

DRILLING, CONSTRUCTION AND 168 HOURS OF PUMPING TEST FOR GROUNDWATER TUBE WELL AT DESARU

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1. INTRODUCTION

Groundwater represents an alternative and reliable supply of good and clean water for daily uses. At times of difficulty in obtaining surface and expensive piped water, groundwater can be used as an alternative source. With the uncertainty and unreliability in obtaining piped water due to various reasons, groundwater has gained in importance in domestic, agricultural and industrial usage. National Hydraulic Research Institute of Malaysia was appointed by TARH to carry out drilling works and construct one (1) units of tube wells and pumping tests at Desaru Coast, Bandar Penawar, Kota Tinggi, Johor for the alternative water supply.

2. LOCATION AND ACCESSIBILITY

The study area is located in the heart of Desaru coast with 22 kilometre long stretch of uninterrupted beach combines the panoramic views of South China Sea with lush rainforests. It is one of the few virgin beaches on the east coast of Peninsular Malaysia (**Figure 1**). The main purpose of the drilling and construction of the groundwater tube well is to abstract the groundwater for construction and support the surface water supply during water disruption.

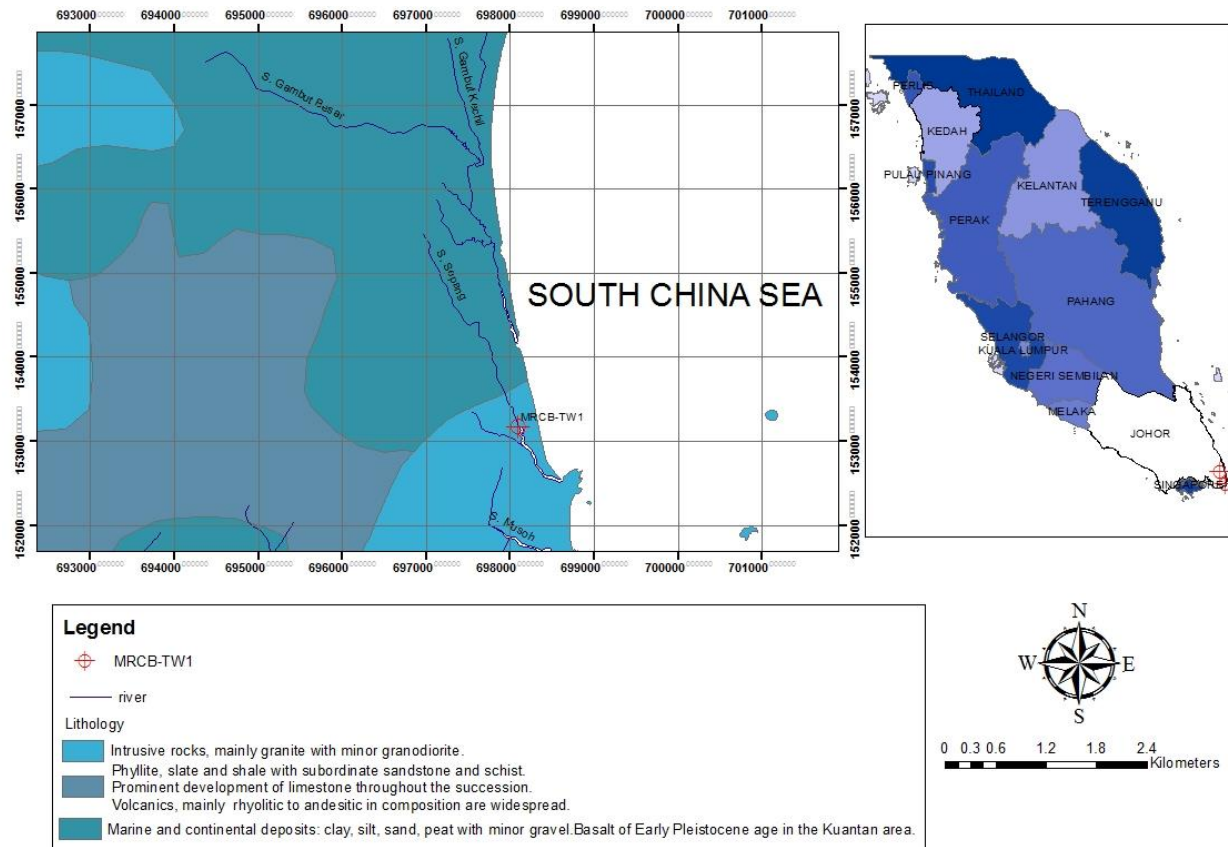


Figure 1: Location map and geology and location of MRCB-TW1 of Desaru Coast, Bandar Penawar, Kota Tinggi, Johor

3. GEOLOGY AND GEOMORPHOLOGY

3.1 Geology of Study Area

The study area located in Desaru coast consists of metamorphic rocks of the Middle to Late Permian age belong to Mersing Formation. The lithology of this rock formation consists of tightly folded indurated shale, interbedded phyllite, schist, quartzite, slate and metaquartzite (Hutchison, 1989). According to Suntharalingam (1991), the metamorphic rock was a result of metamorphism upon deep-sea clastic sediments. However, the occurrence of some medium size cross-beds within grain-supported sandstone observed in this study suggests that at least some of the protolith of the Mersing metamorphic rocks are of shallow marine origin.

Foo (1983) also inferred a shallow marine to mixed condition of depositional environment for the oldest sediment in the eastern belt. The coastal stretches with undulating hilly terrain with ridges running north-northwest to the south-southeast features predominantly sandy beaches dissected by small rivers and rocky headlands. Further inland is hilly to mountainous terrain characterized by steep slopes and deep, narrow valleys.

4. DRILLING WORKS AND CONSTRUCTION OF TUBE WELLS

The location of tube well (MRCB TW1) was determined based on the suitability of the area. The tube well drilling works carried out using crawler mounted drilling rig. Rotary mud drilling with 200 mm diameter drag bit used for penetrating hard rock. Temporary 210 mm diameter steel casing was installed up to 17.0 m depth into the unconsolidated layers to protect the hole from collapsing.

Down-the-hole-hammer of 200 mm diameter, then employed for the hard rock layers to a depth of 105.0 m. Generally, the topsoil up to 3.0 m depth followed by clay of completely weathered metasedimentary rock up to 17.0 m and highly weathered of carbonaceous shale up to 55.0 m. After that, the moderately weathered of dark grey carbonaceous shale with quartz vein and slightly fractured zone at depth of 84.0 m, 96.0 m and 102.0 m. The drilling terminated at a depth of 105.0 m with the estimated yield of 6.5 m³/hour. After the tube well construction was completed, the tube well was cleaned and flushing to remove the remaining rock cutting to overflow out of the well. The 150 mm diameter SIRIM Standard blank PVC casings with screen at 81.0-105.0 m depth was installed and leave 0.36 metres of pipe for well collar above ground surface.

After completing the PVC casing installation, the tube well was then flushed with compressed air until the groundwater discharge was clear and clean of any drilling debris, oil and grease left behind from the drilling works. The groundwater discharge of the tube well during flushing was about 6.50 m³/hour. The geological loggings and well design of MRCB TW1 is as shown in **Figure 2**.

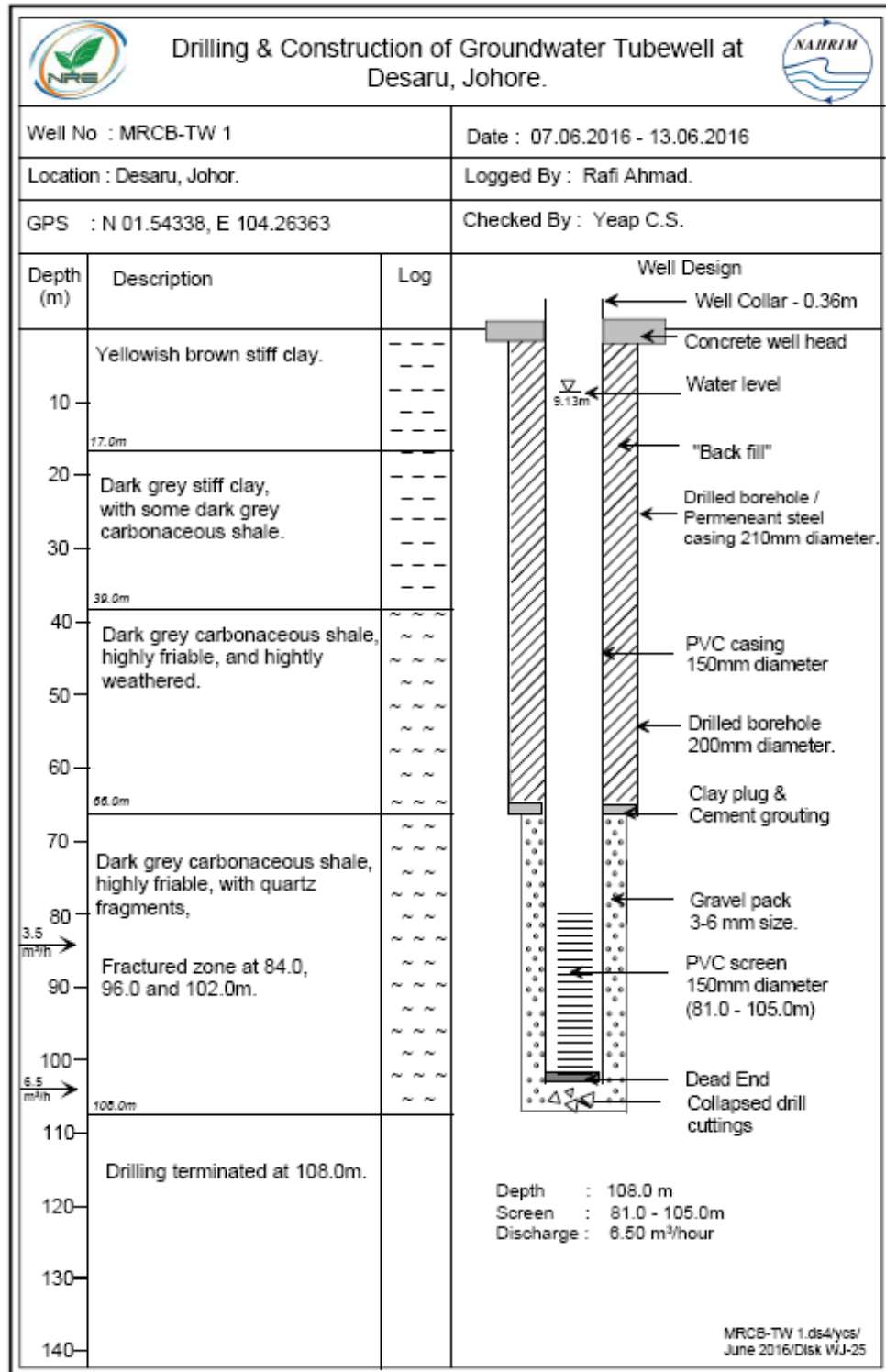


Figure 2: The geological loggings and tube well design of MRCB TW1

5. PUMPING TEST

5.1 Introduction

The groundwater resources investigation includes the determination of aquifer characteristics, groundwater yield, transmissivity, permeability and storage coefficient as well as to assess the safe pumping yield. These characteristics are important in evaluating the natural flow of water through an aquifer and its response to groundwater abstraction. Generally, the determination of actual groundwater yield, transmissivity, permeability and storage coefficient as well as to recommend safe pumping yield are made on the basis of data obtained from test-pumping wells.

Based on the estimated yield during the flushing of the tube well, a suitable capacity submersible pump employed to carry out the pumping test. A pumping test carry out will allow determination of some or all of the following:

- a. the yield characteristics and potential of the well,
- b. the efficiency of the well performance as an indication of its hydraulic conditions,
- c. confirmation of the hydrogeological nature of the aquifer,
- d. determination of the hydraulic properties of the aquifer, and
- e. prediction of the effect(s) of present and/or future abstraction from the well on groundwater condition in the aquifer.

The pumping tests usually consists of the following: -

1. Calibration Test
2. Step Drawdown Test
3. Constant Discharge, and
4. Recovery Test

5.1.1 Calibration Test

The calibration test is to set the flow rate of the pumping and to reveal and resolve if any problems happen. The pump will start and run briefly, just long enough to adjust the flow rate. After that, the pump will shut off and the water level is allowed to fully recover to the level prior to pump on. The actual pumping test conducted in the following day.

5.1.2 Step – Drawdown Test

The step drawdown test is one in which the drawdown of a well is observed while the discharge rate from the well is increased in steps. The step-drawdown test is used to determine both the linear and non-linear well loss coefficients B and C. These coefficients are used to predict an estimate of the real water level drawdown inside a pumping well in response to pumping and the efficiency of the well performance.

The step drawdown test consists of 4 to 5 discharging steps, which each step between 90 to 120 minutes, and the corresponding drawdown observed in the pumped well. Drawdown is measured at fixed time intervals, usually comprising of very short time intervals at the beginning of each step and gradually increasing the time intervals. The measurements recorded on tabulated sheets.

5.1.3 Constant Discharge Test

After completing the step drawdown test, the pumped well left to rest sufficiently long enough for its water level to fully recover to its pre-pumping level. Following recovery from the step drawdown test, the test well pumped at a fixed or constant discharge rate, in which the rate of pumping based on the results of the step drawdown test. This constant discharge test usually carried out for 72 hours.

However, in most cases, the exact duration is normally decided based on knowledge of the aquifer type, with unconfined aquifers normally requiring 3 days or longer to achieve stability.

The drawdown measurements in the pumped well and observation piezometer during the constant discharge test are taken at fixed intervals and recorded on a tabulated sheet.

5.1.4 Recovery Test

After completing the constant discharge test, the pump is shut down and recovery test commence immediately. The recovery test measures the rise of the water level in the tube well, and measurements taken at fixed time intervals and recorded on another tabulated sheet.

5.2 Pumping Test Methodology

5.2.1 MRCB TW1

The pumping test for MRCB TW1 consists of the constant discharge and the recovery test. The pumping test used a Grundfos SP 16-8 submersible pump with a maximum capacity of 16 m³/hour at a head of 60 m. The submersible pump installed at a depth of 60.0 m below ground level, and the 35 mm diameter riser pipes connected to the submersible pump. A 35 mm diameter gate-valve connected to the riser pipe to regulate the flow rate. The riser pipes, then directed to a 90° V-Notch tank to measure the flow rate. After the installation of the pump and all other necessary set-up was completed, the calibration test carried out for 2 hours to determine the capacity of the test well as well as to determine the optimum pumping rate for the constant test.

5.2.1.1 Constant Discharge Test

The pumping rate for the constant discharge test on this test well was set at 4.80 m³/hour. The initial static water during the constant discharge test was 6.51 m below ground level and the maximum water level after continuous pumping of 168 hours was 42.16 m, with a total drawdown of 35.65 m.

5.2.1.2 Recovery Test

The recovery test resumed immediately after the constant discharge test was completed. The recovery test carried out for a total of 420 minutes after the pump shut down. The initial residual drawdown was 35.65 m, and the residual drawdown after 420 minutes was 6.90 m, with a recovery of 80.65%. The constant discharge rate test and recovery test data plotting shown in **Figure 3**.

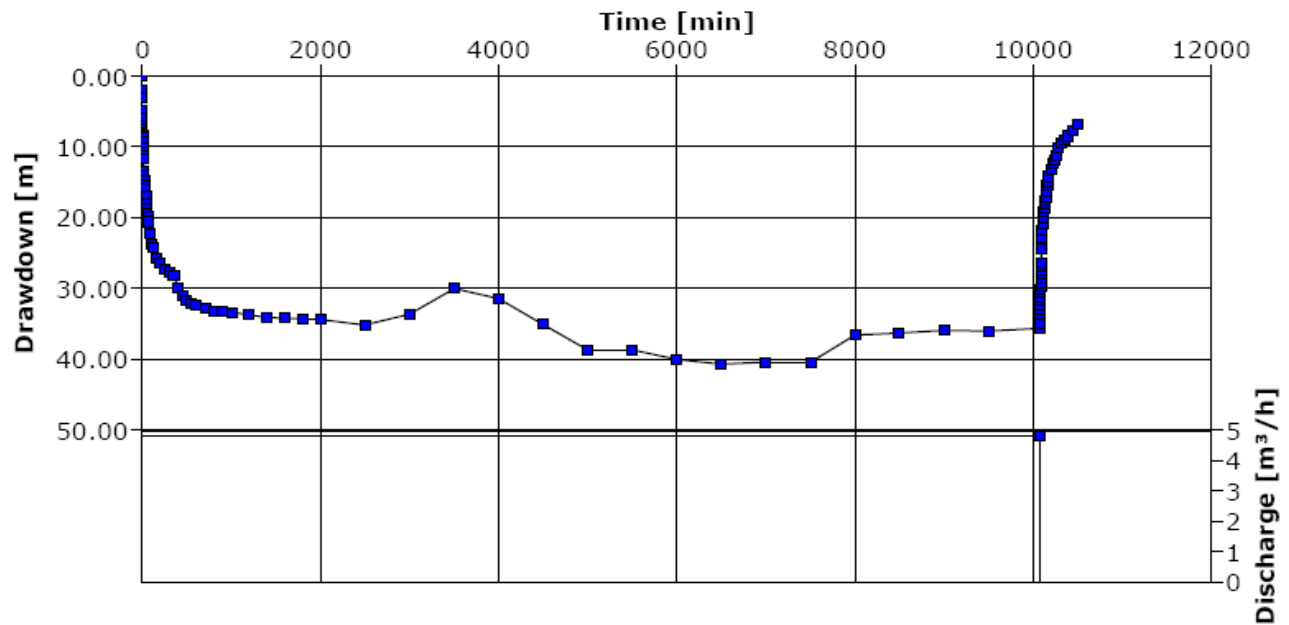


Figure 3: Plotting of time-drawdown for constant rate and recovery test at MRCB TW1

5.3 Pumping Test Data Analysis

5.3.1 Data Processing and Analysis

5.3.1.1 Analysis with *AquiferTest Pro*

The drawdown data (presented in Appendix) were analysed using an easy-to-use pumping test and slug test data analysis package called “AquiferTest Pro Version 2014.1”. AquiferTest Pro provides a flexible, user-friendly environment with automatic type curve fitting to a data set. Where an automatic curve fit is not possible, data manually fitted to the type curve using parameter controls based on our knowledge of the geologic and hydrogeologic setting.

AquiferTest Pro uses the Theory of Superposition for analytical solutions. The results obtained by starting with a standard solution and sequentially applying correction to get the best results. Calculating hydraulic characteristics would be relatively easy if the aquifer system (i.e. aquifer plus well) precisely known. This is generally not the case, so interpreting a pumping test is primarily a matter of identifying an unknown system. System identification relies on models, the characteristics of which assumed to represent the characteristics of the real aquifer system (Kruseman and de Ridder, 1990).

5.4 Results and Discussion

5.4.1 *MRCB TW1*

The lithological log of the test well MRCB TW1 shown in **Figure 2** and derivative analysis in **Figure 4**. The aquifer system can be classified as fractured aquifer with at least three minor fractured zone encountered at 84.0 m, 96.0 m and 102.0 m. Based on the diagnostic plot of the derivative analysis in **Figure 4** is shown that the aquifer was double porosity.

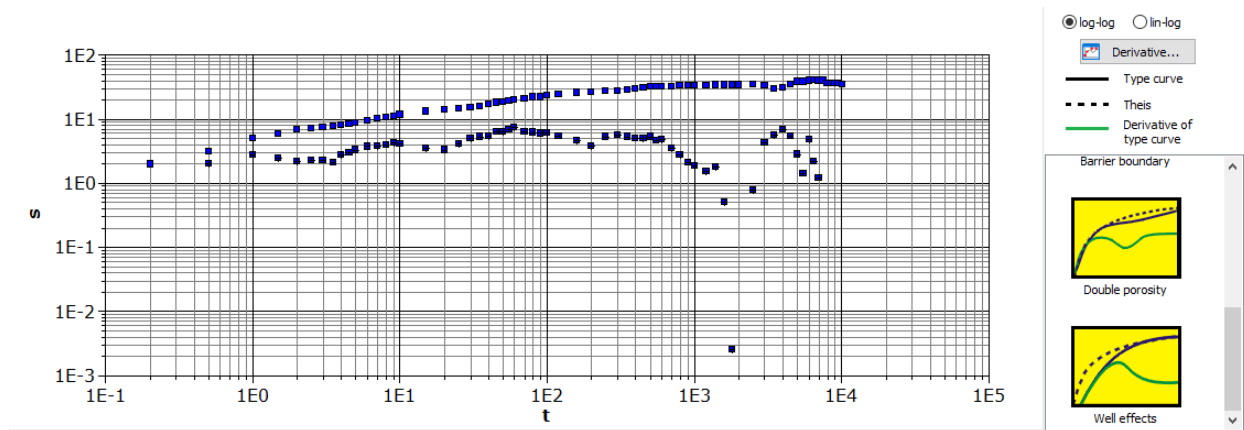


Figure 4: Diagnostic plot (log t vs log s) of the derivative analysis (green) of the MRCB TW1

5.4.2.1 Analysis and Evaluation of the Constant Rate Pumping Test

5.4.2.1.1 Theis

Based on the analysis using Theis equation, the average of the transmissivity, T is $2.29 \text{ m}^2/\text{day}$, the hydraulic conductivity, K is $2.57 \times 10^{-2} \text{ m/day}$ and the storage coefficient, S_c is 2.46×10^{-1} (Figure 5).

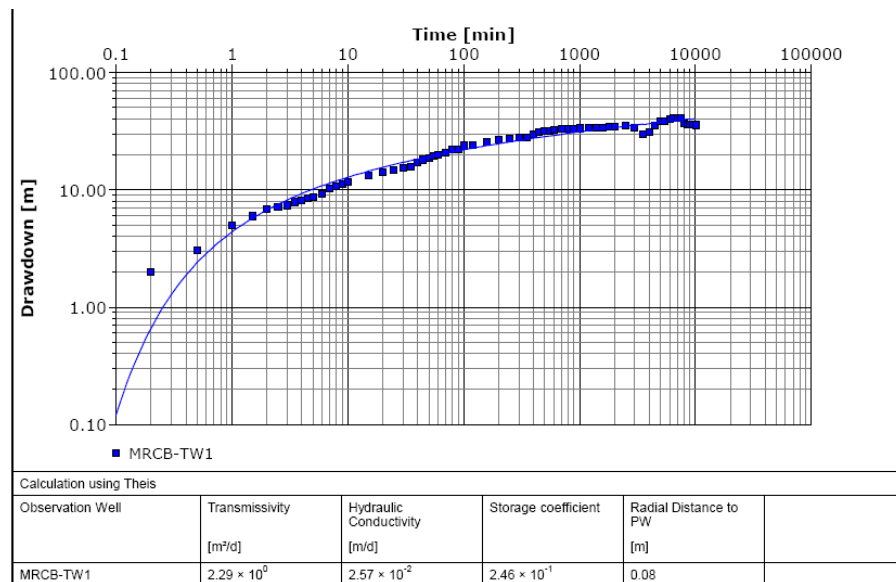


Figure 5: Analysis and evaluation of pumping test data for MRCB TW1 using Theis equation

5.4.2.1.2 Double Porosity

Based on the analysis using double porosity equation (**Figure 6**), the average of the transmissivity, T is $2.30 \text{ m}^2/\text{day}$, the hydraulic conductivity, K is $2.58 \times 10^{-2} \text{ m/day}$ and the storage coefficient, S_c is 1.53×10^{-4} .

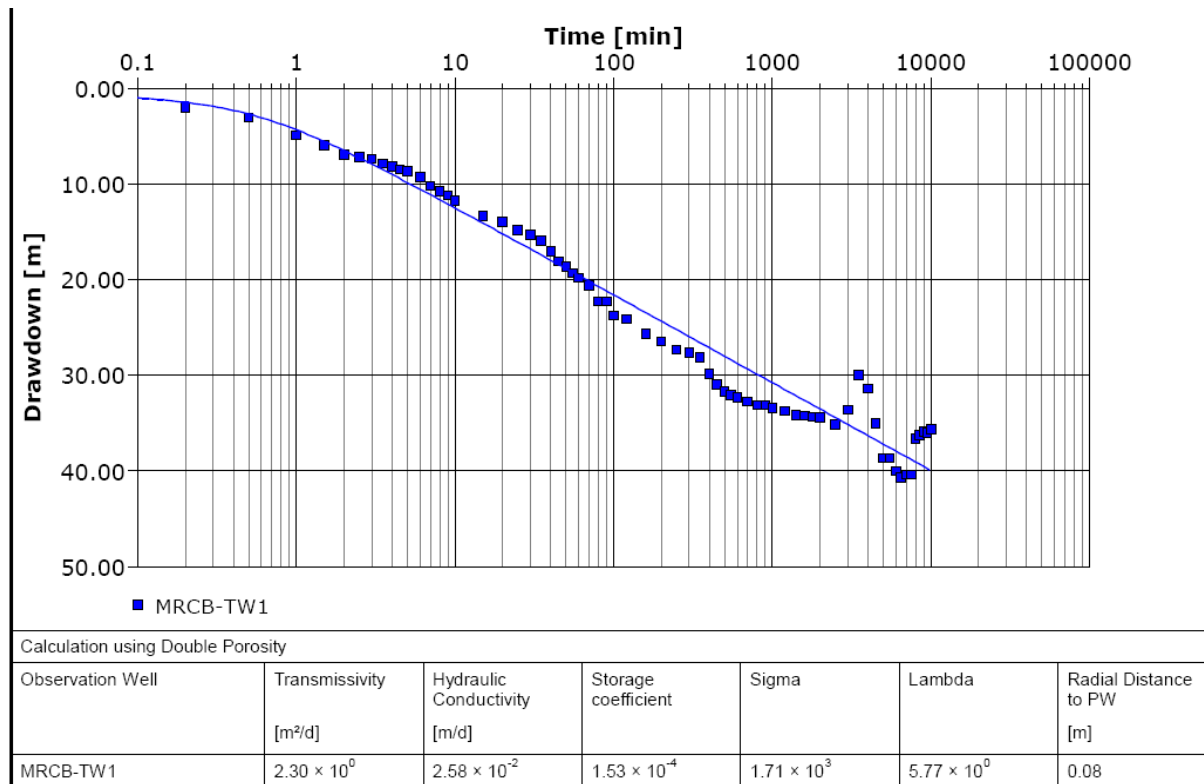


Figure 6: Analysis and evaluation of pumping test data for MRCB TW1 using double porosity

5.4.2.1.3 Moench Fracture Flow

Based on the analysis using Moench fracture flow equation (Figure 7), the average of the transmissivity, T is 2.3 m²/day, the hydraulic conductivity, K is 2.58 x 10⁻² m/day and the storage coefficient, Sc is 2.96 x 10⁻⁵

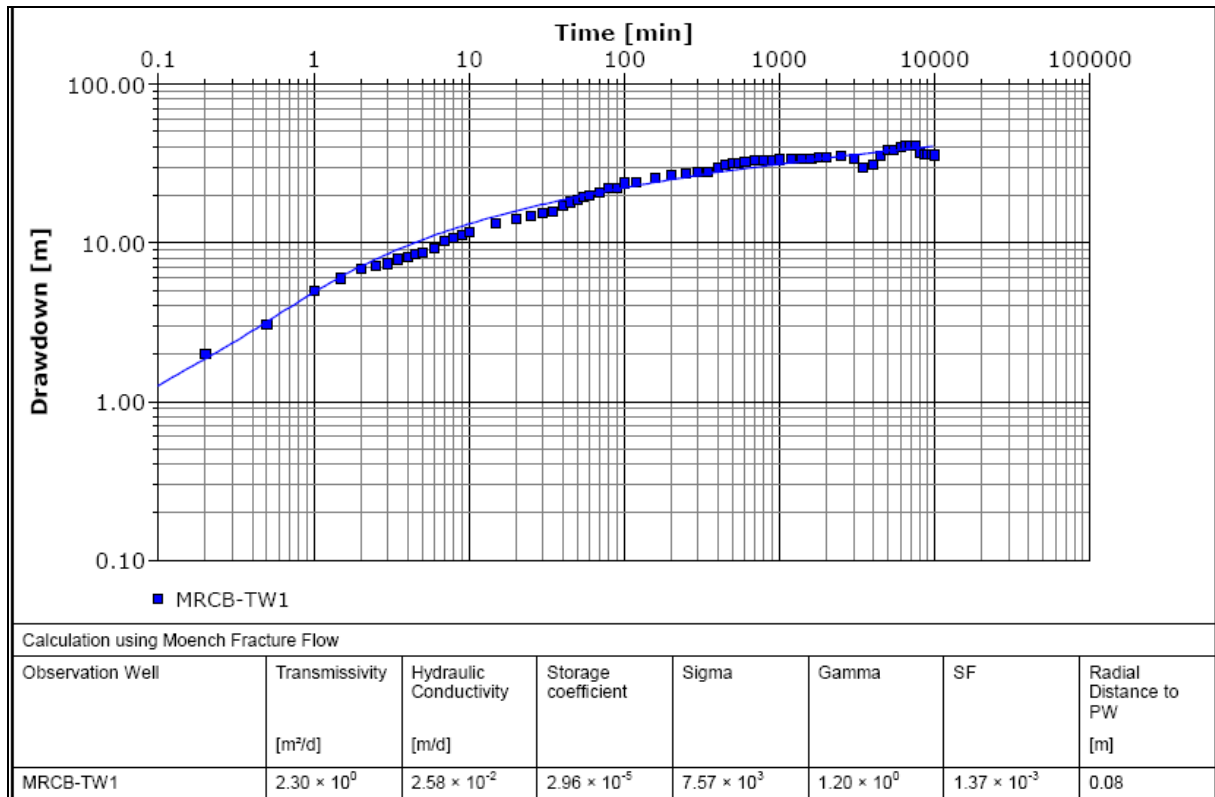


Figure 7: Analysis and evaluation of pumping test data for MRCB TW1 using Moench Fracture Flow

5.4.1.2 Analysis and Evaluation of Recovery Test

5.4.1.2.1 Theis Recovery

Based on the analysis using Theis recovery equation, the average of the transmissivity, T is $1.85 \text{ m}^2/\text{day}$ and the hydraulic conductivity, K is $2.08 \times 10^{-2} \text{ m/day}$ (Figure 8).

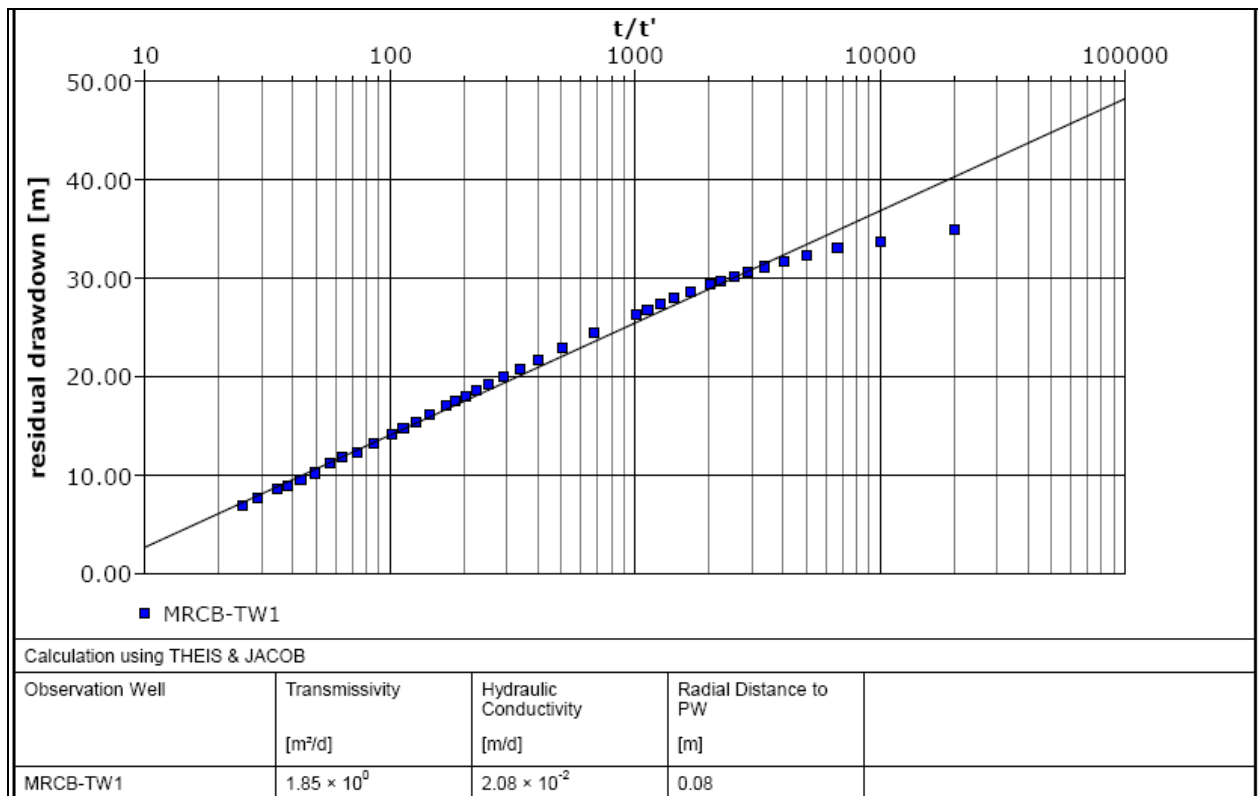


Figure 8: Analysis and evaluation of pumping test data for MRCB TW1 using Theis recovery

5.4.2.3 Analysis and Evaluation of Step Drawdown Test

5.4.2.3.1 Hantush-Bierschenk Well Loss Solution

The Hantush-Bierschenk Well Loss Solution used to analyse the results of a variable rate “step test” to determine both the linear and non-linear well loss coefficients B and C . These coefficients are used to predict an estimate of the real water level drawdown inside a pumping well in response to pumping. Solution methods such as Theis (1935) permit an estimate of the theoretical drawdown inside a pumping well in response to pumping, but do not account for linear and non-linear well losses, which result in an increase in drawdown inside the well. Quite often, the non-linear head losses caused by turbulent flow around the pumping well (Kruseman and de Ridder, 1990). The solution is appropriate for the conditions shown in Figure 9, where the aquifer is confined and D is the thickness of the saturated zone.

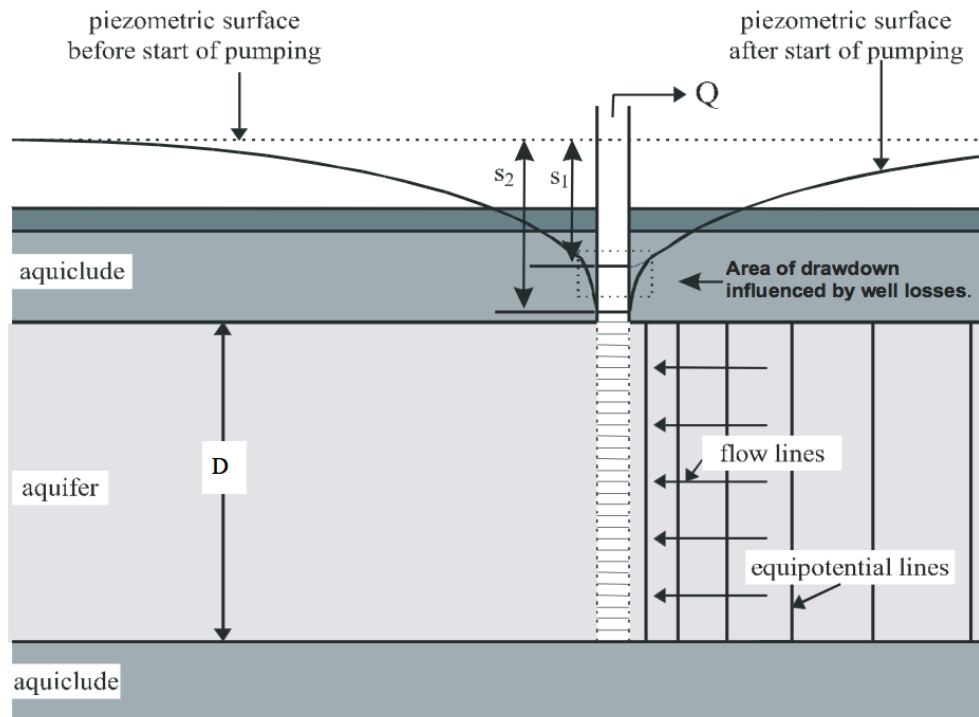


Figure 9: The figure above illustrates a comparison between the theoretical drawdown in a well (S_1) and the actual drawdown in the well (S_2) which includes the drawdown components inherent in S_1 but also includes additional drawdown from both the linear and non-linear well loss components.

The general equation for calculating drawdown inside a pumping well that includes well losses is written as:

$$s_w = BQ + CQ^p$$

where,

s_w = drawdown inside the well

B = linear well-loss coefficient

C = non-linear well-loss coefficient

Q = pumping rate

p = non-linear well loss fitting coefficient

p typically varies between 1.5 and 3.5 depending on the value of Q ; Jacob proposed a value of $p = 2$ which is still widely used today (Kruseman and de Ridder, 1990). AquiferTest calculates a value for the well loss coefficients **B** and **C** which you can use in the equation shown above to estimate the expected drawdown inside your pumping well for any realistic discharge Q at a certain time t (B is time dependent). Based on the analysis using calculation after Hantush & Bierschenk, the linear head losses, B is 73.2 min/m^2 and non-linear well losses, C $605.0 \text{ min}^2/\text{m}^5$ (Figure 10). The relationship between drawdown and discharge to choose, empirically, an optimum yield for the well can be calculated and estimated.

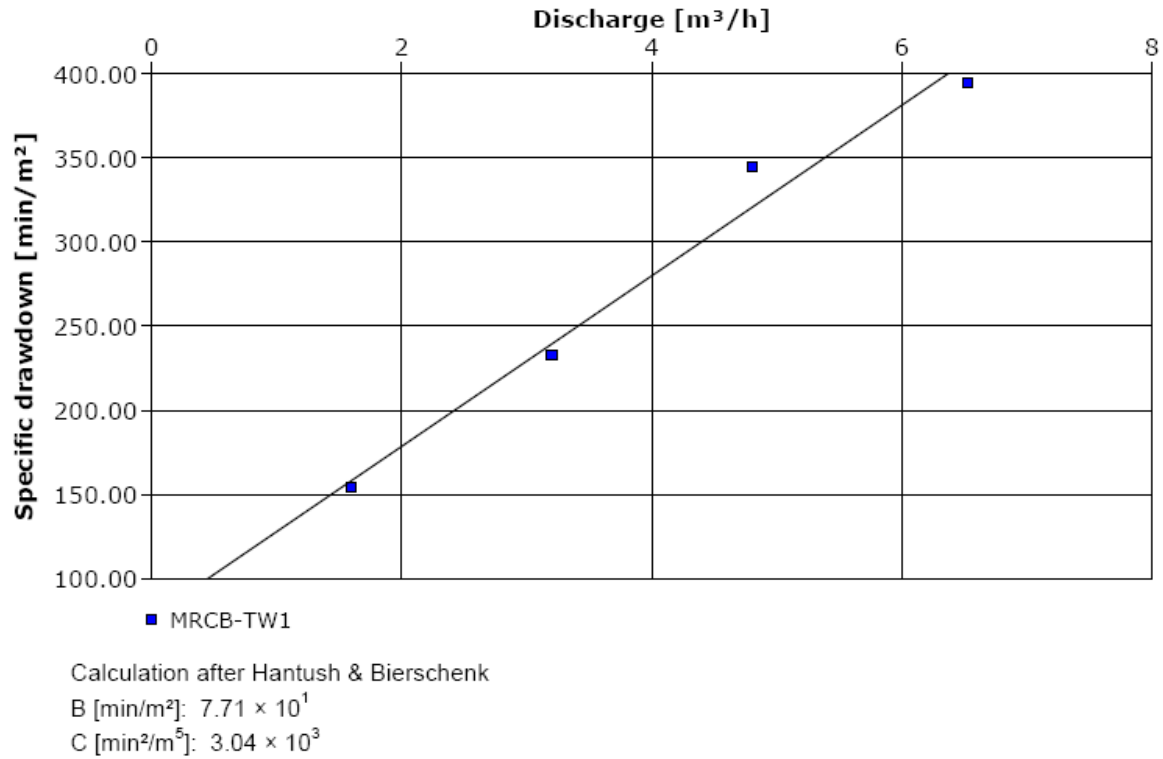


Figure 10: The linear head losses, B and non-linear well losses, C are calculated using drawdown data of step-drawdown test

5.5 Discussion

For the fractured aquifer of MRCB TW1, the average of the transmissivity, T is $0.8360 \text{ m}^2/\text{day}$, the average of hydraulic conductivity, K is $9.08 \times 10^{-3} \text{ m/day}$ and the storage coefficient, S_c is 9.46×10^{-1} . In general, the T and K values are obtained from pumping tests are low for the fractured aquifer system. Based on a constant discharge rate test, the recommended abstraction rates for the continuous long term pumping for test well MRCB TW1 are $4.80 \text{ m}^3/\text{hour}$ with the maximum drawdown of 40.68 m is suggested to avoid the water level to drop into the fractured zone.

6. WATER QUALITY

6.1 Groundwater Sampling

During the constant discharge test for MRCB TW1, groundwater samples collected using clean plastic bottles at the beginning and every 24 hour intervals and sent to the Chemistry Department in Petaling Jaya, Selangor for chemical and physical analyses. As a comparison, one sample of the seawater sample (SW01) taken to differentiate the quality of groundwater and seawater. Each sample consisted of 2.0 L of raw groundwater sample and 1.0 L of groundwater samples acidified with concentrated nitric acid (HNO_3) to a $\text{pH} < 2$, to avoid precipitation of metals.

6.2 Water Quality Result

6.2.1 MRCB TW1

The results of the chemical and physical analyses of the groundwater samples taken during a pumping test showed that the groundwater is generally of good quality. Most of the parameters showed that they are within the limits of the national standard for drinking water quality by the Ministry of Health (MOH), Malaysia (2004). Durov, (1948) diagram provides more information on the hydrochemical facies by helping to identify the water types and it can display some possible geochemical processes that could help in understanding the quality of groundwater and its evaluation.

The diagram consisting of 2 ternary diagrams where the cations of interest are plotted against the anions; sides form a binary plot of the total cation versus total anion concentrations; expanded version includes electrical conductivity ($\mu\text{S}/\text{cm}$) and pH data added to the sides of the binary plot to allow further comparisons. A Durov diagram (Fig. 11) used to illustrate the relative concentrations of the different ions in the individual water samples extracted from the well. The Durov diagram shows the geochemical evolution of groundwater. The Durov diagram for the major cations and anions plotted using AquaChem software as given in Figure 11. The Durov plot for MRCB TW1 groundwater samples indicates that most of the samples are in the phase of

the reverse ion exchange. The pH part of the plot reveals that groundwater in the study area is slightly acidic. All the groundwater samples having electrical conductivity (EC) lie in the range of drinking water standards. The results of the chemical and physical analysis shown in Table 1 and Appendix 3.

The parameters of salinity, electric conductivity (EC), natrium (Na), calcium (Ca) and chloride (Cl) are indicator of salt water. Chemical analyses throughout the end of pumping test shows no significant increased value on those chemicals. The value of the chemicals has remained in the range in fresh water and far below from seawater reading (Table 1).

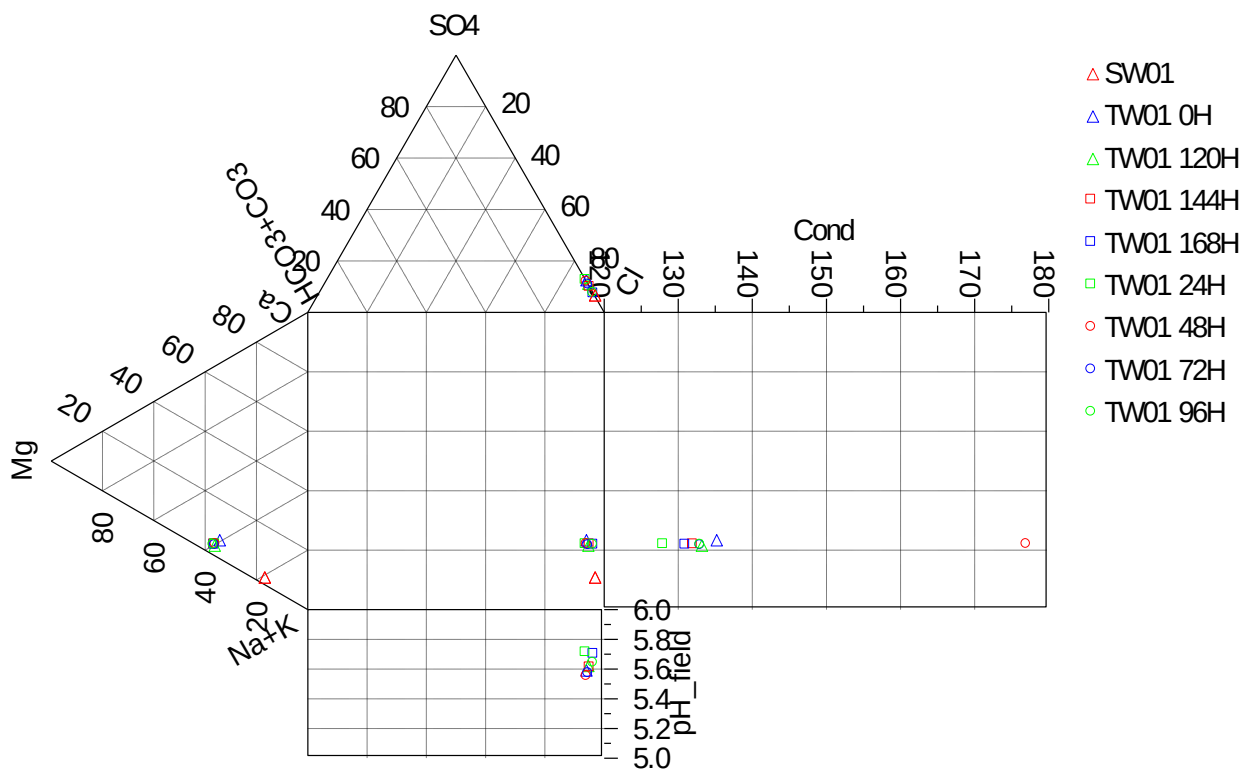


Figure 11: Durov diagram depicting geochemical characteristics of MRCB TW1 tube well

Table 1: Results of water quality analysis and comparison of water quality between seawater and groundwater. SW is Sea Water and TW is sampled from MRCB-TW1 tube well 0 hours, 24 hours, 48 hours, 72 hours, 96 hours, 120 hours, 144 hours and 168 hours

Sample	TW01 0H	TW01 24H	TW01 48H	TW01 72H	TW01 96H	TW01 120H	TW01 144H	TW01 168H	SW01
Time (Hours)	0H	24H	48H	72H	96H	120H	144H	168H	SW01
Date	18/06/2016	19/06/2016	20/06/2016	21/06/2016	22/06/2016	23/06/2016	24/06/2016	25/06/2016	25/06/2016
Water Level (m)	7.11	40.15	41.4	41.85	45.7	47.5	43.68	42.76	-
Temp. (°C)	28.75	28.2	29.77	29.07	29.1	28.38	28.58	28.5	29.74
Salinity (ppm)	0.06	0.06	0.08	0.06	0.06	0.06	0.06	0.06	35.31
DO mg/L	4.03	5.29	1.11	1.2	1.14	1.05	1.44	1.5	4.56
DO%	46.6	61.4	14.7	15.7	13.7	13.4	18.2	18.5	72.9
ORP redox	43.4	47.1	22.9	21.1	31.8	31.9	25	26	26.6
pH	5.6	5.71	5.55	5.57	5.64	5.63	5.61	5.7	7.78
TDS (mg/L)	0.088	0.084	0.115	0.086	0.08	0.08	0.086	0.09	34.88
EC uS/cm	135	128	177	133	133	133	132	131	53662
Ca (mg/L)	0.7521	0.4815	0.4729	0.4241	0.4021	0.4128	0.4280	0.4301	304.7642
Mg (mg/L)	2.5076	2.6938	2.5826	2.6565	2.6408	2.6106	2.6068	2.6487	1240.4815
Na (mg/L)	7.6303	8.1589	7.8584	8.0669	7.8318	7.6582	7.8138	7.9702	10679.2554
K (mg/L)	0.6520	0.6159	0.5884	0.5952	0.5807	0.5811	0.5380	0.5874	301.3592
Cl (mg/L)	21.87	23.50	24.23	27.07	40.79	30.98	30.04	40.61	32291.50
SO ₄ (mg/L)	4.40	4.50	4.37	4.35	4.38	5.50	4.37	4.24	3315.50
F (mg/L)	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
NO ₃ (mg/L)	0.57	0.59	0.57	0.53	0.18	0.08	0.15	0.08	<0.05
As (mg/L)	0.0021	0.0004	0.0025	0.0025	0.0027	0.0026	0.0027	0.0027	0.2836
Cd (mg/L)	0.0003	0.0002	<0.0002	<0.0002	<0.0002	0.0003	0.0004	0.0003	<0.0002
Cr (mg/L)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0006
Cu (mg/L)	0.0014	0.0005	0.0010	0.0011	0.0009	0.0009	0.0010	0.0009	1.2647
Fe ²⁺ (mg/L)	15.3775	6.9271	12.7115	12.5877	12.5136	12.7044	12.2955	12.3856	0.2612
Hg (mg/L)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mn (mg/L)	0.1615	0.1577	0.1542	0.1555	0.1525	0.1565	0.1476	0.1581	0.0045
Ni (mg/L)	0.0085	0.0079	0.0075	0.0076	0.0074	0.0073	0.0076	0.0075	0.0948
Pb (mg/L)	0.0002	<0.0002	0.0003	<0.0002	<0.0002	<0.0002	0.0002	0.0002	<0.0002
Sb (mg/L)	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	0.0008
Se (mg/L)	0.0005	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005	0.0005	0.7533
SiO ₂ (mg/L)	33.1	39.3	41.8	43.9	42.3	46.3	45.0	46.4	12.4
V (mg/L)	0.0008	0.0006	0.0006	0.0005	0.0005	0.0004	0.0004	0.0004	0.2124
Zn (mg/L)	0.3872	0.2713	0.2964	0.3398	0.3485	0.3349	0.3543	0.3652	0.0018
Alkalinity (mg/L)	4.02	13.1	11.1	14.1	7.04	19.1	18.1	9.05	59.4

7. CONCLUSION

Tube well TW-01 was constructed and tested at Desaru Coast, Kota Tinggi, Johor with a total depth of 105.0 m with a groundwater yield of about 6.50 m³/hour observed during the flushing process.

The pumping tests that carried out on MRCB TW1 showed that the safe pumping rate is 4.80 m³/hour, with a drawdown of 40.68 m. This pumping rate is the recommended suitable pumping rate for the tube well. In conclusion, the MRCB TW1 was successfully constructed within the surrounding area of the Desaru Coast (Desaru Phase II Development (DAWP) and can produce 6.50 m³/hour of water. It recommended that the tube well pumped continuously at the recommended rates. Measurements of the water level should maintain and regular water quality test should be conducted to ensure that there is no deterioration of water quality over time due to saline water intrusion and anthropogenic activities in the vicinity. Most of the parameters analysed within the limits of the national standard for drinking water quality by the Ministry of Health (MOH), Malaysia (2004) except iron and manganese.

The chemical and physical analysis results showed that the groundwater is generally good quality, although after 168 hours and result of EC μ S/cm, salinity, sodium, calcium and chloride are remaining low. This indicates that no connection with sea water in the MRCB-TW1 well. The aquifers in this area protected from saltwater intrusion, which is possible due the fractured type of the aquifers. Based on finding of this study, this area is potential to develop the groundwater in bigger scale. It recommended that the detailed study of groundwater, including groundwater modelling to carry out to evaluate sustainable groundwater potential in this area.

References

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APPENDIX

PHOTOS







PUMPING TEST DATA

**CONSTANT DISCHARGE TEST DATA
(PUMPED WELL)**

Well No. :	MRCB-TW 1				Date Started :		18.06.2016 - 9.00 am		
Location :	Desaru, Johore.				Date Stopped :		25.06.2016 - 9.00 am		
Depth of Well : 108.0 m					Well Collar :		0.36 m		
Screen Position : 81.0 - 105.0 m						Static Water Level :		6.51 m	
					Rate of Pumping :		4.80 m³/hour		
Date/ Time	Time Since Pumping Started (minutes)	Water Level (m)	D/down (m)	Remarks	Date/ Time	Time Since Pumping Started (minutes)	Water Level (m)	D/down (m)	Remarks
18.06.16	0	6.51	0.00			100	30.27	23.76	
9.00 am	0.2	8.52	2.01			120	30.66	24.15	
	0.5	9.60	3.09			160	32.20	25.69	
	1.0	11.46	4.95			200	33.00	26.49	
	1.5	12.47	5.96			250	33.82	27.31	
	2.0	13.45	6.94			300	34.20	27.69	Raining
	2.5	13.70	7.19			350	34.65	28.14	Raining
	3.0	13.91	7.40			400	36.37	29.86	Raining
	3.5	14.37	7.86			450	37.43	30.92	Raining
	4.0	14.71	8.20			500	38.22	31.71	Raining
	4.5	14.96	8.45			550	38.56	32.05	Raining
	5.0	15.17	8.66			600	38.81	32.30	Raining
	6.0	15.80	9.29			700	39.25	32.74	Raining
	7.0	16.70	10.19			800	39.62	33.11	Raining
	8.0	17.24	10.73			900	39.65	33.14	Raining
	9.0	17.70	11.19			1000	39.88	33.37	Raining
	10.0	18.25	11.74			1200	40.27	33.76	
	15	19.84	13.33			1400	40.65	34.14	
	20	20.53	14.02			1600	40.70	34.19	
	25	21.28	14.77			1800	40.81	34.30	
	30	21.87	15.36			2000	40.89	34.38	
	35	22.42	15.91			2500	41.67	35.16	
	40	23.58	17.07			3000	40.11	33.60	

Date/ Time	Time Since Pumping Started (minutes)	Water Level (m)	D/down (m)	Remarks	Date/ Time	Time Since Pumping Started (minutes)	Water Level (m)	D/down (m)	Remarks
	45	24.59	18.08			3500	36.52	30.01	Electrical
	50	25.18	18.67			4000	37.93	31.42	supply failure
	55	25.87	19.36			4500	41.53	35.02	
	60	26.31	19.80			5000	45.20	38.69	
	70	27.10	20.59			5500	45.17	38.66	Electrical
	80	28.78	22.27			6000	46.53	40.02	supply failure
	90	28.80	22.29			6500	47.19	40.68	
	7000	46.90	40.39						
	7500	46.88	40.37						
	8000	43.08	36.57	Electrical					
	8500	42.80	36.29	supply failure					
	9000	42.40	35.89						
	9500	42.53	36.02						
	10080	42.16	35.65						

STEP DRAWDOWN TEST

Time	STEP 1		STEP 2		STEP 3		STEP 4	
Since	Q =1.60 m ³ /hour		Q =3.20 m ³ /hour		Q =4.80 m ³ /hour		Q =6.53 m ³ /hour	
Pumping	Water	Drawdown	Water	Drawdown	Water	Drawdown	Water	Drawdown
(minutes)	Level (m)	(m)	Level (m)	(m)	Level (m)	(m)	Level (m)	(m)
0.0	6.48	0.00	10.53	4.05	19.02	12.54	34.02	27.54
0.5	6.89	0.41	10.82	4.34	20.40	13.92	34.30	27.82
1.0	6.92	0.44	10.95	4.47	20.90	14.42	34.95	28.47
1.5	7.05	0.57	11.29	4.81	21.30	14.82	35.70	29.22
2.0	7.25	0.77	11.92	5.44	21.75	15.27	36.08	29.60
2.5	7.50	1.02	12.71	6.23	22.10	15.62	36.51	30.03
3.0	7.50	1.02	13.22	6.74	22.53	16.05	36.82	30.34
3.5	7.55	1.07	13.53	7.05	23.11	16.63	37.45	30.97
4.0	7.67	1.19	13.90	7.42	23.55	17.07	37.86	31.38
4.5	8.02	1.54	14.16	7.68	24.00	17.52	37.97	31.49
5.0	8.21	1.73	14.35	7.87	24.24	17.76	38.22	31.74
7.5	8.58	2.10	15.20	8.72	25.58	19.10	39.30	32.82
10.0	8.76	2.28	15.79	9.31	26.44	19.96	40.13	33.65
15.0	9.65	3.17	16.72	10.24	27.83	21.35	41.57	35.09
20.0	9.80	3.32	17.40	10.92	28.77	22.29	44.17	37.69
25.0	9.99	3.51	17.93	11.45	29.55	23.07	44.70	38.22
30.0	10.10	3.62	18.31	11.83	30.13	23.65	45.55	39.07
35.0	10.15	3.67	18.49	12.01	30.70	24.22	46.16	39.68
40.0	10.24	3.76	18.74	12.26	31.20	24.72	46.70	40.22
45.0	10.35	3.87	18.90	12.42	31.65	25.17	47.20	40.72
50.0	10.38	3.90	19.03	12.55	32.00	25.52	47.50	41.02
55.0	10.45	3.97	19.02	12.54	32.31	25.83	47.80	41.32
60.0	10.53	4.05	19.02	12.54	32.34	25.86	48.15	41.67
70.0					32.63	26.15	48.62	42.14
80.0					33.48	27.00	49.08	42.60
90.0					34.02	27.54	49.43	42.95

WELL RECOVERY TEST (PUMPED WELL)

Well ID. : MRCB-TW 1						Date Started : 25.06.2016 - 9.00 am				
Location: Desaru, Johore.						Date Stopped : 25.06.2016 - 4.00 pm				
Depth of Well : 108.0 m bgl						Static Water Level : 6.51 m bgl				
Depth of Screen : 81.0 - 105.0 m bgl						Well Collar: 0.36 m agl				
Date /	Time	Time		Water	Residual	Time	Time		Water	Residual
Time		Since	t / t'	Level	D/down		Since	t / t'	Level	D/down
		Pump		(m)	(m)		Pump		(m)	(m)
	t _i	Started				t _i	Started			
	(min)	t' (min)				(min)	t' (min)			
25.06.16	0	10080.0	-	42.16	35.65	100	10180.0	101.8	20.73	14.22
9.00 am	0.5	10080.5	20161.0	41.35	34.84	120	10200.0	85.0	19.71	13.20
	1.0	10081.0	10081.0	40.23	33.72	140	10220.0	73.0	18.84	12.33
	1.5	10081.5	6721.0	39.60	33.09	160	10240.0	64.0	18.28	11.77
	2.0	10082.0	5041.0	38.80	32.29	180	10260.0	57.0	17.66	11.15
	2.5	10082.5	4033.0	38.16	31.65	210	10290.0	49.0	16.74	10.23
	3.0	10083.0	3361.0	37.63	31.12	240	10320.0	43.0	16.01	9.50
	3.5	10083.5	2881.0	37.11	30.60	270	10350.0	38.3	15.45	8.94
	4.0	10084.0	2521.0	36.66	30.15	300	10380.0	34.6	15.03	8.52
	4.5	10084.5	2241.0	36.23	29.72	360	10440.0	29.0	14.20	7.69
	5.0	10085.0	2017.0	35.82	29.31	420	10500.0	25.0	13.41	6.90
	6.0	10086.0	1681.0	35.11	28.60	480				
	7.0	10087.0	1441.0	34.49	27.98	540				
	8.0	10088.0	1261.0	33.90	27.39	600				
	9.0	10089.0	1121.0	33.33	26.82	660				
	10	10090.0	1009.0	32.86	26.35	720				
	15	10095.0	673.0	30.90	24.39	780				
	20	10100.0	505.0	29.40	22.89	840				
	25	10105.0	404.2	28.26	21.75	900				
	30	10110.0	337.0	27.33	20.82	960				
	35	10115.0	289.0	26.51	20.00	1020				
	40	10120.0	253.0	25.70	19.19	1080				
	45	10125.0	225.0	25.13	18.62	1140				
	50	10130.0	202.6	24.50	17.99	1200				
	55	10135.0	184.3	24.00	17.49	1260				
	60	10140.0	169.0	23.56	17.05	1320				
	70	10150.0	145.0	22.70	16.19	1380				
	80	10160.0	127.0	21.90	15.39	1440				
	90	10170.0	113.0	21.32	14.81					

WATER QUALITY ANALYSIS



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No. Makmal : B(AS)01730/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

LAPORAN

Berkenaan dengan 9 sampel yang diterima daripada NAHRIM dibawa oleh MOHD KHAIRUL NIZAR SHAMSUDDIN pada 27/06/2016, masa 14:14, keputusan analisis adalah seperti berikut:-

Tanda Sampel	Stesen Percontohan	Tarikh dan Masa Percontohan
TM 01-0H		
TM 01-24H		
TM 01-48H		
TM 01-72H		
TM 01-96H		
TM 01-120H		
TM 01-144H		
TM 01-168H		
SW-01		

Ujian		Tanda Sampel		Kaedah Analisis
		TM 01-0H		
1	Alkalinity	(mg/L)	4.02	APHA 2320 B
2	Klorida	(mg/L)	21.87	APHA 4110 B
3	Fluorida	(mg/L)	<0.06	APHA 4110 B
4	Nitrat	(mg/L)	0.57	APHA 4110 B
5	Fosfat	(mg/L)	<0.10	APHA 4110 B
6	Sulfat	(mg/L)	4.40	APHA 4110 B

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MUKA 1



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Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-24H</u>	
7	Alkalinity	(mg/L)	13.1	APHA 2320 B
8	Klorida	(mg/L)	23.50	APHA 4110 B
9	Fluorida	(mg/L)	<0.06	APHA 4110 B
10	Nitrat	(mg/L)	0.59	APHA 4110 B
11	Fosfat	(mg/L)	1.00	APHA 4110 B
12	Sulfat	(mg/L)	4.50	APHA 4110 B
			<u>TM 01-48H</u>	
13	Alkalinity	(mg/L)	11.1	APHA 2320 B
14	Klorida	(mg/L)	24.23	APHA 4110 B
15	Fluorida	(mg/L)	<0.06	APHA 4110 B
16	Nitrat	(mg/L)	0.57	APHA 4110 B
17	Fosfat	(mg/L)	<0.10	APHA 4110 B
18	Sulfat	(mg/L)	4.37	APHA 4110 B

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MUKA 2



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No. Makmal : B(AS)01730/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-72H</u>	
19	Alkalinity	(mg/L)	14.1	APHA 2320 B
20	Klorida	(mg/L)	27.07	APHA 4110 B
21	Fluorida	(mg/L)	<0.06	APHA 4110 B
22	Nitrat	(mg/L)	0.53	APHA 4110 B
23	Fosfat	(mg/L)	<0.10	APHA 4110 B
24	Sulfat	(mg/L)	4.35	APHA 4110 B
			<u>TM 01-96H</u>	
25	Alkalinity	(mg/L)	7.04	APHA 2320 B
26	Klorida	(mg/L)	40.79	APHA 4110 B
27	Fluorida	(mg/L)	<0.06	APHA 4110 B
28	Nitrat	(mg/L)	0.18	APHA 4110 B
29	Fosfat	(mg/L)	<0.10	APHA 4110 B
30	Sulfat	(mg/L)	4.38	APHA 4110 B

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MUKA 3



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<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-120H</u>	
31	Alkalinity	(mg/L)	19.1	APHA 2320 B
32	Klorida	(mg/L)	30.98	APHA 4110 B
33	Fluorida	(mg/L)	<0.06	APHA 4110 B
34	Nitrat	(mg/L)	0.08	APHA 4110 B
35	Fosfat	(mg/L)	<0.10	APHA 4110 B
36	Sulfat	(mg/L)	5.50	APHA 4110 B
			<u>TM 01-144H</u>	
37	Alkalinity	(mg/L)	18.1	APHA 2320 B
38	Klorida	(mg/L)	30.04	APHA 4110 B
39	Fluorida	(mg/L)	<0.06	APHA 4110 B
40	Nitrat	(mg/L)	0.15	APHA 4110 B
41	Fosfat	(mg/L)	<0.10	APHA 4110 B
42	Sulfat	(mg/L)	4.37	APHA 4110 B

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MUKA 4



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Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-168H</u>	
43	Alkalinity	(mg/L)	9.05	APHA 2320 B
44	Klorida	(mg/L)	40.61	APHA 4110 B
45	Fluorida	(mg/L)	<0.06	APHA 4110 B
46	Nitrat	(mg/L)	0.08	APHA 4110 B
47	Fosfat	(mg/L)	<0.10	APHA 4110 B
48	Sulfat	(mg/L)	4.24	APHA 4110 B
			<u>SW-01</u>	
49	Alkalinity	(mg/L)	59.4	APHA 2320 B
50	Klorida	(mg/L)	32291.50	APHA 4110 B
51	Fluorida	(mg/L)	<0.06	APHA 4110 B
52	Nitrat	(mg/L)	<0.05	APHA 4110 B
53	Fosfat	(mg/L)	<0.10	APHA 4110 B
54	Sulfat	(mg/L)	3315.50	APHA 4110 B

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MUKA 5



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No. Makmal : B(AS)01730/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

Sila rujuk lampiran untuk kaedah analisis

LAMPIRAN

Ulasan : Bekas sampel akan dilupuskan sekiranya tidak dipungut oleh penghantar dalam tempoh satu bulan dari tarikh analisis ini.

KETUA CAWANGAN

NAHRIM

LOT 5377 JALAN PUTRA PERMAI, SERI
KEMBANGAN , SELANGOR DE,

,

,

Selangor

s.k.:

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Ahli Kimia
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No. Makmal : B(AS)01729/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

LAPORAN

Berkenaan dengan 9 sampel yang diterima daripada NAHRIM dibawa oleh MOHD KHAIRUL NIZAR SHAMSUDDIN pada 27/06/2016, masa 12:53, keputusan analisis adalah seperti berikut:-

Tanda Sampel	Stesen Percontohan	Tarikh dan Masa Percontohan
TM 01-0H		
TM 01-24H		
TM 01-48H		
TM 01-72H		
TM 01-96H		
TM 01-120H		
TM 01-144H		
TM 01-168H		
SW-01		

Ujian

Tanda Sampel

Kaedah Analisis

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MUKA 1



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Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-0H</u>	
1	Arsenic	(mg/L)	0.0021	EPA 200.8
2	Cadmium	(mg/L)	0.0003	EPA 200.8
3	Chromium	(mg/L)	<0.0002	EPA 200.8
4	Copper	(mg/L)	0.0014	EPA 200.8
5	Iron	(mg/L)	15.3775	EPA 200.8
6	Mercury	(mg/L)	<0.0001	EPA 200.8
7	Manganese	(mg/L)	0.1615	EPA 200.8
8	Nickel	(mg/L)	0.0085	EPA 200.8
9	Plumbum	(mg/L)	0.0002	EPA 200.8
10	Antimony	(mg/L)	<0.0008	EPA 200.8
11	Selenium	(mg/L)	0.0005	EPA 200.8
12	Tin	(mg/L)	<0.0002	EPA 200.8
13	Vanadium	(mg/L)	0.0008	EPA 200.8
14	Zinc	(mg/L)	0.3872	EPA 200.8
15	Calcium	(mg/L)	0.7521	EPA 200.8
16	Potassium	(mg/L)	0.6520	EPA 200.8
17	Magnesium	(mg/L)	2.5076	EPA 200.8
18	Sodium	(mg/L)	7.6303	EPA 200.8

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MUKA 2



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Ruj. Tuan : NAHRIM 605-1/1/15()

Tarikh : 29/07/2016

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-24H</u>	
19	Arsenic	(mg/L)	0.0004	EPA 200.8
20	Cadmium	(mg/L)	0.0002	EPA 200.8
21	Chromium	(mg/L)	<0.0002	EPA 200.8
22	Copper	(mg/L)	0.0005	EPA 200.8
23	Iron	(mg/L)	6.9271	EPA 200.8
24	Mercury	(mg/L)	<0.0001	EPA 200.8
25	Manganese	(mg/L)	0.1577	EPA 200.8
26	Nickel	(mg/L)	0.0079	EPA 200.8
27	Plumbum	(mg/L)	<0.0002	EPA 200.8
28	Antimony	(mg/L)	<0.0008	EPA 200.8
29	Selenium	(mg/L)	0.0006	EPA 200.8
30	Tin	(mg/L)	<0.0002	EPA 200.8
31	Vanadium	(mg/L)	0.0006	EPA 200.8
32	Zinc	(mg/L)	0.2713	EPA 200.8
33	Calcium	(mg/L)	0.4815	EPA 200.8
34	Potassium	(mg/L)	0.6159	EPA 200.8
35	Magnesium	(mg/L)	2.6938	EPA 200.8
36	Sodium	(mg/L)	8.1589	EPA 200.8

Munirah binti Abdul Zali
Ahli Kimia
b.p. Ketua Pengarah Kimia
Malaysia

MUKA 3



JABATAN KIMIA MALAYSIA

DEPARTMENT OF CHEMISTRY MALAYSIA

Jalan Sultan, 46681 Petaling Jaya, Selangor
Tel: 03-79853000 Fax: 03-79853028



PERINGATAN - Laporan ini tidak boleh digunakan untuk iklan atau dijanakan semula tanpa kebenaran.

No. Makmal : B(AS)01729/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-48H</u>	
37	Arsenic	(mg/L)	0.0025	EPA 200.8
38	Cadmium	(mg/L)	<0.0002	EPA 200.8
39	Chromium	(mg/L)	<0.0002	EPA 200.8
40	Copper	(mg/L)	0.0010	EPA 200.8
41	Iron	(mg/L)	12.7115	EPA 200.8
42	Mercury	(mg/L)	<0.0001	EPA 200.8
43	Manganese	(mg/L)	0.1542	EPA 200.8
44	Nickel	(mg/L)	0.0075	EPA 200.8
45	Plumbum	(mg/L)	0.0003	EPA 200.8
46	Antimony	(mg/L)	<0.0008	EPA 200.8
47	Selenium	(mg/L)	0.0006	EPA 200.8
48	Tin	(mg/L)	<0.0002	EPA 200.8
49	Vanadium	(mg/L)	0.0006	EPA 200.8
50	Zinc	(mg/L)	0.2964	EPA 200.8
51	Calcium	(mg/L)	0.4729	EPA 200.8
52	Potassium	(mg/L)	0.5884	EPA 200.8
53	Magnesium	(mg/L)	2.5826	EPA 200.8
54	Sodium	(mg/L)	7.8584	EPA 200.8

Munirah binti Abdul Zali
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MUKA 4



JABATAN KIMIA MALAYSIA

DEPARTMENT OF CHEMISTRY MALAYSIA

Jalan Sultan, 46681 Petaling Jaya, Selangor
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PERINGATAN - Laporan ini tidak boleh digunakan untuk iklan atau dijanakan semula tanpa kebenaran.

No. Makmal : B(AS)01729/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-72H</u>	
55	Arsenic	(mg/L)	0.0025	EPA 200.8
56	Cadmium	(mg/L)	<0.0002	EPA 200.8
57	Chromium	(mg/L)	<0.0002	EPA 200.8
58	Copper	(mg/L)	0.0011	EPA 200.8
59	Iron	(mg/L)	12.5877	EPA 200.8
60	Mercury	(mg/L)	<0.0001	EPA 200.8
61	Manganese	(mg/L)	0.1555	EPA 200.8
62	Nickel	(mg/L)	0.0076	EPA 200.8
63	Plumbum	(mg/L)	<0.0002	EPA 200.8
64	Antimony	(mg/L)	<0.0008	EPA 200.8
65	Selenium	(mg/L)	0.0006	EPA 200.8
66	Tin	(mg/L)	<0.0002	EPA 200.8
67	Vanadium	(mg/L)	0.0005	EPA 200.8
68	Zinc	(mg/L)	0.3398	EPA 200.8
69	Calcium	(mg/L)	0.4241	EPA 200.8
70	Potassium	(mg/L)	0.5952	EPA 200.8
71	Magnesium	(mg/L)	2.6565	EPA 200.8
72	Sodium	(mg/L)	8.0869	EPA 200.8

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MUKA 5



JABATAN KIMIA MALAYSIA

DEPARTMENT OF CHEMISTRY MALAYSIA

Jalan Sultan, 46661 Petaling Jaya, Selangor
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PERINGATAN - Laporan ini tidak boleh digunakan untuk iklan atau dijanakan semula tanpa kebenaran.

No. Makmal : B(AS)01729/16
Ruj. Tuan : NAHRIM 605-1/1/15()

Tarikh : 29/07/2016

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-96H</u>	
73	Arsenic	(mg/L)	0.0027	EPA 200.8
74	Cadmium	(mg/L)	<0.0002	EPA 200.8
75	Chromium	(mg/L)	<0.0002	EPA 200.8
76	Copper	(mg/L)	0.0009	EPA 200.8
77	Iron	(mg/L)	12.5136	EPA 200.8
78	Mercury	(mg/L)	<0.0001	EPA 200.8
79	Manganese	(mg/L)	0.1525	EPA 200.8
80	Nickel	(mg/L)	0.0074	EPA 200.8
81	Plumbum	(mg/L)	<0.0002	EPA 200.8
82	Antimony	(mg/L)	<0.0008	EPA 200.8
83	Selenium	(mg/L)	0.0005	EPA 200.8
84	Tin	(mg/L)	<0.0002	EPA 200.8
85	Vanadium	(mg/L)	0.0005	EPA 200.8
86	Zinc	(mg/L)	0.3485	EPA 200.8
87	Calcium	(mg/L)	0.4021	EPA 200.8
88	Potassium	(mg/L)	0.5807	EPA 200.8
89	Magnesium	(mg/L)	2.6408	EPA 200.8
90	Sodium	(mg/L)	7.8318	EPA 200.8

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MUKA 6



JABATAN KIMIA MALAYSIA

DEPARTMENT OF CHEMISTRY MALAYSIA

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No. Makmal : B(AS)01729/16
Ruj. Tuan : NAHRIM 605-1/1/15()

Tarikh : 29/07/2016

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-120H</u>	
91	Arsenic	(mg/L)	0.0026	EPA 200.8
92	Cadmium	(mg/L)	0.0003	EPA 200.8
93	Chromium	(mg/L)	<0.0002	EPA 200.8
94	Copper	(mg/L)	0.0009	EPA 200.8
95	Iron	(mg/L)	12.7044	EPA 200.8
96	Mercury	(mg/L)	<0.0001	EPA 200.8
97	Manganese	(mg/L)	0.1565	EPA 200.8
98	Nickel	(mg/L)	0.0073	EPA 200.8
99	Plumbum	(mg/L)	<0.0002	EPA 200.8
100	Antimony	(mg/L)	<0.0008	EPA 200.8
101	Selenium	(mg/L)	0.0005	EPA 200.8
102	Tin	(mg/L)	<0.0002	EPA 200.8
103	Vanadium	(mg/L)	0.0004	EPA 200.8
104	Zinc	(mg/L)	0.3349	EPA 200.8
105	Calcium	(mg/L)	0.4128	EPA 200.8
106	Potassium	(mg/L)	0.5811	EPA 200.8
107	Magnesium	(mg/L)	2.6106	EPA 200.8
108	Sodium	(mg/L)	7.6582	EPA 200.8

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MUKA 7



JABATAN KIMIA MALAYSIA

DEPARTMENT OF CHEMISTRY MALAYSIA

Jalan Sultan, 46601 Petaling Jaya, Selangor
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PERINGATAN - Laporan ini tidak boleh digunakan untuk iklan atau dijanakan semula tanpa kebenaran.

No. Makmal : B(AS)01729/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-144H</u>	
109	Arsenic	(mg/L)	0.0027	EPA 200.8
110	Cadmium	(mg/L)	0.0004	EPA 200.8
111	Chromium	(mg/L)	<0.0002	EPA 200.8
112	Copper	(mg/L)	0.0010	EPA 200.8
113	Iron	(mg/L)	12.2955	EPA 200.8
114	Mercury	(mg/L)	<0.0001	EPA 200.8
115	Manganese	(mg/L)	0.1476	EPA 200.8
116	Nickel	(mg/L)	0.0076	EPA 200.8
117	Plumbum	(mg/L)	0.0002	EPA 200.8
118	Antimony	(mg/L)	<0.0008	EPA 200.8
119	Selenium	(mg/L)	0.0005	EPA 200.8
120	Tin	(mg/L)	<0.0002	EPA 200.8
121	Vanadium	(mg/L)	0.0004	EPA 200.8
122	Zinc	(mg/L)	0.3543	EPA 200.8
123	Calcium	(mg/L)	0.4280	EPA 200.8
124	Potassium	(mg/L)	0.5380	EPA 200.8
125	Magnesium	(mg/L)	2.6068	EPA 200.8
126	Sodium	(mg/L)	7.8138	EPA 200.8

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MUKA 8



JABATAN KIMIA MALAYSIA

DEPARTMENT OF CHEMISTRY MALAYSIA

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No. Makmal : B(AS)01729/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-168H</u>	
127	Arsenic	(mg/L)	0.0027	EPA 200.8
128	Cadmium	(mg/L)	0.0003	EPA 200.8
129	Chromium	(mg/L)	<0.0002	EPA 200.8
130	Copper	(mg/L)	0.0009	EPA 200.8
131	Iron	(mg/L)	12.3856	EPA 200.8
132	Mercury	(mg/L)	<0.0001	EPA 200.8
133	Manganese	(mg/L)	0.1581	EPA 200.8
134	Nickel	(mg/L)	0.0075	EPA 200.8
135	Plumbum	(mg/L)	0.0002	EPA 200.8
136	Antimony	(mg/L)	<0.0008	EPA 200.8
137	Selenium	(mg/L)	0.0005	EPA 200.8
138	Tin	(mg/L)	<0.0002	EPA 200.8
139	Vanadium	(mg/L)	0.0004	EPA 200.8
140	Zinc	(mg/L)	0.3852	EPA 200.8
141	Calcium	(mg/L)	0.4301	EPA 200.8
142	Potassium	(mg/L)	0.5874	EPA 200.8
143	Magnesium	(mg/L)	2.6487	EPA 200.8
144	Sodium	(mg/L)	7.9702	EPA 200.8

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MUKA 9



JABATAN KIMIA MALAYSIA

DEPARTMENT OF CHEMISTRY MALAYSIA

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No. Makmal : B(AS)01729/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>SW-01</u>	
145	Arsenic	(mg/L)	0.2836	EPA 200.8
146	Cadmium	(mg/L)	<0.0002	EPA 200.8
147	Chromium	(mg/L)	0.0006	EPA 200.8
148	Copper	(mg/L)	1.2647	EPA 200.8
149	Iron	(mg/L)	0.2612	EPA 200.8
150	Mercury	(mg/L)	<0.0001	EPA 200.8
151	Manganese	(mg/L)	0.0045	EPA 200.8
152	Nickel	(mg/L)	0.0948	EPA 200.8
153	Plumbum	(mg/L)	<0.0002	EPA 200.8
154	Antimony	(mg/L)	0.0008	EPA 200.8
155	Selenium	(mg/L)	0.7533	EPA 200.8
156	Tin	(mg/L)	<0.0002	EPA 200.8
157	Vanadium	(mg/L)	0.2124	EPA 200.8
158	Zinc	(mg/L)	0.0018	EPA 200.8
159	Calcium	(mg/L)	304.7642	EPA 200.8
160	Potassium	(mg/L)	301.3592	EPA 200.8
161	Magnesium	(mg/L)	1240.4815	EPA 200.8
162	Sodium	(mg/L)	10679.2554	EPA 200.8

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JABATAN KIMIA MALAYSIA

DEPARTMENT OF CHEMISTRY MALAYSIA

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No. Makmal : B(AS)01729/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

Sila rujuk lampiran untuk kaedah analisis

LAMPIRAN

Ulasan : Bekas sampel akan dilupuskan sekiranya tidak dipungut oleh penghantar dalam tempoh satu bulan dari tarikh analisis ini.

KETUA CAWANGAN

NAHRIM
LOT 5377 JALAN PUTRA PERMAI, SERI
KEMBANGAN , SELANGOR DE,

,

Selangor

s.k.:

Munirah binti Abdul Zali
Ahli Kimia
b.p. Ketua Pengarah Kimia
Malaysia



JABATAN KIMIA MALAYSIA

DEPARTMENT OF CHEMISTRY MALAYSIA

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PERINGATAN - Laporan ini tidak boleh digunakan untuk iklan atau dijanakan semula tanpa kebenaran.

No. Makmal : B(AS)01731/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

LAPORAN

Berkenaan dengan 9 sampel AIR TANAH yang diterima daripada NAHRIM dibawa oleh MOHD KHAIRUL NIZAR SHAMSUDDIN pada 27/06/2016, masa 14:14, keputusan analisis adalah seperti berikut:-

Tanda Sampel		Stesen Percontohan	Tarikh dan Masa Percontohan	
TM 01-0H				
TM 01-24H				
TM 01-48H				
TM 01-72H				
TM 01-96H				
TM 01-120H				
TM 01-144H				
TM 01-168H				
SW-01				
Ujian			Tanda Sampel	Kaedah Analisis
1	Silika	(mg/L)	<u>TM 01-0H</u>	
			33.1	APHA 4500 SiO ₂ C
2	Silika	(mg/L)	<u>TM 01-24H</u>	
			39.3	APHA 4500 SiO ₂ C
3	Silika	(mg/L)	<u>TM 01-48H</u>	
			41.8	APHA 4500 SiO ₂ C
4	Silika	(mg/L)	<u>TM 01-72H</u>	
			43.9	APHA 4500 SiO ₂ C
5	Silika	(mg/L)	<u>TM 01-96H</u>	
			42.3	APHA 4500 SiO ₂ C

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JABATAN KIMIA MALAYSIA

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No. Makmal : B(AS)01731/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

<u>Ujian</u>			<u>Tanda Sampel</u>	<u>Kaedah Analisis</u>
			<u>TM 01-120H</u>	
6	Silika	(mg/L)	46.3	APHA 4500 SiO ₂ C
			<u>TM 01-144H</u>	
7	Silika	(mg/L)	45.0	APHA 4500 SiO ₂ C
			<u>TM 01-168H</u>	
8	Silika	(mg/L)	46.4	APHA 4500 SiO ₂ C
			<u>SW-01</u>	
9	Silika	(mg/L)	12.4	APHA 4500 SiO ₂ C

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Malaysia

MUKA 2



JABATAN KIMIA MALAYSIA

DEPARTMENT OF CHEMISTRY MALAYSIA

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No. Makmal : B(AS)01731/16

Tarikh : 29/07/2016

Ruj. Tuan : NAHRIM 605-1/1/15()

Sila rujuk lampiran untuk kaedah analisis

LAMPIRAN

Ulasan : Bekas sampel akan dilupuskan sekiranya tidak dipungut oleh penghantar dalam tempoh satu bulan dari tarikh analisis ini.

KETUA CAWANGAN

NAHRIM

LOT 5377 JALAN PUTRA PERMAI, SERI
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,

,

Selangor

s.k.:

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