Well Design Specifications

Taylors Lane Compositing Site - Mamaroneck, NY

Criteria		**Basis of Design**
Well Diameter	14-in	Well diameter must be large enough to accomodate the pump and to maintain uphole velocity of 5 ft/s or less From Driscoll (1986) for wells with anticipated discharges of 100 gpm or less, the range of casing diameters is 5 to 6 in. Also, need to maintain <0.1 ft/s entrance velocity (see below).
Screen Material	Stainless Steel Type 304	From Driscoll (1986) this type of stainless steel has excellent corrosion resistence and is most commonly used stainless steel material for water well screens
Casing Material	Carbon Steel	
Screen Slot Type	Continuous wire-wound	Provides greatest amount of open area
Well Depth (ft)	14	The well depth will extend to the top of the lower sand layer, which was encountered at approximately 13.7 feet below existing grade.
Screen Length (ft)	6	From Driscoll (1986), theoretical considerations and experience have shown that screening 1/3 to 1/2 of an aquifer less than 150 ft. thick provides the optimum design for homogeneous and hetergeneous unconfined aquifers. Additional consideration as it relates to entrance velocity is also needed. Must balance between well diameter, screen length and required yield to achieve the appropriate entrance velocity of < = 0.1 ft/s (see below). This will allow the well to produce up to 365 gpm without having an entrance velocity above 0.1 ft/s.
Filter Pack Material effective grain size (d10) uniformity coefficient chem. Composition thickness type	 0.035 1.4 > = 90% silica 3 in < t < 8 in No. 1	Determined from grain size distribution. The finest materials were encountered at 10 to 13.7 ft from boring LWB, sample S3, which was used to detemine the slot size and filter pack design. Taking d30/D70 grain size from the finest sample which is 0.3459 mm (0.014 in) multiple this value by factor of 3 to 6 depending on formation characteristics.
Screen Slot Size (in)	0.03	slot size retaining 90% to 99% of filter pack

Leachate Well Samples
Grain Size Distribution Data
Taylors Lane Composting Site - Mamaroneck, NY

Formation Data					
			% Passing		
Sieve	Sieve Size (mm)	Sieve Size (in/1000)	S1	S2	S3
			3 ft to 5 ft	5 ft to 10 ft	10 ft to 13.7 ft
0.375	9.51	374.4	100	100	100
#4	4.75	187.0	82.3	80.7	87.7
#10	2	78.7	65	65.7	71.1
#20	0.841	33.1	44.7	46.2	53.3
#40	0.42	16.5	27.3	29.7	35.1
#60	0.25	9.8	16.5	18.6	21.9
#140	0.105	4.1	7.8	8.7	10.7
#200	0.074	2.9	5.4	6	7.6
	d10 (mm)		0.132	0.1183	0.0984
	d30 (mm)		0.4737	0.4311	0.3459
	d50 (mm)		1.0617	1.0047	0.749
	d60 (mm)		1.6199	1.5574	1.173
	d10 (in/1000)		5.20	4.66	3.87
	d30 (in/1000)		18.65	16.97	13.62
	d50 (in/1000)		41.80	39.56	29.49
	d60 (in/1000)		63.78	61.31	46.18
	U (Uniformity Coefficient)		12.27	13.16	11.92
	n (porosity)		0.28	0.28	0.28

Design Filter Pack Data			
	% Passing		
d30 (S3)	30	13.6	in/1000
3X d30 S3	30	40.9	in/1000
6X d30 S3	30	81.7	in/1000

Typical Commercial Filter Packs

No. 1		in	thousands in	%Passing	%Retained
d10	35	0.094	94	100	0
d60	50	0.067	67	95	5
U	1.4	0.045	45	45	55
d50	47.5	0.033	33	5	95
d30	40	0.023	23	1	99
No. 2		**in**	**thousands in**	**%Passing**	**%Retained**
d10	45	0.132	132	100	0
d60	70	0.094	94	95	5
U	1.6	0.067	67	55	45
d50	66.7	0.045	45	10	90
d30	55	0.033	33	1	99

Taylors Lane Composting Site - Mamaroneck, NY

HYDRAULIC CONDUCTIVITY CALULATIONS FROM GRAIN SIZE DISTRIBUTION CURVES

Methods

Kozeny-Carmen, 1927, 1933, & 1956

$$K = \frac{g}{v} \times 8.3 \times 10^{-3} \left[\frac{n^3}{(1-n)^2} \right] d_{10}^2$$

K = hydraulic conductivity, (m/s)
g= acceleration due to gravity m/s2
v= kinematic viscosity (m2/s)
n= porosity
d10 = 10% passing grain size, (m)

$$\boxed{\eta = 0.255 * \left(1 + 0.83^U\right)}$$

Breyer, 1964 (from Vukovic and Soro, 1992)

$$\boxed{K = Cd^2}$$

$$\boxed{C = 4.5x10^{-3} \log \frac{500}{U}}$$

K = hydraulic conductivity, (m/s)
C= empirical coefficient based on uniformity coefficient
U = uniformity coefficient
d = effective grain size (d10), (mm)
Domain of applicability = 0.06 mm < d10 < 0.6 mm & 1 < n < 20

Slitcher, 1897-1898 (from Vukovic and Soro, 1992)

$$\boxed{K = 4960 * M * d^2}$$

K = hydraulic conductivity, (m/d)
d = effective grain size (d10), (mm)
M = coefficient dependant on porosity assuming 0.28 porosity, therefore M = 0.01517
Domain of applicability = 0.01 mm < d10 < 5 mm

Hydraulic Conductivity Calculation Results

Boring	**LWB**	**LWB**	**LWB**				
Sample	S-1	S-2	S-3				
Depth (ft)	3 to 5	5 to 10	10 to 13.7				
d10 (mm)	0.132	0.1183	0.0984				
d30 (mm)	0.4737	0.4311	0.3459				
d50 (mm)	1.0617	1.0047	0.749				
d60 (mm)	1.6199	1.5574	1.173				
U (Uniformity Coefficient)	12.27	13.16	11.92				
n (porosity)	0.28	0.28	0.28	Geometric Mean			
				m/s	m/d	ft/d	cm/s
Kozeny-Carmen (m/s)	4.7E-05	3.5E-05	2.6E-05	3.5E-05	3.0	10.0	0.004
Breyer (m/s)	1.3E-04	9.9E-05	7.1E-05	9.6E-05	8.3	27.2	0.010
Slitcher (m/s)	1.5E-05	1.2E-05	8.4E-06	1.2E-05	1.0	3.3	0.001

Taylors Lane Composting Site - Mamaroneck, NY

EQUILIBRIUM DRAWDOWN CALCULATIONS

Governing Equation

Theim (1906) Equation for equilibrium radial flow in unconfined aquifers (from Driscoll, 1986)

$$\boxed{Q = \frac{K(H^2 - h^2)}{1055 * \log(R/r)}}$$

Assumptions and Definitions

K (avg)	10	ft/d	hydraulic conductivity based on grain size analysis
K (avg)	75.7	gpd/ft2	
Q	2.0	gpm	discharge rate
	5	gpm	
	10	gpm	
	25	gpm	
R	1 to 10	ft	radius of equilibrium cone of depression
r	0.58	ft	well radius
log (R/r)			
H	10	ft	distance from bottom of aquifer to static water level (ie staurated thickness)
h	?	ft	distance to equilibrium water level
H-h	?	ft	difference between static water level and equilibrium water level (ie drawdown)

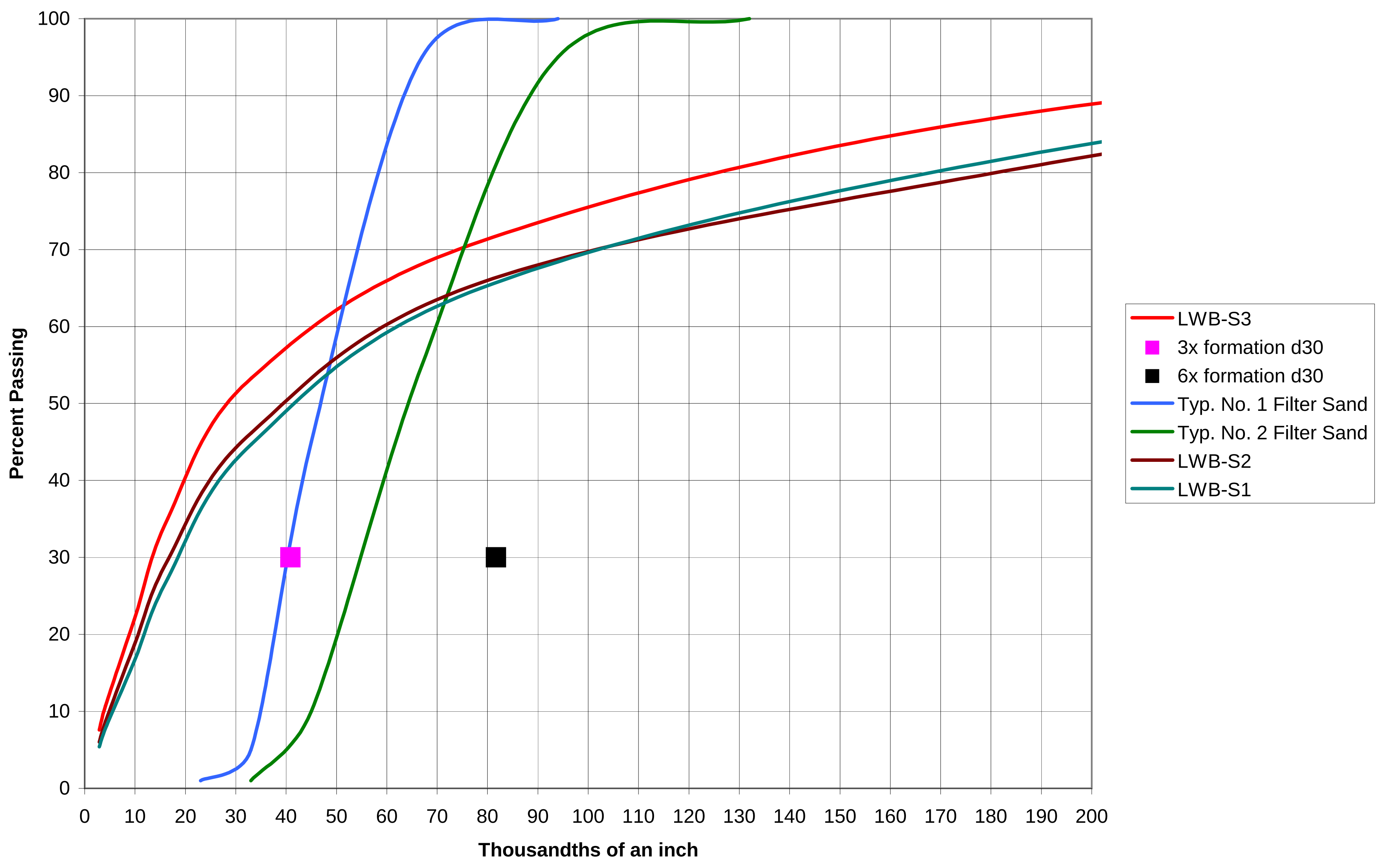
Equilibrium drawdown calculations for different cases

Case	A	B	C	D	E	F	G	H
Q (gpm)	2	2	5	5	10	10	25	25
log R/r	2.2	0.2	1.2	0.2	1.2	0.2	1.2	0.2
h	6.1	9.7	3.7	9.1	#NUM!	8.2	#NUM!	4.2
H-h	3.9	0.3	6.3	0.9	#NUM!	1.8	#NUM!	5.8

Entrance Velocity Calculations

Well diameter (in)	14
screen length (ft)	6
Total screen area (sq. ft.)	21.98
percent open area	0.25
open area[1] (sq. ft.)	5.54
Q (gpm)	2
	5
	10
	25
	250
Velocity (ft/s) @ 2gpm	0.0008
@ 5 gpm	0.002
@ 10 gpm	0.004
@ 25 gpm	0.010
@ 250 gpm	0.101

1. Based on JohnsonsWell Screens company - continuous wire wound stainless steel screen



Percent Passing
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
Thousandths of an inch
LWB-S3
3x formation d30
6x formation d30
Typ. No. 1 Filter Sand
Typ. No. 2 Filter Sand
LWB-S2
LWB-S1

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