Mounding Analysis
343 & 333 Weymouth Street
Rockland, Massachusetts

Mounding Analysis

A groundwater mounding calculation for subsurface infiltration system 1P has been conducted using MOUNDSOLV Groundwater Mounding Analysis for ground water mounding beneath an infiltration basin with 4-feet of separation to groundwater.

The mounding analysis demonstrates that the Required Recharge Volume is fully dewatered and the groundwater mound does not break out above the land within the 72-hour evaluation period.

System Inputs

Test pits were conducted on November 22, 2022 to determine the Vertical Soil Permeability of the soil in the area of the proposed infiltration system (1P) based on the Rawls Rate Table provided in the MADEP Stormwater Handbook:

Test Pit #	Soil Texture	Vertical Soil Permeability (in/day)	Vertical Soil Permeability (ft/day)	Estimated Seasonal High Groundwater (elevation)
1B	Sandy Loam	1.02	2.04	150.6 (28" to Redox)

Recharge Rate Infiltration:

Vertical Soil Permeability based on the Rawls Table for Sandy Loam (see test pits) = 1.02 in/hr. = 2.04 feet/day.

Estimated Specific Yield

Specific yield of 0.19 from Johnson (1967).

Horizontal Hydraulic Conductivity Kh (ft/day)

Kh for Sandy Loam = 50 ft/day (Vermont Mounding Powerpoint)

Recharge (Infiltration) Area

The infiltration area has an irregular shape with a bottom surface area of 3,234 square feet. Therefore, the shape needs to be converted to a rectangular shape that has the same surface area and is best fit to the original shape.

The square root of 3,234 square feet = 56.87'. Therefore, L=56.87' & W=56.87'.

Recharge Rate

100 yr storm total discharge volume= 10,875 cubic feet

R=Q/A

$$\frac{\text{100 yr storm Volume}}{\text{Bottom area of basin}} \quad \frac{\text{10,875 cubic feet/day}}{\text{3,234.06 square feet}} = 3.363 \text{ ft/day}$$

Duration of infiltration (t)

t=24 hours or 1 day.

Total duration of simulation

72 hours or 3 days after 24-hour storm event.

Initial Saturated Thickness (hi):

The initial saturated thickness of the aquifer is the difference between the estimated seasonal high groundwater to bedrock. Well data from 2 Sharp Street shows a depth to bedrock of 24 feet.

Initial saturated thickness = 24 feet-2.33 feet (depth to redox) = 21.67 ft.

Results

See Exhibits

MOUNDSOLV
GROUNDWATER MOUNDING ANALYSIS
FOR A SLOPING WATER-TABLE AQUIFER
ZLOTNIK ET AL. (2017) SOLUTION

Solution Method

Zlotnik et al. (2017) transient solution for a rectangular source (linearization method 1)

Site Description

Aquifer Data

Property	Value
Horizontal hydraulic conductivity, K (ft/d)	50
Specific yield, Sy	0.19
Initial saturated thickness, h_0 (ft)	21.67
Maximum allowable water-table rise, σ (ft)	4
Dip, i (ft/ft)	0
Slope rotation from x axis, γ (°)	0

Recharge Sources

Property	Source 1
X coordinate at center, X (ft)	0
Y coordinate at center, Y (ft)	0
Dimension along x* axis, L (ft)	56.87
Dimension along y* axis, W (ft)	56.87
Rotation from slope direction, ϕ (°)	0
Recharge rate, Q (ft³/d)	10875.3105
Infiltration rate, q (ft/d)	3.3626
Recharge duration, t_0 (d)	1

Monitoring Points

Elapsed Time, t = 4 d

Name	x (ft)	y (ft)	s (ft)	h (ft)	z (ft)
Source 1	0	0	0.2282	21.9	0

Time Series Data

Time	Source 1	
(d)	s (ft)	h (ft)
0	0	21.67
0.002327	0.04119	21.71
0.005236	0.09267	21.76
0.008873	0.1568	21.83
0.01342	0.2353	21.91
0.0191	0.3285	22
0.0262	0.4357	22.11
0.03508	0.5552	22.23
0.04618	0.6853	22.36
0.06005	0.8245	22.49
0.07739	0.971	22.64
0.09906	1.124	22.79
0.1262	1.281	22.95
0.16	1.443	23.11
0.2024	1.608	23.28
0.2553	1.775	23.45
0.3214	1.945	23.62
0.4041	2.116	23.79
0.5075	2.289	23.96
0.6366	2.463	24.13
0.7981	2.638	24.31
1	2.813	24.48
1.007	2.695	24.37
1.016	2.552	24.22
1.027	2.392	24.06

1.04	2.226	23.9
1.057	2.058	23.73
1.079	1.892	23.56
1.105	1.729	23.4
1.139	1.57	23.24
1.18	1.417	23.09
1.232	1.27	22.94
1.297	1.13	22.8
1.378	0.9972	22.67
1.48	0.8733	22.54
1.607	0.7586	22.43
1.766	0.6535	22.32
1.964	0.5585	22.23
2.212	0.4735	22.14
2.522	0.3984	22.07
2.91	0.3329	22
3.394	0.2764	21.95
4	0.2282	21.9

Profile Data

Profile Along X Axis for Source 1 at Elapsed Time, t = 4 d*

x* (ft)	s (ft)	h (ft)	z (ft)
-57	0.2191	21.89	0
-54.72	0.2198	21.89	0
-52.44	0.2204	21.89	0
-50.16	0.2211	21.89	0
-47.88	0.2217	21.89	0
-45.6	0.2223	21.89	0
-43.32	0.2229	21.89	0
-41.04	0.2234	21.89	0

-38.76	0.2239	21.89	0
-36.48	0.2244	21.89	0
-34.2	0.2249	21.89	0
-31.92	0.2253	21.9	0
-29.64	0.2257	21.9	0
-27.36	0.2261	21.9	0
-25.08	0.2264	21.9	0
-22.8	0.2267	21.9	0
-20.52	0.227	21.9	0
-18.24	0.2273	21.9	0
-15.96	0.2275	21.9	0
-13.68	0.2277	21.9	0
-11.4	0.2279	21.9	0
-9.12	0.228	21.9	0
-6.84	0.2281	21.9	0
-4.56	0.2282	21.9	0
-2.28	0.2282	21.9	0
0	0.2282	21.9	0
2.28	0.2282	21.9	0
4.56	0.2282	21.9	0
6.84	0.2281	21.9	0
9.12	0.228	21.9	0
11.4	0.2279	21.9	0
13.68	0.2277	21.9	0
15.96	0.2275	21.9	0
18.24	0.2273	21.9	0
20.52	0.227	21.9	0
22.8	0.2267	21.9	0
25.08	0.2264	21.9	0
27.36	0.2261	21.9	0
29.64	0.2257	21.9	0
31.92	0.2253	21.9	0

34.2	0.2249	21.89	0
36.48	0.2244	21.89	0
38.76	0.2239	21.89	0
41.04	0.2234	21.89	0
43.32	0.2229	21.89	0
45.6	0.2223	21.89	0
47.88	0.2217	21.89	0
50.16	0.2211	21.89	0
52.44	0.2204	21.89	0
54.72	0.2198	21.89	0
57	0.2191	21.89	0

The axes of Source 1 (x, y*) are rotated 0° from the axes of mapping coordinate system (x, y)*

Profile Along Y Axis for Source 1 at Elapsed Time, t = 4 d*

y* (ft)	s (ft)	h (ft)	z (ft)
-57	0.2191	21.89	0
-54.72	0.2198	21.89	0
-52.44	0.2204	21.89	0
-50.16	0.2211	21.89	0
-47.88	0.2217	21.89	0
-45.6	0.2223	21.89	0
-43.32	0.2229	21.89	0
-41.04	0.2234	21.89	0
-38.76	0.2239	21.89	0
-36.48	0.2244	21.89	0
-34.2	0.2249	21.89	0
-31.92	0.2253	21.9	0
-29.64	0.2257	21.9	0
-27.36	0.2261	21.9	0
-25.08	0.2264	21.9	0

-22.8	0.2267	21.9	0
-20.52	0.227	21.9	0
-18.24	0.2273	21.9	0
-15.96	0.2275	21.9	0
-13.68	0.2277	21.9	0
-11.4	0.2279	21.9	0
-9.12	0.228	21.9	0
-6.84	0.2281	21.9	0
-4.56	0.2282	21.9	0
-2.28	0.2282	21.9	0
0	0.2282	21.9	0
2.28	0.2282	21.9	0
4.56	0.2282	21.9	0
6.84	0.2281	21.9	0
9.12	0.228	21.9	0
11.4	0.2279	21.9	0
13.68	0.2277	21.9	0
15.96	0.2275	21.9	0
18.24	0.2273	21.9	0
20.52	0.227	21.9	0
22.8	0.2267	21.9	0
25.08	0.2264	21.9	0
27.36	0.2261	21.9	0
29.64	0.2257	21.9	0
31.92	0.2253	21.9	0
34.2	0.2249	21.89	0
36.48	0.2244	21.89	0
38.76	0.2239	21.89	0
41.04	0.2234	21.89	0
43.32	0.2229	21.89	0
45.6	0.2223	21.89	0
47.88	0.2217	21.89	0

50.16	0.2211	21.89	0
52.44	0.2204	21.89	0
54.72	0.2198	21.89	0
57	0.2191	21.89	0

The axes of Source 1 (x, y*) are rotated 0°*
from the axes of mapping coordinate system (x, y)

Sensitivity Data

Source 1, x=0 ft, y=0 ft

Parameter	Water-Table Rise (ft)		
Multiplier	**K**	**Sy**	**h_0**
0.5	0.4533	0.229	0.4533
0.575	0.3949	0.2289	0.3949
0.65	0.3498	0.2288	0.3498
0.725	0.314	0.2286	0.314
0.8	0.2848	0.2285	0.2848
0.875	0.2606	0.2284	0.2606
0.95	0.2401	0.2283	0.2401
1.025	0.2227	0.2282	0.2227
1.1	0.2076	0.2281	0.2076
1.175	0.1944	0.2279	0.1944
1.25	0.1828	0.2278	0.1828
1.325	0.1725	0.2277	0.1725
1.4	0.1633	0.2276	0.1633
1.475	0.155	0.2275	0.155
1.55	0.1476	0.2274	0.1476
1.625	0.1408	0.2272	0.1408
1.7	0.1346	0.2271	0.1346
1.775	0.129	0.227	0.129
1.85	0.1237	0.2269	0.1237
1.925	0.119	0.2268	0.119
2	0.1145	0.2267	0.1145

Notation

h is water-table elevation above datum[1]
h_0 is aquifer saturated thickness prior to mounding
i is dip of aquifer
K is horizontal hydraulic conductivity
L is dimension of recharge source parallel to x^* axis
q is infiltration rate ($= Q / L \cdot W$)
Q is recharge rate
s is water-table rise above static water table
Sy is specific yield
t is time since start of recharge
t_0 is time when recharge stops
W is dimension of recharge source parallel to y^* axis
x, y are mapping Cartesian coordinate axes
x^*, y^* are recharge source Cartesian coordinate axes
z is elevation above datum[1]
γ is angle between x axis and dip direction
ϕ is angle between dip direction and x^* axis of recharge source
σ is maximum acceptable water-table rise

[1]*Elevation datum is the base of aquifer beneath the center of primary recharge source*

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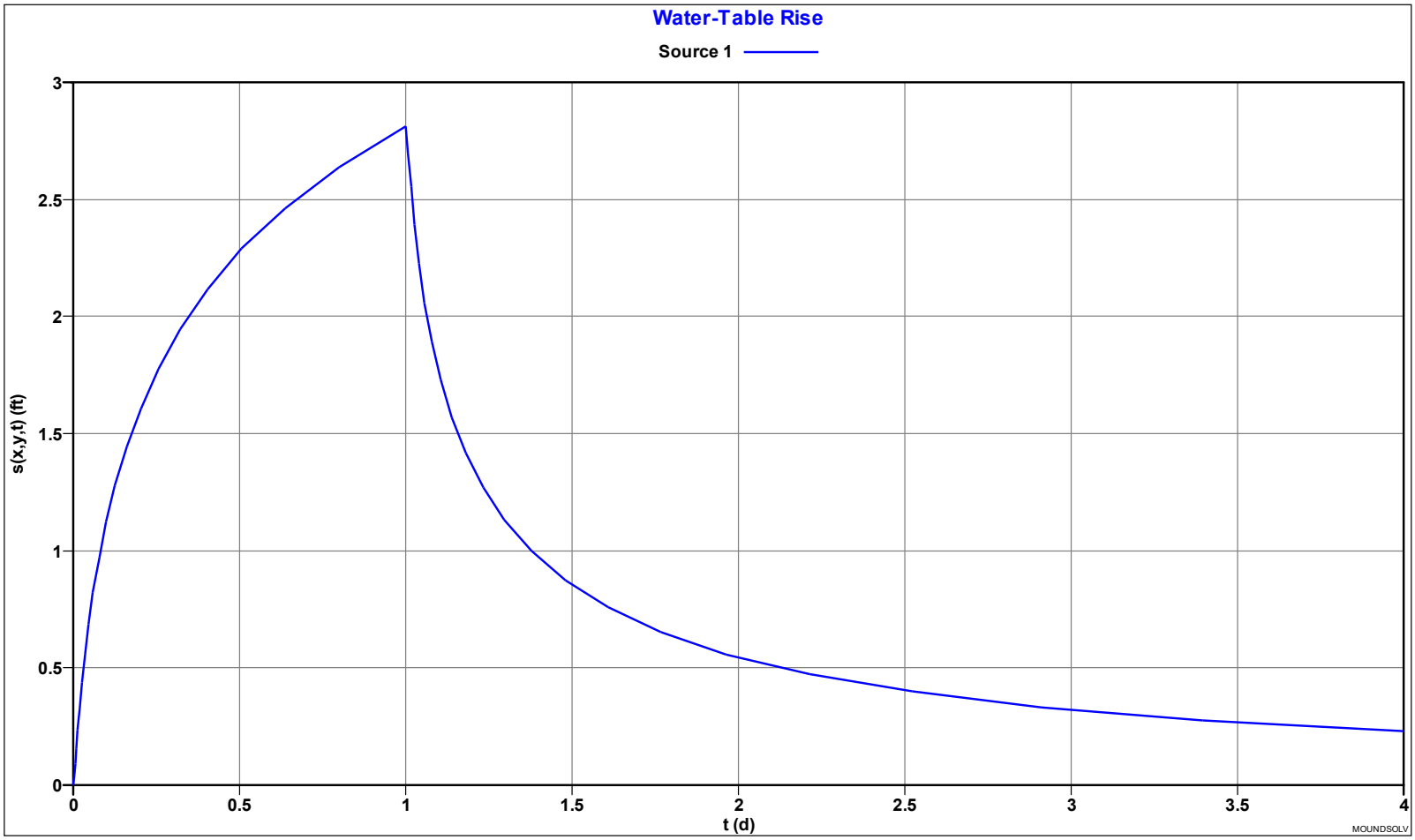
Water-Table Rise
Source 1
s(x,y,t) (ft)
t (d)
0
0.5
1
1.5
2
2.5
3
3.5
4
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