July 30 Meeting – Points to discuss – Proposed by Anish Jantrania

<u>Point #1: Virginia Tech Research Summary</u>

Research Period – From November 1999 to June 2001 (22 Months)

Septic Tank Effluent (STE) versus Recirculating Media Filter (RMF) Effluent – Effects of Loading Rate, Soil Depth, and Fecal Coliform; Column study and Field study.

COLUMN STUDY

RMF + Soil FC >200 counts					**RMF Sample Size**					**RMF Sampling Attempts**			
	2x	3x	5x			2x	3x	5x			2x	3x	5x
15	6		9		15	16		26		15	34		51
30	11	7	13		30	27	26	33		30	51	34	51
45	9		12		45	42		27		45	51		51
STE + Soil FC >200 counts					**STE Sample Size**					**STE Sampling Attempts**			
	1x					1x					1x		
45	23				45	27				45	51		
RMF % FC >200 counts					**Overall Probability for FC >200 w/ RMF ={(samples/attempts)*(hits/samples)}**								
	2x	3x	5x			2x	3x	5x					
15	38%		35%		15	18%		18%					
30	41%	27%	39%		30	22%	21%	25%					
45	21%		44%		45	18%		24%					
STE + Soil % FC >200 counts					**Overall Probability for FC >200 w/ STE**								
	1x					1x							
45	85%				45	45%							
GeoMean RMF+Soil	Excluding 0 and missing values												
	2x	3x	5x										
15	220		91										
30	120	148	121										
45	82		341										
GeoMean STE+Soil	Excluding 0 and missing values												
	1x												
45	745												

FIELD STUDY

RMF Sample Size				
	1x	2x	5x	
15	13	11	8	
30	14	11	12	
45	Not Done	7	20	
				96
STE Sample Size				
	1x			
45	29			*29*
			Total Samples =	125
			Samples >0 =	2
			1 sample for STE	
			1 sample for RMFE	
			STE+45cm1x=	150
			RMFE+45cm5x=	1

Photo of Soil Column at the end of the study period

Photo from Prof. Ray Reneau, Virginia Tech.

Pictures of Drip System from two sites in Virginia

Drip system dispersing STE

Drip system dispersing Sand Filter Effluent

Photos taken by Anish Jantrania with Lots of help from Bob Mayer and Tom Ashton.

THIS DOES NOT MEAN THAT SEPTIC TANK EFFLUENT DISPERSAL IN SOIL IS A BAD IDEA! WE JUST NEED TO CONSIDER BETTER LOADING RATE NUMBERS FOR STE!

STE Effluent Drain Field after some years of use Real World Pictures

Source: Friends from GA (Gravity System)

Source: Friends from WA (Pressure System)

Point #2 Defining Prescriptive Drain Field Design For Achieving Performance Standards

Approach #1 Loading Rate and Horizontal Setbacks

- Hydraulic loading rate cannot be greater than allowable organic loading rate;
- Organic loading rate must be decreased for sites where depth of aerobic soil is less than 18"
- Hydraulic loading rate cannot be greater than some fraction of Ksat for Ksat values >1 cm/day

Loading Rate Adjustment for Treatment (TS1, TS2, TS3, and TS4 & Available Vertical Standoff (>18", 12"-18", 6"-12", and <6")

Following Arizona Formula for Treatment Credits & Anish's Proposal for Loading Rate Adjustment for Available Vertical Standoff, following adjustment values are proposed:

					% Increase in LR	**75%**	**150%**	**300%**
					TS1	**TS2**	**TS3**	**TS4**
% Reduction in LR		0.00150	**IC1**		1.00	1.75	2.50	4.00
	50%	0.00075	**IC2**		0.50	1.25	2.00	3.50
	70%	0.00045	**IC3**		0.30	1.05	1.80	3.30
	90%	0.00015	**IC4**		0.10	0.85	1.60	3.10
			BOD mg/l =		***300***	*30*	*15*	*3*
		% Reduction in BOD =				*90%*	*95%*	*99%*

Applying Safety Factors to Measured or Estimated Ksat (Saturated Hydraulic Conductivity) Values for Calculating Loading Rates

Ksat Class	Typical range **cm/day**	% of Ksat Allowed for TBA
Very High	≥ 864	5%
High	86.4 - 864	10% - 5%
Moderately High	8.64 - 86.4	15% - 10%
Moderately Low	0.864 - 8.64	20% - 15%
Low	0.086 - 0.864	25% - 20%
Very Low	< 0.086	25%

MINIMUM ALLOWABLE TRENCH BOTTOM AREA LOADING RATES FOR MEASURED OR ESTIMATED KSAT <1 CM/DAY (IMPERMEABLE SOIL)

TS1 = 0.01 GPD/SQFT
TS2 = 0.06 GPD/SQFT
TS3 = 0.12 GPD/SQFT
TS4 = 0.60 GPDSQFT (Demo projects in VA support this number!)

USE THE LOADING RATE CALCULATOR DEVELOPED BY ANISH JANTRANIA FOR DETERMING TRENCH BOTTOM AREA LOADING RATE FOR YOUR SITE.

Horizontal Setback Adjustment Proposal for Treatment & Management

			EPA Management Model 1, 2, 3	EPA Management Model 4, 5			
TS =	**TS4**	TS2	10%	30%			
Management =	**Model 4, 5**	TS3	15%	50%			
		TS4	20%	70%			
Reduction Factor =	**0.70**						
	Example: Distance from Edge of Effluent System to Property Lines						
		for TS4 & Management Model 4, 5 = 100*(1-.7) = 30 feet					
	NOTE: Management Model 4, 5 are STRONGLY RECOMMENDED for TS3 and TS4						

Horizontal Setback Chart for TS4 and Management Model 4, 5:

Structure or Topographic Features	Minimum Distance (Ft) from Edges of Effluent Disposal System to Features	
	FOR TS1 and Management 1, 2, 3	For Higher Treatment
Property Lines Up Gradient (Slope>5%)	10	5
Property Lines Down Gradient (Slope>5%)	**100**	30
Building Foundations	10	5
Basements	20	10
Active Groundwater Water Wells		
Class IIIA or IIIB	50	15
Class IIIC or IV	100	30
Abandon Ground Water Wells		
Class IIIA or IIIB	25	10
Class IIIC or IV	50	15
Cisterns (Applicable only when bottom elevation of cistern is lower than ground surface)	100	30
Shellfish Waters	70	25
Natural Lakes & Impounded Waters	50	15
Streams	50	15
Developed Springs (Applicable only when the spring is down slope)	200	60
Drainage Ditches when Ditch Bottoms above Seasonal Water Table	10	5
Drainage Ditches when Ditch Bottom below Seasonal	70	25
Water Table Depressor System	70	25
Lateral Ground Water Movement Interceptor	70	25
Low Point of Sink Holes	100	30
Utility Lines	10	5

Use the Spreadsheet to determine values for different TS and Management.

Approach #2 Flow-Area-Index and Horizontal Setbacks

When the designer (Professional Engineer) wants to deviate from the Loading Rate Calculator then the Flow-Area-Index (Ratio of Flow to Project Area – FAI) must meet the following proposed inch/year values:

Suggested FAI:			
	Management Model Proposed		
Treatmetn Levels	EPA Management Model 1, 2, 3	EPA Management Model 4, 5 Pvt	EPA Management Model 4, 5 Pub
TS1 (Septic Tank)	**0.6**	**1.2**	**1.5**
TS2 (Secondary)	**1.2**	**4.0**	**5.0**
TS3 (Secondary + Disinfection)	**2.4**	**5.0**	**6.0**
TS4 (TS3 + Nutrient Reduction)	**3.0**	**6.0**	**>6.0**

FAI (inch/year) = $0.01344x\frac{GPD}{Acres}$

Where *GPD* = Proposed Design Flow and *Acres* = Project area in Acres.

Management models 4 & 5 are strongly recommended for TS3 and TS4.

With FAI and Horizontal Setbacks requirements met, the designer (Professional Engineer) and the Management Entity (RME/Utility) can select any loading rate for drain field as long as hydraulic performance requirements (no sewage back and no surfacing) are assured.

The proposed values of FAI ensure that the pollution load impact from a proposed onsite system will be contained within the property boundaries, thus ensuring no adverse cumulative impact on environmental quality from multiple onsite systems within any watershed boundary or political boundary.

An onsite system design is only ⅓rd of the total equation. The system must be installed according to the design (assuming that an installer can install the system that is designed), and then the system must be managed (operated and maintained) based on the design specifications in order to get the system to perform.

Performance quality = Design quality + Installation quality + Management quality.

Also, cumulative impact of the systems operated within a drainage basin must be accounted for in order to assure no adverse impact on environmental quality. This means that all the permitted systems must be able to “assimilate” waste load within the property on which the waste is generated. The suggested FAI chart is expected to achieve this goal and thus proposed for starting the performance based regulatory program in VA.