WASTEWATER TECHNOLOGY

NSF/ANSI Standard 40 - *Residential Wastewater Treatment Systems*

Revised Final Report:

SOSystems, Inc.
LooLoop SYS 201
(Previously
Named RecoSept
SYS 201)
15/12/055/0030

NSF International
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Evaluation Report:
LooLoop SYS 201
(Previously Named RecoSept SYS 201) – Wastewater Treatment System

Under the provisions of NSF/ANSI Standard 40
Residential Wastewater Treatment Systems

September 2017

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EXECUTIVE SUMMARY

Testing of the SOSystems, Inc. LooLoop SYS 201 was conducted under the provisions of NSF/ANSI Standard 40 for Residential Wastewater Treatment Systems (April 2013 revision). NSF/ANSI Standard 40 was developed by the NSF Joint Committee on Wastewater Technology.

The performance evaluation was conducted at the NSF International Testing Facility located in Waco, Texas, using wastewater diverted from the City of Waco municipal wastewater collection system, which serves predominantly residential development. The evaluation consisted of sixteen weeks of dosing at design flow, seven and one half weeks of stress testing and an additional two and one half weeks of dosing at design flow. Dosing was initiated on January 10, 2016 and the test was officially started on January 31, 2016. Sampling started in the winter and continued through the spring and summer, covering a range of operating temperatures.

Over the course of the evaluation, the average effluent $CBOD_5$ was 7 mg/L, ranging between 1 and 26 mg/L, and the average effluent total suspended solids was 6 mg/L, ranging between 2 mg/L and 16 mg/L.

The LooLoop SYS 201 produced an effluent that successfully met the performance requirements established by NSF/ANSI Standard 40 for Class I effluent:

> The maximum 7-day arithmetic mean was 16 mg/L for $CBOD_5$ and 12 mg/L for total suspended solids, both below the allowed maximums of 40 and 45 mg/L, respectively. The maximum 30-day arithmetic mean was 13 mg/L for $CBOD_5$ and 9 mg/L for total suspended solids, both below the allowed maximums of 25 mg/L and 30 mg/L, respectively.

The effluent pH during the evaluation ranged between 7.2 and 7.8, within the required range of 6.0 to 9.0. The LooLoop SYS 201 met the requirements for noise levels (less than 60 dbA at a distance of 20 feet), color, threshold odor, oily film and foam.

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PREFACE

Performance evaluation of residential wastewater treatment systems is achieved within the provisions of NSF/ANSI Standard 40: *Residential Wastewater Treatment Systems* (revised April 2013), prepared by the NSF Joint Committee on Wastewater Technology and adopted by the NSF Board of Trustees.

Conformance with the Standard is recognized by issuance of the NSF Mark. This is not to be construed as an approval of the equipment, but a certification of the data provided by the test and an indication of compliance with the requirements expressed in the Standard.

Plants conforming to Standard 40 are classified as Class I or Class II plants according to the quality of effluent produced by the plant during the performance evaluation. Class I plants must meet the requirements of EPA Secondary Treatment Guidelines[1] for five day carbonaceous biochemical oxygen demand ($CBOD_5$), total suspended solids (TSS) and pH. Class I plants must also demonstrate performance consistent with the effluent color, odor, oily film and foam requirements of the Standard. Class II plant effluent must have no more than 1% of samples exceeding 60 mg/L $CBOD_5$ and 100 mg/L TSS.

Permission to use the NSF Mark is granted only after the equipment has been tested and found to perform satisfactorily, and all other requirements of the Standard have been satisfied. Continued use of the Mark is dependent upon evidence of compliance with the Standard and NSF General and Program Specific Policies, as determined by periodic reinspection of the equipment at the factory, distributors and reports from the field.

NSF Standard 40 requires the testing laboratory to provide the manufacturer of a residential wastewater treatment system a report including significant data and appropriate commentary relative to the performance evaluation of the plant. NSF policy specifies provision of performance evaluation reports to appropriate state regulatory agencies at publication. Subsequent direct distribution of the report by NSF is made only at the specific request of or by permission of the manufacturer.

The following report contains results of the entire testing program, a description of the plant, its operation and key process control equipment, and a narrative summary of the test program, including test location, procedures and significant occurrences. The plant represented herein reflects the equipment authorized to bear the NSF Mark.

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CERTIFICATION

NSF International has determined by performance evaluation under the provisions of NSF/ANSI Standard 40 (revised April 2013) that the LooLoop SYS 201 manufactured by SOSystems, Inc. has fulfilled the requirements of NSF/ANSI Standard 40. The LooLoop SYS 201 has therefore been authorized to bear the NSF Mark so long as SOSystems, Inc. continues to meet the requirements of Standard 40 and NSF General and Program Specific Policies.

General performance evaluation and stress tests were performed at the NSF International Wastewater Technology Site located in Waco, Texas. The raw wastewater used in the test was residential wastewater. The characteristics of the wastewater during the test are included in the tabulated data of this report.

The observations and analyses included in this report are certified to be correct and true copies of the data secured during the performance tests conducted by NSF on the wastewater treatment system described herein. The manufacturer has agreed to present the data in this certification in its entirety whenever it is used in advertising, prospectuses, bids or similar uses.

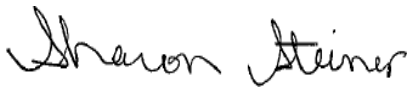

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TABLE OF CONTENTS

Page

Executive Summary 2
Preface 3
Certification 4
Table of Contents 5

1.0 Process Description 7

2.0 Performance Evaluation 7

2.1 Description of Unit Evaluated 7
2.2 Test Protocol 8
2.3 Test Chronology 9

3.0 Analytical Results 9

3.1 Summary 10
3.2 Biochemical Oxygen Demand 11
3.3 Total Suspended Solids 12
3.4 pH 16
3.5 Temperature 16
3.6 Dissolved Oxygen 16
3.7 Color, threshold odor, oily film, foam 16
3.8 Noise 16

4.0 References 16

Appendices

Appendix A - Plant Specifications and Drawings
Appendix B - Standard 40 Section 8 - Performance testing and evaluation
Appendix C - Analytical Results
Appendix D - Owner's Manual

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1.0 PROCESS DESCRIPTION

The SOSystems, Inc. LooLoop SYS 201 is essentially a loop in the normal flow path of a conventional septic system. The loop has a highly aerated segment and a segment that has very little oxygen. The oxygenated portion of the loop is the section containing the BioFilter Cabinet. The BioFilter Cabinet is an ultrahigh rate recirculating trickling filter containing highly porous plastic filter media. Vents at the top and bottom of the BioFilter Cabinet ensure that an oxygen rich environment is maintained.

The low oxygen (anoxic) segment is the section containing the LooLoop tank. In the aerated portion of the loop, effluent is sprayed onto the high porosity plastic filter media. Bacteria attach themselves to the media and use the trickling wastewater for food. The bacteria also convert almost all nitrogen compounds into the nitrate (NO3) form. Some bacteria are constantly being sloughed off the media. The dislodged bacteria get carried by the trickling liquid, along with the dissolved nitrate, out the bottom of the BioFilter Cabinet back to septic Tank 1, then flow into the LooLoop tank (Tank 2). The dislodged bacteria sink or float in the tanks. The mass of floating or settled bacteria becomes what is called sludge. The number of oxygen breathing bacteria accumulated in the LooLoop tank is large. The oxygen needs of the bacteria deplete the oxygen dissolved in the water during its pass through the BioFilter Cabinet. The bacteria then turn to nitrate for their oxygen thereby releasing nitrogen gas to the atmosphere. The anoxic LooLoop tank serves as the receptacle for wastewater sludge and the reaction tank for the removal of nitrogen.

After the wastewater trickles through the BioFilter Cabinet, the wastewater flows by gravity back to the second compartment of the first septic tank (Tank 1). Note: if the existing septic tank (Tank 1) has only one chamber, the wastewater return line from the BioFilter Cabinet connects to the inlet tee of the LooLoop tank. The operation of the recirculating pump is controlled by a repeat cycle timer in the control panel. The wastewater continues to recirculate to the BioFilter Cabinet and back to the septic tanks at the rate of about 8 gallons per minute. The LooLoop tank pump chamber is equipped with an overflow pipe that allows the clean recirculating effluent water to flow to the drain field.

2.0 PERFORMANCE EVALUATION

2.1 Description of Plant Evaluated

The SOSystems, Inc. LooLoop SYS 201 includes the BioFilter Cabinet is the key component of the LooLoop system and has no moving or mechanical components other than three valves and operable vents at the top and bottom of the cabinet. Thus the BioFilter Cabinet is designed for long term performance and minimal maintenance. The BioFilter Cabinet is designed to resemble a small garden or pool equipment shed. The cabinet can be located adjacent to the house, similar to other mechanical systems, or at any other location on the property that permits gravity drainage from the cabinet back to the septic tanks. The BioFilter Cabinet is constructed with water- resistant PVC board, polystyrene foam insulation, and stainless steel vent louvers.

The BioFilter Cabinet has no actively moving parts. The process is passive and uses 27 cubic feet of crossflow plastic media. The media is stacked in three layers supported off the floor of the cabinet. The individual media bales are 12x12x36 inches laid with the bottom and top layers laid parallel with the middle layer at 90 degrees to the top and bottom.

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All components of the system that contact wastewater are of stainless steel, PVC, or rubber construction for durability. The recirculating trickling filter media is a self-supporting PVC sheet media discussed above. A locally acquired 1,500-gallon, two compartment concrete was used to test the LooLoop system. The LooLoop tank submersible pump is 115V, 60 hertz, single phase, fractional horsepower motor of stainless steel and composite resin materials used in all wetted parts. The pump is the only electrically powered moving component of the LooLoop system.

The LooLoop system is supplied with a prewired repeat cycle flow controller contained in a NEMA rated enclosure and is accessible through the door on the cabinet. The controller controls the recirculating pump cycle time and is manufactured, to be programmed to produce a 20 minute on 10 minute off cycle. The weatherproof controller is equipped with a fail to start detector, a visible alarm, an audible alarm and silencer switch. The controller contains a power switch and time clock that control the recirculating pump operation. The local dealers name, address, and telephone number are displayed on the controller cover. A high level switch connected to the alarm circuit is provided to alert the user of blockages in the disposal system piping between the LooLoop and the leaching system components. The LooLoop SYS201 treatment system is capable of treating 500 gallons per day of domestic wastewater from a single-family residence.

2.2 Test Protocol

Section 8 of NSF/ANSI Standard 40 protocol, “Performance Testing and Evaluation”, is included in Appendix B. Start up of the plant was accomplished by filling the plant with 2/3 water and 1/3 raw sewage. The plant was then dosed at the design loading rate of 500 gpd as follows:

6 a.m. to 9 a.m. - 35 percent of daily rated capacity (175 gallons)
11 a.m. to 2 p.m. - 25 percent of daily rated capacity (125 gallons)
5 p.m. to 8 p.m. - 40 percent of daily rated capacity (200 gallons)

Dosing was accomplished by opening an electrically actuated valve to feed wastewater to the test plant. Five gallon doses were spread uniformly over each dosing period to comprise the total dose volume for the period.

After a start up period (up to three weeks at the manufacturer’s discretion), the plant is subjected to the following loading sequence:

Design loading	-	16 weeks
Stress loading	-	7.5 weeks
Design loading	-	2.5 weeks

During the design loading periods, flow proportioned 24-hour composite influent and effluent samples are collected five days per week. The influent samples are analyzed for five-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) concentrations. The effluent samples are analyzed for five-day

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carbonaceous biochemical oxygen demand ($CBOD_5$), and total suspended solids (TSS) concentrations. On-site determinations of the effluent temperature and pH are made five days per week.

Stress testing is designed to evaluate how the plant performs under non-ideal conditions, including varied hydraulic loadings and electrical or system failure. The test sequence includes (1) Wash Day stress, (2) Working Parent stress, (3) Power/Equipment Failure stress, and (4) Vacation stress. Detailed descriptions of the stress sequences are shown in Appendix B.

During the stress test sequences, 24-hour composite samples are collected before and after each stress dosing pattern. The analyses and on-site determinations completed on the samples are the same as described for the design load testing. Each stress is followed by seven consecutive days of dosing at design rated capacity before beginning the next stress test. Sample collection is initiated twenty-four hours after completion of Wash Day, Working Parent, and Vacation stresses, and beginning 48 hours after completion of the Power/Equipment Failure stress.

In order for the plant to achieve Class I effluent it is required to produce an effluent, which meets the EPA guidelines for secondary effluent discharge[1]:

(1) $CBOD_5$: The 30-day average of effluent samples shall not exceed 25 mg/L and each 7-day average of effluent samples shall not exceed 40 mg/L.

(2) TSS: Each 30-day average of effluent samples shall not exceed 30 mg/L and each 7-day average of effluent samples shall not exceed 45 mg/L.

(3) pH: Individual effluent values remain between 6.0 and 9.0.

Requirements are also specified for effluent color, odor, oily film and foam, as well as maximum noise levels allowed from the plant.

2.3 Test Chronology

The system was installed under the direction of the manufacturer on January 8, 2016. The infiltration/exfiltration test, during which the entire system was tested for leaks, was completed on January 5, 2016. The unit was filled with 2/3 fresh water and 1/3 raw sewage and dosing was initiated at the rate of 600 gallons per day beginning January 10, 2016. After a three-week start up period, the test was officially started on January 31, 2016. The dosing was changed from 600 GPD to 500 GPD. The stress test sequence was started on May 23, 2016 and ended on July 13, 2016. Testing was completed on July 29, 2016.

3.0 ANALYTICAL RESULTS

3.1 Summary

Chemical analyses of samples collected during the evaluation were completed using the procedures in *Standard Methods for the Examination of Water and Wastewater 21st edition*. Copies of the data generated during the evaluation are included in Appendix C. Results of the chemical analyses and on-site observations and measurements made during the evaluation are summarized in Table I.

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TABLE I. SUMMARY OF ANALYTICAL RESULTS

	Average	Std. Dev.	Minimum	Maximum	Median	Interquartile Range
Biochemical Oxygen Demand (mg/L)						
Influent (BOD_5)	242	70	66	430	240	200 - 290
Effluent ($CBOD_5$)	7	4	1	26	5	4 - 9
Total Suspended Solids (mg/L)						
Influent	173	49	83	350	165	140 - 190
Effluent	6	3	2	16	6	4 - 8
pH						
Influent	-	-	6.4	7.7	7.0	6.8 – 7.2
Aeration Chamber	-	-	7.1	7.9	7.5	7.4 – 7.6
Effluent	-	-	7.2	7.8	7.5	7.4 – 7.6
Temperature (°C)						
Influent	25	3	20	31	24	22 – 27
Aeration Chamber	24	5	16	32	24	21 - 29
Effluent	24	5	15	33	24	20 - 29
Dissolved Oxygen (mg/L)						
Aeration Chamber	2.8	2.0	0.3	7.7	2.3	0.8 – 4.0
Effluent	2.1	1.5	0.3	6.5	1.5	0.9 – 3.3

Notes: The median is the point where half of the values are greater and half are less.
The interquartile range is the range of values about the median between the upper and lower 25 percent of all values.

Criteria for evaluating the analytical results from the testing are described in Section 8.5 of NSF/ANSI Standard 40. In completing the pass/fail determination for the data, an allowance is made for effluent TSS and $CBOD_5$ during the first month of testing. The 30- and 7-day averages during this time may not equal or exceed 1.4 times the effluent limits required for the rest of the test. This provision recognizes that an immature culture of microorganisms within the system may require additional time to achieve adequate treatment efficiency. Effluent $CBOD_5$ and TSS concentrations from the LooLoop SYS 201 during the first calendar month of testing were within the normal limits and did not need to use this provision.

Section 8.5.1.1 of the Standard provides guidance addressing the impact of unusual testing conditions, including sampling, dosing, or influent characteristics, on operation of a system under test. Specific data points may be excluded from 7- and 30-day average calculations where determined to have an adverse impact on performance of the system, with rationale for the exclusion to be documented in the final report.

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Sections 3.6 and 8.2.1 of the Standard define influent wastewater characteristics as they apply to testing under the Standard. Typical domestic wastewater is defined as having a 30-day average BOD_5 concentration between 100 and 300 mg/L and a 30-day average TSS concentration between 100 and 350 mg/L. The 30-day average influent remained inside this specified range for the duration of the test.

3.2 Biochemical Oxygen Demand

The five-day biochemical oxygen demand (BOD_5) and five-day carbonaceous biochemical oxygen demand ($CBOD_5$) analyses were completed using *Standard Methods for the Examination of Water and Wastewater* 21st *edition*. The results of both analyses are shown in Figure 1.

Influent BOD_5:

Individual influent BOD_5 concentrations ranged from 66 to 430 mg/L during the evaluation, with average concentration of 240 mg/L and a median concentration of 240 mg/L. Thirty-day average concentrations ranged from 170 to 290 mg/L.

Effluent $CBOD_5$:

Effluent $CBOD_5$ concentrations ranged from 1 to 26 mg/L over the course of the evaluation, with an average concentration of 7 mg/L and a median concentration of 5 mg/L.

The Standard requires that the effluent $CBOD_5$ not exceed 40 mg/L on a 7-day average or 25 mg/L on a 30-day average. As presented in Table II, over the course of the test the 7-day average effluent $CBOD_5$ ranged from 2 to 16 mg/L and the 30-day average ranged from 4 to 13 mg/L. The LooLoop SYS 201 met the requirements of Standard 40 for effluent $CBOD_5$.

BOD_5 Loading:

Over the course of the evaluation the influent BOD_5 loading averaged 1.01 lbs./day. The LooLoop SYS 201 achieved an average reduction of 0.98 lbs./day.

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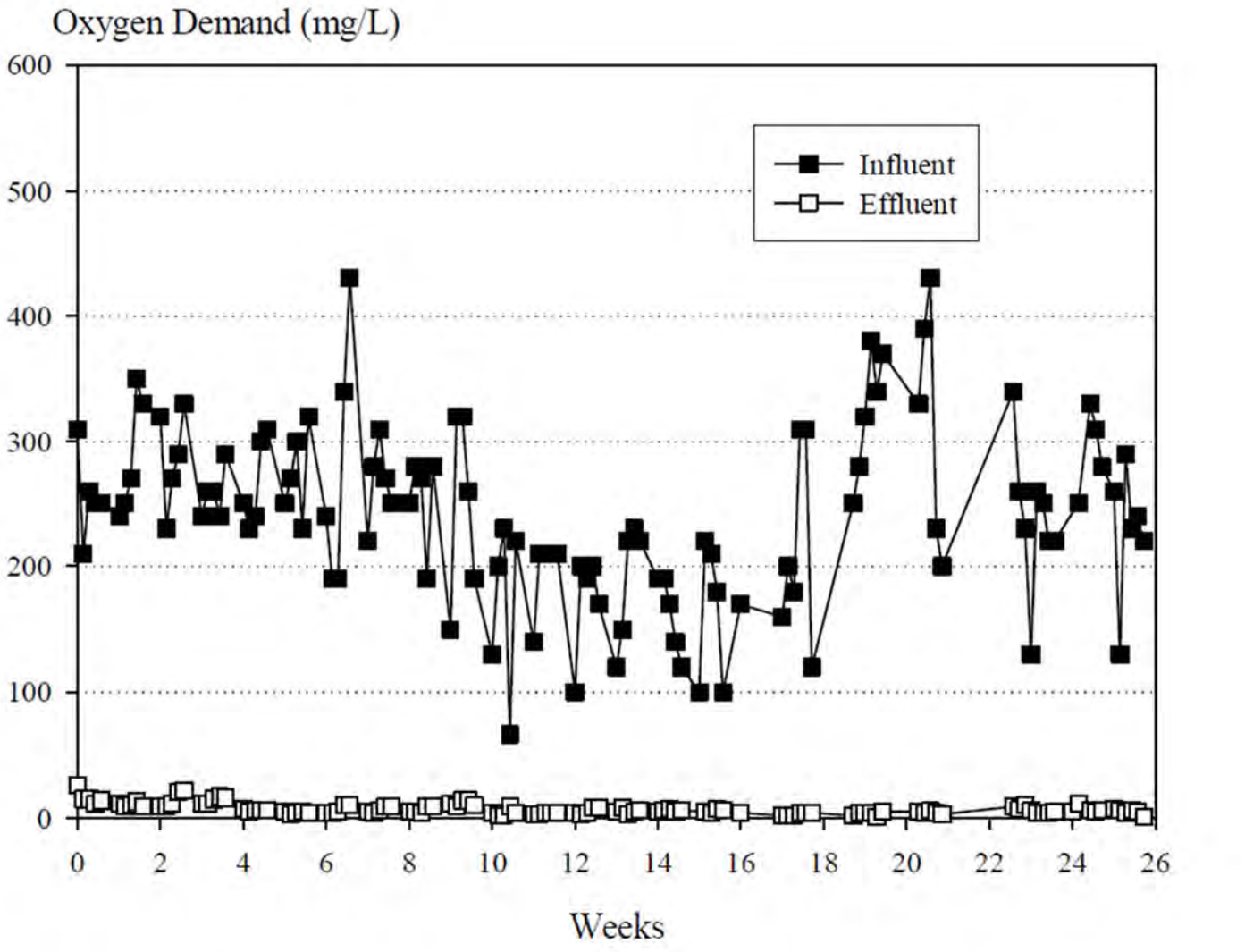

Figure 1. Biochemical Oxygen Demand

3.3 Total Suspended Solids

TSS analyses were completed using *Standard Methods for the Examination of Water and Wastewater* 21st *edition*. The TSS results over the entire evaluation are shown in Figure 2. Data from the TSS analyses are summarized in Table I.

Influent TSS:

The influent TSS ranged from 83 to 350 mg/L during the evaluation, with an average concentration of 170 mg/L and a median concentration of 165 mg/L. The 30-day average concentrations during the test ranged from 140 to 220 mg/L.

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Effluent TSS:

The effluent TSS concentration ranged from 2 to 16 mg/L during the evaluation, with an average and median concentrations of 6 mg/L.

Over the course of the evaluation, NSF/ANSI Standard 40 requires that the effluent TSS not exceed 45 mg/L on a 7-day average or 30 mg/L on a 30-day average. Table III shows the 7- and 30-day total suspended solids averages. The 7-day average effluent TSS ranged from 3 to 12 mg/L and the 30-day average ranged from 4 to 9 mg/L during the test. The LooLoop SYS 201 met the requirements of NSF/ANSI Standard 40 for effluent TSS.

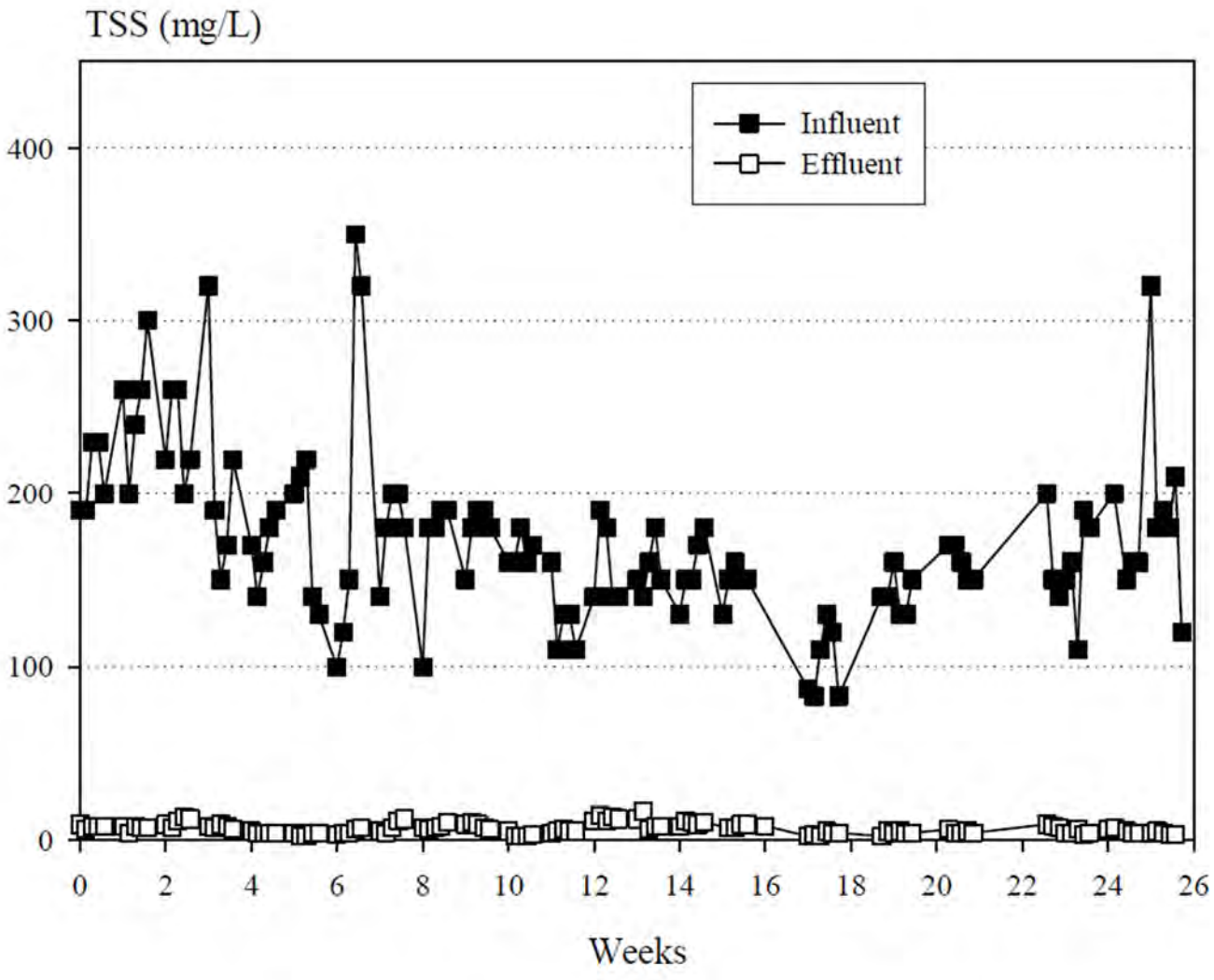

Figure 2. Total Suspended Solids

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Table II. 7- and 30-day Average Effluent $CBOD_5$ and 30-day Average Influent BOD_5

Month	Week	7-day Average Effluent $CBOD_5$ (mg/L)	30-day Average Effluent $CBOD_5$ (mg/L)	30-day Average Influent BOD_5 (mg/L)
1	1	16	13	270
	2	10		
	3	14		
	4	14		
2	5	6	6	270
	6	4		
	7	7		
	8	7		
	9	6		
3	10	12	6	200
	11	4		
	12	4		
	13	5		
4	14	5	5	170
	15	6		
	16	5		
	17	6		
5	18	3	4	290
	19	3		
	20	3		
	21	5		
	22	4		
6	23	9	6	250
	24	5		
	25	7		
	26	6		

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Table III. 7- and 30-day Total Suspended Solids

Month	Week	7-day Average Effluent TSS (mg/L)	30-day Average Effluent TSS (mg/L)	30-day Average Influent TSS (mg/L)
1	1	8	8	220
	2	7		
	3	10		
	4	8		
2	5	4	5	180
	6	3		
	7	5		
	8	8		
	9	8		
3	10	8	7	160
	11	3		
	12	5		
	13	12		
4	14	10	9	150
	15	10		
	16	8		
	17	9		
5	18	3	4	140
	19	3		
	20	4		
	21	5		
	22	4		
6	23	8	5	180
	24	4		
	25	5		
	26	4		

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3.4 pH

Over the entire evaluation period, the influent pH ranged from 6.4 to 7.7 (median of 7.0). The effluent pH ranged from 7.2 to 7.8 during the evaluation (median of 7.5); within the 6 to 9 range required by NSF/ANSI Standard 40. The pH data for the evaluation are shown in Appendix C.

3.5 Temperature

Influent temperatures over the evaluation period ranged from 20 to 31°C (median of 2 4 °C). The temperature data are shown in Appendix C.

3.6 Dissolved Oxygen

Dissolved Oxygen (DO) was measured in the aeration chamber and effluent during the evaluation. The aeration chamber DO ranged between 0.3 and 7.7 mg/L (median of 2.3 mg/L), while the effluent DO ranged between 0.3 and 6.5 mg/L (median of 1.5 mg/L). All dissolved oxygen data are shown in Appendix C.

3.7 Color, Threshold Odor, Oily Film, Foam

Three samples of the effluent were analyzed for color, odor, oily film and foam as prescribed in NSF Standard 40. The effluent was acceptable according to the requirements in NSF Standard 40, with color less than 15 units, non-offensive threshold odor, no visible evidence of oily film and no foam.

3.8 Noise

A reading of the noise level at a distance of 20 feet from the plant was taken while the plant was in operation, using a hand-held decibel meter. The reading was below the 60 dbA required by ANSI/NSF Standard 40.

3.9 Alkalinity

Over the entire evaluation period, the influent alkalinity ranged from 230 to 480 (average of 350). ; within the average greater than 175 mg/L as CaCO3 required by NSF/ANSI Standard 40

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4.0 REFERENCES

1. American Public Health Association (APHA), American Water Works Association (AWWA) & Water Environment Federation (WEF): *Standard Methods for the Examination of Water and Wastewater,* 21st Edition, 2014 (hereinafter referred to as *Standard Methods*.

2. ANSI/AWS D.1.1/D1.1M:2010, *Structural Welding Code – Steel* and ANSI/AWS D1.3/D1.3M:2008, *Structural Welding Code – Sheet Steel,* 5th Edition, with Errata

3. NFPA 70®: *National Electrical Code*® (NEC®), 2011*5*

4. US EPA, *Code of Federal Regulations (CFR), Title 40: Protection of Environment, 2012*.

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APPENDIX A

PLANT SPECIFICATIONS

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PLANT SPECIFICATIONS

SOSystems, Inc. - LooLoop SYS 201

500 GPD

Plant Capacity

Design Flow	500 gpd

System Hydraulic Capacity

Pretreatment Chamber	1000 gallons
Anoxic Chamber	2000 gallons
Clarifier Chamber	1500 gallons
Total Hydraulic Capacity	3000 gallons

Hydraulic Retention Time (at Design Flow)

Pretreatment Chamber	48 hours
Anoxic Chamber	96 hours
Clarifier Chamber	72 hours
Total Hydraulic Retention	96 hours

Filter Media

Manufacture	Raschig
Model #	DURA-PAC XF68
Shape	Modular blocks
Size	1’ x 1’ x 3’
Material	Thermoformed corrugated PVC sheet media

Pump

Tsurumi 50PSF2.4S	115V 60Hz 1/2 HP 10 gpm @ 50 ft. TDH

Alarm Panel

Manfufacture PDIR Instruments, Inc. (Modified Walchem WPHPW100PNN)	Model W-PHE-1-SOS062116 (Custom)!

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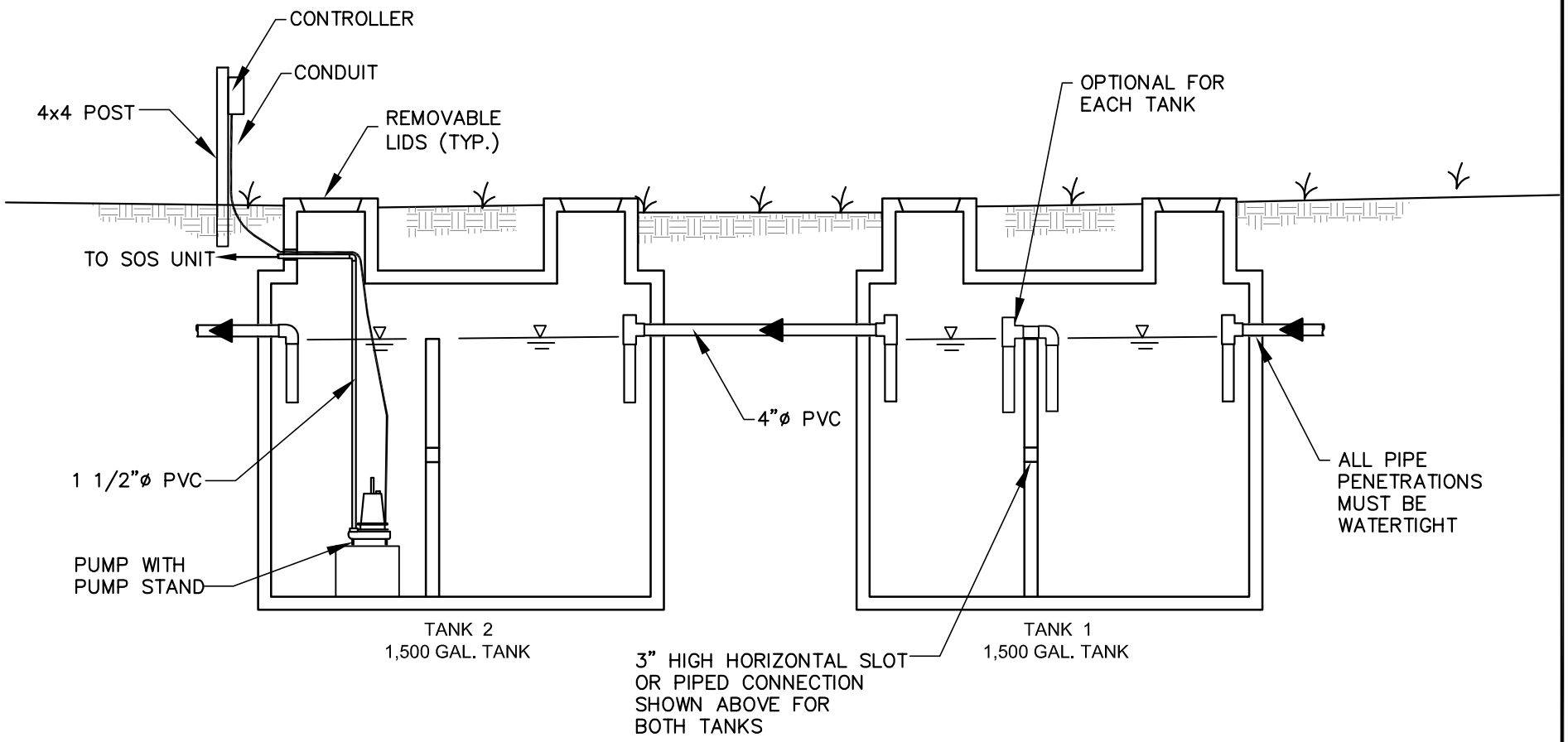

SOS SEPTIC TANK INSTALLATION

FOR NSF INSTALLATION

NOT TO SCALE

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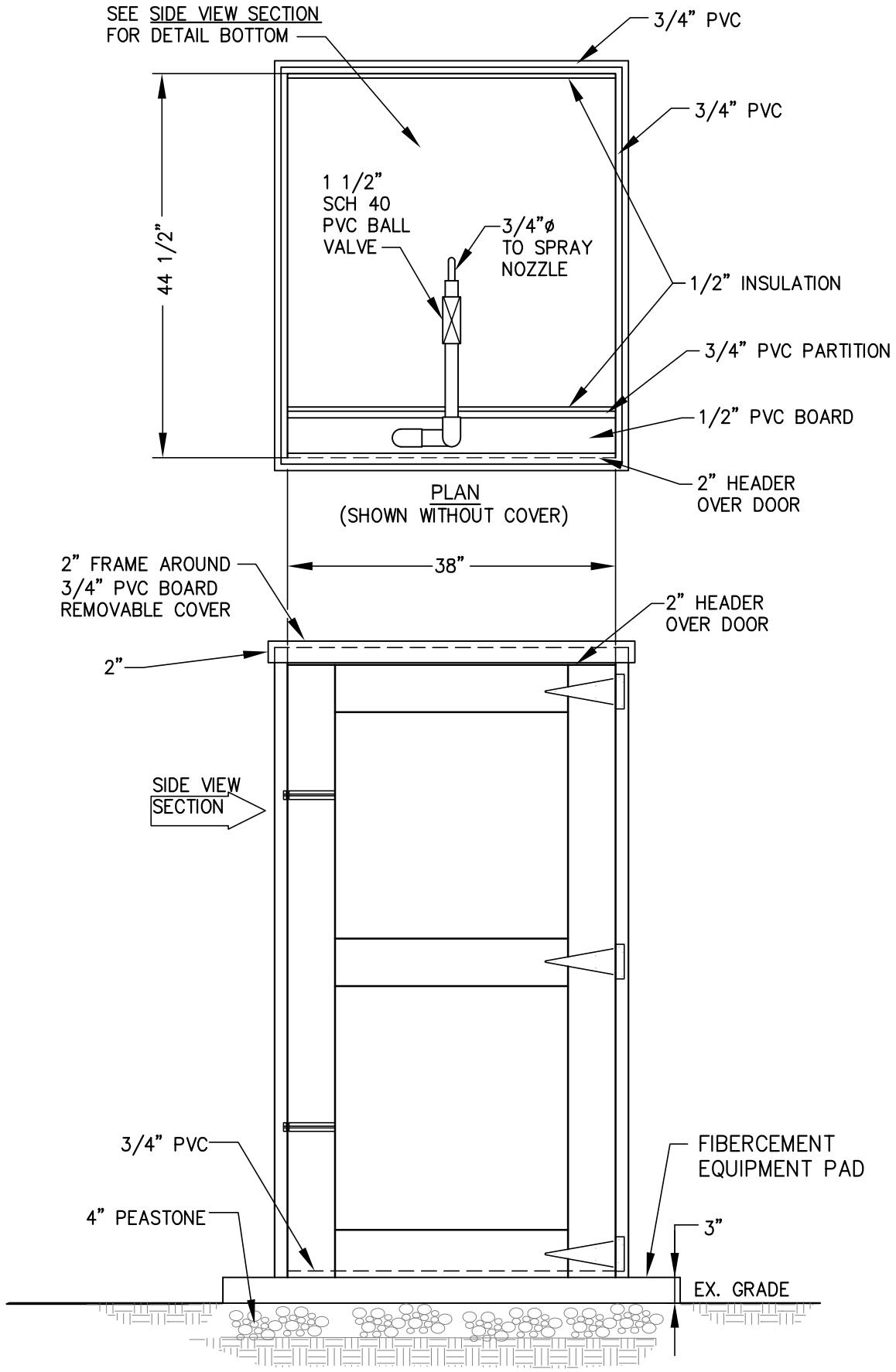

ELEVATION - FRONT VIEW CLOSED
RESIDENTIAL RECIRCULATING TRICKLING FILTER

NOT TO SCALE

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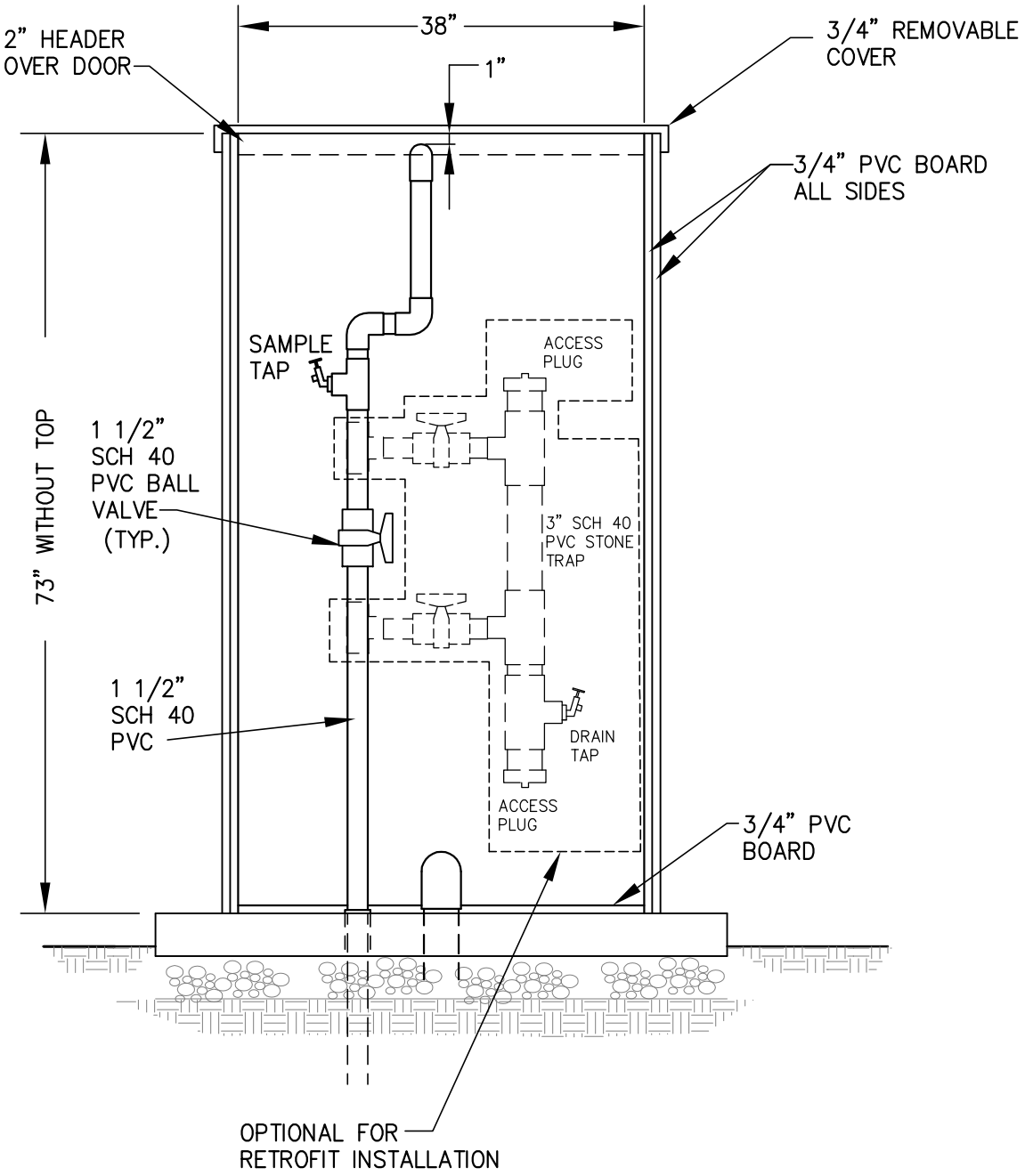

ELEVATION - FRONT VIEW OPENED
RESIDENTIAL RECIRCULATING TRICKLING FILTER

NOT TO SCALE

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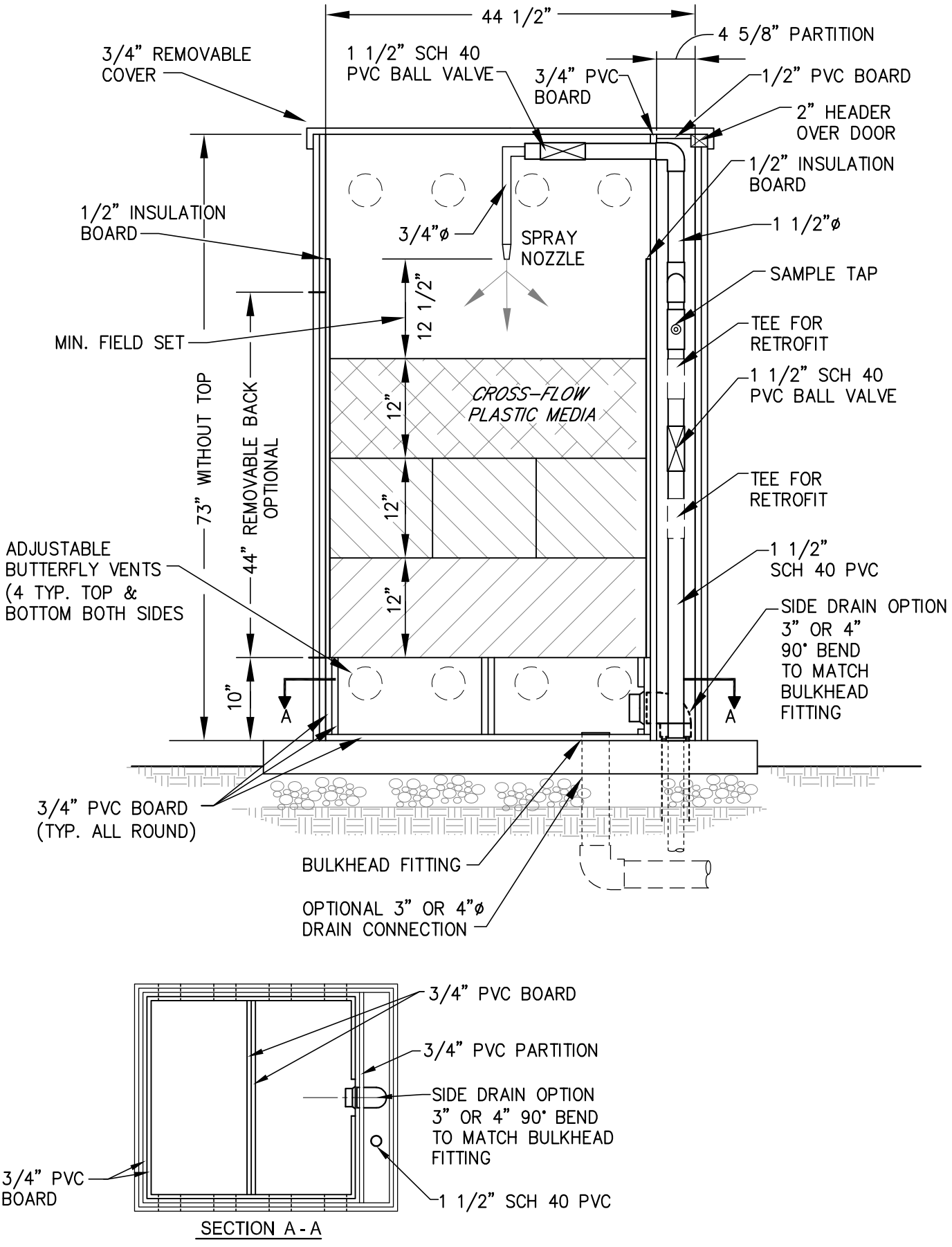

SECTION A - A

ELEVATION - SIDE VIEW SECTION
RESIDENTIAL RECIRCULATING TRICKLING FILTER

NOT TO SCALE

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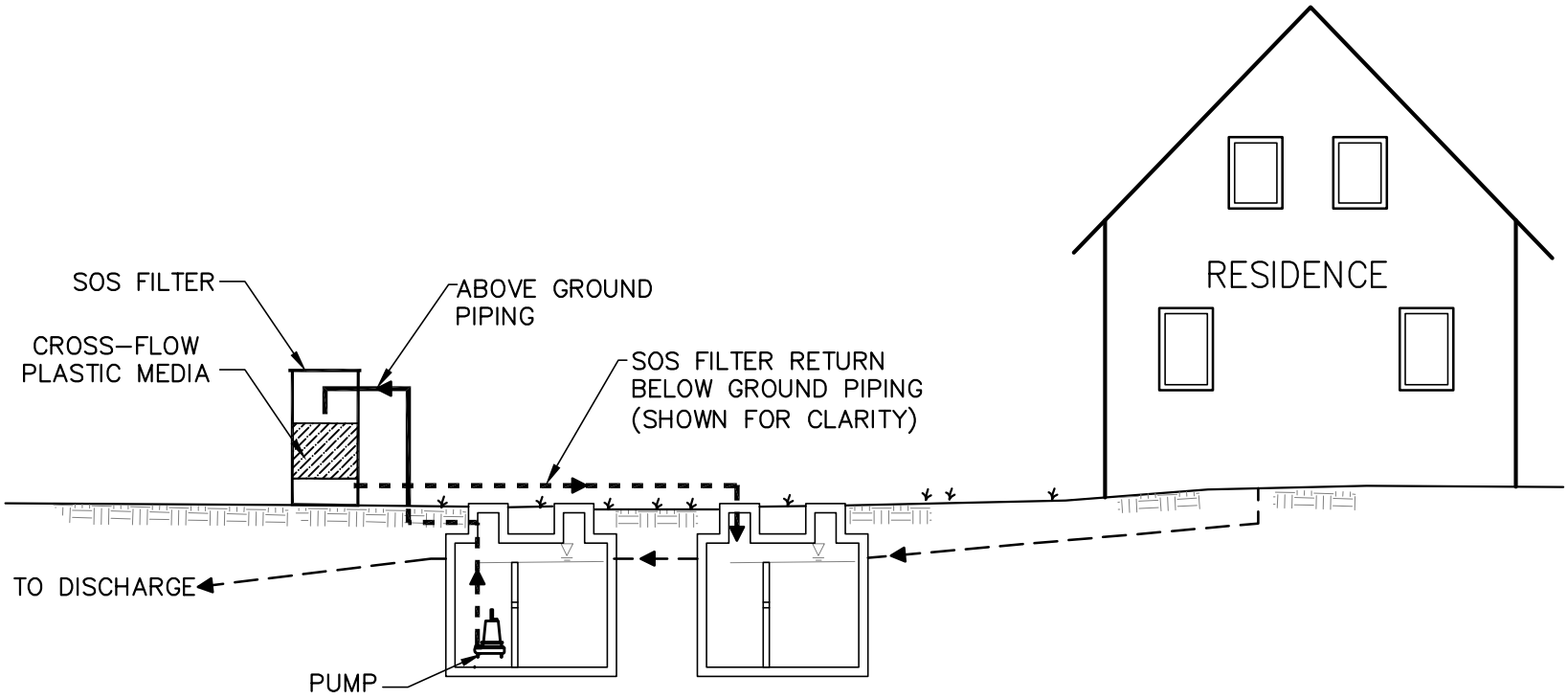

NOT TO SCALE

FLOW SCHEMATIC
RESIDENTIAL RECIRCULATING TRICKLING FILTER

GAF Projects\TrickleFilter\RTFilter2.Dwg\12/10/15

APPENDIX B

NSF STANDARD 40 PERFORMANCE EVALUATION METHOD AND REQUIREMENTS

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8 Performance testing and evaluation

This section describes the methods used to evaluate the performance of residential wastewater treatment systems. Systems shall be designated as Class I or Class II. The performance classification shall be based upon the evaluation of effluent samples collected from the system over a six-month period.

8.1 Preparations for testing and evaluation

8.1.1 The system shall be assembled, installed, and filled in accordance with the manufacturer's instructions.

8.1.2 The manufacturer shall inspect the system for proper installation. If no defects are detected and the system is judged to be structurally sound, it shall be placed into operation in accordance with the manufacturer's start-up procedures. If the manufacturer does not provide a filling procedure, ⅔ of the system's capacity shall be filled with water and the remaining ⅓ shall be filled with residential wastewater.

8.1.3 The system shall undergo design loading (see 8.2.2.1) until testing and evaluations are initiated. Sample collection and analysis shall be initiated within 3 wk of filling the system and, except as specified in 8.5.1.2, shall continue without interruption until the end of the evaluation period.

8.1.4 If conditions at the testing site preclude installation of the system at its normally prescribed depth, the manufacturer shall be permitted to cover the system with soil to achieve normal installation depth.

8.1.5 Performance testing and evaluation of systems shall not be restricted to specific seasons.

8.1.6 When possible, electrical or mechanical defects shall be repaired to prevent evaluation delays. All repairs made during the performance testing and evaluation shall be documented in the final report.

8.1.7 The system shall be operated in accordance with the manufacturer’s instructions. However, routine service and maintenance of the system shall not be permitted during the performance testing and evaluation period.

> NOTE – The manufacturer may recommend or offer more frequent service and maintenance of the system but for the purpose of performance testing and evaluation, service and maintenance shall not be performed beyond what is specified in this Standard.

8.2 Testing and evaluation conditions, hydraulic loading, and schedules

8.2.1 Influent wastewater characteristics

The 30-d average BOD5 concentration of the wastewater delivered to the system shall be between 100 mg/L and 300 mg/L.

The 30-d average TSS concentration of the wastewater delivered to the system shall be between 100 mg/L and 350 mg/L.

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The average wastewater alkalinity of the wastewater delivered to the system over the course of the testing shall be greater than 175 mg/L as CaCO3 (alkalinity may be adjusted if inadequate). Unless requested by the manufacturer, the raw influent shall be supplemented with sodium bicarbonate if the wastewater is found to be deficient in alkalinity.

8.2.2 Hydraulic loading and schedules

The performance of the system shall be evaluated for 26 consecutive wk. During the testing and evaluation period, the system shall be subjected to 16 wk of design loading, followed by 7.5 wk (52 days) of stress loading, and then an additional 2.5 wk (18 days) of design loading.

8.2.2.1 Design loading

The system shall be dosed 7 days a week with a wastewater volume equivalent to the daily hydraulic capacity
of the system. The following schedule shall be adhered to for dosing:

Time Frame	Approximate % rated daily hydraulic capacity
6 a. m. – 9 a. m.	35
11 a. m. – 2 p. m.	25
5 p. m. – 8 p. m.	40

NOTE – The individual dosage shall be no more than 10 gallons per dose, unless the dosage system is based on a continuous flow, and be uniformly applied over the dosing periods.

8.2.2.2 Stress loading

Stress loading is designed to evaluate a system's performance under four non-ideal conditions. Systems shall
be subjected to each stress condition once during the 6-month testing and evaluation period, and each of the four stress conditions shall be separated by 7 days of design loading (see 8.2.2.1).

8.2.2.2.1 Wash-day stress

The wash day stress shall consist of 3 wash days in a 5-day period. Each wash day shall be separated by a 24-h period. During a wash-day, the system shall be loaded at times and capacities similar to those delivered during design loading (see 8.2.2.1), however during the first two dosing periods per day, the design loading shall include 3 wash loads (3 wash cycles and 6 rinse cycles).

8.2.2.2.2 Working-parent stress

For 5 consecutive days, the system shall be subjected to a working-parent stress. During this stress, the system shall be dosed with 40% of its daily hydraulic capacity between 6:00 a.m. and 9:00 a.m. Between 5:00 p.m. and 8:00 p.m., the system shall be dosed with the remaining 60% of its daily hydraulic capacity, which shall include 1 wash load (1 wash cycle and 2 rinse cycles).

8.2.2.2.3 Power/equipment failure stress

The system shall be dosed with 40% of its daily hydraulic capacity between 5:00 p.m. and 8:00 p.m. on the

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day the power/equipment failure stress is initiated. Power to the system shall then be turned off at 9:00 p.m. and dosing shall be discontinued for 48 h. After 48 h, power shall be restored and the system shall be dosed over a 3- h period with 60% of its daily hydraulic capacity, which shall include 1 wash load (1 wash cycle and 2 rinse cycles).

8.2.2.2.4 Vacation stress

On the day that the vacation stress is initiated, the system shall be dosed at 35% of its daily hydraulic capacity
between 6:00 a.m. and 9:00 a.m. and at 25% between 11:00 a.m. and 2:00 p.m. Dosing shall then be discontinued for 8 consecutive days (power shall continue to be supplied to the system). Between 5:00 p.m. and 8:00 p.m. of the ninth day, the system shall be dosed with 60% of its daily hydraulic capacity, which shall include 3 wash loads (3 wash cycles and 6 rinse cycles).

8.2.3 Dosing volumes

The 30-d average volume of the wastewater delivered to the system shall be within 100% ± 10% of the system's rated hydraulic capacity.

> NOTE – All dosing days, except those with dosing requirements less than the daily hydraulic capacity, shall be included in the 30-d average calculation.

8.2.4 Color, odor, foam, and oily film assessments

During the 6-month testing and evaluation, a total of three effluent samples shall be assessed for color, odor, foam, and oily film. The assessments shall be conducted on effluent composite samples selected randomly during the first phase of design loading (weeks 1 – 16), the period of stress loading (weeks 17 – 23.5), and the second phase of design loading (weeks 23.5 – 26).

8.3 Sample collection

8.3.1 General

8.3.1.1 A minimum of 96 data days shall be required during system performance testing and evaluation. The maximum length of the test to obtain the 96 data days shall be no more than 34 wk. No routine service or maintenance shall be performed on the system whether the time period to achieve the 96 data days falls within or exceeds 26 wk.

> NOTE – In the event that a catastrophic site problem occurs, as described in 8.5.1.2, the maximum length of the test shall be no more than 37 wk.

8.3.1.2 All sample collection methods shall be in accordance with *Standard Methods* unless otherwise specified.

8.3.1.3 Influent wastewater samples shall be flow-proportional, 24-h composites obtained during periods of system dosing. Effluent samples shall be flow-proportional, 24-h composites obtained during periods of system discharge. Effluent samples shall be representative of all treated effluent discharged from the system, as sampled from a central point of collection of all treated effluent.

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8.3.2 Design loading

During periods of design loading, daily composite effluent samples shall be collected and analyzed 5 days a week.

8.3.2 Stress loading

During stress loading, influent and effluent 24-h composite samples shall be collected on the day each stress condition is initiated. Twenty-four h after the completion of washday, working-parent, and vacation stresses, influent and effluent 24-h composite samples shall be collected for 6 consecutive days. Forty-eight h after the completion of the power/equipment failure stress, influent and effluent 24-h composite samples shall be collected for 5 consecutive days.

8.4 Analytical descriptions

8.4.1 pH, TSS, BOD5, and CBOD5

The pH, TSS, and BOD5 of the collected influent and the pH, TSS and CBOD5 of the collected effluent 24-h composite samples shall be determined with the appropriate methods in *Standard Methods* for each listed parameter. Grab samples shall be collected during the morning dosing period for gravity flow systems and during a time of discharge for systems that are pump discharged.

NOTE – Standards Methods requires pH and temperature to be sampled as grab samples.

8.4.2 Color, odor, oily film, and foam

8.4.2.1 General

The effluent composite samples shall be diluted 1:1000 with distilled water. Three composite effluent samples
shall be tested during the 6-month evaluation period.

8.4.2.2 Color

The apparent color of the diluted effluent samples shall be determined with the visual comparison method described in *Standard Methods.*

8.4.2.3 Odor

A panel consisting of at least 5 evaluators shall qualitatively rate 200 mL aliquots of the diluted effluent samples as offensive or non-offensive when compared to odor-free water prepared in accordance with *Standard Methods*.

8.4.2.4 Oily film and foam

Diluted effluent sample aliquots shall be visually evaluated for the presence of an oily film or foaming.

8.5 Criteria

8.5.1 General

8.5.1.1 If conditions during the testing and evaluation period result in system upset, improper sampling, improper dosing, or influent characteristics outside of the ranges specified in 8.2.1, an assessment shall be

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conducted to determine the extent to which these conditions adversely affected the performance of the system. Based on this assessment, specific data points may be excluded from the 7-d and 30-d averages of effluent measurements. Rationale for all data exclusions shall be documented in the final report.

8.5.1.2 In the event that a catastrophic site problem not described in this Standard including, but not limited to, influent characteristics, malfunctions of test apparatus, and acts of God, jeopardizes the validity of the performance testing and evaluation, manufacturers shall be given the choice to:

1) Perform maintenance on the system, reinitiate system start-up procedures, and restart the performance testing and evaluation; or

2) With no routine maintenance performed, have the system brought back to pre-existing conditions and resume testing within 3 wk after the site problem has been identified and corrected. Data collected during the system recovery period shall be excluded from 7-d and 30-d averages of effluent measurements.

NOTE – Pre-existing conditions shall be defined as the point when the results of 3 consecutive data days are within 15% of the previous 30-d average(s)

8.5.1.3 A 7-d average discharge value shall consist of a minimum of 3 data days. If a calendar week contains less than 3 data days, sufficient data days may be transferred from the preceding calendar week to constitute a 7-d average discharge value. If there are not sufficient data days available in the preceding calendar week, the transfer of data days may take place from the following calendar week to constitute a 7-d average discharge value. No data day shall be included in more than one 7-d average discharge value.

8.5.1.4 A 30-d average discharge value shall consist of a minimum of 50% of the regularly scheduled sampling days per month. If a calendar month contains less than the required number of data days, sufficient data days may be transferred from the preceding calendar month to constitute a 30-d average discharge value. If there are not sufficient data days available in the preceding calendar month, the transfer of data days
may take place from the following calendar month to constitute a 30-d average discharge value. No data day shall be included in more than one 30-d average discharge value.

8.5.1.5 During the stress loading sequence, consisting of wash-day, working-parent, power/equipment failure,
and vacation stress loading periods, data shall be collected from a minimum of ⅔ of the total scheduled sampling days and from at least 2 of the scheduled sampling days during any single stress recovery.

8.5.2 Class I systems

The following criteria shall be met in order for a system to be classified as a Class I residential wastewater treatment system.

All requirements for each parameter shall be achieved except as provided for in 8.5.2.2.

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NOTE – 8.5.1.3, 8.5.1.4, and 8.5.1.5 are testing minimums. These minimums shall be attained to be considered a valid test.

8.5.2.1 EPA secondary treatment guideline parameters

8.5.2.1.1 CBOD5

The 30-d average of CBOD5 concentrations of effluent samples shall not exceed 25 mg/L.

The 7-d average of CBOD5 concentrations of effluent samples shall not exceed 40 mg/L.

8.5.2.1.2 TSS

The 30-d average of TSS concentrations of effluent samples shall not exceed 30 mg/L.

The 7-d average of TSS concentrations of effluent samples shall not exceed 45 mg/L.

8.5.2.1.3 pH

The pH of individual effluent samples shall be between 6.0 and 9.0.

8.5.2.2 Effluent concentration excursions

System performance shall not be considered outside the limits established for Class I systems if, during the first calendar month of performance testing and evaluation, 7-d average and 30-d average effluent CBOD5 and TSS concentrations do not equal or exceed 1.4 times the effluent limits specified in 8.5.2.1.

NOTE – The technology utilized in many residential wastewater treatment systems is biologically based. The allowance of excursions from the effluent limits established in this Standard during the first calendar month of performance testing and evaluation reflects the fact that an immature culture of microorganisms within the system may require additional time to achieve adequate treatment efficiency

The value of 1.4 is based on the USEPA Technical Review Criteria for Group I Pollutants[6], including CBOD5 and TSS.

8.5.2.3 Color, odor, oily film, and foam

8.5.2.3.1 Color

The color rating of each of the three diluted composite effluent samples shall be reported. There are no criteria that these values shall meet.

8.5.2.3.2 Odor

The overall rating of each of the three diluted composite effluent samples shall be nonoffensive.

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8.5.2.3.3 Oily film and foam

Oily films and foaming shall not be visually detected in any of the diluted composite effluent samples.

8.5.3 Class II systems

The following criteria shall be met in order for a system to be classified as a Class II residential wastewater treatment system.

8.5.3.1 CBOD5

Not more than 10% of the effluent CBOD5 values shall exceed 60 mg/L.

8.5.3.2 TSS

Not more than 10% of the effluent TSS values shall exceed 100 mg/L.

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APPENDIX C

ANALYTICAL RESULTS

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NSF International
Standard 40 - Residential Wastewater Treatment Systems
Plant Effluent

Week Beginning: 31-Jan-16 Plant Code: SYS201

Weeks Into Test: 1

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	5.27	5.09	4.99	5.41	5.33
	effluent	4.97	4.75	4.17	4.92	4.75
Temperature (C)	influent	21	21	21	20	20
	aeration chamber	18	18	18	17	17
	effluent	18	18	15	17	17
pH	influent	7.3	7.4	7.2	7.6	7.2
	aeration chamber	7.6	7.7	7.6	7.7	7.7
	effluent	7.7	7.7	7.7	7.7	7.7
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	310	210	260	250	250
	effluent ($CBOD_5$)	26	15	15	11	14
Suspended Solids (mg/L)	influent	190	190	230	230	200
	effluent	9	6	8	8	8

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

NSF International
Standard 40 - Residential Wastewater Treatment Systems
Plant Effluent

Week Beginning: 7-Feb-16 Plant Code: SYS201

Weeks Into Test: 2

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	7.04	7.15	6.49	5.51	5.31
	effluent	6.51	5.77	5.42	4.87	4.69
Temperature (C)	influent	20	20	20	21	21
	aeration chamber	17	16	17	17	18
	effluent	15	15	16	17	17
pH	influent	7.5	7.5	7.2	7.2	7.2
	aeration chamber	7.7	7.7	7.7	7.7	7.7
	effluent	7.7	7.7	7.7	7.6	7.6
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	240	250	270	350	330
	effluent ($CBOD_5$)	11	9	10	13	9
Suspended Solids (mg/L)	influent	260	200	240	260	300
	effluent	8	4	8	7	7

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

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NSF International
Standard 40 - Residential Wastewater Treatment Systems
Plant Effluent

Week Beginning: 14-Feb-16 Plant Code: SYS201

Weeks Into Test: 3

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	6.89	5.73	4.30	3.86	4.25
	effluent	5.52	4.55	4.06	3.57	3.88
Temperature (C)	influent	21	21	21	21	21
	aeration chamber	19	19	19	19	19
	effluent	19	18	19	19	19
pH	influent	7.0	7.3	7.4	6.8	7.2
	aeration chamber	7.6	7.6	7.6	7.6	7.6
	effluent	7.6	7.6	7.6	7.6	7.6
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	320	230	270	290	330
	effluent ($CBOD_5$)	9	9	11	21	22
Suspended Solids (mg/L)	influent	220	260	260	200	220
	effluent	9	7	11	13	12

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

NSF International
Standard 40 - Residential Wastewater Treatment Systems
Plant Effluent

Week Beginning: 21-Feb-16 Plant Code: SYS201

Weeks Into Test: 4

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	5.00	3.40	3.75	3.96	3.96
	effluent	4.59	3.21	3.37	3.69	3.73
Temperature (C)	influent	22	21	20	21	21
	aeration chamber	20	20	18	18	18
	effluent	20	18	19	17	17
pH	influent	7.2	7.3	7.7	7.0	7.0
	aeration chamber	7.5	7.6	7.6	7.5	7.6
	effluent	7.5	7.6	7.6	7.5	7.6
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	240	260	260	240	290
	effluent ($CBOD_5$)	11	11	15	17	16
Suspended Solids (mg/L)	influent	320	190	150	170	220
	effluent	8	7	9	8	6

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

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NSF International
Standard 40 - Residential Wastewater Treatment Systems
Plant Effluent

Week Beginning: 28-Feb-16 Plant Code: SYS201

Weeks Into Test: 5

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	5.80	4.70	4.61	4.62	2.86
	effluent	5.01	4.42	3.10	4.38	2.20
Temperature (C)	influent	21	22	22	22	22
	aeration chamber	19	19	19	20	20
	effluent	19	20	19	18	20
pH	influent	7.1	7.1	7.5	7.0	7.5
	aeration chamber	7.6	7.6	7.6	7.6	7.6
	effluent	7.6	7.6	7.6	7.6	7.5
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	250	230	240	300	310
	effluent ($CBOD_5$)	7	5	6	6	6
Suspended Solids (mg/L)	influent	170	140	160	180	190
	effluent	5	4	4	4	4

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

NSF International
Standard 40 - Residential Wastewater Treatment Systems
Plant Effluent

Week Beginning: 6-Mar-16 Plant Code: SYS201

Weeks Into Test: 6

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	3.97	3.62	2.69	2.98	3.11
	effluent	3.57	1.78	1.99	2.07	2.01
Temperature (C)	influent	22	22	21	21	21
	aeration chamber	20	21	21	21	21
	effluent	21	20	20	20	21
pH	influent	7.5	7.3	7.0	6.7	7.0
	aeration chamber	7.5	7.3	7.3	7.4	7.4
	effluent	7.5	7.4	7.4	7.4	7.4
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	250	270	300	230	320
	effluent ($CBOD_5$)	5	3	4	5	4
Suspended Solids (mg/L)	influent	200	210	220	140	130
	effluent	4	2	2	4	4

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

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NSF International
Standard 40 - Residential Wastewater Treatment Systems
Plant Effluent

Week Beginning: 13-Mar-16 Plant Code: SYS201

Weeks Into Test: 7

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	4.68	3.64	2.08	1.63	1.98
	effluent	3.53	2.68	1.61	0.95	1.13
Temperature (C)	influent	22	22	22	23	23
	aeration chamber	21	22	21	22	22
	effluent	21	22	21	22	22
pH	influent	7.2	7.0	7.3	7.2	7.1
	aeration chamber	7.5	7.4	7.5	7.6	7.5
	effluent	7.5	7.4	7.5	7.6	7.5
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	240	190	190	340	430
	effluent ($CBOD_5$)	4	4	5	10	10
Suspended Solids (mg/L)	influent	100	120	150	350	320
	effluent	3	4	4	6	7

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

NSF International
Standard 40 - Residential Wastewater Treatment Systems
Plant Effluent

Week Beginning: 20-Mar-16 Plant Code: SYS201

Weeks Into Test: 8

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	475	500	500
Dissolved Oxygen (mg/L)	aeration chamber	5.11	4.34	2.33	0.44	1.47
	effluent	3.97	3.11	1.26	0.66	0.87
Temperature (C)	influent	22	22	23	23	23
	aeration chamber	20	20	20	20	20
	effluent	19	20	20	21	20
pH	influent	7.3	7.1	7.3	6.9	7.0
	aeration chamber	7.7	7.7	7.6	7.6	7.6
	effluent	7.7	7.7	7.6	7.6	7.6
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	220	280	310	270	250
	effluent ($CBOD_5$)	5	4	6	9	9
Suspended Solids (mg/L)	influent	140	180	200	200	180
	effluent	5	4	7	11	12

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes: The first 5 doses of the mid-day dosing period were missed on 3/23 due to lab error. The issue was resolved by noon of the same day.

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NSF International
Standard 40 - Residential Wastewater Treatment Systems
Plant Effluent

Week Beginning: 27-Mar-16 Plant Code: SYS201

Weeks Into Test: 9

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	3.95	3.57	1.80	0.50	0.74
	effluent	2.65	2.37	1.41	0.31	0.62
Temperature (C)	influent	23	23	23	24	24
	aeration chamber	20	21	21	22	22
	effluent	19	20	22	23	22
pH	influent	7.4	7.0	7.0	7.0	7.1
	aeration chamber	7.6	7.6	7.6	7.6	7.6
	effluent	7.6	7.5	7.5	7.6	7.6
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	250	280	270	190	280
	effluent ($CBOD_5$)	5	5	4	9	9
Suspended Solids (mg/L)	influent	100	180	180	190	190
	effluent	7	6	7	8	10

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

NSF International
Standard 40 - Residential Wastewater Treatment Systems
Plant Effluent

Week Beginning: 3-Apr-16 Plant Code: SYS201

Weeks Into Test: 10

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	1.50	0.41	0.57	0.48	0.75
	effluent	1.78	0.77	1.12	0.92	0.81
Temperature (C)	influent	23	24	24	24	24
	aeration chamber	21	22	22	22	22
	effluent	21	22	22	22	22
pH	influent	7.1	7.1	6.8	6.8	6.8
	aeration chamber	7.4	7.5	7.5	7.5	7.5
	effluent	7.4	7.5	7.4	7.4	7.5
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	150	320	320	260	190
	effluent ($CBOD_5$)	11	9	14	14	10
Suspended Solids (mg/L)	influent	150	180	190	190	180
	effluent	9	10	9	7	6

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

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NSF International
Standard 40 - Residential Wastewater Treatment Systems
Plant Effluent

Week Beginning: 10-Apr-16 Plant Code: SYS201

Weeks Into Test: 11

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	1.89	2.11	1.91	2.06	1.96
	effluent	1.41	1.52	1.04	0.91	1.13
Temperature (C)	influent	24	24	24	24	24
	aeration chamber	23	23	23	22	23
	effluent	23	23	22	22	22
pH	influent	6.7	6.8	6.6	6.9	6.8
	aeration chamber	7.5	7.5	7.3	7.4	7.4
	effluent	7.5	7.5	7.3	7.4	7.4
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	130	200	230	66	220
	effluent ($CBOD_5$)	4	2	2	9	4
Suspended Solids (mg/L)	influent	160	160	180	160	170
	effluent	5	2	2	2	3

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes: The lab confirmed the influent BOD result on 4/14/16.

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Plant Effluent

Week Beginning: 17-Apr-16 Plant Code: SYS201

Weeks Into Test: 12

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	2.46	2.77	1.72	1.47	1.35
	effluent	1.51	1.09	1.33	1.31	1.11
Temperature (C)	influent	23	24	23	23	23
	aeration chamber	23	23	23	23	23
	effluent	22	22	23	23	23
pH	influent	6.7	7.3	6.4	6.7	6.6
	aeration chamber	7.2	7.4	7.3	7.3	7.3
	effluent	7.3	7.4	7.4	7.4	7.4
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	140	210	210	210	210
	effluent ($CBOD_5$)	3	3	4	4	4
Suspended Solids (mg/L)	influent	160	110	130	130	110
	effluent	4	5	6	5	5

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

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Plant Effluent

Week Beginning: 24-Apr-16 Plant Code: SYS201

Weeks Into Test: 13

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	3.42	2.87	1.18	0.99	0.68
	effluent	2.87	2.67	1.07	0.82	0.60
Temperature (C)	influent	24	24	24	24	24
	aeration chamber	24	24	24	24	25
	effluent	24	24	24	24	25
pH	influent	7.3	6.8	6.8	6.8	7.1
	aeration chamber	7.6	7.4	7.4	7.3	7.5
	effluent	7.6	7.4	7.4	7.4	7.5
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	100	200	190	200	170
	effluent ($CBOD_5$)	4	3	4	8	8
Suspended Solids (mg/L)	influent	140	190	180	140	140
	effluent	11	14	11	13	12

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

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Plant Effluent

Week Beginning: 1-May-16 Plant Code: SYS201

Weeks Into Test: 14

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	3.34	2.97	2.31	2.93	2.01
	effluent	2.78	2.46	2.06	2.59	1.39
Temperature (C)	influent	24	24	24	24	24
	aeration chamber	24	23	23	24	24
	effluent	24	24	24	24	23
pH	influent	7.4	7.1	6.7	6.8	6.9
	aeration chamber	7.6	7.4	7.3	7.3	7.4
	effluent	7.6	7.4	7.3	7.4	7.4
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	120	150	220	230	220
	effluent ($CBOD_5$)	5	8	3	5	6
Suspended Solids (mg/L)	influent	150	140	160	180	150
	effluent	12	16	6	8	8

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

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Plant Effluent

Week Beginning: 8-May-16 Plant Code: SYS201

Weeks Into Test: 15

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	1.92	1.13	0.77	1.94	2.15
	effluent	1.87	1.29	1.05	2.13	2.09
Temperature (C)	influent	25	24	25	25	25
	aeration chamber	24	25	25	25	25
	effluent	24	25	25	25	25
pH	influent	7.1	7.1	6.7	6.9	6.8
	aeration chamber	7.4	7.4	7.3	7.2	7.2
	effluent	7.5	7.4	7.4	7.3	7.3
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	190	190	170	140	120
	effluent ($CBOD_5$)	5	6	7	5	6
Suspended Solids (mg/L)	influent	130	150	150	170	180
	effluent	8	11	10	9	10

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes: Color, odor, oily film and foam were measured on 5/11:
Color: 30 Pt-Co unit
Odor: 20 T.O.N.
Oily film and foam: Not Detected

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Plant Effluent

Week Beginning: 15-May-16 Plant Code: SYS201

Weeks Into Test: 16

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	3.93	3.09	1.40	1.73	2.00
	effluent	3.42	2.17	1.34	1.39	1.42
Temperature (C)	influent	25	25	25	25	24
	aeration chamber	25	25	25	25	24
	effluent	25	24	24	24	23
pH	influent	6.9	6.7	6.8	6.8	6.6
	aeration chamber	7.3	7.3	7.3	7.2	7.2
	effluent	7.4	7.3	7.4	7.3	7.3
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	95	220	210	180	100
	effluent ($CBOD_5$)	a	5	4	7	6
Suspended Solids (mg/L)	influent	130	150	160	150	150
	effluent	a	7	7	9	9

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes: The composite effluent samples were contaminated on 5/16 due to a problem with test site effluent handling system.

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Plant Effluent

Week Beginning: 22-May-16 Plant Code: SYS201

Weeks Into Test: 17

		Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Dosed Volume (gallons)		500	500	500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber		3.69	1.97	0.28	0.58	0.31	0.89
	effluent		3.44	1.61	0.64	0.94	0.58	1.06
Temperature (C)	influent		24	25	26	26	26	26
	aeration chamber		25	26	26	26	26	26
	effluent		25	26	26	26	26	26
pH	influent		7.2	6.9	7.1	6.8	7.1	6.9
	aeration chamber		7.4	7.6	7.4	7.6	7.3	7.6
	effluent		7.5	7.6	7.2	7.6	7.2	7.6
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)		170					
	effluent ($CBOD_5$)		4					
Suspended Solids (mg/L)	influent		74 (a)					
	effluent		8					

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes: Wash day stress 5/23 through 5/27.
The lower than normal TSS concentratin on 5/23 was due to a problem with the mixing system in the test site influent tank. The problem was resolved on the morning of 5/23.

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Plant Effluent

Week Beginning: 29-May-16 Plant Code: SYS201

Weeks Into Test: 18

		Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Dosed Volume (gallons)		500	500	500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	1.21	3.34	5.28	3.93	3.04	0.94	3.48
	effluent	0.98	2.87	3.59	1.95	1.96	0.50	1.41
Temperature (C)	influent	26	26	26	26	26	26	26
	aeration chamber	26	26	26	26	26	26	26
	effluent	26	26	26	26	25	26	26
pH	influent	7.1	7.3	7.5	7.2	6.9	6.9	6.6
	aeration chamber	7.6	7.7	7.9	7.5	7.6	7.6	7.4
	effluent	7.6	7.6	7.8	7.6	7.5	7.6	7.3
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)		160	200	180	310	310	120
	effluent ($CBOD_5$)		2	2	2	4	4	4
Suspended Solids (mg/L)	influent		87	83	110	130	120	83
	effluent		2	3	2	5	4	4

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes: Working Parent Stress started on 6/4.

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Plant Effluent

Week Beginning: 5-Jun-16 Plant Code: SYS201

Weeks Into Test: 19

		Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Dosed Volume (gallons)		500	500	500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	3.80	4.37	4.48	3.92	3.14	4.09	2.93
	effluent	3.48	3.85	3.81	2.59	3.72	3.33	1.31
Temperature (C)	influent	26	26	26	26	26	26	27
	aeration chamber	26	26	26	27	27	27	28
	effluent	27	26	26	27	27	27	29
pH	influent	6.8	6.6	6.4	6.7	6.6	6.8	6.8
	aeration chamber	7.6	7.5	7.5	7.7	7.5	7.6	7.7
	effluent	7.5	7.4	7.4	7.6	7.6	7.5	7.6
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)							250
	effluent ($CBOD_5$)							2
Suspended Solids (mg/L)	influent							140
	effluent							2

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes: Working Parent Stress completed on 6/8.

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Plant Effluent

Week Beginning: 12-Jun-16 Plant Code: SYS201

Weeks Into Test: 20

		Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Dosed Volume (gallons)		500	500	500	500	500	0	300
Dissolved Oxygen (mg/L)	aeration chamber	7.62	7.66	7.66	7.58	7.60		
	effluent	0.68	1.15	0.88	0.34	0.67		
Temperature (C)	influent	27	27	27	28	28		
	aeration chamber	29	29	29	29	29		
	effluent	29	29	29	29	29		
pH	influent	7.2	7.1	6.8	7.2	7.2		
	aeration chamber	7.6	7.7	7.7	7.6	7.6		
	effluent	7.6	7.6	7.6	7.5	7.6		
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	280	320	380	340	370		
	effluent ($CBOD_5$)	4	4	4	1	5		
Suspended Solids (mg/L)	influent	140	160	130	130	150		
	effluent	5	4	5	4	4		

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes: Power Failure Stress 6/16 through 6/18.
Color, odor, oily film and foam were measured on 6/15:
Color: 30 Pt-Co unit
Odor: 50 T.O.N.
Oily film and foam: Not Detected

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Plant Effluent

Week Beginning: 19-Jun-16 Plant Code: SYS201

Weeks Into Test: 21

		Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Dosed Volume (gallons)		500	500	500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	2.33	2.27	2.73	1.72	0.43	0.51	0.55
	effluent	2.67	2.62	2.58	1.66	0.62	0.42	0.38
Temperature (C)	influent	28	27	28	28	28	28	28
	aeration chamber	29	29	30	30	30	30	30
	effluent	29	30	30	30	30	31	31
pH	influent	6.9	6.8	6.9	7.0	6.8	7.6	7.2
	aeration chamber	7.5	7.4	7.5	7.6	7.5	7.6	7.6
	effluent	7.5	7.4	7.6	7.6	7.5	7.6	7.6
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)				330	390	430	230
	effluent ($CBOD_5$)				5	4	6	4
Suspended Solids (mg/L)	influent				170	170	160	150
	effluent				6	4	4	5

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

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Plant Effluent

Week Beginning: 26-Jun-16 Plant Code: SYS201

Weeks Into Test: 22

		Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Dosed Volume (gallons)		300	0	0	0	0	0	0
Dissolved Oxygen (mg/L)	aeration chamber	0.56						
	effluent	0.37						
Temperature (C)	influent	28						
	aeration chamber	30						
	effluent	31						
pH	influent	7.0						
	aeration chamber	7.6						
	effluent	7.6						
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	200						
	effluent ($CBOD_5$)	3						
Suspended Solids (mg/L)	influent	150						
	effluent	4						

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes: Vaction Stress started on 6/26, after the mid-day dosing period.

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Plant Effluent

Week Beginning: 3-Jul-16 Plant Code: SYS201

Weeks Into Test: 23

		Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Dosed Volume (gallons)		0	0	300	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber				0.57	0.49	0.45	0.30
	effluent				0.83	0.73	0.66	0.45
Temperature (C)	influent				29	29	29	30
	aeration chamber				31	31	31	32
	effluent				33	31	32	33
pH	influent				6.9	6.9	7.0	7.1
	aeration chamber				7.4	7.5	7.5	7.6
	effluent				7.5	7.5	7.6	7.6
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)						340	260
	effluent ($CBOD_5$)						9	7
Suspended Solids (mg/L)	influent						200	150
	effluent						9	8

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes: Vaction Stress completed on 7/5.

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Plant Effluent

Week Beginning: 10-Jul-16 Plant Code: SYS201

Weeks Into Test: 24

Saturday 500 gallons

		Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	0.57	1.23	0.77	0.61	0.73	0.52
	effluent	0.78	0.96	1.11	1.35	0.66	0.65
Temperature (C)	influent	29	29	29	29	29	30
	aeration chamber	31	31	31	31	31	31
	effluent	31	31	32	32	31	31
pH	influent	7.0	6.7	7.0	7.0	6.6	6.7
	aeration chamber	7.4	7.4	7.4	7.5	7.4	7.4
	effluent	7.4	7.4	7.4	7.5	7.4	7.4
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	230	130	260	250	220	220
	effluent ($CBOD_5$)	10	6	4	4	4	5
Suspended Solids (mg/L)	influent	140	150	160	110	190	180
	effluent	7	4	4	6	3	4

(a) Site problem
(b) Malfunction of coffeecup system under test
(c) Weather problem
(d) Other

Notes:

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Plant Effluent

Week Beginning: 17-Jul-16 Plant Code: SYS201

Weeks Into Test: 25

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday	23-Jul Saturday
Dosed Volume (gallons)		500	500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	0.70	0.64	0.57	0.36	0.42	0.59
	effluent	0.62	0.71	0.97	0.62	0.65	0.72
Temperature (C)	influent	30	30	30	30	30	31
	aeration chamber	32	32	32	32	32	32
	effluent	33	33	30	31	32	33
pH	influent	6.6	6.6	6.8	6.8	6.8	6.7
	aeration chamber	7.2	7.4	7.6	7.6	7.6	7.6
	effluent	7.3	7.4	7.6	7.6	7.6	7.6
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	d	250	a	330	310	280
	effluent ($CBOD_5$)	5	11	a	6	5	6
Suspended Solids (mg/L)	influent	d	200	a	150	160	160
	effluent	6	7	a	5	4	4

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes: Influent composite sample missed on 7/18 due to lab error.
No samples on 7/20 due to a problem with the test site effluent handling system. The problem was resolved later that day.
Saturday, 7/23 was added as a sample day to make up for missing samples on 7/20.

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Plant Effluent

Week Beginning: 24-Jul-16 Plant Code: SYS201

Weeks Into Test: 26

Weekend Dosing: Sunday 500 gallons Saturday 500 gallons

		Monday	Tuesday	Wednesday	Thursday	Friday
Dosed Volume (gallons)		500	500	500	500	500
Dissolved Oxygen (mg/L)	aeration chamber	0.57	0.53	0.64	0.69	0.58
	effluent	0.68	0.73	0.81	0.92	0.86
Temperature (C)	influent	30	30	30	30	30
	aeration chamber	32	32	32	32	32
	effluent	33	32	32	32	32
pH	influent	6.6	6.4	6.7	6.7	6.7
	aeration chamber	7.4	7.1	7.1	7.3	7.2
	effluent	7.4	7.2	7.2	7.2	7.2
Biochemical Oxygen Demand (mg/L)	influent (BOD_5)	260	130	290	230	240
	effluent ($CBOD_5$)	7	6	4	6	5
Suspended Solids (mg/L)	influent	320	180	190	180	210
	effluent	4	5	4	3	3

(a) Site problem
(b) Malfunction of system under test
(c) Weather problem
(d) Other

Notes:

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APPENDIX D

OWNER'S MANUAL

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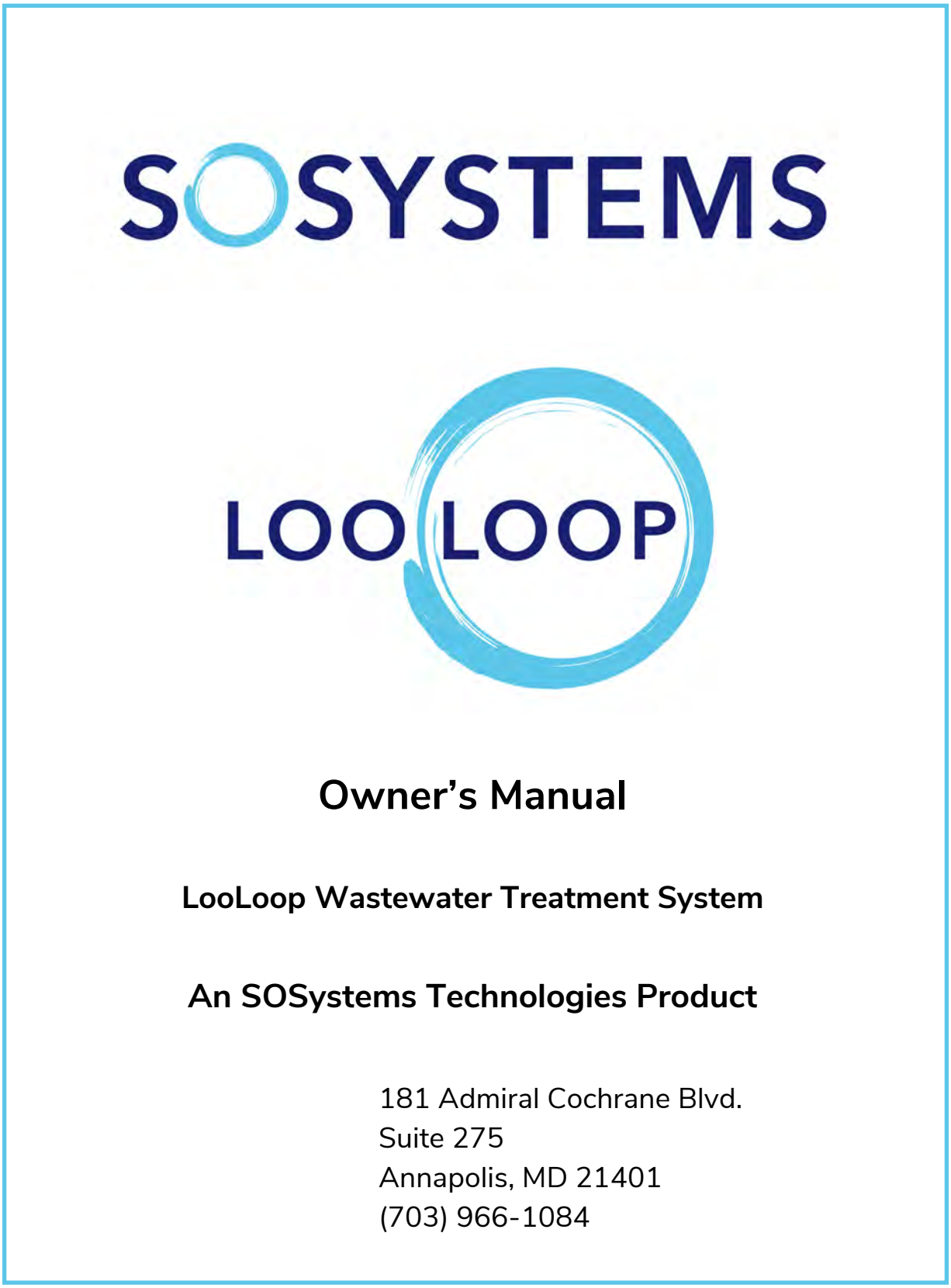

Owner's Manual

LooLoop Wastewater Treatment System

An SOSystems Technologies Product

181 Admiral Cochrane Blvd.
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(703) 966-1084

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Thank You

Thank you for purchasing a LooLoop wastewater treatment system. You have purchased the most robust, easy to operate, effective, yet technically simple onsite wastewater treatment system on the market today. LooLoop system is designed to remove a majority of the nitrogen from your home's wastewater as well as most of the drain field clogging contaminants. Nitrogen run-off is the primary cause of algae growth in our lakes, bays, and waterways. Algae growth contributes to the depletion of oxygen that is critical to sustaining our waterways. The LooLoop system helps you make a difference in watershed recovery efforts and leave a better world for future generations.

The LooLoop system has been tested and is listed under NSF/ANSI Standard 40 for Class 1 treatment systems and NSF/ANSI Standard 245 for nutrient removal systems.

LooLoop System Introduction

The LooLoop wastewater treatment system technology is an enhancement to conventional onsite septic tank systems. LooLoop efficiently and effectively treats septic system wastewater resulting in an effluent that meets the highest standards and expectations for environmental and water quality protection. The LooLoop process is simple and reliable, thereby avoiding the complications and costs associated with other nitrogen-removal products. LooLoop requires minimal maintenance, is simple to repair, and is fabricated using generic components that are universally available.

How the LooLoop System Treatment Process Works

The LooLoop process transforms traditional septic tank effluent to clean, almost odorless, and low nutrient water that prevents leach field failure. In more technical terms, it converts oxygen-starved anaerobic septic tank effluent to oxygen-rich aerobic effluent low in Biological Oxygen Demand (BOD), Total Suspended Solids (TSS, the leach filed clogging material) and nitrogen. As an enhancement to an existing septic system, the LooLoop system (see Figure 1) requires one additional standard 1500 gallon underground two chamber septic tank placed adjacent to your existing septic tank and the installation of the LooLoop BioFilter Cabinet. The BioFilter Cabinet is a 4' X 4' x 6' tall pre-assembled cabinet that can be placed at any location on your property that drains by gravity back to your septic tanks.

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The existing septic tank (Tank 1) continues to be where solids are settled and anaerobically digested. Unlike your current system, however, the wastewater from the first tank is not displaced into the drain field. Instead, the wastewater flows into the LooLoop tank (Tank 2) where additional treatment takes place and a small pump sends effluent to the LooLoop BioFilter Cabinet.

The BioFilter Cabinet is where it all happens. The BioFilter Cabinet is an ultra-high rate recirculating trickling filter containing highly porous plastic filter media with a very high surface area per unit of volume. Wastewater from the second tank is pumped to the BioFilter Cabinet and sprayed directly onto the filter media. The plastic filter media is where aerobic bacteria live and grow using the nutrients and organic materials from the wastewater as their food source. Vents at the top and bottom of the BioFilter Cabinet ensure that an oxygen rich environment is maintained, allowing aerobic bacteria to survive and multiply. The aerobic bacteria consume the organic material in the home's wastewater faster than the anaerobic bacteria growing in the existing septic tank. The aerobic bacteria turn this food into carbon dioxide gas and more bacteria. The bacteria grow so there is just enough of them to consume almost all the "food" available.

The aerobic bacteria also play a key role in reducing nitrogen levels in the effluent reaching the drain field and the nearby groundwater by performing the first key step-converting nitrogen compounds in the wastewater to nitrate. After the nitrified wastewater drains from the BioFilter Cabinet, it flows by gravity back to existing septic tank where it mixes with septic tank effluent. The residual contamination in the BioFilter Cabinet flow plus the added food in the septic tank effluent stimulate bacterial growth and activity. The bacterial population's need for oxygen depletes the oxygen in the water. With the oxygen depleted, the aerobic bacteria (that can't survive without oxygen) get the oxygen needed by splitting it off the nitrate molecule which has 1 nitrogen and 3 oxygen atoms. Relieved of the oxygen atoms, the nitrogen is released to the air as a gas. Nitrogen gas is 70% of the air we breathe, so nitrogen in the air, and not in the water, is the way nature intended things to be.

The wastewater continues to recirculate to the BioFilter Cabinet and back to the septic tanks at the rate of about 7,000 gallons per day. The RecoSept tank pump chamber's final feature is an overflow pipe that allows the clean recirculating effluent water, containing low levels of nitrogen, TSS and BOD, flow to the drain field.

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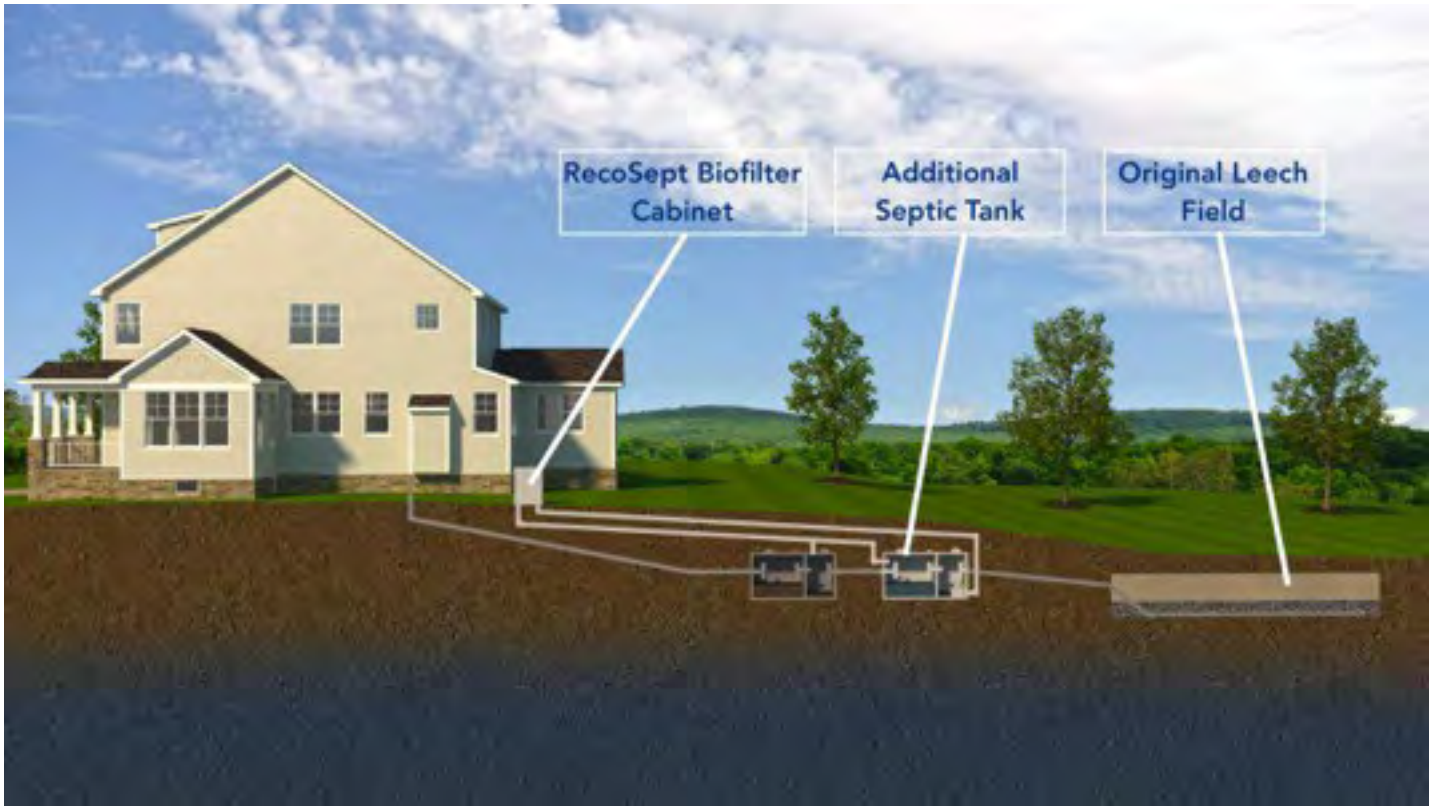

Figure 1. LooLoop System

In Figure 1, note that both tanks have 2 compartments. The LooLoop system can be added to any existing sep- tic system by inserting a second tank between the existing tank and the soil disposal system, or an entirely new system can be installed. For those systems without a compartmented septic tank, the return from the trickling filter can be connected to the LooLoop tank.

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Features and Advantages

The standard LooLoop treatment system consists of the following components:

- The BioFilter Cabinet is the key component of the LooLoop system and has no moving or mechanical components other than three valves and operable vents at the top and bottom of the cabinet. Thus, the BioFilter Cabinet is designed for long term performance and minimal maintenance. The BioFilter Cabinet is designed to resemble a small garden or pool equipment shed that can easily be placed adjacent to the house, similar to other mechanical systems, or on any other part of the property that drains by gravity to the septic tanks. The BioFilter Cabinet is constructed with water-resistant PVC board, polystyrene foam insulation, and stainless steel vent louvers. All components of the system that contact wastewater are of stainless steel, PVC, or rubber construction for durability. The recirculating trickling filter media is a self-supporting PVC sheet media.
- The LooLoop tank is a 1,500-gallon, two compartment concrete or plastic septic tank. The standard tank is sized with ¾ capacity for the first compartment and ¼ for the second compartment. Compartment capacities may vary but in no instance shall the capacity of the first compartment be less than 2/3 total capacity and the second compartment no more than 1/3 of tank capacity. These criteria are flexible to accommodate local tank suppliers. A LooLoop sales agent will determine site-specific tank selection.
- The LooLoop tank submersible pump is 115V, 60 hertz, single phase, fractional horsepower motor of stainless steel and composite resin materials used in all wetted parts. The pump is expected to operate for at least 60,000 hours or about 9 years. The pump is the only electrically powered component of the LooLoop system.
- The LooLoop system is supplied with a prewired repeat cycle flow controller contained in a NEMA rated enclosure and is accessible through the door on the cabinet. The controller controls the recirculating pump cycle time from 5 minutes per hour of operation to 55 minutes per hour of operation. A LooLoop representative will determine the pump cycle time for the specific installation. The weatherproof controller is equipped with a fail to start detector, a visible alarm, an audible alarm and silencer switch. The controller contains a power switch and time clock that control the recirculating pump operation. The local dealers name, address, and telephone number are displayed on a placard located on the wall of the BioFilter Cabinet beside the controller. A high level switch connected to the alarm circuit is provided to alert the user

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of blockages in the disposal system piping between the LooLoop and the leaching system components. The backup alarm is provided for the convenience or the owner and is not integral to the LooLoop system.

- The LooLoop treatment system is capable of treating 500 gallons per day of domestic wastewater from a single-family residence or 250 gallons per day from two single-family residences.

LooLoop System Performance

The performance of the LooLoop system complies with and is listed under NSF/ANSI 40 Class 1 treatment systems and NSF/ANSI 245 for nutrient removal systems. The LooLoop system is certified with a Class 1 rating after successfully completing the 6 month Standard 40 test protocol, with an averaged effluent of < 6 mg/L CBOD and < 7 mg/L TSS and <19 mg/L Total Nitrogen.

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Operational Requirements

The LooLoop system is designed to treat only wastewater generated from a typical residence. Typical domestic wastewater streams include those from kitchen sinks, bathroom sinks, utility sinks, mop basins, shower stalls, bathtubs, clothes washers, dishwashers, drinking fountains, wash sinks, toilets, and whirlpool baths. The LooLoop system is designed to handle typical amounts of wastewater from the kitchen, bathroom, or laundry. The use of the detergents, bleach, and drain cleaners as recommended by the manufacturer is acceptable. The following is summary of items that should not be disposed of into the plumbing system:

Septic System Operation	
	Don't Dispose of These Items
Household Waste	Feminine hygiene products, wipes, paper towels, condoms and their wrappers, cotton swabs, cotton balls, and bandages should not be discharged to the septic tank. The real concern with these items is that they can block the house plumbing and cause a backup. Frequent discharges will necessitate more frequent septic tank pump outs.
Kitchen Waste	**Grease and oil** should not be dumped down the drain. The residual grease on eating utensils is OK but a quick wipe with a paper towel is best before washing. Excessive grease disposal will necessitate more frequent septic tank pumping. Tip, after cooking oils have cooled, place them in an empty jar with screw on lid or a premium grade sealable freezer bag and dispose of them with the dry trash. **Garbage grinders** should not be used unless the capacity of the first compartment of the septic tank is increased by a factor of 2 and the first compartment of the septic tank pumped no less than once every 3 years.
Household Maintenance Waste	Flammable solvents, gasoline, kerosene, toxic liquids, paints, pesticides, liquid fertilizers, and any liquid where you are uncertain about the disposal method should not be disposed of in the septic tank. Call your local solid waste management authority for guidance. Cleaning water soluble paint brushes (in moderation) should not impair the operation of the septic tank or LooLoop. The main concern regarding these household wastes in not the effect that they have on the performance of the septic tank or LooLoop. The concern is that these liquids may not be treated by the septic or aerobic process and could be a source of fire or explosion or they could to get into the groundwater via the soil disposal system.
Medical Waste	Liquid antibiotics and other medicines should not be disposed on in the septic tank. The ability of these substances to pass through wastewater treatment systems unaffected by the treatment process is a developing concern.

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In addition, all water softener backwash, roofing down spouts, sump pump piping, footer drains, basement and garage floor drains, must not be connected to the domestic wastewater plumbing system.

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Electrical Requirements

The LooLoop controller must be wired to a dedicated 115 VAC, single phase, 15 amp circuit with a lockable disconnect switch mounted in the immediate vicinity of the BioFilter Cabinet. The controller wiring diagram is provided in Appendix 1. All electrical work must be completed in accordance with the National Electrical Code and all applicable local codes. A qualified electrician should make all electrical connections, using proper procedures and safety guidelines.

The LooLoop tank submersible pump is 115V, 60 hertz, single phase, fractional horsepower motor of stainless steel and composite resin materials used in all wetted parts. The pump is expected to operate for at least 60,000 hours or about 9 years.

CAUTION: Prior to performing any service or maintenance, first shut off and lock the lockable disconnect switch for the electrical circuit. Next shut off the power switch to the LooLoop controller. Failure to do so could result in serious personal injury or equipment damage.

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LooLoop Operating Instructions

Upon completion of the installation of the system components, the LooLoop tank is filled with clean water to allow the operating system to establish a high oxygen concentration in the water to develop the biological process to treat the wastewater. This procedure will minimize the potential for any odors to be present. The startup and maturation of the biological processes can take from 3 weeks to 2 months, depending on the time of the year. Initially, odors, if any, should be confined to immediate vicinity around the BioFilter Cabinet during start up. Once the biological processes have matured, no noticeable odors should be present. Contact a LooLoop representative if a strong septic system odor is present in the vicinity of the BioFilter Cabinet.

In the event that a problem arises with the system or service is required, please contact SOSystems, 181 Admiral Cochrane Blvd Suite 275, Annapolis, MD 21401, phone (703)966-1084. You can also refer to the LooLoop system data plate located conveniently inside the door of the BioFilter Cabinet where the system piping and LooLoop controller are located. A service data plate is also located adjacent to the visible alarm located on the exterior of the BioFilter Cabinet.

During the startup of the LooLoop System, the recirculating pump cycle time will be set using the repeat cycle flow controller. The cycle timer should only be adjusted by a LooLoop representative.

The LooLoop system is designed for minimal and ease of maintenance. The responsibility of the owner for the LooLoop wastewater treatment system is limited to the following:

The septic system tank (Tank 1) and LooLoop tank should be pumped every three years. The BioFilter Cabinet has 16 vents, eight on the upper part of the BioFilter Cabinet (4 vents on each side) and eight on the lower part of the BioFilter Cabinet (4 vents on each side). The vents can be opened or closed from the outside of the BioFilter Cabinet using the toggle attached to the movable closure of each vent. All vents should be open from April 1 through October 31. From November 1 through March 31, one vent on each side of the BioFilter Cabinet (both top and bottom) should be open and the others closed.

Intermittent or extended periods of non-use:

- The LooLoop system performance is robust and not affected by vacations and extended periods of little or no use. The system can continue to operate without damage.
- If the period of non-use is foreseeable, the LooLoop representative should be contacted to adjust the pump cycle time to reduce electricity consumption and pump

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wear to a minimum.

- If the period of non-use is expected to be 6 months or more, the system can be turned off without damage to the equipment. Prior to restarting the system after a long period of being off, contact a LooLoop representative to restore power to the system and the reset the controller one week prior to initiating use of the wastewater system.
- Should the house be vacated for 5 or more days, the alarm can be silenced to avoid annoying neighbors if the alarm were to sound during your absence.

Power Outage:

- If a power outage occurs at the house, the only thing that will happen is the pump in the LooLoop tank will not pump the wastewater to the BioFilter Cabinet. Instead, any wastewater that flows from the house will displace effluent in the septic tanks to the drain field - operating as a standard septic system until power is restored. There is no chance for back-ups or overflows.

Alarm:

- Should an alarm occur, signaling the pump is not operational, silence the alarm using the silencing switch on the alarm box located on the exterior of the BioFilter Cabinet and notify the LooLoop representative.
- Similar to the conditions of a power outage, the only thing that will happen is the pump in the LooLoop tank will not pump the wastewater to the BioFilter Cabinet. Instead, any wastewater that flows from the house will displace effluent in the septic tanks to the drain field - operating as a standard septic system until power is restored. There is no chance for back-ups or overflows.
- If the alarm were to sound in the middle of the night or on a holiday or weekend, do not worry. An alarm condition is not an emergency. The LooLoop representative can be contacted on the next business day.

Maintain the plumbing and septic system:

- Be aware of the do's and don'ts regarding the home septic system.
- Have the septic tank and LooLoop tank pumped every 3 years.
- Repair plumbing leaks promptly. Unless the leak is large, most leaks will not affect the LooLoop system; however, the leak may overload the drain field system. Note, the most expensive component of the home wastewater septic system is the drain field system.

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Routine Cleaning and Maintenance

The LooLoop system is designed for minimal and ease of maintenance - four inspection/service visits are required during the first two years and annual visits after that. Completion of the required inspection/service visits are required to maintain the LooLoop system warranty. See Table 1 and Table 2 for maintenance schedule summary.

Table 1: LooLoop System Maintenance Schedule Years One and Two

LooLoop System Component	Maintenance Frequency
Spray Piping and Nozzle	Semi-annual inspection and cleaning
Pump/Controller/Alarms	Inspect Semi-annually
BioFilter Cabinet	Inspect Semi-annually
Trickling Filter Media	Inspect Semi-annually
Existing Septic Tank (Tank 1)	Inspect Semi-annually
LooLoop Tank (Tank 2)	Inspect Semi-annually

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Table 2. LooLoop Maintenance Schedule Year Three and Beyond

LooLoop System Component	Maintenance Frequency
Spray Piping and Nozzle	Annual cleaning
Pump/Controller/Alarms	Inspect Annually
BioFilter Cabinet	Inspect Annually
Trickling Filter Media	Inspect Annually
Existing Septic Tank (Tank 1)	Inspect Annually and Pump every 3 years
LooLoop Tank (Tank 2)	Pump every 3 years

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Trouble Shooting and Repair: LooLoop Treatment System

This trouble shooting and repair section is written to help you identify the cause of system problems that may occur at times. Whenever a problem is identified, it is important to take steps to eliminate the cause. Note that all areas of installation, including those typically the responsibility of the contractor, excavator, electrician, plumber, and owner are covered. It is possible that many problems have root causes other than the system or its components.

The trouble shooting guide provides efficient solutions to most wastewater treatment problems when used with the recommended inspection and service procedures performed by a LooLoop representative.

LooLoop System Operational Trouble Shooting

Problem	Possible Cause	Potential Solutions
Mud or Silt in the System	Influent sewer line separated at a joint or fitting	Have contractor excavate and repair
	Sewer line crushed	Have contractor excavate and replace
Septic Odor	Incomplete treatment due to hydraulic overloading	See “Hydralulic Overloading”
	Insufficient flow from pump to BioFilter Cabinet	- Clean spray nozzle - Open all valves - Clear pump intake - Restore pump operation
Hydraulic Overloading	Ground water entering system	- Install curtain drain to lower water table - Install new water tight septic tank - Repair defective valves in building - Disconnect sump pump from sewer line - Raise or regrade around tank risers to shed water - Disconnect roof leaders, footing drains, garage drain, basement floor drain, yard drains from septic system

Problem	Possible Cause	Potential Solutions
Controller Pump Alarm Activated	Pump fails to start	- Check pump wire connections - Replace pump
	Pump motor failure	Replace pump
	High water level in LooLoop tank	Blockage in leaching system
No Electrical Power from Electrical Disconnect to Controller	Circuit breaker tripped	Turn breaker to “off” position, then turn “on”
	Defective circuit breaker	Replace circuit breaker
	Power connection from disconnect to controller severed	Locate break and repair
No Electrical Power from Controller to Pump	Loose wiring connection	- Check all connections - Pump plug not inserted in controller receptacle properly

-

RecoSept Service Program

The SOSystems contact information, address and phone number, is conveniently located inside the door of the BioFilter Cabinet.
Included with your purchase of a LooLoop system is a 5-year operations and maintenance contract that includes four inspection/service visits during the first two years by a certified LooLoop service provider to test and verify system performance, and annual visits for the next three years. Verification of system performance will include evaluation of effluent quality including color, turbidity, scum overflow, and odor. A copy of the Field Inspection and Service Form will be provided to the owner, including any system operation issues that cannot be remedied at the time of inspection.

An extended service policy for annual inspection/service visits is available for purchase by the owner through SOSystems.

Service and Maintenance Agreement

The following represents an example of a LooLoop O&M Agreement

Agreement for Operating and Maintenance (O&M) Services for a LooLoop Wastewater

Treatment System is made on _____(date) between

_____(name) and **SOSystems Inc.** for the dureation of

this contract beginning _____(date), and concluding

_____(date)(5 years). SOSystems shall operate and maintain the

wastewater treatment systems installed at _____(site).

1. Service Provider agrees to submit biannually, in years one and two, and annually, in years three through five, to the Owner, a report including an operation and maintenance summary and analysis of effluent quality sampling (color, turbidity, scum overflow, and color), as required.
2. Service Provider shall perform on a regularly scheduled biannual service inspection (years 1 and 2) and annually (years 3 through 5) including the following procedures:
    A. Observe the general condition of the area over the LooLoop components to identify potential under- ground leaks.
    B. Open all manways and observe the condition of the contents for unusual conditions.
    C. Open the cover of the BioFilter Cabinet to assess the condition of the filter media, the uniformity of the spray, and to remove and clean the spray nozzle.
    D. Check all valves for proper operation
    E. Connect a hose to the faucet on the feed pipe and flush the media.
    F. Collect a sample of the treated wastewater for analysis.
    G. Samples shall be analyzed for the following:
        a. COD
        b. TSS
        c. Total Nitrogen (TN)
        d. Color
        e. Turbidity
        f. Scum overflow
        g. Odor

LooLoop System Limited Warranty

All components of the LooLoop system are warranted to be free from defects in material and workmanship, under normal use and service, for two years from the date of installation. The two year limited warranty is included in the original purchase price of every LooLoop system.

Warranty Registration

Complete the Warranty Registration card and return to SOSystems within thirty days of the installation date for the warranty to be effective from the installation date. The serial number is located on the data plate conveniently inside the door of the BioFilter Cabinet where the system piping and LooLoop controller are located.

LooLoop Warranty Registration

First Name: _____ **Last Name:** _____

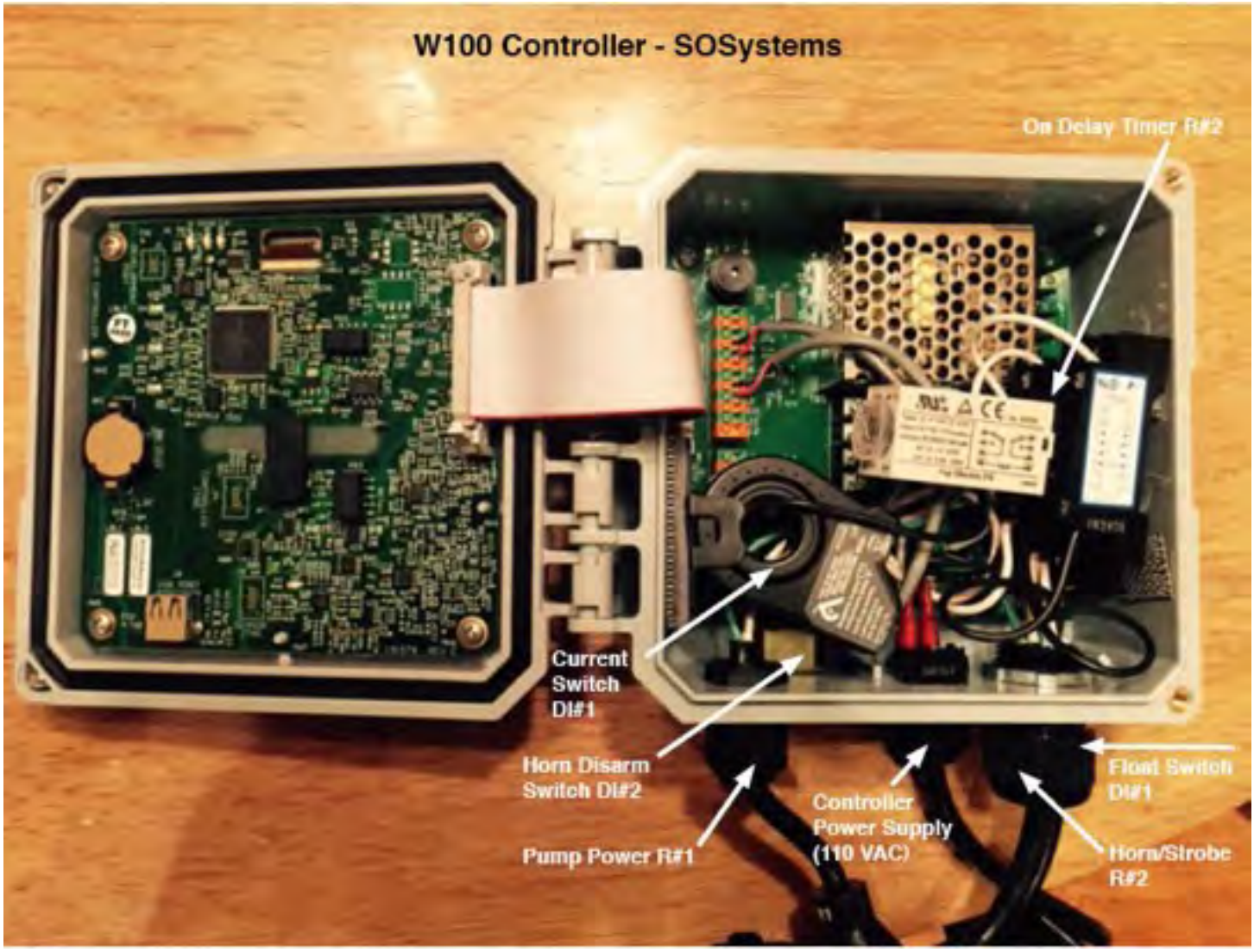
Street Address: _____ **Address 2:** _____

City: _____ **State:** _____ **Zip Code:** _____

Phone Number: _____ **Email:** _____

Serial No.:_____

APPENDIX



APPENDIX