**Lampiran 1.** Sampel air sumur bor dan sumur gali

**Sumur bor**

****

****

**Sumur gali**

**Lampiran 2**. Bagan kerja penentuan kesadahan total

50 ml sampel air sumur gali atau sumur bor di dalam labu Erlenmeyer

Ditambahkan 1 ml NaOH 4N sampai pH 10 dan ditambahkan 5 ml buffer salmaniak

Sampel air sumur gali atau sumur bor yang telah di buffer pH 10

Ditambahkan indikator eriokrom

menghasilkan warna merah anggur

Larutan berwarna merah anggur

Dititrasi dengan larutan Na-EDTA 0,01M

Larutan berwarna biru

Dicatat volume titrasi

Dihitung kesadahan total

Diperoleh data

**Lampiran 3.** Perhitungan pembakuan larutan Na-EDTA

1. Pembuatan Larutan Na-EDTA 0,01 M

BM Na-EDTA = 372, 24

Molaritas (M) =

0,01 M =

Bobot Na-EDTA yang ditimbang = 0,01 x 372,24 = 3.7224 g

Ditimbang 3.7224 g Na-EDTA dilarutkan dengan akuades sampai 1 liter

2. Pembuatan Larutan Zink sulfat 0,01 M

BM ZnSO4 7H,0 =287,54

Molaritas (M) =

Dibuat sebanyak 100 ml

0,01 M=

Bobot yang ditimbang = 0,01 M x 287.54 g/mol xg

Ditimbang 0,2875g Zink sulfat dilarutkan dengan akuades sampai 100 ml

Molaritas Zink sulfat=

3. Pembakuan Larutan Na-EDTA

Rumus perhitungan: V1x M1 = V2 x M2

Molaritas ZnSO4 = 0.0100 M

Volume ZnSO4 = 10,00 ml

Volume Na- - EDTA:

VI = 10,30 ml ; V2 = 10,35 ml ; V3 = 10,30 ml

Volume. rata-rata Na-EDTA= 10,32 ml

Molaritas Na- EDTA = 0,0097 M

**Lampiran 4.** Contoh perhitungan kesadahan di dalam sampel

Diambil contoh dari sumur gali 2, diperoleh data sebagai berikut :

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Volume Sampel  (ml) | Normalitas Na EDTA (N) | Volume  Na EDTA pada titrasi total (ml) | Volume  Na EDTA pada titrasi partial (ml) |
| 1. | 50 | 0,0097 | 9,15 | 6,50 |
| 2. | 50 | 0,0097 | 9,20 | 6,30 |
| 3. | 50 | 0,0097 | 9,15 | 6,30 |
| 4. | 50 | 0,0097 | 9,20 | 6,40 |
| 5. | 50 | 0,0097 | 9,30 | 6,50 |
| 6. | 50 | 0,0097 | 9,20 | 6,50 |

1. Kesadahan total
2. Kesadahan Partial (Kalsium)
3. Kesadahan Partial (Magnesium)

Dengan cara yang sama dihitung untuk sampel lainnya, data dan hasil perhitungan selengkapnya dapat dilihat pada lampiran 6

**Lampiran 5.**Contoh perhitungan standar deviasi kesadahan

Sebagai contoh diambil data dari sampel air sumur gali 2

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Kesadahan total  (mg/liter) () |  |  |
| 1. | 177,51 | -0,8083 | 0,6534 |
| 2. | 178,48 | 0,1617 | 0,0261 |
| 3. | 177,51 | -0,8083 | 0,6534 |
| 4. | 178,48 | 0,1617 | 0,0261 |
| 5. | 179,45 | 1,1317 | 1,2807 |
| 6. | 178,48 | 0,1617 | 0,0261 |
| N = 6 | ∑ X = 1070,91  =178,32 | ∑ = 2,6659 | |

St.deviasi (SD) === 0,73

Dasar penolakan data adalah apabila t hitung > t tabel dengan tingkat kepercayaan 99,99%, α = 0,01 : n=6, dk = 5 dan t tabel = 4,032

1. thitung == 2,71

2. thitung == 0,54

3. thitung == 2,71

4. thitung == 0,54

5. thitung == 3,80

6. thitung == 0,54

Seluruh t hitung yang diperoleh dari ke-6 perlakuan < t tabel , berarti semua data ini bisa diterima.

Menghitung kesadahan total sebenarnya :

Kesadahan total rata-rata = 178,48 mg/liter

Standar deviasi = 1,06

Kesadahan total sebenarnya = ± t (1-1/2α dk) ᵡ

Kesadahan total sebenarnya = ± t (1-1/2α dk) ᵡ

Kesadahan total sebenarnya = 178,48 ± 4,032 ᵡ

Kesadahan total sebenarnya = ( 126,48 ± 1,05) mg/liter

Dengan cara yang sama dihitung untuk sampel lainnya, data dan hasil perhitungan selengkapnya dapat dilihat pada lampiran 6

**Lampiran 6.** Data hasil perhitungan kesadahan dari sampel air

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sampel | | Volume Sampel  (ml) | | Kesadahan Total | | | | | | Kesadahan Partial Kalsium | | | Partial Sebagai Magnesium (mg/l) | |
| Volume  Na-EDTA (ml) | | Normalitas  Na-EDTA  (N) | | Kesadahan Total Sebagai CaCO3 (mg/l) | | Volume Na-EDTA (ml) | | Partial Sebagai Kalsium (mg/l) |
| Sumur gali  1 | | 50,00 | | 26,65 | | 0,0097 | | 517,01 | | 21,50 | | 166,84 | 23,98 | |
| 26,60 | | 0,0097 | | 516,04 | | 22,00 | | 170,72 | 21,42 | |
| 26,55 | | 0,0097 | | 515,07 | | 21,50 | | 166,84 | 23,51 | |
| 26,50 | | 0,0097 | | 514,10 | | 22,00 | | 170,72 | 20,95 | |
| 26,55 | | 0,0097 | | 515,07 | | 21,50 | | 166,84 | 23,51 | |
| 26,65 | | 0,0097 | | 517,01 | | 21,50 | | 166,84 | 23,98 | |
|  | | Kesadahan total rata-rata = 515,72 mg/liter  Standar deviasi = 1,17  Kesadahan total sebenarnya = 515,72mg/liter ±1,93  Kesadahan kalsium rata-rata = 168,13mg/liter  Standar deviasi = 2,00  Kesadahan kalsium sebenarnya = 168,13 mg/liter ±3,30  Kesadahan magnesium rata-rata = 22,89mg/liter  Standar deviasi = 1,35  Kesadahan magnesium sebenarnya = 22,89mg/liter ±2,22 | | | | | | | | | | | | |
| Sumur gali  2 | | 50,00 | | 9,15 | | 0,0097 | | 177,51 | | 6,50 | | 50,44 | 12,34 | |
| 9,20 | | 0,0097 | | 178,48 | | 6,30 | | 48,89 | 13,50 | |
| 9,15 | | 0,0097 | | 177,51 | | 6,30 | | 48,89 | 13,27 | |
| 9,20 | | 0,0097 | | 178,48 | | 6,40 | | 49,66 | 13,04 | |
| 9,30 | | 0,0097 | | 180,42 | | 6,50 | | 50,44 | 13,04 | |
| 9,20 | | 0,0097 | | 178,48 | | 6,50 | | 50,44 | 12,57 | |
|  | | Kesadahan total rata-rata = 178,32 mg/liter  Standar deviasi = 0,73  Kesadahan total sebenarnya = 178,32 ± 1,20 mg/liter  Kesadahan kalsium rata-rata = 49,79 mg/liter  Standar deviasi = 0,76  Kesadahan kalsium sebenarnya = 49,79 ± 1,26 mg/liter  Kesadahan magnesium rata-rata = 12,92 mg/liter  Standar deviasi = 0,44  Kesadahan magnesium sebenarnya = 12,92 ± 0,72 mg/liter | | | | | | | | | | | | |
| Sumur gali  3 | 50,00 | | 11,65 | | 0,0097 | | 153,26 | | 3,30 | | 25,61 | | | 21,42 |
| 11,70 | | 0,0097 | | 151,32 | | 3,00 | | 23,28 | | | 22,35 |
| 11,55 | | 0,0097 | | 149,38 | | 3,00 | | 23,28 | | | 21,88 |
| 11,60 | | 0,0097 | | 153,26 | | 3,30 | | 25,61 | | | 21,42 |
| 11,65 | | 0,0097 | | 153,26 | | 3,20 | | 24,83 | | | 21,88 |
| 11,70 | | 0,0097 | | 151,32 | | 3,10 | | 24,06 | | | 21,88 |
| Kesadahan total rata-rata = 151,97 mg/liter  Standar deviasi = 1,58  Kesadahan total sebenarnya = 151,97 ± 2,61 mg/liter  Kesadahan kalsium rata-rata = 24,44 mg/liter  Standar deviasi = 0,63  Kesadahan kalsium sebenarnya = 24,44 ± 1,76 mg/liter  Kesadahan magnesium rata-rata = 21,81 mg/liter  Standar deviasi = 0,35  Kesadahan magnesium sebenarnya = 21,81 ± 0,58 mg/liter | | | | | | | | | | | | | | |

**Lampiran 6**. Data hasil perhitungan kesadahan dari sampel air (sambungan)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sumur gali  4 | 50,00 | 9,15 | 0,0097 | | 82,45 | | 3,50 | 27,16 | | 3,49 | |
| 9,20 | 0,0097 | | 83,42 | | 3,50 | 27,16 | | 3,72 | |
| 9,15 | 0,0097 | | 81,48 | | 3,70 | 28,71 | | 2,33 | |
| 9,20 | 0,0097 | | 83,42 | | 3,60 | 27,94 | | 3,26 | |
| 9,30 | 0,0097 | | 80,51 | | 3,70 | 28,71 | | 2,10 | |
| 9,20 | 0,0097 | | 81,48 | | 3,60 | 27,94 | | 2,79 | |
|  | Kesadahan total rata-rata = 82,13 mg/liter  Standar deviasi = 1,17  Kesadahan total sebenarnya = 82,13 ± 1,93 mg/liter  Kesadahan kalsium rata-rata = 27,94 mg/liter  Standar deviasi = 0,69  Kesadahan kalsium sebenarnya = 27,94 ± 1,14 mg/liter  Kesadahan magnesium rata-rata = 2,95 mg/liter  Standar deviasi = 0,65  Kesadahan magnesium sebenarnya = 2,95 ± 0,89 mg/liter | | | | | | | | | | |
| Sumur gali  5 | 50,00 | 11,65 | 0,0097 | 162,96 | | 4,00 | | | 31,04 | | 20,49 |
| 11,70 | 0,0097 | 161,99 | | 3,80 | | | 29,49 | | 21,18 |
| 11,55 | 0,0097 | 162,96 | | 3,90 | | | 30,26 | | 20,95 |
| 11,60 | 0,0097 | 164,90 | | 4,00 | | | 31,04 | | 20,95 |
| 11,65 | 0,0097 | 164,90 | | 3,80 | | | 29,49 | | 21,88 |
| 11,70 | 0,0097 | 162,96 | | 3,90 | | | 30,26 | | 20,95 |
|  | Kesadahan total rata-rata = 163,45 mg/liter  Standar deviasi = 1,19  Kesadahan total sebenarnya = 163,45 ± 1,96 mg/liter  Kesadahan kalsium rata-rata = 36,26 mg/liter  Standar deviasi = 0,69  Kesadahan kalsium sebenarnya = 36,26 ± 1,14 mg/liter  Kesadahan magnesium rata-rata = 21,07 mg/liter  Standar deviasi = 0,46  Kesadahan magnesium sebenarnya = 21,07 ± 0,76 mg/liter | | | | | | | | | | |
| Sumur bor  1 | 50,00 | 9,15 | 0,0097 | 77,60 | | 3,50 | | | 27,16 | | 2,33 |
| 9,20 | 0,0097 | 77,60 | | 3,60 | | | 27,94 | | 1,86 |
| 9,15 | 0,0097 | 81,48 | | 3,40 | | | 26,38 | | 3,72 |
| 9,20 | 0,0097 | 79,54 | | 3,70 | | | 28,71 | | 1,86 |
| 9,30 | 0,0097 | 81,48 | | 3,50 | | | 27,16 | | 3,26 |
| 9,20 | 0,0097 | 79,54 | | 3,60 | | | 27,94 | | 2,33 |
|  | Kesadahan total rata-rata = 76,54 mg/liter  Standar deviasi = 1,74  Kesadahan total sebenarnya = 76,54 ± 2,86 mg/liter  Kesadahan kalsium rata-rata = 27,55 mg/liter  Standar deviasi = 0,81  Kesadahan kalsium sebenarnya = 27,55 ± 1,34 mg/liter  Kesadahan magnesium rata-rata = 2,56 mg/liter  Standar deviasi = 0,77  Kesadahan magnesium sebenarnya = 2,56 ± 0,96 mg/liter | | | | | | | | | | |

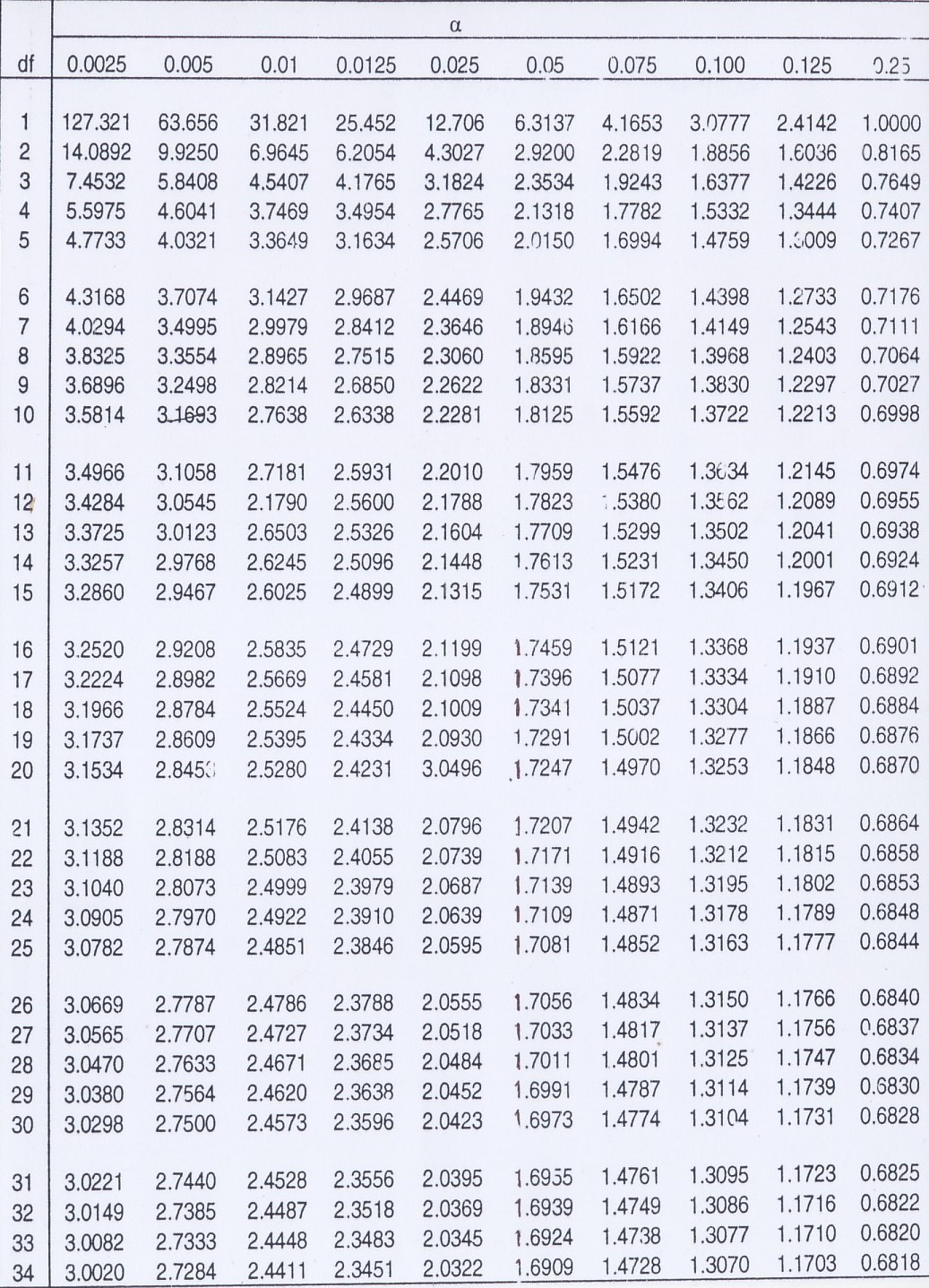
**Lampiran 6**. Data hasil perhitungan kesadahan dari sampel air (sambungan)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sumur bor  2 | 50,00 | 11,65 | 0,0097 | 112,52 | 4,70 | 36,47 | 5,12 |
| 11,70 | 0,0097 | 116,40 | 4,60 | 35,70 | 6,52 |
| 11,55 | 0,0097 | 114,46 | 4,50 | 34,92 | 6,52 |
| 11,60 | 0,0097 | 112,52 | 4,60 | 35,70 | 5,59 |
| 11,65 | 0,0097 | 114,46 | 4,60 | 35,70 | 6,05 |
| 11,70 | 0,0097 | 114,46 | 4,70 | 36,47 | 5,59 |
|  | Kesadahan total rata-rata = 114,14 mg/liter  Standar deviasi = 1,46  Kesadahan total sebenarnya = 114,14 ± 2,40 mg/liter  Kesadahan kalsium rata-rata = 35,83 mg/liter  Standar deviasi = 0,58  Kesadahan kalsium sebenarnya = 35,83 ± 0,96 mg/liter  Kesadahan magnesium rata-rata = 5,90 mg/liter  Standar deviasi = 0,56  Kesadahan magnesium sebenarnya = 5,90 ± 0,93 mg/liter | | | | | | |
| Sumur bor  3 | 50,00 | 9,15 | 0,0097 | 147,44 | 5,50 | 42,68 | 9,78 |
| 9,20 | 0,0097 | 147,44 | 5,60 | 43,46 | 9,31 |
| 9,15 | 0,0097 | 145,50 | 5,80 | 45,01 | 7,92 |
| 9,20 | 0,0097 | 147,44 | 5,70 | 44,23 | 8,85 |
| 9,30 | 0,0097 | 147,44 | 5,60 | 43,46 | 9,31 |
| 9,20 | 0,0097 | 145,50 | 5,60 | 43,46 | 8,85 |
| Kesadahan total rata-rata = 146,79 mg/liter  Standar deviasi = 1,00  Kesadahan total sebenarnya = 146,79 ± 1,65 mg/liter  Kesadahan kalsium rata-rata = 43,71 mg/liter  Standar deviasi = 0,80  Kesadahan kalsium sebenarnya = 43,71 ± 1,32 mg/liter  Kesadahan magnesium rata-rata = 9,00 mg/liter  Standar deviasi = 0,64  Kesadahan magnesium sebenarnya = 9,00 ± 1,05 mg/liter | | | | | | | |

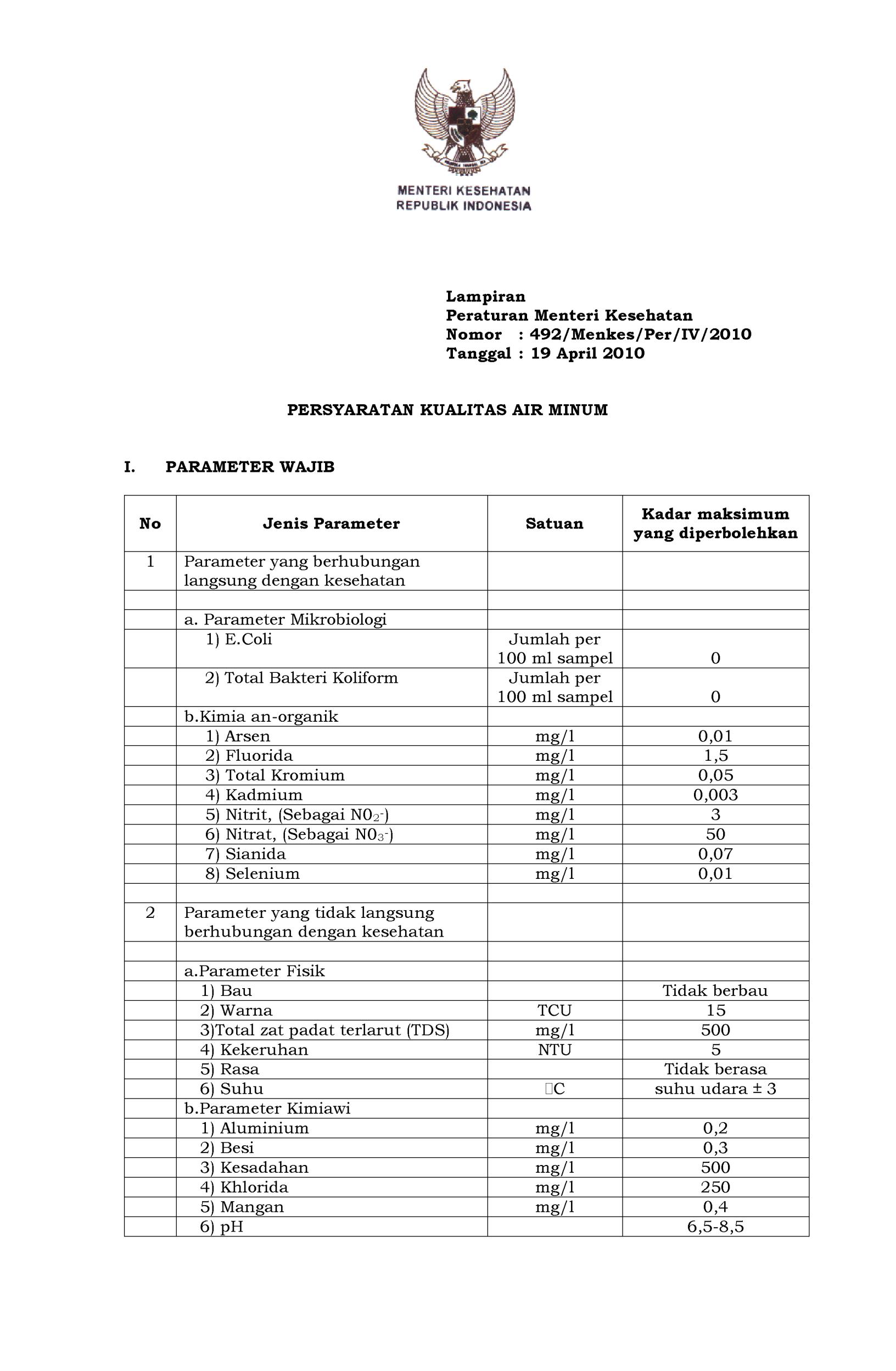
|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sumur bor  4 | 50,00 | 11,65 | 0,0097 | 87,30 | 3,50 | 27,16 | 4,66 |
| 11,70 | 0,0097 | 89,24 | 3,40 | 26,38 | 5,59 |
| 11,55 | 0,0097 | 87,30 | 3,50 | 27,16 | 4,66 |
| 11,60 | 0,0097 | 87,30 | 3,50 | 27,16 | 4,66 |
| 11,65 | 0,0097 | 89,24 | 3,60 | 27,94 | 4,66 |
| 11,70 | 0,0097 | 87,30 | 3,50 | 27,16 | 4,66 |
|  | Kesadahan total rata-rata = 87,95 mg/liter  Standar deviasi = 1,00  Kesadahan total sebenarnya = 87,95 ± 1,65 mg/liter  Kesadahan kalsium rata-rata = 27,16 mg/liter  Standar deviasi = 0,49  Kesadahan kalsium sebenarnya = 27,16 ± 0,81 mg/liter  Kesadahan magnesium rata-rata = 4,81 mg/liter  Standar deviasi = 0,38  Kesadahan magnesium sebenarnya = 4,81 ± 0,63 mg/liter | | | | | | |

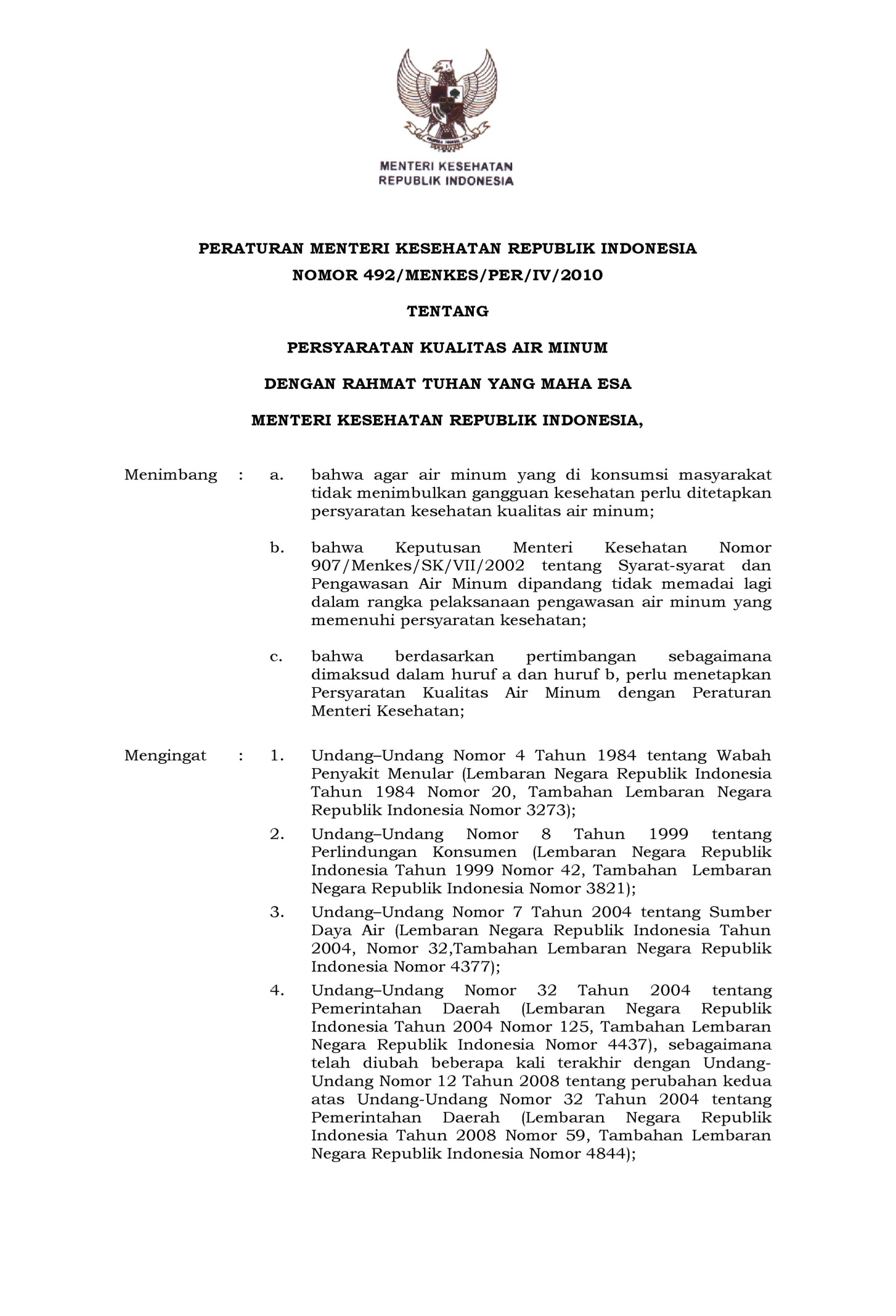
|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sumur bor  5 | 50,00 | 9,15 | 0,0097 | 69,84 | 2,60 | 20,18 | 4,66 |
| 9,20 | 0,0097 | 71,78 | 2,60 | 20,18 | 5,12 |
| 9,15 | 0,0097 | 71,78 | 2,70 | 20,95 | 4,66 |
| 9,20 | 0,0097 | 69,84 | 2,80 | 21,73 | 3,72 |
| 9,30 | 0,0097 | 73,72 | 2,70 | 20,95 | 5,12 |
| 9,20 | 0,0097 | 71,78 | 2,70 | 20,95 | 4,66 |
|  | Kesadahan total rata-rata = 71,46 mg/liter  Standar deviasi = 1,46  Kesadahan total sebenarnya = 71,46 ± 2,40 mg/liter  Kesadahan kalsium rata-rata = 20,82 mg/liter  Standar deviasi = 0,58  Kesadahan kalsium sebenarnya = 20,82 ± 0,96 mg/liter  Kesadahan magnesium rata-rata = 4,66 mg/liter  Standar deviasi = 0,51  Kesadahan magnesium sebenarnya = 4,66 ± 0,84 mg/liter | | | | | | |

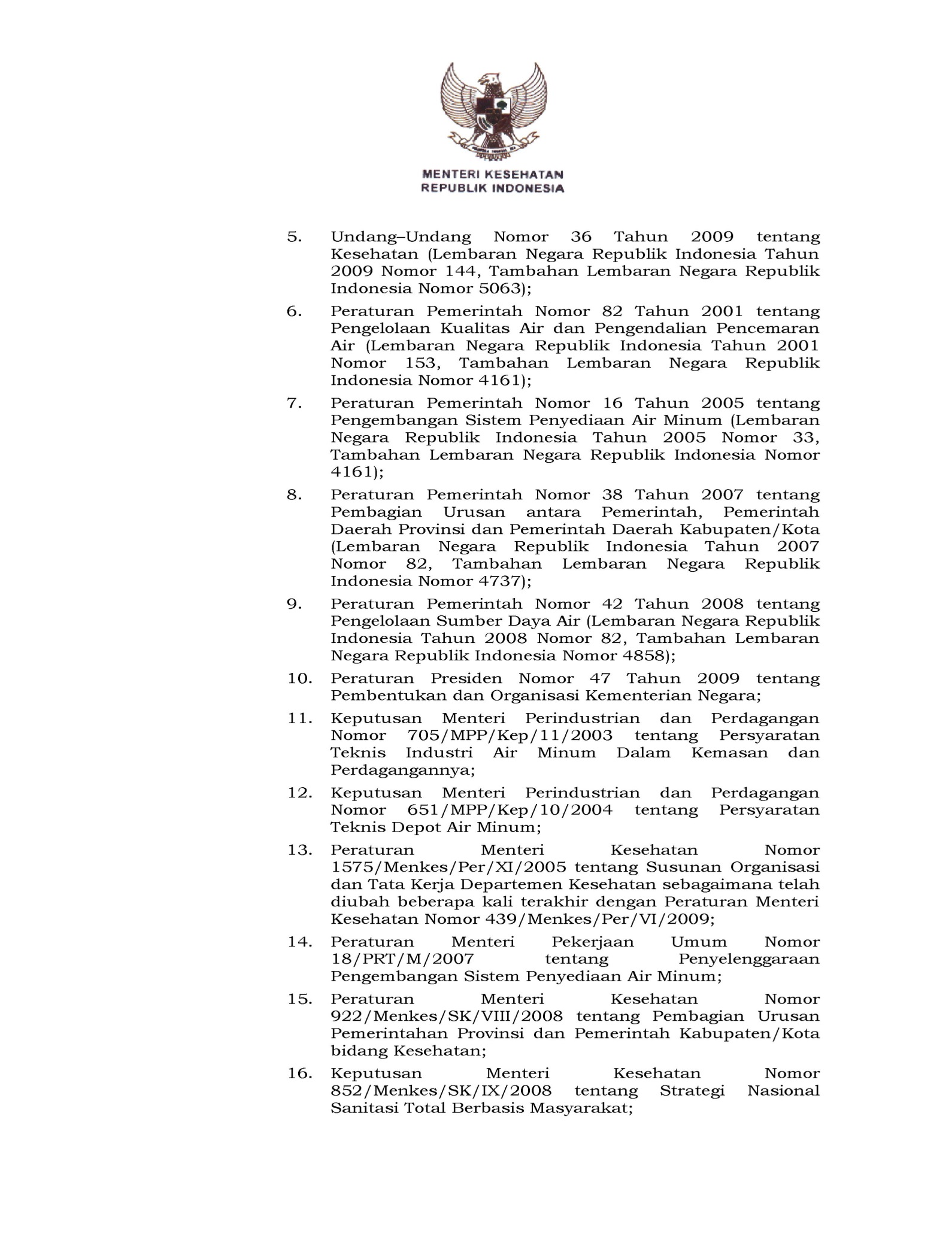
**Lampiran 7**. Data distribusi t

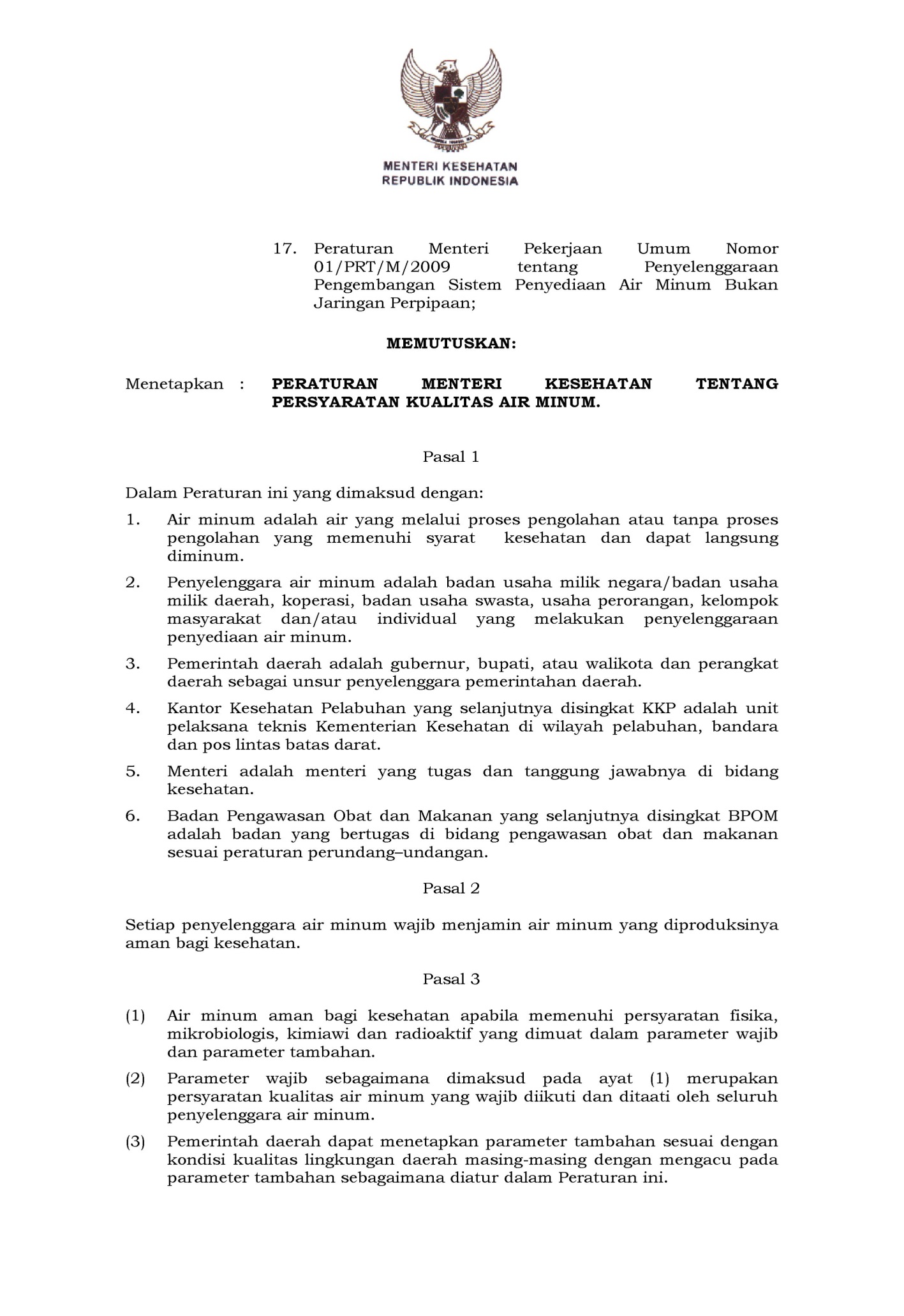


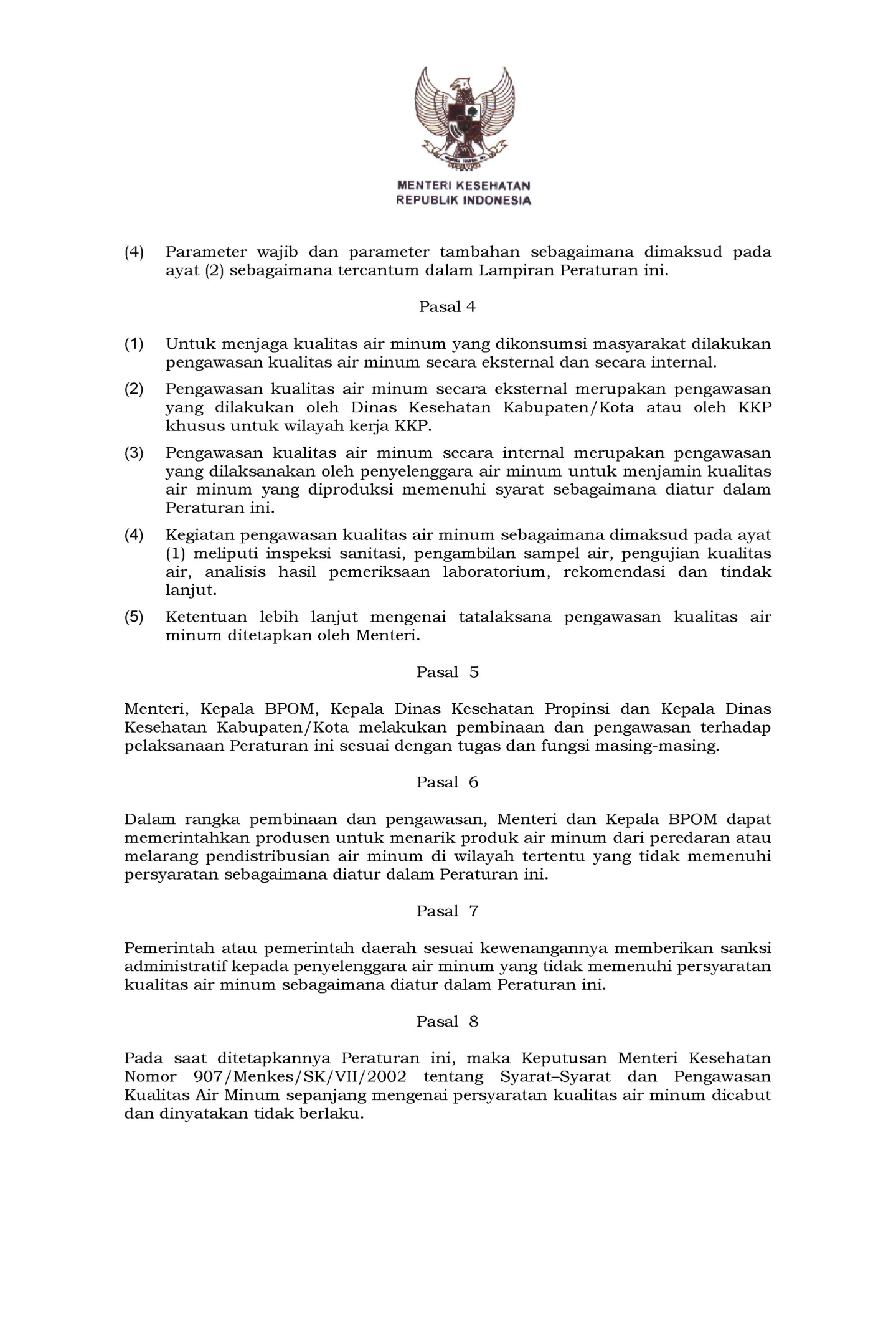
**Lampiran 8**. Persyaratan kualitas air minum PERMENKES no. 492 tahun 2010

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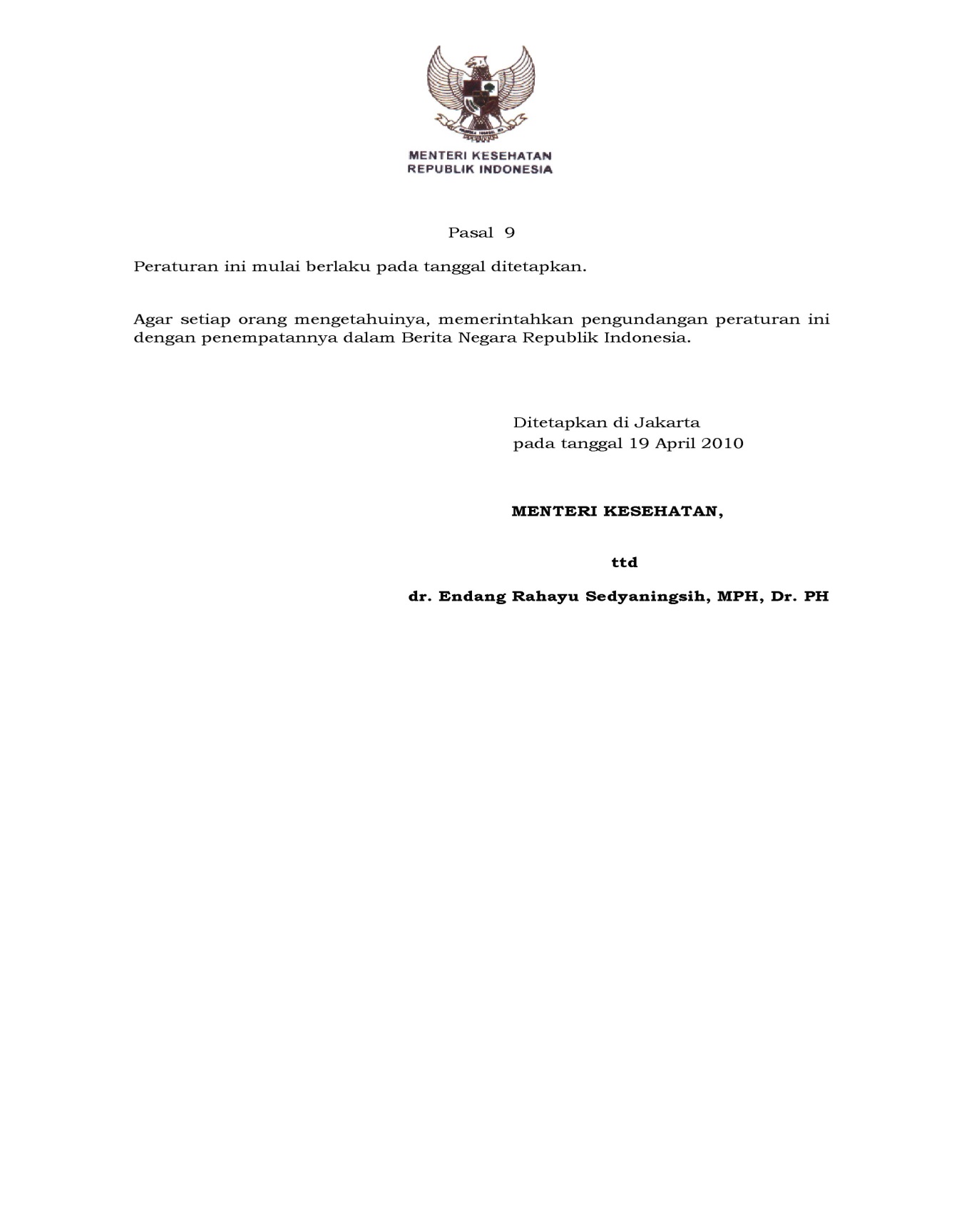
**Lampiran 9.** SK PERMENKES no.492 tahun 2010

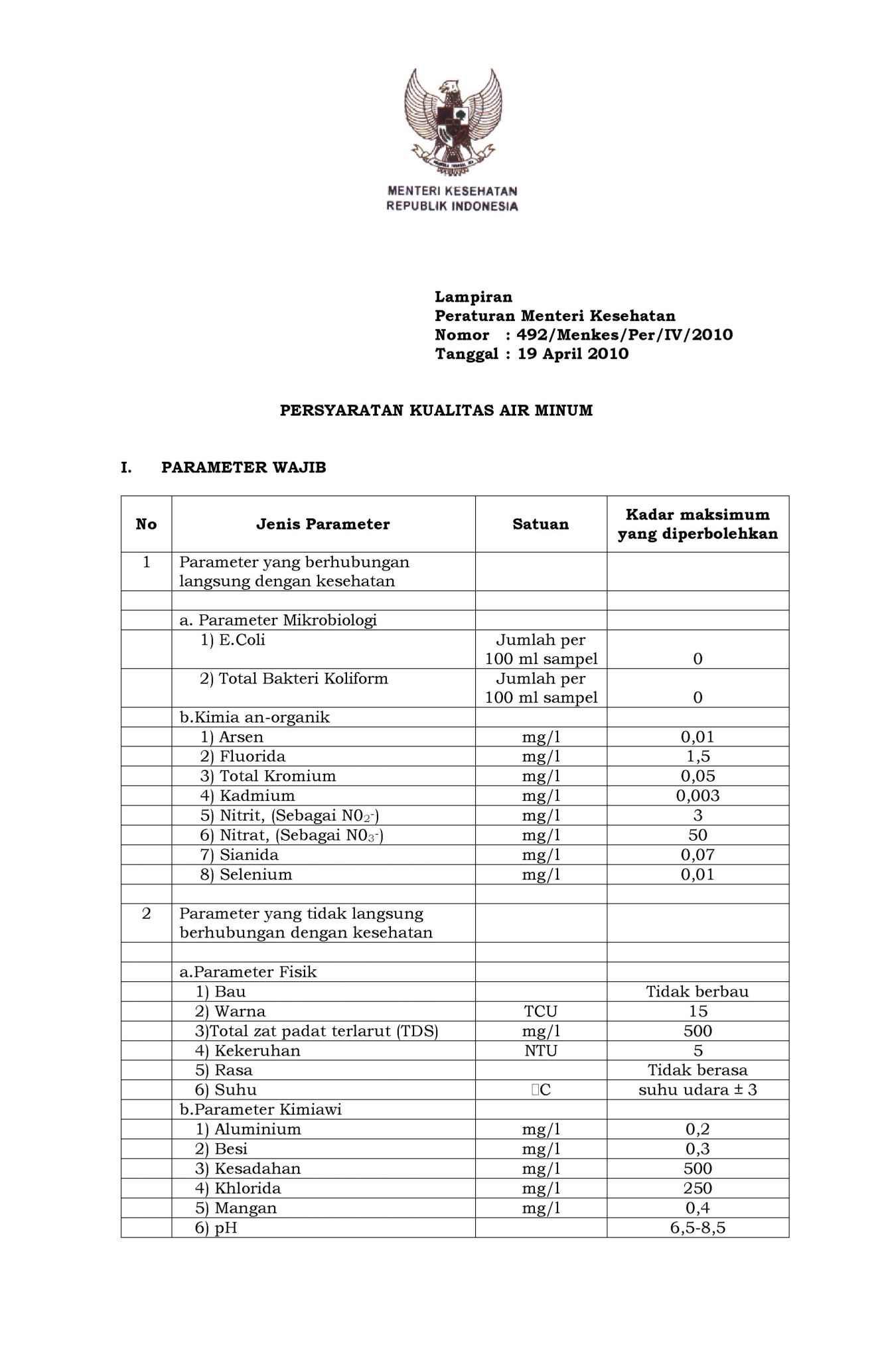
**Lampiran 9.** SK PERMENKES no.492 tahun 2010 (sambungan)

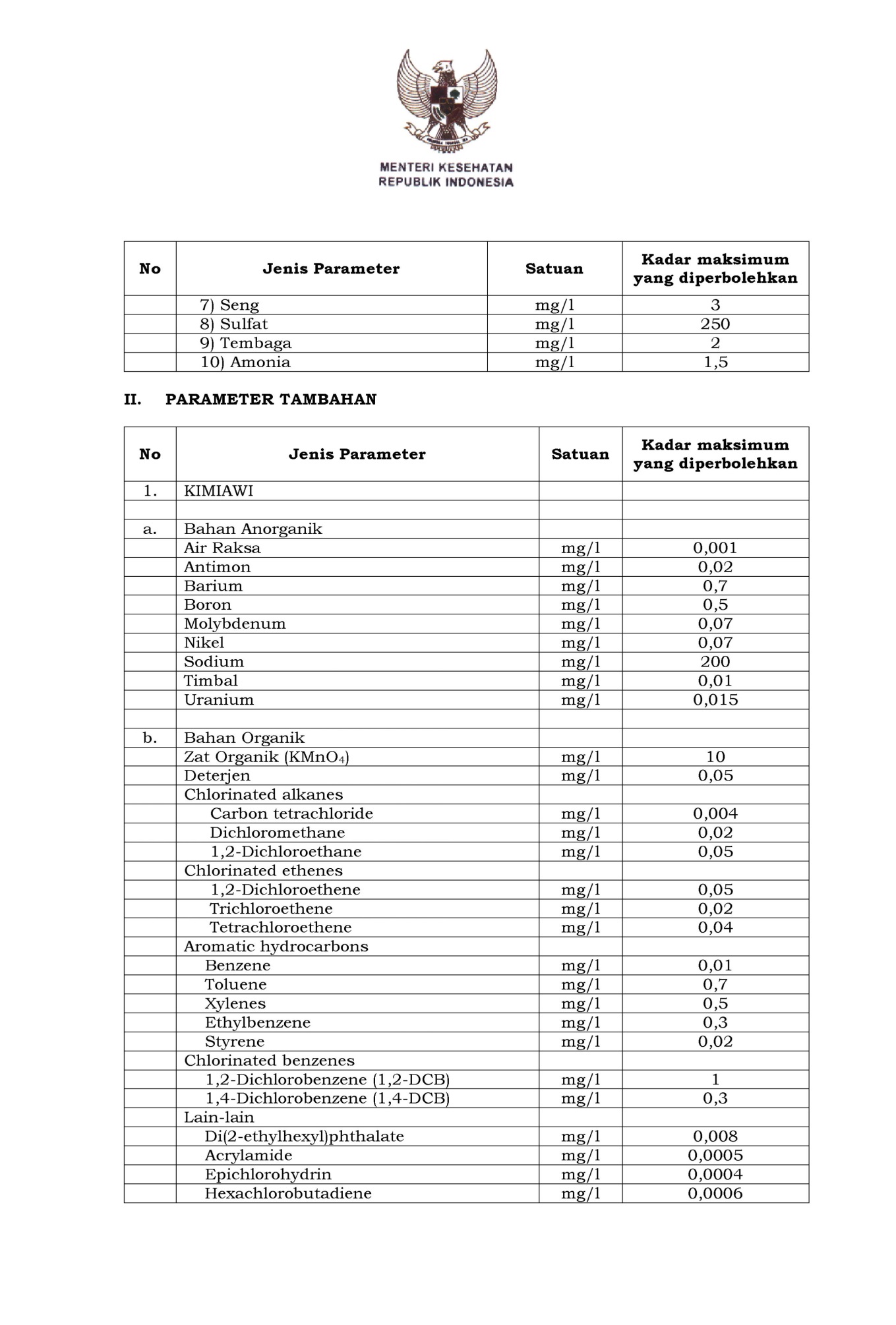
**Lampiran 9.** SK PERMENKES no.492 tahun 2010 (sambungan)

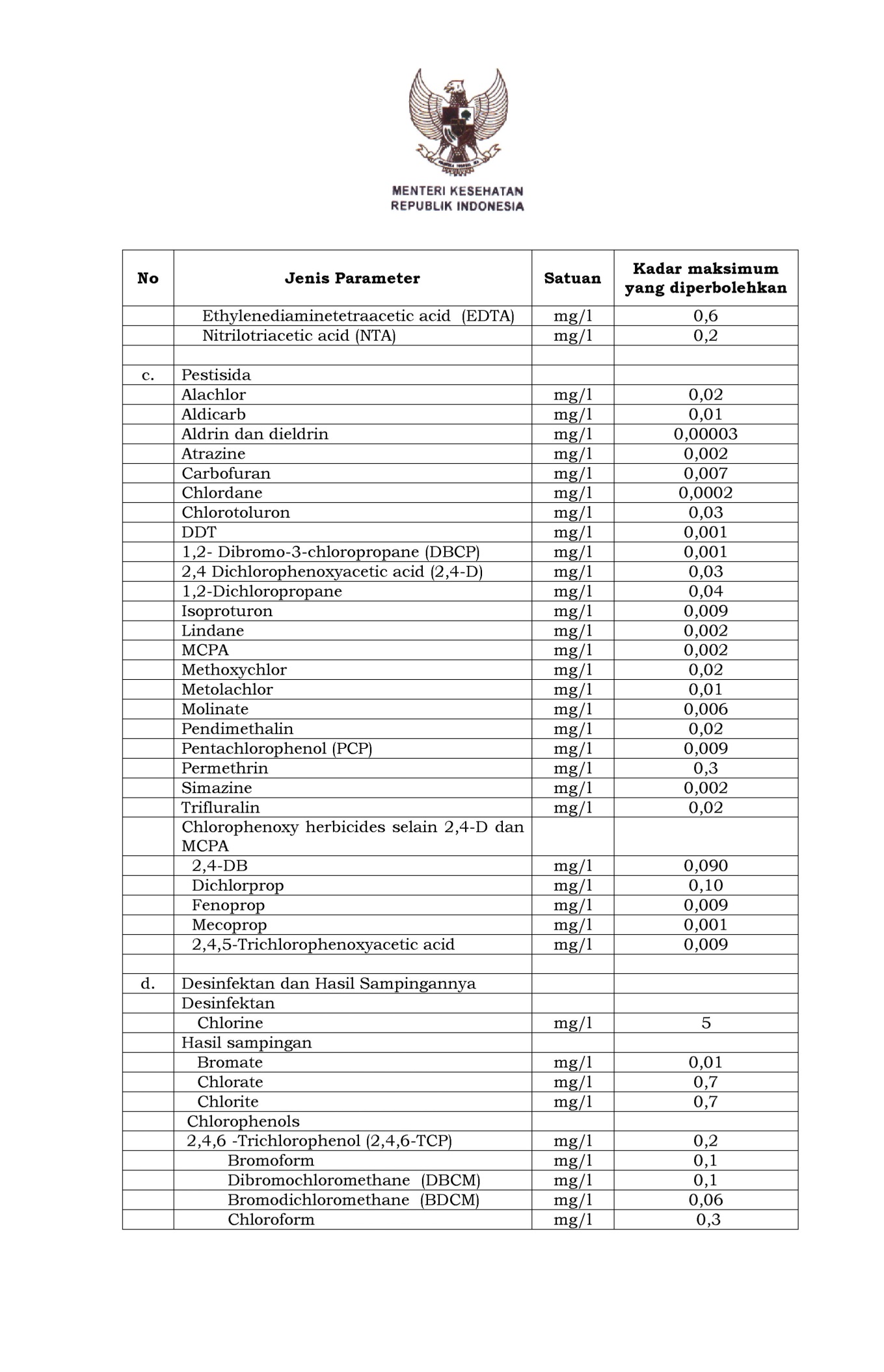
**Lampiran 9.** SK PERMENKES no.492 tahun 2010 (sambungan)

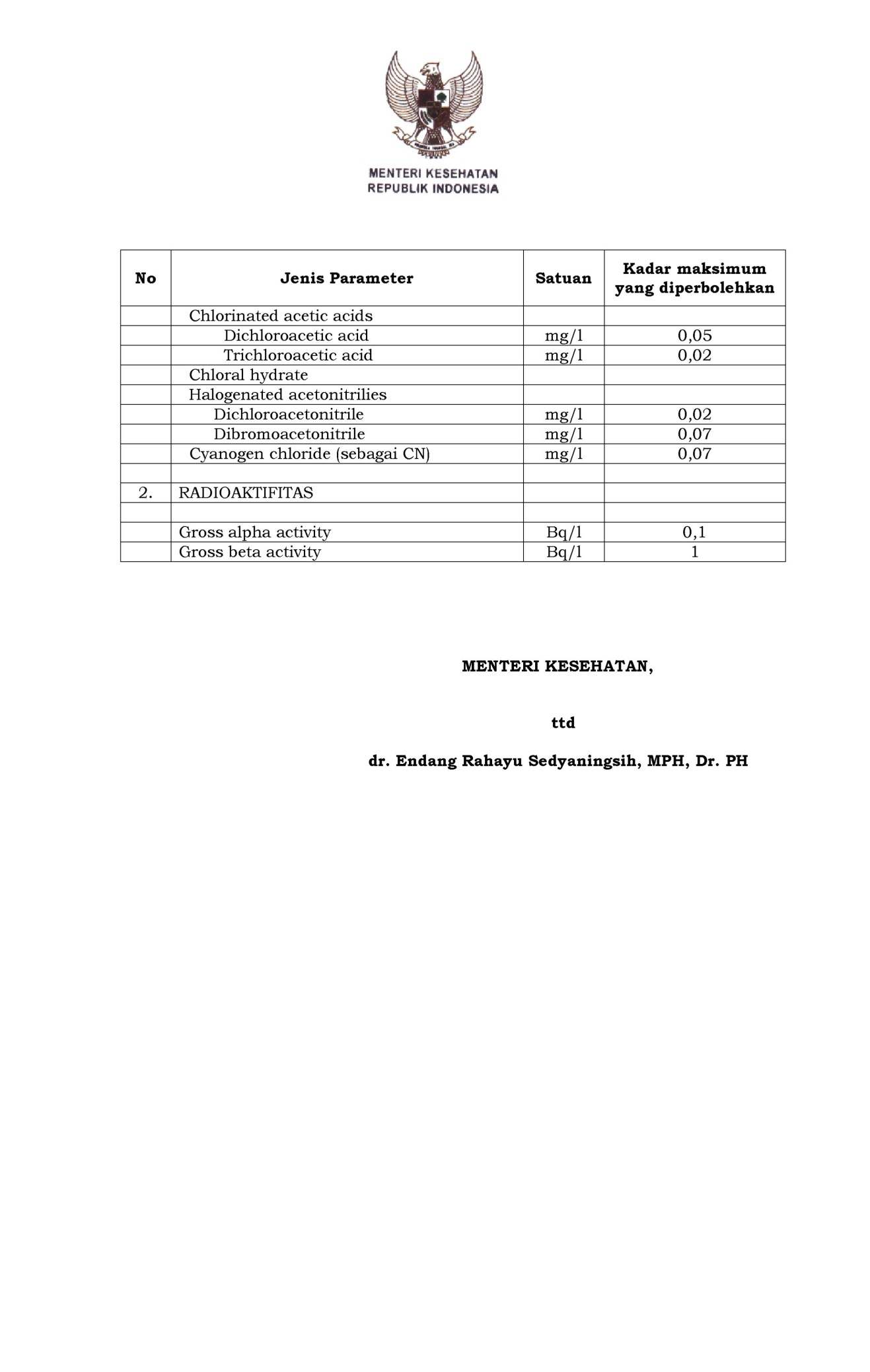
**Lampiran 9.** SK PERMENKES no.492 tahun 2010 (sambungan)



**Lampiran 9.** SK PERMENKES no.492 tahun 2010 (sambungan)

**Lampiran 9.** SK PERMENKES no.492 tahun 2010 (sambungan)

**Lampiran 9.** SK PERMENKES no.492 tahun 2010 (sambungan)

**Lampiran 9.** SK PERMENKES no.492 tahun 2010 (sambungan)