Table 12. LIST OF WATER QUALITY MONITORING STATION (WQMS) BY RIVER (1/2)

| River Name & WQCR No. | WQMS No. | River Name | Latitude | Longitude | Distance from River Mouth (km) | Remarks |
|---|---|---|---|---|---|---|
| Benut (1) | 1632601 | Benut | 1° 39' | 103° 15' | 8.44 | Benut |
| | 1833602 | Benut | 1° 49' | 103° 18' | 33.49 | Simp Rengam Pump House |
| | 1833603 | Ulu. Benut | 1° 51' | 103° 18' | 38.16 | Batu 56, Jln. Air Hitam |
| | 1832604 | Machap | 1° 52' | 103° 15' | 39.77 | Batu 58-1/4, Jln. Air Hitam |
| | 1833605 | - | 1° 48' | 103° 18' | 33.81 | Parit Haji Yasin |
| Pontian Besar (2) | 1534604 | Besar | 1° 34' | 103° 25' | 16.74 | Kg. Parit Kerinchi |
| | 1534605 | Ayer Hitam | 1° 35' | 103° 27' | 23.18 | Dekat Kg. Parit Kerinchi |
| | 1734614 | Besar | 1° 43' | 103° 27' | 38.80 | Batu 32-1/2, Bukit Batu Jln. Air Hitam |
| Pontian Kechil (3) | 1534603 | Kechil | 1° 32' | 103° 29' | 14.26 | Kg. Sawah |
| Skudai (5) | 1536601 | Skudai | 1° 35' | 103° 39' | 17.71 | Bekalan Air |
| | 1536602 | Skudai | 1° 36' | 103° 39' | 21.74 | Ladang Sena |
| | 1636601 | Skudai | 1° 38' | 103° 28' | 28.50 | Selang |
| | 1636603 | Skudai | 1° 36' | 103° 35' | 24.31 | Senai |
| | 1636605 | Skudai | 1° 38' | 103° 37' | 30.91 | Ladang Swee Lam |
| Skudai (5) | 1636606 | Skudai | 1° 39' | 103° 36' | 33.97 | Kulai |
| | 1636607 | Skudai | 1° 41' | 103° 34' | 38.80 | Sengkang |
| | 1735608 | Skudai | 1° 42' | 103° 31' | 45.00 | Sednak |
| Tebrau (6) | 1537609 | Tebrau | 1° 33' | 103° 45' | 9.82 | Kangka Tebrau |
| | 1537613 | Tebrau | 1° 34' | 103° 43.5' | 35.10 | Lembangan Tebrau |
| | 1636612 | Tebrau | 1° 38' | 103° 41' | 42.67 | Selang |
| Johor (7) | 1538601 | Tiram | 1° 34' | 103° 48' | 44.27 | Jamb ulu Tiram |
| | 1637602 | Tiram | 1° 38' | 103° 45' | 38.64 | Pekan ulu Tiram |
| | 1638611 | Berangan | 1° 41' | 103° 52' | 38.16 | Bukit 21, Jln. Kota Tinggi |
| | 1640601 | Temon | 1° 39' | 104° 01' | 31.39 | Felda Air Tawan |
| | 1737604 | Johor | 1° 43' | 103° 54' | 44.28 | Kota Tinggi |
| | 1737606 | Johor | 1° 45' | 103° 46' | 61.09 | Kg. Semangor |
| | 1737607 | Semangor | 1° 44' | 103° 42' | 69.71 | Bukit 10, Jln. Kulai Kota Tinggi |
| | 1834608 | Sayang | 1° 48' | 103° 31' | 99.34 | Ladang Sinora |
| | 1834609 | Sayang | 1° 49' | 103° 29' | 104.17 | Layang-Layang |

Table 13 LIST OF WATER QUALITY MONITORING STATION (WQMS) BY RIVER (2/2)

| River Name & WQCR No. | WQMS No. | River Name | Latitude | Longitude | Distance from River Mouth (km) | Remarks |
|---|---|---|---|---|---|---|
| Johor (7) | 1834610 | Sayang | 1° 53' | 103° 24' | 120.11 | Rengan |
| | 1835611 | Remis | 1° 48' | 103° 28' | 109.0 | Ulu Remis |
| | 1836601 | Sebol | 1° 50' | 103° 41' | 75.5 | Jln. Penggeli Timor |
| | 1836602 | Sayang | 1° 48' | 103° 40' | 78.09 | Jln. Kulai/Penggeli Timor |
| | 1836603 | Pengeli | 1° 49' | 103° 37' | 86.54 | Felda Inas |
| | 1837604 | Linggiu | 1° 50' | 103° 42' | 75.67 | Jln. Penggeli Timor |
| Sedili Besar (8) | 1839604 | Besar | 1° 52' | 103° 57' | 56.99 | Mawai |
| | 1839605 | Dohol | 1° 53' | 103° 55' | 66.98 | Bukit 40, Jln. Kota Tinggi Mersing |
| | 1840602 | Gembot | 1° 53' | 104° 03' | 21.25 | Jamb Sg. Gembot |
| | 2039606 | Besar | 2° 00' | 103° 54' | 61.18 | Ladang Ubi |
| | 2038608 | Besar | 2° 02' | 103° 52' | 92.09 | Bukit 52, Jln. Kota Tinggi Mersing |
| | 2138611 | Ambat | 2° 11' | 103° 52' | 111.25 | Bukit 63, Jln. Kota Tinggi Mersing |

Table 14 INVENTORY OF PURIFICATION SYSTEM FOR RUBBER PROCESSING

| Code No. | Name of Factory | River Name | Type of Production | Actual Production (ton/d) | Purification System | Quantity of Effluent ($m^3$/hr) | Treated Effluent (mg/l) BOD | SS |
|---|---|---|---|---|---|---|---|---|
| 1 | Tropical Products Co. (Pte) Ltd. | Pontian | SMR | 28.85 | Recycle & Anaerobic ponds | 1.52 | 43 | 69 |
| 2 | Sykt. Lai Hup Seng Rubber Factory Sdn. Bhd. | Pulai | Remilles Crepe | 4.84 | Recycle | - | - | - |
| 3 | Lam Leong Rubber Co. Sdn. Bhd. | Pontian | RSS | 7.76 | Anaerobic and facultative ponds | 0.25 | 62.7 | 85 |
| 4 | Hiap Heng Trading Co. Sdn. Bhd. | | Remilles Crepe | * | Anaerobic and facultative ponds | *12.0 | *75 | *300 |
| 5 | Lee Rubber Co. (Pte) Ltd. | | RSS | 11.0 | Anaerobic and facultative ponds | * 0.72 | 190 | 25 |
| 6 | Mardec Kulai Factory | Skudai | SMR & Latex | 28.6 | Anaerobic and facultative ponds | 51.0 | 800 | 335 |
| 7 | Chip Hong Rubber | Skudai | SMR | - | Data Not Available | - | - | - |
| 8 | Seng Cheong Rubber Co. Sdn. Bhd. | Skudai | SMR | * | *Anaerobic Pond | *26.2 | *83 | - |
| 9 | Foh Cheong SMR Factory | Skudai | SMR | 4.0 | Anaerobic and facultative ponds | 3.55 | 47.5 | 116 |
| 10 | Ladang Kulai Besar | Skudai | ADS | 4.0 | Anaerobic and facultative ponds | *38.4 | *200 | *146 |
| 11 | Lee Plantation (Pte) Ltd. | Skudai | Latex & Crepe | 11.66 | Anaerobic and facultative ponds | 8.42 | 27 | 75 |
| 12 | Lee Rubber Co. (Pte) Ltd. | Skudai | SMR | 28.21 | Anaerobic and facultative ponds | 29.3 | 32 | 25 |
| 13 | Lee Latex (Pte) Ltd. | | Latex | * | Data Not Available | *27.7 | *1,953 | *220 |
| 14 | Ladang Tebrau Majidee | Tebrau | Latex | - | *Biological Ponding System | * 9.3 | *200 | *92 |
| 15 | Tropical Produce Co. (Pte) Ltd. | | Latex | 28.0 | Anaerobic and facultative ponds | 231.0 | 1,530 | 320 |
| 16 | Ulu Tiram Rubber Factory | Johor | Latex | 18.46 | Anaerobic and facultative ponds | 11.25 | 34 | 80 |
| 17 | Tai Tak SMR Factory | | SMR | 2.75 | Anaerobic and facultative ponds | 3.27 | 48 | 100 |
| 18 | Kilang Getah felda | | SMR | - | Anaerobic and facultative ponds | - | - | - |
| 19 | Keck Seng (M) Sdn. Bhd. | | SMR | * | *Biological Ponding | *93.5 | *200 | *250 |
| 20 | Teluk Senggat SMR Factory | | SMR | * | *Biological Ponding | *19.3 | *158 | *140 |

* Information carried out by DOE in 1982.

Table 15 INVENTORY OF PURIFICATION SYSTEM FOR PALM OIL PROCESSING

| Code No. | Name of Factory | River Name | Actual Production (ton/hr) | Purification System | Quantity of Effluent ($m^3$/hr) | Treated Effluent (mg/l) BOD | SS |
|---|---|---|---|---|---|---|---|
| 1 | Southern Palm Oil Mill | Benut | 5.65 | Land disposal | 12.28 | 120 | 250 |
| 2 | KKS Kulai, Benta Plantation | Pontian | 8.0 | Land disposal | 10.0 | 237 | 2,609 |
| 3 | Yule Catto Palm Oil Mill | Skudai | 6.0 | Land disposal | 12.0 | 650 | 3,500 |
| 4 | Fraser Palm Oil Mill | Skudai | 6.0 | Land disposal | 20.0 | 117 | 245 |
| 5 | Kulai Palm Oil Mill | Skudai | * | *Biological Treatment | *W;74.5 | *W;26,700 | *W;28,300 |
| 6 | South Johor Palm Oil Mill | Skudai | 2.58 | Land disposal | 12.0 | 80.2 | 130 |
| 7 | Kim Long Palm Oil Mill | Tebrau | 6.0 | Land disposal | 11.0 | 182 | 1,150 |
| 8 | Ulu Remis Palm Oil Mill | Johor | 11.4 | Land disposal | 23.65 | - | - |
| 9 | Felda Ulu Belitong (Propose) | Johor | - | - | - | - | - |
| 10 | Ulu Sebol Palm Oil Mill | Johor | 5.4 | Anaerobic and facultative ponds | 18.0 | 70.2 | 260 |
| 11 | Eng Wei Palm Oil Mill | Johor | 4.0 | Land disposal | 10.0 | 490 | 4,000 |
| 12 | Felda Penggeli Palm Oil Mill | Johor | 10.0 | Anaerobic and facultative ponds | 20.0 | 110 | 250 |
| 13 | Felda Taib Andak Palm Oil Mill | Johor | 6.48 | Anaerobic and facultative ponds | 14.0 | 100 | 200 |
| 14 | Felda Bukit Besar Palm Oil Mill | Johor | * | *Biological treatment | *W;164.0 | 62 | 200 |
| 15 | Kulim Malaysia Sdn. Bhd. | Johor | 9.0 | Land disposal | 10.0 | 237 | 2,609 |
| 16 | Tai Tak Palm Oil Mill | Johor | 9.0 | Anaerobic and facultative ponds | 6.3 | 30 | 136 |
| 17 | Masai Palm Oil Mill | | - | Data Not Available | - | - | - |
| 18 | Felda Air Tawar Palm Oil Mill | | 9.0 | Anaerobic and facultative ponds | 20.0 | 80 | 220 |
| 19 | Felda Semencu Palm Oil Mill | | 10.8 | Anaerobic and facultative ponds | 20.48 | 120 | 230 |
| 20 | Felda Adela Palm Oil Mill | | 14.0 | Anaerobic and facultative ponds | 19.72 | 300 | 300 |
| 21 | Felda Sening Palm Oil Mill | | 11.34 | Anaerobic and facultative ponds | 13.83 | 70 | 140 |
| 22 | Felda Lok Heng Palm Oil Mill | | 14.0 | Anaerobic and facultative ponds | 10.0 | 100 | 400 |
| 23 | Semperna Palm Oil Mill | | 4.0 | Anaerobic and facultative ponds | 4.5 | 30 | 136 |
| 24 | Sungai Ambat Palm Oil Mill | Sedili | 4.0 | Anaerobic and facultative ponds | 4.8 | 95.7 | 490 |
| 25 | Tenggaroh Palm Oil Mill | Sedili | - | Data Not Available | - | - | - |

* Information carried out by DOE in 1980
W Effluent into watercourse

Table 16 INVENTORY OF PURIFICATION SYSTEM FOR PINEAPPLE PROCESSING

| Code No. | Name of Factory | River Name | Type of Production | Actual Production (ton/d) | Purification System | Quantity of Effluent ($m^3$/d) | Treated Effluent (mg/l) BOD | SS |
|---|---|---|---|---|---|---|---|---|
| 1 | Peninsula Plantation Sdn. Bhd. Simpamp Renggam | Benut | Pineapple Cutes (Semi finished products) | 45 | Anaerobic and facultative ponds | - | - | - |
| 2 | Peninsula Plantation, Pineapple Canning Padt, Sikom | Pontian | Canned pineapples | 30 | Anaerobic and facultative ponds | 68 | *1,930 | 65 |
| 3 | Lee Pineapple (M) Sdn. Bhd. | Skudai | Canned pineapples | 0.5 | Land disposal | - | - | - |
| 4 | United Malaysia Pineapple Growers & Canners Pte. Ltd. | Skudai | Canned pineapples | 1.6 | Anaerobic and facultative ponds | 273 | 5.0 | 20 |

* The purification system was not working.

Table 17 INVENTORY OF STOCK FARMS

| Code No. | District | River Name | No. of Heads | Amount of Water Used ($m^3/d$) |
|---|---|---|---|---|
| 1 | Kuluang | Benut | 12,000 | 78.54 |
| 2 | Kuluang | Benut | 800 | - |
| 3 | Pontian | - | 1,800 | 17.99 |
| 4 | Kuluang | Pontian Besar | 2,000 | 13.09 |
| 5 | Pontian | Pontian Besar | 3,950 | - |
| 6 | Pontian | Pontina Besar | 750 | 13.09 |
| 7 | Pontian | Pontian Kechil | 1,611 | 26.18 |
| 8 | Pontian | Pontian Kechil | 3,620 | 15.99 |
| 9 | Pontian | Pontian Kechil | 1,110 | 8.73 |
| 10 | Pontian | Pontian Kechil | 980 | 17.45 |
| 11 | Pontian | Pontian Kechil | 1,376 | 17.45 |
| 12 | Pontian | Pontian Kechil | 800 | 13.99 |
| 13 | Pontian | Pontian Kechil | 1,500 | 17.45 |
| 14 | Pontian | Pontian Kechil | 1,280 | 26.18 |
| 15 | Pontian | Pontian Kechil | 2,000 | 26.18 |
| 16 | Pontian | Pontian Kechil | 873 | 13.09 |
| 17 | Pontian | Pontian Kechil | 2,811 | - |
| 18 | Pontian | Pontian Kechil | 1,900 | 26.19 |
| 19 | Pontian | Pontian Kechil | 800 | 21.82 |
| 20 | Pontian | Pontian Kechil | 2,000 | - |
| 21 | Pontian | Pontian Kechil | 3,500 | 26.18 |
| 22 | Pontian | Pontian Kechil | 4,200 | 52.36 |
| 23 | Pontian | Pontian Kechil | 1,200 | 17.45 |
| 24 | Pontian | Pontian Kechil | 1,300 | 17.45 |
| 25 | Pontian | Pontian Kechil | 950 | 26.19 |
| 26 | Pontian | Pontian Kechil | 800 | 8.73 |
| 27 | Pontian | Pontian Kechil | 885 | 26.18 |
| 28 | Pontian | Pulai | 10,470 | - |
| 29 | Johor Bahru | Pulai | 22,000 | 147.27 |
| 30 | Johor Bahru | Skudai | 18,000 | - |
| 31 | Johor Bahru | Skudai | 1,500 | - |
| 32 | Johor Bahru | Skudai | 5,000 | 24.54 |
| 33 | Johor Bahru | Skudai | 4,000 | 47.27 |
| 34 | Johor Bahru | Tebrau | 5,000 | - |
| 35 | Johor Bahru | - | 9,000 | 87.27 |
| 36 | Johor Bahru | - | 5,000 | - |
| 37 | Johor Bahru | - | 1,000 | - |
| 38 | Johor Bahru | Johor | 5,000 | - |
| 39 | Johor Bahru | Johor | 1,000 | 16.34 |
| 40 | Johor Bahru | Johor | 3,000 | 16.36 |
| 41 | Johor Bahru | Johor | 2,000 | 16.36 |
| 42 | Johor Bahru | Johor | 2,000 | 27.27 |
| 43 | Johor Bahru | Johor | 2,000 | 20.04 |
| 44 | Johor Bahru | Johor | 22,000 | 147.27 |
| 45 | Johor Bahru | Johor | 1,000 | 8.18 |
| 46 | Johor Bahru | Johor | 4,000 | 34.09 |
| 47 | Johor Bahru | Johor | 3,000 | 32.72 |
| 48 | Johor Bahru | Johor | 1,000 | 16.36 |
| 49 | Kota Tinggi | Sedili Besar | 1,075 | 12.27 |

Table 18 NUMBER OF WATER QUALITY MONITORING STATION BY WATER QUALITY CONTROL REGION

| WQCR | River Name | Catchment Area ($km^2$) | No. of WQMS | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
| 1 | Benut | 568.0 | 3 | 2 | - | 4 | 4 | 5 |
| 2 | Pontian Besar | 323.4 | - | - | - | 3 | 3 | 3 |
| 3 | Pontian Kechil | 92.4 | - | - | - | 1 | 1 | 1 |
| 4 | Pulai | 292.0 | - | - | - | - | - | - |
| 5 | Skudai | 297.1 | 8 | 8 | 8 | 8 | 8 | 8 |
| 6 | Tebrau | 258.1 | - | - | - | 2 | 3 | 3 |
| 7 | Johor | 2,686.8 | 6 | 6 | 8 | 7 | 7 | 15 |
| 8 | Sedili Besar | 1,396.8 | - | - | 7 | - | 5 | 6 |
| 9 | Sedili Kechil | 302.2 | - | - | - | - | - | - |
| Total | | | 17 | 16 | 23 | 25 | 31 | 41 |

Table 19 SAMPLING FREQUENCY OF WQCR

| River Name | Sampling Frequency (Times Per Year) | | | | | |
|---|---|---|---|---|---|---|
| | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
| Benut | 1 | 9 | - | 1 | 5 | 7 or 8 |
| Pontian Besar | - | - | 3 | 2 or 3 | 2 | 4 |
| Pontian Kechil | - | - | - | 3 | 2 | 4 |
| Skudai | 8 or 9 | 9 | 12 | 1-3 | 5 | 8 |
| Tebrau | - | - | - | 3 | 2 | 3 or 4 |
| Johor | 5 or 6 | 8 or 9 | 11 | 6 or 7 | 4 or 5 | 5-9 |
| Sedili Besar | - | - | - | - | 1 | 2 or 3 |

Table 20 CAPITAL COSTS FOR SEWERAGE AND SEWAGE TREATMENT

(Unit: M$10^3)

| | 1980-1990 | 1991-2000 | 2001-2010 | TOTAL |
|---|---|---|---|---|
| Johor Bahru | 58,471 | 25,642 | 92,972 | 177,085 |
| Skudai Valley | 14,075 | 13,727 | 66,597 | 94,399 |
| Pasir Gudang | 1,578 | 8,186 | 7,891 | 17,655 |
| Sub-Total | 74,134 | 47,545 | 167,460 | 289,139 |
| Subsidiary Drainage | 6,912 | 11,328 | - | 18,240 |
| Immediate Improvements | 2,721 | - | - | 2,721 |
| Total Capital Costs | 83,767 | 58,873 | 167,460 | 310,100 |

Table 21 COSTS FOR OPERATION AND MAINTENANCE

(Unit: M$10^3)

| | 1980-1990 | 1991-2000 | 2001-2010 | TOTAL |
|---|---|---|---|---|
| Johor Bahru | 6,191 | 21,995 | 42,071 | 70,257 |
| Skudai Valley | 2,556 | 7,966 | 19,813 | 30,335 |
| Pasir Gudang | 2,428 | 12,460 | 24,929 | 39,817 |
| Sub-Total | 11,175 | 42,421 | 86,813 | 140,409 |
| Subsidiary Drainage | 1,909 | 4,033 | 6,170 | 12,112 |
| Immediate Improvements | 5,828 | - | - | 5,828 |
| Total O & M Costs | 18,912 | 46,454 | 92,983 | 158,349 |

Table 22 ASSUMED DISCHARGE RATIO, RUNOFF RATIO, INFILTRATION RATIO AND BOD CONCENTRATION OF EFFLUENT ASSUMED UNDER PRESENT PURIFICATION LEVEL

| Pollution Source | Discharge Ratio | NUPL (mg/l) | Runoff Ratio | Infiltration Ratio |
|---|---|---|---|---|
| Domestic | | | | |
| Urban sewerage | 0.9 | 20 | 1.0 | 0.2 |
| Urban non-sewerage | 0.9 | *2 | 0.6 | 0 |
| Rural | 0.8 | 200 | 0.1 | 0 |
| Manufacture | | | | |
| Urban sewerage | 1.0 | 20 | 1.0 | 0.2 |
| Urban non-sewerage | 1.0 | *3 | 0.6 | 0 |
| Rural | 1.0 | *3 | 0.1 | 0 |
| Palm Oil Mills | | | | |
| With P.S. *1 | 1.0 | 50 | 0.6 | 0 |
| Without P.S. | 1.0 | 22,000 | 0.6 | 0 |
| Land Disposal | 0.1 | 50 | 0.6 | 0 |
| Rubber Factories | | | | |
| With P.S. | 1.0 | 50 | 0.6 | 0 |
| Without P.S. | 1.0 | 2,320 | 0.6 | 0 |
| Land Disposal | 0.1 | 50 | 0.6 | 0 |
| Pineapple Factories | | | | |
| With P.S. | 1.0 | 50 | 0.6 | 0 |
| Without P.S. | 1.0 | 1,120 | 0.6 | 0 |
| Land Disposal | 0.1 | 50 | 0.6 | 0 |
| Animal Husbandry | 1.0 | 20 *4 | 0.1 | 0 |

Remark: *1 : Purification System
*2 : See Table 23
*3 : See Table 24
*4 : g/day/Head

Table 23 ASSUMED DEVELOPMENT OF SEPTIC TANK IN URBAN AREA

Unit : %

| Pollution Source | 1980 | 1983 | 1985 | 1990 | 1995 | 2000 | 2005 |
|---|---|---|---|---|---|---|---|
| Septic tank | 28 | 30 | 35 | 40 | 45 | 50 | 55 |
| Others | 72 | 70 | 65 | 60 | 55 | 50 | 45 |

Table 24 ASSUMED BOD CONCENTRATION OF NON-SEWERAGE-URBAN DOMESTIC

Unit : mg/l

| Pollution Source | NUPL | 1980 | 1983 | 1985 | 1990 | 1995 | 2000 | 2005 |
|---|---|---|---|---|---|---|---|---|
| Septic tank | 80 | 22 | 24 | 28 | 32 | 36 | 40 | 44 |
| Others | 200 | 144 | 140 | 130 | 120 | 110 | 100 | 90 |
| Non sewerage urban domestic | | 166 | 164 | 158 | 152 | 146 | 140 | 134 |

Table 25 NUPL BY CLASSIFICATION OF MANUFACTURING, CUSTOMER WATER DEMAND AND NUPL OF INDUSTRIAL EFFLUENT

| Classification of Manufacturing | NUPL (mg/l) | Customer Water Demand ($10^6$ $m^3$/y) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1983 | 1985 | 1990 | 1995 | 2000 | 2005 |
| Food | 250 | 24.5 | 27.4 | 35.0 | 42.2 | 45.3 | 56.9 |
| Textile | 400 | 10.3 | 10.5 | 11.3 | 12.1 | 11.9 | 12.9 |
| Wood Product | 610 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Paper Product | 150 | 6.4 | 7.4 | 13.5 | 23.7 | 38.6 | 69.9 |
| Publishing | 150 | 0.0 | 0.0 | 0.1 | 0.1 | 0.2 | 0.3 |
| Chemicals | 160 | 15.3 | 17.8 | 25.7 | 35.8 | 43.8 | 69.2 |
| Rubber | 10 | 7.3 | 7.2 | 6.4 | 5.8 | 4.3 | 4.4 |
| Non-metal | 10 | 0.7 | 0.7 | 0.9 | 1.2 | 1.5 | 1.9 |
| Basic Metal | 10 | 0.1 | 0.1 | 0.2 | 0.3 | 0.4 | 0.6 |
| Machinery | 10 | 1.9 | 2.2 | 3.5 | 5.0 | 5.1 | 9.1 |
| Miscellaneous | 350 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| NUPL of Industrial Effluent (mg/l) | | 209 | 208 | 204 | 198 | 193 | 184 |

Table 26 WATER DEMAND PROJECTION OF RUBBER FACTORIES

Unit: $10^3$ $m^3/y$

| Rubber Factory No. | Water Demand | | | | | |
|---|---|---|---|---|---|---|
| | 1983 | 1985 | 1990 | 1995 | 2000 | 2005 |
| 1 | 164 | 151 | 114 | 82 | 53 | 36 |
| 2 | 20 | 15 | 11 | 8 | 5 | 4 |
| 3 | 44 | 41 | 31 | 22 | 14 | 10 |
| 4 | 21 | 19 | 14 | 10 | 7 | 5 |
| 5 | 64 | 58 | 44 | 32 | 20 | 14 |
| 6 | 97 | 97 | 97 | 96 | 96 | 97 |
| 7 | 63 | 63 | 63 | 63 | 63 | 63 |
| 8 | 69 | 69 | 69 | 69 | 69 | 69 |
| 9 | 20 | 20 | 20 | 20 | 20 | 20 |
| 10 | 20 | 20 | 20 | 20 | 20 | 20 |
| 11 | 94 | 94 | 94 | 94 | 94 | 94 |
| 12 | 147 | 147 | 147 | 147 | 147 | 147 |
| 13 | 107 | 107 | 107 | 107 | 107 | 107 |
| 14 | 127 | 127 | 126 | 124 | 128 | 131 |
| 15 | 98 | 98 | 98 | 98 | 98 | 98 |
| 16 | 125 | 125 | 125 | 125 | 125 | 125 |
| 17 | 11 | 11 | 11 | 11 | 11 | 11 |
| 18 | 135 | 135 | 133 | 131 | 130 | 127 |
| 19 | 174 | 174 | 173 | 171 | 178 | 178 |
| 20 | 52 | 51 | 51 | 50 | 50 | 44 |
| Total | 1,652 | 1,622 | 1,548 | 1,480 | 1,435 | 1,400 |

Table 27 WATER DEMAND PROJECTION OF PALM OIL MILLS

Unit: $10^3$ $m^3/y$

| Palm Oil Mill No. | Water Demand | | | | | |
|---|---|---|---|---|---|---|
| | 1983 | 1985 | 1990 | 1995 | 2000 | 2005 |
| 1 | 167 | 167 | 167 | 167 | 167 | 167 |
| 2 | 139 | 139 | 139 | 139 | 139 | 139 |
| 3 | 171 | 171 | 171 | 171 | 171 | 171 |
| 4 | 171 | 171 | 171 | 171 | 171 | 171 |
| 5 | 139 | 139 | 139 | 139 | 139 | 139 |
| 6 | 69 | 69 | 69 | 69 | 69 | 69 |
| 7 | 198 | 198 | 198 | 198 | 198 | 198 |
| 8 | 324 | 324 | 324 | 324 | 324 | 324 |
| 9 | - | 193 | 215 | 214 | 202 | 198 |
| 10 | 165 | 165 | 165 | 165 | 165 | 165 |
| 11 | 120 | 120 | 120 | 120 | 120 | 120 |
| 12 | 201 | 201 | 194 | 188 | 196 | 202 |
| 13 | 193 | 192 | 189 | 193 | 204 | 213 |
| 14 | 126 | 123 | 122 | 124 | 143 | 143 |
| 15 | 220 | 220 | 220 | 220 | 220 | 220 |
| 16 | 279 | 279 | 279 | 279 | 279 | 279 |
| 17 | 121 | 121 | 121 | 121 | 121 | 121 |
| 18 | 229 | 224 | 216 | 214 | 217 | 256 |
| 19 | 317 | 315 | 310 | 301 | 304 | 319 |
| 20 | 350 | 349 | 346 | 338 | 340 | 344 |
| 21 | 185 | 190 | 285 | 289 | 293 | 287 |
| 22 | 331 | 337 | 323 | 325 | 324 | 318 |
| 23 | 114 | 114 | 114 | 114 | 114 | 114 |
| 24 | 135 | 135 | 135 | 135 | 135 | 135 |
| 25 | 288 | 410 | 254 | 211 | 239 | 237 |
| 26 | - | - | 264 | 272 | 276 | 269 |
| 27 | - | - | 307 | 345 | 333 | 313 |
| 28 | 100 | 181 | 189 | 174 | 174 | 174 |
| 29 | - | - | 183 | 174 | 174 | 174 |
| 30 | - | - | - | 161 | 219 | 229 |
| Total | 4,852 | 5,247 | 5,928 | 6,055 | 6,170 | 6,208 |

Table 28 WATER DEMAND PROJECTION OF PINEAPPLE FACTORIES

Unit: $10^3$ $m^3/y$

| Pineapple Factory No. | Water Demand | | | | | |
|---|---|---|---|---|---|---|
| | 1983 | 1985 | 1990 | 1995 | 2000 | 2005 |
| 1 | 209 | 212 | 239 | 274 | 285 | 292 |
| 2 | - | 60 | 63 | 96 | 100 | 109 |
| 3 | 113 | 127 | 149 | 178 | 200 | 226 |
| 4 | 83 | 103 | 116 | 144 | 157 | 182 |
| 5 | 72 | 91 | 110 | 137 | 150 | 197 |
| 6 | - | - | 52 | 103 | 143 | 175 |
| 7 | - | - | - | - | 100 | 146 |
| Total | 477 | 593 | 729 | 932 | 1,135 | 1,327 |

Table 29 DOMESTIC WATER DEMAND PROJECTION OF CITIES/TOWNS

Unit: $10^6$ $m^3/y$

| City/Town No. | Name | Domestic Water Demand 1983 | 1985 | 1990 | 1995 | 2000 | 2005 |
|---|---|---|---|---|---|---|---|
| 1 | Johor Bahru | 18.7 | 22.2 | 31.3 | 46.0 | 60.1 | 76.5 |
| 2 | Masai & P.G. | 1.0 | 1.1 | 1.6 | 2.2 | 2.5 | 3.8 |
| 3 | Kulai | 1.8 | 2.1 | 3.5 | 5.2 | 6.5 | 10.9 |
| 4 | Senai | 0.2 | 0.2 | 0.5 | 0.8 | 1.1 | 1.7 |
| 5 | Kelapa Sawit | 0.2 | 0.2 | 0.3 | 0.7 | 0.9 | 1.3 |
| 6 | Ulu Tiram | 0.2 | 0.3 | 0.6 | 1.0 | 1.7 | 2.5 |
| 7 | Bandar Penawa | - | - | 0.1 | 0.1 | 0.3 | 1.1 |
| 8 | P4 | - | 0.2 | 0.2 | 0.3 | 0.8 | 1.2 |
| 9 | P7 | - | 0.2 | 0.3 | 0.7 | 1.0 | 1.3 |
| 10 | Kota Tinggi | 0.8 | 1.1 | 1.5 | 2.2 | 3.2 | 4.1 |
| 11 | P2 | - | 0.2 | 0.2 | 0.3 | 0.8 | 1.2 |
| 12 | Bandar Tenggara | - | 0.4 | 0.7 | 1.1 | 1.8 | 2.6 |
| 13 | Pontian Kechil | 1.5 | 1.8 | 2.8 | 4.2 | 5.9 | 8.3 |
| 14 | Pekan Nanas | 0.5 | 0.6 | 0.7 | 0.9 | 1.0 | 1.1 |
| 15 | Layang-Layang | - | 0.2 | 0.1 | 0.2 | 0.4 | 1.1 |
| 16 | Renggam | 0.1 | 0.2 | 0.1 | 0.2 | 0.4 | 1.1 |
| 17 | Simpang Renggam | - | 0.2 | 0.2 | 0.3 | 0.4 | 1.1 |
| | Total | 25.0 | 31.2 | 44.7 | 66.4 | 88.8 | 120.9 |

Table 30 INDUSTRIAL WATER DEMAND PROJECTION OF CITIES/TOWNS

Unit: $10^6$ $m^3/y$

| City/Town No. | Name | Industrial Water Demand 1983 | 1985 | 1990 | 1995 | 2000 | 2005 |
|---|---|---|---|---|---|---|---|
| 1 | Johor Bahru | 17.3 | 20.7 | 30.1 | 40.9 | 49.8 | 81.1 |
| 2 | Masai & P.G. | 7.3 | 7.9 | 9.9 | 12.6 | 15.8 | 17.4 |
| 3 | Kulai | 1.8 | 2.1 | 3.4 | 5.1 | 7.0 | 12.3 |
| 4 | Senai | 0.5 | 0.6 | 0.9 | 1.2 | 1.4 | 2.0 |
| 5 | Kelapa Sawit | 0.5 | 0.7 | 0.7 | 1.0 | 1.2 | 1.6 |
| 6 | Ulu Tiram | 0.5 | 0.6 | 1.0 | 1.3 | 1.8 | 3.1 |
| 7 | Bandar Penawa | - | 0.1 | 0.1 | 0.2 | 0.6 | 1.3 |
| 8 | P4 | - | 0.3 | 0.5 | 0.6 | 1.2 | 1.3 |
| 9 | P7 | - | 0.3 | 0.5 | 0.8 | 1.4 | 1.4 |
| 10 | Kota Tinggi | 1.0 | 1.2 | 1.6 | 2.4 | 4.3 | 5.0 |
| 11 | P2 | - | 0.3 | 0.5 | 0.6 | 1.2 | 1.3 |
| 12 | Bandar Tenggara | - | 0.4 | 0.7 | 1.2 | 2.5 | 2.9 |
| 13 | Pontian Kechil | 1.5 | 1.9 | 2.8 | 4.3 | 5.5 | 9.6 |
| 14 | Pekan Nanas | 0.6 | 0.7 | 0.9 | 1.0 | 1.1 | 1.5 |
| 15 | Layang-Layang | 0.3 | 0.3 | 0.5 | 0.5 | 0.7 | 1.4 |
| 16 | Lenggam | 0.3 | 0.3 | 0.5 | 0.5 | 0.6 | 1.4 |
| 17 | Simpang Renggam | 0.3 | 0.3 | 0.5 | 0.6 | 0.7 | 1.4 |
| | Total | 31.9 | 38.7 | 55.1 | 74.8 | 96.8 | 146.0 |

Table 31 PROJECTION OF STOCK FARMS

| Stock Farm No. | Number of Heads | | | | | |
|---|---|---|---|---|---|---|
| | 1983 | 1985 | 1990 | 1995 | 2000 | 2005 |
| 1 | 12,280 | 12,850 | 14,400 | 15,660 | 17,040 | 18,540 |
| 2 | 820 | 860 | 960 | 1,040 | 1,130 | 1,240 |
| 3 | 1,840 | 1,930 | 2,160 | 2,350 | 2,560 | 2,780 |
| 4 | 2,050 | 2,140 | 2,400 | 2,610 | 2,840 | 3,090 |
| 5 | 4,040 | 4,230 | 4,740 | 5,150 | 5,600 | 6,100 |
| 6 | 770 | 800 | 900 | 980 | 1,070 | 1,160 |
| 7 | 1,650 | 1,720 | 1,930 | 2,100 | 2,280 | 2,490 |
| 8 | 3,700 | 3,880 | 4,350 | 4,720 | 5,140 | 5,590 |
| 9 | 1,140 | 1,190 | 1,330 | 1,450 | 1,580 | 1,710 |
| 10 | 1,000 | 1,050 | 1,180 | 1,280 | 1,390 | 1,510 |
| 11 | 1,410 | 1,470 | 1,650 | 1,800 | 1,960 | 2,130 |
| 12 | 820 | 860 | 960 | 1,040 | 1,130 | 1,240 |
| 13 | 1,530 | 1,610 | 1,800 | 1,960 | 2,130 | 2,320 |
| 14 | 1,310 | 1,370 | 1,530 | 1,670 | 1,820 | 1,980 |
| 15 | 2,050 | 2,140 | 2,400 | 2,610 | 2,840 | 3,090 |
| 16 | 890 | 930 | 1,040 | 1,140 | 1,240 | 1,350 |
| 17 | 2,880 | 3,010 | 3,370 | 3,670 | 3,990 | 4,340 |
| 18 | 1,940 | 2,030 | 2,270 | 2,480 | 2,700 | 2,930 |
| 19 | 820 | 860 | 960 | 1,040 | 1,130 | 1,240 |
| 20 | 2,050 | 2,140 | 2,400 | 2,610 | 2,840 | 3,090 |
| 21 | 3,580 | 3,750 | 4,200 | 4,570 | 4,970 | 5,410 |
| 22 | 4,300 | 4,500 | 5,040 | 5,480 | 5,960 | 6,490 |
| 23 | 1,230 | 1,290 | 1,450 | 1,570 | 1,710 | 1,850 |
| 24 | 1,330 | 1,390 | 1,560 | 1,700 | 1,850 | 2,010 |
| 25 | 970 | 1,020 | 1,140 | 1,240 | 1,350 | 1,470 |
| 26 | 820 | 860 | 960 | 1,040 | 1,130 | 1,240 |
| 27 | 910 | 950 | 1,060 | 1,150 | 1,250 | 1,370 |
| 28 | 10,710 | 11,210 | 12,560 | 13,660 | 14,860 | 16,170 |
| 29 | 22,510 | 23,550 | 26,390 | 28,710 | 31,230 | 33,980 |
| 30 | 18,410 | 19,270 | 21,590 | 23,490 | 25,560 | 27,800 |
| 31 | 1,530 | 1,610 | 1,800 | 1,960 | 2,130 | 2,326 |
| 32 | 5,120 | 5,350 | 5,990 | 6,520 | 7,090 | 7,720 |
| 33 | 4,090 | 4,280 | 4,800 | 5,220 | 5,680 | 6,180 |
| 34 | 5,120 | 5,350 | 5,990 | 6,520 | 7,090 | 7,720 |
| 35 | 9,210 | 9,640 | 10,800 | 11,740 | 12,770 | 13,900 |
| 36 | 5,120 | 5,350 | 5,990 | 6,520 | 7,090 | 7,720 |
| 37 | 1,020 | 1,070 | 1,200 | 1,300 | 1,410 | 1,540 |
| 38 | 5,120 | 5,350 | 5,990 | 6,520 | 7,090 | 7,720 |
| 39 | 1,020 | 1,070 | 1,200 | 1,300 | 1,410 | 1,540 |
| 40 | 3,070 | 3,210 | 3,600 | 3,910 | 4,250 | 4,630 |
| 41 | 2,050 | 2,140 | 2,400 | 2,610 | 2,840 | 3,090 |
| 42 | 2,050 | 2,140 | 2,400 | 2,610 | 2,840 | 3,090 |
| 43 | 2,050 | 2,140 | 2,400 | 2,610 | 2,840 | 3,090 |
| 44 | 22,510 | 23,550 | 26,390 | 28,710 | 31,230 | 33,980 |
| 45 | 1,020 | 1,070 | 1,200 | 1,300 | 1,410 | 1,540 |
| 46 | 4,090 | 4,280 | 4,800 | 5,220 | 5,680 | 6,180 |
| 47 | 3,070 | 3,210 | 3,600 | 3,910 | 4,250 | 4,630 |
| 48 | 1,020 | 1,070 | 1,200 | 1,300 | 1,410 | 1,540 |
| 49 | 1,100 | 1,150 | 1,290 | 1,400 | 1,520 | 1,660 |

Remark: (1) Number of heads is assumed to grow with the annual average rate of 2.3% during the period from 1983 to 2990, and 1.7% from 1990 to 2005.

(2) The farms which have more than 1,000 heads at 2005 are picked up.

Table 32 SUMMARY OF PROJECTED BOD LOAD AND BOD CONCENTRATION

| Basin Name | 1995 BOD LOAD From Source (ton/d) | 1995 BOD LOAD Into River (ton/d) | 1995 BOD Concentration in River (mg/l) | 2005 BOD LOAD From Source (ton/d) | 2005 BOD LOAD Into River (ton/d) | 2005 BOD Concentration in River (mg/l) |
|---|---|---|---|---|---|---|
| Benut | 1.7 | 0.3 | 0- 2 | 2.9 | 1.0 | 0- 8 |
| P. Besar | 2.5 | 1.2 | 0-13 | 3.4 | 1.6 | 0-17 |
| P. Kechil | 6.6(4.9) | 0.5 | 0-19 | 12.9(9.8) | 0.7 | 0-26 |
| Pulai | 2.3 | 0.8 | 0- 4 | 2.8 | 1.0 | 0- 6 |
| Skudai | 9.0 | 5.0 | 0-43 | 16.7 | 9.6 | 0-68 |
| Tebrau | 0.4 | 0.1 | 0- 1 | 0.5 | 0.1 | 0- 1 |
| Johor | 10.9 | 4.6 | 0-13 | 20.4 | 10.2 | 0-33 |
| S. Besar | 1.7 | 0.5 | 0- 1 | 2.8 | 1.1 | 0- 2 |
| S. Kechil | 0.3 | - | - | 0.4 | - | - |
| Total | 35.4(4.9) | 13.0 | | 61.9(9.8) | 25.3 | |

Remarks: ( ) : BOD LOAD discharged to the sea directly.

Table 33 COMPOSITION OF BOD LOAD INTO RIVER

Unit: ton/d

| Name | 1995 BOD LOAD into River | | | | 2005 BOD LOAD into River | | | |
|---|---|---|---|---|---|---|---|---|
| | PRP | UI | RA | Total | PRP | UI | RA | Total |
| Benut | 0.1 | 0.1 | 0.1 | 0.3 | 0.1 | 0.8 | 0.1 | 1.0 |
| P. Besar | 0.5 | 0.6 | 0.1 | 1.2 | 0.5 | 1.0 | 0.1 | 1.6 |
| P. Kechil | 0.4 | 0 | 0.1 | 0.5 | 0.6 | 0 | 0.1 | 0.7 |
| Pulai | 0 | 0.7 | 0.1 | 0.8 | 0 | 0.9 | 0.1 | 1.0 |
| Skudai | 0.7 | 4.2 | 0.1 | 5.0 | 0.7 | 8.8 | 0.1 | 9.6 |
| Tebrau | 0.1 | 0 | 0 | 0.1 | 0.1 | 0 | 0 | 0.1 |
| Johor | 0.6 | 3.7 | 0.3 | 4.6 | 0.6 | 9.2 | 0.4 | 10.2 |
| S. Besar | 0.2 | 0.2 | 0.1 | 0.5 | 0.2 | 0.8 | 0.1 | 1.1 |
| S. Kechil | 0 | 0 | 0.1 | 0.1 | 0 | 0 | 0.1 | 0.1 |
| Total | 2.6 | 9.5 | 1.0 | 13.1 | 2.8 | 21.5 | 1.1 | 25.4 |
| | (20) | (73) | (7) | (100) | (11) | (85) | (4) | (100) |

Remarks:
PRP: Palm oil mills, rubber factory and pineapple factory effluent
UI: Urban domestic and urban industry effluent
RA: Rural and animal husbandry
( ): % of the total BOD load

Table 34 STANDARD RELATING TO LIVING ENVIRONMENT FOR RIVER IN JAPAN

| Category | Purpose of Utilization | Standard Values/1 pH | BOD (mg/l) | SS (mg/l) | DO (mg/l) | Number of Coliform Groups (MPN/$10^{-1}$ l) |
|---|---|---|---|---|---|---|
| AA | Water supply, class 1; conservation of natural environment & uses listed in A-E | 6.5 - 8.5 | 1 or less | 25 or less | 7.5 or more | 50 or less |
| A | Water supply, class 2; fishery, class 1; bathing & uses listed in B-E | 6.5 - 8.5 | 2 or less | 25 or less | 7.5 or more | 1,000 or less |
| B | Water supply, class 3; fishery, class 2, & uses listed in C-E | 6.5 - 8.5 | 3 or less | 25 or less | 5 or more | 5,000 or less |
| C | Fishery, class 3; industrial water, class 1, & uses listed in D-E | 6.5 - 8.5 | 5 or less | 50 or less | 5 or more | |
| D | Industrial water, class 2; agricultural water/2, & uses listed in E | 6.0 - 8.5 | 8 or less | 100 or less | 2 or more | |
| E | Industrial water, class 3; conservation of environment | 6.0 - 8.5 | 10 or less | Floating matter such as garbage should not be observed. | 2 or more | |

Remarks; /1: The standard value is based on the daily average value.
(The same applies to the standard values of lakes and coastal waters.)
/2: At the point of abstraction for agriculture, pH shall be between 6.0 and 7.5 and dissolved oxygen shall not be less than 5 mg/l.

(The same applies to the standard values of lakes.)

1. Conservation of natural environment: Conservation of scenic spots and other natural resources.
2. Water supply, class 1: Water treated by simply cleaning operation, such as filtration.
   Water supply, class 2: Water treated by normal cleaning operation such as sedimentation and filtration.
   Water supply, class 3: Water treated through a highly sophisticated cleaning operation including pretreatment.
3. Fishery, class 1: For aquatic life such as trout and bull trout inhabiting oligosaprobic water, and those of fishery classes 2 & 3
   Fishery, class 2: For aquatic life, such as the salmon family and sweetfish inhabiting oligosaprobic water and those of fishery class 3.
   Fishery, class 3: For aquatic life such as carp and silver carp inhabiting β-mesosaprobic water.
4. Industrial water, class 1: Water given normal cleaning treatment such as sedimentation.
   Industrial water, class 2: Water given sophisticated treatment by chemicals.
   Industrial water, class 3: Water given special cleaning treatment.
5. Conservation of environment: Up to the limits at which no unpleasantness is caused to people in their daily life (including a walk by the riverside, etc.).

Table 35 WATER QUALITY CRITERIA FOR FRESH SURFACE WATER PROPOSED BY THE NATIONAL POLLUTION CONTROL COMMISSION IN PHILIPPINES

| Classification | Purpose of Utilization | Standard Values | | | |
|---|---|---|---|---|---|
| | | pH | BOD (mg/l) | DO (mg/l) | Coliform (MPN/100 ml) |
| AA | Domestic Water Supply/1 | 7 - 8.5 | - | - | 50 or less |
| A | Domestic Water Supply/2 | 6.5 - 8.5 | 5 or less | 5 or more | 500 or less |
| B | Bathing | 6.5 - 8.5 | 10 or less | 5 or more | 1,000 or less |
| C | Fishing | 6.5 - 8.5 | 15 or less | 5 or more | 5,000 or less |
| D | Agricultural and Industrial Water Supply | 6.5 - 8.5 | - | 3 or more | - |

Remarks; /1: Domestic water supply: Water from watersheds which are uninhabited and otherwise protected and can be used for water supply with limited treatment.

/2: Domestic water supply: A conventional treatment is necessary for water supply use of these waters.

Table 36 PRESENT $BOD_3$ CONCENTRATION LIMITS FOR WATERCOURSE DISCHARGE FOR PALM OIL MILLS AND RUBBER FACTORIES

Unit: mg/lit

| Year | Palm Oil Mill | SMR & Conventional Grade Factory | Latex Concentration Factory |
|---|---|---|---|
| 1978 | 5,000 | - | - |
| 1979 | 2,000 | 300 | - |
| 1980 | 1,000 | 200 | 450 |
| 1981 | 1,000 - 500 | 100 (50)* | 300 |
| 1982 | 500 - 250 | - | 200 |
| 1983 | 250 | - | 100 (50)* |

Remarks: *: This additional limit is the arithmetic mean value determined on the basis of a minimum of four samples taken at least once a week for four weeks consecutively.

Table 37 OUTLINE OF PROPOSED PUBLIC SEWERAGE SYSTEM FOR POLLUTANT LOAD ABATEMENT FOR RIVER WATER

| City/Town | Basin | 1995 Treatment Capacity ($10^3$ $m^3$/d) | 1995 Service Factor (%) | 1995 Served Population ($10^3$) | 2005 Treatment Capacity ($10^3$ $m^3$/d) | 2005 Service Factor (%) | 2005 Served Population ($10^3$) |
|---|---|---|---|---|---|---|---|
| Johor Bahru | - | 108 | 40 | 216 | 345 | 70 | 558 |
| Masai & P.G. | - | 41 | 85 | 26 | 65 | 95 | 43 |
| Kulai | Skudai | 27 | 85 | 60 | 73 | 100 | 123 |
| Senai | Skudai | 5 | 85 | 12 | 12 | 100 | 20 |
| Kelapa Sawit | P. Besar | 0 | 0 | 0 | 2 | 20 | 3 |
| Kota Tinggi | Johor | 0 | 0 | 0 | 14 | 50 | 25 |
| B. Tenggara | Johor | 6 | 85 | 15 | 17 | 100 | 31 |
| P. Kechil | P. Kechil | 23 | 85 | 50 | 56 | 100 | 97 |
| Total | | 210 | - | 379 | 584 | - | 900 |

Remarks: Public sewerage system in Johor Bahru, Masai & P.G. and P. Kechil are not affecting to river water quality.

Table 38 TREATMENT CAPACITY TO BE TREATED IN RUBBER FACTORIES, PALM OIL MILLS AND PINEAPPLE FACTORIES

Unit: $10^3$ $m^3/d$

Total Capacity of Rubber Factories by Product

| Basin Name | 1995 | | | 2005 | | |
|---|---|---|---|---|---|---|
| | SMR | Latex | Total | SMR | Latex | Total |
| Benut | 0 | 0 | 0 | 0 | 0 | 0 |
| P. Besar | 0 | 0 | 0 | 0 | 0 | 0 |
| P. Kechil | 0 | 0 | 0 | 0 | 0 | 0 |
| Pulai | 0 | 0 | 0 | 0 | 0 | 0 |
| Skudai | 0.64 | 0.08 | 0.72 | 0.64 | 0.08 | 0.72 |
| Tebrau | 0 | 0.50 | 0.50 | 0 | 0.52 | 0.52 |
| Johor | 0 | 0 | 0 | 0 | 0 | 0 |
| S. Besar | 0 | 0 | 0 | 0 | 0 | 0 |
| S. Kechil | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0.64 | 0.58 | 1.22 | 0.64 | 0.60 | 1.24 |

Treatment Capacity of Palm & Pineapple Factories by Purification System

| Basin Name | 1995 | | | 2005 | | |
|---|---|---|---|---|---|---|
| | E.A. | L.D. | Total | E.A. | L.D. | Total |
| Benut | 0 | 0.67 | 0.67 | 0 | 0.67 | 0.67 |
| P. Besar | 0.38 | 0.56 | 0.94 | 0.44 | 0.56 | 1.00 |
| P. Kechil | 0.55 | 0 | 0.55 | 0.79 | 0 | 0.79 |
| Pulai | 0 | 0 | 0 | 0 | 0 | 0 |
| Skudai | 0.56 | 1.37 | 1.93 | 0.56 | 1.37 | 1.93 |
| Tebrau | 0 | 0.79 | 0.79 | 0 | 0.79 | 0.79 |
| Johor | 4.08 | 1.36 | 5.44 | 4.31 | 1.36 | 5.67 |
| S. Besar | 0.84 | 0 | 0.84 | 0.95 | 0 | 0.95 |
| S. Kechil | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 6.41 | 4.75 | 11.16 | 7.05 | 4.75 | 11.80 |

Remarks: Operation days per year are 250 days.
E.A.: with Extended Aeration
L.D.: with Land Disposal

Table 39 POLLUTANT LOAD BY BASIN WITH AND WITHOUT PROJECT

1995

| Basin Name | Without Project: BOD Load into River (ton/d) PRP | UI | RA | Total | Max. BOD in River (mg/l) | With Project: BOD Load into River (ton/d) PRP | UI | RA | Total | Max. BOD in River (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| Benut | 0.1 | 0.1 | 0.1 | 0.3 | 2 | 0.1 | 0.1 | 0.1 | 0.3 | 2 |
| P. Besar | 0.5 | 0.6 | 0.1 | 1.2 | 13 | 0.1 | 0.6 | 0.1 | 0.8 | 8 |
| P. Kechil | 0.4 | 0 | 0.1 | 0.5 | 19 | 0 | 0 | 0.1 | 0.1 | 5 |
| Pulai | 0 | 0.7 | 0.1 | 0.8 | 3 | 0 | 0.7 | 0.1 | 0.8 | 4 |
| Skudai | 0.7 | 4.2 | 0.1 | 5.0 | 43 | 0.1 | 1.3 | 0.1 | 1.5 | 11 |
| Tebrau | 0.1 | 0 | 0 | 0.1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Johor | 0.6 | 3.7 | 0.3 | 4.6 | 13 | 0.3 | 3.0 | 0.3 | 3.6 | 7 |
| S. Besar | 0.2 | 0.2 | 0.1 | 0.5 | 1 | 0.1 | 0.2 | 0.1 | 0.4 | 1 |
| S. Kechil | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 2.6 | 9.5 | 0.9 | 13.0 | | 0.7 | 5.9 | 0.9 | 7.5 | |

2005

| Basin Name | Without Project: BOD Load into River (ton/d) PRP | UI | RA | Total | Max. BOD in River (mg/l) | With Project: BOD Load into River (ton/d) PRP | UI | RA | Total | Max. BOD in River (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| Benut | 0.1 | 0.8 | 0.1 | 1.0 | 8 | 0.1 | 0.8 | 0.1 | 1.0 | 8 |
| P. Besar | 0.5 | 1.0 | 0.1 | 1.6 | 17 | 0.1 | 0.8 | 0.1 | 1.0 | 10 |
| P. Kechil | 0.6 | 0 | 0.1 | 0.7 | 120 | 0.1 | 0 | 0.1 | 0.2 | 16 |
| Pulai | 0 | 0.9 | 0.1 | 1.0 | 6 | 0 | 0.9 | 0.1 | 1.0 | 6 |
| Skudai | 0.7 | 8.8 | 0.1 | 9.6 | 68 | 0.1 | 1.8 | 0.1 | 2.0 | 11 |
| Tebrau | 0.1 | 0 | 0 | 0.1 | 1 | 0 | 0 | 0 | 0 | 0 |
| Johor | 0.6 | 9.2 | 0.4 | 10.2 | 33 | 0.3 | 5.6 | 0.4 | 6.3 | 9 |
| S. Besar | 0.2 | 0.8 | 0.1 | 1.1 | 2 | 0.1 | 0.8 | 0.1 | 1.0 | 2 |
| S. Kechil | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 2.8 | 21.5 | 1.0 | 25.3 | | 0.8 | 10.9 | 1.0 | 12.7 | |

Remarks:
PRP: Palm oil mill, rubber factory and pineapple factory effluent
UI: Urban domestic and urban industry effluent
RA: Rural and animal husbandry

Table 40 DIRECT CONSTRUCTION COST AND LAND ACQUISITION COST OF SEWERAGE FACILITIES IN CASE OF BUTTERWORTH PROJECT

| Item | Treatment Plant | | |
|---|---|---|---|
| | Sg. Juru T.P. | Mak Madin T.P. | Sg. Nyor T.P. |
| Served Population ($10^3$) | | | |
| 1985 & 1990 | ——— | 84 | ——— |
| Final | ——— | 103 | ——— |
| Served Area (ha) | | | |
| 1985 & 1990 | ——— | 1,066 | ——— |
| Final | ——— | 1,200 | ——— |
| Treatment Capacity ($10^3$ $m^3$/d) | | | |
| 1985 & 1990 | 34 | 14 | 3 |
| Final | 53 | 17 | 3 |
| Treatment Plant Area (ha) | 13.2 | 11.8 | 6.5 |
| Construction Cost (M$$10^6$) | 6.7 | 5.0 | 4.7 |
| Land Acquisition Cost (M$$10^6$) | 3.3 | 2.9 | 1.6 |
| Sewer Length (km) | ——— | 51 | ——— |
| Construction Cost of Sewer (M$$10^6$) | ——— | 34 | ——— |

Remarks; (1): Costs are 1983 price
(2): Price escalation rate to 1985 is assumed to be 5%

Table 41 BREAKDOWN OF CONSTRUCTION COST OF PUBLIC SEWERAGE SYSTEMS FOR BUTTERWORTH AND BUKIT MERTAJAM

| | Cost ($M\$10^6$) | Share (%) |
|---|---|---|
| Trunk Sewer | 166 | 27 |
| Pumping Facilities | 5 | 1 |
| Treatment Facilities | 50 | 8 |
| Land | 45 | 7 |
| Sub-total | 266 | 44 |
| Branch Sewer | 281 | 46 |
| House Connection Pipe | 62 | 10 |
| Sub-total | 343 | 56 |
| Total | 609 | 100 |

Remarks; (1): At 1976 price
(2): Excluding engineering cost and physical contingency

Table 42 PRETREATMENT CAPACITY TO BE PRETREATED IN D&I WATER DEMAND WITH AND WITHOUT PROJECT

Without Project

| Intake No. | Basin Name | 1995 Max.BOD (mg/l) | 1995 Pre. (103 m3/d) | 1995 R.L. (%) | 2005 Max.BOD (mg/l) | 2005 Pre. (103 m3/d) | 2005 R.L. (%) |
|---|---|---|---|---|---|---|---|
| R24 | Benut | 1.9 | 0 | - | 2.2 | 0 | - |
| R26 | Johor | 10.3 | 0 | - | 47.5 | 11 | 58 |
| R29 | P.Besar | 11.4 | 0 | - | 13.0 | 0 | - |
| R31 | Skudai | 20.9 | 161 | 4 | 33.2 | 161 | 40 |
| R41 | Johor | 2.0 | 0 | - | 5.0 | 0 | - |
| Total | | | 161 | - | | 172 | - |

With Project

| Intake No. | Basin Name | 1995 Max.BOD (mg/l) | 1995 Pre. ($10^3$ $m^3$/d) | 1995 R.L. (%) | 2005 Max.BOD (mg/l) | 2005 Pre. ($10^3$ $m^3$/d) | 2005 R.L. (%) |
|---|---|---|---|---|---|---|---|
| R24 | Benut | 1.8 | 0 | - | 2.1 | 0 | - |
| R26 | Johor | 4.2 | 0 | - | 7.7 | 0 | - |
| R29 | P.Besar | 1.2 | 0 | - | 1.5 | 0 | - |
| R31 | Skudai | 10.9 | 0 | - | 10.5 | 0 | - |
| R41 | Johor | 0.3 | 0 | - | 1.1 | 0 | - |
| Total | | | 0 | - | | 0 | - |

Remarks: Pre.: Primary Pretreatment capacity
R.L.: Reduction Level

Table 43 ASSUMED UNIT CONSTRUCTION COST FOR POLLUTION LOAD ABATEMENT FACILITIES

Unit: M$10$^6$/100 x 10$^3$ m$^3$/d

| Item | Public Sewerage System | Purification Facilities | | | | Pretreatment Facilities |
|---|---|---|---|---|---|---|
| | | Palm & Pineapple | | Rubber | | |
| | | E.A. | L.D. | SMR | Latex | |
| Direct Const. Cost | 81.5 | 378.0 | 252.0 | 74.0 | 221.0 | 33.3 |
| Land Acquisition | 11.2 | - | - | - | - | - |
| Engineering | 8.2 | 37.8 | 25.2 | 7.4 | 22.1 | 3.3 |
| Sub-total | 100.9 | 415.8 | 277.2 | 81.4 | 243.1 | 36.6 |
| Physical Contingency | 30.3 | 124.7 | 83.2 | 24.4 | 72.9 | 11.0 |
| Total | 131.2 | 540.5 | 360.4 | 105.8 | 316.0 | 47.6 |

Remarks: E.A.: Purification system with extended aeration

L.D.: Purification system with land disposal

SMR, Latex: Products of rubber factories

Table 44 ESTIMATED PUBLIC DEVELOPMENT EXPENDITURE FOR SEWERAGE SYSTEM

Unit: M$ $10^6$

| City/Town | 5MP | 6MP | 7MP | 8MP | Total |
|---|---|---|---|---|---|
| Johor Bahru | 61 | 118 | 134 | 100 | 413 |
| Masai & P.G. | 25 | 31 | 22 | 18 | 96 |
| Kulai | 16 | 26 | 26 | 20 | 88 |
| Senai | 5 | 3 | 7 | 5 | 25 |
| Kota Tinggi | 3 | 8 | 10 | 8 | 29 |
| B. Tenggara | 6 | 9 | 9 | 7 | 31 |
| P. Kechil | 14 | 22 | 21 | 16 | 73 |
| Total | 130 | 222 | 229 | 174 | 755 |

Table 45 ESTIMATED PRIVATE DEVELOPMENT EXPENDITURE FOR SEWERAGE SYSTEM

Unit: M$ $10^6$

| City/Town | 5MP | 6MP | 7MP | 8MP | Total |
|---|---|---|---|---|---|
| Johor Bahru | 23 | 65 | 90 | 65 | 243 |
| Masai & P.G. | 9 | 15 | 15 | 12 | 51 |
| Kulai | 8 | 19 | 24 | 17 | 68 |
| Senai | 2 | 5 | 5 | 4 | 16 |
| Kota Tinggi | 1 | 4 | 6 | 5 | 16 |
| B. Tenggara | 3 | 6 | 8 | 6 | 23 |
| P. Kechil | 6 | 14 | 18 | 13 | 51 |
| Total | 52 | 128 | 166 | 122 | 468 |

Table 46 ESTIMATED PRIVATE DEVELOPMENT EXPENDITURE FOR PURIFICATION SYSTEM IN RUBBER FACTORIES, PALM OIL MILLS AND PINEAPPLE FACTORIES

Unit: M$ $10^6$

| Basin Name | 5MP | 6MP | 7MP | 8MP | Total |
|---|---|---|---|---|---|
| Benut | 1.5 | 1.5 | 0.6 | 0.6 | 4.2 |
| P. Besar | 2.4 | 2.6 | 1.2 | 1.2 | 7.4 |
| P. Kechil | 1.8 | 2.2 | 1.6 | 1.3 | 6.9 |
| Pulai | 0 | 0 | 0 | 0 | 0 |
| Skudai | 5.3 | 5.4 | 2.2 | 2.2 | 15.1 |
| Tebrau | 2.7 | 2.7 | 1.1 | 1.1 | 7.6 |
| Johor | 16.2 | 16.8 | 7.5 | 7.3 | 47.8 |
| S. Besar | 2.7 | 3.0 | 1.5 | 1.4 | 8.6 |
| S. Kechil | 0 | 0 | 0 | 0 | 0 |
| Total | 32.6 | 34.2 | 15.7 | 15.1 | 97.6 |

Table 47 BENEFICIAL AND ADVERSE EFFECTS OF WATER POLLUTION ABATEMENT PLAN

| Item | | Amount |
|---|---|---|
| 1. National Economic Development | | |
| 1.1 Economic Benefit | | |
| Sewerage | (M$10^6$) | 168 |
| Saving in pre-treatment for D&I water supply | (M$10^6$) | 23 |
| Total | (M$10^6$) | 191 |
| 1.2 Economic Cost | | |
| Sewerage | (M$10^6$) | 276 |
| Private purification facilities | (M$10^6$) | 43 |
| Pre-treatment for D&I water supply | (M$10^6$) | 0 |
| Total | (M$10^6$) | 319 |
| 1.3 EIRR | (%) | - |
| 2. Environmental Quality | | |
| 2.1 Beneficial Effects | | |
| Reduction in length of river stretch where BOD concentration is more than 10 mg/l in 2005 | (km) | 119 |
| 3. Social Well-Being | | |
| 3.1 Beneficial Effects | | |
| Number of people served by proposed sewerage system in 2005 | ($10^3$) | 900 |
| 3.2 Adverse Effect | | - |

Table 48 LENGTH OF RIVER STRETCHES WHERE BOD CONCENTRATION IS MORE THAN 10 mg/ℓ WITH AND WITHOUT PROJECT

Unit: km

| Basin Name | Studied Length | Length of Stretch where BOD Concentration is more than 10 mg/l | | | |
|---|---|---|---|---|---|
| | | 1995 | | 2005 | |
| | | Without | With | Without | With |
| Benut | 41 | 0 | 0 | 0 | 0 |
| P. Besar | 33 | 8 | 0 | 8 | 0 |
| P. Kechil | 18 | 18 | 0 | 18 | 0 |
| Pulai | 28 | 0 | 0 | 0 | 0 |
| Skudai | 37 | 37 | 0 | 37 | 0 |
| Tebrau | 30 | 0 | 0 | 0 | 0 |
| Johor | 85 | 42 | 0 | 56 | 0 |
| S. Besar | 67 | 0 | 0 | 0 | 0 |
| S. Kechil | 35 | 0 | 0 | 0 | 0 |
| | 374 | 105 | 0 | 119 | 0 |

Table 49 ESTIMATED MANPOWER REQUIREMENT FOR PUBLIC SEWERAGE SYSTEM BY CITY (1/2)

| Category | Construction | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|
| | 5MP | 6MP | 7MP | 8MP | 5MP | 6MP | 7MP | 8MP |
| **Johor Bahru** | | | | | | | | |
| Engineer | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 4 |
| T. Assistant | 1 | 1 | 1 | 1 | 2 | 2 | 4 | 6 |
| Technician | 1 | 1 | 1 | 1 | 8 | 10 | 21 | 32 |
| Others | 1 | 1 | 1 | 1 | 11 | 13 | 29 | 45 |
| Total Government Staff | 4 | 4 | 4 | 4 | 23 | 27 | 57 | 87 |
| **Masai & P.G.** | | | | | | | | |
| Engineer | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| T. Assistant | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Technician | 1 | 1 | 1 | 1 | 3 | 4 | 5 | 6 |
| Others | 1 | 1 | 1 | 1 | 4 | 5 | 6 | 8 |
| Total Government Staff | 4 | 4 | 4 | 4 | 9 | 11 | 13 | 17 |
| **Kulai** | | | | | | | | |
| Engineer | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| T. Assistant | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 2 |
| Technician | 1 | 1 | 1 | 1 | 0 | 3 | 5 | 7 |
| Others | 1 | 1 | 1 | 1 | 0 | 4 | 7 | 9 |
| Total Government Staff | 4 | 4 | 4 | 4 | 0 | 9 | 14 | 19 |
| **Senai** | | | | | | | | |
| Engineer | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| T. Assistant | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| Technician | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 2 |
| Others | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 2 |
| Total Government Staff | 4 | 4 | 4 | 4 | 0 | 4 | 4 | 6 |

Table 50 ESTIMATED MANPOWER REQUIREMENT FOR PUBLIC SEWERAGE SYSTEM BY CITY (2/2)

| Category | Construction | | | | O&M | | | |
|---|---|---|---|---|---|---|---|---|
| | 5MP | 6MP | 7MP | 8MP | 5MP | 6MP | 7MP | 8MP |
| **Kota Tinggi** | | | | | | | | |
| Engineer | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| T. Assistant | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| Technician | 0 | 1 | 1 | 1 | 0 | 0 | 2 | 2 |
| Others | 0 | 1 | 1 | 1 | 0 | 0 | 2 | 3 |
| Total Government Staff | 0 | 4 | 4 | 4 | 0 | 0 | 6 | 7 |
| **Bandar Tenggara** | | | | | | | | |
| Engineer | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| T. Assistant | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| Technician | 1 | 1 | 1 | 1 | 0 | 2 | 2 | 2 |
| Others | 1 | 1 | 1 | 1 | 0 | 2 | 2 | 3 |
| Total Government Staff | 4 | 4 | 4 | 4 | 0 | 6 | 6 | 7 |
| **Pontian Kechil** | | | | | | | | |
| Engineer | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| T. Assistant | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Technician | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 6 |
| Others | 1 | 1 | 1 | 1 | 2 | 3 | 5 | 7 |
| Total Government Staff | 4 | 4 | 4 | 4 | 6 | 8 | 11 | 15 |

# FIGURES

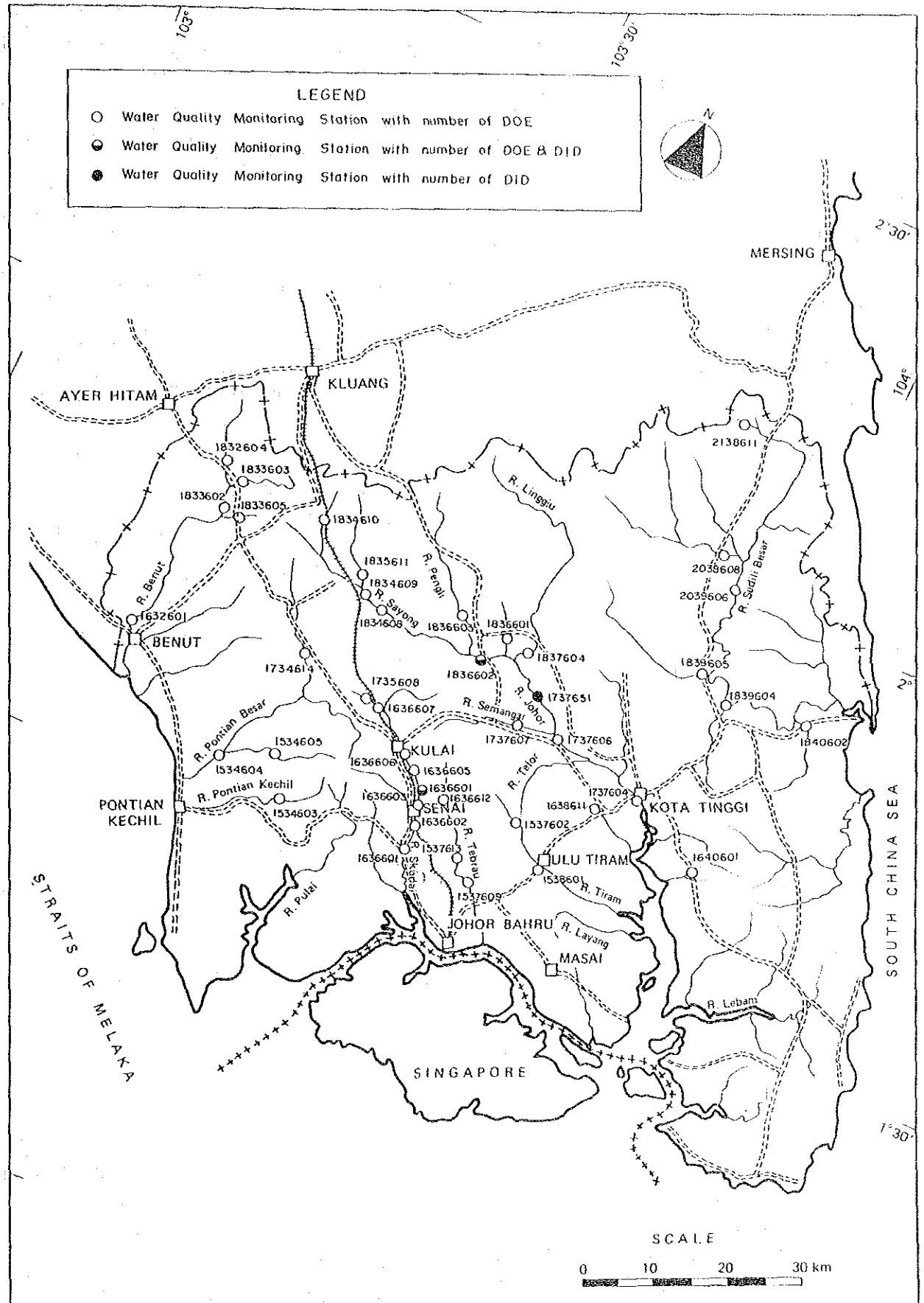


Fig. 1 Location of Water Quality Monitoring Stations

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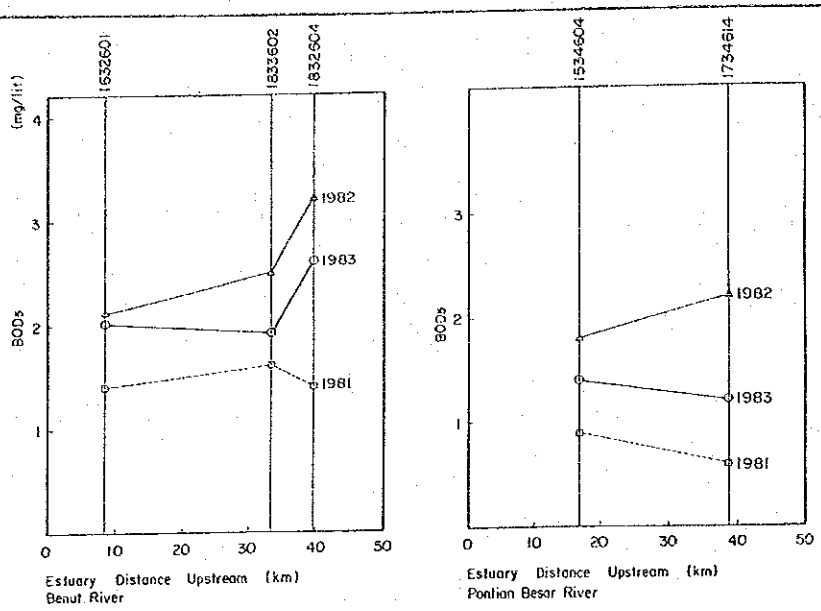





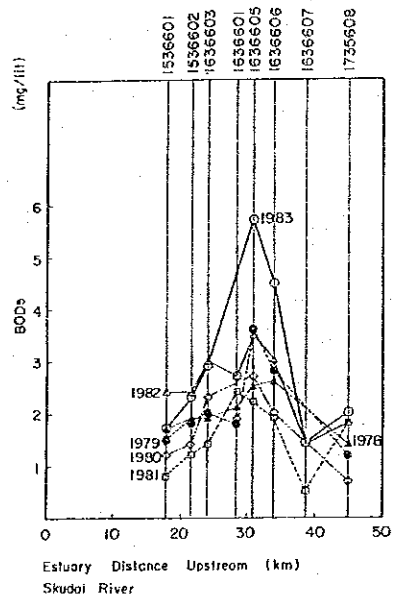


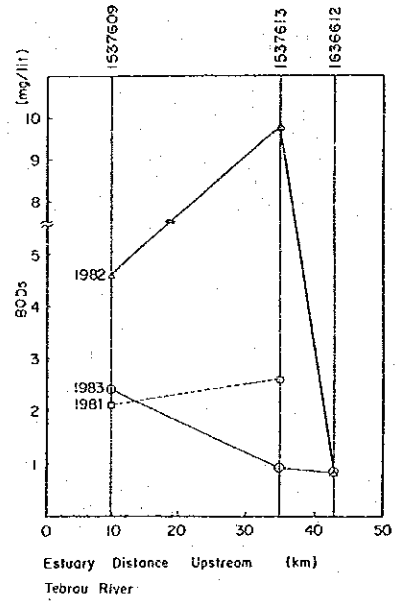


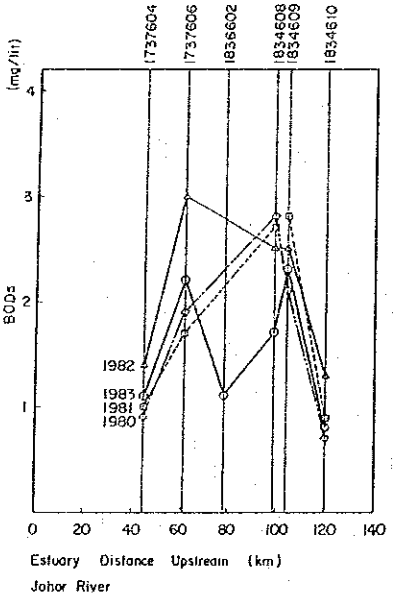


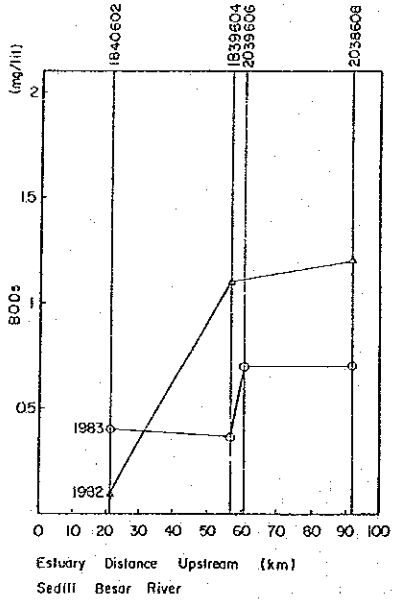


Fig. 2 Distribution of Mean $BOD_5$ Levels by WQMS from 1978 to 83

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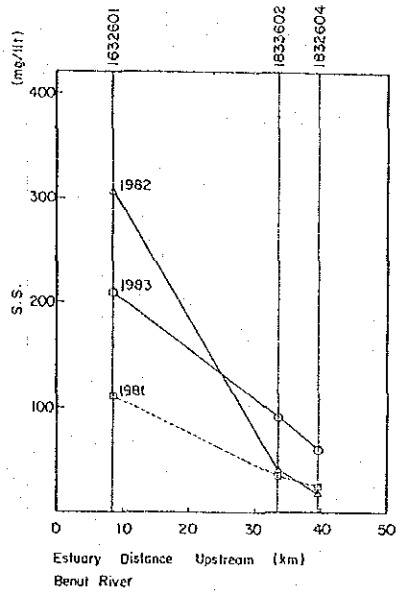


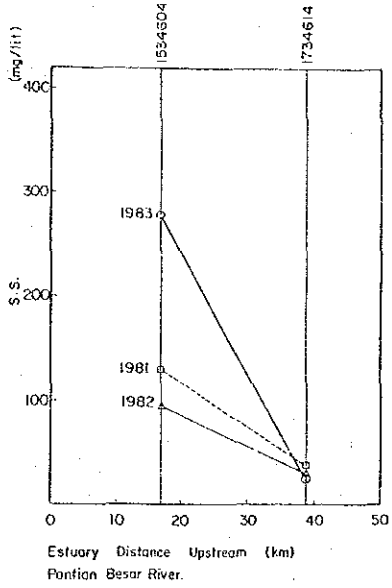


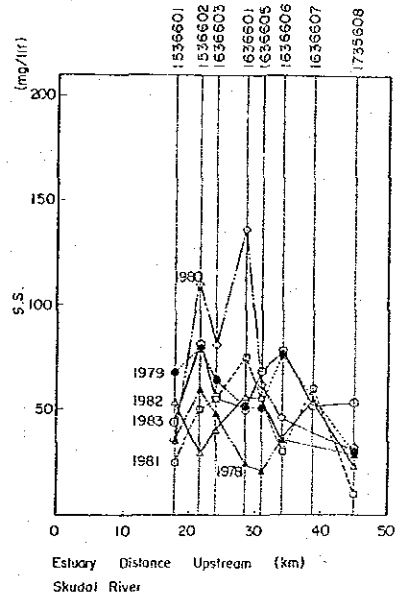


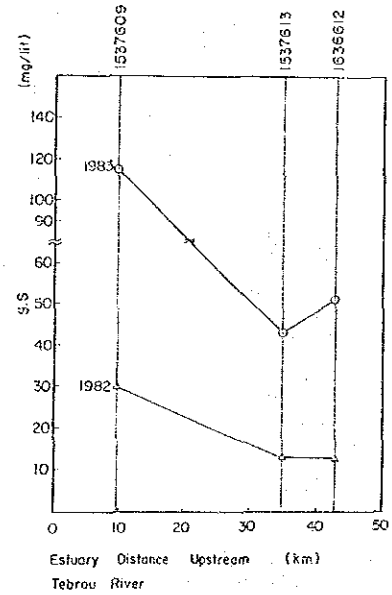


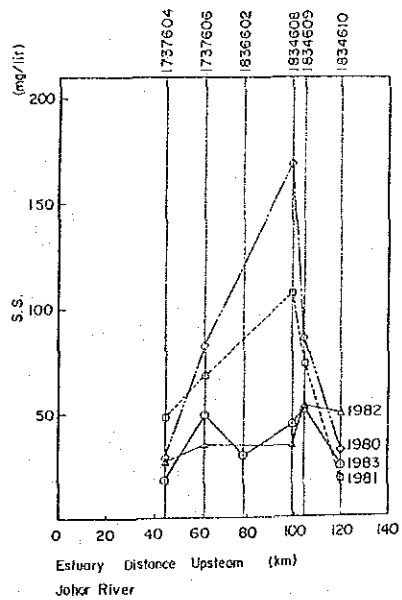


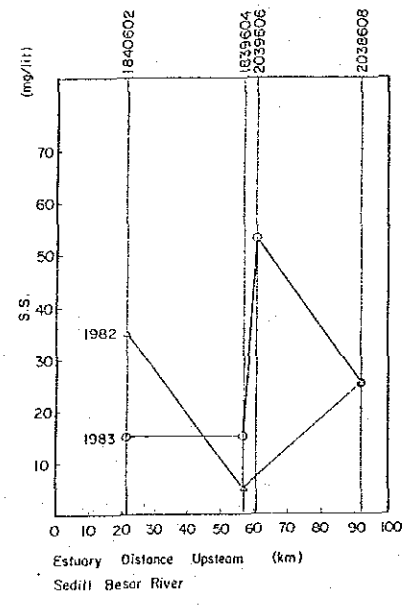


Fig. 3 Distribution of Mean SS Levels by WQMS from 1978 to 83

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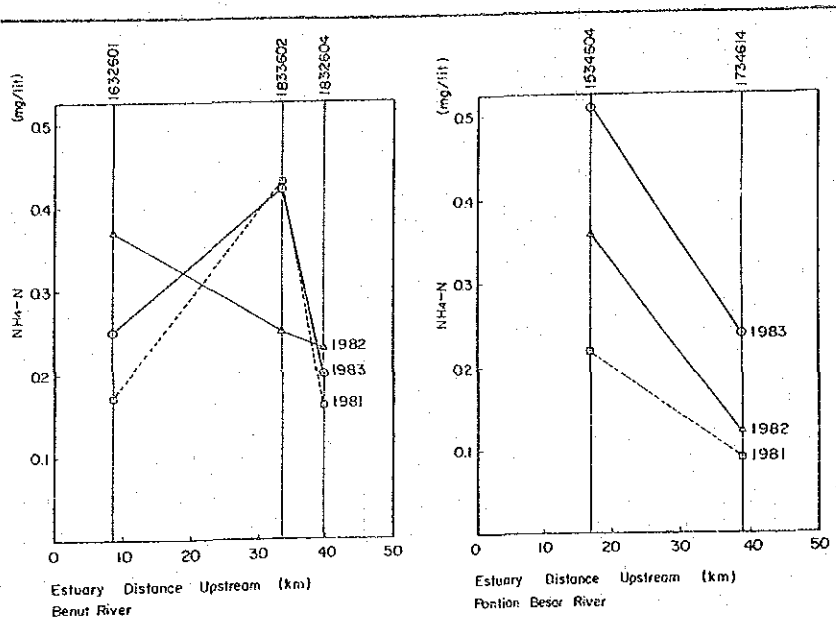





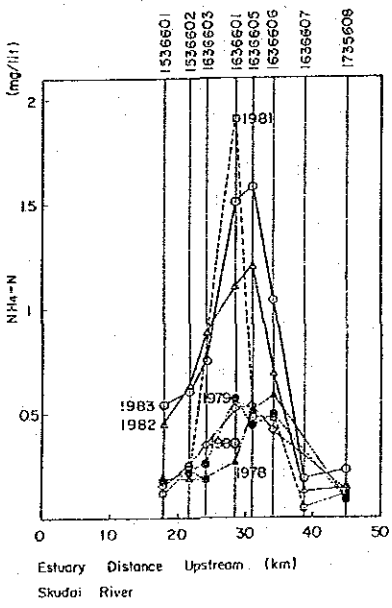


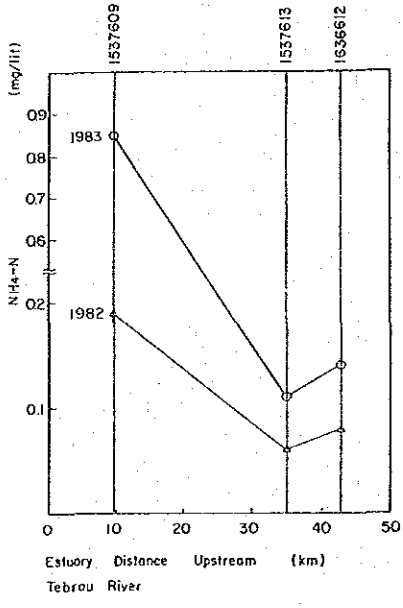


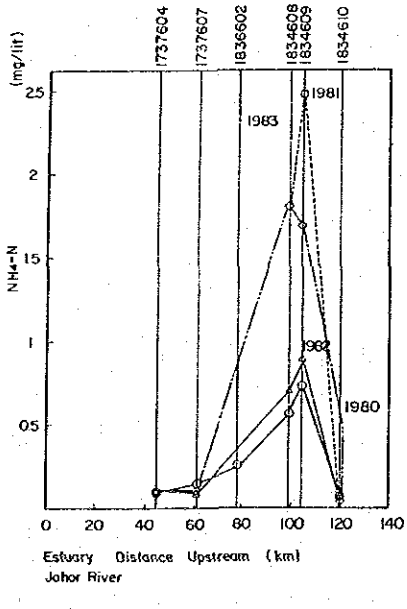


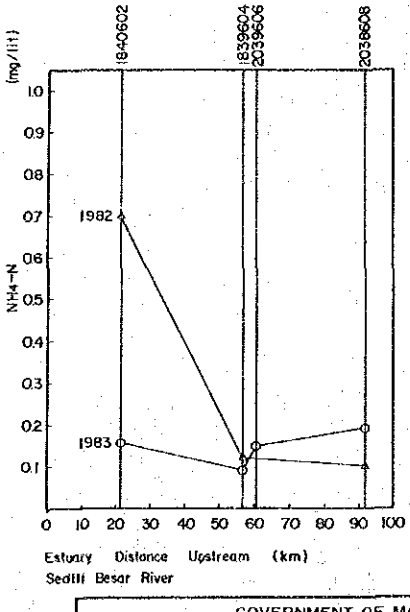


Fig. 4 Distribution of Mean $NH_4$-N Levels by WQMS from 1978 to 83

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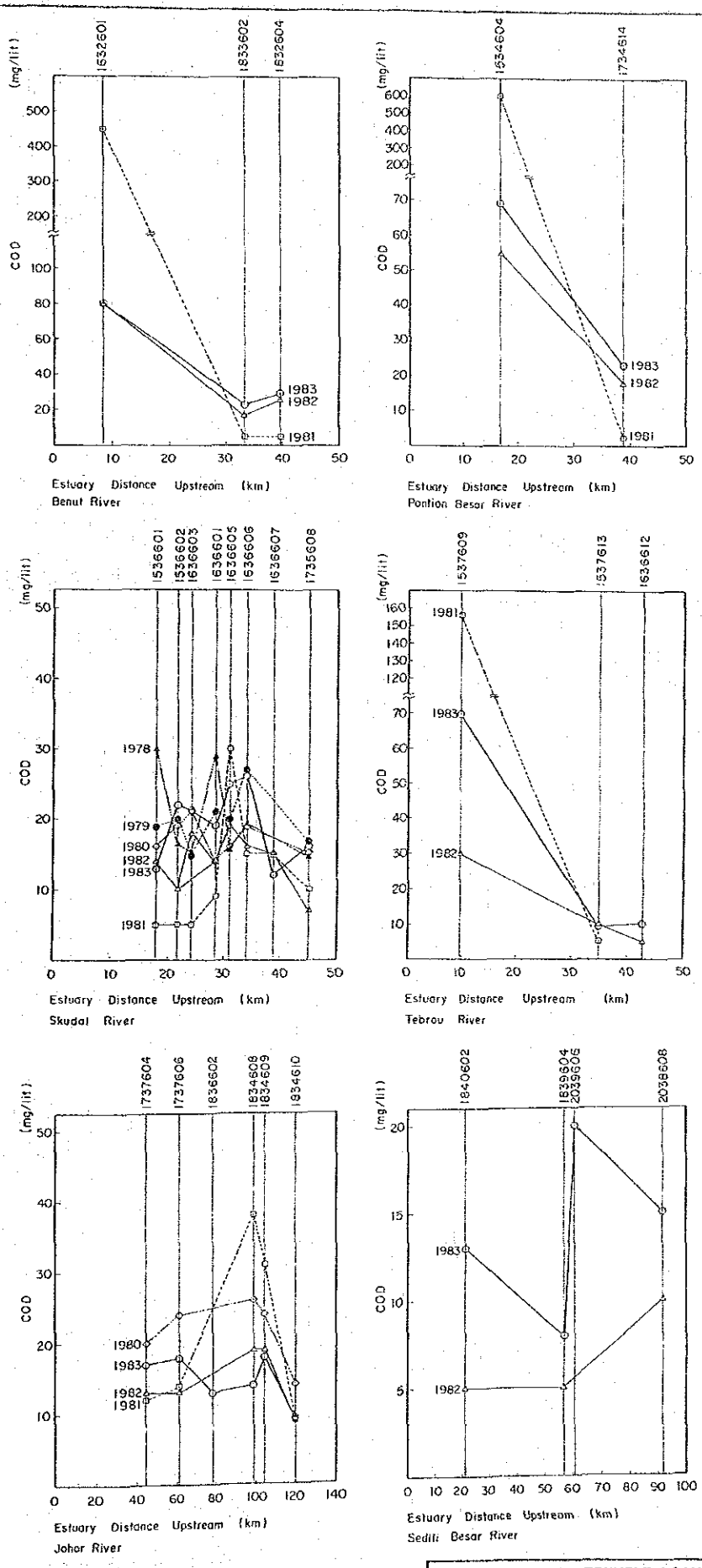


Fig. 5 Distribution of Mean COD Levels by WQMS from 1978 to 83

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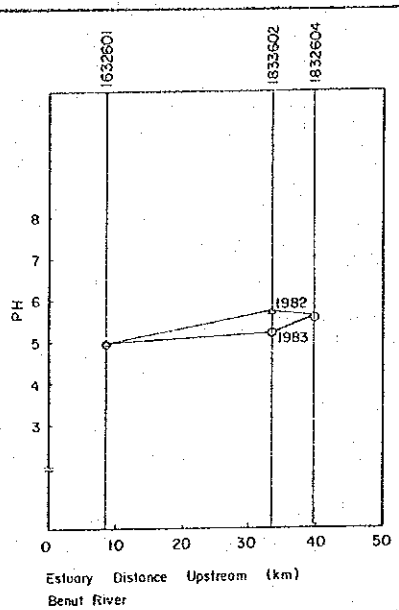


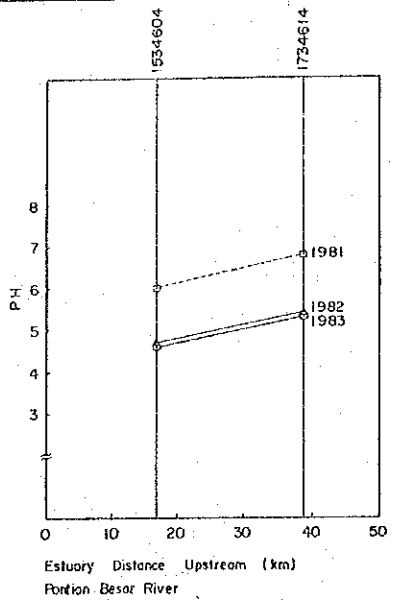


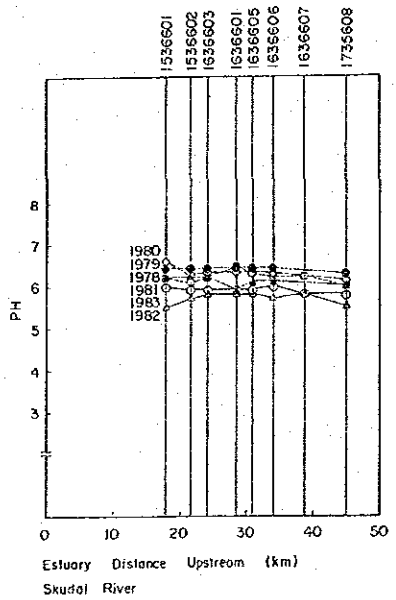


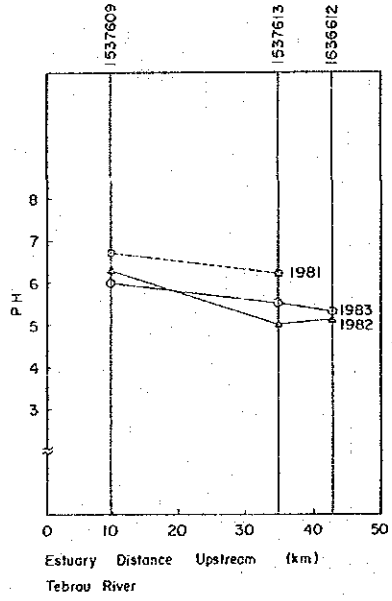


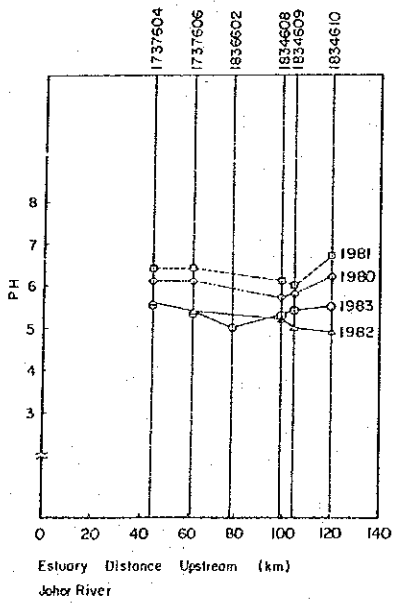


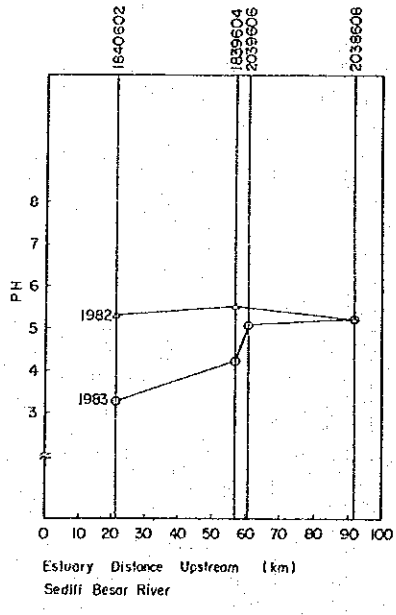


Fig. 6 Distribution of Mean pH Levels by WQMS from 1978 to 83

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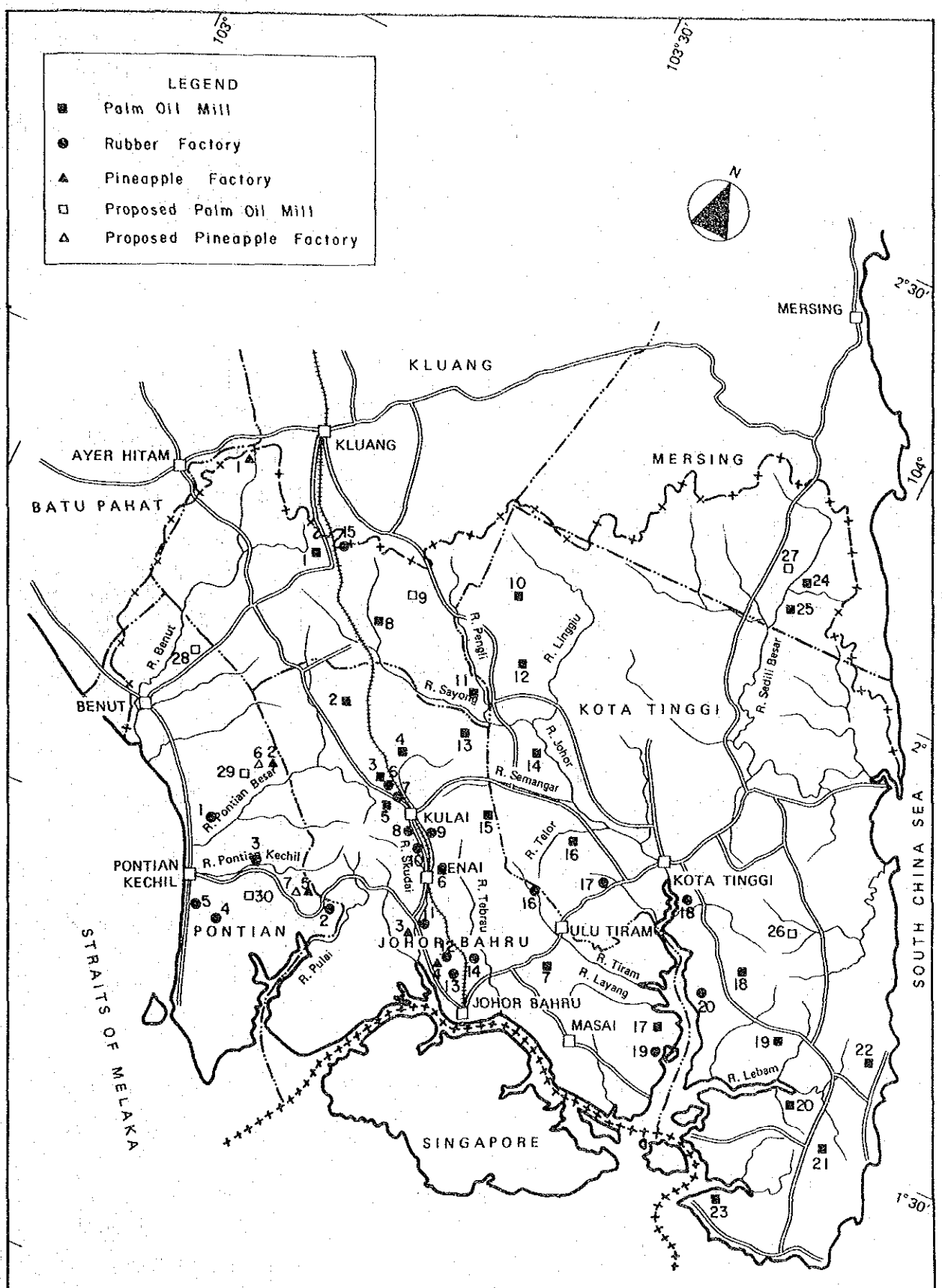


Fig. 7 Location of Pollution Sources (1/2)
Palm Oil Mills, Rubber Factories
and Pineapple Factories

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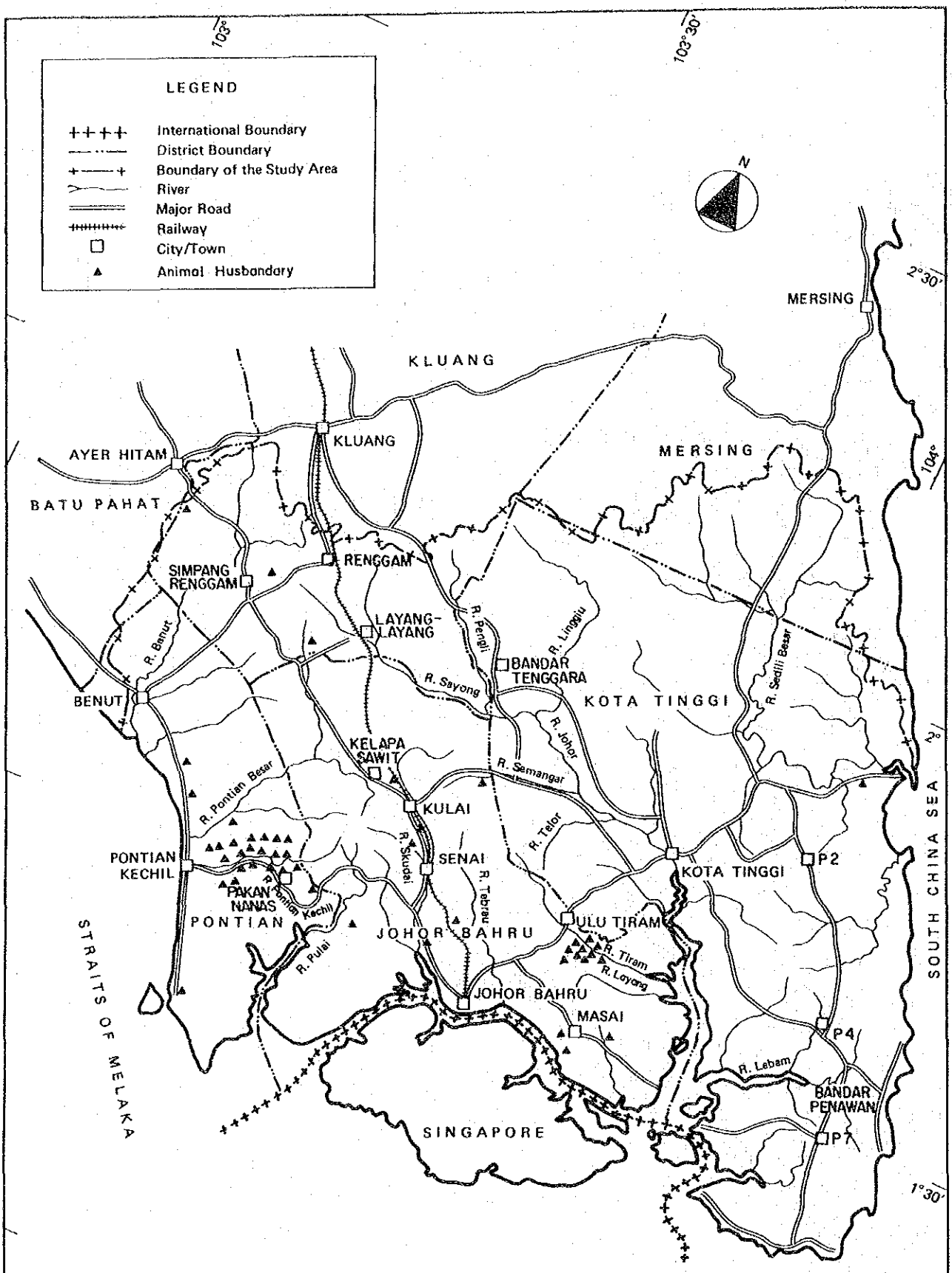


Fig. 8 Location of Pollution Sources (2/2) Cities/Towns and Animal Husbandaries

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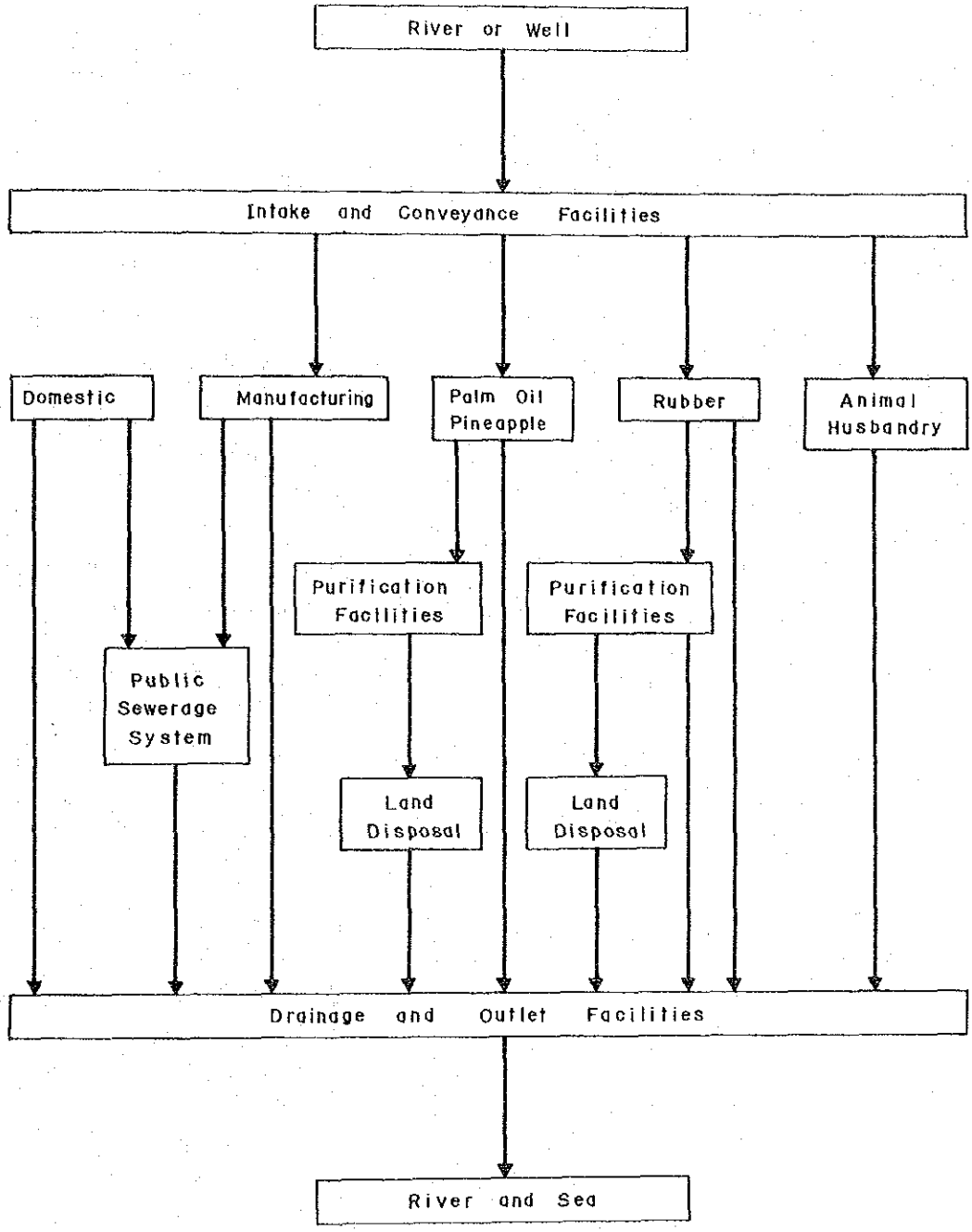


Fig. 9 Composition of Pollution Sources

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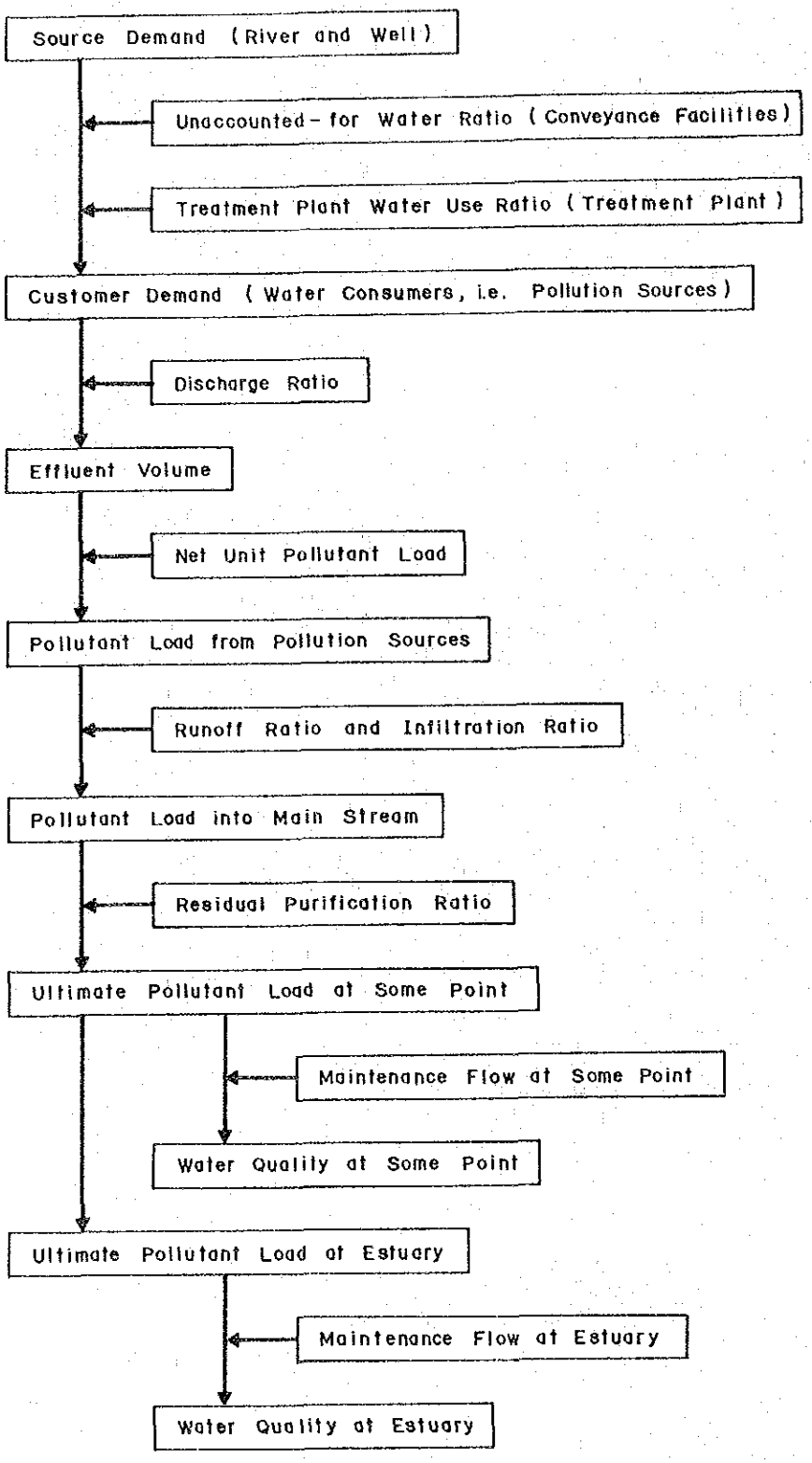


Fig. 10 Water Quality Projection Flow Chart

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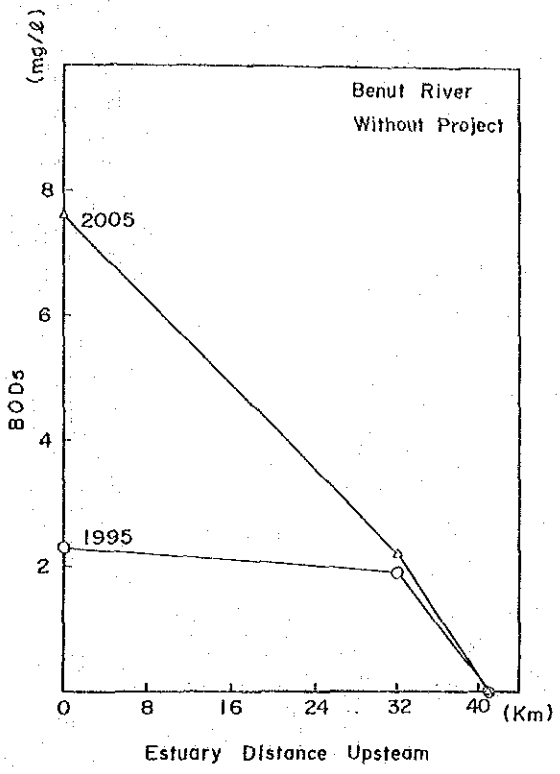


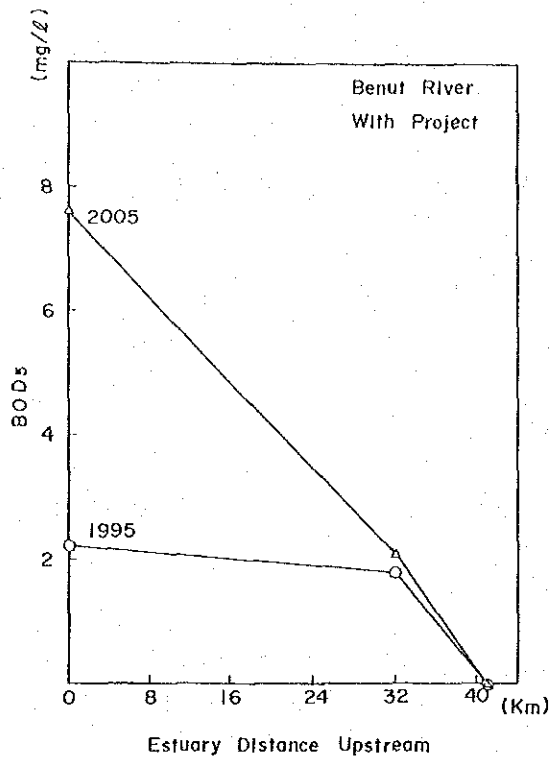


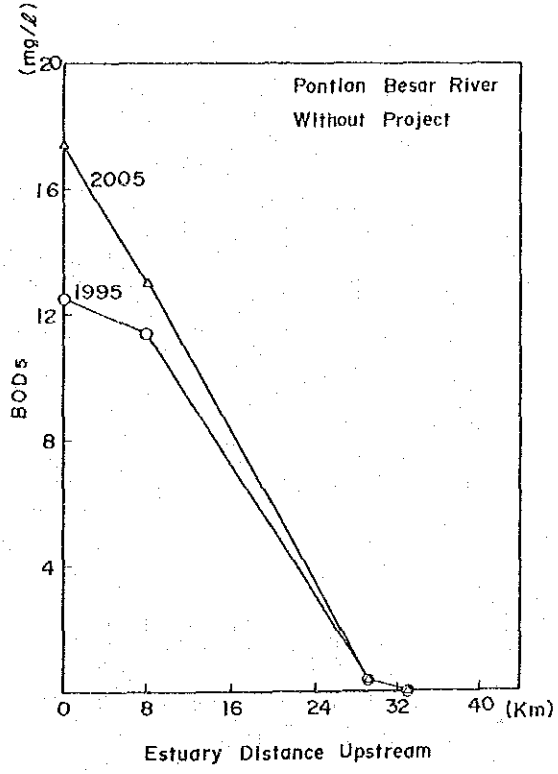


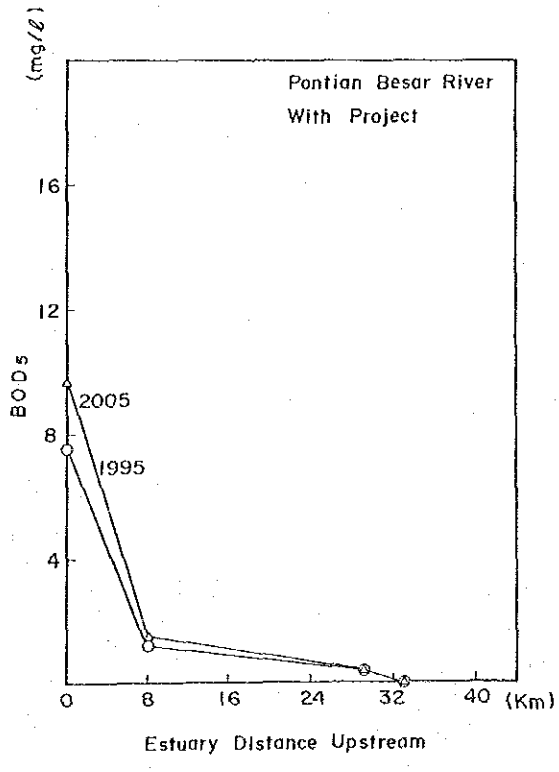


Fig. 11 Distribution of Projected BOD Concentration (1/3)

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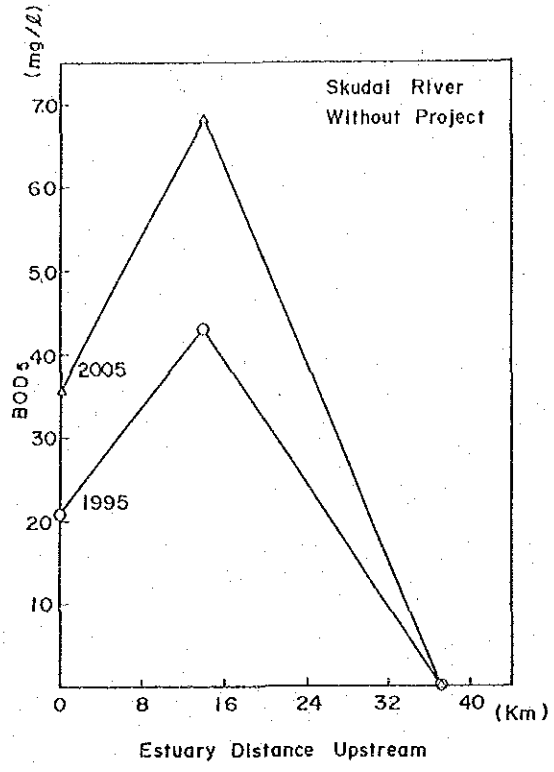


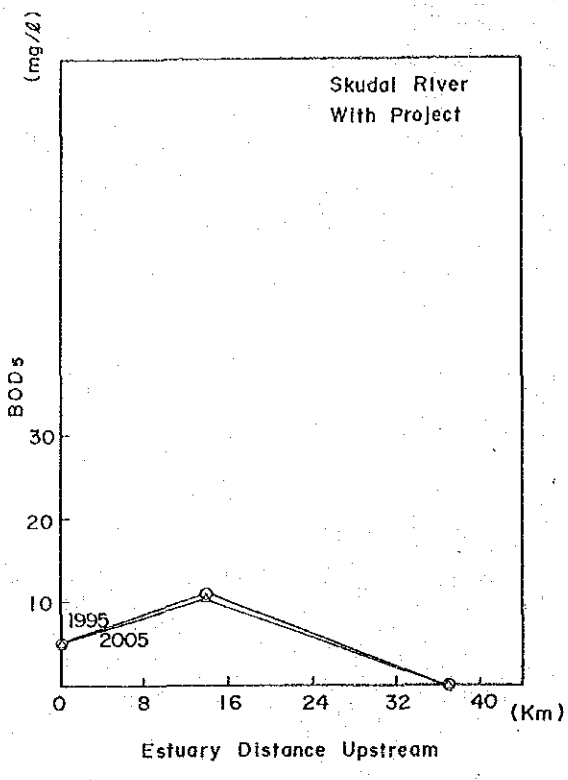


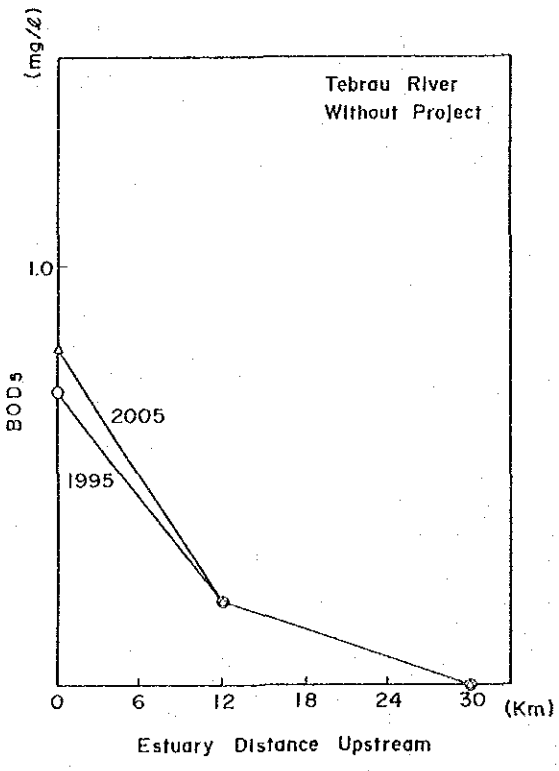


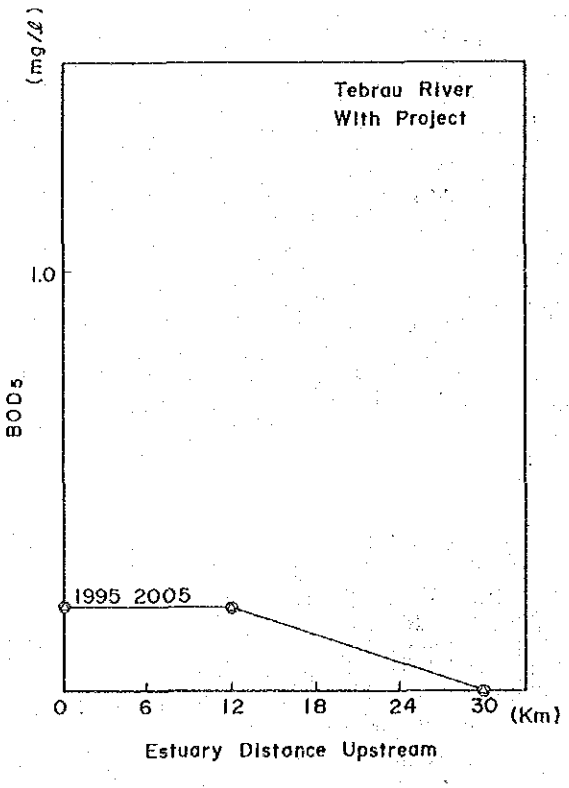


Fig. 12 Distribution of Projected BOD Concentration (2/3)

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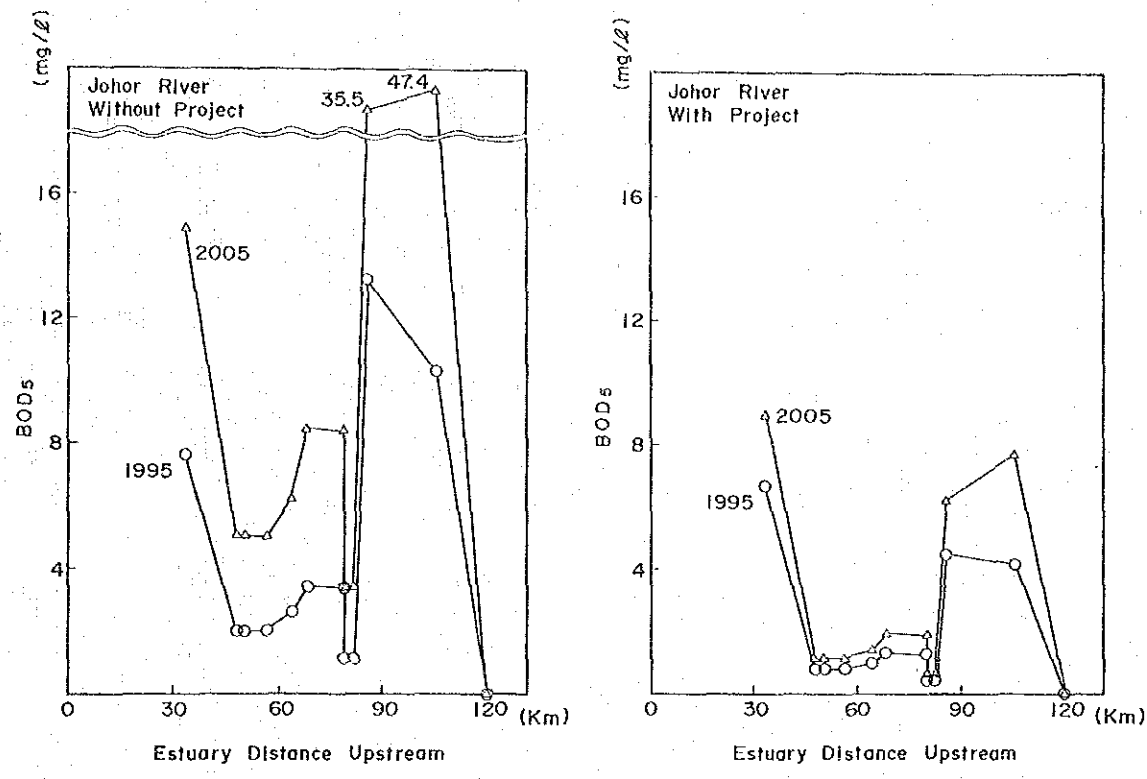


Fig. 13 Distribution of Projected BOD Concentration (3/3)

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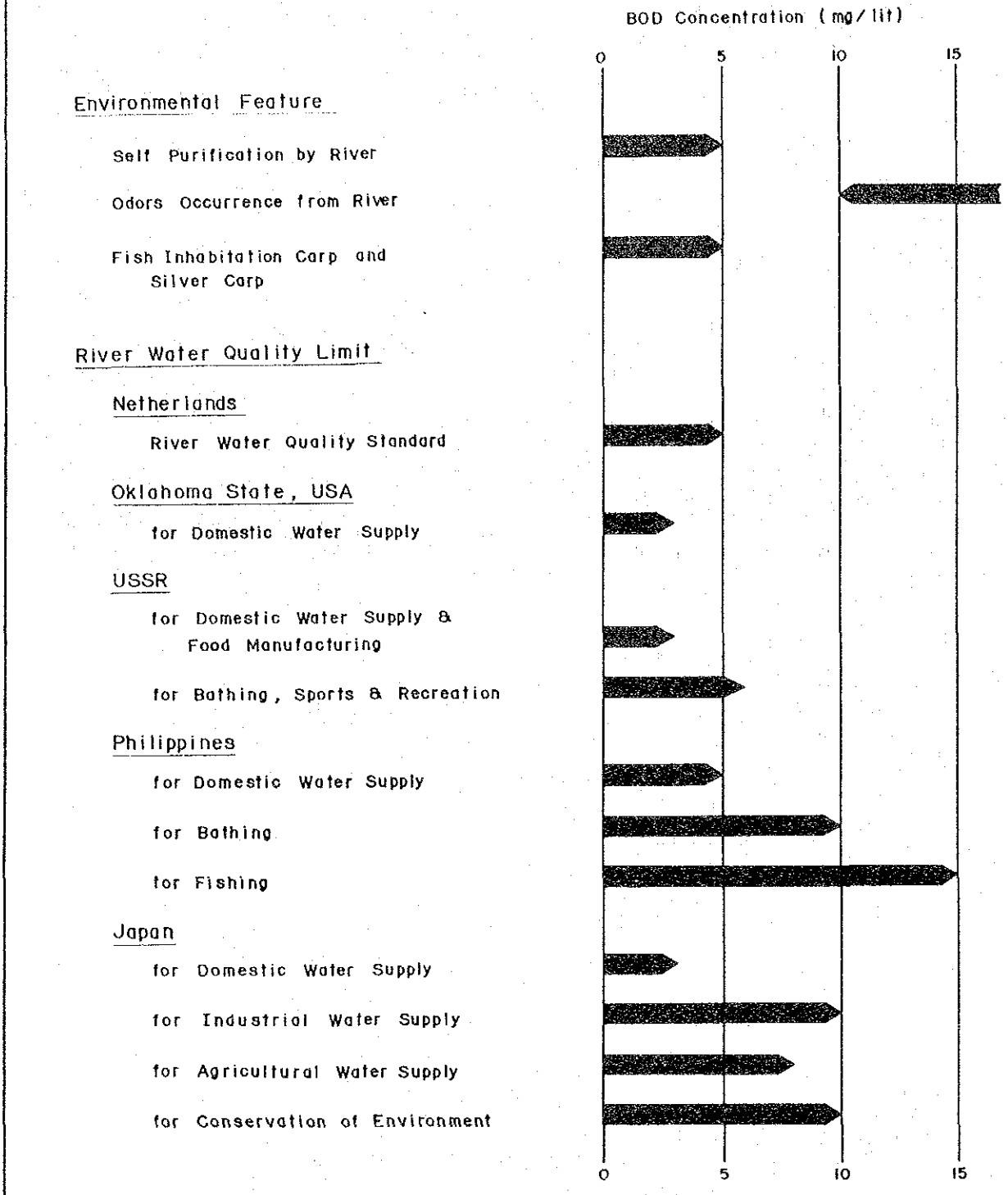


Fig. 14 Relationships Between BOD Concentration and Environmental Feature, and River Water Quality Limit

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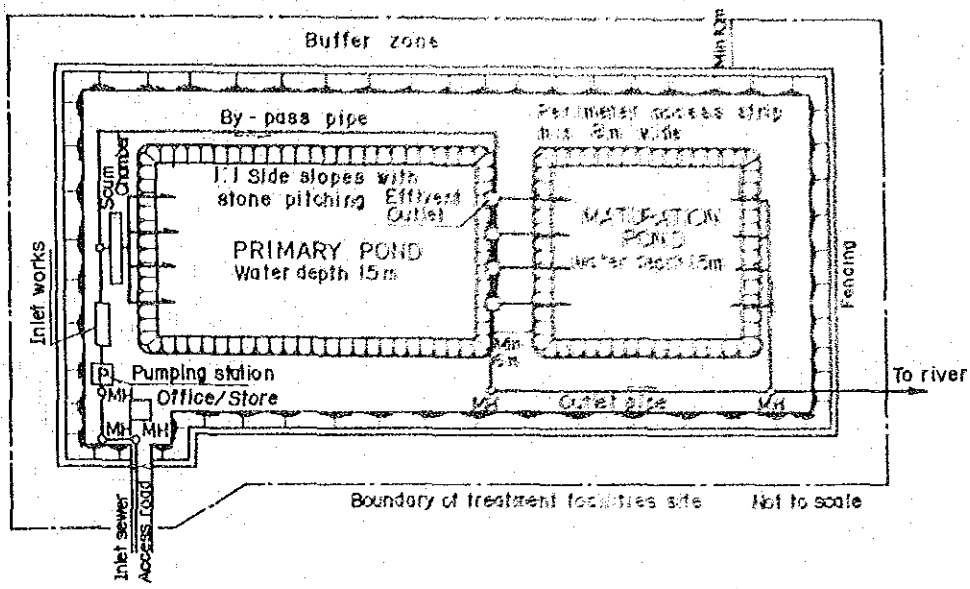


Fig.15 Typical Layout of Stabilization Pond Process

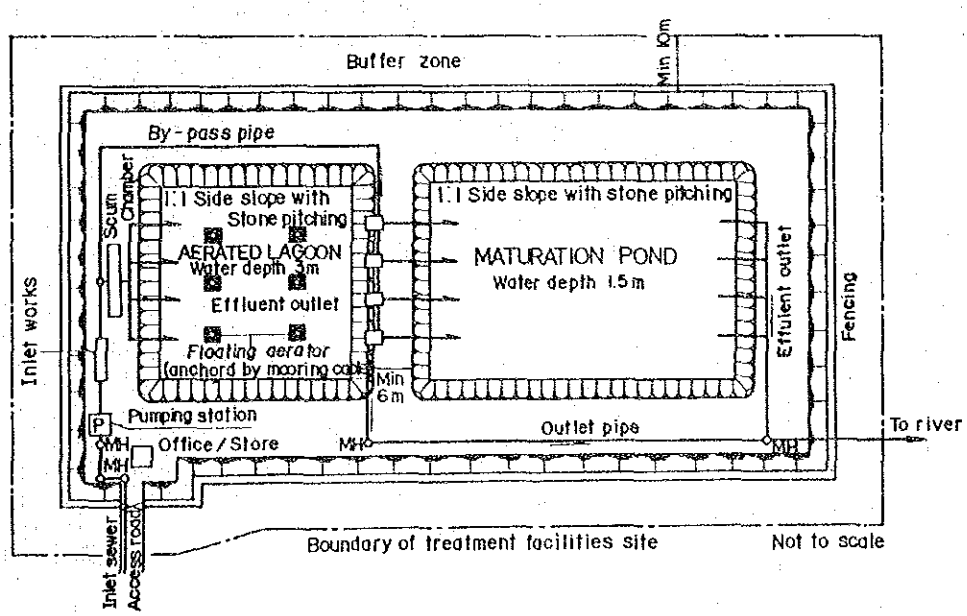


Fig.16 Typical Layout of Aerated Lagoon Process

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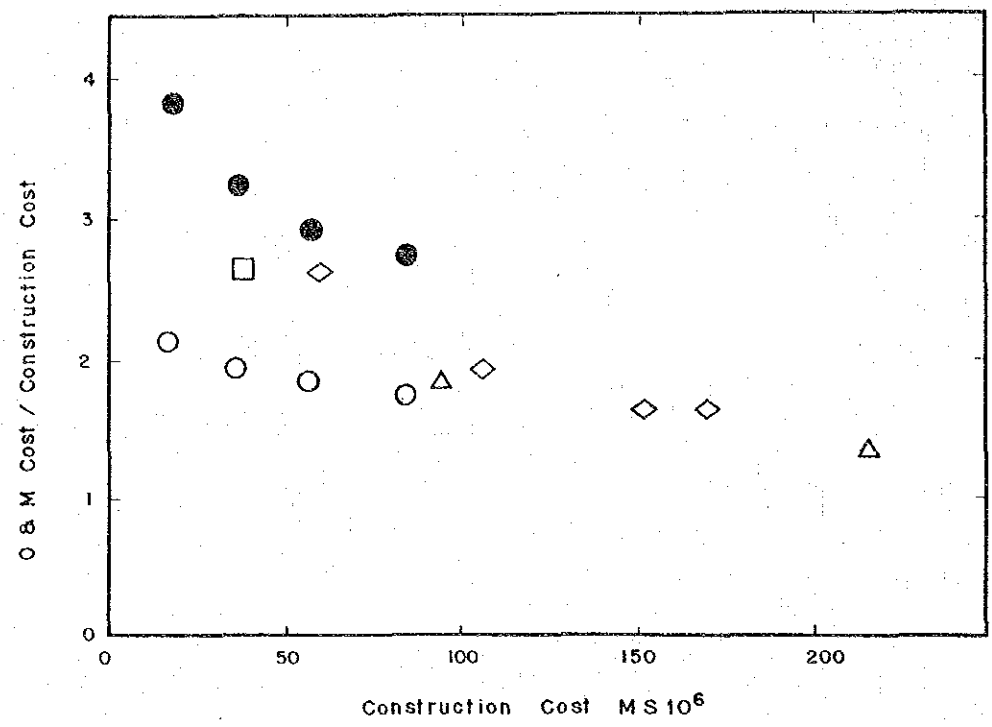


LEGEND

- ○ Alor Setar, Stabilization Pond
- ● Alor Setar, Aerated Lagoon
- △ Kuala Lumpur, Stabilization Pond
- □ Butterworth, Stabilization Pond
- ◇ Georgetown, Preliminary Treatment

Fig. 17 Relationships Between O&M Cost and Construction Cost

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