APPENDIX A
NOMENCLATURE

WF1, WF2	$[-]$	Wetting front 1 and 2 of the GAR method
Z	$[L]$	Wetting front depth
Z_1, Z_2	$[L]$	Wetting front 1 and 2 depths
Z_3, Z_4	$[L]$	Wetting front 3 and 4 depths
Z_{i1}, Z_{i2}	$[L]$	Top and bottom wetting depths of interest
θ_s	$[L^3 L^{-3}]$	Saturated water content
θ_r	$[L^3 L^{-3}]$	Residual water content
θ_i	$[L^3 L^{-3}]$	Initial water content
θ_{wp}	$[L^3 L^{-3}]$	Wilting point water content
θ_o	$[L^3 L^{-3}]$	Surface water content
θ_1, θ_2	$[L^3 L^{-3}]$	Water contents of wetting fronts 1 and 2
θ_{0-50}	$[L^3 L^{-3}]$	Average water content, observation layer 0-50 cm
θ_{50-100}	$[L^3 L^{-3}]$	Average water content, obs. layer 50-100 cm
Θ_o	$[-]$	Relative surface water content
h_b	$[L]$	Bubbling pressure
λ	$[-]$	Pore size distribution index
K_s	$[LT^{-1}]$	Saturated hydraulic conductivity
S_{av}	$[L]$	Suction at the wetting front
FC	$[L^3 L^{-3}]$	Field capacity
α	$[L^{-1}]$	van Genuchten parameter
n	$[-]$	van Genuchten parameter
m	$[-]$	van Genuchten parameter
f_p	$[LT^{-1}]$	Potential infiltration rate
F	$[L]$	Cumulative infiltration
F_1, F_2	$[L]$	Cumulative infiltration of wetting fronts 1 and 2
F_3, F_4	$[L]$	Cumulative infiltration of wetting fronts 3 and 4
WC_1, WC_2	$[L^3 L^{-3}]$	Water contents of wetting fronts 1 and 2
WC_3, WC_4	$[L^3 L^{-3}]$	Water contents of wetting fronts 1 and 2
WCO	$[L^3 L^{-3}]$	Surface water content
RWC	$[L^3 L^{-3}]$	Relative water content at surface
C_{eff}	$[-]$	Nash and Sutcliffe (1970) coefficient of efficiency
Γ	$[L^3 L^{-3}]$	Redistribution coefficient
T_R	$[T]$	Redistribution time
N_R	$[-]$	Redistribution number
Q	$[L3T-1]$	Emitter flow rate
r_o	$[L]$	Emitter supply radius
$\Delta\theta$	$[L^3 L^{-3}]$	Soil water deficit
R	$[L]$	Wetting front radius
R0	$[L]$	Maximum wetted radius
R1	$[L]$	Maximum wetted depth
smax	$[L]$	Maximum ponding depth allowed at surface

ncells   [–]   Number of cells for 3DGAR grid (ncells x ncells)
dL   [L]   Size of cells for 3DGAR grid

APPENDIX B
SAMPLE MGAR 1D INPUT FILES

Units: Length [mm], Time [h]

_____c:\MGARInputFiles\clay_soil.txt_____

0.6	622.5	0.385	0.272	0.090	373.0	0.165	0.0	0.296
3	365	1.0						
500.0	500.0	1000.0						
0.0	500.0	0.0						

_____

K_s S_{av} θ_s θ_i θ_r h_b λ s_{max} FC
NumObsLayers   PrecipCount   deltaT
ProfileDepth[1] ProfileDepth[2] ProfileDepth[3]
TopObsLayer[1] TopObsLayer[2] TopObsLayer[3]

_____c:\MGARInputFiles\clay_rain.txt_____

10	10	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	10
20	10	10	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	10	10	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	20	10	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	10	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	10	10	20	20	10
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	20	20	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	10	20	20	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0							

_____

(Precips[k], k = 1, precipCount) (all values in a continuous line)

SAMPLE MGAR 1D OUTPUT FILES

Z_1, Z_2	[L]	Wetting front 1 and 2 depths
Z_3, Z_4	[L]	Wetting front 3 and 4 depths
F_1, F_2	[L]	Cumulative infiltration of wetting fronts 1 and 2
F_3, F_4	[L]	Cumulative infiltration of wetting fronts 3 and 4
WC_1, WC_2	[L^3L^{-3}]	Water contents of wetting fronts 1 and 2
WC_3, WC_4	[L^3L^{-3}]	Water contents of wetting fronts 1 and 2
WCO	[L^3L^{-3}]	Surface water content
RWC	[L^3L^{-3}]	Relative water content at surface
θ_{0-50}	[L^3L^{-3}]	Average water contents of observation layers 0-50 cm
θ_{50-100}	[L^3L^{-3}]	Average water contents of observation layers 50-100 cm
θ_{0-100}	[L^3L^{-3}]	Average water contents of observation depth 0-100 cm

APPENDIX C
MGAR 3D SAMPLE INPUT FILE

Units: Length [cm], Time [h]

```
_____c:/fortran/3DGAR/clayIn.txt _____
0.385   0.09    0.272   0.165   0.06    62.25   5.0     500.0   96              96.0
1       1       0       0       0       0       0       0       1       1       0       0       0
0       0       0       1       1       0       0       0       0       0       0       1       1
0       0       0       0       0       0       1       1       0       0       0       0       0
0       1       1       0       0       0       0       0       0       1       1       0       0
0       0       0       0       1       1       0       0       0       0       0       0       1
1       0       0       0       0       0       0       1       1       0       0       0       0
0       0       1       1       0       0       0       0       0       0       1       1       0
0       0       0       0       0
-------------------------------------------------------------------------------------------------
$\theta_s$      $\theta_r$      $\theta_i$      $\lambda$       Ks      $S_{av}$        dL      Q       nTimeSteps      tstop
(IrrigFlag(j), j = 1, nTimeSteps)
```

APPENDIX B
3DGAR SAMPLE OUTPUT FILE

90 Degree Line Results

Table G-1. Sample 3DGAR Output

Time (h)	5 (cm)	10 (cm)	15 (cm)	20 (cm)	25 (cm)	30 (cm)
1	0.385	0.385	0.294	0.272	0.272	0.272
2	0.385	0.385	0.347	0.272	0.272	0.272
3	0.371	0.371	0.348	0.272	0.272	0.272
4	0.363	0.363	0.348	0.272	0.272	0.272
5	0.357	0.357	0.348	0.272	0.272	0.272
6	0.352	0.352	0.348	0.272	0.272	0.272
7	0.349	0.349	0.348	0.272	0.272	0.272
8	0.346	0.346	0.346	0.273	0.272	0.272
9	0.385	0.385	0.381	0.276	0.272	0.272
10	0.385	0.385	0.385	0.303	0.272	0.272
11	0.373	0.373	0.373	0.311	0.272	0.272
12	0.366	0.366	0.366	0.316	0.272	0.272
13	0.361	0.361	0.361	0.319	0.272	0.272
14	0.356	0.356	0.356	0.321	0.272	0.272
15	0.353	0.353	0.353	0.323	0.272	0.272
16	0.350	0.350	0.350	0.325	0.272	0.272
17	0.385	0.385	0.385	0.326	0.272	0.272
18	0.385	0.385	0.385	0.353	0.272	0.272
19	0.374	0.374	0.374	0.358	0.272	0.272
20	0.367	0.367	0.367	0.360	0.272	0.272
21	0.362	0.362	0.362	0.362	0.272	0.272
22	0.358	0.358	0.358	0.358	0.276	0.272
23	0.355	0.355	0.355	0.355	0.280	0.272
24	0.352	0.352	0.352	0.352	0.284	0.272
25	0.385	0.385	0.385	0.352	0.287	0.272
26	0.385	0.385	0.385	0.375	0.289	0.272
27	0.374	0.374	0.374	0.374	0.294	0.272
28	0.367	0.367	0.367	0.367	0.301	0.272
29	0.363	0.363	0.363	0.363	0.306	0.272
30	0.359	0.359	0.359	0.359	0.310	0.272
31	0.356	0.356	0.356	0.356	0.313	0.272
32	0.354	0.354	0.354	0.354	0.315	0.272
33	0.385	0.385	0.385	0.355	0.318	0.272
34	0.385	0.385	0.385	0.377	0.320	0.272
35	0.374	0.374	0.374	0.374	0.325	0.272
36	0.368	0.368	0.368	0.368	0.332	0.272
37	0.363	0.363	0.363	0.363	0.336	0.272
38	0.359	0.359	0.359	0.359	0.339	0.272
39	0.356	0.356	0.356	0.356	0.342	0.272
40	0.354	0.354	0.354	0.354	0.344	0.272
41	0.385	0.385	0.385	0.356	0.345	0.272
42	0.385	0.385	0.385	0.378	0.347	0.272
43	0.374	0.374	0.374	0.374	0.353	0.272
44	0.368	0.368	0.368	0.368	0.357	0.274
45	0.363	0.363	0.363	0.363	0.358	0.277
46	0.359	0.359	0.359	0.359	0.358	0.279
47	0.356	0.356	0.356	0.356	0.356	0.283

Table G-1. Continued

Time (h)	5 (cm)	10 (cm)	15 (cm)	20 (cm)	25 (cm)	30 (cm)
48	0.354	0.354	0.354	0.354	0.354	0.287
49	0.385	0.385	0.385	0.356	0.352	0.290
50	0.385	0.385	0.385	0.378	0.350	0.293
51	0.374	0.374	0.374	0.374	0.354	0.295
52	0.368	0.368	0.368	0.368	0.358	0.297
53	0.363	0.363	0.363	0.363	0.359	0.299
54	0.359	0.359	0.359	0.359	0.359	0.301
55	0.357	0.357	0.357	0.357	0.357	0.306
56	0.354	0.354	0.354	0.354	0.354	0.309
57	0.385	0.385	0.385	0.356	0.352	0.312
58	0.385	0.385	0.385	0.379	0.350	0.314
59	0.374	0.374	0.374	0.374	0.354	0.317
60	0.368	0.368	0.368	0.368	0.358	0.318
61	0.363	0.363	0.363	0.363	0.360	0.320
62	0.359	0.359	0.359	0.359	0.359	0.322
63	0.357	0.357	0.357	0.357	0.357	0.327
64	0.354	0.354	0.354	0.354	0.354	0.330
65	0.385	0.385	0.385	0.356	0.352	0.332
66	0.385	0.385	0.385	0.379	0.350	0.335
67	0.374	0.374	0.374	0.374	0.354	0.337
68	0.368	0.368	0.368	0.368	0.358	0.338
69	0.363	0.363	0.363	0.363	0.360	0.340
70	0.359	0.359	0.359	0.359	0.359	0.342
71	0.357	0.357	0.357	0.357	0.357	0.346
72	0.354	0.354	0.354	0.354	0.354	0.348
73	0.385	0.385	0.385	0.356	0.352	0.349
74	0.385	0.385	0.385	0.379	0.350	0.349
75	0.374	0.374	0.374	0.374	0.354	0.349
76	0.368	0.368	0.368	0.368	0.358	0.347
77	0.363	0.363	0.363	0.363	0.360	0.346
78	0.359	0.359	0.359	0.359	0.359	0.346
79	0.357	0.357	0.357	0.357	0.357	0.348
80	0.354	0.354	0.354	0.354	0.354	0.349
81	0.385	0.385	0.385	0.356	0.352	0.349
82	0.385	0.385	0.385	0.379	0.350	0.349
83	0.374	0.374	0.374	0.374	0.354	0.349
84	0.368	0.368	0.368	0.368	0.358	0.347
85	0.363	0.363	0.363	0.363	0.360	0.346
86	0.359	0.359	0.359	0.359	0.359	0.346
87	0.357	0.357	0.357	0.357	0.357	0.348
88	0.354	0.354	0.354	0.354	0.354	0.349
89	0.385	0.385	0.385	0.356	0.352	0.349
90	0.385	0.385	0.385	0.379	0.350	0.349
91	0.374	0.374	0.374	0.374	0.354	0.349
92	0.368	0.368	0.368	0.368	0.358	0.347
93	0.363	0.363	0.363	0.363	0.360	0.346
94	0.359	0.359	0.359	0.359	0.359	0.346
95	0.357	0.357	0.357	0.357	0.357	0.347
96	0.354	0.354	0.354	0.354	0.354	0.349