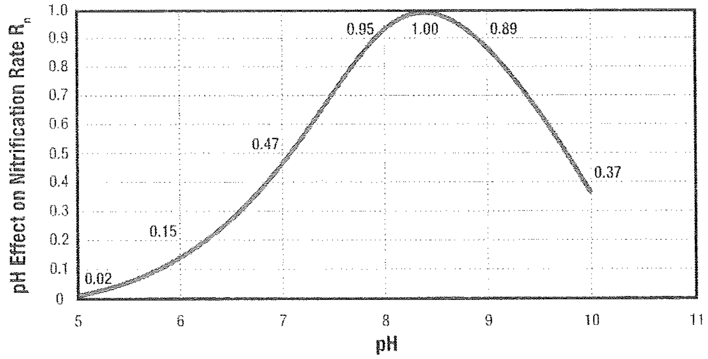


Figure 7. pH Effects on Nitrification

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.

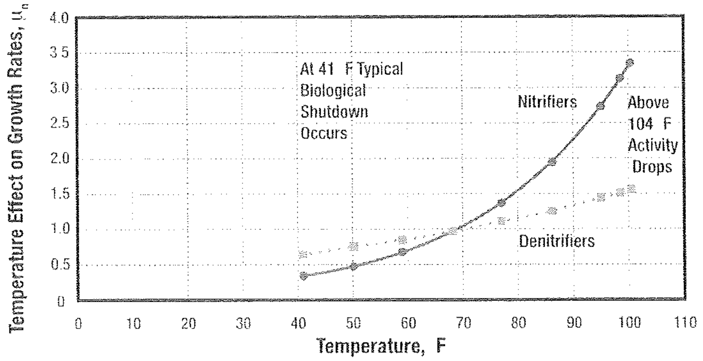


Figure 8. Temperature Effect on Nitrification and Denitrification

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.

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*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:

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

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

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

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

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

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

$$\text{Conversion Factor, CF}_{CM} = \frac{1\text{ kg}}{1{,}000{,}000\text{ mg}} \text{ x } \frac{1000\text{ L}}{1\text{ m}^3} = \mathbf{0.001}\,\frac{\mathbf{kg \bullet L}}{\mathbf{mg \bullet m^3}}$$

<u>Example 1</u>

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:

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

<u>Example 2</u>

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:

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

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

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

<u>Example</u>

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

$$\text{Alkalinity Demand} = \text{TKN}_i\ \text{mg/L x}\ \frac{5\ \text{mg/L Alkalinity}}{1\ \text{mg/L TKN}}$$

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

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

Equation B6

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

Equation B7

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

Equation B8

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

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:

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

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

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

Example

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

Solving for Equation B9:

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

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):

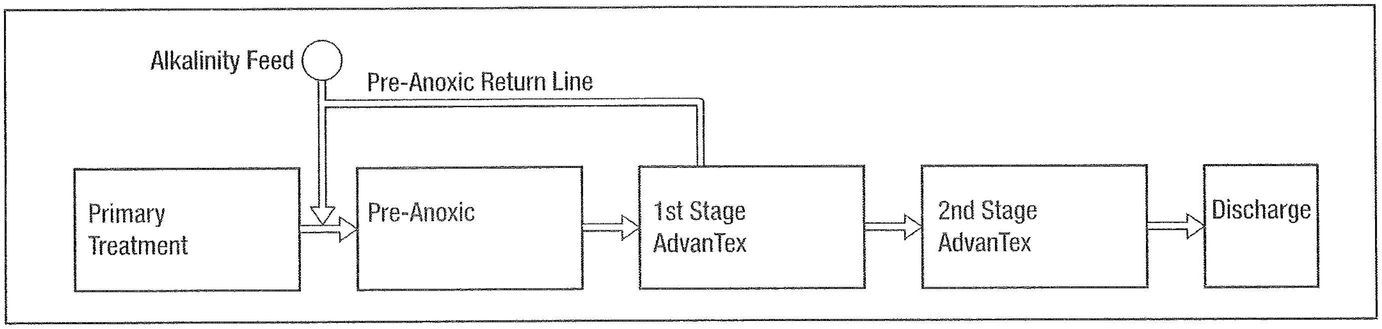


Figure 1A-1. Configuration for Alkalinity Removal

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:

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

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

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

Hydraulic Loading

Design average HLR_A is 25 gpd/ft².((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:

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

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:

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

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:

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

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:

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

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:

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

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):

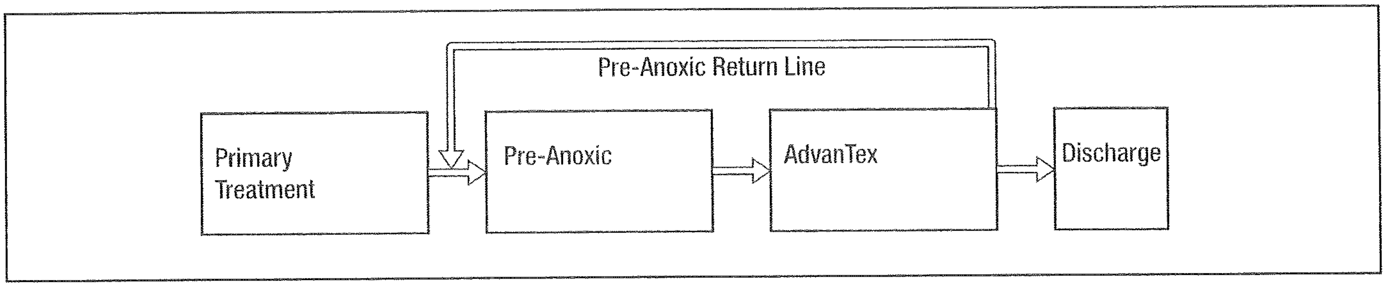


Figure 2A-1. Treatment Configuration for Organic Constituents

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:

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

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

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

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.

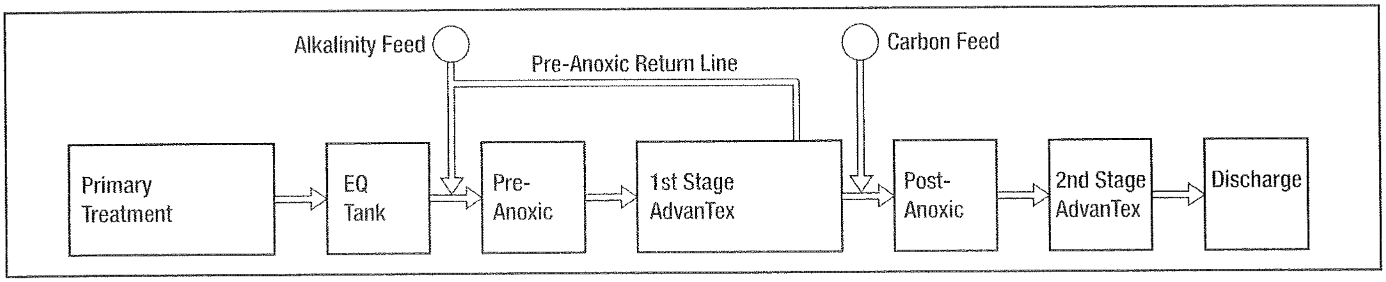


Figure 3A-1. Treatment Configuration for Organic Constituents

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 $BOD_5/ft^2 \bullet d$ (from page 15).

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

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

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/ft^2 (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/ft^2 (from page 15).

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

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

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 ft^2.

Treatment Unit Options — First Stage

Option 1: Using AX-Max units – 1000 ft^2 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 ft^2 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 $BOD_5/ft^2 \bullet d$ (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:

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

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/ft^2 (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/ft^2. 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 :

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

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 ft^2.

Treatment Unit Options — Second Stage

Option 1: Using AX-Max units – 140 ft^2 area

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

Option 2: Using AX pod units – 140 ft^2 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.

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

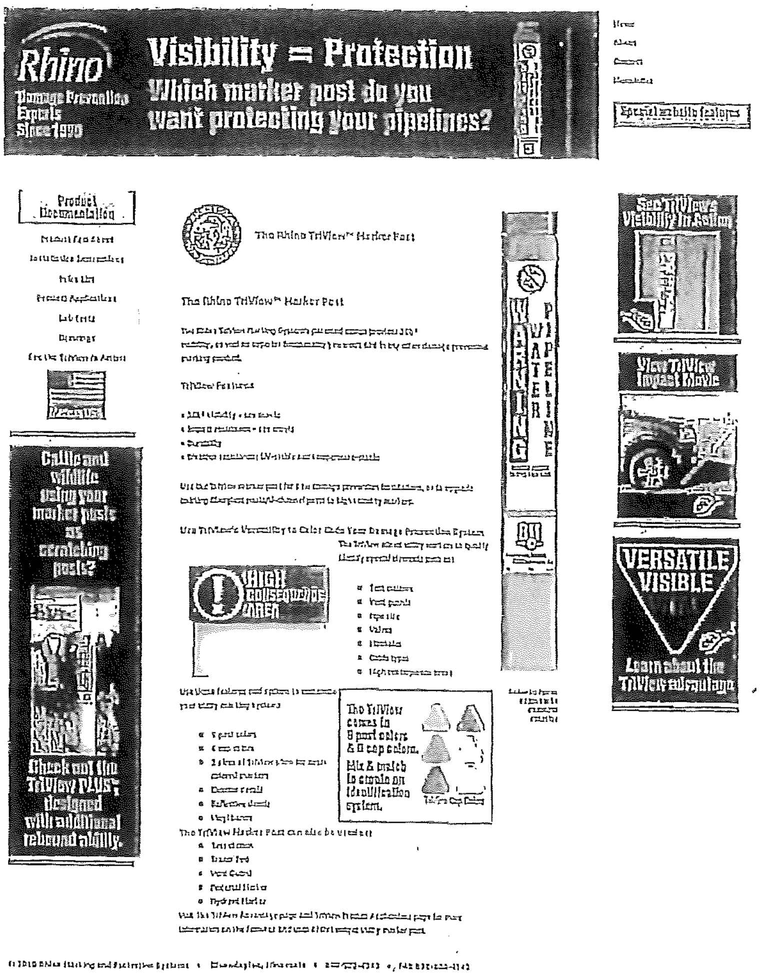
Given the project specific information of flow and influent constituents provided to Orenco, and considering the loading rates as outlined above, the following Table 2 summarizes the system sizing calculations. This system is hydraulically governed, with the hydraulic load yielding the highest square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



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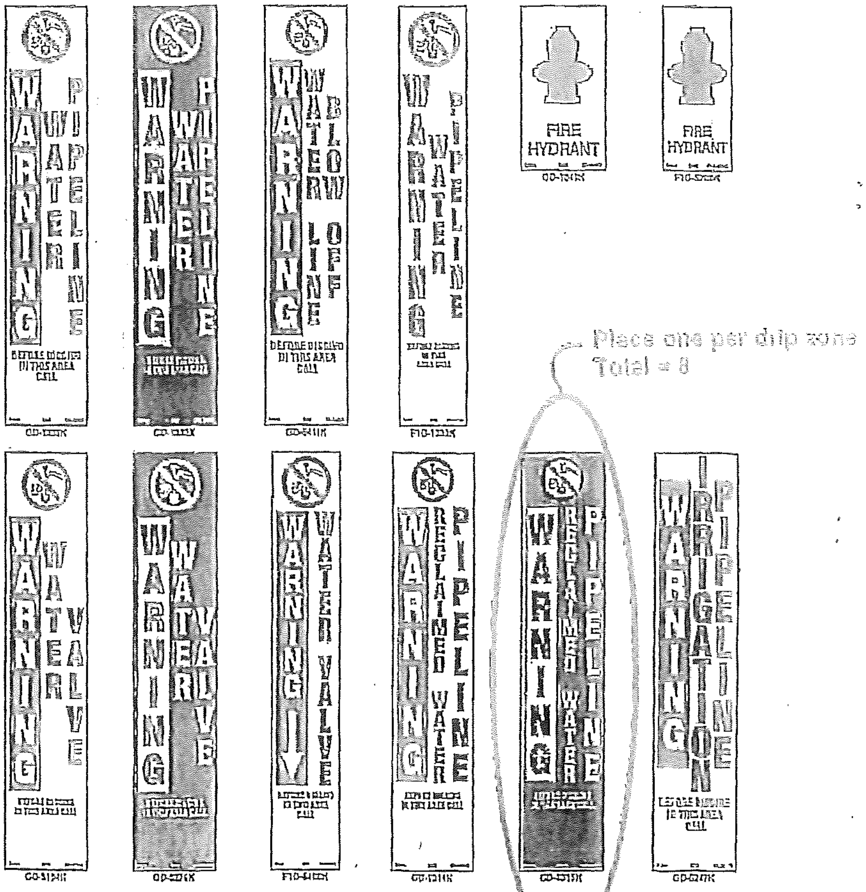

Place one per drip zone
Total = 8

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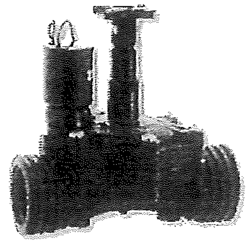
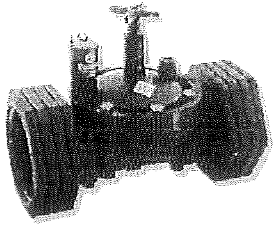
2-WAY ELECTRIC VALVES

PRODUCT ADVANTAGES

- Durable, glass reinforced nylon construction provides superb hydraulic performance.
- Large internal water passage with no moving parts in the flow path prevents clogging.
- Built-in 2-Way Solenoid with low power requirement for ease of operation and reliability.
- Simple installation either vertically or horizontally.
- High resistance to corrosive water containing fertilizer and chemicals.
- Standard with a flow control (throttling) handle.



1" ELECTRIC PBI
THROTTLING NYLON VALVE



323 ELECTRIC PBI
THROTTLING NYLON VALVE

APPLICATIONS

- Ideal for mild corrosive and mild acidity levels in the water

SPECIFICATIONS

- Available Sizes: 1", 1 1/2", 2" and 323
- Maximum Working Pressure:
  1" - 115 psi and 2" to 323 - 150 psi
- Maximum Water Temperature: 140° F
- Connections: Female Threaded NPT
- Electrical Specifications:
  Voltage - Standard 24 VAC, 60 Hz
  Inrush Current - 29mA
  Holding Current - 14mA
  Allowable Voltage Variation: 10%

MATERIALS

- Body and Bonnet: Glass Reinforced Nylon
- Spring: Stainless Steel (AISI 302)
- Nuts, Bolts, Washers: Stainless Steel (304)
- Diaphragm: Natural Rubber

2-WAY CONTROL VALVES

The 2-Way control valve continuously ports water into and from the control chamber, making it an excellent choice when a very accurate and sensitive regulation performance is required. The 2-Way valves may be used with clean water when a minimal pressure difference is allowed and a fast, accurate response is required.

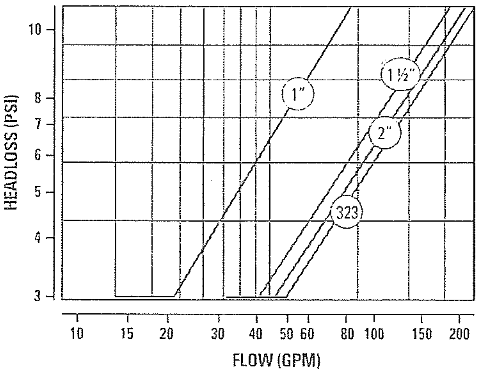
DIMENSIONS & WEIGHT

SIZE	LENGTH	HEIGHT	WEIGHT
1"	4 7/8"	4 7/8"	.5 LBS.
1 1/2"	7 3/8"	6"	2.0 LBS.
2"	7 7/8"	6"	2.2 LBS.
323	9 1/4"	6 5/8"	3.1 LBS.

FLOW RANGE

SIZE	GPM
1"	1 - 50
1 1/2"	1 - 125
2"	1 - 175
323	1 - 225

FLOW RATE VS. PRESSURE LOSS



LIGHT PURPLE AREA INDICATES RECOMMENDED OPERATING RANGE.

ORDERING INFORMATION

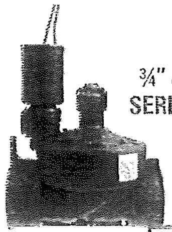
SIZE	ITEM NUMBER	MODEL NUMBER
1"	71610-014015	61ET1PBI-BC
1 1/2"	71610-014040	61ET1.5PBI2-BC
2"	71610-014507	61ET2PBI2-BC
323	71610-015202	61ET323PBI2-BC

SOLD IN CASE QUANTITIES AND 24VAC ONLY
1" CASE QUANTITY = 20
1 1/2" AND 2" CASE QUANTITY = 8
323 CASE QUANTITY = 4

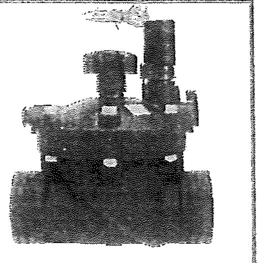
SERIES 80 2-WAY ELECTRIC VALVES

PRODUCT ADVANTAGES

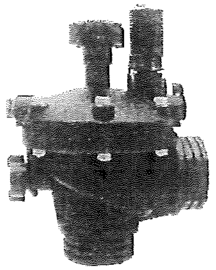
- Suitable for high pressure applications with quick reaction to opening and closing.
- Exceptionally low inrush and holding current allows the longest wire run from valve to controller.
- Quick reaction to opening and closing and a drip-tight seal for accurate irrigation.
- Stable solenoid to voltage fluctuations with low sensitivity to dirt - no diode solenoid.
- Integrated check valve ensures valve remains closed until the controller designates opening.
- Flow control stem allows manual control from full closure up to maximum capacity.



¾" & 1" GLOBE
SERIES 80 2-WAY



1 ½" & 2" GLOBE
SERIES 80 2-WAY



1 ½" & 2" ANGLE
SERIES 80 2-WAY

APPLICATIONS

- Ideal for mild corrosive and mild acidity levels in the water

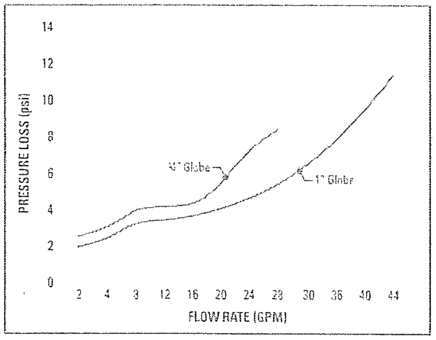
SPECIFICATIONS

- Recommended Flow Ranges:
  ¾" valve - .01 to 26 GPM
  1" valve - .01 to 44 GPM
  1 ½" valve - .25 to 110 GPM
  2" valve - .25 to 176 GPM
- Valve Configurations:
  ¾" & 1" valves - Globe
  1 ½" & 2" valves - Globe or Angle
- Minimum Operating Pressure: 7 psi
- Maximum Operating Pressure: 150 psi
- Maximum Water Temperature: 140° F
- Standard Solenoid Voltage: 24VAC ± 10% voltage
- Solenoid Inrush Current: .22A
- Solenoid Holding Current: .095A

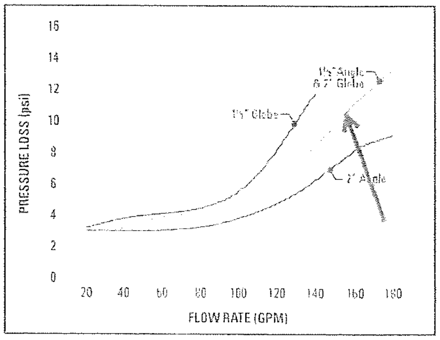
MATERIALS

- Body, Bonnet, Diaphragm Seat: Glass Reinforced Polyamide (GRP)
- Nuts, Bolts, Washers: Stainless Steel 304
- Spring: Stainless Steel AISI 302

¾" & 1" FLOW RATE VS. PRESSURE LOSS



1½" & 2" FLOW RATE VS. PRESSURE LOSS



DIMENSIONS & WEIGHT

SIZE	LENGTH	WIDTH	HEIGHT	WEIGHT
3/4" GLOBE	3 15/16"	3"	4 3/8"	.62 LBS
1" GLOBE	4 1/8"	3"	4 1/2"	.64 LBS
1 ½" GLOBE	6 9/16"	6 1/2"	6 3/8"	2 LBS
1 ½" ANGLE	3 1/2"	6 1/2"	6 13/16"	1.8 LBS
2" GLOBE	6 9/16"	6 1/2"	6 5/8"	2 LBS
2" ANGLE	3 1/2"	6 1/2"	6 13/16"	1.8 LBS

ORDERING INFORMATION
STANDARD 24VAC VALVES

VALVE SIZE	ITEM NUMBER	MODEL NUMBER
¾" GLOBE	00135-000995	LVET.75GH2
1" GLOBE	00135-001005	LVET1GH2
1 ½" GLOBE	00135-001015	LVET1.5GH2
1 ½" ANGLE	00135-001016	LVET1.5GH2-AN
2" GLOBE	00135-001025	LVET2GH2
2" ANGLE	00135-001026	LVET2GH2-AN

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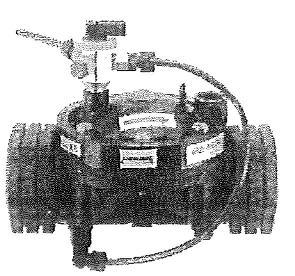
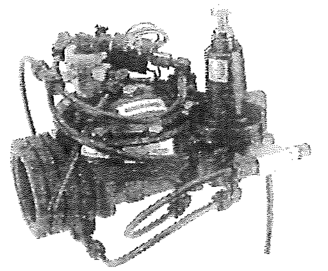
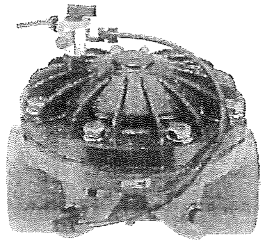
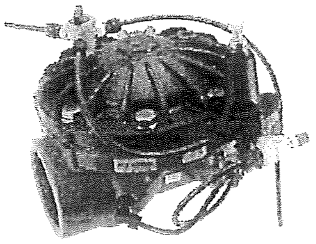
NYLON AND PVC VALVES

HIGH FLOW, LOW FRICTION LOSS AND MINIMUM SERVICING FOR A BROAD RANGE OF APPLICATIONS


MANUAL NYLON
THREADED VALVE


PRESSURE REDUCING ELECTRIC
NYLON THREADED VALVE


MANUAL PVC
SLIP VALVE


PRESSURE REDUCING
PVC THREADED VALVE

PRODUCT ADVANTAGES

- Superb hydraulic performance.
- Simple design with only one moving component, the diaphragm, means parts are not located in the water passage way.
- Low operating pressure.
- Simple inline installation with minimal maintenance requirements for maximum dependability.
- Durable, corrosion-resistant materials provide high resistance to corrosive water containing fertilizers and chemicals.
- Nylon valves have threaded connections.
- PVC valves have threaded or socket (slip) connections allowing pipes to be cemented into the valves.

AVAILABLE MODELS & SIZES

	MATERIAL	NYLON	PVC	
	CONNECTION	THREADED	THREADED	SLIP
SIZES	1"	X	-	-
	1 ½"	X	-	-
	2"	X	-	-
	323	X	-	-
	3"	-	X	X
	4"	-	-	X
	6"	-	-	X

APPLICATIONS

- Headworks assemblies for use in advanced treatment wastewater drip dispersal systems
- Ideal for water control in all piping networks
- Above or below grade installations
- Remote control irrigation for master valves and automated or manual operations
- Nylon valves are ideal for mild corrosive and acidity levels in the water
- PVC Valves are ideal for higher corrosive and acidity levels in the water

SPECIFICATIONS

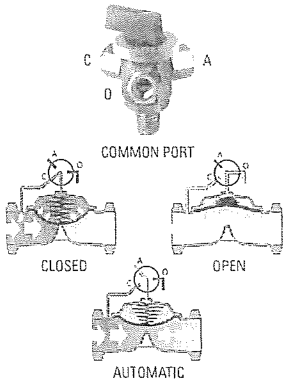
- Recommended Operating Pressure (psi):
  Nylon - 12 minimum to 145 maximum
  PVC - 12 minimum to 115 maximum
  (based on valve size - see chart)
- Maximum Water Temperature: 140° F
- Optional Functions:
  Manual, Electric, Pressure Reducing, Pressure Sustaining

MATERIALS

- Nylon Valve Body, Bonnet, Seat:
  Glass Reinforced Polyamide (GRP)
- PVC Valve Body: uPVC
- Spring: Stainless Steel (AISI 302)
- Nuts, Bolts, Washers:
  Zinc Coated Steel (BS 5216)
- Diaphragm: Natural Rubber
- Connections:
  Threaded - ANSI (NPT Female)
  Socket - IPS, PVC Standard

MANUAL VALVE OPERATION WITH A 3-WAY SELECTOR

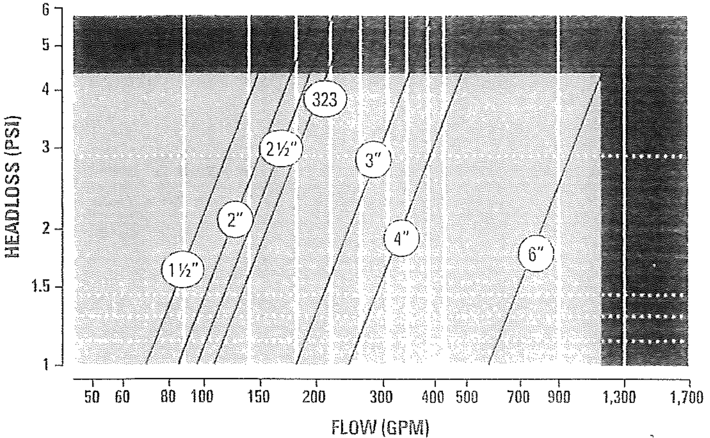
- CLOSED (C): Upstream pressure or pressure from an external source is applied to the control chamber. Initiated by the spring, the diaphragm is pressed down to close the valve drip-tight.
- OPEN (O): Relieving the water or air pressure to the atmosphere from the control chamber causes the valve to open.
- AUTOMATIC (A): The automatic port of the 3-Way selector is connected to a solenoid, hydraulic relay or pilot which controls the valve. The common port of the 3-Way selector connects the control chamber to either A, O or C, depending on the direction the selector is pointed.



3-WAY CONTROL VALVES

The 3-Way control valve only ports water (or air) into the control chamber to close the valve or releases it from the control chamber to open the valve. This non-continuous porting technique allows for full opening of the main valve when operating conditions require the valve to be fully open.

FLOW RATE VS. PRESSURE LOSS



GREY AREA INDICATES
RECOMMENDED OPERATING RANGE

$H\,(psi) = \left(\frac{Q\,(GPM)}{Cv}\right)^2$

SPECIFICATIONS

SIZE	MAX. FLOW (GPM)	Cv	OPERATING PRESSURE (psi) *
1"	44	18	12 - 115
1½"	110	66	12 - 145
2"	176	83	12 - 145
323	176	103	12 - 145
3"	396	175	12 - 115
4"	440	250	12 - 115
6"	1,540	554	12 - 145

* Low Pressure Diaphragms also available

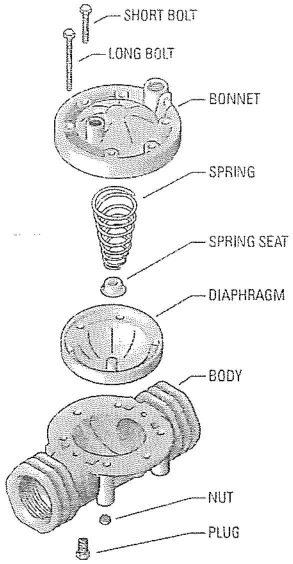
DIMENSIONS & WEIGHT

SIZE/CONNECTION	LENGTH	HEIGHT	WEIGHT *
1" NYLON THREADED	4 7/8"	2 7/8"	0.4 LBS.
1 1/2" NYLON THREADED	7 3/8"	4 3/8"	2.0 LBS.
2" NYLON THREADED	7 7/8"	4 3/8"	2.2 LBS.
323 NYLON THREADED **	9 1/4"	4 3/4"	3.1 LBS.
3" PVC THREADED	10 1/8"	7 5/8"	9.3 LBS.
3" PVC SLIP	10 1/8"	7 5/8"	9.3 LBS.
4" PVC SLIP	11"	8"	9.5 LBS.
6" PVC SLIP	14"	15"	20 LBS.

* Weight for Basic Valve
** Refers to a 2" Valve body with a 3" inlet and outlet

ORDERING INFORMATION

REFER TO WASTEWATER PRICE LIST FOR ORDERING INFORMATION FOR 3-WAY VALVES



NYLON VALVE SHOWN

VALVE INSTALLATION TIPS

- THREADED VALVES: Use a few layers of Teflon sealer compound on the adapter and tighten by hand. Use a wrench to tighten the adapter another half revolution.
- SOCKET OR 'SLIP' VALVE WITH PVC PIPE: Use the same procedure as when cementing PVC pipes. Mark the pipe first, then apply glue to the socket of the valve and the PVC pipe. Insert the pipe until reaching the mark and rotate a quarter turn. Hold the joint in place until the cement hardens.
- INSTALLATION ABOVE GROUND: When installing a manifold above ground, the length of the manifold should be kept as short as possible (this eliminates the need for additional support). For longer lengths, a firm support under the horizontal pipes is recommended. Always install the valve with the bonnet exposed to the sun.

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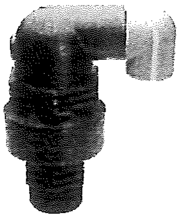
WASTEWATER DIVISION

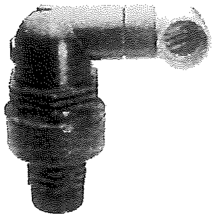
AIR VENTS

COMBINATION AIR/VACUUM & CONTINUOUS ACTING AND GUARDIAN AIR/VACUUM AIR VENTS

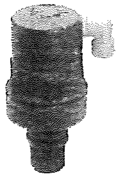
PROVEN DESIGN PROVIDES MORE AIR RELEASE CAPACITY THAN OTHER VENTS OF SIMILAR SIZES



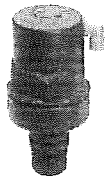
2" COMBINATION



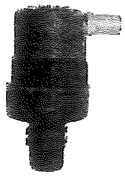
2" COMBINATION
with Vacuum Guard



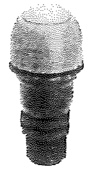
1" COMBINATION



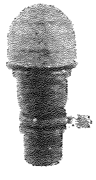
¾" & 1"
AUTOMATIC



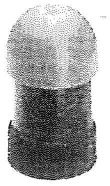
¾" & 1"
AUTOMATIC



¾" & 1"
GUARDIAN



¾" & 1"
GUARDIAN
with Shrader Valve



2" & 3"
GUARDIAN

PRODUCT ADVANTAGES

- Ensures maximum protection of irrigation system with proper sizing and placement.
- Aerodynamic float design ensures vent closure as water fills the system, remains open when air pressure reaches 5-12 psi depending on model.
- Large capacity vents dampen water hammer preventing pipes and fittings from cracking or bursting.
- Unique rolling seal feature allows gradual opening, closing and self-cleaning.
- Made of corrosion-resistant reinforced UV protected nylon - no metal parts to rust or corrode, no need for spare parts.
- Guardian with shrader valve is ideal for measuring local line pressure.
- Five year warranty.

APPLICATIONS

- 1" & 2" COMBINATION AIR/VACUUM AND CONTINUOUS ACTING AIR VENTS
  - For discharge and intake of large volumes of air at pump and filter stations, along mains and at the end of mainlines.
  - For continuous air release at high points in pipe network or upstream of manifolds.
  - Every 1,500 feet along mainlines.
- 2" COMBINATION AIR RELEASE/VACUUM GUARD & CONTINUOUS ACTING AIR VENT
  - Releases air at pump priming and maintains the prime by not allowing air intake in long and/or undulating suction lines to pump stations.
  - Releases entrapped air while ensuring continuous prime at centrifugal pumps.
  - Builds up siphons with air release, maintains the siphon by continuously releasing air and not allowing air intake.
- ¾" & 1" AUTOMATIC CONTINUOUS ACTING AIR VENTS
  - For high spots where air accumulates.
- ¾" & 1" CONTINUOUS ACTING/VACUUM GUARD AIR VENTS
  - For release of entrapped air while ensuring continuous pump prime with no air intake in centrifugal pumps and pump suction lines.
  - Protects mechanical seals in vertical pumps by not allowing air to accumulate in the stuffing boxes.
  - Maintain siphons with continuous air release while not allowing air intake.
- ¾", 1", 2" & 3" GUARDIAN AIR/VACUUM RELIEF AIR VENTS
  - Commonly used downstream of valves, primarily at manifolds, to break vacuum caused by system draining.
  - On sloping terrain to prevent collapsing of pipes caused by vacuum when pipe networks drain.
  - Upstream of valves for air discharge during system start-up.

AIR VENTS

COMBINATION AIR/VACUUM AND CONTINUOUS ACTING AIR VENT - STAGES OF OPERATION

1. During start-up, the air vent discharges large volumes of air and as the system builds pressure, the body fills with water, forcing the float upwards and closing the air vent.
2. While the system is pressurized, the "automatic" function continuously releases accumulated air.
3. At shutdown, the air vent's large opening allows air back into the system preventing the pipe and accessories from collapsing, and preventing suction of mud and debris.

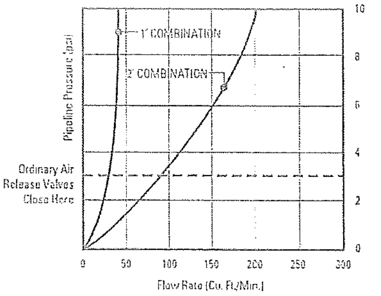
AUTOMATIC CONTINUOUS ACTING AIR VENT
STAGES OF OPERATION

1. While the system is pressurized, air accumulates in the body, systematically dropping the rolling seal mechanism releasing the trapped air.
2. After air is released, water again enters the body and forces the float to close the air vent.

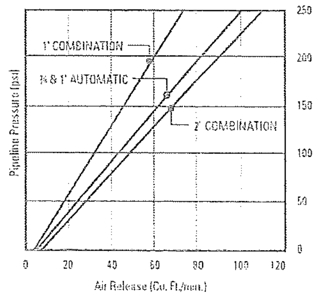
GUARDIAN AIR & VACUUM AIR VENTS
STAGES OF OPERATION

1. Discharges large quantities of air through an opening and as water enters, the float rises and forces the air vent to close.
2. During normal flow, while the line is under pressure, the air vent remains closed.
3. As the line empties, or during a drop in pressure, the float drops down and opens the air vent admitting air, breaking the vacuum created by the withdrawing water and prevents the collapse of pipelines and suction of soil into driplines.

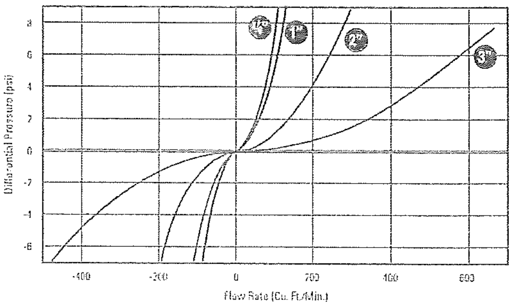
COMBINATION AIR & VACUUM FUNCTION



AUTOMATIC FUNCTION



GUARDIAN AIR & VACUUM FUNCTION



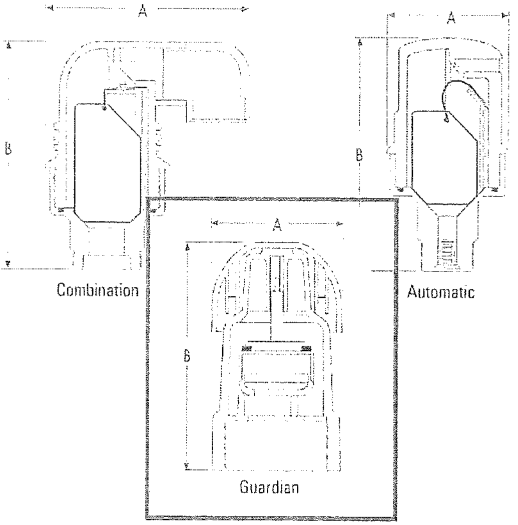
COMBINATION/AUTOMATIC ORDERING, DIMENSIONS & WEIGHT

MODEL NUMBER	SIZE/MATERIAL	CONNECTION	A	B	WEIGHT
65ARIB2	2" COMBO (N)	MPT	7.09"	8.23"	2.35 LBS.
65ARIB2-B	2" COMBO (NB)	MPT	7.09"	8.23"	4.75 LBS.
65ARIB2PP	2" COMBO (P)	MPT	7.09"	8.23"	1.90 LBS.
65ARIB2-BPP	2" COMBO (PBR)	MPT	7.09"	8.23"	3.80 LBS.
65ARIB2VM	2" COMBO (NV)	MPT	8.09"	8.23"	2.50 LBS.
65ARIB1	1" COMBO (N)	MPT	3.93"	5.51"	0.66 LBS.
65ARIB1-B	1" COMBO (NB)	MPT	3.93"	5.51"	1.54 LBS.
65ARIB1-B	1" COMBO (P)	MPT	3.93"	5.51"	0.65 LBS.
65ARIS075	¾" AUTO (N)	MPT	3.20"	5.51"	0.56 LBS.
65ARIS075VM	¾" AUTO (NV)	MPT	3.20"	5.51"	0.56 LBS.
65ARIS1	1" AUTO (N)	MPT	2.95"	5.51"	0.65 LBS.
65ARIS1VM	1" AUTO (NV)	MPT	3.20"	5.51"	0.66 LBS.

N = Nylon body NB = Nylon body, brass base NV = Nylon body, vacuum guard
P = Polypropylene body PBR = Polypropylene body, brass base

GUARDIAN ORDERING, DIMENSIONS & WEIGHT

MODEL NUMBER	SIZE	CONNECTION	A	B	WEIGHT
65ARIA075	¾"	MPT	2.36"	5.11"	0.22 LBS.
65ARIA075S	¾" SHRADER	MPT	2.55"	5.11"	0.44 LBS.
65ARIA100	1"	MPT	2.36"	4.79"	0.35 LBS.
65ARIA100S	1" SHRADER	MPT	2.55"	5.11"	0.44 LBS.
65ARIA2	2"	FPT	2.87"	4.79"	0.44 LBS.
65ARIA3	3"	FPT	4.10"	6.50"	1.30 LBS.



SPECIFICATIONS

- Maximum Operating Pressures:
  - 1", 2" Nylon Combination: 240 psi
  - 1", 2" Polypropylene Combination: 150 psi
  - ¾" & 1" Automatic: 240 psi
  - All Sizes Guardian: 150 psi
- Pressure for Vent to Remain Open:
  - ¾" & 1" Guardian: 5 psi
  - 2" Guardian: 10 psi
  - 3" Guardian: 8 psi
  - All Combination & Automatic: 12 psi

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Continuous Current Solenoid Pilot Valves

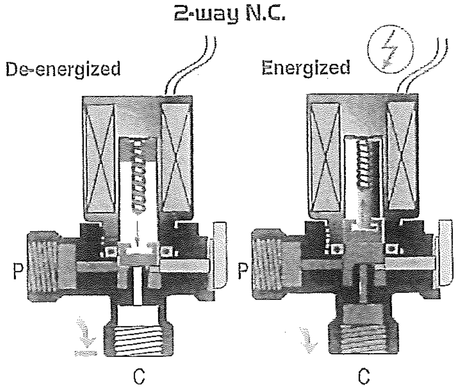
Model S-390: 2-way Solenoid Pilot Valve

Technical Data and Specifications:

- Pressure Range: 0-10 bar
- Materials:
  - Seals: NBR
  - Wet parts: Stainless steel 400 and nylon
- Base Flow Factor: Kv = 1.3 l/min at ΔP of 1 bar with orifice size 1.8 mm
- Solenoid to Base Connection: 3/4" 20 UNEF threaded
- Leads: 0.32 mm² x 30 cm

Operating Principle

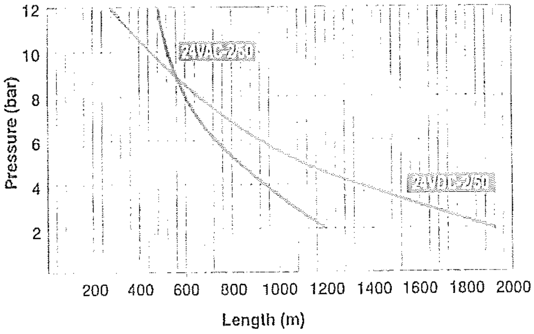
2-way N.C.



2Way Electrical Data

Actuator Type	Actuator Index	Cable Color	Power (watt)	Current (amp)		Coil Resistance ohm@20°C
				Inrush	Holding	
24VAC-R	AR	Red	1.7	0.28	0.14	35
24VAC-D	ED	Red/Orange	2.2	0.13	0.13	56
24VAC-R	DR	Red	2.2	0.76	0.43	6
24VDC	AO	Black	3.6	0.15	0.15	170
12VDC	HO	Blue	3.8	0.17	0.17	38

Maximum cable length according to coil type (at cable cross section: 0.5 mm², orifice size: 1.8 mm, air gap: 0.8 mm)



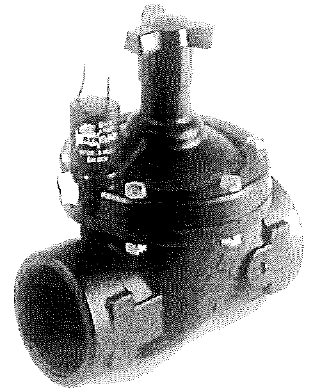
For cables longer than shown in diagram...
In order to calculate the cross section of a length other than shown in the diagram, use the following equation:

$$S = \frac{L\ (sol)}{L\ (diagram)} \times 0.5$$

S = Minimum conductor cross-section in mm²
L (sol) = Length of actual cable to solenoid
L (diagram) = Length of cable shown in this diagram

Typical Applications

200 Series, Globe Pattern

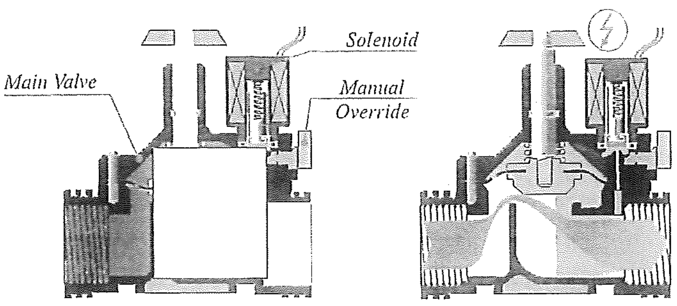


Description

A 3/4" or 1", Globe pattern, main hydraulic valve is directly operated by an S-390 2-way solenoid. These solenoid pilot valves are typically used in irrigation systems for turf, public and private gardens, greenhouses and small plots.

Valve Configuration

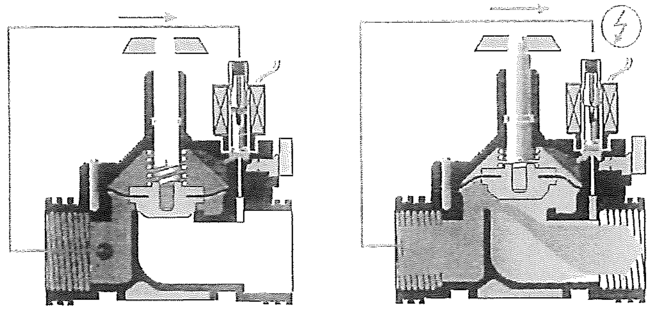
N.C. Valve
(2-way Solenoid Operated)



Valve closed

Valve open

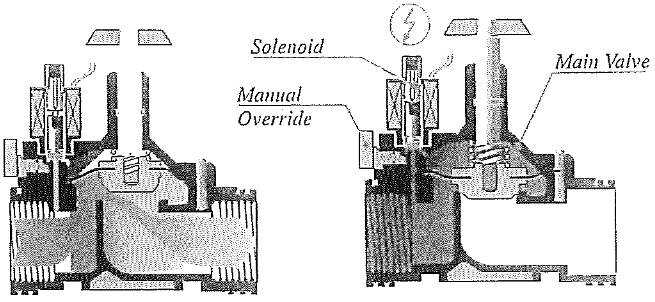
N.C. Valve
(3-way N.O. Solenoid Operated)
Designed for debris laden water.



Valve closed

Valve open

N.O. Valve
(3-way N.C. Solenoid Operated)

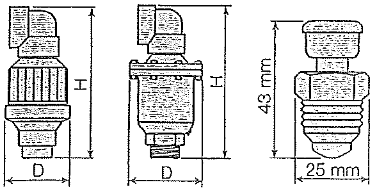


Valve open

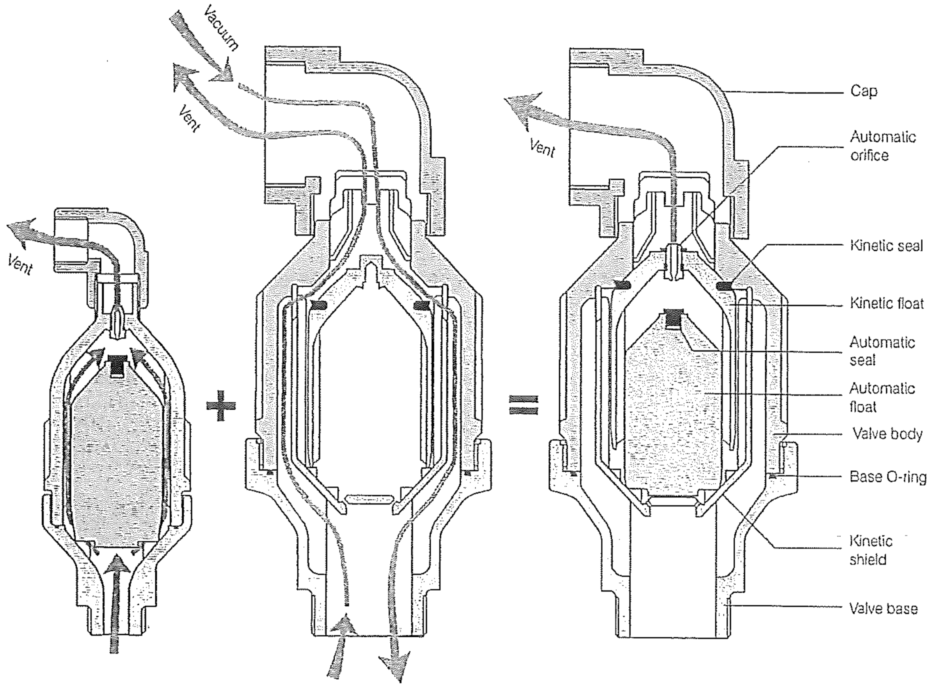
Valve closed

Dimensions and Weights

Valve Model	Size	Plastic Body			Metallic Body		
		D (mm)	H (mm)	Weight (mm)	D (mm)	H (mm)	Weight (mm)
Combination (02-ARC)	2"	130	245	2.8	150	290	5.5
Kinetic (02-ARK)	2"	130	245	2.7	150	290	5.4
Automatic (01-ARA)	1"	85	180	0.9	120	230	3.0
Vacuum Breaker (ARV)	½"	25	43	0.1			



Valve Assembly



1" Automatic Pressure Air Release Valve (Model 01-ARA)

2" Kinetic Air and Vacuum Release Valve (Model 02-ARK)

2" Combination Air and Vacuum Release Valve (Model 02-ARC)

Technical Data

Sizes: 2", 1", ½"

End Conection: Threading BSP, NPT

Pressure Rating:

Plastic body models: ISO: PN 10

Cast iron models: ISO: PN 16; ANSI: # 125

Operating Pressure Range:

Plastic body: 0.1-10 bar (1½-150 psi)

Iron body: 0.1-16 bar (1½-225 psi)

Temperature Range: Water up to 80°C (180°F)

Materials:

Body and Cover: Plastic or Polyester-coated Cast Iron

Floats and Kinetic Shield: Plastic

Automatic Orifice: Stainless Steel

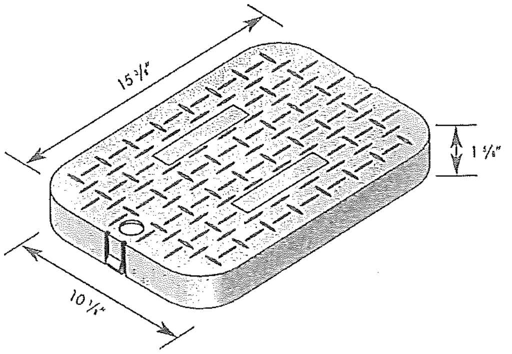
Seals: Buna-N and NR

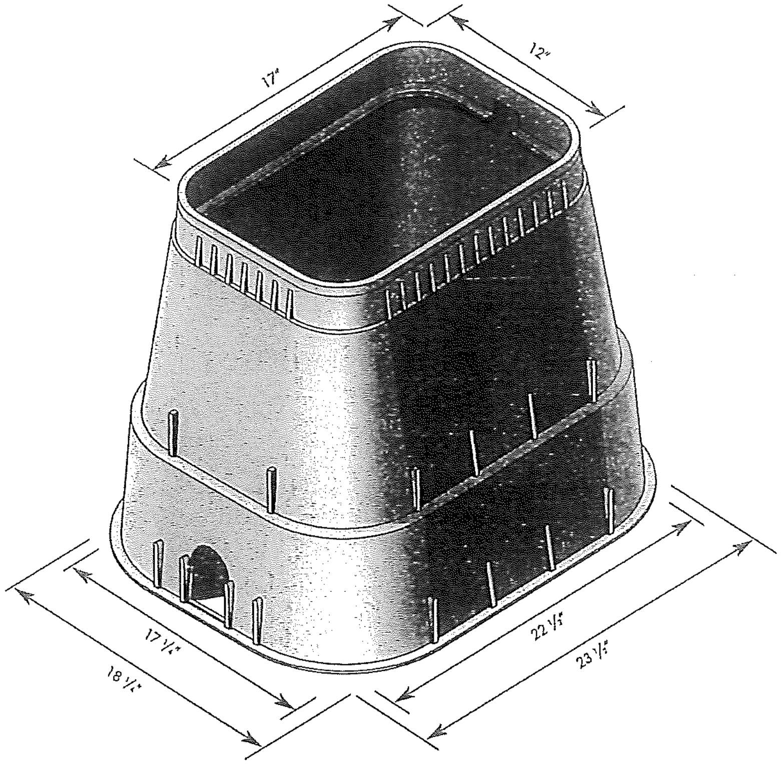
NDS D1800 Rectangular Meter Boxes

NDS METER BOX SPEC

NDS 12"x17" meter boxes and covers are injection molded of structural foam recycled polypropylene material with a melt index between 10-12. Coloring and UV stabilizers are added, along with processing lubricants when needed.

The 12"x17" body shall be tapered and have a minimum wall thickness of . 25". The body shall have a double wall at the top cover seat area with a minimum thickness of . 22". The cover seat area shall have 26 structural support ribs on the underside of the seat, each with a minimum thickness of .12". The bottom of the body shall have a .50" flange. The 12"x17" cover shall have an average thickness of .20".





Product is not to be installed in concrete and is not to be used in vehicular applications. Weights and dimensions are nominal.

Part Number	Box Description	Cover Description – Marking	Cover Type	Color (Box/Cover)	Weight (lbs)
Drop In Box & Cover					
D1800-DISB	12"x17"x18" Box	Drop-in Cover - Water Meter	Solid Plastic	Black/Black	
D1800-DIRB	12"x17"x18" Box	Drop-in Meter Reader Cover - Water Meter	Plastic w/ Plastic Reader	Black/Black	
D1800-DICIR	12"x17"x18" Box	Drop-in Meter Reader Cover - Water Meter	Plastic w/ Cast Iron Reader	Black/Black	
Drop In Cover Only					
D1200-DISBL		12"x17" Drop-in Cover - Water Meter	Solid Plastic	Black	
D1200-DIRBL		12"x17" Drop-in Meter Reader Cover - Water Meter	Plastic w/ Plastic Reader	Black	
D1200-DICIRLID		12"x17" Drop-in Meter Reader Cover - Water Meter	Plastic w/ Cast Iron Reader	Black	
Box Only					
D1800-B/O	12"x17"x18" Box (with no holes)			Black	

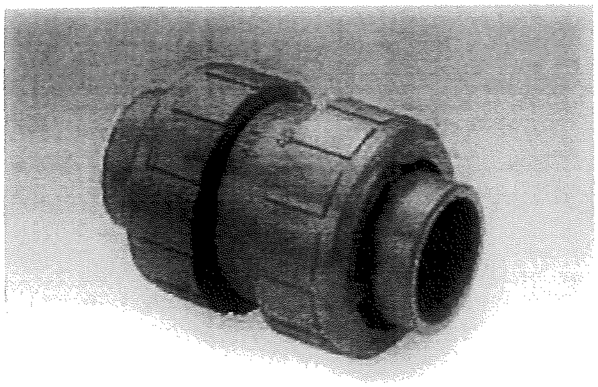
Call for additional options and availability

Properties of Unfoamed Resin		
	ASTM Test Method	Polypropylene
Tensile Strength, Yield	ASTM D 638	3300 psi
Density	ASTM D 792	0.915
Durometer, Shore D	ASTM D 2240	66
Flexural Modulus	ASTM D 790	191,000 psi
Notched Izod Impact Strength @ 23 degrees C.	ASTM D 256	1.43 ft. lbs/in.
Notched Izod Impact Strength @ 18 degrees C.	ASTM D 256	6.8 ft. lbs/in.
Heat Deflection Temperature @ 66 PSI, Degrees F.	ASTM D 648	209 degrees F.

Shipping Configuration	
Pallet	48
Pieces Per Stack	12
Stack Per Pallet	4
Pallet Dimensions	42"x 42"x 52"

NDS Customer Service
851 N. Harvard Ave
Lindsay, CA 93247
Phone: (800) 726-1994
(559) 562-9888
Fax: (800) 726-1998
(559) 562-4488

www.NDSPRO.com



Specifications

Sizes: True Union : 1/2" - 2"
Single Union: 3" - 4"
Models: Socket, Threaded, Flanged (ANSI), Butt End
Bodies: PVC, CPVC, PP and PVDF
Seats: EPDM, FKM, PTFE
Seals: EPDM, FKM, PTFE
Option: Foot Valve

Sizes 1/2" - 4" PVC/EPDM/FKM Models are available with NSF-61 Certification

True Union Ball Check Valve

Standard Features (Sizes 1/2" – 2")

- Uniseat/seal of EPDM or FKM
- Ball is the only moving part. It unseats to permit flow in one direction but seals against seat to prevent backflow.
- May be used vertically or horizontally
- Minimum shut-off of 5 psi
- All sizes rated for full vacuum service
- Solid thermoplastic ball

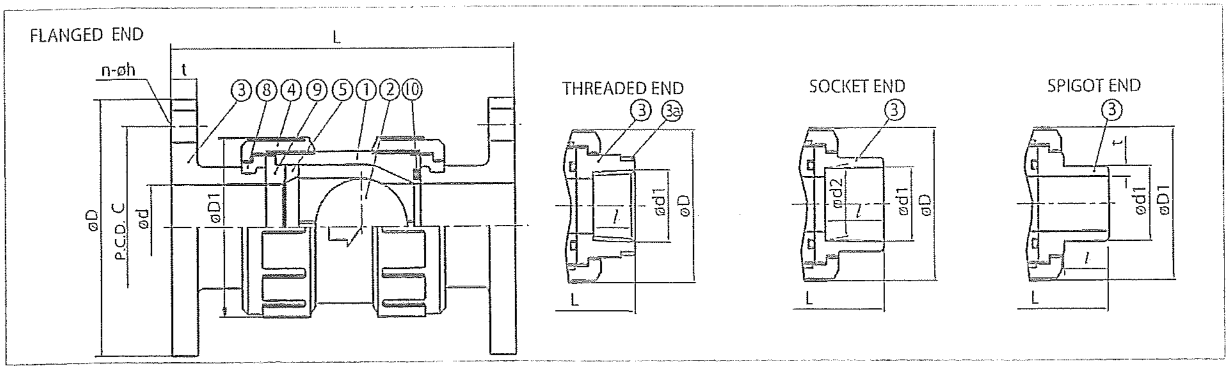
Options:

- PTFE coated FKM uniseat/seal
- Spring-loaded ball to assist ball in seating faster

Parts List – True Union (Sizes 1/2" – 2")

PARTS			
NO.	DESCRIPTION	PCS.	MATERIAL
1	Body	1	PVC, CPVC, PP, PVDF
2	Ball	1	PVC, CPVC, PP, PVDF
3	End Connector	2	PVC, CPVC, PP, PVDF
4	Union Nut	2	PVC, CPVC, PP, PVDF
5	Stop Ring (A)	1	PVC, CPVC, PP, PVDF
8	Stop Ring (B)*	1	PVDF
9	Seat	1	EPDM, FKM, PTFE
10	O-Ring	1	EPDM, FKM, PTFE
3a	Ring**	1	Stainless Steel 304

* Used for flanged end
** Used for CPVC body, threaded end; 1/2" - 1"



Dimensions (Sizes 1/2" – 2")

NOMINAL SIZE		FLANGED						THREADED					SOCKET											SPIGOT(BUTT END)				
		ANSI CLASS 150											PVC, CPVC PP, PVDF				PP, PVDF (DIN) DIN 16962				PP, PVDF (IPS)			PP, PVDF				
																								DIN 3442		PP	PVDF	
INCHES	mm	D	C	n	h	L	t	d1	l	L	d	D1	d1	d2	l	L	d1	d2	l	L	d1	l	L	d1	l	t	t	L
1/2	15	3.50	2.38	4	0.62	5.12	0.47	1/2-14NPT	0.59	3.39	0.59	1.89	0.848	0.836	0.688	3.43	0.768	0.760	0.57	3.19	0.83	0.87	3.31	0.787	0.728	0.098	0.075	4.00
3/4	20	3.88	2.75	4	0.62	6.10	0.55	3/4-14NPT	0.67	4.06	0.79	2.36	1.058	1.046	0.719	3.86	0.965	0.957	0.63	3.70	1.03	1.00	4.43	0.984	0.866	0.106	0.075	4.35
1	25	4.25	3.12	4	0.62	6.50	0.55	1-11 1/2NPT	0.79	4.45	0.98	2.76	1.325	1.310	0.875	4.37	1.240	1.232	0.71	4.13	1.30	1.13	4.35	1.260	0.866	0.118	0.094	4.75
1 1/4	30	-	-	-	-	-	-	1 1/4-11 1/2NPT	0.87	5.00	1.22	3.78	1.670	1.655	0.938	4.92	-	-	-	-	-	-	-	-	-	-	-	-
1 1/2	40	5.00	3.88	4	0.62	7.56	0.63	1 1/2-11 1/2NPT	0.98	5.94	1.57	3.78	1.912	1.894	1.094	5.94	1.947	1.937	0.93	5.62	1.89	1.37	5.57	1.969	1.260	0.181	0.118	5.75
2	50	6.00	4.75	4	0.75	8.43	0.63	2-11 1/2NPT	1.10	6.97	2.01	4.17	2.387	2.369	1.156	6.77	2.461	2.445	1.08	6.69	2.36	1.50	6.49	2.480	1.417	0.228	0.118	6.50

Ball Valves

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The Professional's Choice

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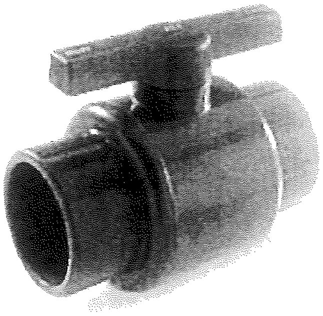
Commercial Ball Valves (Solvent)

Features:

- EPDM O'rings.
- Meets/exceeds ASTM schedule 80 dimensional and material standards.
- Precision molded micro-finish ball for long life.
- HMW-HDPE "floating seals" resist sticking.
- High quality series, ideal for all residential, industrial and commercial irrigation applications.
- Pressure rated at 235 psi (tested to 500 psi static @ 73°F).
- Patent pending "Stem-Lock" design.
- Full port design and schedule 80 sockets.
- Molded in the USA by KBI.
- Replacement handles available.
- Listed by IAPMO as meeting the requirements of the Uniform Plumbing Code (UPC).
- NSF Standard 61 listed.



Model	Size	Connection	Case
LT-0500-S	1/2"	Solvent	36
LT-0750-S	3/4"	Solvent	24
LT-0750-S	1"	Solvent	18
LT-1250-S	1 1/4"	Solvent	8
LT-1500-S	1 1/2"	Solvent	6
LT-2000-S	2"	Solvent	4

Some fields might not be applicable for

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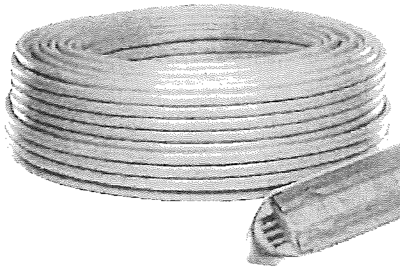
NETAFIM™

BIOLINE DRIPPERLINE

The world's most advanced continuous self-cleaning, pressure-compensating dripperline for wastewater.



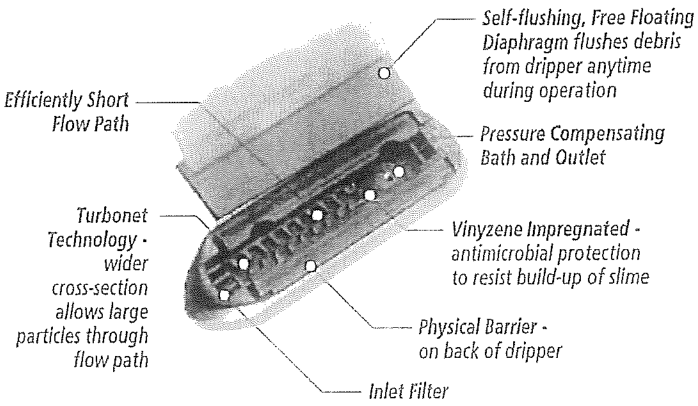
Applications

- Can be used with domestic septic tank effluent of 220/220 (ppm) BOD/TSS with proper design, filtration and operation
- Typically installed following a treatment process
- Reuse applications including municipally treated effluent designated for irrigation

Features/Benefits

- Pressure Compensation - all drippers deliver equal flow, even on sloped or rolling terrain.
- Unique Flow Path - Turbonet technology provides more control of water and a high resistance to clogging.
- Continuous Self-Flushing Dripper Design - flushes debris, as it is detected - throughout operation, not just at the beginning or end of a cycle. Ensures uninterrupted dripper operation.
- Single Hole Dripper Outlet from Tubing:
  - Better protection against root intrusion
  - Allows the dripperline to be used in subsurface applications without need for chemical protection
- Drippers Capture Water Flow From the Center of the Tubing - ensures that only the cleanest flow enters the dripper.
- Built-In Physical Root Barrier - drippers are protected from root intrusion without the need for chemical protection. Water exits dripper in one location while exiting the tubing in another.
- Three Dripper Flow Rates - provides the broadest range of flow rates available. Allows the designer to match the dripperline to any soil or slope condition.
- Bioline Tubing is Completely Wrapped in Purple - the complete tubing is purple,easily identifiying it as a non-potable, regardless of how the tubing is installed.
- Vinyzene-Impregnated Drippers - prevents buildup of microbial slime.
- Can be used subsurface - Bioline can be installed on-surface, under cover or subsurface.
- No Special Storage Requirements - does not degrade if stored outdoors.
- Techfilter Compatible - an optional level of protection, provides a limited lifetime warranty against root intrusion.

EXPLODED VIEW OF BIOLINE DRIPPER



Specifications

- Dripper flow rates: 0.4, 0.6 or 0.9 GPH
- Dripper spacings: 12", 18" or 24" dripper spacings and blank tubing
- Pressure compensation range: 7 to 70 psi (stainless steel clamps recommended above 50 psi)
- Maximum recommended system pressure: 50 psi
- Tubing diameter: 0.66" OD, 0.57" ID
- Tubing color: Purple color indicates non-potable
- Coil lengths: 500' or 1,000' (Blank tubing in 250')
- Recommended filtration: 120 mesh
- Bending radius: 7"
- UV resistant
- Tubing material: Linear low-density polyethylene

Additional flow, spacings, and pipe sizes available by special order. Please contact Netafim USA Customer Service for details.

NETAFIM™

NETAFIM USA
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www.netafimusa.com

BIOLINE TECHNICAL SPECIFICATIONS

BIOLINE DOSING CHART Maximum Length *(feet)* of a Single Lateral

Dripper Spacing		12"			18"			24"		
Dripper Flow Rate (GPH)		0.4	0.6	0.9	0.4	0.6	0.9	0.4	0.6	0.9
Inlet Pressure (psi)	**15**	292	233	175	410	322	247	510	405	308
	25	397	312	238	558	438	335	660	550	423
	35	486	365	279	656	514	394	760	649	497
	45	520	407	311	732	574	439	880	725	555

Lateral lengths are calculated for operation while dosing, and allow for the pressure at the end of the dripperline to be 7 psi or greater. These data do not take scouring velocity into account.

BIOLINE FLUSHING CHART Maximum Length of a Single Lateral *(feet)* Allowing for 2 fps Scouring Velocity

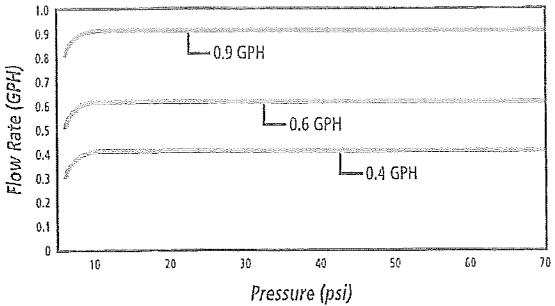
Dripper Spacing		12"			18"			24"		
Dripper Flow Rate (GPH)		0.4	0.6	0.9	0.4	0.6	0.9	0.4	0.6	0.9
Inlet Pressure (psi)	**15** Inlet 8Δ	115	100	85	160	140	120	210	190	170
	25 Inlet 18Δ	200	170	140	270	230	200	360	320	280
	35 Inlet 28Δ	260	210	180	360	300	250	470	410	350
	45 Inlet 38Δ	310	250	210	420	350	290	560	490	420

Lateral lengths are calculated to achieve 2 fps scouring velocity and pressure at the distal end of the lateral to be 7 psi.

BIOLINE Flow per 100 Feet

Dripper Spacing	*0.4 GPH Dripper*		*0.6 GPH Dripper*		*0.9 GPH Dripper*	
	GPH	*GPM*	*GPH*	*GPM*	*GPH*	*GPM*
12"	40.0	0.67	61.0	1.02	92.0	1.53
18"	26.7	0.44	41.0	0.68	61.0	1.02
24"	20.0	0.34	31.0	0.51	46.0	0.77

BIOLINE Dripper Flow Rate vs. Pressure



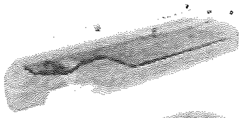
Between 0 and 7 psi, the dripper functions as a turbulent flow emitter, ensuring that the nominal design flow is not exceeded at system start-up.

BIOLINE DRIPPER OPERATION

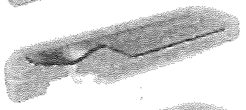
Bioline's **continuous** self-cleaning, pressure compensating dripper is a fully self-contained unit molded to the interior wall of the dripper tubing.

As shown at right, Bioline is continuously self-cleaning during operation, not just at the beginning and end of a cycle. The result is dependable, clog-free operation, year after year.

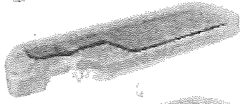
1. Regulating mode



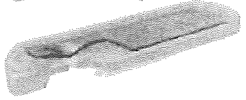
2. Initiation of flushing cycle



3. Flushing cycle

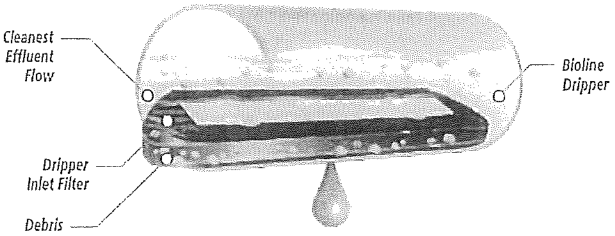


4. Regulating mode



CROSS SECTION OF BIOLINE DRIPPER

Shows how effluent enters the dripper from the center of the flow where it is the cleanest.



BIOLINE Specifying Information

SAMPLE MODEL NUMBER

① ② ③

08WRAM.6-24 V

Ⓐ

Ⓐ Bioline Dripperline = 08WRAM

① Dripper Flow Rate

0.4 GPH = .4
0.6 GPH = .6
0.9 GPH = .9

② Dripper Spacing

12" = 12
18" = 18
24" = 24

③ Coil Length

500' = V500
1,000' = V

BLANK Tubing Model Number: 250' = 08WRAM-250

BIOLINE Ordering Information

Flow Rate	*Dripper Spacing*	*Coil Length*	*Model Number*
0.4 GPH	12"	1,000' 500'	08WRAM.4-12V 08WRAM.4-12V500
0.4 GPH	18"	1,000' 500'	08WRAM.4-18V 08WRAM.4-18V500
0.4 GPH	24"	1,000' 500'	08WRAM.4-24V 08WRAM.4-24V500
0.6 GPH	12"	1,000' 500'	08WRAM.6-12V 08WRAM.6-12V500
0.6 GPH	18"	1,000' 500'	08WRAM.6-18V 08WRAM.6-18V500
0.6 GPH	24"	1,000' 500'	08WRAM.6-24V 08WRAM.6-24V500
0.9 GPH	12"	1,000' 500'	08WRAM.9-12V 08WRAM.9-12V500
0.9 GPH	18"	1,000' 500'	08WRAM.9-18V 08WRAM.9-18V500
0.9 GPH	24"	1,000' 500'	08WRAM.9-24V 08WRAM.9-24V500
Blank Tubing 17mm		250'	08WRAM-250

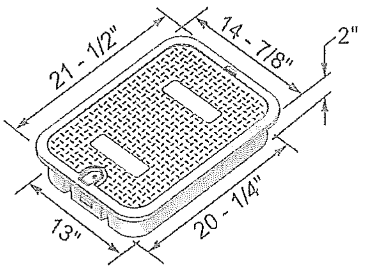
NDS

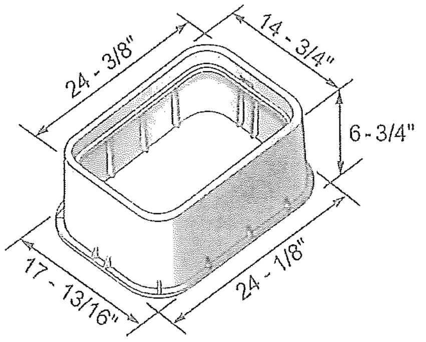
One source. Many solutions.

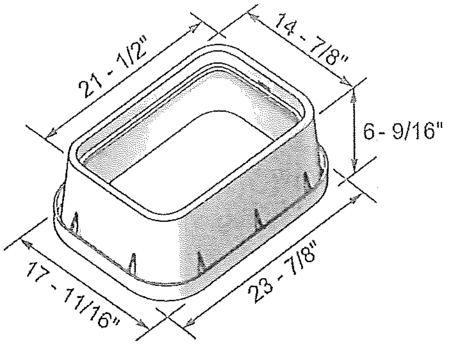
TECHNICAL SPECIFICATIONS

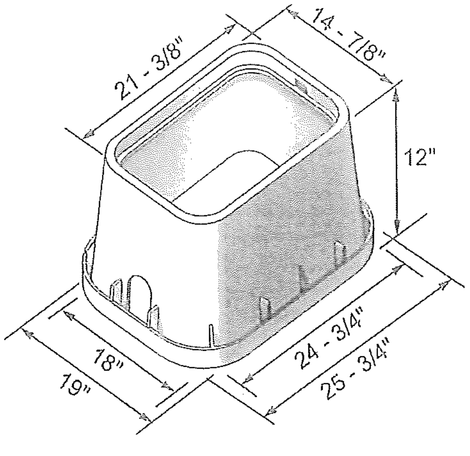
NDS Standard Series 13" x 20" Rectangular Valve Boxes

Specifications: The NDS STANDARD SERIES 13"x20" valve boxes and covers are injection molded of structural foam polyolefin material with a melt index between 10-12. Coloring and UV stabilizers are added, along with processing lubricants when needed. The 13"x20" body shall be tapered and have a minimum wall thickness of .250". The body shall have a double wall at the top cover seat area with a minimum thickness of .250". The cover seat area shall have 16 structural support ribs on the underside of the seat, each with a minimum thickness of .250". The bottom of the body shall have a .500" flange. The 13"x20" cover shall have an average thickness of .250".









3" x 4" Pipe Slot

Product is not to be installed in concrete and is not to be used in vehicular applications. Weights and dimensions are nominal.

Part Number	Box Description	Cover Description - Marking	Color (Box/Cover)	Pallet Qty	Weight Ea
Box & Cover					
117BC	13"x20" Jumbo Box	Overlapping Cover - ICV	Black/Green	56	14.00
117BCB	13"x20" Jumbo Box	Overlapping Bolt-Down Cover - ICV	Black/Green	56	14.10
117BC SAND	13"x20" Jumbo Box	Overlapping Cover - ICV	Sand/Sand	56	14.00
117PBCR	13"x20" Jumbo Box	Overlapping Cover - Reclaimed Water	Purple/Purple	56	14.00
117BCBS	13"x20" Jumbo Box	Overlapping Bolt-Down Cover - Sewer	Black/Black	56	14.10
117BCS	13"x20" Jumbo Box	Overlapping Cover - Sewer	Black/Green	56	14.00
119	13"x20"x6" Jumbo extension	Overlapping Cover - ICV	Black/Green	32	12.00
119TBC	13"x20"x6" Tapered Box	Overlapping Cover - ICV	Black/Green	56	12.00
119 SAND	13"x20"x6" Jumbo extension	Overlapping Cover - ICV	Sand/Sand	32	12.00
Cover Only					
117C		13"x20" Overlapping Cover - ICV	Green	180	5.00
117C SAND		13"x20" Overlapping Cover - ICV	Sand	180	5.00
117CR		13"x20" Overlapping Cover - Reclaimed	Purple	180	5.00
117CS		13"x20" Jumbo Overlapping Cover - Sewer	Green	180	5.00
Box Only					
117B	13"x20" Jumbo Box		Black	56	9.00
117B SAND	13"x20" Jumbo Box		Sand	56	9.00
117PB	13"x20" Jumbo Box		Purple	56	9.00
117-6	13"x20" Jumbo extension		Black	32	6.00
119TB	13"x20"x6" Tapered Box		Black	56	6.00
	2-1/2" X 3/8" SS bolt		Steel	1	0.10

Call for additional options and availability

Properties of Unfoamed Resin

	ASTM Test Method	Polyolefin
Tensile Strength, Yield	ASTM D 638	3100-4400 PSI
Density	ASTM D 792	.900-.956
Notched Izod Impact Strength	ASTM D 256	4-15 ft. lbs/in.
Heat Deflection Temperature @ 66 PSI, Degreees F.	ASTM D 648	165-212 degrees F.

Shipping Configuration

	Box	Extension	Cover
Pallet	56	32	180
Pieces per Stack	14	8	30
Stack per Pallet	4	4	6
Pallet Dimensions	40"x51 ½"x53 ½"	40"x49"x55"	43"x48"x66"

NDS

NDS Customer Service
851 N. Harvard Ave
Lindsay, CA 93247
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(559) 562-9888
Fax: (800) 726-1998
(559) 562-4488

www.NDSPRO.com

Sikaflex® 11FC

Caulk-style Adhesive

One component polyurethane sealant/adhesive

Description

Sikaflex 11FC is a fast curing one-component polyurethane sealant/adhesive with permanent elasticity.

Uses

As an elastic adhesive for:

- Assembling metal framed buildings.
- Cover plates and covings.
- Light-weight construction materials.
- Acoustic ceiling tiles.
- Wood, metal or plastic window and door frames.
- Floor mouldings and door sills.

As an elastic joint sealant for:

- Sealing joints in concrete, epoxy, stone and quarry tiled floors.
- Sealing joints in roofing and guttering etc.
- Flexible draught proofing.
- Containers, water tanks and silos.
- Excellent pick resistance for applications in shop fronts, prisons, schools, public amenities and buildings.
- Bolted lap joints.
- Sealing penetrations in walls or floors for ducts, piping, etc.
- Sanitary purposes.

Advantages

- New Sikaflex 11FC will bond to well cleaned old Sikaflex 11FC.
- Excellent adhesion on all cement-based materials, brick, ceramics, metals, wood, polyurethane, epoxy, and some polyesters.
- Fast cure rate.
- High durability.
- High abrasion resistance and tear strength.
- Good weathering and water resistance.
- Non-sag on vertical joints up to 30 mm width.
- Ready for immediate use -- no mixing.
- Non-corrosive.
- Can be painted over with many water, solvent and rubber-based paints (preliminary tests recommended).
- Certified for use in contact with potable water (AS4020-1999).

Instructions for Use

Surface Preparation

Clean, sound, dry and free of oil, grease and surface contaminants such as form release agents, curing membranes and hydrophobic water repellents. Thoroughly remove all loose particles and dust.

Priming

(Refer to Primer Selection Guide for detailed information. This is a separate document).

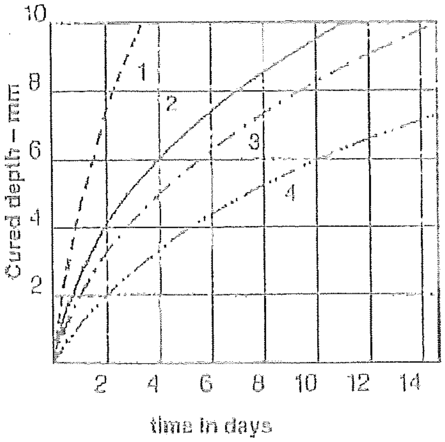
Application

Minimum application temperature 5°C. For easier use store cartridges at temperatures between 10°C and 20°C. Break inner seal at extrusion end of cartridge. Affix nozzle to cartridge, cut tip to suit joint size. Install into a caulking gun. For adhesive purposes apply in spots or beads on the prepared surface, tapping or pressing the part to be adhered against the substrate. The thickness of the bead depends on the surface texture (1mm to 5mm). When sealing is completed, joints may be smoothed with a 20% solution of washing up detergent in water. When masking sides of joints for

Technical Data (Typical)

Colours	Grey, White, Black, Beige
Density	1.15 – 1.2 kg/litre depending on colour
Basis	Accelerated moisture curing polyurethane prepolymer
Priming	Refer separate Primer Selection Guide for details
Application Temperature	5°C to 40°C
Service Temperature	-40°C to 80°C (maximum 50°C in water)
Shelf Life	Minimum 12 months stored dry below 30°C unopened in original container
Skinning Time	45 to 75 minutes depending on climate
Shore A hardness	40-45
Elastic Recovery	>90%
Tensile Strength	0.5 MPa approx. @ 50% elongation (20°C)
Elongation at Break	Over 450%
Maximum Working Expansion and Contraction	Refer Joint Design section
Tear propagation resistance	7 MPa
Tensile Strength at Break	Approx. 1.4 MPa

Cure rate at various relative humidities and temperatures



1)................ 40°C/65%RH
2)................ 20°C/65% RH
3)................ 20°C/40% RH
4)................ 5°C/65% RH

Chemical Resistance	*Long Term*	*Medium Term*	*Low to Very Low Term*
	Water	Mineral oils	Organic solvents
	Weak acids	Vegetable oils	Paint thinners
	Weal alkalis	Fats	Strong acids
	Sewage	Fuels	Strong alkalis

Consumption

One pack of Sikaflex-11FC will produce the following lengths of bead for various bead diameters (approx. per pack):

310 ml Cartridge		*600 ml Sausage*	
3 mm bead	43 metres	3 mm bead	81 metres
4 mm bead	24 metres	4 mm bead	45 metres
5 mm bead	15 metres	5 mm bead	28 metres
6 mm bead	10 metres	6 mm bead	19 metres

Sika Primers (referred to above): About 5m² per kilo of primer.

As a typical guide a 250 ml can of primer will normally be sufficient for about 11 to 13 cartridges or 5 to 8 600ml sausages of Sikaflex-11FC.

Sika Adhesive Cleaner 1 approximately 0.13litres/m².

2-Part Epoxy

PRODUCT BULLETIN • SPECIFICATIONS

810 A&B

2-PART HIGH STRENGTH REACTIVE ADHESIVE

GENERAL DESCRIPTION:

Weld-On 810 A&B is a white, reduced VOC emissions, thick syrupy, two-component, high strength reactive adhesive. Weld-On 811 A&B has the same physical properties and capabilities as Weld-On 810 A&B, but packaged in a 470ml dual cylinder cartridge and requires a dispensing gun and mixing tip.

PRODUCT USES:

Weld-On 810 A&B is specially formulated for bonding large diameter PVC and CPVC pipe and fittings. It also bonds ABS, Styrene, Acrylic, FRP (fiberglass-reinforced polyester), aluminum (non-anodized), other metals, concrete, clay and other materials to themselves or to dissimilar materials. It provides excellent adhesion in peel, tensile or sheer applications. It also has a fast cure time, withstands very high pressure and is high impact resistant. It is great for repairing cracks or leaky pipe valves and fittings. It fills gaps too large for solvent cement to fill, making it excellent for fabrication of fittings and joining saddles to pipe. **Not recommended for use on Teflon, Silicone, Polypropylene, Polyethylene and other Polyolefin's or joints with an interference fit.**

GENERAL INSTALLATION INFORMATION:

This product is mixed by hand and has a mixing ratio of 100:13. Pot life and working time is about 30 minutes at 70°F (21°C). Recommended set time is 1 hour. Recommended cure time is 2 hours to reach 80% bond strength, 24 hours for near ultimate strength. The cured layer is a tough, chemical and water resistant plastic. Warmer weather will shorten pot life and cure time. Colder weather will increase the time for both. Applying heat may speed up the cure time. Note: When joining CPVC for service temperatures over 150°F (65°C), please contact IPS Corporation for more information.

For installation instructions that are more detailed, refer to the 810 A&B Installation Instructions Bulletin.

AVAILABILITY:

This product is available in 4 oz., pint, quart and gallon two-part, pre-measured, plastic container kits. For detailed information on containers and applicators, see our current Price List.

SPECIFICATIONS:

COLOR:	White
RESIN:	Component "A" - Acrylic Component "B" - Plasticizer
SPECIFIC GRAVITY:	1.03 ± 0.040
BROOKFIELD VISCOSITY:	Minimum 40,000 cps @ 73 ± 3.6°F
APPROXIMATE COVERAGE:	20mil thickness: 14 sq. ft/Pint 115 sq. ft/Gallon
MAX VOC EMISSIONS:	75 G/L , per SCAQMD Rule 1168, Method 316A

SHELF LIFE and STORAGE:

When both components are stored between 50°F (10°C) and 70°F (21°C), 1 year shelf life can be expected in unopened containers.

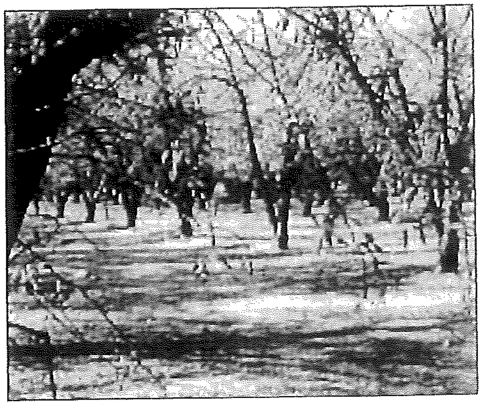
Agricultural Products, Inc.
a Summa Industries company

I.P.S. FLEXIBLE VINYL PIPE

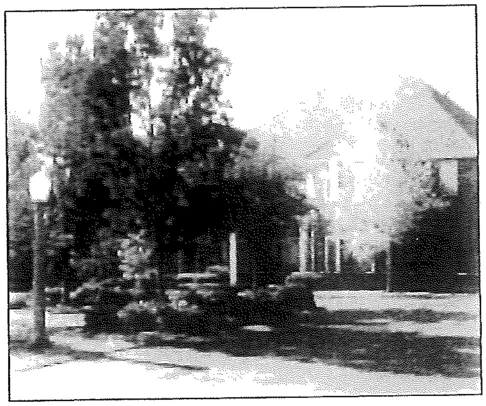
DURABLE **RELIABLE** **PROVEN** **TRUSTED**

Applications

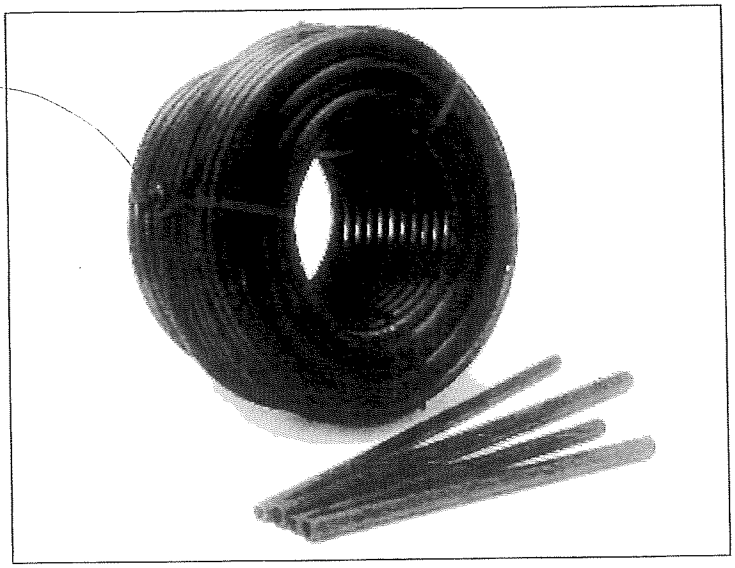
Agriculture



Landscape



Greenhouse/Nursery



Product Features

IPS Flexible vinyl pipe offers more flexibility, durability and shock resistance to an irrigation system than standard PVC pipe can provide.

- Heavy duty pipe for use as risers or swing joints
- Heavy wall thickness makes tight bends possible without kinking
- Available in ½", ¾" and 1" I.P.S. (Iron Pipe Size)
- Coils of 100' and 200' in ½" and ¾" sizes, 100' in 1"
- Pre-cut lengths are also available
- Flexible pipe can be readily assembled using standard Schedule 40 PVC fittings with flexible to rigid PVC adhesive

How I.P.S. Flexible Vinyl Pipe Is Used

I.P.S. Flexible Vinyl Pipe can be used...

- For use in connecting submain to drip hose lateral
- To make flexible swing joints
- To easily and inexpensively repair breaks in rigid PVC pipe
- To easily get around, under or over obstacles
- To carry irrigation water to interior and exterior planters, arbors, waterfalls, etc.

Note: Flexible PVC pipe should be used only on irrigation water systems and downstream of irrigation control valves. Flexible PVC pipe is not recommended for use in applications involving high heat, high pressure or constant pressure situations.

Specifications for 1174 Standard Material

Shore Durometer – "A" Scale (ASTM-D676) .... Instantaneous...92
10 Second Delay...88
Specific Gravity (ASTM-D792)...1.40 + .02

PHYSICAL PROPERTIES		
	BEFORE WEATHERING	**AFTER WEATHERING**
Ultimate Tensile Strength (ASTM D-412)	2900 psi	3050 psi
Ultimate Elongation (ASTM D-4120)	265%	240%
100% Modulas (ASTM D-412)	1600 psi	1750 psi

THERMAL PROPERTIES

Brittle Temperature (ASTM D-746) (-22□F.)
Air Oven Aging - 7 days @ 100□F. (retention of elongation) 87%
Outdoor Weathering (500 hours atlas weather-o-meter) No Change

FRICTION LOSS CHARACTERISTICS

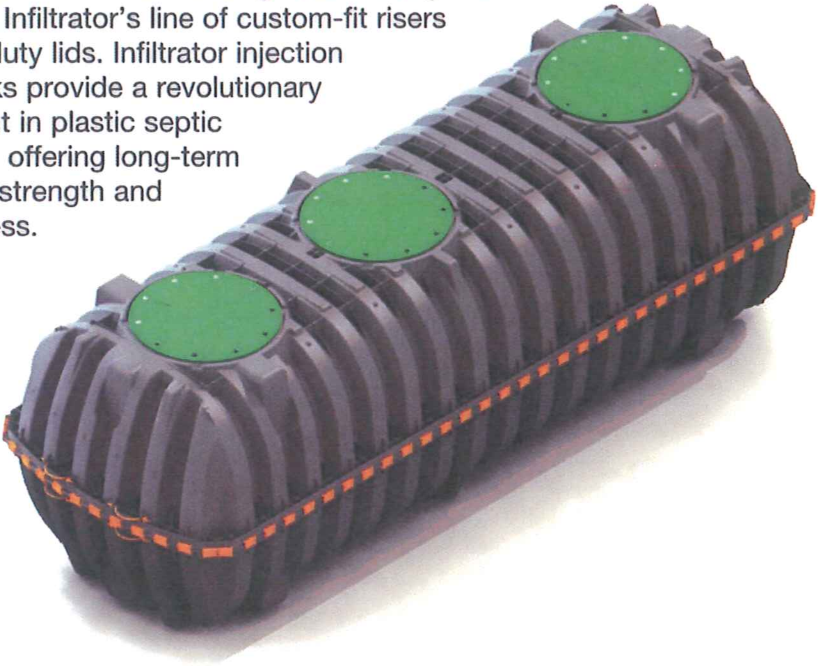
SIZE	GPM	LOSS/CFT (psi)	VELOCITY
1/2"	2	2.42	2.74
	4	10.52	5.48
	6	22.26	8.22
	8	37.92	10.95
3/4"	2	0.66	1.48
	4	2.36	2.97
	6	5	4.45
	8	8.52	5.93
	10	12.88	7.41
1"	6	1.46	2.67
	8	2.48	3.57
	10	3.74	4.46
	12	5.24	5.35
	14	6.96	6.24

API
Agricultural Products, Inc.
a Summa Industries company
P.O. Box 3760 - Ontario, CA 91761 - 800.828.9919 - Fax: 800.777.6162
P.O. Box 3546 - Haines City, FL 33845 - 800.848.8153 - Fax: 800.533.6421
Visit us at: www.agproducts.com

INFILTRATOR®
tanks

IM-1530

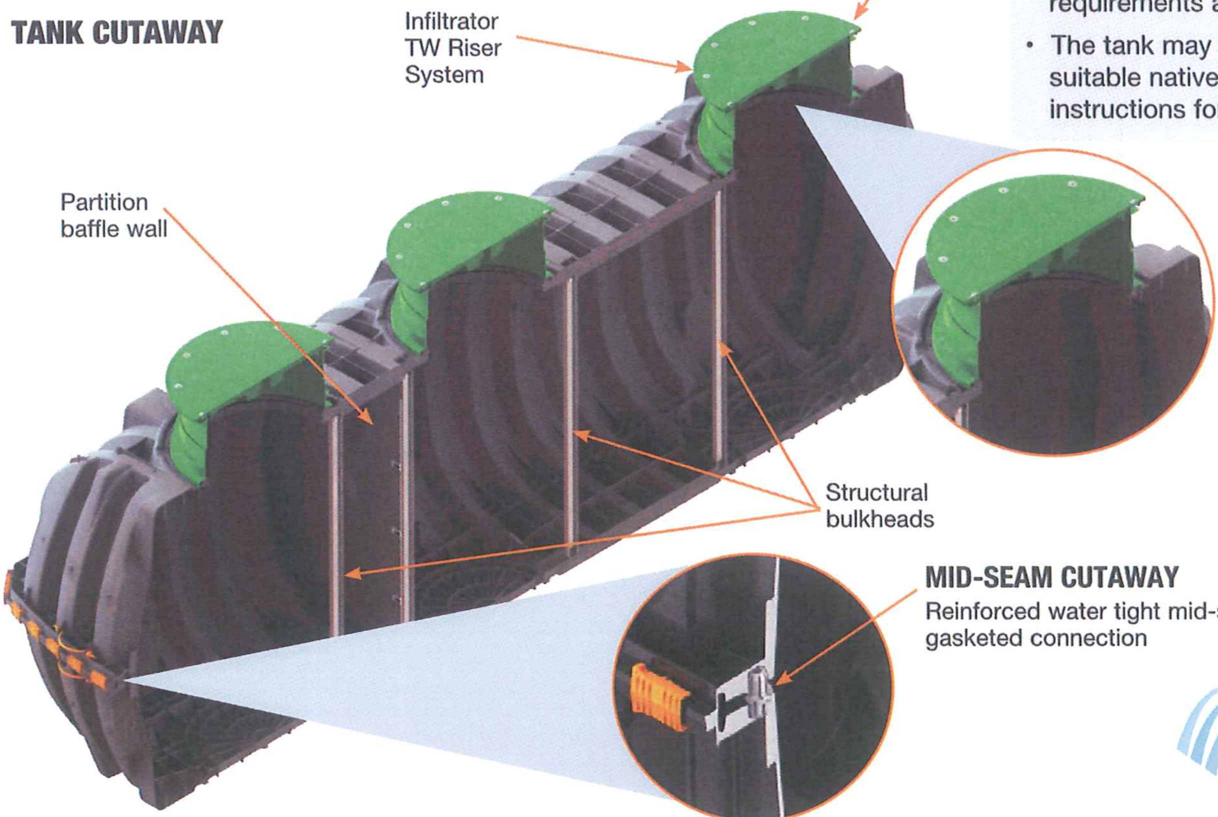
The Infiltrator IM-1530 is a lightweight strong and durable septic tank. This watertight tank design is offered with Infiltrator's line of custom-fit risers and heavy-duty lids. Infiltrator injection molded tanks provide a revolutionary improvement in plastic septic tank design, offering long-term exceptional strength and watertightness.



Features & Benefits

- Strong injection molded polypropylene construction
- Lightweight plastic construction and inboard lifting lugs allow for easy delivery and handling
- Integral heavy-duty green lids that interconnect with TW™ risers and pipe riser solutions
- Structurally reinforced access ports eliminate distortion during installation and pump-outs
- Reinforced structural ribbing and fiberglass bulkheads offer additional strength
- Can be installed with 6" to 48" of cover
- Can be pumped dry during pump-outs
- Suitable for use as a septic tank, pump tank, or rainwater (non-potable) tank
- No special water filling requirements are necessary
- The tank may be backfilled with suitable native soil. See installation instructions for guidance.

TANK CUTAWAY



HEAVY DUTY LID CUTAWAY

Reinforced 24" structural access port

MID-SEAM CUTAWAY

Reinforced water tight mid-seam gasketed connection

Protecting the Environment with **Innovative Wastewater Treatment Solutions**

INFILTRATOR®
water technologies

IM-1530 General Specifications and Illustrations

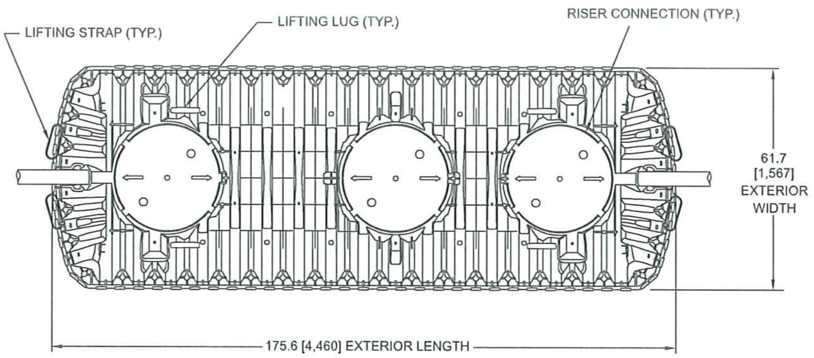
The IM-1530 is an injection molded two piece mid-seam plastic tank. The IM-1530 injection molded plastic design allows for a mid-seam joint that has precise dimensions for accepting an engineered EPDM gasket. Infiltrator's gasket design utilizes technology from the water industry to deliver proven means of maintaining a watertight seal.

The two-piece design is permanently fastened using a series of non-corrosive plastic alignment dowels and locking seam clips. The IM-1530 is assembled and sold through a network of certified Infiltrator distributors.

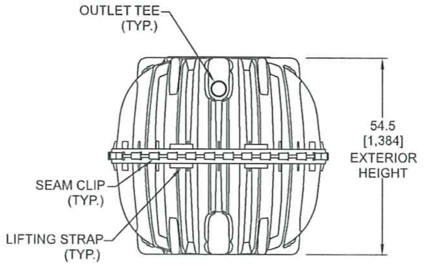
Must be backfilled and installed in accordance with Infiltrator Water Technologies, Infiltrator IM-Series Septic Tank General Installation Instructions and for shallow ground water conditions reference the Infiltrator IM-Series Tank Buoyancy Control Guidance.

Please visit www.infiltratorwater.com/images/pdf/ManualsGuides/TANK01.pdf for the latest information.

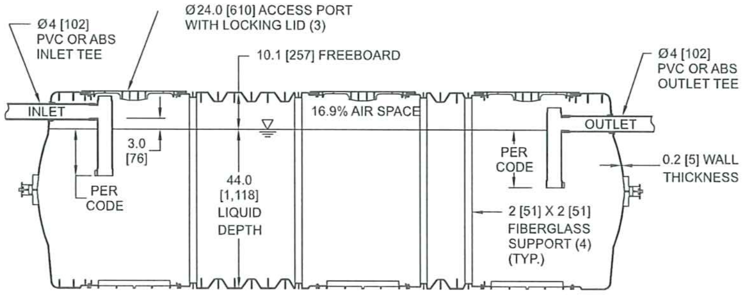
IM-1530	
Working Capacity	1537 gal (5818 L)
Total Capacity	1787 gal (6765 L)
Airspace	16.9%
Length	176" (4460 mm)
Width	62" (1567 mm)
Length-to-Width Ratio	2.8 to 1
Height	55" (1384 mm)
Liquid Level	44" (1118 mm)
Invert Drop	3" (76 mm)
Fiberglass Supports	4
Compartments	1 or 2
Maximum Burial Depth	48" (1219 mm)
Minimum Burial Depth	6" (152 mm)
Maximum Pipe Diameter	4" (100 mm)
Weight	501 lbs (228 kg)



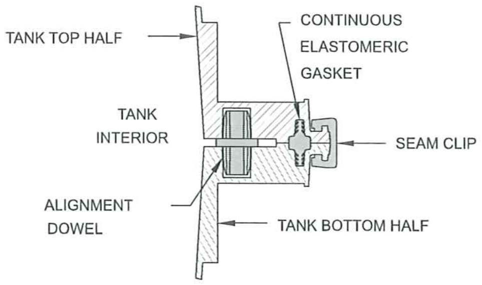
TOP VIEW



END VIEW



SIDE VIEW



MID-HEIGHT SEAM SECTION

INFILTRATOR®
water technologies

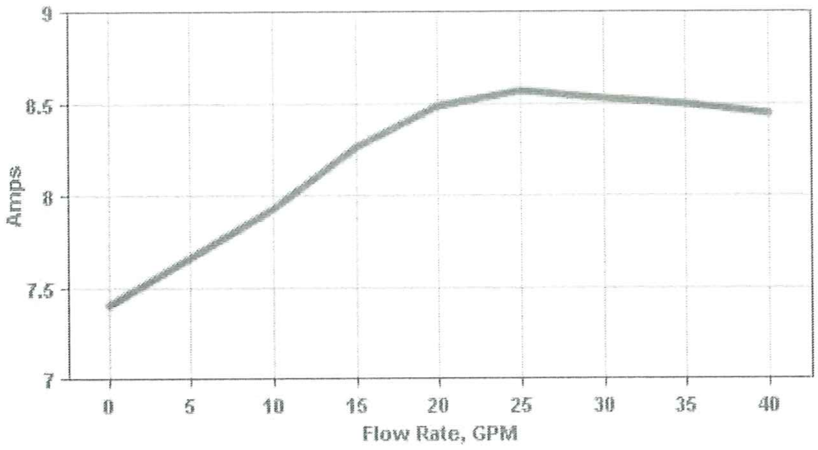
4 Business Park Road
P.O. Box 768
Old Saybrook, CT 06475
860-577-7000 • Fax 860-577-7001
1-800-221-4436
www.infiltratorwater.com

Contact Infiltrator Water Technologies' Technical Services Department for assistance at 1-800-221-4436

Print Data: **March 25, 2019**

HPH #1

Amps Chart



	Pump 1 PF300712	
GPM	AMPS	TDH
0	7.41	185.00
5	7.66	185.00
10	7.93	178.00
15	8.27	169.00
20	8.49	149.00
25	8.57	120.00
30	8.53	92.00
35	8.50	63.00
40	8.45	22.00

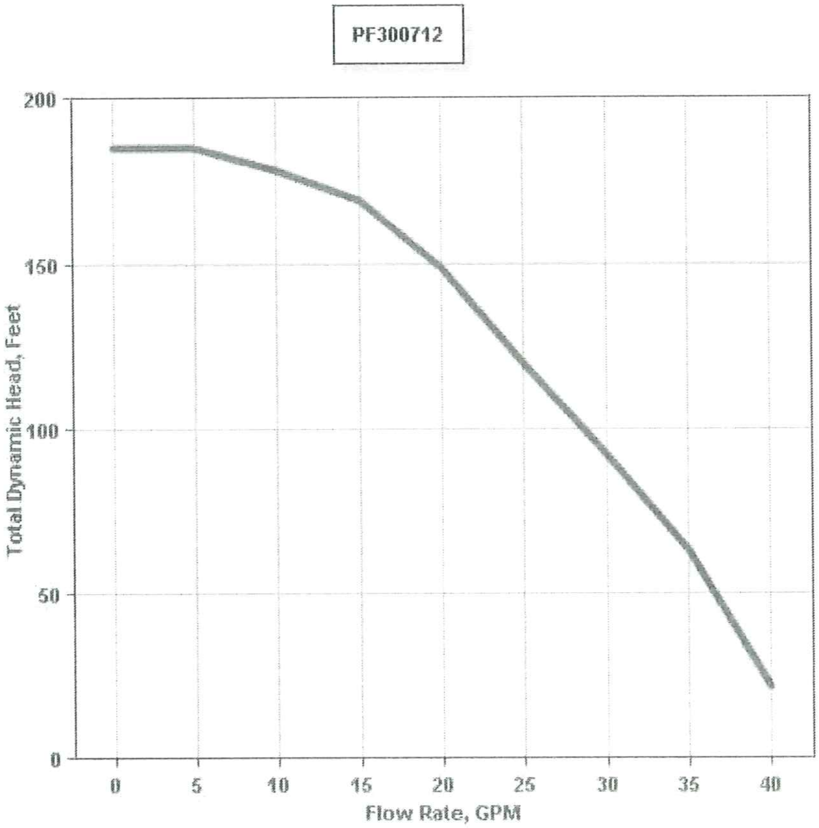
BENCHMARK NOTE:

For pumps tested at Orenco (O)

- All 115 V. nameplate pumps are tested at 119 to 121 V.
- All 200 V. three phase nameplate pumps are tested at 209 to 211 V.
- All 220/230 V. (50HZ) nameplate pumps are tested at 228 to 230 V.
- All 230 V. (60HZ) nameplate pumps are tested at 240 to 242 V.

P1:O-10/03/07

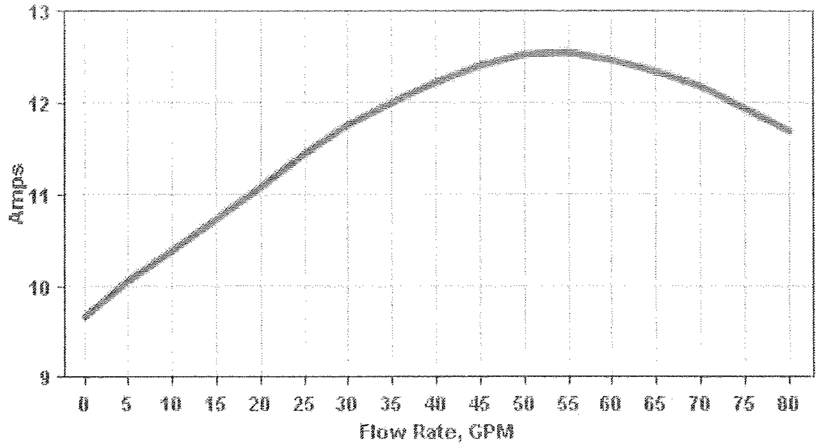
TDH Chart



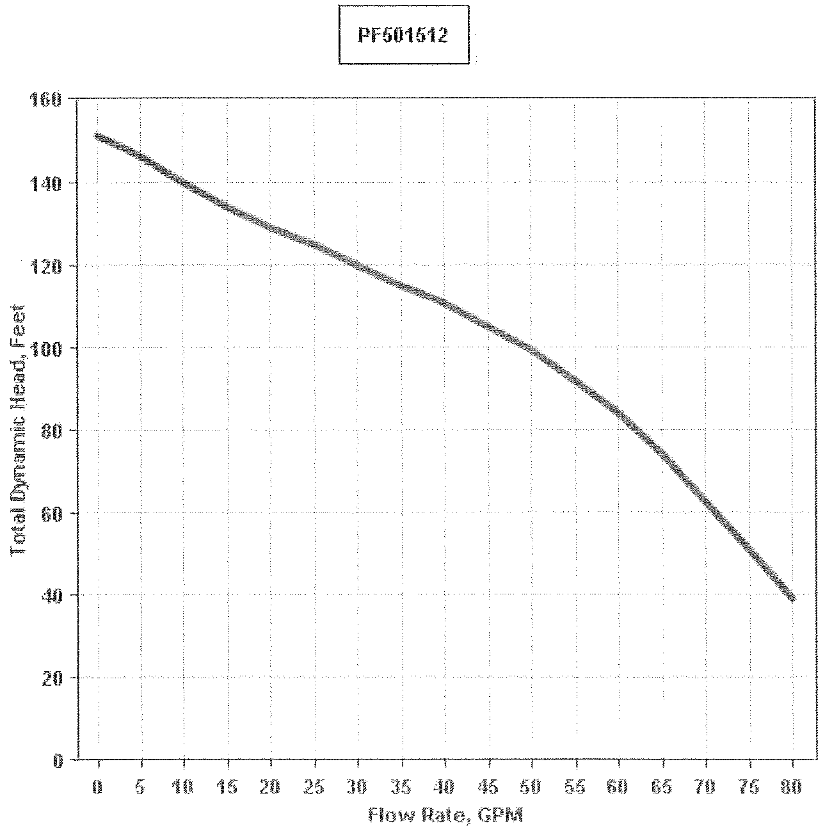
Print Data: **March 25, 2019**

HPH #2

Amps Chart



TDH Chart



	Pump 1 PF501512	
GPM	AMPS	TDH
0	9.67	151.00
5	10.05	146.00
10	10.38	140.00
15	10.74	134.00
20	11.09	129.00
25	11.45	125.00
30	11.75	120.00
35	12.00	115.00
40	12.23	111.00
45	12.42	105.00
50	12.54	99.50
55	12.55	92.00
60	12.47	84.00
65	12.35	74.00
70	12.18	63.00
75	11.95	51.00
80	11.69	39.00

BENCHMARK NOTE:

For pumps tested at Orenco (O)

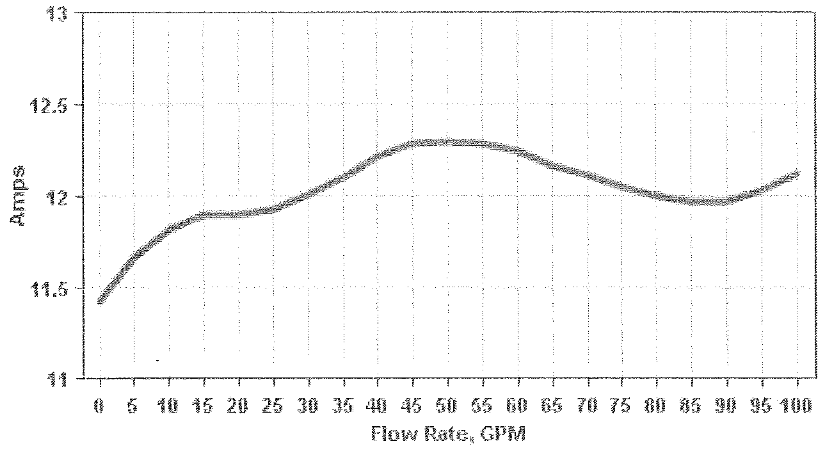
- All 115 V. nameplate pumps are tested at 119 to 121 V.
- All 200 V. three phase nameplate pumps are tested at 209 to 211 V.
- All 220/230 V. (50HZ) nameplate pumps are tested at 228 to 230 V.
- All 230 V. (60HZ) nameplate pumps are tested at 240 to 242 V.

P1:O-10/09/07

Print Data: **March 25, 2019**

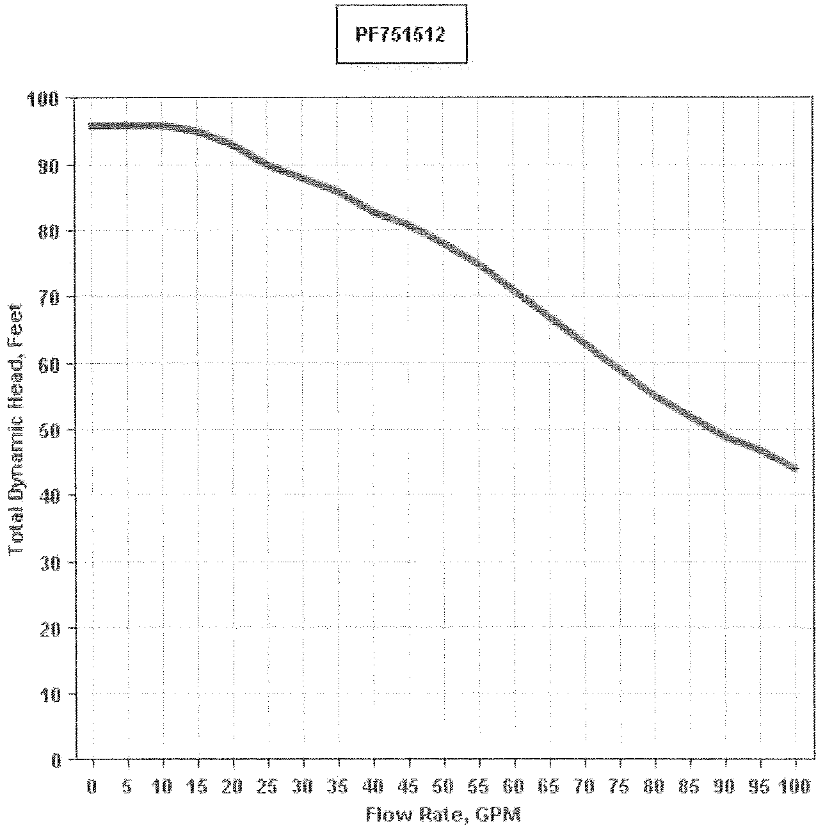
HPA #3

Amps Chart



	Pump 1 PF751512	
GPM	AMPS	TDH
0	11.43	96.00
5	11.66	96.00
10	11.82	96.00
15	11.90	95.00
20	11.90	93.00
25	11.93	90.00
30	12.01	88.00
35	12.10	86.00
40	12.22	83.00
45	12.29	81.00
50	12.30	78.00
55	12.29	75.00
60	12.25	71.00
65	12.16	67.00
70	12.11	63.00
75	12.05	59.00
80	12.00	55.00
85	11.97	52.00
90	11.97	49.00
95	12.03	47.00
100	12.12	44.00

TDH Chart



BENCHMARK NOTE:

For pumps tested at Orenco (O)

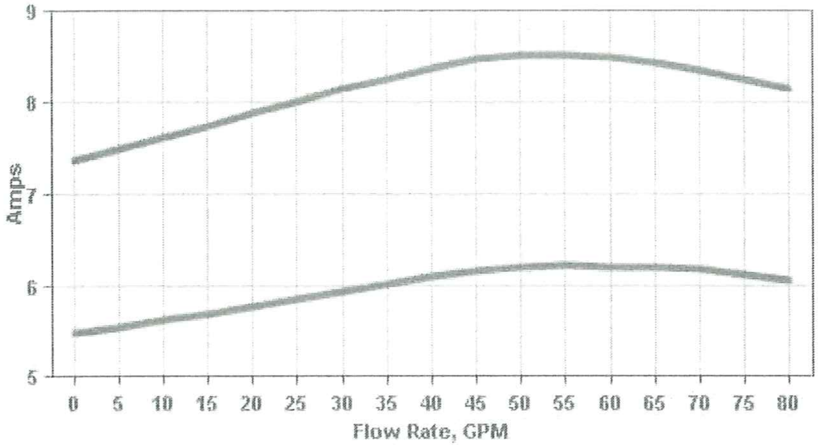
- All 115 V. nameplate pumps are tested at 119 to 121 V.
- All 200 V. three phase nameplate pumps are tested at 209 to 211 V.
- All 220/230 V. (50HZ) nameplate pumps are tested at 228 to 230 V.
- All 230 V. (60HZ) nameplate pumps are tested at 240 to 242 V.

P1:O-01/17/08

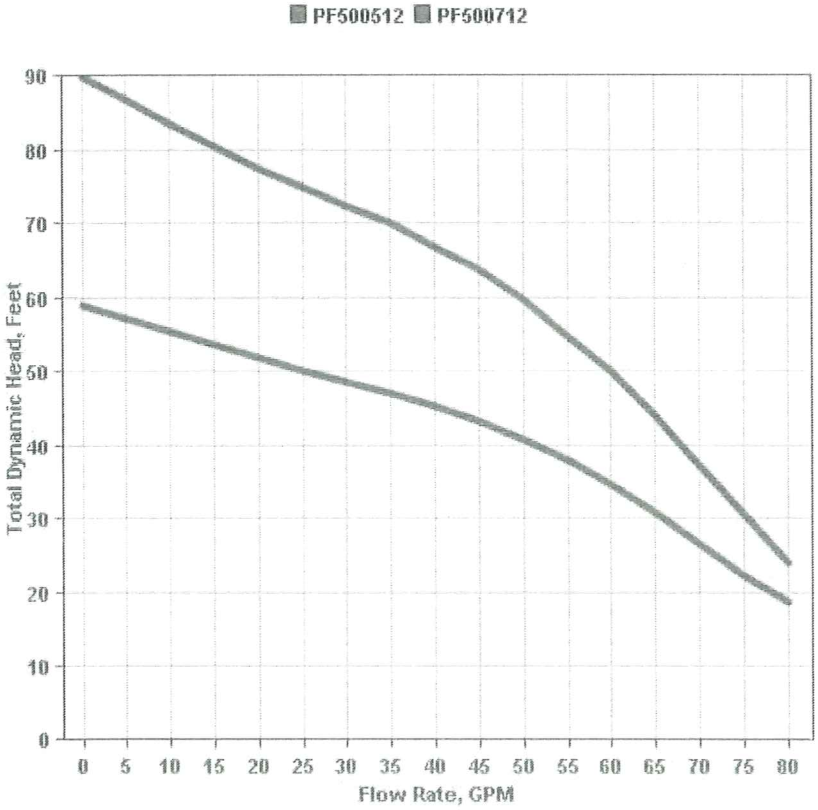
Print Data: **March 25, 2019**

KC#3'

Amps Chart



TDH Chart



	Pump 1 PF500512		Pump 2 PF500712	
GPM	AMPS	TDH	AMPS	TDH
0	5.49	59.00	7.36	89.80
5	5.55	57.10	7.50	86.90
10	5.62	55.30	7.62	83.50
15	5.69	53.50	7.74	80.40
20	5.76	51.80	7.88	77.40
25	5.85	50.10	8.01	74.90
30	5.94	48.60	8.15	72.40
35	6.02	47.00	8.26	70.00
40	6.09	45.30	8.38	66.90
45	6.15	43.30	8.47	63.70
50	6.20	40.80	8.51	59.60
55	6.22	37.90	8.52	54.60
60	6.21	34.70	8.49	50.00
65	6.19	30.90	8.43	44.00
70	6.17	26.60	8.36	37.10
75	6.12	22.30	8.25	30.50
80	6.06	18.60	8.14	23.90

BENCHMARK NOTE:

For pumps tested at Orenco (O)

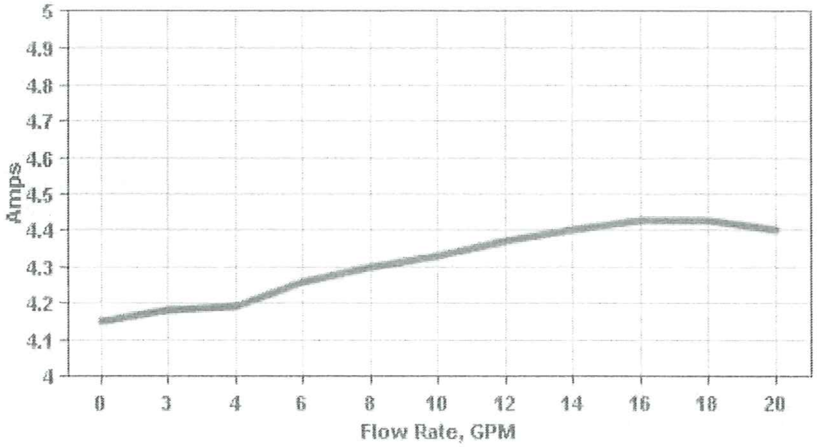
- All 115 V. nameplate pumps are tested at 119 to 121 V.
- All 200 V. three phase nameplate pumps are tested at 209 to 211 V.
- All 220/230 V. (50HZ) nameplate pumps are tested at 228 to 230 V.
- All 230 V. (60HZ) nameplate pumps are tested at 240 to 242 V.

P1:O-02/26/07

P2:O-02/26/07

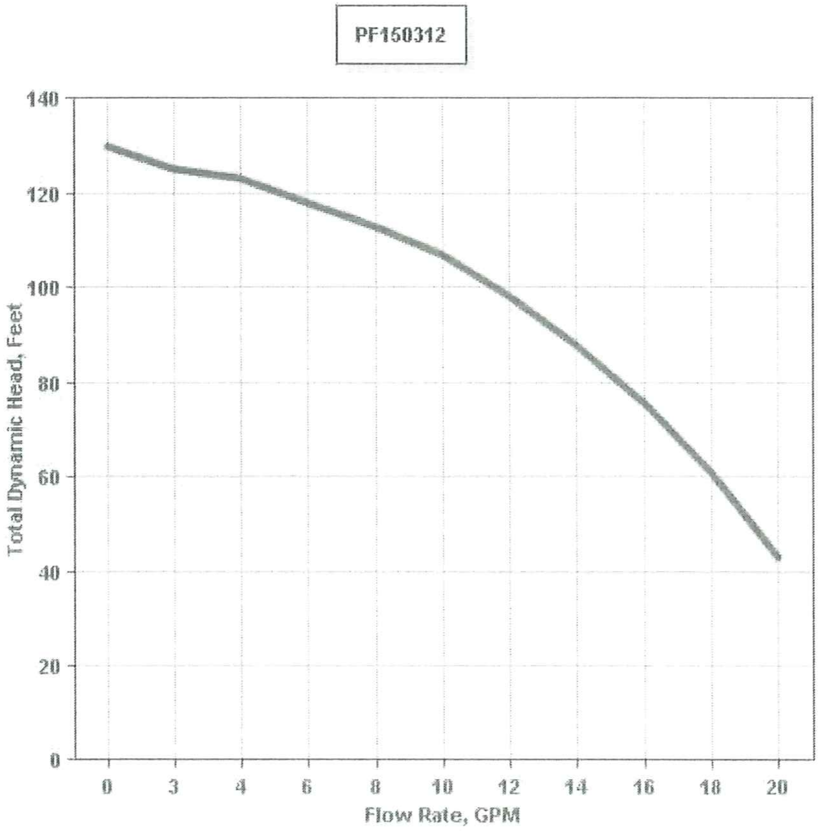
Print Data: **March 25, 2019** KC#4

Amps Chart



	Pump 1 PF150312	
GPM	AMPS	TDH
0	4.15	130.00
3	4.18	125.00
4	4.19	123.00
6	4.26	118.00
8	4.30	113.00
10	4.33	107.00
12	4.37	98.00
14	4.40	88.00
16	4.43	75.50
18	4.43	61.00
20	4.40	43.00

TDH Chart



BENCHMARK NOTE:

For pumps tested at Orenco (O)

- All 115 V. nameplate pumps are tested at 119 to 121 V.
- All 200 V. three phase nameplate pumps are tested at 209 to 211 V.
- All 220/230 V. (50HZ) nameplate pumps are tested at 228 to 230 V.
- All 230 V. (60HZ) nameplate pumps are tested at 240 to 242 V.

P1:O-03/23/11

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 1.9**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 1.9 – Anticipated Construction Dates

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 Fox Parcel will take approximately 60 days to complete and be immediately placed into service. All construction is being completed in a single phase.

Petition to Amend CCN to provide service to Fox Parcel

Exhibit 1.10 – Anticipated Construction Dates

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 Fox Parcel will be completed in a single phase and ultimately provide service to 78 single family homes.

SUPERIOR WASTEWATER SYSTEM **EXHIBIT 1.11**

Petition to Amend CCN to provide service to Fox Parcel

Exhibit 1.11 – Developer Identification

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

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

Charlie Fox
Debbie Hicklen
Fox Family Farm, LLC
2193 Osburn Road
Arrington, TN 37014

August 18, 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:

2193 Osburn Road; Map 109 & 86, Parcels 4.07 & 4.06 on the Williamson County, Tennessee tax maps

We would like to initiate proceedings to include this project into the Superior Wastewater Systems service area. We anticipate Superior Wastewater Systems serving single family residents on the parcels.

Respectfully Requested

Charlie Fox

Charlie Fox

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

Exhibit 2.1 – Decline of Service by Existing Utilities

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 letters from Williamson County and Milcrofton Utility District declining to provide wastewater service to the Fox Parcel. There are no other existing wastewater utilities in the surrounding territory.

LETTERS HAVE BEEN REQUESTED FROM WILLIAMSON COUNTY AND LOCAL UTILITY. FILING WILL BE UPDATED UPON RECEIPT OF LETTERS.

Charlie Fox
Debbie Hicklen
Fox Family Farm, LLC
2193 Osburn Road
Arrington, TN 37014

August 25, 2020

Rogers Anderson
County Mayor
1320 West Main Street. Suite 125
Franklin TN 37064

Dear Rogers,

We with Ashby Communities, LLC are currently in the process of developing the rear of our property located at:

2193 Osburn Road; Map 109 & 86, Parcels 4.07 & 4.06 on the Williamson County, Tennessee tax maps

Ashby has decided to use an alternative sewer system, with a public sewer provider, regulated by the Tennessee Public Utility Commission, TPUC, with a CCN and further regulated by the Tennessee Department of Environment and Conservation, TDEC with a SOP.

We and Ashby Communities respectfully request a letter from the Williamson County Government that it has no plans to provide public sewer or it cannot provide public sewer for the above listed property. The letter may have language on it like this:

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

Of course time is critical for us and please feel free to email us your response to
John-powell@comcast.net foxc@gtspecnet.com

Respectfully Requested

Charlie Fox

Charlie Fox

Charlie Fox
Debbie Hicklen
Fox Family Farm, LLC
2193 Osburn Road
Arrington, TN 37014

August 25, 2020

Mike Jones
Milcrofton Utility District
6333 Arno Road
Franklin TN 37064

Dear Mr. Jones,

We are currently in the process of developing our property located at:

2193 Osburn Road; Map 109 & 86, Parcels 4.07 & 4.06 on the Williamson County, Tennessee tax maps

We have decided to use an alternative sewer system, with a public sewer provider, regulated by the Tennessee Public Utility Commission, TPUC, with a CCN and further regulated by the Tennessee Department of Environment and Conservation, TDEC with a SOP.

I respectfully request a letter from the District that it has no plans to provide public sewer or it cannot provide public sewer for these above listed properties. The letter may have language on it like this:

> *On August ____ , 2020 Milcrofton Utility District received your request that sewer service be provided to the above-named property. In response to your inquiry, this correspondence confirms that Milcrofton Utility District does not currently provide public sewer service and has no plans in the foreseeable future to provide said service.*

Of course times is critical for us and please feel free to email us your response to Foxc@gtspecnet.com and john-powell@comcast.net

Respectfully Requested

Charlie Fox

Charlie Fox

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 2.2**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 2.2 – Franchise Agreements

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 Fox Parcel. In addition, the Fox Parcel is not located within any municipal boundaries.

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 2.3**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 2.3 – Developer/Construction Contractor/Utility Contract

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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 Fox 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

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 3.1**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 3.1 – Biographies of Officers and Key Staff

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.

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 3.2**

Petition to Amend CCN to provide service to Fox Parcel

Exhibit 3.2 – State Wastewater Provider Status

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.

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 3.3**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 3.3 – Pending Mergers or Acquisitions

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.

Petition to Amend CCN to provide service to Fox Parcel

Exhibit 3.4 – Construction Company Contractor's License

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

Petition to Amend CCN to provide service to Fox Parcel
Exhibit 4.1 – TDEC State Operating Permit Application

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. SWS's SOP application that was filed with TDEC
2. Letter from TDEC indicating receipt of the completed application
3. Design Development Report
4. Detailed Soils Investigation Report
5. Wastewater Site Plan

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
(615) 532-0625

APPLICATION FOR A STATE OPERATION PERMIT (SOP)

Type of application: ☐ New Permit ☐ Permit Reissuance ☑ Permit Modification

Permittee Identification: (Name of city, town, industry, corporation, individual, etc., applying, according to the provisions of Tennessee Code Annotated Section 69-3-108 and Regulations of the Tennessee Water Quality Control Board.)

Permittee Name (applicant): Mr. John Powell
Superior Wastewater Systems (formerly Kings Chapel Capacity, LLC)

Permittee Address: P.O. Box 40 Arrington, TN 37014

Official Contact: Mr. John Powell	Title or Position: Managing Member		
Mailing Address: P.O. Box 34	City: Arrington	State: TN	Zip: 37014
Phone number(s): 615.496.8681	E-mail: john-powell@comcast.net		

Optional Contact: Linda Sullivan, P.E.	Title or Position: CIA Engineers - President		
Address: 307 Hickerson Drive	City: Murfreesboro	State: TN	Zip: 37129
Phone number(s): 615.516.2852	E-mail: lsullivan@cia-engineers.com		

Application Certification (must be signed in accordance with the requirements of Rule 0400-40-05-.05)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. As specified in Tennessee Code Annotated Section 39-16-702(a)(4), this declaration is made under penalty of perjury.

Name and title; print or type	Signature	Date

SOP APPLICATION – page 2

Permit Number: SOP-________

Facility Identification:	**Existing Permit No.**
Facility Name: Superior Wastewater Systems - Kings Chapel WWTP	County: Williamson
Facility Address or Location: 4900 Meadowbrook Drive, Arrington TN 37014	Latitude: 35.866944 Longitude: -86.691944

Name and distance to nearest receiving waters: Arrington Creek - Beside it.

If any other State or Federal Water/Wastewater Permits have been obtained for this site, list their permit numbers: N/A

Name of company or governmental entity that will operate the permitted system: Superior Wastewater Sys. (formerly K.C. Capacity, LLC)

Operator address: P.O. Box 40 Arrington TN 37014

Has the owner/operator filed for a Certificate of Convenience & Necessity (CCN), or an amended CCN, with the Tennessee Regulatory Authority (TRA) (may be required for collection systems and land application treatment systems)? ☑ Yes ☐ No ☐ N/A

If the applicant listed above does not yet own the facility/site or if the applicant will not be the operator, explain how and when the ownership will be transferred or describe the contractual arrangement and renewal terms of the contract for operations. N/A

Complete the following information explaining the entity type, number of design units, and daily design wastewater flow:

Entity Type	Number of Design Units		Flow (gpd)
☐ City, town or county	No. of connections:		
☑ Subdivision	No. of homes: 729	Avg. No. bedrooms per home: 4	218,700
☐ School	No. of students:	Size of cafeteria(s): No. of showers:	
☐ Apartment	No. of units:	No. units with Washer/Dryer hookups: No. units without W/D hookups:	
☐ Commercial Business	No. of employees:	Type of business:	
☐ Industry	No. of employees:	Product(s) manufactured:	
☐ Resort	No. of units:		
☐ Camp	No. of hookups:		
☐ RV Park	No. of hookups:	No. of dump stations:	
☐ Car Wash	No. of bays:		
☑ Other		Clubhouse	1,500

Describe the type and frequency of activities that result in wastewater generation. Residential Subdivision

Permit Number: SOP-_________

Engineering Report (required for collection systems and/or land application treatment systems): ☐ N/A

☑ Prepared in accordance with Rule 0400-40-05-.03 and Section 1.2 of the State of Tennessee Design Criteria for Sewage Works

☑ Attached, or 2019 DDR Modification for Kings Chapel

☑ Previously submitted and entitled: Approved? ☑ Yes. Date: ☐ No

Operation and Maintenance Inspection Schedule Submitted:

Approved? ☐ Yes. Date: ☐ No

Wastewater Collection System: ☐ N/A

System type (i.e., gravity, low pressure, vacuum, combination, etc.): Gravity

System Description: STEG to RSF and AXMAX, UV Disinfection, Drip Irrigation

Describe methods to prevent and respond to any bypass of treatment or discharges (i.e., power failures, equipment failures, heavy rains, etc.): Emergency generator connections and 24 hours storage in Tankage and a site pond.

In the event of a system failure describe means of operator notification: Telephone Telemetry

List the **emergency** contact(s) (name/phone): 615.496.8681 John Powell

For low-pressure systems, who is responsible for maintenance of STEP/STEG tanks and pumps or grinder pumps (list all contact information)? N/A

Approximate length of sewer (excluding private service lateral): 88,920 L.F.

Number/hp of lift stations: 7 / 3 hp Number/hp of lift pumps 14 1/3 hp and below

Number/volume of low pressure and or grinder pump tanks 729 / 1500 Gallon Septic Tanks

Number/volume septic tanks /

Attach a schematic of the collection system. ☑ Attached

If this is a satellite sewer and you are tying in to another sewer system complete the following section, listing tie-in points to the sewer system and their location (attach additional sheets as necessary):

Tie-in Point	Latitude (xx.xxxx°)	Longitude (xx.xxxx°)
N/A		

Permit Number: SOP-_________

Land Application Treatment System:	☐ N/A

Type of Land Application Treatment System: ☑ Drip ☐ Spray ☐ Other, explain:

Type of treatment facility preceding land application (recirculating media filters, lagoons, other, etc.): 1,716,131 S.F.

Attach a treatment schematic. ☑ Attached

Describe methods to prevent and respond to any bypass of treatment or discharges (i.e., power failures, equipment failures, heavy rains, etc.): Storage in septic tanks 24 hours in treatment tankege and Storage Pond

For New or Modified Projects: Same owner, adding lots to Kings Chapel and serving lot/development beside this parcel.

Name of Developer for the project:

Developer address and phone number: John Powell, P.O. Box 34, Arrington, TN 37014 - 615.496.8681

For land application, list: Proposed acreage involved: 8.06 acres of new soils

Inches/week gpd/sq.ft loading rate to be applied: 0.21 gpd per S.F.

Is wastewater disinfection proposed?

☑ Yes Describe land application area access: Will be fenced and gated off

☐ No Describe how access to the land application area will be restricted:

Attach required additional Engineering Report Information (see website for more information)

☑ Topographic map (1:24,000 scale presented at a six inch by six inch minimum size) showing the location of the project including quadrangle(s) name(s) GPS coordinates, and latitude and longitude in decimal degrees should also be included.

☑ Scaled layout of facility showing the following: lots, buildings, etc. being served, the wastewater collection system routes, the pretreatment system location, the proposed land application area(s), roads, property boundaries, and sensitive areas such as streams, lakes, springs, wells, wellhead protection areas, sinkholes and wetlands.

☑ Soils information for the proposed land disposal area in the form of a Water Resources Soils Map per Chapter 16 and 17 State of Tennessee Design Criteria for Sewage Work. The soils information should include soil depth (borings to a minimum of 4 feet or refusal) and soil profile description for each soil mapped.

☑ Topographic map of the area where the wastewater is to be land applied with no greater than ten foot contours presented at a minimum size of 24 inches by 24 inches.

☑ Describe alternative application methods based on the following priority rating: (1) connection to a municipal/public sewer system, (2) connection to a conventional subsurface disposal system as regulated by the Division of Groundwater Protection, and/or (3) land application.

Permit Number: SOP-_________

For Drip Dispersal Systems Only: Unless otherwise determined by the Department, sewage treatment effluent wells, i.e, large capacity treatment/drip dispersal systems after approval of the SOP Application, will be issued an UIC tracking number and will be authorized as Permit by Rule per UIC Rule 0400-45-06-.14(2) and upon issue of a State Operating Permit and Sewage System Construction Approval by the Department. Describe the following:	☐ N/A

The area of review (AOR) for each Drip Dispersal System shall, unless otherwise specified by the Department, consist of the area lying within a one mile radius or an area defined by using calculations under 0400-45-06-.09 of the Drip Dispersal System site or facility, and shall include, but not be limited to general surface geographic features, general subsurface geology, and general demographic and cultural features within the area. Attach to this part of the application a general characterization of the AOR, including the following: (This can be in narrative form)

☑ A general description of all past and present groundwater uses as well as the general groundwater flow direction and general water quality. See attached narrative.

☑ A general description of the population and cultural development within the AOR (i.e. agricultural, commercial, residential or mixed)

☑ Nature of injected fluid to include physical, chemical, biological or radiological characteristics.

☑ If groundwater is used for drinking water within the area of review, then identify and locate on a topographic map all groundwater withdrawal points within the AOR, which supply public or private drinking water systems. Or supply map showing general location of publicly supplied water for the area (this can be obtained from the water provider)

☑ If the proposed system is located within a wellhead protection area or source water protection area designated by Rule 0400-45-01-.34, show the boundary of the protection area on the facility site plan.

☑ Description of system, Volume of injected fluid in gallons per day based upon design flow, including any monitoring wells

☑ Nature and type of system, including installed dimensions of wells and construction materials

Pump and Haul:	☑ N/A

Reason system cannot be served by public sewer:

Distance to the nearest manhole where public sewer service is available:

When sewer service will be available:

Volume of holding tank: gal.

Tennessee licensed septage hauler (attach copy of agreement):

Facility accepting the septage (attach copy of acceptance letter):

Latitude and Longitude (in decimal degrees) of approved manhole for discharge of septage:

Describe methods to prevent and respond to any bypass of treatment or discharges (i.e., power failures, equipment failures, heavy rains, etc.):

Holding Ponds (for non-domestic wastewater only):	☑ N/A
Pond use: ☐ Recirculation ☐ Sedimentation ☐ Cooling ☐ Other (describe):	
Describe pond use and operation:	
If the pond(s) are existing pond(s), what was the previous use?	
Have you prepared a plan to dispose of rainfall in excess of evaporation? ☐ Yes ☐ No	
If so, describe disposal plan:	
Is the pond ever dewatered? ☐ Yes ☐ No	
If so, describe the purpose for dewatering and procedures for disposal of wastewater and/or sludge:	
Is(are) the pond(s) aerated? ☐ Yes ☐ No	
Volume of pond(s): gal. Dimensions:	
Is the pond lined (Note if this is a new pond system it must be lined for SOP coverage. Otherwise, you must apply for an Underground Injection Control permit.)? ☐ Yes ☐ No	
Describe the liner material (if soil liner is used give the compaction specifications):	
Is there an emergency overflow structure? ☐ Yes ☐ No	
If so, provide a design drawing of structure.	
Are monitoring wells or lysimeters installed near or around the pond(s)? ☐ Yes ☐ No	
If so, provide location information and describe monitoring protocols (attach additional sheets as necessary):	

Permit Number: SOP-_________

Mobile Wash Operations: ☑ N/A

☐ Individual Operator ☐ Fleet Operation Operator

Indicate the type of equipment, vehicle, or structure to be washed during normal operations (check all that apply):

☐ Cars

☐ Trucks

☐ Trailers (Interior washing of dump-trailers, or tanks, is prohibited.)

☐ Other (describe):

☐ Parking Lot(s): sq. ft.

☐ Windows: sq. ft.

☐ Structures (describe):

Wash operations take place at (check all that apply):

☐ Car sales lot(s)

☐ Private industry lot(s)

☐ County(ies), list:

☐ Public parking lot(s)

☐ Private property(ies)

☐ Statewide

Wash equipment description:

☐ Truck mounted

☐ Rinse tank size(s) (gal.):

☐ Collection tank size(s) (gal.):

☐ Trailer mounted

☐ Mixed tanks size(s) (gal.):

Number of tanks per vehicle:

Pressure washer: psi (rated) gpm (rated)

☐ gas powered ☐ electric

Vacuum system manufacturer/model: Vacuum system capacity: inches Hg

Describe any other method or system used to contain and collect wastewater:

List the public sewer system where you are permitted or have written permission to discharge waste wash water (include a copy of the permit or permission letter):

Are chemicals pre-mixed, prior to arriving at wash location? ☐ Yes ☐ No

Describe all soaps, detergents, or other chemicals used in the wash operation (attach additional sheets as necessary):

Chemical name:	Manufacturer:	Primary CAS No. or Product No.

APPLICATION FOR A STATE OPERATION PERMIT (SOP)
INSTRUCTIONS

Purpose of this form A completed SOP application must be submitted to obtain SOP coverage. This permit is required to operate a sewage, industrial waste or other waste collection and/or treatment system that does not have a point source discharge to any surface or subsurface waters. This form must be submitted at least 180 days before starting any new activity, before an existing permit expires, or when renewing a permit.

Complete the form Type or print clearly, using black or blue ink; not markers or pencil. Answer each item or enter "N/A," for not applicable. If you need additional space, attach a separate piece of paper to the SOP application. Applicants may be required to submit engineering reports, plans and specifications. Contact the division for the applicable items, or refer to Appendix 1-D of the state Design Criteria for Sewage Works for more information. **The application will be considered incomplete without supplying all of the required information, Engineering Reports, and an original signature.**

Permittee Identification/Facility Identification Describe and locate the project, use the legal or official name of the facility or site. Provide the latitude and longitude (expressed in decimal degrees) of the center of the site, which can be located on USGS quadrangle maps. The quadrangle maps can be obtained at 1-800-USA-MAPS, or at the Census Bureau world wide web site: http://www.census.gov/cgi-bin/gazetteer. Attach a copy of a portion of a 7.5 minute quad map, showing location of site, with boundaries at least one mile outside the site boundaries. If business is mobile give the owner of operations' home, or business office address, and list all current areas of operation by city and county.

Wastewater Collection System These types of systems require engineering reports, refer to Appendix 1-D of the state Design Criteria for Sewage Works for more information.

Land Application Treatment System These types of systems require engineering reports, refer to Appendix 1-D of the state Design Criteria for Sewage Works for more information. Public access to the treatment area must be restricted, if disinfection is not part of the treatment. Applicants completing this section of the application must also complete the Wastewater Collection System section.

Pump and Haul These types of systems may require engineering reports, refer to Appendix 1-D of the state Design Criteria for Sewage Works for more information.

Holding Ponds Given that annual rainfall onto open ponds exceeds annual evaporation (in Tennessee), the permittee must develop a written plan (to be retained on site and be available to the division upon request) that addresses how excess rainfall will be disposed of in compliance with the no discharge requirement of this permit. Treatment ponds are not to be used for stormwater treatment or storage. All new and existing point source industrial stormwater discharges associated with industrial activity require coverage under the

Tennessee industrial stormwater multi-sector general permit TMSP, refer to the website for more information. Describe the system for re-routing surface runoff away from ponds in the rainfall disposal plan.

Mobile Wash Operations Indicate whether the operation is run by an individual or a corporation with a fleet of vehicles equipped to wash and collect waste waters. If a corporation, indicate the home office as the “Official Contact”. Indicate if operations take place at specific sites and list those counties that apply. Note that this permit covers operations for all of Tennessee. Operations indicated as "statewide" generally apply as a fleet type operation and each office location shall be individually permitted. Equipment may be truck or trailer-mounted, or both, indicate all that applies. Soaps, detergents, and other chemicals used should be non-toxic and biodegradable. All “chemically enhanced” (soaps, detergents, and other chemicals) waste-wash waters must be collected for proper disposal. If no chemically enhanced washwaters are used, clear-wash waters may travel by sheet flow to a gravel or grassy area where there is no opportunity to enter waters of the state. There should be no discharge to a storm water inlet, ditch, conveyance, stream, etc. If you are unsure of your wash area drainage, contact the area Environmental Field Office (EFO) prior to setting up your wash operation.

Fees Refer to the TDEC-DWR Environmental Protection Fund Fee Rule 0400-40-11-.02. Links to publications are available on Department of Environment and Conservation, Division of Water Resources webpage and the webpage for the Tennessee Secretary of State.

Submitting the form and obtaining more information Note that this form must be signed by the chief executive officer, owner, or highest ranking elected official. For more information, contact your local EFO at the toll-free number 1-888-891-8332 (TDEC). Submit a complete application electronically to water.permits@tn.gov (preferred) or to the appropriate EFO for the county(ies) where the facility is located, addressed to **Attention: DWR, Permit Section.** Please keep a copy for your records.

EFO	**Street Address**	**Zip Code**	**EFO**	**Street Address**	**Zip Code**
Memphis	8383 Wolf Lake Drive, Bartlett	38133	Cookeville	1221 South Willow Ave.	38506
Jackson	1625 Hollywood Dr	38305-4316	Chattanooga	1301 Riverfront Parkway Suite 206	37402
Nashville	711 R S Gass Boulevard	37243	Knoxville	3711 Middlebrook Pike	37921
Columbia	1421 Hampshire Pike	38401	Johnson City	2305 Silverdale Road	37601

Upon receipt of the required items, the division conducts a review of the material, and the applicant is notified of any deficiencies. When all the deficiencies have been corrected, the division makes a determination of whether to publish a draft permit. When a draft permit is generated, a public notice is issued and published in a local newspaper. The draft permit is then reviewed by the applicant, and division field staff. The general public also has an opportunity to review the permit. Based on public response, a public hearing may be held. After considering public comments and a final review, the permit may be issued. The entire process normally takes from five (5) to nine (9) months. Permits are normally valid for five (5) years, except those for pump and haul systems, which are generally valid for one (1) year.

The division has the right to inspect a facility when deemed necessary. In addition, the division has the right to revoke or suspend any permit for violation of permit conditions or any other provisions of the Tennessee Water Quality Control Act and other water pollution control rules.

The division is responsible for regulating any activity, which involves a potential discharge in order to protect waters of the State from pollution and to maintain the highest possible standards in water quality.

CIVIL
INFRASTRUCTURE
ASSOCIATES

307 Hickerson Drive
Murfreesboro, TN 37129
tel 615.663.7678
www.cia-engineers.com

August 25, 2020

State Operation Permit Revision (SOP) Application
Superior Wastewater Systems / formerly Kings Chapel Capacity
Williamson County, Tennessee

Sanitary Sewer Collection System: STEG System
Treatment: Existing RSF with Orenco Ax-Max pod additions
Disposal: Drip field for soil treatment.

Appendix 5 – Narrative Responses to SOP Questions:

Q: Reasoning for Alternative Application Methods:
A: Municipal sewer service unavailable, lot density too high for conventional septic tanks; therefore, Ax-Max treatment system with drip dispersal chosen.

Q: Description of population and culture within AOR:
A: Light commercial along Murfreesboro Road, with large lot residential and current growth in the form of PUD type subdivisions, this area is currently zoned for the planned use.

Q: Nature of Injected Fluid:
A: Residential wastewater that exhibits average characteristics of: Total solids of 700 mg/l, BOD5 of 250 mg/L, Total Nitrogen of 40 mg/l, Ammonia of 25 mg/L, total phosphorous of 12 mg/L, Alkalinity of 100 mg/L.

Q: Identify and locate groundwater withdrawal points within AOR:
A: Shown on site plan in engineering report. Data pulled in 2008 and re-confirmed as accurate as per phone call to TDEC July 2020. No wellhead or source water protection areas within a 1 mile radius of drip dispersal areas.

Q: Volume of injected fluid:
A: 122 homes x 300 gallons per day each average daily flow.
122 x 300 = 36,600

Q: Nature and type of system, including dimensions and materials:
A: Existing RSF, New Orenco Ax-Max pod system, dimensions and construction materials shown on site plan in engineering report and further described within text of engineering report.

From: Liz Campbell [mailto:Liz.Campbell@tn.gov]
Sent: Tuesday, September 8, 2020 1:04 PM
To: Terry Law <tlaw@cia-engineers.com>
Subject: Kings Chapel SOP modification

Good Afternoon,

This email is to acknowledge a Sewage Works Construction Project plans submittal.
This email is a notification of receipt only and does not confirm or imply any decisions on the part of Division of Water Resources staff members.
These documents have been made available for the plans reviewer.
Correspondence received by TDEC becomes part of the public record.
This project has been assigned tracking number WPN20.0553 , please refer to this number in any future correspondence.

0400-40-11-.03 SCHEDULE FOR TIMELY ACTION
The Division shall complete its review of plan documents within 30 days of receipt, provided the plans contain sufficient information to make the necessary determinations.

Please consider saving a copy of this email for your records.

Liz Campbell | Administrative Service Assistant, Water-Based Systems
Division of Water Resources
William R. Snodgrass Tennessee Tower, 11th Floor
312 Rosa L. Parks Ave, Nashville, TN 37243
p. 615-532-1172
liz.campbell@tn.gov
tn.gov/environment

We accept and encourage electronic document submittals.
Please tell us how you think we're doing by completing this survey: TDEC Customer Satisfaction Survey

Superior Wastewater Systems Utility District (formerly Kings Chapel Capacity) DDR/DSIR Modification for WWTP System Upgrades

To serve future phases of Kings Chapel Subdivision

Williamson County, Tennessee

Engineering Report
for
Sanitary Sewer Collection (STEG System),
RSF & Orenco AdvanTex Treatment System,
and Drip Dispersal Disposal System

August 26, 2020

Report Created By:

CIVIL INFRASTRUCTURE ASSOCIATES

Civil Infrastructure Associates, LLC
307 Hickerson Drive
Murfreesboro TN 37129

Table of Contents

DDR

Appendices:

4. Scaled Drawing of Preliminary Site Plan
5. 2019 and 2020 MOR Flow Data for Existing RSF
6. 2019 and 2020 Quarterly TDEC Reports for Existing WWTP/RSF
7. AxMax Design Data
8. Cut sheets for Treatment System Components
9. Cost Estimates
10. Draft SOP
11. CCN Letter
12. DSIR
13. Water Availability letter

1. Summary of Existing DDR/DSIR Submittals for Kings Chapel Subdivision:

DDR #1 – Dated March 10, 2004

Titled: Arrington Meadows Subdivision

Summary: Construct RSF for 266 homes.

Design Flows: 266 EDU's at 300 gpd/home = 79,800 gpd

Clubhouse flow 1500 gpd

Total daily design flow 81,300 gpd

DDR #2 - Dated March 2008

Titled: Addition to Kings Chapel

Summary: Mirror existing RSF, and add additional drip fields to allow 234 homes in addition to the homes above.

Design Flows: 234 EDU's at 300 gpd/home = 70,200 gpd

DDR#3 - Dated July 2019

Titled: Superior Wastewater Systems Utility District DDR/DSIR Modification for WWTP System Upgrades

Summary: Rather than mirroring existing RSF, change treatment technology for future flows to Orenco Ax-Max technology, and expand WWTP and system capacity from 500 lots to 607 lots (possible by utilizing all soils tested in the 2008 DDR).

Currently approved DDR/DSIR lots for Kings Chapel Capacity:

DDR#1-2004	266
DDR#2-2008	234
DDR#3-2019	107
Total	607 lots

2. Summary of 2020 DDR/DSIR Modification Request:

The basis of this DDR/DSIR modification request is to add two additional soil disposal areas to the SWS Utility District WWTP system. The utility district has purchased a portion of two contingent properties; the Fox property, and the Roberts property as shown on the site plan in this report.

The table below also summarizes historical soils data:

DDR Year	Req Soils at 0.21 gpd/ft2	# of Homes
2004	8.72	266
2008	7.67	234
2019	3.74	107
Totals	20.13	607

Kings Chapel Total Lot Buildout in phases shown below:

Phase	# Lots	Kings Chapel Year Projected
1	48	
2	48	
3	38	
4	43	
5	28	
6	34	
7	37	
8	53	
9	0	2019
10	7	2019
11	31	2020
12	28	2020
13	32	2020
Future	22	2021
Total	449	

Excess Capacity soils available from property purchases in this DDR/DSIR Modification:

Additional Soil Mapping	Roberts Property sqft	Fox Property sqft
Total soils area mapped	137,500	309,756
Poorly Drained soils High Traffic/platy, Within 10 yr floodplain, Within 100 ft power easement Buffering drains.	Subtract 81,617	Subtract 14,233

Total soils available	55,883	295,523
Total soils available, both properties added together: 351,406 sq ft		

Existing Excess Capacity in 2008 DSIR Soils previously tested and approved for use:

2019 DSIR Modification Request: Although 958,835 ft2 of useable soils were identified by the soil scientist in the 2008 DDR, they were not used to calculate capacity in 2008 because they were not needed at that time. In the meantime, Williamson County Article 20 had been revised to allow 0.21 gpd/ft2 vs 0.20 gpd/ft2, (2013 ordinance modification). The above resulted in an available capacity for 107 additional lots based on soils information from the 2008 DDR which was updated and confirmed by a licensed soil scientist in 2019.

Additional Excess Capacity in terms of additional lot capacity in Treatment system for the newly added soil treatment properties:

Property	Available Soils Sq ft	50% Removal For 100% Reserve Sq ft	Sewer flow Available at 0.21 gpd/ft2 In gpd	Lot Availability At 300 gpd Per house
Fox Property	295,523	147,761.5	31,030	103
Roberts Property	55,883	27,941.5	5,867	19
Totals	351,406	175,703.00		***122***

3. Summary of Collection System and Treatment Upgrades/Additions:

Collection System: The collection system methodology (STEG with a few lift stations) has been working successfully for 15 years. One minor change has been the use and approval of 2-piece injection molded watertight septic tanks (Infiltrator IM-1530). All 2020 proposed collection system additions would be in accordance with the Utility Districts Standard Specifications currently on file with TDEC and would be located as shown on the attached site plan.

RSF: The existing recirculating sand filter would remain in place during proposed construction and continue to serve the homes currently plated. The proposed AX-Max treatment system will have the capacity to serve the lot additions requested (230), plus give the utility district some treatment duplicity, allowing for periodic scheduled maintenance for both the existing sand filter as well as the new Ax-Max system.

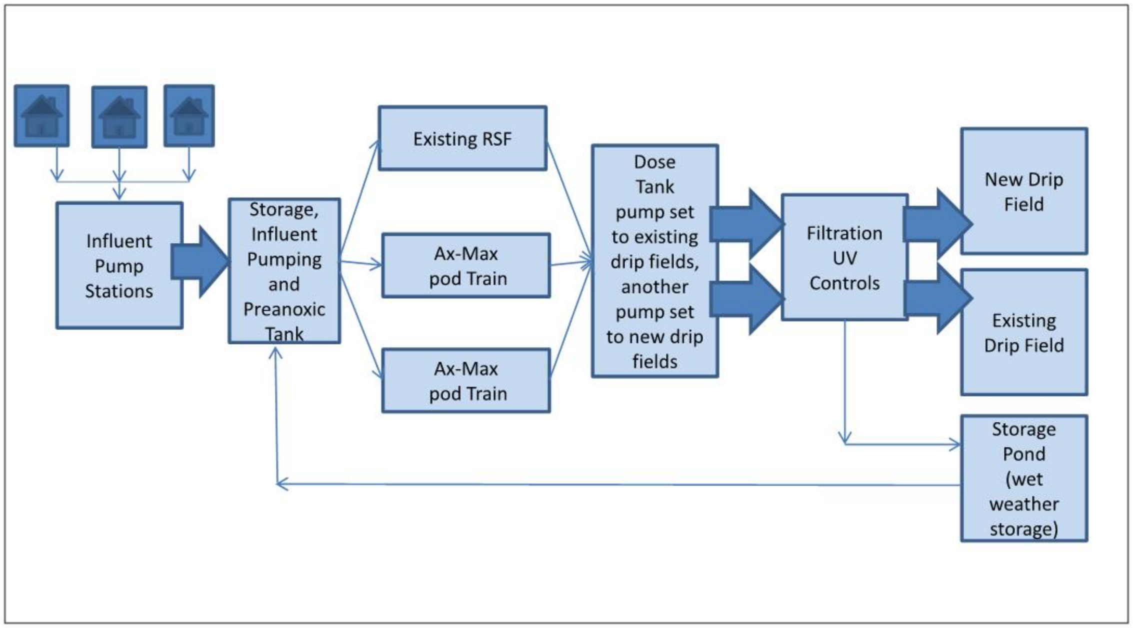
2020 AX-Max treatment system: The utility district has chosen this treatment system rather than the traditional RSF system for several reasons:

- Ease of maintenance (all components accessible and visible)
- Improvement of effluent quality (lowered ammonia and nitrogen)
- More capacity within a smaller footprint
- Ease of construction (containerized, fast, minimizes contractor error)
- Improved energy efficiency
- Simple to operate
- Excellent customer support

Upon completion of proposed lots, the controls for the treatment scheme would alternate dosing cycles between all the treatment trains; RSF, and Ax-Max pods. Since actual flows are about half of design flows, one of these treatment trains can be taken out of service periodically for needed maintenance with no reduction in treatment capacity and down time. See treatment scheme below.

Another copy of the 2008 DSIR Soils Map is included with this report to show the previously tested and approved area (Appendix 2).

Superior Wastewater Systems
Kings Chapel WWTP
Wastewater Treatment Process Schematic



Operationally, the controls would rotate the influent between all the treatment trains, and the effluent would rotate between the drip field zones collectively.

4. Recommended Buffer Distances for treatment, storage, and primary, reserve and auxiliary areas as given in Article 20, table 10.12-1 are adhered to.

5. Williamson County – Article 20 - DDR Required Information

A. Site Description

1. Location map – Appendix 1
2. Climate – Average data already given in 2004 and 2008 DDR's.
3. Geology – Updated for additional areas in DSIR
4. Topography – Appendix 3
5. Access – Shown in Appendix 4 Site Plan
6. Water Supply Wells within 1500 lf of Facility – 2008 DDR denotes that the closest well on record is 6000 lf from the treatment and disposal facilities.
7. CWTD Evaluations

If the RSF were to be replaced with an Ax-Max pod system at a later date, the smaller footprint would fit on the existing WWTP site and allow the potential for additional treatment capacity as well.

B. Scaled Drawing of Preliminary Site Layout:
Attached as Appendix 4.
Special Note: All proposed treatment facilities are out of the 100-year floodplain.

C. Design Wastewater Characteristics

Recorded flow data from July 2015 through June 2020 is included in Appendix 5.

	In to Septic Tank	In to RSF	Out to Drip Field
BOD	200-300 mg/l	120-150 mg/l	<5 mg/l
TSS		80-120 mg/l	<5 mg/l
Ammonia Nitrogen TKN Nitrate Nitrite		Am Nitrogen 30-50 mg/l Tot Nitrogen 40 to 60 mg/l	Ammonia < 2 mg/l Nitrate <15 mg/l Nitrite < 1 mg/l TKN <20 mg/l
Total Phosphorus		4 mg/l	<2 mg/l
Chloride		30 mg/l	<10 mg/l
Sodium Adsorption Ratio		n/a	10
Electrical Conductivity		n/a	2 ds/m
Metals/Priority Pollutants		<10mg/l	<10 mg/l

D. Water balance – given in previous DDRs. The soil loading rate used is 0.21 gpd/ft2 as per TDEC guidelines for the soils given in the 2008 DSIR and this 2020 DSIR for the included properties.

E. Nitrogen Balance – Cover crop will be fescue and existing grasses. As given in previous DDR's 0.21 gpd/ft2 is conservative for this site. Grass will be mowed when it exceeds 24 inches in height.

F. Background groundwater samples – as per previous DDR Data, and an updated check (Appendix 10) – no wells are on site, but sampling indicates expected values would be – Fecal Coliform 0/100 mg/l and Nitrate as N – 0.06 mg/l

G. Phosphorus and other constituent loading rates.
Typical for residential domestic waste – 7 mg/l

H. Determination of wetted field areas and required storage volume.

Wetted Field Area Required:

The total area required for drip irrigation for the 4-bedroom, 122 lot excess capacity request:
Average daily flow (300 gpd/home) – 122 x 300 = 36,600 gallons per day
Wetted Field Area Required: 36,600 gpd / 0.21 gpd/ft2 = 174,285.7sq ft or 87,142.85 ft2 for primary and a duplicate of that same area for reserve.

Emergency Storage Pond:

Williamson County requires the Treatment System provide the ability to store wastewater that would normally be applied to the field areas during winter periods of potentially frozen soils. That would be 11 days in December, 21 days in January, and 9 days in February, totaling 41 days of average daily flow storage needed. In addition to that flow, storage of the 22 inches of average rainfall is also required in that pond. To accommodate the increased average daily flow, the pond size has been increased as shown on the site plan. The total volume of the pond is calculated below:

Lots: 607(2017 DDR)+122(2020 DDR) = 729 lots
(41 days x 729 lots x 300gpd)+1500 gall = 8,968,200 gallons
Plus 22 inches of surface depth for rainfall.
The existing pond volume has been increased to hold this amount as shown by the grading on the preliminary site plan.

Clay was found on site for the lining of the previous pond, if not found, owner will truck in. Clay must meet the following criteria:

- Clay content – 40-70%
- Permeability – 10(-7) to 10(-6) cm/sec
- Plasticitly – 21 index
- Consistency - medium stiff to stiff

I. Process Design

Treatment:

AX-Max tank, media, and piping are pre-assembled and shipped to the site. The pre-engineered treatment system treats 15,000 gpd per pod. The proposed lot additions for the Ax-Max additions total: (234 + 107+ 122 lots). 463 lots x 300 gpd/lot = 138,900 gpd of additional treatment capacity needed. The process schematic shows parallel treatment schemes:

1. Existing RSF – 81,300 gpd

2. Proposed AX-Max additions – 10 pods at 15,000 gpd/ea =150,000 gpd.

The above processes (RSF+AxMax) total 231,300 gpd of provided treatment capacity. Since actual flows are approximately half of the design flow, the utility will be able to schedule service as needed on any of the treatment trains. For additional ORENCO design experience, specifications, and system information, please see Appendix 7.

Pump curves and hydraulic calculations for both the collection system pump stations and the drip field dosing system are given in appendices 8, as well as several other system components cut sheets. STEG piping will be sized, specified and installed as per the Utility District Standard Specifications on file with TDEC.

The design life of treatment and disposal system when well-maintained will be 50+ years.

Treatment System Storage

Tennessee Department of Environment and Conservation (TDEC) requires 24 hours of treatment storage volume for drip dispersal. The calculations below show the required storage based on the number of residences and daily projected flow as well as the provided storage within the different treatment system tanks.

Required Storage is 24 hours of average daily flow:

463 lots x 300 gpd =	138,900 gpd
Clubhouse	1500 gpd
Total average daily flow:	140,400 gpd
Total Required storage:	140,400 gpd

Storage provided:

4 pod AX-Max train	29,056 gallons
Second 4 pod train	29,056 gallons
Third 2 pod train	14,528 gallons
Preanoxic tank	35,000 gallons
Dosing tank	35,000 gallons
Total provided storage:	142,640 gallons

142,640 > 140,400, therefore TDEC requirement made.

Dosing Tank, Lab Building, Disc Filter, UV Disinfection, Controls

A pipe exiting the outlet riser of the 20% compartment within the sand filter will be gradually sloped to direct water to the dosing tank. The outlets from each Ax-Max treatment train will also be directed to the dosing tank. From the dosing tank, the water is pumped to the disc filter and UV disinfection equipment. After disinfection the treated effluent is directed to the drip field. To prevent biological growth from clogging the lab equipment and drip field lines, flush lines are routed from the lab building and drip field distribution zones back to the dosing tank.

Building: An existing concrete block building (12’ x 9’ interior dimensions) is located near the dosing tank and will house the treatment system control panels, drip field control panels, disc filter, and UV disinfection equipment. The building will have ventilation, interior lighting and an emergency generator hookup.

Filter: Flow from the dosing tank is directed to the disc filter to remove suspended solids. The disc filters are to be a cylindrical and consist of flat, grooved polypropylene rings with a hole in the center. The filter is to be made of reinforced polyamide with a drain valve located at the bottom. The minimum working and backflow pressures for the filter are to be 140 psi and 50 psi respectively. The filtered water from the disc filter is directed to the UV disinfection equipment.

Disinfection: Wastewater effluent prior to subsurface discharge will undergo UV disinfection. Within the lab building the water is disinfected by the UV light to neutralize microorganisms without impacting the chemical composition or the dissolved oxygen content of the water as it passes through to the drip distribution system. Each chamber is to be completely self-contained including a lamp, quartz jacket, ballast, and wiper system.

Controls: Influent dosing pump controls and drip field dosing pump controls will all have to be coordinated. TDEC required alarms and communication devices will be in final designs.

Dosing Tank Pumps

Bioline drip lines require 1.6 gpm per distal end to properly flush the emitters.
The industry standard of 30 psi, or 69.3 feet will govern doing tank pump size.

Total flushing flow rate and TDH calculations:

Total flow rate = Flow(dose) + Flow(flush) = 23.88 + 73.6 = 97.48 or 98 gpm

This is preliminary sizing and will be double checked with final zone design prior to TDEC submittal.

Total flush flow TDH = 6 + 0.84+11.84+11+2.4+69.3 = 100.5 feet

Longest run FM is 8937 lf, head loss:	5 feet
Head loss In manifold piping:	0.84 feet
Head loss in drip field supply line:	11.84 feet
Lift to Distribution Point:	11 feet out of tank
Discharge assembly head losses:	2.4 feet
Bioline assembly head losses:	69.3 feet

In order to adequate dose and flush the Bioline drip line, each pump must produce:
98 gpm @ 100 TDH
Cut sheets for Orenco pumps are included in Appendix 8.

Drip Field Zones and Valves

According to Chapter 17 of the TDEC manual, it is desirable to have a minimum depth of 20” of undisturbed soil above a restrictive horizon in order to provide adequate installation depth and buffer below the drip lines. Drip lines are to be buried 8-10” below the soil surface with a 12” minimum buffer below before reaching the restrictive horizon. The lines transporting the water from the dosing tank throughout the drip field system are to be buried 18” below grade. The drip field is to be separated into zones. Upstream of each zone is a Solenoid valve. The drip field distribution zones are to operate one at a time as signaled by the control panel. The Solenoid valve located upstream of the operating zone is to direct the flow to the distribution lines while the other Solenoid valves are closed. Downstream of each zone is a check valve to allow for an open circuit connecting back to the dosing tank. As mentioned previously, open circuits prevent clogging and allow biological growth to be flushed through the drip field distribution lines.

Emitter Sizing and Spacing

To evenly distribute and maximize the utilization of the on-site soil, 1.25” drip lines are to be spaced at 4 feet intervals (on contour) with emitters spacing every 2 feet. The maximum length of a drip line is 400 feet. Emitters are to be capable of delivering 0.61 gal/hr. The drip emitters are to be root resistant and pressure compensating. Drip lines are to operate at a minimum 20 psi and maximum 60 psi.

The proposed drip field is to have horse farm fencing along the perimeter and will contain grass which will be mowed regularly.

J. DSIR – Utilizing 2008 DSIR Information, as well as 2020 DSIR information.

K. Reserve Soil Sites – Shown on site plan in appendix 4.

L. Cost Estimates – Separated into Collection and Treatment Components and included as appendix 9.

M. Auxiliary Soil Sites – 2 new soil treatment areas have been purchased by the owner and are shown on the site plan.

N. Phasing of treatment system construction – None planned.

O. Reference Materials – TDEC Design Guidelines, Williamson County Zoning Ordinance Article 20: Nontraditional Wastewater Treatment and Disposal Systems.

P. Detailed Specifications

Cut sheets for individual pieces of equipment are included as Appendix 8

LONNIE NORROD SOIL CONSULTING, LLC.

Kings Chapel S/D DSIR

2193 Osburn Rd. and 4860 Murfreesboro Rd. (Williamson County, TN tax map #109, parcels #4.07 and 23)

8-3-2020

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

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

CIA – Civil Infrastructure Associates

MCS – Mid Cumberland Soils (Jay Andrews/Soil Scientist)

Detailed Soil Investigation Report

INTRODUCTION:

The Following is a Detailed Soil Investigation Report (DSIR) prepared by Lonnie Norrod Soil Consulting (LNSC) for Kings Chapel S/D. This report was done at the Fox Family Farms property at 2193 Osburn Rd and the Roberts property at 4860 Murfreesboro Rd. in Arrington, 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. Jay Andrews of MCS.   The soil pedon descriptions were done by Mr. Terry Henry of TDEC and Mr. Jay Andrews of MCS. Hydraulic conductivity testing, research data collection, and soil sample collection was performed by LNSC. 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.

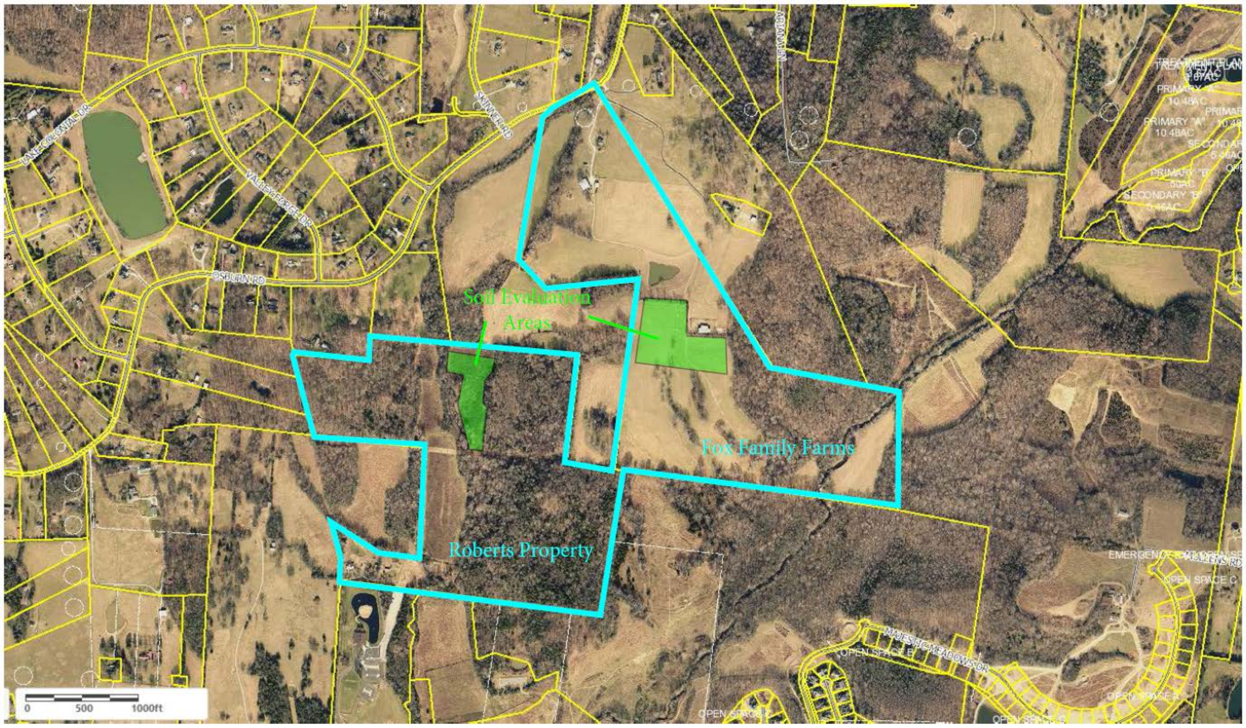
DETAILED SOIL INVESTIGATION REPORT

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:

-See Appendix 1.2 for the soil maps prepared by MCS.

-The Topographic Map will be provided by CIA 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 MCS at appropriate intervals in order to create the Water Resources 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. 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.

- Twenty pits were excavated and soil pedon descriptions were performed at these locations by Mr. Terry Henry of TDEC and Jay Andrews of MCS. 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.

-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

3.0 Soil Characteristics (each soil series present)

3.1 Hand auger, test pits and soil boring logs:

--Hand auger holes were bored by MCSH 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 structured clay 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 "Hampshire 20+", the "Marsh 20+", the "Marsh-Maury 20+" and the "Marsh-Sandhill 20+" units. The soil map unit labeled "Poorly-Somewhat Poorly Drained Wet Soils Complex" has a seasonably high water table that is less than 20" from the soil surface which makes it unsuitable for drip dispersal. The soil map unit labeled "High Traffic area" has a layer with platy structure in the upper 20" due to compaction which makes it unsuitable for drip dispersal at this time.

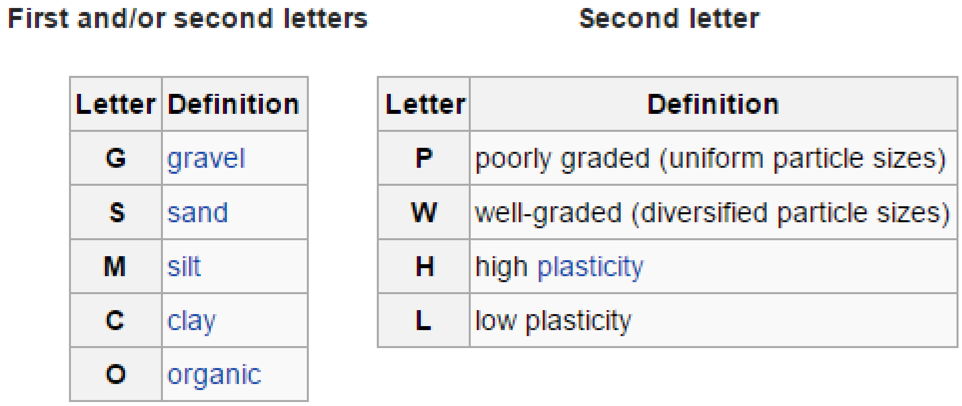
-Twenty pits were excavated and Soil Pedon descriptions were performed at numerous locations which are numbered and marked on the soil map displayed in Appendix 1.2.

3.2 Unified Soil Classification (USC): This data is compiled from NRCS Web Soil Surveys

Soil Series:	Depth in inches:	Unified Soil Classification
Hampshire	0-10 10-30 30-49	CL-ML, CL, ML CL, CH, MH CL, GC, SC, GM
Marsh	0-3 3-19 19-23	CL, CL-ML, ML CL, CL-ML, ML CL, GC, GM, ML
Maury	0-7 7-24 24-48 48-65	CL, CL-ML ML, CL CL, MH, CH MH,CH,CL
Wolftever	0-7 7-16 16-65 65-79	CL, CL-ML, ML ML, CL MH, ML CL-ML, 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:

-Seventeen saturated hydraulic conductivity tests were performed and recorded. One of the test holes flooded after a heavy rainfall event and is not included in the final results. 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" to "moderate" hydraulic conductivity classes as designated by the following chart from the NRCS Web Soil Survey except for two that fell in the "moderately rapid" class and one that fell in the "very slow" class.

Saturated Hydraulic Conductivity

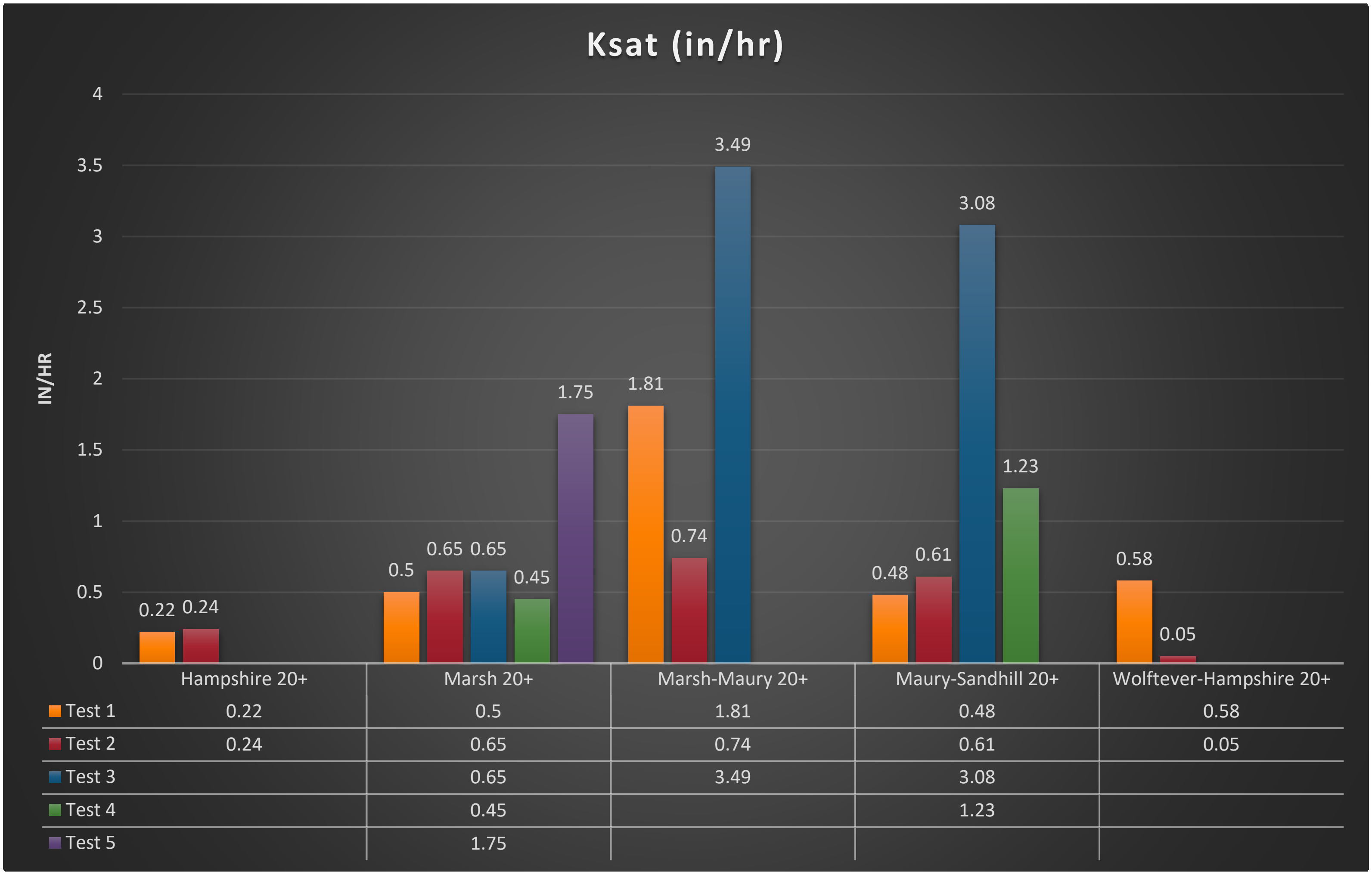
Saturated Hydraulic Conductivity in Relation to Soil Texture

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/*](http://websoilsurvey.nrcs.usda.gov/)



	Hampshire 20+	Marsh 20+	Marsh-Maury 20+	Maury-Sandhill 20+	Wolftever-Hampshire 20+
Test 1	0.22	0.5	1.81	0.48	0.58
Test 2	0.24	0.65	0.74	0.61	0.05
Test 3		0.65	3.49	3.08	
Test 4		0.45		1.23	
Test 5		1.75			

-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 should be benchmarked as they are encountered during the construction process and should 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 should be hauled in to the site or a PVC liner should 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, the rock layer in the units with “Marsh” in the label and a seasonal high water table in the “Poorly-Somewhat Poorly Drained Wet Soils Complex”. There was no weak structured or sturctureless clay horizon, rock horizon or seasonal high water table 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 should be a minimum buffer of 12” from the drip lines to the clay, rock horizon or seasonal high water table 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”. The soil map units labeled “Poorly-Somewhat Poorly Drained Wet Soils Complex” and “High Traffic area (platy structure) 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)**
Hampshire 20+	0.22, 0.42
Marsh 20+	0.50, 0.65 0.65 0.45 1.75
Marsh-Maury 20+	1.81, 0.74, 3.49
Marsh-Sandhill 20+	0.48, 0.61, 3.08, 1.23
Wolftever-Hampshire 20+	0.58, .05, flooded
Overall Average:	**1.04 in/hr**

APPENDIX 1.2

EXTRA-HIGH INTENSITY SOIL MAP

SURVEYOR'S CERTIFICATE:

THIS SOIL GRID MAP AND THE FIELD WORK UPON WHICH IT IS BASED WAS PREPARED IN ACCORDANCE WITH 0400-48-01-.03 OF THE REGULATIONS TO GOVERN SUBSURFACE SEWAGE DISPOSAL SYSTEMS PUBLISHED BY THE TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION.

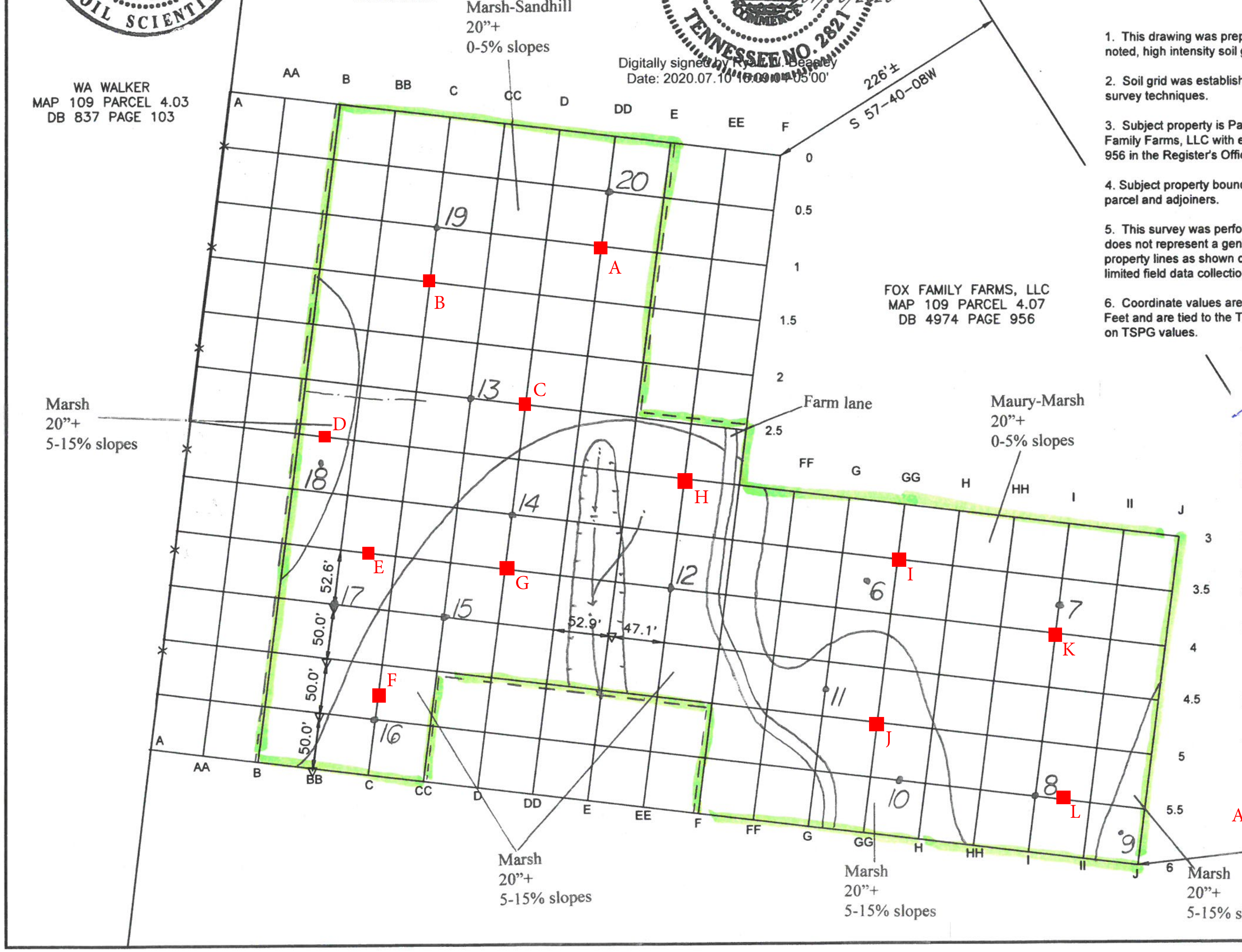
RYAN W. BEASLEY

TN RLS #2821

RYAN W. BEASLEY No. 2821 07/10/2020

Digitally signed by Ryan W. Beasley
Date: 2020.07.10 16:09:04 -05'00'

JAY C. ANDREWS LIC. #42 6-5-20



GRAPHIC SCALE

100 0 50 100 200

(IN FEET)
1 inch = 100 ft.

1. This drawing was prepared to illustrate the location of a 50'x 50',unless otherwise noted, high intensity soil grid as staked in the field for soil analysis.

2. Soil grid was established on the ground with dual frequency base & rover RTK GPS survey techniques.

3. Subject property is Parcel 4.07 on Williamson County Tax Map 109. Owner is Fox Family Farms, LLC with express rights of ownership as referenced in Book 4974, Page 956 in the Register's Office of Rutherford County, Tennessee.

4. Subject property boundary information was derived from recorded deeds for this parcel and adjoiners.

5. This survey was performed under the authority of TCA 62-18-126 This drawing does not represent a general property survey as defined by rule 0820-3-07. The property lines as shown on this drawing were reconstructed from record deeds and limited field data collection and are for reference only.

6. Coordinate values are Tennessee State Plane Grid (TSPG), NAD 83, US Survey Feet and are tied to the Tennessee Geodetic Reference Network. Bearings are based on TSPG values.

Water Resources Soils Map Completed by:

Jay Andrews
Soil Scientist
License # 42
6-5-20

"I, Jay Andrews affirm that this Water Resources Soils Map has been prepared in accordance with accepted standards of soil science practice and the standards and methodologies established in the Soil Survey Manual and USDA Soil Taxonomy. No other warranties are made or implied."

Legend:

- 🟩 - End of evaluation
- - Drain, path of run-off
- - Drain, up to 1' in depth

■ -LOCATION OF KSAT TEST

CHAPEL NORTH SOIL GRID

2193 OSBURN ROAD
TAX MAP 109 PARCEL 4.07
ARRINGTON, WILLIAMSON CO., TN

ORIG ISSUE DATE: 7/09/20

REVISIONS: NO. / DATE / DESC.

CIVIL INFRASTRUCTURE ASSOCIATES

307 HICKERSON DRIVE
MURFREESBORO, TN 37129
www.cia-engineers.com

HIGH INTENSITY SOIL GRID

SG 1.0

SHEET NO. 1 OF 1

LEGEND

————	PROPERTY LINE
—— X ——	FENCE LINE
—— OE ——	OVERHEAD UTILITY LINE
—— G ——	NATURAL GAS LINE

1. This drawing was prepared to illustrate the location of a 50'x 50' extra high intensity soil grid as staked in the field for soil analysis.

2. Soil grid was established on the ground with dual frequency base & rover RTK GPS survey techniques.

3. Subject property is Parcel 23.00 on Williamson County Tax Map 109. Current owner is George M. Roberts with express rights of ownership as referenced in Book 1536 Page 388 in the Register's Office of Williamson County, Tennessee.

4. Subject property boundary information was derived from recorded deeds for this parcel and adjoiners.

5. This survey was performed under the authority of TCA 62-18-126 This drawing does not represent a general property survey as defined by rule 0820-3-07. The property lines as shown on this drawing were reconstructed from record deeds and limited field data collection and are for reference only.

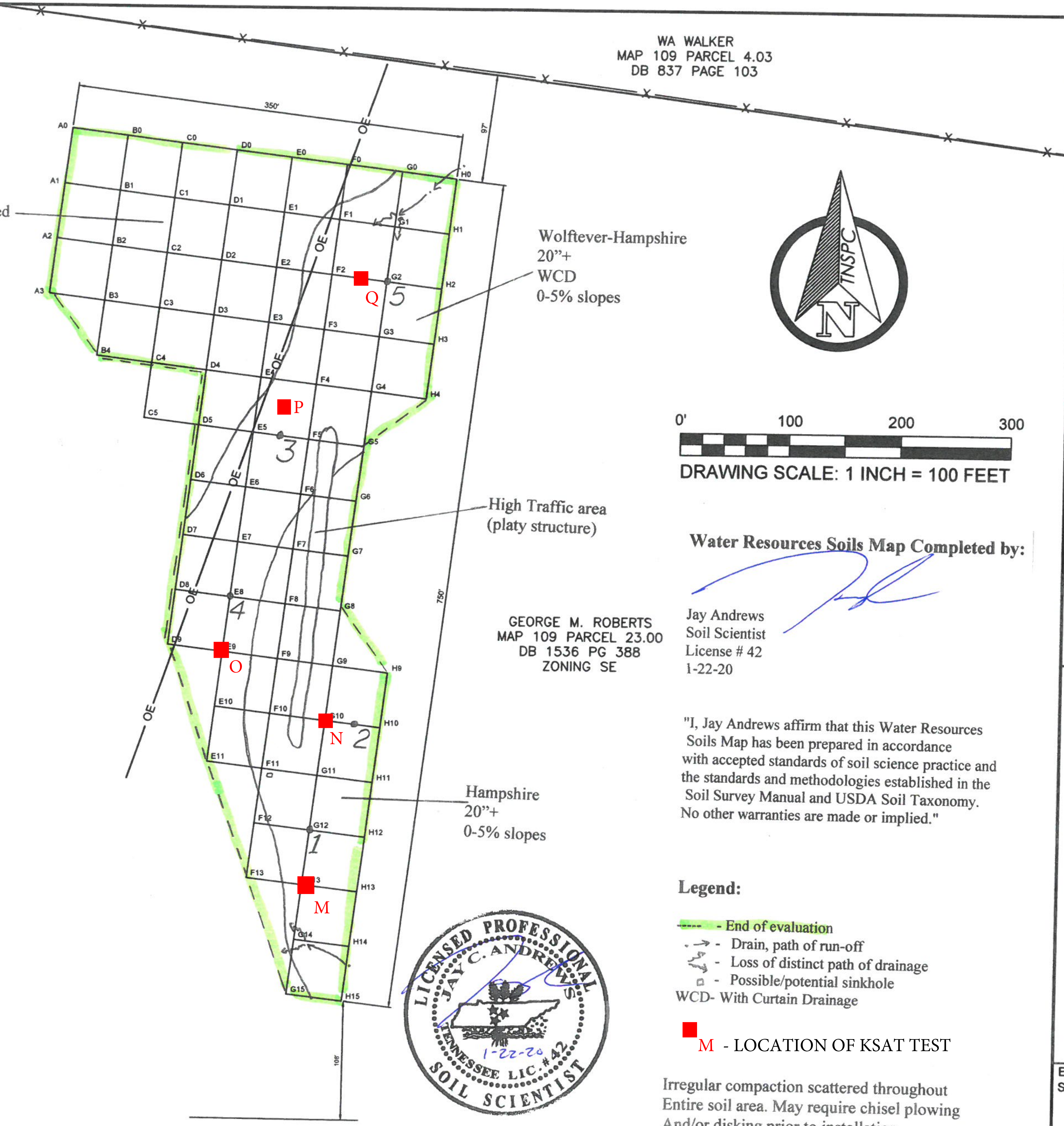
6. Coordinate values are Tennessee State Plane Grid (TSPG), NAD 83, US Survey Feet and are tied to the Tennessee Geodetic Reference Network. Bearings are based on TSPG values.

SURVEYOR'S CERTIFICATE:

THIS SOIL GRID MAP AND THE FIELD WORK UPON WHICH IT IS BASED WAS PREPARED IN ACCORDANCE WITH 0400-48-01-.03 OF THE REGULATIONS TO GOVERN SUBSURFACE SEWAGE DISPOSAL SYSTEMS PUBLISHED BY THE TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION.

RYAN W. BEASLEY

TN RLS #2821



DRAWING SCALE: 1 INCH = 100 FEET

Water Resources Soils Map Completed by:

Jay Andrews
Soil Scientist
License # 42
1-22-20

"I, Jay Andrews affirm that this Water Resources Soils Map has been prepared in accordance with accepted standards of soil science practice and the standards and methodologies established in the Soil Survey Manual and USDA Soil Taxonomy. No other warranties are made or implied."

JAY C. ANDREWS
LIC. #42
1-22-20

Legend:

- ---- - End of evaluation
- ‐→ - Drain, path of run-off
- ⤳ - Loss of distinct path of drainage
- ◻ - Possible/potential sinkhole
- WCD- With Curtain Drainage

🟥 M - LOCATION OF KSAT TEST

Irregular compaction scattered throughout Entire soil area. May require chisel plowing And/or disking prior to installation.

ROBERTS PROPERTY SOIL GRID

4860 MURFREESBORO ROAD
TAX MAP 109 PARCEL 23.00
ARRINGTON, WILLIAMSON CO., TN

ORIG ISSUE DATE: 11/09/2018

REVISIONS: NO. / DATE / DESC.
REV:1 7/15/20 50 TO 100 SCALE.

CIVIL INFRASTRUCTURE ASSOCIATES
307 HICKERSON DRIVE
MURFREESBORO, TN 37129
www.cia-engineers.com

CHECKED BY: RWB
DRAWN BY: PDJ
CIA JOB NO.: 2020-04

EXTRA-HIGH INTENSITY SOIL GRID

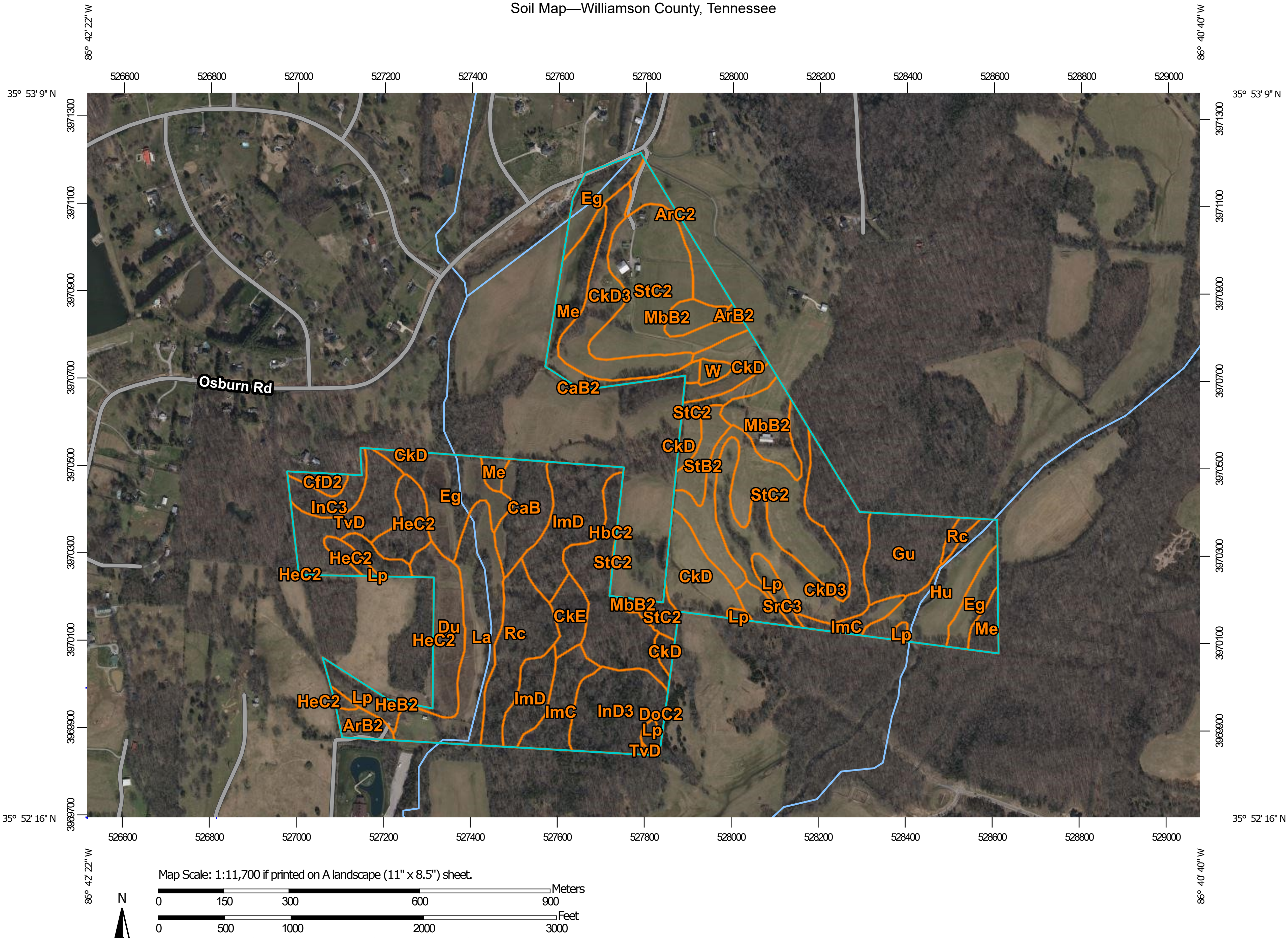
SG 1.0

SHEET NO. 1 OF 1

APPENDIX 1.3

NRCS SOIL SURVEY MAP

Soil Map—Williamson County, Tennessee



Map Scale: 1:11,700 if printed on A landscape (11" x 8.5") sheet.

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.

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 15, Jun 1, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 14, 2020—Mar 1, 2020

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	2.0	0.9%
ArC2	Armour silt loam, 5 to 12 percent slopes, eroded	3.8	1.7%
CaB	Captina silt loam, phosphatic, 2 to 5 percent slopes	5.8	2.6%
CaB2	Captina silt loam, phosphatic, 2 to 5 percent slopes, eroded	0.0	0.0%
CfD2	Culleoka flaggy loam, 12 to 20 percent slopes, eroded	1.1	0.5%
CkD	Culleoka silt loam, 12 to 20 percent slopes	10.4	4.6%
CkD3	Culleoka silt loam, 12 to 20 percent slopes, severely eroded	24.3	10.8%
CkE	Culleoka silt loam, 20 to 35 percent slopes	2.7	1.2%
DoC2	Donerail silt loam, concretionary, 5 to 12 percent slopes, eroded	0.2	0.1%
Du	Dunning silt loam, phosphatic	6.7	3.0%
Eg	Egam silt loam, phosphatic	14.6	6.5%
Gu	Gullied land	7.9	3.5%
HbC2	Hampshire silt loam, 5 to 12 percent slopes, eroded	10.2	4.5%
HeB2	Hampshire-colbert silt loams, 2 to 5 percent slopes, eroded	0.2	0.1%
HeC2	Hampshire-colbert silt loams, 5 to 12 percent lopes, eroded	5.0	2.2%
Hu	Huntington silt loam, phosphatic	7.9	3.5%
ImC	Inman flaggy silty clay loam, 5 to 12 percent slopes, eroded	6.3	2.8%
ImD	Inman flaggy silty clay loam, 12 to 20 percent slopes, eroded	12.2	5.4%
InC3	Inman silty clay loam, 5 to 12 percent slopes, severely eroded	2.8	1.2%
InD3	Inman silty clay loam, 12 to 20 percent slopes, severely eroded	8.6	3.8%
La	Lanton silt loam, phosphatic	12.7	5.6%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Lp	Lindell silt loam, 0 to 2 percent slopes, occasionally flooded	6.6	2.9%
MbB2	Maury silt loam, 2 to 5 percent slopes, eroded	7.6	3.4%
Me	Melvin silt loam, phosphatic	8.6	3.8%
Rc	Rockland	9.1	4.1%
SrC3	Stiversville clay loam, 5 to 12 percent slopes, severely eroded	1.6	0.7%
StB2	Stiversville silt loam, 2 to 5 percent slopes	2.8	1.3%
StC2	Stiversville silt loam, 5 to 12 percent slopes, eroded	34.8	15.4%
TvD	Talbott very rocky soils, 2 to 15 percent slopes	8.0	3.6%
W	Water	0.8	0.3%
Totals for Area of Interest		**225.2**	**100.0%**

APPENDIX 2.0

OFFICIAL SOIL DESCRIPTIONS

`LOCATION HAMPSHIRE          TN+KY`

Established Series
Rev. RPS
04/2001

HAMPSHIRE SERIES

The Hampshire series consists of deep, well drained, soils on uplands. These soils formed in clayey residuum of interbedded limestone and shale and the underlying residuum of interbedded siltstone, fine grained sandstone, shale and limestone. Slopes range from 2 to 30 percent.

TAXONOMIC CLASS: Fine, mixed, active, thermic Ultic Hapludalfs

TYPICAL PEDON: Hampshire silt loam--pasture. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 7 inches; brown (10YR 4/3) silt loam; moderate medium granular structure; friable; many grass roots; strongly acid; clear wavy boundary. (5 to 9 inches thick)

Bt1--7 to 12 inches; brown (7.5YR 4/4) silty clay loam; moderate medium and fine subangular blocky structure; firm; common faint clay films on faces of peds; many fine roots; few soft fragments of shale; strongly acid; clear wavy boundary. (3 to 7 inches thick)

Bt2--12 to 24 inches; strong brown (7.5YR 5/6) clay; moderate medium and fine subangular blocky structure; firm; many distinct clay films on faces of peds; few small soft and hard fragments of shale and limestone most of which are coated with clay films; few roots; strongly acid; gradual wavy boundary. (8 to 15 inches thick)

Bt3--24 to 30 inches; strong brown (7.5YR 5/6) clay; moderate medium and fine subangular blocky structure; firm; many distinct clay films on faces of peds; few soft and hard fragments of shale and limestone; few fine roots; strongly acid; clear wavy boundary. (Combined thickness of the Bt horizon ranges from 25 to 45 inches)

2Bt4--30 to 40 inches; strong brown (7.5YR 5/6) clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; 15 percent by volume of soft fragments of sandstone and siltstone and a few hard fragments of limestone; few roots; strongly acid; clear wavy boundary. (0 to 10 inches thick)

2C--40 to 47 inches; strong brown (7.5YR 5/6) very channery loam; massive; friable; 60 percent soft and hard, flat fragments of sandstone, siltstone and limestone up to 10 inches across strongly acid; clear smooth boundary. (0 to 12 inches thick)

2Cr--47 to 60 inches; interbedded sandstone, siltstone and limestone. Weathered bedrock that is rippable and can be dug with a spade except for some hard strata.

TYPE LOCATION: Dekalb County, Tennessee; 1 mile southeast of Alexandria, in northwest corner of Lawrence farm.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 30 to 50 inches and depth to bedrock ranges from 40 to 60 inches. Fragments of rock range from 0 to 15 percent in the A and Bt horizons, 10 to 50 percent in the BC and C horizons where present, 5 to 20 percent in the 2Bt horizon, and 25 to 75 percent in the 2C horizon. Reaction ranges from medium acid to very strongly acid. Phosphate content is medium or high.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. The chroma of 6 is in severely eroded areas. It is dominantly silt loam, but ranges to silty clay loam in severely eroded areas.

Some pedons have a transitional horizon between the A and Bt horizons.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. Some pedons are mottled with shades of brown and yellow in the middle and lower parts. It is clay, silty clay, silty clay loam or clay loam. Clay content of the control section is dominantly 40 to 45 percent, but ranges from 35 to 55 percent.

A lithologic discontinuity is not a requirement of the series. Where present, the BC and C horizons have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. The fine earth texture ranges from loam to clay.

The 2Bt horizon has the same colors as the Bt horizon. The fine texture is clay loam, silty clay loam or clay.

The 2C horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. Mottles are in shades of brown, yellow, and gray. The fine earth fraction is loam, silt loam, clay loam, or silty clay loam.

The 2Cr horizon is interbedded siltstone sandstone, shale and limestone. The weathered bedrock is rippable and in most places can be dug with a spade, but it includes some thin strata that is hard. Most of the rock was calcareous prior to weathering and some strata contains phosphate nodules.

COMPETING SERIES: These are the Brantley, Canton Bend, Capshaw, Cowton, Enon, Gundy, Maben, Magnet, Mecklenburg, Meth, Spray, and Zion series in the same family and Mimosa, Needmore and Talbott series in similar families. Brantley and Enon soils are deeper than 60 inches to bedrock. Canton Bend, Gundy, Maben, Magnet and Mecklenburg soils have hues of 5YR or redder in the B horizon. Capshaw soils have gray mottles in the B horizon. Cowton and Needmore soils have rippable bedrock at a depth of 40 to 60 inches. Meth soils have a solum greater than 60 inches thick. Mimosa soils have a solum less than 20 inches thick. Talbott soils have hue of 5YR or redder in the major part of the B horizon. Zion soils have hard bedrock at a depth of 20 to 40 inches.

GEOGRAPHIC SETTING: Gently sloping to steep uplands. Slopes range from 2 to 30 percent. These soils formed in clayey residuum of interbedded limestone and shale the underlying residuum of interbedded siltstone, fine grained sandstone and limestone. Near the type location, the average annual air temperature is 60 degrees F. and the average annual precipitation is about 52 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Mimosa soils and the Hicks, Inman, Dowellton and Sandhill and Stiversville series. Hicks soils formed partly in a loess mantle and are fine-silty. Inman soils are 20 to 40 inches to bedrock and are flaggy. Dowellton soils have gentle slopes and are poorly drained. Sandhill soils are fine-loamy and are flaggy. Stiversville soils are fine-loamy.

DRAINAGE AND PERMEABILITY: Well drained; moderately slow permeability; medium to rapid runoff.

USE AND VEGETATION: Most areas are cleared. Much of the soil is in pasture and hay, but some is used for growing corn, small grains, and tobacco. The native vegetation is forests of oaks, walnut, locust, ash, hickory, beech, elm, and maple.

DISTRIBUTION AND EXTENT: The Central Basin in Tennessee. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Maury County, Tennessee; 1954.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - The zone from 0 to 7 inches (Ap horizon)

Argillic horizon - The zone from 7 to 40 inches (Bt horizon)

Paralithic contact - at 47 inches (top of Cr horizon)

`LOCATION MARSH TN+KY`

Established Series
REV - CLD,JCJ
04/2001

MARSH SERIES

The Marsh series consists of moderately deep, well drained soils on uplands. The soil formed in colluvium or residuum from interbedded sandy limestone, siltstone, and shale. These soils are on gently sloping to steep, highly dissected back slopes, shoulders, and narrow on ridgecrests. Slopes range from 2 to 45 percent.

TAXONOMIC CLASS: Fine-loamy, mixed, semiactive, thermic Ultic Hapludalfs

TYPICAL PEDON: Marsh silt loam on a south facing, convex, 20 percent slope under hardwoods at an elevation of 740 feet. (Colors are for moist soil unless otherwise noted.)

Oi-- 1 to 0 inches; fibric material; slightly decomposed leaves, twigs, and woody materials. (0 to 2 inches thick)

A-- 0 to 3 inches; dark brown (10YR 3/3) loam; weak fine and medium granular structure; very friable; common fine roots; approximately 2 percent channers of sandy limestone; slightly acid; clear wavy boundary (2 to 7 inches thick).

BE-- 3 to 11 inches; yellowish brown (10YR 5/4) loam; weak medium subangular blocky structure; friable; common fine and medium roots; approximately 10 percent channers of sandy limestone; strongly acid; clear wavy boundary.

Bt-- 11 to 19 inches; yellowish brown (10YR 5/6) loam; weak medium subangular blocky structure; friable; common fine and few medium and coarse roots; few faint yellowish brown (10YR 5/4) clay films on faces of peds; approximately 10 percent channers of sandy limestone and siltstone; very strongly acid; clear wavy boundary. (8 to 30 inches thick)

CB-- 19 to 23 inches; yellowish brown (10YR 5/6) very channery loam; weak medium subangular blocky structure; friable; few fine roots; approximately 55 percent channers of sandy limestone and siltstone; strongly acid; abrupt wavy boundary. (5 to 9 inches thick)

Cr-- 23 to 35 inches; highly weathered, interbedded siltstone and sandy limestone with thin strata of clayey soil material.

TYPE LOCATION: Marshall County, Tennessee; 0.8 miles north of the community of Mooresville on Fitzpatrick Road; 1000 feet northwest on a hillside.

RANGE IN CHARACTERISTICS: Depth to a paralithic contact is 20 to 40 inches. Content of fragments, dominantly channers of sandy limestone or siltstone, range from 0 to 20 percent in the A horizon, 0 to 35 percent in the B horizon, and 10 to 59 percent in the C horizon. Reaction ranges from slightly acid to very strongly acid, except where limed.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 4, and chroma of 3 or 4. Texture is loam or silt loam, or their channery or gravelly analogs.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 or 6. Some pedons have variegations of parent material in shades of red or brown. Texture of the fine-earth fraction is loam, silt loam, or silty clay loam. In some pedons, the lower part of the B horizon has texture ranging to clay loam or silty clay.

The C horizon variegated colors from parent material in shades of red, brown, olive, or gray. Texture is loam, silt loam, silty clay loam, clay loam, or silty clay, or their channery or flaggy analogues.

The Cr horizon consists of interbedded sandy limestone, shale, and siltstone. Some pedons include a few thin strata of hard limestone. Typically, this horizon can be dug with a spade, except for the hard strata.

COMPETING SERIES: These are the Bolivar, Deanburg, Liddieville, Pamunkey, Sandhill, Stiversville, and Toine series in the same family. Bolivar soils have hues redder than 7.5YR in the Bt horizon. Deanburg, Liddieville, Pamunkey, and Toine soils are greater than 60 inches to bedrock. Sandhill and Stiversville soils have a paralithic contact between 40 and 60 inches.

GEOGRAPHIC SETTING: Steep upland hillsides and narrow rolling ridgecrests in the Nashville Basin. Slopes range from 2 to 45 percent. Marsh soils developed in colluvium or residuum from thinly bedded sandy limestone interbedded with siltstone and shale. Near the type location the mean annual air temperature is 57 degrees F and the mean annual precipitation is about 54 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: The Hampshire, Mimosa, Talbott, Hicks, Armour, and Stiversville soils. The Hampshire, Mimosa, and Talbott soils have a fine family particle size control section. In addition, the Mimosa and Talbott soils are underlain by hard limestone bedrock. The Hicks and Armour soils are in a fine-silty family particle size control section and are greater than 60 inches to bedrock. The Stiversville soils are 40 to 60 inches to a paralithic contact.

DRAINAGE AND PERMEABILITY: Marsh soils are well drained with medium to rapid runoff. Permeability is moderate or moderately rapid.

USE AND VEGETATION: Chiefly pasture and hay, with some areas cropped in tobacco and small grains. Native forest has oak, maple, hickory, black walnut, beech, hackberry, poplar, ash, and elm as the dominant species.

DISTRIBUTION AND EXTENT: Nashville Basin of Tennessee. The series is of small extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Marshall County, Tennessee, 1996.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Argillic horizon - 11 to 19 inches (Bt horizon)

Ochric epipedon - 0 to 11 inches (A and BE horizons)

Paralithic contact - at 23 inches (top of Cr horizon)

This soil was previously mapped as the Culleoka series, which is now mesic.

National Cooperative Soil Survey
U.S.A.

LOCATION MAURY KY+TN

Established Series
Rev. SJB, RAE
01/2010

MAURY SERIES

The Maury series consists of very deep, well drained, moderately permeable soils that formed in silty material over residuum weathered from phosphatic limestone. These soils are on uplands.

TAXONOMIC CLASS: Fine, mixed, active, mesic Typic Paleudalfs

TYPICAL PEDON: Maury silt loam--cultivated. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 9 inches; brown (10YR 4/3) silt loam; moderate medium granular structure parting to moderate fine granular structure; very friable; common fine roots throughout; moderately acid; abrupt smooth boundary. (5 to 10 inches thick)

Bt1--9 to 16 inches; reddish brown (5YR 4/4) silty clay loam; moderate fine and medium subangular blocky structure; friable; common fine roots throughout; 30 percent discontinuous distinct clay films on vertical faces of peds; 1 percent fine prominent spherical weakly cemented, black (7.5YR 2.5/1) iron-manganese nodules with sharp boundaries in matrix; slightly acid; clear smooth boundary.

Bt2--16 to 36 inches; reddish brown (5YR 4/4) silty clay; strong medium and coarse subangular blocky structure; firm; few fine roots between peds; 40 percent discontinuous distinct clay films on vertical faces of peds; 8 percent fine prominent spherical moderately cemented black (7.5YR 2.5/1) iron-manganese nodules with sharp boundaries in matrix and 10 percent fine prominent irregular black (7.5YR 2.5/1) iron-manganese masses with clear boundaries in matrix; slighty acid; clear smooth boundary.

Bt3--36 to 53 inches; reddish brown (5YR 4/4) clay; moderate medium and coarse subangular blocky structure; very firm; 60 percent discontinuous distinct clay films on vertical faces of peds; 1 percent coarse prominent irregular moderately cemented black (7.5YR 2.5/1) iron-manganese nodules with sharp boundaries in matrix and 15 percent medium prominent irregular black (7.5YR 2.5/1) iron-manganese nodules with sharp boundaries in matrix and 15 percent fine prominent irregular black (7.5YR 2.5/1) iron-manganese nodules with sharp boundaries in matrix and 15 percent medium prominent irregular black (7.5YR 2.5/1) iron-manganese masses with clear boundaries in matrix and 15 percent fine prominent irregular black (7.5YR 2.5/1) iron-manganese masses with clear boundaries in matrix; slightly acid; clear smooth boundary. (combined thickness of the Bt horizon ranges from 30 to 60 inches thick)

BC1--53 to 71 inches; yellowish red (5YR 4/6) clay; weak medium subangular blocky structure; very firm; 1 percent coarse prominent irregular black (7.5YR 2.5/1) iron-manganese masses with clear boundaries in matrix and 8 percent medium prominent irregular black (7.5YR 2.5/1) iron-manganese masses with clear boundaries in matrix and 10 percent fine prominent irregular black (7.5YR 2.5/1) iron-manganese masses with clear boundaries in matrix; moderately acid; clear smooth boundary.

BC2--71 to 100 inches; yellowish red (5YR 4/6) clay; weak medium subangular blocky structure; very firm; 8 percent medium prominent irregular black (7.5YR 2.5/1) iron-manganese masses with clear boundaries in matrix and 10 percent fine prominent irregular black (7.5YR 2.5/1) iron-manganese masses with clear boundaries in matrix; moderately acid. (combined thickness of the BC horizon ranges from 20 to 60 inches thick)

TYPE LOCATION: Fayette County, Kentucky; 600 feet north of I-64/75, 0.25 miles northwest of I-64/75 & KY 922 interchange; 4.5 miles north of Lexington. USGS Centerville Quadrangle (Latitude 38 degrees, 6 minutes, 20.00 seconds North; Longitude 84 degrees 29 minutes, 38.00 seconds West; UTM Easting 719716 UTM Northing 4220516).

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 60 to 120 inches or more. Thickness of the argillic horizon ranges from 50 to 100 inches. Depth to bedrock ranges from 60 to 200 inches or more. Chert fragments, less than 3 inches in diameter, range from 0 to 5 percent in the Bt, BC and C horizons. The reaction of the Ap or A horizons range from neutral to strongly acid; the upper part of the Bt horizon ranges from slightly acid to strongly acid; the lower part of the Bt, BC and C horizons range from moderately acid to very strongly acid. The phosphate content in the solum is variable but is typically medium or high.

The Ap or A horizons have hue of 10YR or 7.5YR, value of 4, and chroma from 2 to 4. Some pedons have Ap or A horizons less than 7 inches thick with a value of 3 after mixing.

The AB or BA horizons, where present, have a hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. Texture is silt loam or light silty clay loam.

The upper part of Bt horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is light silty clay loam to clay.

The lower part of the Bt, BC, and C horizons have hue of 7.5YR to 2.5YR, value of 4 or 5, and chroma of 4 to 8. Texture is heavy silty clay loam to clay. Some pedons are mottled in shades of red, brown or yellow, or are a variegation of these colors.

Some pedons in the transition zone between the Inner and Outer Bluegrass Physiographic Regions have lower Bt, BC, and C horizons with hue of 10YR, value of 3 to 5, and chroma of 3 to 6. Many pedons have few to many, fine to coarse, black iron and manganese oxide nodules, masses or concretions.

COMPETING SERIES: There are no competing series. The Bluegrass, Lowell, and Faywood Series are in related families. The Bluegrass Series has less than 35 percent clay in the particle size control section. The Lowell Series has hue of 7.5YR or yellower in the Bt horizon. The Faywood Series has hue of 7.5YR or yellower and is moderately deep.

GEOGRAPHIC SETTING: Maury soils are on nearly level to moderately steep uplands. Slopes are commonly 0 to 12 percent, but range to 20 percent. The underlying limestone is cavernous and some areas have karst topography. The upper 10 to 20 inches of the solum formed in silty material and the lower part formed in residuum weathered from phosphatic limestone. The phosphatic limestone members include the Lexington and Cynthiana Limestone Formations of the Inner Bluegrass Physiographic Region. The mean annual precipitation is about 45 inches and the mean annual temperature is about 54 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Ashton, Bluegrass, Caleast, Donerail, Elk, Fairmount, Faywood, Loradale, Lowell, McAfee, and Nicholson series. Ashton soils are located on low stream terraces and alluvial fans, have a dark colored surface layer, and have a solum thickness of 40 to 60 inches. Bluegrass soils have less than 35 percent clay in the particle size control section. Caleast soils formed in residuum weathered from limestone interbedded with thin strata of calcareous shale and siltstone, have a dark colored surface layer, have an average of more than 35 percent clay in the particle size control section, and have a solum thickness of 40 and 60 inches. Donerail soils have a dark colored surface layer, are moderately well drained, have an average of more than 35 percent clay in the particle size control section, and have hues of 10YR or yellower in the subsoil. Elk soils are located on stream terraces, and are typically more acid. Fairmount soils formed in limestone residuum interbedded with thin layers of calcareous shales, have a solum thickness and depth to bedrock from 10 to 20 inches, have a dark colored surface layer, have more than 35 percent clay in the particle size control section, and do not have argillic horizons. Faywood soils have hues of 7.5YR yellower in the Bt horizon and are moderately deep. Loradale soils formed in residuum or old alluvium from limestone and thin layers of calcareous shale, have a dark colored surface layer, and have hues of 10YR or yellower in the subsoil. Lowell soils formed in residuum weathered from limestone interbedded with thin layers of shale, have more than 35 percent clay in the particle size control section, have a solum thickness of 30 to 60 inches, and have hues of 7.5YR or yellower in the lower part of the subsoil. McAfee soils have a solum thickness and depth to bedrock from 20 to 40 inches, have a dark colored surface layer, and have an average of more than 35 percent clay in the particle size control section. Nicholson soils are moderately well drained with a slowly permeable fragipan in the subsoil.

DRAINAGE AND PERMEABILITY: Well drained. Runoff is slow to medium and permeability is moderate to moderately rapid.

USE AND VEGETATION: Most areas are used for crops such as burley tobacco, corn, small grains, and alfalfa; and for pasture. Bluegrass and white clover are the most common pasture plants. Native vegetation was dominated by oaks, elm, ash, black walnut, black and honey locust, hackberry, black cherry, and Kentucky coffee tree. Glades of native grasses and canes were reported by early settlers.

DISTRIBUTION AND EXTENT: The Inner Bluegrass Physiographic Region of Kentucky.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Garrard County, Kentucky; 1921.

REMARKS: The Maury series is currently used in the Central Basin of Tennessee as a thermic taxajunct. The extent is large.
Diagnostic horizons in the pedon are:
Ochric epipedon 0 to 9 inches (Ap)
Argillic horizon 9 to 53 inches (Bt1, Bt2, Bt3)

ADDITIONAL DATA: Characterization sample 08KY-067-04-(1-6) by the University of Kentucky.

National Cooperative Soil Survey
U.S.A.

LOCATION WOLFTEVER TN+AL GA KY

Established Series
Rev. JCJ/JLN
04/2011

WOLFTEVER SERIES

The Wolftever series consists of very deep, moderately well drained soils formed in fine or moderately fine textured alluvium. The soil is on low stream and river terraces. Slopes range from 0 to 12 percent.

TAXONOMIC CLASS: Fine, mixed, semiactive, thermic Aquic Hapludults

TYPICAL PEDON: Wolftever silty clay loam - cultivated. (Colors are for moist soils unless otherwise stated.)

Ap--0 to 7 inches, dark grayish brown (10YR 4/2) silty clay loam; moderate medium granular structure; friable; common fine and medium roots; few fine black (10YR 2/1) manganese concretions; slightly acid; clear smooth boundary. (5 to 10 inches thick)

Bt1--7 to 15 inches; yellowish brown (10YR 5/4) silty clay; moderate fine and medium subangular blocky structure; firm; few fine roots; few fine faint dark yellowish brown (10YR 4/4) clay films on the faces of peds; few fine black (10YR 2/1) manganese concretions; strongly acid; clear smooth boundary.)

Bt2--15 to 22 inches; yellowish brown (10YR 5/4) silty clay; moderate fine and medium angular blocky structure; firm; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few fine black (10YR 2/1) manganese concretions and stains; strongly acid; clear smooth boundary.

Bt3--22 to 31 inches; yellowish brown (10YR 5/4) silty clay; moderate medium angular and subangular blocky structure; firm; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; few fine black (10YR 2/1) manganese concretions and common stains; few medium distinct light brownish gray (10YR 6/2) and few fine faint brown (10YR 5/3) iron depletions; strongly acid; clear smooth boundary.

Bt4--31 to 42 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium angular blocky structure; firm; common distinct dark yellowish brown (10YR 4/4) clay films on faces of peds; common fine black (10YR 2/1) manganese concretions and stains; common fine and medium distinct light brownish gray (10YR 6/2) iron depletions; common fine and medium strong brown (7.5YR 5/6) iron accumulations as soft masses; strongly acid; clear wavy boundary.

Bt5--42 to 53 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium angular blocky structure; firm; few fine faint dark yellowish brown (10YR 4/4) clay films on faces of peds; few fine black (10YR 2/1) manganese concretions; common black (10YR 2/1) manganese stains; many fine and medium distinct light brownish gray (10YR 6/2) iron depletions; many fine and medium strong brown (7.5YR 5/6) iron accumulations as soft masses; few fine flakes of mica; few gravel; strongly acid; clear wavy boundary. (Thickness of the Bt horizon ranges from 22 to 50 inches)

C1--53 to 65 inches; dark yellowish brown (10YR 4/4) silty clay loam; massive; firm; common fine black (10YR 2/1) manganese concretions; many medium distinct light brownish gray (10YR 6/2) iron depletions; common medium yellowish brown (10YR 5/4) iron accumulations as soft masses; few fine flakes of mica; strongly acid; gradual wavy boundary.

C2--65 to 89 inches; 34 percent dark yellowish brown (10YR 4/4), 33 percent light brownish gray (10YR 6/2), and 33 percent yellowish brown (10YR 5/4) clay loam; massive; friable; common fine and medium black (10YR 2/1) and dark brown (10YR 3/3) manganese and iron concretions; common fine flakes of mica; strongly acid. (Thickness of the C horizon ranges from 5 to 40 inches).

TYPE LOCATION: Hardin County, Tennessee; on low terrace of Tennessee River, 4 miles southwest of Savannah on Diamond Island road and 1/2 miles west of Mud Creek, on C. S. Roberts' farm.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 25 to 60 inches or more. Depth to bedrock is greater than 60 inches. Water rounded gravel are less than 5 percent in the A and upper Bt horizons and range from 0 to 15 percent in the lower Bt and C horizons. Reaction is strongly acid or very strongly acid, except the surface layer where limed. Black and dark brown iron and manganese concretions range from none to common in each horizon.

The Ap or A horizon has hue of 10YR, value of 4 or 5 and chroma of 2 to 4. Texture is silt loam, silty clay loam, or loam.

The E horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 3 to 6. Texture is silt loam, silty clay loam, or loam.

The Bt horizon has hue of 7.5YR to 2.5Y, value of 4 to 6 and chroma of 3 to 6. Redoximorphic depletions with value of 4 or more and chroma 2 or less are within the upper 24 inches of the argillic horizon, but not within the upper 10 inches. Redoximorphic features range from few to common in shades of brown, red, black, or gray Texture is silty clay loam, silty clay or clay.

The Btg horizon, where present, has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 1 or 2, or is neutral. Few to many redoximorphic features are in shades of brown, red, or black. Texture is silty clay loam, silty clay, or clay.

The BC, C or Cg horizon has hue of 10YR or 2.5Y, value of 4 to 6 and chroma of 1 to 4, or is neutral. Redoximorphic features are in shades of brown, yellow, red, or gray and some pedons are an evenly mottled pattern without a dominant matrix color. Texture is loam, clay loam, silt loam, or silty clay loam and allows sub-horizons of silty clay or clay.

COMPETING SERIES: These are the Annemaine, Beason, Cid, Creedmore Dogue, Gritney, Helena, and Lignum series. Annemaine soils have redder hue in the Bt horizon. Beason soils have redox depletions in chroma of 2 or less in the upper 10 inches of the argillic horizon. Cid soils have paralithic contact within 40 inches. Creedmore soils have sandy clay loam upper B horizons and clay lower B horizons that have a COLE of .09 or more. Dogue soils have less than 30 percent silt in the particle-size control section. Gritney soils typically are redder in the lower sola and have less than 30 percent silt in the control section. Helena and Lignum soils are on Piedmont uplands and formed in saprolite of metmorphic origin.

GEOGRAPHIC SETTING: Wolftever soils are on low stream and river terraces. Slopes range from 0 to 12 percent. These soils formed in moderately-fine and fine textured alluvium. Near the type location the average annual temperature is 60.5 F. and average annual precipitation is 56.9 inches near the type location.

GEOGRAPHICALLY ASSOCIATED SOILS: The competing Beason series and the Dowellton, Egam, Etowah, Busseltown, Gumdale, and Staser series. Dowellton soils are poorly drained. Egam and Staser soils, which are on flood plains, have thick dark A horizons and lack argillic horizons. Etowah soils are well drained and have a fine-loamy control section. Busseltown and Gumdale soils are fine-loamy and have a fragipan in the subsoil..

DRAINAGE AND PERMEABILITY: Moderately well drained; low to high runoff; moderately slow permeability. Lower areas are subject to flooding during periods of high rainfall in winter and early spring

USE AND VEGETATION: Most of this soil is used for cropland but some is used for pasture. The native vegetation was forest of oaks, hickory, beech, and maple.

DISTRIBUTION AND EXTENT: The Appalachian Ridge and Valley, Highland Rim and Southern Coastal Plain MLRAs of Tennessee, northwest Georgia, and northern Alabama. The series is of moderate extent.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Morgantown, West Virginia
SERIES ESTABLISHED: Hamilton County, Tennessee; 1938.

REMARKS: Diagnostic horizons in this pedon are:

Ochric epipedon - 0 to 7 inches (Ap horizon)

Argillic horizon - 7 to 53 inches (Bt horizons)

NSSL sample number: S59TN-36-5-1-7

National Cooperative Soil Survey
U.S.A.

APPENDIX 3.1

SOIL PEDON DESCRIPTIONS

TDEC - DWR Soil Pedon Description Form

Date: 6-18-20 Described By: Jay Andrews QA/QC By: Terry Henry
Property Name:
Road Name: 4860 Murfreesboro Rd (Chapel North) County: Williamson

Stop or Pit #: 1 SOP # (office use only):

Soil Series: Hampshire Drainage Class: Well

Soil Control Section: Fine Depth to Ground Water or Water Table: None

Parent Material: Residuum Erosion: none to slight

Climate: Thermic Land Cover: mixed grasses

Slope of Map Unit: 0-5% Slope of Pit: 5%

Geomorphic Description: Footslope / High Stream Terrace Latitude/Longitude:

Physiographic Location: Nashville Basin

Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Color(s) Depletions/Concentrations	Depth to Redox Features Depletions	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-5				Sil	2	F&m	gr & sbk	
Ap2	5-14				Sil	1	m	sbk	
BA	14-17				Sicl	2	m	sbk	
Bt1	17-24				Sicl	2	m	sbk	
Bt2	24-29				SiC	2	m	sbk	
Bt3	29-34				SiC	1	m	sbk	
Bt4	34-37				SiC	1	m	sbk	
Bt5	37-45				SiC	1	m	sbk	

TDEC - DWR Soil Pedon Description Form

Date: 6-18-20
Described By: Jay Andrews
QA/QC By: Terry Henry
Site Name & Location: 4860 Murfreesboro Rd ((Chapel North)
County: Williamson
Stop or Pit #: 2
SOP # (office use only):
Soil Series: Hampshire
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: 0-5%
Slope of Pit: 5%
Geomorphic Description: Footslope
Latitude/Longitude (Center of soil area):
Physiographic Location: Nashville Basin
Additional Note:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap_1	0-3				Sil	3	VF	gr	
Ap_2	3-11				Sil	1	m	sbk	
AB	11-23				Sil	2	m	sbk	
Bt_1	23-28				Sic	2	m	sbk	
Bt_2	28-31				Sic	2	m	sbk	
Bt_3	31-41				Sic	2	m	sbk	

TDEC - DWR Soil Pedon Description Form

Date: 6-18-20

Described By: J. Andrews

QA/QC By: Terry Henry

Site Name & Location: 4860 Murfreesboro rd (Chapel North)

County: Williamson

Stop or Pit #: 3

SOP # (office use only):

Soil Series: Wolftever

Drainage Class: Mod 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: 0-5%

Slope of Pit: 2%

Geomorphic Description: Stream Terrace

Latitude/Longitude (Center of soil area):

Physiographic Location: Nashville Basin

Additional Notes: Wolftever / Beeson (Chisel Plow)

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-4				Sil	2	F&m	gr & sbk	
Ap2	4-8				Sil	2	m	sbk	
BA	8-13				Sicl	1	c	Sbk	
Bt1	13-23				Sic	2	m	Sbk	
Bt2	23-29	10yr 6/4	10yr 7/2	26"	SiC	2	m	Sbk	
Bt3	29-36	10yr 6/3	10yr 7/2 / 7.5yr 5/6		C	2	m	Sbk	
Bt4	36-48				C	2	m	Sbk	

TDEC - DWR Soil Pedon Description Form

Date: 6-18-20
Described By: Jay Andrews
QA/QC By: Terry Henry
Site Name & Location: 4860 Murfreesboro rd ((Chapel North)
County: Williamson
Stop or Pit #: 4
SOP # (office use only):
Soil Series: Wolftever OW
Drainage Class: Mod-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: 0-5%
Slope of Pit: 2%
Geomorphic Description: Stream Terrace
Latitude/Longitude (Center of soil area):
Physiographic Location: Nashville Basin
Additional Notes: 11" overwash Wolftever ow

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap$_1$	0-3				L	2	F+m	gr	
Ap$_2$	3-6				SiCl	2	m	sbk	
Bt	6-11				Cl	2	m	sbk	
Ab	11-15				Sil	1	m	sbk	
ABb	15-22				SiCl	2	m	sbk	
BAb	22-27				SiCl	2	m	sbk	
Bt$_1$b	27-31				SiC	2	m	sbk	
Bt$_2$b	31-38				C	2	m	sbk	
Bt$_3$b	38-44	10yr 5/4	10yr 6/2 + 6/3 5yr 4/6	38"	C	2	m	sbk	

TDEC - DWR Soil Pedon Description Form

Date: 6-18-20
Described By: Jay Andrews
QA/QC By: Terry Henry
Site Name & Location: 4860 Murfreesboro rd (Chapel North)
County: Williamson
Stop or Pit #: 5
SOP # (office use only):
Soil Series: Hampshire
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: 0-5%
Slope of Pit: 4%
Geomorphic Description: Stream Terrace / Footslope
Latitude/Longitude (Center of soil area):
Physiographic Location: Nashville Basin
Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-4				Sil	2	F	gr	
Ap2	4-11				Sil	1	m	sbk	
AB	11-14				Sil	1	m	sbk	
BA	14-19				Sicl	2	m	sbk	
Bt1	19-23				SiC	2	m	sbk	
Bt2	23-28				SiC	2	m	sbk	
Bt3	28-39				SiC	2	m	sbk	
Bt4	39-47				SiC	2	m	sbk	

TDEC - DWR Soil Pedon Description Form

Date: June 18, 2020
Described By: Jay Andrews
QA/QC By: Terry Henry
Property Name:
Road Name: 2193 Osburn Rd (Chapel North)
County: Williamson
Stop or Pit #: 6
SOP # (office use only):
Soil Series: Maury
Drainage Class: Well
Soil Control Section: Fine-silty or Fine
Depth to Ground Water or Water Table: None
Parent Material: Residuum
Erosion: None to slight
Climate: Thermic
Land Cover: Mixed grasses
Slope of Map Unit:
Slope of Pit: 6%
Geomorphic Description: Upland
Latitude/Longitude:
Physiographic Location: Nashville Basin
Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Color(s) Depletions/Concentrations	Depth to Redox Features Depletions	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-8				SIL	1	M	SBK	
Ap2	8-14				SIL	1	M	SBK	
Bt1	14-20				SICL	2	M	SBK	
Bt2	20-29				SICL	2	M	SBK	
Bt3	29-36				SIC	2	M	SBK	
BC	36-44				GRV-C	1	M	SBK	

TDEC - DWR Soil Pedon Description Form

Date: 6-13-20

Described By: Jy Andrews

QA/QC By: Terry Henry

Site Name & Location: 2193 Osburn Rd (Chapel North)

County: Williamson

Stop or Pit #: 7

SOP # (office use only):

Soil Series: Maury

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: 0-5%

Slope of Pit: 2%

Geomorphic Description: Upland

Latitude/Longitude (Center of soil area):

Physiographic Location: Nashville Basin

Additional Notes: 44"

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-4				L	1	m	gr + sbk	
Ap2	4-9				L	1	m	sbk	
BA	9-16				Sil	2	m	sbk	
Bt1	16-29				Sicl	2	m	sbk	
Bt2	29-36				Sic	2	m	sbk	
Bt3	36-40				C	2	m	sbk	
Bt4	40-44				gr-c	1	m	sbk + Abk	

TDEC - DWR Soil Pedon Description Form

Date: 6-18-20
Described By: Jay Andrews
QA/QC By: Troy Henry
Site Name & Location: 2193 Osburn Rd (Chapel North)
County: Williamson
Stop or Pit #: 8
SOP # (office use only):
Soil Series: Marsh
Drainage Class: well
Soil Control Section: Fine
Ground Water or Water Table: none
Parent Material: Residuum
Erosion: Moderate
Climate: Thermic
Land Cover: mixed grasses
Slope of Map Unit: 0-5%
Slope of Pit: 4%
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 Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap	0-7				Sil	2	vc	sbk	
Bt1	7-13				Sicl	1	m	sbk	
Bt2	13-20				gr-Sicl	2	m	sbk	
Bt3	20-28				SiC	2	m	sbk	
BC	28-36				grx-SiC	1	m	sbk	
Cr	36-50								

TDEC - DWR Soil Pedon Description Form

Date: June 18, 2020 Described By: Jay Andrews QA/QC By: Terry Henry

Site Name & Location: 2193 Osburn Rd (chapel north) County: Williamson

Stop or Pit #: 9 SOP # (office use only):

Soil Series: Marsh Drainage Class: Well

Soil Control Section: Fine Ground Water or Water Table: None

Parent Material: Residuum Erosion: Severe

Climate: Thermic Land Cover: Mixed grasses

Slope of Map Unit: 5-15% Slope of Pit: 6%

Geomorphic Description: Upland Latitude/Longitude (Center of soil area):

Physiographic Location: Nashville Basin

Additional Notes: 47"

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap	0-3				SIL	1	M	SBK	
BA	3-9				SICL	2	m	SBK	
Bt	9-17				GR-SIC	2	m	SBK	
Bt/Cr	17-35				C	2	m	SBK/ABK	
Cr	35-47				—	—	—	—	

TDEC - DWR Soil Pedon Description Form

Date: June 19, 2020
Described By: Jan Andrews
QA/QC By: Terry Henry
Property Name:
Road Name: 2193 Osburn Rd (Chapel North)
County: Williamson
Stop or Pit #: 10
SOP # (office use only):
Soil Series: Marsh
Drainage Class: Well
Soil Control Section: Fine Loamy
Depth to 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: 6%
Geomorphic Description: Upland
Latitude/Longitude:
Physiographic Location: Nashville Basin
Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Color(s) Depletions/Concentrations	Depth to Redox Features Depletions	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-3				Sil	2	m	sbk/sr	
Ap2	3-11				L	1	m	sbk	
Bt1	11-23				Cl	1	m	sbk	
Bt2	23-30				Cl	1	m	sbk	
Bt3	30-38				Cl	1	m	sbk	
Cr	38·45					–	–	–	

TDEC - DWR Soil Pedon Description Form

Date: 6-19-20

Described By: Jay Andrews

QA/QC By: Terry Henry

Site Name & Location: 2193 Osburn Rd (Chapel North)

County: Williamson

Stop or Pit #: 11

SOP # (office use only):

Soil Series: Marsh

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: 7%

Geomorphic Description: Upland

Latitude/Longitude (Center of soil area):

Physiographic Location: Nashville Basin

Additional Notes: 44"

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap	0-3				Sil	1	m	sbk	
BA	3-10				Sil	2	m	sbk	
Bt1	10-16				Sicl	2	r	sbk	
Bt2	16-22				gr. SiC	2	r	sbk	
Bt/Cr	22-33				C	2	m	sbk	
Cr	33-44								

TDEC - DWR Soil Pedon Description Form

Date: 6-19-20 Described By: Jay Andrews QA/QC By: Terry Henry

Property Name:

Road Name: 2193 Osburn Rd (Chapel North) County: Williamson

Stop or Pit #: 12 SOP # (office use only):

Soil Series: Mersh Drainage Class: Well

Soil Control Section: Fine loamy Depth to 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: 15%

Geomorphic Description: Upland Latitude/Longitude:

Physiographic Location: Nashville Basin

Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Color(s) Depletions/Concentrations	Depth to Redox Features Depletions	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-4				L	2	m	GR/SBK	
Ap2	4-11				L	1	m	SBK	
AB	11-15				CL	2	m	SBK	
Bt1	15-24				GR-CL	1	m	SBK	
BC	24-33				VGR-CL	1	m	SBK	
Cr	33-52				—	—	—	—	

TDEC - DWR Soil Pedon Description Form

Date: 6-19-20 Described By: Jay Andrews QA/QC By: Terry Henry

Site Name & Location: 2193 Osburn Rd (Chapel North) County: Williamson

Stop or Pit #: 13 SOP # (office use only):

Soil Series: Stiversville / Sandhill Drainage Class: well

Soil Control Section: Fine loamy Ground Water or Water Table: none

Parent Material: Residuum Erosion: none to slight

Climate: Thermic Land Cover: mixed grasses

Slope of Map Unit: 0-5% Slope of Pit: 3%

Geomorphic Description: Upland Latitude/Longitude (Center of soil area):

Physiographic Location: Nashville Basin

Additional Notes: 47"

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap	0-9				Sil	2	m	gr/sbk	
BA	9-15				Sil	1	m	sbk	
Bt1	15-25				Sicl	2	m	sbk	
Bt2	25-38				Cl	2	m	sbk	
Bt3	38-47				gr-C	1	m	sbk	

TDEC - DWR Soil Pedon Description Form

Date: 6-15-20
Described By: Jay Andrews
QA/QC By: Terry Henry
Property Name:
Road Name: 2193 Osburn Rd (Chapel North)
County: Williamson
Stop or Pit #: 14
SOP # (office use only):
Soil Series: Marsh / Sandhill
Drainage Class: Well
Soil Control Section: Fine Loamy
Depth to 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: 7%
Geomorphic Description: Upland
Latitude/Longitude:
Physiographic Location: Nashville Basin
Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Color(s) Depletions/Concentrations	Depth to Redox Features Depletions	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-2				L	2	C/m	sbk	
Ap2	2-10				L	1	m	sbk	
BA	10-18				Sicl	2	m	sbk	
Bt1	18-22				Cl	2	m	sbk	
Bt2	22-28				Cl	2	m	sbk	
Bt3	28-32				Cl	2	m	sbk	
Bt4	32-38				Cl	1	m	sbk	
Bt/Cr	38-41				Cl	1	m	sbk	
Cr	41-50								

TDEC - DWR Soil Pedon Description Form

Date: 6-19-20
Described By: Jay Andrews
QA/QC By: Terry Henry
Site Name & Location: 2193 Osburn Rd (Chapel North)
County: Williamson
Stop or Pit #: 15
SOP # (office use only):
Soil Series: Marsh
Drainage Class: well
Soil Control Section: Fine Silty
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: 7%
Geomorphic Description: Upland
Latitude/Longitude (Center of soil area):
Physiographic Location: Nashville Basin
Additional Notes: 48"

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap	0-9				Sil	1	m	sbk	
BA	9-15				Sil	2	m	sbk	
Bt	15-20				Sicl	2	m	sbk	
Bt/Cr	20-34				C	2	m	sbk	
Cr	34-48					-	-	-	

TDEC - DWR Soil Pedon Description Form

Date: 6-19-20 Described By: Jay Andrews

Site Name & Location: 2193 Osburn Rd (Chapel North) QA/QC By: Terry Henry

Stop or Pit #: 16 County: Williamson

Soil Series: Mersh SOP # (office use only):

Soil Control Section: Fine loamy Drainage Class: well

Parent Material: Residuum Ground Water or Water Table: none

Climate: Thermic Erosion: none to slight

Slope of Map Unit: 5-15% Land Cover: mixed grasses

Geomorphic Description: upland Slope of Pit: 7%

Physiographic Location: Nashville Basin Latitude/Longitude (Center of soil area):

Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-2				L	2	F&m	gr&sbk	
Ap2	2-11				SiCl	1	m	sbk	
Bt1	11-21				Cl	2	m	sbk	
Bt2	21-30				gr-Cl	1	m	sbk	
Bt3	30-36				vgr-Cl	1	m	sbk	
Cr	36-50								

TDEC - DWR Soil Pedon Description Form

Date: 6-19-20
Described By: Jay Andrews
QA/QC By: Terry Henry
Site Name & Location: 2193 Osburn Rd (Chapel North)
County: Williamson
Stop or Pit #: 17
SOP # (office use only):
Soil Series: Marsh / Sandhill
Drainage Class: Well
Soil Control Section: Fine loamy
Ground Water or Water Table: none
Parent Material: Residuum
Erosion: none to slight
Climate: Thermic
Land Cover: mixed grasses
Slope of Map Unit: 0-5%
Slope of Pit: 4%
Geomorphic Description: Upland
Latitude/Longitude (Center of soil area):
Physiographic Location: Nashville Basin
Additional Notes: 48"

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap	0-9				SiL	1+2	m	sbk	
BA	9-16				L	2	m	sbk	
Bt1	16-26				SiCL	2	m	sbk	
Bt2	26-32				gr-CL	2	m	sbk	
Bt/Cr	32-41				CL	1	m	sbk	
Cr	41-48					—	—	—	

TDEC - DWR Soil Pedon Description Form

Date: 6-19-20

Described By: Jay Andrews

Site Name & Location: 2193 Osburn Rd (Chapel North)

QA/QC By: Terry Henry

Stop or Pit #: 18

County: Williamson

Soil Series: Marsh

SOP # (office use only):

Soil Control Section: Fine loamy

Drainage Class: well

Parent Material: Residuum

Ground Water or Water Table: none

Climate: Thermic

Erosion: none to slight

Slope of Map Unit: 5-15%

Land Cover: mixed grasses

Geomorphic Description: Upland

Slope of Pit: 7%

Physiographic Location: Nashville Basin

Latitude/Longitude (Center of soil area):

Additional Notes:

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap1	0-3				L	1	m	sbk	
Ap2	3-13				L	1	m	sbk	
Bt1	13-18				Cl	2	m	sbk	
Bt2	18-23				Cl	2	m	sbk	
Bt3	23-33				gr-Cl	2	m	sbk	
Bt4	33-37				gr-Cl	2	m	Sbk	
Cr	37-47								

TDEC - DWR Soil Pedon Description Form

Date: 6-19-20

Described By: Jay Andrews

Site Name & Location: 2193 Osburn Rd (Chapel north)

QA/QC By: Terry Henry

Stop or Pit #: 19 C1

County: Williamson

Soil Series: Sandhill

SOP # (office use only):

Soil Control Section: Fine loamy

Drainage Class: Well

Parent Material: Residuum

Ground Water or Water Table: None

Climate: Thermic

Erosion: none to slight

Slope of Map Unit: 0-5%

Land Cover: Mixed grasses

Geomorphic Description: Upland

Slope of Pit: 2%

Physiographic Location: Nashville Basin

Latitude/Longitude (Center of soil area):

Additional Notes: 50"

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	
Ap	0-9				Sil	1&2	F+m	gr & sbk	
BA	9-14				L	1	m	sbk	
Bt1	14-23				Sicl	2	m	sbk	
Bt2	23-30				Cl	2	m	sbk	
Bt3	30-38				C	2	m	sbk	
Bt4	38-46				gr-C	1	m	sbk	
Cr	46-50					–	–	–	

TDEC - DWR Soil Pedon Description Form

Date: 6-19-20

Described By: Jay Andrews

QA/QC By: Terry Henry

Site Name & Location: 2193 Osburn Rd (Chapel North)

County: Williamson

Stop or Pit #: 20

SOP # (office use only):

Soil Series: Sandhill

Drainage Class: Well

Soil Control Section: Fine loamy

Ground Water or Water Table: None

Parent Material: Residuum

Erosion: none to slight

Climate: Thermic

Land Cover: mixed grasses

Slope of Map Unit: 0-5%

Slope of Pit: 3%

Geomorphic Description: upland

Latitude/Longitude (Center of soil area):

Physiographic Location: Nashville Basin

Additional Notes: Bt 13" gr-Bt 34" Cr @ 46" Similar to pits 18 & 19

Soil Pedon Description

Horizon	Depths (inches)	Matrix Color	Redox Depletions/Concentrations Color	Depth to Low Chroma Mottles (inches)	Soil Texture	Soil Structure			Soil Horizon Notes
						Grade	Size	Type	

APPENDIX 3.3

RESULTS FROM Ksat TESTS

A

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/29/20	Permeameter #:	
Location:	Fox Family Farms	Air Temperature (F) initial:	79
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Marsh-Sandhill	[1]Soil Moisture Content (%):	moist
Pedon Number:	A	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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!
3.00	105.0		10	0.167	1890.0	1.79510	0.70673
15.50	105.0		69	1.150	1415.2	1.34415	0.52919
2.75	105.0		15	0.250	1155.0	1.09700	0.43189
2.00	105.0		10	0.167	1260.0	1.19673	0.47115
					Mean K:	1.21263	0.47741
					St. Dev:	0.1243	0.0490

Average of "steady state" readings:

0.48 in/hr

B

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/29/20	Permeameter #:	
Location:	Fox Family Farms	Air Temperature (F) initial:	79
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Marsh-Sandhill	[1]Soil Moisture Content (%):	moist
Pedon Number:	B	*[1] If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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!
4.10	105.0		10	0.167	2583.0	2.45330	0.96587
17.90	105.0		69	1.150	1634.3	1.55228	0.61113
3.90	105.0		15	0.250	1638.0	1.55575	0.61250
2.60	105.0		10	0.167	1638.0	1.55575	0.61250
					Mean K:	1.55459	0.61204
					St. Dev:	0.0020	0.0008

Average of "steady state" readings:

0.61 in/hr

C

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/29/20	Permeameter #:	
Location:	Fox Family Farms	Air Temperature (F) initial:	84
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Marsh-Sandhill	[1]Soil Moisture Content (%):	moist
Pedon Number:	C	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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):	18.4
[2] *You want this value to be very close to 15 cm. (Record to nearest millimeter.)*	Initial:	18.4
	Final:	18.4
r =	[3]Auger Hole Radius (cm) Standard kit (6 cm) diam. auger	3.5

Outflow Chamber (s) used: [Associated Conversion Factor:]	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!
15.70	150.0		7	0.117	20185.7	14.55590	5.73067
12.90	150.0		7	0.117	16585.7	11.95994	4.70864
8.60	105.0		5	0.083	10836.0	7.81383	3.07631
12.30	105.0		7	0.117	11070.0	7.98257	3.14274
13.70	105.0		8	0.133	10788.8	7.77976	3.06290
6.80	105.0		4	0.067	10710.0	7.72297	3.04054
					Mean K:	7.82843	3.08206
					St. Dev.:	0.1365	0.0537

Average of "steady state" readings:

3.08 in/hr

This hole was presoaked

D

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/29/20	Permeameter #:	
Location:	Fox Family Farms	Air Temperature (F) initial:	84
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Marsh-Sandhill	[1]Soil Moisture Content (%):	moist
Pedon Number:	D	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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):		19.1
[2] *You want this value to be very close to 15 cm. (Record to nearest millimeter.)*		Initial:	19.1
		Final:	19.1
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!
3.50	150.0		13	0.217	2423.1	1.65434	0.65131
3.80	105.0		14	0.233	1710.0	1.16749	0.45964
3.80	105.0		13	0.217	1841.5	1.25729	0.49500
3.80	105.0		13	0.217	1841.5	1.25729	0.49500
1.50	105.0		5	0.083	1890.0	1.29038	0.50802
					Mean K:	1.26832	0.49934
					St. Dev.:	0.0191	0.0075

Average of "steady state" readings:

0.50 in/hr

This hole was presoaked

E

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/29/20	Permeameter #:	
Location:	Fox Family Farms	Air Temperature (F) initial:	85
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Marsh-Sandhill	[1]Soil Moisture Content (%):	moist
Pedon Number:	E	*[1] If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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):	18.4
[2] You want this value to be very close to 15 cm. (Record to nearest millimeter.)	Initial:	18.4
	Final:	18.4
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
4.95	105.0		10	0.167	3118.5	2.24875	0.88533
5.15	105.0		10	0.167	3244.5	2.33961	0.92110
5.40	105.0		10	0.167	3402.0	2.45318	0.96582
6.30	105.0		11	0.183	3608.2	2.60186	1.02435
12.10	150.0		20	0.333	5445.0	3.92638	1.54582
8.40	105.0		14	0.233	3780.0	2.72575	1.07313
12.30	105.0		18	0.300	4305.0	3.10433	1.22218
6.90	105.0		10	0.167	4347.0	3.13462	1.23410
6.90	105.0		10	0.167	4347.0	3.13462	1.23410
					Mean K:	3.12452	1.23013
					St. Dev.:	0.0175	0.0069

Average of "steady state" readings:

1.23 in/hr

This hole was presoaked

F

Amoozemeter Data Sheet

User(s): Lonnie Norrod Soil Consulting LLC
Date: 7/29/20
Permeameter #:
Location: Fox Family Farms
Air Temperature (F) initial: 86
Soil Survey Area/Special Project:
Air Temperature (F) final:

Series or Map Unit Component: Marsh-Sandhill
Pedon Number: F
Horizon Tested:
[1]Soil Moisture Content (%): moist

[1] If not known, give a relative soil moisture content. i.e. 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!
2.85	105.0		10	0.167	1795.5	1.70534	0.67139
2.30	150.0		10	0.167	2070.0	1.96606	0.77404
3.00	105.0		10	0.167	1890.0	1.79510	0.70673
5.80	105.0		22	0.367	1660.9	1.57751	0.62107
4.95	105.0		18	0.300	1732.5	1.64551	0.64784
5.45	105.0		19	0.317	1807.1	1.71636	0.67573
					Mean K:	1.64646	0.64821
					St. Dev:	0.0694	0.0273

Average of "steady state" readings:

0.65 in/hr

This hole was presoaked

G

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/29/20	Permeameter #:	
Location:	Fox Family Farms	Air Temperature (F) initial:	87
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Marsh-Sandhill	[1]Soil Moisture Content (%):	moist
Pedon Number:	G	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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 Conversion Factor:]	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!
7.95	105.0		22	0.367	2276.6	2.16228	0.85129
7.55	150.0		23	0.383	2954.3	2.80600	1.10472
3.50	105.0		12	0.200	1837.5	1.74523	0.68710
2.85	105.0		10	0.167	1795.5	1.70534	0.67139
4.80	105.0		18	0.300	1680.0	1.59564	0.62821
3.80	105.0		14	0.233	1710.0	1.62413	0.63942
					Mean K:	1.64171	0.64634
					St. Dev:	0.0569	0.0224

Average of "steady state" readings:

0.65 in/hr

This hole was presoaked

H

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/29/20	Permeameter #:	
Location:	Fox Family Farms	Air Temperature (F) initial:	86
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Marsh	[1]Soil Moisture Content (%):	moist
Pedon Number:	H	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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!
2.00	105.0		15	0.250	840.0	0.79782	0.31410
2.90	105.0		22	0.367	830.5	0.78875	0.31053
3.65	150.0		23	0.383	1428.3	1.35654	0.53407
4.05	105.0		23	0.383	1109.3	1.05364	0.41482
4.00	105.0		21	0.350	1200.0	1.13974	0.44872
3.10	105.0		16	0.267	1220.6	1.15933	0.45643
3.30	105.0		17	0.283	1222.9	1.16153	0.45730
					Mean K:	1.15354	0.45415
					St. Dev:	0.0120	0.0047

Average of "steady state" readings:

0.45 in/hr

This hole was presoaked

I

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/31/20	Permeameter #:	
Location:	Fox Family Farms	Air Temperature (F) initial:	86
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Marsh-Maury	[1]Soil Moisture Content (%):	moist
Pedon Number:	I	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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):	14.6
[2] *You want this value to be very close to 15 cm. (Record to nearest millimeter.)*	Initial:	14.6
	Final:	14.6
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!
10.75	105.0		15	0.250	4515.0	4.54043	1.78757
11.70	105.0		16	0.267	4606.9	4.63282	1.82394
12.30	105.0		17	0.283	4558.2	4.58390	1.80469
					Mean K:	4.58572	1.80540
					St. Dev:	0.0462	0.0182

Average of "steady state" readings:

1.81in/hr

This hole was presoaked

J

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/31/20	Permeameter #:	
Location:	Fox Family Farms	Air Temperature (F) initial:	82
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Marsh-Maury	[1]Soil Moisture Content (%):	moist
Pedon Number:	J	*[1] If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
16.60	105.0		21	0.350	4980.0	4.43554	1.74628
16.70	105.0		21	0.350	5010.0	4.46226	1.75680
16.60	105.0		21	0.350	4980.0	4.43554	1.74628
					Mean K:	4.44445	1.74978
					St. Dev.:	0.0154	0.0061

Average of "steady state" readings:

1.75 in/hr

This hole was presoaked

K

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/29/20	Permeameter #:	
Location:	Fox Family Farms	Air Temperature (F) initial:	82
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Marsh-Maury	[1]Soil Moisture Content (%):	moist
Pedon Number:	K	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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!
2.95	105.0		13	0.217	1429.6	1.35783	0.53458
3.05	105.0		13	0.217	1478.1	1.40386	0.55270
4.50	105.0		16	0.267	1771.9	1.68290	0.66256
4.45	105.0		13	0.217	2156.5	2.04825	0.80640
3.30	105.0		11	0.183	1890.0	1.79510	0.70673
3.00	105.0		10	0.167	1890.0	1.79510	0.70673
					Mean K:	1.87948	0.73995
					St. Dev:	0.1462	0.0575

Average of "steady state" readings:

0.74 in/hr

This hole was presoaked

L

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/29/20	Permeameter #:	
Location:	Fox Family Farms	Air Temperature (F) initial:	82
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Marsh-Maury	[1]Soil Moisture Content (%):	moist
Pedon Number:	L	*[1] If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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!
				0.000	#DIV/0!	#DIV/0!	#DIV/0!
15.50	105.0		10	0.167	9765.0	7.39006	2.90947
7.60	105.0		5	0.083	9576.0	7.24703	2.85316
9.40	105.0		5	0.083	11844.0	8.96343	3.52891
20.40	105.0		11	0.183	11683.6	8.84207	3.48113
9.20	105.0		5	0.083	11592.0	8.77272	3.45383
					Mean K:	8.85941	3.48796
					St. Dev.:	0.0965	0.0380

Average of "steady state" readings:

3.49 in/hr

This hole was presoaked

M

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/31/20	Permeameter #:	
Location:	Roberts Property	Air Temperature (F) initial:	85
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Hampshire	[1]Soil Moisture Content (%):	moist
Pedon Number:	M	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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!
3.40	105.0		48	0.800	446.3	0.42384	0.16687
2.80	105.0		33	0.550	534.5	0.50770	0.19988
1.50	105.0		16	0.267	590.6	0.56097	0.22085
4.60	105.0		44	0.733	658.6	0.62556	0.24629
					Mean K:	0.56475	0.22234
					St. Dev:	0.0590	0.0232

Average of "steady state" readings:

0.22 in/hr

N

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/31/20	Permeameter #:	
Location:	Roberts Property	Air Temperature (F) initial:	76
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Hampshire	[1]Soil Moisture Content (%):	moist
Pedon Number:	N	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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):		19.1
[2] *You want this value to be very close to 15 cm. (Record to nearest millimeter.)*		Initial:	19.1
		Final:	19.1
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!
7.50	105.0		16	0.267	2953.1	2.01622	0.79379
5.35	105.0		16	0.267	2106.6	1.43824	0.56624
5.85	105.0		20	0.333	1842.8	1.25812	0.49532
7.05	105.0		27	0.450	1645.0	1.12311	0.44217
6.65	105.0		27	0.450	1551.7	1.05939	0.41708
5.10	105.0		20	0.333	1606.5	1.09682	0.43182
2.00	105.0		8	0.133	1575.0	1.07532	0.42335
					Mean K:	1.07718	0.42409
					St. Dev:	0.0188	0.0074

Average of "steady state" readings:

0.42 in/hr

O

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/31/20	Permeameter #:	
Location:	Roberts Property	Air Temperature (F) initial:	76
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Wolftever-Hampshire	[1]Soil Moisture Content (%):	moist
Pedon Number:	O	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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
3.35	105.0		24	0.400	879.4	0.83522	0.32883
2.80	105.0		17	0.283	1037.6	0.98554	0.38801
3.45	105.0		20	0.333	1086.8	1.03218	0.40637
4.90	105.0		26	0.433	1187.3	1.12769	0.44397
5.80	105.0		27	0.450	1353.3	1.28538	0.50605
9.20	105.0		38	0.633	1525.3	1.44867	0.57034
4.60	105.0		18	0.300	1610.0	1.52916	0.60203
4.60	105.0		19	0.317	1525.3	1.44867	0.57034
2.40	105.0		10	0.167	1512.0	1.43608	0.56538
					Mean K:	1.47130	0.57925
					St. Dev:	0.0505	0.0199

Average of "steady state" readings:

0.58 in/hr

P

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/31/20	Permeameter #:	
Location:	Roberts Property	Air Temperature (F) initial:	86
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Wolftever-Hampshire	[1]Soil Moisture Content (%):	moist
Pedon Number:	P	[1] *If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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):		
[2] *You want this value to be very close to 15 cm. (Record to nearest millimeter.)*		Initial:	
		Final:	
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!
2.70	105.0		15	0.250	1134.0	#DIV/0!	#DIV/0!
3.20	105.0		24	0.400	840.0	#DIV/0!	#DIV/0!
FLOODED	105.0		FLOODED	#VALUE!	#VALUE!	#VALUE!	#VALUE!
					Mean K:	#DIV/0!	#DIV/0!
					St. Dev:	#DIV/0!	#DIV/0!

Average of "steady state" readings:

N/A

A heavy rain fall event occurred during this test and flooded the test hole. No results

Q

Amoozemeter Data Sheet

User(s):	Lonnie Norrod Soil Consulting LLC		
Date:	7/31/20	Permeameter #:	
Location:	Roberts Property	Air Temperature (F) initial:	86
Soil Survey Area/Special Project:		Air Temperature (F) final:	

Series or Map Unit Component:	Wolftever-Hampshire	[1]Soil Moisture Content (%):	moist
Pedon Number:	Q	*[1] If not known, give a relative soil moisture content. i.e. dry, moist, or wet.*	
Horizon Tested:			

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!
0.20	105.0		20	0.333	63.0	0.05984	0.02356
0.50	105.0		24	0.400	131.3	0.12466	0.04908
0.40	105.0		20	0.333	126.0	0.11967	0.04712
0.20	105.0		10	0.167	126.0	0.11967	0.04712
					Mean K:	0.12134	0.04777
					St. Dev:	0.0029	0.0011

Average of "steady state" readings:

0.05 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: 0 - 4

Grower: LONNIE NORROD CONS
Farm ID: B
Field ID:
Lab Number: 149252SO
Layer ID:

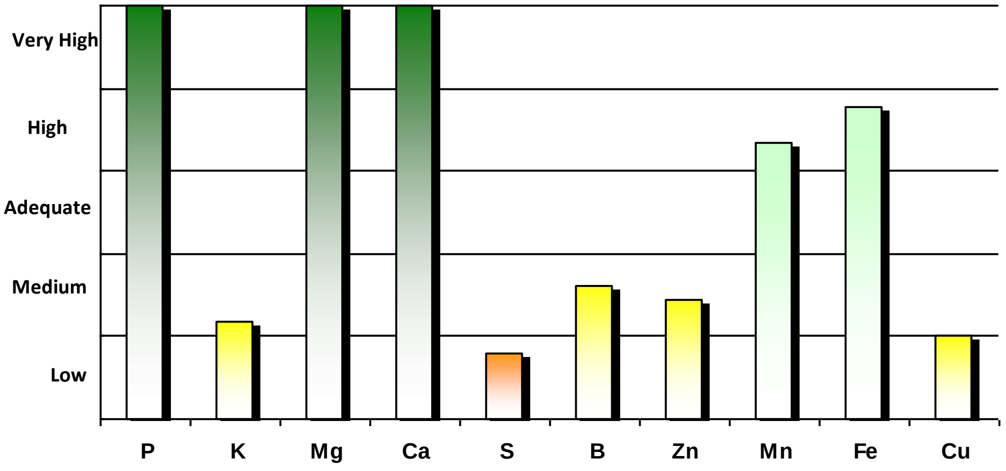
Received: 7/30/2020
Processed: 8/3/2020

Test Method: Mehlich III — **Soil Laboratory Data (lbs/a)** — **Target pH** 6.5

P Phosphorus	K Potassium	Mg Magnesium	Ca Calcium	Soil pH	Buffer pH Adams-Evans	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
206 VH	142 M	491 VH	3292 VH	6.7	7.65	20 L	1.3 M	4.9 M	270 H	354 H	1.5 M

Al Aluminum	Na Sodium	NO3-N Nitrate-N	NH4 Ammonia	Soluble Salts	Organic Matter	ENR	Mo Molybdenum	Ni Nickel	BiCarbs	
	13	ppm	ppm	mmhos/cm	2.46 %	49	ppm	ppm	meq/L	

Soil Analysis Ratings

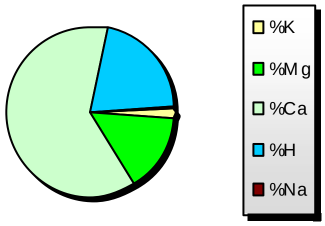


Cation Exchange Capacity 13.3 meq/100g

Base Saturation

K:	1.4 %	**Mg:**	15.4 %
Ca:	61.9 %	**H:**	21.1 %
Na:	0.2 %		

Base Saturation



Crop: NO CROP — **Fertility Recommendations (lbs/a)** — **Yield:**

Lime Tons/Acre	Gypsum Tons/Acre	N Nitrogen	P205 Phosphate	K20 Potash	Mg Magnesium	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper

* = Maintenance Recommendation

Comments

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: 0-4

Grower: LONNIE NORROD CONS
Farm ID: G
Field ID:
Lab Number: 149253SO
Layer ID:

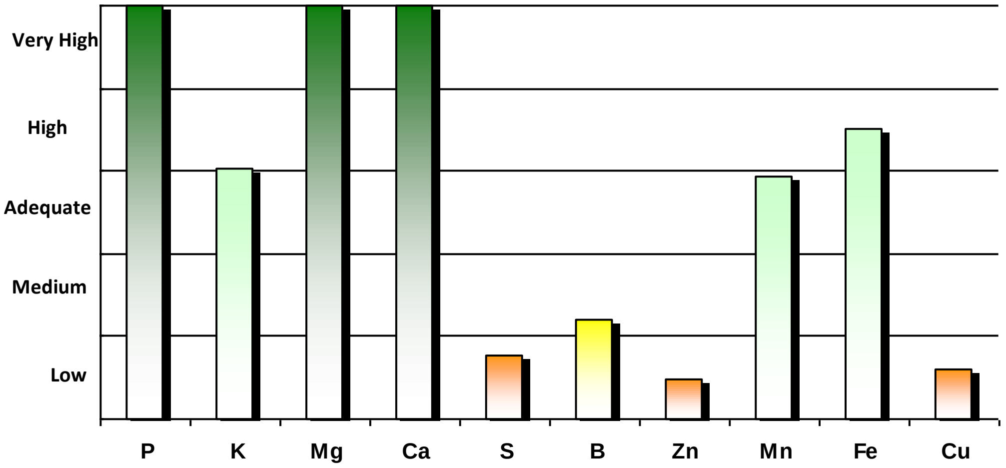
Received: 7/30/2020
Processed: 8/3/2020

Test Method: Mehlich III — **Soil Laboratory Data (lbs/a)** — **Target pH** 6.5

P Phosphorus	K Potassium	Mg Magnesium	Ca Calcium	Soil pH	Buffer pH Adams-Evans	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
260 VH	328 H	439 VH	2823 VH	6.7	7.70	19 L	1.1 M	1.9 L	189 A	304 H	0.9 L

Al Aluminum	Na Sodium	NO3-N Nitrate-N	NH4 Ammonia	Soluble Salts	Organic Matter	ENR	Mo Molybdenum	Ni Nickel	BiCarbs	
	10	ppm	ppm	mmhos/cm	2.76 %	55	ppm	ppm	meq/L	

Soil Analysis Ratings

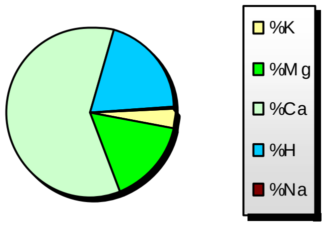


Cation Exchange Capacity 11.7 meq/100g

Base Saturation

K:	3.6 %	**Mg:**	15.6 %
Ca:	60.2 %	**H:**	20.5 %
Na:	0.2 %		

Base Saturation



Crop: NO CROP — **Fertility Recommendations (lbs/a)** — **Yield:**

Lime Tons/Acre	Gypsum Tons/Acre	N Nitrogen	P205 Phosphate	K20 Potash	Mg Magnesium	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper

* = Maintenance Recommendation

Comments

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: 0-4

Grower: LONNIE NORROD CONS
Farm ID: K
Field ID:
Lab Number: 149254SO
Layer ID:

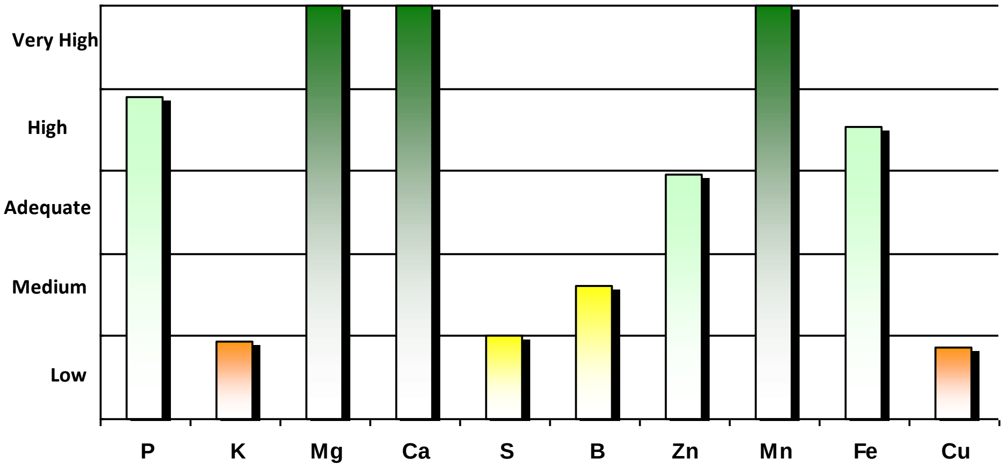
Received: 7/30/2020
Processed: 8/3/2020

Test Method: Mehlich III **Soil Laboratory Data (lbs/a)** **Target pH** 6.5

P Phosphorus	K Potassium	Mg Magnesium	Ca Calcium	Soil pH	Buffer pH Adams-Evans	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
195 H	117 L	586 VH	3325 VH	7.4	7.80	25 M	1.3 M	9.8 A	474 VH	307 H	1.3 L

Al Aluminum	Na Sodium	NO3-N Nitrate-N	NH4 Ammonia	Soluble Salts	Organic Matter	ENR	Mo Molybdenum	Ni Nickel	BiCarbs	
	16	ppm	ppm	mmhos/cm	2.08 %	42	ppm	ppm	meq/L	

Soil Analysis Ratings

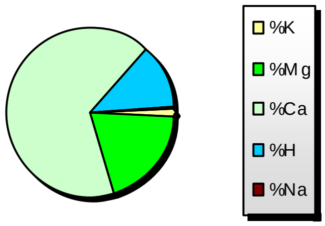


Cation Exchange Capacity 12.5 meq/100g

Base Saturation

K: 1.2 %	**Mg:** 19.5 %
Ca: 66.3 %	**H:** 12.8 %
Na: 0.3 %	

Base Saturation



Crop: NO CROP **Fertility Recommendations (lbs/a)** **Yield:**

Lime Tons/Acre	Gypsum Tons/Acre	N Nitrogen	P205 Phosphate	K20 Potash	Mg Magnesium	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper

* = Maintenance Recommendation

Comments

WATERS AGRICULTURAL LABORATORIES, INC.

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: 0-4

Grower: LONNIE NORROD CONS
Farm ID: N
Field ID:
Lab Number: 149255SO
Layer ID:

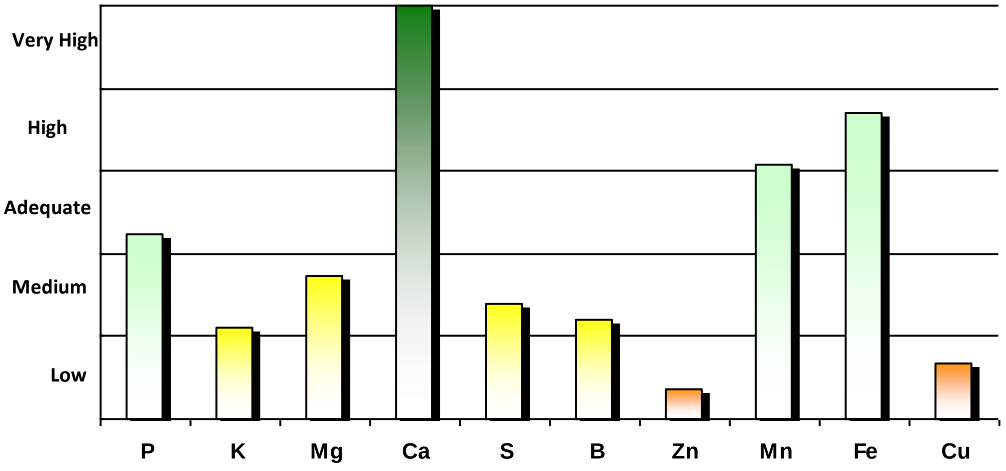
Received: 7/30/2020
Processed: 8/3/2020

Test Method: Mehlich III **Soil Laboratory Data (lbs/a)** **Target pH** 6.5

P Phosphorus	K Potassium	Mg Magnesium	Ca Calcium	Soil pH	Buffer pH Adams-Evans	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
112 A	136 M	136 M	2447 VH	6.1	7.70	35 M	1.1 M	1.4 L	217 H	342 H	1 L

Al Aluminum	Na Sodium	NO3-N Nitrate-N	NH4 Ammonia	Soluble Salts	Organic Matter	ENR	Mo Molybdenum	Ni Nickel	BiCarbs	
	20	ppm	ppm	mmhos/cm	2.02 %	40	ppm	ppm	meq/L	

Soil Analysis Ratings

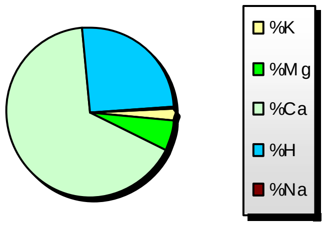


Cation Exchange Capacity 9.3 meq/100g

Base Saturation

K:	1.9 %	Mg:	6.1 %
Ca:	65.8 %	H:	25.8 %
Na:	0.5 %		

Base Saturation



Crop: NO CROP **Fertility Recommendations (lbs/a)** **Yield:**

Lime Tons/Acre	Gypsum Tons/Acre	N Nitrogen	P205 Phosphate	K20 Potash	Mg Magnesium	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
0.5											

* = Maintenance Recommendation

Comments

WATERS AGRICULTURAL LABORATORIES, INC.

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: 0-4

Grower: LONNIE NORROD CONS
Farm ID: P
Field ID:
Lab Number: 149256SO
Layer ID:

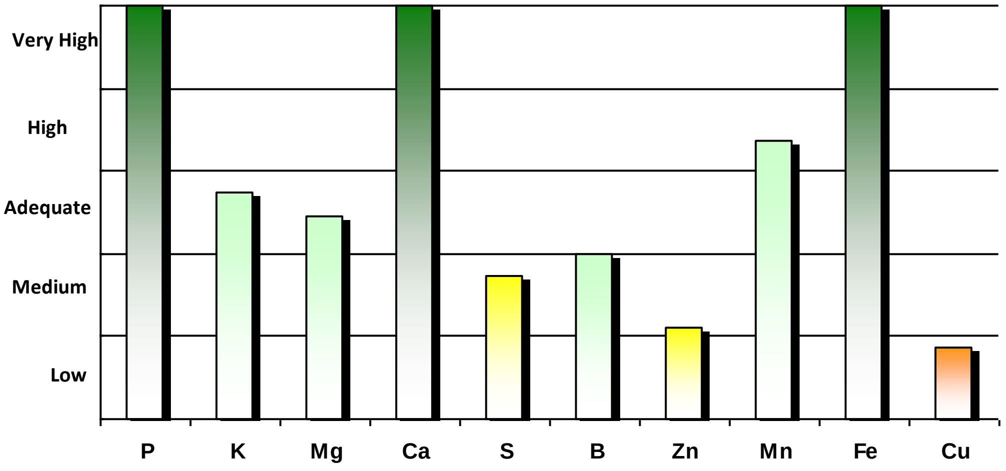
Received: 7/30/2020
Processed: 8/3/2020

Test Method: Mehlich III | **Soil Laboratory Data (lbs/a)** | **Target pH 6.5**

P Phosphorus	K Potassium	Mg Magnesium	Ca Calcium	Soil pH	Buffer pH Adams-Evans	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
234 VH	299 A	196 A	2481 VH	4.9	7.30	43 M	1.5 A	4.2 M	274 H	593 VH	1.3 L

Al Aluminum	Na Sodium	NO3-N Nitrate-N	NH4 Ammonia	Soluble Salts	Organic Matter	ENR	Mo Molybdenum	Ni Nickel	BiCarbs	
	18	ppm	ppm	mmhos/cm	4.38 %	88	ppm	ppm	meq/L	

Soil Analysis Ratings

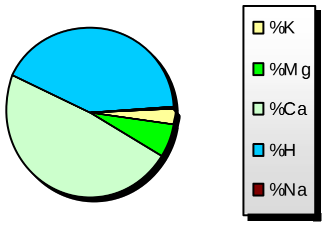


Cation Exchange Capacity	13.0	meq/100g

Base Saturation

K:	2.9 %	**Mg:**	6.3 %
Ca:	47.6 %	**H:**	42.9 %
Na:	0.3 %		

Base Saturation



Crop: NO CROP | **Fertility Recommendations (lbs/a)** | **Yield:**

Lime Tons/Acre	Gypsum Tons/Acre	N Nitrogen	P205 Phosphate	K20 Potash	Mg Magnesium	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
3.6											

* = Maintenance Recommendation

Comments

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

Project Information:

Grower: LONNIE NORROD
Farm ID: LONNIE NORROD
Field ID: 6-12

Received: 7/30/2020
Processed: 7/31/2020

Lab ID	Sample ID	NO3-N ppm				
1784X	B	1.00				
1786X	G	0.44				
1788X	K	0.69				
1790X	N	2.70				
1792X	P	8.98				

BDL = Below Detection Limit **-- = Analysis Not Performed For Analyte**

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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
Farm: LONNIE NORROD
Field: 16-20

Received: 7/30/2020
Processed: 8/3/2020

Sample ID	Lab Number	Soil Classification	% Silt+Clay	%Sand	%Clay	%Silt			
B	1785	CLAY LOAM	74.56	25.44	33.20	41.36			
G	1787	CLAY LOAM	62.40	37.60	31.16	31.24			
K	1789	CLAY LOAM	70.72	29.28	29.36	41.36			
N	1791	CLAY LOAM	74.92	25.08	31.20	43.72			
P	1793	CLAY LOAM	79.20	20.80	31.40	47.80			

Comments

STEG System Design - Wastewater Site Plan

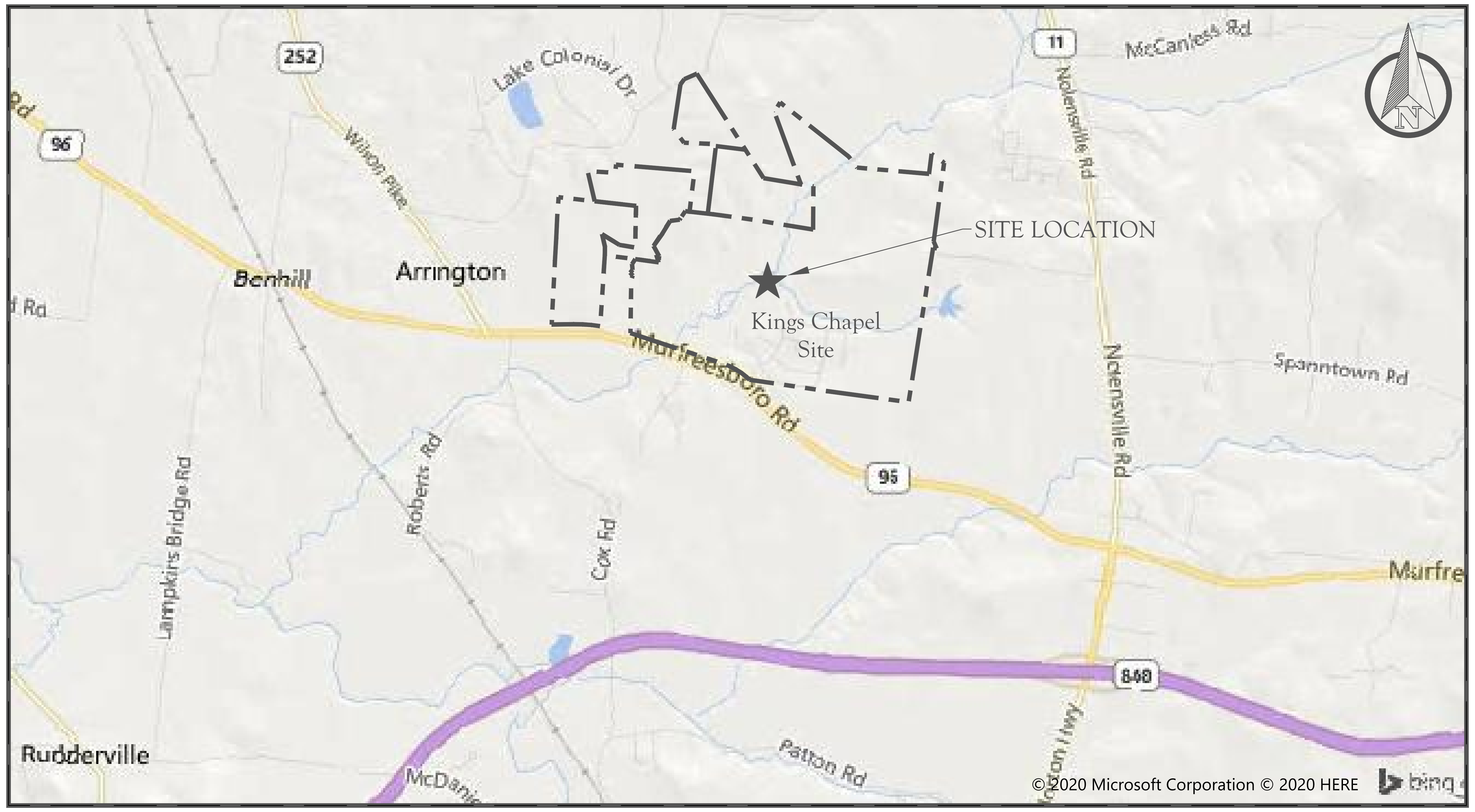
for

KINGS’ CHAPEL

Community

Date: August 26, 2020
Utility District: Superior Wastewater System
PO Box 190 Arrington, TN 37014 - Williamson County.

DRAWING INDEX



VICINITY MAP
NOT TO SCALE

KING'S CHAPEL Developer:

JP Properties LLC	Acreage of Parcel 214.04
PO Box 190	DB 7604, DP 823
Arrington, TN 37014	Map 018, Parcel 109

Floodplain Note:

A portion of this site is within the 100 year floodplain.
CP 47187C0240F & CP 47187C0380F Dated 09.26.2006

Land Data: Zoning: RD-1

STEG System Data:

Design Flow (KC) = 449 Lots x 300 gpd/lot = 134,700 gpd average daily design flow.
Plus Clubhouse at 1,500 gpd, Total=136,200 gpd average daily sewer flow.
Design Flow (Excess Capacity) = 107 Lots (2019 DDR) + 122 (2020 DDR) =229 lots x 300 gpd/lot = 68,700 gpd average daily sewer flow.
Total Design Flow: 136,200 gpd + 38,700 gpd = 204,900 gpd average daily sewer flow.
Land Application Area Required + 100% Reserve = 30.42 acres
Land Application Area Provided = 30.42 Acres

Approved by the Williamson County Planning Commission, with such conditions as are indicated in the minutes of the Commission on __________.

NOTES:

1. THIS PROPERTY HAS BEEN REVIEWED FOR THE EXISTENCE OF INTERMITTENT AND PERENNIAL STREAMS. STREAMS THAT WOULD REQUIRE WATERWAY NATURAL AREAS AS DESCRIBED IN SECTION 4 OF THE WILLIAMSON COUNTY STORM WATER MANAGEMENT REGULATIONS HAVE BEEN LOCATED AS SHOW.

2. THE SITE HAS BEEN REVIEWED FOR THE PRESENCE OF STEEP SLOPES, HILLTOPS AND RIDGETOPS, SLIPPAGE SOILS, AND KARST FEATURES. NONE OF THE MENTIONED FEATURES ARE PRESENT ON THIS SITE.

3. THIS SITE HAS BEEN REVIEWED FOR THE PRESENCE OF STEEP SLOPES, HILLTOPS AND RIDGETOPS, SLIPPAGE SOILS, AND KARST FEATURES. AREAS FALLING WITHIN THIS CATEGORIES ARE NOTED ON THIS PLAN.

4. ALL COMPONENTS OF THE WASTEWATER TREATMENT SYSTEM ARE ON SLOPES LESS THAN 15%.

County Engineering:
Williamson County Engineering Dept.
Suite 400
1320 West Main Street
Franklin, TN 37064
(615) 790-5809

Middle Tennessee Electric Membership Corp.
2156 Edward Curd Lane
Franklin, TN 37067
1 (877) 777-9020

Milcrofton Utility District (WATER)
6333 Arno Road
Franklin, TN 37064
(615) 794-5947

CIVIL INFRASTRUCTURE ASSOCIATES
307 HICKERSON DRIVE
MURFREESBORO, TN 37129
PHONE: 615-663-7678 www.cia-engineers.com
CIA CONTACTS: LINDA J. SULLIVAN, P.E. / MARK S. WARNER II

GRADING AND DRAINAGE NOTES:

1. EPSCS SHALL BE INSTALLED BEFORE THE COMMENCEMENT OF EARTHWORK.
2. INSPECTIONS OF OUTFALLS/EPSC MEASURES SHALL BE CONDUCTED AT LEAST TWICE WEEKLY AND AT LEAST 72 HOURS APART. SEDIMENT SHALL BE REMOVED FROM SILT FENCING WHEN REACHING $\frac{1}{3}$ THE HEIGHT OF THE FENCE. CONTRACTOR TO REMOVE SEDIMENT AS RECOMMENDED IN THE TNEPSC HANDBOOK.
3. ALL NECESSARY BEST MANAGEMENT PRACTICES SHALL BE INSTALLED AND MAINTAINED REGULARLY TO PREVENT ALL POSSIBLE SEDIMENT FROM EXITING THE SITE.
4. THE PROPOSED CONTOURS AND ELEVATIONS INDICATE FINISHED SURFACE GRADE.
5. THE GENERAL CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO AVOID DAMAGE TO ADJACENT PROPERTIES DURING CONSTRUCTION. THE CONTRACTOR WILL BE HELD SOLELY RESPONSIBLE FOR ANY DAMAGES TO ADJACENT PROPERTIES OCCURRING DURING CONSTRUCTION OF THIS PROJECT. NO WORK SHALL BE PERFORMED OUTSIDE THE PROJECT BOUNDARY WITHOUT PROPER AGREEMENTS WITH THE AFFECTED PROPERTY OWNERS.
6. THE GENERAL CONTRACTOR SHALL BE SOLELY AND COMPLETELY RESPONSIBLE FOR JOB SITE CONDITIONS, INCLUDING THE SAFETY OF ALL PERSONS AND PROPERTY DURING CONSTRUCTION. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND IS NOT LIMITED TO NORMAL WORKING HOURS.
7. THE LOCATION AND/OR ELEVATION OF THE EXISTING UTILITIES SHOWN HEREON ARE BASED ON UTILITY COMPANY RECORDS, AND WHERE POSSIBLE, FIELD MEASUREMENTS. THE CONTRACTOR SHALL NOT RELY UPON THIS INFORMATION AS BEING EXACT OR COMPLETE. THE CONTRACTOR SHALL CALL THE APPROPRIATE UTILITY COMPANY AT LEAST 3 DAYS BUT NOT MORE THAN 10 DAYS PRIOR TO ANY EXCAVATION AND REQUEST FIELD VERIFICATION OF UTILITY LOCATIONS. THE CONTRACTOR SHALL VERIFY THE LOCATION AND DEPTH OF ALL UTILITIES TO REMAIN. THE CONTRACTOR SHALL REPAIR OR REPLACE ANY DAMAGED UTILITIES ACCORDING TO LOCAL CODES AT THE CONTRACTORS EXPENSE.
8. THE CONTRACTOR SHALL CHECK ALL EXISTING AND FINISHED GRADES, DIMENSIONS, ETC. PRIOR TO BEGINNING WORK. NOTIFY THE OWNERS REPRESENTATIVE OF ANY DISCREPANCIES AND/OR ERRORS IN THE PLANS PRIOR TO COMMENCING WORK.
9. TOPSOIL AND OTHER MATERIALS NOT SUITABLE FOR FILL OR REUSE SHALL BE DISPOSED OF OFFSITE IN ACCORDANCE WITH THE REQUIREMENTS OF WILLIAMSON COUNTY AND AS DIRECTED BY THE OWNER OR THEIR REPRESENTATIVE.
8. THE CONTRACTOR SHALL COMPLY WITH ALL PERTINENT O.S.H.A. PROVISIONS AND THE MANUAL OF ACCIDENT PREVENTION AND CONSTRUCTION, ISSUED BY THE AGC OF AMERICA, INCORPORATED, AND THE SAFETY AND HEALTH REGULATIONS OF CONSTRUCTION ISSUED BY THE U.S. DEPARTMENT OF LABOR.
9. THE CONTRACTOR SHALL CONFORM TO ALL APPLICABLE LOCAL, STATE, AND FEDERAL CODES.
10. THE CONTRACTOR SHALL PROVIDE POSITIVE DRAINAGE THROUGH THE SITE DURING ALL PHASES OF CONSTRUCTION.
11. EXCAVATED SUBGRADES AND EACH LAYER OF FILL SHALL BE OF A QUALITY ACCEPTABLE TO THE OWNERS REPRESENTATIVE AND SHALL NOT INCLUDE ORGANIC MATERIAL, BOULDERS, DEBRIS, WET MATERIAL, ETC. CUT OR STRIPPED AREAS SHALL BE PROOF ROLLED PRIOR TO ANY FILLING. ALL GRADING ACTIVITY AND PLACEMENT OF MATERIAL SHALL BE MONITORED BY A QUALIFIED GEOTECHNICAL ENGINEER (OR THEIR REPRESENTATIVE), OR AS DIRECTED BY THE OWNERS REPRESENTATIVE. MATERIAL SHALL MEET OR EXCEED COMPACTION REQUIREMENTS AS RECOMMENDED BY THE GEOTECHNICAL ENGINEER.
12. ALL CONSTRUCTION MATERIALS, PAVEMENT MATERIALS, ROADWAY AND SIDEWALK CONSTRUCTION SHALL CONFORM TO LOCAL CODES AND/OR DOT STANDARDS AND SPECIFICATIONS.

SITE PLAN NOTES:

1. BASE INFORMATION WAS TAKEN FROM A SURVEY. CONTRACTOR TO NOTIFY ENGINEER OF ANY DISCREPANCIES BEFORE COMMENCEMENT OF WORK.
2. ALL SITE CONSTRUCTION MATERIALS AND WORKMANSHIP, INCLUDING BUT NOT LIMITED TO PAVING, STRIPING, AND CONCRETE SHALL CONFORM TO THE CURRENT STANDARD SPECIFICATIONS, DETAILS AND REQUIREMENTS OF WILLIAMSON COUNTY AND/OR T.D.O.T.
3. THE CONTRACTOR SHALL CHECK AND VERIFY ALL EXISTING CONDITIONS, UTILITIES, AND DIMENSIONS IN THE FIELD PRIOR TO BEGINNING CONSTRUCTION. IF ANY DISCREPANCIES AND/OR ERRORS ARE FOUND ON THE DRAWINGS OR IF PROBLEMS ARE ENCOUNTERED DURING CONSTRUCTION, THE CONTRACTOR SHALL NOTIFY THE ENGINEER BEFORE PROCEEDING WITH THE WORK.
4. THE CONTRACTOR SHALL PROTECT ANY EXISTING UTILITIES, TREES, BUILDINGS, ETC. THAT ARE TO REMAIN. CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGES.
5. THE CONTRACTOR SHALL GIVE ALL NECESSARY NOTICES, OBTAIN ALL NECESSARY PERMITS, AND PAY ALL APPLICABLE FEES. CONTRACTOR TO ABIDE BY ALL LOCAL CODES.
6. SHOULD ANY DAMAGES OCCUR DURING EITHER ON-SITE OR OFF-SITE CONSTRUCTION TO ANY IMPROVEMENTS TO REMAIN (SUCH AS UTILITIES, PAVEMENTS, FENCES, ETC.) OR TO ANY SURVEY POINTS TO REMAIN (SUCH AS REFERENCE POINTS, PROPERTY CORNERS, ETC.) AND IF SAID DAMAGES ARE CAUSED BY OR ARE THE RESULT OF ACTIVITIES OF THE CONTRACTOR, HIS SUBCONTRACTORS, OR THE CARELESSNESS OR NEGLIGENCE OF HIS EMPLOYEES, THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIRING THE DAMAGED IMPROVEMENTS AND/OR POINTS.
7. CONTRACTOR SHALL VERIFY THE EXACT LOCATION OF ALL UTILITIES PRIOR TO BEGINNING CONSTRUCTION. UTILITY LINE LOCATIONS SHOWN HEREON ARE APPROXIMATE ONLY.

UTILITY PLAN NOTES:

1. ALL GAS, ELECTRIC, AND TELEPHONE SERVICE LINES AND EXTENSIONS ARE TO BE CONSTRUCTED TO THE RESPECTIVE UTILITY COMPANY SPECIFICATIONS. UTILITY DISCONNECTIONS TO BE COORDINATED WITH THE APPROPRIATE UTILITY COMPANY.
2. THE GENERAL CONTRACTOR IS PARTICULARLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF THE EXISTING UTILITIES SHOWN HEREON IS BASED ON UTILITY COMPANY RECORDS, AND WHERE POSSIBLE, FIELD MEASUREMENTS. THE CONTRACTOR SHALL NOT RELY UPON THIS INFORMATION AS BEING EXACT OR COMPLETE. THE CONTRACTOR SHALL CALL THE APPROPRIATE UTILITY COMPANY AT LEAST 48 HOURS PRIOR TO ANY EXCAVATION AND REQUEST FIELD VERIFICATION OF UTILITY LOCATIONS. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO RELOCATE EXISTING UTILITIES CONFLICTING WITH IMPROVEMENTS SHOWN HEREON IN ACCORDANCE WITH ALL LOCAL, STATE, AND FEDERAL REGULATIONS GOVERNING SUCH OPERATIONS.
3. BEFORE INSTALLATION OF WATER LINE, THE CONTRACTOR SHALL EXCAVATE AND VERIFY ALL CROSSINGS AND INFORM THE OWNER AND THE ENGINEER OF ANY CONFLICTS. THE ENGINEER WILL BE HELD HARMLESS IN THE EVENT HE IS NOT NOTIFIED OF DESIGN CONFLICTS PRIOR TO CONSTRUCTION.
4. ALL WATER AND SEWER CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH WILLIAMSON COUNTY STANDARD SPECIFICATIONS.
5. THE CONTRACTOR SHALL PAY ANY APPLICABLE WATER AND SEWERAGE SERVICES INSPECTION FEES.
6. MAINTAIN 10 FEET HORIZONTAL SEPARATION AND 18 INCHES OF VERTICAL SEPARATION (WATER OVER SEWER) BETWEEN SANITARY SEWERS AND WATER LINES WHERE POSSIBLE.
7. THE CONTRACTOR IS TO VERIFY THE EXACT LOCATION OF ALL EXISTING UTILITIES AND TAKE CARE TO PROTECT UTILITIES THAT ARE TO REMAIN. REPAIR ANY DAMAGE ACCORDING TO UTILITY STANDARDS AND AT THE CONTRACTOR'S EXPENSE. COORDINATE ALL CONSTRUCTION WITH THE APPROPRIATE UTILITY COMPANY.
8. ALL AND ANY FEES, LICENSES AND PERMITS NECESSARY FOR THIS CONSTRUCTION ARE TO BE OBTAINED PRIOR TO INITIATION OF CONSTRUCTION AND THE COST OF SAME TO BE BORNE BY THE CONTRACTOR.
9. CONTRACTOR SHALL EXERCISE EXTREME CAUTION IN THE USE OF EQUIPMENT IN AND AROUND OVERHEAD AND UNDERGROUND ELECTRICAL WIRES AND SERVICES. IF AT ANY TIME IN THE PURSUIT OF THIS WORK, THE CONTRACTOR MUST WORK IN THE CLOSE PROXIMITY OF THE ABOVE-NOTED WIRES, THE ELECTRIC COMPANY SHALL BE CONTACTED PRIOR TO SUCH WORK AND THE PROPER SAFETY MEASURES TAKEN. A THOROUGH EXAMINATION OF THE OVERHEAD AND UNDERGROUND WIRES IN THE PROJECT AREA SHOULD BE MADE BY THE CONTRACTOR PRIOR TO THE INITIATION OF CONSTRUCTION.
10. ALL PUBLIC WATER SYSTEMS SHALL BE CONSTRUCTED UTILIZING MATERIALS THAT AREA A.S.T.M. AND/OR A.W.W.A APPROVED.
11. PROVIDE A MINIMUM 36" OF COVER OVER ALL WATER LINES, 48" UNDER PAVEMENT.
12. THE OWNER/CONTRACTOR IS RESPONSIBLE FOR PROVIDING ALL MATERIALS AND INSTALLING ALL WATER INFRASTRUCTURE. THIS INCLUDES VALVES, HYDRANTS, METER BOXES, SERVICE LINES, WATER MAINS, TAPPING SLEEVES, TAPPING VALVES, SERVICE YOKES, ETC. THE ONLY COMPONENT THAT IS THE EXCEPTION IS THE WATER METER. THE OWNER/CONTRACTOR IS RESPONSIBLE FOR PURCHASING AND SHIPPING THE WATER METERS TO WADC FOR STORAGE, AND WADC WILL INSTALL METERS. WITH REGARD TO THE MAINLINE TAPS, THERE IS A $1,000 FEE FOR EACH MAINLINE TAP. THE CONTRACTOR WILL PROVIDE THE MATERIALS (TS&V) AND PERFORM ALL SITE WORK, AND WADC WILL MAKE THE TAPS. WADC PREFERS MUELLER STAINLESS STEEL TAPPING SLEEVES AND TAPPING VALVES.
13. ALL WATER LINE BENDS AND FITTINGS MUST HAVE KICKERS AS PER WADC STANDARD SPECIFICATIONS AND DETAILS.

NOTES:

1. THIS PROPERTY HAS BEEN REVIEWED FOR THE EXISTENCE OF INTERMITTENT AND PERENNIAL STREAMS. STREAMS THAT WOULD REQUIRE WATERWAY NATURAL AREAS AS DESCRIBED IN SECTION 4 OF THE WILLIAMSON COUNTY STORM WATER MANAGEMENT REGULATIONS HAVE BEEN LOCATED AS SHOW.
2. THE SITE HAS BEEN REVIEWED FOR THE PRESENCE OF STEEP SLOPES, HILLTOPS AND RIDGETOPS, SLIPPAGE SOILS, AND KARST FEATURES. NONE OF THE MENTIONED FEATURES ARE PRESENT ON THIS SITE.
3. THIS SITE HAS BEEN REVIEWED FOR THE PRESENCE OF STEEP SLOPES, HILLTOPS AND RIDGETOPS, SLIPPAGE SOILS, AND KARST FEATURES. AREAS FALLING WITHIN THIS CATEGORIES ARE NOTED ON THIS PLAN.
4. ALL COMPONENTS OF THE WASTEWATER TREATMENT SYSTEM ARE ON SLOPES LESS THAN 15%.

LEGEND:

WATER METER	◫
WATER VALVE	⊠
FIRE HYDRANT	☿
IRON PIN (SET)	◉
MANHOLE	◎
PROPERTY LINE	────
PROPOSED WATER LINE	── W ── W ──
PROPOSED 1.5" SEWER LINE	━━━━
PROPOSED 2" SEWER LINE	━━━━
PROPOSED 2.5" SEWER LINE	━━━━
PROPOSED 4" SEWER LINE	━━━━
FORCE MAIN	────
PUBLIC UTILITY & DRAINAGE EASEMENT	20' PUDE
MILCROFTON UTILITY DISTRICT EASEMENT	20' MUDEE
MINIMUM BUILDING SETBACK LINE	30' MBSL
EXISTING CONTOUR	830
EXISTING TREE LINE	
PHASE LINE	▬▬▬▬
PROPOSED CONTOUR	860
PROPOSED WATER LINE AIR RELEASE VALVE WITH BOX	ARV ●
PROPOSED LIMITS OF DISTURBANCE	────
PROPOSED FORCEMAIN SEWER	────
PROPOSED FORCEMAIN SEWER PVC CASING PIPE	──▭──
PROPOSED SEPTIC TANK	──▭
PROPOSED SIDEWALK	▨
PROPOSED CRUSHED STONE PAVING	▨

811

Know what's **below.**
Call before you dig.

NOTE:
ALL WORK TO BE CONDUCTED IN ACCORDANCE TO WILLIAMSON COUNTY SUBDIVISION REGULATIONS AND ZONING ORDINANCE.

CIVIL INFRASTRUCTURE ASSOCIATES

307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

LINDA J. SULLIVAN
NO. 023015
08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID
SOIL MAPPING PLAN

ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004
DRAWN BY: MSW
CHECKED BY: LJS

REVISIONS

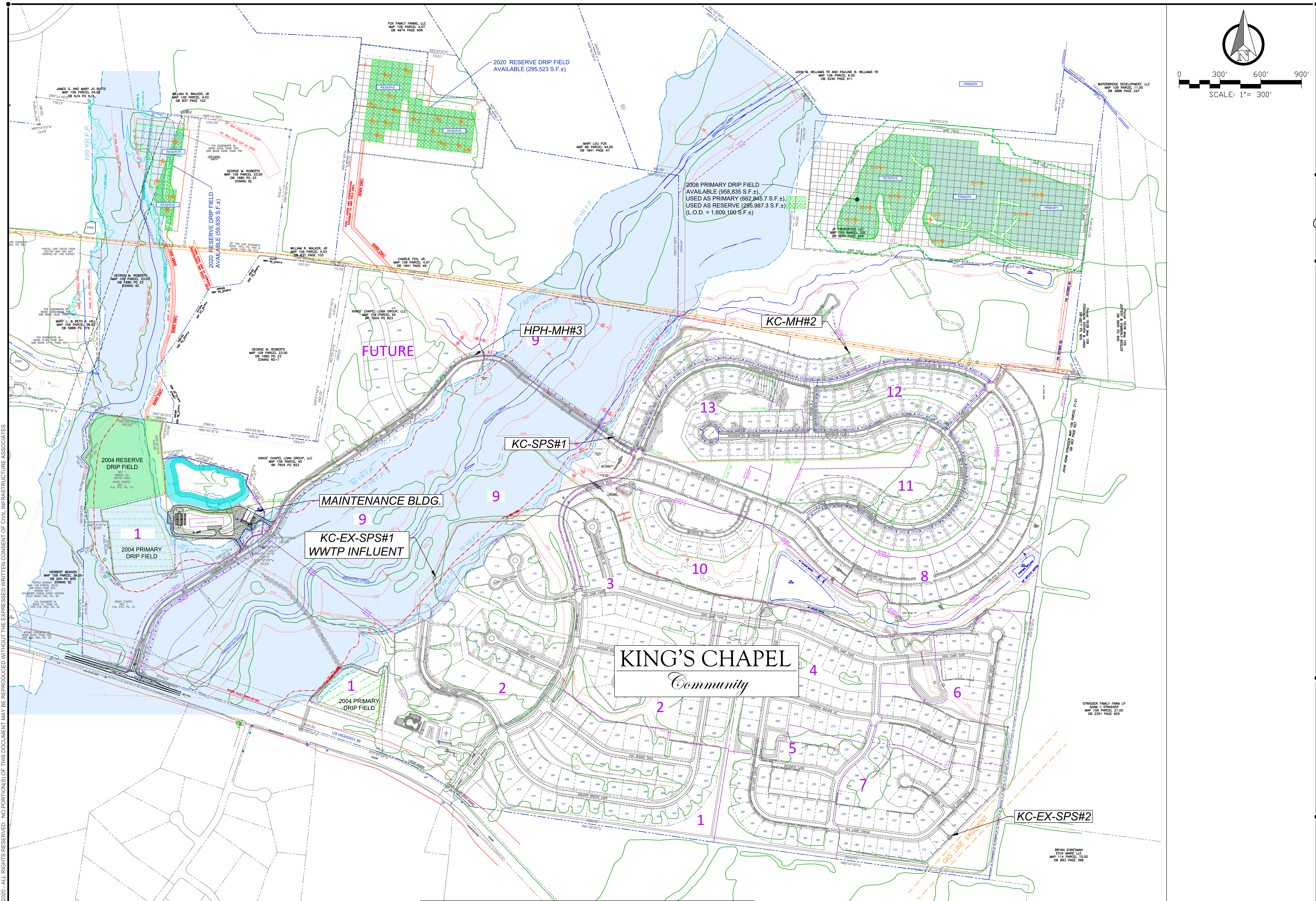
◇ PRE-BID SET ISSUE DATE
△ POST BID SET ISSUE DATE

DATE		DESCRIPTION

ORIGINAL ISSUE DATE: August 2020

GENERAL NOTES

C0.01



MASTER OVERALL SITE PLAN

CIVIL INFRASTRUCTURE ASSOCIATES
307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

LINDA J. SULLIVAN
NO. 023015
08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID
SOIL MAPPING PLAN
ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004
DRAWN BY: MSW
CHECKED BY: LJS

REVISIONS

◇ PRE-BID SET ISSUE DATE
△ POST BID SET ISSUE DATE

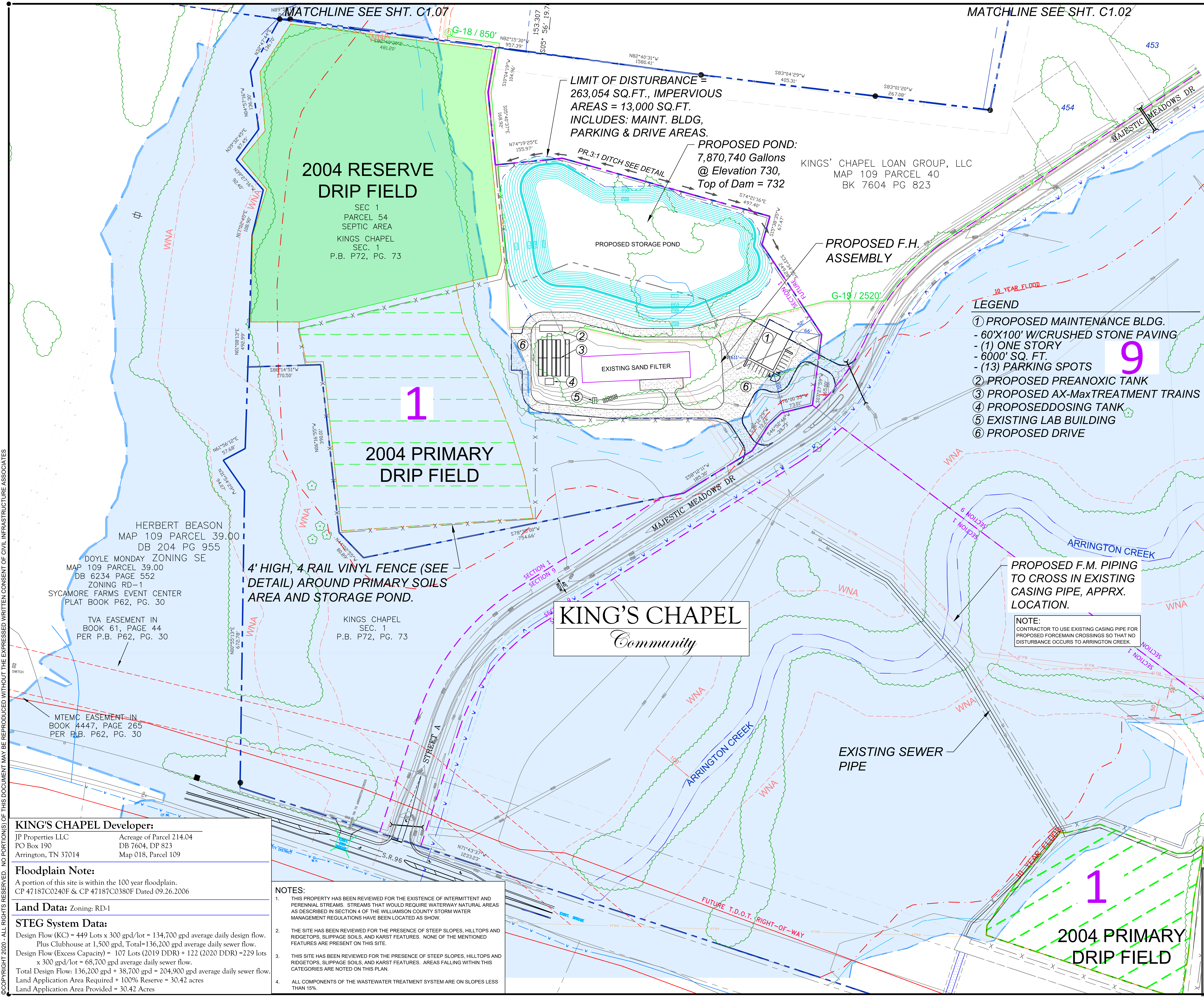
DATE		DESCRIPTION

ORIGINAL ISSUE DATE: August 2020

MASTER OVERALL SITE PLAN

C1.00

PLOT DATE: 8/26/2020 11:20:33 AM (MWARNER)



LEGEND

1. ① PROPOSED MAINTENANCE BLDG.
   - 60'X100' W/CRUSHED STONE PAVING
   - (1) ONE STORY
   - 6000' SQ. FT.
   - (13) PARKING SPOTS
2. ② PROPOSED PREANOXIC TANK
3. ③ PROPOSED AX-MaxTREATMENT TRAINS
4. ④ PROPOSEDDOSING TANK
5. ⑤ EXISTING LAB BUILDING
6. ⑥ PROPOSED DRIVE

NOTE:
CONTRACTOR TO USE EXISTING CASING PIPE FOR PROPOSED FORCEMAIN CROSSINGS SO THAT NO DISTURBANCE OCCURS TO ARRINGTON CREEK.

KING'S CHAPEL Developer:

JP Properties LLC	Acreage of Parcel 214.04
PO Box 190	DB 7604, DP 823
Arrington, TN 37014	Map 018, Parcel 109

Floodplain Note:

A portion of this site is within the 100 year floodplain.
CP 47187C0240F & CP 47187C0380F Dated 09.26.2006

Land Data: Zoning: RD-1

STEG System Data:

Design Flow (KC) = 449 Lots x 300 gpd/lot = 134,700 gpd average daily design flow.
Plus Clubhouse at 1,500 gpd, Total=136,200 gpd average daily sewer flow.
Design Flow (Excess Capacity) = 107 Lots (2019 DDR) + 122 (2020 DDR) =229 lots x 300 gpd/lot = 68,700 gpd average daily sewer flow.
Total Design Flow: 136,200 gpd + 38,700 gpd = 204,900 gpd average daily sewer flow.
Land Application Area Required + 100% Reserve = 30.42 acres
Land Application Area Provided = 30.42 Acres

NOTES:

1. THIS PROPERTY HAS BEEN REVIEWED FOR THE EXISTENCE OF INTERMITTENT AND PERENNIAL STREAMS. STREAMS THAT WOULD REQUIRE WATERWAY NATURAL AREAS AS DESCRIBED IN SECTION 4 OF THE WILLIAMSON COUNTY STORM WATER MANAGEMENT REGULATIONS HAVE BEEN LOCATED AS SHOW.
2. THE SITE HAS BEEN REVIEWED FOR THE PRESENCE OF STEEP SLOPES, HILLTOPS AND RIDGETOPS, SLIPPAGE SOILS, AND KARST FEATURES. NONE OF THE MENTIONED FEATURES ARE PRESENT ON THIS SITE.
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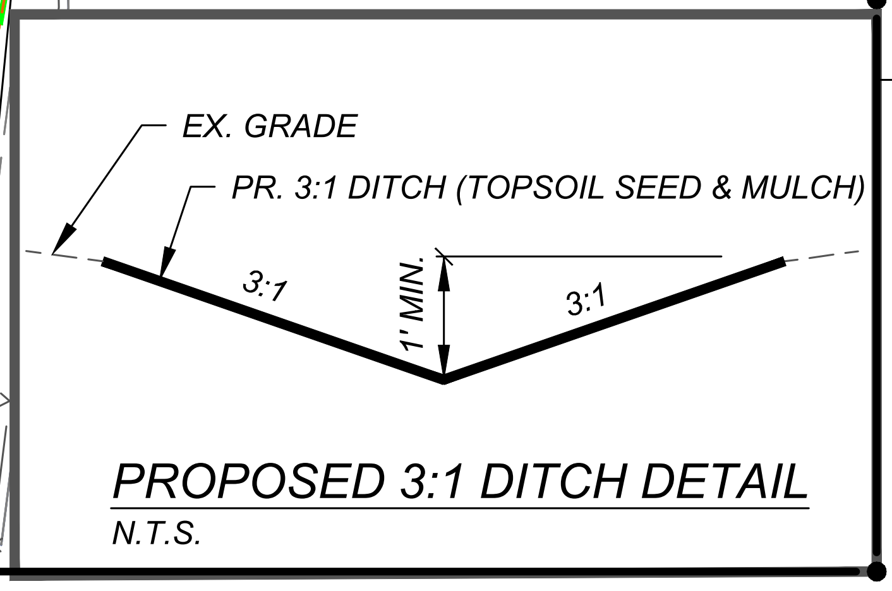
4. ALL COMPONENTS OF THE WASTEWATER TREATMENT SYSTEM ARE ON SLOPES LESS THAN 15%.



PROPOSED 3:1 DITCH DETAIL
N.T.S.

PLOT DATE: 8/26/2020 11:22:52 AM (MWARNER)

CIVIL
INFRASTRUCTURE
ASSOCIATES
307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

LINDA J. SULLIVAN
NO. 023015
08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID
SOIL MAPPING PLAN
ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004
DRAWN BY: MSW
CHECKED BY: LJS

REVISIONS
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△ POST BID SET ISSUE DATE

DATE		DESCRIPTION

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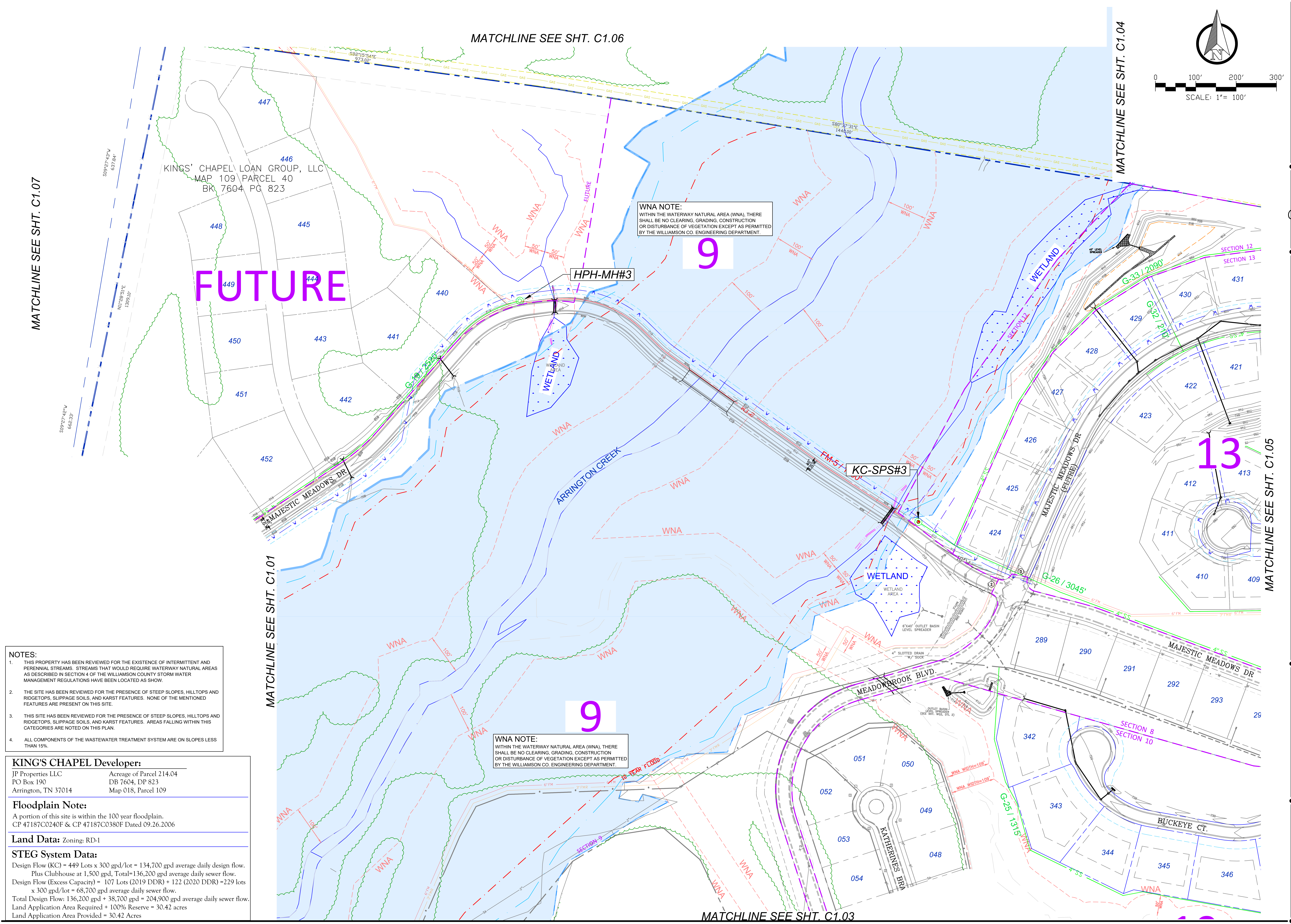
KINGS CHAPEL
SITE PLAN

C1.01



WNA NOTE:
WITHIN THE WATERWAY NATURAL AREA (WNA), THERE SHALL BE NO CLEARING, GRADING, CONSTRUCTION OR DISTURBANCE OF VEGETATION EXCEPT AS PERMITTED BY THE WILLIAMSON CO. ENGINEERING DEPARTMENT.

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Arrington, TN 37014	Map 018, Parcel 109

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Land Application Area Provided = 30.42 Acres

PLOT DATE: 8/26/2020 11:23:46 AM (MWARNER)

CIVIL
INFRASTRUCTURE
ASSOCIATES
307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

LINDA J. SULLIVAN
NO. 023015
08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID

SOIL MAPPING PLAN

ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004
DRAWN BY: MSW
CHECKED BY: LJS

REVISIONS
◇ PRE-BID SET ISSUE DATE
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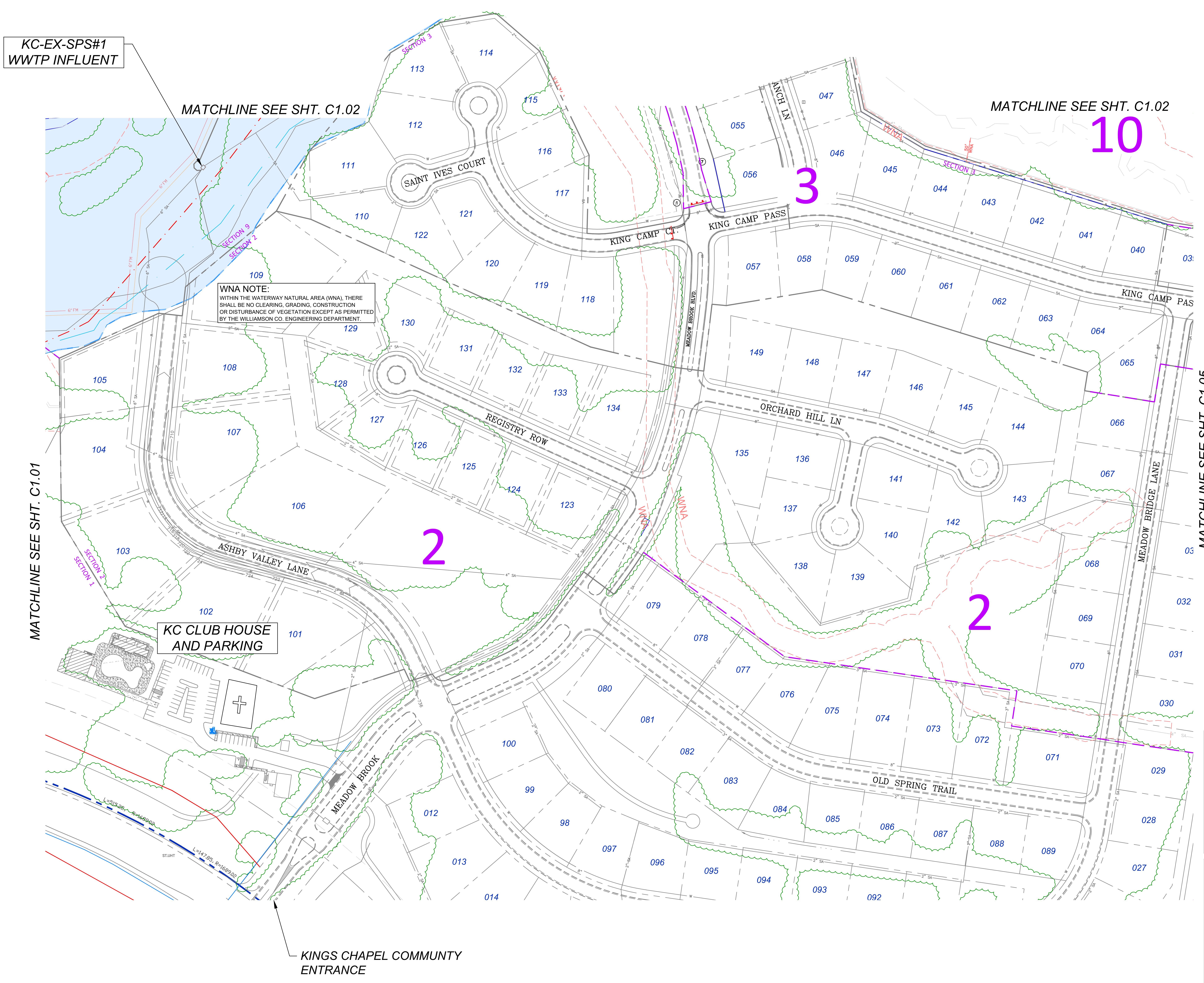
DATE		DESCRIPTION

ORIGINAL ISSUE DATE: August 2020

KING'S CHAPEL SITE PLAN

C1.02



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KING'S CHAPEL Developer:

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PO Box 190	DB 7604, DP 823
Arrington, TN 37014	Map 018, Parcel 109

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Land Application Area Provided = 30.42 Acres

CIVIL INFRASTRUCTURE ASSOCIATES
307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

LINDA J. SULLIVAN
NO. 023015
08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID
SOIL MAPPING PLAN

ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004
DRAWN BY: MSW
CHECKED BY: LJS

REVISIONS

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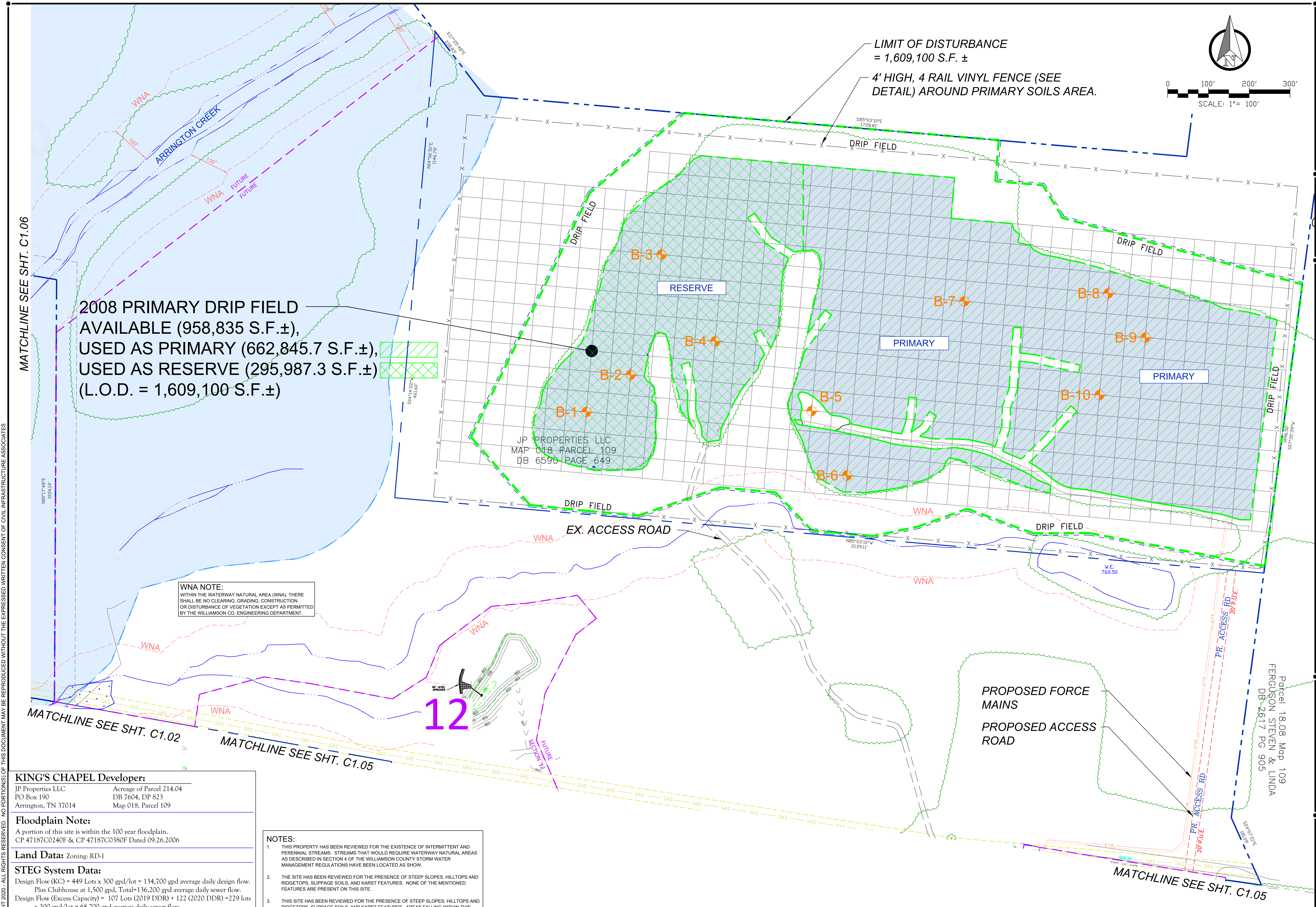
KING'S CHAPEL
SITE PLAN

C1.03



2008 PRIMARY DRIP FIELD
AVAILABLE (958,835 S.F.±),
USED AS PRIMARY (662,845.7 S.F.±), ▨
USED AS RESERVE (295,987.3 S.F.±) ▨
(L.O.D. = 1,609,100 S.F.±)

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PLOT DATE: 8/26/2020 11:26:36 AM (MWARNER)

CIVIL
INFRASTRUCTURE
ASSOCIATES
307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

LINDA J. SULLIVAN
NO. 023015
08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID
SOIL MAPPING PLAN
ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004
DRAWN BY: MSW
CHECKED BY: LJS

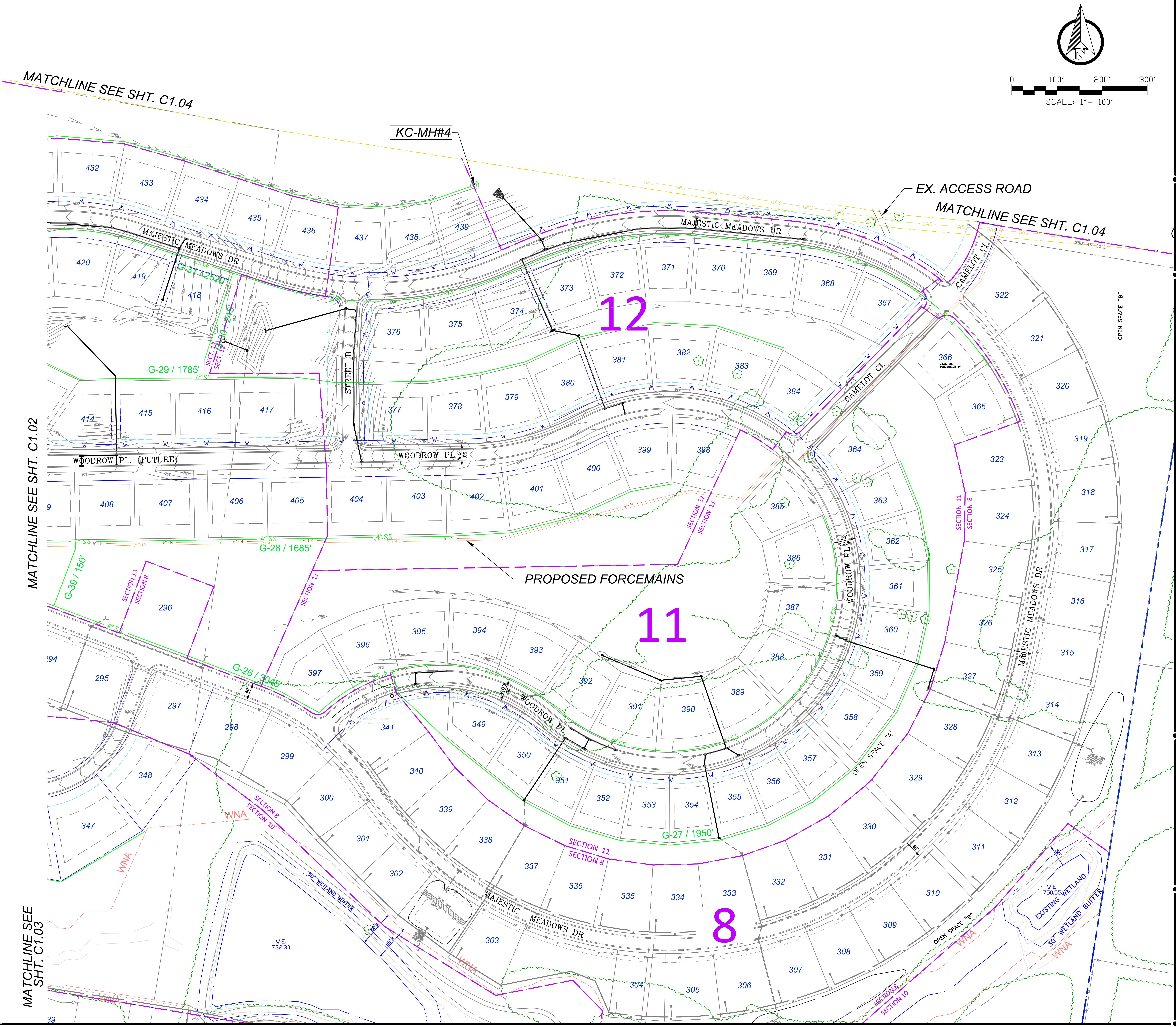
REVISIONS
◇ PRE-BID SET ISSUE DATE
△ POST BID SET ISSUE DATE

DATE		DESCRIPTION

ORIGINAL ISSUE DATE: August 2020

KING'S CHAPEL
SITE PLAN

C1.04



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PLOT DATE: 8/26/2020 11:29:25 AM (MWARNER)

CIVIL INFRASTRUCTURE ASSOCIATES
307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

LINDA J. SULLIVAN
NO. 023016
08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID
SOIL MAPPING PLAN
ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004
DRAWN BY: MSW
CHECKED BY: LJS

REVISIONS

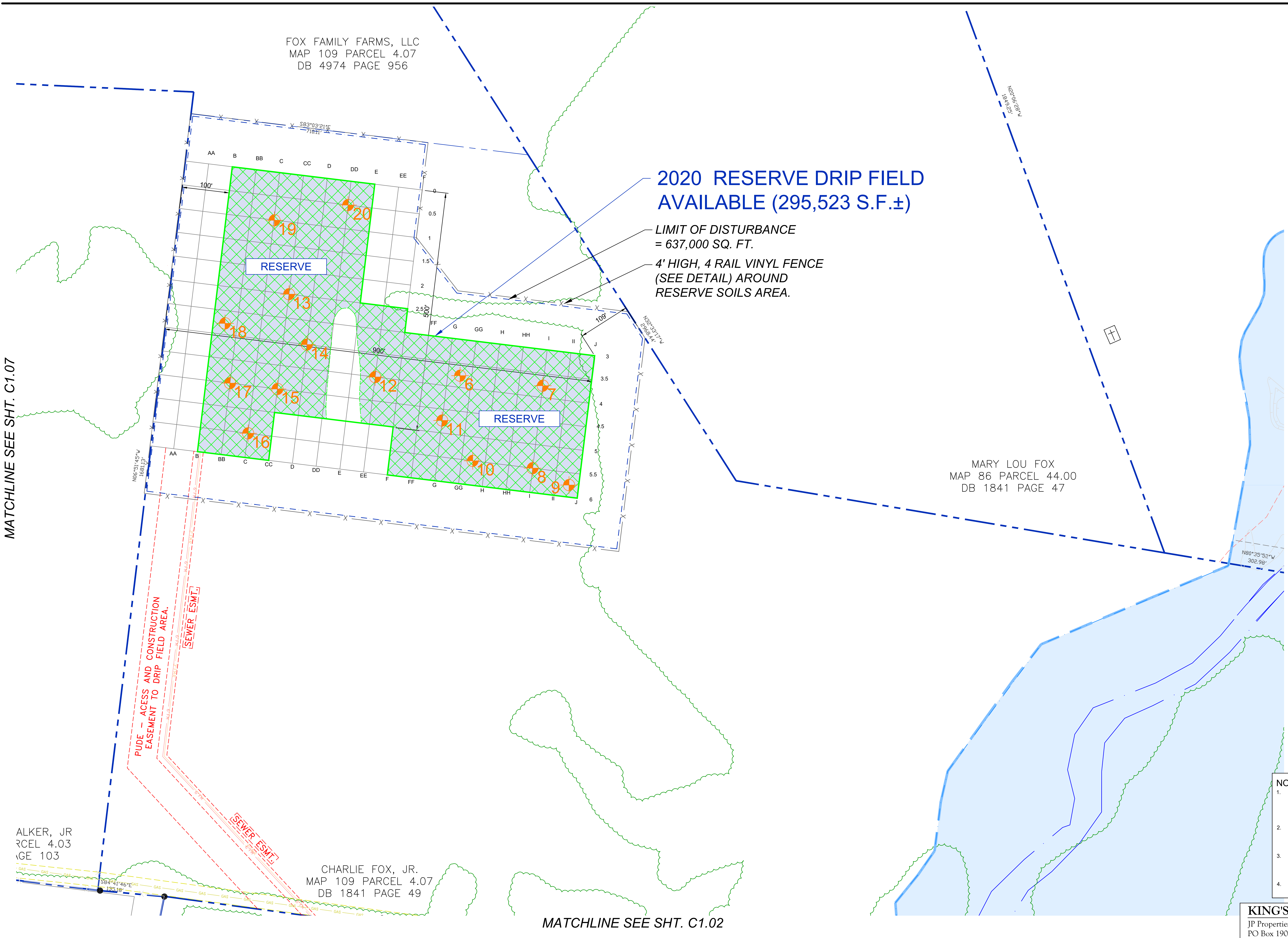
◇ PRE-BID SET ISSUE DATE
△ POST BID SET ISSUE DATE

DATE		DESCRIPTION

ORIGINAL ISSUE DATE: August 2020

KING'S CHAPEL
SITE PLAN

C1.05



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CIVIL
INFRASTRUCTURE
ASSOCIATES

307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

LINDA J. SULLIVAN
NO. 023015
08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID
SOIL MAPPING PLAN

ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

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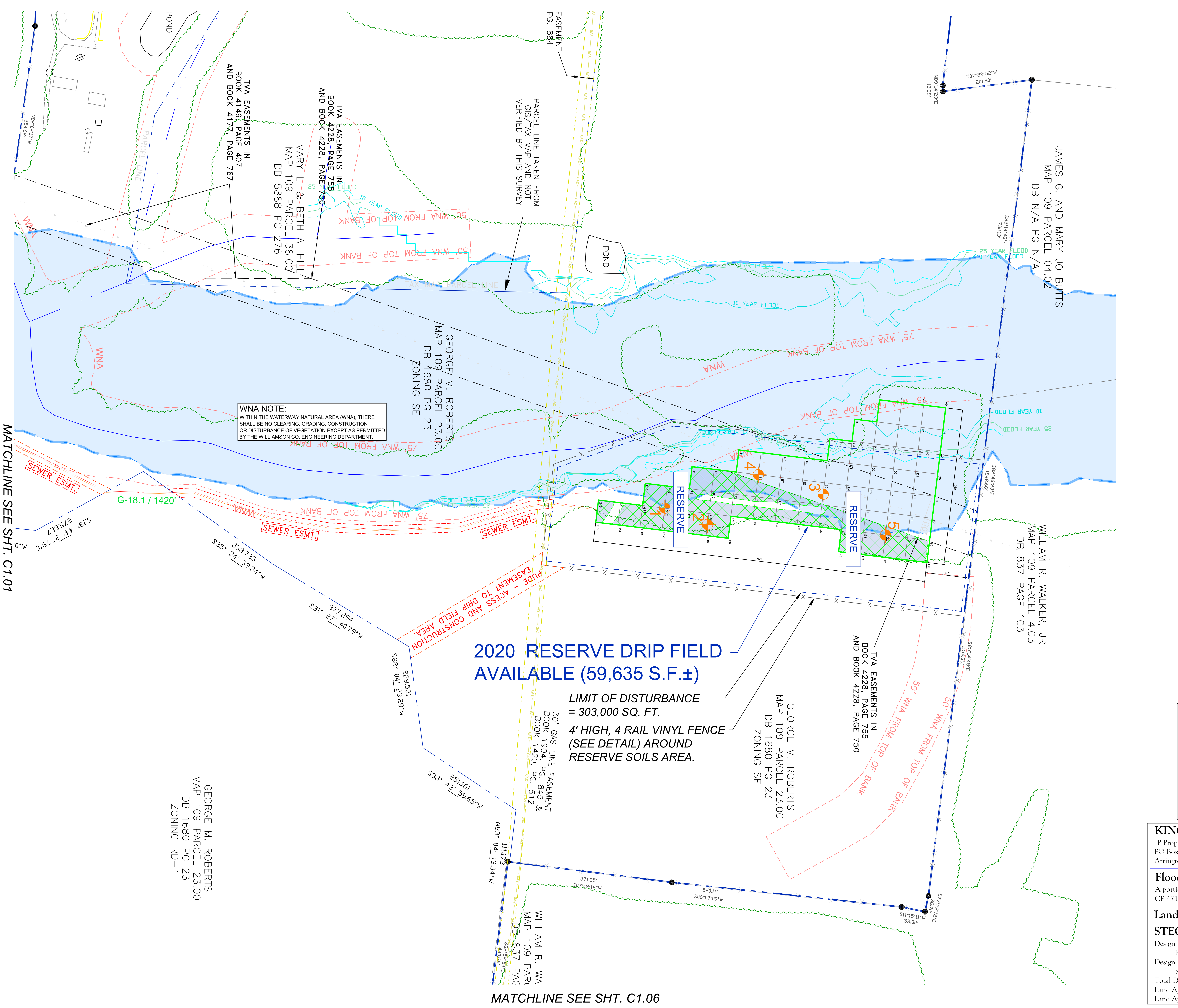
KING'S CHAPEL
SITE PLAN

C1.06



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MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

LINDA J. SULLIVAN
08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID
SOIL MAPPING PLAN

ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004 | DRAWN BY: MSW | CHECKED BY: LJS

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DATE		DESCRIPTION

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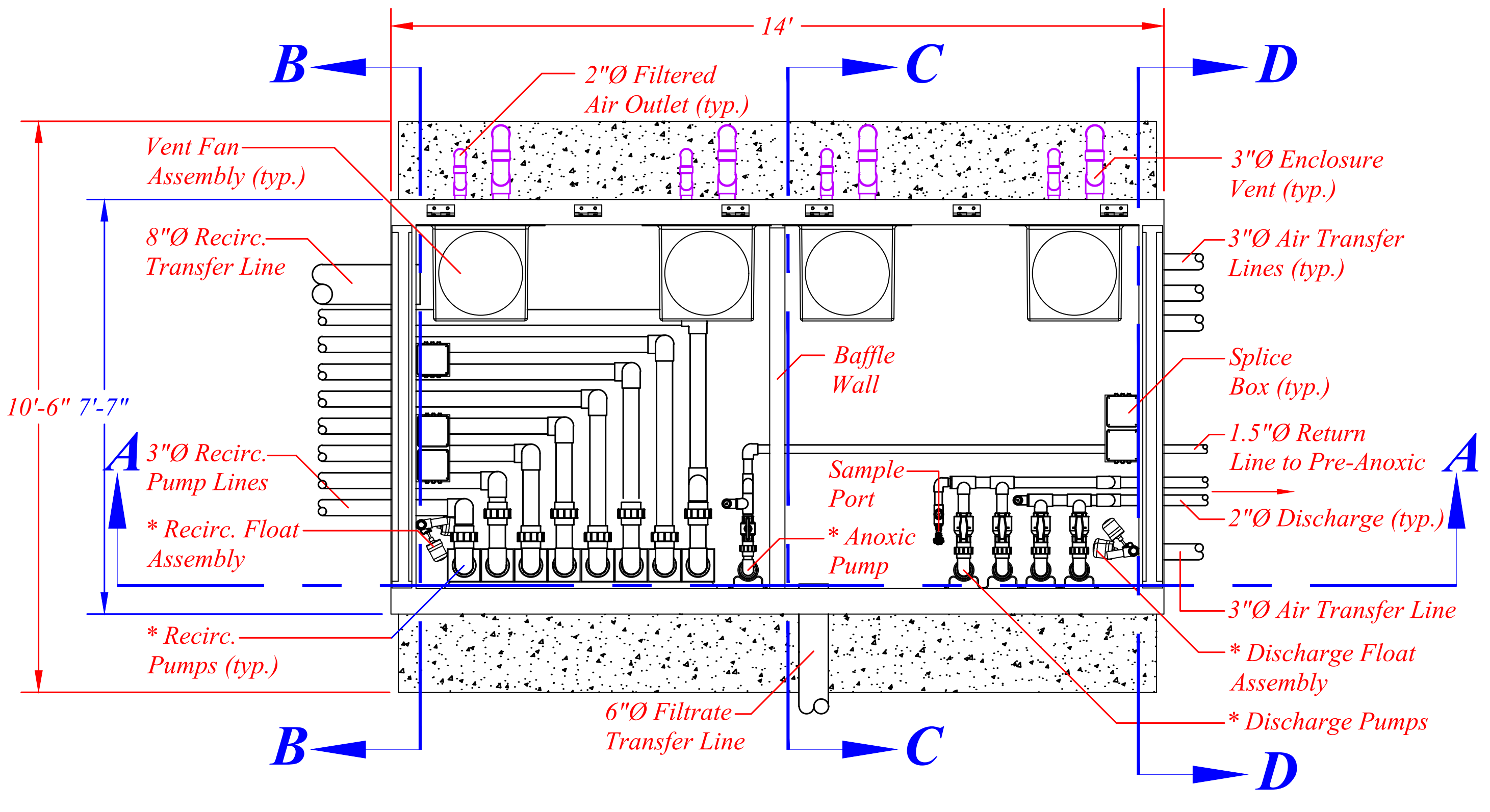
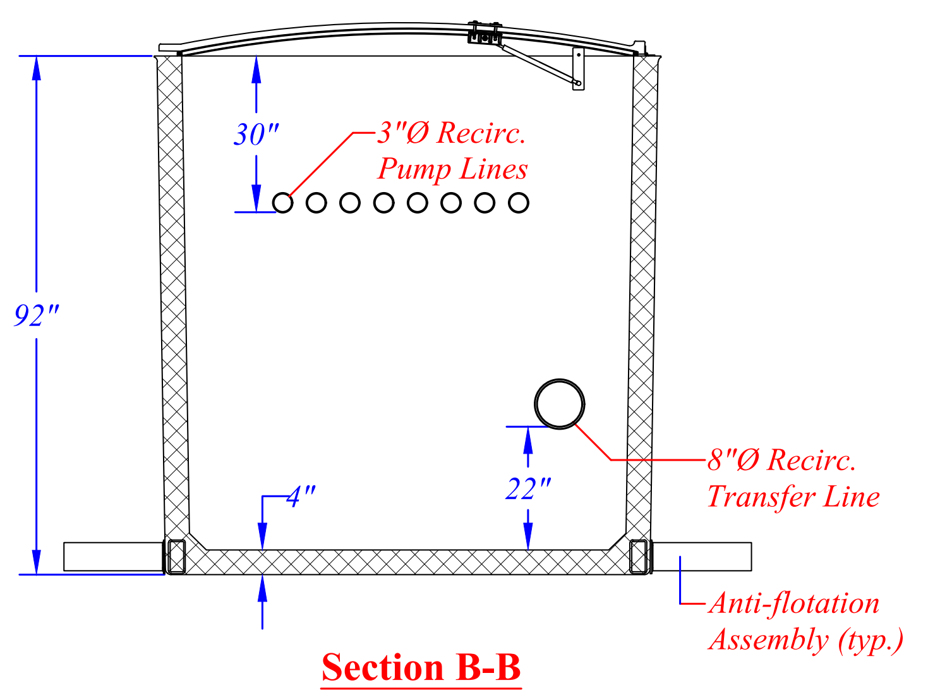
KING'S CHAPEL
SITE PLAN

C1.07

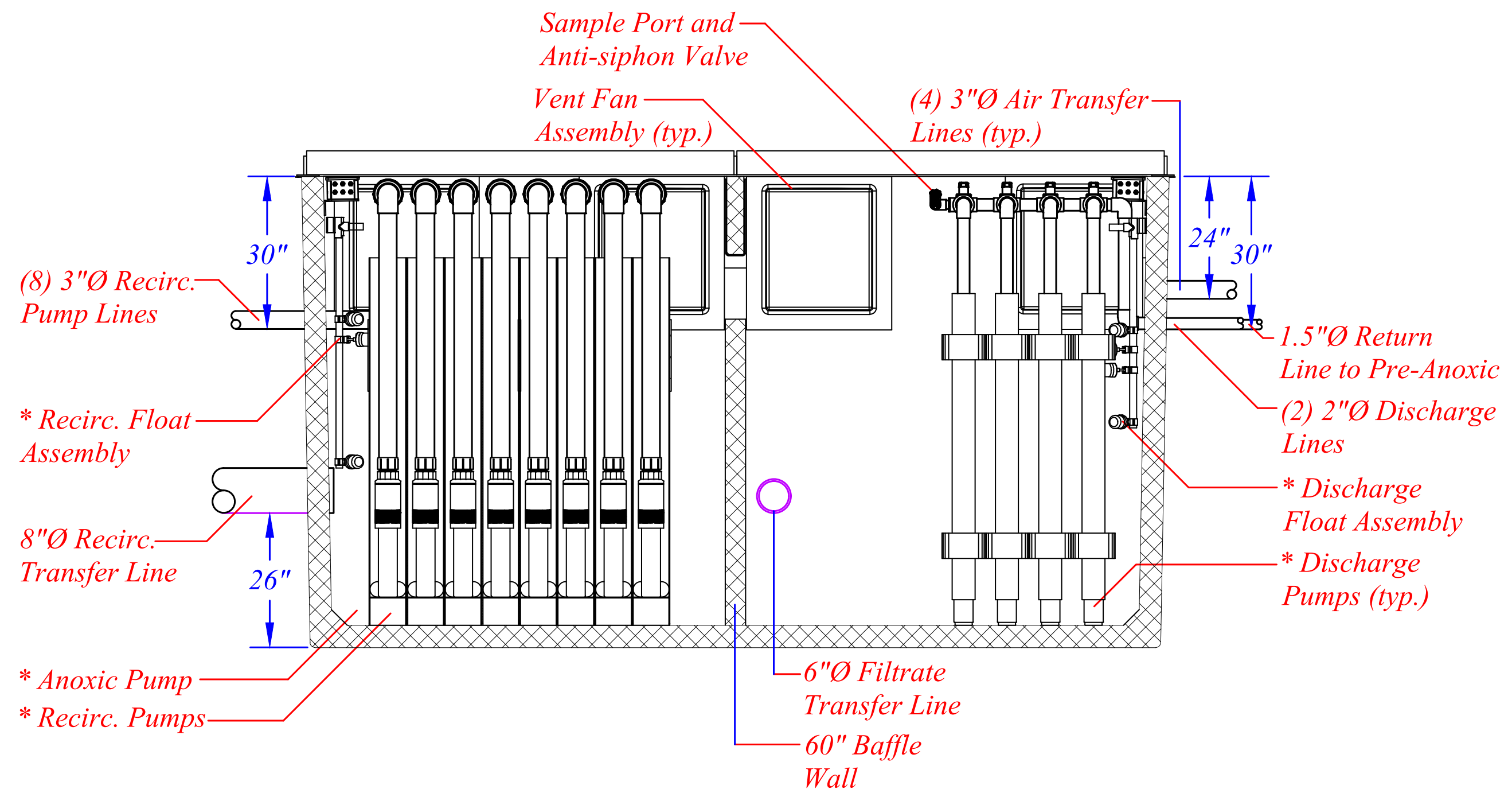
PLOT DATE: 8/26/2020 11:32:02 AM (MWARNER)



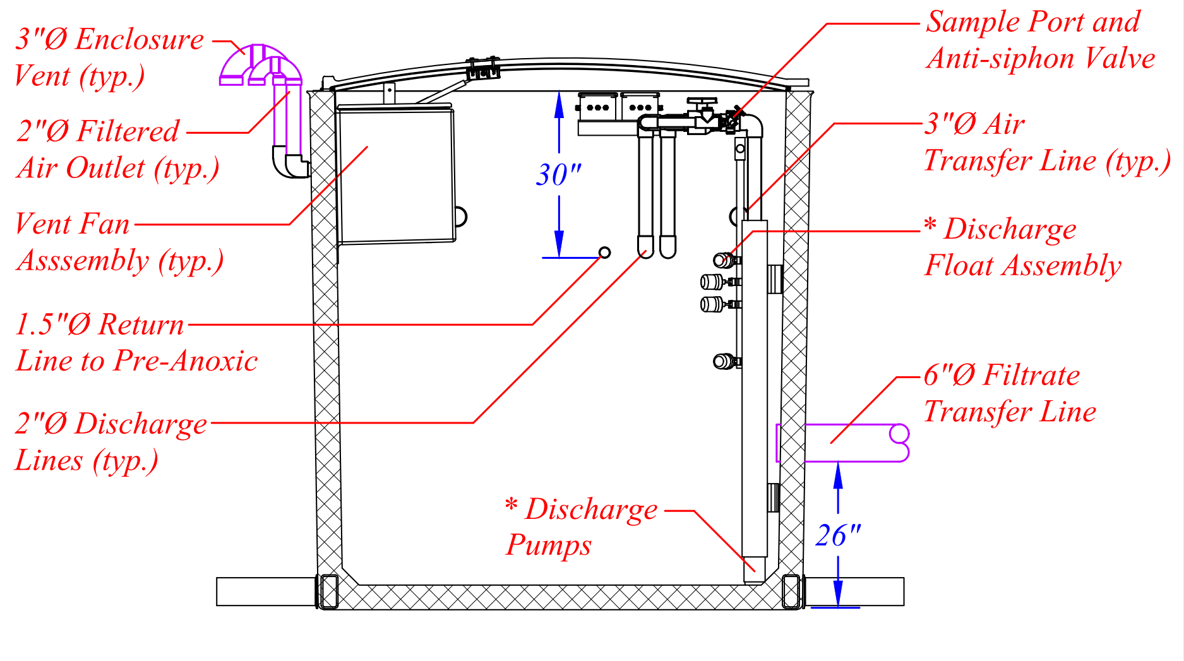
14' Pump Station Planview
Scale: 1" = 4'-0"



Section B-B
Scale: 1" = 4'-0"



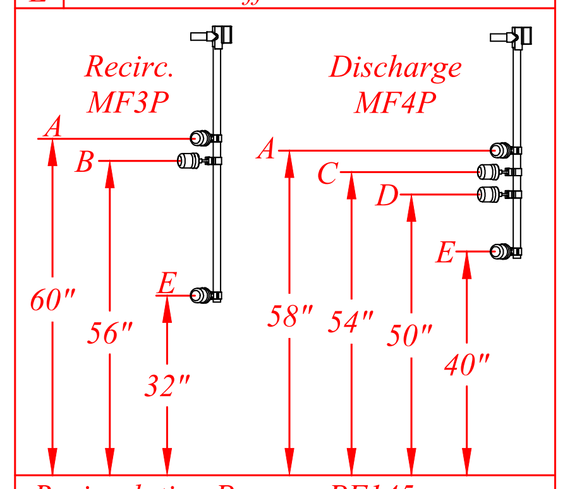
Section A-A
Scale: 1" = 4'-0"



Section C-C
Scale: 1" = 4'-0"

* Float Functions & Pump Index

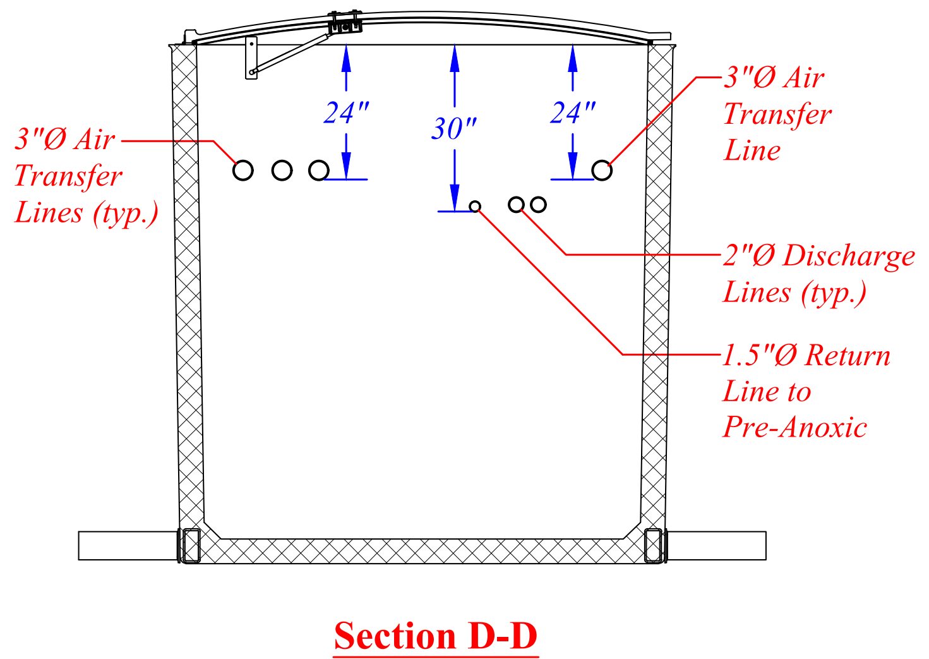
A	High Level Alarm / Lag Enable
B	Override Timer
C	Pump ON
D	Pump OFF
E	Redundant Off / Low Level Alarm



Recirculation Pumps: PF145

Discharge Pumps: TBD

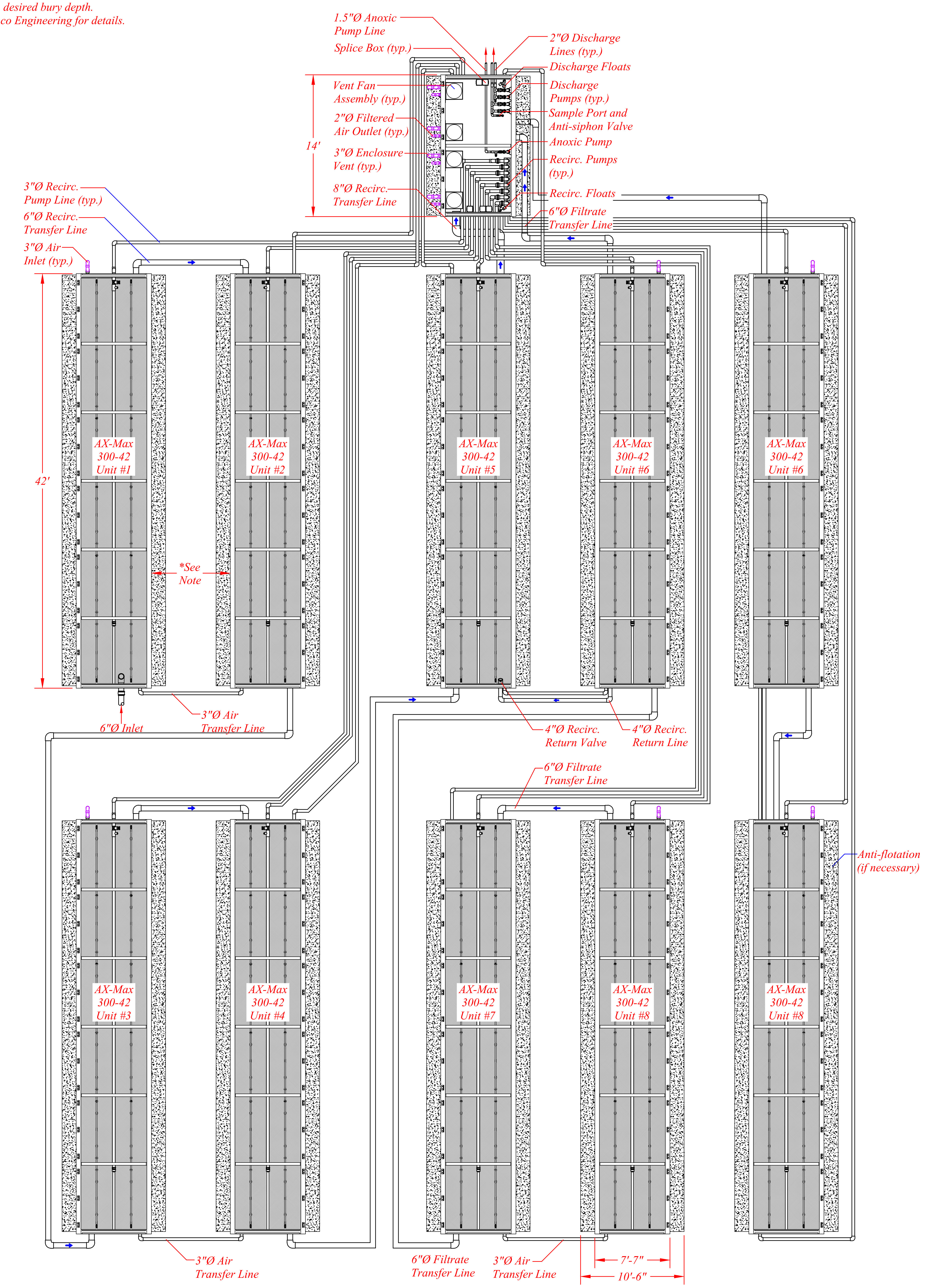
Anoxic Return Pump: PF3005



Section D-D
Scale: 1" = 4'-0"

AdvanTex AX-Max2400
Pump Discharge
Pump Station Details

Note: Spacing between AX-Max units is dependent on desired bury depth. Consult Orenco Engineering for details.



AdvanTex AX-Max2400
Pump Discharge

Plan View

CIVIL
INFRASTRUCTURE
ASSOCIATES

307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

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NO. 023015
08.26.20

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SOIL MAPPING PLAN

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DATE	DESCRIPTION

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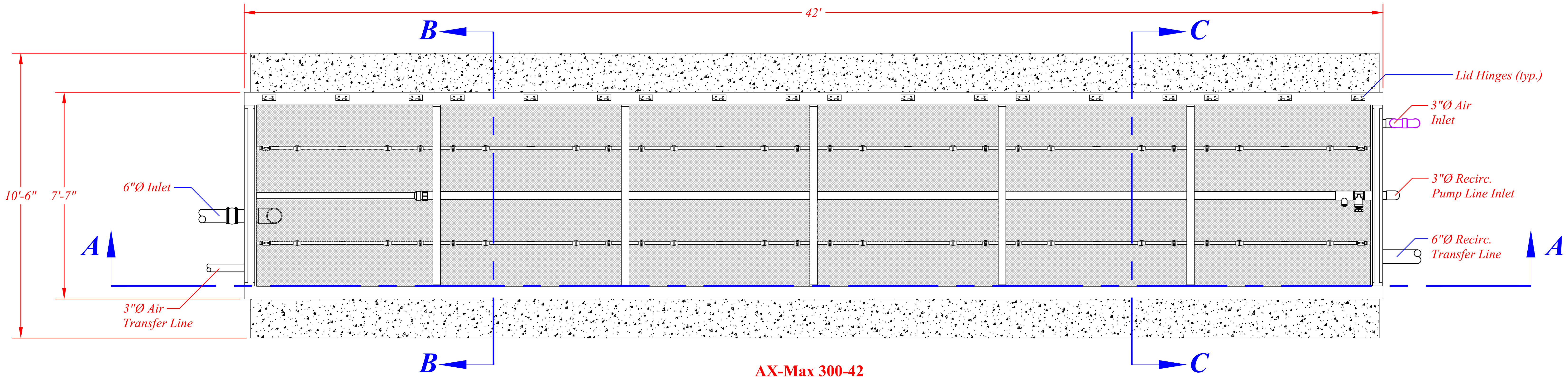
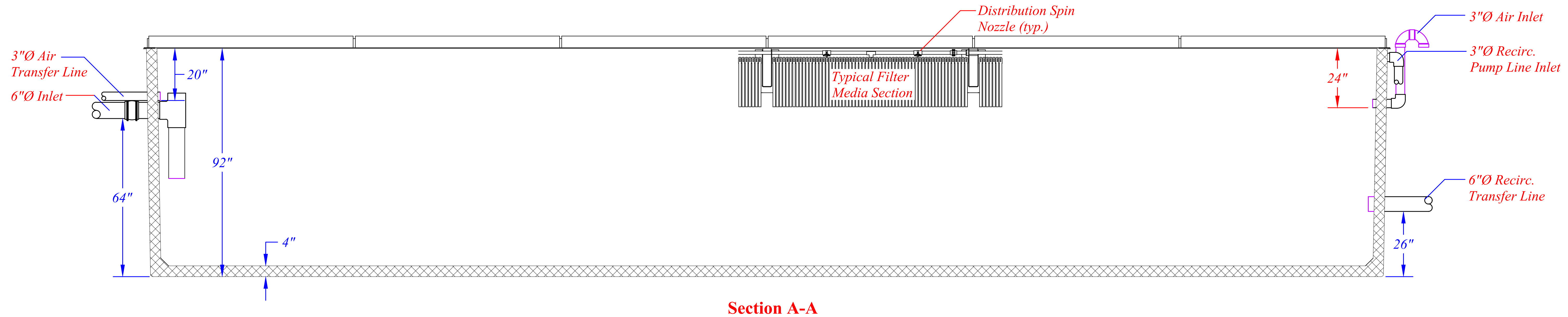
ADVANTEX
AX-MAX2400 PUMP
DISCHARGE AND
PUMP STATION
DETAILS

C4.01

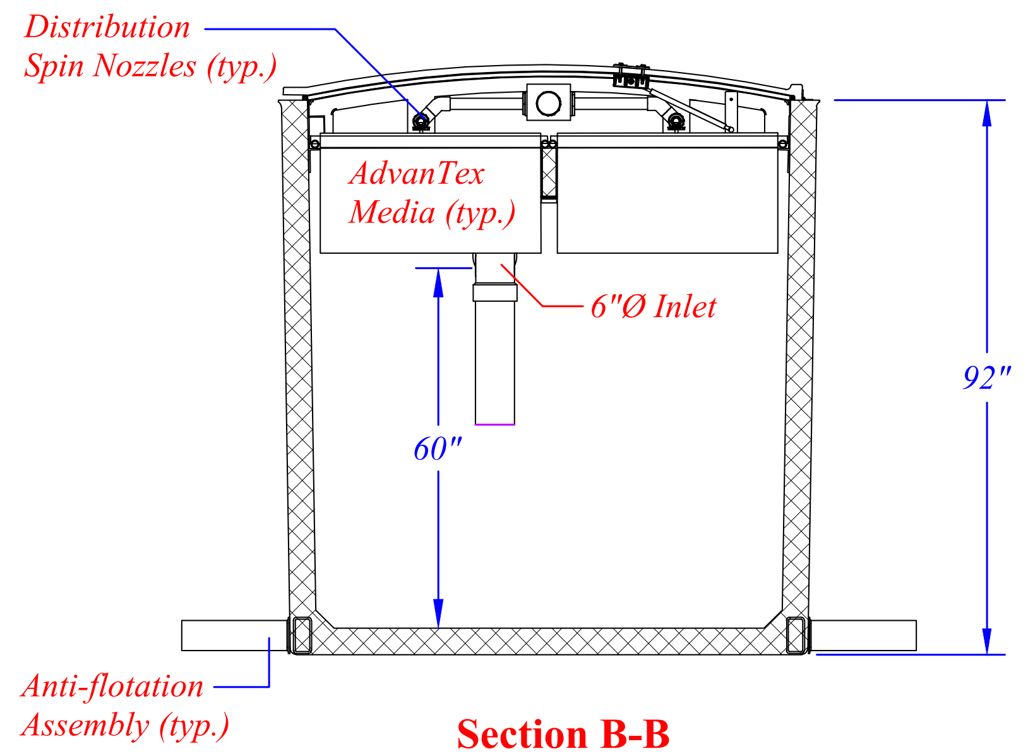
PLOT DATE: 8/26/2020 12:09:16 PM (MWARNER)



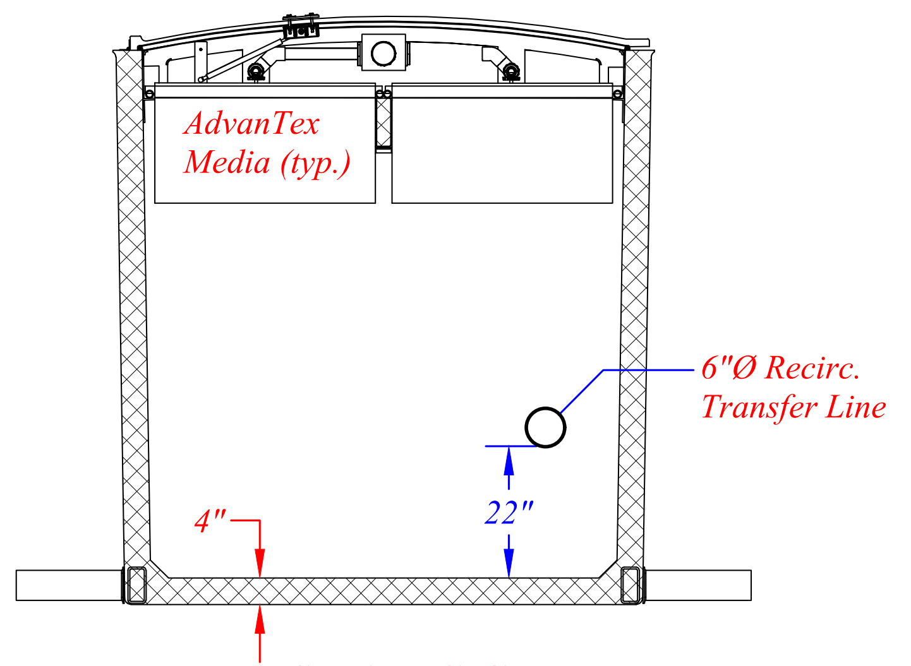
AX-Max 300-42
Unit #1 Planview
Scale: 1" = 4'-0"



Section A-A
Scale: 1" = 4'-0"



Section B-B
Scale: 1" = 4'-0"



Section C-C
Scale: 1" = 4'-0"

CIVIL
INFRASTRUCTURE
ASSOCIATES

307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

LINDA J. SULLIVAN
NO. 023015
08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID
SOIL MAPPING PLAN
ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004
DRAWN BY: MSW
CHECKED BY: LJS

REVISIONS
◇ PRE-BID SET ISSUE DATE
△ POST BID SET ISSUE DATE

DATE	DESCRIPTION

ORIGINAL ISSUE DATE: August 2020

AdvanTex AX-Max 2400
Pump Discharge

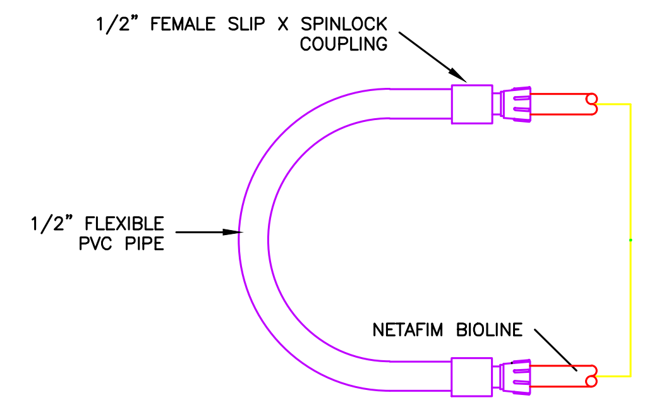
C4.02

PLOT DATE: 8/26/2020 9:31:32 AM (MWARNER)

8 DETAIL
N.T.S.

6 DETAIL
N.T.S.

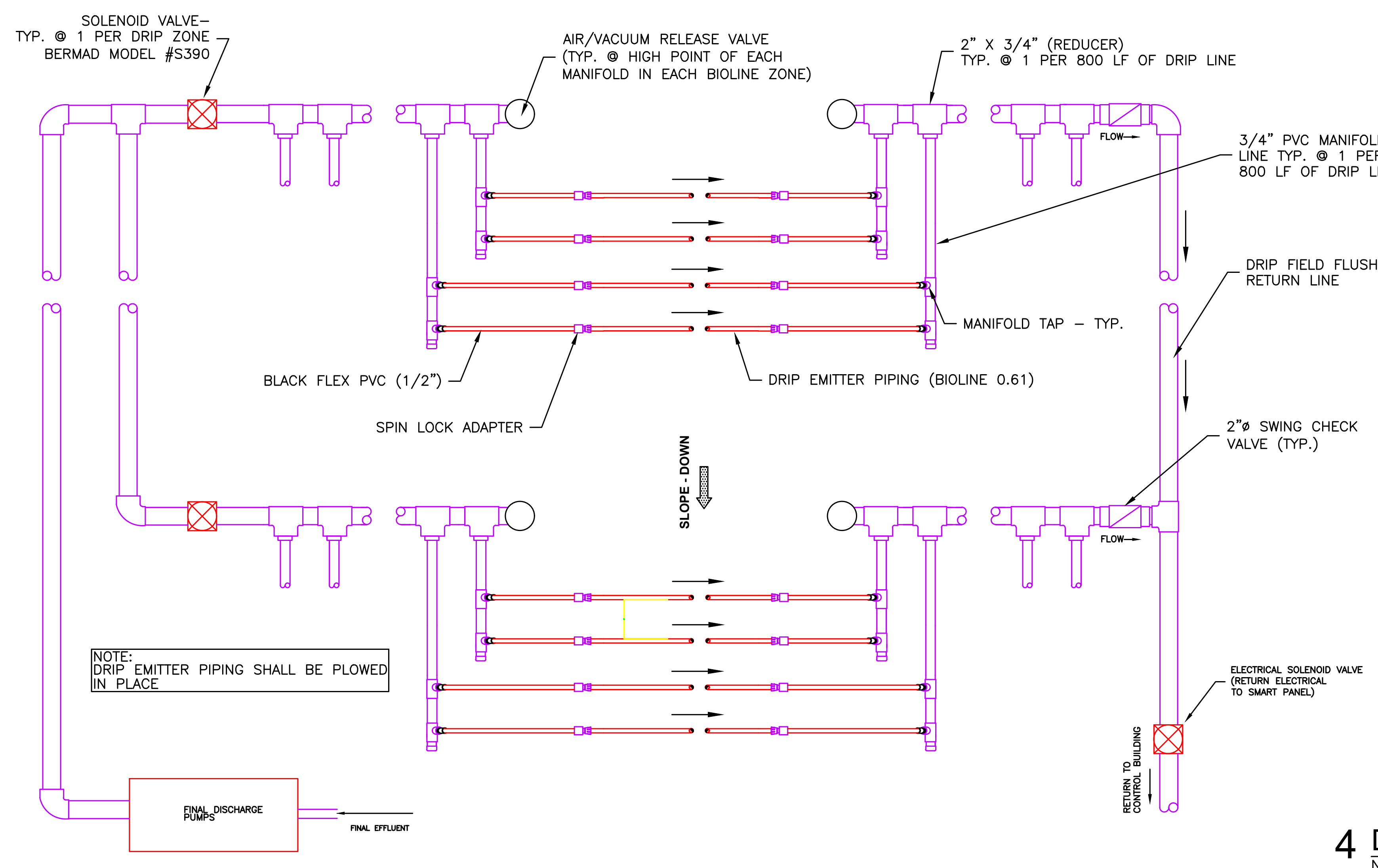
3 DETAIL
N.T.S.



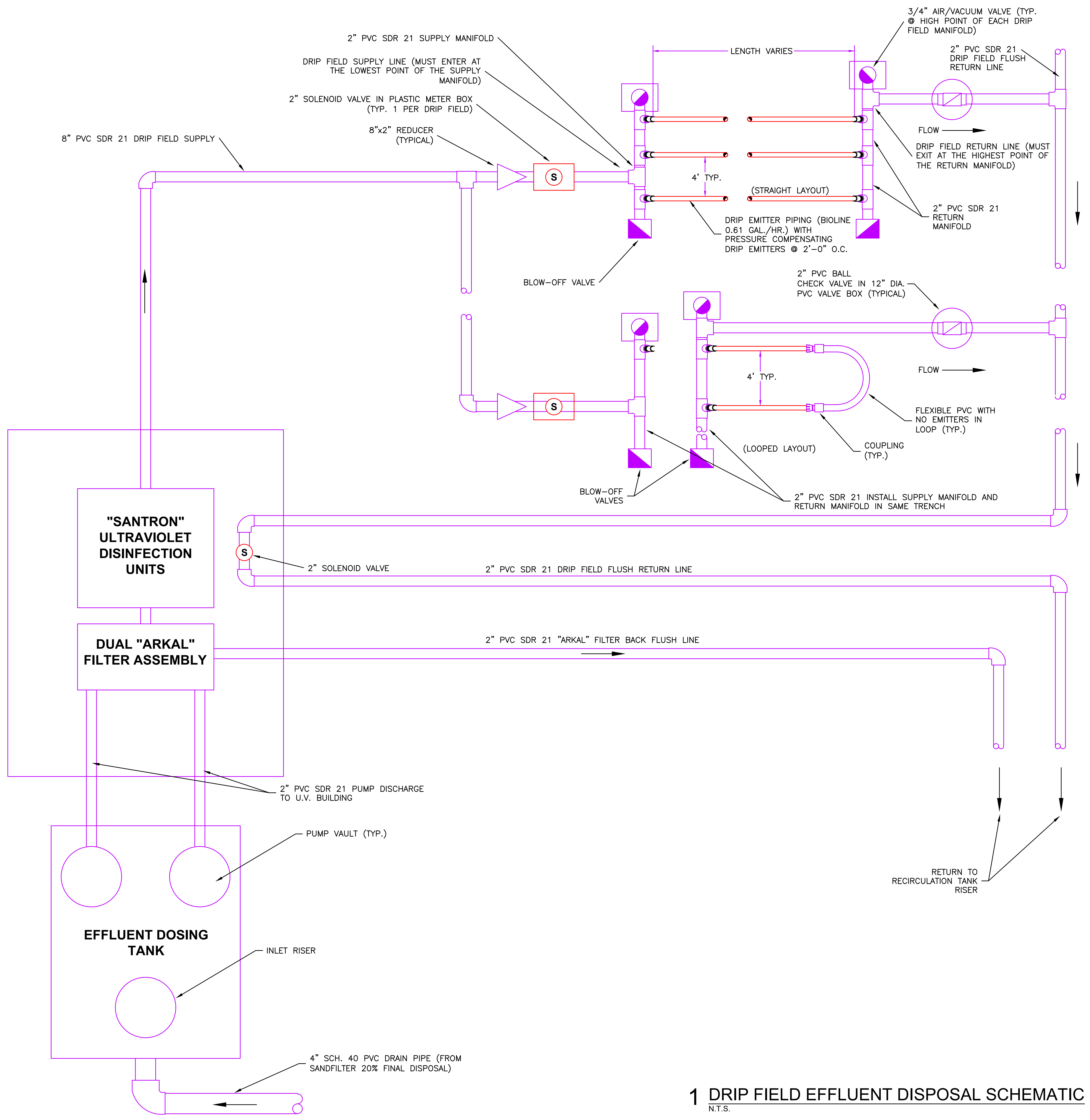
2 BIOLINE LOOP DETAILS
N.T.S.

7 DETAIL
N.T.S.

5 DETAIL
N.T.S.



4 DRIP EMITTER PIPING
N.T.S.



1 DRIP FIELD EFFLUENT DISPOSAL SCHEMATIC
N.T.S.

CIVIL
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SOIL MAPPING PLAN
ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004
DRAWN BY: MSW
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REVISIONS
◇ PRE-BID SET ISSUE DATE
△ POST BID SET ISSUE DATE

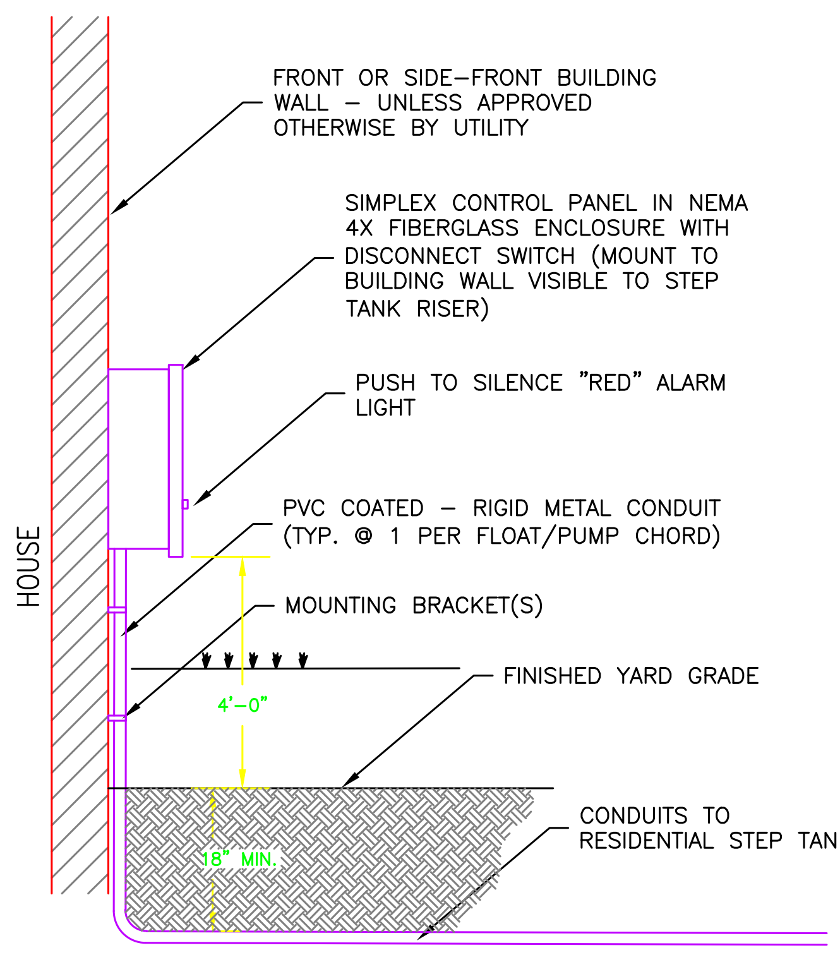
DATE		DESCRIPTION

ORIGINAL ISSUE DATE: August 2020

DRIP FIELD DETAILS

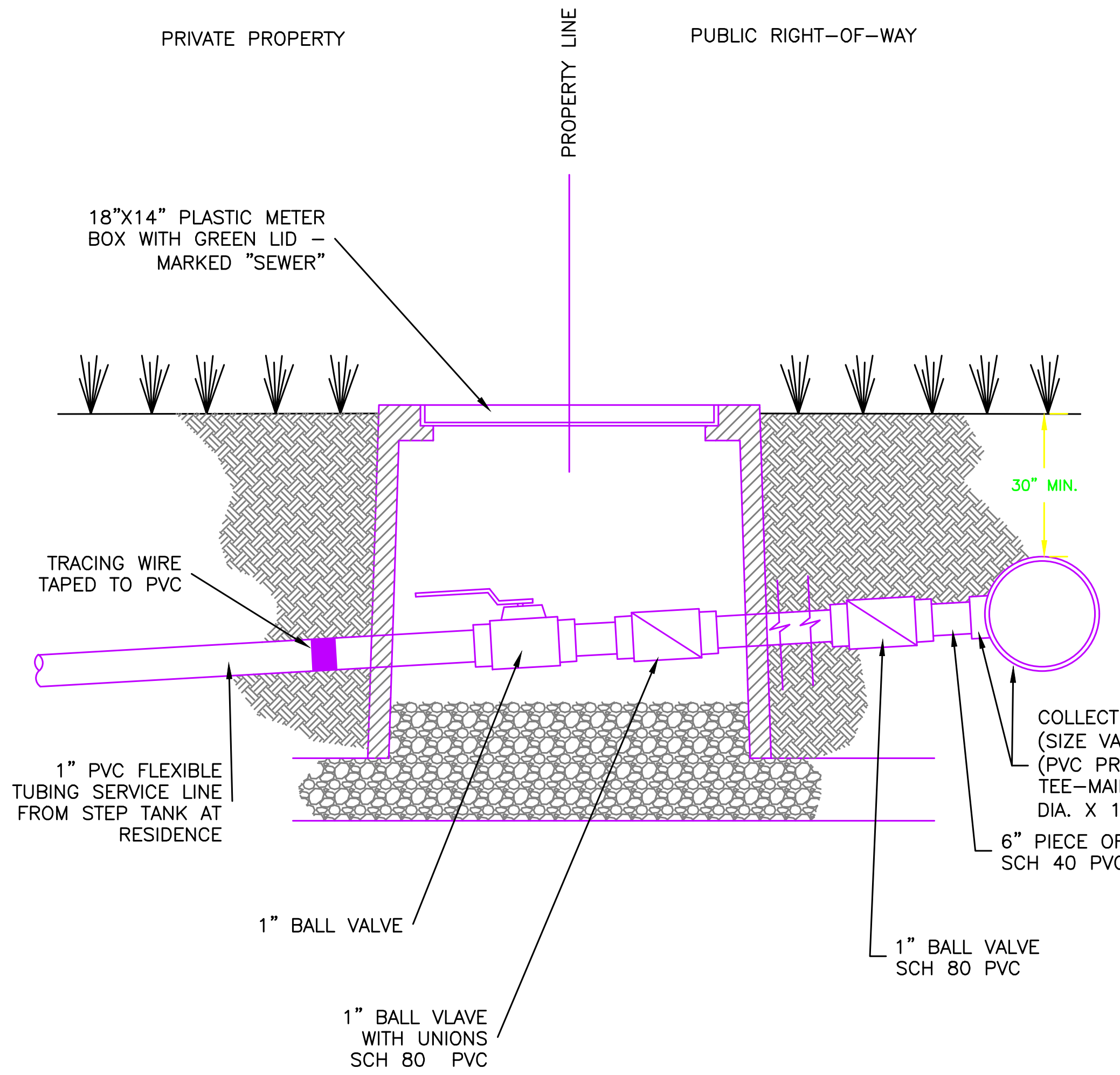
C4.03

PLOT DATE: 8/26/2020 9:32:00 AM (MWARNER)



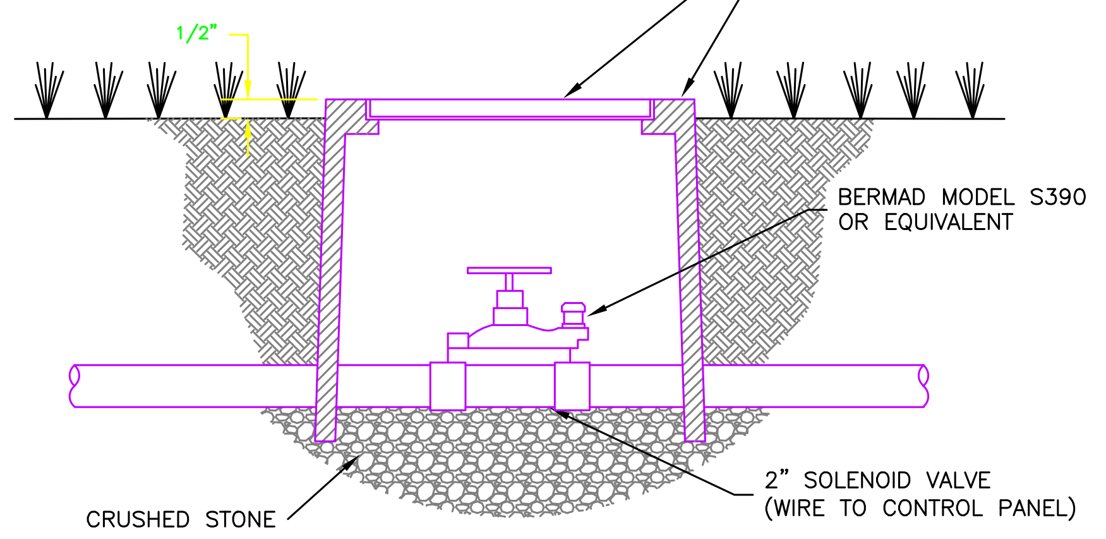
12 RESIDENTIAL CONTROL PANEL

N.T.S.



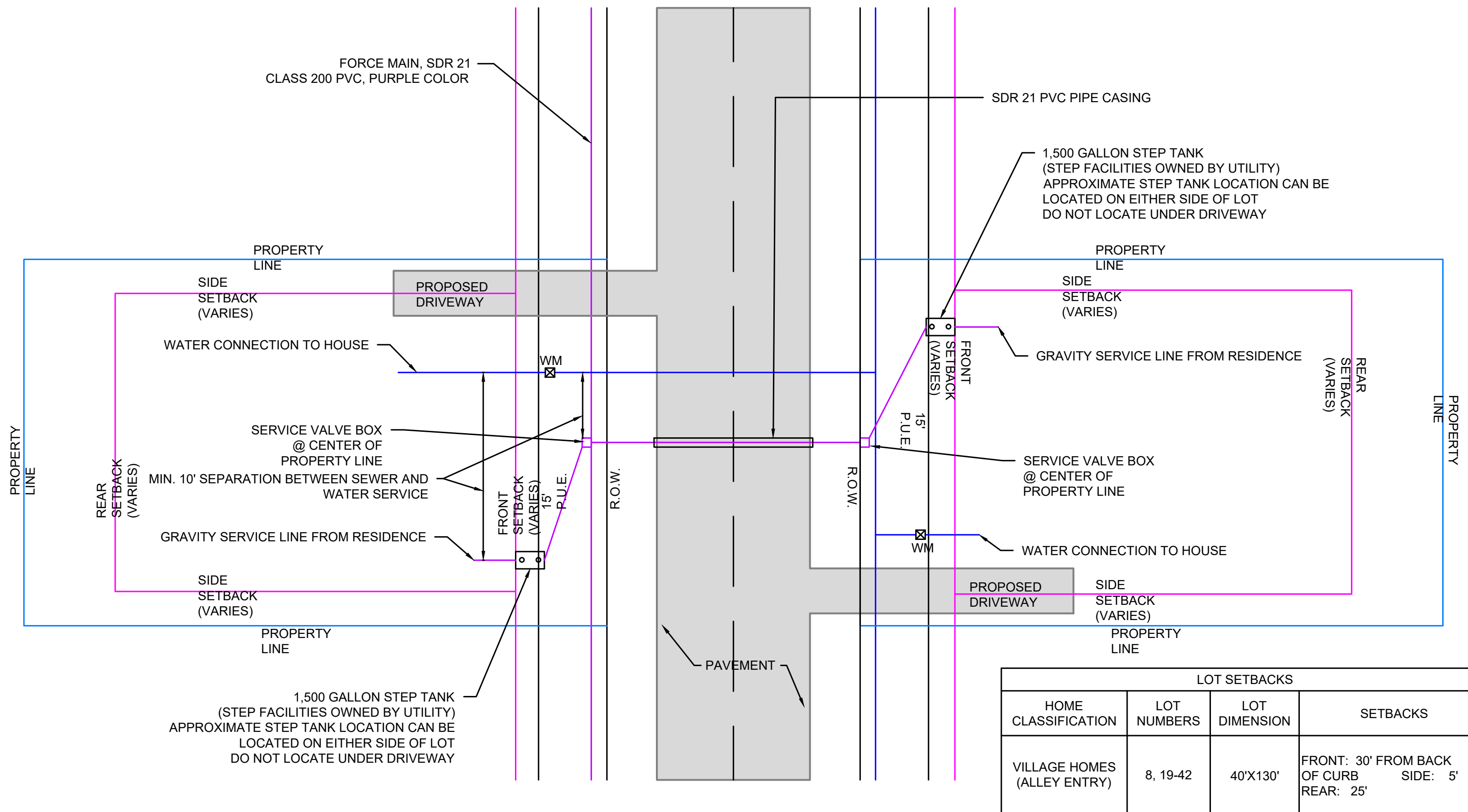
10 TYP. SERVICE CONNECTION (PRESSURE)

N.T.S.



8 ELECTRIC SOLENOID VALVE

N.T.S.



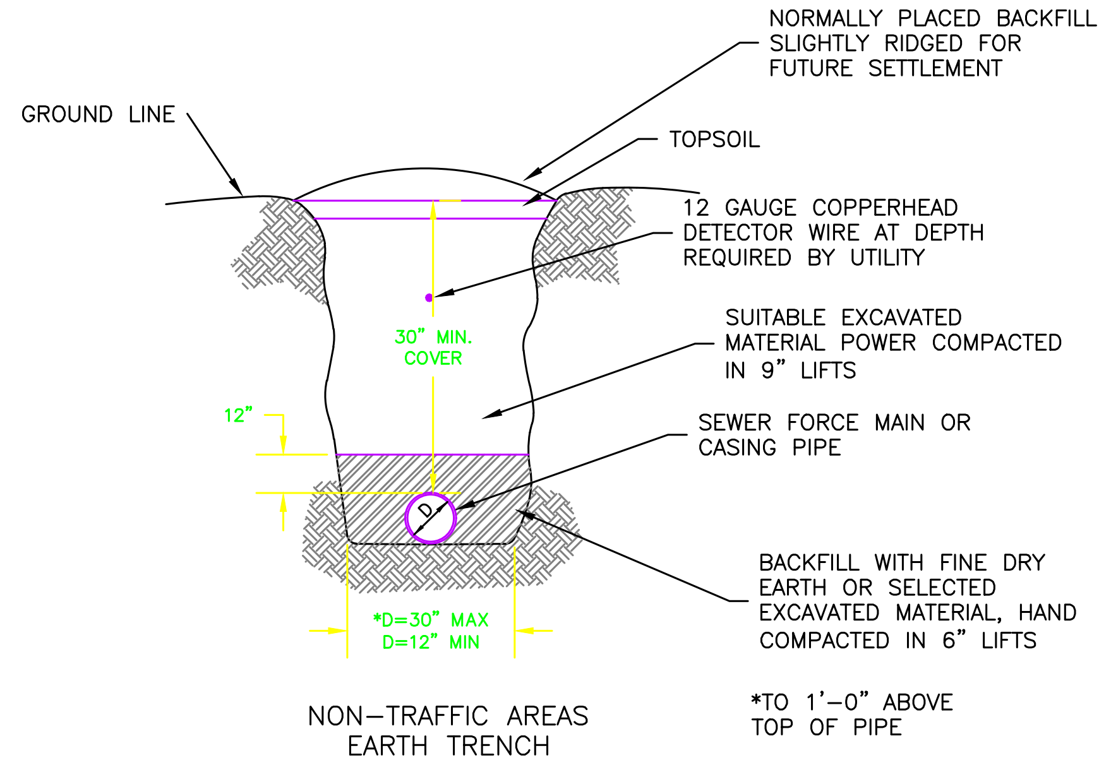
NOTE:
1. STEP TANK OR SERVICE CONNECTION SHALL NOT BE PLACED UNDER DRIVEWAY LOCATION.
2. STEP TANK TO BE PLACED WITHIN 50 FEET OF HOUSE LOCATION.
3. UTILITY TO HAVE RIGHT OF ACCESS AND MAINTENANCE FOR ALL STEP SYSTEM FACILITIES.

LOT SETBACKS

HOME CLASSIFICATION	LOT NUMBERS	LOT DIMENSION	SETBACKS
VILLAGE HOMES (ALLEY ENTRY)	8, 19-42	40'X130'	FRONT: 30' FROM BACK OF CURB SIDE: 5' REAR: 25'
CLASSIC HOMES (FRONT ENTRY)	7, 9-18, 43-84	65'X150'	FRONT: 35' FROM BACK OF CURB SIDE: 7.5' REAR: 25'
ESTATE HOMES (FRONT/SIDE ENTRY)	1-6	100'X200'	FRONT: 35' FROM BACK OF CURB SIDE: 15' REAR: 25'

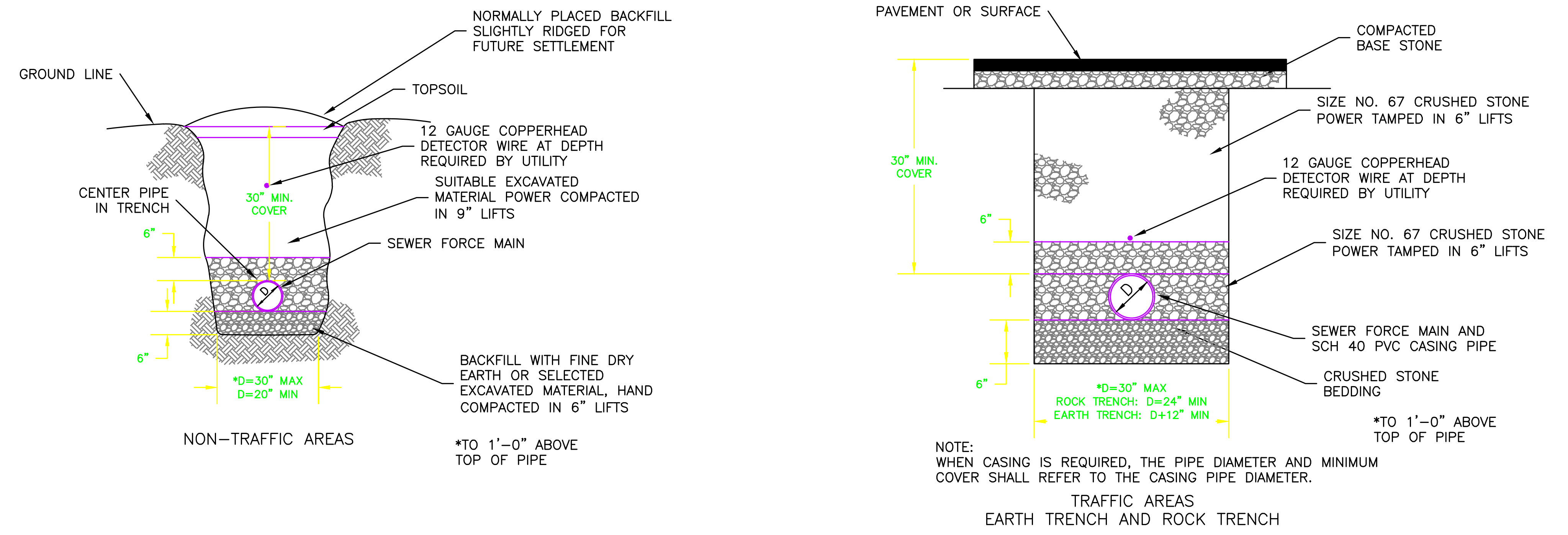
4 UTILITY SERVICE LINES LAYOUT

N.T.S.



11 DRIP ZONE SUPPLY AND RETURN LINES PIPE TRENCH DETAIL

N.T.S.

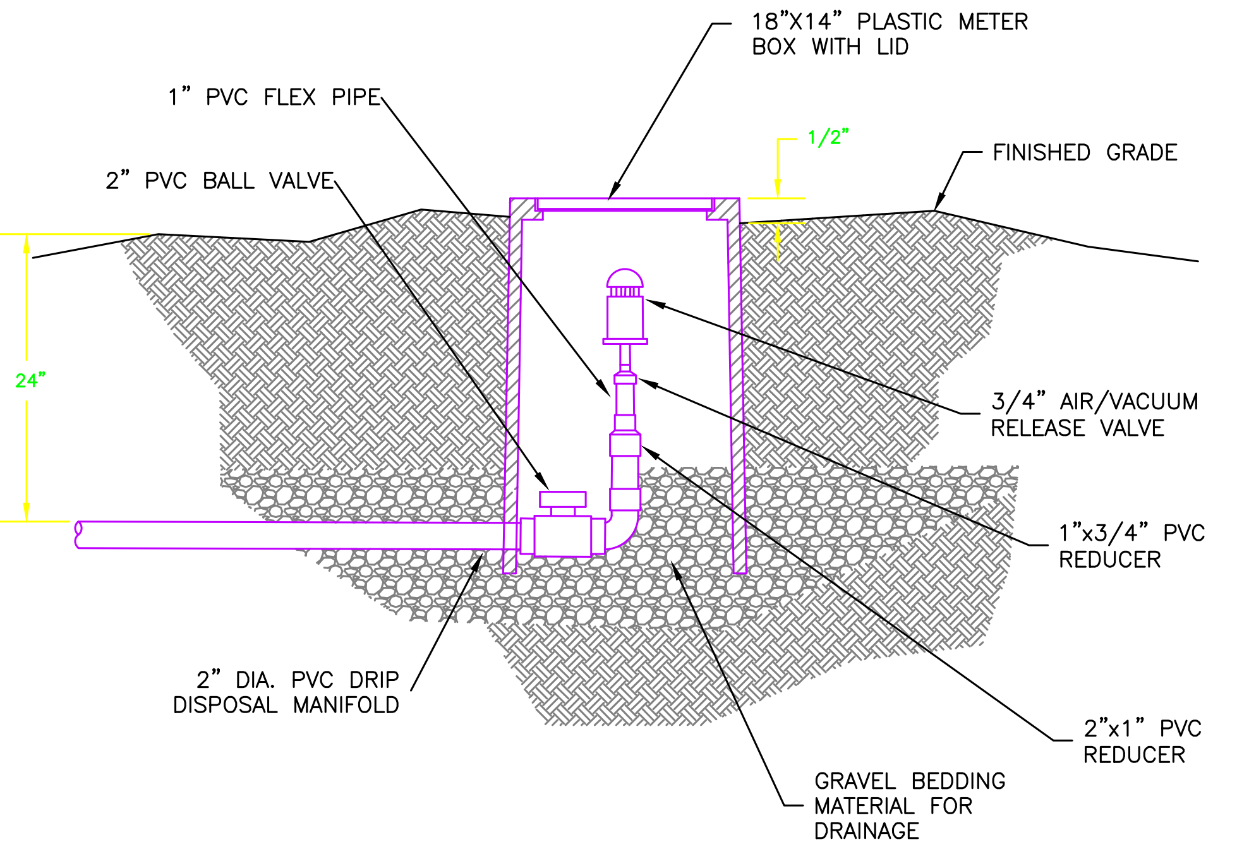


NOTE:
WHEN CASING IS REQUIRED, THE PIPE DIAMETER AND MINIMUM COVER SHALL REFER TO THE CASING PIPE DIAMETER.

TRAFFIC AREAS
EARTH TRENCH AND ROCK TRENCH

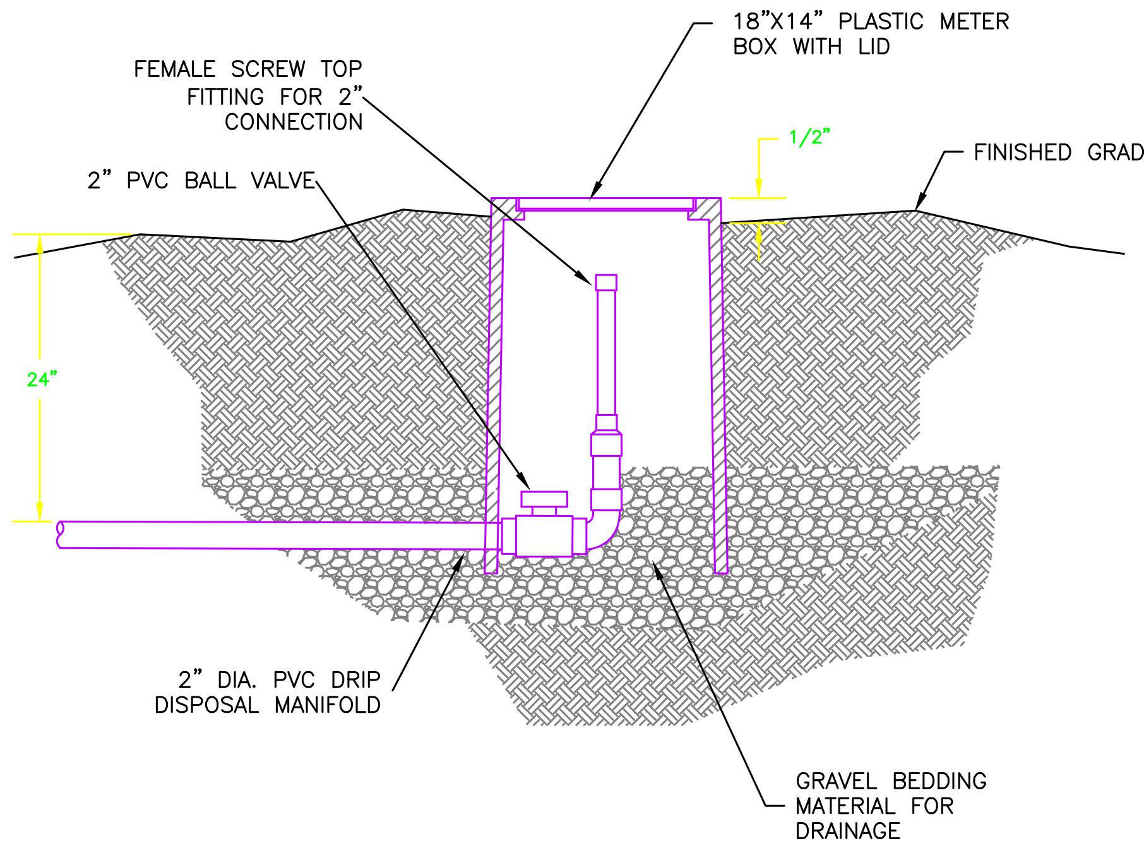
7 PIPE TRENCH DETAILS COLLECTION PIPE

N.T.S.



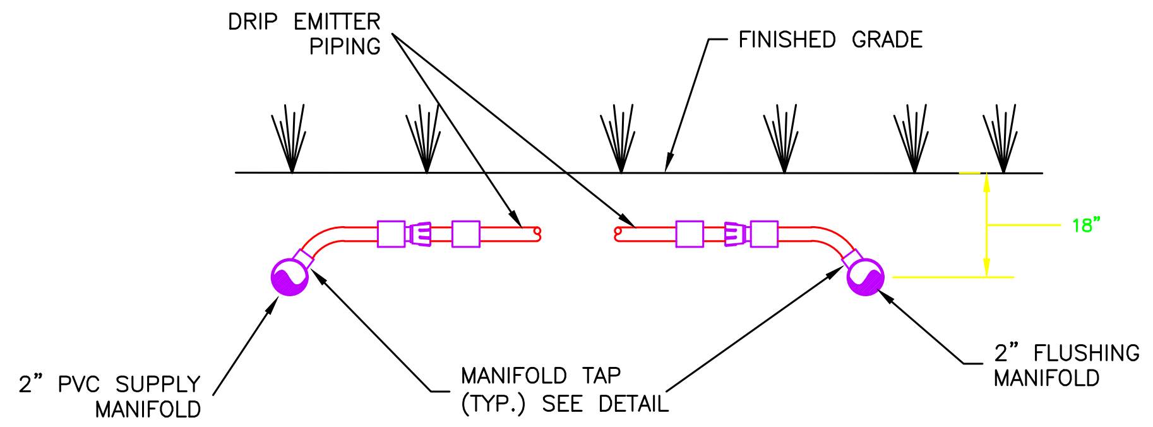
3 DRIP DISPOSAL AUTOMATIC AIR RELEASE VALVE ASSEMBLY

N.T.S.



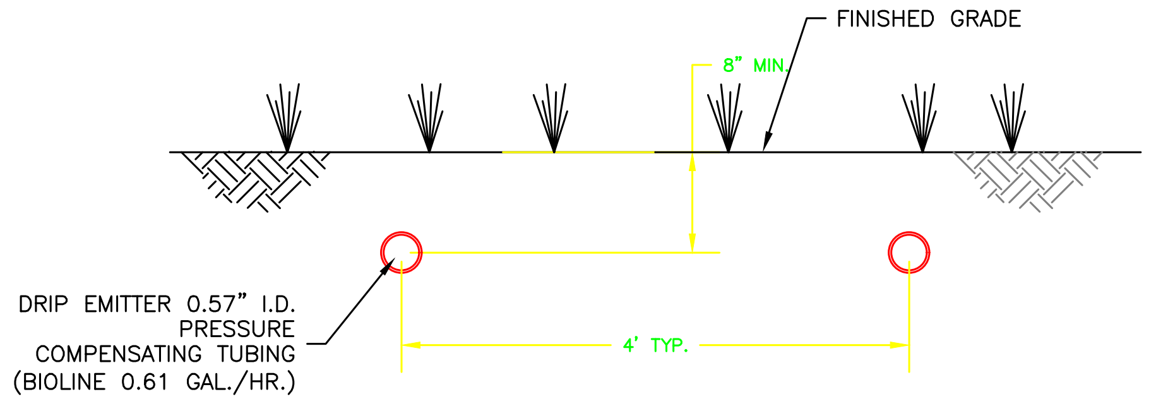
11 END-OF-LINE BLOW-OFF ASSEMBLY

N.T.S.



9 DRIP DISPOSAL PIPING END MANIFOLD ELEV.

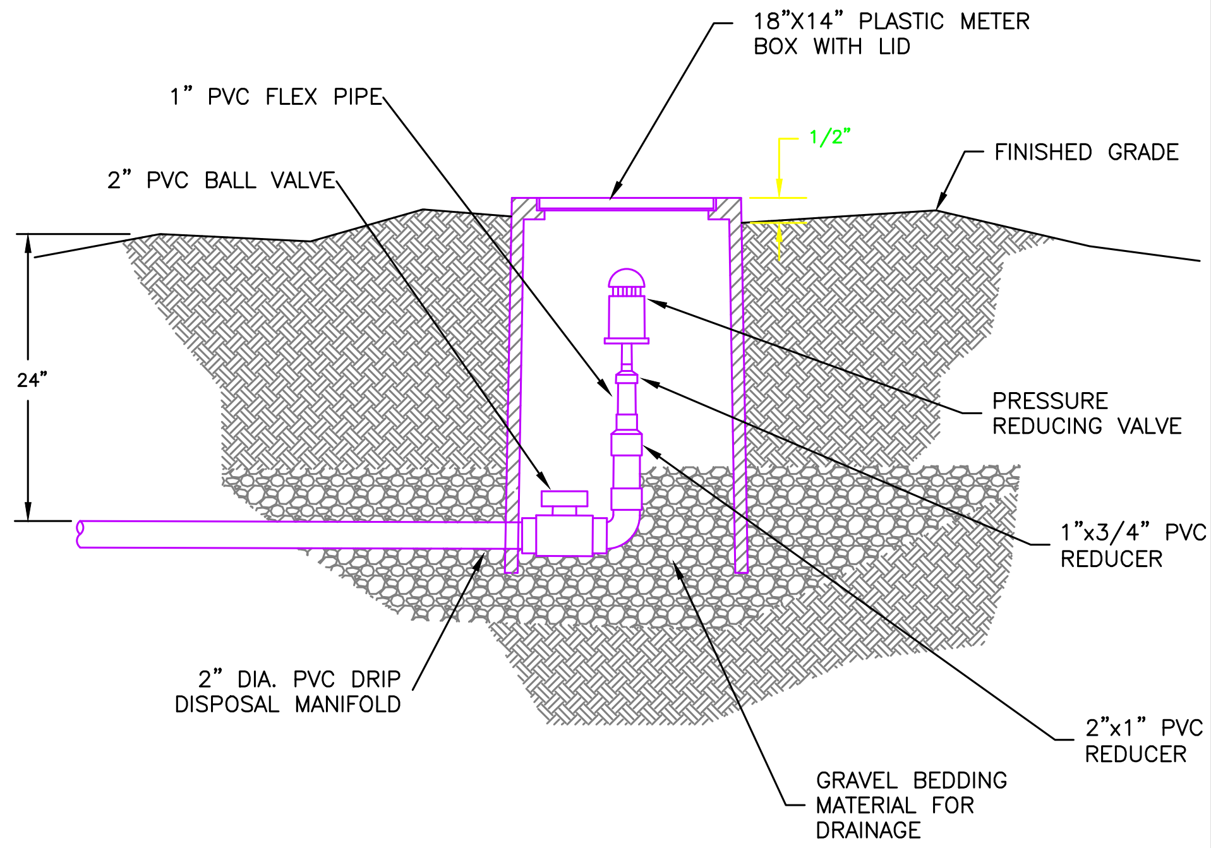
N.T.S.



NOTE:
DRIP EMITTER PIPING SHALL BE PLOWED IN PLACE.

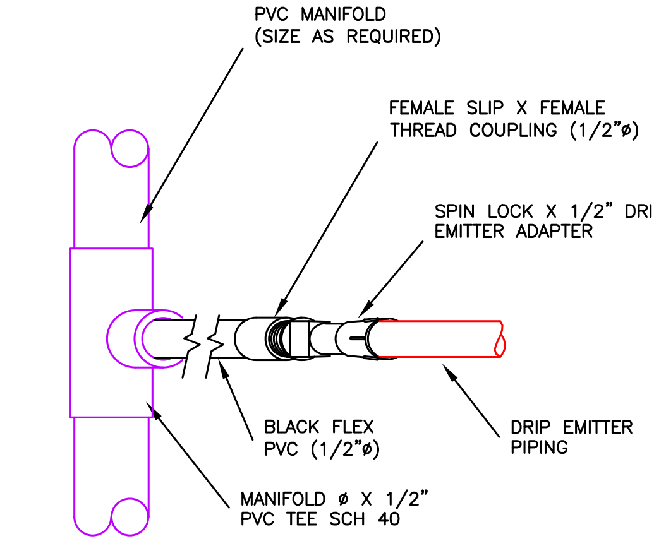
6 DRIP EMITTER PIPING

N.T.S.



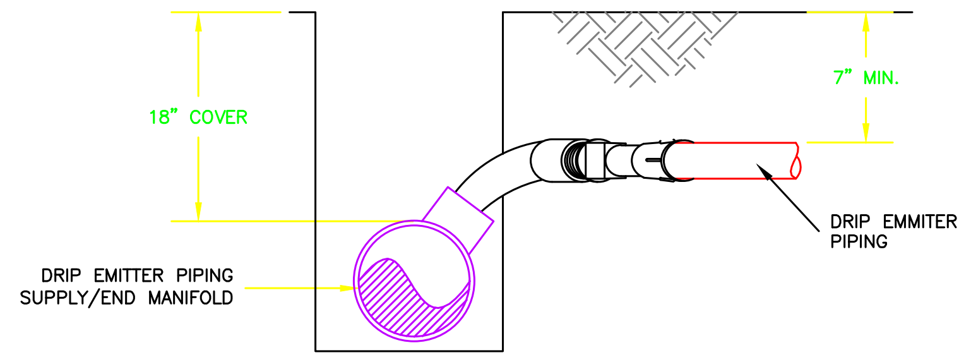
5 PRESSURE REDUCING VALVE ASSEMBLY

N.T.S.



2 MANIFOLD TAP

N.T.S.



1 DRIP EMITTER MANIFOLD - SECTION

N.T.S.

CIVIL INFRASTRUCTURE ASSOCIATES

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08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID
SOIL MAPPING PLAN
ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004
DRAWN BY: MSW
CHECKED BY: LJS

REVISIONS

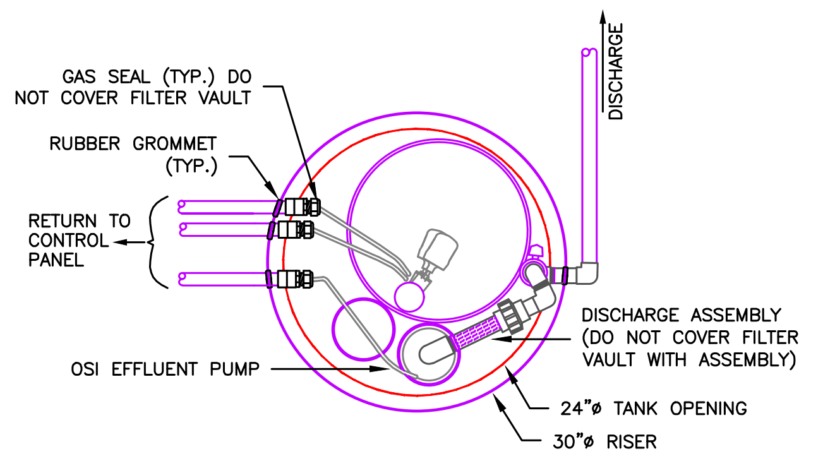
◇ PRE-BID SET ISSUE DATE
△ POST BID SET ISSUE DATE

DATE		DESCRIPTION

ORIGINAL ISSUE DATE: August 2020

DRIP FIELD DETAILS

C4.04



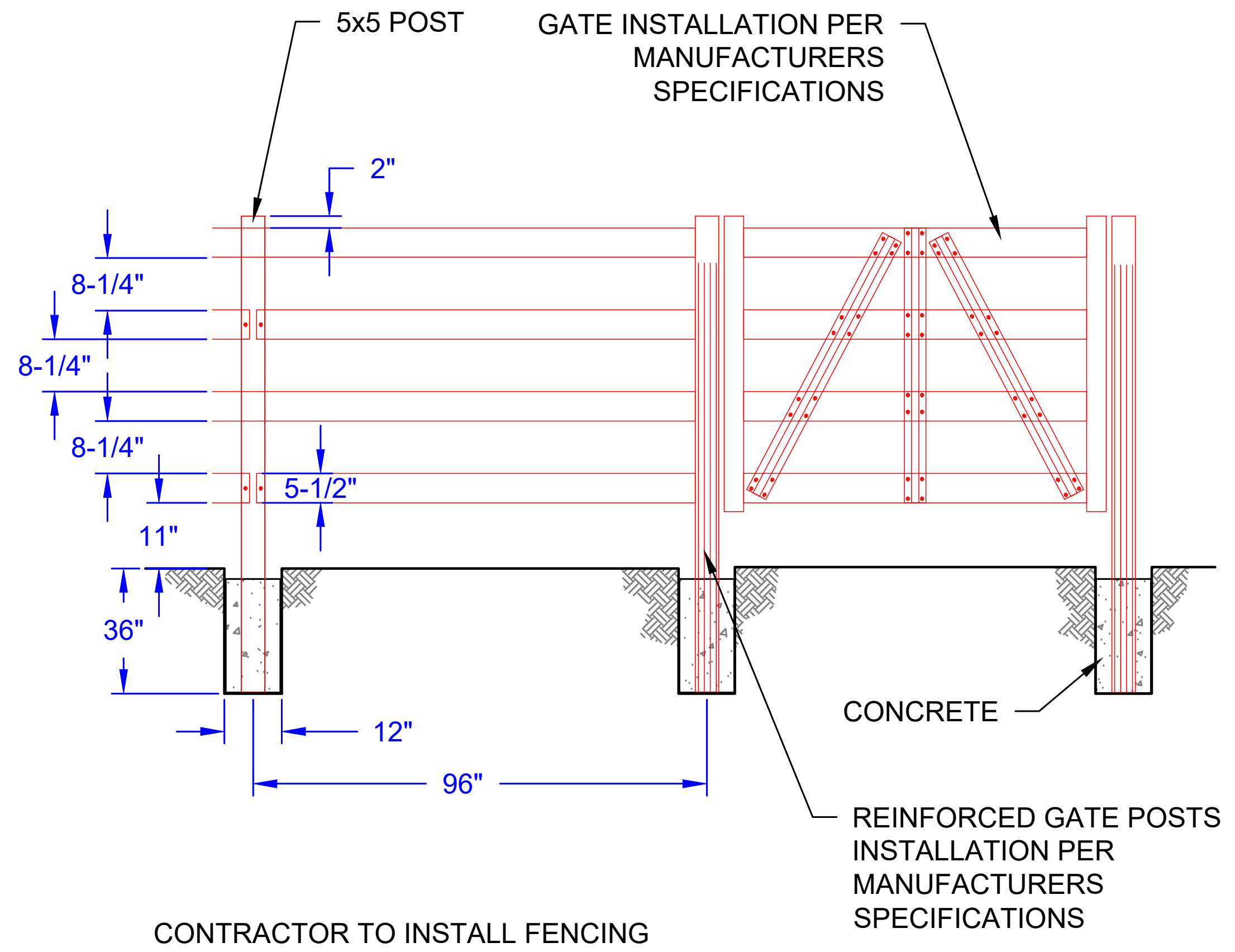
CONTROL PUMP VAULT – PLAN

N.T.S.

SPECIAL NOTE:
ONLY ONE PUMP VAULT SHALL CONTAIN FLOAT SWITCHES. THIS VAULT SHALL CONTAIN THE LOW LEVEL OFF FLOAT. ALL DUPLEX PUMP UNITS SHALL BE CONTROLLED BY THE TELEMETRY (SMART) PANEL LEVEL CONTROL PRESSURE SENSOR

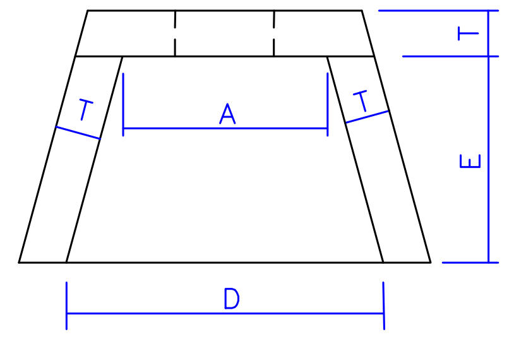
ALL TANKS SHALL BE ONE–PIECE, STRUCTURALLY SOUND, WATERTIGHT TANKS AS MANUFACTURED BY JARRETT CONCRETE PRODUCTS, OR APPROVED EQUAL

7 RECIRCULATION CONTROL PUMP VAULT
N.T.S.



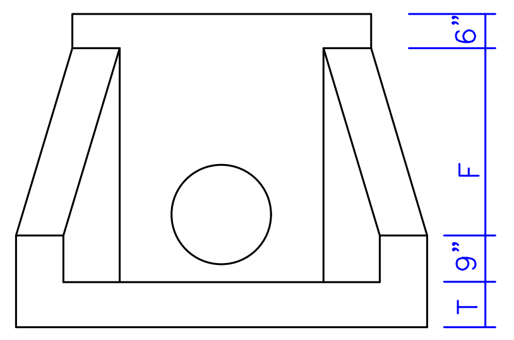
CONTRACTOR TO INSTALL FENCING COMPONENTS AND APPURTENANCES PER MANUFACTURERS SPECIFICATIONS

6 4-RAIL VINYL FENCE
N.T.S.

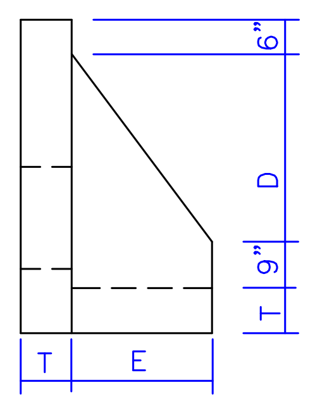


TOP VIEW

TABLE OF DIMENSIONS					
PIPE SIZES	A	D	E	F	T (MIN.)
15"	2'–6"	5'–0"	2'–6"	1'–9"	6"
18"	2'–6"	5'–0"	2'–6"	1'–9"	6"
21"	2'–6"	5'–0"	2'–6"	1'–9"	6"
24"	4'–0"	6'–6"	4'–0"	3'–3"	6"
30"	4'–0"	6'–6"	4'–0"	3'–3"	6"
36"	5'–6"	8'–0"	3'–6"	4'–5"	6"
42"	5'–6"	8'–0"	3'–6"	4'–5"	6"
48"	5'–6"	8'–0"	3'–6"	4'–5"	6"
54"	7'–0"	9'–5"	4'–6"	5'–9"	6"
60"	7'–0"	9'–5"	4'–6"	5'–9"	6"
66"	8'–6"	11'–0"	5'–6"	6'–11"	6"
72"	8'–6"	11'–0"	5'–6"	6'–11"	6"



FRONT VIEW

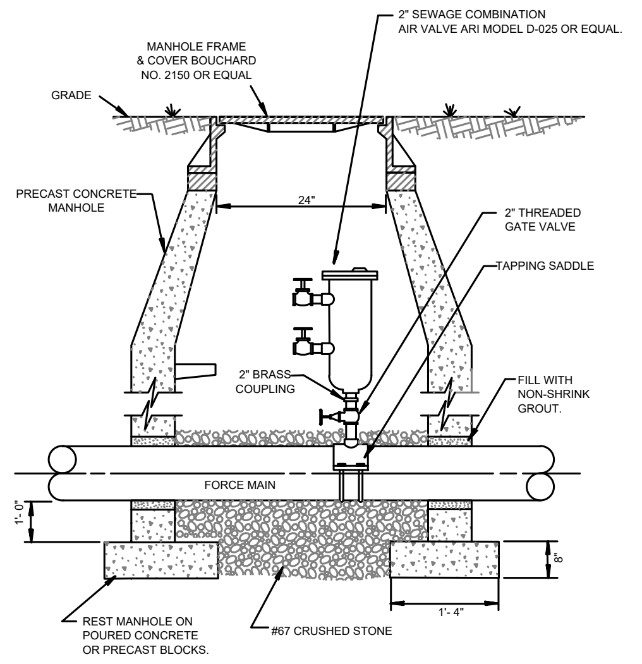


SIDE VIEW

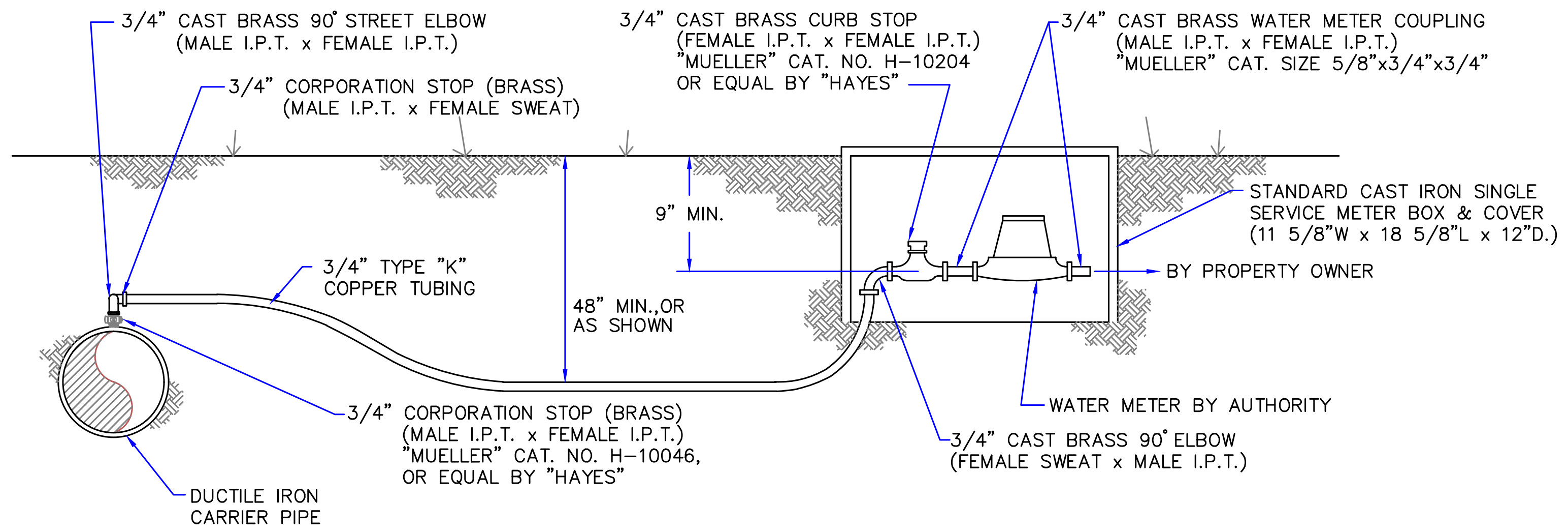
CONCRETE: 4000 PSI AT 28 DAYS REINFORCED W/NO. 4 BARS 10" C/C EACH WAY W/WINGS & TOE SLAB DOWELLED TO HEADWALL W/NO. 5 BARS.

3/4" CHAMFER ON ALL EXPOSED EDGES.

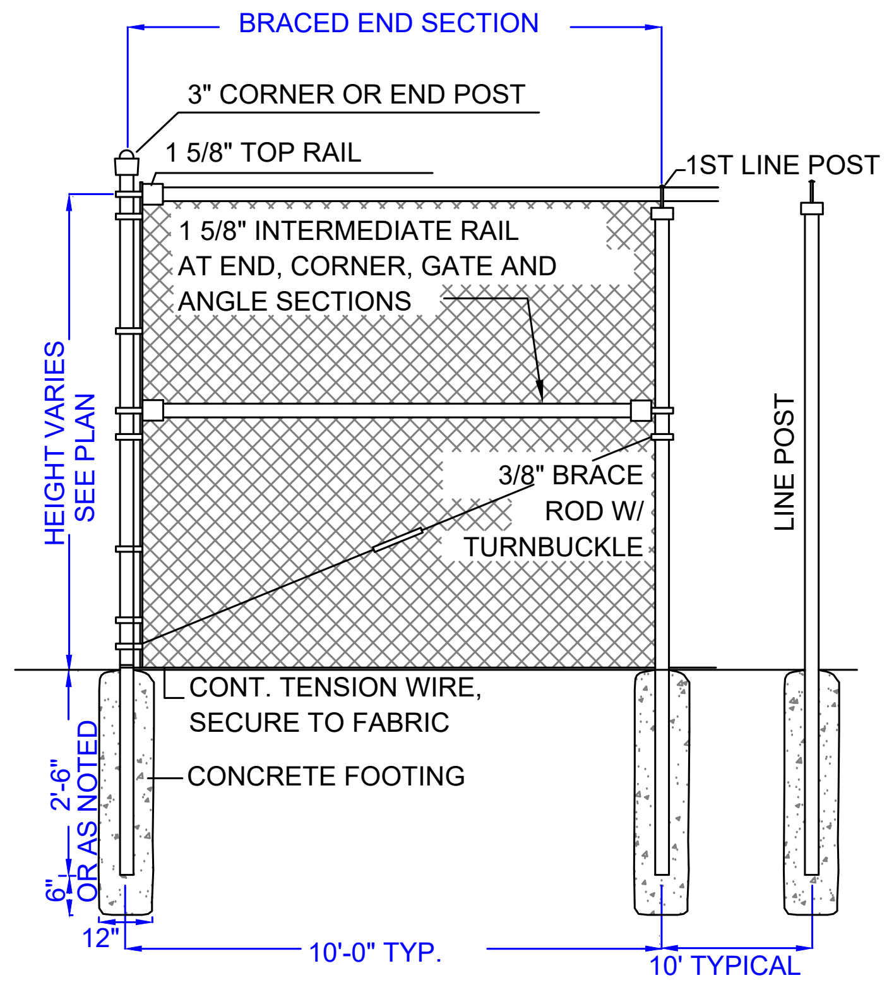
3 ENDWALL DETAIL
N.T.S.

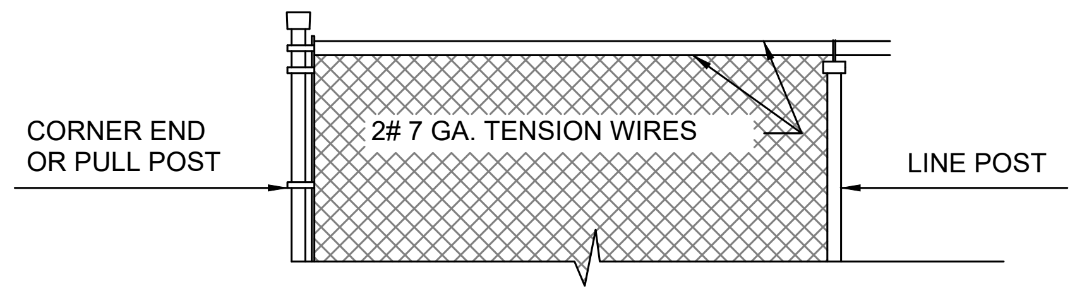


2 SEWER AIR RELEASE VALVE
N.T.S.

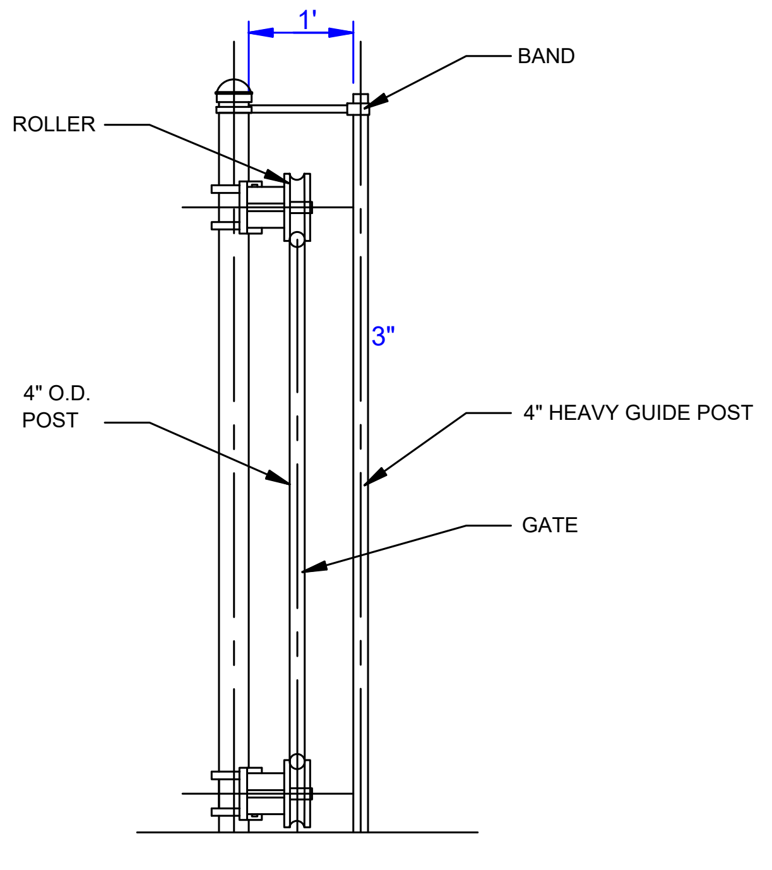


5 WATER METER
N.T.S.

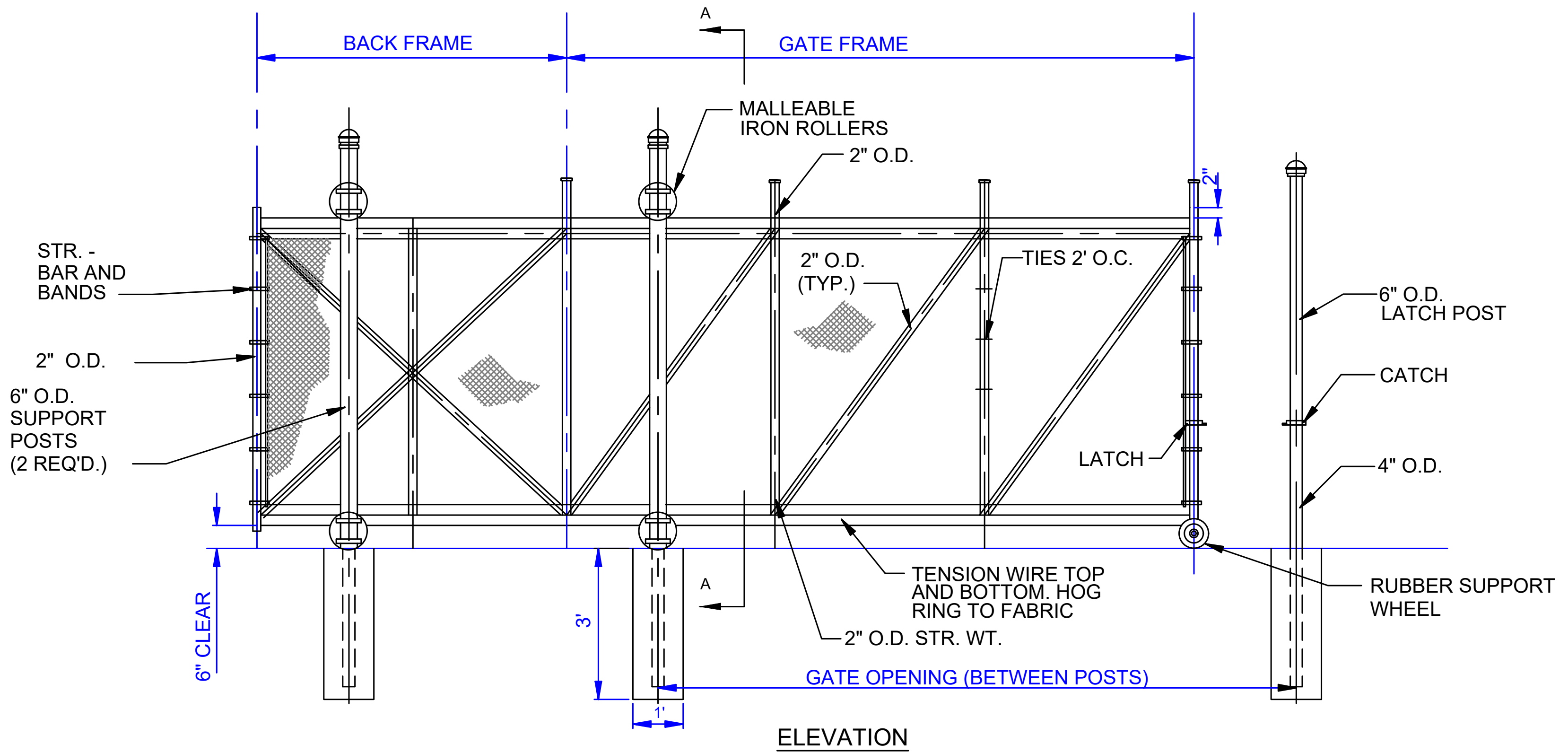




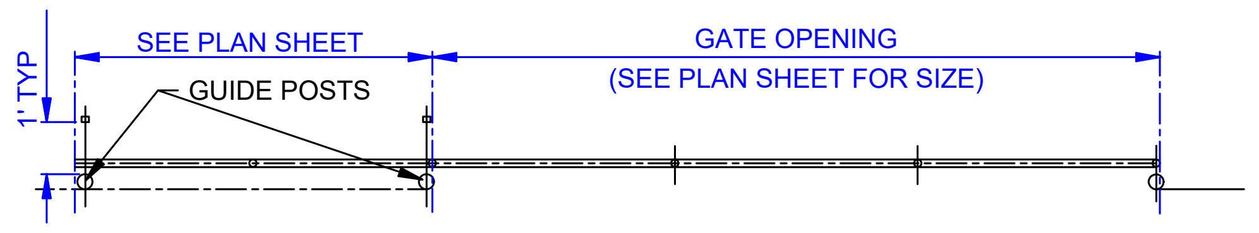
4 6' FENCE DETAIL
N.T.S.



SECTION A-A



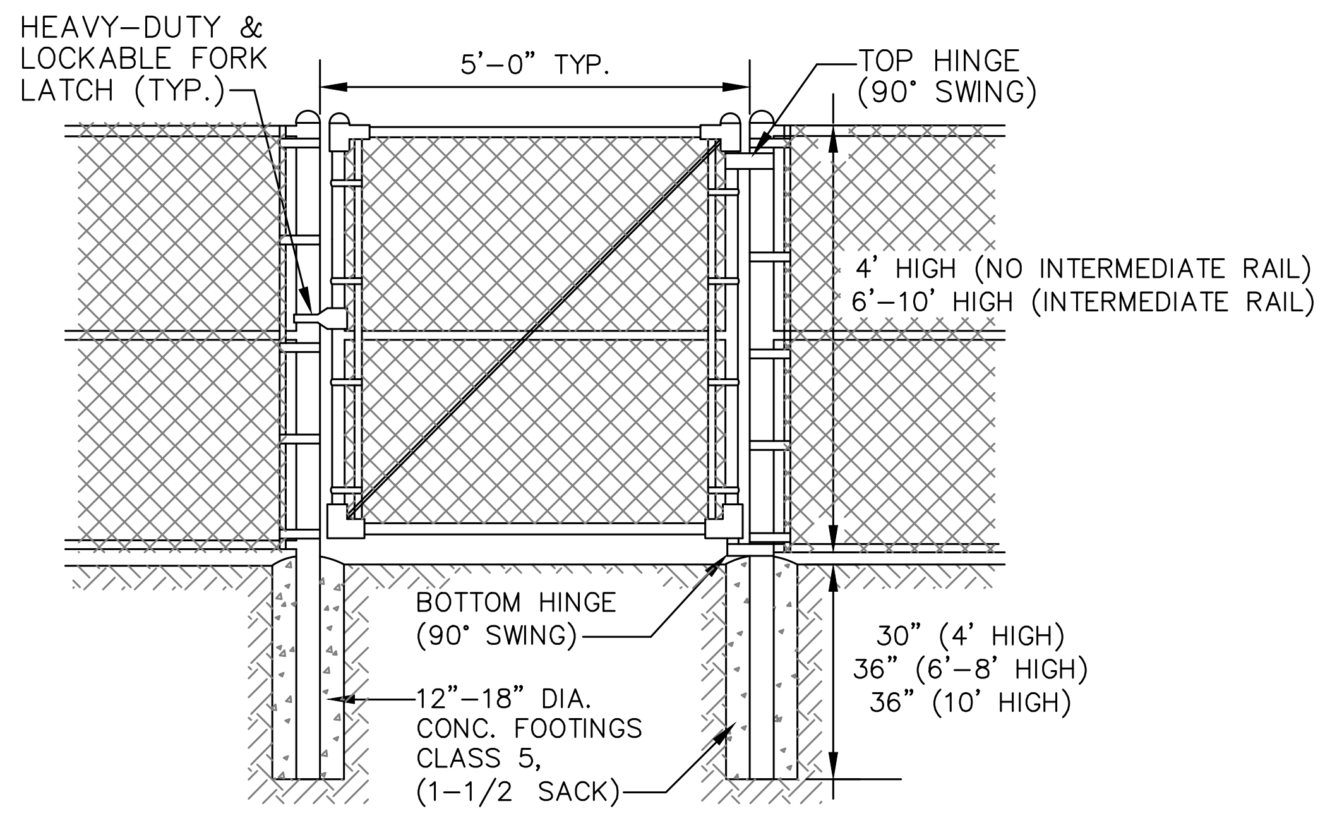
ELEVATION



PLAN VIEW

20' CANTILEVERED GATE

NOTES:
1. REFER TO CONSOLIDATED UTILITY DISTRICT TECHNICAL SPECIFICATIONS FOR FURTHER DETAIL, DIMENSIONS AND NOTES.
2. FENCE FABRIC SHALL BE SECURED TO GATE FRAMES WITH KNUCKLED SELVAGE ALONG ALL EDGES FOR ALL TYPES CHAIN LINK FENCE INSTALLATIONS.
3. FENCING SHALL HAVE A COLOR COATING, CONTRACTOR TO COORDINATE COLOR WITH WADC.
4. ALL CONCRETE FOOTINGS AROUND POSTS AT GROUND LINE SHALL BE MOUNDED & SLOPED FOR POSITIVE DRAINAGE.



TYPICAL PEDESTRIAN GATE

1 GATE DETAILS
N.T.S.

CIVIL
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ASSOCIATES

307 HICKERSON DRIVE
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08.26.20

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ARRINGTON, TENNESSEE 37014
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CIA PROJECT No: 2020-004
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REVISIONS

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△ POST BID SET ISSUE DATE

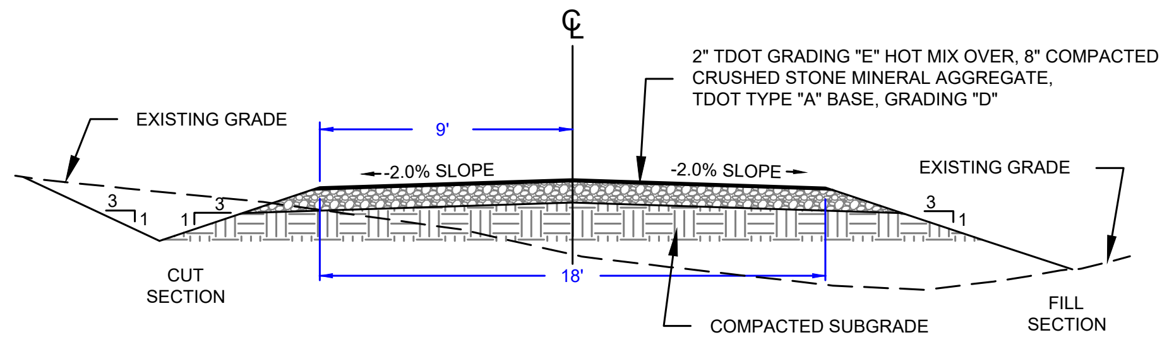
DATE		DESCRIPTION

ORIGINAL ISSUE DATE: August 2020

STANDARD DETAILS

C4.05

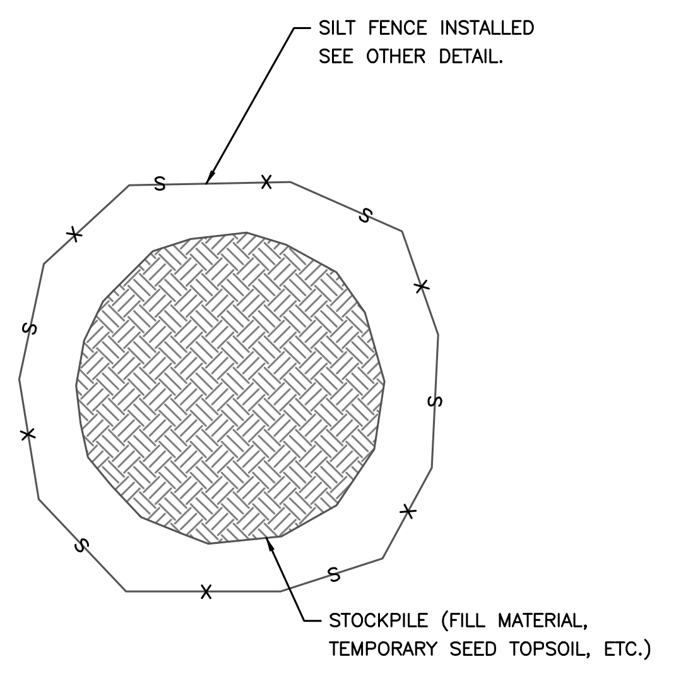
PLOT DATE: 8/26/2020 9:32:52 AM (MWARNER)



NOTE:
ACCESS DRIVE TO DRIP FIELDS SHALL BE SURFACED WITH 8" INCHES OF COMPACTED CRUSHED LIMESTONE GRAVEL.

11 ACCESS ROAD SECTION

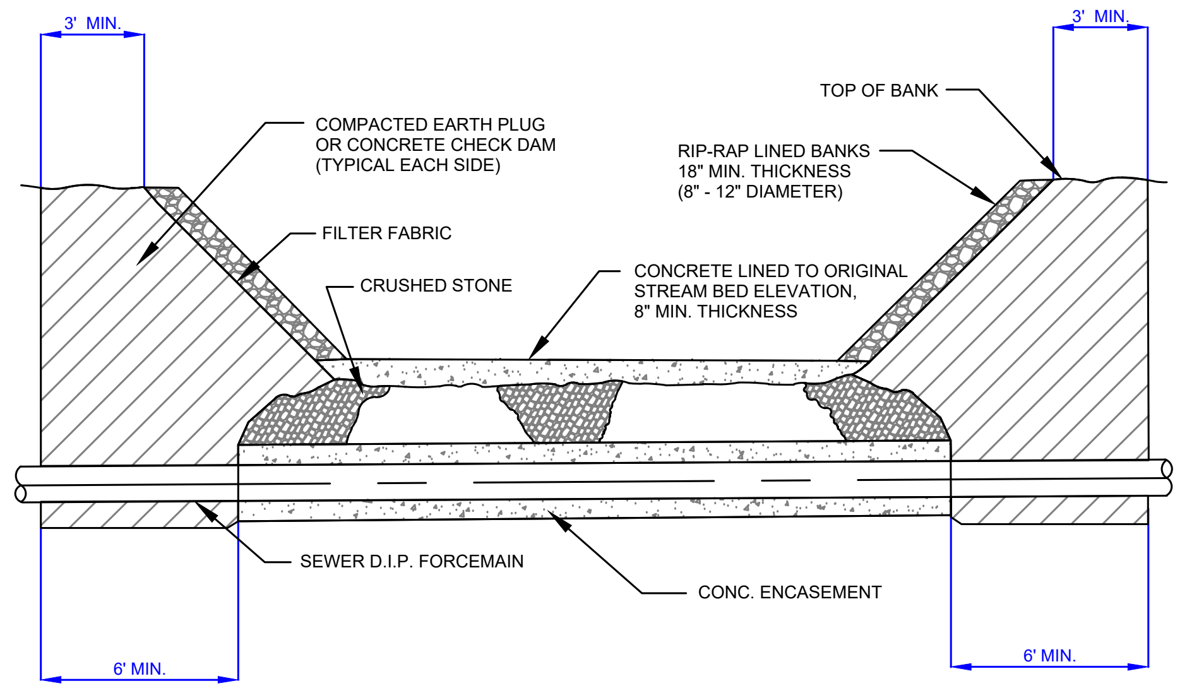
N.T.S.



NOTE:
SILT FENCE IS REQUIRED AROUND ANY AND ALL MATERIAL STOCKPILES.

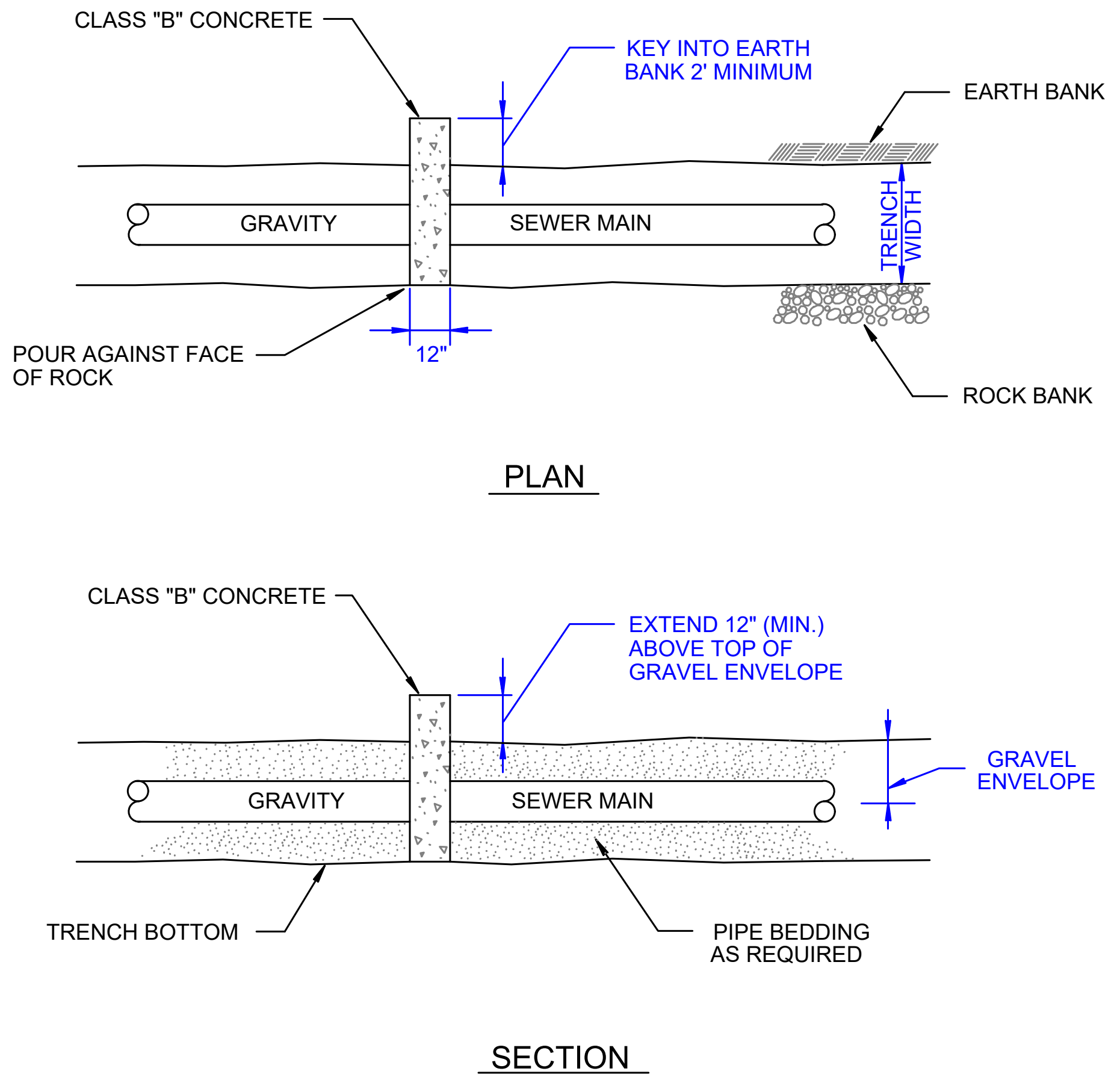
9 EROSION CONTROL AROUND STOCKPILE

N.T.S.



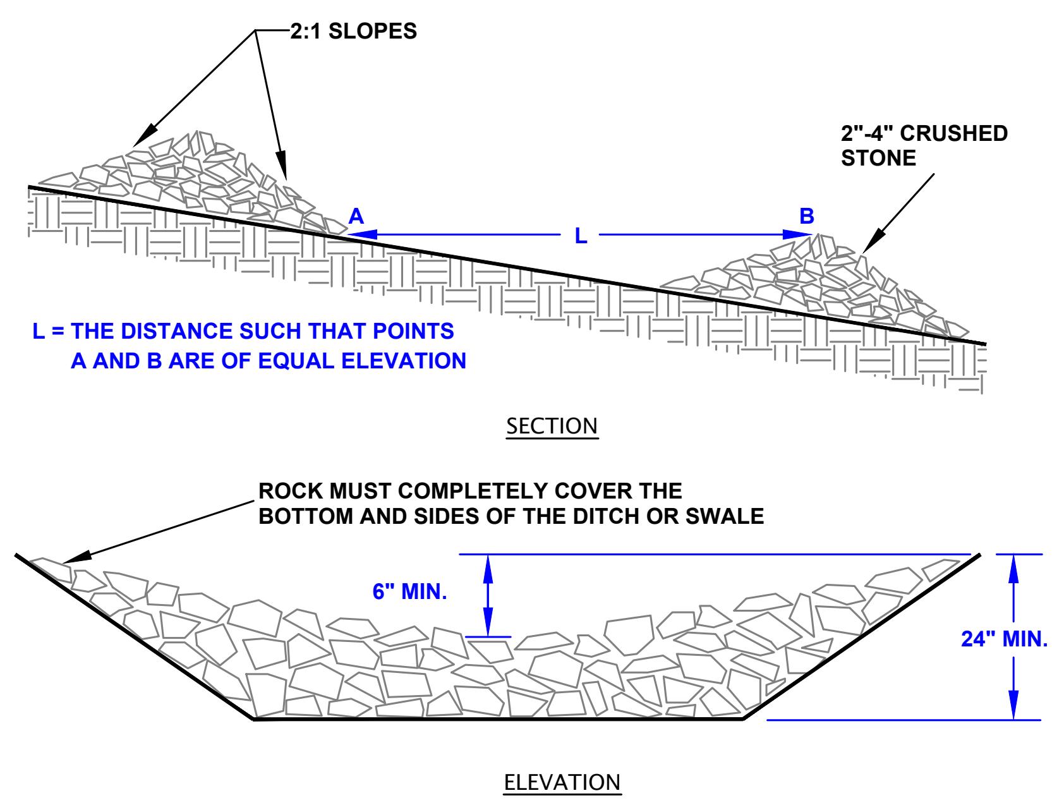
8 CREEK CROSSING DETAIL

N.T.S.



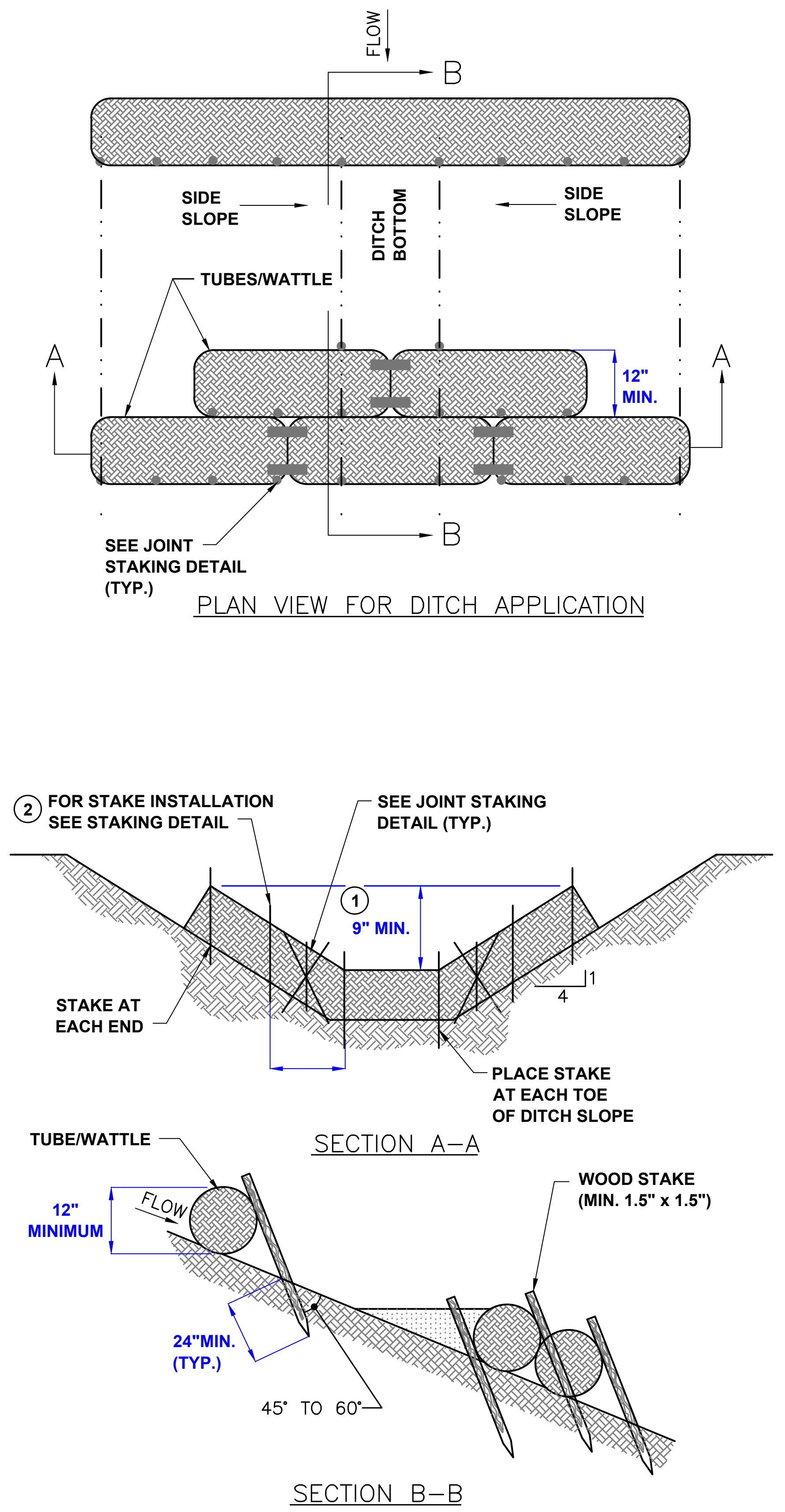
6 CHECK DAM

N.T.S.



3 STONE CHECK DAM

N.T.S.



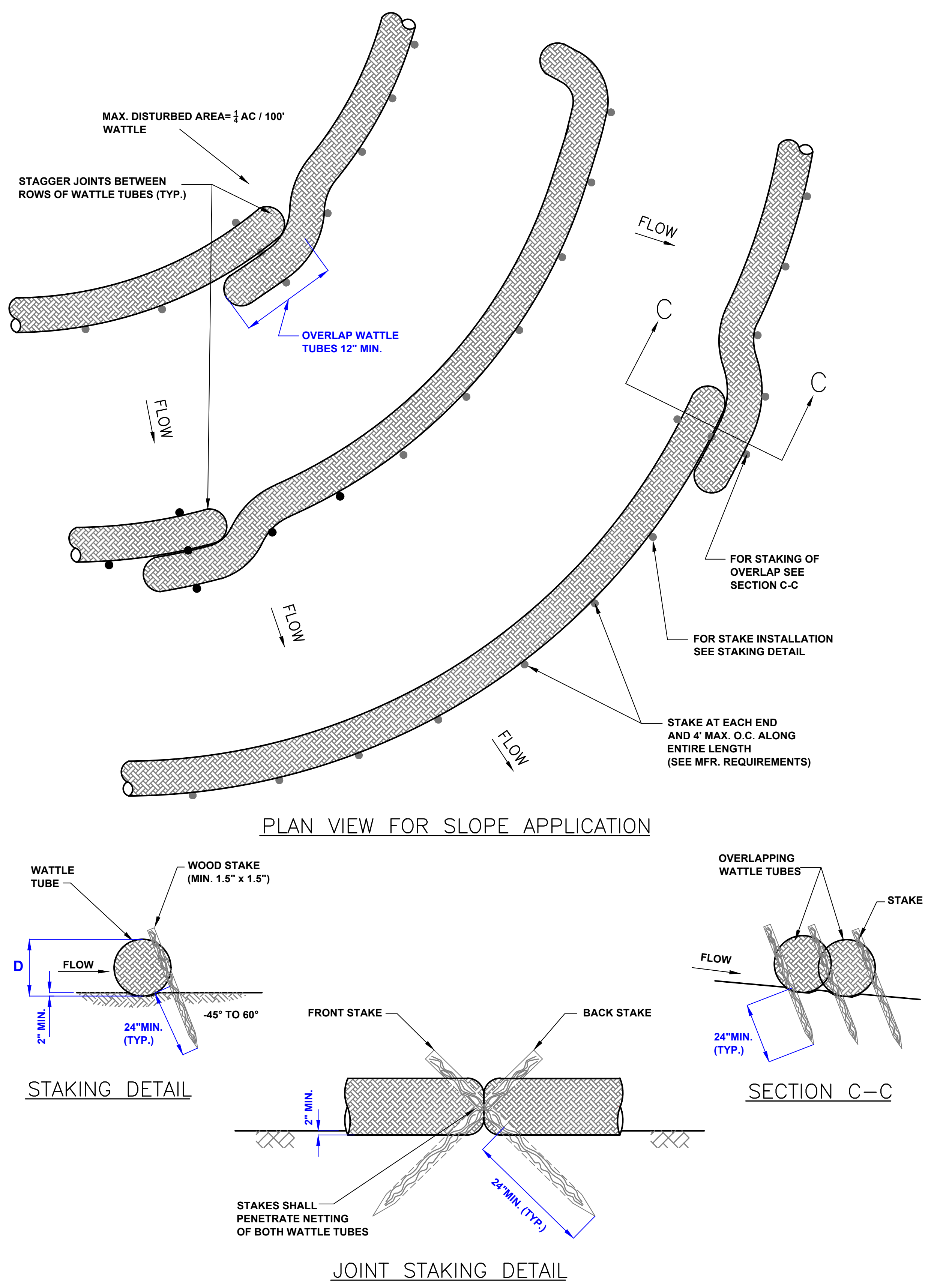
NOTES:

① THE DEPTH AND WIDTH OF THE WEIR SECTION OF THE WATTLE SHALL BE DESIGNED TO PASS THE 2yr/24hr OR 5yr/24hr STORM EVENT WITHOUT OVERTOPPING THE CHANNEL.

② STAKE PER MANUFACTURERS RECOMMENDATIONS.

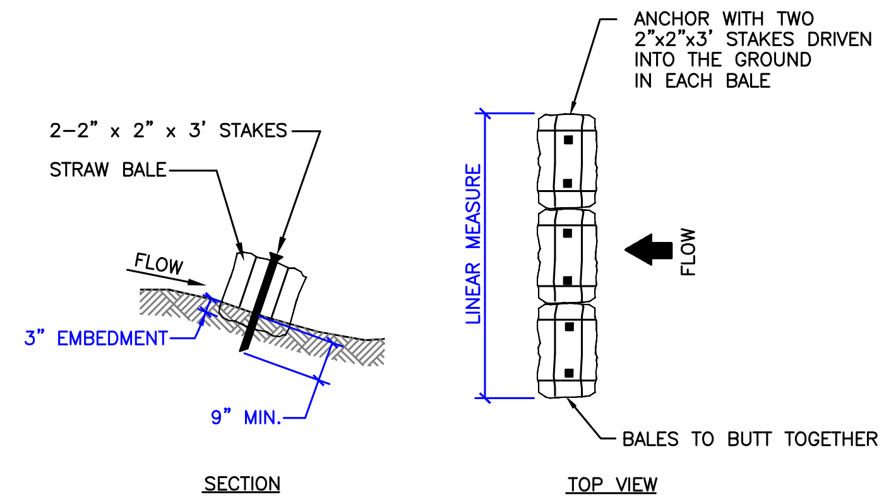
10 WATTLE/TUBES CHANNEL APPLICATION

N.T.S.



7 WATTLE/TUBES SLOPE APPLICATION

N.T.S.

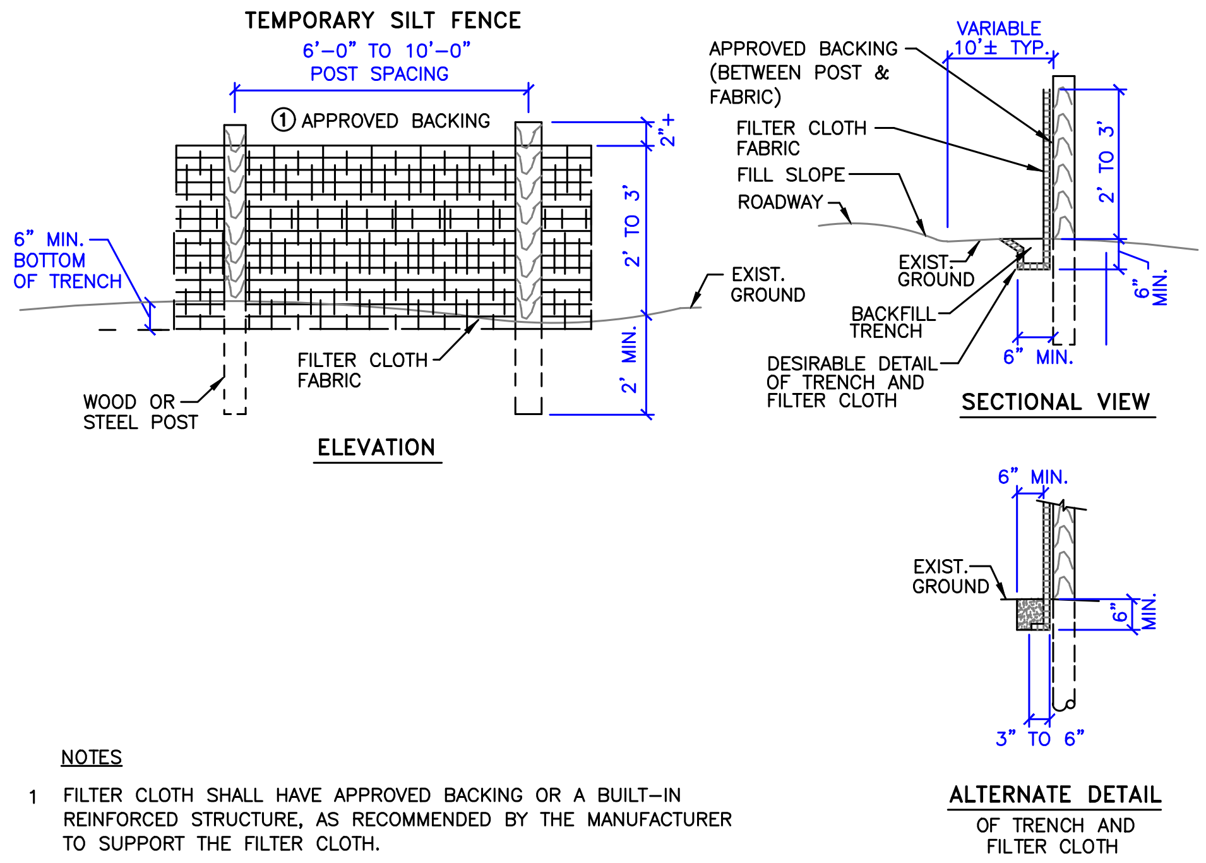


NOTES

1. TO BE INSTALLED AS NOTED ON PLAN BEFORE COMMENCING GRADING OPERATION AND LEFT IN PLACE UNTIL A GOOD STAND OF GRASS IS ESTABLISHED OVER ALL DISTURBED AREAS.
2. STRAW BALE SEDIMENT CONTROL BARRIERS SHALL BE DESIGNED AND PLACED PER THE TDEC EROSION AND SEDIMENT CONTROL HADBOOK, LATEST EDITION.

5 STRAW BALE SILT BARRIER

N.T.S.



NOTES

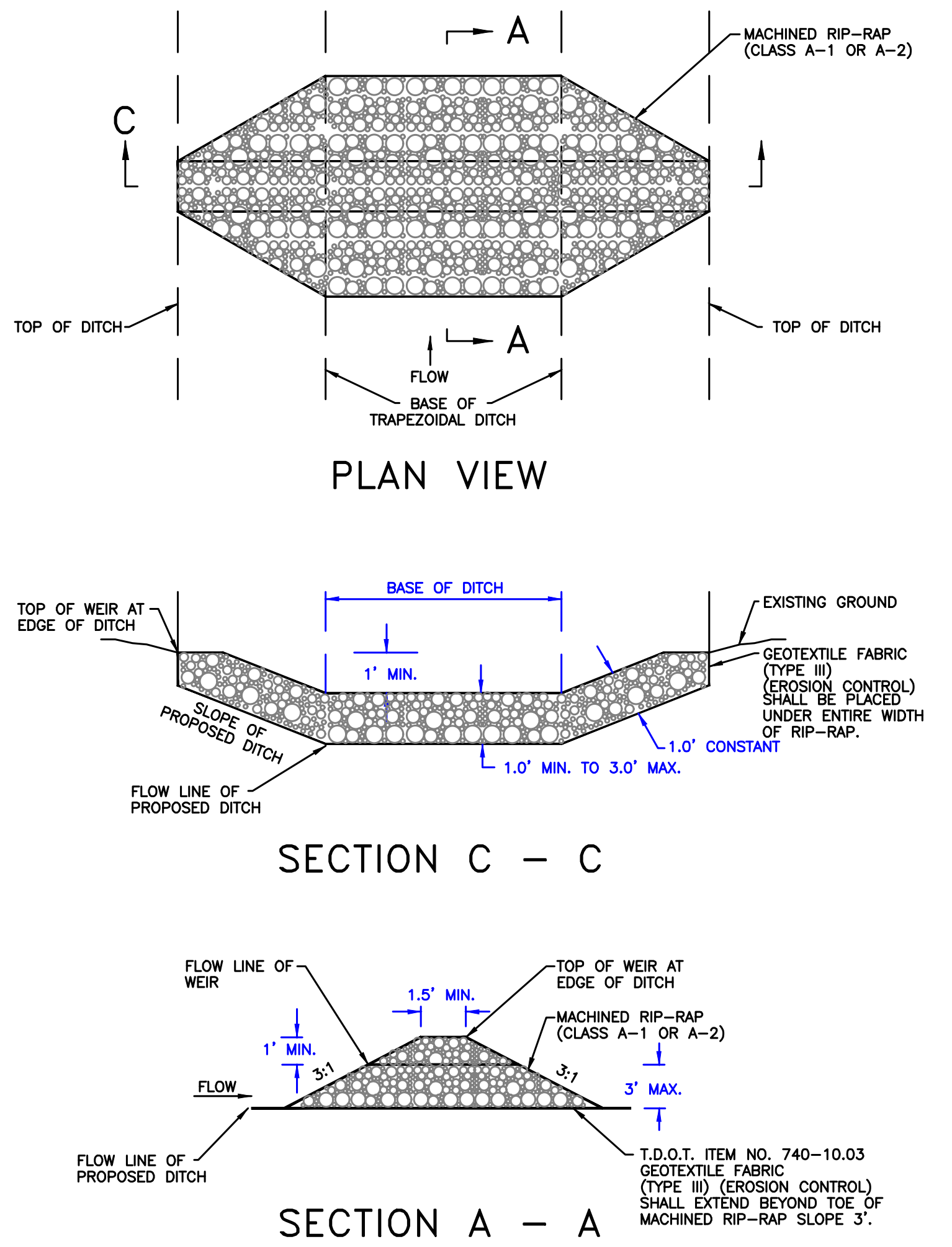
1 FILTER CLOTH SHALL HAVE APPROVED BACKING OR A BUILT–IN REINFORCED STRUCTURE, AS RECOMMENDED BY THE MANUFACTURER TO SUPPORT THE FILTER CLOTH.

2 FILTER CLOTH SHALL MEET THE REQUIREMENTS OF SECTION 209 OF T.D.O.T. STANDARD SPECIFICATIONS

3 A PREASSEMBLED SILT FENCE MEETING THE REQUIRMENTS OF THIS DRAWING IS ACCEPTABLE IN LIEU OF A FIELD CONSTRUCTED SILT FENCE

2 SILT FENCE DETAIL

N.T.S.

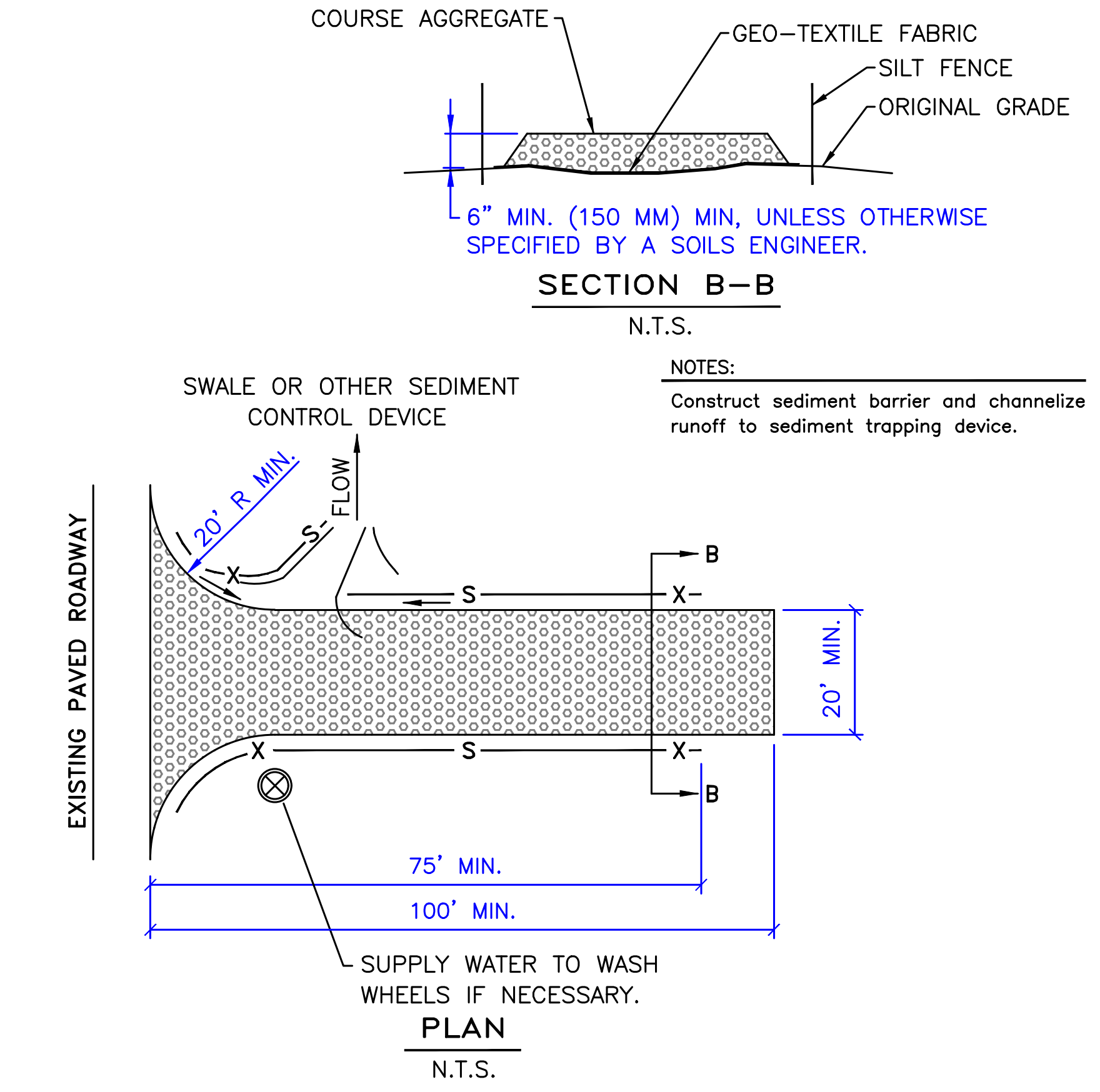


NOTES

1. REFER TO TDOT STANDARD DRAWING NO. EC–STR–6 FOR DETAILS AND NOTES NOT SHOWN.

4 ROCK CHECK DAMS DETAIL

N.T.S.



NOTES:
Construct sediment barrier and channelize runoff to sediment trapping device.

NOTES

1. COORDINATE WITH C.O.C. BMP MANUAL FOR ADDITAIONAL DETAILS AND NOTES.

1 CONSTRUCTION ENTRANCE

N.T.S.

CIVIL
INFRASTRUCTURE
ASSOCIATES

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PHONE: 615-663-7678

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REVISIONS

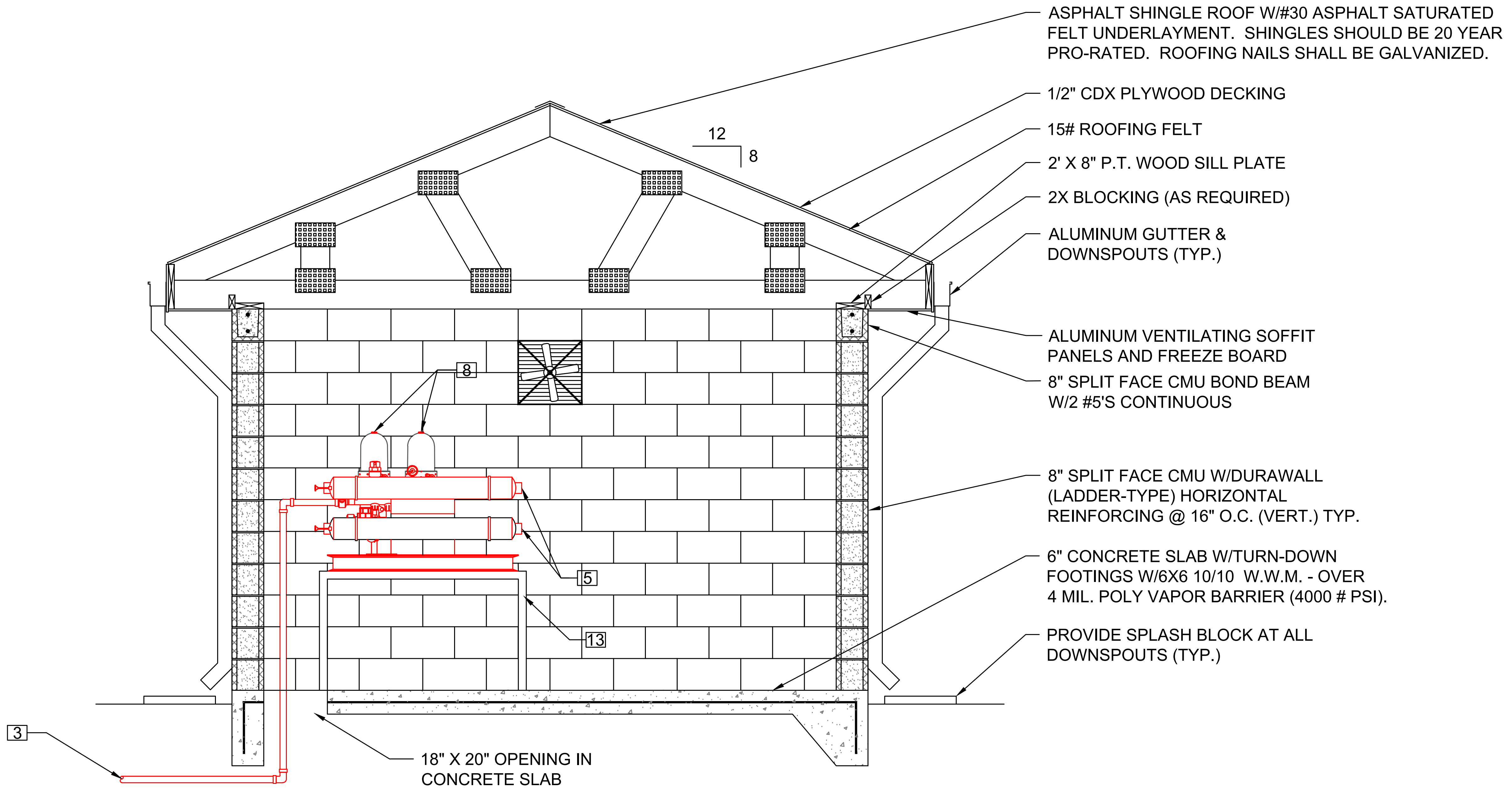
◇ PRE-BID SET ISSUE DATE
△ POST BID SET ISSUE DATE

DATE		DESCRIPTION

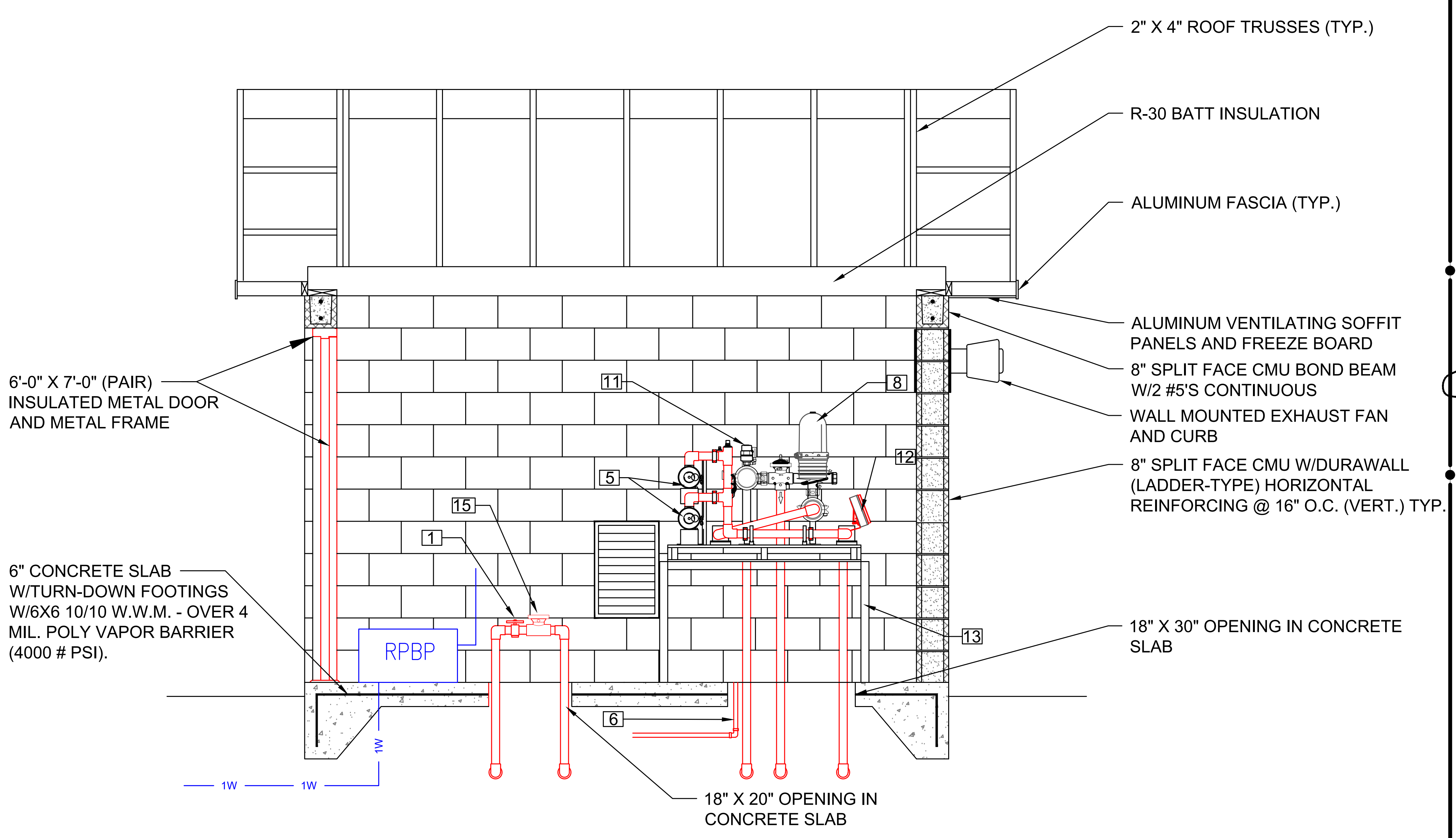
ORIGINAL ISSUE DATE: August 2020

STANDARD DETAILS

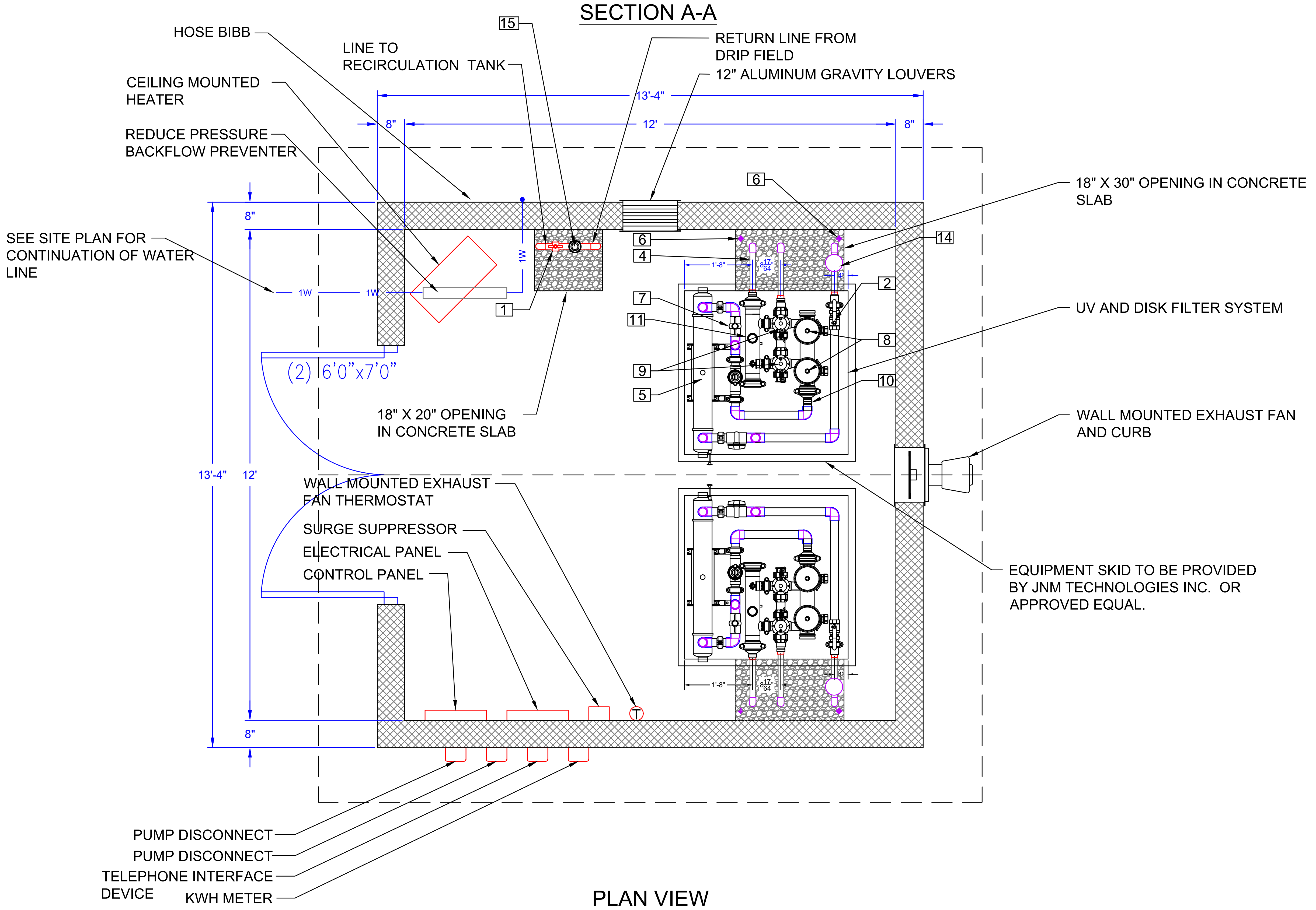
C4.06



SECTION B-B



SECTION A-A



PLAN VIEW

EQUIPMENT LIST:

1 2" DRIP FIELD FLUSH SOLENOID CONTROL VALVE
2 HYDRO METER WITH SOLENOID CONTROL VALVE
3 2" PVC INLET FROM DOSE TANK.
4 2" DIA HIGH PRESSURE FLEXIBLE HOSE (2) REQUIRED.
5 SANITRON U.V. DISINFECTION UNIT (TYP. FOR 2).
6 3/4 HOSE BIBB.
7 2" SOLENOID CONTROL VALVE.
8 2"x3" DISK FILTER (ARKAL "SUPER FILTER" OR EQUAL).
9 FILTER FLUSHING SOLENOID VALVES.
10 2" UNION.
11 AIR RELEASE VALVE.
12 FILTER WIRING JUNCTION BOX.
13 30" HEIGHT ALUMINUM TABLE
14 EXPANSION TANK
15 FLOW METER

GENERAL NOTES:
1. PIPING SHOWN IS FOR TWO PIPE INLET AND TWO U.V. UNITS. LAYOUT AND COMPONENTS FOR ADDITIONAL UNITS SHALL BE SIMILAR.
2. ALL BUILDING PIPING AND VALVES SHALL BE 2" SCHEDULE 80 PVC.
3. CONTRACTOR SHALL LEAVE PIPE STUB-OUTS IN BUILDING IF FUTURE ADDITIONAL U.V. DISINFECTION UNITS ARE PLANNED.
4. ALL SUFFICIENT SPACE BETWEEN WALL AND END OF U.V. UNIT FOR REMOVAL OF BULB. U.V. UNITS MAY BE ROTATED FOR ADDITIONAL SPACE.
5. FILTER UNITS AND U.V. UNITS TO BE SUPPORTED BY CUSTOM-MADE WELDED ANGLE IRON FRAME. FRAME TO BE PAINTED WITH TWO COATES BLACK ENAMEL. FRAME TO BE STURDY AND LEVEL.
6. CONTRACTOR TO SUPPLY ALL PIPING AND FITTINGS NOT LISTED IN EQUIPMENT LIST, NEEDED FOR ASSEMBLY OF EQUIPMENT.

PLOT DATE: 8/26/2020 9:33:59 AM (MWARNER)

CIVIL
INFRASTRUCTURE
ASSOCIATES
307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

LINDA J. SULLIVAN
NO. 023015
08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID
SOIL MAPPING PLAN
ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004
DRAWN BY: MSW
CHECKED BY: LJS

REVISIONS
◇ PRE-BID SET ISSUE DATE
△ POST BID SET ISSUE DATE

DATE		DESCRIPTION

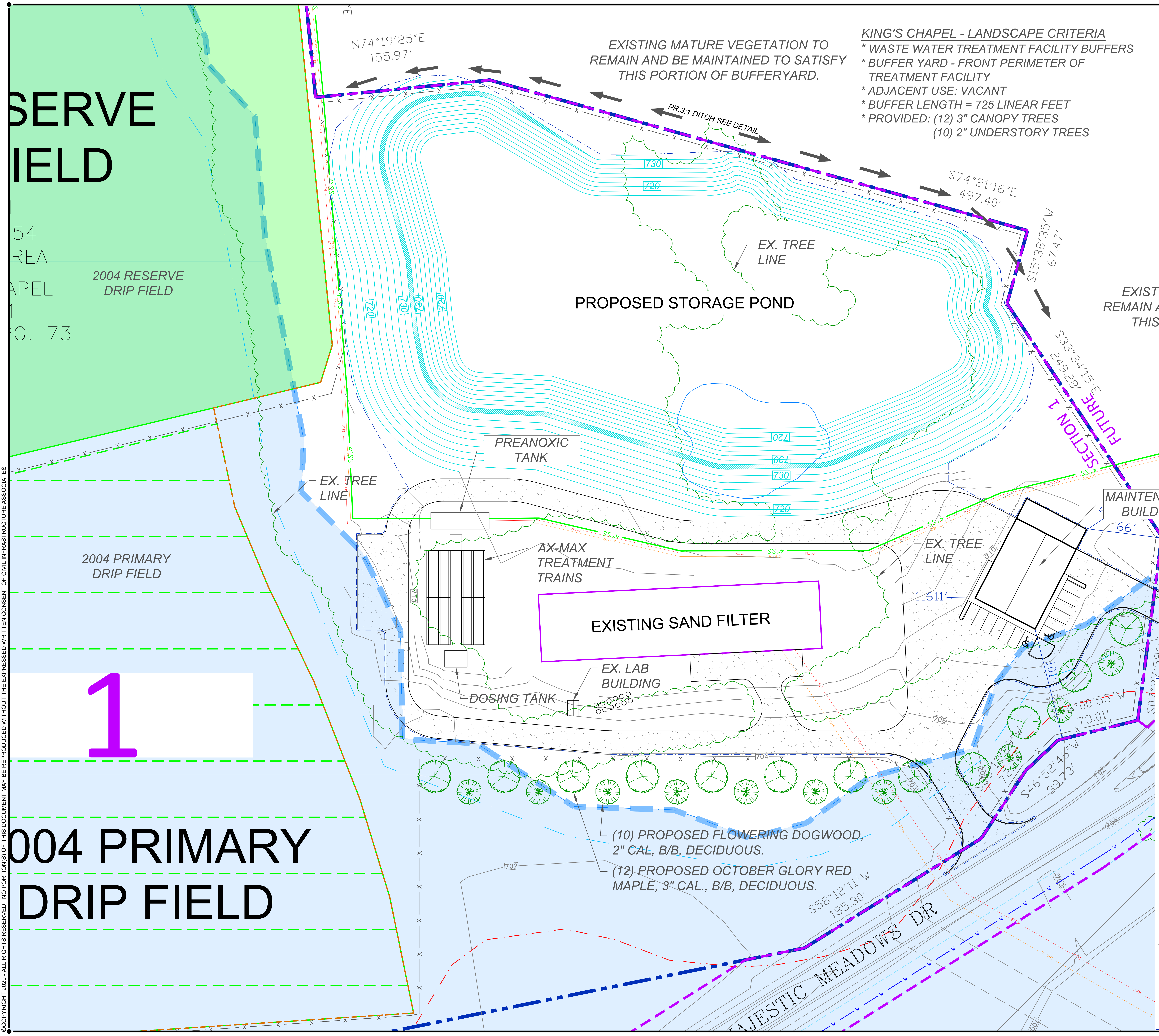
ORIGINAL ISSUE DATE: August 2020

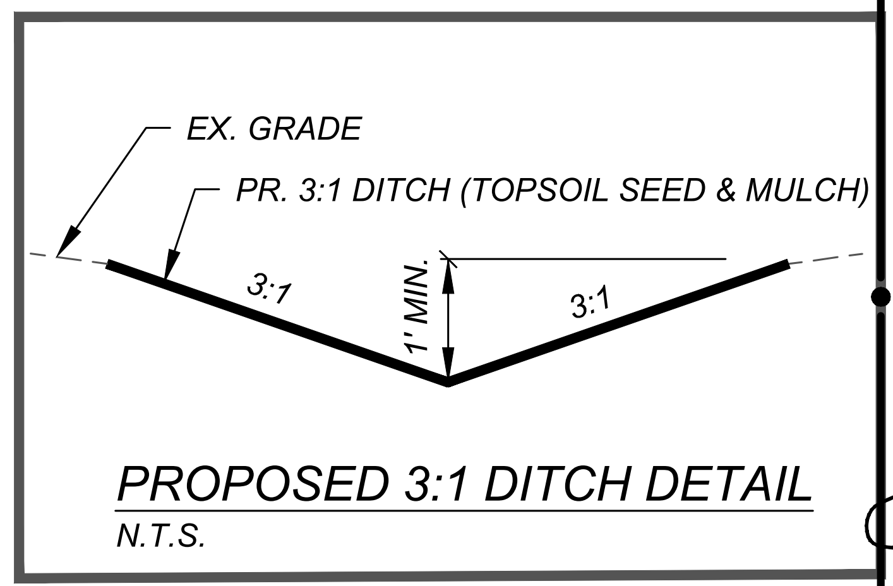
LAB BUILDING

C4.07

KING'S CHAPEL - LANDSCAPE CRITERIA

- * WASTE WATER TREATMENT FACILITY BUFFERS
- * BUFFER YARD - FRONT PERIMETER OF TREATMENT FACILITY
- * ADJACENT USE: VACANT
- * BUFFER LENGTH = 725 LINEAR FEET
- * PROVIDED: (12) 3" CANOPY TREES
  (10) 2" UNDERSTORY TREES



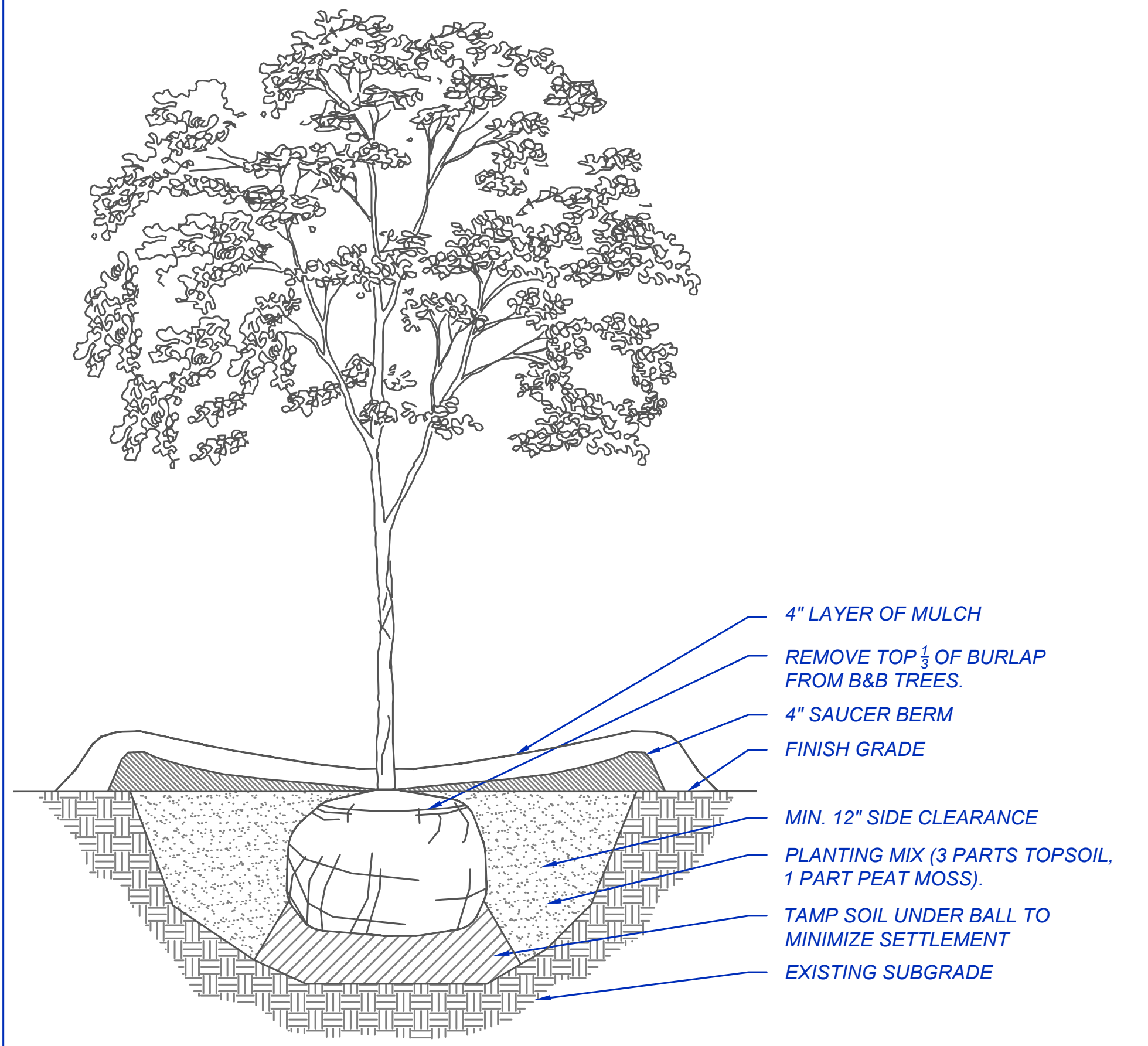


PROPOSED 3:1 DITCH DETAIL

N.T.S.

GENERAL NOTES:

1. ALL TREES ARE TO BE NURSERY GROWN, BURLAP AND BALL (B&B). MINIMUM TREE SIZE IS PER SCHEDULE (MEASURED 6" ABOVE ROOT BALL).
2. REMOVE ALL TREATED OR PLASTIC COATED BURLAP, STRAPPING WIRE OR NYLON TWINE FROM ROOT BALL. AFTER SETTING IN HOLE, CUT AWAY TOP AND SIDES OF WIRE BASKET, IF ANY.
3. INSTALL TOP OF PLANT BALL EVEN WITH OR 1" ABOVE EXISTING GRADE.
4. SET TREE IN VERTICAL POSITION PRIOR TO STAKING.
5. SOAK PLANT BALL AND PIT IMMEDIATELY AFTER INSTALLATION. PLACE 4" TO 6" OF SEASONED MULCH OR PINE NEEDLES AROUND BASE OF TREE, 3' DIAMETER MINIMUM.



SINGLE TRUNK DECIDUOUS TREE

N.T.S.

CIVIL INFRASTRUCTURE ASSOCIATES
307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

LINDA J. SULLIVAN
NO. 023015
08.26.20

KINGS CHAPEL - FOX FAMILY FARMS SOIL GRID
SOIL MAPPING PLAN

ARRINGTON, TENNESSEE 37014
WILLIAMSON COUNTY

CIA PROJECT No: 2020-004 | DRAWN BY: MSW | CHECKED BY: LJS

REVISIONS

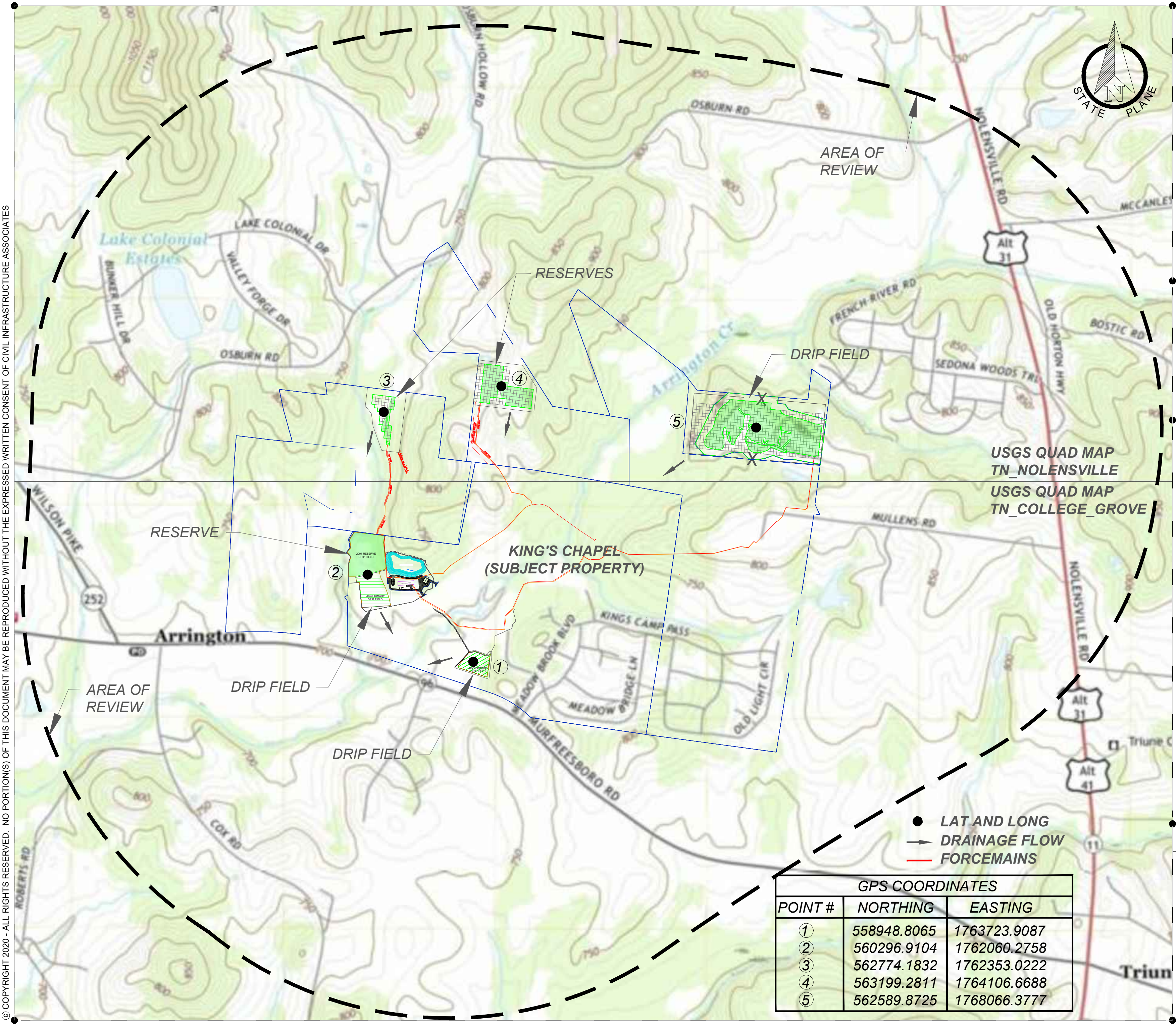
◇ PRE-BID SET ISSUE DATE
△ POST BID SET ISSUE DATE

DATE	DESCRIPTION

ORIGINAL ISSUE DATE: August 2020

LANDSCAPE PLAN
BUFFERING
TREATMENT
FACILITY

L1.00



● LAT AND LONG
→ DRAINAGE FLOW
🟥 FORCEMAINS

GPS COORDINATES		
POINT #	NORTHING	EASTING
①	558948.8065	1763723.9087
②	560296.9104	1762060.2758
③	562774.1832	1762353.0222
④	563199.2811	1764106.6688
⑤	562589.8725	1768066.3777

PLOT DATE: 8/26/2020 12:58:15 PM (MWARNER)

CIVIL
INFRASTRUCTURE
ASSOCIATES
307 HICKERSON DRIVE
MURFREESBORO, TENNESSEE 37129
PHONE: 615-663-7678

KING'S CHAPEL COMMUNITY
ARRINGTON, TENNESSEE
WILLIAMSON COUNTY

CHECKED BY:
DRAWN BY:
CIA PROJECT No:

ORIGINAL ISSUE DATE: August 2020

STATE OPERATIONAL PERMIT
AREA OF REVIEW

SOP 1.0

DATE: 2016 US TOPO

SCALE: 1" = 2000'

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 4.2**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 4.2 – State Operator Certificate

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.

<u>RESPONSE</u>:
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

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 4.4**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 4.4 – Complaints, Notices or Administrative Actions

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.

Exhibit 4.5 – Design Engineer Certification

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

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 5.1**

Petition to Amend CCN to provide service to Fox Parcel

Exhibit 5.1 – 2019 Financial Statements

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.

John S. Powell
(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)

TABLE OF CONTENTS

AFFIDAVIT - First page of this Report

FINANCIAL SECTION

WATER SECTION

SEWER SECTION

SUPPLEMENTAL FINANCIAL DATA

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	100%	$0	N/A
	Arrington, TN 37014			

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)**	
						1
						2
						3
						4
						5
						6
Gross Revenue:						7
Residential			$102,037		$102,037	8
Commercial			0		0	9
Industrial			0		0	10
Multi-Family			0		0	11
Other (Please Specify)			0		0	12
Other (Please Specify)			0		0	13
Other (Please Specify)			0		0	14
Other (Please Specify)			0		0	15
Total Gross Revenue			**$102,037**		**$102,037**	16
						17
						18
						19
Operation & Maint. Expense	W3/S3		$89,502		$89,502	20
Depreciation Expense	F-5		0		0	21
Amortization Expense			0		0	22
Other Expense (Please Specify)			0		0	23
Other Expense (Please Specify)			0		0	24
Taxes Other Than Income	F-7		4,077		4,077	25
Income Taxes	F-7		0		0	26
Total Operating Expenses			**$93,579**		**$93,579**	27
						28
						29
						30
Net Operating Income			**$8,458**		**$8,458**	31
						32
						33
						34
Other Income:						35
Nonutility Income			$0		$0	36
Other (Please Specify)			0		0	37
Other (Please Specify)			0		0	38
Other (Please Specify)			0		0	39
Other (Please Specify)			0		0	40
Total Other Income			**$0**		**$0**	41
						42
						43
						44
Other Deductions:						45
Misc. Nonutility Expenses			$0		$0	46
Other - Interest Expense			0		0	47
Other (Please Specify)			0		0	48
Other (Please Specify)			0		0	49
Other (Please Specify)			0		0	50
Total Other Deductions			**$0**		**$0**	51
						52
						53
						54
Net Income			**$8,458**		**$8,458**	55

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				8
Utility Plant in Service (101-105)	F5/W1/S1	$689,063	$689,063	10
Accum. Depreciation and Amortization (108)	F5/W2/S2	177,950	164,588	11
Net Utility Plant		**$511,113**	**$524,475**	12
Cash		$6,004	$4,177	14
Customer Accounts Receivable (141)		0	0	15
Escrow Deposits (132)		9,126	43	16
Other Assets (Please Specify)		0	0	17
Other Assets (Please Specify)		0	0	18
Other Assets (Please Specify)		0	0	19
Total Assets		**$526,243**	**$528,695**	20
LIABILITIES AND CAPITAL				25
Common Stock Issued (201)	F-6	$0	$0	27
Preferred Stock Issued (204)	F-6	0	0	28
Other Paid-In Capital (211)		0	0	29
Retained Earnings (215)	F-6	-4,381	-12,838	30
Capital (Proprietary & Partnership-218)	F-6	169,114	177,812	31
Total Capital		**$164,733**	**$164,974**	32
Long-Term Debt (224)	F-6	$0	$0	37
Accounts Payable (231)		0	0	38
Notes Payable (232)		0	0	39
Customer Deposits (235)		2,760	2,760	40
Accrued Taxes (236)		0	0	41
Advances Payable		0	0	42
Escrowed Deposits (235.1)		99,836	88,685	43
Other Liabilities (Please Specify)		0	0	44
Other Liabilities (Please Specify)		0	0	45
Other Liabilities (Please Specify)		0	0	46
Advances for Construction		0	0	47
Contributions In Aid Of Const.-Net (271-2)	F-8	258,914	272,276	48
Total Liabilities		**$361,510**	**$363,721**	49
Total Liabilities & Capital		**$526,243**	**$528,695**	55

Name of Respondent Superior Wastewater Systems, LLC	**This Report is:** (1) X An Original (2) ___ A Resubmission	**Date of Report** (Mo, Da, Yr) 3-31-20	**Year of Report** 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**
Superior Wastewater Systems, LLC	(1) _X_ An Original (2) ___ A Resubmission	(Mo, Da, Yr) 3-31-20	2019

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 Superior Wastewater Systems, LLC	**This Report is:** (1) X An Original (2) ___ A Resubmission	**Date of Report** (Mo, Da, Yr) 3-31-20	**Year of Report** 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 Superior Wastewater Systems, LLC	This Report is: (1) X An Original (2) ___ A Resubmission	Date of Report (Mo, Da, Yr) 3-31-20	Year of Report 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 Superior Wastewater Systems, LLC	**This Report is:** (1) X An Original (2) ___ A Resubmission	**Date of Report** (Mo, Da, Yr) 3-31-20	**Year of Report** 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.

SU-1

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

SUPPLEMENTAL FINANCIAL DATA TO THE ANNUAL REPORT		1
Rate Base		2
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
		26
Adjusted Net Operating Income		27
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
Activity Report for Escrow Account
For the Twelve Months Ended December 31, 2019

SU-2

	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.

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 5.2**
Petition to Amend CCN to provide service to Fox Parcels
Exhibit 5.2 – Pro Forma Income Statement

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 Fox Parcel along with an outline of assumptions considered.

Superior Wastewater Systems
Pro Forma Rate Calculation for Fox Parcel
10 Year Income Projection

Exhibit 5.2
Schedule 1

Item	SWS 2019 O&M Expense	SWS 2019 Customers	Unit Rate	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Projected Customers:													
Fox Parcel				14	25	39	0	0	0	0	0	0	0
Cumulative Customer Count				**14**	**39**	**78**	**78**	**78**	**78**	**78**	**78**	**78**	**78**
Revenues:													
Service Charges - Current Tariff Rate			$35.11	$5,898.48	$16,431.48	$32,862.96	$32,862.96	$32,862.96	$32,862.96	$32,862.96	$32,862.96	$32,862.96	$32,862.96
Access Fees - Current Tariff Rate			7.00	5,376.00	3,276.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Revenue				**$11,274.48**	**$19,707.48**	**$32,862.96**	**$32,862.96**	**$32,862.96**	**$32,862.96**	**$32,862.96**	**$32,862.96**	**$32,862.96**	**$32,862.96**
Expenses:													
704 - Employee Pensions & Benefits	$42,904.32	277	$154.89	$2,168.45	$6,040.68	$12,081.36	$12,081.36	$12,081.36	$12,081.36	$12,081.36	$12,081.36	$12,081.36	$12,081.36
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	483.50	1,346.89	2,693.77	2,693.77	2,693.77	2,693.77	2,693.77	2,693.77	2,693.77	2,693.77
720 - Materials & Supplies	688.63	277	2.49	34.80	96.96	193.91	193.91	193.91	193.91	193.91	193.91	193.91	193.91
730 - Contractual Services	25,969.25	277	93.75	1,312.53	3,656.32	7,312.64	7,312.64	7,312.64	7,312.64	7,312.64	7,312.64	7,312.64	7,312.64
750 - Transportation Expense	1,928.11	277	6.96	97.45	271.47	542.93	542.93	542.93	542.93	542.93	542.93	542.93	542.93
775 - Miscellaneous Expense	8,445.06	277	30.49	426.83	1,189.02	2,378.03	2,378.03	2,378.03	2,378.03	2,378.03	2,378.03	2,378.03	2,378.03
408 - Taxes Other Than Income Taxes	4,077.17	277	14.72	206.07	574.04	1,148.08	1,148.08	1,148.08	1,148.08	1,148.08	1,148.08	1,148.08	1,148.08
Total Expenses	**$93,578.88**			**$2,561.17**	**$7,134.69**	**$14,269.37**	**$14,269.37**	**$14,269.37**	**$14,269.37**	**$14,269.37**	**$14,269.37**	**$14,269.37**	**$14,269.37**
Net Operating Income				**$8,713.31**	**$12,572.79**	**$18,593.59**	**$18,593.59**	**$18,593.59**	**$18,593.59**	**$18,593.59**	**$18,593.59**	**$18,593.59**	**$18,593.59**

NOTE*: Monthly Service Charge excludes local and state bonding surcharges which will be billed specifically to Fox Parcel customers.*

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 5.3**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 5.3 – Chart of Accounts

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

Exhibit 5.4 – Pro Forma Plant in Service

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 Fox Parcel is as follows:

Account	Debit	Credit
353 – Land & Land Rights	$10	
360 – Collection Sewers-Force	134,455	
380 – Treatment & Disposal Equipment	1,430,450	
271 – Contributions in Aid of Construction		1,564,915

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 5.5**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 5.5 – Depreciation Rates

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 Fox 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%

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 5.6**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 5.6 – Estimated Wastewater Construction Cost

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 Fox Parcel is $1,564,905. See attached back up for detailed costs. All these costs will be funded by the developer of the Fox Parcel.

Superior Wastewater Systems

Kings Chapel WWTP Expansion with additional excess capacity.

2020 DDR Modification Cost Estimates

Supply (to 3 drip fields) and Return Piping (from same drip fields) :

	Item Description	Quantity	Unit Price/lf	Total Price
1	6 inch SDR 21 FM Pipe	12,850 lf	$6.30	$80,955.00
2	4 inch SDR 21 FM Pipe	2300 lf	$4.50	$10,350.00
3	3 inch SDR 21 FM Pipe	12,850 lf	$3.00	$38,550.00
4	2 inch SDR 21 FM pipe	2300 lf	$2.00	$4600.00
			Total	$134,455.00

Treatment System:

	Item Description	Quantity	Unit Price/ea	Total Price
2	Influent Collection/Preanoxic Tank	1 LS	$55,000	$55,000
3	AxMax Treatment System w/controls	1 LS	$812,500	$812,500
4	Dosing Tank with Pumps	1 LS	$42,500	$42,500
5	Arkal Filter and UV Disinfection	1 LS	$145,000	$145,000
6	Drip field (drip tubing and valves)	1 LS	$125,000	$125,000
7	Crushed stone paving	400 CY	$50	$20,000
8	Drip Field Fencing	13,800 LF	$9	$124,200
9	Pond Excavation/Lining	21,250 CY	$5	$106,250
			Total	$1,430,450.00

Petition to Amend CCN to provide service to Fox Parcel

Exhibit 5.7 – Ownership of Wastewater System

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 Fox 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	134,455	
380 – Treatment & Disposal Equipment	1,430,450	
271 – Contributions in Aid of Construction		1,564,915

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 5.8**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 5.8 – Wastewater Tariff

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 Fox 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
Fox Parcel – Sheet 3	35.11

Superior Wastewater Systems
Fox 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.**

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 5.9**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 5.9 – Estimated Monthly Customer Additions

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 Fox 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 Fox Parcel

	Monthly Totals			
	2021	**2022**	**2023**	**2024**
January	0	0	0	0
February	0	0	0	3
March	0	0	3	5
April	0	0	3	5
May	0	0	4	4
June	0	0	4	4
July	0	4	2	0
August	0	5	0	0
September	0	2	2	5
October	0	3	4	6
November	0	0	1	5
December	0	0	2	2
Total	**0**	**14**	**25**	**39**

	Cumulative Totals			
	2021	**2022**	**2023**	**2024**
January	0	0	14	39
February	0	0	14	42
March	0	0	17	47
April	0	0	20	52
May	0	0	24	56
June	0	0	28	60
July	0	4	30	60
August	0	9	30	60
September	0	11	32	65
October	0	14	36	71
November	0	14	37	76
December	0	14	39	78

NOTES:

Total number of lots in the Fox Parcel is 78.

Developer estimates construction to begin in 2021 with first home sales occuring in summer of 2022.

Ashby Communities, LLC
P.O. Box 190
Arrington, TN 37014

September 8, 2020

Superior wastewater Systems, LLC
P.O. Box 40
Arrington, TN 37014

RE: Homes Completed and Occupied by Residents.

Dear Mr. Powell

Ashby Communities expects that this additional contiguous property north of The Kings Chapel to actually have residents in homes based on this schedule:

14 residents in 2022

25 residents in 2023

39 residents in 2024

Respectfully Submitted

J. Powell

John Powell

Exhibit 5.10 – Local Bonding Requirements

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 Fox 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 Fox Parcel.

Exhibit 5.11 – Wastewater System Performance Bond for Construction

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 Fox Parcel will be paid by the developer, therefore Superior Wastewater Systems does not anticipate a performance bond will be necessary.

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 5.12**
Petition to Amend CCN to provide service to Fox Parcel
Exhibit 5.12 – Funding Sources

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 Fox 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 Fox Parcel.

SUPERIOR WASTEWATER SYSTEMS **EXHIBIT 5.13**

Petition to Amend CCN to provide service to Fox Parcel

Exhibit 5.13 – Compliance with TPUC Financial Security

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.