CDM

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# Memorandum

*To:* *Robert P. Scott, Boeing Realty Corporation*
*Joseph Weidmann, P.G., Haley and Aldrich*

*From:* *Ravi Subramanian, P.E, CDM*
*Mike Smith, CDM*
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*Cc:* *Pat Evans, Ph.D., CDM*
*Ryan Wymore, P.E., CDM*
*Kent Sorenson, P.E., CDM*

*Date:* *September 6, 2006*

*Subject:* *Summary of Slug Test Analysis for C-Sand Aquifer Unit*
*Remediation of Volatile Organic Compounds*
*Former C-6 Facility, Los Angeles, California*

Camp Dresser & McKee Inc. (CDM) has prepared this memorandum presenting the procedures and results of the slug tests conducted on select C-Sand screened monitoring wells at the former C-6 Facility (site). The objective of the slug tests was to estimate the aquifer characteristics of the C-Sand aquifer.

The slug tests were completed in Wells IRZCMW0002, MWC009, MWC015, MWC017 and MWC022 (Figure 1). Based on the previous investigation data at the site, the C-sand aquifer is composed of predominantly coarse grained strata from approximately 96 to 145 feet below ground surface (ft bgs).

## 1.0 Selection of Wells

An initial slug test was performed by Tait Environmental Management (Tait) under direct contract with Boeing Realty Corporation during the quarterly groundwater monitoring event in June 2006. Based on CDM's recommendation, the C-sand well sampled and slug tested was IRZCMW0002. The purpose of testing this well was to determine its potential for use as an observation well during any proposed aquifer performance tests (APTs). The value of hydraulic conductivity (K) for the C-sand aquifer obtained from this well (discussed below in

Section 3), was two orders of magnitude lower than the estimated K value of 145 feet per day (ft/day) for the C-Sand aquifer in the site vicinity (CH2MHill, 2004). As a result, CDM recommended conducting additional slug tests at the site to confirm these results and obtain better information regarding the probable range of hydraulic conductivity in the C-Sand aquifer.

The wells recommended by CDM for additional slug testing consisted of MWC009, MWC011, MWC015, and MWC017 selected to obtain an estimate of the range of K values in the C-sand aquifer across the site. The slug tests were conducted on August 2, 2006 by Tait. Initially, MWC011 in Lot 8 was selected to perform a slug test since the well is screened in the "window" where the confining aquitard unit (Middle Bellflower Mud) between the lower Bellflower and the C-Sand aquifer was noted to be absent (Rubicon Crossections, August 2006). Due to access issues at this well and the first alternate well MWC006, Tait, with concurrence from CDM, performed the slug test in the second alternate location, well MWC022, which was approximately 200 feet east of MWC006. This well was projected to be screened in the same zone as MWC011 and MWC006.

## 2.0 Slug Test Procedures

Slug tests were performed in well IRZCMW0002 on June 19, 2006; and in wells MWC009, MWC015, MWC017 and MWC022 on August 2, 2006 by Tait. In general, the slug tests were performed in accordance with the CDM Standard Operating Procedures (SOPs) for slug testing which were provided to Tait prior to initiating each of the test events. Water levels were recorded using a downhole data logger (Solnist Troll Model F30/M10). An electronic water-level indicator was used to measure the static water level prior to the start of the slug test. Manual water-level measurements were also collected during the test at regular intervals. The field notes complied by Tait during the slug test is presented in Appendix A.

Each test was initiated by quickly lowering the slug into the water column (falling-head test). The falling head test was then simulated after the well recovered to static conditions. The water level in the well was monitored until static conditions were achieved; thereafter a second test was initiated by rapidly lifting the slug to a point above the static water level (rising-head test). Upon completion of the test, the data from the transducer was downloaded to a computer and reduced into spreadsheet format. Analysis of the water level response with time permits the estimation of K for the area immediately adjacent to the screened portion of the well.

## 3.0 Test Analysis and Results

The Bouwer and Rice solution, developed by Bouwer and Rice (1976) and modified by Bouwer (1989) was used to analysis the slug test data. The Bouwer and Rice solution was

developed for use with fully or partially penetrating wells screened in unconfined aquifers; however, the solution is also appropriate for confined or stratified aquifers. Computations were done using commercial software that implements the Bouwer and Rice method.

Well characteristics required for slug test analysis and the range of calculated values of K are presented in Table 1. The estimated K values for the C-Sand aquifer unit range from 4.1 ft/day to 13.4 ft/day for the test conducted in August 2006. The semi-log plots of water level change versus time for the slug tests performed are presented in Appendix B along with other related data.

## 4.0 Conclusions

Based on the data presented in this memorandum, the following conclusions can be made:

- This estimated K value of 0.13 ft/day in IRZCMW002 is anomalously low and is not believed to be representative of the C-Sand aquifer. This could be attributed to the fact that this is an amendment well or was in the general area where electron donor (molasses) injections were conducted previously, which could have resulted in clogging of the screen and surrounding soil. Since slug tests values are representative only of the saturated soils in the immediate vicinity of the screen, K-values are likely underestimated. This well is not suitable for use as an observation well during any APTs.

- Based on the second round of slug tests, the values of K in the C-Sand aquifer are estimated to range from 4.1 to 13.4 ft/day. These values are similar to the B-Sand aquifer unit and an order of magnitude lower than the estimated K value of 145 feet per day (ft/day) for the C-Sand aquifer in the site vicinity (CH2MHill, 2004).

## 5.0 Limitations

The influence of a slug test extends only a short distance into the soils surrounding a well screen, and the area tested is relatively small compared with that influenced by a pumping test. Therefore, aquifer parameters determined by slug testing are representative only of the saturated soils in the immediate vicinity of the screen and may be affected by the well construction.

## References

CH2MHill. 2004. *Initial Calibration and Data Gap Analysis Report, Dual Site Groundwater Operable Unit Remedial Design, Montrose Chemical and Del Amo Superfund Site.* October 2004.

## Attachments

Table 1 - C-Sand Slug Test Summary (June and August 2006)
Figure 1 - Well Location Map
Appendix A - Slug Test Analysis Data Sheets
Appendix B - Tait Field Data Sheets

# Table 1
## C-Sand Slug Test Summary (June and August 2006)
## Former C-6 Facility, Boeing Reality Corporation, Long Beach, California

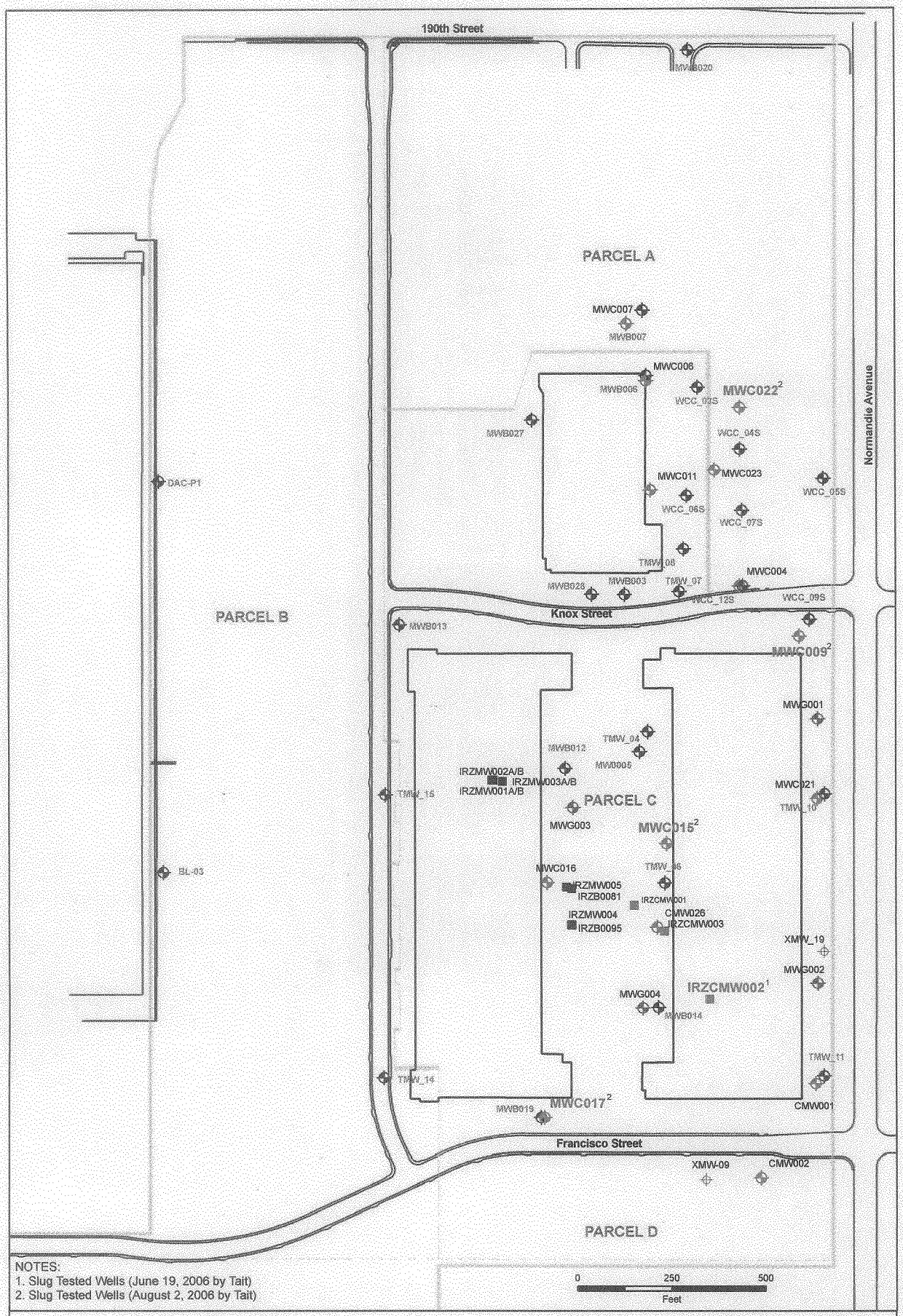
| Monitoring Well Designation (Unit) | Date Tested | Slug Test Type | Well Casing Radius $r_c$ (feet) | Borehole Radius $r_w$ (feet) | Saturated Screen Interval $L_e$ (feet) | Depth to Screen Bottom (feet) | Interpreted Aquifer Thickness [1] (feet) | Static Water Level Depth (feet) | Estimated Hydraulic Conductivity K (feet/day) | Estimated Hydraulic Conductivity (Average) K (feet/day) |
|---|---|---|---|---|---|---|---|---|---|---|
| IRZCMW0002 | 6/19/2006 | Falling Head Test | 0.17 | 0.42 | 25 | 121 | 30 | 65.00 | 0.14 | **0.13** |
| | | Rising Head Test | | | | | | | 0.13 | |
| MWC009 | 8/2/2006 | Falling Head Test | 0.17 | 0.42 | 20 | 121 | 40 | 62.55 | 7.63 | **7.66** |
| | | Rising Head Test | | | | | | | 7.70 | |
| MWC015 | 8/2/2006 | Falling Head Test | 0.17 | 0.42 | 25 | 125 | 30 | 60.51 | 10.83 | **10.77** |
| | | Rising Head Test | | | | | | | 10.71 | |
| MWC017 | 8/2/2006 | Falling Head Test | 0.17 | 0.42 | 25 | 125 | 40 | 64.75 | 13.41 | **13.39** |
| | | Rising Head Test | | | | | | | 13.38 | |
| MWC022 | 8/2/2006 | Falling Head Test | 0.17 | 0.42 | 20 | 117 | 45 | 59.33 | 4.38 | **4.10** |
| | | Rising Head Test | | | | | | | 3.84 | |

**Notes:**

| | |
|---|---|
| c | Depth to aquifer bottom assumed to be equivalent to the depth to the bottom of the screened portion of the well. |
| $R_e$ | Effective radial distance over which Y is dissipated. |
| Y | Head change induced within the well. |
| * | The screen was not fully saturated for this test, so only the rising head test was used with an adjusted saturated interval. |
| cm/sec | Centimeters per second. |
| 1 | Estimated from crossections produced by Rubicon, August 2006 |

**References:**


1) Bouwer, H. and R.C. Rice, 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells. Water Resources Research, v. 12, pp. 423-428.
2) Bouwer, H., 1989. The Bouwer and Rice Slug Test - An Update. Ground Water, v. 12, No. 3, pp. 304 - 309.




NOTES:
1. Slug Tested Wells (June 19, 2006 by Tait)
2. Slug Tested Wells (August 2, 2006 by Tait)

**Legend**

- Parcel Boundary
- Property Boundary
- B-Sand Monitoring Well
- C-Sand Monitoring Well
- Gage Monitoring Well
- Montrose Monitoring Well (B-Sand)
- B-Sand IRZ Bioremediation Monitoring Well
- C-Sand IRZ Bioremediation Monitoring Well

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Figure 1
Boeing Realty Corporation
Former C-6 Facility
**Well Location Map**

# Appendix A
# Slug Test Analysis Data Sheets

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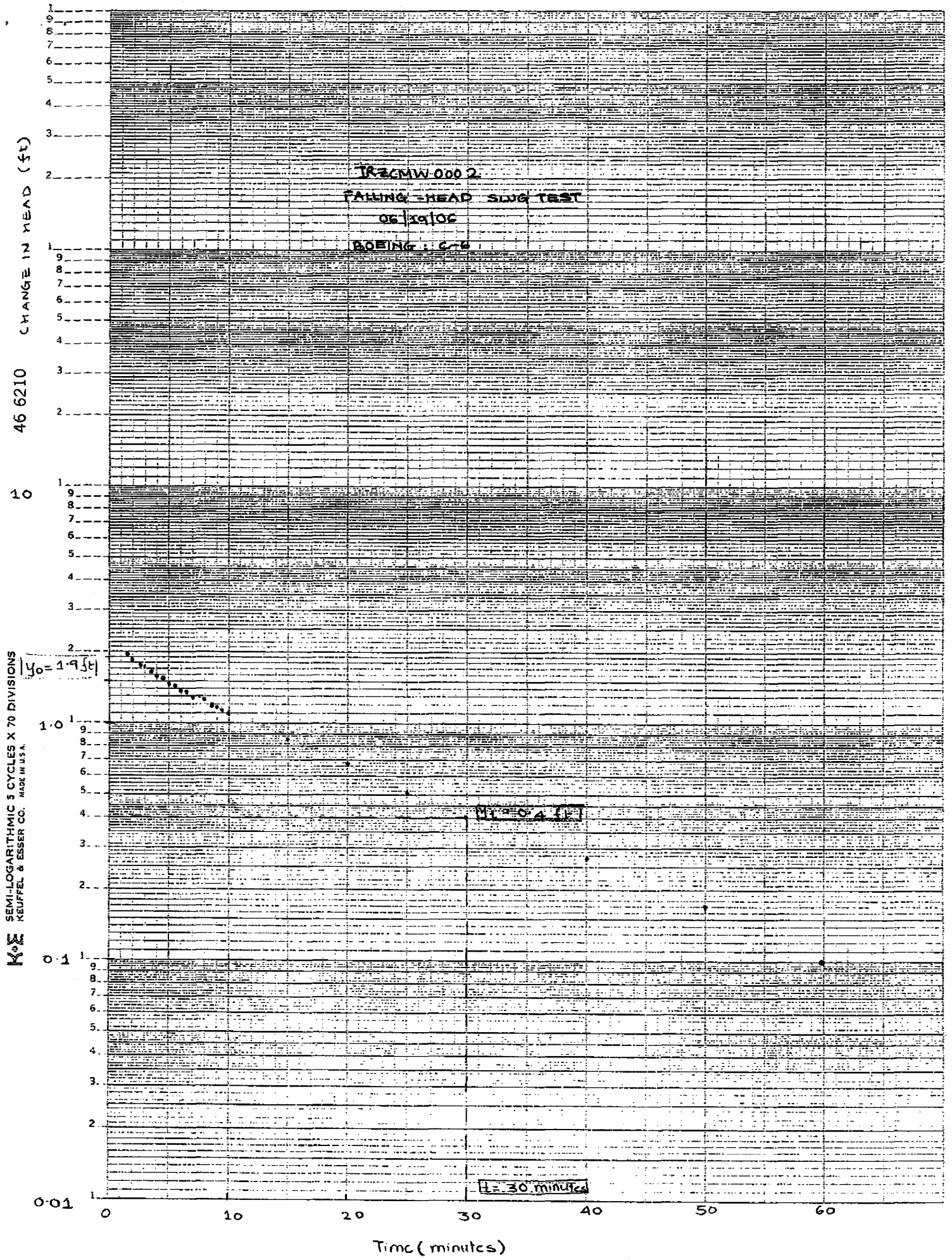
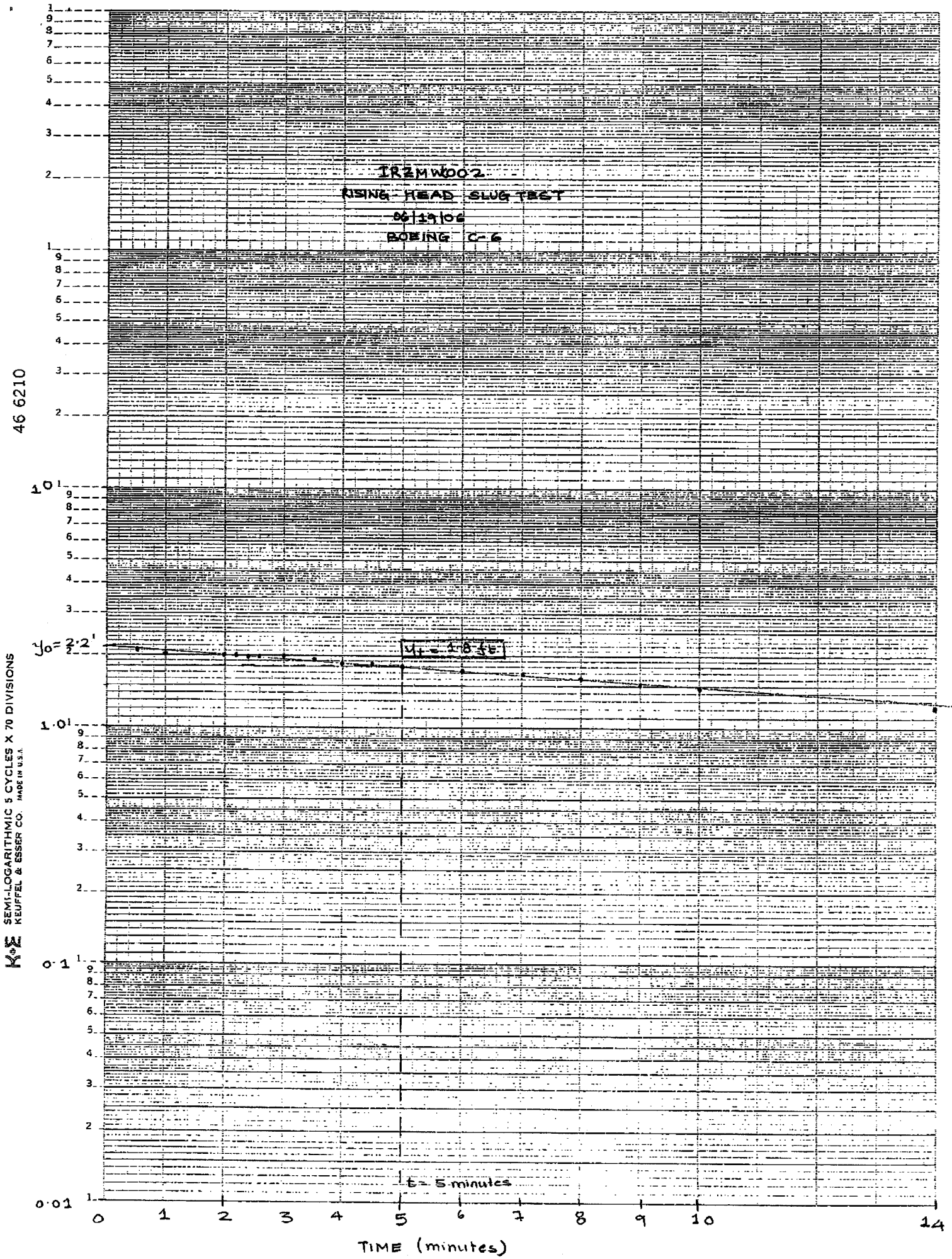
## IV CONCLUSION

$$K = 0.13 \frac{ft}{day} = 4.51E-05 \frac{cm}{sec}$$

∴ Value of K indicate material screened = silt to silty sand .... Freeze & Cherry, 1979

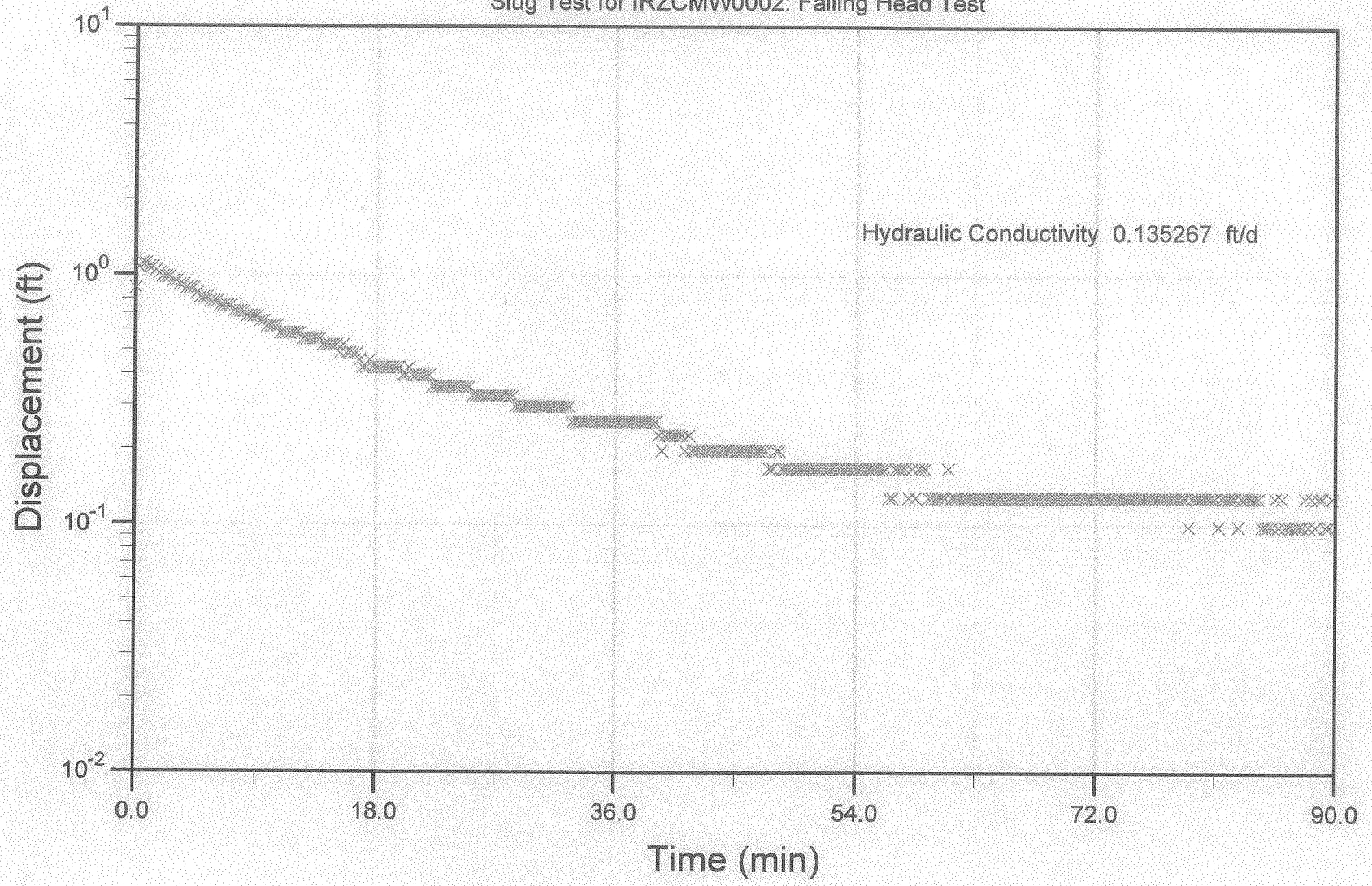
∴ ROI is small due to permeability of material.


IRZCMW 0002
FALLING-HEAD SLUG TEST
06/19/06
BOEING : C-6
CHANGE IN HEAD (ft)
46 6210
$|y_0 = 1.9 ft|$
$M_t = 0.4$ ft
t = 30 minutes
Time (minutes)
0
10
20
30
40
50
60
10
1.0
0.1
0.01
K+E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.


IR2MW002
RISING HEAD SLUG TEST
06/19/06
BOEING C-6
$y_0 = 2.2'$
$y_t = 1.8'$
t = 5 minutes
TIME (minutes)
0 1 2 3 4 5 6 7 8 9 10 14
0.01
0.1
1.0
10
46 6210
K&E SEMI-LOGARITHMIC 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

# Bouwer & Rice

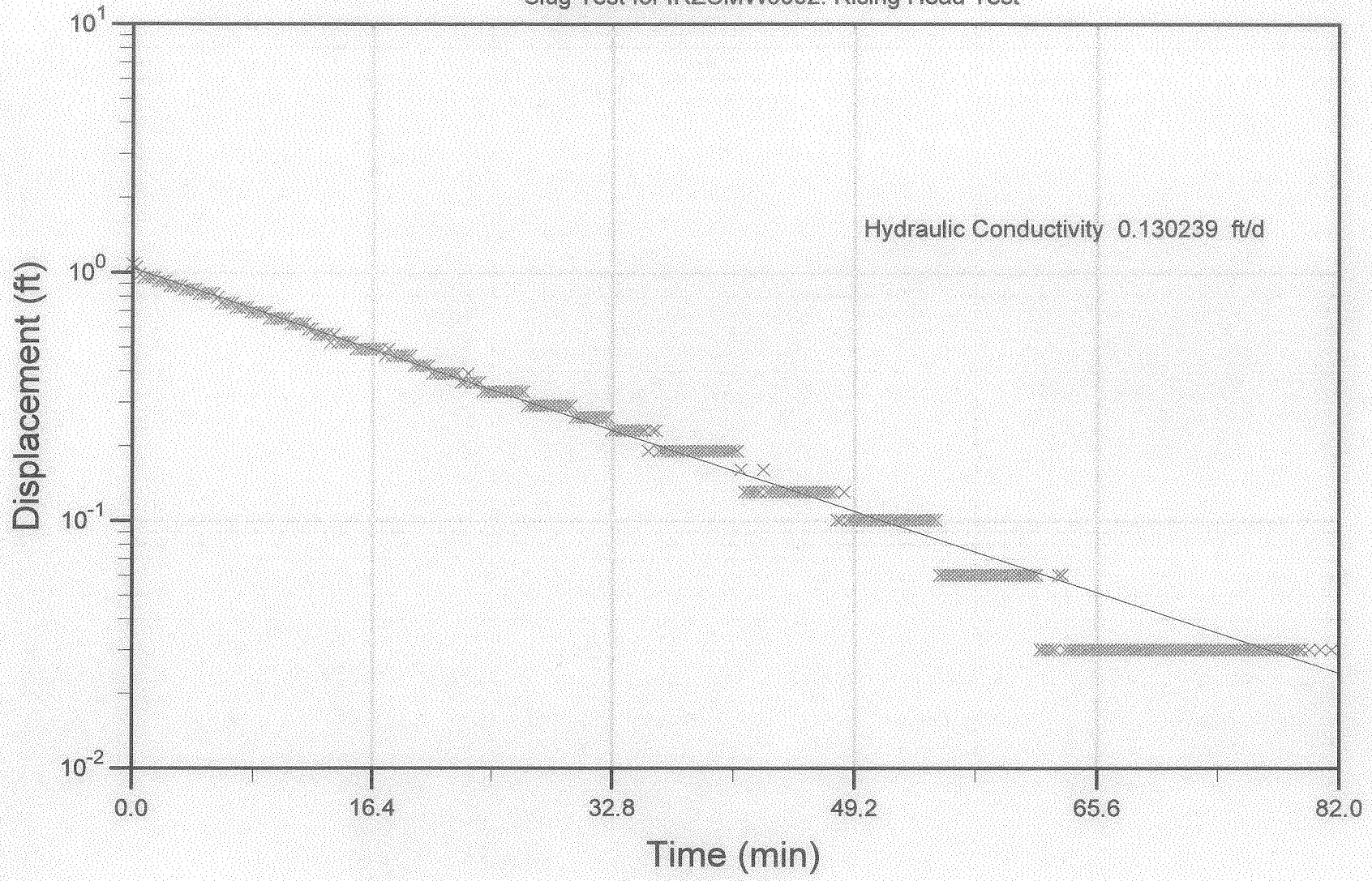
Slug Test for IRZCMW0002: Falling Head Test




BOE-C6-0139370

# Bouwer & Rice

Slug Test for IRZCMW0002: Rising Head Test



## I FIELD EQUIPMENT

- Solinst F15/M5

  = 15 psi rating = 34.65 ft of water

- slug

  $l = 5.22'$

  $\phi = 3''$ (o.d)

  ∴ volume of slug $= \pi r^2 h = 3.14 \times (0.125)^2 \times 5.22 = 0.26\ ft^3$

- Theoretical $H_o = \frac{0.26}{0.65}$ (for 4"$\phi$) $= \boxed{0.41\ ft}$

## II WELL INFORMATION

1) MWC009

$\phi = 4''$

borehole diameter = 10"

TD = 119.53'

screen = 101 to 121 = 20 ft

$\Sigma$ = 62.55 (8/2/6 @ 745) ··· static

2) MWC015

$\phi = 4''$

borehole diameter = 10"

T.D = 120.26' (Tait's field notes) = 128' (boeing portal)

screen = 100 to 125 = 25'

$\Sigma$ = 60.51 (8/2/06 @ 0932) ···· static

3) MWC017

$\phi = 4''$

borehole diameter = 10"

T.D = 124.82 (Tait's field notes) = 128' (boeing portal)

screen = 100 - 125 = 25'

$\Sigma$ = 64.75 (8/2/06 @ 1200) ···· static

4) MWC022

$\phi = 4''$

borehole diameter = 10"

T.D = 115.80 (Tait's field notes) = 120 (boeing portal)

screen = 97 - 117 = 20'

$\Sigma$ = 59.33 (8/2/6 @ 1453)

## III. ANALYSIS

- gravel pack porosity = 0.3
- Aquifer thickness
  - MWC017 ≅ 40'
  - MWC022 ≅ 45'
  - MWC009 = 40'
  - MWC015 ≅ 30'
- Bouwer & Rice 1989 for confined systems

  Cooper, Bredehoeft and Papadopulus, 1967 for confined aquifer

## IV. RESULTS FOR K (ft/day)

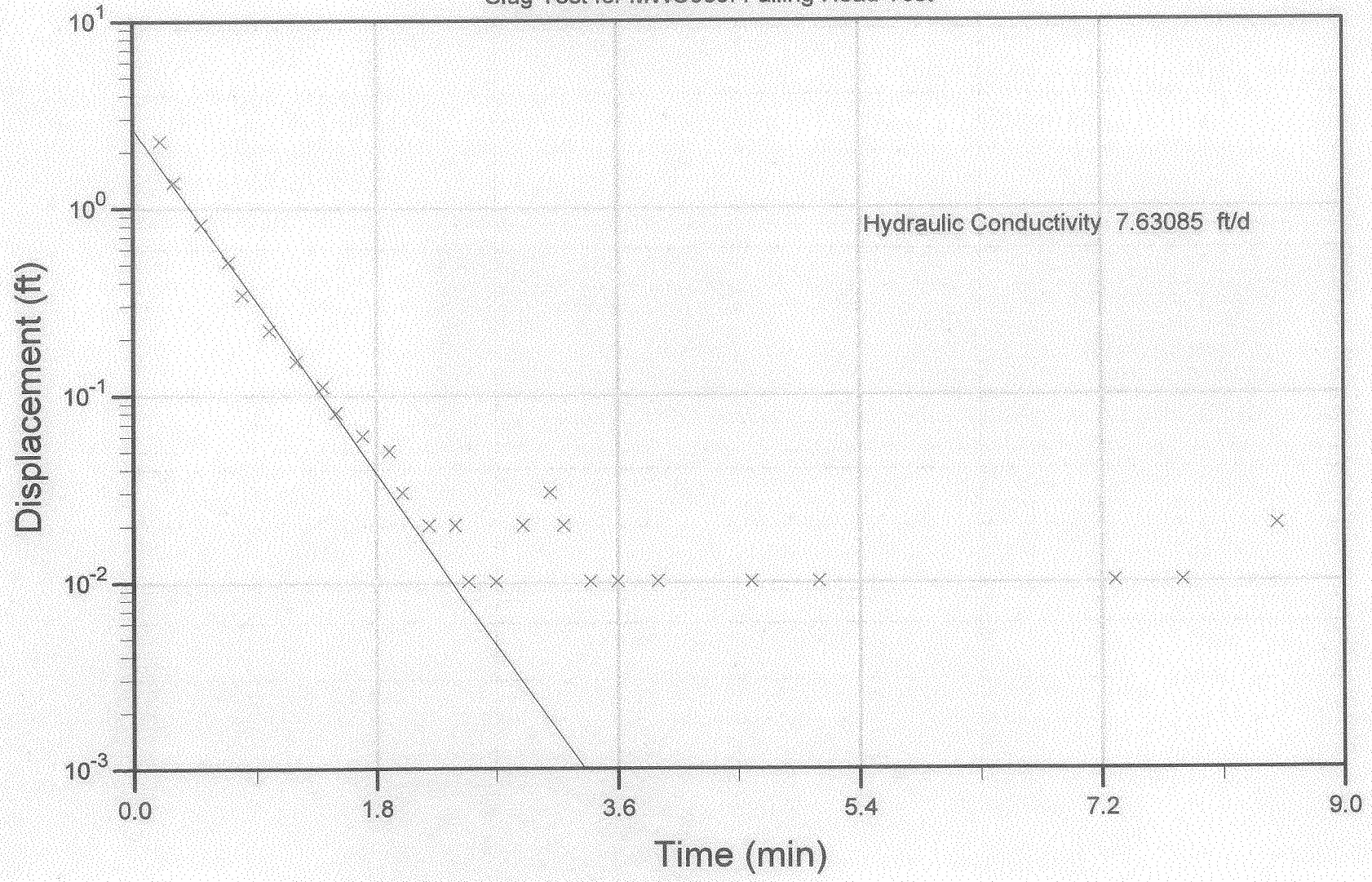
| | MWC009 | MWC015 | MWC017 | MWC022 |
|---|---|---|---|---|
| FALLING HEAD | 7.63 [1]<br>12.82 [2] | 10.83 [1]<br>18.99 [2] | 13.41 [1]<br>27.12 [2] | 4.38 [1]<br>7.13 [2] |
| RISING HEAD | 7.70 [1]<br>12.63 [2] | 10.71 [1]<br>10.14 [2] | 13.34 [1]<br>28.81 [2] | 3.84 [1]<br>7.18 [2] |
| GEOMEAN [3] | 9.88 | 12.22 | 19.34 | 5.42 |

Notes: Units are in ft/day for hydraulic conductivity (K)

1. Results from Bouwer & Rice analysis
2. Results from Cooper analysis. For cooper analysis $K = \frac{\text{Transmissivity } (ft^2/day)}{\text{thickness } (ft)}$
3. K (ft/day) is average geomean values from falling & Rising tests using Bouwer & Cooper solutions.

# Bouwer & Rice

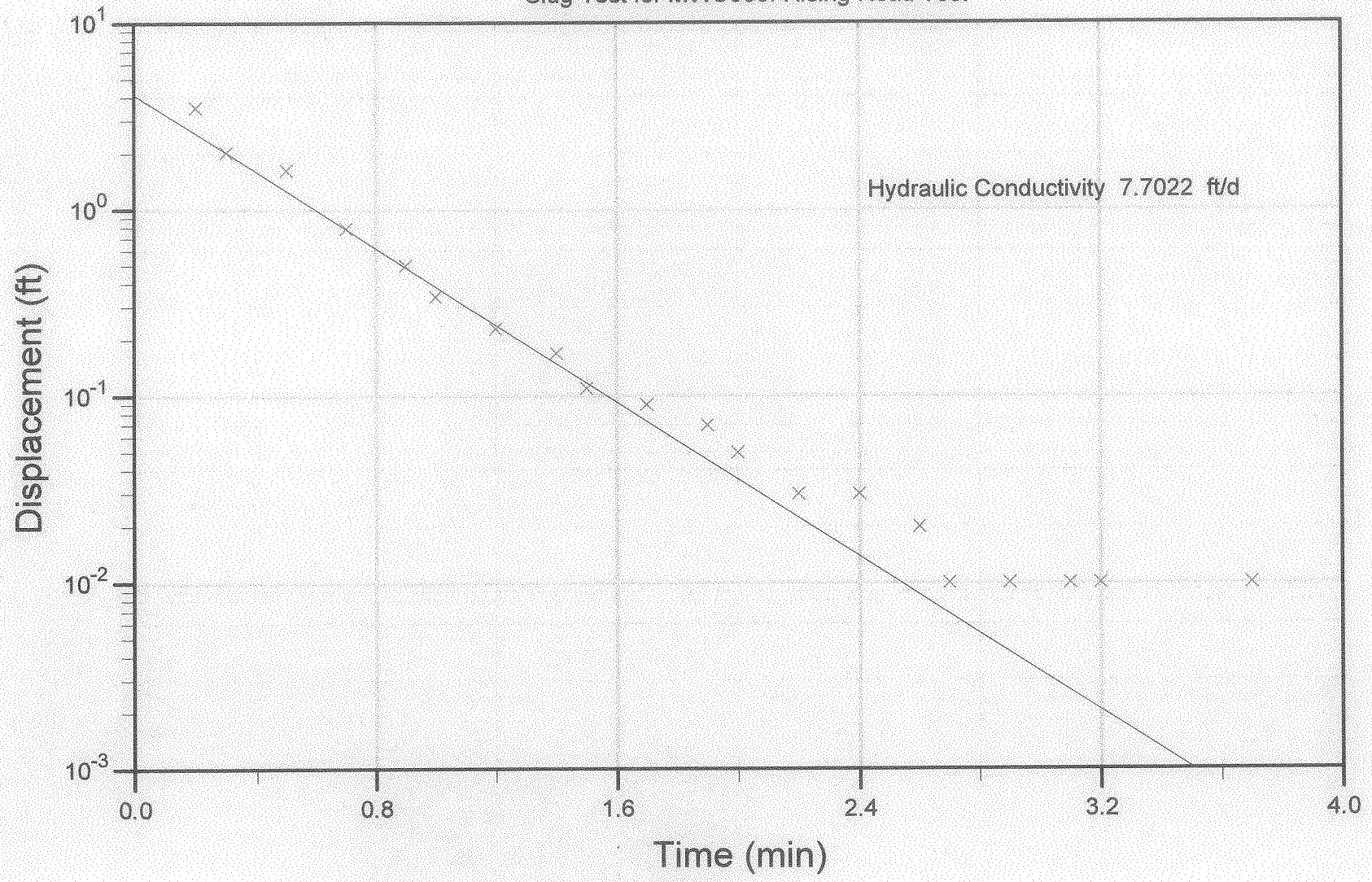
Slug Test for MWC009: Falling Head Test




BOE-C6-0139374

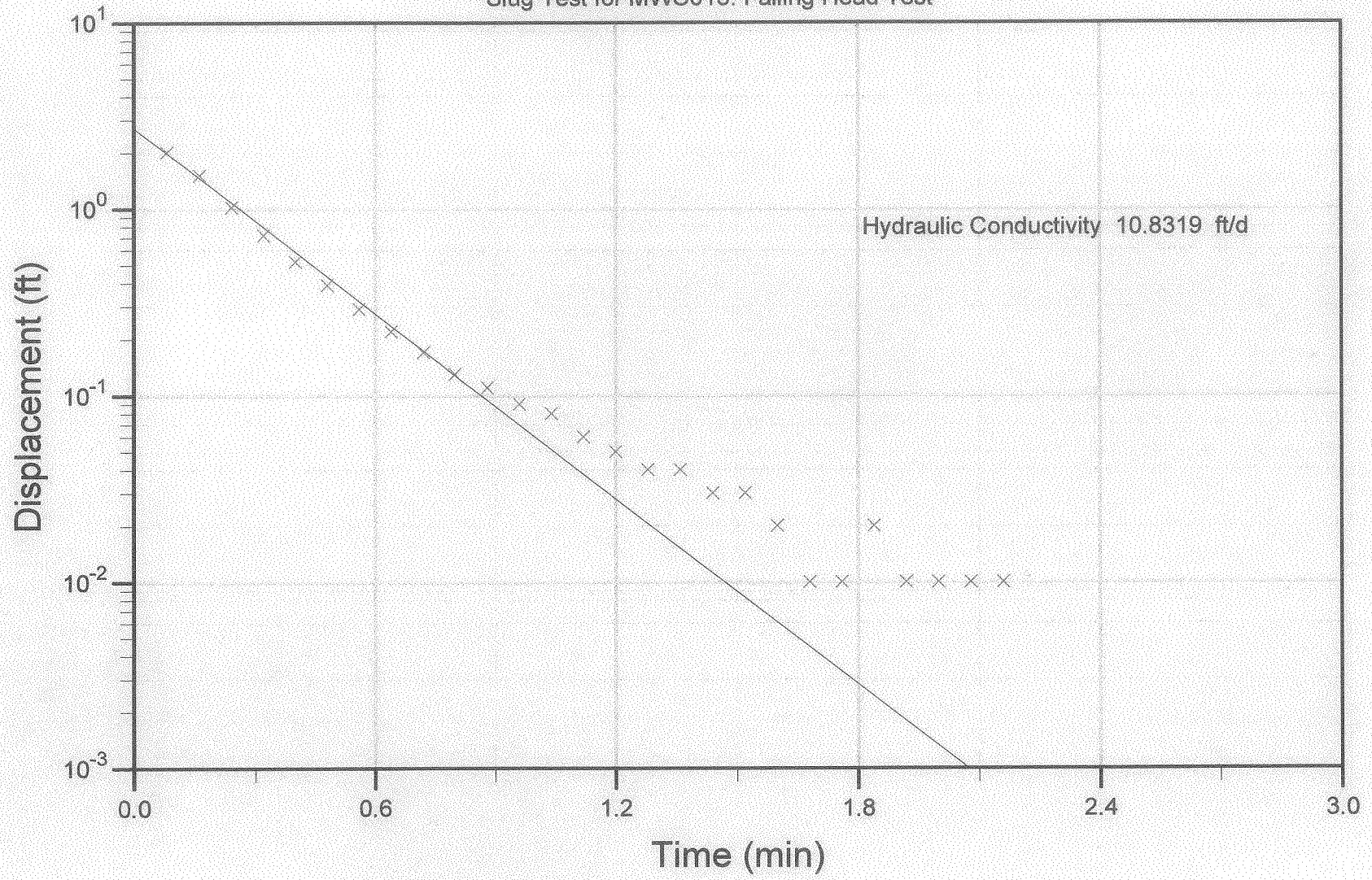
# Bouwer & Rice

Slug Test for MWC009: Rising Head Test



# Bouwer & Rice

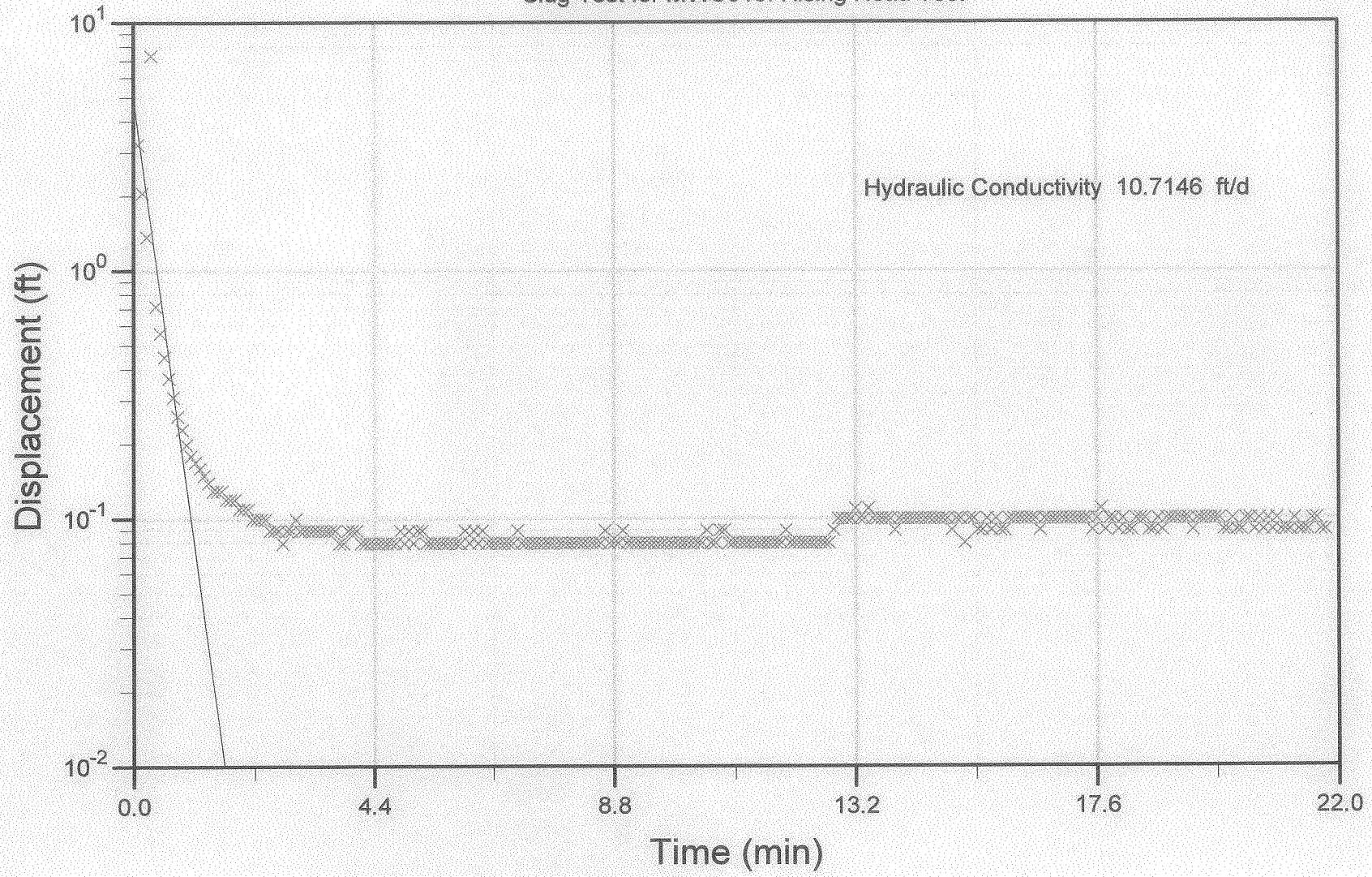
Slug Test for MWC015: Falling Head Test




BOE-C6-0139376

# Bouwer & Rice

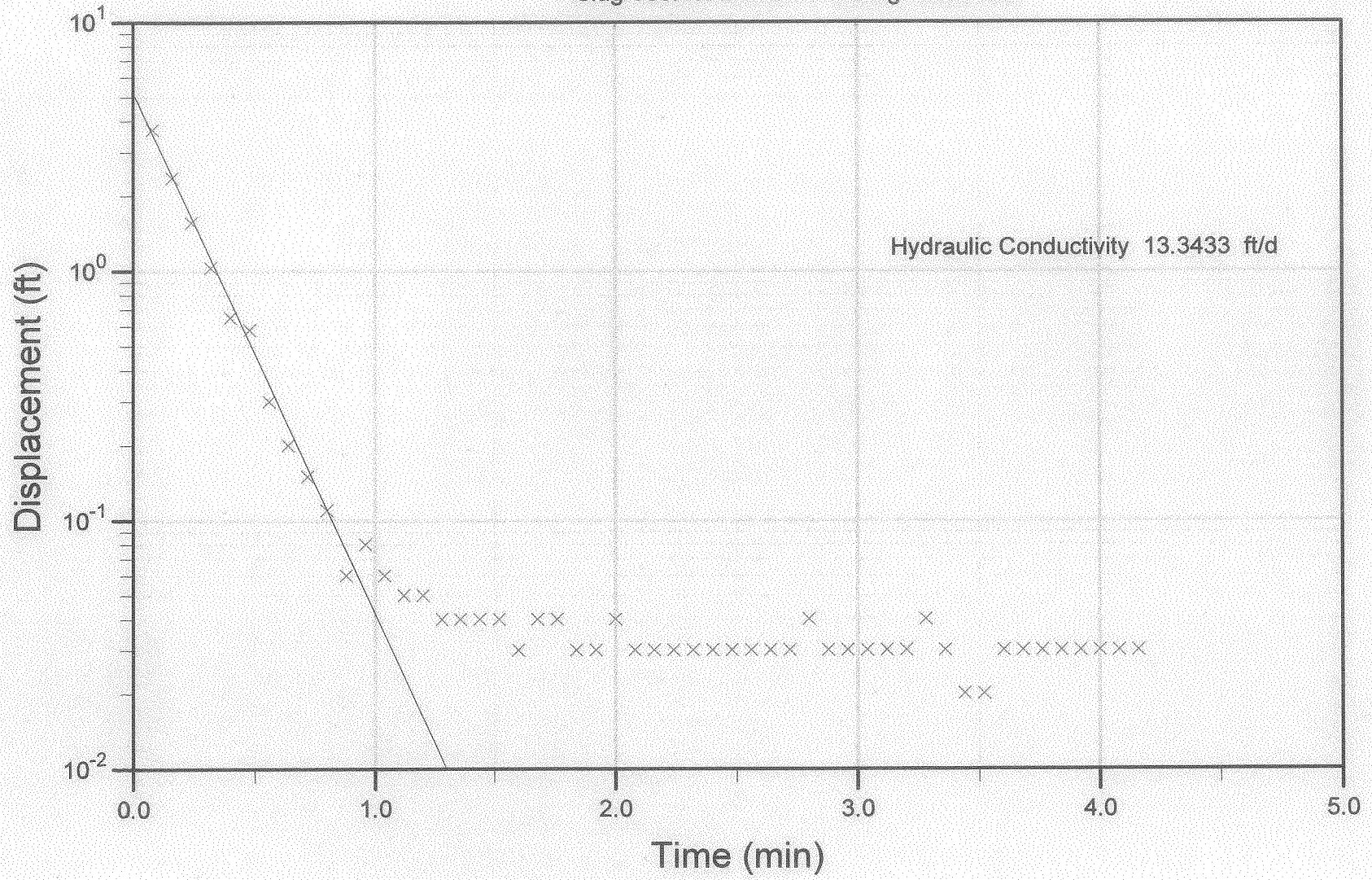
Slug Test for MWC015: Rising Head Test




BOE-C6-0139377

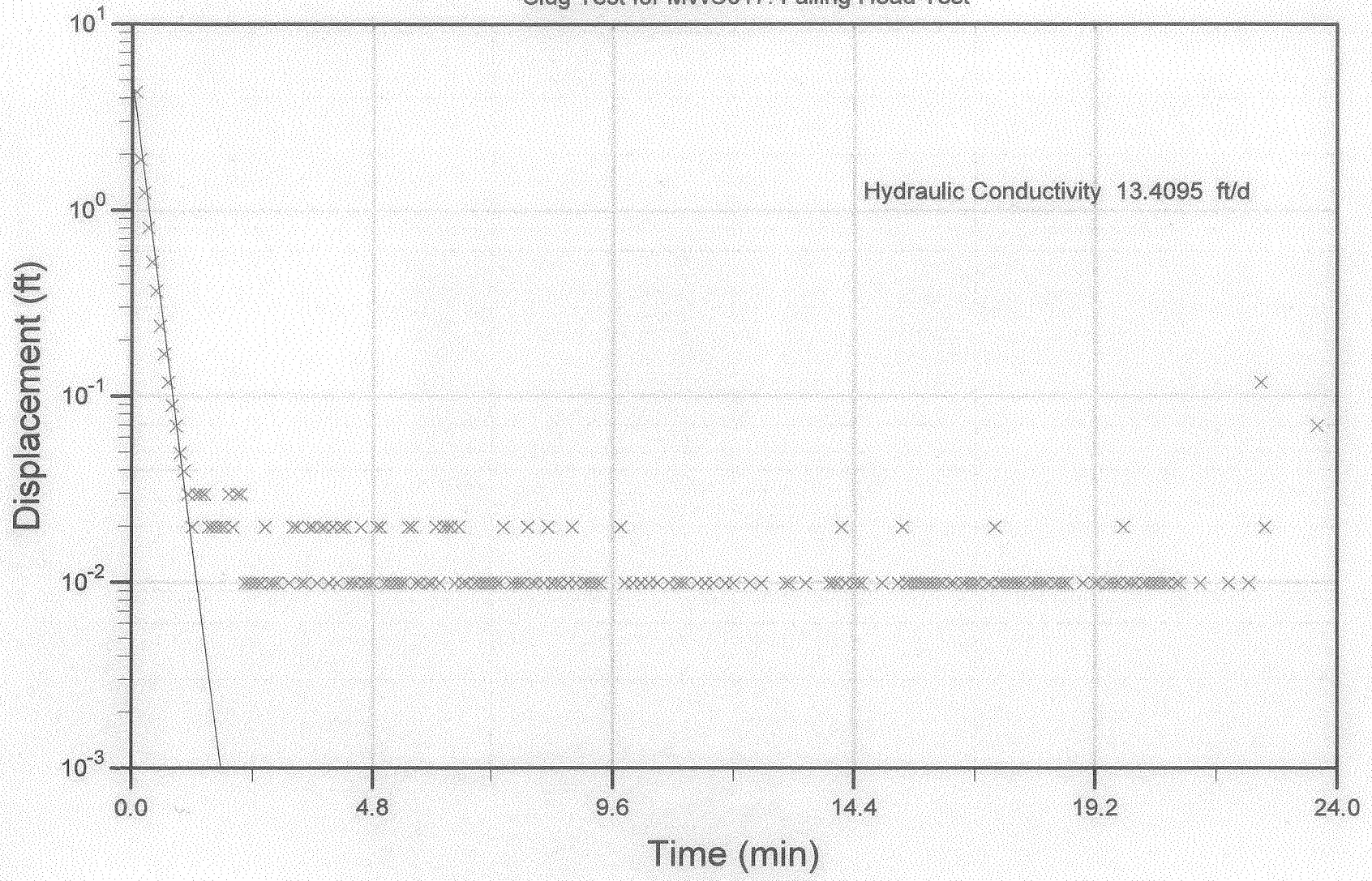
# Bouwer & Rice

Slug Test for MWC017: Rising Head Test



# Bouwer & Rice

Slug Test for MWC017: Falling Head Test

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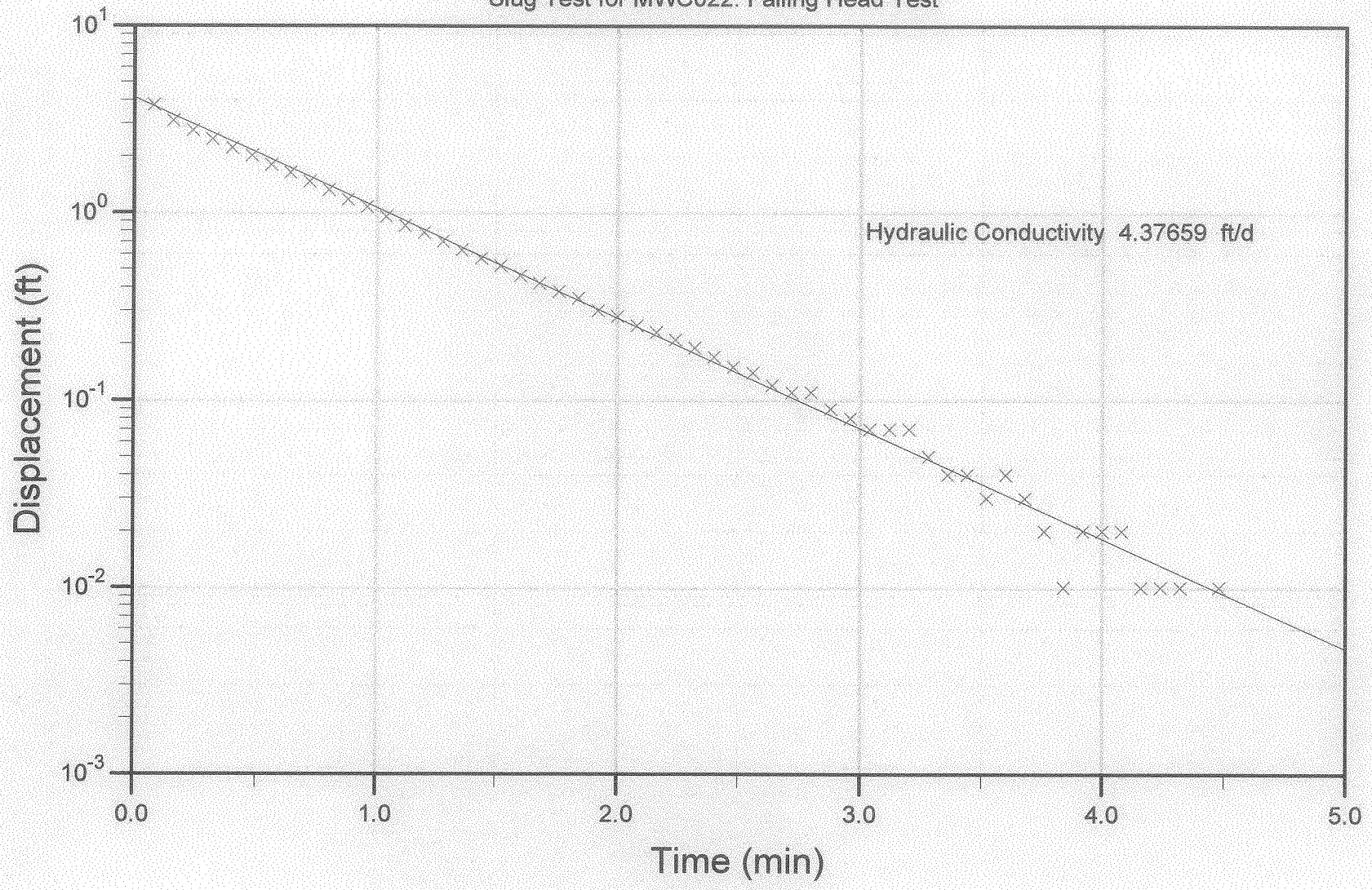
# Bouwer & Rice

Slug Test for MWC022: Falling Head Test

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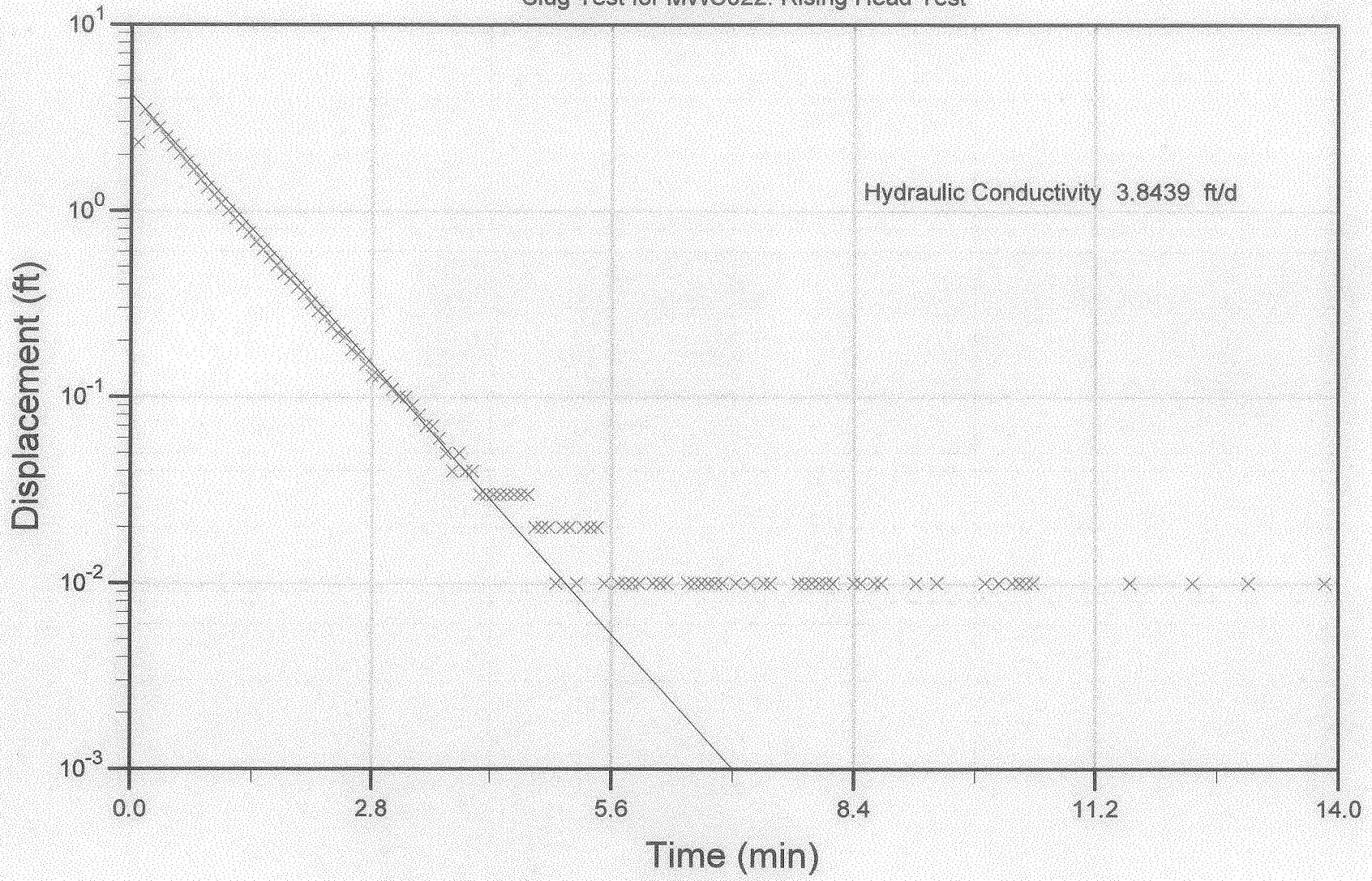
# Bouwer & Rice

Slug Test for MWC022: Rising Head Test




BOE-C6-0139381

# Appendix B
# Tait Field Data Sheets

CDM

eing Former Torrance C-6 Facility

Torrance, California

**Well Number** IRZCMW0002
**SLUG TEST WELL**

Test Date(s): 06/19/06

**Page** 1 **of** _____

Slug Test Well Casing Diameter: 4" inches ID
Slug Test Well Borehole Diameter 10" inches
Slug Test Well Screen Interval (feet bMP): 96 to 121
Slug Test Well Total Depth (feet bMP): 121
Measuring Point (MP) Description: TOR (pre-marked pts
MP distance (above/below) survey point: —
Top of slug depth (feet below MP) 70'
Slug Volume _____(CF); Slug Length 5.4" (feet); Slug Diameter 3" in. OD

Data logger Serial # 06234
Data logger type: Solinst F30/M10
Data Logger depth (bMP): 75'
Pre-determined minimum drawdown depth (feet bMP): _____
Bottom of Slug Depth 75.4

| DATE | TIME (h:min:sec) | ELAPSED TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes bailing comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| 6/19 | 9:15 | Static Water Level (Pre-emplacement reading) | 65.07 | 0 | @10:40 Dropped slug, but had to pull out, because it was not completely submerged. |
| | 10:30 | Post-emplacement Water Level Reading | 65.07 | | |
| | | Pre-removal Water Level Reading 1 | | | |
| | | Pre-removal Water Level Reading 2 | | | |
| | | | | | |
| 6/19 | 10:40 | | | | see notes above letting levels restabalize |
| | | | | | |
| 6/19 | 11:10 | 0:00 | 65.17 | approximate | |
| | 11:10.5 | 1:30 | 63.1 | | |
| | 11:12 | 2:00 | 63.22 | | |
| | | 2:45 | 63.32 | | |
| | 11:13 | 3:00 | 63.35 | | |
| | | 3:30 | 63.42 | | |
| | 11:14 | 4:00 | 63.48 | | |
| | | 4:30 | 63.52 | | |
| | 11:15 | 5:00 | 63.59 | | |
| | | 5:30 | 63.64 | | |
| | 11:16 | 6:00 | 63.70 | | |
| | | 6:30 | 63.73 | | |
| | 11:17 | 7:00 | 63.78 | | |

**Page** 2 **of** _____

| DATE | TIME (h:min:sec) | ELAPSED TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes bailing comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| | | 7:30 | 63.80 | | |
| | 11:18 | 8:00 | 63.82 | | |

Explanation-
bMP = below measuring point

eing Former Torrance C-6 Facility

Torrance, California

**Well Number** _____
**SLUG TEST WELL**

Test Date(s): _____

| | | | | | |
|---|---|---|---|---|---|
| | | 8:30 | 63.88 | | |
| 6/19 | 11:19 | 9:00 | 63.90 | | |
| | | 9:30 | 63.93 | | |
| | 11:20 | 10:00 | 63.96 | | |
| | 11:25 | 15:00 | 64.22 | | |
| | 11:30 | 20:00 | 64.40 | | |
| | 11:35 | 25:00 | 64.56 | | |
| | 11:40 | 30:00 | 64.66 | | |
| | 11:50 | 40:00 | 64.80 | | |
| | 12:00 | 50:00 | 64.90 | | |
| | 12:10 | 60:00 | 64.97 | | |
| | 12:25 | 75:00 | 65.00 | | |
| | 12:40 | 90:00 | 65.06 | | |
| | | | | | |
| | | SLUG | OUT | | |
| | 12:40 | | | | |
| | | 1:30 | | 67.18 | |
| | | 1:45 | | 67.14 | |
| | 12:42 | 2:00 | | 67.10 | |
| | | 2:15 | | 67.08 | |
| | | 2:30 | | 67.05 | |
| | | 2:45 | | 67.05 | |
| | 12:43 | 300 | | 67.04 | |
| | | 3:30 | 67.00 | 67.00 | |
| | 12:44 | 4:00 | 66.95 | 66.95 | |
| | | 4:30 | 66.92 | 66.92 | |
| | 12:45 | 5:00 | 66.87 | 66.87 | |
| | 12:46 | 6:00 | 66.80 | 66.80 | |
| | 12:47 | 7:00 | 66.75 | 66.75 | |
| | 12:48 | 8:00 | | | |
| | 12:49 | 9:00 | 66.68 | 66.68 | |
| | 12:50 | 10:00 | 66.60 | 66.60 | |
| | 12:55 | 15:00 | 66.55 | 66.55 | |

next page

Explanation-
bMP = below measuring point

eing Former Torrance C-6 Facility

Torrance, California

**Well Number** IRZCMW 0002
**SLUG TEST WELL**

Test Date(s): 06/19/06

| | Time | Elapsed time | Depth | | |
|---|---|---|---|---|---|
| | 12:55 | 15:00 | 66.29 | 66.29 | |
| | 13:00 | 20:00 | 66.14 | 66.14 | |
| | 13:05 | 25:00 | 65.95 | 65.95 | |
| | 13:10 | 30:00 | 65.80 | 65.80 | |
| | 13:20 | 40:00 | 65.58 | 65.58 | |
| | 13:30 | 50:00 | 65.44 | 65.44 | |
| | 13:40 | 60:00 | 65.36 | 65.36 | |
| | 13:55 | 75:00 | 65.21 | 65.21 | |
| | 14:10 | 90:00 | 65.17 | 65.17 | |

Explanation-
bMP = below measuring point

# SLUG TEST FIELD FORM

Site Info:
BRC Former C-6 Facility
Torrance, CA

Well Number MWC 009
SLUG TEST TYPE: Slug in / Slug out
Test Date(s): 8-2-06
Page 1 of 1

Slug Test Well Casing Diameter: 4 inches ID
Slug Test Well Borehole Diameter 10 inches
Slug Test Well Screen Interval (feet bMP): 101 to 121
Slug Test Well Total Depth (feet bMP): 119.53
Measuring Point (MP) Description: TOC N-side
MP distance (above/below) survey point: 0
Top of slug depth (feet below MP) 63.50
Slug Volume 0.32 (CF); Slug Length 62 5/8 (~~feet~~ in); Slug Diameter 3 3/8" in. OD
CSV File Directory/Name
Levelogger File directory/name:

Data logger Serial # 40249
Data logger type: Solinst LT F15/M5
Data Logger depth (bMP): ≈ 73'
Obs Well(s): MIN
Pre-determined minimum drawdown depth (feet bMP): NA

| DATE | TIME (h:min:sec) | ELAPSED TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| 8/2/06 | | Static Water Level (Pre-test-01) | 62.55 | 0 | TD 119.53 |
| | | Static Water Level (Pre-test-02) | 62.55 | | |
| | | Pre-removal Water Level Reading 1 | | | |
| | | Pre-removal Water Level Reading 2 | | | Start test @ 8:41.00 |
| | 8:42. | | 62.35 | | |
| | 8.42.09 | | 62.40 | | |
| NA | ~~8.429~~ | 8.42.29 | 62.47 | | |
| | 842.50 | | 62.50 | | |
| | 8:44.0 | | 62.52 | | |
| | 8.44.00 | | 62.54 | | |
| | 8.44.47 | | 62.55 | | |
| | | | | | |
| | | | | | |
| | | | | | |
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# SLUG TEST FIELD FORM

Site Info:
BRC Former C-6 Facility
Torrance, CA

Well Number ~~MW05~~ 015
SLUG TEST TYPE: Slug in / Slug out
Test Date(s): 8-2-06
Page 1 of 1

Slug Test Well Casing Diameter: 4 inches ID
Slug Test Well Borehole Diameter: 10 inches
Slug Test Well Screen Interval (feet bMP): 100 to 125
Slug Test Well Total Depth (feet bMP): 120.26
Measuring Point (MP) Description: North side TOC
MP distance (above/below) survey point: 0
Top of slug depth (feet below MP) 62.45
Slug Volume 0.32 (CF); Slug Length 62 5/8 (feet); Slug Diameter 3 3/8 in. OD
CSV File Directory/Name
Levelogger File directory/name:

Data logger Serial #: 40249
Data logger type: Solinst LT F15/M5
Data Logger depth (bMP): ≈ 70 ft.
Obs Well(s): None
Pre-determined minimum drawdown depth (feet bMP): NA

| DATE | TIME (h:min:sec) | ELAPSED TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| 8/2/06 | 0932 | Static Water Level (Pre-test-01) | 60.51 | 0 | TD 120.26 |
| | 0940 | Static Water Level (Pre-test-02) | 60.51 | | removed hoses |
| | | Pre-removal Water Level Reading 1 | ~~60.51~~ | | |
| | | Pre-removal Water Level Reading 2 | ~~60.51~~ | | |
| | 10:04.00 | | | | start 10:04.00 |
| | 05.30 | | | | |
| | 05.00 | | 60.40 | | |
| | 05.30 | | 60.47 | | |
| | 06.0 | | 60.50 | | |
| | 06.30 | | 60.51 | | |
| | 07.00 | | 60.51 | | |
| | 10:07.30 | | 60.51 | | top of slug 62.45 to TOC |
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# SLUG TEST FIELD FORM

**Site Info:**
**BRC Former C-6 Facility**
**Torrance, CA**

**Well Number** MWC 015
**SLUG TEST TYPE: Slug in / Slug out**

Test Date(s): _____

Page 1 of _____

Slug Test Well Casing Diameter: 4 inches ID

Slug Test Well Borehole Diameter: 10 inches

Slug Test Well Screen Interval (feet bMP): 100 to 125

Slug Test Well Total Depth (feet bMP): 120.26

Measuring Point (MP) Description: North Side TOC

MP distance (above/below) survey point: 0

Top of slug depth (feet below MP) 62.45

Slug Volume 0.32 (CF); Slug Length 62 5/12 (feet); Slug Diameter 3 3/8 in. OD

CSV File Directory/Name

Levelogger File directory/name:

Data logger Serial # 40249

Data logger type: Solinst LT F15/M5

Data Logger depth (bMP): ≈ 70 ft.

Obs Well(s): None

Pre-determined minimum drawdown depth (feet bMP): NA

| DATE | TIME (h:min:sec) | ELAPSED TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| 8/2/06 | 10:14:00 | Static Water Level (Pre-test-01) | 60.51 | 0 | |
| | | Static Water Level (Pre-test-02) | | | |
| | | Pre-removal Water Level Reading 1 | | | |
| | | Pre-removal Water Level Reading 2 | | | |
| | 10:20:00 | | | | Slug out |
| | 10:21.00 | | 60.70 | | |
| | 10:21.10 | | 60.86 | | |
| | | | ~~60.65~~ | | |
| | 10:21.50 | | 60.65 | | |
| | 10:22.00 | | 60.58 | | |
| | 10:22.10 | | 60.56 | | |
| | 10:22.20 | | 60.55 | | |
| | 10:22.30 | | 60.55 | | |
| | 10:22.40 | | 60.54 | | |
| | 10:22.50 | | 60.54 | | |
| | 10:23.00 | | 60.54 | | |
| | 10:23.30 | | 60.~~53~~ 55 | | |
| | 10:24.30 | | 60.53 | | |

Site: MWC015 Page 2 of 2

| DATE | TIME (h:min:sec) | ELAPSED TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| 8/2 | 10 25:30 | | 60.53 | | |
| | 10:26:30 | | 60.52 | | |
| | 10:27:30 | | 60.52 | | |
| | 10:37:00 | | 60.51 | | |

# Object Information

MWC015

| | |
|---|---|
| Object Name | MWC015 |
| Object Type | Groundwater Monitoring Well |
| Geological Unit | C-Sand |
| Date Completed | 5/17/2004 |
| Object Status | Active |
| Location Description | Surveyed by Tait and Associates |
| Sub Area/Zone | |
| Top Of Casing Z | 51.51 |
| Groundwater Elevation | -9.45 |
| Survey Date | 5/19/2005 |
| Depth To Top Of Screen | 100 |
| Depth To Bottom Of Screen | 125 |
| Total Depth/Height | 128 |
| # Samples Collected | Water - 6<br>Soil - 0 |
| Last Sample Date | Water - Mar 16 2006 11:15AM<br>Soil - |
| Analysis Groups | VOC |
| Latest PCE, TCE, cis-DCE in Water | 40.00 U, 1300.00, 40.00 U |
| Max PCE, TCE, cis-DCE in Water | 50.00 U, 1700.00, 50.00 U |
| Max PCE, TCE, cis-DCE in Soil | |
| VOCs Detected in Water | 1,1-Dichloroethene, cis-1,2-Dichloroethene, Tetrahydrofuran (THF) |
| VOCs Detected in Soil | |



BOE-C6-0139390

Slug in

# SLUG TEST FIELD FORM MWC017

| Site Info: |
|---|
| BRC Former C-6 Facility |
| Torrance, CA |

Well Number
SLUG TEST TYPE: ~~Slug-in / Slug-out~~
Test Date(s): 8/2/06
Page 1 of 1

Slug Test Well Casing Diameter: 4 inches ID
Slug Test Well Borehole Diameter: 10 inches
Slug Test Well Screen Interval (feet bMP): 100 to 125
Slug Test Well Total Depth (feet bMP): 124.82
Measuring Point (MP) Description: TOC
MP distance (above/below) survey point: 0
Top of slug depth (feet below MP) 65.80 5/8
Slug Volume 0.32 (CF); Slug Length 62 (~~feet~~ in); Slug Diameter 3 3/8 in. OD
CSV File Directory/Name
Levelogger File directory/name:

Data logger Serial # 40249
Data logger type: Solinst LT F15/M5
Data Logger depth (bMP) ~75.00 ft
Obs Well(s): MWB019
Pre-determined minimum drawdown depth (feet bMP): NA

| DATE | TIME (h:min:sec) | ELAPSED TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| 8/02/06 | 1200 | Static Water Level (Pre-test-01) | 64.75 | 0 | |
| | 1245 | Static Water Level (Pre-test-02) | 64.75 | | |
| | | Pre-removal Water Level Reading 1 | | | |
| | | Pre-removal Water Level Reading 2 | | | |
| | 13:10.00 | | 64.60 | | |
| | 13:10.40 | | 64.66 | | |
| | 13:10.50 | | 64.67 | | |
| | 13:11:00 | | 64.672 | | |
| | 13:11.10 | | 64.673 | | |
| | 13:12.30 | | 64.735 | | |
| | 13:12.40 | | 64.740 | | |
| | 13:12.50 | | 64.745 | | |
| | 13:13.00 | | 64.750 | | |
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# SLUG TEST FIELD FORM

Site Info:
BRC Former C-6 Facility
Torrance, CA

Well Number MWC 017
SLUG TEST TYPE: Slug in / Slug out

Test Date(s): 8-2-06

Page 1 of 1

Slug Test Well Casing Diameter: 4 inches ID

Slug Test Well Borehole Diameter 12 inches

Slug Test Well Screen Interval (feet bMP): 100 to 125

Slug Test Well Total Depth (feet bMP): 124.82

Measuring Point (MP) Description: TOC

MP distance (above/below) survey point: 0

Data logger Serial # 40249

Data logger type: Solinst LT F15/M5

Data Logger depth (bMP): ≈ 75.00 ft

Obs Well(s): MWB 019

Pre-determined minimum drawdown depth (feet bMP): NA

Top of slug depth (feet below MP) 65.80

Slug Volume 0.32 (CF): Slug Length 62.5/8 ~~(feet)~~ inch; Slug Diameter 3 3/8 in. OD

CSV File Directory/Name

Levelogger File directory/name:

| DATE | TIME (h:min:sec) | ELAPSED TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| 8/2/06 | 1332 | Static Water Level (Pre-test-01) | 64.75 | 0 | |
| | 1334 | Static Water Level (Pre-test-02) | 64.75 | | |
| | | Pre-removal Water Level Reading 1 | | | |
| | | Pre-removal Water Level Reading 2 | | | |
| | | | | | Slug out 1335.00 |
| | 1335.45 | | 64.78 | | |
| | 1336.00 | | 64.78 | | |
| | 1336.30 | | 64.75 | | |
| | 1336.45 | | 64.73 | | |
| | 1337.00 | | 64.73 | | |
| | 1338.00 | | 64.73 | | |
| | 1338.30 | | 64.73 | | |
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Levelogger Serial No 105799 L F 15/M5
Set @ 72 ft btoc. MW B019 Obs well

Site: Page 1 of 1

| DATE | TIME (h:min:sec) | ELAPSED TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| | 12:30 | | 64.62 | | |
| | 13:01 | | 64.620 | | |
| | ~~101.00~~ 1309.00 | | 64.615 | | Slug in 1310.00 |
| | ~~1309.00~~ 1311.00 | | 64.62 | | |
| | ~~1311.16~~ 1313.00 | | 64.62 | | |
| | 1315.00 | | 64.62 | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | Slug out |
| | | | | | |
| | | | | | |
| | | | | | Set Transducer approximately 8 ft below water level @ 72 ft ~~bgs~~ below TOC |
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# Object Information

MWC017

| | |
|---|---|
| Object Name | MWC017 |
| Object Type | Groundwater Monitoring Well |
| Geological Unit | C-Sand |
| Date Completed | 5/17/2004 |
| Object Status | Active |
| Location Description | Surveyed by Tait and Associates |
| Sub Area/Zone | |
| Top Of Casing Z | 55.16 |
| Groundwater Elevation | -10.2 |
| Survey Date | 5/19/2005 |
| Depth To Top Of Screen | 100 |
| Depth To Bottom Of Screen | 125 |
| Total Depth/Height | 128 |
| # Samples Collected | Water - 7<br>Soil - 0 |
| Last Sample Date | Water - Mar 14 2006 12:10PM<br>Soil - |
| Analysis Groups | Alkalinity, Anions, Metals, TOC, Unspecified, VOC |
| Latest PCE, TCE, cis-DCE in Water | 0.62 J, 100.00, 39.00 |
| Max PCE, TCE, cis-DCE in Water | 25.00 U, 1300.00, 46.00 |
| Max PCE, TCE, cis-DCE in Soil | |
| VOCs Detected in Water | 1,1-Dichloroethane, 1,2-Dichloroethane, Chlorobenzene, cis-1,2-Dichloroethene, Tetrachloroethene, trans-1,2-Dichloroethene |
| VOCs Detected in Soil | |

# SLUG TEST FIELD FORM

**Site Info:**
BRC Former C-6 Facility
Torrance, CA

Well Number MWC 022
SLUG TEST TYPE: Slug in / Slug out
Test Date(s): 8-2-06
Page 1 of 2

Slug Test Well Casing Diameter: 4 inches ID
Slug Test Well Borehole Diameter 10 inches
Slug Test Well Screen Interval (feet bMP): 97 to 117
Slug Test Well Total Depth (feet bMP): 115.80
Measuring Point (MP) Description: N. side of TOC
MP distance (above below) survey point: 0

Data logger Serial # 40249
Data logger type: Solinst LT F15/M5
Data Logger depth (bMP): 75.00 NA
Obs Well(s): None
Pre-determined minimum drawdown depth (feet bMP): NA

Top of slug depth (feet below MP) 64.56
Slug Volume 0.32 (CF); Slug Length 62 5/8 (feet); Slug Diameter 3 3/8 in. OD

CSV File Directory/Name

Levelogger File directory/name:

| DATE | TIME (h:min:sec) | ELAPSED TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| 8/2 | 1453 | Static Water Level (Pre-test-01) | 59.33 | 0 | TD 115.80 |
| | | Static Water Level (Pre-test-02) | | | |
| | | Pre-removal Water Level Reading 1 | | | |
| | | Pre-removal Water Level Reading 2 | | | |
| | 1520 | | 58.51 | | Slug in test |
| | 1521.30 | | 58.71 | | |
| | 1521.45 | | 58.91 | | |
| | 1522.0 | | 59.0 | | |
| | 1522.10 | | 59.05 | | |
| | 1522.15 | | 59.10 | | |
| | 1522.30 | | 59.15 | | |
| | 1522.45 | | 59.20 | | |
| | 1523.10 | | 59.25 | | |
| | 1523.00 | | 59.29 | | |
| | 1524.15 | | 59.30 | | |
| | 1524.50 | | 59.31 | | |
| | 1526.00 | | 59.31 | | |
| | 1527.00 | | 59.32 | | |

Site: MW C 022 Page 2 of 2

| DATE | TIME (h:min:sec) | ~~ELAPSED~~ TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| 8/2/06 | | 1528.0 | 59.32 | | |
| | | 1529.0 | 59.32 | | |
| | | 1530.0 | 59.325 | | |
| | | 1531.0 | 59.325 | | top of slug 61.36' TOC |
| | | 1540 | 59.325 | | |

# SLUG TEST FIELD FORM

**Site Info:**
**BRC Former C-6 Facility**
**Torrance, CA**

**Well Number** MW 022
**SLUG TEST TYPE: Slug in / Slug out**

Test Date(s): 8-2-06
Page 1 of 2

Slug Test Well Casing Diameter: 4 inches ID
Slug Test Well Borehole Diameter: 10 inches
Slug Test Well Screen Interval (feet bMP): 97 to 117
Slug Test Well Total Depth (feet bMP): 115.80
Measuring Point (MP) Description:
MP distance (above/below) survey point: N. side of TOC
Top of slug depth (feet below MP) 60.86
Slug Volume 0.32 (CF): Slug Length 62 9/8 (feet); Slug Diameter 3 3/8 in. OD
CSV File Directory/Name
Levelogger File directory/name:

Data logger Serial #: 40249
Data logger type: Solinst LT F15/M5
Data Logger depth (bMP): 75.00 ft
Obs Well(s): NA
Pre-determined minimum drawdown depth (feet bMP): NA

| DATE | TIME (h:min:sec) | ELAPSED TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| 8/2 | 1540 | Static Water Level (Pre-test-01) | 59.325 | 0 | |
| | | Static Water Level (Pre-test-02) | | | |
| | | Pre-removal Water Level Reading 1 | | | |
| | | Pre-removal Water Level Reading 2 | | | |
| | | | | | Slug out test |
| | 1542.0 | | — | | 1542.0 |
| | 1542.45 | | 60.60 | | |
| | 1543.0 | | 60.40 | | |
| | 1543.10 | | 60.20 | | |
| | 1543.20 | | 60 | | |
| | 1543.30 | | 59.90 | | |
| | 1543.40 | | 59.80 | | |
| | 1543.50 | | 59.75 | | |
| | 1543.55 | | 59.70 | | |
| | 1544.00 | | 59.65 | | |
| | 1544.10 | | 59.6 | | |
| | 1544.26 | | 59.55 | | |
| | 1544.30 | | 59.5 | | |

Site: MWC 022 Page 2 of 2

| DATE | TIME (h:min:sec) | ELAPSED TIME (min) | DEPTH TO WATER (feet below MP) | DRAWDOWN (feet) | COMMENTS (includes comments before slug emplacement, water level stabilization after slug emplacement, observations, etc.) |
|---|---|---|---|---|---|
| 6/8/06 | | 1544.45 | 59.45 | | |
| | | 1545.00 | 59.40 | | |
| | | 1546.00 | 59.35 | | |
| | | 1548.40 | 59.33 | | |
| | | 1550.20 | 59.32 | | |

# Object Information

MWC022

| | |
|---|---|
| Object Name | MWC022 |
| Object Type | Groundwater Monitoring Well |
| Geological Unit | C-Sand |
| Date Completed | 6/7/2005 |
| Object Status | |
| Location Description | |
| Sub Area/Zone | |
| Top Of Casing Z | 51.6 |
| Groundwater Elevation | -8.72 |
| Survey Date | 6/13/2005 |
| Depth To Top Of Screen | 97 |
| Depth To Bottom Of Screen | 117 |
| Total Depth/Height | 120 |
| # Samples Collected | Water - 4<br>Soil - 0 |
| Last Sample Date | Water - Mar 13 2006 10:10AM<br>Soil - |
| Analysis Groups | VOC |
| Latest PCE, TCE, cis-DCE in Water | 1.00 U, 47.00, 5.40 |
| Max PCE, TCE, cis-DCE in Water | 10.00 U, 120.00, 7.60 |
| Max PCE, TCE, cis-DCE in Soil | |
| VOCs Detected in Water | 1,1-Dichloroethane, cis-1,2-Dichloroethene, Toluene, trans-1,2-Dichloroethene |
| VOCs Detected in Soil | |

Tait Environmental Management, Inc.

Engineering · Environmental · Compliance

# DAILY FIELD REPORT

| | | |
|---|---|---|
| **Project Name:** BRC-C6 SLUGTEST | **Project #:** EM27270 | **Date:** 8-2-06 |
| **Personnel:** MP/KL/NJB | **Sub Contractors:** NONE | |

**Task:** PERFORM SLUGTEST IN 4 WELLS.

| | | |
|---|---|---|
| **Time Arrived at Site:** 6:30 A. | **Time Left Site:** 5:30 PM | **Total Hours at Site:** 11:00 |
| **Odometer (Start):** — | **Odometer (End):** — | **Total Miles:** — |

**Equipment List:**

- ☑ Solinst Water Level Meter Serial #: 35566, 29484, 29625
- ☑ Solinst Water/~~Product Level Interface Meter~~ Serial #: _____
- ☐ Horiba U-22 Water Quality Meter Serial #: _____
- ☐ PID/FID Type: _____ Serial #: _____
- ☐ Submbersible Pump Type: _____ Serial #: _____
- ☐ Generator Type: _____ Serial #: _____
- ☑ Company Truck License #: _____
- ☑ Other(s): SLUG, LEVELLOGERS (3 used)

**Desription of Work Performed:** (Summarize all field activities in a chronological sequence. Include tailgate health and safety meeting, personnel/visitors at site, calibration times and methods.)

Arrive on site @ 6:30 Kevin was onsite
Pearl from CDM SHOWED UP AT 6:45 Real Arrival 7:00
Had HSP Meeting. Discussed work scope
HSP, HOSP. etc.

**Client Signature** (if applicable): _____ **Date:** _____

Tait Environmental Management, Inc.
Engineering • Environmental • Consulting



Calibrate Tapes (WLL.)

| | | | | | |
|---|---|---|---|---|---|
| 29484 | Solinst | 30.05 | Steel tape | | 30.00 |
| 35566 | " | 30.02 | " | " | 30.00 |
| 29625 | " | 30.09 | " | " | 30.00 |

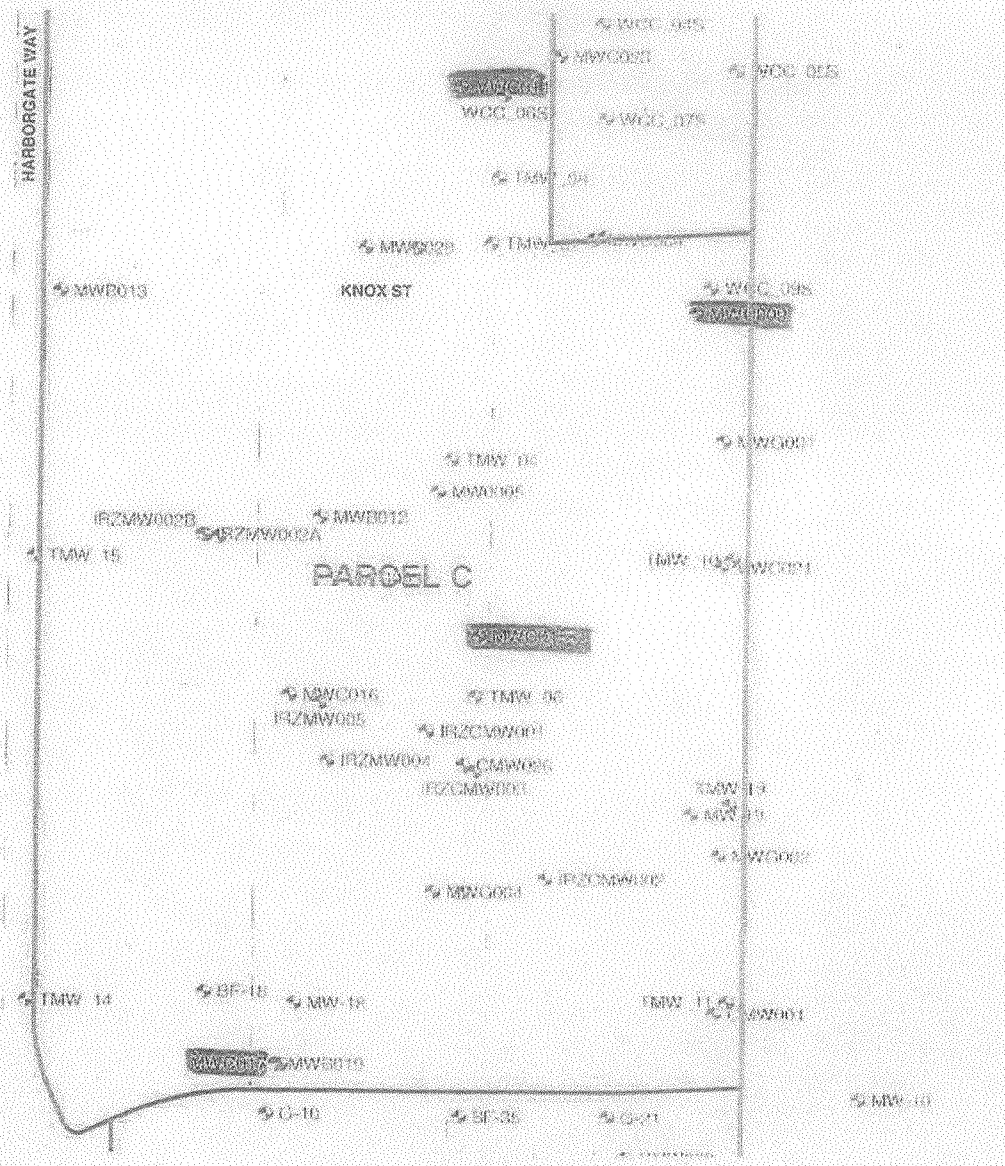
Start with the Taton MWC009
MWC011 had a trailer parked over could not be reached.

0755 mwc009 WL 62.55, TD 119.53 (Sol#29484)
0841 Started slug in test MWC009
0850 Started slug out test MWC009
0900 Pearl w/ CDM left the site
1004 Started slug in test MWC015
1020 Started slug out test MWC015
1040 Calibrated watched used for timing with computer setting transducers. The watch was 0.30 seconds faster.
1120 Neal off to Home Depot
1200 Monitored MWC 017, obs. MWB 019
1330 Jeremy Squire w/ [illegible] onsite. Signed H&S Plan
1335 Started slug out test MWC017
14:00 Completed " " " " "
14:01 Checked MWC011 was not blocked anymore opened the box well was 2" Moved to MWC006 checked that it was also 2". Called Pavi left a message [illegible] on computer for a suitable well in the area found MWC022 being 4".
14:53 Gauged MWC022, Setup and performed slug in and slug out tests. Downloaded transducers after the test
17:30 Depart site.

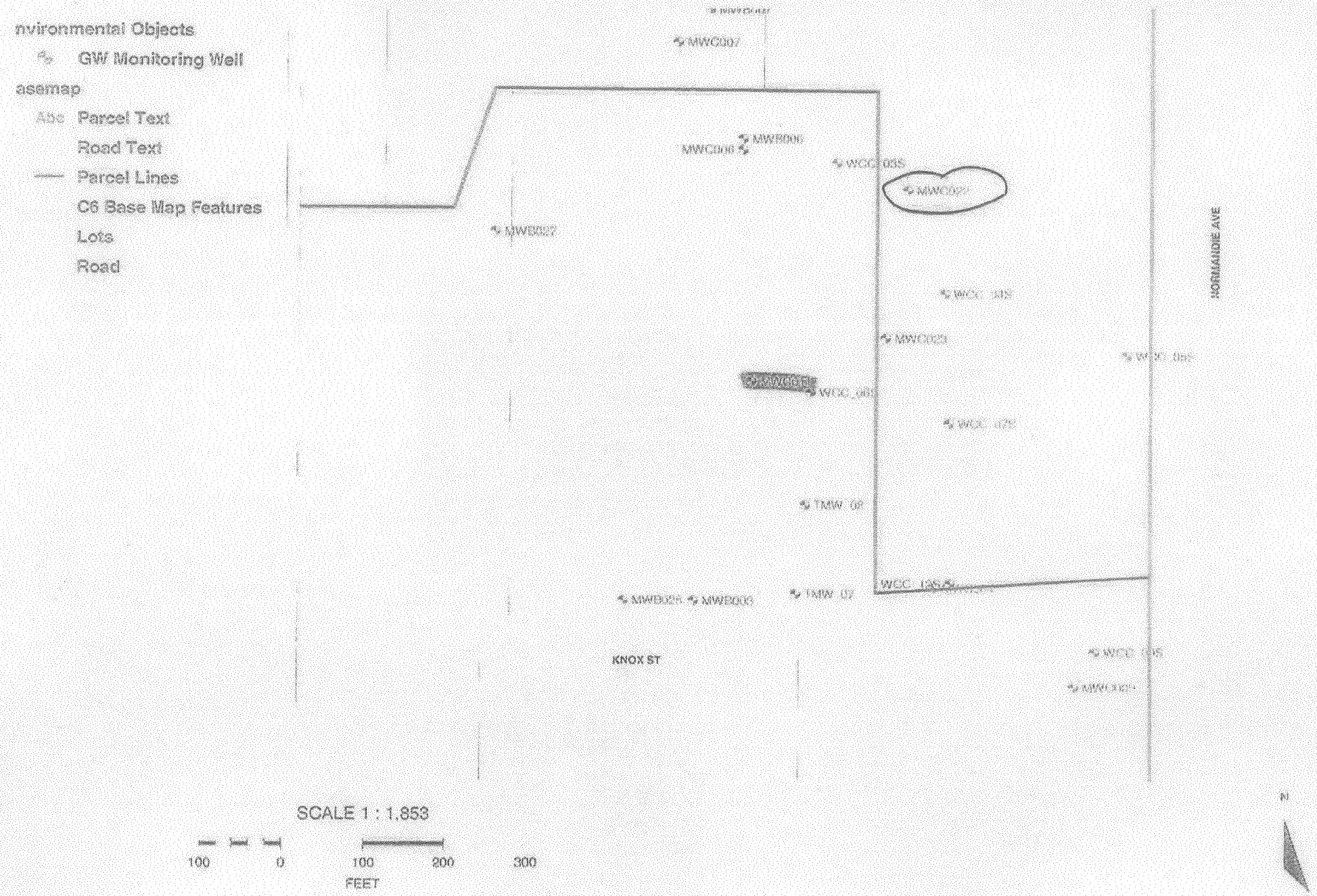
# BRC Former C-6 Facility and Surrounding Geography

Environmental Objects
- GW Monitoring Well

Basemap
- Abc Parcel Text
- Road Text
- Parcel Lines
- C6 Base Map Features
- Lots
- Road



# BRC Former C-6 Facility and Surrounding Geography




s://bpn.boeing.com/bedms/GIS/219_PRV.mwl

Monday, July 31, 2006 10:58 AM

# CDM Transmittal

CDM

18581 Teller Avenue, Suite 200
Irvine, CA 92612
949-752-5452
949-752-1307

| | | | |
|---|---|---|---|
| **To:** | Ms. Susan N. Jimenez | **From:** | Ravi Subramanian |
| **Organization/ Address:** | Boeing Realty Corporation | **Date:** | October 24, 2006 |
| | 4900 E. Conant Street, Building 1 | | |
| | Long Beach, CA 90808 | | |

**Re:** Document for Due Diligence File Copy

**Job #:** 27355-47930-T10A3

**Via:** *Mail:* *Overnight:* **XXX** *Courier:*

**Enclosed please find:** See below

| | | | |
|---|---|---|---|
| **For your information** | XXX | **Approved** | |
| **For your review** | | **Approved as noted** | |
| **For your signature** | | **Returned to you for correction** | |

**Message:**

Document titled "Summary of Slug Test Analysis for C-Sand Aquifer Unit, Remediation of Volatile Organic Compounds, Former C-6 Facility, Los Angeles, California"
Please call if any questions

Ravi Subramanian

Signed