APPENDIX L

PUMPING INFLUENCE OF SUPPLY WELL 302D

Because of the uncertainty associated with the extension of the Robinson Run plume to the west of Green Pond Brook can be solely attributed to the pumping influence of supply well 302D (i.e., TCE being drawn under the stream), or whether TCE is also emanating from an additional source to the west, the continuous monitoring of water levels with pressure transducers/data loggers in selected wells was conducted to determine the area of influence of production well 302D. The results of this continuous water level monitoring study indicate some degree of influence by this well on the bedrock and lower semi-confined aquifers within Area G and, to some extent, Areas F and H. It should be noted that water from Production Well 302D sampled as part of this study was found to have 2.6 ppb TCE.

Production well 302D is an open-hole bedrock well (it's total depth is in excess of 500 feet) and is the primary source of water production for Picatinny Arsenal. During operation, it is estimated that 302D withdraws between 550 and 580 gallons of water per minute from the Leithsville dolomite.

Mini-Troll pressure transducers were installed in 12 monitoring wells from six well pair clusters screened within different hydrogeologic units in Areas F and G (see **Figure G1**) and the operation of 302D was tracked and recorded by US Filter personnel. The six graphs included within this appendix show the change in static water level from each well pair in response to the operation of well 302D. It is clear that 302D has a noticeable influence on the bedrock and overburden aquifers as evidenced by the miniTroll data from a majority of the wells included in the continuous water level monitoring study.

The monitoring well pair consisting of MWF-1A and MWF-1B, located the furthest east of 302D in southeastern Area F, exhibited no signs of change in static water level coincident with the operation of the production well.

Six monitoring wells from three well pair clusters (MWG-2A & 2B, MWF-3A & 3B, and 52MW-4A & 4B) located between Areas F and G and the southwestern portion of Area F, all exhibited a similar, moderate response (drawdown of less that 12 inches) to the operation of 302D. It should be noted here that the well pair containing MWF-3A and MWF-3B is located on the eastern side of Green Pond Brook within AOC 1.

Two wells proximal to 302D (MWG-1B screened in the lower semi-confined aquifer, and 185MW-1B screened within the bedrock aquifer) exhibited a noticeable response to the operation of the production well. The water table as measured within MWG-1B was found to fall approximately two feet during the sustained operation of 302D. Similarly, the water table as measured within 185MW-1B was found to fall approximately 1.2 feet during the sustained operation of 302D. In contrast, the mates to these two wells (MWG-1A and 185MW-1A both screened in the unconfined aquifer) show no apparent response to the operation of 302D.

A simple estimate of the area of influence of the supply well based on the drawdown data collected as part of the continuous water level monitoring study confirms the conclusion that the influence of 302D extends beyond MWF-3B and 3B but not as far as MWF-1A and 1B. The estimated area of influence as well as the mathematical derivation of this estimate is included in this appendix.

DRAWING NUMBER: Monitoring Cont_

CHECKED BY	APPROVED BY
A. Smith	--
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DRAWN BY: A. Smith

185MW-1A
185MW-1B
GMW-5
MWG-1A
MWG-1B
MW52-3
MW52-2
MW52-1
MW-4
MW-3
101MW-6
MW-2
MW-1
138MW-6
38MW
176DD
176D
176S
61MW-1B
61MW-1A
MWG-2A
MWG-2B
52MW-4A
52MW-4B
GMW-4
MW-6
MWF-3B
MWF-3A
104MW-1
MWF-1A
104MW-3
104MW-4
104MW-2
104MW-6A
104MW-6B
AREA G
AREA F
SITE 134
PUMPING WELL 302D
SITE 95
SITE 96
SITE 31
SITE 61
SITE 60
SITE 104
SITE 126
TR 307
TR 302
TR 151
TR 491
TR 166
TR 193
TR 173
307
309
306
326
302F
303
302
302E
302A
304
301
305
301A
302D
302C
302B
308A
308
308B
314
314D
314E
314C
314B
110
102
100
114A
114
151
113
123
152
115
115A
168
154
178
164
197
166
167
163
183
172
174
152
173
171
175
176
405
119
SCALE 0 50 100 FEET

RAILROAD
TREE LINE
FENCE
TR-732 TRANSFORMER
BLAST WALL
===ST=== OR ---ST--- STORM SEWER
===SS=== OR ---SS--- SANITARY SEWER
EARTH MOUND
BLDG NO. BUILDING
BLDG NO. FORMER BUILDING
COVERED WALKWAY
SWAMP
WATER

MONITORING WELLS:
- SCREENED IN BEDROCK AQUIFER
- SCREENED IN LOWER SEMI-CONFINED AQUIFER
- SCREENED IN UNCONFINED AQUIFER
- INCLUDED IN CONTINUOUS WATER LEVEL MONITORING STUDY

Picatinny Arsenal Installation Restoration Program

U.S. Army Corps of Engineers

Shaw Shaw Environmental, Inc.

FIGURE G1

CONTINUOUS WATER LEVEL MONITORING
PUMPING WELL 302D DRAWDOWN EFFECTS
MID-VALLEY DATA GAP INVESTIGATION
PICATINNY ARSENAL, DOVER, NEW JERSEY

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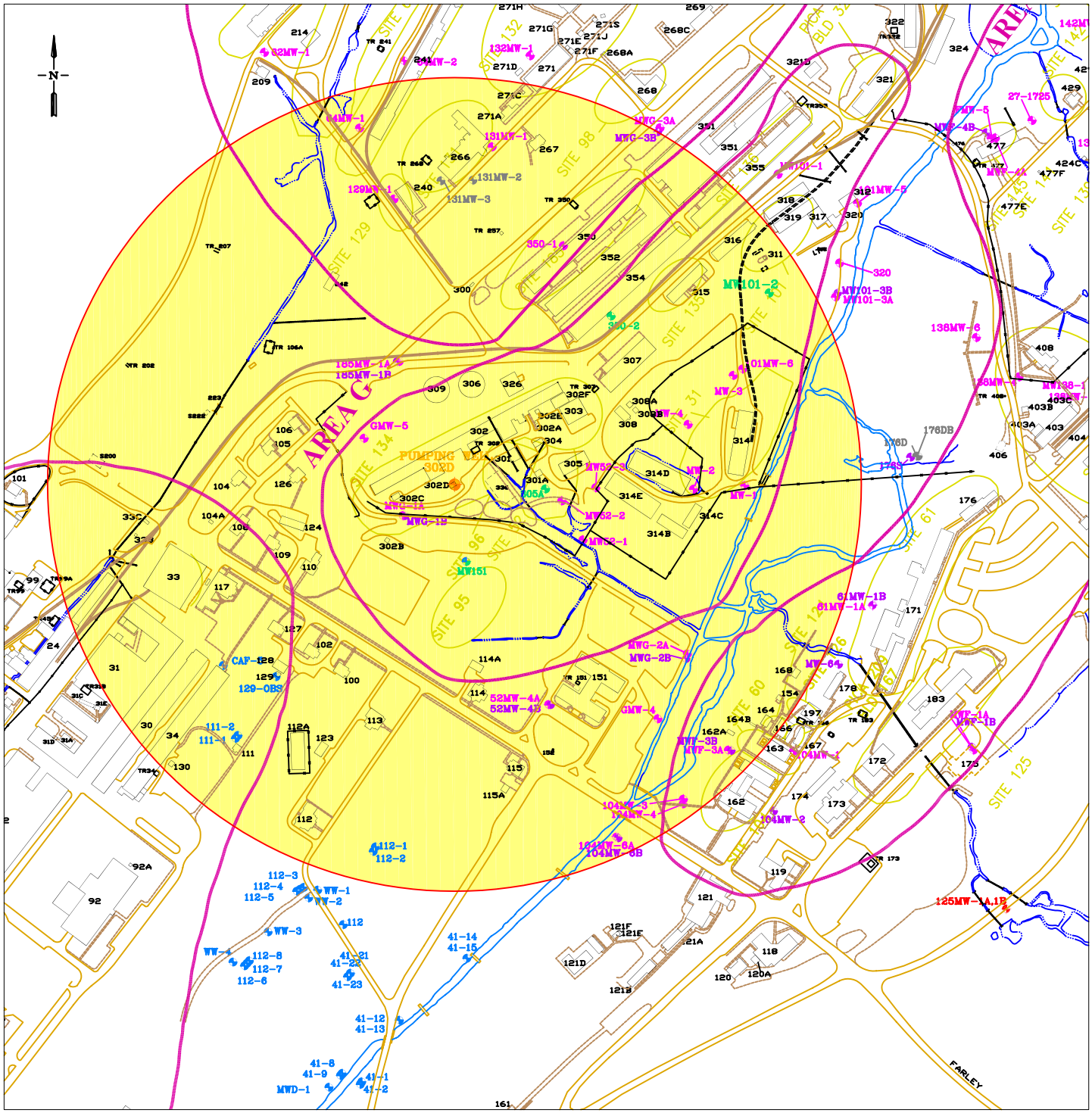
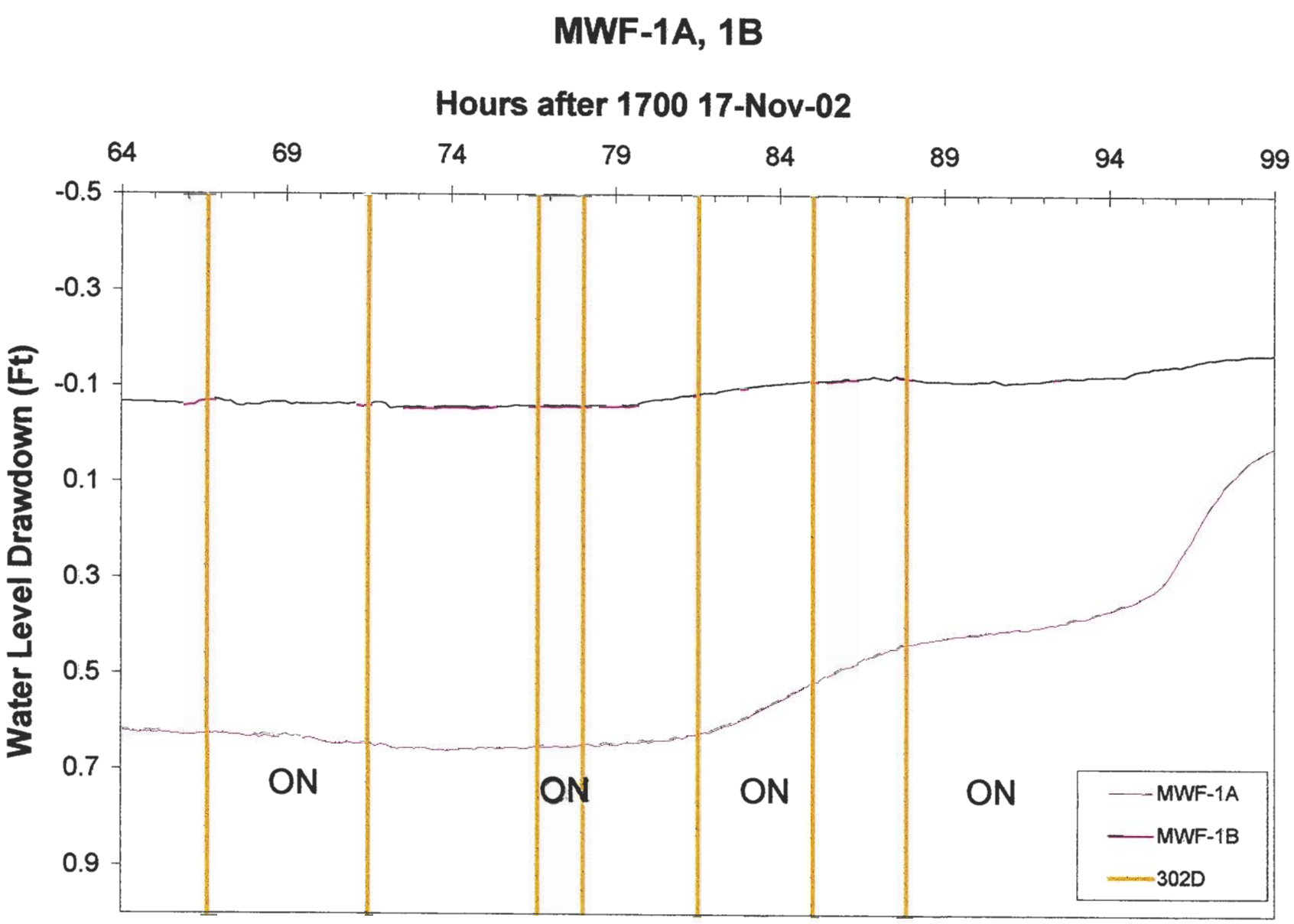
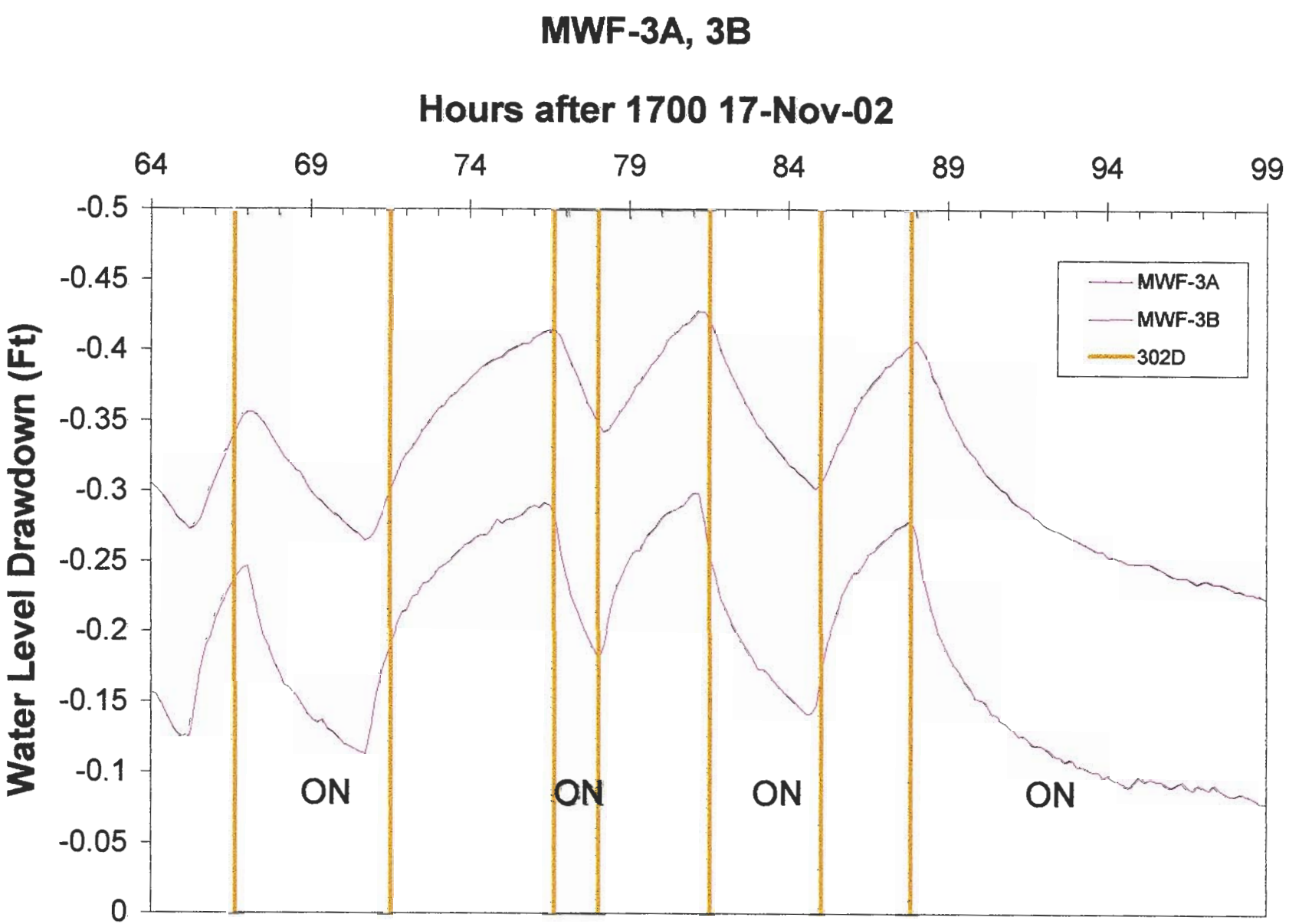
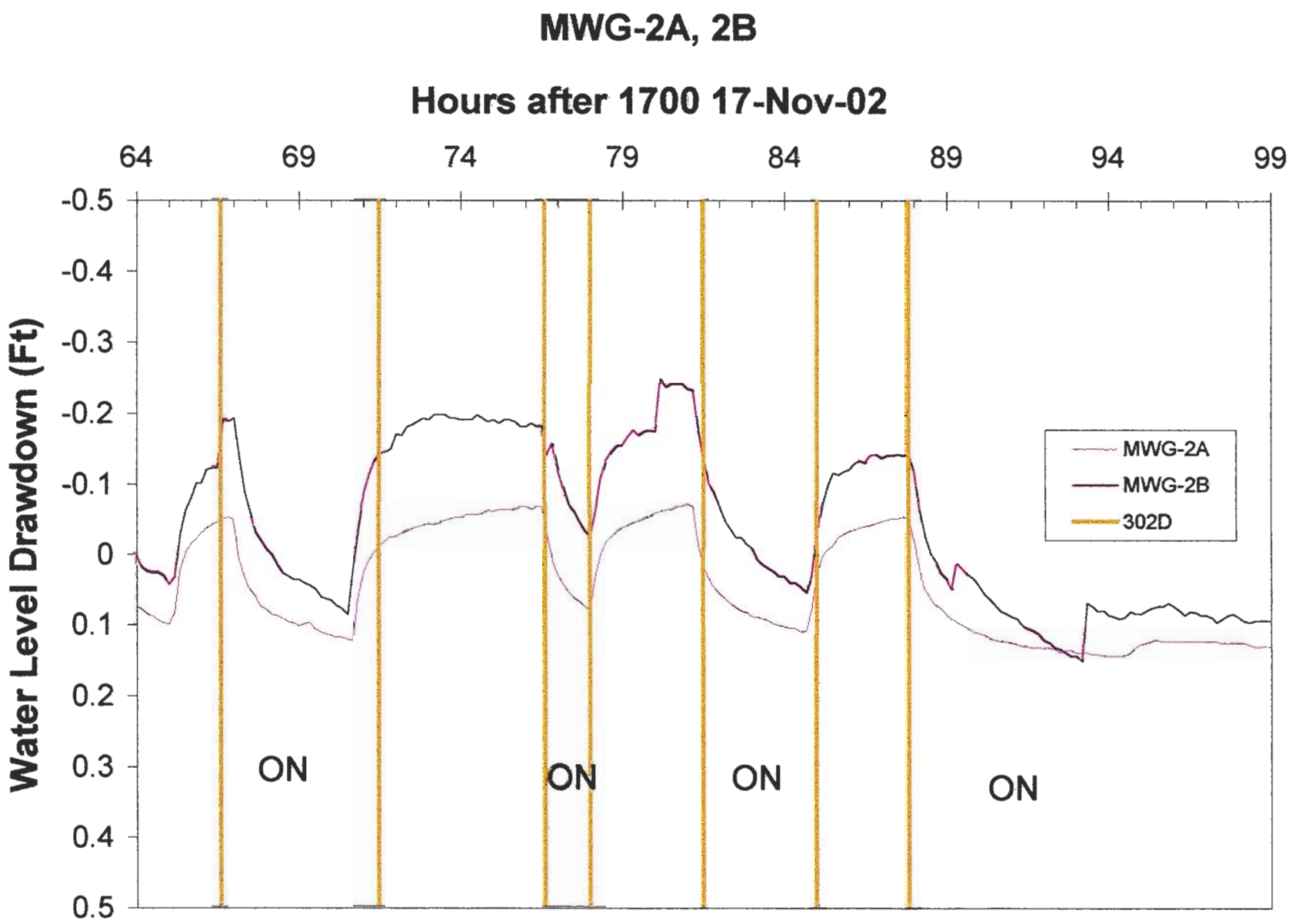
Plot Date/Time: 5 2003 - 11:13am
Plotted By: alfred

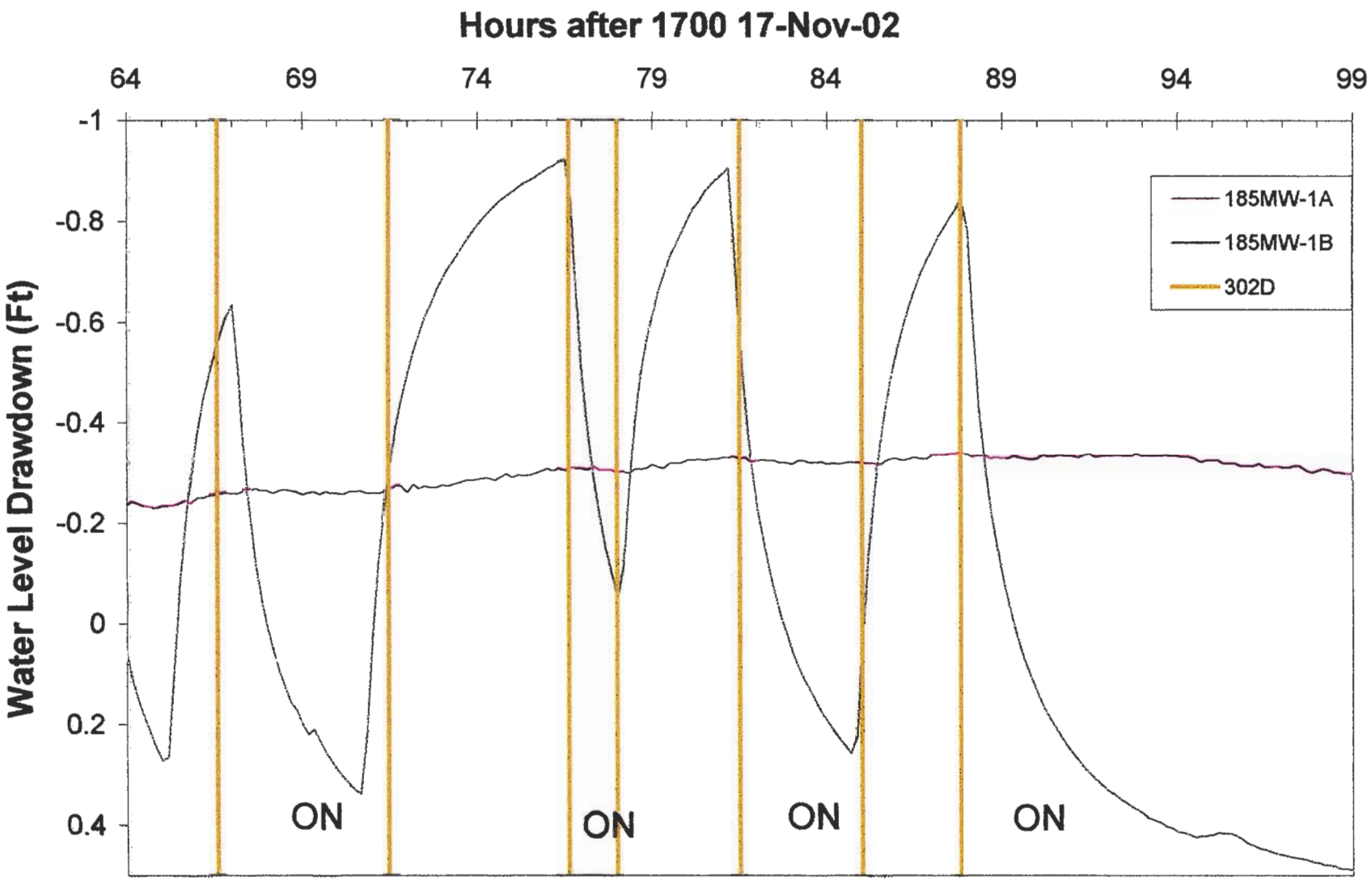

AREA G
PUMPING 302D
SITE 134
SITE 129
SITE 98
SITE 96
SITE 95
SITE 132
SITE 135
SITE 61
SITE 60
SITE 125
SITE 126
SITE 145
SITE 146
SITE 147
SITE 148
SITE 149
SITE 150
SITE 151
SITE 152
SITE 153
SITE 154
SITE 155
SITE 156
SITE 157
SITE 158
SITE 159
SITE 160
SITE 161
SITE 162
SITE 163
SITE 164
SITE

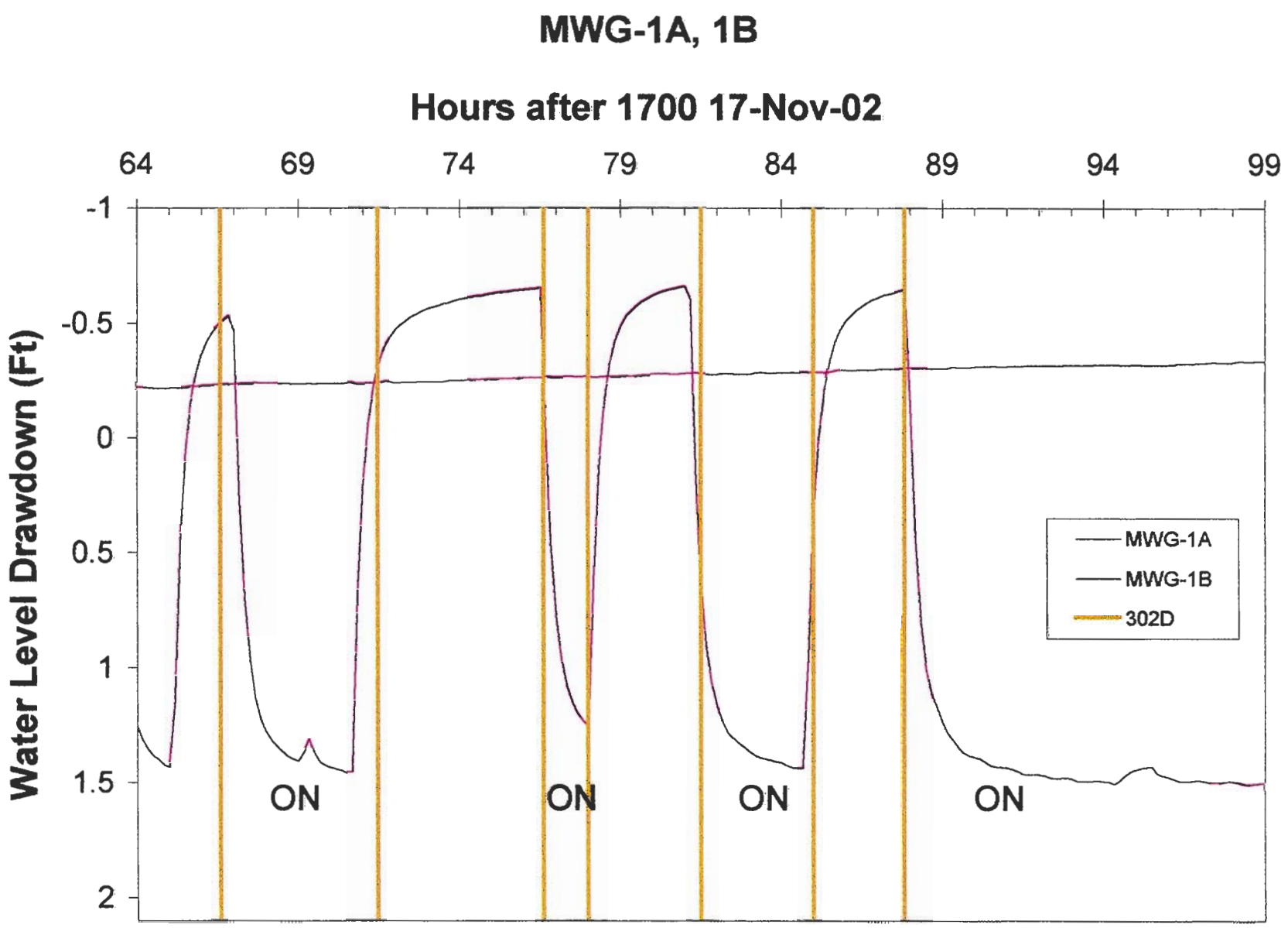

MWF-1A, 1B
Hours after 1700 17-Nov-02
64
69
74
79
84
89
94
99
-0.5
-0.3
-0.1
0.1
0.3
0.5
0.7
0.9
Water Level Drawdown (Ft)
ON
ON
ON
ON
MWF-1A
MWF-1B
302D


MWF-3A, 3B
Hours after 1700 17-Nov-02
64
69
74
79
84
89
94
99
-0.5
-0.45
-0.4
-0.35
-0.3
-0.25
-0.2
-0.15
-0.1
-0.05
0
Water Level Drawdown (Ft)
MWF-3A
MWF-3B
302D
ON
ON
ON
ON

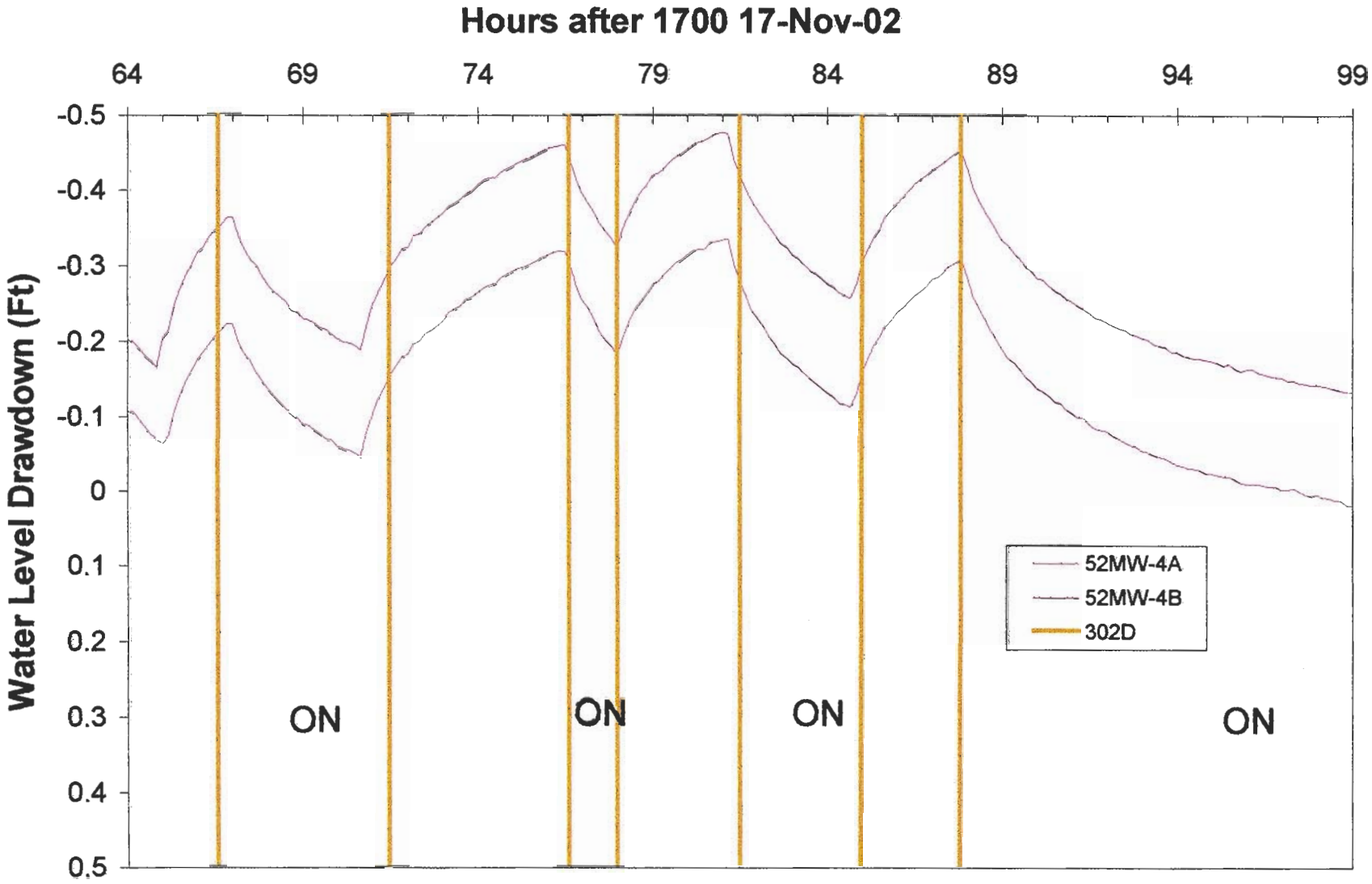

MWG-2A, 2B
Hours after 1700 17-Nov-02
64
69
74
79
84
89
94
99
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Water Level Drawdown (Ft)
MWG-2A
MWG-2B
302D
ON
ON
ON
ON

185MW-1A, 1B


Hours after 1700 17-Nov-02
64
69
74
79
84
89
94
99
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
Water Level Drawdown (Ft)
185MW-1A
185MW-1B
302D
ON
ON
ON
ON


MWG-1A, 1B
Hours after 1700 17-Nov-02
64
69
74
79
84
89
94
99
-1
-0.5
0
0.5
1
1.5
2
Water Level Drawdown (Ft)
ON
ON
ON
ON
MWG-1A
MWG-1B
302D

52MW-4A, 4B


Hours after 1700 17-Nov-02
64
69
74
79
84
89
94
99
Water Level Drawdown (Ft)
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
ON
ON
ON
ON
52MW-4A
52MW-4B
302D

DATE: 7/22/03
SUBJECT: CONTINUOUS WATER LEVEL MONITORING & ASSESSMENT OF INFLUENCE OF PW302D
BY: AS

PURPOSE - ESTIMATE THE RADIUS OF INFLUENCE OF SUPPLY WELL 302D AT PICATINNY ARSENAL BASED ON WATER LEVEL DATA ACQUIRED FROM A CONTINUOUS WATER LEVEL MONITORING STUDY THAT WAS CONDUCTED FROM 11/18/02 - 11/26/02 AS PART OF THE MID-VALLEY INVESTIGATION.

METHOD - THEORETICAL DRAWDOWN (S_t) IS ESTIMATED BY PROJECTING A LINEAR REGRESSION OF DISTANCE-DRAWDOWN DATA AT A CONSTANT ELAPSED TEST TIME TO A DISTANCE EQUAL TO THE RADIUS OF THE PUMPING WELL ON A PLOT OF DRAWDOWN VS. LOG(RADIAL DISTANCE).

- RADIUS OF INFLUENCE (r_o) IS ESTIMATED BY PROJECTING A LINEAR REGRESSION OF DISTANCE-DRAWDOWN DATA AT A CONSTANT ELAPSED TEST TIME TO ZERO DRAWDOWN ON A PLOT OF DRAWDOWN VS. LOG(RADIAL DISTANCE).

ASSUMPTIONS
- AQUIFER SYSTEM IS BOUNDED ABOVE & BELOW BY CONFINING LAYERS
- AQUIFER SYTEM & CONFINING LAYERS ARE HORIZONTAL & INFINITE IN AERIAL EXTENT
- AQUIFER SYSTEM IS CONSIDERED HOMOGENEOUS & ISOTROPIC
- STATIC PIEZIOMETRIC SURFACE IS HORIZONTAL & INFINITE IN AREAL EXTENT
- PUMPING & OBSERVATION WELLS ARE SCREENED OVER ENTIRETY OF AQUIFER THICKNESS
- PUMPING RATE IS CONSTANT.

CALCULATIONS

SEE ATTACHED TABLE FOR RADIAL DISTANCE (r) & MEASURED DRAWDOWN (s) VALUES

RADIUS OF PUMPING WELL (r_w)

r_w = 4 INCHES = 0.333 FT

LINEAR REGRESSION OF DRAWDOWN DATA AT OBSERVATION WELLS

EQ.1: $S_t = m \cdot \log(r_w) + b_o$

- S_t: 302D THEORETICAL DRAWDOWN
- m: SLOPE OF LINEAR REGRESSION
- b_o: Y-INTERCEPT OF LINEAR REGRESSION

SEE ATTACHED PLOT FOR LINEAR REGRESSION & RESULTING LINER EQUATION.

* NOTE DATA POINTS FROM MWG-1A & 185MW-1A WERE NOT USED FOR THE GENERATION OF THE LINEAR REGRESSION AS SHOWN. THESE WELLS APPEAR TO BE HYDROGEOLOGICALLY ISOLATED FROM THE REST OF THE SYSTEM.

THUS EQ. 1 BECOMES:

$$S_t = -2.4283 \cdot \log(0.333) + 7.5754$$

$$S_t = -2.4283 \cdot (-0.477) + 7.5754$$

$$S_t = 1.1583 + 7.5754$$

$$S_t = 8.734 \text{ FT.}$$

CALCULATION OF ESTIMATED RADIUS OF INFLUENCE (r_o):

EQ. 2: $\log(r_o) = -b_o/m$

OR

$$r_o = 10^{(-b_o/m)} = 10^{(-7.5754/-2.4283)} = 10^{3.1196} = 1317.14 \text{ FT}$$

$$r_o = 1317.14 \text{ FT.}$$

REFERENCES:

DAWSON, K.J., AND J.D. ISTOK, 1991, AQUIFER TESTING, DESIGN AND ANALYSIS OF PUMPING AND SLUG TESTS, LEWIS PUBLISHERS, CHELSEA, MI, PP. 77-78

Well ID	Radial Distance ft (r)	Log (r)	Drawdown (s) ft
MWG-1A	194.91	2.289834	-0.034
MWF-1A	1882.18	3.274661	-0.421
MWG-2A	932.51	2.969653	0.184
MWF-3A	1235.12	3.091709	0.115
52MW-4A	774.38	2.888954	0.334
185MW-1A	435.08	2.638569	0.043
MWF-1B	1875.42	3.273099	-0.047
MWG-2B	938.7	2.972527	0.237
MWF-3B	1239.83	3.093362	0.187
52MW-4B	778.28	2.891136	0.33
MWG-1B	189.63	2.277907	2.163
185MW-1B	438.68	2.642148	1.341
302D	0.3333	-0.47712	8.734

Drawdown vs LOG Radial Dist
PW 302D CWLM Pump Test