(GROUND) WATER RESOURCES CONSERVATION IN BANDUNG BASIN BY REDEVELOP DRY WELL INTO RECHARGE WELL

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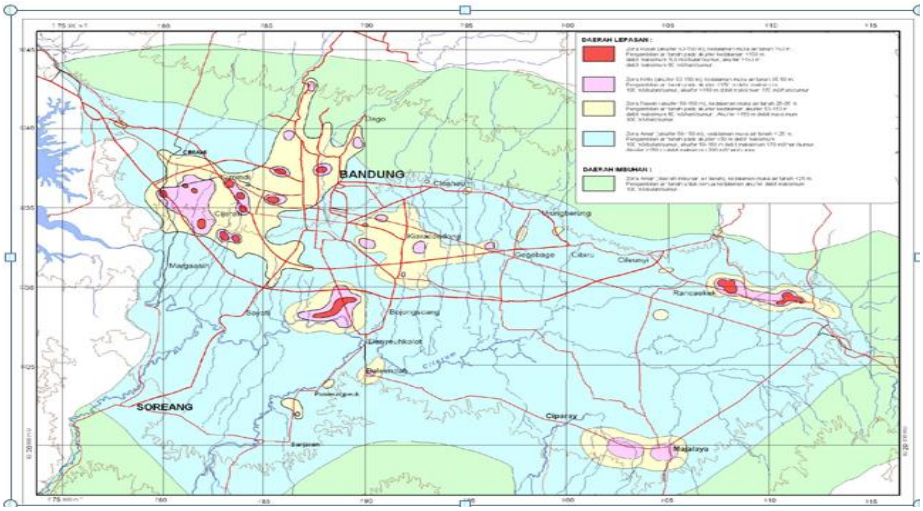
Significant groundwater level drawdown caused by groundwater abstraction has been reported to occur in Bandung Basin. One potential method to recover the groundwater condition by artificial recharge, considering high quantity of rainfall in this area. Beside landsubsidence, groundwater level drawdown had caused a lot of deep well was became dry. Survey non productive well (dry well) has been conducted and has found arround 80 wells, most of in industrial areas of Bandung Basin such as Rancaekek, Dayeuhkolot and Cimahi. After survey, we identificated and selected some dry wells to used as recharge wells, they are in PT. Sunson of Rancaekek area and PT. Mulia Lestari of Cimahi area. Start redevelop dry wells are; first recharge test in two methods, contant head and falling head, and had result capacity of recharge are 2-3 L/s. Second, study of potential and quality water source form rain through widely roof industrial building, then design, built and until monitore prototype of recharge wells. Hope, this study be a guide to water resources conservation and technical policy water resources (groundwater) in Bandung Basin and also for same tipical areas.

Keywords: Bandung basin, artificial recharge, conservation, recharge well, dry well, deep well

INTRODUCTION

Degradation of groundwater level already happened in Bandung basin, that specially in industrial complex areas as Rancaekek, Dayeuhkolot, Cimahi, Banjaran, Ujungberung and Baleendah (Picture 1), as consequence of groundwater abstraction. This condition has been reported, for example by Iwaco-Waseco (1990) and Departemen of Public Work (1990), Wibowo and Repoyadi (1995), Priyowirjanto and Marsudi (1995), Environmetal Geological Researceh Center (2001), On duty Mining and Energi West Java and Institute of Technology Bandung (ITB) (2002 & 2006). Negative impact that has been are a lot of deepwell becaome dry, new well need deeper pump installation and degradation quality of groundwater. Landsubsidence in this area is also reported by Abidin dkk (2008) caused by same causes.



Picture 1. Location of Study (Red color are zone of groundwater crisis area)

Increasing population and industrial growth, while alternative of water source there is no, groundwater abstraction will increasingly, and will negative impact as same as called above. In this area, industrial complex, the water resources must maintain to reduce degradation of groundwater level, with develop artificial recharge and prevent from more abstraction.

METHODOLOGY

Methodology as used in this research as follows:

1) Survey and collect base on stakeholder report
    - Choice several dry well base on the best data as log bore, data of old well design and potential of rainwater
    - Graph secondary data, specially groundwater level, for hydrogeological analysis
    - Collect secondary data about geological and its parameter
2) Recharge test with cleaning well
    - In this research, it by two gravity methods are falling head test and constant head test
    - Gravity methods are suited with the plan in recharge well by rain harvesting from building roofs
3) Analysis of water quality by using standard PERMENKES No.416/MENKES/PER/IX/1990
4) Design and built of prototype, consist of;
    - Model of rain water processing include water collector
    - Instrumentation for monitoring, in while are flow meter and water level
    - Recharge well after cleaning and test
5) Analysis of effective in processing water quality and recharging
6) Comparison with monitoring well
7) Groundwater analysis for water conservation

From this research being a scientific base to be a guide to water resources conservation and technical policy water resources (groundwater) in Bandung Basin.

RESULTS

- Wells that non productive (dry well) base of NPA in Distamben, West Java, from January - May 2010 amount are 87 wells, and 25 wells had primary survey are potential to redevelop into recharge well. In this research, we choice dry well base on the best data as log bore, data of old well design and potential of rainwater are in PT. Sunson, Rancaekek (as discussed) and in PT Mulia Lestari, Cimahi.
- Base on last data of monitoring groundwater level until 2009, can be made graph between groundwater level and time are decrease 1-2 m/year. Example at Rancaekek industrial zone as Figure 1.

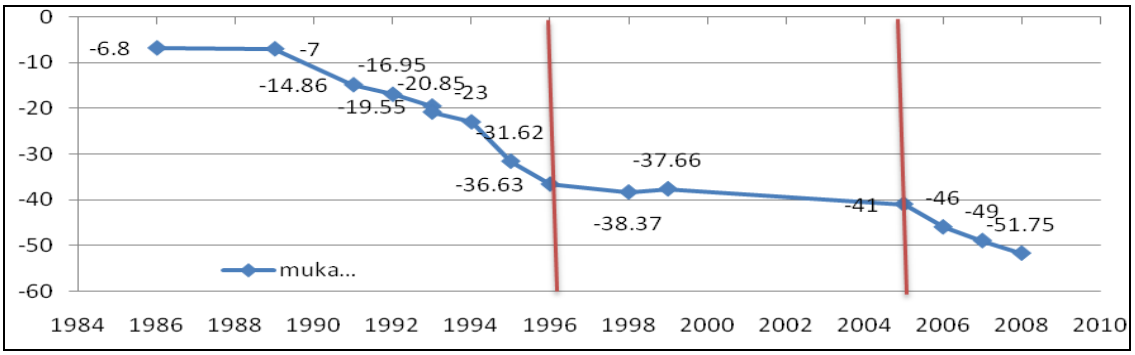


Figure 1. Groundwater level of Rancaekek industrial zone (Distamben Jabar)

- Geological section of Rancaekek area as from bore log well and correlated with regional section from Distamben, West Java and LPPM-ITB, 2006. Geological section are made of Kosambi Formation and Cibeureum Formation untill Cikapundung Formation that considered as bedrock or boundary in hydrogeological system (Hutasoit, 2009).

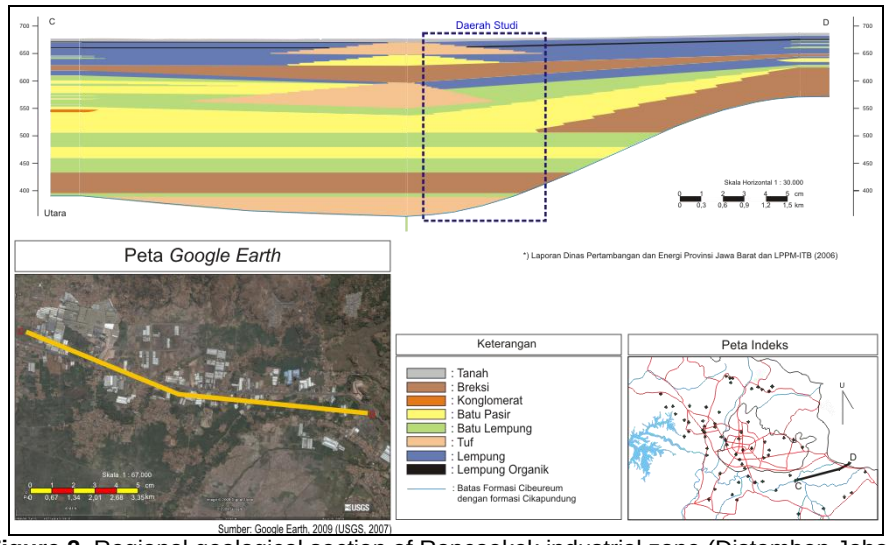


Figure 2. Regional geological section of Rancaekek industrial zone (Distamben Jabar) (Data source: Distamben, West Java, 2006)

- Geological parameter, physical and mechanic of each geological unit get from laboratory result for 30 – 40 m in depth and more than 40 m from empiric correlation of lithology log description.

KEDALAMAN (m)	SIMBOL	DESKRIPSI	PARAMETER TEKNIK								KET.
			γ_{dry}	γ_{sat}	kx	E	$\sqrt{}$	c	phi	ψ	
			kN/m3	kN/m3	m/day	kN/m2	nu	kN/m2	o	o	
0	co1	**Lempung organik**; lempung coklat kehitaman, konsistensi lunak, kelulusan kecil, mengandung organik	13.10	15.20	3.40E-03	3.00E+03	0.30	10	30	0	1)
	co2	**Lempung organik**; lempung organik, abu - abu hitam, mudah hancur, konsistensi lunak, kelulusan kecil	08.50	10.80	9.88E-02	4.00E+03	0.30	10	20	0	1)
	ts1	**tuf pasiran**; tuf pasiran, abu-abu, berbutir halus-sedang; pemilahan baik, lulus air, tersementasi buruk	17.00	20.00	7.80E-01	1.10E+04	0.3	5	38	0	1)
	ss1	**pasir lanauan**; pasir dengan matriks lanauan, berbutir halus-sedang; kebundaran bagus, pemilahan baik, lulus air, tersementasi sedang	17.40	19.50	8.88E-02	1.30E+04	0.25	10	32	0	1)
50	bs1	**breksi**; breksi dengan semen pasir halus-sedang, pemilahan buruk, tersementasi cukup, kebundaran buruk, berbutir pasir-gravel	19.00	22.50	1.33E-03	1.21E+05	0.25	2	35	5	2)
100	ts2	**tuf pasiran**; tuf pasiran, abu-abu, berbutir halus-sedang; pemilahan baik, lulus air, tersementasi buruk	17.30	20.00	9.90E-01	1.20E+04	0.3	5	30	0	2)
	ct1	**lempung tufan**; lempung abu - abu keputihan, mengandung tuf pasir, kelulusan kecil, plastisitas buruk-sedang	16.00	17.50	8.80E-03	1.70E+04	0.35	14	21	0	2)
	st2	**pasir tufan**; pasir dengan matriks lanauan-tufan, berbutir halus-kasar; kebundaran sedang, pemilahan buruk, cukup lulus air, tersementasi sedang	17.00	20.00	8.80E-01	3.50E+04	0.28	5	38	0	2)
150	ct2	**lempung tufan**; lempung abu - abu keputihan, mengandung tuf, kelulusan kecil, plastisitas sedang	16.00	17.50	8.80E-03	1.80E+04	0.35	14	21	0	2)
	st3	**pasir tufan**; pasir tufan dengan matriks lempung, berbutir halus-sedang; kebundaran sedang, pemilahan cukup, tersementasi cukup kuat	17.50	20.50	1.11E-03	2.40E+04	0.30	3	38	0	2)
200	ct3	**lempung tufan**; lempung abu - abu keputihan, mengandung tuf, kelulusan kecil, plastisitas sedang, kompak	16.00	17.50	4.43E-05	1.90E+04	0.35	10	15	0	2)
	bs2	**breksi**; breksi dengan semen pasir halus-sedang pemilahan buruk, tersementasi cukup kuat, kebundaran buruk, mengandung tufan	19.00	22.50	1.30E-03	1.22E+05	0.25	2	35	5	2)
	ct4	**lempung tufan**; lempung abu - abu keputihan, mengandung tuf, kelulusan kecil, plastisitas sedang, kompak	16.00	17.50	8.82E-05	1.70E+04	0.35	10	15	0	2)
250	bs3	**breksi**; breksi dengan semen pasir halus-sedang pemilahan buruk, tersementasi kuat, kebundaran buruk, dominan berbutir gravel	19.00	22.50	1.20E-03	1.23E+05	0.25	2	35	5	2)

Keterangan :
1) Sumber; PT. Bina Karya dari data pemboran geologi teknik dan data laboratorium
2) Sumber; Distamben Jabar dari data pemboran sumur, logging, diskripsi dengan korelasi empiriknya

Figure 3. Stratigraphy and its parameter of Rancaekek industrial zone

- Two measurement gravity test types are constant head test and falling head test conducted at dry well drill with cleaning before. At constant head test and falling head test get capacity of gravity recharge around 2-3 liter/second. In those methods, twice per method total deliver water of 36.000 liters.

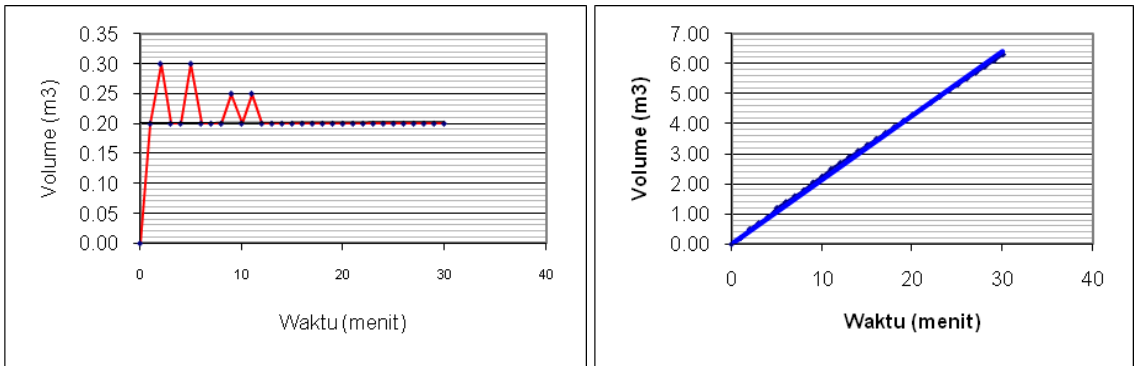


Figure 4 Graph of *Contant Head* test and *Falling Head* test

- Criteria design is after result of laboratory scale test to processing rain water into standart quality of pure water PERMENKES No.416/MENKES/PER/IX/1990. By laboratory test conclude need put down zeolite before sand or screening. Processing capacity is 1 L/s while under a capacity recharge and for suit with site plan (detailed at Table 1).

Table1. Criteria design model of processing water

No.	Description	Location
		Industry
	Basin -Netralitation	
	Length	0,60 m
	Wide	0,60 m
	Height	0,75 m
	Basin - Planning :	
	Debit	1 – 2
	Screening Speed	0,05-0,1 L/det/ m2
	Length	4,00 m
	Wide	2,00 m
	Height	2,00 m
	Gravel	0,30 m
	Sand	0,30 m
	Other	
	Pipe moniflod	PVC 3 inchs
	Pipe underdrain	PVC 3 inchs
	Receptacle	
	- Planning :	
	Relocation Time	1 hour
	- Dimension :	
	Length	0,80 m
	Wide	2,00 m
	Height	2,00 m

- Analysis of effective in processing water quality with comparison laboratorial result before and after flowing in model. Acid rain in industrial complex could reduced by model with completely zeolite layer around 1 m in height.

Table 2. Comparison laboratory result of water quality

No.	Parameter	Set of	Comparison		Difference	Percentage
			Before	After		
1	Temperature	oC	-	-		
2	Color	Unit Pt Co	12.4	3.4	9	73%
3	Turbidity	NTU	14.4	1.4	13	90%
4	Solid substance	mg/L	96	10	86	90%
5	DHL		-			
	CHEMISTRY					
6	pH	-	6.1	6.3	-0.2	3%
7	Kesadahan (CaCO3)	mg/L	50	8.6	41.4	83%
8	Iron (Fe)	mg/L	<0.008	<0,008		
9	Manganese (Mn)	mg/L	<0.007	<0,007		
10	Copper (Cu)	mg/L	<0.016	<0,016		
11	Zinc (Zn)	mg/L	0.185	0.107	0.078	42%
12	Chrome VI (Cr)	mg/L	<0.002	<0,002		
13	Kadmiun (Cd)	mg/L	<0.004	<0,004		
14	Lead (Pb)	mg/L	<0.021	<0,021		
15	Fluorida (F)	mg/L	0,04	0.058		
16	Chloride (Cl)	mg/L	6.8	1	5.8	85%
17	Sulphate (SO4)	mg/L	6.6	3.1	3.5	53%
18	Nitrate (NO3-N)	mg/L	1.06	0.33	0.73	69%
19	Niitrit (NO2-N)	mg/L	0.15	<0,002		
20	Compound Active Birumeliten	mg/L	<0,02	<0,02		
21	Value Permanganat (KMnO4)	mg/L	7.45	6.7	0.75	10%

- Effectively groundwater recharge by comparison between calculation follow equation from Todd, 1980 and actual (monitoring)

Table 3. Comparison result of groundwater head

2010	Groundwater head (m bmt)		difference
	actual	analytic	
JANUARY	-32.50	-32.50	0.00
FEBRUARY	-32.50	-32.50	0.00
MARCH	-32.47	-32.47	0.00
APRIL	-32.37	-32.19	-0.18
MAY	-32.00	-32.01	0.01
JUNE	-31.67	-31.97	0.30

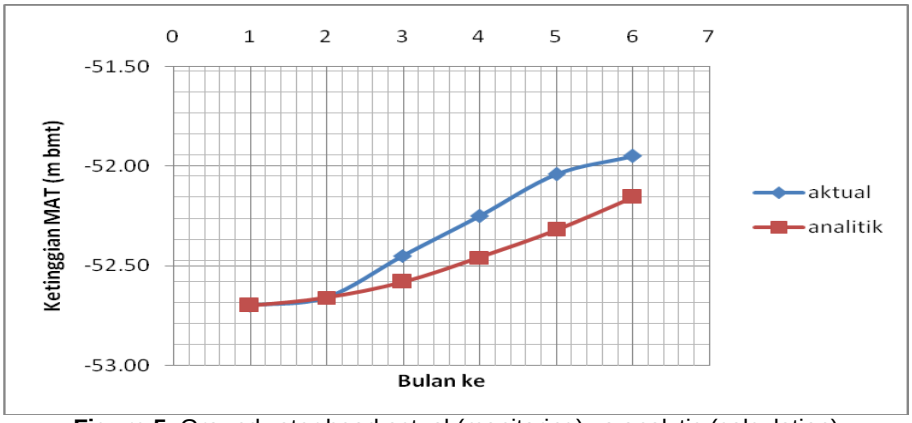


Figure 5. Groundwater head actual (monitoring) vs analytic (calculation)

- From result of monitoring groundwater head range January-June 2010 got profile tend to improvement. Profile of change, got trend pattern follows equation depth to time follows m (y) = 0.164 (month (x)) – 32.82.

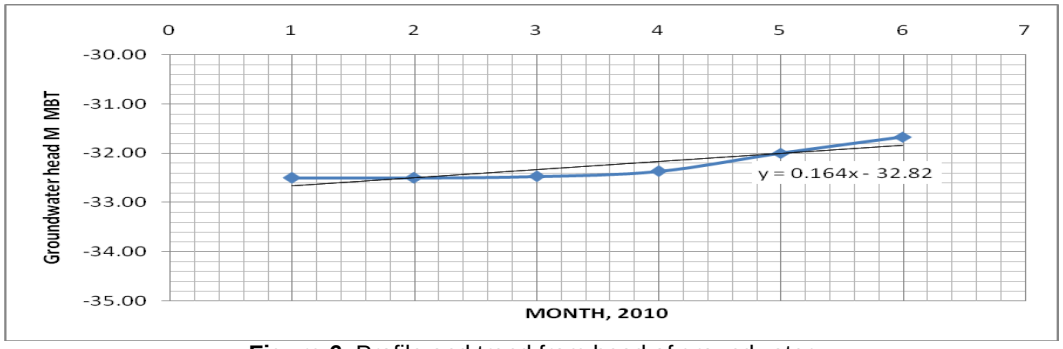


Figure 6. Profile and trend from head of groundwater

- At this phase, had be calculated potency surface water that could into recharge for conservation mainly region at Rancaekek, Cimahi and Dayeuhkolot. With data of industrial roof from Goolgle Earth Map, 2009, predicted wide capture in those are has 24.745.157 m^2. From annual rain assumption 2000 mm, with coefficient assumption runoff roof 0.9, so get potential 1.43 around 1432 L/s and estimate number recharge well need Rancaekek 141 wells, Cimahi 114 wells and Dayuehkolot 31 wells (also see capacity of recharge test as before)

Figure 7. Google Earth Map of Industrial area at Rancaekek, Cimahi and Dayeuhkolot

CONCLUSION AND SUGGESTION

1. Survey in order to dry wells identification that non productive has been conducted in industry area in area Rancaekek, sub-province Sumedang, Dayeuhkolot, sub-province Bandung and Leuwigajah, Cimahi, those all potential to be recharge wells.
2. By recharge test, example in Rancaeke area with redevelop dry well had rate of capacity recharge arround 2-3 L/s.
3. Base result and evaluation of rain quality of indutrial roof is acid rain, so before to recharge that need passed by filtesand pprosed combine wtih zeolite layer.
4. From result of monitoring groundwater head range January-June 2010 got profile tend to improvement as suit with calculation.
5. At Bandung basin had potency surface water that could into recharge for conservation mainly at region are Rancaekek, Cimahi and Dayeuhkolot.

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