Truro Board of Health

Tuesday March 15, 2022
Regular Meeting- 4:30 PM

REGULAR MEETING

Remote Meeting Access Instructions

This will be a remote meeting. Citizens in Truro can view the meeting on Channel 18 and on the homepage of the Town of Truro website on the "Truro TV Channel 18" button found under "Helpful Links". To view, click on the green "Watch" button in the upper right of the page. **To provide comment during the meeting, please call in toll free at 1-866-899-4679 and enter the following access code when prompted: 972-302-709; or access the meeting from your computer, tablet or smartphone.** https://global.gotomeeting.com/join/972302709 There may be a slight delay (15-30 seconds) between the meeting and the live-stream and television broadcast. If you are watching the meeting and calling in, please lower the volume on your computer or television during public comment so that you may be heard clearly. We ask that you identify yourself when calling in to help us manage multiple callers effectively. Citizens may also provide public comment for this meeting by emailing the Health Agent Emily Beebe at ebeebe@truro-ma.gov with your comments.

I. PUBLIC COMMENT

Please note that the Commonwealth's Open Meeting Law limits any discussion by members of the Board of an issue raised to whether that issue should be placed on a future agenda

II. AGENDA ITEMS

1. **Variance Request:** 45 Corn Hill Road *(continued from 3/1/2022)*

2. **Variance Requests/Local Upgrade Approval:** 127 & 133 South Pamet Road, Dennis/Whitelaw *(continued from the 2/1/2022 meeting; requested a continuance to the 4/5/2022 meeting)*

3. **Variance Request**: 8 Well Sweep Lane

4. **New Business Application**: Salty Market, 2 Highland Road

5. **Change of Manager:** 566 Shore Rd, Ocean Breeze Condominiums

6. **Change of Manager:** 658 Shore Rd, Bayview Village Condominiums

7. **Discussion on Groundwater Resources**

8. **Local Board of Health Regulation Review**
   a. **Section IIX - Well Water Testing (proposed amendment to Rental Registration water test validity schedule)**

III. MINUTES: December

IV. REPORTS

- Report of the Chair-packets
- Health Agent's Report

Office of Town Clerk
Treasurer – Tax Collector
12:17 pm
MAR 10 2022
Received TOWN OF TRURO
By

V2022-05

Fee: $75.00

PAID 951

TRURO HEALTH & CONSERVATION DEPARTMENT
24 Town Hall Road, Truro 02666

APPLICATION FOR BOARD OF HEALTH VARIANCES

Date: FEBRUARY 15, 2022

Property Owner's Name: THE WELL SWEEP LANE REALTY TRUST
C/O JOHN E. O'BRIEN, TRUSTEE

Mailing Address: 101 GLENDALE ROAD
QUINCY, MA 02169-1932

Address of Property: 8 WELL SWEEP LANE

Map and Parcel Number: Map # 53 Parcel # 41

Design Engineer/~~Sanitarian~~ WILLIAM N. ROGERS II

Firm/Company Name: William N. Rogers II, PE, PLS Phone #: 1-508-487-1565

Address: 41 OFF CEMETERY ROAD, P.O. BOX 631
PROVINCETOWN, MA 02657

Please check type of variance requested:

☒ **Title 5 Variance Request: Section** 310 CMR 15.221(7)

☐ **Board of Health Variance Request: Section/Article**

William N. Rogers II
Signature (Representative)

Date FEBRUARY 15, 2022

* John E. O'Brien, TRUSTEE
Signature (Property Owner)

FEBRUARY 15, 2022

HEALTH DEPARTMENT
TOWN OF TRURO
FEB 23 2022
RECEIVED BY:

NOTIFICATION TO ABUTTERS

Check One: ☐ This is the applicant ☑ Applicant's Representative Other ☐

Dear Abutter:

You are being notified pursuant to 310 CMR 15.000, State Environmental Code Title 5 and the Truro Board of Health Regulations that the Board of Health will hold a public hearing to hear requests for variances from applicable State and Local regulations.

Applicant Information:

THE WELL SWEEP LANE REALTY TRUST
c/o JOHN E. O'BRIEN, TRUSTEE
Name

101 GLENDALE ROAD, QUINCY, MA 02169-1932
Address

Representative Information:

WILLIAM N. ROGERS II
Name

41 OFF CEMETERY ROAD, P.O. BOX 631, PROVINCETOWN, MA 02657
Address

1. Address of proposed work: 8 WELL SWEEP LANE, TRURO

2. Description of Work: INSTALLATION OF AN UPGRADED SEPTIC SYSTEMS

3. Variance from Regulation (list regulation):

310 CMR 15.221(7)

1. **The variance hearing begins at ~~4:00~~ 4:30 pm in the Selectmen's Meeting Room, 2nd Floor, Truro Town Hall, 24 Town Hall Road, Truro MA 02666 on** MARCH 15, 2022
(date of hearing)

The Variance Request, plans and other pertinent information may be examined prior to the public hearing at the Health Department, Town Hall, 24 Town Hall Rd., Truro from 8am to 4pm, Monday thru Friday, 508-349-7004 x 32.

[signature]
Signature of Applicant or Representative

FEBRUARY 15, 2022
Date

WILLIAM N. ROGERS II, P.E., P.L.S.
PROFESSIONAL
CIVIL ENGINEERS & LAND SURVEYORS

41 OFF CEMETERY ROAD
P.O. BOX 631
PROVINCETOWN, MASSACHUSETTS 02657
TEL: (508) 487-1565
FAX: (508) 487-5809
EMAIL: WMROGERS2@VERIZON.NET

RUTH E. ROGERS
GARY L. LOCKE

STRUCTURAL CONSULTANT
DR. FRANK A. MARAFIOTI, P.E.

February 15, 2022

Ms. Tracey Rose, Chairman
Board of Health
Town of Truro Town Hall
P.O. Box 2030
Provincetown, MA 02657

HEALTH DEPARTMENT
TOWN OF TRURO
FEB 23 2022
RECEIVED BY:

Re: Request for Variance – Title 5
The Well Sweep Lane Realty Trust
8 Well Sweep Lane
Truro, Massachusetts

Dear Ms. Rose:

Pursuant to being engaged by The Well Sweep Lane Realty Trust to prepare a Site Plan & Upgraded Sanitary Subsurface Sewage Disposal System Design Plan in accordance with the D.E.P. State Environmental Code, Title 5, to service the existing structure at Locus, 8 Well Sweep Lane, Truro, Massachusetts, I hereby request on my client's behalf the following Variance:

1. A Variance be granted from 310 CMR 15.221(7) to allow the proposed distribution box and the proposed soil absorption system to be located greater than thirty-six (36") inches below finish grade.

The above Variance is sought due to the lack of available area on said Locus because of the existing lot size and building location thereon.

If I can be of any further assistance to you on this matter, please do not hesitate to contact me.

Respectfully submitted,

William N. Rogers II, PE, PLS

William N. Rogers II, PE, PLS

TOWN OF TRURO

Assessors Office
Certified Abutters List
Request Form

RECEIVED
FEB 15 2022
ASSESSOR'S OFFICE
TOWN OF TRURO

DATE: February 15, 2022

NAME OF APPLICANT: THE WELL SWEEP LANE REALTY TRUST
c/o JOHN E. O'BRIEN, TRUSTEE

NAME OF AGENT (if any): WILLIAM N. ROGERS II

MAILING ADDRESS: 41 OFF CEMETERY ROAD, P.O. BOX 631
PROVINCETOWN, MA 02657

CONTACT: HOME/CELL 1-508-487-1565 EMAIL willsier@verizon.net

PROPERTY LOCATION: 8 WELL SWEEP LANE
(street address)

PROPERTY IDENTIFICATION NUMBER: MAP 53 PARCEL 41 EXT. ________
(*if condominium*)

ABUTTERS LIST NEEDED FOR: **FEE: $15.00 per checked item**
(*please check all applicable*) (*Fee must accompany the application unless other arrangements are made*)

✓ Board of Health[5]
___ Cape Cod Commission
___ Conservation Commission[4]
___ Licensing
Type: ________

Planning Board (PB)
___ Special Permit[1]
___ Site Plan[2]
___ Preliminary Subdivision[3]
___ Definitive Subdivision[3]
___ Accessory Dwelling Unit (ADU)[2]

Zoning Board of Appeals (ZBA)
___ Special Permit[1]
___ Variance[1]

___ Other ________________ (*Fee: Inquire with Assessors*)
(*Please Specify*)

***Note*: Per M.G.L., processing may take up to 10 calendar days. Please plan accordingly.**

THIS SECTION FOR ASSESSORS OFFICE USE ONLY

Date request received by Assessors: 2/15/2022 Date completed: 2/15/2022
List completed by: [signature] Date paid: 2/15/2022 Cash/Check #9510

[1]Abutters, owners of land directly opposite on any public or private street or way, and abutters to the abutters within 300 feet of the property line.

[2]Abutters to the subject property, abutters to the abutters, and owners of properties across the street from the subject property.

[3]Landowners immediately bordering the proposed subdivision, landowners immediately bordering the immediate abutters, and landowners located across the streets and ways bordering the proposed subdivision. Note: For Definitive Subdivision only, responsibility of applicant to notify abutters and produce evidence as required.

[4]All abutters within 300 feet of parcel, except Beach Point between Knowles Heights Road and Provincetown border, in which case it is all abutters within 100 feet. Note: Responsibility of applicant to notify abutters and produce evidence as required.

[5]Abutters sharing any boundary or corner in any direction – including land across a street, river or stream. Note: Responsibility of applicant to notify abutters and produce evidence as required.

Revised December 2019

TRURO ASSESSORS OFFICE
PO Box 2012 Truro, MA 02666
Telephone: (508) 214-0921
Fax: (508) 349-5506

Date: February 15, 2022

To: William N. Rogers II, Agent for Well Sweep Lane Realty Trust

From: Assessors Department

Certified Abutters List: 8 Well Sweep Lane (Map 53, Parcel 41)

Board of Health

Attached is a combined list of abutters for property located at 8 Well Sweep Lane.

The current owner is Well Sweep Lane Realty Trust; John & Patricia O'Brien, Trustees.

The names and addresses of the abutters are as of January 28, 2022 according to the most recent documents received from the Barnstable County Registry of Deeds.

Certified by: ______________________

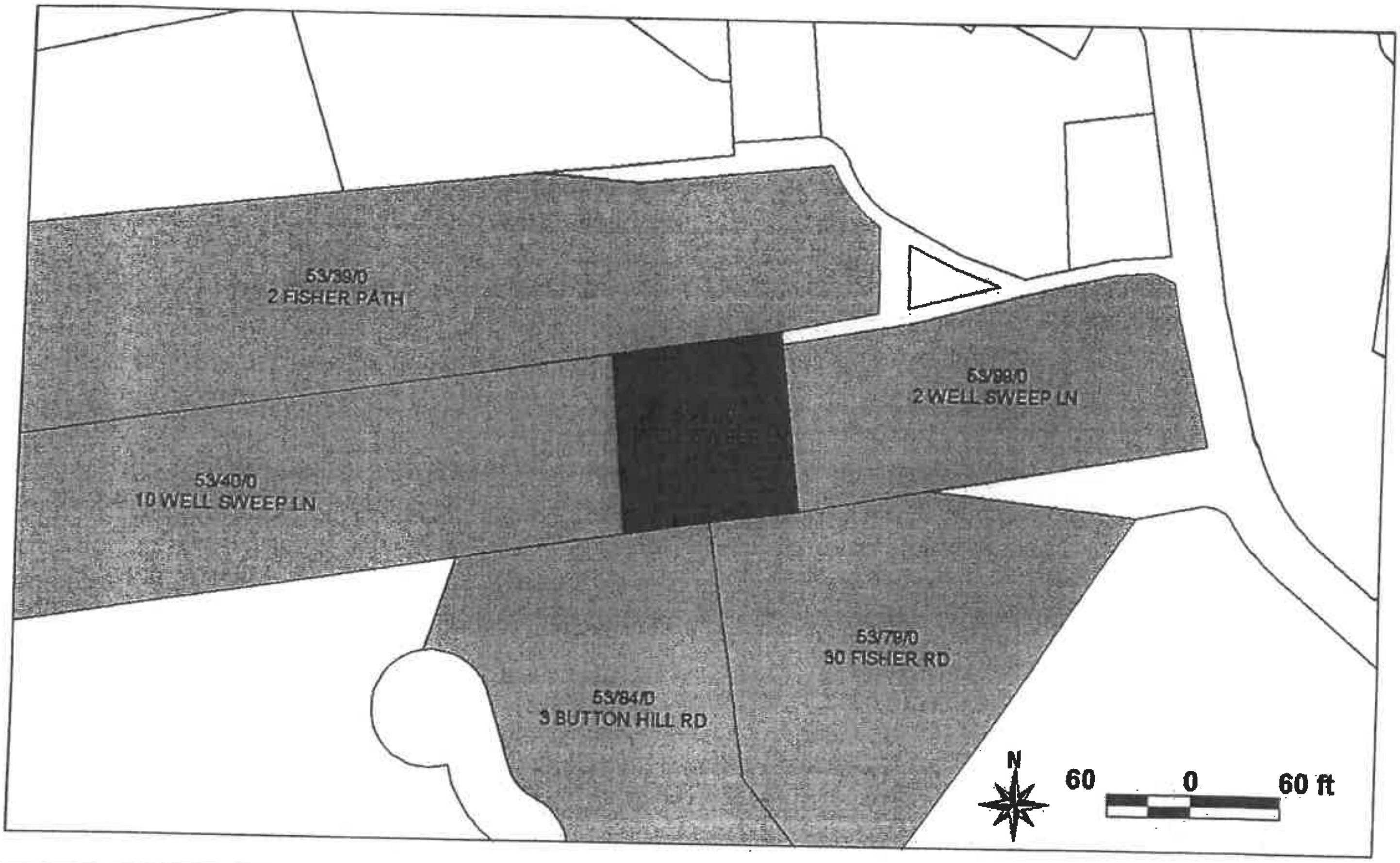
Olga Farrell
Assessing Clerk

HEALTH DEPARTMENT
TOWN OF TRURO
FEB 23 2022
RECEIVED BY: ______________________

8 Well Sweep Lane
Map 53, Parcel 41
Board of Health

TOWN OF TRURO, MA
BOARD OF ASSESSORS
P.O. BOX 2012, TRURO MA 02666

Custom Abutters List



Key	Parcel ID	Owner	Location	Mailing Street	Mailing City	ST	ZipCd/Country
3185	53-39-0-R	RUDYKOFF NATHANIEL T & STILMAN NAEMI	2 FISHER PATH	220 WEST 148TH STREET APT 4F	NEW YORK	NY	10039
3186	53-40-0-R	FRAZIER KRISTIN F REV LIV TRST TRS: FRAZIER KRISTIN F ET AL	10 WELL SWEEP LN	PO BOX 573	WELLFLEET	MA	02667-0573
3220	53-79-0-R	EHRENREICH PAUL & RIKER ELLEN	30 FISHER RD	7400 BARRA DR	BETHESDA	MD	20817
3225	53-84-0-R	AVERBACK MARIAN E & ROBERT S	3 BUTTON HILL RD	601 ELIOT DR	URBANA	IL	61801
5566	53-99-0-R	KINNEALEY JOSEPH	2 WELL SWEEP LN	11 HUTCHINSON LN	QUINCY	MA	02171

HEALTH DEPARTMENT
TOWN OF TRURO

FEB 23 2022

RECEIVED BY:

2/15/2022

53-39-0-R

RUDYKOFF NATHANIEL T &
STILMAN NAEMI
220 WEST 148TH STREET
APT 4F
NEW YORK, NY 10039

53-40-0-R

FRAZIER KRISTIN F REV LIV TRST
TRS: FRAZIER KRISTIN F ET AL
PO BOX 573
WELLFLEET, MA 02667-0573

53-79-0-R

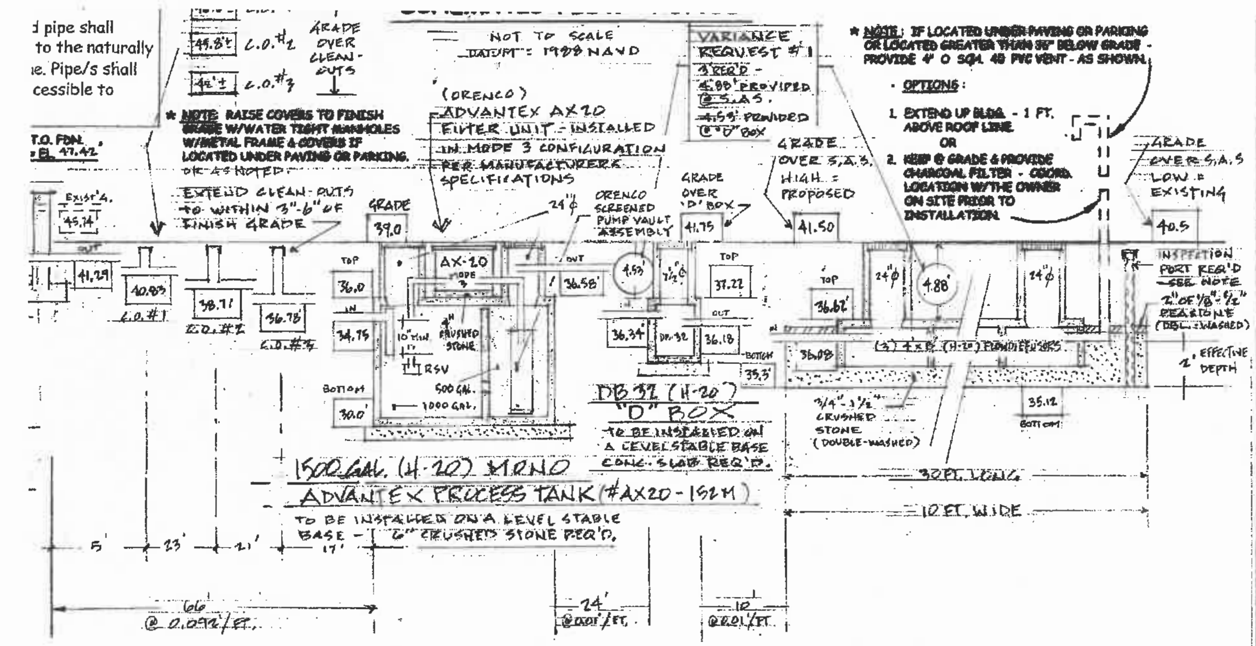
EHRENREICH PAUL & RIKER ELLEN
7400 BARRA DR
BETHESDA, MD 20817

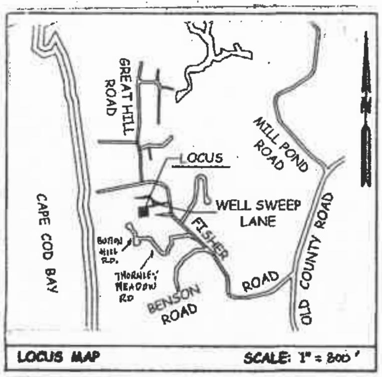
53-84-0-R

AVERBACK MARIAN E & ROBERT S
601 ELIOT DR
URBANA, IL 61801

53-99-0-R

KINNEALEY JOSEPH
11 HUTCHINSON LN
QUINCY, MA 02171





LEGEND:

- S.A.S. = SOIL ABSORPTION SYSTEM
- —W— = WATER SERVICE
- —E—E— = UNDERGROUND
- (W) = WATER GATE
- (32) — — = EXIST'G CONTOUR
- (42) —•—•— = PROPOSED CONTOUR
- TH #1 = TEST HOLE LOCATION
- X 35.19 = EXISTING SPOT ELEVATION
- B.S.L. = BUILDING SETBACK LINE
- = EXIST'G TREE
- S.S.L. = SEPTIC SETBACK LINE
- Ø T.P. = UTILITY POLE
- 29 | 25 = PROPOSED SPOT ELEV.
- C.O. = CLEANOUT

GENERAL NOTES:

1.) ALL SYSTEM COMPONENTS SHALL BE INSTALLED IN ACCORDANCE W/ TITLE 5 OF THE SANITARY CODE & ANY APPLICABLE REGULATIONS.
2.) PRIOR TO BACKFILLING THE INSTALLATION, THE ENGINEER & HEALTH AGENT SHALL BE NOTIFIED FOR INSPECTION.
3.) ANY ALTERATIONS TO THIS DESIGN MUST BE APPROVED BY THE ENGINEER & BOARD OF HEALTH, IN WRITING.
4.) ALL LINES SHALL BE 4" DIA. SCH. 40 PVC PIPE PITCHED 0.010'/FT. MINIMUM, EXCEPT AS NOTED.
5.) ANY/ALL UNDERGROUND UTILITIES ARE TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO SYSTEM INSTALLATION. (CONTACT DIG SAFE).
6.) ALL UNSUITABLE MATERIAL WITHIN 5 FT. IN ALL DIRECTIONS FROM THE SOIL ABSORPTION SYSTEM SHALL BE REMOVED & REPLACED W/CLEAN, COARSE WASHED SAND.
7.) ALL FILL MATERIAL UTILIZED FOR THE SOIL ABSORPTION SYSTEM SHALL BE CLEAN, COARSE, WASHED SAND FREE FROM DELETERIOUS MATERIAL & SHALL HAVE A PERC. RATE OF LESS THAN 2 MIN/IN. BEFORE & AFTER PLACEMENT.
8.) ALL FILL SERVICING THE SOIL ABSORPTION SYSTEM SHALL BE PROPERLY PLACED & COMPACTED TO MINIMIZE SETTLEMENT.
9.) FINISH GRADES SHALL COMPLY W/MINIMUM COVER & SLOPE SETBACK REQUIREMENTS OF TITLE 5.
10.) DURING INSTALLATION, THE CONTRACTOR IS RESPONSIBLE TO PROVIDE ADEQUATE PROTECTION TO ABUTTING PROPERTIES & TO MAINTAIN A SAFE EXCAVATION AREA.
11.) DATUM = 1988 NAVD
12.) PROVIDE SHOP DWGS. OF ALL PRECAST COMPONENTS FOR ENGINEERS APPROVAL - PER ENGINEERS REQUEST.
13.) IN CASE OF FAILURE - LEACHING TRENCH SHOULD BE REMOVED, REHABILITATED & REPLACED.

DATA:

RED FLOW: 3 BEDROOMS x 110 GPD/BEDROOM = 330 GPD.

TOTAL = 330 GPD.

TANK CAPACITY 330 GPD x 2 = 660 GPD.

) 1500 GAL. (H-20) ADVANTEX PROCESS TANK #AX20-152M
/ SHOREY OR EQ. WITH ADVANTEX AX-20 PROCESS UNIT
E 3 CONFIGURATION - INSTALLED PER MANUF. SPEC'S.
Q'D. WITHOUT GARBAGE GRINDER.

ING FACILITY:

LONG x 2 FT. DEEP x 2 SIDES x .74 GPD/sq.ft. = 89 GPD (SIDES)

WIDE x 2 FT. DEEP x 2 ENDS x .74 GPD/sq.ft. = 30 GPD (ENDS)

LONG x 10 FT. WIDE x .74 GPD/sq.ft. = 222 GPD (BOTTOM)

TOTAL = 341 GPD.

GPD PROVIDED > 330 GPD REQUIRED.

) 4'x 8' (H-20) CONC. FLOWDIFFUSORS - TYPE 'D' IN A
x 10'W x 2'D LEACHING TRENCH W/ 3' OF STONE ON
& ENDS & 1.04' OF STONE ON BOTTOM.

COMMONWEALTH OF MASSACHUSETTS — WILLIAM N. ROGERS II — No. 28410 — REGISTERED LAND SURVEYOR

William N. Rogers II, PLS
DECEMBER 10, 2021

COMMONWEALTH OF MASSACHUSETTS — WILLIAM N. ROGERS II — No. 26942 — REGISTERED PROFESSIONAL ENGINEER

William N. Rogers II, PE
DECEMBER 10, 2021

PLAN OF LAND IN TRURO

DEPICTING A

SANITARY SUBSURFACE SEWAGE DISPOSAL SYSTEM UPGRADE

AS PREPARED FOR

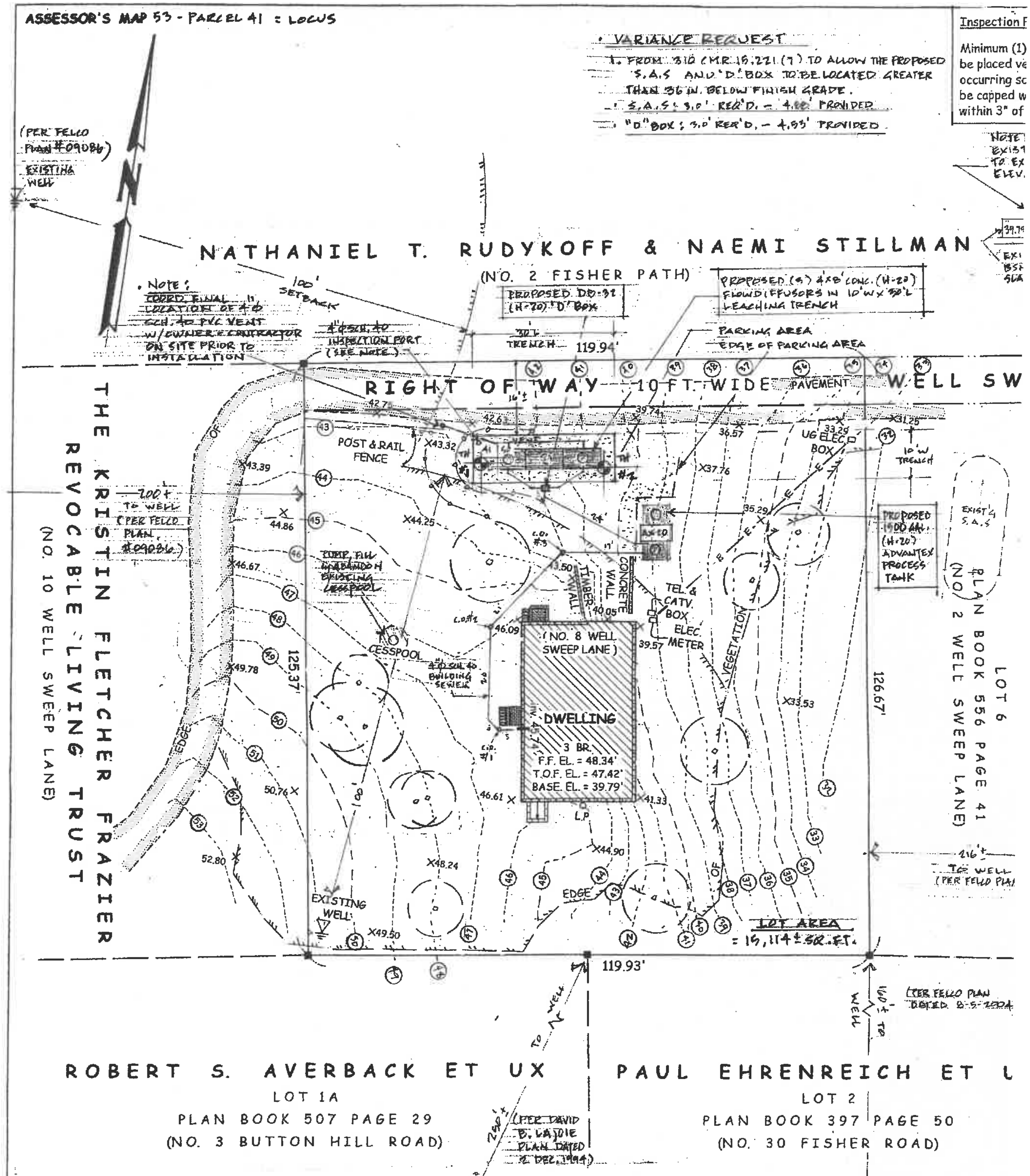
THE WELL SWEEP LANE REALTY TRUST
(No. 8 WELL SWEEP LANE)

SCALE: AS SHOWN — DECEMBER, 2021

HEALTH DEPARTMENT
TOWN OF TRURO
FEB 23 2022
RECEIVED BY:

WILLIAM N. ROGERS
PROFESSIONAL
CIVIL ENGINEERS & LAND SURVEYORS
41 OFF CEMETERY ROAD, PROVINCETOWN, MASS.
508.487.1565 / 508.487.5809 FAX

T-21-2159



WATER SERVICE GENERAL NOTE:

WHENEVER SEPTIC LINES CROSS WATER SERVICE LINES OR WHEN WATER SERVICE LINES COME WITHIN 10 FT. OF THE PROPOSED S.A.S., PIPES SHALL BE SLEEVED W/ CLASS 150 PRESSURE PIPE AND SHOULD BE PRESSURE TESTED TO ASSURE WATER TIGHTNESS. - COORD. W/ TOWN OF PROVINCETOWN WATER DEPT. AS NECESSARY.

TEST DATE: DEC. 10, 2021

TEST BY:

L. SCHOFIELD, CERTIFIED SOIL EVALUATOR #SE 2173

A. DAVIS - AGENT FOR BOARD OF HEALTH

PERC RATE: IN HORIZON C1 (-29" TOP @ TH #2) LOAMY SAND = < 2 MIN./IN.

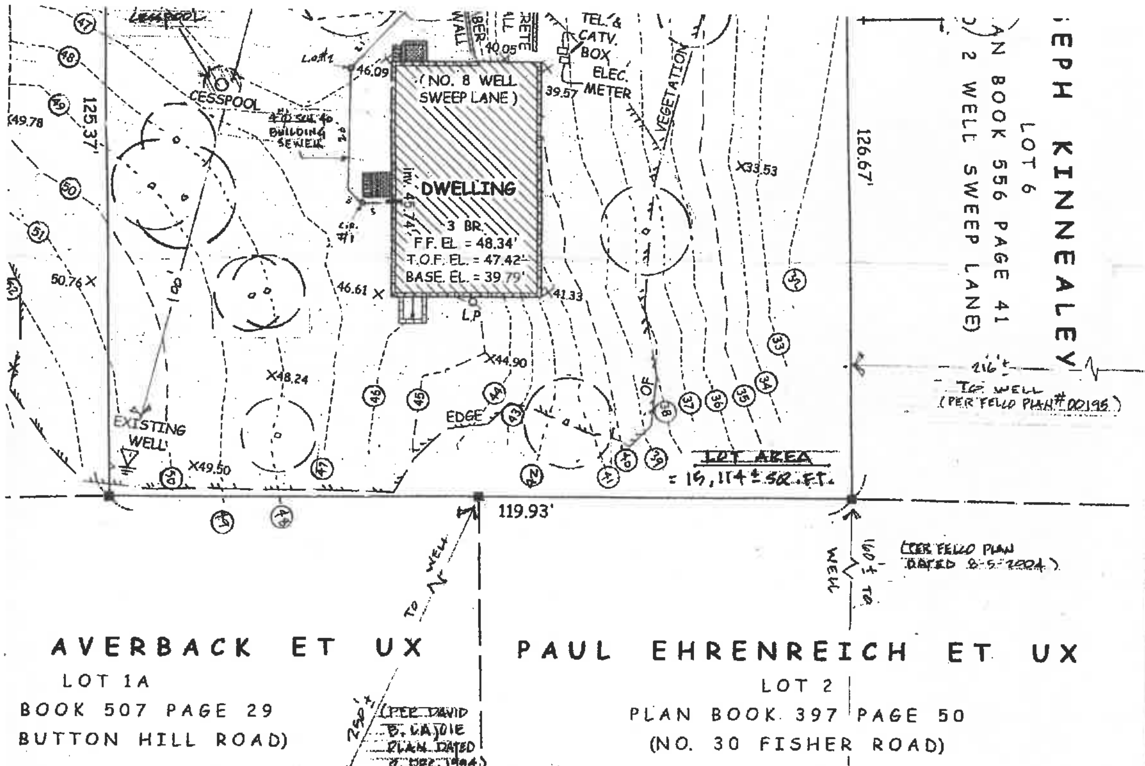
EL. 41.5'

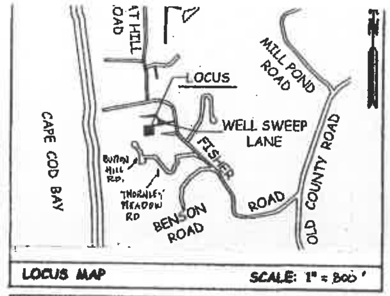
DEPTH	HORIZON	TEXTURE	COLOR	MOTTLING
0-11"	A	SANDY LOAM	10YR 4/3	NONE
11"-20"	BW	LOAMY SAND	7.5YR 4/6	↓
20"-120"	C	SAND	10YR 5/6	↓

EL. 40.5'

DEPTH	HORIZON	TEXTURE	COLOR	MOTTLING
0-8"	A	SANDY LOAM	10 YR 4/4	NONE
8"-21"	BW	LOAMY SAND	5 YR 4/4	↓
21"-67"	C1	↓	10 YR 5/6	↓
67"-120"	C2	SAND	10 YR 6/4	↓

- NO GROUNDWATER ENCOUNTERED.
- IT IS THE OPINION OF THE ENGINEER THAT THE SOIL PROFILE DOES NOT VARY SIGNIFICANTLY THROUGHOUT THE LOT.





LEGEND:

- S.A.S. = SOIL ABSORPTION SYSTEM
- —W— = WATER SERVICE
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- (W) = WATER GATE
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- (42) = PROPOSED CONTOUR
- X 35.19 = EXISTING SPOT ELEVATION
- = EXIST'G TREE
- T.P. = UTILITY POLE
- C.O. = CLEANOUT
- TH #1 = TEST HOLE LOCATION
- B.S.L. = BUILDING SETBACK LINE
- S.S.L. = SEPTIC SETBACK LINE
- 29.25 = PROPOSED SPOT ELEV.

PLAN
SCALE: 1" = 20'-0"
BENCHMARK = (1988 NAVD)

NOTE:
...TER ...RVICE ... PROPOSED ...LASS 150 ...SSURE ...ESS. - ... WATER

TEST DATE: DEC. 10, 2021
TEST BY:
L. SCHOFIELD, CERTIFIED SOIL EVALUATOR # SE 2173
A. DAVIS - AGENT FOR BOARD OF HEALTH
PERC RATE: IN HORIZON C (-24" TOP @ TH#2) LOAMY SAND = <2 MIN./IN.

- NO GROUNDWATER ENCOUNTERED.
- IT IS THE OPINION OF THE ENGINEER THAT THE SOIL PROFILE DOES NOT VARY SIGNIFICANTLY THROUGHOUT THE LOT.

TH#1 — EL. 42.5'

DEPTH	HORIZON	TEXTURE	COLOR	MOTTLING	COMMENTS
0-11"	A	SANDY LOAM	10YR 4/3	NONE	MASSIVE - FRIABLE
11"-20"	BW	LOAMY SAND	7.5YR 4/6	↓	SINGLE GRAIN - LOOSE
20"-120"	C	SAND	10YR 5/6		↓

TH#2 — EL. 40.5'

DEPTH	HORIZON	TEXTURE	COLOR	MOTTLING	COMMENTS
0-8"	A	SANDY LOAM	10 YR 4/4	NONE	MASSIVE - FRIABLE
8"-21"	BW	LOAMY SAND	5 YR 4/4		SINGLE GRAIN - LOOSE
21"-67"	C1	↓	10 YR 8/4		↓
67"-120"	C2	SAND	10 YR 6/4	↓	COARSE

DESIGN DATA:

1.) REQUIRED FLOW: 3 BEDROOMS x 110 GPD/BEDROOM = 330 GPD.
TOTAL = 330 GPD.

2.) SEPTIC TANK CAPACITY 330 GPD x 2 = 660 GPD.
USE (1) 1500 GAL. (H-20) ADVANTEX PROCESS TANK # AX20-152M - ACME/SHOREY OR EQ. WITH ADVANTEX AX-20 PROCESS UNIT IN MODE 3 CONFIGURATION - INSTALLED PER MANUF. SPEC'S.
- MIN. REQ'D. WITHOUT GARBAGE GRINDER.

3.) LEACHING FACILITY:
- 30 FT. LONG x 2 FT. DEEP x 2 SIDES x .74 GPD/sq.ft. = 89 GPD (SIDES)
- 10 FT. WIDE x 2 FT. DEEP x 2 ENDS x .74 GPD/sq.ft. = 30 GPD (ENDS)
- 30 FT. LONG x 10 FT. WIDE x .74 GPD/sq.ft. = 222 GPD (BOTTOM)

TOTAL = 341 GPD.

341 GPD PROVIDED > 330 GPD REQUIRED.
USE (3) 4'x8' (H-20) CONC. FLOWDIFFUSORS - TYPE 'D' IN A 30 FT. L x 10' W. x 2' D LEACHING TRENCH W/ 3' OF STONE ON SIDES & ENDS & 1.04' OF STONE ON BOTTOM.

... OF THE SANITARY CODE & ANY ...
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7.) ALL FILL MATERIAL UTILIZED F... BE CLEAN, COARSE, WASHED SA... & SHALL HAVE A PERC. RATE OF I... PLACEMENT.
8.) ALL FILL SERVICING THE SOIL A... & COMPACTED TO MINIMIZE SE...
9.) FINISH GRADES SHALL COMPLY... REQUIREMENTS OF TITLE 5.
10.) DURING INSTALLATION, THE CO... ADEQUATE PROTECTION TO ABU... A SAFE EXCAVATION AREA.
11.) DATUM = 1988 NAVD
12.) PROVIDE SHOP DWGS. OF ALL PR... APPROVAL - PER ENGINEERS REQ...
13.) IN CASE OF FAILURE - LEACHING... REHABILITATED & REPLACED.

COMMONWEALTH OF MASSACHUSETTS
WILLIAM N. ROGERS II
No. 28410
REGISTERED LAND SURVEYOR

William N. Rogers II, PLS
DECEMBER 10, 2021

PLA...

SANITARY S...
DISPOSAL...
AS...
THE WELL...
REALT...
(NO. 8 ...
SCALE: AS SHOWN

WILL...
P...
CIVIL ENGIN...
41 OFF CEMETERY...
508.487.

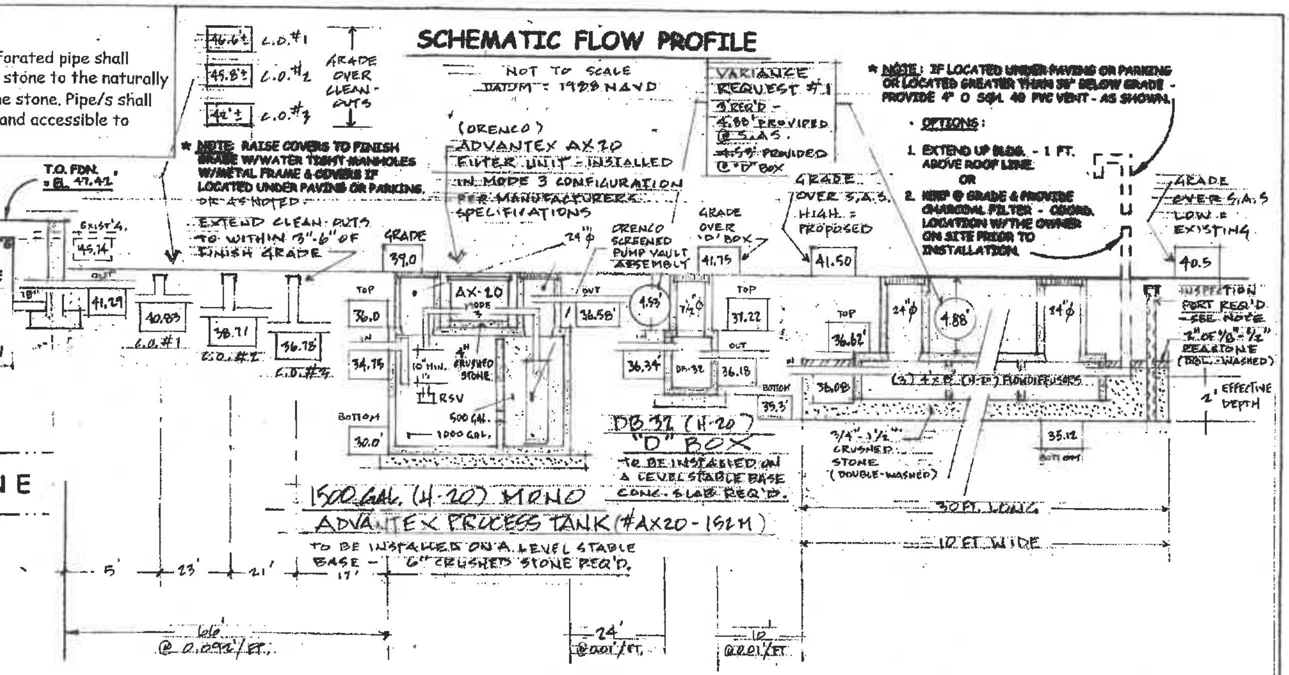
15.405 1 (B)

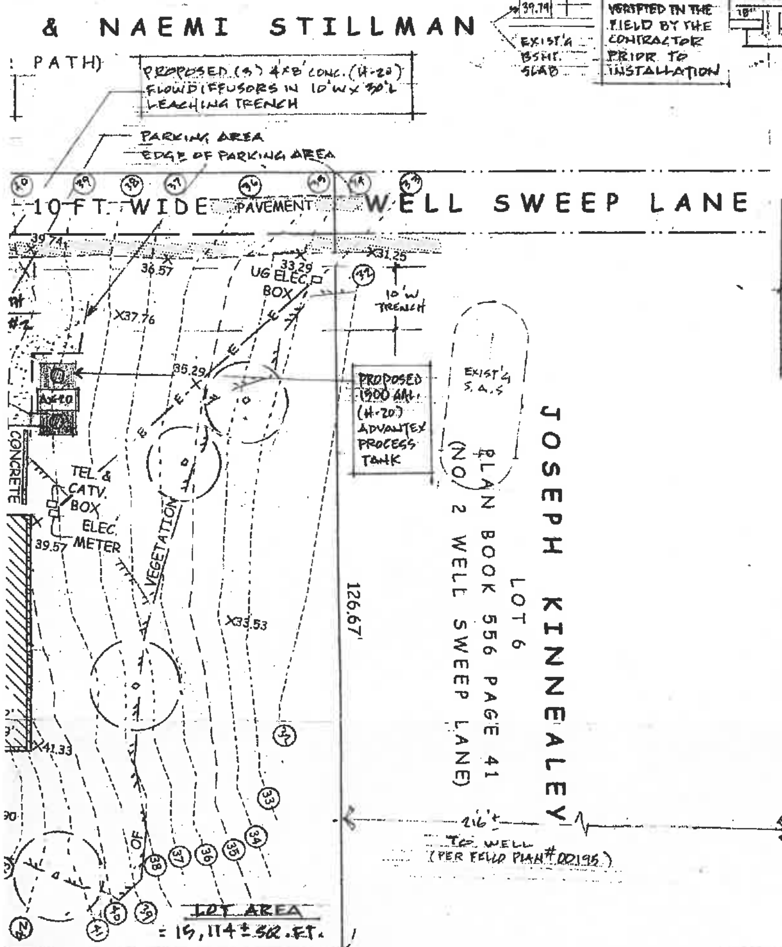
VARIANCE REQUEST

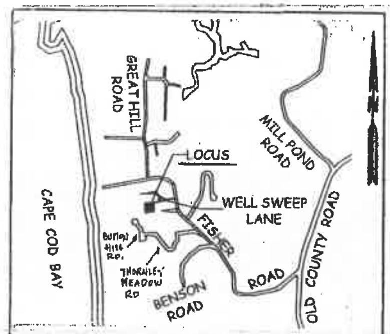
FROM 310 CMR 15.221 (7) TO ALLOW THE PROPOSED S.A.S AND 'D' BOX TO BE LOCATED GREATER THAN 36 IN. BELOW FINISH GRADE.
S.A.S: 3.0' REQ'D. – 4.88' PROVIDED
"D" BOX: 3.0' REQ'D. – 4.53' PROVIDED

Inspection Port Required:

Minimum (1)-4"Ø Sch. 40 PVC perforated pipe shall be placed vertically down into the stone to the naturally occurring soil or sand fill below the stone. Pipe/s shall be capped with a screw-type cap, and accessible to within 3" of Finish Grade.







LOCUS MAP SCALE: 1" = 800'

LEGEND:

S.A.S. = SOIL ABSORPTION SYSTEM
—W— = WATER SERVICE
—E—E— = UNDERGROUND
(W) = WATER GATE
(32) - - - = EXIST'G CONTOUR
(42) —•—•— = PROPOSED CONTOUR
TH #1 = TEST HOLE LOCATION
X 35.19 = EXISTING SPOT ELEVATION
B.S.L. = BUILDING SETBACK

GENERAL NOTES:

1.) ALL SYSTEM COMPONENTS SHALL BE INSTALLED IN ACCORDANCE W/ TITLE 5 OF THE SANITARY CODE & ANY APPLICABLE REGULATIONS.
2.) PRIOR TO BACKFILLING THE INSTALLATION, THE ENGINEER & HEALTH AGENT SHALL BE NOTIFIED FOR INSPECTION.
3.) ANY ALTERATIONS TO THIS DESIGN MUST BE APPROVED BY THE ENGINEER & BOARD OF HEALTH, IN WRITING.
4.) ALL LINES SHALL BE 4" DIA. SCH. 40 PVC PIPE PITCHED 0.010'/FT. MINIMUM, EXCEPT AS NOTED.
5.) ANY/ALL UNDERGROUND UTILITIES ARE TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO SYSTEM INSTALLATION. (CONTACT DIG SAFE)
6.) ALL UNSUITABLE MATERIAL WITHIN 5 FT. IN ALL DIRECTIONS FROM THE SOIL ABSORPTION SYSTEM SHALL BE REMOVED & REPLACED W/CLEAN, COARSE WASHED SAND.
7.) ALL FILL MATERIAL UTILIZED FOR THE SOIL ABSORPTION SYSTEM SHALL BE CLEAN, COARSE, WASHED SAND FREE FROM DELETERIOUS MATERIAL & SHALL HAVE A PERC. RATE OF LESS THAN 2 MIN./IN. BEFORE & AFTER PLACEMENT.
8.) ALL FILL SERVICING THE SOIL ABSORPTION SYSTEM SHALL BE PROPERLY PLACED & COMPACTED TO MINIMIZE SETTLEMENT.
9.) FINISH GRADES SHALL COMPLY W/MINIMUM COVER & SLOPE SETBACK REQUIREMENTS OF TITLE 5.
10.) DURING INSTALLATION, THE CONTRACTOR IS RESPONSIBLE TO PROVIDE

B #2022-113

HEALTH DEPARTMENT
TOWN OF TRURO
FEB 1 6 2022
RECEIVED BY

Town of Truro

Board of Health

24 Town Hall Road, P.O. Box 2030, Truro, MA 02666
Tel: 508-349-7004, Extension: 131 Fax: 508-349-5508
Email: ebeebe@truro-ma.gov or adavis@truro-ma.gov

APPLICATION FOR FOOD SERVICE – COMMON VICTUALER

☑ New ☐ Renewal

Section 1 – License Type

Type of License: ☐ **Food Service** ☑ **Common Victualer**

Type of Food Service Establishment:

- ☑ Food Service (restaurant or take out)
- ☑ Retail Food (commercially prepared foods)
- ☐ Residential Kitchen
- ☐ Bed & Breakfast w/Continental Breakfast
- ☑ Catering #2022-113A
- ☐ Manufacturer of Ice Cream/Frozen Dessert
- ☑ Bakery #2022-113B

Section 2 – Business/Owner/Manger Information

Federal Employers Identification Number (FEIN/SS) [redacted]

Business Name: SAlty MARKET Farmstand

Owner Name: Liam **Email Address:** [redacted]

Mailing Address: 25 way 112 Wellfleet, MA 02667

Phone No: 774-722-5427

Person Directly Responsible for Daily Operations: (Owner, Person In Charge, Supervisor, Manager)

Name: Liam SAME **Email Address:** Chefliam@gmail.com

Mailing Address: 25 way 112 Weyllfleet

Phone No: [redacted] **24 Hour Emergency:** ______

Section 3 – Business Operation Details

Number of Seats: Inside: 0 Outside: ? Number of Employees: 4-6 *

Length of Permit: ☑ **Annual** ☐ **Seasonal Operation**

Hours of Operation: 8 To 6pm

Days Closed Excluding Holidays: Mon & tuesday except July & august

N/A **If Seasonal: Approximate Dates of Operation:** __/__/__ To __/__/__

Rev 9/17

Open April 15th (Hopefully)

Certified Food Manager(s) (attach copy): (at least 1 full-time equivalent PER SHIFT required)

_______________ _______________ _______________

Allergen Awareness Certification (attach copy):

_______________ _______________ _______________

Has your menu changed from last year? ☐ **Yes** ☐ **No**

If yes please attach copy of menu or provide description of food to be prepared and sold:

____

____

Section 4 - Attestation

Attestation

I, the undersigned, attest to the accuracy of the information provided in this application and further agree to allow the regulatory authority access to the food service establishment as specified under § 8-402.11. I affirm that the food establishment operation will comply with 105 CMR 590.000, Truro Board of Health Regulation Section X, Food Service Regulations and all other applicable laws. Pursuant to MGL Ch. 62C § 49A, I certify under the penalties of perjury that I, to my best knowledge and belief, have filed all state tax returns and paid state and local taxes required by law.

Signature of Applicant: [signature] **Date:** Feb / 25th

****

Application Checklist:

☐ **Food Service Permit Application**

☐ **Smoke Detector/Fire Protection Certification**

☐ **Workers Compensation Affidavit/Certificate of Insurance**

☐ **Copy of Inspection of Kitchen Equipment: Commercial Hood and Ventilation System Report**

☐ **Copy of Service report of mechanical washing equipment (Dishwasher)**

☐ **Copy of ServSafe Certification and Allergy Awareness**

☐ **Copy of Choke Saver (for food service establishment w/seating capacity of 25 or more)**

FOR HEALTH DEPARTMENT USE ONLY

Comments: ____

____

Review by Date

#2022-113

TOWN OF TRURO
BOARD OF HEALTH
PO Box 2030, Truro MA 02666
P: 508-349-7004 x 131 F: 508-349-5508

APPLICATION FOR PERMIT TO SELL TOBACCO AND TOBACCO PRODUCTS

Renewal ☐ New ☑ Fees due upon approval: **$50.00 total**

In accordance with MGL c.111, Section 31, and Section XI, of the Truro Board of Health Tobacco Control Regulations, the undersigned makes application to the Board of Health or approving authority for permission to sell tobacco and tobacco products.

Applicant Information:

Salty Market Foodstand, Inc. — 02/11/2022
Establishment Name — Date

Salty Market Foodstand — 03/07/2022
Establishment Address — Phone

2 Highland Road, North Truro
Establishment Mailing Address (if different)

MA Department of Revenue Retailer's License Number: [redacted] (Required)

Applicant's Name Liam Rowland Title Owner & Manager

Applicant's Address 25 Way 112, Wellfleet, MA 02667

Certification

I certify that the information I have provided is true and accurate. I fully understand that granting of the annual Tobacco Sales Permit is contingent upon my adherence to all applicable State laws and local regulations governing the sale and distribution of tobacco products. Failure to comply may result in the suspension or revocation of my annual permit to operate and any other legal action deemed appropriate by the Town of Truro.

[signature] — 02/11/2022
Signature of Applicant — **Date**

BOTH SIDES OF THIS APPLICATION MUST BE COMPLETED BEFORE A PERMIT WILL BE ISSUED.

TOWN OF TRURO
TOBACCO SALES
EMPLOYEE SIGNATURE FORM

This form is for official use to indicate that the employee(s) of this establishment received and understood Section XI, Article 5 and 6 of the Truro Board of Health Sale and Distribution of Tobacco Products Regulation (below) and the enclosed copy of Chapter 270, Section 6 of the Massachusetts General Laws which describes the penalties for selling and/or giving tobacco products to any person under the age of eighteen (18).

SECTION 8 – SALE AND DISTRIBUTION OF TOBACCO PRODUCTS
B. Sales to Minors: In conformance with Massachusetts General Laws, Chapter 270, Section 6, no person, firm, corporation, establishment, or agency, shall sell tobacco products to a minor. Each employee working in an establishment licensed to sell tobacco products shall be required to read the Board of Health regulations and State Laws regarding the sale of tobacco and top sign a form indicating that such regulations/laws have been read and understood, a copy of which must be placed in the office of the employer and retained. Such signed forms must be made available for inspection, during the license holder's normal business hours upon request of an agent of the Board of Health. **C. Distribution of Tobacco Products:** All distributors/retailers of tobacco products or tobacco merchandise must require that, if a customer appears possibly to be under 27 years of age, the customer must present a valid State issued picture identification card or driver's license with appropriate photograph to confirm that the customer is of a legal age to purchase the tobacco product.

The following employee(s) received and understood Section XI, Article 5 and 6 of the Truro Board of Health Sale and Distribution of Tobacco Products Regulation and Chapter 270, Section 6 of the Massachusetts General Laws:

SIGNATURE	PRINT NAME	DATE
[signature]	Liam Rowland	02/11/22

Lynne Budnick

From: Liam luttrell-rowland <chefliam@gmail.com>
Sent: Wednesday, February 16, 2022 11:21 AM
To: Lynne Budnick
Subject: Fwd: Menu for Salty
Attachments: Menu Selection for Salty Market .docx

Thanks Lynne !

Here is sample of our menus .

Cheers
L

HEALTH DEPARTMENT
TOWN OF TRURO
FEB 16 2022
RECEIVED BY

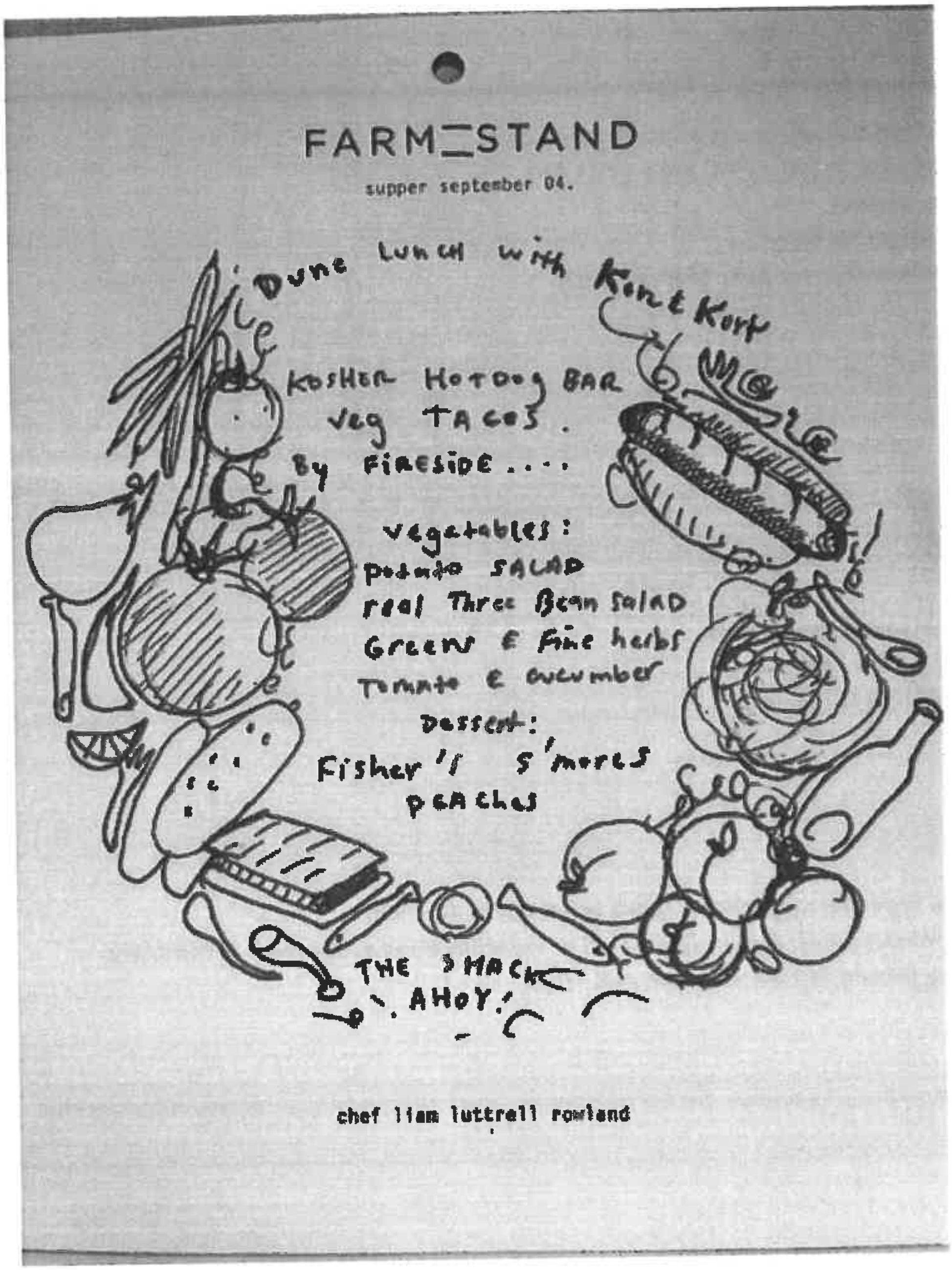
From: Liam luttrell-rowland <chefliam@gmail.com>
Date: February 4, 2022 at 12:02:44 PM EST
To: Robin Reid <robin@robinbreidesq.com>
Subject: Menu for Salty

Hey Robin

Here is a quick view of the menu type and upgrade for quick serve am and Lunch.
I am also attaching Farm Stand Menus which is my supper club or catering service. We cook at the Mary Heaton Vorce and many amazing private homes in Ptown and Truro.

Thanks Liam

CAUTION: This email originated from outside of the organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.


FARM STAND
supper september 04.
Dune Lunch with Kent Kerr
KOSHER HOTDOG BAR
veg TACOS.
By FIRESIDE....
vegetables:
potato SALAD
real Three Bean salad
Greens & Fine herbs
Tomato & cucumber
Dessert:
Fisher's s'mores
peaches
THE SHACK
AHOY!
chef liam luttrell rowland

BREAKFAST

served daily until 11am

EGG & CHEDDAR $4
BACON, EGG & CHEDDAR $5.5
SAUSAGE, EGG & CHEDDAR $5.5
HAM, EGG & CHEDDAR $5.5
AVOCADO, EGG & CHEDDAR $5.5

BREAD: multigrain or sourdough toast, bulkie roll
house-made buttermilk or jalapeno-cheddar biscuit +$1
house-made bagel +$1
gluten free bread +$1, saladized +$2

ADD-ONS: arugula, tomato, onion, pepper relish, spicy mayo +$0
avocado or extra meat +$1.5
extra cheese +$1

BREAKFAST GRAIN BOWL $6
quinoa with onion, chickpeas, arugula, fried egg
seasonal veggies, yogurt sauce
(add: cheese +$1, avocado or meat +$1.5)

TOAST AND JAM $3.25
buttered, toasted sourdough, mixed berry jam

AVOCADO TOAST $4.5
multigrain, avocado, everything bagel seasoning

BAGEL AND CREAM CHEESE $4
toasted house bagel, plain or scallion cream cheese
(add lox +$6)

SAUSAGE BISCUIT $4
grilled buttermilk or jalapeno cheddar biscuit
with breakfast sausage patty

THE SENATOR $6.99
fried egg, cheddar, ham, avocado,
arugula, spicy mayo,
on jalapno-cheddar biscuit

THE BOSSLADY $6.99
fried egg, cheddar, bacon,
Cuddy Provisions garlic chili crisp cream cheese
on a house made bagel

THE SIBERIAN $10
scallion cream cheese, lox,
tomato, cucumber, dill, on a house bagel

THE GENERAL $6.99
fried egg, cheddar, sausage, arugula,
pepper relish, on house everything bagel

THE BLT·E $6.99
fried egg, cheddar, bacon, lettuce, tomato,
spicy mayo, on bulky roll

THE NO EGG BREAKY $5.5
mashed avocado, seasonal roasted vegetables,
arugula, hot sauce, on sourdough (vegan)

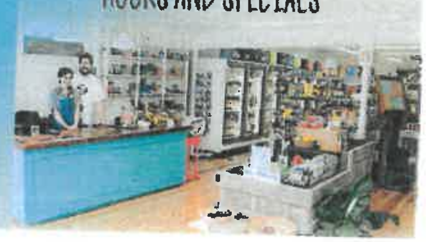
2 HIGHLAND ROAD, NORTH TRURO, MA
508-487-0711

SALTY MARKET NORTH TRURO

LOCAL STORE

SANDWICHES
GROCERIES
LIQUOR

VISIT WWW.THESALTYMARKET.COM FOR HOURS AND SPECIALS



Salty Market Farmstand

- We will offer similar sandwich & quick serve Bagel and egg sandwich along with a lunch of classic soups and sandwiches like Pastrami on Rye, Corned Beef and the Italian.

- Regionally sourced meats including organic slow cooked meats Like rotisserie chickens and brisket

- Charcuterie Boards and house made Snacks for Entertaining to accompany the stores wine tastings

- Fresh Salads & Juice shared with theme of the store:
  A farm stand or fruit stand

HEALTH DEPARTMENT
TOWN OF TRURO

FEB 16 2022

RECEIVED BY:

360 TRAINING™ LEARN 2 SERVE™

HEALTH DEPARTMENT
TOWN OF TRURO
FEB 16 2022
RECEIVED BY

CERTIFICATE OF COMPLETION

This certifies that

Liam Rowland

is awarded this certificate for

Learn2Serve Food Allergy Training Course

Hours	Completion Date	Expiration Date	Certificate #
2.00	02/11/2022	02/10/2025	ANSI-FA-001110

Official Signature

ANAB
ANSI National Accreditation Board
ACCREDITED
ANSI/ASTM E2659
CERTIFICATE ISSUER
#0975

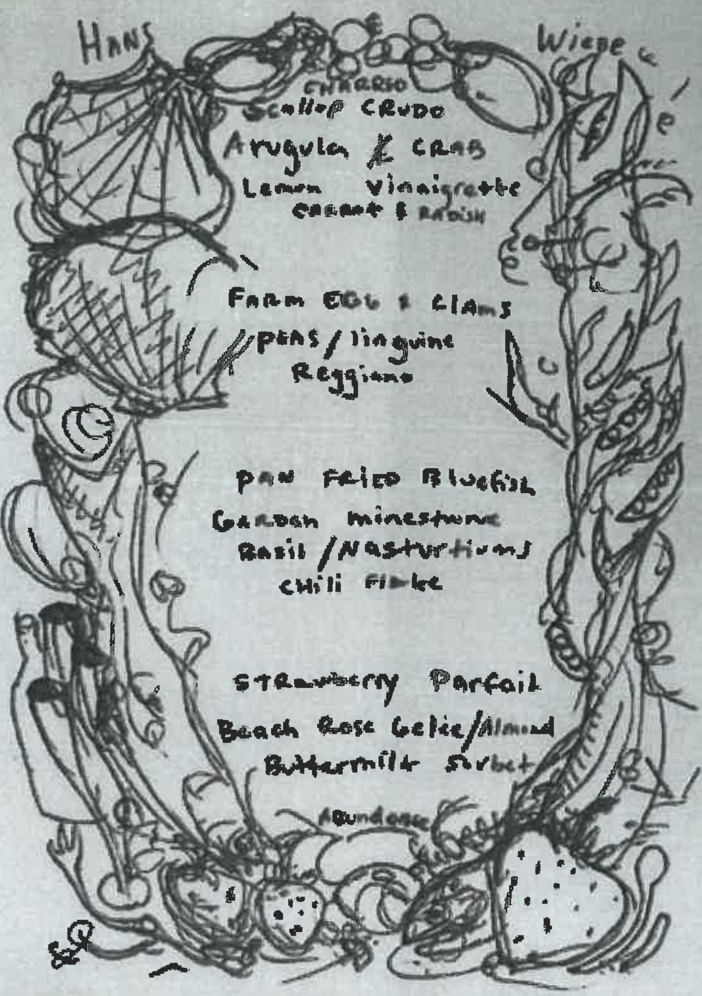
THIS CERTIFICATE IS NON-TRANSFERABLE

For employer verification of certificate validity, please send your request to FoodHandlerProgramAdmin@360training.com

5000 Plaza on the Lake, Suite 305 | Austin, TX 78746 | 877.881.2235 | www.360training.com

FARM=STAND

supper june 18.

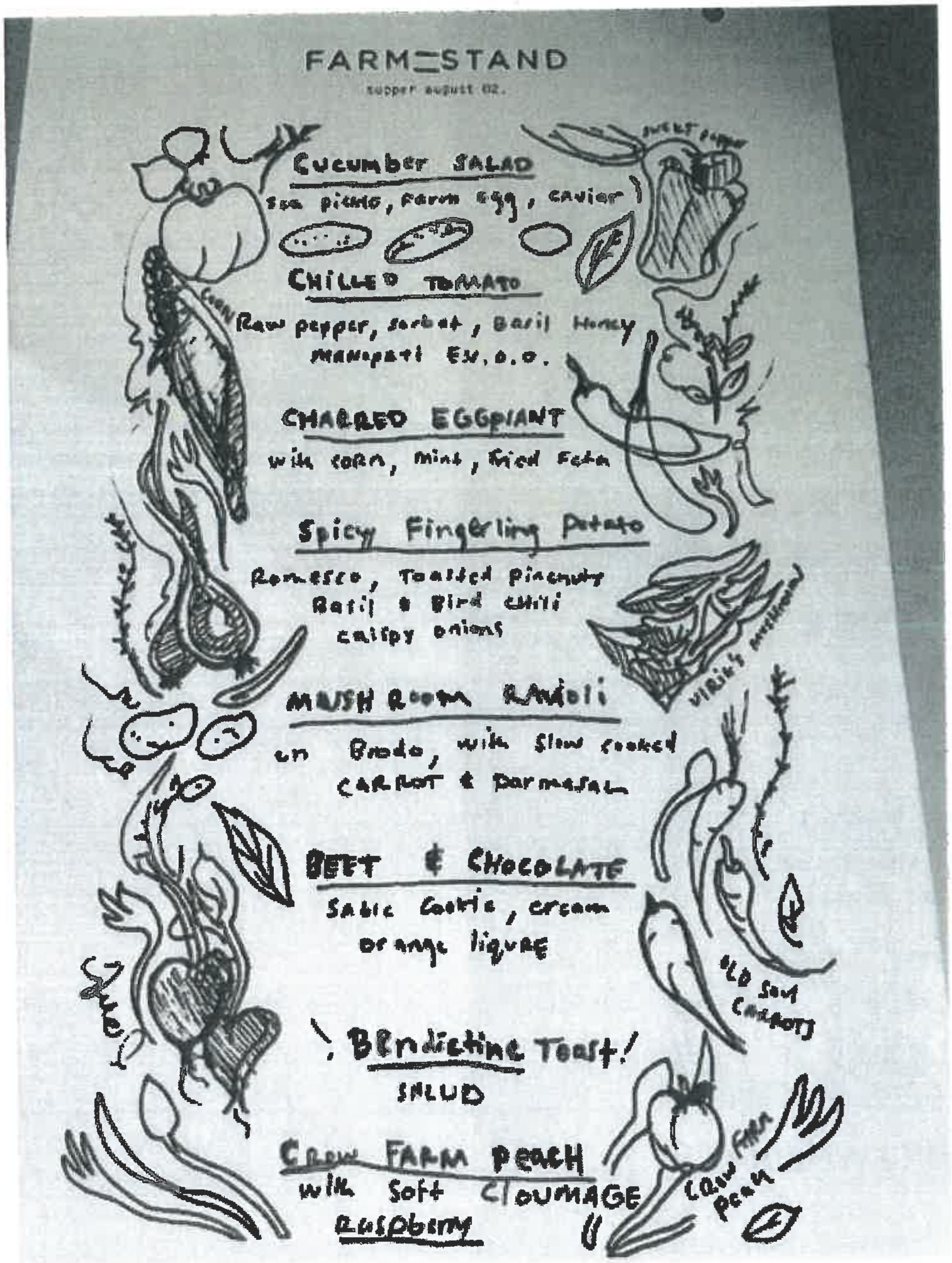


chefs liam luttrell rowland & raina stefani

HEALTH DEPARTMENT
TOWN OF TRURO

FEB 16 2022

RECEIVED BY


FARM=STAND
supper august 02.
Cucumber SALAD
Farm egg, caviar
CHILLED TOMATO
Raw pepper, sorbet, Basil Honey
CHARRED EGGPLANT
with corn, mint, fried Feta
Spicy Fingerling Potato
Romesco, Toasted pinenuts
Basil & Bird chili
crispy onions
MUSHROOM RAVIOLI
in Brodo, with slow cooked
CARROT & parmesan
BEET & CHOCOLATE
Sable Cookie, cream
orange liqure
! Benedictine Toast!
SALUD
Crow FARM PEACH
with Soft CLOUMAGE
Raspberry
Old Soul Carrots
Crow Farm Peach

ServSafe

ServSafe® CERTIFICATION

DAVID LUTTRELL-ROWLAND

For successfully completing the standards set forth for the ServSafe® Food Protection Manager Certification Examination, which is accredited by the American National Standards Institute (ANSI)-Conference for Food Protection (CFP).

15227966	10551
[illegible] NUMBER	EXAM FORM NUMBER
6/15/20[illegible]	6/15/2022
DATE OF EXAMINATION	DATE OF EXPIRATION

Local laws apply. Check with your [illegible] agency for recertification requirements.

[illegible]

HEALTH DEPART[illegible]
TOWN OF TRUR[illegible]

FEB 16 2022

RECEIVED BY

[illegible]

TOWN OF TRURO

Health Department
P.O. Box 2030, Truro, MA 02666
PH: 508-349-7004, Ext. 131 Fax: 508-349-5508
Email: ebeebe@truro-ma.gov or adavis@truro-ma.gov

HEALTH DEPARTMENT
TOWN OF TRURO
MAR 03 2022
RECEIVED BY:

APPLICATION TO NAME A MANAGER

This application is used for a Change of Manager, Add Co-Managers or to Name a Property Management Company as Manager with the Board of Health

Section 1 – Business Information

Date: 3/2/22

Print Name of Applicant: Laurie Ferrari - Peters Property Management

Business Name of DBA to be managed: Ocean Breeze Condominium Number of Units: 10

Street Address of Business: 566 Shore Road Business Email: info@petersproperty mgt.com

Mailing Address of Business: (☑ Check if New Address) PO Box 542, Provincetown, MA 02657

Section 2 – Manager Information

Name of Previous Manager: RKM On-Site Manager Unit #: _____

Name of New Onsite Manager: _____ On-Site Manager Unit #: _____

Name of Property Management (10 Units or less): Peters Property Management

Mailing Address of New Manager and/or Property Management Company: PO Box 542 Provincetown MA 02657 Phone (24 hours/day): 508-487-0399 Email: [redacted]

Name of Co-Managers:

Name	Unit #	Phone (24hrs/day)

I have read & understand the Board of Health Manager Regulation, Section III, Article 4. Signature of New Manager, Co-Managers or Contact Person for Property Management is required.

SIGNATURE	PRINT NAME	DATE
Laurie Ferrari (signature)	Laurie Ferrari	3/2/22

Section 3 - **Office Use Only**

	Scheduled	Date	Fee	Paid
Team Inspection *(If over 3yrs since last one)*	☒	/	~~$45.00~~	☐
Board of Health Hearing	☑	3/15/22		

Owes $75.00

TOWN OF TRURO

Health Department
P.O. Box 2030, Truro, MA 02666
PH: 508-349-7004, Ext. 131 Fax: 508-349-5508
Email: ebeebe@truro-ma.gov or adavis@truro-ma.gov

PAID P8138
HEALTH DEPARTMENT
TOWN OF TRURO
MAR 0 8 2022
RECEIVED BY:

APPLICATION TO NAME A MANAGER

This application is used for a Change of Manager, Add Co-Managers or to Name a Property Management Company as Manager with the Board of Health

Section 1 – Business Information

Date: 3/1/2022

Print Name of Applicant: PETER BUNTING

Business Name or DBA to be managed: BAYVIEW COTTAGES Number of Units: 10

Street Address of Business: 658 SHORE RD Business Email: [redacted]

Mailing Address of Business: (☐ Check if New Address) P.O. BOX 513, N. TRURO 02652

Section 2 – Manager Information

Name of Previous Manager: DAVID GARRETT On-Site Manager Unit #: 1

Name of New Onsite Manager: NORMAN TOURVILLE On-Site Manager Unit #: 1

Name of Property Management (10 Units or less): N/A

Mailing Address of New Manager and/or Property Management Company: SAME AS ABOVE

Phone (24 hours/day): [redacted] Email: [redacted]

Name of Co-Managers:

Name	Unit #	Phone (24hrs/day)
N/A		

I have read & understand the Board of Health Manager Regulation, Section III, Article 4. Signature of New Manager, Co-Managers or Contact Person for Property Management is required.

SIGNATURE	PRINT NAME	DATE
* [signature]	Norman Tourville	03-7-22

Section 3 - **Office Use Only**

	Scheduled	Date	Fee	Paid
Team Inspection *(If over 3yrs since last one)*	☐		$45.00	☐
Board of Health Hearing	☑	3/15/22		

residence or nonresidential establishment. Multiplying the typical flow estimated (140 gallons/day) by a safety factor of 2 yields a design flow of 280 gallons/day (1,058 liters/day). Factors of safety used for individual systems will usually be higher than those used for larger systems of 10 homes or more.

Great care should be exercised in predicting wastewater characteristics so as not to accumulate multiple factors of safety that would yield unreasonably high design flows and result in unduly high capital costs. Conversely, underestimating flows should be avoided because the error will quickly become apparent if the system overloads and requires costly modification.

3.6 Integrating wastewater characterization and other design information

Predicting wastewater characteristics for typical residential and nonresidential establishments can be a difficult task. Following a logical step-by-step procedure can help simplify the characterization process and yield more accurate wastewater characteristic estimates. Figure 3-7 is a flow chart that illustrates a procedure for predicting wastewater characteristics. This strategy takes the reader through the characterization process as it has been described in this chapter. The reader is cautioned that this flowchart is provided to illustrate one simple strategy for predicting wastewater characteristics. Additional factors to consider, such as discrepancies between literature values for wastewater flow and quality and/or the need to perform field studies, should be addressed based on local conditions and regulatory requirements.

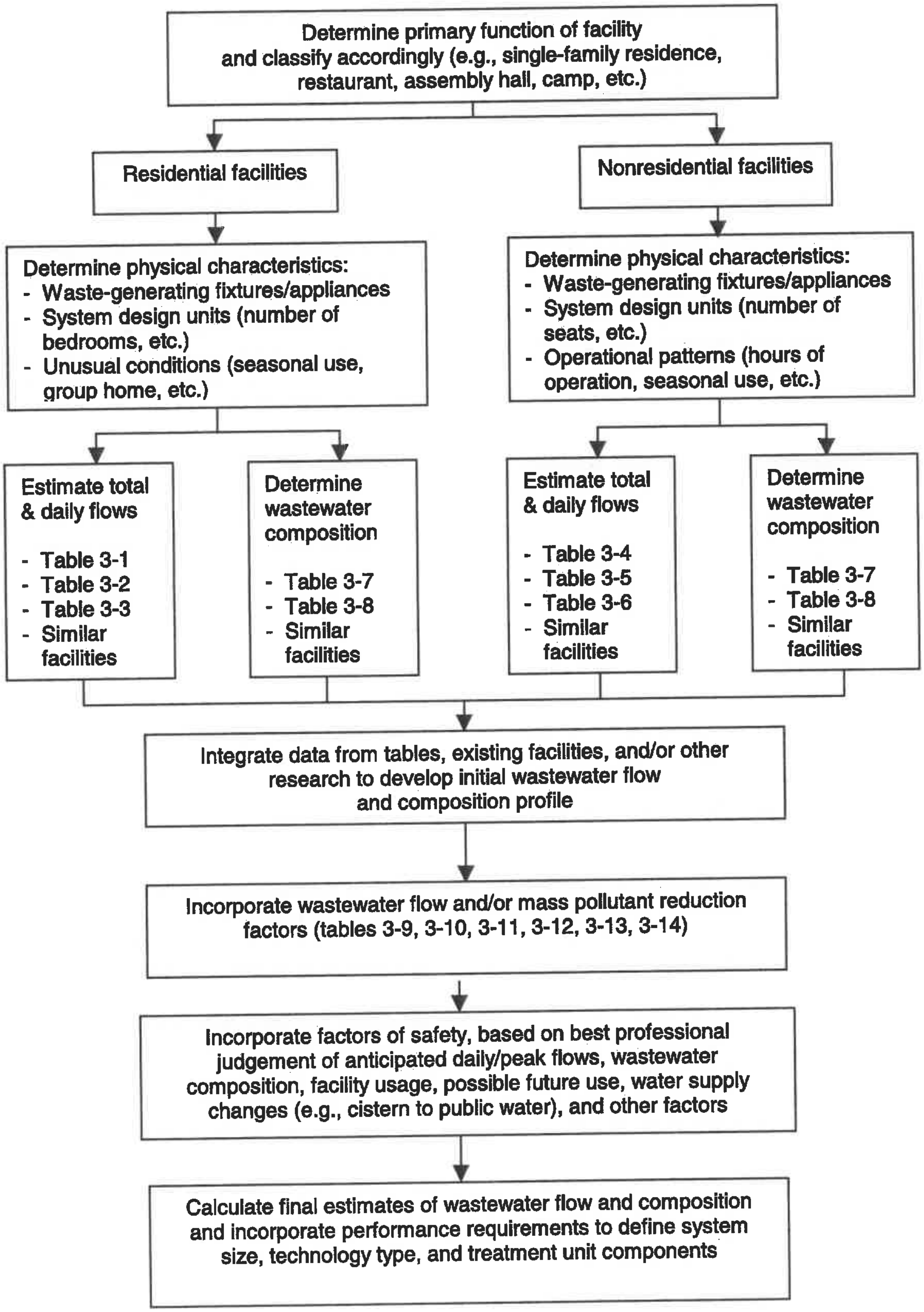
In designing wastewater treatment systems, it is recommended that designers consider the most significant or limiting parameters, including those that may be characterized as outliers, when considering hydraulic and mass pollutant treatment requirements and system components. For example, systems that will treat wastewaters with typical mass pollutant loads but hydraulic loads that exceed typical values should be designed to handle the extra hydraulic input. Systems designed for facilities with typical hydraulic loads but atypical mass pollutant loads (e.g., restaurants, grocery stores, or other facilities with high-strength wastes) should incorporate pretreatment units that address the additional pollutant loadings, such as grease traps.

3.7 Transport and fate of wastewater pollutants in the receiving environment

Nitrate, phosphorus, pathogens, and other contaminants are present in significant concentrations in most wastewaters treated by onsite systems. Although most can be removed to acceptable levels under optimal system operational and performance conditions, some may remain in the effluent exiting the system. After treatment and percolation of the wastewater through the infiltrative surface biomat and passage through the first few inches of soil, the wastewater plume begins to migrate downward until nearly saturated conditions exist. The worst case scenario occurs when the plume is mixing with an elevated water table. At that point, the wastewater plume will move in response to the prevailing hydraulic gradient, which might be lateral, vertical, or even a short distance upslope if ground water mounding occurs (figure 3-8). Moisture potential, soil conductivity, and other soil and geological characteristics determine the direction of flow.

Further treatment occurs as the plume passes through the soil. The degree of this additional treatment depends on a host of factors (e.g., residence time, soil mineralogy, particle sizes). Permit writers should consider not only the performance of each individual onsite system but also the density of area systems and overall hydraulic loading, the proximity of water resources, and the collective performance of onsite systems in the watershed. Failure to address these issues can lead ultimately to contamination of lakes, rivers, streams, wetlands, coastal areas, or ground water. This section examines key wastewater pollutants, their impact on human health and water resources, how they move in the environment, and how local ecological conditions affect wastewater treatment.

Figure 3-7. Strategy for estimating wastewater flow and composition



3.7.1 Wastewater pollutants of concern

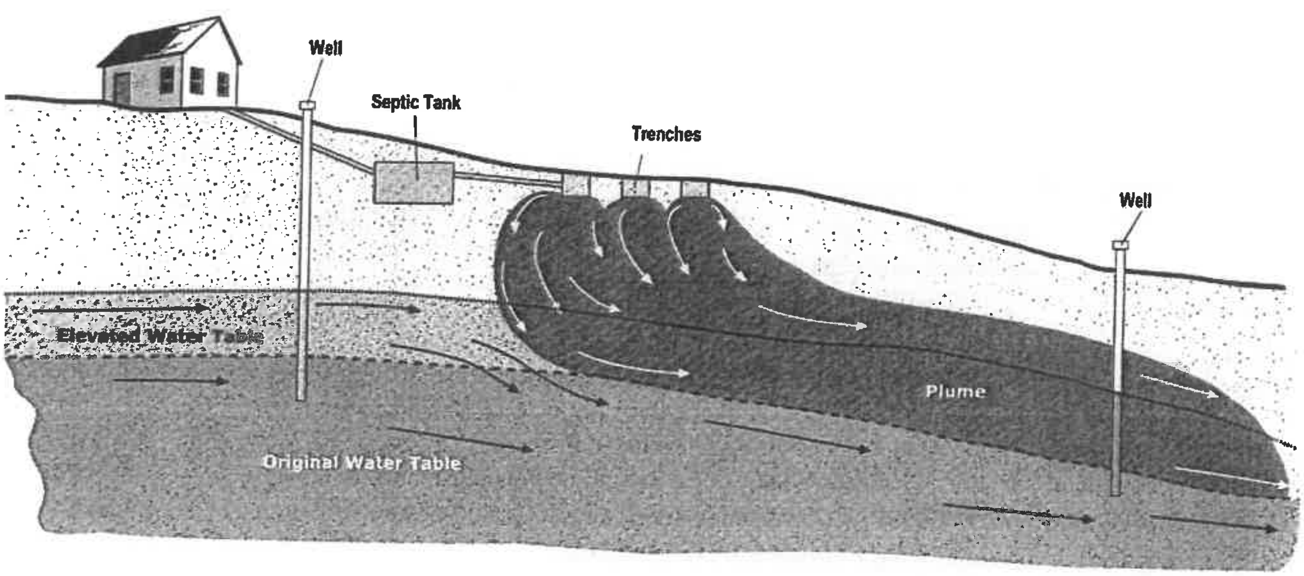
Environmental protection and public health agencies are becoming increasingly concerned about ground water and surface water contamination from wastewater pollutants. Toxic compounds, excessive nutrients, and pathogenic agents are among the potential impacts on the environment from onsite wastewater systems. Domestic wastewater contains several pollutants that could cause significant human health or environmental risks if not treated effectively before being released to the receiving environment.

A conventional OWTS (septic tank and SWIS) is capable of nearly complete removal of suspended solids, biodegradable organic compounds, and fecal coliforms if properly designed, sited, installed, operated, and maintained (USEPA, 1980a, 1997). These wastewater constituents can become pollutants in ground water or surface waters if treatment is incomplete. Research and monitoring studies have demonstrated removals of these typically found constituents to acceptable levels. More recently, however, other pollutants present in wastewater are raising concerns, including nutrients (e.g., nitrogen and phosphorus), pathogenic parasites (e.g., *Cryptosporidum parvum, Giardia lamblia*), bacteria and viruses, toxic organic compounds, and metals. Their potential impacts on ground water and surface water resources are summarized in table 3-16. Recently, concerns have been raised over the movement and fate of a variety of endocrine disrupters, usually from use of pharmaceuticals by residents. No data have been developed to confirm a risk at this time.

3.7.2 Fate and transport of pollutants in the environment

When properly designed, sited, constructed, and maintained, conventional onsite wastewater treatment technologies effectively reduce or eliminate most human health or environmental threats posed by pollutants in wastewater (table 3-17). Most traditional systems rely primarily on physical, biological, and chemical processes in the septic tank and in the biomat and unsaturated soil zone below the SWIS (commonly referred to as a leach field or drain field) to sequester or attenuate pollutants of concern. Where point discharges to surface waters are permitted, pollutants of concern should be removed or treated to acceptable, permit-specific levels (levels permitted under the National Pollutant Discharge Elimination System of the Clean Water Act) before discharge.

Figure 3-8. Plume movement through the soil to the saturated zone.



Source: Adapted from NSFC, 2000.

Table 3-16. Typical wastewater pollutants of concern

Pollutant	Reason for concern
Total suspended solids (TSS) and turbidity (NTU)	In surface waters, suspended solids can result in the development of sludge deposits that smother benthic macroinvertebrates and fish eggs and can contribute to benthic enrichment, toxicity, and sediment oxygen demand. Excessive turbidity (colloidal solids that interfere with light penetration) can block sunlight, harm aquatic life (e.g., by blocking sunlight needed by plants), and lower the ability of aquatic plants to increase dissolved oxygen in the water column. In drinking water, turbidity is aesthetically displeasing and interferes with disinfection.
Biodegradable organics (BOD)	Biological stabilization of organics in the water column can deplete dissolved oxygen in surface waters, creating anoxic conditions harmful to aquatic life. Oxygen-reducing conditions can also result in taste and odor problems in drinking water.
Pathogens	Parasites, bacteria, and viruses can cause communicable diseases through direct/indirect body contact or ingestion of contaminated water or shellfish. A particular threat occurs when partially treated sewage pools on ground surfaces or migrates to recreational waters. Transport distances of some pathogens (e.g., viruses and bacteria) in ground water or surface waters can be significant.
Nitrogen	Nitrogen is an aquatic plant nutrient that can contribute to eutrophication and dissolved oxygen loss in surface waters, especially in lakes, estuaries, and coastal embayments. Algae and aquatic weeds can contribute trihalomethane (THM) precursors to the water column that may generate carcinogenic THMs in chlorinated drinking water. Excessive nitrate-nitrogen in drinking water can cause methemoglobinemia in infants and pregnancy complications for women. Livestock can also suffer health impacts from drinking water high in nitrogen.
Phosphorus	Phosphorus is an aquatic plant nutrient that can contribute to eutrophication of inland and coastal surface waters and reduction of dissolved oxygen.
Toxic organics	Toxic organic compounds present in household chemicals and cleaning agents can interfere with certain biological processes in alternative OWTSs. They can be persistent in ground water and contaminate downgradient sources of drinking water. They can also cause damage to surface water ecosystems and human health through ingestion of contaminated aquatic organisms (e.g., fish, shellfish).
Heavy metals	Heavy metals like lead and mercury in drinking water can cause human health problems. In the aquatic ecosystem, they can also be toxic to aquatic life and accumulate in fish and shellfish that might be consumed by humans.
Dissolved inorganics	Chloride and sulfide can cause taste and odor problems in drinking water. Boron, sodium, chlorides, sulfate, and other solutes may limit treated wastewater reuse options (e.g., irrigation). Sodium and to a lesser extent potassium can be deleterious to soil structure and SWIS performance.

Source: Adapted in part from Tchobanoglous and Burton, 1991.

Table3-17. Examples of soil infiltration system performance

Parameter	Applied concentration in milligrams per liter	Percent removal	References
BOD_5	130–150	90–98	Siegrist et al., 1986 U. Wisconsin,1978
Total nitrogen	45–55	10–40	Reneau 1977 Sikora et al., 1976
Total phosphorus	8–12	85–95	Sikora et al., 1976
Fecal coliforms	NA[a]	99–99.99	Gerba, 1975

[a] Fecal coliforms are typically measured in other units, e.g., colony-forming units per 100 milliliters.

Source: Adapted from USEPA, 1992.

Onsite systems can fail to meet human health and water quality objectives when fate and transport of potential pollutants are not properly addressed. Failing or failed systems threaten human health if pollutants migrate into ground waters used as drinking water and nearby surface waters used for recreation. Such failures can be due to improper siting, inappropriate choice of technology, faulty design, poor installation practices, poor operation, or inadequate maintenance. For example, in high-density subdivisions conventional septic tank/SWIS systems might be an inappropriate choice of technology because leaching of nitrate-nitrogen could result in nitrate concentrations in local aquifers that exceed the drinking water standard. In soils with excessive permeability or shallow water tables, inadequate treatment in the unsaturated soil zone might allow pathogenic bacteria and viruses to enter the ground water if no mitigating measures are taken. Poorly drained soils can restrict reoxygenation of the subsoil and result in clogging of the infiltrative surface.

A number of factors influence the shape and movement of contaminant plumes from OWTSs. Climate, soils, slopes, landscape position, geology, regional hydrology, and hydraulic load determine whether the plume will disperse broadly and deeply or, more commonly, migrate in a long and relatively narrow plume along the upper surface of a confining layer or on the surface of the ground water. Analyses of these factors are key elements in understanding the contamination potential of individual or clustered OWTSs in a watershed or ground water recharge area.

Receiving environments and contaminant plume transport

Most onsite systems ultimately discharge treated water to ground water. Water beneath the land surface occurs in two primary zones, the aerated or vadose zone and the saturated (groundwater) zone. Interstices in the aerated (upper) vadose zone are unsaturated, filled partially with water and partially with air. Water in this unsaturated zone is referred to as vadose water. In the saturated zone, all interstices are filled with water under hydrostatic pressure. Water in this zone is commonly referred to as ground water. Where no overlying impermeable barrier exists, the upper surface of the ground water is called the water table. Saturation extends slightly above the water table due to capillary attraction but water in this "capillary fringe" zone is held at less than atmospheric pressure.

Onsite wastewater treatment system performance should be measured by the ability of the system to discharge a treated effluent capable of meeting public health and water quality objectives established for the receiving water resource. Discharges from existing onsite systems are predominantly to ground water but they might involve direct (point source) or indirect (nonpoint source) surface water discharges in some cases. Ground water discharges usually occur through soil infiltration. Point source discharges are often discouraged by regulatory agencies because of the difficulty in regulating many small direct, permitted discharges and the potential for direct or indirect human contact with wastewater. Nonpoint source surface water discharges usually occur as base flow from ground water into watershed surface waters. In some cases regional ground water quality and drinking water wells might be at a lesser risk from OWTS discharges than nearby surface waters because of the depth of some aquifers and regional geology.

The movement of subsurface aqueous contaminant plumes is highly dependent on soil type, soil layering, underlying geology, topography, and rainfall. Some onsite system setback/separation codes are based on plume movement models or measured relationships that have not been supported by recent field data. In regions with moderate to heavy rainfall, effluent plumes descend relatively intact as the water table is recharged from above. The shape of the plume depends on the soil and geological factors noted above, the uniformity of effluent distribution in the SWIS, the orientation of the SWIS with respect to ground water flow and direction, and the preferential flow that occurs in the vadose and saturated zones (Otis, 2000).

In general, however, plumes tend to be long, narrow, and definable, exhibiting little dispersion (figure 3-9). Some studies have found SWIS plumes with nitrate levels exceeding drinking water standards (10 mg/L) extending more than 328 feet (100 meters) beyond the SWIS (Robertson, 1995). Mean effluent plume dispersion values used in a Florida study to assess subdivision SWIS nitrate loadings over 5 years were 60 feet, 15 feet, and 1.2 feet for longitudinal, lateral, and vertical disper-

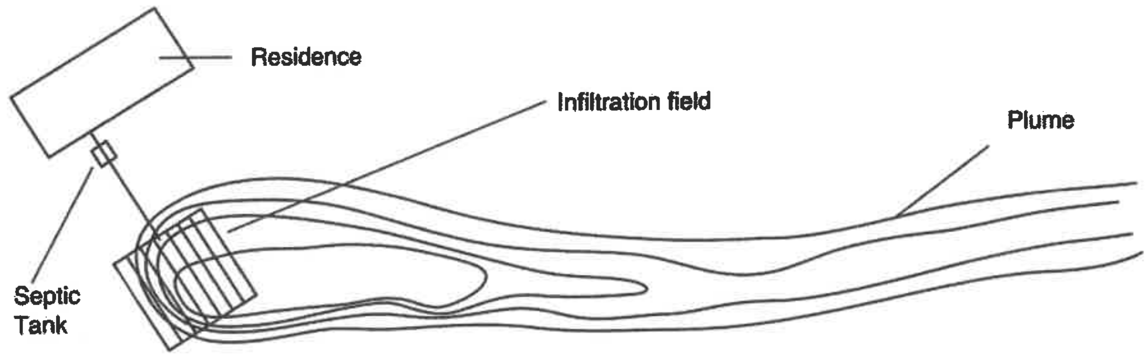


Figure 3-9. An example of effluent plume movement

Source: [illegible] (Florida HRS, 1993). A study that examined SWIS plume movement in a shallow, unconfined sand aquifer found that after 12 years the plume had sharp lateral and vertical boundaries, a length of 426 feet (130 meters), and a uniform width of about 32.8 feet (10 meters) (Robertson, 1991). At another site examined in that study, a SWIS constructed in a similar carbonate-depleted sand aquifer generated a plume with discrete boundaries that began discharging into a river 65.6 feet (20 meters) away after 1.5 years of system operation.

Given the tendency of OWTS effluent plumes to remain relatively intact over long distances (more than 100 meters), dilution models commonly used in the past to calculate nitrate attenuation in the vadose zone are probably unrealistic (Robertson, 1995). State codes that specify 100-foot separation distances between conventional SWIS treatment units and downgradient wells or surface waters should not be expected to always protect these resources from dissolved, highly mobile contaminants such as nitrate (Robertson, 1991). Moreover, published data indicate that viruses that reach groundwater can travel at least 220 feet (67 meters) vertically and 1,338 feet (408 meters) laterally in some porous soils and still remain infective (Gerba, 1995). One study noted that fecal coliform bacteria moved 2 feet (0.6 meter) downward and 50 feet (15 meters) longitudinally 1 hour after being injected into a shallow trench in saturated soil on a 14 percent slope in western Oregon (Cogger, 1995). Contaminant plume movement on the surface of the saturated zone can be rapid, especially under sloping conditions, but it typically slows upon penetration into ground water in the saturated zone. Travel times and distances under unsaturated conditions in more level terrain are likely much less.

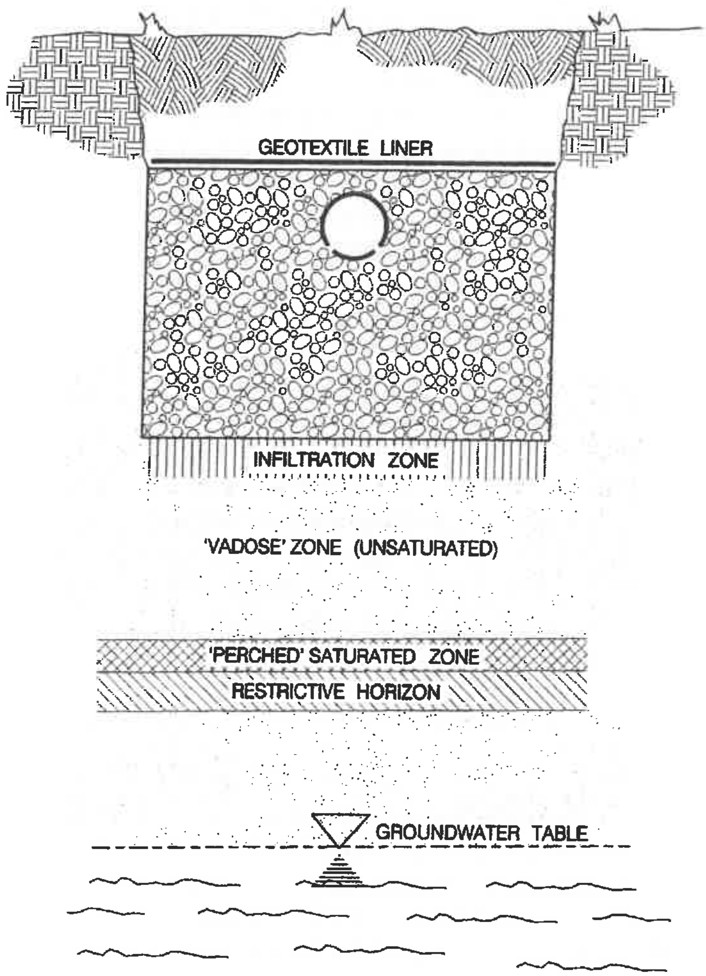
Ground water discharge

A conventional OWTS (septic tank and SWIS) discharges to ground water and usually relies on the unsaturated or vadose zone for final polishing of the wastewater before it enters the saturated zone. The septic tank provides primary treatment of the wastewater, removing most of the settleable solids, greases, oils, and other floatable matter and anaerobic liquifaction of the retained organic solids. The biomat that forms at the infiltrative surface and within the first few centimeters of unsaturated soil below the infiltrative field provides physical, chemical, and biological treatment of the SWIS effluent as it migrates toward the ground water.

Because of the excellent treatment the SWIS provides, it is a critical component of onsite systems that discharge to ground water. Fluid transport from the infiltrative surface typically occurs through three zones, as shown in figure 3-10 (Ayres Associates, 1993a). In addition to the three zones, the figure shows a saturated zone perched above a restrictive horizon, a site feature that often occurs.

Pretreated wastewater enters the SWIS at the surface of the infiltration zone. A biomat forms in this zone, which is usually only a few centimeters thick. Most of the physical, chemical, and biological treatment of the pretreated effluent occurs in this zone and in the vadose zone. Particulate matter in the effluent accumulates on the infiltration surface and within the pores of the soil matrix, providing a

Figure 3-10. Soil treatment zones



Source: Ayres Associates, 1993a.

source of carbon and nutrients to the active biomass. New biomass and its metabolic by-products accumulate in this zone. The accumulated biomass, particulate matter, and metabolic by-products reduce the porosity and the infiltration rate through them. Thus, the infiltration zone is a transitional zone where fluid flow changes from saturated to unsaturated flow. The biomat controls the rate at which the pretreated wastewater moves through the infiltration zone in coarse- to medium-textured soils, but it is less likely to control the flow through fine-textured silt and clay soils because they may be more restrictive to flow than the biomat.

Below the zone of infiltration lies the unsaturated or vadose zone. Here the effluent is under a negative pressure potential (less than atmospheric) resulting from the capillary and adsorptive forces of the soil matrix. Consequently, fluid flow occurs over the surfaces of soil particles and through finer pores of the soil while larger pores usually remain air-filled. This is the most critical fluid transport zone because the unsaturated soil allows air to diffuse into the open soil pores to supply oxygen to the microbes that grow on the surface of the soil particles. The negative soil moisture potential forces the wastewater into the finer pores and over the surfaces of the soil particles, increasing retention time, absorption, filtration, and biological treatment of the wastewater.

From the vadose zone, fluid passes through the capillary fringe immediately above the ground water and enters the saturated zone, where flow occurs in response to a positive pressure gradient. Treated wastewater is transported from the site by fluid movement in the saturated zone. Mixing of treated water with ground water is somewhat limited because ground water flow usually is laminar. As a result, treated laminar water can remain as a distinct plume at the ground water interface for some distance from its source (Robertson et al., 1989). The plume might descend into the ground water as it travels from the source because of recharge from precipitation above. Dispersion occurs, but the mobility of solutes in the plume varies with the soil-solute reactivity.

Water quality-based performance requirements for ground water discharging systems are not clearly defined by current codes regulating OWTSs. Primary drinking water standards are typically required at a point of use (e.g., drinking water well) but are addressed in the codes only by requirements that the infiltration system be located a specified horizontal distance from the wellhead and vertical distance from the seasonal high water table. Nitrate-nitrogen is the common drinking water pollutant of concern that is routinely found in ground water below conventional SWISs. Regions with karst terrain or sandy soils are at particular risk for rapid movement of bacteria, viruses, nitrate-nitrogen, and other pollutants to ground water. In addition, geological conditions that support "gaining streams" (streams fed by ground water during low-flow conditions) might result in OWTS nutrient or pathogen impacts on surface waters if siting or design criteria fail to consider these conditions.

Surface water discharge

Direct discharges to surface waters require a permit issued under the National Pollutant Discharge Elimination System (NPDES) of the Clean Water

Act. The NPDES permitting process, which is administered by all but a few states, defines discharge performance requirements in the form of numerical criteria for specific pollutants and narrative criteria for parameters like color and odor. The treated effluent should meet water quality criteria before it is discharged. Criteria-based standards may include limits for BOD_5, TSS, fecal coliforms, ammonia, nutrients, metals, and other pollutants, including chlorine, which is often used to disinfect treated effluent prior to discharge. The limits specified vary based on the designated use of the water resource (e.g., swimming, aquatic habitat, recreation, potable water supply), state water classification schemes (Class I, II, III, etc.), water quality criteria associated with designated uses, or the sensitivity of aquatic ecosystems—especially lakes and coastal areas—to eutrophication. Surface water discharges are often discouraged for individual onsite treatment systems, however, because of the difficulty in achieving regulatory oversight and surveillance of many small, privately operated discharges.

Atmospheric discharge

Discharges to the atmosphere also may occur through evaporation and transpiration by plants. Evapotranspiration can release significant volumes of water into the atmosphere, but except for areas where annual evaporation exceeds precipitation (e.g., the American Southwest), evapotranspiration cannot be solely relied on for year-round discharge. However, evapotranspiration during the growing season can significantly reduce the hydraulic loading to soil infiltration systems.

Contaminant attenuation

Performance standards for ground water discharge systems are usually applied to the treated effluent/ground water mixture at some specified point away from the treatment system (see chapter 5). This approach is significantly different from the effluent limitation approach used with surface water discharges because of the inclusion of the soil column as part of the treatment system. However, monitoring ground water quality as a performance measure is not as easily accomplished. The fate and transport of wastewater pollutants through soil should be accounted for in the design of the overall treatment system.

Contaminant attenuation (removal or inactivation through treatment processes) begins in the septic tank and continues through the distribution piping of the SWIS or other treatment unit components, the infiltrative surface biomat, the soils of the vadose zone, and the saturated zone. Raw wastewater composition was discussed in section 3.4 and summarized in table 3-7. Jantrania (1994) found that chemical, physical, and biological processes in the anaerobic environment of the septic tank produce effluents with TSS concentrations of 40 to 350 mg/L, oil and grease levels of 50 to 150 mg/L, and total coliform counts of 10^6 to 10^8 per 100 milliliters. Although biofilms develop on exposed surfaces as the effluent passes through piping to and within the SWIS, no significant level of treatment is provided by these growths. The next treatment site is the infiltrative zone, which contains the biomat. Filtration, microstraining, and aerobic biological decomposition processes in the biomat and infiltration zone remove more than 90 percent of the BOD and suspended solids and 99 percent of the bacteria (University of Wisconsin, 1978).

As the treated effluent passes through the biomat and into the vadose and saturated zones, other treatment processes (e.g., filtration, adsorption, precipitation, chemical reactions) occur. The following section discusses broadly the transport and fate of some of the primary pollutants of concern under the range of conditions found in North America. Table 3-18 summarizes a case study that characterized the septic tank effluent and soil water quality in the first 4 feet of a soil treatment system consisting of fine sand. Results for other soil types might be significantly different. Note that mean nitrate concentrations still exceed the 10 mg/L drinking water standard even after the wastewater has percolated through 4 feet of fine sand under unsaturated conditions.

Biochemical oxygen demand and total suspended solids

Biodegradable organic material creates biochemical oxygen demand (BOD), which can cause low dissolved oxygen concentrations in surface water, create taste and odor problems in well water, and cause leaching of metals from soil and rock into ground water and surface waters. Total suspended solids (TSS) in system effluent can clog the infiltrative surface or soil interstices, while colloidal solids

Table 3-18. Case study: septic tank effluent and soil water quality [a]

Parameter (units)	Statistics	Septic tank effluent quality	Soil water quality [b] at 0.6 meter	Soil water Quality[b] at 1.2 meters
BOD (mg/L)	Mean	93.5	<1	<1
	Range	46–156	<1	<1
	# samples	11	6	6
TOC (mg/L)	Mean	47.4	7.8	8.0
	Range	31–68	3.7–17.0	3.1–25.0
	# samples	11	34	33
TKN (mg/L)	Mean	44.2	0.77	0.77
	Range	19–53	0.40–1.40	0.25–2.10
	# samples	11	35	33
NO_3-N (mg/L)	Mean	0.04	21.6	13.0
	Range	0.01–0.16	1.7–39.0	2.0–29.0
	# samples	11	35	32
TP (mg/L)	Mean	8.6	0.40	0.18
	Range	7.2–17.0	0.01–3.8	0.02–1.80
	# samples	11	35	33
TDS (mg/L)	Mean	497	448	355
	Range	354–610	184–620	200–592
	# samples	11	34	32
Cl (mg/L)	Mean	70	41	29
	Range	37–110	9–65	9–49
	# samples	11	34	31
F. Coli (log # per 100 mL)	Mean	4.57	nd [c]	nd
	Range	3.6–5.4	<1	<1
	# samples	11	24	21
F. strep. (log # per 100 mL)	Mean	3.60	nd	nd
	Range	1.9–5.3	<1	<1
	# samples	11	23	20

[a] The soil matrix consisted of a fine sand; the wastewater loading rate was 3.1 cm per day over 9 months. TOC = total organic carbon; TKN = total Kjeldahl nitrogen; TDS = total dissolved solids; Cl = chlorides;
F. coli = fecal coliforms; F. strep = fecal streptococci.
[b] Soil water quality measured in pan lysimeters at unsaturated soil depths of 2 feet (0.6 meter) and 4 feet (1.2 meters).
[c] nd = none detected.

Source: Adapted from Anderson et al., 1994.

cause cloudiness in surface waters. TSS in direct discharges to surface waters can result in the development of sludge layers that can harm aquatic organisms (e.g., benthic macro invertebrates). Systems that fail to remove BOD and TSS and are located near surface waters or drinking water wells may present additional problems in the form of pathogens, toxic pollutants, and other pollutants.

Under proper site and operating conditions, however, OWTSs can achieve significant removal rates (i.e., greater than 95 percent) for biodegradable organic compounds and suspended solids. The risk of ground water contamination by BOD and TSS (and other pollutants associated with suspended solids) below a properly sited, designed, constructed, and maintained SWIS is slight (Anderson et al., 1994; University of Wisconsin, 1978). Most settleable and floatable solids are removed in the septic tank during pretreatment. Most particulate BOD remaining is effectively removed at the infiltrative surface and biomat. Colloidal and dissolved BOD that might pass through the biomat are removed through aerobic biological processes in the vadose zone, especially when uniform dosing and reoxygenation occur. If excessive concentrations of BOD and TSS migrate beyond the tank because of poor maintenance, the infiltrative surface can clog and surface seepage of wastewater or plumbing fixture backup can occur.

Nitrogen

Nitrogen in raw wastewater is primarily in the form of organic matter and ammonia. After the septic tank, it is primarily (more than 85 percent) ammonia. After discharge of the effluent to the infiltrative surface, aerobic bacteria in the biomat and upper vadose zone convert the ammonia in the effluent almost entirely to nitrite and then to nitrate. Nitrogen in its nitrate form is a significant ground water pollutant. It has been detected in urban and rural ground water nationwide, sometimes at levels exceeding the USEPA drinking water standard of 10 mg/L (USGS, 1999). High concentrations of nitrate (greater than 10 mg/L) can cause methemoglobinemia or "blue baby syndrome," a disease in infants that reduces the blood's ability to carry oxygen, and problems during pregnancy. Nitrogen is also an important plant nutrient that can cause excessive algal growth in nitrogen-limited inland (fresh) waters and coastal waters, which are often limited in available nitrogen. High algal productivity can block sunlight, create nuisance or harmful algal blooms, and significantly alter aquatic ecosystems. As algae die, they are decomposed by bacteria, which can deplete available dissolved oxygen in surface waters and degrade habitat conditions.

Nitrogen contamination of ground water below infiltration fields has been documented by many investigators (Anderson et al., 1994; Andreoli et al., 1979; Ayres Associates, 1989, 1993b, c; Bouma et al., 1972; Carlile et al., 1981; Cogger and

Table 3-19. Wastewater constituents of concern and representative concentrations in the effluent of various treatment units

Constituents of concern	Example direct or indirect measures (Units)	Tank-based treatment unit effluent concentrations					SWIS percolate into ground water at 3 to 5 ft depth (% removal)
		Domestic STE[1]	Domestic STE with N-removal recycle[2]	Aerobic unit effluent	Sand filter effluent	Foam or textile filter effluent	
Oxygen demand	BOD_5 (mg/L)	140-200	80-120	5-50	2-15	5-15	>90%
Particulate solids	TSS (mg/L)	50-100	50-80	5-100	5-20	5-10	>90%
Nitrogen	Total N (mg N/L)	40-100	10-30	25-60	10-50	30-60	10-20%
Phosphorus	Total P (mg P/L)	5-15	5-15	4-10	<1-10[4]	5-15[4]	0-100%
Bacteria (e.g., *Clostridium perfringens, Salmonella, Shigella*)	Fecal coliform (organisms per 100 mL)	10^6-10^8	10^5-10^8	10^3-10^4	10^1-10^3	10^1-10^3	>99.99%
Virus (e.g., hepatitis, polio, echo, coxsackie, coliphage)	Specific virus (pfu/mL)	0-10^5 (episodically present at high levels)	0-10^5 (episodically present at high levels)	0-10^5 (episodically present at high levels)	0-10^5 (episodically present at high levels)	0-10^5 (episodically present at high levels)	>99.9%
Organic chemicals (e.g., solvents, petro-chemicals, pesticides)	Specific organics or totals (µg/L)	0 to trace levels (?)	0 to trace levels (?)	0 to trace levels (?)	0 to trace levels (?)	0 to trace levels (?)	>99%
Heavy metals (e.g., Pb, Cu, Ag, Hg)	Individual metals (µg/L)	0 to trace levels	0 to trace levels	0 to trace levels	0 to trace levels	0 to trace levels	>99%

[1]Septic tank effluent (STE) concentrations given are for domestic wastewater. However, restaurant STE is markedly higher particularly in BOD_5, COD, and suspended solids while concentrations in graywater STE are noticeably lower in total nitrogen.
[2]N-removal accomplished by recycling STE through a packed bed for nitrification with discharge into the influent end of the septic tank for denitrification.
[3]P-removal by adsorption/precipitation is highly dependent on media capacity, P loading, and system operation.

Source: Siegrist, 2001 (after Siegrist et al., 2000)

Source: Siegrist, 2001 (after Siegrist et al., 2000).

Carlile, 1984; Ellis and Childs, 1973; Erickson and Bastian, 1980; Gibbs, 1977a, b; Peavy and Brawner, 1979; Peavy and Groves, 1978; Polta, 1969; Preul, 1966; Reneau, 1977, 1979; Robertson et al., 1989, 1990; Shaw and Turyk, 1994; Starr and Sawhney, 1980; Tinker, 1991; Uebler, 1984; Viraraghavan and Warnock, 1976a, b, c; Walker et al., 1973a, b; Wolterink et al., 1979). Nitrate-nitrogen concentrations in ground water were usually found to exceed the drinking water standard of 10 mg/L near the infiltration field. Conventional soil-based systems can remove some nitrogen from septic tank effluent (table 3-19), but high-density installation of OWTSs can cause contamination of ground or surface water resources. When nitrate reaches the ground water, it moves freely with little retardation. Denitrification has been found to be significant in the saturated zone only in rare instances where carbon or sulfur deposits are present. Reduction of nitrate concentrations in ground water occurs primarily through dispersion or recharge of ground water supplies by precipitation (Shaw and Turyk, 1994).

Nitrogen can undergo several transformations in and below a SWIS, including adsorption, volatilization, mineralization, nitrification, and denitrification. Nitrification, the conversion of ammonium nitrogen to nitrite and then nitrate by bacteria under aerobic conditions, is the predominant transformation that occurs immediately below the infiltration zone. The negatively charged nitrate ion is very soluble and moves readily with the percolating soil water.

Biological denitrification, which converts nitrate to gaseous forms of nitrogen, can remove nitrate from percolating wastewater. Denitrification occurs under anaerobic conditions where available electron donors such as carbon or sulfur are present. Denitrifying bacteria use nitrate as a substitute for oxygen when accepting electrons. It has been generally thought that anaerobic conditions with organic matter seldom occur below soil infiltration fields. Therefore, it is has been assumed that all the nitrogen applied to infiltration fields ultimately leaches to ground water (Brown et al., 1978; Walker et al., 1973a, b). However, several studies indicate that denitrification can be significant. Jenssen and Siegrist (1990) found in their review of several laboratory and field studies that approximately 20 percent of nitrogen is lost from wastewater percolating through soil. Factors found to favor denitrification are fine-grained soils (silts and clays) and layered soils (alternating fine-grained and coarser-grained soils with distinct boundaries between the texturally different layers), particularly if the fine-grained soil layers contain organic material. Jenssen and Siegrist concluded that nitrogen removal below the infiltration field can be enhanced by placing the system high in the soil profile, where organic matter in the soil is more likely to be present, and by dosing septic tank effluent onto the infiltrative surface to create alternating wetting and drying cycles. Denitrification can also occur if ground water enters surface water bodies through organic-rich bottom sediments. Nitrogen concentrations in ground water were shown to decrease to less than 0.5 mg/L after passage through sediments in one Canadian study (Robertson et al., 1989, 1990).

It is difficult to predict removal rates for wastewater-borne nitrate or other nitrogen compounds in the soil matrix. In general, however, nitrate concentrations in SWIS effluent can and often do exceed the 10 mg/L drinking water standard. Shaw and Turyk (1994) found nitrate concentrations ranging from 21 to 108 mg/L (average of 31 to 34 mg/L) in SWIS effluent plumes analyzed as part of a study of 14 pressure-dosed drain fields in sandy soils of Wisconsin. The limited ability of conventional SWISs to achieve enhanced nitrate reductions and the difficulty in predicting soil nitrogen removal rates means that systems sited in drinking water aquifers or near sensitive aquatic areas should incorporate additional nitrogen removal technologies prior to final soil discharge.

Phosphorus

Phosphorus is also a key plant nutrient, and like nitrogen it contributes to eutrophication and dissolved oxygen depletion in surface waters, especially fresh waters such as rivers, lakes, and ponds. Monitoring below subsurface infiltration systems has shown that the amount of phosphorus leached to ground water depends on several factors: the characteristics of the soil, the thickness of the unsaturated zone through which the wastewater percolates, the applied loading rate, and the age of the system (Bouma et al., 1972; Brandes, 1972; Carlile et al., 1981, Childs et al., 1974; Cogger and Carlile, 1984; Dudley and Stephenson, 1973; Ellis and Childs, 1973; Erickson and Bastian, 1980; Gilliom and Patmont, 1983; Harkin et al., 1979;

Jones and Lee, 1979; Whelan and Barrow, 1984). The amount of phosphorus in ground water varies from background concentrations to concentrations equal to that of septic tank effluent. However, removals have been found to continue within ground water aquifers (Carlile et al., 1981; Childs et al., 1974; Cogger and Carlile, 1984; Ellis and Childs, 1973; Gilliom and Patmont, 1983; Rea and Upchurch, 1980; Reneau, 1979; Reneau and Pettry, 1976; Robertson et al., 1990).

Retardation of phosphorus contamination of surface waters from SWISs is enhanced in fine-textured soils without continuous macropores that would allow rapid percolation. Increased distance of the system from surface waters is also an important factor in limiting phosphorus discharges because of greater and more prolonged contact with soil surfaces. The risk of phosphorus contamination, therefore, is greatest in karst regions and coarse-textured soils without significant iron, calcium, or aluminum concentrations located near surface waters.

The fate and transport of phosphorus in soils are controlled by sorption and precipitation reactions (Sikora and Corey, 1976). At low concentrations (less than 5 mg/L), the phosphate ion is chemisorbed onto the surfaces of iron and aluminum minerals in strongly acid to neutral systems and on calcium minerals in neutral to alkaline systems. As phosphorus concentrations increase, phosphate precipitates form. Some of the more important precipitate compounds formed are strengite, $FePO_4 \cdot 2H_2O$; variscite, $AlPO_4 \cdot 2H_2O$; dicalcium phosphate, $CaHPO_4 \cdot 2H_2O$; octacalcium phosphate, $Ca_4H(PO_4)_3 \cdot 3H_2O$; and hydroxyapatite, $Ca_{10}(PO_4)_6(OH_2)$. In acidic soils, phosphate sorption probably involves the aluminum and iron compounds; in calcareous or alkaline soils, calcium compounds predominate.

Estimates of the capacity of the soil to retain phosphorus are often based on sorption isotherms such as the Langmuir model (Ellis and Erickson, 1969; Sawney, 1977; Sawney and Hill, 1975; Sikora and Corey, 1976; Tofflemire and Chen, 1977). This method significantly underestimates the total retention capacity of the soil (Anderson et al., 1994; Sawney and Hill, 1975; Sikora and Corey, 1976; Tofflemire and Chen, 1977). This is because the test measures the chemi-sorption capacity but does not take into account the slower precipitation reactions that regenerate the chemi-sorption sites. These slower reactions have been shown to increase the capacity of the soil to retain phosphorus by 1.5 to 3 times the measured capacity calculated by the isotherm test (Sikora and Corey, 1976; Tofflemire and Chen, 1977). In some cases the total capacity has been shown to be as much as six times greater (Tofflemire and Chen, 1977). These reactions can take place in unsaturated or saturated soils (Ellis and Childs, 1973; Jones and Lee, 1977a, b; Reneau and Pettry, 1976; Robertson et al., 1990; Sikora and Corey, 1976).

The capacity of the soil to retain phosphorus is finite, however. With continued loading, phosphorus movement deeper into the soil profile can be expected. The ultimate retention capacity of the soil depends on several factors, including its mineralogy, particle size distribution, oxidation-reduction potential, and pH. Fine-textured soils theoretically provide more sorption sites for phosphorus. As noted above, iron, aluminum, and calcium minerals in the soil allow phosphorus precipitation reactions to occur, a process that can lead to additional phosphorus retention. Sikora and Corey (1976) estimated that phosphorus penetration into the soil below a SWIS would be 52 centimeters per year in Wisconsin sands and 10 centimeters per year in Wisconsin silt loams.

Nevertheless, knowing the retention capacity of the soil is not enough to predict the travel of phosphorus from subsurface infiltration systems. Equally important is an estimate of the total volume of soil that the wastewater will contact as it percolates to and through the ground water. Fine-textured, unstructured soils (e.g., clays, silty clays) can be expected to disperse the water and cause contact with a greater volume of soil than coarse, granular soils (e.g., sands) or highly structured fine-textured soils (e.g., clayey silts) having large continuous pores. Also, the rate of water movement and the degree to which the water's elevation fluctuates are important factors.

There are no simple methods for predicting phosphorus removal rates at the site level. However, several landscape-scale tools that provide at least some estimation of expected phosphorus loads from clusters of onsite systems are available. The MANAGE assessment method, which is profiled in section 3.9.1, is designed to estimate existing and projected future (build-out) nutrient loads and to identify "hot spots" based on land use and cover (see **http://www.epa.gov/owow/watershed/Proceed/joubert.html; http://www.edc.uri.edu/cewq/manage.html**). Such estimates provide at least some guidance in siting onsite systems and considering acceptable levels of both numbers and densities in sensitive areas.

Pathogenic microorganisms

Pathogenic microorganisms found in domestic wastewater include a number of different bacteria, viruses, protozoa, and parasites that cause a wide range of gastrointestinal, neurological, respiratory, renal, and other diseases. Infection can occur through ingestion (drinking contaminated water; incidental ingestion while bathing, skiing, or fishing), respiration, or contact (table 3-20). The occurrence and concentration of pathogenic microorganisms in raw wastewater depend on the sources contributing to the wastewater, the existence of infected persons in the population, and environmental factors that influence pathogen survival rates. Such environmental factors include the following: initial numbers and types of organisms, temperature (microorganisms survive longer at lower temperatures), humidity (survival is longest at high humidity), amount of sunlight (solar radiation is detrimental to survival), and additional soil attenuation factors, as discussed below. Typical ranges of survival times are presented in table 3-21. Among pathogenic agents, only bacteria have any potential to reproduce and multiply between hosts (Cliver, 2000). If temperatures are between 50 and 80 degrees Fahrenheit (10 to 25 degrees Celsius)

Table 3-20. Waterborne pathogens found in human waste and associated diseases

Type	Organism	Disease	Effects
Bacteria	*Escherichia coli* enteropathogenic)	Gastroenteritis	Vomiting, diarrhea, death in susceptible populations
	Legionella pneumophila	Legionellosis	Acute respiratory illness
	Leptospira	Leptospirosis	Jaundice, fever (Well's disease)
	Salmonella typhi	Typhoid fever	High fever, diarrhea, ulceration of the small intestine
	Salmonella	Salmonellosis	Diarrhea, dehydration
	Shigella	Shigellosis	Bacillary dysentery
	Vibrio cholerae	Cholera	Extremely heavy diarrhea, dehydration
	Yersinia enterolitica	Yersinosis	Diarrhea
Protozoans	*Balantidium coli*	Balantidiasis	Diarrhea, dysentery
	Cryptosporidium	Crypotosporidiosis	Diarrhea
	Entamoeba histolytica	Ameobiasis (amoebic dysentery)	Prolonged diarrhea with bleeding, abscesses of the liver and small intestine
	Giardia lambia	Giardiasis	Mild to severe diarrhea, nausea, indigestion
	Naegleria fowleri	Amebic Meningoencephalitis	Fatal disease; inflammation of the brain
Viruses	Adenovirus (31 types)	Conjunctivitis	Eye, other infections
	Enterovirus (67 types, e.g., polio-, echo-, and Coxsackie viruses)	Gastroenteritis	Heart anomalies, meningitis
	Hepatitis A	Infectious hepatitis	Jaundice, fever
	Norwalk agent	Gastroenteritis	Vomiting, diarrhea
	Reovirus	Gastroenteritis	Vomiting, diarrhea
	Rotavirus	Gastroenteritis	Vomiting, diarrhea

Source: USEPA, 1999.

Table 3-21. Typical pathogen survival times at 20 to 30 °C

Pathogen	Typical survival times in days: In fresh water & sewage	In unsaturated soils
Viruses[a]		
Enteroviruses[b]	< 120 but usually < 50	< 100 but usually < 20
Bacteria		
Fecal coliforms[a]	< 60 but usually < 30	< 70 but usually < 20
Salmonella spp.[a]	< 60 but usually < 30	< 70 but usually < 20
Shigella spp.[a]	< 30 but usually < 10	
Protozoa		
Entamoeba histolytica cysts	< 30 but usually < 15	< 20 but usually < 10
Helminths		
Ascaris lumbricoides eggs	Many months	Many months

[a] In seawater, viral survival is less and bacterial survival is very much less than in fresh water.
[b] Includes polio-, echo-, and Coxsackie viruses.
Source: Adapted from Feacham et al., 1983, cited in UNDP-World Bank, 1992.

and nutrients are available, bacterial numbers may increase 10- to 100-fold. However, such multiplication is usually limited by competition from other, better-adapted organisms (Cliver, 2000).

Enteric bacteria are those associated with human and animal wastes. Once the bacteria enter a soil, they are subjected to life process stresses not encountered in the host. In most nontropical regions of the United States, temperatures are typically much lower; the quantity and availability of nutrients and energy sources are likely to be appreciably lower; and pH, moisture, and oxygen conditions are not as likely to be conducive to long-term survival. Survival times of enteric bacteria in the soil are generally reduced by higher temperatures, lower nutrient and organic matter content, acidic conditions (pH values of 3 to 5), lower moisture conditions, and the presence of indigenous soil microflora (Gerba et al., 1975). Potentially pathogenic bacteria are eliminated faster at high temperatures, pH values of about 7, low oxygen content, and high dissolved organic substance content (Pekdeger, 1984). The rate of bacterial die-off approximately doubles with each 10-degree increase of temperature between 5 and 30 °C (Tchobanoglous and Burton, 1991). Observed survival rates for various potential pathogenic bacteria have been found to be extremely variable. Survival times of longer than 6 months can occur at greater depths in unsaturated soils where oligotrophic (low-nutrient) conditions exist (Pekdeger, 1984).

The main methods of bacterial retention in unsaturated soil are filtration, sedimentation, and adsorption (Bicki et al., 1984; Cantor and Knox, 1985; Gerba et al., 1975). Filtration accounts for the most retention. The sizes of bacteria range from 0.2 to 5 microns (μm) (Pekdeger, 1984; Tchobanoglous and Burton, 1991); thus, physical removal through filtration occurs when soil micropores and surface water film interstices are smaller than this. Filtration of bacteria is enhanced by slow permeability rates, which can be caused by fine soil textures, unsaturated conditions, uniform wastewater distribution to soils, and periodic treatment system resting. Adsorption of bacteria onto clay and organic colloids occurs within a soil solution that has high ionic strength and neutral to slightly acid pH values (Canter and Knox, 1985).

Normal operation of septic tank/subsurface infiltration systems results in retention and die-off of most, if not all, observed pathogenic bacterial indicators within 2 to 3 feet (60 to 90 centimeters) of the infiltrative surface (Anderson et al., 1994; Ayres Associates, 1993a, c; Bouma et al., 1972; McGauhey and Krone, 1967). With a mature biomat at the infiltrative surface of coarser soils, most bacteria are removed within the first 1 foot (30 centimeters) vertically or horizontally from the trench-soil interface (University of Wisconsin, 1978). Hydraulic loading rates of less than 2 inches/day (5 centimeters/day) have also been found to promote better removal of bacteria in septic tank effluent (Ziebell et al., 1975). Biomat formation and lower hydraulic loading rates promote unsaturated flow, which is one key to soil-based removal of bacteria from wastewater. The retention behavior of actual pathogens in unsaturated soil might be different from that of the indicators (e.g., fecal coliforms) that have been measured in most studies.

Failure to properly site, design, install, and/or operate and maintain subsurface infiltration systems can result in the introduction of potentially pathogenic bacteria into ground water or surface waters. Literature reviews prepared by Hagedorn (1982) and Bicki et al. (1984) identify a number of references that provide evidence that infiltrative surfaces improperly constructed below the ground water surface or too near fractured bedrock correlate with such contamination. Karst geology and seasonally high water tables that rise into the infiltrative field can also move bacteria into ground water zones. Once in ground water, bacteria from septic tank effluent have been observed to survive for considerable lengths of time (7 hours to 63 days), and they can travel up to and beyond 100 feet (30 meters) (Gerba et al., 1975).

Viruses are not a normal part of the fecal flora. They occur in infected persons, and they appear in septic tank effluent intermittently, in varying numbers, reflecting the combined infection and carrier status of OWTS users (Berg, 1973). It is estimated that less than 1 to 2 percent of the stools excreted in the United States contain enteric viruses (University of Wisconsin, 1978). Therefore, such viruses are difficult to monitor and little is known about their frequency of occurrence and rate of survival in traditional septic tank systems. Once an infection (clinical or subclinical) has occurred, however, it is estimated that feces may contain 10^6 to 10^{10} viral particles per gram (Kowal, 1982). Consequently, when enteric viruses are present in septic tank effluent, they might be present in significant numbers (Anderson et al., 1991; Hain and O'Brien, 1979; Harkin et al., 1979; Vaughn and Landry, 1977; Yeager and O'Brien, 1977).

Some reduction (less than 1 log) of virus concentrations in wastewater occurs in the septic tank. Higgins et al. (2000) reported a 74 percent decrease in MS2 coliphage densities, findings that concurs with those of other studies (Payment et al., 1986; Roa, 1981). Viruses can be both retained and inactivated in soil; however, they can also be retained but not inactivated. If not inactivated, viruses can accumulate in soil and subsequently be released due to changing conditions, such as prolonged peak OWTS flows or heavy rains. The result could be contamination of ground water. Soil factors that decrease survival include warm temperatures, low moisture content, and high organic content. Soil factors that increase retention include small particle size, high moisture content, low organic content, and low pH. Sobsey (1983) presents a thorough review of these factors. Virus removal below the vadose zone might be negligible in some geologic settings. (Cliver, 2000).

Most studies of the fate and transport of viruses in soils have been columnar studies using a specific serotype, typically poliovirus 1, or bacteriophages (Bitton et al., 1979; Burge and Enkiri, 1978; Drewry, 1969, 1973; Drewry and Eliassen, 1968; Duboise et al., 1976; Goldsmith et al., 1973; Green and Cliver, 1975; Hori et al., 1971; Lance et al., 1976; Lance et al., 1982; Lance and Gerba, 1980; Lefler and Kott, 1973, 1974; Nestor and Costin, 1971; Robeck et al., 1962; Schaub and Sorber, 1977; Sobsey et al., 1980; Young and Burbank, 1973; University of Wisconsin, 1978). The generalized results of these studies indicate that adsorption is the principal mechanism of virus retention in soil. Increasing the ionic strength of the wastewater enhances adsorption. Once viruses have been retained, inactivation rates range from 30 to 40 percent per day.

Various investigations have monitored the transport of viruses through unsaturated soil below the infiltration surface has been monitored by (Anderson et al., 1991; Hain and O'Brien, 1979; Jansons et al., 1989; Schaub and Sorber, 1977; Vaughn and Landry, 1980; Vaughn et al., 1981; Vaughn et al., 1982, 1983; Wellings et al., 1975). The majority of these studies focused on indigenous viruses in the wastewater and results were mixed. Some serotypes were found to move more freely than others. In most cases viruses were found to penetrate more than 10 feet (3 meters) through unsaturated soils. Viruses are less affected by filtration than bacteria (Bechdol et al., 1994) and are more resistant than bacteria to inactivation by disinfection (USEPA, 1990). Viruses have been known to persist in soil for up to 125 days and travel in ground water for distances of up to 1,339 feet (408 meters). However, monitoring of eight conventional individual home septic tank systems in Florida indicated that 2 feet (60 centimeters) of fine sand effectively removed viruses (Anderson et al., 1991; Ayres Associates, 1993c). Higgins (2000) reported 99 percent removal of virus particles within the first 1 foot (30.5 centimeters) of soil.

Recent laboratory and field studies of existing onsite systems using conservative tracers (e.g., bromide ions) and microbial surrogate measures (e.g., viruses, bacteria) found that episodic break-throughs of virus and bacteria can occur in the SWIS, particularly during early operation (Van Cuyk et al., 2001). Significant (e.g., 3-log) removal of viruses and near complete removal of fecal bacteria can be reasonably achieved in 60 to 90 centimeters of sandy media (Van Cuyk et al., 2001).

Inactivation of pathogens through other physical, chemical, or biological mechanisms varies considerably. Protozoan cysts or oocysts are generally killed when they freeze, but viruses are not. Ultraviolet light, extremes of pH, and strong oxidizing agents (e.g., hypochlorite, chlorine dioxide, ozone) are also effective in killing or inactivating most pathogens (Cliver, 2000). Korich (1990) found that in demand-free water, ozone was slightly more effective than chlorine dioxide against *Cryptosporidium parvum* oocysts, and both were much more effective than chlorine or monochloramine. *C. parvum* oocysts were found to be 30 times more resistant to ozone and 14 times more resistant to chlorine dioxide than are *Giardia lamblia* cysts (Korich et al., 1990).

Toxic organic compounds

A number of toxic organic compounds that can cause neurological, developmental, or other problems in humans and interfere with biological processes in the environment can be found in septic tank effluent. Table 3-22 provides information on potential health effects from selected organic chemicals, along with USEPA maximum containment levels for these pollutants in drinking water. The toxic organics that have been found to be the most prevalent in wastewater are 1,4-dichlorobenzene, methylbenzene (toluene), dimethylbenzenes (xylenes), 1,1-dichloroethane, 1,1,1-trichloroethane, and dimethylketone (acetone). These compounds are usually found in household products like solvents and cleaners.

No known studies have been conducted to determine toxic organic treatment efficiency in single-family home septic tanks. A study of toxic organics in domestic wastewater and effluent from a community septic tank found that removal of low-molecular-weight alkylated benzenes (e.g., toluene,

Table 3-22. Maximum contaminant levels (MCLs) for selected organic chemicals in drinking water

Contaminant	MCL (mg/L)	Potential health effects
Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer
Chlordane	0.002	Liver or nervous system problems; increased risk of cancer
Chlorobenzene	0.1	Liver or kidney problems
2,4-D	0.07	Liver, kidney, or adrenal gland problems
o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems
1,2-Dichloroethane	0.005	Increased risk of cancer
Dichloromethane	0.005	Liver problems, increased risk of cancer
Dioxin	0.00000003	Reproductive difficulties; increased risk of cancer
Ethylbenzene	0.7	Liver or kidney problems
Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer
Lindane	0.0002	Liver or kidney problems
Toluene	1.0	Nervous system, kidney, or liver problems
Trichloroethylene	0.005	Liver problems; increased risk of cancer
Vinyl chloride	0.002	Increased risk of cancer
Xylenes (total)	10	Nervous system damage

Source: USEPA, 2000a.

xylene) was noticeable, whereas virtually no removal was noted for higher-molecular-weight compounds (DeWalle et al., 1985). Removal efficiency was observed to be directly related to tank detention time, which is directly related to settling efficiency.

The behavior of toxic organic compounds in unsaturated soil is not well documented. The avenues of mobility available to toxic organics include those which can transport organics in both gaseous and liquid phases. In the gaseous phase toxic organics diffuse outward in any direction within unobstructed soil voids; in the liquid phase they follow the movement of the soil solution. Because of their nonpolar nature, certain toxic organics are not electrochemically retained in unsaturated soil. Toxic organics can be transformed into less innocuous forms in the soil by indigenous or introduced microorganisms. The biodegradability of many organic compounds in the soil depends on oxygen availability. Halogenated straight-chain compounds, such as many chlorinated solvents, are usually biodegraded under anaerobic conditions when carbon dioxide replaces oxygen (Wilhelm, 1998). Aromatic organic compounds like benzene and toluene, however, are biodegraded primarily under aerobic conditions. As for physical removal, organic contaminants are adsorbed by solid organic matter. Accumulated organic solids in the tank and in the soil profile, therefore, might be important retainers of organic contaminants. In addition, because many of the organic contaminants found in domestic wastewater are relatively volatile, unsaturated conditions in drain fields likely facilitate the release of these compounds through gaseous diffusion and volatilization (Wilhelm, 1998).

Rates of movement for the gaseous and liquid phases depend on soil and toxic organic compound type. Soils having fine textures, abrupt interfaces of distinctly different textural layers, a lack of fissures and other continuous macropores, and low moisture content retard toxic organic movement (Hillel, 1989). If gaseous exchange between soil and atmosphere is sufficient, however, appreciable losses of low-molecular-weight alkylated benzenes such as toluene and dimethylbenzene (xylene) can be expected because of their relatively high vapor pressure (Bauman, 1989). Toxic organics that are relatively miscible in water (e.g., methyl tertiary butyl ether, tetrachloroethane, benzene, xylene) can be expected to move with soil water. Nonmiscible toxic organics that remain in liquid or solid phases (chlorinated solvents, gasoline, oils) can become tightly bound to soil particles (Preslo et al., 1989). Biodegradation appears to be an efficient removal mechanism for many volatile organic compounds. Nearly complete or complete removal of toxic organics below infiltration systems was found in several studies (Ayres Associates, 1993a, c; Robertson, 1991; Sauer and Tyler, 1991).

Some investigations have documented toxic organic contamination of surficial aquifers by domestic wastewater discharged from community infiltration fields (Tomson et al., 1984). Of the volatile organic compounds detected in ground water samples collected in the vicinity of subsurface infiltration systems, Kolega (1989) found trichloromethane, toluene, and 1,1,1-trichloroethane most frequently and in some of the highest concentrations. Xylenes, dichloroethane, and dichloromethane were also detected.

Table 3-23. Case study: concentration of metals in septic tank effluent[a]

Metal constituent	Mean concentration (µg/L)	Range (µg/L)
Arsenic	37 (5)[b]	6–59
Barium	890 (5)	400–1310
Cadmium	83 (7)	30–330
Chromium	320 (7)	60–1400
Lead	2700 (1)	-
Mercury	2 (2)	1–3
Nickel	4000 (1)	-
Selenium	15 (6)	3–39

[a] Samples collected from the outlet of nine septic tanks.
[b] Number in parentheses indicates number of septic tanks in which metals were detected.
Source: Florida HRS, 1993, after Watkins, 1991.

Once toxic organics reach an aquifer, their movement generally follows the direction of ground water movement. The behavior of each within an aquifer, however, can be different. Some stay near the surface of the aquifer and experience much lateral movement. Others, such as aliphatic chlorinated hydrocarbons, experience greater vertical movement because of their heavier molecular weight (Dagan and Bresler, 1984). Based on this observation, 1,4-dichlorobenzene, toluene, and xylenes in septic tank effluent would be expected to experience more lateral than vertical movement in an aquifer; 1,1-dichloroethane, 1,1,1-trichloroethane, dichloromethane, and trichloromethane would be expected to show more vertical movement. Movement of toxic organic compounds is also affected by their degree of solubility in water. Acetone, dichloromethane, trichloromethane, and 1,1-dichloroethane are quite soluble in water and are expected to be very highly mobile; 1,1,1-trichloroethane, toluene, and 1,2-dimethylbenzene (o-xylene) are expected to be moderately mobile; and 1,3-dimethylbenzene (m-xylene), 1,4-dimethylbenzene (p-xylene), and 1,4-dichlorobenzene are expected to have low mobility (Fetter, 1988).

System design considerations for removing toxic organic compounds include increasing tank retention time (especially for halogenated, straight-chain compounds like organic solvents), ensuring greater vadose zone depths below the SWIS, and placing the infiltration system high in the soil profile, where higher concentrations of organic matter and oxygen can aid the volatilization and treatment of aromatic compounds. It should be noted that significantly high levels of toxic organic compounds can cause die-off of tank and biomat microorganisms, which could reduce treatment performance. Onsite systems that discharge high amounts of toxic organic compounds might be subject to USEPA's Class V Underground Injection Control Program (see **http://www.epa.gov/safewater.uic.html**).

Metals

Metals like lead, mercury, cadmium, copper, and chromium can cause physical and mental developmental delays, kidney disease, gastrointestinal illnesses, and neurological problems. Some information is available regarding metals in septic tank effluent (DeWalle et. al. 1985). Metals can be present in raw household wastewater because many commonly used household products contain metals. Aging interior plumbing systems can contribute lead, cadmium, and copper (Canter and Knox, 1985). Other sources of metals include vegetable matter and human excreta. Several metals have been found in domestic septage, confirming their presence in wastewater. They primarily include cadmium, copper, lead, and zinc (Bennett et al., 1977; Feige et al., 1975; Segall et al., 1979). OWTSs serving nonresidential facilities (e.g., rural health care facilities, small industrial facilities) can also experience metal loadings. Several USEPA priority pollutant metals have been found in domestic septic tank effluent (Whelan and Titmanis, 1982). The most prominent metals were nickel, lead, copper,

Table 3-24. Maximum contaminant levels (MCLs) for selected inorganic chemicals in drinking water

Contaminant	MCL (mg/L)	Potential health effects
Arsenic	0.05[1]	Increase in blood cholesterol; decrease in blood glucose
Cadmium	0.005	Kidney damage
Chromium	0.1	Possible allergic dermatitis after long exposures
Copper	1.3 (action level)	Gastrointestinal distress with short-term exposure; liver or kidney damage possible with long-term exposure
Lead	0.015 (action level)	Physical and mental developmental delays in children; kidney problems, high blood pressure for adults
Inorganic mercury	0.002	Kidney damage
Nitrate-nitrogen	10.0	Methemoglobinemia (blue baby syndrome)
Nitrite-nitrogen	1.0	Methemoglobinemia (blue baby syndrome)
Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems

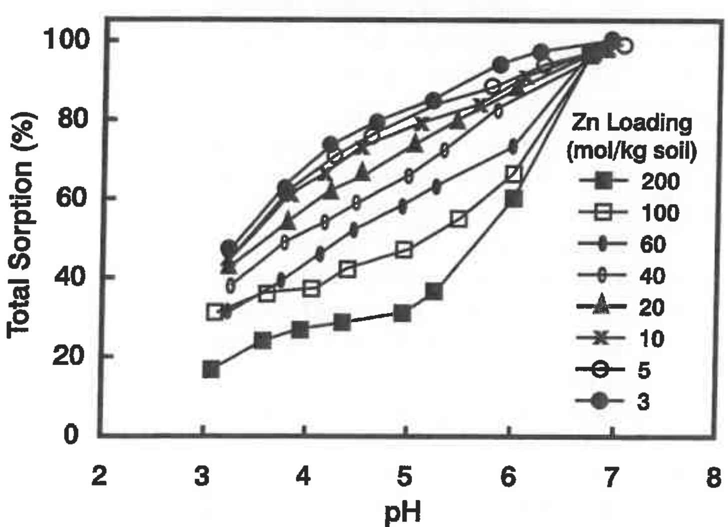
[1] The MCL for arsenic is currently under review by USEPA.
Source: USEPA, 2000a.

zinc, barium, and chromium. A comparison of mean concentrations of metals in septic tank effluent as found in one study (table 3-23) with the USEPA maximum contaminant levels for drinking water noted in table 3-24 reveals a potential for contamination that might exceed drinking water standards in some cases.

The fate of metals in soil is dependent on complex physical, chemical, and biochemical reactions and interactions. The primary processes controlling the fixation/mobility potential of metals in subsurface infiltration systems are adsorption on soil particles and interaction with organic molecules. Because the amount of naturally occurring organic matter in the soil below the infiltrative surface is typically low, the cation exchange capacity of the soil and soil solution pH control the mobility of metals below the infiltrative surface. Acidic conditions can reduce the sorption of metals in soils, leading to increased risk of ground water contamination (Evanko, 1997; Lim et al., 2001). (See figure 3-11.) It is likely that movement of metals through the unsaturated zone, if it occurs at all, is accomplished by movement of organic ligand complexes formed at or near the infiltrative surface (Canter and Knox, 1985; Matthess, 1984).

Information regarding the transport and fate of metals in ground water can be found in hazardous waste and soil remediation literature (see **http://www.gwrtac.org/html/Tech_eval.html#METALS**). One study attempted to link septic tank systems to metal contamination of rural potable water supplies, but only a weak correlation was found (Sandhu et al., 1977). Removal of sources of metals from the wastewater stream by altering user habits and implementing alternative disposal practices is recommended. In addition, the literature suggests that improving treatment processes by increasing septic tank detention times, ensuring greater unsaturated soil depths, and improving dose and rest cycles may decrease risks associated with metal loadings from onsite systems (Chang, 1985; Evanko, 1997; Lim et al., 2001).

Figure 3-11. Zinc sorption by clay as a function of pH at various loading concentrations (in 0.05 M NaCl medium)



Source: Lim et al., 2001.

Surfactants

Surfactants are commonly used in laundry detergents and other soaps to decrease the surface tension of water and increase wetting and emulsification. Surfactants are the largest class of anthropogenic organic compounds present in raw domestic wastewater (Dental et al., 1993). Surfactants that survive treatment processes in the septic tank and subsequent treatment train can enter the soil and mobilize otherwise insoluble organic pollutants. Surfactants have been shown to decrease adsorption — and even actively desorb — the pollutant trichlorobenzene from soils (Dental, 1993). Surfactants can also change soil structure and alter wastewater infiltration rates.

Surfactant molecules contain both strongly hydrophobic and strongly hydrophilic properties and thus tend to concentrate at interfaces of the aqueous system including air, oily material, and particles. Surfactants can be found in most domestic septic tank effluents. Since 1970 the most common anionic surfactant used in household laundry detergent is linear alkylbenzenesulfonate, or LAS. Whelan and Titmanis (1982) found a range of LAS concentrations from 1.2 to 6.5 mg/L in septic tank effluent. Dental (1993) cited studies finding concentrations of LAS in raw wastewater ranging from 3 mg/L to 21 mg/L.

Because surfactants in wastewater are associated with particulate matter and oils and tend to concentrate in sludges in wastewater treatment plants (Dental, 1993), increasing detention times in the tank might aid in their removal. The behavior of surfactants in unsaturated soil is dependent on surfactant type. It is expected that minimal retention of anionic and nonionic surfactants occurs in unsaturated soils having low organic matter content. However, the degree of mobility is subject to soil solution chemistry, organic matter content of the soil, and rate of degradation by soil microorganisms. Soils with high organic matter should favor retention of surfactants because of the lipophilic component of surfactants. Surfactants are readily biodegraded under aerobic conditions and are more stable under anaerobic conditions. Substantial attenuation of LAS in unsaturated soil beneath a subsurface infiltration system has been demonstrated (Anderson et al., 1994; Robertson et al., 1989; Shimp et al., 1991). Cationic surfactants strongly sorb to cation exchange sites of soil particles and organic matter (McAvoy et al., 1991). Thus, fine-textured soils and soils having high organic matter content will generally favor retention of these surfactants.

Some investigations have identified the occurrence of methylene blue active substance (MBAS) in ground water (Perlmutter and Koch, 1971; Thurman et al., 1986). The type of anionic surfactant was not specifically identified. However, it was surmised that the higher concentrations noted at the time of the study were probably due to use of alkylbenzenesulfonate (ABS), which is degraded by microorganisms at a much slower rate than LAS. There has also been research demonstrating that all types of surfactants might be degraded by microorganisms in saturated sediments (Federle and Pastwa, 1988). No investigations have been found that identify cationic or nonionic surfactants in ground water that originated from subsurface wastewater infiltration systems. However, because of concerns over the use of alkylphenol polyethoxylates, studies of fate and transport of this class of endocrine disrupters are in progress.

Summary

Subsurface wastewater infiltration systems are designed to provide wastewater treatment and dispersal through soil purification processes and ground water recharge. Satisfactory performance is dependent on the treatment efficiency of the pretreatment system, the method of wastewater distribution and loading to the soil infiltrative surface, and the properties of the vadose and saturated zones underlying the infiltrative surface. The soil should have adequate pore characteristics, size distribution, and continuity to accept the daily volume of wastewater and provide sufficient soil-water contact and retention time for treatment before the effluent percolates into the ground water.

Ground water monitoring below properly sited, designed, constructed, and operated subsurface infiltration systems has shown carbonaceous biochemical oxygen demand (CBOD), suspended solids (TSS), fecal indicators, metals, and surfactants can be effectively removed by the first 2 to 5 feet of soil under unsaturated, aerobic conditions. Phosphorus and metals can be removed through adsorption, ion exchange, and precipitation reactions, but the capacity of soil to retain these ions is finite and varies with soil mineralogy, organic content, pH, reduction-oxidation potential, and cation exchange capacity. Nitrogen removal rates vary significantly, but most conventional SWISs do not achieve drinking water standards (i.e., 10 mg/L) for nitrate concentrations in effluent plumes. Evidence is growing that some types of viruses are able to leach with wastewater from subsurface infiltration systems to ground water. Longer retention times associated with virus removal are achieved with fine-texture soil, low hydraulic loadings, uniform dosing and resting, aerobic subsoils, and high temperatures. Toxic organics appear to be removed in subsoils, but further study of the fate and transport of these compounds is needed.

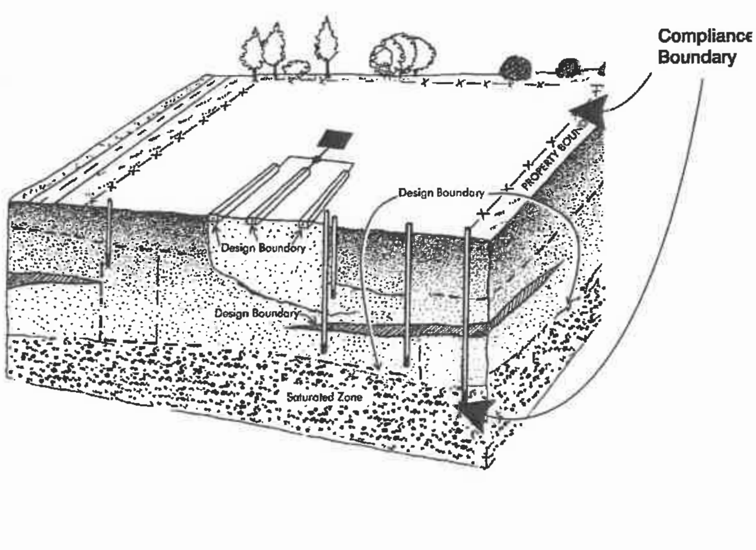
Subsurface wastewater infiltration systems do affect ground water quality and therefore have the potential to affect surface water quality (in areas with gaining streams, large macropore soils, or karst terrain or in coastal regions). Studies have shown that after the treated percolate enters ground water it can remain as a distinct plume for as much as several hundred feet. Concentrations of nitrate, dissolved solids, and other soluble contaminants can remain above ambient ground water concentrations within the plume. Attenuation of solute concentrations is dependent on the quantity of natural recharge and travel distance from the source, among other factors. Organic bottom sediments of surface waters appear to provide some retention or removal of wastewater contaminants if the ground water seeps through those sediments to enter the surface water. These bottom sediments might be effective in removing trace organic compounds, endotoxins, nitrate, and pathogenic agents through biochemical activity, but few data regarding the effectiveness and significance of removal by bottom sediments are available.

Public health and environmental risks from properly sited, designed, constructed, and operated septic tank systems appear to be low. However, soils with excessive permeability (coarse-texture soil or soil with large and continuous pores), low organic matter, low pH, low cation exchange capacities, low oxygen-reduction potential, high moisture content, and low temperatures can increase health and environmental risks under certain circumstances.

3.8 Establishing performance requirements

As noted in chapter 2, the OWTS regulatory authority and/or management entity establishes performance requirements to ensure future compliance with the public health and environmental objectives of the community. Performance requirements are based on broad goals such as eliminating health threats from contact with effluent or direct/indirect ingestion of effluent contaminants. They are intended to meet standards for water quality and public health protection and can be both quantitative (total mass load or concentration) or qualitative (e.g., no odors or color in discharges to surface waters). Compliance with performance requirements is measured at a specified performance boundary (see chapter 5), which can be a physical boundary or a property boundary. Figure 3-12 illustrates performance and compliance boundaries and potential monitoring sites in a cutaway view of a SWIS.

Figure 3-12. Example of compliance boundaries for onsite wastewater treatment systems



Design boundaries are where conditions abruptly change. A design boundary can be at the intersection of unit processes or between saturated and unsaturated soil conditions (e.g., the delineation between the infiltrative, vadose, and ground water zones) or at another designated location, such as a drinking water well, nearby surface water, or property boundary.

Performance requirements for onsite treatment systems should be established based on water quality standards for the receiving resource and the assimilative capacity of the environment between the point of the wastewater release to the receiving environment and the performance boundary designated by the management entity or regulatory authority. Typically, the assimilative capacity of the receiving environment is considered part of the treatment system to limit costs in reaching the desired performance requirement or water quality goals (see figure 3-12). The performance boundary is usually a specified distance from the point of release, such as a property boundary, or a point of use, such as a drinking water well or surface water with designated uses specified by the state water agency.

Achievement of water quality objectives requires that treatment system performance consider the assimilative capacity of the receiving environment. If the assimilative capacity of the receiving environment is overlooked because of increases in pollutant loadings, the treatment performance of onsite systems before discharge to the soil should increase. OWTSs serving high-density clusters of homes or located near sensitive receiving waters might be the subject of more stringent requirements than those serving lower-density housing farther from sensitive water resources.

Performance requirements for onsite systems should be based on risk assessments that consider the hazards of each potential pollutant in the wastewater to be treated, its transport and fate, potential exposure opportunities, and projected effects on humans and environmental resources. A variety of governmental agencies have already established water quality standards for a wide range of surface water uses. These include standards for protecting waters used for recreation, aquatic life support, shellfish propagation and habitat, and drinking water. In general, these standards are based on risk assessment processes and procedures that consider the designated uses of receiving waters, the hazard and toxicity of the pollutants,

SECTION VIII WATER WELLS

Article 6 - Required Water Quality Testing

Commented [EB1]: Revision date March 11, 2022

1. ~~Upon~~ **Transfer of Real Estate**

Prior to selling, conveying, or transferring title to real property (a "transfer" of real property is defined in these Board of Health regulations section 6.5) in the Town of Truro, the owner thereof shall:

a. Test the water of every private potable well serving that property. A water sample from each well shall be submitted to a certified laboratory for testing for the parameters outlined above in Article 4. This water quality test shall be performed not more than one year prior to transfer of the property.

b. the owner shall provide copies of all water test results of which they have knowledge (regardless of age of results) for the private potable well in question to any buyer and/or broker identified with the transfer. In the event that there is no buyer at the time the water is tested, a copy of all water test results must be given by the owner to the buyer before the property is put under agreement.

2. ~~Upon applying for a b~~**Building permit** application~~, other than an express permit.~~

A water quality analysis result from sampling completed within one calendar year of the date of submitted application for a building permit (other than an express permit) shall be provided with the application. The analysis must be of a water sample taken from the private well serving the facility and shall be submitted to a certified laboratory to analyze the following parameters: Sodium, Nitrate N, pH, iron, conductivity, coliform bacteria) and sampled as described in Article 4.2.d.

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3. ~~Upon applying for a~~ **D~~d~~isposal W~~w~~orks C~~c~~onstruction P~~p~~ermit** Application~~.~~

a. A water quality analysis result from sampling completed within one calendar year of the date of submitted application for a disposal works construction permit shall be provided with the application. The analysis must be of a water sample taken from the private well serving the facility and shall be submitted to a certified laboratory to analyze the following parameters: Sodium, Nitrate N, pH, iron, conductivity, coliform bacteria), and sampled as described in Article 4.2.d.

b. This applies to construction, upgrade and replacement of tanks, pump-chambers and leaching facilities. The replacement of the building sewer, tees, pumps, and distribution boxes, and the sealing of tanks are exempt from this requirement.

4. ~~Upon a~~New Appl**ication or renewal** ~~ying for or renewing~~ **a rental registration certificate from the Town of Truro.**

a. A water quality analysis result from sampling completed within 4 months of the application shall be submitted with the application for a rental registration renewal. The analysis must be of a water sample taken from the private well serving the facility and shall be submitted to a certified laboratory to analyze the following parameters: Sodium, Nitrate N, pH, iron, conductivity, coliform bacteria), and sampled as described in Article 4.2.d.

b. This analysis result must be provided prior to issuance of an annual rental registration certificate (as described in the Truro general bylaws Chapter 2 section 1).

Commented [EB2]: 1-25-2022: Proposal to change language to within 1 calendar year

5. **Upon submitting a septic Inspection report to the Town of Truro for a facility served by a private well.**

DRAFT

Minutes of the Truro Board of Health, Tuesday December 7, 2021
This was a remote meeting. Board members in attendance:
Chair Tracey Rose; Vice Chair, Jason Silva, Board members: Helen Grimm, Brian Koll; *Member Tim Rose and Alternate member Candida Monteith joined the call at 4:30.* Also Present: Health and Conservation Agent Emily Beebe.
The meeting was called to order at 4:05 PM by the Chair, Tracey Rose; she announced the remote meeting procedures and described the process for public participation.

Public Comment: In anticipation of comments, this was deferred til the end of the meeting.

Local Upgrade Approval: 127 & 133 South Pamet Road, Whitelaw/ Dennis:
Coastal Engineering Sanitarian John Schnaibel was present with the owner of 133 South Pamet Road, Thomas Dennis. The structure, referred to as "the Boathouse", (as it is in-part a portion of the former Pamet Lifesaving station) was relocated in 2010 and is again, in need of relocation. Mr. Dennis's neighbor, the Whitelaws, own 127 South Pamet Road have agreed to a plan that allows Mr.Dennis to relocate his structure onto the property at 127 South Pamet, via easements created for: the Boathouse location, the septic system area, and the well area. The sanitarian, John Schnaibel, explained that they seek 2 variances.
One variance pertains to the Board of Health regulation Section VI article 7.1- and 7.3 which states that septic systems shall be constructed on the same lot as the facility they are serving; although the septic tank will be installed on the lot that the house will be moved on, the leaching field would not be moved.
The second variance is to Section VI article 9, setbacks from the wetlands.
The Agent described the proposal approved by the Conservation Commission: The house would be relocated and the utilities would follow, with the exception of the leaching pit which would be removed when erosion of the the top of the Coastal bank was 15' from the pit. There was a question about the easements marked on the site plan. John Schnaibel confirmed that there was a well easement. A copy of the easement was requested.
It was suggested that the Board would want to see an I/A system on any future septic plans. The The Chair was not comfortable with the plan as proposed, Board members expressed concern about disturbing the natural area more than once if the leaching field was not expanded as part of the moving phase. Board member Helen Gimm agreed that though it is not a new house, it is a new location, and the septic upgrade plan should be in place.
Motion: Board Member Jason Silva moved to continue this request until the January 4, 2022 meeting. **Second**: Board Member Brian Koll ; **Vote:** 5-0, unanimously in favor.

Request to Extends a Waiver of Time: 2 Ryder Hollow Rd. Brundage Site Works:
No one represented the project. The Chair decided to move on from the request as there was nobody there to present the request.

Review proposed Board of Health Meeting Dates for December 2021 through December 2022
The Agent stated that there was a perennial conflict with the Board of Health and the Selectboard meeting dates and times in November and December. This year, there is a conflict for the December 21 meeting, and the Board agreed to cancel.

The Chair asked whether any of the Board Members had any conflicts with the proposed calendar; based on the discussion some of the meeting times and dates were shifted, and the Oct 4-2022 meeting was cancelled.

PUBLIC COMMENT- Karen Ruyman made requests that: the Town policy on vaccination and masking regarding the Public be posted on the Town website; that they post the Pond Village report on the website; could the Board consider making the 26 recommendations from the Commission as action Items.

Review of Local Health regulations, Section 6

The Agent suggested amending the requirements about installing an I/A system; it was suggested to rewrite it to read that if a septic system is non-compliant it must be brought into compliance The Agent explained that this section doesn't illustrate the spectrum of non-compliance. Chair Tracy Rose continued the amendment of the Board of Health Regulations to the next meeting.

Minutes: May 18th, 2021
Motion: The Chair moved to approve the minutes as amended
Second: Helen Grimm; Vote 5-0

Minutes: August 6, 2021
Motion: Brian Koll moved to approve the minutes
Second: Helen Grimm; Vote 5-0

Minutes: August 17, 2021
Motion: Brian Koll moved to approve the minutes
Second: Helen Grimm; Vote 5-0

Report of the Chair: Chair Tracey Rose reminded the members that there would be an opportunity to re-organize officers in the New Year, and to think about it!

Motion: Tim Rose to adjourn the meeting
Second from Jason Silva; the roll call vote was unanimously in favor, and the motion carried, 5-0.
Meeting adjourned at 5:30 PM

Minutes compiled by N. Richey

MDPH-Public Health Excellence Grant

CROSS-JURISDICTIONAL SHARING

Background

Massachusetts has 351 cities and towns, each of which has an autonomous Board of Health. Given the disparity in size and resources among municipalities, this has led to inconsistencies in local public health capacity to carry out statutory powers and duties and in resources available to smaller or less affluent communities. Despite its value, the use of shared services in Massachusetts has been limited.

The Special Commission on Local and Regional Public Health (SCLRPH) recommended that the number of Massachusetts local boards of health utilizing cross-jurisdictional services or shared services be increased as part of its blueprint for a more effective and efficient local public health system. The Commission noted in its final report (available at www.mass.gov/orgs/special-commission-on-local-and-regional-public-health) "By pooling resources, functions, and expertise, a consortium of cities and towns, especially those that are smaller or less prosperous, can improve compliance with their statutory and regulatory mandates and expand the protections and opportunities they offer residents". Shared services can be beneficial for health departments that believe by working together – pooling resources, sharing staff, expertise, funds and programs – across boundaries, they can accomplish more than they could do alone.

The national Center for Sharing Public Health Services (CSPHS) has identified a spectrum of public health sharing arrangements ranging from as needed or limited shared service arrangements to full regionalization/consolidation of all health services (see Spectrum of Cross-jurisdictional Sharing Arrangements in COMMBUYS). The spectrum provides useful framing for considering options for cross-jurisdictional sharing. Please note that this RFR is intended to support the more tightly integrated arrangements on the spectrum.

This RFR represents a unique opportunity to transform the Massachusetts local public health system into a public health system of the 21st Century and improve health and enhance equity for all. Building on existing infrastructure and respecting local autonomy, Massachusetts can offer new ways to organize and support local health departments to raise standards, strengthen collaboration, better use technology, improve skills, and stabilize resources.

PROGRAM PURPOSE:

Expand and formalize shared services arrangements to provide a more comprehensive and equitable set of public health services with a sustainable business model.

WHO DOES THIS INVOLVE:

Each town will have a representative on the Governance Board. Resources and assistance provided by MDPH, MAHB and CSPHS Roadmap.

HOW:

Governance board will include a representative from each town and will meet regularly under established rules of procedure to make democratic decisions about cross-jurisdictional policies, personnel, operations, and finances.

PHASE I:

Hire Cross Jurisdictional Sharing Coordinator for this project. Focus on "conceptual feasibility" with respect to cross-jurisdictional sharing arrangements. What type of agreement to use based on the needs of each municipality and available resources? Do we have many small arrangements, larger arrangements or a mix of both? What public health services can we add or improve upon?

As funding is made available, two additional staff will be hired to provide direct services to each town.

PHASE II

Look at results from Phase I and examine our priorities to develop a plan or plans for implementation. Sample agreements and resources for development of agreements are available through MDPH, MAHB and the Center for Sharing Public Health Services (CSPHS). To assist with developing plans, the CSPHS has identified a spectrum of public health sharing arrangements extending from as needed or limited shared service arrangements to full regionalization/consolidation of all health services.

As funding is made available, two additional staff will be hired to provide direct services to each town.

PHASE III

Focus on ensuring implementation meets the overall plan and goals for the sharing arrangement(s) as well as for the individual, participating municipalities. As opportunities to improve are identified, the governing body will continue to provide guidance to the Cross Jurisdictional Sharing Coordinator for the continued development of the program.

NOTE

As the program continues, we will cycle through phases I-III to continue to enhance current public health services across the County.

Next Steps:

- Confirm each town's participation in project and identify town representatives.
- Town will complete and return Letters of Commitment.
- Set up initial meeting to develop governance structure.
- Hire Cross- Jurisdictional Sharing (CJS) Coordinator.

**** Each municipality shall retain its board of health legal authority unless a municipality votes to delegate part or all of its authority to the governance board and the governance board votes to accept it. Boards of health must approve agreements to delegate their legal authority.****