Appendix D

SLUG TEST RESULTS

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10 February 2016

Attn: Colin Burns
Iluka Resources Limited
By email

Iluka Douglas Mine By-products Disposal
IS118500

Slug tests from West Bondi report

Dear Colin,

I refer to our ongoing discussions regarding supplementary information to support the Works Approval Application for disposal of mining by-products at the Douglas mine.

We understand that the EPA has requested more information on the calculations that were undertaken on slug tests in the vicinity of the Douglas mine. The works approval application refers to a report by SKM entitled “Bondi West Hydrogeological Investigation” dated 2004. In this report results from slug test analyses were presented as Appendix D. You have indicated that the EPA reviewer has asked for more information than was provided in the original report on the nature of the slug test calculations and results.

SKM was purchased by Jacobs and so we have access through our archives to the original project files associated with the report. We have retrieved the archive files and we can now offer the following further information on the slug test analysis:

- Six sites were tested and the sites are listed in Appendix D of the 2004 report;
- Data from all sites were collected by data logger and downloaded to excel for review;
- Data were collected from falling head and rising head tests for each bore;
- The data were converted to the required format for analysis using the AQTESOLV analysis software;
- Data were analysed using the method of Bower-Rice for an unconfined aquifer;
- Rising head data were converted to drawdown for analysis purposes (positive values);
- Rising and falling head tests were analysed for site 2,4 and 5 and only falling head tests for sites 1, 3 and 6;

The original AQTESOLV format files were preserved in our archive and we have been able to plot the results of the analysis and curve matching. This is presented in the attached figures. The date of the plot is shown on the figures as10 Feb 2016, but the data on which this plot is based are the original data that were measured in 2004.

You will see in some cases the fitted curve from the archive does not provide exactly the same value as in the table. In the case where falling and rising head tests have been analysed it appears that a blended value has been chosen for representation in the table in the original Appendix D.

I trust that this information provides the background to the tests and the values that have been reported.

Yours sincerely

Greg Hoxley
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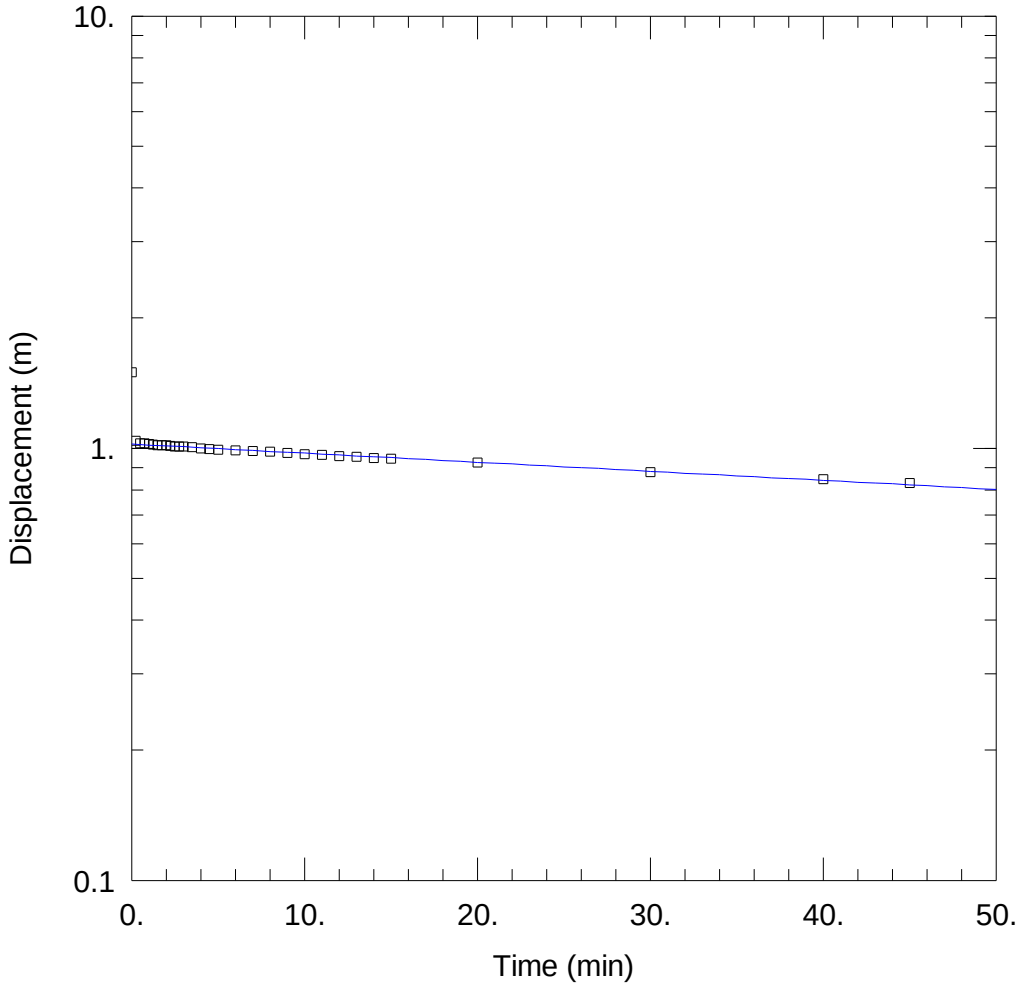
Appendix D Slug Test Results

SKM undertook slug testing of all 6 recently established monitoring bores to determine the hydraulic conductivity of the formations monitored namely the Parilla Sand unit and underlying weathered bedrock. Subsequent calculation of the hydraulic conductivities of these units provided key input data to the modelling of the mining impact and confirmed the discrepancies observed between recent geotechnical results and previous slug testing. A summary of the results is presented below in Table 9-2.

- **Table 9-2 – Summary of Slug Test Results**

Bore	Property	Depth	Screen Interval	Formation Monitored	Hydraulic Conductivity (m/day)
IWB001	Costello	26.1	23.6 – 25.6	Weathered bedrock	0.01
IWB002	Costello	21	18.5 – 20.5	Parilla Sand	1.04
IWB003	Eder (test pit)	23.5	21 – 23	Weathered bedrock	0.16
IWB004	Eder (test pit)	18	15.5 – 17.5	Parilla Sand	1.04
IWB005	Elliots Back Lane	25.2	22.7 – 24.7	Parilla Sand	1.07
IWB006	Lyons	5.5	4 – 5.5	Parilla Sand	0.8



IWB001

Data Set: T:\FEB\gph\WC02701\Disc_1097\WC02701\Technical\Slug Testing\IWB001.aqt
Date: 02/10/16 Time: 10:19:38

PROJECT INFORMATION

Company: SKM
Client: Iluka
Project: WC02701.400
Location: Costello (Basement)
Test Well: IWB001
Test Date: 03/02/04

AQUIFER DATA

Saturated Thickness: 13.44 m Anisotropy Ratio (Kz/Kr): 1.

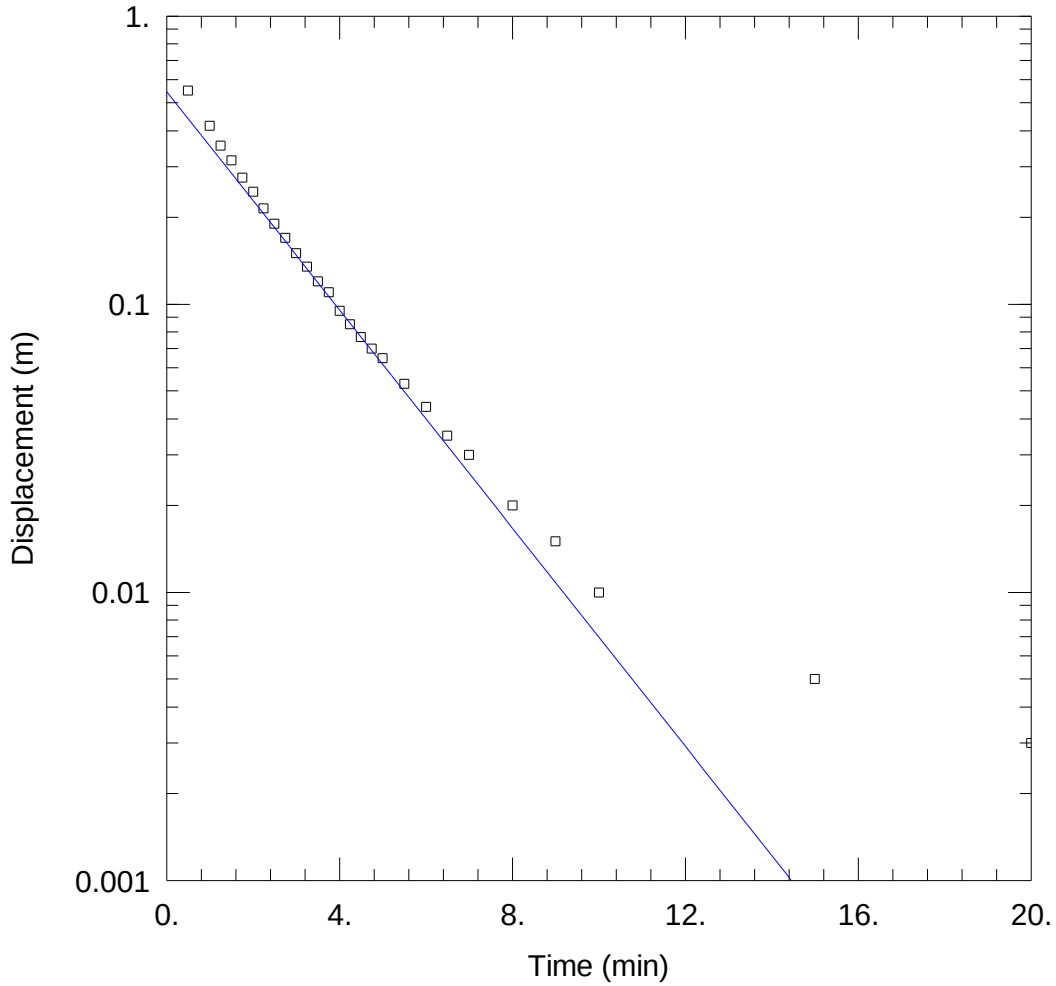
WELL DATA (IWB001)

Initial Displacement: 1.5 m
Static Water Column Height: 12.44 m
Total Well Penetration Depth: 12.44 m
Screen Length: 2. m
Casing Radius: 0.05 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.01161 m/day
y0 = 1.022 m



IWB002_1

Data Set: T:\FEB\gph\WC02701\Disc_1097\WC02701\Technical\Slug Testing\IWB002_1.aqt
Date: 02/10/16 Time: 10:09:44

PROJECT INFORMATION

Company: SKM
Client: Iluka
Project: WC02701.400
Location: Costello (Parilla)
Test Well: IWB002_1
Test Date: 03/02/04

AQUIFER DATA

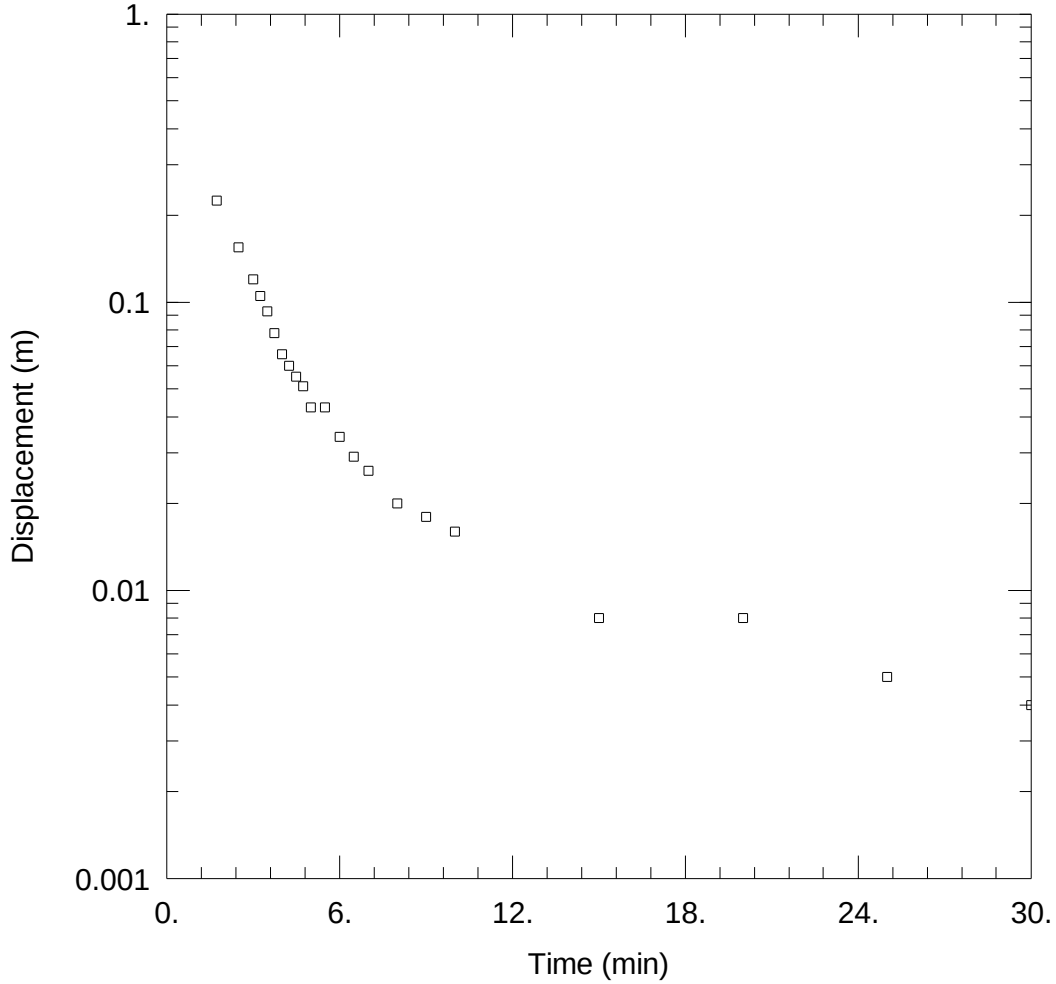
Saturated Thickness: 7.98 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (IWB002)

Initial Displacement: 1.5 m
Total Well Penetration Depth: 17.5 m
Casing Radius: 0.05 m
Static Water Column Height: 17.5 m
Screen Length: 2. m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
K = 1.326 m/day
Solution Method: Bouwer-Rice
y0 = 0.5459 m



IWB002_2

Data Set: T:\FEB\gph\WC02701\Disc_1097\WC02701\Technical\Slug Testing\IWB002_2.aqt
Date: 02/10/16 Time: 10:10:11

PROJECT INFORMATION

Company: SKM
Client: Iluka
Project: WC02701.400
Location: Costello (Parilla)
Test Well: IWB002
Test Date: 03/02/04

AQUIFER DATA

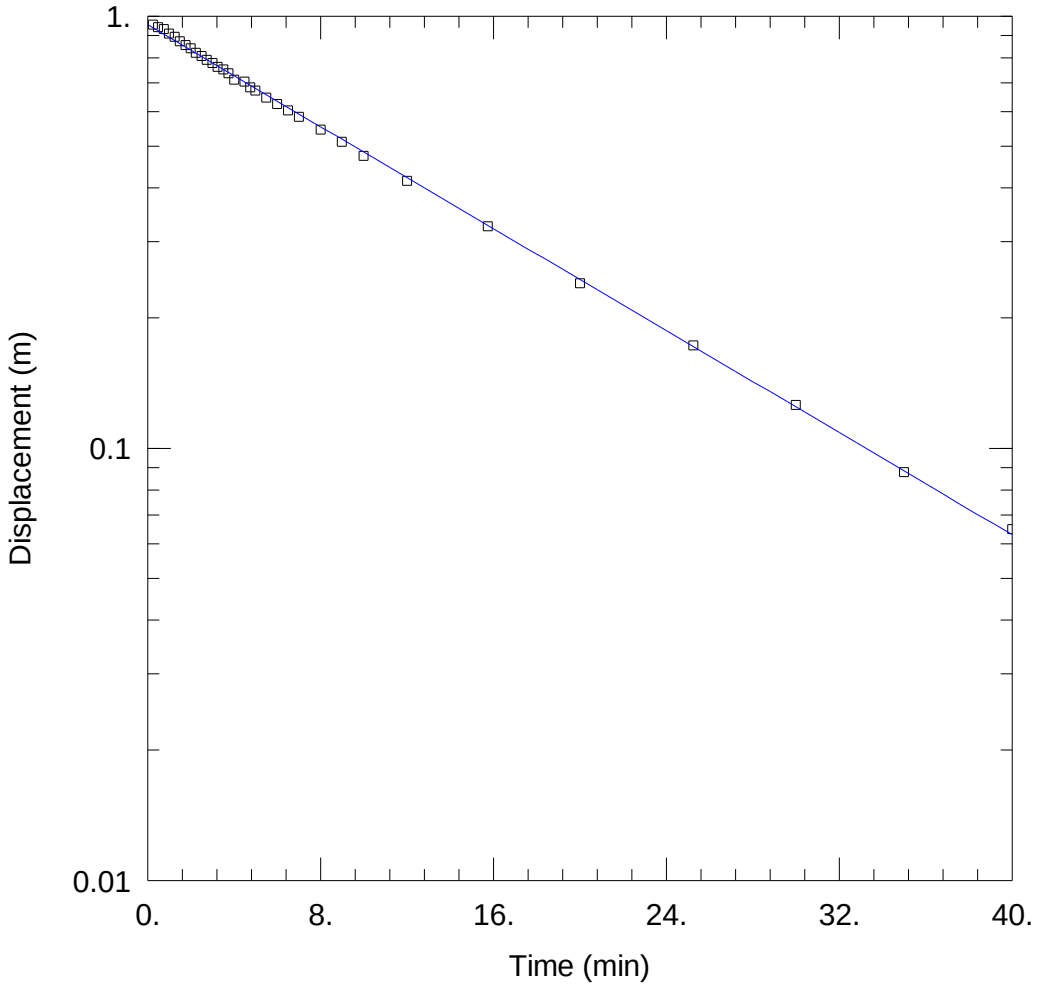
Saturated Thickness: 7.98 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (IWB002)

Initial Displacement: 1.5 m
Total Well Penetration Depth: 1.48 m
Casing Radius: 0.05 m
Static Water Column Height: 1.48 m
Screen Length: 2. m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
= 0.0005263
Solution Method: Bouwer-Rice
= 0.5001



IWB003

Data Set: T:\FEB\gph\WC02701\Disc_1097\WC02701\Technical\Slug Testing\IWB003.aqt
Date: 02/10/16 Time: 10:10:34

PROJECT INFORMATION

Company: SKM
Client: Iluka
Project: WC02701.400
Location: Eder (basement)
Test Well: IWB003
Test Date: 03/02/04

AQUIFER DATA

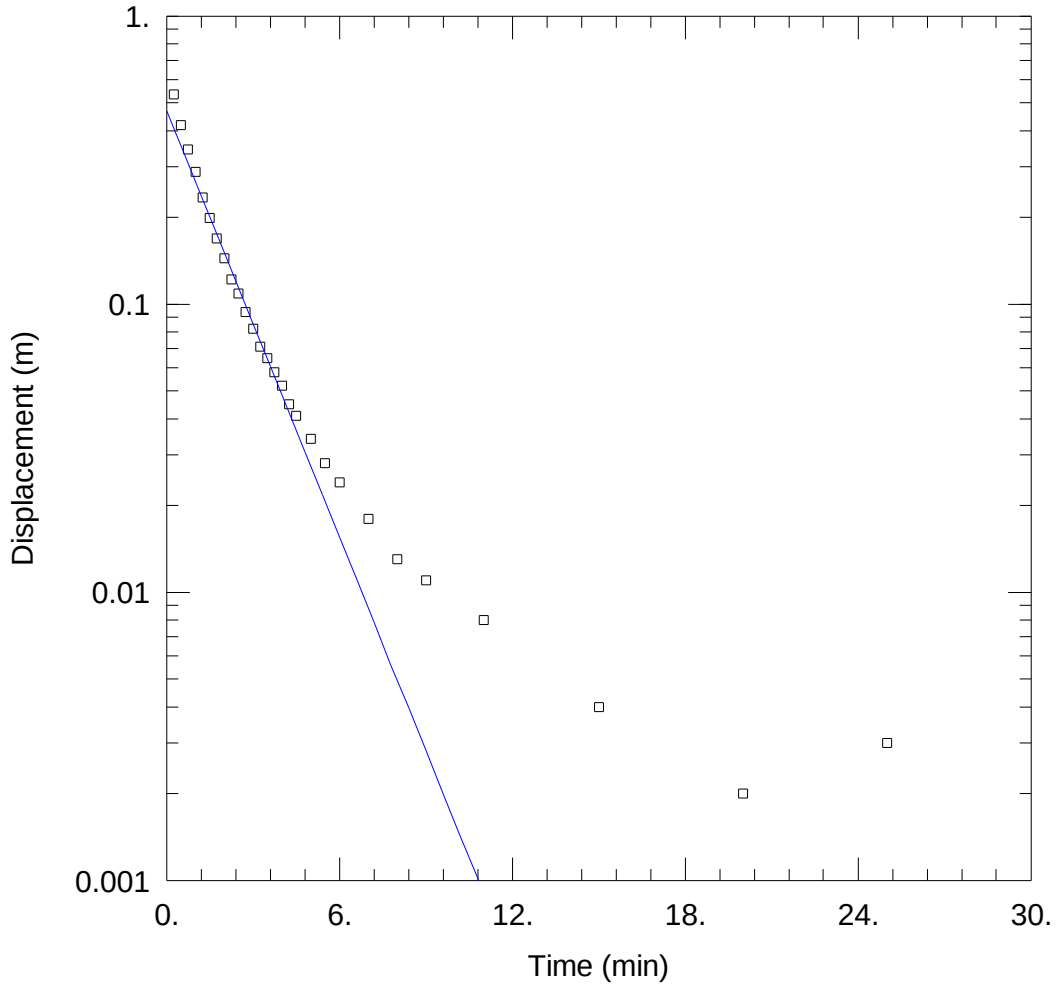
Saturated Thickness: 8.34 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (IWB003)

Initial Displacement: 1.5 m
Total Well Penetration Depth: 7.84 m
Casing Radius: 0.05 m
Static Water Column Height: 7.84 m
Screen Length: 2. m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
K = 0.158 m/day
Solution Method: Bouwer-Rice
y0 = 0.954 m



IWB004_1

Data Set: T:\FEB\gph\WC02701\Disc_1097\WC02701\Technical\Slug Testing\IWB004.aqt
Date: 02/10/16 Time: 10:10:57

PROJECT INFORMATION

Company: SKM
Client: Iluka
Project: WC02701.400
Location: Eder (Parilla)
Test Well: IWB004_1
Test Date: 03/02/04

AQUIFER DATA

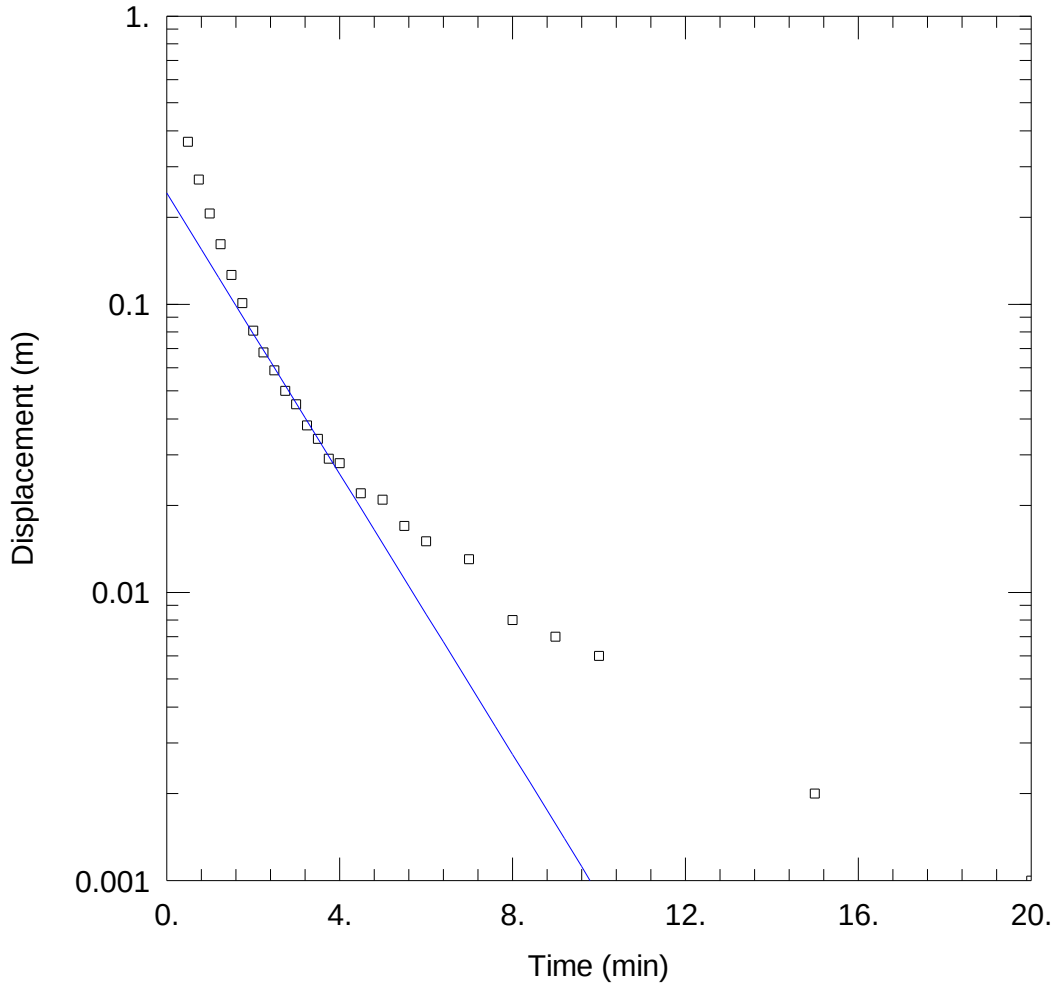
Saturated Thickness: 2.766 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (IWB004)

Initial Displacement: 1.5 m
Total Well Penetration Depth: 2.266 m
Casing Radius: 0.05 m
Static Water Column Height: 2.266 m
Screen Length: 2. m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
K = 1.05 m/day
Solution Method: Bouwer-Rice
y0 = 0.4687 m



IWB004_2

Data Set: T:\FEB\gph\WC02701\Disc_1097\WC02701\Technical\Slug Testing\IWB004_2.aqt
Date: 02/10/16 Time: 10:11:43

PROJECT INFORMATION

Company: SKM
Client: Iluka
Project: WC02701.400
Location: Eder (Parilla)
Test Well: IWB004_2
Test Date: 03/02/04

AQUIFER DATA

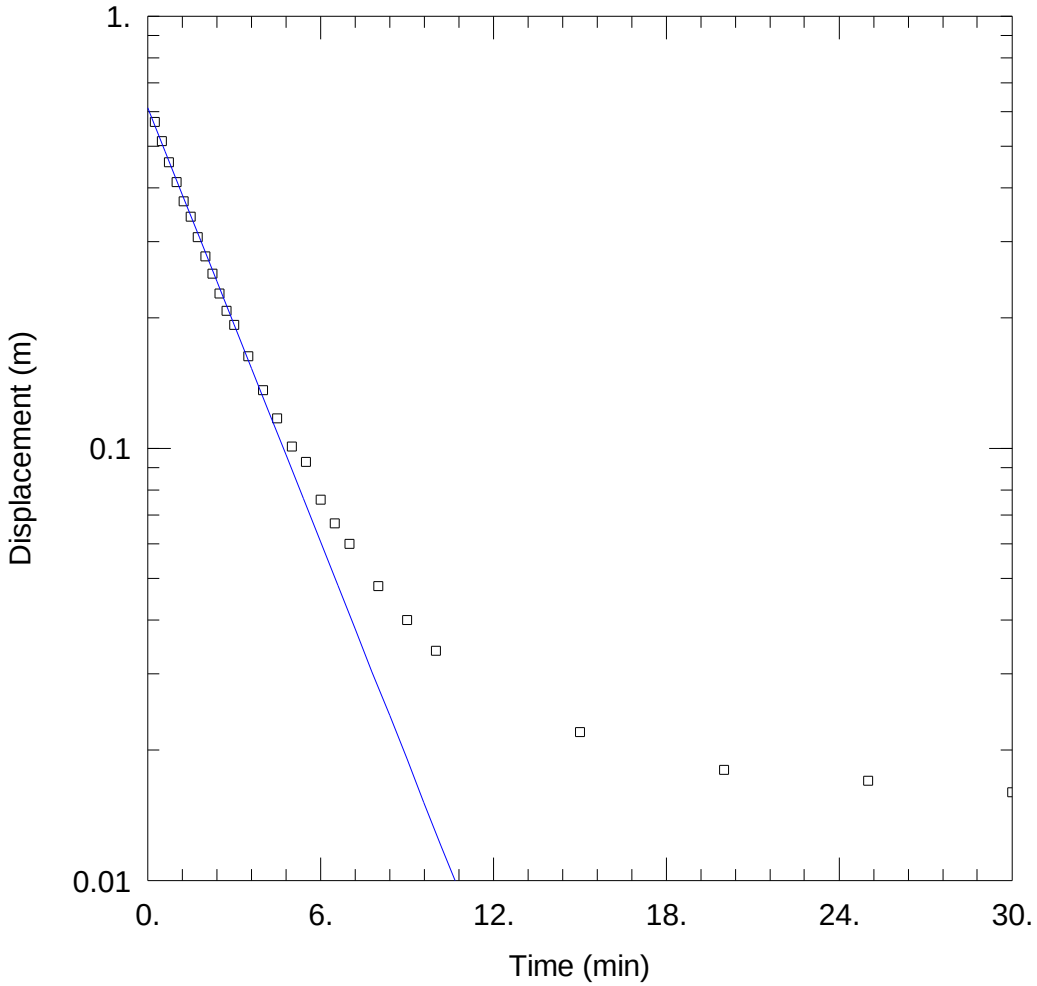
Saturated Thickness: 2.766 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (IWB004)

Initial Displacement: 1.5 m
Total Well Penetration Depth: 2.266 m
Casing Radius: 0.05 m
Static Water Column Height: 2.266 m
Screen Length: 2. m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
K = 1.035 m/day
Solution Method: Bouwer-Rice
y0 = 0.2424 m



IWB005_1

Data Set: T:\FEB\gph\WC02701\Disc_1097\WC02701\Technical\Slug Testing\IWB005_1.aqt
Date: 02/10/16 Time: 10:12:11

PROJECT INFORMATION

Company: SKM
Client: Iluka
Project: WC02701.400
Location: Elliots Back Lane
Test Well: IWB005_1
Test Date: 03/02/04

AQUIFER DATA

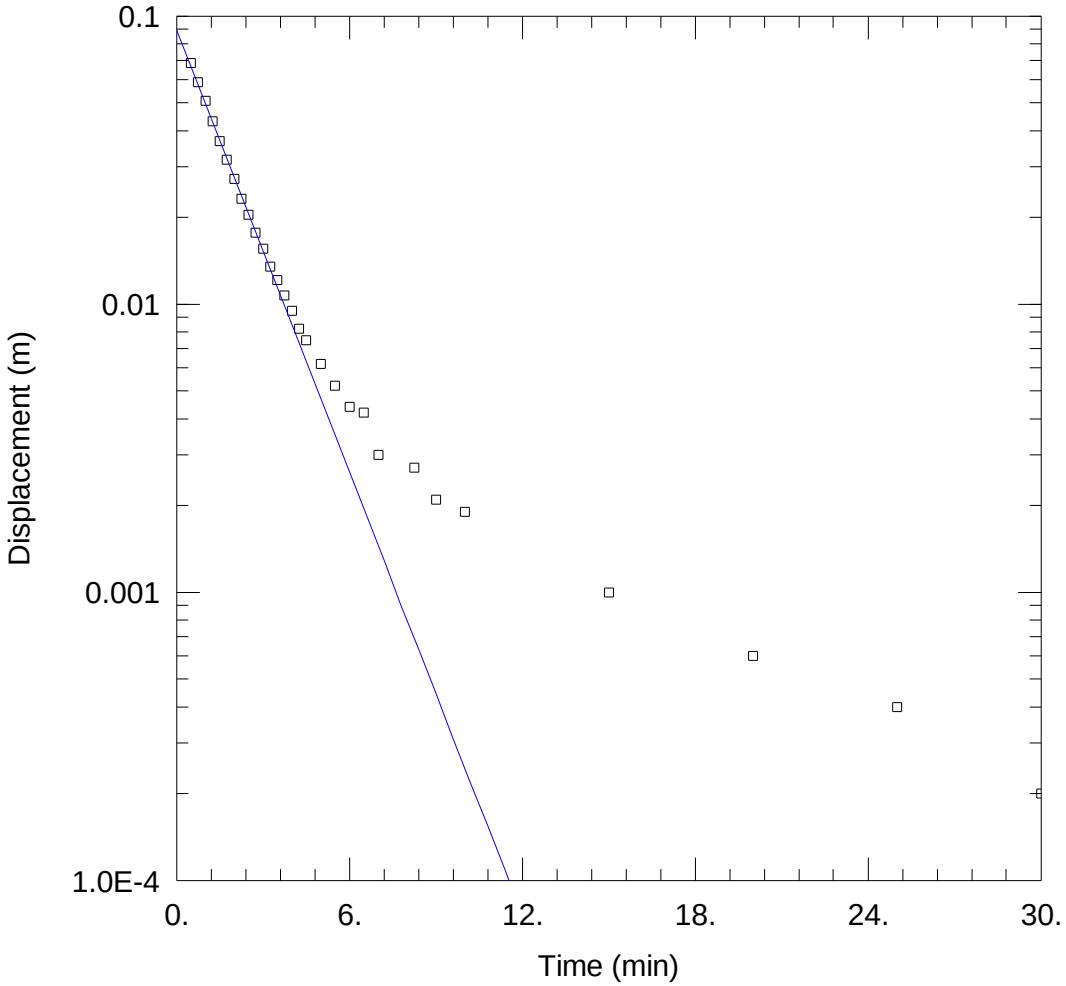
Saturated Thickness: 7. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (IWB005)

Initial Displacement: 1.5 m
Static Water Column Height: 6.5 m
Total Well Penetration Depth: 6.5 m
Screen Length: 2. m
Casing Radius: 0.05 m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.8714 m/day
y0 = 0.613 m



IWB005_2

Data Set: T:\FEB\gph\WC02701\Disc_1097\WC02701\Technical\Slug Testing\IWB005_2.aqt
Date: 02/10/16 Time: 10:12:30

PROJECT INFORMATION

Company: SKM
Client: Iluka
Project: WC02701.400
Location: Elliots Back Lane
Test Well: IWB005_2
Test Date: 03/02/04

AQUIFER DATA

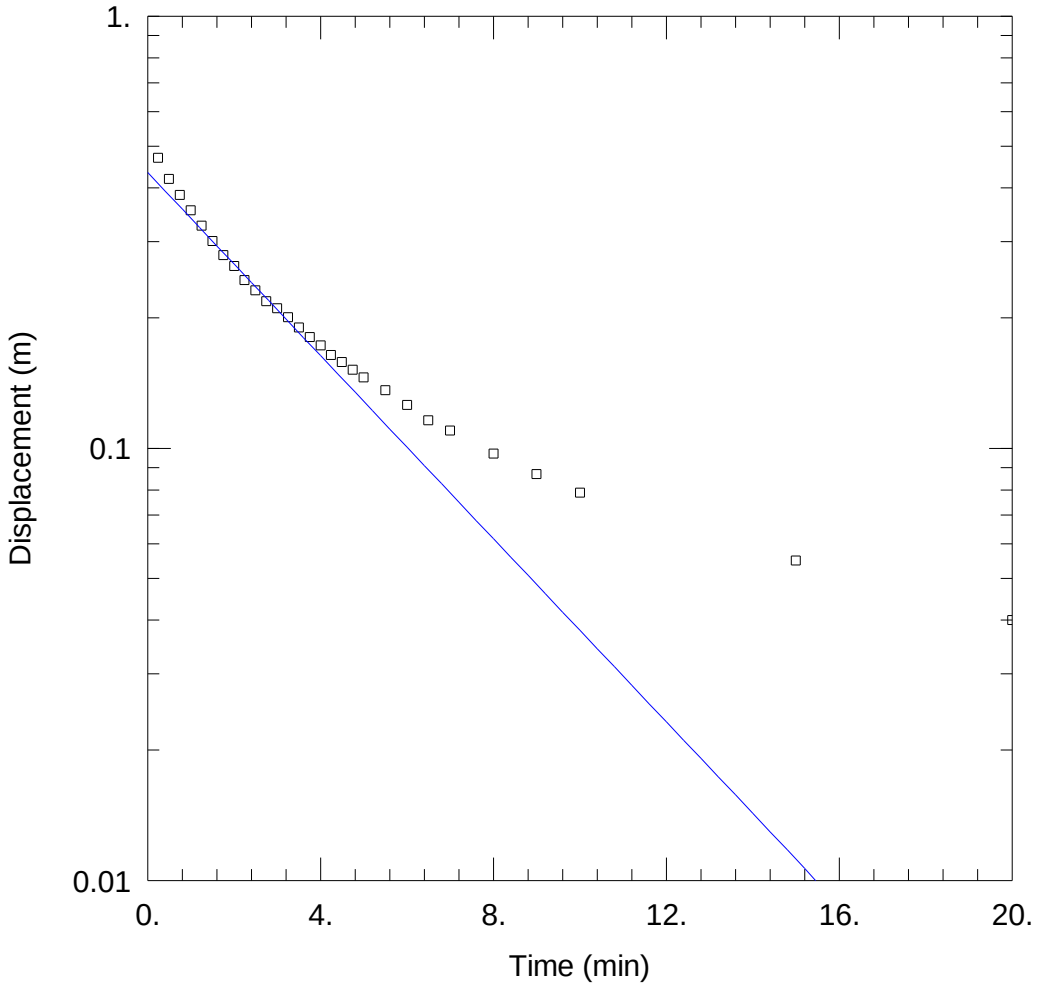
Saturated Thickness: 7. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (IWB005)

Initial Displacement: 1.5 m
Total Well Penetration Depth: 6.5 m
Casing Radius: 0.05 m
Static Water Column Height: 6.5 m
Screen Length: 2. m
Well Radius: 0.1 m

SOLUTION

Aquifer Model: Unconfined
K = 1.332 m/day
Solution Method: Bouwer-Rice
y0 = 0.0893 m



IWB006

Data Set: T:\FEB\gph\WC02701\Disc_1097\WC02701\Technical\Slug Testing\IWB006.aqt
Date: 02/10/16 Time: 10:12:51

PROJECT INFORMATION

Company: SKM
Client: Iluka
Project: WC02701.400
Location: Lyons
Test Well: IWB006
Test Date: 03/02/04

AQUIFER DATA

Saturated Thickness: 3.23 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (IWB006)

Initial Displacement: 1.5 m
Total Well Penetration Depth: 3.23 m
Casing Radius: 0.05 m
Static Water Column Height: 3.23 m
Screen Length: 1.5 m
Well Radius: 0.1 m
Gravel Pack Porosity: 0.05

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.8081 m/day
y0 = 0.4339 m

Bore:	IWB001	Costello (Basement)
SWL:	13.16	
TEST 1		
Time Elapsed	Water Level	Disp.
0.25	12.12	1.04
0.5	12.135	1.025
0.75	12.135	1.025
1	12.138	1.022
1.25	12.141	1.019
1.5	12.144	1.016
1.75	12.145	1.015
2	12.146	1.014
2.25	12.148	1.012
2.5	12.15	1.01
2.75	12.151	1.009
3	12.153	1.007
3.5	12.156	1.004
4	12.16	1
4.5	12.164	0.996
5	12.168	0.992
6	12.171	0.989
7	12.176	0.984
8	12.18	0.98
9	12.186	0.974
10	12.191	0.969
11	12.196	0.964
12	12.201	0.959
13	12.205	0.955
14	12.21	0.95
15	12.215	0.945
20	12.235	0.925
30	12.28	0.88
40	12.312	0.848
45	12.33	0.83

Bore:	IWB002	Costello (Parilla)			
SWL:	13.02				
TEST 1			TEST 2		
Time Elapsed	Water Level	Disp.	Time Elapsed	Water Level	Displacement
0.5	12.47	0.55	1.75	13.245	-0.225
1	12.605	0.415	2.5	13.175	-0.155
1.25	12.665	0.355	3	13.14	-0.12
1.5	12.705	0.315	3.25	13.125	-0.105
1.75	12.745	0.275	3.5	13.113	-0.093
2	12.775	0.245	3.75	13.098	-0.078
2.25	12.805	0.215	4	13.086	-0.066
2.5	12.83	0.19	4.25	13.08	-0.06
2.75	12.85	0.17	4.5	13.075	-0.055
3	12.87	0.15	4.75	13.071	-0.051
3.25	12.885	0.135	5	13.063	-0.043
3.5	12.9	0.12	5.5	13.063	-0.043
3.75	12.91	0.11	6	13.054	-0.034
4	12.925	0.095	6.5	13.049	-0.029
4.25	12.935	0.085	7	13.046	-0.026
4.5	12.943	0.077	8	13.04	-0.02
4.75	12.95	0.07	9	13.038	-0.018
5	12.955	0.065	10	13.036	-0.016
5.5	12.967	0.053	15	13.028	-0.008
6	12.976	0.044	20	13.028	-0.008
6.5	12.985	0.035	25	13.025	-0.005
7	12.99	0.03	30	13.024	-0.004
8	13	0.02			
9	13.005	0.015			
10	13.01	0.01			
15	13.015	0.005			
20	13.017	0.003			
30	13.02	0			

Bore:	IWB003	EDER (Basement)
SWL:	15.156	
TEST 1		
Time Elapsed	Water Level	Disp.
0.25	14.2	0.956
0.5	14.215	0.941
0.75	14.225	0.931
1	14.247	0.909
1.25	14.262	0.894
1.5	14.283	0.873
1.75	14.3	0.856
2	14.315	0.841
2.25	14.333	0.823
2.5	14.348	0.808
2.75	14.364	0.792
3	14.378	0.778
3.25	14.393	0.763
3.5	14.405	0.751
3.75	14.42	0.736
4	14.443	0.713
4.5	14.45	0.706
4.75	14.472	0.684
5	14.483	0.673
5.5	14.509	0.647
6	14.53	0.626
6.5	14.552	0.604
7	14.571	0.585
8	14.611	0.545
9	14.644	0.512
10	14.682	0.474
12	14.74	0.416
15.75	14.83	0.326
20	14.915	0.241
25.25	14.983	0.173
30	15.03	0.126
35	15.068	0.088
40	15.091	0.065

Bore: **IWB004** **EDER (Parilla)**
SWL: 15.234

TEST 1			TEST 2		
Time Elapsed	Water Level	Disp.	Time Elapsed	Water Level	Disp.
0.25	14.7	0.534	0.5	15.6	-0.366
0.5	14.815	0.419	0.75	15.505	-0.271
0.75	14.89	0.344	1	15.44	-0.206
1	14.947	0.287	1.25	15.395	-0.161
1.25	15	0.234	1.5	15.36	-0.126
1.5	15.035	0.199	1.75	15.335	-0.101
1.75	15.065	0.169	2	15.315	-0.081
2	15.09	0.144	2.25	15.302	-0.068
2.25	15.112	0.122	2.5	15.293	-0.059
2.5	15.125	0.109	2.75	15.284	-0.05
2.75	15.14	0.094	3	15.279	-0.045
3	15.152	0.082	3.25	15.272	-0.038
3.25	12.163	3.071	3.5	15.268	-0.034
3.5	15.169	0.065	3.75	15.263	-0.029
3.75	15.176	0.058	4	15.262	-0.028
4	15.182	0.052	4.5	15.256	-0.022
4.25	15.189	0.045	5	15.255	-0.021
4.5	15.193	0.041	5.5	15.251	-0.017
5.5	15.206	0.028	6	15.249	-0.015
6	15.21	0.024	7	15.247	-0.013
7	15.216	0.018	8	15.242	-0.008
8	15.221	0.013	9	15.241	-0.007
9	15.223	0.011	10	15.24	-0.006
11	15.226	0.008	15	15.236	-0.002
15	15.23	0.004	20	15.235	-0.001
20	15.232	0.002			
25	15.231	0.003			

Bore: **IWB005** **Elliots Back Lane**
SWL: 18.193

TEST 1			TEST 2		
Time Elapsed	Water Level	Disp.	Time Elapsed	Water Level	Disp.
0.25	17.625	0.568	0.5	18.88	-0.687
0.5	17.68	0.513	0.75	18.783	-0.59
0.75	17.735	0.458	1	18.7	-0.507
1	17.78	0.413	1.25	18.625	-0.432
1.25	17.82	0.373	1.5	18.56	-0.367
1.5	17.85	0.343	1.75	18.51	-0.317
1.75	17.885	0.308	2	18.465	-0.272
2	17.915	0.278	2.25	18.425	-0.232
2.25	17.94	0.253	2.5	18.397	-0.204
2.5	17.965	0.228	2.75	18.37	-0.177
2.75	17.985	0.208	3	18.349	-0.156
3	18	0.193	3.25	18.328	-0.135
3.5	18.03	0.163	3.5	18.314	-0.121
4	18.057	0.136	3.75	18.3	-0.107
4.5	18.076	0.117	4	18.288	-0.095
5	18.092	0.101	4.25	18.275	-0.082
5.5	18.1	0.093	4.5	18.268	-0.075
6	18.117	0.076	5	18.255	-0.062
6.5	18.126	0.067	5.5	18.245	-0.052
7	18.133	0.06	6	18.237	-0.044
8	18.145	0.048	6.5	18.235	-0.042
9	18.153	0.04	7	18.223	-0.03
10	18.159	0.034	8.25	18.22	-0.027
15	18.171	0.022	9	18.214	-0.021
20	18.175	0.018	10	18.212	-0.019
25	18.176	0.017	15	18.203	-0.01
30	18.177	0.016	20	18.199	-0.006
			25	18.197	-0.004
			30	18.195	-0.002

Bore: **IWB006** **Lyons**
SWL: 2.27

Time Elapsed	Water Level	Disp.
0.25	1.8	0.47
0.5	1.85	0.42
0.75	1.885	0.385
1	1.915	0.355
1.25	1.943	0.327
1.5	1.969	0.301
1.75	1.99	0.28
2	2.006	0.264
2.25	2.025	0.245
2.5	2.038	0.232
2.75	2.051	0.219
3	2.059	0.211
3.25	2.069	0.201
3.5	2.08	0.19
3.75	2.089	0.181
4	2.097	0.173
4.25	2.106	0.164
4.5	2.112	0.158
4.75	2.118	0.152
5	2.124	0.146
5.5	2.134	0.136
6	2.144	0.126
6.5	2.154	0.116
7	2.16	0.11
8	2.173	0.097
9	2.183	0.087
10	2.191	0.079
15	2.215	0.055
20	2.23	0.04